# Technical Appendix 7: Flood Risk Assessment and Drainage Impact Assessment

Colehill 110kV Substation and Grid Route

25/11/2025

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# Contents

# EXECUTIVE SUMMARY

4.1 This Flood Risk and Drainage Impact Assessment has been carried out for the Proposed Development consisting of the installation and operation of a 110kV substation and grid route in the townlands of Ballyteige Little, Wood of O, Corndarragh, Derrynagall or Ballydaly, Ardan and Puttaghan, Co. Offaly.

4.2 The Preliminary Flood Risk Assessment (PFRA), National Infrastructure Fluvial Mapping (NIFM) and CFRAM flood maps flood maps present no areas within the Proposed Substation identified as being at risk of flooding from fluvial or coastal events and therefore the Proposed Substation Site is situated in 'Flood Zone C'.

4.3 The proposed type of development is specified as Highly Vulnerable Development category outlined in The Planning System and Flood Risk Management Guidelines. The access track can be classed as 'Water Compatible Development', whilst the substation has been classed as 'Highly Vulnerable Development'. Both are appropriate for Flood Zone C.

4.4 In addition to fluvial and coastal flood risk, the PFRA map also indicates areas of flood risk due to pluvial sources. This indicates no areas of pluvial flooding within the Proposed Substation Site. In addition, the topographical survey was analysed and due to the sloping land down to the watercourse, it is unlikely any surface water flooding will occur. There is a small area of pluvial flooding where HDD is proposed from the Derrygrogan Solar Farm, however this will be managed by only conducting the HDD when there is no forecast of rain.

4.5 It is proposed to construct a network of rainwater harvesting tanks and two soakaway pits/infiltration drains within the Proposed Substation Site. The idea is to capture any overland flow in the SuDS device before infiltrating into the surrounding soils.

4.6 The underground piped system connects the Eirgrid building and IPP switchrooms to rainwater harvesting tanks, which overflow into soakaway pits/infiltration drains. As the transformers will hold a volume of oil, the system will include a class 1 full retention separator. The soakaway pit and rainwater harvesting tanks will be designed to hold a total volume of 111m$^3$ with the detailed design of the structure being submitted to the council for review prior to the construction period.

4.7 A permanent toilet is proposed within the Eirgrid building and IPP compound and will be utilised by maintenance staff of substation. Each toilet will be off grid toilet with a foul holding tank which will be emptied when required by an approved contractor.

4.8 Additional drainage measures to be implemented on-site include the following:

- Laydown areas: Laydown areas are to be unpaved and constructed from local stone. Temporary swales or similar shall be utilised to collect runoff from access tracks with discharge to ground through percolation areas. Where swales are utilised, frequent

checks of dams formed from gravels and other excavated material should be undertaken.

4.9 The FRA and DIA have therefore demonstrated that the Proposed Development will **not increase flood risk** away from the Proposed Substation Site during the construction and operation phases. The Proposed Development is therefore considered to be acceptable in planning policy terms.

# INTRODUCTION

## Background

4.10 Neo Environmental Ltd has been appointed by Renewable Energy Systems on behalf of Ballyteige Solar Limited ("the Applicant") to undertake a Flood Risk Assessment ("FRA") and Drainage Impact Assessment ("DIA") for a Strategic Infrastructure Development ("SID") Application for a new 110kV Substation ("Colehill 110kV Substation") and grid connection to the existing Thornsberry 110kV substation.

## Development Description

4.11 "The Proposed Development" comprises of a 110kV substation, access road, interconnection cables and grid route. The Proposed Development is to facilitate the connection of Ballyteige (PA Ref: 2198) and Derrygrogan (PA Ref: 22378 and ABP 318041-23) solar farms to the national grid. The method of connection to the national grid for the new substation will be a 110kV tail-fed connection into the existing Thornsberry Substation.

4.12 The Proposed Development will consist of:

- 1No. substation compound comprising of No.3 work areas with CCTV and associated drainage which will be enclosed by 2.6m high palisade fencing and gates:
    - 1No. Eirgrid control building, 110kV bay arrangements, 4No. lightning poles, compound road,
    - Crane hardstand, 2No. transformers and 2. No auxiliary transformers, 110kV electrical equipment, back up generator,
    - 2No. Independent Power Purchaser (IPP) control buildings and compound including toilet, 2No. grid code compliance equipment, 2No. harmonic filters, car parking and telecoms pole),
- Property boundary fencing;
- Access tracks (upgraded existing and new);
- Temporary construction compound and temporary access track,
- Temporary and permanent road re-alignment of a section of O of Wood local road;
- c.7.3km of underground 110kV cabling with joint bays, over and under watercourse crossing and a potential horizontal directional drill on access track and local roads;

- c.610m of medium voltage underground interconnection cable with associated horizontal directional drill.

## Site Description

4.13 The Proposed Development is situated within the townlands of Ballyteige Little, Wood of O, Corndarragh, Derrynagall or Ballydaly, Ardan and Puttaghan, Co. Offaly.

4.14 The Colehhill 110kV Substation is proposed to be located in one relatively flat agriculture field. The proposed 7.3km grid route will run in a northeast direction from the proposed Colehill 110kV substation to the existing ESB Thornsberry 110kV substation via private land and local roads. Interconnection cables from the eastern sections of Derrygrogan Solar Farm will be installed via horizontal directional drilling on a section of an agricultural field underneath the dry canal into the proposed access and track of Colehill 110kV Substation.

4.15 The Proposed Development lies at an elevation of c. 71.7 to 77.8m AOD and covers a total area of c. 11.2 hectares. The approximate Irish Grid Reference points (ITM) of the proposed Colehill 110kV substation are X 639234 and Y 727175. Access to the proposed substation will be from the Kilbeggan Road to the east of the Proposed Substation Site which is the same entrance point for the consented Ballyteige Solar Farm (PA Ref: 2198).

4.16 The grid route is c.250m northeast of Tullamore Town, while the substation is 5.8km northeast from Tullamore Town.

## Scope of Report

4.17 The aim of this assessment is to identify the baseline geological and hydrological conditions of the site and surrounding area, to assess the potential impacts of the Proposed Development during the construction and operation phases, to identify the risk of flooding at the Proposed Substation Site and to recommend mitigation measures where appropriate.

4.18 The grid route, cut and fill and horizontal directional drilling proposed as part of this Proposed Development will be underground and will not increase flood risk elsewhere or be impacted by any flooding. The report therefore will focus on the substation development (Proposed Substation Site) alone.

4.19 This Flood Risk Assessment has been prepared in accordance with 'The Planning System and Flood Risk Management: Guidelines for Planning Authorities[1]' document, prepared by the Department of Environment, Heritage and Local Government (DoEHLG).

[1] Department of Environment, Heritage and Local Government (2009) *The Planning System and Flood Risk Management: Guidelines for Planning Authorities.* Available at: http://www.opw.ie/media/Planning%20System%20and%20Flood%20Risk%20Management%20Guidelines.pdf

4.20 This report is supported by the following figures and appendices:

- Appendix 4A Figures:

– Figure 4.1: Watercourses and Photo Locations

– Figure 4.2: Topographical Survey

– Figure 4.3: Preliminary Flood Risk Assessment (PFRA) Map

– Figure 4.4: Outline SuDS Design

Appendix 4B: Flow Output

## Statement of Authority

4.21 This Flood Risk Assessment (FRA) has been produced by Michael McGhee and Tom Saddington of Neo Environmental. Having completed a civil engineering degree in 2012, Michael has worked on over 1GW of renewable development flood risk and drainage impact assessments across the UK and Ireland whilst working towards becoming a Chartered Engineer. Michael has over 12 years of environmental consultancy experience, mainly producing technical assessments for energy projects. Tom has an undergraduate degree in Bioengineering and graduated with an MSc in Environmental and Energy Engineering in January 2020. He has been working on various technical assessments including flood risk assessment reports for numerous renewable developments in Ireland and the UK.

# LEGISLATION

4.22 A review of relevant legislation has been conducted to ensure the Proposed Development complies with the following:

- EU Directive on the Assessment and Management of Flood Risks [2007/60/EC];
- The Water Framework Directive [2000/60/EC] (as amended);
- Planning and Development Act 2000 (as amended);
- The Water Policy Regulations (S.I. No. 722 of 2003);
- Surface Waters Regulations (S.I. No. 272 of 2009);
- Groundwater Regulations (S.I. No. 9 of 2010); and
- Environmental Protection Agency Acts, 1992 (as amended).

## Review of County Development Plan Policy

### Offaly County Development Plan (CDP)[2]

4.23 The Offlay County Development Plan (CDP) for the period 2021-2027 was adopted 10th September 2021. The below policies are believed to be of relevance to this Flood Risk Assessment/Drainage Impact Assessment.

Table 4 - 1: Offaly CDP Flood Management Policies/Objectives

| Planning Policy/Objective | Assess | Comment |
|---|---|---|
| CAEP – 53<br><br>*"It is Council policy to support, in co-operation with the OPW, the implementation of the EU Flood Risk Directive, the Flood Risk Regulations (S.I. No. 122 of 2010) and the 'The Planning System and Flood Risk Management Guidelines for Planning Authorities (2009) and Department* | