Solar Farm, Cappakeel, Co. Laois, Flood Risk Assessment

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Abbreviation

AEP	Annual Exceedance Probability
AFA	Area for Further Assessment
CFRAM	Catchment Flood Risk Assessment and Management
DTM	Digital Terrain Model
FB	Freeboard
FFL	Finish Floor Levels
FRA	Flood Risk Assessment
FSR	Flood Studies Report
GSI	Geological Survey of Ireland
LiDAR	Light Detection and Ranging
NIFM	National Indicative Fluvial Mapping
OPW	Office of Public Works
PFRA	Preliminary Flood Risk Assessment
RR	Rainfall-Runoff
SAAR	Standard Average Annual Rainfall (mm)
SFRA	Strategic Flood Risk Assessment
SuDS	Sustainable Urban Drainage System
WL	Water Level

1 Introduction

Under the Planning System and Flood Risk Management Guidelines for Planning Authorities (DoEHLG & OPW, 2009), the proposed development must undergo a Flood Risk Assessment (FRA) to ensure sustainability and effective management of flood risk.

1.1 Terms of Reference

JBA Consulting was appointed to prepare a Flood Risk Assessment (FRA) for a proposed grid connection system as part of a wider a solar farm development. The grid connections run from the townland of Cappakeel, to the town of Portlaoise, Co. Laois and Coolnabacky Substation. The solar farm development is covered by the planning application (25/60148).

1.2 Flood Risk Assessment Aims and Objectives

This study is being completed to inform the future development of the site as it relates to flood risk. It aims to identify, quantify, and communicate to Planning Authority officials and other stakeholders the risk of flooding to land, property and people and the measures that would be recommended to manage the risk.

The objectives of this FRA are to:

- Identify potential sources of flood risk.
- Confirm the level of flood risk and identify key hydraulic features.
- Assess the impact that the proposed development has on flood risk.
- Develop an appropriate flood risk mitigation and management measures which will allow for the long-term development of the site.

Recommendations for development have been provided in the context of the 2009 OPW / DECLG planning guidance, "The Planning System and Flood Risk Management". A review of the likely effects of climate change and the long-term impacts this may have on any development has also been undertaken.

For general information on flooding, the definition of flood risk, flood zones and other terms see 'Understanding Flood Risk' in Appendix A.

1.3 Proposed Development

The focus of this report regards the cable routes connected to a solar farm located in Cappakeel, Co. Laois which can be seen in Figure 1-1, details of which can be found in the accompanying Planning and Environmental Report. The proposed cable route can be found in Figure 1-2.

The proposed 110kV Substation and associated Grid Connection is subject to a Strategic Infrastructure Development (SID) application to An Coimisiún Pleanála, under section 182A of the PDA.

110kV Substation Details:

The proposed 110kV substation is located within the townland of Morett, and will provide a Loop-In/Loop-Out (LILO) grid connection to the national grid via the existing Portlaoise – Cushaling 110kv Overhead line which traverses the substation site.

Grid Connection Details:

An underground Tail-Fed connection within the public roadway from the 110kV substation in Morett to the Coolnabacky 110kV Substation, within the townlands of Dysart, Coolnacarrick, Greatheath, Cremorgan, Money Upper, Lamberton Demesne, Killenny, Aghnahily, Ballygormill South, Coolnabacky, Ballygormill North, Ballinlough, Raheen, Hophall, Heathlodge, Ballycarroll, Morett, Powelstown, Derrytrasna, Esker and Greatheath.

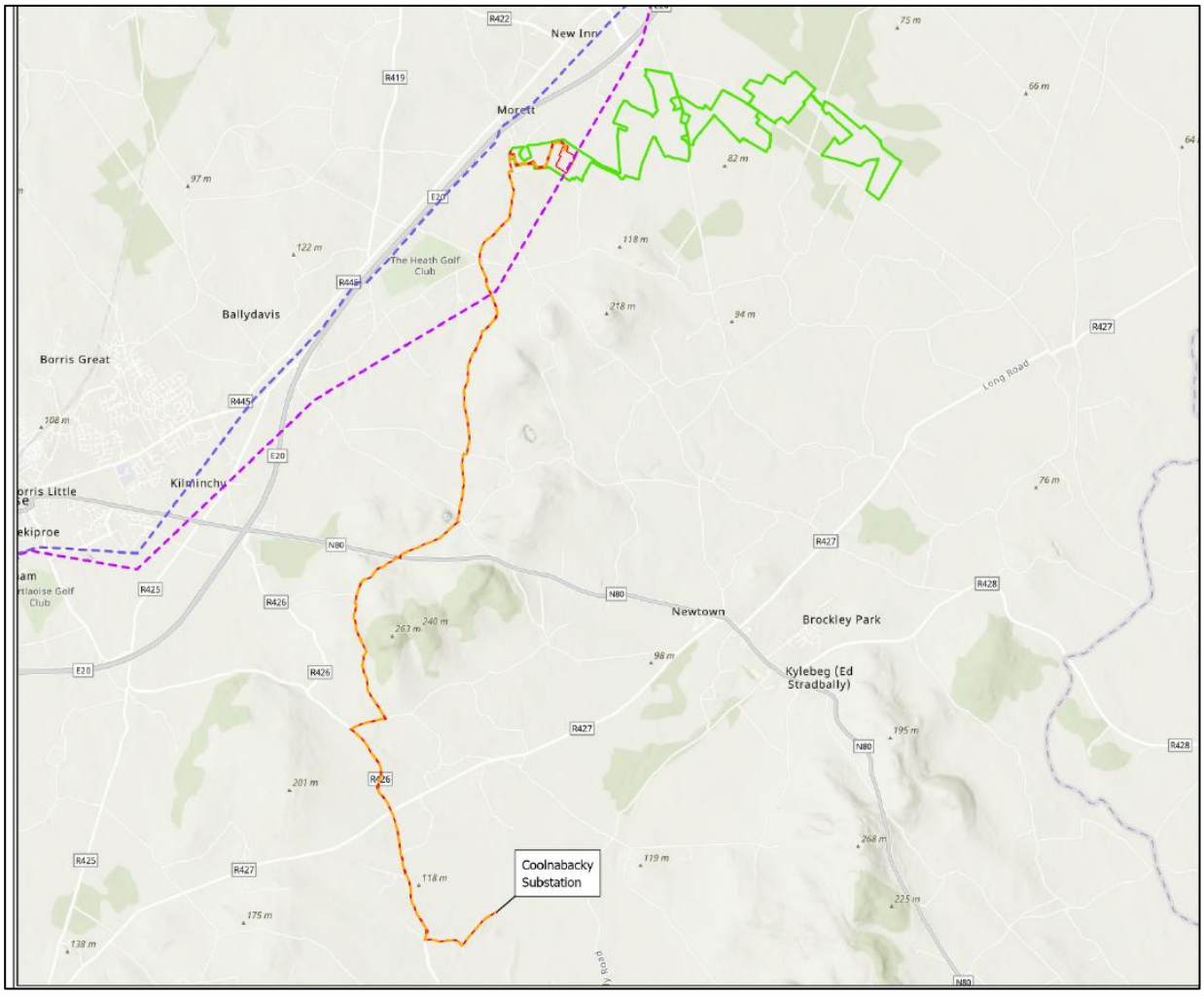


Figure 1-1: Solar Farm Development

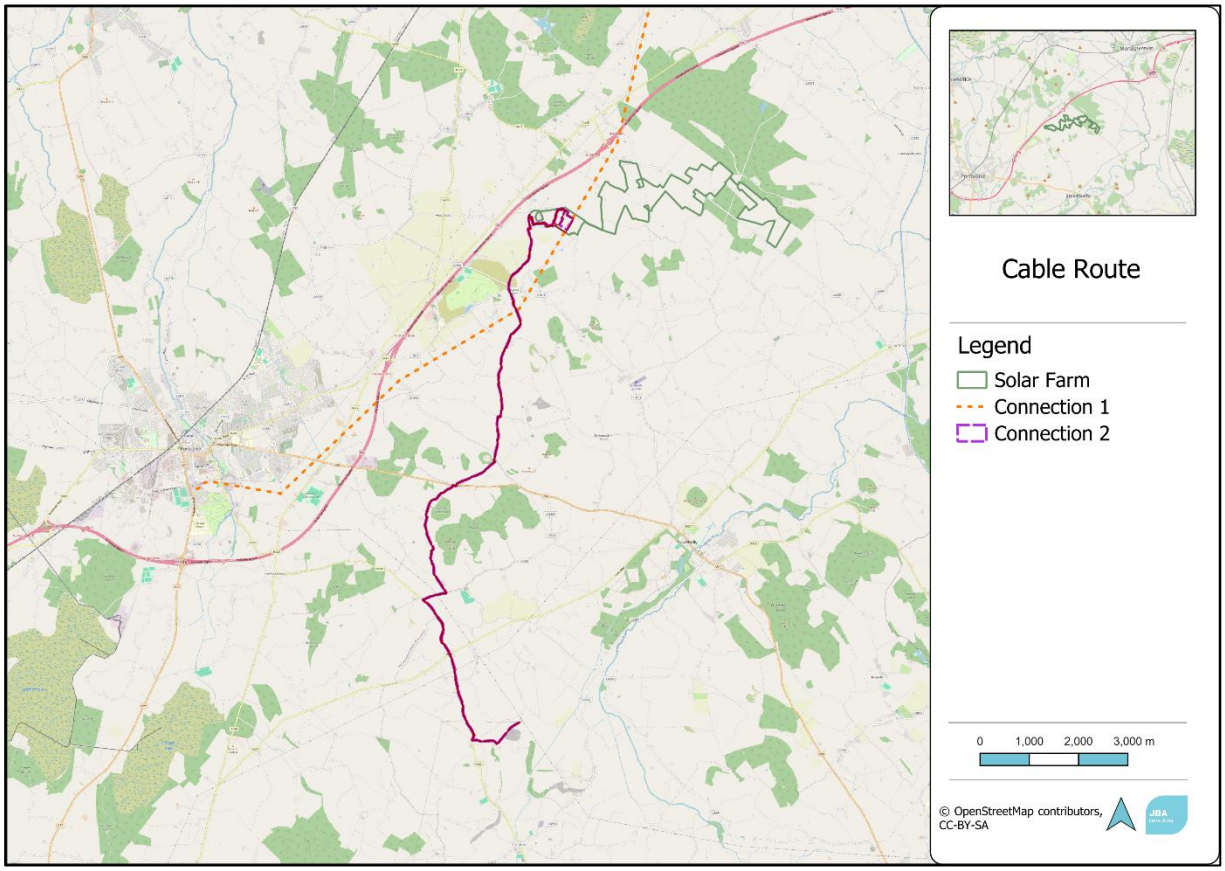


Figure 1-2: Cable Route Options

1.4 Report Overview

Section 2 of this report gives an overview of the study location and associated watercourses. Section 3 contains background information on flood risk. Section 4 provides initial assessment of flood risk and Section 5 contains mitigation measures. Conclusions are provided in Section 6.

2 Site Background

This section describes the receiving environment of the proposed development site in terms of watercourses, geology, and characteristics of the wider geographical area.

2.1 Location

Figure 2-1 shows the location of the site. The proposed cable routes are located along various arable lands located in the electoral district of Cappakeel, Co. Laois. The M7 motorway intersects Connection 1. Both connections intersect a number of local roads, drainage ditches and streams.

