MAGHERAMORE WIND FARM
Environmental Statement

Volumes 4 - Appendices



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Introduction & Policy Context

Appendix 1: Introduction & Policy Context

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Renewable Energy Systems Limited
Willowbank Business Park, Willowbank Road, Millbrook, Larne
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E info@res-group.com **www.res-group.com**

Ms E Olphert
Causeway Coast & Glens BC
Cllonavin
66 Portstewart Road
Coleraine
BT52 1EY

Our Ref: 03426-000141

31st July 2018

Dear Ms Olphert,

Re: Intention to Submit an Environmental Statement for the proposed Magheramore Wind Farm

Pursuant with the Planning (Environmental Impact Assessment) Regulations (Northern Ireland) 2017 (Part III: Preparation of Environmental Statements), Regulation 9 (1), RES Ltd duly gives notice of its intention to submit an Environmental Statement in support of a planning application for a wind energy project referred to as Magheramore Wind Farm, in the townlands of Carnanbane and Magheramore approximately 5km south of Dungiven, Co. Londonderry (see enclosed Survey Boundary Drawing which includes Site Location). Please find enclosed Proposal of Application Notice in respect of this project.

The Environmental Statement will be submitted in support of a planning application for a wind farm comprising up to 6 three bladed wind turbines, each up to a maximum of 149.9m tip height, associated external electricity transformers; underground cabling; a new created site entrance; access tracks; turning heads; crane hardstandings; control building and substation compound and energy storage containers. During construction and commissioning there would be a number of temporary works including a construction compound with car parking; temporary parts of crane hardstandings; welfare facilities and temporary guyed meteorological masts. The purpose of the development is for the generation of electricity.

Under Part III, Regulation 9 (2), we identify the major issues which will be addressed in this Environmental Statement as:

- the implications of siting the wind turbines on the landscape quality and the visual character of the site;
- the impact on local population (traffic generation, noise, shadow flicker, employment);
- the impact on local flora and fauna;
- the impact on the historic and archaeological interest of the site and surrounding area.

We note that on receipt of the developer's notice of intention to submit, the Council will notify the relevant authorities likely to be concerned by the proposed development under Part III, Regulation 9, Paragraph 3 (b) (i &ii). The developer would like to be informed of the names and addresses of the bodies as detailed under Part III, Regulation 9, Paragraph 3 (b) (iii).

We also request that the Council communicates our intention to enter into consultation, with anybody identified by the Council in order to ascertain whether the body has information in its possession that they consider relevant to the preparation of the environmental statement and that such information should be made available to the developer, under Part III Regulation 8.

Further to this, RES and the various consultants that are carrying out survey work for the Magheramore site, have notified some authorities regarding the proposed development in order to ascertain whether the body has information which they consider to be relevant to the preparation of the environmental statement.

We trust the information provided is satisfactory, however if you have any queries please do not hesitate to contact us.

Yours sincerely,

Garth McGimpsey
Senior Development Project Manager
E garth.mcgimpsey@res-group.com
T +44 (0) 28 2844 0597

Enc:
Form PAN1 - Proposal of Application Notice
Survey Boundary Drawing 03426D2505-01

Appendix 1.2 CC & G BC Response

Causeway
Coast & Glens
Borough Council

Renewable Energy Systems Limited
Willowbrook Business Park
Willowbrook Road
Millbrook
Larne
BT40 2SF

Causeway Coast and Glens
Local Planning Office
Cloonavin
66 Portstewart Road
Coleraine
BT52 1EY

Date:	22nd August 2018
Your Ref:	
Our Ref:	LA01/2018/1019/DETEIA (Please quote at all times)
Please Contact:	
Contact Number	028 7034 7100

Dear Sir/Madam,

Location: **Magheramore Wind Farm, Dungiven,**

Proposal: **Intention to submit an Environmental Statement for the proposed Magheramore Wind Farm**

Thank you for your application received on 2nd August 2018 regarding the above proposed development.

Please note that when you submit a planning application, the information, including plans, maps and drawings will appear on the Planning Register and, along with any associated documentation, will also be published on the NI Planning Portal through the Public Access Portal [www.planningni.gov.uk]. Other information submitted in relation to the planning application, including consultation responses, objection and supporting letters, will also be published on the Portal in due course. The Council will process your information in line with the GDPR requirements. A copy of the full Privacy Statement is available at www.infrastructure-ni.gov.uk/dfi-privacy alternatively you can contact the relevant Data Protection Officer listed and request a copy of the Statement to be posted directly to you. The Council will take extreme care not to publish signatures, personal telephone numbers, personal email addresses and any sensitive personal data received such as medical or financial evidence.

The viewing of planning applications online is a service aimed at improving overall accessibility of the planning process. You can track the progress of your planning application online by logging onto the Public Access Portal and entering your planning application reference number. If you do not have access to the Public Access Portal, you can call into this office during normal office hours and we will make the information available to you at one of our computers at reception. If you wish to view the main planning file you can do so by making an appointment to view during normal office hours. You should note, however, that the main file is a working document and at certain times of the process will not be immediately available. An appointment is therefore essential.

The Council operates a Scheme of Delegation for certain types of local development where decisions will be taken by appointed planning officers. Please refer to the Council's website or contact this office for further iinformation on the Council's Scheme of Delegations.

There are a number of key stages in processing a planning application before it reaches a final decision, therefore the length of the determination process will vary depending on the complexity of the application. You can however keep track of your application by checking the Public Access Portal or by contacting this office.

Yours faithfully

Causeway Coast and Glens Planning Manager

Department for the
Economy

Netherleigh
Massey Avenue
Belfast BT4 2JP
Tel: 028 9052 9240 (ext: 29240)
TextRelay: 18001 028 9052 9240
Web: www.economy-ni.gov.uk

Cathy McKeary
Causeway Coast and Glens Borough Council
Local Planning Office
Cloonavin
66 Portstewart Road
Coleraine
BT52 1EY

5 September 2018

Dear Cathy

Planning Service Ref:	LA01/2018/1019/DETEIA
Location:	Magheramore Wind Farm, Dungiven
Proposal:	Intention to submit an Environmental Statement for the proposed Magheramore Wind Farm

Your automated notification in respect of the above-mentioned planning application refers.

DfE notes the proposed proposal and have no comments to make regarding this application.

RENEWABLE ELECTRICITY BRANCH

Dear Sir/Madam,

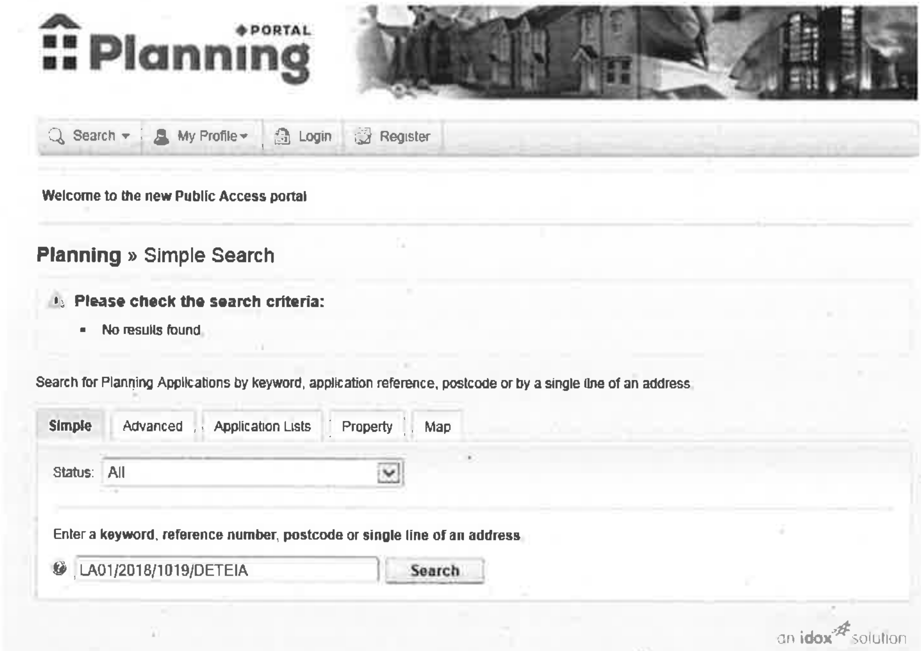
RE: PROPOSED MAGHERAMORE WIND FARM, DUNGIVEN-
PLANNING APPLICATION LA01/2018/1019/DETEIA

Our Ref;WID10845

Thank you for your email dated 05/09/2018.

We have been unable to study this Windfarm proposal with respect to EMC and related problems to BT point-to-point microwave radio links due to the fact you have not provided essential information, such as 12 figure grid references for the six turbines proposed , turbine hub height and rotor blade diameter. We were unable to search via either the planning application number or name of windfarm under the view planning applications online via the public access website and the associated documents tab on the Consultation Details was inconclusive showing only a vague location map.

I have tried searching on the NI planning portal using both LA01/2018/1019/DETEIA and the name Magheramore Wind Farm, Dungiven but nether showed any results. Please can you check it is on the system.



The conclusion is that, the Project indicated may cause interference to BT's current and presently planned radio networks, until we have this information, BT would object to the development of this wind farm.

Yours sincerely,
Paul Atkinson

Kind Regards,
Paul Atkinson
Fibre and Network Delivery
Radio Frequency Allocation & Network Protection (BNJ553)

Openreach
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Mobile 07711111453
Web: www.openreach.co.uk
PLEASE ALWAYS RESPOND TO radionetworkprotection@bt.com

Openreach is Britain's digital network business. We connect homes, mobile phone masts, schools, shops, banks, hospitals, libraries, broadcasters, governments and businesses - large and small - to the world.

Causeway Coast & Glens Borough Council

CONSULTEE COMMENTS

Application Reference:	LA01/2018/1019/DETEIA	Council Ref:	3589/18
Date Consulted:	04/09/2018		
Location:	Magheramore Wind Farm, Dungiven		
Proposed Development:	Intention to submit an Environmental Statement for the proposed Magheramore Wind Farm		

Comments:

The Environmental Health Department wishes to acknowledge receipt of the recent consultation.
The consultation has been issued as a Non-Statutory Consultation, it is requested that this Department is consulted as "Internal Advice" to enable a response to be submitted.

Date: 5/9/2018	Issued on behalf of the Head of the Health and Built Environment Department

Note - Any consultation response provided by this Department is based on currently available information relevant at the time of application and is limited to the supporting documentation submitted by the applicant/agent. This Department accepts no responsibility for any inaccuracies contained within the application documentation or associated communications available.

Northern Ireland Electricity Networks

Northern Ireland Electricity Networks Ltd
Fortwilliam House
Edgewater Office Park
Edgewater Road
Belfast BT3 9JQ

Tel 028 9066 1100
Fax 028 9095 4326
Website: www.nienetworks.co.uk

Your ref **LA01/2018/1019/DETEIA**

Causeway Coast and Glens Borough Council

18th September 2018

Dear Sir/Madam,

RE: NIE Networks' response to Causeway Coast and Glens Borough Council Planning Office in respect of Planning Application LA01/2018/1019/DETEIA – Proposed Intention to submit an Environmental Statement for the proposed Magheramore Wind Farm, Dungiven.

We refer to the above numbered planning application and would ask you to note the following:

At present, there are existing NIE Networks high voltage overhead lines running through the proposed wind farm site. As these lines may service both the immediate and wider areas, it is NIE Networks' view that these lines are presently required to remain.

NIE Networks' policy for safety clearances to 11kV lines is the overall height of the turbine plus 6m[1].

On the basis that the proposed wind farm would infringe on the required NIE Networks safety clearance, NIE Networks hereby object to this application.

If you require any further clarification or additional information with regard to NIE Networks' objection then please do not hesitate to contact us.

Yours faithfully,

Dean Morrow
Network Development
NIE Networks

[1] The NIE Networks clearance policy is based on the ENA documents TS 43-8 Issue 3 2004 and ER L44 Issue 1 2012

Department of
Agriculture, Environment
and Rural Affairs
www.daera-ni.gov.uk

Planning Response Team
Klondyke Building
Cromac Avenue
Gasworks Business Park
Lower Ormeau Road
Belfast
BT7 2JA
Tel: 028 9056 9604
Email: planningresponse.team@daera-ni.gov.uk

Date:25 September 2018

Dear Sir/Madam

Planning Application Ref.:	LA01/2018/1019/DETEIA
Location:	Magheramore Wind Farm Dungiven
Proposal:	Intention to submit an Environmental Statement for the proposed Magheramore Wind Farm

Thank you for your consultation on the above which was received by DAERA on 04/09/2018

Our statutory duty is to ensure that the natural and historic environment is conserved, enhanced and managed for the benefit of present and future generations, thereby contributing to sustainable development.

We have reviewed the details of the application and would provide summary comments as follows:

Drainage and water
Water Management Unit note the applicant has not identified the impact of the proposed development upon water quality. This is an are that requires assessment with the EIA process. More information is available in DAERA's Standing Advice on Pre-Application Discussion, Pollution Prevention, Sustainable Drainage, Discharges and Abstractions. All available at: www.daera-ni.gov.uk/water-environment-standingadvice

Land, Soil and Air
The foundations of wind turbines have the potential to impact on the groundwater environment. An assessment of the potential impact facilitates the Regulation Unit, Land and Groundwater Team to form an opinion on the application and this is required regardless of the EIA determination. Therefore it is the planning case officer's decision whether they wish to obtain the relevant surveys and assessments as part of the EIA or separately.

Natural Heritage and Conservation Areas
Natural Environment Division have provided advice in relation to this EIA determination.

If you wish to discuss anything raised in our response, please do not hesitate to contact Planning Response Team (details above).

Kind Regards

Planning Response Team

On behalf of DAERA

Land, Soil & Air

EIA Determination and likely significant effects.

The foundations of wind turbines have the potential to impact on the groundwater environment. An assessment of the potential impact facilitates the Regulation Unit, Land and Groundwater Team to form an opinion on the application and this is required regardless of the EIA determination. Therefore it is the planning case officer's decision whether they wish to obtain the relevant surveys and assessments as part of the EIA or separately.

At this EIA Determination stage the Land and Groundwater Team will wait for the EIA determination decision prior to reviewing any documents submitted by the applicant. Only if potential receptors (water features) have been identified and a risk assessment has been prepared, Regulation Unit (Land and Groundwater Team) should be consulted further for advice.

An assessment of the development's potential risk to impact on the groundwater environment typically requires a Water Features Survey as part of a Hydrogeological Assessment. Further information is provided within "Environmental information required" and "Baseline environmental information".

Environmental information required

The foundations of wind turbines have the potential to impact on the groundwater environment for example groundwater flow paths, groundwater receptors (aquifers) or secondary receptors (including private water supplies). Groundwater receptors should be identified and the risk of potential impact assessed and, where required, mitigation measures should be identified. These steps should be assessed through a Water Feature Survey.

Please see our guidance available on the DAERA website on 'Water feature surveys' and 'Wind farms and groundwater impacts' available at: https://www.daera-ni.gov.uk/publications/best-practice-guidance-documents

It is recommended that the applicant seeks the professional advice of a hydrogeologist. Hydrogeologists (not hydrologists) can be identified through internet search, Yellow Pages or the Ends Directory (www.endsdirectory.com)

In addition to the guidance listed above Regulation Unit (land and Groundwater Team) would direct the attention of the applicant / agent to the planning advice which is available on the DAERA website under the Topic: **Environmental Advice for Planning** with particular reference to the following pages:

https://www.daera-ni.gov.uk/articles/development-may-have-effect-water-environment-including-groundwater-and-fisheries

https://www.daera-ni.gov.uk/articles/wind-energy-installations

Baseline environmental information

Groundwater baseline information which will feed into a water feature survey can be obtained from our online River Basin Map Viewer at https://appsd.daera-ni.gov.uk/RiverBasinViewer/ and our WMU Water Information Request Viewer at https://appsd.daera-ni.gov.uk/WaterInformationRequest/

Information on private water supplies sourced from groundwater might be obtained from:

- Northern Ireland Environment Agency groundwater monitoring sites: Information on the sites can be obtained by either the WMU Water Information Request Viewer or by contacting waterinfo@daera-ni.gov.uk

- Abstraction & Impoundment Licensing: Information on the licensed sites can be obtained by either the WMU Water Information Request Viewer or by contacting waterinfo@daera-ni.gov.uk

- Drinking Water Inspectorate: Information on private water supplies can be obtained by contacting dwi@daera-ni.gov.uk

- Environmental Health section of the local council

Some layers displayed on the map viewers are also available as a digital dataset, which can be downloaded and used within your own project. Follow the guidance on the web page at https://www.daera-ni.gov.uk/articles/wmu-digital-dataset-downloads

Natural Heritage

Planning Reference No.: LA01/2018/1019/DETEIA

Section Reference: CB 26503

Baseline environmental information

Date of NED data check: 24 September 2018

NIEA, Natural Environment Division (NED) can provide the following information to aid the Planning Authority in making their EIA determination.

Please note that this proposal is subject to the Conservation (Natural Habitats, etc) Regulations (Northern Ireland) 1995 (as amended) (known as the Habitats Regulations).

The application site is in close proximity to Banagher Glen SAC/ASSI and the River Roe and Tributaries SAC/ASSI which are of international importance and are protected by legislation.

The application site may contain priority habitat such as peatland and support priority species such as bats and birds.

Likely significant environmental effects

Describe the environmental sensitivity of the location likely to be affected by the development and the type of impact that may occur.

Based on the information submitted, NIEA Natural Environment Division (NED) considers that the proposal is likely to have significant environmental effects with regard to the Planning (Environmental Impact Assessment) Regulations (Northern Ireland) 2015.

Environmental information required

Should the planning authority determine that a development proposal is EIA development, NIEA should be consulted as appropriate to advise further on the scope of the environmental information required to support this application.

Please note that should natural heritage issues set out in Schedule 3 of the Planning (General Development Procedure Order) Northern Ireland 2015 (GDPO)) be identified, NIEA advises that information to assess potential impacts on the natural heritage can be submitted either via suitable environmental reports as part of a standard consultation process, or as part of an environmental statement.

NED has carried out a desktop search of currently available information – see below. Please note that this information is correct at this point in time, but should be reviewed before submitting the Environmental Statement (ES) / planning application. You should also refer to the recommended websites, detailed below, for other relevant information.

Please also find enclosed advice on the scope of work / information that NED considers necessary to assess the potential effects on natural heritage interests from this development proposal. The information provided should be as comprehensive as possible and follow the guidance detailed below. This will reduce the likelihood of further environmental information being requested which could delay the processing of the planning application. We recommend that the applicant contacts the planning authority to engage in the pre-application process to avoid any delays.

Natural Heritage

NED standing advice can be found at: https://www.daera-ni.gov.uk/publications/standing-advice-development-land-may-affect-natural-heritage-interests and NED survey specifications and other planning related advice can be found at: http://www.doeni.gov.uk/niea/land-home/plan/surveys.htm.

The NI Biodiversity Checklist (see https://www.daera-ni.gov.uk/publications/ni-biodiversity-checklist-documents) should be used to establish if a survey is required for a complete application. NED recommends that all survey works comply with British Standard 42020:2013, which came into effect on 31 August 2013. The British Standard provides recommendations and guidance for those engaged in planning and development, whose work might affect or have implications for conservation, or the enhancement of biodiversity.

Site specific information

From the data NED currently holds:

Designated Sites

Banagher Glen SAC/ASSI
River Roe and Tributaries SAC/ASSI

Sites of Local Nature Conservation Importance (SLNCI) within 3km of the site

Benady Glen

Brown Hill

Owenbeg

River Roe

Priority species

Birds

Bats

Otter

Priority habitats

Peatland

Rivers

Natural Heritage

Additional sources of information

1. The NED website http://www.doeni.gov.uk/niea/ includes:

   - Details of all regional, national and international designated sites in Northern Ireland
   - Northern Ireland Biodiversity Strategy
   - Northern Ireland Habitat and Species Action Plans
   - Areas of Outstanding Natural Beauty
   - Landscape Character Areas
   - Environmental Legislation

2. Useful information on planning and natural heritage, including survey specifications, can be found on the NED website at http://www.doeni.gov.uk/niea/land-home/plan.htm

3. Information on the flora, fauna and geology of Northern Ireland can be obtained from the Habitas website: http://www.habitas.org.uk/

4. Site specific environmental data (e.g. species records) can be obtained from the Centre for Environmental Data and Recording (CEDaR). These can be accessed by contacting CEDaR, National Museums NI, 153 Bangor Road, Cultra, Holywood, BT18 0EU. Website: http://www.nmni.com/cedar

5. NED promotes the submission of biodiversity data to CEDaR, and recommends that species records generated as part of the EIA process are submitted to CEDaR by going to: http://nmni.com/CEDaR/Submit-records

General Scoping Guidance for Environmental Impact Assessment

Guidance on the scoping stage of Environmental Impact Assessment (EIA) and on the information to be included in an Environmental Statement (ES) is provided by the European Commission and can be found at: http://ec.europa.eu/environment/eia/eia-support.htm.

NED recommends *"Guidelines for Ecological Impact Assessment in the UK"* produced by the Institute of Ecology and Environmental Management (IEEM). This provides best practice guidance for assessing the ecological impact of projects and plans. The document can be downloaded from
http://www.cieem.net/data/files/Resource_Library/Technical_Guidance_Series/EcIA_Guidelines/TGSEcIA-EcIA_Guidelines-Terestrial_Freshwater_Coastal.pdf

NED would emphasise the following:

Natural Heritage

- The ES should describe both habitats and species of flora and fauna present. It should cover both the proposed site and the surrounding area. It should include any designated sites and protected species which may be affected.

- Proposals which may impact on a European site, however distant (i.e. Special Areas of Conservation and Special Protection Areas), will require a Habitats Regulations Assessment (HRA). Sufficient information must be provided to the competent authority to enable them to complete this.

- The topography, geology, soils and water environment of the site and surrounding area should be described.

- The ES should include a description of the likely significant effects, both positive and negative, at all stages of the development to include direct, indirect, secondary and cumulative effects in the short, medium and long term. A description of the forecasting methods used to predict these effects should also be included.

- A description of proposed measures to prevent, reduce or offset any significant adverse affects on the environment (i.e. Avoidance, Mitigation, Compensation, and Enhancement) must be included.

- An indication of any difficulties encountered during the EIA process, limitations of surveys and any uncertainties in the data must be included.

- The different chapters of the ES should be inter-related and the ecology chapter should be cross referenced where appropriate.

Flora and Fauna

- The ecological baseline of the site must be characterised. Following from this, the extent and nature of any further survey work that may be required should be identified. Surveys must cover flora and fauna present in all seasons.

- A habitat survey (i.e. JNCC Phase 1) should be carried out to map the habitats on site and identify areas which are likely to be of high nature conservation value or particularly vulnerable to impact from the proposed development. Areas thus identified should be subject to more detailed survey, i.e. National Vegetation Classification (NVC).

- Faunal surveys should include a full breeding bird survey and protected species surveys. The timing of surveys is critical and they must be carried out at appropriate times of year.

Natural Heritage

- Surveys should highlight any Northern Ireland or European priority habitats and species which may be present on the site or surrounding area.

- Baseline surveys conducted over a short period may not identify long term trends and reference should be made to previous records.

- Protected species surveys should be carried out to NED specifications. Note that these maybe updated in the light of new knowledge at any time. Therefore it is advised to check the NED website for the most up to date specifications immediately prior to commencement of surveys.

- Full survey reports should be included in the appendix of the ES. All maps and diagrams should be of an appropriate scale for interpretation.

- NED reserve the right to determine whether the survey information submitted is adequate or when additional information is required.

- Survey information regarding species vulnerable to persecution should be included as a confidential annex to the ES, which should not be made publically available. The species of concern are badgers *(Meles meles),* freshwater pearl mussels *(Margaritifera margaritifera),* goshawks *(Accipiter gentilis),* hen harriers *(Circus cyaneus),* and peregrines *(Falco peregrinus).*

Water and Hydrology

- A description of the water environment of the area - running and static surface waters, groundwaters, estuaries, coastal waters and the sea, including run-off and drainage.

- A description of the hydrology, water quality and use of any water resources that may be affected by the development (e.g. water supply, fisheries, angling, bathing, amenity, navigation, effluent disposal).

- The consequences of changes to the hydro-geological system of the area on peatland, rivers, streams, flushes and wetland habitats should be described.

Mitigation Measures

A description of the measures proposed to prevent, reduce or offset any significant adverse effects on the environment caused by the development must be included in the ES. These measures can be summarised as:

Natural Heritage

- Avoidance: Priority should be given to avoiding negative impacts, especially those that could be significant. Consideration should be given to alternative strategies or locations, changes to the project design and layout, changes to methods and processes, changes to implementation plans and management practices including regulating the timing of activities.

- Mitigation: Opportunities should be sought, wherever possible, to reduce negative impacts on the environment, ideally to the point where they are no longer significant.

- Compensation: Where avoidance or mitigation of negative impacts is not practicable measures to compensate for impacts should be proposed.

- Enhancement: Opportunities should be sought in every new development to deliver net ecological gain rather than just limiting environmental damage. Enhancement measures may lead to an increase in the biodiversity of a site.

Mitigation measures should be incorporated into the design of a project from the outset and included on plans and drawings where appropriate. Mitigation which simply comprises a list of recommendations will generally not be acceptable.

Other recommendations include:

- A description of the criteria used to establish the magnitude and significance of environmental impacts. A tabular presentation should be used to summarise key direct and indirect impacts.

- The mitigation proposed should be clearly described and its effect on the magnitude and significance of these impacts should be assessed and clearly explained.

- Any uncertainty in the effectiveness of proposed mitigation measures should be explained and, where appropriate, evidence should be provided of successes from other similar projects.

- The implementation of proposed mitigation should be clearly described and, if necessary, arrangements for monitoring the implementation and success of mitigation measures should be stated.

Environmental Management Plan

An Environmental Management Plan (EMP) should be produced to detail the construction phase of the project and the implementation of the mitigation measures described in the ES.

Natural Heritage

It will provide the management framework for the planning and implementation of construction activities and describe how working practices will avoid or minimise impacts to the environment at all stages of the development. It should provide details of procedures for monitoring and reporting the environmental effects of the development during construction. It should include the following information:

- Pre construction site conditions should be described to establish a baseline against which construction effects can be assessed.
- A site plan to show the location of construction activities, access routes, the storage of materials, the position of plant and the location of any sensitive receptors (e.g trees, peat, watercourses).
- A detailed programme of the work to be carried out including timing and sequencing of works.
- Methods of construction and working practices should be specified, including equipment and materials to be used.
- Details of how mitigation measures will be implemented should be clearly stated.
- Details of procedures for monitoring and reporting the environmental effects of the development during construction and in the operation phase.

A Habitat Management Plan should form part of the EMP. This should show how the habitats, flora and fauna of the site will be protected during and after construction. It should include a long term plan for the management of the site for nature conservation and, if appropriate, show details of compensation measures such as habitat creation. It should also include details of how the ecology of the site will be monitored to show the success of mitigation measures and may include species specific monitoring requirements.

Environment, Marine & Fisheries Group
Marine & Fisheries Division

Department of
Agriculture, Environment and Rural Affairs
www.daera-ni.gov.uk

www.planningni.gov.uk

1st Floor
Rathkeltair House
Market Street
Downpatrick
BT30 6UU

Application Reference;
LA0/2018/1019/DETEIA

25th September 2018

PROPOSED WINDFARM AT MAGHERAMOER DUNGIVEN

TO WHOM IT MAY CONCERN,

DAERA Sea Fisheries Inspectorate has no issues or concerns to raise from an aquaculture/sea fisheries aspect with this proposal.

But we would like to remind the applicant that;

It is an offence under Article 47 of the Fisheries Act (NI) 1966 to cause pollution which is subsequently shown to have a deleterious effect on fish stocks.

All works near watercourses to be carried out in line with guidance as described in the Pollution Prevention Guidelines 5 (Works In, Near or Liable to Affect Watercourses).

Yours Sincerely,
Marine & Fisheries Division – Fisheries Inspectorate

Department for
Infrastructure
An Roinn
Bonneagair
www.infrastructure-ni.gov.uk

DfI Rivers Planning Advisory Unit

44 Seagoe Industrial Estate
CRAIGAVON
Co. Armagh
BT63 5QE
Tel: 028 3839 9118

Cathy McKeary
Causeway Coast and Glens Borough Council
Local Planning Office
Cloonavin
66 Portstewart Road
Coleraine
BT52 1EY

Your Ref:
LA01/2018/1019/DETEIA
Our Ref: IN1-18-11521

Date: 16/10/2018

Dear Sir / Madam,

Re: Environmental Statement for a Wind Farm - Magheramore, Dungiven - LA01/2018/1019/DETEIA

Thank you for your consultation dated 4th September 2018 regarding the above proposal. DfI Rivers have assessed the application and our comments are as follows:-

DfI Rivers remit is limited to commenting on flood risk and drainage matters in accordance with planning Policy Statement 15 Planning and Flood Risk (PPS 15). It is outside DfI Rivers area of expertise to express an opinion as to whether the proposed development would or would not be EIA development. If the planning authority deems that an EIA is required then paragraph 5.8 of PPS 15 requires that flood risk and drainage assessment are addressed in the Environmental Statement.

Policy FLD 1 Development in Fluvial (River) and Coastal Flood Plains
The Strategic Flood Map (NI) indicates that a small portion of the site lies within the 1 in 100 year fluvial flood plain.

PPS15 Policy FLD 2 Protection of Flood Defence and Drainage Infrastructure
The site is traversed by various undesignated watercourses. Under 6.32 of the policy a 5m maintenance strip is required. It should be marked up on a drawing and be protected from impediments (including tree planting, hedges, permanent fencing and sheds), land raising or future unapproved development by way of a planning condition. Clear access and egress should be provided at all times. Planning N I may wish to apply the last sentence of 6.40 of Planning Policy Statement 15.

Department for
Infrastructure
An Roinn
Bonneagair
www.infrastructure-ni.gov.uk

PPS15 Policy FLD 3 Development and Surface Water (Pluvial) Flood Risk Outside Flood Plains

Due to the size and nature of the development FLD3 of PPS15 applies. DfI Rivers would recommend that a Drainage Assessment is carried out for our consideration.

The applicant should refer to paragraph D17 and D18 of PPS 15.
In carrying out the drainage assessment the applicant should acquire from the relevant authority evidence that the proposed storm water run-off from the site can be safely discharged. If the proposal is to discharge into a watercourse then an application should be made to the local DfI Rivers office for consent to discharge storm water under Schedule 6 of the Drainage (NI) Order 1973.

If it is proposed to discharge storm water into an NI Water system then a Pre-Development Enquiry should be made and if a simple solution cannot be identified then a Network Capacity Check should be carried out. Correspondence with both authorities should be included in the drainage assessment regardless of outcome.

PPS15 Policy FLD 4 Artificial Modification of Watercourses

Not applicable to this site

PPS15 Policy FLD 5 Development in Proximity to Reservoirs

Not applicable to this site

Under the terms of Schedule 6 of the Drainage (Northern Ireland) Order 1973 the applicant must submit to DfI Rivers, for its consent for any proposal to carry out works which might affect a watercourse such as culverting, bridging, diversion, building adjacent to or discharge of storm water etc. Failure to obtain such consent prior to carrying out such proposals is an offence under the aforementioned Order which may lead to prosecution or statutory action as provided for.

I trust you find the foregoing to be helpful but should you require any further information or clarification please contact me at the above address.

Please quote our reference number above on any future correspondence.

Yours faithfully,

Mark Woods

Shared Environmental Service
County Hall
182 Galgorm Road
Ballymena
Co. Antrim
BT42 1QF

Date: 02/11/2018

Planning Reference: LA01/2018/1019/DETEIA

Location: Magheramore Wind Farm, Dungiven

Proposal: Intention to submit an Environmental Statement for the proposed Magheramore Wind Farm

Consultation Type: Environmental Impact Assessment (EIA) 8

Shared Environmental Service (SES) advises that this application is not wholly or partly in a sensitive area within the meaning of Part 1, Regulation 2 (f) of The Planning (Environmental Impact Assessment) Regulations (Northern Ireland) 2017.

The proposed site hydrologically connected to the River Roe and Tributaries. The proposed site also falls slightly within Banagher Glen SAC as it runs adjacent the southern section of the red line boundary. The potential for a likely significant effect on site selection features or an adverse effect on site integrity cannot be ruled out at this stage.

Causeway Coast and Glens Borough Counci is advised to consult Shared Environmental Service on the Northern Ireland Planning Portal, so that the proposal can be considered in accordance with the requirements of Regulation 43 (1) of the Conservation (Natural Habitats, etc) Regulations (Northern Ireland) 1995 (as amended).

If it is determined that an EIA is required SES requests that a shadow Habitats Regulations Assessment (sHRA) is undertaken by the applicant in consultation with the Northern Ireland Environment Agency (NIEA) which is best placed to provide the necessary information to inform the ES and sHRA. The sHRA should be included as a stand-alone document or Annex to the ES and include findings specific to the sites identified above. The EIA should be consistent with the information in and findings of the sHRA.

sharedenvironmentalservice@midandeastantrim.gov.uk

DFI Roads

Department for
Infrastructure
An Roinn
Bonneagair
www.infrastructure-ni.gov.uk

Network Planning
Northern Division

Co.Hall
Castlerock Road
Coleraine
BT51 3HS

Tel: 028 7034 1421

Causeway Coast and Glens
Local Planning Office

Planning Authority Case Officer:	Cathy McKeary
Planning Application Ref:	LA01/2018/12019/DETEIA
Date consultation received:	4th September 2018
Date of Reply:	20th September 2018

Location: Magheramore Wind Farm, Dungiven

Proposal: Intention to submit an Environmental Statement for the proposed Magheramore Wind Farm

Plan received dated 2nd August 2018 refers.

DFI Roads will require a Traffic and Transportation Chapter to be included in the required Environmental Statement. The proposed Haul Routes and any mitigation measures required on the public road network should be addressed.

DFI Roads Case Officer: Victor Sinclair
Network Planning

Issued on behalf of the Divisional Roads Manager

Infrastructure Planning
Westland House
Old Westland Road
Belfast
BT41 6TE

Tel: 028 90354813 Ext 20646
www.niwater.com

northern ireland water

Causeway Coast and Glens Borough Council
Local Planning Office
County Hall
Castlerock Road
Coleraine
BT51 3HS

Your Ref:
LA01/2018/1019/DETEIA

Our Ref:

Date: 31 October 2018

Dear Sir / Madam.

PLANNING CONSULTATION REFERENCE – LA01/2018/1019/DETEIA

NI Water would advise as follows –

This proposed development is located in close proximity to Altnahegish Impounding Reservoir and Caugh Hill Water Treatment Works. Any future consultations should be forwarded to both NIW Strategic Applications and NIW Windfarms.

Yours faithfully

Alan Moore
Infrastructure Planning

2

Proposed Development

Appendix 2: Proposed Development

Appendix 2.1 Potential Grid Connection Assessment

Appendix 2.1

Introduction

The Consenting Context

2.1 Although a grid connection is an integral, requisite part of any wind farm project, it typically follows a completely separate consenting route. Depending upon its scale and significance, consent for the wind farm is sought either from the relevant owner of the local distribution or transmission network, in this case Northern Ireland Electricity Ltd.

2.2 The Best Practice Guidance to PPS 18 states that whilst the routing of such lines by NIE is usually dealt with separately to the application for the wind farm, developers will generally be expected to provide details of indicative routes and method of connection.

2.3 Any Environmental Impact Assessment should assess the complete project, rather than a portion thereof and this is the purpose of this Appendix.

2.4 This chapter contains the following:

- Appendix A - Figures 1 & 2 are referenced in the text as appropriate.

Potential Grid Connection

2.5 The exact means of grid connection is unknown at the time of writing. However, based on RES's knowledge of the grid connection system and NIE's published plans for future upgrades, RES has been able to undertake an assessment to determine the grid connection option, most likely favoured by NIE, which is to proposed Agivey Cluster Substation.

2.6 The Development would be connected to the cluster substation by approximately 17.9 km of underground cable. The grid connection will originate at the Development and connect to the proposed Agivey cluster substation on Drumbane Road approximately 1 km to the south west of Glenullin and 5 km southwest of Garvagh. The Development is approximately 13.6 km from the Agivey Cluster substation (straight line distance). The proposed grid connection route follows the Magheramore Road northeast for approximately 3.2km before continuing onto New Street and crossing the Dungiven Main Street before travelling southeast on Station Road. The connection would then travel northeast along Garvagh Road and continue onto Legavallon Road for approximately 5.8km before travelling east along the Gelvin and Glen Roads for approximately 7.7km before turning south onto the Drumbane Road for 650 meters to the Agivey Cluster Substation.

2.7 The route would begin at the connection point within the Development, and thereafter would follow the public road corridor from the wind farm site entrance to the indicative cluster location, as shown in **Appendix 2.1 Figure 1: Potential Grid Connection.**

2.8 For an underground cable connection, the trench would be similar to those used on the main Development site, as shown in Volume 3 Figure 2.15. The trench will be approximately 0.5 m – 0.75 m wide and 1.0 m deep and could run in the road side verges adjoining the carriageway, or within footways adjoining the carriageway, although it is also possible that the cable would be laid within the carriageway itself. At 33 kV, underground cables are normally laid to a depth of 0.9 m. To lay this cable a trench is dug, bedding material, normally sand, is placed along the trench-base, the cable laid and then covered with more sand. The cables are then protected by a layer of protective plastic covers and then backfilled with subsoil and original topsoil and turfs.

2.9 For bridge crossings along the road, the cable could be laid within the bridge, if there is sufficient excavation depth, or otherwise via directional drilling under the watercourse.

2.10 The construction activities would include the following:

- Clearance of land (including vegetation strip as appropriate)
- Digging of trenches
- Backfilling of trenches and remediation.

2.11 The land should be reinstated as near as reasonably practicable to its original condition.

2.12 It is anticipated that the works would be implemented by NIE using its permitted development rights as a statutory undertaker.

Potential Impacts

2.13 An assessment of the likely significant environmental impacts of the proposed underground grid connection route has been undertaken under the following headings:

- Landscape and visual
- Ecology
- Ornithology
- Geology and the water environment
- Fisheries
- Cultural heritage and archaeology
- Noise
- Traffic and transport.

Landscape and Visual

2.14 The grid connection will connect to the Agivey cluster substation on Drumbane Road approximately 13.6 km from the proposed Development (straight line distance).

The proposed grid connection route is described in detail in paragraph 2.6. It is anticipated that, in most instances the cable will be located below the road surface in order to minimise disturbance to existing trees, hedgerows or adjacent fields. However, there may be disturbance to grass verges adjacent to the road where it is not possible to do this.

2.15 The road corridor varied in character and physical condition along the length of the route. Where the road corridor and verges are narrower, such as along the initial Magheramore Road section, it may be necessary to trim back or remove some sections of existing hedgerows and trees in order to allow sufficient working space for construction machinery. There are residential properties along either side of the road in proximity to Dungiven and the road corridor here is wider and includes paved surfaces on one or both sides. The Legavallon Road is more frequently bounded by low gappy hedgerows and scrubby vegetation, post and wire fences. The Gelvin and Garvagh Roads are more pastoral in character with good quality established hedgerows and shallow grass verges.

2.16 The following measures are recommended:

- Consideration should be given to the protection of established trees and hedgerows during cable installation and where appropriate temporary fencing should be erected;
- Excavated materials arising from the excavations that cannot be reused in reinstatement works should not be dumped onto roadside verges but should be removed from site on an ongoing basis during the construction period;
- Construction works should be planned such that they occur within as short a time period as reasonably practicable in order to minimise the period during which visual and physical disturbance occurs;
- Where there is disturbance to grass verges it should be reinstated promptly on completion of the construction works subject to the appropriate ground and weather conditions. The ground should be regraded to a profile that matches adjacent verges and should be cultivated where necessary and re-seeded with grass seed of an appropriate species mix to that which is present elsewhere along the road corridor. Reseeded areas should be watered in periods of dry weather in order to ensure that the seed germinates and establishes successfully. Works to verges should be planned to give due consideration to weather conditions and, when necessary, avoided in excessively wet or cold conditions in order to avoid compacting or otherwise damaging soil structure.

2.17 The grid connection route is largely located outside the Sperrin AONB although the Development itself is located within the north eastern boundary. The road corridors within the AONB are deemed to be of higher quality and higher sensitivity to alterations. However, the proposed grid connection works will not introduce a permanently visible new element of landscape character because all cables will be undergrounded. Therefore, providing the aforementioned measures are adopted, the magnitude of effects on landscape character will be negligible and the overall landscape effects are deemed to be Not Significant.

2.18 The primary visual receptors will be users of the road network who are generally deemed to be of low sensitivity but also residents on the outskirts of Dungiven who are deemed to be of medium sensitivity. Farmers on the adjacent upland grazing and pastoral fields are deemed to be of low sensitivity although they may be most affected by physical alterations to agricultural land for a temporary period of time. There are unlikely to be significant views of the grid connection works beyond the immediately vicinity of the works.

2.19 There will be temporary disruption to road corridors during construction of the grid connection route which will be experienced by all visual receptors for a short period of time. However, the completed works will not be visible, and the experience of visual receptors located along the grid connection route will be unchanged by its construction. Therefore, the overall magnitude of visual effects is also deemed to be negligible and the overall visual effects are deemed to be Not Significant.

Ecology

2.20 This section considers the potential impacts of the proposed grid connection on the flora & fauna interests along the proposed route. Mature trees, hedgerows and river crossings are the areas of conservation value along the proposed grid connection route. However, it is proposed to bury the cable in the roadside verge, (within footways adjoining the carriageway, (or even within the carriageway itself)) therefore the impact to these habitats of conservation value should be limited. In addition, tree roots will be avoided by the use of British Standard BS5837: 2005 Trees in relation to Construction - Recommendations.

2.21 The direct potential impacts on important ecological receptors are related mostly to any potential habitat loss and disturbance of habitats as a result of activities to excavate a trench for an underground cable. Any trenching to lay an underground cable should involve immediate reinstatement of the low-quality habitats found in the roadside verges. Therefore, the net habitat loss should be neutral.

2.22 In addition, there is the potential for direct disturbance to protected fauna from construction noise and associated activities themselves. However, it is proposed to engage an ECoW (Ecological Clerk of Works) in order to survey the route (preconstruction) for any species which could potentially be disturbed by construction works. Mitigation to reduce disturbance (i.e. by restricting timing of works) can be implemented then.

2.23 Disturbance of habitats along the route also has the potential to result in indirect impacts on faunal species which inhabit those habitats, and this could include, bat species, smooth newt, badger and common lizard all of which have been recorded along or in close proximity to the route.

2.24 No operational impacts from normal operation of an underground connection are predicted. Should the cable be required to be excavated for maintenance this would result in habitat disturbance, but this should be reinstated following works.

2.25 On the basis of the desk study undertaken the significance of the potential impacts is assessed to be low-negligible, however pre-construction mitigation measures that should be adopted by the construction contractor are proposed below:

- Pre-construction surveys to identify areas of sensitive habitat which should be avoided;
- Pre-construction protected species to identify species or features supporting species along the route and allow the preparation of appropriate mitigation;
- Preparation of a construction method statement for the grid connection stating how impacts on protected species and habitats would be avoided; and
- The use of an ECoW during construction to ensure that all of the above measure is properly implemented.
- Tree roots will be protected by the implementation of BS5837:2005, where excavations will not be permitted inside the RPA (Root Protection Area). Which are;
    - 12 times the diameter of the trunk measured at 1.5 m for a single stemmed tree or;
    - 10 times the diameter of the tree measured immediately above the root flare for a multi-stemmed tree.
- No spoil, vehicles, fuel, materials, temporary buildings or ancillary equipment shall be stored inside the RPA. Existing ground levels within the RPA should not be raised or lowered.
- It is not possible at this stage to completely rule out the need to remove small sections of hedgerow or trees but if this was required, these should be replanted or replaced.

2.26 Completion of a programme of ecological and ornithological mitigation works would offset the loss of the ecological resource that would occur as a result of the construction of the grid connection. Taking the proposed mitigation into account, no significant residual effects are anticipated to occur.

Ornithology

2.27 During the construction phase there is a low risk of disturbance to breeding birds in any hedges or trees along the minor road sections of the route (the route section south of Dungiven and the northern section past Gortnamoyagh Forest). For the section of the route following the B64 the risk of disturbance to breeding birds would be less. No operational effects are predicted.

2.28 The following mitigation measures are recommended:

- If significant cutting or removal of hedges and trees is required then this should be done outside the bird breeding season (1st March to 31st August).

- If hedges / trees are to be removed during the breeding season then there should be a pre-construction survey to establish whether nesting birds are present. During March and after mid-July the likelihood of active nests being present would be very low.

2.29 With implementation of the proposed mitigation there should be no residual effects.

Geology & Water Environment

2.30 Potential direct effects of the proposed grid connection route are on water quality, morphology, water resource and flood risk to surface and groundwater in the affected sub-catchments. The nature of the development type would not be anticipated to have any potential for significant geological effect. Potential indirect effects on water dependant habitats are addressed separately within the ecology section.

Hydrogeology

2.31 The proposed grid route crosses the Claudy, Artikelly, Magilligan and Coleraine Kilrea groundwater bodies.

2.32 The aquifers underlying the route vary in nature; GSNI mapping indicates high to limited productivity with predominantly fracture flows. In areas of sandstone, the bedrock aquifer would have probable high to moderate yields; however, part-dependence on fracture flow makes poorer yields possible. In areas of basalt, the bedrock aquifer would have high to moderate yields possible in places; however, dependence on fracture flow makes poorer yields possible. In areas of psammite and metalimestone, shallow, local flows and low yields from the aquifer would be more common.

2.33 The Claudy and Artikelly groundwater bodies have a Water Framework Directive (WFD) water quality status of 'Good'. The Magilligan and Coleraine Kilrea groundwater bodies have a WFD water quality status of 'Poor'.

2.34 The majority of the proposed route is overlain by Till Diamicton. Where the route is in proximity to watercourses i.e. Roe River and Formil River (Agivey River catchment), Alluvium (Clay, Silt, Sand and Gravel) is prevalent.

2.35 Groundwater vulnerability is categorised from Highest (5) to Lowest (1) and is variable along the length of the proposed connection route:

- From the north-east boundary of the Development into Dungiven, there is a groundwater vulnerability Class 4e;
- East from Dungiven, approximately 3.5 km along the Legavallion Road, there is
- a vulnerability Class 2;
- The remaining 1.7km the proposed route that travels along Legavallion Road, and for approximately 2.1 km along Gelvin Road, there is a vulnerability Class of 3.
- A short section of Gelvin Road (c. 1.8 km) has a vulnerability Class 4e and 5;

- The following 3.2 km along Gelvin Road has a vulnerability Class 2; and
- The final section of the proposed route along Drunbane Road leading to the Substation has a groundwater vulnerability Class 4a.

2.36 Good practice guidance on pollution prevention (as outlined in Appendix 9.1) should be adhered to during works across the proposed route, with particular focus on areas identified as vulnerable where potential superficial aquifers may be located i.e. north-east of the Development and along Gelvin Road.

2.37 Several industrial consents are in the vicinity of the proposed route. They include:

- Private Sewage (domestic and unspecified) between the Development site and Dungiven; parallel to Legavallion Road north-east of Dungiven; and in the vicinity of Gelvin Road; and
- Minerals: Concrete Products at the Magheramore Road crossing over Roe River.

2.38 Consultation with statutory stakeholders regarding private water supplies (PWS) was undertaken during the preparation of the Environmental Statement for the Development. It is not anticipated that PWS will be affected by cable laying as the works will be confined to the road corridors, will not require new watercourse crossings (utilising existing bridges and culverts), and laying the cable at a shallow depth will avoid impacting groundwater quality/ flow.

2.39 Three non-PWS abstractions are in the vicinity of the proposed connection route. Each are associated with hydro power and all are upstream of the proposed route; therefore, they will not be disturbed by the works associated with the laying of the connection cable.

Hydrology

2.40 The proposed grid route crosses seven surface water catchments. Much of the hydrology baseline of the route is consistent with the baseline presented in Chapter 9: Geology and Water Environment with WFD mapping placing approximately 70% of the proposed grid route within the Roe Local Management Area (LMA) which falls under the control of North Western the River Basin District (RBD). The remainder of the proposed route is located within the Lower Bann LMA which falls under the Neagh Bann RBD.

2.41 The proposed cable laying route is in proximity to, and crosses parts of, the River Roe and Tributaries Special Area of Conservation (SAC) and Area of Special Scientific Interest (ASSI). A section of the proposed route also borders the edge of Ballymacallion ASSI.

2.42 Presence of Atlantic salmon (*Salmo salar*) as an Annex II species are the primary reason for River Roe and Tributaries selection as a SAC. Otter (*Lutra lutra*) are also present as an Annex II species qualifying feature, but are not the primary reason for site selection. Ballymacallion is an ASSI because of its species-rich grassland i.e. purple moor-grass and rush pastures, and lowland meadow. Details are outlined in the table below.

Appendix 2.1 Table 1: Summary of Catchments along Proposed Cable Route

Catchment	Approx. cable length (km)	Approx. % of overall proposed cable route	NIEA waterbody WFD status	Local Management Area	Catchment Stakeholder Group	River Basin District	Associated Protected Areas
Owenrigh River	1.9	11	Moderate Ecological Potential	Roe	Lower Foyle	North Western	River Roe and Tributaries SAC and ASSI
River Roe (Benady)	0.32	2	Good	Roe	Lower Foyle	North Western	River Roe and Tributaries SAC and ASSI
River Roe (Limavady)	4.7	28	Good	Roe	Lower Foyle	North Western	River Roe and Tributaries SAC and ASSI
Gelvin River (Benview)	1.0	6	Good	Roe	Lower Foyle	North Western	River Roe and Tributaries SAC and ASSI
Gelvin River (Lenamore)	4.3	25	Good	Roe	Lower Foyle	North Western	River Roe and Tributaries SAC and ASSI
Brockagh Water	1.9	11	Good	Lower Bann	Lower Neagh Bann	Neagh Bann	N/A
Agivey River (Glen Ullin)	2.8	1	Good	Lower Bann	Lower Neagh Bann	Neagh Bann	N/A

2.43 Construction works associated with the proposed development (underground cable to a depth of 0.9 m) will follow the route of existing road corridors, cross watercourses via existing bridges and culverts, and will not further encroach into existing floodplains compared to existing conditions.

2.44 Similarly, during the operational phase of the Development, the cable route would by its nature (buried) have no effect on flooding by causing restrictions or disruption to flood flows. Any above ground structure (e.g. the proposed Agivey Cluster Substation) is to be sited outside of fluvial floodplains and shall be resilient to surface water flooding.

2.45 The route is in proximity to areas of surface water flooding identified by "strategic" type mapping on Flood Maps NI. It is noted that the coarse resolution of the mapping may not accurately capture the raised elevation of the existing roads along which the proposed route will follow, which will act as a barrier to overland flow and prevent flooding to working areas.

2.46 However; the Applicant should take a precautionary approach and adopt appropriate measures to avoid earthworks becoming inundated and potentially transporting sediment off-site into the water environment. Measures may include, but not be limited to:

- Preparing and implementing a Flood Response Plan;
- Routinely checking weather warnings;

- Storing plant and materials in areas outside known areas of surface water flooding where practicable;
- Implementing temporary drainage systems to alleviate localised surface water flood risk and prevent surface water ingress to the construction working areas; and
- Prevent obstruction of existing surface runoff pathways.

2.47 The nature of the proposed development (underground cable) and the methods used to cross watercourses (i.e. within existing bridge decks or by directional drilling) would have no potential to affect watercourse morphology, and so potential for effects at watercourse crossings are not considered further.

2.48 Other effects associated with typical construction activities would be similar to those described in Chapter 9: Geology and Water Environment and would be solely associated with the construction phase. No operational effects are anticipated.

2.49 The following table summarises the potential surface and ground water constraints to development of the grid connection, as well as likely potential effects.

Appendix 2.1 Table 2: Summary of Hydrological Constraints and Effects

Baseline Characteristic / Summary Description		**Receptor**	**Unmitigated Potential Effect**	
Groundwater	Aquifers with high to low yield and local flow.	Abstractions / Private Water Supplies in proximity to the proposed cable route.	Reduced Groundwater Quality	Limited potential for short term slight deteriorations in water quality due to excavations that would release sediments; use of mechanical plant with associated fuels and lubricants.
			Reduced Groundwater Quantity	Shallow excavations associated with cable laying would not be anticipated to cause any change in groundwater flow routes.
Surface Water	Waterbodies with current WFD status of	Water feature crossings and works in	Reduced water quality	All watercourse crossings coincide with existing road crossings and culverts; the cable will be laid within the

Baseline Characteristic / Summary Description		Receptor	Unmitigated Potential Effect	
	"Moderate Ecological Potential" to "Good".	proximity to water features.	Changes to watercourse morphology	road deck over the existing culvert, or via directional drilling under the watercourse. Methods will not cause requirement for any in-stream work or work that would directly affect watercourse morphology or cause potential for pollution of the watercourse.
Surface Water	**Floodplains**	Route in proximity to discrete areas of fluvial and surface water floodplain.	Flood Risk to the development	The cable route would by its nature (buried) be unaffected by flooding. Any above ground structure (in particular the proposed Cluster Substation) is to be sited outside of fluvial floodplains and shall be resilient to surface water flooding. Appropriate techniques to manage surface water around working areas would be implemented.
			Increased flood risk elsewhere	The cable route would by its nature (buried) have no effect on flooding by causing restrictions or disruption to flood flows.
Protected Areas	**Waterbodies protected for species**	Cables would directly cross the Roe River and	Reduced water quality	All watercourse crossings coincide with existing road crossings and culverts; the

Baseline Characteristic / Summary Description		Receptor	Unmitigated Potential Effect	
		Tributaries SAC and ASSI, designated as protected areas under the WFD due to presence of Atlantic salmon	Changes to watercourse morphology	cable will be laid within the road deck over the existing culvert, or via directional drilling under the watercourse. Methods will not cause requirement for any in-stream work or work that would directly affect watercourse morphology or cause potential for pollution of the watercourse.

2.50 Mitigation to address potential deterioration of water quality (due to excavations, runoff from the works, and use of oils fuels and lubricants) associated with the types of construction activities anticipated shall be similarly addressed by the surface water management and pollution prevention measures stated in Chapter 9: Geology and Water Environment and accompanying Technical Appendix 9.1: Water Framework Directive Assessment.

2.51 Given the short duration of construction and limited localised areas of disturbance proposed during the construction of the grid connection route, it is considered that there would be no significant impacts on the water quality or flow of the surface water and groundwater, or on the use of groundwater by identified abstractions and water supplies provided the mitigation measures set out above are adopted.

Fisheries & Aquatic Ecology

2.52 The proposed underground grid route crosses 18 watercourses between the proposed Magheramore Wind Farm Substation and the proposed Agivey Cluster Substation, as detailed in the Geology and Water Environment section. These watercourses are spread across two major river catchments, the Roe and the Agivey, and seven constituent waterbodies as defined under the WFD; ecological status as determined in 2015 is noted as follows:

- Owenrigh River (UKGBNI1NW020202010), Moderate Ecological Potential (MEP);
- River Roe (Benady) (UKGBNI1NW020202015), Good Ecological Status;
- River Roe (Limavady) (UKGBNI1NW020202018) Good Ecological Status;
- Gelvin River (Benview) (UKGBNI1NW020202012) Good Ecological Status;
- Gelvin River (Lenamore) (UKGBNI1NW020202039) Good Ecological Status;
- Brockagh Water (UKGBNI1NB030301216) Good Ecological Status;
- Agivey River (Glen Ullin) (UKGBNI1NB030301215) Good Ecological Status.

2.53 Six of the 18 watercourses to be traversed are significant in terms of channel size and fisheries sensitivity, while the remainder are relatively small and likely to be at best of Medium sensitivity with regard to fisheries and aquatic ecology.

2.54 Installation of the cable should be within the existing bridge structure at all watercourse crossing locations provided there is sufficient excavation depth. If this cannot be achieved, installation should be by directional drilling under the watercourse. Either approach will avoid any interference with the integrity of the stream channel and will therefore not result in any loss of or damage to aquatic habitats. Similarly, there will be no interruption to fish passage within stream channels.

2.55 In addition to watercourse crossings, there are two sections of the cable laying route which lie directly adjacent to watercourses of High or Very High fisheries sensitivity, the Turmeel Burn and the Gelvin River. The Gelvin forms part of the River Roe and Tributaries SAC and is an important salmon spawning and nursery stream. The risk of any effect on fisheries and aquatic ecology will ultimately depend upon which side of the road the cable is to be located.

2.56 Construction processes should follow industry standard guidelines to ensure that no sediment or other polluting substances are released into the watercourses, in particular Pollution Prevention Guidance (PPG5): Works and maintenance in or near water.

2.57 With the suggested mitigation it is predicted that there will be no residual effects on fisheries and aquatic ecology.

Archaeology and Cultural Heritage

2.58 A detailed desktop survey was undertaken for the proposed grid connection route, extending to a 1 km wide corridor centred on the route. This entailed a review of the Sites and Monuments Records, the Industrial Archaeological Records, the Historic Buildings Archive, the Historic Gardens Register and the Defence Heritage Records, which are maintained by the Department of the Communities Historic Environment Division (DfC: HED).

2.59 The identification of historic environment constraints is based solely upon the results of the desk-based assessment. No field survey was carried out at this stage of the assessment.

2.60 Appendix 2.1 - Figure 2 shows the route of the proposed grid connection and the location of cultural heritage assets within the search area.

Cultural Heritage Assets on Route of Grid Connection

2.61 Along the line of the route the grid connection passes through one Area of Archaeological Potential in Dungiven and over five bridges (Table 3) which are not listed buildings but are included in the Industrial heritage Record.

Appendix 2.1 Table 3: Industrial Heritage Assets on Route of the Grid Connection

IHR Ref No	Name	NGR
01845:000:00	Turmeel Bridge	268740, 408770
01853:000:00	Upper Gelvin Bridge	272770, 413570
01857:000:00	Formil Bridge	277790, 411740
01860:000:00	Derryware Bridge	269410, 410110
01877:000:00	Ashlamaduff Bridge	278720, 411670

Scheduled Monuments in the 1km Study Area

2.62 There are three scheduled monuments within the 1km study area; Dungiven Castle (LDY 025:005), Brockaghboy Rath (LDY 026:050) and Banagher Old Church (LDY 030:029).

Appendix 2.1 Table 4: Scheduled Monuments in 1km Study Area

Ref No	Name	NGR
LDY 025:005	Dungiven Castle	269227, 409113
LDY 026:050	Lismore Rath	280273, 412203
LDY 030:029	Banagher Old Church	267556, 406597

Listed Buildings in the 1km Study Area

2.63 There are eight listed buildings within the 1km Study Area, with the exception of Mount Prospect House and Apartments (HB02/05/001 A & B) these assets are all located within the town of Dungiven.

Appendix 2.1 Table 5: Listed Buildings in 1km Study Area

Ref No	Name	NGR	Grade
HB02/05/001 A	Mount Prospect House	267773, 406881	B2
HB02/05/001 B	Mount Prospect House (Apartments.)	267765, 406910	B2
HB02/06/002	Church of Ireland Church	269357, 409124	B2
HB02/06/003 A	Dungiven Castle	269216, 409107	B1
HB02/06/006 A	7 Lower Main Street	268698, 409543	B2
HB02/06/006 B	9 Lower Main Street	268705, 409539	B2
HB02/06/006 C	11 Lower Main Street	268714, 409539	B2
HB02/06/006 E	15 Lower Main Street	268725, 409539	B2

Registered Parks and Gardens in the 1km Study Area

2.64 There is one registered Park and Garden within the 1km Study Area; Pellipar (L-018) which is included in the main register as a designated supplementary site.

Appendix 2.1 Table 6: Registered Parks and Gardens in 1km Study Area

Ref No	Name	NGR
L-018	Pellipar	267773, 406881

Locally Designated Heritage Assets in the 1km Study Area

2.65 The SMR records a total of 25 undesignated assets within the 1km Study Area. This includes 11 undesignated SMR assets (Table 7, Figure 2) of these four are recorded as unlocated and seven are recorded as located. The located SMR assets include four enclosures, a cairn, a mill, a holy well and a settlement. There are 12 industrial heritage assets (Table 8, Figure 2) of these comprise of seven are related to flax or corn milling, three bridges, a station and a quarry. There is one defence heritage asset (Table 9, Figure 2) an observation post.

Appendix 2.1 Table 7: Undesignated SMR assets in 1km Study Area

SMR No	Name/Description	NGR
LDY024:049	Historic Settlement: Dungiven	268700, 409500
LDY025:006	Enclosure	273070, 414000
LDY025:008	Holy Well: Toberpatrick	269150, 408650

SMR No	Name/Description	NGR
LDY025:015	Earthwork (O.S. Memoir Site, Unlocated)	272000, 413000
LDY025:025	Enclosure	276780, 411510
LDY026:033	Enclosure: Lisbeg	280000, 412260
LDY026:051	Two Cairns: Uaghullin	279050, 412260
LDY026:102	Burial Ground: Garahaynalaniv - Garden Of The Infants (O.S. Memoir Site, Unlocated)	278000, 412000
LDY026:103	Standing Stone: Lisnascreghog (O.S. Memoir Site, Unlocated)	278000, 412000
LDY026:104	Cist Burial (Unlocated)	280000, 412000
LDY030:048	Mill	269019, 408456

Appendix 2.1 Table 8: Industrial heritage assets in 1km Study Area

IHR No	Name/Description	NGR
01433:029:00	Milepost & Bridge	269230, 410180
01433:030:00	Station / Terminus, Goods Store, Signal House & 2 Signal Posts	269010, 409650
01842:000:00	Flax Mill - Flax & Saw Mill site	268660, 409930
01843:000:00	Dungiven Bridge	268510, 409540
01844:000:00	Corn Mill & Kiln - Saw & Corn Mill site	268580, 409520
01852:000:00	Corn Mill & Kiln - Flax Mill site	272720, 413590
01859:000:00	Bridge	269200, 410210
01863:000:00	Saw Mill	269100, 409370
01876:000:00	2 Limekilns on edge of Quarry	279660, 412110
01953:000:00	Flax Mill site	267820, 407700
01954:000:00	Flax, Corn & Saw Mill site	268290, 407680
01955:000:00	Flax Mill site	267800, 406950

Appendix 2.1 Table 9: - Defence heritage assets in 1km Study Area

Defence Heritage No	Type	Townland
DHP278	Observation Post	Teevan

Archaeological Potential

2.66 The proposed grid connection route largely passes through the fertile valley floors of the area which would historically have been more attractive to agriculture and settlement than the surrounding uplands. It is considered that there is medium potential for assets of prehistoric to modern date to survive within the grid connection route, this potential will increase in areas in close proximity to known cultural heritage assets.

2.67 It is possible that the construction of the existing roads and verges will have damaged or removed previously unrecorded cultural heritage assets, however this will vary depending on the construction methods of the road; the Magheramore Road is unlikely to have had as large a construction impact as the larger Legavallon Road. However, neither of these roads appear large enough to confidently state that the potential for previously unrecorded archaeological assets in their footprint has been removed.

2.68 It should also be taken into account that while the grid connection is a long linear cutting it will also be narrow. The footprint of the grid connection will therefore be relatively limited. Taking these factors into account it is considered that while there is medium potential for previously unrecorded cultural heritage assets to survive in the area the risk that they will be affected by the proposed grid connection is considered to be low.

Potential Impacts

Construction

2.69 There is potential for direct impacts on the five IHR recorded bridges along the route of the grid connection.

2.70 There is medium potential that previously unrecorded or unlocated cultural heritage assets survive unrecorded within the route of the grid connections. However, given the narrow footprint of the grid connection and as it is within a road corridor it is considered that there is low risk of previously unrecorded cultural heritage assets being affected. It is therefore considered possible, though unlikely, for direct impacts upon archaeological deposits that may survive as buried remains within the proposed development footprint.

Operational

2.71 It is considered that as the grid connection will be built subsurface there is no potential for operational impacts on cultural heritage assets.

Conclusion

2.72 It is considered that archaeological mitigation will be required regarding the construction of the proposed grid connection. The details of this mitigation will be agreed with the HED, but in general it could entail historic building recording of the IHR bridges accompanied by archaeological monitoring of work on and around those bridges, and/or a targeted archaeological watching brief along the route of the grid connection.

2.73 Following mitigation, it is considered that there will be no adverse residual effects from the proposed grid connection on cultural heritage assets.

Noise

2.74 There are a limited number of residential properties located along, and within the vicinity of the potential underground grid connection route.

2.75 During the construction phase, noise generating plant would be used and it is likely that noise levels would temporarily increase at residential properties within the vicinity of the construction works along the grid connection route.

2.76 Construction activities with the potential to generate noise from grid connection construction are likely to include clearance of land, digging of trenches and backfilling of trenches and remediation.

2.77 In Northern Ireland, advice on construction noise assessment is referred to in 'The Control of Noise (Codes of Practice for Construction and Open Sites) Order (Northern Ireland) 2002[1]. This legislation advises the use of British Standard BS 5228: Part 1:1997 as being suitable for giving guidance on appropriate methods for minimising noise from construction and open sites in Northern Ireland.

2.78 Since the 1997 version has been superseded by British Standard BS 5228-1:2009 'Code of practice for noise and vibration control on construction and open sites - Part 1: Noise'[2] this has been identified as being suitable for the purpose of giving guidance on appropriate methods for minimising noise from construction activities.

2.79 The ABC method described in Annex E of BS 5228-1:2009 sets threshold noise levels for specific periods based on the ambient noise level. Category A would be deemed appropriate due to the relatively low levels of ambient noise along the proposed route. This category sets minimum LAeq criteria of: 65 dB(A) during weekdays (0700-1900) and Saturdays (0700-1300); below 55 dB(A) at evenings and weekends; and below 45 dB(A) for night-time (2300-0700) periods.

2.80 Noise levels due to the construction of the grid connection route will be mitigated by the short-term nature of the activity but further mitigation including the installation of acoustic barriers or the restriction of working hours per day could also be considered, if required.

2.81 There are many strategies to reduce construction noise and any mitigation adopted should not be limited to the measures suggested.

2.82 The Pollution Control and Local Government (NI) Order 1978 provides information on the need for ensuring that best practicable means are employed to minimise noise[3]. For all activities, measures will be taken to reduce noise levels with due regard to practicality and cost.

[1] 'The Control of Noise (Codes of Practice for Construction and Open Sites) Order (Northern Ireland) 2002', The Department of the Environment, November 2002

[2] 'Code of Practice for Noise and vibration control on construction and open sites - Part 1: Noise', British Standards Institution, BS 5228-1:2009

[3] 'Pollution Control and Local Government (NI) Order 1978', published by Her Majesty's Stationary Office, 1978

2.83 With appropriate mitigation, if required, it is assessed that there will be no residual significant effects during the construction phase.

2.84 There are no anticipated effects during the operational phase.

Traffic and Transport

2.85 The connection is approximately 17.9 km in plan length. The proposed grid connection route follows the Magheramore Road northeast for approximately 3.2km before continuing onto New Street and crossing the Dungiven Main Street before travelling southeast on Station Road. The connection would then travel northeast along Garvagh Road and continue onto Legavallon Road for approximately 5.8km before travelling east along the Gelvin and Glen Roads for approximately 7.7km before turning south onto the Drumbane Road for 650 meters to the Agivey Cluster Substation.

2.86 All grid connection construction works should be undertaken in accordance with a Construction Method Statement and any associated road opening licences, agreements or permits. A Traffic Management Plan including details of any temporary road closures should be agreed with Transport NI prior to the commencement of works. The Traffic Management Plan should be developed to ensure any disruption during the underground cable works will be kept to a minimum. However, it is likely that there will be temporary, local traffic disruptions for the duration of the underground cable installation works.

2.87 It is expected that there will be some disruption to traffic flows along the carriageways flanking the proposed grid route that will be managed but some narrower routes (i.e. bridge crossings / Drumbane Road) may require temporary road closures.

2.88 No significant residual effects are anticipated to occur.

2.89 When installed, the underground cable will have no adverse effect upon traffic during the operational phase.

Summary

Appendix 2.1 - Table A provides a summary of the potential environmental effects and proposed mitigation.

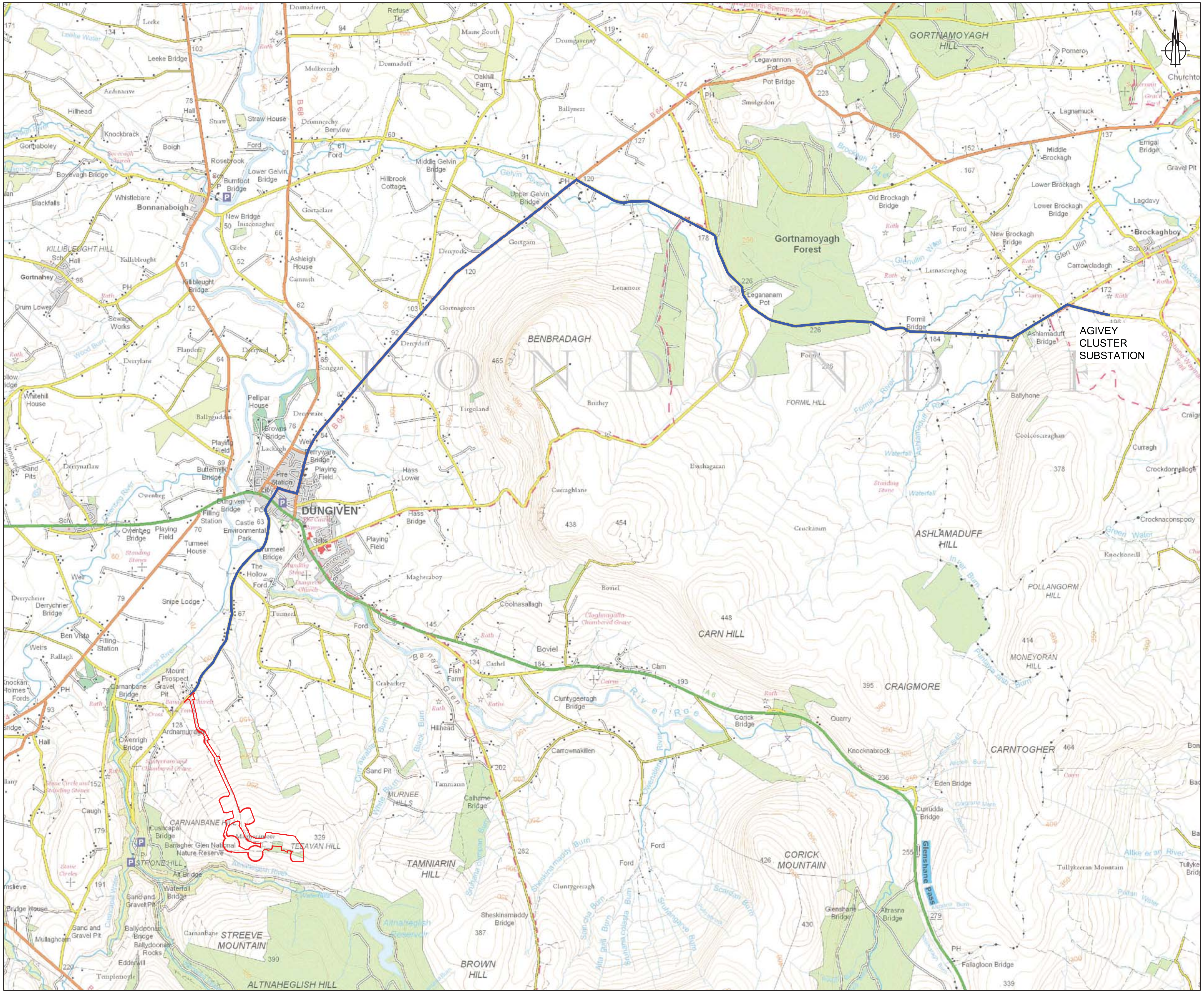
Topic	Construction Impacts	Operational Impacts	Mitigation	Residual Effects
Landscape and visual	Disturbance to grass verges, cutting and potential removal where necessary of hedgerows and trees.	None	▪ Consideration should be given to the protection of established trees and hedgerows during cable installation and where appropriate temporary fencing will be erected. ▪ Excavated materials arising from the excavations that cannot be reused in reinstatement works should not be dumped onto roadside verges but should be removed from site on an ongoing basis during the construction period ▪ Construction works should be planned such that they occur within as short a time period as reasonably practicable in order to minimise the period during which landscape and visual effects occur ▪ Where there is disturbance to grass verges it should be reinstated promptly on completion of the construction works subject to the appropriate ground and weather conditions.	No significant impacts

Topic	Construction Impacts	Operational Impacts	Mitigation	Residual Effects
Ecology	Damage to habitat in roadside verge. Indirect impacts due to habitat disturbance along the route on faunal species which inhabit those habitats, which could include otter, bat species, smooth newt, badger, hedgehog and common lizard all of which have been recorded along or in close proximity to the route.	None	▪ Tree roots should be protected by the implementation of BS5837:2005, where excavations will not be permitted inside the RPA (Root Protection Area). ▪ No spoil, vehicles, fuel, materials, temporary buildings or ancillary equipment should be stored inside the RPA. Existing ground levels within the RPA will not be raised or lowered. ▪ Pre-construction surveys to identify areas of sensitive habitat which should be avoided ▪ Pre-construction protected species surveys to identify species or features supporting species along the route and allow the preparation of appropriate mitigation ▪ Preparation of a construction method statement for the grid connection stating how impacts on protected species and habitats would be avoided ▪ The use of an ECoW (Ecological Clerk of Works) during construction to ensure that all of the above measures are properly implemented.	No significant impacts
Ornithology	Low risk of disturbance to breeding birds along the route.	None	▪ If cutting or removal of hedges and trees is required then this should be done outside the bird breeding season (1st March to 31st August). ▪ If work is to be done during the breeding	No residual impacts

Topic	Construction Impacts	Operational Impacts	Mitigation	Residual Effects
			season then there should be a pre-construction survey to establish whether nesting birds are present. During March and after mid-July the likelihood of active nests being present would be very low.	
Geology, Hydrology & Hydrogeology	Limited potential for short term impacts associated with typical construction activities. Limited potential for short term impacts associated with works in proximity to areas of surface water flooding.	None	▪ Appropriate surface water management and pollution prevention techniques around working areas, in line with good practice guidance, shall be implemented.	No significant impacts
Fisheries	Release of sediment or pollutants into watercourses near crossings.	None	▪ Construction processes should follow industry standard guidelines to ensure that no sediment or other polluting substances are released into the watercourses, in particular Pollution Prevention Guidance (PPG5): Works and maintenance in or near water.	No residual effects
Archaeology & Cultural Heritage	Potential impact on IHR 1878 bridge which carries the Drumbane Road over the	None	▪ Directional drilling should be considered at IHR 1878 to take the grid connection below the level of the bridge.	No residual effects

Topic	Construction Impacts	Operational Impacts	Mitigation	Residual Effects
	Brockagh River. Very low potential for impacts on previously undiscovered sites of archaeological significance.			
Noise	Potential short term noise increase at residential properties within the vicinity of the construction works along the grid connection route.	None	▪ Installation of acoustic barriers or the restriction of working hours per day could be considered, if required.	No residual impacts
Transport and Traffic	Temporary local traffic disruption for the duration of the cable laying, including some temporary road closures.	None	▪ Grid connection construction works should be undertaken in accordance with an agreed Construction Method Statement and any associated road opening licences, agreements or permits. ▪ A Traffic Management Plan including details of any temporary road closures should be agreed with Transport NI prior to the commencement of works to ensure any disruption during the underground cable works will be kept to a minimum.	No significant impacts

Appendix A



MAGHERAMORE WIND FARM

APPENDIX 2.1

FIGURE 1 POTENTIAL GRID CONNECTION ROUTE

KEY:

- PLANNING APPLICATION BOUNDARY
- POTENTIAL GRID CONNECTION ROUTE

LAYOUT DWG N/A

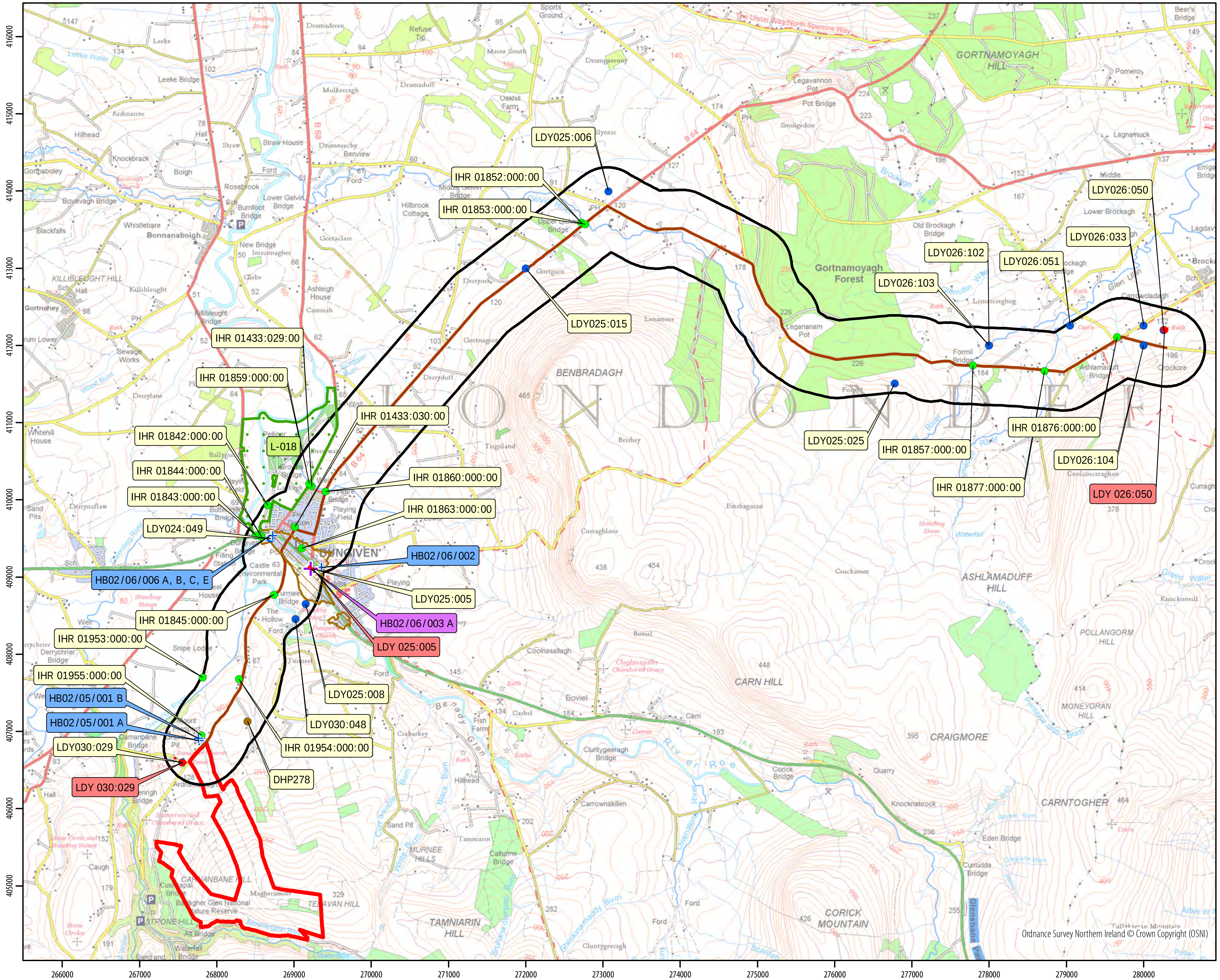
T-LAYOUT NO. N/A

DRAWING NUMBER

03426D2223-01

SCALE - 1:50,000 @ A3

ENVIRONMENTAL STATEMENT



HEADLAND ARCHAEOLOGY

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KEY

- Scheduled monument
- Grade B1 listed building
- Grade B2 listed building
- Historic park and garden
- Area archaeological potential
- SMR asset
- Industrial heritage asset
- Defence heritage asset
- Potential grid route
- 1km study area
- Wind farm site boundary

Scheduled monument area information derived from NIEA data dated 15.05.18 © Crown Copyright (NIEA)

Listed Building data provided by NIEA dated 15.05.18 © Crown Copyright (NIEA)

Registered Park and Garden information derived from NIEA data dated 15.05.18. © Crown Copyright (NIEA).

Sites and Monuments Record information derived from NIEA data dated 15.05.18. © Crown Copyright (NIEA).

N

1:50,000 @ A3

0 1,000m

Appendix 2.1 Figure 2

Cultural heritage assets in the 1km Study Area

4

Landscape & Visual

4 Landscape & Visual Impact Assessment Technical Appendices

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- Table 4.1 The Development's Zone of Theoretical Visibility
- Table 4.2 Summary of Visual Effects on Viewpoints
- Table 4.3 Clusters of Cumulative Wind Farm
- Table 4.4 The Development's Cumulative Zone of Theoretical Visibility
- Table 4.5 Summary of Cumulative Visual Effects on Viewpoints

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- Figure 4.2 Landscape Designations and Classifications
- Figure 4.3 Landscape Character Areas
- Figure 4.4 Viewpoint Selection
- Figure 4.5 Cumulative Baseline

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- Figure 4.15 Viewpoint 3: Fincarn Crossroads at B40 – B44 road junction
- Figure 4.16 Viewpoint 4: Banagher Old Church
- Figure 4.17 Viewpoint 5: Banagher Road
- Figure 4.18 Viewpoint 6: Magheramore Road near site entrance
- Figure 4.19 Viewpoint 7: Creebarky – Teeavan Road junction
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- Figure 4.28 Viewpoint 16: Plantation Road near Park
- Figure 4.29 Viewpoint 17: Slieve Kirk Hill and Viewpoint 18: Craignagapple near Owenreagh (wireline-only)

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List of Technical Appendices Accompanying Chapter 4

- Technical Appendix 4.1 LVIA Figure List, Glossary and References

- Technical Appendix 4.2 LVIA Methodology
- Technical Appendix 4.3 Landscape Character Areas
- Technical Appendix 4.4 Viewpoint Selection
- Technical Appendix 4.5 Cumulative Baseline

Abbreviations used in the Landscape and Visual Impact Assessment

- AONB Area of Outstanding Natural Beauty
- EIA Environmental Impact Assessment
- LCA Landscape Character Area
- LVIA Landscape and Visual Impact Assessment
- NIEA Northern Ireland Environment Agency
- NILCA Northern Ireland Landscape Character Assessment
- NIRLCA Northern Ireland Regional Landscape Character Assessment
- PPS 2 'Planning Policy Statement 2 Natural Heritage'
- PPS 18 'Planning Policy Statement 18 Renewable Energy'
- PVP Provisional Viewpoint
- RES RES UK & Ireland Ltd; the Applicant
- SSPS 'Strategic Planning Policy Statement for Northern Ireland (SPPS): Planning for Sustainable Development'
- SPG 'Supplementary Planning Guidance to Accompany Planning Policy Statement 18, Renewable Energy'
- ZTV Zone of Theoretical Visibility

Best Practice Guidance publications used in the formulation of the LVIA Methodology

The Landscape Institute / Institute of Environmental Management and Assessment (2013) 'Guidelines for Landscape and Visual Impact Assessment, Third Edition'

4.1 The aim of these guidelines (GLVIA) is to encourage high standards for the scope and content of landscape and visual impact assessments, based on the opinion and practice of members of the Landscape Institute and the Institute of Environmental Management and Assessment.

4.2 The guidelines establish principles to assist in achieving consistency, credibility and effectiveness in LVIA, when carried out as part of an EIA. The following general principles of good practice are adhered to in the methodology for this LVIA:

- Clearly describe the methodology and the specific techniques that have been used;
- Use clearly defined and agreed terminology;
- Avoid generalisations about designated landscapes and their ability to accommodate change;
- Be as impartial as possible;
- Draw upon the advice and opinions of others and carry out consultations;
- Organise and structure the assessment to focus upon the key issues of relevance to decision-making;
- Openly acknowledge any deficiencies or limitations that may have constrained the assessment;
- Consider the most significant effects in all instances.

Scottish Natural Heritage (August 2017) 'Siting and Designing Wind farms in the Landscape. Version 3a'

4.3 This guidance provides principles for the design and location of wind farms with the aim of ensuring that wind farm developments appear appropriate within the landscape. The guidance supersedes the landscape sections within SNH (2001) 'Guidelines on the Environmental Impacts of Wind farms and Small Scale Hydroelectric Schemes' and reflects a development in the understanding of issues such as appropriate layouts for different locations, turbine size and design, wind farm extensions and cumulative development. The guidance acknowledges that understanding of these issues is constantly evolving and this guidance will be regularly reviewed and updated to reflect this.

Scottish Natural Heritage (March 2012) 'Assessing the Cumulative Impact of Onshore Wind Energy Developments'

4.4 This guidance sets out recommended principles for the assessment of cumulative landscape and visual impacts arising from wind farms. As per the guidance above, it is acknowledged that understanding of cumulative issues is constantly evolving and this guidance would be regularly reviewed and updated to reflect this.

Scottish National Heritage (February 2017) 'Visual Representation of Wind Farms, Version 2.2'

4.5 This guidance was originally published in 2006 to summarise and explain what was feasible, available and reasonable in terms of current good practice in the production of illustrations such as photomontages, wirelines and ZTV figures for use within an LVIA. It was revised in 2014 and 2017 to reflect developing experience and to ensure that visualisations are easier for the public and decision makers to use whilst also stressing that they are only a tool to aid decision making and must be considered alongside other information. SNH also recognise that different approaches may be appropriate for different types of developments, in different countries and for small scale projects. The prescriptive aspects of the guidance, and how they are interpreted in this LVIA, are included in Technical Appendix 4.2, paragraph 4.46.

4.6 Cognisance has been taken of the new guidance in this LVIA and its recommended methodology for taking photographs has been followed. However, the visualisations that accompany this LVIA are not printed at the large scale recommended by the guidance to allow for the practical and cost-effective distribution of public consultation material. SNH advises that printed visualisations should be produced at A1 size and viewed at a comfortable arm's length distance to facilitate easy comparison between viewpoints. In this LVIA the visualisations have been produced at A3 and, for clarity, the finished photomontages are presented on the same page as their corresponding wirelines for all shortlisted viewpoints.

Landscape Institute (June 2018) Technical Guidance Note: Photography and Photomontage in Landscape and Visual Impact Assessment'

4.7 This publication provides advice to landscape professionals on photography and photomontage methods in LVIA for all types of development. It does not provide specific advice in relation to wind energy development and endorses SNH guidance in this respect.

Northern Ireland Environment Agency (August 2010) 'Wind Energy Development in Northern Ireland's Landscapes: Supplementary Planning Guidance to Accompany Planning Policy Statement 18 Renewable Energy'

4.8 The SPG provides broad strategic guidance on appropriate locations for wind energy development based on the definition of Landscape Character Areas (LCAs) within the NILCA. It is described in detail in Chapter 4, paragraph 4.65.

The Countryside Agency and Scottish Natural Heritage (2004) 'Landscape Character Assessment Guidance for England and Scotland. Topic Paper 6: Techniques and Criteria for Judging Capacity and Sensitivity'

4.9 The topic paper provides an overview of current thinking about landscape sensitivity and landscape capacity in terms of the concept involved and the practical techniques that are being used. Its aim is to set out some of the key principles, clarifying some of the issues, helping with definitions of key terms and providing examples of the approaches that are currently being used.

Technical Appendix 4.2: LVIA Methodology

4.10 This LVIA methodology has been specifically developed for wind farm development in Northern Ireland in accordance with the best practice guidance, where applicable (listed in Technical Appendix 4.1). The LVIA makes reference to mapped information, planning policy and existing landscape character assessment documents, and uses photographs and field survey work, together with the professional judgement of an experienced Landscape Architect. It combines existing desktop information, such as maps and documents, with detailed site surveys of the Study Area. The desktop study includes a review of relevant planning policies in order to identify any elements or parts of the Study Area which are recognised for their landscape or visual qualities and any preferred locations for wind farms that may already have been identified. It also evaluates likely levels of acceptable change for various parts of the Study Area in accordance with current definitions of landscape and visual sensitivity.

4.11 Potential landscape and visual effects are assessed as separate but linked issues. Both require a combination of quantitative and qualitative evaluation. The 'Magnitude' of landscape effects is derived from the extent to which physical changes cause changes in landscape character and value. The 'Magnitude' of visual effects relates to changes in the composition of views and people's perception of/responses to these physical changes.

4.12 For both landscape and visual effects the 'Significance' of effect is derived from the assessment of 'Landscape Value', the nature of the receptors in question (hereafter referred to as 'Sensitivity') and the nature of the effects on these receptors (hereafter referred to as the 'Magnitude' of change that will be experienced) and also by using professional judgement in relation to site circumstances. It is important to recognise that the landscape is constantly evolving and that opinions on the beneficial or adverse effects of wind farms are highly subjective. Therefore, whilst a judgement is made on the significance of effects, no judgement is made on whether these effects are beneficial or adverse.

Baseline Characterisation: Landscape Character

4.13 The meaning of landscape in this LVIA is in accordance with the SPPS definition as "*an area, as perceived by people, whose character is the result of the action and interaction of natural and / or human factors*" (see section 4.2.1 of SPPS). The first stage of this LVIA establishes the existing landscape character of the Study Area. It includes a description of landform, land cover, seasonal elements and historical and cultural associations. Landscape character is the result of unique interactions between different elements such as geology, soils, vegetation and historical and current human influences. Natural, man-made, physical and aesthetic attributes are considered alongside the physical condition, frequency and rarity of these attributes. Areas of distinct, recognisable or common character are defined individually as LCAs. Existing definitions of LCAs are analysed by site survey.

4.14 Defining landscape character allows landscape value to be analysed. An understanding of landscape character and value requires an understanding of the processes that have created this character and future processes that may alter it. The overall value to society of each LCA is evaluated against defined criteria and their Sensitivity to development and change is established. The LVIA notes if/where existing definitions of landscape character have been amended. Some LCAs may not be considered in detail following the Baseline Assessment if they are not judged to be significantly affected by the Development. For example, LCAs on the periphery of the Study Area, or those from which there are few or no views of the Development. Such LCAs are clearly identified in the Baseline Assessment (Chapter 4, starting at paragraph 4.93), Technical Appendix 4.3 and Figure 4.3.

Landscape Value

4.15 Values are attached to landscapes by different stakeholders for a variety of reasons. The LVIA process seeks to establish a definition of Landscape Value that reflects both this range of opinions and each particular landscape's contribution to the overall landscape character of the Study Area. Defining the value of a particular landscape to society requires the recognition of 'sense of place' through consideration of factors such as condition, scenic quality, tranquillity, remoteness, rarity, cultural associations, history, conservation and recreational interests, and broader social, economic and environmental aspects.

4.16 The definition of landscape value has been derived from best practice guidance and the SPG, which defines Landscape Value as "*the intrinsic value that is attached to a landscape, often reflected in designation or recognition. It expresses national or local consensus as to the (degree of) importance of a landscape, for reasons including landscape quality, scenic (or visual) quality, wildness and tranquillity, natural and cultural heritage interests, cultural associations and recreational opportunities*."

4.17 The following criteria outline the general principles that are used to inform and guide the assessment of Landscape Value:

- ***Outstanding Landscape Value***: Such landscapes may be outstanding because of factors such as dramatic scenic quality, or unspoilt beauty. They may also contain rare cultural or historic features, have notable cultural associations, important geological features or contain a large proportion of high quality habitats. They are likely to be in good condition, with a distinctive sense of place, and may be of national or international importance that is evidenced by statutory designation;
- ***High Landscape Value***: Such landscapes may be aesthetically pleasing and have positive characteristics including features that are unspoilt and in good condition, a high proportion of sites that are of geological or

ecological interest, notable historic associations and a strong sense of place. These areas may be of national or regional importance that is evidenced by relevant statutory designations;

- ***Moderate Landscape Value***: Such landscapes may have overall good aesthetic qualities, with some intact characteristic features, but with other features that are not in optimum condition, or which are fragmented or spoilt. These areas may contain a smaller number of features of interest and may be of local importance;
- ***Low Value***: Such landscapes may be in poor condition, or have undergone change to the extent that they do not have a distinctive or coherent character, aesthetic quality or strong sense of place. Few characteristic features are likely to remain intact and features may be highly fragmented or spoilt. These areas may contain a limited number of notable features or associations and are unlikely to be statutorily designated.

Landscape Sensitivity

4.18 The SPG defines 'Landscape Sensitivity' as a term based on the inherent sensitivity of landscape receptors to changes in both landscape character and visual terms, and which, in EIA terms, can also be used to encompass the value placed upon landscape. This definition has been updated by the GLVIA[1] which advises that sensitivity should be clearly separate from value. It should combine judgements on the susceptibility of landscape receptors to change caused specifically by the Development with the Value attached to the landscape in question. Therefore, in the context of this LVIA judgements on Landscape Sensitivity consider the susceptibility of landscape receptors to the changes caused specifically by the Development. The LVIA takes account of the stability and resilience of LCAs to withstand change and recuperate from loss or damage to their character elements resulting from the Development without unacceptable detrimental effects on overall character. An understanding of how different landscape attributes interact assists in defining if, and how, wind farm development may be suitably placed in the landscape. It also allows choices to be made on suitable turbine layouts and sizes of wind farms, which vary according to the characteristics of the receiving landscape. Key landscape attributes that are likely to influence sensitivity to wind farm developments include:

- ***Scale and Enclosure:*** The perception of the size and presence of various character elements, such as landform, trees and houses, against which the relative scale of larger features such as wind turbines are perceived. Consideration is given to whether the landscape is open or enclosed, the range of views (e.g. close, medium or long range), and the extent to which elements such as topography and vegetation provide screening. Landscapes that are visually contained may be less sensitive, although

[1] The Landscape Institute and IEMA (April 2013) *'Guidelines for Landscape and Visual Impact Assessment 3rd Edition' section 5.39*

close range views from populated areas may increase sensitivity. A Proposed Development should be of a size and layout that is in keeping with the receiving landscape character;

- ***Skyline:*** The extent to which people's eyes are drawn towards the skyline depends on the simplicity or complexity of the skyline and whether there are other elements or foci distributed in the view and/ or along the skyline. Where they are visible, skylines are often important character components, and wind farm developments should relate well to them;
- ***Landscape Pattern:*** Understanding the complexity of a landscape can help to determine how a development might relate or conflict with the character of the receiving landscape. A landscape may have a simple composition, such as open moorland, or be more complex, for example, a rugged landscape containing many peaks, or a mosaic of land uses. New development should be designed to relate well to any strong existing landscape patterns, such as hedgerow networks or drainage ditches;
- ***Remoteness and Tranquillity:*** The introduction of turbines may not only result in physical effects on the landscape but, together with the movement of blades, may impact on the perceived sense of remoteness and tranquillity. The extent to which a landscape is remote or tranquil is considered in the assessment of Sensitivity;
- ***Features of Interest:*** The presence of natural and cultural heritage features, such as designated habitats, archaeological sites, and specific cultural associations, which serve to make a landscape particularly special or unique. New developments should not diminish the enjoyment of these features;
- ***Manmade Influence:*** Some landscapes may contain existing, large-scale elements, such as buildings, structures, commercial forestry, and transport infrastructure, which indicate the extent to which the character is already shaped by man. This may influence how the landscape would be affected by wind farm development. A mix of different man-made elements may lead to visual confusion or interruption. Landscapes which are already heavily influenced by man-made elements may also be less sensitive to wind farm development, although close proximity to settlement may also increase sensitivity;
- ***Rarity*** is the frequency, or density of rare or unusual landscape features which serve to make a landscape particularly special or unique;
- ***Quality*** is influenced by the physical state of the existing landscape, its intactness and its ability to repair after loss. High quality landscapes may be more or less sensitive to change depending on the robustness of their individual character elements;

- ***Value:*** The value attributed to the landscape is an important factor to be considered when assessing the sensitivity of a given landscape.

4.19 The consideration of each of the key landscape attributes described above enables a considered judgement to be made on the level of sensitivity to be apportioned to each defined LCA within the Study Area. The level of sensitivity relates specifically to the Development. The following criteria outline the general principles that are used to inform and guide the assessment of Landscape Sensitivity:

- ***High Landscape Sensitivity:*** A landscape where the majority of attributes are unlikely to withstand change without causing a change to overall landscape character to the extent that it would be difficult or impossible to restore. The frequency and sensitivity of receptors may be high but not exclusively so;
- ***Medium Landscape Sensitivity:*** A landscape with a combination of attributes that is capable of absorbing some degree of change without affecting overall landscape character. There are unlikely to be large numbers of sensitive receptors;
- ***Low Landscape Sensitivity:*** A landscape where the majority of attributes are robust and/ or tolerant of change to the extent that change or development would have little or no effect on overall landscape character. It is likely to be easily restored and the frequency and sensitivity of receptors may be Low but not exclusively so.

Baseline Characterisation: Visual Character

4.20 The visual context of the site is described and a ZTV is established to indicate where all, or part of, the Development is likely to be visible from. A ZTV is a map-based diagram of where and how many wind turbines, or wind farms, would theoretically be visible from all parts of the Study Area. The ZTV is first used to assist the identification of areas with theoretical visibility and the location of viewpoints as part of the Baseline Assessment. It is then used to aid the assessment of visual effects because the turbines would be the most visible element of the Development, particularly during the operational period.

4.21 The ZTV is created using computer-generated contour data at 50 m intervals (Ordnance Survey of Northern Ireland's digital terrain model, or 'DTM'). A three-dimensional computer model of the Development is created and accurately located within the DTM. Categories of theoretical visibility are indicated using different colours, for example, areas with theoretical visibility of all the proposed turbines would be indicated by one colour, and areas with visibility of lesser numbers of turbines would be indicated by contrasting colours. The computer model takes account of the effect the curvature of the earth would have on visibility, and is based on a viewing height of 2 m.

4.22 ZTV diagrams are based on the visibility of either the turbine blade tips or hub height. Blade tip visibility means that any area where the tip of the blade is theoretically visible is indicated on the diagram. It shows the highest potential levels of theoretical visibility. This approach is in accordance with the SNH recommendation to err on the side of over-representation of potential effects. However, it does not necessarily illustrate the most realistic levels of visibility because blade tips may be counted even where they protrude only a small amount above a skyline and this type of visibility will change continuously as the turbines rotate. Hub height ZTV diagrams represent a more realistic illustration because they show theoretical visibility of all points of the turbines to the hub/ nacelle, and therefore also include the upper parts of the turbine blades as a minimum. A Reverse ZTV diagram is used as a clear means of illustrating the parts of the Study Area where no turbines would be visible.

Viewpoint Selection

4.23 Viewpoints are chosen as part of the Baseline Assessment to provide a representative sample of viewers (receptors) and types of views of the Development across the Study Area and, most importantly, to demonstrate potential views of the Development rather than to show the screening effect of landscape features. Viewpoints are always selected in publicly accessible locations and those frequented by members of the public, such as public rights of way, car parks, popular visitor attractions and views from settlements, as well as viewpoints located in particularly scenic areas, are favoured because these are likely to represent a greater concentration of sensitive visual receptors. Viewpoints from which the Development is likely to be prominent are also favoured if they are available. Private residential views are represented where possible by the selection of appropriate viewpoints on public roads in proximity to residential receptors. This is in accordance with current best practice guidance. A selection of Provisional Viewpoints (PVPs) is identified through the Baseline Assessment. These are assessed through an initial site survey and those that are most representative of typical views, locations and receptors across all parts of the Study Area that fall within the ZTV are retained from more detailed assessment in the LVIA. The viewpoint selection process for this project is described in Technical Appendix 4.4 and illustrated on Figure 4.3.

4.24 When carrying out viewpoint surveys, the nature of the view is noted, whether partial or full views of the Development would be experienced, whether views are static or transitory, how prominent the Development may be, and whether large numbers of properties or viewers would experience such views. In many cases finding an uninterrupted view can be difficult and viewpoint locations where there is a significant amount of existing screening or no safe stopping place (e.g. on a busy road) are generally not shortlisted. This is to ensure the safety of both the surveyor and any third parties, such as the planning authority and members of the public, who may wish to visit the viewpoints. Therefore, although the views chosen are representative they cannot always be typical of the whole Study Area.

4.25 Viewpoint locations are illustrated in all the Figures which accompany the LVIA and the process for producing these illustrations is described in detail in paragraph 4.41 below.

Summary Description of the Development

4.26 Details of the Development and its associated infrastructure are described in detail in Chapter 2 of this ES and summarised briefly in relation to landscape and visual effects in Chapter 4, paragraph 4.40. To ensure that visual effects are minimised, factors such as layout and turbine specification, colour scheme, rotation pattern of blades, uniformity, and infrastructure design may be considered. The Development is considered from the perspective of the shortlisted viewpoints. Computer generated wireline models and photomontages are used to examine the design.

Assessment of Effects on Landscape Character

4.27 Landscape effects may include direct physical changes to landscape elements caused by the Development or indirect effects, such as effects on the setting of a particular landscape that may arise as a consequence of the Development. The potential landscape effects across the Study Area are identified by the on-site analysis and verification of landscape character information gathered as part of the Baseline Assessment. The landscape assessment criteria described below provides a framework for the assessment of landscape effects. It must be noted that there may be exceptions to these broad categories due to specific local characteristics that may apply in individual circumstances. This LVIA does not seek to determine whether the potential landscape effects of the Development would be beneficial or adverse because this is a subjective matter that depends very much on the viewer's own opinion.

Magnitude of Landscape Effects

4.28 The Magnitude of effect on landscape character is defined as the degree of change that would result from the introduction of the Development in terms of size or scale, geographical extent of the area that would be influenced, and the duration and reversibility of the proposed change. It is dependent on a number of factors, including:

- The degree to which landscape character elements would be altered by the Development;
- The number of turbines and their prominence within the landscape;
- Whether effects would have a direct physical effect on a landscape or indirectly affect its character by having an effect on its setting;
- The distance of the Development from the LCA in question;
- The duration, permanence and extent of the effect in physical terms.

4.29 The following criteria outline the general principles that are used to inform and guide the assessment of the Magnitude of landscape effects:

- ***High Landscape Magnitude***: The Development would be immediately apparent and would result in substantial loss or major alteration to key elements of landscape character to the extent that there is a fundamental and permanent, or long-term, change to landscape character. The change may occur over an extensive area;
- ***Medium Landscape Magnitude***: The Development would be apparent in the view and would result in loss or alteration to key elements of landscape character to the extent that there is a partial long-term change to landscape character. The change may occur over a limited area;
- ***Low Landscape Magnitude***: The Development would result in minor loss or alteration to key elements of landscape character to the extent that there may be some slight perception of change to landscape character. The change may be temporary and occur over a limited area;
- ***Negligible Landscape Magnitude***: The Development would result in such a minor loss or alteration to key elements of landscape character that there would be no fundamental change.

Significance of Landscape Effects

4.30 The EIA Directive requires the LVIA to identify and assess the acceptability of significant effects. Best practice guidance recognises that the significance of effects is not absolute and is related specifically to the Development. It is also dependent on the points considered within the landscape sensitivity appraisal, the factors that influence the Magnitude of change, and the relationship between Landscape Sensitivity and Magnitude of Landscape Effect.

4.31 This LVIA uses the following criteria to inform and guide the assessment of the Significance of Landscape Effects:

- ***Significant Landscape Effects:*** Effects that would occur when the majority of landscape attributes are deemed to be highly sensitive and the magnitude of change would alter landscape character to the extent that it would become defined, or considerably influenced, by the presence of the Development;
- ***No Significant Landscape Effects***: Effects would not be significant when the majority of landscape attributes are not deemed to be highly sensitive and where the Development would have little, or no, effect on existing landscape character. This would also occur where the Development can be integrated into the existing Study Area without the loss of key landscape attributes landscape effects. Where the Development is easily noticeable but the number and sensitivity of landscape attributes decreases, so landscape character will become less defined by the Development and more so by other landscape attributes.

Assessment of Visual Effects

4.32 Visual effects relate to changes in the composition of views and people's responses to these changes. It is evident from research, and publications on public attitudes to wind farms, that opinions vary greatly, ranging from strongly adverse to strongly positive, depending on the type and nature of effects and individual perceptions. This LVIA does not seek to determine whether the potential visual effects of the Development would be beneficial or adverse because this is a subjective matter that depends very much on the viewer's own opinion. The assessment criteria described in this section below provides a framework for the assessment of visual effects. It is noted that there may be exceptions to these broad categorisations due to specific characteristics that may apply to individual circumstances.

4.33 The potential visual effects across the Study Area are identified in four stages:

i. ZTV diagrams are created. A desk-based analysis of these is carried out in order to gain a broad understanding of the nature of visibility in the Study Area, and to identify viewpoint locations. Wirelines are created as working drafts for all viewpoints;

ii. The ZTVs and viewpoint locations are verified on site. The presence of screening elements, such as vegetation, is noted because this is not reflected by the ZTVs bare-ground representation of visibility. Key visual receptors within the Study Area are identified during the site survey, and the assessment of potential visual effects on each of these receptor groups is made. Visual receptors may include, for example, people within settlements, on vehicular routes, at tourist destinations, etc. The viewpoints are assessed for the extent to which they provide truly representative views of the key visual receptors and typical views within the Study Area.

iii. In most cases photographs are taken from each viewpoint location. However, in accordance with SNH guidance, viewpoint locations beyond 20 km from the Development may not require photomontages where the proposed turbines are below 150 m in height and where they are unlikely to be perceptible features in the view. A judgement on which viewpoints require photomontages is made on a case-by-case basis in each LVIA;

iv. Finally, a detailed assessment of visual effects is made from each viewpoint. This is assisted by computer-generated wirelines and photomontages, which provide as realistic as possible visualisations of how the Development would appear within each viewpoint, and which are presented as Figures in the Environmental Statement.

Assessment of Viewpoints

4.34 From each viewpoint a description is provided of the existing view and potential changes that would result from the Development. The effect of the Development on the existing view is then assessed. The following elements are considered in the description and assessment of visual effects from each viewpoint:

- The existing visual character and quality of the viewpoint (including whether it is within a designated landscape, the presence of visual detractors, etc.);
- The character of the existing landscape against which the turbines would be viewed including any screening provided by existing surface features, vegetation and local topography;
- The viewpoint location, the presence and concentration of receptors, and receptor sensitivity (for example, would people view the site during work or leisure activities, whilst in transit, etc.);
- The number of turbines that would be visible, their scale, distance from the viewpoint and their position in the view in relation to other features in the viewpoint;
- The duration of the potential effect, i.e. is it long term or temporary, continuous or transitory (the latter meaning that the receptor would be exposed to the effect for a short time);
- Whether effects would occur during construction and decommissioning of the Development.
- The presence of existing wind farms, particularly those in close proximity to the Development, are considered as part of the assessment of visual effects as well as the assessment of cumulative visual effects.

Sensitivity of Visual Receptors

4.35 The Sensitivity of visual receptors is dependent on the nature of the receptor and the value of the view, including other landscape elements within it. The following criteria, which are drawn from current best practice guidance (Technical Appendix 4.1), outline the general principles that are used to inform and guide the assessment of visual sensitivity at each viewpoint:

- ***High Visual Sensitivity***: may typically include residents of properties where the main view is orientated towards the Development, or people undertaking recreation where the landscape within which the Development is seen is the primary reason for attraction (e.g. walkers, cyclist and drivers on scenic routes). Receptors are more likely to be within a designated landscape and could be attracted to visit more frequently, or stay for longer, by virtue of the view;
- ***Medium Visual Sensitivity***: may typically involve people undertaking active recreational pursuits where the wider landscape within which the Development is not seen as the primary reason for attraction (e.g. golf, water sports, theme and adventure parks, historic sites, parks and gardens). Receptors are less likely to be within a designated landscape

and could be attracted to visit more frequently or stay for longer by virtue of the facilities and features of the particular attraction rather than by the value of the view;

- ***Low Visual Sensitivity***: may typically include vehicular travellers; outdoor workers (e.g. farm and forestry workers); people in indoor workplaces and community facilities; and residents within larger settlements. Receptors are unlikely to be within a designated landscape and are most likely to be present at a given viewpoint by virtue of some other need or necessity unrelated to the appreciation of the landscape or visual value.

Magnitude of Visual Effects

4.36 The Magnitude of effect on visual character is defined as the degree of change that would result from the introduction of the Development. It is dependent on a number of factors, including:

- The prominence of the Development within the view;
- The number of turbines and extent of the Development that would be visible;
- The angle and elevation of the view;
- The proportion of the view that is affected by the Development;
- The scale and character of the landscape in which the Development would be viewed;
- The duration, permanence and frequency of available views.

4.37 Factors such as the distance of a wind farm from a viewpoint, weather conditions, time of day/year, angle of view, and composition of other elements in the view, all contribute to the assessment of visual effects. This LVIA uses these factors to define levels of visual prominence as follows:

- ***Visually Dominant***: The Development would occupy a commanding or elevated position and would seem to tower above the surrounding landscape from the viewpoint in question and/or from the surrounding landscape. The Development would become more important or noticeable than anything else in the view.
- ***Visually Prominent***: The Development would be immediately noticeable and likely to attract attention due to its size or position within the view.
- ***Visible***: The Development would be evident and perceptible from the viewpoint in question and/or from the surrounding landscape but would not be a prominent feature.
- ***Not Visible***: The Development would not be seen or would not be immediately apparent to the naked eye.

4.38 The following criteria outline the general principles that are used to inform and guide the assessment of the Magnitude of visual effects:

- ***High Visual Magnitude***: The Development would be a dominant and immediately apparent feature that would affect and change the overall character of the view and to which other features would become subordinate;
- ***Medium Visual Magnitude***: The Development would form a visible and recognisable new element within the overall view and would be readily noticed without changing the overall nature of the view;
- ***Low Visual Magnitude***: The Development would form a component of the wider view that might be missed by the casual observer. Awareness of the Development would not have a marked effect on the overall quality of the view;
- ***Negligible Visual Magnitude***: The Development would be barely perceptible, or imperceptible, and would have no marked effect on the overall quality of the view.

Significance of Visual Effects

4.39 The EIA Directive requires the LVIA to identify and assess the acceptability of significant effects. Best practice guidance recognises that the significance of effects is not absolute and is related specifically to the Development. It is also dependent on the points considered within the appraisal of sensitive visual receptors, the factors that influence the magnitude of change, and the relationship between Visual Sensitivity and Magnitude of Visual Effect.

4.40 This LVIA uses the following criteria to inform and guide the assessment of the Significance of Visual Effects:

- ***Significant Visual Effects***: Effects that would occur when the majority of visual receptors are deemed to be highly sensitive and the magnitude of change would alter visual character to the extent that it would become defined, or considerably influenced, by the presence of the Development;
- ***No Significant Visual Effects***: Effects would not be significant when the majority of visual receptors are not deemed to be highly sensitive and where the Development would have little or no effect on existing views. The Development would be likely to constitute a minor component of the wider view, which might be missed by the casual observer, and awareness of the Development would not have a marked effect on the overall quality of the view. Where the Development is easily noticeable but the number and sensitivity of visual receptors decreases, so overall visual character will remain less defined by the Development and more so by other elements of the existing view.

Production of Viewpoint Visualisations: Wirelines and Photomontages

4.41 Computer-generated wirelines and photomontages are used to assist the assessment of potential visual effects by providing an accurate impression of the scale, size and appearance of the turbines from the chosen viewpoints.

4.42 A wireline model of the Development and surrounding terrain is generated from each viewpoint using ReSoft Wind Farm R4, map tiles and digital terrain data provided by Ordnance Survey of Northern Ireland, the proposed turbine layout, and individual turbine geometry. Turbine blades are displayed at an angle of 0º, i.e. the uppermost blade is always shown pointing directly upwards, in order to demonstrate the highest possible level of visibility. All cumulative wind farms are shown on the wirelines. The wireline model is an accurate model of the bare-ground topography. Land cover elements are then overlaid onto this model in the form of photographs, which are taken at each viewpoint location. Both the wireline and photograph cover a minimum 80º - 180º angle of view depending on the actual extent of the view on site. For example, the view on site may be constrained on both sides by tall vegetation or be part of a wider panorama. A 50º - 53.5º view is generally accepted as the normal viewing angle of the human eye[2].

4.43 In accordance with best practice guidance all photographs are taken with a full frame digital Single Lens Reflex (SLR) camera and a digital lens focal length of 50 mm (to provide as accurate a representation of the human eye as possible). The largest possible aperture setting is used to ensure the maximum level of detail in the view is shown. A panoramic tripod head is used to obtain true horizontal alignment of the photographs and maintain a constant height above ground (1.5 m).

4.44 Accurate records are taken on site of weather conditions and time of day. Viewpoint coordinates are recorded using a hand-held Global Positioning System (GPS, accurate to 3.65 m).

4.45 The photographs are merged together and the resulting image is imported into the software programme where it provides the backdrop to the wireline. The wireline terrain data may differ slightly from that pictured in the photograph due to deficiencies in the digital terrain model data (DTM). This can cause the turbines to appear slightly above or below the ground. Therefore minor adjustments may be made to the software settings to ensure that the photograph and wireline match before the turbines are rendered consistently with model data. On completion the wireline is hidden so that only the finished photomontage is visible.

4.46 Visualisations are prepared in accordance with the SNH best practice guidance as far as practical and SNH's best practice guidance recommends that the following information on the limitations of visualisations is included in all LVIA methodologies[3]:

[2] Paper presented to British Wind Energy Association Conference by K. Hawkins of E4environment Ltd and Dr P. Marsh of Environmental Data Analysis (2001) 'The Camera Never Lies' and Scottish National Heritage (2017) 'Visual Representation of Wind Farms'

[3] Scottish National Heritage (2017) 'Visual Representation of Wind Farms', Annex A: Information on limitations of visualisations

- *"Visualisations of wind farms have a number of limitations which you should be aware of when using them to form a judgement on a wind farm proposal. These include:*
- *A visualisation can never show exactly what the wind farm will look like in reality due to factors such as: different lighting, weather and seasonal conditions which vary through time and the resolution of the image;*
- *The images provided give a reasonable impression of the scale of the turbines and the distance to the turbines, but can never be 100% accurate;*
- *A static image cannot convey turbine movement, or flicker or reflection from the sun on the turbine blades as they move;*
- *The viewpoints illustrated are representative of views in the area, but cannot represent visibility at all locations;*
- *To form the best impression of the impacts of the wind farm proposal these images are best viewed at the viewpoint location shown;*
- *The images must be printed at the right size to be viewed properly (The visualisations in this LVIA are 130 mm x 42 mm at A3);*
- *You should hold the images flat at a comfortable arm's length. If viewing these images on a wall or board at an exhibition, you should stand at arm's length from the image presented to gain the best impression.*
- *It is preferable to view printed images rather than view images on screen. If you do view images on screen you should do so using a normal PC screen with the image enlarged to the full screen height to give a realistic impression. Do not use a tablet or other device with a smaller screen to view the visualisations described in this guidance*."

4.47 In many scenarios wind farms are visible as elements of wide angle views which can only be appreciated if viewers turn their heads from side to side or move through the landscape. Wirelines and photomontages show the turbines in accurate proportion to other visual elements. However, the overall scale of the view is reduced by the practical need to illustrate the view on a single sheet of paper that allows as many people as possible to have fair and easy access to the published Environmental Statement. Features that are of note in wider views, but which are beyond the angle that can be illustrated in the viewpoint figures, such as other wind farms, are included in the detailed written descriptions of viewpoints in the LVIA report. Photomontage figures should be reproduced at a minimum of 300 pixels per inch to ensure best quality representation of the viewpoints.

4.48 It must be noted that the purpose of wirelines and photomontages is to help the assessor establish what the Development's visual effect might be by providing a 'snapshot' of what the Development would look like within the landscape. They should always be viewed in conjunction with the LVIA report which provides a detailed written assessment of visual effects, as well as a visit to all of the viewpoints in appropriate weather conditions. Wirelines are not intended to be visually representative images but they are generally accepted as an illustrative digital imaging tool. They provide a good indication of the location of turbines within the landscape and their relationship with the Cumulative Baseline of other wind farms in the Study Area. If these limitations are recognised, visualisations can be accepted as adequate representations for the purpose of the LVIA.

Assessment of Effects of the Proposed Layout on the Site

4.49 This LVIA is primarily concerned with the operational phase of the Development. However, consideration is also given to the potential effects during construction and decommissioning. During the construction period a number of activities would occur that may temporarily or permanently affect the physical landscape or visual amenity of the Study Area. Temporary effects may only last for the duration, or part of, the construction period and may include effects such as the visibility of construction traffic, plant, and stockpiled materials. If managed adequately these construction effects can be minimised or avoided. Permanent effects would result from irreversible physical changes to the site such as the removal of vegetation, alteration of landform and new access arrangements.

4.50 Details of the Development and its associated infrastructure are described briefly, starting at paragraph 4.40 and in more detail in Chapter 2. Mitigation measures to avoid or minimise both temporary and permanent effects are proposed in paragraph 4.209.

Design Evolution and Mitigation Measures

4.51 During the course of the EIA the layout of the Development may change as part of an iterative assessment and design process. Liaison between all parties involved in the EIA is a key part of this process and the LVIA takes cognisance of the findings of other chapters, such as Archaeology and Cultural Heritage. Mitigation measures which seek to avoid, reduce, or compensate for landscape and visual effects would generally be implemented as part of this process and may include, for example, changes to layout and turbine specification, colour, uniformity of layout, under-grounding of onsite power cables, and infrastructure design. Following the implementation of mitigation measures in relation to physical site constraints (e.g. the presence of protected species, hydrological features, etc.) the Development would be considered from the perspective of the identified viewpoints. The computer-generated wirelines would be used to examine initial designs and identify opportunities to improve the layout in visual terms where necessary.

4.52 Further mitigation proposals, including any potential enhancement of landscape and visual character, will be made, where possible and appropriate, to address any potential effects which would remain with the final layout. It is important to note that the scope for mitigating the visual effect of wind farms is greatly restricted by the functional siting requirements, the scale of the turbines, and the characteristic movement of the blades.

Assessment of Residual Landscape and Visual Effects

4.53 Where mitigatory design proposals are implemented in order to reduce significant landscape and visual effects, the resulting reduction in effects is assessed and described in paragraph 4.211.

Assessment of Cumulative Effects

4.54 In relation to LVIAs of individual developments, cumulative effects are taken to mean *"the additional changes caused by a proposed wind farm in conjunction with other similar developments*"[4].

4.55 "*The purpose of a Cumulative Landscape and Visual Impact Assessment (CLVIA) is to describe, visually represent and assess the ways in which a wind farm would have additional impacts when considered in addition to other existing, consented or proposed windfarms. It should identify the significant cumulative effects arising from the proposed wind farm*"[5]. In other words, the purpose of the cumulative impact assessment is to measure the incremental effect of the Development on the Cumulative Baseline rather than to assess the combined effects of all, or some, of the Cumulative Baseline with the Development.

4.56 The Cumulative Baseline comprises existing, consented and proposed (in-planning) wind farms in an appropriate cumulative Study Area. In this LVIA the cumulative Study Area extends to a 30 km radius (see Technical Appendix 4.4 and Figure 4.5). Particular attention is paid to clusters of wind farms because these are already likely to be prominent features. Existing single turbines are noted as features within the existing landscape and visual baseline, and in particular if they appear within selected viewpoints.

4.57 It must be noted that cumulative effect of some magnitude is largely unavoidable in any Study Area which contains existing wind farms and a judgement must be made on the relative and appropriate weight that is given to the various elements of the actual and assumed Cumulative Baseline. Current best practice guidance[6] makes it clear that this baseline should extend to operational and consented schemes but not necessarily to those which are the subject of undetermined applications for planning permission. Existing and consented wind farms are generally considered to be part of baseline landscape and visual character and the effects of the Development take consideration of their presence, or anticipated presence. The incremental effect of the Development on a Cumulative Baseline which includes other proposed wind farms is also considered. However, it is noted that

[4] Scottish Natural Heritage (March 2012), '*Assessing the Cumulative Impacts of Onshore Wind Energy Developments*' paragraph 7, paraphrased from the GLVIA para 7.12

[5] Scottish Natural Heritage (March 2012), '*Assessing the Cumulative Impacts of Onshore Wind Energy Developments*', paragraph 55

[6] Including PPS18 at paragraph 1.3.37 and the Planning (Environmental Impact Assessment) Regulations (Northern Ireland) 2017

applications for planning permission may be rejected and therefore, if a scheme is not yet approved, relatively limited weighting should be afforded to it when assessing the incremental effects of the Development. This LVIA includes existing, consented and proposed wind farms in its cumulative assessment but the weight afforded to individual schemes is a matter for the decision maker based on the evidence presented in the LVIA.

4.58 The assessment criteria described in this section provides a framework for the assessment of cumulative landscape and visual effects. It is noted that there may be exceptions to these broad categorisations due to specific characteristics that may apply to individual circumstances.

Assessment of Cumulative Landscape Effects

4.59 Cumulative landscape effects relate to the incremental degree of change to the existing landscape character or physical fabric of the Study Area that would result from the introduction of the Development over and above that of the Cumulative Baseline. The magnitude of cumulative change to landscape character is dependent on a number of factors, including:

- The presence, appearance and interrelationship of other cumulative wind farms in the Cumulative Baseline, and the degree to which this already influences landscape character;
- The incremental change to landscape character elements that would be caused by the Development;
- The incremental effect of the Development on the overall number of turbines, their prominence within the landscape, and their effect on landscape scale;
- Whether effects are direct or indirect;
- The distance of the Development from the LCA in question, and from other cumulative wind farms that may also affect the LCA in question;
- The duration, nature, permanence and extent of the effect in physical and visual terms;
- The value attached to the landscape in question, including any landscape designations.

Magnitude of Cumulative Landscape Effects

4.60 The following criteria outline the general principles that are used to inform and guide the assessment of the Magnitude of Cumulative Landscape Effects:

- ***High Cumulative Landscape Magnitude***: The introduction of the Development to the Cumulative Baseline would be immediately apparent and would result in substantial incremental loss of, or major alteration to, key elements of landscape character to the extent that there would be a fundamental and permanent, or long-term, change to landscape character. The change may occur over an extensive area;

- ***Medium Cumulative Landscape Magnitude***: The introduction of the Development to the Cumulative Baseline would be immediately apparent and would result in the incremental loss of, or alteration to, key elements of landscape character to the extent that there would be a partial long-term change to landscape character. The change may occur over a limited area;
- ***Low Cumulative Landscape Magnitude***: The introduction of the Development to the Cumulative Baseline would result in minor incremental loss of, or alteration to, key elements of landscape character to the extent that there may be some slight perception of change to landscape character. The change may be temporary and occur over a limited area;
- ***Negligible Cumulative Landscape Magnitu***de: The introduction of the Development to the Cumulative Baseline would result in such a minor incremental loss of, or alteration to, key elements of landscape character that there would be no fundamental change to landscape character.

Significance of Cumulative Landscape Effects

4.61 The Significance of Cumulative Landscape Effects is dependent on the points considered within the landscape sensitivity appraisal, the factors that influence the Magnitude of change upon it, and the relationship between landscape Sensitivity and Magnitude of cumulative landscape effect. The following criteria outline the general principles that are used to inform and guide the assessment of the Significance of cumulative landscape effects:

- ***Significant Cumulative Landscape Effects***: Effects that would occur when the majority of landscape attributes are deemed to be highly sensitive and the incremental effects of the Development would alter landscape character to the extent that it would become defined or considerably influenced by the presence of wind farms, taking account of Cumulative Baseline conditions;
- ***No Significant Cumulative Landscape Effects***: Effects would not be significant when the majority of landscape attributes are not deemed to be highly sensitive and where the Development would have little or no incremental effect on the existing landscape character. Where the Development can be integrated into the existing Cumulative Baseline, without the loss of key landscape attributes, cumulative landscape effects would also be deemed as Not Significant. This level of significance would also occur where the Development is easily noticeable but its incremental effects would not cause the landscape character to become more defined

by wind farms than it currently is, or to become more defined by wind farms than by other landscape attributes.

Assessment of Cumulative Visual Effects

4.62 Cumulative visual effects relate to the degree to which wind energy developments feature in particular views or sequences of views, and the resulting effects of this upon visual receptors. Current best practice guidance advises that the potential receptors of cumulative visual effects should be identified and the most significant receptors selected for detailed assessment. This LVIA considers simultaneous and sequential cumulative visual effects that may arise within the Study Area, and in relation to the selected viewpoints. The presence of existing wind farms, particularly those that are closely related to the Development, are considered as part of the assessment of visual effects as well as the assessment of cumulative visual effects.

4.63 Simultaneous cumulative visibility is the extent to which the Development would be visible with one or more other cumulative wind farms from a single location, either in the same or different directions. Sequential cumulative visibility is the extent to which the Development would be viewed in succession with one or more other cumulative wind farms by receptors travelling through the landscape, regardless of whether or not the sites themselves are inter-visible.

4.64 The LVIA principally considers the degree to which the Development would contribute to wind energy development becoming a significant or defining characteristic of visual character. The sensitivity of visual receptors remains the same as that already defined in the visual effect assessment because the visual resource is unaltered. Different criteria are used for assessing Magnitude and Significance of Cumulative Visual Effects.

Magnitude of Cumulative Visual Effect

4.65 The Magnitude of cumulative visual effect is dependent on a number of factors, including:

- The nature of the Cumulative Baseline, i.e. the presence, appearance and intervisibility of existing, consented and proposed developments;
- The incremental effect that the Development would have on the prominence and distance of wind farms from visual receptors;
- The incremental effect that the Development would have on the number of turbines and the extent of wind farms that can be seen simultaneously, or sequentially;
- The incremental effect that the Development would have on the proportion of the view that is affected by wind turbines and the number of wind farms that would be visible in their entirety or otherwise;
- The visual relationship between the Development and other wind farms, including separation distances between developments;

- The scale and character of the landscape in which the Development would be viewed alongside the Cumulative Baseline;
- The nature of available views, including angle of view, prominence, screening elements, elevation, and distance from the viewpoint location.
- The duration, frequency and permanence of available views, including whether the potential cumulative effect is likely to be frequent (i.e. it would occur regularly, repetitively, or with short time lapses between occurrences) or occasional (i.e. it would occur infrequently, with long time lapses or distances between occurrences);
- Whether the viewer would need to look in the same direction or different directions to obtain cumulative views;
- The speed and mode of travel of visual receptors, and duration of cumulative views.

4.66 The following criteria outline the general principles that are used to inform and guide the assessment of the Magnitude of cumulative visual effects:

- ***High Cumulative Visual Magnitude***: The Development would increase the scale of wind turbines in the landscape to a level at which the view would become dominated by wind farms;
- ***Medium Cumulative Visual Magnitude***: The Development would result in a noticeable increase in turbines but this increase would not result in wind farms being the dominant feature of the view;
- ***Low Cumulative Visual Magnitude***: The Development would be visible but would constitute a component of the view that might be easily missed by the casual observer and would not contribute to the overall prominence of wind farms within the view;
- ***Negligible Cumulative Visual Magnitude***: The Development would be barely perceptible, or imperceptible, and would have no effect on the perception of wind turbines within the view.

Significance of Cumulative Visual Effect

4.67 The Significance of cumulative visual effects is dependent on the points considered within the appraisal of sensitive receptors, the factors that influence the Magnitude of cumulative visual effects, and the relationship between visual Sensitivity and Magnitude of cumulative visual effect. The following general principles are used to inform and guide the assessment of the Significance of Cumulative Visual Effects:

- ***Significant Cumulative Visual Effects***: Effects that would occur when the majority of visual receptors are deemed to be highly sensitive and the addition of the Development to the Cumulative Baseline would result in the view becoming defined, or considerably influenced, by wind turbines;
- ***No Significant Cumulative Visual Effects***: Effects would not be significant when the majority of visual receptors are not deemed to be

highly sensitive and where the Development would have little or no incremental effect on existing views. The Development is likely to constitute a barely perceptible, or imperceptible, component of the wider view, which might be missed by the casual observer. Awareness of the Development would not have a marked effect on the overall quality of the view. Where the Development may still be a noticeable addition to views containing wind farms in the cumulative baseline but it would not cause the overall visual character of the view to become defined by wind turbines rather than by other elements of the existing view the overall effects would also be deemed to be Not Significant.

Technical Appendix 4.3: Landscape Character Areas

4.68 There are 26 Landscape Character Areas (LCAs) within the Study Area. The Development is located within LCA 29 Sperrin Mountains and a detailed description of this LCA is contained within the Baseline Assessment of the LVIA, Chapter 4, starting at paragraph 4.97.

4.69 There are four other LCAs which are in close proximity to the Development or which contain shortlisted viewpoints. Detailed descriptions of these LCAs are contained within the Northern Ireland Landscape Character Assessment (NILCA) and the SPG to PPS 18. The NILCA classifies the landscape into areas of distinct and separate character called Landscape Character Areas (LCAs), and defines overall Landscape Value. The SPG provides further broad guidance on the LCAs that are defined in the NILCA, including their overall Sensitivity, specifically in relation to wind energy developments. The detailed descriptions of the LCAs that are contained in the NILCA and SPG are not reproduced in this LVIA but Table 4.3.1 summarises the Landscape Value and Sensitivity of these LCAs in relation to the Development. The location of all LCAs is shown on Figure 4.2.

Technical Appendix Table 4.3.1: Summary of Landscape Value and Sensitivity

Landscape Character Area	Landscape Value	Landscape Sensitivity to proposed Development
LCA 29 Sperrin Mountains	**Outstanding**	**Medium to Low - Direct physical effects on landscape character are confined to a peripheral location in this LCA that is in close proximity to a major road corridor and large town. Forestry is a characteristic of the site and surrounding landscape. Very limited effects on landscape character across the majority of the LCA.**
LCA 30 Sperrin Foothills	High	Low – limited and indirect effects on baseline landscape character which is already heavily influenced by existing Slieve Kirk cluster of wind farms; variations in topography and vegetation limit influence of Development on character of many parts of this LCA.
LCA 36 Binevenagh	Outstanding	Low – limited and indirect effects on baseline landscape character which is influenced by several other wind farm clusters within and surrounding this LCA.
LCA 37 Roe Basin	High	Medium to Low - relatively prominent location of Development on hills which provide setting to southern edge of this LCA but less prominent as a landscape character element in other parts of this LCA where setting becomes more defined by ranges of hills to east and west that already contain large clusters of wind farms. Quality and condition of landscape within this LCA is relatively high and robust.

Landscape Character Area	Landscape Value	Landscape Sensitivity to proposed Development
LCA 41 Slieve Gallion	Moderate to High	Low – baseline character influenced by existing wind turbines, some degraded elements, no direct physical effects on any part of LCA

4.70 The following 21 LCAs have not been assessed in detail because the Baseline Assessment, including site assessment and analysis of provisional viewpoint locations, indicates that they are on the periphery of the Study Area and the ZTV, and/or because they do not contain shortlisted Viewpoints. Such LCAs would not be significantly affected by the Development and have therefore not been subject to further detailed assessment.

Technical Appendix Table 4.3.2: LCAs not assessed in this LVIA

Landscape Character Area
LCA 24 South Sperrin
LCA 25 Beaghmore Moors and Marsh
LCA 26 Bessy Bell and Gortin
LCA 27 Foyle Valley
LCA 28 Glenelly Valley
LCA 31 Burngibbah and Drumahoe
LCA 32 Derry Slopes
LCA 33 Lough Foyle Alluvial Plain
LCA 34 Loughermore Hills
LCA 35 Magilligan Lowlands
LCA 38 Eastern Binevenagh Slopes
LCA 39 Glenshane Slopes
LCA 40 Upper Moyola Valley
LCA 42 Cookstown Farmland
LCA 43 Carrickmore Hills
LCA 49 Magherafelt Farmland
LCA 50 Moyola Floodplain
LCA 51 Garvagh Farmland
LCA 52 Lower Bann Valley
LCA 53 Lower Bann Floodplain
LCA 54 Coleraine Farmland

Northern Ireland Regional Landscape Character Assessment

4.71 A Regional Landscape Character Assessment has recently been prepared for Northern Ireland (NIRLCA, 2015) and is intended to provide a strategic overview of landscape character that can be used to inform future detailed local studies and that will be updated on a more regular basis than the NILCA. It divides the province into 26 regional landscape character areas that updates and provides further detail on the previous 130 LCAs. However, because the NIRLCA is still in its early stages and has yet to be reflected in the development of detailed local studies the NILCA still provides a greater level of detail and is used as a direct reference point for the SPG.

4.72 Sperrins is Regional LCA 7 and is described in the NIRLCA as covering the uplands and valleys focussed on the spine of the Sperrin Mountains which are the principal mountain range in the north west of the country. The various hills within the range include outlying hills Bessy Bell in the west and Slieve Gallion in the east; a series of mountains in the centre with Mount Sawel forming the highest peak; and Benbradagh and Carntogher in the north. The latter two link the Sperrins to the adjacent Binevenagh Ridge RLCA and both combine to form the setting for the North Sperrin Hills and Roe Valley (RLCA 8) in the north west of the country where the lower foothills of the Sperrins become progressively shallower and interspersed with valleys. The landscape in proximity to the Development - the point at which the Sperrins meets the prominent escarpment of Benbradagh - is noted in the RLCA as dominating the head of the Roe Valley. The route of the A6 road corridor over the Glenshane Pass is noted as being an extremely busy route and the main access corridor through the Sperrins linking the east and north-west of the country. The large conifer plantations at Banagher and along the Glenshane Pass are described as being in contrast to the surrounding open moorland.

4.73 The boundary of this RLCA is indicated on Figure 4.2. It does not cover the entire Sperrin AONB and it extends into LCA 40 Upper Moyola Valley which is out-with the AONB. It reflects a broadly similar area to that covered by the southern parts of LCA 36 Binevenagh and LCA 39 Glenshane Slopes which fall within the Sperrin AONB boundary, LCA 29 Sperrin Mountains which includes the central and highest part of the mountain range as well as peripheral areas at the head of the Roe Valley, other upland parts covered by LCA 24 South Sperrin and LCA 26 Bessy Bell and Gortin which combine to enclose LCA 28 Glenelly Valley. The RLCA also covers the north and eastern parts of LCA 41 Slieve Gallion but not the south western to south eastern parts. The description of RLCA 7 is broadly similar to these LCAs. It refers to the heart of the Sperrins having more dispersed settlement patterns than the outer edges with the former being "*the wildest and most remote of Northern Ireland's landscapes*". That does not however mean that the Sperrins are wild – the RLCA also notes the concentration prehistoric sites and historic field patterns, ongoing pastoral farming practices, extensive forestry, quarrying activities which indicate long standing man-made influence on all parts of the landscape. Views are noted as being expansive in all directions from the highest points in the Sperrins but these are also described as being inaccessible.

4.74 Renewable energy is described as one of the "Past, present and future forces for change" in this RLCA but only one operational wind farm at Owenreagh Hill is listed alongside a large-scale proposed wind farm in the central Sperrins (assumed to be referring to Doraville Wind Farm which is currently pending appeal). The cumulative effects of wind turbines around the edges of the RLCA is noted as an issue that should be given consideration in relation to the scale, openness and tranquillity of the area. These elements are considered in the assessment of effects in this LVIA. In addition the LVIA identifies a number of existing and consented wind farm clusters around the edges of the AONB that are not mentioned in the RLCA but which contribute to the existing character of the landscape that is assessed by the RLCA. These are illustrated and described in the LVIA Chapter (starting at paragraph 4.188), Figure 4.5 and Technical Appendix 4.5. Other forces for change in this RLCA include commercial mining, forestry, peat extraction and the lack of an AONB Management Plan to guide such change

4.75 In addition to landscape character as a largely aesthetic quality, the NIRLCA defines a number of 'Ecosystem Services'[7]. Whilst wind farms are recognised as being a past, present and future force for change in RLCA 7 they are also recognised as 'provisioning' and 'climate regulating' ecosystem services that are of benefit to us terms of energy production and their contribution to mitigating the effects of climate change.

[7] The UK National Ecosystem Assessment (UK-NEA, 2011) defines ecosystem services as "*the benefits provided by ecosystems that contribute to making human life both possible and worth living*".

Technical Appendix 4.4: Viewpoint Selection

Desk-based selection of Provisional Viewpoint Locations

4.76 The Baseline Assessment stage of the LVIA identified locations most likely to experience visibility of the Development and contain key receptors due the theoretical levels of visibility indicated by the ZTV diagrams and the potential sensitivity of either the location and / or the visual receptors likely to be present at these locations. The following were identified as being potential key receptors and key parts of the Study Area which should be considered in the search for provisional viewpoints PVPs:

- Locations within the two AONBs in the Study Area – Binevenagh and the Sperrins - because these areas are statutorily designated as nationally recognised high quality landscapes. They are likely to attract visitors by virtue of this designation and contain various visitor amenity sites and attractions;
- Locations from which the Development would be seen within the wider landscape context of the Study Area including the various ranges of uplands – the Sperrins and foothills, Binevenagh, Loughermore Hills, Glenshane slopes and Carntogher mountain – and locations within the setting for two AONBs such as the Roe Valley and A6 road corridor;
- Locations from public rights of way, scenic drives and cycling routes where viewers are likely to be present for the primary purpose of appreciating scenic views. Such locations might include the Ulster Way network of footpaths including waymarked trails through Banagher and Glenshane Forests, around the summit of Benbradagh, the Binevenagh range of uplands to north, the National Cycle Network including parts of the route which traverse Binevenagh and the Roe Valley, classified scenic driving routes in the Sperrins AONB, the Roe Valley, the Binevenagh Scenic Drive which terminates at viewing areas on the summit of Binevenagh Mountain and parts of the Causeway Coast scenic driving route along the A2 at the northern edge of the Study Area;
- Residential properties and areas of rural settlement in close proximity to the Development where viewers may be static and obtain views for long periods of time as well as views from in and around Dungiven where the site of the Development is likely to form a key element of the town’s setting.

4.77 Using this search criteria, 43 PVPs were identified and analysed through the production of a preliminary ZTV diagram, preliminary wirelines and map-based research. These PVPs are listed in Table 4.4.1 below.

Initial site assessment and viewpoint 'shortlisting'

4.78 All 43 PVP locations were visited as part of an initial site assessment (PVP locations are indicated on Figure 4.4). Levels of actual visibility, the nature of visual receptors present at each location, and the overall viability of each viewpoint location were analysed (see Table 4.4.1 below). A 'shortlist' of 22 viewpoint locations was made which included a proportionate number of locations representing typical views of the Development, key visual receptors and key locations within the Study Area. For ease of analysis these shortlisted viewpoints were categorised as follows:

A. Views from rural roads in proximity to the Development;
B. Views from Dungiven and approaches to the town;
C. Elevated views from within the Sperrin AONB;
D. Elevated views from within the Binevenagh AONB;
E. Views overlooking the Roe Valley and the landscape in the north west of the Study Area.

4.79 A number of PVPs were not shortlisted because they were found to provide no actual view of the Development. The reasons for this usually arose from differences between theoretical and actual visibility which is explained in Technical Appendix 4.2. Other PVPs were not shortlisted if a more typical view was demonstrated elsewhere, where no safe stopping place was possible to take a photograph or where the viewpoint location would not be easily accessible to the public.

4.80 Both wirelines and photomontages have been prepared to illustrate all shortlisted viewpoint locations within 20 km of the Development and wireline-only diagrams have been prepared for two locations in the Sperrin AONB (Viewpoints 17 and 18 – Figure 4.29) which were selected to represent long range views beyond 20 km. This approach is in accordance with current Scottish Natural Heritage Guidelines on wind farm visualisations.

