APPENDIX 23-1

FLOOD RISK ASSESSMENT

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SCEIRDE ROCKS OFFSHORE WIND FARM – ONSHORE SITE, CO. CLARE

FLOOD RISK ASSESSMENT

FINAL REPORT

Prepared for:
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1. INTRODUCTION

1.1 BACKGROUND

Hydro-Environmental Services (HES) were requested by MKO, on behalf of Fuinneamh Sceirde Teoranta (FST), to undertake a Stage II Flood Risk Assessment (FRA) for a planning application for the onshore elements of the Sceirde Rocks Offshore Wind Farm (i.e. 'the Project').

This FRA is written to accompany Chapter 24 of the Environmental Impact Assessment Report (EIAR) for the Project. The Project is described in full in Chapter 5 of the EIAR. For the purposes of this FRA, and consistent with the EIAR, the various components are described and assessed using the following references: the 'Project', the 'Onshore Site', the Onshore Grid Connection ('OGC'), the Onshore Compensation Compound ('OCC'), and the Onshore Land Location ('OLL').

This FRA is carried out in accordance with 'The Planning System and Flood Risk Management Guidelines for Planning Authorities' (DoEHLG, 2009).

1.2 STATEMENT OF EXPERIENCE

Hydro-Environmental Services (HES) are a specialist geological, hydrological, hydrogeological and environmental practice that delivers a range of water and environmental management consultancy services to the private and public sectors across Ireland and Northern Ireland. HES was established in 2005, and our office is located in Dungarvan, County Waterford. We routinely complete impact assessments for hydrology and hydrogeology for a large variety of project types including wind farms.

This WFD assessment was prepared by Michael Gill, Conor McGettigan and Nitesh Dalal.

Michael Gill (P. Geo., B.A.I., MSc, Dip. Geol., MIEI) is an Environmental Engineer with over 22 years' environmental consultancy experience in Ireland. 22 years' environmental consultancy experience in Ireland. Michael has a degree in Civil and Environmental Engineering, a MSc in Engineering hydrology from TCD and a MSc in Applied Hydrogeology from Newcastle University. Michael has completed numerous (60+) hydrological and hydrogeological assessments relating to bedrock quarries and sand and gravel pits. Recent examples include Ardfert quarry in County Kerry and Middleton Quarry in County Cork.

Conor McGettigan (MSc, BSc) is an Environmental Scientist with over 4 years' experience in the environmental sector in Ireland. Conor holds an MSc in Applied Environment Science and a BSc in Geology. Conor routinely completed hydrological and hydrogeological impact assessment, flood risk assessments and WFD compliance assessments for a range of proposed developments including wind farms, residential developments, industrial developments, and quarries.

Nitesh Dalal (B.Tech, PG Dip., MSc) is an Environmental Scientist with over 7 years' experience in environmental consultancy and environmental management in India. Nitesh holds a M.Sc. in Environmental Science from University College Dublin (2024), a PG Diploma in Health, Safety and Environment from Annamalai University, India (2021) and B.Tech. in Environmental Engineering (2016) from Guru Gobind Singh Indraprastha University, India (2016).

1.3 REPORT LAYOUT & METHODOLOGY

This FRA report is structured as follows:

- Section 2 describes the proposed site setting and details of the onshore elements of the Project;
- Section 3 outlines the hydrological and geological characteristics of the local surface water catchment in the vicinity of the Onshore Site;
- Section 4 presents our initial flood risk identification undertaken for the Onshore Site based on desk studies and walkover surveys;
- Section 5 deals with a detailed site-specific flood risk assessment (FRA) and a Justification Test;
- Section 6 outlined the drainage proposals for the onshore elements of the Project in terms of flood prevention; and,
- Section 7 presents the FRA report conclusions.

2. BACKGROUND INFORMATION

2.1 INTRODUCTION

This section provides details on the topographical setting of the Onshore Site along with a description of the onshore elements of the Project.

2.2 SITE LOCATION AND TOPOGRAPHY

2.2.1 Onshore Landfall Location

The Onshore Landfall Location (OLL) is located in the townland of Killard, approximately 1km northwest of White Strand and approximately 3.5km northwest of the village of Doonbeg in west County Clare. This is the location where the Offshore Export Cable will be brought ashore to meet the Transition Joint Bay (TJB). The OLL stands at an elevation of approximately 10metres above Ordnance Datum (mOD). The proposed TJB at the OLL is situated approximately 100m from the cliffs edge. This area can be accessed from an unnamed local road which runs from northwest to southeast, approximately 300m southeast of the proposed construction compound location. The site of the OLL is currently a greenfield site comprising of agricultural land.

2.2.2 Onshore Grid Connection

The Onshore Grid Connection (OGC) has a total length of 22.3km and is divided into 2 no. sections. The first section extends from the OLL to the OCC in the townland of Ballymacrinan and has a total length of 19.3km. The second section extends from the OCC to Moneypoint Power Station and has a total length of 3km. The OGC comprises an underground cable connection which will travel along third-party lands and the local public road network. The local topography is relatively flat to gently undulating with elevations ranging from approximately 5mOD to 55mOD.

Upon exiting the TJB at the OLL, the OGC travels to the south along local roads and third-party lands before crossing the N67 in the townland of Doonmore. The route then continues to the southeast along the L2034 before travelling east and crossing the R483. From here the cables will be routed through Kilrush Golf Club in the townlands of Ballykett and Parknamoney. After exiting Kilrush Golf Club the OGC will then travel across the road into third-party lands, travelling south before entering onto the L6150 and continuing to the southeast as far as the 220kV OCC in the townland of Ballymacrinan.

Upon exiting the OCC, the OGC cable continues to the south on the local road network before it joins the N67. From here, it travels east in the verge of the N67. In the vicinity of Moneypoint 220kV substation, a small section (approximately 600m) of the OGC is located off-road and crosses a forested area in the townland of Carrowdotia South. Local ground elevations along this section of the OGC range from approximately 5 to 25mOD. The vast majority of the OGC will be located in the existing public road corridor with a section from the OCC to Moneypoint located within the road verge along the N67. Meanwhile, additional sections are located in 3rd party lands.

Some sections of the OGC are located off road. An overview of both sections of the OGC (from the TJB at the OLL to the OCC, and from the OCC to Moneypoint) including the length of the sections within the public road, third-party lands, and the total length of each route is provided in Table A below.

Table A: Onshore Grid Connection Sections

Cable Route Section	*Public Roadway*	*Road Verge*	*Third-Party Lands*	*Total Length*
Section A (Landfall to OCC)	14.8 km	----	4.5 km	19.3km
Section B (OCC to Moneypoint)	0.7km	0.7km	1.6 km	3.0 km
Total				22.3km

2.2.3 Onshore Compensation Compound

The Onshore Compensation Compound (OCC) is located within the townland of Ballymacrinan, approximately 3.5km to the southeast of the town of Kilrush. The site of the proposed OCC can be accessed via the L6150, situated to the east. The local ground elevations stand at ~20mOD. The Lower Shannon Estuary is located ~700m to the south. The site on which the OCC is located is currently a greenfield site in agricultural use.

A study area location map is shown as **Figure A below.**

2.3 PROPOSED DEVELOPMENT DETAILS

The Project is described in full in Chapter 5 of this EIAR.

The onshore components associated with the Project include the OLL, the OCC and the OGC.

