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ENVIRONMENTAL IMPACT ASSESSMENT REPORT (EIAR) FOR THE PROPOSED CROAGHAUN WIND FARM, CO. CARLOW

VOLUME 2 – MAIN EIAR

CHAPTER 10 – HYDROLOGY AND WATER QUALITY

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10. HYDROLOGY AND WATER QUALITY

10.1 INTRODUCTION

This chapter has been prepared to describe the existing hydrology and water quality of the local environment in the study area and to examine the aspects of the hydrology and water quality of the local environment that could be affected by the activities associated with the proposed project.

Section 10.3 of this chapter provides details on the existing hydrology and water quality in the receiving environment including receiving waterbodies and catchments.

Following an analysis of the receiving environment potential impacts during construction, operation and decommission phases are identified and discussed in Sections 10.4. Flood risk assessment is carried out in Section 10.5.

Section 10.6 identifies the proposed drainage layout at the main wind farm site and Section 10.7 identifies the proposed mitigation measures for impacts identified in Section 10.4 and 10.5.

10.1.1 Project Description and Study Area

A detailed description of the project assessed in this EIAR is provided in Chapter 3 and is comprised of three main elements:

- The wind farm (hereinafter referred to as the 'main wind farm site');
- Turbine delivery route (hereinafter referred to as the 'turbine delivery route' or 'TDR');
- Grid connection (hereinafter referred to as the 'grid connection'.

The main wind farm site includes the wind turbines, internal access tracks, hard standings, the permanent meteorological mast, recreational amenity trail and associated signage, onsite substation, internal electrical and communications cabling, temporary construction compound, drainage infrastructure and all associated works related to the construction of the wind farm.

The grid connection includes the buried grid connection cable route from the on-site substation to the existing grid substation at Kellistown, Co. Carlow and the proposed off-site substation, also at Kellistown.

The turbine delivery route includes all aspects of the route from the M11/N30 junction to the site entrance including proposed temporary accommodation works to facilitate the delivery of wind turbine components.

Replanting lands at Sroove Co. Sligo and Crag Co. Limerick have also been assessed for cumulative impacts. Reports detailing environmental assessments carried out on these sites are contained in Appendix 3.3 and 4.4 of this EIAR.

The study area for this assessment comprises the relevant hydrological catchments within which elements of the above project are located. A detailed description of the existing environment of the study area is contained in Section 10.3. As described above, replanting lands have been assessed separately for potential cumulative impacts with the Croghaun Wind Farm project.

10.2 METHODOLOGY

The following sources of information were considered in this assessment:

- The design layout of the main wind farm site, grid connection and TDR.
- Legislation and guidance, as described in Section 10.2.1 below.
- A desk-based assessment of the surface water hydrology and water quality in the catchments relevant to the s proposed project, including an assessment of the watercourses which will be intercepted by the layout of the main wind farm site, grid connection and TDR, and those which will receive surface water runoff from same.
- A field assessment of the existing hydrological environment, to both verify desk-based assessment and record all significant hydrological features.
- Reports detailing environmental assessments carried out on replanting lands at Sroove Co. Sligo and Crag Co. Limerick contained in Appendix 3.3 and 4.4 of this EIAR.
- Carlow County Development Plan 2015-2021.

10.2.1 Relevant Legislation and Guidance

10.2.1.1 Relevant EU Directives and Legislation

Water Framework Directive (WFD)

The WFD established a new system for the protection and improvement of water quality and water dependent ecosystems. It has influenced the management of water resources and has affected conservation, fisheries, flood defense, planning and development. It has endeavoured to ensure that all impacts on water resources – physical modification, diffuse and point source pollution, abstraction or otherwise – are controlled.

The overriding purpose of the WFD is to achieve at least 'good status' in all European waters and to ensure that no further deterioration occurs in these waters. European waters are classified as ground waters, rivers, lakes, transitional and coastal waters. The WFD has been implemented in Ireland by dividing the island of Ireland into eight river basin districts. These districts are natural geographical areas that occur in the landscape.

The WFD has been transposed into Irish law following:

- European Communities (Water Policy) Regulations, 2003 (S.I. No. 722 of 2003)[1]
- European Union (Water Policy) Regulations 2014 (S.I. No. 350 of 2014)
- European Communities Environmental Objectives (Surface Waters) Regulations, 2009 (S.I. No. 272 of 2009)[2]
- European Communities Environmental Objectives (Groundwater) Regulations, 2010 (S.I. No. 9 of 2010)[3]

[1] Amended in 2005 (S.I. No 413/2005), 2008 (S.I. No. 219/2008) and 2010 (S.I. No. 93/2010)

[2] Amended in 2012 (S.I. No. 327/2012) and 2015 (S.I. No. 386/2015)

[3] Amended in 2011 (S.I. No 389/2011), 2012 (S.I. No 149/2012) and 2016 (S.I. No 366/2016)

- European Communities (Good Agricultural Practice for Protection of Waters) Regulations 2010 (S.I. No. 610 of 2010)[4]
- European Communities (Technical Specifications for the Chemical Analysis and Monitoring of Water Status) Regulations, 2011 (S.I. No. 489 of 2011)

To ensure no further deterioration of water occurs it is required to address possible impacts of the project and propose mitigation measures within the EIAR.

Water Framework Directive Waterbody Status

The European Communities Environmental Objectives (Surface Water) Regulations 2009 (S.I. No. 272 of 2009)[5] (the Surface Water Regulations), give effect to the criteria and standards used for classifying surface waters in accordance with the WFD. There are five categories of surface water status: 'High', 'Good', 'Moderate', 'Poor' and 'Bad'.

A surface waterbody must achieve both good ecological status and good chemical status before it can be considered to be of good status. The chemical status of a waterbody is assessed based on certain chemical pollutants. The ecological status is assessed based on Biotic Indices or Quality (Q) Values. The EPA Biological Quality Rating System for Rivers (Q Rating System) and its relationship with the WFD Status is shown in Table 10-1.

Table 10-1: EPA Q Rating System and WFD Status

Q-Value	Water Quality	WFD Status
Q5	Pristine	High
Q4-5	Very good	
Q4	Good	Good
Q3-4	Slightly Polluted	Moderate
Q3	Moderately Polluted	Poor
Q2-3	Moderate to Poor	
Q2	Poor	Bad
Q1-2	Poor to bad	
Q1	Bad	

In accordance with the Surface Water Regulations, water classified as 'High' or 'Good' must not be allowed to deteriorate. Water classified as less than good must be restored. The Surface Water Regulations also state that, for the purpose of classification, a status of less than good is assigned in the case of a waterbody where the environmental objectives are not met.

[4] Amended in 2014 (S.I. 31/2014)

[5] Amended in 2012 (S.I. No. 327 of 2012) and 2015 (S.I. No. 386 of 2015)

10.2.1.2 Relevant Guidance

The following guidelines were considered to identify relevant objectives relating to hydrology and surface water quality:

- Guidelines on the information to be contained in Environmental Impact Assessment Reports - Draft, Environmental Protection Agency (EPA), August 2017
- Advice Notes for Preparing Environmental Impact Statements, EPA, Draft September 2015
- Wind Energy Development Planning Guidelines - Department of the Environment, Heritage and Local Government, 2006
- Best Practice Guidelines for the Irish Wind Energy Industry - Irish Wind Energy Association, 2012

Due regard has been given to the Draft Revised Wind Energy Development Guidelines were published on the 19th December 2019. The 2019 draft guidelines were out to public consultation until the 19th February 2020 and may be subject to further revision.

In addition to considering the documents above, the methodology for the baseline assessment has been devised with due consideration of the following guidelines:

- Greater Dublin Strategic Drainage Study (GDSDS): New Development Policy, Dublin Drainage, March 2005
- The Planning System and Flood Risk Management - Guidelines for Planning Authorities - Department of Environment, Heritage and Local Government (DoEHLG) and the Office of Public Works (OPW), November 2009
- Environmental good practice on site guide (fourth edition) (C741) - Construction Industry Research and Information Association (CIRIA), January 2015)
- River Basin Management Plan 2018-2021 (Department of Housing, Planning and Local Government)
- Best Practice Guide BPGCS005 Oil Storage Guidelines (Enterprise Ireland) Guidelines for the Crossing of Watercourses During the Construction of National Road Schemes (National Roads Authority, 2005)
- Guidelines on Protection of Fisheries During Construction Works in and Adjacent to Waters (Inland Fisheries Ireland, 2016)
- The SuDS Manual (C753) - Construction Industry Research and Information Association (CIRIA), 2015
- Control of water pollution from linear construction projects (C648) - Construction Industry Research and Information Association (CIRIA), December 2001
- Control of water pollution from construction sites. Guidance for Consultants and Contractors (C532) - Construction Industry Research and Information Association (CIRIA), December 2001
- PUB C571 Sustainable construction procurement - a guide to delivering environmentally responsible projects - Construction Industry Research and Information Association (CIRIA), January 2001
- UK Guidance for Pollution Prevention (GPP):
  - GPP2: Above ground oil storage tanks (Natural Resources Wales (NRW), Northern Ireland Environment Agency (NIEA), the Scottish Environment Protection Agency (SEPA), Energy Institute, Oil Care Campaign, January 2018)
  - GPP4: Treatment and disposal of wastewater where there is no connection to the public foul sewer (NRW, NIEA, SEPA, November 2017)

- GPP5: Works and maintenance in or near water (NRW, NIEA, SEPA, January 2017)
- GPP8: Safe storage and disposal of used oil (NRW, NIEA, SEPA, July 2017)
- GPP21: Pollution Incident Response Plans (NRW, NIEA, SEPA, July 2017)
- GPP22: Dealing with Spills (NRW, NIEA, SEPA, October 2018)
- GPP26: Safe storage of Drums and intermediate Bulk Containers (IBCs), (NRW, NIEA, SEPA, February 2019)

- GE-INT-01003- Introduction to the NRA Design Manual for Roads and Bridges (Transport Infrastructure Ireland, December 2013)
- Coillte (2009): Forest Operations & Water Protection Guidelines
- Forestry and Water Quality Guidelines (Forest Service, Department of the Marine and Natural Resources, July 2000)
- Good Practice During Wind Farm Construction (Scottish Natural Heritage, 2010)

10.2.2 Desk Study

The desk top study involved an examination of the hydrological aspects and water quality aspects of the following sources of information:

- Current and historic Ordnance Survey Ireland mapping, and ortho-photography,
- Water Framework Directive Map Viewer (www.catchments.ie/),
- OPW Indicative Flood Maps (www.floodinfo.ie/map/floodplans/),
- Geological Survey of Ireland (www.gsi.ie),
- Review of the WFD online mapping and data (available at http://www.wfdireland.ie/maps.html),
- Review of the EPA online mapping (https://gis.epa.ie/EPAMaps/),
- History of flooding and status of drainage in the study area (available at http://www.floodinfo.ie/map/floodmaps/),
- Met Eireann Meteorological Database (available at https://www.met.ie).

10.2.3 Field Assessment

A walkover survey was carried out on 19th November 2019 to establish the pattern of existing drainage and to record existing hydrology features of the proposed project (excluding replanting lands which were assessed separately. See Appendix 3.3 and 3.4). During the inspection of the main wind farm site, TDR and grid connection, the GPS coordinates, descriptions, and photographs of the hydrological features were recorded. The walkover involved an initial review of available information gathered in the desk study.

A total of 18 no. surface water samples were undertaken on 29th July 2020, 6th August and 13th August 2020 to assess the current baseline water quality of the primary surface waters originating from the main wind farm site.

No significant constraints were noted in terms of hydrology and water quality during the visits.

10.2.4 Evaluation Criteria

The sensitivity of receptors, the quality of impacts the magnitude of impacts, the probability and duration of the impacts are assessed for the proposed project to determine significance of the impacts.

Thresholds for assessing the sensitivity of the environment and magnitude of impacts are outlined in Figure 10-1.

Quality of effect of an impact is either 'Positive, 'Neutral' or 'Negative' and may have influence in the 'Momentary', 'Short', 'Medium' or 'Long-term'. Impacts may also be either 'Temporary' or 'Permanent'.

The probability of impact can be either 'Likely' or 'Unlikely'.

The impact can be 'high', 'medium', 'low' or 'negligible'.

10.2.4.1 Sensitivity of Receptors

The sensitivity of a hydrological receptor or attribute is based on its ability to absorb development without perceptible change. Levels of sensitivity are then used to assess the potential effect that the proposed project may have on them. According to the Table 10-2, the hydrological environment of proposed project (excluding the replant lands) is considered to be 'Very Sensitive' for receptors draining to the Slaney River Valley SAC.

Table 10-2: Receptor Sensitivity Criteria (Source: sepa.org.uk)

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

10.2.4.2 Assessment of Significance of Hydrological Impact

The assessment of the magnitude of an impact incorporates the timing, scale, size, duration and probability of the impact in accordance with the EPA Guidelines. The significance criteria, which is a combination of sensitivity and the magnitude, probability, duration, consequences, character of the impact, for hydrological impacts are defined as set out in Table 10-3.

Table 10-3: Significance of Hydrological Impact [6]

Impact Significance	Criteria
Imperceptible	An impact capable of measurement but without noticeable consequences
Not significant	An impact which causes noticeable changes in the character of environment but without significant consequences
Slight impacts	An impact which causes noticeable changes in the character of the environment without affecting its sensitivities
Moderate impacts	An impact that alters the character of the environment in a manner that is consistent with existing and emerging trends
Significant impacts	An impact which, by its character, magnitude, duration or intensity significantly alters a sensitive aspect of the environment
Very Significant	An impact which, by its character, magnitude, duration or intensity significantly alters most of a sensitive aspect of the environment
Profound impacts	An impact which obliterates sensitive characteristics

The diagram below, Figure 10-1, shows how comparison of the character of the predicted impact to the sensitivity of the receiving environment can determine the significance of the impact. Sensitivity of the receiving environment can be ‘high’, ‘medium’, ‘low’ or ‘negligible’. Description of impact is defined by its character, magnitude, duration, probability and consequences and it can be ‘high’, ‘medium’, ‘low’ or ‘negligible’.

[6] Guidelines on the information to be contained in environmental impact assessment report Draft August 2017

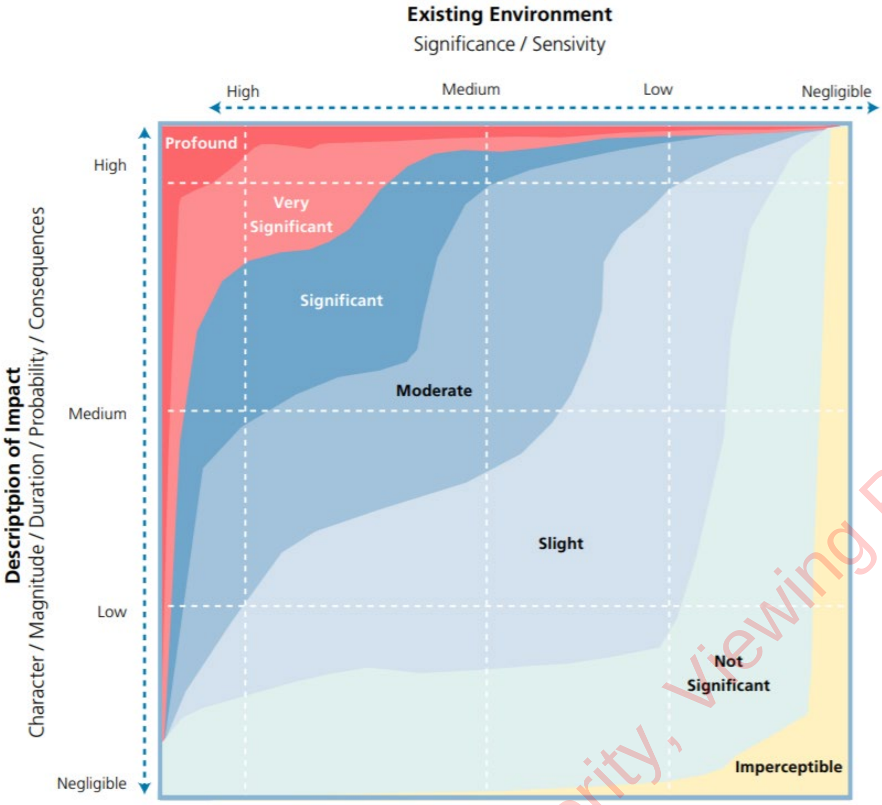

Figure 10-1: Classifications of the Significance of Impacts[7]

10.2.5 Consultation

This chapter considers the consultation responses as referred to in Chapter 5, with particular regard to concerns relating to hydrology and water quality. The scope of this appraisal has been informed by consultation with the Inland Fisheries Ireland (IFI).

10.3 EXISTING ENVIRONMENT

This section describes the receiving environment and sets out a summary of historical flooding, existing protection policies and water quality of rivers within the study area.

10.3.1 General Description of the Catchments

The main wind farm site is located within Hydrometric Area No. HA 12, Slaney & Wexford Harbour, of the Irish River Network System. The standard average annual rainfall at the location of the proposed wind farm is 1,063 mm.

M5-60[8] at the location of the main wind farm site is 17.2 mm according to the Met Éireann rainfall data. This is the predicted rainfall depth in a sixty minute storm that will occur with a frequency of once every five years.

[7] Guidelines on the information to be contained in environmental impact assessment report Draft August 2017

[8] This is for a 5-year return period, with a 60-minute duration rainfall.

The proposed wind farm is situated within one sub-catchment as defined by the WFD as shown on Figure 10-2. This waterbody is known as:

- Slaney_SC_050 (12_8)

The sub-catchments associated with the grid connection and turbine delivery route are shown on Figure 10-2.

The proposed wind farm is situated within five sub-basins as defined by the WFD and shown on Figure 10-2. These waterbodies are known as:

- Clashavey_River_010 - IE_SE_12C00500
- Kildavin_Stream_010_010 - IE_SE_12K040800
- Clody_010 – IE_SW_12C030080
- Burren_020 – IE_SE_14B050110
- Douglas (Ballon)_010 – IE_SE_12D030200

Turbines T1 and T4 are within Clashavey_River_010 - IE_SE_12C00500 waterbody catchment. Turbine T6 is within Kildavin_Stream_010 – IE_SE_12K040800 sub-basin. Turbines T2, T3, T5 and T7 are within Clody_010 – IE_SW_C030080 waterbody. No turbines are planned in Burren_020 sub-basin.

Surface runoff from turbines T1 and T4 drains to the Clashavey River which is a tributary of the River Slaney. The Clashavey river rises to an elevation of 300m OD approximately 0.25km south-west of the turbine T1. The Clashavey River runs in a northern direction for approximately 4.65km where it turns to the east where it joins the River Slaney approximately 6.3km north-east of the turbine T4.
Surface runoff from turbine T6 drain to the Kildavin Stream which rises to an elevation of 205m OD approximately 0.87km north of turbine T6. The Kildavin Stream flows in a north-eastern direction for approximately 2.9km where it turns to the east where it continues to flow for approximately 2.1km before it joins the River Slaney.

Surface runoff from turbines T2, T3 and T5 drains into the Kilbrannish-South Stream and from T7 towards the Kilbrannish-North Stream. Both streams run in south-eastly direction for approximately 2.8km where they join the River Clody. The River Clody flows to the west for approximately 6.8km where it joins the River Slaney.

The cable route between the proposed on-site 38kV substation and existing 110/220kV substation at Kellistown is within six sub-basins as defined by the WFD. These are:

- Clashavey_River _010 - IE_SE_12C00500,
- Douglas_(Ballon)_010 – IE_SE_12D030200,
- Burren_030 – IE_SE_14B050200,
- Ballaghmore_Distibutary_010 – IE_SE12B120990,
- Burren_040 – IE_SE_14B050310,
- Burren_050 – IE_SE_14B050400.

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Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community
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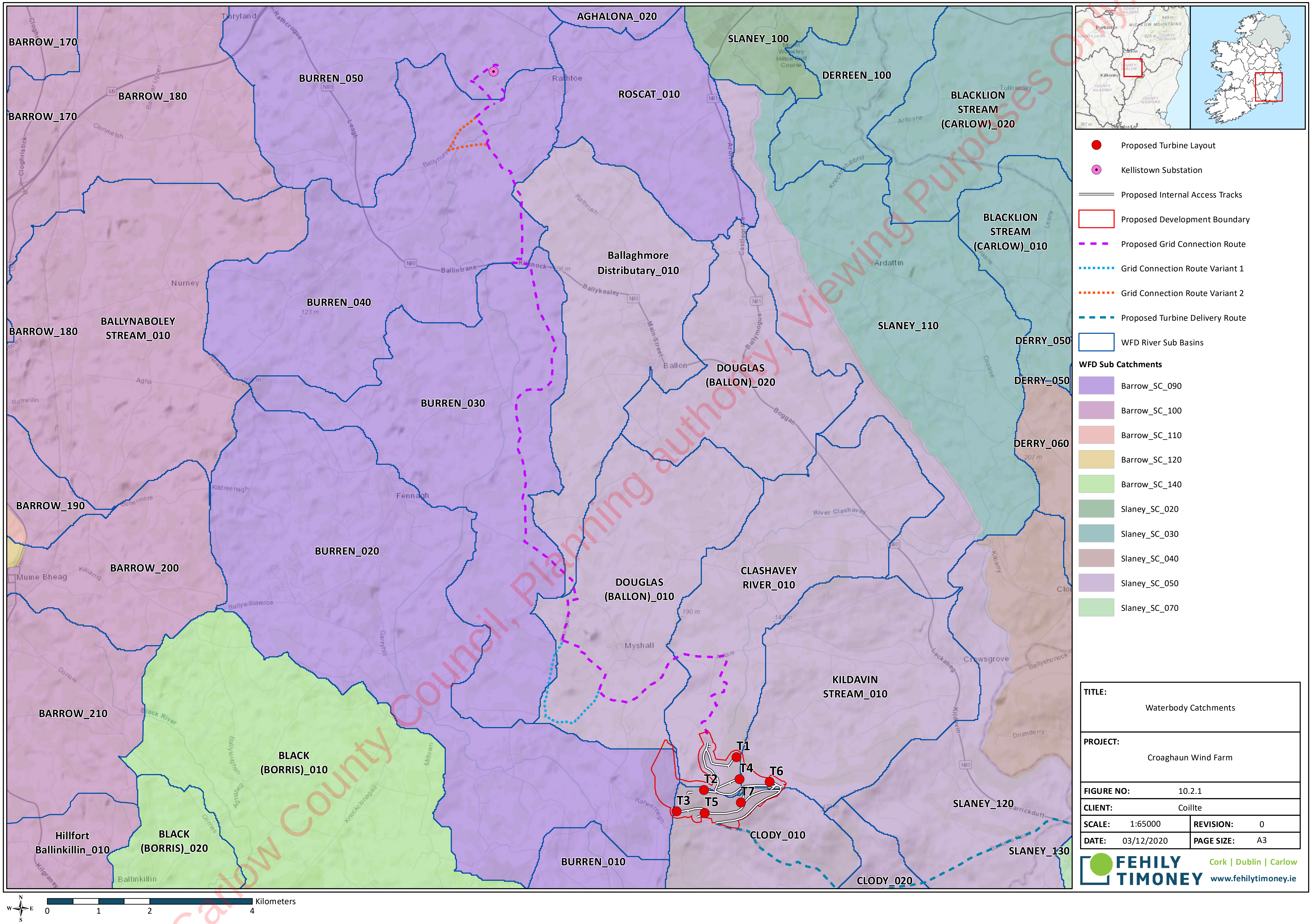

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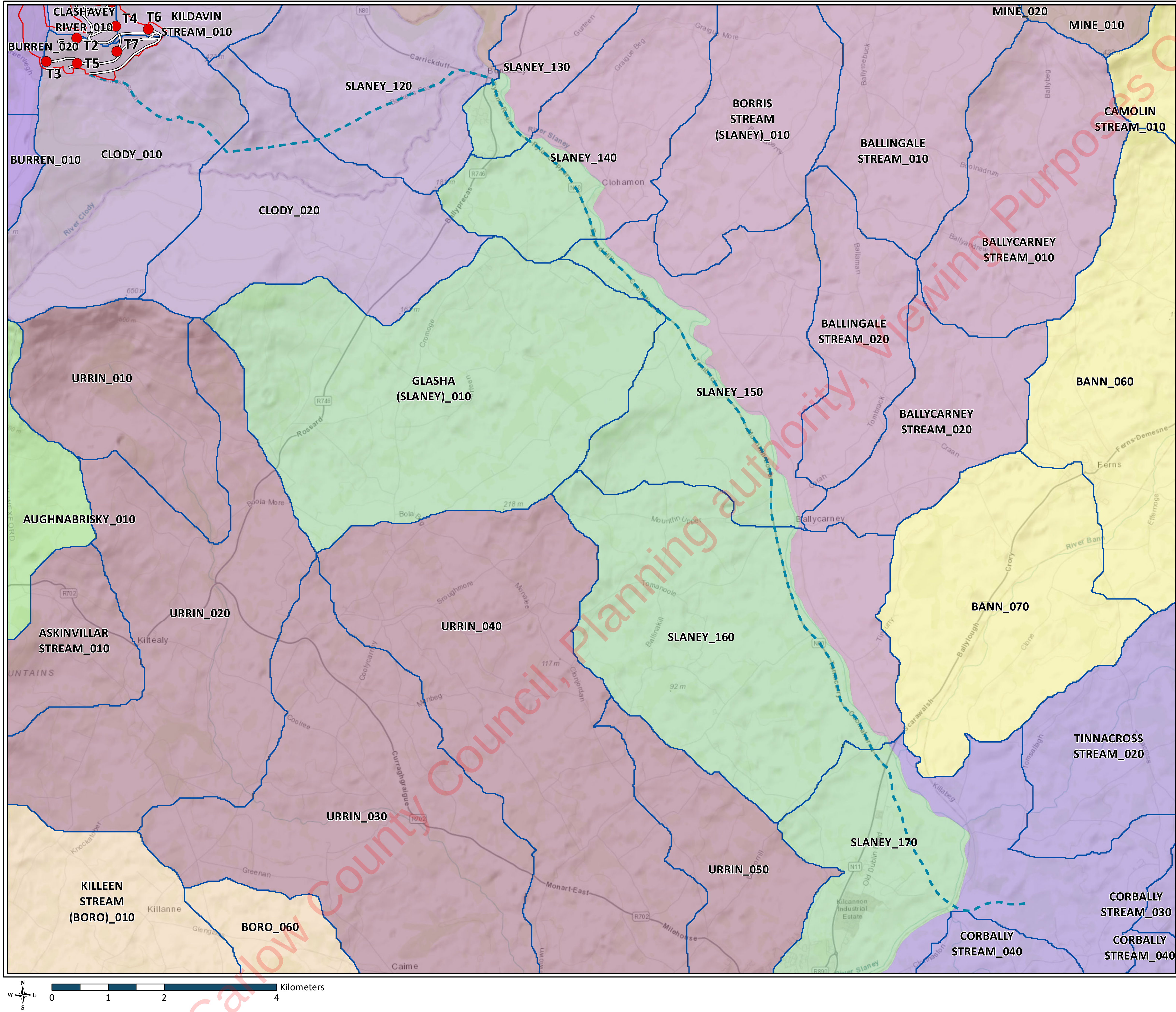

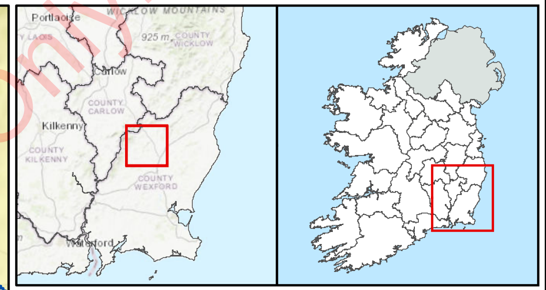

- Proposed Turbine Layout
- Proposed Internal Access Tracks
- Proposed Development Boundary
- Proposed Turbine Delivery Route
- WFD River Sub Basins

WFD Sub Catchments

- Bann[Wexford]_SC_010
- Barrow_SC_090
- Barrow_SC_140
- Boro_SC_010
- Slaney_SC_040
- Slaney_SC_050
- Slaney_SC_060
- Slaney_SC_070
- Slaney_SC_080
- Urrin_SC_010

TITLE:	Waterbody Catchments		
PROJECT:	Croaghaun Wind Farm		
FIGURE NO:	10.2.2		
CLIENT:	Coillte		
SCALE:	1:65000	REVISION:	0
DATE:	03/12/2020	PAGE SIZE:	A3

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10.3.2 Historical Flooding

The OPW has produced indicative flood mapping to assist in a preliminary flood risk assessment (PFRA).[9] The PFRA mapping was prepared as part of the high-level screening exercise to identify areas for further assessment under the Catchment Flood Risk Assessment and Management (CFRAM) Programme.

According to PFRA flood mapping the all the proposed turbines, hardstanding areas and on site substation are within 'Flood Zone C', -Low risk of flooding (less than 0.1%). The northern part of the main wind farm site is within Flood Zone A. However, no works are proposed in this area. The indicative flood mapping for the main wind farm site and grid connection is shown on Figure 10-3.

The national flood hazard mapping (www.floodmaps.ie), does not indicate any record of historical flooding within the main wind farm site boundary, as shown on Figure 10-3.

The nearest flood incident has been recorded at the town of Bunclody. The flood event has been recorded under the name Slaney Bunclody Wexford Nov. 2000 (flood ID 522). The flooding in Wexford on the 5th and 6th November 2000 occurred following rainfall which varied in intensity from 400 to 100mm in the 24h period. The flood impacted on a number of towns in the Wexford area. Details of the flooding in Bunclody indicates that houses, commercial premises and roads were flooded.

There is one recurring flood incident along the grid connection along the route from the on-site substation to the proposed 110/220 kV substation at Kellis. The recurring flooding has been recorded under the name 'Turtane Ballon recurring' (flood ID 3290). According to the OPW report, dated on 16/11/2005, local road L2022 is periodically impassable. This is the only recorded flood incident in the buffer zone of 1km of the grid connection.

There are no areas defined as 'benefiting lands' within the main wind farm site boundary. Benefiting lands are defined as a dataset prepared by OPW identifying land that might benefit from the implementation of Arterial Drainage Schemes (under the Arterial Drainage act 1945) and indicating areas of land subject to flooding or poor drainage.