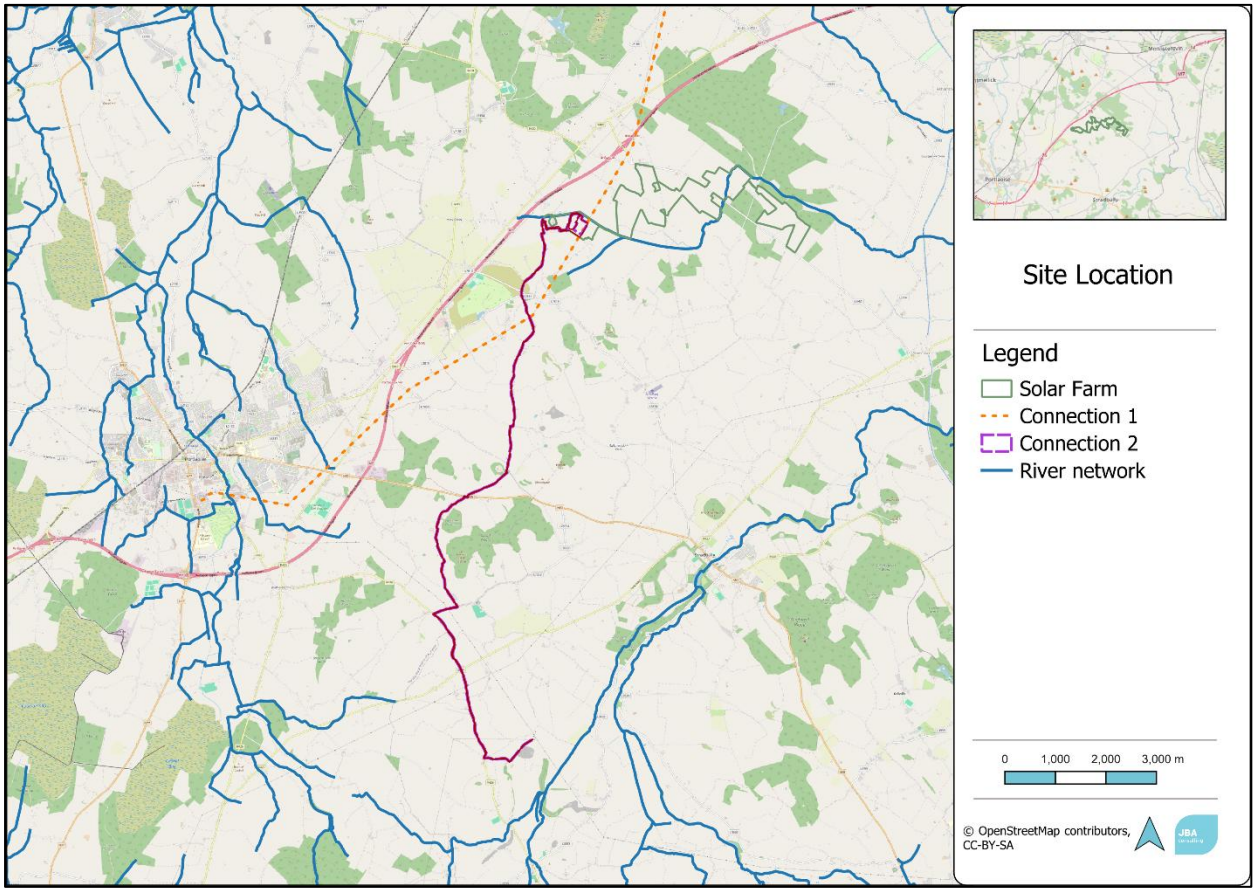


Figure 2-1: Site Location and Watercourses

2.2 Watercourses

The site is within the Barrow catchment. The Dunrally Stream is the main hydrological feature in the area which becomes the Glasha River further west. The Tonafarna Stream also runs through the area at the location of the solar farm. Much of the area is part of the OPW Drainage District Scheme. Several drainage channels and stream are located along the cable routes. Refer to Figure 2-1 for the location of waterbodies located in the study area.

2.3 Site Visit

A site visit was undertaken during November 2025 to identify any additional waterbodies along the proposed connection routes. The focus has been placed on Connection 2 as this will be installed on ground level.

It is noted that the Connection 1 crosses a number of stream and drainage channels as depicted in Figure 2-2. However, as this connection will be constructed via an existing overhead powerline, the cable will be located above the predicted flood levels, and it is not at risk of inundation.

Regarding Connection 2, the route does not cross predicted Flood Zone A or B extents. Based on a review of the OSI Geo-viewer and site visit, there is only one single stream channel and associated culvert system crossing across the entire route, while two further local drainage culverts have been identified. With reference to Figure 2-2 and Figure 2-3, the stream culvert is presented in Plate 1 and the local drainage culverts are located in Plate 2 & 3. The Connection 2 route will be constructed along the road verge along the entire route underground and at this crossing the duct will not impact on the existing flood levels. The construction of the duct will not impact upon the culverts at these locations.

A detailed Construction Methodology Plan1 has been prepared as part of the wider development. With reference to Section 10.10 of the plan, which specifically covers the construction method of installing the connection cable across waterbodies. It is proposed to implement horizontal directional drilling across all watercourse crossings where the cable and associated ductwork will be installed by a minimum of 1.5m below the bed level. This will ensure that the river flows will not be impacted by the proposed works.

A number of small and short roadside drainage ditches have been noted along Connection 2, as depicted in Figure 2-2 and Figure 2-3. The drainage ditches were noted to be relatively short. The proposed construction works will not impact the function of the drainage network along Connection 2.

1 Outline Constuction Methodology, Orsted, December 2025 Version 300-1000925-R03-01

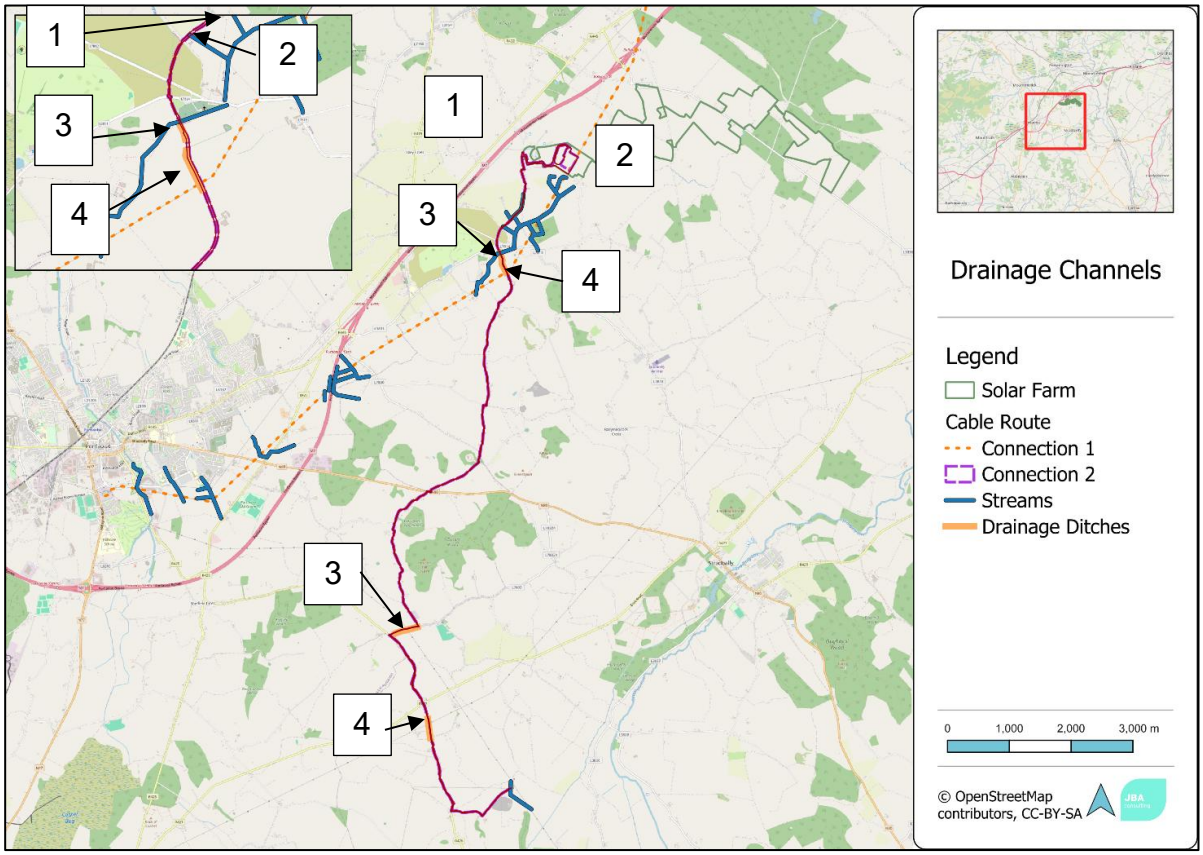


Figure 2-2: Drainage Map



Plate 1- Culvert



Plate 2- Culvert



Plate 3- Culvert



Plate 4



Plate 5



Plate 6



Plate 7

Figure 2-3: Drainage Culverts & Ditches

2.4 Site Geology

The groundwater and geological maps of the site, provided by the Geological Survey of Ireland (GSI), have been reviewed as part of the FRA process.

The underlying bedrock is a mixture of crinoidal wackestone/packstone limestone (Ballyadams Formation), Calp limestone, peloidal calcarentitic limestone (Milford Formation) and Thick-bedded Limestone (Allenwood Formation). Two fault lines are present within the Ballyadams Formation. The subsoil is predominantly till derived from limestones, and cutover peat, with small portions of glacial limestone till and alluvial deposits adjacent to parts of the Dunrally Stream, refer to Figure 2-2.

There are several karst features in the area which include wells and springs associated with fault contact, however none of these intersect with cable routes (refer to Figure 2-3).

