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APPENDIX 12

HYDROLOGY AND WATER QUALITY

Appendix 12.1 – Site-Specific Flood Risk Assessment

Appendix 12.2 – Surface Water Management Plan

APPENDIX 12.1

Site-Specific Flood Risk Assessment

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DESIGNING AND DELIVERING
A SUSTAINABLE FUTURE

ENVIRONMENTAL IMPACT ASSESSMENT REPORT (EIAR) FOR THE PROPOSED DERRYNADARRAGH WIND FARM

Site Specific Flood Risk Assessment For Derrynadaragh Wind Farm

Prepared for:

Dara Energy Limited

Dara Energy Limited

Date: **September 2025**

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Site Specific Flood Risk Assessment For Derrynadaragh Wind Farm

REVISION CONTROL TABLE, CLIENT, KEYWORDS AND ABSTRACT

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Abstract: Fehily Timoney and Company (FT) was commissioned by Dara Energy Limited to prepare a Site-Specific Flood Risk Assessment (SSFRA) for Derrynadaragh Wind Farm in County Kildare and County Offaly; this is in response to a request for further information by An Bórd Pleanála with respect to the planning application for the renewable energy development.

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1. INTRODUCTION

Fehily Timoney and Company (FT) was commissioned by Dara Energy Limited to prepare a Site Specific Flood Risk Assessment (SSFRA) for the Proposed Wind Farm Development located within the townlands of Cushina, Clonsast Lower and Chevychase Or Derrynadaragh in County Offaly and Aughrin and Derrylea in County Kildare.

The Proposed Development consists of a 9 no. turbine wind farm and associated infrastructure including internal access tracks, hard standings, onsite 110 kV substation and associated grid connection infrastructure, internal electrical and communications cabling, temporary construction compounds, drainage infrastructure, biodiversity enhancement measures, temporary accommodations works along the Proposed Turbine Delivery Route and all associated works related to the construction of the Proposed Development.

The proposed wind farm site is located in a rural area and the nearest settlement is the village of Bracknagh which is located approximately 2 km to the north of the wind farm site.

Access to the proposed wind farm site is provided by the construction of a new access track located along the R419 regional road in the townland of Cushina.

Figure 1-1: Proposed Wind Farm -Site Location

Figure 1-2 Proposed Wind Farm and TDR

The report aims to confirm if there are any potential flood risks to the subject site and the turbine delivery route (TDR) as well as any potential increase of flood risk elsewhere as they are in a flood risk areas.

As part of the scope of work, FT was commissioned to carry out a flood modelling along the River Cushina and River Daingean, which cross the proposed site and the turbine delivery route, respectively.

2. FLOOD RISK ASSESSMENT METHODOLOGY

2.1 General

The Guidelines for Planning Authorities and its Technical Appendices outline the requirements for a SSFRA. The Guidelines for Planning Authorities requires that works:

- Avoid development in areas at risk of flooding.
- Substitute less vulnerable uses where avoidance is not possible.
- Mitigate and manage the risk where avoidance and substitution are not possible.

The key principles of the Guidelines for Planning Authorities apply the Sequential Approach to the planning process. Figure 2-1 of this report describes the mechanism of the sequential approach for use in the planning process.

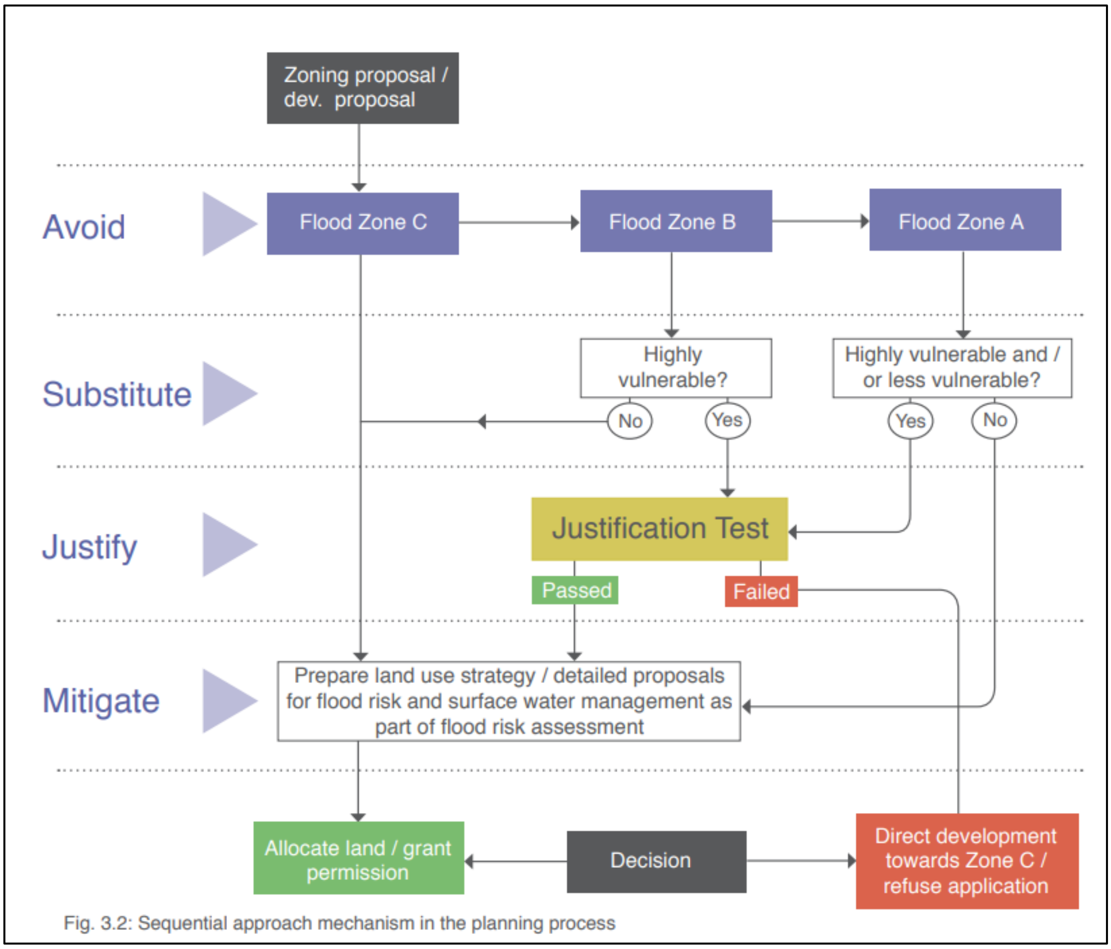


Figure 2-1: Sequential Approach Mechanism[1]

[1] Figure 3.2 of the *Guidelines for Planning Authorities*.

2.2 Source-Pathway-Receptor Model

The assessment of flood risk requires a thorough understanding of the following:

- The sources of flood water (e.g., high sea levels, intense or prolonged rainfall leading to runoff and increased flow in rivers and sewers)
- The pathways by which the flood water reaches those receptors (e.g., river channels, river and coastal floodplains, drains, sewers and overland flow).
- The people and assets affected by flooding (known as the receptors).

The Source-Pathway-Receptor (S-P-R) Model illustrated in Figure 2-2 has become widely used to assess and inform the management of environmental risks.

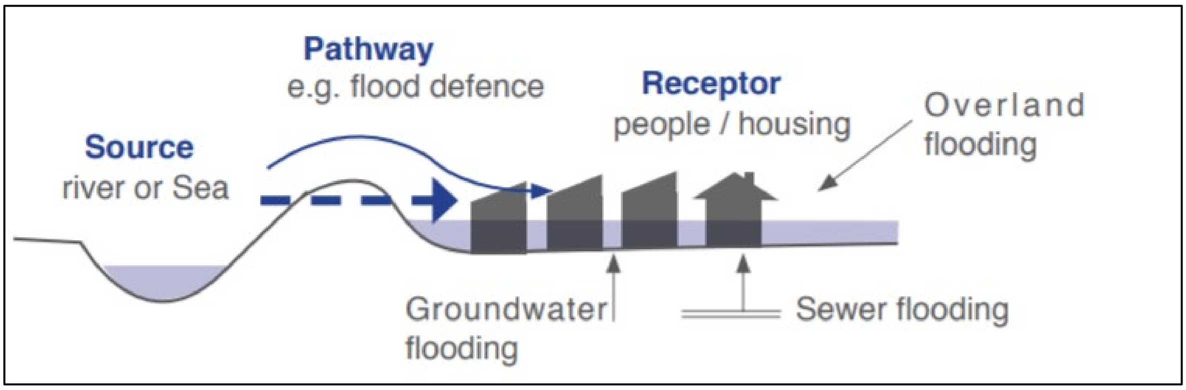


Figure 2-2: Source-Pathway- Receptor Model[2]

2.3 Likelihood of Flooding and Definition of Flood Zones

The Guidelines for Planning Authorities define the likelihood of flooding as the percentage probability of a flood of a given magnitude occurring or being exceeded in any given year. The likelihood of flooding is expressed as a return period or annual exceedance probability (AEP).

Flood Zones are graphical areas within which the likelihood of flooding is in a particular range. They are a key tool in flood risk management within the planning process as well as in flood warning and emergency planning. The Guidelines for Planning Authorities split these flood zones into three categories:

- Flood Zone A – where the probability of flooding from rivers and the sea is high (greater than 1% AEP for river flooding or 0.5% AEP for coastal flooding).
- Flood Zone B – where the probability of flooding from rivers and the sea is moderate (between 0.1% AEP and 1% AEP for river flooding and between 0.1% AEP and 0.5% AEP for coastal flooding).
- Flood Zone C – where the probability of flooding from rivers and the sea is low (less than 0.1% AEP for both river and coastal flooding).

[2] Source: Fig 2.2 of the *Guidelines for Planning Authorities*.

2.4 Classification of the Proposed Development and Justification Test

The Guidelines for Planning Authorities categorises all types of development as either:

- Highly Vulnerable (garda, ambulances, schools, hospitals, dwelling houses, student halls…).
- Less Vulnerable (buildings used for: retail leisure, warehousing, commercial, industrial, and non-residential institutions,).
- Water Compatible (flood control infrastructure, docks, marinas, amenity open spaces...).

The Guidelines classify potential development in terms of its vulnerability to flooding. The types of development falling within each vulnerability class are described in Table 2.1 of the Guidelines, which is reproduced in Table 2-2:Matrix of Vulnerability Versus Flood Zone.

Table 2-1: Vulnerability Class[3]

Highly vulnerable development (Including essential infrastructure)	• Garda, ambulance and fire stations and command centres required to be operational during flooding; • Hospitals; • Emergency access and egress points; • Schools; • Dwelling houses, student halls of residence and hostels; • Residential institutions such as residential care homes, children's homes and social services homes; • Caravans and mobile home parks; • Dwelling houses designed, constructed or adapted for the elderly or, other people with impaired mobility; • Essential infrastructure, such as primary transport and utilities distribution, including electricity generating power stations and sub-stations, water and sewage treatment, and potential significant sources of pollution (SEVESO sites, IPPC sites, etc.) in the event of flooding.
Less vulnerable development	• Buildings used for: retail, leisure, warehousing, commercial, industrial and non-residential institutions; • Land and buildings used for holiday or short-let caravans and camping, subject to specific warning and evacuation plans; • Land and buildings used for agriculture and forestry; • Waste treatment (except landfill and hazardous waste); • Mineral working and processing; • Local transport infrastructure.

[3] Source: Table 3.1 of the *Guidelines for Planning Authorities*.

Water-compatible development	• Flood control infrastructure; • Docks, marinas and wharves; • Navigation facilities; • Ship building, repairing and dismantling, dockside fish processing and refrigeration and compatible activities requiring a waterside location; • Water-based recreation and tourism (excluding sleeping accommodation); • Lifeguard and coastguard stations; • Amenity open space, outdoor sports and recreation and essential facilities such as changing rooms; • Essential ancillary sleeping or residential accommodation for staff required by uses in this category (subject to a specific warning and evacuation plan).

*Uses which are not listed in the table should be considered on their own merits.

The Sequential Approach restricts development types to occur within the flood zone appropriate to their respective vulnerability classes. Table 2-2 identifies the types of development appropriate for each flood zone and those that will require a Justification Test.

Table 2-2: Matrix of Vulnerability Versus Flood Zone[4]

	Flood Zone A	Flood Zone B	Flood Zone C
Highly vulnerable development (including essential infrastructure)	Justification Test	Justification Test	Appropriate
Less vulnerable development	Justification Test	Appropriate	Appropriate
Water-compatible development	Appropriate	Appropriate	Appropriate

The Justification Test has been designed to rigorously assess the appropriateness of developments that are being considered in areas of moderate or high flood risk. There are two types of Justification Tests:

- The first is the Plan-making Justification Test which is used at the plan preparation and adoption stage where it is intended to zone or otherwise designate land which is at moderate or high risk of flooding.
- The second is the Development Management Justification Test which is used at the planning application stage where it is intended to develop land at moderate or high risk of flooding for uses or development vulnerable to flooding that would generally be inappropriate for that land.

[4] Source: Table 3.2 of the *Guidelines for Planning Authorities*.

2.5 Flood Risk Assessment Stages

The Guidelines for Planning Authorities outline that a staged approach should be adopted when carrying out a SSFRA. These stages are the following:

- Stage 1 Flood Risk Identification.
- Stage 2 Initial Flood Risk Assessment.
- Stage 3 Detailed Flood Risk Assessment.

Shapes FRA

Influences FRA

	Flood risk identification	Initial flood risk assessment	Detailed flood risk assessment
Regional Flood Risk Appraisal	✓	U	U
Strategic Flood Risk assessment – County-wide	✓	P	U
Strategic Flood Risk Assessment – City or town within a county plan	✓	✓	P
Site-specific flood risk assessment	✓	✓	✓

P = Probably needed to meet the requirements of the Justification Test

U = Unlikely to be needed

✓ = Required to be undertaken

Figure 2-3: Flood risk assessment stages required per scale of study undertaken[5]

Stage 1: Flood risk identification – to identify whether there may be any flooding or surface water management issues relating to the Proposed Development site that may warrant further investigations. The flood risk identification stage uses existing information to identify whether there may be any flooding or surface water management issues related to the site. Flood risks identified in this stage are then addressed in Stage 2.

Stage 2: Initial flood risk assessment – to confirm sources of flooding that may affect the development site, to appraise the adequacy of existing information and to determine what surveys and modelling approach is appropriate to match the spatial resolution required and complexity of the flood risk issues. This stage involves the review of data addressed in Stage 1. Data where the flood risk at the site is recognised as being low is screened out and it is not further addressed in the report, data which recognised the flood risk on the site to be medium or high is further analysed in the report.

Stage 3: Detailed flood risk assessment – to assess flood risk issues in sufficient detail and to provide a quantitative appraisal of potential flood risk to a proposed or existing development, of its potential impacts on flood risk elsewhere and of the effectiveness of any proposed mitigation measures. This will typically involve the use of an existing or construction of a hydraulic model across a wide enough area to appreciate the catchment wide impacts and hydrological process involved.

[5] Source: Appendix A of *Guidelines for Planning Authorities*, Table A3.

3. EXISTING SITE

3.1 Description of Catchments

This section addresses catchment characteristics of the proposed wind farm site and the turbine delivery route.

3.1.1 Proposed Wind Farm

The proposed wind farm site is located within the Barrow Catchment (ID 14) and the Barrow_SC_040 sub-catchment as defined by the WFD. The waterbody in this sub-catchment that is crossing the proposed site is known as FIGILE_080 (EPA Name: Cushina 14).

In addition, the wind farm is located within two sub-basins:

- *FIGILE_070- IE_SE_14F010510.*
- FIGILE_080- IE_SE_14F010600.

The elevation range of the overall wind farm site varies between approximately 66 m OD and 59 m OD, and it generally has a flat topography. Turbines will be installed in the range between approximately 64 m OD and 60 m OD.

The main hydrology feature within the wind farm site is the Cushina River (FIGILE_080). A large area of the surface runoff drains into this river within FIGILE_080 sub-basin. The Cushina River runs in an easternly direction, and it is a tributary of the Figile River (FIGILE_080). The remaining of the site drains into FIGILE_070 sub-basin or directly into Figile River. In addition, there are no lakes or reservoirs within the wind farm site study area.

Rainfall data from Met Éireann was analysed and recorded at Casement Station, which is c.46 km northeast of the Site and associated infrastructure.

The 30-year annual average rainfall at Casement weather station, recorded from 1991 to 2020, was calculated to be 783.5 mm. The average rainfall at the proposed wind farm site may vary due to its geographical location.

The Standard Average annual Rainfall (SAAR) of the site from the FSU Portal is approximately 827 mm, which gives a more conservative output and it will be used for the Hydraulic Analysis in Section 7.1.

Following further research into the Rainfall data from Met Éireann , Table 3-1 below shows the average annual rainfall recorded from the closest weather station with more available data which is in Lullymore, Co. Kildare. This station is approximately 15 km north-east of the subject site and associated infrastructure.

Table 3-1: Rainfall Data - Lullymore Nature Centre Station

Total rainfall in millimetres for Lullymore Nature Centre Station														
Year	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	Average
Rainfall	839	976	818	848	1025	868	877	747	986	1008	845	834	1038	785	892

This station is closer to the Site than Casement weather station, but it is still 15 km away and at a different elevation, therefore the Standard Average Annual Rainfall (SAAR) from the FSU Portal was chosen.

The M5-60 at development location is 16.5 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.

3.1.2 Turbine Delivery Route (TDR)

The watercourse crossing of the Turbine Delivery Route is located within the Barrow Catchment (ID 14) and the Figile_SC_020 sub-catchment as defined by the WFD. *The waterbody in this sub-catchment that is affected by the TDR is named as Daingean_030 (also known as Philipstown). This watercourse runs in an easternly direction, and it is a tributary of the Figile River.*

This watercourse crossing is located approximately 5 km east of Daingean town and is bordered by the R402 to the north, where the TDR branches off, and the R400 to the east.

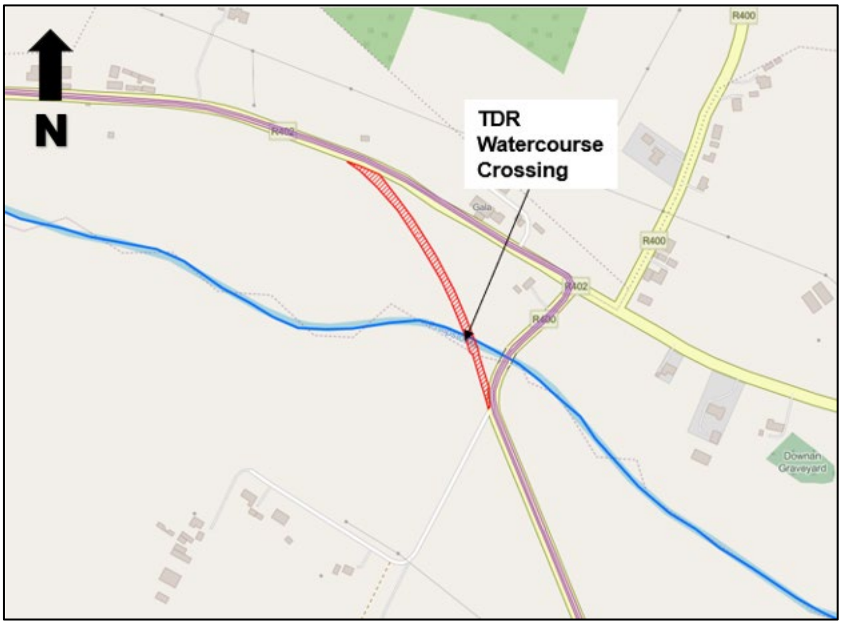


Figure 3-1: TDR Watercourse Crossing

Rainfall data from Met Éireann was also analysed, including records from the Lullymore Nature Centre Station, located approximately 18 km east of the watercourse crossing. However, due to the distance and difference in elevation, the Standard Average Annual Rainfall (SAAR) value from the FSU Portal was used instead

3.2 Subsoil and Hydrogeology

A desk study was undertaken to gather relevant background information prior to undertaking the site walkovers and ground investigations. The mapping data of the area produced by the Geological Survey of Ireland (GSI) was examined.

According to the GSI, the local deposits are mainly comprised of cut over raised peat and lake marl. To the north of the site, but outside of the boundary, alluvium deposits are identified.

The figure below shows the distribution of Quaternary deposits from the GSI.

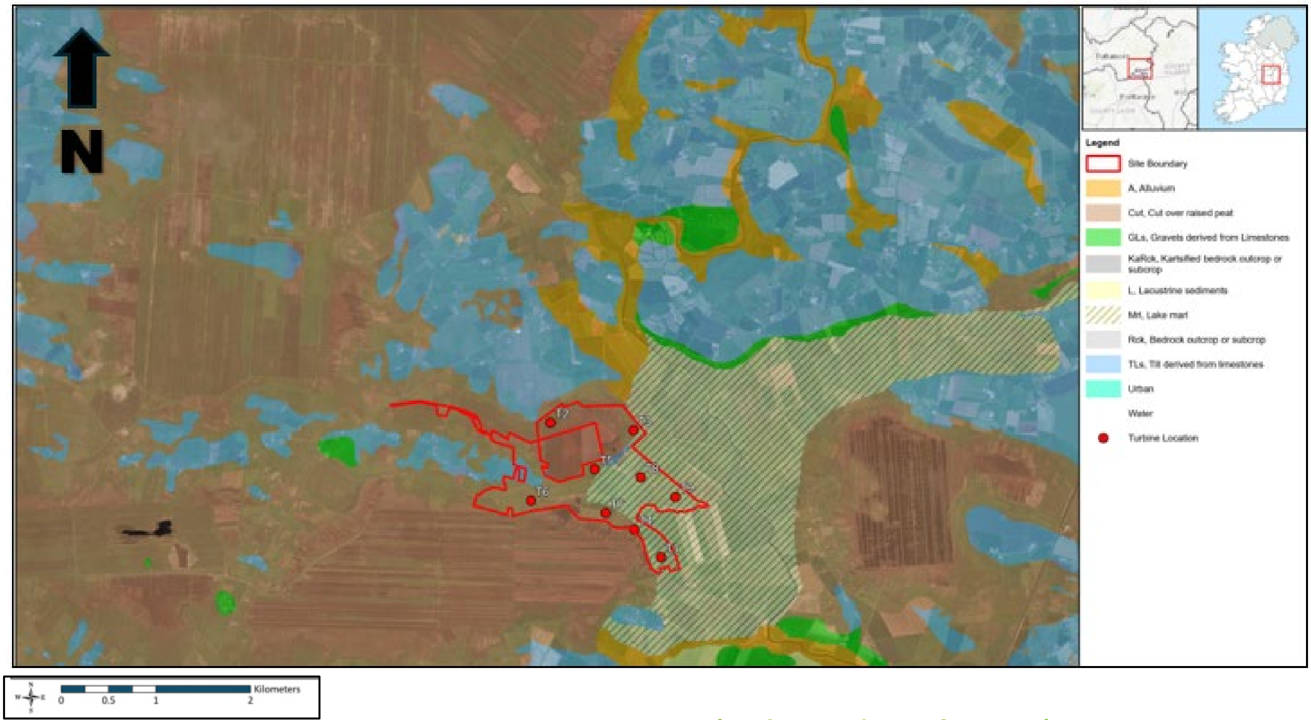


Figure 3-2: Quaternary Deposits (Background Map from GSI)

According to GSI, there is one main bedrock formation underlying the site:

- Lucan Formation: Dark limestone and shale. The formation comprises dark-grey to black, fine-grained, occasionally cherty, micritic limestones that weather paler, usually to pale grey. There are rare dark coarser grained calcarenitic limestones, sometimes graded.

The figure below shows the bedrock formation distribution according to GSI.

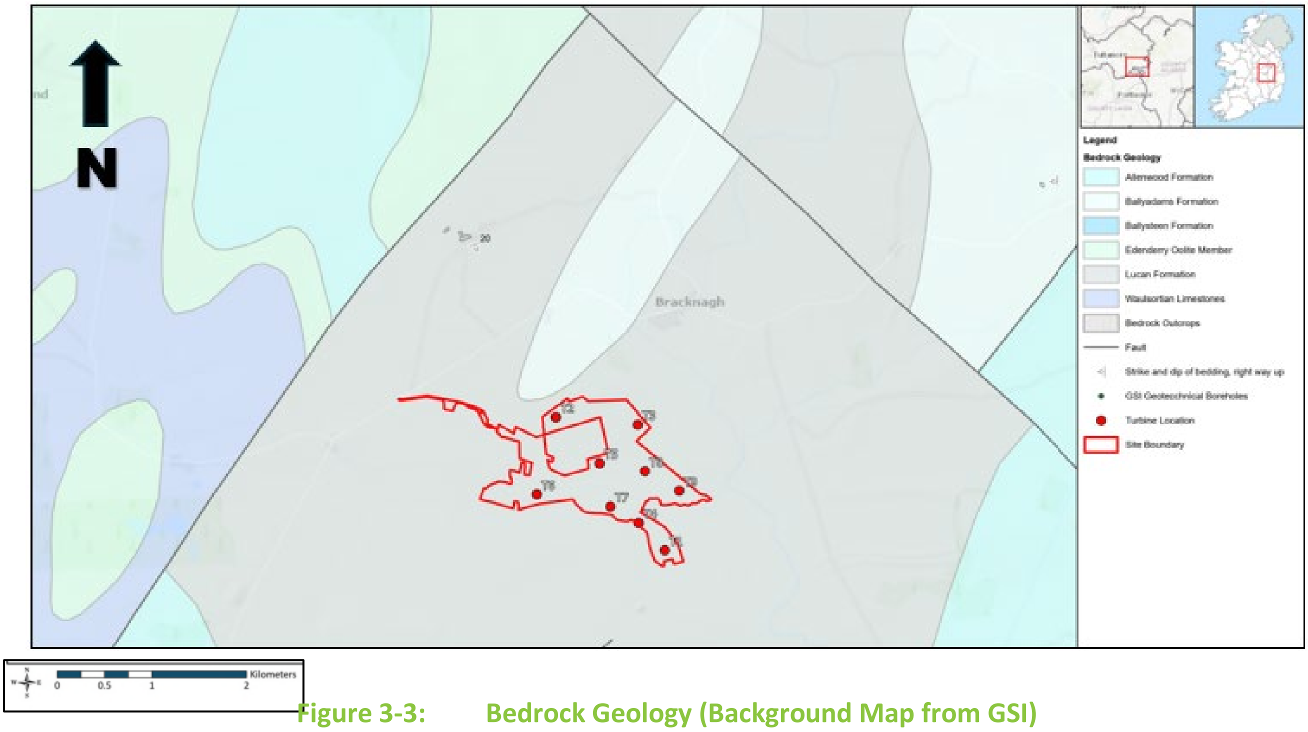


Figure 3-3: Bedrock Geology (Background Map from GSI)

According to GSI Subsoil Permeability mapping, the overburden deposits of till and peat are mapped as having low permeability. These strata may therefore act as a confining layer (where present), preventing the free movement of surface water to the underlying Aquifer.

Findings from the walkover surveys confirm that the site is predominantly underlain by peat with the eastern area of the site underlain by a thin layer of peaty topsoil overlying a soft clay/ marl. It also confirmed that there are no bedrock outcrops or subcrops across the site.

In addition, the ground investigation works concluded that the groundwater levels across the site are shallow and that the predominant Quaternary deposits across the proposed wind farm comprise low permeability fine grained till.

Further information and details on subsoil and hydrogeology can be found in Chapter 10 of Volume 2 of the EIAR, titled "Soils, Geology and Hydrogeology".

3.3 Hydrological Features

A site walkover survey was conducted in April 2023 to establish the drainage pattern and to record existing hydrology features; a collection of the site visit photos can be found in Appendix 7, lodged with this report. The site of the proposed wind farm has a generally flat slope, with a flood plain that starts widening on both sides approximately 470 m east of a proposed bridge crossing, following the downstream direction of the Cushina River. This is the main river within the site which flows in an easternly direction and is a tributary of the Figile River.

The Turbine Delivery Route (TDR) intersects the Daingean River and its flood plain and a bridge is also proposed here. This river flows in an easternly direction, and the surrounding area generally follows a flat slope.

3.3.1 Proposed Wind Farm-Surface Water Crossings

As part of this SSFRA, a detailed review of the proposed internal wind farm watercourse crossings was carried out to ensure the designs would be in accordance with OPW requirements.

There is one main watercourse crossing on the western side of the subject site for which a detailed flood modelling and hydrological analysis were carried out and are shown in Sections 7.1 and 7.2. As a result of this assessment, a single span bridge is proposed with a span of 19.00 m.

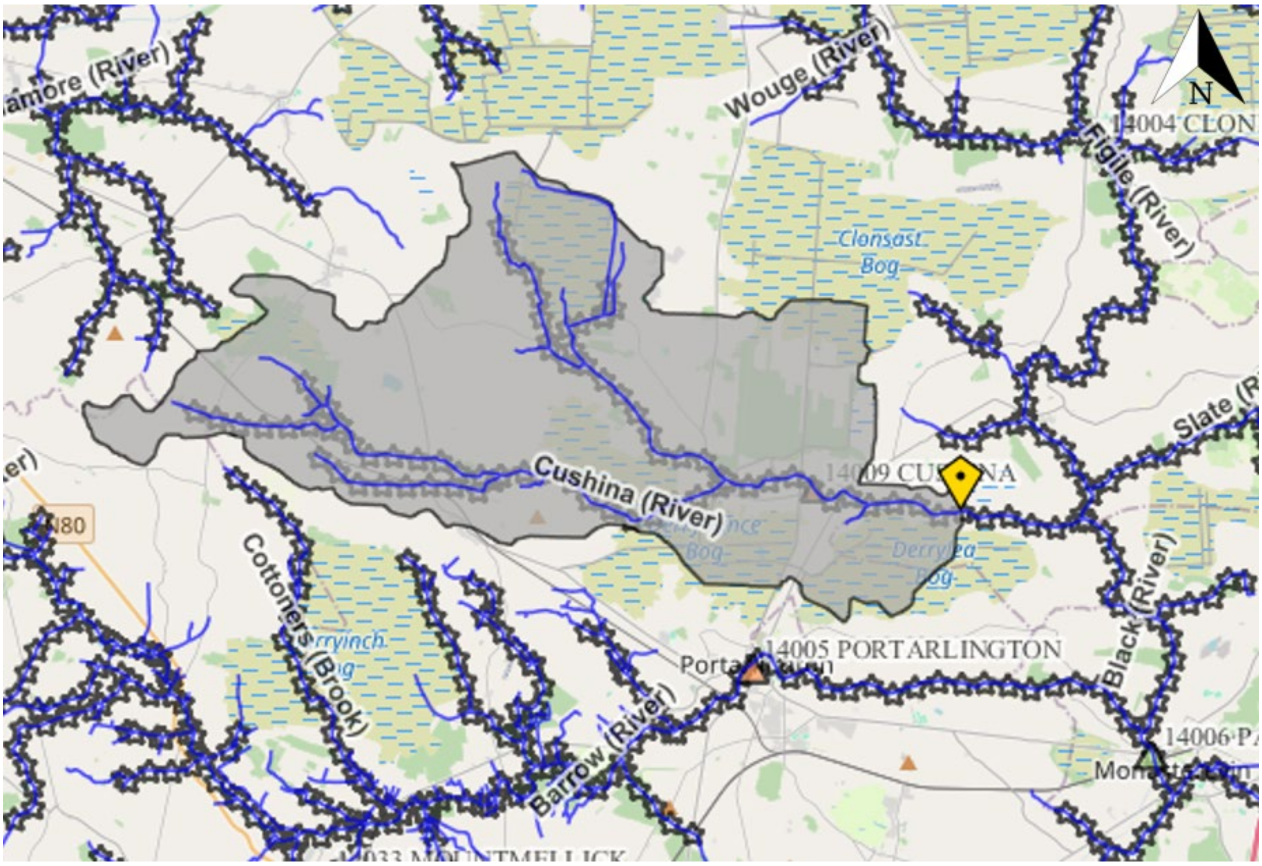


Figure 3-4: Proposed Structure Location (Map from https://opw.hydronet.com)

3.3.2 Proposed Surface Water Drainage

The proposed development requires surface water drainage systems to manage and collect overland flow, as well as surface water from infrastructure elements such as access tracks, turbine bases, the substation and other hardstanding areas. The main components of the proposed drainage network are:

- Interceptor Drains: they collect the overland flow and discharge it through access tracks via cross drains. It will then be directed to areas where it can be redistributed over the ground or discharge to existing land drains or streams.
- Swales: they are installed along access tracks and other hardstanding areas to collect the surface water from these areas and separate them from the overland flow.
- Settlement Ponds: the surface water collected by the swales will pass through these settlement ponds to reduce the concentration of suspended solids before discharging over the ground.

- Diffuse outfall: discharge from settlement ponds and interceptor drains will be provided by a diffuse stone filled outflow which will encourage the diffuse spread of flows overland and back into natural drains.
- Check Dams: at slopes greater than 1%, check dams will be required in the swales and interceptor drains to slow down the velocities of flows and prevent erosion occurring.

The proposed surface water drainage systems utilises sustainable drainage elements that aim to reduce or minimise any impact on the existing drainage conditions.