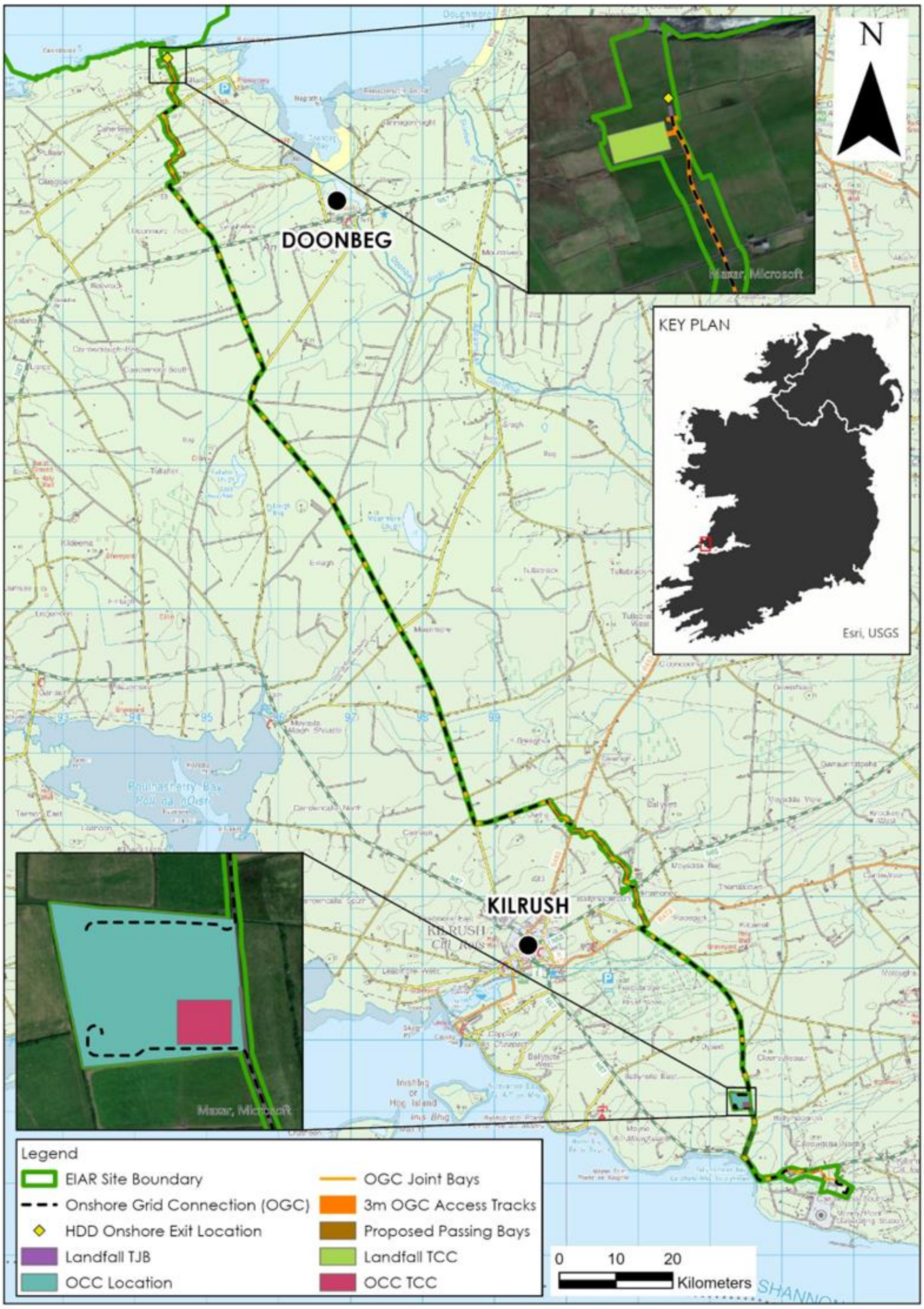

Figure A: Site Location Map

3. EXISTING ENVIRONMENT AND CATCHMENT CHARACTERISTICS

3.1 INTRODUCTION

This section gives an overview of the hydrological and geological characteristics in the area of the Onshore Site.

3.2 BASELINE HYDROLOGY

Regionally, the Onshore Site is located in 2 no. regional surface water catchments. The northern section of the Onshore Site, including the OLL and the northern section of the OGC, is located in the Mal Bay surface water catchment within Hydrometric Area 28. Meanwhile, the southern section of the Onshore Site, including the OCC and the southern section of the OGC, is located in the Shannon Estuary North surface water catchment within Hydrometric Area 27. Both of these regional surface water catchments are located in the Shannon River Basin District.

A local hydrology map is included as **Figure B** below.

3.2.1 Onshore Landfall Location

Within the Mal Bay surface water catchment, the OLL is located in the Doonbeg River WFD sub-catchment (Doonbeg_SC_010).

On a local scale, the OLL is situated within the northwestern section of the Doonbeg_050 WFD river sub-basin. The closest mapped watercourse is an unnamed 1st order stream located approximately 150m to the southeast. This watercourse flows northeast for ~680m before entering into the Shannon Plume coastal water body.

The Shannon Plume coastal water body is located approximately 100m to the north of the Transition Joint Bay and the land slopes gently in the direction of the coastal water body.

3.2.2 Onshore Grid Connection

Within the Mal Bay surface water catchment the OGC is located within the Doonbeg River sub-catchment (Doonbeg_SC_010). Within this catchment there are a total of 4 no. crossings over EPA mapped watercourses:

- 1 no. existing watercourse crossing is located along a local road in the townland of Killard. This watercourse is locally unnamed, but has been assigned a name by the EPA (Killard Stream). This watercourse directly discharges into Doonbeg Bay;
- A new crossing is proposed over a locally unnamed stream, referred to by the EPA as the Caherlean Stream on the boundary between the townlands of Killard and Doonmore. This watercourse flows to the east and discharges directly into Doonbeg Bay;
- An existing crossing along a local road over a locally unnamed stream, referred to by the EPA as the Doonbeg stream, in the townland of Doonmore to the south of the N67. This watercourse flows to the northeast and discharges into the Doonbeg River immediately upstream of Doonbeg Bay; and,
- An existing crossing along a local road over a locally unnamed stream, referred to by the EPA as the Carrowmore South Stream. This watercourse originates from Tullaher Lough and flows to the northeast, before discharging into the Doonbeg River.

Within the Shannon Estuary North surface water catchment, the OGC is predominantly mapped in the Wood River sub-catchment (Wood_SC_010). Meanwhile, approximately 1.7km in the south is located in the Cloon[Clare] River sub-catchment (Cloon[Clare]_SC_010).

Within the Shannon Estuary North surface water catchment, there are a total of 7 no. existing watercourse crossings over EPA mapped watercourses:

- An existing crossing along a local road over a locally unnamed stream, referred to by the EPA as the Einagh Stream, on the boundary between the townlands of Einagh and Moanmore North. This stream originates from Moanmore Lough and flows to the southeast before it confluences with the Moyasta Stream;
- An existing crossing along a local road over a locally unnamed stream, referred to by the EPA as the Moyasta Stream. This crossing is located at the boundary between the townlands of Moanmore Lower and Moanmore South;
- An existing crossing along an access road within Kilrush Golf Club over the EPA named Parknamoney Stream. This crossing is located at the boundary between the townlands of Ballykett and Parknamoney;
- An existing crossing over the EPA named Wood River in the townland of Kilcarroll;
- An existing crossing along a local road over the EPA named Moyne Stream in the townland of Dysert;
- An existing crossing over the EPA named Ballynote East Stream in the townland of Ballymacrinan, north of the OCC; and,
- An existing crossing along the N67 over a locally unnamed 2^{nd} order stream, referred to by the EPA as the Molougha Stream. This watercourse is mapped to discharge into the Lower Shannon Estuary in Ballymacrinan Bay directly downstream of this mapped crossing. However, surveys along this section of the OGC have revealed that the Molougha Stream has been diverted through outfalls to accommodate the Moneypoint Power Generation Fly Ash Storage facility.

3.2.3 Onshore Compensation Compound

Within the Shannon Estuary North surface water catchment the OCC is located in the Cloon[Clare] River sub-catchment (Cloon[Clare]_SC_010).

On a more local scale, the OCC is located within the Tonahover_010 WFD river sub-basin.

The closest EPA mapped watercourse to the OCC is the Ballynote East stream. This stream runs along the norther border of the OCC. This stream flows in a westerly direction and then south for 1.78km before discharging into the Lower Shannon Estuary.