Technical Appendix Table 4.4.1: Provisional Viewpoints and Proposed Shortlist

Provisional Viewpoint **(shortlisted PVPs shown in bold)**		Provisional grid reference	Approx. distance from nearest proposed turbine & direction of view	Reason for provisional selection and shortlisting decision
P1	**Benbradagh Mountain**	**272732; 410267**	**6.5 km, south west**	**Shortlisted as VP 15. Good clear view of Development with Sperrins beyond, on the Ulster Way/ tourist destination, panoramic and highly scenic location.**

Provisional Viewpoint (**shortlisted PVPs shown in bold**)		Provisional grid reference	Approx. distance from nearest proposed turbine & direction of view	Reason for provisional selection and shortlisting decision
P2	B74 between Claudy & Dungiven	258379; 405914	9.9 km, east	Secondary route in close proximity, scenic driving route. No clear views for long periods of time due to varied topography and lots of foreground vegetation. Intermittent views only.
P3	Roe Valley	267522; 417611	12.3 km, south	Views unlikely to be clear due to low-lying nature of viewpoint and vegetation.
P4	**Altnaheglish Dam, Banagher Forest**	**269567; 404185**	**0.6 km, north west**	**Shortlisted as VP 1. In very close proximity to wind farm, destination for visitors to Banagher Glen, mentioned by Council in scoping discussions.**
P5	Number not used			
P6	"			
P7	Banagher Glen car park	267000; 404500	1.4 km, north east	No views - see PVP 34 as an alternative location.
P8	Dungiven Priory	269400; 408400	3.2 km, south west	Views unlikely - site is in a hollow and surrounded by mature farmland (trees & hedgerows) although graveyard is at a higher elevation. Path continues in a loop to river and town - see PVP 33 as an alternative location.
P9	**B40 Glenedra Road**	**266432; 402728**	**2.8 km, north east**	**Shortlisted as VP 2. Good clear views from this stretch of the B40 and adjacent Banagher Rd, part of scenic driving route within Sperrin AONB.**
P10	Claudy Country Park	254967; 406521	13.3 km, east	Views unlikely - this part of Study Area surrounding Claudy is particularly well vegetated which frequently screens wider views.
P11	**Slieve Kirk Hill**	**247409; 408523**	**21.1 km, south east**	**Shortlisted as VP 17. Clear long distance elevated views over much of Study Area where wind farm seen in conjunction with other cumulative developments. Photomontage not proposed due to distance.**
P12	**Drum Road near Altahullion**	**263687; 409861**	**8.3 km, south east**	**Shortlisted as VP 21. National Cycle Network (route 93) bus stop & residential properties in vicinity; views from this location are clear across Roe Valley to Binevenagh and**

Provisional Viewpoint (**shortlisted PVPs shown in bold**)		Provisional grid reference	Approx. distance from nearest proposed turbine & direction of view	Reason for provisional selection and shortlisting decision
				Sperrin ranges of uplands; Altahullion wind farm is a nearby visitor attraction.
P13	Roe Valley Country Park	268150; 420250	14.9 km, south	Views unlikely to be clear due to low-lying nature of viewpoint and vegetation
P14	Tamniarin Hill	272218; 404608	2.9 km, west	Part of the Ulster Way, elevated location, and potentially close range views from lower sections of this road in close proximity to residential properties. However site visit revealed that views are largely screened by forestry around the reservoir and views in this direction are well removed from the main focus of views from this road which are either orientated towards the main Sperrin range in the south east or towards Loughermore. Binevenagh/ Inishowen to the north east/ north west.
P15	Cashel Picnic Area, A6	271650; 407370	3.6 km, south west	Mostly contained by trees with no views available. The one section void of trees is largely obscured by a tall tourist information board. There are clearer views from the A6 road corridor - see PVPs 32, 35 & 36.
P16	Picnic area on B74 between Feeny & Dungiven	264600; 405950	3.7 km, south east	Views appear to be screened by hill in foreground. See PVP 31 as an alternative location.
P17	**Killunaght Road, A6 near Dungiven**	**264590; 409150**	**5.3 km, south east**	**Shortlisted as VP 9. Good views from primary route through AONB with residential properties in proximity; one of several views along A6 to demonstrate sequential views.**
P18	**Plantation Road near Park & Learmount Woods**	**258109; 401347**	**10.5 km, north east**	**Shortlisted as VP 16. Represents views from this part of Study Area in proximity to Park village (village itself would have no views towards wind farm). Adjacent elevated roads with rural properties may also experience similar views to this one.**
P19	Highland Hill near Claudy at Gortilea/ Baranailt Road	257000; 409900	12.1 km, south east	Clear views including Altahullion, Roe Valley, Binevenagh & Sperrins. As per PVP 2, site visit revealed few safe

Provisional Viewpoint (**shortlisted PVPs shown in bold**)		Provisional grid reference	Approx. distance from nearest proposed turbine & direction of view	Reason for provisional selection and shortlisting decision
	junction			places to stop along this road where wind farm was likely to be prominent. Road corridor often contained by high hedgerows which prevent views.
P20	**Edge of Drumsurn Village**	**272227; 416701**	**12.4 km, south west**	**Shortlisted as VP 22. Represents longer range views from within a settlement and also from this part of the Study Area between Binevenagh & Roe Valley**
P21	**Keady Mountain**	**272146; 423983**	**19.1 km, south**	**Shortlisted as VP 19. Elevated view across Sperrins & Roe Valley from key summit along Binevenagh range. Cumulative visibility with Altahullion & Rigged Hill, sequential to Dunbeg cluster.**
P22	**Binevenagh Scenic Loop at Lisnagrib**	**270487; 427688**	**22.4 km, south**	**Shortlisted as VP 20. Similar to above; residential properties & scenic drive.**
P23	Magilligan lowlands near Ballykelly town	263516; 426927	22.1 km, south east	Views unlikely to be clear from this distance and low elevation due to screening effects of field boundary vegetation in middle distance.
P24	Picnic area below Binevenagh escarpment	267131; 429850	24.5 km, south	as above
P25	Slieve Gallion	279750; 391850	16.5 km, north west	Location in heart of Sperrins but views of some blade tips only, unlikely to be clearly discernible.
P26	Viewing point at Crockandun	277289; 388146	18.3 km, north west	Selected for location in heart of Sperrins at defined viewpoint area but no views shown on preliminary wireline
P27	Sluggada Burn, Sperrin Mountains	259925; 400344	9.5 km, north east	Selected for location in heart of Sperrins but no views shown on prelim. wireline or revealed in close proximity during initial site visit
P28	**Craignagapple near Owenreagh**	**242700; 397200**	**26.7 km, north east**	**Shortlisted as VP 18. Selected to represent long range views from this part of the Sperrins but photomontage not proposed due to distance.**
P29	B44 near Tamnyagan	263400; 403600	5.1 km, north east	Nature of views and visual receptors is similar to those available at p30 which

Provisional Viewpoint (**shortlisted PVPs shown in bold**)		Provisional grid reference	Approx. distance from nearest proposed turbine & direction of view	Reason for provisional selection and shortlisting decision
	residential properties			is in proximity and offers a safer stopping point - not necessary to select both locations.
P30	**Fincarn Crossroads at B44 - B40 junction**	**263667; 404445**	**4.5 km, east**	**Shortlisted as VP 3. Photo taken from road side. Near scenic drive, residential properties and secondary route between larger settlements.**
P31	B74 Feeny Road at junction with B44	265850; 406700	2.8 km, south east	Alternative to PVP 16; scenic driving route between two settlements in relative proximity to wind farm.
P32	**A6 at FP McCann Quarry**	**276459; 406159**	**7.2 km, west**	**Shortlisted as VP 12. One of four locations chosen to represent sequence of views available from primary road network through Sperrin AONB and linking main settlements in Study Area.**
P33	Environmental Park, Dungiven town	269150; 086650	3.4 km, south	Public open space linked to Priory (PVP 8) on outskirts of closest settlement to wind farm. Glimpsed views may be possible but in general views likely to be screened by foreground woodland within park.
P34	**Banagher Old Church**	**267509; 406593**	**1.4 km, south east**	**Shortlisted as VP 4. Taken from back left-hand corner of church to include view towards Benbradagh, Rigged Hill & single turbines in Roe Valley. Altahullion visible in other direction. Brown sign-posted site on North Sperrins Scenic Drive and Heritage Trail in close proximity to site and Banagher Glen (see PVP7);**
P35	**A6 at Corick Road junction**	**274600; 406750**	**5.7 km, south west**	**as per PVP 32. Shortlisted as VP 13.**
P36	**A6 at Cashel Road junction**	**273271; 407167**	**3.4 km, south west**	**as per PVP 32. Shortlisted as VP 14.**
P37	**Banagher Road**	**266634; 404918**	**1.7 km, east**	**Shortlisted as VP 5. Represents view from clearer sections of this road which include residential properties.**
P38	Number not used			
P39	**Garvagh Road, Dungiven**	**269392; 410211**	**5.0 km, south**	**Shortlisted as VP 11. Parking layby on outskirts of town - represents view looking across town towards**

Provisional Viewpoint (**shortlisted PVPs shown in bold**)		Provisional grid reference	Approx. distance from nearest proposed turbine & direction of view	Reason for provisional selection and shortlisting decision
				site.
P40	**Dungiven river**	**268454; 409533**	**4.2 km, south**	**Shortlisted as VP 10. Represents views from A6 road corridor, glimpsed views between properties along main street within town and from rear windows of properties/ side streets to south of main street, including Magheramore Road junction.**
P41	Magheramore Road, central section	268345; 407767	2.4 km, south east	Selected to represent views from road corridor in close proximity to site at cluster of houses. However, clear views of site unlikely to be significant due to high levels of roadside vegetation around road corridor and many houses in this area orientated towards north west and not in direction of Development. PVP 43 selected instead.
P42	Magheramore Road near Dungiven Environmental Park	268458; 408466	3.1 km, south	Similar to above, viewpoint located on outskirts of main town within study area. Not shortlisted in favour of pvp 40 which represents similar views from more frequented location.
P43	**Magheramore Road near site entrance**	**267707; 406752**	**1.6 km, south east**	**Shortlisted as VP 6. Selected to represent views from road corridor in close proximity to site at cluster of houses and tourist accommodation (self-catering cottages).**
P44	Teeavan Road to north east of site	268906; 407159	1.9 km, south west	Selected to represent views from road corridor and rural properties in close proximity to site. Clearer and more representative views of Teeavan Road corridor represented by PVP 46 where views are less constrained by roadside hedgerow.
P45	**Creebarky - Teeavan Road junction**	**270112; 406785**	**2.2 km, south west**	**Shortlisted as VP 7. As above; residential clusters and large farmsteads; elevated location; clear views towards Benbradagh and lower slopes to north of Study Area.**
P46	**Teeavan Road to north east of site**	**268679; 407382**	**2.0 km, south**	**Shortlisted as VP 8. Alternative location to p44 located at cluster of houses in dog-leg bend in road with**

Provisional Viewpoint (**shortlisted PVPs shown in bold**)		Provisional grid reference	Approx. distance from nearest proposed turbine & direction of view	Reason for provisional selection and shortlisting decision
				elevated views showing wider context including views towards Loughermore & Altahullion.

Final Viewpoint Selection

4.81 A total of 22 final Viewpoints have been selected for consideration in this LVIA. Detailed descriptions of the final Viewpoints are an integral part of the Visual Impact Assessment section of the LVIA (Chapter 4 starting at paragraph 4.114). Their locations are indicated on all map-based Figures (Figures 4.1 – 4.12) and visualisations to accompany the detailed written analysis of these Viewpoints are provided in Figures 4.13 – 4.33.

4.82 The baseline assessment, including the viewpoint selection process, identified a number of key visual receptors including; residents of rural properties and settlements located in close proximity to the Development but also elsewhere in the Study Area; tourists on scenic routes, footpaths and cycle routes throughout the Study Area; receptors located within the AONB but also those located at greater distances with views illustrating the wider landscape setting and visibility of the Development in the context of this setting. Planning policy guidance recognises that wind farms will, by their nature, often be clearly visible from close range viewpoints but that this will not necessarily equate to adverse visual effects. Therefore, the final Viewpoints presented in this LVIA are intended to represent typical views of the Development that are likely to be obtained in different parts of the Study Area, from key locations and by key visual receptors. They have been grouped into categories so that the different types of views, receptors, and specific areas they represent can be accurately described and understood without unnecessary repetition. A complete list of the final Viewpoints and categories are provided in Table 4.4.2 below. Detailed descriptions of these Viewpoints are provided in the LVIA, Chapter 4 starting at paragraph 4.126.

Technical Appendix Table 4.4.2: Final Viewpoints

Final Viewpoint no. and location		PVP number	Final Grid Reference
Category A: Views from rural roads and amenity sites in proximity to the Development			
1	Altnaheglish Dam, Banagher Forest	P4	269567; 404185

Final Viewpoint no. and location		PVP number	Final Grid Reference
2	North Sperrins Scenic Drive, B40 Glenedra Road	P9	266432; 402728
3	Fincarn Crossroads at B40 – B44 road junction	P30	263667; 404445
4	Banagher Old Church	P34	267509; 406593
5	Banagher Road	P37	266634; 404918
6	Magheramore Road near site entrance	P43	267707; 406752
7	Creebarky – Teeavan Road junction	P45	270175; 406757
8	Teeavan Road to north east of site	P46	268679; 407379
Category B: Views from Dungiven and approaches to the town			
9	Killunaght Road, A6 near Dungiven	P17	264590; 409150
10	Dungiven, Bridge over River Roe	P40	268455; 409530
11	B64 Garvagh Road, Dungiven	P39	269392; 410211
12	A6 at FP McCann Quarry	P32	276459; 406159
13	A6 at Corick Road junction	P35	274600; 406750
14	A6 at Cashel Road junction	P36	273271; 407167
Category C: Elevated views from within the Sperrin AONB			
15	Benbradagh Mountain	P1	272732; 410267
16	Plantation Road near Park	P18	258109; 401347
17	Slieve Kirk Hill	P11	247409; 408523
18	Craignagapple near Owenreagh	P28	242700; 397200
Category D: Elevated views from within the Binevenagh AONB			
19	Keady Mountain	P21	272086; 424045
20	Binevenagh Scenic Drive at Lisnagrib	P20	270487; 427688
Category E: Views overlooking the Roe Valley and the landscape in the north west of the Study Area			
21	Drum Road near Altahullion	P12	263687; 409861
22	Edge of Drumsurn village	P20	272227; 416701

Technical Appendix 4.5: Cumulative Baseline

4.83 This Technical Appendix provides details of the wind farms that are considered to form the 'Cumulative Baseline' for this LVIA as described in the LVIA, Chapter 4 starting at paragraph 4.188. The Cumulative Baseline refers to all existing, consented and proposed wind farms within the 30 km Study Area. There are a total of 37 wind farms considered to be part of the Cumulative Baseline for this LVIA, of which 19 are existing, 11 are consented and 7 are proposed.

4.84 Visually and / or physically distinct clusters of wind farms are grouped together in this LVIA for ease of reference and because it allows for a better understanding of their interrelationships. These clusters are referred to in Table 4.5.1 below and described in the LVIA chapter 4, Table 4.3.

Technical Appendix Table.4.5.1 Wind Farms included in the Cumulative Baseline

See following page

Technical Appendix Table A.5 Wind Farms included in the Cumulative Baseline for Magheramore Wind Farm

Name of wind farm	status	Approx. distance from Development*	No. of turbines	Rotor dia.	Hub height	Blade tip height	Visible from which shortlisted Viewpoints
BINEVENAGH CLUSTER							
Croaghan	Prop	23.2 km to north east	5	81	80	120.5	none
Dunbeg	Ex	22.6 km to north east	14	82	84	125	2, 7, 16, 19, 20
Dunbeg Extension	Cons	22.3 km to north east	3	82	84	125	19, 20,
Dunbeg South	Prop	20.4 km to north east	9	99.8	100	149.9	2, 3, 7, 8, 16, 18, 19, 20, 22
Dunmore	Ex	24 km to north east	7	90	80	125	2, 7, 16, 19, 20
Dunmore 2	Cons	23.9 km to north east	8	93	85	131.5	2, 3, 19, 20
RIGGED HILL CLUSTER							
Craiggore	Cons	14 km to north east	10	90	80	125	3, 4, 16, 17, 18, 21, 22
Rigged Hill	Ex	16 km to north east	10	37	39	56.5	2, 3, 4, 8, 16, 17, 18, 19, 21, 22
Smulgedon	Cons	11.8 km to north east	7	70	85	120.5	16, 17, 18, 21, 22
Upper Ballyrogan	Cons	15.8 km to north east	5	71	85	120.5	17, 18, 21
CARNTOGHER CLUSTER							
Brockaghboy	Ex	12.5 km to north east	15	93	80	126.5	none
Brockaghboy Extension	Ex	13.4 km to north east	4	93	80	125	none
Corlacky Hill	Prop	11.7 km to north east	11	99.8	100	149.9	16, 17, 18
Evishagaran	Cons	8.2 km to north east	14	100	90	140	3, 16, 17, 18, 19, 20, 21, 22
LOUGHERMORE CLUSTER							
Altahullion Phase I	Ex	10.1 km to north west	20	62	49	80	2, 3, 4, 7, 8, 12, 15, 17, 18, 19, 20, 21, 22
Altahullion Phase II	Ex	9.7 km to north west	9	66	49	82	
Barr Cregg	Prop	14.9 km to north west	7	90	80	125	2, 8, 13, 17, 18, 20
Glenconway	Ex	11 km to north west	8	93	68.5	115	2, 3, 4, 7, 8, 12, 15, 17, 18, 20, 21, 22
Glenconway II	Ex	9.5 km to north west	12	82.4	60	101.2	
Monnaboy	Ex	15.1 km to north west	4	82.4	80	121.2	2, 4, 7, 8, 15, 17, 18, 20
SLIEVE KIRK CLUSTER							
Carrickatane	Ex	25.2 km to west	9	84	70	112	1, 12, 13, 14, 15, 18, 19, 20
Curryfree	Ex	24.3 km to west	6	80	60	100	
Eglish	Ex	18.3 km to west	6	90	70	115	1, 4, 8, 12, 13, 14, 15, 17, 18, 19, 20, 21
Slieve Kirk	Ex	20.2 km to west	12	82.4	68.3	110	1, 7, 12, 13, 14, 15, 17, 18, 19, 20, 21
Slieve Kirk Extension	Ex	22.5 km to west	4	82.4	68.3	110	
CROCKANDUN CLUSTER							
Brackagh (Draperstown)	Ex	16.3 km to south east	3	80	70	110	none
Creagh	Cons	16.4 km to south east	3	80	70	110	
Crockandun	Ex	19 km to south east	6	90	80	125	
OWENREAGH CLUSTER							
Craignagapple	Cons	26.7 km to south west	9	82	67	108	15, 18
Owenreagh	Ex	27 km to south west	10	40	40	60	
Owenreagh II	Ex	27 km to south west	6	52	40	66	
WIND FARMS NOT IN CLUSTERS							
Ballyhanedin	Cons	6.7 km to north west	8	82	85	126	All except VPs 5, 6, 9
Barony	Prop	28.9 km to south west	4	93	80	126.5	none
Beltonanean	Cons	22.5 km to south	1	70	71	106	
Beltonanean Extension	Prop	22.3 km to south	1	71	78	113.5	
Cam Burn	Cons	22 km to north east	6	71	85	120.5	
Doraville	Prop	13.5 km to south	36	117	90.5 / 77.5	149 / 136	

* Distance measured from centre of Development to nearest turbine in wind farm

5

Archaeology & Cultural Heritage

Appendix 5.1: Cultural heritage assets not subject to operational impacts

Scheduled Monuments

Standing Stones

5.1 There are seven standing stones within the ZTV and included in this assessment; all are scheduled monuments and are therefore of high importance. Six are single stones, one is a pair of stones, all are of assumed prehistoric date. As standing stones their cultural significance is primarily derived from their fabric and the potential that excavating the surrounding area may reveal information which could add to our knowledge of prehistoric ritual activities.

5.2 **Derrychrier standing stone (LDY024:005)** is located on a relatively flat ground in the middle of a field of improved pasture. Roughly 1.55m tall, the asset in proximity is a striking large pointed stone. However, it is not a prominent feature in the wider landscape as surrounding field boundaries obscure views into this asset from all but the immediate surrounding area. From the stone itself there are wide panoramic views over the surrounding flat agrarian landscape with distant rising hills forming the horizon in all directions. These views are largely filtered by surrounding hedgerows and trees. Located 130m to the south-east of Owenbeg stones (LDY024:006) it is probable that these assets have been built with reference to each other. There is nothing to suggest that distant views to the asset contribute to its cultural significance.

5.3 The Development will be located to the south-east of the standing stone, at a distance of 3.4km to the nearest turbine. All six turbines will be visible. Views to the south-east are not critical, and do not contribute to the asset's cultural significance. It is therefore considered that there will be no impact on Derrychrier standing stone.

5.4 The **Owenbeg stones (LDY024:006)** are located in an area of relatively flat ground on the edge of a field of improved pasture. The two stones are 1.65m and 1.2m high and may originally have been part of a megalithic tomb. The stones are now incorporated in a field boundary and are not prominent features in the landscape. From the stones there are wide panoramic views over the surrounding flat agrarian landscape with distant rising hills forming the horizon in all directions. These views are largely filtered by surrounding hedgerows and trees. Located 130m to the south-east of Derrychrier standing stone (LDY024:005) it is probable that these assets have been built with reference to each other. There is nothing to suggest that distant views to the asset contribute to its cultural significance.

5.5 The Development would be located to the south-east of the standing stone, at a distance of 3.4km to the nearest turbine. All six turbines will be visible. Views to the south-east are not critical, and do not contribute to the asset's cultural significance. It is therefore considered that there will be no impact on the Owenbeg stones.

5.6 **Dungiven Standing Stone (LDY025:004)** is located on a mound in a field of improved pasture on the south edge of Dungiven, to the north-east of Dungiven Church (LDY031:015) and to the immediate south-west of St Patrick's Church (HB02/06/001). The stone is a thin slab, 2.05m high, it is located on high ground which falls steeply away to the south-west with panoramic views all around and particularly over the Roe Valley. While the scheduling document notes that *"tradition states that this stone was set up as a record of an ecclesiastical assembly held here in 590 A.D., at which Columbkille was present."* The mound and the find of a flint implement on the site suggest that it dates from the prehistoric period. There is nothing to suggest that distant views to the asset contribute to its cultural significance.

5.7 The Development would be located to the south-west of the standing stone, at a distance of 3.3km to the nearest turbine. All six turbines will be visible. Distant views to the south-west are not critical, and do not contribute to the asset's cultural significance. It is therefore considered that there will be no impact the Dungiven Standing Stone.

5.8 **Drumcovit Standing Stone (LDY030:013)** is situated in a raised and banked boundary with wire fences on two sides, a GAA pitch has been built to its immediate north and in all other directions it is surrounded by improved pasture. The stone is 1.35m high and of a blocky shape. It is located in an area of raised ground with panoramic views in an arc from the east through the south to the west, over the surrounding agrarian landscape to distant hills. These views are somewhat filtered by intervening hedgerows and trees. It has been suggested that this stone forms a group with the nearby standing stones (LDY030:016, LDY 030:017 and LDY030:089). There is nothing to suggest that distant views to the asset contribute to its cultural significance.

5.9 The Development would be located to the east of the standing stone, at a distance of 4.9km to the nearest turbine. All six turbines will be visible. Distant views to the east are not critical, and do not contribute to the asset's cultural significance. It is therefore considered that there will be no impact on Drumcovit Standing Stone.

5.10 **Gallany Standing Stone (LDY030:016)** is located at the base of a north facing slope, a field gate lies to its immediate north-west. Views in all direction are restricted to the immediate surrounding fields which rise to the east through the south to the west. This is a small stone 1.05m in height and is not a prominent feature in the landscape. It has been suggested that this stone forms a group with the nearby standing stones (LDY030:013, LDY 030:017 and LDY030:089). There is nothing to suggest that distant views to the asset contribute to its cultural significance.

5.11 The Development would be located to the east of the standing stone, at a distance of 3.8km to the nearest turbine. The bare earth ZTV suggests that all six turbines will be visible, however local topography may block any such views and in any event, long-distance views make no contribution to the stone's cultural significance. It is therefore considered that there will be no impact on Gallany Standing Stone.

5.12 **Fincairn Standing Stone (LDY030:017)** is located on a north south ridge in a field of improved pasture to the immediate east of a farmstead. This stone has wide panoramic views in particular to the Sperrin mountains to the south-east. This is an almost triangular shaped stone, 1.25m high, 1m broad at the base tapering up to a point. It has been suggested that this stone forms a group with the nearby standing stones (LDY030:013, LDY 030:016 and LDY030:089). There is nothing to suggest that distant views to the asset contribute to its cultural significance.

5.13 The Development would be located to the east of the standing stone, at a distance of 3.9km to the nearest turbine. All six turbines will be visible. Distant views to the east are not critical, and do not contribute to the asset's cultural significance. It is therefore considered that there will be no impact on Fincairn Standing Stone.

5.14 **Tamnyagan Standing Stone (LDY030:089)** is located in a field of improved pasture to the immediate south-west of the Altinure (B44) road and south of a modern bungalow. The stone would have had long views to the north and south along the Valley however the views to the north are now largely blocked by the bungalow and its surrounding hedgerow. Views to the south and east are of the rising ground of Mullaghash and to the west Umrycam Hill. This stone is 1.3m high and is a four sided block. It has been suggested that this stone forms a group with the nearby standing stones (LDY030:013, LDY 030:016 and LDY030:017). Due its proximity to the road this asset has become a locally significant landmark, however there is nothing to suggest that distant views to the asset contribute to its cultural significance.

5.15 The Development would be located to the east of the standing stone, at a distance of 5.2km to the nearest turbine. The bare earth ZTV suggests that all six turbines will be visible, however local topography may block any such views. It is therefore considered that there will be no impact on Tamnyagan Standing Stone.

Tombs

5.16 **Carnanbane court tomb (LDY030:028)** Wireline Figure 5.12 is a scheduled monument and as such is considered an asset of high importance. This is the remains of a highly disturbed court tomb, which is historically recorded as having a large souterrain (LDY030:038) (subterranean stone lined structure dating from the medieval period) running from it. If the souterrain is present it is highly likely to have been built using stones from this cairn, in part explaining its disturbed nature.

5.17 The Carnanbane court tomb conforms to the basic model of court tombs; its cairn survives approximately 10m long and up to 4m wide, orientated north-east to south-west with the court at its north-east end. The remains of two chambers can be identified internally, however the highly disturbed nature of this cairn makes it difficult to confidently describe the tomb further.

5.18 The cairn is in a corner of a field to the immediate east of Magheramore Road, from which it is signposted, with a style into the field. To the west of the road is an opencast quarry. The cairn is located on a relatively flat area of ground, to the west the ground slopes steeply to the Owenrigh River, to the east are the gently rising slopes of Carnanbane Hill. This asset is partly overgrown with gorse and deciduous trees.

5.19 This asset primarily gains its cultural significance from its fabric and its potential to increase our knowledge of funerary practice in the Neolithic. The possible souterrain starting at the tomb adds further to the cultural significance of the assets fabric as it has the potential to add to our knowledge of re-use of the tomb.

5.20 This tomb is experienced and understood in a setting that makes some contribution to its overall cultural significance. The surrounding hedgerows obscure views from this asset and place it in a modern agricultural landscape removing any open views it may have had in the past. It appears that this tomb was not obviously orientated to any particular landscape feature.

5.21 The Development will be visible at a distance of 1.3km to the south-east from this asset. The turbines will be prominent features in the view to the south-east from the tomb. However, at this range the Development would not have a material effect on the immediate setting of the tomb and the ability for visitors to understand and enjoy the remains of this monument.

5.22 The proposed wind farm would change the appearance of the wider rural landscape setting of the monument, but this setting is already a modern landscape. This would not materially diminish the limited contribution that this modern landscape setting currently makes to a visitor’s understanding and enjoyment of the monument. It would continue to be experienced in a rural setting and it is this characteristic that is relevant to the cultural significance of the monument. It is therefore considered that there will be no impact on Carnanbane court tomb.

5.23 **Cloghnagalla wedge tomb (LDY031:003),** Wireline Figure 5.13, is a scheduled monument and as such is considered an asset of high importance. Cloghnagalla is a relatively well-preserved funerary tomb of late Neolithic date and is readily identifiable in the local landscape.

5.24 Wedge Tombs were named for the wedge-shaped nature of the burial chamber which, in well-preserved examples, is seen to become lower and narrower away from the entrance. The orientation of the entrance, where this can be determined, is seen to cluster strongly with most examples lying between north-west and south-west ((Ó Nualláin, 1989, 109;Waddell, 2010, 106). The elongated megalithic chambers are enclosed in a cairn, typically circular or oval in shape, but many examples are only known as highly denuded chambers with only a few large set stones surviving prolonged robbing for re-use in surrounding field walls and buildings (Waddell, 2010, 102-109).

5.25 The Cloghnagalla Wedge Tomb conforms to this basic model; it is a heel-shaped cairn 8.4m long, 5.1m wide at the front tapering to 2.5m at the back, with outer walling and a wedge-shaped gallery. The tomb is aligned on a south-west to north-east axis, with the entrance at the south-west. The tomb was excavated in 1938 and finds including the cremated remains of an adult dated the site to the Late Neolithic, with one Bronze Age pottery sherd.

5.26 This asset is located on a level area of ground near the top of a steep slope with good views over the Roe Valley to the south. The Sperrins which encircle the plateau to the north, east and south create an bowl-like effect. To the immediate south-east of the asset, across a track, is a modern house which effectively blocks views out from the asset in this direction.

5.27 The cultural significance of this monument derives primarily from the potential of its fabric to inform our knowledge of funerary practice in the Late Neolithic. This tomb is experienced and understood in a wider landscape setting that makes some contribution to its overall cultural significance as the wide panoramic views over the surrounding landscape and the surrounding hills enables an appreciation of why the tomb builders chose this location.

5.28 The bare earth ZTV suggests that Development will be visible in views to the south-west at a distance of 4.8km to the nearest turbine. However, it seems probable that the view to the turbines will at least be partly blocked by the nearby house. Given the distance and it's appearance in a view of limited relevance to the tomb the Development will not alter the visitor's ability to understand appreciate, experience and enjoy the asset. It is therefore considered that there will be no impact on Cloghnagalla Wedge Tomb.

5.29 **Carn Wedge Tomb (LDY031:021)** Wireline Figure 5.14 is a scheduled monument and as such is considered an asset of high importance.

5.30 The Carn Wedge Tomb has been classified as a wedge tomb (as described in the assessment of Cloghnagalla wedge tomb LDY031:003). This monument survives as a high stone cairn though it seems probable that much of this results from later dumps of field clearance stones. Beneath the cairn, an outer façade of large kerbstones remains partly visible. The cairn is 9m long by 8m wide on an east to west axis with a possible entrance to the west. The later clearance dump, partially obscures the structure of the cairn. This cairn has not been excavated so it is difficult to confidently state more about this tomb.

5.31 This asset is located in a large field to the immediate south of Glenshane Road (A6) on an area of level ground at the top of a rise. Its location affords the cairn extensive panoramic views from the east through the south to the west along and over the Glenshane Valley. To the east through north to west the view is to the rising ground of the northern Sperrin mountains.

5.32 The cultural significance of this monument derives primarily from the potential of its fabric to inform our knowledge of funerary practice in the Late Neolithic. This tomb is experienced and understood in a wider landscape setting that makes some contribution to its overall cultural significance as the wide panoramic views over the surrounding landscape enables an appreciation of why the tomb builders chose this location.

5.33 The Development will be visible to the south-west at a distance of 4.8km to the nearest turbines. At this distance the Development will not dominate or detract from the ability to understand appreciate, experience and enjoy the asset. It is therefore considered that there will be no impact on Carn Wedge Tomb.

Ringforts

5.34 There are six ring forts (including raths and cashels) within the ZTV and included in this assessment. These are all scheduled monuments and are therefore of high importance. Ring forts largely date from the early medieval period and are a form of enclosed and defended farmstead. They are often sited in areas offering good all-round visibility in order to monitor approaches to the settlement and the surrounding agricultural land.

5.35 **Tandragee Fort (LDY030:014) Figure 5.15.** The rath interior was sub-circular measuring roughly 40m by 30m enclosed by a bank, the bank has two forms of construction; wholly earthen at the north-east side and earthen with stones elsewhere. It is located in an area of rough grazing and improved grassland on the summit of a small unnamed hill to the north of Glendra Road (B44). It has wide views over Altcatten Glen from the village of Feeny in the west to Fincairn Crossroads to the south-east and the Sperrin Mountains beyond.

5.36 This asset primarily gains its cultural significance from its fabric and its potential to inform our understanding of domestic, defensive and agricultural activities during the medieval period. This fort is experienced and understood in a setting that makes some contribution to its overall cultural significance. The location of the fort was presumably chosen as it provided an accessible but defensible location for residents in close proximity to agricultural land and well placed to monitor the communication routes running east to the west along Altcatten Glen. There is no evidence to suggest that more distant views to or from the ringfort were of importance.

5.37 The Development would be located to the east of the rath, at approximately 4.9km to the nearest turbine. The presence of turbines in views to east of the rath will not hinder the understanding or appreciation of the contribution made by setting to the cultural significance of the monument. It is therefore considered that there will be no impact on Tandragee Fort.

5.38 **Rallagh Fort (LDY030:026)** Figure 5.16 is located on the edge of a steep sided slope on the west side of the Owenrigh Valley, it has extensive views in an arc from the north, through the west to the south. Views to the east are blocked by the dense deciduous woodland of the valley side. This rath survives as a raised platform with an eroded perimeter bank it was sub-circular measuring approximately 39m by 30.5m internally.

5.39 This asset primarily gains its cultural significance from its fabric and its potential to inform our understanding of domestic, defensive and agricultural activities during the medieval period. This fort is experienced and understood in a setting that makes some contribution to its overall cultural significance. The location of the fort was presumably chosen as it provided an accessible but defensible location for residents in close proximity to agricultural land. The rath was also sited for the wide views it commands, it is likely that the rath was placed to monitor the communication route north to south along the Owenrigh Valley. There is no evidence to suggest that more distant views to or from the rath were of importance.

5.40 The Development would be located to the east of the rath, at approximately 2km to the nearest turbine. At present views to the Development would be blocked by intervening woodland. However, even in the absence of this woodland the presence of turbines in views to south-east of the rath will not hinder the understanding or appreciation of the contribution made by setting to the cultural significance of the monument. It is therefore considered that there will be no impact on Rallagh Fort.

5.41 **Templemoyle Rath (LDY030:027)** Wireline Figure 5.17 is located immediately to the east of and partly cut by Banagher Road on a gentle sloping field which then falls steeply to Owenrigh River valley to the east, there are open views to the hills to the east and north to south along Owenrigh River valley, the view to the west is limited to the rising ground of Caugh Hill.

5.42 This asset primarily gains its cultural significance from its fabric and its potential to inform our understanding of domestic, defensive and agricultural activities during the medieval period. This fort is experienced and understood in a setting that makes some contribution to its overall cultural significance. The location of the fort was presumably chosen as it provided an accessible but defensible site in close proximity to agricultural land, and for views along the Owenrigh River Valley. There is no evidence to suggest that distant views to or from the rath were of relevance.

5.43 The Development would be located to the south-east of the rath, at approximately 1.7km to the nearest turbine. The presence of turbines in views to south-east of the rath will not alter the understanding or appreciation of the contribution made by setting to the cultural significance of the monument. It is therefore considered that there will be no impact on Templemoyle Rath.

5.44 **Tamniaran Rath (LDY031:006)** is located in a field of improved pasture on a north/south ridge between the River Roe and the Black burn. It has commanding views in an arc from the west through north to the east over and along the Roe Valley and Benady Glen. The rath also overlooks the Black Fort (LDY31:007) and the White Fort (LDY 31:008) which are located on the opposite side of Benady Glen to the east. This circular rath is 30m in diameter with a well-preserved bank, though the interior appears to have been levelled.

5.45 This asset primarily gains its cultural significance from its fabric and its potential to inform our understanding of domestic, defensive and agricultural activities during the medieval period. This fort is experienced and understood in a setting that makes some contribution to its overall cultural significance. The location of the fort was presumably chosen as it provided an accessible but defensible location for residents in close proximity to agricultural land, and for views along the communication corridors of the Roe Valley and Benady Glen. It is presumed that the Tamniaran Rath (LDY031:006) has also been placed to enable intervisibility with the (probably) contemporary Black Fort (LDY31:007) and White Fort (LDY 31:008). There is nothing to suggest that other, more distant views from the rath were of relevance.

5.46 The Development would be located to the south-west of the rath, at approximately 2.8km to the nearest turbine. The presence of turbines in views to south-west of the rath will not hinder the understanding or appreciation of the contribution made by setting to the cultural significance of the monument. Nor will it affect the interrelationship between Tamniaran Rath (LDY031:006) and Black Fort (LDY31:007) and White Fort (LDY 31:008). It is therefore considered that there will be no impact on Tamniaran Rath.

5.47 **The Black Fort Rath (LDY031:007)** is located in a field of improved pasture on a south facing slope overlooking Benady Glen and the Roe River. The rath has extensive views along Benady Glen and the Roe Valley to the north and south, to the south-west is the rising ground of the other side of Benady Glen on which Tamniaran Rath (LDY031:006) is located and the rising ground of the Sperrins beyond. Views to the north-east are restricted by a belt of plantation forestry and the rising ground of Carn Hill and Benbradagh, 75m to the east of the rath is the White Fort (LDY031:008).The Black Fort is a relatively is well preserved circular rath approximately 30m in diameter enclosed by a bank of earth and stone, while there are now two entrances to this rath the original entrance appears to be at the south-east.

5.48 This asset primarily gains its cultural significance from its fabric and its potential to inform our understanding of domestic, defensive and agricultural activities during the medieval period. This fort is experienced and understood in a setting that makes some contribution to its overall cultural significance. The location of the fort was presumably chosen as it provided an accessible but defensible location for residents in close proximity to agricultural land with good views over the communication corridors of Benady Glen and the Roe Valley and because of its presumed relationship with the neighbouring Raths (LDY031:006 and LDY031:008). There is nothing to suggest that other distant views from the rath were of relevance.

5.49 The Development would be located to the south-west of the rath at approximately 3.3km to the nearest turbine. The presence of turbines in views to south-west of the rath will not hinder the understanding or appreciation of the contribution made by setting to the cultural significance of the monument. Nor will it affect the interrelationship between the Black Fort (LDY031:007) and Tamniaran Rath (LDY31:006) and White Fort (LDY 31:008). It is therefore considered that there will be no impact on The Black Fort Rath.

5.50 **The White Fort (LDY031:008)** Wireline Figure 5.18 is a cashel located in field of improved pasture on the top of a flat ridge above the south facing slope of Benady Glen. The cashel has extensive views along Benady Glen and the Roe Valley to the north and south, to the south-west is the rising ground of the other side of Benady Glen on which Tamniaran Rath (LDY031:006) is located and the rising ground of the Sperrins beyond. Views to the north-east are restricted by a belt of plantation forestry and the rising ground of Carn Hill and Benbradagh, 75m to the east of the rath is the Black Fort (LDY031:007). The White Fort is a sub-circular cashel approximately 22.5m in diameter, it was built with a stone earth wall though much of the facing stone has been removed there is a possible entrance on the south-east side. A modern field fence divides the cashel and there are two mature fir trees in its interior.

5.51 This asset primarily gains its cultural significance from its fabric and its potential to inform our understanding of domestic, defensive and agricultural activities during the medieval period. This fort is experienced and understood in a setting that makes some contribution to its overall cultural significance. The location of the fort was presumably chosen as it provided an accessible but defensible location for residents in close proximity to agricultural land with good views over the communication corridors of Benady Glen and the Roe Valley and because of its presumed relationship with the neighbouring Raths (LDY031:007 and LDY031:008). There is nothing to suggest that other distant views from the rath were of relevance.

5.52 The Development would be located to the south-west of the cashel at approximately 3.4km to the nearest turbine. The presence of turbines in views to south-west of the cashel will not hinder the understanding or appreciation of the contribution made by setting to the cultural significance of the monument. Nor will it affect the interrelationship between the White Fort (LDY031:008) and Tamniaran Rath (LDY31:006) and the Black Fort (LDY 31:007). It is therefore considered that there will be no impact on The White Fort.

Other Scheduled Monuments

5.53 **Templemoyle Church (LDY030:030)** Photomontage Figure 5.9 is a scheduled monument and therefore of high importance. It is the remains of a late medieval church in a field of improved pasture to the west of the Owenrigh River. Located in a low-lying level field and surrounded by similar fields the church has wide views in all directions over the surrounding flat agricultural land to rising hills and the mountains in the north-east and south. To the immediate north-east of the church is a modern farm and cottage. This church is believed to predate the 12th century Banagher Old Church (LDY030:029) and it is suggested that it was abandoned due to its low-lying location in favour of the hilltop location of Banagher Old Church (LDY030:029). The church is no longer extant though the remains of the lower courses of some walls are believed to be preserved beneath later deposits of field clearance stones.

5.54 This asset primarily gains its cultural significance from its fabric and its potential to inform our understanding of ecclesiastical activity in the early medieval period. The setting of the church adds little to the cultural significance of the asset though it would have been sited for its relationship with its parishioners and may have been abandoned due to its low-lying location.

5.55 The Development would be located to the south-east of the church site at a minimum distance of approximately 2.3km to the nearest turbine. Direct views to the Development will be filtered by intervening trees and hedgerows. Nonetheless, the Development would be visible on the hillside to the south-east, but these distant views are not critical, and do not contribute to the asset’s cultural significance. Those aspects of the site’s setting that do contribute to its cultural significance (namely the low-lying level fields which may have resulted in its abandonment) will continue to be readily appreciated and understood. The presence of the turbines will not interrupt or distract from those aspects of the church site's setting which contribute to its cultural significance. It is therefore considered that there will be no impact on Templemoyle Church.

5.56 **Altnaheglish Reservoir (LDY031:500)** is a scheduled monument and therefore of high importance. This reservoir was built between 1930 and 1940 and officially opened in November 1935. It is a curved dam of mass concrete construction; the curved dam wall is 110m long at the crest and has a height of 42m from foundations making it the highest dam wall in Northern Ireland. It was built to supply water to Londonderry and its surrounding districts and continues to do so to date. While the reservoir has a picturesque setting within Banagher Glen it gains very little of its cultural heritage value from its setting, the reservoir was built as a functional feature and it is primarily this that gives it it's cultural heritage importance.

5.57 The Development will be visible to the north-west of the Reservoir at a minimum distance of 530m to the nearest turbine. It is considered that the presence of the turbines will not affect the ability to understand or appreciate the aspects of this dam from which it gains its cultural heritage value. It may be suggested that as reservoirs and turbines are both ways of providing supplies (water and electricity) to the surrounding districts they are culturally complimentary. It is therefore considered that there will be no impact on Altnaheglish Reservoir.

Listed Buildings not subject to Operational Impact

5.58 **Dungiven Priory (LDY031:015)** Photomontage Figure 5.10 is a scheduled monument and State Care Monument and as such an asset of high importance. Dungiven Priory has a complicated history; in brief, it was founded as an Augustinian Priory in the mid-12th century and may have been built on the site of an earlier ecclesiastical building. By the late 15th century the Priory was no longer in ecclesiastical use and a tower house – Ó Catháin's castle was in use, this secular defended structure was in use until the early 17th century when a garrison was placed at Dungiven and a manor house and bawn were built on the site (Hamlin A, 2002, 131).

5.59 Dungiven Priory is located on a high promontory on the north bank of the River Roe, the priory is almost entirely enclosed by surrounding mature trees and beyond this there are fields of improved pasture. There are no notable long views to or from this asset; all views of importance to the cultural significance of this asset are within its immediate surroundings. The situation of the Priory provides a tranquil, secluded and isolated setting, characteristics which would have been attractive to the founding Augustinian monks who had an ethos of poverty and contemplative nature, their priories often growing from eremitic sites. The promontory location above the River Roe would have also made this an attractive defensive location for the tower house and fortified manor house, although the current surrounding trees limit the ability to appreciate the defensive nature of the setting.

5.60 The Development will be located approximately 3km to the south of Dungiven Priory. Intervening deciduous trees will block views from the Priory to the turbines as demonstrated in the visualisation (Figure 5.10). In the absence of the intervening trees three of the turbines would be visible across the valley to the south to hub height and a further three to tip height. However, given the density of the intervening trees in this mature deciduous woodland along the banks of the River Roe, it is highly unlikely that enough trees would be felled to make the Development visible. The key characteristics of the Priory's setting which add to the cultural importance of the site; its tranquil, secluded and relatively isolated nature will therefore be retained unchanged. The Development will not dominate or detract from the Priory and the ability to understand, appreciate, experience and enjoy the asset will be unchanged. It is considered that the proposed wind farm will have no impact on Dungiven Priory.

Bridges

5.61 Within 5km of the turbines there are eight listed bridges. These include three Grade B1 (HB02/05/007, HB02/05/012 and HB02/07/022) and five Grade B2 listings (HB02/05/016, HB02/05/019, HB02/06/009, HB02/07/001 and HB02/05/040) (Chapter5; Table 5.9). As listed buildings these are assets of high importance.

5.62 These bridges were built from the late 18th to late 19th centuries to carry roads over rivers and streams connecting communities. Bridges are primarily functional assets, intended to enable the passage of vehicles and livestock across water with ease and the architectural evidence of this functional setting is of relevance. The immediate physical setting is often relevant, in that the original route to and from the bridge can still be appreciated as can its relationship with the immediate topography and/or watercourses. These bridges largely have picturesque settings with views along rural rivers and riverbanks and out to the surrounding agrarian landscape. Knocknan Bridge (HB02/05/007) gains further functional setting value from its relationship with the Registered park and Garden, Ash Park, which it provides one of the accesses too.

5.63 The Development will be at a distance of 1.9km or further from all the listed bridges. At this distance it is considered that the turbines will not obstruct or obscure any critical views to and from these bridges or their approaches. It is also considered that the turbines will not hinder any understanding orexperience of the functional, physical and visual setting of these bridges. The turbines will not be a visual change that will impact on the key attributes of their setting nor will it erode the characteristics of the setting of these assets from which they gain heritage significance. No impact on these assets is predicted.

5.64 **7, 9, 11 and 15 Lower Main Street, Dungiven (HB02/06/006 A, B, C & E)** are designated as four Grade B2 listed buildings and as such are assets of high importance. These buildings form a simple Georgian style terrace on the western approach to Dungiven. Located on the south side of the Lower Main Street the main views from these buildings are to the north and along the street to the east and west. The HED listing document for these assets evaluates their values as largely deriving from their pleasing character at the western entrance to Dungiven.

5.65 The Development will be at a distance of 4.2km to the south of this group of buildings. The key characteristics of this group's setting are its relationship with the main street of Dungiven and its appearance in the approach to the town from the west. The bare earth ZTV suggests that the turbines will be visible from these buildings. If visible the turbines will only be visible from the rear of these buildings and therefore not in views along or across Lower Main Street. No impact on the cultural significance of the Lower Main Street listed buildings is predicted.

5.66 **Drumcovit House (HB02/05/008A)** Wireline Figure 5.19 is a Grade B+ listed building and as such is an asset of high importance. It was originally built in the 17th century as a farmhouse and at the end of the 18th century a large Georgian facade was added to the house. The house remains part of a working farm while outbuildings have been converted to holiday accommodation. Approximately 865 m north of Feeny, the complex of buildings is on the north-western side of the A6. According to Ordnance Survey maps, apart from some changes to outbuildings the layout of Drumcovit House has not substantially changed between the first edition map of 1832 to 1846 and the current mapping. The house is set in mature grounds with established trees and gardens surrounded by agricultural land. The main front of the House faces north-east and, as the designation document states, appears to have been sited for the "fine prospect of Benbradagh mountain beyond Dungiven with the spire of Banagher parish church in the middle distance".

5.67 According to tradition Fredrick Hervey, the Anglican Bishop of Derry, was a frequent visitor to the house and enjoyed the fine views from the house, particularly towards the Parish Church (Banagher Church of Ireland, HB02/06/003 A), 2.8km to the north-east. The North Sperrins heritage trail uses place name evidence to suggest that "Drumcovitt stems from the Irish druim coimead meaning 'ridge of the watching' and it is believed to describe the place for watching along the main road that was frequently used by highwaymen in the 17th century" (North Sperrins Heritage Trail, 2007, 24)

5.68 As a farmhouse, the elements of setting that contribute most to Drumcovit House's cultural significance are the physical and visual relationships between the house, its outbuildings and the surrounding fields. The house is largely screened in views to the south and east by surrounding mature trees and outbuildings, the house is visible in glimpsed views from the A6 road to the north-east.

5.69 The ZTV and wirelines indicate that all six turbines will be visible from Drumcovit House at a minimum distance of 4.3km to the south-east. They will appear on the rising ground of Carnanbane on the far side of the valley. At present, views to the turbines will largely be screened by the mature trees that surround the house to the south and east. While the turbines will be visible in some views to the south-east from the house, they will not distract or compete with the physical, function and visual setting of this house and its relationship with the surrounding outbuildings and farmland, or its distant views to Benbradagh mountain and the steeple of Banagher parish church. Nor will the turbines obstruct or obscure views towards Drumcovit

House from the A6. The contribution made by setting to the cultural heritage significance of Drumcovit House will remain readily appreciable. There will be no operational impact upon Drumcovit House.

5.70 **St Joseph's R.C Church (HB02/05/010A)** is a Grade B2 listed building and as such an asset of high importance. Built in the late 19th century on the site of an earlier church, the building has seen subsequent alterations and was renovated in the 1980s. The listing evaluation notes that this is "a rather bleak plain Gothic style church of late 19th cent. which has a more interesting interior because of its dominant wagon type ceiling and sanctuary wall mosaics." The church is located on the summit of a small hill to the east of Feeny and to the immediate north of Glendra Road. To its rear is an associated Catholic primary school; St Canicess. The church is surrounded by its graveyard.

5.71 The key characteristics of the church's setting are its relationship with Feeny and the small settlement of Fincairn which has developed around the church. These characteristics reflect the status of the church in the community and its function as a local parish church. The church does not have a steeple and is therefore not a prominent landmark in more distant views, although it is imposing when approaching from Feeny along the Glendara Road due to its hilltop position. The visual and physical relationship between the church and its graveyard also make a contribution.

5.72 The ZTV indicates that the six turbines will be visible in views from the church at a minimum distance of 4.8km. It is probable that intervening trees will largely screen or filter any views to these turbines. The presence of turbines in distant views to the north-east will not affect the cultural significance of the church or its setting. It will remain possible to understand and appreciate the setting of the church and its relationship with the neighbouring settlements. The local setting and key views of the church would not be affected by the Development. It is therefore considered that there will be no impact on St Joseph's R.C Church.

5.73 **The Church of Ireland, Dungiven (HB02/06/002)** is a Grade B2 listed building and as such is an asset of high importance. It was built in 1816 on the site of an earlier church and has seen subsequent alterations and additions. As the listing evaluation notes the church "enjoys a prominent location at the upper end of Main Street and provides a focal point."

5.74 The key characteristics of the church's setting are its relationship with the settlement of Dungiven, its prominent position reflecting the church's status in the community and its function as a local parish church. The visual and physical relationships between the church and associated structures (including boundary walls, gates, a monument, and the graveyard) are also setting characteristics relevant to its cultural significance.

5.75 The bare earth ZTV suggests that the proposed turbines will be visible from this church at a minimum distance of 3.9km to the south. However, intervening buildings and the mature trees that line the south side of Dungiven Main Street opposite the church are likely to screen or filter views to the turbine. The presence of turbines in distant views to the south will not affect the cultural significance of the church or its setting. It will remain possible to understand and appreciate the setting of the church and its prominent position within Dungiven Main Street. The local setting and key views of the church would not be affected by the Development. It is therefore considered that there will be no impact on The Church of Ireland, Dungiven

5.76 **St Patrick's R.C Church (HB02/06/001)** is a Grade B2 listed building and as such is an asset of high importance. The church was built in the late 19th century (with subsequent alterations and additions) to replace an earlier church which was on the opposite side of the road. The church is near the south-east end of Dungiven and is set back from Glenshane Road behind a stone boundary wall. To the front (north-east) of the church, between it and the road, is a large well-maintained lawn with mature trees and bushes. To the rear (south-west) of the church is a large graveyard surrounded by mature trees and hedges, and to the immediate south-east of the church is its large carpark.

5.77 The characteristics of the church's setting of most relevance to its cultural significance are its relationship with the settlement of Dungiven, and its prominent location near the south-east entrance to Dungiven reflecting the church's status in the community and is function as a local parish church. The visual and physical relationships between the church and its surrounding grounds and graveyard also contribute to its setting.

5.78 The bare earth ZTV suggests that the proposed turbines will be visible from this church at a minimum distance of 3.5km to the south. The surrounding mature trees may filter these views from the rear of the church to an extent. Where visible the presence of turbines in distant views to the south will not affect the cultural significance of the church or its setting. It will remain possible to understand and appreciate the setting of the church and it prominent position within Dungiven. The local setting and key views of the church would not be affected by the Development. It is therefore considered that there will be no impact on St Patrick's Roman Catholic Church.

5.79 **Banagher Church of Ireland (HB02/05/004)** (Photomontage, Figure 5. 8) is a Grade B+ listed building and as such is an asset of high importance. This church was built in the late 18th century bringing a church back to the parish of Banagher after the old Banagher Church (LDY030:029) was abandoned in the early 18th century in favour of the new parish church in Dungiven. This church is set back from the Altinure Road, accessed through the church carpark, then up a winding drive surrounded by mature trees to the church at the summit of a small hill. The church is not visible from the immediate surroundings, Altinure Road or its carpark, though as one nears the top of the drive it becomes a dominating feature backdropped only by the sky. To the rear (south-east) of the church is a graveyard from which the surrounding countryside is visible.

5.80 Although in its immediate vicinity views to the church are not possible until immediately upon it, in views from the wider countryside the church spire is a visible feature. The listing document notes "the spire of Banagher Church forms a salient feature of the Townlands of Derrychier, Rallagh, Knockan and Drumcovit.". The view of the Spire from Drumcovit House (HB02/05/008) to its south-west is also of importance as, **a**ccording to tradition, the Anglican Bishop of Derry enjoyed the fine views of it from the house. Fearing that the Parish Church was becoming obscured from view, he paid for the tower and octagonal spire to be built. (North Sperrins Heritage Trail, 2007, 24).

5.81 Characteristics of the church's setting relevant to its cultural significance are its visibility in the wider landscape and its connection with, and importance to, the community. The secluded setting of the church – almost hidden by trees until arrival at the summit of the hill – adds to the sense of place as does the appearance of the church against the sky. The church also gains visual and physical value from its relationship with its graveyard and the agrarian landscape beyond.

5.82 The proposed wind farm will not be visible in approaches to the church along the driveway and the open backdrop will be retained. The turbines will be visible at a distance of 2.68km to the south-east from the graveyard behind the church. This may add an element of visual distraction to this viewpoint which is of limited relevance to the cultural significance of the church. While the Development will appear in combination with the spire in some views from the surrounding townlands there will be sufficient separation that the turbines will not compete with or visually dominate the spire and it will remain a prominent focal point in the landscape. It is therefore considered that there will be an impact of negligible magnitude resulting in an effect of negligible significance on Banagher Church of Ireland.

5.83 **Knockan / Ash Park Registered Park and Garden (RPG)** Wireline Figure 5.20 is considered here as a group with **Ash Park House HB02/05/005 A Grade B+, Knockan House HB02/05/006 A Grade B+, 714 Glenshane Road HB02/05/005 B Grade B1 and Outbuilding Knockan House HB02/05/006 B Grade B2**, all six are assets of high importance. Knockan House was built in the late 18th century as a Georgian country residence and substantially added to in the early 19th century. Ash Park House was built in 1796 as the Dowager House of Knockan House and is itself a generous Georgian country house. 714 Glenshane Road is a farm cottage and outbuilding behind Ash Park House and appears to be contemporary. The outbuilding (HB02/05/006) is an eighteenth-century farm building which may have been used as a linen warehouse and neighbours Knockan House to the south-east. This group of buildings are surrounded by plantations of mature deciduous trees giving them a secluded nature with only glimpsed views into the grounds possible.

5.84 The listing document for Ash park house notes that it is "set in generous grounds containing much mature planting if latterly somewhat overgrown. The secluded gardens sweep down to the banks of the Owenbeg River."

5.85 The bare earth ZTV suggests that the 6 turbines will be visible from the Knockan/ Ash Park RPG at a minimum distance of 3.7km to the south-east. It is probable that due to the amount of mature trees surrounding this group there will be no visibility of the turbines. If or where the turbines are visible they will be at a sufficient distant not to distract from the key characteristics of cultural heritage importance to these assets their relationship with each other and the mature secluded ground that surround them. Nor will it detract from the views out to their associated farmland from 714 Glenshane Road. It is therefore considered that there will be no impact on the cultural significance of the Knockan/ Ash Park group of buildings.

5.86 **The Pellipar Estate including; Pellipar House (HB02/06/007 A) Grade B+, Outbuildings Pellipar House (HB02/06/007 A) Grade B1 and Pellipar Supplementary Park and Garden (L-018)** are considered here as a group. These are assets of high importance.

5.87 Pellipar House is a late 18th century country house, which was later extended in the early 20th century in a small French Chateau style. The outbuilding lies to the south of Pellipar House. The entrance and principal façade of Pellipar House faces north and the house has been set adjacent to the River Roe. The surrounding park and garden has been landscaped and there is a substantial number of mature deciduous trees. The trees surround the outbuildings on all sides and surround Pellipar House to the east, west and south. The planting of the trees has been designed to provide the buildings of the estate with a sense of seclusion and privacy.

5.88 Setting adds to the cultural heritage significance of this group as the principal building; Pellipar House has clearly been orientated to capture the view to the north. In addition to this the planting of trees around the buildings has added to the sense of privacy and seclusion in the estate.

5.89 The Development will be 5.2km to the south of the Pellipar House. While the bare earth ZTV suggests that the development will be visible from the Pellipar Estate it is considered that the surrounding trees will block any key views from the Pellipar Estate towards the development. The characteristics of the setting of Pellipar Estate from which it gains cultural significance will not be affected by the development and it will remain possible to understand, appreciate and enjoy Pellipar Estate. It is therefore considered that there will no impact on the Pellipar SPG and associated buildings.

5.90 **Mount Prospect House (HB02/05/001 A)** and **Mount Prospect House (Apartments)** (**HB02/05/001 B**) are Grade B2 listed buildings and as such are assets of high importance. These buildings are on the Magheramore Road, approximately 2.6km south of Dungiven. Built in the 18th century this farmhouse and its associated outbuildings have since been altered, with the outbuildings being converted into holiday accommodation in 1999. The outbuildings form a three-sided courtyard to the rear (west) of the House with a garden and mature trees to the front (east) of Mount Prospect House. The outbuildings are surrounded by numerous modern farm buildings. As a farmhouse and associated outbuildings, the elements of the setting that contribute most to Mount Prospects cultural significance are the physical and visual relationships between them and their associated farm buildings. Views to surrounding associated fields are also of value as they comprise the farmlands associated with these buildings. Views into these buildings from Magheramore Road are largely screened by the mature trees that surround them.

5.91 The ZTV indicates that up to 6 turbines will be visible from these buildings at a minimum distance of 1.6km. They may largely be screened from the buildings by the mature trees however if visible they will appear on the rising ground to the south-east and while visible will not obscure any views between the House, associated outbuildings and surrounding farmland. It will remain possible to understand and appreciate the contribution setting makes to the cultural significance of these buildings. It is therefore considered that there will be no impact on the cultural significance of the on Mount Prospect House and Mount Prospect House (Apartments)

5.92 The cast-iron, late 19th century **water pump (HB02/05/033)** at 128 Glendara Road a Grade B2 listed building and as such is an asset of high importance. The pump is in working condition in a farmyard, against the wall of a former cottage now an outbuilding it can be presumed this pump was the main water supply for this farm when it was installed. The pump's immediate surroundings contribute some heritage significance, but wider views are of limited relevance. As noted, in its listing document this pump is listed as a good example of a cast iron water pump and is of industrial heritage interest. The presence of turbines in views to or from the water pump would not detract from understanding or appreciating its cultural significance. It is therefore considered there will be no impact on the cultural significance of the water pump.

5.93 **31 Birren Road (HB02/07/026)** is a Grade B2 farmhouse and as such is an asset of high importance. It is located approximately 2.6km south-east of Dungiven. Built in the 19th century, the building has survived relatively unchanged although modern agricultural buildings have been built around it. As a farmhouse, the elements of setting that contribute most to the cultural heritage significance are the physical and visual relationships with the associated farm buildings and surrounding farmland. The farmhouse is located on a north-east facing slope with the front of the building facing north over the Benady Glen. The farmhouse and its associated farmland are visible in views from Birren Road to the north.

5.94 The bare earth ZTV suggests the 6 turbines will be visible in views from the farmhouse to at a minimum distance of 2.8km to the south-west. The turbines will not be in key views from this farmhouse to its outbuildings and surrounding farmland nor in its view over Benady Glen. It will remain possible to appreciate and understand the contribution setting makes to this farmhouse's cultural significance. It is therefore considered that there will be no impact on the cultural significance of 31 Birren Road.

5.95 **The Old Rectory (HB02/05/003 A)** is a Grade B+ listed building and as such is an asset of high importance. The rectory is sited on top of a small hillock to the east of the Glenshane Road B74, it is approached by a long winding drive. This large country house was built as residence of the minister of Banagher Church of Ireland (HB02/06/003 A) which sits approximately 930m to the south-west. There are the remains of paths from the Rectory to the church. The front of the building faces to the north as stated in the listing document "Like many of the larger country houses in the area the principal elevation faced in a northerly direction to obtain a view of the fine panorama which includes Binevenagh headland. This no longer is the case with the rectory building because of the surrounding trees". This rectory was originally sited for its proximity to the church and the panoramic views to the north. However, the extent of the mature trees that surround this building means that views out of and into this property are now very restricted.

5.96 The Development would be located to the south-west of the Rectory at a distance of approximately 2.5km to the nearest turbine. If visible through the surrounding trees the turbines would not be located in key view from this building and would not affect the ability to understand and appreciate the Rectory. It is therefore considered that there will be no impact on the cultural significance of the Old Rectory.

Undesignated Assets not subject to Operational Impact

5.97 Of the 28 undesignated SMR assets recorded within 2km of the turbines only three survive as possibly identifiable features; two enclosures (LDY031:013 & LDY031:015) and a souterrain (LDY030:038)

5.98 Enclosure LDY031:013 is the remains of a feature identified on the 2nd Edition OS map as a platform or mound. Recent farm improvements have removed nearly all traces of this site; however the remains of a slight perimeter scarp can be traced in the fields.

5.99 Enclosure LDY031:015 is also recorded from OS map evidence, however a house has been built on this site and it is not clear if any remains of the enclosure survive. The SMR notes that "there is a strong possibility that the house was built on an enclosure, probably a rath".

5.100 The souterrain (LDY030:038) is the historic record of a large souterrain running from **Carnanbane court tomb (LDY030:028).** As an unexcavated subterranean stone lined structure there is no upstanding evidence of this asset.

5.101 Given the extent to which these three assets survive it is considered that their cultural significance derives wholly from the potential any subsurface fabric has to inform our knowledge of these assets and what was once present on this site. The wider landscape setting of these assets does not contribute to their cultural significance. It is therefore considered that the Development does not have the potential to impact on the cultural significance of the two enclosures (LDY031:013 & LDY031:015) or the possible souterrain (LDY030:038).

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6

Ecology

Appendix 6: Ecology

Appendix 6.1	Information to Inform HRA
Appendix 6.2	Habitat Survey Report
Appendix 6.3	Bat Survey Report
Appendix 6.4	Outline Habitat Management Plan (oHMP)
Appendix 6.5	Outline Construction Environmental Management Plan (oCEMP)

Appendix 6.1: Information to Inform a Habitat Regulations Assessment

Introduction

1. Blackstaff Ecology was commissioned by RES Ltd (RES) to provide information to inform a Habitat Regulations Assessment (HRA) for a proposed wind farm at Magheramore, near Dungiven, Co. Derry/Londonderry.
2. A HRA is required where a project may give rise to significant effects upon a Natura 2000 site. Natura 2000 is a European network of protected sites which includes Special Areas of Conservation (SAC) and Special Protection Areas (SPA). Minor streams flow through the proposed site and enter the Owenrigh River, a component of the River Roe and Tributaries SAC, approximately 300m northwest of the site boundary.
3. The Owenrigh River is a tributary of the River Roe, which enters the Lough Foyle SPA. Lough Foyle is also a Ramsar site, with boundaries coincident with those of the SPA. However, the only potential functional pathway connecting the proposed development with Lough Foyle SPA is the rivers of the River Roe catchment. The SPA is approximately 25km downstream of the wind farm site. The scale of potential effects on the SPA designation features (populations of wintering waterfowl) and conservation objectives is unlikely to be detectable in view of the nature of potential impacts arising from construction (possible sediment release) and the effective remoteness of the proposed development from the SPA. Lough Foyle SPA is therefore not considered further in this HRA.
4. The Development is also 250m from the boundary of Banagher Glen SAC. This SAC is also hydrologically connected to the Development via a minor stream that flows into the Altnaheglish River to the south of T6.
5. A HRA is undertaken by the Competent Authority that takes the decision on the project, in this case the Department of the Environment (DoE). The following information (to inform a HRA) has been compiled in order to present the information required for DAERA to undertake a HRA.

Habitat Regulations Assessment

6. HRA consists of a four staged approach (EC 2002[1]) consisting of a 'Test of Likely Significance' and if necessary, an 'Appropriate Assessment':
   - **Stage One: *Screening or 'Test of Likely Significance'*** - the process which identifies the likely impacts upon a Natura 2000 site of a project or plan, either alone or in combination with other projects or plans, and considers whether these impacts are likely to be significant;

[1] European Commission (2002) *Assessment of plans & projects significantly affecting Natura 2000 sites, Methodological guidance on the provisions of Article6 (3) & (4) of the Habitats Directive 92/43/EEC*, Office of the Official Publications of the European Communities, Luxembourg.

- **Stage Two: *Appropriate Assessment*** - the consideration of the impact on the integrity of the Natura 2000 site of the project or plan, either alone or in combination with other projects or plans, with respect to the site's structure and function and its conservation objectives. Additionally, where there are adverse impacts, an assessment of the potential mitigation of those impacts;
- **Stage Three: *Assessment of Alternative Solutions*** - the process which examines alternative ways of achieving the objectives of the project or plan that avoid adverse impacts on the integrity of the Natura 2000 site;
- **Stage Four: *Assessment Where Adverse Impacts Remain*** - an assessment of compensatory measures where, in the light of an assessment of Imperative Reasons of Overriding Public Interest (IROPI), it is deemed that the project or plan should proceed.

Description of the Project

Site Description

7. The Proposed Magheramore Wind Farm, hereafter referred to as 'the Development' is located on privately owned agricultural lands. The site is located approximately 4km south of Dungiven, Co. Derry/Londonderry.

Proposed Development

8. The Planning Application Boundary (red line boundary) is shown on Figure 6.1. This boundary contains the main wind farm site, including positions of the turbines and associated infrastructure. A detailed plan of the Development showing the position of the turbines and other infrastructure is shown on Figure 6.2.
9. It is anticipated that the Development will have an operational lifetime of approximately 30 years from the date of commissioning, after which the above ground infrastructure would be removed and the land remediated. Therefore, the effects are largely long-term temporary as opposed to permanent.
10. Planning permission is being sought for the Development comprising the following:
    - 6 three-bladed horizontal axis wind turbines of up to 149.9 m tip-height
    - Turbine foundations
    - Hardstanding areas at each turbine location for use by cranes erecting and maintaining the turbines
    - Electricity transformers
    - Approximately 4.25km of new access track
    - Three temporary meteorological ('met') masts
    - Wind farm substation compound containing a control building
    - Energy storage containers
    - On-site electrical and control network of underground (buried) cables
    - Connection from the substation to the local grid network
    - Temporary construction compound

- Temporary enabling works compound
- Permanent and temporary drainage works
- Associated ancillary works
- New site entrance from the public road.

11. A temporary construction compound measuring 2430m^2 will be constructed. On completion of the wind farm construction, 1,056m^2 of temporary construction compound will be utilised permanently for Energy Storage and the remaining 1,374m^2 will be reinstated to their original form following construction.

12. A summary of the hardstanding that will be constructed for the Development is provided in Table 1.

Table 1 - Summary of Temporary and Permanent Hardstanding

Wind Farm Element	Temporary hardstanding[2] in m^2	Permanent Hardstanding[3] in m^2
Turbines and transformer pads	N/A	226 per turbine = 1,356
Crane pads and laydown areas	630 per turbine = 3,780	800 per turbine = 4,800
On-site access tracks (new)	N/A	12,168 m^2
On-site access tracks (upgraded)	N/A	10,205 m^2
Control building & substation compound with permanent hardstanding	N/A	1,724
Construction Compound / Energy storage hardstanding	1,374	1,056
Enabling Works Construction compound	400	N/A
Total hardstanding in m^2	**5,554**	**31,309**
Total Hardstanding in ha	**0.55 ha**	**3.13 ha**
Total Hardstanding as % of total area within the Planning Application Boundary (41.01ha).	**1.35%**	**7.63%**

13. The Development will also have to be connected to the cluster substation by approximately 17.9 km of underground cable. The grid connection will originate at the Development and connect to the proposed Agivey cluster substation on Drumbane Road approximately 1 km to the south west of Glenullin and 5 km southwest of Garvagh as shown in **Appendix 2.1 Figure 1: Potential Grid Connection**.

[2] Temporary hardstanding: this refers to ground which will be occupied by hardstanding / built structures during the construction of the Proposed Wind Farm Development, and the temporary met mast. However, once the proposed wind farm has been constructed / mast removed this land will be reinstated and available for grazing.

[3] Permanent hardstanding: this refers to ground which will be occupied by hardstanding / built structures throughout the lifetime of the proposed wind farm.

14. The proposed underground grid route crosses 18 watercourses between the proposed Magheramore Wind Farm Substation and the proposed Agivey Cluster Substation. These watercourses are spread across two major river catchments, the Roe (70%) and the Agivey (30%) Six of the 18 watercourses to be traversed are significant in terms of channel size and fisheries sensitivity, while the remainder are relatively small and likely to be at best of Medium sensitivity with regard to fisheries and aquatic ecology.

15. Installation of the underground cable should be within the existing bridge structure at all watercourse crossing locations provided there is sufficient excavation depth. If this cannot be achieved, installation should be by directional drilling under the watercourse. Either approach will avoid any interference with the integrity of the stream channel and will therefore not result in any loss of or damage to aquatic habitats. Similarly, there will be no interruption to fish passage within stream channels.

16. In addition to watercourse crossings, there are two sections of the cable laying route which lie directly adjacent to watercourses of High or Very High fisheries sensitivity, the Turmeel Burn and the Gelvin River. The Gelvin forms part of the River Roe and Tributaries SAC and is an important salmon spawning and nursery stream. The risk of any effect on fisheries and aquatic ecology will ultimately depend upon which side of the road the cable is to be located.

17. Construction processes should follow industry standard guidelines to ensure that no sediment or other polluting substances are released into the watercourses, in particular Pollution Prevention Guidance (PPG5): Works and maintenance in or near water. With the suggested mitigation it is predicted that there will be no residual effects on fisheries and aquatic ecology.

Site Drainage

18. Buffers to watercourses have taken account of and infrastructure designed in accordance with best practice guidance for site drainage. The potential impact of preferential routing of drainage and associated erosion and sediment wash-off within the sub-catchments draining the site will be mitigated through the measures which will be incorporated into the site SuDS Design. Contractors and sub-contractors will be required to follow all pertinent Pollution Prevention Guidance (PPG).

19. In particular, to address potential effects on waters entering local watercourses:

- Attenuation ponds and silt fences will be provided adjacent to surface water drains to prevent pollution and sedimentation of watercourses;
- Direct drainage into existing watercourses will also be avoided to ensure that sediment and runoff from disturbed ground is not routed directly to the watercourses;

- Flow and sediment transport in any track drainage swales will be minimised by reducing concentrated flows, installing regular cross culverts and the use of check dams placed at regular intervals within the trackside drainage swales; and
- Track drainage swales, where required, will discharge into attenuation ponds excavated on the downslope side, or silt fences.

20. Measures will be used to mitigate any potential impacts on the water quality of sub-catchments through peat erosion, stream acidification and metals leaching during construction. Measures will include:

- Sediment control measures (e.g. check dams, silt fences etc.) will be employed in the vicinity of watercourses and within the artificial drainage network during construction;
- Watercourses will be monitored throughout the construction period by the ECoW to identify any excessive mobilisation of sediments through the minor channels network, which will be mitigated by temporary sediment control measures (e.g. geotextiles/straw/bales/brash);
- If dewatering of excavations is required, pumped discharges will be passed through attenuation ponds and silt fences to capture sediments before release to the surrounding land;
- Where there is a permanent relocation of peat, the ground will be reinstated with vegetation as soon as practicable; and
- Works requiring disturbance of soils and peat will be suspended during periods of heavy rain.

Impacts on Natura 2000 Sites

21. The proposed project is not directly connected with or necessary to the management of the Natura 2000 sites.

22. The likely significance of effects of the proposed project on the Natura 2000 sites and their conservation objectives have been assessed taking into account the source-pathway-receptor model. The source is defined as the individual elements of the proposed project that have the potential to impact on the Natura 2000 sites, its qualifying features and its conservation objectives. The pathway is defined as the means or route by which a source can migrate to the receptor. The receptor is defined as the Natura 2000 sites and their qualifying features. Each element can exist independently however a potential impact is created where there is a linkage between the source, pathway and receptor.

Description of Natura 2000 Sites

River Roe and Tributaries

23. The Owenrigh and Altnaheglish Rivers, constitute part of the River Roe and Tributaries SAC. The former flows northwards approximately 300m to the northwest of the RLB (red line boundary). While the latter flows westwards 250m south of the RLB (at its closet point). Two minor streams and their tributaries flow through the development, one entering each of the two aforementioned rivers. The boundary of the SAC in relation to the proposed wind farm is illustrated in Figure 6.1.

24. The primary reason for designation is the presence of the Annex II species Atlantic salmon *Salmo salar*. Other qualifying features present include the Annex I listed habitats 'Old sessile oak woodland with *Ilex* and *Blechnum* in the British Isles' and 'Water courses of plain to montane levels with the *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation' and the Annex II species otter *Lutra lutra*. Other Annex II species present include sea lamprey *Petromyzon marinus* and river lamprey *Lampetra fluviatilis*. Table 2 below describes the qualifying features for the designation of the Natura 2000 site.

Table 2: River Roe and Tributaries SAC Qualifying Features

Feature type	Feature	Global Status	Size/extent/population
Species	Atlantic Salmon *Salmo salar*	B	1,000- 10,000
Habitat	Water courses of plain to montane levels with the *Ranunculus fluitans* and *Callitricho-Batrachion* vegetation	C	20km or 20% of channel length
Habitat	Old sessile oak woods with *Ilex* and *Blechnum* in the British Isles	C	145.45ha
Species	Otter *Lutra lutra*	C	C

Likely Significance of Effects on Qualifying Features & Conservation Objectives

Atlantic Salmon

25. The presence of Atlantic salmon is the primary reason for site selection. Salmon require clean, well-oxygenated river gravel for spawning, good water quality, a substrate consisting of coarse boulder, cobble and pebble for juvenile fry and parr, an abundant food supply and unimpeded access to and from the sea (JNCC 2013[4]). The overall conservation status of Atlantic salmon in the SAC is Favourable: Unclassified) (NIEA 2011). JNCC 2013 indicates that the number of spawners reaching Northern Ireland waters since 2007 has declined due to reduced survival at sea.

[4] Joint Nature Conservation Committee (2012) *Third Report by the UK under Article 17 on the implementation of the Habitats Directive from January 2007 to December 2012*, Peterborough, JNCC, viewed on 06.07.2017, Available from: <http://www.jncc.gov.uk/article17>.

26. There is a potential link between source, pathway and receptor during construction, operation and decommissioning of the proposed wind farm. Elements of the proposed wind farm as described above in paragraphs 7–11 above have in the absence of appropriate mitigation measures the potential to have significant adverse effects on the water quality downstream which is a key component in the conservation status of salmon. Salmon are particularly susceptible to deteriorating water quality due to sedimentation. Suspended solids can physically choke fish, disrupt feeding behaviour, smother salmon eggs and disrupt or prevent alevin emergence reducing the fitness of fry and parr and their ability to cope with natural pressures (Hendry & Crag-Hine 2003[5]). The significance of effects would be greater during the salmon spawning season which extends from October to March.

Water-crowfoot Rivers

27. 'Water courses of plain to montane levels with the *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation' is a qualifying feature, but is not the primary reason for site selection. Stream flow characteristics vary from fast-flowing spate rivers with dynamic flow regimes in upper catchments to the broad, slower moving, mature River Roe as it nears Lough Foyle. At the upper end of the River Roe and along its tributaries, the aquatic flora reflects the highly acidic character of the water, particularly in its moss communities, In the middle reach the channel vegetation is characterised by greater water -moss Fontinalis antipyretica while in lower reaches of the River Roe where the flow is less dynamic the bryophyte community is generally replaced by beds of stream water-*crowfoot Ranunculus penicillatus ssp. penicillatus* in the channel and reed canary-grass *Phalaris arundinacea* along the banks.

Oak Woods

28. The habitat type 'old sessile oak woods with Ilex and Blechnum in the British Isles' is a qualifying feature, but is not the primary reason for site selection. The habitat is characterised as woodland dominated by a mixture of oak Quercus spp. and birch Betula spp. The overall conservation status of the oak woods present in the SAC was Unfavourable/Unclassified (NIEA 2011).

29. The river channel of the River Roe and its tributaries has a tree fringe along a large proportion of its length. Occasionally this fringe widens out up the valley sides to discreet woodland blocks. The site is considered to support one of the best examples of the oakwood habitat in the UK. There is no identified pathway between source and receptor during construction, operation or decommissioning.

Otter

30. Otter is a qualifying feature, but is not the primary reason for site selection. Otter requires good water quality, suitable shelter for resting and breeding and an abundant

[5] Hendry, K. & Cragg-Hine, D (2003) *Ecology of the Atlantic Salmon, Conserving Natura 2000 Rivers, Ecology Series No. 7*, English Nature, Peterborough.

food supply dominated by fish (Chanin 2003[6]). The overall conservation status of otter in the River Roe is Favourable (NIEA 2010).

31. There is a potential link between source, pathway and receptor during construction, operation and decommissioning of the proposed wind farm. Elements of the proposed wind farm as describe above in 8–12 above have in the absence of appropriate mitigation measures the potential to have significant adverse effects on water quality that could lead to a reduction in fish populations, ultimately impacting on the conservation status of otter.

Likely Significance of Effects on Integrity of Natura 2000 Site

32. The primary potential effect associated with the proposed wind farm is a possible change in the water quality of watercourses within the Natura 2000 site during construction, operation and decommissioning. Maintaining water quality is the most important factor required for the specific structure and function of the site. It is a key indicator of conservation status and is an important factor for the conservation status of the qualifying features.

33. Changes in the chemical and biological water quality of watercourses can be used as an indicator to evaluate the condition of the Natura 2000 site and its qualifying features taking into account the conservation objectives. Good water quality is necessary for the long-term maintenance of the Natura 2000 site and its designation features.

34. In the absence of appropriate mitigation measures, deterioration of water quality during construction, operation or decommissioning of the proposed wind farm has the potential to have a significant effect on the integrity of the Natura 2000 site and on its water dependant qualifying features affecting their conservation status and resulting in significant adverse effects on the distribution and abundance of species populations. The design of the proposed wind farm has evolved throughout the EIA process taking into consideration constraints that have been identified and highlighted as part of baseline environmental surveys. A number of mitigation measures have therefore been incorporated into the design of the proposed wind farm in order to avoid and/or reduce any adverse effects on the Natura 2000 site (see paragraph 14 above).

Banagher Glen

35. The woodland of Banagher Glen (which is in close proximity to the Planning Application Boundary) is primarily located on the slopes above the Altnaheglish River, approximately 250m south of the Development (at its closet point). There is a minor stream which flows through the Development, eventually joining the aforementioned river. The boundary of the SAC in relation to the proposed wind farm is illustrated in Figure 6.1.

[6] Chanin, P. (2003) Ecology of the European Otter, Conserving Natura 2000 Rivers Ecology Series No. 10, English Nature, Peterborough.

36. The primary reason for designation is the presence the Annex I listed habitats 'Old sessile oak woodland with *Ilex* and *Blechnum* in the British Isles' and '*Tilio-Acerion* forests of slopes, screes and ravines.' And the Annex II species otter *Lutra lutra* is also present (but is not a reason for designation). Other Annex I habitats present include North Atlantic wet heath with *Erica tetralix*. Table 3 below describes the qualifying features for the designation of the Natura 2000 site.

Table 3: Banagher Glen SAC Qualifying Features

Feature type	Feature	Global Status	Size/extent/population
Habitat	Old sessile oak woods with Ilex and Blechnum in the British Isles	B	60.4ha
Habitat	Tilio-Acerion forests of slopes, screes and ravines	C	17.5ha

Likely Significance of Effects on Qualifying Features & Conservation Objectives

Oak Woods

37. The habitat type 'old sessile oak woods with Ilex and Blechnum in the British Isles' is the primary reason for SAC site selection. The habitat is characterised as woodland dominated by a mixture of oak *Quercus spp*. and birch *Betula spp*. The overall conservation status of the oak woods in Banagher is Unfavourable/No change (NIEA 2011).

38. Banagher Glen is considered to support one of the best examples of the oakwood habitat in the UK. The proposed wind farm at its nearest point is 250m from the SAC boundary, where this habitat type is present. However, there is no identified pathway between source and receptor during construction, operation or decommissioning.

Tilio-Acerion Forests

39. The habitat type Tilio-Acerion forests of slopes, screes and ravines. These habitats are not the primary reason for SACs being selected (being in Global Status Category C). However, Category C examples of the habitat which are of at least national interest (i.e. usually above the threshold for SSSI/ASSI notification on terrestrial sites) but not significantly above this. There is therefore a distinction between the principal features for which sites have been selected (those graded A or B) and those which are only of secondary interest (those graded C). This is a useful distinction but it is important to note that all three grades are qualifying SAC interest feature. The overall conservation status of the Tilio-Acerion forests in Banagher is Unfavourable: No change (NIEA 2011).

Likely Significance of Effects on Integrity of Natura 2000 Site

40. Potential impacts from the Development, (that could arise as a result of the works outlined in paragraphs 8-12), are listed in the following table which identifies those that could affect the selection features of this site.

Table 4: Pathway for potential impacts to Qualifying Features of Banagher Glen SAC

Potential impacts	Pathway for impact to site	Comments

Habitat loss	None	There will be no development within the SAC. Habitat loss as a result of other factors is considered below.
Direct disturbance	None	The SAC site selection features are not vulnerable to disturbance.
Indirect disturbance	None	
Introduced species	None	This is a threat to the SAC however, will not arise from the Development
Aerial emissions	None	Potential nitrogen deposition from intensive agriculture could cause degradation or loss of habitat. But this impact is not relevant to the windfarm proposal.
Water pollution	None	Could not affect the site selection features.
Hydrological change	None	Could not affect the site selection features.

In-Combination Effects with Other Projects

41. The assessment undertaken can objectively and reasonably conclude that the proposed Development, in the absence of mitigation, will not adversely affect selection features or the integrity of this SAC. Mitigation measures are not therefore required in order to ensure that the Development (as designed) will not have any effect on the integrity of the SAC.

42. No in-combination effects from other projects are likely, given that there are no pathways for impact to any of the SAC site designation features.

Stage One: Test of Likely Significance (River Roe & Tributaries)

Table 5: Screening Matrix	
Name of project or plan	Construction of 6 turbine wind farm at Magheramore
Project reference	Not known
Name and location of Natura 2000 site	River Roe and Tributaries SAC, Co. Derry/Londonderry
Brief description of the project or plan	RES Ltd propose to construct a wind farm consisting of six wind turbines with associated infrastructure at Magheramore, near Dungiven, Co. Derry/Londonderry. The layout of the proposed project is shown in Figure 6.2. The proposed project is not directly connected with or necessary to the management of the Natura 2000 site.
Brief description of the Natura 2000 site	The River Roe and Tributaries SAC approaches to within 250m of the proposed wind farm. The boundary of the SAC in relation to the proposed wind farm is illustrated in Figure 6.1. The primary reason for designation is the presence of the Annex II species Atlantic salmon *Salmo salar*. Other qualifying features present include the Annex I habitats 'Old sessile oak woodland with *Ilex* and *Blechnum* in the British Isles' and 'Water courses of plain to montane levels with the *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation' and the Annex II species otter *Lutra lutra*. Other species present include brook lamprey *Lampetra planeri* and river lamprey *Lampetra fluviatilis*. A copy of the Natura 2000 Standard Data Form and the Conservation Objectives can be found at http://jncc.defra.gov.uk/protectedsites/sacselection/n2kforms/UK0030361.pdf.
Assessment Criteria	
Describe the individual elements of the project (either alone or in combination with other plans or	• **Proposed Project** The proposed wind farm will involve construction of six wind turbines (overall height 149.9 m) and associated infrastructure, including newly

projects) likely to give rise to impacts on the Natura 2000 site.	created site entrance, access tracks, crane hardstandings, control building and substation compound, electricity transformers, underground cabling, energy storage containers and drainage works. During construction there would be a number of temporary works including a construction compound with car parking, an enabling works compound, temporary parts of crane hardstandings, welfare facilities and three temporary guyed lattice type meteorological masts. These activities have the potential to cause peat slide, accidental leaks or spillage and release of pollutants such as sediment, silt, concrete, fuel, oils, chemicals or other waste material that would result in point source pollution causing significant adverse effects on the designated sites, their qualifying features and conservation objectives. • **In Combination with Other Projects** There are currently a number of impacts occurring within the Natura 2000 site that have an influence on its conservation and management including pollution from urban and industrial centres, existing (and consented) wind farm developments, commercial forestry and farming.
Describe any likely direct, indirect or secondary impacts of the project (either alone or in combination with other plans or projects) on the Natura 2000 site by virtue of: • Size and scale; • Land-take; • Distance from Natura 2000 site or key features of the site; • Resource requirements (water abstraction etc); • Emission (disposal to land, water or air); • Excavation requirements; • Transportation requirements; • Duration of construction, operation, de-commissioning etc;	• **Size and scale** The Planning Application Boundary for the proposed wind farm encloses approximately 41ha. The proposed wind farm will result in the permanent land take of approximately 3.13ha to accommodate the infrastructure footprint and a temporary land take of approximately 0.55ha to accommodate the construction footprint. • **Land-take** No land within the boundary of the River Roe and Tributaries SAC will be required for the construction, operation or decommissioning of the wind farm. • **Distance from Natura 2000 site** The red line boundary lies approximately 250m to the south of the SAC boundary. • **Resource requirements** None • **Emission (disposal to land, water or air)** Excavation of foundations for turbines, hardstandings and associated buildings may require disposal of mineral soil to licensed landfill sites. Possible temporary dewatering may require disposal to local land surfaces via attenuation ponds and screens. • **Excavation requirements** Excavation of foundations for turbines, hardstandings and associated buildings, and for access routes will be required. Excavation will also be required for the proposed undergrounded grid connection electrical cabling (17.9km from the Development substation to the Agivey Cluster substation). • **Transportation requirements** Construction materials and equipment, turbine towers, blades and machinery, together with all materials and hardware for the construction of the substation, transformers and temporary structures will be transported to the site using the public highway network. Decommissioning will require the removal of wind farm components by road. • **Duration of construction, operation, de-commissioning etc.**

	Duration of construction has yet to be determined. It is anticipated that the wind farm will have an operational life of 30 years. • **In Combination with Other Projects** The primary effects relevant to the proposed project include deterioration of water quality within the catchment of the Natura 2000 site from point-source pollution including urban and industrial centres; point-source pollution from development including existing (and consented) wind farm developments; and diffuse pollution from commercial forestry in the upper catchment and farming in the lower catchment. There is potential for these impacts to act in combination causing cumulative adverse effects on water dependent qualifying features, affecting their conservation status, and the overall integrity of the Natura 2000 site.
Describe any likely changes to the site arising as a result of: • Reduction of habitat area: • Disturbance to key species; • Habitat or species fragmentation; • Reduction in species density; • Changes in key indicators of conservation value (water quality etc).	• **Reduction of habitat area** There will be no reduction of habitat area. • **Disturbance to key species** The proposed development is distant from key species and they will not be disturbed. • **Habitat or species fragmentation** The proposed development is distant from the SAC and there will be no habitat or species fragmentation. • **Reduction in species density** The primary effect associated with the proposed wind farm is a potential change in the water quality of watercourses hydrologically linked to the Natura 2000 site. Poor water quality and increased sedimentation can have significant influences on qualifying features and can result in population declines. Salmon are susceptible to deteriorating water quality due to sedimentation. Suspended solids can physically choke fish, disrupt feeding behaviour, smother salmonid eggs and disrupt or prevent alevin emergence reducing the fitness of fry and parr and their ability to cope with natural pressures (Hendry & Cragg-Hine 2003). Pollution can also have a major impact of lamprey; smothering spawning gravels and nursery silt habitat and making the watercourse unsuitable for ammocoetes (Maitland 2003 & Goodwin 2009). The significance of effects on salmon and lamprey would be greater during the spawning season. A decline in fish populations has the potential to impact on the otter population. Sediment control measures will be an integral part of the design of the wind farm, including attenuation ponds and silt fences adjacent to surface water drains; avoiding direct drainage into existing watercourses; installing regular cross culverts and check dams placed at regular intervals within the trackside drainage swales; track drainage swales, will discharge into attenuation ponds excavated on the downslope side, or silt fences; where there is a permanent relocation of peat, the ground will be reinstated with vegetation as soon as practicable; and works requiring disturbance of soils and peat will be suspended during periods of heavy rain. As a result, there will be no effects on species downstream of the wind farm and no reduction in species density. • **Changes in key indicators of conservation value (water quality etc).** There will be no change in water quality or other ecological parameters in the SAC as a result of construction, operation or decommissioning of the wind farm.

Provide indicators of significance as a result of the identification of effects set out above in terms of: • Loss • Fragmentation • Disruption • Disturbance; • Change to key elements of the site (e.g. water quality etc).	In the absence of likely effects on designation feature species and habitats, there is no requirement for impact significance indicators.
Describe from the above those elements of the project or plan, or combination of elements, where the above impacts are likely to be significant or where the scale or magnitude of impacts are not known.	Impacts on designation features and SAC conservation objectives are not likely to be significant.
Is the proposal directly connected with or necessary to management of the site for conservation of N2K features? If yes proceed no further.	No
Describe the individual elements of the project (either alone or in combination with other plans or projects) likely to give rise to impacts on the Natura 2000 site	Minor streams that flow through the development site enter the Altnaheglish River, 250m outside the development site boundary. Waterborne pollutants have the potential to enter the Natura site, with adverse effects on designation features.

N2K Feature: Mention all features	**Describe any likely direct or indirect effects to the N2K features arising as a result of:** **loss;** **reduction of habitat area;** **disturbance;** **habitat or species fragmentation;** **reduction in species density;** **changes in key indicators of conservation value (e.g. water quality, climate change).**	***Effect Significant/Not Significant? Why?**
Atlantic salmon	Streams draining the proposed development site could potentially become contaminated with hydrocarbons, cements, peat and silt leading to pollution affecting individual fish and salmon breeding habitats in the SAC.	**Not significant** Minor streams draining the site have low flow volumes and are unlikely to be able to carry significant loads of pollutants. Sediment control measures will ensure that any sediments arising from the works will not reach the streams. The distance of the Development from the Altnaheglish River means that any pollutants would in any case be well-dispersed and diluted and would not affect transient or breeding salmon. There will be no loss of habitat that supports the designation features, there will be no reduction of habitat area, there will be no disturbance of designation species, habitat or species fragmentation, reduction in species density or changes in

		key indicators of conservation value arising from the Development.
Lamprey species	Streams draining the proposed development site could potentially become contaminated with hydrocarbons, cements, peat and silt leading to pollution affecting individual fish and lamprey breeding habitats in the SAC.	**Not significant** See comments for Atlantic salmon (above).
Otter	Streams draining the proposed development site could potentially become contaminated with hydrocarbons, cements, peat and silt leading to pollution affecting otters and their aquatic prey in the SAC.	**Not significant** See comments for Atlantic salmon (above).
Old sessile oakwoods with *Ilex* and *Blechnum* in the British Isles	There are no likely impacts of the Development on SAC terrestrial habitats.	**Not significant** There are no likely pathways for effects on woodland habitats arising from the Development. The distance from the Natura site indicates that there are unlikely to be issues arising from runoff or other factors during construction, operation or decommissioning.
Water courses of plain to montane levels with the *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation	Streams draining the proposed development site could potentially become contaminated with hydrocarbons, cements, peat and silt leading to pollution of SAC waters, leading to changes in water quality, affecting aquatic plant communities through blanketing and toxic or near-toxic effects.	Minor streams draining the site have low flow volumes and are unlikely to be able to carry significant loads of pollutants. Sediment control measures will ensure that any sediments arising from the works will not reach the streams. The distance of the Development from the Altnaheglish River means that any pollutants would in any case be well-dispersed and diluted and would not have significant effects on plant communities. There will be no loss of habitat that supports the designation feature, there will be no reduction of habitat area, there will be no disturbance of species that are components of the designation habitat, habitat or species fragmentation, reduction in species density or changes in key indicators of conservation value arising from the Development.

***Only mitigation measures designed within the application can be considered at this stage. Any conditions that NIEA would impose must be assessed through the appropriate assessment stage.**

Describe any likely impacts on the Natura 2000 site as a whole in terms of:	**Effect considered significant/non-significant: Finding of No significant effects Matrix**
• Interference with the key relationships that define the structure of the site;	

• Interference with key relationships that define the function of the site.	
The Altnaheglish River, part of the SAC, could potentially become contaminated with sediment, derived from construction and decommissioning activities at the proposed development site, which could be transported downstream to affect water quality and thus salmon individuals from the designation population.	**Not significant** Distance of the proposed development from the SAC, flow characteristics of minor tributary streams and on-site sediment control measures will ensure that there will be no interference with the key relationships that define the structure or the function of the site.

Provide details of any other projects or plans that together with the project or plan being assessed could (directly or indirectly) affect the site.	**Provide details of any likely in-combination effects and quantify their significance -**
None known	N/A
Is the potential scale or magnitude of any effect likely to be significant?	
Alone?	Yes☐ No☒
In-combination with other projects of plans?	Yes☐ No☒

Conclusion: Is the proposal likely to have a significant effect on an N2K site?	**Yes**☐ **No**☒
IF IT HAS BEEN DETERMINED THAT THE PROPOSAL WILL NOT HAVE A SIGNIFICANT EFFECT THEN ASSESSMENT IS COMPLETED. **IF ANY PART OF THE PROPOSAL IS LIKELY TO HAVE A SIGNIFICANT EFFECT AN APPROPRIATE ASSESSMENT WILL BE REQUIRED – STAGE 2 AA.**	

Data collected to carry out the assessment

Who carried out the assessment?	Cormac Loughran CEnv MCIEEM MSc
Sources of data	Provided with application, client's drawings, Spatial-NI website and aerial photography.
Level of assessment completed	Stage 1 – Test of Likely Significance
Where can the full results of the assessment be accessed and viewed?	
NIEA CDP Response to consultation.	

Stage One: Test of Likely Significance (Banagher Glen)

Table 5: Screening Matrix	
Name of project or plan	Construction of 6 turbine wind farm at Magheramore
Project reference	Not known
Name and location of Natura 2000 site	Banagher Glen SAC
Brief description of the project or plan	RES Ltd propose to construct a wind farm consisting of six wind turbines with associated infrastructure at Magheramore, near Dungiven, Co. Derry/Londonderry. The layout of the proposed project is shown in Figure 6.2. The proposed project is not directly connected with or necessary to the management of the Natura 2000 site.
Brief description of the Natura 2000 site	The proposed Development approaches to within 250m SAC. The boundary of the SAC in relation to the proposed wind farm is illustrated in Figure 6.1. The area

	has been designated as a Special Area of Conservation (SAC) because it contains habitat types and/or species which are rare or threatened within a European context. The ASSI citation describes the special interests for which the site was notified in the Northern Ireland context. The interests for which the site was selected as ASSI may differ from the interests selected in a European context. A copy of the Natura 2000 Standard Data Form and the Conservation Objectives can be found at https://www.daera-ni.gov.uk/sites/default/files/publications/doe/land-information-reasons-for-designation-special-area-of-conservation-banagher-glen-2006.pdf .
Assessment Criteria	
Describe the individual elements of the project (either alone or in combination with other plans or projects) likely to give rise to impacts on the Natura 2000 site.	• **Proposed Project** The proposed wind farm will involve construction of six wind turbines (overall height 149.9 m) and associated infrastructure, including newly created site entrance, access tracks, crane hardstandings, control building and substation compound, electricity transformers, underground cabling, energy storage containers and drainage works. During construction there would be a number of temporary works including a construction compound with car parking, an enabling works compound, temporary parts of crane hardstandings, welfare facilities and three temporary guyed lattice type meteorological masts. These activities have the potential to cause peat slide, accidental leaks or spillage and release of pollutants such as sediment, silt, concrete, fuel, oils, chemicals or other waste material that would result in point source pollution causing significant adverse effects on the designated sites, their qualifying features and conservation objectives. • **In Combination with Other Projects** There are currently a number of impacts occurring within the Natura 2000 site that have an influence on its conservation and management including pollution from urban and industrial centres, existing (and consented) wind farm developments, commercial forestry and farming.
Describe any likely direct, indirect or secondary impacts of the project (either alone or in combination with other plans or projects) on the Natura 2000 site by virtue of: • Size and scale; • Land-take; • Distance from Natura 2000 site or key features of the site; • Resource requirements (water abstraction etc); • Emission (disposal to land, water or air); • Excavation requirements; • Transportation requirements; • Duration of construction, operation, de-commissioning etc;	• **Size and scale** The Planning Application Boundary for the proposed wind farm encloses approximately 41ha. The proposed wind farm will result in the permanent land take of approximately 3.13ha to accommodate the infrastructure footprint and a temporary land take of approximately 0.55ha to accommodate the construction footprint. • **Land-take** No land within the boundary of the River Roe and Tributaries SAC will be required for the construction, operation or decommissioning of the wind farm. • **Distance from Natura 2000 site** The red line boundary lies approximately 250m to the south of the SAC boundary. • **Resource requirements** None • **Emission (disposal to land, water or air)** Excavation of foundations for turbines, hardstandings and associated buildings may require disposal of mineral soil to licensed landfill sites. Possible temporary dewatering may require disposal to local land surfaces via attenuation ponds and screens. • **Excavation requirements** Excavation of foundations for turbines, hardstandings and associated buildings, and for access routes will be required. • **Transportation requirements**

	Construction materials and equipment, turbine towers, blades and machinery, together with all materials and hardware for the construction of the substation, transformers and temporary structures will be transported to the site using the public highway network. Decommissioning will require the removal of wind farm components by road. • **Duration of construction, operation, de-commissioning etc.** Duration of construction has yet to be determined. It is anticipated that the wind farm will have an operational life of 30 years. • **In Combination with Other Projects** The primary effects relevant to the proposed project include deterioration of water quality within the catchment of the Natura 2000 site from point-source pollution including urban and industrial centres; point-source pollution from development including existing (and consented) wind farm developments; and diffuse pollution from commercial forestry in the upper catchment and farming in the lower catchment. There is potential for these impacts to act in combination causing cumulative adverse effects on water dependent qualifying features, affecting their conservation status, and the overall integrity of the Natura 2000 site.
Describe any likely changes to the site arising as a result of : • Reduction of habitat area: • Disturbance to key species; • Habitat or species fragmentation; • Reduction in species density; • Changes in key indicators of conservation value (water quality etc).	• **Reduction of habitat area** There will be no reduction of habitat area. • **Disturbance to key species** The proposed development is distant from key species and they will not be disturbed. • **Habitat or species fragmentation** The proposed development is distant from the SAC and there will be no habitat or species fragmentation. • **Reduction in species density** Could not affect the site selection features. • **Changes in key indicators of conservation value (water quality etc).** There will be no change in water quality or other ecological parameters in the SAC as a result of construction, operation or decommissioning of the wind farm.
Provide indicators of significance as a result of the identification of effects set out above in terms of: • Loss • Fragmentation • Disruption • Disturbance; • Change to key elements of the site (e.g. water quality etc).	In the absence of likely effects on designation feature species and habitats, there is no requirement for impact significance indicators.
Describe from the above those elements of the project or plan, or combination of elements, where the above impacts are likely to be significant or where the scale or magnitude of impacts are not known.	Impacts on designation features and SAC conservation objectives are not likely to be significant.

Is the proposal directly connected with or necessary to management of the site for conservation of N2K features? If yes proceed no further.	No
Describe the individual elements of the project (either alone or in combination with other plans or projects) likely to give rise to impacts on the Natura 2000 site	Minor streams that flow through the development site enter the Altnaheglish River, 250m outside the development site boundary. Waterborne pollutants have the potential to enter the Natura site, although there is no pathway for these (should they occur) to impact upon designation features (i.e. the oakwoods/forests).

N2K Feature: Mention all features	**Describe any likely direct or indirect effects to the N2K features arising as a result of: loss; reduction of habitat area; disturbance; habitat or species fragmentation; reduction in species density; changes in key indicators of conservation value (e.g. water quality, climate change).**	***Effect Significant/Not Significant? Why?**
Old sessile oakwoods with *Ilex* and *Blechnum* in the British Isles. *Tilio-Acerion* forests of slopes, screes and ravines	There are no likely impacts of the Development on SAC terrestrial habitats.	**Not significant** There are no likely pathways for effects on woodland habitats arising from the Development. The distance from the Natura site indicates that there are unlikely to be issues arising from runoff or other factors during construction, operation or decommissioning.

***Only mitigation measures designed within the application can be considered at this stage. Any conditions that NIEA would impose must be assessed through the appropriate assessment stage.**

Describe any likely impacts on the Natura 2000 site as a whole in terms of: • Interference with the key relationships that define the structure of the site; • Interference with key relationships that define the function of the site.	**Effect considered significant/non-significant: Finding of No significant effects Matrix**
The Altnaheglish River, part of the SAC, could potentially become contaminated with sediment, derived from construction and decommissioning activities at the proposed development site, which could be transported downstream to affect water quality and thus salmon individuals from the designation population.	**Not significant** Distance of the proposed development from the SAC, flow characteristics of minor tributary streams and on-site sediment control measures will ensure that there will be no interference with the key relationships that define the structure or the function of the site.

Provide details of any other projects or plans that together with the project or plan being assessed could (directly or indirectly) affect the site.	**Provide details of any likely in-combination effects and quantify their significance -**
None known	N/A
Is the potential scale or magnitude of any effect likely to be significant?	
Alone?	Yes☐ No☒

In-combination with other projects of plans?	Yes☐ No☒

Conclusion: Is the proposal likely to have a significant effect on an N2K site?	**Yes☐ No☒**
IF IT HAS BEEN DETERMINED THAT THE PROPOSAL WILL NOT HAVE A SIGNIFICANT EFFECT THEN ASSESSMENT IS COMPLETED. **IF ANY PART OF THE PROPOSAL IS LIKELY TO HAVE A SIGNIFICANT EFFECT AN APPROPRIATE ASSESSMENT WILL BE REQUIRED – STAGE 2 AA.**	

Data collected to carry out the assessment

Who carried out the assessment?	Cormac Loughran CEnv MCIEEM MSc
Sources of data	Provided with application, client's drawings, Spatial-NI website and aerial photography.
Level of assessment completed	Stage 1 – Test of Likely Significance
Where can the full results of the assessment be accessed and viewed?	
NIEA CDP Response to consultation.	

Appendix 6.2 Habitat Survey Report

Phase I and Phase II Habitat Survey

Magheramore Windfarm, Co. Derry

For: res power for good

059/2019-02

May 2019

Ecological Assessment | Ecological Clerk of Works | Bat Surveys | Badger Surveys
Biodiversity Checklists | Ornithological Assessment | Preliminary Ecological Appraisal

Blackstaff Ecology

Document history

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Introduction

1. RES Ltd is in the process of evaluating a site at Magheramore, near Dungiven (Co. Derry), for the purpose of developing a windfarm. Six possible turbine locations have been identified within a large block of upland pasture and semi-natural grassland, heath and blanket bog. A JNCC (2010) Phase I habitat survey was carried out on 04.09.18 and 07.9.18 to identify the vegetation communities present within the red line boundary of the site. A Phase II study was carried out to provide detailed descriptions of the various vegetation communities that had the potential to be impacted in the vicinity of the identified potential turbine locations.

Statement of Authority

2. Observations were carried out and this report was prepared and undertaken by Dr Brian Sutton BSc PhD CEnv MCIEEM and was reviewed by Mr Cormac Loughran MSc CEnv MCIEEM of Blackstaff Ecology Ltd.

3. Dr Sutton was awarded a PhD in Environmental Science by the University of Ulster. Prior to working at Blackstaff Ecology, he worked as a member of the Habitat Survey Team of the Environment and Heritage Service (now the Northern Ireland Environment Agency) for two years. Following this, he worked as a consultant ecologist for AECOM Ltd for 15 years, carrying out habitat, bird and mammal surveys for a wide range of governmental and private clients. Projects undertaken were at a range of scales, from small private developments to major infrastructure projects. He has worked for Blackstaff Ecology Ltd for the past three years, and has continued to carry out a wide range of projects of a similar nature.

4. Cormac Loughran is a Chartered Environmentalist (CEnv), and a full member of the Chartered Institute of Ecology and Environmental Management (MCIEEM). Cormac has worked professionally as a Consultant Ecologist for the past eleven years. He holds an MSc (Distinction) in Environmental Management from the University of Ulster, and has extensive experience in a broad range of flora and fauna surveys. He has undertaken and coordinated the EcIAs for numerous infrastructure developments. Cormac is also an experienced field naturalist and prior to his consultancy work, he worked as a warden/ranger for The National Trust on a number of important nature reserves between 1995 and 2004. These included Crom Estate in County Fermanagh and Murlough NNR and Slieve Donard in County Down. Cormac therefore also has a wide range of habitat management experience including; broadleaved woodland, wetland, dune grassland, wet and dry heathland and blanket bog.

Methodology

5. The entire site within the red line boundary was walked and target notes were made of the habitat types present and any variations within habitat types. The site has numerous field boundaries, and each field was visited and described individually. Habitats were mapped and each field was given an identifying number. Photographs were taken of the various habitat types, and to illustrate any features of interest, as required by JNCC Phase I methodology. Quadrats were set out within at the locations of potential turbines and at other locations within the red line boundary where habitats of conservation interest were found. For this Phase II survey, detailed observations were made of the species present and the percentage cover of each species recorded. Quadrats consisted of 2m x 2m squares.

6. The weather at the time of survey was generally cloudy, but warm and dry, and followed a prolonged period during which there had been little rain.

Baseline

Site general description

7. The site has an irregular shape, with the red line following the boundaries of fields and land holdings. It has longest dimensions of around 2.8km from north to south and 2.2km from west to east, and covers an area of approximately 197ha. Access to the site is along existing farm tracks. Much of the site, particularly around its margins, consists of agricultural fields that support species-poor improved and semi-improved grassland, with variable cover of rushes in the wetter fields.

8. Some fields are separated by mature coniferous shelter belts, and a more extensive area of coniferous plantation is present along one field boundary. Fields on lower ground are often separated by hedgerows or discontinuous shrubs, and occasionally mature trees. Hedgerows are invariably species-poor and support species-poor basal vegetation communities. The higher ground formerly supported extensive blanket bog and heath communities, as is evidenced by the presence of the degraded and heath habitats that are present in some of the more extensive field units. The peat substrate has been almost universally cut over and has since become fully vegetated. Many fields retain thin peat that now supports marshy grassland and which may be dominated by rush Juncus species or purple moor-grass Molinia caerulea, or may support patchy acid grassland.

9. Grassland habitats have low species diversity and are generally of low botanical interest. Minor streams or active drains are present in parts of the site; their banks generally support vegetation that is similar to that of the adjacent fields, or may be marked by increased rush growth. In the following account TN denotes a target note, the locations of which are to be found on the habitat map in Annex 1. Target notes are located in Annex 2, site photographs in Annex 3 and quadrat data in Annex 4. Photographs are referenced in the relevant Target Notes. A list of plant species found during the survey is in Annex 5.

A1 Plantation woodland

10. Dense shelter belts of mainly *Picea sitchensis* have been planted along the boundaries of a number of improved grassland fields. A broader conifer plantation along the southern boundary of Field 20 consists mainly of *Pinus sylvestris*.

A2 Scrub

11. Patchy *Ulex europaeus* scrub (Field 48) occurs around the margins of a few fields, or along the banks that mark the location of former field margins (Field 45).

B1 Acid grassland

12. Acid grassland is a minor component of habitat mosaics in predominantly bog, heath and marshy grassland habitats (TN10, 37). No species-rich variants of acid grassland have been found and restricted areas of acid grassland are not mapped separately because of the scale of survey required at this stage of the site development.

B4 Improved grassland

13. Improved grassland is present on the lower ground along the southern end of the site (Fields 1-7, TN1-TN7, Field 16, TN16), in the central part of the site (Fields 25, 26, TN26, 27) and towards the northern end of the site (Field 30, TN31; Fields 32-33, TN33, 34: Fields 35-43, TN36, 37). Fields 23 and 24 (TN24, TN25) still retain large areas of modified bog and heath, but broad margins of the

fields have been improved. A number of fields have been improved, but rush-dominated marshy grassland persists in their wetter parts (Field 11, TN13; Field 18, TN18: Field 20, TN21). These improved grassland habitats are generally dominated by *Lolium perenne* and support a limited grange of common forbs typical of agricultural grassland.

B5 Marshy grassland

14. Significant areas of the site support marshy grassland, which may be characterised by dominant Molinia on shallow peat, or rush-dominated communities on wetter ground. The most extensive area of Molinia-dominated marshy grassland is present in adjacent Fields 8, 9, 10 and 47 (TN8-12, TN43). This area is likely to have formerly supported heath or blanket bog habitats and there is some evidence of past peat cutting. Other graminids are generally scarce, although more open areas in Field 9 support a limited range of common grasses. Forbs are limited to a small number of common acidophiles, principally Galium saxatile and Potentilla erecta, with occasional Viola palustris and Epilobium palustre in wetter locations. Common mosses are frequent, but Sphagnum species are almost exclusively limited to the beds and sides of the drainage network across the fields.

15. Marshy grassland characterised by significant Juncus cover may occur on wet substrates (Fields 28, TN29; Field 29, Field TN30; Field 48 TN44), where the dominant species is J. acutiflorus, or as components in the wetter parts of fields that been improved to varying degrees (e.g. Field 18, TN18; Field 21, TN20; Field 44, TN38), with J.effusus the dominant species. Rush-dominated grassland is species-poor, with few forbs and a limited range of common mosses.

B6 Poor semi-improved grassland

16. Semi-improved grassland fields are present on the lower ground towards the southern end of the site (Fields 12-15, TN14, 15). Fields 44 and 45 (TN38, TN40) towards the northern end of the site support marshy grassland that grades into species-poor semi-improved grassland, often retaining a rushy component.

C3.1 Tall ruderal

17. A stand of *Urtica dioica* adjacent to the access track at the southern end of the site is the only significant area of tall ruderals. Elsewhere isolated stands, mainly of *U. dioica*, are occasionally present in grassland fields but are too restricted to be mapped.

D1/D2 Dry/wet dwarf shrub heath mosaic

18. Field 27 (TN28) is a more extensive area of modified mire, with both wet (Q10) and dry (Q11) heath variants present. Of note is an extensive area of *Myrica gale*-dominated dry heath towards the northern end of the field (Q13).

D2 Wet dwarf shrub heath

19. Fields 23 and 24 (TN24, 25) retain a central core of mire habitats, although there has been extensive agricultural improvement around their margins. Wet heath on shallower peat is present towards the southern end of Field 23 (Quadrat Q7) and is likely to occur elsewhere within this area in mosaic with modified bog habitats. Field 29 (TN30) supports patchy wet heath (Q12) in mosaic with scrub and marshy grassland communities.

E1.7 Wet modified bog / E1.8 Dry modified bog

20. Field 19 (TN19) supports modified bog vegetation on a generally dry surface (Q2), but extensive areas are dominated by *Molinia caerulea* (Q3). Sphagna are generally absent, but may be locally frequent in damper hollows (Q4). Contiguous parts of Fields 23 (TN24) and 24 (TN25) retain an extensive area of mainly dry bog (Q5, 6) that has been modified by past cutting. Vegetation is often dominated by *Eriophorum vaginatum*, but patches of, particularly, Field 23, have high *Sphagnum* cover in the wetter parts.

G2 Running water

21. Minor streams pass through the site, flowing both towards the north (Field 27) and towards the south (Field 23), but do not support significant vegetation communities. A stream/drain flowing through Field 26 was also of limited interest, supporting Juncus effusus and a restricted range of common wetland herbs (TN27).

J1.1 Arable

22. Field 31 (TN32) had been re-seeded recently, prior to survey.

J2.1 Intact hedge

23. Improved grassland fields towards the northern end of the site generally have intact hedge boundaries. Many of these have been planted in recent years and are dominated by *Crataegus monogyna*, Fields towards the southern end of the site also frequently have intact hedge boundaries, particularly along access routes.

J2.2 Defunct hedge

24. Many of the fields towards the southern end of the site retain vestiges of former hedge boundaries as isolated trees, shrubs and patchy *Ulex europaeus* scrub. No species-rich hedgerows were noted.

J2.3 Hedgerow with trees.

25. Occasionally, hedgerows support isolated trees or groups of trees. Trees are generally young or young mature, but there are occasional *Fraxinus excelsior* at the northern end of Fields 31 and 32.

Habitats in the vicinity of potential turbine locations

26. Potential locations for turbines were examined in some detail, and quadrats were set out in their immediate vicinity. The only exception was the T3 location, which was in an improved grassland field with little conservation interest (Photograph 18). Characteristics of these locations are indicated in Table 1.

Table 1 - Parameters of potential turbine locations.

T no.	Field no.	Habitat	TN	Active peat	Quadrat	Photo
1	19	Dry modified bog	19	N	Q2	17
2	20	Improved grassland	21	N	Q16	Q16
3	22	Improved grassland	23	N	-----	18
4	26	Improved grassland	27	N	-----	20

5	18	Improved grassland	18	N	Q1	16
6	23/24	Dry modified bog (Field 23) and wet modified bog (Field 24).	24/25	N	Q6/Q8	Q6 (Field 23) Q8 (Field 24)

Northern Ireland priority habitats

Blanket bog

27. Although modified bog habitats are present in Fields 19, 23 and 24, they are generally in poor condition, reflecting past management, including extensive peat cutting. Bog habitats in Field 19 are in particularly bad condition, with poor structure, desiccation of the bog surface and low cover values for Sphagnum species and ericoid shrubs. The areas of degraded bog present on the site are at the lower altitudinal limit of, but are contiguous with, the extensive blanket bog of the northern slopes of the Sperrins. The close association of the surveyed lands with agricultural grasslands and the dense pattern of drains across the degraded bog indicates that the bog hydrology in these areas has been comprehensively disrupted, and further desiccation of the bog surface is likely. Blanket bog habitats on the site are generally variants of NVC communities, often impoverished, reflecting their historical and current management.

Lowland heathland

28. The wet and dry dwarf shrub heath that occurs in Fields 23, 24, 27 and 29 conform to the lowland heathland priority habitat. Dwarf shrub cover in these areas generally exceeds the 25% that is the minimum required by the priority habitat definition and peat depths recorded at quadrat locations are <0.5m. As is frequently the case, heathland habitats are generally in a mosaic with other mire types, acid grassland and marshy grassland with much Molinia. As with surviving blanket bog communities, heathland habitats are often variants of NVC communities.

Hedgerows

29. All hedgerows are included within the NI priority habitat. However, the conservation value of hedgerows varies considerably, with long-established and species-rich types being of greatest interest. Neither of these types was found in the survey area, and most hedgerows were dominated by continuous Crataegus monogyna.

Lowland dry acid grassland.

30. Acid grassland is a minor component of the various habitat mosaics across the site, and no species-rich (>20 or so plant species) variants were found. None of the grassland found on the site can be assigned to the priority habitat.

Purple moor-grass and rush pastures

31. Molinia is a frequent constituent of bog, heath and marshy grassland communities, and Juncus species are important in defining the extent of much of the marshy grassland on the site. However, there are no species-rich variants of these communities, and no examples of the priority habitat were found on the site.

Rivers

32. Minor streams that drain parts of the site may be examples of the priority habitat, since they are

likely to be within 2.5km of their source, and are therefore within the defining criterion for headwater streams. However, they have been modified to a considerable extent as a result of straightening to facilitate peat exploitation and the development of adjacent agricultural grassland. The short stretches visible on the site do not have a markedly natural aspect and do not support significant vegetation communities.

Active peat

33. Planning policy in Northern Ireland is that there shall be no development within active peatland unless there are imperative reasons of overriding public interest (DOE 2009). Active blanket bog is an Annex I European priority habitat, meaning that there is an international obligation to conserve this habitat.

34. NIEA guidelines (Appendix 4) states that active (peat forming) bog is more likely to be present if any of the following occur:
    - Sphagnum is present;
    - If the surface is spongy underfoot;
    - Deep peat is present (>0.5m);
    - Intact peat is present or the hydrology is still intact;
    - E. vaginatum/ angustifolium is present in significant quantities with some Sphagnum;
    - The typical range of blanket bog and raised bog species is present as indicated within the interpretation manual (EC 2013): and/or
    - There is a hummock and pool topography

35. Active peatland is less likely if:
    - None or very little Sphagnum is present;
    - A significant amount of non-typical bog community species is present as indicated within the interpretation manual e.g. soft rush;
    - There is a mosaic with acid grassland or dry heath;
    - Peat depth is less than 0.5m ;
    - The surface is dry and / or the hydrology is severely affected by deep drains; and/or
    - There are large areas of bare peat and / or algal mats.

36. The manual (EC 2013) defines active blanket bog as “still supporting a significant area of vegetation that is normally peat forming”. The following conditions must therefore be concurrent for active peat to be considered present, using the NI Priority Habitat definition of blanket bog (NIEA 2003), the EC Manual definition of active peat (EC 2013) and the requirements of PPS 18 (DOE 2009):
    - A significant area of habitat that supports typical peat-forming species;
    - Significant areas that support the primary peat-forming species within the blanket bog;
    - Hydrological conditions that encourage the anaerobic accumulation of partially-decomposed vegetation; and/or
    - Hydrological conditions that are currently not suitable for peat formation but are part of a cycle that indicates that these conditions are merely temporary.

37. Although there are sizeable areas of peatland on the site, it is unlikely that there is any significant area of active peat accumulation. Sphagna are patchy and nowhere form the continuous, extensive layer that is typical of peat-forming communities. Bog hydrology has been disrupted, and peat cutting has reduced much of the peat depth to <0.5m. Much of the modified bog surface has become desiccated, and it is likely that the process of desiccation will continue.

Summary

38. The site is dominated by a range of highly modified habitats resulting from agricultural improvement and past management, including drainage and peat cutting. The majority of habitats on the site are of low conservation interest, although generally poor examples of a number of Northern Ireland priority habitats are present. Of greatest interest are those habitats that have retained semi-natural mire communities, although these too are often poorly structured and are often species-deficient.

39. The scope of this survey did not include an assessment of mammal and bird populations.

Annex 1 - Site Maps

For site maps refer to Figures 6.1 & 6.2

Annex 2 - Target notes

Habitat type codes: A – Arable grassland; AG – Acid grassland; D – Drain; DH – Dry heath; DMB – Dry modified bog; H – Hedgerow IG – Improved grassland: MG – Marshy grassland: PW – Plantation woodland; RW – Running water; S – Scrub; SIG – Semi-improved grassland; WH – Wet heath; WMB – Wet modified bog;					
TN	**Location**	**Description**	**Habitat type**	**Active peat Y/N**	**Photo**
1	C67325 05405 Field 1	Improved grassland dominated by *Lolium perenne.* Hedge of *Crataegus monogyna, Ilex aquilinum, Fraxinus excelsior, Hedera helix* along trackside. Other boundaries are banks with dispersed mature *C.monogyna* and patchy *Ulex europaeus.*	IG, H	N	1
2	C67361 05354 Field 2	Improved grassland, dominated by *L.perenne*, with frequent *Trifolium repens, Rumex obtusifolius.* Dense *C.monogyna, U.europaeus* hedge along track, otherwise fenced.	IG, H	N	2
3	C67432 05274 Field 3	Improved grassland, dominated by *L.perenne*, with frequent *T. repens, R. obtusifolius,* with patchy *Juncus effusus* on lower ground. More or less continuous *U.europaeus, Rubus fruticosus, C.monogyna* hedge along track, otherwise fenced. N. part of field separated from S by low grassy bank. Conifer plantation outside red line along western boundary.4	IG, H	N	3
4	C67446 05270 Field 4	Improved grassland dominated by *L.perenne*, with rare small stands of *J.effusus*. Dense, mainly *U.europaeus, C.monogyna, F.excelsior* hedge along track. Other boundaries with patchy *U.europaeus,* frequent to occasional mature *C.monogyna, Acer pseudoplatanus, Sorbus aucuparia.*	IG. H	N	4
5	C67524 05186 Field 5	Improved grassland dominated by *L.perenne,* with more or less continuous hedge along track. S and W boundaries with patchy *U.europaeus* and/or dispersed mature *C.monogyna, S.aucuparia, F.excelsior.* N. boundary a fenced bank.	IG, H	N	5
6	C67578 05126 Field 6	Improved grassland dominated by *L.perenne*, with occasional small stands of *J.effusus*. Trackside dense hedge, elsewhere fenced with occasional *U.europaeus*.	IG H	N	6
7	C67641 05048 Field 7	Improved grassland, dominated by *L.perenne*, with frequent *T. repens, R. obtusifolius, Ranunculus repens*, occasional *J.effusus*	IG	N	7
8	C67745 05033 Field 8	Marshy grassland dominated by *Molinia caeruleus*, with dense, frequent tussocks supporting common mosses, mainly *Hylocomium splendens, Pseudoscleropodium purum*, occasional *Rhytidiadelphus loreus, R.squarrosus* and with frequent *Vaccinium myrtillus, Potentilla erecta.* Other grasses scarce, generally occasional *Anthoxanthum odoratum, Agrostis capillaris.* Occasional dispersed stands of *Eriophorum vaginatum, Carex echinata.* Ericoids scarce, with well-dispersed small patches of *Calluna*, rare *Erica tetralix*. Drain across field supports much *J.effusus*, with frequent *Molinia,* occasional	MG H	N	8

Habitat type codes: A – Arable grassland; AG – Acid grassland; D – Drain; DH – Dry heath; DMB – Dry modified bog; H – Hedgerow IG – Improved grassland: MG – Marshy grassland: PW – Plantation woodland; RW – Running water; S – Scrub; SIG – Semi-improved grassland; WH – Wet heath; WMB – Wet modified bog;					
TN	**Location**	**Description**	**Habitat type**	**Active peat Y/N**	**Photo**
		A.odoratum, A.capillaris and more extensive patches of *Calluna* along banks. *Sphagna,* mainly *S.denticulatum* frequent along drain, also frequent *P.erecta*, locally frequent *Polytrichum commune*. Discontinuous hedge to E.			
9	C67743 04882 Field 9	Marshy grassland dominated by *Molinia*, with more open areas dominated by other grasses – *A.odoratum, Holcus lanatus, A.capillaris,* with occasional *P.erecta, T.repens, R.repens, Carex binervis*, locally frequent *Galium saxatile*, rare *Luzula multiflora. R.squarrosus* abundant throughout.	MG	N	9
10	C67751 94810 Field 10	Area dominated by *Molinia*, with evidence of former peat cutting, but cut faces now thickly vegetated with *V.myrtillus, G.saxatile.* Hummocks throughout support common acrocarpous mosses, with frequent *V.myrtillus,* occasional *Viola* palustris. Ericoids scarce, most frequently as patches of *Calluna, Erica cinerea* on shallow soils on bedrock knolls, which also support patches of species-poor acid grassland. . *U.europaeus* locally patchy, with line marking location of former field boundary and ditch. Patch of *Picea sitchensis* in field corner.	MG AG	N	10
11	C67895 04782 Field 10	Northeast corner of field, with *P.erecta hummocks* with rare *S.capillifolium.* Rare damper patches with *J.acutiflorus, R.acris, E.palustre.* Mainly grassy bank, but with patchy *Calluna* and frequent *V.myrtillus* marks location of former field boundary.	MG	N	
12	C67977 04798 Field 8	Trackside drain is dry, with much desiccated *Sphagnum* along its bottom and occasional *S.capillifolium* along the bank top. Bank with much *Calluna, J.squarrosus, Molinia.* Bed with frequent *J.effusus*, patchy *S.capillifolium*, occasional *E.angustifolium, Potamogeton polygonifolius, C.pratensis, C.echinata, C.binervis, Nardus.*	D	N	
13	C68017 04758 Field 11	Improved grassland but with much *J.effusus* in parts. Patches of *U.europaeus* mark former field boundaries. Separated from Field 9 by fence.	IG/MG	N	11
14	C08019 04638 Field 12/13/14	Small fields of species-poor semi-improved grassland, with variable *J.effusus.* Fields 13/14 with boundary ditch and bank separating from Field 11.	SIG	N	12
15	C68202 04693 Field 15	Species-poor semi-improved grassland with widespread *J.effusus* and occasional stands of *Cirsium* spp. Separated from Field 16 by recently planted hedge.	SIG H	N	13

Habitat type codes: A – Arable grassland; AG – Acid grassland; D – Drain; DH – Dry heath; DMB – Dry modified bog; H – Hedgerow IG – Improved grassland: MG – Marshy grassland: PW – Plantation woodland; RW – Running water; S – Scrub; SIG – Semi-improved grassland; WH – Wet heath; WMB – Wet modified bog;					
TN	**Location**	**Description**	**Habitat type**	**Active peat Y/N**	**Photo**
16	C68226 04675 Field 16	Species-poor semi-improved grassland with dispersed small stands of *J.effusus, U.dioica.* Minor stream cuts across field, the channel supporting frequent *J.effusus*, patchy *U.dioica*, but grass-dominated. Track lined with *C.monogyna* hedge.	IG H	N	14
17	C68384 04610 Field 17	Series of combined small fields, with former boundaries marked by dispersed shrubs, mainly *C.monogyna.* Species-poor semi-improved grassland with frequent *J.effusus.*	SIG	N	15
18	C68398 04640 Field 18	Mainly improved grassland with extensive stands of rushes. Separated from Field 19 by line of mature *P.sitchensis.* Vicinity of T5. See Quadrat 1.	IG/MG	N	16, Q1
19	C69048 04623 Field 19	Modified bog on deep peat (>1m). Extensively cut over but now well vegetated, with remnants of a series of low amplitude former bog roads and occasional cut faces. Now a mosaic of species-poor acid grassland, small areas of rushy marshy grassland and extensive areas dominated by *Molinia. Calluna* patchy but more frequent on bog roads. *Sphagnum* cover patchy, with extensive areas with low cover values, and others with denser, but still patchy, and often desiccated, cover (Quadrat 3). Bog surface generally dry but locally saturated (Quadrat 4). Much poaching over whole field.	DMB WMB	N	17, Q3, Q4
20	C69330 04575 Field 19	Area in vicinity of T1, Quadrat 2. Area of broad swathe of bleached, broken and dead *Calluna*, surrounded by heathy vegetation.	DMB	N	Q2
21	C69078 04872 Field 20	Mainly improved grassland with occasional wetter areas, and southern end of field supporting rush-dominated marshy grassland. Vicinity of T2, Quadrat 16. . Conifer plantation (Field 21) along southern boundary.	IG MG	N	Q16
22	C68982 04767 Field 21	Conifer plantation, mainly *Pinus sylvestris*, occasional *Picea sitchensis.* Dense with little vegetation under canopy.	PW	N	
23	C68642 05193 Field 22	Improved grassland dominated by *L.perenne* Location of T3.	IG	N	18
24	C63361 04913 Field 23	Modified blanket bog on deep peat (>1m), generally dominated by *E.vaginatum*, but *Calluna* widespread and often abundant (Quadrat 5). *Molinia* dispersed throughout. *Sphagnum* frequent and locally dominant. Extensive areas of improved grassland around margins. Drier surface near location of T6 with high acro moss cover (Quadrat 6). Grades into wet heath towards southern end of field (Q7). Minor stream along eastern side of field.	DMB/WMB WH IG RW	Possible locally Y	Q5, Q6, Q7

Habitat type codes: A – Arable grassland; AG – Acid grassland; D – Drain; DH – Dry heath; DMB – Dry modified bog; H – Hedgerow IG – Improved grassland: MG – Marshy grassland: PW – Plantation woodland; RW – Running water; S – Scrub; SIG – Semi-improved grassland; WH – Wet heath; WMB – Wet modified bog;					
TN	**Location**	**Description**	**Habitat type**	**Active peat Y/N**	**Photo**
25	C68426 04843 Field 24	Field is a mosaic of wet heath and modified wet bog (Q8 – near location of T6, Q9), but with generally low *Sphagnum* cover. Improved grassland along eastern side of field.	WMB WH IG	N	Q8, Q9
26	C68471 05235 Field 25	Improved grassland dominated by *L.perenne*.	IG	N	19
27	C68441 05318 Field 26	Improved grassland dominated by *L.perenne*, but with localised stands and ribbons of *J.effusus.* Stream with much *J.effusus* in channel flows through field. Location of T4 under improved grassland, with *J.effusus* becoming more frequent along boundary ditch. Ditch with limited range of wetland herbs, including *Montia fontana, Myosotis* cespitosa. Conifer shelter belts along boundaries, mainly *P.sitchensis*, with localised *Salix* sp.	IG D PW	N	20
28	C68512 05323 Field 27	Extensive field, a mosaic of wet (Q10)and dry (Q11) heath. Heath dominated by *Myrica gale* in NW corner of field (Q13). Minor stream flows along eastern side of field, with *U.europaeus* scrub along part of the eastern boundary.	WH DH RW S	N	Q10, Q11, Q13
29	C68296 05612 Field 28	Species-poor marshy grassland, generally dominated by *J.acutiflorus*, but grasses abundant, with much *A.capillaris, A.odoratum, Nardus.* Forbs scarce.	MG	N	21
30	C68260 05553 Field 29	Mainly wet heath (Q12), with localised *U.europaeus* scrub. Heath grades into *J.acutiflorus*-dominated marshy grassland, with occasional patchy acid grassland on drier ground. Occasional *Salix caprea* along edge of field boundary conifer shelter belt.	WH MG AG S PW	N	22, Q12
31	C68111 05668 Field 30	Mainly improved grassland with occasional isolated stands of *J.effusus, U.dioica.*	IG	N	23
32	C68109 05833 Field 31	Recently re-seeded arable grassland, with mature *F.excelsior* at N end.	A	N	24
33	C68122 05862 Field 32	Improved grassland, surrounded by mainly *C.monogyna* hedge, and with mature *F.excelsior* at N end.	IG H	N	25
34	C68231 06041 Field 33	Improved grassland, dominated by *L.perenne.*	IG	N	26
35	C68190 06110 Field 34	Marshy grassland, dominated by *Juncus* spp, grasses generally abundant, but species-poor.	MG	N	27
36	C68110 06207 Field 35	Improved grassland, dominated by *L.perenne.*	IG	N	28

Habitat type codes: A – Arable grassland; AG – Acid grassland; D – Drain; DH – Dry heath; DMB – Dry modified bog; H – Hedgerow IG – Improved grassland: MG – Marshy grassland: PW – Plantation woodland; RW – Running water; S – Scrub; SIG – Semi-improved grassland; WH – Wet heath; WMB – Wet modified bog;					
TN	**Location**	**Description**	**Habitat type**	**Active peat Y/N**	**Photo**
37	C67982 06318, C67887 06453 Fields 36-43	A series of similar fields, all under improved grassland, generally dominated by *L.perenne.* Photograph 29 shows Field 39 as an example. Fields are generally surrounded by more or less intact hedges.	IG	N	29
38	C68142 05455 Field 44	Marshy grassland, often with *C.echinata* the dominant species. *J.effusus* frequent throughout, and *R.squarrosus* forms a dense moss layer over much of the field. Grades into species-poor semi-improved grassland along S end of field.	MG SIG	N	Q14
39	C68115 05339 Field 45	Marshy, species-poor grassland, often dominated by *J.effusus.* Patchy stands of *U.europaeus.* Common mosses abundant – *P.purum, H.splendens, R.squarrosus.* Grasses abundant, often dominated by *A.odoratum*, but *A.capillaris, Molinia* are frequent. Forbs often scarce, but occasional *C.palustre, V.palustris, G.saxatile. Sphagnum* abundant along drain and in occasional hollows. *C.echinata* frequent throughout.	MG S	N	30
40	C68141 05197 Field 45	Marshy grassland grades into species-poor semi-improved grassland, with much *L.perenne*, and *J.effusus* more dispersed. *A.odoratum, A.capillaris* frequent, together with frequent *T.repens. R.squarrosus* abundant throughout. Banks marking former field boundaries often with *U.europaeus* scrub.	SIG S	N	31
41	C68136 05137 Field 45	Patches of acid grassland, with locally frequent *Molinia, C.echinata.*	AG	N	
42	C68139 05030 Field 46	*J.effusus*-dominated marshy grassland, species-poor, in mosaic with patches where forbs are scarce and which are frequently dominated by *R.squarrosus.* Location of T7.	MG	N	32, Q15
43	C68012 04949 Field 47	Species-poor marshy grassland with much *Molinia, A.capillaris, A.odoratum* and locally frequent *J.effusus.* Mosses generally restricted to *R.squarrosus*, frequent throughout. Rushes become more abundant towards the west, with increasing heathy element and patchy *Calluna, P.erecta, G.saxatile*, but *R.squarrosus* remains dominant moss.	MG	N	33, 34
44	67660 05267 Field 48	*J.acutiflorus*-dominated species-poor marshy grassland, with patchy *U.europaeus* scrub around margins.	MG S	N	35

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Annex 3 - Photographs


Photograph 1: Field 1, improved grassland with discontinuous hedgerow.


Photograph 2: Field 2, improved grassland.

Photograph 3: Field 3, improved grassland, with conifer plantation along western boundary.

Photograph 4: Field 4, improved grassland, with hedgerow along trackside.


Photograph 5: Field 5, improved grassland, with discontinuous hedgerow.


Photograph 6: Field 6, improved grassland.


Photograph 7: Field 7, improved grassland.


Photograph 8: Field 8, marshy grassland dominated by *Molinia.*


Photograph 9: Field 9, marshy grassland dominated by *Molinia.*


Photograph 10: Field 10, *Molinia*-dominated marshy grassland on thin peat.


Photograph 11: Field 11, species-poor semi-improved grassland with frequent rushes.


Photograph 12: Field 13, one of three small semi-improved grassland fields, with boundary ditch separating from Field 11.


Photograph 13: Field 15, species-poor semi-improved grassland field, with recently planted hedge.


Photograph 14: Field 16, Improved grassland field.


Photograph 15: Field 17, species-poor semi-improved grassland, with dispersed trees along former field boundaries.


Photograph 16: Field 18, species-poor semi-improved grassland, with extensive stands of rushes.


Photograph 17: Field 19, modified blanket bog.


Photograph 18: Field 22, improved grassland.


Photograph19: Field 25, improved grassland.


Photograph 20: Field 26, improved grassland with conifer shelter belts.


Photograph 21: Field 28, species-poor marshy grassland.


Photograph 22: Field 29, wet heath grading into marshy grassland.


Photograph 23: Field 30, improved grassland, with isolated stands of *U. dioica, J.effusus.*


Photograph 24: Field 31, arable grassland.


Photograph 25: Field 32, improved grassland surrounded by *C. monogyna* hedge.


Photograph 26: Field 33, improved grassland.


Photograph 27: Field 34, marshy grassland.


Photograph 28: Field 35, improved grassland.

Photograph 29: Field 39, improved grassland.

Photograph 30: Field 45, marshy grassland, with abundant *Carex echinata*, and patchy *Ulex europaeus* scrub.

Photograph 31: Field 45, species-poor semi-improved grassland, with *Ulex europaeus* scrub along banks of former field boundaries.

Photograph 32: Field 46, species-poor marshy grassland.


Photograph 33: Field 47, marshy grassland with *Juncus effusus* and *Molinia.*


Photograph 34: Field 47, marshy grassland with increasing rush cover towards west and abundant *Rhytidiadelphus squarrosus.*

Photograph 35: Field 48, *Juncus acutiflorus*-dominated marshy grassland with *U.europaeus* scrub around boundary.