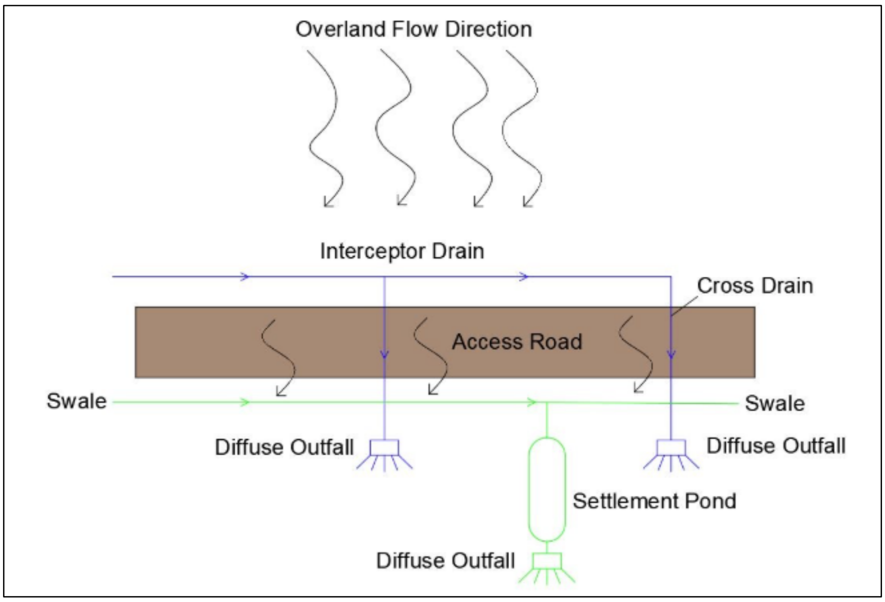


Figure 3-5: Drainage Design Principles

3.3.3 Turbine Delivery Route (TDR)

A detailed review of the proposed watercourse crossing of Daingean River was carried out to ensure the design is in compliance with OPW requirements.

A detailed flood modelling and a hydrological analysis were carried out where a single span bridge with a span of 20.00 m and five relief culverts were proposed.

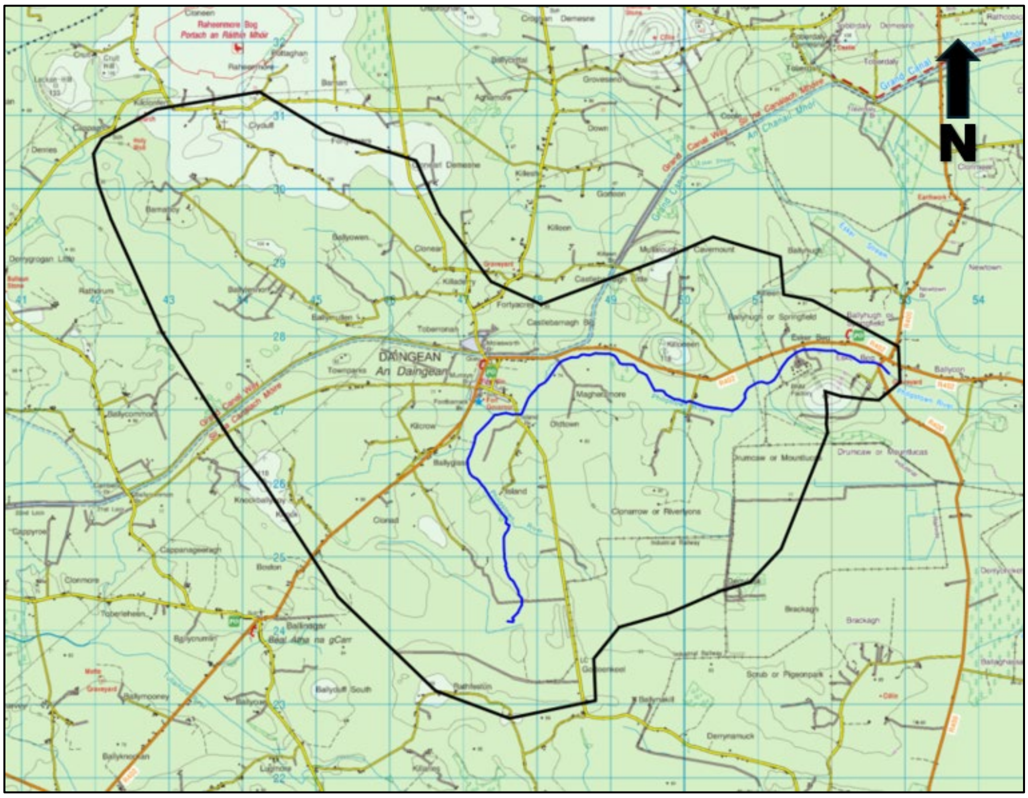


Figure 3-6: Catchment- Proposed TDR Watercourse Crossing

4. OFFALY AND KILDARE COUNTY DEVELOPMENT PLANS

The proposed wind farm is located under the jurisdiction of two counties: Offaly and Kildare.

Offaly County Development Plan (2021-2027) came into effect in October 2021 and Kildare County Development Plan (2023-2029) came into effect in January 2023. They both sets out the proposed policies and objectives for the Development of the County over the Plan period. The Development Plans seek to develop and improve, in a sustainable manner, the social, economic, environmental and cultural assets of the Counties. The approach to Flood Risk Management is set out in Chapter 3 Climate Action and Energy -Volume 1 (Offaly CDP) and Chapter 6 Infrastructure & Environmental Services - Volume 1 (Kildare CDP) and in their Strategic Flood Risk Assessments (SFRA).

The SFRAs were undertaken by the counties in accordance with the Planning System and Flood Risk Management- Guidelines for Planning Authorities (Department of the Environment, Heritage and Local Government and Office of Public Works, 2009) and Department of the Environment, Community and Local Government Circular PL 2/2014. The SFRA provides an assessment of flood risk and includes mapped boundaries for Flood Risk Zones .

Offaly County Council shows on their GIS Viewer the flood extents around the proposed development but only within the Offaly County. Also, it shows that this a rural area that hasn't been land zoned for but provides Landscape Sensitivity zones.

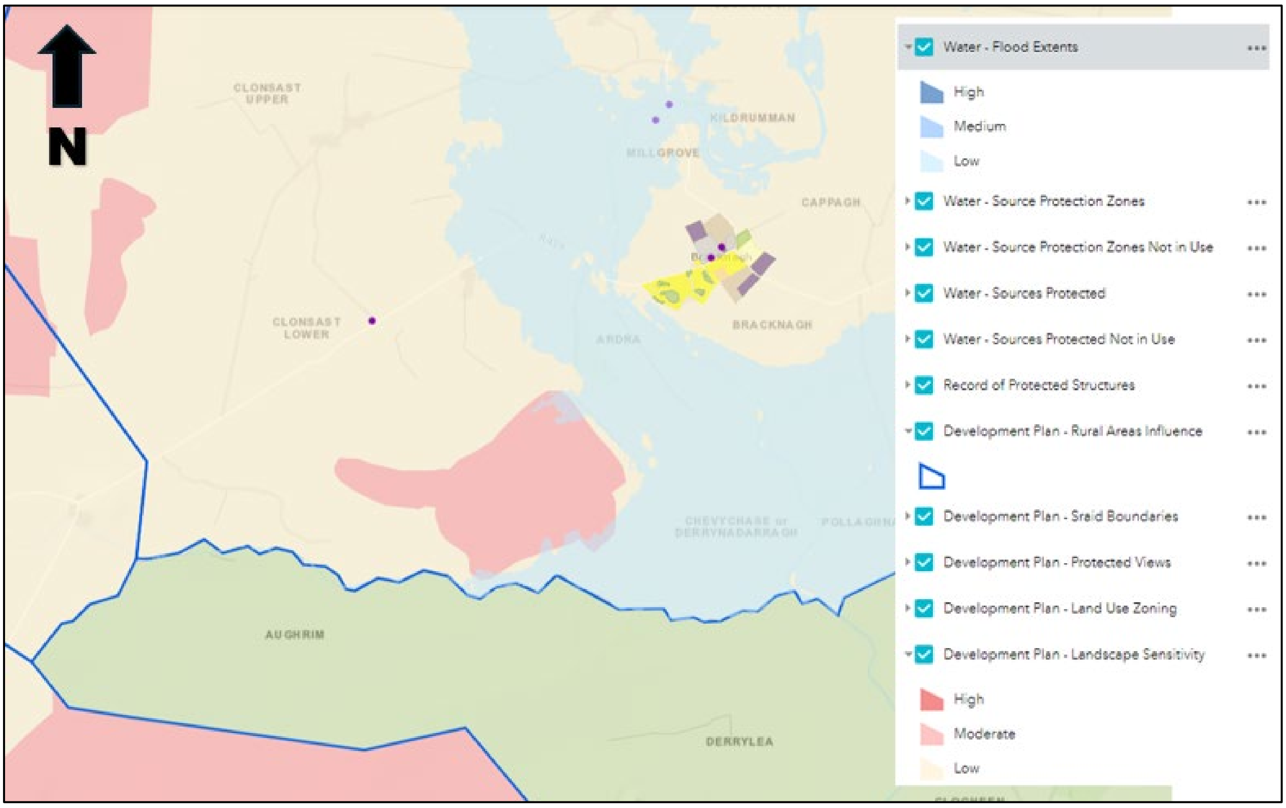


Figure 4-1: Offaly County Flood Extents and Land Zones

Both counties have developed a Wind Energy Strategy document as part of the County Development Plan which identify key areas within the county for the development of Wind Energy and also identifies unsuitable areas for these types of developments.

The Figure below was taken from Offaly Wind Energy Strategy document and shows that part of the proposed development lies in an area that is "Open For Consideration" for Wind Energy Development. These areas are characterised by low housing densities, they do not conflict with European or National designated sites and have the ability by virtue of their landscape characteristics to absorb wind farm developments. Notwithstanding this designation, wind farm developments in these areas are to be evaluated on a case-by-case basis.

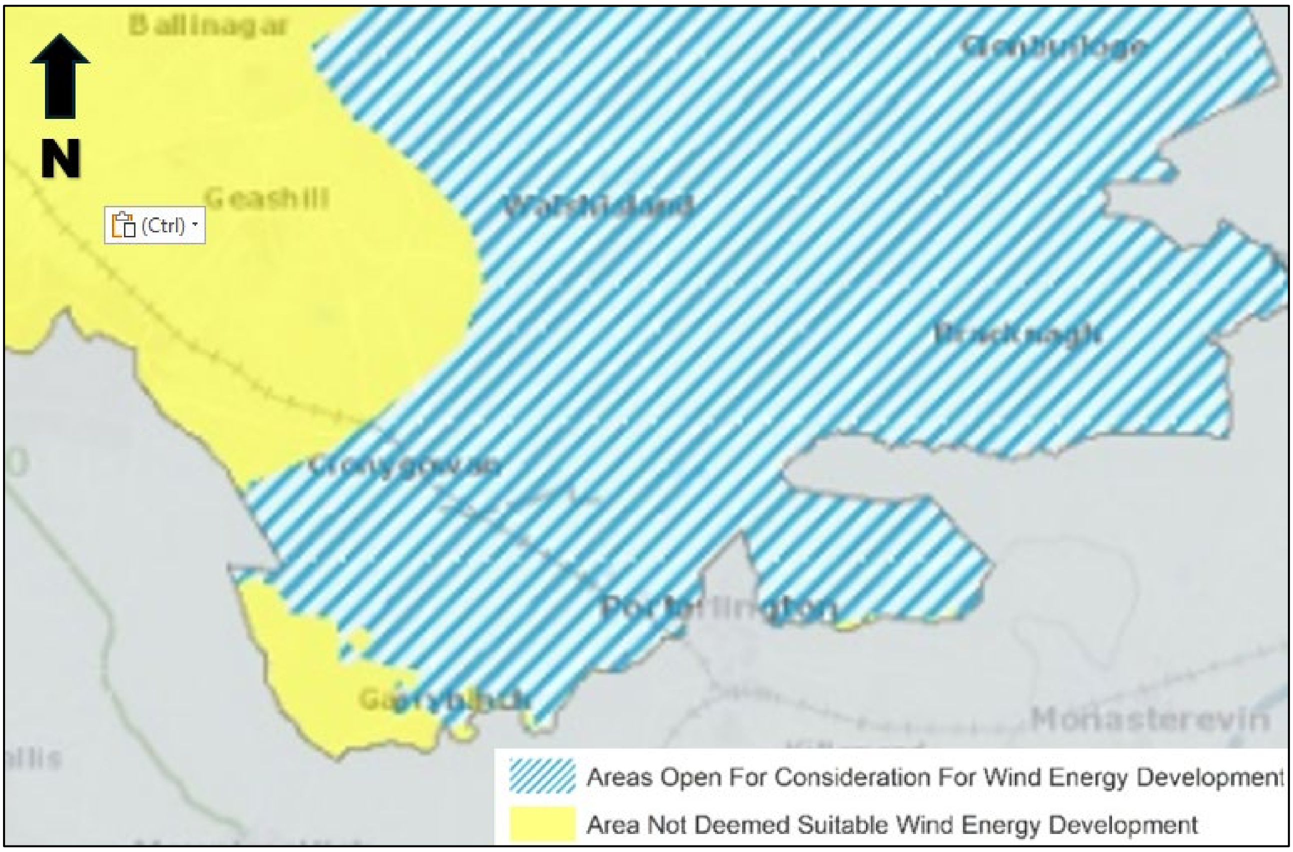


Figure 4-2: Offaly Wind Energy Strategy

Kildare Wind Energy Strategy classifies the other side of proposed development as "Acceptable in Principle"for windfarm development which are areas that are predominantly flat, rural and well serviced by the existing electricity transmission grid.

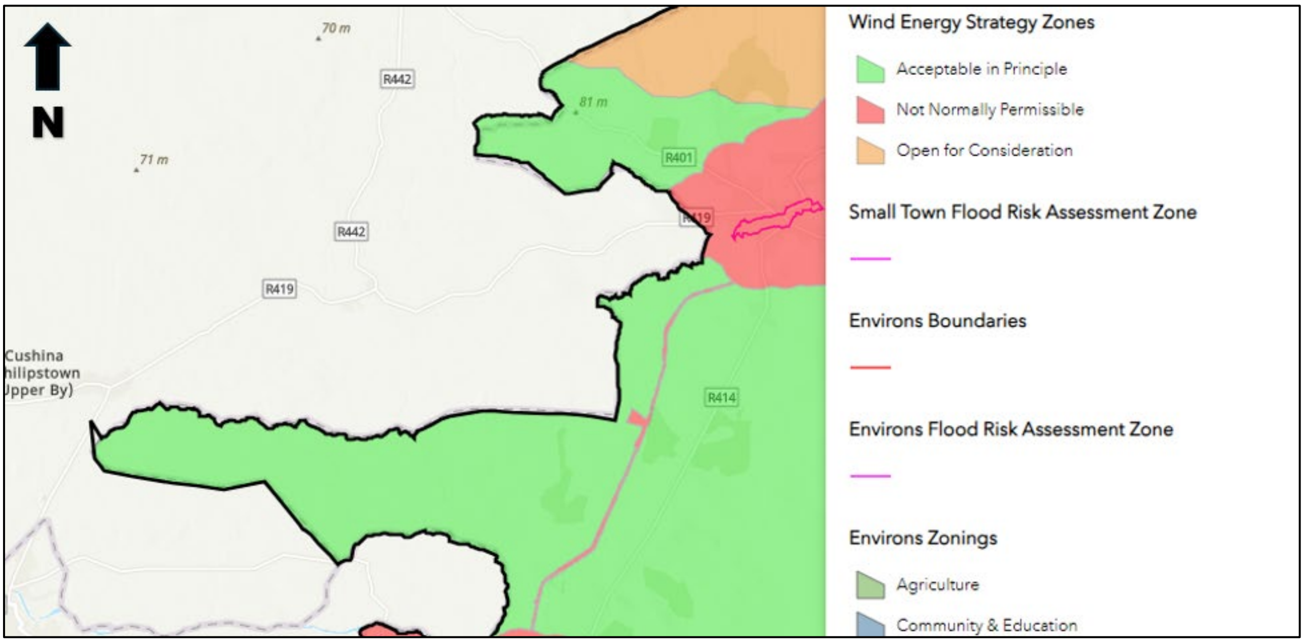


Figure 4-3: Kildare Wind Energy Strategy

5. STAGE 1 - FLOOD RISK IDENTIFICATION

5.1 Areas for Further Assessment and Benefiting Lands

The National Catchment Flood Risk Management (CFRAM) Programme has examined the flood risk, and possible mitigation measures to address it in 300 communities throughout the country at potentially significant flood risk. These communities were identified through the Preliminary Flood Risk assessment (PFRA), which was a national screening assessment of flood risk. The communities recognized as being at a significant flood risk are called Areas for Further Assessment (AFA). For the AFAs a detailed hydraulic modelling has been carried out to produce indicative flood maps (CFRAM Maps).

The subject site and the TDR watercourse crossing are within an AFA and therefore, flooding maps have been produced as part of the CFRAM mapping.

Local Authority is charged with responsibility of maintaining Drainage Districts. According to the OPW database, the Cushina, Figile and Daingean Rivers as well as a number of local drains in the area form part of the Drainage Districts.

5.2 Coastal Flooding

The ground levels within the site range from 66 mOD to 59 mOD and it is located approximately 68 km from the coast at its nearest point. As such, the site is not considered to be at risk of coastal flooding. Similarly, the TDR watercourse crossing is not impacted by coastal flooding, as it lies approximately 75 km from the sea and is situated at an elevation of around 70 mOD.

5.3 Groundwater Flooding

Based on the information described in Section 3.2, Subsoil and Hydrogeology, which was gathered from a desktop study, site walkovers, and ground investigation works, the subject site is, in general, not at risk of groundwater flooding. The ground investigation revealed that groundwater levels across the site are shallow; however, the predominant overburden deposits of till and peat across the proposed wind farm comprise low permeability which indicate a low risk of groundwater flooding.

5.4 Fluvial Flooding

5.4.1 CFRAM and NIFM Maps

The CFRAM Programme extends to the subject site and the TDR watercourse crossing showing that both locations are vulnerable to fluvial flooding. Figure 5-1 below shows the flood extents for the 1 % annual exceedance event-Current Scenario.

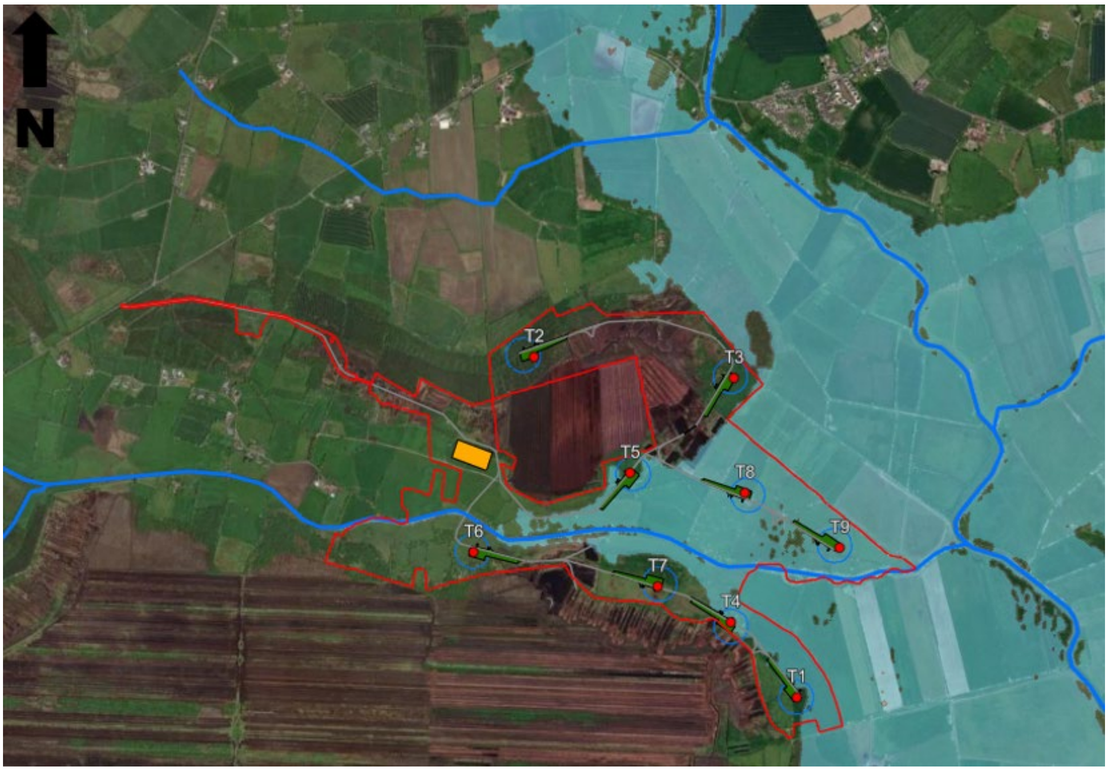


Figure 5-1: CFRAM Flood Map - Medium Probability-Proposed Wind Farm Location (Map from www.floodmaps.ie)

Figure 5-2: CFRAM Flood Map -Medium Probability-TDR Watercourse Crossing (Map from www.floodmaps.ie)

5.5 Pluvial Flooding

The Winter 2015/2016 Surface Water Flooding map shows fluvial (rivers) and pluvial (rain) floods, excluding urban areas, during the winter 2015/2016 flood event. Figure 5-3 below shows that there was pluvial flooding in combination with fluvial within the site boundary, probably due to the overland flow in these low lying and flat areas.

Pluvial flood risk should be considered, and the proposed development should not increase the flood risk elsewhere due to the construction of new access tracks, hardstanding areas, and the proposed discharge points.

Figure 5-3: GSI Winter 2015/2016 Surface Water Flooding-Proposed Wind Farm Location (Map from www.floodmaps.ie)

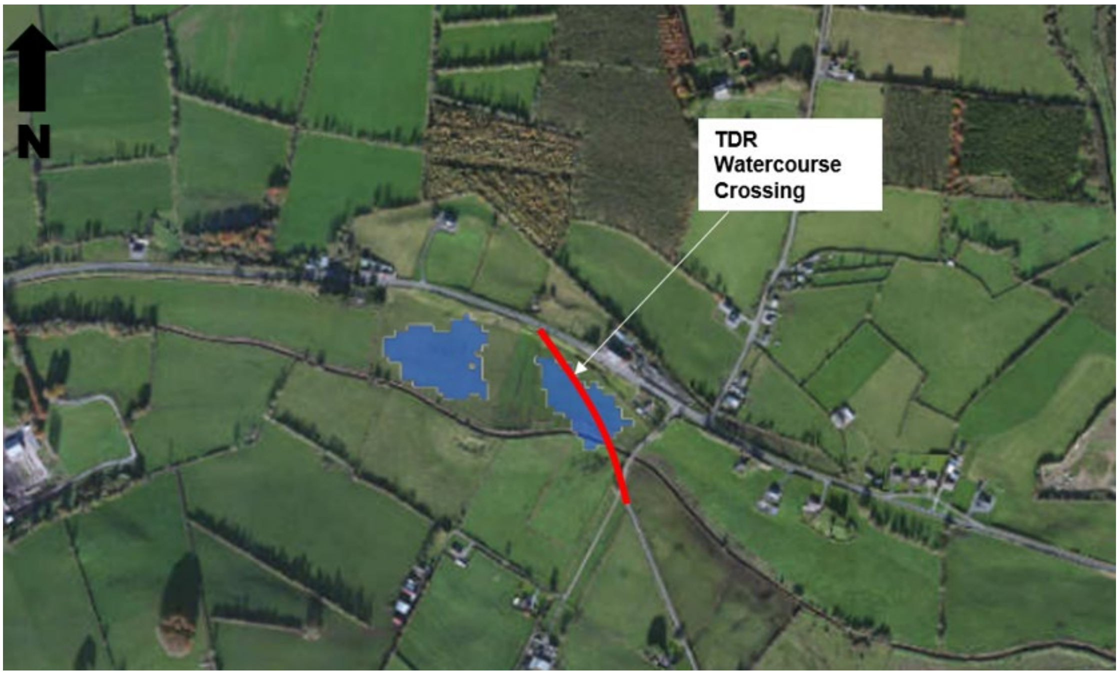


Figure 5-4: GSI Winter 2015/2016 Surface Water Flooding-TDR Watercourse Crossing

5.6 Historical Flooding

The national flood hazard mapping (www.floodmaps.ie), indicates that there are historical or past flooding events within the proposed site boundary . This past flood event has been mapped defining the extend of the flood along the Cushina River. There are also some single and recurring flood events in the area but are outside of the proposed site boundary.

The past flood event that has been mapped as shown in Figure 5-4 below appears to extend only within County Kildare. However, the floodplain also extends towards County Offaly on the north side of the Cushina River. Therefore, this map is considered only as part of the information gathered and a more detailed assessment will be required.

Figure 5-5: Past Flood Event-Proposed Wind Farm Location (Map taken from www.floodmaps.ie)

Figure 16 below shows a recurring flood event to the west of the TDR Watercourse Crossing, approximately less than 1 km away, which appears to be associated with the Daingean River.

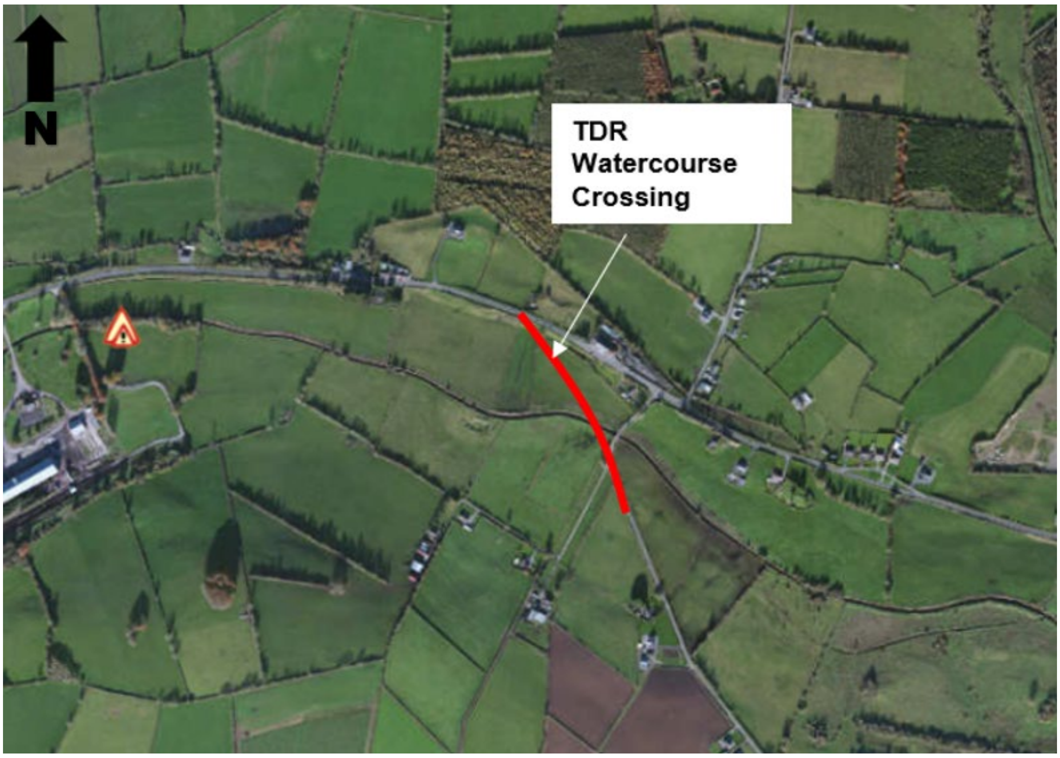


Figure 5-6: Past Flood Event-TDR Watercourse Crossing (Map taken from www.floodmaps.ie)

There are areas defined as 'benefiting lands' within the subject site and the TDR watercourse crossing. Benefiting lands were lands that were drained as part of the Drainage District to improve land for agriculture and to mitigate flooding.

Figure 5-7: Drainage Districts, Benefitting Lands and Channels-Proposed Wind Farm (Map from www.floodmaps.ie)

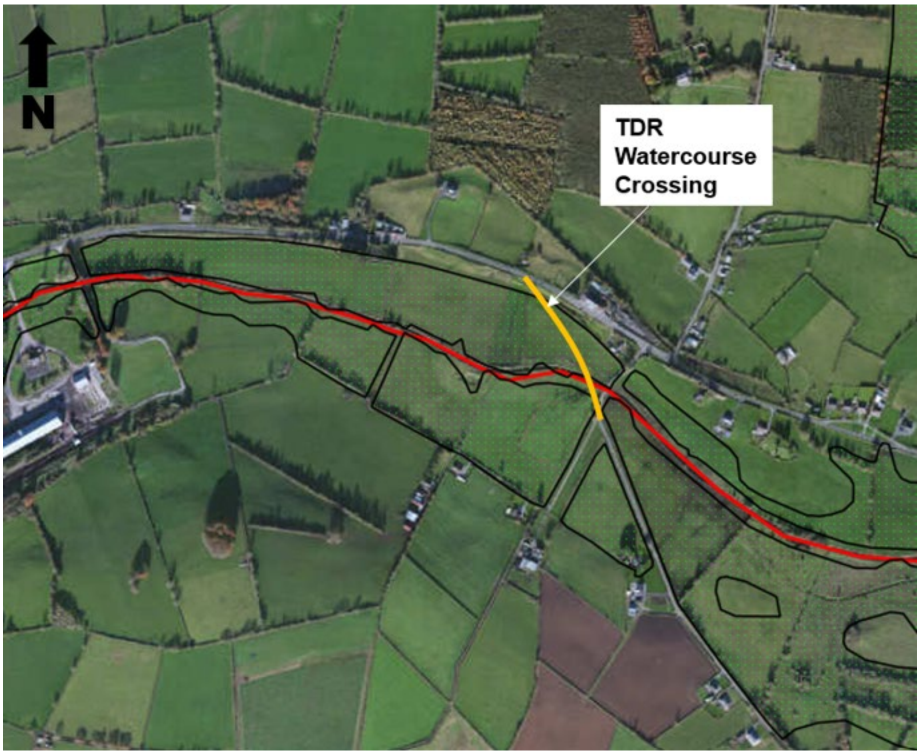


Figure 5-8: Drainage Districts, Benefitting Lands and Channels - TDR Watercourse Crossing (Map from www.floodmaps.ie)

6. STAGE 2 - INITIAL FLOOD RISK ASSESSMENT

The primary objective of conducting an initial flood risk assessment is to investigate flood-related concerns identified during Stage 1 Flood Risk Identification. Based on the information recorded in Stage 1, it has been determined that the Site is at risk of fluvial and pluvial flooding.

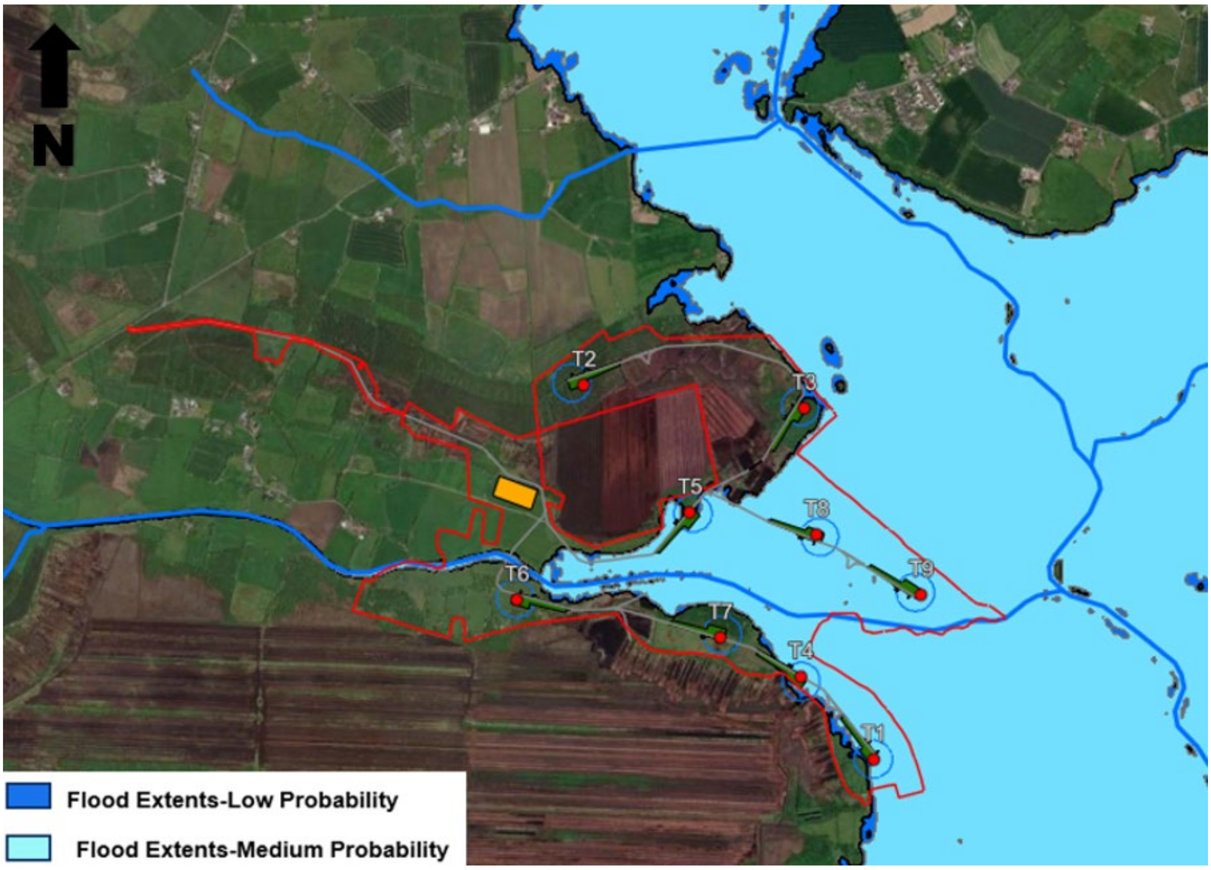


Figure 6-1: CFRAM Fluvial Flood Map - Medium and Low Probability-Mid Range Future Scenario (Map from www.floodmaps.ie)

Figure 6-2: Winter 2015/2016 Surface Water Flooding (Map from www.floodmaps.ie)

According to the CFRAM, some areas of the site are within Flood Zones A and B which are T1, T4, T8 and T9 and their access roads. Other access roads and infrastructure are also within the flood zones or are very close to it such as T5. However, the critical or essential parts of the windfarm such as the substation and the grid route connection joint bays are outside of the flood zones.