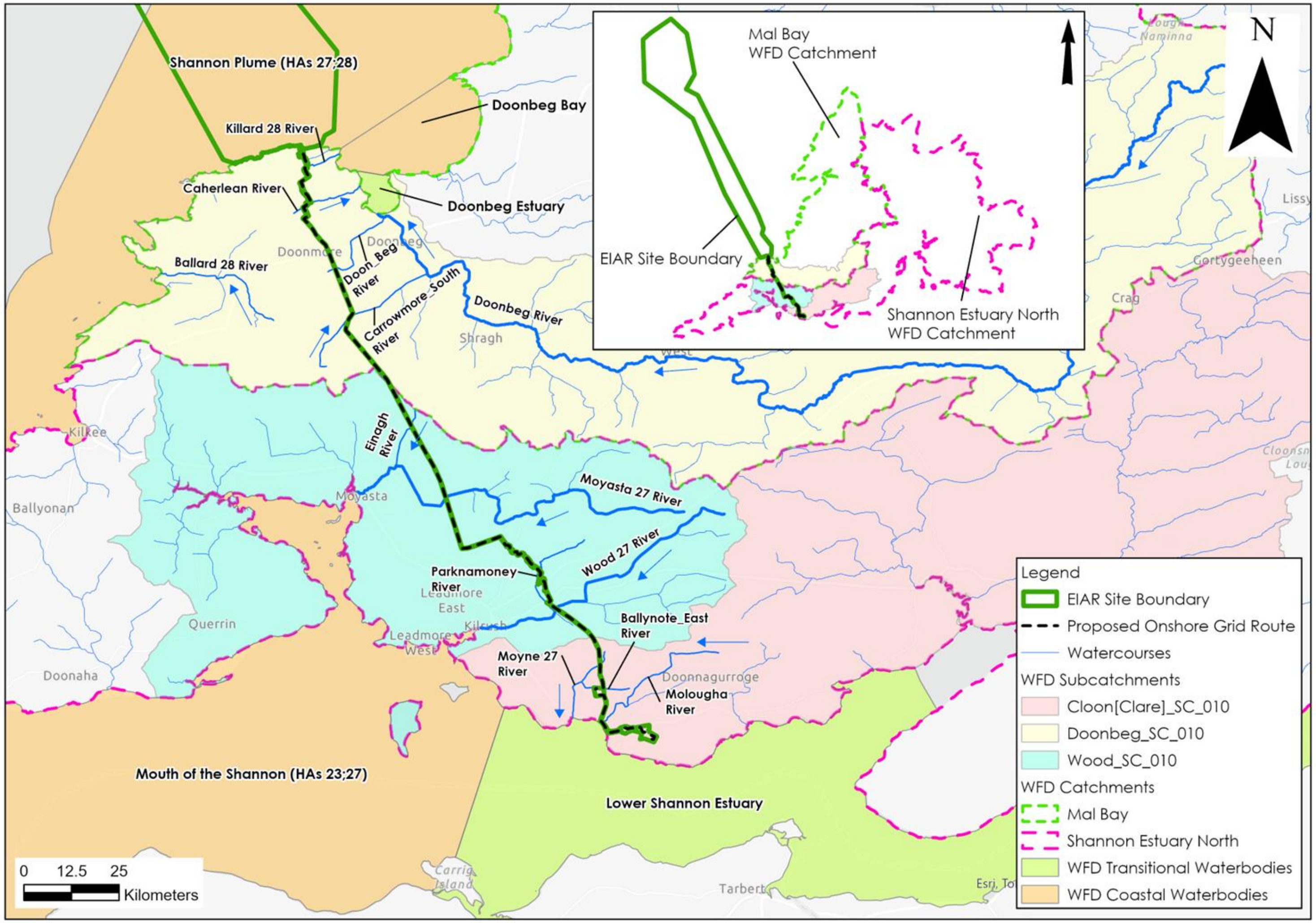

Figure B: Local Hydrology Map

3.3 RAINFALL AND EVAPORATION

The SAAR (Standard Average Annual Rainfall) recorded at Doonbeg Garda Station approximately 3.5km southeast of the OLL, is 1,186mm/year (www.met.ie).

Met Éireann also provide a grid of average annual rainfall for the entire country for the period of 1991 to 2020. Based on this more site-specific modelled rainfall values, the average annual rainfall at the Onshore Site ranges from 1,144mm/year in the vicinity of Moneypoint substation to 1,250mm/year along the OCG to the east of Moyasta. The average annual rainfall at the Onshore Site is 1,197mm/yr (this is considered to be the most accurate estimate of average annual rainfall from the available sources).

The average potential evapotranspiration (PE) at Shannon Airport, approximately 35km northeast of the OCC, is 578mm/year (www.met.ie). The actual evapotranspiration ("AE") is calculated to be 549mm/year (95% PE). Using the above figures the effective rainfall ("ER")[1] for the area is calculated to be (ER = SAAR – AE) 648mm/year.

Groundwater recharge and runoff coefficient estimates are available from the GSI (www.gsi.ie). Within the OLL and the OCC groundwater recharge coefficients range from 15% to 22.5%. These areas are mapped as having low recharge rates due to the presence of low permeability subsoils and poorly drained soils.

An estimate of ~96mm/year average annual recharge is given for the OLL and OCC. This calculation is based on a recharge coefficient of 15% (this represents the worst-case scenario in terms of runoff volumes). This means that the hydrology of these areas is characterised by high surface water runoff rates and relatively low groundwater recharge rates. This is supported by on-site observations made during the site walkover surveys whereby a high density of surface water features were recorded in the vicinity of the Onshore Site.

Therefore, conservative annual recharge and runoff rates for the OLL and the OCC are estimated to be ~97mm/yr and ~551mm/yr respectively.

Table B below presents return period rainfall depths for the OCC. These data are taken from https://www.met.ie/climate/services/rainfall-return-periods and they provide rainfall depths for various storm durations and sample return periods (1-year, 5-year, 30-year, 100-year).

Table B: Rainfall return period depths for the OCC

	Return Period (Years)			
Duration	**1**	**5**	**30**	**100**
5 mins	3.7	5.1	7.0	8.5
15 mins	6.1	8.3	11.4	13.9
30 mins	8.0	10.8	14.7	17.9
1 hour	10.3	14.0	19.0	23.0
6 hours	20.3	27.1	36.6	44.0
12 hours	26.3	35.1	47.1	56.6
24 hours	34.2	45.4	60.7	72.7
2 days	43.3	56.2	73.4	86.7

[1] *ER – Effective Rainfall is the excess rainfall after evaporation which produces overland flow and recharge to groundwater.*

3.4 GEOLOGY

The published Teagasc soil mapping (www.gsi.ie) shows that the Onshore Site is overlain predominantly by acidic poorly drained mineral soils and peat. Furthermore, the published GSI subsoils map (www.gsi.ie) shows that the majority of the Onshore Site is underlain by till derived from Namurian sandstones and shales with some peat. Site investigations comprising of trial pit excavations (2 no. at the OLL and 3 no. at the OCC), borehole drilling (2 no. at the OLL) were completed to determine the nature of the soils/subsoils at the OLL and OCC. Meanwhile, peat probes, hand augers and geophysical surveys were completed along sections of the OGC mapped to be underlain by peat. A full description of the results of these site investigations are provided in Section 8.3.3 of the EIAR.

Based on the GSI bedrock mapping (www.gsi.ie), the OLL and the majority of the OGC are underlain by the Gull Island Formation which is comprised of grey siltstone and sandstone. Meanwhile, the southern section of the OGC and the OCC are mapped to be underlain by the Central Clare Group. This bedrock geological formation is comprised of 5 no. cyclothems consisting of a basal mudstone which is overlain by laminated to massive grey siltstones, which are in turn overlain by thick, laminated and cross bedded sandstones.

The GSI maps the presence of bedrock outcrop immediately to the north of the OLL, along the coastline. There are no significant or extensive areas of bedrock outcrop mapped by the GSI along the OGC. The GSI maps some small exposures of the Gull Island Formation along the OGC in the townland of Doonmore in the north and further south along the N68 in the townland of Parknamoney. Some isolated areas of bedrock outcrop of the Central Clare Group are mapped along the OGC in the townlands of Kilcarroll and Clooneylissaun. Meanwhile, there are no mapped bedrock outcrops in the vicinity of the OCC or along the OGC from the OCC to Moneypoint.

The GSI records the presence of a coal seam approximately 500m to the west of the OCC. There are no bedrock geology faults mapped in the local area of the Onshore Site.

3.5 DESIGNATED SITES & HABITATS

Within the Republic of Ireland, designated sites include Natural Heritage Areas (NHAs), Proposed Natural Heritage Areas (pNHAs), candidate Special Areas of Conservation (cSAC), Special Areas of Conservation (SAC) and Special Protection Areas (SPAs).

The Onshore Site is not located within any designated conservation site, however there are designated sites located immediately adjacent to the OGC route as described below:

- Approximately 1.3km of the OGC in the townland of Carrowmore South is located adjacent to Tullaher Lough and Bog SAC (Site Code: 002343) and pNHA (Site Code: 000070). This designated site is located immediately to the west of the local road within which the OGC is proposed; and,
- Approximately 400m of the OGC between the OCC and Moneypoint, along the N67, is located adjacent and to the east of the River Shannon and River Fergus Estuaries SPA (Site Code: 004077) and the Lower River Shannon SAC (Site Code: 002165).

Other designated sites downstream of the Onshore Site include:

- The Mid-Clare Coast SPA (Site Code: 004182) which is located downstream of the OGC via the Doonbeg River and its tributaries;
- Carrowmore Dunes SAC (Site Code: 002250) which is located downstream of the OGC via the Doonbeg River and its tributaries;
- The White Strand/Carrowmore Marsh pNHA (Site Code: 01007) which is located downstream of the OGC via the Doonbeg River and its tributaries;

- Farrihy Lough pNHA (Site Code: 000200) is located downstream of the OGC in the Ballard_010 river sub-basin. There is no direct mapped hydrological connection between the Onshore Site and this pNHA. Only 200m of the OGC is mapped within this river sub-basin, thereby further limiting the potential for effects to occur;
- Kilkee Reefs SAC (Site Code: 002264) is located downstream of the OGC in the Ballard_010 river sub-basin. There is no direct hydrological connection between the Onshore Site and this SAC;
- The River Shannon and River Fergus Estuaries SPA (Site Code: 004077) is located downstream of the OGC and OCC in the Shannon Estuary North surface water catchment; and,
- The Lower River Shannon SAC (Site Code: 002165) is located downstream of the OGC and OCC in the Shannon Estuary North surface water catchment.