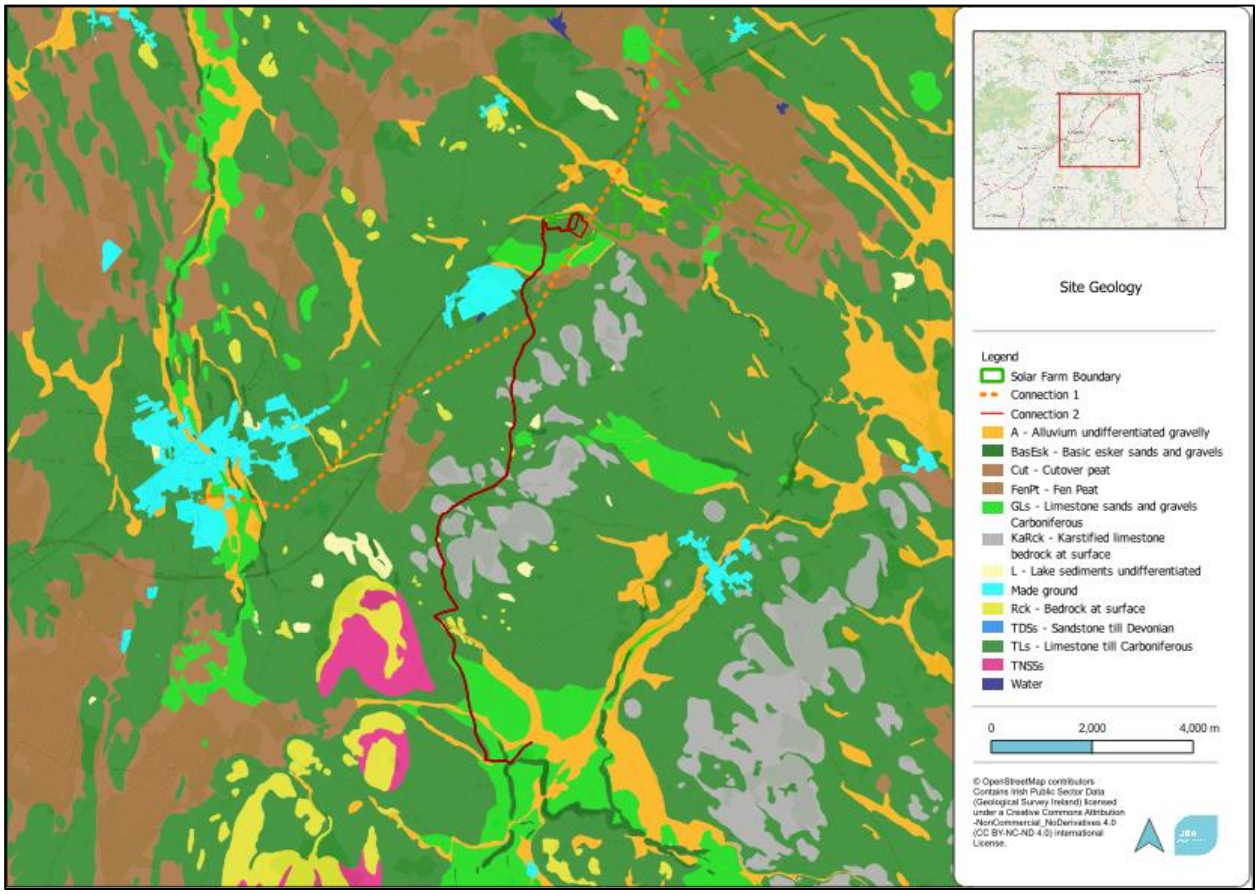


Figure 2-4: Quaternary Sediments Map

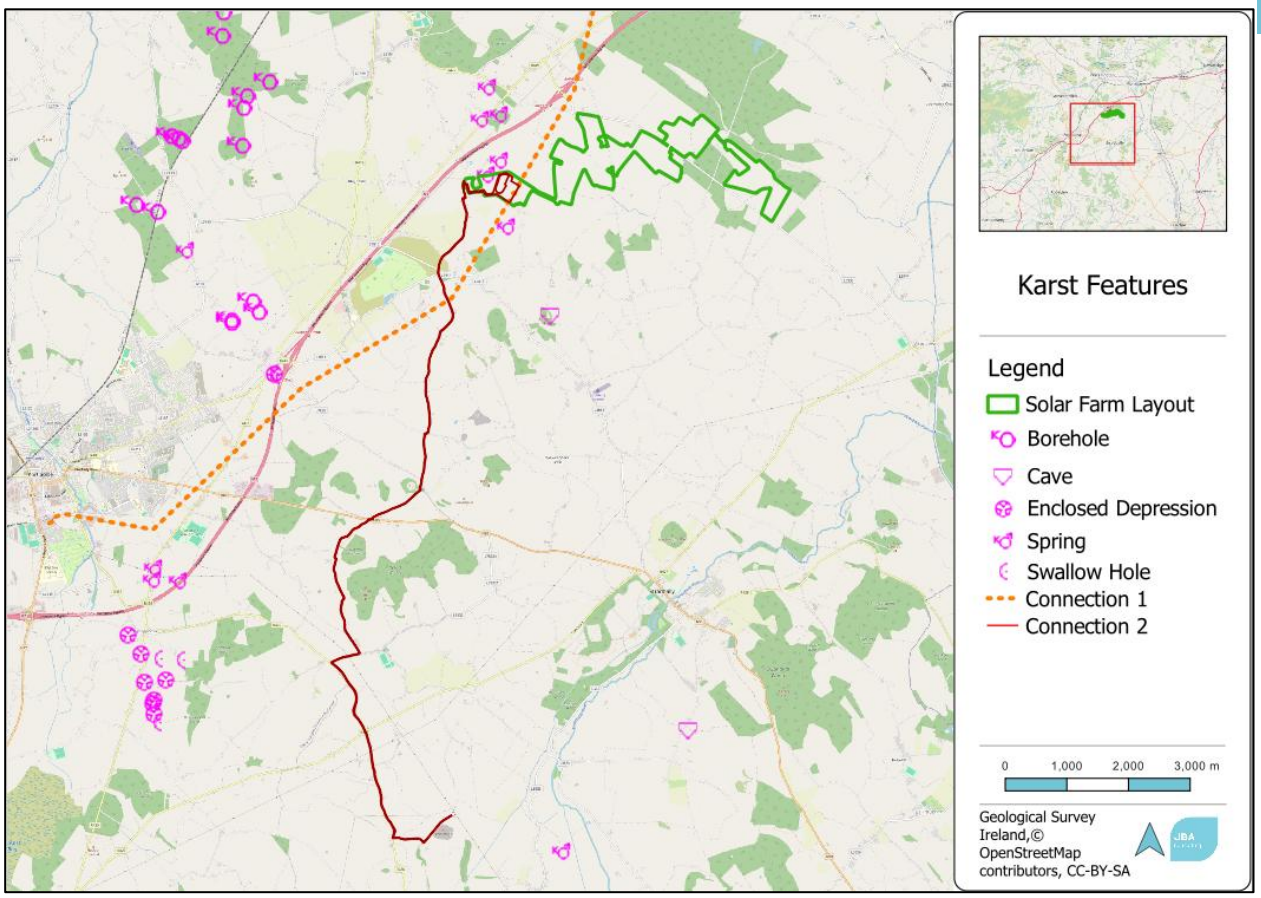


Figure 2-5: Karst Features

2.4.1 Groundwater

The site is within the Bagenalstown Upper groundwater body. The aquifer associated with Calp is classified as moderately productive only in local zones. The Ballyadams and Milford Formations are associated with regionally important karstified aquifer characterised by diffuse flow. Dolomitization, to varying degrees, is evident in both formations and transmissivity ranges from 20-200m²/day. Three springs in proximity to the site are associated with the faults present in the Ballyadams crinoidal wackestone and packstone.

The GSI Groundwater Flooding viewer has been reviewed and shows that the site is not at risk of groundwater flooding. There have been historic instances of groundwater flooding outside of the site boundary; however no groundwater flooding has been identified within the site, refer to Figure 2-4.

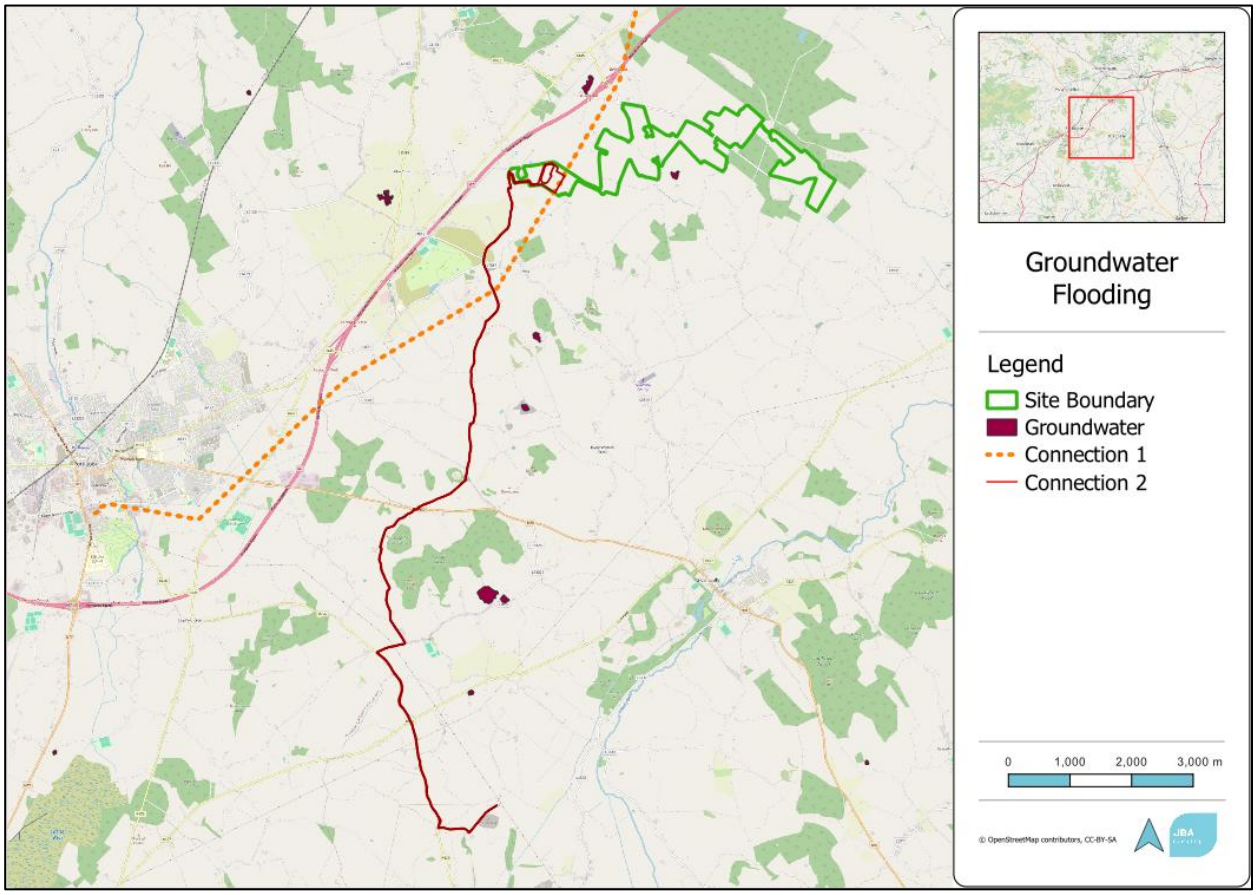


Figure 2-6: Groundwater Flooding

2.5 Topography

The solar farm site is approximately 2.5km². 5m resolution LIDAR was available for the study area. The LIDAR extent at the solar farm shown in Figure 2-5 and covers the entire model area. Topography of the general cable routes is shown in Figure 2-8 using an SRTM 30m radar image.

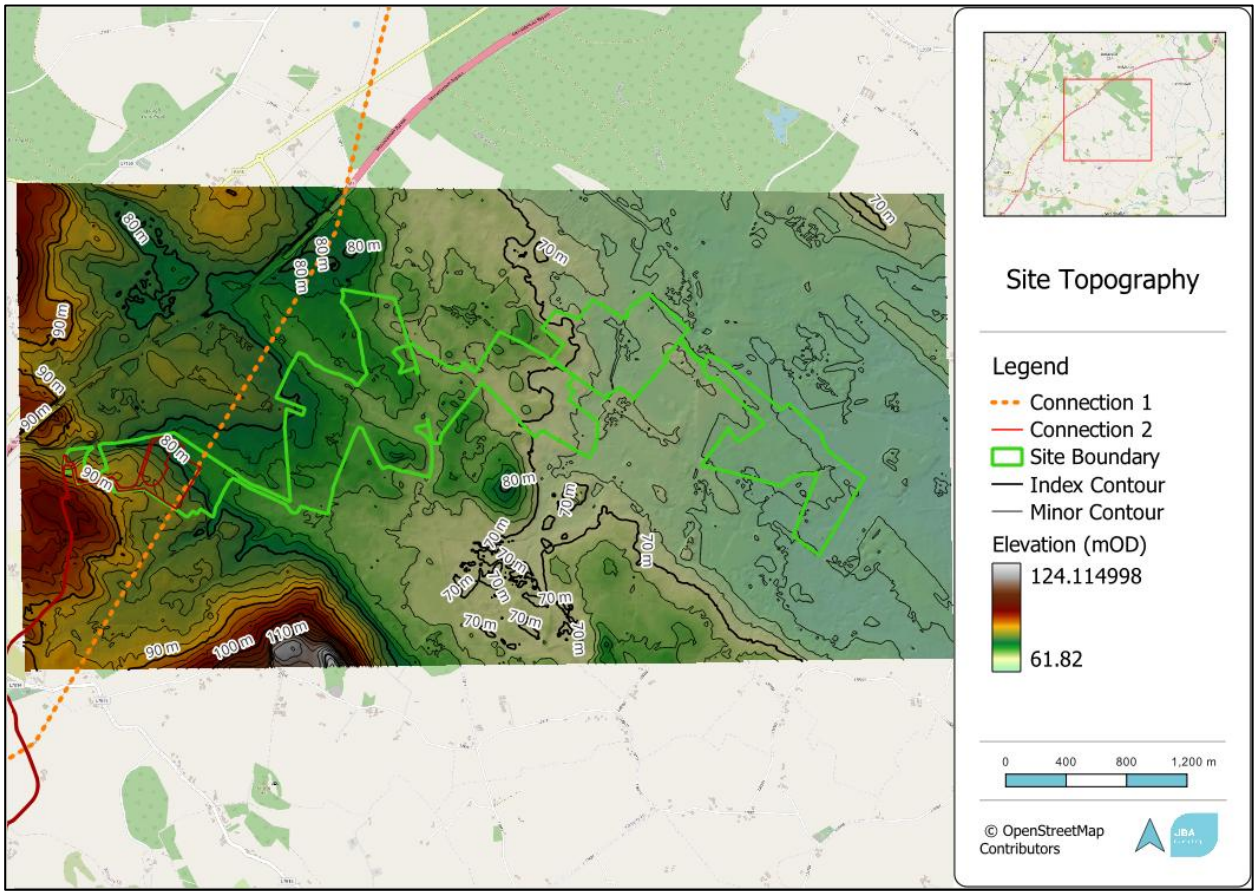


Figure 2-7: Local Topography at Solar Farm

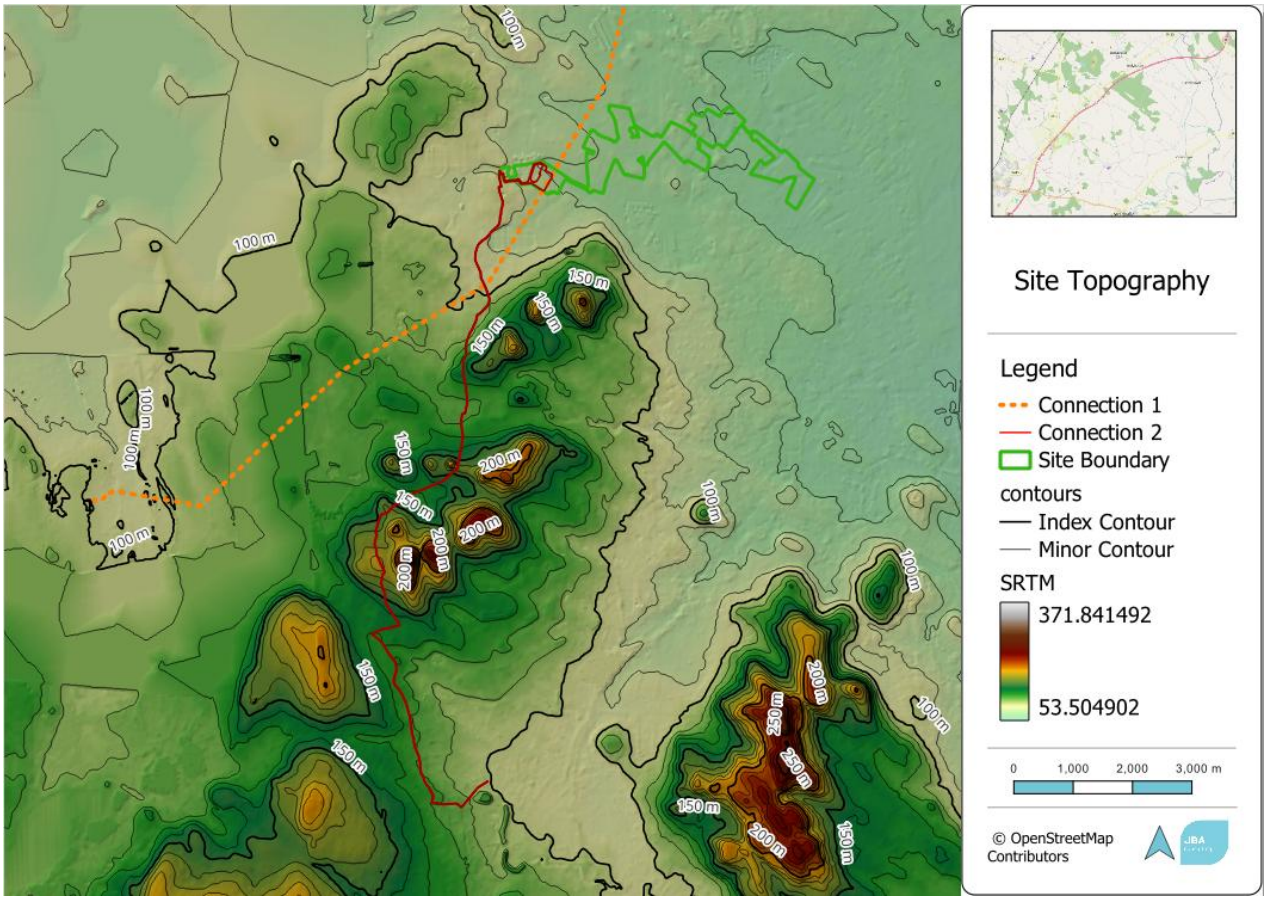


Figure 2-8 Cable Route Topography

2.6 Laois County Development Plan 2021 - 2027

Section 10 of the Planning and Development Act 2000 requires that development plans comprise objectives for the zoning of lands for particular purposes, in the interest of proper planning and sustainable development. Effective zoning promotes orderly development by integrating land use and transportation, providing a high quality of life for the county's population, eliminating potential conflicts between incompatible land uses, and establishing an efficient basis for investment in public infrastructure and facilities. In addition, it is important that the Development Plan fulfils the requirements of the document "The Planning System and Flood Risk Management Guidelines for Planning Authorities" (OPW/DoEHLG, 2009), which states that flood risk management should be integrated into spatial planning policies at all levels to enhance certainty and clarity in the overall planning process.

As part of the Laois County Development Plan 2021 - 2027, a Strategic Flood Risk Assessment (SFRA) was undertaken to inform the zoning of settlements. The development site does not fall within or near a town or village and therefore the site area has been zoned as rural.

3 Flood Risk Identification

An assessment of the potential for and scale of flood risk at the site is conducted using historical and predictive information. This identifies any sources of potential flood risk to the site and reviews historical flood information. The findings from the flood risk identification stage of the assessment are provided in the following sections. Further detail on the Planning Guidelines and technical concepts are provided in Appendix A.

3.1 Flood History

A number of sources of flood information have been reviewed to establish any recorded flood history at, or near the site. This includes the OPWs national flood information portal, www.floodinfo.ie, and general internet searches.

3.1.1 Floodinfo.ie

The OPW have established a National Flood Risk Hazard Mapping website, www.floodinfo.ie, which highlights areas at flood risk through the collection of recorded data and observed flood events. The website provides significant national data and indicates there are multiple reports of flooding along the Barrow, however, the site is unaffected by these flood events, refer to Figure 3-1. The closest events to the cable routes are:

- Flood ID-2739: Recurring flood event in Tonafarna, Cappakeel. A tributary of the River Glasha overflows its banks after heavy rain every year. The river channel needs regular maintenance to reduce the flooding.
- Flood Summary (ID-2645): Triogue Timahoe Road, Portlaoise Recurring. The River Triogue overflows its banks after very heavy rainfall. Last occurred in the winter of 1994/1995. The council has undertaken redial work and hasn't flooded since.
- Flood Summary (ID-2914): Cork Road Portlaoise Recurring. Surface flooding occurs along the roadway adjacent to Cherry Garth. This is due to the existing main storm sewer having inadequate capacity.

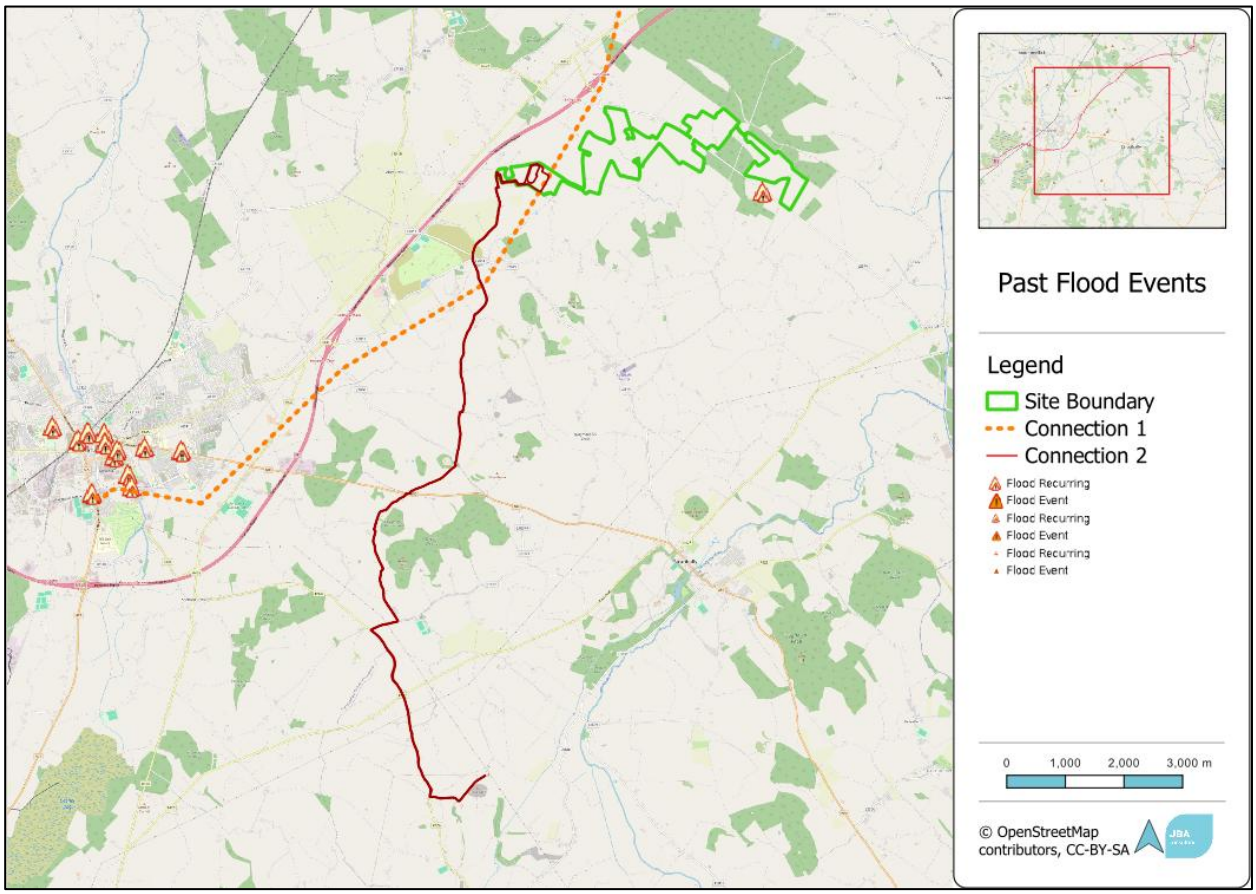


Figure 3-1: Past Flood Event Points

3.1.2 Internet Searches

An internet search was conducted to gather additional information on reported flood events or information not recorded on official flood mapping databases. No such information was found regarding the cable routes specifically.

3.1.3 Arterial Drainage

Under section 37 of the 1945 Act, the OPW is required to maintain drainage works in proper repair and effective condition. The OPW manage a number of Arterial Drainage Schemes within the wider area including the Dunrally Stream, the Glasha River and the Tonafarna Stream.

Figure 3-2 provides both the arterial drainage channels and benefitting lands in the study area. It is noted that the solar farm is partially located within the benefitting lands. The proposed cables routes, Connection 1 & 2 are not located within the identified benefitting lands or cross arterial drainage channels.

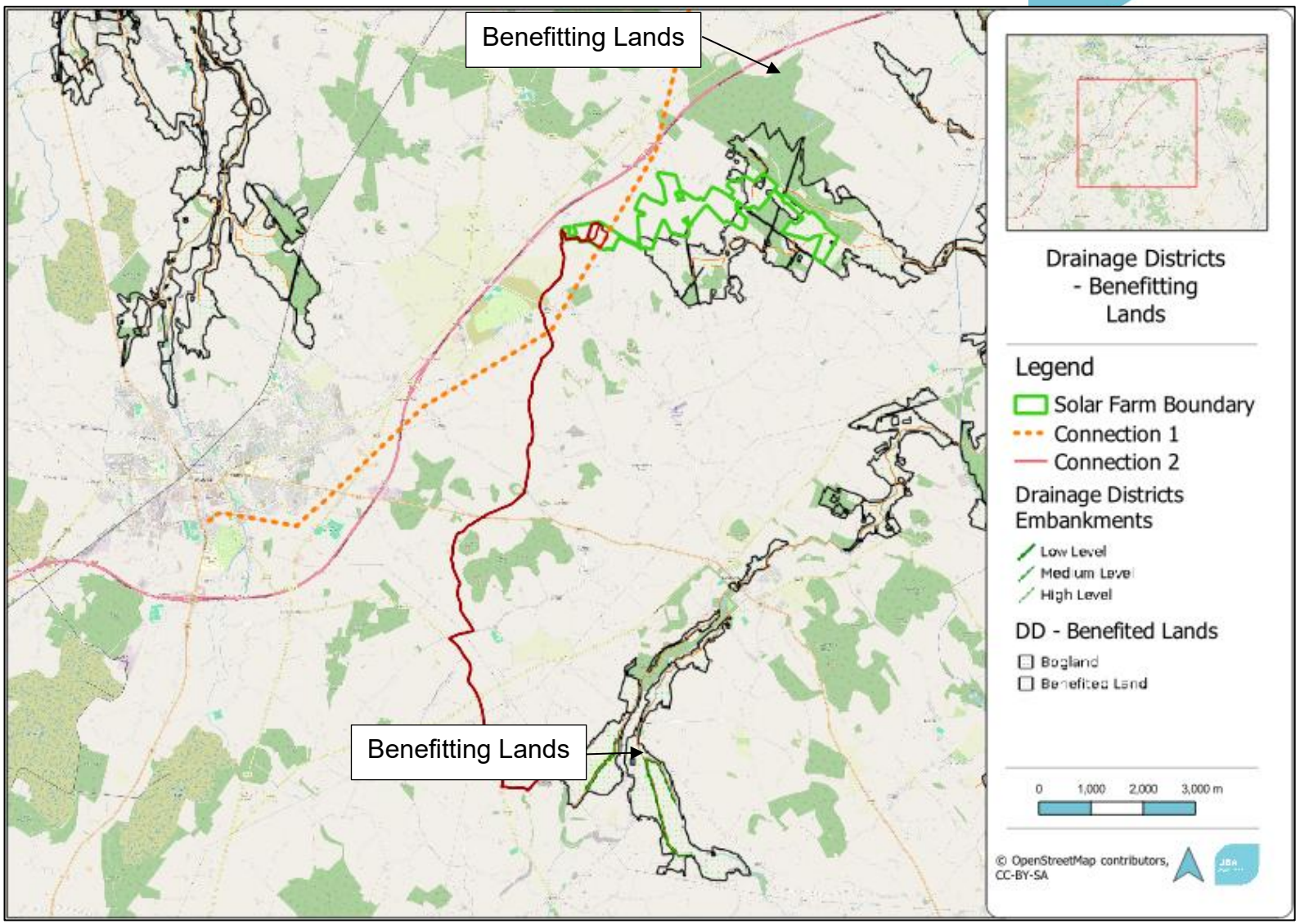


Figure 3-2: Arterial Drainage

3.2 Predictive Flood Mapping

The wider area has been a subject to predictive flood mapping or modelling studies and other related studies and plans.