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Annex 4 - Quadrats

Q1	C68698 04660	Field 18	
Semi-improved grassland		NVC –N/A	
Species	% cover	Species	% cover
Lolium perenne	35	*Anthoxanthum odoratum*	20
Agrostis capillaris	15	*Cerastium fontanum*	<1
Holcus lanatus	35	*Rhytidiadelphus squarrosus*	40

Quadrat 1

Q2	C69330 04574	Field 19	
Dry modified bog	Peat depth >1m	NVC – M19 *Calluna-E. vaginatum* blanket mire	
Species	% cover	Species	% cover
Juncus bulbosus	<1	*Vaccinium myrtillus*	1
Molinia caerulea	2	*Potentilla erecta*	<1
Eriophorum vaginatum	15	*Galium saxatile*	1
Eriophorum angustifolium	<1	*Rhytidiadelphus loreus*	1
Calluna vulgaris	20	*Hylocomium splendens*	30
Erica tetralix	<1	Litter	35

Quadrat 2

Q3	C69203 04571	Field 19	
Wet modified bog	Peat depth >1m	NVC – M19 *Calluna-E. vaginatum* blanket mire	
Species	% cover	Species	% cover
Molinia caerulea	35	*Sphagnum capillifolium*	4
Eriophorum vaginatum	25	*Aulocomnium palustre*	<1
Calluna vulgaris	20	*Rhytidiadelphus squarrosus*	3
Erica tetralix	2	*Rhytidiadelphus loreus*	<1
Vaccinium myrtillus	3	*Hylocomium splendens*	1
Potentilla erecta	4	*Pseudoscleropodium purum*	1
Polygala serpyllifolium	1	*Polytrichum commune*	<1
Sphagnum recurvum	1	Litter	15
Sphagnum tenellum	1	Dung	<1
Sphagnum subnitens	1		

Quadrat 3

Q4	C69121 04601	Field 19	
Wet modified bog	Peat depth >1m	NVC – M19 *Calluna-E. vaginatum* blanket mire	
Species	% cover	Species	% cover
Juncus effusus	20	*Sphagnum denticulatum*	6
Eriophorum vaginatum	15	*Sphagnum capillifolium*	6
Calluna vulgaris	3	*Sphagnum subnitens*	5
Vaccinium myrtillus	6	*Sphagnum palustre*	8
Potentilla erecta	32	*Pseudoscleropodium purum*	25
Galium saxatile		*Polytrichum commune*	8

Quadrat 4

Q5	C68361 04913	Field 23	
Dry modified bog	Peat depth >1m	NVC – M19 *Calluna-E. vaginatum* blanket mire	
Species	% cover	Species	% cover
Juncus squarrosus	3	*Potentilla erecta*	2
Molinia caerulea	6	*Polygala serpyllifolium*	<1
Anthoxanthum odoratum	1	*Sphagnum tenellum*	1
Deschampsia flexuosa	1	*Sphagnum capillifolium*	3
Eriophorum vaginatum	15	*Aulocomnium palustre*	<1
Eriophorum angustifolium	1	*Pseudoscleropodium purum*	1
Calluna vulgaris	60	*Rhytidiadelphus squarrosus*	3
Erica tetralix	1	*Rhytidiadelphus loreus*	10
Vaccinium myrtillus	2	*Hylocomium splendens*	12

Quadrat 5

Q6	C68350 04809	Field 23	
Dry modified bog	Peat depth >1m	NVC – M19 *Calluna-E. vaginatum* blanket mire	
Species	% cover	Species	% cover
Molinia caerulea	20	*Galium saxatile*	8
Deschampsia flexuosa	1	*Luzula multiflora*	1
Agrostis capillaris	1	*Carex echinata*	1
Eriophorum vaginatum	15	*Rhytidiadelphus loreus*	1
Calluna vulgaris	3	*Rhytidiadelphus squarrosus*	25
Vaccinium myrtillus	4	*Hylocomium splendens*	20
Potentilla erecta	7	*Dicranum scoparium*	3

Quadrat 6

Q7	C68348 04771	Field 23	
Wet heath.	Peat depth 0.35m	NVC – M19 *Calluna-E. vaginatum* blanket mire	
Species	% cover	Species	% cover
Molinia caerulea	20	*Aulocomnium palustre*	1
Eriophorum vaginatum	8	*Hypnum jutlandicum*	15
Calluna vulgaris	65	*Rhytidiadelphus loreus*	1
Erica tetralix	1	*Sphagnum capillifolium*	6
Vaccinium myrtillus	1	*Sphagnum tenellum*	1
Potentilla erecta	1	*Sphagnum papillosum*	<1
Pseudoscleropodium purum	1		

Quadrat 7

Q8	C68363 04809	Field 24	
Wet modified bog.	Peat depth >1m	NVC – M25 *Molinia caeruea-Potentilla erecta* mire	
Species	% cover	Species	% cover
Molinia caerulea	85	*Galium saxatile*	1
Anthoxanthum odoratum	1	*Potentilla erecta*	1
Deschampsia flexuosa	<1	*Hylocomium splendens*	6
Eriophorum vaginatum	4	*Rhytidiadelphus squarrosus*	10
Vaccinium myrtillus	1	*Pleurozium schreberi*	2

Quadrat 8

Q9	C68426 04843	Field 24	
Wet modified bog.	Peat depth 1.0m	NVC – M19 *Calluna-E. vaginatum* blanket mire	
Species	% cover	Species	% cover
Molinia caerulea	12	*Aulocomnium palustre*	2
Deschampsia flexuosa	8	*Polytrichum commune*	4
Eriophorum vaginatum	25	*Rhytidiadelphus squarrosus*	8
Calluna vulgaris	7	*Sphagnum denticulatum*	5
Erica tetralix	<1	*Sphagnum papillosum*	8
Vaccinium myrtillus	7	*Sphagnum capillifolium*	7
Carex echinata	1	*Sphagnum tenellum*	1
Potentilla erecta	1	*Sphagnum palustre*	1
Pseudoscleropodium purum	12	*Sphagnum subnitens*	2

Quadrat 9

Q10	C68512 05323	Field 27	
Wet heath.	Peat depth 0.45m	NVC – M19 *Calluna-E. vaginatum* blanket mire	
Species	% cover	Species	% cover
Eriophorum vaginatum	45	*Rhytidiadelphus loreus*	1
Calluna vulgaris	35	*Dicranum scoparium*	<1
Erica tetralix	2	*Polytrichum commune*	1
Vaccinium myrtillus	1	*Sphagnum capillifolium*	20
Eriophorum angustifolium	<1	*Sphagnum subnitens*	1
Hylocomium splendens	3	*Sphagnum tenellum*	1
Hypnum jutlandicum	1	*Lophocoleon bidentata*	<1

Quadrat 10

Q11	C68556 05458	Field 27	
Dry heath.	Peat depth 0.35m	NVC – H12 *Calluna vulgaris-Vaccinium myrtillus* heath	
Species	% cover	Species	% cover
Juncus squarrosus	2	*Potentilla erecta*	1
Molinia caerulea	3	*Galium saxatile*	1
Agrostis capillaris	1	*Hylocomium splendens*	9
Eriophorum vaginatum	2	*Rhytidiadelphus squarrosus*	2
Calluna vulgaris	85	*Pseudoscleropodium purum*	5
Vaccinium myrtillus	3		

Quadrat 11

Q12	C68260 05553	Field 29	
Wet heath,	Peat depth 0.35m	NVC – H21 *Calluna vulgaris-Vaccinium myrtillus-Sphagnum capillifolium* heath	
Species	% cover	Species	% cover
Juncus squarrosus	2	*Aulocomnium palustre*	<1
Molinia caerulea	30	*Polytrichum commune*	3
Deschampsia flexuosa	1	*Hylocomium splendens*	8
Carex echinata	<1	*Rhytidiadelphus squarrosus*	4
Calluna vulgaris	50	*Rhytidiadelphus loreus*	1
Erica tetralix	4	*Sphagnum denticulatum*	2
Vaccinium myrtillus	2	*Sphagnum papillosum*	5
Potentilla erecta	<1	*Sphagnum capillifolium*	10
Galium saxatile	<1	*Sphagnum tenellum*	1

Quadrat 12

Q13	C68246 05876	Field 27	
Wet heath.	Peat depth 0.45m	NVC – M25 *Molinia caerulea-Potentilla erecta* mire	
Species	% cover	Species	% cover
Molinia caerulea	15	*Carex binervis*	1
Agrostis canina	1	*Potentilla erecta*	2
Lolium perenne	15	*Galium saxatile*	1
Holcus lanatus	2	*Rhytidiadelphus squarrosus*	1
Anthoxanthum odoratum	1	*Pseudoscleropodium purum*	4
Myrica gale	45	*Hylocomium splendens*	20
Vaccinium myrtillus	2	Litter	6

Quadrat 13

Q14	C68142 05455	Field 44	
Marshy grassland		No clear NVC type – characteristics of both M23 *Juncus effusus/J. acutiflorus-Galium palustre* rush pasture and M10 *Holcus lanatus-J. effusus* rush pasture	
Species	% cover	Species	% cover
Juncus effusus	12	*Ranunculus repens*	1
Molinia caerulea	2	*Cirsium palustre*	7
Anthoxanthum odoratum	4	*Pseudoscleropodium purum*	4
Lolium perenne	4	*Epilobium palustre*	<1
Festuca ovina	<1	*Cardamine pratensis*	<1
Carex echinata	60	*Luzula multiflora*	<1
Carex ovalis	<1	*Rhytidiadelphus squarrosus*	60
Carex nigra	<1	*Calliergonella cuspidata*	1

Quadrat 14

Q15	C68148 04986	Field 46	
Marshy grassland		No clear NVC type – characteristics of both M23 *Juncus effusus/J. acutiflorus-Galium palustre* rush pasture and M10 *Holcus lanatus-J. effusus* rush pasture	
Species	% cover	Species	% cover
Juncus effusus	10	*Carex nigra*	1
Molinia caerulea	15	*Carex binervis*	2
Holcus lanatus	2	*Cirsium palustre*	1
Lolium perenne	25	*Luzula multiflora*	<1
Agrostis capillaris	2	*Rhytidiadelphus squarrosus*	70
Carex echinata	5		

Quadrat 15

Q16	C69078 04872	Field 20	
Improved grassland		NVC – N/A	
Species	% cover	Species	% cover
Agrostis capillaris	20	*Cerastium fontanum*	<1
Lolium perenne	40	*Stellaria media*	<1
Holcus lanatus	45		

Quadrat 16

Annex 5 - Plant species list

Scientific Name	English Name	Scientific Name	English Name
Acer pseudoplatanus	sycamore	*Lophocolea bidentata*	Bifid crestwort
Agrostis capillaris	Common bent	*Luzula multiflora*	Heath wood-rush
Agrostis stolonifera	Creeping bent	*Matricaria discoidea*	Pineappleweed
Alnus glutinosa	Alder	*Molinia caerulea*	Purple moor-grass
Anthoxanthum odoratum	Sweet vernal-grass	*Montia fontana*	Blinks
Anthriscus sylvestris	Cow parsley	*Myosotis cespitosa*	Tufted forget-me-not
Athyrium filix-femina	Lady fern	*Myrica gale*	Bog myrtle
Aulocomnium palustre	Bog groove-moss	*Nardus stricta*	Mat-grass
Betula pendula	Silver birch	*Pedicularis sylvatica*	Common lousewort
Blechnum spicant	Hard fern	*Picea sitchensis*	Sitka spruce
Calliergonella cuspidata	Pointed spear-moss	*Pinus sylvestris*	Scots pine
Calluna vulgaris	Heather	*Plantago major*	Great plantain
Cardamine pratensis	Cuckooflower	*Pleurozium schreberi*	Red-stemmed feather-moss
Carex binervis	Green-ribbed sedge	*Poa annua*	Annual meadow-grass
Carex echinata	Star sedge	*Poa pratensis*	Smooth meadow-grass
Carex hirsuta	Hairy sedge	*Polygala serpyllifolia*	Heath milkwort
Carex nigra	Common sedge	*Polygonum aviculare*	Knotgrass
Carex ovalis	Oval sedge	*Polytrichum commune*	Common haircap
Cerastium fontanum	Mouse-ear chickweed	*Potamogeton polygonifolius*	Bog pondweed
Chamerion angustifolium	Rosebay willowherb	*Potentilla erecta*	Tormentil
Cirsium arvense	Creeping thistle	*Prunus spinosa*	Blackthorn
Cirsium palustre	Marsh thistle	*Pseudoscleropodium purum*	Neat feather-moss
Corylus avellana	Hazel	*Pteridium aquilinum*	Bracken
Crataegus monogyna	Hawthorn	*Ranunculus acris*	Meadow buttercup
Cynosurus cristatus	Crested dog's-tail	*Ranunculus repens*	Creeping buttercup
Dactylis glomerata	Cock's-foot	*Rhytidiadelphus loreus*	Little shaggy-moss
Deschampsia flexuosa	Wavy hair-grass	*Rhytidiadelphus squarrosus*	Springy turf-moss
Dicranum scoparium	Broom fork-moss	*Rosa canina*	Dog-rose
Dryopteris filix-mas	Male fern	*Rosa rugosa*	Japanese rose
Epilobium palustre	Marsh willowherb	*Rubus fruticosus* agg	Bramble
Equisetum arvense	Field horsetail	*Rumex acetosa*	Common sorrel
Erica cinerea	Bell heather	*Rumex obtusifolius*	Broad-leaved dock
Erica tetralix	Cross-leaved heath	*Salix caprea*	Goat willow
Eriophorum angustifolium	Common cotton-grass	*Salix cinerea*	Grey willow
Eriophorum vaginatum	Hare's-tail cotton-grass	*Sonchus asper*	Perennial sow-thistle
Fraxinus excelsior	Ash	*Sorbus aucuparia*	Rowan
Galium saxatile	Heath bedstraw	*Sphagnum capillifolium*	Red bog-moss
Geranium robertianum	Herb-Robert	*Sphagnum denticulatum*	Cow-horn bog-moss
Gnaphalium uliginosum	Marsh cudweed	*Sphagnum palustre*	Blunt-leaved bog-moss
Hedera helix	Ivy	*Sphagnum papillosum*	Papillose bog-moss
Holcus lanatus	Yorkshire fog	*Sphagnum subnitens*	Lustrous bog-moss
Hypochaeris radicata	Common cat's-ear	*Sphagnum tenellum*	Soft bog-moss
Hypnum jutlandicum	Heath plait-moss	*Stachys palustris*	Marsh woundwort

Hylocomium splendens	Glittering wood-moss	*Stellaria alsine*	Common bog-stitchwort
Ilex aquilinum	Holly	*Stellaria media*	Common chickweed
Juncus acutiflorus	Sharp-flowered rush	*Trifolium repens*	White clover
Juncus articulatus	Jointed rush	*Ulex europaeus*	Gorse
Juncus bulbosus	Bulbous rush	*Urtica dioica*	Common nettle
Juncus effusus	Soft rush	*Vaccinium myrtillus*	Bilberry
Juncus squarrosus	Heath rush	*Vicia sepium*	Bush vetch
Leontodon autumnalis	Autumnal hawkbit	*Viola palustris*	Marsh violet
Lolium perenne	Perennial rye-grass		

Appendix 6.3 Bat Survey Report

Bat Survey Report for Magheramore Windfarm

For: res

059/2019-03

June 2019

Ecological Assessment | Ecological Clerk of Works | Bat Surveys | Badger Surveys
Biodiversity Checklists | Ornithological Assessment | Preliminary Ecological Appraisal

Blackstaff Ecology

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Executive Summary

This is a brief summary of survey results. For full details please read the report in its entirety.

- No bat roosts were recorded during surveys. As a result, the proposed development was assessed as having a **negligible** potential to impact upon roosting bats.

- Low levels of bat activity were recorded during transect surveys.

- There are significant areas of more favoured foraging habitat along the River Roe and associated riparian woodland to the west and south of the turbines (>350m).

- Overall bat activity at turbines 1-5 during spring was **low.** However, moderate levels of activity were recorded at **T1** (during two nights in May).

- During summer and autumn **low** numbers of bat passes were again recorded at the proposed turbine locations during the automated monitoring (for all species (and at all turbines), with the exception of a single night (at T3) during July (when 51 bat passes were recorded).

- For all species, activity levels at the proposed turbine locations were **significantly lower** than at adjacent habitat features (i.e. stream corridors), during most periods.

- Therefore, the collision risk at turbines 2, 4, 5 & 6 is assessed as **low.** Whilte at T1 (May) & at T3 (July) the collision risk was assessed as (a precautionary) **moderate.**

- Moderate & high levels of activity recorded at the T2 & T3 habitat features during the spring & summer monitoring sessions (Tables 18 & 20).

- Therefore, (as a precaution) a BMMP (Bat Monitoring & Mitigation Plan), including carcass searches has been recommended. With this mitigation, the Development will **not have a significant impact** on local bat populations.

Introduction

1. Blackstaff Ecology Ltd. was commissioned by RES UK & Ireland Ltd to assess bat activity at lands situated 1.76km southeast of the Magheramore Road, in the townland of Dungiven.

2. The site was identified as being of low risk (see Table 4.4, Chapter 10 BCT Good Practice Guidelines (2012)) due to the presence of largely low-quality foraging habitat for bats (improved grassland and degraded blanket bog/heath) across the majority of the site with some areas of moderate quality foraging habitat (stream valleys/ hedges) which are located around the periphery of the site.

3. In addition to the three transects, 15 nights of automated monitoring was also carried out (at the proposed turbine locations). The 15 nights involved three rounds of five nights during each season (spring, summer & autumn) as required by the BCT (2012) guidance for a low-risk site.

4. The automated monitoring involves the placement of 'paired' detectors (one at each turbine location and a second at the nearest habitat feature ((i.e. stream/hedgerow) where present)). Bat activity levels between the various locations can then be compared in order to build up a picture of the levels of activity within the site.

5. Hand-held bat detectors were used to record bat activity during the crepuscular surveys, with static bat detectors also deployed to provide additional data on bat activity. All detectors used/methods of recording allow for the identification of all species of bat and store the information for later analysis (as required by the NIEA guidance[1]).

Statement of Authority

6. This report was prepared and work undertaken by Mr Cormac Loughran (MSc CEnv MCIEEM), Director of Blackstaff Ecology Ltd. While one of the 2018 transect surveys were also undertaken by Karl Hamilton, Ecologist.

7. Cormac is a Chartered Environmentalist (CEnv), and a full member of the Chartered Institute of Ecology and Environmental Management (MCIEEM). He holds an MSc (Distinction) in Environmental Management from the University of Ulster, and has extensive experience in bat surveys; having undertaken and coordinated full bat surveys and associated impact assessments for 21 major wind farm developments, and 15 single turbines.

8. Cormac has also previously held a Natural England Disturbance Licence (20121610) for Bats (all species, (all counties of England)). He has attended numerous courses and conferences, specifically relating to bats, for the purposes of CPD (Continuing Professional Development). These have included the Natural England approved 'Bat Licence Training Course' run by Wildwood Ecology (Cardiff). Cormac has also attended the BCT (Bat Conservation Trust) approved course 'Bats and Trees', and has attended three BCI (Bat Conservation Ireland) biannual conferences (2010 Kilkenny, 2012 Sligo & Cork 2014). He also attended the Nathusius' Pipistrelle Workshop in Enniskillen (2009).

9. Karl Hamilton has extensive experience in providing ecological consultancy advice, including habitat monitoring & management advice for a wide range of native flora &

[1] https://www.daera-ni.gov.uk/sites/default/files/publications/daera/bat-survey-specifications.pdf

fauna. He also has extensive experience in bat surveying. His recent consultancy work includes bat surveys for five windfarm and ten single turbine projects, as well as emergence surveys for both The National Trust (Castle Coole) and Whitemountain Quarries (demolition for a quarry extension project). Karl also carries out; extended phase one habitat surveys; National Vegetation Classification surveys; habitat assessment & management as mitigation for breeding waders, vantage point surveys for raptors and migratory species; walkover surveys including Breeding Bird Surveys and Brown & Shepard surveys; wetland bird surveys (WeBS), and surveys of lowland species-rich meadows.

Legislation

10. All bat species found in Northern Ireland are listed under Appendix III of the Bern Convention and Annex IV of the EC Habitats Directive. In addition, bats and their habitats are listed under Appendix II of the Bonn Convention; therefore, there is an obligation to protect the habitat of bats, including links to important feeding areas. Bats also receive protection under Schedule 2 of the Conservation (Natural Habitats) Regulations (NI) 1995, as amended.

11. In relation to the above European Protected Species, it is an offence if:

- *They are deliberately captured, injured or killed*
- *These animals are disturbed in such a way as to significantly affect their ability to survive, breed, or rear / nurture their young, or in a way that affects the local distribution or abundance of that species*
- *A breeding site or resting place of these species is damaged or destroyed, even if this is unintentional and / or when the animal is not present*
- *Access to a structure or place used by these species for protection or shelter is intentionally or recklessly obstructed*
- *This legislation applies to all life stages of these species*

12. Also note that a licence may be required from the Northern Ireland Environment Agency for development work which is likely to affect a bat roost.

13. In addition to the above legislation, local planning authorities are also required to take into consideration natural heritage (including protected species and habitats) when a proposed planning application is being considered; the criteria used for this purpose are detailed in the guidance document 'Planning Policy Statement 2 (PPS2) – Natural Heritage'. The local planning authority should also consult with the Northern Ireland Environment Agency regarding protected species and / or habitats which may be present within the application area.

Bats & Wind Turbines

14. There is evidence from the USA and mainland Europe to suggest that single wind turbines can impact upon bats as dead bats have been found beneath some turbines. Such deaths may have been caused either by direct collision with the turbine blades, or caused by damage to the bat's lungs as they pass close to the rotating turbine blades.

15. Such damage is called 'pulmonary barotrauma' and is thought to occur as bats fly into areas of low air pressure which are created as the turbine blades are rotating; the resulting sudden change in air pressure is thought to cause the bat's lungs to expand at a rate which causes soft tissues within the lungs to rupture.

16. A European Union Advisory Committee called EUROBATs (which was initiated in 1994

and is concerned with the conservation of European bat populations) has produced guidance on how any potential impacts of wind turbines on bats can be assessed.

17. The guidance, 'EUROBATS Publication Series No. 3: Guidelines for consideration of bats in windfarm projects (2008)' identifies a need to conduct pre-construction bat activity surveys as well as assessing any habitat feature(s) which may be used by bats within the local landscape. Such a survey should particularly aim to identify situations which would pose a high level of risk to bats e.g. active bat roost, commuting corridor or foraging habitat in close proximity to a proposed turbine location.

18. Various bat species are at varying degrees of risk from wind turbines as each species has a different flight style, foraging method and echolocation call. Using these parameters, it has been determined that two Irish bat species are at a high level of risk from turbines (at a population level)[2] Leisler's bat and Nathusius' Pipistrelle; the remaining six Irish bat species were all regarded as being at a low level of risk from turbines (at a population level).

Bat Call Analysis

19. Analysis of recordings from the Batlogger M which was used during one of the activity transects was carried out using BatExplorer software. Analysis of recordings from the EchoMeter Touchpro which was used during the remaining two manual activity survey and analysis was carried out using Kaleidoscope Pro software.

20. Kaleidoscope Pro was used to undertake analysis of data collected during automated passive monitoring, although noise files were also manually checked using AnalookW in order to double check the bat classifiers were accurate. Bat activity was measured using the number of files containing a bat call or bat call sequence irrespective of length, for a complete night of recording. This method of passive monitoring enables determination of species composition, temporal activity patterns (between different times of year and different times of night) at a fixed location.

21. All detectors used during surveys are broadband detectors however, the frequencies of ultrasonic calls (from the static detectors) were divided by a factor of 8 and the data produced were then viewed as ZC (zero-crossed) files.

22. All the various software programmes used represent the recorded calls as sonograms (graphs of call frequency along the Y axis against time (duration) of the call along the X axis). All sonograms were then analysed to determine bat species. Echolocation calls are reliably distinguishable from other sounds (e.g. wind, mechanical sounds, birds or insects), but the ability to distinguish species of bats varies with taxon, location, type of equipment & quality of recording, and can be difficult. Some bats are relatively easy to speciate from viewing sonograms and very little additional analysis of the sonograms may be required. Some species, such as those within the genus Myotis, can be extremely difficult, if not impossible to separate into species.

23. Bat echolocation calls consist of repetitive patterns commonly referred to as pulses or calls. Here, a singularly produced sound is defined as a pulse and the consecutive repetition (sequence) of pulses is defined as a call. Calls which were difficult to identify from viewing the sonogram alone were analysed in more detail by determining the mathematical parameters of the pulses that could be defined. Any noise distorting the clear definition of a pulse was excluded from analysis. The mathematical parameters measured included:

- Time between each pulse known as Inter Pulse Interval (IPI);

[2] Natural England Technical Information Note TIN051 Bats and onshore wind turbines Interim guidance. Third edition 11 March 2014.

- Duration of call (Dur);
- Maximum frequency of call (Fmax);
- Minimum frequency of call (Fmin); and,
- Peak frequency of the call (Fpeak).

24. There are inherent limitations when surveying bats using ultrasonic detectors. Ultrasound, unlike audible sound, is attenuated rapidly in air. Many echolocation calls are in the 40KHz to 60KHz region, where air attenuation is over 1dB per metre. Sound absorption increases exponentially with frequency and a bat echolocating at 30kHz is unlikely to have a range exceeding 30m, with the range decreasing to 10m at 100KHz. Some bats call louder than others, notably Leisler's bat, which calls at the lowest frequency of any Irish at <25KHz where excess attenuation is around 0.5 dB per metre. It is frequently audible at around 80m (Altringham, 2003).

25. In practice this means that bat detectors do not detect most bats calling from 30kHZ and upwards at distances over 30m[3]. Some species, such as brown long-eared bat, make very directional and quiet calls and can only easily be detected when the detector is facing the source of call (i.e. the bat) and at close range.

26. Therefore, there may be some bias in the recording of bat species, caused by variations in the detectability of different species. The potential for some species of bats to be overlooked has been reduced as much as possible by the use of a variety of broadband (full-spectrum & frequency division) bat detectors (and with the use of headphones to cut down on background noise experienced by the surveyors), static recording, subsequent analysis of recordings and by the use of point counts (listening stops) during transects, where the surveyors are standing still, which reduces background noise on the detectors caused by surveyor movement. The manual surveys also used a combination of electronic detectors and observing bat behaviour where possible; the behaviour and size of bats can be used in combination with the calls to indicate species.

27. Table 1 indicates the maximum distances of ultrasonic detection for bat species occurring in the UK. The data has been taken from Eurobats and was collated based on a literature review and on the experience of Eurobat Intercessional Working Group members. It should be noted that this data is from surveys carried out on the continent and using a Pettersson Elektronik D980 bat detector.

Table 1 - Distances of ultrasonic detection for bats occurring in Northern Ireland[4]

Species	Forages close to habitat structure	High Flight (>40 m high)	Low Flight (i.e. almost ground level)	Maximum distance of ultrasonic detection (m)
Common pipistrelle	Yes	Yes	Yes	30
Soprano pipistrelle	Yes	Yes	Yes	30
Nathusius' pipistrelle	Yes	Yes	Yes	30-40
Brown long-eared	Yes	Yes	Yes	30
Daubenton's bat	Yes	Yes	Yes	30
Natterers' bat	Yes		Yes	20
Whiskered bat	Yes		Yes	15
Leisler's bat		Yes		60-80

28. Data from automated/static systems is limited because there is no observational

[3] John D. Altrincham (2003) British Bats

[4] Information taken from Rodrigues, L., L. Bach, M.J. Dubourg-Savage, J. Goodwin & C. Harbusch (2008): *Guidelines for consideration of bats in wind farm projects.* EUROBATS Publication Series No. 3 (English version). UNEP/EUROBATS Secretariat, Bonn, Germany, 51 pp. (Table 2, pp 48-49)

context. Fifty bat passes could represent one bat passing 50 times (i.e. while foraging along a riparian corridor) or 50 bats each passing once (i.e. when commuting between a roost and a favoured foraging location. Reality is likely to be somewhere between these two extremes.

29. Therefore, the ability to estimate abundance of bats by carrying out detector surveys is limited as it requires differentiation between multiple passes of a single bat and multiple bats making single passes, and is not usually possible through echolocation monitoring. However, the results can be used to indicate relative activity of bats in different habitats based on number of bat passes over time.

30. There are also some limitations on identification of some bats to species level, particularly those of the genera Myotis. This is due to similarities in calls of the different species and they can be difficult to identify to species level in cases where the bat pass was; brief, distant, faint or if the bat was not seen. Due to the similarities in call parameters, species of the genera Myotis can often not be identified to species level using analysis of recorded bat calls.

31. The methods used have referred to best practice guidance available at the time of the surveys and used a range of survey methods on a number of visits to increase the chances of encountering bats. Bat activity surveys and static recording has been carried out within the active season (May – September), including within the periods of key bat activity at upland windfarm sites (late-summer/early–autumn), and have covered all of the proposed turbine locations and key habitats close by. The data collected is therefore suitable for evaluation and impact assessment in relation to the proposed development.

Evaluation

32. Although the CIEEM (2018) Guidelines on Ecological Impact Assessment in the UK provide general guidance for evaluating the nature conservation value of habitats, it is extremely difficult to evaluate the value of species; species and the habitats that support them are generally considered together.

33. For the purpose of this project the guidance Valuing Bats in Ecological Impact Assessment (CIEEM, 2010)[5] has been considered. This guidance is based upon the rarity of bat species (see Table 2). The limitations involved in this evaluation method are largely related to the limited data available on bat populations in Britain and Ireland.

Table 2 - Categories of bat rarity in Northern Ireland (adapted from CIEEM, 2010)

Rarity within Range	Northern Ireland
Rarest (population under 10,000)	whiskered
Rarer (population 10,000 to 100,000)	Daubenton's Natterer's Leisler's Nathusius' pipistrelle brown long-eared
Common (population over 100,000)	common pipistrelle soprano pipistrelle

[5] Wray S, Wells D, Long E, Mitchell-Jones T (December 2010) Valuing Bats in Ecological Impact Assessment, IEEM In-Practice p 23-25

Species Present and Conservation Status

34. Bat species recorded during the surveys (in order of abundance from most abundantly recorded to least recorded) together with details of the species' conservation status are given in Table 3.

35. The potential presence of a number of species of the genera Myotis was identified but could not be identified with certainty to species level. However, analysis of the recordings suggested that whiskered/ Natterer's bats were present. Table 3 below includes the Myotis species that could be within the geographic area.

36. Along with the information received from the data search, the following references were used for information on the national and local status of bat populations:
    - Bat Conservation Trust, 2000: Distribution Atlas of Bats in Britain and Ireland;
    - The National Bat Monitoring Programme. Annual Report 2010. Bat Conservation Trust, London. (http://www.bats.org.uk/pages/national_bat_monitoring_programme_annual_report_2010.html);
    - UK Biodiversity Action Plan (http://jncc.defra.gov.uk/default.aspx?page=5155);
    - Harris S., Morris, P., Wray, S. & Yalden, D. (1995) A review of British mammals: population estimates and conservation status of British mammals other than cetaceans. JNCC, Peterborough; and
    - Harris, S. and Yalden, D. (2008) Mammals of the British Isles Handbook, 4th Edition. The Mammal Society.

37. All UK bats are listed under the following European Community Directives, Conventions or UK legislation:
    - Appendix II of the Bern Convention. An agreement on the Conservation of Bats in Europe (EUROBATS) under the auspices of the Bonn Convention, also known as the Convention on Migratory Species (CMS) is in force, and all European bats are listed under Appendix II of the CMS;
    - Appendix II of the Bonn Convention (and Recommendation 36 on the Conservation of Underground Habitats),
    - Annexes II and IV of the EC Habitats Directive; and
    - The Conservation (Natural Habitats etc.) Regulations (Northern Ireland) 1995 (as amended).

38. All of the bat species listed in Table 3 below have been recorded commuting and/or foraging within habitats in the application site. The population of each of the bat species listed in Table 3 within NI are unknown; however, estimates of the NI population trends have been derived from Car-based Bat Monitoring Scheme undertaken (since 2003) by BCI (Bat Conservation Ireland) and part-funded by NIEA.

Table 3 - Bat species recorded within the survey area and their conservation status

Bat Species	Species Action Plan (SAP) Status	NI Population Trend	Estimated Population size, rarity and distribution
Common pipistrelle	All Ireland SAP LBAP	Increasing	Results from this scheme indicate that since 2003 the soprano pipistrelle has increased significantly while the common pipistrelle has also increased, albeit more slowly. The reasons for these increases are poorly understood but both species may be recovering from past declines, or responding to increased woodland cover and/or climate change.
Leisler's	All Ireland SAP LBAP	Increasing	Leisler's bat is monitored by the Car-based Bat Monitoring Scheme and its annual trend has shown significant increases since 2003. The reasons for the increase are poorly understood but it may be recovering from past declines, or

Bat Species	Species Action Plan (SAP) Status	NI Population Trend	Estimated Population size, rarity and distribution
			responding to increased woodland cover and/or climate change.
Soprano pipistrelle	All Ireland SAP UK SAP LBAP	Increasing	Results from this scheme indicate that since 2003 the soprano pipistrelle has increased significantly while the common pipistrelle has also increased, albeit more slowly. The reasons for these increases are poorly understood but both species may be recovering from past declines, or responding to increased woodland cover and/or climate change.
Other bats that could be present within the Myotis spp.			
Natterer's bat	All Ireland SAP LBAP	No trend data available	One of the rarer Irish bat species, the Natterer's bat likes woodland, mature hedgerow and pasture habitats.
Daubenton's bat	All Ireland SAP LBAP	No trend data available	The Daubenton's bat annual trend is monitored using a volunteer-based programme – the All Ireland Daubenton's Bat Waterways Survey. This scheme has been ongoing since 2006 and the Daubenton's bat trend has been reasonably stable since this time.
Whiskered bat	All Ireland SAP LBAP	No trend data available	Another uncommon and little-known bat, the whiskered is closely related to the Natterer's, Daubenton's and Brandt's bats. The whiskered bat typically forages along forest tracks or near water. It has a rapid fluttering flight and flies along a regular 'beat' over and over again. It is sometimes found roosting in attics of old buildings but there are very few confirmed roosts in Ireland.
Nathusius pipistrelle	All Ireland SAP LBAP	No trend data available	The species is recorded by the Car-based Bat Monitoring Scheme, although in such low numbers that its annual population trend is difficult to establish with certainty.
Brown long-eared bat	UK BAP	No trend data available	A scheme for monitoring the brown long-eared bat at its roosts was developed in 2007 (the Brown Long-eared Bat Roost Monitoring Scheme). Thus far its population has been stable.

Table 4 - Nature conservation importance of individual bat species present within the survey area

Species	Relative population size and status[6]	Background
Common pipistrelle	Common	This species is common and widely distributed across NI and uses a range of habitats including urban and industrial areas. No roosts are present within 500m of the proposed turbine locations, although roosts are known within 5km. This is the most frequently recorded species within the 5km desk study search area and was the most frequently registered bat species during both the manual and static bat surveys. The population using the site is unlikely to be of importance at the county level (i.e. medium importance) given their widespread distribution.
Soprano pipistrelle	Common	This species is common and widely distributed across NI. No roosts are present within 500m of the proposed turbine locations. The population using the site is unlikely to be of importance at the county level (i.e. medium importance) given their widespread distribution.
Leisler's	Scarce	This is a rarer bat species in Britain but is much more common in NI. Present bat population in the county unknown. No roosts are present within the survey area (500m) However, Leisler's bats in Ireland were found to commute to their feeding sites at speeds of up to 40 km/h at a distance of up to 13.4km (Shiel et al., 1999).

[6] Based on Battersby, J (Ed) & Tracking Mammals Partnership (2005).

Myotis	Common/fairly common/locally distributed (depending on species)	These rarer species are widespread across the UK but in low numbers (the low numbers of these species could be due to a lack of recording effort rather than them not being present). Present bat population in the county is unknown.
Nathusius pipistrelle	Rare	This species is uncommon and localised within NI. Anecdotally it is mostly found near large water bodies such as Lough Neagh and Upper Lough Erne. No roosts are present within the survey area. The population in the area is likely to be small and this species was recorded infrequently during the surveys for Magheramore.
Brown long-eared bat	Common	Brown long-eared bats are common throughout Northern Ireland, and it is our third most commonly recorded species with just over 200 records to-date. Even so, as roost sizes are quite small and many of the records are of single bats, the overall number of individuals is not high. Historically the picture would seem to be rather different with brown long-eared bats reported to be 'met with everywhere' in late nineteenth-century (Knox, 1875).

Methodology

39. Survey methodology followed guidance in Table 10.2 of the 2012 BCT Guidelines for 'Low-risk' sites, but also took cognisance of the Bat Conservation Trust Bat Surveys: Good Practice Guidelines' (2016); the Northern Ireland Environment Agency also recommends consultation with this publication with reference to any bat surveys carried out within Northern Ireland.

Desk Study

40. Bat surveys (including; pre-survey site visit, manual bat activity transects and automated passive monitoring) were conducted between April and September 2018 as per NIEA NH recommendations in force at that time.

Bat Records

41. Consultation with the NIBG (Northern Ireland Bat Group) was undertaken in order to obtain records for roosts within 10km of the site. Records were also obtained from the Biodiversity Maps website as this contains some All-Ireland records (i.e. Daubenton's Bat Waterway Survey (which is managed by Bat Conservation Ireland).

Pre-Survey Site Visit

42. A daytime inspection of trees and structures within 200m of the developable area[7] was undertaken for evidence of roosting bats and to make a general assessment of potential roosting features within the survey area to identify structures or trees which could potentially be used by bats. Ordinance Survey mapping and aerial photographs were also used to aid in the identification of potential features prior to the site visit.

43. Both direct and indirect methods were employed in order to search for evidence of bats. Direct methods involve surveying for observations of bats or the remains of dead bats. Indirect methods involve identification of faecal pellets, urine, oil stains and feeding remains, which indicate evidence of bat activity. It should be noted however that bats often leave little evidence of their presence.

44. The site of the proposed development was visited on three occasions between late

[7] Survey area consisted of 200m buffer around the developable area (100m plus rotor radius (56m)), i.e. 356m in total.

May and early October 2018 to assess the level of bat activity in the area around the site of the proposed wind turbine installation. Both hand-held and static bat detectors were used to record the ultrasonic calls of bats. Details of each of the visits are provided in Table 5 below.

Table 5 - Bat Activity Survey dates

Survey Type	Date of survey	Air Temp ºC	Time of survey
Dusk survey	29th May 2018	10	2123 – 2353
Dusk survey	9th August 2018	15	2050 – 2320
Dusk survey	6th September 2018	11	1947 – 2217

45. Crepuscular surveys were conducted during periods of favourable weather (light or no wind, air temperature >10º Celsius, no precipitation) using a hand-held Wildlife Acoustics Echo Meter Touch Pro 2 bat detector (or a Batlogger M) to assess bat activity. These surveys commenced 15 minutes before sunset (for dusk surveys), with each survey lasting for 2.5 hours. Each survey involved walking along a pre-determined, looping line transect which included all habitat features identified on site as having the potential to attract roosting, commuting and / or foraging bats within 150m of the proposed turbines (100m plus rotor radius). The bat detector recorded the activity of each bat species encountered as well as its spatial location and time of activity.

46. Numerous listening points were positioned along the transect route; at each of these points the surveyor would stop for a period of 3-5 minutes to record any bat activity. These listening points were selected to be within (or in close proximity to) a habitat feature which was likely to be used by bats (i.e. a hedgerow), as well as the proposed turbine locations.

47. All bat passes were recorded through the Wildlife Acoustics Echo Meter Touch app onto the phone/tablet memory, where it was stored for later analysis using Wildlife Acoustics Kaleidoscope Pro software. Or in the case of the Batlogger M the data was recorded on to the inserted SD card for later analysis using BatExplorer software.

48. Survey transect routes are shown on Figures 6.3 – 6.5 (Annex 4), and the results of manual surveys are provided in the tables/charts below. Areas of bat activity are also mapped on Figures 6.3 – 6.5.

Automated Monitoring

49. Various ultrasonic detectors with omnidirectional microphones were used during the automated monitoring sessions. All detectors were set to record simultaneously (during each session) to allow a comparison of results to be made. Detectors were programmed to record, beginning 30 minutes prior to sunset until 30 minutes after sunrise each night. The location of the detectors, including photographs (with a brief description) are contained in Annex 3.

50. Automated passive monitoring was also undertaken across 5 nights between the 22nd May and 10th October 2018). This was carried out simultaneously (using pairs of calibrated detector units (SM2Bat+/SMZC/SM4ZC or Anabat Express')) at each turbine location and the nearest habitat feature.

51. The locations of static monitoring equipment are shown on the photographs in Annex 2 and on Figure 6.6. The results of the static monitoring are also provided in Annex 1.

Results

Desk Study

52. The results of 2018 bat activity surveys confirmed commuting and foraging activity within the survey site. The majority of commuting and foraging was confined along linear features such as tracks, treelines and hedgerows. On a few occasions' bats were observed commuting across open ground. Bat species recorded included Leisler's bat, soprano pipistrelle, common pipistrelle, brown long-eared and Myotis spp.

53. Records were obtained from the Northern Ireland Bat Group (NIBG). A total of 27 records within 10km of the Site were provided by the NIBG. As is typical for such records they are dominated by pipistrellus species and are clustered in proximity to human habitation (i.e. within and surrounding the town of Dungiven). Only one of the records were of Leisler's bats *Nyctalus leisleri*, and that was for roost containing five bats. There were also no records for Nathusius pipistrelle, although there were 12 records for 'bats' or 'unidentified'. In addition, 7 of the records for of Daubenton's bat, a species which specialises in lakes and waterways.

Pre-Survey Site Visit

54. The daytime inspection of trees within 200m of the developable area (356m) did not reveal any trees with BRP (Bat Roost Potential). Trees present are of insufficient age to have developed any holes (as a result of damage or disease), consequently their BRP was assessed as low.

55. There are no buildings within 356m of any of the turbines on site. Therefore, it was not necessary to carry out a BRP (buildings) assessment, nor were any specific emergence surveys undertaken.

Transect Results

56. Dusk Survey, 29th May 2018: a total of 4 bat passes were recorded. Two species were recorded during this session – soprano pipistrelle and Nathusius' pipistrelle.

57. The majority of passes (N=3) were from Soprano pipistrelle which were detected while commuting in various locations across the transect (see Figure 6.3). There was also a single pass attributed to a Nathusius pipistrelle.

58. The Dusk Survey of the 9th August 2018 recorded a total of 3 bat passes; this time a single species was recorded Leisler's bat (Figure 6.4).

59. The Dusk Survey of the 6th September 2018: again recorded a total of 3 bat passes. Two bat species were recorded (Figure 6.5); common pipistrelle (N=2) and soprano pipistrelle (N=1).

60. Overall, combined across the three 2018 transects the transects results are as follows;

    - Common pipistrelle (n=2), 0.26 bat passes per hour;
    - Leisler's bat (n=3), 0.4 bat passes/hour;
    - Nathusius' pipistrelle (n=1), 0.13 bat passes/hour;
    - Soprano pipistrelle (n=4), 0.53 bat passes per hour.

61. This level of activity is considered to be **Low** (BAI - 4).

Static Detector Results

62. Overall there was approximately 1300 hours of recording across the combined automated monitoring sessions during 2018.

63. There was significant variation in night length throughout the survey period, so the number of bat passes recorded during different months of the year are not directly comparable. In order to standardise bat activity between survey periods, results are displayed as a 'Bat Activity Index' (BAI), which is the total number of bat passes divided by the number of hours per night (Hundt 2012). This was calculated from sunset to sunrise, using publicly-available data from www.timeanddate.com.

64. At present there is not a standard system in the UK to categorise bat activity as low, moderate or high, because activity levels vary depending on the species involved and the location of the site. For the purposes of this report we use a bespoke system to discuss and compare levels of bat activity at the site, as outlined in the table below. This approach uses standardised terms (e.g. occasional, frequent) to categorise bat activity indices within certain ranges; the average time interval between passes is also provided to give a more- intuitive interpretation of the terms. For the purposes of this assessment, we consider activity levels of occasional or higher (i.e. a BAI of >5) to be significant. This is similar to the threshold of 50 bat passes used in Mathews et al (2016) to define 'high bat activity', because 50 bat passes in a 10-hour night gives a BAI of 5.

65. It should be noted that activity levels should only be compared within a species and not between species, due to differences in the detection distances for each species and their flight characteristics. For example, if there are infrequent passes by brown long-eared bats (a species with short-range echolocation pulses) and occasional passes by Leisler's bats (which has longer-range echolocation pulses), it does not necessarily mean that Leisler's bats are more abundant than brown long-eared bats at that location.

Table 6 – Description of levels of bat activity (adopted from Matthews 2016)

Description	Bat Activity Index	Interval between passes
Negligible	<1	>60 minutes
Low	1 – 5	12 – 60 minutes
Moderate	5 – 12	5 – 12 minutes
High	12 – 60	1 – 5 minutes
Near-constant	>60	<1 minute

66. The abbreviations in the charts that follow are; NYLE – *Nyctalus leisler* (Leisler's bat)*i*; PIPI – *Pipistrellus pipistrellus* (common pipisitrelle); PIPY – *Pipistrellus pygmaeus* (soprano pipistrelle); PINA – *Pipistrellus nathusii* (Nathusius pipistrelle), and PLAUR – *Plecotus auritus* (brown long-eared bat) Myotis spp – *Myotis species* (collectively refers to Daubenton's bat *Myotis daubentonii,* whiskered bat *Myotis mystacinus* and Natterer's bat *Myotis nattereri*).

Spring

Turbine 1

67. The monitoring period at T1 ran for a total of five nights across, (22nd to 27th May 2018). This equates to approximately 40 hours of recording.

68. The total number of bat passes at the proposed turbine location (n= 277).

Table 7 – Total number of bat passes/bat activity index for T1

	NYLE	PIPI	PIPY	PINA	Myotis spp
Total Passes	182	65	26	2	2
Passes (per/hr)	**4.55**	**1.625**	**0.65**	**0.05**	**0.05**

69. The overall activity levels ((BAI) calculated as bat passes per hour)), for three of the five species encountered were below 1 and this value is considered negligible. While the BAI for both Leisler's bat and common pipistrelle were between 1 & 5 (i.e. low).

70. However, when the BAI is combined for all species at T1 during spring, the figure is 6.925 (this figure is considered to be moderate). Therefore, bat activity at T1 is assessed as moderate (during spring).

71. As T1 is located in close proximity to an existing habitat feature (i.e. the southern edge of a coniferous plantation shelterbelt), a 'paired' detector set-up was not therefore required.

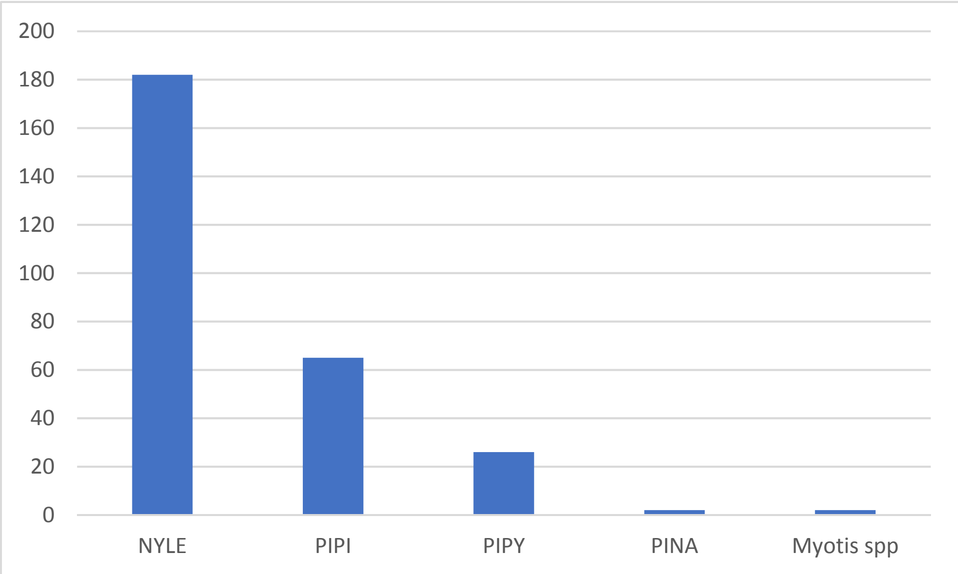

Chart 1 - Total bat passes recorded at T1 (spring).

Turbine 2

72. The monitoring period at T2 & adjacent habitat feature ran for a total of five nights between (28th May to 2nd June). This equates to approximately 40 hours of recording.

73. On this occasion, the total number of bat passes was significantly lower at the proposed turbine location (n= 91) compared to the habitat feature which had (n= 362). Also, for Leisler's bat the number of passes at the proposed turbine locations was (n= 78), while at the adjacent habitat feature, the figure was (n= 263).

Table 8 – Total number of bat passes/bat activity index for T2

	NYLE	PIPI	PIPY	PINA	PLAUR
Total Passes	78	7	2	3	1
Passes (per/hr)	**1.95**	**0.175**	**0.05**	**0.075**	**0.025**

74. The overall activity levels (BAI) for most species were however, below 1 and this value is considered negligible. However, the figure for Leisler's bat is **1.95,** while the BAI for all species combined is **2.275** (bat passes per hour), this figure is considered to be **Low.** Therefore, bat activity at T2 is assessed as **Low**.

Table 9 – Total number of bat passes/bat activity index for T2's habitat feature

	NYLE	PIPI	PIPY	Myotis spp
Total Passes	263	85	11	3

Passes (per/hr)	**6.575**	**2.125**	**0.275**	**0.075**

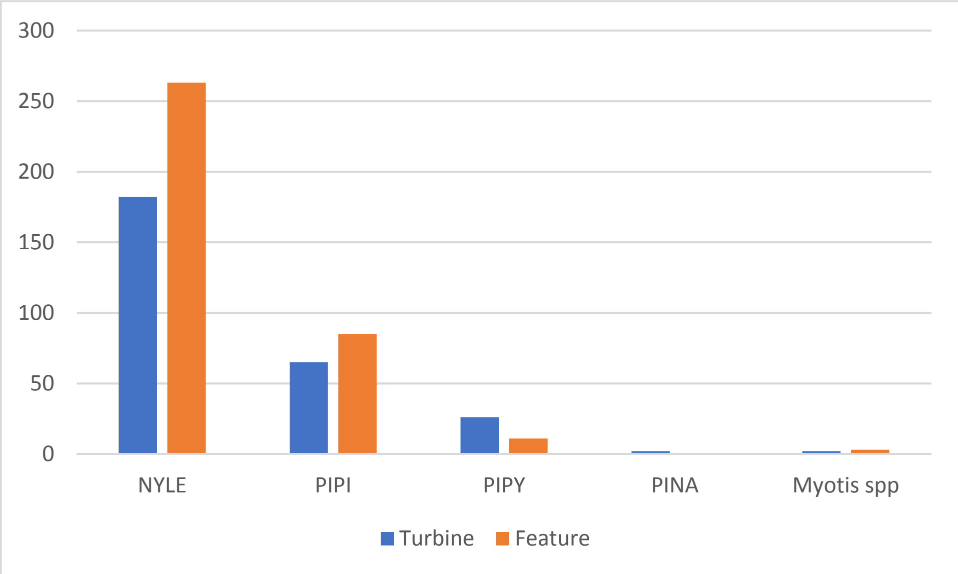

Chart 2 – Total bat passes recorded at T2 and adjacent habitat feature (spring).

Turbine 3

75. The monitoring period at T3 & adjacent habitat feature (coniferous plantation) ran for a total of five nights (28th May to 2nd June). This equates to approximately 40 hours of recording.

76. On this occasion, the total number of bat passes was significantly lower at the proposed turbine location (n= 85) compared to the adjacent feature which had (n= 852). The majority of the bat passes were attributed to Leisler's bat (T= 78; HF= 334) and Common Pipistrelle (T= 10; HF= 433).

Table 10 – Total number of bat passes/bat activity index for T3

	NYLE	PIPI	PIPY	Myotis spp	PLAUR
Total Passes	71	10	2	1	1
Passes (per/hr)	**1.775**	**0.25**	**0.05**	**0.025**	**0.025**

77. The overall activity levels (BAI) for most species were however, below 1 and this value is considered negligible. However, the figure for Leisler's bat is **1.775,** while the BAI for all species combined is **2.125** (bat passes per hour), this figure is considered to be **Low**. Therefore, bat activity at T3 is assessed as Low.

Table 11 – Total number of bat passes/bat activity index for T3's habitat feature

	NYLE	PIPI	PIPY	PINA	PLAUR	Myotis spp
Total Passes	334	433	69	11	2	3
Passes (per/hr)	**8.35**	**10.8**	**1.725**	**0.275**	**0.05**	**0.075**

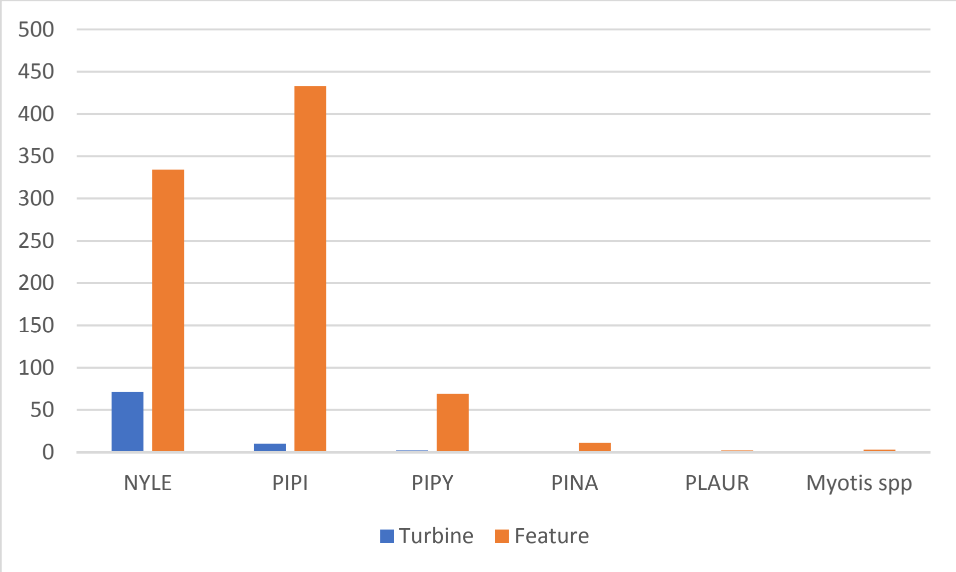

Chart 3 – Total bat passes at T3 and adjacent habitat feature (spring).

Turbine 4

78. Due to alterations in the turbine layout, there is no data for T4 for spring. This is due to the fact that the turbine was moved to its current location only after the spring round of monitoring had already taken place. It should also be noted that the turbine was moved in order to ensure a 57.57m buffer from the adjacent canalised immediately to the west.

79. There was data gathered for five nights at an adjacent habitat feature (a canalised stream) between the 22nd & 27th May which equates to approximately 40 hours of recording.

80. A total of 174 bat passes for all species combined were recorded at this feature across the 40 hours of static monitoring carried out at this location. This gives a BAI of **4.35**; which is assessed as **Low**.

Table 12 – Total number of bat passes/bat activity index for T4 HF

	NYLE	PIPI	PIPY	PINA
Total Passes	104	59	10	1
Passes (per/hr)	**2.6**	**1.475**	**0.25**	**0.025**

Turbine 5

81. The monitoring period at T5 & adjacent habitat feature ran for a total of five nights 22nd to 27th May which equates to approximately 40 hours of recording.

82. The total number of bat passes at the turbine location (n= 75) compared to the habitat feature which had (n= 113). Leisler's bat was the most commonly encountered species (T= 61, HF= 65).

Table 13 – Total number of bat passes/bat activity index for T5

	NYLE	PIPI	PIPY	PLAUR
Total Passes	61	5	5	4
Passes (per/hr)	**1.525**	**0.125**	**0.125**	**0.1**

83. The overall activity levels (BAI) all species the combined (at the proposed Turbine) is **1.875** (bat passes per hour), this figure is considered to be **Low**.

Table 14 – Total number of bat passes/bat activity index for T5's habitat feature (stream)

	NYLE	PIPI	PIPY	Myotis spp	PLAUR
Total Passes	65	33	11	2	2
Passes (per/hr)	**1.625**	**0.825**	**0.275**	**0.05**	**0.05**

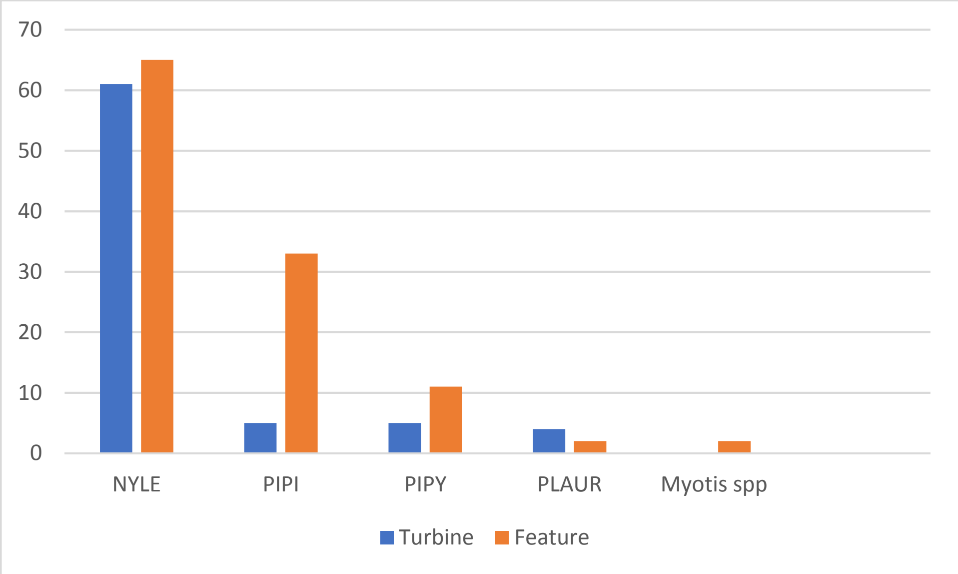

Chart 4 – Total bat passes at T5 and adjacent habitat feature (spring).

Turbine 6

84. The monitoring period at T6 ran for a total of five nights during the spring period, (22nd to 27th May). This equates to approximately 40 hours of recording. As T6 is located close to an existing feature (a canalised stream/drain) there was no requirement to use a 'paired' detector.

85. The total number of bat passes at the proposed turbine (n= 32), with 17 of those passes attributed to Leisler's.

Table 15 – Total number of bat passes/bat activity index for T6

	NYLE	PIPI	PIPY
Total Passes	17	7	8
Passes (per/hr)	**0.425**	**0.175**	**0.2**

86. Overall activity levels (BAI) for most species were below 1 and this value is considered **negligible**.

Summer

Turbine 1

87. The monitoring period at T1 ran for a total of five nights from the 07th to 12th June 2018). This equates to approximately 40 hours of recording.

88. The total number of bat passes at the proposed turbine location (n= 89).

Table 16 – Total number of bat passes/bat activity index for T1

	NYLE	PIPI	PIPY	PINA	PLAUR	Myotis spp
Total Passes	30	49	3	1	2	4
Passes (per/hr)	**0.75**	**1.225**	**0.075**	**0.025**	**0.05**	**0.1**

89. The overall activity levels (BAI) for most species were however, below 1 and this value is considered negligible. While the BAI for all species combined is 2.225 (bat passes

per hour), this figure is considered to be Low. Therefore, bat activity at T1 is assessed as **Low** (during summer).

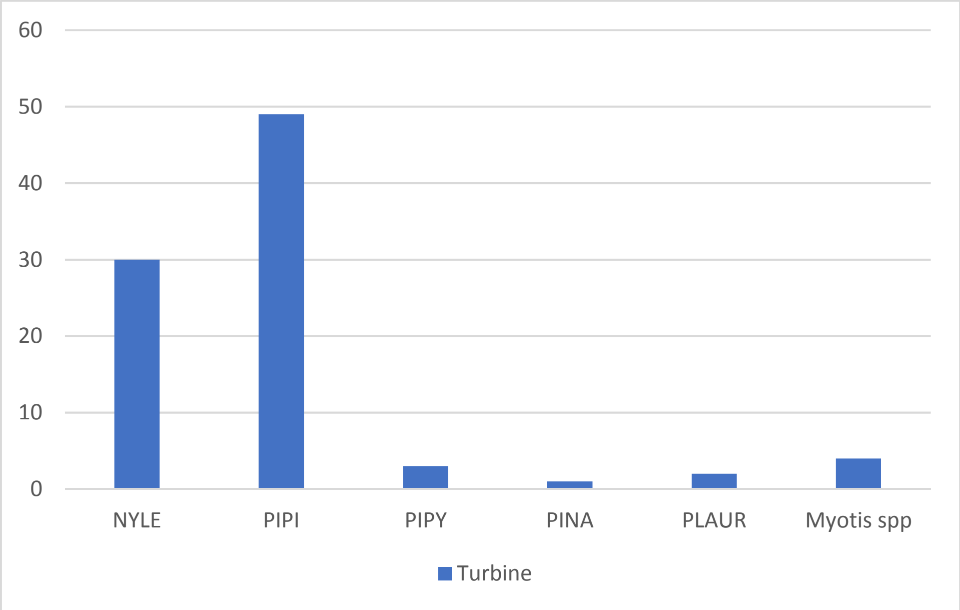

Chart 5 - Total bat passes recorded at T1 (spring).

Turbine 2

90. The monitoring period at T2 & adjacent habitat feature ran for a total of five nights between (02nd to 07th June). This equates to approximately 40 hours of recording.

91. On this occasion, the total number of bat passes was significantly lower at the proposed turbine location (n= 110) compared to the habitat feature which had (n= 448). Also, for Leisler's bat the number of passes at the proposed turbine locations was (n= 87), while at the adjacent habitat feature, the figure was (n= 359).

Table 17 – Total number of bat passes/bat activity index for T2

	NYLE	**PIPI**	**PIPY**	**PINA**	**PLAUR**
Total Passes	87	15	3	1	4
Passes (per/hr)	**2.175**	**0.375**	**0.075**	**0.025**	**0.1**

92. The overall activity levels (BAI) for most species were however, below 1 and this value is considered negligible. However, the figure for Leisler's bat is **2.175,** while the BAI for all species combined is **2.75** (bat passes per hour), this figure is considered to be **Low.** Therefore, bat activity at T2 during summer is assessed as **Low**.

Table 18 – Total number of bat passes/bat activity index for T2's habitat feature

	NYLE	**PIPI**	**PIPY**	**PLAUR**	**Myotis spp**
Total Passes	359	70	12	4	3
Passes (per/hr)	**8.975**	**1.75**	**0.3**	**0.1**	**0.075**

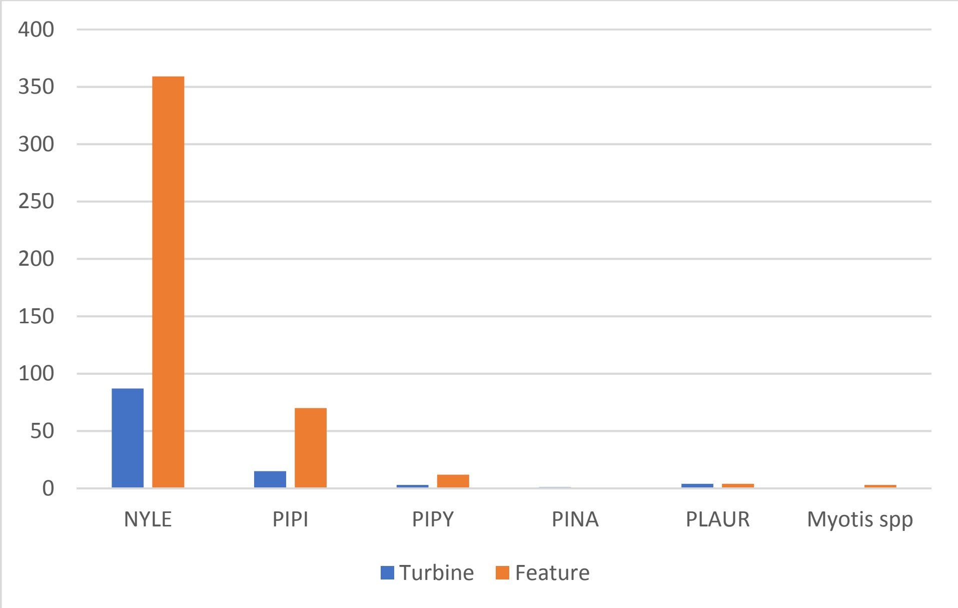

Chart 6 – Total bat passes recorded at T2 and adjacent habitat feature (summer).

Turbine 3

93. The monitoring period at T3 & adjacent habitat feature (coniferous plantation) ran for a total of five nights (04th to 9th July). This equates to approximately 40 hours of recording.

94. On this occasion, the total number of bat passes was higher at the proposed turbine location (n= 98) compared to the adjacent feature which had (n= 378). The majority of the bat passes were attributed to Leisler's bat (T= 87; HF= 64) and Common Pipistrelle (T= 8; HF= 305).

Table 19 – Total number of bat passes/bat activity index for T3

	NYLE	PIPI	PIPY	PLAUR
Total Passes	87	8	2	1
Passes (per/hr)	**2.175**	**0.2**	**0.05**	**0.025**

95. The overall activity levels (BAI) for most species were however, below 1 and this value is considered negligible. However, the figure for Leisler's bat is **2.175,** while the BAI for all species combined is **2.45** (bat passes per hour), this figure is considered to be **Low**. Therefore, bat activity at T3 is assessed as Low.

Table 20 – Total number of bat passes/bat activity index for T3's habitat feature

	NYLE	PIPI	PIPY	Myotis spp
Total Passes	64	305	8	1
Passes (per/hr)	**1.6**	**7.625**	**0.2**	**0.025**

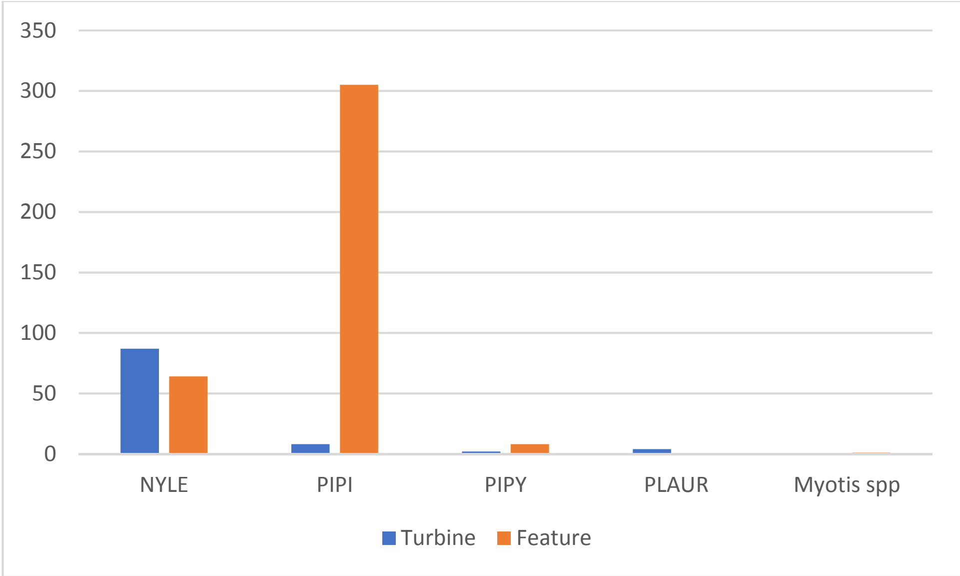

Chart 7 – Total bat passes at T3 and adjacent habitat feature (summer).

Turbine 4

96. There was data gathered for five nights at T4 and an adjacent habitat feature (a canalised stream) between the 07th & 12th June which equates to approximately 40 hours of recording.

97. The total number of bat passes at the turbine location (n= 42) compared to the habitat feature which had (n= 119). Leisler's bat was the most commonly encountered species (T= 31, HF= 80).

Table 21 – Total number of bat passes/bat activity index for T4

	NYLE	PIPI	PIPY	PINA	PLAUR
Total Passes	31	5	1	3	2
Passes (per/hr)	**0.775**	**0.125**	**0.025**	**0.075**	**0.05**

98. A total of 42 bat passes for all species combined were recorded at this turbine across the 40 hours of static monitoring carried out at this location. This gives a BAI of **1.05**; which is assessed as **Low**.

Table 22 – Total number of bat passes/bat activity index for T4's habitat feature (stream)

	NYLE	PIPI	PIPY	Myotis spp	PLAUR
Total Passes	80	32	1	5	1
Passes (per/hr)	**2**	**0.8**	**0.025**	**0.125**	**0.025**

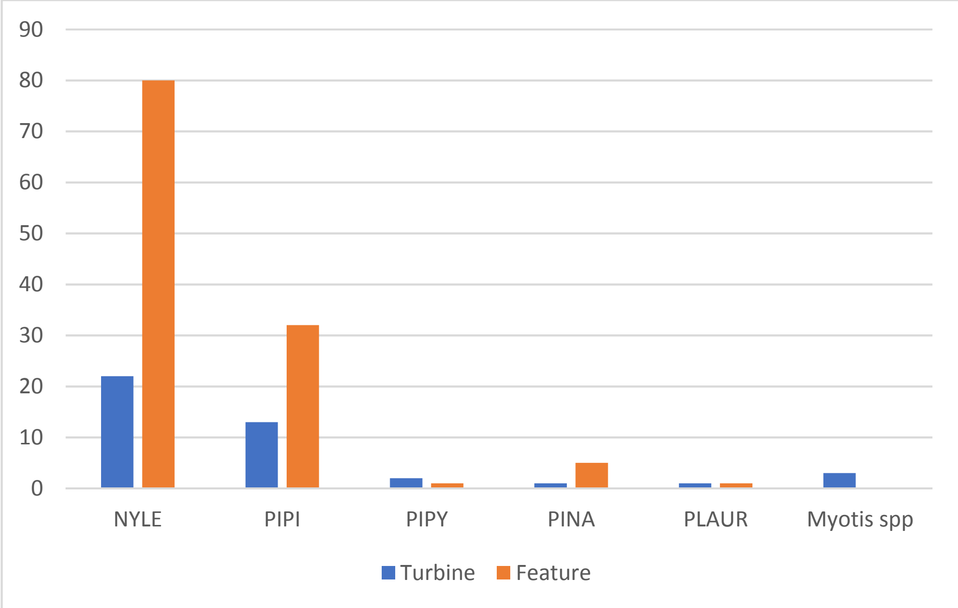

Chart 8 – Total bat passes at T4 and adjacent habitat feature (summer).

Turbine 5

99. The monitoring period at T5 & adjacent habitat feature ran for a total of five nights 07th to 12th June which equates to approximately 40 hours of recording.

100. The total number of bat passes at the turbine location (n= 42) compared to the habitat feature which had (n= 85). Leisler's bat was the most commonly encountered species (T= 22, HF= 71).

Table 23 – Total number of bat passes/bat activity index for T5

	NYLE	PIPI	PIPY	PINA	PLAUR	Myotis spp
Total Passes	22	13	2	1	1	3
Passes (per/hr)	**0.55**	**0.325**	**0.05**	**0.025**	**0.025**	**0.075**

101. The overall activity levels (BAI) all species the combined (at the proposed Turbine) is **1.05** (bat passes per hour), this figure is considered to be **Low**.

Table 24 – Total number of bat passes/bat activity index for T5's habitat feature (stream)

	NYLE	PIPI	PIPY
Total Passes	71	13	1
Passes (per/hr)	**1.775**	**0.325**	**0.025**

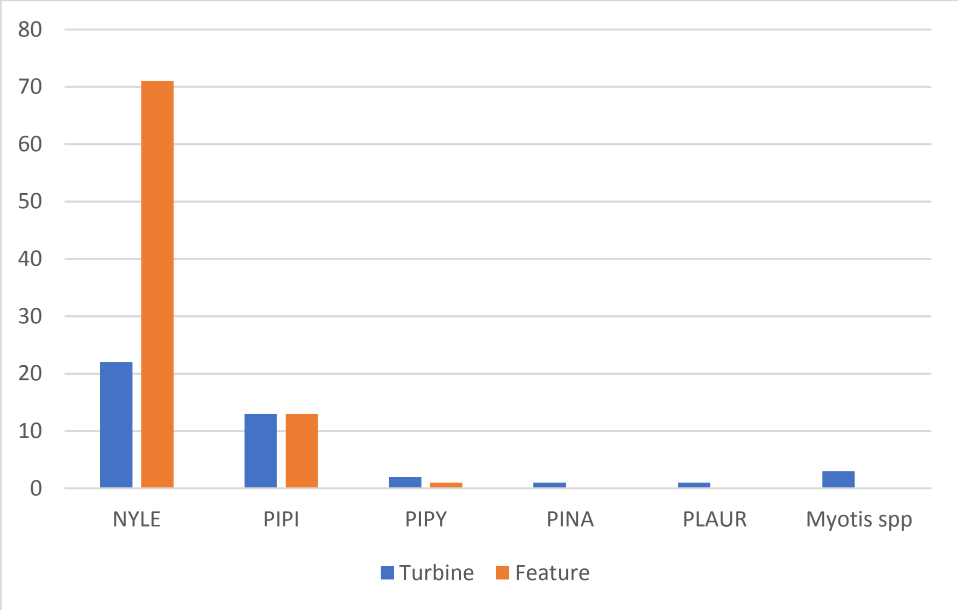

Chart 9 – Total bat passes at T5 and adjacent habitat feature (summer).

Turbine 6

102. The monitoring period at T6 ran for a total of five nights during the summer period, (02nd to 07th June). This equates to approximately 40 hours of recording. As T6 is located close to an existing feature (a canalised stream/drain) there was no requirement to use a 'paired' detector.

103. The total number of bat passes at the proposed turbine (n= 44), with 26 of those passes attributed to Leisler's.

Table 25 – Total number of bat passes/bat activity index for T6

	NYLE	PIPI	PIPY
Total Passes	26	10	8
Passes (per/hr)	**0.65**	**0.25**	**0.2**

104. Overall activity levels (BAI) for all species were below 1 and this value is considered **negligible**. While for all species combined the BAI was **1.1** and this value is only just **Low.**

Autumn

Turbine 1

105. The monitoring period at T1 ran for a total of five nights from the 05th to 10th October 2018). This equates to approximately 60 hours of recording. The total number of bat passes at the proposed turbine location (n= 2). Single passes were attributed to myotis spp., and Nathusius pipistrelle. This level of activity is assessed as **negligible.**

Table 26 – Total number of bat passes/bat activity index for T1

	Myotis spp	PINA
Total Passes	1	1
Passes (per/hr)	**0.016**	**0.016**

Turbine 2

106. The monitoring period at T2 & adjacent habitat feature ran for a total of five nights between (05th to 10th October). This equates to approximately 60 hours of recording.

Table 27 – Total number of bat passes/bat activity index for T2

	NYLE	PIPI	PIPY	Myotis spp
Total Passes	4	11	3	1
Passes (per/hr)	**0.066**	**0.18**	**0.05**	**0.016**

107. On this occasion, overall bat activity was low with only 19 bat passes as the proposed turbine location and 12 at the adjacent habitat feature. The overall (BAI) at the both the proposed turbine location and the adjacent HF were below 1 and this value is considered negligible. A detailed breakdown of the bat passes (per species per night) is provided in Annex 1.

Turbine 3

108. The monitoring period at T3 & adjacent habitat feature again ran for a total of five nights (05th to 10th October). This equates to approximately 60 hours of recording.

109. On this occasion, the total number of bat passes was higher at the proposed turbine location (n= 29) compared to the adjacent feature which had (n= 3). The majority of the bat passes were attributed to soprano pipistrelle (n= 16).

Table 28 – Total number of bat passes/bat activity index for T3

	NYLE	PIPI	PIPY
Total Passes	2	12	15
Passes (per/hr)	**0.033**	**0.2**	**0.25**

110. The overall activity levels (BAI) for all species were again below 1 and this value is considered negligible. Therefore, bat activity at T3 is assessed as **negligible** (during autumn).

Turbine 4

111. The monitoring period at T4 again ran for a total of five nights (05th to 10th October). This equates to approximately 60 hours of recording.

112. On this occasion, the total number of bat passes at the proposed turbine location (n= 4). No recording was undertaken at a habitat feature as the turbine is located close enough to a coniferous plantation shelterbelt to record activity along it.

Table 29 – Total number of bat passes/bat activity index for T4

	NYLE	PIPI	Myotis spp
Total Passes	2	1	1
Passes (per/hr)	**0.033**	**0.016**	**0.016**

113. The overall activity levels (BAI) for all species were again below 1 and this value is considered negligible. Therefore, bat activity at T4 is assessed as **negligible** (during autumn).

Turbine 5

114. The monitoring period at T5 & adjacent habitat feature ran for a total of five nights 05th to 10th October which equates to approximately 60 hours of recording.

115. The total number of bat passes at the turbine location (n= 15) compared to the habitat feature which had (n= 40). The most commonly encountered species was Leisler's bat (T= 11, HF= 12).

Table 30 – Total number of bat passes/bat activity index for T5

	NYLE	PIPI	PIPY	Myotis spp
Total Passes	11	2	1	1
Passes (per/hr)	**0.18**	**0.033**	**0.016**	**0.016**

116. The overall activity levels (BAI) all species the combined (at the proposed Turbine) is **0.245** (bat passes per hour), this figure is considered to be **negligible**. While at the habitat feature the figure was **0.662**, also negligible.

Turbine 6

117. As for all six turbines the autumn monitoring period ran for a total of five nights from the 05th to 10th October 2018. This equates to approximately 60 hours of recording. As T6 is located close to an existing feature (a canalised stream/drain) there was no requirement to use a 'paired' detector.

Table 31 – Total number of bat passes/bat activity index for T6

	NYLE	PIPI	PIPY	Myotis spp
Total Passes	5	14	9	1
Passes (per/hr)	**0.08**	**0.23**	**0.15**	**0.016**

118. The total number of bat passes at the proposed turbine (n= 29). Overall activity levels (BAI) therefore, for all species (combined) were below 1 (0.476) and this value is considered **negligible**.

Assessment

Survey Constraints

119. There were no constraints to survey noted during either the transects or automated monitoring sessions. Meteorological conditions were reasonably favourable for bat activity, access to site was unimpeded and all equipment functioned normally. As a consequence, the data provided is considered to be sound and sufficient to allow an assessment to be completed.

Discussion

120. Recent University of Exeter / DEFRA research has led NED to adopting a more precautionary approach when assessing the likely impact of wind turbines on bat populations. NED also considers that any proposed mitigation must consider the results of the recent research.

121. Therefore, a review of the DEFRA report was undertaken with specific reference to the site at Magheramore.

122. The DEFRA (2016) report concluded that: -

- Bat casualty rates at British wind farms are similar to those recorded elsewhere in Europe. At a third of sites studied no casualties were found. From the DEFRA project it is not possible to conclude whether or not there is an impact on local or national bat populations;

- The species most at risk from collisions are common pipistrelle, soprano pipistrelle and noctule bats;
- Casualty rates are highly variable. Most of this variability appears to be due to site-specific factors, and is not simply explained by differences in bat activity levels; collision risk is generally lowest at locations with low bat activity;
- The size of the wind turbine installation had no link with the per turbine casualty rate;
- Turbines with larger blade lengths pose an increased risk to bats, and this is stronger predictor than the height of the nacelle;
- Most fatalities occur on nights of relatively low mean wind speed (<5m/s at ground level). All casualties occurred on nights with mean wind speed <10m/s;
- The presence of woodland within a 1500m radius of the centre of wind farms appears to reduce the risk to pipistrelles but increase the risk to noctule bats;
- Trained search dogs are the most effective way of identifying dead bats at turbines;
- Acoustic recordings at ground level and nacelle give different estimates of the relative abundance of species on site, with ground level recordings underestimating the abundance of soprano pipistrelle and noctule bats within the rotor swept area;
- Bat activity shows extremely high variability. Much longer monitoring periods than are currently used as standard practice are therefore required for robust estimation of bat activity.

123. This relates to Magheramore in that;

   a. Activity levels were significantly lower at the proposed turbine than at adjacent habitat features for all species. This is likely due to the proximity of the more favourable foraging areas nearby (i.e. the River Roe & the associated woodland of Banagher Glen);
   b. There is a substantial area of broadleaved woodland (excluding conifers) within 1.5km of the 6 turbines (88ha approximately). For all bats collectively, this is associated with an 18% fall in collision risk (according to the DEFRA report). For every percentage point increase in woodland cover within the buffer;
   c. A (precautionary) Bat Monitoring & Mitigation Plan has been recommended.

Potential Impacts

Construction phase

124. Site clearance works will involve the localised removal of vegetation particularly at the access to and along the proposed upgraded access tracks. However, there are similar habitats throughout the site and surrounding area, so the removal of these vegetation features will not have a significant impact on any bat species.

125. In addition, the coniferous plantation shelterbelts will be cleared around all turbines (except T6) out to a distance of 100m. This is fall in excess of the 57.57m[8] required in order to maintain the minimum 50 buffer (blade tip to tree top height) as required by the SNH[9] (2019) guidelines.

Operation phase

126. Although bat fatalities have been reported from operational windfarms in North America and parts of Europe for almost twenty years, evidence from Britain and

[8] Calculated based on a tree height of 5m, blade length of 56m and a hub-height of 94m.

[9] Bats and Onshore Wind Turbines: Survey, Assessment and Mitigation (SNH January 2019).

Ireland has only begun to emerge in recent years. The publication in 2016 of a large-scale study by researchers at Exeter University (Mathews et al.), which was based on observations of bat activity and carcass searches at 46 operational wind farms throughout Britain (but excluding NI).

127. Bat carcasses were found at two-thirds of these sites, of which 48% of fatalities were common pipistrelles, 40% were soprano pipistrelles and 10% were noctule bats (which are closely related to Leisler's bats, and in fact this species is commonly referred to as the lesser noctule across much of the rest of Europe).

128. The estimated casualty rates, which were corrected for predator removals and the efficiency of the searchers, ranged from 0 - 5.25 bats per turbine per month, and from 0 - 77 bats per site per month, during the period of the study. As with previous studies on bats & windfarms, there was a relationship between weather conditions and recorded bat fatalities: most nights where casualties occurred (81.5%) had low mean wind speeds (less than or equal to 5m/s measured at the ground} and maximum night-time temperatures of >10ºC. However, it was also estimated that 95.3% of nights with mean wind speeds >5m/s would have no casualties.

129. The study revealed no clear relationship between recorded bat activity levels and the number of fatalities recorded at a site, as follows: "*Activity at the control locations (a proxy for pre-construction surveys) was not a useful predictor of the number of bat casualties, although it was a predictor of whether or not any casualties occurred (i.e. a binary yes/no categorisation*)".

130. The nights of highest pipistrelle activity were considered to have the highest likelihood of casualties, although bat fatalities were only recorded in one third of locations. In the Mathews et al. (2016) study, 'high activity' was defined as a night with more than 50 bat passes, which is similar to the BAI of 5 used in this assessment (i.e. 50 bat passes over a 10-hour night gives a BAI of 5).

131. Fatality research studies elsewhere in Europe have shown that, due to their different behaviour and flight style, bat species are affected differently by wind turbines (Rodrigues et al., 2014, Natural England, 2014). The only species recorded in significant numbers (and in close proximity to the proposed turbines) at Magheramore were Leisler's bats. This species is considered to have a high risk of collision with wind turbines, and a high risk that collision-related mortalities could affect their populations (Natural England, 2014). On this basis, the risk of impacts for this species are assessed below.

132. Significant activity levels were recorded on 2 nights at T1 (25/26 & 26/27 May) & 1 night at T3 (7/8 July). Although overall, there were significant levels of bat activity (i.e. a BAI of >5) at these turbines on 1-2 out of a total of 15 survey nights, with negligible or low activity on all other nights.

133. Therefore, these (2) turbines may present a risk to bats during the spring-summer period. It is not possible to make a prediction about the number of bats that may be affected, but in a worst-case scenario it is possible that there could be a significant impact on local populations of this species (without mitigation).

134. All bat species receive strict protection under the Conservation (Natural Habitats, etc.) Regulations (Northern Ireland) 1995 (S.I. 1995/380, as amended), under which it is an offence to kill, injure or disturb any bat species. In accordance with policy NH 2 of the Planning Policy Statement 2: Natural Heritage (DOENI, 2013), planning permission will only be granted for a development that is not likely to harm any protected species (subject to suitable mitigation measures).

Decommissioning phase

135. All decommissioning work will be carried out from internal access tracks and hardstanding areas, so it will not be necessary to clear any trees, hedgerows or other vegetation. As a result, there will be no impact on feeding areas or commuting routes.

Mitigation

136. The Project ECoW will carry out a pre-construction BRP survey on any trees to be removed along the route of the access track into the site. This is required to take account to any changes in the status of any trees which may have taken place between the surveys undertaken to inform the EcIA and the commencement of construction.

137. Under the precautionary principle, and due to the presence of several species of bat know for open-air foraging (i.e. considered at risk from turbine associated mortality; Leisler's bat (N. leisleri) high risk; and Common pipistrelle (P. pipistrellus); Soprano pipistrelle (P. pygmaeus) medium risk) a Bat Monitoring & Mitigation Plan (BMMP) has been recommended.

138. Monitoring, (in the form of bat mortality surveys), will be undertaken for the first 3-years (post-consent (if approved)) and will be reviewed annually to determine whether remedial action is required to mitigate the effects of the Development on bats. In the event that a bat carcass if found, NIEA NED will be immediately contacted in order to discuss/agree the implementation of mitigation measures.

139. The BMMP will be agreed with NIEA/The Council and monitoring will be undertaken in years 1, 2 & 3 and will be reviewed after each survey period to determine whether remedial action is required to mitigate the effects of the Development on bats. At the end of year 5, the data will be reviewed to determine whether monitoring should continue.

Frequency of searches and number of turbines to be searched

140. It is recommended that systematic searches should be conducted within a 100m x 100m grid centred on the turbine being monitored. Two search periods are recommended, spring (based on the results of the automated monitoring) with a second round during either summer or autumn. Three turbines will be searched during each visit, and these will be selected at random across the year.

141. Searches will be conducted at 2 to 4-day intervals (based on National Bats and Wind Turbines study recommendations). Data must be obtained from the turbine operators on whether or not the target turbine was operational on the night preceding the search, with the surveying protocol being adjusted as necessary if the turbines were either non-operational or were not rotating because of a lack of wind.

142. To maximise the duration of monitoring during each season, whilst maintaining low carcass removal rates, it is recommended that surveying should be split into blocks as illustrated below. This is the spring schedule, which will be repeated during summer or autumn (and alternated across the three years of the programme).

Table 32 - Summary of proposed schedule for carcasses searches (spring)

Days 1-10	Days 11-20	Days 21-30	Days 31-40	Days 41-50	Days 51-60
Initial 'sweep' then	*No Survey*	*Initial 'sweep' then survey*	*No survey*	*Initial 'sweep' then survey*	*No survey*

survey alternate days (d2, d4, d6, d8, d10)		*alternate days*		*alternate days*	

Bat Carcass (Mortality) Searches

143. Bat carcass searches will be undertaken using a specialist ECoW; and will only take place the morning after optimal conditions for bats have occurred. These are defined as;

- <5m/s ground wind speed,
- >10ºC of temperature (1 hour after dusk),
- no rain, and
- after a warm day of similar settled conditions (i.e. the dusk should have a peak in bat activity in the area).

144. Carcass searches will commence one hour after dawn to minimise the potential for carcass removal by predators.

145. This approach has been selected to maximise the likelihood of finding bat carcasses, which is essential in enabling predicted bat mortality to be accurately estimated. Bat carcasses will be collected (if found) to enable accurate species identification using DNA where required.

Meteorological Data

146. Simultaneous daily collection of meteorological data including wind speed, temperature, and precipitation will be undertaken at the turbine location, alongside bat carcass searches to identify the effect on levels of bat activity at the turbine.

Operational curtailment

147. All turbine blades shall be "feathered" when wind speeds are below the "cut-in speed" of the operational turbines. This shall involve pitching the blades to 90 degrees and/or rotating the blades parallel to the wind direction to reduce the blade rotation speeds below two revolutions per minute while idling. This will substantially reduce the risk of bats being struck by idling blades, and will reduce the spatial extent of low-pressure vortices in the wake of the blades (i.e. will substantially reduce the potential for barotrauma to occur).

Remedial Measures

148. The trigger threshold for remedial measures will be linked to ‘significance’ in line with the CIEEM guidelines for EcIA. Remedial measures will be triggered by an impact predicted to be of significance to bats at the Local level or greater.

149. For geographic context, the local level is considered to represent the site boundary plus a 15km radius. A significant effect would be triggered where the level of bat mortality is considered to reduce the ability of the bat population at the Local scale to sustain a viable and stable population, as informed by monitoring.

150. The requirement for and design of additional remedial measures will depend upon the findings and conclusions of monitoring and specific measures will be developed as

appropriate to mitigate and significant impact predicted (those considered significant to bat populations at the Local scale or above). Where significant impacts are predicted, potential remedial options may include, but are not limited to, the feathering of the turbine.

Conclusions

151. The implementation of the BMMP should substantially reduce the risk of fatalities at the proposed windfarm. There is a high degree of confidence in the effectiveness of the measures described (as it has been demonstrated to reduce bat fatalities in peer-reviewed studies (e.g. Arnett et al. 2013), and is widely implemented elsewhere in Europe.

152. Overall, the potential impacts to the local bat population (and in particular to Leisler's bats) should be reduced to a **not significant** with the implementation of the mitigation measures (as outlined above).

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Annex 1 – Static Detector Data (2018)

Static Detector Monitoring Results

Spring

T1	NYLE	PIPI	PIPY	PINA	Myotis spp
22nd – 23rd May	28	5	1	0	0
23rd – 24th May	24	9	0	0	1
24th – 25th May	10	20	7	2	0
25th – 26th May	38	10	7	0	0
26th – 27th May	82	21	11	0	1
Totals	**182**	**65**	**26**	**2**	**2**

All nights data combined – five nights at 8 hours recording time per night = 40 hours recording

	NYLE	PIPI	PIPY	PINA	Myotis spp
Total Passes	182	65	26	2	2
Passes (per/hr)	**4.55**	**1.625**	**0.65**	**0.05**	**0.05**

T2	NYLE	PIPI	PIPY	PINA	PLAUR
28th – 29th May	7	1	0	2	0
29th – 30th May	10	1	1	0	0
30th – 31st May	12	1	1	1	1
31st – 1st June	8	1	0	0	0
1st – 2nd June	41	3	0	0	0
Totals	**78**	**7**	**2**	**3**	**1**

All nights data combined – five nights at 8 hours recording time per night = 40 hours recording

	NYLE	PIPI	PIPY	PINA	PLAUR
Total Passes	78	7	2	3	1
Passes (per/hr)	**1.95**	**0.175**	**0.05**	**0.075**	**0.025**

T2 Feature	NYLE	PIPI	PIPY	Myotis spp
28th – 29th May	14	2	0	0
29th – 30th May	14	2	0	1
30th – 31st May	60	45	4	1
31st – 1st June	33	26	6	0
1st – 2nd June	142	10	1	1
Totals	**263**	**85**	**11**	**3**

All nights data combined – five nights at 8 hours recording time per night = 40 hours recording

	NYLE	PIPI	PIPY	Myotis spp
Total Passes	263	85	11	3
Passes (per/hr)	**6.575**	**2.125**	**0.275**	**0.075**

T3	NYLE	PIPI	PIPY	PLAUR	Myotis spp
28th – 29th May	6	0	0	0	0
29th – 30th May	3	4	0	0	0
30th – 31st May	23	1	1	0	0
31st – 1st June	16	3	1	0	0
1st – 2nd June	23	2	0	1	1
Totals	**71**	**10**	**2**	**1**	**1**

All nights data combined – five nights at 8 hours recording time per night = 40 hours recording

	NYLE	PIPI	PIPY	PLAUR	Myotis spp
Total Passes	71	10	2	1	1
Passes (per/hr)	**1.775**	**0.25**	**0.05**	**0.025**	**0.025**

T3 Feature	NYLE	PIPI	PIPY	PINA	PLAUR	Myotis spp
28th – 29th May	7	94	17	1	0	0
29th – 30th May	14	51	7	0	0	2
30th – 31st May	88	178	23	4	0	1
31st – 1st June	93	72	22	6	0	0
1st – 2nd June	132	38	0	0	2	0
Totals	**334**	**433**	**69**	**11**	**2**	**3**

All nights data combined – five nights at 8 hours recording time per night = 40 hours recording

	NYLE	PIPI	PIPY	PINA	PLAUR	Myotis spp
Total Passes	334	433	69	11	2	3
Passes (per/hr)	**8.35**	**10.8**	**1.725**	**0.275**	**0.05**	**0.075**

T4 Feature	NYLE	PIPI	PIPY	PINA
22nd – 23rd May	3	1	1	0
23rd – 24th May	7	4	2	1
24th – 25th May	52	41	2	0
25th – 26th May	24	5	2	0
26th – 27th May	18	8	3	0
Totals	**104**	**59**	**10**	**1**

All nights data combined – five nights at 8 hours recording time per night = 40 hours recording

	NYLE	PIPI	PIPY	PINA
Total Passes	104	59	10	1
Passes (per/hr)	**2.6**	**1.475**	**0.25**	**0.025**

T5	NYLE	PIPI	PIPY	PLAUR
22nd – 23rd May	8	0	0	0
23rd – 24th May	5	0	0	0
24th – 25th May	12	0	0	0
25th – 26th May	30	5	3	2
26th – 27th May	6	0	2	2
Totals	**61**	**5**	**5**	**4**

All nights data combined – five nights at 8 hours recording time per night = 40 hours recording

	NYLE	PIPI	PIPY	PLAUR
Total Passes	61	5	5	4
Passes (per/hr)	**1.525**	**0.125**	**0.125**	**0.1**

T5 Feature	NYLE	PIPI	PIPY	PLAUR	Myotis spp
22nd – 23rd May	5	1	1	0	0
23rd – 24th May	5	10	5	0	1
24th – 25th May	16	16	3	0	1
25th – 26th May	36	2	2	2	0
26th – 27th May	3	4	0	0	0
Totals	**65**	**33**	**11**	**2**	**2**

All nights data combined – five nights at 8 hours recording time per night = 40 hours recording

	NYLE	PIPI	PIPY	PLAUR	Myotis spp
Total Passes	65	33	11	2	2
Passes (per/hr)	**1.625**	**0.825**	**0.275**	**0.05**	**0.05**

T6	NYLE	PIPI	PIPY
28th – 29th May	3	0	0
29th – 30th May	4	0	1
30th – 31st May	3	1	2
31st – 1st June	3	2	0
1st – 2nd June	4	4	5
Totals	**17**	**7**	**8**

All nights data combined – five nights at 8 hours recording time per night = 40 hours recording

	NYLE	PIPI	PIPY
Total Passes	17	7	8
Passes (per/hr)	**0.425**	**0.175**	**0.2**

Summer

T1	NYLE	PIPI	PIPY	PINA	PLAUR	Myotis spp
7th – 8th June	4	5	0	0	0	0
8th – 9th June	6	13	1	0	0	0
9th – 10th June	7	13	1	1	2	1
10th – 11th June	6	7	1	0	0	1
11th – 12th June	7	11	0	0	0	2
Totals	**30**	**49**	**3**	**1**	**2**	**4**

All nights data combined – five nights at 8 hours recording time per night = 40 hours recording

	NYLE	PIPI	PIPY	PINA	PLAUR	Myotis spp
Total Passes	30	49	3	1	2	4
Passes (per/hr)	**0.75**	**1.225**	**0.075**	**0.025**	**0.05**	**0.1**

T2	NYLE	PIPI	PIPY	PINA	PLAUR
2nd – 3rd June	11	1	1	0	0
3rd – 4th June	34	6	1	0	2
4th – 5th June	28	5	0	0	0
5th – 6th June	9	2	1	1	1
6th – 7th June	5	1	0	0	1
Totals	**87**	**15**	**3**	**1**	**4**

All nights data combined – five nights at 8 hours recording time per night = 40 hours recording

	NYLE	PIPI	PIPY	PINA	PLAUR
Total Passes	87	15	3	1	4
Passes (per/hr)	**2.175**	**0.375**	**0.075**	**0.025**	**0.1**

T2 Feature	NYLE	PIPI	PIPY	PLAUR	Myotis spp
2nd – 3rd June	82	24	2	0	0
3rd – 4th June	137	21	5	1	0
4th – 5th June	86	8	1	1	2
5th – 6th June	51	14	2	1	0
6th – 7th June	3	3	2	1	1

Totals	359	70	12	4	3

All nights data combined – five nights at 8 hours recording time per night = 40 hours recording

	NYLE	PIPI	PIPY	PLAUR	Myotis spp
Total Passes	359	70	12	4	3
Passes (per/hr)	**8.975**	**1.75**	**0.3**	**0.1**	**0.075**

T3	NYLE	PIPI	PIPY	PLAUR
4th – 5th July	1	0	0	0
5th – 6th July	16	5	0	0
6th – 7th July	6	1	0	0
7th – 8th July	49	0	2	0
8th – 9th July	15	2	0	1
Totals	**87**	**8**	**2**	**1**

All nights data combined – five nights at 8 hours recording time per night = 40 hours recording

	NYLE	PIPI	PIPY	PLAUR
Total Passes	87	8	2	1
Passes (per/hr)	**2.175**	**0.2**	**0.05**	**0.025**

T3 Feature	NYLE	PIPI	PIPY	Myotis spp
4th – 5th July	1	0	1	0
5th – 6th July	17	3	1	1
6th – 7th July	8	5	0	0
7th – 8th July	27	209	1	0
8th – 9th July	11	88	5	0
Totals	**64**	**305**	**8**	**1**

All nights data combined – five nights at 8 hours recording time per night = 40 hours recording

	NYLE	PIPI	PIPY	Myotis spp
Total Passes	64	305	8	1
Passes (per/hr)	**1.6**	**7.625**	**0.2**	**0.025**

T4	NYLE	PIPI	PIPY	PINA	PLAUR
7th – 8th June	0	0	0	0	0
8th – 9th June	5	1	0	0	1
9th – 10th June	18	1	0	2	1
10th – 11th June	4	1	0	0	0
11th – 12th June	4	2	1	1	0
Totals	**31**	**5**	**1**	**3**	**2**

All nights data combined – five nights at 8 hours recording time per night = 40 hours recording

	NYLE	PIPI	PIPY	PINA	PLAUR
Total Passes	31	5	1	3	2
Passes (per/hr)	**0.775**	**0.125**	**0.025**	**0.075**	**0.05**

T4 Feature	NYLE	PIPI	PIPY	PLAUR	Myotis spp
7th – 8th June	1	0	0	1	0
8th – 9th June	28	7	0	1	0
9th – 10th June	34	8	1	0	1
10th – 11th June	12	10	0	1	0
11th – 12th June	5	7	0	2	0
Totals	**80**	**32**	**1**	**5**	**1**

All nights data combined – five nights at 8 hours recording time per night = 40 hours recording

	NYLE	PIPI	PIPY	PLAUR	Myotis spp
Total Passes	80	32	1	5	1
Passes (per/hr)	**2**	**0.8**	**0.025**	**0.125**	**0.025**

T5	NYLE	PIPI	PIPY	PINA	PLAUR	Myotis spp
7th – 8th June	4	2	1	0	0	0
8th – 9th June	4	2	0	0	0	0
9th – 10th June	6	6	0	0	1	1
10th – 11th June	6	1	1	1	0	1
11th – 12th June	2	2	0	0	0	1
Totals	**22**	**13**	**2**	**1**	**1**	**3**

All nights data combined – five nights at 8 hours recording time per night = 40 hours recording

	NYLE	PIPI	PIPY	PINA	PLAUR	Myotis spp
Total Passes	22	13	2	1	1	3
Passes (per/hr)	**0.55**	**0.325**	**0.05**	**0.025**	**0.025**	**0.075**

T5 Feature	NYLE	PIPI	PIPY
7th – 8th June	33	1	0
8th – 9th June	2	8	0
9th – 10th June	17	4	1
10th – 11th June	13	0	0
11th – 12th June	6	0	0
Totals	**71**	**13**	**1**

All nights data combined – five nights at 8 hours recording time per night = 40 hours recording

	NYLE	PIPI	PIPY
Total Passes	71	13	1
Passes (per/hr)	**1.775**	**0.325**	**0.025**

T6	NYLE	PIPI	PIPY
2nd – 3rd June	1	2	3
3rd – 4th June	14	1	0
4th – 5th June	5	0	1
5th – 6th June	4	4	1
6th – 7th June	2	3	3
Totals	**26**	**10**	**8**

All nights data combined – five nights at 8 hours recording time per night = 40 hours recording

	NYLE	PIPI	PIPY
Total Passes	26	10	8
Passes (per/hr)	**0.65**	**0.25**	**0.2**

Autumn

T1	MYOTIS SPP	PINA
5th – 6th Oct	-	-
6th – 7th Oct	-	-
7th – 8th Oct	-	-

8th – 9th Oct	1	-
9th – 10th Oct	-	1
Totals	**1**	**1**

All nights data combined – five nights at 12 hours recording time per night = 60 hours recording

	MYOTIS SPP	PINA
Total Passes	1	1
Passes (per/hr)	**0.016**	**0.016**

T2	PIPI	PIPY	NYLE	MYOTIS SPP
5th – 6th Oct	2	1	1	-
6th – 7th Oct	-	-	-	-
7th – 8th Oct	9	2	1	-
8th – 9th Oct	-	-	1	-
9th – 10th Oct	-	-	-	1
Totals	**11**	**3**	**3**	**1**

All nights data combined – five nights at 12 hours recording time per night = 60 hours recording

	PIPI	PIPY	NYLE	MYOTIS SPP
Total Passes	11	3	4	1
Passes (per/hr)	**0.18**	**0.05**	**0.066**	**0.016**

T2 Feature	PIPI	PIPY	NYLE
5th – 6th Oct	-	1	-
6th – 7th Oct	-	-	-
7th – 8th Oct	3	-	3
8th – 9th Oct	1	2	1
9th – 10th Oct	-	1	-
Totals	**4**	**4**	**4**

All nights data combined – five nights at 12 hours recording time per night = 60 hours recording

	PIPI	PIPY	NYLE
Total Passes	4	4	4
Passes (per/hr)	**0.066**	**0.066**	**0.066**

T3	PIPI	PIPY	NYLE
5th – 6th Oct	-	-	-
6th – 7th Oct	1	2	-
7th – 8th Oct	-	-	-
8th – 9th Oct	9	13	1
9th – 10th Oct	2	-	1
Totals	**12**	**15**	**2**

All nights data combined – five nights at 12 hours recording time per night = 60 hours recording

	PIPI	PIPY	NYLE
Total Passes	12	15	2
Passes (per/hr)	**0.2**	**0.25**	**0.033**

T3 Feature	PIPI	PIPY
5th – 6th Oct	-	1
6th – 7th Oct	-	-
7th – 8th Oct	2	-

8th – 9th Oct	-	-
9th – 10th Oct	-	-
Totals	**2**	**1**

All nights data combined – five nights at 12 hours recording time per night = 60 hours recording

	PIPI	PIPY
Total Passes	2	1
Passes (per/hr)	**0.033**	**0.016**

T4	PIPI	NYLE	MYOTIS SPP
5th – 6th Oct	1	1	1
6th – 7th Oct	-	-	-
7th – 8th Oct	-	-	-
8th – 9th Oct	-	1	-
9th – 10th Oct	-	-	-
Totals	**1**	**2**	**1**

All nights data combined – five nights at 12 hours recording time per night = 60 hours recording

	PIPI	NYLE	MYOTIS SPP
Total Passes	1	2	1
Passes (per/hr)	**0.016**	**0.033**	**0.016**

T5	PIPI	PIPY	NYLE	MYOTIS SPP
5th – 6th Oct	1	1	1	-
6th – 7th Oct	-	-	-	-
7th – 8th Oct	1	-	9	-
8th – 9th Oct	-	-	1	1
9th – 10th Oct	-	-	-	-
Totals	**2**	**1**	**11**	**1**

All nights data combined – five nights at 12 hours recording time per night = 60 hours recording

	PIPI	PIPY	NYLE	MYOTIS SPP
Total Passes	2	1	11	1
Passes (per/hr)	**0.033**	**0.016**	**0.18**	**0.016**

T5 Feature	PIPI	PIPY	NYLE	MYOTIS SPP
5th – 6th Oct	5	3	1	3
6th – 7th Oct	2	-	-	-
7th – 8th Oct	10	2	10	1
8th – 9th Oct	-	2	1	-
9th – 10th Oct	-	-	-	-
Totals	**17**	**7**	**12**	**4**

All nights data combined – five nights at 12 hours recording time per night = 60 hours recording

	PIPY	PIPI	NYLE	MYOTIS SPP
Total Passes	17	7	12	4
Passes (per/hr)	**0.28**	**0.116**	**0.2**	**0.066**

T6	PIPI	PIPY	NYLE	MYOTIS SPP
5th – 6th Oct	14	6	-	-
6th – 7th	-	-	-	-
7th – 8th	-	3	-	-
8th – 9th	-	-	4	1

9th – 10th	-	-	-	-
Totals	**14**	**9**	**4**	**1**

All nights data combined – five nights at 12 hours recording time per night = 60 hours recording

	PIPI	PIPY	NYLE	MYOTIS SPP
Total Passes	14	9	5	1
Passes (per/hr)	**0.23**	**0.15**	**0.08**	**0.016**

Transect Results (150 mins)

29th May 2018

	PIPY	PINA
Total Passes	3	1
Passes (per/hr)	**1.2**	**0.4**

9th August 2018

	NYLE
Total Passes	3
Passes (per/hr)	**1.2**

6th September 2018

	PIPI	PIPY
Total Passes	2	1
Passes (per/hr)	**0.8**	**0.4**

Annex 2 – Photographs

Photo 1 – SM4 ZC static detector on a post at the proposed location of T1.

Photo 2 – SM4ZC static detector at the proposed location of T2.

Photo 3 – Paired SM4ZC static detector on a post at the habitat feature north of T2

Photo 4 – SMZC detector on a post at the proposed location of T3.

Photo 5 – Paired SMZC detector on a post at the habitat feature to the north west of T3.

Photo 6 – SMZC detector on a post at the proposed location of T4.

Photo 7 – SM4ZC detector on a post at the proposed location of T5.

Photo 8 – Paired SM4ZC detector attached to a tree at the habitat feature east of T5.

Photo 9 – An SM2 Bat+ detector on the ground at the proposed location of T6.

Annex 3 – Figures

See Figures 6.3 – 6.6 in Environmental Statement

Appendix 6.4 Outline Habitat Management Plan (oHMP)

Outline Habitat Management Plan

Magheramore Windfarm, Co. Derry

For: res power for good

141/2019-02

June 2019

Document history

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Introduction

1. This outline Habitat Management Plan (oHMP) was produced by Blackstaff Ecology on behalf of the windfarm owner as part of the EIA for the proposal. The HMP sought to deliver ecological mitigation and enhancement measures associated with the Magheramore Windfarm. It is intended to inform a broad audience including DAERA (NIEA), Ecologists and Local Authority Planning Officers. It is intended to be simple and effective.

2. It was envisaged that the HMP would represent an iterative and adaptive process which will continue to be informed by new guidance and best practice and will be guided by the Project Ecologist/ECoW. The Project Ecologist will liaise with appropriate specialists from the Council, NIEA and the windfarm owner. Subsequent document review will be informed by monitoring, to ensure the scope of the HMP remains appropriate and the objectives successfully achieved.

Background Information

3. The project has been subject to Environmental Impact Assessment through which a range of impacts on ecological features have been identified and mitigation measures set out.

4. This oHMP Outline Habitat Management Plan (OHMP) focuses the compensation measures on sensitive grazing management and the restriction of damaging activities across 15.5ha of lands under the applicant's control. In addition, a further 1.1ha of natural woodland regeneration will also be facilitated as part of the oHMP and 2.1km of replacement hedgerow will be planted/translocated.

5. This oHMP ensures that standard DAERA requirements are appropriately considered before, during and following construction works. This oHMP also considers the requirement for an appropriate Decommissioning and Restoration Plan.

Planning Policy Statement 2

6. Planning Policy Statement 2 (Natural Heritage) - Policy NH 5 Habitats, Species or Features of Natural Heritage Importance states that; *Planning permission will only be granted for a development proposal which is not likely to result in the unacceptable adverse impact on, or damage to known*:
    - *priority habitats;*
    - *priority species;*
    - *active peatland;*
    - *ancient and long-established woodland;*
    - *features of earth science conservation importance;*
    - *features of the landscape which are of major importance for wild flora and fauna;*
    - *rare or threatened native species;*
    - *wetlands (includes river corridors); or*
    - *other natural heritage features worthy of protection.*

7. A development proposal which is likely to result in an unacceptable adverse impact on, or damage to, habitats, species or features may only be permitted where the benefits of the proposed development outweigh the value of the habitat, species or feature. In such cases, appropriate mitigation and/or compensatory measures will be required.

8. Priority habitats and species may fall within and beyond designated sites. They include both European (as identified under Annex I and II of the Habitats Directive and Annex I of the

Birds Directive) and Northern Ireland priority habitats and species, identified through the Northern Ireland Biodiversity Strategy (NIBS) 27 (in pursuance of the statutory duties under the Wildlife and Natural Environment (NI) Act 2011).

9. To ensure international and domestic responsibilities and environmental commitments with respect to the management and conservation of biodiversity are met, the habitats, species and features mentioned above are material considerations in the determination of planning applications.

10. It is therefore expected that wind farm proposals will provide measures that enhance the site for biodiversity. Accordingly, RES Ltd (supported by Blackstaff Ecology) have been exploring opportunities for habitat management at the site, which would operate throughout the wind farm's consented lifespan through a dedicated HMP.

Project Ecologist/ECoW

11. The role of the Project Ecologist/ECoW will be to measure the success of the HMP in line with objectives, ensure the frequency of monitoring is adhered to (and after year five), assess the requirement for any remedial measures or changes to the existing prescriptions in light of monitoring results and new emerging guidance and best practice. The ECoW will consult with and take advice (as appropriate) from representatives from the following key stakeholders:

- *DAERA (NIEA NED)*
- *The Planning Authority*
- *The windfarm owner*

Habitat Losses

12. The Magheramore Windfarm will result in permanent habitat loss of 0.3ha and temporary habitat loss of 0.5ha, largely comprising degraded blanket bog/wet (dwarf shrub) heath. In addition, 2.1km of hedgerow will also be lost. Habitat loss figures have been taken from Chapter 6 (of the Magheramore ES) - Ecology.

13. A summary of the extent of loss of habitat types which represent Priority Habitats in the Northern Ireland Habitat Action Plan (HAP) are shown in Table 1 below. The habitat calculations provided in the ES distinguish between the 'permanent' and 'temporary' habitat loss. Also, the areas of 'permanent' represent real world calculations based on the experience of the author and best practice and are not 'idealised' calculations which can occasionally underestimate the 'permanent' while overestimating the 'temporary' habitat loss.

14. In summary, the loss of HAP habitats will comprise 0.8ha of degraded bog/heath. In addition, the ES reported a loss of 2.1km of hedgerow, which is also a NI Priority Habitat. The extent of habitat loss has been used to inform the prescriptions detailed in this HMP, including a commitment to enhance approximately **20 times** the area of NI Priority Habitat lost as result of the Development.

Table 1: Temporary and Long-Term Habitat Loss (hectares)

Habitat	Temporary Loss	Long-term Loss	Total Loss
Wet heath (M15)	0.15	0.25	0.4
Dry/wet modified bog (M19)	0.15	0.25	0.4
Totals (hectares)	**0.3**	**0.5**	**0.8**

Calculated using a continuous 2.5m buffer around all construction structures and a 7m wide track (5m for running surface and 1m either side for drainage.

15. The ES chapter specified a range of mitigation measures to avoid, or where this was not possible, minimise detrimental effects on certain habitats and species. Enhancement

measures were also specified to achieve benefits for biodiversity within the site as a whole, in accordance with planning policy requirements. It is these mitigation and enhancement measures that will be delivered via this outline HMP.

NIEA HAP – Minimum Habitat Targets

16. Several NI Habitat Action Plans (HAP's) have been produced by NIEA. Each HAP contains a series of action plans covering the nationally threatened or declining habitats in Northern Ireland. Each action plan includes actions aimed at safeguarding that particular habitat. As a result, the HAP's for blanket bog, upland heath, and woodland (various plans) have been used to guide and develop the objectives set out in this HMP to maximise the contribution towards the aims of the NI HAP. Table 2 below demonstrates how the HMP objectives will contribute to the NI HAP targets.

17. NIEA has previously requested that habitat establishment should seek to provide approximately five times the habitat area lost for habitat types represented in the HAP. As a result, minimum target areas have been established for each habitat type and are also provided in Table 2 below.

Table 2 - Minimum establishment targets for NI HAP habitats

Relevant component habitats	Associated species of principal importance	Contributing HMP objectives	Area to be lost	Area proposed to mitigate for the loss
Blanket bog/upland heath	- skylark, meadow pipit, cuckoo, grasshopper warbler, curlew, lapwing, golden plover, red grouse, hen harrier - Irish hare - Juniper, bog orchid, stags horn club moss, globeflower, wood bitter vetch	Establishment of heathland and acid/marshy grassland mosaic in semi-improved grassland Establishment of heathland and acid/marshy grassland mosaic alongside new access tracks	0.8 ha	15.5 ha
Mixed Ashwoods	- Red Squirrel, - Common Pipistrelle, - Soprano Pipistrelle - Spotted Flycatcher, - Bullfinch, - Song Thrush, - Scottish wood ant - Small cow wheat, and - The Lichen *Enterographa elaborate*.	Establish 160 ha of mixed ashwoods by 2010. Establish a further 180 ha of mixed ashwoods by 2015.	0	1.1 ha

Hedgerows	- Red Squirrel, - Common Pipistrelle, - Soprano Pipistrelle - Linnet, - Reed Bunting, - Spotted Flycatcher, - Tree Sparrow, - Bullfinch, - Song Thrush and, - Purple ramping fumitory.	Maintain the current distribution and extent of species-rich hedgerows. Maintain overall numbers of hedgerow trees within each county at least at current levels, through ensuring a balanced age structure.	2.1 km	2.1 km

Mitigation for NI Priority Habitats

Background

18. The objective of this mitigation is to enhance & restore 15.5ha of former heath/blanket bog to compensation for the habitat loss resulting from the proposal. This will be achieved through the use of grazing prescriptions and drain blocking. The oHMP has been produced collaboratively and all proposed measures have been agreed with the landowners.

19. The overall aim of the oHMP is to bring the habitat within the proposed habitat management area into favourable (conservation) condition via sensitive grazing management and the restriction of damaging activities (e.g. over-stocking, supplementary feeding and drainage).

20. It is also proposed to establish 1.1ha of native woodland (mixed ashwoods) via natural regeneration over 30-years.

21. In addition, 2.1km of hedgerows will be translocated/replaced in order to compensate for the loss of 2.1km of hedgerow during the upgrading of existing site tracks within the LUAC.

Habitat Management

22. Nearly all species-rich swards require management if they are not to be taken over by coarser vegetation, scrub, and eventually by woodland. The nature and speed of this process; and hence the intensity and frequency of management required to counter it, vary greatly with the depth and fertility of the soil, and with topography and local climate.

23. The proposed HMA will require a few years to develop after the initial removal of grazing for 3-5 years. After this light grazing (preferably cattle) can be introduced at the behest of the project ECoW in order to improve sward diversity. The management of the habitat will be grazed in the traditional way as grazed swards usually support a greater diversity; however, the stocking rates will be much reduced over historic levels, which should further allow for the gradual recovery of the habitats over the 30-year lifetime of the windfarm.

24. Grazing by cattle is the desired management tool (however, sheep are permitted as long as the overall stocking densities are not exceeded). Grazing will be to NICMS levels for blanket bog (i.e. 0.075 LU/Ha).

Prescriptions

Objective: Allow natural regeneration within the HMA for 3-5 years

25. No livestock will be permitted on the HMA for 3-5 years in order to allow the vegetation to recover.[1]

Objective: Re-establish the characteristic floristic diversity of the HMA via ongoing management

26. The aim of this management prescription is therefore to increase the floristic diversity of the habitat. The vegetation within the habitat management area will be managed in line with the following key measures:

- No grazing will be permitted between 1 November and 28/29 February.
- Grazing is permitted between 01 March and 31 October at a stocking density of 0.075 LU/ha (cattle should be included in the grazing regime).
- No use of inorganic fertilisers, lime or animal slurry.
- Cultivation, reseeding, reclamation, infilling, dumping or application of herbicide, pesticide, sheep dip, poultry litter or any other material will not be permitted.
- Installation of new drainage systems will not be permitted.
- Supplementary feeding will not be permitted.
- No poaching of ground will be permitted.
- Noxious weeds may be controlled by cutting between 15 July and 15 March, or with herbicides applied using a spot sprayer only.
- No peat cutting.
- No burning, flailing or harrowing of vegetation.
- Ditches/drains will be blocked (i.e. water-levels will be maintained as close as possible to bank height).

Objective: Establish mixed ashwood via natural regeneration

27. Natural regeneration is the best way of creating a new woodland for wildlife and expanding ancient semi natural woodland. Trees established by regeneration are more likely to be better adapted to local conditions and will result in a more natural composition suited to a variety of wildlife.

28. Natural regeneration occurs when trees develop naturally from seeds that have fallen from a nearby woodland. New trees can also be produced next to existing woodland by suckering or layering. Tree seeds are moved into a new area by gravity, wind, mammals and birds. The spread of natural regeneration is dependent on the method of dispersal, the speed of growth of the species of tree and the distance from existing woodland. For instance, cherry seeds are spread by birds, mammals and gravity so can potentially be transported far. Ash tree seeds, however are dispersed by wind so would only grow less than 100 metres from existing trees.

29. The aim of this management prescription is to establish 1.1ha of native woodland adjacent to Banagher Glen SAC. The vegetation within the proposed natural regeneration area will remain ungrazed for 30-years.

[1] Should the ECoW deem grazing to be necessary in order to maintain the improvements in sward diversity; cattle/sheep will be permitted at 0.075 LU/Ha.

30. The fencing will be checked on a weekly basis and maintained as required. Deer browsing/presence will be monitored and fencing undertaken in the event >20% of tree saplings show browsing damage.

31. Non-native invasive species (i.e. *rhododendron ponticum*) will be controlled in the event that these are recorded during monitoring works.

Objective: Replace any/all hedgerows lost during construction

32. Translocate[2] existing hedges where possible under the supervision of an ECoW experienced in the use of the technique. Where not feasible plant replacement hedging (staggered double row primarily hawthorn/blackthorn) and fence off from grazing livestock (and protect from rabbit damage).

33. In addition, intersperse 5-6 native species along each 30m length (e.g. oak, ash, aspen, bird cherry, rowan, downy birch, spindle, guelder rose, Scot's pine, yew) in order to produce a species-rich hedgerow. Fencing should be 2m wide in order to give a wide base to the hedge which is also beneficial for biodiversity.

Monitoring and Maintenance

34. Monitoring targets have been devised to measure the success of the objectives described above. Maintenance requirements have been established to maximise the likelihood of success. In years 1-5 the priority is a gradual improvement in species diversity and sward structure. This has been reflected in the broad nature of the targets outlined below. At Year 5, new specific habitat targets and maintenance requirements will be devised as informed by the results of habitat monitoring and assessment of achievement/failure against the targets.

35. Monitoring of the habitat management area will be undertaken using fixed $4m^2$ quadrats spaced, totalling approximately 25 quadrats. The location of quadrats will be recorded using GPS and marked using marker stakes. Quadrat locations will be re-surveyed in subsequent years. Quadrat surveys will be undertaken between June – August (inclusive). Quadrats will record vegetation structure and species % cover, including bare ground. Monitoring will also record ground conditions including topography and surface wetness.

Table 3 – Management objectives & monitoring targets

Objective	Monitoring Targets
Establish, permanent quadrats – Habitat Management Area	Record species diversity, habitat type, sward height, fixed point photograph, percentage cover, presence of animal dung, wetness - Increase in species diversity, sward height & structure. - No increase in % cover of non-target species. Quadrat surveys undertaken in year 1 prior to construction to establish species diversity (minimum of 50 (2m x 2m) quadrats). Quadrats repeated in years 1, 2, 3, 5, 10, 15, 20, 25 & 30 to assess species change.

[2] See Annex 1 for the translocation technique/procedure as recommended by Wiltshire County Council.

Establish, permanent quadrats – woodland regeneration area	Record species diversity, habitat type, sward height, fixed point photograph, percentage cover, presence of animal dung, wetness - Increase in species diversity, sward height & structure. - No increase in % cover of non-target species. Quadrat surveys undertaken in year 1 prior to construction to establish species diversity (minimum of 50 (2m x 2m) quadrats). Quadrats repeated in years 1, 2, 3, 5, 10, 15, 20, 25 & 30 to assess species change.

Mitigation for Hedgerow loss

36. The existing site tracks are 4-5m wide while the proposed new tracks are 7m wide (5m running surface). Therefore, additional land is required at the site of the existing tracks in order to construct the upgraded tracks. The track will be widened to one side; however, this will require the removal of existing hedgerows along much of the length of the existing track infrastructure. The existing hedgers primarily consist of hawthorn and are mostly well maintained by the landowner. Lengths of more mature hedgerows with greater diversity have been avoided.

37. To compensate for the hedgerow loss, the 2.1km of hedgerow will be replaced with a combination of translocation (where the existing hedgerow is sufficiently recent in origin that there I a reasonable likelihood of success); or new native hedging (double-row hawthorn/blackthorn) as previously utilised by the landowners on site. Any failure (of either the translocated hedgerow or the newly planted hedgerows (within 5 years)) will be replaced with new planting by the windfarm owner.

Timeframe

38. The timings required for management are detailed above. In summary, habitat creation and establishment will be undertaken in tandem with construction. Management operations will be undertaken as specified above and as informed by monitoring conclusions post-construction.

Implementation of HMP

Roles and Responsibilities

39. It will be the responsibility of the wind farm owner to ensure that the HMP is implemented in accordance with the specifications detailed herein for the 30-year lifetime of the wind farm. The windfarm owner will therefore assume the lead role and responsibility in ensuring tasks are undertaken in accordance with the necessary timings specified. Many of the on-site monitoring tasks and overseeing of method statements and ensuring adequate implementation by contractors during construction will be undertaken by the Ecological Clerk of Works, who will be appointed prior to commencement of construction works. Following construction, the windfarm owner will manage and oversee the operation of the wind farm including implementation of the requirements set out within this oHMP.

40. The role of DAERA NED will be primarily advisory in that they will provide support and advice as necessary to ensure that HMP prescriptions and objectives are appropriate, realistic, successfully implemented and in accordance with the requirements set out in any potential future Planning Conditions.

Reporting

41. Monitoring of specific features will be undertaken in line with the timeframes (in years 1- 5) which have been outlined previously. In line with these timings monitoring reports will be provided by end of December in each year.

Photographic Records

42. A baseline photographic record of the site will be completed prior to construction. Photographs will be mapped using 10 figure grid references and accompanied by comments as appropriate, including a compass orientation. A photographic record will be repeated every in line with the details provided in Table 3 (above). This will provide a valuable aide memoir and will include the specific habitat features including (but not limited to):

- All turbine locations;
- Access track verges; and,
- Within the Habitat Management Area.

Sharing of Data

43. Monitoring data will be provided to DAERA and The Council in a suitable format (i.e. Microsoft Excel for data, and shape file format for mapping data).

Contingency

44. The following measures will be completed in order to ensure that there is a 'Net Gain' for biodiversity and to allow for the any failure in the management prescriptions due to unforeseen events.

Protection of restored areas

45. All restored areas will be protected against livestock grazing, for at least the first 18-months (2 growing seasons), as reviewed by the ECoW. Ideally protection should be by (electric) exclusion fencing (rather than permanent fencing).

Grazing management - HMA

46. The HMA area will be closely monitoring during the first 5-years post construction. The results of the vegetation surveys will be provided/discussed with NIEA as to whether or not grazing should commence in advance of year 5.

Resourcing

47. Detailed prescriptions in terms of requirement for, and timing and frequency of tasks are detailed within specific topic sections above. This will be largely dependent on the monitoring findings. Most tasks specified will be undertaken by contracted specialists with appropriate expertise as specified below. Time and costs associated with the specified tasks will vary in line with market forces as part of the bidding and tendering process. Compliance of tasks will be monitored on site by the ECoW (during construction) and overseen by the windfarm owners environmental management team (during operation).

Table 4: Resourcing Breakdown

Task	Frequency years 1-5	Frequency year 6-30	Expertise Required
Grazing management[3]	None	per DARD CMS prescriptions	landowner
Drain blocking	Annually	Annually	Landowner
Quadrat monitoring (HMA/woodland regeneration area)	annually, from years 1-5	years 10, 15, 20, 25	ECoW
Interpretation of monitoring results, reporting and planning	annually	years 10, 15, 20, 25	ECoW

Note – drain blocking will be undertaken by the landowner; but under the supervision of the ECoW/Project Ornithologist.

Decommissioning and Restoration

48. This element of the project works is included in the outline Construction Environmental Management Plan (oCEMP) which has been prepared for the Development.

Conclusions

49. The revised oHMP has focussed the compensation measures on sensitive grazing management and the restriction of damaging activities in order to restore 15.5ha of degraded bog/heath, 1.1ha of woodland and 2.1km of hedgerow, and aims to improve the conservation status of said habitats so that at the end of the 30-year lifetime of the project that it meets the criteria as an NI Priority Habitat.

50. Overall with the successful implementation of the oHMP there should be a 'Net Gain' in biodiversity terms, which more than offsets for any habitat lost or damaged during the construction and operation of the windfarm.

References

Countryside Council for Wales, Natural England, Environment and Heritage Service, Exmoor National Park, The National Trust, RSPB, Wildlife Trusts Wales, WWT (2009) *HMP Management Planning for Nature Conservation Sites – Core Principles.* HMP Consortium

Hill, H., Fasham, M., Tucker, G., Shewry, M. and Shaw, P. (2006) *Handbook of Biodiversity Methods: survey, evaluation and monitoring*

JNCC (2001) *National Vegetation Classification: Field guide to woodland.* JNCC, Peterborough

[3] There will be no grazing for 3-5 growing seasons unless the project ECoW determines that grazing is required in order to maintain progress towards a more species-rich sward.

Annex 1 – Hedgerow Translocation Technique

Timing

Any time in the period October to March inclusive is considered suitable for hedgerow translocation, allowing the hedge to acclimatise to its new location before the summer.

Translocation should not be undertaken during hot dry spells or low temperatures resulting in ground frost. Ideal conditions are cool days with persistent light rain.

To ensure successful translocation it is essential that the hedgerow roots are exposed for as short a time as possible - they must never dry out completely. Sections of hedge must be removed and placed in to the receptor trench as soon as possible.

Site Preparation

The exact location of the receptor trench should be agreed and marked out in advance and fertiliser, water retention granules, watering equipment and topsoil (as detailed below) should be purchased and on site.

Hedge Cutting

Prior to translocation the hedge will require cutting back to reduce its size. This makes it easier to move but more importantly reduces the strain on the roots in the year following translocation.

The contractor should allow for cutting the hedge back to a height of approximately 30-60cm, and reducing the side growth back to solid wood.

Cutting should be undertaken with chainsaws, taking care to leave clean sloping cuts across stems of not less than 30 degrees.

All arisings must be removed from site.

Receptor Trench Construction

The trench must be dug at least 750 mm from the proposed site boundary line. This is to ensure that where fencing is required, the fence posts are not driven into disturbed ground, and to give sufficient room for the hedge to grow out.

The width and depth of the receptor trench will vary depending on the size of the hedgerow plants. The width of the trench will be approximately 1.5 m, however, this may need to be increased to accommodate larger sections of root. The trench will vary in depth but on average will require excavating to a depth of 1 m.

The base of the trench should be scarified and slow release Fertilizer 20:4:10 N:P:K applied at a rate of 50 g per metre. Broadleaf P4 water retention granules should also be spread along the base of the trench at a rate of 30 g per metre length.

The trench must not be allowed to dry out, so if the weather is dry, only short lengths of ditch should be dug at any one time. In dry weather allow for the trench to be open for a maximum of 1 hour. This will equate to a length of approximately 20 – 30 m at a time. In damp weather, it will be safe to dig up to 50 m at a time.

Translocation

Short sections of hedge should be dug and transferred to the receptor trench in sequence. A chainsaw operative should be available to cut roots or stems rather than breaking them with the excavator (cleanly cut roots are less susceptible to fungal infection). Safe working practices must be agreed between the plant operator and chainsaw operator.

The translocated sections must be set at the required depth within the trench, neither below or above ground level. Top soil from around the original hedge can be used around the translocated sections.

Making Good

A suitably qualified ecologist must check the translocated hedge to ensure it is sitting at the correct depth and that there is sufficient top soil around the roots. This must be undertaken as soon as possible after translocation, but only when it is safe to do so. A site specific risk assessment must be undertaken.

Any exposed roots should be carefully buried with a spade. Additional top soil may be needed to place around the root plates and provision should be made for this. Top soil should be firmed in by operatives. A dumper and small digger would facilitate this.

On completion the hedge should be well watered to ensure top soil is washed in to fill any voids. Top soil levels should be topped up if any roots become exposed.

The ground flora should be left to regenerate naturally from the translocated hedgerow root ball and soils.

Equipment

The contractor should use a suitable 360 degree excavator to be able to move the sections of hedge with the minimum ground disturbance. A low ground pressure tracked machine with a long reach should be used.

The recommended bucket width is 1.5 m, but ground condition may require a narrower bucket to be employed. The bucket should be sufficient to remove roots from a depth of approximately 1 m, though most roots will be within the first 500 mm. The width of the hedge excavated will be approximately 1.5 m.

Additional Hedgerow Planting

Where damage occurs during the translocation or where the new alignment is shorter (due to bunching up) than the original line of the hedgerow, additional planting may be required. Additional planting will also ensure that the hedgerow remains a robust linear feature for wildlife.

Contractors should allow for the planting of an additional 10 m of hedgerow using bare root transplants, to mitigate the effects of bunching up or loss due to damage. Further planting should then be

Hedgerow plants should be dominated by locally native woody species in an appropriate ratio (as per the current hedge species). 750- 900 mm bare root transplants should be planted in a double staggered row with 300 mm between plants and 300 mm between the two rows (minimum 9 plants per metre). Each plant should be protected with a 600 mm spiral rabbit guard and a support cane.

The site should be dug over to a depth of 300 mm prior to planting, incorporating slow release fertilizer (20:4:10) as directed. Additional planting should be undertaken during the dormant season (Nov– March) in suitable weather conditions.

Semi-Mature Tree Planting

A square hole one third bigger than the root balls, to a depth of the root ball or a minimum of 300 mm (i.e. a spit depth), should be dug out. Research has shown that wide rather than deep planting holes result in better tree establishment (Whitcomb, 1987) and that root penetration outside the tree pit is quicker through a square hole rather than round (Kirkham, 1990).

The soil removed from the tree pit will be broken up and returned to the tree pit with additional soil so that the final planting position is slightly raised. An appropriate fertilised (recommended by the supplier) should be mixed with the returned soil.

Inspection of the root ball should be conducted before planting. If the health, rooting or general quality are not acceptable, a specimen should not be returned to the supplier and a replacement requested.

The tree should be placed upright in the centre of the tree pit with the roots spread out around the pit to encourage outward growth. Excess or damaged roots can be pruned after consultation with the supplier.

Planting depth is critical - planting too deep is the case of a high percentage of mortality. The root collar should be level with the surrounding ground or mound top. The backfill should be firmed evenly around the roost of the tree.

Tree staking will only be used where necessary (where the root size of a newly planted tree does not provide adequate anchorage or support). The stake should extend to one third of the overall tree height. Stakes must be positioned at time of planting to minimise any damage to roots.

A mesh cage (minimum 4.0 m girth) should be provided around each newly planted tree to act as protection from pests.

Appendix 6.5 Outline Construction Environmental Management Plan (oCEMP)

Appendix 6.5 -
Outline Construction Environmental Management Plan (oCEMP)

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1.0 INTRODUCTION

This outline Construction Environmental Management Plan (oCEMP) is submitted by RES Ltd (RES). The principal objective of this document is to provide information on the methodologies to construct and decommission Magheramore Wind Farm.

As the outline CEMP is being prepared as part of the planning application, RES Ltd are yet to appoint a wind turbine manufacturer or contractors to undertake the electrical or civil engineering works. The contractor(s) appointed to construct the project will prepare detailed method statements to construct the works which will incorporate the details outlined in this outline CEMP.

This outline CEMP sets out the overarching construction management philosophy for the site and provides further details on specific activities that will be undertaken on the site.

The Annexes within the outline CEMP include information / reports produced for the Environmental Statement and to avoid unnecessary duplication they have not been reproduced in this document but signpost to the relevant location within the Environmental Statement.

1.1 Project Description

The proposed Magheramore Wind Farm includes the installation of six wind turbines with a maximum height to blade tip of 149.9m and associated infrastructure associated external electricity transformers, underground cabling, a newly created site entrance, access tracks, turning heads, crane hardstandings, control building and substation compound and energy storage containers. During construction and commissioning there would be a number of temporary works including an enabling works compound, construction compound with car parking, temporary parts of crane hardstandings and welfare facilities.

Relevant Drawings of the Site infrastructure are included as Annex 1.

Table 1.1: Outline Project Programme

TASK	CONSTRUCTION MONTH											
	1	2	3	4	5	6	7	8	9	10	11	12
Mobilisation & setup construction compound												
Site entrance and tracks												
Crane hardstandings												
Turbine foundations												
Control building & substation												
Cable installation												
Turbine deliveries												
Turbine erection												
Operational take over												

1.2 Conditions of Consent

Planning permission for the construction and operation of the Wind Farm is yet to be received. Upon receiving conditions, RES Ltd will provide an updated to illustrate how applicable conditions will be discharged, aligning current construction methods with relevant legislation and environmental protection practices.

1.3 Community Liaison

Throughout the construction period of the project, RES Ltd will maintain an open dialogue with local residents and all other interested parties. RES Ltd will ensure the local community is provided with regular updates on the progress of construction and upcoming activities through appropriate channels.

A member of staff will be appointed for responsibility of key contact between RES Ltd and the community. This person will be the nominated point of contact for local residents in connection any issues that may be raised during construction, operation and decommissioning of the wind farm.

Any change to the appointed person shall be communicated to the planning authority and the local community representatives as required.

2.0 GENERAL CONSTRUCTION MANAGEMENT PRINCIPLES

Magheramore Wind Farm will be constructed in accordance with the Environmental Statement (2019) prepared during the development stage of the project and in line with good practice outlined in the Scottish National Heritage guidance "Good Practice during Windfarm Construction" – 4th Edition 2019.

Throughout the development of the project, the aim has been to ensure the design:

- Minimises the extent of infrastructure;
- Avoids sensitive habitats;
- Minimises environmental impacts; and
- Maximises health and safety.

Where appropriate and practicable, local plant and materials will be used in order to maximise the benefit of the wind farm project to the local economy.

2.1 Environmental Management and Pollution Prevention

Specific procedures to ensure that the local environment is protected during construction works are managed through our Environmental Management System Procedures and Policies which is certified to ISO 14001.

2.1.1 Contractors Requirements

Details of the environmental management and emergency procedures to be adopted by Contractors during the construction phase are contained within the RES management system procedure Safety and Environmental Requirements of Contractors – 01059R00038.

2.1.2 Surface and Ground Water Management

In accordance with, a sustainable drainage system (SuDS) will be implemented to provide a series of surface water management techniques to mitigate any adverse impact on the hydrology of the site.

The Magheramore Wind Farm – Water Framework Directive Assessment details the design criteria and philosophy for the SuDS system. This document is included as Annex 2.

The above document also makes reference to the design of watercourse crossing, and an inventory of identified watercourse locations.

2.1.3 Water Quality Monitoring

Any potential pollution incident on site that may impact water quality will be dealt with in accordance with the Water Framework Directive Assessment. This document is included as Annex 2.

Water quality monitoring will be undertaken on discharge waters during the construction phase to ensure that the development does not impact on local watercourses and rivers.

A bespoke water monitoring strategy will be prepared and implemented by a specialist consultant, detailing monitoring locations, sampling frequency and the methodology for chemical and biological analyses. Site sensitivity will be considered when deciding on the level and periodicity of sampling and the proposed monitoring plan discussed and agreed with Water Management Unit prior to implementation.

The exact location of each sampling point will be determined during a walkover survey, and will reflect the point on all relevant controlled waters closest to the proposed active construction areas. Sampling points up- and down-stream of the construction activity will be selected to provide a full profile of the controlled waters.

A baseline report will be prepared following initial pre-construction water quality monitoring. This report will provide details of any contamination concentrations recorded and will be used to depict "uncontaminated background pollution levels" for the site.

In the event of a potential pollution incident, all relevant monitoring points would be visited and re-sampled to determine any changes relative to the baseline data. A report detailing the findings would be prepared for each incident and recommendations provided for further monitoring and / or requisite mitigation measures.

Following completion of the construction of the wind farm, all sample points will be revisited, re-sampled and analysed for a full suite of analytical parameters and a further report prepared discussing any impacts upon water quality arising from the construction process.

2.1.4 Foul Water Management

Foul drainage will be provided in agreement with the relevant authorities and most likely involve Foul effluent disposal via chemical facilities with periodic tankered removal by a licensed waste haulier for licensed offsite disposal (i.e. there shall be no emission on site).

2.1.5 Noise Management

The sources of construction noise are temporary and vary in location, duration and level as the different elements of the wind farm are constructed. Construction noise arises primarily through the operation of large items of plant and equipment such as excavators, diesel generators, vibration plates, concrete mixer trucks, rollers etc. Noise also arises due to the temporary increase in construction traffic near the site.

BS 5228-1:2009 'Noise control on construction and open sites; Part 1 – Noise' is identified as being suitable for the purpose of giving guidance on appropriate methods for minimising noise from construction activities.

For all activities, measures shall be taken to reduce noise levels with due regard to practicality and cost as per the concept of 'best practicable means' as defined in Section 72 of the Control of Pollution Act 1974.

It's proposed the following noise mitigation measures will be implemented where appropriate and in line with further guidance from BS 5228-1;

- Consideration will be given to noise emissions when selecting plant and equipment to be used on site. Where appropriate, quieter items of plant and equipment will be given preference.

- All equipment should be maintained in good working order and fitted with the appropriate silencers, mufflers or acoustic covers where applicable;

- Stationary noise sources shall be sited as far as reasonably possible from residential properties and, where necessary and appropriate, acoustic barriers installed to further reduce the impact;

- The movement of vehicles to and from site will be controlled; and

- Employees will be instructed to ensure compliance with the noise control measures adopted.

Should it be considered necessary to further reduce noise levels, mitigation measures would be considered and appropriate measures will be undertaken.

There are many strategies that could be employed to reduce construction noise levels; BS 5228-1 also states that the 'attitude to the contractor' is important in minimising the likelihood of complaints and therefore consultation with the local community should occur. Non-acoustic factors such as mud on roads and dust generation, which can also influence the overall level of complaints, will also be controlled as detailed elsewhere in this document.

In the event that noise complaints are received, the RES onsite staff member will contact the complainant and if required, visit the property to discuss the complaint and subjectively assess the noise levels. If the noise complaint is found to be merited, additional mitigation measures will be put in place.

In the event a resolution cannot be reached between RES and the complainant, the planning authority will be informed in order that they can carry out their own subjective assessment and if required agree any additional mitigation.

All noise complaints will be recorded along with actions taken to resolve the issue. These records will be available to the Council on request.

2.1.6 Dust Management

The potential issue of dust creation during the works will be weather and season dependant, therefore detailed dust management methods will be subject to the works programme and contractor working methods.

Dust management will be carried out at all times in accordance with industry best practice to ensure that any local sensitive receptors are not affected by nuisance levels of dust from the works.

The following methods of dust suppression will be considered during the construction phase of the wind farm as required:

- Site tracks to be damped down using bowser or other suitable system;

- Road sweeper to be used to remove loose material from adjacent public roads during construction;

- Cleaning of vehicles, including provision of waterless wheel washing facilities, prior to exiting site onto the public road;

- Soil erosion control measures;

- Speed limits to be put in place to ensure low vehicle speeds;

- Vehicle loads to be covered;

- Damping of dry excavations and cutting activities which generate dust; and

- Sequencing of works to minimise the time that soils are exposed.

2.1.7 Spoil Management Bunds

Excavated peat, topsoil and subsoil are expected to be reused within the works either as part of backfilling or reinstatement operations or used to form landscaping bunds. Materials will generally be stockpiled close to the location of reuse to limit vehicle movements on site. Details of peat and soil stripping at the site and the proposed use and placement of peat, topsoil and subsoil is detailed in Annex 3: Geotechnical Assessment.

2.1.8 On-Site Fuel and Chemical Storage

All fuel and chemicals will be stored within appropriately specified containers and within specifically designed stores / storage areas, and shall include appropriate measures to avoid spillages in accordance with Control of Pollution (Oil Storage) Regulations (NI) 2010.

2.2 Temporary Lighting

Temporary lighting will be required at the construction compounds for security purposes and to ensure that a safe working environment is provided to construction staff. In addition, temporary lighting may be required to ensure safe working conditions at tracks, control building and turbine locations during construction.

All temporary lighting installations will be downward facing and all lights will be switched off during daylight hours and in accordance with any mitigation proposed to avoid disturbance to badgers.

2.3 Peat Slide Risk and Slope Stability

A Quantitative Slope Stability Assessment has been undertaken as part of the Environmental Statement (see Appendix 9.3 of ES) and the design of infrastructure has taken into account the findings of the assessment. The recommendations highlighted in Annex 3 will be followed.

Prior to commencement of construction, detailed method statements will be prepared to address the working methods to be used. Additionally, a “toolbox talk” will be provided by the site management team to highlight possible events causing slope instability and provide guidance on best practice when operating in areas identified as at risk.

2.4 Post Construction Restoration and Reinstatement

During construction of the infrastructure elements (detailed in Section 3), the vegetated layer will be stripped from the area of the excavation and stored locally with the growing side up. The remaining organic topsoil and subsoils will be excavated down to formation level, or a suitable stratum, and again will be stored local to the point of excavation, but shall remain segregated to avoid mixing of materials.

Temporary storage areas shall take consideration of all identified buffer areas and be stripped of vegetation prior to stockpiling in line with best working practices. As construction is progressed the effectiveness of the buffer zones will be reviewed and if necessary adjusted. Alternatively the construction procedure may be reviewed and altered or additional control measures put in place.

Post-construction reinstatement will be undertaken as work progresses to minimise the period any organic material is stockpiled. Subsoils shall be used in landscaping and backfilling around structures while the vegetated layer and/or topsoil will be used to reinstate storage and working areas, road verges, drainage swales and embankments. In addition, following the completion of the works, a final inspection of the wind farm site will be undertaken and in circumstances where reinstatement using vegetation and/or topsoil is unsuccessful alternative methods will be considered.

Upon completion of all construction works, the temporary construction compounds will be reinstated to their approximate pre-wind farm condition. All temporary structures and construction equipment will be removed and the granular material that forms the hardstandings will be moved to areas agreed with the landowner or removed from site. Following this, the areas will be backfilled with material stripped and stored during the construction of the wind farm and reseeded as required.

In line with construction best practice and to suit the ground conditions anticipated on site, the track and hardstanding design has endeavoured to minimise spoil generated during construction.

2.5 Traffic Management

Details of the proposed traffic management arrangements will be contained in a Traffic Management Plan (TMP). Any operations not covered by the TMP will be performed in accordance with local and national standards and specifications. All abnormal load movements associated with the project will be performed in accordance with the anticipated Article 78 Permit, using the delivery route shown on drawing 03426D2509-01, *Turbine Delivery Route*.

2.6 Health and Safety Management

The Principal Contractor will be responsible for ensuring that a construction phase health and safety plan is prepared and implemented on site. All work will be carried out in accordance with:

- The Health and Safety at Work etc. Act 1974;
- The Construction (Design and Management) Regulations (NI) 2016; and
- All applicable third party safety guidelines.

2.7 Environmental

An Ecological Clerk of Works (ECoW) will be appointed, and will be fully engaged in preparatory works that will be undertaken, with their terms of appointment extended throughout the construction period into the operational period. The agreed terms of appointment, to be agreed with Causeway Coast and Glens Borough Council, will be provided prior to construction.

The provision of an Archaeologist will be implemented during any excavation works, in agreement with Causeway Coast, and a Written Scheme of Investigation will be provided and agreed with Causeway Coast & Glens Borough Council and applied to all applicable areas of work.

3.0 DESIGN PHILOSOPHY AND CONSTRUCTION METHODS

3.1 Site Entrance

The traffic associated with construction of the wind farm will access the site from the Magheramore Road using the proposed site entrance. Wheel cleaning facilities will be set up at the site entrance to remove mud from the wheels of vehicles leaving the site. Public roads will be inspected daily and a road sweeper will be employed to remove any mud or debris transferred onto the roads from site activities.

3.1.1 General Construction Method

The site entrance will be constructed in accordance with the design drawings as follows:

- Traffic management to be installed;
- Topsoil shall be removed and carefully stockpiled;
- New drainage shall be installed taking care to ensure that existing drainage will not be compromised;
- Road pavement works to be completed to the design requirements;
- Line marking, signage, fencing and vehicle restraint systems required as part of the design will be installed;
- Upon completion of the construction works the the site entrance will be reinstated to reduce the extent of hardstanding back to its original pre-construction state. Stone pillars and walls removed to allow access will be reinstated as will stock proof fencing. Any trees and hedgerows removed will be replanted.

3.2 Temporary Construction Compounds, Site Tracks and Crane Hardstandings

3.2.1 Temporary Construction Compounds

Temporary construction compounds are required for the provision of site offices, welfare facilities and storage arrangements for materials, plant and equipment. There is one temporary construction compound required for the construction phase of the project.

The temporary construction compound will be constructed at the location indicated on Drawing 'Infrastructure Layout' 03426D1001, in Annex 1.

Initial welfare provision will be made for use during construction of the access tracks to the temporary construction compound. This will likely be a single unit for use by a small workforce tasked with the enabling works.

The temporary construction compound will be the main compound for the site with welfare facilities at this location.

An area will be assigned for the storage of fuels and chemicals, ensuring any spillage is captured and appropriately dealt with.

3.2.2 Site Tracks

The running width of the tracks will be typically 5 m on straight sections, increasing at corners and passing places to accommodate the swept path of turbine delivery vehicles. The track working area will be kept to the minimum required allowing for working area, safe access, drainage and electrical works.

Site tracks will consist of compacted crushed-stone. Where tracks cross over services such as gas pipelines or electricity cables, they will be designed in consultation with the relevant authority and accordance with their specific requirements.

A number of track designs may be utilised on site which will be determined during detailed design, dependent on the ground conditions encountered on site and include:

- Typical track founded on suitable load bearing strata;

- Floating Track, laying a suitable membrane on existing ground level and constructing off that layer;

Track drainage will be incorporated within the design in accordance with sustainable drainage design principles. Where the road alignment crosses existing drainage channels, crossings appropriate to the location will be designed in accordance with the relevant guidelines.

A buffer zone in accordance with the relevant guidance from NIEA will be maintained around watercourses shown on Drawing M01616-05 WFD 01-05 Rev2 in Annex 2: WFD Assessment. The exceptions to these buffers will be where the existing tracks are located within the buffer zone and where there are watercourse crossings. Site personnel will be made aware of the buffer zones through the site induction and specific tool box talks.

<u>Typical Track</u>

Typical track construction may be used in areas identified where the thickness of soft soils is low, and the underlying layer has adequate load bearing properties. This track system will likely consist of a suitable capping layer and then a suitable running layer.

3.2.3 Crane Hardstandings

The main crane hardstanding area is anticipated to be 40m x 20m. There may be additional temporary hardstanding areas required for the erection of the main crane, lay down of materials and turbine components.

The main crane hardstanding area will be left uncovered for the operational lifetime of the wind farm in line with good practice outlined in the Scottish National Heritage guidance "Good Practice during Windfarm Construction" – 4th Edition 2019. Any temporary crane hardstanding elements will be reinstated post construction.

All crane hardstandings will consist of a compacted stone structure bearing directly on a suitable formation strata.

3.2.4 General Construction Method

Where competent soils exist close to the existing ground surface the following construction method will typically be followed:

- Track and crane hardstanding alignments will be established from the construction drawings and marked out with ranging rods, timber posts or steel pins;

- Track corridors and crane hardstanding locations shall be pegged out 500 - 1000m in advance of operations;

- Where possible, upgraded access tracks will re-use the structure of the existing track to reduce construction requirements;

- Drainage swales will be excavated adjacent to the tracks where required. Surface water runoff will not be allowed to discharge directly into existing watercourses but will be routed through a Sustainable Drainage System (SuDS);

- A surface water cut off ditch may be installed on the slope above the earthworks footprint where achievable given the topography;

- Material will be excavated and stored;

- Cut track construction will be used where soils are identified as being shallow. This cut track system will likely consist of a suitable layer of crushed aggregate, either spread by a dozer or placed by hydraulic excavator, prior to being compacted in layers by vibratory rollers. If ground conditions dictate a geotextile membrane will be applied;

- Crane hardstanding construction will follow the same construction method as cut track;

- Floating track construction may be adopted where the ground conditions dictate. This system involves installing a geogrid membrane directly onto the organic vegetated layer and placing layers of suitable stone and additional geogrid layers (if required by the design) above;

- Where the road alignment crosses existing drainage channels, crossings appropriate to the location will be designed in accordance with the relevant guidelines;

- Depending on depth and type of material, adjacent slopes are anticipated to be between 1:1 to 1:3.

- Post-construction reinstatement shall be in line with the details of Section 2.5.

Where the load bearing properties of the underlying soils are determined to be insufficient, ground stabilisation may be carried out to provide adequate bearing capacity of the formation level. Due to the variable nature of the ground at the site, specific construction methods shall be selected at detailed design stage in consultation with specialist contractors. Such methods may consist of:

- Compaction of the existing in situ soils;

- Lime/cement stabilisation of the existing in situ soils; or

- Installation of stone or concrete columns to provide adequate support.

3.3 Turbine Foundations

Foundations will be designed as a reinforced concrete slab, in accordance with the relevant design standards, specific turbine supplier load information and ground conditions. Due account will be taken of guidance provided in appropriate codes and standards such as Eurocodes, British Standards and other specialist design documents.

Due to the anticipated load bearing capacity of the near surface soils, gravity base turbine foundations are expected to be used to support the wind turbine.

3.3.1 General Gravity Base Construction Method

The gravity base foundation general construction method would generally be as follows:

- A surface water cut off ditch may be installed on the slope above the earthworks footprint where achievable given the topography;
- The topsoil will be excavated and stored to one side for reuse during the landscaping round the finished turbine;
- Excavation will be undertaken to competent material. Excavated subsoil material may be stockpiled temporarily adjacent to the excavation for later use as backfill or stored elsewhere on site. Temporary & permanent drainage shall be installed at the same time as the excavation works;
- In the case where competent material is lower than the required formation level the foundation will likely be over-excavated to competent material and compacted engineering fill placed to the required level;

- Where excavation is required to extend below the water table or in material which does not drain freely, temporary pumping will be employed to keep the excavation dry. Water pumped from an excavation shall be adequately treated in line with the SuDS philosophy, before being discharged directly to any watercourse;
- A layer of concrete blinding will be laid directly on top of the newly exposed formation, finished to ensure a flat and level working surface;
- Steel reinforcement, the turbine anchorage system and cable ducts will be fixed in place and formwork erected around the steel cage;
- Concrete will be placed using a pump, or other suitable device, and compacted using vibrating pokers;
- Following the setting process, the foundation will be backfilled with suitable material, and landscaped using the vegetated soil layer set aside during the initial excavation; and
- A gravel path will be built leading from the access track or crane hardstanding to the turbine door or access steps and around the turbine for maintenance.

3.4 Turbines and Turbine Transformers

3.4.1 Turbines

The turbine will typically be supplied with a light grey semi-matt finish (RAL colour 7035) and installed with a height not exceeding 149.9m measured from ground level to the blade tip in the vertical position.

The turbines shall not carry any symbols, logos or other lettering except where required under other legislation. However, RES proposes to add turbine numbers to the base of each tower to aid service engineers during the operational phase of the wind farm.

In line with Health and Safety best practice, turbine manufacturers have indicated a preference to locate a passive infra-red (PIR) detector and light above each turbine door. It should be noted that this lamp will not be permanently lit and would only be switched on by the PIR when personnel approach a particular turbine.

Specific locations for the turbines are as per 'Infrastructure Layout' 03426D1001-01 in Annex 1.

3.4.2 Turbine Transformers

Depending on the model of turbine finally chosen for the site, turbine transformers will either be placed internally, or externally in close proximity to the turbine.

Oil cooled transformers will be supplied full of oil and will not require topping up on site. The transformers will be sealed and will be inspected for any damage prior to offloading. Air cooled or cast resin transformers do not require cooling oil.

Exterior transformers will be located within enclosures which shall be locked, accessible by trained and authorised personnel only, and displaying appropriate warning signs.

3.4.3 General Turbine Erection Method

The following general steps will be undertaken to erect the turbines on site:

- Turbine components will be lifted by adequately sized cranes (one main crane and one smaller tail crane) and positioned on the foundations / other turbine sections until the entire turbine is erected;
- Upon completion of the erection all fasteners will be tightened and the internal fit out of the turbine undertaken;
- The turbines will then be connected to the wind farm substation; and finally

- Turbine testing and commissioning will be undertaken before the turbines will be handed over as complete.

3.5 Control Building and Substation Compound

Cables will transfer power from the wind turbines to the substation compound and control building before being transferred to the National Grid. The location of the Control Building and Substation Compound is shown on Drawing 03426D1001-01 in Annex 1.

The control building has been designed, sized and positioned to be sympathetic with the surroundings. The building typically contains the following rooms; control room, switch room, SCADA room, and equipment store and welfare facilities.

The detailed design of the foundations for the building will be based on the Site Investigation reports and building requirements, and will ensure loads associated with the building are transferred to the appropriate bearing layer in the sub-surface.

The building will likely consist of masonry/block cavity.

Foul drainage will be provided in agreement with the relevant authorities and most likely involve Foul effluent disposal via chemical facilities with periodic tankered removal by a licensed waste haulier for licensed offsite disposal (i.e. there shall be no emission on site).

Communications to the site is anticipated to be provided via direct cable connection with the service provider.

3.5.1 Sub Station Finishes

The superstructure will consist of cavity wall construction with external cladding in some sections and a traditional pitch roof construction spanning front to back. Final building finishes will be widely in keeping with the local area where possible.

3.5.2 General Construction Method

The control building and substation compound will generally be constructed in accordance with the following:

- A surface water cut off ditch may be installed on the slope above the earthworks footprint where achievable given the topography;
- The plan area of the substation control building and compound will be set out and the topsoil stripped and removed to a temporary stockpile;
- The building foundations will be excavated and concrete poured;
- The building structure will be constructed from the foundations, in accordance with current practice and specific design;
- The internal fit out of the building including installation of services will be completed.

3.6 Cabling Works

All electricity and other service cables between the turbines and the substation will be placed underground.

The detailed construction and trenching specifications will depend on the ground conditions encountered but typically cables will be directly buried inside a trench, except at road crossings when cables will be ducted.

Specific cable layout plans will be provided prior to construction.

3.6.1 General Construction Method

The following construction method will typically be used:

- Trenches will be excavated and a suitable bedding material placed for which to lay the cables upon. The ground is trenched typically using a mechanical digging machine;
- The cables shall be laid directly onto the bedding material;
- The trench will then be backfilled and compacted with suitable material up to the required level and finished with a layer of topsoil to aid in the trench reinstatement;
- A suitable marking tape is installed between the cables and the surface; and
- The cables are terminated on the switchgear at each turbine and at the substation.

4.0 OUTLINE DECOMISSIONING PLAN

Prior to decommissioning, a detailed site restoration scheme will be provided to the Causeway Coast and Glens Borough Council for written approval.

Outlined in the following sections are the general procedures to be followed in the decommissioning of the wind farm based on current knowledge.

4.1 Site Track & Hardstanding Areas

New site tracks and hardstanding areas constructed during development of the wind farm will be reinstated to the approximate pre-wind farm condition, unless otherwise agreed with the Landowner and/or Local Planning Authority. Areas to be reinstated would be treated in the following way:

- The material used to construct the tracks will be taken up and removed to areas identified in the site restoration scheme;
- The areas will be backfilled with suitable fill material, covered with topsoil and reseeded as required; and
- Backfilling of access tracks will be carefully planned in advance to avoid having to unnecessarily move plant and equipment on freshly reinstated land.
- Any tracks which were upgraded during the development of the wind farm would be left unchanged from the conditions used during the operation phase of the wind farm.

4.2 Wind Turbines

The decommissioning of the wind turbines will be the reverse of the erection process involving similar lifting plant and equipment:

- Wind turbines will be disconnected from the cabling and internal components stripped and taken off site;
- It is anticipated that the turbine nacelle would then be taken down and loaded straight onto the back of transport vehicles and removed from site for reconditioning or scrap; and
- The turbine towers and blades would be taken down and either transported directly off site or broken down into smaller components if required.

4.3 Turbine Foundations

It is widely accepted that there is no appreciable effect on the local environment from buried reinforced concrete structures left in-situ due to the inert state of concrete. Therefore the foundations will be reinstated as follows:

- Following the removal of the wind turbine, topsoil and subsoil will be excavated to expose the top of the foundation and set aside for reuse;

- The reinforced concrete foundation will then be broken out to an agreed depth below existing the ground level and the material will be taken up and removed as identified in the site restoration scheme; and
- The excavation will be then backfilled with suitable fill material, covered with topsoil and reseeded as required.

4.4 Control Building and Substation Compound

The control building and substation compound will be decommissioned by disconnecting and dismantling all the surface plant. Solid structures such as the building and equipment plinths will be demolished and the foundation will be removed to an agreed depth below ground level. Ducting and cabling that is within the depth to be cleared will be removed.

The fence surrounding the compound will be removed and the area landscaped so it can revert to its original state.

4.5 Electrical Equipment

The electrical equipment will be decommissioned in the reverse of the installation method involving similar plant. The equipment will be dismantled, removed from site and disposed of in an appropriate manner.

4.5.1 Cabling

Cables will be removed if it is deemed that removal would not be detrimental to the local environment. If removed, trenches will be backfilled with material removed during the cable removal process, covered with topsoil and reseeded as required.

5.0 RECORDS

Records, as-built drawings, specifications, operational maintenance manuals and residual risks will be collated and filed in the Project Health & Safety file based upon the requirements of CDM Regulations (NI) 2016.

ANNEX 1: DRAWINGS

(SEE ENVIRONMENTAL STATEMENT - VOLUME 3)

Drawing Name	**Drawing Reference**
Site Location Plan	03426D2202-01
Infrastructure Layout	03426D1001-01
Turbine Elevation	03426D2902-01
Track Construction	03426D2302-01
Construction Compound	03426D2208-01
Wind Turbine Foundation	03426D2303-01
Crane Hardstanding	03426D2304-02

ANNEX 2: WATER FRAMEWORK DIRECTIVE ASSESSMENT

(SEE ENVIRONMENTAL STATEMENT - VOLUME 4 – APPENDIX 9.1)

ANNEX 3: GEOTECHNICAL ASSESSMENT (SEE ES VOLUME 4 – APPENDIX 9.3)

ANNEX 4: ES MITIGATION TABLE (SEE ES VOLUME 2 – CHAPTER 14)

7

Ornithology

Appendix 7: Ornithology

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Appendix 7.1 - Details of Moorland Bird Survey Visits

Survey Date (DD/MM/YY)	Observer	Time Start	Duration (hrs)	Weather / Remarks
05/07/2018	DS	1000	5	cloudy then warm sunny spells, light NW breeze Force 1-2, dry
10/06/2018	DS	0800	5	sunny, light N breeze Force 2-3
24/05/2018	DS	1230	5.5	light cloud, warm, humid, light SE breeze Force 1-2, dry
23/04/2018	DS	0800	5	cloudy, cool, bright spells, moderate SW breeze Force 3-4, dry
08/07/2015	DS	0730	4.5	cloudy, warm, humid, light SW breeze Force 2, dry
14/06/2015	DS	0800	5	sunny, light N breeze Force 2-3, air temperature cool but feeling warm in strong sun
17/05/2015	DS	0800	5	cloudy, bright spells, moderate W breeze Force 3, rain shower but mainly dry
12/04/2015	DS	1000	5	early rain clearing away then fine with a light NW breeze Force 2-3, cool
22/05/2014	DS	0830	5	partial cloud, sunny spells, moderate S breeze Force 3, dry
08/05/2014	DS	0830	5	cloudy then bright spells, light SW breeze Force 2-3, mild and humid, dry
10/04/2014	DS	0800	5	mainly cloudy, bright spells, light W breeze Force 2, dry
13/06/2013	DS	0730	5	partial cloud, sunny spells, light N breeze Force 1-3, rain shower

Appendix 7.2 - Details of Winter Bird Survey Visits

Survey Date (DD/MM/YY)	Observer	Time Start	Duration (hrs)	Weather / Remarks
01/02/2019	DS	0830	5	Sunny, very cold (minus 4C), hard frost all day, almost calm, patchy lying snow (ca 50% ground cover)
09/01/2019	DS	0830	5	Light cloud then sunny, near calm or light NW breeze, cold (4C)
01/11/2018	DS	0830	5	Early air frost then fine and sunny, calm then light NW breeze
15/10/2018	DS	0830	5	early grass frost then fine and sunny, near calm or light S breeze F1-2
19/03/2015	DS	0800	5	early frost then becoming mild with hazy sun and light S breeze
06/02/2015	DS	1300	5	cloudy, dry, cold, calm or light N breeze Force 1-2, slow thaw of lying snow (snow cover 20%), some ice on reservoir
08/01/2015	DS	0830	5	bright, cold, moderate W breeze, small snow-patches on N facing slopes, *survey from 15 minutes before sunrise*

Survey Date (DD/MM/YY)	Observer	Time Start	Duration (hrs)	Weather / Remarks
17/12/2014	DS	1200	4.5	cloudy, mild, moderate SW breeze Force 3, some light drizzle but mainly dry, *survey till dusk (30 minutes after sunset)*
02/11/2014	DS	0800	4.5	fine and bright, good sunny spells, light SW breeze
14/10/2014	DS	0800	5	cold start (slight air frost) then sunny and mild, light E breeze Force 2-3
19/09/2014	DS	0900	5	cloudy, warm, humid, hazy (visibility 2km), light SE breeze Force 1-2
04/02/2014	DS	0800	5	partial cloud, long sunny spells, cold, light SW breeze Force 2
17/01/2014	DS	0900	4.5	mainly cloudy, bright spells, calm then light SW breeze, early hill mist clearing
09/12/2013	DS	0900	4.5	mainly cloudy, brief sunny spells, mild, moderate SW breeze easing
18/11/2013	DS	0800	4.5	partial cloud, sunny spells, cold, light NW breeze Force 2, light wintry showers

Appendix 7.3A - Monthly Summary of Vantage Point Survey Effort (VP1)

Month	Year / Hours Effort (VP1)				
	2013	2014	2015	2018	2019
Jan	-	6	6	-	4
Feb	-	6	6	-	7
Mar	-	6	3	3	-
Apr	-	9	9	8	-
May	-	6	5	9	-
Jun	-	3	6	6	-
Jul	-	6	6	3	-
Aug	-	6	7	6	-
Sep	-	6	-	7.5	-
Oct	-	6	-	7	-
Nov	6	6	-	7	-
Dec	6	6	-	3	-

Appendix 7.3B - Monthly Summary of Vantage Point Survey Effort (VP2)

Month	Year / Hours Effort (VP2)				
	2013	2014	2015	2018	2019
Jan	-	6	6	-	9
Feb	-	6	3	-	6
Mar	-	6	6	3	-
Apr	-	6	6	6	-
May	-	6	6	12	-
Jun	-	6	3	3	-
Jul	-	6	6	6	-
Aug	-	6	9	6	-
Sep	-	6	-	6	-
Oct	-	6	-	6	-
Nov	6	3	-	4	-
Dec	6	6	-	3	-

Appendix 7.3C - Monthly Summary of Vantage Point Survey Effort (VP3)

Month	Year / Hours Effort (VP3)				
	2013	2014	2015	2018	2019
Jan	-	6	6	-	4.75
Feb	-	6	6	-	6
Mar	-	3	3	6	-
Apr	-	5.5	6	6	-
May	-	6	3	6	-
Jun	-	6	6	7	-
Jul	-	6.5	5	7	-
Aug	-	9	13	6	-
Sep	-	5.5	-	7	-
Oct	-	9	-	6	-
Nov	6	6.5	-	10.25	-
Dec	6	3	-	0	-

Appendix 7.4 - Details of Vantage Point Watches (Update Baseline Period)

Date (DD/MM/YY)	Vantage Point	Observer	Time Start	Duration (hours)	Weather / Remarks
18/02/19	1	DS	1000	4	Partial cloud, sunny spells, moderate SW breeze, mild
18/02/19	1	DS	0800	1.5	Cloudy, moderate SW breeze, mild
17/02/19	1	DS	1730	1.5	Sunny, mild, light S breeze, spring-like, watch till dusk
12/01/19	1	DS	0930	4	Cool with blustery showers on fresh NW breeze, sunny spells
22/12/19	1	DS	1000	3	Fine, bright and mild, light SW breeze, rain shower
02/11/18	1	DS	1115	4	Weak sun then cloudy, freshening southerly breeze
02/11/18	1	DS	0800	3	Air frost, calm and sunny, light SE breeze
05/10/18	1	DS	1200	4	Partial cloud, sunny spells, light W breeze, mild, light rain shower
05/10/18	1	DS	0800	3	Grass frost then sunny and near calm or light W breeze
20/09/18	1	DS	1200	4.5	Light cloud, intermittent hazy sun, light SW breeze, mild
20/09/18	1	DS	0800	3	Sunny after cold start, light SW breeze
27/08/18	1	DS	1200	3	Cloudy, cool, moderate W breeze, light shower
21/08/18	1	DS	1700	3	Sunny then light cloud, light S breeze
27/07/18	1	DS	1700	3	Light cloud, warm and humid, southerly breeze falling light
26/06/18	1	DS	1145	3	Light cloud, warm and humid, light NE breeze
26/06/18	1	DS	1500	3	Sunny and warm, light SE breeze
29/05/18	1	DS	1600	2	Sunny and warm, light E breeze, slight haze
29/05/18	1	DS	1200	4	Sunny and warm or very warm, light SE breeze, slight haze
29/05/18	1	DS	0800	3	Sunny, becoming warm, light SE breeze, slight haze
30/04/18	1	DS	1500	2	Light cloud, long sunny spells, light N breeze
30/04/18	1	DS	1130	3	Partial cloud, long sunny spells, light N breeze
30/04/18	1	DS	0800	3	Sunny after early grass frost, light N breeze
22/03/18	1	DS	1300	3	Light cloud, moderate S breeze, cool

Date (DD/MM/YY)	Vantage Point	Observer	Time Start	Duration (hours)	Weather / Remarks
18/02/19	2	DS	1500	3	Rain clearing to long sunny spells, cool, moderate SW breeze
01/02/19	2	DS	1330	3	Mainly sunny, cold, light NW breeze, lying snow
11/01/19	2	DS	1000	3	Light cloud, light rain shower, light W breeze
11/01/19	2	DS	1330	3	Partial cloud, light W breeze, watch till sunset
22/12/18	2	DS	1330	3	Sunny, mild, moderate S breeze, watch till sunset
15/11/18	2	DS	0915	4	Partial cloud, sunny spells, fresh to strong S breeze, dry, mild
10/10/18	2	DS	1200	3	Sunny, very mild or warm, fresh SE breeze
10/10/18	2	DS	0800	3	Partial cloud, hazy sun, very mild, freshening SE breeze
11/09/18	2	DS	1130	3	Partial cloud, sunny spells, moderate SW breeze, light rain shower
11/09/18	2	DS	0800	3	Partial cloud, sunny spells, light then moderate SW breeze
27/08/18	2	DS	0800	3	Partial cloud, brief sunny spells, moderate NW breeze, some light patchy drizzle
23/08/18	2	DS	1500	3	Long sunny spells, passing showers on moderate to fresh W breeze
18/07/18	2	DS	1300	3	Partial cloud, brief sunny spells, warm and humid, nearly calm
18/07/18	2	DS	1630	3	Cloudy, mild, humid, nearly calm
26/06/18	2	DS	0800	3	Light cloud, warm and humid, light NE breeze
30/05/18	2	DS	1500	3	Warm and sunny, passing high cloud, light E breeze
30/05/18	2	DS	1030	3	Partial cloud, warm sunny spells, light E breeze
02/05/18	2	DS	1130	3	Sunny spells and fast moving showers on moderate to fresh NW breeze, cool
02/05/18	2	DS	0800	3	Sunny spells and scattered showers, moderate NW breeze, cool
24/04/18	2	DS	0800	3	Bright, high cloud, cool, light SW breeze
09/04/18	2	DS	1500	3	Mainly cloudy, moderate SE breeze, cool
22/03/18	2	DS	0930	3	Cloudy, bright spells, cool, moderate S breeze
17/02/19	3	DS	1330	3	Sunny, mild, spring-like, light S breeze

Date (DD/MM/YY)	Vantage Point	Observer	Time Start	Duration (hours)	Weather / Remarks
17/02/19	3	DS	1000	3	Cloudy, dry, mild, light S breeze
09/01/19	3	DS	1430	2.25	Sunny, cold, near calm, watch till after sunset
09/01/19	3	DS	1100	2.5	Sunny, cold, near calm
26/11/18	3	DS	1100	4	Sunny after frosty start, light to moderate SE breeze
13/11/18	3	DS	1330	3.25	Partial cloud, long sunny spells, mild, fresh to strong S breeze, watch to sunset
13/11/18	3	DS	1000	3	Sunny, mild, light then moderate S breeze
01/10/18	3	DS	1130	3	Bright then increasing cloud on SW breeze, mild
01/10/18	3	DS	0800	3	Light cloud, light W breeze
18/09/18	3	DS	1330	3	Partial cloud, sunny spells, very mild, moderate S breeze
03/09/18	3	DS	1000	4	Partial cloud, sunny spells, mild, light W breeze, intermittent noise from quarry
21/08/18	3	DS	0900	3	Partial cloud, warm sunny spells, moderate S breeze
21/08/18	3	DS	1230	3	Cloudy, humid, moderate S breeze, intermittent light drizzle but mostly dry
27/07/18	3	DS	1300	4	Light cloud, bright spells, moderate S breeze, humid, mild
27/07/18	3	DS	0940	3	Light cloud, warm and humid, moderate S breeze
12/06/18	3	DS	1230	4	Light cloud, mild, dry, light NW breeze
12/06/18	3	DS	0850	3	Cloudy, mild, dry, light NW breeze
16/05/18	3	DS	1300	3	Sunny, moderate N breeze
16/05/18	3	DS	0900	3	Partial cloud, long sunny spells, cool N breeze
24/04/18	3	DS	1500	3	Partial cloud, sunny spells, light W breeze, light rain shower
24/04/18	3	DS	1130	3	Light cloud, cool, light W breeze
29/03/18	3	DS	0830	3	Partial cloud, sunny spells, cold (4C), light E breeze
29/03/18	3	DS	1200	3	Partial cloud, sunny spells, moderate E breeze, cold, light wintery shower

Appendix 7.5 - Summary of Vantage Point Watches at Dusk

Month	Year / No Watches to Dusk (all VPs)				
	2013	2014	2015	2018	2019
Jan	-	4	0	-	1
Feb	-	4	1	-	1
Mar	-	0	0	0	-
Sep	-	0	0	0	-
Oct	-	0	0	0	-
Nov	3	1	0	1	-
Dec	2	2	0	1	-

Appendix 7.6 - Summary of Wider Area Surveys

Date (DD/MM/YY)	Time Start	Duration (hours)	Observer	Remarks
27/07/18	0845	3	DS	-
18/07/18	0900	3	DS	-
09/07/18	1530	3	DS	-
05/07/18	1300	3	DS	-
03/07/18	1000	7	DS	-
02/05/18	1500	3	DS	-
09/04/18	1000	4	DS	-
08/07/15	1200	6	DS	-
10/06/15	0800	9	DS	-
03/06/15	0900	6	DS	-
21/04/15	0800	8	DS	-
15/07/14	0900	6	DS	-
13/06/14	0900	6	DS	-
21/05/14	1000	6	DS	-
31/03/14	0900	6	DS	-
11/03/14	1030	8	DS	-

Appendix 7.7 - IEEM Probability Table

The IEEM probability scale used in the Assessment of Effects is given below:

- Certain / near-certain – probability estimated at 95% or higher
- Probable – probability estimated at above 50% but below 95%

- Unlikely – probability estimated at above 5% but below 50%
- Extremely unlikely – probability estimated at less than 5%

Appendix 7.8 - Summary of MBS Results (2014 and 2015)

Species	No. of Breeding Pairs / Territories		Remarks
	2014	2015	
Grey heron	0	0	Non-breeding transient
Mallard	0	0	Non-breeding transient
Cuckoo	2	2	Singing males
Swallow	0	0	Non-breeding transient
Sand martin	0	0	Non-breeding transient
House martin	0	0	Non-breeding transient
Skylark	5	6	Singing males
Meadow pipit	21	22	
Stonechat	2	1	
Wheatear	0	0	Non-breeding transient
Robin	4+	4+	Associated with shelterbelts
Song thrush	1	1	Associated with shelterbelts
Mistle thrush	0	1	Associated with shelterbelts
Blackbird	1+	1+	Associated with shelterbelts
Wren	6+	6+	
Coal tit	2+	2+	Associated with shelterbelts
Grey wagtail	0	0	Non-breeding transient (max. count one bird)
Goldcrest	2	2	Associated with shelterbelts
Willow warbler	8	10	
Grasshopper warbler	0	1	2015 only
Blackcap	2		
Whitethroat	1	0	2014 only
Starling	0	0	Non-breeding transient
Chaffinch	10+	10+	Associated with shelterbelts
Crossbill	1	0	2014 only
Linnet	0	1	
Redpoll	2	2	
Hooded crow	4+	6+	Pairs associated with shelterbelts

Species	No. of Breeding Pairs / Territories		Remarks
	2014	2015	
Rook	0	0	Non-breeding transient
Raven	0	0	Non-breeding transient
Reed bunting	2	2	

Appendix 7.9 - Summary of Winter Bird Survey Results

Species	No. Surveys Species Recorded (N=15)	Maximum Count	Average Count (N=15)	Remarks
Great black-backed gull	2	2	<1	Scavenging at sheep carcasses
Mallard	2	2	<1	
Woodpigeon	10	20	9	
Snipe	7	6	1	
Skylark	4	10	1	Not present during mid-winter period
Meadow pipit	11	150	19	Peak count in September (small numbers during mid-winter period)
Stonechat	5	6	1	
Wheatear	2	1	<1	September and March surveys only
Robin	14	6	3	
Dunnock	3	2	<1	
Song thrush	6	2	<1	
Redwing	5	10	2	
Fieldfare	8	60	14	Peak count in October
Mistle thrush	9	40	4	Peak count in September
Blackbird	6	2	<1	
Wren	9	6	2	
Coal tit	7	6	2	
Great tit	2	2	<1	
Blue tit	4	2	<1	

Species	No. Surveys Species Recorded (N=15)	Maximum Count	Average Count (N=15)	Remarks
Long-tailed tit	1	10	<1	
Grey wagtail	2	1	<1	
Goldcrest	7	4	1	
Chaffinch	11	12	4	
Bullfinch	2	1	<1	
Crossbill	6	8	1	
Linnet	1	15	1	
Redpoll	6	100	8	Flock of 100 birds in November 2018, otherwise in small numbers
Siskin	4	22	3	
Hooded crow	15	26	6	Larger flocks at sheep carcasses
Raven	14	30	5	Larger flocks at sheep carcasses
Jay	4	6	<1	
Reed bunting	7	12	3	
Snow bunting	1	1	<1	5th November 2014

Appendix 7.10 - Summary of Water-bird Counts at Altnaheglish Reservoir

Count Date (DD/MM/YY)	Species Code / Count						
	WN	TL	MA	CA	H	GB	LB
01/02/2019	0	0	0	0	0	0	0
09/01/2019	0	0	0	0	0	0	0
01/11/2018	0	0	0	0	0	0	0
15/10/2018	4	6	10	1	1	0	0
19/03/2015	0	6	11	0	0	0	2
06/02/2015	0	0	0	0	0	0	0
08/01/2015	0	0	0	0	0	0	0
17/12/2014	0	0	0	0	0	0	0
02/11/2014	0	0	20	1	0	0	0
14/10/2014	0	0	0	0	0	0	0

Count Date (DD/MM/YY)	Species Code / Count						
	WN	TL	MA	CA	H	GB	LB
19/09/2014	0	0	15	0	0	1	4
04/02/2014	0	2	5	0	0	0	0
17/01/2014	0	6	26	0	1	0	0
09/12/2013	0	0	0	0	0	0	0
18/11/2013	0	0	0	0	0	0	0

Key to species codes: WN = wigeon; TL = teal; MA = mallard; CA = cormorant; H = grey heron; GB = great black-backed gull; LB = lesser black-backed gull

Appendix 7.11 - Details of Records of Annex-1 Raptor Species (All Baseline Period)

Species	VP	Date (DD/MM/YY)	Time	No. Birds	Age / Sex	Total Duration (s)	Duration at Rotor Height (s)	Behaviour / Remarks
hen harrier	2	18/02/2019	1540	1	ringtail	30	0	low travelling flight
hen harrier	3	11/08/2015	1400	1	3rd cal-yr male	110	0	foraging, caught small bird
hen harrier	3	05/11/2014	1505	1	grey male	105	0	foraging
hen harrier	3	12/09/2014	1215	1	juvenile	120	0	foraging, mobbed by pipits
merlin	3	13/11/2018	1200	1	female type	165	30	flying downwind, landed briefly
merlin	3	13/11/2018	1520	1	female type	145	145	flying upwind
merlin	3	12/09/2014	1450	1	female type	40	0	direct flight
merlin	1	15/07/2014	1630	1	male	38	0	foraging, landed briefly
peregrine	3	01/10/2018	1310	1	adult	30	15	travelling flight
peregrine	3	01/10/2018	1400	1	adult	170	20	foraging, landed on fence
peregrine	3	12/06/2018	1440	1	2nd cal-yr	50	0	hunting starlings
peregrine	3	24/04/2018	1325	1	2nd cal-yr	185	185	travelling flight

Species	VP	Date (DD/MM/YY)	Time	No. Birds	Age / Sex	Total Duration (s)	Duration at Rotor Height (s)	Behaviour / Remarks
peregrine	3	29/03/2018	0910	1	2nd cal-yr	93	46	travelling flight
peregrine	3	29/03/2018	1255	1	2nd cal-yr	100	0	travelling flight
peregrine	3	29/03/2018	1420	1	2nd cal-yr	65	0	direct low flight
peregrine	3	15/07/2015	1005	1	2nd cal-yr	60	30	travelling flight
peregrine	3	16/02/2015	1040	1	2nd cal-yr	50	25	travelling flight
peregrine	3	05/11/2014	1530	1	adult	70	70	travelling flight
peregrine	3	12/09/2014	1200	1	juvenile	40	20	travelling flight
peregrine	1	07/08/2014	1100	1	adult	30	0	travelling flight
peregrine	2	08/07/2014	1518	1	adult	110	110	travelling flight
peregrine	3	26/02/2014	1430	2	pair	330	185	interacting with ravens
peregrine	3	02/01/2014	1405	1	2nd cal-yr	58	29	foraging

Appendix 7.12 - Details of Records of Non-Annex 1 Raptor Species (Update Baseline Period)

Species	VP	Date (DD/MM/YY)	Time	No. Birds	Age / Sex	Total Duration (s)	Duration at Rotor Height (s)	Behaviour / Remarks
Buzzard	1	26/06/18	1345	1	-	123	93	Circling
Buzzard	1	30/04/18	1425	1	-	125	125	Circling
Buzzard	1	29/05/18	1135	1	-	92	26	Travelling flight
Buzzard	1	29/05/18	1740	1	-	95	0	Foraging
Buzzard	1	20/09/18	1205	1	-	100	52	Foraging
Buzzard	1	05/10/18	1250	1	-	358	192	Soaring
Buzzard	1	05/10/18	1330	1	-	60	60	Circling
Buzzard	1	02/11/18	1210	1	-	39	0	Foraging
Buzzard	1	02/11/18	1225	1	-	312	162	Foraging
Buzzard	2	02/05/18	1015	1	-	245	0	Foraging
Buzzard	2	02/05/18	1150	1	-	346	0	Foraging, settling on ground

Species	VP	Date (DD/MM/YY)	Time	No. Birds	Age / Sex	Total Duration (s)	Duration at Rotor Height (s)	Behaviour / Remarks
Buzzard	2	02/05/18	1215	1	-	310	0	Foraging
Buzzard	2	02/05/18	1255	1	-	336	0	Foraging, settling on ground
Buzzard	2	02/05/18	1415	1	-	305	195	Circling
Buzzard	2	02/05/18	1330	1	-	120	90	Circling
Buzzard	2	30/05/18	1325	1	-	121	80	Foraging
Buzzard	2	18/07/18	1355	1	adult	75	0	Foraging
Buzzard	2	18/07/18	1415	1	-	125	125	Circling
Buzzard	3	01/10/18	1345	1	-	260	120	Foraging
Buzzard	3	13/11/18	1230	1	-	117	60	Circling
Buzzard	3	13/11/18	1520	1	-	145	0	Foraging
Buzzard	3	13/11/18	1540	1	-	628	251	Circling with ravens
Buzzard	3	18/09/18	1355	1	-	350	175	Foraging
Buzzard	3	21/08/18	1135	1	Adult	60	0	Travelling flight
Buzzard	3	21/08/18	1200	1	Adult	118	0	Foraging
Buzzard	3	21/08/18	1245	1	Juvenile	55	25	Circling
Buzzard	3	21/08/18	1340	1	Adult	360	270	Foraging
Buzzard	3	12/06/18	1235	1		180	105	Circling
Buzzard	3	16/05/18	1455	1	-	110	0	Foraging
Buzzard	3	16/05/18	1550	1	-	340	0	Travelling flight, very high
Buzzard	3	24/04/18	1235	1	-	175	70	Foraging
Buzzard	3	24/04/18	1245	1	-	120	0	Foraging
Buzzard	3	24/04/18	1345	1	-	473	337	Foraging
Buzzard	3	24/04/18	1535	1	-	150	150	Circling
Buzzard	3	24/04/18	1630	1	-	75	0	Foraging
Buzzard	3	13/11/18	1230	1	-	45	34	Circling
Kestrel	1	30/04/18	1145	1	male	350	162	Circling / soaring
Kestrel	2	02/05/18	1005	1	male	300	150	Foraging
Kestrel	3	24/04/18	1150	1	male	60	0	Flying very high

Species	VP	Date (DD/MM/YY)	Time	No. Birds	Age / Sex	Total Duration (s)	Duration at Rotor Height (s)	Behaviour / Remarks
Kestrel	3	21/08/18	1105	1	juvenile	175	110	Foraging
Kestrel	3	21/08/18	1120	1	juvenile	105	23	Travelling flight
Kestrel	3	21/08/18	1345	1	juvenile	555	240	Foraging
Kestrel	3	18/09/18	1405	1	male	132	0	Foraging
Kestrel	3	18/09/18	1445	1	juvenile	90	15	Foraging
Kestrel	3	01/10/18	1045	1	juvenile	95	0	Travelling flight, chased by hooded crow
Kestrel	3	01/10/18	1330	1	male	310	60	Foraging
Sparrowhawk	2	26/06/18	1600	1	male	50	0	Flying with prey
Sparrowhawk	2	02/05/18	1150	1	-	60	60	Travelling flight
Sparrowhawk	2	18/07/18	1345	1	female	320	320	Circling
Sparrowhawk	3	24/04/18	1145	2	pair	140	140	Displaying
Sparrowhawk	3	01/10/18	1240	1	-	40	0	Travelling flight

Appendix 7.13 - Summary of Activity by Non-Annex 1 Raptor Species (Earlier Baseline Period)

Appendix 7.13A – Summary of Activity by Buzzards (Earlier Baseline Period)

Month	Buzzard Sightings		
	2013	2014	2015
Jan	-	1	2
Feb	-	6	0
Mar	-	2	3
Apr	-	6	6
May	-	2	6

Month	Buzzard Sightings		
	2013	2014	2015
Jun	-	1	5
Jul	-	4	3
Aug	-	4	6
Sep	-	2	-
Oct	-	3	-
Nov	2	1	-
Dec	0	0	-

Appendix 7.13B – Summary of Activity by Kestrels (Earlier Baseline Period)

Month	Kestrel Sightings		
	2013	2014	2015
Jan	-	0	0
Feb	-	0	1
Mar	-	0	1
Apr	-	2	0
May	-	0	3
Jun	-	1	0
Jul	-	1	2
Aug	-	2	2
Sep	-	2	-
Oct	-	1	-
Nov	0	0	-
Dec	0	1	-

Appendix 7.13C – Summary of Activity by Sparrowhawks (Earlier Baseline Period)

Month	Sparrowhawk Sightings		
	2013	2014	2015
Jan	-	1	1
Feb	-	1	1
Mar	-	0	1
Apr	-	0	0

Month	Sparrowhawk Sightings		
	2013	2014	2015
May	-	1	0
Jun	-	0	0
Jul	-	0	1
Aug	-	1	1
Sep	-	2	-
Oct	-	0	-
Nov	0	1	-
Dec	0	2	-

Appendix 7.14 Details of Raptor Breeding Activity (CONFIDENTIAL)

Appendix 7.15 NIRSG Data Request (CONFIDENTIAL)

Appendix 7.16 Details of Collision Risk Modelling of Buzzards

Appendix 7.16 - Details of Collision Risk Assessment for Buzzards

Wind Farm Parameters

The wind farm parameters input to the Collision Risk Model (CRM) are given in the table below.

Table A- Wind Farm Parameters Input to the Collision Risk Model

Parameter	Input Value	Remarks
Size of wind farm envelope	1	Optional input (a value of 1 or more must be entered) - this value has no effect on collision risk
Number of turbines	6	
Rotor diameter (m)	112	Value is rounded to 100m by the CRM spreadsheet
Hub height (m)	94	
Rotor depth (m)	-	Not available – optional input
Rotor chord (m)	4	
Rotor pitch (degrees)	6	
Rotation period (seconds)	4.2	
Turbine operation time (%)	91.41	Value is rounded to 91 by the CRM spreadsheet

Bird Parameters

The bird parameters input to the CRM are given in the table below. In line with SNH guidance[1], flight speeds and wing-spans are taken from Alerstam *et al*.[2] Bird lengths are taken from Forsman[3], which is the standard published reference for raptor identification in Europe. *Note: some input values are rounded by the CRM spreadsheet.*

Table B - Bird Parameters Input to the Collision Risk Model

Species	Wing-span (m)	Length (m)	Flight speed (m / s)
Buzzard	1.24	0.54	12.5 (range 11.6 - 13.3)

Band Used To Define Risk Height

The band used to define risk height in the CRM is:

Maximum height 150m;
Minimum height 38m.

[1] SNH (2014): Flight Speeds and Biometrics for Collision Risk Modelling (SNH Guidance Note, October 2014)
[2] Alerstam, T. *et al.* (2007): Flight Speeds Among Bird Species – Allometric and Phylogenetic Effects (PLoS Biol. 5)
[3] Forsman, D. (1999): The Raptors of Europe and the Middle East – A Handbook of Field Identification (Poyser)

Watch Data

The watch data input to the CRM are given in the table below. The time at each vantage point is taken from Table 7.3 in the Ornithology Chapter of the ES. Areas visible at lowest edge of risk height (38m) have been calculated from the viewpoint coverage shown in Figure 7.1.

Table C - Watch Data Input to the Collision Risk Model

Vantage Point	Area Visible at Risk Height (ha)	Observation Time (Hours)
VP1	176.58	70
VP2	114.4	70
VP3	206.8	72
Total	497.8	212

Summary of Collision Risk Model Results

The results of the CRM are summarized in the table below. The avoidance rates used are those recommended by SNH[4]. The bird flight data (total duration and duration at risk height) are taken form Appendix 7.12. *Note: the completed CRM Excel spreadsheet is available to be supplied separately in electronic format.*

Table D- Summary of Results of the Collision Risk Model

Species	Baseline Period	No. of Months Potentially Present	Total Duration (s)	Duration at Risk Height (s)	Avoidance Rate	Equivalent Collision Rate
Buzzard	12 months Mar 2018 to Feb 2019	12	7048	2797	98%	one bird every 3.1 years

[4] SNH (2016): Avoidance rates for the SNH onshore wind farm Collision Risk Model (SNH Guidance Note, October 2016)

9

Geology & Water Environment

Appendix 9: Geology & Water Environment

Appendix 9.1	Water Framework Directive Assessment
Appendix 9.2	Flood Risk & Drainage Assessment
Appendix 9.3	Geotechnical Assessment
Appendix 9.4	Combined Consultation Responses

McCloy Consulting

Water Framework Directive Assessment

Magheramore Wind Farm

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McCloy Consulting

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1 INTRODUCTION

1.1 Terms of Reference

RES Ltd (RES) has appointed McCloy Consulting Ltd to undertake a Water Framework Directive (WFD) Assessment for a planning application for the proposed Magheramore Wind Farm. The purpose of this WFD assessment is to:

- Determine if specific components or activities related to the development of the proposed Development will compromise the attainment of a WFD objective or result in the deterioration in the ecological status of any waterbodies in the vicinity of the site.
- Provide details of proposed mitigation measures specifically in relation to management of surface water from the developed site if there is initially a perceived risk of deterioration in the ecological status of any affected waterbody.

The assessment is intended to supplement the Environmental Statement (and in particular Chapter 9 Geology and Water Environment) submitted in support of the planning application for the proposal.

1.2 Statement of Authority

McCloy Consulting is an independent environmental consultancy specialising in the water environment, with specialist knowledge of hydrological and hydrogeological assessments, sustainable drainage systems (SuDS), drainage, river modelling, and flood risk assessment.

McCloy Consulting has ongoing involvement in numerous geology and water environment studies and SuDS projects across the UK and has developed a particular expertise in surface water management for wind farms. The company has successfully designed a number of SuDS/silt management solutions for wind farms in accordance with current best practice guidance. The primary personnel responsible for undertaking this WFD Assessment are:

- Caítríona Downey BSc (Hons)– Graduate Environmental Consultant experienced in undertaking hydrology and hydrogeology assessments, water quality monitoring projects and flood risk and drainage assessments.
- Francis McAuley BSc (Hons) MSc FGS – Senior Project Consultant (Hydrogeologist) experienced in undertaking geo-environmental investigations, site investigations, and hydrogeological risk assessments.
- Kyle Somerville BEng (Hons) CEng MIEI – Associate and Chartered Engineer with experience in the fields of hydrology, surface water management, groundwater screening assessments and geology assessments for wind farm developments in the UK and Ireland, and has overseen outline and detailed design of surface water management for in excess of thirty onshore wind farm developments in the UK and Ireland.

1.3 Water Framework Directive

The EU Water Framework Directive (2000/60/EC, as amended by Directives 2008/105/EC, 2013/39/EU and 2014/101/EU) was established as a new integrated approach to the protection of the water environment.

The Directive is transposed in Northern Ireland through the Water Environment (Water Framework Directive) Regulations (Northern Ireland) 2017.

A fundamental requirement of the Water Framework Directive (WFD) is to attain good ecological water status and that deterioration in the status of water is prevented. The Environmental Impact Assessment Directive (85/337/EEC) requires likely significant environmental impacts to be identified, assessed and mitigated. The Northern Ireland Environment Agency (NIEA) Water Management Unit (WMU) would regard an impact that would compromise the achievement of a WFD objective or result in the deterioration in the status of waters as a significant impact.

Any new development must ensure that this fundamental requirement of the directive is not compromised. A WFD Assessment of the proposed scheme should therefore be carried out and form part of the Environmental Impact Assessment (EIA).

1.3.1 River Basin Districts

The WFD is implemented through River Basin Management Plans (RBMP) which introduces a six-yearly cycle of planning, action and review. The plans will include identifying river basin districts, identifying water bodies and protected areas, identifying pressures and risks, monitoring and setting environmental objectives, classification systems and standards.

The WFD was initially implemented in Northern Ireland through three RBMPs that were published in December 2009; as required by WFD the plans are reviewed and updated every six years.

A second set of Plans was published in 2015.

1.3.2 Local Management Areas

The RBMPs have been put into practice by a Local Management Area (LMA) Action Plans during the planning cycle from 2009 to 2015.

LMAs outline some of the measures carried out locally that will contribute to protecting or improving waterbody status, while others involve long-term projects and multiple partners.

1.3.3 Catchment Stakeholder Group

Nine catchment stakeholder groups were set up in Northern Ireland to encourage public participation in dealing with water quality issue. Each group comprises representatives of all local and regional stakeholder sectors / groups and relevant government agencies, brought together to support and encourage a joint approach to identifying and solving catchment scale water management issues. NIEA works with the stakeholders, through Catchment Stakeholder Group meetings, to develop the focused Local Management Area Plans, used to implement the Water Framework Directive.

1.3.3.1 Water Framework Directive Assessment

The aims, objectives and processes of a WFD Assessment are outlined by the Northern Ireland Environment Agency (NIEA) Water Management Unit within their report published in March 2012[1] which outlines how to carry out a Water Framework Directive Assessment on EIA Developments.

A WFD Assessment should be used as a decision making tool; the proposer of the scheme should use the conclusions of the assessment to decide whether to proceed with the development or to amend proposed works and / or instigate mitigating measures prior to proceeding.

Each specific component of the proposed development, that may interact with or pose a risk to a waterbody, is required to have its potential impact assessed. The cumulative effect of a number of such impacts should also be considered.

This report provides a description of the specific activities being undertaken (construction of compounds, hardstanding areas, tracks, trenches and turbine excavations, and electrical cabling etc.), identifies the potentially impacted waterbodies and provides baseline data for the waterbody.

The potential impact of the proposed works is then assessed considering the relevant WFD classification and the following WFD key environmental objectives:

- To prevent deterioration in the ecological status of the waterbody.
- To prevent the introduction of impediments to the attainment of 'Good' WFD status of the waterbody.
- To ensure that the attainment of the WFD objectives for the waterbody are not compromised.
- To ensure the achievement of the WFD objectives in the other waterbodies within the same catchment are not permanently excluded or compromised.

[1] NIEA (2012) Carrying Out A Water Framework Directive (WFD) Assessment on EIA Developments. Available: https://www.daera-ni.gov.uk/publications/guidance-note-carrying-out-water-framework-directive-assessment-environmental-impact [Accessed 12/10/2017]

1.3.4 Approach to the Assessment

This WFD Assessment will comprise of three stages:

- Stage I: Review of WFD Waterbody catchments, classifications and LMA Plans.
- Stage II: Assessment of proposals for the Magheramore Wind Farm.
- Stage III: Proposed mitigation measures where key WFD objectives are not met.

2 STAGE I: WATERBODY IDENTIFICATION AND CLASSIFICATION

2.1 Approach

The first stage identifies those surface water and groundwater bodies with potential to be affected by the development and reviews any available WFD information to classify the waterbody including a review of the current WFD status, future status, identified environmental constraints and any existing / proposed 'mitigation approaches' for the waterbody.

Hydrological catchment boundaries established are as shown on the NIEA River Basin Plan Interactive Map[2] and classification information was primarily sourced from RBMP documents for the relevant LMA.

2.2 Surface Waterbody Identification

The site boundary considered as part of this assessment falls entirely with the Owenrigh River waterbody (UKGBNI1NW020202010).

The Owenrigh River flows into the designated River Roe c. 4 km north of the site, which flows north for a further 34 km and eventually discharges to Lough Foyle. Figure 2-1 below shows the site boundary in the context of the Local Management Area group and river water body catchment. Water quality data is shown as per the NIEA River Basin Plan Interactive Map.

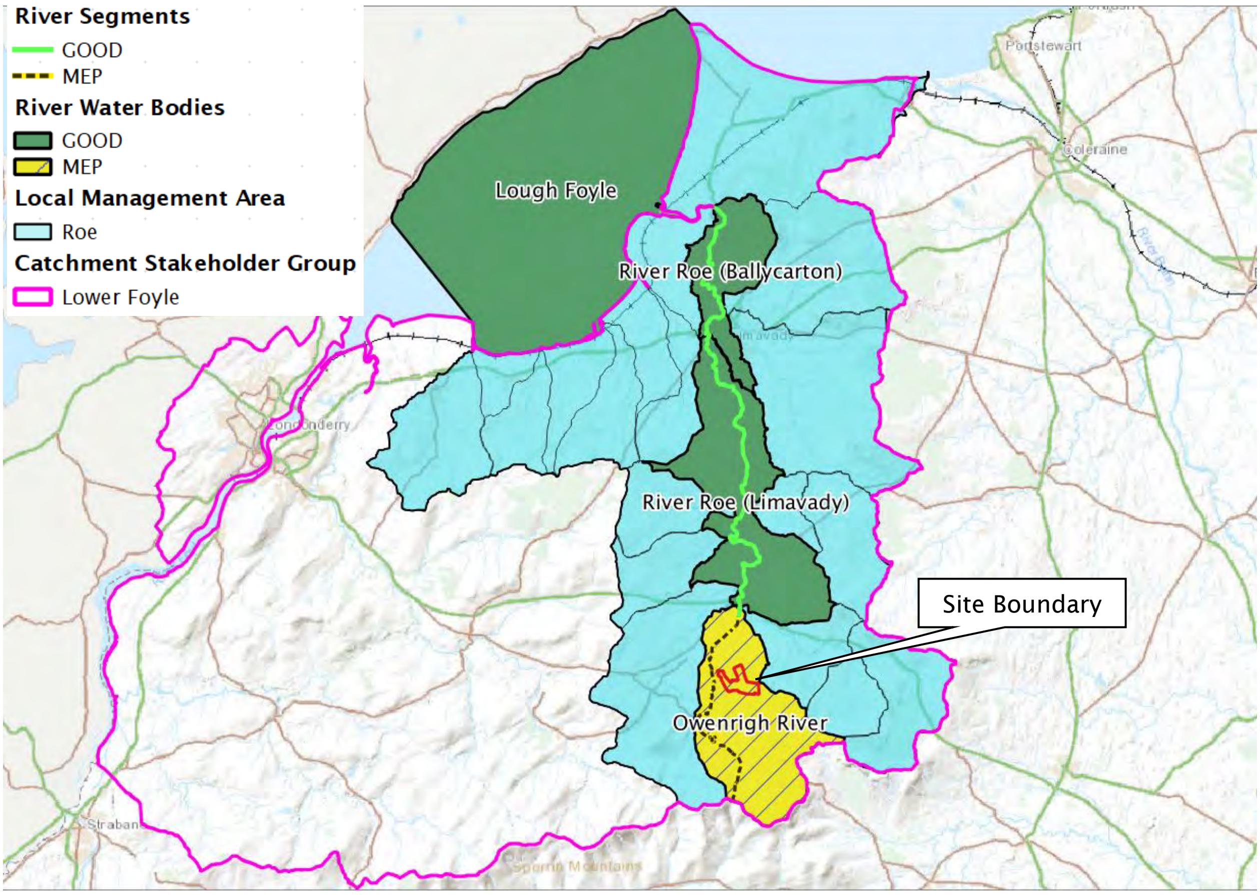

Figure 2-1: Site Hydrological Context

[2] NIEA River Basin Viewer. Available at https://appsd.daera-ni.gov.uk/RiverBasinViewer/

2.3 Surface Waterbody Classification

The following section is intended to provide a qualitative appraisal of existing surface water quality in the waterbody whose catchment the proposed development lies within.

As identified within Section 2.2; for purposes of classification under the WFD the Owenrigh River which is located within the Roe Local Management Area[3, 4] and the Lower Foyle Catchment Stakeholder Group. The River Roe and its tributaries are located within the North Western River Basin District[5].

Following the publication of the Water Framework Directive waterbodies are given a WFD classification based on annual average / percentile results from several individual monitoring stations. WFD classification or status is a combination of chemical, biological and hydromorphological elements, whereby the overall status is the lowest of the combined constituents.

A number of biological and chemical water quality elements used in classification in the Roe Catchment can be affected by both diffuse and point source pollution. Within the LMA Plan the main impact has been assessed as affecting invertebrate communities. This element is associated with organic enrichment.

2.3.1 Surface Water Quality

The current Overall Current Status for the Owenrigh River (UKGBNI1NW020202010**)** is 'Moderate Ecological Potential' with an objective to achieve 'Good' status through to 2021 and 2027. The Owenrigh is designated under the Drainage (Northern Ireland) Order 1973 3.5 km downstream of the site.

The Owenrigh River was designated under the WFD as a Freshwater Fish Directive protected area due to the presence of economically significant species. The Directive 2006/44/EC has since been revoked, however NIEA:WMU continues to recognise the Altnaheglish, Owenrigh and Roe Rivers as protected areas containing economically significant species.

The WFD results are detailed within Table 2.1.

[3] DAERA (2012) Roe Local Management Area Action Plan 2009 to 2015 https://www.daera-ni.gov.uk/publications/roe-local-management-area-action-plan-2009-2015

[4] Roe Local Management Areas Action Plan and Update (2013) https://www.daera-ni.gov.uk/sites/default/files/publications/doe/roe-swmi-joined.PDF

[5] DAERA (2015) North Western River Basin Management Plan 2015 to 2010 https://www.daera-ni.gov.uk/publications/north-western-river-basin-management-plan-2015-2021

Table 2.1: Owenrigh River LMA Waterbody Classification

River Classification Element		2009 Status	2010 Status	2011 Status	2012 Status	2013 Status	2014 Status	2015 Status
Overall Status		MEP	MEP	MEP	MEP	MEP	MEP	MEP
Confidence in Overall Status		High	High	High	Medium	Medium	Medium	High
Biological	Benthic Invertebrates	Good	Good	Good	Good	Good	Good	High
	Macrophytes	High	High	High	High	High	High	High
	Phytobenthos	-	-	-	-	High	High	High
	Fish	-	-	-	-	-	-	-
Chemical / Physio-chemical	Ammonia	High	High	High	High	High	High	Good/ High
	Dissolved Oxygen	High	High	High	High	High	High	High
	pH	High	High	High	High	High	High	High
	Soluble Reactive Phosphate	High	High	High	High	High	High	High
	Biological Oxygen Demand*	High	High	High	High	High	High	High
	Temperature*	High	High	High	High	High	High	High
Specific Pollutants	Dissolved Copper	Fail	Fail	-	-	Fail	Fail	-
	Total Zinc	Pass	Pass	-	-	Pass	Pass	-
Hydro-morphology	Hydrological Regime	Bad	Bad	Bad	Bad	Bad	Bad	Good
	Morphological conditions#	-	-	-	Good	Good	Good	Good

*Element does not contribute to overall classification.

2.3.2 Roe Local Management Area Action Plan and Update

The LMA Action Plan and Update (2013) states that many rivers (62 %) within the River Roe Catchment have been classified as less than 'Good' status. The main reason is due to the impact on invertebrate communities. The main pressures being abstraction and flow regulation, diffuse and point source pollution, changes to morphology (physical habitat).

The update states that the aim is to achieve 'Good' quality or better in 81 % of surface waters by 2015.

Catchment wide actions to be implemented to maintain and improve the water environment are outlined within the Action Plan and the plan also outlines surface water catchment specific actions to be undertaken to maintain and improve the Catchment as follows:

2.3.2.1 Catchment Wide Actions

- Carry out agricultural advisory site visits where identified as an issue through river walks and spot checks or as identified by stakeholders.

- Carry out fish habitat improvement works at identified areas within the LMA.
- Conduct a water resource assessment to inform an ongoing review of abstraction licences within Northern Ireland.
- Encourage riparian zone management with an aim to improve biodiversity and minimise sedimentation through practical management measures on farms.
- Raise awareness and promote the benefits of effective farm nutrient and waste management.
- Support local environmental initiatives such as river clean-up campaigns.
- Review of groundwater abstraction and planning applications where necessary.
- Provide advice on protected area designations to work towards improving the condition assessment of the 'River Roe & its tributaries' Special Area of Conservation (SAC).

2.3.2.2 Owenrigh River Actions

The Owenrigh River is heavily modified due to the reservoir at Altnaheglish making the river water body susceptible to impacts from abstraction and flow regulation. The list of Actions to be taken to improve the water environment in this water body as outlined in the Roe Local Management Area Action Plan and Update are summarised below;

- Determine and address sources of organic pollution affecting aquatic invertebrates, downstream of Banagher Forest;
- Carry out agricultural advisory site visits where necessary;
- Conduct invasive species recording, raise awareness on preventing the spread of invasive species;
- Carry out pollution prevention and if necessary, enforcement measures at active quarries in this water body;
- Mitigate against forestry operations at Banagher Forest;
- Carry out a full RHAT (River Hydromorphology Assessment Technique) to assess the hydromorohological classification and produce recommendations at a water body scale;
- Investigation the feasibility and practicality of implementing morphological mitigation measures as recommended;
- Obtain data on reservoir / lake levels, catchment flows and transfers of water from other water body sources to inform the review of the current abstraction / impoundment licence at Altnaheglish reservoir. Agree monitoring plans and include details on augmented flows returned to the waterway below;
- Review the current abstraction licence to finalise maximum abstraction volumes, take account of seasonal variations and ensure the ecological need for compensation flows are fully considered at Altnaheglish reservoir;
- Identification of contamination risks from 'source to tap' through the development of drinking water safety plans at Caugh Hill WTW;
- Continue to monitor mitigation measures through Drinking Water Inspectorate regulatory processes within this catchment;
- Support local measures that will improve water quality, in particular, reduction in the presence of pesticides and the levels of organic matter in raw water which cause implications for water treatment at Caugh Hill WTW.
- Investigate identified water quality impacts e.g. Dissolved Copper.

2.4 Groundwater Body Identification

The proposed Development is situated within the catchment of the Claudy Groundwater Body (UKGBNI4NW003), within the North-Western River Basin District.

2.5 Groundwater Body Classification

The site is underlain by the Claudy groundwater body (UKGBNI4NW003), which has an area of 917 km^2. The body extents southwards from Lough Foyle and eastwards from the Foyle River, the southern and south eastern boundary is defined by surface water catchments with the remaining part of the eastern boundary defined by the geological boundary with the Triassic Sherwood Sandstone or Palaeogene Basalts.

The body includes the entire catchments of the Burndennett and the Faughan and a significant portion of the River Roe. The main urban centres are Derry, Limavady and Dungiven. The primary land use is pasture / improved grassland (82.6 %).

Lowland areas occur around the coast and in the main river valleys, the land rises away from these areas with peaks close to 400 m AOD, in the south the land rises towards the Sperrin mountains.

The characteristics of the groundwater body are summarised in the following sections.

Table 2.2: Characterisation of Claudy Groundwater Body

Region	Geological Characteristics	Aquifer Type	
Majority of Groundwater Body	Dalradian, Carboniferous	Bl (f)	The majority of bedrock is considered to have limited potential for significant abstraction. Intergranular porosity is negligible and fracture flow dominates.
Basalt occurs as an isolated outcrop extending from the main basalt area	Palaeogene Basalts	Bm(f)	Generally considered to have moderate productivity potential. Intergranular flow is negligible and fracture flow dominates. As basalt is an outcrop considered as having limited productivity potential.

2.5.1 Groundwater Body WFD Classifications

Following publication of the NIEA River Basin Management Plan in 2009 only an initial characterisation had been carried out for this groundwater body. The plan classified the quantitative, chemical, and overall status of the groundwater body as 'Good'.

Second cycle results for the 2015-2021 cycle indicated water quality (quantitative, chemical, and overall) remained classified as 'Good'.

2.5.2 Groundwater Body WFD Objectives

The updated RBMP document "What We Plan to Achieve by 2021 and Beyond"[6,7] produced in December 2014 following the second cycle; highlights changes to original 2009-2015 WFD objectives. The RBMP now aims to maintain 'Good' status and ensure there is no deterioration in the water quality of these waters.

2.5.3 Local Management Area Action Plans

The Roe Action Plan and Update published in December 2013 highlighted any actions which had been implemented to date and stated the aim to maintain a 'Good' status in 100% of LMA's groundwaters.

6 NIEA (2014) RBMP What we plan to achieve by 2021 and beyond https://www.daera-ni.gov.uk/sites/default/files/publications/doe/water-plan-what-we-plan-to-achieve-by-2021-beyond-2014.pdf [Accessed 14/06/2017]
7 NIEA (2015) Review of the Environmental Objects for the Second Cycle RBMP Available: https://www.daera-ni.gov.uk/publications/what-we-plan-achieve-by-2021-and-beyond-2015 [Accessed 15/06/2017]

Catchment wide actions to be implemented to maintain and improve the groundwater environment were outlined within the Action Plan as follows:

- Review of groundwater abstraction and planning applications where necessary;
- Review authorisation of discharges to groundwater;
- Protection of drinking water sources;
- Abstraction and Impoundment control;
- Point source and diffuse source discharge control;
- Prevention or reduction of the impact of accidental pollution incidents;
- Priority substances control;
- Controls on other activities impacting on water status.

3 STAGE II: ASSESSMENT OF PROPOSALS

3.1 Approach

The next stage undertaken will identify the nature of the development, the construction activities proposed and the potential specific detrimental effect to the water environment based on the key WFD objectives.

3.2 Development Description

The proposed Development comprises:

- Construction of new access tracks, upgrading of existing tracks and maintenance of existing tracks;
- Construction of a temporary construction compound, for the duration of the construction period;
- Construction of a permanent control building and substation compound with permanent hardstanding area;
- Excavation of six turbine foundations and associated dewatering and concrete pouring activities and construction of nine crane pads and lay-down areas;
- Construction of seven watercourse crossings, of which 4 are upgrades or replacements of existing culverts;
- Construction of drainage ancillary to proposed wind farm infrastructure including track drainage, minor watercourse diversions, and surface water attenuation.
- Installation of underground power and telemetry cables;
- Temporary and permanent stockpiling of soils associated with all of the above.

3.3 Potential Effects

The proposed Development works include works over, in and in close proximity to waterbodies. There are a number of potential adverse effects to both surface and groundwater and these will be considered in the following sections. The risks will be considered on a case by case basis in the WFD Schedules presented this assessment.

Potential effects of wind farm construction are outlined in greater detail in **Chapter 9: Geology and Water Environment**.

3.3.1 Surface Water

The primary risks of degradation of surface water bodies, including streams and drains, are summarised as follows:

- Changes in runoff and flow patterns;
- Silt / suspended solids pollution of surface waters;
- Chemical pollution of surface waters e.g. oil / fuels.

3.3.2 Groundwater

Groundwater is not at risk from as many sources of pollution as surface waters. However, potential risks are considered to be as listed below:

- Chemical pollution of groundwater e.g. oil / fuels;
- Due to the nature of the works (deep excavations / importing of fill material) it is considered that there is potential for disturbance of aquifers and aquifer recharge.

3.4 Site Specific Proposals Assessment

The following sections (Table 3.1 - **Error! Reference source not found.**) detail those areas where the Development has potential to affect the water environment, detailing the nature and extent of work required and potential for adverse impacts.

The format generally mirrors that required by the guidance provided by NIEA Northern Ireland Environment Agency Water Management Unit (NIEA WMU) in 'Carrying out a Water Framework Directive Assessment on EIA Developments'.

Note that the "Current" status shown is taken from the most recent year a particular parameter was tested for and can vary between watercourses and parameters.

3.5 WFD Objectives

A fundamental requirement of the Water Framework Directive is to attain 'Good' ecological water quality status and that the deterioration in the status of water is prevented. The aim of carrying out a WFD Assessment is to determine if specific components or activities related to the planned development scheme will compromise the attainment of a WFD objective or result in a deterioration in the ecological status of any waterbodies.

The following tables assess the impact of the activities associated with the construction of the Development against the relevant WFD classification elements and the following WFD Objectives;

1. To prevent deterioration in the ecological status of the water body;
2. To prevent the introduction of impediments to the attainment of 'Good' WFD status for the water body;
3. To ensure that the attainment of the WFD objectives for the water body are not compromised;
4. To ensure the achievement of the WFD objectives in other water bodies within the same catchment are not permanently excluded or compromised.

3.5.1 Potential Effect of Construction - Changes in Runoff and Flow Patterns

Table 3.1: Potential Impact of Changes in Runoff and Flow Patterns in on site watercourses affecting the Owenrigh River

WATERCOURSE				
	Waterbody Name	Owenrigh River	WFD Waterbody ID	(UKGBNI1NW020202010)
	Local Management Area	Roe		
	2015 Status	Moderate Ecological Potential	Objective 2021- 2027	Good Ecological Potential

UNMITIGATED IMPACT DISCUSSION

Proposed Works

Installation of new temporary or permanent impermeable surfaces.

New temporary or permanent excavations and structures acting as barriers to runoff.

Temporary Compaction of soils due to plant and site traffic.

Potential Impacts

Increased rate and volume of surface runoff, ponding and alterations to preferential flow routes, reduced surface permeability on site.

Consequences

Temporary or permanent redirection of surface water flows can result in potential adverse effects to down gradient dependant habitats either through starvation of areas where water currently flows, or flooding.

Temporary or permanent increases in surface water runoff rates and volumes can result in increased flood risk and increased effects of erosion and scour in down gradient watercourses.

Adopting a precautionary approach, flow changes in affected watercourses may affect benthic invertebrate communities, given that individual species are adapted to specific flow conditions.

Changes to flow patterns causing sediment movement may impact adversely on any macrophytes via smothering or changes to water depth.

Soluble reactive phosphate status concentrations may be expected to increase if sediment concentrations increase (as a result of changes to flow patterns and runoff characteristics).

A reduced water depth may also be associated with increased water temperatures; and consequently dissolved oxygen decreases.

Changes to flow patterns have the potential to affect the hydrological regime of the river.

WFD CLASSIFICATION

WFD Element	Current Status	Assessed Change
Benthic Invertebrates	High	Moderate
Phytobenthos	High	Moderate
Ammonia	Good /High	Good /High
Dissolved Oxygen	High	Good / Moderate
pH	High	High
Soluble Reactive Phosphate	High	Good
Biological Oxygen Demand	High	Good
Temperature	High	Good
Hydrological Regime	Good	Moderate
Morphological conditions	Good	Moderate

ASSESSMENT	Does the component comply with WFD Objectives 1, 2, 3 and 4?		
	No		Do not proceed or complete Article 4.7 assessment.
	Yes (Justification provided)		Proceed after NIEA agreement.
	Yes, with mitigation	✓	Complete Schedule B.

3.5.2 Potential Effect of Construction - Silt / Suspended Solid Pollution of Surface Waters

Table 3.2: Potential Impact of Silt / suspended solid pollution on watercourses leading to the Owenrigh River

WATERCOURSE	Waterbody Name	Owenrigh River	WFD Waterbody ID	(UKGBNI1NW020202010)	
	Local Management Area	Roe			
	2015 Status	Moderate Ecological Potential	Objective 2021-2027	Good Ecological Potential	

UNMITIGATED IMPACT DISCUSSION				
Proposed Works Excavations, ground disturbance, stripping of top soil and temporary soil deposition will be required during construction of the wind farm infrastructure. Importing, handling and placement of aggregate for access tracks. Plant and maintenance vehicle movement across disturbed soils and stone access tracks and washing down plant and machinery. Potential Impacts The proposed works have the potential to release fine sediments, fine soil, clay and aggregate particles into surface runoff or where construction is in the vicinity off watercourses. Shallow groundwater gathering in excavations will come in contact with excavated surfaces and aggregate. Traffic movements can transport silts and find grade aggregates. Consequences Polluted groundwater within excavations will have to be pumped and (without treatment) if discharged to nearby watercourses will result in the release of a potentially heavily polluted effluent. Sediments and debris entering watercourses have the potential to adversely modify stream morphologies, smother habitats, harm aquatic flora / fauna and increase risk of blockage to culverts / drainage channels.	WFD CLASSIFICATION	WFD Element	Current Status	Assessed Change
		Benthic Invertebrates	High	Poor
		Phytobenthos	High	Good
		Ammonia	Good /High	Good /High
		Dissolved Oxygen	High	Good / Moderate
		pH	High	High
		Soluble Reactive Phosphate	High	Poor
		Biological Oxygen Demand	High	Poor

	Increased suspended sediment concentrations may affect benthic invertebrate communities given that individual species are adapted to specific water quality conditions. Changes to suspended sediment concentrations may impact adversely on macrophytes via smothering or changes to water depth and flow patterns for example. Soluble reactive phosphate status concentrations may be expected to increase given that phosphorus adheres strongly to some sediment particles. BOD concentrations may increase if it is presumed that some of the sediment fraction is organic. Some influence on water temperature may be exhibited due to changes to the turbidity. A reduced water depth (caused by sediment build up) may also be associated with increased water temperatures – in reality this is unlikely to increase the temperature to such a degree that the WFD status is affected; however a precautionary approach is adopted here. Some increased concentrations of metals may occur (given their association with sediments) but such increases are likely to be negligible.		Temperature	High	Good
			Hydrological Regime	Good	Moderate
			Morphological conditions	Good	Moderate

ASSESSMENT		
Does the component comply with WFD Objectives 1, 2, 3 and 4?		
No		Do not proceed or complete Article 4.7 assessment.
Yes (Justification provided)		Proceed after NIEA agreement.
Yes, with mitigation	✓	Complete Schedule B.

3.5.3 Potential Effect of Construction - Chemical Pollution of Surface Waters

Table 3.3: Potential Impact of Chemical pollution on site watercourses affecting the Owenrigh River

WATERCOURSE				
Waterbody Name	Owenrigh River	WFD Waterbody ID	(UKGBNI1NW020202010)	
Local Management Area	Roe			
2015 Status	Moderate Ecological Potential	Objective 2021-2027	Good Ecological Potential	

UNMITIGATED IMPACT	WFD CLASSIFICATIO	WFD Element	Current Status	Assessed Change
Proposed Works The proposed works will require the temporary presence of chemicals, fuels and other oils and alum flocculants along with permanent presence of oils and lubricants associated with turbine maintenance.		Benthic Invertebrates	High	Poor

<table>
<tr><td rowspan="9"></td><td rowspan="9">Excavations, deforestation / replanting, soil stripping, concrete pouring and construction of temporary welfare facilities.
<u>Potential Impacts</u>
There is the potential for chemicals to enter a watercourse through accidental spillage, improper transport and refuelling or inappropriate storage and disposal procedures.
Earthworks in areas previously forested may cause the release of residual fertilisers and in areas of peat excavations may cause acidification of surface waters.
Unregulated use of flocculants can result in large doses entering surface waters.
Cementitious materials and discharge from temporary welfare activities have the potential to enter the watercourses.
<u>Consequences</u>
Oils and chemicals entering watercourses have the potential to adversely affect water quality, with associated effects to fish and aquatic ecology.
Release of forestry fertilisers and acidification from peat may adversely affect nitrate and pH levels and unregulated use of flocculants has the potential to cause locally significant fluctuations in pH, with adverse effects to fish.
Wastewater and associated coliforms discharged to subsoil irrigation or to the ground surface can percolate through to underlying aquifer and adversely affect water quality.</td><td rowspan="9"></td><td>Phytobenthos</td><td>High</td><td>Good</td></tr>
<tr><td>Ammonia</td><td>Good /High</td><td>Moderate / Good</td></tr>
<tr><td>Dissolved Oxygen</td><td>High</td><td>Good / Moderate</td></tr>
<tr><td>pH</td><td>High</td><td>Good / Moderate</td></tr>
<tr><td>Soluble Reactive Phosphate</td><td>High</td><td>Poor</td></tr>
<tr><td>Biological Oxygen Demand</td><td>High</td><td>Poor</td></tr>
<tr><td>Temperature</td><td>High</td><td>Good</td></tr>
<tr><td>Hydrological Regime</td><td>Good</td><td>Moderate</td></tr>
<tr><td>Morphological conditions</td><td>Good</td><td>Moderate</td></tr>
<tr><td rowspan="4">ASSESSMENT</td><td colspan="5">Does the component comply with WFD Objectives 1, 2, 3 and 4?</td></tr>
<tr><td>No</td><td></td><td colspan="3">No</td></tr>
<tr><td>Yes (Justification provided)</td><td></td><td colspan="3">Yes (Justification provided)</td></tr>
<tr><td>Yes, with mitigation</td><td>✓</td><td colspan="3">Yes, with mitigation</td></tr>
</table>

3.5.5 Potential Impact of Chemical pollution to Claudy Groundwater body

Table 3.4: Potential Impact of Chemical pollution to Claudy Groundwater body

WATERCOURSE				
Groundwater Body	Claudy	WFD Waterbody ID	(UKGBNI4NW003)	
River Basin District	North Western			
2015 Status	Good			

UNMITIGATED IMPACT DISCUSSION

Proposed Works

The proposed works will require the temporary presence of chemicals, fuels and other oils and alum flocculants along with permanent presence of oils and lubricants associated with turbine maintenance on the site. Excavations, deforestation / replanting, soil stripping, concrete pouring and construction of temporary welfare facilities.

Potential Impacts

There is the potential for chemicals to enter the groundwater through accidental spillage, improper transport and refuelling or inappropriate storage and disposal procedures.

Earthworks in areas previously forested may cause the release of residual fertilisers into the groundwater and shallow groundwater can gather in significant excavations.

Unregulated use of flocculants can result in large doses entering groundwater.

Cementitious materials have the potential to enter the groundwater.

Leakage from the discharge from temporary welfare activities (above ground storage and taken off-site by licensed waste disposal team) has the potential to enter shallow groundwater.

Consequences

Oils and chemicals entering groundwater have the potential to adversely affect water quality.

Acidification from peat may adversely affect pH levels.

Unregulated use of flocculants has the potential to cause locally significant fluctuations in pH.

Wastewater and associated coliforms discharged to subsoil irrigation or to the ground surface can percolate through to underlying aquifer and adversely affect water quality.

WFD CLASSIFICATION

WFD Element	Current Status	Assessed Change
Chemical Status	Good	
Quantitative Status	Good	
Overall Status	Good	

ASSESSMENT	Does the component comply with WFD Objectives 1, 2, 3 and 4?		
	No		No
	Yes (Justification provided)		Yes (Justification provided)
	Yes, with mitigation	✓	Yes, with mitigation

3.5.6 Potential Impact of Construction Disturbance of Aquifer / Aquifer Recharge to Claudy Groundwater Body

Table 3.5: Potential Impact of Construction Disturbance of Aquifer / Aquifer Recharge to Claudy Groundwater Body

WATERCOURSE	Groundwater Body	Claudy	WFD Waterbody ID	(UKGBNI4NW003)		
	River Basin District	North Western				
	2015 Status	Good				
UNMITIGATED IMPACT DISCUSSION	Proposed Works Installation of new temporary or permanent impermeable surfaces. Potential Impacts Reduced surface permeability. The detailed geology and hydrogeology assessment for the project has determined that works proposed are unlikely to encounter caustic features in limestone, and that potential for causing morphological change to fractured groundwater flow is not a significant consideration at the site. Consequences Reduction of permeable areas on the site can reduced the potential for groundwater recharge.			WFD CLASSIFICATION	WFD Element	Current Status	Assessed Change
					Chemical Status	Good	Good
					Quantitative Status	Good	
					Overall Status	Good	
ASSESSMENT	Does the component comply with WFD Objectives 1, 2, 3 and 4?					
	No		No			
	Yes (Justification provided)		Yes (Justification provided)			
	Yes, with mitigation	✓	Yes, with mitigation			

4 STAGE III: MITIGATING MEASURES

4.1 Approach

Sections 4 to 9 of this report detail the third stage of the assessment; the approach to implementation of specific mitigation measures to be applied at the site.

In order to mitigate the potential degradation of surface and groundwater quality, changes in runoff and flow patterns, and morphology, identified in Section 3 as a result of construction activities associated with the development, mitigation measures are to be implemented during all stages of the construction process.

4.2 Introduction

The construction phase of all projects is a period within which there is increased potential for pollution, in particular silt pollution to local watercourses. In relation to pollution, this document is intended to provide sufficient detail to ensure that water pollution will not occur as a result of construction activities at the site and to minimise the risk of any such occurrence. Measures are also proposed to ensure no adverse effect to stream flow and morphology.

Environmental Statement Chapter 9: Geology and Water Environment has identified particular downstream receptors, of significance from a drainage perspective especially watercourses with fisheries potential and should be referred to for a detailed appraisal of the site hydrology and hydrogeology.

The main objectives of the following sections are to demonstrate that sufficient measures have been put in place so as to protect those identified receptors and to ensure that drainage is constructed to relevant guidance and standards, particularly as follows:

- To propose appropriate, robust and buildable SuDS techniques for the prevention of erosion and the removal of silts and pollutants from construction runoff;
- To ensure that permanent drainage at the development is designed to a sufficient hydraulic capacity to contain a pre-determined return period rainfall event;
- To give consideration of the control and monitoring proposals for the dewatering of excavations;
- To ensure that surrounding agricultural lands, heath and peat lands are not negatively affected by surface water runoff from the site;

The drainage design adopts a SuDS approach, using temporary SuDS for the drainage of the temporary works during the construction phase.

Where construction activities near water courses and water bodies are essential, steps have been undertaken to identify sufficient mitigation measures for the protection of the watercourses against pollution and have been presented on drawings accompanying this report within Annex A and Annex B. Silt management and pollution prevention during all elements of construction has been given due consideration within the design statement herein and within the scope of the full SuDS design.

This report gives both specific and general details on the drainage method for temporary works, permanent site drainage and pollution prevention measures for silt management.

4.3 Additional References

This document refers to and should be read in conjunction with the Magheramore Environmental Statement, in particular:

- Chapter 6: Ecology / Chapter 8: Fisheries;
- Technical Appendix 9.3: Geotechnical Assessment

Chapters are contained within Volume 2 and Technical Appendices are included within Volume 4 of the ES. In addition; the following accompanying drawings included within Annex A and Annex B of this Technical Appendix:

- Figures WFD_01 through WFD_05: Preliminary SuDS General Arrangements;
- Figures WFD_07 through WFD_: Preliminary SuDS Typical Details.

5 SITE DRAINAGE INFORMATION

5.1 Site Area

The Development is located approximately 4 km to the south of Dungiven. The Site area considered within this assessment occupies an area of approximately 1.5 km2.

5.2 Topography

The Site lies on the northern and southern flank of Teeavan Hill, with wind turbines sited on the western ridge of the Hill.

Ground levels within the Site range from approximately 325 m to 110m at the northern extent. Surface slopes within the site range from approximately 1 to 47%, with an average (mean) slope of approximately 13%.

5.3 Site Hydrology

The following is based on a combination of desktop study and walkover survey observations. Main stream reach lengths identified are as per OSNI 1:2,500 scale mapping, validated or otherwise by means of visual survey on-site.

The Development is located entirely within the Owenrigh River Catchment.

The site is drained by several undesignated watercourses. At the site entrance a water feature draining the northern fields in the western area of the site, adjacent to the north of the farmers track, joins Altabeg Burn, a tributary which then flows 295 m to join the Owenrigh River. The east and south of the site drains towards the Altnaheglish River which flows in Banagher Glen, and joins the Owenrigh to the south west of the site. The north of the site drains towards a tributary of the Owenrigh, which connects to the river approximately 1.8 km north of the site boundary.

The Altnaheglish River flows 50 m south of the site boundary. 500 m to the south west of the site it joins the Owenrigh River which flows 280 m west of the site at the nearest point. The Owenrigh is undesignated as it flows parallel to the site. However, it is designated under the Drainage (Northern Ireland) Order 1973 3.5 km downstream of the site. The watercourse joins the designated River Roe c. 4 km north of the site. The River Roe flows for 34 km, eventually discharging to Lough Foyle.

Based on NIEA River Basin Management Plan boundaries; the site is situated within the Roe Local Management Area (LMA) which is within the Lower Foyle Catchment Stakeholder Group and falls under the control of the North Western Basin District.

6 SUDS DESIGN APPROACH

6.1 Relevant Guidance and Legislative Requirements

It is proposed that all drainage relating to Magheramore Wind Farm will be constructed using best practice and in conformance with the requirements of the relevant regulatory authorities. The key legislation and guidance which will be adhered to are defined in the Environmental Statement Chapter 9 – Geology and Water Environment, and are not repeated here.

In order to meet the design criteria and objectives detailed previously in this report and regulatory authority requirements, the following design philosophy has been developed.

6.2 Controlling Runoff

- Track and hardstanding runoff will be handled by sheet flow to trackside ditches or swales.
- Tracks and hardstanding areas are to be constructed from unbound aggregate and are not surfaced, thus helping to reduce runoff volumes. This has been allowed for within the design philosophy through the utilisation of a reduced runoff coefficient of 70 %, and a heavy silt loading assumed as defined by D'Arcy et al (2000), for light industrial and engineering land uses.
- Piped under track drainage will be provided with associated sumps and check dams. The under track drainage will provide a means for flows to pass from a swale on the uphill side to the downhill side of the slope.
- In cases where the tracks must run significantly downhill, transverse drains ('grips') will be constructed where appropriate in the surface of the tracks to divert any runoff flowing down the track into the adjacent drainage ditch/across open ground.
- Rate and volume of runoff will be attenuated using check dams located in trackside swales and ponds located at significant new hardstanding areas. Attenuation features will also reduce flow velocities preventing scour, and allow settlement of silts prior to discharge.
- The use of large balancing ponds is to be avoided and there will be no merit in using other methods such as filter drains or hard permeable surfacing due to the lack of infiltration capacity in prevalent soil types.

6.3 Water Quality and Treatment

- Clean / dirty water separation will be maintained on site in all practicable instances. Clean water will be prevented from entering excavations and dirty water drainage swales through use of clean water diversion / cut-off ditches.
- A treatment train will be designed with a minimum of two stages of treatment for polluted runoff from the site during the construction phase.
- All treatment settlement features (check dam backwaters and ponds) are to be designed to offer sufficient retention time to settle out the silt grain sizes anticipated.
- Silt laden runoff within trackside swales will be treated through the provision of small check dams at specified centres along the swales (to be specified as part of detailed design). Note that steeper swale sections will require a greater frequency of check dams.
- Appropriate site management measures will be taken to ensure that runoff from the construction site is not contaminated by fuel or lubricant spillages. Earth spillages into any existing streams will also be avoided. There will be no discharge of trade effluent, sewage effluent or contaminated drainage into any watercourse system or ditch. Any dewatering from excavations will be via surface silt traps, check dams and settlement ponds to ensure sediment does not enter surrounding watercourses.
- Areas stripped of vegetation should be kept to a minimum. Stripped vegetation should be reinstated on slopes as early as possible.

6.4 Preserving Hydrology and Groundwater Recharge / Amenity & Biodiversity

- Drainage design will ensure natural streams are piped directly through appropriately sized drainage pipes on their original alignment.
- Runoff from new hardstanding areas will be collected and attenuated before discharge to receiving drainage networks.

6.5 Summary

The proposed SuDS design provides a surface water management train that will seek to mitigate potentially adverse impacts on the hydrology of the Development

Application of the above design philosophy in the detailed design and construction of site specific elements is considered in the following sections of this report.

7 DRAINAGE DESIGN PHASE - DETAILED CONSIDERATIONS

7.1 Preamble

The following key considerations have been identified in the preliminary design of hydrology and drainage (including foul) for the site in order to preserve water quality, downstream hydrology and preserve stream morphology. These issues and development of suitable mitigating measures will be given further consideration during the detailed design stage of the project.

- Identification of watercourse crossings and drainage paths across the site;
- Sizing and definition of hydraulic capacity requirements for watercourse crossings;
- Detailed design of track and hardstanding drainage and silt management;
- Separation of ‘clean’ and ‘dirty’ water;
- Spoil storage;
- Management and discharge of runoff in areas of upland heath and in areas of improved grassland and peat land;
- Requirement for attenuation storage;
- Definition of “Buffer Zones”.

Note that the infrastructure layout and associated SuDS design prepared for purposes of Planning is preliminary only. Post consent, track layout design and associated SuDS design will be further developed to minimise and mitigate for the effects of pollution to all local watercourses.

Preliminary drainage layout is shown on accompanying drainage management drawings within **Annex A.**

7.2 Watercourses and Watercourse Crossings

7.2.1 Identification of Watercourse Crossings

Watercourses significant for purposes of environmental design have been identified within the Hydrology Assessment undertaken for the Environmental Statement for the project. Sensitive water features on the site comprise natural watercourses and main flowing drains.

- Two crossings of significant watercourses are required to allow development (neither of which are significant in terms of fisheries potential per **Chapter 8: Fisheries**), both of which comprise upgrades or replacement of existing culvert structures..
- Five crossings of minor watercourses are proposed to allow development, of which two are replacement crossings, and all of which affect watercourses characteristic of existing trackside drainage or peat drains.

Additional consideration will be given to design of drainage crossings at detailed (post-planning) design stage, including other drainage crossings where other drainage crossings may be ditches and drains as encountered alongside existing roads tracks and field boundaries or moorland / peatland drainage.

Works to watercourse crossings will be subject to authorisation by DfI Rivers under Schedule 6 of the Drainage (Northern Ireland) Order 1973. Works causing disturbance to the riverbed shall similarly be subject to Loughs Agency Section 46/47 permit.

7.2.2 Design of Watercourse Crossings

Full design of watercourse crossings will be undertaken at detailed design stage, post planning consent. Outline designs sufficient to allow assessment of environmental effects have been prepared as part of this assessment.

The following guidance has been adhered to in the outline design and will be similarly applied in the detailed design of watercourse crossings:

- Hydrological assessments made using a number of methods including Flood Estimation Handbook to determine the design flow;
- SNIFFER WFD 111 documents;

- CIRIA Culvert design and operation guide (C689);
- Fisheries considerations shall incorporate guidance stated in Loughs Agency Guidelines for Fisheries Protection during Development Works (2011) and Scottish Executive (2002) River Crossings and Migratory Fish: Design Guidance (where appropriate).

Watercourse crossings on the site shall comprise conventional closed culverts, with the requirement for bottomless culverts driven by consideration of fish passage determined in conjunction with the site specific fisheries assessment included with the Environmental Statement, which concludes that such measures are unnecessary.

Factors considered in the design and orientation of all watercourse crossings includes:

- Crossing direction to generally be perpendicular with access track direction, therefore minimising the length of stream affected;
- Consideration of the passage of out-of-bank flood flows;
- Crossings are generally located in an area where bank slopes are the shallowest available, thus reducing the potential for runoff to carry sediment into the watercourse.
- Additional mitigation will be designed to prevent pollution of the watercourse during the construction of the watercourse crossing to reduce residual risk; comprising the temporary installation of silt fences in the stream channel downstream or similarly effective measures.
- Typical in-channel silt fence arrangements are shown on drawing **WFD_07** included in **Annex B.**

7.2.2.1 Culvert Crossings

Conventional piped or closed bottom culverts are proposed at minor water features (based on site observations and catchment size < 0.25 km^2), and at water features where the requirement to maintain fish habitat in the channel has been determined to be not applicable within **Chapter 8: Fisheries**. These crossings and other culverts for surface flood conveyance or similar, shall be piped or box culverts.

Design requirements will be imposed to ensure that culverts are installed at a level lower than existing bed levels in order to create a "stilling" effect and reduce potential for increased local flow velocities in the culvert in addition to promoting the formation of a natural substrate within the culvert. Mitigation of construction of the culvert within watercourses is discussed further in Section 8.2.2.

A typical culvert representing an outline design is shown on drawing **WFD_08** included in **Annex B.**

7.2.3 Design of Watercourse Diversions

Realignment of existing track drainage or peat drainage to permit the development of access tracks is proposed at 3 locations. The proposed drainage channel will be designed to ensure a hydraulic capacity not less than the channel it is replacing.

Works to watercourses will be subject to authorisation by DfI Rivers under Schedule 6 of the Drainage (Northern Ireland) Order 1973. Works causing disturbance to the riverbed shall similarly be subject to Loughs Agency Section 46/47 permit.

Areas where minor watercourse diversions are proposed are shown on drawings **WFD01 to 06** within **Annex A.**

7.2.4 Water Feature Buffer Zones

Buffer zones to water features have been established for the Site within **Chapter 9: Geology and Water Environment** for the project and are shown on accompanying drainage management drawings **WFD01 to 06** within **Annex A.** Buffers apply to "diverted" watercourse channels (where applicable), where the watercourse diversion would be installed as enabling works and in-place prior to commencement of main earthworks.

Infrastructure designed to lie outwith stated hydrological buffer zones comprises those elements of the works associated with significant earthworks, and greatest potential for spillage or leakage of chemical pollutants, i.e.:

- All turbine bases, met mast foundations, crane pads, and associated working areas including spoil storage areas.

- Areas designated for temporary or permanent spoil management or storage.
- Substation buildings and compounds, temporary construction compounds, fuel and chemical storage areas, and any other platforms.

Buffers would be imposed during the construction phase in order to limit the types of construction activities permissible in proximity to water. Where the local site environment requires additional protection (e.g. steep slopes or lack of vegetation between construction corridor and watercourse) the buffer zone will be increased or stringent mitigation measures introduced. Buffer areas will act as riparian zones allowing filtration and settlement, minimising sediment transport, attenuating flows and maximising infiltration.

All turbines and infrastructure are outside the recommended buffers (other than unavoidable watercourse crossings) as described in **Chapter 3**: **Design Evolution & Alternatives**.

7.3 Temporary Drainage

7.3.1 Clean / Polluted Water Separation

Drainage management will ensure that clean water is not permitted to mix with contaminated water from sources such as excavation dewatering or track runoff, where "clean water" should be interpreted as natural surface runoff unaffected by construction / earthworks runoff.

Design will ensure that upslope cut off ditches are to be installed in order to intercept and divert clean upslope surface water runoff flowing overland prior to it coming in contact with areas of excavation. Design will ensure that clean water cut off ditches are installed ahead of main earthworks wherever practical. This is intended to reduce the flow of clean water onto any exposed areas of rock and soil, thereby reducing the amount of potential silt laden runoff requiring treatment.

Installed drainage will allow provision for clean water intercepted in cut-off ditches to pass through and under track structures separate to drainage provided for track runoff.

Temporary silt / pollution prevention and scour protection measures will be provided in artificial clean water drainage installed in order to mitigate potential for scouring and transport of sediment from newly excavated channels.

Diversion drainage is to discharge either to existing watercourse channels (via silt removal features) or be dispersed over vegetated ground. Diversions are to be designed to avoid collection and interception of large catchments creating significant point flows, with associated risks due to scour and hydraulic capacity.

7.4 Track Drainage

7.4.1 Trackside Drainage

The cross fall on the track will be aligned to divert "dirty" surface water (i.e. contaminated surface water from track surface or excavations) into trackside swales by overland sheet flow or via track surface grips.

The swale and track shoulder will be vegetated as soon as possible after construction, in order to reduce potential for runoff from exposed aggregates and clays, and promote removal of suspended solids within runoff by filtration in vegetation. Any vegetation used will be appropriate to the local area. Temporary erosion protection may be required until the vegetation becomes established (coir matting or similar).

All swales will be kept as shallow as possible so that they pose no health and safety risk to plant or personnel. Maximum depth of standing water will be limited to 0.5m within the ponds and 0.3m within the swales.

Drainage swales shall be designed to satisfy the following conveyance and water quality criteria:

- Hydraulic conveyance of runoff appropriate to the protection of the surrounding land use, with additional consideration of effect of a 100-yr (flood protection) event (i.e. exceedance event);
- Store treatment volume (T_v) (15 mm rainfall on drained area).

Under-track piped drainage crossings will be provided to allow up-slope swales to drain to the down slope side. Crossings will be provided at regular intervals (to be determined at detailed design stage) and at all localised low points. Outlets from crossing pipes shall generally coincide with swale breakouts.

Note that dirty water under track crossings and breakouts are to be maintained separate from clean water crossings (see Section 7.3.1).

Where appropriate on areas of upland heath, there will be regular outflow points ("breakouts") from the swales throughout the SuDS system to eliminate the potential for the generation of large flows at single outflow points. This will assist the drainage network in maintaining the natural hydrological response displayed by the natural catchment. Outflows will be directed away from watercourses and across open vegetation to increase the drainage path and buffer zone between the point of discharge and the watercourse.

Typical trackside swale arrangements are shown on **WFD01 to 06** within **Annex A** and track drainage details are shown on **WFD 9 and 10** in **Annex B.**

7.4.2 Drainage Grips

Drainage grips may be installed on the track surface where deemed a requirement in order to direct runoff into trackside drainage or to downslope settlement / filtration features. Positioning of grips will be determined at detailed design stage and on an observational basis during construction, however in general the need for grips will be greatest in areas on steep longitudinal track gradient.

Installation of grips will prevent extensive rutting of the track structure and aids drainage of the track surface, which in turn reduces potential for trafficking of the surface to cut the track and generate silt.

Drainage grips will generally comprise a steel channel section installed flush to the track surface, with concrete haunching as may be required in areas of heavy trafficking.

7.4.3 Runoff Attenuation

Runoff from large hardstanding areas such as the site compound, turbine hardstandings, and substation will be attenuated to mimic natural runoff patterns. Flow rates from tracks will be reduced through use of attenuating check dams within swales installed adjacent to all hardstanding areas, providing immediate attenuation "at source", with pass-forward flow rate reduced by filtration and temporary detention.

Frequent breakouts from swales to discharge accumulated runoff overland at regular frequencies will further encourage attenuation of runoff peaks by dispersing runoff over vegetation where losses would be expected by vegetative retention, transpiration, and infiltration.

Attenuation will utilise shallow ponds to aid removal of suspended solids. Calculations for the determination of storage requirements will be undertaken at detailed design stage. Preliminary calculations are included in ES Technical Appendix 9.2 – Flood Risk and Drainage Assessment, and attenuation features are shown on on **WFD01 to 06** within **Annex A** and track drainage details are shown on **WFD 9 and 10** in **Annex B.** An attenuation basin detail is included on **WFD_12** in **Annex B.**

7.5 Management of Suspended Solids

Runoff from the site shall be required to ensure that water quality in the receiving watercourses, including those draining to areas of fisheries interest, is not adversely affected in terms of key water quality parameters. The primary means by which the development could cause adverse effect is by release of suspended solids.

Detailed drainage design shall ensure that settlement and filtration of runoff from the site is designed such that the water quality standard is preserved.

7.5.1 Check Dams

Initial treatment will be provided "at source" by check dams installed within trackside swales at regular frequencies, in order to reduce flow velocities and improve conditions for the settlement of solids in transit.

Check dams shall ideally be of stone formation however compacted clay check dams may be used should suitable stone be unavailable locally.

Where stone is used, the aggregate used to form check dams will be a small 'clean' graded stone. On steeper slopes the check dams will be anchored using larger stone placed on the downhill side of the check dam to prevent washing away of the smaller graded stone. The frequency of the check dams will be determined at detailed design stage.

The check dams will serve dual functions, by both removing and settling out silts and reducing flow velocities, therefore mitigating against the effects of erosion within the swale and improving the design life of end of line infiltration features.

Where feasible and where observed site conditions allow, the frequency of installed check dams may be reduced post-construction phase, due to reduced silt loading anticipated following completion of construction activities and reduced site traffic.

Typical swale check dam arrangements are shown on track drainage drawing **WFD_09** in **Annex B.**

7.5.2 Settlement Ponds

All locations where significant accumulations of dirty water discharge in the vicinity of watercourses will pass through one or a sequence of settlement lagoons in order that suspended solid concentrations released can demonstrably be shown to have no detrimental effect to downstream fish life.

Temporary and permanent settlement lagoons shall be sized to allow treatment of the levels of silt and suspended solids anticipated in construction phase and operational phase runoff respectively and shall be informed by intrusive site investigation post consent.

Where runoff contains solids unlikely to settle adequately in conventional settlement lagoons, it shall be subject to additional treatment by flocculent (refer to Annex C - Typical Flocculent Datasheet for further information). In such a scenario, secondary lagoons or a containerised system would be used in which flocculent dosing and final settlement would occur. Particular requirements for flocculent dosing (in terms of type of dosing, concentration, flocculent type etc) would be determined on an observational basis to suit the nature of suspended solids within the runoff measured on site. Treated water from settlement ponds would be discharged over intact vegetation for further treatment.

Typical settlement lagoon arrangements are shown on drawing **WFD_11** included in **Annex B.**

7.5.3 Vegetative Filtration

In areas not classified as improved agricultural grassland; all runoff from swales, ponds, or other pumped discharges will be dispersed over undisturbed intact vegetation, nominally over agreed riparian watercourse buffer zones, in order to allow vegetative filtration of runoff prior to water entering the receiving watercourse.

7.5.4 Dewatering and Washout Pits

Washout pits to be located local to significant excavations will be designed to accommodate the anticipated volume of contaminated water to be removed from the excavation, either through unavoidable surface water runoff or accumulation of shallow groundwater. Washout pits shall be sized to accommodate the volume for a period until such times as the water has been clarified, with the water subsequently pumped out and into the site drainage system.

7.6 Temporary Spoil Management

Management of spoil, including temporary and permanent spoil generated from excavations, will be considered as part of a Construction Method Statement to be approved by the planning authority prior to construction and is discussed further within **ES Technical Appendix 6.5: Outline CEMP**. Site and drainage design would ensure the following in terms of drainage for temporary spoil management areas:

- There will be no depositing of material within the watercourse buffer zones.
- Spoil shall be placed in such a manner so as to ensure no ponding of surface water on top of spoil heaps. Temporary spoil should be graded to ensure that all direct precipitation will run directly off the surface.
- Temporary spoil deposition areas will be designed to ensure that natural flow paths (drainage channels) are not be altered or blocked by deposited spoil, or will have new intercepting cut-off drainage installed upslope to divert water around the spoil.

- Spoil heaps in the vicinity of watercourses would be surrounded on the low side with silt fences in order to trap fine sediment in runoff, or shall drain to a swale and sediment trap.

7.7 Foul Drainage

In order to prevent the requirement for a discharge of treated effluent of poor quality to a watercourse or percolation to groundwater that may cause nutrient enrichment of habitats, foul water from temporary compounds and the permanent substation will drain to temporary or permanent chemical facilities.

There will be no treated foul water discharge from the facilities. Emptying of chemical facilities (by tanker or similar) will be undertaken by a licensed haulier and waste will be disposed of at a suitable licensed waste disposal facility.

Detailed foul design (to establish suitability of cesspool or septic tank etc.) will be determined at detailed design stage incorporating results from percolation tests.

8 CONSTRUCTION PHASE – DETAILED CONSIDERATIONS

Specific requirements to be imposed on any Contractor involved in the construction of the scheme will be further detailed in a Construction Method Statement to be approved by NIEA / the relevant local planning authority prior to construction.

All site personnel will be made aware of their environmental responsibilities at the site induction prior to being allowed to work on site, and through the production of a Method Statement, outlining Environmental Requirements for Sub-Contractors, which will include environmental emergency response procedures to deal with spillages, should they occur.

This section of the report outlines the steps which will be undertaken during the construction phase of the project to ensure compliance with relevant best practice guidance stated in ES Chapter 9. Site visits by the SuDS Engineer will be agreed in advance and will be undertaken at various stages of the construction process to ensure that the proposed SuDS scheme is being constructed in line with the design.

Essential mitigation measures relevant to controlling erosion and runoff from construction of the SuDS are described in NIEA's Guidance for Pollution Prevention and Pollution Prevention Guidance notes.

8.1 Planning and Phasing of Drainage Works

8.1.1 Site-Wide Requirements

Temporary or permanent drainage and silt management features (SuDS) will be constructed prior to earthworks (including preliminary or enabling works) proceeding to construct any linear works (tracks / hardstanding areas / cable routes), turbine bases, and other infrastructure. Drainage will be provided to temporary works and reinstated to suit the final footprint of the completed development.

Temporary measures may include:

- Temporary silt fences erected in areas where risk of pollution to watercourses has been identified e.g. watercourse crossing locations and areas where tracks or other infrastructure lie within watercourse buffer zones.
- Upslope cut-off drainage channels approximately parallel to the proposed track alignment installed in advance of any excavated cuttings for the track or turbine hardstanding areas. This will prevent washout by surface flows of exposed clays in excavations and fine sediments in track makeup, and increase efficiency of silt removal in future trackside drainage swales.
- Watercourses, drains, natural flow paths and cut-off drain outlet locations should be identified and charted, in order to ensure that piped crossings can be installed in advance of or adjacent to the track construction.
- Settlement ponds should be constructed in advance of commencing excavations for foundations and at any other locations identified as required at detailed design stage.
- Watercourse or drainage diversions should be installed as enabling works and prior to main earthworks associated with track and turbine construction.
- Trackside drainage swales should be installed in parallel with track construction. Note that this may require that drainage swales are reformed on an ongoing basis as temporary track alignments are modified to their eventual finished design level.

In addition, spoil management is to be planned in advance of earthworks and on an ongoing basis, in order to allow planning of drainage required in advance of spoil being deposited.

Suitable prevention measures should be in place at all times to prevent the conveyance of silts to receiving watercourses.

8.1.2 Timing of Works

Works on the site likely to cause a high risk to surface water will be programmed so as to avoid unfavourable prevailing ground conditions and high volumes or extended periods of seasonal rainfall. Site clearance will take place in advance of construction works.

8.2 Specific Construction Phase Measures

8.2.1 Working in the Vicinity of Water / Buffer Zones

Construction buffer zones to drainage features will be set as stated within **Chapter 9: Geology and Water Environment** and are shown on the accompanying Drainage Management Drawings within **Annex A.**

The following procedures apply to the general construction activities either within watercourses or in the vicinity of watercourses (i.e. within buffer zones):

- Due cognisance will be given to the prevailing ground conditions and season when programming the execution of the works, in order to seek to undertake the works in a period with low potential to cause introduction of silt laden runoff to on site water features.
- Works will plan so that trackside drains do not discharge directly into watercourses, but rather through a buffer area of adequate width or via a constructed settlement feature such as pond or sequence of silt fences.
- Cement and concrete will be kept outwith buffer zone to avoid contamination of watercourses.
- Runoff from excavations will not be pumped directly to watercourses. Where dewatering of excavations is required, water shall be pumped to the head of a treatment train (swale, basin, or detention pond) in order to receive full treatment prior to re-entry to the natural drainage system.
- SuDS treatment techniques will be utilised to remove silts from runoff prior to the discharge of flows over open vegetated areas.

In the event that a specific short term risk to water quality is identified on site, specific localised measures will be implemented including:

- Placing temporary filtration silt fences within drainage channels where siltation is observed.
- Installing temporary constructed settlement features such as sumps or settlement ponds / lagoons where required.

8.2.2 Watercourse / Drain Realignment

Residual risk to watercourses specific to the construction stage will be fully addressed in the Contractor's construction method statement. Methods to divert minor watercourses will include the following:

- Works to divert drains (at the locations shown on drainage drawings WFD01 to 06 in Annex A) shall be programmed to coincide with a period of anticipated low drain flow and shall be undertaken prior to adjacent main earthworks associated with the reason for the diversion or realignment.
- The new channel alignment will be excavated starting from its downstream extent. The channel will be lined to prevent scour of the newly excavated surface. Scour protection (liners or rip rap) will be placed at bends.
- Temporary barriers (silt fences or check dams) may be placed in the new channel and the downstream in-situ channel.
- The upstream drain will be diverted into the realigned channel and the former channel dammed and backfilled.

8.2.3 Watercourse Crossings

Residual risk to watercourses specific to the construction stage will be fully addressed in the Contractor's construction method statement. Methods will include measures as per the guidance stated in Loughs Agency Guidelines for Fisheries Protection during Development Works[8]. And in addition to "designed" measures stated in Section 7.2.2, will include the following:

[8] Loughs Agency (2011) Guidelines for Fisheries Protection during Development Works. Available: http://www.loughs-agency.org/wp-content/uploads/2015/05/loughs-agency-guidelines-for-fisheries-protection-during-development-works.pdf [Accessed 17/06/2018]

- Works to install all crossings shall be programmed to coincide with a period of anticipated low drain flow and firm ground conditions in order to minimise potential for silt laden runoff draining toward the stream.
- The channel will be dammed upstream of the proposed culvert location using sandbags or similar in order to provide a dry working environment at the culvert location. Dammed flows will be pumped out of channel and returning directly to the drain shortly downstream of the culvert location. Erosion protection shall be placed at the point of pump return. All pumping will be controlled on a contractor permit-to–pump scheme, such that pumping operations can be carefully planned, installed and monitored.
- Geotextile silt fences shall be installed adjacent to the drain bank upstream and downstream of the culvert location in order to filter contaminated runoff that may be caused by plant movement associated with the culvert installation. A sequence (minimum 2 no.) in-channel geotextile check dams will be installed within the drain channel downstream of the culvert location and downstream of the pump-return.
- The culvert comprising pre-cast concrete or pre-formed plastic pipes shall be installed and backfilled with suitable aggregate. Headwalls and scour protection to the drain bed shall be formed at the culvert inlet and outlet using dry formed components (lean-mix concrete-filled sandbags or similar). Washed gravel or pebbles (including if feasible that material recovered from the natural substrate excavated to permit the culvert installation) shall be introduced to cover and protect the extent of the drain channel affected by excavations. No wet concrete or cementitious material shall be required to be used within the drain channel.
- Over pumping and upstream dams shall be removed and water permitted to pass through the culvert. Downstream in-channel filtration check dams shall be retained and renewed as necessary in order to trap sediment until any residual washout of sediment from the exposed excavation has stabilised to a normal (pre-construction) level.
- Geotextile or equivalent splash-guards shall be erected to the track embankment over the culvert or clear span crossing prior to trafficking.

8.2.4 Turbine Bases and Crane Pads

Excavated turbine foundations are likely to result in large volumes of displaced excavated material as spoil, as well as concrete operations. Specific measures are therefore required to manage potential for silt laden runoff from spoil, silt laden runoff from pumped dewatering, and cementitious contamination in pumped dewatering from turbine bases.

Concrete will not be allowed to enter watercourses under any circumstances, and drainage from excavations in which concrete is being poured will not be discharged directly into existing watercourses without appropriate treatment. Delivery trucks, tools and equipment will be cleaned at designated washout areas located conveniently and within a controlled area of the construction compound. Runoff from wash-out areas will be appropriately stored within bunded containers and removed off-site by an appropriate waste disposal company. In addition the following drainage measures will apply;

- Installation of cut-off drains around the working areas to intercept clean surface runoff and divert it around and away from the works.
- Minimising the stockpiling of materials and locating essential stockpiles outside any watercourse buffer zone.
- Polluted (silt laden) water collected in the base of any excavation would be gathered in a sump, and pumped at a low flow rate into either the mini-settlement pond or track swale for treatment. Dewatering of excavations direct to watercourses will not be permitted.
- The foundation working areas should be re-vegetated as soon as possible after construction.

8.2.5 Cable Trenches

It is noted that where feasible, the design of cable trench alignment will avoid the creation of preferential flow routes. The following shall apply to the construction of all cable trenches at the site:

- To minimise impacts from disturbance, cables will be laid in small trenches along the side of access tracks, as far as possible.
- Due cognisance will be given to the prevailing ground conditions and season when programming the execution of the works, in order to seek to undertake the works in a period with low potential to cause introduction of silt laden runoff from excavations.

- Excavation of cable trenches will be carried out over short distances, with frequent backfilling of trenches, in order to minimise opportunity for the ingress of water into open trenches.
- Temporary silt traps will be provided in longer trench runs and on steeper slopes.
- Where constructed trackside swales are disturbed by cable installation, swale slopes will be correctly reinstated post infilling of the cable trench.

8.2.6 Dewatering

In order to control dewatering activities and to ensure that all dewatering allows for pollution prevention measures, a permit-to-work system will be imposed on the Contractor, particularly to ensure pumped dewatering from excavations is controlled. A permit will be required to be issued to a competent person prior to allowing any specific dewatering to commence.

8.2.7 Use of Flocculant

The use of flocculant is generally discouraged where possible in favour of using conventional settlement techniques to remove suspended solids, due to the preference to avoid introducing artificial chemicals to the surface water environment.

Where flocculant is ultimately required on a temporary basis, due to the presence of extremely fine particles within clays or aggregates that cannot be effectively removed using filtration or settlement ponds or where a particular pollution risk is observed due to weather conditions, then it will be installed at settlement lagoons per the detail shown on drawing **WFD_11** in **Annex B.**

Flocculant would generally be installed in solid form in a culvert with water allowed to flow around the flocculant block. A datasheet for the flocculant type preferred, comprising a cationic polyacrylamide, is included in **Annex C**, confirming that the product is non-toxic – refer specifically to datasheet Section 12.

Use of flocculant, which will be on a temporary basis-only, will be strictly regulated with a permit scheme to be put in place and competent person installed to oversee installation, monitoring and removal of flocculant. The permit scheme will record the location, time and date of installation, date of removal, and the quantity of product used, and this schedule will be maintained for inspection by the interested regulatory body, nominally NIEA:WMU or Loughs Agency.

Flocculant would be required to be removed immediately upon reduction of the observed pollution risk that prompted its use.

8.2.8 Excavated Track Drainage

Excavated type tracks are initially expected to be used in all instances at the site. Where this construction type is specified, all track runoff (polluted water) would be directed to flow to track-side drainage channels as per Section 7.4, to be installed as tracks are constructed.

Due to anticipated low rates of infiltration and high ground water tables, as is common in predominately peat conditions, it is likely across the majority of the site that flows will not percolate through the base of the swale and will therefore be discharged from the swale via frequent spillways created through the embankments on the downhill sides of the access tracks.

Drainage swales and track shoulders will be re-vegetated as soon as feasible after completion of the track and drainage across the site. Typical drainage installation for excavated tracks is shown on drawing **WFD_09** in **Annex B.**

8.2.9 Floated Track Drainage

If subject to detailed design a floating type track construction is specified, existing drainage paths are not to be unnecessarily re-routed or changed. Existing drainage paths and overland flow-routes should be maintained through the placement of drainage pipes at existing land drainage locations and/or at regular intervals.

Track runoff will be directed over the edge of the track structure to discharge across existing vegetation to allow filtration / settlement of suspended solids. Typical drainage installation for floated tracks is shown on drawing **WFD_10** in **Annex B.**

9 MAINTENANCE

9.1 Construction Phase

The following is intended to inform the detailed drainage / SuDS maintenance manual for the construction phase.

It is envisaged that an Engineer specialising in surface water management and SuDS would be required to undertake regular site inspections during the construction phase of the wind farm, in order to validate that any detailed SuDS design and associated requirements to ensure construction methods are adhered to on site, and in order to identify areas where additional or enhanced mitigation is required.

In addition to the regular site inspections carried out by the Engineer, the following construction inspections will be undertaken during the construction phase of the project. The list is not exhaustive and should be added to as per the requirements of the site.

9.1.1 Swales / Check Dams

- All check dams and settlement basins to be checked weekly in dry weather and daily during periods of heavy rainfall via a walkover survey during the construction phase. Excess trapped silt to be removed and disposed of/ re-used as may be agreed with relevant authorities.
- Where check dams have become fully blocked with silt, they should be replaced. Procedure for replacement of the check dam as follows:
    - silt deposits to be removed from the upstream side of check dams.
    - removed silt to be buried or re-used by spreading in an area of the site where surface runoff will not convey silt deposits back to a watercourse.
    - where there are regular incidents of check dam blockage further check dams to be installed (every 15-20 m intervals) within the swales.
- Monitor side slopes of swales and basins and reinstate any areas of slope slippage by battering back or otherwise as may be appropriate;
- Should there be noticeable effects of erosion along the swales or at discharge points, suitable erosion protection measures such as placement of large stones or erosion protection textiles should be installed at the area affected;
- Any temporarily stored or stockpiled material will be placed in a manner to ensure stability and set back sufficiently far such that in the case of unforeseen collapse, spoil would not cause infilling of swales.

9.1.2 Settlement / Detention Basins

- Basin inlets to be cleared of debris.
- Silt in aggregate forebays to be removed by excavator and disposed of. Any aggregate removed to be replaced with clean stone.
- Any flow control device (orifice, weir or similar) to be checked and cleared of any debris.

9.2 Operational Phase

A post construction phase maintenance manual will be produced upon production of as built drainage survey for the site. This maintenance manual will contain recommendations identified above, augmented with further drainage findings collected during the construction phase which are deemed to assist in provision of long term drainage management for the site.

10 ASSESSMENT OF MITIGATION

10.1 Assessment of Mitigation against WFD Objectives

Table 10.1: Schedule B – Assessment of Specific Mitigation Against WFD Objectives

Scheme Component / Effect	Objective 1	Objective 2	Objective 3	Objective 4
	To prevent deterioration in the ecological status of the waterbody.	To prevent the introduction of impediments to the attainment of Good WFD status for the waterbody.	To ensure the attainment of the WFD objectives for the waterbody are not compromised.	To ensure the achievement of WFD objectives in other waterbodies within the same catchment are not permanently excluded or compromised.
	Describe mitigation required to meet objective 1:	Describe mitigation required to meet objective 2:	Describe mitigation required to meet objective 3:	Describe mitigation required to meet objective 4:
Changes in Runoff and Flow Patterns In relation to the surface water body.	Detailed in Sections 3.3 to 3.4, and summarised as follows: Track and hardstanding runoff will be handled by sheet flow to trackside ditches or swales; Tracks and hardstanding areas are to be constructed from unbound aggregate and are not surfaced, thus helping to reduce runoff volumes; Piped under track drainage will be provided with associated sumps and check dams. The under track drainage will provide a means for flows to pass from a swale on the uphill side of the slope to the downhill side of the slope; In cases where the tracks must run significantly downhill, transverse drains ('grips') will be constructed where appropriate in the surface of the tracks to divert any runoff flowing down the track into the adjacent drainage ditch/across open ground; Rate and volume of runoff will be attenuated using check dams. Attenuation features will reduce flow velocities preventing scour, and allow settlement of silts prior to discharge; Drainage design will ensure natural streams are piped directly through appropriately sized drainage pipes; Settlement ponds will be designed to cater for infilling and rehabilitation post construction phase of the project; Buffer zones to water features will be established.			

Table 10.1: Schedule B – Assessment of Specific Mitigation Against WFD Objectives

Scheme Component / Effect	Objective 1	Objective 2	Objective 3	Objective 4
	To prevent deterioration in the ecological status of the waterbody.	To prevent the introduction of impediments to the attainment of Good WFD status for the waterbody.	To ensure the attainment of the WFD objectives for the waterbody are not compromised.	To ensure the achievement of WFD objectives in other waterbodies within the same catchment are not permanently excluded or compromised.
	Describe mitigation required to meet objective 1:	Describe mitigation required to meet objective 2:	Describe mitigation required to meet objective 3:	Describe mitigation required to meet objective 4:
Silt / Suspended Solid pollution of surface water In relation to the surface water body.	Detailed in Sections 3.3 to 3.4, and summarised as follows: • Clean / dirty water separation will be maintained on site in all practicable instances; • A treatment train will be designed with a minimum of two stages of treatment for polluted runoff from the site during the construction phase; • All treatment settlement features (check dam backwaters and ponds) are to be designed to offer sufficient retention time to settle out the silt grain sizes anticipated; • Silt laden runoff within trackside swales will be treated through the provision of small check dams at specified centres along the swales; • Areas stripped of vegetation should be kept to a minimum and any stripped vegetation should be reinstated on slopes as early as possible. • Earth spillages into any existing streams will also be avoided; • Any dewatering from excavations will be via surface silt traps, check dams and settlement ponds to ensure sediment does not enter surrounding watercourses; • Runoff from new hardstanding areas will be collected and attenuated before discharge to receiving drainage networks.			
Chemical Pollution of surface water and groundwater In relation to the surface water body and groundwater body.	Detailed in Sections 3.3 to 3.4, and summarised as follows: • Appropriate site management measures will be taken to ensure that runoff from the construction site is not contaminated by fuel or lubricant spillages; • There will be no discharge of trade effluent, sewage effluent or contaminated drainage into any watercourse.			

11 SUMMARY AND CONCLUSION

11.1 Assessment of Post-Construction WFD Status

In all instances, the mitigation described previously is sufficient to meet the WFD Objectives 1 to 4. The post-construction assessment of WFD elements for the on-site WFD waterbody is summarised in Table 11.1 below. The assessed post works status, without mitigation, is based on the worst-case scenario outlined in Tables 3.1 to 3.4.

Table 11.1: Summary of post-construction WFD Status

WFD Element	Current Status	Assessed Post-Works Status - No Mitigation	Assessed Post-Works Status - With Mitigation
Owenrigh River (2015)			
Benthic Invertebrates	High	Poor	High
Phytobenthos	High	Moderate	High
Ammonia	Good /High	Moderate / Good	Good /High
Dissolved Oxygen	High	Good / Moderate	High
pH	High	Good / Moderate	High
Soluble Reactive Phosphate	High	Poor	High
Biological Oxygen Demand	High	Poor	High
Temperature	High	Good	High
Hydrological Regime	Good	Moderate	Good
Morphological conditions	Good	Moderate	Good
Claudy Groundwater Body			
Chemical Status	Good	Good	Good

11.2 Summary

This Water Framework Directive Assessment has been undertaken to determine the effects of Magheramore Wind Farm on the ecological quality status of waterbodies potentially affected by construction activities associated with the development.

In order to consider and assess potential impacts, the elements that constitute the current and predicted status for the waterbodies affected have been considered in the context of the proposed development initially assuming no mitigation measures are implemented. This approach allows the identification of the activities with the potential to cause an adverse impact on the current and / or predicted WFD status of the waterbody.

Consideration was then given to the design and mitigation measures incorporated into the scheme. Further mitigation measures were outlined where required and general pollution prevention measures were presented.

11.3 Conclusion

Following incorporation of site-wide general binding mitigation control measures, NIEA approved Guidance for Pollution Prevention (GPPs) and Pollution Prevention Guidelines (PPGs), and site specific mitigation, no adverse effect is anticipated to the Water Framework Directive classification of the affected waterbodies caused by the Development.

Annex A

Drainage Management - General Arrangements

M01616-05 _WFD_01	M01616-05 Drainage GA Sheet 1
M01616-05 _WFD_02	M01616-05 Drainage GA Sheet 2
M01616-05 _WFD_03	M01616-05 Drainage GA Sheet 3
M01616-05 _WFD_04	M01616-05 Drainage GA Sheet 4
M01616-05 _WFD_05	M01616-05 Drainage GA Sheet 5
M01616-05 _WFD_06	M01616-05 Drainage GA Sheet 6

NOTES

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2. ALL LOCATIONS OF SUDS FEATURES IDENTIFIED ARE APPROXIMATE AND ARE LIMITED BY THE LEVEL OF INFORMATION AVAILABLE. DETAILED SITING OF SUDS FEATURES SHALL BE UNDERTAKEN ON AN OBSERVATIONAL BASIS DEPENDANT ON LOCAL TOPOGRAPHY AND CHANGES IN ROAD ALIGNMENT DESIGN.
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POLLUTION PREVENTION

6. ALL SETTLEMENT FEATURES SUBJECT TO DETAILED DESIGN.
7. DRAINAGE / SILT MANAGEMENT FEATURES INCLUDING SETTLEMENT FEATURES AND DRAINAGE CROSSINGS TO BE INSTALLED PRIOR TO OR IN PARALLEL WITH ROAD CONSTRUCTION.
8. INTERIM MEASURES TO BE EMPLOYED IN ALL INSTANCES WHERE WORK CARRIED OUT TO CONSTRUCT THE ACCESS ROAD IS LIKELY TO CAUSE ADVERSE ENVIRONMENTAL IMPACTS THROUGH INCREASED SILT LOADINGS BEING GENERATED DURING THE CONSTRUCTION PHASE.
9. SUITABLE PREVENTION MEASURES SHOULD BE IN PLACE AT ALL TIMES TO PREVENT THE CONVEYANCE OF SILTS TO RECEIVING WATERCOURSES.
10. OIL FUEL SHOULD BE STORED WITHIN CONTAINMENT AND CEMENT SHOULD BE MIXED WITHIN COMPOUND / CONTAINMENT, TOOLS WASHED IN THE SAME AREA AND WATER RECYCLED (IN THE CEMENT MIX).

TRACK / INFRASTRUCTURE DRAINAGE

11. MINOR WATERCOURSE DIVERSIONS (WHERE THOSE EXISTING DRAINS ARE EFFECTIVELY EXISTING TRACK DRAINAGE IN AREAS WHERE THE EXISTIN TRACK IS TO BE UPGRADED OR REPLACED ARE TO BE UNDERTAKEN AS ENABLING WORKS PRIOR TO MAIN EARTHWORKS, AND SUITABLE MEASURES (SUCH AS CHANNEL LINING WITH COIRE MATTING OR SIMILAR) SHALL BE IN PLACE TO PREVENT SCOUR OF THE DIVERTED CHANNEL BED. TEMPORARY UPSLOPE CUTOFF / DIVERSION DRAINAGE TO BE INSTALLED IN ADVANCE OF MAIN EARTHWORKS IN AREAS INDICATED IN ORDER TO MINIMISE SURFACE WATER INGRESS TO EXCAVATIONS
12. SETTLEMENT/ATTENUATION PONDS ARE RETAINED FOLLOWING COMPLETION OF CONSTRUCTION ACTIVITIES.
13. BATTERS OF SWALES TO HAVE DIMENSIONS AS PER SEPARATELY ISSUED TYPICAL DETAIL DRAWING. SWALE TO BE RE-VEGETATED WITH LOCAL SPECIES.
14. SLOPES OF SWALES TO BE VEGETATED OR PROTECTED FROM EROSION UNTIL VEGETATION HAS BEEN ESTABLISHED. STRIPPED VEGETATIVE LAYER FROM EXCAVATIONS TO BE STORED LOCALLY AND USED TO LINE SLOPES AND BASE OF SWALE. VEGETATIVE LAYER TO BE PLACED INTO SWALE AFTER CONSTRUCTION OF THE SWALE.
15. CLEAN STONE CHECK DAMS TO BE INSTALLED IN ALL DRAINAGE CHANNELS IN ORDER TO PROMOTE SETTLEMENT OF SUSPENDED SOLIDS AND CONTROL FLOW RATES. CHECK DAMS GENERALLY TO BE LOCALLY WON WELL GRADED STONE. AGGREGATE SIZE FOR STONE CHECK DAMS TO BE TYPICALLY 5-40MM CLEAN STONE. ON STEEP SECTIONS SMALL STONE TO BE ANCHORED THROUGH THE PLACEMENT OF 100MM STONE ON THE DOWNHILL FACE OF THE CHECK DAM
16. SPACING AND FREQUENCY OF CHECK DAMS WILL BE DEPENDANT UPON LONGITUDINAL GRADIENT OF SWALE, TO BE DETERMINED AT DETAILED DESIGN.

WATERCOURSE & TRACK DRAINAGE CROSSINGS

17. THE MINIMUM PIPE DIAMETER FOR ANY TRACK DRAINAGE CROSSING SHALL BE 450MM.
18. ALL HDPE PIPES SHALL BE TWINWALL TYPE, BBA HAPAS APPROVED.
19. ALL CROSSINGS TO BE INSTALLED MIN. 0.15M BELOW EXISTING BED LEVEL AND TO SUIT EXISTING STREAM CHANNEL GRADIENTS.

MAINTENANCE

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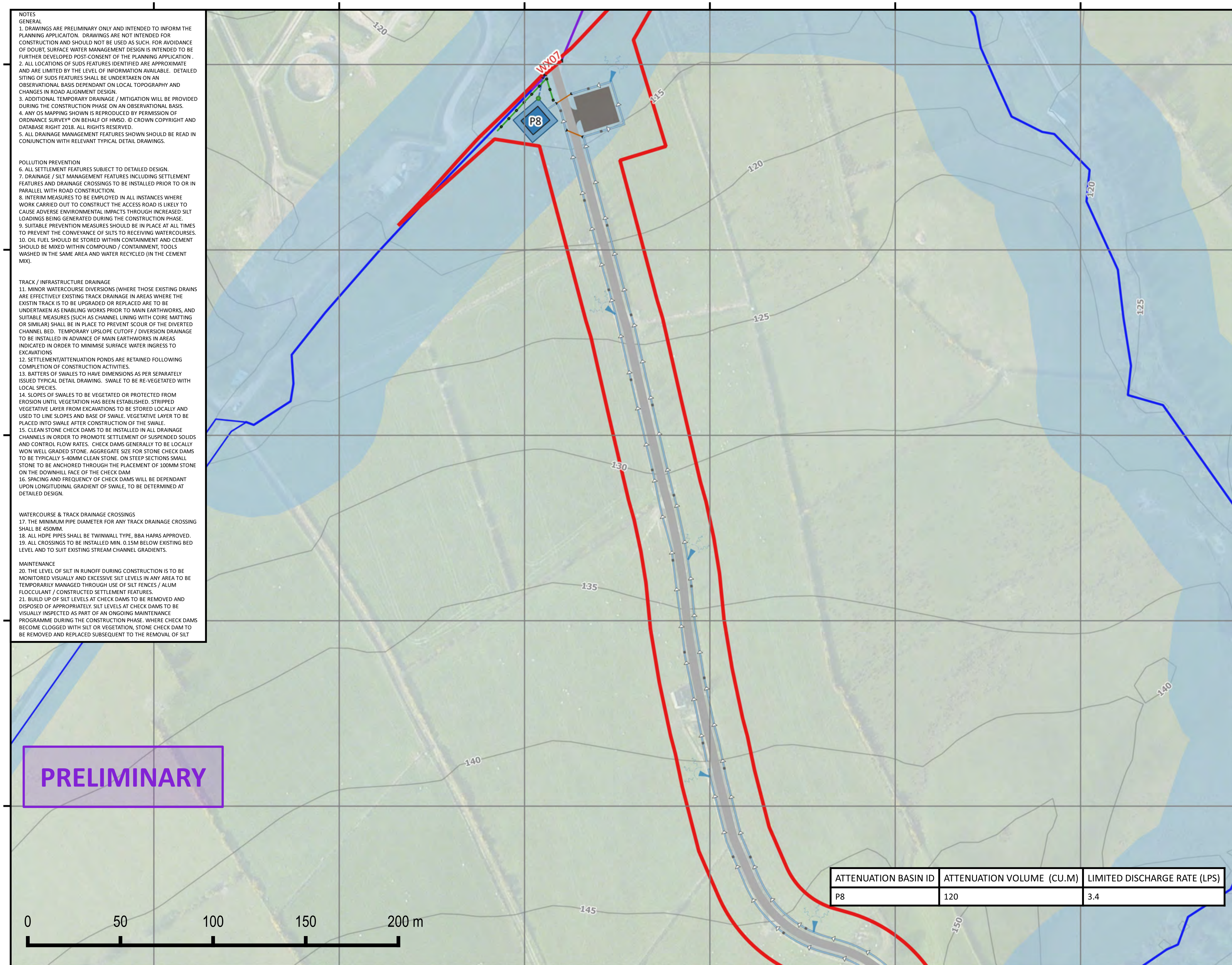
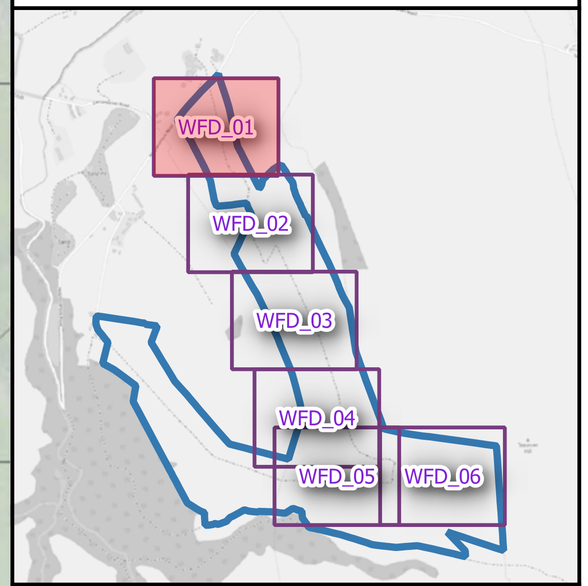
21. BUILD UP OF SILT LEVELS AT CHECK DAMS TO BE REMOVED AND DISPOSED OF APPROPRIATELY. SILT LEVELS AT CHECK DAMS TO BE VISUALLY INSPECTED AS PART OF AN ONGOING MAINTENANCE PROGRAMME DURING THE CONSTRUCTION PHASE. WHERE CHECK DAMS BECOME CLOGGED WITH SILT OR VEGETATION, STONE CHECK DAM TO BE REMOVED AND REPLACED SUBSEQUENT TO THE REMOVAL OF SILT



ATTENUATION BASIN ID	ATTENUATION VOLUME (CU.M)	LIMITED DISCHARGE RATE (LPS)
P8	120	3.4

KEY PLAN



LEGEND

The Development
- Application Boudary
- Buildings Compounds
- Tracks and Hardstanding
- Habitat Management Area

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- Hydrological Buffers for Construction Phase (50m & 10m)

Watercourses and Ex. Drainage
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- Minor Watercourse
- Diverted Minor Watercourse
- Abandoned Minor Watercourse
- Peat or Field Drain
- Abandoned Field Drain

Existing Culverts
- Ex. Culvert

Track Drainage Features
- Swale
- Track Drainage Breakout
- Clean Cutoff Drain
- Silt Fence
- Clean Drainage Pipe
- Dirty Track Drainage Pipe
- Watercourse Crossing
- Attenuation Basin
- Limited Discharge (Outfall)
- Pumped dewatering (indicative)
- Settlement Basin
- Spoil storage

WX ID	DESCRIPTION	COMMENT
WX07	LARGE DIA. OR BOX CULVERT	EXISTING CULVERT - NEED FOR REPLACEMENT OR UPGRADE SUBJECT TO DESIGN

POLLUTION PREVENTION GUIDANCE NOTES:

1. Suitable SUDS prevention measures should be in place at all times to prevent the conveyance of silts to receiving watercourses.

2. Temporary or permanent SuDS features should be installed BEFORE or adjacent to construction of new access road and hardstanding.

3. Clean water cutoff ditch and crossing should be planned and installed BEFORE construction. Clean water management must consider spoil deposition on the site.

4. Direct discharge of road drainage to watercourses shall not be permitted.

5. Buffer zones are to be maintained around all relevant watercourses as indicated on this drawing. No excavated material is to be stored within the buffer zone.

6. DO NOT pump water direct to watercourses.

7. DO NOT strip vegetation from existing ditches unless absolutely necessary.

8. If water pollution is identified the following steps should 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 / NIEA) should be notified immediately to ensure that measures can be implemented downstream to protect fisheries and other sensitive areas.

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E: info@mccloyconsulting.com
w: www.mccloyconsulting.com

DESCRIPTION			
MAGHERAMORE WIND FARM - DRAINAGE LAYOUT SHEET 1 OF 6			
PROJECT / FIGURE NO.			
M01616-05_WFD_01			
DRAWN BY	SCALE	REVISION	DATE
MD	1:2000	2	03/06/2019

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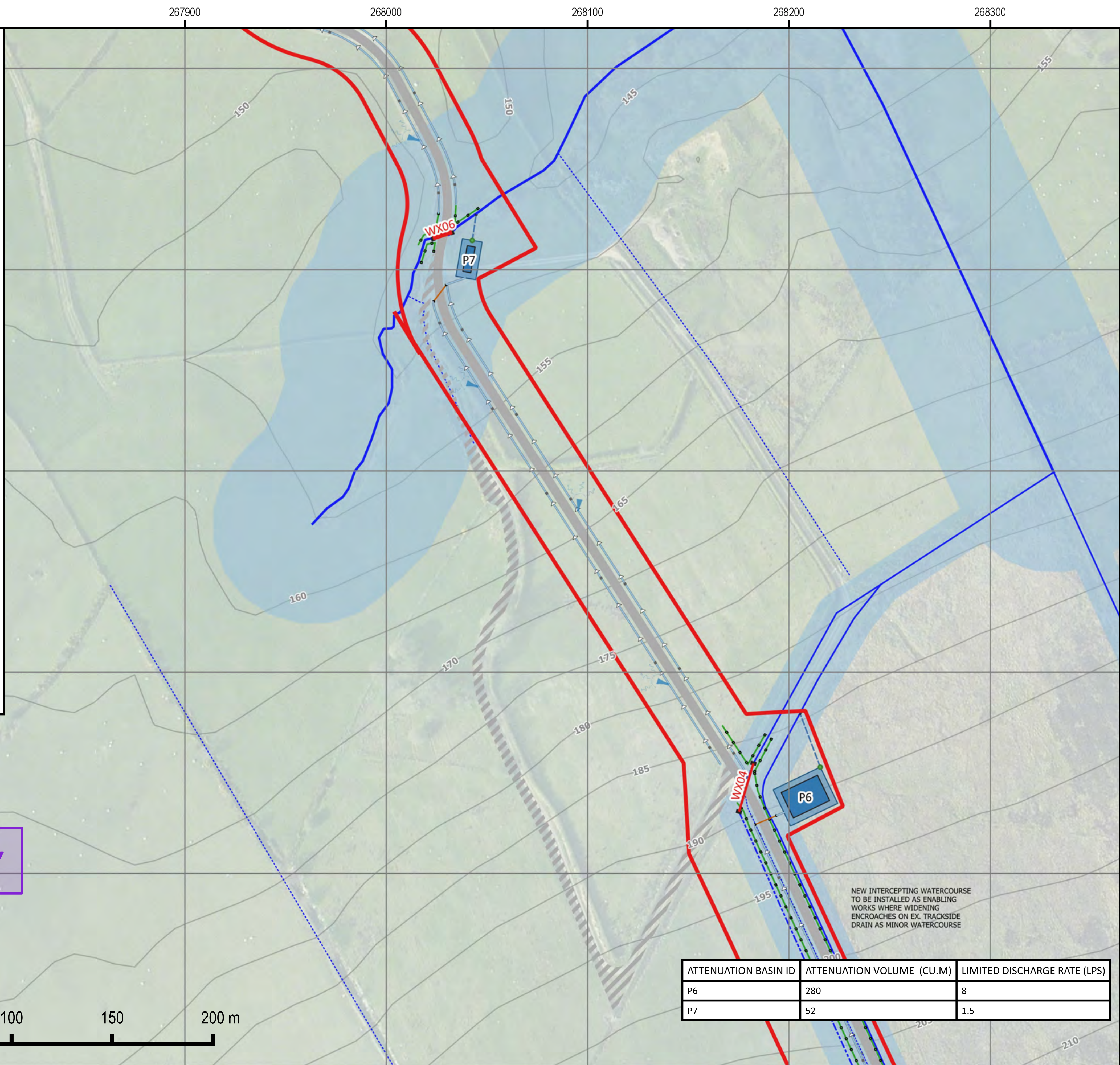
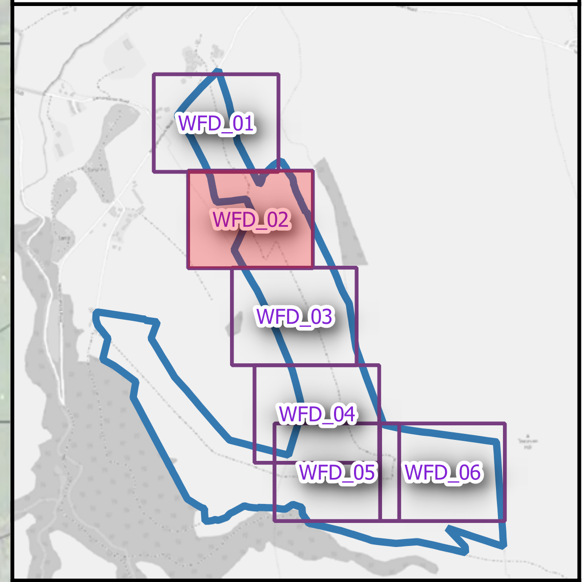


ATTENUATION BASIN ID	ATTENUATION VOLUME (CU.M)	LIMITED DISCHARGE RATE (LPS)
P6	280	8
P7	52	1.5

KEY PLAN



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WX ID	DESCRIPTION	COMMENT
WX04	MIN 600 CIRCULAR	EXISTING SMALL DIA. TRACK CULVERT TO BE REPLACED

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DESCRIPTION			
MAGHERAMORE WIND FARM - DRAINAGE LAYOUT SHEET 2 OF 6			
PROJECT / FIGURE NO.			
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DRAWN BY	SCALE	REVISION	DATE
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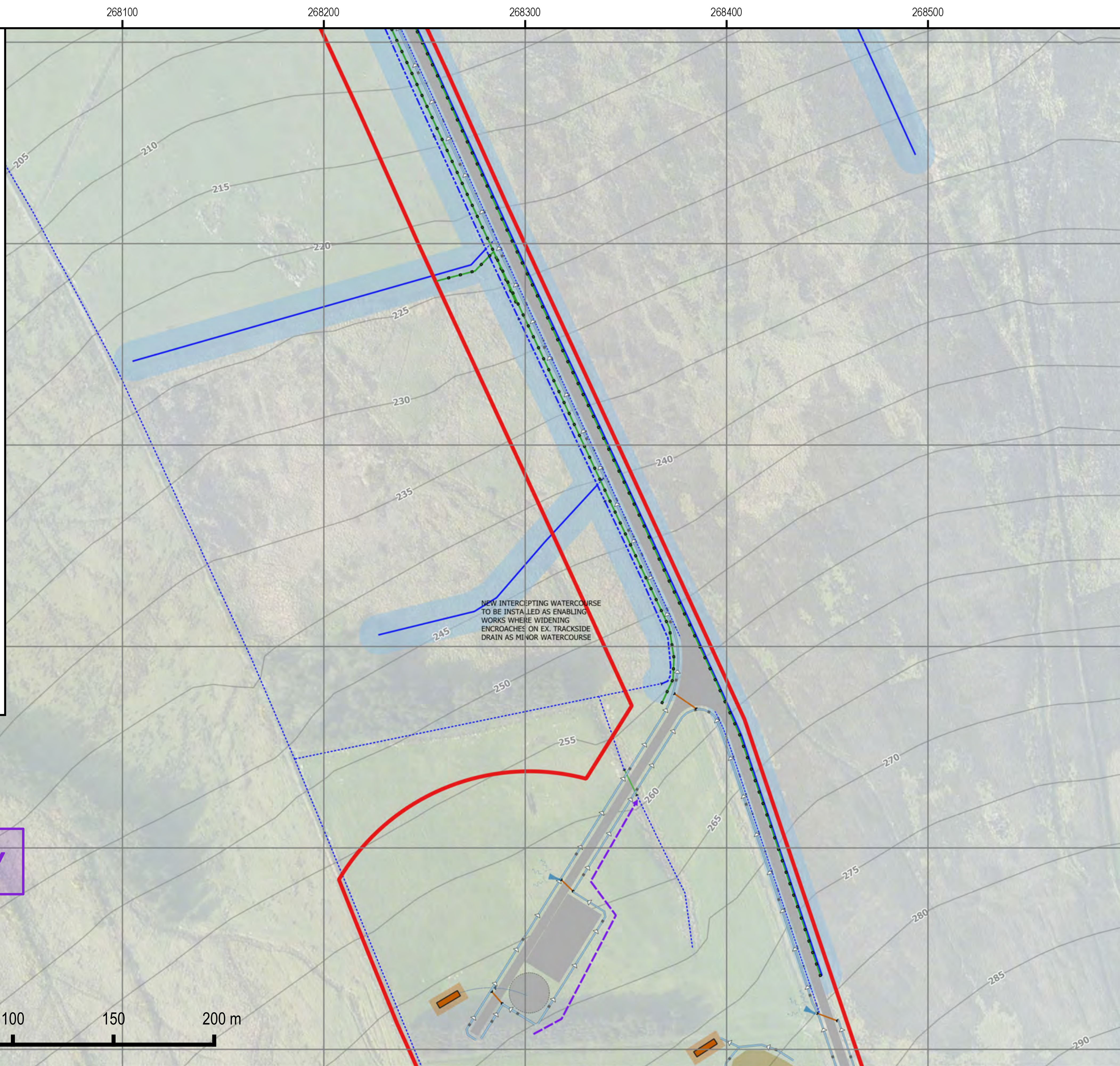
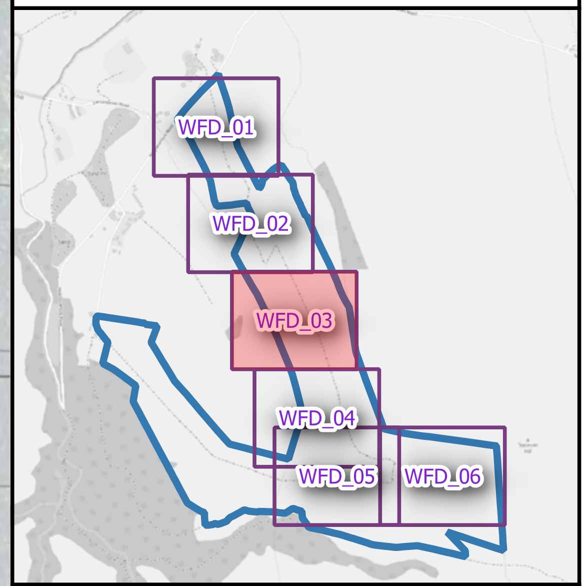


PRELIMINARY

0 50 100 150 200 m

KEY PLAN



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- Settlement Basin
- Spoil storage

POLLUTION PREVENTION GUIDANCE NOTES:

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NOTIFY - The relevant authorities (Site Manager / NIEA) should be notified immediately to ensure that measures can be implemented downstream to protect fisheries and other sensitive areas.