4. FLOOD RISK IDENTIFICATION

4.1 INTRODUCTION

The following assessment is carried out in accordance with '*The Planning System and Flood Risk Management Guidelines for Planning Authorities*' (DoEHLG, 2009). The basic objectives of these guidelines are to:

- Avoid inappropriate development in areas at risk of flooding;
- Avoid new developments increasing flood risk elsewhere, including that which may arise from surface water run-off;
- Ensure effective management of residual risks for development permitted in floodplains;
- Avoid unnecessary restriction of national, regional or local economic and social growth;
- Improve the understanding of flood risk among relevant stakeholders; and,
- Ensure that the requirements of EU and national law in relation to the natural environment and nature conservation are complied with at all stages of flood risk management.

4.2 FLOOD RISK ASSESSMENT PROCEDURE

This section of the report details the site-specific flood risk assessment carried out for the Onshore Site and surrounding area. The primary aim of the assessment is to consider all types of flood risks and the potential impact on the development. As per the relevant guidance (DoEHLG, 2009), the stages of a flood risk assessment are:

- *Flood risk identification* – identify whether there are surface water flooding issues at a site;
- *Initial flood risk assessment* - confirm sources of flooding that may affect a proposed development; and,
- *Detailed flood risk assessment – quantitative appraisal of potential risk to a proposed development*.

As per the Guidelines, there are essentially two major causes of flooding:

Coastal flooding, which is caused by higher sea levels than normal, largely as a result of storm surges, resulting in the sea overflowing onto the land. Coastal flooding is influenced by the following three factors, which often work in combination:

- High tide level;
- Storm surges caused by low barometric pressure exacerbated by high winds (the highest surges can develop from hurricanes); and,
- Wave action, which is dependent on wind speed and direction, local topography and exposure.

Inland flooding which is caused by prolonged and/or intense rainfall. Inland flooding can include a number of different types:

- Overland flow occurs when the amount of rainfall exceeds the infiltration capacity of the ground to absorb it. This excess water flows overland, ponding in natural hollows and low-lying areas or behind obstructions. This occurs as a rapid response to intense rainfall and eventually enters a piped or natural drainage system.
- River flooding occurs when the capacity of a watercourse is exceeded or the channel is blocked or restricted, and excess water spills out from the channel onto

adjacent low-lying areas (the floodplain). This can occur rapidly in short steep rivers or after some time and some distance from where the rain fell in rivers with a gentler gradient.

- Flooding from artificial drainage systems results when flow entering a system, such as an urban storm water drainage system, exceeds its discharge capacity and the system becomes blocked, and / or cannot discharge due to a high water level in the receiving watercourse. This mostly occurs as a rapid response to intense rainfall. Together with overland flow, it is often known as pluvial flooding. Flooding arising from a lack of capacity in the urban drainage network has become an important source of flood risk, as evidenced during recent summers.
- Groundwater flooding occurs when the level of water stored in the ground rises as a result of prolonged rainfall to meet the ground surface and flows out over it, i.e. when the capacity of this underground reservoir is exceeded. Groundwater flooding tends to be very local and results from interactions of site-specific factors such as tidal variations. While water level may rise slowly, it may be in place for extended periods of time. Hence, such flooding may often result in significant damage to property rather than be a potential risk to life.
- Estuarial flooding may occur due to a combination of tidal and fluvial flows, i.e. interaction between rivers and the sea, with tidal levels being dominant in most cases. A combination of high flow in rivers and a high tide will prevent water flowing out to sea tending to increase water levels inland, which may flood over river banks.

The Flood Risk Management Guidelines provide direction on flood risk and development. The guidelines recommend a precautionary approach when considering flood risk management and the core principle of the guidelines is to adopt a risk based sequential approach to managing flood risk and to avoid development in areas that are at risk. The sequential approach is based on the identification of flood zones for inland and coastal flooding.

Flood zones are geographical areas within which the likelihood of flooding is in a particular range and they are a key tool in flood risk management within the planning process as well as in flood warning and emergency planning.

There are three types or levels of flood zones defined within the guidelines:

Flood Zone A – where the probability of flooding from rivers and the sea is highest (greater than 1% or 1 in 100 for river flooding or 0.5% or 1 in 200 for coastal flooding);

Flood Zone B – where the probability of flooding from rivers and the sea is moderate (between 0.1% or 1 in 1000 and 1% or 1 in 100 for river flooding and between 0.1% or 1 in 1000 year and 0.5% or 1 in 200 for coastal flooding); and,

Flood Zone C – where the probability of flooding from rivers and the sea is low (less than 0.1% or 1 in 1000 for both river and coastal flooding). Flood Zone C covers all areas of the plan which are not in zones A or B.

Once a flood zone has been identified for a site, the guidelines set out the different types of development appropriate to each identified zone (pg 25, Table 3.1 of the Guidelines). Exceptions to the restriction of development due to potential flood risks are provided for through the application of a Justification Test, where the planning need and the sustainable management of flood risk to an acceptable level must be demonstrated by the Applicant.

The Justification Test has been designed to rigorously assess the appropriateness, or otherwise, of particular developments that, for the reasons outlined above, are being considered in areas of moderate or high flood risk. The test is comprised of two processes.

- The first is the **Plan-making Justification Test** described in chapter 4 of the Guidelines and 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. Plan making Justification Tests are made at Plan/Policy development stage such as County Development Plans, or Local Area Plans.

- The second is the **Development Management Justification Test** described in chapter 5 of the Guidelines and 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. For example, application of Development Management Justification Test would be required at a site specific level, such as for this FRA, if a Justification Test is required.

4.3 FLOOD RISK IDENTIFICATION

4.3.1 Historical Mapping

To identify those areas as being at risk of flooding, historical mapping (i.e. 6" and 25" base maps) were consulted. There was no identifiable map text on local available historical 6" or 25" mapping for the study area that would identify lands that are "liable to flood" within the area and the vicinity of the Onshore Site.

4.3.2 Soils Maps – Fluvial Maps

A review of the soil types in the vicinity of the Onshore Site was undertaken as soils can be a good indicator of past flooding in an area. Due to past flooding of rivers deposits of transported silts/clays referred to as alluvium build up within the floodplain and hence the presence of these soils is a good indicator of potentially flood-prone areas.

Based on the EPA/Teagasc soil map for the local area, there are no alluvial soils present in the vicinity of the OLL or the OCC.

With regards to the OGC, alluvial soils are mapped approximately 1.36km south of the OLL. The alluvial soils correspond to the location of an EPA mapped Caherlean Stream. Further to the south, alluvial soils are also mapped along the Wood Stream immediately to the north of the OGC and approximately 1.5km east of Kilrush. However, the mapped alluvial soils at these locations are not widespread, appear to be constrained by the river channel and do not indicate the presence of a floodplain. Existing watercourse crossings are present at both of these locations.

4.3.3 OPW Past Flood Events Mapping

To identify those areas as being at risk of flooding, OPW's indicative river and coastal flood maps (www.floodinfo.ie) were consulted.

Historic and recurring flood events in the vicinity and downstream of the Site are shown on **Figure C** below.

The OPW do not map any recurring or historic flood events within the vicinity of the OLL or the OCC. The closest mapped historic flood event to the OLL is located at Doonbeg (ID: 12973), approximately 2.3km to the southeast of the OLL. This flood event is also approximately 1.63km east and downstream of the OGC and was associated with coastal flooding on 1st January 2014.
Another historic coastal flood event dating from 1st January 2014 (ID: 12978) occurred approximately 2.2km west of the OGC at Moyasta. Recurring flood events (ID: 4639) and historic flood events (ID: 4640) are also mapped in Kilrush approximately 1.3km to the west of

the OGC. A historic flood event associated with the coastal flooding on 1st January 2014 is also mapped along the N67 and the OGC in the townland of Carrowdotia (Flood ID: 12970).

The closest flooding event to the OCC is at Carrowdotia (ID: 12970), approximately ~1km to the south.

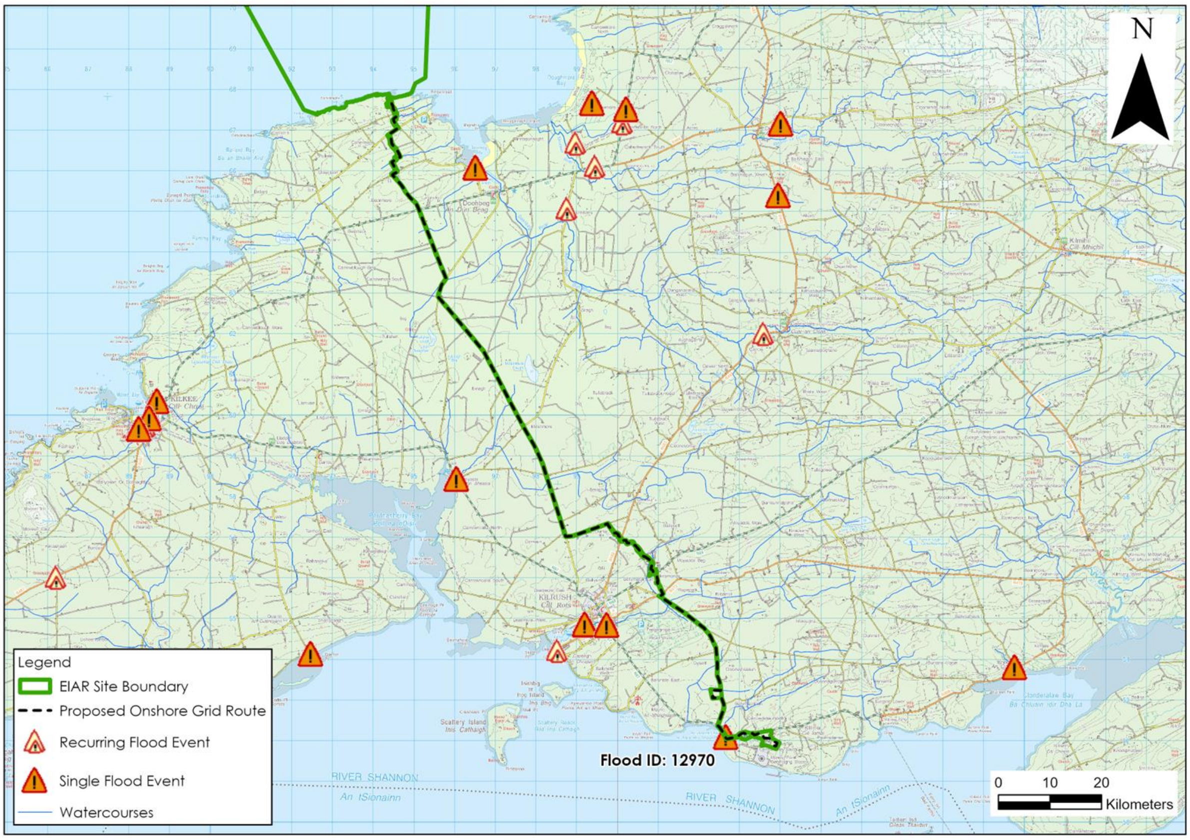

Figure C: OPW Past Flood Events Map

4.3.4 GSI Winter 2015/2016 Surface Water Flood Mapping

The GSI Winter 2015/2016 Surface Water Flooding map shows fluvial (rivers) and pluvial (rain) floods, excluding urban areas, during the winter 2015/2016 flood event, which was the largest recorded flood event in many areas. This surface water flood map is available at www.floodinfo.ie.

The GSI do no record any historic surface water flood zones in the vicinity of the OLL or the OCC.

Some historic surface water flood zones are mapped along the OGC at the following locations:

- Several surface water flood zones are located in the area of the OGC associated with the Moanmore and Tullaher Loughs. These flood zones do not encroach upon the OGC; and,
- Flood zones are also mapped immediately to the west/southwest of the N67 at Ballymacrinan Bay.

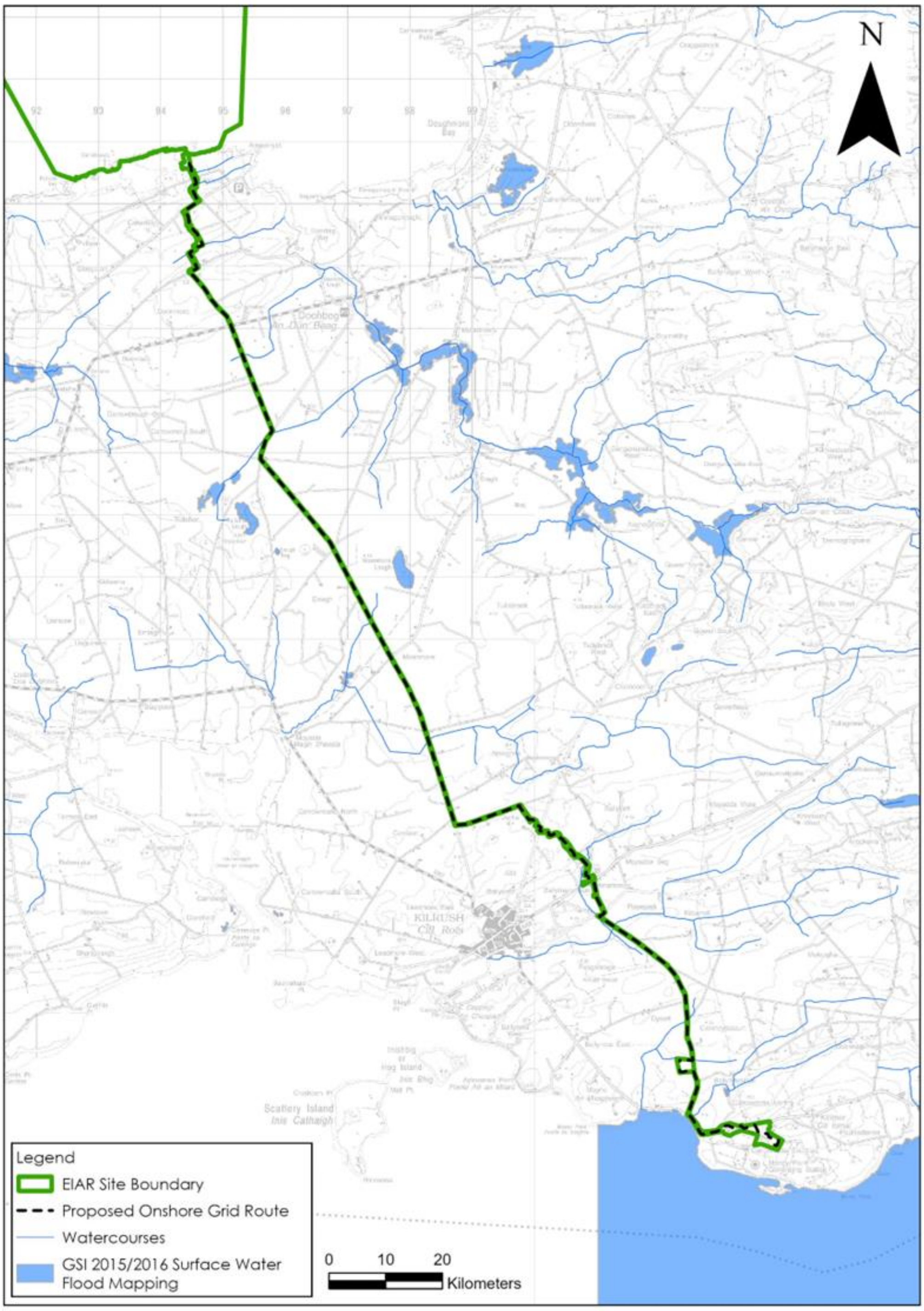

Figure D: GSI 2016/2016 Surface Water Flood Mapping

4.3.5 CFRAM Mapping

4.3.5.1 Fluvial Flood Mapping

Where complete the Catchment Flood Risk Assessment and Management (CFRAM)[2] OPW Flood Risk Assessment Maps are now the primary reference for flood risk planning in Ireland and supersede the Preliminary Flood Risk Assessment Maps (PFRA) maps. CFRAM mapping of rover flood extents are available at www.floodinfo.ie.

No CFRAM fluvial flood mapping has been completed for the area of the OLL or the OCC.

However, CFRAM fluvial flood mapping has been completed in the vicinity of Kilkee along the OGC. The CFRAM mapping is associated with the Wood Stream. Approximately 500m of the OGC along the L6150 is mapped within this high probability fluvial flood zone. The Temporary construction compound located in Kilrush Golf Club is located to the west of the flood zones mapped along the Parknamoney Stream.

4.3.5.2 Coastal Flood Mapping

No CFRAM coastal flood mapping has been completed for the area of the OLL or the OCC.

However, CFRAM coastal flood mapping has been completed in the vicinity of Kilrush along the OGC. The mapped coastal flood zones are similar in extent to the CFRAM fluvial flood zones along the Wood Stream and the Parknomoney Stream as described above.

Figure E below shows CFRAM fluvial and coastal flood zones in the vicinity of the Onshore Site.

4.3.6 National Indicative Fluvial Flood Mapping

The National Indicative Fluvial Flood Mapping (NIFM) (www.floodinfo.ie) shows probabilistic fluvial flood zones for catchments greater than 5km² for which flood maps were not produced under the CFRAM Programme.

The National Indicative Fluvial Flood Map (NIFM) for the present-day scenario does not map any flood zones in the area of the OLL or the OCC.

However, several fluvial flood zones are mapped along and downstream of the OGC as described below:

- Fluvial flood zones are mapped downstream of the OGC along the Doonbeg River. These flood zones are located approximately 1.7km to the east of the OGC;
- Approximately 50m of the OGC along the L2034 is mapped within the 1 in 100-year fluvial flood zone associated with the Moyasta River.
- Approximately 10m of the OGC along the L6150 is mapped within the 1 in 100-year flood zone associated with the Wood River.

A fluvial map showing the National Indicative Fluvial Flood Mapping for the present-day scenario is included as **Figure E** below.

[2] *CFRAM is Catchment Flood Risk Assessment and Management. The national CFRAM programme commenced in Ireland in 2011,and is managed by the OPW. The CFRAM Programme is central to the medium to long-term strategy for the reduction and management of flood risk in Ireland.*

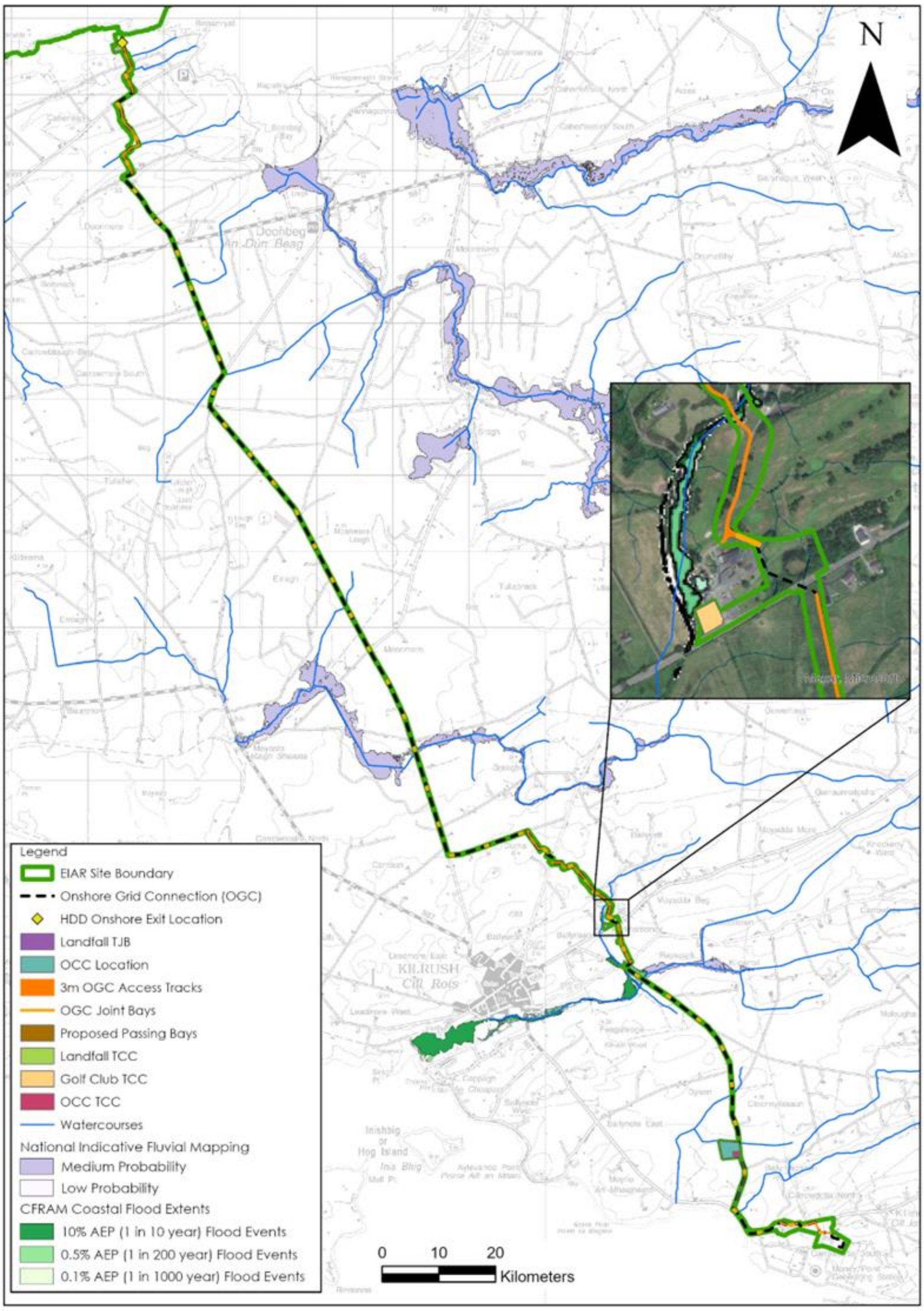

Figure E: CFRAM and OPW National Indicative Flood Mapping

4.3.7 Groundwater Flooding

The GSI Historical Groundwater flood map and the modelled groundwater flood extents map (www.floodinfo.ie) do not show the occurrence of any groundwater flooding within the Onshore Site.

4.3.8 ICPSS Mapping

Additional modelling of coastal flooding has been undertaken as part of the Irish Coastal Protection Strategy (ICPSS). The coastal flood modelling is available to view at https://www.floodinfo.ie/map/coastal_map/?X=6912721.2958086515&Y=-1053011.0262517757&Z=14. These modelled coastal flood zones represent a worst-case scenario as any flood defences potentially protecting the coastal floodplain are not taken into account.

The present-day scenario does not consider the potential changes due to climate change. The potential effects of climate change on coastal flooding have been separately modelled (refer to Section 4.3.9 below).

No ICPSS coastal flood zones are mapped in the area of the OLL. The coastal flood zones along the coastline to the north of the OLL do not extend any significant distance inland due to the presence of a cliff face. As a result, the 1 in 10-year and 1 in 1,000-year coastal flood zones are similar in extent and do not encroach upon the OLL.

No ICPSS coastal flood zones are mapped the area of the OCC due to its elevation and location approximately 600m from the coast.

Meanwhile, approximately 300m of the OGC adjacent to the N67 is mapped within the 1 In 10-year coastal flood zone associated with flooding at Ballymacrinan Bay.

ICPSS Coastal Flood Zones are shown in **Figure F** below.