- National Indicative Fluvial Mapping (NIFM) Program

3.2.1 NIFM

The OPW hosts the National Indicative Fluvial Mapping (NIFM) study on the floodinfo.ie portal. This fluvial mapping shows the modelled extent of lands that might be flooded by rivers during a theoretical flood event with an estimated probability of occurrence for watercourses not covered by the CFRAM AFAs. This predictive flood mapping replaces the superseded OPW PFRA study and presents the most up to date flood mapping of the Cappakeel area.

Current Scenario (no climate change) fluvial flood extents for the Cappakeel area are shown in Figure 3-2 and Figure 3-4. Review of Figure 3-3 confirms that a portion of the site is at risk during the 1% AEP and 0.1% AEP events and therefore, this area may be subject to fluvial flooding.

Review of Figure 3-4 confirms that neither of the proposed cable routes are located within the NIFM flood extents.

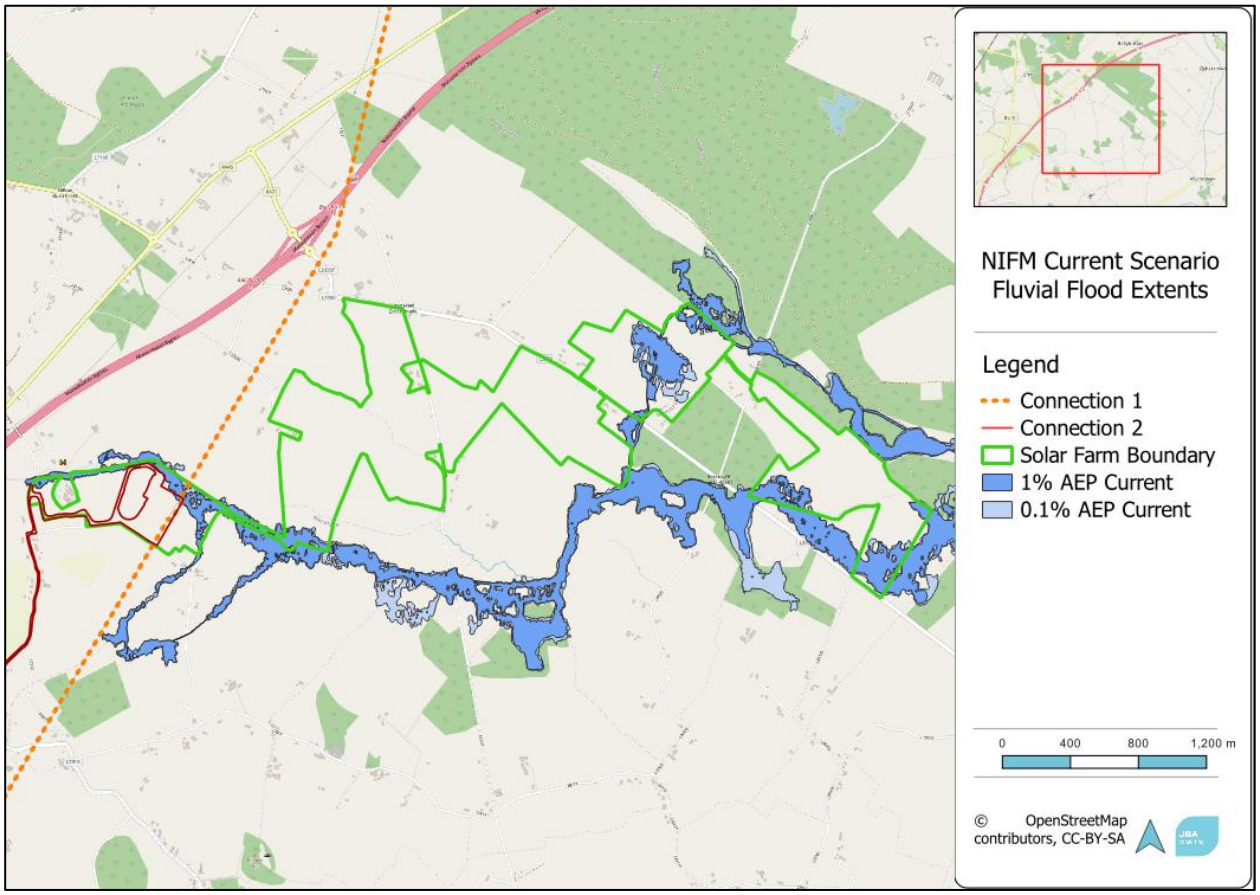


Figure 3-3: NIFM Fluvial Flood Extents - Current Scenario Solar Farm

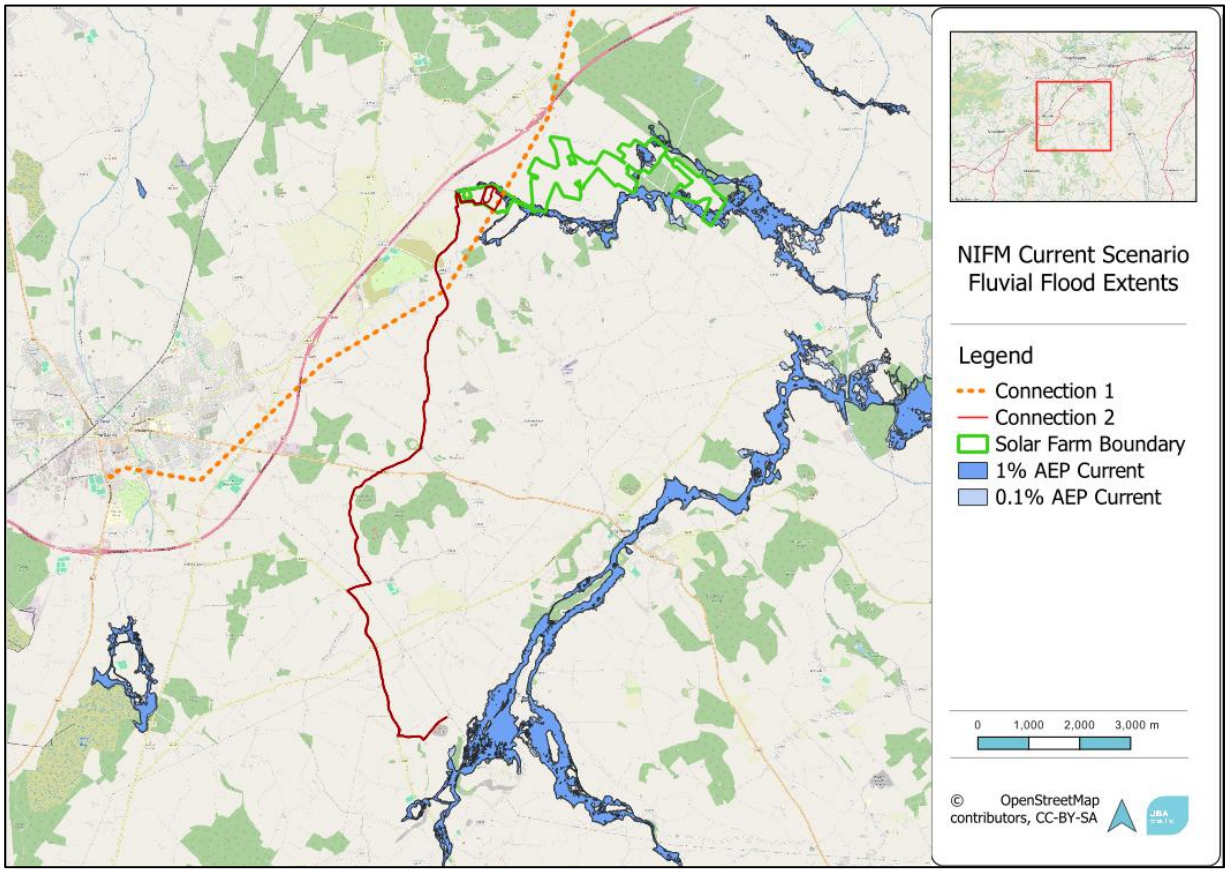


Figure 3-4: NIFM Fluvial Flood Extents - Cable Route

3.2.2 South Eastern CFRAM Study

In 2011 the OPW commenced appointment of consultants to carry out a more detailed flood risk assessment on key flood risk areas. This work was undertaken under the CFRAM programme across seven river basin districts in Ireland.

While the majority of the cable routes lie outside of any CFRAM extents, there's some small overlaps of Connection 1 with the 1% AEP and 0.1% AEP extents (see Figure 3-5). It is noted that Connection 1 follows existing overhead infrastructure.

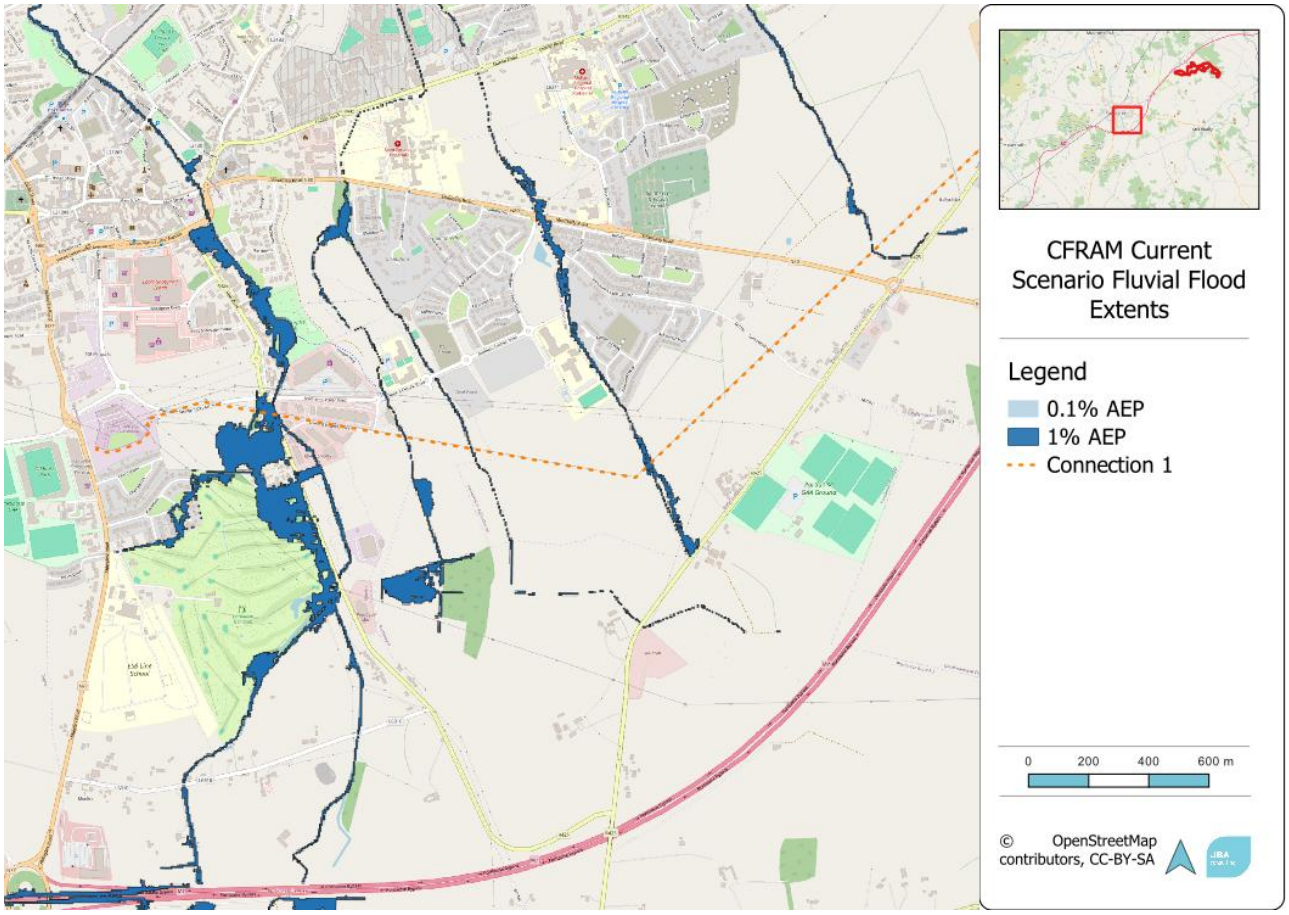


Figure 3-5 CFRAM Fluvial - Current Scenario

3.3 Sources of Flooding

The initial stage of a Flood Risk Assessment requires the identification and consideration of probable sources of flooding. Following this initial phase of this Flood Risk Assessment, it is possible to summarise the level of potential risk posed by each source of flood sources are described below.

3.3.1 Fluvial

The main flood risk to the cable route is from fluvial flooding. Review of the NIFM flood extents shows that sections of the solar farm are partially inundated during the 1% and 0.1% AEP extents while the cable routes lie outside of NIFM extents. There is minor overlap with Connection 1 and CFRAM extents in the outer boundary of Portlaoise. Connection 1 comprises overhead conductors with support structures set outside Flood Zones A and B, therefore the fluvial flood risk to the operational assets of the Connection 1 is Low, with residual risk limited to temporary access constraints during extreme events.

The proposed underground cable route (Connection 2) runs predominantly along existing public road verges and agricultural field boundaries, situated outside both, NIFM, and CFRAM Flood extents. Local drainage features include field ditches, minor drains and small streams which convey surface runoff. CFRAM mapping confirms no overlap between the proposed trench alignment and mapped 1% AEP (Zone A) or 0.1% AEP (Zone B) flood extents. Given the shallow, buried nature of the cable and absence of above-ground structures, the operational fluvial flood risk is Low.

To further assess the potential flood risk and examine residual risks to the solar farm an in-depth flood risk assessment using a site-specific hydraulic model has been carried out and is discussed in Section 4.

3.3.2 Coastal

The study area is located inland and therefore coastal flooding has been screened out at this stage.

3.3.3 Pluvial

Pluvial, or surface water, flooding is the result of rainfall-generated flows that arise before run-off can enter a watercourse or sewer. It is usually associated with high intensity rainfall. Flood risk from pluvial sources exists in all areas.

3.3.4 Groundwater

Groundwater flooding results from high-sub surface water levels that impact upper levels of the soil strata and overland areas that are usually dry. The GSI groundwater vulnerability mapping indicated a low risk to the groundwater at the site as well as the subsoil being of low permeability which indicates a large depth to bedrock. There is a record of historic groundwater flooding in the area, however there is no recorded groundwater flooding within the site boundary. Similarly, there were no predictive groundwater flooding extents identified on-site or nearby. There are several karst features in proximity to the West Parcel, refer to Section 2.3.

In summary, there is no known risk of groundwater flooding in this area. Having reviewed the GSI data, groundwater flooding will not be considered and has been screened out at this stage.

4 Flood Risk Assessment

4.1 Hydrology

4.1.1 Catchment Characteristics

The physical characteristics of the catchments influence the hydrology; these include catchment size, soil type, steepness, and average rainfall. Catchment descriptors were sourced from the FSU catchments database for each Hydrological Estimation Point (HEP).

Table 4-1 lists the parameters pertinent to the hydrology calculations discussed in the following sections:

Table 4-1: Final catchment descriptors at each HEP.

Descriptor	14_1242_5	14_1746_4	14_1746_13	14_1746_14
AREA	9.192	19.594	49.89	50.303
SAAR1991-20	892	888	869	869
FARL	1	1	1	1
BFI Soil	0.712	0.713	0.677	0.677
URBEXT (CORINE 2018)	0.0485	0.0228	0.0089	0.0089
MSL	2.003	3.759	8.264	8.767
S1085	7.373	5.547	2.363	1.741
DrainD	0.218	0.26	0.193	0.201
ArtDrain2	0	0	0	0

4.1.2 Flow Estimation

To estimate the peak flows for the 50%, 20%, 5%, 2%, 1% and 0.1% AEP events a variety of methods were considered for the watercourse. The methods used to estimate flows for the watercourse are:

- Flood Studies Update Methods (FSU and FSU Small Catchments)

The locations of the Hydrological Estimation Points (HEP) are provided in Figure 4-1. The final decision of choosing the best estimate of growth curve was based on the pooling groups of gauge data from across Ireland. The Pooled GLO and Pooled GEV curves were considered for all catchments. The GLO curve is steeper than the GEV curve. Therefore, as a conservative approach, it is recommended to apply the GLO curve over all catchments.

Table 4-2 compares the peak flow estimates for the HEP using the different estimated Qmed values and the FSU growth curve.

It has been noted that although the catchment area is much larger for catchments 14_1746_13 and 14_1746_14, the final QMED value is lower. This due to the shallow slope of these catchments. For the purpose of this study, it is more appropriate to apply the FSU 7-variable method to all catchments. A Factorial Standard error (FSE) has been applied to mitigate against uncertainty in flow estimation. The associated 95%ile FSE for the FSU Method is 2.79. This represents a conservative estimate of flows in the catchment.

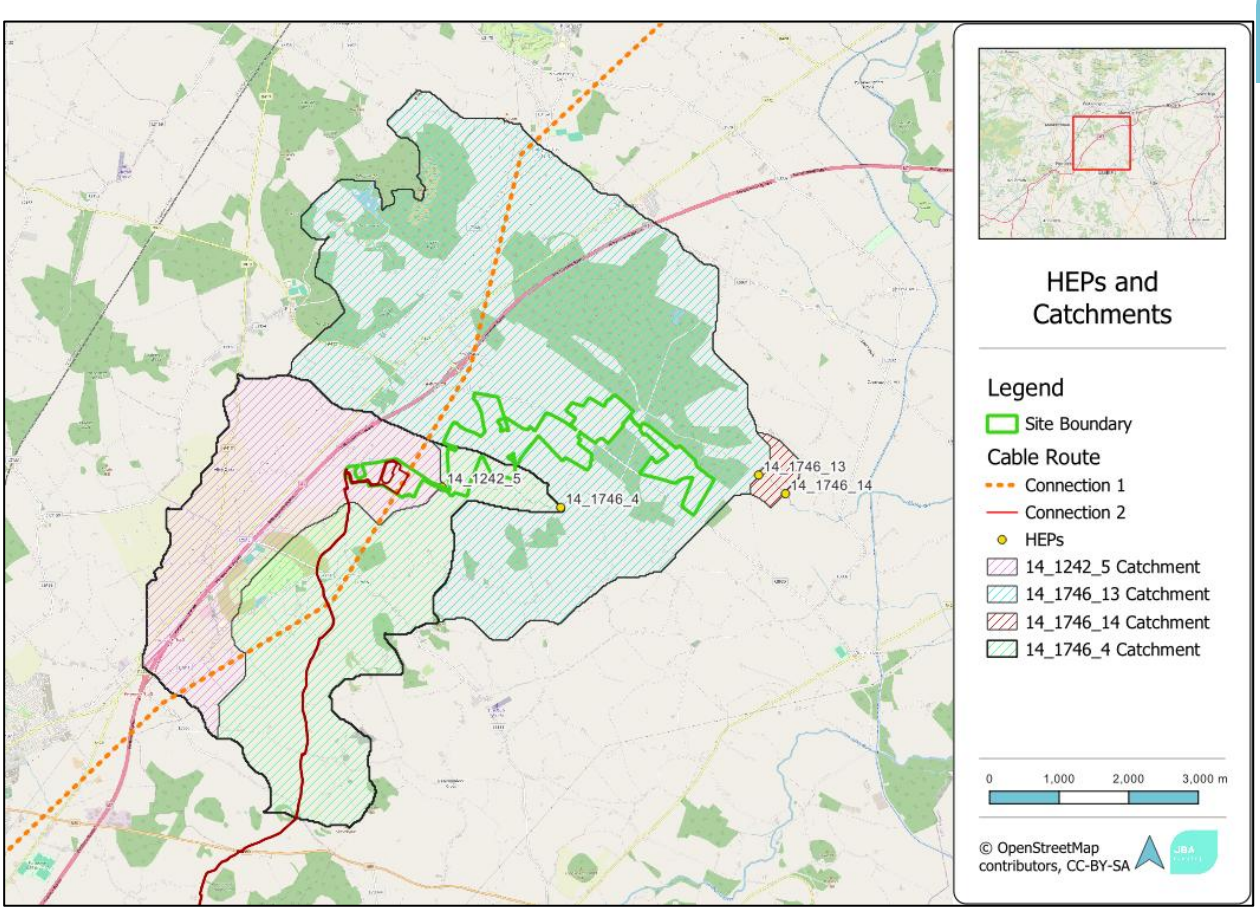


Figure 4-1: HEP Location & Catchment Area

The final decision of choosing the best estimate of growth curve was based on the pooling groups of gauge data from across Ireland. The Pooled GLO and Pooled GEV curves were considered for all catchments. The GLO curve is steeper than the GEV curve. Therefore, as a conservative approach, it is recommended to apply the GLO curve over all catchments.

Table 4-2: QMED estimates for HEPs

HEP code	50% AEP	1% AEP	0.1% AEP
14_1242_5	0.89	1.92	2.68
14_1746_4	1.75	3.77	5.25
14_1746_13	3.23	6.98	9.72
14_1746_14	3.07	6.64	9.26

4.2 Hydraulics

The hydraulic modelling for this study was completed using ESTRY and TUFLOW software packages. When both are used in conjunction with each other, they form what is termed a 'linked model'. A linked-model allows flow in the river channel and structures to be represented using 1D modelling equations (ESTRY) and allows any out-of-bank volumes to be represented by 2D routing equations (TUFLOW). The modelling results were obtained by using TUFLOW version 2023-03- AA-iDP.

The model has been developed to assess the flood risk to the solar farm development but also provides valuable information concerning the proposed connection routes.

The hydraulic modelling was carried out in the following stages:

- The Glasha River and Tonafarna Stream were built using the ESTRY 1D software using cross section.
- A 2D model grid enclosing the study area was created using DTM data from Bluesky with an XY accuracy of +/- 1m rmse, and a z accuracy of +/- 1.5m rms.
- 1D and 2D components were linked along the bank crest lines.
- Hydraulic simulations were run to derive the existing flood extents for the 1% and 0.1% AEP flood events.
- The post-development design has been assessed against a climate change scenario (MRFS).
- Residual risks (structure blockage) have been tested to assess the residual risk for the site.

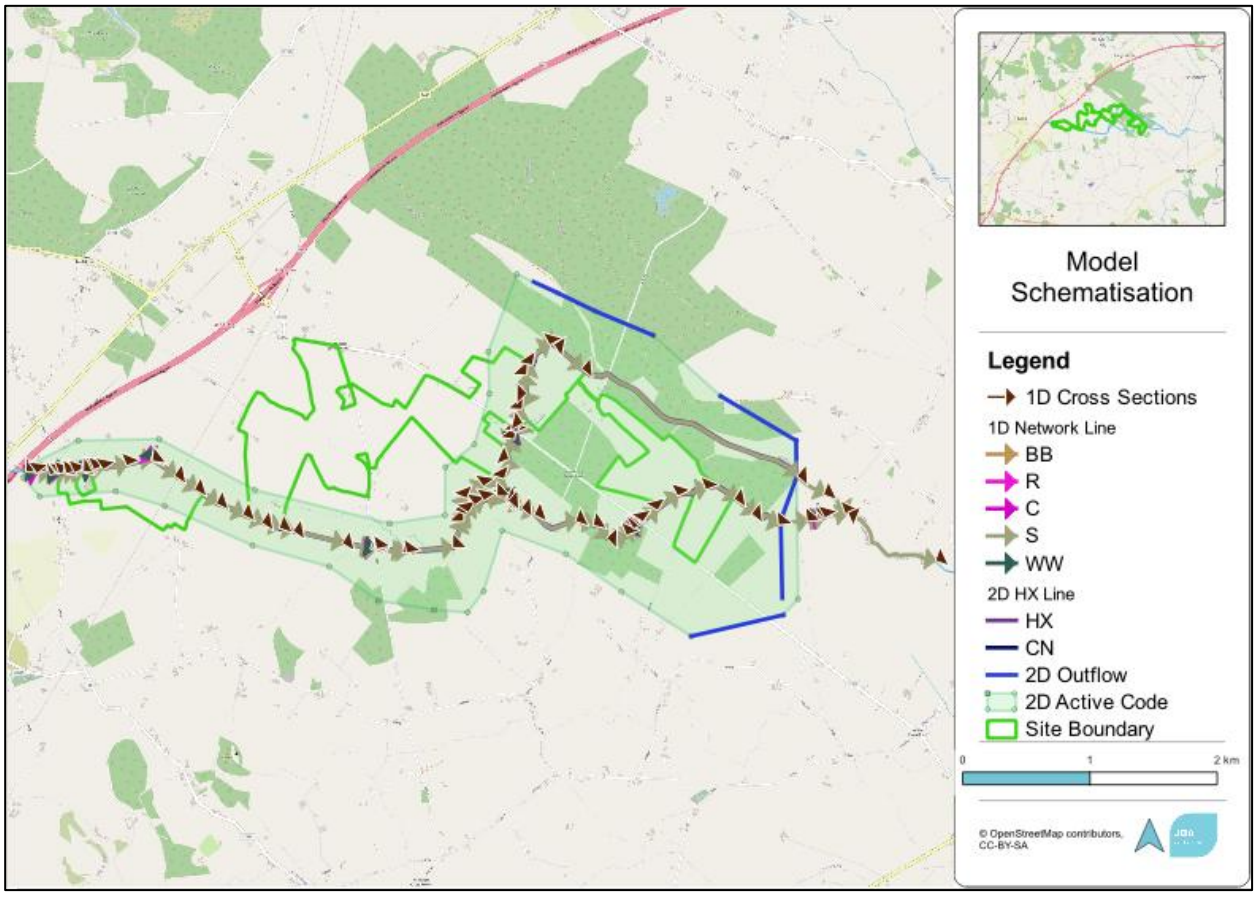


Figure 4-2: Model Schematic

4.3 Model Results

The baseline scenario was run to define flood extents for Flood Zones A (1% AEP Event) and B (0.1% AEP Event).

Figure 4-3 shows the modelled flood extents for fluvial flooding for the 1% AEP and 0.1% AEP events. These constitute the Flood Zones as defined under the Planning System and Flood Risk Management Guidelines. The results show most of the site is in Flood Zone C and at low risk from flooding. A section of each parcel is located in Flood Zone A/B. The flood flow pathways and extents are similar to the NIFM flood outlines which are presented in Figure 3-2.

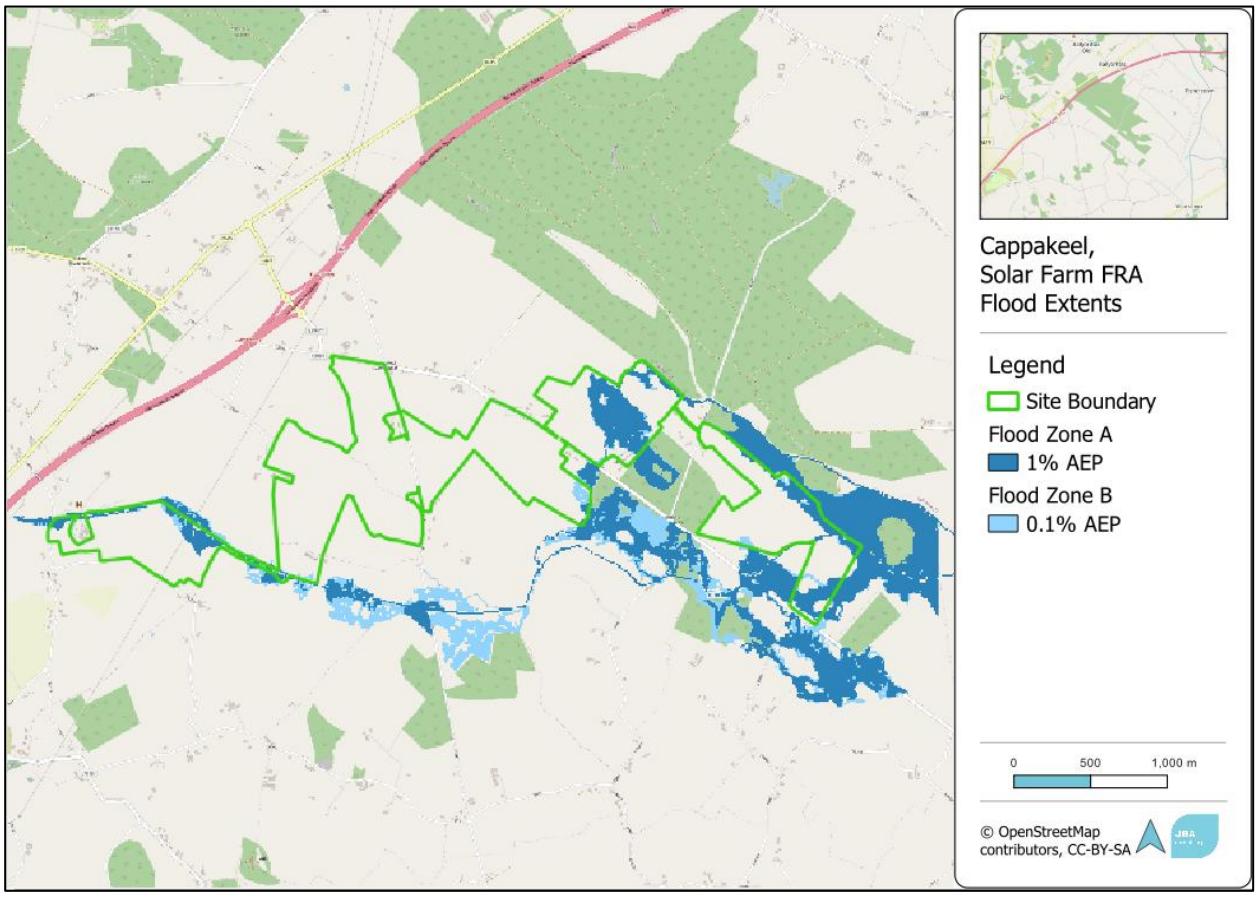


Figure 4-3: Flood Zones

5 Flood Risk Assessment

5.1 Flood Risk

From the detailed flood risk assessment carried out in Section 4 the majority of the proposed connection routes are located in Flood Zone C.

Based on the available flood maps, Connection 2 is located fully within Flood Zone C. Connection 1 does traverse Flood Zone A/B as identified within the CFAM Study (Figure 3-5). It is noted that the Connection 1 route follows an overhead powerline and there is raised above the 1% AEP and 0.1% AEP flood levels and therefore is not impacted by these flood events.

5.2 Mitigation Measures

Currently there are two cable routes considered as part of the development

- Connection 1 - A loop-in/loop-out (LILO) connection to the existing Cushaling–Portlaoise 110 kV overhead line within the townland of Morett.
- Connection 2 - A Tail-Fed connection within the public roadway to the Coolnabacky 110kV Substation

With reference to Figure 3-4, it is confirmed that Connection 1 crosses Flood Zone A/B. It is noted that the route also crosses a number of stream and drainage channels as depicted in Figure 5-1. However, as this connection will be constructed via an existing overhead powerline, therefore the cable will be located above the predicted flood levels, and it is not at risk of inundation.

Regarding Connection 2, the route does not cross predicted Flood Zone A or B extents. Based on a review of the OSI Geo-viewer and site visit, there is only one single stream/ drainage channel crossing across the entire route, while two local drainage culverts have also been identified. The Connection 2 route will be constructed along the road verge along the entire route underground and at the watercourse crossing, the duct will be installed by a minimum of 1.5m below the riverbed therefore there will be no impact on the existing flood levels.

As previously stated, local roadside drainage channels have been identified along the route as depicted in Figure 2-2. along the verge of the road for the entire proposed route. The implementation of the Construction Methodology will ensure that the impacts are minimised. All roadside drainage channels will be maintained

Therefore, the route is considered not to be at risk of inundation nor will increase flood risk elsewhere.

5.2.1 Residual Risk

Residual risks are defined as risks that remain after all risk avoidance, substitution and mitigation measures have been taken. The flood risk assessment identifies that the potential blockage of culvert/bridge structures in the site is the main source of residual risk to the proposed development.

Potential blockages along any structures within the study area will not impact upon either Connect 1 or 2 due to the construction methodologies i.e. an overhead cable and underground duct.

5.3 Climate change

Regarding the potential impacts of climate change, the connection routes will not be impacted by the predicted increases in river flows. This is outlined further as follows:

- Connection 1 will be raised substantially above the existing ground via the overhead powerline therefore it will not be impacted by climate change.
- Connection 2, which comprises an underground cable along public road verges, remains outside the climate-adjusted flood extents. The installation is buried and sealed and therefore, is not vulnerable to temporary flooding.
  Where the cable crosses existing watercourses/ local drainage channels the cable will be installed 1.5m below the river bed level therefore there will be no impact on the existing hydrology.

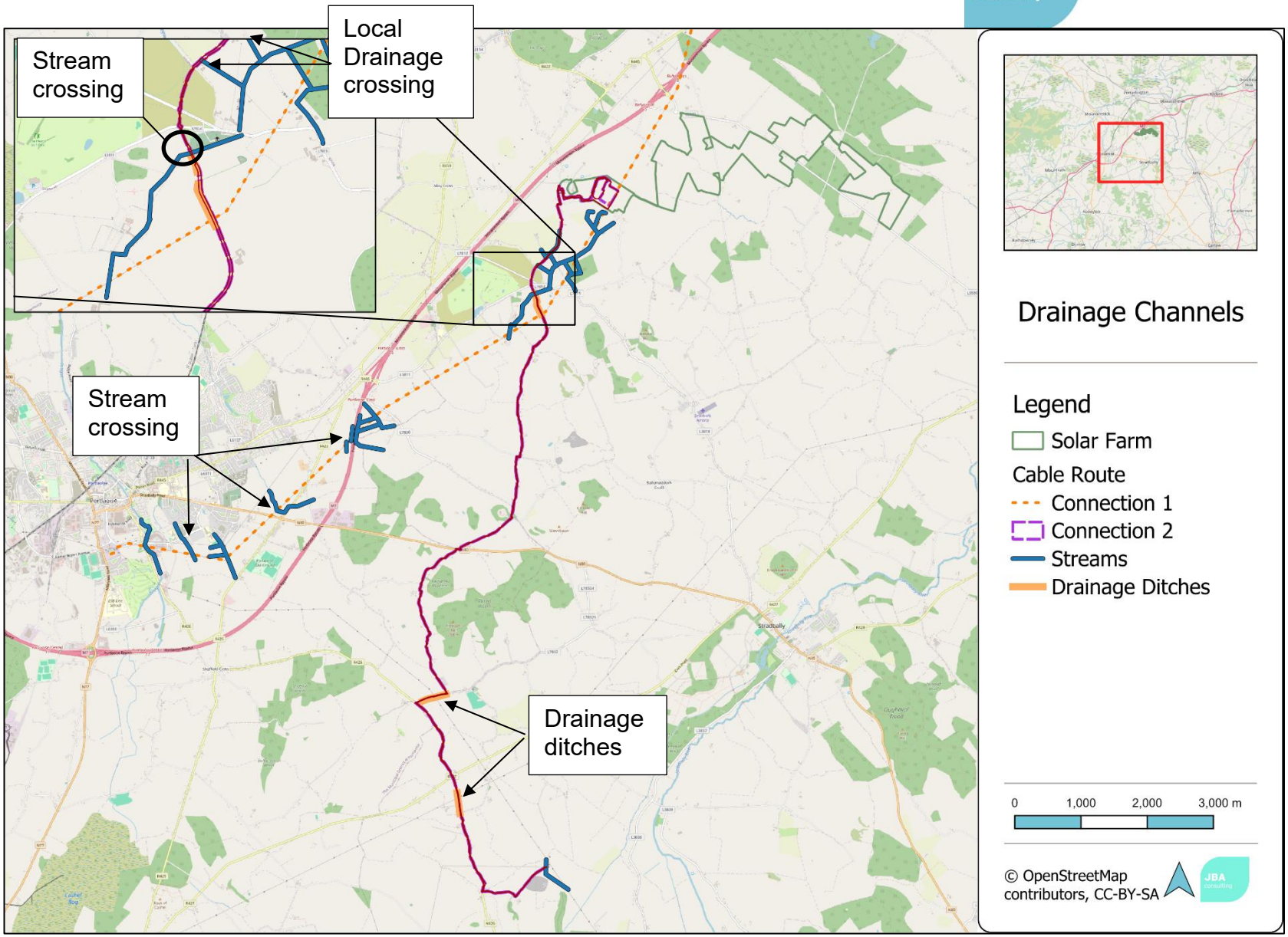


Figure 5-1: Arterial Drainage

6 Conclusion

JBA Consulting were appointed by Fehily Timoney and Company to appraise the flood risk associated with the proposed grid-connection routes linking the Cappakeel Solar Farm to the national grid near Portlaoise, Co. Laois and Coolnabacky Substation.

The assessment was undertaken in accordance with The Planning System and Flood Risk Management Guidelines for Planning Authorities (DoEHLG/OPW, 2009) and accompanying Technical Appendices.

To inform the assessment, available OPW CFRAM and NIFM flood mapping, the Laois County SFRA, topographic data and site-walkover information were reviewed to determine the relationship of the proposed cable routes to Flood Zones A and B. A hydraulic model was also constructed for the associated Solar Farm development.

No site-specific hydraulic modelling was required for the connection works, as the CFRAM extents provide sufficient resolution for route-scale assessment.

The results indicate that Connection 1 (overhead line) partially intersects the CFRAM 1% AEP and 0.1% AEP fluvial flood zones at several small stream crossings near the outskirts of Portlaoise, while Connection 2 (underground cable) lies entirely outside mapped flood extents.

Connection 1 – Overhead line:

- Localised sections of the alignment pass through mapped Flood Zones A and B associated with minor tributaries. The conductors are elevated well above predicted flood levels, and the support poles are slender structures that do not obstruct flow or reduce floodplain storage.
- These characteristics make the asset effectively water compatible, and the residual risk is limited to temporary access constraints during extreme events.
- Construction will occur via an existing overhead powerline.

Connection 2 – Underground cable:

- This route follows public road verges and remains outside all mapped flood extents.
- Only one small steamcrossing is present, and two local drainage channels where the ducting will be installed at a minimum of 1.5m below the riverbed.
- A number of short drainage ditches are located along the route that provide local drainage only. These will not be impacted by the construction of the proposed connection.
- The reinstated profile will maintain existing drainage connectivity, ensuring no increase in local flood levels.

The 1% AEP + climate-change CFRAM outlines show a modest expansion of flood extents along the same minor tributaries intersected by Connection 1. Because the line is overhead, with all electrical components elevated, this increase in flood level does not

materially affect the function or resilience of the asset. Connection 2 remains outside the climate-adjusted outlines. Therefore, the overall fluvial flood-risk classification for both connections remains Low, though temporary access limitations may arise during extreme climate-adjusted events.

The connection infrastructure is inherently water-resistant and introduces no new impermeable area. Standard best practice construction measures will include maintaining separation from open drains, avoiding spoil storage near watercourses, and reinstating ditches to their original cross-section will ensure there is no increase in flood risk to or from the development.

Accordingly, the proposed grid connection is appropriate for this type of utility infrastructure.

The fluvial flood risk to the cable routes is classified as Low, consistent with the Planning System and Flood Risk Management Guidelines (DoEHLG/OPW, 2009).

A Understanding Flood Risk

Flood risk is generally accepted to be a combination of the likelihood (or probability) of flooding and the potential consequences arising. Flood risk can be expressed in terms of the following relationship: Flood Risk = Probability of Flooding x Consequences of Flooding

A.1 Probability of Flooding

The likelihood or probability of a flood event (whether tidal or fluvial) is classified by its Annual Exceedance Probability (AEP) or return period (in years). A 1% AEP flood has a 1 in 100 chance of occurring in any given year.

In this report, flood frequency will primarily be expressed in terms of AEP, which is the inverse of the return period, as shown in the table below and explained above. This can be helpful when presenting results to members of the public who may associate the concept of return period with a regular occurrence rather than an average recurrence interval and is the terminology which will be used throughout this report.

Table A-1: Conversion between return periods and annual exceedance probabilities

Return period (years)	Annual exceedance probability (%)
2	50
10	10
50	2
100	1
200	0.5
1000	0.1

A.2 Flood Zones

Flood Zones are geographical areas illustrating the probability of flooding. For the purposes of the Planning Guidelines, there are 3 types or levels of flood zones, A, B and C.

Table A-2: Flood Zones

Zone	Description
Flood Zone A	Where the probability of flooding is highest; greater than 1% (1 in 100) from river flooding or 0.5% (1 in 200) for coastal/tidal flooding.
Flood Zone B	Moderate probability of flooding; between 1% and 0.1% from rivers and between 0.5% and 0.1% from coastal/tidal.

Flood Zone C	Lowest probability of flooding; less than 0.1% from both rivers and coastal/tidal.

It is important to note that the definition of the flood zones is based on an undefended scenario and does not take into account the presence of flood protection structures such as flood walls or embankments. This is to allow for the fact that there is a residual risk of flooding behind the defences due to overtopping or breach and that there may be no guarantee that the defences will be maintained in perpetuity.



A.3 Consequence of Flooding

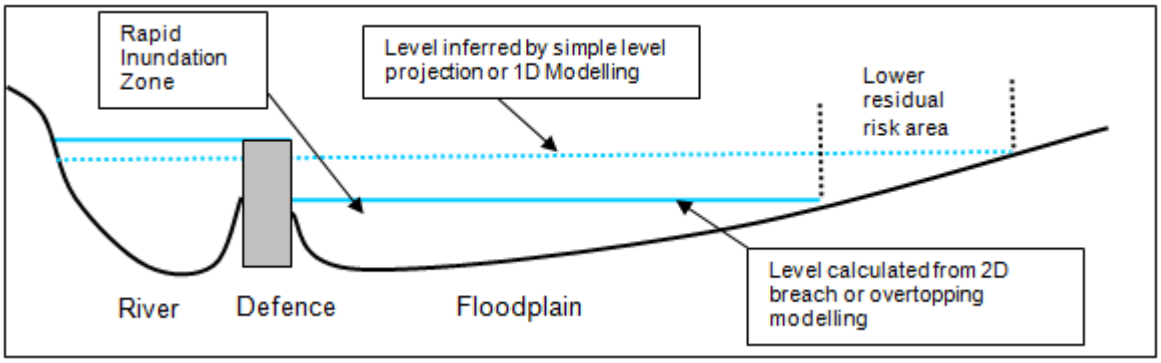
Consequences of flooding depend on the hazards caused by flooding (depth of water, speed of flow, rate of onset, duration, wave-action effects, water quality) and the vulnerability of receptors (type of development, nature, e.g. age-structure, of the population, presence and reliability of mitigation measures etc.).

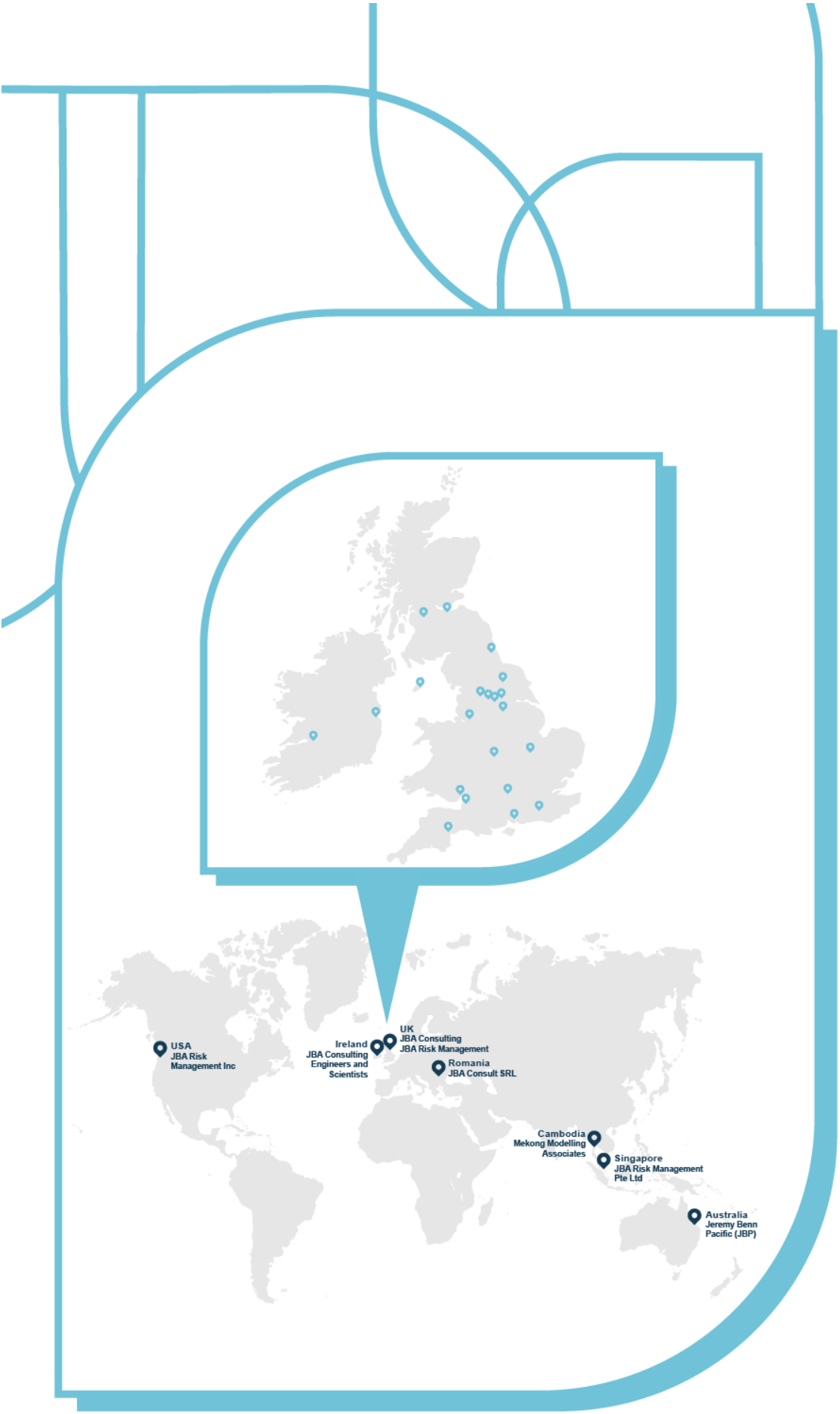
The 'Planning System and Flood Risk Management' provides three vulnerability categories, based on the type of development, which are detailed in Table 3.1 of the Guidelines, and are summarised as:

- Highly vulnerable, including residential properties, essential infrastructure and emergency service facilities;
- Less vulnerable, such as retail and commercial and local transport infrastructure;
- Water compatible, including open space, outdoor recreation and associated essential infrastructure, such as changing rooms.

A.4 Residual Risk

The presence of flood defences, by their very nature, hinder the movement of flood water across the floodplain and prevent flooding unless river levels rise above the defence crest level, or a breach occurs. This is known as residual risk.


Rapid Inundation Zone
Level inferred by simple level projection or 1D Modelling
Lower residual risk area
Level calculated from 2D breach or overtopping modelling
River
Defence
Floodplain



JBA consulting

Offices at

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Coleshill
Doncaster
Dublin
Edinburgh
Exeter
Glasgow
Haywards Heath
Isle of Man
Leeds
Limerick
Newcastle upon Tyne
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