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w: www.mccloyconsulting.com

DESCRIPTION			
MAGHERAMORE WIND FARM - DRAINAGE LAYOUT SHEET 3 OF 6			
PROJECT / FIGURE NO.			
M01616-05_WFD_03			
DRAWN BY	**SCALE**	**REVISION**	**DATE**
MD	1:2000	2	03/06/2019

res

NOTES

GENERAL

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POLLUTION PREVENTION

6. ALL SETTLEMENT FEATURES SUBJECT TO DETAILED DESIGN.
7. DRAINAGE / SILT MANAGEMENT FEATURES INCLUDING SETTLEMENT FEATURES AND DRAINAGE CROSSINGS TO BE INSTALLED PRIOR TO OR IN PARALLEL WITH ROAD CONSTRUCTION.
8. INTERIM MEASURES TO BE EMPLOYED IN ALL INSTANCES WHERE WORK CARRIED OUT TO CONSTRUCT THE ACCESS ROAD IS LIKELY TO CAUSE ADVERSE ENVIRONMENTAL IMPACTS THROUGH INCREASED SILT LOADINGS BEING GENERATED DURING THE CONSTRUCTION PHASE.
9. SUITABLE PREVENTION MEASURES SHOULD BE IN PLACE AT ALL TIMES TO PREVENT THE CONVEYANCE OF SILTS TO RECEIVING WATERCOURSES.
10. OIL FUEL SHOULD BE STORED WITHIN CONTAINMENT AND CEMENT SHOULD BE MIXED WITHIN COMPOUND / CONTAINMENT, TOOLS WASHED IN THE SAME AREA AND WATER RECYCLED (IN THE CEMENT MIX).

TRACK / INFRASTRUCTURE DRAINAGE

11. MINOR WATERCOURSE DIVERSIONS (WHERE THOSE EXISTING DRAINS ARE EFFECTIVELY EXISTING TRACK DRAINAGE IN AREAS WHERE THE EXISTIN TRACK IS TO BE UPGRADED OR REPLACED ARE TO BE UNDERTAKEN AS ENABLING WORKS PRIOR TO MAIN EARTHWORKS, AND SUITABLE MEASURES (SUCH AS CHANNEL LINING WITH COIRE MATTING OR SIMILAR) SHALL BE IN PLACE TO PREVENT SCOUR OF THE DIVERTED CHANNEL BED. TEMPORARY UPSLOPE CUTOFF / DIVERSION DRAINAGE TO BE INSTALLED IN ADVANCE OF MAIN EARTHWORKS IN AREAS INDICATED IN ORDER TO MINIMISE SURFACE WATER INGRESS TO EXCAVATIONS
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13. BATTERS OF SWALES TO HAVE DIMENSIONS AS PER SEPARATELY ISSUED TYPICAL DETAIL DRAWING. SWALE TO BE RE-VEGETATED WITH LOCAL SPECIES.
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MAINTENANCE

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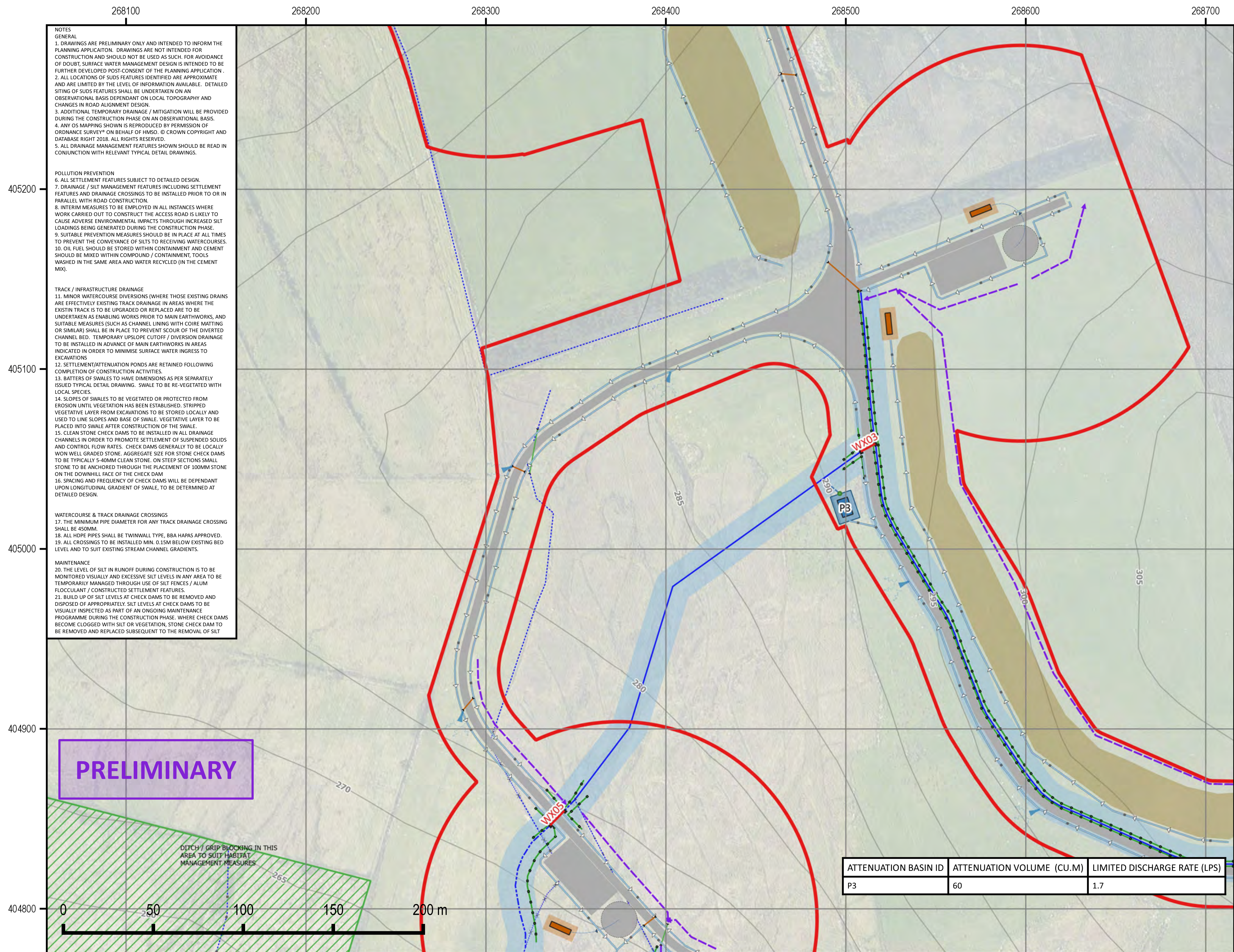
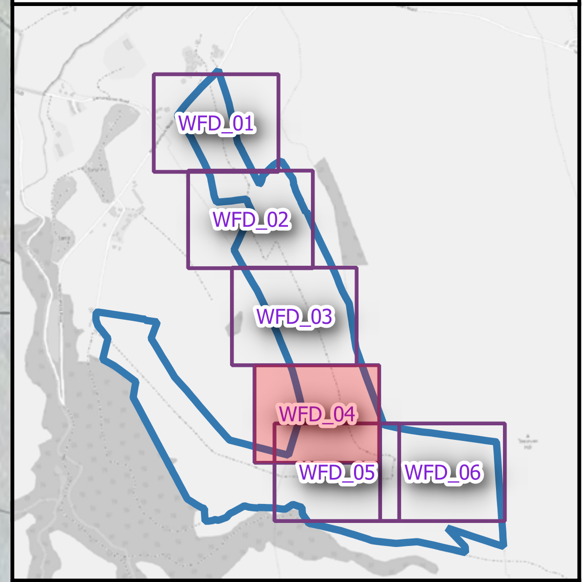


ATTENUATION BASIN ID	ATTENUATION VOLUME (CU.M)	LIMITED DISCHARGE RATE (LPS)
P3	60	1.7

KEY PLAN



LEGEND

The Development
- Application Boudary
- Buildings Compounds
- Tracks and Hardstanding
- Habitat Management Area

Existing Hydrology
- Hydrological Buffers for Construction Phase (50m & 10m)

Watercourses and Ex. Drainage
- Significant Watercourse
- Minor Watercourse
- Diverted Minor Watercourse
- Abandoned Minor Watercourse
- Peat or Field Drain
- Abandoned Field Drain

Existing Culverts
- Ex. Culvert

Track Drainage Features
- Swale
- Track Drainage Breakout
- Clean Cutoff Drain
- Silt Fence
- Clean Drainage Pipe
- Dirty Track Drainage Pipe
- Watercourse Crossing
- Attenuation Basin
- Limited Discharge (Outfall)
- Pumped dewatering (indicative)
- Settlement Basin
- Spoil storage

WX ID	DESCRIPTION	COMMENT
WX03	MIN 600 CIRCULAR	EXISTING SMALL DIA. SHORE / CULVERT TO BE REPLACED
WX05	MIN 600 CIRCULAR	NEW CULVERT

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DESCRIPTION			
MAGHERAMORE WIND FARM - DRAINAGE LAYOUT SHEET 4 OF 6			
PROJECT / FIGURE NO.			
M01616-05_WFD_04			
DRAWN BY	SCALE	REVISION	DATE
MD	1:2000	2	03/06/2019

NOTES

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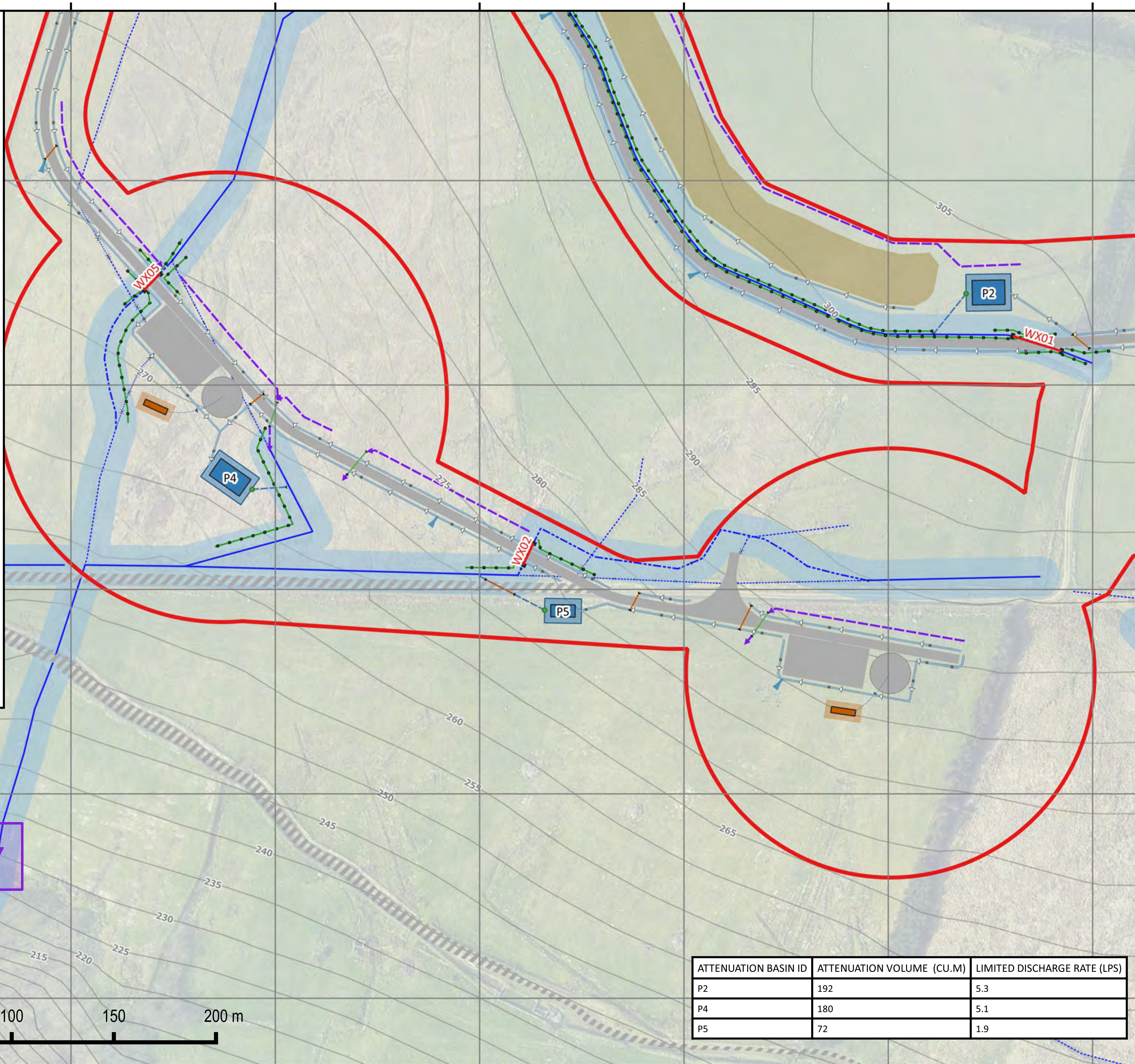
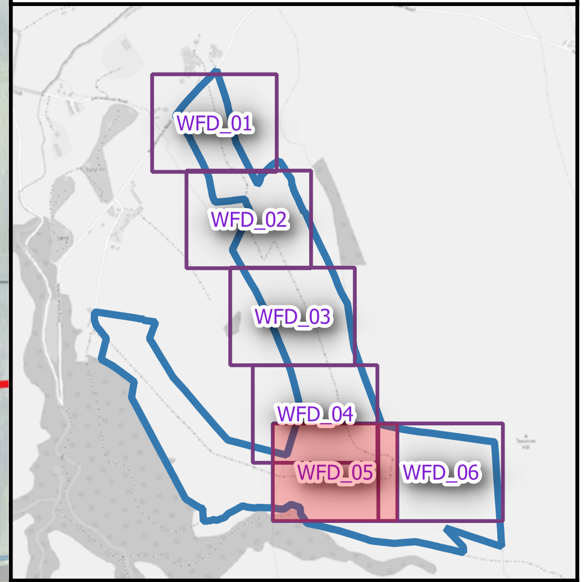


ATTENUATION BASIN ID	ATTENUATION VOLUME (CU.M)	LIMITED DISCHARGE RATE (LPS)
P2	192	5.3
P4	180	5.1
P5	72	1.9

KEY PLAN



LEGEND

The Development

- Application Boudary
- Buildings Compounds
- Tracks and Hardstanding
- Habitat Management Area

Existing Hydrology

- Hydrological Buffers for Construction Phase (50m & 10m)

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- Diverted Minor Watercourse
- Abandoned Minor Watercourse
- Peat or Field Drain
- Abandoned Field Drain

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- Ex. Culvert

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- Swale
- Track Drainage Breakout
- Clean Cutoff Drain
- Silt Fence
- Clean Drainage Pipe
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- Watercourse Crossing
- Attenuation Basin
- Limited Discharge (Outfall)
- Pumped dewatering (indicative)
- Settlement Basin
- Spoil storage

WX ID	DESCRIPTION	COMMENT
WX01	MIN 600 CIRCULAR	NEW CULVERT - EX TRACKSIDE DRAIN AS MINOR WATERCOURSE
WX02	MIN 600 CIRCULAR	NEW CULVERT

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DESCRIPTION			
MAGHERAMORE WIND FARM - DRAINAGE LAYOUT SHEET 5 OF 6			
PROJECT / FIGURE NO.			
M01616-05_WFD_05			
DRAWN BY	SCALE	REVISION	DATE
MD	1:2000	2	03/06/2019

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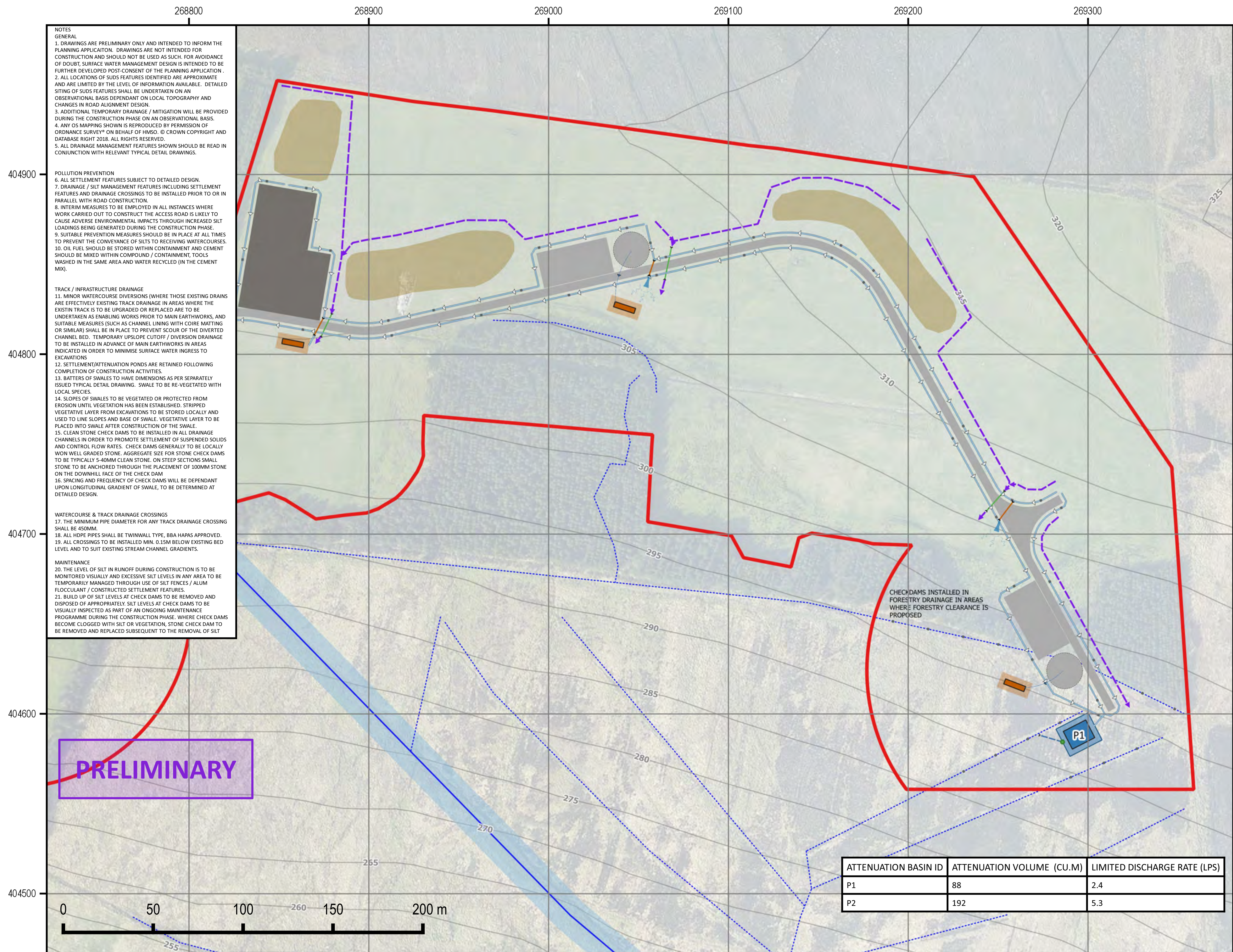
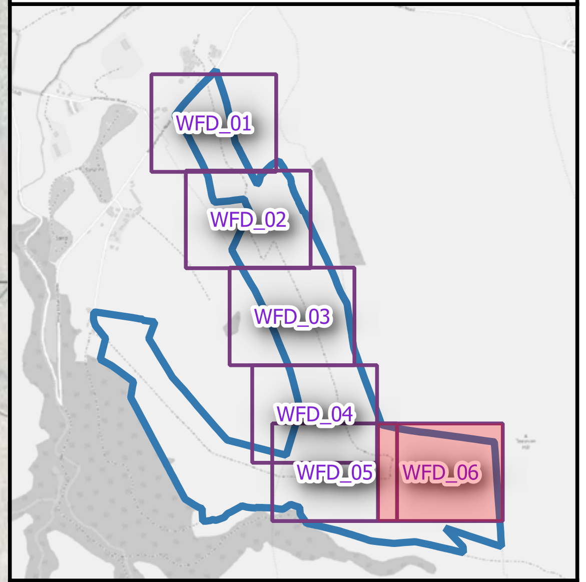


ATTENUATION BASIN ID	ATTENUATION VOLUME (CU.M)	LIMITED DISCHARGE RATE (LPS)
P1	88	2.4
P2	192	5.3

KEY PLAN



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WX ID	DESCRIPTION	COMMENT
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DESCRIPTION			
MAGHERAMORE WIND FARM - DRAINAGE LAYOUT SHEET 5 OF 6			
PROJECT / FIGURE NO.			
M01616-05_WFD_06			
DRAWN BY	**SCALE**	**REVISION**	**DATE**
MD	1:2000	2	03/06/2019

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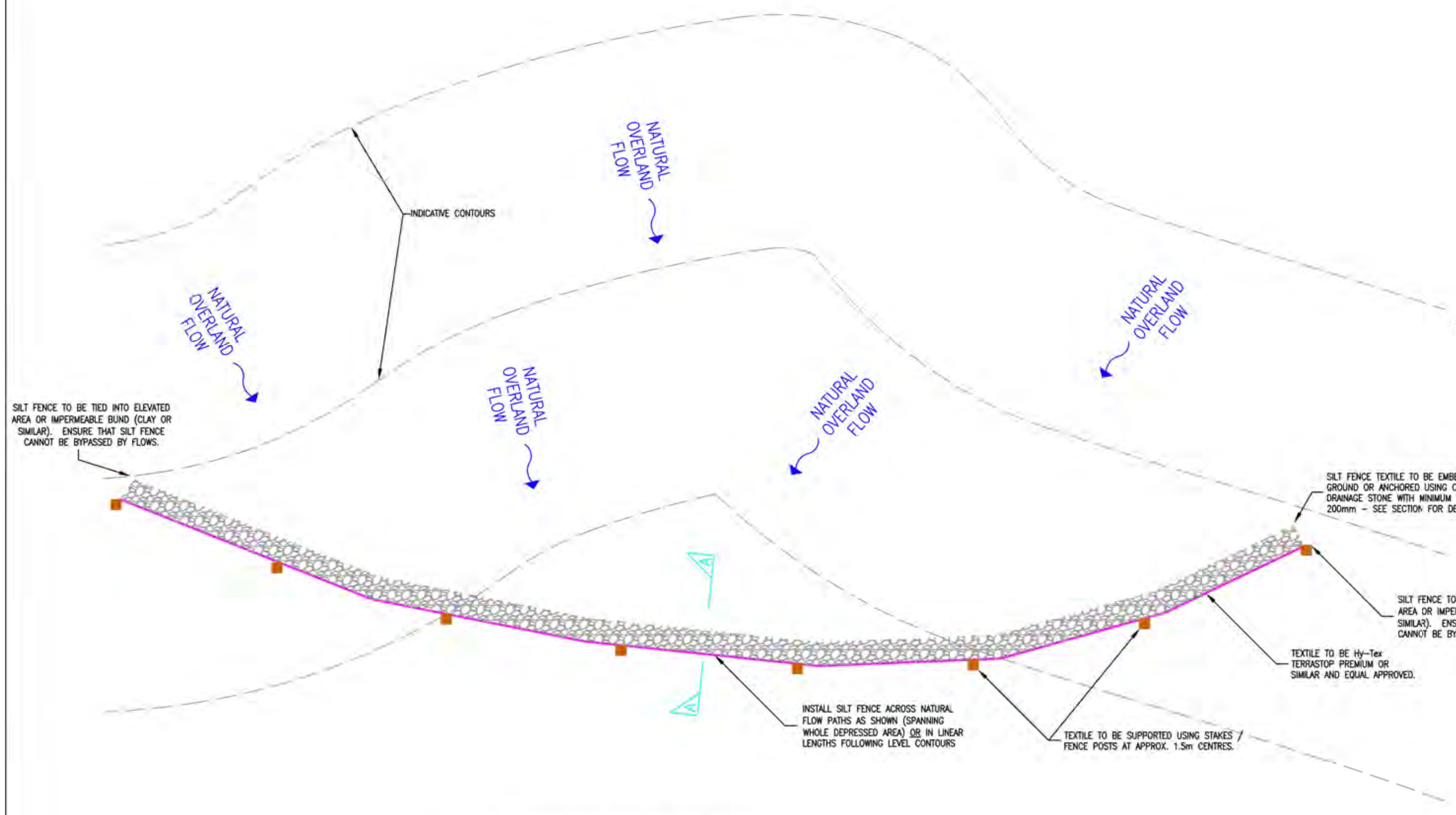
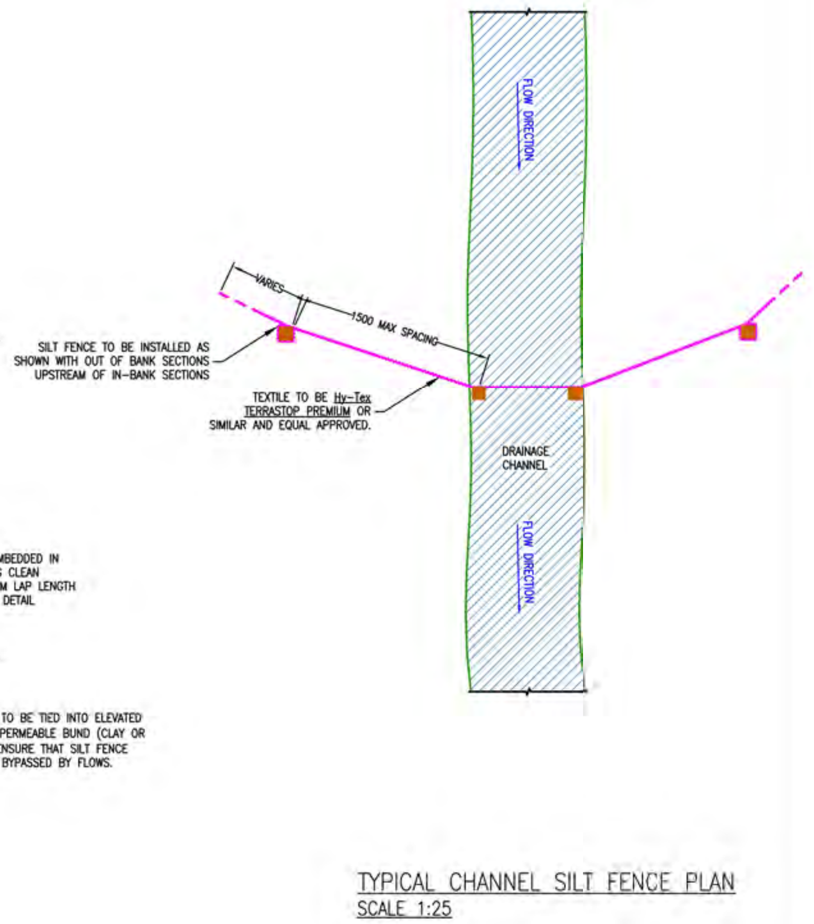
Annex B

Drainage Management – Typical Details

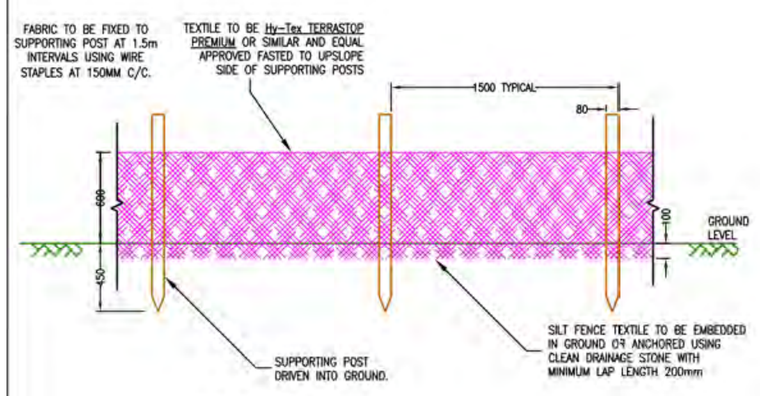
M01616-05 _WFD_07	Typical Detail - Silt Fence
M01616-05 _WFD_08	Typical Detail - Piped Culverts
M01616-05 _WFD_09	Typical Detail - Drainage at Excavated (Cut) Track
M01616-05 _WFD_10	Typical Detail - Drainage at Floated Track
M01616-05 _WFD_11	Typical Detail - Settlement Lagoon Arrangement
M01616-05 _WFD_12	Typical Detail - Detention Basin/Attenuation Pond



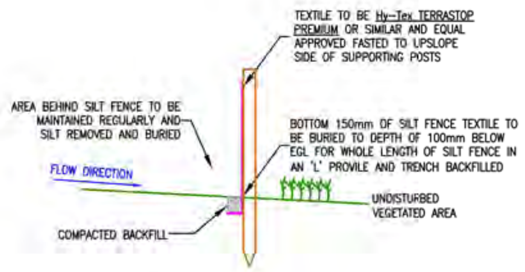
TYPICAL OVERLAND SILT FENCE PLAN
SCALE 1:25



TYPICAL CHANNEL SILT FENCE PLAN
SCALE 1:25

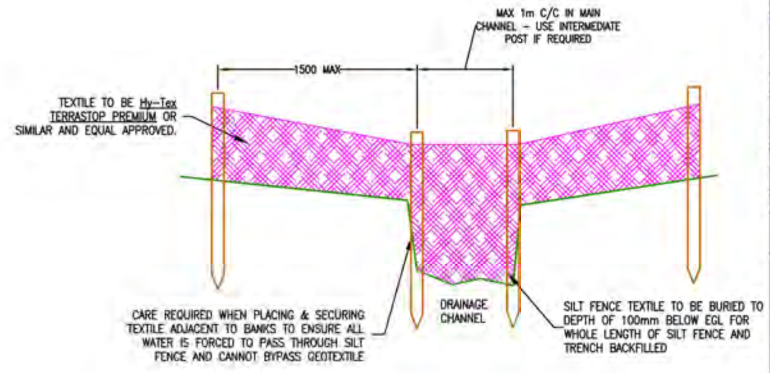


ELEVATION
SCALE 1:25



SECTION A-A
BURIED TYPE OPTION
SCALE 1:25

EXAMPLE OF CHANNEL SILT FENCE INSTALLATION
NTS



TYPICAL CHANNEL SILT FENCE ELEVATION
SCALE 1:25

INDICATIVE DESIGN

NOTE: THIS DRAWING IS BASED ON 3RD PARTY INFRASTRUCTURE / PROPOSAL DRAWING:
N/A

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PROJECT
MAGHERAMORE WINDFARM

CLIENT
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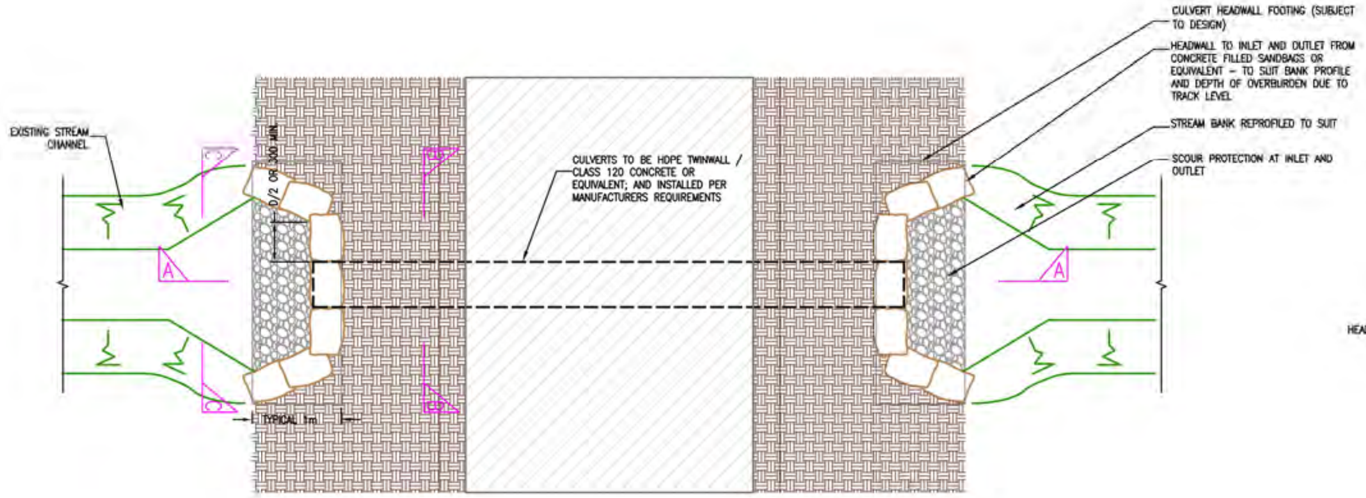
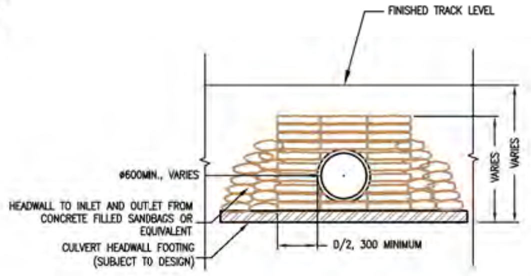
DRAWING TITLE
DRAINAGE MANAGEMENT (SuDS) INDICATIVE TYPICAL DETAILS SILT FENCE

SCALE	ORIGINAL SIZE	
AS SHOWN	A1	
DRAWN: MD	CHECKED: JD	DATE: 27/05/2019
PROJECT No.: M01639-05	DRAWING No.: WFD_07	ISSUE NO: 1



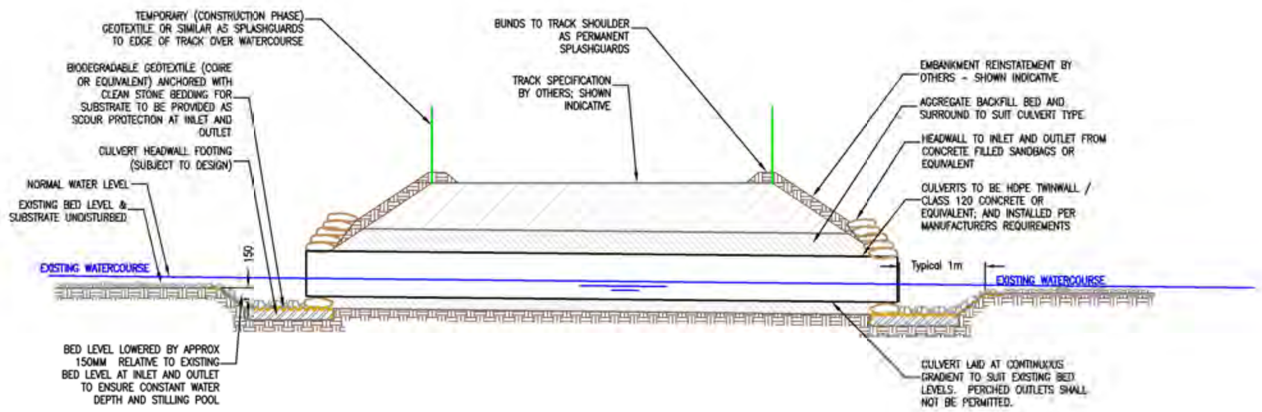
PLAN
SCALE 1:50



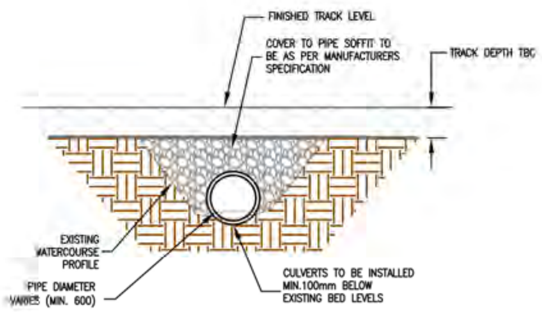
ELEVATION C–C (WITH HEADWALL)
1:50

NOTES FOR CONSTRUCTION METHODS & ENVIRONMENTAL PROTECTION

1. WORKS TO BE PROGRAMMED TO SUIT PERIODS OF LOW RIVER FLOW AND RAINFALL. DUE COGNISANCE GIVEN TO THE PREVAILING GROUND CONDITIONS AND SEASONAL WEATHER CONDITIONS.
2. CULVERT LOCATION TO BE DAMMED UPSTREAM BY USE OF SANDBAGS OR EQUIVALENT AND OVERPUMPED IN ORDER TO PROVIDE A DRY WORKING ENVIRONMENT.
3. IN CHANNEL SILT FENCING TO BE INSTALLED DOWNSTREAM OF THE WORKS AND DOWNSTREAM OF OVERPUMPING FOR THE DURATION OF THE CULVERT INSTALLATION WORKS.



SECTION A–A
SCALE 1:50



SECTION B–B
SCALE 1:50

INDICATIVE DESIGN

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PROJECT
MAGHERAMORE WINDFARM

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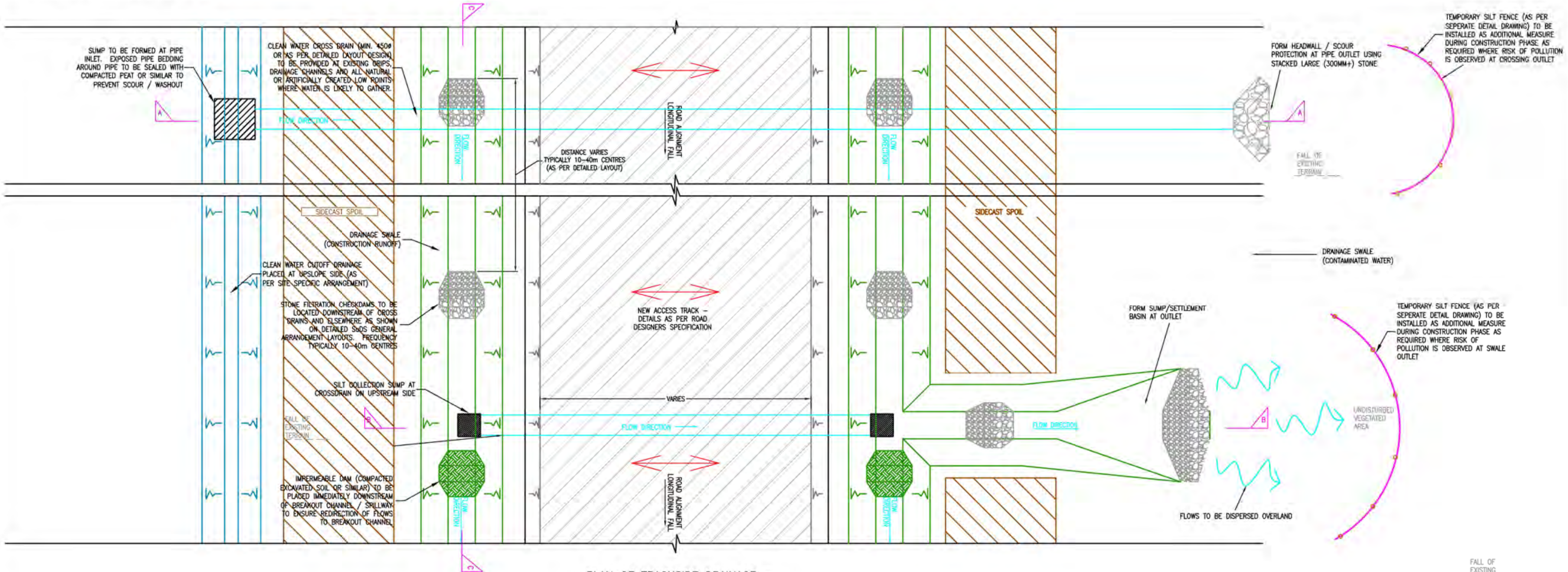
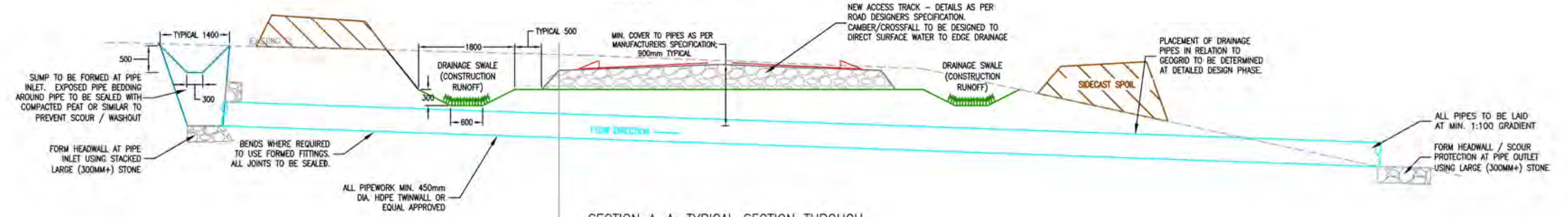
DRAWING TITLE
DRAINAGE MANAGEMENT (SuDS) INDICATIVE TYPICAL DETAILS PIPED CULVERTS

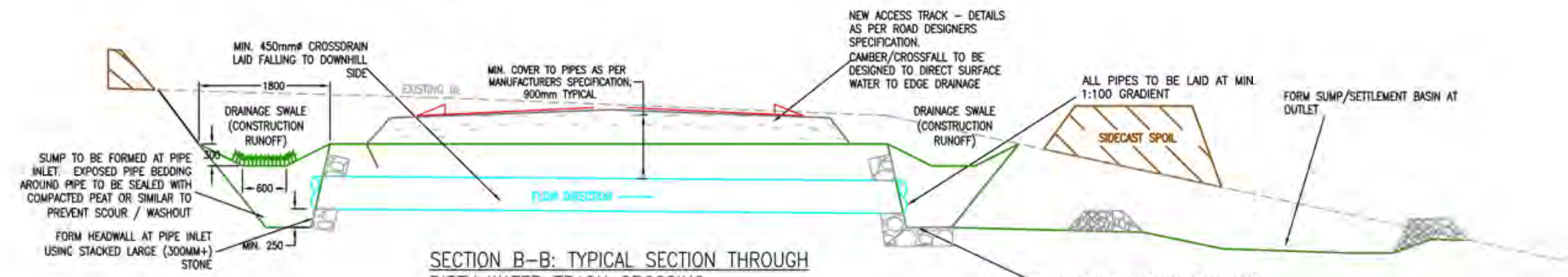
SCALE	ORIGINAL SIZE	
AS SHOWN	A1	
DRAWN	CHECKED	DATE
MD	JD	27/05/2019
PROJECT No.	DRAWING No.	ISSUE NO.
M01639-05	WFD_08	1



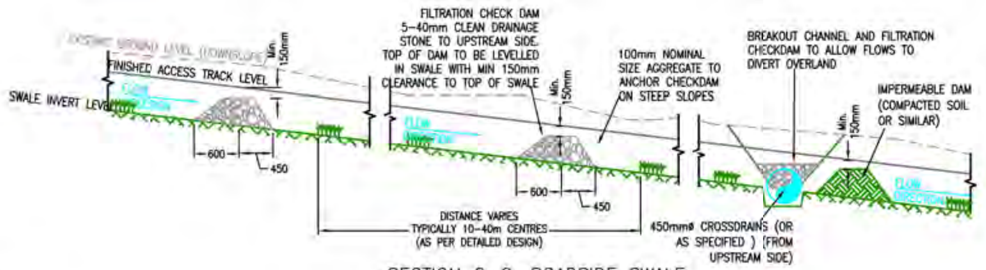
PLAN OF TRACKSIDE DRAINAGE - ROAD SECTIONS IN CUT
SCALE 1:50



SECTION A-A: TYPICAL SECTION THROUGH CLEAN WATER TRACK CROSSING
SCALE 1:50



SECTION B-B: TYPICAL SECTION THROUGH DIRTY WATER TRACK CROSSING
SCALE 1:50



SECTION C-C: ROADSIDE SWALE & CHECK DAMS
SCALE 1:50

NOTES:
1. ROAD CONSTRUCTION TO BE AS PER HIGHWAY ENGINEERS DESIGN & SPECIFICATION
2. REFER TO DETAILED PLAN SuDS DRAWINGS FOR DETAILS OF CHECK DAM / CROSS DRAIN / CUTOFF DRAIN / OUTFALL LOCATIONS ETC.
3. FEATURES SHOWN ARE PERMANENT SITE DRAINAGE. TEMPORARY SITE DRAINAGE OVER AND ABOVE THAT SHOWN ON DRAWINGS MAY BE REQUIRED TO SUIT TEMPORARY ROAD ALIGNMENTS AND LEVELS.

INDICATIVE DESIGN

N/A

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PROJECT: MAGHERAMORE WINDFARM

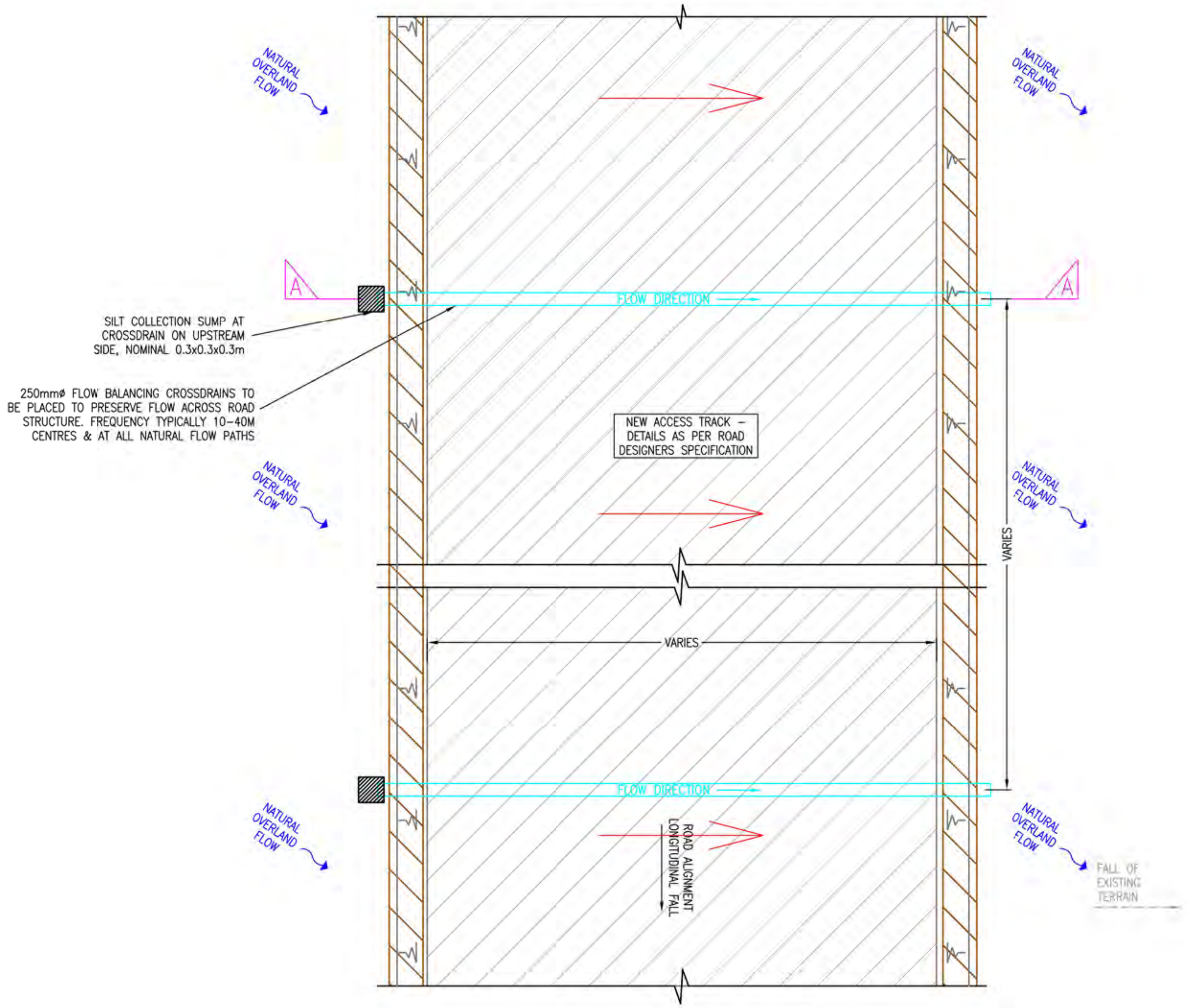
CLIENT: res

DRAWING TITLE: DRAINAGE MANAGEMENT (SuDS) INDICATIVE TYPICAL DETAILS DRAINAGE AT EXCAVATED (CUT) TRACK

SCALE	ORIGINAL SIZE
AS SHOWN	A1

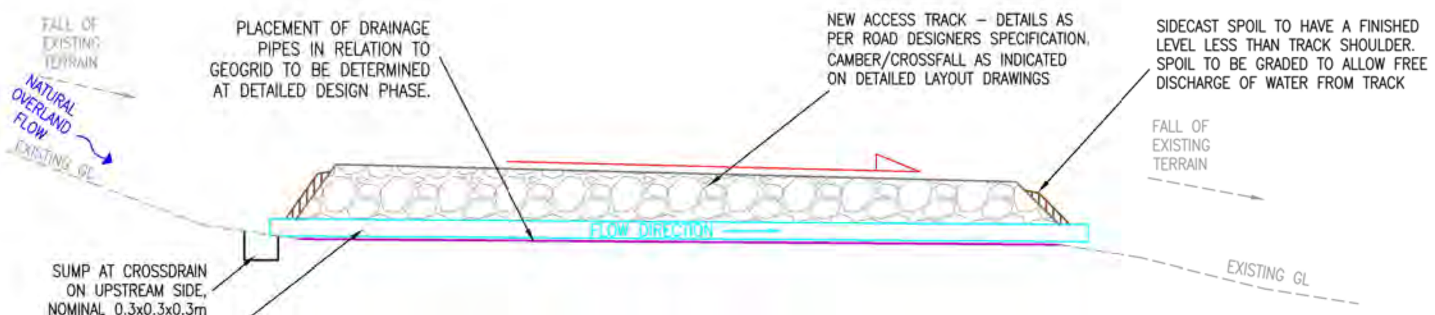
DRAWN	CHECKED	DATE
MD	JD	27/05/2019

PROJECT No.	DRAWING No.	ISSUE NO
M01639-05	WFD_09	1



PLAN OF ROADSIDE DRAINAGE – FLOATED ROAD SECTIONS

SCALE 1:50



SECTION A–A: TYPICAL SECTION

SCALE 1:50

INDICATIVE DESIGN

NOTE: THIS DRAWING IS BASED ON 3RD PARTY INFRASTRUCTURE / PROPOSAL DRAWING

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PROJECT: MAGHERAMORE WINDFARM

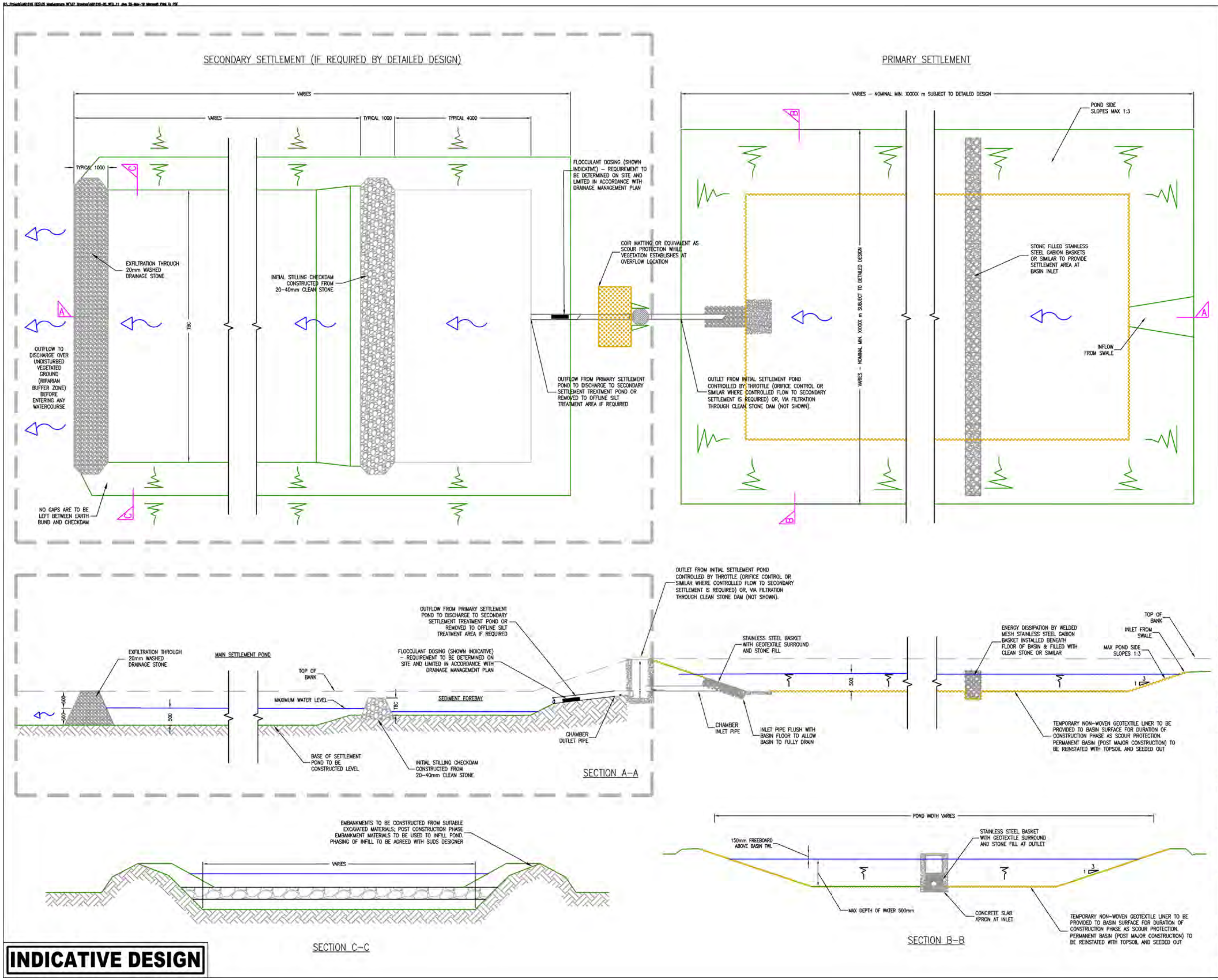
CLIENT: res

DRAWING TITLE: DRAINAGE MANAGEMENT (SuDS) INDICATIVE TYPICAL DETAILS DRAINAGE AT FLOATED TRACK

SCALE	ORIGINAL SIZE
AS SHOWN	A1

DRAWN	CHECKED	DATE
MD	JD	27/05/2019

PROJECT No.	DRAWING No.	ISSUE NO.
M01639-05	WFD_10	1



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PROJECT

MAGHERAMORE WINDFARM

CLIENT

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DRAWING TITLE

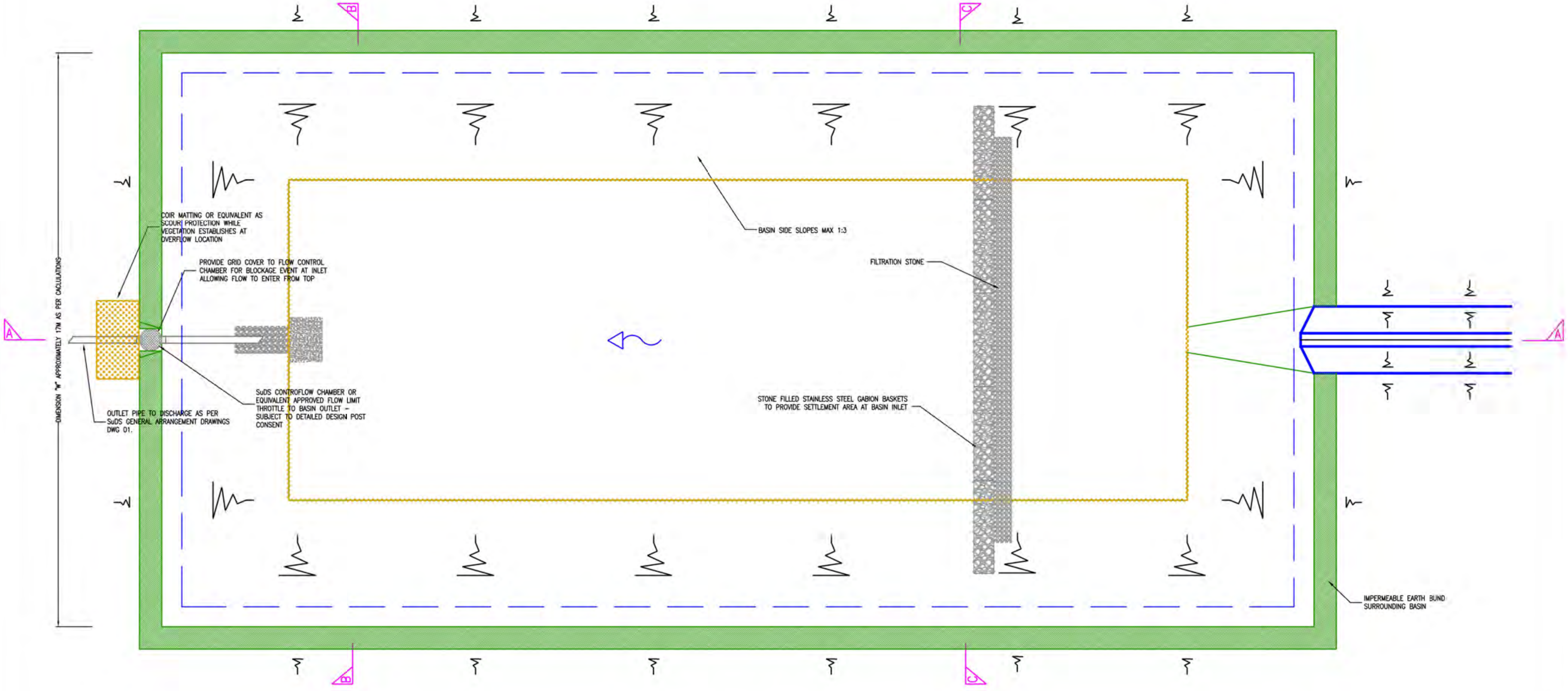
DRAINAGE MANAGEMENT (SuDS) INDICATIVE TYPICAL DETAILS SETTLEMENT LAGOON ARRANGEMENT

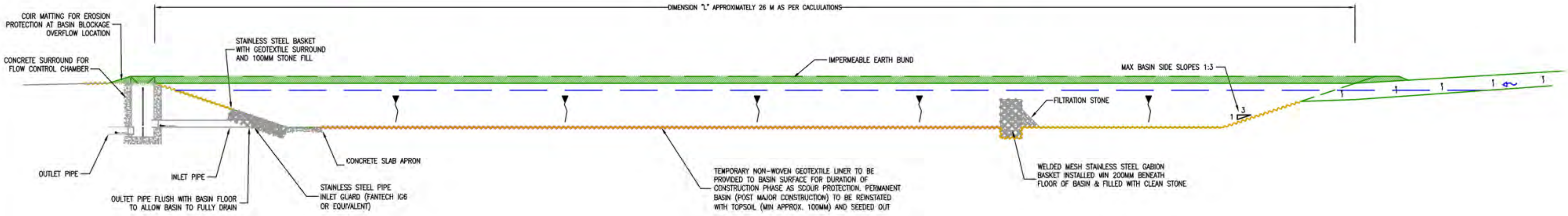
SCALE	ORIGINAL SIZE
AS SHOWN	A1

DRAWN	CHECKED	DATE
MD	DKS	29/05/2019

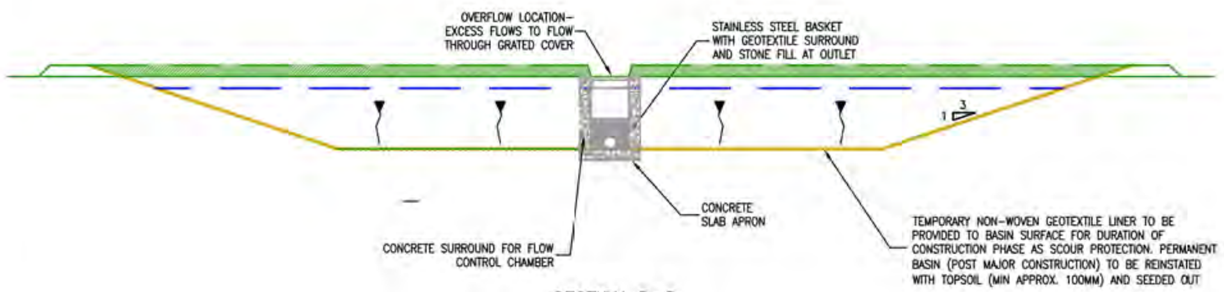
PROJECT No.	DRAWING No.	ISSUE NO.
M01616–05	WFD_11	1

INDICATIVE DESIGN

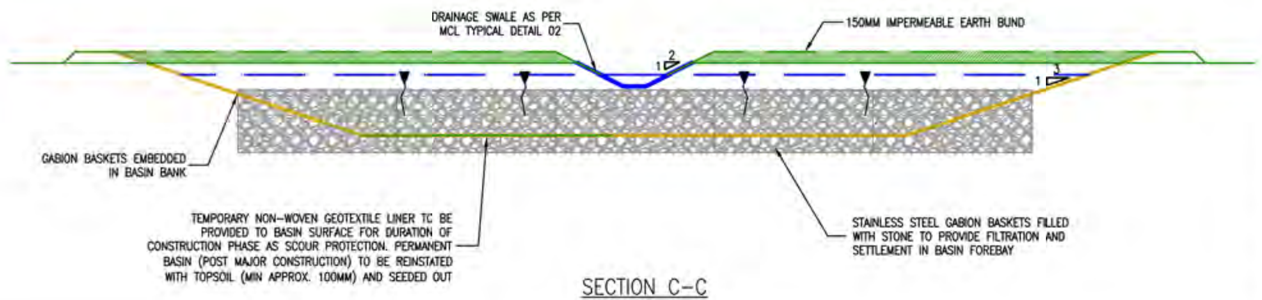




SECTION A–A



SECTION B–B



SECTION C–C

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PROJECT
MAGHRERAMORE WINDFARM

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DRAWING TITLE
DRAINAGE MANAGEMENT (SuDS) OUTLINE TYPICAL DETAILS DETENTION BASIN/ ATTENUATION POND

SCALE	ORIGINAL SIZE	
AS SHOWN	A1	
DRAWN: MD	CHECKED: JD	DATE: 27/05/2019
PROJECT No.: M01639-05	DRAWING No.: WFD_12	ISSUE NO.: 1

Annex C

Typical Flocculent Datasheet

SECTION 1: Identification of the substance/mixture and of the company/undertaking

1.1. Product identifier

Product form	:	Mixtures
Product name	:	Floc blocks (all AN grades)
Type of product	:	Construction materials,Construction materials additives

1.2. Relevant identified uses of the substance or mixture and uses advised against

1.2.1. Relevant identified uses

Industrial/Professional use spec	:	Industrial use Professional use
Use of the substance/mixture	:	Flocculant

1.2.2. Uses advised against

No additional information available

1.3. Details of the supplier of the safety data sheet

Mudtech Ltd
Wyburn House
ST16 1SB Stafford - United Kingdom
T +44 (0)845 299 0790 - F +44 (0)1929 554361
sales@mudtech.co.uk

1.4. Emergency telephone number

Emergency number	:	CHEMTEL International: +1 813-248-0585; USA/Canada And Territories 800-255-3924, Chemtel - will accept call charge.

SECTION 2: Hazards identification

2.1. Classification of the substance or mixture

Classification according to Regulation (EC) No. 1272/2008 [CLP]

Not classified

Adverse physicochemical, human health and environmental effects

To our knowledge, this product does not present any particular risk, provided it is handled in accordance with good occupational hygiene and safety practice.

2.2. Label elements

Labelling according to Regulation (EC) No. 1272/2008 [CLP]

EUH-statements	:	EUH210 - Safety data sheet available on request

2.3. Other hazards

Other hazards not contributing to the classification	:	Very slippery when wet.

SECTION 3: Composition/information on ingredients

3.1. Substances

Not applicable

3.2. Mixtures

Comments	:	An anionic polyacrylamide blend

This mixture does not contain any substances to be mentioned according to the criteria of section 3.2 of REACH annex II

SECTION 4: First aid measures

4.1. Description of first aid measures

First-aid measures general	:	Never give anything by mouth to an unconscious person. If you feel unwell, seek medical advice (show the label where possible).
First-aid measures after inhalation	:	Not expected to present a significant inhalation hazard under anticipated conditions of normal use.

First-aid measures after skin contact	:	Take off contaminated clothing and wash it before reuse. Wash with plenty of soap and water. Get medical advice if skin irritation persists.
First-aid measures after eye contact	:	Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing. If eye irritation persists: Get medical advice/attention.
First-aid measures after ingestion	:	Rinse mouth. Give water to drink. Do NOT induce vomiting. Get immediate medical advice/attention.

4.2. Most important symptoms and effects, both acute and delayed

Symptoms/injuries after inhalation	:	Not expected to present a significant inhalation hazard under anticipated conditions of normal use.
Symptoms/injuries after skin contact	:	May cause slight irritation.
Symptoms/injuries after eye contact	:	May cause slight irritation.
Symptoms/injuries after ingestion	:	May cause irritation to the respiratory tract.

4.3. Indication of any immediate medical attention and special treatment needed

Treat symptomatically.

SECTION 5: Firefighting measures

5.1. Extinguishing media

Suitable extinguishing media	:	Carbon dioxide. Dry powder. Foam. Use extinguishing media appropriate for surrounding fire.
Unsuitable extinguishing media	:	Do not use a heavy water stream.

5.2. Special hazards arising from the substance or mixture

Fire hazard	:	The product is not flammable.
Explosion hazard	:	Product is not explosive.
Reactivity in case of fire	:	Not known.
Hazardous decomposition products in case of fire	:	Toxic fumes may be released.

5.3. Advice for firefighters

Precautionary measures fire	:	No special measures required. Stop leak if safe to do so.
Firefighting instructions	:	Use extinguishing media appropriate for surrounding fire. Exercise caution when fighting any chemical fire. Prevent fire fighting water from entering the environment.
Protection during firefighting	:	Do not enter fire area without proper protective equipment, including respiratory protection. Do not attempt to take action without suitable protective equipment. Self-contained breathing apparatus. Complete protective clothing.
Other information	:	Very slippery when wet.

SECTION 6: Accidental release measures

6.1. Personal precautions, protective equipment and emergency procedures

6.1.1. For non-emergency personnel

Protective equipment	:	Wear suitable gloves and eye/face protection.
Emergency procedures	:	Ventilate spillage area. Avoid contact with skin and eyes.

6.1.2. For emergency responders

Protective equipment	:	Wear suitable protective clothing, gloves and eye or face protection. For further information refer to section 8: "Exposure controls/personal protection". Avoid contact with skin and eyes.
Emergency procedures	:	Ventilate area.

6.2. Environmental precautions

Avoid release to the environment. Prevent entry to sewers and public waters.

6.3. Methods and material for containment and cleaning up

For containment	:	No special measures required.
Methods for cleaning up	:	Sweep up the product. Shovel into suitable and closed container for disposal. This material and its container must be disposed of in a safe way, and as per local legislation. Do not use water for cleaning.
Other information	:	Dispose of in accordance with relevant local regulations.

6.4. Reference to other sections

For further information refer to section 8: "Exposure controls/personal protection". For disposal of solid materials or residues refer to section 13 : "Disposal considerations".

SECTION 7: Handling and storage

7.1. Precautions for safe handling

Additional hazards when processed	:	Very slippery when wet.

Precautions for safe handling	:	Wear personal protective equipment. Wash hands and other exposed areas with mild soap and water before eating, drinking or smoking and when leaving work. Avoid contact with skin and eyes.
Hygiene measures	:	Always wash hands after handling the product. Do not eat, drink or smoke when using this product.

7.2. Conditions for safe storage, including any incompatibilities

Storage conditions	:	Store in a well-ventilated place. Keep container closed when not in use. Keep away from water or moist air. Keep dry.
Incompatible products	:	Strong bases. Strong acids.
Incompatible materials	:	Direct sunlight.
Storage area	:	Store in a well-ventilated place.
Packaging materials	:	Keep only in original container.

7.3. Specific end use(s)

No special requirements.

SECTION 8: Exposure controls/personal protection

8.1. Control parameters

No additional information available

8.2. Exposure controls

Appropriate engineering controls:

Ensure good ventilation of the work station.

Personal protective equipment:

Protective goggles. Gloves. Protective clothing.

Materials for protective clothing:

Wear suitable protective clothing

Hand protection:

protective gloves

Eye protection:

tightly fitting safety goggles

Skin and body protection:

Wear suitable protective clothing

Respiratory protection:

Not required for normal conditions of use

Environmental exposure controls:

Avoid release to the environment.

Other information:

Do not eat, drink or smoke when using this product. Provide readily accessible eye wash stations and safety showers.

SECTION 9: Physical and chemical properties

9.1. Information on basic physical and chemical properties

Physical state	:	Solid
Appearance	:	Emulsion.
Colour	:	white.
Odour	:	odourless.
Odour threshold	:	No data available
pH	:	6.5 Approx
Relative evaporation rate (butylacetate=1)	:	No data available

Melting point	:	Not applicable
Freezing point	:	No data available
Boiling point	:	No data available
Flash point	:	≈ °C
Auto-ignition temperature	:	No data available
Decomposition temperature	:	No data available
Flammability (solid, gas)	:	Non flammable
Vapour pressure	:	No data available
Relative vapour density at 20 °C	:	No data available
Relative density	:	g/cm3
Solubility	:	Soluble.
Log Pow	:	No data available
Viscosity, kinematic	:	> mm²/s
Viscosity, dynamic	:	No data available
Explosive properties	:	Product is not explosive.
Oxidising properties	:	Oxidising solids Not applicable.
Explosive limits	:	No data available

9.2. Other information

No additional information available

SECTION 10: Stability and reactivity

10.1. Reactivity

The product is non-reactive under normal conditions of use, storage and transport.

10.2. Chemical stability

Stable under normal conditions.

10.3. Possibility of hazardous reactions

No dangerous reactions known under normal conditions of use.

10.4. Conditions to avoid

Moisture. Extremely high or low temperatures.

10.5. Incompatible materials

Strong acids. Strong bases. Strong oxidizing agents.

10.6. Hazardous decomposition products

fume. Carbon monoxide. Carbon dioxide.

SECTION 11: Toxicological information

11.1. Information on toxicological effects

Acute toxicity : Not classified (Based on available data, the classification criteria are not met)

Floc blocks (all AN grades)	
LD50 oral rat	> 2000 mg/kg

Skin corrosion/irritation	:	Not classified (Based on available data, the classification criteria are not met) pH: 6.5 Approx
Serious eye damage/irritation	:	Not classified (Based on available data, the classification criteria are not met) pH: 6.5 Approx
Respiratory or skin sensitisation	:	Not classified (Based on available data, the classification criteria are not met)
Germ cell mutagenicity	:	Not classified (Based on available data, the classification criteria are not met)
Carcinogenicity	:	Not classified (Based on available data, the classification criteria are not met)
Reproductive toxicity	:	Not classified (Based on available data, the classification criteria are not met)
STOT-single exposure	:	Not classified
STOT-repeated exposure	:	Not classified
Aspiration hazard	:	Not classified (Based on available data, the classification criteria are not met)
Potential adverse human health effects and symptoms	:	Based on available data, the classification criteria are not met.

SECTION 12: Ecological information

12.1. Toxicity

Ecology - general : The product is not considered harmful to aquatic organisms nor to cause long-term adverse effects in the environment.

Ecology - water : The product does not have any known adverse effect on the tested aquatic organisms.

Floc blocks (all AN grades)	
LC50 fish 1	> 100 mg/l
LC50 fish 2	≈ mg/l
LC50 other aquatic organisms 1	> mg/l
EC50 Daphnia 1	> 100 mg/l

12.2. Persistence and degradability

Floc blocks (all AN grades)	
Persistence and degradability	No data available.

12.3. Bioaccumulative potential

Floc blocks (all AN grades)	
Bioaccumulative potential	No data available.

12.4. Mobility in soil

Floc blocks (all AN grades)	
Ecology - soil	Soluble in water.

12.5. Results of PBT and vPvB assessment

No additional information available

12.6. Other adverse effects

Other adverse effects : None known.

Additional information : The product does not have any known adverse effect on the tested aquatic organisms

SECTION 13: Disposal considerations

13.1. Waste treatment methods

Regional legislation (waste) : Disposal must be done according to official regulations.

Waste treatment methods : Dispose of contents/container in accordance with licensed collector's sorting instructions.

Waste disposal recommendations : Dispose in a safe manner in accordance with local/national regulations.

SECTION 14: Transport information

In accordance with ADR / RID / IMDG / IATA / ADN

14.1. UN number

UN-No. (ADR) : Not applicable

UN-No. (IMDG) : Not applicable

UN-No. (IATA) : Not applicable

UN-No. (ADN) : Not applicable

UN-No. (RID) : Not applicable

14.2. UN proper shipping name

Proper Shipping Name (ADR) : Not applicable

Proper Shipping Name (IMDG) : Not applicable

Proper Shipping Name (IATA) : Not applicable

Proper Shipping Name (ADN) : Not applicable

Proper Shipping Name (RID) : Not applicable

14.3. Transport hazard class(es)

ADR

Transport hazard class(es) (ADR) : Not applicable

IMDG

Transport hazard class(es) (IMDG) : Not applicable

IATA

Transport hazard class(es) (IATA) : Not applicable

ADN

Transport hazard class(es) (ADN) : Not applicable

RID

Transport hazard class(es) (RID) : Not applicable

14.4. Packing group

Packing group (ADR) : Not applicable
Packing group (IMDG) : Not applicable
Packing group (IATA) : Not applicable
Packing group (ADN) : Not applicable
Packing group (RID) : Not applicable

14.5. Environmental hazards

Dangerous for the environment : No
Marine pollutant : No
Other information : No supplementary information available

14.6. Special precautions for user

- Overland transport

Not applicable

- Transport by sea

Not applicable

- Air transport

Not applicable

- Inland waterway transport

Not applicable

- Rail transport

Not applicable

14.7. Transport in bulk according to Annex II of Marpol and the IBC Code

Not applicable

SECTION 15: Regulatory information

15.1. Safety, health and environmental regulations/legislation specific for the substance or mixture

15.1.1. EU-Regulations

Contains no REACH substances with Annex XVII restrictions
Contains no substance on the REACH candidate list
Contains no REACH Annex XIV substances

15.1.2. National regulations

Classified in line with 29 CFR

15.2. Chemical safety assessment

No chemical safety assessment has been carried out

SECTION 16: Other information

Other information : None.

Full text of H- and EUH-statements:

EUH210	Safety data sheet available on request

SDS EU (REACH Annex II)

This information is based on our current knowledge and is intended to describe the product for the purposes of health, safety and environmental requirements only. It should not therefore be construed as guaranteeing any specific property of the product

Appendix 9.2 Flood Risk & Drainage Assessment

Flood Risk & Drainage Assessment

Magheramore WF

M01616-05_DG03 | June 2019

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DISTRIBUTION

Recipient	**Revision**					
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RES	✓	✓				

DISCLAIMER

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1 INTRODUCTION

1.1 Terms of Reference

This Drainage Assessment has been commissioned by RES, to support a planning application for a proposed wind farm development at Magheramore Road, in the parish of Banagher, Dungiven.

The purpose of this assessment is to address Revised Planning Policy Statement 15 (PPS15). The assessment will therefore determine potential sources of flooding at the site and their associated risk to life and property; and shall discuss the site suitability for development and outline proposed design and mitigation measures where appropriate.

1.2 Statement of Authority

This report and assessment has been prepared and reviewed by qualified professional civil engineers, specialising in the fields of hydrology, drainage and flood risk as required by DfI Rivers. The key staff members involved in this project are as follows:

- Jill Dick MEng – Project Engineer specialising in the fields of flood risk assessment, drainage, SuDS and surface water management design
- Kyle Somerville BEng (Hons) CEng MIEI – associate and Senior Engineer specialising in the fields of flood risk assessment; flood modelling, drainage and surface water management design.

1.3 Approach to the Assessment

Consideration has been given to the sources and extent of fluvial and tidal flooding at the site, as well as flooding of the site from pluvial sources, infrastructure failure, overland flow and ponding of localised rainfall within the site. The assessment is intended to be proportionate to the scale and nature of the development and the perceived risk to it.

For the purposes of this study the following have been considered:

- Available information on historical flooding in the area.
- Site level information based on available DTM data;
- High-level assessment of potential flooding from rivers and the sea;
- Assessment of potential flooding to the site from overland sources;
- Assessment of potential flood risk to adjacent lands caused by development at the site; and
- Determination of the availability of safe discharge of surface water from the site.

Further guidance is also provided in the CIRIA Research Project 624 “Development and Flood Risk: Guidance for the Construction Industry” and Revised Planning Policy Statement 15 (PPS 15) – Planning and Flood Risk.

1.4 Site Location and Description

The application site within which the Development sits lies within a landholding (lands under applicant control) located east of Magheramore Road, Dungiven and on the south-western flank of Teeavan Hill.

For purposes of this assessment the “Site” shall refer to the lands under applicant control. Site has an area of 169 Ha. The site can be located at Irish Grid ref. 268483, 405068. Site context and location are shown on the drawings submitted in support of the application.

Figure 1-1 Site Location – Context

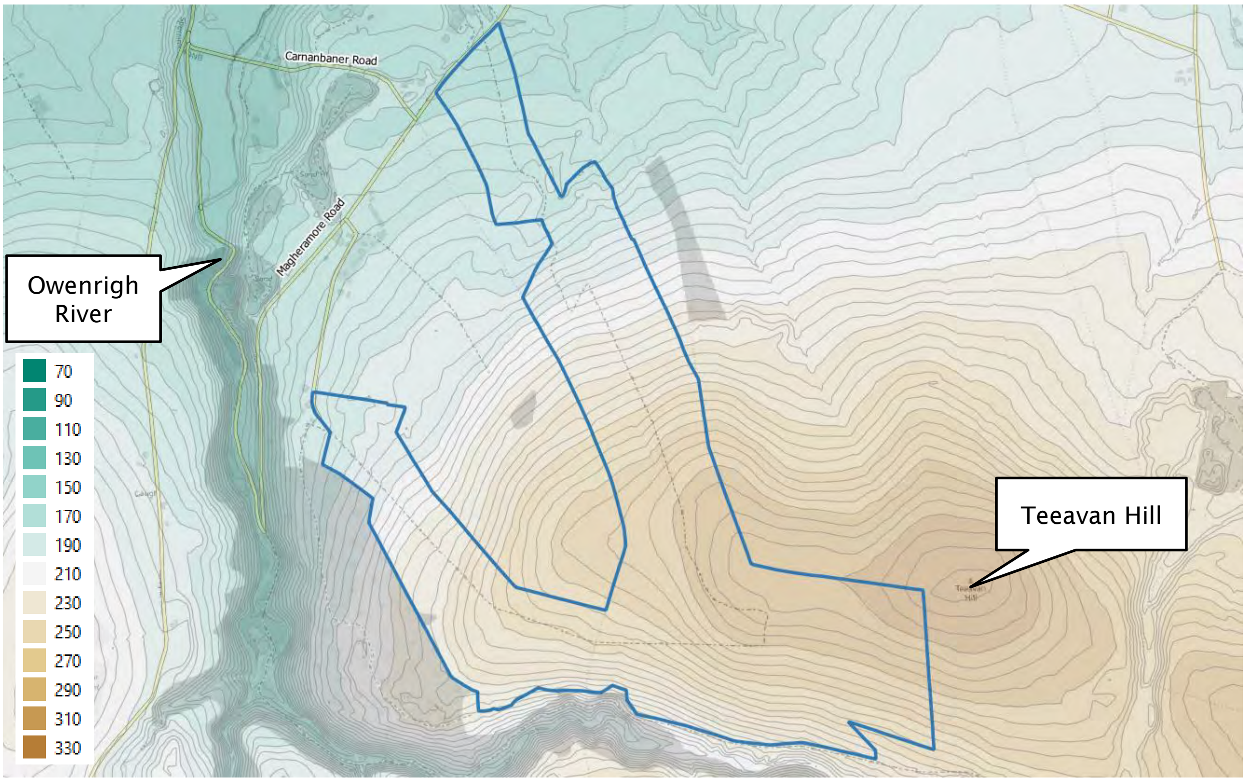


Figure 1-2 Site location and Topography

1.4.1 Existing Land Use

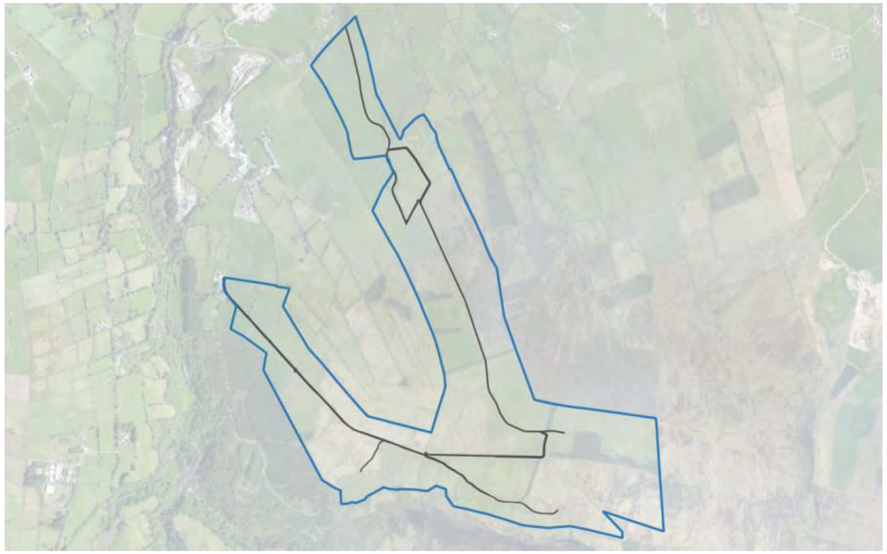
The site is undeveloped land on the south-western flank of Teeavan Hill largely used for agricultural grazing. The site is accessible via a number of unbound agricultural tracks.

1.4.2 Proposed Development

The proposed development involves the construction of six no. wind turbines with associated permanent unbound gravel track for access and egress, associated site infrastructure and permanent drainage features.

Change of land use within the site is shown on the following figure.

Existing Use		Proposed Use	
Land Use	Agricultural	Land Use	Wind Farm
Impermeable Area	0%	Impermeable Area	2%



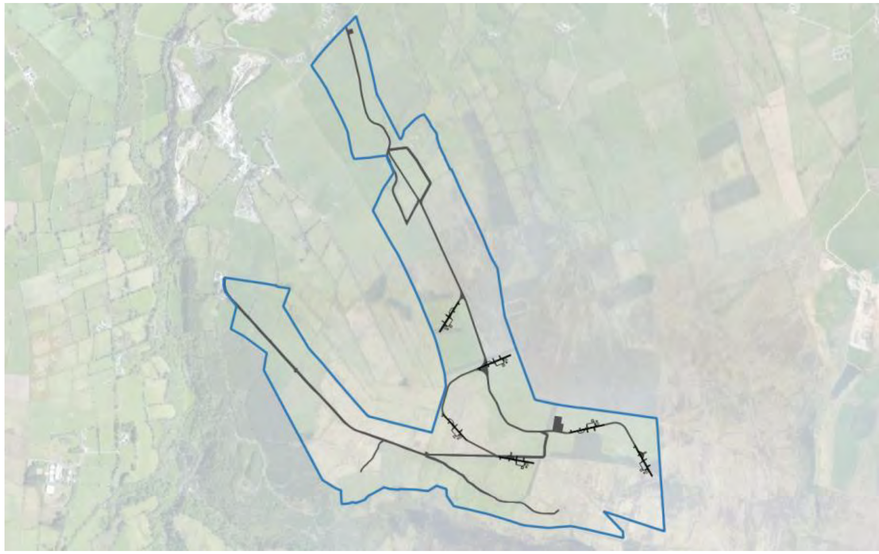


Figure 1-3 Summary of Land Use Change

1.4.3 Affected Watercourses

The site drains to the Altnaheglish and Owenrigh Rivers via 4 tributary subcatchments within and downstream of the site. The Owenrigh is undesignated in close proximity of the site and designated 1.5km north of the site (DfI watercourse Ref. 111).

A number of other watercourses, characteristic of minor watercourses, peat/land drainage and field boundary drainage, have been mapped as part of the wider hydrological assessment. A summary of water features on and adjacent to the site is shown on Figure 1-4.

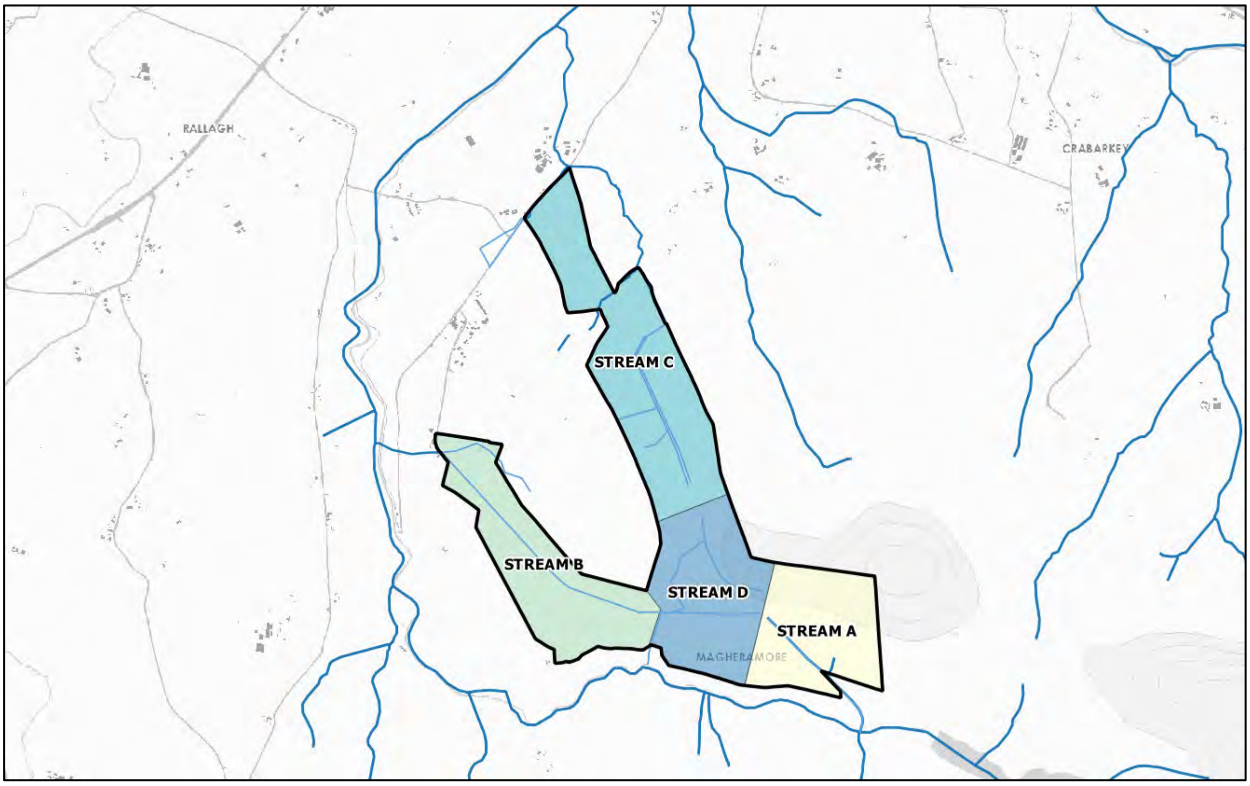


Figure 1-4 Site Hydrology

2 BACKGROUND INFORMATION REVIEW

As part of the data collection phase, a number of sources of information were investigated in order to develop an understanding of the potential site flood risk. The following review highlights the findings of the anecdotal evidence collection exercise.

2.1 Internet/Media/Background Search

Preliminary consultation with online media sources indicate that there are no recorded flood incidents which have affected the site.

2.2 Northern Ireland Water

2.2.1 Out of Sewer Flooding

Northern Ireland Water (NI Water) has indicated that it is generally unable to provide data relating to out of sewer flooding.

2.2.2 Asset Information

NI Water asset information shows no drainage infrastructure that would be of material concern to this assessment within the vicinity of the development.

2.3 DfI Rivers

2.3.1 Flood Maps NI

The extent of development was reviewed with reference to Flood Maps (NI). Information obtained from flood maps is summarised as follows:

- There is no record of historic flooding within or in close proximity of the proposed development.
- DfI Rivers indicative fluvial flood maps – present day indicates that the site is not affected by the 1% AEP fluvial flood extents.
- DfI Rivers indicative surface water flood maps – present day indicates that parts of the site are affected by the 0.5% AEP surface water flood extents.
- The DfI Reservoir inundation maps confirms that the site is unaffected by the inundation zone of any controlled reservoir.

2.3.2 Consultation

DfI Rivers was consulted as part of scoping for the planning application and Environmental Statement. Rivers confirmed that PPS15 requires flood risk and drainage are assessed in the ES., and commented specially in relation to planning policy as follows:

- FLD 1 – a small portion of the site lies within the 1 in 100 yr fluvial flood plain.
- FLD 2 – the site is traversed by various undesignated watercourses, to which a 5m maintenance strip should be applied. Clear access and egress should be provided at all times and be protected from impediments (including tree planting, hedges, permanent fencing and sheds), land raising or future unapproved development.
- FLD 3 – the applicant should refer to para. D17 and D18 of PPS15. The drainage assessment should acquire evidence from the relevant authority that the proposed storm water run-off from the site can be safely discharged.
- Under the terms of Schedule 6 of the Drainage (NI) Order 1973 the applicant must submit to DfI Rivers for its consent for any proposal to carry out works which might affect a watercourse.

The consultation response has been provided in Appendix C.

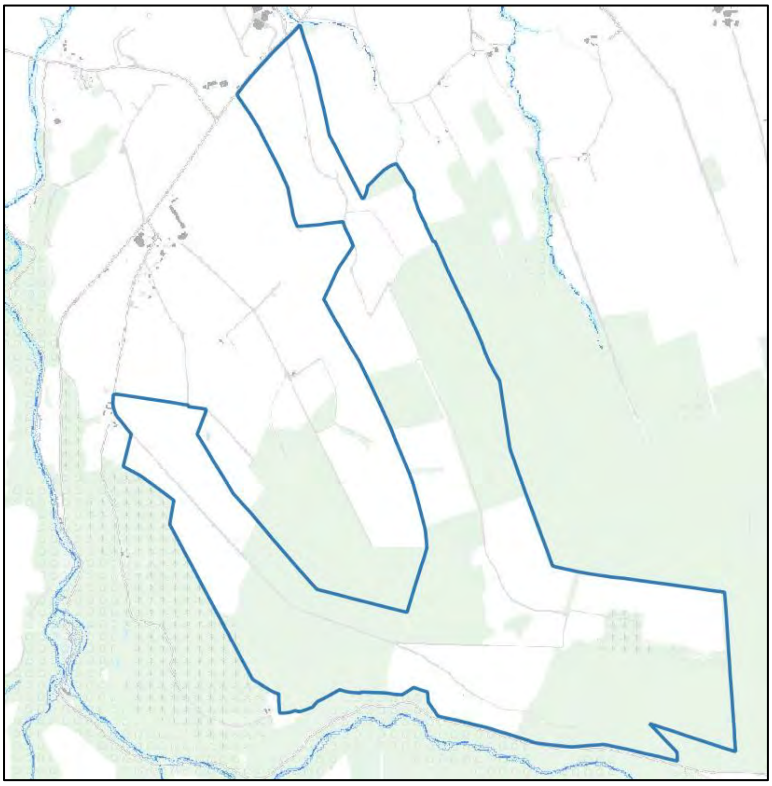


Figure 2-1 Extract from Flood Maps NI – Indicative 1% AEP Fluvial Flood Extent

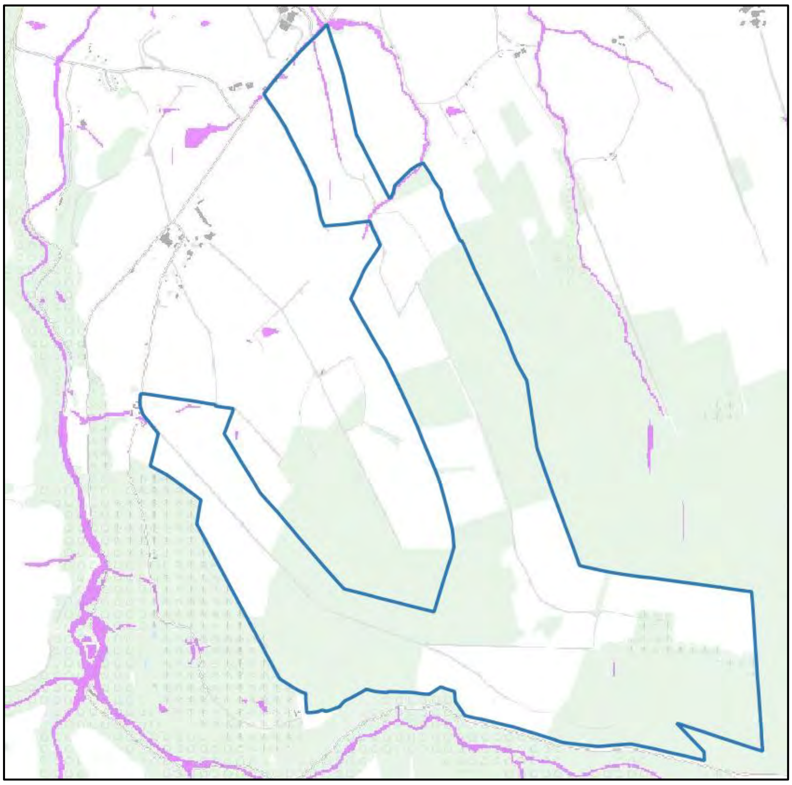


Figure 2-2 Extract from Flood Maps NI – Indicative 0.5% AEP Surface Water Flood Extent

2.3.3 Designated Watercourses

No designated watercourses are present within the site boundary. The nearest downstream designation is the Owenrigh Water c. 1.6km north of the site.

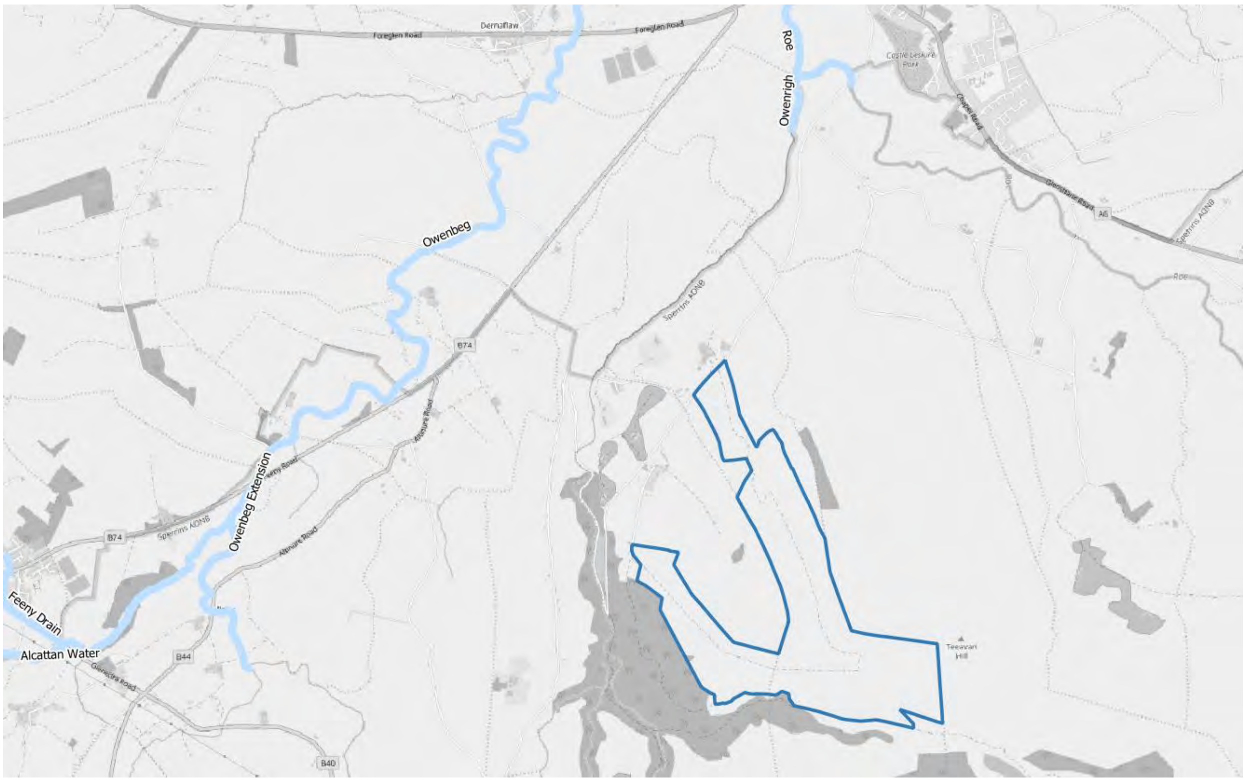


Figure 2-3 Designated Watercourses

3 FLOOD RISK ASSESSMENT

3.1 Initial Assessment

The following flood mechanism and policy screening is undertaken on the basis of the initial information obtained and is informed by DfI Rivers opinion established in consultation to determine scoping opinion.

Table 3-1 Potential Flood Mechanism and Policy Screening

Policy	Flood Mechanism	Initial Assessment	Policy Applies?	Assess further?
FLD 1 - Development in Fluvial & Coastal Flood Plains	Fluvial Flooding	The site is unaffected by fluvial flooding as indicated on Flood Maps NI. Reference to predicted flooding on the site by DfI Rivers in its opinion is due to a change in lands under control following date of consultation.	No	No
	Coastal Flooding	The site is unaffected by any coastal floodplain as indicated on Flood Maps NI.	No	
	Flood Defence / Failure	The site does not lie in a defended area.	No	
FLD 2 - Protection of Flood Defence & Drainage Infrastructure	Development near drainage or flood defence assets	The site is currently occupied by watercourses and field drains in a number of locations.	Yes	Yes
FLD 3 – Development and Pluvial Flood Risk Outside Flood Plains	Surface water flooding	Part of the site is affected by pluvial flooding as indicated on Flood Maps NI.	Yes	Yes
	Surface water discharge	The development would potentially modify surface water run-off characteristics onsite/offsite. The scale and nature of the proposal triggers the need for a drainage assessment; development is required to demonstrate that safe discharge of surface water is feasible.	Yes	
	Culvert Blockage	No existing culverted watercourses have potential to affect the site in areas that would be of concern in relation to flood damage to the proposal.	No	
	Urban Drainage / Local Drainage Failure	No record of local drainage failures.	No	
	Groundwater	Not for consideration due to underlying geology and soil types.	No	
FLD 4 – Artificial Modification of Watercourses	Development affecting watercourses	The development shall involve a number of crossings of undesignated watercourses and field drains to permit access.	Yes	Yes
FLD 5 - Development in Proximity to Reservoirs	Reservoir Flooding	The site is not located within a reservoir inundation zone.	No	No

3.2 Surface Water

3.2.1 Flood Risk to Site

DfI Rivers Indicative surface water flood mapping indicates the site and adjacent lands are at risk of surface water run-off.

The majority of surface water flood risk predicted by Flood Maps NI coincides with minor watercourses, and their flood risk would be mitigated by suitable culvert crossings of the watercourses where those locations conflict with proposed development.

A surface water flow route is predicted to coincide with an existing access track which is proposed to be upgraded as shown on Figure 3-1. Flood risk is likely to be shallow, and the track is not of a type that would be susceptible to flood damage. Any restriction to access is unlikely to be of adverse consequence as the site is unmanned.

Figure 3-1 Surface Water Flooding at Access Track

Mitigation of flood risk to the track will be by provision of track drainage, where local to the area affected by flooding will comprise rural SuDS including track-side swales, with downstream discharge to a watercourse managed by an attenuation basin. Particular requirements are stated in Section 4.2.1 and a preliminary drainage design is included in Appendix B.

3.2.2 Effect of the Development

The proposed development shall lead to an increase in the impermeable area of the site. Therefore, the risk of flooding from surface water run-off from the site shall be greater relative to the existing scenario without appropriate mitigation.

An estimate of the unmitigated post-development run-off for the extent of development has been made as part of this assessment. A comparison of existing and proposed run-off rates in litres per second (lps) are provided in Table 3-2.

Table 3-2 Comparison of surface water run-off rates (Peak [1hr] Runoff rates)

Return Period	Existing Site (l/s)	Proposed Site (l/s)	Increase (l/s)
1 in 2 year	11.8	87.7	75.9
1 in 30 year	20.4	209.8	189.4
1 in 100 year	24.3	298.2	273.9

3.2.2.1 *Potential for Overland Flooding*

The site setting is rural and the proposal is unlikely to cause any significant effect to lands downgradient. Mitigation of surface water flood risk to adjacent lands shall be by provision of an adequate drainage system, see Section 4.2.1.

3.2.2.2 *Effect on Downstream Watercourses*

All runoff from the site will drain to downstream watercourses within the site or within lands under control of the applicant. All run-off shall ultimately drain to Owenrigh Water catchment, with direct discharges to minor undesignated watercourses within the application boundary.

The effect of the development has been assessed as causing an increased rate and volume of run-off. To mitigate this effect, it is proposed to use a rural SuDS approach to encourage dispersal of runoff over the site and discourage point discharges to watercourses; and to limit run-off from direct discharges to watercourses to a greenfield equivalent pre-development run-off rate.

Particular requirements for the attenuation and discharge of surface water based on the proposals at the site are discussed in Section 4.2.

4 SUMMARY OF FINDINGS AND RECOMMENDATIONS

4.1 Summary of Findings

DfI Rivers Indicative surface water flood mapping indicates that part of the site is affected by the 0.5% AEP surface water flood extent sand therefore is at risk of surface water flooding.

The localised areas of surface water flood risk observed on Flood Maps NI coincide with minor watercourses and localised depressions, and do not have the potential to significantly affect the site.

No development is sited within any surface water flood extents with the exception of the proposed access track and suitably designed water feature crossing required to permit access to the site. The proposed development has been assessed and is determined to cause no adverse effect outside lands under control of the applicant. Design information relating to water feature crossings has been provided in section 4.2.4.

The development of the site causes an increase in peak rate and volume of run-off from the site. Mitigation of surface water flood risk to the development, by providing an adequate drainage system, is discussed below.

4.2 Design Considerations

This section details measures which have been incorporated into the proposal submitted in support of the planning application, and to be further developed in any detailed design or variation post-determination of the planning application.

4.2.1 Drainage Design

It has been demonstrated that the proposed development of the site will cause an increase in the peak rate and volume of runoff from the site without mitigation. Drainage from the site shall discharge to the Owenrigh Water.

Due to the nature of the development, a formalised conventional drainage system is not considered feasible or practical at the site. The design principles in summary are as follows:

- The drainage system will cater for a 1 in 30 year storm, with additional protection for up to a 1 in 100 year event, common to the standard of protection for flooding from surface water drainage afforded by Sewers for Adoption.
- Runoff from the access track shall be collected via open swales. Run-off shall be attenuated with the use of check dams in order to reduce the peak rate of run-off and to encourage infiltration of surface water.
- Settlement/attenuation basins will be provided where drainage from significant areas of hardstanding discharge directly to streams and watercourses.
- If feasible at detailed design, run-off should be encouraged to discharge overland, rather than accumulate concentrated peak flows to discharge to watercourses.

The drainage networks should also allow for a 20% allowance for climate change at all of the above listed return periods. SuDS features shall be designed in accordance with best practice guidance in The SuDS Manual (Document ref: C753; CIRIA).

4.2.1.1 Discharge Rate and Location

To aid in the demonstration that the safe discharge of surface water from the proposed wind farm site is feasible, a concept drainage design has been prepared and is included in Appendix B. The proposal involves surface water from the proposed development discharging directly to the existing on site watercourses and field drains, at the 8 no. locations indicated on the drainage design.

Direct discharges to watercourses shall be subject to discharge consent under Schedule 6 of the Drainage (Northern Ireland) Order 1973. An application has been made to DfI Rivers in relation to the proposal under application reference IN1-19-7510. Consent to discharge shall be forwarded under separate cover when available.

Surface water run-off shall be limited as closely as feasible to the greenfield run-off rate of 10l/s/ha for the developed site area. Given the impracticability of heavily engineered flow control solutions at the remote location of the site, the flow shall be limited by an orifice plate. Flow rates and proposed discharge locations are subject to DfI Rivers Consent.

4.2.1.2 Attenuation Requirement

The indicative drainage design shown intends surface water from the site to discharge into 8 no. attenuation basins at locations adjacent watercourses and field drains. Flows controls shall be installed at the pond outflow points to ensure that flows are discharging to watercourses as per Table 4-1.

The storage calculation has not included the storage provided within the drainage conveyance system i.e. by checkdams in swales, and loss of water by overland dispersal. The attenuation sizes required are therefore considered highly conservative.

Attenuation calculations demonstrate that the following is required:

Table 4-1 Attenuation Requirements

Catchment	Drainage area (m^2)	Allowable run-off rate (l/s)	Attenuation storage required (m^3)
1	2,440	2.4	88
2	5,310	5.3	192
3	1,660	1.7	60
4	5,140	5.1	180
5	1,940	1.9	72
6	8,020	8.0	280
7	1,470	1.5	52
8	3,460	3.4	120

The attenuation volume stated is based on preliminary information; drainage catchments are subject to change dependent on the finalised layout of any drainage layout and finished ground levels. Volumes stated are dependent on the type and efficiency of the flow control method used. Ultimately the final design (to be completed and agreed post-consent) must comply with the limiting discharge rate (per hectare) applied to the drained development area.

The location of attenuation and minor drain crossings can be viewed in drawing nos. M01616-05 WFD01-06 as provided in Appendix B.

4.2.2 Exceedance

In the event of an unprecedented flood, any attenuation pond is expected to overtop and drain overland. This overland flow is expected to be collected by existing downstream watercourses and field drains, which will contribute to the overall catchment at a location downstream of the site.

Any overland flow from the site is expected to drain as shown in Figure 4-1.

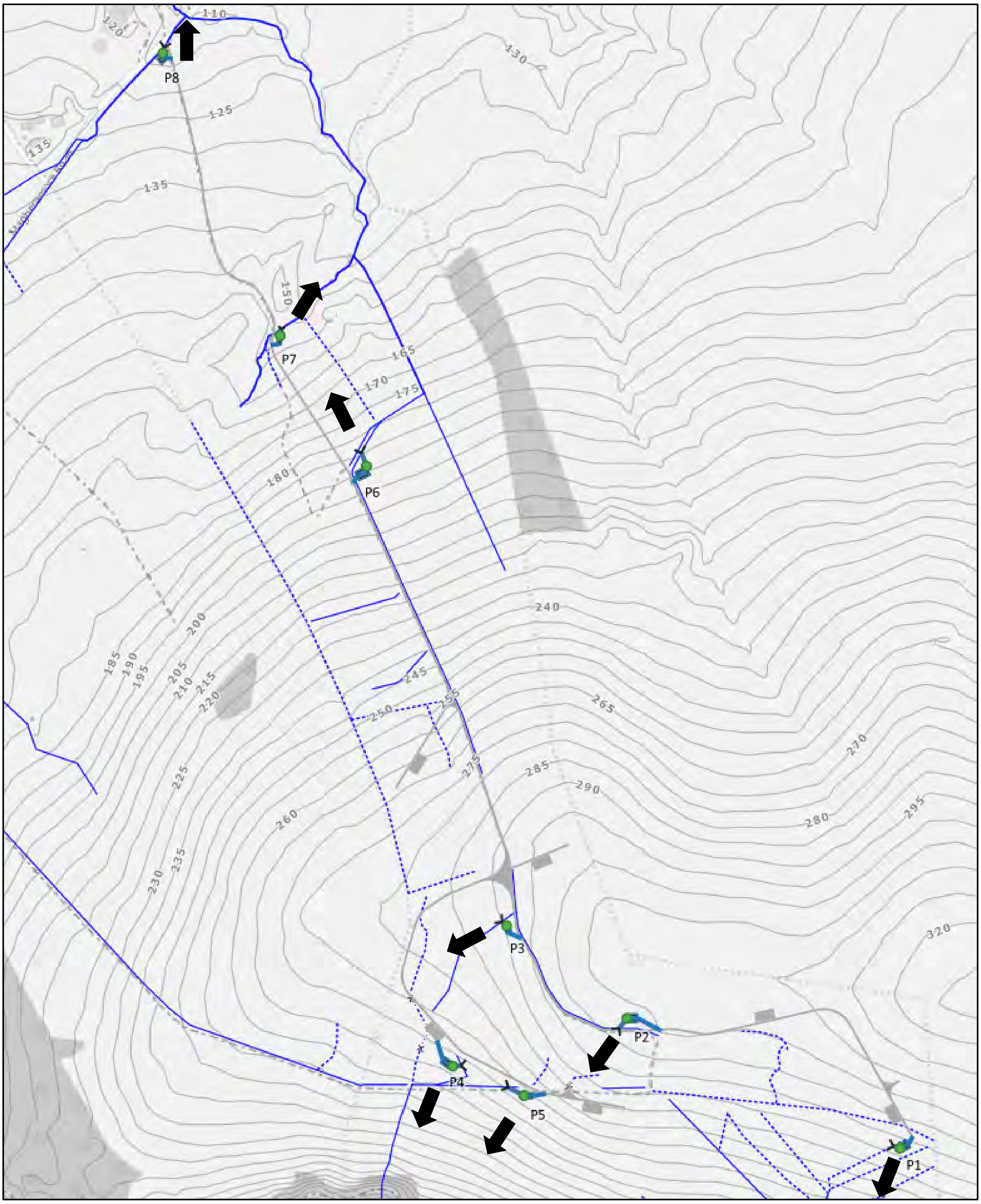


Figure 4-1 Surface Water Flow Exceedance Routes

4.2.3 Protection of Watercourses

The nature of the proposal causes no built development of a type that would impede riparian maintenance of watercourses, and as such meets the normal requirements stated in policy FLD2 in relation to watercourse maintenance.

4.2.4 Water feature crossings

The development shall involve the installation of piped crossings for seven water features at a number of locations across the site to permit access, of which four are upgrades to existing structures. A schedule of culvert crossings and the watercourses affected is shown on Table 4-2. Watercourse crossings are shown on drainage drawings included in Appendix B.

Table 4-2 Watercourse Crossing Schedule

Id	Proposal	Comment
WX01	Min 600 Circular	New culvert - Minor watercourse is an existing trackside drain.
WX02	Min 600 Circular	New culvert – Minor watercourse is an existing trackside drain.
WX03	Min 600 Circular	Existing small dia. shore / culvert to be replaced. Minor watercourse is an existing trackside drain.
WX04	Min 600 Circular	Existing small dia. track culvert to be replaced. Minor watercourse is an existing trackside drain.
WX05	Min 600 Circular	New culvert. Minor watercourse is a diverted peat drainage channel.
WX06	Large Dia. Or Box Culvert	Existing concrete deck structure - replacement subject to design. Watercourse is a more significant (c. 1m wide) stream.
WX07	Large Dia. Or Box Culvert	Existing culvert - need for replacement or upgrade subject to design. Watercourse is a more significant (< 1m wide) stream, extensively culverted immediately upstream.

Piped crossings shall be designed as to mitigate potential for flooding of infrastructure. Culverts shall be designed to have free inlet conditions for an appropriate flood design standard, nominally 1% AEP / 1-in 100 years with climate change allowance or as may otherwise be required by DfI Rivers in consultation.

Any crossings required shall be designed to accommodate track crossings whilst limiting the length of the channel affected.

Hydraulic design of crossings shall be undertaken as per the guidance and requirements provided in CIRIA C689 "Culvert Design and Operation Guide" (or other standard as may be required by DfI Rivers in post-consent consultation), with primary parameters likely to include:

- Width of the crossing will be greater than the width of the active drainage channel;
- Alignment of the crossing will suit the alignment of the drainage channel i.e. preserve the existing direction of flow;
- The slope of the crossing will not exceed the slope of the bed of the existing channel.

Proposed culverts shall be subject to future approval from DfI Rivers through a Schedule 6 application, under the Drainage Order (NI) 1973. The locations affected are not located in any floodplain and are of a conventional nature and there is no significant potential for the culverts in themselves to cause a new flood risk requiring consideration as part of this flood risk assessment. As such detailed design and consent for those crossings is not material to determination of an associated planning application and can satisfactorily be deferred post-consent of the application.

4.3 Maintenance Requirements

4.3.1 Drainage System Maintenance

Where drainage has not underwent the adoption process, maintenance is the responsibility of the relevant landowner. The developer/site operator is to ensure that the maintenance of the drainage system is included within the overall management plan for the site. Detailed drainage layouts for the site shall ensure that key features requiring maintenance (e.g. flow control devices) are located in accessible locations.

Maintenance plans for SuDS are to include (where applicable):

- Cyclical (min. annual, or after significant storm event) check of any flow control device for damage, debris or blockage.
- Seasonal maintenance of any surface water feature e.g. swales/ponds – nominally to include management of vegetation, clearing of obstructions, etc.

4.3.2 Drainage Feature Maintenance

The operator is reminded of their statutory obligations set out in the Drainage (Northern Ireland) Order 1973 in relation to their role as a riparian landowner to the watercourses and field drains located on site.

4.4 Flood Risk & Planning Policy Summary

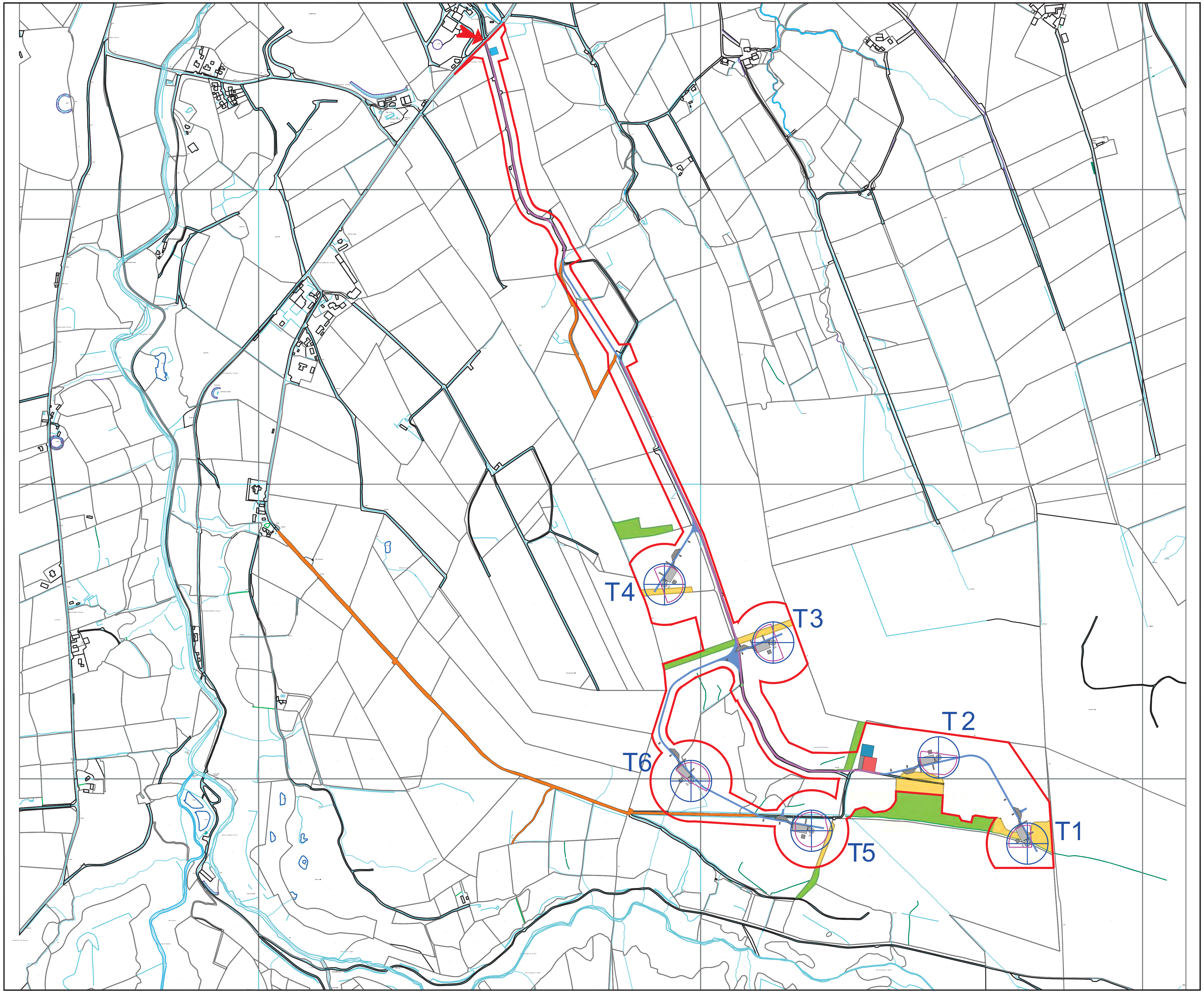
The following table summarises the findings, mitigation, and policy context of those flood mechanisms and policies deemed to be required to be investigated further by the initial assessment.

Table 4-3 PPS15 Policy Summary

Policy	Flood Mechanism	Assessment / Mitigation	Complies?
FLD 1 - Development in Fluvial & Coastal Flood Plains	Does not apply (see Table 3-1)		
FLD 2 - Protection of Flood Defence & Drainage Infrastructure	Development near drainage or flood defence assets	The proposals shall not impede riparian maintenance of watercourses. The proposal therefore complies with FLD2.	Yes
FLD 3 – Development and Pluvial Flood Risk Outside Flood Plains	Discharge of Surface Water Surface water flooding	Site drainage shall ensure that the site is adequately drained and flood resilient. Drainage design shall adopt suitable hydraulic standards in relation to standards of flood protection. Surface water can be safely disposed of to existing field drains and watercourses. The proposal complies with FLD3.	Yes
FLD 4 – Artificial Modification of Watercourses	Culverting of Watercourses	The proposed development shall involve the construction of crossings to existing watercourses and field drains. The crossings shall be constructed to facilitate access only and are a permissible exception to policy FLD4.	Yes
FLD 5 - Development in Proximity to Reservoirs	Does not apply (see Table 3-1)		

Appendix A

Client Drawings



MAGHERAMORE WIND FARM

FIGURE 2.1

INFRASTRUCTURE LAYOUT

KEY

- PLANNING APPLICATION BOUNDARY
- WIND TURBINE LOCATION
- TURBINE MICROSITING
- NEW SITE TRACKS
- UPGRADED SITE TRACKS
- EXISTING TRACKS
- WATERCOURSE CROSSING
- CRANE HARDSTANDING AREA
  - PERMANENT
  - TEMPORARY
- TEMPORARY ENABLING CONSTRUCTION COMPOUND
- TEMPORARY CONSTRUCTION COMPOUND/ ENERGY STORAGE AREA.
- CONTROL BUILDING & SUBSTATION COMPOUND WITH PERMANENT HARDSTANDING AREA
- FORESTRY TO BE RETAINED
- FORESTRY TO BE REMOVED
- SITE ENTRANCE LOCATION

LAYOUT DWG	03426D0001-06	T-LAYOUT NO.	PNIRmgh020

DRAWING NUMBER 03426D1001-01

SCALE - 1:10,000 @ A3

ENVIRONMENTAL STATEMENT

Appendix B

Preliminary Drainage Layouts

NOTES

GENERAL

1. DRAWINGS ARE PRELIMINARY ONLY AND INTENDED TO INFORM THE PLANNING APPLICAITON. DRAWINGS ARE NOT INTENDED FOR CONSTRUCTION AND SHOULD NOT BE USED AS SUCH. FOR AVOIDANCE OF DOUBT, SURFACE WATER MANAGEMENT DESIGN IS INTENDED TO BE FURTHER DEVELOPED POST-CONSENT OF THE PLANNING APPLICATION .
2. ALL LOCATIONS OF SUDS FEATURES IDENTIFIED ARE APPROXIMATE AND ARE LIMITED BY THE LEVEL OF INFORMATION AVAILABLE. DETAILED SITING OF SUDS FEATURES SHALL BE UNDERTAKEN ON AN OBSERVATIONAL BASIS DEPENDANT ON LOCAL TOPOGRAPHY AND CHANGES IN ROAD ALIGNMENT DESIGN.
3. ADDITIONAL TEMPORARY DRAINAGE / MITIGATION WILL BE PROVIDED DURING THE CONSTRUCTION PHASE ON AN OBSERVATIONAL BASIS.
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POLLUTION PREVENTION

6. ALL SETTLEMENT FEATURES SUBJECT TO DETAILED DESIGN.
7. DRAINAGE / SILT MANAGEMENT FEATURES INCLUDING SETTLEMENT FEATURES AND DRAINAGE CROSSINGS TO BE INSTALLED PRIOR TO OR IN PARALLEL WITH ROAD CONSTRUCTION.
8. INTERIM MEASURES TO BE EMPLOYED IN ALL INSTANCES WHERE WORK CARRIED OUT TO CONSTRUCT THE ACCESS ROAD IS LIKELY TO CAUSE ADVERSE ENVIRONMENTAL IMPACTS THROUGH INCREASED SILT LOADINGS BEING GENERATED DURING THE CONSTRUCTION PHASE.
9. SUITABLE PREVENTION MEASURES SHOULD BE IN PLACE AT ALL TIMES TO PREVENT THE CONVEYANCE OF SILTS TO RECEIVING WATERCOURSES.
10. OIL FUEL SHOULD BE STORED WITHIN CONTAINMENT AND CEMENT SHOULD BE MIXED WITHIN COMPOUND / CONTAINMENT, TOOLS WASHED IN THE SAME AREA AND WATER RECYCLED (IN THE CEMENT MIX).

TRACK / INFRASTRUCTURE DRAINAGE

11. MINOR WATERCOURSE DIVERSIONS (WHERE THOSE EXISTING DRAINS ARE EFFECTIVELY EXISTING TRACK DRAINAGE IN AREAS WHERE THE EXISTIN TRACK IS TO BE UPGRADED OR REPLACED ARE TO BE UNDERTAKEN AS ENABLING WORKS PRIOR TO MAIN EARTHWORKS, AND SUITABLE MEASURES (SUCH AS CHANNEL LINING WITH COIRE MATTING OR SIMILAR) SHALL BE IN PLACE TO PREVENT SCOUR OF THE DIVERTED CHANNEL BED. TEMPORARY UPSLOPE CUTOFF / DIVERSION DRAINAGE TO BE INSTALLED IN ADVANCE OF MAIN EARTHWORKS IN AREAS INDICATED IN ORDER TO MINIMISE SURFACE WATER INGRESS TO EXCAVATIONS
12. SETTLEMENT/ATTENUATION PONDS ARE RETAINED FOLLOWING COMPLETION OF CONSTRUCTION ACTIVITIES.
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WATERCOURSE & TRACK DRAINAGE CROSSINGS

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18. ALL HDPE PIPES SHALL BE TWINWALL TYPE, BBA HAPAS APPROVED.
19. ALL CROSSINGS TO BE INSTALLED MIN. 0.15M BELOW EXISTING BED LEVEL AND TO SUIT EXISTING STREAM CHANNEL GRADIENTS.

MAINTENANCE

20. THE LEVEL OF SILT IN RUNOFF DURING CONSTRUCTION IS TO BE MONITORED VISUALLY AND EXCESSIVE SILT LEVELS IN ANY AREA TO BE TEMPORARILY MANAGED THROUGH USE OF SILT FENCES / ALUM FLOCCULANT / CONSTRUCTED SETTLEMENT FEATURES.
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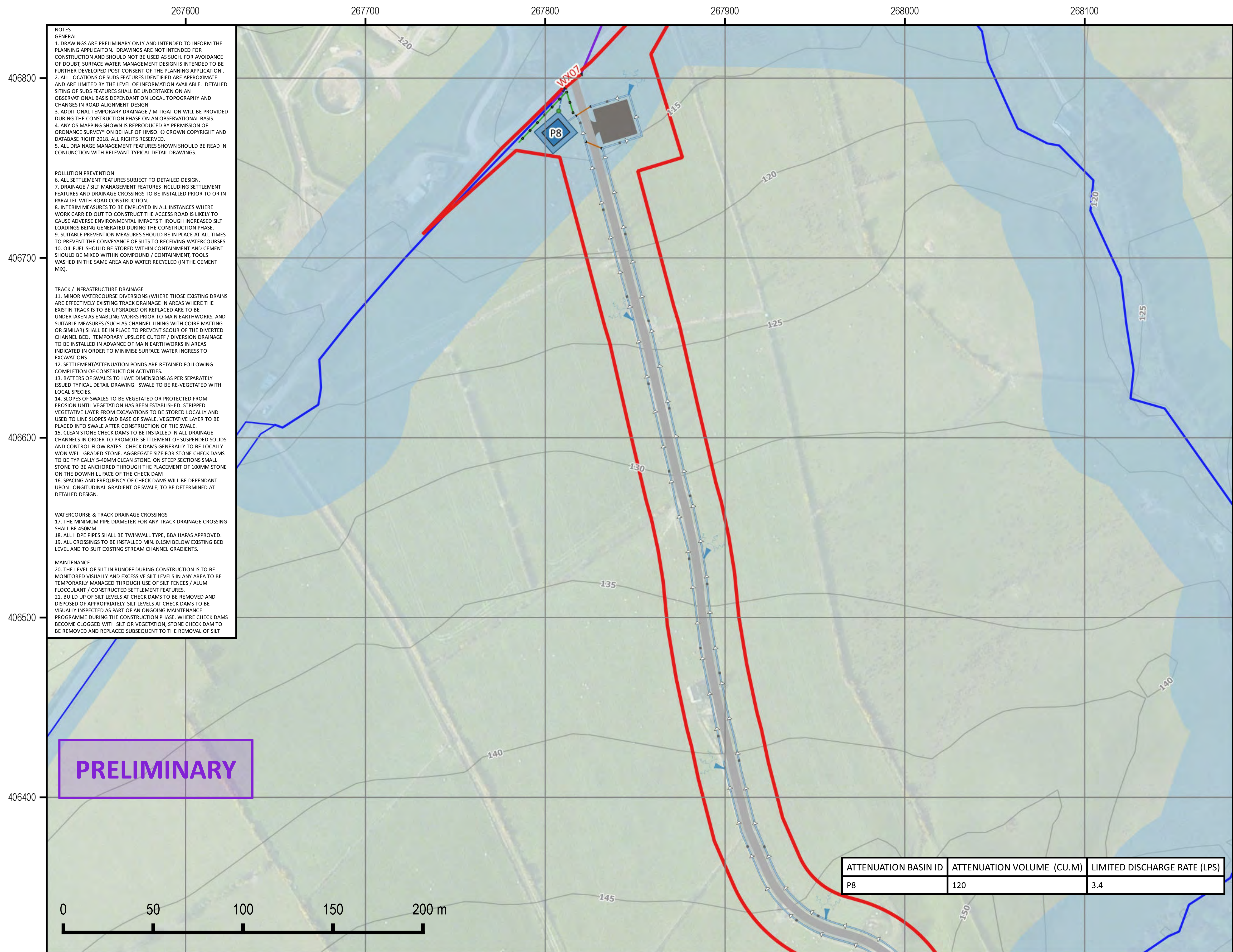
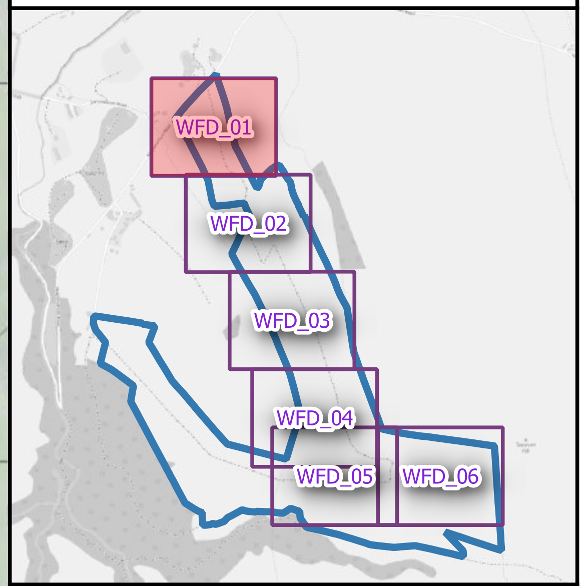


ATTENUATION BASIN ID	ATTENUATION VOLUME (CU.M)	LIMITED DISCHARGE RATE (LPS)
P8	120	3.4

KEY PLAN



LEGEND

The Development
- Application Boudary
- Buildings Compounds
- Tracks and Hardstanding
- Habitat Management Area

Existing Hydrology
- Hydrological Buffers for Construction Phase (50m & 10m)

Watercourses and Ex. Drainage
- Significant Watercourse
- Minor Watercourse
- Diverted Minor Watercourse
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- Peat or Field Drain
- Abandoned Field Drain

Existing Culverts
- Ex. Culvert

Track Drainage Features
- Swale
- Track Drainage Breakout
- Clean Cutoff Drain
- Silt Fence
- Clean Drainage Pipe
- Dirty Track Drainage Pipe
- Watercourse Crossing
- Attenuation Basin
- Limited Discharge (Outfall)
- Pumped dewatering (indicative)
- Settlement Basin
- Spoil storage

WX ID	DESCRIPTION	COMMENT
WX07	LARGE DIA. OR BOX CULVERT	EXISTING CULVERT - NEED FOR REPLACEMENT OR UPGRADE SUBJECT TO DESIGN

POLLUTION PREVENTION GUIDANCE NOTES:

1. Suitable SUDS prevention measures should be in place at all times to prevent the conveyance of silts to receiving watercourses.

2. Temporary or permanent SuDS features should be installed BEFORE or adjacent to construction of new access road and hardstanding.

3. Clean water cutoff ditch and crossing should be planned and installed BEFORE construction. Clean water management must consider spoil deposition on the site.

4. Direct discharge of road drainage to watercourses shall not be permitted.

5. Buffer zones are to be maintained around all relevant watercourses as indicated on this drawing. No excavated material is to be stored within the buffer zone.

6. DO NOT pump water direct to watercourses.

7. DO NOT strip vegetation from existing ditches unless absolutely necessary.

8. If water pollution is identified the following steps should 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 / NIEA) should be notified immediately to ensure that measures can be implemented downstream to protect fisheries and other sensitive areas.

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DESCRIPTION			
MAGHERAMORE WIND FARM - DRAINAGE LAYOUT SHEET 1 OF 6			
PROJECT / FIGURE NO.			
M01616-05_WFD_01			
DRAWN BY	SCALE	REVISION	DATE
MD	1:2000	2	03/06/2019

NOTES

GENERAL

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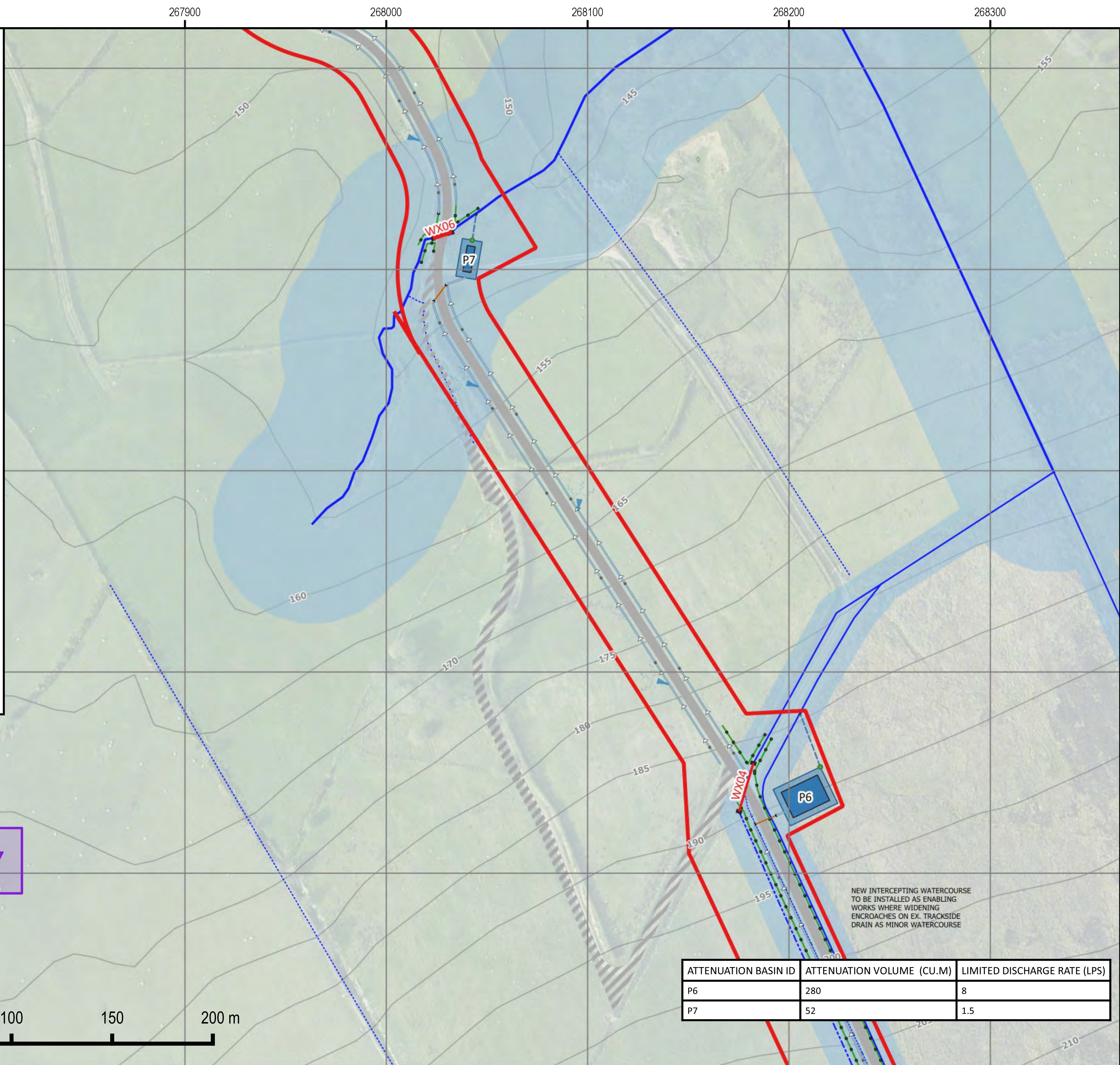
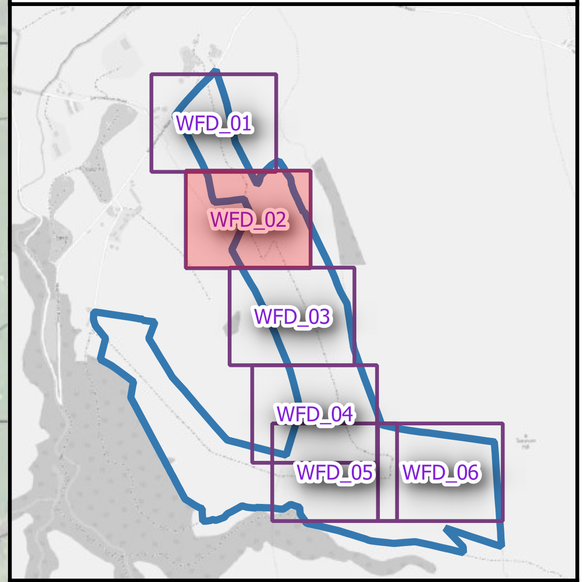


ATTENUATION BASIN ID	ATTENUATION VOLUME (CU.M)	LIMITED DISCHARGE RATE (LPS)
P6	280	8
P7	52	1.5

KEY PLAN



LEGEND

The Development
- Application Boudary
- Buildings Compounds
- Tracks and Hardstanding
- Habitat Management Area

Existing Hydrology
- Hydrological Buffers for Construction Phase (50m & 10m)

Watercourses and Ex. Drainage
- Significant Watercourse
- Minor Watercourse
- Diverted Minor Watercourse
- Abandoned Minor Watercourse
- Peat or Field Drain
- Abandoned Field Drain

Existing Culverts
- Ex. Culvert

Track Drainage Features
- Swale
- Track Drainage Breakout
- Clean Cutoff Drain
- Silt Fence
- Clean Drainage Pipe
- Dirty Track Drainage Pipe
- Watercourse Crossing
- Attenuation Basin
- Limited Discharge (Outfall)
- Pumped dewatering (indicative)
- Settlement Basin
- Spoil storage

WX ID	DESCRIPTION	COMMENT
WX04	MIN 600 CIRCULAR	EXISTING SMALL DIA. TRACK CULVERT TO BE REPLACED

POLLUTION PREVENTION GUIDANCE NOTES:

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DESCRIPTION			
MAGHERAMORE WIND FARM - DRAINAGE LAYOUT SHEET 2 OF 6			
PROJECT / FIGURE NO.			
M01616-05_WFD_02			
DRAWN BY	SCALE	REVISION	DATE
MD	1:2000	2	03/06/2019

NOTES

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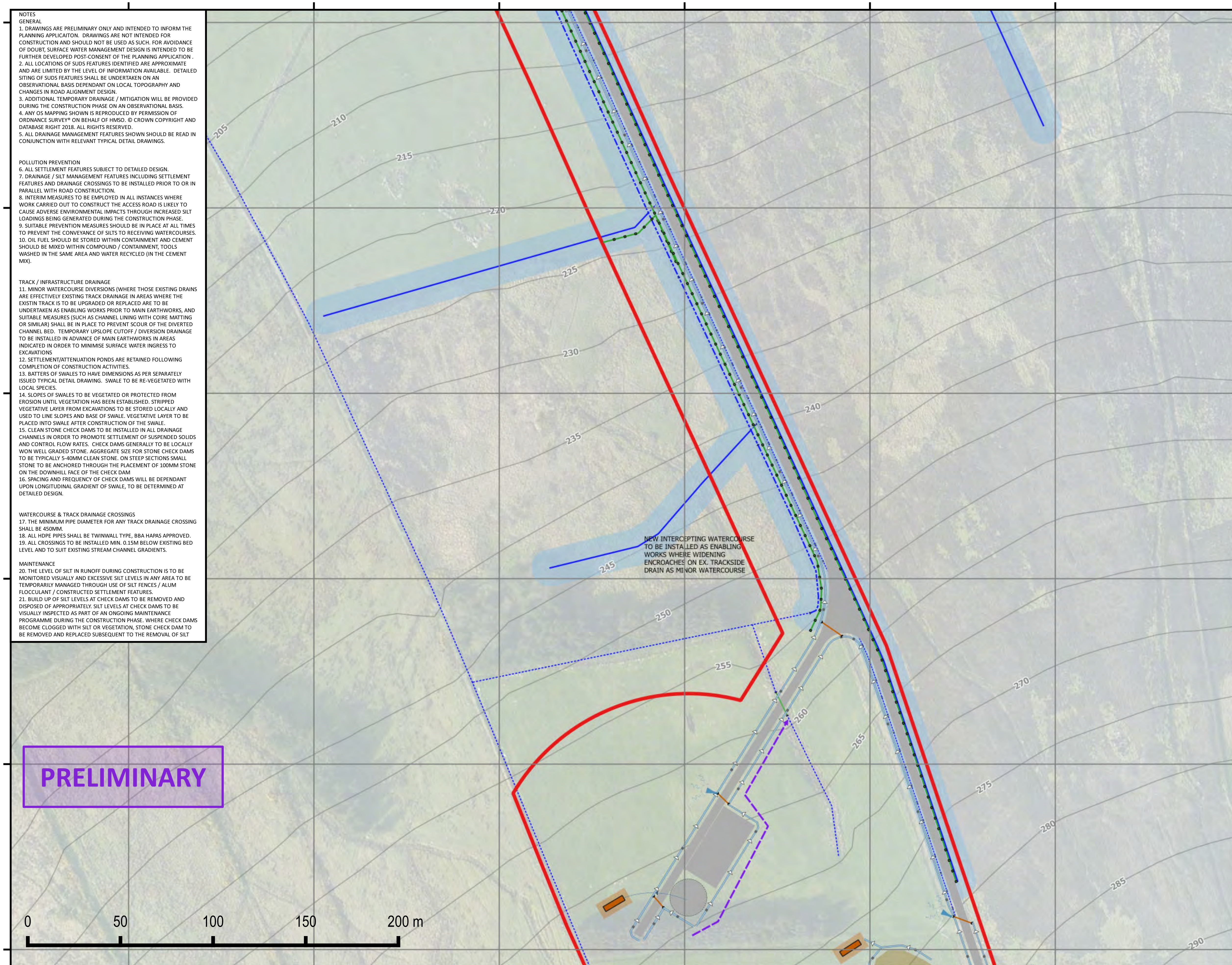
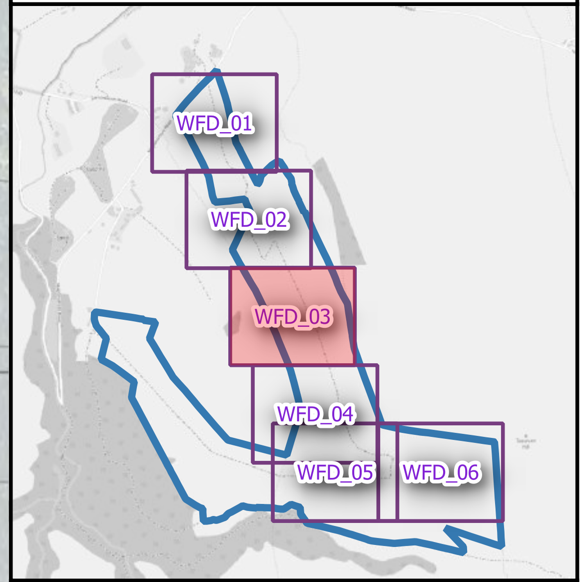


KEY PLAN



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The Development
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DESCRIPTION			
MAGHERAMORE WIND FARM - DRAINAGE LAYOUT SHEET 3 OF 6			
PROJECT / FIGURE NO.			
M01616-05_WFD_03			
DRAWN BY	SCALE	REVISION	DATE
MD	1:2000	2	03/06/2019

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NOTES

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WATERCOURSE & TRACK DRAINAGE CROSSINGS

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MAINTENANCE

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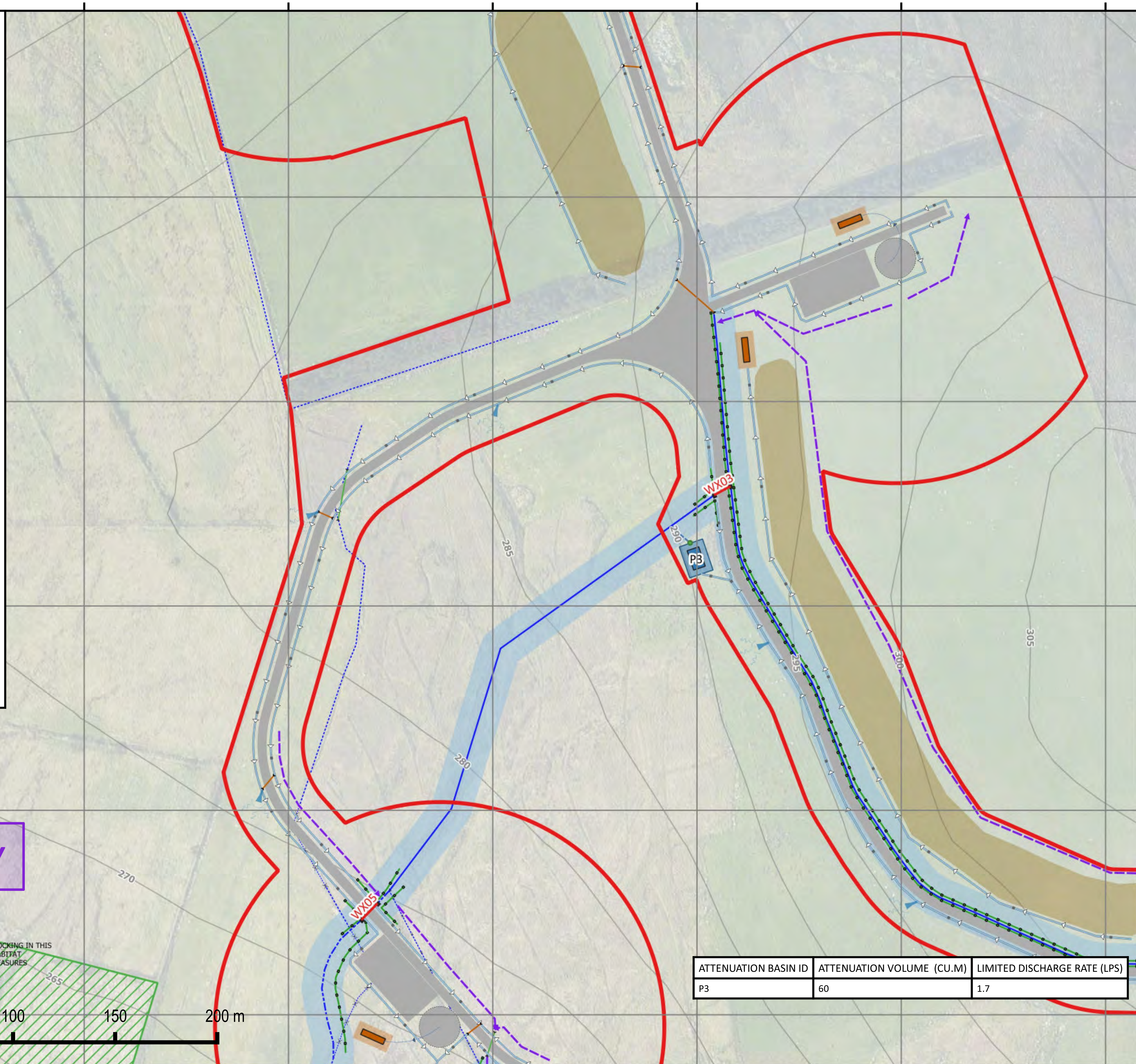
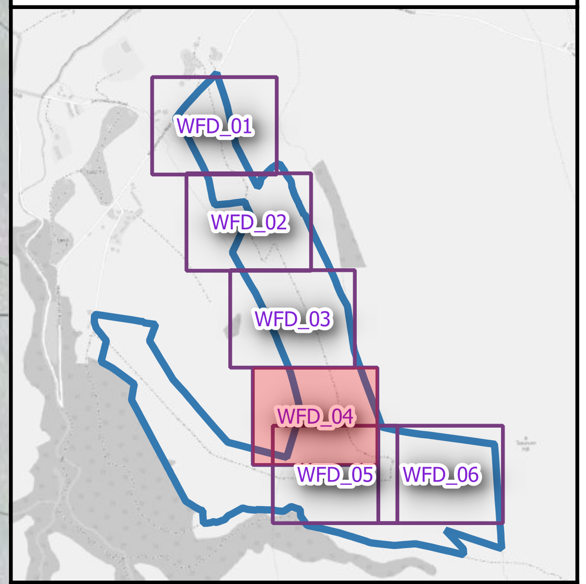


ATTENUATION BASIN ID	ATTENUATION VOLUME (CU.M)	LIMITED DISCHARGE RATE (LPS)
P3	60	1.7

KEY PLAN



LEGEND

The Development
- Application Boudary
- Buildings Compounds
- Tracks and Hardstanding
- Habitat Management Area

Existing Hydrology
- Hydrological Buffers for Construction Phase (50m & 10m)

Watercourses and Ex. Drainage
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- Minor Watercourse
- Diverted Minor Watercourse
- Abandoned Minor Watercourse
- Peat or Field Drain
- Abandoned Field Drain

Existing Culverts
- Ex. Culvert

Track Drainage Features
- Swale
- Track Drainage Breakout
- Clean Cutoff Drain
- Silt Fence
- Clean Drainage Pipe
- Dirty Track Drainage Pipe
- Watercourse Crossing
- Attenuation Basin
- Limited Discharge (Outfall)
- Pumped dewatering (indicative)
- Settlement Basin
- Spoil storage

WX ID	DESCRIPTION	COMMENT
WX03	MIN 600 CIRCULAR	EXISTING SMALL DIA. SHORE / CULVERT TO BE REPLACED
WX05	MIN 600 CIRCULAR	NEW CULVERT

POLLUTION PREVENTION GUIDANCE NOTES:

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5. Buffer zones are to be maintained around all relevant watercourses as indicated on this drawing. No excavated material is to be stored within the buffer zone.

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NOTIFY - The relevant authorities (Site Manager / NIEA) should be notified immediately to ensure that measures can be implemented downstream to protect fisheries and other sensitive areas.

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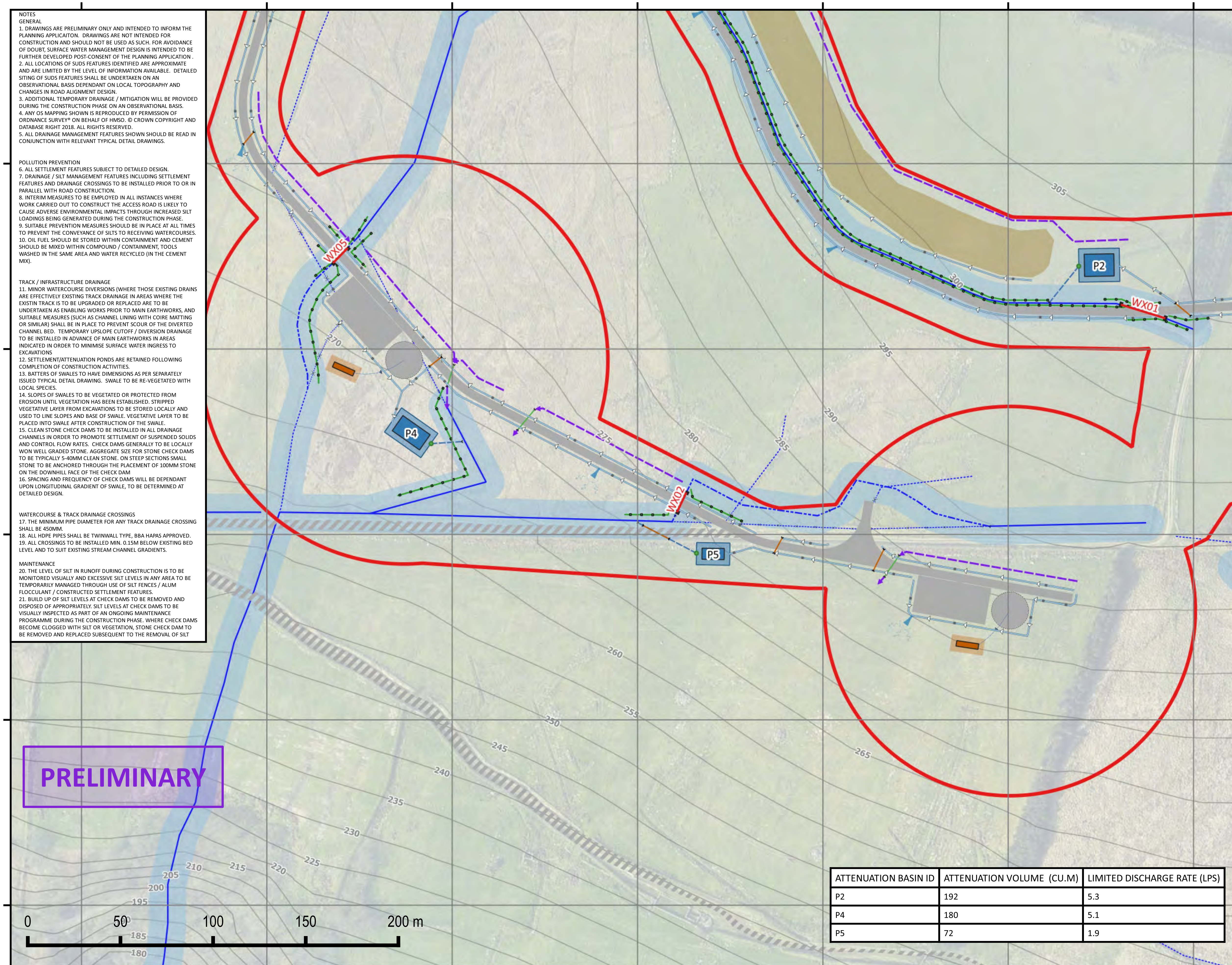
Carnmoney Road North,
Newtownabbey BT36 5QA
T: 028 9084 8694
E: info@mccloyconsulting.com
w: www.mccloyconsulting.com

DESCRIPTION			
MAGHERAMORE WIND FARM - DRAINAGE LAYOUT SHEET 4 OF 6			
PROJECT / FIGURE NO.			
M01616-05_WFD_04			
DRAWN BY	SCALE	REVISION	DATE
MD	1:2000	2	03/06/2019



NOTES

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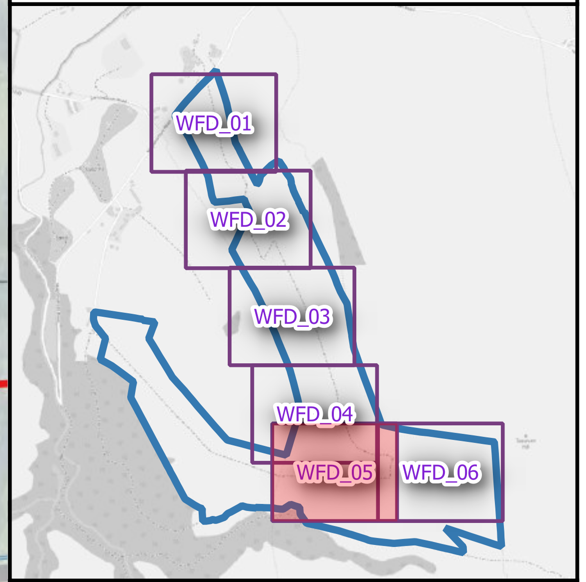
ATTENUATION BASIN ID	ATTENUATION VOLUME (CU.M)	LIMITED DISCHARGE RATE (LPS)
P2	192	5.3
P4	180	5.1
P5	72	1.9

KEY PLAN



LEGEND

The Development
- Application Boudary
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- Settlement Basin
- Spoil storage

WX ID	DESCRIPTION	COMMENT
WX01	MIN 600 CIRCULAR	NEW CULVERT - EX TRACKSIDE DRAIN AS MINOR WATERCOURSE
WX02	MIN 600 CIRCULAR	NEW CULVERT

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E: info@mccloyconsulting.com
w: www.mccloyconsulting.com

DESCRIPTION			
MAGHERAMORE WIND FARM - DRAINAGE LAYOUT SHEET 5 OF 6			
PROJECT / FIGURE NO.			
M01616-05_WFD_05			
DRAWN BY	SCALE	REVISION	DATE
MD	1:2000	2	03/06/2019

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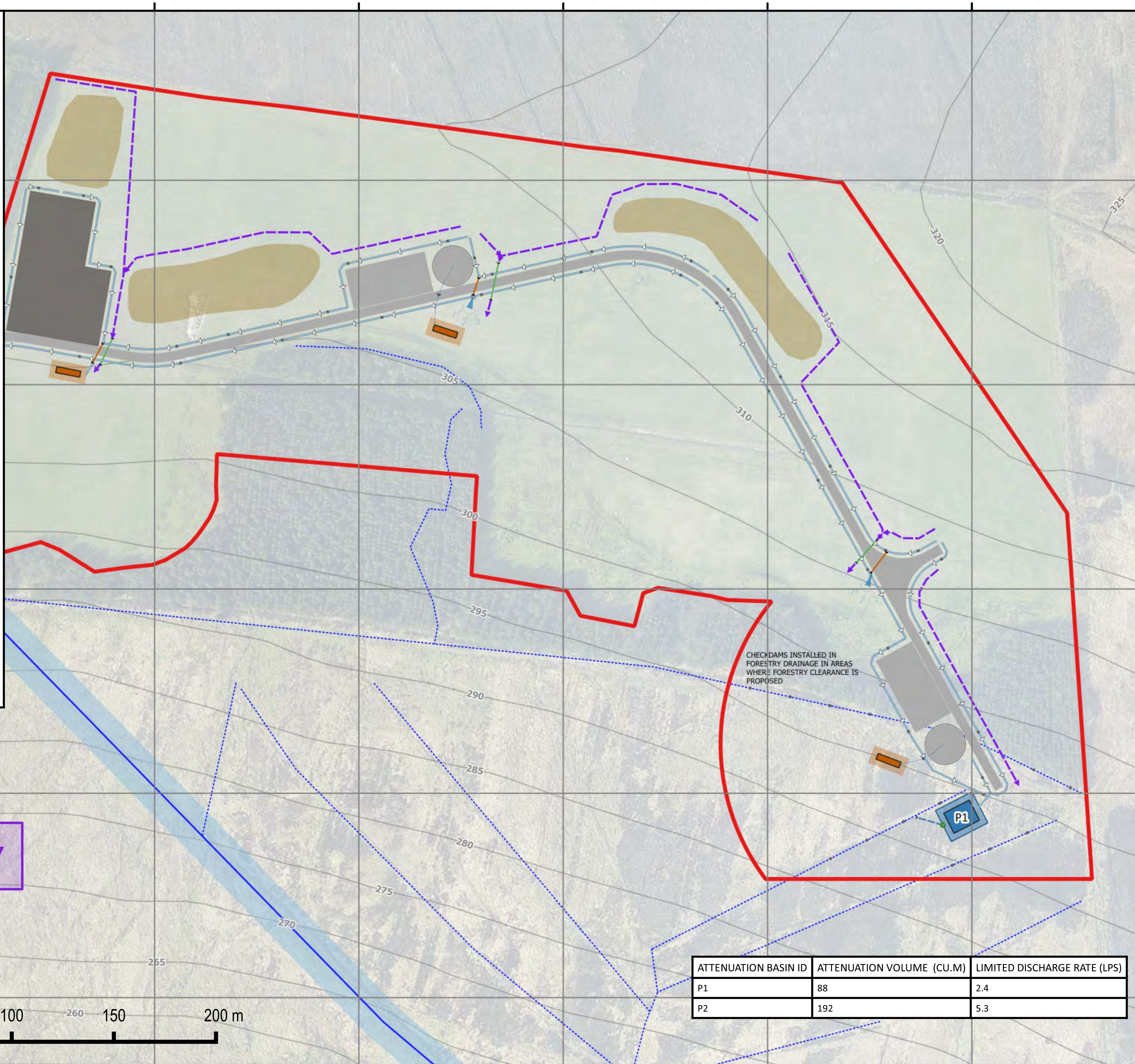

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P1	88	2.4
P2	192	5.3

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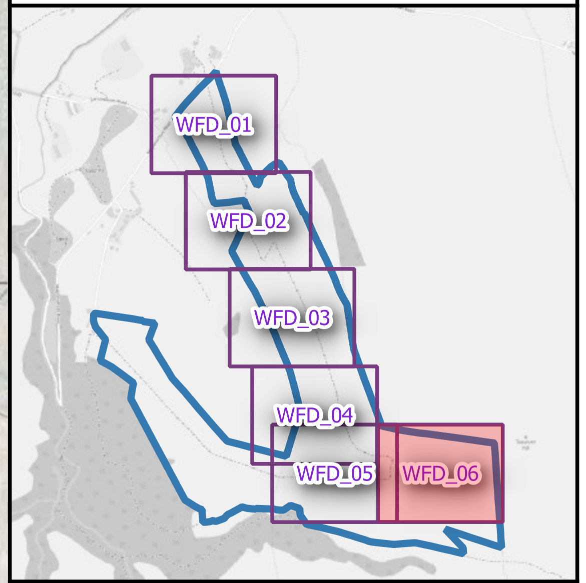

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WX ID	DESCRIPTION	COMMENT
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DESCRIPTION			
MAGHERAMORE WIND FARM - DRAINAGE LAYOUT SHEET 5 OF 6			
PROJECT / FIGURE NO.			
M01616-05_WFD_06			
DRAWN BY	SCALE	REVISION	DATE
MD	1:2000	2	03/06/2019

Appendix C

Correspondence

Department for
Infrastructure
An Roinn
Bonneagair
www.infrastructure-ni.gov.uk

DfI Rivers Planning Advisory Unit

44 Seagoe Industrial Estate
CRAIGAVON
Co. Armagh
BT63 5QE
Tel: 028 3839 9118

Cathy McKeary
Causeway Coast and Glens Borough Council
Local Planning Office
Cloonavin
66 Portstewart Road
Coleraine
BT52 1EY

Your Ref:
LA01/2018/1019/DETEIA
Our Ref: IN1-18-11521

Date: 16/10/2018

Dear Sir / Madam,

Re: Environmental Statement for a Wind Farm - Magheramore, Dungiven - LA01/2018/1019/DETEIA

Thank you for your consultation dated 4th September 2018 regarding the above proposal. DfI Rivers have assessed the application and our comments are as follows:-

DfI Rivers remit is limited to commenting on flood risk and drainage matters in accordance with planning Policy Statement 15 Planning and Flood Risk (PPS 15). It is outside DfI Rivers area of expertise to express an opinion as to whether the proposed development would or would not be EIA development. If the planning authority deems that an EIA is required then paragraph 5.8 of PPS 15 requires that flood risk and drainage assessment are addressed in the Environmental Statement.

Policy FLD 1 Development in Fluvial (River) and Coastal Flood Plains
The Strategic Flood Map (NI) indicates that a small portion of the site lies within the 1 in 100 year fluvial flood plain.

PPS15 Policy FLD 2 Protection of Flood Defence and Drainage Infrastructure
The site is traversed by various undesignated watercourses. Under 6.32 of the policy a 5m maintenance strip is required. It should be marked up on a drawing and be protected from impediments (including tree planting, hedges, permanent fencing and sheds), land raising or future unapproved development by way of a planning condition. Clear access and egress should be provided at all times. Planning N I may wish to apply the last sentence of 6.40 of Planning Policy Statement 15.

PPS15 Policy FLD 3 Development and Surface Water (Pluvial) Flood Risk Outside Flood Plains

Due to the size and nature of the development FLD3 of PPS15 applies. DfI Rivers would recommend that a Drainage Assessment is carried out for our consideration.

The applicant should refer to paragraph D17 and D18 of PPS 15.
In carrying out the drainage assessment the applicant should acquire from the relevant authority evidence that the proposed storm water run-off from the site can be safely discharged. If the proposal is to discharge into a watercourse then an application should be made to the local DfI Rivers office for consent to discharge storm water under Schedule 6 of the Drainage (NI) Order 1973.

If it is proposed to discharge storm water into an NI Water system then a Pre-Development Enquiry should be made and if a simple solution cannot be identified then a Network Capacity Check should be carried out. Correspondence with both authorities should be included in the drainage assessment regardless of outcome.

PPS15 Policy FLD 4 Artificial Modification of Watercourses

Not applicable to this site

PPS15 Policy FLD 5 Development in Proximity to Reservoirs

Not applicable to this site

Under the terms of Schedule 6 of the Drainage (Northern Ireland) Order 1973 the applicant must submit to DfI Rivers, for its consent for any proposal to carry out works which might affect a watercourse such as culverting, bridging, diversion, building adjacent to or discharge of storm water etc. Failure to obtain such consent prior to carrying out such proposals is an offence under the aforementioned Order which may lead to prosecution or statutory action as provided for.

I trust you find the foregoing to be helpful but should you require any further information or clarification please contact me at the above address.

Please quote our reference number above on any future correspondence.

Yours faithfully,

Mark Woods

Appendix D

Calculations

Project: Magheramore WF
Ref: M01616-05
Date: 24/05/2019

McCloy Consulting

Purpose

To estimate the change in runoff rate on a greenfield (undeveloped) site caused by the proposed redevelopment, by comparison of IH-124 greenfield runoff rates and Modified Rational Method for developed runoff rates

Inputs

Length (m)	2700	m	From Survey
Total Site Area (m2)	29341	m2	From Survey
Total Site Area (ha)	2.9	Ha	Calculated
Max Height	323.0	mAOD	From Survey
Min Height	111.0	mAOD	From Survey
SAAR	1522	mm	From FEH3
SAAR4170	1439	mm	From FEH3
UCWI	117	mm	From Figure 4.4, CIRIA C697
SOIL	2	n/a	From WRAP maps
M5-60	12.99		From FEH3
M5-2D	63.5		From FEH3

Proposed Site Impermeable Areas	A1	A2	A3	A4	TOTAL	
Roof	3193.00				3193.0	m^2
Bitmac / Paved / Hardstanding	26148.00				26148.0	m^2
					29341.0	m^2
				or	2.934	ha

IoH124Parameters

Region: I

Modified Rational Method Parameters

DeltaH	212.000	m
Slope (%)	7.85	%
Te (mins)	12.10	mins
ARF	0.980	n/a
SOIL	0.30	n/a
DEEPSTOR	0.26	n/a
PIMP	100.000	%
PR	78.80	%
Cv	0.79	n/a
Cr	1.3	n/a
Wallingford Ratio r	0.2	n/a

Summary of Results - Peak (1-hr) Runoff Rates

Results relate to area subject to development (change of surface) only

Return Period	Existing Scenario (lps)	Proposed Scenario (1-hr) (lps	*Increase (lps)*	Increase (%)
1 in 2 year	11.77	87.65	*75.88*	644%
1 in 30 year	20.43	209.81	*189.38*	927%
1 in 100 year	24.31	298.21	*273.91*	1127%

By	Checked	Revision	Reason for Change	Date
JD	KS	1		24/05/2019

Client:	RES Ltd.
Project:	Magheramore Wind Farm
Location:	Dungiven
Catchment:	1

Catchment Details:

Buildings	0	m^2	x 95 %
Dense surfacing	2443	m^2	x 90 %
Effective Area	2198.7	m^2	

Storage Details:

Length	11	m
Width	8	m
Depth	1	m
Porosity	100	%
Area Increase	0	%

Rainfall Details - FEH Method:

Return Period		30	years
Climate Change Factor		20	%
c	-0.028	d1	0.474
d2	0.432	d3	0.34
e	0.288	f	2.291

	mm	mm/h	storage (m^3)
30 min	24.2	48.3	48.823
45 min	28.2	37.6	55.497
60 min	31.4	31.4	60.481
2 hours	40.9	20.4	72.623
6 hours	62.0	10.3	84.530
24 hours	101.9	4.2	16.719

Outflow Details:

Infiltration rate	0	m/hr
Attenuation Control	Fixed Outflow	
Control Diameter	-	mm
Discharge rate	2.4	l/s

Results:

Outcome:	Pass
Critical Storm Duration	6 hrs
Hmax	0.961 m
Time to half empty	4.9 hrs

CRM Stormflow Stormwater Management Software

Client:	RES Ltd.
Project:	Magheramore Wind Farm
Location:	Dungiven
Catchment:	2

Catchment Details:

Buildings	2768	m^2	x 95 %
Dense surfacing	2541	m^2	x 90 %
Effective Area	4916.5	m^2	

Storage Details:

Length	16	m
Width	12	m
Depth	1	m
Porosity	100	%
Area Increase	0	%

Rainfall Details - FEH Method:

Return Period		30	years
Climate Change Factor		20	%
c	-0.028	d1	0.474
d2	0.432	d3	0.34
e	0.288	f	2.291

	mm	mm/h	storage (m^3)
30 min	24.2	48.3	109.294
45 min	28.2	37.6	124.276
60 min	31.4	31.4	135.482
2 hours	40.9	20.4	162.872
6 hours	62.0	10.3	190.456
24 hours	101.9	4.2	43.141

Outflow Details:

Infiltration rate	0	m/hr
Attenuation Control	Fixed Outflow	
Control Diameter	-	mm
Discharge rate	5.3	l/s

Results:

Outcome:	Pass
Critical Storm Duration	6.12 hrs
Hmax	0.992 m
Time to half empty	5 hrs

CRM Stormflow Stormwater Management Software

Client:	RES Ltd.
Project:	Magheramore Wind Farm
Location:	Dungiven
Catchment:	3

Catchment Details:

Buildings	0	m^2	x 95 %
Dense surfacing	1659	m^2	x 90 %
Effective Area	1493.1	m^2	

Storage Details:

Length	10	m
Width	6	m
Depth	1	m
Porosity	100	%
Area Increase	0	%

Rainfall Details - FEH Method:

Return Period		30	years
Climate Change Factor		20	%
c	-0.028	d1	0.474
d2	0.432	d3	0.34
e	0.288	f	2.291

	mm	mm/h	storage (m^3)
30 min	24.2	48.3	33.029
45 min	28.2	37.6	37.498
60 min	31.4	31.4	40.819
2 hours	40.9	20.4	48.812
6 hours	62.0	10.3	55.886
24 hours	101.9	4.2	5.288

Outflow Details:

Infiltration rate	0	m/hr
Attenuation Control	Fixed Outflow	
Control Diameter	-	mm
Discharge rate	1.7	l/s

Results:

Outcome:	Pass
Critical Storm Duration	5.6 hrs
Hmax	0.932 m
Time to half empty	4.6 hrs

Client:	RES Ltd.
Project:	Magheramore Wind Farm
Location:	Dungiven
Catchment:	4

Catchment Details:

Buildings	0	m^2	x 95 %
Dense surfacing	5135	m^2	x 90 %
Effective Area	4621.5	m^2	

Storage Details:

Length	18	m
Width	10	m
Depth	1	m
Porosity	100	%
Area Increase	0	%

Rainfall Details - FEH Method:

Return Period		30	years
Climate Change Factor		20	%
c	-0.028	d1	0.474
d2	0.432	d3	0.34
e	0.288	f	2.291

	mm	mm/h	storage (m^3)
30 min	24.2	48.3	102.524
45 min	28.2	37.6	116.501
60 min	31.4	31.4	126.928
2 hours	40.9	20.4	152.250
6 hours	62.0	10.3	176.479
24 hours	101.9	4.2	30.356

Outflow Details:

Infiltration rate	0	m/hr
Attenuation Control	Fixed Outflow	
Control Diameter	-	mm
Discharge rate	5.1	l/s

Results:

Outcome:	Pass
Critical Storm Duration	5.88 hrs
Hmax	0.981 m
Time to half empty	4.8 hrs

CRM Stormflow Stormwater Management Software

Client:	RES Ltd.
Project:	Magheramore Wind Farm
Location:	Dungiven
Catchment:	5

Catchment Details:

Buildings	0	m^2	x 95 %
Dense surfacing	1942	m^2	x 90 %
Effective Area	1747.8	m^2	

Storage Details:

Length	12	m
Width	6	m
Depth	1	m
Porosity	100	%
Area Increase	0	%

Rainfall Details - FEH Method:

Return Period 30 years

Climate Change Factor 20 %

c	-0.028	d1	0.474
d2	0.432	d3	0.34
e	0.288	f	2.291

	mm	mm/h	storage (m^3)
30 min	24.2	48.3	38.825
45 min	28.2	37.6	44.137
60 min	31.4	31.4	48.106
2 hours	40.9	20.4	57.786
6 hours	62.0	10.3	67.364
24 hours	101.9	4.2	13.965

Outflow Details:

Infiltration rate	0	m/hr
Attenuation Control	Fixed Outflow	
Control Diameter	-	mm
Discharge rate	1.9	l/s

Results:

Outcome:	Pass
Critical Storm Duration	6.03 hrs
Hmax	0.936 m
Time to half empty	4.9 hrs

CRM Stormflow Stormwater Management Software

Client:	RES Ltd.
Project:	Magheramore Wind Farm
Location:	Dungiven
Catchment:	6

Catchment Details:

Buildings	0	m^2	x 95 %
Dense surfacing	8018	m^2	x 90 %
Effective Area	7216.2	m^2	

Storage Details:

Length	20	m
Width	14	m
Depth	1	m
Porosity	100	%
Area Increase	0	%

Rainfall Details - FEH Method:

Return Period		30	years
Climate Change Factor		20	%
c	-0.028	d1	0.474
d2	0.432	d3	0.34
e	0.288	f	2.291

	mm	mm/h	storage (m^3)
30 min	24.2	48.3	160.018
45 min	28.2	37.6	181.810
60 min	31.4	31.4	198.059
2 hours	40.9	20.4	237.465
6 hours	62.0	10.3	274.770
24 hours	101.9	4.2	44.233

Outflow Details:

Infiltration rate	0	m/hr
Attenuation Control	Fixed Outflow	
Control Diameter	-	mm
Discharge rate	8	l/s

Results:

Outcome:	Pass
Critical Storm Duration	5.85 hrs
Hmax	0.981 m
Time to half empty	4.8 hrs

CRM Stormflow Stormwater Management Software

Client:	RES Ltd.
Project:	Magheramore Wind Farm
Location:	Dungiven
Catchment:	7

Catchment Details:

Buildings	0	m^2	x 95 %
Dense surfacing	1472	m^2	x 90 %
Effective Area	1324.8	m^2	

Storage Details:

Length	13	m
Width	4	m
Depth	1	m
Porosity	100	%
Area Increase	0	%

Rainfall Details - FEH Method:

Return Period		30	years
Climate Change Factor		20	%
c	-0.028	d1	0.474
d2	0.432	d3	0.34
e	0.288	f	2.291

	mm	mm/h	storage (m^3)
30 min	24.2	48.3	29.321
45 min	28.2	37.6	33.294
60 min	31.4	31.4	36.248
2 hours	40.9	20.4	43.370
6 hours	62.0	10.3	49.768
24 hours	101.9	4.2	5.416

Outflow Details:

Infiltration rate	0	m/hr
Attenuation Control	Fixed Outflow	
Control Diameter	-	mm
Discharge rate	1.5	l/s

Results:

Outcome:	Pass
Critical Storm Duration	5.65 hrs
Hmax	0.958 m
Time to half empty	4.6 hrs

CRM Stormflow Stormwater Management Software

Client:	RES Ltd.
Project:	Magheramore Wind Farm
Location:	Dungiven
Catchment:	8

Catchment Details:

Buildings	421	m^2	x 95 %
Dense surfacing	2936	m^2	x 90 %
Effective Area	3042.35	m^2	

Storage Details:

Length	12	m
Width	10	m
Depth	1	m
Porosity	100	%
Area Increase	0	%

Rainfall Details - FEH Method:

Return Period		30	years
Climate Change Factor		20	%
c	-0.028	d1	0.474
d2	0.432	d3	0.34
e	0.288	f	2.291

	mm	mm/h	storage (m^3)
30 min	24.2	48.3	67.415
45 min	28.2	37.6	76.578
60 min	31.4	31.4	83.404
2 hours	40.9	20.4	99.919
6 hours	62.0	10.3	115.255
24 hours	101.9	4.2	16.298

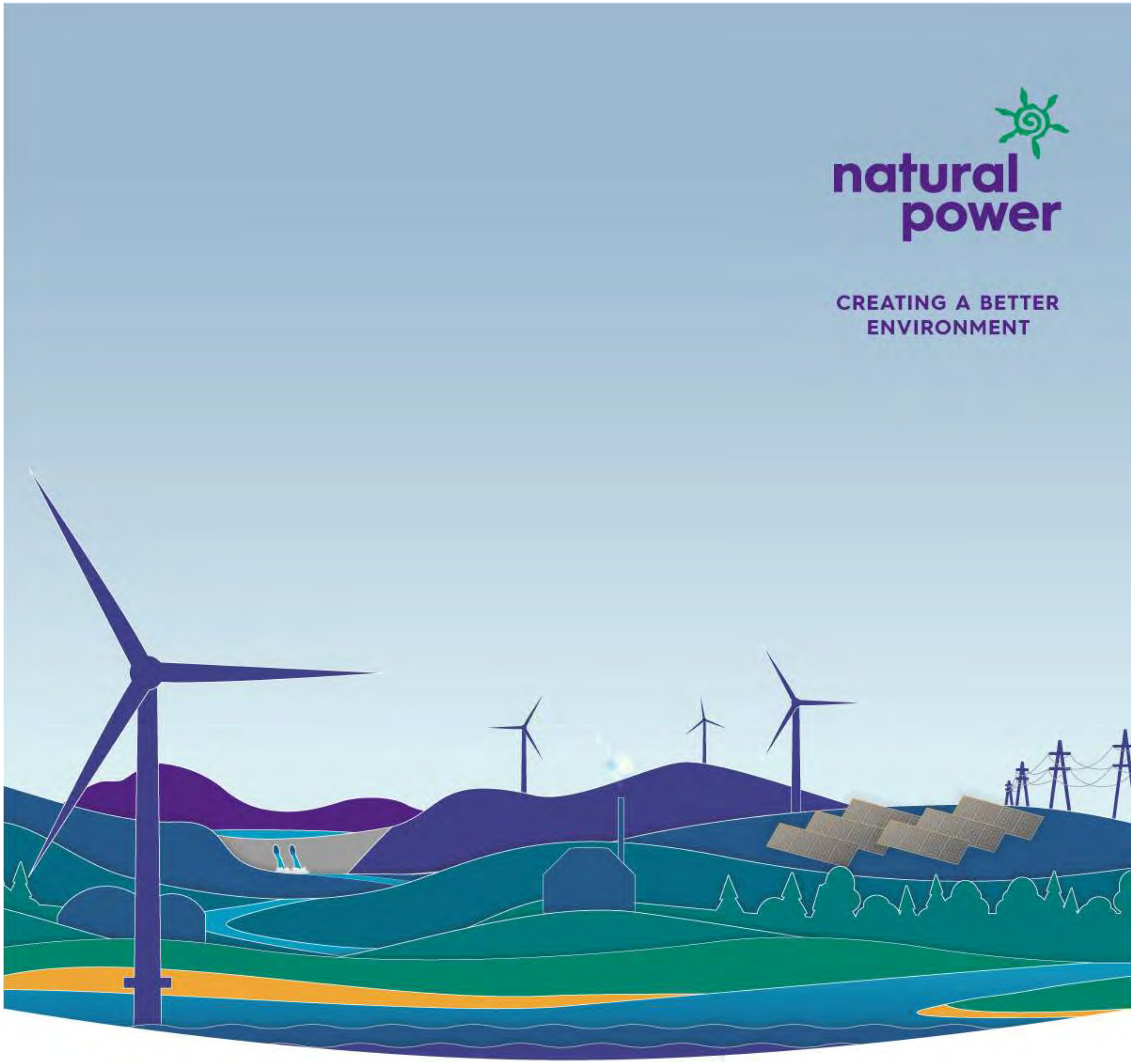
Outflow Details:

Infiltration rate	0	m/hr
Attenuation Control	Fixed Outflow	
Control Diameter	-	mm
Discharge rate	3.4	l/s

Results:

Outcome:	Pass
Critical Storm Duration	5.77 hrs
Hmax	0.961 m
Time to half empty	4.7 hrs

Appendix 9.3 Geotechnical Assessment



Magheramore Windfarm

Phase I Geotechnical Study

5th April 2019

1196155

Commercial Confidential

RES Garth McGimpsey

Document history

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1. Brief

Natural Power was appointed by RES in April 2019 to undertake detailed peat probing and Geotechnical and Environmental Desk Study Report for the proposed Magheramore Wind Farm, near Dungiven, Co Londonderry. Emphasis for this study was placed on identification of any ground stability hazards including the potential for peat slide.

This survey report is based on the boundary presented in RES Drawing Reference: '03426D1001-01'.

Peat probes were carried out at 186 locations alongside and within the infrastructure footprint; peat cores and shear vane testing was carried out at two discrete locations where the peat was of sufficient depth.

1.1. Sources of Information

The main sources of information used in the preparation of this report are:

- Historical Ordinance Survey Map review
- British Geological Survey (BGS) geology map data and historical borehole records.
- Geological Survey Northern Ireland (GSNI)
- Aerial photographic records, assessed on Google Earth Professional.
- Northern Ireland Rivers Agency Flood Map.

1.2. Summary of Development

The onshore wind farm project is located on reclaimed peatland, currently used for livestock grazing. The development is located along the broad hilltop of Carnanbane hill and Teeaven Hill, south of Dungiven. Access is via an existing farm track from the Magheramore road, (IG 267814,406804)

Vegetation is predominantly grass for grazing with occasional forestry plantation; long grasses and reeds are present in a few discrete locations indicating sporadic areas saturated ground and poor drainage. A geomorphology map can be found in figure 4 of the appendices.

1.3. Geotechnical Classification of Structures

In line with BS EN 1997:1 – 2004 (Eurocode 7 Geotechnical Design), the structures on the development have been classified as detailed in Table 1.3.

Table 1.3: Geotechnical Structure Category

Construction Element	Geotechnical Category
Wind Turbine Generator and Foundation	3
Control Building/ substation	2
Access Tracks / Hardstands / Compound	2

Geotechnical Category 2 structures: include conventional types of structure and foundations with no exceptional risk or difficult ground or loading conditions. Designs for structures in this category should normally include quantitative geotechnical data and analysis to ensure that the fundamental requirements are satisfied.

Routine procedures for field and laboratory testing and for design and execution may be used for Geotechnical Category 2 designs.

Geotechnical Category 3 structures: are those which fall outside the limits of geotechnical categories 1 and 2. This category has been set for wind turbines due to their large size and exceptional loading conditions which incorporates, dynamic loading and high overturning forces.

1.4. Objectives of Report

The central objectives of this report are to:

- Review the available information on the likely ground conditions;
- Summarise and present results from the Peat Probing Survey;
- Develop a conceptual geotechnical ground model for the development;
- Identify geo-hazards and conduct a preliminary peat slide risk assessment;
- Identify geotechnical parameters where possible;
- Identify any potential geotechnical or environmental constraints associated with development of the development.

2. Environmental Setting

2.1. Development Location & Access

The Development is located within the county of Londonderry approximately 5km south-east of the town of Dungiven. The development is accessed from Magheramore road, following a farm track to the top of Carnanbane hill and Teeaven Hill.

2.2. Topography

The development extends over the southern and western sides of a broad hilltop. The main site is at an elevation of approximately 300mAOD descending to 100mAOD where the access track meets the public road.

Terrain relief is shallow across the site, with occasional open field ditches.

2.3. Hydrology & Drainage

Information on the Northern Irish Rivers Agency interactive viewer doesn't indicate any flooding potential or surface water within the main site. There is one small stream crossing the access track at IG 268025, 406200. During the peat survey various ditches were observed to contain small quantities of surface water.

2.4. Historical Development of the Development

2.4.1. Ordnance Survey Maps

The historical development was established from examination of the historical Ordnance Survey maps provided on www.nidirect.gov.uk. 'PRONI' Historical Map Viewer web development and the historical aerial photography available from Google Earth Professional.

The findings of the historical map review are summarised in Table 2.4.1 below.

Table 2.4.1: Summary Review of Historical Maps

Map Reference	Scale	Date	Summary Description
OSNI Historical Edition 1	1:10,560	**1832 - 1846**	Site is mapped as open peatland, access road from main road exists but doesn't extend to the top of the hill.
OSNI Historical Edition 3	1:10,560	**1900 - 1907**	Site is still mapped as open peatland. Access track extends to the top of the hill following an alternate route.
Google Earth Aerial Imagery	Variable	**2010**	Field boundaries and track position are similar to the present day.
Google Earth Aerial Imagery	Variable	**Present**	No significant change.

Source: Ordnance Survey Mapping

3. Geology

3.1. Superficial Deposits

The site exhibits deposits' typical of a previously glacially dominated environment, with glaciofluvial material, tills with later peat deposits formed from the surface. A superficial geology map can be found in figure 1 in the appendices below.

The glaciofluvial deposits are located at the base of the hill where the main access track joins the public road. They are described on the BGS online geology viewer as 'Sand and Gravel', deposited by seasonal and post glacial meltwaters. The BGS engineering geology viewer defines these deposits as 'Coarse Soil' which covers all size variations and mixes of sand and gravel. Conditions for foundations are considered good, with frost susceptibility of near-surface silts and sands. Excavation is easy, but occasionally hard, Immediate support will be required, ground water controls may be required. Depending on composition soil can be used or separated into desired grades, otherwise it is suitable for granular fill. Any future site investigation should seek to understand the presence of any heterogeneity within the soil, as this could lead to differential settlement or difficult ground water conditions.

Till deposits are located at higher elevations of the site along the access track and before the main site. The BGS online viewer classifies these as 'diamicton'. The BGS engineering viewer defines these as firm to very stiff gravelly sandy CLAY with many cobbles and boulders. This is often fissured within the top few meters. Foundation conditions are variable and dependent on shear strength, heterogeneity of clast size and groundwater conditions can lead to differential settlement. Excavation is easy, but large boulders may require hard digging to blasting. Excavations should remain stable for short periods of time. If of suitable grading, plasticity and water content, the sediment may be suitable for general cohesive fill. Boulders may need to be removed to allow grading. In general, it should be placed as soon as possible and subject to minimal construction traffic. Any future site investigation should obtain information on deposit thickness and lithological differences; presence of silts and clays as well as water-bearing sands and gravels should be obtained.

3.1.1. Peat Deposits

The BGS online geology viewer maps the entire top of the hill as covered by peat. Natural Power has conducted a detailed site walk-over and peat probing survey along the infrastructure layout proposed in 'MM Infrastructure Layout 03426D1001-01.'

Peat depth was relatively shallow over the whole infrastructure footprint, no peat was found for the first 900m of access track and reached a maximum of 1.3m. Two pockets where found at T1 and for 300m of track around T6, where the depth was consistently above 0.5m reaching a maximum of 1.3m. A map of the peat survey results can be found in Figure 5, within the report appendices.

Peat core descriptions and hand shear vane testing was carried out when possible and at the foundation centre of T1 and T6. The results are presented in Table 3.1.1 below:

Table 3.1.1: Summary of Surveyed Peat Data

Turbine	Cu Undrained Shear Strength (kPa)			Core	
	Depth	Peak	Remould	Depth	Description
T1	0.5	32	17	0.0 – 0.75	Very soft black amorphous plastic PEAT (H6/B1)
	1.0	42	22	0.75 – 1.0	Firm black amorphous slightly sandy PEAT (H5/B1)
T6	0.5	43	22	0.0 – 0.6	Firm black pseudofibrous slightly spongy PEAT (H5/B3)

Source: Natural Power

The peat composition changes across the site, with a pocket of dry slightly more decomposed peat at T1, and wetter pseudofibrous peat at T6. From index cores taken during the peat probing survey it was found that the grassy fields are underlain by a thin layer of peat under the plough base. They exhibited 100 to 200mm of treated peaty soil with a thin 50 to 100mm layer of unaltered peat.

3.2. Solid Geology

The site is primarily underlain by metamorphic psammites, semipelites and pelites from the Argyll Group, some unnamed igneous intrusions strike northeast southwest across the main part of the site. The first part of the access track is underlain by The Roe Valley Group sedimentary rocks. During the peat survey no bedrock outcrops were observed, this could be due to the superficial deposits being of a substantial thickness. A solid geology map can be found as Figure 2 within the appendices.

The Argyll Group is made up of the Dart Psammite formation originally deposited in the Neoproterozoic between 542 to 1000 million years ago, some beds are described as pebbly. This group contains psammite semipelite and pelite, the BGS online engineering viewer classifies this as Slate, Schist and Granofels.

The BGS Engineering Geology Map resource has been reviewed: Slate is generally strong to very strong with a large range of bed sizes, joint spacing is medium to wide with well-marked cleavage planes. Rock weathers to clayey gravel, ground water flow is low, with flow restricted to discontinuities. Slate is generally good for foundations depending on the nature of the weathered zone. Excavation is generally hard, with fresh rock requiring blasting. Slate is suitable for granular fill if its tabular nature can be dealt with. It is important that any future site investigation determines the discontinuity spacing and orientation, as well as the nature of the weathered zone.

Schist exhibits a wide range of strengths, often exhibiting pronounced mineral layering. Schist will weather to gravelly sand or sandy clay. Groundwater flow is restricted to discontinuities. Schist is considered good for foundations but has an inherent variability of weathering depth and nature. Ripping and blasting will be required to excavate. Schist is generally suitable as fill, but care must be taken when selecting to account for variable strengths and durability. As with slate it is important that any future site investigation determines information about the orientation, spacing and nature of the discontinuities, as well as the nature of the weathered zone.

Granofels is strong to extremely strong with no foliation. Granofels will weather to different proportions of sand and gravel. Groundwater flow is restricted to discontinuities. With favourable degrees of metamorphism and variability of interbedded metamorphic layers granofels is considered good for foundations. Highly weathered material may be excavatable by ripping, but fresh material will require blasting. Granofels is suitable for selected granular fill. As with slate and schist the SI should obtain information on the spacing, orientation and nature of discontinuities, as well as the nature of the weathered zone.

The Argyll Group is intruded with several Meta-Gabbroic sills intruded in the late Neoproterozoic.

The sills are not likely to be large features, and will likely provide heterogeneity within the bedrock, but are given the following properties by the BGS: Considered to be strong to extremely strong, with medium spaced joints. Gabbroic rocks weather to clayey gravelly sand or sandy gravel. Ground water flow is restricted to discontinuities. Conditions are very good for foundations. Heavily weathered zones may be ripable, but fresh material will require blasting. Fresh rock is suitable for selected granular fill. SI should determine discontinuities and nature of weathered zone, as well as extent of sill presence.

The Roe Valley Group underlies the first few hundred meters of access track, this is made up of the Barony Glen Formation and the Spincha Burn Conglomerate formation laid down in the Carboniferous 352 to 359 million years ago.

The Barony Glen formation is described by the BGS as a medium strong to extremely strong sandstone, it may contain slate or mudstone and siltstone beds. Weathers to loose to very dense sand, gravel or silty/clayey sand. Groundwater flow can be through matrix and discontinuities. foundation conditions are usually very good, depending on the nature of the weathered zone. Highly weathered rock may be excavatable by hard digging, but fresher material may require blasting. When excavated as a slope fresh or slightly weathered material may maintain long term stability. Strong sandstone is suitable as selected granular fill if care is taken during abstraction. SI should determine intact rock strength as well as nature of discontinuities and weathered zone.

The Spincha Burn Conglomerate formation is described by the BGS as very weak to very strong coarse-grained Conglomerate. May weather to silty, sandy gravels, cobbles or boulders depending on inherent clast size. Groundwater flow is extremely variable through either matrix or discontinuities. Conglomerate is generally good for foundations, depending on the bed thickness and nature of weathered zone. Excavation depends on degree of weathering and matrix strength, some material can be extracted by hard digging and require immediate support, with fresher or stronger material needing ripping or blasting. Can be suitable for selected granular fill if separated from matrix or compositions suitable, generally suitable for general fill. During the SI it is important to determine the intact rock strength and well as discontinuities and nature of weathering zone.

3.3. Historical Borehole Records

The GSNI GeoIndex records 4No. boreholes 2km west of the site at a water treatment plant on a nearby hill and 6No. boreholes approximatley 0.5km south east of the site at Altnaeglish Dam. A summary of the published information can be found below in Table 3.1:

Table 3.1: Summary of Historical Borehole Data

BH_ID	Location	Coordinate (Irish Grid)	Elevation (mAOD)	Total Depth	Rockhead Depth	Comments
63NW2	Waterworks	266451, 404626	210.6	4m	3m	Boreholes conducted in glacial till, above Argyll Group geology. Location is 2km west of the main site, 90m lower and on the
63NW1	Waterworks	266448, 404589	210.7	5m	5m	
63NW3	Waterworks	266484, 404600	207.6	4m	3m	

BH_ID	Location	Coordinate (Irish Grid)	Elevation (mAOD)	Total Depth	Rockhead Depth	Comments
63NW4	Waterworks	266504, 404599	204.5	3m	2m	opposite side of a river cut valley.
63NE1	Altnaheglish Dam	269654, 404165	250.3	17m	7m	Boreholes conducted in glacial till, above Argyll Group geology. Location is ~500m south east of the main site ~50 to 70m lower than the main site across the base of a river cut valley.
63NE2	Altnaheglish Dam	269652, 404141	240.2	13m	3m	
63NE3	Altnaheglish Dam	269643, 404119	220.6	47m	16m	
63NE4	Altnaheglish Dam	269635, 404104	220.4	57m	27m	
63NE5	Altnaheglish Dam	269626, 404092	215.5	52m	20m	
63NE6	Altnaheglish Dam	269606, 404069	242.1	15m	5m	

Source: GSNI

3.4. Mineral Extraction

Murnies Sandpit, Crebarkey is located 1.6km north east of the main site. It is hosted in Glaciolacustrine deltaic sands and gravels, deposited in the Quaternary.

Banagher sand and gravel pit located 1.6km south west of the main site. This is also hosted in glaciolacustrine deltaic sands and gravel, deposited in the Quaternary. It doesn't appear to be in use in the present day.

D Murphy Quarry is located just across from the site access track. This is also hosted in glaciolacustrine deltaic sands and gravel, deposited in the Quaternary.

3.5. Hydrogeology

There are no significant aquifers underlying the site. The Roe Valley Group, Argyll Group and the unnamed igneous intrusions are all classified as low productivity by the BGS.

3.6. Radon Gas

The entire site is in an area with the highest radon potential, between 10% and 30%. Radon protective measures may be necessary at discrete infrastructure locations as described in publication BR211 by the Building Research Establishment.

3.7. Natural Ground Hazards

The BGS Onshore Geoindex does not show any mass movement deposits or landslides within 1 km of the development boundary. As this is an upland development the risk of landslides cannot be negated and must therefore be considered by any future phase of intrusive geotechnical site investigation.

There are landslide deposits hosted in similar superficial deposits, but these are generally associated with high relief features such as glacially cut U-shaped valley and fluvial erosion.

4. Environmental Information

4.1. Landfill and Other Waste Developments

There are no records of any landfill developments on development or within 250m of the development.

4.2. Industrial Land Uses

There are no records of industrial land uses on development or within 200m of the development.

4.3. Records of Petrol and Fuel Developments or Pipelines

There are no records of fuel developments or pipeline on the development, although no accurate information is available at this stage.

4.4. Water Abstraction Licenses

There are not water abstraction licenses documented within the site boundary or surrounding area.

4.5. Source Protection Zones

There are no groundwater Source Protection Zones (SPZ) within 500m of the development.

4.6. Designated Environmentally Sensitive Developments

The entire development is within the Sperrins Area of Outstanding Natural Beauty. Banagher Glen is located at to the south west of the main site, at the bottom of the valley, it is designated as a nature reserve as well as being a Special Area of Conservation and Area of Special Scientific Interest with all the other rivers in the area.

5. Peat Slide Risk Assessment

Between Tuesday 16th to Thursday 28th of April, a detailed peat survey was carried out over the proposed infrastructure foot print of the wind farm.

The majority of the site exhibited a peat depth of under 0.5m, which is generally considered to have a negligible peat slide potential. Peat in many of these areas appears to have been historically treated resulting in an increased shear strength further reducing the risk. Typically, this may have comprised artificial drainage and mixing ploughing with topsoil materials and is likely to have taken place historically as part of the local farming practice.

Two principal contributors to peat slide are peat depth and slope angle. The locations of T6 and T1 are recorded with peat depths and slopes that may elevate risk of peat slides. There is a low to medium risk with peat depth of just over 1m and a slope angle of 6 degrees at T6 and 8 degrees at T1. The slope angle increases downslope from T1 to between 10 and 15 degrees, this is the slope angle at the highest risk from peat slide, although no peat depth data is taken from this area. A slope angle map can be found in figure 3 in the appendices below.

It is advised that care is taken when working peat in these areas, not to load the peat deposits on the downslope side or increase peat depth by stock piling in these areas due to the slope angles.

During the survey no previous instability was observed, nor are there any peatland features such as peat hags or peat pipes that could increase the risk of instability.

The Altnaheglish River is the only potential receptor at risk from peat slide from the proposed development. It is situated 500m downslope from the development and is designated as a SAC and ASSI, as well as being a national park downstream. There is no planned infrastructure at risk from peat slide, but an existing track runs along the northern bank of the Altnaheglish River.

5.1. Infinite Slope analysis

The purpose of this analysis is to identify the baseline FOS and the minimum un-drained shear strength (Cu_{min}) required for stability of peat deposits. When the (in-situ) measured peat strength values (Cu) exceed the minimum value (Cu_{min}) there is limited potential for peat failure to occur. The analysis uses a Factor of Safety (FoS) of 1.3; based on BS6031:2009: Code of practice for Earthworks (BSI, 2009).

The infinite slope analysis, as recommended in Peat Landslide Hazards and Risk Assessments: Best practice guide for Proposed Electricity Generation Developments (PLHRAG, 2017) is based on a translational slide, which is understood to represent the prevalent mechanism for peat failures. This analysis adopts total stress (un-drained) conditions in the peat. This state applies to short-term conditions that occur theoretically during construction and for a time following construction until construction induced pore water pressures dissipate (ground water pressures requires time to dissipate as the hydraulic conductivity can be very low in peat deposits).

The following assumptions were used in the analysis of peat deposits across the Development:

- The groundwater is resting at ground level;
- Minimum acceptable factor of safety required is 1.3 (BS6031:2009);
- Failure plane assumed at the basal contact of the peat layer;

- Slope angle on base of sliding assumed to be parallel to ground surface and that the depth of the failure plane is small with respect to the length of the slope;
- Thus, the slope is considered as being of infinite length with any end effect ignored;
- The peat is homogeneous at each location;
- In the surcharged case a 20 kPa stress is modelled, this is approximately equivalent to a 2m high peat stockpile or 1.5m high subsoil stockpile.

The analysis method for a planar translational peat slide along an infinite slope was for calculated using the following equation in total stress terms highlighted by MacCulloch, (2005) and originally reported by Barnes, (2000):

$$F = Cu / (\gamma\ z\ \sin\beta\ \cos\beta)$$

Where:

F = Factor of Safety (FOS)

Cu = Undrained shear strength of the peat (kPa)

γ = Bulk unit weight of saturated peat (kN/m^3)

z = Peat depth in the direction of normal stress

β = Slope angle to the horizontal and hence assumed angle of sliding plane (degrees)

Un-drained shear strength values (Cu) are used throughout this assessment. Effective strength values are not applicable for the case of rapid loading of the peat during construction hence the Barnes, (2000) formula cited above, has been adopted throughout.

Factors of Safety for three different loading scenarios are calculated one with no load on undisturbed peat, a 20kPa surcharge load on undisturbed peat and a 20kPa surcharge on disturbed peat. These were calculated for peat deposits are T1 and T6. Both locations achieved FOS values above 4.9 in all three of these scenarios. This is well in excess of 1.3 and therefore indicates a negligible risk from peat slide based on this numerical analysis.

It should be noted that these values are created using current slope and peat deposit conditions, changes to these conditions would require separate testing and analysis to be carried out. Such analysis would typically be revised following detailed intrusive ground investigation.

6. Conclusions

6.1. Development Setting

Natural Power has carried out a Phase I Geotechnical desk Study on behalf of RES as part of pre-planning of Magheramore Wind Farm near Dungiven in Northern Ireland. The development occupies a broad ridge between Carnanbane Hill and Teeavan Hill, just north of the Altnaheglish River.

Historically the land was an undeveloped peatland, which has since been reclaimed to grazing grassland.

6.2. Conceptual Geotechnical Ground Model

Based on the available desk study data and surveyed peat data, the following generalised conceptual geotechnical ground model has been developed for the development:

- A relatively shallow 0.5m deposit of peaty soil covers most of the main site, with an increased depth of peat at T1 and T6 where this increases to a maximum of 1.1m at T1 and 1.3m at T6.
- A deposit of Diamicton Till underlies the peat and peaty soil. Using nearby boreholes this is likely to be between 3 and 5 meters thick; but could be up to 10 meters depending on the depositional environment.
- The main site in underlain by the Argyll Group meta-sediments, this is intruded with unnamed meta-gabbroic intrusions. The rock mass is therefore predicted to offer favourable foundation conditions where rock mass is unaffected by weathering and located at shallower depths below ground level.

6.3. Summary of Potential Geotechnical Constraints

The geotechnical model for the development is based on interpretation of online information and observations made while carrying out the peat surveying.

The majority of the development is covered by peaty topsoil and represents reclaimed land now existing in agricultural use. There are however thicker deposits of peaty soil with unmodified peat beneath across turbine locations T1 and T6. Figure 5, Appendix A depicts the peat depths across the development.

The risk of peat instability can be elevated in scenarios where there is confluence of increased peat depth across moderately sloping terrain. Other factors such as peat material strength, rainfall/hydrology, hydrogeology, and anthropogenic influences can also remedy an area at peat slide risk where these influences cannot be suitably mitigated or managed effectively.

Peat deposits and slopes at T1 and T6 (un-mitigated) are at an elevated risk of peat slide during wind farm construction. This is due to the recorded peat depth of approximately 1m and the terrain slope angles encountered across these turbine and hardstand areas at T1 & T6. Any resultant peat slide into minor watercourses surrounding these positions could result in pollution being carried offsite in the form of suspended particulates and into sensitive environmental receptors such as the Altnaheglish River system.

This risk can be mitigated through the routine application of best practice design and construction methodology. Peat at these locations is still relatively shallow that infrastructure micro-siting would not need to be considered. Preservation and protection of the natural hydrological regime and any proposed drainage diversion at T6 will be a key factor to incorporate into civil infrastructure design and the construction environmental management plan (CEMP). Through this approach it would be expected that any low risk of peat slide at T1 & T6 would be further reduced and is not significant. Table 6.1 forms an initial geotechnical risk register which is aimed at relaying the risk of peat instability and highlights suitability mitigation measures.

Considering the geotechnical performance of the surface soils: further investigation into the peaty subsoil should be undertaken if tracks are designed to run over the top of these layers. That is where floating access track construction is proposed there will likely be required to be an assessment of required soil reinforcing geogrid to mitigate settlement of the track construction.

Superficial glacial till deposits are of unknown depth with estimates taken from historical boreholes located some distance from the site.

6.4. Geotechnical Risk Register

The following geotechnical risk register (Table 6.1) has been established for the development. Risk assessment is semi-quantitative and based on geotechnical site assessment.

Probability (P)		
Very Likely	1 in 10	5
Likely	1 in 100	4
Probable	1in 1000	3
Unlikely	1 in 10,000	2
Negligible	1 in 100,000	1

Impact (I)		Time	Cost
Very High	5	>10 weeks on completion	>20%
High	4	> 1 week on completion	5-20%
Medium	3	>4 weeks: <1 week on completion	2-5%
Low	2	1 – 4 weeks: none on completion	0.5 – 2%
Very Low	1	<1 week to activity: none on completion	<0.5%

Risk Rating (R) = Probability P x Impact I

		I	I	I	I	I
		5	4	3	2	1
P	5	25	20	15	10	5
P	4	20	16	12	8	4
P	3	15	12	9	6	3
P	2	10	8	6	4	2
P	1	5	4	3	2	1

Risk ratings	
1 to 4	Trivial, no action required
5 to 8	Tolerable, but must consider solutions or improvements
9 to 12	Substantial and construction must not start until risk has been reduced
13+	Intolerable and construction must not start until risk has been reduced

Table 6.1: Magheramore Geotechnical Risk Register

Hazard / Risk	Cause	P	I	Risk Rating	Consequences	Mitigation	P	I	Risk Rating
Peat Landslide	High rainfall, increased surface water infiltration (T1 & T6)	2	3	6	Instability of superficial deposits around earthworks Harm to personnel and equipment Destruction of built infrastructure	Due consideration given to the prevailing ground and weather conditions when scheduling construction works Monitoring of rainfall and weather forecasts Contingency plans for wet weather working Robust drainage design Preservation of natural hydrological regime Monitoring (visual) regular site inspection to detect early indications of ground movement (tension cracks, groundwater issues etc.)	2	2	4
Peat Landslide	Weather conditions, flooding, loss of support from forestry plantation (Area around T1)	3	2	6	Localised instability and damage to temporary and permanent earthworks.	Due consideration given to the prevailing ground and weather conditions when scheduling construction works Use of appropriate drainage medium in ditches Monitoring of rainfall and weather forecasts Contingency plans for wet weather working	1	1	1

Hazard / Risk	Cause	P	I	Risk Rating	Consequences	Mitigation	P	I	Risk Rating
Peat Landslide	Concentrated loads placed at top of slope system or on marginally stable peat deposits (T1 & T6)	2	5	10	Rapid ground movement Harm to personnel and equipment Destruction of temporary or permanent works	Where areas of deep peat (>1m) are included in the infrastructure design a robust construction method statement must be in place for construction of floating access track sections Utilise detailed peat depth contour plan in construction planning No peat storage at the top of a slope system of over marginally stable peat deposits at T1 & T6 A programme of inspections should be implemented during excavation and access track construction works Monitoring of excavated materials	1	2	2
Peat Landslide	Uncontrolled water flows	2	3	6	Rapid ground erosion around and within temporary and permanent earthworks	Detailed drainage design undertaken Geotechnical supervision of any de-watering operations Due consideration given to the prevailing ground and weather conditions when scheduling site works	1	2	2
Peat Landslide	Unstable excavations	4	2	8	Localised instability associated with temporary and permanent earthworks	Earthworks plan should incorporate geotechnical data and design specification	2	1	3

Hazard / Risk	Cause	P	I	Risk Rating	Consequences	Mitigation	P	I	Risk Rating
					Harm to personnel and equipment	A programme of inspections should be implemented during excavation and access track construction works. Contingency plan for slope stabilisation and rapid reaction strategy developed in the event of instability			
Peat Landslide	Removal of toe support to slope system	3	3	9	Long term ground movements, causing deterioration and damage to temporary and permanent earthworks	Avoidance action during geotechnical design stage Routine geotechnical inspection Contingency plans for slope stabilisation measures	2	2	4
Peat Landslide	Surface water erosion	3	1	3	Localised instability associated with temporary and permanent earthworks Harm to personnel and equipment	Long term established vegetation cover on slopes Suitable temporary surface water management Addressed in drainage design plans	2	1	2
Peat Landslide	Subsurface groundwater flow and ‘piping’	2	2	4	Localised instability associated with temporary and permanent earthworks Harm to personnel and equipment	Blockage prevention using free draining fill A programme of geotechnical inspections will be implemented during excavation works	2	1	2
Bearing Capacity Failure (Peat Surface)	Areas of soft wet peat land (T1 & T6)	5	2	10	Localised instability associated with temporary and permanent earthworks Harm to personnel and equipment	Due consideration given to the prevailing ground and weather conditions when scheduling site works	3	1	3

Hazard / Risk	Cause	P	I	Risk Rating	Consequences	Mitigation	P	I	Risk Rating
						Utilise detailed peat depth contour plan to in construction planning Use of appropriate plant machinery (low ground pressure and long reach to avoid over loading peat deposits) A programme of geotechnical inspections will be implemented during excavation works Geotechnical monitoring of verges post-construction			
Peat Failure	Mass movement of temporary storage mounds and bunds.	4	4	16	Localised instability and settlement associated with temporary and permanent earthworks Harm to personnel and equipment	Storage site selection by geotechnical engineer Routine maintenance and inspection of peat storage mounds	2	2	4
Ultimate limit state failure (bearing capacity)	Construction loading and poor ground conditions	3	2	6	Bearing capacity failure, localised instability, damage to temporary and permanent structure and earthworks	Appropriate geotechnical design applied Excavation of shallow peat along tracks Expose competent formation at turbine sites Adopt floating road construction over deep peat, if appropriate	1	1	1

Hazard / Risk	Cause	P	I	Risk Rating	Consequences	Mitigation	P	I	Risk Rating
Serviceability limit state failure (settlement)	Construction loading and poor ground conditions	5	2	10	Excessive settlement Damage to temporary and permanent structures and earthworks Construction delayed Additional fill required	Ground improved with structural fill addressed as part of detailed geotechnical design Adopt geotechnical monitoring of tracks Contingency to re-level tracks on completion	3	1	3
Creep, long term settlement of tracks (floating sections over peat)	Poor and variable foundation soils	5	1	5	Ongoing settlement, damage to access track running surface	Contingency for routine maintenance	3	1	3

Source: Natural Power

6.5. Summary of Potential Environmental Constraints

From information compiled within this desk study there are no major environmental constraints within the development. External to the site, it is worth noting that environmental protections are in place for the Altnaheglish River located to the south and downslope from the development.

Thus, protection of onsite watercourses which flow south into the Altnaheglish River system will further be an essential facet of the construction environmental management planning.

The site is also located in an Area of Outstanding Natural Beauty.

Although not indicated there is the potential for services on the development, a utilities search must be conducted before any intrusive works begin on development.

6.6. Site Investigation

Based on the findings of this report, it is recommended a phased site investigation be carried out for this project, to confirm the deeper geological conditions across the development. This further site investigation would typically be carried out as part of pre-construction phase of works and be suitable for informing the detailed design.

The key objective of the site investigations will be to provide sufficient information to allow the detailed design of all components of the wind farm to be completed.

The general approach and standards of work should adhere to British Eurocode Standards, where appropriate. outline proposals for the development investigation works are given below:

6.6.1. Pre-Intrusive Works

As the site is relatively small with easy access an aerial topographic survey would provide high resolution topographical data to feed into the civil infrastructure design. As well as high resolution aerial imagery. UAV/Drone supported surveys would suit the site conditions and provide an efficient means of survey.

6.6.2. Intrusive Ground Investigation

It is advised that low ground pressure plant be used for the investigation to reduce damage to the peat deposits and increase stability and prevent lasting damage to fields.

- Dynamic Cone Penetrometer (DCP) testing would provide efficient and adequate sub-grade information for shallow infrastructure such as tracks and crane pads;
- Trial pits and disturbed sampling should be used in conjunction with in-situ DCP testing to obtain soil profile descriptions and lab samples to further refine design;
- Depending on ground conditions plate load tests should be carried out at each crane pad location to give accurate bearing capacity estimates.
- It is recommended that a carefully planned drilling investigation be carried out at each turbine foundation. Due to the variable nature of the ground conditions, different techniques may be required at different locations. Peat deposits would be sampled using driven soil samplers, followed by sampling and Standard Penetration Testing (SPT) of superficial and weathered material, followed by rotary core drilling. Class A samples should be obtained in soils and rock for lab tests to further refine foundation design. For areas over thick deposits of glacial till, GeoBore drilling may be required to allow high quality samples to be obtained for lab testing, this will feed into any piling design should it be needed.
- Boreholes should be drilled to sufficient depth for anticipated foundation design for the proposed wind turbines. Eurocode 7 indicates this is typically 1.5times the base depth, initially assuming approximately 18m diameter

bases, drilling depths of approximately 27m depth are anticipated. This could be reduced if good quality bedrock can be proven and backed up with other site investigation data.

- Appropriately targeted geotechnical laboratory testing, which is likely to comprise material classification/ index testing, point load, unconfined shear strength, compaction testing, shear strength testing, CBR, and chemical testing, where necessary and/ or appropriate.

6.6.3. Resistivity Testing

It is recommended electrical resistivity testing is carried out at each turbine and the control building/substation to enable electrical earthing design.

6.6.4. Reporting

It is recommended the investigation findings should be compiled into an interpretative Ground Investigation Report (GIR) as part of a pre-construction phase of works and to inform the detailed design. The report should include derivation of the geology and groundwater regime, identification of engineering properties of the materials, identification of geohazards, and recommendations for geotechnical design and construction at all key infrastructure locations, including the turbine foundations and access tracks.

1. References

- BS EN 1997-1:2004, EC7: Geotechnical Design, Part 1: General Rules.
- BS EN 1997-2:2007, EC7: Geotechnical Design, Part 2: Ground Investigation and Testing.
- British Geological Survey, Northern Ireland 1:50,000 Digital Data
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- Northern Ireland Rivers Agency, Flood Map, Risk of Flooding from Rivers and Sea.
- Health Protection Agency, Radon Maps, Indicative Atlas of Radon
- BRE 211, RADON, Guidance on protective measures for new buildings, BRE Press, 2007.
- Gas Networks.ie, Gas Networks Pipeline Map

Appendix A – Maps & Plans

Figure 1. Superficial Geology

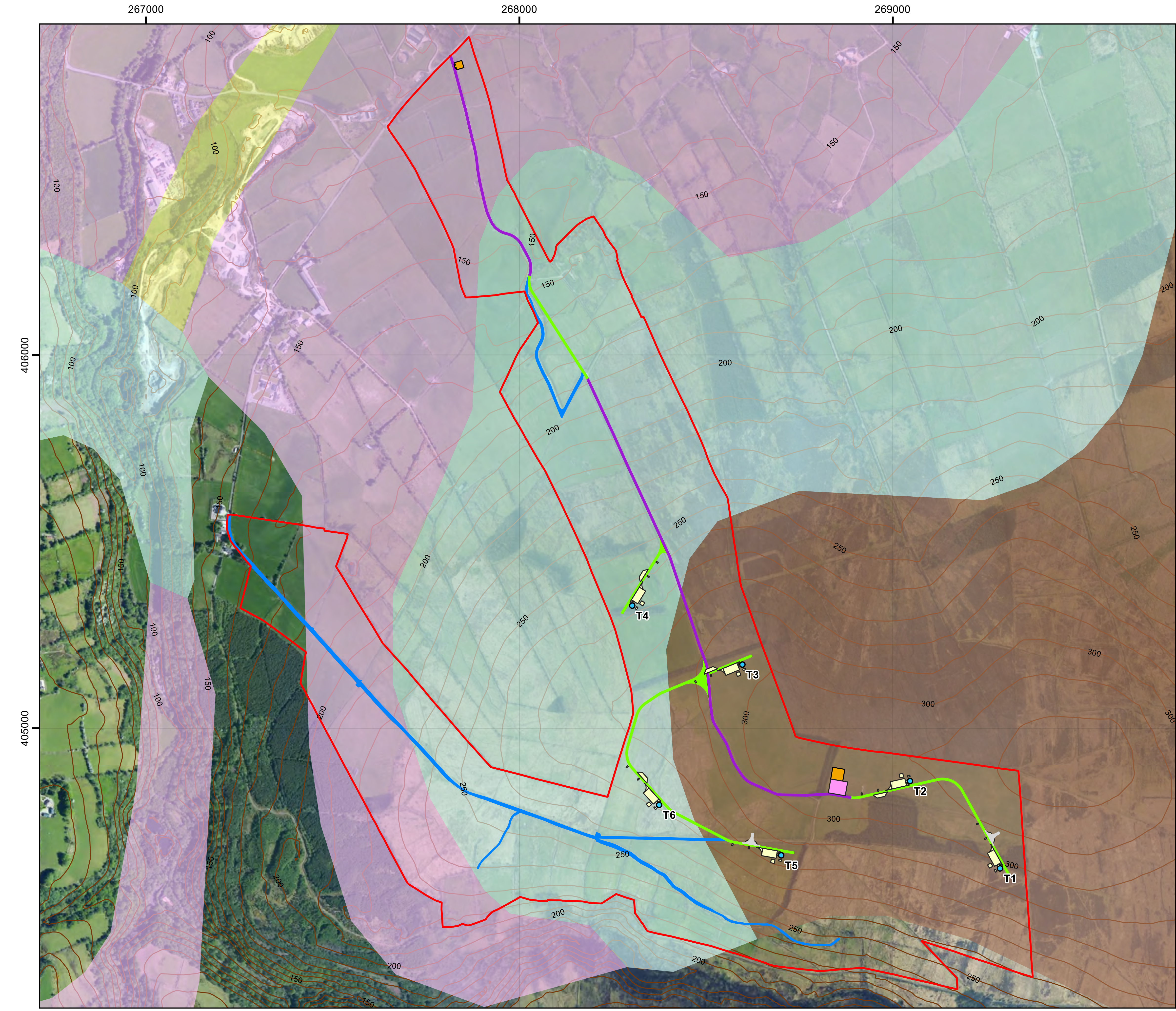
Figure 2. Solid Geology

Figure 3. Slope Angle

Figure 4. Geomorphological Features

Figure 5. Peat Depth

Figure 6. Peat Spoil Management Plan



Project:

Magheramore Wind Farm, Co. Londonderry

Title:

Figure 1: Superficial Geology

Key

- Development boundary
- Proposed turbine
- Existing track
- New track
- Turning head
- Upgraded track
- Cranepad
- Control building
- Construction compound
- 10 m contour

Superficial geology*

- Alluvium
- Till
- Peat
- Glacial sand and gravel

* Data reproduced from GSNI 250k superficial geology dataset

Sources: Esri, DigitalGlobe, GeoEye, i-cubed, USDA FSA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community Reproduced from the Geological Survey of Northern Ireland, with the permission of the Director. © Crown Copyright.

Scale @ A3: 1:10,000

Coordinate System: OSNI 1952 Irish National Grid

0 125 250 375 500 m

N

Date: 15-05-19	Prepared by: AB	Checked by: CM
Ref: GB202040_M_001_B	Layout: 220419_6t_A	

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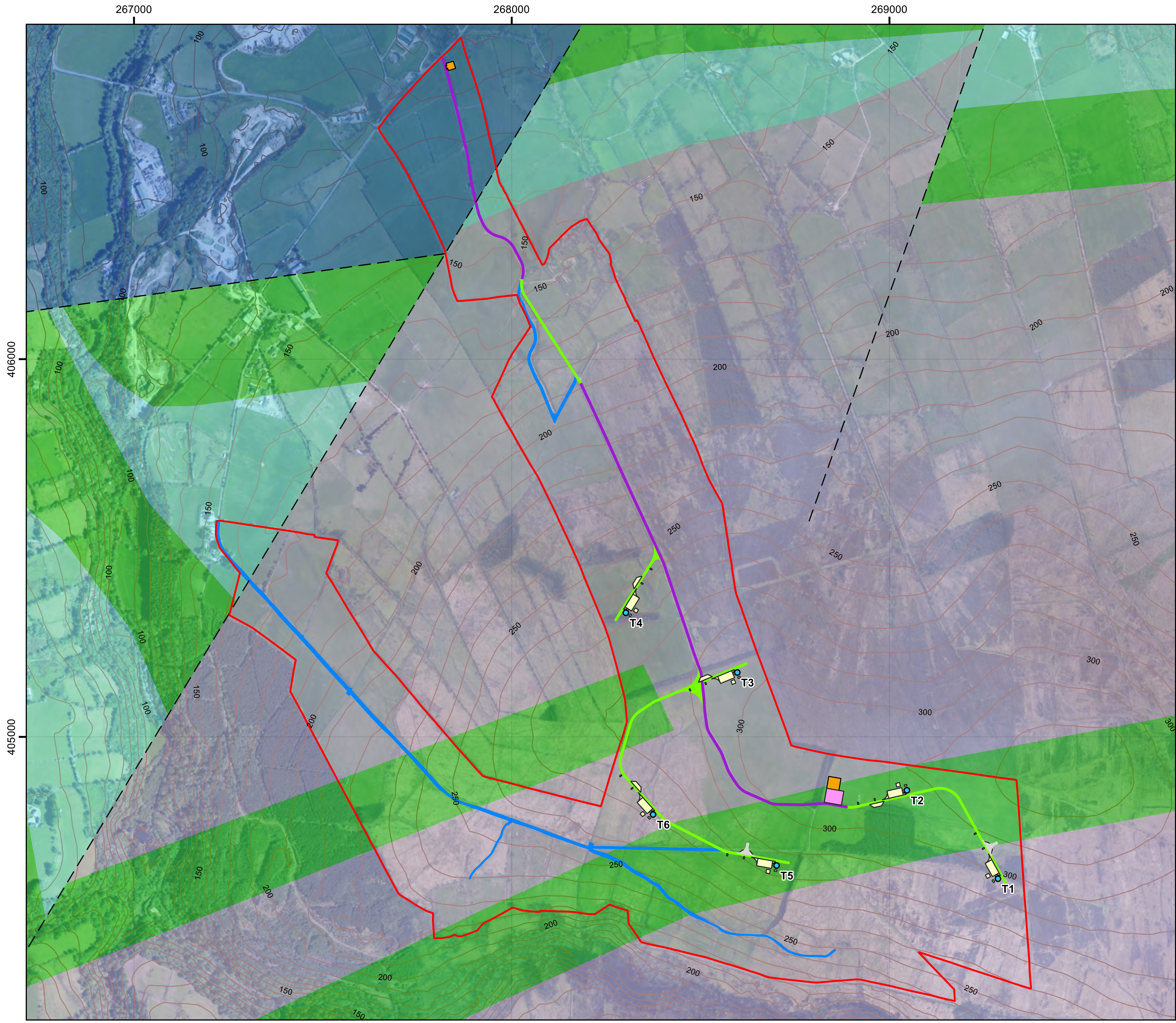

Project:

Magheramore Wind Farm, Co. Londonderry

Title:

Figure 2: Bedrock Geology

Key

- Development boundary
- Proposed turbine
- Existing track
- New track
- Turning head
- Upgraded track
- Cranepad
- Control building
- Construction compound
- 10 m contour

Bedrock geology*

- Dart formation
- Unnamed igneous intrusion, Pre-Caledonian
- Dungiven formation
- Barony Glen formation
- Fault

* Data reproduced from GSNI 250k bedrock geology dataset

Scale @ A3: 1:10,000

Coordinate System: OSNI 1952 Irish National Grid

0 125 250 375 500 m

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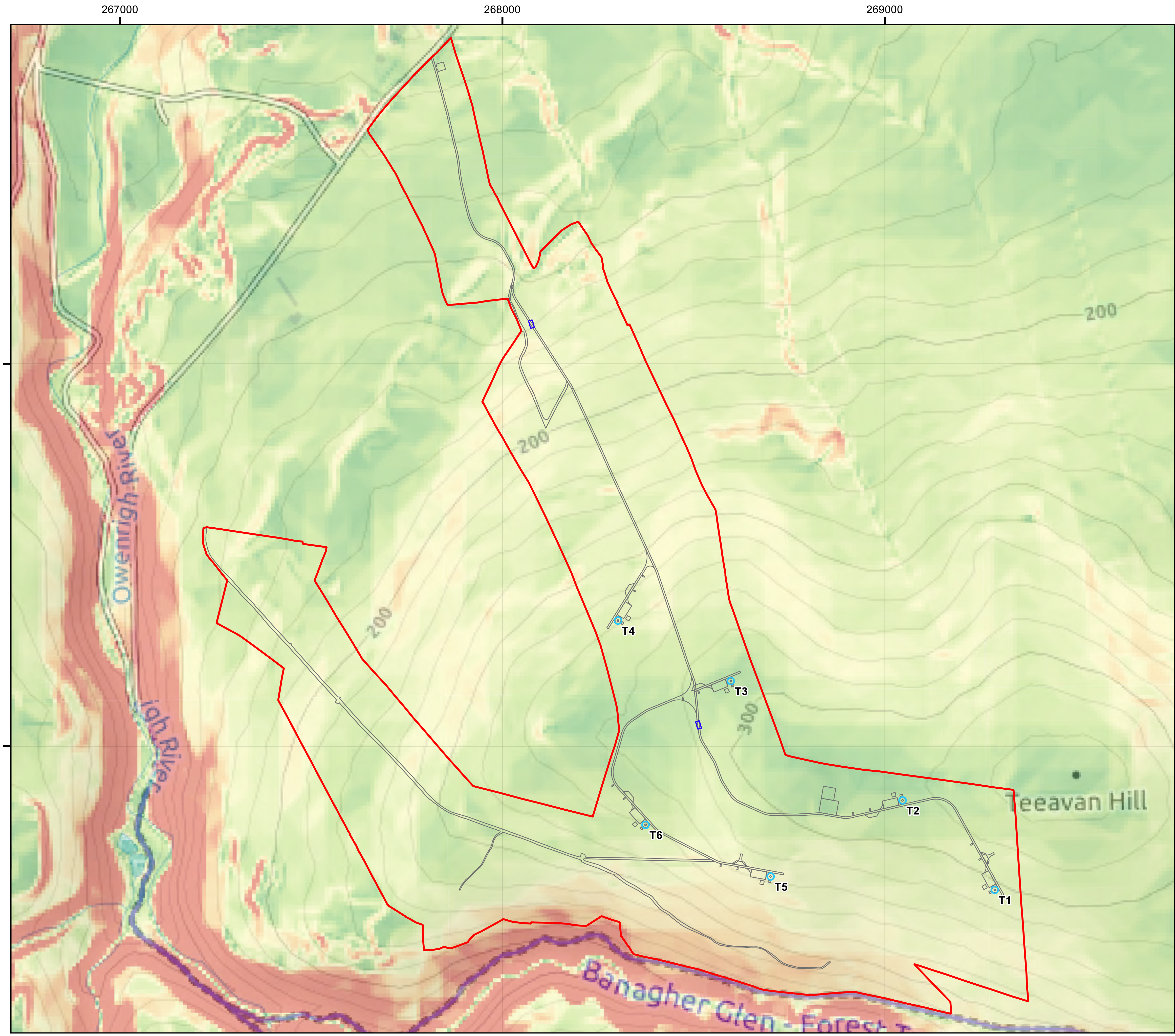

Project:

Magheramore Wind Farm, Co. Londonderry

Title:

Figure 3: Slope angle

Key

- Development boundary
- Turbine
- Infrastructure footprint
- Water crossing

Slope angle

- 0°
- 5°
- 10°
- 15°
- ≥ 20°

Scale @ A3: 1:10,000

Coordinate System: OSNI 1952 Irish National Grid

0 125 250 375 500 m

N

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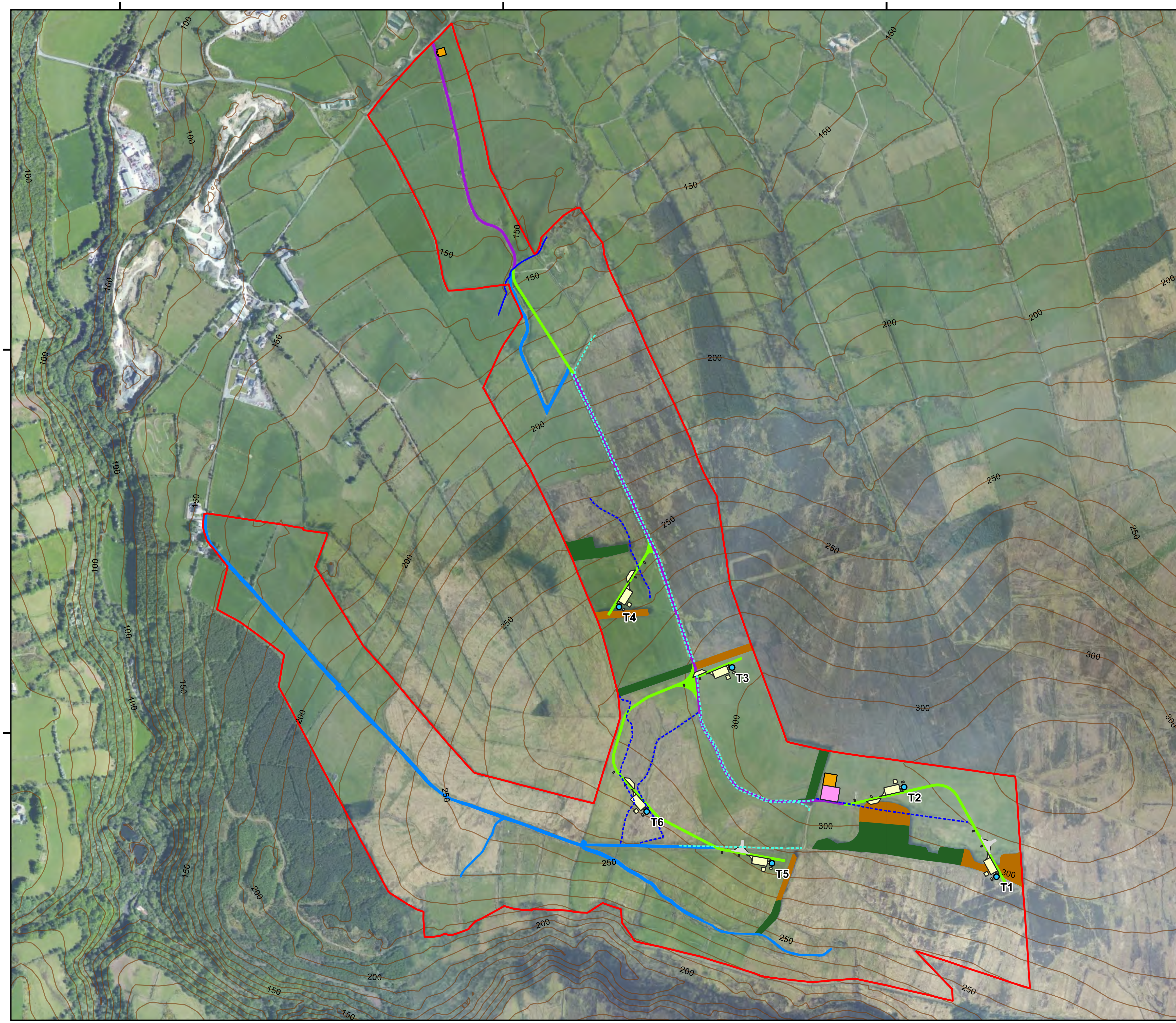

Project:

Magheramore Wind Farm, Co. Londonderry

Title:

Figure 4: Geomorphological Features

Key

Development boundary
Turbine
Existing track
New track
Turning head
Upgraded track
Cranepad
Control building
Compound
10 m contour

Forestry status

Retained
Removed

Geomorphological feature

Natural peat
Peaty soil
Soft ground
Watercourse
Roadside Ditch
Field Ditch

Scale @ A3: 1:10,000

Coordinate System: OSNI 1952 Irish National Grid

0 125 250 375 500 m

N

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Project:

Magheramore Wind Farm, Co. Londonderry

Title:

Figure 5: Peat Depth

Key

- Development boundary
- Turbine
- Infrastructure footprint
- Water crossing
- 10 m contour
- Peat probe

Peat depth (m BGL)*

0.01 - 0.25	2.00 - 2.25
0.25 - 0.50	2.25 - 2.50
0.50 - 0.75	2.50 - 2.75
0.75 - 1.00	2.75 - 3.00
1.00 - 1.25	3.00 - 3.25
1.25 - 1.50	3.25 - 3.50
1.50 - 1.75	3.50 - 3.75
1.75 - 2.00	3.75 - 4.00

* Peat probe data interpolated using IDW. Distance coefficient = 10.

Sources: Esri, DigitalGlobe, GeoEye, i-cubed, USDA FSA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community Contains public sector information licensed under the Open Government Licence v3.0.

Scale @ A3: 1:5,500

Coordinate System: OSNI 1952 Irish National Grid

0 75 150 225 300 m

N

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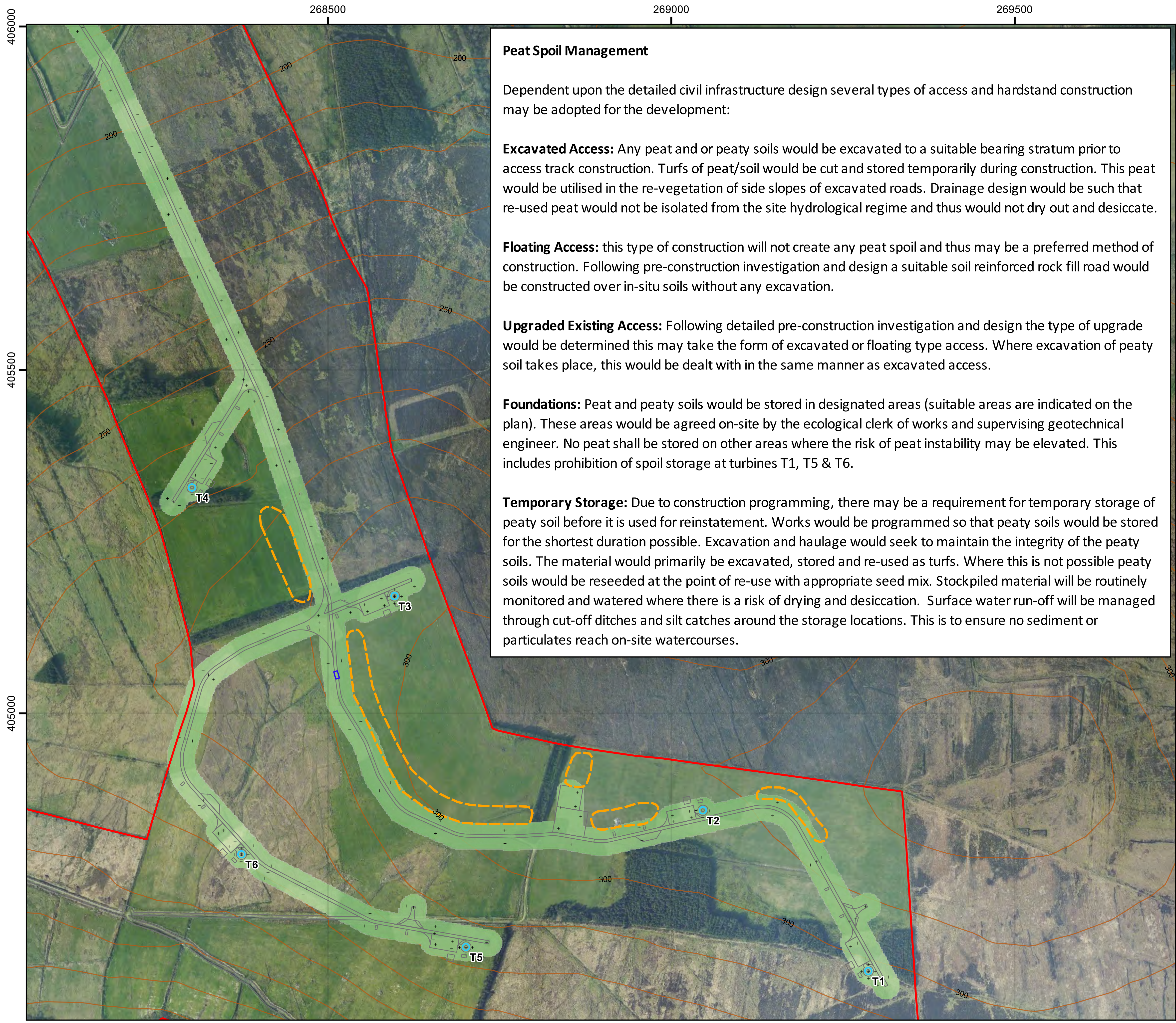

Peat Spoil Management

Dependent upon the detailed civil infrastructure design several types of access and hardstand construction may be adopted for the development:

Excavated Access: Any peat and or peaty soils would be excavated to a suitable bearing stratum prior to access track construction. Turfs of peat/soil would be cut and stored temporarily during construction. This peat would be utilised in the re-vegetation of side slopes of excavated roads. Drainage design would be such that re-used peat would not be isolated from the site hydrological regime and thus would not dry out and desiccate.

Floating Access: this type of construction will not create any peat spoil and thus may be a preferred method of construction. Following pre-construction investigation and design a suitable soil reinforced rock fill road would be constructed over in-situ soils without any excavation.

Upgraded Existing Access: Following detailed pre-construction investigation and design the type of upgrade would be determined this may take the form of excavated or floating type access. Where excavation of peaty soil takes place, this would be dealt with in the same manner as excavated access.

Foundations: Peat and peaty soils would be stored in designated areas (suitable areas are indicated on the plan). These areas would be agreed on-site by the ecological clerk of works and supervising geotechnical engineer. No peat shall be stored on other areas where the risk of peat instability may be elevated. This includes prohibition of spoil storage at turbines T1, T5 & T6.

Temporary Storage: Due to construction programming, there may be a requirement for temporary storage of peaty soil before it is used for reinstatement. Works would be programmed so that peaty soils would be stored for the shortest duration possible. Excavation and haulage would seek to maintain the integrity of the peaty soils. The material would primarily be excavated, stored and re-used as turfs. Where this is not possible peaty soils would be reseeded at the point of re-use with appropriate seed mix. Stockpiled material will be routinely monitored and watered where there is a risk of drying and desiccation. Surface water run-off will be managed through cut-off ditches and silt catches around the storage locations. This is to ensure no sediment or particulates reach on-site watercourses.

Project:

Magheramore Wind Farm, Co. Londonderry

Title:

Figure 6: Peat Spoil Management Plan

Key

- Development boundary
- Turbine
- Infrastructure footprint
- Indicative temporary spoil storage area
- Water crossing
- 10 m contour
- Peat probe

Peat depth (m BGL)*

0.01 - 0.25	2.00 - 2.25
0.25 - 0.50	2.25 - 2.50
0.50 - 0.75	2.50 - 2.75
0.75 - 1.00	2.75 - 3.00
1.00 - 1.25	3.00 - 3.25
1.25 - 1.50	3.25 - 3.50
1.50 - 1.75	3.50 - 3.75
1.75 - 2.00	3.75 - 4.00

* Peat probe data interpolated using IDW. Distance coefficient = 10.

Sources: Esri, DigitalGlobe, GeoEye, i-cubed, USDA FSA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community
Contains public sector information licensed under the Open Government Licence v3.0.

Scale @ A3: 1:5,500

Coordinate System: OSNI 1952 Irish National Grid

0 75 150 225 300 m

N

Date: 15-05-19	Prepared by: AB	Checked by: CM
Ref: GB202040_M_006_B	Layout: 220419_6t_A	

Drawing by:
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Appendix 9.4 Combined Consultation Responses

Caitriona Downey

Subject: FW: Environmental Information Regulations 2004 Request No 807901 - PROPOSED WF MAGHERAMORE,

From: Joanne OKane
Sent: 16 October 2018 16:54
To: Caitriona Downey
Subject: RE: Environmental Information Regulations 2004 Request No 807901 - PROPOSED WF MAGHERAMORE,

Hi Caitriona

Please see below list of private water supplies we have identified within a 2km radius of the proposed windfarm site at Magheramore Dungiven.

Magheramore Road

Well near no:94	54.879635, -6.945681
Well	54.912790, -6.934971
Well to rear of no:17	54.919851, -6.934288
Well	54.902567, -6.938486
Well near no:25	54.914403, -6.936928
Spring	54.911365, -6.934975

Teeavan Road

3 x wells in the vicinity of no:72	54.908054, -6.928706
	54.907886, -6.928859
	54.907729, -6.928955
2x wells @ no:78	54.911470, -6.928171
	54.911331, -6.928792
Springs	54.909715, -6.930327
	54.912780, -6.927727
	54.913575, -6.926451

Banagher Road

Well at no:70	54.886360, -6.9613.2
Well at no:56	54.890842, -6.961734
3x wells	54.882087, -6.965120
	54.881708, -6.965381
	54.880871, -6.967805

This information is to the best of our knowledge. Some of these supplies may not be in use but are on private land.

I trust this is of assistance

Regards

Joanne

Joanne O'Kane
Environmental Health Officer | Environmental Services
7 Connell Street, Limavady, BT49 0HA

Caitriona Downey

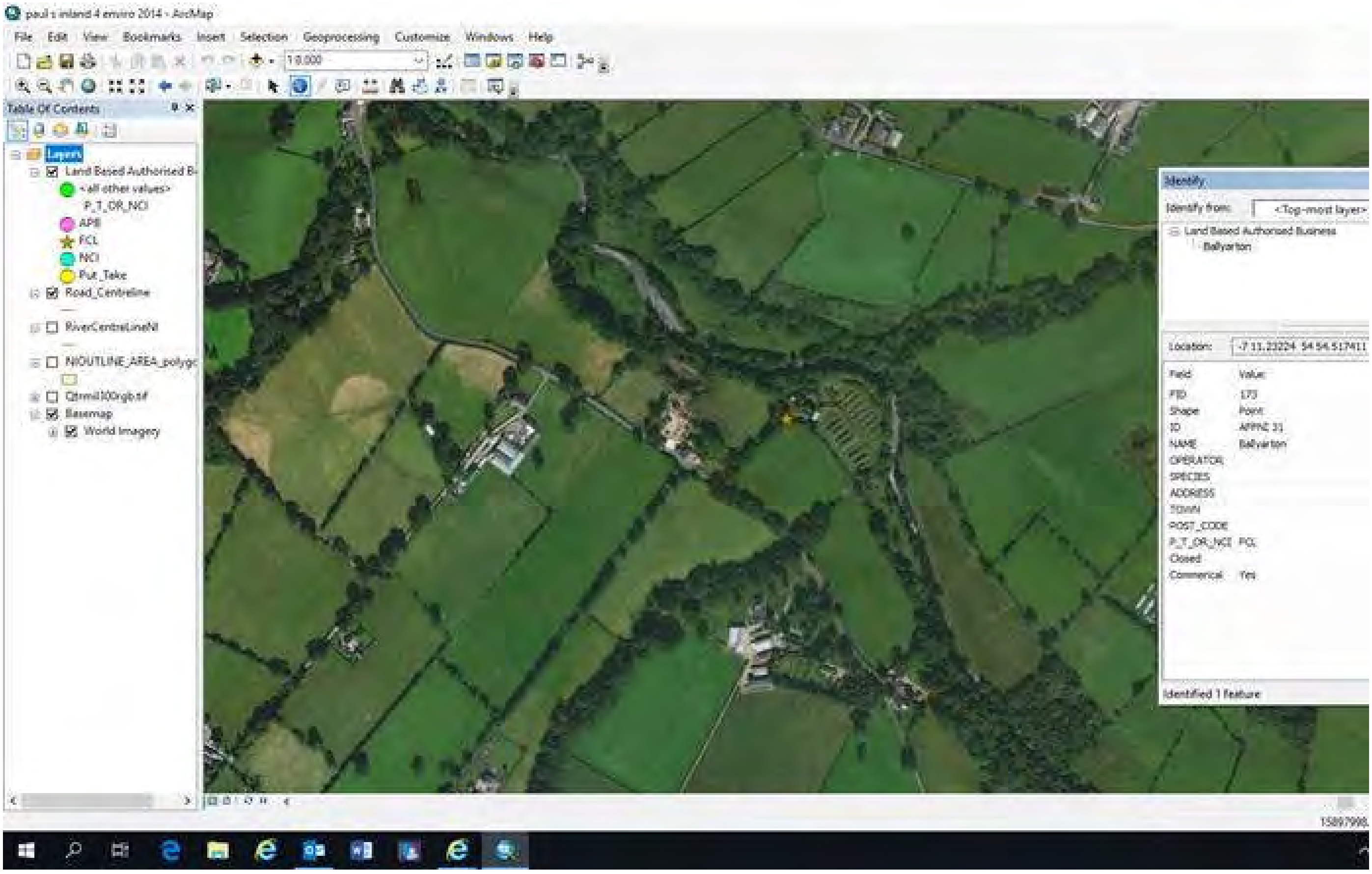
Subject: FW: M01616-05 Magheramore Environmental Statement

From: Ferguson, Paul <Paul.Ferguson@daera-ni.gov.uk>
Sent: 16 April 2019 16:24
To: Caitriona Downey
Subject: RE: M01616-05 Magheramore Environmental Statement

Hi Caitriona,

Please find the information you required.

Regards Paul



From: Caitriona Downey
Sent: 16 April 2019 11:30
To: Ferguson, Paul <Paul.Ferguson@daera-ni.gov.uk>
Subject: RE: M01616-05 Magheramore Environmental Statement

Hi Paul,

Would you be able to provide a location map of the fishery at Claudy for the purposes of informing appropriate mitigation measures at the site?

Kind regards,

Caítríona

From: Ferguson, Paul <Paul.Ferguson@daera-ni.gov.uk>
Sent: 03 July 2018 17:14
To: Caitriona Downey
Subject: RE: M01616-05 Magheramore Environmental Statement

Hi,

Yes the site is downstream at Claudy.

Regards Paul

From: Caitriona Downey [mailto:Caitriona.Downey@mccloyconsulting.com]
Sent: 03 July 2018 17:01
To: Ferguson, Paul <Paul.Ferguson@daera-ni.gov.uk>
Subject: RE: M01616-05 Magheramore Environmental Statement

Hi Paul,

Thank for the response on this. Would you have any further details on the location of this site? IGR co-ordinates or general location? Much appreciated

Kind regards,

Caítríona

From: Ferguson, Paul <Paul.Ferguson@daera-ni.gov.uk>
Sent: 03 July 2018 16:56
To: Caitriona Downey
Cc: Hayes, Jim <Jim.Hayes@daera-ni.gov.uk>
Subject: RE: M01616-05 Magheramore Environmental Statement

Dear Caitriona,

DAERA SEA FISHERIES INSPECTORATE have an aquaculture site downstream from the proposed development which had been damaged in floods in 2017 but may be back in operation in the future. It is important that this site is kept in mind for any future developments up stream.

For the salmonid or other fishery related designations you can contact Jim Hayes of Inland Fisheries for their input. And as always we would like to remind the applicant that;

> It is an offence under Article 47 of the Fisheries Act (NI) 1966 to cause pollution which is subsequently shown to have a deleterious effect on fish stocks

Regards Paul

From: Caitriona Downey [mailto:Caitriona.Downey@mccloyconsulting.com]
Sent: 28 June 2018 12:17
To: Ferguson, Paul <Paul.Ferguson@daera-ni.gov.uk>
Subject: M01616-05 Magheramore Environmental Statement

Our Ref: M01616-05 Magheramore
Proposed WF Site at Magheramore, Dungiven, Co. Derry

FAO Fisheries Inspectorate

McCloy consulting have been commissioned to undertake a Water and Geology assessment as part of an Environmental Statement for a proposed development in Magheramore, Dungiven – The site centroid is IGR: 268485, 404805

As part of this assessment the following will be carried out to assess the impact on baseline hydrological conditions.

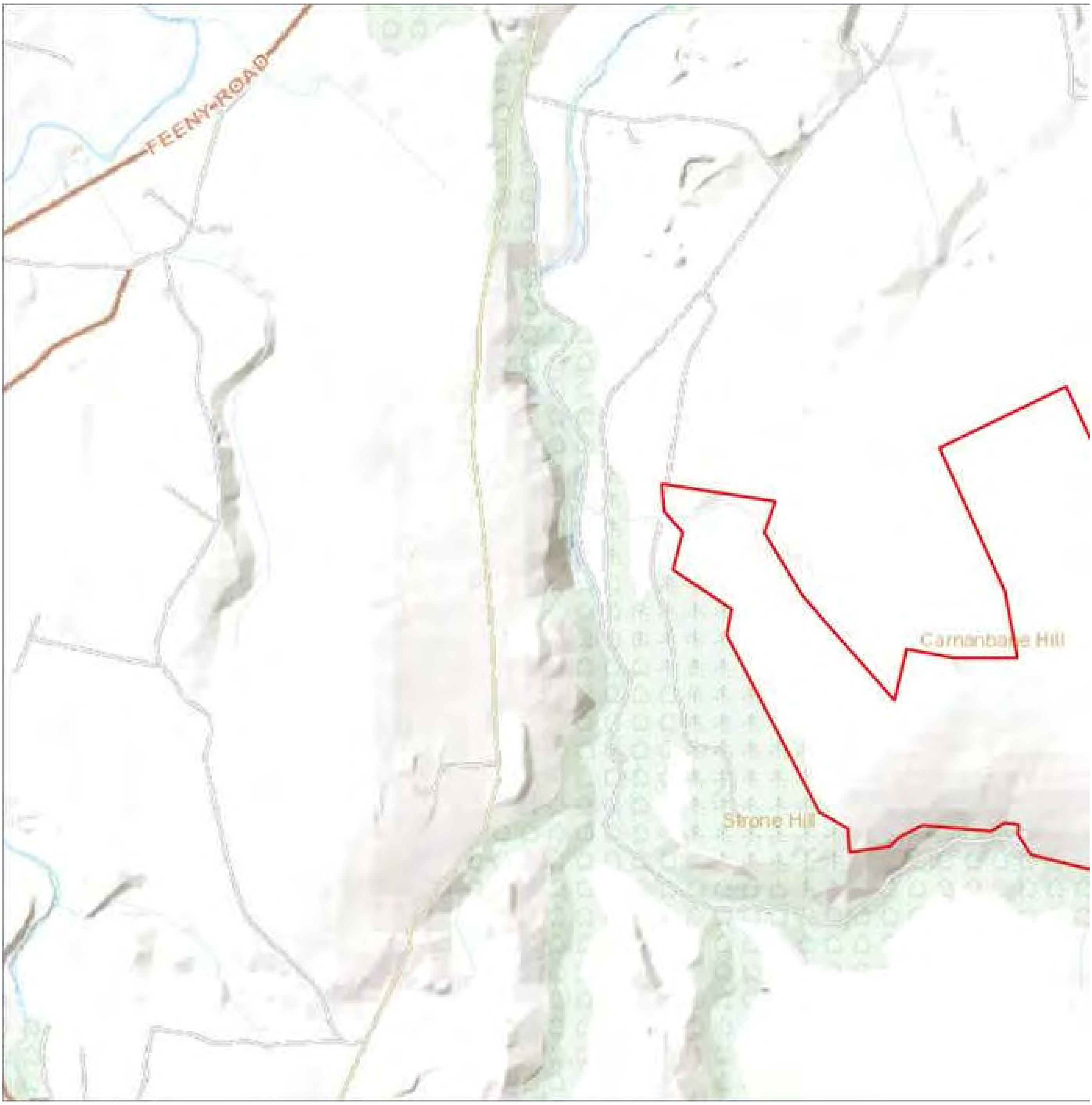
- Mapping of watercourses on site
- Review and assessment of existing water quality
- Assessment of the impact on watercourses and water quality caused by the proposed development
- Provide initial details of mitigation proposed.

We would be grateful if the Fisheries Inspectorate as a statutory consultee could provide the following:

- Details of any salmonid or other fishery related designations for all watercourses in the vicinity of the site and any downstream catchments of the site.
- Advise any further considerations that are deemed appropriate for a hydrological, hydrogeological or geological assessment at the site from your perspective.

We would be grateful if you could acknowledge receipt of this request and provide an indicative timescale for the issue of a response.

If you have any queries regarding this request please do not hesitate to contact me.



Kind regards,

Caítríona

Caitriona Downey

Graduate Consultant | Belfast

E: Caitriona.Downey@mccloyconsulting.com | T: +44 (0) 28 9084 8694 | W: www.mccloyconsulting.com
Mossley Mill, Lower Ground (West), Carnmoney Road North, Newtownabbey BT36 5QA

Check out our new website at www.mccloyconsulting.com

Department for
Infrastructure
An Roinn
Bonneagair
www.infrastructure-ni.gov.uk

Asset Management Unit

DfI Rivers
49 Tullywiggan Road
Loughry
Cookstown
BT80 8SG
Tel: 02886 768300

Ms Catriona Downey
McCloy Consulting
52 Mallusk Entrerprise Park
Newtownabbey
BT36 4GN

YourRef:
OurRef: IN1-18-8866
Date: 18 July 2018

Dear Catriona

Re: Magheramore WF

Thank you for your enquiry received 05/07/2018 regarding the above site. There are no watercourses within or bounding the site, which are designated within the terms of the Drainage (Northern Ireland) Order 1973.

There may be undesignated watercourses, within or bounding the site, about which we are unaware. DfI Rivers does not maintain a database of undesignated watercourses, which may be present at the site. In this regard, you are advised to consult with Ordnance Survey, and/or undertake site inspections, etc. DfI Rivers have a record of flooding downstream of this site dated 31st August 2005, adjacent to 11 Carnanbane Road, the cause of which was a storm run-off.

Within the terms of the above mentioned Order you are advised as follows:

1. If during the course of developing a site a watercourse is uncovered which was not previously evident, the Coleraine Office at 37 Castleroe Road, COLERAINE, BT513RL, Tel. 02870342357, should be contacted immediately in order that arrangements may be made for an investigation and direction in respect of any possible actions that may be necessary to maintain its drainage function; moreover

2. Any proposal either temporary or permanent, in connection with a development that may impact on the drainage function of any watercourse within the site, now or in the future, such as release of storm water to, culverting, bridging, diverting, building adjacent to and/or over, etc requires prior written consent from the Department. Details of such proposals, together with accompanying drawings, maps and calculations etc must be submitted in advance of any development to the Coleraine Office at 37 Castleroe Road, COLERAINE, BT51 3RL, Tel. 02870342357.

Failure to obtain such a written consent is an offence under the provisions of the above Order, which may lead to prosecution or other statutory action as provided for.

The Department does not accept any liability for loss, injury or damage to any

person or property as a result of any inaccuracy in the above information provided.
In this regards you are to seek the services of qualified competent professional bodies to ascertain the suitability and completeness of the information regarding the location, condition of and responsibility for any buried services at this location.

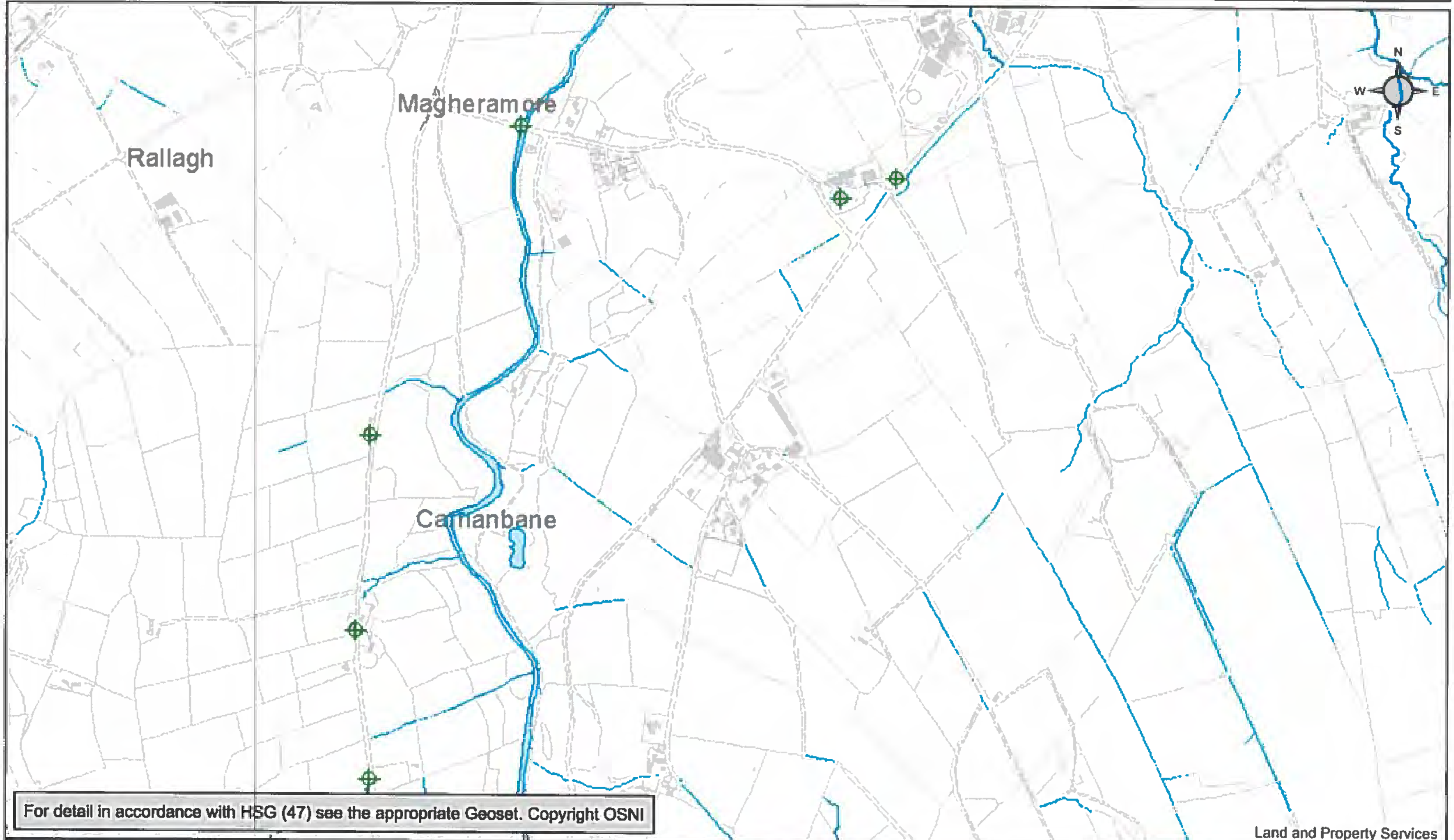
Future requests regarding the information on the Department's drainage and flood defence infrastructure should continue to be addressed to the DfI RiversAsset Management Unit at the above address.

Yours sincerely

Anne McGuigan.

Anne McGuigan
Asset Management

IN1-18-8866



RIVERS Agency

An Agency within the Department of Agriculture and Rural Development

Date:20/07/2018

Scale: 1:10,000

1 Any proposals, either temporary or permanent, which involve interference with any watercourse, such as culverting, bridging, diversion, building adjacent to, or discharge of stormwater etc. require the written consent of Rivers Agency. Failure to obtain such written consent is an offence under the provisions of the Drainage (NI) Order 1973, which may lead to prosecution or other statutory action as provided for.

2. If during the course of developing a site, a watercourse is uncovered which was not previously evident, Rivers Agency should be notified immediately in order that arrangements may be made for investigation and direction in respect of any action to deal with said watercourse. You are advised to assess the suitability/ correctness of the information provided as the Rivers Agency does not accept liability for loss, injury or damage to any person or property caused as a result of any inaccuracy in the information provided

- Watercourses (Designated)
- Info Pipes
- Info Nodes
- FloodDefence
- GaugingStations
- AlertStations

Caitriona Downey

Subject: FW: M01616-05 Magheramore Consultee Request - Mineral Prospecting Licence

From: Wilson, Paul (DfE)
Sent: 16 August 2018 12:15
To: Patton, Mark (DfE)
Cc: Caitriona Downey Johnston, Jackie (DfE)
Subject: RE: M01616-05 Magheramore Consultee Request - Mineral Prospecting Licence

Dear Caítríona,

I have undertaken a search of our Groundwater Data Repository and karst features dataset for the site that you supplied.

There are no boreholes, springs or shallow wells recorded within 1km of this site. That is not to say there aren't any, we just do not have data on them.

There are also no recorded karst features within 1km of this site and none would be expected based on the geology.

For future reference, our karst features dataset can be downloaded from here.

Our standard charge for a search of our groundwater data repository is £40 +VAT. I have cc'd Jackie, our Business Assistant who can manage payment as per your preferred method.

Yours sincerely,

Paul Wilson
Hydrogeologist
The Geological Survey of Northern Ireland
British Gelogical Survey
Dundonald House
Upper Newtownards Road
Belfast, BT4 3SB
Tel: 028 9052 0973 (ext: 20973)

Need a Borehole?

Department of
Agriculture, Environment
and Rural Affairs
www.daera-ni.gov.uk

Planning Response Team
Klondyke Building
Cromac Avenue
Gasworks Business Park
Lower Ormeau Road
Belfast
BT7 2JA
Tel: 028 9056 9604
Email: planningresponse.team@daera-ni.gov.uk

Date:25 September 2018

Dear Sir/Madam

Planning Application Ref.:	LA01/2018/1019/DETEIA
Location:	Magheramore Wind Farm Dungiven
Proposal:	Intention to submit an Environmental Statement for the proposed Magheramore Wind Farm

Thank you for your consultation on the above which was received by DAERA on 04/09/2018

Our statutory duty is to ensure that the natural and historic environment is conserved, enhanced and managed for the benefit of present and future generations, thereby contributing to sustainable development.

We have reviewed the details of the application and would provide summary comments as follows:

Drainage and water
Water Management Unit note the applicant has not identified the impact of the proposed development upon water quality. This is an are that requires assessment with the EIA process. More information is available in DAERA's Standing Advice on Pre-Application Discussion, Pollution Prevention, Sustainable Drainage, Discharges and Abstractions. All available at: www.daera-ni.gov.uk/water-environment-standingadvice

Land, Soil and Air
The foundations of wind turbines have the potential to impact on the groundwater environment. An assessment of the potential impact facilitates the Regulation Unit, Land and Groundwater Team to form an opinion on the application and this is required regardless of the EIA determination. Therefore it is the planning case officer's decision whether they wish to obtain the relevant surveys and assessments as part of the EIA or separately.

Natural Heritage and Conservation Areas
Natural Environment Division have provided advice in relation to this EIA determination.

If you wish to discuss anything raised in our response, please do not hesitate to contact Planning Response Team (details above).

Kind Regards

Planning Response Team

On behalf of DAERA

Land, Soil & Air

EIA Determination and likely significant effects.

The foundations of wind turbines have the potential to impact on the groundwater environment. An assessment of the potential impact facilitates the Regulation Unit, Land and Groundwater Team to form an opinion on the application and this is required regardless of the EIA determination. Therefore it is the planning case officer's decision whether they wish to obtain the relevant surveys and assessments as part of the EIA or separately.

At this EIA Determination stage the Land and Groundwater Team will wait for the EIA determination decision prior to reviewing any documents submitted by the applicant. Only if potential receptors (water features) have been identified and a risk assessment has been prepared, Regulation Unit (Land and Groundwater Team) should be consulted further for advice.

An assessment of the development's potential risk to impact on the groundwater environment typically requires a Water Features Survey as part of a Hydrogeological Assessment. Further information is provided within "Environmental information required" and "Baseline environmental information".

Environmental information required

The foundations of wind turbines have the potential to impact on the groundwater environment for example groundwater flow paths, groundwater receptors (aquifers) or secondary receptors (including private water supplies). Groundwater receptors should be identified and the risk of potential impact assessed and, where required, mitigation measures should be identified. These steps should be assessed through a Water Feature Survey.

Please see our guidance available on the DAERA website on 'Water feature surveys' and 'Wind farms and groundwater impacts' available at: https://www.daera-ni.gov.uk/publications/best-practice-guidance-documents

It is recommended that the applicant seeks the professional advice of a hydrogeologist. Hydrogeologists (not hydrologists) can be identified through internet search, Yellow Pages or the Ends Directory (www.endsdirectory.com)

In addition to the guidance listed above Regulation Unit (land and Groundwater Team) would direct the attention of the applicant / agent to the planning advice which is available on the DAERA website under the Topic: **Environmental Advice for Planning** with particular reference to the following pages:

https://www.daera-ni.gov.uk/articles/development-may-have-effect-water-environment-including-groundwater-and-fisheries

https://www.daera-ni.gov.uk/articles/wind-energy-installations

Baseline environmental information

Groundwater baseline information which will feed into a water feature survey can be obtained from our online River Basin Map Viewer at https://appsd.daera-ni.gov.uk/RiverBasinViewer/ and our WMU Water Information Request Viewer at https://appsd.daera-ni.gov.uk/WaterInformationRequest/

Information on private water supplies sourced from groundwater might be obtained from:

- Northern Ireland Environment Agency groundwater monitoring sites: Information on the sites can be obtained by either the WMU Water Information Request Viewer or by contacting waterinfo@daera-ni.gov.uk
- Abstraction & Impoundment Licensing: Information on the licensed sites can be obtained by either the WMU Water Information Request Viewer or by contacting waterinfo@daera-ni.gov.uk
- Drinking Water Inspectorate: Information on private water supplies can be obtained by contacting dwi@daera-ni.gov.uk
- Environmental Health section of the local council

Some layers displayed on the map viewers are also available as a digital dataset, which can be downloaded and used within your own project. Follow the guidance on the web page at https://www.daera-ni.gov.uk/articles/wmu-digital-dataset-downloads

Natural Heritage

Planning Reference No.: LA01/2018/1019/DETEIA

Section Reference: CB 26503

Baseline environmental information

Date of NED data check: 24 September 2018

NIEA, Natural Environment Division (NED) can provide the following information to aid the Planning Authority in making their EIA determination.

Please note that this proposal is subject to the Conservation (Natural Habitats, etc) Regulations (Northern Ireland) 1995 (as amended) (known as the Habitats Regulations).

The application site is in close proximity to Banagher Glen SAC/ASSI and the River Roe and Tributaries SAC/ASSI which are of international importance and are protected by legislation.

The application site may contain priority habitat such as peatland and support priority species such as bats and birds.

Likely significant environmental effects

Describe the environmental sensitivity of the location likely to be affected by the development and the type of impact that may occur.

Based on the information submitted, NIEA Natural Environment Division (NED) considers that the proposal is likely to have significant environmental effects with regard to the Planning (Environmental Impact Assessment) Regulations (Northern Ireland) 2015.

Environmental information required

Should the planning authority determine that a development proposal is EIA development, NIEA should be consulted as appropriate to advise further on the scope of the environmental information required to support this application.

Please note that should natural heritage issues set out in Schedule 3 of the Planning (General Development Procedure Order) Northern Ireland 2015 (GDPO)) be identified, NIEA advises that information to assess potential impacts on the natural heritage can be submitted either via suitable environmental reports as part of a standard consultation process, or as part of an environmental statement.

NED has carried out a desktop search of currently available information – see below. Please note that this information is correct at this point in time, but should be reviewed before submitting the Environmental Statement (ES) / planning application. You should also refer to the recommended websites, detailed below, for other relevant information.

Please also find enclosed advice on the scope of work / information that NED considers necessary to assess the potential effects on natural heritage interests from this development proposal. The information provided should be as comprehensive as possible and follow the guidance detailed below. This will reduce the likelihood of further environmental information being requested which could delay the processing of the planning application. We recommend that the applicant contacts the planning authority to engage in the pre-application process to avoid any delays.

Natural Heritage

NED standing advice can be found at: https://www.daera-ni.gov.uk/publications/standing-advice-development-land-may-affect-natural-heritage-interests and NED survey specifications and other planning related advice can be found at: http://www.doeni.gov.uk/niea/land-home/plan/surveys.htm.

The NI Biodiversity Checklist (see https://www.daera-ni.gov.uk/publications/ni-biodiversity-checklist-documents) should be used to establish if a survey is required for a complete application. NED recommends that all survey works comply with British Standard 42020:2013, which came into effect on 31 August 2013. The British Standard provides recommendations and guidance for those engaged in planning and development, whose work might affect or have implications for conservation, or the enhancement of biodiversity.

Site specific information

From the data NED currently holds:

Designated Sites

Banagher Glen SAC/ASSI
River Roe and Tributaries SAC/ASSI

Sites of Local Nature Conservation Importance (SLNCI) within 3km of the site

Benady Glen

Brown Hill

Owenbeg

River Roe

Priority species

Birds

Bats

Otter

Priority habitats

Peatland

Rivers

Natural Heritage

Additional sources of information

1. The NED website http://www.doeni.gov.uk/niea/ includes:

    - Details of all regional, national and international designated sites in Northern Ireland
    - Northern Ireland Biodiversity Strategy
    - Northern Ireland Habitat and Species Action Plans
    - Areas of Outstanding Natural Beauty
    - Landscape Character Areas
    - Environmental Legislation

2. Useful information on planning and natural heritage, including survey specifications, can be found on the NED website at http://www.doeni.gov.uk/niea/land-home/plan.htm

3. Information on the flora, fauna and geology of Northern Ireland can be obtained from the Habitas website: http://www.habitas.org.uk/

4. Site specific environmental data (e.g. species records) can be obtained from the Centre for Environmental Data and Recording (CEDaR). These can be accessed by contacting CEDaR, National Museums NI, 153 Bangor Road, Cultra, Holywood, BT18 0EU. Website: http://www.nmni.com/cedar

5. NED promotes the submission of biodiversity data to CEDaR, and recommends that species records generated as part of the EIA process are submitted to CEDaR by going to: http://nmni.com/CEDaR/Submit-records

General Scoping Guidance for Environmental Impact Assessment

Guidance on the scoping stage of Environmental Impact Assessment (EIA) and on the information to be included in an Environmental Statement (ES) is provided by the European Commission and can be found at: http://ec.europa.eu/environment/eia/eia-support.htm.

NED recommends *"Guidelines for Ecological Impact Assessment in the UK"* produced by the Institute of Ecology and Environmental Management (IEEM). This provides best practice guidance for assessing the ecological impact of projects and plans. The document can be downloaded from
http://www.cieem.net/data/files/Resource_Library/Technical_Guidance_Series/EcIA_Guidelines/TGSEcIA-EcIA_Guidelines-Terestrial_Freshwater_Coastal.pdf

NED would emphasise the following:

Natural Heritage

- The ES should describe both habitats and species of flora and fauna present. It should cover both the proposed site and the surrounding area. It should include any designated sites and protected species which may be affected.

- Proposals which may impact on a European site, however distant (i.e. Special Areas of Conservation and Special Protection Areas), will require a Habitats Regulations Assessment (HRA). Sufficient information must be provided to the competent authority to enable them to complete this.

- The topography, geology, soils and water environment of the site and surrounding area should be described.

- The ES should include a description of the likely significant effects, both positive and negative, at all stages of the development to include direct, indirect, secondary and cumulative effects in the short, medium and long term. A description of the forecasting methods used to predict these effects should also be included.

- A description of proposed measures to prevent, reduce or offset any significant adverse affects on the environment (i.e. Avoidance, Mitigation, Compensation, and Enhancement) must be included.

- An indication of any difficulties encountered during the EIA process, limitations of surveys and any uncertainties in the data must be included.

- The different chapters of the ES should be inter-related and the ecology chapter should be cross referenced where appropriate.

<u>Flora and Fauna</u>

- The ecological baseline of the site must be characterised. Following from this, the extent and nature of any further survey work that may be required should be identified. Surveys must cover flora and fauna present in all seasons.

- A habitat survey (i.e. JNCC Phase 1) should be carried out to map the habitats on site and identify areas which are likely to be of high nature conservation value or particularly vulnerable to impact from the proposed development. Areas thus identified should be subject to more detailed survey, i.e. National Vegetation Classification (NVC).

- Faunal surveys should include a full breeding bird survey and protected species surveys. The timing of surveys is critical and they must be carried out at appropriate times of year.

Natural Heritage

- Surveys should highlight any Northern Ireland or European priority habitats and species which may be present on the site or surrounding area.

- Baseline surveys conducted over a short period may not identify long term trends and reference should be made to previous records.

- Protected species surveys should be carried out to NED specifications. Note that these maybe updated in the light of new knowledge at any time. Therefore it is advised to check the NED website for the most up to date specifications immediately prior to commencement of surveys.

- Full survey reports should be included in the appendix of the ES. All maps and diagrams should be of an appropriate scale for interpretation.

- NED reserve the right to determine whether the survey information submitted is adequate or when additional information is required.

- Survey information regarding species vulnerable to persecution should be included as a confidential annex to the ES, which should not be made publically available. The species of concern are badgers *(Meles meles),* freshwater pearl mussels *(Margaritifera margaritifera),* goshawks *(Accipiter gentilis),* hen harriers *(Circus cyaneus),* and peregrines *(Falco peregrinus)*.

Water and Hydrology

- A description of the water environment of the area - running and static surface waters, groundwaters, estuaries, coastal waters and the sea, including run-off and drainage.

- A description of the hydrology, water quality and use of any water resources that may be affected by the development (e.g. water supply, fisheries, angling, bathing, amenity, navigation, effluent disposal).

- The consequences of changes to the hydro-geological system of the area on peatland, rivers, streams, flushes and wetland habitats should be described.

Mitigation Measures

A description of the measures proposed to prevent, reduce or offset any significant adverse effects on the environment caused by the development must be included in the ES. These measures can be summarised as:

Natural Heritage

- Avoidance: Priority should be given to avoiding negative impacts, especially those that could be significant. Consideration should be given to alternative strategies or locations, changes to the project design and layout, changes to methods and processes, changes to implementation plans and management practices including regulating the timing of activities.

- Mitigation: Opportunities should be sought, wherever possible, to reduce negative impacts on the environment, ideally to the point where they are no longer significant.

- Compensation: Where avoidance or mitigation of negative impacts is not practicable measures to compensate for impacts should be proposed.

- Enhancement: Opportunities should be sought in every new development to deliver net ecological gain rather than just limiting environmental damage. Enhancement measures may lead to an increase in the biodiversity of a site.

Mitigation measures should be incorporated into the design of a project from the outset and included on plans and drawings where appropriate. Mitigation which simply comprises a list of recommendations will generally not be acceptable.

Other recommendations include:

- A description of the criteria used to establish the magnitude and significance of environmental impacts. A tabular presentation should be used to summarise key direct and indirect impacts.

- The mitigation proposed should be clearly described and its effect on the magnitude and significance of these impacts should be assessed and clearly explained.

- Any uncertainty in the effectiveness of proposed mitigation measures should be explained and, where appropriate, evidence should be provided of successes from other similar projects.

- The implementation of proposed mitigation should be clearly described and, if necessary, arrangements for monitoring the implementation and success of mitigation measures should be stated.

Environmental Management Plan

An Environmental Management Plan (EMP) should be produced to detail the construction phase of the project and the implementation of the mitigation measures described in the ES.

Natural Heritage

It will provide the management framework for the planning and implementation of construction activities and describe how working practices will avoid or minimise impacts to the environment at all stages of the development. It should provide details of procedures for monitoring and reporting the environmental effects of the development during construction. It should include the following information:

- Pre construction site conditions should be described to establish a baseline against which construction effects can be assessed.

- A site plan to show the location of construction activities, access routes, the storage of materials, the position of plant and the location of any sensitive receptors (e.g trees, peat, watercourses).

- A detailed programme of the work to be carried out including timing and sequencing of works.

- Methods of construction and working practices should be specified, including equipment and materials to be used.

- Details of how mitigation measures will be implemented should be clearly stated.

- Details of procedures for monitoring and reporting the environmental effects of the development during construction and in the operation phase.

A Habitat Management Plan should form part of the EMP. This should show how the habitats, flora and fauna of the site will be protected during and after construction. It should include a long term plan for the management of the site for nature conservation and, if appropriate, show details of compensation measures such as habitat creation. It should also include details of how the ecology of the site will be monitored to show the success of mitigation measures and may include species specific monitoring requirements.

Environment, Marine & Fisheries Group
Marine & Fisheries Division

Department of
Agriculture, Environment and Rural Affairs
www.daera-ni.gov.uk

www.planningni.gov.uk

1st Floor
Rathkeltair House
Market Street
Downpatrick
BT30 6UU

Application Reference;
LA0/2018/1019/DETEIA

25th September 2018

PROPOSED WINDFARM AT MAGHERAMOER DUNGIVEN

TO WHOM IT MAY CONCERN,

DAERA Sea Fisheries Inspectorate has no issues or concerns to raise from an aquaculture/sea fisheries aspect with this proposal.

But we would like to remind the applicant that;

It is an offence under Article 47 of the Fisheries Act (NI) 1966 to cause pollution which is subsequently shown to have a deleterious effect on fish stocks.

All works near watercourses to be carried out in line with guidance as described in the Pollution Prevention Guidelines 5 (Works In, Near or Liable to Affect Watercourses).

Yours Sincerely,
Marine & Fisheries Division – Fisheries Inspectorate

Department for
Infrastructure
An Roinn
Bonneagair
www.infrastructure-ni.gov.uk

DfI Rivers Planning Advisory Unit

44 Seagoe Industrial Estate
CRAIGAVON
Co. Armagh
BT63 5QE
Tel: 028 3839 9118

Cathy McKeary
Causeway Coast and Glens Borough Council
Local Planning Office
Cloonavin
66 Portstewart Road
Coleraine
BT52 1EY

Your Ref:
LA01/2018/1019/DETEIA
Our Ref: IN1-18-11521

Date: 16/10/2018

Dear Sir / Madam,

Re: Environmental Statement for a Wind Farm - Magheramore, Dungiven - LA01/2018/1019/DETEIA

Thank you for your consultation dated 4th September 2018 regarding the above proposal. DfI Rivers have assessed the application and our comments are as follows:-

DfI Rivers remit is limited to commenting on flood risk and drainage matters in accordance with planning Policy Statement 15 Planning and Flood Risk (PPS 15). It is outside DfI Rivers area of expertise to express an opinion as to whether the proposed development would or would not be EIA development. If the planning authority deems that an EIA is required then paragraph 5.8 of PPS 15 requires that flood risk and drainage assessment are addressed in the Environmental Statement.

Policy FLD 1 Development in Fluvial (River) and Coastal Flood Plains
The Strategic Flood Map (NI) indicates that a small portion of the site lies within the 1 in 100 year fluvial flood plain.

PPS15 Policy FLD 2 Protection of Flood Defence and Drainage Infrastructure
The site is traversed by various undesignated watercourses. Under 6.32 of the policy a 5m maintenance strip is required. It should be marked up on a drawing and be protected from impediments (including tree planting, hedges, permanent fencing and sheds), land raising or future unapproved development by way of a planning condition. Clear access and egress should be provided at all times. Planning N I may wish to apply the last sentence of 6.40 of Planning Policy Statement 15.

Department for
Infrastructure
An Roinn
Bonneagair
www.infrastructure-ni.gov.uk

PPS15 Policy FLD 3 Development and Surface Water (Pluvial) Flood Risk Outside Flood Plains
Due to the size and nature of the development FLD3 of PPS15 applies. DfI Rivers would recommend that a Drainage Assessment is carried out for our consideration.

The applicant should refer to paragraph D17 and D18 of PPS 15.
In carrying out the drainage assessment the applicant should acquire from the relevant authority evidence that the proposed storm water run-off from the site can be safely discharged. If the proposal is to discharge into a watercourse then an application should be made to the local DfI Rivers office for consent to discharge storm water under Schedule 6 of the Drainage (NI) Order 1973.

If it is proposed to discharge storm water into an NI Water system then a Pre-Development Enquiry should be made and if a simple solution cannot be identified then a Network Capacity Check should be carried out. Correspondence with both authorities should be included in the drainage assessment regardless of outcome.

PPS15 Policy FLD 4 Artificial Modification of Watercourses
Not applicable to this site

PPS15 Policy FLD 5 Development in Proximity to Reservoirs
Not applicable to this site

Under the terms of Schedule 6 of the Drainage (Northern Ireland) Order 1973 the applicant must submit to DfI Rivers, for its consent for any proposal to carry out works which might affect a watercourse such as culverting, bridging, diversion, building adjacent to or discharge of storm water etc. Failure to obtain such consent prior to carrying out such proposals is an offence under the aforementioned Order which may lead to prosecution or statutory action as provided for.

I trust you find the foregoing to be helpful but should you require any further information or clarification please contact me at the above address.

Please quote our reference number above on any future correspondence.

Yours faithfully,

Mark Woods

Shared Environmental Service
County Hall
182 Galgorm Road
Ballymena
Co. Antrim
BT42 1QF

Date: 02/11/2018

Planning Reference: LA01/2018/1019/DETEIA

Location: Magheramore Wind Farm, Dungiven

Proposal: Intention to submit an Environmental Statement for the proposed Magheramore Wind Farm

Consultation Type: Environmental Impact Assessment (EIA) 8

Shared Environmental Service (SES) advises that this application is not wholly or partly in a sensitive area within the meaning of Part 1, Regulation 2 (f) of The Planning (Environmental Impact Assessment) Regulations (Northern Ireland) 2017.

The proposed site hydrologically connected to the River Roe and Tributaries. The proposed site also falls slightly within Banagher Glen SAC as it runs adjacent the southern section of the red line boundary. The potential for a likely significant effect on site selection features or an adverse effect on site integrity cannot be ruled out at this stage.

Causeway Coast and Glens Borough Counci is advised to consult Shared Environmental Service on the Northern Ireland Planning Portal, so that the proposal can be considered in accordance with the requirements of Regulation 43 (1) of the Conservation (Natural Habitats, etc) Regulations (Northern Ireland) 1995 (as amended).

If it is determined that an EIA is required SES requests that a shadow Habitats Regulations Assessment (sHRA) is undertaken by the applicant in consultation with the Northern Ireland Environment Agency (NIEA) which is best placed to provide the necessary information to inform the ES and sHRA. The sHRA should be included as a stand-alone document or Annex to the ES and include findings specific to the sites identified above. The EIA should be consistent with the information in and findings of the sHRA.

sharedenvironmentalservice@midandeastantrim.gov.uk

Infrastructure Planning
Westland House
Old Westland Road
Belfast
BT41 6TE

Tel: 028 90354813 Ext 20646
www.niwater.com

northern ireland **water**

Causeway Coast and Glens Borough Council
Local Planning Office
County Hall
Castlerock Road
Coleraine
BT51 3HS

Your Ref:
LA01/2018/1019/DETEIA

Our Ref:

Date: 31 October 2018

Dear Sir / Madam.

PLANNING CONSULTATION REFERENCE – LA01/2018/1019/DETEIA

NI Water would advise as follows –

This proposed development is located in close proximity to Altnahegish Impounding Reservoir and Caugh Hill Water Treatment Works. Any future consultations should be forwarded to both NIW Strategic Applications and NIW Windfarms.

Yours faithfully

Alan Moore
Infrastructure Planning

northern ireland water
Delivering what matters

Caitriona.Downey@mccloyconsulting.com

Information Management Unit
IT Suite
Westland House
40 Old Westland Road
Belfast
BT14 6TE

Tel: 9035 4813 ext 20242

Email: john.collins@niwater.com

Your reference:
Our reference: NIW 1819106

Date: 30 July 2018

Dear Ms Downey,

Environmental Information Regulations 2004

Thank you for your email of 29 June 2018, in which you requested information about water abstractions at Altnaheglish/Banagher Reservoir.

As your query falls under the definition of an environmental request, NI Water is replying under the disclosure provisions of the Environmental Information Regulations 2004 (“the EIR”).

Altnaheglish Impounding Reservoir is owned and operated by NI Water. In relation to surface water abstractions / intakes from the reservoir or the surrounding area, apart for the abstraction from Altnaheglish we abstract from the Glenedra River and Kerlin’s Burn.

For future reference, information on public and private water abstractions should be sought from the Department of Agriculture, Environment and Rural Affairs (DAERA). Their contact details are as follows.

Abstraction & Impoundment Licensing Team
Water Management Unit
NIEA
17 Antrim Road
Tonagh
Lisburn
County Antrim
BT28 3AL
Email: AIL@daera-ni.gov.uk

You have the right to request that NI Water formally review this response within forty working days of the date of this letter. If you wish to do so, please write to NI Water Information Management Unit, IT Suite, Westland House, 40 Old Westland Road, Belfast, BT14 6TE.

If, after such an internal review, you are still unhappy with the response, you have the right to appeal to the Information Commissioner at Wycliffe House, Water Lane, Wilmslow, CHESHIRE, SK9 5AF, who will undertake an independent review.

If you have any queries about this letter, please contact me. Please remember to quote the reference number above in any future communications.

Yours sincerely

John Collins
Head of Corporate Information
Northern Ireland Water

Caitriona Downey

Subject: NIEA -DWI - PWS 1068 - M01616-05 - Magheramore, Dungiven

From: PWS <privatewatersupplies@daera-ni.gov.uk>
Sent: 06 June 2018 11:54
To: Caitriona Downey
Cc: DWI <dwi@daera-ni.gov.uk>; PWS <privatewatersupplies@daera-ni.gov.uk>
Subject: NIEA -DWI - PWS 1068 - M01616-05 - Magheramore, Dungiven

NIEA -DWI - PWS 1068 - M01616-05 - Magheramore, Dungiven

Dear Caitriona

The Drinking Water Inspectorate only holds information on private water supplies registered with the Inspectorate under The Private Water Supplies Regulations (Northern Ireland) 2017 and has provided this below.

There are **no** private drinking water supplies registered with the Inspectorate within **5km** of the outlined site.

Please note the information provided in this e-mail is accurate in accordance with our latest records only.

Primary production sites, such as dairy farms, are not required to be registered with the Drinking Water Inspectorate. If you require information on these, you should contact the Quality Assurance Branch of the Department of Agriculture, Environment and Rural Affairs at Dundonald House, Upper Newtownards Road, Belfast. Tel. (028) 90 525001.

It is important that you note that the Drinking Water Inspectorate does not hold information on private water supplies which supply single dwellings. Details on these may be obtained from the Environmental Health Department of Causeway Coast and Glens Borough Council Tel: 028 7034 7034 or email: info@causewaycoastandglens.gov.uk .

You may also wish to contact Northern Ireland Water for information on any Northern Ireland Water sites in the area - Tel. 03457 440088 or Email: waterline@cs.niwater.com .

NIEA Water Management Unit can be contacted regarding other information that you may require: waterinfo@daera-ni.gov.uk .

You should also undertake your own scoping exercise of premises in the vicinity of the development as there may be private water supplies for which records are not held by the above agencies. This should include a survey of the surrounding properties to determine if they have a private water supply. This scoping exercise should include a desk study of relevant OS maps or other relevant information. If it has been assessed, in undertaking this assessment, that private drinking water supplies could be impacted upon by the development then the applicant should propose appropriate steps to mitigate against either a deterioration of drinking water quality or sufficiency of supply. This should include appropriate monitoring and sampling of the supply, if deemed appropriate. Details of any assessment of private water supplies should be made available to the DWI.

The Inspectorate is not in a position to comment on what other information may be relevant to a hydrology assessment.

Kind regards,

Karen Stevenson

Drinking Water Inspectorate
T: +44 (0) 28 9056 9282

E: Privatewatersupplies@daera-ni.gov.uk

www.daera-ni.gov.uk

Caitriona Downey

Subject: NIEA - WMU - WQU457 - WMU Response - Magheramore Windfarm
Attachments: Regional Groundwater Aquifer and Vulnerability Classification - April 20....pdf; NIEA - WMU - WQU - Pollution Prevention - Response.DOCX; NIEA - WMU - WQU457 Water Quality - Response - Classification.XLSX; NIEA - WMU - WQU457- Water Quality - Response.DOCX; NIEA - WMU - WQU457 - Abstractions - Response.DOCX

From: DAERA NIEA Water Info <WaterInfo@daera-ni.gov.uk>
Sent: 18 July 2018 15:12
To: Caitriona Downey
Subject: NIEA - WMU - WQU457 - WMU Response - Magheramore Windfarm

Hi Caitriona

Our ref WQU457, re Magheramore, Dungiven

A search of the groundwater monitoring database has found there are no groundwater monitoring points within the search area. Please see attached Surface Water Quality and Abstraction responses, also Groundwater Aquifers and Vulnerability and pollution prevention documents.

If you require any further information please contact waterinfo@daera-ni.gov.uk

Regards
Data Management

Department of Agriculture, Environment and Rural Affairs
www.daera-ni.gov.uk
NIEA Northern Ireland Environment Agency
www.daera-ni.gov.uk

Pollution Prevention

The aim of the Northern Ireland Environment Agency's (NIEA) Pollution Prevention Team is to reduce the number of water pollution incidents and minimize the impact of human activities on the environment by ensuring appropriate mitigation measures are in place during both the construction and operational phase of activities/projects.

This process involves customer engagement, planning process responses, agreement of construction method statements and completing proactive risk assessment site inspections to mitigate against the risk of water pollution. This enables the team to offer proactive advice appropriate to the circumstances or project.

To identify risks to the receiving environment the Pollution Prevention Team make use of the 'Source, Pathway, Receptor' model. It is suggested that contractors/site operators employ the same approach.

The NIEA recommends that all necessary source control and mitigation measures to prevent pollution of the water environment during construction, operational or maintenance phase of a project are identified and employed.

It is highly recommended that, as a first step, the customer identify any relevant Guidelines for Pollution Prevention (PPG and GPP) and adhere to the precepts contained within these. http://www.netregs.org.uk/library_of_topics/pollution_prevention_guides/all_ppgs.aspx

Since there is limited information about the scope or nature of this project the team can only provide 'general' advice at this stage.

It is recommended that NIEA Pollution Prevention Team be consulted about any work, to be conducted in or near a waterway, or liable to affect any waterway, to agree a method statement with contractors prior to the commencement of any works. This should be submitted 8 weeks prior to commencement of such works.

Risks to the water environment and the best practice principles and mitigation measures to minimise such risks should be identified, incorporated in contractors method statements and be in place prior to the commencement of any works. Such steps will help protect the aquatic environment from potential sources of pollution.

The team can provide guidance on what should be incorporated in such method statements e.g.

- Identify the perceived risks to any waterway e.g. from cement, concrete, grout, fuels/ oil/ hydrocarbons and suspended solids;
- Identify potential pollution pathways;
- Identify Mitigation measures that will be employed to minimise the risk of pollution to any waterway (as defined by the Water (NI) Order 1999), e.g:

1. Site drainage plans for the construction phase should be considered at an early stage. Surface water control on construction sites is extremely important to ensure site water is minimised (e.g. utilising cut off channels) collected, channelled and treated prior to discharge.
2. The use of cut of drains and check dams are useful. The water collected in these features should be channelled to settlement features (built and maintained according to industry bet practice) for treatment of suspended solids prior to discharge.
3. Phased stripping and minimisation of exposed land to control suspended solid generation should be considered.
4. Use of settlement systems for settlement of suspended solids from site drainage. These should be built and maintained according to industry best practice.

5. Any works in a waterway must be conducted 'in the dry' e.g. behind coffer dams, use of over pumping, the use of temporary diversions etc. The NIEA Pollution Prevention Team do not permit machinery to enter any waterway at any time. NIEA must be consulted prior to commencement of any such works to ensure appropriate mitigation measures are in place. The Pollution Prevention Team also work with contractors to ensure minimal disturbance and generation of suspended solids during the placement and removal of cofferdams/diversions etc
6. The NIEA do not encourage in stream settlement as a primary mitigation measure, the contractor must strive to ensure the generation of suspended solids is prevented/ minimised in the first instance. The use of downstream settlement measures is considered a secondary line of protection.
7. Management and maintenance of mitigation measures to ensure effective functioning.
8. Prevent pollution by fuel/oil, from leaking machinery, there must be regular inspections of machinery working near any waterway.
9. Safe refuelling, handling and storage practices for earth stockpiles and secondary containment for chemicals, oil, fuels etc.
10. Compliance with the requirements of Control of Pollution (Oil Storage) Regulations (NI) 2010.
11. Emergency spill procedures should be addressed

(This list is not exhaustive but should merely be used as a starting point for considerations to be made.)

- Demonstrate adherence of working practises to the precepts contained in relevant PPG's. e.g. PPG5 Works in, near or liable to affect watercourses and PPG6 Working at Demolition and Construction sites.

The Pollution Prevention Team would like to highlight the requirements of the Control of Pollution (Oil Storage) Regulations which have moved through transitional arrangements over a 4 year period.

From 31st December 2015 all non exempt oil storage facilities must comply with the Regulatory requirements.

The primary requirement is that oil (as defined by the regulations) stored in above ground containers over 200L (over 3500L in domestic premises) must be kept within secondary containment with 110% capacity.

Further guidance is available at the following link:
https://www.daera-ni.gov.uk/articles/oil-storage

The team will be happy to advise further as required is contactable at
nieapollutionprevention@daera-ni.gov.uk

ABSTRACTION RESPONSE

The dataset of Abstraction locations can be found online at:
https://www.daera-ni.gov.uk/publications/abstractions-and-discharges OR
https://www.opendatani.gov.uk/user/niea-water.

From either of these 2 websites, I would advise to carry out the following procedure to access a list of the data:

- Download the SHP version .zip file;
- Open up the .dbf file using a programme such as MS Excel;
- Re-save the file opened in stage (2) as .xls or .xlsx file or other relevant format.

You should now have a spreadsheet where you can filter the data as appropriate.

Please check the Abstractions Dataset Dictionary for further information. This dataset will be updated quarterly.

If you require any additional information on your request, please outline the specific data you need to WaterInfo@daera-ni.gov.uk or ail@daera-ni.gov.uk.

For information on Public Water Supplies in this area, contact Northern Ireland Water: waterline@niwater.com.

For information on Private Water Supplies in this area, contact the Drinking Water Inspectorate: dwi@daera-ni.gov.uk.

You will find other datasets on the NIEA WMU Water Information Request Viewer: https://appsd.daera-ni.gov.uk/WaterInformationRequest/, an overview of which can be found here: https://www.daera-ni.gov.uk/articles/information-requests.

River Water Body ID	Location	Local Management Area	Sitecode	Monitoring Station	IGR	Classify by site(s) or by other water body	Overall NI Site Class 2015	River Waterbody Class 2015
GBNI1NB030303227	Douglas River	Moyola	F10377	DOUGLAS R AT BOHERADAILE BR	H774967	Classify	HIGH	GOOD
GBNI1NW020202005	Owenalena River	Roe	F10169	OWENALENA R AT OWENALENA BR	C743060	Classify	HIGH	GOOD
GBNI1NW020202010	Owenrigh River	Roe	F10179	OWENRIGH R AT CARNANBANE	C669067	Classify	HIGH	MODERATE ECOLOGICAL POTENTIAL
GBNI1NW020202015	River Roe (Benady)	Roe	F11208	ROE R AT TURMEEL BR	C688088	Classify	HIGH	GOOD
GBNI1NW020202018	River Roe (Limavady)	Roe	F10171	ROE R AT LIMAVADY	C668229	Av with F10172	GOOD	GOOD
GBNI1NW020202018	River Roe (Limavady)	Roe	F10172	ROE R AT DOG LEAP	C679203	Av with F10171	GOOD	GOOD
GBNI1NW020202023	Owenbeg River	Roe	F10178	OWENBEG R AT DUNGIVEN	C683098	Classify	GOOD	GOOD

Sitecode	FFD
F10377	SAL
F10169	SAL
F10179	SAL
F11208	SAL
F10171	SAL
F10172	SAL
F10178	SAL

SAL = Salmonid

Site Code	Location	Grid Refere	Date	Time	Depth	ALK	NH3	BOD	COND	CUSOL1	DO	DO %	T/HARD	NO3-N	NO2-N	NH4-N	OILVIS	PH	P(SOL)	SS	TEMP	TON	ZNTOT2
						(MG/L)	(MG/L)	(MG/L)	(US/CM)	(MG/L)	(MG/L)	(SATN)	(MG/L)	(MG/L)	(MG/L)	(MG/L)	()	(PH UNITS)	(MG/L)	(MG/L)	(DEG C)	(MG/L)	(MG/L)
10169	OWENALENA R AT OWENALENA BR	C743060	05/01/2009	11:25	0	63 <	0.001	1.6	167	0.0005			70	0.21 <	0.006 <	0.04	0	7.8 <	0.01		2.5	0.21	0.007
10169	OWENALENA R AT OWENALENA BR	C743060	04/02/2009	11:55	0	33 <	0.001 <	1	102				38	0.18 <	0.006 <	0.04	0	7.5 <	0.01 <	2	1.2	0.18	
10169	OWENALENA R AT OWENALENA BR	C743060	05/03/2009	09:30	0	39 <	0.001	1.9	116		13.8	102	50	0.09	0.006 <	0.04	0	7.7 <	0.01 <	2	2.8	0.09	
10169	OWENALENA R AT OWENALENA BR	C743060	31/03/2009	09:45	0	43 <	0.001	1.3	144		11.5	96	61 <	0.05 <	0.006 <	0.04	0	7.82 <	0.01 <	2	7.5 <	0.05	
10169	OWENALENA R AT OWENALENA BR	C743060	05/05/2009	10:50	0	11 <	0.001	3.8	69		10.8	95	20	0.33	0.01	0.05	0	7.1 <	0.01	39	9.5	0.34	
10169	OWENALENA R AT OWENALENA BR	C743060	03/06/2009	12:00	0	81	0.001	1.5	189		9.8	96	91	0.12	0.007 <	0.04	0	7.9 <	0.01	7	14.5	0.12	
10169	OWENALENA R AT OWENALENA BR	C743060	02/07/2009	11:40	0	89	0.001	2	208	0.0008	8.5	89	89	0.15	0.008 <	0.04	0	8 <	0.01	2	17	0.16	0.02
10169	OWENALENA R AT OWENALENA BR	C743060	17/07/2009	00:00	0						10.1	97									13.3		
10169	OWENALENA R AT OWENALENA BR	C743060	06/08/2009	11:15	0	44	0.001	1.1	132		9.8	94	52	0.08 <	0.006 <	0.04	0	7.8 <	0.01 <	2	12.5	0.09	
10169	OWENALENA R AT OWENALENA BR	C743060	26/08/2009	11:20	0	6 <	0.001	1.8	41		10.1	95	14 <	0.05 <	0.006 <	0.04	0	6.5 <	0.01	8	13.5 <	0.05	
10169	OWENALENA R AT OWENALENA BR	C743060	29/09/2009	11:40	0	87	0.001	1.6	201		10.4	98	93	0.15	0.006 <	0.04	0	7.9 <	0.01 <	2	12.7	0.15	
10169	OWENALENA R AT OWENALENA BR	C743060	30/10/2009	10:50	0	28 <	0.001	1.1	91		10	95	35	0.14 <	0.006 <	0.04	0	7.4 <	0.01	5	12	0.14	
10169	OWENALENA R AT OWENALENA BR	C743060	25/11/2009	09:40	0	6 <	0.001	1.5	41		10.5	84	14 <	0.05 <	0.006 <	0.04	0	6.8 <	0.01	3	6 <	0.05	
10169	OWENALENA R AT OWENALENA BR	C743060	05/01/2011	11:50	0	18 <	0.001	2.1	65		12.5	91	28	0.14 <	0.006 <	0.04	0	7.5 <	0.01 <	2	2.1	0.15	
10169	OWENALENA R AT OWENALENA BR	C743060	01/02/2011	11:45	0	40 <	0.001		109		13.3	103	46	0.09 <	0.006 <	0.04	0	7.5 <	0.01	2	4.6	0.1	
10169	OWENALENA R AT OWENALENA BR	C743060	28/02/2011	11:55	0	26 <	0.001		86				33	0.08 <	0.006 <	0.04	0	7.5 <	0.01 <	2	3.8	0.09	
10169	OWENALENA R AT OWENALENA BR	C743060	30/03/2011	11:50	0	74	0.001	1.2	177		11.6	99	77	0.07 <	0.006 <	0.04	0	8 <	0.01 <	2	8.3	0.08	
10169	OWENALENA R AT OWENALENA BR	C743060	03/05/2011	12:10	0	93	0.001 <	1	217		11.7	101	102 <	0.05 <	0.006 <	0.04	0	8.3 <	0.01 <	2	8.7 <	0.05	
10169	OWENALENA R AT OWENALENA BR	C743060	02/06/2011	12:05	0	60	0.001	1.6	146		10.5	103	63 <	0.05 <	0.006 <	0.04	0	7.9 <	0.01 <	2	14.6 <	0.05	
10169	OWENALENA R AT OWENALENA BR	C743060	29/06/2011	10:40	0	60	0.001	1.5	141		10.7	98	60	0.06 <	0.006 <	0.04	0	7.8 <	0.01	2	11.7	0.07	
10169	OWENALENA R AT OWENALENA BR	C743060	01/08/2011	10:00	0	85	0.001 <	1	198		10.5	102	91	0.13 <	0.006 <	0.04	0	8	0.01 <	2	14.2	0.14	
10169	OWENALENA R AT OWENALENA BR	C743060	30/08/2011	09:00	0	89	0.001 <	1	200		10.6	96	93	0.09 <	0.006 <	0.04	0	8.1 <	0.01 <	2	10.9	0.1	
10169	OWENALENA R AT OWENALENA BR	C743060	29/09/2011	08:30	0	62	0.001	1.7	152		9.7	94	65	0.07 <	0.006 <	0.04	0	7.9 <	0.01 <	2	14.1	0.08	
10169	OWENALENA R AT OWENALENA BR	C743060	27/10/2011	10:20	0	29 <	0.001 <	1	82		11.4	96	36	0.13 <	0.006 <	0.04	0	7.3	0.01	4	8	0.14 <	0.005
10169	OWENALENA R AT OWENALENA BR	C743060	21/11/2011	12:20	0	30 <	0.001	1.1	84		11.2	97	42	0.09 <	0.006	0.06	0	7.4	0.01	3	9.3	0.1	
10169	OWENALENA R AT OWENALENA BR	C743060	04/01/2012	11:20	0 <	6 <	0.001	1.2	82		12.7	98	20	0.07 <	0.006 <	0.04	0	6.9 <	0.01	3	4.6	0.08	0.0063
10169	OWENALENA R AT OWENALENA BR	C743060	31/01/2012	11:35	0	21 <	0.001 <	1	92		13.2	95	32	0.17 <	0.006 <	0.04	0	7.4 <	0.01	3	1.9	0.18	
10169	OWENALENA R AT OWENALENA BR	C743060	27/02/2012	11:15	0	45 <	0.001	1.1	143		10.9	94	54	0.09 <	0.006 <	0.04	0	7.7 <	0.01 <	2	8.9	0.1	
10169	OWENALENA R AT OWENALENA BR	C743060	27/03/2012	12:50	0	79	0.001	1.1	190		11.8	107	83		<	0.04	0	8.2 <	0.01 <	2	10.8	<	0.005
10169	OWENALENA R AT OWENALENA BR	C743060	25/04/2012	09:10	0	45 <	0.001	1.6	126		11.6	93	51 <	0.08 <	0.006 <	0.04	0	7.7 <	0.01 <	2	6 <	0.08	
10169	OWENALENA R AT OWENALENA BR	C743060	21/05/2012	11:05	0	54	0.001 <	1	152		11.8	108	61 <	0.08 <	0.006 <	0.04	0	8.1 <	0.01 <	2	11.4 <	0.08	
10169	OWENALENA R AT OWENALENA BR	C743060	27/06/2012	10:40	0	38 <	0.001	1.3	186		9.5	92	75	0.5 <	0.006 <	0.04	0	7.6 <	0.01	4	14.1	0.51	0.0063
10169	OWENALENA R AT OWENALENA BR	C743060	24/07/2012	09:35	0	33 <	0.001	1.7	84		10.2	97	42 <	0.08 <	0.006 <	0.04	0	7.6 <	0.01 <	2	13.1 <	0.08	
10169	OWENALENA R AT OWENALENA BR	C743060	23/08/2012	12:15	0	47	0.001	1.5	113		9.6	93	50 <	0.08 <	0.006 <	0.04	0	7.8 <	0.01 <	2	13.9 <	0.08	
10169	OWENALENA R AT OWENALENA BR	C743060	20/09/2012	09:00	0	30 <	0.001	1.7	88		10.5	93	35 <	0.08 <	0.006 <	0.04	0	7.6 <	0.01	3	10.1 <	0.08	
10169	OWENALENA R AT OWENALENA BR	C743060	15/10/2012	12:35	0	37 <	0.001	1.6	95		11.6	96	46 <	0.08 <	0.006 <	0.04	0	7.6 <	0.01 <	2	7.3 <	0.08	
10169	OWENALENA R AT OWENALENA BR	C743060	15/11/2012	11:30	0	31 <	0.001	1.1	92		11.6	99	42 <	0.08 <	0.006 <	0.04	0	7.4 <	0.01 <	2	8.6 <	0.08	
10169	OWENALENA R AT OWENALENA BR	C743060	05/03/2015	12:11	0 <	10 <	0.001 <	2	64		12.2	97	27 <	0.06	0.006 <	0.04	0	7.2 <	0.01	4	5.6 <	0.06	
10169	OWENALENA R AT OWENALENA BR	C743060	01/06/2015	10:48	0	30 <	0.001 <	2	92		11.2	97	45 <	0.06 <	0.005 <	0.04	0	7.8 <	0.01 <	2	9 <	0.06	
10169	OWENALENA R AT OWENALENA BR	C743060	26/08/2015	11:53	0	13 <	0.001 <	2	52		10	94	35 <	0.06	0.008 <	0.04	0	7.4 <	0.01	2	12.5 <	0.06	
10169	OWENALENA R AT OWENALENA BR	C743060	12/11/2015	11:27	0	25 <	0.001	2.2	85		11.4	96	39 <	0.06	0.007 <	0.04	0	7.7 <	0.01 <	2	8 <	0.06	
10169	OWENALENA R AT OWENALENA BR	C743060	02/03/2016	00:00	0	19 <	0.001 <	2	81		12.7	96	37	0.07 <	0.005	0.04	0	7.6	0.01	5	3.6	0.07	
10169	OWENALENA R AT OWENALENA BR	C743060	02/06/2016	00:00	0	87	0.001 <	2	196		10.2	101	94 <	0.06 <	0.005 <	0.04	0	8 <	0.01 <	2	15 <	0.06	
10169	OWENALENA R AT OWENALENA BR	C743060	30/08/2016	00:00	0	75	0.001 <	2	170		10.7	106	94	0.08 <	0.005 <	0.04	0	7.9 <	0.01 <	2	14.8	0.08	
10169	OWENALENA R AT OWENALENA BR	C743060	28/11/2016	11:36	0	40 <	0.001 <	2	113		11.9	95	55	0.08 <	0.005 <	0.04	0	7.7 <	0.01 <	2	5.5	0.08	
10169	OWENALENA R AT OWENALENA BR	C743060	05/01/2017	00:00	0									0.1 <	0.005 <	0.04		<	0.01			0.1	
10169	OWENALENA R AT OWENALENA BR	C743060	25/01/2017	00:00	0									0.21 <	0.005 <	0.04			0.01			0.21	
10169	OWENALENA R AT OWENALENA BR	C743060	06/03/2017	00:00	0	33 <	0.001 <	2	104		11.9	94	45	0.09 <	0.005 <	0.04	0	7.6 <	0.01 <	2	5.5	0.09	
10169	OWENALENA R AT OWENALENA BR	C743060	29/03/2017	00:00	0									0.07 <	0.005 <	0.04	0		0.01			0.07	
10169	OWENALENA R AT OWENALENA BR	C743060	03/05/2017	00:00	0								<	0.06 <	0.005 <	0.04	0	<	0.01		<	0.06	
10169	OWENALENA R AT OWENALENA BR	C743060	05/06/2017	11:15	0	12 <	0.001	2	51		10.8	100	31 <	0.06	0.006 <	0.04	0	7	0.01	6	12 <	0.06	
10169	OWENALENA R AT OWENALENA BR	C743060	05/07/2017	00:00	0								<	0.06	0.006 <	0.04	0		0.01		<	0.06	
10169	OWENALENA R AT OWENALENA BR	C743060	01/08/2017	10:00	0								<	0.06	0.005 <	0.04	0		0.01		<	0.06	
10169	OWENALENA R AT OWENALENA BR	C743060	29/08/2017	00:00	0	55 <	0.001 <	2	134		10.3	95	61	0.08 <	0.005 <	0.04	0	7.7 <	0.01	2	11.6	0.08	
10169	OWENALENA R AT OWENALENA BR	C743060	28/09/2017	00:00	0								<	0.06	0.006 <	0.04	0	<	0.01		<	0.06	
10169	OWENALENA R AT OWENALENA BR	C743060	26/10/2017	09:00	0									0.07 <	0.005 <	0.04	0	<	0.01			0.07	
10169	OWENALENA R AT OWENALENA BR	C743060	23/11/2017	00:00	0	20 <	0.001 <	2	73		12	94	28	0.07	0.005 <	0.04	0	7.3 <	0.01 <	2	5	0.07	
10171	ROE RIVER AT LIMAVADY	C668229	05/01/2009	10:40	0	84 <	0.001	2.2	281	0.001	13.3	101	103	1.71	0.011 <	0.04	0	7.8	0.02		3.5	1.72	0.006
10171	ROE RIVER AT LIMAVADY	C668229	04/02/2009	10:30	0	53 <	0.001	2.2	256		12.7	95	73	1.21	0.007 <	0.04	0	6.9	0.02	8	2.5	1.21	
10171	ROE RIVER AT LIMAVADY	C668229	05/03/2009	10:50	0	57 <	0.001	2.6	213		12.3	95	77	0.96	0.014	0.04	0	7.7	0.02 <	2	4.5	0.97	
10171	ROE RIVER AT LIMAVADY	C668229	31/03/2009	11:00	0	64 <	0.001 <	1	225	0.0023	11.6	100	95	0.95	0.007 <	0.04	0	7.81	0.02	4	9	0.95	
10171	ROE RIVER AT LIMAVADY	C668229	05/05/2009	08:30	0	43 <	0.001	2.4	151		11.5	102	52	0.59	0.013	0.05	0	7.7	0.01	6	10	0.6	
10171	ROE RIVER AT LIMAVADY	C668229	03/06/2009	08:00	0	94	0.001	1.1	276		9.8	101	117	1.14	0.014 <	0.04	0	7.9 <	0.01 <	2	16.5	1.15	
10171	ROE RIVER AT LIMAVADY	C668229	02/07/2009	09:00	0	101		2.4	289	0.0013	9.2	99	111	0.81	0.012 <	0.04	0	8	0.01			0.82	0.0125
10171	ROE RIVER AT LIMAVADY	C668229	06/08/2009	08:15	0	44	0.001	1.5	150		10.1	100	58	0.52	0.008 <	0.04	0	7.7	0.02 <	2	15.3	0.53	
10171	ROE RIVER AT LIMAVADY	C668229	26/08/2009	11:00	0	51 <	0.001	1.5	174		9.6	94	67	0.62 <	0.006 <	0.04	0	7.7	0.03	4	14	0.62	
10171	ROE RIVER AT LIMAVADY	C668229	29/09/2009	09:00	0	96	0.001	1.5	278		10	97	111	1.04	0.011 <	0.04	0	7.9	0.01 <	2	14	1.05	
10171	ROE RIVER AT LIMAVADY	C668229	30/10/2009	11:00	0	56 <	0.001	1.9	188		9.9	95	76	0.9 <	0.006 <	0.04	0	7.6	0.02	6	11	0.9	
10171	ROE RIVER AT LIMAVADY	C668229	25/11/2009	09:15	0	30 <	0.001	2.5	117				44	0.65 <	0.006	0.07	0	7.4	0.03	37	6.7	0.65	
10171	ROE RIVER AT LIMAVADY	C668229	05/01/2010	09:00	0	76 <	0.001		330	0.0019	12.4	87	98	1.32	0.01	0.08	0	7.8	0.03	3	1	1.33	0.0063
10171	ROE RIVER AT LIMAVADY	C668229	02/02/2010	11:45	0	35 <	0.001	1.8	151		13.1	103	72	0.62	0.01	0.06	0	7.5	0.02	24	5	0.63	
10171	ROE RIVER AT LIMAVADY	C668229	08/03/2010	10:00	0	45 <	0.001	1.9	164		11.8	87	62	0.93	0.007 <	0.04	0	7.6	0.01	6	2.5	0.94	
10171	ROE RIVER AT LIMAVADY	C668229	30/03/2010	09:30	0	26 <	0.001	3	158	0.004115	12.1	91	44	1.84	0.014	0.18	0	7.1	0.12	34	3.6	1.85	0.015899
10171	ROE RIVER AT LIMAVADY	C668229	06/05/2010	10:00	0	78 <	0.001	1.2	235		11.2	100	96	0.75	0.009 <	0.04	0	7.2 <	0.01	10	11	0.76	
10171	ROE RIVER AT LIMAVADY	C668229	03/06/2010	09:40	0	70	0.001	2.9	214		9.8	97	89	0.91	0.017	0.05	0	7.8	0.02	5	15.1	0.93	
10171	ROE RIVER AT LIMAVADY	C668229	05/07/2010	10:10	0	27 <	0.001	2.9	103	0.002401	9.1	89	47	0.41	0.007 <	0.04	0	7.6	0.01	19	14.3	0.42	0.006738
10171	ROE RIVER AT LIMAVADY	C668229	04/08/2010	11:45	0	75	0.001	1.1	228		10.1	99	91	0.8	0.007 <	0.04	0	8	0.03 <	2	14.9	0.81	
10171	ROE RIVER AT LIMAVADY	C668229	02/09/2010	10:05	0	82	0.001	1.2	232		8.5	83	97	0.85	0.008 <	0.04	0	7.9	0.02 <	2	14.1	0.86	
10171	ROE RIVER AT LIMAVADY	C668229	29/09/2010	11:30	0	72	0.001	2.3	208	0.0028	9.3	86	87	0.82	0.02	0.05	0	7.8	0.04	8	11.9	0.84	0.0079
10171	ROE RIVER AT LIMAVADY	C668229	03/11/2010	10:00	0	27 <	0.001	2.4	119		9.4	79	40	1.03 <	0.006 <	0.04	0	7.3	0.04	10	7.9	1.04	
10171	ROE RIVER AT LIMAVADY	C668229	25/11/2010	11:20	0	57 <	0.001	2.5	232		12.7	97	82	1.06	0.008	0.07	0	7.6	0.02	3	4	1.07	
10171	ROE RIVER AT LIMAVADY	C668229	06/01/2011	09:50	0	39 <	0.001		167		12.3	92	56	1.06 <	0.006	0.04	0	7.6	0.02	4	3.4	1.07	
10171	ROE RIVER AT LIMAVADY	C668229	01/02/2011	09:45	0	81	0.001		257		13.3	103	97	1.51	0.013	0.09	0	7.8	0.02 <	2	5.3	1.52	
10171	ROE RIVER AT LIMAVADY	C668229	28/02/2011	10:45	0	44 <	0.001		158		13.6	106	57	0.82 <	0.006 <	0.04	0	7.6	0.02	3	4.8	0.83	
10171	ROE RIVER AT LIMAVADY	C668229	30/03/2011	09:30	0	89 <	0.001 <	1	275		9.9	87	111	1.28 <	0.006 <	0.04	0	7.8	0.01 <	2	9.4	1.29	
10171	ROE RIVER AT LIMAVADY	C668229	03/05/2011	10:40	0	106	0.002 <	1	308		11.4	105	133	0.99	0.019 <	0.04	0	8.3 <	0.01 <	2	12	1.01	
10171	ROE RIVER AT LIMAVADY	C668229	02/06/2011	09:40	0	75	0.001	1.4	229		10.1	101	88	0.93	0.015 <	0.04	0	8	0.02	4	15.6	0.94	
10171	ROE RIVER AT LIMAVADY	C668229	29/06/2011	10:35	0	69	0.002	3.9	216		10.4	99	78	1.46	0.024	0.18	0	7.7	0.08	13	13.1	1.48	
10171	ROE RIVER AT LIMAVADY	C668229	01/08/2011	09:30	0	97	0.001 <	1	274		10.6	107	115	1.08 <	0.006 <	0.04	0	8.1	0.01 <	2	15.9	1.09	
10171	ROE RIVER AT LIMAVADY	C668229	30/08/2011	10:30	0	81	0.001	1	273		10.9	103	111	1.85	0.019 <	0.04	0	7.8	0.03	2	13	1.87	
10171	ROE RIVER AT LIMAVADY	C668229	29/09/2011	10:10	0	79	0.001	1.6	226		9.5	96	89	0.96 <	0.006 <	0.04	0	8	0.03 <	2	15.7	0.97	
10171	ROE RIVER AT LIMAVADY	C668229	27/10/2011	11:00	0	52 <	0.001	1.2	178		11	95	71	0.96	0.006 <	0.04	0	7.5	0.03	3	9	0.97 <	0.005
10171	ROE RIVER AT LIMAVADY	C668229	21/11/2011	10:20	0	58 <	0.001	1.4	185		10.9	97	69	0.93 <	0.006 <	0.04	0	7.5	0.03	5	10.3	0.94	
10171	ROE RIVER AT LIMAVADY	C668229	04/01/2012	11:00	0	24 <	0.001	1.6	157		13	101	41	0.56 <	0.006 <	0.04	0	7.2	0.02	9	5.2	0.57	0.0159
10171	ROE RIVER AT LIMAVADY	C668229	31/01/2012	10:00	0	37 <	0.001	1.2	185		13.1	99	60	0.74 <	0.006 <	0.04	0	7.6	0.02	6	3.7	0.75	
10171	ROE RIVER AT LIMAVADY	C668229	27/02/2012	10:30	0	70 <	0.001	2	231		11	95	90	1.17	0.008 <	0.04	0	7.7	0.03	3	9.2	1.18	
10171	ROE RIVER AT LIMAVADY	C668229	27/03/2012	08:20	0	91	0.001	1.7	275		10.7	93	107		<	0.04	0	8	0.01 <	2	9.3	<	0.005
10171	ROE RIVER AT LIMAVADY	C668229	25/04/2012	09:15	0	59 <	0.001	1.3	125		11.2	95	75	0.81 <	0.006 <	0.04	0	7.7	0.01 <	2	8.2	0.82	
10171	ROE RIVER AT LIMAVADY	C668229	21/05/2012	10:20	0	73	0.001	1.4	224		10.6	96	93	0.79 <	0.006 <	0.04	0	7.9	0.02	2	12	0.8	
10171	ROE RIVER AT LIMAVADY	C668229	27/06/2012	10:00	0	66	0.001	1.2	208		10	99	89	1.14 <	0.006 <	0.04	0	7.8	0.02	2	14.3	1.15 <	0.005
10171	ROE RIVER AT LIMAVADY	C668229	24/07/2012	11:40	0	51	0.001	2.1	163		9.5	96	63	1	0.02	0.08	0	7.7	0.03	5	15.7	1.02	
10171	ROE RIVER AT LIMAVADY	C668229	23/08/2012	11:30	0	69	0.001	1.6	201		9.9	99	77	0.76	0.006 <	0.04	0	7.9	0.03	2	15.2	0.77	
10171	ROE RIVER AT LIMAVADY	C668229	20/09/2012	10:25	0	56	0.001	1.7	181		10.8	98	69	0.69 <	0.006 <	0.04	0	7.8	0.03	3	11.2	0.7	
10171	ROE RIVER AT LIMAVADY	C668229	15/10/2012	09:45	0	56 <	0.001	1.6	173		11.6	98	68	0.58 <	0.006 <	0.04	0	7.7	0.02	2	7.9	0.59	

10171	ROE RIVER AT LIMAVADY	C668229	15/11/2012	10:15	0	49	< 0.001	1.2	162		11.4	96	67	0.56	< 0.006	< 0.04	0	7.6	0.02	< 2	8	0.57	
10171	ROE RIVER AT LIMAVADY	C668229	07/01/2013	10:15	0	28	< 0.001	1.7	101	0.0021	11.2	97	36	0.31	< 0.006	< 0.04	0	7.2	0.03	22	9	0.32	0.0086
10171	ROE RIVER AT LIMAVADY	C668229	28/01/2013	09:50	0	29	< 0.001	2.3	129	0.0018	13.2	99	44	0.49	< 0.006	0.05	0	7	0.03	9	3.2	0.5	0.0065
10171	ROE RIVER AT LIMAVADY	C668229	26/02/2013	12:00	0	85	< 0.001	< 1	263	0.0009	12.9	99	107			0.05	0	7.7	0.02	< 2	4.7		0.0037
10171	ROE RIVER AT LIMAVADY	C668229	28/03/2013	09:15	0	71	< 0.001		240	0.0017	13.6	100	92	1.02	0.007	< 0.04	0	7.8	0.02	< 2	2.8	1.03	0.0031
10171	ROE RIVER AT LIMAVADY	C668229	01/05/2013	12:10	0	65		1.5	203	0.001	11.6	102	77				0	8		< 2	9.8		0.0034
10171	ROE RIVER AT LIMAVADY	C668229	28/05/2013	13:00	0	37	< 0.001	1.5	143	0.0019	10.5	97	50	0.82	0.013	< 0.04	0	7.5	0.02	3	12.1	0.83	0.0036
10171	ROE RIVER AT LIMAVADY	C668229	24/06/2013	12:45	0	28	< 0.001	1.3	104	0.0025	10.6	98	40	0.49	0.01	< 0.04	0	7.4	0.03	4	12	0.5	0.0044
10171	ROE RIVER AT LIMAVADY	C668229	25/07/2013	12:00	0	97	0.003	1.7	285	0.0018	11.3	124	111	1.23	0.024	< 0.04	0	8.3	0.01	3	19.6	1.25	0.0032
10171	ROE RIVER AT LIMAVADY	C668229	22/08/2013	12:40	0	86	0.001	1.1	255	0.0015	10.1	105	102	0.95	0.008	< 0.04	0	7.9	0.03	3	17.5	0.96	0.0019
10171	ROE RIVER AT LIMAVADY	C668229	17/09/2013	12:25	0	35	< 0.001	1.1	146	0.0039	10.9	98	73	0.8	0.01	0.04	0	7.5	0.03	5	10.8	0.81	0.0065
10171	ROE RIVER AT LIMAVADY	C668229	16/10/2013	12:20	0	95	< 0.001	1.3	275	0.0009	10.1	90	113	1.04	0.005	< 0.04	0	7.8	0.03	< 2	10.4	1.04	0.0033
10171	ROE RIVER AT LIMAVADY	C668229	13/11/2013	12:35	0	60	< 0.001	1.7	198	0.0017	12	100	75	0.89	0.007	< 0.04	0	7.7	0.02	3	7.3	0.9	0.0046
10171	ROE RIVER AT LIMAVADY	C668229	07/01/2014	12:20	0	35	< 0.001	< 1	149		11.6	95	53	0.75	0.006	< 0.04	0	7.5	0.02	3	6.8	0.76	
10171	ROE RIVER AT LIMAVADY	C668229	03/02/2014	11:40	0	41	< 0.001	1.2	175		11.8	96	59	1.07	0.006	< 0.04	0	7.4	0.02	4	6.5	1.08	
10171	ROE RIVER AT LIMAVADY	C668229	04/03/2014	12:10	0	49	< 0.001	1.6	188		12.1	97	65	1	0.01	0.04	0	7.6	0.02	4	6.2	1.01	
10171	ROE RIVER AT LIMAVADY	C668229	03/04/2014	11:30	0	16	< 0.001	3.2	74		11.3	98	36	0.31	0.009	0.05	0	7.2	0.02	38	9	0.32	
10171	ROE RIVER AT LIMAVADY	C668229	08/05/2014	09:30	0	31	< 0.001	2.4	112		10.7	97	43	0.43	0.01	< 0.04	0	7.5	< 0.01	6	11	0.44	
10171	ROE RIVER AT LIMAVADY	C668229	09/06/2014	09:10	0	19	< 0.001	3	71		10.4	98	31	0.22	0.012	< 0.04	0	7.3	0.02	9	12.7	0.23	
10171	ROE RIVER AT LIMAVADY	C668229	30/06/2014	09:40	0	98	0.001	2.2	278		10.6	104	118	0.85	0.012	< 0.04	0	8.1	0.01	3	14.9	0.86	
10171	ROE RIVER AT LIMAVADY	C668229	30/07/2014	09:30	0	51	0.001	1.6	167		9.1	92	67	0.67	0.014	< 0.04	0	7.8	0.02	2	15.8	0.68	
10171	ROE RIVER AT LIMAVADY	C668229	28/08/2014	09:35	0	69	0.001	1	207		9.5	93	86	0.74	0.009	< 0.04	0	7.9	0.19	5	14	0.75	
10171	ROE RIVER AT LIMAVADY	C668229	23/09/2014	09:30	0	107	0.001	2.4	296		11.4	109	123	0.47	0.006	< 0.04	0	8.2	0.01	< 2	13.1	0.48	
10171	ROE RIVER AT LIMAVADY	C668229	22/10/2014	09:20	0	31	< 0.001	1.9	134		11.2	97	53	0.89	0.009	< 0.04	0	7.4	0.03	3	9.1	0.9	
10171	ROE RIVER AT LIMAVADY	C668229	19/11/2014	09:30	0	61	< 0.001	1.3	203		11.2	96	82	1.19	0.007	< 0.04	0	7.7	0.03	2	8.7	1.2	
10171	ROE RIVER AT LIMAVADY	C668229	22/01/2015	08:15	0	59	< 0.001	2.4	239		13.1	99	83	1.28	0.005	< 0.04	0	7.6	0.02	3	3.4	1.28	
10171	ROE RIVER AT LIMAVADY	C668229	17/02/2015	08:44	0	41		< 2	179		13.2	100	64	0.76	0.007		0	7.5	0.02	2	3.8	0.77	
10171	ROE RIVER AT LIMAVADY	C668229	05/03/2015	09:26	0	21	< 0.001	2.1	127		12.8	101	39	0.4	0.008	< 0.04	0	7.1	0.02	15	5	0.41	
10171	ROE RIVER AT LIMAVADY	C668229	22/04/2015	08:48	0	88	0.001	< 2	275		11.2	101	107	0.9	0.007	< 0.04	0	7.9	< 0.01	< 2	10.5	0.91	
10171	ROE RIVER AT LIMAVADY	C668229	06/05/2015	08:51	0	23	< 0.001	2.5	106		11.4	96	43	0.44	0.008	0.06	0	7.4	0.02	8	7.6	0.45	
10171	ROE RIVER AT LIMAVADY	C668229	01/06/2015	08:32	0	35	< 0.001	< 2	133		10.9	98	49	0.49	0.007	< 0.04	0	7.7	0.01	3	10.7	0.5	
10171	ROE RIVER AT LIMAVADY	C668229	20/07/2015	08:44	0	32	< 0.001	< 2	118		9.9	95	44	0.37	0.011	0.05	0	7.5	0.03	3	13.3	0.38	
10171	ROE RIVER AT LIMAVADY	C668229	03/08/2015	08:43	0	68	< 0.001	< 2	209		9.8	94	82	0.71	0.01	< 0.04	0	7.6	0.04	4	13.5	0.72	
10171	ROE RIVER AT LIMAVADY	C668229	26/08/2015	09:19	0	53	< 0.001	< 2	177		10.1	95	74	0.65	0.009	< 0.04	0	7.3	0.04	11	12.6	0.66	
10171	ROE RIVER AT LIMAVADY	C668229	13/10/2015	08:43	0	103	< 0.001	< 2	278		11.3	95	115	0.97	0.006	< 0.04	0	7.9	0.02	< 2	7.7	0.98	
10171	ROE RIVER AT LIMAVADY	C668229	22/10/2015	08:38	0	60	< 0.001	3.4	192		10.4	94	78	0.56	0.008	< 0.04	0	7.6	0.03	6	10.5	0.57	
10171	ROE RIVER AT LIMAVADY	C668229	12/11/2015	09:34	0	40	< 0.001	< 2	147		11.2	96	57	0.61	0.009	< 0.04	0	7.6	0.03	2	8.9	0.62	
10171	ROE RIVER AT LIMAVADY	C668229	19/01/2016	00:00	0	55	< 0.001	< 2	137		12.5	98	59	0.75	0.005	< 0.04	0	7.3	0.02	4	5	0.75	
10171	ROE RIVER AT LIMAVADY	C668229	11/02/2016	00:00	0	51	< 0.001	< 2	197		13	98	129	0.87	0.006	< 0.04	0	7.6	0.02		3.3	0.88	
10171	ROE RIVER AT LIMAVADY	C668229	02/03/2016	00:00	0	32	< 0.001	< 2	178		12.7	97	51	0.45	0.007	0.06	0	7.4	0.03		4	0.46	
10171	ROE RIVER AT LIMAVADY	C668229	20/04/2016	00:00	0	80	< 0.001	< 2	251		12.1	101	106	1	0.008	< 0.04	0	7.8	0.03	3	7.5	1.01	
10171	ROE RIVER AT LIMAVADY	C668229	23/05/2016	00:00	0	41	< 0.001	< 2	144		10.9	99	63	0.53	0.009	< 0.04	0	7.6	0.02		10.8	0.54	
10171	ROE RIVER AT LIMAVADY	C668229	02/06/2016	00:00	0	99	0.001	< 2	292		10.1	100	116	1.15	0.014	< 0.04	0	7.9	0.02		15	1.16	
10171	ROE RIVER AT LIMAVADY	C668229	26/07/2016	00:00	0	89	0.001	< 2	257		11.1	110	105	0.94	0.014	< 0.04	0	7.9	0.04	4	14.6	0.95	
10171	ROE RIVER AT LIMAVADY	C668229	18/08/2016	00:00	0	88	0.001	< 2	254		10.6	107	108	0.99	0.007	< 0.04	0	7.8	0.04		15.8	1	
10171	ROE RIVER AT LIMAVADY	C668229	30/08/2016	00:00	0	85	0.001	< 2	239		10.7	106	94	0.83	0.006	< 0.04	0	7.9	0.04		14.8	0.84	
10171	ROE RIVER AT LIMAVADY	C668229	10/10/2016	08:59	0	96	0.003	< 2	278		10.2	92	113	0.95	0.008	0.17	0	7.9	0.04	< 2	11.1	0.96	
10171	ROE RIVER AT LIMAVADY	C668229	17/11/2016	09:05	0	48	< 0.001	2.7	184		11.5	93	75	0.74	0.01	0.05	0	7.6	0.06		6.1	0.75	
10171	ROE RIVER AT LIMAVADY	C668229	28/11/2016	09:16	0	55	< 0.001	< 2	189		11.8	95	79	0.7	0.006	< 0.04	0	7.6	0.03		6.1	0.71	
10171	ROE RIVER AT LIMAVADY	C668229	05/01/2017	09:24	0	54	< 0.001	< 2	197		12.4	95	85	0.72	0.008	< 0.04	0	7.7	0.03	< 2	4.1	0.73	
10171	ROE RIVER AT LIMAVADY	C668229	25/01/2017	00:00	0	85	< 0.001	< 2	263		11.4	95	110	1.2	0.009	< 0.04	0	7.9	0.03	5	7.1	1.21	
10171	ROE RIVER AT LIMAVADY	C668229	06/03/2017	00:00	0	48	< 0.001	< 2	181		11.8	93	70	0.95	0.005	< 0.04	0	7.6	0.02		5.5	0.95	
10171	ROE RIVER AT LIMAVADY	C668229	29/03/2017	00:00	0	87	0.001	< 2	267		11	95	109	1.24	0.006	< 0.04	0	7.9	0.03		8.7	1.25	
10171	ROE RIVER AT LIMAVADY	C668229	03/05/2017	00:00	0	98	0.001	< 2	279		10.2	94	116	0.51	0.007	< 0.04	0	8.1	0.01	< 2	11.8	0.52	
10171	ROE RIVER AT LIMAVADY	C668229	05/06/2017	09:50	0	60	0.001	7.8	184		9.5	89	75	0.71	0.015	0.09	0	7.6	0.05		12.8	0.72	
10171	ROE RIVER AT LIMAVADY	C668229	05/07/2017	00:00	0	20	< 0.001	< 2	96		10.2	96	32	0.37	0.011	0.04	0	7.2	0.03	7	12.6	0.38	
10171	ROE RIVER AT LIMAVADY	C668229	02/08/2017	00:00	0	43	< 0.001	< 2	140		9.8	95	52	0.38	0.009	0.04	0	7.6	0.04		14.1	0.39	
10171	ROE RIVER AT LIMAVADY	C668229	29/08/2017	00:00	0	70	0.001	< 2	216		9.9	95	85	0.86	0.007	< 0.04	0	7.8	0.04		13.7	0.87	
10171	ROE RIVER AT LIMAVADY	C668229	28/09/2017	00:00	0	18	< 0.001	3.2	81		10.6	98	30	0.25	0.009	< 0.04	0	7.2	0.04	28	11.7	0.26	
10171	ROE RIVER AT LIMAVADY	C668229	26/10/2017	09:00	0	58	< 0.001	< 2	193		10.9	97	71	0.72	0.008	< 0.04	0	7.6	0.03		9.9	0.73	
10171	ROE RIVER AT LIMAVADY	C668229	23/11/2017	00:00	0	31	< 0.001	< 2	133		11.8	95	44	0.71	0.009	< 0.04	0	7.4	0.04		6.2	0.72	
10172	ROE RIVER AT DOG LEAP	C679203	05/01/2009	11:00	0	84	< 0.001	1.3	270	0.001	12.9	97	107	1.64	0.013	0.05	0	7.8	0.03		3.5	1.66	0.0029
10172	ROE RIVER AT DOG LEAP	C679203	04/02/2009	10:45	0	52	< 0.001	1.4	237		13.2	98	71	1.14	< 0.006	< 0.04	0	7.5	0.02	2	2.5	1.14	
10172	ROE RIVER AT DOG LEAP	C679203	05/03/2009	11:00	0	58	< 0.001	2.3	211		12.9	98	75	0.88	0.014	< 0.04	0	7.8	0.02	< 2	4	0.89	
10172	ROE RIVER AT DOG LEAP	C679203	31/03/2009	11:20	0	64	0.003	> 10	238	0.0016	10	93	89	0.97	0.017	0.22	0	7.83	0.09	3	12	0.99	0.0061
10172	ROE RIVER AT DOG LEAP	C679203	05/05/2009	10:50	0	44	0.001	2.7	153		11.5	102	52	0.75	0.016	0.11	0	7.7	0.03	49	9.5	0.76	
10172	ROE RIVER AT DOG LEAP	C679203	03/06/2009	11:00	0	95	0.001	< 1	268		10.3	104	113	0.98	0.014	< 0.04	0	8	0.01	< 2	18	0.99	
10172	ROE RIVER AT DOG LEAP	C679203	02/07/2009	10:45	0	98		2.5	285	0.0012	8.7	95	111	0.87	0.016	< 0.04	0	8.1	0.01	< 2		0.89	0.0028
10172	ROE RIVER AT DOG LEAP	C679203	06/08/2009	09:40	0	46	0.001	1.5	153		9.9	98	58	0.48	0.008	< 0.04	0	7.7	0.03	2	14.9	0.48	
10172	ROE RIVER AT DOG LEAP	C679203	26/08/2009	11:30	0	53	< 0.001	1.4	176		9.3	90	69	0.59	< 0.006	< 0.04	0	7.6	0.03	25	13.5	0.59	
10172	ROE RIVER AT DOG LEAP	C679203	29/09/2009	10:30	0	94	0.001	1.1	269		10.5	101	107	0.93	0.012	< 0.04	0	8	0.01	< 2	13.9	0.94	
10172	ROE RIVER AT DOG LEAP	C679203	30/10/2009	11:15	0	55	< 0.001	1.4	183		10.1	96	74	0.76	< 0.006	< 0.04	0	7.7	0.03	< 2	13	0.76	
10172	ROE RIVER AT DOG LEAP	C679203	25/11/2009	10:40	0	32	< 0.001	1.6	137				42	0.68	< 0.006	0.05	0	7.3	0.03	22	6.7	0.68	
10172	ROE RIVER AT DOG LEAP	C679203	05/01/2011	09:15	0	25	< 0.001	2.8	135		11.9	89	42	0.82	< 0.006	< 0.04	0	7.4	0.03	13	3	0.83	
10172	ROE RIVER AT DOG LEAP	C679203	01/02/2011	10:05	0	80	< 0.001		259		13.1	103	97	1.41	0.013	0.1	0	7.5	0.03	2	5.2	1.42	
10172	ROE RIVER AT DOG LEAP	C679203	28/02/2011	11:10	0	44	< 0.001		159		13.6	105	59	0.88	< 0.006	< 0.04	0	7.6	0.02	2	4.4	0.89	
10172	ROE RIVER AT DOG LEAP	C679203	30/03/2011	10:45	0	89	0.001	1.3	270		10	87	109	1.29	0.007	< 0.04	0	7.9	0.02	< 2	9.4	1.3	
10172	ROE RIVER AT DOG LEAP	C679203	03/05/2011	11:10	0	103	0.004	< 1	290		11.2	105	123	0.75	0.019	< 0.04	0	8.7	< 0.01	< 2	12.5	0.77	
10172	ROE RIVER AT DOG LEAP	C679203	02/06/2011	11:05	0	73	0.001	1.7	224		9.1	102	86	0.87	0.027	< 0.04	0	8	0.03	3	16.7	0.9	
10172	ROE RIVER AT DOG LEAP	C679203	29/06/2011	11:00	0	64	0.001	4.2	198		10.7	100	72	1.21	0.022	0.13	0	7.7	0.07	9	12.4	1.23	
10172	ROE RIVER AT DOG LEAP	C679203	01/08/2011	11:00	0	96	0.002	< 1	272		10.6	104	109	0.81	< 0.006	< 0.04	0	8.2	0.01	< 2	16.4	0.82	
10172	ROE RIVER AT DOG LEAP	C679203	30/08/2011	08:15	0	92	0.001	1.3	260		10.5	98	107	0.81	< 0.006	< 0.04	0	8	0.01	< 2	12.5	0.82	
10172	ROE RIVER AT DOG LEAP	C679203	29/09/2011	10:30	0	79	0.001	1.6	221		9.7	97	89	0.85	< 0.006	< 0.04	0	8.1	0.03	< 2	15.7	0.86	
10172	ROE RIVER AT DOG LEAP	C679203	27/10/2011	11:20	0	51	< 0.001	1.5	174		10.4	89	65	0.99	0.006	< 0.04	0	7.4	0.03	3	8.5	1	0.00525
10172	ROE RIVER AT DOG LEAP	C679203	21/11/2011	10:45	0	58	< 0.001	1.1	181		10.9	97	69	0.87	< 0.006	< 0.04	0	7.6	0.03	< 2	10.1	0.88	
10172	ROE RIVER AT DOG LEAP	C679203	31/01/2012	10:30	0	39	< 0.001	< 1	161		13.1	99	58	0.7	< 0.006	0.04	0	7.6	0.02	< 2	3.5	0.71	< 0.005
10172	ROE RIVER AT DOG LEAP	C679203	27/02/2012	10:50	0	69	< 0.001	1.3	222		11	96	88	1.06	0.008	< 0.04	0	7.8	0.03	5	9.4	1.07	
10172	ROE RIVER AT DOG LEAP	C679203	27/03/2012	11:30	0	90	0.001	1.6	250		12.1	110	105			< 0.04	0	8.2	0.01	< 2	11.2		
10172	ROE RIVER AT DOG LEAP	C679203	27/03/2012	12:30	0																		0.00663
10172	ROE RIVER AT DOG LEAP	C679203	25/04/2012	10:45	0	60	0.001	1.8	201		11.2	96	79	0.74	< 0.006	< 0.04	0	7.9	0.02	< 2	8.6	0.75	
10172	ROE RIVER AT DOG LEAP	C679203	21/05/2012	10:40	0	72	0.001	< 1	219		10.8	100	91	0.68	< 0.006	< 0.04	0	8	0.02	2	12.3	0.69	
10172	ROE RIVER AT DOG LEAP	C679203	27/06/2012	09:30	0	67	0.001	1.3	204		10.1	98	85	0.97	< 0.006	< 0.04	0	7.8	0.02	< 2	13.8	0.98	< 0.005
10172	ROE RIVER AT DOG LEAP	C679203	24/07/2012	10:20	0	49	0.001	2.1	152		9.5	94	65	0.82	0.015	0.05	0	7.7	0.02	6	14.9	0.83	
10172	ROE RIVER AT DOG LEAP	C679203	23/08/2012	09:30	0	65	0.001	1.7	191		10	97	75	0.63	0.006	< 0.04	0	7.9	0.04	3	14.1	0.64	
10172	ROE RIVER AT DOG LEAP	C679203	20/09/2012	10:50	0	58	< 0.001	1.5	182		10.8	98	69	0.65	< 0.006	< 0.04	0	7.8	0.03	3	10.8	0.66	
10172	ROE RIVER AT DOG LEAP	C679203	15/10/2012	10:30	0	54	< 0.001	1.8	163		11.5	97	64	0.52	< 0.006	< 0.04	0	7.7	0.02	< 2	8	0.53	
10172	ROE RIVER AT DOG LEAP	C679203	15/11/2012	10:40	0	49	< 0.001	1.5	160		11.4	96	63	0.53	< 0.006	< 0.04	0	7.7	0.02	< 2	8.1	0.54	
10172	ROE RIVER AT DOG LEAP	C679203	05/03/2015	09:53	0	18	< 0.001	< 2	118		12.9	100	43	0.35	0.007	< 0.04	0	7.5	0.02	12	4.4	0.36	
10172	ROE RIVER AT DOG LEAP	C679203	01/06/2015	08:48	0	37	< 0.001	< 2	135		11.1	97	52	0.44	0.007	< 0.04	0	7.7	0.02	3	9.5	0.45	
10172	ROE RIVER AT DOG LEAP	C679203	26/08/2015	09:38	0	56	< 0.001	< 2	180		10.1	95	74	0.63	0.009	< 0.04	0	7.4	0.04	3	12.4	0.64	
10172	ROE RIVER AT DOG LEAP	C679203	12/11/2015	09:56	0	39	< 0.001	< 2	139		11.1	96	57	0.51	0.009	< 0.04	0	7.7	0.03	2	8.8	0.52	
10172	ROE RIVER AT DOG LEAP	C679203	02/03/2016	00:00	0	32	< 0.001	< 2	178		12.7	96	55	0.44	0.007	0.07	0	7.5	0.03	8	3.8	0.45	
10172	ROE RIVER AT DOG LEAP	C679203	02/06/2016	00:00	0	98	0.001	< 2	274		9.9	99	114	0.96	0.014	< 0.04	0	7.9	0.03	3	15.6	0.97	
10172	ROE RIVER AT DOG LEAP	C679203	30/08/2016	00:00	0	82	0.001	< 2	235		10.8	106	98	0.72	0.007	< 0.04	0	7.9	0.04	3	14.6	0.73	
10172	ROE RIVER AT DOG LEAP	C679203	28/11/2016	09:42	0	54	< 0.001	< 2	185		11.8	95	69	0.62	0.006	< 0.04	0	7.6	0.03	< 2	6	0.63	
10172	ROE RIVER AT DOG LEAP	C679203	05/01/2017	00:00	0									0.66	0.007	< 0.04			0.03			0.67	

10172	ROE RIVER AT DOG LEAP	C679203	25/01/2017	00:00	0									1.14	0.009 <	0.04			0.04			1.15	
10172	ROE RIVER AT DOG LEAP	C679203	06/03/2017	00:00	0	49 <	0.001 <	2	181		11.6	93	68	0.92	0.005 <	0.04	0	7.6	0.02 <	2	5.9	0.92	
10172	ROE RIVER AT DOG LEAP	C679203	29/03/2017	00:00	0									1.22	0.008 <	0.04	0		0.03			1.23	
10172	ROE RIVER AT DOG LEAP	C679203	03/05/2017	00:00	0									0.37	0.007 <	0.04	0		0.01			0.38	
10172	ROE RIVER AT DOG LEAP	C679203	05/06/2017	10:10	0	35 <	0.001	6.6	112		9.8	90	49	0.28	0.009	0.05	0	7.5	0.03	85	11.9	0.29	
10172	ROE RIVER AT DOG LEAP	C679203	05/07/2017	00:00	0									0.37	0.011	0.04	0		0.03			0.38	
10172	ROE RIVER AT DOG LEAP	C679203	01/08/2017	10:00	0									0.39	0.012 <	0.04	0		0.04			0.4	
10172	ROE RIVER AT DOG LEAP	C679203	29/08/2017	00:00	0	70	0.001 <	2	213		10	96	88	0.79	0.007 <	0.04	0	7.8	0.04 <	2	13.6	0.8	
10172	ROE RIVER AT DOG LEAP	C679203	28/09/2017	00:00	0									0.26	0.009 <	0.04	0		0.04			0.27	
10172	ROE RIVER AT DOG LEAP	C679203	26/10/2017	09:00	0									0.68	0.008 <	0.04	0		0.03			0.69	
10172	ROE RIVER AT DOG LEAP	C679203	23/11/2017	00:00	0	31 <	0.001 <	2	134		11.7	95	45	0.67	0.009 <	0.04	0	7.4	0.04	7	6.1	0.68	
10178	OWENBEG R AT DUNGIVEN	C683098	05/01/2009	10:00	0	65 <	0.001	1.8	277	0.0008			91	1.76	0.013	0.07	0	7.6	0.02		3.5	1.77	0.0145
10178	OWENBEG R AT DUNGIVEN	C683098	04/02/2009	10:30	0	49 <	0.001	2	193				83	1.45 <	0.006 <	0.04	0	7.4	0.01	8	2.7	1.45	
10178	OWENBEG R AT DUNGIVEN	C683098	05/03/2009	10:15	0	52 <	0.001	2.2	232		12.3	94	83	1.05	0.011 <	0.04	0	7.5	0.01 <	2	4.3	1.06	
10178	OWENBEG R AT DUNGIVEN	C683098	31/03/2009	10:45	0	52 <	0.001	1.5	196	0.0011	11.8	99	79	1.04	0.007 <	0.04	0	7.59	0.01 <	2	8.1	1.04 <	0.002
10178	OWENBEG R AT DUNGIVEN	C683098	05/05/2009	09:30	0	40 <	0.001	2.6	145		10.2	90	52	0.59	0.014	0.05	0	7.4	0.01	16	9.5	0.6	
10178	OWENBEG R AT DUNGIVEN	C683098	03/06/2009	10:50	0	76 <	0.001	1.9	245		10.4	101	97	1.39	0.014 <	0.04	0	7.7 <	0.01	3	14	1.41	
10178	OWENBEG R AT DUNGIVEN	C683098	02/07/2009	10:10	0	75	0.001	2.1	247	0.0014	8.4	87	93	1.37	0.019 <	0.04	0	7.7	0.01		16.5	1.39	0.011
10178	OWENBEG R AT DUNGIVEN	C683098	17/07/2009	00:00	0						10	97									13.7		
10178	OWENBEG R AT DUNGIVEN	C683098	06/08/2009	09:30	0	46 <	0.001	1.2	161		9.8	94	58	0.83	0.007 <	0.04	0	7.6	0.02 <	2	13	0.84	
10178	OWENBEG R AT DUNGIVEN	C683098	26/08/2009	12:00	0	14 <	0.001	2.2	66		10	94	25	0.11 <	0.006 <	0.04	0	7.1	0.01	21	18	0.11	
10178	OWENBEG R AT DUNGIVEN	C683098	29/09/2009	10:15	0	73 <	0.001	1.6	233		9.5	92	89	1.12	0.009 <	0.04	0	7.7	0.01	2	13.2	1.13	
10178	OWENBEG R AT DUNGIVEN	C683098	30/10/2009	10:00	0	49 <	0.001	1.5	169		9.8	94	67	0.73 <	0.006	0.06	0	7.5	0.03 <	2	12.5	0.73	
10178	OWENBEG R AT DUNGIVEN	C683098	25/11/2009	11:30	0	20 <	0.001	2.6	88		9.8	79	28 <	0.05 <	0.006	0.05	0	7.2	0.04	35	6.5 <	0.05	
10178	OWENBEG R AT DUNGIVEN	C683098	05/01/2011	10:00	0	27 <	0.001	2.4	142		12.9	96	44	0.72 <	0.006 <	0.04	0	7.3	0.02	3	3.1	0.73	
10178	OWENBEG R AT DUNGIVEN	C683098	01/02/2011	10:00	0	65 <	0.001		240		11	86	81	1.37	0.012	0.05	0	7.4	0.02	5	5	1.38	
10178	OWENBEG R AT DUNGIVEN	C683098	28/02/2011	09:50	0	45 <	0.001		166				59	0.97 <	0.006 <	0.04	0	7.5	0.01 <	2	3.9	0.98	
10178	OWENBEG R AT DUNGIVEN	C683098	30/03/2011	10:20	0	69 <	0.001 <	1	246		11.1	95	89	1.42 <	0.006 <	0.04	0	7.5 <	0.01 <	2	8.5	1.43	
10178	OWENBEG R AT DUNGIVEN	C683098	03/05/2011	10:30	0	81 <	0.001 <	1	259		12.7	113	98	1.18	0.007 <	0.04	0	7.3 <	0.01	3	10.2	1.19	
10178	OWENBEG R AT DUNGIVEN	C683098	02/06/2011	10:00	0	62 <	0.001	1.2	205		10.3	99	77	0.98	0.009 <	0.04	0	7.5	0.01 <	2	13.7	0.99	
10178	OWENBEG R AT DUNGIVEN	C683098	29/06/2011	10:00	0	69 <	0.001 <	1	225		10.6	100	80	1.08	0.011 <	0.04	0	7.6	0.02	3	12.7	1.09	
10178	OWENBEG R AT DUNGIVEN	C683098	01/08/2011	10:20	0	76 <	0.001 <	1	240		11.3	111	97	1.25	0.008 <	0.04	0	7.3	0.02 <	2	14.7	1.26	
10178	OWENBEG R AT DUNGIVEN	C683098	30/08/2011	10:00	0	70	0.001	1.2	219		10.6	98	85	1.09	0.006 <	0.04	0	7.9	0.02 <	2	11.9	1.1	
10178	OWENBEG R AT DUNGIVEN	C683098	29/09/2011	09:20	0	68	0.001	1.4	210		9.4	93	77	0.99 <	0.006 <	0.04	0	7.7	0.02	3	14.8	1	
10178	OWENBEG R AT DUNGIVEN	C683098	27/10/2011	08:40	0	52 <	0.001 <	1	176		10.4	92	67	0.98 <	0.006 <	0.04	0	7.3	0.02	16	10	0.99 <	0.005
10178	OWENBEG R AT DUNGIVEN	C683098	21/11/2011	10:15	0	56 <	0.001 <	1	181		10.6	96	67	0.97 <	0.006 <	0.04	0	7.5	0.02 <	2	10.9	0.98	
10178	OWENBEG R AT DUNGIVEN	C683098	04/01/2012	10:25	0	23 <	0.001	1.6	296		12.5	98	39	0.44 <	0.006 <	0.04	0	7.3	0.01	4	5.1	0.45	0.00994
10178	OWENBEG R AT DUNGIVEN	C683098	31/01/2012	10:00	0	42 <	0.001 <	1	171		12.2	93	60	0.92 <	0.006 <	0.04	0	7.4 <	0.01	3	4	0.93	
10178	OWENBEG R AT DUNGIVEN	C683098	27/02/2012	09:40	0	59 <	0.001	1.4	202		10.6	91	78	1.09	0.008 <	0.04	0	7.6	0.01	12	9	1.1	
10178	OWENBEG R AT DUNGIVEN	C683098	27/03/2012	09:20	0	74 <	0.001	1.8	333		12	101	87		<	0.04	0	7.7 <	0.01 <	2	8.3	<	0.005
10178	OWENBEG R AT DUNGIVEN	C683098	25/04/2012	10:20	0	55 <	0.001	1.4	187		11	95	69	0.74 <	0.006 <	0.04	0	7.6	0.01	2	8.8	0.75	
10178	OWENBEG R AT DUNGIVEN	C683098	21/05/2012	09:45	0	67 <	0.001	1.4	210		11.8	107	79	0.83 <	0.006 <	0.04	0	7.7	0.01	2	10.8	0.84	
10178	OWENBEG R AT DUNGIVEN	C683098	27/06/2012	10:15	0	61 <	0.001	1.4	192		9.3	91	73	0.89 <	0.006 <	0.04	0	7.5	0.01	2	14.5	0.9	0.0052
10178	OWENBEG R AT DUNGIVEN	C683098	24/07/2012	11:00	0	33 <	0.001	1.8	111		10	97	46	0.45 <	0.006 <	0.04	0	7.3 <	0.01	3	13.9	0.46	
10178	OWENBEG R AT DUNGIVEN	C683098	23/08/2012	09:45	0	50	0.001	1.4	156		9.5	92	59	0.49	0.007 <	0.04	0	7.8	0.02	2	13.7	0.5	
10178	OWENBEG R AT DUNGIVEN	C683098	20/09/2012	10:00	0	52 <	0.001	1.4	170		10.2	92	61	0.52 <	0.006 <	0.04	0	7.6	0.02	6	11.1	0.53	
10178	OWENBEG R AT DUNGIVEN	C683098	15/10/2012	11:35	0	50 <	0.001	1.5	156		11.2	96	60	0.49 <	0.006	0.04	0	7.4	0.01 <	2	8.4	0.5	
10178	OWENBEG R AT DUNGIVEN	C683098	15/11/2012	10:05	0	48 <	0.001 <	1	157		11.6	98	61	0.58 <	0.006 <	0.04	0	7.4	0.01 <	2	8	0.59	
10178	OWENBEG R AT DUNGIVEN	C683098	05/03/2015	10:40	0	17 <	0.001 <	2	110		12.3	98	39	0.35	0.007 <	0.04	0	7.3	0.01	13	5.7	0.36	
10178	OWENBEG R AT DUNGIVEN	C683098	01/06/2015	09:21	0	40 <	0.001 <	2	145		11.2	97	56	0.53	0.006 <	0.04	0	7.7	0.01	2	8.9	0.54	
10178	OWENBEG R AT DUNGIVEN	C683098	26/08/2015	10:46	0	52 <	0.001 <	2	172		9.9	93	65	0.6	0.01	0.05	0	7.5	0.03	3	12.7	0.61	
10178	OWENBEG R AT DUNGIVEN	C683098	12/11/2015	10:51	0	32 <	0.001 <	2	122		11	94	53	0.32	0.007 <	0.04	0	7.6	0.02	2	8.7	0.33	
10178	OWENBEG R AT DUNGIVEN	C683098	02/03/2016	00:00	0	35 <	0.001 <	2	193		12.5	95	53	0.51	0.007	0.07	0	7.5	0.03	6	3.7	0.52	
10178	OWENBEG R AT DUNGIVEN	C683098	02/06/2016	00:00	0	78	0.001 <	2	240		10.4	100	92	1.13	0.016 <	0.04	0	7.9	0.02	2	13.3	1.15	
10178	OWENBEG R AT DUNGIVEN	C683098	30/08/2016	00:00	0	68 <	0.001 <	2	209		10.7	104	90	0.85	0.007 <	0.04	0	7.7	0.03	4	14	0.86	
10178	OWENBEG R AT DUNGIVEN	C683098	28/11/2016	10:43	0	48 <	0.001 <	2	164		11.6	93	71	0.56	0.006 <	0.04	0	7.5	0.02	3	6.1	0.57	
10178	OWENBEG R AT DUNGIVEN	C683098	05/01/2017	00:00	0									0.62	0.007 <	0.04			0.02			0.63	
10178	OWENBEG R AT DUNGIVEN	C683098	25/01/2017	00:00	0									0.98	0.008 <	0.04			0.02			0.99	
10178	OWENBEG R AT DUNGIVEN	C683098	06/03/2017	00:00	0	48 <	0.001 <	2	174		11.7	93	72	0.77	0.005 <	0.04	0	7.5	0.02	3	5.7	0.77	
10178	OWENBEG R AT DUNGIVEN	C683098	29/03/2017	00:00	0									1.01	0.007 <	0.04	0		0.02			1.02	
10178	OWENBEG R AT DUNGIVEN	C683098	03/05/2017	00:00	0									0.74	0.007 <	0.04	0		0.01			0.75	
10178	OWENBEG R AT DUNGIVEN	C683098	05/06/2017	10:00	0	12 <	0.001	3.8	64		11.1	100	36	0.14	0.007 <	0.04	0	7	0.02	47	11	0.15	
10178	OWENBEG R AT DUNGIVEN	C683098	05/07/2017	00:00	0									0.35	0.01 <	0.04	0		0.03			0.36	
10178	OWENBEG R AT DUNGIVEN	C683098	01/08/2017	10:00	0									0.47	0.007 <	0.04	0		0.03			0.48	
10178	OWENBEG R AT DUNGIVEN	C683098	29/08/2017	00:00	0	59 <	0.001 <	2	189		9.9	94	77	0.62	0.007 <	0.04	0	7.5	0.03	3	12.8	0.63	
10178	OWENBEG R AT DUNGIVEN	C683098	28/09/2017	00:00	0									0.18	0.009 <	0.04	0		0.03			0.19	
10178	OWENBEG R AT DUNGIVEN	C683098	26/10/2017	09:00	0									0.57	0.007 <	0.04	0		0.02			0.58	
10178	OWENBEG R AT DUNGIVEN	C683098	23/11/2017	00:00	0	34 <	0.001 <	2	138		11.5	92	47	0.52	0.008	0.04	0	7.3	0.02	6	6.1	0.53	
10179	OWENRIGH R AT CARNANBANE	C669067	05/01/2009	10:35	0	44 <	0.001	1.6	160	0.0006			52	0.46 <	0.006 <	0.04	0	7.7 <	0.01		3	0.46	0.0095
10179	OWENRIGH R AT CARNANBANE	C669067	04/02/2009	10:05	0	24 <	0.001 <	1	116				38	0.39 <	0.006 <	0.04	0	7.4 <	0.01	11	1.9	0.39	
10179	OWENRIGH R AT CARNANBANE	C669067	05/03/2009	10:45	0	27 <	0.001	1.6	111		13	98	44	0.22 <	0.006 <	0.04	0	7.5 <	0.01 <	2	3.6	0.22	
10179	OWENRIGH R AT CARNANBANE	C669067	31/03/2009	11:15	0	23 <	0.001	2.4	136		11.7	98	48	0.13 <	0.006 <	0.04	0	7.6 <	0.01 <	2	7.5	0.13 <	0.002
10179	OWENRIGH R AT CARNANBANE	C669067	05/05/2009	09:50	0	12 <	0.001	2.3	73		11	95	20	0.09	0.008 <	0.04	0	7.3 <	0.01	22	9	0.1	
10179	OWENRIGH R AT CARNANBANE	C669067	03/06/2009	10:45	0	47	0.001	1	158		10.1	96	61	0.3 <	0.006	0.07	0	7.8 <	0.01 <	2	13	0.3	
10179	OWENRIGH R AT CARNANBANE	C669067	02/07/2009	11:00	0	49	0.001	2.1	162	0.0011	9.1	92	57	0.28	0.008 <	0.04	0	7.8 <	0.01	4	16	0.28	0.0443
10179	OWENRIGH R AT CARNANBANE	C669067	17/07/2009	00:00	0						10.5	99									12.8		
10179	OWENRIGH R AT CARNANBANE	C669067	06/08/2009	10:00	0	21 <	0.001	1	93	0.0022	10.8	102	30	0.08 <	0.006 <	0.04	0	7.5 <	0.01		12.7	0.08	0.0029
10179	OWENRIGH R AT CARNANBANE	C669067	26/08/2009	10:30	0 <	5 <	0.001	2.7	41		10.5	97	12 <	0.05 <	0.006 <	0.04	0	5.7	0.01	160	12.5 <	0.05	
10179	OWENRIGH R AT CARNANBANE	C669067	29/09/2009	11:20	0	41 <	0.001	1.6	139				63	0.18	0.007 <	0.04	0	7.7 <	0.01 <	2	12.8	0.19	
10179	OWENRIGH R AT CARNANBANE	C669067	30/10/2009	11:35	0	18 <	0.001	1.5	83		9.9	95	29	0.13 <	0.006 <	0.04	0	7.2	0.01	3	12.5	0.13	
10179	OWENRIGH R AT CARNANBANE	C669067	25/11/2009	10:15	0	5 <	0.001	1.9	48		9.9	81	14	0.09 <	0.006 <	0.04	0	6.6	0.01	23	6.5	0.09	
10179	OWENRIGH R AT CARNANBANE	C669067	05/01/2011	10:40	0	9 <	0.001	2.6	62		12.5	92	24	0.18 <	0.006 <	0.04	0	7.3 <	0.01	4	2.7	0.19	
10179	OWENRIGH R AT CARNANBANE	C669067	01/02/2011	10:50	0	29 <	0.001		108		10.7	84	42	0.24 <	0.006 <	0.04	0	7.5 <	0.01 <	2	5	0.25	
10179	OWENRIGH R AT CARNANBANE	C669067	28/02/2011	11:05	0	20 <	0.001		87				33	0.24 <	0.006 <	0.04	0	7.4 <	0.01	3	3.3	0.25	
10179	OWENRIGH R AT CARNANBANE	C669067	30/03/2011	11:00	0	46 <	0.001	1.3	163		11.4	97	63	0.32 <	0.006 <	0.04	0	7.7 <	0.01 <	2	8.3	0.33	
10179	OWENRIGH R AT CARNANBANE	C669067	03/05/2011	11:00	0	54	0.001 <	1	172		11.9	103	67	0.23 <	0.006 <	0.04	0	8.2 <	0.01 <	2	9	0.24	
10179	OWENRIGH R AT CARNANBANE	C669067	02/06/2011	10:30	0	35 <	0.001	1.6	115		10.5	99	41	0.21 <	0.006 <	0.04	0	7.6 <	0.01 <	2	13	0.22	
10179	OWENRIGH R AT CARNANBANE	C669067	29/06/2011	11:20	0	35 <	0.001	1.4	135		10.6	98	40	0.19 <	0.006 <	0.04	0	7.6 <	0.01 <	2	12	0.2	
10179	OWENRIGH R AT CARNANBANE	C669067	01/08/2011	09:10	0	44	0.001 <	1	146		10.3	100	53	0.25 <	0.006 <	0.04	0	7.8 <	0.01 <	2	14.1	0.26	
10179	OWENRIGH R AT CARNANBANE	C669067	30/08/2011	09:40	0	43	0.001 <	1	139		10.5	96	60	0.21 <	0.006 <	0.04	0	8 <	0.01 <	2	11.4	0.22	
10179	OWENRIGH R AT CARNANBANE	C669067	29/09/2011	09:05	0	34	0.001	1.8	118		9.8	96	44	0.14 <	0.006 <	0.04	0	7.8 <	0.01	2	14.4	0.15	
10179	OWENRIGH R AT CARNANBANE	C669067	27/10/2011	09:10	0	20 <	0.001	1.1	82		10.5	92	32	0.23 <	0.006 <	0.04	0	7.1	0.01	8	9.5	0.24	0.00561
10179	OWENRIGH R AT CARNANBANE	C669067	21/11/2011	10:50	0	19 <	0.001 <	1	81		11.1	99	30	0.2 <	0.006 <	0.04	0	7.4	0.01	5	10.2	0.21	
10179	OWENRIGH R AT CARNANBANE	C669067	04/01/2012	10:50	0 <	6 <	0.001	1	79		12.8	100	20	0.12 <	0.006 <	0.04	0	6.7 <	0.01	11	5	0.13	0.011
10179	OWENRIGH R AT CARNANBANE	C669067	31/01/2012	10:30	0	13 <	0.001 <	1	104		12.9	96	32	0.22 <	0.006 <	0.04	0	7.2 <	0.01 <	2	3	0.23	
10179	OWENRIGH R AT CARNANBANE	C669067	27/02/2012	10:00	0	22 <	0.001 <	1	98		11	94	32	0.17 <	0.006 <	0.04	0	7.5 <	0.01	2	8.5	0.18	
10179	OWENRIGH R AT CARNANBANE	C669067	27/03/2012	09:45	0	42 <	0.001 <	1	143		12.4	104	54		<	0.04	0	7.9 <	0.01	2	7.5	<	0.005
10179	OWENRIGH R AT CARNANBANE	C669067	25/04/2012	09:55	0	21 <	0.001	1.5	96		11.3	93	30	0.08 <	0.006 <	0.04	0	7.6 <	0.01 <	2	7	0.09	
10179	OWENRIGH R AT CARNANBANE	C669067	21/05/2012	10:10	0	33 <	0.001	1.5	123		11.6	102	38 <	0.08 <	0.006 <	0.04	0	7.8 <	0.01 <	2	9.9	0.08	
10179	OWENRIGH R AT CARNANBANE	C669067	27/06/2012	11:30	0	45	0.001	1.4	111		9.5	93	52 <	0.08 <	0.006 <	0.04	0	7.7 <	0.01	6	14.8 <	0.08	0.0188
10179	OWENRIGH R AT CARNANBANE	C669067	24/07/2012	10:30	0	15 <	0.001	2.3	62		10.3	98	22 <	0.08 <	0.006 <	0.04	0	7.1 <	0.01	5	13 <	0.08	
10179	OWENRIGH R AT CARNANBANE	C669067	23/08/2012	09:05	0	23 <	0.001	1.5	85		9.9	94	34	0.11 <	0.006 <	0.04	0	7.7 <	0.01 <	2	12.7	0.12	
10179	OWENRIGH R AT CARNANBANE	C669067	20/09/2012	09:40	0	24 <	0.001	1.7	89		10.5	94	31	0.08 <	0.006 <	0.04	0	7.5	0.01 <	2	10.5	0.09	
10179	OWENRIGH R AT CARNANBANE	C669067	15/10/2012	11:55	0	40 <	0.001	1.5	165		11.6	97	62	0.21 <	0.006 <	0.04	0	7.6 <	0.01	3	7.7	0.22	
10179	OWENRIGH R AT CARNANBANE	C669067	15/11/2012	10:30	0	16 <	0.001	1.5	78		11.9	100	22	0.1 <	0.006 <	0.04	0	7.2 <	0.01	2	7.9	0.11	
10179	OWENRIGH R AT CARNANBANE	C669067	03/03/2015	11:00	0 <	10 <	0.001	2.2	75		11.9	98	27	0.11	0.007 <	0.04	0	7	0.02	5	6.9	0.12	

10179	OWENRIGH R AT CARNANBANE	C669067	01/06/2015	00:00	0		13			<	2		77								29	<	0.06		0.005	<	0.04		0		7.7	<	0.01	<	2			<	0.06		
10179	OWENRIGH R AT CARNANBANE	C669067	26/08/2015	11:14	0		12	<	0.001	<	2		65				10.3		95		27	<	0.06		0.008	<	0.04		0		7.6	<	0.01		6		11.7	<	0.06		
10179	OWENRIGH R AT CARNANBANE	C669067	12/11/2015	09:15	0	<	10	<	0.001		2.1		66				11.4		97		25		0.07		0.009	<	0.04		0		7.4		0.01	<	2		8.2		0.08		
10179	OWENRIGH R AT CARNANBANE	C669067	02/03/2016	00:00	0	<	10	<	0.001	<	2		75				12.7		97		33		0.13	<	0.005	<	0.04		0		7.5		0.01		9		3.8		0.13		
10179	OWENRIGH R AT CARNANBANE	C669067	02/06/2016	00:00	0		53		0.001	<	2		162				10.6		99		67		0.24	<	0.005	<	0.04		0		7.9	<	0.01		4		12.2		0.24		
10179	OWENRIGH R AT CARNANBANE	C669067	30/08/2016	00:00	0		35		0.001		2		117				10.9		105		53		0.11	<	0.005	<	0.04		0		7.8		0.01		4		13.9		0.11		
10179	OWENRIGH R AT CARNANBANE	C669067	28/11/2016	11:09	0		18	<	0.001	<	2		84				12.1		96		38		0.11	<	0.005	<	0.04		0		7.5	<	0.01		4		5.5		0.11		
10179	OWENRIGH R AT CARNANBANE	C669067	05/01/2017	00:00	0																		1.75		0.009		0.05					<	0.01						1.76		
10179	OWENRIGH R AT CARNANBANE	C669067	25/01/2017	00:00	0																		0.11	<	0.005	<	0.04					<	0.01						0.11		
10179	OWENRIGH R AT CARNANBANE	C669067	06/03/2017	00:00	0		17	<	0.001	<	2		94				11.7		93		37		0.19	<	0.005	<	0.04		0		7.3	<	0.01	<	2		5.7		0.19		
10179	OWENRIGH R AT CARNANBANE	C669067	29/03/2017	00:00	0																		0.21		0.005		0.04		0				0.03						0.21		
10179	OWENRIGH R AT CARNANBANE	C669067	03/05/2017	00:00	0																		0.14	<	0.005	<	0.04		0				0.01						0.14		
10179	OWENRIGH R AT CARNANBANE	C669067	05/06/2017	10:35	0	<	10	<	0.001		2.3		52				11.3		102		21		0.09		0.008	<	0.04		0		6.3		0.01		10		11.1		0.1		
10179	OWENRIGH R AT CARNANBANE	C669067	05/07/2017	00:00	0																	<	0.06		0.008	<	0.04		0				0.01					<	0.06		
10179	OWENRIGH R AT CARNANBANE	C669067	01/08/2017	10:00	0																	<	0.06	<	0.01	<	0.04		0				0.02						0.06		
10179	OWENRIGH R AT CARNANBANE	C669067	29/08/2017	00:00	0		23	<	0.001	<	2		94				10.3		96		31		0.11	<	0.005	<	0.04		0		7.4		0.01		3		11.9		0.11		
10179	OWENRIGH R AT CARNANBANE	C669067	28/09/2017	00:00	0																	<	0.06		0.01	<	0.04		0				0.02					<	0.06		
10179	OWENRIGH R AT CARNANBANE	C669067	26/10/2017	09:00	0																		0.12		0.007	<	0.04		0				0.03						0.13		
10179	OWENRIGH R AT CARNANBANE	C669067	23/11/2017	00:00	0		12	<	0.001	<	2		71				11.8		95		22		0.12		0.006	<	0.04		0		7		0.01		4		6		0.13		
10377	DOUGLAS R AT BOHERADAILE BR	H774967	16/01/2009	09:55	0		53	<	0.001		1.9		158		0.0012		11.4		90		64		0.56	<	0.006	<	0.04		0		7.5		0.01		4		5.5		0.56		0.0042
10377	DOUGLAS R AT BOHERADAILE BR	H774967	02/02/2009	09:45	0		57	<	0.001		2		173								68		0.8	<	0.006	<	0.04		0		7.7	<	0.01	<	2		2.7		0.8		
10377	DOUGLAS R AT BOHERADAILE BR	H774967	03/03/2009	09:40	0		70	<	0.001				188				12.8		101		81		0.79	<	0.006	<	0.04		0		7.7	<	0.01	<	2		5.3		1.79		
10377	DOUGLAS R AT BOHERADAILE BR	H774967	30/03/2009	10:20	0		59	<	0.001	<	1		190		0.001		11.6		95		73		0.52		0.006	<	0.04		0		7.8	<	0.01	<	2		6.8		0.53		0.003
10377	DOUGLAS R AT BOHERADAILE BR	H774967	30/04/2009	10:10	0		33	<	0.001		1.7		105		0.0014		12.1		104		38		0.22		0.007	<	0.04		0		7.6	<	0.01		14		8.7		0.22		0.0041
10377	DOUGLAS R AT BOHERADAILE BR	H774967	01/06/2009	10:20	0		103		0.001		1		250				11.6		108		111		0.82		0.01	<	0.04		0		8	<	0.01	<	2		12.2		0.83		
10377	DOUGLAS R AT BOHERADAILE BR	H774967	30/06/2009	10:25	0		108		0.001		1.6		282				11.8		116		133		1.08	<	0.006	<	0.04		0		8.1		0.01	<	2		14.4		1.08		0.0028
10377	DOUGLAS R AT BOHERADAILE BR	H774967	30/07/2009	10:00	0		73		0.001		1.3		194				10.6		98		85		0.58		0.007	<	0.04		0		8		0.02	<	2		11.9		0.59		
10377	DOUGLAS R AT BOHERADAILE BR	H774967	25/08/2009	10:00	0		51	<	0.001		1.1		146				10.2		95		61		0.33	<	0.006	<	0.04		0		7.5	<	0.01	<	2		11.9		0.33		
10377	DOUGLAS R AT BOHERADAILE BR	H774967	21/09/2009	09:55	0		101		0.001		1.7		247				10.9		101		108		0.81		0.007	<	0.04		0		7.9		0.01	<	2		11.6		0.82		
10377	DOUGLAS R AT BOHERADAILE BR	H774967	28/10/2009	10:10	0		33	<	0.001		1.4		126				9.8		90		43		0.28	<	0.006	<	0.04		0		7.5	<	0.01	<	2		11.3		0.28		
10377	DOUGLAS R AT BOHERADAILE BR	H774967	27/11/2009	11:50	0		35	<	0.001	<	1		240				10.7		86		46		1.14		0.01	<	0.04		0		7.4	<	0.01	<	2		6.2		1.15		
10377	DOUGLAS R AT BOHERADAILE BR	H774967	04/01/2011	10:25	0		46	<	0.001		1.1		157				12.1		92		62		0.56	<	0.006		0.04		0		7.5		0.02		15		3.7		0.57		
10377	DOUGLAS R AT BOHERADAILE BR	H774967	31/01/2011	11:00	0		81	<	0.001				217				12.2		94		89		0.75	<	0.006	<	0.04		0		7.9	<	0.01	<	2		4.3		0.76		
10377	DOUGLAS R AT BOHERADAILE BR	H774967	02/03/2011	11:10	0		69	<	0.001		1.2		193				13.5		104		83		0.62	<	0.006	<	0.04		0		7.7	<	0.01		2		4.5		0.63		
10377	DOUGLAS R AT BOHERADAILE BR	H774967	29/03/2011	10:50	0		94		0.001	<	1		241				11.9		98		101		0.73	<	0.006	<	0.04		0		8	<	0.01	<	2		7.1		0.74		
10377	DOUGLAS R AT BOHERADAILE BR	H774967	27/04/2011	10:40	0		104		0.002	<	1		267				13.5		115		116		0.67	<	0.006	<	0.04		0		8.4	<	0.01		3		8.5		0.68		
10377	DOUGLAS R AT BOHERADAILE BR	H774967	01/06/2011	11:00	0		76		0.001				202				10		92		88		0.59	<	0.006	<	0.04		0		7.8	<	0.01	<	2		11.5		0.6		
10377	DOUGLAS R AT BOHERADAILE BR	H774967	27/06/2011	10:20	0		76		0.001				195				10.7		100		80		0.56	<	0.006	<	0.04		0		8	<	0.01	<	2		12.3		0.57		
10377	DOUGLAS R AT BOHERADAILE BR	H774967	28/07/2011	10:45	0		104		0.001	<	1		257				10.7		103		115		0.82	<	0.006	<	0.04		0		8		0.01		2		13.3		0.83		
10377	DOUGLAS R AT BOHERADAILE BR	H774967	23/08/2011	12:15	0		103		0.001	<	1		253				11.4		105		108		0.75	<	0.006	<	0.04		0		8.1		0.02	<	2		12		0.76		
10377	DOUGLAS R AT BOHERADAILE BR	H774967	28/09/2011	11:00	0		77		0.001		1.2		199				10.1		98		79		0.45	<	0.006	<	0.04		0		7.8		0.01		3		13.8		0.46		
10377	DOUGLAS R AT BOHERADAILE BR	H774967	24/10/2011	11:10	0		27	<	0.001		1.4		95				10.6		97		38		0.3	<	0.006	<	0.04		0		7.2		0.01		6		11.4		0.31	<	0.005
10377	DOUGLAS R AT BOHERADAILE BR	H774967	24/11/2011	11:15	0		36	<	0.001		1.3		126				11.1		98		46		0.29	<	0.006	<	0.04		0		7.4		0.01		2		9.7		0.3		
10377	DOUGLAS R AT BOHERADAILE BR	H774967	03/01/2012	10:30	0		19	<	0.001	<	1		114				12		95		35		0.22	<	0.006		0.08		0		7.2		0.01		19		5.3		0.23		0.00613
10377	DOUGLAS R AT BOHERADAILE BR	H774967	01/02/2012	10:00	0		56	<	0.001		1.4		185				12.9		97		68		0.59	<	0.006	<	0.04		0		7.7	<	0.01	<	2		3.5		0.6		
10377	DOUGLAS R AT BOHERADAILE BR	H774967	01/03/2012	11:35	0		72	<	0.001		1.1		198				11.3		97		77		0.56	<	0.006		0.04		0		7.6		0.01	<	2		8.9		0.57		
10377	DOUGLAS R AT BOHERADAILE BR	H774967	28/03/2012	11:00	0		100		0.001		1.3		252				12.6		107		105					<	0.04		0		8.2	<	0.01	<	2		8.2			<	0.005
10377	DOUGLAS R AT BOHERADAILE BR	H774967	24/04/2012	09:50	0		66		0.001	<	1		182				12.2		103		73		0.47	<	0.006	<	0.04		0		7.9	<	0.01	<	2		8		0.48		
10377	DOUGLAS R AT BOHERADAILE BR	H774967	24/05/2012	10:25	0		99		0.001		1.7		246				11.4		106		107		0.59	<	0.006	<	0.04		0		8.1	<	0.01	<	2		12.2		0.6		
10377	DOUGLAS R AT BOHERADAILE BR	H774967	19/06/2012	10:05	0		28	<	0.001		1.6		93				10.8		96		34		0.29	<	0.006	<	0.04		0		7.3	<	0.01		5		10.4		0.3	<	0.005
10377	DOUGLAS R AT BOHERADAILE BR	H774967	23/07/2012	09:40	0		88		0.001		1.1		218				9.8		96		89		0.53	<	0.006	<	0.04		0		7.9	<	0.01	<	2		14.4		0.54		
10377	DOUGLAS R AT BOHERADAILE BR	H774967	22/08/2012	09:50	0		69		0.001	<	1		179				10		95		83		0.42	<	0.006	<	0.04		0		7.8	<	0.01	<	2		13.4		0.43		
10377	DOUGLAS R AT BOHERADAILE BR	H774967	17/09/2012	09:50	0		83		0.001		1		210				10.6		95		94		0.5	<	0.006	<	0.04		0		7.9	<	0.01	<	2		10.6		0.51	<	0.005
10377	DOUGLAS R AT BOHERADAILE BR	H774967	18/10/2012	09:50	0		23	<	0.001		1.2		82				10.9		95		38		0.13	<	0.006	<	0.04		0		7.3		0.01		6		9.3		0.14		
10377	DOUGLAS R AT BOHERADAILE BR	H774967	12/11/2012	10:40	0		71	<	0.001		1.1		191				11.5		96		79		0.44	<	0.006	<	0.04		0		7.7		0.02	<	2		7.6		0.45		
10377	DOUGLAS R AT BOHERADAILE BR	H774967	13/01/2015	10:37	0		37	<	0.001	<	1		140				12.4		94		49		0.49	<	0.005	<	0.04		0		7.4		0.01	<	2		3.7		0.49		
10377	DOUGLAS R AT BOHERADAILE BR	H774967	08/04/2015	09:24	0		75	<	0.001	<	2		213				11.9		100		88		0.58	<	0.005	<	0.04		0		7.9	<	0.01	<	2		7.6		0.58		
10377	DOUGLAS R AT BOHERADAILE BR	H774967	06/07/2015	10:40	0		97		0.001	<	2		243				10.4		98		115		0.68	<	0.005	<	0.04		0		8		0.01	<	2		12.6		0.68		
10377	DOUGLAS R AT BOHERADAILE BR	H774967	17/09/2015	10:10	0		89	<	0.001	<	2		231				10.6		95		103		0.59	<	0.005	<	0.04		0		7.8		0.02	<	2		10.6		0.59		
10377	DOUGLAS R AT BOHERADAILE BR	H774967	07/01/2016	00:00	0		18	<	0.001	<	2		73				12		94		34		0.3	<	0.005	<	0.04		0		7.2		0.03				5		0.3		
10377	DOUGLAS R AT BOHERADAILE BR	H774967	05/04/2016	00:00	0		49	<	0.001	<	2		149				11.7		98		62		0.39		0.005	<	0.04		0		7.7		0.02				7.8		0.39		
10377	DOUGLAS R AT BOHERADAILE BR	H774967	06/07/2016	00:00	0		69	<	0.001	<	2		176				10.6		99		87		0.42		0.006	<	0.04		0		7.7		0.02				12.1		0.43		
10377	DOUGLAS R AT BOHERADAILE BR	H774967	03/10/2016	11:18	0		87		0.001	<	2		220				9.9		91		99		0.52	<	0.005	<	0.04		0		7.8		0.02				11.8		0.52		
10377	DOUGLAS R AT BOHERADAILE BR	H774967	16/01/2017	11:03	0		42	<	0.001	<	2		146				11.7		98		65		0.39		0.005	<	0.04		0		7.5		0.01				7.8		0.39		
10377	DOUGLAS R AT BOHERADAILE BR	H774967	13/02/2017	09:00	0																		0.72		0.005	<	0.04		0				0.02						0.72		
10377	DOUGLAS R AT BOHERADAILE BR	H774967	15/03/2017	00:00	0																		0.7	<	0.005	<	0.04		0				0.02						0.7		
10377	DOUGLAS R AT BOHERADAILE BR	H774967	12/04/2017	00:00	0		94		0.001	<	2		249				11.7		102		118		0.8		0.005	<	0.04		0		8.2		0.03				9.3		0.8		
10377	DOUGLAS R AT BOHERADAILE BR	H774967	17/05/2017	00:00	0																		0.84		0.005	<	0.04		0				0.05						0.84		
10377	DOUGLAS R AT BOHERADAILE BR	H774967	23/06/2017	00:00	0																		1.05		0.005	<	0.04		0				0.03						1.05		
10377	DOUGLAS R AT BOHERADAILE BR	H774967	06/07/2017	00:00	0		67		0.001	<	2		178				10.1		98		74		0.43	<	0.005	<	0.04		0		7.9		0.03				13.9		0.43		
10377	DOUGLAS R AT BOHERADAILE BR	H774967	15/08/2017	10:00	0																		0.38		0.005	<	0.04		0				0.02						0.38		
10377	DOUGLAS R AT BOHERADAILE BR	H774967	12/09/2017	00:00	0																		0.22		0.005	<	0.04		0				0.02						0.22		
10377	DOUGLAS R AT BOHERADAILE BR	H774967	09/10/2017	09:00	0		68	<	0.001	<	2		184				10.8		98		76		0.37	<	0.005	<	0.04		0		7.7		0.02				11.3		0.37		
10377	DOUGLAS R AT BOHERADAILE BR	H774967	09/11/2017	00:00	0																		0.2		0.005	<	0.04		0				0.02						0.2		
10377	DOUGLAS R AT BOHERADAILE BR	H774967	05/12/2017	00:00	0																		0.4	<	0.005	<	0.04		0				0.01						0.4		
11208	RIVER ROE AT TURMEEL BRIDGE	C688088	05/01/2009	10:55	0		112	<	0.001		1.9		330		0.0006		12.3		91		124		0.76	<	0.006	<	0.04		0		8	<	0.01				3		0.76		0.0268
11208	RIVER ROE AT TURMEEL BRIDGE	C688088	04/02/2009	11:00	0		66	<	0.001		1.3		229								77		0.62	<	0.006	<	0.04		0		7.8	<	0.01		3		2		0.62		
11208	RIVER ROE AT TURMEEL BRIDGE	C688088	05/03/2009	10:00	0		73	<	0.001	<	1		361				13.1		100		93		0.39		0.008	<	0.04		0		8	<	0.01	<	2		3.9		0.4		
11208	RIVER ROE AT TURMEEL BRIDGE	C688088	31/03/2009	10:15	0		79		0.001		1.5		233				11.9		100		97		0.36	<	0.006	<	0.04		0		8.01	<	0.01	<	2		7.8		0.36	<	0.002
11208	RIVER ROE AT TURMEEL BRIDGE	C688088	05/05/2009	09:40	0		49		0.001		3.7		146				10.6		94		54		0.21		0.013		0.08		0		7.7		0.04		21		9.5		0.22		
11208	RIVER ROE AT TURMEEL BRIDGE	C688088	03/06/2009	10:30	0		128		0.001		2.5		315				10		97		140		0.7		0.011	<	0.04		0		7.9	<	0.01	<	2		14.5		0.71		
11208	RIVER ROE AT TURMEEL BRIDGE	C688088	02/07/2009	10:45	0		128		0.002		1.8		322		0.0011		9.6		100		140		0.61		0.012	<	0.04		0		8.1	<	0.01	<	2		17.5		0.63		0.0077
11208	RIVER ROE AT TURMEEL BRIDGE	C688088	17/07/2009	00:00	0												10.2		99																		13.7				
11208	RIVER ROE AT TURMEEL BRIDGE	C688088	06/08/2009	09:40	0		73		0.001		1.5		196				10.2		97		82		0.3	<	0.006	<	0.04		0		8		0.01	<	2		13.3		0.3		
11208	RIVER ROE AT TURMEEL BRIDGE	C688088	26/08/2009	10:45	0		11	<	0.001		2.9		46				10.4		97		20	<	0.05	<	0.006	<	0.04		0		7		0.01		30		13	<	0.05		
11208	RIVER ROE AT TURMEEL BRIDGE	C688088	29/09/2009	11:35	0		129		0.001		1.7		312				9.3		88		137		0.5		0.009	<	0.04		0		8.2	<	0.01		10		13.2		0.51		
11208	RIVER ROE AT TURMEEL BRIDGE	C688088	30/10/2009	11:15	0		59		0.001		1.2		165				9.8		93		82		0.29	<	0.006	<	0.04		0		7.8		0.01	<	2		13		0.29		
11208	RIVER ROE AT TURMEEL BRIDGE	C688088	25/11/2009	10:00	0		21	<	0.001		2.4		80				10.3		84		34		0.2	<	0.006	<	0.04		0		7.4		0.02		43		6		0.2		
11208	RIVER ROE AT TURMEEL BRIDGE	C688088	05/01/2011	10:25	0		58	<	0.001		2.7		141				12.8		95				0.37	<	0.006	<	0.04		0		7.7	<	0.01		2		2.6		0.38		
11208	RIVER ROE AT TURMEEL BRIDGE	C688088	01/02/2011	10:30	0		100	<	0.001				282				11.7		92		109		0.59	<	0.006	<	0.04		0		7.9	<	0.01	<	2		5		0.6		
11208	RIVER ROE AT TURMEEL BRIDGE	C688088	28/02/2011	10:40	0		51	<	0.001				154								63		0.33	<	0.006	<	0.04		0		7.3	<	0.01		4		3.3		0.34		
11208	RIVER ROE AT TURMEEL BRIDGE	C688088	30/03/2011	10:40	0		122		0.001	<	1		329				11.8		101		133		0.55	<	0.006	<	0.04		0		8.1	<	0.01	<	2		8.7		0.56		
11208	RIVER ROE AT TURMEEL BRIDGE	C688088	03/05/2011	11:20	0		140		0.001	<	1		347				11.9		106		155		0.61	<	0.006	<	0.04		0		8.3	<	0.01	<	2		10.1		0.62		
11208	RIVER ROE AT TURMEEL BRIDGE	C688088	02/06/2011	10:50	0		98		0.001		1.2		254				10.6		102		110		0.45	<	0.006	<	0.04		0		8.1	<	0.01	<	2		13.8		0.46		
11208	RIVER ROE AT TURMEEL BRIDGE	C688088	29/06/2011	11:00	0		84		0.001		1.5		215				10.9		101		90		0.34	<	0.006	<	0.04		0		8		0.01		2		12.1		0.35		
11208	RIVER ROE AT TURMEEL BRIDGE	C688088	01/08/2011	08:55	0		124		0.001	<	1		307				10.6		104		140		0.54	<	0.006	<	0.04		0		8.1	<	0.01	<	2		14.5		0.55		
11208	RIVER ROE AT TURMEEL BRIDGE	C688088	30/08/2011	09:20	0		127		0.002	<	1		314				10.7		99		140		0.51	<	0.006	<	0.04		0		8.3	<	0.01	<	2		11.6		0.52		
11208	RIVER ROE AT TURMEEL BRIDGE	C688088	29/09/2011	08:50	0		96		0.002		1.5		242				9.8		97		99		0.38	<	0.006	<	0.04		0		8.2	<	0.01	<	2		14.7		0.39		
11208	RIVER ROE AT TURMEEL BRIDGE	C688088	27/10/2011	09:35	0		60	<	0.001	<	1		166				10.9		95		71		0.36	<	0.006	<	0.04		0		7.7		0.01		3		9.5		0.37	<	0.005
11208	RIVER ROE AT TURMEEL BRIDGE	C688088	21/11/2011	11:20	0		60	<	0.001	<	1		164				11.2		100		73		0.34	<	0.006	<	0.04		0		7.8		0.01		3		10.1		0.35		
11208	RIVER ROE AT TURMEEL BRIDGE	C688088	04/01/2012	11:00	0		18	<	0.001		1.6		116				12.9		100		33		0.15	<	0.006	<	0.04		0		7.3	<	0.01				4.9		0.16		0.00721
11208	RIVER ROE AT TURMEEL BRIDGE	C688088	31/01/2012	10:55	0		46	<	0.001		1.5		164				13.1		97		66		0.41	<	0.006	<	0.04		0		7.7	<	0.01	<	2		2.9		0.42		
11208	RIVER ROE AT TURMEEL BRIDGE	C688088	27/02/2012	10:20	0		88		0.001		1.2		240				10.9		95		100		0.44	<	0.006	<	0.04		0		8.1	<	0.01	<	2		9.4		0.45		
11208	RIVER ROE AT TURMEEL BRIDGE	C688088	27/03/2012	09:45	0																																			<	0.005
11208	RIVER ROE AT TURMEEL BRIDGE	C688088	27/03/2012	10:00	0		128		0.001		1.3		317				12.5		107		131					<	0.04		0		8.3	<	0.01	<	2		8.9				
11208	RIVER ROE AT TURMEEL BRIDGE	C688088	25/04/2012	09:35	0		80		0.001		1.4		222				11.4		95		95		0.33	<	0.006	<	0.04		0		8	<	0.01	<	2		7.4		0.34		

11208	RIVER ROE AT TURMEEL BRIDGE	C688088	21/05/2012	10:25	0		92		0.001		1.5		240				11.8		106		99		0.26	<	0.006	<	0.04		0		8.3	<	0.01	<	2		10.6		0.27		
11208	RIVER ROE AT TURMEEL BRIDGE	C688088	27/06/2012	11:00	0		80		0.001		1.5		208				9.5		94		87		0.38	<	0.006	<	0.04		0		8	<	0.01		13		15		0.39		0.0063
11208	RIVER ROE AT TURMEEL BRIDGE	C688088	24/07/2012	10:00	0		52		0.001		1.8		137				10.2		99		61		0.15	<	0.006	<	0.04		0		7.9	<	0.01	<	2		14.2		0.16		
11208	RIVER ROE AT TURMEEL BRIDGE	C688088	23/08/2012	09:25	0		74	<	0.001		1.7		192				9.9		95		81		0.28	<	0.006	<	0.04		0		7.3	<	0.01		2		13.6		0.29		
11208	RIVER ROE AT TURMEEL BRIDGE	C688088	20/09/2012	09:20	0		76		0.001		1.2		196				10.6		95		84		0.3	<	0.006	<	0.04		0		8	<	0.01		2		10.8		0.31		
11208	RIVER ROE AT TURMEEL BRIDGE	C688088	15/10/2012	12:15	0		59	<	0.001		1.6		156				11.8		99		70		0.2	<	0.006	<	0.04		0		7.7	<	0.01	<	2		7.5		0.21		
11208	RIVER ROE AT TURMEEL BRIDGE	C688088	15/11/2012	10:50	0		55	<	0.001		1.1		156				11.8		101		65		0.21	<	0.006	<	0.04		0		7.7	<	0.01	<	2		8.3		0.22		
11208	RIVER ROE AT TURMEEL BRIDGE	C688088	03/03/2015	11:15	0		15	<	0.001	<	2		101				12.5		99		41		0.13		0.007	<	0.04		0		7.5		0.01		4		5.8		0.14		
11208	RIVER ROE AT TURMEEL BRIDGE	C688088	01/06/2015	10:08	0		53		0.001	<	2		159				11.6		99		62		0.22	<	0.005	<	0.04		0		7.9	<	0.01	<	2		8.7		0.22		
11208	RIVER ROE AT TURMEEL BRIDGE	C688088	26/08/2015	11:03	0		28	<	0.001		2.1		89				10.2		96		41		0.07		0.008	<	0.04		0		7.7	<	0.01		4		12.6		0.08		
11208	RIVER ROE AT TURMEEL BRIDGE	C688088	12/11/2015	10:51	0		44	<	0.001	<	2		130				11.5		98		55		0.18		0.008	<	0.04		0		7.5		0.01	<	2		8.2		0.19		
11208	RIVER ROE AT TURMEEL BRIDGE	C688088	02/03/2016	00:00	0		39	<	0.001	<	2		282				12.9		98		59		0.26	<	0.005	<	0.04		0		7.4		0.01		3		3.6		0.26		
11208	RIVER ROE AT TURMEEL BRIDGE	C688088	02/06/2016	00:00	0		133		0.001	<	2		318				10.6		102		123		0.52	<	0.005	<	0.04		0		8.2	<	0.01	<	2		13.7		0.52		
11208	RIVER ROE AT TURMEEL BRIDGE	C688088	30/08/2016	00:00	0		114		0.002	<	2		284				11.1		107		123		0.4	<	0.005	<	0.04		0		8.2		0.01	<	2		13.9		0.4		
11208	RIVER ROE AT TURMEEL BRIDGE	C688088	28/11/2016	10:58	0		71	<	0.001	<	2		220				11.9		95		18		0.31	<	0.005	<	0.04		0		7.9	<	0.01	<	2		6		0.31		
11208	RIVER ROE AT TURMEEL BRIDGE	C688088	05/01/2017	00:00	0																		0.31		0.005	<	0.04						0.01						0.31		
11208	RIVER ROE AT TURMEEL BRIDGE	C688088	25/01/2017	00:00	0																		0.46	<	0.005	<	0.04						0.01						0.46		
11208	RIVER ROE AT TURMEEL BRIDGE	C688088	06/03/2017	00:00	0		62	<	0.001		2.1		189				11.9		95		78		0.42	<	0.005	<	0.04		0		7.8		0.01	<	2		5.9		0.42		
11208	RIVER ROE AT TURMEEL BRIDGE	C688088	29/03/2017	00:00	0																		0.38		0.006	<	0.04		0				0.02						0.39		
11208	RIVER ROE AT TURMEEL BRIDGE	C688088	03/05/2017	00:00	0																		0.33	<	0.005	<	0.04		0				0.02						0.33		
11208	RIVER ROE AT TURMEEL BRIDGE	C688088	05/06/2017	10:20	0		12	<	0.001		2.8		60				11.3		103		26		0.1		0.007	<	0.04		0		7.2		0.02		9		11.3		0.11		
11208	RIVER ROE AT TURMEEL BRIDGE	C688088	05/07/2017	00:00	0																		0.16		0.007	<	0.04		0				0.02						0.17		
11208	RIVER ROE AT TURMEEL BRIDGE	C688088	01/08/2017	10:00	0																		0.18		0.005	<	0.04		0				0.01						0.18		
11208	RIVER ROE AT TURMEEL BRIDGE	C688088	29/08/2017	00:00	0		88		0.001	<	2		221				10.3		96		95		0.34	<	0.005	<	0.04		0		8		0.01		4		12.5		0.34		
11208	RIVER ROE AT TURMEEL BRIDGE	C688088	28/09/2017	00:00	0																		0.1		0.007	<	0.04		0				0.02						0.11		
11208	RIVER ROE AT TURMEEL BRIDGE	C688088	26/10/2017	09:00	0																		0.27		0.005	<	0.04		0				0.01						0.27		
11208	RIVER ROE AT TURMEEL BRIDGE	C688088	23/11/2017	00:00	0		39	<	0.001	<	2		136				12.1		96		49		0.25		0.006	<	0.04		0		7.6		0.02		3		5.5		0.26		

Site Code	Location	Grid Refere	Date	Time	Depth		ASPT		BIOSCO		NO TAX
							()		()		()
10169	OWENALENA R AT OWENALENA BR	C743060	29/04/2009	00:00	0		6.39		147		23
10169	OWENALENA R AT OWENALENA BR	C743060	19/10/2009	00:00	0		5.83		105		18
10169	OWENALENA R AT OWENALENA BR	C743060	13/04/2011	00:00	0		6.44		161		25
10169	OWENALENA R AT OWENALENA BR	C743060	17/10/2011	00:00	0		5.95		131		22
10169	OWENALENA R AT OWENALENA BR	C743060	24/10/2012	00:00	0		6		114		19
10171	ROE RIVER AT LIMAVADY	C668229	29/04/2009	00:00	0		5.52		127		23
10171	ROE RIVER AT LIMAVADY	C668229	19/10/2009	00:00	0		5.52		138		25
10171	ROE RIVER AT LIMAVADY	C668229	19/04/2010	00:00	0		5.83		134		23
10171	ROE RIVER AT LIMAVADY	C668229	05/10/2010	00:00	0		5.57		117		21
10171	ROE RIVER AT LIMAVADY	C668229	18/04/2011	00:00	0		5.75		138		24
10171	ROE RIVER AT LIMAVADY	C668229	02/11/2011	00:00	0		5.35		139		26
10171	ROE RIVER AT LIMAVADY	C668229	18/04/2012	00:00	0		6.04		139		23
10171	ROE RIVER AT LIMAVADY	C668229	24/10/2012	00:00	0		4.91		113		23
10171	ROE RIVER AT LIMAVADY	C668229	01/05/2013	00:00	0		6.53		124		19
10171	ROE RIVER AT LIMAVADY	C668229	09/10/2013	00:00	0		5		115		23
10171	ROE RIVER AT LIMAVADY	C668229	12/05/2014	00:00	0		6.04		151		25
10171	ROE RIVER AT LIMAVADY	C668229	19/11/2014	00:00	0		5.08		127		25
10172	ROE RIVER AT DOG LEAP	C679203	29/04/2009	00:00	0		6.28		113		18
10172	ROE RIVER AT DOG LEAP	C679203	19/10/2009	00:00	0		5.29		111		21
10172	ROE RIVER AT DOG LEAP	C679203	18/04/2011	00:00	0		6.04		151		25
10172	ROE RIVER AT DOG LEAP	C679203	02/11/2011	00:00	0		5.7		114		20
10172	ROE RIVER AT DOG LEAP	C679203	18/04/2012	00:00	0		6.18		136		22
10172	ROE RIVER AT DOG LEAP	C679203	24/10/2012	00:00	0		6.11		110		18
10178	OWENBEG R AT DUNGIVEN	C683098	29/04/2009	00:00	0		6.28		113		18
10178	OWENBEG R AT DUNGIVEN	C683098	19/10/2009	00:00	0		4.81		77		16
10178	OWENBEG R AT DUNGIVEN	C683098	18/04/2011	00:00	0		6.09		134		22
10178	OWENBEG R AT DUNGIVEN	C683098	17/10/2011	00:00	0		5.55		111		20
10178	OWENBEG R AT DUNGIVEN	C683098	18/04/2012	00:00	0		6.64		146		22
10178	OWENBEG R AT DUNGIVEN	C683098	24/10/2012	00:00	0		5.84		111		19
10179	OWENRIGH R AT CARNANBANE	C669067	29/04/2009	00:00	0		6.21		118		19
10179	OWENRIGH R AT CARNANBANE	C669067	19/10/2009	00:00	0		6.57		138		21
10179	OWENRIGH R AT CARNANBANE	C669067	18/04/2011	00:00	0		6.73		101		15
10179	OWENRIGH R AT CARNANBANE	C669067	17/10/2011	00:00	0		6.59		112		17
10179	OWENRIGH R AT CARNANBANE	C669067	23/04/2012	00:00	0		6.29		132		21
10179	OWENRIGH R AT CARNANBANE	C669067	24/10/2012	00:00	0		6.56		105		16
10377	DOUGLAS R AT BOHERADAILE BR	H774967	01/04/2009	00:00	0		6.12		104		17
10377	DOUGLAS R AT BOHERADAILE BR	H774967	16/09/2009	00:00	0		5.72		103		18
10377	DOUGLAS R AT BOHERADAILE BR	H774967	28/03/2011	00:00	0		5.94		101		17
10377	DOUGLAS R AT BOHERADAILE BR	H774967	21/09/2011	00:00	0		5.44		98		18
10377	DOUGLAS R AT BOHERADAILE BR	H774967	28/03/2012	00:00	0		6		120		20
10377	DOUGLAS R AT BOHERADAILE BR	H774967	03/10/2012	00:00	0		5.8		116		20
11208	RIVER ROE AT TURMEEL BRIDGE	C688088	29/04/2009	00:00	0		6.58		158		24
11208	RIVER ROE AT TURMEEL BRIDGE	C688088	19/10/2009	00:00	0		5.18		88		17
11208	RIVER ROE AT TURMEEL BRIDGE	C688088	18/04/2011	00:00	0		6.31		164		26
11208	RIVER ROE AT TURMEEL BRIDGE	C688088	17/10/2011	00:00	0		6.32		139		22
11208	RIVER ROE AT TURMEEL BRIDGE	C688088	18/04/2012	00:00	0		6.65		173		26
11208	RIVER ROE AT TURMEEL BRIDGE	C688088	24/10/2012	00:00	0		6.39		115		18

Selected Parameters	Abbreviation	Units
ALKALINITY	ALK	MG PER LITRE
AMMONIA (NON-IONISED)	NH3	MG PER LITRE
BIOCHEMICAL OXYGEN DEMAND	BOD	MG PER LITRE
CONDUCTIVITY	COND	USIEMENS/CM
COPPER DISSOLVED	CUSOL1	MG PER LITRE
DISSOLVED OXYGEN	DO	MG PER LITRE
DISSOLVED OXYGEN % SATURATION	DO %	PER CENT SAT
HARDNESS (TOTAL)	T/HARD	MG PER LITRE
NITRATE	NO3-N	MG PER LITRE
NITRITE	NO2-N	MG PER LITRE
NITROGEN (AMMONIACAL)	NH4-N	MG PER LITRE
PETROLEUM HYDROCARBONS	OILVIS	
PH VALUE	PH	PH UNITS
PHOSPHORUS SOL	P(SOL)	MG PER LITRE
SOLIDS (SUSPENDED)	SS	MG PER LITRE
TEMPERATURE	TEMP	DEGREES C
TOTAL OXIDISED NITROGEN	TON	MG PER LITRE
ZINC TOTAL	ZNTOT2	MG PER LITRE
ASPT	ASPT	
BIOTIC SCORE	BIOSCO	
NO OF TAXA	NO TAX	

<u>Enquiries</u>

There is also an Enquiries option under the map theme drop down menu, where information about the listed datasets can be requested e.g. borehole records.

It should be noted that the boreholes recorded do not relate to specific water abstractions, but instead represent records of boreholes, shafts and wells from all forms of drilling and site investigation work that have been collected by GSNI over the years. They are approximately 24,000 records dating back over 200 years and ranging between one and several thousand metres deep. New records are being added to the collection each year and will be included in the GeoIndex each it is updated. Depending on the circumstances of the request, there is usually a charge for these data sets (unless for academic use), but further details can be obtained by contacting GSNI - gsni@economy-ni.gov.uk

If information relating to licensed water abstraction boreholes is required, then this information can be obtained by contacting AIL@daera-ni.gov.uk.

Further Guidance –

NIEA Groundwater Web Page - https://www.daera-ni.gov.uk/articles/groundwater

NIEA – Assessment of Environmental Impact (Water Resources) Mineral Workings Advice Notice - https://www.daera-ni.gov.uk/publications/assessment-environmental-impact-water-resources-mineral-workings-advice-note

NIEA – Cemeteries, Burials and the Water Environment - https://www.planningni.gov.uk/index/advice/northern_ireland_environment_agency_guidance/practice_guide_-_cemeteries_burials_and_the_water_environment.pdf

NIEA – Water Features Survey - https://www.planningni.gov.uk/index/advice/northern_ireland_environment_agency_guidance/water_features_surveys.pdf

NIEA – Windfarms and Groundwater Impacts - https://www.daera-ni.gov.uk/publications/best-practice-guidance-documents

DAERA – WMU Digital Dataset Downloads - https://www.daera-ni.gov.uk/articles/wmu-digital-dataset-downloads

NIEA – WMU – WQU4575– WATER QUALITY - RESPONSE

WFD classification for river water bodies within 5 km radius are recorded in the attached excel spreadsheet along with details of monitoring stations and how they were used in classification. Individual classifications of quality elements for each site and river water body are available if required.

The excel spreadsheet also contains raw chemical and biological data where available from 2009 - 2017. The FFD classification for the monitoring sites are included.

A full description of WFD classification for freshwaters, including chemical standards and with references to supporting documents, can be found at **http://www.wfduk.org/**

Details of River Basin Management in Northern Ireland can be found at: **https://www.daera-ni.gov.uk/topics/water/river-basin-management**

Guidance Note:

Enquiries Relating to Regional Groundwater Aquifer and Vulnerability Classification – Use of GSNI GeoIndex

Update April 2018

Department of Agriculture, Environment and Rural Affairs
www.daera-ni.gov.uk

Northern Ireland Environment Agency
www.daera-ni.gov.uk

Department for the Economy
www.economy-ni.gov.uk

GSNI Geological Survey of Northern Ireland
www.bgs.ac.uk/gsni

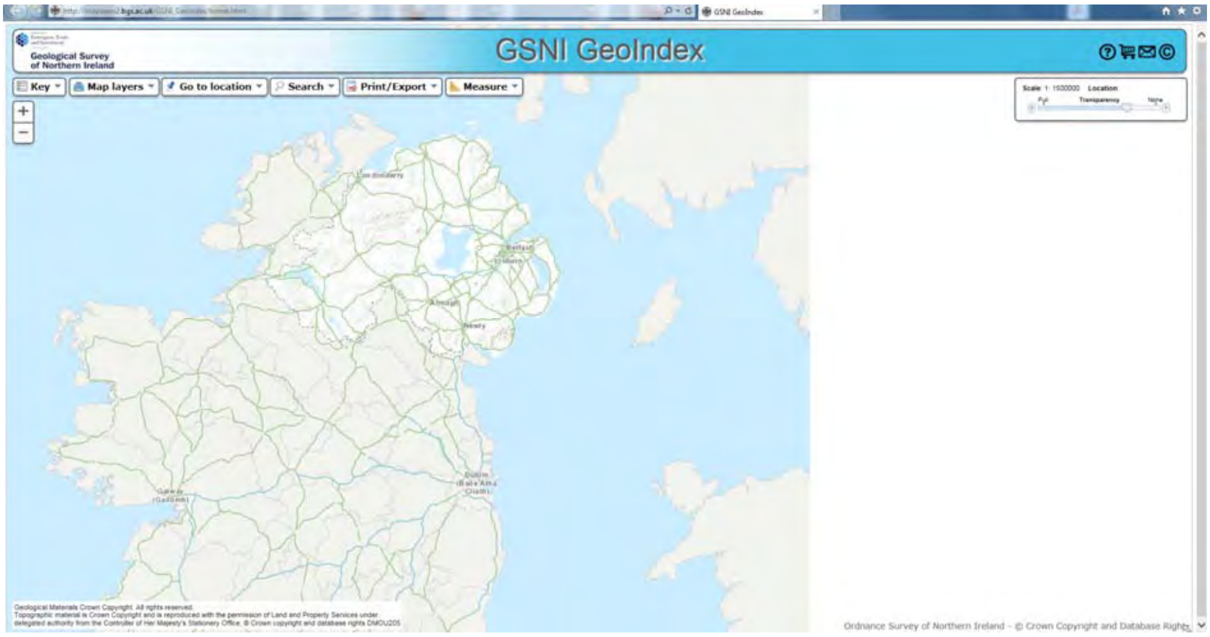
Background

Information relating to groundwater aquifer classification, superficial aquifers and groundwater vulnerability is available online directly from the Geological Survey of Northern Ireland's (GSNI) GeoIndex website:

http://mapapps2.bgs.ac.uk/GSNI_Geoindex/home.html

If seeking information in relation to the preparation of an environmental assessment i.e. a hydrogeological or water features survey, then it should be noted that other third party stakeholder organisations should also be contacted, in addition to the Northern Ireland Environment Agency and the Geological Survey of Northern Ireland as they might also hold relevant information. Furthermore, a prudent assessment would also usually include, as a minimum, a site visit in order to verify the information collated.

The information hosted on the GeoIndex is used by both the Northern Ireland Environment Agency Water Management Unit (NIEA WMU) and the GSNI when responding to general enquiries requesting hydrogeological information.



The GeoIndex portal allows the user to view and search the GSNI data holdings. A data enquiry form (trolley icon, top right) can also be submitted via the GeoIndex for further details on datasets.

In addition to hydrogeological information, the GeoIndex portal also hosts a range of other GSNI datasets including:

- 1:250,000 bedrock, structural and superficial geology;
- Soil, water and sediment geochemistry;
- Regional geophysical survey results including magnetic, electromagnetic, radiometric and gravity datasets;
- Active quarry locations;
- Recorded mineral occurrences; and
- Mineral and mining licence information.

Using the GeoIndex

The GeoIndex portal is located at:

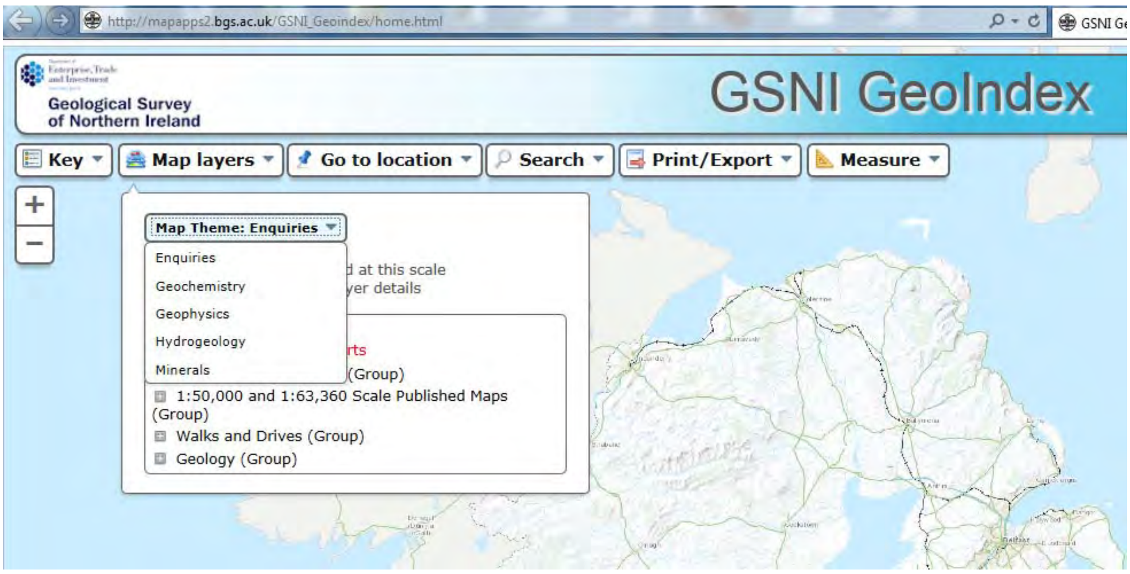
http://mapapps2.bgs.ac.uk/GSNI_Geoindex/home.html

The GeoIndex provides the option of viewing datasets under 5 different topic areas (referred to as themes), namely:

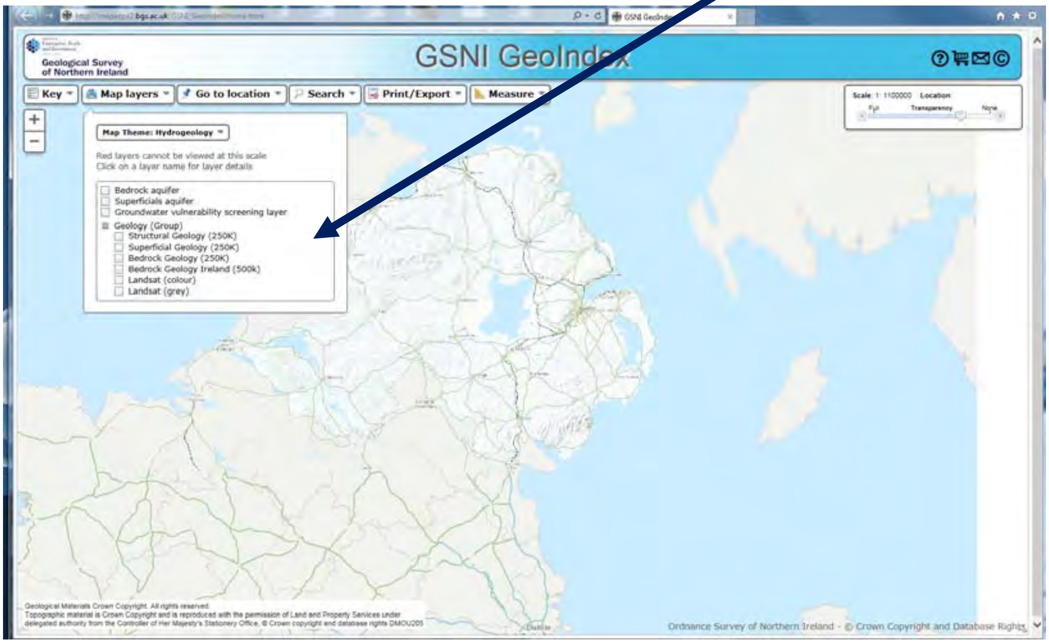
- Enquiries;
- Geochemistry;
- Geophysics;
- Hydrogeology; and
- Minerals.

It should be noted however, that the information as presented on the GeoIndex portal is based on regional assessment of datasets, and cannot be directly used to determine site specific conditions without further supporting investigation and interpretation.

The default map theme is “enquiries” but to select one of the other 4 listed above use the map layers drop down menu located below the GSNI GeoIndex title, to change it.



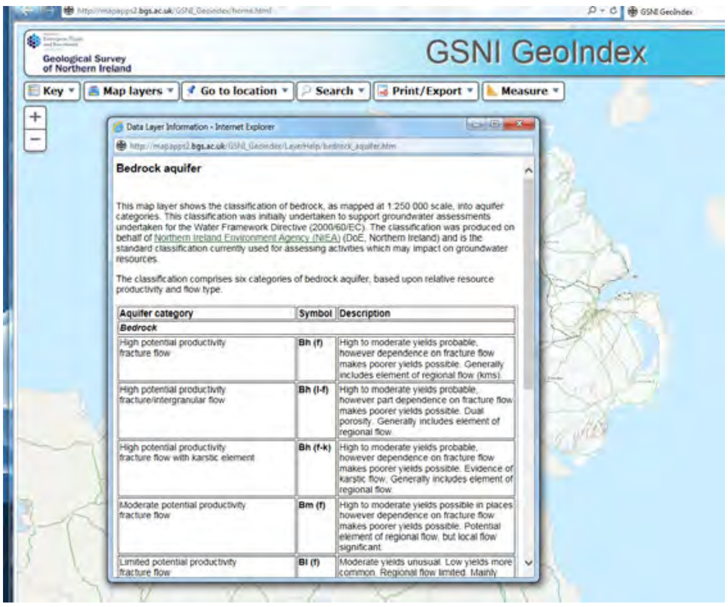
As you toggle through the 5 map themes, you will notice the map contents on the left hand side of the page changing.



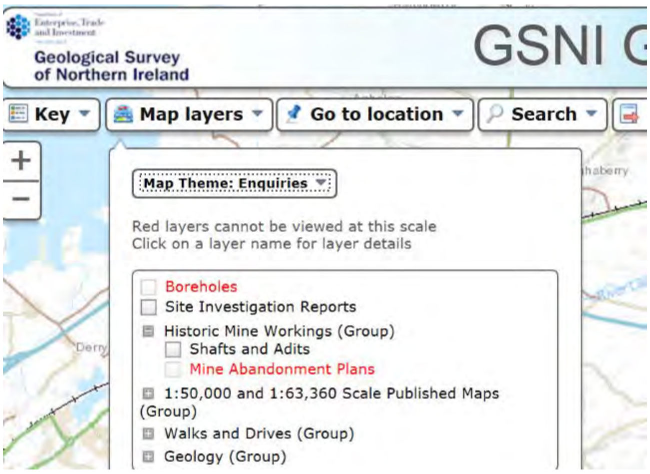
Map Contents:

Data can be viewed regionally by zooming in and out (+ / -), or site specific searches can be carried out using the Go to Location or Search options on the top toolbar. Go to Location allows the map to zoom to a known location using co-ordinates or town/street name. Search allows a rectangle/polygon to be drawn and results for some selected layers to be shown in a table.

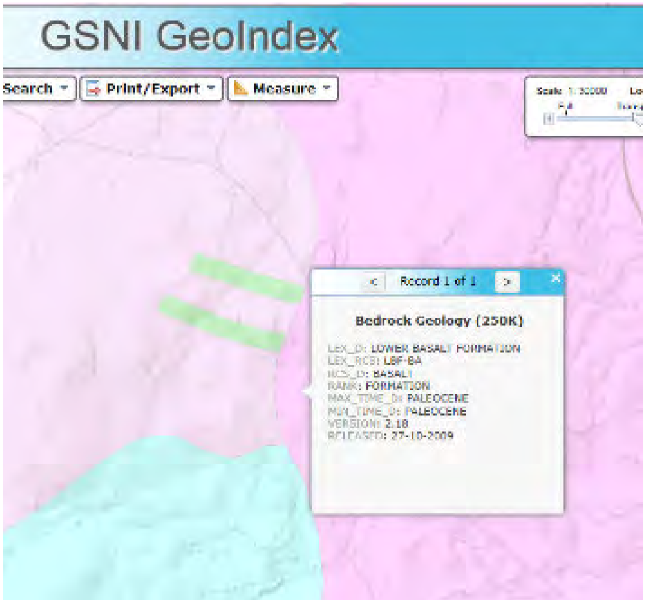
Map content items can be expanded ⊞ within the contents box, and if any further explanatory detail is needed on a particular map item, then click on the data set name in the map contents box and a pop-up will appear.



Example pop up window



Depending on the resolution, some of the datasets may be written in red and cannot be viewed. This means the current view level is beyond the level of detail appropriate to the data set, use the zoom function until the writing changes to black when the data set can be viewed.



Clicking on the map with layers displayed will also give more information about dataset

An option to Print and Export results is available, as is the ability to Measure the length or area.

As previously highlighted, users should note that information as presented on the GeoIndex portal is based on regional assessment of datasets, and should not be directly used to determine site specific conditions.

Department for
Infrastructure
An Roinn
Bonneagair
www.infrastructure-ni.gov.uk

Asset Management Unit

DfI Rivers
49 Tullywiggan Road
Loughry
Cookstown
BT80 8SG
Tel: 02886 768300

Ms Catriona Downey
McCloy Consulting
52 Mallusk Entrerprise Park
Newtownabbey
BT36 4GN

YourRef:
OurRef: IN1-18-8866
Date: 18 July 2018

Dear Catriona

Re: Magheramore WF

Thank you for your enquiry received 05/07/2018 regarding the above site. There are no watercourses within or bounding the site, which are designated within the terms of the Drainage (Northern Ireland) Order 1973.

There may be undesignated watercourses, within or bounding the site, about which we are unaware. DfI Rivers does not maintain a database of undesignated watercourses, which may be present at the site. In this regard, you are advised to consult with Ordnance Survey, and/or undertake site inspections, etc. DfI Rivers have a record of flooding downstream of this site dated 31st August 2005, adjacent to 11 Carnanbane Road, the cause of which was a storm run-off.

Within the terms of the above mentioned Order you are advised as follows:

1. If during the course of developing a site a watercourse is uncovered which was not previously evident, the Coleraine Office at 37 Castleroe Road, COLERAINE, BT513RL, Tel. 02870342357, should be contacted immediately in order that arrangements may be made for an investigation and direction in respect of any possible actions that may be necessary to maintain its drainage function; moreover

2. Any proposal either temporary or permanent, in connection with a development that may impact on the drainage function of any watercourse within the site, now or in the future, such as release of storm water to, culverting, bridging, diverting, building adjacent to and/or over, etc requires prior written consent from the Department. Details of such proposals, together with accompanying drawings, maps and calculations etc must be submitted in advance of any development to the Coleraine Office at 37 Castleroe Road, COLERAINE, BT51 3RL, Tel. 02870342357.

Failure to obtain such a written consent is an offence under the provisions of the above Order, which may lead to prosecution or other statutory action as provided for.

The Department does not accept any liability for loss, injury or damage to any

person or property as a result of any inaccuracy in the above information provided.
In this regards you are to seek the services of qualified competent professional bodies to ascertain the suitability and completeness of the information regarding the location, condition of and responsibility for any buried services at this location.

Future requests regarding the information on the Department's drainage and flood defence infrastructure should continue to be addressed to the DfI RiversAsset Management Unit at the above address.