It is a key mitigation of the project to is ensure all surface water runoff from the main wind farm site will be treated (water quality control) and attenuated (water quantity/flood management control), prior to diffuse discharge at pre-existing greenfield rates. As such the mechanism by which downstream flooding is prevented and controlled is through avoidance by design.

These proposed drainage attenuation measures are outlined in the impact assessment Section 10.6 and 10.7.

[9] http://www.floodinfo.ie/map/floodmaps/

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Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community
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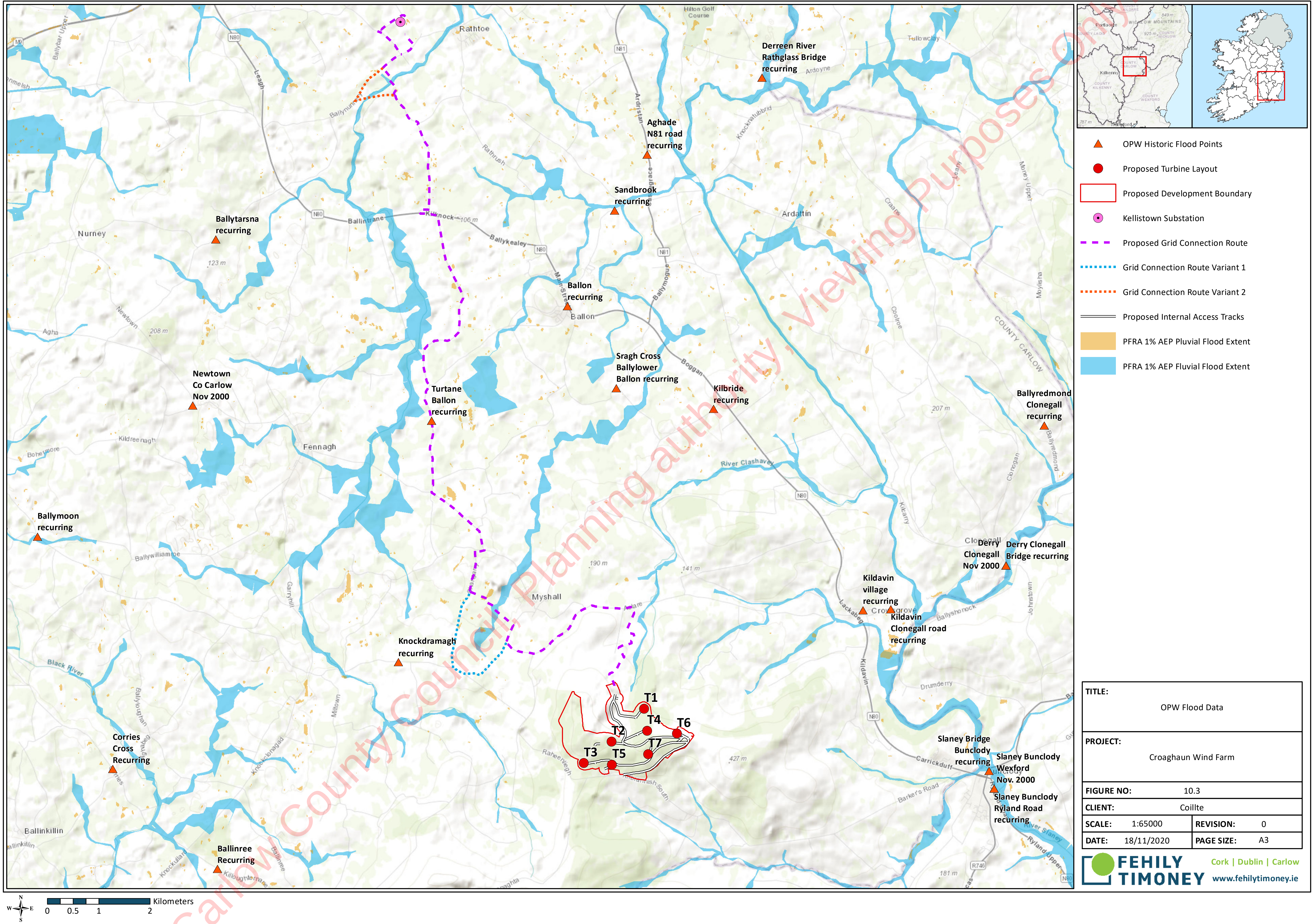

TITLE:	OPW Flood Data		
PROJECT:	Croaghaun Wind Farm		
FIGURE NO:	10.3		
CLIENT:	Coillte		
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DATE:	18/11/2020	PAGE SIZE:	A3

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10.3.3 Surface Water Quality

WFD water quality status and river waterbody risk within the study area is provided in Table 10-4. It can be observed that the river status and waterbody risk of the receiving waters at the northern side of the wind farm is classified as 'Moderate' and 'At Risk'. River status and waterbody risk of the receiving waters at the southern side of the proposed wind farm is classified as 'Good' or 'High' and 'Not at Risk'.

Table 10-4: WFD River Status and River Waterbody Risk (Source: EPA[10])

Waterbody	Waterbody	River Status	Waterbody Risk
Wind Farm			
Clashavey River	IE_SE_12C100500	Moderate	At Risk
Aclare	IE_SE_12C100500	Moderate	At Risk
Rossacurra	IE_SE_12C100500	Moderate	At Risk
Kildavin Stream	IE_SE_12K040800	Moderate	At Risk
Old Deerpark	IE_SE_12K040800	Moderate	At Risk
Kilbrannish South	IE_SE_12C030080	High	Not at Risk
Unnamed Stream	IE_SE_12C030080	High	Not at Risk
Kilbrannish North	IE_SE_12C030080	High	Not at Risk
Unnamed Stream	IE_SE_12C030080	High	Not at Risk
Clody	IE_SE_12C030200	Good	Not at Risk
Grid Connection			
Rossacurra	IE_SE_12C100500	Moderate	At Risk
Douglas (Ballon)	IE_SE_12D030200	Poor	At Risk
Kilmaglush	IE_SE_14B050200	Moderate	At Risk
Ballykealey	IE_SE_14B050200	Moderate	At Risk
Burren	IE_SE_14B050310	Moderate	At Risk

The EPA scheme of Biotic Indices or Quality (Q) Values was developed to determine the status of organic pollution in Irish rivers by assessing the occurrence of macro-invertebrate taxa of varying sensitivity to pollution. Biological Water Quality data was examined as part of this assessment.Error! Bookmark not defined.

The location of the EPA's Q-value stations for the receiving waters are shown on Figure 10-4.

Biological water quality ratings Q5, Q5-4 and Q4 relate to 'Unpolluted' status, Q3-4 relates to 'Slightly polluted', Q3 and Q2-3 relate to 'Moderately polluted' and Q2, Q1-2, Q1 relate to 'Seriously polluted' watercourse.[11]

[10] https://gis.epa.ie/EPAMaps/

[11] http://www.epa.ie/QValue/webusers/

Table 10-5: EPA Biological Water Quality Ratings

Station ID	Location	2010	2013	2016	2017	2019
Wind Farm						
RS12K040700	Bridge on N80 at Kildavin u/s	3	3-4	3-4	4	4
RS12K040800	Bridge NE of Ballypierce	3-4	3-4	3-4	3-4	3-4
RS12C030080	Bridge d/s confluence N&S Kilbrannish	4-5	4-5	4-5	4-5	4-5
RS12C030100	Ford NE of Craan	-	-	-	-	-
RS12C100500	Clashavey Bridge	3	3-4	3-4	3-4	3-4
Grid Connection						
RS12D030080	Douglas (Ballon) Bridge SW of Myshall	-	-	-	-	-
RS12D030090	Myshall Upsteam	-	-	-	-	-
RS12D030100	Myshall Bridge	4	3	3	3-4	3-4
RS12D030120	Douglas (Ballon) 3rd Bridge u/s Ballyhealy Bridge	-	-	-	-	-
RS14B050150	Burren – Killane Bridge	-	-	-	-	-
RS14B050200	Ballintrane Bridge	-	-	-	3-4	-
RS14B050250	Burren – Ballynunnery Bridge	-	-	-	-	-
RS14B050300	Rathtoe Bridge	-	-	-	3-4	-

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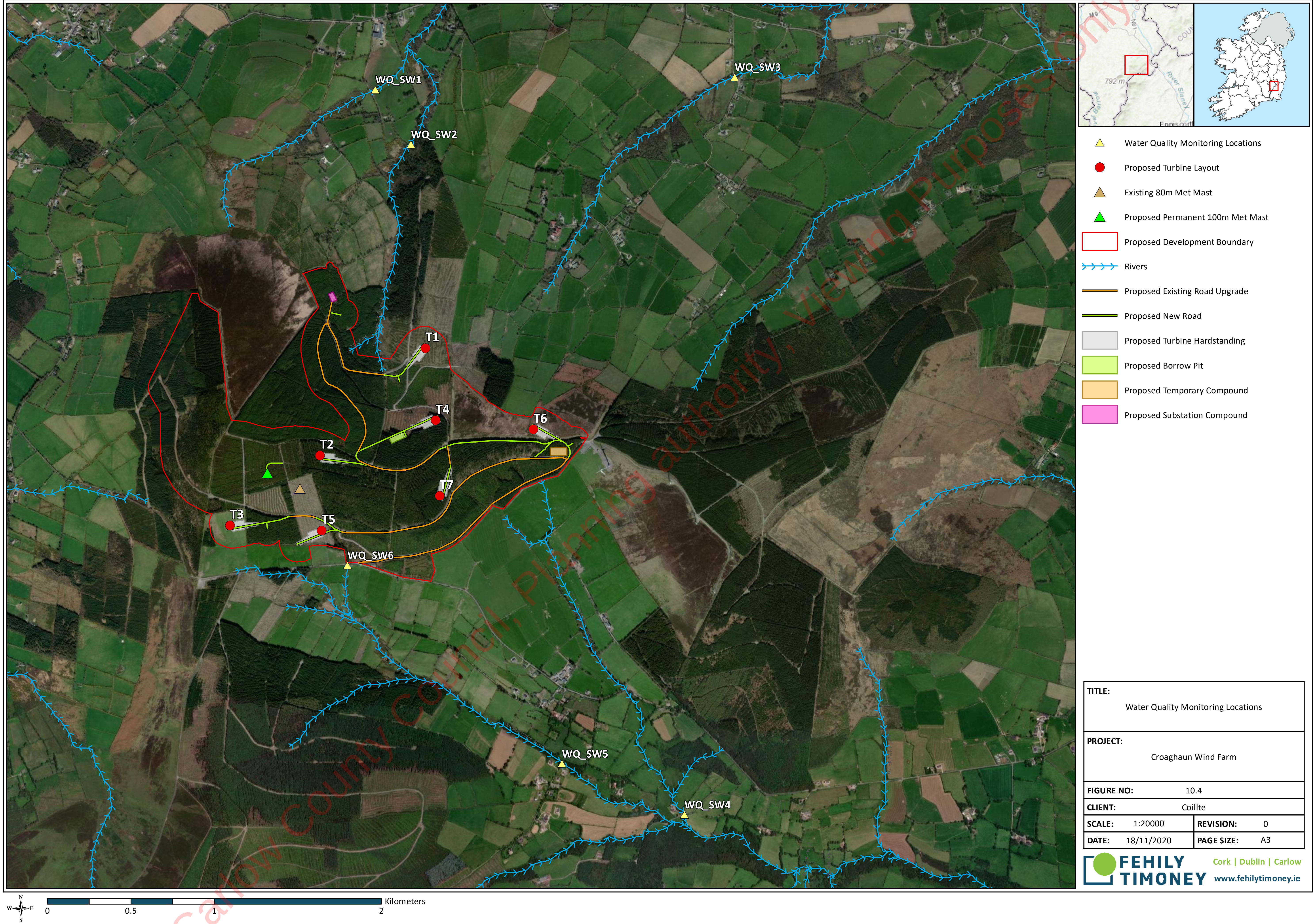

TITLE: Water Quality Monitoring Locations	
PROJECT: Croaghaun Wind Farm	
FIGURE NO: 10.4	
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SCALE: 1:20000	**REVISION:** 0
DATE: 18/11/2020	**PAGE SIZE:** A3

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10.3.4 Water Quality Monitoring Programme

A water quality monitoring programme was set up for the proposed project to establish a baseline for water quality within the study area. Water sampling took place for 3 separate weather conditions on 29th July, 6th August and 13th August at 6 locations to establish baseline conditions. Results of the laboratory analysis are shown alongside relevant water quality regulation in Table 10-6.

The following parameters were measured:

- Biological oxygen demand (BOD)
- Nitrate as N
- Phosphate as P
- Total Suspended Solids
- Hydrocarbons

Table 10-6: Results of Surface Water Samples

Parameter	EC Directives			Sample Location						Sampling Date
	Salmonid	Cyprinid	EC DW Regs 2009	SW1	SW2	SW3	SW4	SW5	SW6	
Total Suspended Solids (mg/L)	≤25	≤25	-	12	3	2	2	2	41	29.07.2020
				38	4	6	2	3	12	06.08.2020
				7	10	2	2	4	124	13.08.2020
Nitrates as N (mg/L)	-	-	50	<0.7	<0.7	<0.7	<0.7	<0.7	<0.7	29.07.2020
				<0.7	<0.7	<0.7	<0.7	<0.7	<0.7	06.08.2020
				<0.7	<0.7	0.8	1.1	<0.7	<0.7	13.08.2020
BOD	≤3	≤6	-	7	1	1	1	1	1	29.07.2020
				3	<1	<1	<1	<1	<1	06.08.2020
				4	4	<1	<1	<1	<1	13.08.2020
Orthophosphate	-	-	-	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	29.07.2020
				<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	06.08.2020
				<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	13.08.2020
Hydrocarbons (EH > C6 – C40)	-	-	-	11	<10	<10	<10	<10	<10	29.07.2020
				<10	<10	<10	<10	<10	<10	06.08.2020
				130	112	115	<10	<10	11	13.08.2020

The monitoring point WQ-SW1 was located at the Rossacurra Stream at the location GCR-10. The monitoring WQ-SW2 was located approximately 350m south west of WQ-SW1 at the River Clashavey. The monitoring point WQ-SW3 was located at the Kildavin Stream approximately 2.5km northeast of the turbine T1.

Monitoring locations WQ-SW4, WQ-SW5 and WQ-SW6 were located at watercourses which drain the land of the southern side of the proposed wind farm. WQ-SW4 was located at Kilbrannish North Stream, SW5 at Kilbrannish South. The monitoring point at the Unnamed stream which runs east of the turbine T5. This unnamed stream is a tributary of the Kilbrannish South Stream.

The exact locations of the pre-construction monitoring points are shown on Figure 10-4.

The concentration of Nitrate as N was <0.7 mg/l for all locations for all three sampling events with an exception for locations SW3 and SW4 where the concentration was 0.8 and 1.1 mg/l respectively. The concentration of suspended solids was higher at locations SW1 and SW6 compared to other locations. The concentration of orthophosphates was <0.6 for all locations. The high concentration of hydrocarbons (EH > C6-40) was noted at locations SW1, SW2 and SW3 on 13th August.

Original laboratory results are attached in Appendix 10.1.

In addition, European Communities Environmental Objectives (Surface Water) Regulations S.I. 272 of 2009, (EOSWR 272/09) are shown in Table 10-7.

Table 10-7: Chemical Conditions

Parameter	Threshold Values (mg/L)
BOD	High status ≤ 1.3 (mean)
	High status ≤ 2.2 (95%ile)
	Good status ≤ 1.5 (mean)
	Good status ≤ 2.6 (95%ile)
Ortho-phosphate	High status ≤ 0.025 (mean)
	Good status ≤ 0.035 (mean)

10.3.5 Protected Ecological Environment

The proposed project is not situated within any environmentally designated areas, however surface water running off the main wind farm site drains into the Slaney River Valley SAC. The closest SAC is just south-west of the main wind farm site, Blackstairs Mountains SAC (000770). However, no runoff from the main wind farm site will discharge in that area. The proposed grid connection will cross watercourses which drain into the River Barrow and River Nore SAC.

The proposed project does not traverse any Special Protection Area (SPA) or natural Heritage Area (NHA). The closest SPA, Wexford Harbour and Slobs SPA (004076), is approximately 22km southeast of the min wind farm site.

Environmentally designated areas are described in Chapter 8.

10.3.6 Internal Main Wind Farm Site Drainage

A walkover survey of the main wind farm site took place on 19th November 2019 and on 29th August 2020 to examine the existing drainage and hydrological features at the proposed locations for infrastructure within the proposed project. The visits involved a walkover of the main wind farm site by FT staff, recording existing drainage features and noting their locations. The locations of the hydrological features observed during the visit are shown in Figure 10-5. Description of existing crossings are provided in Table 10-8.

Photographs of existing hydrological features are included in Appendix 10.2.

Drains and existing road drainage

The existing drainage system is based on surface water being collected in drainage ditches located along the access roads. Water from drains is discharged overland downslope of the access road.

Existing tracks are present throughout the main wind farm site. The access tracks are approximately 4.0 m wide and made up of sandstone/siltstone hardcore and are used for forest inspection, maintenance and access for tree felling and extraction. The existing track drainage consists of 'over the edge' drainage to roadside drains.

A key design principle is to make use of existing tracks to access the new turbines. The existing tracks will require strengthening and widening to achieve a track width of 5 m. All access tracks will be up to 5m wide along straight sections and wider at bends as required.

The access road between the proposed location of the compound and proposed turbine T7 does not have road drainage. Surface runoff overtops the road. At the southern side of the main wind farm site the road crossing structure is a 300mm concrete pipe. At the northern side of the main wind farm site the road cross drains are 450mm PE pipes.

No existing drains need to be diverted due to the construction of the wind farm.

Drain Crossing Infrastructure

During the main wind farm site visits 8 existing crossing points, over the small stream and road cross drains were identified. The locations of crossings are shown on Figure 10-5 and a general description of these crossings are provided in Table 10-8.

Table 10-8: Existing Internal Main Wind Farm Site Stream Crossings

Feature ID	General description
WF – HF1	Road cross drain, concrete pipe, 300 mm diameter
WF – HF2	Road cross drain, concrete pipe, 300 mm diameter
WF – HF3	Road cross drain, concrete pipe, 300 mm diameter
WF – HF4	Inaccessible during site visit. Likely small diameter forestry pipe culvert as part of forestry drainage.
WF – HF5	Small stream crossing, PE pipe, 600mm diameter

Feature ID	General description
WF – HF6	Road cross drain, PE pipe, 450 mm diameter
WF – HF7	Road cross drain, PE pipe, 450 mm diameter
WF – HF8	Road cross drain, PE pipe, 450 mm diameter

The hydrology features WF-HF1 and WF-HF2 and are located on the southern part of the main wind farm site. Crossing WF-HF1 is located along the access road between the proposed main wind farm site entrance and turbine T5. Crossing WF-HF2 is located along the access road between the proposed main wind farm site entrance and turbine T6. Crossings WF-HF3 is approximately 40m east of the crossing WF-HF4. Crossing WF-HF3 is a 300m concrete pipe road cross drain.

The type of crossing HF4 has not been identified during multiple visits due to the heavy vegetation upstream and downstream of it. This crossing is over a small drain which runs in the northern direction and continues to the River Clashavey River approximately 220m downstream of it.

Crossings WF-HF5, WF-HF6, WF-HF7 and WF-HF8 are road cross drains located along the access road between the proposed turbine T1 and proposed on-site substation.

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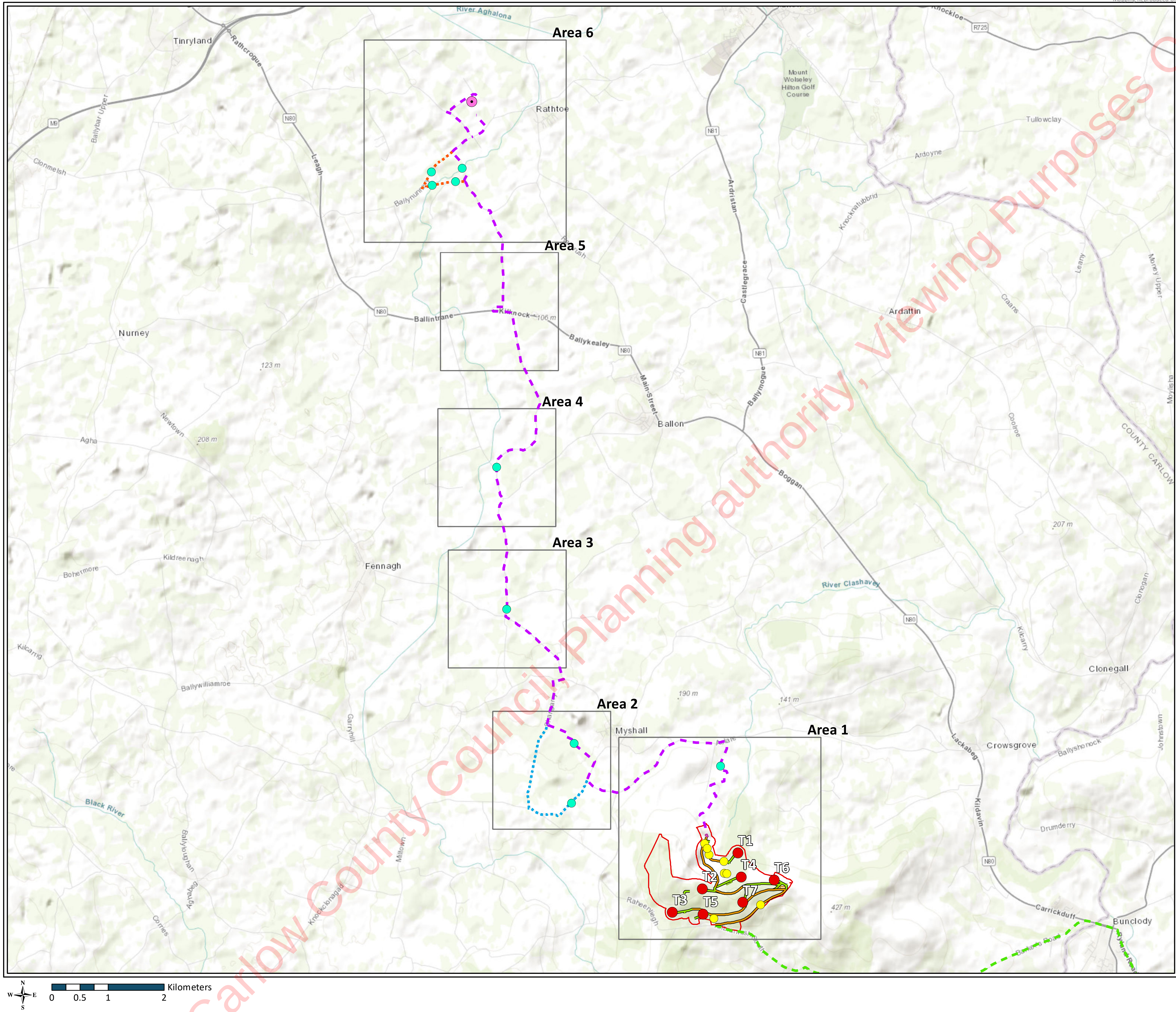

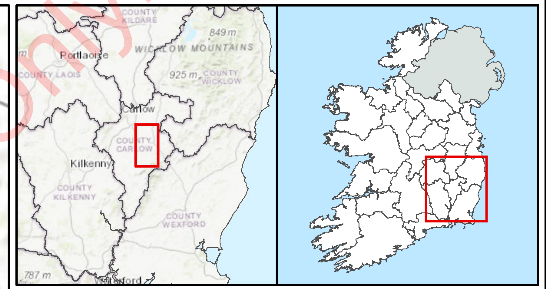

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PROJECT:	Croaghaun Wind Farm
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DATE: 18/11/2020	PAGE SIZE: A3

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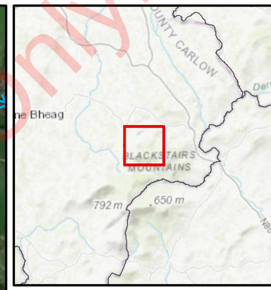

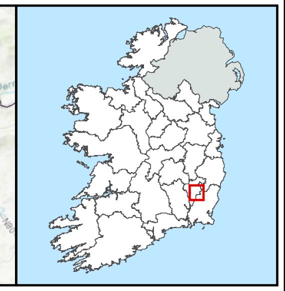

- Hydrological Features
- Grid Route Watercourse Crossings
- Proposed Turbine Layout
- Existing 80m Met Mast
- Proposed Permanent 100m Met Mast
- Rivers
- Proposed Existing Road Upgrade
- Proposed New Road
- Proposed Grid Connection Route
- Grid Connection Route Variant 1
- Proposed Turbine Delivery Route
- Proposed Croaghaun Loop
- Proposed Development Boundary
- Proposed Turbine Hardstanding
- Proposed Borrow Pit
- Proposed Temporary Compound
- Proposed Substation Compound

TITLE: Hydrological Features Overview			
PROJECT: Croaghaun Wind Farm			
FIGURE NO:	10.5.2		
CLIENT:	Coillte		
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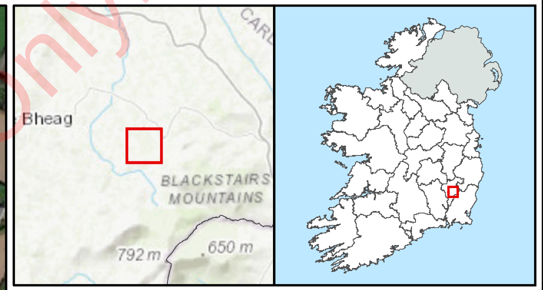

- Grid Route Watercourse Crossings
- Rivers
- Proposed Grid Connection Route
- Grid Connection Route Variant 1

TITLE:	Hydrological Features Overview
PROJECT:	Croaghaun Wind Farm
FIGURE NO:	10.5.3
CLIENT:	Coillte
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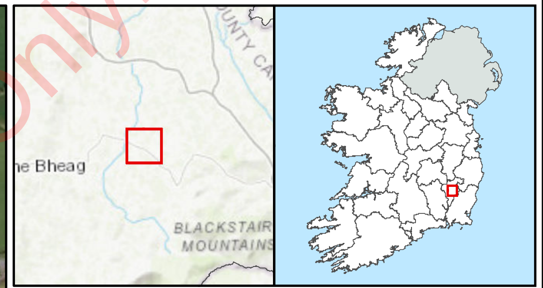

- Grid Route Watercourse Crossings
- Rivers
- Proposed Grid Connection Route

TITLE:	Hydrological Features Overview
PROJECT:	Croaghaun Wind Farm
FIGURE NO:	10.5.4
CLIENT:	Coillte
SCALE: 1:10000	**REVISION:** 0
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Grid Route Watercourse Crossings

Rivers

Proposed Grid Connection Route

TITLE:	Hydrological Features Overview
PROJECT:	Croaghaun Wind Farm
FIGURE NO:	10.5.5
CLIENT:	Coillte
SCALE: 1:10000	**REVISION:** 0
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Rivers

Proposed Grid Connection Route

0 0.5 1 2 Kilometers

TITLE:	Hydrological Features Overview
PROJECT:	Croaghaun Wind Farm
FIGURE NO:	10.5.6
CLIENT:	Coillte
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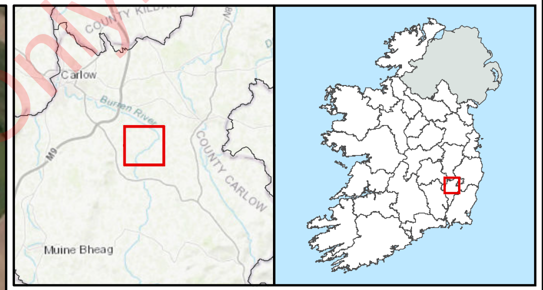

- Grid Route Watercourse Crossings
- Kellistown Substation
- Rivers
- Proposed Grid Connection Route
- Grid Connection Route Variant 2

TITLE:	Hydrological Features Overview
PROJECT:	Croaghaun Wind Farm
FIGURE NO:	10.5.7
CLIENT:	Coillte
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10.3.7 Grid Connection

As shown in Figure 10-5, two grid connection route variants have been assessed in addition to the primary route which makes use of private agricultural lands at two separate locations to both minimise the overall length of the route and reduce the number of watercourse crossings required for the project. In both cases, where the primary route leaves the public road and passes through private lands, an alternative route variant has been assessed which involves the cable route following the public road corridor. Two separate cable route options for entering the proposed substation at Kellistown substation (see Section 3.5.9.2 of Chapter 3) have also been assessed. For the purposes of assessing worst case, the maximum possible route length and number of watercourse crossings based on the route permutations available have been used for quantities and material calculations. Should the proposed primary route be constructed, the total number of watercourse crossings shall amount to 5no. (2no. in the public road corridor and 3no. in private lands). The maximum possible number of watercourse crossings required is 7no. and would involve the inclusion of both route variants in the final grid connection. In this scenario, 6no. watercourse crossings will be located in the public road corridor and 1no. will be on private lands.

All crossing locations associated with the grid connection options are listed in Table 10-9. The method of crossing over the watercourses is proposed for each crossing location.

The proposed grid connection trench will be 600 mm wide and 1200 mm deep. Where the proposed grid connection cable route encounters minor culverts, the ducts will be installed above or below the culvert depending on its depth in accordance with construction methodologies outlined in the CEMP (Appendix 3.1). The cable ducting will be installed so as not to impact the existing culvert.

Table 10-9: Grid Connection Crossing Method

Feature ID	ITM_X	ITM_Y	Grid cable method crossing
GCR-WCC1	679096.96	670298.85	HDD in public road corridor
GCR-WCC2	679110.52	670057.43	HDD in public road corridor
GCR-WCC3	679529.02	670126.05	HDD in public road corridor
GCR-WCC4	680262.95	665039.41	HDD in public road corridor
GCR-WCC5	680437.80	662507.73	HDD in public road corridor
GCR-WCC6	681594.32	659057.55	Ducts laid in flat profile within concrete bridge beam in road deck
GCR-WCC7	684252.84	659716.09	HDD in private field
GCR-WCC8	679645.23	670366.41	HDD in private field
GCR-WCC9	681641.77	660121.93	HDD in private field

For crossings where HDD has been identified as the preferred crossing method, open cut trenching methods shall be permitted in dry conditions where there is no-flow in the watercourse and there is no risk of in-stream works. In such instances, cable ducts will be laid under the stream bed which would then be fully reinstated to its pre-existing condition.

The cable route between the proposed on-site 38kV substation and the existing 110/220kV substation at Kellistown is within six sub-basins as defined by the WFD. These are:

- Clashavey_River _010 - IE_SE_12C00500,
- Douglas_(Ballon)_010 – IE_SE_12D030200,
- Burren_030 – IE_SE_14B050200,
- Ballaghmore_Distibutary_010 – IE_SE12B120990,
- Burren_040 – IE_SE_14B050310,
- Burren_050 – IE_SE_14B050400.

The grid connection crosses Flood Zone A at two locations. This is further discussed in section 10.5.2.

10.3.7.1 Internal Wind Farm Buried Electrical Cables

As outlined in Chapter 3 of this EIAR, electricity generated from wind turbines shall be collected at medium voltage (20/33kV) by an internal circuit of buried cables which will follow on-site access tracks. This circuit shall be terminated at a proposed onsite substation before being exported to the grid via a 38kV buried cable to the existing Kellistown substation.

Crossings for the cables in the internal access roads serving the main wind farm site, have been assessed.

10.3.8 Turbine Delivery Route

As discussed in Section 13.4.5, turbine components will be delivered along the route as shown on Figure 10-5. Crossings listed below were indentfied between the roundabout at M11-N30 and the proposed entrance to the wind farm during the TDR inspection:

- Toom 12 (12T49)
- Slaney (12S02)
- Moyne Lower (12M71)
- Moyne 12 (12M82)
- Marshalstown 12 (12M61)
- Tomgarrow 12 (12T37)
- Mountfin Lower (12M57)
- Tombrick 12 (12T34)
- Glasha 12 (12G01)
- Newtownbarry 12 (12N14)
- Clody (12C03)
- Unnamed Stream (tributary of the River Clody, just west of townland Bunclody)
- Deerpark New (12D25)
- Kilbrannish North (12K82)

There are a total of 14 watercourse crossings along the TDR from the roundabout at M11-N30 and the main wind farm site entrance. No modifications were identified as being required at these stream crossings, except for crossings over the Kilbrannish North Stream at the local road L2026 (POI43). It is proposed to cross this watercourse using an existing bridge. A temporary bridge will be constructed directly south of the existing bridge for oversized vehicles for turbine delivery purposes. A detailed description of this proposed crossing is contained in Chapter 3.

The locations of proposed temporary accommodation works including the above temporary bridge crossing (POI43) along the TDR are shown in Figure 3.3.

The potential impact on hydrology and water quality of the TDR is discussed in Section 10.4.2.2.

10.4 Potential Impacts

The potential impacts on the hydrological regime are assessed in the following sections for the activities associated with each phase (construction, operation, maintenance and decommissioning) of the proposed project. The conventional source-pathway-target model was applied to assess potential impacts on downstream environment receptors as a result of the proposed project. Where potential impacts are identified, the classification of the impact is evaluated as per criteria outlined in Section 10.2.4.

The potential significance of the impacts in relation to an increase in surface runoff, specific impacts during the various phases of the project and cumulative flood risk with neighbouring developments are outlined below.

The summary of potential impacts, magnitude, duration, likelihood and whether it is of a direct or indirect nature is provided in Section 10.4.7.

10.4.1 Do Nothing Impact

If the proposed project does not proceed, the main wind farm site will remain as predominantly forestry for the foreseeable future.

10.4.2 Potential Impacts During Construction

During the construction period, the project has the potential to lead to impacts on hydrology and water quality unless appropriate mitigations are applied. Inappropriate construction practices could also have the potential to impact the water quality and WFD status of existing waterbodies listed in Table 10-4which includes the Slaney River Valley SAC.

Tree felling, new access tracks and upgrade of existing tracks, turbine hardstanding areas, the on-site substations, amenity trail and all other new, hard surfaces have the potential to contribute to the increase in runoff, as indicated in Table 10-10.

The estimated peak runoff from the main wind farm site was calculated using Modified Rational Equation (MRE) for pre and post-construction scenario for 1 in 100 year storm event. The difference between these two values is equal to an increase in runoff resulted from changes in the surface at hardstanding area around turbines, access roads and substation.

The peak runoff for MRE equation occurs for a storm event with duration equal to the time of concentration. Time of concentration at the location of the main wind farm site is estimated to be 180 min. Therefore, the estimated increase in runoff was calculated for a 1-in-100 year storm event with a duration of 180 minutes. This equates to rainfall with an intensity of 15.5 mm/h. The intensity is increased by 10% to accommodate a climate change allowance.

The estimated increase in peak runoff due to project is provided in Table 10-10.

As illustrated in Figure 10-2 the greenfield runoff drains to five sub-basins. Table 10-10 indicates the estimated changes in the amount of surface water runoff to each sub-basin. It can be seen from Table 10-10 that there is no increase in runoff on two sub-basins. This is due to no changes in impermeable surfaces in these sub-basins.

Surface water peak runoff from impermeable surfaces of the main wind farm site within the Clashavey_River_010 sub-basin will increase by 0.024 m^3/s (or 0.11%). It will increase by 0.010 m^3/s (or 0.05%) within Kildavin_Stream_010 and by 0.043 m^3/s (or 0.20%) within Clody_010 sub-basin. There will be an increase by 0.001 m^3/s (0.00%) within Burren_020 sub-basin due to the reconstruction of the recreation trail.

There will be no increase in runoff within catchment Douglas (Ballon) because no new impermeable areas are envisaged to be constructed or existing roads upgraded.

The overall estimated increase in the peak runoff due to the project is 0.077 m^3/s (or 0.0 %) for a 1 in 100 years storm event.

As discussed in Section 10.2.4.1 the hydrological environment of the Croaghaun wind farm is considered to be of 'high' sensitivity for receptors draining to the River Slaney. The significance of the effect of the increase in runoff is imperceptible on receiving waters because estimated increases in runoff are low compared to the flows of receiving waters. This is without taking account of mitigation measures that will be put in place to slow runoff down within the proposed wind farm drainage system.

Table 10-10: Increase in Surface Water Runoff

			Sub-basin Area	Construction Area	Overland	New tracks (5m wide)	Widening of existing tracks	Hardstanding, Compound and Substation Area	Turbine Foundation	Total Runoff (Area x runoff coeff.)	Rainfall Intensity	Run-off	Increase in Runoff	Increase in Runoff
	Catchment	Scenario	ha	ha	ha	ha	ha	ha	ha	ha	mm/hr	m^3/s	m^3/s	%
Croaghaun Wind Farm	Clashavey_River_010	Existing	1540	3.29	3.29					**0.99**	17.1	0.05		
		Post Development			0.00	0.555	1.029	1.693	0.013	**1.49**	17.1	0.07		
		Increase in Run-off											**0.024**	**0.11**
	Kildavin_Stream_010	Existing	1449	1.38	1.38					**0.41**	17.1	0.02		
		Post Development			0.00	0.572	0.038	0.761	0.006	**0.62**	17.1	0.03		
		Increase in Run-off											**0.010**	**0.05**
	Clody_010	Existing	1473	5.91	5.91					**1.77**	17.1	0.08		
		Post Development			0.00	0.786	1.563	3.539	0.025	**2.68**	17.1	0.13		
		Increase in Run-off											**0.043**	**0.20**
	Burren_020	Existing	3331	0.13	0.13					**0.04**	17.1	0.00		
		Post Development			0.00	0.000	0.130	0.000	0.000	**0.06**	17.1	0.00		
		Increase in Run-off											**0.001**	**0.00**
	Douglas (Ballon)_010	Existing	1530	0.00	0.00					**0.00**	17.1	0.00		
		Post Development			0.00	0.000	0.000	0.000	0.000	**0.00**	17.1	0.00		
		Increase in Run-off											**0.000**	**0.00**
												TOTAL INCREASE:	**0.077**	**0.07**

Notes: *Impervious factor for overland flow is 0.3. For tracks and hardstanding areas impervious factor of 0.45 is applied; for turbine foundation the runoff coefficient of 1.00 is applied.*

Rainfall Intensity for 1-in-100 year return period storm of 180 minutes duration supplied by Met Eireann.
10% increase is applied to rainfall intensity to allow for climate change. [12]

Q100 flow derived using the Modified Rational method Q=2.78 x (Rainfall Intensity) x (Contributing Impervious Area(factored).)

[12] Greater Dublin Strategic Drainage Study – Regional Drainage Policies – Volume 5 Climate Change

The relatively low increase in run-off has however, the potential to cause soil erosion and consequent sediment release into the receiving watercourses.

Possible potential impacts on surface water quality during tree felling and construction activities include:

- Increased sediment loading of streams from personnel and traffic activities.
- Standing water in excavations could contain an increased concentration of suspended solids as a result of the disturbance of the underlying soils.
- Haul roads passing close to watercourses could allow the migration of silt laden runoff into watercourses.
- Silt carried on the wheels of vehicles leaving the main wind farm site could be carried onto the public road.
- Tree felling could lead to an increase in sediment and nutrients in the surface water runoff, if the brash is left in place in the riparian buffer zones.
- Small diameter cross-drains could lead to blockages and consequent flooding and concentration of flows.
- Suspended solids could potentially lead to siltation and physical effects on flora and fauna in aquatic habitats.
- Refueling activities could result in fuel spillages which could pollute underground and surface water.
- There is the potential for fuel spill/leaks from storage tanks which will be stored on main wind farm site for plant machinery. Fuel spill/leaks could infiltrate underground and pollute underground water. Fuel spills/ leaks could be drained to watercourses and pollute them.
- Sanitary waste could lead to contamination of receiving waters.
- Inappropriate management of excavations could lead to loss of suspended solids to surface waters.
- Inappropriate management of the excavated material could lead to loss of suspended solids to surface waters.
- Inappropriate management of the drainage of material storage areas could lead to loss of suspended solids to surface waters. This could result in blockage of cross drains which could lead to flooding.
- Overland flow entering excavations could increase the quantity of surface water to be treated for sediment removal.
- Overland flows entering roadside drains could result in a concentration of flows and subsequent erosion of drains
- Grid connection and internal cable trenches could act as a conduit for surface water flows.
- The velocity of flows in roadside drainage could cause erosion in steeply sloping roadside drains.
- Runoff from the borrow pit area could be silt laden, with the risk of draining into receiving watercourses, given the exposed nature of the borrow pit areas due to the excavation and haulage of stone from the area.
- Flows from the new drainage system could be impeded, should blockages occur in the existing roadside drains.
- The construction of new infrastructure has the potential to obstruct existing overland flow.
- A blockage in the proposed roadside drains could allow a break out of silt laden runoff to reach adjacent watercourses or streams.

- Wet concrete could lead to contamination of receiving waters and groundwaters. Concrete and other cement-based products are highly alkaline and corrosive and can have significant negative impacts on water quality. They generate very fine alkaline silt (pH 11.5) that can physically damage fish. Peat ecosystems are dependent on low pH hydrochemistry.
- Proposed roadside drains on the uphill side of new roads will have to convey all of the contributing runoff from the land above resulting in large drains being required in certain areas and mixing of overland flow with runoff from construction works. This would reduce the efficiency of any proposed settlement ponds.

10.4.2.1 Grid Connection Cable Installation and Horizontal Directional Drilling

It is proposed that directional drilling under the stream bed will be undertaken to prevent direct impacts on the watercourses. However, there is a risk of indirect impacts.

The following potential impacts could result from the construction activities related to grid connection cable installation and watercourse crossings:

- Cable trench could act as a conduit for surface runoff
- Excavated soil could be mobilised in the surface water runoff during an extreme rainfall event
- Inadequate storage of fuels and oils could lead to contamination of surface water
- The excavation of trenches for cable laying, and the launch and reception areas for directional drilling, could lead to silt laden surface water run-off
- Silt carried on the wheels of vehicles could be carried onto the public roads and washed into watercourses
- Refuelling activities could result in fuel spillage
- Suspended solids drained to watercourse could potentially lead to siltation and physical effect on flora and fauna
- Works leading to erosion of the river banks/bed could negatively impact on the fisheries habitat
- Drilling fluids could pollute watercourse
- Sediment laden runoff during the launch pit and reception pit excavation works.

Duration and significance of the impacts on hydrology and water quality associated with grid connection cable installation and HDD are provided in Table 10-11.

10.4.2.2 Potential Impacts During Turbine Delivery

The turbine delivery route will cross 14 watercourses as discussed in Section 10.3.8. The locations of accommodation works are shown in Figure 3-3 and identified as “Points of Interest (POI’s)”. The location and nature of proposed temporary accommodation works are described in further detail in Chapter 3.

Other modifications along the TDR involves the temporary removal of street furniture and removal of some vegetation in addition to the temporary local widening at bends using hardcore material. Inappropriate management of the carrying out of these modifications could result in blockages of existing roadside drainage.

Temporary accommodation work is required to widen bends. It is not anticipated that these works will have any significant hydrological impact due to the scale and nature of the works. The proposed accommodation works areas are isolated from each other and do not involve significant volumes of material or excavations. The proposed accommodation works are temporary in nature.

The most significant accommodation works will be required at the POI43 - Crossing of Killbranish North River at Killbranish and POI52 Proposed Turning Point as described in Chapter 3 and Chapter 13.

It is proposed to cross the Killbranish North River using the existing road bridge as described in Section 3.5.6. A temporary bridge will be constructed directly south of the existing bridge for oversized vehicles for turbine delivery purposes at the location shown in Plate 3-1 and accompanying drawings. However, no in-stream works are required.

The following potential impacts could result from the construction activities related to installation of a temporary bridge:

- Release of sediments and nutrients in watercourses due to tree felling
- Tree felling process require trafficking of heavy machinery which can lead to pollution of watercourses due to spillage of fuels and hydrocarbons.
- Inappropriate site management of excavations could lead to loss of suspended solids to surface waters.
- Inappropriate management of the excavated material could lead to loss of suspended solids to surface waters.
- Inappropriate management of the drainage of material storage areas could lead to loss of suspended solids to surface waters. This could result in blockage of cross drains which could lead to flooding.
- Wet concrete could lead to contamination of receiving waters and groundwaters. Concrete and other cement-based products are highly alkaline and corrosive and can have significant negative impacts on water quality. They generate very fine alkaline silt (pH 11.5) that can physically damage fish.

A temporary hardstanding area and road shall be constructed at location POI152 Proposed Turning Point. The area of hardstanding is 0.13ha. The estimated increase in runoff due to installation of temporary hardstanding areas is 0.002 m^3/s for a 1 in 100 years storm event. This storm event is unlikely to happen during the turbine installation stage and it has a momentary effect, therefore the estimated increase in runoff is not significant.

10.4.2.3 Potential Impacts During Tree Felling

It is estimated that 24.4 ha in total of existing forestry will be felled to allow for development of the main wind farm site infrastructure.

The main potential impacts during tree felling process are release of sediments and nutrients in watercourses due to exposure of soil and subsoil following vehicle tracking, skidding and extraction methods. The release of nutrients in watercourses can come from pine brushes if not managed correctly during felling process. The tree felling process may require trafficking of heavy machinery which can lead to pollution of watercourses due to spillage of fuels and hydrocarbons.

10.4.3 Potential Impacts During Operation and Maintenance

The main hydrological impact of the project is estimated increasing runoff of 0.077 m^3/s (or 0.07%) as discussed in Section 10.4.2. The increase in runoff will be mitigated with the drainage system. This is further discussed in Section 10.5.

Due to the grassing over the drainage swales and revegetation of other exposed surfaces, and the non-intrusive nature of operations, there is a negligible risk of sediment release to the watercourses during the operational stage.

During the operation stage, small quantities of oil will be used in cooling the transformers associated with the facility. There is therefore a potential for small oil spills.

It is not envisaged that the operation period will involve significant impacts on the water quality of the area. There is a potential risk of some hydrocarbons polluting the watercourses following run-off from the impermeable trafficked areas.

10.4.4 Potential Impacts During Decommissioning

In the event of decommissioning, activities would take place in a similar fashion to the construction phase. Potential impacts would be similar to the construction phase but to a lesser degree.

There would be increased trafficking and an increased risk of disturbance to underlying soils at the wind farm, during the decommissioning phase, in this instance, leading to the potential for silt laden run-off entering receiving watercourses from the wheels of vehicles.

Any such potential impacts would be likely to be less than during the construction stage as the drainage swales would be fully mature and would provide additional filtration of runoff. Any diesel or fuel oils stored on main wind farm site would be bunded.

The decommissioning phase is described in Chapter 3 of this EIAR and these works will be subject to a decommissioning plan, to be agreed with Carlow County Council. A decommissioning plan can be found in the CEMP in Appendix 3.1.

Access tracks and hardstanding areas in private landholding for turbine T3 and T6 will be fully reinstate rather than being left in situ. The potential impacts would be similar to the construction phase but to a lesser degree.

For the remaining access tracks and turbine foundations it is proposed that they are left in place and covered with local topsoil and revegetated. Removal of this infrastructure would result in considerable disruption to the local environment in terms of an increased possibility of sedimentation. It is considered that leaving the turbine foundations hardstanding areas in-situ will cause less environmental damage than removing them.

Grid connection cables will be left in the ground, therefore no potential impacts during decommissioning stage are likely to occur.

It is proposed that the internal main wind farm site access tracks will be left in place.

10.4.5 Potential Impacts of a Risk of Flooding

A flood risk assessment (FRA) was prepared, to determine the impact of increased hard surfaces from the project on downstream flooding. The flood risk identification and assessment are included in Section 10.5.

10.4.6 Potential Cumulative Impact

As part of the assessment of cumulative impacts, planning searches were undertaken using Carlow County Council (CCC) and Wexford County Council online planning enquiry portals to search for large scale developments within 20km of the proposed Croaghaun wind farm project area. The CCC planning portal was also searched for small scale developments. The majority of the applications were of a scale and/or distance that they would not cause a cumulative effect in relation to Hydrology and Water quality.

Projects and activities that are likely to have an impact on the Hydrology and Water quality, in the proximity to the proposed project including the grid connection and substation at Kellistown are listed below:

- Greenoge Wind Farm (0.5km distance).
- Battery Storage at Kellistown substation (0 km distance)

The nearest wind farm development is the Greenoge wind farm just east of the main wind farm site. As stated in Section 10.4.2 the increase in runoff due to the construction and operational stage of the project is 'not significant'. This will be further reduced with the drainage system within the main wind farm site. Thus, there is no cumulative impact with the Greenoge wind farm. The release of suspended solids and pollutants during the construction of the proposed wind farm will be mitigated by proposed mitigation measures described in Section 10.7. The Greenoge wind farm is operational, therefore, no soil disruption and release of suspended solids is anticipated. The cumulative impact on hydrology and water quality with the existing Greenoge wind farm is not envisaged.

Ten-year planning permission for a 100 MW battery storage facility has been granted next to the connection substation at Kellistown. The battery storage facility will have drainage system to mitigate the increase in runoff due to the construction of new hard surfaces. The proposed substation will have its own drainage system to control the surface runoff and to attenuate volumes generated due to the construction of the substation. The construction of the substation might commence at the period of the construction of the battery storage facility. Therefore, the disturbance of the soil might take place at the same time. The release of suspended solids and pollutants during the construction of the proposed wind farm will be mitigated by proposed mitigation measures described in Section 10.7. Thus, the cumulative impact of the Battery storage facility and construction of the substation is not envisaged.

The grid connection route of the Twerra II solar farm will utilize part of the grid connection of the proposed Croaghaun wind farm. The excavated trenches will be slightly bigger. With mitigation measures related to the grid connection cable installation being in place, the cumulative impact is not significant.

The existing commercial forestry activities will most likely take place during the construction activities of the wind farm. The potential cumulative impact is an increased release of sediments and nutrients. The impact of activities related with the construction of the proposed wind farm will be mitigated with the proposed measures discussed in Section 10.7. Thus, the cumulative impact of the existing commercial forestry activities and the wind farm is not envisaged.

Potential replanting sites have been identified at Sroove, Co. Sligo and Crag, Co. Limerick. The total area identified for replanting is 34.8ha. The Sroove site has been technical approved and planted. A technical approval application for the Crag site for the has been submitted by the applicant to forest service. If these replant lands become unavailable, other similarly approved lands will be used for replanting should the proposed project receive planning permission. The replanting activities and the main wind farm site, grid connection and TDR are not within the same catchment area. Thus, there is no cumulative impact.

10.4.7 Summary of Unmitigated Hydrological Impacts on Sensitive Receptors

A summary of unmitigated potential impacts due to the project is provided in Table 10-11. The potential impacts listed above which are not summarized in the table below do not have a significant impact on the hydrology and water quality, and mitigation measures are not required.

Table 10-11: Summary of Potential Hydrological Impacts on Sensitive Receptors

Potential Impact	Activity/ Location	Receptor	Quality / Duration /	Magnitude/ Probability	Significance
Construction Phase					
Increase in rate of runoff	Main wind farm site tracks, turbine construction, hard surfaces, substations, recreational amenity trail	Surface waters	Negative/ Reversible	Negligible	Not significant
Release of suspended solids into watercourse	Main wind farm site tracks, crossings, HDD, cabling, turbine construction, crane pad construction, substation, tree felling, borrow pit and management of material storage areas, recreational amenity trail	Surface waters	Negative/ Temporary	Medium	Significant
Release of concrete and cement based products into watercourse	Installation of Met Mast, substation and turbines construction	Surface waters	Negative/ Temporary	Low	Slight
Release of nutrients into watercourse	Tree felling	Surface waters	Negative/ Temporary	Medium	Slight
Release of hydrocarbons or fuel spill	Main wind farm site tracks, crossings, HDD, cabling, turbine construction, crane pad construction, sub-station, tree felling and management of material storage areas, recreational amenity trail	Surface waters	Negative/ Brief	Low	Not significant
Obstruct hydrological flow	Drainage crossings, turbine hardstanding areas, substations, temporary compounds, borrow pit	Surface waters	Negative/ Reversible	Low	Not significant
Operation & Maintenance Phase					
Increase in rate of runoff	Rainfall landing on hard surfaces	Surface waters	Negative/ Reversible	Negligible	Imperceptible

Potential Impact	Activity/ Location	Receptor	Quality / Duration /	Magnitude/ Probability	Significance
Construction Phase					
Erosion and sedimentation	Runoff from: main wind farm site access tracks, turbine hardstanding areas, substations	Surface waters	Negative/ Temporary	Negligible	Imperceptible
Decommission Phase					
Release of hydrocarbons or fuel spill	Use of equipment for dismantling and removing turbine components	Surface waters	Negative/ Temporary	Low	Not significant
Release of suspended solids into watercourse	Use of equipment for dismantling and removing turbine components	Surface waters	Negative/ Temporary	Low	Not significant

It can be observed from Table 10-11 that the impact of activities during the construction, if unmitigated, would be 'Not significant' on receiving watercourses in terms of an increase in runoff. The risk of sedimentation in sensitive catchments has the potential to have a 'Significant' impact.

As discussed in Section 10.2.4.1, the hydrological environment of the project is considered to be of 'high' sensitivity due to the receptors draining to the Slaney River Valley SAC. The effects of the increase in runoff has negligible magnitude on receiving waters because estimated increases in runoff are low compared to the flows of receiving waters. Thus, the significance of the increased runoff is 'Not significant'.

The release of sediments has 'Medium' magnitude on receiving waters because it has a negative impact on the receiving waters and it is likely to happen. However, it has a temporary effect. Therefore, the impact is of 'Significant' significance. During construction activities there is a low possibility of fuel spillage, release of hydrocarbons and concrete/concrete based products being released from plant because these volumes are likely to be small, therefore the significance is 'Not significant'.

Operation and maintenance phase will have 'Imperceptible' significance on the receiving waters. Decommissioning activities are expected to have 'Not significant' significance on the receiving watercourses.

The impact on hydrology and water quality will be reduced by implementing measures discussed in Section 10.6 and 10.7.

10.5 FLOOD RISK IDENTIFICATION AND ASSESSMENT

As part of the flood risk identification the following elements of the project were assessed:

- Main wind farm site
- Turbine delivery route
- Grid connection

A detailed description of the project assessed in the EIAR can be found in Chapter 3.

10.5.1 Methodology

Main Wind Farm

As discussed in Section 10.4.2 the increase in peak runoff due to project is 0.07 m^3/s. The increase in runoff is likely to increase the risk of flooding if additional volumes are not retained. The flood risk can also increase if time of concentration is reduced. Time of concentration (Tc) is time required for an entire catchment to contribute to runoff at the point of interest. This time is calculated as the time for runoff to flow from the most hydraulically remote point of the drainage area to the point under investigation.

Time of concentration will not be analyzed in this exercise because time of concentration is increased with a drainage system. This is achieved by retaining the surface runoff in swales.

This exercise will determine if the proposed swales have enough capacity to retain volumes generated due to the construction of the wind farm for 1 in 100 years storm event for a 6h storm event.

Turbine Delivery Route

The general locations of accommodation work along TDR are shown in Figure 3-3. Significant works will be required at the POI43 and POI52 as described in Section 3.5.6.

Temporary accommodation works are required to construct a temporary bridge. The temporary road widening, and temporary bridge area are small in scale and therefore shall not contribute significant amounts of additional runoff. The proposed temporary infrastructure will be in place for a short period of time and it is not concentrated in one area. Therefore, it is not anticipated that this will have any significant hydrological impact due to an increase in runoff. Therefore, no flood risk is expected.

Grid connection

The increase in runoff due to grid connection cable installation is not expected because the finished surfaces are not changed. Therefore, no impacts on the flood risk is envisaged. The off-site substation at Kellistown is located with Flood Zone C according to the PFRA maps. The proposed substation will have a drainage system in place to mitigate the potential risk of flooding at the sub-station and downstream of it.

10.5.2 Flood Zones

Wind Farm

As discussed in Section 10.3.2, all new surfaces including turbines, hardstanding areas and substation are located within Flood Zone C. The proposed access tracks do not cross an area identified by OPW PFRA mapping as an indicative floodplain.

Grid Connection

According to the PFRA flood mapping, the grid connection crosses Flood Zone A at the location GCR – WCC1, GCR – WCC2 and GCR – WCC3 as shown on Figure 10-3.

Turbine Delivery Route

Turbine delivery route crosses Flood Zone A along the national road N30 at one location. This is over the River Slaney. National road N30 continues to national N80.

TDR along N80 crosses Flood Zone A at 7 locations. These crossings are over the following watercourses:

- Moyne
- Marshalstown
- Tom Garrow
- Tom Brick
- Glasha
- New Townbarry
- Clody

On the route from Bunclody towards the proposed wind farm, there are 2 additional existing crossings over Flood Zone A according to the PFRA mapping. These are over the Unnamed Stream (tributary of the River Clody, at townland Bunclody) and over the Kilbrannish North Stream (POI43). At the location over the Kilbrannish North Stream a temporary bridge will be constructed. In order that flood flows will not be obstructed, the stream crossings will be sized to convey a 1 in 100-year flood flow.

Based on the high level assessment of the bridge and site visit inspection, it was calculated that water depth in the channel is lower than the depth of the channel. Thus, it was concluded that the channel has enough capacity to convey 1 in 100 year flow. This is further addressed in Appendix 10.3.

10.5.3 Estimation of Capacity of Swales

In Section 10.4.2 it was estimated that the increase in peak runoff for 1 in 100 years storm event is 0.077 m^3/s (0.07%) due to construction of all new hardstanding areas, on-site substation, new roads and the widening of the existing road. For a 1 in 100 year storm event with 6h storm duration, an additional 827m^3 will runoff from the main wind farm site.

$$V_{additional\ discharge} = \text{Flow x Duration} = 0.5 * 0.077 m^3/s \times 6*3600s = 827\ m^3$$

Approximately 3.91 km new road will be constructed, and 5.26 km of existing roads will be upgraded. This gives in total 9.17km of swales, which gives a potential storage volume of 4130 m^3.

$$V_{swale} = \text{Length x Area} = 9170m \times 0.45m^2 = 4130m^3$$

Additional 827m^3 will be discharged due to the construction of the wind farm. Swale storage capacity is 4130m^3. It is concluded that swales have sufficient capacity to retain volumes generated due to the main wind farm site and that the main wind farm site does not increase the flood risk on the main wind farm site and downstream of it.

The applicant, through their community consultation for the project, received feedback from a local resident who complained of periods of flooding through their farmyard. During the assessment, FT considered potential impacts on this property as part of the flood risk assessment for the proposed project. One proposed wind turbine (T6) is located in the same catchment as this property at a distance of 1.1km from the farmyard. As described above, the proposed wind farm site will not increase downstream flood risk due to the proposed drainage system.

10.5.4 Essential Infrastructure

Essential Infrastructure is defined in Table 3.1 of *The Planning System and Flood Risk Management Guidelines for Planning Authorities, OPW, November 2009*, as ‘Primary transport and utilities distribution, including electricity generating power stations and substations, water and sewage treatment, and potential significant sources of pollution (SEVESO site, IPPC sites, etc.) in the event of flooding’. The proposed substation in this project therefore comes under the category of ‘Essential Infrastructure’.

The proposed substation is located in Flood Zone C as shown on Figure 10-3.

10.5.5 Summary of Flood Risk Identification and Assessment

A flood risk assessment has been carried out.

The impact on the flood risk is based on comparing volumes generated due to changes in surface and potential storage volume in swales constructed as part of a drainage system.

It was estimated that for a 1 in 100 year storm event with storm duration of 6h, the additional 827m^3 would be generated due to changes in the surfaces. Approximately 3.91 km new road will be constructed, and 5.26 km of existing roads will be upgraded. This is in total of 9.17 km of swales, which gives a potential volume storage of 4130 m^3.

Swales have enough capacity to retain additional volumes generated due to the construction of the main wind farm site. A flood risk assessment concludes that the main wind farm site will not have a negative impact on flooding risk in the surrounding area.

10.6 Proposed Drainage

The proposed drainage for the subject development has been addressed by the potential impacts, discussed in Section 10.4 and it has also been addressed by the flood risk assessment undertaken in Section 10.5.

An appropriate drainage design will be the primary mitigation measure for the project which will incorporate silt protection control measures and reduce the rate of surface water runoff.

The mitigation measures that follow in Section 10.7 refer to the drainage design and also include other best practice measures to mitigate any potential impacts from the project.

The proposed layout of the drainage for the main wind farm site is shown in Surface Water Management Plan (SWMP).

The following types of elements of infrastructure are considered in addressing the drainage:

1) existing hardcore tracks and surfaced access roads which will be widened
2) proposed new main wind farm site access tracks and hard standings associated with the construction of turbines and met mast
3) proposed on-site and off-site substation
4) temporary main wind farm site compound
5) borrow pit
6) recreational amenity trail.

10.6.1 Internal Drainage

It is not expected that overland flows will be obstructed to any great extent by the drainage layout, however, where required, interceptor drains will collect overland flows on the upslope side of all infrastructure including the access tracks and hardstanding areas. The overland flow will then discharge diffusely on the downslope side over vegetated areas within the main wind farm site boundary.

Existing forest track drainage is extensive throughout the main wind farm site and shall be maintained wherever possible and upgraded as required to meet the requirements of the proposed wind farm drainage design. SuDS design approach shall ensure that existing drainage patterns shall be maintained throughout the main wind farm site.

10.6.2 Existing Tracks and Surfaced Access Roads

The drainage system for the existing tracks and roads will largely be retained. During the main wind farm site walkover it was observed that most of the existing tracks were approximately 4 m wide. It is proposed to widen approximately 5.26km of existing roads by approximately 1 m, with some additional widening at bends. All track widening will be undertaken using clean uncrushable stone with a minimum of fines. This will involve slight relocation of existing roadside ditches to allow widening.

Still traps will be placed in the new roadside swales.

10.6.3 New Main Wind Farm Site Access Tracks and Hard Surfaces

It is proposed to construct approximately 3.91 km of completely new access track. Proposed new tracks and hardstanding areas will be drained as per the existing drainage system via roadside swales with settlement ponds at the end of the swale. These grassed swales will serve to detain flow and reduce the velocities of surface water flows. The swales will be 0.3 m deep with a bottom width of 0.6 m and side slope of 1 in 3. The swales will be constructed in accordance with CIRIA C698 Site Handbook for the Construction of SuDS.

Where roadside drains are laid at slopes greater than 2%, check damns will be provided. This will reduce effective slope and runoff velocities and any consequent potential for erosion.

Main wind farm site drainage, including silt traps and settlement ponds, will be put in place in parallel with or ahead of construction, such that excavation for new infrastructure will have functional drainage system in place.

The settlement ponds will remain in place during construction phase. The outfall from the settlement ponds will discharge diffusely overland, over existing vegetated areas, within the main wind farm site boundary. The settlement ponds will be filled in and the swales that were connected to them will be re-connected to the outfall once construction is completed. This is further described in SWMP.

Silt fencing will be provided at strategic locations to further protect watercourses during the construction phase.

10.6.4 Proposed Watercourse Crossings

The proposed main wind farm layout infrastructure does not cross any significant stream within the main wind farm site boundary.

Minor drains such as manmade agricultural and forest drains will be crossed using 450mm diameter pipes.

Where cross drains are to be provided to convey the drainage across the track, the recommended sizes of these cross drains are 225 mm diameter pipes.

Silt Protection Controls (SPCs) are proposed at the location of the drain crossings. It is recommended that the SPCs will consist of a minimum of silt traps containing filter stone and filter material staked across the width of the swales and upstream of the outfall to any watercourse.

Some drain clearing will be required at existing crossings, where they have become blocked, to maintain the continuity of flows. These existing pipes may need replacing if they are found to be in a collapsed state.

10.6.5 Drainage of On-site Substation

The proposed location of the on-site substation is shown on Figure 3.1. It is proposed to drain the substation using shallow swales, with a settlement pond at the end of the swale run. The settlement ponds will remain in place following the construction period. The settlement ponds will be filled in and the swales that were connected to them will be re-connected to the outfall once construction is completed.

At the upslope side of the substation, interceptor drains will be installed and….

The runoff from roofs will be collected to water harvesting tanks with overflow being directed to interceptor drain. Wastewater will drain to a tank which will be regularly emptied and maintained. More details are provided in SWMP.

A suitable permanent petrol and oil interceptor will be installed to deal with all substation surface water drainage.

10.6.6 Drainage of Temporary Main Wind Farm Site Compound

The main wind farm site layout consists of a temporary compound as shown on Figure 3.1. The compound is set back from the stream approximately 150m.

Drains around the hardstanding areas of the compound will be in the form of shallow grassed swales to minimise the disturbance to sub-soils.

Surface water runoff from the compound will be directed through a Class 1 Full Retention Oil Interceptor before discharging water into a settlement pond before final discharge over land.

During the construction phase, it will be necessary to provide bottled water for potable supply for the construction personnel. A water tanker will supply water used for other purposes.

Portaloo and/or containerised toilets and welfare units with storage tanks will be used to provide toilet facilities for site personnel during construction.

All portaloo units located on main wind farm site during the construction phase will be operated and maintained in accordance with the manufacturer's instructions and will be serviced under contract with the supplier. All such units will be removed off-site following completion of the construction phase.

10.6.7 Drainage of Borrow Pit

The proposed borrow pit is located as shown on Figure 3.1. The borrow pit is approximately 380m from the closest stream. At the upslope of the borrow pit interceptor drains will be installed. It is proposed to drain the borrow pit to a settlement pond.

The main wind farm site drainage system will be put in place prior to borrow pit excavation, therefore the discharge routes from any temporary stockpiling will be via the main wind farm site drainage system as detailed in the planning drawings. There will be no permanent stockpiling of material on the main wind farm site.

10.6.8 Drainage of Recreational Trial

It is not expected that overland flows will be obstructed to any great extent by the amenity trail. However, where required, interceptor drains will collect overland flows on the upslope side of the amenity trail. The overland flow will then discharge diffusely on the downslope side over vegetated areas within the main wind farm site boundary.

It is proposed to use over-the-edge drainage. Over the edge drainage refers to surface water from the road freely discharge over the edge of the road/trail.

10.6.9 Drainage of Off-Site Substation at Kellistown

It is proposed to drain the substation using shallow swales, with a settlement pond at the end of the swale run. The settlement pond will remain in place during the construction period. The settlement ponds will be filled in and the ditches that were connected to them will be re-connected to the outfall once construction is completed.

At the upslope side of the substation, interceptor drains will be installed.

The runoff from roofs will be collected to water harvesting tank with overflow being directed to interceptor drain. Wastewater will drain to a tank which will be regularly emptied and maintained. More details are provided in SWMP.

A suitable permanent petrol and oil interceptor will be installed to deal with all substation surface water drainage.

10.7 Proposed Mitigation Measures

10.7.1 Proposed Mitigation Measures for the Construction Stage

Proposed drainage measures to reduce, and protect the receiving waters from potential impacts during the construction are as outlined in Section 10.6. These include measures to prevent runoff erosion from vulnerable areas and consequent sediment release into the nearby watercourses to which the main wind farm site drains.

The mitigation measures are outlined below:

- The increase in the rate of runoff along the route of the main wind farm site access roads and hardstanding areas will be mitigated by the proposed drainage system which includes provision of settlement ponds to reduce concentration of suspended solids in the runoff from these areas as shown on Drawing submitted with this application. This has been further mitigated by avoidance through design, in the utilisation of existing tracks and existing drainage systems where possible. During the wind farm construction phase a self-imposed buffer zone of 50m will be maintained from all streams with the exception of one location where an existing forest track which will be upgraded and used for access to T1 crosses an existing watercourse. This crossing is located approximately 20m from the Clashavey River. No modification of the existing culvert crossing at this location is required as part of the proposed works.
- Settlement ponds with a diffuse outflow detail will be put in place in advance as construction progresses across the main wind farm site. Erosion control and retention facilities, including settlement ponds will be regularly maintained during the construction phase. The three-stage treatment train (swale – settlement pond – diffuse outflow) proposed to retain and treat the discharges from hard surface areas will reduce any risk of flooding downstream.
- A water quality monitoring programme will be established to ensure that water quality is maintained throughout the construction phase. The details of this programme are outlined below. This programme will ensure that designed measures including settlement ponds are working, and existing water quality is maintained.
- Where haul roads pass close to watercourses, silt fencing will be used to protect the streams.
- Silt traps will also be provided at outfalls from roadside swales to settlement ponds.
- A suitably qualified person, Environmental Clerk of Works (ECOW), will be appointed by the developer to ensure the effective operation and maintenance of drainage and other mitigation measures during the construction process.
- Standing water, which could arise in excavations, has the potential to contain an increased concentration of suspended solids as a result of the disturbance to soils. The excavations for turbines will be pumped into the main wind farm site drainage system (including settlement ponds), which will be constructed at site clearance stage, in advance of excavations for the turbine bases.
- Drains around hardstanding area will be shallow to minimise the disturbance of sub soil.
- The developer will ensure that erosion control, namely silt-traps, silt fencing, swales, settlement ponds and diffuse outflow areas are regularly maintained during the construction phase.

Interceptor cut-off drains will be provided on the upslope side of the access roads to prevent the mixing of overland flows with the drainage for the main wind farm site. These interceptor drains will discharge diffusely over land to avoid concentration of runoff.

- drains will therefore only carry the main wind farm site access road runoff and so avoid carrying large volumes of water and concentrating flows.
- Interceptor cut-off drains will be provided around borrow pit where required to divert overland flow to the nearest watercourse and prevent it from entering the borrow pit.
- Cross drains of 450 mm will be provided to prevent a risk of clogging for drainage crossings and conveying flow from agricultural drains and forestry drains under access track roads.

- Where new cross-drains are proposed on main wind farm site to convey surface water from roadside swales to settlement ponds, these will be sized at a minimum of 225 mm diameter to avoid blockages.
- Roadside swales will serve to attenuate any increase in surface water runoff.
- Silt fencing will be erected at the locations of the drain crossings for the duration of the construction period.
- All open water bodies adjacent to proposed construction areas will be protected by fencing including the proposed settlement ponds.
- Excavated subsoil material that is not required for in-site reinstatement will be removed to the designated material storage areas at the borrow pit location.
- Main wind farm site access tracks have been laid out to reduce longitudinal slope of roadside drains where possible. Where roadside drains are laid at slopes greater than 2%, check damns will be provided. This will reduce effective slope and runoff velocities and any consequent potential for erosion.
- Where agricultural tracks and forestry roads will be used to access the main wind farm site, the roadside drains alongside these roads will be cleared of obstructions, should it be found that debris and vegetation are impeding flows.
- Any diesel, fuel or hydraulic oils stored on main wind farm site will be stored in bunded storage tanks – the bund area will have a volume of at least 110 % of the volume of such materials stored.
- Refueling of plant during construction will only be carried out at designated refueling station locations on main wind farm site.
- Prior to leaving the main wind farm site, every truck delivering concrete to the main wind farm site must wash the chute at designated washing location.
- Silt fencing will be erected at the location of stream crossings along the cable route.
- Cables will be installed in trenches adjacent to the site access roads, or laid within the access road line, where required. Trenches will be excavated during dry periods where possible in short sections and left open for minimal periods, to avoid acting as a conduit for surface water flows.
- The temporary storage of excavated material on main wind farm site will be at least 50 m from watercourses.
- Wet concrete operations are not required for the construction of the wind farm within or adjacent to watercourses. However, if wet concrete operations are required, a suitable risk assessment will be completed prior to works being carried out and strategically located concrete washout areas will be provided.
- There will be usage of concrete for foundations and anchoring. No batching of wet-cement products will occur within the main wind farm site.
- No discharge of cement contaminated waters to the construction phase drainage system or directly to any artificial drain or watercourse will be allowed.
- Use weather forecasting to plan dry conditions for pouring concrete. Concrete operations shall be carried out in accordance with the CEMP attached in Appendix 3.1.
- Ensure pour site is free of standing water. Plastic covers will be ready in case of sudden rainfall event.
- Portaloos and/or containerised toilets and welfare units will be used to provide toilet facilities for site personnel. Sanitary waste will be removed from main wind farm site via a licenced waste disposal contractor.
- Emergency drip trays and spill kits will be kept available on main wind farm site, to ensure that any spills from vehicles are contained and removed off main wind farm site. The emergency response procedure is provided in section 1.8 of SWMP.

Concrete operations shall be carried out in accordance with the CEMP which is located in Appendix 3.1.

All of the mitigation measures detailed above will ensure that the water quality status of the receiving waterbodies is not affected by the project.

Water Quality Monitoring Programme

A monitoring programme will be established to ensure that water quality is maintained. The details of this programme are outlined below. This programme will ensure that designed measures are working, and water quality is not affected.

An Environmental Manager will be on-site during construction to monitor water quality. Should the measured parameters during construction be higher than the pre-construction levels, construction will be stopped, and remediation measures will be put in place immediately.

Water samples will be taken monthly during ground disturbance works and will include measurement of the parameters provided in Table 10-12. Parameters listed in table below were measured at the pre-construction phase as mentioned in Section 10.3.4.

Table 10-12: Surface Water Quality Monitoring Parameters

Parameter	Maximum Value	Regulation
Turbidity	-	-
pH	6.0 < pH < 9.0	Surface Water Regulations 2009
BOD	High Status < 1.3 (mean) or <2.2 (95%ile) Good Status <1.5 (mean) or < 2.6 (95%ile)	Surface Water Regulations 2009
Total Suspended Solids (mg/l)	<25	Salmonid Water Regulations 1988
Total Ammonia (mg/l N)	High Status < 0.04 (mean) or <0.09 (95%ile) Good Status <0.14 (mean) or < 0.065 (95%ile)	Surface Water Regulations 2009
Nitrite (NO_2) (mg/l)	<0.05	Salmonid Water Regulations 1988
Molybdate Reactive Phosphorus (mg/l P)	High Status < 0.025 (mean) or <0.045 (95%ile) Good Status <0.035 (mean) or < 0.075 (95%ile)	Surface Water Regulations 2009

10.7.1.1 Proposed Mitigation Measures for Grid Connection Cable Installation

The following mitigation measures are proposed during construction stage:

- Weather warnings will be monitored, and no construction will take place during extreme events to mitigate against potential flooding.
- Mitigation measures will be provided where surface water flows may be temporarily prevented from reaching gullies during trench excavation. Mitigation measures will include the provision of temporary over ground surface water channels using sand bagging for example to divert flows to downstream gullies.
- Trenches will be excavated during dry periods where possible in short sections and left open for minimal periods, to avoid acting as a conduit for surface water flows.
- Any excavated material will be used in the reinstatement of the cable trenches subject to approval. Surplus material will be removed to an appropriate licenced facility. There will be no stockpiling of excavated material. For trenching within the domain of public roads, approved fill material will be imported.
- All excavated soil material will be managed in accordance with the CEMP.
- Silt fencing will be provided around any exposed areas to prevent the ingress of suspended solids into adjacent watercourses. These mitigation measures will prevent surface water contamination and will prevent subsequent flows of contaminated water into watercourses.
- Additional protection will be provided in the form of silt fencing downslope where required during construction, to further ensure that there is no impact to streams and rivers..
- Daily visual inspections of drains and streams will be performed during the construction period to ensure suspended solids are not entering the streams and rivers alongside the work area, to identify any obstructions to channels, and to allow for appropriate maintenance of the existing roadside drainage regime. If excessive suspended solids are noted, construction work will be stopped, and remediation measures will be put in place immediately.

The proposed mitigation measures for HDD are proposed in Section 10.7.1.2. Standard trench crossing under existing services and laying ducts in flat profile within concrete bridge beam in a road deck will be in accordance with CEMP provided in Appendix 3.1.

10.7.1.2 Proposed Mitigation Measures for Horizontal Directional Drilling (HDD)

The proposed mitigation measures during HDD are listed below:

- An Environmental Engineer with a "stop work" authority will be engaged to monitor the construction phase when the water crossing is being undertaken.
- The working area around the bridge/culvert crossings will be fenced off prior to the commencement of works to avoid damage to bankside habitat
- Watercourses will be visually inspected
- Should increase levels of siltation be recorded within the watercourses during the course of the construction phase, the environmental auditor will seek to halt construction works until the source of the pressure can be found and remediated

- Surplus material will be removed to an appropriate facility. There will be no stockpiling of excavated material. A setback distance of at least 20 m from watercourses will be adhered to when storing temporary spoil
- Prior to any works taking place near water courses the Inland Fisheries Ireland will be consulted
- Construction works will be timed to occur outside periods where heavy rainfall would be expected
- Silt traps will be regularly maintained during the construction phase. All personnel working onsite will be trained in pollution incident control response.
- Appropriate signage will be placed along the proposed route outlining the spillage response procedure and a contingency plan to contain silt. A regular review of weather forecasts of heavy rainfall is required, and the contractor is required to prepare a contingency plan for before and after such events
- Visual inspection to take place at all times along the bore path of the alignment.
- Silt fences will be constructed around proposed work areas prior to commencement of works.
- No refueling will take place within 50m of the stream zone or any sensitive habitats.
- During the drilling process, a mixture of a natural, inert and fully biodegradable drilling fluid will be used.

For crossings where HDD has been identified as the preferred crossing method, open cut trenching methods shall be permitted in dry conditions where there is no-flow in the watercourse and there is no risk of in-stream works. In such instances, cable ducts would be laid under the stream bed which would then be fully reinstated to its pre-existing condition. The following mitigation measures are proposed:

- Weather warnings will be monitored, and no construction will take place during extreme events.
- No refueling will take place within 50m of the stream zone or any sensitive habitats.
- The working area around the bridge/culvert crossings will be fenced off prior to the commencement of works to avoid damage to bankside habitat
- There will be no stockpiling of excavated material. A setback distance of at least 10 m from watercourses will be adhered to when storing temporary spoil.

10.7.1.3 Proposed Mitigation Measures for Tree Felling

Tree felling will be undertaken prior to the construction of main wind farm site access tracks and hardstanding areas. The area of proposed felling is small relative to the overall area and is expected to develop a vegetation ground cover relatively quickly on areas which are not built upon. Thus, no significant increase in the rate of runoff is anticipated as a result of felling nor is there a risk of downstream flooding or sedimentation due to increased erosion.

Tree felling will be permitted under limited felling license(s) from the Forest Service and to the conditions of such a license. A Limited Felling License will be in place prior to works commencing on site. To ensure a tree clearance method that reduces the potential for sediment and nutrient runoff, the construction methodology will follow the specifications set out in the Forest Service Forestry and Water Quality Guidelines (2000) and Forest Harvesting and Environmental Guidelines (2000).

There is a requirement in the Forest Service Code of Practice and in the FSC Certification Standard under which all Coillte forests are certified, for the installation of buffer zones adjacent to aquatic zones. Minimum buffer zone widths recommended in the Forest Service (2000) guidance document "Forestry and Water Quality Guidelines" are shown in Table 10-13.

Table 10-13: Minimal Buffer Zone Widths for Tree Felling (Forest Service, 2000)

Average slope leading to the watercourse	Buffer zone width – aquatic zone on both sides	Buffer zone width – aquatic zone on one side
Moderate (0-15%)	10m	15m
Steep (15-30%)	15m	20m
Very steep (>30%)	20m	25m

Additional mitigation measures are listed below:

In areas particularly sensitive to erosion or where felling inside the 50m buffer is required, it will be necessary to install double sediment traps. This measure will be undertaken during construction:

- Double silt fencing will also be put down slope of felling areas which are located inside the 50m buffer zone;
- All drainage channels will taper out before entering the aquatic buffer zone. On erodible soils, silt traps will be installed at the end of the drainage channels, to the outside of the buffer zone;
- Drains and silt traps will be maintained throughout all felling works, ensuring that they are clear of sediment build-up and are not severely eroded.
- Brash mats will be used to support vehicles on soft ground, reducing peat and mineral soils erosion and avoiding the formation of rutted areas, in which surface water ponding can occur. Brash mat renewal will take place when they become heavily used and worn. Provision will be made for brash mats along all off-road routes, to protect the soil from compaction and rutting. Where there is risk of severe erosion occurring, extraction will be suspended during periods of high rainfall;
- Timber will be stacked in dry areas, and outside a local 50m watercourse buffer. Straw bales and check dams to be emplaced on the down gradient side of timber storage/processing sites; Machine combinations will be chosen which are most suitable for ground conditions at the time of felling, and which will minimize soils disturbance;
- Checking and maintenance of roads and culverts will be on-going through any felling operation. No tracking of vehicle through watercourses will occur, as vehicles will use road infrastructure and existing watercourse crossing points.
- Ditches which drain from the proposed area to be felled towards existing surface watercourses will be blocked, and temporary silt traps will be constructed. No direct discharge of such ditches to watercourses will occur. Drains and sediment traps will be installed during ground preparation. Collector drains will be excavated at an acute angle to the contour
- Sediment traps will be sited in drains downstream of felling areas. Machine access will be maintained to enable the accumulated sediment to be excavated.
- Refueling or maintenance of machinery will not occur within 100m of a watercourse. Mobile bowser, drip kits, qualified personnel will be used where refueling is required;
- Branches, logs or debris will not be allowed to build up in aquatic zones. All such material will be removed when harvesting operations have been completed
- Silt traps will be strategically placed down-gradient within forestry drains near streams. The main purpose of the silt traps and drain blocking is to slow water flow, increase residence time, and allow settling of silt in a controlled manner.

- Communication with tree felling operatives in advance to determine whether any areas have been reported where there is unusual water logging or bogging of machines;
- Inspection of all areas reported as having unusual ground conditions;
- Inspection of main drainage ditches and outfalls. During pre-felling inspection, the main drainage ditches shall be identified.
- Following tree felling all main drains shall be inspected to ensure that they are functioning;
- Extraction tracks near drains need to be broken up and diversion channels created to ensure that water in the tracks spreads out over the adjoining ground;
- All accumulated silt will be removed from drains and culverts, and silt traps, and this removed material will be deposited away from watercourses to ensure that it will not be carried back into the trap or stream during subsequent rainfall.

10.7.1.4 Proposed Mitigation Measures for Turbine Delivery

The main hydrological and water quality impact of the TDR is potential release of suspended solids and release of cement-based products in the watercourse as indicated in Section 10.4.2.2.

The following mitigation measures listed below will be implemented:

- All open water bodies adjacent to proposed construction areas will be protected by silt fencing.
- Drains around hardstanding areas will be shallow to minimise the disturbance of sub soil.
- Weather warnings will be monitored, and no construction will take place during extreme events.
- Refueling of plant during construction will only be carried out at designated refueling station locations on main wind farm site.
- Wet concrete operations will be required at POI43. A suitable risk assessment will be completed prior to works being carried out. No concrete washout will be permitted at this location. Due to the small quantities of concrete required, all concrete will be delivered and poured directly from ready mix trucks.
- Emergency drip trays and spill kits will be kept available on main wind farm site, to ensure that any spills from vehicles are contained and removed off site.

10.7.2 Proposed Mitigation Measures for Operation and Maintenance Stage

The main hydrological impact of the project is an increase in runoff. This is mitigated by the drainage layout. It is anticipated that the drainage system will increase time of concentration and consequently the peak runoff will be decreased. The drainage system will be left in-situ during operational stage. Due to the insignificant increase in potential runoff from the main wind farm site, there should be negligible release of sediment to the watercourses post-construction.

When operational, the project will have a negligible effect on surface water quality as there will be no further disturbance of soils post-construction.

The following mitigation measures are proposed for replacing or removal of the wind turbine blades:

- Emergency drip trays and spill kits will be available on main wind farm site, to ensure that any spills from vehicles are contained and removed off site.

- Refueling or maintenance of machinery will not occur within 100m of a watercourse. Mobile bowser, drip kits, qualified personnel will be used where refueling is required.

Mitigation measures listed in Section 10.7.1.1 are proposed for replacing the grid connection cable.

During the operation stage, small quantities of oil will be used in cooling the transformers associated with the facility. There is therefore a potential for small oil spills. Risks of potential oil leakage and pollutions draining to the watercourse from the installed transformer is mitigated with transformer interceptor bund wall.

It is not envisaged that the maintenance period will involve any significant impacts on the hydrological regime of the area. The maintenance will incorporate effective maintenance of the drainage system. The maintenance regime will include inspecting the following post extreme storm event:

- Drains, cross-drains and culverts for any blockages
- Outfalls to existing field drains and watercourses
- Existing roadside swales for any obstructions
- Swales
- Progress of the re-establishment of vegetation.

The maintenance regime will also include implementing appropriate remedial measures as required after the above inspections and testing the water quality at the outfalls at appropriate intervals. Visual inspections will be undertaken during the maintenance period in accordance with maintenance schedule in CIRIA C753.

10.7.3 Proposed Mitigation Measure for Decommissioning Stage

In the event of decommissioning of the Croaghaun wind farm, the access tracks will be used in the decommissioning process. Mitigation measures applied during decommissioning activities will be similar to those applied during construction but will be of reduced magnitude.

Access tracks and hardstanding areas in private landholding for turbine T3 and T6 will be fully reinstate rather than being left in situ. For the remaining access tracks and turbine foundations it is proposed that they are left in place and covered with local soil/topsoil at decommissioning stage. It is considered that leaving the turbine foundations, access tracks and hardstanding areas in-situ will cause less environmental damage than removing them.

The grid connection ducting will be left in the ground, therefore no potential impacts during decommissioning stage are likely to occur. Hence no mitigation measures are required.

10.7.4 Proposed Mitigation Measures for Flooding

The FRA concludes that as the increase in flow from the main wind farm site will be attenuated in the drainage system. The proposed project has a minimal impact on flooding risk in the surrounding area and therefore the increased risk of flooding as a result of the proposed project is negligible.

10.8 RESIDUAL IMPACTS

The residual impacts are summarised in Table 10-14 below, using the impact assessment criteria outlined in Section 10.2.4.

Table 10-14 indicates that, following the implementation of mitigation measures, the residual risk to the receiving watercourses would be 'Imperceptible' and 'Not significant' during the construction, operation and decommissioning stage.

By implementing the mitigation measures outlined in Section 10.7, there will be no deterioration in WFD classifications for the waterbodies described in Table 10-4, which includes the Slaney River Valley SAC.

10.8.1 Residual Impacts during Construction Stage

The increased surface runoff is mitigated with a drainage system as discussed in Section 10.5 and 10.7. Sedimentation and nutrient release are likely to occur due to disturbance of soils and tree felling. Increased releases to watercourses are mitigated with mitigation measures outlined in Section 10.7.1.

This will ensure that the residual impacts of the construction stage are 'Imperceptible' and 'Not significant'.

10.8.2 Residual Impacts during Operation and Maintenance Stage

There are no significant residual impacts relating to hydrology and water quality as the increased surface runoff measures are implemented and sedimentation release to watercourses is unlikely to occur as there is no disruption in soils.

10.8.3 Residual Impacts during Decommissioning Stage

The decommissioning plan will include a surface water management plan.

Negative or adverse effects on the receiving environment associated with decommissioning works are considered to be temporary in duration and 'Imperceptible' following mitigation measures.

Decommissioning stage impacts will be much less than the construction stage as the drainage system is already in place and there will be much less ground disturbance works. New access tracks will be left in place and used for forest roads. Hardstanding areas will be left in place and/or covered over and re-vegetated.

Infrastructure associated with the grid connection will form part of the national transmission network and will be left in-situ. Therefore, no impacts are envisaged.

Table 10-14: Residual Hydrological Impact Significance

Potential Impact	Activity/Location	Receptor	Sensitivity	Before Mitigation		After Mitigation	
				Magnitude/ Probability	Significance	Magnitude/ Probability	Residual Significance
Construction Phase							
Increase in rate of runoff	Main wind farm site tracks, turbine construction, substations, amenity trail	Surface waters	Negative/ Reversible	Negligible	Not significant	Negative/ Reversible	Imperceptible
Release of suspended solids into watercourse	Main wind farm site tracks, crossings, HDD, cabling, turbine construction, crane pad construction, substation, tree felling, borrow pit and management of material storage areas, recreational amenity trail	Surface waters	Negative/ Temporary	Medium	Significant	Negative/ Temporary	Not significant
Release of concrete and cement based products into watercourse	Installation of Met Mast, substation and turbines construction	Surface waters	Negative/ Temporary	Low	Slight	Negative/ Temporary	Imperceptible
Release of nutrients into watercourse	Tree felling	Surface waters	Negative/ Temporary	Medium	Slight	Negative/ Temporary	Not significant
Release of hydrocarbons or fuel spill	Main wind farm site tracks, crossings, HDD, cabling, turbine construction, crane pad construction, sub-station, tree felling and management of material	Surface waters	Negative/ Brief	Low	Not significant	Negative/ Brief	Imperceptible

Potential Impact	Activity/Location	Receptor	Sensitivity	Before Mitigation		After Mitigation	
				Magnitude/ Probability	Significance	Magnitude/ Probability	Residual Significance
	storage areas, recreational amenity trail						
Obstruct hydrological flow	Drainage crossings, turbine hardstanding areas, substations, temporary compounds, borrow pit	Surface waters	Negative/ Reversible	Low	Not significant	Negative/ Reversible	Imperceptible
Operation & Maintenance Phase							
Increase in rate of runoff	Main wind farm site access tracks, turbine hardstanding areas, substations	Surface waters	Negative/ Reversible	Negligible	Imperceptible	Negative/ Reversible	Imperceptible
Erosion and sedimentation	Main wind farm site access tracks, turbine hardstanding areas, substations	Surface waters	Negative/ Temporary	Negligible	Imperceptible	Negative/ Temporary	Imperceptible
Decommissioning Phase							
Release of hydrocarbons or fuel spill	Use of equipment for dismantling and removing turbine components	Surface waters	Negative/ Temporary	Low	Not significant	Negative/ Temporary	Imperceptible
Release of suspended solids into watercourse	Use of equipment for dismantling and removing turbine components	Surface waters	Negative/ Temporary	Low	Not significant	Negative/ Temporary	Imperceptible

10.9 CONCLUSION

During each phase of the project a number of activities will take place on the main wind farm site, grid connection and TDR, some of which will have the potential to significantly affect the hydrological regime or water quality at the study area. These significant potential impacts generally arise from release of the sediments due to the soil disturbance.

The surface water drainage plan will be the principle means of significantly reducing sediment runoff arising from construction activities and to control runoff rates. The key surface water control measure is that there will be no direct discharge of wind farm runoff into local watercourses. This will be achieved by avoidance methods (stream buffers) and design methods.

By implementing the mitigation measures outlined in Section 10.7, there will be no deterioration in WFD classifications for the waterbodies described in Table 10-4 which includes the Slaney River Valley SAC and River Barrow and River Nore SAC. Surface water drainage measures, pollution control and other preventative measures have been incorporated into the project design to minimise significant adverse impacts on water quality and downstream designated sites. A 50m stream buffer was used during the layout of the main wind farm site, thereby avoiding sensitive hydrological features.

The proposed project is not expected to contribute to any significant, negative cumulative effects with other existing or proposed developments in the vicinity.

With mitigation measures put in place during construction, operational and decommissioning stage the proposed project will have imperceptible significance on the hydrology and water quality.

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