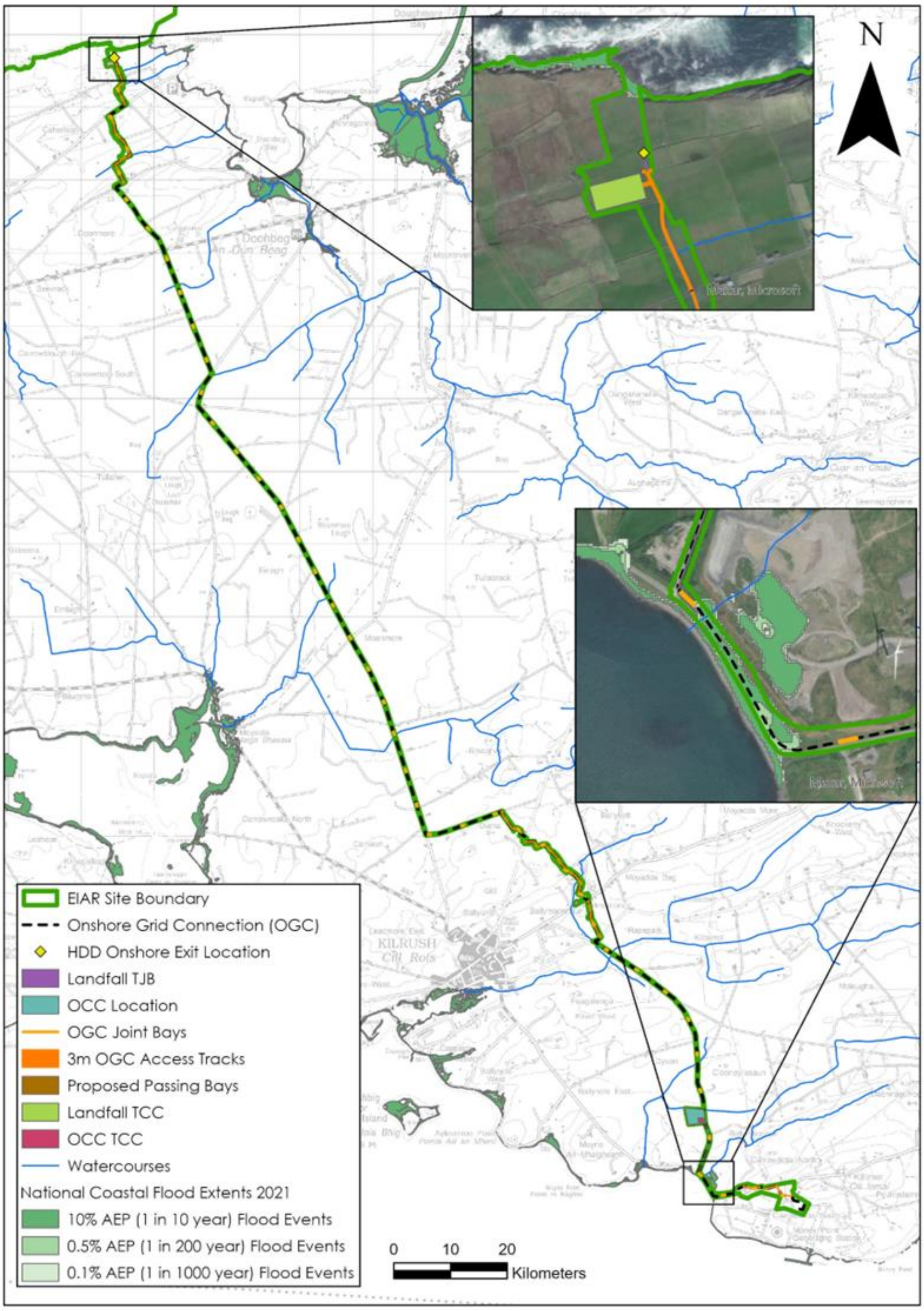

Figure F: ICPSS Coastal Flood Mapping

4.3.9 Climate Change

4.3.9.1 Fluvial Flooding

It is likely that climate change will have significant impacts on flooding and flood risk in Ireland due to rising sea levels, increased winter rainfall and more intense rainfall. The CFRAM Programme has modelled flooding associated with potential future climate change scenarios. These CFRAM flood zones have been modelled for 2 no. potential future climate change scenarios, with the Mid-Range and High-End Future Scenario flood extents generated using an increase in rainfall of 20% and 30% respectively.

However as stated above no CFRAM fluvial modelling has been completed in the vicinity of the OLL or the OCC. CFRAM River flood extents show similar flood zones associated with the Wood Stream along the OGC as described above in **Section 4.3.5.1**.

Similarly, NIFM flood zones have also been modelled for the 2 no. potential future climate change scenarios. Both of these modelled flood extents show similar flood zones to the present-day scenario discussed above in **Section 4.3.6**. Therefore, fluvial flood zones at the Onshore Site are unlikely to be significantly impacted by future climate change.

4.3.9.2 Coastal Flooding

ICPSS coastal flood mapping has been completed for the Mid-Range and High-End Scenario which includes a 0.5m and 1m rise in sea levels respectively. The modelled flood zones associated with these future scenarios do not differ significantly to those described in **Section 4.3.8** above. Therefore, coastal flood zones at the Onshore Site are unlikely to be significantly impacted by future climate change.

4.3.10 Summary – Flood Risk Identification

Based on the information gained through the flood identification process, it appears that OLL and OCC are not constrained by coastal, fluvial or groundwater flooding. The majority of the OGC is located in Flood Zone C. However, some sections of the OGC route, in the vicinity of local watercourses are mapped in fluvial flood zones. Some sections of the route are also mapped in coastal flood zones. Due to the nature of the underground cabling, this will have no effect during the operational phase of the Project. During the construction phase, works in these areas may have to be postponed following heavy rainfall events, or in the occurrence of high spring tides, which may cause flooding at these locations.

5. INITIAL FLOOD RISK ASSESSMENT

5.1 SITE SURVEY AND DRAINAGE

Detailed walkover surveys of the OLL, OCC and OGC, including drainage mapping, were completed by Michael Gill and Conor McGettigan of HES on 19th July 2023. Additional site walkover surveys and hydrological monitoring, including surface water flow monitoring were undertaken by Conor McGettigan of HES on 15th August 2023

The Onshore Site is drained by several 1st and 2nd order streams and in places the natural drainage is further facilitated by a network of manmade drains. These manmade drains are concentrated within the areas of peat bog located along the OGC in the townlands of Doonmore and Carrowmore South. The majority of the OGC is located in the carriageway of the existing public road network which is flanked by deeply incised drains on either side. In agricultural areas, including at the OLL and the OCC, deeply incised manmade field drains were noted along several field boundaries and hedgerows. The field within which the OCC is proposed was also noted to be quite wet underfoot during walkover surveys.

With the exception of the EPA mapped watercourses, no significant drainage features, other than manmade field drains, are located in the vicinity of the Onshore Site.

Monitoring of stream discharge on the main watercourses along the OGC was undertaken on 15th August 2023. The measured flows in the watercourses along the OGC were small, ranging from 0.5 to 6L/s.

5.2 HYDROLOGICAL FLOOD CONCEPTUAL MODEL

Potential flooding in the vicinity of the Onshore Site can be described using the Source – Pathway – Receptor Model ("S-P-R"). The primary potential sources of flooding in this area, and the ones with most consequence for the Onshore Site are fluvial and coastal flooding. The primary potential pathway would be fluvial overbank flooding of the main river channel which flows through the site, during significant rainfall events. The potential receptors in the area are infrastructure and land as outlined below.

5.3 SUMMARY – INITIAL FLOOD RISK ASSESSMENT

Based on the information gained through the flood identification process and Initial Flood Risk Assessment process, the sources of flood risk for the Project are outlined and assessed in **Table C**.

Table C: Initial S-P-R Assessment of Flood Sources for the Onshore Site

Source	Pathway	Receptor	Comment
Tidal	Not applicable.	Land and infrastructure.	The OLL and OCC are located in Coastal Flood Zone C and are not at risk of coastal flooding. However, some sections of the OGC are mapped in coastal flood zones. These areas are located along existing roads.
Fluvial	Overbank flooding	Land and infrastructure.	The OLL and OCC are located in Fluvial Flood Zone C and are not considered to be at risk of fluvial flooding. The majority of the OGC is mapped in Fluvial Flood Zone C and is at low risk of flooding. Some existing watercourse crossings are

			mapped in fluvial flood zones associated with the Moyasta and Moyne Streams.
Pluvial	Ponding of rainwater on the route right of way.	Land and infrastructure.	The GSI Historical 2015/2016 surface water flood map[3] shows fluvial and pluvial floods during the winter 2015/2016 flood event. This map does not show any flooding within the Onshore Site. There is a small risk of pluvial flooding following periods of intense rainfall.
Surface water	Surface ponding/ Overflow.	Land and infrastructure	Same as above (pluvial).
Groundwater	Rising groundwater levels.	Land and infrastructure.	There are no historic or modelled groundwater flood zones located within the Onshore Site. The risk of groundwater flooding is low.

5.4 REQUIREMENT FOR A JUSTIFICATION TEST

The matrix of vulnerability versus flood zone to illustrate appropriate development and that required to meet the Justification Test[4] is shown in **Table D** below.

It may be considered that the majority of the components of the Project can be categorised as "Highly Vulnerable Development" as they are electricity generating infrastructure. All "Highly Vulnerable Development" infrastructure including the OCC are located in Flood Zone C (Low risk) and can therefore be considered as appropriate from a flood risk perspective.

However, some sections of the OGC, comprising existing watercourse crossings and roadways are located in Fluvial and Coastal Flood Zone A. These elements of the Proposed Project can be considered to be "Less Vulnerable Developments", and Justification Tests is completed below for those elements in Flood Zone A.

Table D: Matric of Vulnerability versus Flood Zone

	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

Note: *Taken from Table 3.2 (DoEHLG, 2009)*
Bold: *Applies to this project.*

[3] *GSI Historical flood mapping principally developed using Sentinel-1 Satellite Imagery from the European Space Agency Copernicus Programme as well as any available historic records (from winter 2015/2016 or otherwise)*
[4] *A 'Justification Test' is an assessment process designed to rigorously assess the appropriateness, or otherwise, of particular developments that are being considered in areas of moderate or high flood risk, (DoEHLG, 2009).*

Box 5.1 (**Table E**) of "The Planning System and Flood Risk Management Guidelines" (PSFRM Guidelines) outlines the criteria required to complete the "Justification Test".

Table E: Format of Justification Test for Development Management

Box 5.1 Justification Test for Development Management (to be submitted by the applicant)
When considering proposals for development, which may be vulnerable to flooding, and that would generally be inappropriate as set out in Table 3.2, the following criteria must be satisfied: 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. 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; ii. The development proposal includes measures to minimise flood risk to people, property, the economy and the environment as far as reasonably possible; 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 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 acceptability or otherwise of levels of residual risk should be made with consideration of the type and foreseen use of the development and the local development context.

Note: *this table has been adapted from Box 5.1 of "The Planning System and Flood Risk Management Guidelines", (2009).*

Referring to Point 1 and Points 2 (i) to (iv) inclusive:

The Onshore Site is compatible with the planning objectives of the local area.

No displacement of floodwaters will result from the emplacement of the OGC. At watercourse crossings the cables will be installed by either directional drilling, standard trefoil formation or flatbed formation and there will be no in-stream works or alteration of the existing hydromorphological regime (MWP, 2024). Meanwhile, along the N67, where the OGC is mapped within coastal flood zones, the cable will be installed in a trench in the road verge and there will be no displacement of floodwaters.

During the construction phase, works at these locations may be postponed in the event of flooding.

1. The Project has been the subject of a flood risk assessment (this report) and the following has been determined:

   i. Due to the relatively small footprint of the Project and given that the only elements of the Project located within modelled flood zones relate to the OGC, the Project is predicted to have no impact on flood water levels downstream. No increase in downstream flood risk will occur;
   ii. The OCC and OLL are located outside of the flood zones. These measures will mitigate against any potential disruption to the natural hydrology. No increase in flood risk to people, property, the economy or the environment during extreme flood events as a result of the Project is predicted due to the appropriate design measures which will result in unmeasurable/imperceptible upstream and downstream effects;
   iii. The OGC crossing of the Moyasta and Moyne Streams will not have an effect on flood levels. These crossings will be achieved by horizontal directional

drilling below the ground surface. Therefore, there will be no displacement of flood waters;

iv. The OGC adjacent to the N67 will not have the potential to displace coastal floodwaters as the verge will be reinstated to existing ground levels; and,

v. The Project is compatible with the wider planning objectives of the area, including the provision of supporting infrastructure for offshore renewable energy developments at appropriate locations and the proper planning and sustainable development of the area.

6. FLOOD IMPACT PREVENTION AND DRAINAGE MANAGEMENT

6.1 PROPOSED DRAINAGE MANAGEMENT DURING CONSTRUCTION

The site drainage system was designed integrally with the Project design layout as a measure to ensure that the proposal will not change the existing flow regime across the Onshore Site, will not deteriorate water quality and will safeguard existing water quality status of the catchments from sediment runoff.

A fundamental principle in the drainage design is that clean water flowing in the upstream catchment, including overland flow and flow in existing streams and drains, is allowed to bypass the works areas without being contaminated by silt from the works. The dirty water from the works areas is collected in a separate drainage system and treated by removing the suspended solids before discharging it to the downstream watercourse. This minimises the volume of dirty water requiring treatment.

Existing streams crossing the works area will be piped to isolate them from the works. New drains will be constructed to collect overland flow that is intercepted by the works areas or by new access roads. These will be constructed on the uphill side of the works and piped to the downhill side, bypassing the works areas. However, this will cause the normally dispersed flow to be concentrated at specific discharge points downstream of the works. In order to disperse this flow each clean water drain will be terminated in a discharge channel running parallel to the ground contours that will function as a weir to disperse the flow over a wider area of vegetation. This will prevent erosion of the ground surface and will attenuate the flow rate to the downstream receiving waters.

6.2 PROPOSED ON-SITE ATTENUATION DURING OPERATIONAL PHASE

The creation of impermeable areas within a site has the effect of increasing rates of runoff into the downstream drainage system and this may increase flood risk and flood severity downstream. This applies particularly to urban areas that drain to closed pipe systems which do not have the capacity to cater for increased hydraulic loads. The onshore elements of the Project are located within a large rural catchment with an open drainage system. The footprint of the impermeable areas and the associated increase in runoff rate is very small in the context of the catchment size and therefore represents a negligible increase in downstream flood risk. Notwithstanding the low increase in flood risk due to the Project, the drainage system has been designed to prevent any increase in discharge rates above that which already exist in the undeveloped site.

The construction compounds at the OLL are temporary and will be removed once construction works are completed and the area will be reinstated. Therefore, there will be no potential for significant increased surface water runoff at the OLL.

There will be no potential increase in runoff along the OGC. The works are predominantly located in the carriageway of the existing public road network and no change in surface water runoff rates will result as the trench and road surfaces will be reinstated. Similarly, where the trench is proposed in the road verge along the N67, this area will be reinstated post cable installation. Meanwhile, new access tracks will be constructed where the OGC is proposed to cross 3rd party lands and there is no existing track or roadway. These new proposed access roads will be subject to over the side drainage and due to their small footprint will have no significant effects.

With regards to the OCC, an operational phase drainage system will be put in place to ensure there is no increase in runoff rates (MWP, 2024). All rainfall from the buildings and bunded areas of the OCC will be treated and attenuated prior to release at a controlled and restricted rate via a hydrobrake. The drainage system includes sumps, hydrocarbon interceptor and a suitably sized attenuation tank. Discharge will be to the stream to the north of the OCC and will have a restricted peak discharge rate of 12l/s, equivalent to greenfield runoff rates. Meanwhile, the proposed access roads and compound area will be constructed with permeable material which will allow infiltration and recharge to ground. Therefore, there will be no increase in the downstream flood risk.

7. CONCLUSIONS

- A flood risk identification study was undertaken to identify existing potential flood risks associated with the onshore elements of the Project. From this study:
    - No instances of historical flooding were identified in historic OS maps;
    - No instances of recurring or historic flooding were identified on OPW maps within the OCC or OLL. However, a historic flood event has been recorded along the OGC, associated with coastal flooding at Ballymacrinan Bay;
    - The GSI Historical 2015/2016 flood map does not record any historic surface water flood zones in immediate vicinity of the Onshore Site;
    - The Onshore Site is not mapped within any historic or predictive groundwater flood zone;
    - The OLL and the OCC are not identified as being within CFRAM Fluvial Flood Zones. Some short sections of the OGC are mapped within CFRAM Fluvial Flood Zone A;
    - The National Indicative Fluvial Food Mapping does show any fluvial flood zones in the vicinity of the OLL or the OCC. 2 no. sections of the OGC are mapped within NIFM Fluvial Flood Zones; and,
    - The OLL and OCC are not mapped within any coastal flood zone. A section of the OGC adjacent to the N67 is mapped within coastal flood zones.
- During the walkover surveys and flow monitoring at the Onshore Site there was no evidence of out of bank flow from within the various stream/river channels. No widespread or even localized flooding was observed during these site visits;
- The OLL and the OCC are located in Flood Zone C and are at low risk of flooding;
- The majority of the OGC is also located within Flood Zone C. However, some sections associated with existing watercourse crossings over the Moyasta and Moyne Streams are located in Fluvial Flood Zone A. Furthermore, a section of the route adjacent to the N67 is mapped in Coastal Flood Zone A;
- Based on the flood risk identification process, and considering the temporary and transient nature of the grid construction process, and its below ground reinstated finish, we consider there are no significant flood risk issues arising from or along the OGC. Justification of this conclusion is provided in Section 5.4; and,
- In addition, the risk of the Onshore Site contributing to downstream flooding is also very low. The works areas at the OLL will be reinstated following construction and the vast majority of the OGC will be reinstated to a comparable ground surface. Where new access tracks are proposed over the OGC, these areas will drain over the edge, have a very small footprint and no potential to impact downstream flooding. In addition, a drainage system is proposed for the OCC which will attenuate and treat all water before discharge to a local stream. The discharge rate will be restricted to greenfield runoff rates and there will be no potential to increase the downstream flood risk.

* *

8. REFERENCES

AGMET	1996	Agroclimatic Atlas of Ireland.
DOEHLG	2009	The Planning System and Flood Risk Management.
Met Eireann	1996	Monthly and Annual Averages of Rainfall for Ireland 1961-1990.
OPW	2011	Preliminary Flood Risk Assessment Maps
MWP	2024	Sceirde Rocks Grid Line Outline Construction Methodology
MWP	2024	Substation Drainage Report