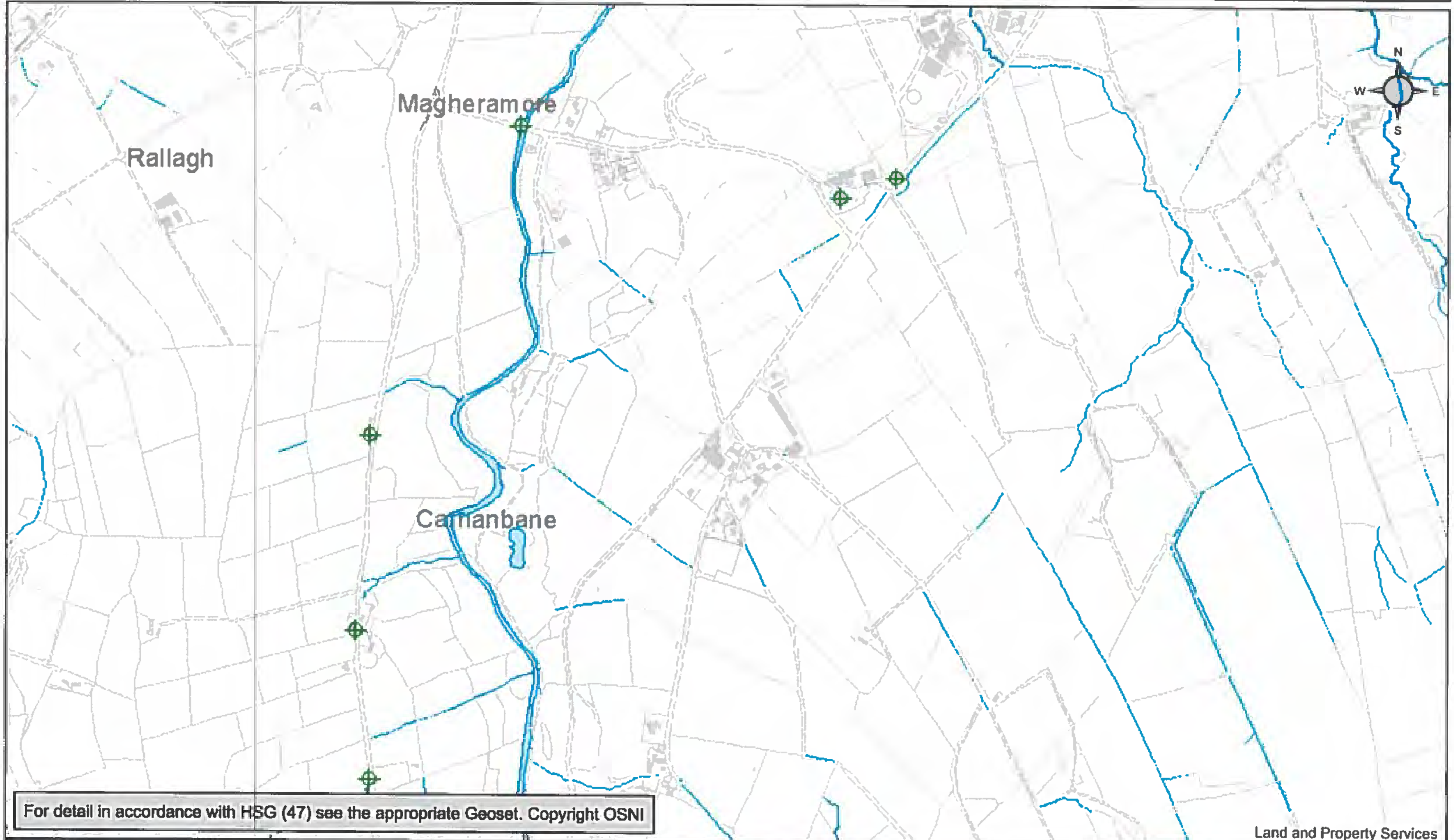
Yours sincerely

Anne McGuigan.

Anne McGuigan

Asset Management

IN1-18-8866



RIVERS Agency

An Agency within the Department of Agriculture and Rural Development

Date:20/07/2018

Scale: 1:10,000

1 Any proposals, either temporary or permanent, which involve interference with any watercourse, such as culverting, bridging, diversion, building adjacent to, or discharge of stormwater etc. require the written consent of Rivers Agency. Failure to obtain such written consent is an offence under the provisions of the Drainage (NI) Order 1973, which may lead to prosecution or other statutory action as provided for

2. If during the course of developing a site, a watercourse is uncovered which was not previously evident, Rivers Agency should be notified immediately in order that arrangements may be made for investigation and direction in respect of any action to deal with said watercourse. You are advised to assess the suitability/ correctness of the information provided as the Rivers Agency does not accept liability for loss, injury or damage to any person or property caused as a result of any inaccuracy in the information provided

- Watercourses (Designated)
- Info Pipes
- Info Nodes
- FloodDefence
- GaugingStations
- AlertStations

10

Noise

Appendix 10: Noise

Appendix 10.1	Assessment of Energy Storage Facility
Appendix 10.2	Scope of Assessment
Appendix 10.3	Calculating Standardise Wind Speed
Appendix 10.4	Propagation Height & Valley Effect
Appendix 10.5	Background Noise Surveys
Appendix 10.6	Instrumentation Records
Appendix 10.7	Charts
Appendix 10.8	Suggested Planning Conditions - Noise

Technical Appendix 10.1: Assessment of Energy Storage Facility

10.1.1 In addition to the wind farm it is also proposed to include energy storage on site. An acoustic assessment in accordance with BS 4142: 2014[19] has been undertaken in order to determine the acoustic impact due to the operation of this part of the Development.

10.1.2 The baseline data adopted is that recorded at a wind speed of 1 ms^{-1} during the background sound measurement surveys made to inform the acoustic assessment of operational noise from the proposed wind farm which correspond to the worst case, or quietest, levels.

10.1.3 The main sources of sound within the Development are the four inverters, four transformers and air conditioning for the Energy Storage Systems (ESS). The four ESS units are expected to be continuously charging and discharging. If there are any rest periods for the inverters these are likely to be infrequent and the Heating Ventilation and Air Conditioning systems (HVAC) would still be functioning.

10.1.4 Acoustic emission data for the proposed equipment is detailed in Table 10.1.1. The data corresponds to the maximum acoustic emission for each device as advised by the manufacturer. Predictions based on this data therefore represent the worst case and the sound levels would be expected to be less when the site isn't operating at maximum capacity. The amount of the time that this is the case is unknown at this stage as it depends upon which services the site is used to provide.

Table 10.1.1 - Acoustic Emission Data

Equipment	Sound Pressure Level at 1m, dB L_{Aeq}
Inverter	79
ESS unit HVAC	65
Transformer	68

10.1.5 Predicted specific sound levels due to the proposed energy storage facility at nearby residential properties, calculated using the ISO 9613-2 propagation model, are detailed in Table 10.1.2. A sound footprint for the energy storage facility is shown in Figure 10.1.1.

10.1.6 The propagation model takes account of sound attenuation due to geometric spreading and atmospheric absorption. The assumed temperature and relative humidity are 10 ˚C and 70 % respectively.

10.1.7 Ground effects are also taken into account by the propagation model, with a ground factor of 0.5 adopted to reflect a mix of hard and porous ground between the site and the assessment locations. A 4 m receiver height has been used. The effect of surface features such as buildings and trees has not been considered. There is a degree of conservatism built into the model as a result of the adoption of these settings.

10.1.8 ISO 9613-2 is a downwind propagation model. Where conditions less favourable to sound propagation occur, such as when the assessment locations are crosswind or upwind of the proposed energy storage facility, the predicted sound levels would be expected to be less and the downwind predictions presented here would be regarded as conservative.

[19] "Methods for rating and assessing industrial and commercial sound", The British Standards Institution 2014

Table 10.1.2 - Predicted Specific Sound Levels

House ID	Sound Pressure Level, dB L_{Aeq}
H1	12
H2	-9
H3	7
H4	7
H5	8
H6	8
H7	8
H8	6
H9	7
H10	7
H11	8
H12	7
H13	6
H14	6
H15	4
H16	3
H17	2
H18	1
H19	0
H21	2
H26	8
H27	8
H28	8
H29	8
H30	7
H31	6
H32	6
H33	6
H34	8

10.1.9 The sound emitted by the inverter cooling fans and HVAC units can have distinctive character. A correction of 4 dB has been applied in the event that tones are clearly perceptible at the assessment locations. This is a conservative measure as it may not be the case in practice.

10.1.10 The results of an acoustic assessment at the property where the predicted sound level is largest relative to the background sound level, H1, are shown in Table 10.1.3.

Table 10.1.3 – BS 4142: 2014 Assessment Results

Results	Day	Night
Residual sound level	33 dB $L_{Aeq,\ 16\ hour}$	29 dB $L_{Aeq,\ 16\ hour}$
Background sound level	23 dB $L_{A90,\ 10\ min}$	20 dB $L_{A90,\ 10\ min}$
Predicted specific sound level	12 dB L_{Aeq}	
Acoustic feature correction	4 dB	
Rating sound level	16 dB L_{Aeq}	
Excess of rating level over background	-7 dB	-4 dB
Predicted ambient sound level	33 dB $L_{Aeq,\ 16\ hour}$	29 dB $L_{Aeq,\ 16\ hour}$
Conclusion	Low impact	Low impact

10.1.11 The proposed energy storage facility is predicted to have a low impact during both day and night time periods as the rating sound level is below the existing background sound level.

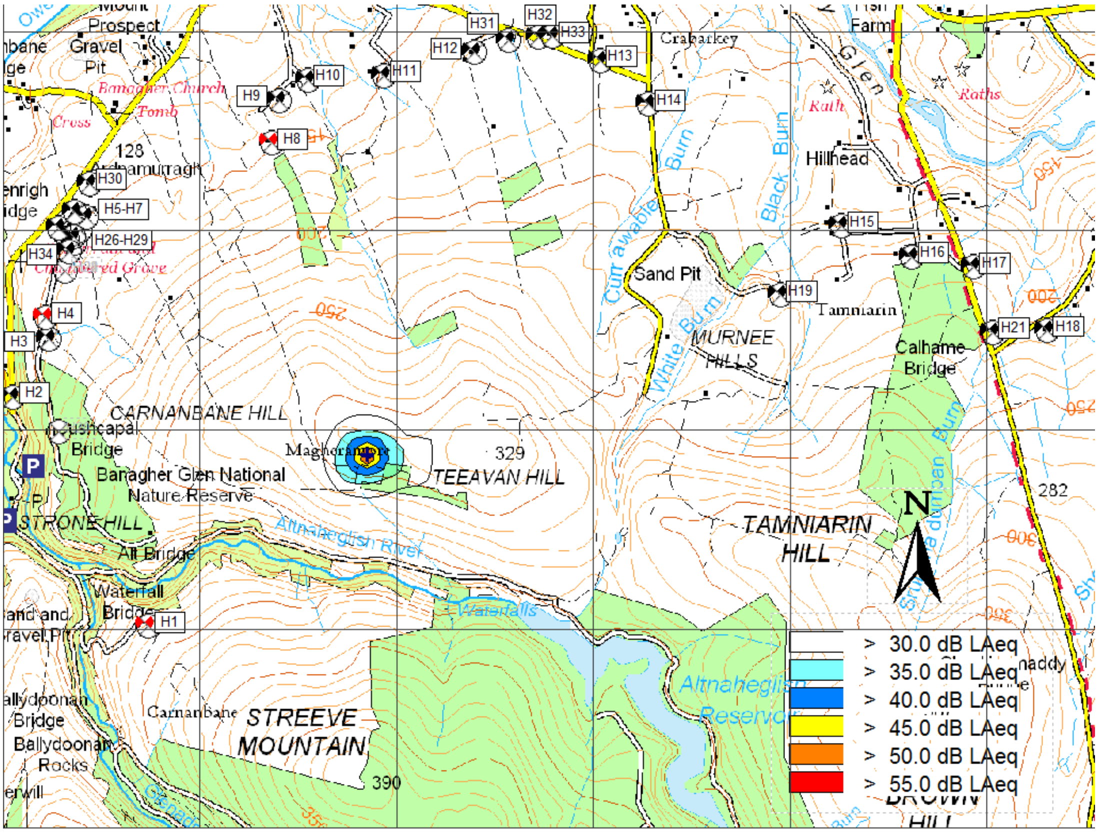
10.1.12 There is expected to be no change in the ambient sound level due to the introduction of the energy storage facility, consistent with it having a low impact.

10.1.13 The sound levels due to the proposed energy storage facility are predicted to be greater than or equal to 10 dB below the cumulative predicted wind farm sound levels such that they would be deemed insignificant in comparison.

10.1.14 In conclusion, the acoustic assessment shows that the impact due to the operation of the proposed energy storage facility is predicted to be low during both day and night time periods such that no adverse impacts would be expected.

10.1.15 Sound emitted during construction of the energy storage facility, including that due to associated traffic flows, is not predicted to exceed the criteria specified in BS 5228-1:2009 such that significant effects would not be anticipated.

Figure 10.1.1 – Predicted Energy Storage Sound Footprint



Technical Appendix 10.2: Scope of Assessment

Low Frequency Noise

10.148 The frequency range of 'audible noise' is generally taken to be 20 Hz to 20,000 Hz, with the greatest sensitivity to sound typically in the central 500 Hz to 4,000 Hz region. The range from 10 Hz to 200 Hz is generally used to describe 'low frequency noise', and noise with frequencies below 20 Hz used to describe 'infrasound'[20], although there is sometimes a lack of consistency regarding the definition of these terms in both common usage and the literature.

10.149 Low frequency noise is always present, even in an ambient 'quiet' background[20]. It is generated by natural sources, including the sea, earthquakes, the rumble of thunder and wind. It is additionally an emission from many artificial sources found in modern life, such as household appliances (e.g. washing machines, dishwashers) and all forms of transport.

10.150 Noise emitted from wind turbines covers a broad spectrum from low to high frequencies. In relation to human perception of the broadband noise produced by wind turbines, the dominant frequency range is not the low frequency or infrasonic ranges[21]. The reason for this is that the perception threshold for hearing in these ranges is much higher than for speech frequencies of between 250 Hz and 4000 Hz. As a result of this decreased sensitivity, wind turbine noise at the lowest frequencies of the range described as 'low frequency noise' would be below the average hearing threshold.

10.151 A comprehensive literature review of 'Low Frequency Noise and Infrasound Associated with Wind Turbine Generator Systems', undertaken for the Ontario Ministry for the Environment in 2010, indicated that low frequency noise from wind turbines crosses the threshold boundary, and thus would be considered to become audible, above frequencies of around 40-50 Hz[21]. The degree of audibility depends upon the wind conditions, the degree of masking from background noise sources and the distance from the wind turbines[21].

10.152 Although audible under some conditions, a paper; 'Infrasound and low frequency noise from wind turbines: exposure and health effects'[22], published by the authors of a literature review on the subject prepared for the Swedish Environmental Protection Agency in 2011[23], concludes that the level of low frequency noise produced by wind turbines does not exceed levels from other common sources, such as road traffic noise[22].

10.153 In response to an article published in the national press in 2004, alleging that low frequency noise from wind turbines may give rise to adverse health effects, the Department of Trade and Industry (DTI) commissioned the Hayes McKenzie Partnership

[20] 'A Review of Published Research on Low Frequency Noise and Its Effects', Leventhall, Report for DEFRA, 2003

[21] 'Low Frequency Noise and Infrasound Associated with Wind Turbine Generator Systems, a Literature Review', Ontario Ministry of the Environment, OSS078696, December 2010

[22] 'Infrasound and low frequency noise from wind turbines: exposure and health effects', Bolin et al, Environmental Research Letters Volume 6, September 2011

[23] 'A literature review of infra and low frequency noise from wind turbines: exposure and health effects', prepared for Swedish Environmental Protection Agency, November 2011

to perform an independent study to investigate these claims[24]. The Government released the following advice based on the report's findings[25]:

"The report concluded that there is no evidence of health effects arising from infrasound or low frequency noise generated by wind turbines."

10.154 This is re-iterated in the review undertaken for the Ontario Ministry for the Environment, which concludes that publications by medical professionals indicate that; at typical setback distances, the noise levels produced by wind turbines, including noise at low and infrasound frequencies, do not represent a direct health risk.

10.155 The Oregon Health Authority's Public Health Division conducted a strategic Health Impact Assessment in response to a convergence of questions about potential health impacts from wind energy facilities in Oregon. The report, titled 'Strategic Health Impact Assessment on Wind Energy Development in Oregon[26]' states that:

"Some field studies have found that in some locations near wind turbine facilities, low frequency noise (frequencies between 10 and 200 Hz) may be near or at levels that can be heard by humans. However, there is insufficient evidence to determine if low frequency noise from wind turbines is associated with increased annoyance, disturbance or other health effects".

10.156 Whilst low frequency content of the noise from wind farms shall be considered through the use of octave band specific noise emission and propagation modelling within the assessment presented here, it is considered that specific and targeted assessment on low frequency content of noise emissions from the Development is not necessary in light of available information and scientific reviews detailed above.

Infrasound

10.157 In relation to infrasound in general, frequencies below 20 Hz may be audible, although tonality is lost below 16 - 18 Hz, thus losing a key element of perception[20]. In relation to modern, upwind turbines; there is strong evidence that the levels of infrasound produced are well below the average threshold of human hearing[21]. The aforementioned DTI report extended this conclusion to more sensitive members of the population[24]:

"Even assuming the most sensitive members of the population have a hearing threshold which is 12 dB lower than the median hearing threshold, measured infrasound levels are well below this criterion".

10.158 As such[22]:

"infrasound from wind turbines is not audible at close range and even less so at distances where residents are living".

[24] 'The Measurement of Low Frequency Noise at Three UK Wind Farms', Hayes, Contract Number W/45/00656/00/00, URN 06/1412, 2006, www.berr.gov.uk/files/file31270.pdf

[25] 'Advice on findings of the Hayes McKenzie report on noise arising from Wind Farms', DTI, URN 06/2162, November 2006, www.berr.gov.uk/files/file35592.pdf

[26] 'Strategic Health Impact Assessment on Wind Energy Development in Oregon', Sujata Joshi et al, Prepared By: Public Health Division Oregon Health Authority, March 2013, www.healthimpactproject.org

10.159 In February 2005, the BWEA[27] published background information on low frequency noise from wind farms[28]. The conclusion states that:

"It has been repeatedly shown, by measurements of wind turbine noise undertaken in the UK, Denmark, Germany and the USA over the past decade, and accepted by experienced noise professionals, that the levels of infrasonic noise and vibration radiated from modern upwind configuration wind turbines are at a very low level; so low that they lie below the threshold of perception, even for those people who are particularly sensitive to such noise, and even on an actual wind turbine site".

10.160 The BWEA report goes on to quote Dr Geoff Leventhall, author of the DEFRA report on 'Low Frequency Noise and its Effects', as saying:

"I can state, quite categorically, that there is no significant infrasound from current designs of wind turbines".

10.161 With regard to health effects, the DTI report quotes the document 'Community Noise', prepared for the World Health Organisation (WHO), which states that[24]:

"there is no reliable evidence that infrasound below the hearing threshold produce physiological or psychological effects".

10.162 The DTI report goes on to conclude that:

"infrasound associated with modern wind turbines is not a source which will result in noise levels which may be injurious to the health of a wind farm neighbour".

10.163 Furthermore, researchers at Keele University explain that:

"The infrasound generated by wind turbines can only be detected by the most sensitive equipment, and again this is at levels far below that at which humans will detect the low frequency sound. There is no scientific evidence to suggest that infrasound has an impact on human health."[29]

10.164 In January 2013 the Environment Protection Authority, South Australia, presented their findings of a study into the level of infrasound within typical environments with a particular focus on comparing wind farm environments to urban and rural environments away from wind farms[30]. The report states:

"This study concludes that the level of infrasound at houses near the wind turbines assessed is no greater than that experienced in other urban and rural environments, and is also significantly below the human perception threshold. Also, that the contribution of wind turbines to the measured infrasound levels is insignificant in comparison with the background level of infrasound in the environment."

[27] BWEA is now known as RenewableUK, a group representing the concerns of companies in the Renewable Energy Industry

[28] 'Low Frequency Noise and Wind Turbines', The British Wind Energy Association, 2005, www.bwea.com/ref/lowfrequencynoise.html & Technical Annex www.bwea.com/pdf/lfn-annex.pdf

[29] 'Wind farm noise', Styles, & Toon, printed in the Scotsman newspaper as a rebuttal of claims made by the Renewable Energy Foundation, August 2005

[30] 'Infrasound Levels Near Windfarms and in Other Environments' Environment Protection Authority & Resonate Acoustics, January 2013, www.epa.sa.gov.au

10.165 The Australian Medical Association[31] in March 2014 issued a position statement which detailed their findings on the health impacts due to the generation of infrasound from wind turbines. The findings concluded that:

"The available Australian and international evidence does not support the view that the infrasound or low frequency sound generated by wind farms, as they are currently regulated in Australia, causes adverse health effects on populations residing in their vicinity. The infrasound and low frequency sound generated by modern wind farms in Australia is well below the level where known health effects occur, and there is no accepted physiological mechanism where sub audible infrasound could cause health effects".

10.166 In April 2015, at the International Conference on Wind Turbine Noise in Glasgow[32], a number of papers were presented on Low Frequency Noise and Infrasound. The findings of the research work undertaken were as follows.

10.167 A paper by Berger et al[33], investigates whether current audible noise-based guidelines for wind turbines account for the protection of human health, given the levels of infrasound and low frequency noise typically produced by wind turbines. New field measurements of indoor infrasound and outdoor low frequency noise at locations between 400m and 900m from the nearest turbine, which were previously underrepresented in the scientific literature, are reported and put into context with existing published work. The findings concluded that:

"The analysis showed that indoor IS (infrasound) levels were below auditory threshold levels while LFN (low frequency noise) levels at distances >500m were similar to background LFN levels. Overall, the available data from this and other studies suggest that health-based audible noise wind turbine siting guidelines provide an effective means to evaluate, monitor, and protect potential receptors from audible noise as well as IS and LFN".

10.168 Research by Hansen et al[34] proposed to examine the effect of infrasound tonal components on perceived low frequency noise annoyance for short exposure durations. The investigated spectra were synthesized based on measured wind turbine noise, which consisted of amplitude modulated tonal components. Listening tests were developed, based on data measured outside a residence, 1.3 km from a wind farm in South Australia. The research concluded that:

"For evaluation times of 5 minutes, it has been shown that for the persons tested, the presence of infrasound at realistic levels does not influence audibility, annoyance or ability to fall asleep."

[31] "AMA Position – Wind Farms and Health 2014", Australian Medical Association, March 2014

[32] International Conference on Wind Turbine Noise, An INCE Series of International Conferences on Wind Turbine Noise Held Biennially, Wind Turbine Noise 2015, 20th – 23rd April 2015, Glasgow

[33] "Health-based Audible Noise Guidelines Account for Infrasound and Low Frequency Noise Produced by Wind Turbines", Berger et al, Sixth International Meeting on Wind Turbine Noise, Glasgow 20-23 April 2015, Frontiers in Public Health, 24 February 2015

[34] "Perception and annoyance of low frequency noise versus infrasound in the context of wind turbine noise", Hansen et al, Sixth International Meeting on Wind Turbine Noise, Glasgow 20-23 April 2015

10.169 Leventhall[35] presented a paper which assesses the scientific basis of the "Plympton-Wyoming bylaw". This is a bylaw which has recently introduced limits on infrasound from wind turbines. The author concludes:

"Science does not support the conditions of the bylaw, which is largely aimed at restricting blade pass tones. There is no evidence that the very low level of blade pass tones affects humans, whilst there is evidence that it does not."

10.170 The work carried out by Tonin et al[36] was an investigation into the effect on the reported pathological symptoms of simulated infrasound produced by wind turbines. The infrasound waveform was generated using a custom-made headphone apparatus. Volunteers were manipulated into states of either high or low expectancy of negative effects from infrasound and their reactions to either infrasound or a sham noise were recorded in a double blind experiment. The findings of the investigation state that:

"It was found, at least for the short-term exposure times conducted here-in, that the simulated infrasound has no statistically significant effect on the symptoms reported by volunteers, however the state of prior concern that volunteers had about the effect of infrasound has a statistically significant influence."

10.171 A study by Walker & Celano[37] considered the subjective effects of wind turbine noise in a controlled environment and how to faithfully generate acoustic signatures produced by actual turbines. Field measurements indicate that theses signatures encompass a wide frequency range, extending from below 1Hz to several kHz. The authors present conceptual descriptions and preliminary demonstrations of an infrasound synthesizer that is capable of producing turbine-faithful signals at least 10 dB greater than experienced in the field. The authors concluded from their research:

"It has been demonstrated that simulation of wind turbine noise and infrasound levels representative of those observed at distances of 100 meters can be accomplished in a typical residential-sized room with a modest array of electro-acoustic actuators. To date, subjective reactions to the synthesized signals are not conclusive due to the small number of test subjects and constrained exposure times. However, no individual thus far has reported any sensation when exposed to infrasound alone at peak levels up to 97dB."

10.172 Therefore, in accordance with literature, it is not considered appropriate or relevant to undertake specific assessment in relation to infrasound for the Development.

Sleep Disturbance

10.2.1 Research evidence supports the conclusion that noise from any source would result in measurable effects on sleep when it reaches a certain level. Such effects may comprise changes in sleep state without those exposed actually awakening, or they may comprise complete awakenings. Either of these responses may or may not have a consequential

35 "On the overlap region between wind turbine infrasound and infrasound from other sources and its relation to criteria", G Leventhall, Sixth International Meeting on Wind Turbine Noise, Glasgow 20-23 April 2015

36 "Response to Stimulated Wind Farm Infrasound Including Effect of Expectation", Tonin et al, Sixth International Meeting on Wind Turbine Noise, Glasgow 20-23 April 2015

37 "Progress Report on Synthesis of Wind Turbine Noise and Infrasound", Walker & Celano, Sixth International Meeting on Wind Turbine Noise, Glasgow 20-23 April 2015

long-term effect on wellbeing depending on the subjects concerned and the extent of the effects being considered.

10.2.2 There is no reason why wind turbine noise should be any different to other forms of noise, in that there will be a certain level at which wind turbine noise would impact on the sleep of those exposed to it. As with other forms of noise, some variability in response across the exposed population would be expected, with some people being more noise sensitive and others more noise tolerant.

10.2.3 While some studies have found an association between wind turbine noise and sleep disturbance, others have not[38]. A selection of these studies is summarised below, followed by an explanation of how the night time noise limit recommended by the ETSU-R-97[39] guidelines, used to assess wind farm noise in the UK, was derived and an outline of the latest WHO advice.

10.2.4 A review undertaken by the Chief Medical Officer of Health of Ontario[40] in response to public health concerns about wind turbine noise concluded that:

"...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..."

10.2.5 A report published the Massachusetts Department of Environmental Protection concludes that[41]:

"Evidence regarding wind turbine noise and human health is limited. There is limited evidence of an association between wind turbine noise and both annoyance and sleep disruption, depending on the sound pressure level at the location of concern".

10.2.6 A study carried out by Health Canada[42] found that self-reported sleep (including general disturbance, use of sleep medication, diagnosed sleep disorders and sleep quality) was not associated with wind turbine noise exposure. Furthermore, when sleep quality was measured objectively, calculated wind turbine noise levels outside the participants' homes were not found to be associated with sleep efficiency, the rate of awakenings, duration of awakenings, total sleep time, or how long it took to fall asleep.

10.2.7 In contrast to the conclusions of the three studies described above, a report entitled 'Sleep Disturbance and Wind Turbine Noise' by Dr Christopher Hanning reviewed the potential consequences of wind turbine noise and its effect on sleep and health, making recommendations on setback distances[43]. The report was created on behalf of 'Stop Swinford Wind Farm Action Group' (SSWFAG) and states that:

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[38] 'A Review of the Potential Impacts of Wind Farm Noise on Sleep', Micic et al., Acoustics Australia, February 2018

[39] 'The Assessment and Rating of Noise from Wind Farms', The Working Group on Noise from Wind Turbines, ETSU Report for the DTI, ETSU-R-97

[40] 'The Potential Health Impact of Wind Turbines', Chief Medical Officer of Health (CMOH) Report, May 2010

[41] 'Wind Turbine Health Impact Study: Report of Independent Expert Panel'" Jeffrey M. Ellenbogen et al, Prepared for: Massachusetts Department of Environmental Protection Massachusetts Department of Public Health, January 2012

[42] "Wind Turbine Noise and Health Study: Summary of Results", Health Canada, November 2014, http://www.hc-sc.gc.ca/ewh-semt/noise-bruit/turbine-eoliennes/summary-resume-eng.php

[43] 'Sleep Disturbance and Wind Turbine Noise', Hanning, on behalf of Stop Swinford Wind Farm Action Group (SSWFAG), June 2009

"There can be no doubt, that groups of industrial wind turbines ("wind farms") generate sufficient noise to disturb the sleep and impair the health of those living nearby."

10.2.8 In another article by Dr Hanning and Professor Alun Evans published in the British Medical Journal[44] it states:

"A large body of evidence now exists to suggest that wind turbines disturb sleep and impair health at distances and external noise levels that are permitted in most jurisdictions, including the United Kingdom."

10.2.9 A criticism of Dr Hanning's work is its focus on recommending a fixed setback distance between wind turbines and residential properties. This generalisation obscures the link between noise level and sleep disturbance in that it does not account for variations in the size of wind farm sites and differences in the noise levels emitted by different turbine types. Care is required when interpreting the findings of studies undertaken in multiple countries as different noise limits would likely apply such that the participants could be exposed to different noise levels. It might also be the case that the relevant noise guidance in a given country has changed over time such that older wind farms were assessed against different standards. Other differences between countries might include the specification of a noise limit that applies at all times or separate limits for day and night time periods. If separate limits for day and night time periods are defined it may be the case that the noise limit for one period effectively restricts the amount of noise that can be emitted during the other period such that the limit for the period where a higher limit is permitted on paper is rarely, if ever, reached in practice.

10.2.10 UK wind farm noise guidance, ETSU-R-97, states that different limits should be applied during daytime and night-time periods. The daytime limits are intended to preserve outdoor amenity, while the night-time limits are intended to prevent sleep disturbance. A lower fixed limit of 35-40 dB L_{A90} applies during daytime periods. The night-time lower fixed limit of 43 dB L_{A90} is derived from the 35 dB(A) sleep disturbance criterion referred to in ETSU-R-97, with an allowance of 10 dB for attenuation through an open window (which is at the conservative end of the 10 – 15 dB range deemed typical) and a correction of 2 dB to allow for the use of L_{A90}, rather than L_{Aeq}.

10.2.11 The 35 dB(A) sleep disturbance criterion was consistent with WHO advice at the time[45]. The WHO Guidelines for Community Noise[46], published in 1995, reduced the indoor limit to 30 dB L_{Aeq} but translated this into an outdoor limit of 45 dB L_{Aeq} which remained consistent with the recommendations of ETSU-R-97.

10.2.12 The Night Noise Guidelines for Europe[47], published by the WHO in 2009, recommend target levels for the protection of public health from night time noise. The limits proposed are aspirations and have yet to be adopted by any EU Member State. The Night Noise Guideline (NNG) is an outdoor annualised free field noise level of 40 dB L_{Aeq} during night time periods. An interim target of 55 dB L_{Aeq} is recommended in situations where the NNG is not feasible in the short term. Annual averaging would allow noise

[44] 'Wind Turbine Noise', Hanning et al, British Medical Journal, March 2012

[45] WHO Environmental Health Criteria 12 - Noise: 1980

[46] WHO Guidelines for Community Noise, 1995

[47] 'Night Noise Guidelines for Europe', World Health Organisation, 2009

levels in excess of 40 dB L_{Aeq} to occur for a certain amount of the time without the NNG being breached. The WHO guidelines are therefore not directly comparable to the noise limits for the Proposed Development derived from ETSU-R-97 as these are specified as levels that should not be exceeded. Likewise, the predicted wind farm noise levels shown in the acoustic assessment are not directly comparable to the NNG as they do not represent annual average night time values. The annual average wind farm noise level would depend upon the range of wind speeds and wind directions experienced during night time periods over the year in question.

10.2.13 The Environmental Noise Guidelines for the European Region[48], published by the WHO in 2018, are described as complementary to the Night Noise Guidelines and state that:

"No statistically significant evidence was available for sleep disturbance related to exposure from wind turbine noise at night."

10.173 Since ETSU-R-97 accounted for sleep disturbance when setting night time noise limits and continues to be endorsed by planning guidance it is concluded that protection from sleep disturbance is considered within the acoustic impact assessment of the Development.

Vibration

10.174 Structure borne noise, originating in vibration, is also low frequency, as is neighbour noise heard through a wall, since walls generally block higher frequencies more than lower frequencies.

10.175 In 2004/2005, researchers at Keele University investigated the effects of the extremely low levels of vibration resulting from wind farms on the operation of the seismic array at Eskdalemuir, one of the most sensitive installations in the world[29]. The results of this study have frequently been misinterpreted and, to clarify the position, the authors have explained that:

"The levels of vibration from wind turbines are so small that only the most sophisticated instrumentation and data processing can reveal their presence, and they are almost impossible to detect."

10.176 They go on to say:

"Vibrations at this level and in this frequency range will be available from all kinds of sources such as traffic and background noise - they are not confined to wind turbines. To put the level of vibration into context, they are ground vibrations with amplitudes of about one millionth of a millimetre. There is no possibility of humans sensing the vibration and absolutely no risk to human health."

10.177 The Ministry of Defence's approach to safeguarding the Eskdalemuir seismic array is to allocate a budget in terms of the cumulative level of seismic vibration from wind turbines. This restricts the number of wind farms that can be located within a certain distance of the Eskdalemuir seismic array (EKA) without adversely impacting upon its operation. In June 2014, a report was prepared by Xi Engineering Consultants with the

[48] 'Environmental Noise Guidelines for the European Region, World Health Organisation, 2018

full cooperation and significant input from the Ministry of Defence[49]. The report builds on initial Phase 0 work which identified that the current budget over estimates the seismic vibration produced by wind turbines and that there is a likelihood of significant prospective head room that would allow the building of wind farms without breaching the 0.336 nm threshold. The goal of the research was to produce an algorithm that could better predict the amplitude of seismic vibrations produced by wind turbines in the 0.5 to 0.8 Hz passband, which might allow the exploitation of wind resource in the Southern Uplands while maintaining protection of the detection capabilities of EKA. The work of the research allows for the determination of how close to EKA wind turbines can be built while optimising the generating capacity within the consultation zone. The application of a physics based algorithm allowed for the calculation of cumulative seismic vibration at EKA. From these calculations they were able to predict that:

"The cumulative amplitude of all turbines currently allocated budget and currently subject to objection with a utilisation factor of unity and minimum hub height of 40 m is 0.193833 nm."

This value falls well below the 0.336 nm threshold as set by the MOD.

10.178 A scientific advisory panel comprising independent experts in acoustics, audiology, medicine and public health conducted a comprehensive review of the available literature on the issue of perceived health effects of wind turbines, titled 'Wind Turbine Sound and Health Effects - An Expert Panel Review', and prepared a report for the American and Canadian Wind Energy Associations in December 2009[50]. The authors explain that:

"Vibration of the body by sound at one of its resonant frequencies occurs only at very high sound levels and is not a factor in the perception of wind turbine noise".

10.179 The authors further state that:

"Airborne sound can cause detectable body vibration, but this occurs only at very high levels — usually above sound pressure levels of 100 dB. There is no scientific evidence to suggest that modern wind turbines cause perceptible vibration in homes or that there is an associated health risk".

10.180 Therefore, in accordance with relevant literature and evidence reviews, it is not considered appropriate or relevant to undertake specific assessment in relation to vibration caused by the operation of the Development.

Aerodynamic Modulation

10.181 A noise sometimes associated with wind turbines and commonly referred to as 'blade swish' is the modulation of aerodynamic noise produced at blade passing frequency (the frequency at which a blade passes a fixed point). This noise character is acknowledged by, and accounted for, in the recommendations of ETSU-R-97[2]. However the aforementioned DTI report[24] noted that 'Aerodynamic Modulation', alternatively referred to as 'Amplitude Modulation' (AM) was, in some isolated circumstances,

[49] "Seismic vibration produced by wind turbines in the Eskdalemuir region. Release 2.0 of Substantial Research project" prepared by Xi Engineering Consultants Ltd, Document Number FMB_203_FINAL_V5R, 15th June 2014

[50] 'Wind Turbine Sound and Health Effects - An Expert Panel Review' W.D. Colby et al, 2009

occurring in ways not anticipated by ETSU-R-97. AM above and beyond that considered by ETSU-R-97 is often referred to as Excess, or Other, Amplitude Modulation (EAM/OAM).

10.182 In December 2013, the wind industry trade association, RenewableUK, published detailed new scientific research[51] into causes and effects of wind turbine AM. The work was carried out by a group of independent experts, including academics from the Universities of Salford and Southampton, the National Aerospace Laboratory of the Netherlands, Hoare Lea Acoustics, Robert Davies Associates and DTU Riso in Denmark.

10.183 The Chairman of the IOA Noise Working Group said of the study:

"This research is a significant step forward in understanding what causes amplitude modulation from a wind turbine, and how people react to it."

10.184 The RenewableUK work encouraged further research in the area, which has led to the identification of suitable mitigation methods. At the EWEA Technology Workshop on Wind Turbine Sound in 2014, Hoare Lea Acoustics presented a paper entitled: "Measurements to assess the effectiveness of turbine modifications to reduce the occurrence of AM in the far-field"[52]. The paper concludes that turbine blade modifications can result in significant reductions in AM in the far-field and that similar effects can also be achieved through blade pitch modification.

10.185 The authors state that:

"This shows that effective mitigation of AM on operational turbines is technically feasible."

10.186 The other notable outcome of the RenewableUK research was a proposed planning condition informed by listening tests and work undertaken to determine how AM should be measured. The IOA recommended a period of testing and validation before the condition was adopted such that the work again proved valuable as a catalyst for further research.

10.187 The IOA created a dedicated AM Working Group to undertake the further testing and validation recommended. A discussion document[53] on methods for rating amplitude modulation in wind turbine noise was published in April 2015. The document proposed a definition of AM and provided a literature review of the available metrics before selecting three for detailed discussion. The intention was to obtain feedback from the acoustic community, allowing a preferred rating method to be selected following the consultation period. The final report[54], detailing the recommended metric for the quantification of the level of AM in wind turbine noise, and the reasoning behind it, was published in August 2016.

10.188 A separate, government funded, study was commissioned by the Department of Energy and Climate Change (DECC) with a view to recommending how an appropriate AM

[51] 'Wind Turbine Amplitude Modulation: Research to Improve Understanding as to its Cause and Effects', RenewableUK, 2013, www.renewableuk.com

[52] "Measurements to assess the effectiveness of turbine modifications to reduce the occurrence of AM in the far-field", Bullmore & Cand, Hoare Lea Acoustics, EWEA Technology Workshop: Wind Turbine Sound 2014, Malmo, Sweden, 9-10 December 2014

[53] Institute of Acoustics, IOA Noise Working Group (Wind Turbine Noise), Amplitude Modulation Working Group, Discussion Document, "Methods for Rating Amplitude Modulation in Wind Turbine Noise", April 2015

[54] Institute of Acoustics Noise Working Group, A Method for Rating Amplitude Modulation in Wind Turbine Noise, 9 August 2016

threshold should be defined. A report summarising the work[55], undertaken by WSP Parsons Brinkerhoff, was published in August 2016 and proposes an appropriate penalty scheme informed by studies into subjective response to a given level of AM.

10.2.14 There is therefore a method of quantification of the level of AM over a given 10 minute period and the appropriate penalty to apply where necessary. It should be noted that this is in addition to any penalty for tonal noise.

10.2.15 There are no standard or agreed methods, however, by which to predict with any certainty, the likelihood of AM occurring at a level requiring a penalty, only some possible indicators such as relatively high wind shear conditions under certain circumstances or particular turbine designs and/or dimensions for example.

10.189 Appropriate elements for a planning condition to control AM were proposed by the acoustic experts undertaking the research. The specific wording for a condition was not within the scope of the research report and it was noted that legal advice would be required to ensure any proposed condition for a particular proposal met the necessary policy guidance tests.

Wind Turbine Syndrome

10.190 The condition proposed by paediatrician Dr Nina Pierpont in her report 'Wind Turbine Syndrome: A Report on a Natural Experiment' cites a range of physical sensations and effects as being caused by living near a wind farm[56]. This study is based on a series of interviews comprising a study group of 10 families. It is a self-published report with none of the research being published in any peer reviewed medical journal.

10.191 In a NHS response to the Pierpont report, a report titled 'Are wind farms a health risk?' states that there is no conclusive evidence that wind turbines have an effect on health or are causing the set of symptoms described as 'wind turbine syndrome'[57]. It was noted that the group study by Pierpont was not sufficient to grant the claims stated.

10.192 The aforementioned report 'Wind Turbine Sound and Health Effects - An Expert Panel Review'[50], prepared by a scientific advisory panel for the American and Canadian Wind Energy Associations, concludes that Wind Turbine Syndrome is:

"not a recognized medical diagnosis, is essentially reflective of symptoms associated with noise annoyance and is an unnecessary and confusing addition to the vocabulary on noise".

10.193 The report went on to say:

"There are no unique symptoms or combinations of symptoms that would lead to a specific pattern of this hypothesized disorder."

10.194 An independent review of the state of knowledge about the alleged health condition was carried out[58]. This report includes three expert opinions provided by: Richard J.Q. McNally - Reader in Epidemiology at the Institute of Health and Society Newcastle University; Geoff Leventhall – an independent consultant specialising in low frequency

[55] WSP Parsons Brinckerhoff, Wind Turbine AM Review, Phase 2 Report, August 2016

[56] 'Wind Turbine Syndrome - A Report on a Natural Experiment', Pierpont, K-Selected Books, 2009

[57] 'Are wind farms a health risk?', NHS, 2009, www.nhs.uk

[58] 'Wind Turbine Syndrome (WTS) - An independent review of the state of knowledge about the alleged health condition', RenewableUK, 2010, www.bwea.com

noise, infrasound and vibration; and Mark E. Lutman - Professor of Audiology at the University of Southampton. Their critique of Pierpont's study concludes that the reported symptoms are the effects mediated by stress and anxiety when exposed to an adverse element in their environment. There is no evidence that they are patho-physiological effects of wind turbine noise.

10.195 A paper by Pedersen explores data from three cross-sectional studies comprising A-weighted sound pressure levels of wind turbine noise, and subjectively measured responses from 1,755 people, to find the relationships between sound levels and aspects of health and well-being[59]. It was concluded that there is no consistent association between wind turbine noise exposure and the symptoms associated with Wind Turbine Syndrome.

10.196 A study conducted by Simon Chapman, Professor of Public Health at Sydney University, provides evidence that noise and health complaints about wind turbines are psychogenic[60]. The authors conclude that:

"In view of scientific consensus that the evidence for wind turbine noise and infrasound causing health problems is poor, the reported spatio-temporal variations in complaints are consistent with psychogenic hypotheses that health problems arising are communicated diseases with nocebo effects likely to play an important role in the aetiology of complaints".

10.197 Therefore, in accordance with this literature and the studies detailed above, it is not considered appropriate or relevant to undertake any assessment in relation to Wind Turbine Syndrome in relation to the Development.

Wind Turbine Noise and Associated Health Effects Studies

10.198 In 2014 Health Canada released its findings from the "Wind Turbine Noise and Health Study"[61]. Health Canada, in partnership with Statistics Canada, conducted the study between residents of southern Ontario and Prince Edward Island where there were a sufficient number of homes within the vicinity of wind turbine installations. Twelve and six wind turbine developments were sampled in Ontario and PEI, representing 315 and 84 wind turbines, respectively. All potential homes within approximately 600 m of a wind turbine were selected, as well as a random selection of homes between 600 m and 10 km. A total of 1,238 households participated out of a possible 1,570.

10.199 The study was comprised of three parts: an in-person questionnaire given to randomly selected participants living at various distances from wind turbines; a collection of physical health measures that assessed stress levels using hair cortisol, blood pressure and resting heart rate as well as measures of sleep quality; and more than 4,000 hours of wind turbine noise measurements conducted by Health Canada to support calculations of wind turbine noise levels (WTN) in all homes in the study.

[59] 'Health aspects associated with wind turbine noise—results from three field studies' Pedersen, Noise Control Engineering Journal, Volume 59, Issue 1, 2011

[60] 'Spatio-temporal differences in the history of health and noise complaints about Australian wind farms: evidence for the psychogenic, communicated disease hypothesis', Chapman et al, University of Sydney, 2013

[61] "Wind Turbine Noise and Health Study: Summary of Results", Health Canada, November 2014, http://www.hc-sc.gc.ca/ewh-semt/noise-bruit/turbine-eoliennes/summary-resume-eng.php

10.200 Health Canada broke the findings into five parts: illness and chronic disease, stress, sleep, annoyance and quality of life and noise.

10.201 Under Self-reported Illnesses and Chronic Diseases, Health Canada states:

"Self-reports of having been diagnosed with a number of health conditions were not found to be associated with exposure to WTN levels. These conditions included, but were not limited to chronic pain, high blood pressure, diabetes, heart disease, dizziness, migraines, ringing, buzzing or whistling sounds in the ear (i.e., tinnitus)".

10.202 Under the heading of Self-reported Stress, Health Canada states no association was found between the multiple measures of stress (such as hair cortisol, blood pressure, heart rate, self-reported stress) and exposure to wind turbine noise.

"Self-reported stress, as measured by scores on the Perceived Stress Scale, was not found to be related to exposure to WTN levels".

10.203 For Self-reported Sleep:

"Results of self-reported measures of sleep, that relate to aspects including, but not limited to general disturbance, use of sleep medication, diagnosed sleep disorders and scores on the Pittsburgh Sleep Quality Index (PSQI), did not support an association between sleep quality and WTN levels".

10.204 However, the study states, while some people reported some of the aforementioned health conditions, their existence was not found to change in relation to exposure to wind turbine noise.

10.205 An association was found, however, between increasing levels of wind turbine noise and individuals reporting to be very or extremely annoyed. No association was found with any significant changes in reported quality of life or with overall quality of life and satisfaction with health. This was assessed using the abbreviated version of the World Health Organization's Quality of Life Scale.

"The overall conclusion to emerge from the study findings is that the study found no evidence of an association between exposure to WTN and the prevalence of self-reported or measured health effects beyond annoyance. Collectively, the findings related to annoyance suggest that health and well-being effects may be partially related to activities that influence community annoyance, over and above exposure to WTN. Therefore, efforts that aim to identify and mitigate high levels of annoyance with wind turbines may have benefits that go beyond annoyance"[62].

10.206 Lastly, under noise, calculated noise levels were found to be below levels that would be expected to directly affect health, according to the World Health Organization Community Noise Guidelines, 1999.

10.207 A review conducted by McCunney et al in[63] November 2014, examines the literature related to health effects of wind turbines. The review was intended to assess the peer-reviewed literature regarding evaluations of potential health effects among people living in the vicinity of wind turbines. It included analysis and commentary of the

[62] 'Wind Turbine Noise and Health Study: Summary of Results', Michaud, Sixth International Meeting on Wind Turbine Noise, Glasgow, 20-23 April 2015

[63] "Wind Turbines and Health: A Critical Review of the Scientific Literature" McCunney et al, Journal of Occupational & Environmental Medicine, November 2014

scientific evidence regarding potential links to health effects, such as stress, annoyance, and sleep disturbance, among others, that have been raised in association with living in proximity to wind turbines. Also addressed were specific components of noise associated with wind turbines such as infrasound and low-frequency sound and their potential health effects.

10.208 The review attempts to address the following questions regarding wind turbines and health:

- Is there sufficient scientific evidence to conclude that wind turbines adversely affect human health? If so, what are the circumstances associated with such effects and how might they be prevented?
- Is there sufficient scientific evidence to conclude that psychological stress, annoyance, and sleep disturbance can occur as a result of living in proximity to wind turbines? Do these effects lead to adverse health effects? If so, what are the circumstances associated with such effects and how might they be prevented?
- Is there evidence to suggest that specific aspects of wind turbine sound such as infrasound and low-frequency sound have unique potential health effects not associated with other sources of environmental noise?

10.209 The co-authors represent professional experience and training in occupational and environmental medicine, acoustics, epidemiology, otolaryngology, psychology, and public health.

10.210 The findings of the review are summarised thus:

- Measurements of low-frequency sound, infrasound, tonal sound emission, and amplitude-modulated sound show that infrasound is emitted by wind turbines. The levels of infrasound at customary distances to homes are typically well below audibility thresholds.
- No cohort or case–control studies were located in this updated review of the peer-reviewed literature. Nevertheless, among the cross-sectional studies of better quality, no clear or consistent association is seen between wind turbine noise and any reported disease or other indicator of harm to human health.
- Components of wind turbine sound, including infrasound and low-frequency sound have not been shown to present unique health risks to people living near wind turbines.
- Annoyance associated with living near wind turbines is a complex phenomenon related to personal factors. Noise from turbines plays a minor role in comparison with other factors in leading people to report annoyance in the context of wind turbines.

10.2.16 The WHO's Environmental Noise Guidelines[48] conditionally recommend that average exposure to wind turbine noise is limited to 45 dB L_{den} as wind turbine noise above this level is associated with adverse health effects. The recommendation is conditional as evidence of the adverse effects of wind turbine noise was rated as being of low quality. The limit is set at this level as there was deemed to be sufficient, albeit still low quality, evidence that this represented the threshold at which 10 % of people would be expected to be highly annoyed. The risk of other health outcomes at given levels of wind turbine noise could not be assessed due to a lack of evidence.

10.2.17 The day-evening-night level (L_{den}) is an annual average L_{eq} with a 5 dB penalty applied to noise levels occurring during the evening and a 10 dB penalty applied to noise levels during the night. The WHO limit is not directly comparable to the noise limits for the Proposed Development derived from ETSU-R-97 which are specified as L_{90} levels that should not be exceeded. Likewise, the predicted wind farm noise levels shown in the acoustic assessment are not directly comparable to the WHO limit as they do not represent annual average values and do not have the penalties applicable during evening and night time periods applied. The annual average wind farm noise level experienced by nearby residents would depend upon the range of wind speeds and wind directions over the year in question.

10.2.18 Given the lack of evidence of health effects caused by wind turbine noise, the conditional nature of the WHO guidance and the continued endorsement of ETSU-R-97 by planning policy, no additional assessment of health effects due to the Proposed Development has been undertaken.

Technical Appendix 10.3: Calculating Standardised Wind Speed

10.211 In order to derive appropriate noise limits the ETSU-R-97 guidance requires the correlation of background noise survey data with wind speed data referenced to 10 m height. In contrast to this, acoustic emission measurements on wind turbines are undertaken in accordance with international standard IEC 61400-11, 'Wind Turbine Generator Systems – Part 11: Acoustic Noise Measurement Techniques'[64], which specifies that the turbine noise emission should be reported as a function of 'standardised' wind speed at 10 m height. In practice this translates as extrapolation of wind speed at hub height down to 10 m height using a specified, and fixed, relationship.

10.212 The use of a fixed relationship between hub height and 10 m wind speed means that potential exists for the background noise data and acoustic emission data to be misaligned i.e. a wind speed measured at 10 m height is not necessarily equivalent to a 'standardised' 10 m wind speed of the same magnitude, with the difference depending upon the site specific shear exponent (the rate of change of wind speed with height).

10.213 To account for the effects of wind shear, the background noise data is referenced to the same wind speed as the acoustic emission data. This approach is defined as appropriate, both by a group of independent acoustic consultants who have undertaken work on behalf of wind farm developers, local planning authorities and third parties in the IoA Bulletin, and in the subsequent IoA GPG. The methodology outlined below is followed to convert the wind speed measured concurrently with the background noise data to 'standardised' 10 m height:

- Extrapolate the wind speed from the measurement height to the proposed hub height by use of a calculated wind shear exponent. The wind shear exponent is a commonly used, empirically based, engineering description of the rate of change of wind speed with height and may vary according to atmospheric conditions and be affected by interactions between ground features and the wind flow. The hub height wind speed for each 10 minute period may be calculated from the measured wind speed and the calculated wind shear exponent as follows:

$$v_{hub} = v_{H1}\left(\frac{h_{hub}}{h_{H1}}\right)^{\alpha}$$

  Where: v_{H1} = measured wind speed
  v_{hub} = wind speed at proposed hub height
  h_{H1} = measurement height
  h_{hub} = proposed hub height
  a = calculated wind shear exponent from measured site data

- The 'standardised' 10 m wind speed is determined from the calculated hub height wind speed according to the procedure specified in IEC 61400-11. The 'standardised' wind speed is essentially a proxy for hub height wind speed (the

[64] 'Wind turbine generator systems – Part 11: Acoustic noise measurement techniques', IEC 61400-11:2003 (Amendment 1: 2006)

primary driver of noise emission from the turbine) and is found by extrapolating the hub height wind speed to 10 m height according to the following formula:

$$v_S = v_Z \left[\frac{\ln \frac{z_{ref}}{z_{0ref}}}{\ln \frac{z}{z_{0ref}}} \right]$$

Where: v_s is the ‘standardised’ wind speed

v_z is the wind speed at height z (the hub height wind speed)

z_{0ref} is the reference roughness length (0.05 m)

z_{ref} is the reference height, 10 m

z is the proposed hub height

- The resulting ‘standardised’ 10 m wind speed is correlated with the measured background noise survey data.

Technical Appendix 10.4: Propagation Height & Valley Effect

10.214 To model the propagation of noise between each proposed turbine and residential property in accordance with the IoA GPG the mean propagation height has to be calculated in order to determine whether the correction specified by the guidance for propagation over a concave ground profile, or where the ground falls away significantly between the source and receiver, is applicable.

10.215 The mean propagation height between each turbine and considered property is detailed in the table below. Instances where the threshold specified by the IoA GPG is exceeded, and 3 dB(A) has therefore been added to the noise level predicted by the ISO 9613-2 propagation model due to that specific turbine at that specific property, are highlighted.

Instances Where Ground Correction Applied

House ID	T1	T2	T3	T4	T5	T6
H1	3	3	3	0	3	3
H12	0	0	3	0	0	0
H31	0	0	3	0	0	0
H32	0	0	3	0	0	0
H33	0	0	3	0	0	0

Cells highlighted grey for turbine and house locations where correction applied

Technical Appendix 10.5: Background Noise Survey Photos

Photo 1: Noise Apparatus in Relation to H1

Photo 2: Noise Apparatus in Relation to H4

Photo 3: Noise Apparatus in Relation to H8

Technical Appendix 10.6: Instrumentation Records

Survey Location	Meter Type	Meter S/N	Calibration Certificate No.	Date of Issue	Microphone S/N	Preamp S/N	Calibrator Type	Calibrator S/N	Calibrator Certificate No.	Date of Issue
H1	Rion NL-31	00983381	UCRT17/1418	26/05/17	321278	28714	Rion NC-74	34851904	UCRT18/1140	06/02/18
H4	Rion NL-31	00952272	UCRT18/1620	18/06/18	309098	17123	Rion NC-74	34851904	UCRT18/1140	06/02/18
H8	Rion NL-31	00952274	UCRT17/1421	26/05/17	321532	17126	Rion NC-74	34851904	UCRT18/1140	06/02/18

Technical Appendix 10.7: Charts

Chart 1: Wind Speed and Direction during the Background Noise Survey

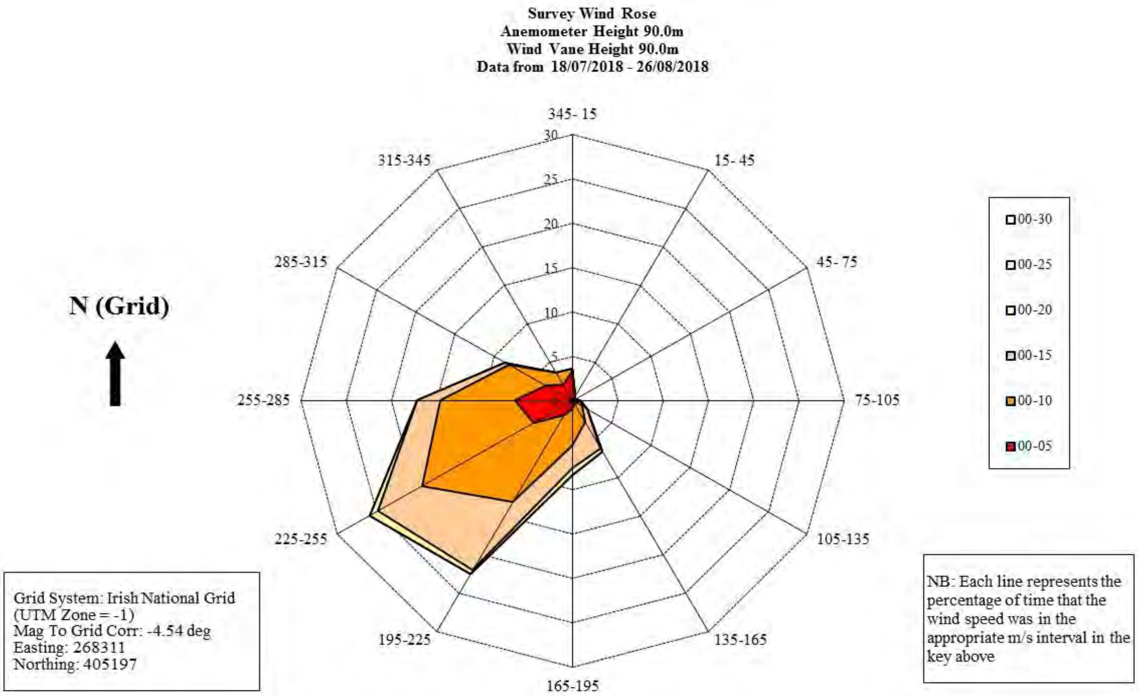


Chart 2: Measured Wind Rose over an Extended Period

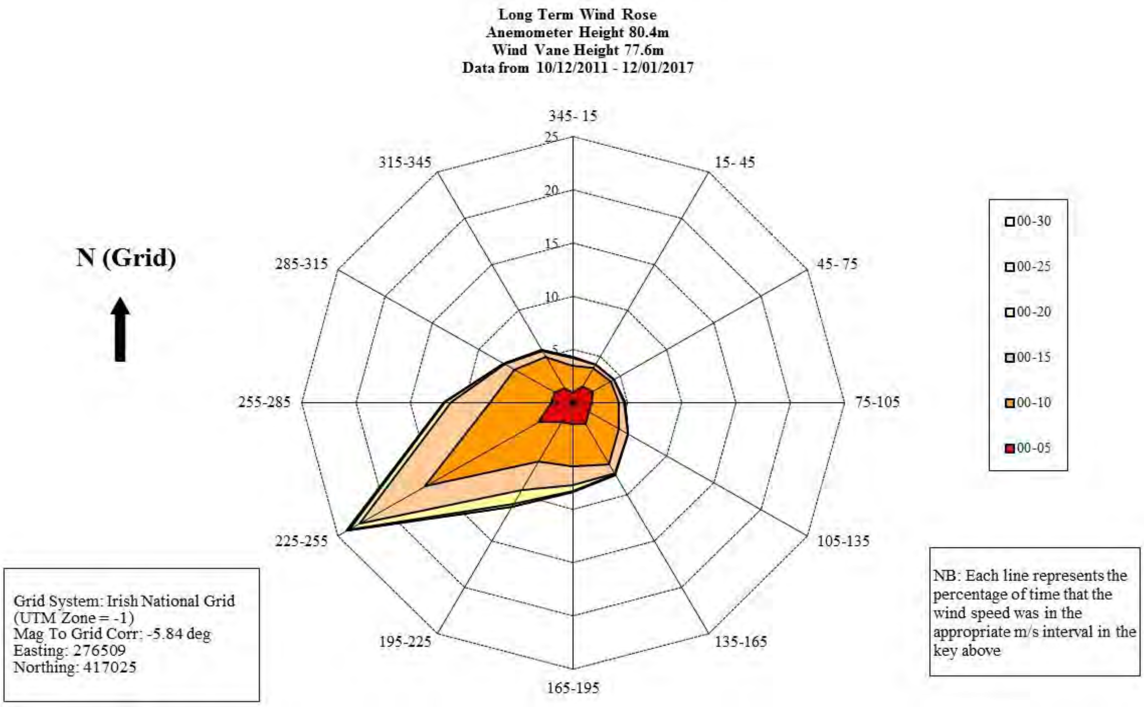


Chart 3: Downwind Predicted Noise Levels, Noise Limits and Background Noise Levels during Quiet Daytime Periods at H1

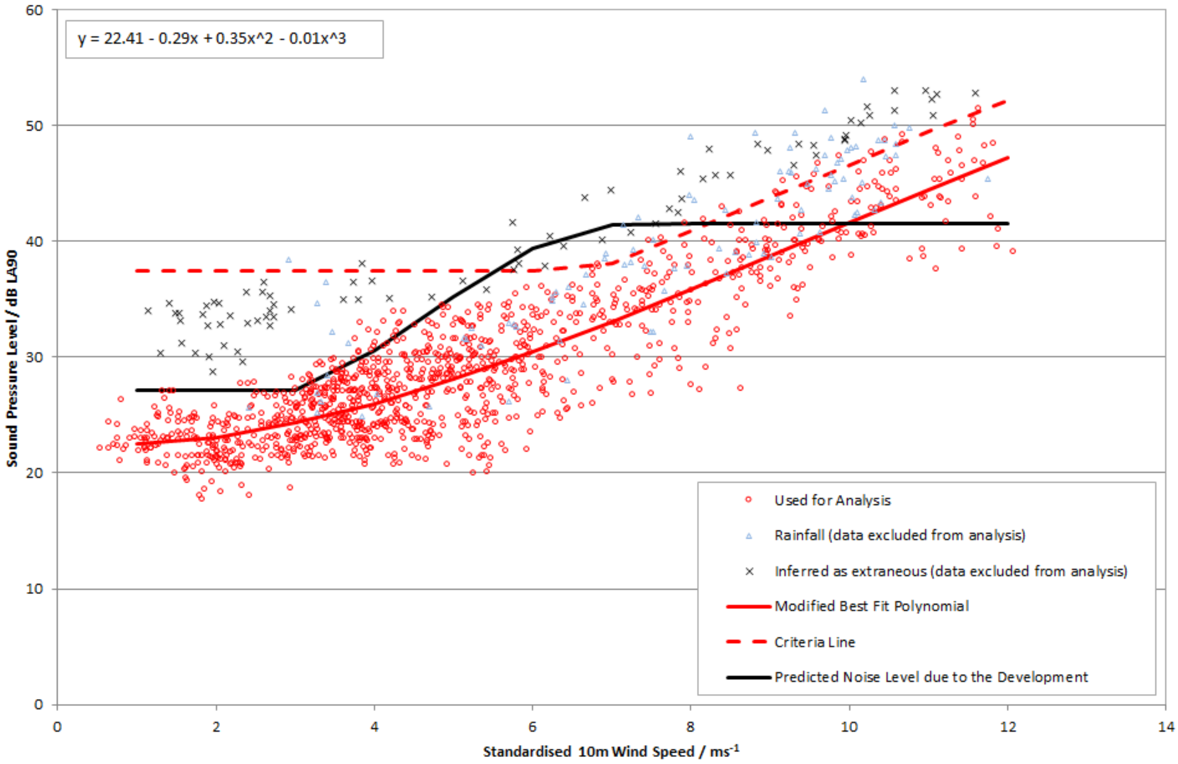


Chart 4: Downwind Predicted Noise Levels, Noise Limits and Background Noise Levels during Quiet Daytime Periods at H4

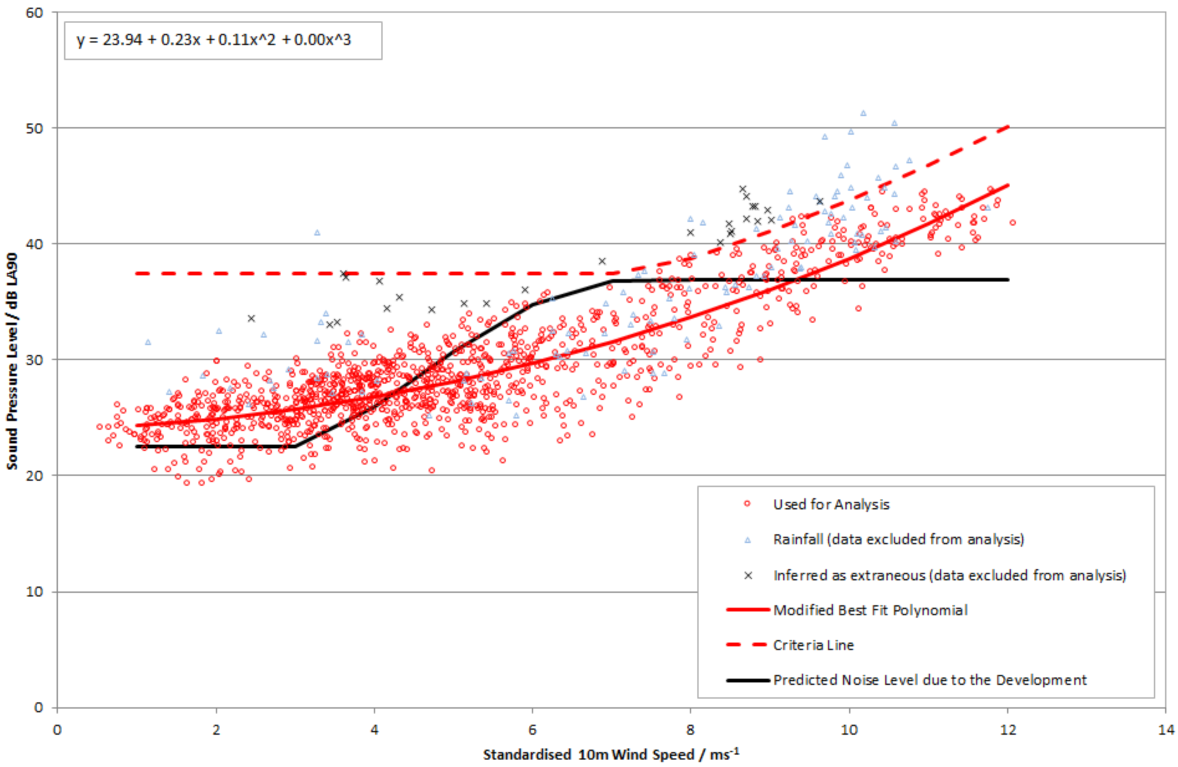


Chart 5: Downwind Predicted Noise Levels, Noise Limits and Background Noise Levels during Quiet Daytime Periods at H8

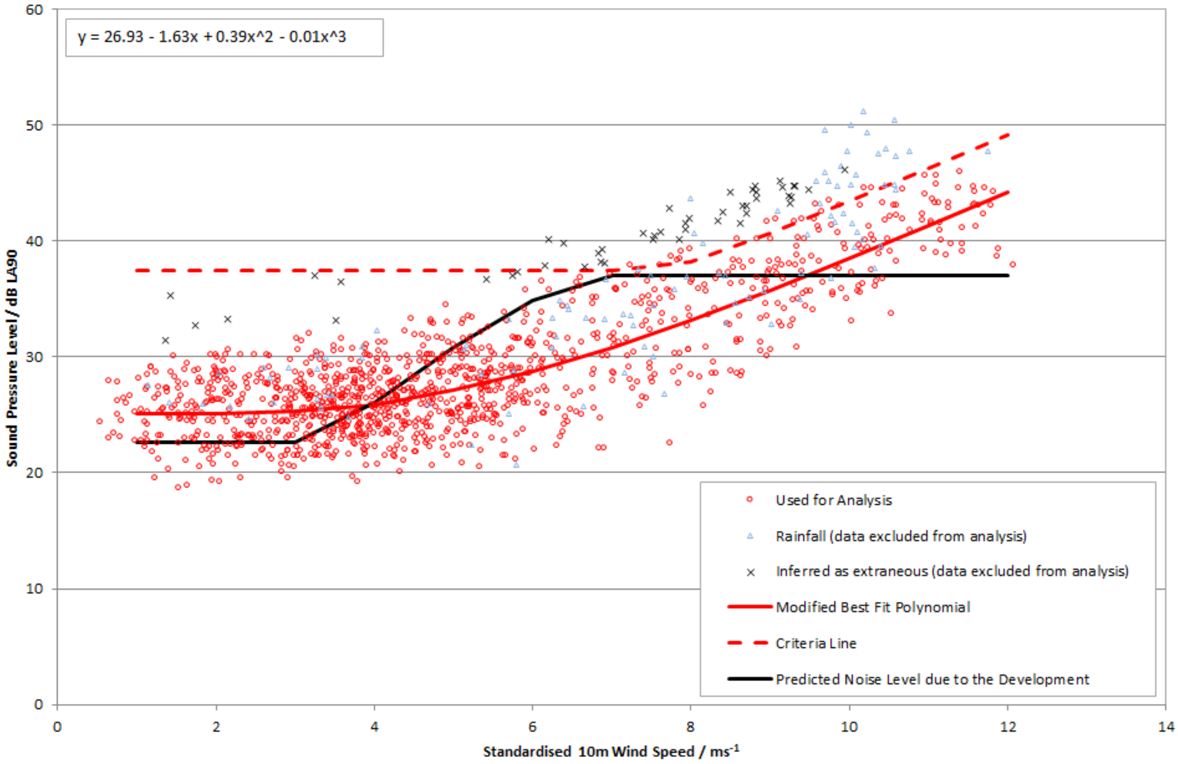


Chart 6: Downwind Predicted Noise Levels, Noise Limits and Background Noise Levels during Night-Time Periods at H1

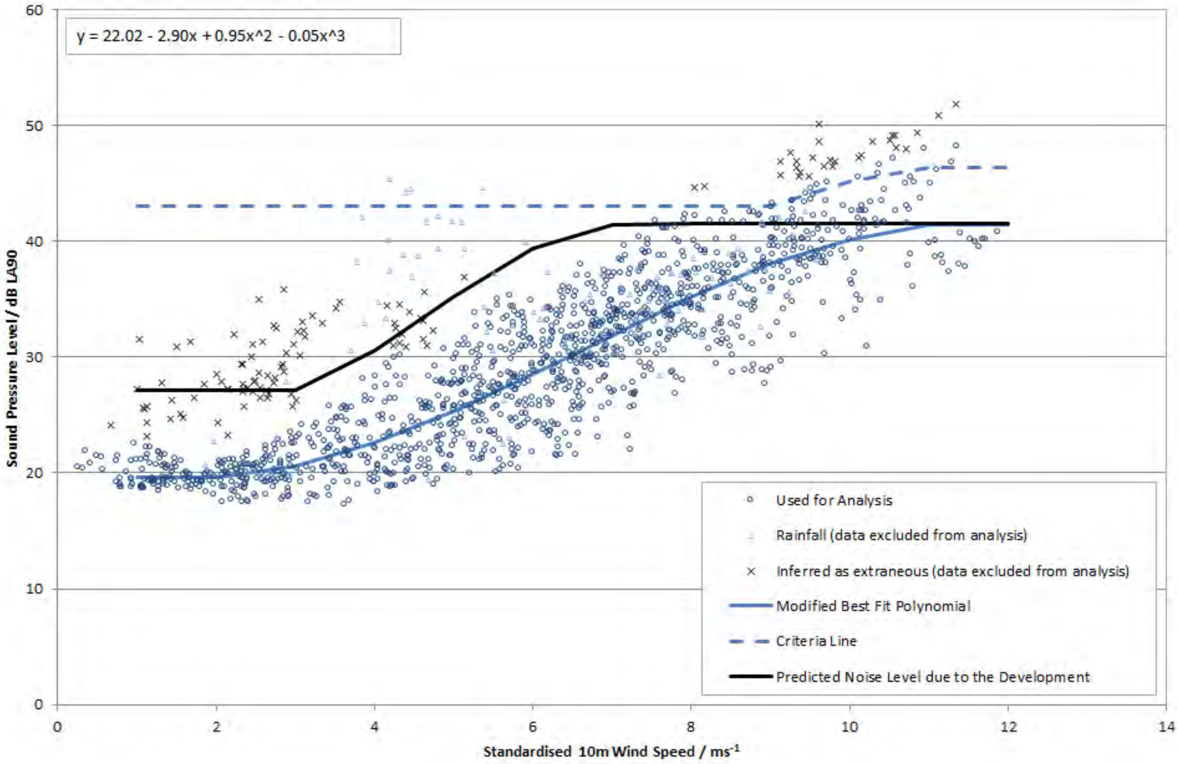


Chart 7: Downwind Predicted Noise Levels, Noise Limits and Background Noise Levels during Night-Time Periods at H4

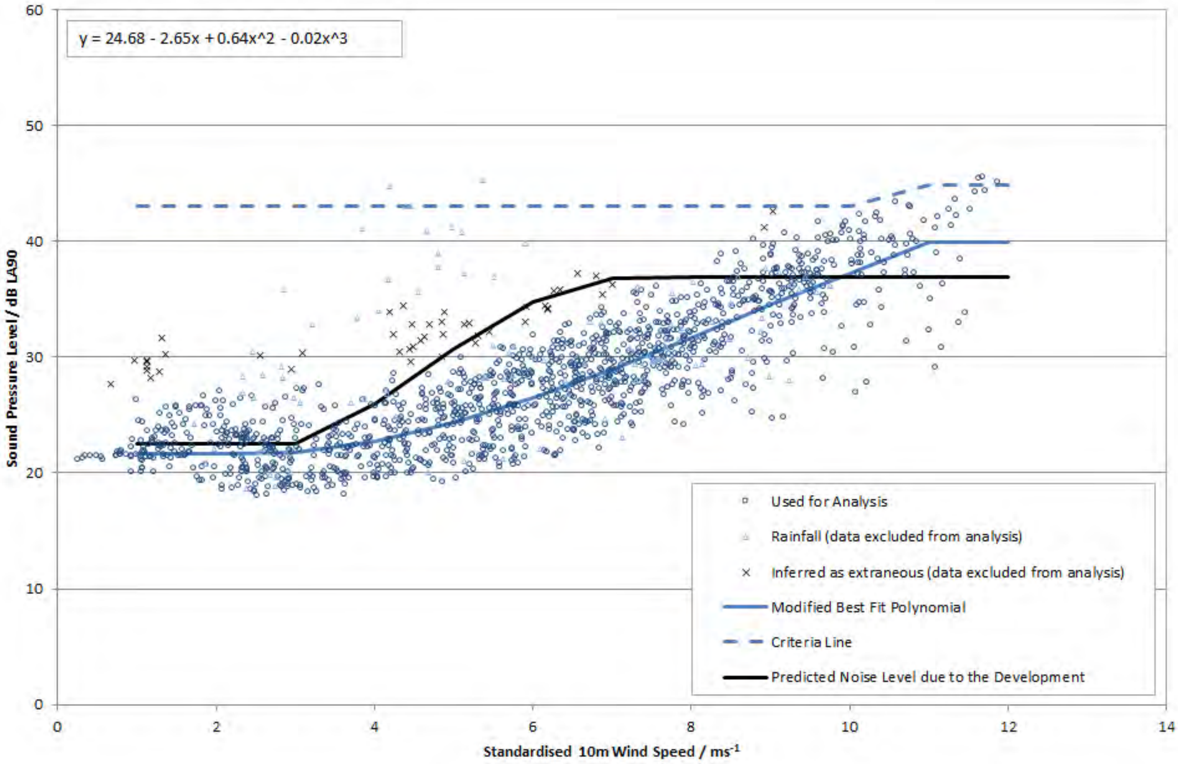


Chart 8: Downwind Predicted Noise Levels, Noise Limits and Background Noise Levels during Night-Time Periods at H8

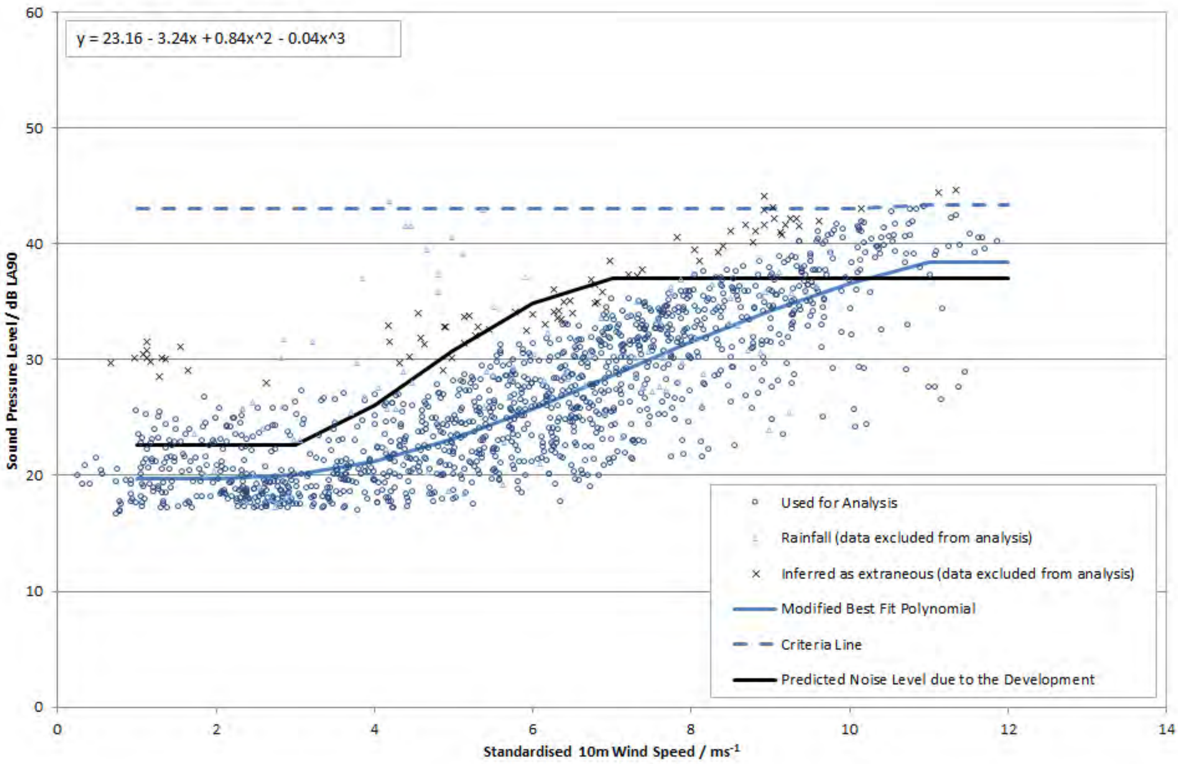


Chart 9: Downwind Predicted Noise Levels with and without Noise Management vs Noise Limits at H1

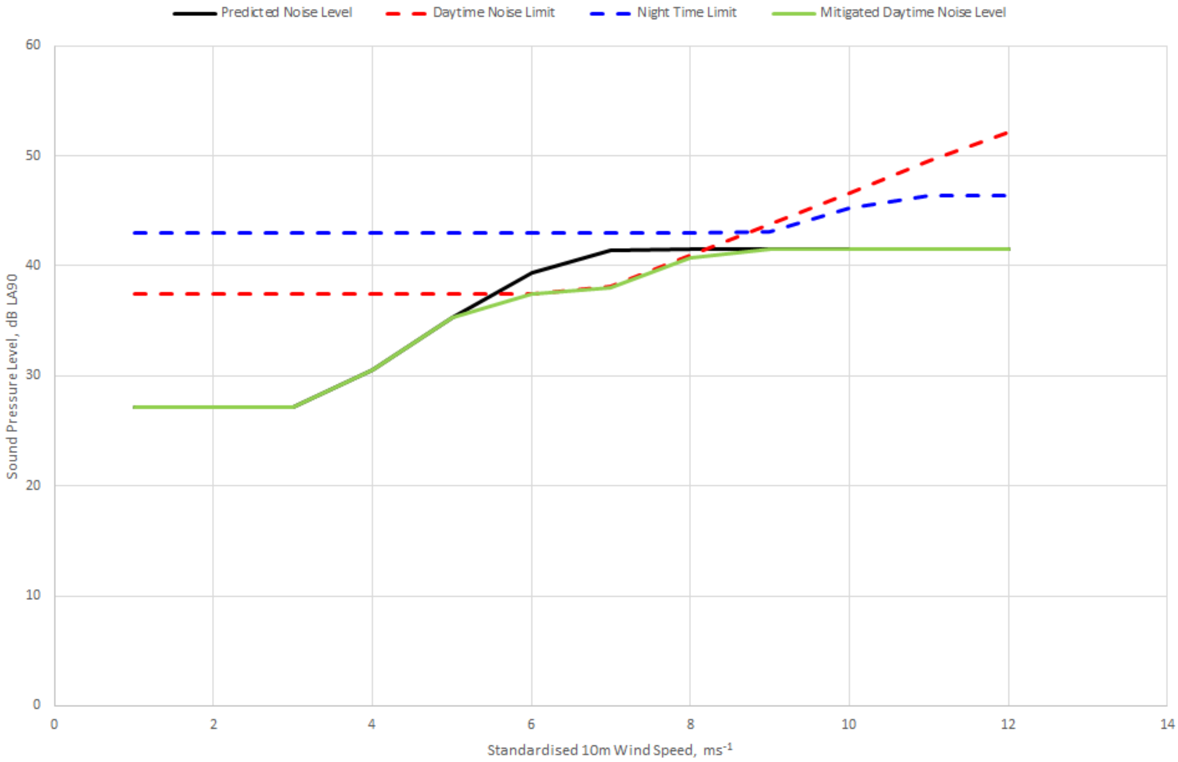


Chart 10: Directional Predicted Noise Levels with and without Noise Management vs Noise Limits at 6 ms^{-1} at H1

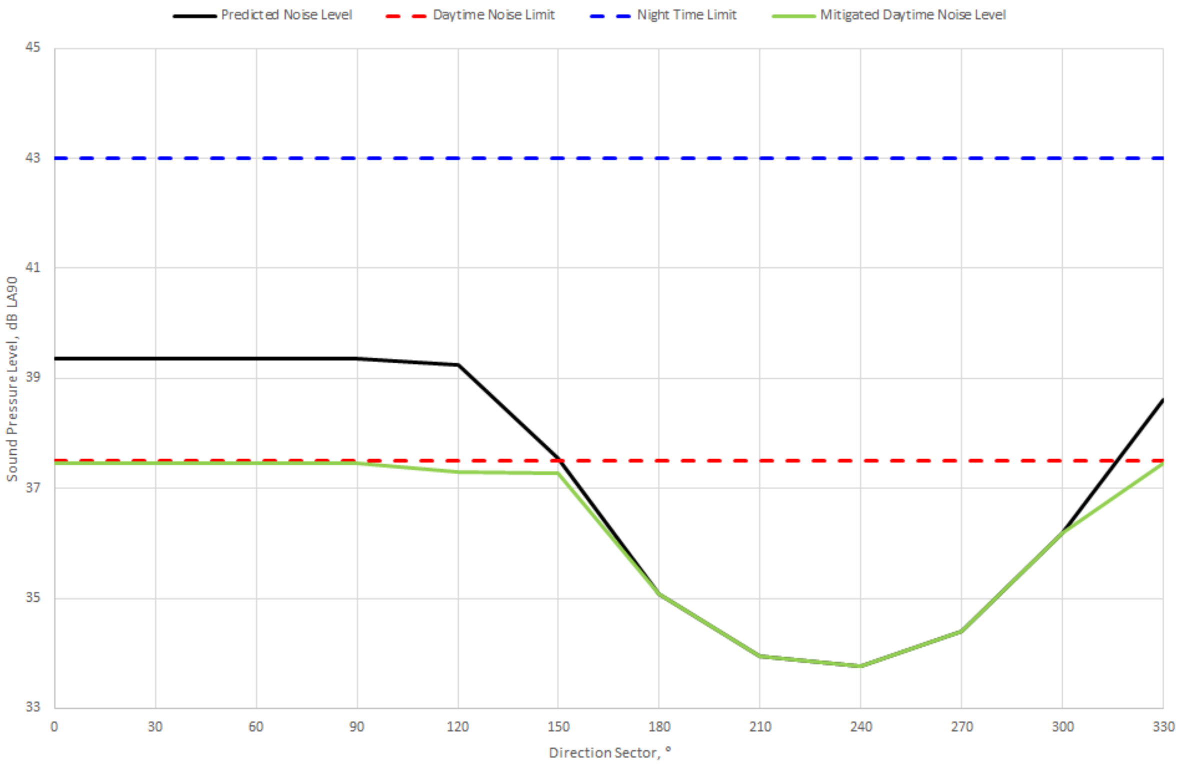


Chart 11: Directional Predicted Noise Levels with and without Noise Management vs Noise Limits at 7 ms^{-1} at H1

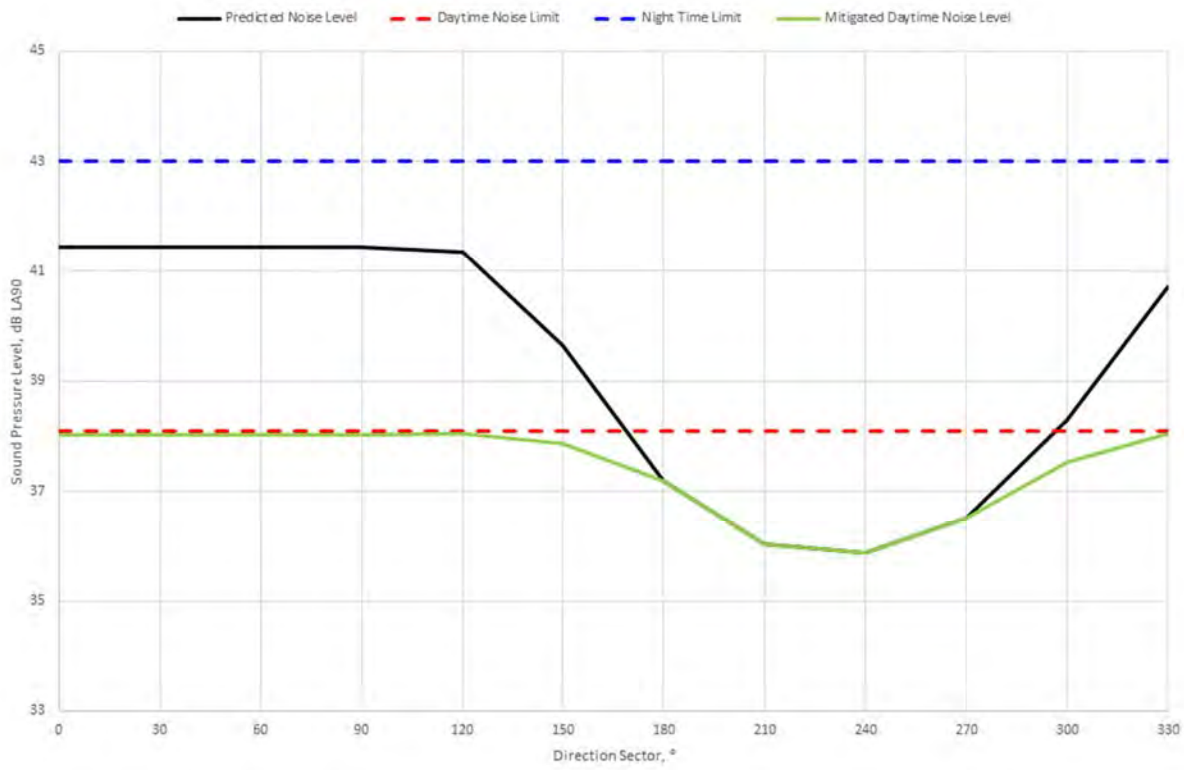


Chart 12: Directional Predicted Noise Levels with and without Noise Management vs Noise Limits at 8 ms^{-1} at H1

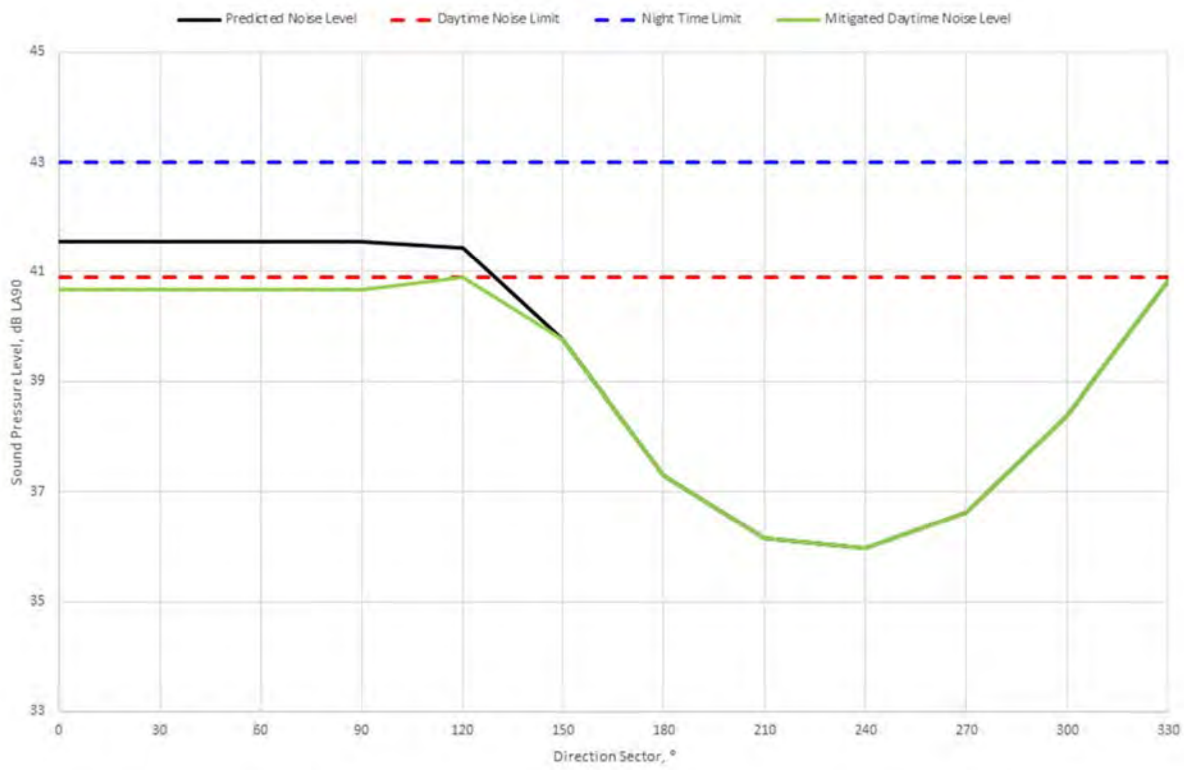


Chart 13: Cumulative Downwind Predicted Noise Levels vs Noise Limits during Daytime Periods at H1

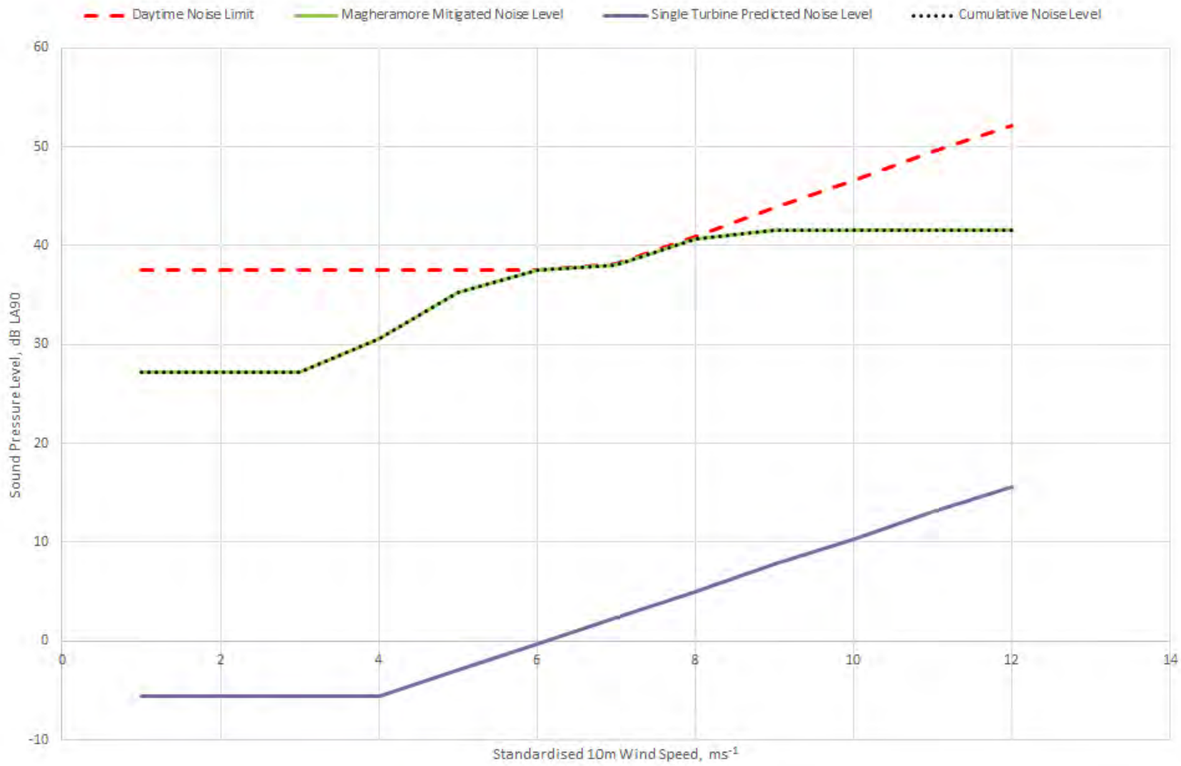
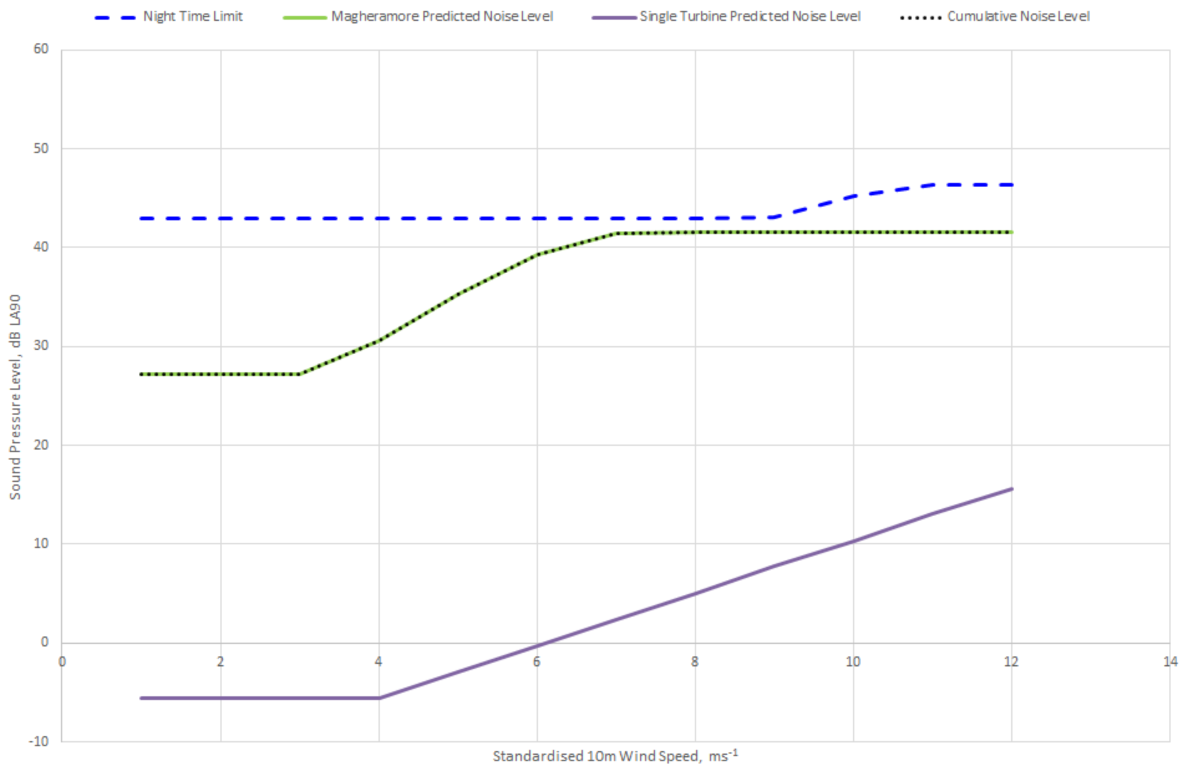


Chart 14: Cumulative Downwind Predicted Noise Levels vs Noise Limits during the Night at H1



Technical Appendix 10.8: Suggested Planning Conditions: Noise

10.216 If the wind farm was successful in its application for planning permission any resulting decision notice would likely contain appropriately worded noise conditions, written so as to be in accordance with Planning Policy PPS 1[65].

10.217 Such conditions would provide a degree of protection to nearby residents in the event that noise from the wind farm causes disturbance. To that end, presented below are a set of relevant, precise and enforceable conditions that RES suggest may be considered as appropriate. The form of condition wording suggested has been adopted at sites such as Freasdail[66], Minnygap[67], Roos[68], Solwaybank[69] and Wryde Croft[70]. Any final conditions attached to the proposal would be according to the discretion of the decision maker.

10.218 The proposed limits are derived by subtracting the predicted noise levels due to the existing single turbine scheme from the total ETSU-R-97 limit. This produces noise limits applicable to the Development alone such that the total ETSU-R-97 limit is met in combination with the single turbine scheme.

10.219 The use of downwind predicted noise levels for each of the schemes considered implies that the limits remaining for the Development are conservative in that a greater amount of the total limit would potentially be available when the property in question is located crosswind or upwind of the schemes whose predicted noise levels are being subtracted from the total ETSU-R-97 limit.

[65] Department for the Environment, Northern Ireland "PPS 1: General Principles", March 1998

[66] Directorate for Planning and Environmental Appeals, Appeal Decision Notice, Appeal Reference PPA-130-2036, Decision Date: 15 April 2014

[67] Directorate for Planning and Environmental Appeals, Appeal Decision Notice, Appeal Reference PPA-170-2055, Decision Date: 19 June 2014

[68] The Planning Inspectorate, Appeal Decision, Appeal Reference: APP/E2001/A/09/2113076, Decision Date: 21 June 2010

[69] Directorate for Planning and Environmental Appeals, Appeal Decision Notice, Appeal Reference PPA-170-2091, Decision Date: 23 September 2014

[70] The Planning Inspectorate, Appeal Decisions for Appeal References: APP/J0540/A/08/2083801 and APP/J0540/A/08/2090541, Decision Date: 1 April 2010

1. The level of noise immissions from the combined effects of the wind turbines (including the application of any tonal penalty) when calculated in accordance with the attached Guidance Notes, shall not exceed the values set out in the attached Table 1 or Table 2 (as appropriate). Noise limits for dwellings which lawfully exist or have planning permission for construction at the date of this consent but are not listed in the Tables attached shall be those of the physically closest location listed in the Tables unless otherwise agreed with the Local Planning Authority. The coordinate locations to be used in determining the location of each of the dwellings listed in Tables 1 and 2 shall be those listed in Table 3.

2. Within 21 days from the receipt of a written request from the Local Planning Authority and following a complaint to the Local Planning Authority from the occupant of a dwelling which lawfully exists or has planning permission at the date of this consent, the wind farm operator shall, at the wind farm operators expense, employ an independent consultant approved by the Local Planning Authority to assess the level of noise immissions from the wind farm at the complainant's property following the procedures described in the attached Guidance Notes.

3. The wind farm operator shall provide to the Local Planning Authority the independent consultant's assessment and conclusions regarding the said noise complaint, including all raw data upon which those assessments and conclusions are based. Such information shall be provided within 2 months of the date of the written request of the Local Planning Authority, with an additional 3 weeks allowed should further investigation pursuant to Guidance Note 4 be required, unless otherwise extended in writing by the Local Planning Authority.

4. Wind speed, wind direction and power generation data shall be continuously logged and provided to the Local Planning Authority at its request and in accordance with the attached Guidance Notes within 14 days of such request. Such data shall be retained for a period of not less than 24 months.

5. No development shall commence until there has been submitted to the Local Planning Authority details of a nominated representative for the development to act as a point of contact for local residents (in connection with conditions 1 - 4) together with the arrangements for notifying and approving any subsequent change in the nominated representative. The nominated representative shall have responsibility for liaison with the Local Planning Authority in connection with any noise complaints made during the construction, operation and decommissioning of the wind farm.

SCHEDULE OF NOISE GUIDANCE NOTES

These notes form part of conditions 1-5. They further explain these conditions and specify the methods to be deployed in the assessment of complaints about noise immissions from the wind farm.

Reference to ETSU-R-97 refers to the publication entitled "The Assessment and Rating of Noise from Wind Farm" (1997) published by the Energy Technology Support unit (ETSU) for the Department of Trade and Industry (DTI).

NOTE 1

a) Values of the $L_{A90,10min}$ noise statistic shall be measured at the complainant's property using a sound level meter of EN 60651/BS EN 60804 Type 1, or EN 61672 Class 1 quality (or the replacement thereof) set to measure using a fast time weighted response as specified in BS EN 60651/BS EN 60804 or BS EN 61672-1 (or the equivalent UK adopted standard in force at the time of the measurements). This shall be calibrated in accordance with the procedure specified in BS 4142: 1997 (or the replacement thereof). These measurements shall be made in such a way that the requirements of Note 3 shall also be satisfied.

b) The microphone should be mounted at 1.2 - 1.5 m above ground level, fitted with a two layer windshield (or suitable alternative approved in writing from the Local Planning Authority), and placed outside the complainant's dwelling. Measurements should be made in "free-field" conditions. To achieve this, the microphone should be placed at least 3.5 m away from the building facade or any reflecting surface except the ground at a location agreed with the Local Planning Authority.

c) The $L_{A90,10min}$ measurements shall be synchronised with measurements of the 10-minute arithmetic mean wind speed and with operational data, including power generation information for each wind turbine, from the turbine control systems of the wind farm.

d) The wind farm operator shall continuously log arithmetic mean wind speed and arithmetic mean wind direction data in 10 minute periods on the wind farm site to enable compliance with the conditions to be evaluated. The mean wind speed at hub height shall be 'standardised' to a reference height of 10 metres as described in ETSU-R-97 at page 120 using a reference roughness length of 0.05 metres. It is this standardised 10 m height wind speed data which is correlated with the noise measurements of Note 2(a) in the manner described in Note 2(c).

NOTE 2

a) The noise measurements shall be made so as to provide not less than 20 valid data points as defined in Note 2 paragraph (b). Such measurements shall provide valid data points for the range of wind speeds, wind directions, times of day and power generation requested by the Local Planning Authority. In specifying such conditions the Local Planning Authority shall have regard to those conditions which were most likely to have prevailed during times when the complainant alleges there was disturbance due to noise.

b) Valid data points are those that remain after all periods during rainfall have been excluded. Rainfall shall be assessed by use of a rain gauge that shall log the occurrence of rainfall in each 10-minute period concurrent with the measurement periods set out in Note 1(c) and is situated in the vicinity of the sound level meter.

c) Data points considered valid in accordance with Note 2(b) shall be plotted against the corresponding wind speed value determined in accordance with Note 1(d). A least squares, "best fit" curve of 2nd order shall be fitted to the data. In the event that this is a poor fit to the data, a higher (maximum 4th) order polynomial or data binning can be used. The noise level at each integer speed shall be derived from this best-fit curve, or the relevant data bin, as appropriate.

NOTE 3

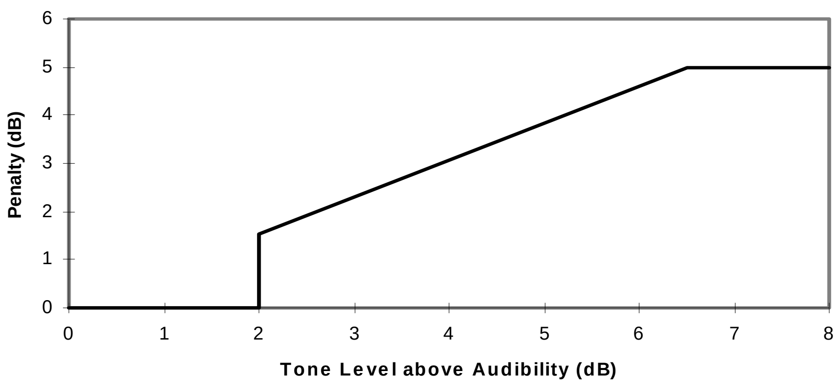
Where, in the opinion of the Local Planning Authority, noise immissions at the location or locations where assessment measurements are being undertaken contain a tonal component, the following rating procedure shall be used.

a) For each 10-minute interval for which $L_{A90,10min}$ data have been obtained as provided for in Notes 1 and 2, a tonal assessment shall be performed on noise immissions during 2-minutes of each 10-minute period. The 2-minute periods shall be regularly spaced at 10-minute intervals provided that uninterrupted clean data are available. Where clean data are not available, the first available uninterrupted clean 2 minute period out of the affected overall 10 minute period shall be selected. Any such deviations from standard procedure, as described in Section 2.1 on pages 104-109 of ETSU-R-97, shall be reported.

b) For each of the 2-minute samples the margin above or below the audibility criterion of the tone level difference, ΔL_{tm} (Delta L_{tm}), shall be calculated by comparison with the audibility criterion, given in Section 2.1 on pages 104-109 of ETSU-R-97.

c) The arithmetic average margin above audibility shall be calculated for each wind speed bin where data is available, each bin being 1 metre per second wide and centred on integer wind speeds. For samples for which the tones were below the audibility criterion or no tone was identified, a value of zero audibility shall be substituted.

d) The tonal penalty shall be derived from the margin above audibility of the tone according to the figure below. The rating level at each wind speed shall be calculated as the arithmetic sum of the wind farm noise level, as determined from the best-fit curve described in Note 2, and the penalty for tonal noise.



NOTE 4

If the wind farm noise level (including the application of any tonal penalty as per Note 3) is above the limit set out in the conditions, measurements of the influence of background noise shall be made to determine whether or not there is a breach of condition. This may be achieved by repeating the steps in Notes 1 & 2 with the wind farm switched off in order to determine the background noise, L_3, at the assessed wind speed. The wind farm noise at this wind speed, L_1, is then calculated as follows, where L_2 is the measured wind farm noise level at the assessed wind speed with turbines running but without the addition of any tonal penalty:

$$L_1 = 10\log\left[10^{L_2/10} - 10^{L_3/10}\right]$$

The wind farm noise level is re-calculated by adding the tonal penalty (if any) to the wind farm noise.

TABLE OF NOISE LIMITS RELATING TO CONDITION 1

Table 1: The $L_{A90,10min}$ dB Wind Farm Noise Level Between 23:00 and 07:00 hours:

House ID	Standardised 10m Wind Speed, ms^{-1}											
	1	2	3	4	5	6	7	8	9	10	11	12
H1	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.1	45.2	46.4	46.4
H2	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	44.9	44.9
H3	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	44.9	44.9
H4	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	44.9	44.9
H5	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	44.9	44.8
H6	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	44.9	44.8
H7	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	44.8	44.8
H8	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	42.9	42.9	43.2	43.0
H9	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	42.9	42.9	43.2	42.9
H10	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	42.9	42.9	43.2	43.1
H11	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.3	43.3
H12	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.4	43.4
H13	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.4	43.4
H14	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.4	43.4
H15	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.4	43.4
H16	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.4	43.4
H17	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.4	43.4
H18	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.4	43.4
H19	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.4	43.4
H21	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.4	43.4
H26	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	44.9	44.8
H27	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	44.9	44.8
H28	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	44.9	44.8
H29	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	44.8	44.8
H30	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	42.9	42.8	44.7	44.5
H31	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.4	43.4
H32	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.4	43.4
H33	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.4	43.4
H34	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	44.9	44.8

Table 2: $L_{A90,10min}$ dB Wind Farm Noise Level at all other times:

House ID	Standardised 10m Wind Speed, ms^{-1}											
	1	2	3	4	5	6	7	8	9	10	11	12
H1	37.5	37.5	37.5	37.5	37.5	37.5	38.1	40.9	43.8	46.6	49.5	52.2
H2	37.5	37.5	37.5	37.5	37.5	37.5	37.5	38.7	41.1	43.8	46.8	50.1
H3	37.5	37.5	37.5	37.5	37.5	37.5	37.5	38.7	41.1	43.8	46.8	50.1
H4	37.5	37.5	37.5	37.5	37.5	37.5	37.5	38.7	41.1	43.8	46.8	50.1
H5	37.5	37.5	37.5	37.5	37.5	37.5	37.5	38.7	41.1	43.8	46.8	50.1
H6	37.5	37.5	37.5	37.5	37.5	37.5	37.5	38.7	41.1	43.8	46.8	50.1
H7	37.5	37.5	37.5	37.5	37.5	37.5	37.5	38.7	41.1	43.8	46.8	50.1
H8	37.5	37.5	37.5	37.5	37.5	37.5	37.4	38.1	40.6	43.4	46.2	49.1
H9	37.5	37.5	37.5	37.5	37.5	37.5	37.4	38.1	40.6	43.4	46.2	49.1
H10	37.5	37.5	37.5	37.5	37.5	37.5	37.4	38.1	40.6	43.4	46.2	49.1
H11	37.5	37.5	37.5	37.5	37.5	37.5	37.5	38.2	40.7	43.5	46.3	49.2
H12	37.5	37.5	37.5	37.5	37.5	37.5	37.5	38.2	40.7	43.5	46.3	49.2
H13	37.5	37.5	37.5	37.5	37.5	37.5	37.5	38.2	40.7	43.5	46.3	49.2
H14	37.5	37.5	37.5	37.5	37.5	37.5	37.5	38.2	40.7	43.5	46.3	49.2
H15	37.5	37.5	37.5	37.5	37.5	37.5	37.5	38.2	40.7	43.5	46.3	49.2
H16	37.5	37.5	37.5	37.5	37.5	37.5	37.5	38.2	40.7	43.5	46.3	49.2
H17	37.5	37.5	37.5	37.5	37.5	37.5	37.5	38.2	40.7	43.5	46.3	49.2
H18	37.5	37.5	37.5	37.5	37.5	37.5	37.5	38.2	40.7	43.5	46.3	49.2
H19	37.5	37.5	37.5	37.5	37.5	37.5	37.5	38.2	40.7	43.5	46.3	49.2
H21	37.5	37.5	37.5	37.5	37.5	37.5	37.5	38.2	40.7	43.5	46.3	49.2
H26	37.5	37.5	37.5	37.5	37.5	37.5	37.5	38.7	41.1	43.8	46.8	50.1
H27	37.5	37.5	37.5	37.5	37.5	37.5	37.5	38.7	41.1	43.8	46.8	50.1
H28	37.5	37.5	37.5	37.5	37.5	37.5	37.5	38.7	41.1	43.8	46.8	50.1
H29	37.5	37.5	37.5	37.5	37.5	37.5	37.5	38.7	41.1	43.8	46.8	50.1
H30	37.5	37.5	37.5	37.5	37.5	37.5	37.4	38.6	41.0	43.7	46.7	50.0
H31	37.5	37.5	37.5	37.5	37.5	37.5	37.5	38.2	40.7	43.5	46.3	49.2
H32	37.5	37.5	37.5	37.5	37.5	37.5	37.5	38.2	40.7	43.5	46.3	49.2
H33	37.5	37.5	37.5	37.5	37.5	37.5	37.5	38.2	40.7	43.5	46.3	49.2
H34	37.5	37.5	37.5	37.5	37.5	37.5	37.5	38.7	41.1	43.8	46.8	50.1

TABLE OF COORDINATE LOCATIONS OF PROPERTIES

Note to Table 3: The geographical co-ordinates references are provided for the purpose of identifying the general location of dwellings to which a given set of noise limits applies

Table 3: Coordinate locations of the properties listed in Table 1 & 2.

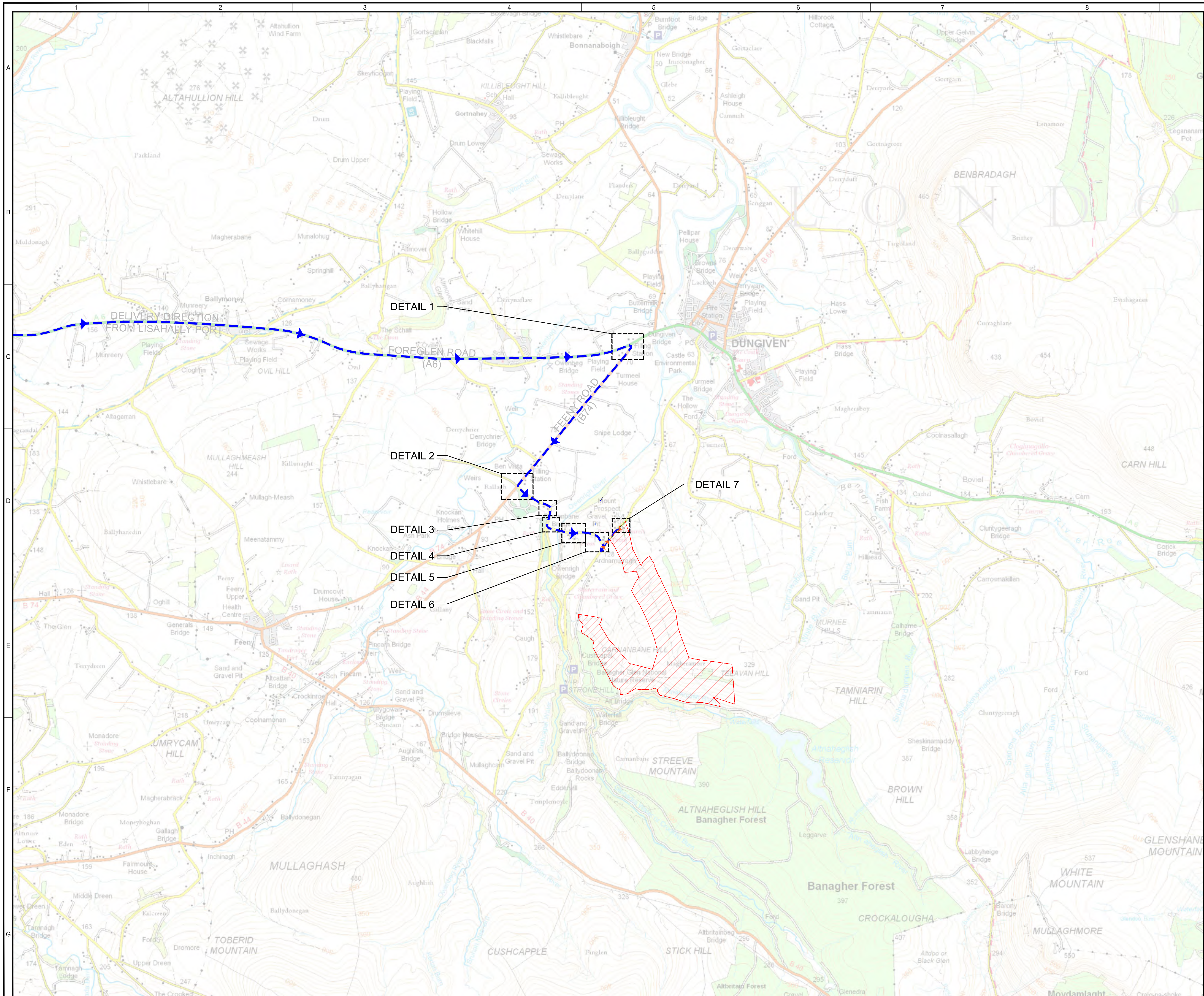
House ID	Co-ordinates	
	X (m)	Y (m)
H1	267720	404034
H2	267031	405186
H3	267216	405477
H4	267195	405586
H5	267345	405961
H6	267370	406025
H7	267401	406087
H8	268344	406462
H9	268382	406674
H10	268528	406780
H11	268917	406800
H12	269378	406917
H13	270014	406877
H14	270260	406657
H15	271242	406044
H16	271598	405890
H17	271911	405839
H18	272285	405520
H19	270930	405697
H21	272009	405511
H26	267308	405981
H27	267336	405990
H28	267265	406037
H29	267343	406116
H30	267421	406259
H31	269549	406980
H32	269700	406993
H33	269772	406997
H34	267317	405918

11

Traffic & Transport

Appendix 11: Traffic and Transport

Appendix 11.1 Delivery Analysis



KEY

SITE LOCATION

ROUTE OPTION

DIRECTION OF TRAVEL

NOTE:

PREFERRED PORT OF ENTRY TO BE DETERMINED.

DIRECTIONS:
TRAVELING EAST FROM LISAHALLY PORT ALONG THE FOREGLEN ROAD (A6)TURN RIGHT ONTO FEENY ROAD (B74) BEFORE REACHING DUNGIVEN. CONTINUE FOR 1.6mi THEN TURN LEFT ONTO BANAGHER ROAD. FOLLOW ROAD FOR 0.6mi BEARING LEFT ONTO CARNANBANE ROAD. AT THE JUNCTION TURN RIGHT UNTIL VEHICLE IS PARALLEL WITH THE ROAD. COMMENCE REVERSE MANEUVER FOR 0.2mi UNTIL FRONT OF VEHICLE HAS PASSED THE SITE ENTRANCE. TURN LEFT INTO SITE AND CONTINUE ALONG SITE TRACKS.

OVERVIEW
SHEET 1 OF 9

ISSUE	DRAWN	CHKD	APPD	DATE	REVISION NOTES
01	SD	GMcG	SMcC	2019-06-14	FIRST ISSUE

LAYOUT DWG N/A

T-LAYOUT NO. N/A

DRAWING NUMBER
03426D2301-01

COORDS ING 95

PURPOSE PRELIMINARY

SCALE 1:50,000

ORIGINAL PLOT SIZE A3

PROJECT TITLE
MAGHERAMORE WIND FARM

DRAWING TITLE
54m SWEPT PATH ANALYSIS

BEAUFORT COURT, EGG FARM LANE, KINGS LANGLEY, HERTS WD4 8LR.
TEL +44 (0) 1923 299200
FAX +44 (0) 1923 299299

VIEW A

VIEW B

KEY

- EXISTING ROAD SURFACE
- OVER-SAIL
- CAMERA DIRECTION

VEHICLE PATH

- WHEEL EXTENTS (BLACK)
- DELIVERY VEHICLE (BLACK)
- BODY EXTENTS (GREEN)
- LOAD EXTENTS (MAGENTA)
- LOAD (BLUE)

ANALYSIS CARRIED OUT FOR:
55m V112 DELIVERY VEHICLE SUPER WIND CARRIER.
ALL VEHICLE DIMENSIONS SHOWN ARE TYPICAL, FOR INDICATION ONLY.
(REAR STEER VEHICLE)

N

DETAIL 1
FOREGLEN ROAD
SHEET 2 OF 9

ISSUE	DRAWN	CHKD	APPD	DATE	REVISION NOTES
01	SD	GMcG	SMcC	2019-06-14	FIRST ISSUE

LAYOUT DWG N/A	T-LAYOUT NO. N/A
DRAWING NUMBER 03426D2301-01	
COORDS ING 95	
PURPOSE PRELIMINARY	
SCALE 1:750	ORIGINAL PLOT SIZE A3
PROJECT TITLE MAGHERAMORE WIND FARM	
DRAWING TITLE 54m SWEPT PATH ANALYSIS	

res
BEAUFORT COURT, EGG FARM LANE,
KINGS LANGLEY, HERTS WD4 8LR.
TEL +44 (0) 1923 299200
FAX +44 (0) 1923 299299

VIEW A

VIEW B

KEY

- EXISTING ROAD SURFACE
- OVER-RUN
- OVER-SAIL
- CAMERA DIRECTION

VEHICLE PATH

- WHEEL EXTENTS (BLACK)
- DELIVERY VEHICLE (BLACK)
- BODY EXTENTS (GREEN)
- LOAD EXTENTS (MAGENTA)
- LOAD (BLUE)

ANALYSIS CARRIED OUT FOR:
55m V112 DELIVERY VEHICLE SUPER WIND CARRIER.
ALL VEHICLE DIMENSIONS SHOWN ARE TYPICAL, FOR INDICATION ONLY.
(REAR STEER VEHICLE)

N

DETAIL 2
FEENY ROAD
SHEET 3 OF 9

01	SD	GMcG	SMcC	2019-06-14	FIRST ISSUE
ISSUE	DRAWN	CHKD	APPD	DATE	REVISION NOTES

LAYOUT DWG N/A | T-LAYOUT NO. N/A

DRAWING NUMBER
03426D2301-01

COORDS ING 95

PURPOSE PRELIMINARY

SCALE 1:1,250 | ORIGINAL PLOT SIZE A3

PROJECT TITLE
MAGHERAMORE
WIND FARM

DRAWING TITLE
54m SWEPT PATH ANALYSIS

BEAUFORT COURT, EGG FARM LANE,
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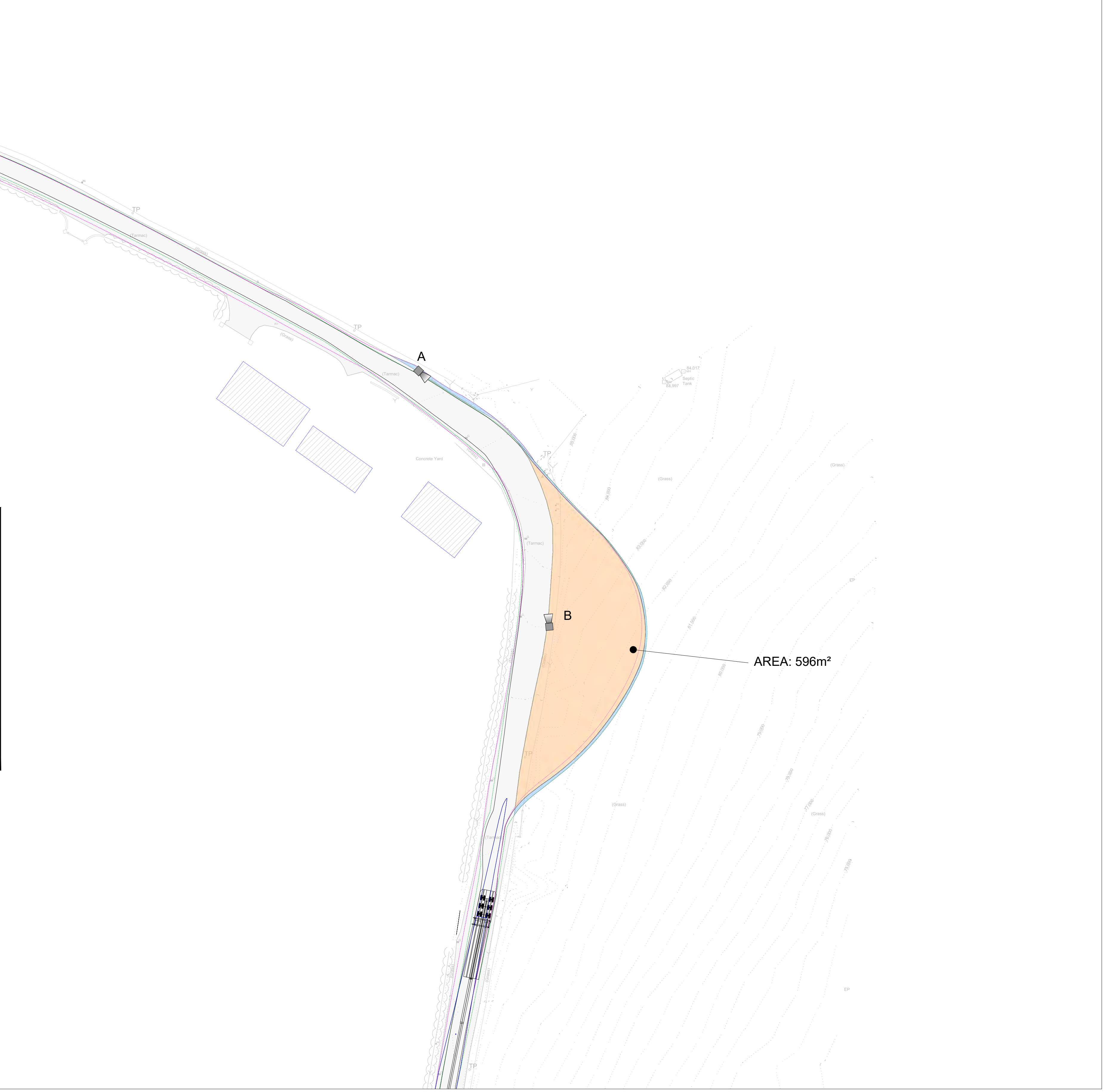


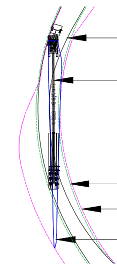
VIEW A

VIEW B

KEY

- EXISTING ROAD SURFACE
- OVER-RUN
- OVER-SAIL
- CAMERA DIRECTION

VEHICLE PATH



ANALYSIS CARRIED OUT FOR:
55m V112 DELIVERY VEHICLE SUPER WIND CARRIER.
ALL VEHICLE DIMENSIONS SHOWN ARE TYPICAL, FOR INDICATION ONLY.
(REAR STEER VEHICLE)

N

DETAIL 3
BANAGHER ROAD
SHEET 4 OF 9

ISSUE	DRAWN	CHKD	APPD	DATE	REVISION NOTES
01	SD	GMcG	SMcC	2019-06-14	FIRST ISSUE

LAYOUT DWG N/A | T-LAYOUT NO. N/A

DRAWING NUMBER
03426D2301-01

COORDS ING 95

PURPOSE PRELIMINARY

SCALE 1:750 | ORIGINAL PLOT SIZE A3

PROJECT TITLE
MAGHERAMORE
WIND FARM

DRAWING TITLE
54m SWEPT PATH ANALYSIS

BEAUFORT COURT, EGG FARM LANE,
KINGS LANGLEY, HERTS WD4 8LR.
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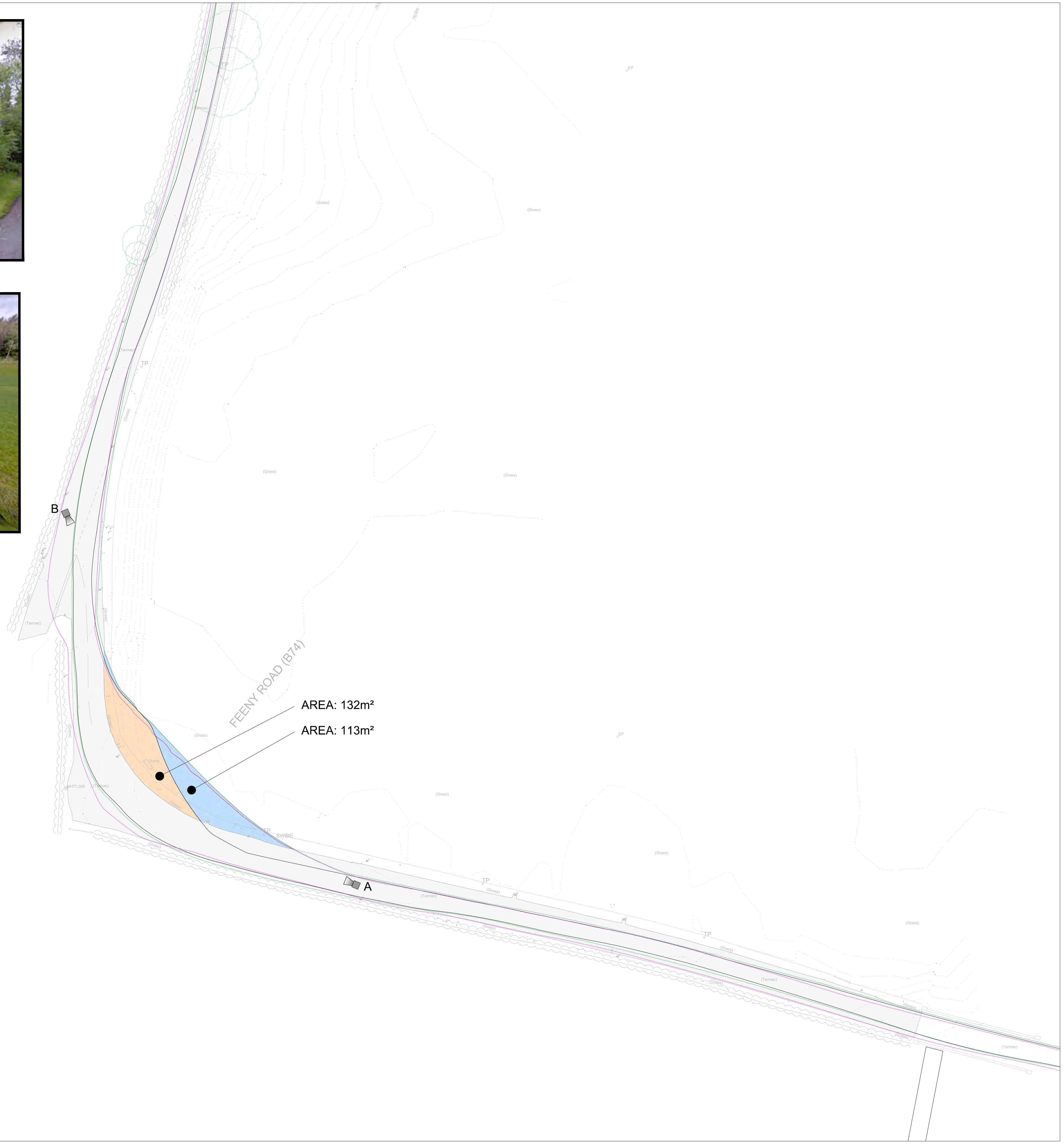
VIEW A

VIEW B



KEY

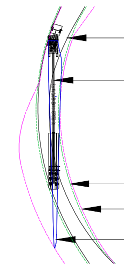
EXISTING ROAD SURFACE

OVER-RUN

OVER-SAIL

CAMERA DIRECTION

VEHICLE PATH



ANALYSIS CARRIED OUT FOR:
55m V112 DELIVERY VEHICLE SUPER WIND CARRIER.
ALL VEHICLE DIMENSIONS SHOWN ARE TYPICAL, FOR INDICATION ONLY.
(REAR STEER VEHICLE)

N

DETAIL 4
BANANGHER ROAD
SHEET 5 OF 9

ISSUE	DRAWN	CHKD	APPD	DATE	REVISION NOTES
01	SD	GMcG	SMcC	2019-06-14	FIRST ISSUE

LAYOUT DWG N/A

T-LAYOUT NO. N/A

DRAWING NUMBER
03426D2301-01

COORDS ING 95

PURPOSE PRELIMINARY

SCALE 1:750

ORIGINAL PLOT SIZE A3

PROJECT TITLE
MAGHERAMORE
WIND FARM

DRAWING TITLE
54m SWEPT PATH ANALYSIS

BEAUFORT COURT, EGG FARM LANE,
KINGS LANGLEY, HERTS WD4 8LR.
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VIEW A

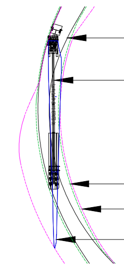
VIEW B

KEY

EXISTING ROAD SURFACE

CAMERA DIRECTION

VEHICLE PATH



ANALYSIS CARRIED OUT FOR:
55m V112 DELIVERY VEHICLE SUPER WIND CARRIER.
ALL VEHICLE DIMENSIONS SHOWN ARE TYPICAL, FOR INDICATION ONLY.
(REAR STEER VEHICLE)

N

DETAIL 5
CARNANBANE ROAD
SHEET 6 OF 9

ISSUE	DRAWN	CHKD	APPD	DATE	REVISION NOTES
01	SD	GMcG	SMcC	2019-06-14	FIRST ISSUE

LAYOUT DWG N/A — T-LAYOUT NO. N/A

DRAWING NUMBER
03426D2301-01

COORDS ING 95

PURPOSE PRELIMINARY

SCALE 1:1,000 — ORIGINAL PLOT SIZE A3

PROJECT TITLE
MAGHERAMORE
WIND FARM

DRAWING TITLE
54m SWEPT PATH ANALYSIS

BEAUFORT COURT, EGG FARM LANE,
KINGS LANGLEY, HERTS WD4 8LR.
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FAX +44 (0) 1923 299299

VIEW A

VIEW C

VIEW B

VIEW D

KEY

- EXISTING ROAD SURFACE
- OVER-RUN
- OVER-SAIL
- CAMERA DIRECTION

VEHICLE PATH

- WHEEL EXTENTS (BLACK)
- DELIVERY VEHICLE (BLACK)
- BODY EXTENTS (GREEN)
- LOAD EXTENTS (MAGENTA)
- LOAD (BLUE)

ANALYSIS CARRIED OUT FOR:
55m V112 DELIVERY VEHICLE SUPER WIND CARRIER.
ALL VEHICLE DIMENSIONS SHOWN ARE TYPICAL, FOR INDICATION ONLY.
(REAR STEER VEHICLE)

N

DETAIL 6
CARNANBANE RD /
MAGHERAMORE RD JUNCTION
SHEET 7 OF 9

ISSUE	DRAWN	CHKD	APPD	DATE	REVISION NOTES
01	SD	GMcG	SMcC	2019-06-14	FIRST ISSUE

LAYOUT DWG N/A | T-LAYOUT NO. N/A

DRAWING NUMBER
03426D2301-01

COORDS ING 95

PURPOSE PRELIMINARY

SCALE 1:1,000 | ORIGINAL PLOT SIZE A3

PROJECT TITLE
MAGHERAMORE
WIND FARM

DRAWING TITLE
54m SWEPT PATH ANALYSIS

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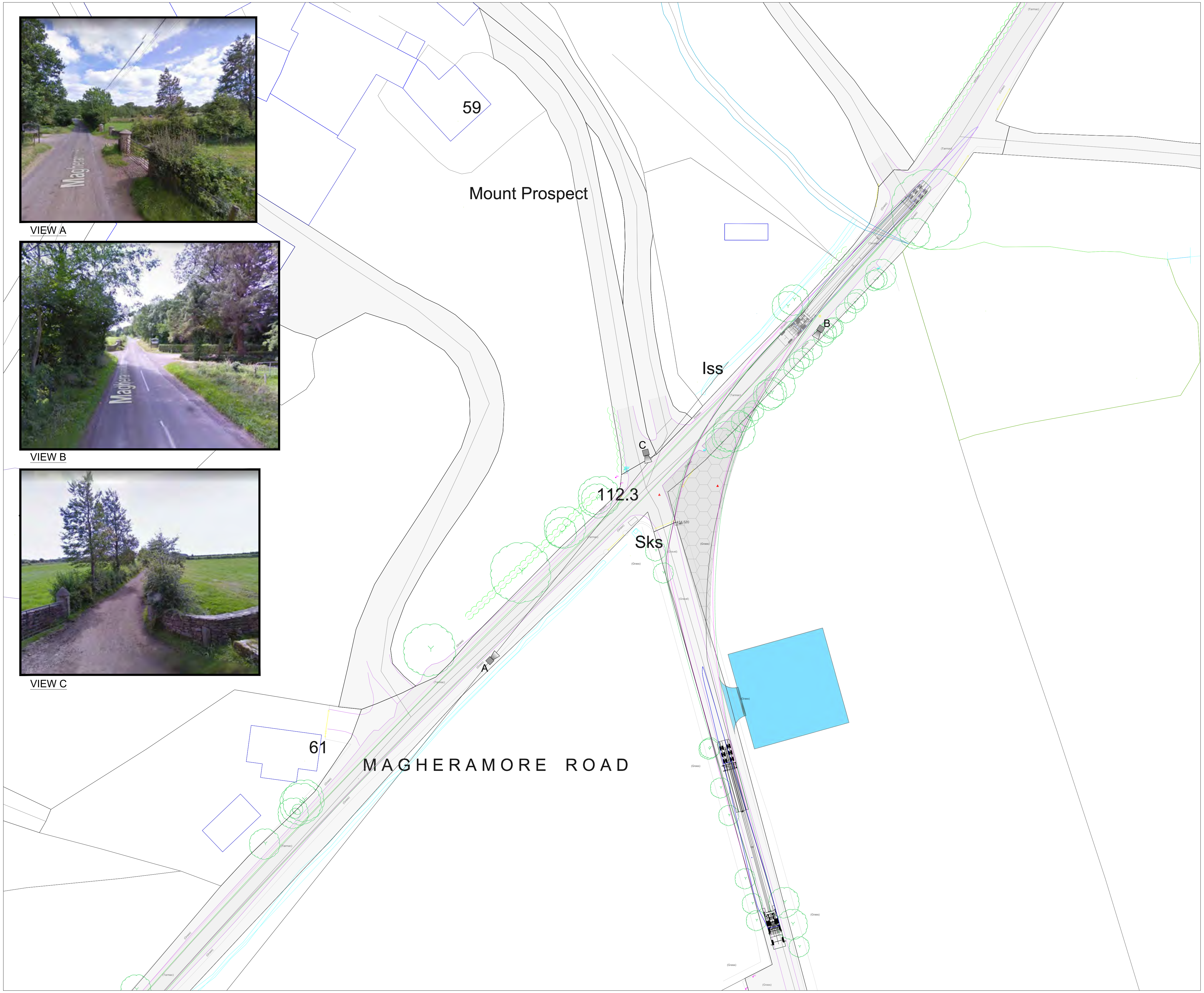

KEY

EXISTING ROAD SURFACE
OVER-RUN
OVER-SAIL
CAMERA DIRECTION

VEHICLE PATH
FORWARDS

WHEEL EXTENTS (BLACK)
DELIVERY VEHICLE (BLACK)
BODY EXTENTS (GREEN)
LOAD EXTENTS (MAGENTA)
LOAD (BLUE)

REVERSE

WHEEL EXTENTS (BLACK)
DELIVERY VEHICLE (BLACK)
LOAD EXTENTS (MAGENTA)
LOAD (BLUE)
BODY EXTENTS (GREEN)

ANALYSIS CARRIED OUT FOR:
55m V112 DELIVERY VEHICLE SUPER WIND CARRIER.
ALL VEHICLE DIMENSIONS SHOWN ARE TYPICAL, FOR INDICATION ONLY.
(REAR STEER VEHICLE)

N

DETAIL 7
SITE ENTRANCE
SHEET 8 OF 9

ISSUE	DRAWN	CHKD	APPD	DATE	REVISION NOTES
01	SD	GMcG	SMcC	2019-06-14	FIRST ISSUE

LAYOUT DWG N/A
T-LAYOUT NO. N/A

DRAWING NUMBER
03426D2301-01

COORDS ING 95
PURPOSE PRELIMINARY
SCALE 1:750
ORIGINAL PLOT SIZE A3

PROJECT TITLE
MAGHERAMORE
WIND FARM

DRAWING TITLE
54m SWEPT PATH ANALYSIS

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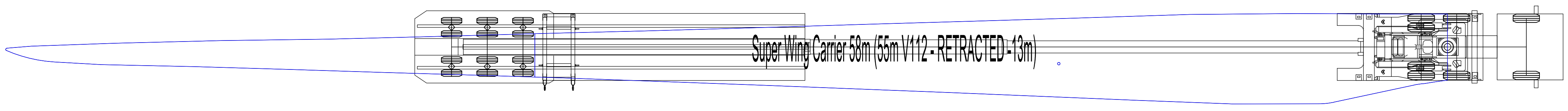
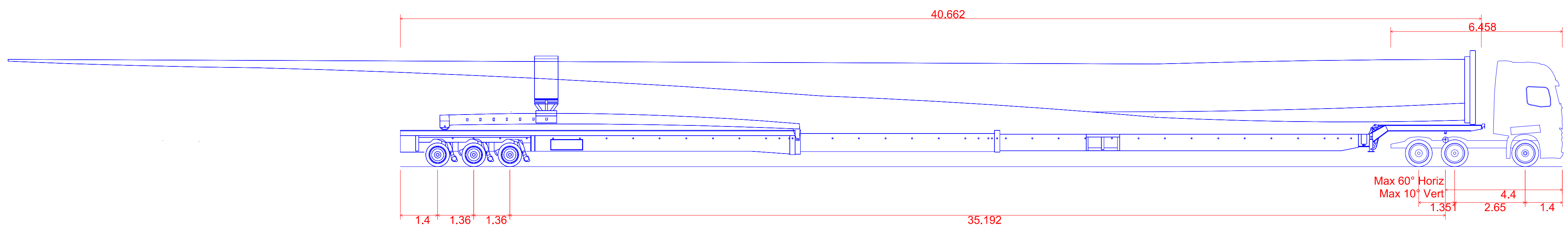
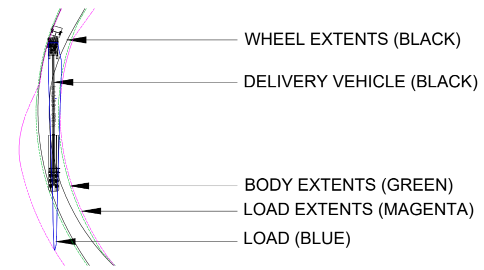




Super Wing Carrier 58m (55m V112 - RETRACTED -13m)

Overall Length	43.712m
Overall Width	2.740m
Overall Body Height	4.371m
Min Body Ground Clearance	0.193m
Max Track Width	2.540m
Lock to Lock Time	6.00s
Kerb to Kerb Turning Radius	15.500m

VEHICLE PATH



ANALYSIS CARRIED OUT FOR:
55m V112 DELIVERY VEHICLE SUPER WIND CARRIER.
ALL VEHICLE DIMENSIONS SHOWN ARE TYPICAL, FOR INDICATION ONLY.
(REAR STEER VEHICLE)

VEHICLE DETAILS
SHEET 9 of 9

ISSUE	DRAWN	CHKD	APPD	DATE	REVISION NOTES
01	SD	GMcG	SMcC	2019-06-14	FIRST ISSUE

LAYOUT DWG N/A
T-LAYOUT NO. N/A

DRAWING NUMBER
03426D2301-01

COORDS ING 95

PURPOSE PRELIMINARY

SCALE NTS
ORIGINAL PLOT SIZE A3

PROJECT TITLE
MAGHERAMORE
WIND FARM

DRAWING TITLE
54m SWEPT PATH ANALYSIS

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