The proposed wind farm is classified as a Less Vulnerable Development in accordance with Table 2-1, as the critical infrastructure—such as the substation and the grid connection joint bays—is located outside the flood zones. However, some elements, including turbines and access roads, are within Flood Zone A. Therefore, a Justification Test is required, as outlined in Table 5-1.

Table 6-1: Matrix of Vulnerability Versus Flood Zone - Case of Study

	Flood Zone A	Flood Zone B	Flood Zone C
Highly Vulnerable Development	Justification Test	Justification Test	Appropriate
Less Vulnerable Development	Justification Test	Appropriate	Appropriate
Water-Compatible Development	Appropriate	Appropriate	Appropriate

A Stage 3 Detailed Flood Risk Assessment will be carried out to determine the flood levels and extends; also, there is a proposed bridge that crosses the Cushina River and the design of this structure is required to comply with the OPW requirements.

The TDR watercourse crossing is also affected by fluvial and pluvial flooding as identified in the previous section.

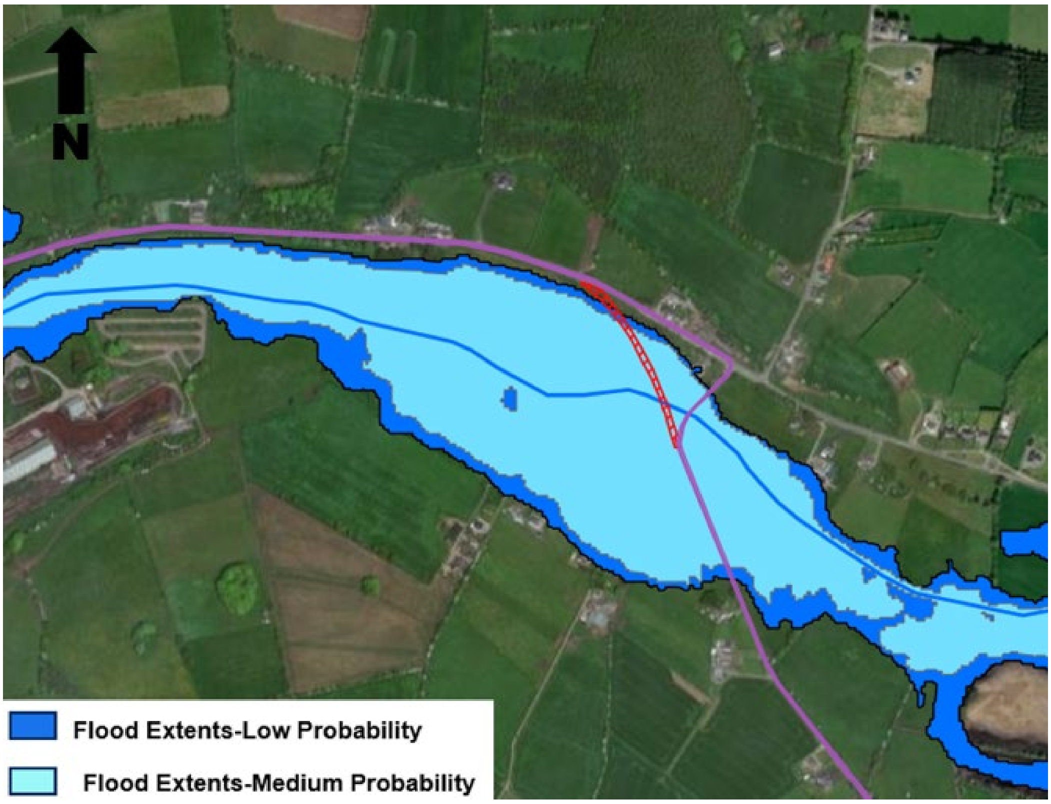


Figure 6-3: CFRAM Fluvial Flood Map- Medium and Low Probability-Mid Range Future Scenario (Map from www.floodmaps.ie)

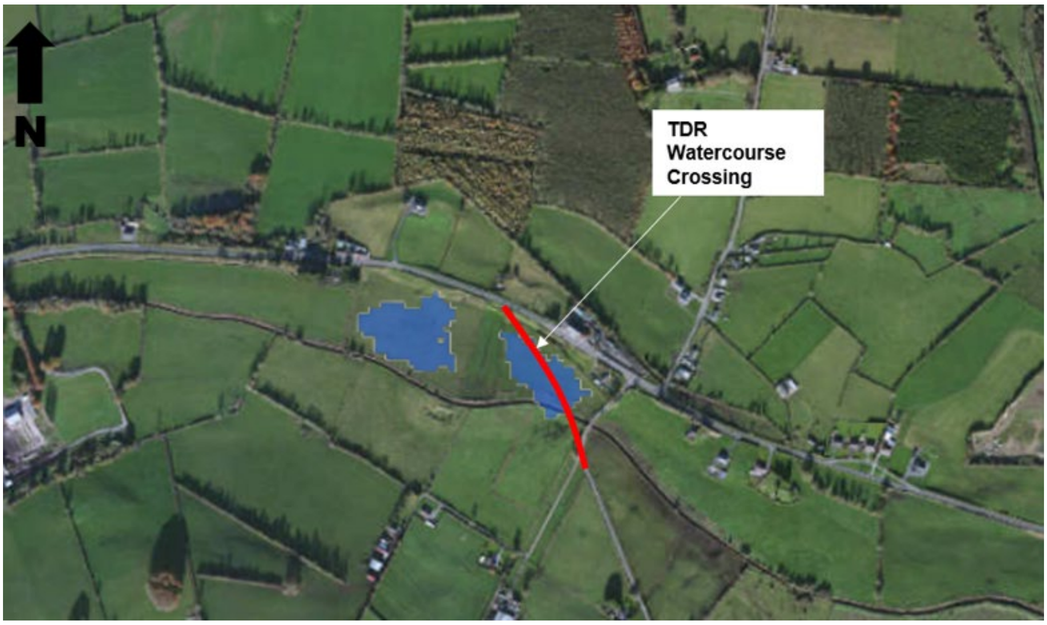


Figure 6-4: Winter 2015/2016 Surface Water Flooding (Map from www.floodmaps.ie)

This watercourse crossing is located within Flood Zones A and B and is classified as "Less vulnerable development" as per Table 2-1, therefore, a Justification Test is required as shown in Table 5-1. This will be included as part of the Justification Test for the overall project.

A Stage 3 Detailed Flood Risk Assessment will be carried out to determine the flood levels and extents, and to design the proposed bridge crossing the Daingean River, which is also required to comply with OPW requirements. In addition, any mitigation measures required will also be determined as the access road crosses a flood plain.

7. STAGE 3- DETAILED FLOOD RISK ASSESSMENT

7.1 Proposed Wind Farm- River Cushina

A site-specific hydraulic model was developed as part of this FRA to quantify the flood levels at the site and to design the proposed bridge crossing. Hydrological and hydraulic analysis were undertaken along the specific reach of the Hydrological Features to enable the delineation of appropriate flood zones. This model also allowed to quantify the water depths at the locations where relevant infrastructure were located in flood zones such as some of the turbines.

In order to undertake the hydraulic modelling, the peak flood flows were estimated along Two Hydrological Estimation Flows (HF's) as per the following figures below. The estimated peak flows, in conjunction with a digital terrain model (DTM) were used to generate the flood extent and flood depth maps for 1% AEP (annual exceedance probability) and 0.1%AEP.

The first Hydrological Estimation Flow is located near the end of the Cushina River, before joining the Figile River.

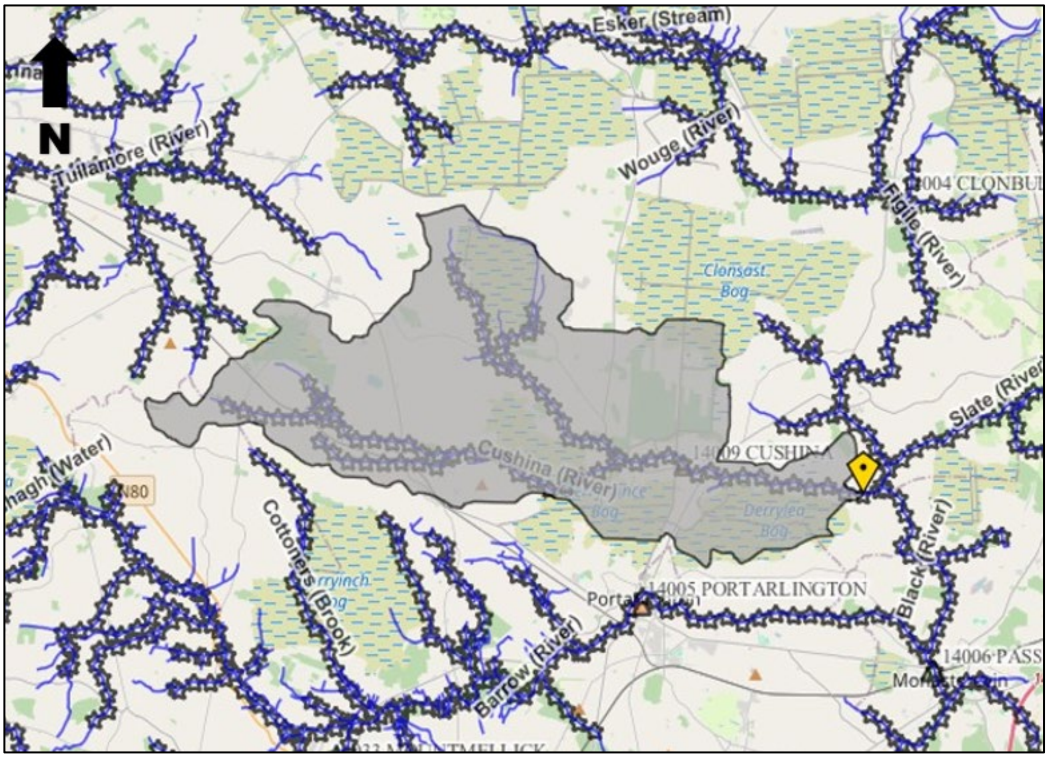


Figure 7-1: Location of First Hydrological Estimation Flow (HEF-1)

The second Hydrological Estimation Flow is located along the Figile River, before the junction with the Cushina River.

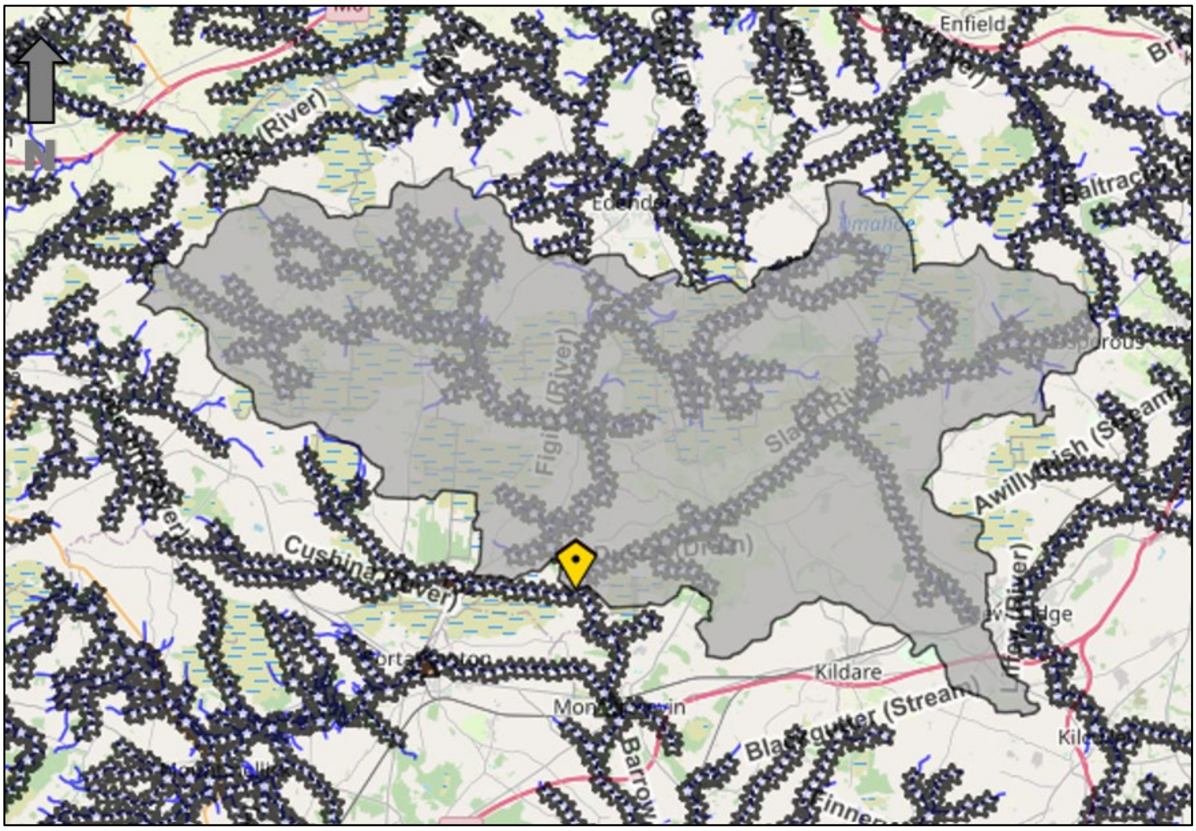


Figure 7-2: Location of Second Hydrological Estimation Flow (HEF-2)

7.1.1 Hydrology Analysis

The proposed development is located within an ungauged catchment; therefore, the flow estimations are based on ungauged methods. The FSU method was considered to estimate the peak flow of the watercourses as per OPW guidelines and in particular the FSU-7 Variable Equation was applied. This method is recommended for catchment sizes over 25 km2 and estimates the flow (Qmed) based on seven catchment descriptors.

The catchment descriptors are summarised in Table 6-1 below:

Table 7-1: Catchment Descriptors for the Hydrological Estimation Flow Locations

Feature ID	Area	BFSOIL	SAAR	FARL	DRAIND	S1085	ARTDRAIN	URBEXT
	Km2		mm		Km/Km2	m/km		
HEF-1	83.683	0.6069	827.12	1	0.577	2.1191	0	0.001
HEF-2	521.706	0.5981	829.34	0.999	0.508	0.56	0	0.0132

The Hydrology Analysis will be conducted to ascertain the flow values corresponding to the Annual Exceedance Probabilities (AEP) of 1% and 0.1%, plus 20% of Climate Change. This analysis aims to simulate a flooding event and generate flood zone scenarios A and B. Below the Table 6-2 shows these flow values for the different return periods.

Table 7-2 Flood Estimations for the different return periods

Hydrological Estimation Flows	AEP (%)	
	1% AEP +20 % CC (m3/s)	0.1%AEP +20%CC (m3/s)
HEF-1	42.30	54.79
HEF-2	143.65	181.41

7.1.2 Hydraulic Analysis

7.1.2.1 Model Details

A flood model of the Cushina River in the vicinity of the subject site was constructed using the software package HEC-RAS. This software was developed by the Hydraulic Engineering Centre of the US Army Corps of Engineers.

The primary inputs into the HEC-RAS Model are summarised below:

- Geometric Data:

Cushina River- channel cross sections and part of the flood plain. Surveyed by Murphy Geospatial in November 2023.

Terrain: DTM.

- Inflow Data - estimated using the FSU- 7 Variable Equation:

  100-year Mid-Range Future Scenario.

  1000-year Mid-Range Future Scenario.

- Boundary Conditions:

  HEF-1 Flow applied at the upstream end of the model.

  Normal depth (downstream channel).

  HEF-2 Flow applied as a downstream boundary condition.

The proposed bridge is designed for the 100 years return period (1% AEP) with a 20% inclusion for climate change and aims to have a minimal impact on the flood levels upstream and downstream of the structure. This consists of a single span bridge with a span of 19.00 m and a minimum soffit level of 62.30 m OD to provide a minimum freeboard of 300 mm as per the OPW requirements. The 0.1 % AEP (1 in 1000 years) was also modelled in order to map the flood zones A and B.

The Manning's values for the river channel and flood plain were determined by identifying the different type of materials encountered during a site visit and site survey where photos were taken; this assisted in selecting the appropriate manning's coefficient from the Hec-Ras Reference Manual. The contraction and expansion coefficients utilized were likewise drawn from the recommendations of the same manual.

Table 7-3: Design parameter used in the Hydraulic Analysis.

Parameter	Value	Source
Manning's Value (Channel)	0.08 0.12	Hec-Ras Reference Manual
Manning's Value (Flood Plain)	0.08 0.10	Hec-Ras Reference Manual
Contraction Coefficient	0.1	Hec-Ras Reference Manual
Expansion Coefficient	0.3	Hec-Ras Reference Manual

Two separate scenarios were modelled to compare the existing conditions or pre-development and post-development scenario which includes the proposed bridge.

7.1.2.2 Flood Zone A

7.1.2.2.1 Comparison Between Existing and Proposed Scenarios with Proposed Bridge

Upon completion of the hydraulic modelling, a comparison has been undertaken between the water levels obtained from the existing and proposed scenarios. This comparison allowed for conclusions to be drawn regarding the potential impact of the proposed bridge. The table below compares the result of the existing and proposed scenarios at each cross-section.

Table 7-4: Water Level Comparison – Existing VS Proposed - 1% AEP+ CC

River Station	Location	ES	PS	Diff (PS-ES)	Observations
		W.S. Elev	W.S. Elev	W.S. Elev	
2735.71	Upstream	62.19	62.23	0.04	Slight increase of water level
2678.54	Upstream	62.14	62.18	0.04	Slight increase of water level
2604.70	Upstream	62.06	62.12	0.06	Slight increase of water level
2535.23	Upstream	62.00	62.07	0.07	Slight increase of water level
2498.64	Upstream	61.96	61.98	0.02	Slight decrease of water level
2494.67	Proposed Bridge				
2490.70	Development	61.95	61.95	0.00	No variation of water level
2450.07	Development	61.89	61.89	0.00	No variation of water level
2397.96	Development	61.80	61.80	0.00	No variation of water level
2342.83	Development	61.67	61.67	0.00	No variation of water level

*The model extends further downstream but only the relevant cross sections have been shown in this Table

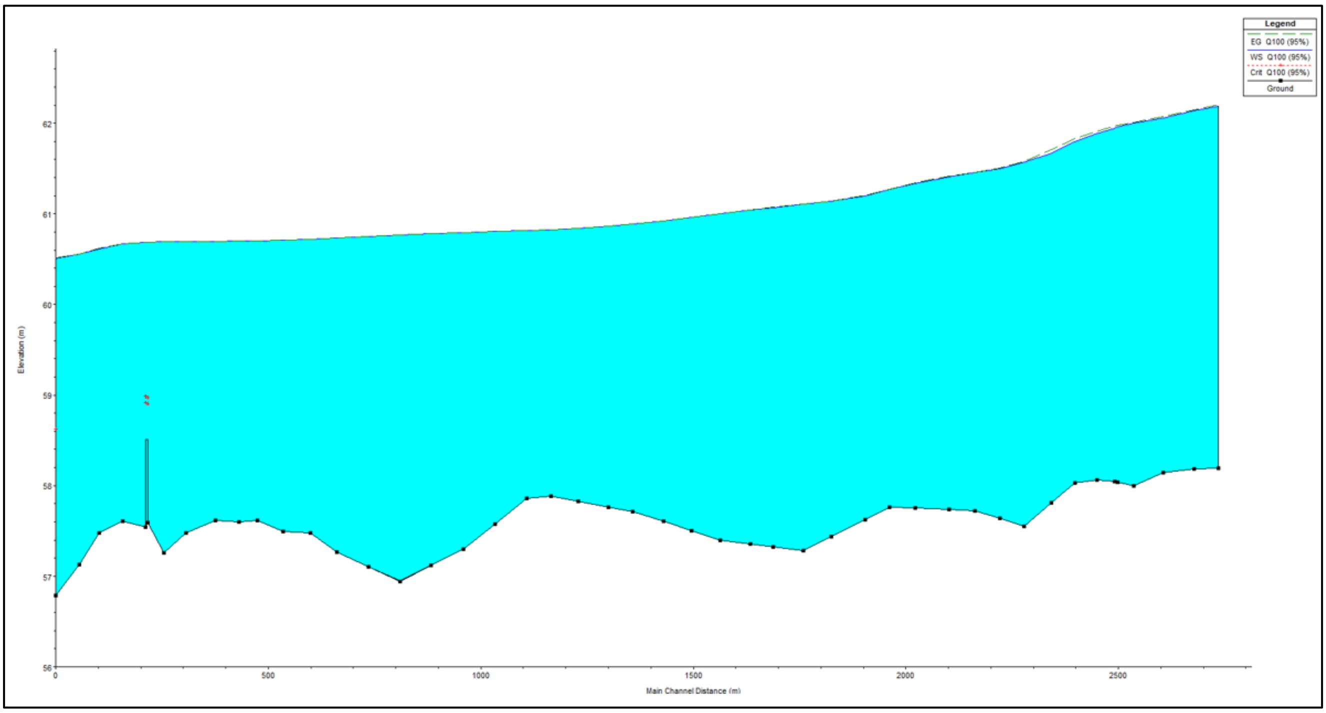


Figure 7-3: Longitudinal Section - 1% AEP + CC - Existing Scenario

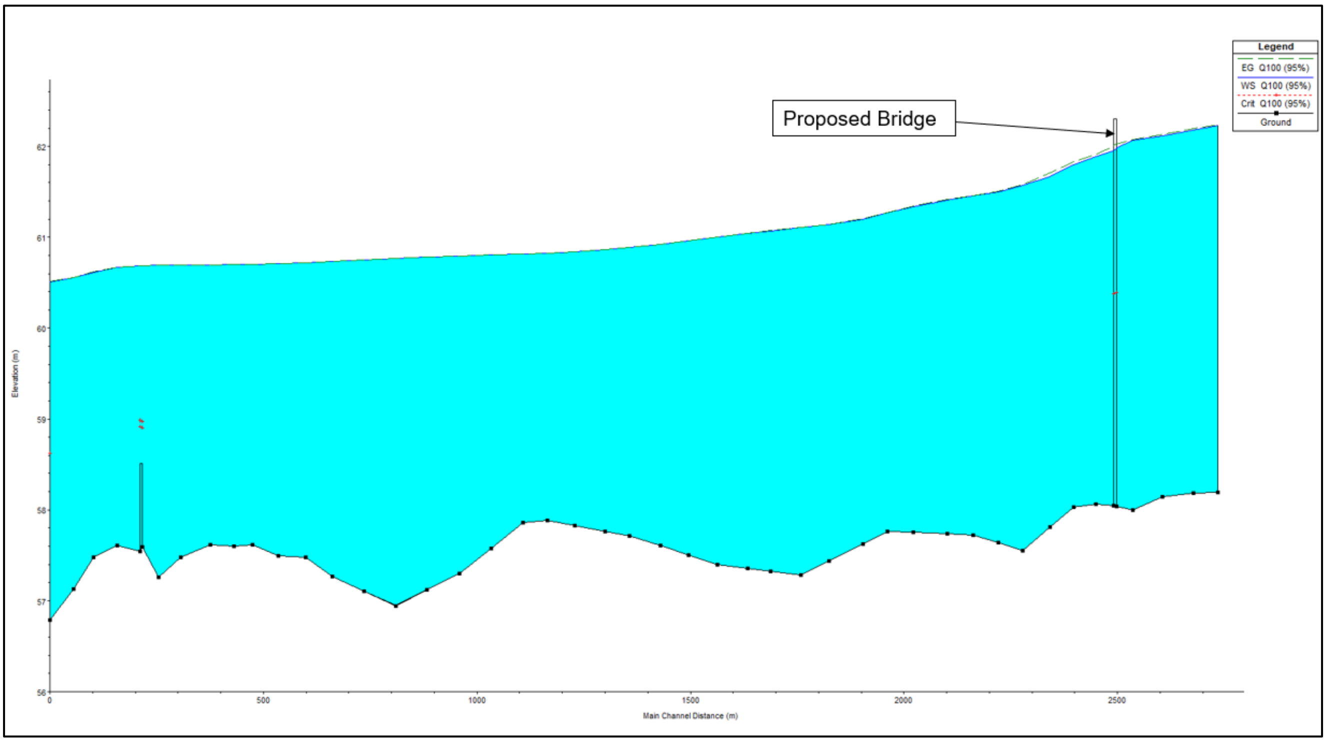


Figure 7-4: Longitudinal Section - 1% AEP+CC - Proposed Scenario

7.1.2.3 Flood Zone B

7.1.2.3.1 Comparison Between Existing and Proposed Scenarios with Proposed Bridge

Upon completion of the hydraulic modelling, a comparison has been undertaken between the water levels obtained from the existing and proposed scenarios. This comparison allowed for conclusions to be drawn regarding the potential impact of the proposed bridge. The table below compares the result of the existing and proposed scenarios at each cross-section.

Table 7-5: Water Level Comparison - Existing VS Proposed -0.1%AEP + CC

River Station	Location	ES	PS	Diff (PS-ES)	Observations
		W.S. Elev	W.S. Elev	W.S. Elev	
2735.71	Upstream	62.19	62.23	0.04	Slight increase of water level
2678.54	Upstream	62.14	62.18	0.04	Slight increase of water level
2604.7	Upstream	62.06	62.12	0.06	Slight increase of water level
2535.23	Upstream	62.00	62.07	0.07	Slight increase of water level
2498.64	Upstream	61.96	61.98	0.02	Slight increase of water level
2494.67	Proposed Bridge				
2490.7	Development	61.95	61.95	0	No variation of water level
2450.07	Development	61.89	61.89	0	No variation of water level
2397.96	Development	61.80	61.80	0	No variation of water level
2342.83	Development	61.67	61.67	0	No variation of water level

*The model extends further downstream but only the relevant cross sections have been shown in this Table

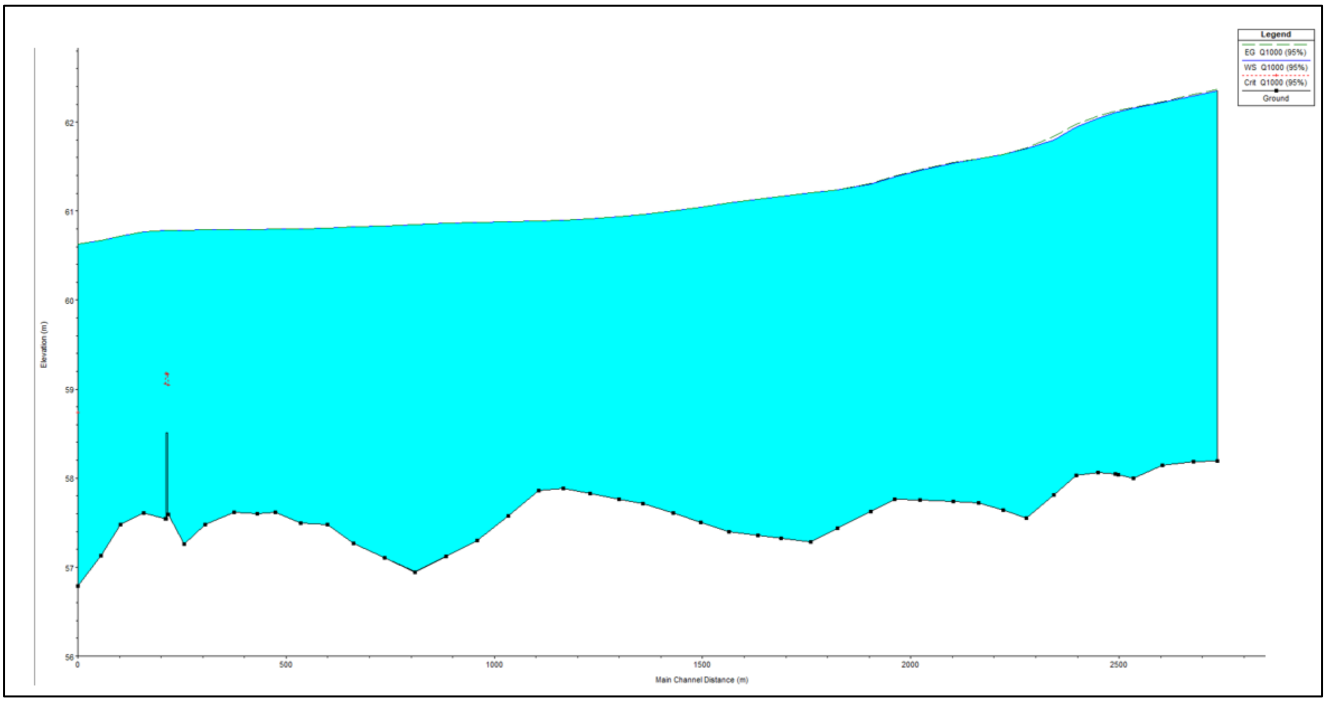


Figure 7-5: Longitudinal Section -0.1% AEP +CC - Existing Scenario

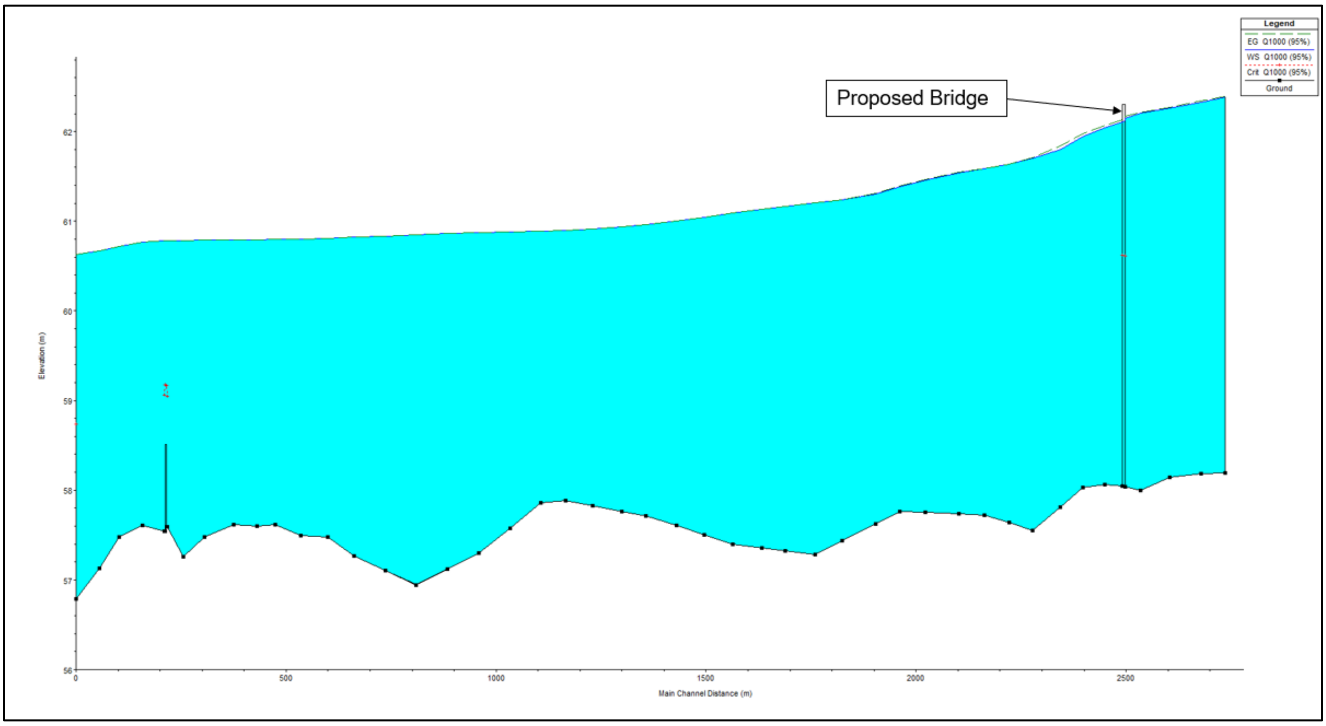


Figure 7-6: Longitudinal Section - 0.1% AEP + CC - Proposed Scenario

7.2 Turbine Delivery Route-Daingean River

A site-specific hydraulic model was developed as part of this FRA to quantify the flood levels at the TDR watercourse crossing and to design the proposed bridge. Hydrological and hydraulic analysis were undertaken along the specific reach of the Hydrological Features to enable the delineation of appropriate flood zones.

In order to undertake the hydraulic modelling, the peak flood flow was estimated along one Hydrological Estimation Flows (HF's) as per the following figure below. The estimated peak flow, in conjunction with a digital terrain model (DTM) were used to generate the flood extent and flood depth maps for 1% AEP (annual exceedance probability) and 0.1%AEP.

The Hydrological Estimation Flow is located downstream of the existing bridge, which is approximately 35 m downstream of the proposed bridge crossing.

Figure 7-7: Location of the Hydrological Estimation Flow (HEF-1)

7.2.1 Hydrology Analysis

The TDR watercourse crossing is located within an ungauged catchment; therefore, the flow estimations are based on ungauged methods. The FSU method was considered to estimate the peak flow of the watercourse as per OPW guidelines and in particular the FSU-7 Variable Equation was applied. This method is recommended for catchment sizes over 25 km2 and estimates the flow (Qmed) based on seven catchment descriptors.

The catchment descriptors are summarised in Table -7-6 below:

Table 7-6: Catchment Descriptors for the Hydrological Estimation Flow Locations

Feature ID	Area	BFSOIL	SAAR	FARL	DRAIND	S1085	ARTDRAIN	URBEXT
	Km2		mm		Km/Km2	m/km		
HEF-1	49.25	0.608	841.37	1	0.612	1.288	0	0.0075

The Hydrology Analysis will be conducted to ascertain the flow values corresponding to the Annual Exceedance Probabilities (AEP) of 1% and 0.1%, plus 20% of Climate Change. This analysis aims to simulate a flooding event and generate flood zone scenarios A and B. Below the Table 7-7 shows these flow values for the different return periods.

Table 7-7: Flood Estimations for the different return periods

Hydrological Estimation Flows	AEP (%)	
	1% AEP +20 % CC (m3/s)	0.1%AEP +20%CC (m3/s)
HEF-1	21.10	27.11

7.2.2 Hydraulic Analysis

7.2.2.1 Model Details

A flood model of the Daingean River in the vicinity of the TDR river crossing was constructed using the software package HEC-RAS.

The primary inputs into the HEC-RAS Model are summarised below:

- Geometric Data:
  Daingean River- channel cross sections and part of the flood plain. Surveyed in February 2025.

  Terrain: DTM.
- Inflow Data - estimated using the FSU- 7 Variable Equation:
  100-year Mid-Range Future Scenario.
  1000-year Mid-Range Future Scenario.
- Boundary Conditions:
  HEF-1 Flow applied at the upstream end of the model.

Normal depth (downstream channel).

The proposed bridge is designed for the 100 years return period (1% AEP) with a 20% inclusion for climate change and aims to have a minimal impact on the flood levels upstream and downstream of the structure. This consists of a single span bridge with a span of 20.00 m and a minimum soffit level of 70.61 m OD to provide a minimum freeboard of 300 mm as per the OPW requirements. The 0.1 % AEP (1 in 1000 years) was also modelled in order to map the flood zones A and B.

As the TDR crosses a flood plain and in order to minimise the impact on the existing flood levels, five flood relief culverts were also modelled together with the bridge. These culverts consist of five 900 mm dia. Pipes.

The Manning's values for the river channel and flood plain were determined by identifying the different type of materials encountered during a site survey where photos were taken; this assisted in selecting the appropriate manning's coefficient from the Hec-Ras Reference Manual. The contraction and expansion coefficients utilized were likewise drawn from the recommendations of the same manual.

Table 7-8: Design parameter used in the Hydraulic Analysis.

Parameter	Value	Source
Manning's Value (Channel)	0.08	Hec-Ras Reference Manual
Manning's Value (Flood Plain)	0.045	Hec-Ras Reference Manual
Contraction Coefficient	0.1	Hec-Ras Reference Manual
Expansion Coefficient	0.3	Hec-Ras Reference Manual

Two separate scenarios were modelled to compare the existing conditions or pre-development and post-development scenario which includes the proposed bridge and the access track leading to it.

7.2.2.2 Flood Zone A

7.2.2.2.1 Comparison Between Existing and Proposed Scenarios with Proposed Bridge

Upon completion of the hydraulic modelling, a comparison has been undertaken between the water levels obtained from the existing and proposed scenarios. This comparison allowed for conclusions to be drawn regarding the potential impact of the proposed bridge and access track. The table below compares the result of the existing and proposed scenarios at each cross-section.

Table 7-9: Water Level Comparison – Existing VS Proposed - 1% AEP+ CC

River Station	Location	ES	PS	Diff (PS-ES)	Observations
		W.S. Elev	W.S. Elev	W.S. Elev	
505.91	Upstream	70.42	70.42	0.02	Negligible increase in water level
455.88	Upstream	70.35	70.36	0.01	Negligible increase in water level
405.01	Upstream	70.33	70.34	0.02	Negligible increase in water level
389.99	Upstream	70.31	70.33	0.02	Negligible increase in water level
382.49	Upstream	70.31	70.32	0.02	Negligible increase in water level
375.95	Upstream	70.30	70.32	0.01	Negligible increase in water level
371.05	Proposed Bridge + Flood Relief Culverts				
366.15	Downstream	70.3	70.3	0.00	No variation of water level
356.15	Downstream	70.3	70.3	0.00	No variation of water level
346.15	Downstream	70.3	70.3	0.00	No variation of water level

*The model extends further upstream and downstream but only the relevant cross sections have been shown in this Table

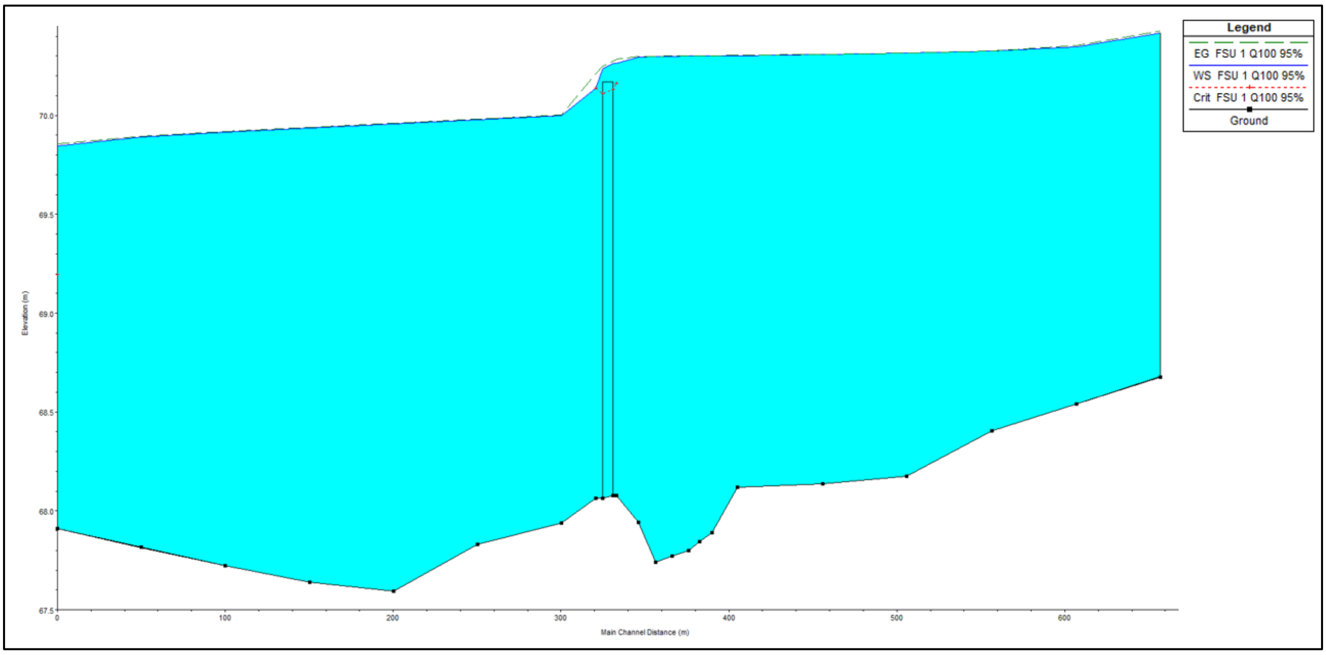


Figure 7-8: Longitudinal Section - 1% AEP + CC - Existing Scenario

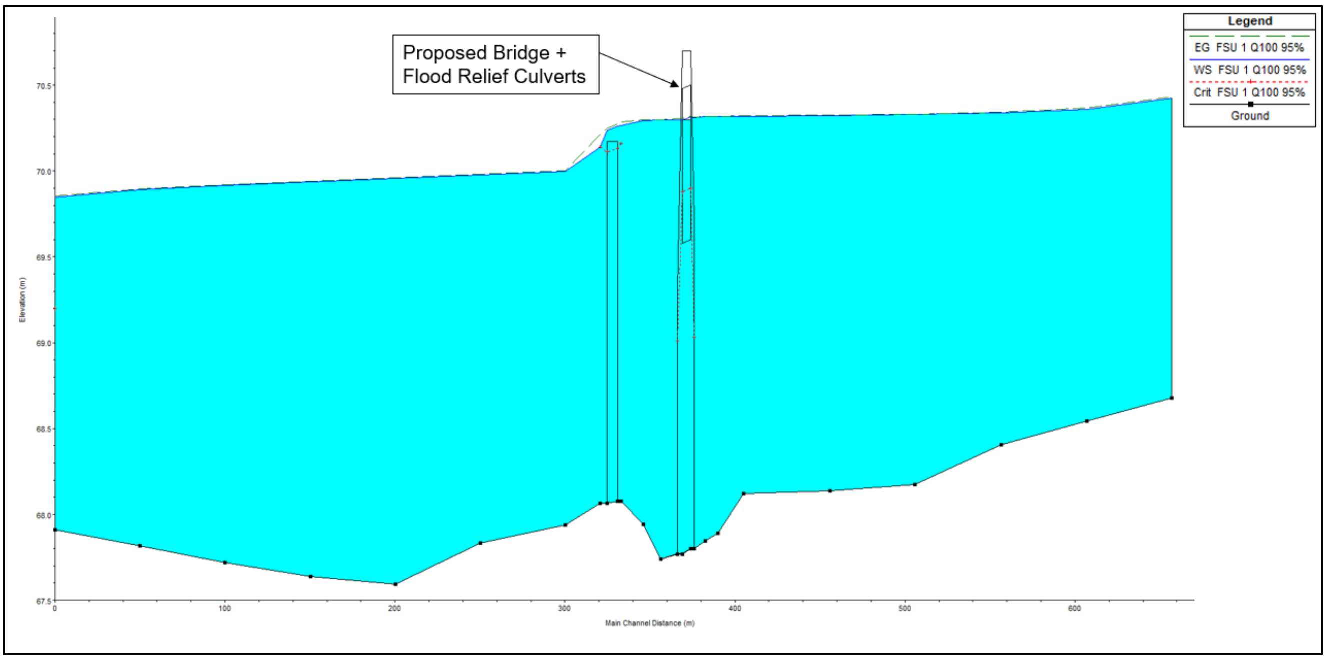


Figure 7-9: Longitudinal Section - 1% AEP+CC - Proposed Scenario

7.2.2.3 Flood Zone B

7.2.2.3.1 Comparison Between Existing and Proposed Scenarios with Proposed Bridge

Upon completion of the hydraulic modelling, a comparison has been undertaken between the water levels obtained from the existing and proposed scenarios. This comparison allowed for conclusions to be drawn regarding the potential impact of the proposed bridge. The table below compares the result of the existing and proposed scenarios at each cross-section.

Table 7-10: Water Level Comparison - Existing VS Proposed -0.1%AEP + CC

River Station	Location	ES	PS	Diff (PS-ES)	Observations
		W.S. Elev	W.S. Elev	W.S. Elev	
505.91	Upstream	70.36	70.37	0.01	Negligible increase in water level
455.88	Upstream	70.35	70.36	0.01	Negligible increase in water level
405.01	Upstream	70.35	70.36	0.01	Negligible increase in water level
389.99	Upstream	70.35	70.36	0.01	Negligible increase in water level
382.49	Upstream	70.35	70.36	0.01	Negligible increase in water level
375.95	Upstream	70.34	70.35	0.01	Negligible increase in water level
371.05	Proposed Bridge + Flood Relief Culverts				

River Station	Location	ES	PS	Diff (PS-ES)	Observations
		W.S. Elev	W.S. Elev	W.S. Elev	
366.15	Downstream	70.34	70.34	0	No variation of water level
356.15	Downstream	70.34	70.34	0	No variation of water level
346.15	Downstream	70.34	70.34	0	No variation of water level

*The model extends further upstream and downstream but only the relevant cross sections have been shown in this Table

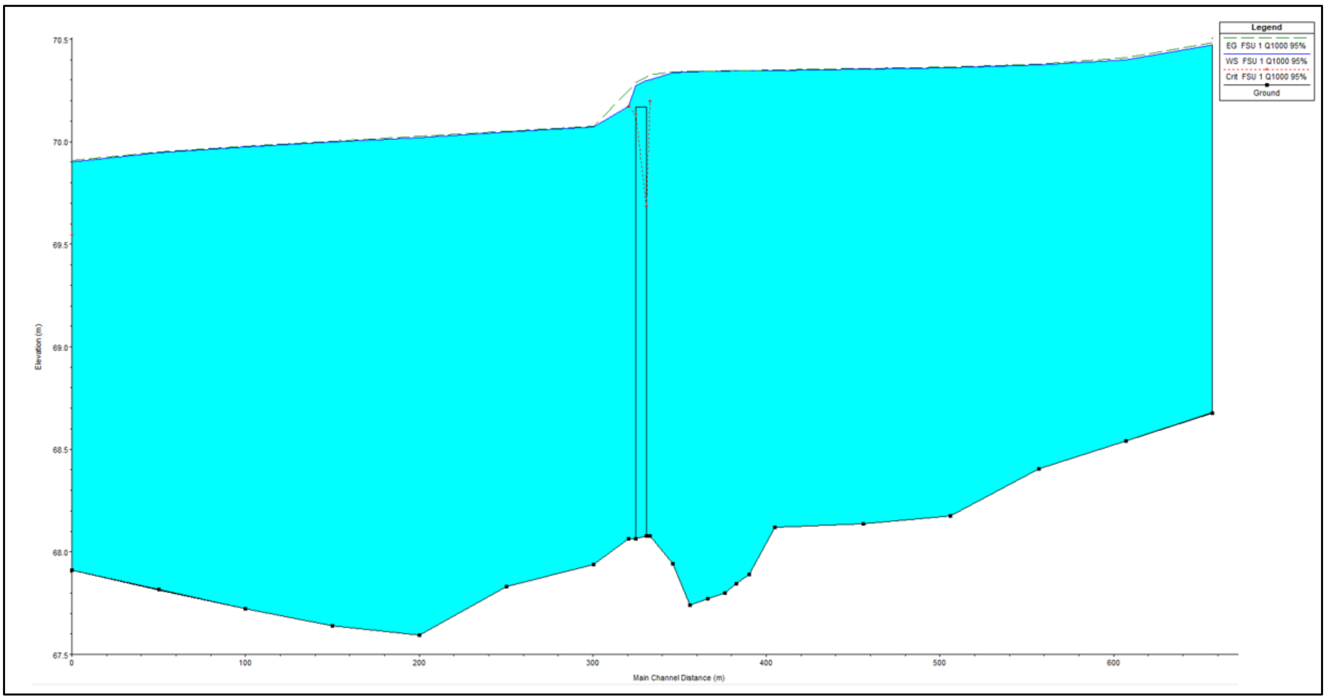


Figure 7-10: Longitudinal Section -0.1% AEP +CC - Existing Scenario

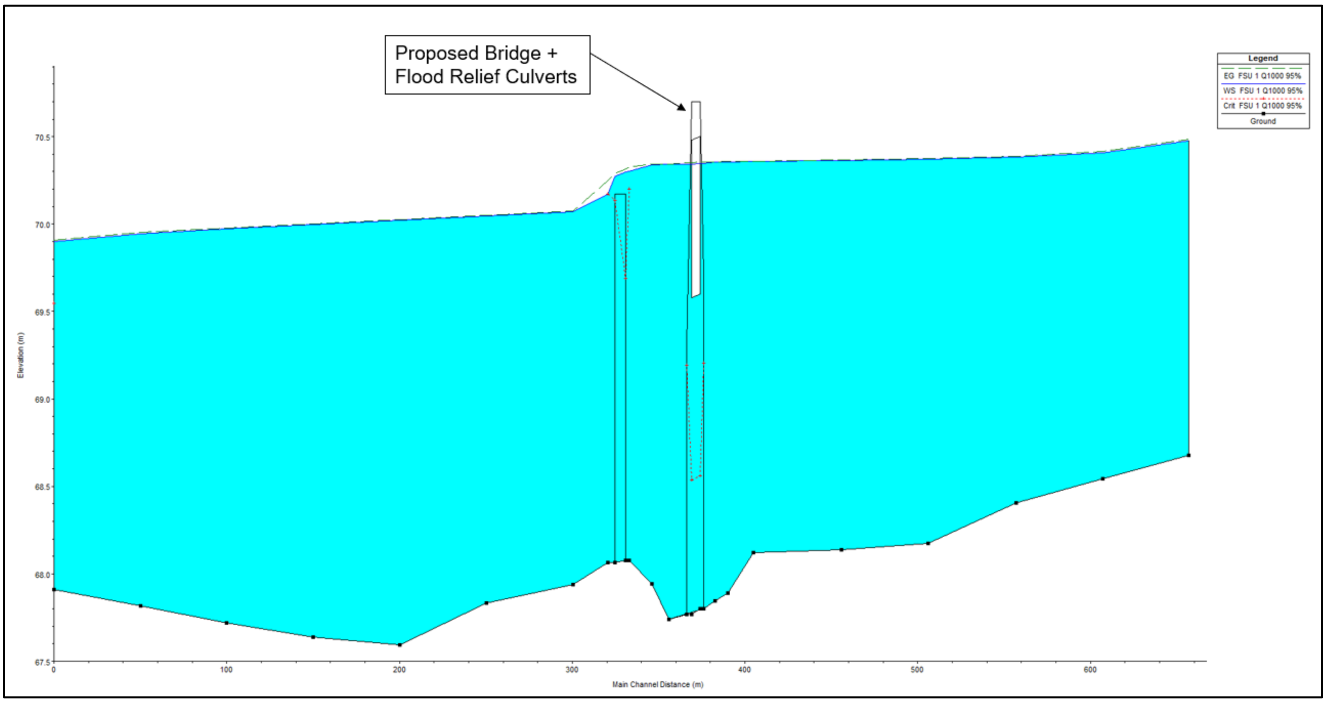


Figure 7-11: Longitudinal Section - 0.1% AEP + CC - Proposed Scenario

8. MITIGATION MEASURES

Some areas of the proposed development as well as a section of the TDR are within the Flood Zones A and B; therefore, mitigation measures have been proposed to reduce the flood risk to the development, the TDR and elsewhere. The following measures have been included:

- The proposed bridge that crosses the Cushina River has been designed with a minimum freeboard of 300 mm between the 1% AEP +CC flood level and the bridge deck to reduce the likelihood of debris blockage and also allows for uncertainties in hydrological and hydraulic design calculations. Sufficient span has been designed to minimise the afflux.
- The proposed bridge for the section of the TDR crossing the Deangean River has been designed following the same principles as the other bridge; however, flood relief culverts have also been included, as the TDR crosses a floodplain in this area.
- Some wind farm infrastructure, such as certain access tracks and turbines, is located within Flood Zones A and B. To minimise any impact on existing flood levels, the access tracks and hardstanding areas within these zones will be constructed at ground level. For turbines located within or very close to flood zones—such as T1, T4, T5, T8, and T9—the plinths to which the towers will be bolted will be raised above the design flood levels with a minimum clearance of 500 mm. This will guarantee that the critical electrical and mechanical components housed in the base of the turbine tower will be protected.
- Other essential and critical elements of the proposed development such as the susbstation and the grid connection route joint bays will be placed outside of the flood zones.
- The proposed drainage design for the various elements of the wind farm aims to replicate the existing hydrological regime of the catchment as closely as possible. The proposed outfalls will discharge to the same catchments or watercourses as they would have prior to the development. On one hand, overland flow is collected by interceptor drains and discharged to the nearest watercourse or over the ground through outfall diffusers. Check dams are also incorporated into the interceptor drains where required on steep slopes to slow down velocities, and the outfall diffusers help distribute and slow down the discharge. On the other hand, surface water from the access tracks and other hardstanding areas will be collected by a swale and conveyed to settlement ponds, with an outfall diffuser to discharge into the nearest watercourse or over the ground. Although the primary function of the settlement ponds is to separate particles and reduce pollution, the settlement ponds along with the outfall diffuser will also help slow down velocities and provide some attenuation.
- Monitoring and maintenance of the proposed bridges, flood connectivity culverts and proposed drainage is required to reduce or minimise any residual risk.

9. JUSTIFICATION TEST

Box 5.1 Justification Test for development management (to be submitted by the applicant)	
1. The subject lands have been zoned or otherwise designated for the particular use or form of development in an operative development plan, which has been adopted or varied taking account of these Guidelines.	The proposed wind farm and the TDR watercourse crossing are located in unzoned rural areas. However, the site falls within the designated zoning areas for Wind Energy Development as defined in the respective County Councils' boundaries and in accordance with the Counties' Wind Energy Strategies: • Kildare County Council - Site falls within the 'Zone 1 - Acceptable in Principle'; and • Offaly County Council - Site falls within an area identified as 'Open to Consideration for Wind Energy Development'.
2. The proposal has been subject to an appropriate flood risk assessment that demonstrates:	
(i)The development proposed will not increase flood risk elsewhere and, if practicable, will reduce overall flood risk;	The proposed wind farm will slightly increase the water levels locally and within acceptable levels (<150 mm afflux as per OPW requirements) and the proposed TDR watercourse crossing will have a negligible impact on flood levels.
(ii)The development proposal includes measures to minimise flood risk to people, property, the economy and the environment as far as reasonably possible;	The proposed wind farm has been designed so that critical or essential infrastructure, such as the substation and the joint bays along the grid connection route, are located outside of flood zones. However, other elements of the development, such as some turbines and access tracks, are situated within flood-prone areas. In these cases, turbine plinths have been elevated above the 1-in-100-year flood level, accounting for the effects of climate change and incorporating a freeboard (clearance) of 500 mm. This design ensures that floodwaters will not impact the electrical or mechanical components of the turbines. Access tracks have not been raised above flood levels in order to avoid obstructing the floodplain and to preserve its storage capacity. Since these tracks will primarily be used for maintenance rather than emergency access, and during known weather conditions, this approach has been deemed acceptable.

Box 5.1 Justification Test for development management (to be submitted by the applicant)	
	The development does not increase the risk to human life, as access will be controlled and managed during adverse conditions. There will be no permanent human occupation within the flood zone. At the TDR watercourse crossing, which traverses a floodplain, five relief culverts have been designed alongside the proposed bridge to minimize any impact on existing flooding conditions. All proposed bridges, both for the wind farm and the TDR watercourse crossing, have been designed to comply with OPW requirements. They are designed for a 1-in-100-year return period, including a 20% allowance for climate change, and a minimum freeboard of 300 mm.
(iii) The development proposed includes measures to ensure that residual risks to the area and/or development can be managed to an acceptable level as regards the adequacy of existing flood protection measures or the design, implementation and funding of any future flood risk management measures and provisions for emergency services access; and	The residual risks to the area and the proposed development can be managed to an acceptable level, as mitigation measures have been incorporated into the design. Access to essential infrastructure, such as the substation and joint bays for the grid connection, is possible outside of flood conditions. For other infrastructure located within flood zones, such as some turbines, access is only required for periodic maintenance, which will be restricted during flood events. Appropriate maintenance should be carried out on the proposed bridge, flood connectivity culverts, and drainage systems associated with the access roads and tracks.
(iv) The development proposed addresses the above in a manner that is also compatible with the achievement of wider planning objectives in relation to development of good urban design and vibrant and active streetscapes.	The Offaly and Kildare Wind Energy Strategies support this renewable energy source which can play a vital role in achieving national targets in relation to reductions in fossil fuel dependency and greenhouse emissions. The proposed development helps achieve this target.

10. CONCLUSION

This Site-Specific Flood Risk Assessment (SSFRA) has investigated the local hydrological conditions relevant to the proposed wind farm and the TDR watercourse crossing. The study indicates that the proposed development, including a section of the TDR, is susceptible to fluvial flooding during 1-in-100-year (Flood Zone A) flood events, as identified in Stage 1 – Flood Risk Identification and further analysed in Stage 2 – Initial Flood Risk Assessment. It was also established that the site is affected by pluvial flooding, as evidenced by historical records.

The areas particularly affected include turbines T1, T4, T5, T8, and T9, along with their associated access tracks, as well as other areas where localised impacts on access roads were identified. A proposed bridge crossing the River Cushina is necessary to access the turbines located on the southern side of the site and to facilitate the grid connection route.

As the proposed development is considered a 'Less Vulnerable Development' under the Planning Guidelines (with the exception of the substation and the joint bays of the grid connection), and some infrastructure lies within Flood Zone A, it was determined that a Justification Test is required in accordance with the Guidelines.

A Stage 3 Detailed Flood Risk Assessment was undertaken to establish design flood levels and assess any potential impacts that the proposed bridge structures—for both the wind farm and the TDR watercourse crossing—may have on existing flood conditions. Hydraulic modelling concluded that a single-span bridge of 19.0 m clear span is required to cross the River Cushina, while a 20.0 m clear span bridge with five flood relief culverts is required to cross the Daingean River and its associated floodplain.

Mitigation measures have been incorporated to minimise potential impacts, protect the proposed development and its surroundings, and reduce any residual flood risks. It is therefore considered that any residual risks associated with the development can be managed to an acceptable level and that the proposed works are not expected to have a negative impact on flood extents or levels either on-site or elsewhere. The increase in flood levels resulting from the inclusion of the proposed bridge and associated infrastructure is within acceptable limits and not considered significant. In the case of the TDR watercourse crossing, the increase in flood levels is considered negligible.

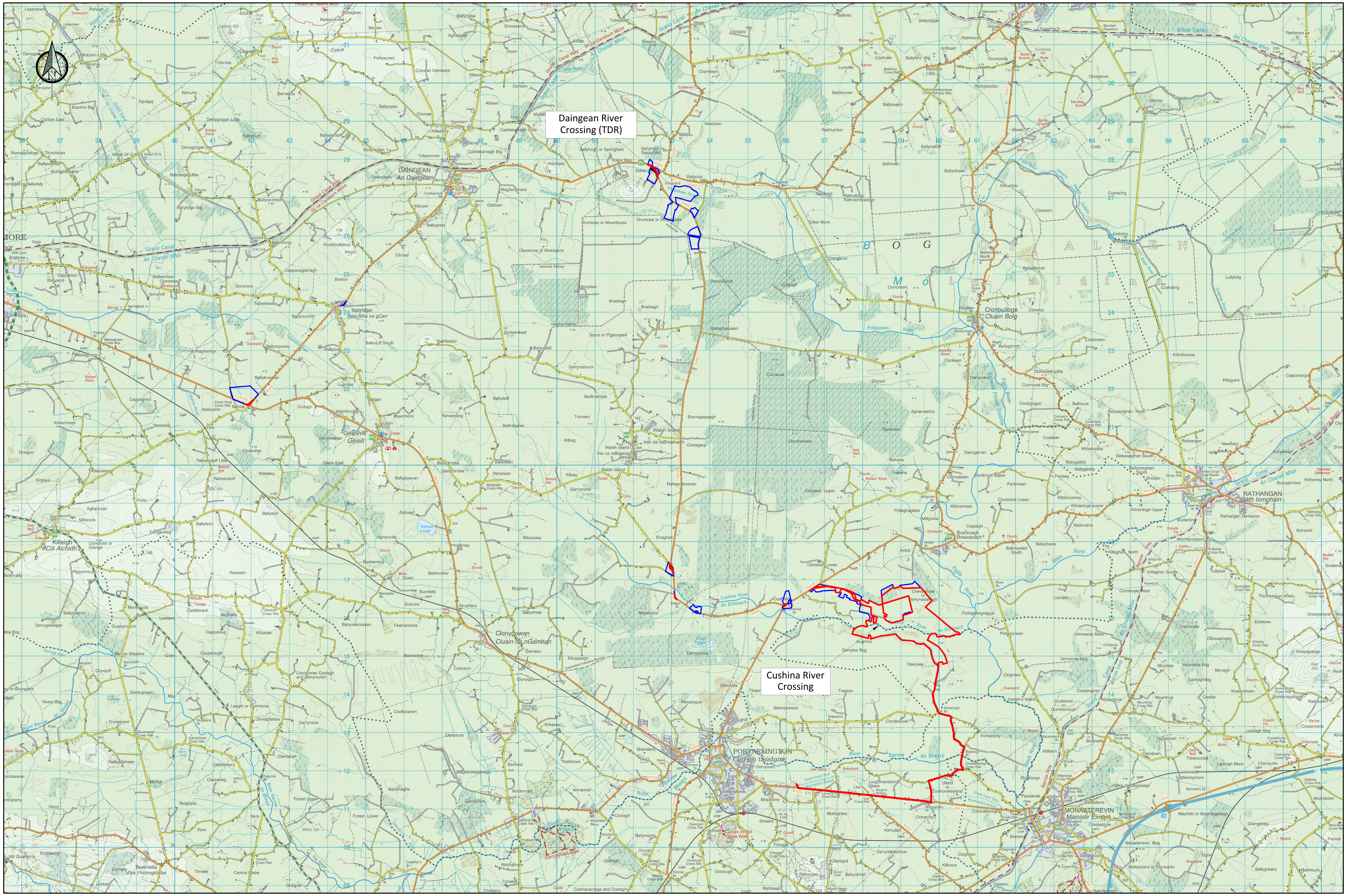
Accordingly, the proposed development is considered to comply with the core principles of the Planning System and Flood Risk Management Guidelines.

FEHILY TIMONEY

DESIGNING AND DELIVERING
A SUSTAINABLE FUTURE

APPENDIX 1

SITE LAYOUT PLAN



LEGEND:

Planning Site Boundary

Ownership Boundary

0m 500m 1000m 1500m 2000m 2500m 3000m 3500m 4000m 4500m 5000m

Scale 1:50000

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Rev.	Description	App By	Date
A	ISSUE FOR INFORMATION	JH	27.06.25

PROJECT

DERRYNADARRAGH WIND FARM

SHEET

PROJECT OVERVIEW

CLIENT

Dara Energy Limited

Date	Project number	Scale (@ A1-)
27.06.25	P22-145	1:50000

Drawn by	Drawing Number	Rev
CS	P22-145-INFO-0001 (Sheet set subset INFO)	A
Checked by SHS		

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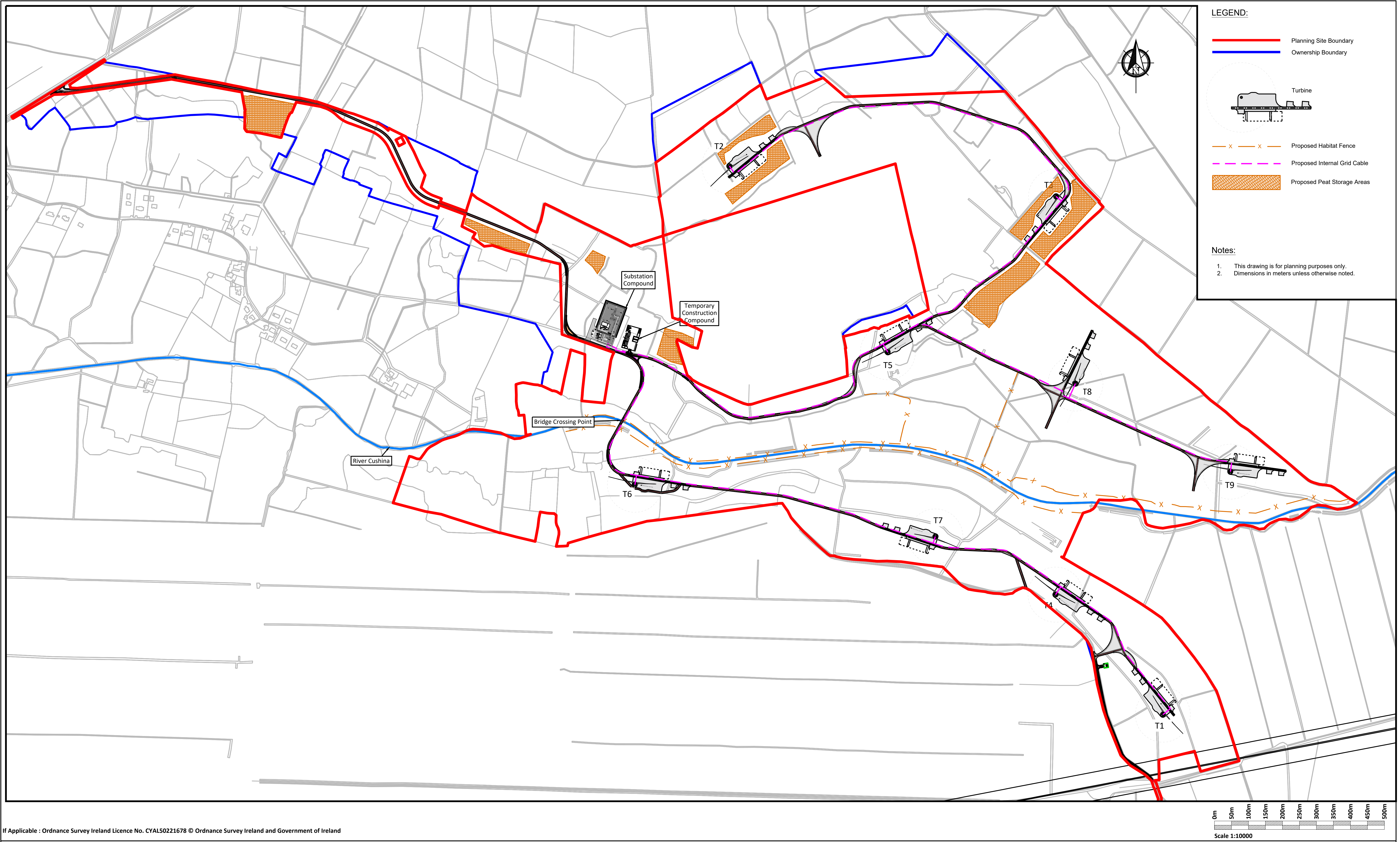
27 June 2025



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Rev.	Description	App By	Date
A	ISSUE FOR INFORMATION	JH	27.06.25

PROJECT

DERRYNADARRAGH WIND FARM

SHEET

1:10000 SITE LAYOUT

CLIENT

Dara Energy Limited

Date	Project number	Scale (@ A3-)	
27.06.25	P22-145	1:10000	
Drawn by	Drawing Number		Rev
CS	P22-145-INFO-0002		A
Checked by			
SHS			

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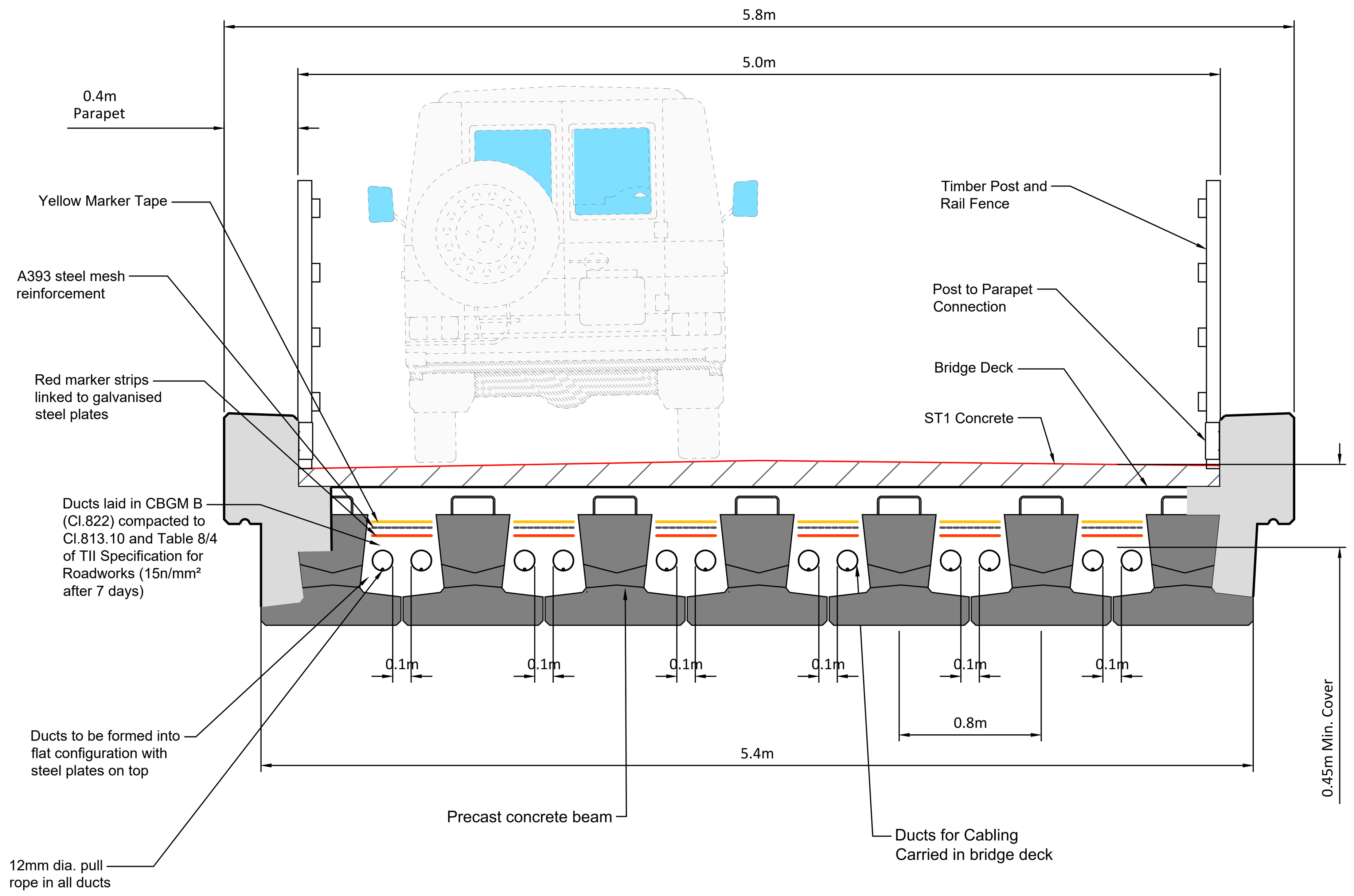
24 July 2025

FEHILY TIMONEY

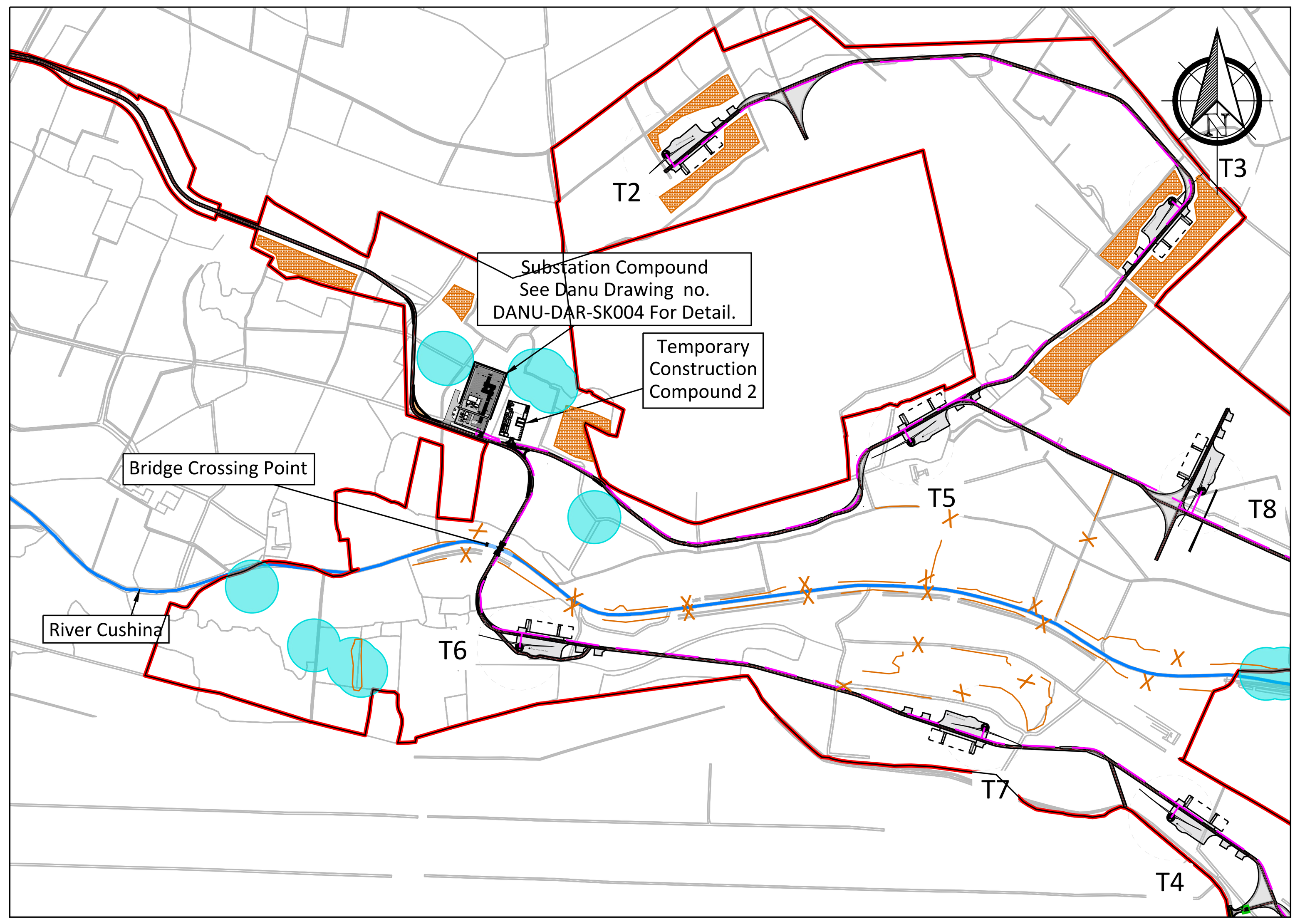
DESIGNING AND DELIVERING
A SUSTAINABLE FUTURE

APPENDIX 2

PROPOSED STRUCTURES



SECTION B-B
Scale 1:25

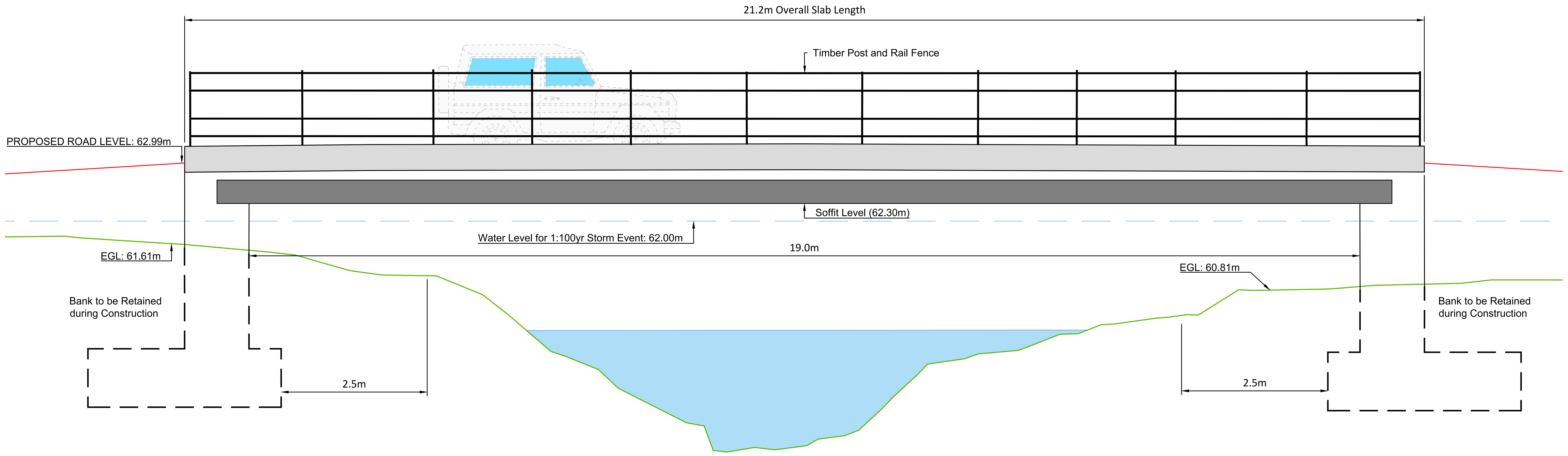


LOCATION PLAN
Scale 1:10000

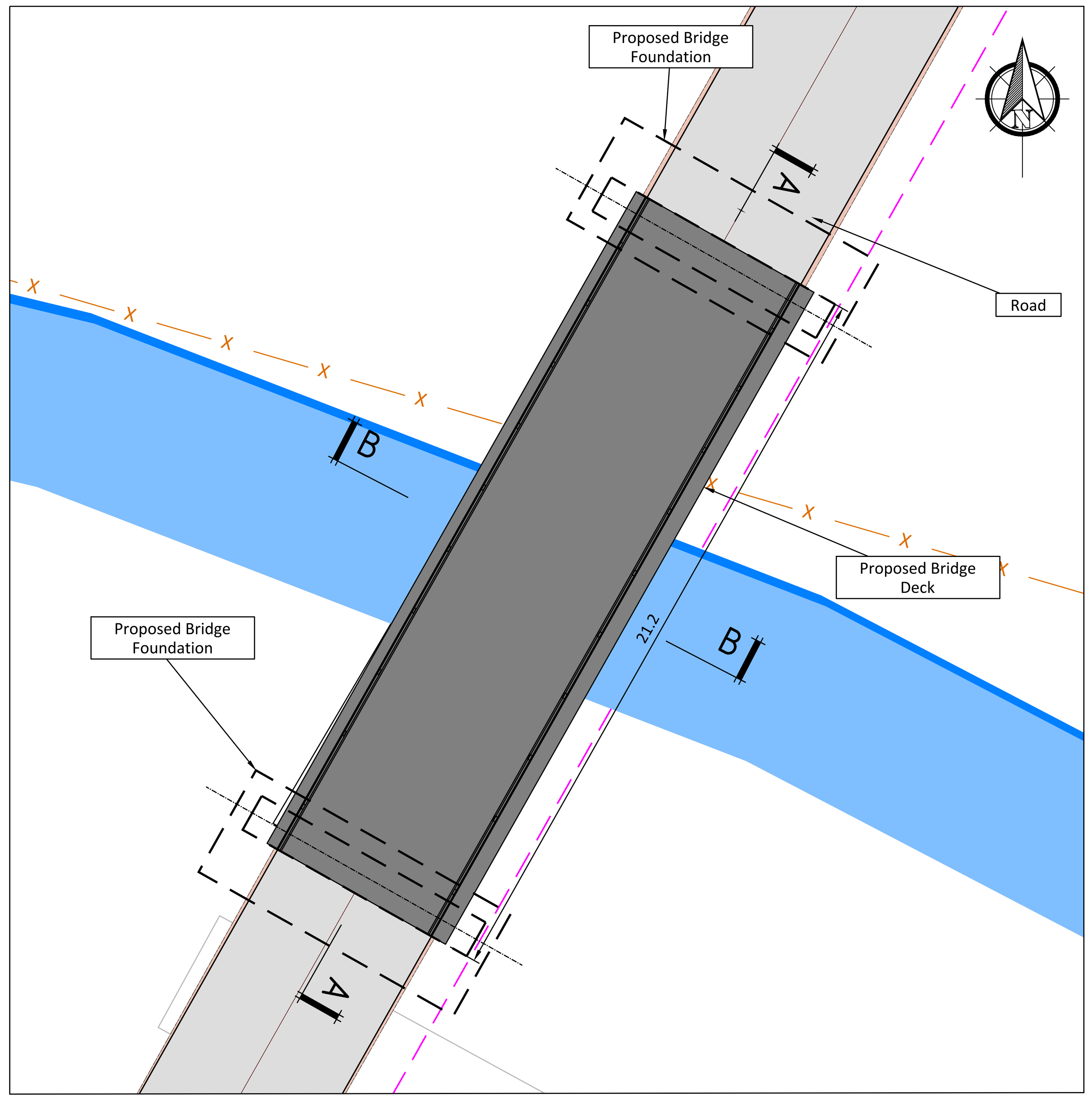
LEGEND:

- Planning Site Boundary
- Proposed Habitat Fence

Notes:
1. This drawing is for planning purposes only.
2. Dimensions in meters unless otherwise noted.
3. Levels shown relative to ordinance datum (Malin Head).
4. Co-ordinates are to Irish Transverse Mercator (ITM).
5. Extent of earthworks not shown.
6. Foundation to be designed according to geotechnical engineers, specification at detailed design.



SECTION A-A
Scale 1:50



BRIDGE PLAN
Scale 1:125

0m 1.3m 2.5m 3.8m 5.0m 6.3m 7.5m 8.8m 10.0m 11.3m 12.5m
Scale 1:125

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OSI 3497,3437,3376,3439,3550,3599,3600,3601,3657,3656

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Rev.	Description	App By	Date
A	ISSUE FOR CLIENT COMMENTS	JH	15.09.25

PROJECT: DERRYNADARRAGH WIND FARM

CLIENT: Dara Energy Limited

SHEET: PRELIMINARY DESIGN - CUSHINA BRIDGE CROSSING DETAIL

Date	Project number	Scale (@ A1-)
15.09.25	P22-145	1:10000

Drawn by	CS
Checked by	LD
Drawing Number	P22-145-0300-0001
Rev	A

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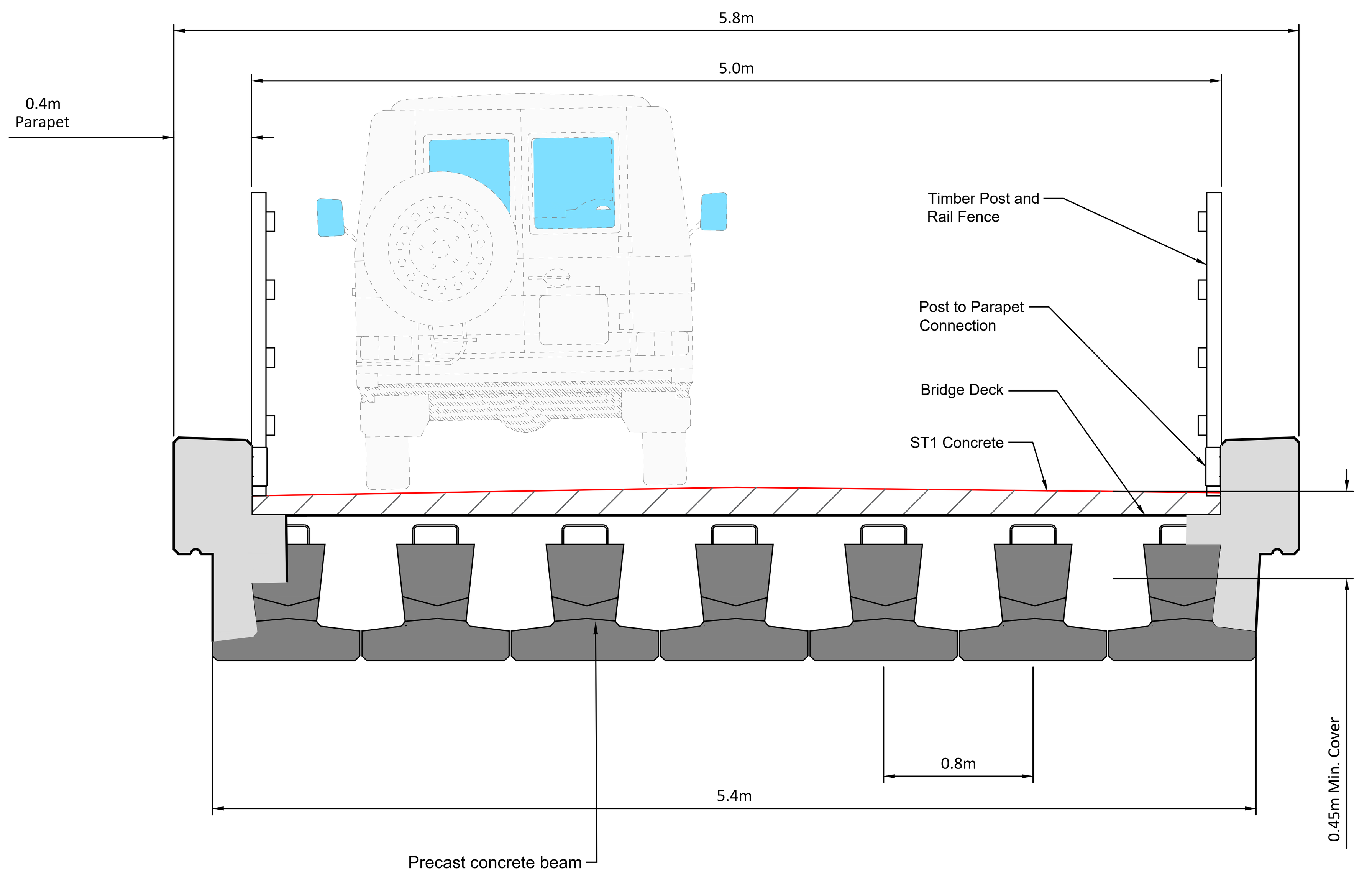
16 September 2025



SECTION B-B

Scale 1:25

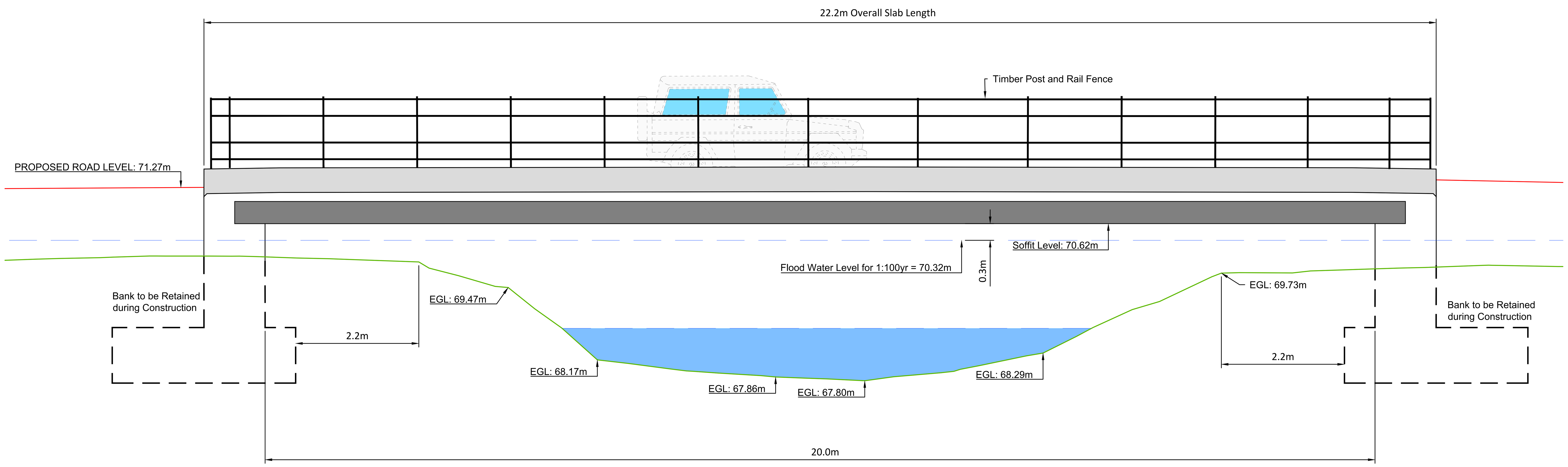
LOCATION PLAN

Scale 1:10000

LEGEND:

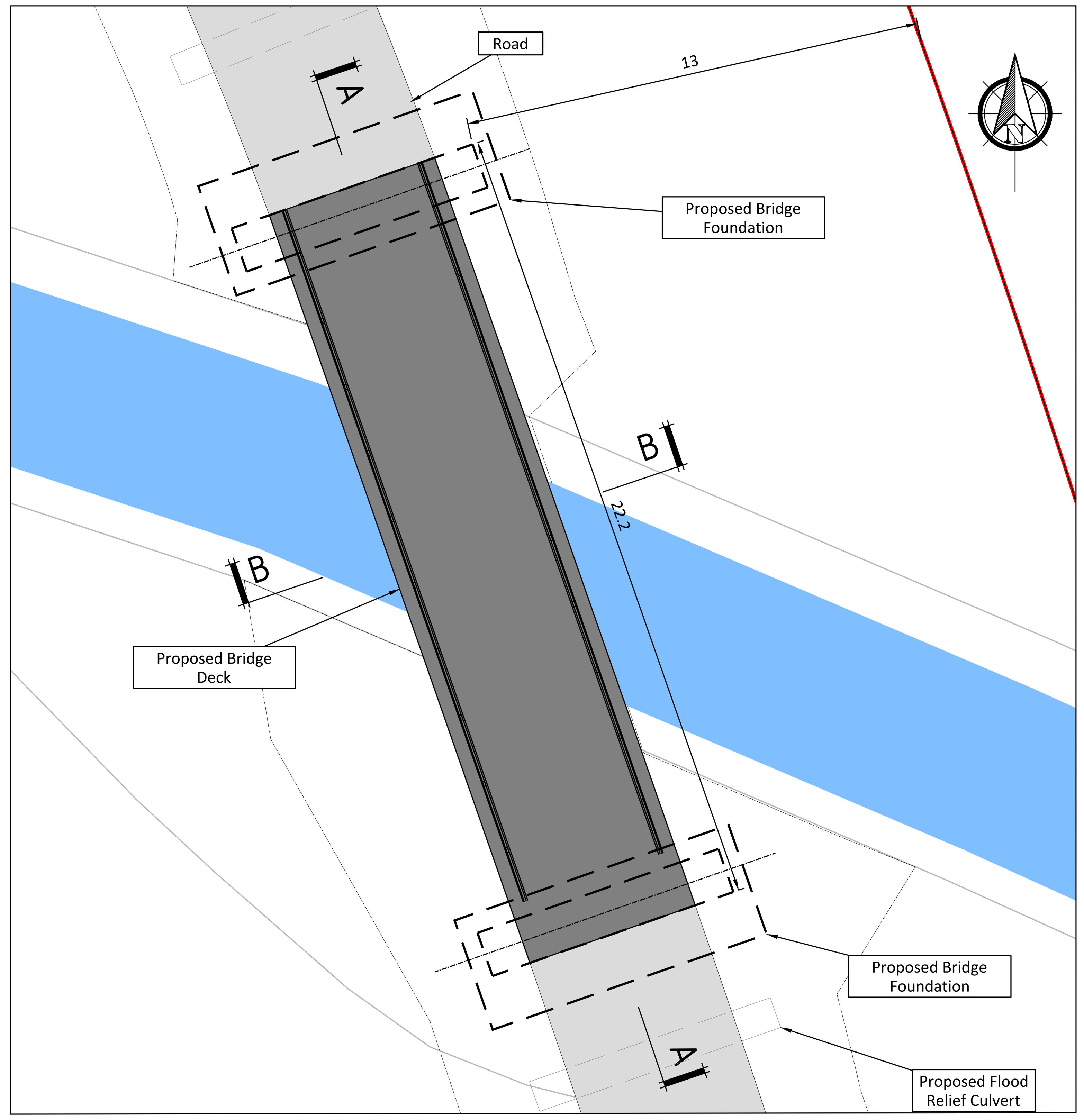
- Planning Site Boundary
- Ownership Boundary

Notes:
1. This drawing is for planning purposes only.
2. Dimensions in meters unless otherwise noted.
3. Levels shown relative to ordinance datum (Malin Head).
4. Co-ordinates are to Irish Transverse Mercator (ITM).
5. Extent of earthworks not shown.
6. Foundation to be designed according to geotechnical engineers, specification at detailed design.



SECTION A-A

Scale 1:50



BRIDGE PLAN

Scale 1:125

0m 1.2m 2.5m 3.7m 5.0m 6.2m 7.5m 8.7m 10.0m 11.2m 12.5m

Scale 1:125

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Rev.	Description	App By	Date
A	ISSUE FOR CLIENT COMMENTS	JH	15.09.25

PROJECT

DERRYNADARRAGH WIND FARM

CLIENT

Dara Energy Limited

SHEET

PRELIMINARY DESIGN - TDR BRIDGE CROSSING DETAIL - SHEET 1 OF 2

Date	15.09.25	Project number	P22-145	Scale (@ A1-)	As Shown
Drawn by	CS	Drawing Number	P22-145-0300-0002	Rev	A
Checked by	LD				

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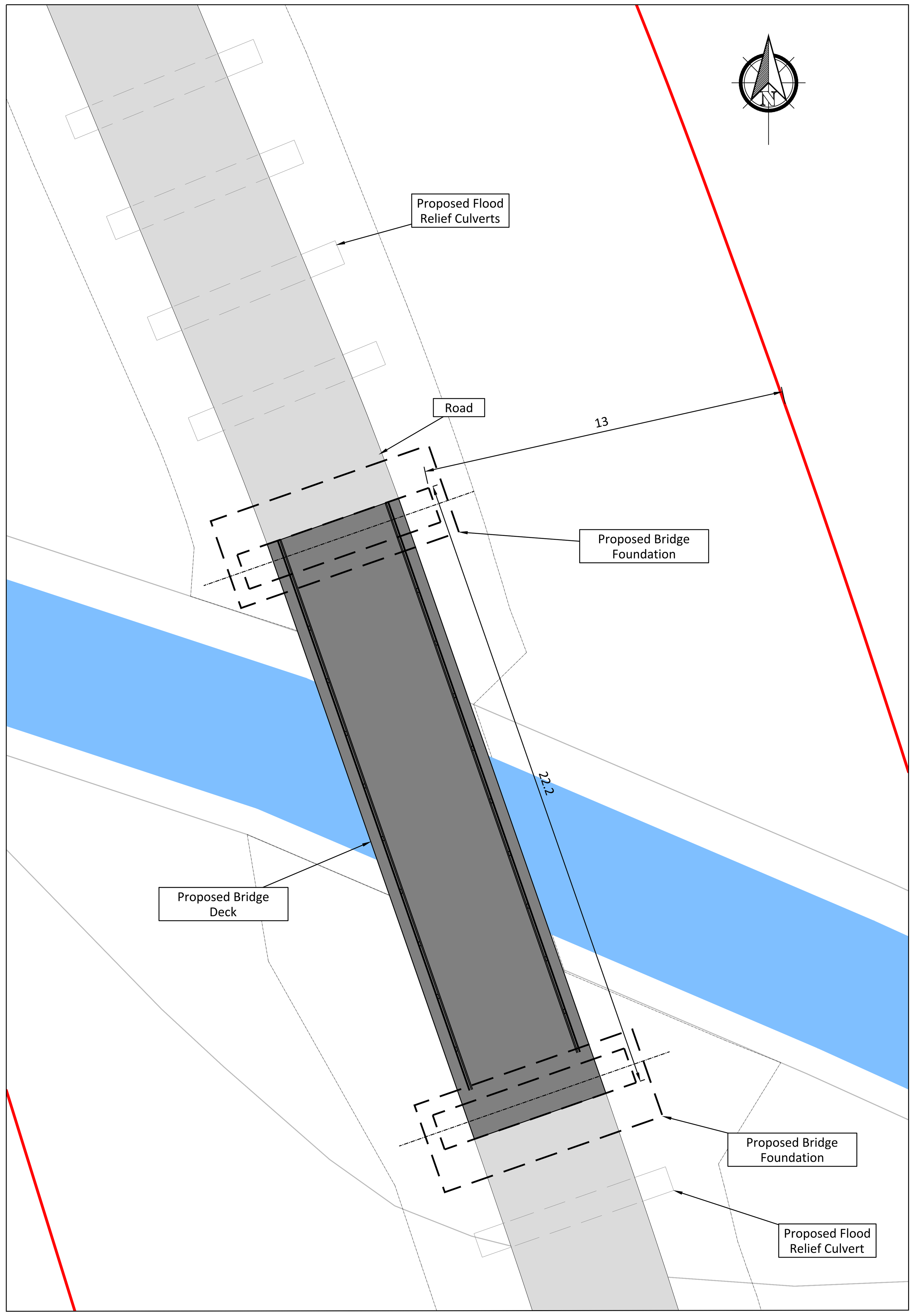
16 September 2025

LEGEND:

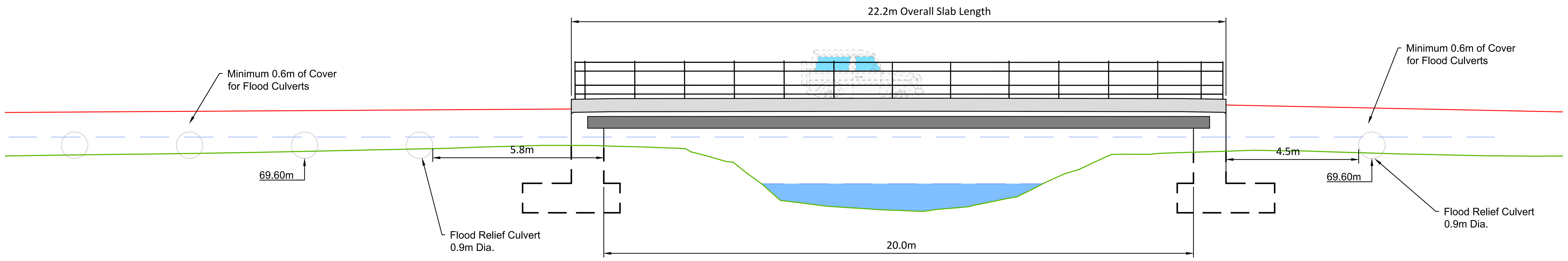
- Planning Site Boundary (red line)
- Ownership Boundary (blue line)

Notes:
1. This drawing is for planning purposes only.
2. Dimensions in meters unless otherwise noted.
3. Levels shown relative to ordinance datum (Malin Head).
4. Co-ordinates are to Irish Transverse Mercator (ITM).
5. Extent of earthworks not shown.
6. Foundation to be designed according to geotechnical engineers, specification at detailed design.



BRIDGE PLAN

Scale 1:125



SECTION

Scale 1:100

0m 1.2m 2.5m 3.7m 5.0m 6.2m 7.5m 8.7m 10.0m 11.2m 12.5m

Scale 1:125

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OSI 3497,3437,3376,3439,3550,3599,3600,3601,3657,3656

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Rev.	Description	App By	Date
A	ISSUE FOR PLANNING	JH	15.09.25

PROJECT: DERRYNADARRAGH WIND FARM

CLIENT: Dara Energy Limited

SHEET: PRELIMINARY DESIGN - TDR BRIDGE CROSSING DETAIL - SHEET 2 OF 2

Date	Project number	Scale (@ A1-)
15.09.25	P22-145	As Shown

Drawn by	Drawing Number	Rev
CS	P22-145-0300-0003	A

Checked by: LD

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16 September 2025

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DESIGNING AND DELIVERING
A SUSTAINABLE FUTURE

APPENDIX 3

HYDROLOGY ANALYSIS

Project	Derrynadaragh Wind Farm		
Subject	Flood Risk Assessment		
	Calculation of Flow Estimation		
Prepared by:	SH	Job No	P22-145
Checked by:	PD	Date	05/12/2023
Approved by:	PD	Revision	P01

1.0 PHYSICAL CATCHMENT DESCRIPTORS (PCD'S):

1.1 Hydrological PCD's

S1085 - Mainstream Slope	2.119 m/km	

1.2 Spatial PCD's

AREA - Catchment Area	83.68 km^2	
SAAR - Standard Annual Average Rainfall	827.12 mm	*
FARL - Flood Attenuation by Rivers and Lakes	1	

1.3 Spatial PCD's Representing Soil, Subsoil & Aquifer Types

BFI_{SOIL}	0.6069	*
URBEXT	0.001	*
SOIL		
DRAIND	0.577 km/km^2	
ARTDRAIN2	0	*

7.0 FSU - 7 VARIABLE EQUATION

$$QMED_{rural} = 1.237\times10^{-5}\ AREA^{0.937}\ BFIsoils^{-0.922}\ SAAR^{1.306}\ FARL^{2.217}\ DRAIND^{0.341}\ S1085^{0.185}\ (1+ARTDRAIN2)^{0.408}$$

$QMED_{RURAL}$ 7.640 m^3/s

$$QMED_{urban} = QMED_{rural}(1+URBEXT)^{1.482}$$

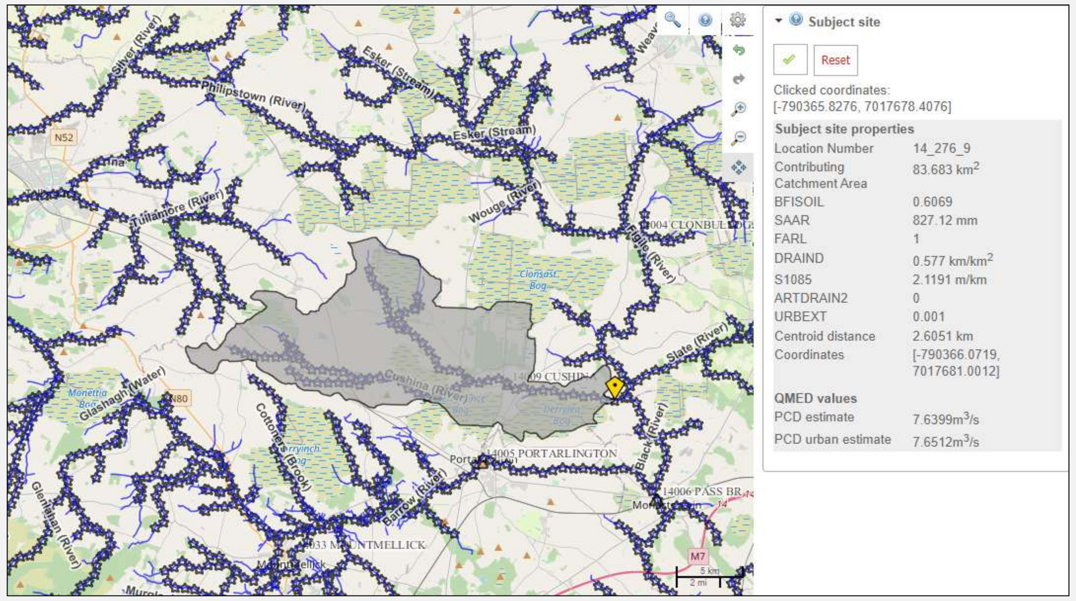
QMED 7.651 m^3/s

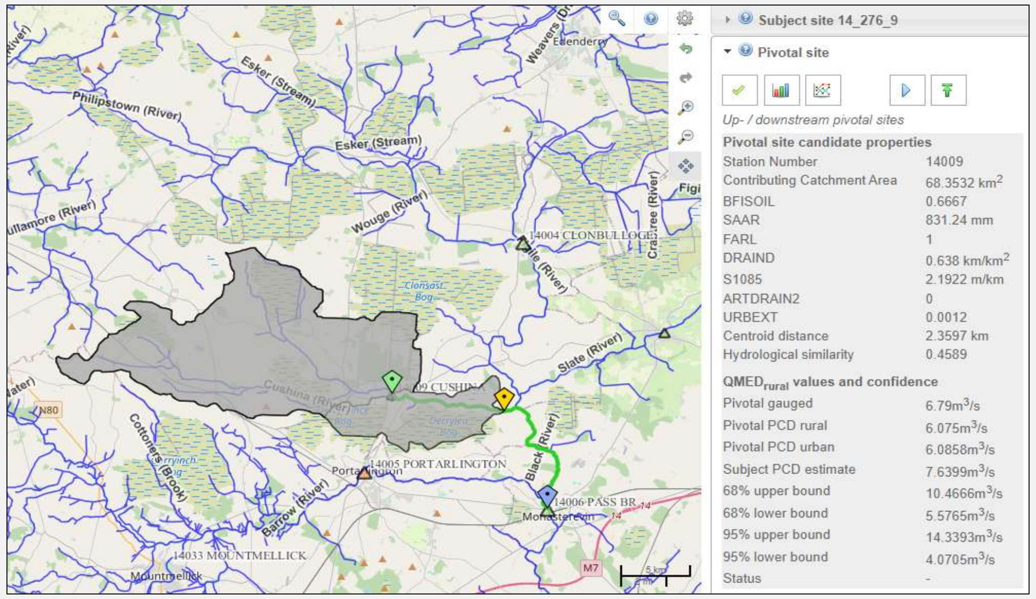
River Cushina

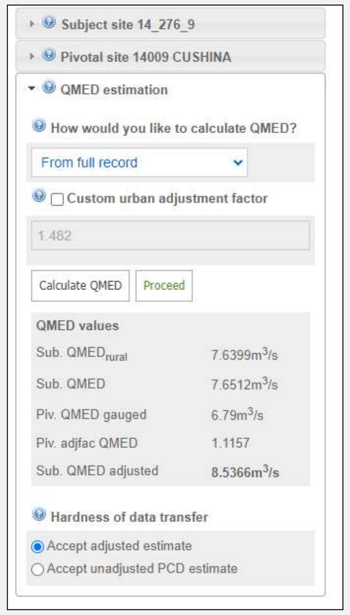
Using Pivotal/ Pooled Analysis Factors

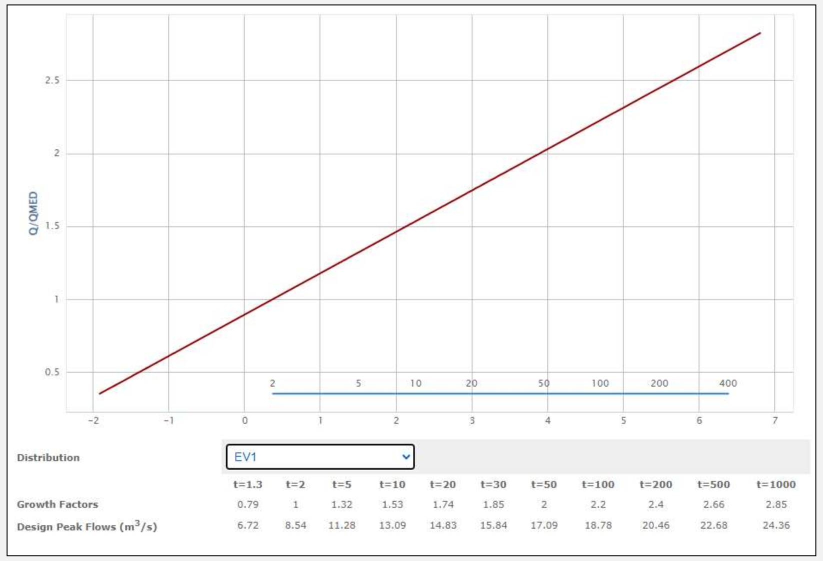
Calculation of Flow Estimation

Method	QMED	FSE	QMED (68% C.I.)	QMED (95% C.I.)	Growth Factor Q100	Growth Factor Q1000	FSU Adjustment Factor	Climate Change		Q100 Design Flow (95% C.I.)	Q1000 Design Flow (95% C.I.)
FSU - 7 Variable Equation	7.651 m3/s	1.37	10.48 m3/s	14.36 m3/s	2.2	2.85	1.116	1.2		42.30 m3/s	54.79 m3/s









Project	Derrynadaragh Wind Farm		
Subject	Flood Risk Assessment		
	Calculation of Flow Estimation		
Prepared by:	SH	Job No	P22-145
Checked by:	PD	Date	05/12/2023
Approved by:	PD	Revision	P01

1.0 PHYSICAL CATCHMENT DESCRIPTORS (PCD'S):

1.1 Hydrological PCD's

S1085 - Mainstream Slope	0.560	m/km	

1.2 Spatial PCD's

AREA - Catchment Area	521.71	km^2	
SAAR - Standard Annual Average Rainfall	829.34	mm	*
FARL - Flood Attenuation by Rivers and Lakes	0.999		

1.3 Spatial PCD's Representing Soil, Subsoil & Aquifer Types

BFI_{SOIL}	0.5981		*
URBEXT	0.0132		*
SOIL			
DRAIND	0.508	km/km^2	
ARTDRAIN2	0		*

7.0 FSU - 7 VARIABLE EQUATION

$$QMED_{rural} = 1.237x10^{-5}\ AREA^{0.937}\ BFIsoils^{-0.922}\ SAAR^{1.306}\ FARL^{2.217}\ DRAIND^{0.341}\ S1085^{0.185}\ (1+ARTDRAIN2)^{0.408}$$

$QMED_{RURAL}$ 32.242 m^3/s

$$QMED_{urban} = QMED_{rural}(1+URBEXT)^{1.482}$$

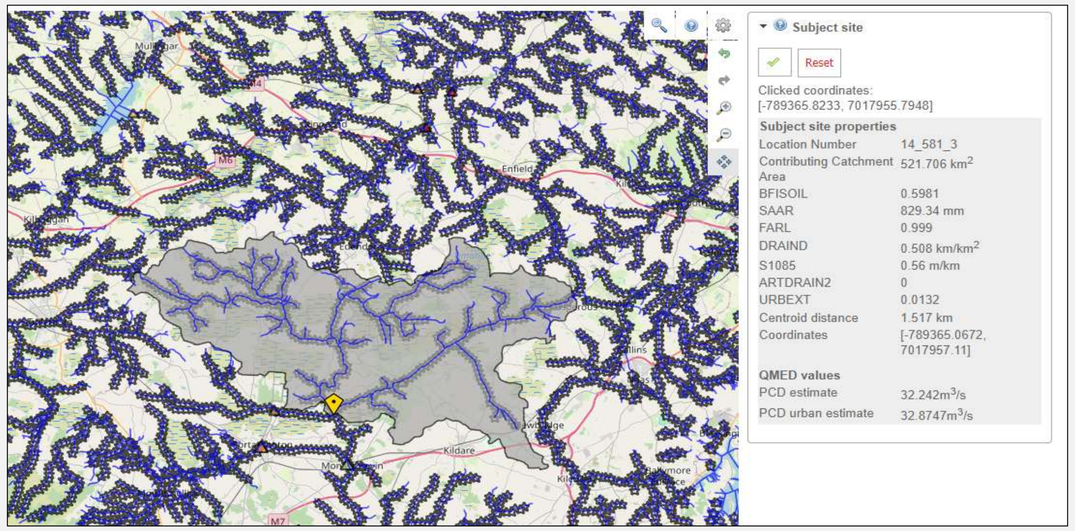
$QMED$ 32.875 m^3/s

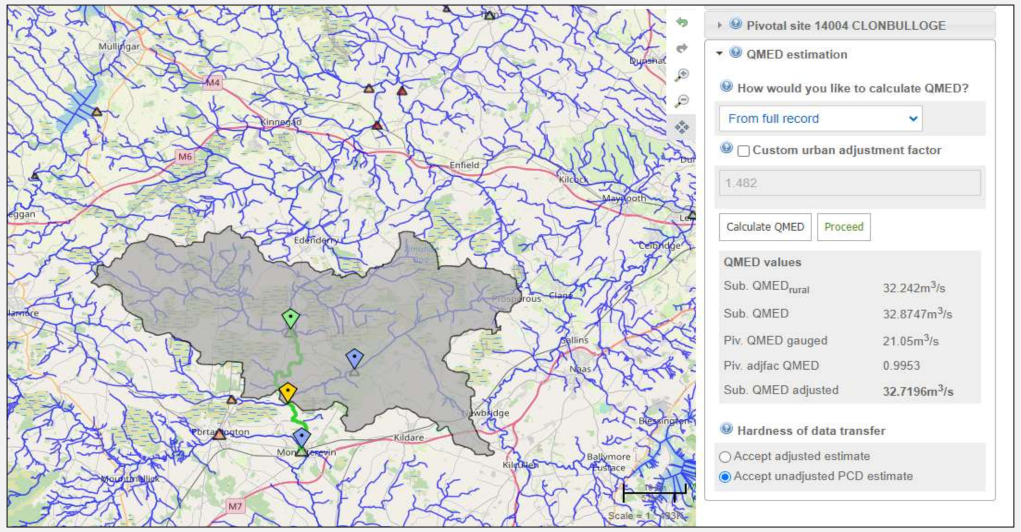
River Figile

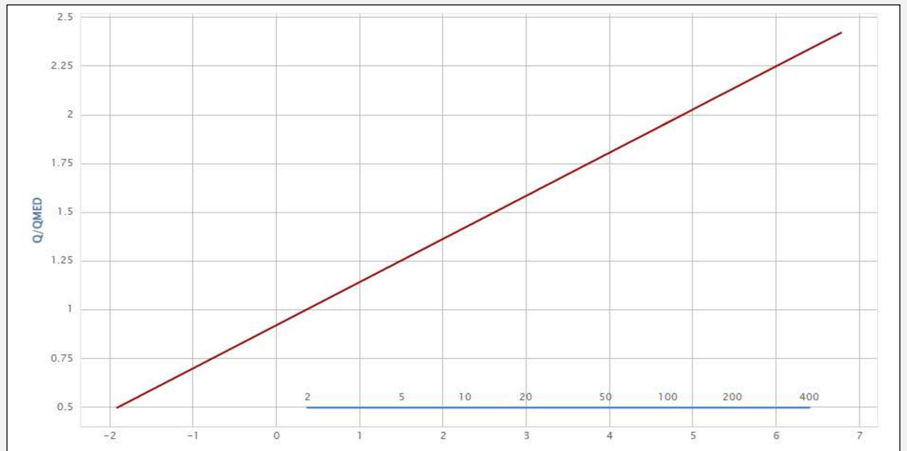
Using Pivotal/ Pooled Analysis Factors

Calculation of Flow Estimation

Method	QMED	FSE	QMED (68% C.I.)	QMED (95% C.I.)	Growth Factor Q100	Growth Factor Q1000	FSU Adjustment Factor	Climate Change		Q100 Design Flow (95% C.I.)	Q1000 Design Flow (95% C.I.)
FSU - 7 Variable Equation	32.875 m3/s	1.37	45.04 m3/s	61.70 m3/s	1.94	2.45	1.000	1.2		143.65 m3/s	181.41 m3/s







Distribution: EV1

	t=1.3	t=2	t=5	t=10	t=20	t=30	t=50	t=100	t=200	t=500	t=1000
Growth Factors	0.83	1	1.25	1.42	1.58	1.67	1.78	1.94	2.09	2.29	2.45
Design Peak Flows (m^3/s)	27.29	32.72	40.93	46.37	51.59	54.59	58.34	63.4	68.44	75.09	80.11

Project	Derrynadarragh		
Subject	Flood Risk Assessment Calculation of Flow Estimation		
Prepared by:	SH	Job No	P22-145
Checked by:	PD	Date	15/04/2025
Approved by:	PD	Revision	P01

FEHILY TIMONEY

1.0 PHYSICAL CATCHMENT DESCRIPTORS (PCD'S):

1.1 Hydrological PCD's

S1085 - Mainstream Slope	1.288	m/km	

1.2 Spatial PCD's

AREA - Catchment Area	49.25	km^2	
SAAR - Standard Annual Average Rainfall	841.37	mm	*
FARL - Flood Attenuation by Rivers and Lakes	1		

1.3 Spatial PCD's Representing Soil, Subsoil & Aquifer Types

BFI_{SOIL}	0.608		*
URBEXT	0.0075		*
SOIL			
DRAIND	0.612	km/km^2	
ARTDRAIN2	0		*

7.0 FSU - 7 VARIABLE EQUATION

$$QMED_{rural} = 1.237x10^{-5}\ AREA^{0.937}\ BFIsoils^{-0.922}\ SAAR^{1.306}\ FARL^{2.217}\ DRAIND^{0.341}\ S1085^{0.185}\ (1+ARTDRAIN2)^{0.408}$$

$QMED_{RURAL}$	4.416	m^3/s

$$QMED_{urban} = QMED_{rural}(1+URBEXT)^{1.482}$$

QMED	4.465	m^3/s
QBAR	**4.651**	m^3/s

River Daingean

Calculation of Flow Estimation

Method	QMED	FSE	QMED (68% C.I.)	QMED (95% C.I.)	Growth Factor Q100	Growth Factor Q1000	Climate Change		Q100 Design Flow (95% C.I.)	Q1000 Design Flow (95% C.I.)
FSU 1 - 7 Variable Equation	4.465 m3/s	1.37	6.12 m3/s	8.38 m3/s	2.098	2.696	1.2		**21.10 m3/s**	**27.11 m3/s**

Table1: Automatically generated upon selection of ungauged node			
Physical Catchment Descriptors			
AREA	47.39	Node East	252826
BFIsoils	0.608	Node North	227453
SAAR	841.37	Centroid East	247100
FARL	1	Centroid North	227030
DRAIND	0.612	ALLUV	0.0116
S1085	1.28839	ARTDRAIN	0
ARTDRAIN2	0	FOREST	0.0242
URBEXT	0.0075		

EV1		
Return Period (T)	Growth Factors	Design Flows
1.3	0.806	2.492
2	1.000	3.093
5	1.294	4.002
10	1.488	4.604
20	1.675	5.181
25	1.734	5.364
30	1.782	5.513
35	1.823	5.639
50	1.917	5.928
100	2.098	6.488
200	2.278	7.046
500	2.516	7.782
1000	2.696	8.338

FEHILY TIMONEY

DESIGNING AND DELIVERING
A SUSTAINABLE FUTURE

APPENDIX 4

HYDRAULIC ANALYSIS

River Cushina

Existing Scenario -100-year storm event

Cross Section / Chainages	Location	Water Surface Elevation (m)	Flow (m3/s)	Velocity (m/s)
2735.71	Upstream	62.19	42.3	0.64
2678.54	Upstream	62.14	42.3	0.63
2604.7	Upstream	62.06	42.3	0.69
2535.23	Upstream	62	42.3	0.59
2498.64	Development	61.96	42.3	0.69
2490.7	Development	61.95	42.3	0.73
2450.07	Development	61.89	42.3	0.91
2397.96	Development	61.8	42.3	0.92
2342.83	Development	61.67	42.3	1.08
2277.97	Development	61.57	42.3	0.68
2221.17	Development	61.5	42.3	0.47
2162.4	Development	61.45	42.3	0.31
2101.8	Development	61.41	42.3	0.35
2022.09	Development	61.34	42.3	0.34
1960.5	Development	61.27	42.3	0.38
1903.7	Development	61.2	42.3	0.39
1824.65	Development	61.14	42.3	0.29
1759.46	Development	61.11	42.3	0.28
1688.42	Development	61.07	42.3	0.32
1633.35	Development	61.04	42.3	0.28
1563.84	Development	61	42.3	0.32
1496.01	Development	60.96	42.3	0.32
1430.35	Development	60.92	42.3	0.29
1357.05	Development	60.89	42.3	0.27
1299.7	Development	60.86	42.3	0.27
1229.75	Development	60.84	42.3	0.21
1165.15	Development	60.82	42.3	0.16
1107.38	Development	60.82	42.3	0.13
1033.05	Development	60.81	42.3	0.11
959.34	Development	60.79	42.3	0.15
883.45	Development	60.78	42.3	0.16
809.83	Development	60.77	42.3	0.2
736.4	Development	60.75	42.3	0.19
661.8	Downstream	60.73	42.3	0.18
598.62	Downstream	60.72	42.3	0.19
534.53	Downstream	60.71	42.3	0.11
474.38	Downstream	60.7	42.3	0.1
430.91	Downstream	60.7	42.3	0.08
374.88	Downstream	60.7	42.3	0.08
306.55	Downstream	60.69	42.3	0.08
254.81	Downstream	60.69	42.3	0.09
216.68	Downstream	60.69	42.3	0.1
213.58	Existing Structure			
210.48	Downstream	60.69	42.3	0.09
157.89	Downstream	60.67	185.95	0.27
102.64	Downstream	60.61	185.95	0.34
55.77	Downstream	60.55	185.95	0.38
0	Downstream	60.51	185.95	0.3

River Cushina

Proposed Scenario Structure - 100-year storm event

Cross Section / Chainages	Location	Water Surface Elevation (m)	Flow (m3/s)	Velocity (m/s)
2735.71	Upstream	62.23	42.3	0.61
2678.54	Upstream	62.18	42.3	0.59
2604.7	Upstream	62.12	42.3	0.64
2535.23	Upstream	62.07	42.3	0.54
2498.64	Upstream	61.98	42.3	1.02
2494.67	Proposed Bridge			
2490.7	Development	61.95	42.3	1.09
2450.07	Development	61.89	42.3	0.91
2397.96	Development	61.8	42.3	0.92
2342.83	Development	61.67	42.3	1.08
2277.97	Development	61.57	42.3	0.68
2221.17	Development	61.5	42.3	0.47
2162.4	Development	61.45	42.3	0.31
2101.8	Development	61.41	42.3	0.35
2022.09	Development	61.34	42.3	0.34
1960.5	Development	61.27	42.3	0.38
1903.7	Development	61.2	42.3	0.39
1824.65	Development	61.14	42.3	0.29
1759.46	Development	61.11	42.3	0.28
1688.42	Development	61.07	42.3	0.32
1633.35	Development	61.04	42.3	0.28
1563.84	Development	61	42.3	0.32
1496.01	Development	60.96	42.3	0.32
1430.35	Development	60.92	42.3	0.29
1357.05	Development	60.89	42.3	0.27
1299.7	Development	60.86	42.3	0.27
1229.75	Development	60.84	42.3	0.21
1165.15	Development	60.82	42.3	0.16
1107.38	Development	60.82	42.3	0.13
1033.05	Development	60.81	42.3	0.11
959.34	Development	60.79	42.3	0.15
883.45	Development	60.78	42.3	0.16
809.83	Development	60.77	42.3	0.2
736.4	Development	60.75	42.3	0.19
661.8	Downstream	60.73	42.3	0.18
598.62	Downstream	60.72	42.3	0.19
534.53	Downstream	60.71	42.3	0.11
474.38	Downstream	60.7	42.3	0.1
430.91	Downstream	60.7	42.3	0.08
374.88	Downstream	60.7	42.3	0.08
306.55	Downstream	60.69	42.3	0.08
254.81	Downstream	60.69	42.3	0.09
216.68	Downstream	60.69	42.3	0.1
213.58	Existing Structure			
210.48	Downstream	60.69	42.3	0.09
157.89	Downstream	60.67	185.95	0.27
102.64	Downstream	60.61	185.95	0.34
55.77	Downstream	60.55	185.95	0.38
0	Downstream	60.51	185.95	0.30

River Cushina

Water Level Comparison - Existing Vs. Proposed Scenario 100-year storm event

Cross Section / Chainages	Location	Water Surface Elevation (Existing) (m)	Water Surface Elevation (Proposed) (m)	Difference of Water Surface Elevation (Proposed - Existing) (m)
2735.71	Upstream	62.19	62.23	0.04
2678.54	Upstream	62.14	62.18	0.04
2604.70	Upstream	62.06	62.12	0.06
2535.23	Upstream	62.00	62.07	0.07
2498.64	Upstream	61.96	61.98	0.02
2494.67	Proposed Bridge			
2490.70	Development	61.95	61.95	0
2450.07	Development	61.89	61.89	0
2397.96	Development	61.80	61.80	0
2342.83	Development	61.67	61.67	0
2277.97	Development	61.57	61.57	0
2221.17	Development	61.50	61.50	0
2162.40	Development	61.45	61.45	0
2101.80	Development	61.41	61.41	0
2022.09	Development	61.34	61.34	0
1960.50	Development	61.27	61.27	0
1903.70	Development	61.20	61.20	0
1824.65	Development	61.14	61.14	0
1759.46	Development	61.11	61.11	0
1688.42	Development	61.07	61.07	0
1633.35	Development	61.04	61.04	0
1563.84	Development	61.00	61.00	0
1496.01	Development	60.96	60.96	0
1430.35	Development	60.92	60.92	0
1357.05	Development	60.89	60.89	0
1299.70	Development	60.86	60.86	0
1229.75	Development	60.84	60.84	0
1165.15	Development	60.82	60.82	0
1107.38	Development	60.82	60.82	0
1033.05	Development	60.81	60.81	0
959.34	Development	60.79	60.79	0
883.45	Development	60.78	60.78	0
809.83	Development	60.77	60.77	0
736.40	Development	60.75	60.75	0
661.80	Downstream	60.73	60.73	0
598.62	Downstream	60.72	60.72	0
534.53	Downstream	60.71	60.71	0
474.38	Downstream	60.70	60.70	0
430.91	Downstream	60.70	60.70	0
374.88	Downstream	60.70	60.70	0
306.55	Downstream	60.69	60.69	0
254.81	Downstream	60.69	60.69	0
216.68	Downstream	60.69	60.69	0
213.58	Existing Structure			
210.48	Downstream	60.69	60.69	0
157.89	Downstream	60.67	60.67	0
102.64	Downstream	60.61	60.61	0
55.77	Downstream	60.55	60.55	0
0	Downstream	60.51	60.51	0

River Cushina

Existing Scenario - 1000 year storm event

Cross Section / Chainages	Location	Water Surface Elevation (m)	Flow (m3/s)	Velocity (m/s)
2735.71	Upstream	62.35	54.79	0.67
2678.54	Upstream	62.30	54.79	0.67
2604.7	Upstream	62.22	54.79	0.73
2535.23	Upstream	62.15	54.79	0.63
2498.64	Development	62.11	54.79	0.73
2490.7	Development	62.10	54.79	0.77
2450.07	Development	62.04	54.79	0.99
2397.96	Development	61.94	54.79	1.01
2342.83	Development	61.80	54.79	1.15
2277.97	Development	61.70	54.79	0.70
2221.17	Development	61.63	54.79	0.47
2162.4	Development	61.59	54.79	0.33
2101.8	Development	61.54	54.79	0.37
2022.09	Development	61.46	54.79	0.37
1960.5	Development	61.38	54.79	0.42
1903.7	Development	61.31	54.79	0.42
1824.65	Development	61.24	54.79	0.31
1759.46	Development	61.20	54.79	0.30
1688.42	Development	61.16	54.79	0.35
1633.35	Development	61.13	54.79	0.31
1563.84	Development	61.09	54.79	0.34
1496.01	Development	61.04	54.79	0.34
1430.35	Development	61.00	54.79	0.31
1357.05	Development	60.96	54.79	0.28
1299.7	Development	60.94	54.79	0.27
1229.75	Development	60.91	54.79	0.21
1165.15	Development	60.90	54.79	0.16
1107.38	Development	60.89	54.79	0.13
1033.05	Development	60.88	54.79	0.12
959.34	Development	60.87	54.79	0.15
883.45	Development	60.86	54.79	0.16
809.83	Development	60.85	54.79	0.18
736.4	Development	60.83	54.79	0.18
661.8	Downstream	60.82	54.79	0.17
598.62	Downstream	60.81	54.79	0.16
534.53	Downstream	60.80	54.79	0.10
474.38	Downstream	60.80	54.79	0.09
430.91	Downstream	60.79	54.79	0.08
374.88	Downstream	60.79	54.79	0.08
306.55	Downstream	60.79	54.79	0.08
254.81	Downstream	60.78	54.79	0.09
216.68	Downstream	60.78	54.79	0.10
213.58	Existing Structure			
210.48	Downstream	60.78	54.79	0.09
157.89	Downstream	60.76	236.2	0.28
102.64	Downstream	60.71	236.2	0.32
55.77	Downstream	60.67	236.2	0.34
0	Downstream	60.63	236.2	0.31

River Cushina

Proposed Scenario Structure - 1000-year storm event

Cross Section / Chainages	Location	Water Surface Elevation (m)	Flow (m3/s)	Velocity (m/s)
2735.71	Upstream	62.38	54.79	0.65
2678.54	Upstream	62.33	54.79	0.64
2604.70	Upstream	62.26	54.79	0.69
2535.23	Upstream	62.20	54.79	0.59
2498.64	Upstream	62.15	54.79	0.85
2494.67	Proposed Bridge			
2490.70	Development	62.10	54.79	0.99
2450.07	Development	62.04	54.79	1.01
2397.96	Development	61.94	54.79	1.15
2342.83	Development	61.80	54.79	0.70
2277.97	Development	61.70	54.79	0.47
2221.17	Development	61.63	54.79	0.33
2162.40	Development	61.59	54.79	0.37
2101.80	Development	61.54	54.79	0.37
2022.09	Development	61.46	54.79	0.42
1960.50	Development	61.38	54.79	0.42
1903.70	Development	61.31	54.79	0.31
1824.65	Development	61.24	54.79	0.30
1759.46	Development	61.20	54.79	0.35
1688.42	Development	61.16	54.79	0.31
1633.35	Development	61.13	54.79	0.34
1563.84	Development	61.09	54.79	0.34
1496.01	Development	61.04	54.79	0.31
1430.35	Development	61.00	54.79	0.28
1357.05	Development	60.96	54.79	0.27
1299.70	Development	60.94	54.79	0.21
1229.75	Development	60.91	54.79	0.16
1165.15	Development	60.90	54.79	0.13
1107.38	Development	60.89	54.79	0.12
1033.05	Development	60.88	54.79	0.15
959.34	Development	60.87	54.79	0.16
883.45	Development	60.86	54.79	0.18
809.83	Development	60.85	54.79	0.18
736.40	Downstream	60.83	54.79	0.17
661.80	Downstream	60.82	54.79	0.16
598.62	Downstream	60.81	54.79	0.10
534.53	Downstream	60.80	54.79	0.09
474.38	Downstream	60.80	54.79	0.08
430.91	Downstream	60.79	54.79	0.08
374.88	Downstream	60.79	54.79	0.08
306.55	Downstream	60.79	54.79	0.09
254.81	Downstream	60.78	54.79	0.10
216.68	Downstream	60.78	54.79	
213.58	Existing Structure			
210.48	Downstream	60.78	54.79	0.09
157.89	Downstream	60.76	236.2	0.28
102.64	Downstream	60.71	236.2	0.32
55.77	Downstream	60.67	236.2	0.34
0.00	Downstream	60.63	236.2	0.31

River Cushina

Water Level Comparison - Existing Vs. Proposed Sscenario - 1000-years storm and tide events

Cross Section / Chainages	Location	Water Surface Elevation (Existing) (m)	Water Surface Elevation (Proposed) (m)	Difference of Water Surface Elevation (Proposed - Existing) (m)	Observations
2735.71	Upstream	62.35	62.38	0.03	Slight increase of water level
2678.54	Upstream	62.30	62.33	0.03	Slight increase of water level
2604.7	Upstream	62.22	62.26	0.04	Slight increase of water level
2535.23	Upstream	62.15	62.20	0.05	Slight increase of water level
2498.64	Upstream	62.11	62.15	0.04	Slight increase of water level
2494.67	Proposed Bridge				
2490.7	Development	62.10	62.10	0	No variation of water level
2450.07	Development	62.04	62.04	0	No variation of water level
2397.96	Development	61.94	61.94	0	No variation of water level
2342.83	Development	61.80	61.80	0	No variation of water level
2277.97	Development	61.70	61.70	0	No variation of water level
2221.17	Development	61.63	61.63	0	No variation of water level
2162.4	Development	61.59	61.59	0	No variation of water level
2101.8	Development	61.54	61.54	0	No variation of water level
2022.09	Development	61.46	61.46	0	No variation of water level
1960.5	Development	61.38	61.38	0	No variation of water level
1903.7	Development	61.31	61.31	0	No variation of water level
1824.65	Development	61.24	61.24	0	No variation of water level
1759.46	Development	61.20	61.20	0	No variation of water level
1688.42	Development	61.16	61.16	0	No variation of water level
1633.35	Development	61.13	61.13	0	No variation of water level
1563.84	Development	61.09	61.09	0	No variation of water level
1496.01	Development	61.04	61.04	0	No variation of water level
1430.35	Development	61.00	61.00	0	No variation of water level
1357.05	Development	60.96	60.96	0	No variation of water level
1299.7	Development	60.94	60.94	0	No variation of water level
1229.75	Development	60.91	60.91	0	No variation of water level
1165.15	Development	60.90	60.90	0	No variation of water level
1107.38	Development	60.89	60.89	0	No variation of water level
1033.05	Development	60.88	60.88	0	No variation of water level
959.34	Development	60.87	60.87	0	No variation of water level
883.45	Development	60.86	60.86	0	No variation of water level
809.83	Development	60.85	60.85	0	No variation of water level
736.4	Development	60.83	60.83	0	No variation of water level
661.8	Downstream	60.82	60.82	0	No variation of water level
598.62	Downstream	60.81	60.81	0	No variation of water level
534.53	Downstream	60.80	60.80	0	No variation of water level
474.38	Downstream	60.80	60.80	0	No variation of water level
430.91	Downstream	60.79	60.79	0	No variation of water level
374.88	Downstream	60.79	60.79	0	No variation of water level
306.55	Downstream	60.79	60.79	0	No variation of water level
254.81	Downstream	60.78	60.78	0	No variation of water level
216.68	Downstream	60.78	60.78	0	No variation of water level
213.58	Existing Bridge				
210.48	Downstream	60.78	60.78	0	No variation of water level
157.89	Downstream	60.76	60.76	0	No variation of water level
102.64	Downstream	60.71	60.71	0	No variation of water level
55.77	Downstream	60.67	60.67	0	No variation of water level
0	Downstream	60.63	60.63	0	No variation of water level

River Daingean

Existing Scenario -100-year storm event

Cross Section / Chainages	Location	Water Surface Elevation (m)	Flow (m3/s)	Velocity (m/s)
656.8	Upstream	70.42	21.1	0.54
606.94	Upstream	70.35	21.1	0.57
556.8	Upstream	70.33	21.1	0.25
505.91	Upstream	70.31	21.1	0.22
455.88	Upstream	70.31	21.1	0.17
405.01	Upstream	70.3	21.1	0.15
389.99	Upstream	70.3	21.1	0.17
382.49	Upstream	70.3	21.1	0.17
375.95	Upstream	70.3	21.1	0.17
366.15	Downstream	70.3	21.1	0.2
356.15	Downstream	70.3	21.1	0.25
346.15	Downstream	70.3	21.1	0.24
333.04	Downstream	70.26	21.1	0.96
326.85	Existing Bridge			
320.67	Downstream	70.14	21.1	1.54
300.37	Downstream	70	21.1	0.33
250.25	Downstream	69.98	21.1	0.33
200.21	Downstream	69.96	21.1	0.35
150.21	Downstream	69.94	21.1	0.34
100	Downstream	69.92	21.1	0.33
50	Downstream	69.89	21.1	0.39
0	Downstream	69.85	21.1	0.51

River Daingean

Proposed Scenario Structure - 100-year storm event

Cross Section / Chainages	Location	Water Surface Elevation (m)	Flow (m3/s)	Velocity (m/s)
656.8	Upstream	70.42	21.1	0.53
606.94	Upstream	70.36	21.1	0.54
556.8	Upstream	70.34	21.1	0.24
505.91	Upstream	70.33	21.1	0.21
455.88	Upstream	70.32	21.1	0.17
405.01	Upstream	70.32	21.1	0.14
389.99	Upstream	70.32	21.1	0.17
382.49	Upstream	70.32	21.1	0.16
375.95	Upstream	70.31	21.1	0.41
371.05	Proposed Bridge + Flood Relief Culverts			
366.15	Downstream	70.3	21.1	0.46
356.15	Downstream	70.3	21.1	0.25
346.15	Downstream	70.3	21.1	0.24
333.04	Downstream	70.26	21.1	0.96
326.85	Existing Bridge			
320.67	Downstream	70.14	21.1	1.54
300.37	Downstream	70	21.1	0.33
250.25	Downstream	69.98	21.1	0.33
200.21	Downstream	69.96	21.1	0.35
150.21	Downstream	69.94	21.1	0.34
100	Downstream	69.92	21.1	0.33
50	Downstream	69.89	21.1	0.39
0	Downstream	69.85	21.1	0.51

River Daingean

Water Level Comparison - Existing Vs. Proposed Scenario 100-year storm event

Cross Section / Chainages	Location	Water Surface Elevation (Existing) (m)	Water Surface Elevation (Proposed) (m)	Difference of Water Surface Elevation (Proposed - Existing) (m)
656.80	Upstream	70.42	70.42	0
606.94	Upstream	70.35	70.36	0.01
556.80	Upstream	70.33	70.34	0.01
505.91	Upstream	70.31	70.33	0.02
455.88	Upstream	70.31	70.32	0.01
405.01	Upstream	70.30	70.32	0.02
389.99	Upstream	70.30	70.32	0.02
382.49	Upstream	70.30	70.32	0.02
375.95	Upstream	70.30	70.31	0.01
371.05	Proposed Bridge + Flood Relief Culverts			
366.15	Downstream	70.30	70.30	0
356.15	Downstream	70.30	70.30	0
346.15	Downstream	70.30	70.30	0
333.04	Downstream	70.26	70.26	0
326.85	Existing Bridge			
320.67	Downstream	70.14	70.14	0
300.37	Downstream	70.00	70.00	0
250.25	Downstream	69.98	69.98	0
200.21	Downstream	69.96	69.96	0
150.21	Downstream	69.94	69.94	0
100.00	Downstream	69.92	69.92	0
50.00	Downstream	69.89	69.89	0
0.00	Downstream	69.85	69.85	0

River Daingean

Existing Scenario -1000-year storm event

Cross Section / Chainages	Location	Water Surface Elevation (m)	Flow (m3/s)	Velocity (m/s)
656.8	Upstream	70.47	27.11	0.56
606.94	Upstream	70.4	27.11	0.60
556.8	Upstream	70.38	27.11	0.28
505.91	Upstream	70.36	27.11	0.25
455.88	Upstream	70.35	27.11	0.20
405.01	Upstream	70.35	27.11	0.17
389.99	Upstream	70.35	27.11	0.20
382.49	Upstream	70.35	27.11	0.19
375.95	Upstream	70.34	27.11	0.19
366.15	Downstream	70.34	27.11	0.22
356.15	Downstream	70.34	27.11	0.28
346.15	Downstream	70.34	27.11	0.28
333.04	Downstream	70.3	27.11	1.04
326.85	Existing Bridge			
320.67	Downstream	70.17	27.11	1.66
300.37	Downstream	70.07	27.11	0.35
250.25	Downstream	70.05	27.11	0.39
200.21	Downstream	70.02	27.11	0.38
150.21	Downstream	70	27.11	0.38
100	Downstream	69.97	27.11	0.36
50	Downstream	69.95	27.11	0.41
0	Downstream	69.9	27.11	0.52

River Daingean

Proposed Scenario Structure - 1000-year storm event

Cross Section / Chainages	Location	Water Surface Elevation (m)	Flow (m3/s)	Velocity (m/s)
656.8	Upstream	70.48	27.11	0.55
606.94	Upstream	70.41	27.11	0.58
556.8	Upstream	70.38	27.11	0.27
505.91	Upstream	70.37	27.11	0.24
455.88	Upstream	70.36	27.11	0.19
405.01	Upstream	70.36	27.11	0.17
389.99	Upstream	70.36	27.11	0.20
382.49	Upstream	70.36	27.11	0.19
375.95	Upstream	70.35	27.11	0.48
371.05	Proposed Bridge + Flood Relief Culverts			
366.15	Downstream	70.34	27.11	0.52
356.15	Downstream	70.34	27.11	0.28
346.15	Downstream	70.34	27.11	0.28
333.04	Downstream	70.3	27.11	1.04
326.85	Existing Bridge			
320.67	Downstream	70.17	27.11	1.66
300.37	Downstream	70.07	27.11	0.35
250.25	Downstream	70.05	27.11	0.39
200.21	Downstream	70.02	27.11	0.38
150.21	Downstream	70	27.11	0.38
100	Downstream	69.97	27.11	0.36
50	Downstream	69.95	27.11	0.41
0	Downstream	69.9	27.11	0.52

River Daingean

Water Level Comparison - Existing Vs. Proposed Scenario 1000-year storm event

Cross Section / Chainages	Location	Water Surface Elevation (Existing) (m)	Water Surface Elevation (Proposed) (m)	Difference of Water Surface Elevation (Proposed - Existing) (m)
656.80	Upstream	70.47	70.48	0.01
606.94	Upstream	70.40	70.41	0.01
556.80	Upstream	70.38	70.38	0
505.91	Upstream	70.36	70.37	0.01
455.88	Upstream	70.35	70.36	0.01
405.01	Upstream	70.35	70.36	0.01
389.99	Upstream	70.35	70.36	0.01
382.49	Upstream	70.35	70.36	0.01
375.95	Upstream	70.34	70.35	0.01
371.05	Proposed Bridge + Flood Relief Culverts			
366.15	Downstream	70.34	70.34	0
356.15	Downstream	70.34	70.34	0
346.15	Downstream	70.34	70.34	0
333.04	Downstream	70.30	70.30	0
326.85	Existing Bridge			
320.67	Downstream	70.17	70.17	0
300.37	Downstream	70.07	70.07	0
250.25	Downstream	70.05	70.05	0
200.21	Downstream	70.02	70.02	0
150.21	Downstream	70.00	70.00	0
100.00	Downstream	69.97	69.97	0
50.00	Downstream	69.95	69.95	0
0.00	Downstream	69.90	69.90	0

DESIGNING AND DELIVERING
A SUSTAINABLE FUTURE

APPENDIX 5

FLOOD MAPS

FEHILY TIMONEY

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Rev.	Description	App By	Date
A	ISSUE FOR INFORMATION	JH	26.06.25

PROJECT: **DERRYNADARRAGH WIND FARM**

CLIENT: Dara Energy Limited

SHEET: **RIVER CUSHINA FLOOD EXTENTS EXISTING & PROPOSED 1 IN 100 YEARS STORM EVENT**

Date	Project number	Scale (@ A1-)
26.06.25	P22-145	1:5000

Drawn by	Drawing Number	Rev
CS	P22-145-INFO-0003	A

Checked by: SHS

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5 August 2025

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Rev.	Description	App By	Date
A	ISSUE FOR INFORMATION	JH	26.06.25

PROJECT

DERRYNADARRAGH WIND FARM

SHEET

RIVER CUSHINA FLOOD EXTENTS EXISTING & PROPOSED 1 IN 1000 YEARS STORM EVENT

CLIENT

Dara Energy Limited

Date 26.06.25	Project number P22-145	Scale (@ A1-) 1:5000	
Drawn by CS	Drawing Number P22-145-INFO-0004		Rev A
Checked by SHS			

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Rev.	Description	App By	Date
A	ISSUE FOR PLANNING	JH	26.06.25

PROJECT

DERRYNADARRAGH WIND FARM

CLIENT

Dara Energy Limited

SHEET

DAINGEAN RIVER FLOOD EXTENTS EXISTING & PROPOSED 1 IN 100 YEARS STORM EVENT

Date 26.06.25	Project number P22-145	Scale (@ A1-) 1:1250	
Drawn by CS	Drawing Number		Rev
Checked by SHS	P22-145-INFO-0005		A

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5 August 2025

0m 13m 25m 38m 50m 63m 75m 88m 100m 113m 125m
Scale 1:1250

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Rev.	Description	App By	Date
A	ISSUE FOR PLANNING	JH	26.06.25

PROJECT
DERRYNADARRAGH WIND FARM

CLIENT
Dara Energy Limited

SHEET
DAIGEAN RIVER FLOOD EXTENTS EXISTING & PROPOSED 1 IN 1000 YEARS STORM EVENT

Date 26.06.25	Project number P22-145	Scale (@ A1-) 1:1250	
Drawn by CS	Drawing Number		Rev
Checked by SHS	P22-145-INFO-0006		A

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5 August 2025

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APPENDIX 6

SITE PHOTOS

River Cushina- Proposed Bridge Crossing Location

River Cushina- Proposed Bridge Crossing Location

Land Drain crossing T9 hardstanding area and discharging to River Cushina

Substation Location-Standing water

T5 Location-Drain with standing water

Land drain next to T8 hardstanding area and access track

Deep land drain crossing T3 hardstanding area and access track

Deep land drains on the northern side of the Proposed Wind Farm near T2 area

River Daingean-Existing Bridge crossing

River Daingean

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APPENDIX 12.2

Surface Water Management Plan

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ENVIRONMENTAL IMPACT ASSESSMENT REPORT (EIAR) FOR THE PROPOSED DERRYNADARRAGH WIND FARM, CO. KILDARE, OFFALY & LAOIS

Volume III - Appendices

Appendix 12.2 - Surface Water Management Plan (SWMP)

Prepared for:
Dara Energy Limited

Dara Energy Limited

Date: January 2026

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1. INTRODUCTION

This document is a Surface Water Management Plan (SWMP) for the construction of Derrynadarragh Wind Farm. The document sets out the measures that shall be implemented during the construction stage of the Proposed Development to ensure the protection of the existing hydrological environment in accordance with mitigation measures set out in the Derrynadarragh Wind Farm Environmental Impact Assessment Report (EIAR).

This SWMP shall be read in conjunction with the EIAR and planning application drawings and in particular the following documents:

- EIAR Chapter 2 - Description of the Development [EIAR Volume II];
- EIAR Chapter 11 - Soils, Geology and Hydrogeology [EIAR Volume II];
- EIAR Chapter 12 - Flooding, Hydrology & Water Quality [EIAR Volume II];
- Site Specific Flood Risk Assessment (SSFRA) [EIAR Volume III, Appendix 12.1];
- Construction and Environmental Management Plan [EIAR Volume III, Appendix 2.1];
- Grid Connection Construction Methodology [EIAR Volume III, Appendix 2.1B];
- Aquatic Ecology Assessment Report [EIAR Volume III, Appendix 9.2];
- Biodiversity Enhancement Management Plan (BEMP) [EIAR Volume III, Appendix 2.2];
- Peat and Spoil Management Plan [EIAR Volume III, Appendix 11.3];
- The preliminary drainage design presented in 0100 and 0500-Series planning application drawings.

The SWMP for the construction stage of the Proposed Development shall be finalised in accordance with this plan following the appointment of the contractor for the works.

1.1 Statement of Authority

This SWMP was completed by Fehily Timoney and Company where it was drafted by Aoife Hurd and reviewed and by Pablo Delgado.

Aoife Hurd is a Senior Civil Engineer at Fehily Timoney and Company working in the Energy and Planning Department. She holds a First-Class Honours Bachelor's Degree and First-Class Honours with Distinction Master's Degree in Civil, Structural and Environmental Engineering from Trinity College Dublin. She is a member of Engineers Ireland (EI) and has experience working on residential, infrastructure and renewable energy projects at all stages from concept to construction. Aoife provides technical and engineering support to the EIAR teams for a variety of commercial scale renewable energy projects.

Aoife has experience in the preparation of Traffic and Transportation assessments, Air and Climate assessments, as well as other technical chapters associated with EIARs and environmental reports for renewable energy projects ranging from wind farms, solar farms, grid connections, battery energy storage systems and ancillary grid infrastructure projects. She also has experience in the design of renewable energy developments.

Pablo is a Principal Engineer and Drainage Lead at Fehily Timoney and a Chartered Member of Engineers Ireland. He has extensive experience in planning, design, and construction of hydraulic engineering projects, collaborating effectively with clients and contractors. Specialising in hydraulic infrastructure, he works closely with all stakeholders to deliver practical and efficient designs while addressing issues throughout project delivery.

He has strong expertise in hydraulic design, including developing best-practice guidelines, drainage design, standards, and specialist software tools. Pablo has delivered drainage designs in Design & Build and Public-Private Partnership environments, with experience across the UK, Ireland, and Spain. He holds a Bachelor's degree in Civil Engineering, a Master's degree, and Postgraduate Diplomas in Civil and Environmental Engineering from the University of Zaragoza and the Polytechnic University of Valencia, Spain, focusing on hydraulic design of civil and environmental infrastructure.

Throughout his career, Pablo has provided technical design and advisory services across all project stages in both urban and rural settings. His major projects include Dunkettle Interchange, N4 Collooney to Castlebaldwin, N22 Baile Bhuirne to Macroom, HS2, A737 Dalry Bypass, and Leanamore Wind Farm. He has also served as a Third-Party Checker on projects such as Adare Bypass and the N5 Ballaghaderreen to Scramoge. Additionally, he has delivered preliminary and detailed designs for renewable energy developments, including flood risk assessments, modelling, hydrological and hydraulic analyses, and environmental impact assessment chapters.

1.2 Existing Environment

The Proposed Development consists of a 9 no. turbine wind farm and associated infrastructure including internal access tracks, hard standings, onsite 110 kV substation and associated grid connection infrastructure, internal electrical and communications cabling, temporary construction compounds, drainage infrastructure, biodiversity enhancement measures, temporary accommodations works along the Proposed Turbine Delivery Route and all associated works related to the construction of the Proposed Development.

The Proposed Development assessed in this EIAR comprises the following elements:

- The 'Proposed Wind Farm' (also referred to in this EIAR as the 'Site');
- The 'Proposed Grid Connection' (also referred to in this EIAR as the 'GC');
- The 'Turbine Delivery Route' (also referred to in this EIAR as the 'TDR');
- The 'Biodiversity Enhancement Management Plan Lands' (also referred to in this EIAR as the 'BEMP Lands').

For a detailed description of the Proposed Development please refer to Chapter 2, Volume II of the EIAR.

A detailed description of the existing hydrological environment and existing drainage is contained in Chapter 12 of the EIAR.

The proposed wind farm site is located within the Barrow Catchment (ID 14) and the Barrow_SC_040 sub-catchment as defined by the Water Framework Directive (WFD). The waterbody in this sub-catchment that is crossing the proposed site is known as FIGILE_080 (EPA Name: Cushina 14).

In addition, the wind farm is located within two sub-basins:

- FIGILE_070- IE_SE_14F010510.
- FIGILE_080- IE_SE_14F010600.

The main hydrology feature within the wind farm site is the Cushina River (FIGILE_080). A large area of the surface runoff drains into this river within FIGILE_080 sub-basin. The Cushina River runs in an easterly direction, and it is a tributary of the Figile River (FIGILE_080). The remaining of the site drains into FIGILE_070 sub-basin or directly into Figile River. There are no lakes or reservoirs within the wind farm site study area.

Existing access tracks and lands are generally drained by adjacent drainage ditches and swales. These drainage features will be retained and upgraded where necessary to the same standard as the proposed drainage design. Where existing tracks are widened, existing drainage will be realigned or replaced. The replacement sections of drain shall have a similar gradient and width as existing channels to ensure the flow rate and capacity of the existing channel is retained and adequate for the contributing area.

2. DRAINAGE OF THE PROPOSED WIND FARM

The proposed surface water drainage system utilises sustainable drainage devices and methods where appropriate, incorporating the main components of Sustainable Drainage Systems (SuDS). A fundamental principle of the drainage design is that clean water flowing in the upstream catchment, including overland flow and flow in existing drains, is allowed to bypass the works areas without being contaminated by silt from the works. This will be achieved by intercepting the clean water and conveying it to the downstream side of the works areas either by piping it or diverting it by means of new drains.

The proposed layout of the drainage system is provided in 0100 and 0500-Series planning application drawings.

The drainage strategy within internal areas of the Site will incorporate the following main components of Sustainable Drainage Systems (SuDS):

- Interceptor Drains
- Cross Drains
- Diffusers
- Swales
- Settlement Ponds

On the upslope side of new sections of access track and hardstanding areas, overland flows will be intercepted in channels. The flow will then be discharged diffusely over vegetated areas. The roadside drains will therefore only carry the site access track runoff. This will ensure that there will be no mixing of 'clean' and 'dirty' water as shown in Plate 2-1, and will avoid a large concentration of flows. Thus, erosion risks will be reduced and the quantity of water requiring treatment will be minimised.

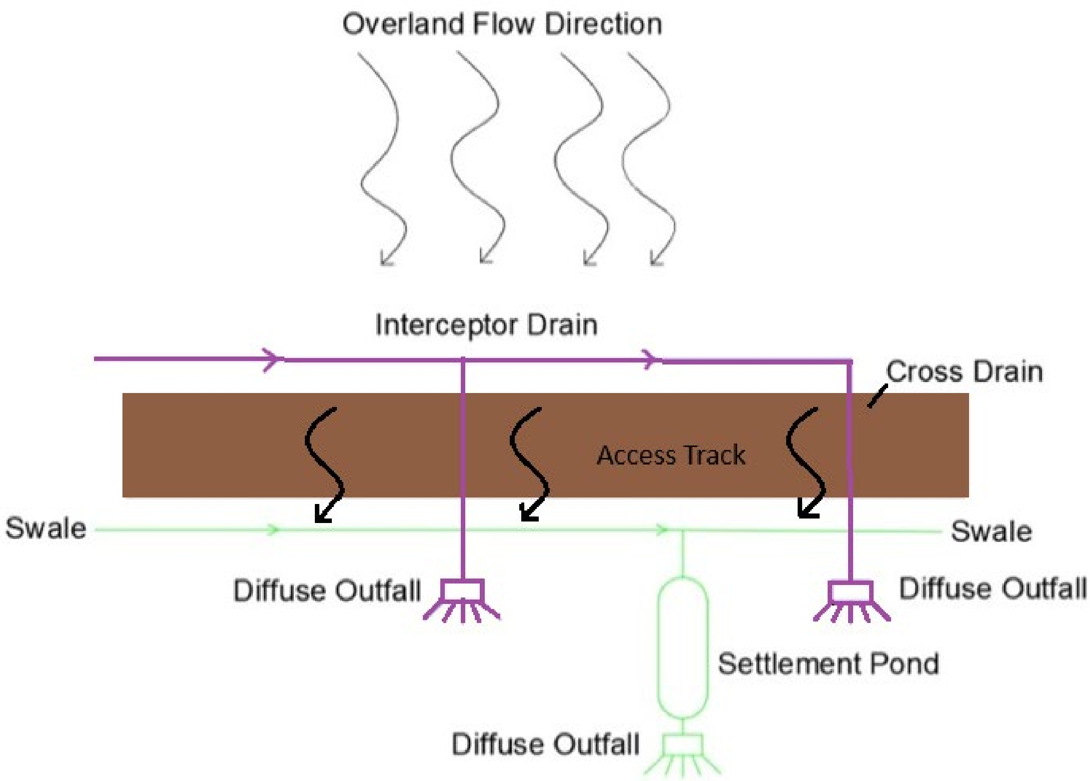

Plate 2-1: Drainage Design Principles

The drainage system outlined below provides for a multi-stage treatment train of the discharges from the development, as recommended in The SuDS Manual (C753), 2015:

- Grassed swales removing some of the sediment borne contaminants,
- Settlement ponds providing retention and treatment of discharges,
- Diffuse outflow from settlement ponds providing for further retention and settlement of suspended solids by reducing the velocities of flows and increasing the flow path of discharges,
- Continuation of flows by natural flow paths over vegetated areas before entering the watercourse, providing further retention and treatment of discharges.

Interceptor Drains

Interceptor drains will be installed ahead of the main earthworks activities to minimise the effects of collected water on the stripped/exposed soils once earthworks commence. These drainage ditches will be installed on the upgradient boundary of the areas affected by the access track earthworks operations and installed ahead of the main track construction operations commencing.

They will generally follow the natural flow of the ground. The interceptor drains will intercept any storm water surface runoff and collect it to the existing low points in the ground, allowing the clean water flows to be transferred independently through the works without mixing with the construction drainage. Collected runoff will be discharged through the roads via cross drains.

It will then be directed to areas where it can be redistributed over the ground. The overland flow will then discharge diffusely on the downslope side over vegetated areas within the site boundary.

Cross Drains

Cross drains will be implemented prior to the initiation of primary earthworks activities to mitigate the impact of accumulated water on exposed soils resulting from earthworks commencement. These drainage channels will be positioned at the elevated boundaries of regions influenced by the earthworks operations associated with site infrastructure, and they will be installed in advance of the primary earthworks construction activities.

These channels will typically conform to the natural topographical contours. The cross drains will intercept surface runoff and direct it towards pre-existing low points in the terrain, enabling the unadulterated flow of uncontaminated water through the Proposed Development area without mingling with construction-related drainage.

The cross drains should be installed in such a way that the invert levels are slightly lower than the corresponding levels on the inlet and outlet sides, to allow a natural bed to form. Cross drains should not be installed with a "hanging" outlet (i.e. significantly higher than the corresponding ground level), as this will cause erosion of the ground through the forced action of the water flows and would not provide a suitable path for small mammals to use in periods of drier conditions.

The location of cross drains associated with the Proposed Development can be found in the associated 0100 and 0500-Series planning application drawings.

Diffuser in Gravel and Stones

A gravel and stone-lined diffuser, also known as a gravel or stone-lined diffuser, is a hydraulic structure commonly utilized in interceptor drains. Its primary purpose is to effectively manage water flow and prevent erosion in areas with loose or erodible soils, such as gravel beds or riverbanks.

The structure consists of a layer of gravel of a minimum of 40 mm diameter or stones that disperses the flowing water's energy, safeguarding the surrounding environment from erosion impacts. By distributing water across a larger area, slowing down its velocity, and facilitating water infiltration, the diffuser ensures energy dissipation and sediment trapping. This eco-friendly solution supports ecological coexistence and sustainable water management practices. Regular maintenance is essential to sustain its effectiveness in controlling water flow and preventing soil erosion.

Swales

The surface water drainage is designed to capture surface water run-off from the roads and other hardstanding areas in swales and discharge into settlement ponds specifically constructed for managing surface water runoff generated from the proposed wind farm infrastructure and earthworks. After passing through the settlement pond, surface run-off will be permitted to spread across the adjacent lands.

This treated water will ultimately percolate to groundwater or travel over ground and be assimilated into the existing drainage network. There will be no direct discharges from the proposed wind farm to any existing natural watercourse.

The internal access tracks will be constructed using unbound aggregate materials such that they will permit some degree of infiltration and reduce the volume of runoff generated.

Swales along access tracks will be installed in parallel of the main construction phase. Swales will provide additional storage of storm water where located along gradient. Given the steep longitudinal gradients on some sections of access track, regular check dams will be employed within the trackside swale on these sections to reduce the flow velocity and provide settlement opportunity. Check dams will be constructed from course gravel/ crushed rock.

The swales will be 0.3 m in depth with a bottom width of 0.5 m and side slopes of 1 in 3. A grassed swale is shown on Plate 2-2. The swales will be constructed in accordance with CIRIA C698 Site Handbook for the Construction of SUDS (CIRIA, 2007).

All drainage elements will be designed with a freeboard of 300 mm to provide additional hydraulic capacity to accommodate heavy rainfall event.

Plate 2-2: Grassed Swale along Access Track

Check Dams

At slopes greater than 2%, check dams will be required in the swales and interceptor drains to slow down the velocities of flows and prevent erosion occurring, as shown in Plate 2-3. These check dams will be in stone of minimum size 40 mm and will be laid at a spacing of between 10 and 30 m dependent on the slope.

All check dams, etc will be checked at least once weekly via a walkover survey during the full period of construction. All excess silts will be removed and placed in borrow pit reinstatement or embankments. Where check dams have become fully blocked with silt, they will be replaced.

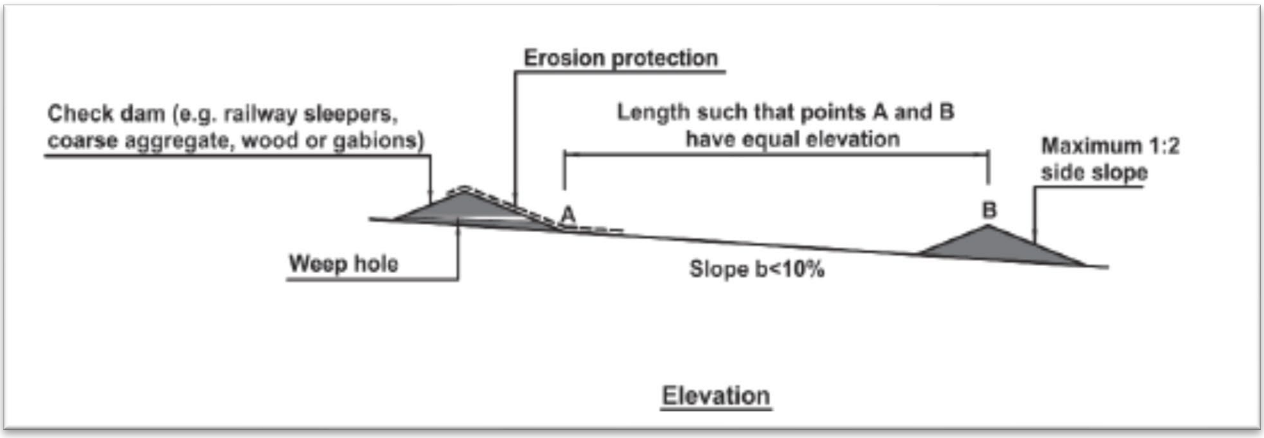

Plate 2-3: Check Dam Detail

Settlement Ponds

Settlement ponds will be put in place across the Site (refer to 0100 Series planning drawings for layout and 0501 Series planning drawings for details). Settlement ponds will have a diffuse stone filled outflow which will encourage the diffuse spread of flows overland and back into natural drains down slope of the settlement ponds. Drainage stone will be placed at the inlet to the ponds to filter the flows before they enter the ponds.

After passing through the settlement ponds, the concentration of suspended solids in the surface water run-off due to the excavations will be reduced.

The following shall apply to construction of settlement ponds at the Site:

- Pond depths generally to be excavated to less than 1.5m;
- Side slopes to be shallow, nominally at a 1 in 3 side slope (maximum); and
- Material excavated from the settlement pond should be compacted around the edge of the pond.

The settlement ponds will be designed with a freeboard of 300 mm to provide additional hydraulic capacity to accommodate heavy rainfall event.

The settlement pond design is based on primary settling out of suspended solids from aqueous suspension. The theory behind the design of the settlement ponds is the application of Stoke’s Law. The settlement ponds will be designed to provide sufficient retention time and a low velocity environment to allow suspended solids of a very small particle size (greater than or equal to 0.02 mm) to settle prior to allowing the water to outfall to the receiving environment. Flow rates for storm events will be maintained at or below greenfield run-off rates.

For the preliminary design Stokes' law is used in combination with the Rational Method. The inflow to stilling pond is calculated using Modified Rational Method:

$$Q = 2.78 \times c \times I \times A \text{ (l/s)}$$

C = coefficient runoff, for infrastructure the value of 0.84 is used as per DN-DNG-03066 (TII, 2015).
I = intensity (mm/h) for 1 in 10 years storm event, duration 1h, as per CIRIA C698 Site Handbook for the Construction of SUDS (CIRIA, 2007).
A = contributing area (ha).

According to the CIRIA 648 a pond volume is defined by inflow and retention time:

$$V = Q \times t$$

Settlement ponds will be installed concurrently with the formation of the road and will be fenced off for safety. Machine access will be required at settlement ponds to remove accumulated sediment.

Further sediment pond control measures include:

- Settlement pond maintenance and/or cleaning will not take place during periods of extended heavy rain; this will be carried out under low or zero flow conditions so as not to contaminate the clean effluent from the pond. The water level would first be lowered to a minimum level by pumping through a settlement tank without disturbing the settled sediment. Then excavator can remove sediment;
- Settlement ponds will be monitored closely over the construction timeframe to ensure that they are operating effectively.

In the event of an emergency, the settlement ponds will provide a temporary holding area for any accidental spills on site as it will be possible to block off the outflow from these ponds for a limited period. Erosion control and retention facilities, including settlement ponds will be regularly maintained during the construction phase.

The drainage system will remain operational and will be utilised for the decommissioning phase to treat any surface water from exposed areas as a result of decommissioning at the site. During the decommissioning of the turbine base, hardstanding areas and access tracks shall remain in place and be covered with local soil/topsoil to minimise disturbance to soils.

Swale draining to settlement pond is shown on Plate 2-4.

The locations of temporary settlement pond will be adjacent to earthworks, as close as possible to the source of sediment while maintaining a minimum 50 m buffer distance from existing watercourses. The settlement pond will also provide containment capacity in the event of a spill or leak within the drained area and the outflow can be closed off by a penstock device or similar to contain any potential pollutants within the settlement ponds. In the event of contaminated runoff being contained in a settlement pond, the incident will be reported in accordance with the CEMP (refer to Appendix 2.1 of Volume III), samples taken of the contaminated liquid for classification, as required, and the liquid pumped out of the pond using a suitable vacuum truck and disposed of at a licensed waste facility off-site.

The contractor, during the construction phase, will be responsible to provide the temporary settlement ponds, including the design, maintenance and operation. After the completion of the construction phase the contractor will be responsible to the decommission and the reinstatement of these settlement ponds.

Plate 2-4: Swale draining to Settlement Pond

Drainage of Temporary Site Compounds

Temporary settlement ponds will be put in place downstream of the location of the temporary site construction compounds to ensure water retention and settling of the particles. To improve water quality control the flow from the compound areas will be treated with Full Retention Petrol Interceptor before reaching the settlement ponds.

The settlement ponds will have a diffuse stone filled outflow which will encourage the diffuse spread of flows overland and back into natural drains down slope of the settlement ponds. Drainage stone will be placed at the inlet to the ponds to filter the flows before they enter the ponds.

The locations of settlement ponds will be adjacent to earthworks, as close as possible to the source of sediment while maintaining a minimum 10m buffer distance from existing watercourses. The settlement pond will also provide containment capacity in the event of a spill or leak within the drained area, and the outflow can be closed off by a penstock device or similar to contain any potential pollutants within the settlement ponds. In the event of contaminated runoff being contained in a settlement pond, the incident will be reported in accordance with the CEMP (refer to Appendix 2.1 of Volume III), samples taken of the contaminated liquid for classification, as required, and the liquid pumped out of the pond using a suitable vacuum truck and disposed of at a licensed waste facility off-site.

3. WATERCOURSE CROSSINGS

All crossings will be designed in accordance with National Roads Authority guidance 'Guidelines for the Crossing of Watercourses During the Construction of National Road Schemes' and Inland Fisheries guidance 'Guidelines on protection of Fisheries During Construction Works in and Adjacent to Waters' (2016) , with clear span bridges being the preferable type of water crossing, with box culverts and piped culverts used where a bridge would not be feasible. The crossing structures will be installed with a minimum 300mm freeboard elevation for 1% AEP MRFS flows (annual exceedance probability, medium range future scenario).

Table 3-1 below details all drain and watercourse crossings associated with the Proposed Development.

For further details on drain and watercourse crossings please refer to Chapter 12, Volume II of the EIAR. The proposed drainage layout which includes the location of crossings can be found on 0100 and 0500-Series planning application drawings. For further information on construction methodologies, please refer to Chapter 2, located in Volume II and the CEMP located in Appendix 2.1 of Volume III.

Table 3-1: Drain and Watercourse Crossings

Feature ID	Element of Project	X (ITM)	Y (ITM)	WFD Waterbody (Yes/No)	Existing Culvert/ Structure	Proposed Crossing Method
WCC-WF1	Wind Farm	659082	716063	No	No	Pipe Culvert
WCC-WF2	Wind Farm	659031	715998	No	No	Pipe Culvert
WCC-WF3	Wind Farm	659513	716003	No	Yes	Box Culvert
WCC-WF4	Wind Farm	659862	715831	No	No	Pipe Culvert
WCC-WF5	Wind Farm	660099	715739	No	No	Box Culvert
WCC-WF6	Wind Farm	659533	716372	No	No	Box Culvert
WCC-WF7	Wind Farm	659129	716789	No	No	Pipe Culvert
WCC-WF8	Wind Farm	659294	716786	No	No	Box Culvert
WCC-WF9	Wind Farm	658817	716702	No	No	Pipe Culvert
WCC-WF10	Wind Farm	658347	715857	Yes	No	Bridge
WCC-WF11	Wind Farm	658504	716006	No	No	Pipe Culvert
WCC-WF12	Wind Farm	658237	716098	No	No	Pipe Culvert
WCC-WF13	Wind Farm	658183	716296	No	No	Box Culvert
WCC-WF14	Wind Farm	658088	716388	No	No	Box Culvert
WCC-WF15	Wind Farm	657968	716432	No	No	Pipe Culvert
WCC-WF16	Wind Farm	658001	716418	No	No	Pipe Culvert
WCC-WF17	Wind Farm	657885	716466	No	No	Box Culvert
WCC-WF18	Wind Farm	657749	716523	No	No	Pipe Culvert
WCC-WF19	Wind Farm	657807	716496	No	No	Pipe Culvert
WCC-WF20	Wind Farm	657621	716718	No	No	Box Culvert
WCC-WF21	Wind Farm	657438	716792	No	No	Pipe Culvert
WCC-WF22	Wind Farm	656792	716839	No	No	Pipe Culvert
WCC-WF23	Wind Farm	658985	715592	No	Yes	Pipe Culvert
WCC-WF24	Wind Farm	658813	715638	No	No	Pipe Culvert
WCC-WF25	Wind Farm	659330	715481	No	No	Box Culvert
WCC-WF26	Wind Farm	658725	715865	No	No	Pipe Culvert
WCC-WF27	Wind Farm	656919	716853	No	No	Pipe Culvert
WCC-WF28	Wind Farm	656944	716857	No	No	Pipe Culvert
WCC-WF29	Wind Farm	657033	716864	No	No	Pipe Culvert
WCC-WF30	Wind Farm	657269	716819	No	No	Pipe Culvert
WCC-WF31	Wind Farm	658180	716261	No	No	Box Culvert
WCC-WF32	Wind Farm	659337	716089	No	No	Box Culvert

Feature ID	Element of Project	X (ITM)	Y (ITM)	WFD Waterbody (Yes/No)	Existing Culvert/ Structure	Proposed Crossing Method
WCC-WF33	Wind Farm	659634	716590	No	No	Pipe Culvert
WCC-WF34	Wind Farm	659359	716765	No	No	Box Culvert
WCC-WF35	Wind Farm	659036	716783	No	No	Pipe Culvert
WCC-WF36	Wind Farm	659719	715314	No	No	Pipe Culvert
WCC-GCR1	GC	659966	713535	No	Yes	HDD
WCC-GCR2	GC	660546	712416	Yes	Yes	HDD
WCC-GCR3	GC	660321	711962	No	Yes	Crossing Over
WCC-GCR4	GC	659745	711434	No	Yes	HDD
WCC-GCR5	GC	658244	711382	No	Yes	HDD
WCC-GCR6	GC	658769	711330	No	Yes	HDD
WCC-GCR7	GC	659917	714781	No	Yes	HDD
WCC-TDR5	TDR	652594	727645	Yes	Yes	Bridge

3.1 Wind Farm

Within the Site there are 35 no. drain crossings and 1 no. watercourse crossing, as identified in Table 3-1. There is one WFD River watercourse crossing point proposed on the Cushina River (FIGILE_080) which is a tributary of the River Barrow (reference WCC-WF10 of Table 3-1). It is proposed to construct a single span bridge at this location where the internal wind farm access track crosses the Cushina River.

A cross section of the proposed new single-span bridge is included within the Planning Drawings. The soffit level of the bridge will provide a minimum freeboard of 300mm to allow a fluvial flood level of 1 in 100 years (+20%). The crossing shall also be sized to convey the flow from 1 in 100-year (+20%) flood event unobstructed.

The supports for the proposed clear span bridge crossing at this location shall be set back 5 m from the riverbank.

Other drain crossings within the wind farm site comprise bottomless box culverts and pipe culverts where the proposed wind farm access track crosses minor streams and land drains. Details of these are shown in Table 3-1. For more information and illustrations of proposed single span bridge crossings, box culverts and piped culverts, see Chapter 12, located in Volume II of the EIAR.

Plate 3-1: WFD River watercourse crossing point at FIGILE_080 River

3.2 Grid Connection

The onsite substation (contained within the Proposed Wind Farm area) will be connected to the grid via high voltage (110kV) and communication underground cabling to the existing 110KV GIS Bracklone Substation.

There will be 7 no. crossing points comprising 6 no. watercourse crossings and one dry stone arch bridge crossing at a disused canal. There will be 6 no. Horizontal Directional Drilling (HDD) and 1 no. flat formation crossing within the road above an existing culvert.

It is proposed to cross the GC cable on the Barrow River (BARROW_090) where there is an existing bridge (reference WCC-GCR2 of Table 3-1).

Construction methodologies can be found in Chapter 2 - Description of the Proposed Development, the CEMP in Appendix 2.1, and the Grid Connection Construction Methodology in Appendix 2.1B of Volume III.

HDD will be employed on the GCR crossing point in accordance with the following methodology:

- A specialist contractor will be appointed to prepare Method Statements of works;
- Fuels, lubricants and hydraulic fluids for equipment use on Site will be carefully handled to avoid spillage, properly secured and provided with spill containment kits in case of incident;

- The depth of the bore should be at least 3m below the level of the public road and stream bed so as not to conflict with the road drainage and watercourse;
- Fluid return lines used in HDD process will be tested for leaks prior to use to check their reliability;
- Inert, biodegradable drilling fluid will be used;
- All practices involving bentonite will be monitored closely, that is: pumping pressure, drilling mud formulation i.e., drilling fluid volume and the volume of mud returns;
- A comprehensive monitoring system will be established to closely oversee any procedures involving bentonite, encompassing the careful observation of pumping pressure, the precise formulation of drilling mud (including drilling fluid volume), and the accurate measurement of mud returns.

Plate 3-2: Existing bridge on BARROW_090 River

3.3 Turbine Delivery Route

The Turbine Delivery Route (TDR) will utilise existing public highways, which cross a number of existing WFD watercourses. In addition, a new single span bridge will be constructed along the TDR to cross the Philipstown River, constructed adjacent to the existing Philipstown Bridge.

Further details on the watercourse crossing Construction methodologies are provided in Chapter 2 - Description of Proposed Development and the CEMP in Appendix 2.1 of Volume III.

Bottomless box culverts shall be of pre-cast concrete construction and sized to accommodate the 1 in 100-year (+20%) flood flow and will include a minimum freeboard of 300mm.

Piped culverts will be sized to accommodate the 1 in 100-year flood flow (plus a 20% allowance for climate change) and will be minimum 450mm in diameter.

With suitably sized piped culvert and box culvert crossings, and a suitably designed bridge, there will be no impact on flows within watercourses and the risk of flooding will not be increased as a result of the Proposed Development.

Plate 3-3: Existing Philipstown Bridge Watercourse Crossing at TDR Node No. 29/30

All in-stream works will be carried out under dry works conditions i.e. the works area will be isolated from the river/stream/drain flow by means of temporarily over pumping or fluming the flow. The diversion of flow by over pumping / fluming will be into the same waterbody i.e. flows will not be diverted from one watercourse to another. The flume pipe and / or the pumps will be sized appropriate to watercourse flow and will have capacity to accommodate storm flows. Fluming is the preferred option for fishery water courses and must be such that fish passage is maintained. Where over pumping is proposed, measures (such as screening) will be taken to ensure that fish do not become entrained in the pump. Additionally, measures will be taken to reduce the sedimentation caused by pumping e.g. creating a gravel-lined sump.

To create a dry works area, an upstream barrier will be installed using aquadam or sandbags (which will be double bagged and tied). Straw bales will not be permitted. Flows will either be over pumped or flumed downstream of the works area. A downstream barrier will then be installed and the works area dewatered. Direct dewatering into the watercourse will not be permitted as it will increase the risk of sedimentation. Instead dewatering will be via filter bag, sediment tank, filter mats or natural vegetation adjacent to the watercourse. Discharging construction water (trade effluent) directly to surface waters is a licensed activity. No extracted or pumped or treated construction water from the isolated construction area will be discharged directly to a drain or watercourse (This is in accordance with Local Government (Water Pollution) Act, 1977 as amended).

Any water courses requiring a dry works area will require a fish salvage exercise which must firstly be Authorised under Section 14 of the Fisheries (Consolidation) Act 1959. Fish salvage by electrofishing will not be carried out where water temperature exceeds 20ºC. Fish salvage operations can only be conducted by qualified ecologists under said license. A detailed method statement will be required as part of the license application. The work will have regard to the following general guidelines for electrical fishing include Beaumount et al., (2002) “Guidelines for Electric Fishing Best Practice” and Scottish Fisheries Coordination Centre (2007) “Electrofishing team leader training manual” and Central Fisheries Board (2008) Methods for the Water Framework Directive Electric Fishing in wadable reaches”.

No in-stream works will be carried out in any WFD mapped watercourse or associated riparian area during the salmonid spawning season (which is October to May inclusive).

4. SURFACE WATER MANAGEMENT AND WATER QUALITY MONITORING

4.1 Daily Preparation During the Implementation of the Surface Water Management Plan

The Drainage Engineer appointed by the contractor shall conduct regular meetings with the Construction Management Team to discuss the phasing of construction and drainage as the work progresses. The focus of these meetings will be on establishing an operational drainage system in advance of the progression of the works.

Particular regard will be taken of daily weather conditions and long-range forecasts. The Drainage Engineer will have the authority to suspend the works if weather conditions are deemed too extreme for the effective protection of receiving watercourses. Mitigation measures to protect receiving watercourses will be put in place as directed by the Drainage Engineer in response to extreme forecasts.

The surface water management system will be visually inspected on a daily basis during construction works by the SHEQ Officer (or equivalent appointed person) to ensure that it is working optimally. The frequency of inspection will be increased at settlement ponds adjacent to areas where earthworks are being carried out and at the borrow pits during excavations. Where issues arise, construction works will be stopped immediately, and the source of the issue will be investigated. Records of all maintenance and monitoring activities associated with the surface water network will be retained by the Contractor on-site, including results of any discharge testing requirements.

The Contractor will implement temporary control measures such as silt fences, silt bags, temporary settlement tanks, as required.

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

4.2 Personnel Qualifications and Key Contacts

Subject to planning consent and following the appointment of the Contractor for the works and Ecological Clerk of Works (ECoW), the SWMP for the construction stage of the Proposed Development shall be finalised in accordance with this plan.

All those carrying out work on site must have a FÁS/Solas Safe Pass Card. All works must be supervised by a competent supervisor. Workers must be adequately trained in the tasks they are required to carry out. The key contact names and contact details shall be supplied to all personnel entering the site. All site staff shall be informed of the emergency procedures for the site.

4.3 Mitigation Measures for Pollution Control to Protect Water Quality

Additional infrastructure and measures used to protect water quality are described in the following sub-sections.

Silt Traps and Silt Fences

Silt traps will be provided in swales which will consist of geotextile staked across the swale at regular intervals. The geotextile will be weighed down on the upstream side with clean filter stone to provide further filtration and stability to the silt trap, as shown in Plate 4-1 and Plate 4-2. Silt traps will be decommissioned after the end of the construction phase and will be replaced by check dams.

Silt fencing will be kept on site and erected as required during construction to provide further protection to prevent the ingress of silt into the existing land drains, streams and watercourses. Silt fences will be constructed using a permeable filter fabric (e.g. Hy Tex Terrastop Premium silt fence or similar) and not a mesh (see 0501 Series Planning Drawings for details). The base of the silt fence will be bedded at least 15-30 cm and posts set a maximum of 2m intervals. Once installed the silt fence will be inspected daily during the proposed works, weekly on completion of the works for at least one month, but particularly after heavy rains and periodically thereafter. The silt fencing will be kept in place until the natural vegetation has been re-established.

Plate 4-1: Silt trap across grassed swale

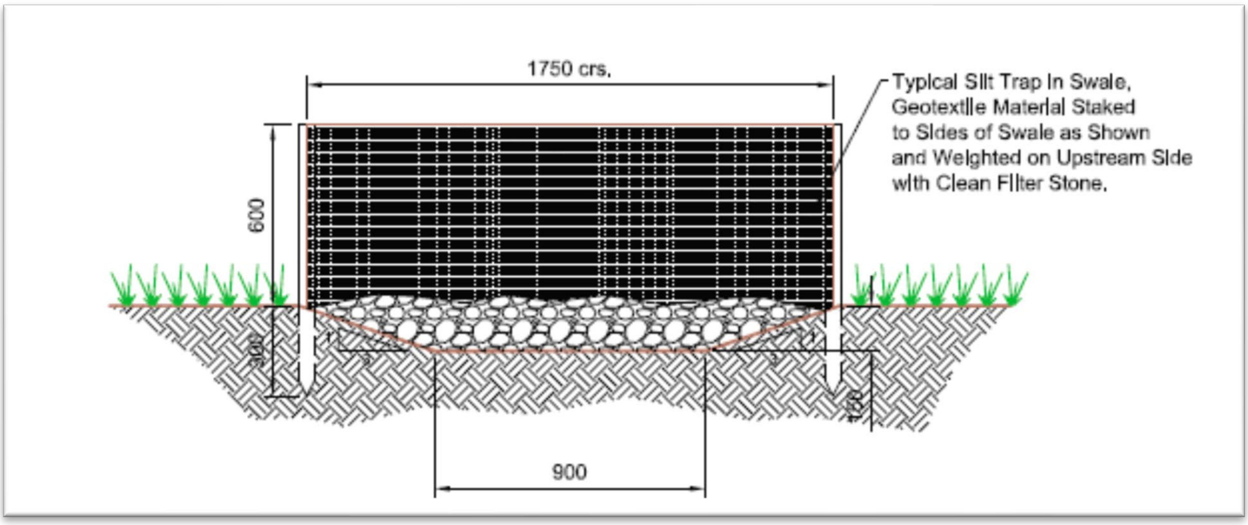

Plate 4-2: Trap Details

Plate 4-3: Silt Fence

Drainage of Temporary Site Compounds

The site compounds will be set back a minimum of 50 m from existing watercourses. Drains around the hard-standing areas of the site compounds will be in the form of shallow grassed swales to minimise the disturbance to sub-soils.

Concrete trucks will not be washed out on Site. Where chutes, hoppers/skips and equipment (e.g. vibrating wands) associated with concrete works need to be washed down this will be done into a sealed mortar bin / skip with the appropriate capacity, and which has been examined in advance for any defects. The location of wash down areas will be set back as far as practically possible from any drain or watercourse, and a minimum of 50 m.

Any diesel or fuel oils stored at the temporary site compounds will be bunded. The bund capacity will be sufficient to contain 110% of the tank's maximum capacity. Where there is more than one tank within the bund, the capacity will be sufficient to accommodate 110% of the largest tank's maximum capacity or 25% of the total maximum capacities of all tanks, whichever is the greater. Design and installation of fuel tanks will be in accordance with best practice guidelines BPGCS005 (Oil Storage Guidelines).

Portaloos and / or containerised toilets and welfare units with storage tanks will be used to provide toilet facilities for site personnel during construction. The sanitary waste will be removed from site by a licensed waste disposal contractor.

All Portaloo units located on 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. Potable water will be brought onsite in bottles.

Temporary petrol and oil interceptors will be installed at the site compounds and at all locations dedicated for plant repairs/storage of fuel/temporary generator installation. Surface water run-off from the compound will be directed through a Class 1 Full Retention Oil Interceptor before discharge to the surface water drainage system for the site. This surface water drains flows to a settlement pond before final discharge over land. A trained and dedicated environmental and fuel spill emergency response team will be set up on site before commencement of construction on-site.

Drainage of Substation Compound

The permitted on-site substation will be drained using shallow swales, with a suitably designed settlement pond. The settlement pond will remain in place following the construction period. At the upslope side of the sub-station overland flows will be intercepted in channels and discharged diffusely over vegetated areas.

In the operational stage, the substation drainage will consist of an underground surface water pipe system. This system will include a number of surface water manholes, rainwater pipes for the compound building roof, Class 1 Full Retention Oil Separator, an oil sensitive bund dewatering system, attenuation tank, ACO drains and filter drains. The system will discharge overland limited to the greenfield runoff.

In accordance with SuDs best practice, it is proposed to include rainwater harvesting tanks within the surface water system which will comprise of a filter, an underground tank and a pump. The system allows rainwater to run down the roof and into the guttering and downpipes in the normal way before passing through the filter, which removes any leaves and debris. Rainwater is then stored in the underground tank for reuse. Potable water will be brought onsite in bottles.

A foul system is proposed within the station to cater for the wastewater generated in the welfare facilities of the control building. The foul system will consist of an underground pipe network, foul manholes and a 10,000L full retention foul effluent storage tank. The tank will have an associated high-level alarm which will be connected to the control building.

A foul holding tank to be maintained and emptied bi-annually is the most preferable means of treating and disposing of foul waste from the site. The licensed contractor charged to empty and dispose of the waste will be the holder of a valid waste collection permit. It is not proposed to treat wastewater onsite.

Drainage of Turbine Bases and Hardstanding

The excavations for turbines will be pumped into the site drainage system (including settlement ponds), which will be constructed at site clearance stage, in advance of excavations for the turbine bases.

As discussed above, the new turbine hard-standing areas will be drained via shallow swales with suitably designed settlement ponds. The settlement ponds for the turbine bases and hardstanding will remain in place following the construction period.

If cross-drains are required to convey the drainage across the hardstanding area, the diameters will be suitably designed in advance.

Drainage of Cable Trenches

Cables running throughout the wind farm site will be installed in trenches adjacent to site access tracks, where possible. Cable trenches will be excavated using a mechanical excavator and the excavated materials placed in small bunds adjacent to the trenches for back filling, as shown in Plate 4-4.

The seed bank is to be retained for placing back as the top layer of backfill to the trench, to aid successful restoration of vegetation in disturbed areas.

Cable 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.

Plate 4-4: Backfill over Cable Trench

Procedure for Dewatering of Excavations

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. Water in the excavations will be pumped into the 'dirty water' drainage system which will be constructed at site clearance stage, in advance of and excavation works. Where dewatering is required in areas away from the Site drainage system, dewatering will be to adjacent lands contained within the Planning Boundary which are down topography of the works area and will be via filter bags (appropriate sized relative to pump rate) onto natural vegetation set back a minimum of 50m from any drain or watercourse. There will be no direct discharge to the existing drainage or river network.

Drainage of Stockpiled Material and Embankments

During the construction period, the excavated material will be used to reinstate the turbine bases or will be placed within the Spoil Management Area. All excavations shall be constructed and backfilled as quickly as possible. Excavation will stop during or immediately after heavy rainfall.

Excavation will precede the turbine base construction, cable trench and access track construction. Soil will be excavated and replaced with granular fill where required. Excavation will be carried out from access tracks where possible in order to reduce the compaction of topsoil. The silt fences will be inspected weekly and after rainfall events by Environmental Clerk of Works (ECoW).

During the construction period, spoil heaps from the excavations for the turbine bases will be stored and permanently kept during the Proposed Development. The following are the details of the permanent spoil heap drainage process:

- Collection: A system of open channel drain and catchment basins is installed on the spoil heap to collect and channel water to a central location.
- Treatment: The water collected from the spoil heap may contain pollutants and require treatment before being released back into the environment. The treatment process depends on the type of pollutants present and may include physical, chemical or biological methods.

- Reuse or discharge: The treated water can either be reused for other purposes or safely released back into the environment.
- Maintenance: The permanent spoil heap drainage system requires regular maintenance and inspection to ensure that it continues to function effectively and prevent any environmental harm.

Overall, permanent spoil heap drainage helps to maintain the stability of the spoil heap, prevent water-related environmental problems, and reduce the risk of accidents. It is a crucial aspect of responsible mining and environmental management.

Control of Concrete

Only ready-mixed concrete will be used during the construction phase, delivered from local batching plants in sealed concrete delivery trucks. This approach eliminates potential environmental risks associated with onsite batching.

Any plant operating within 50 m of a drain or watercourse will require special consideration of the transport of concrete from the point of discharge from the mixer to final discharge into the delivery pipe (tremie). Care will be exercised when slewing concrete skips or mobile concrete pumps over or near surface waters. Placing of concrete in or near watercourses will be carried out only under the supervision of the Ecological Clerk of Works (ECoW).

Concrete trucks will not be washed out on site. Washing of equipment associated with concrete works (e.g. chutes, hoppers, skips, and vibrating wands) will take place only in designated sealed mortar bins or skips, which will be pre-inspected for defects. These wash-down areas will be set back as far from drains or watercourses as practically possible, at a minimum of 50 m.

Concrete washing will be contained and managed appropriately. Regular inspections of wash-down areas and associated mortar bins will be undertaken, with adequate records maintained. Waste concrete slurry, washings, and supernatant will be allowed to settle and dry, and will then be disposed of at a licensed waste facility.

A small volume of water generated from washing of concrete truck chutes will be directed into a semi-permanent lined impermeable containment area, as shown in Plate 4-5, or into a designated concrete wash unit. The containment lagoon will be lined with a 1 mm LLDPE impermeable liner and equipped with a sump to collect wash water. Excavated material from this area will be retained on site for reinstatement following construction.

During construction, wash water and any solids collected in the sump will be removed periodically to a licensed waste facility, with daily emptying available if required. After construction, the liner, remaining wash water, and any accumulated solids will be removed and disposed of appropriately, and the sump will be reinstated.

Concrete, cement, grout, or similar materials will not be hosed into surface water drains under any circumstances. Any concrete spills shall be contained immediately, and runoff prevented from entering nearby watercourses.

Plate 4-5: Lined Settlement Lagoon for Concrete Washout Facility

General Pollution Control Measures

Refuelling of plant during construction will be carried out at the temporary compounds, which will be located a minimum of 50 m from any watercourse. The station will be fully equipped for a spill response and a specially trained and dedicated environmental and emergency spill response team will be appointed before commencement on site. In addition to the above, onsite re-fuelling of machinery will be carried out 50 m from watercourses using a mobile double skinned fuel bowser.

The fuel bowser, a double axel custom-built refuelling trailer will be re-filled off site or at the designated refuelling area and will be towed by a 4x4 jeep to designated re-fuelling areas near to where machinery is located but at distances of greater than 50 m from watercourses.

Drip trays and spill kits will be kept available on site, to ensure that any spills from vehicles are contained and removed off site.

Any diesel, fuel or hydraulic oils stored at the temporary site compounds will be bunded. The bund capacity will be sufficient to contain 110 % of the tank’s maximum capacity.

Vehicles entering the site shall be in good working order, free from leakage of fuel or hydraulic fluid.

A wheel wash will be provided at the site entrance draining to a silt trap to avoid any silt laden run-off flowing on to the public road and entering roadside drains.

Portaloos and/or containerised toilets and welfare units will be used to provide toilet facilities for site personnel during construction. Sanitary waste will be removed from site via a licenced waste disposal contractor.

Emergency Response Procedure in the Case of Leaks or Silt Breakout

All personnel working on site will be trained in pollution incident control response. An emergency response procedure is contained in the following sections ("Accidental Spillage from Leaking or Damaged Fuel Lines" and "Accidental Break Out of Silt from Settlement Ponds") and which will ensure that appropriate information will be available on site outlining the spillage response procedure and a contingency plan to contain silt.

A regular review of forecasts of heavy rainfall is required, and a contingency plan will be prepared before and after such events.

In the event of a risk of pollution to a drain or watercourses due to an accidental spill, suitably sized pumps will be on hand to over pump the flow from upstream with the of isolating the flow away from the area of spill. Oil booms will be placed downstream of the spill as necessary.

Procedures for particular accidental spillages, from leaking or damaged fuel lines or a break-out of silt are outlined below.

Plate 4-6: Typical Mobile Fuel Boswer

Accidental spillage from leaking or damaged fuel lines

Emergency spill kits with oil boom and absorbent materials will be kept on-site in the event of an accidental spill. Spill kits will be kept in construction compound, the 4x4 vehicle transporting the fuel bowser and smaller spill control kits will be kept in all construction machinery. All construction personnel will be notified of where the spill kits are located as part of the site induction and will be trained on the site procedures for dealing with spills.

In the event of a leak or a spill in the field, the spill kits will be used to contain and absorb the pollutant and prevent any further potential contamination. The absorbed pollutants and contaminated materials will be placed into leak proof containers and transferred to a suitable waste container for hazardous materials in the construction compound. Where a leak has occurred from machinery, the equipment will not be permitted to be used further until the issue has been resolved.

The SHEQ Officer (or equivalent appointed person) will be notified of any spills on-site and will determine the requirement to notify the authorities.

Typically, the following procedures will be followed in the event of an incident:

- Works will stop immediately where safe to do so,
- The SHEQ Officer (or equivalent appointed person) will be contacted,

- The size of the incident will be assessed and determined if it can be controlled by site staff or if emergency services are required to attend,
- The appropriate enforcing authority will be contacted,
- The SHEQ Officer (or equivalent appointed person) will investigate after the incident,
- The findings will be sent to the appropriate authority; and
- An action plan will be prepared to set out any modifications to working practices required to prevent a recurrence.

Accidental break out of silt from settlement ponds

The settlement ponds will be equipped with a spillway to control overflow scenarios related to the not manageable storm events (more extreme than the design return period provided for the settlement ponds). To ensure to avoid potential erosion due to the overflow, scour protection (riprap or equivalent) will be provided along and the outfall location of the spillway.

The drainage engineer shall be contacted if there is an accidental spillage or break out of silt on the Site.

4.4 Maintenance of Site Drainage Systems

The proposed drainage system has been designed in accordance with the current standards and guidelines to minimise the maintenance requirement for the proposed site, however excessive debris in the system could still result in loss of performance.

The drainage system for the development shall be maintained regularly to keep it operating effectively. The maintenance shall include the following:

- Inspection and maintenance of swales,
- Inspecting cross-drains for any blockages,
- Inspecting settlement ponds and outfalls,
- Inspecting the stream crossings and piped crossings for obstructions,
- Inspecting the progress of the re-establishment of vegetation,
- Implementing appropriate remedial measures as required after the above inspections.

Regular maintenance shall be provided to the site drainage system to ensure optimal operation to accommodate heavy rainfall events. All the drainage elements will be designed with a freeboard of 300 mm to provide additional hydraulic capacity to accommodate heavy rainfall event.

Biannual inspections will take place in spring and autumn where there is additional risk of blockage from debris associated with fallen leaves.

The proposed drainage system includes SuDS drainage ditches and settlement ponds. The key maintenance requirement for the ditches and associated headwalls and pipework will be the maintenance of vegetation and mowing of grass within and on the banks/verges and the removal of accumulated sediments and collection of litter and debris.

During the inspections the general operation, and structural condition of the headwalls and any erosion of banks or scour control features should be identified and rehabilitated as required.

Vegetation within and on the banks of the drainage ditches and settlement ponds should be trimmed twice a year, preferably in April and October to a height of 100mm to establish a dense sward and provide long grass margins.

All access tracks will be constructed from aggregate which will allow a portion of rainfall to infiltrate and, therefore, reduce surface water runoff. Adjacent swales will also intercept and retain surface water runoff allowing this to disperse naturally via infiltration and evapotranspiration. Where swales are installed on sloped ground, check dam structures will be used within the channels to provide attenuation, allowing a portion of the flows to disperse naturally.

Swales and drainage channels will discharge runoff from access roads and areas of hardstanding to settlement ponds. These will be suitably sized to accommodate flows from storm events up to and including the 1 in 100-year storm event.

Settlement ponds will not discharge directly to any drain or watercourse. Rather, flows from the ponds will be dispersed diffusely over land to allow natural overland flow and percolation within the catchment.

Watercourse crossings will be designed and suitably sized to accommodate peak, or storm discharge rates so as not to cause risk of impeding flows during extreme storm events and causing flooding upstream of the crossing. All drain and watercourse crossings will be designed in accordance with the requirements of Regulation 50 of the European Communities (Assessment and Management of Flood Risks) Regulations 2010 SI 122 of 2010. The channel width will be maintained, and the crossings will be designed so as not to cause an impediment to the passage of woody debris or sediment transport. Appropriate freeboard will be provided to OPW requirements.

The cable trenches will be excavated in dry weather where possible and infilled and revegetated if required to prevent soil erosion or generation of silt pollution of nearby surface water. There will, therefore, be no increase in the risk of flooding.

The surface water management system at the Site will ensure that there will be no increase in the risk of fluvial or surface water flooding downstream as a result of the windfarm development.

After the heavy rainfall and winds, it is necessary to assess the conditions of the site drainage system to evaluate that it is operating according to the design requirements. Maintenance is required to re-establish the regular status of the drainage system. If the event was too heavy and the drainage system is damaged, it is necessary to re-build the damaged drainage elements, according to the design requirements.

4.5 Water Quality Monitoring Plan

An Environmental / Ecological Clerk of Works (EnCoW / ECoW) will be appointed by the Developer with responsibility for monitoring at the Site during the construction phase of the Development. The Clerk of Works will have the authority to temporarily stop works to prevent negative effects on hydrology or to ensure corrective action is taken to mitigate adverse effects.

A Surface Water Quality Monitoring Programme will be established which will commence 12 months prior to construction in order to establish baseline physio-chemical conditions and hydromorphological conditions of the watercourses within the Site and will continue throughout construction and for three months post-commissioning phase of the Proposed Development.

Monthly water quality grab samples will be taken from the Cushina River (FIGILE_080) at locations approximately 10m downstream of the proposed watercourse crossing within the Proposed Wind Farm. Water quality sampling will be undertaken in accordance with BS EN ISO 5667 - Water Quality Sampling. The samples will be checked in situ for:

I. pH;
II. Temperature;
III. Turbidity;
IV. Conductivity; and
V. Dissolved Oxygen.

using a fully calibrated portable pH/temperature/conductivity meter (with pH resolution of 0.01 pH), turbidity probe and a flow impellor.

The samples will then be submitted to an appropriately certified laboratory (ILAB or similar) in accordance with the laboratory custody protocol for assessment of the following parameters:

i. Biological Oxygen Demand;
ii. Chemical Oxygen Demand;
iii. Total Hardness;
iv. Total Suspended Solids;
v. Total Dissolved Solids;
vi. Nitrate;
vii. Nitrite;
viii. Ammoniacal Nitrogen;
ix. Molybdate Reactive Phosphorus;
x. Total Coliforms; and
xi. Faecal Coliforms (E.coli).

A record of monthly meteorological conditions (as a minimum precipitation and temperature) will be maintained.

Biological water quality assessment using the EPA Q-value methodology will be carried out once prior to the commencement of construction and on a six-month basis during the monitoring period.

The hydromorphological baseline at the proposed watercourse crossings within the Site will be established using the River Hydromorphology Assessment Technique (RHAT)[1]. Annual RHAT assessments will be carried out which will be compared against the baseline. The Design and Construction of the bridge crossing and culverts will minimise upstream afflux, avoid turbulence and minimise loss of the natural channel bed due to the culvert or structure in order to ensure that hydromorphology is not affected. The Design will ensure that the baseline river Hydromorphological Condition Score derived from the initial RHAT assessment is not altered such that it would impact the derived WFD hydromorphology classification.

The Contractor will ensure that the daily visual monitoring of the surface water network for visible signs of construction impact is carried out on a daily basis for example, riparian vegetation loss, evidence of oil/fuel slick, sediment plumes, fish kill.

[1] https://www.riverhabitatsurvey.org/RHSfiles/RHSToolboxHelp/RiverHabitatSurveyToolbox.html?RHAT.html

During the construction and commissioning phase, water quality monitoring results will be recorded and compared against baseline data and where there is a deviation beyond the 95%ile, the Contractor will investigate and as necessary sample further upstream and determine if elevated concentrations are coming from the Site, in which case the Contractor will ensure that emergency control measures are put in place to return the levels to the baseline. Similarly, the Contractor will compare results of water quality monitoring with the 95%ile High Status Environmental Quality Standards arising from the European Union Environmental Objectives (Surface Waters) Regulations 2009 as amended. Any deviation beyond these standards will be investigated and the findings will be report to the Community Water Officer, Midlands & East Region.

During the construction and commissioning phase, daily inspection of environmental protection measures e.g. silt traps, check dams, ponds and outfalls and drainage channels will be carried out and any improvement works carried out within a timely manner.

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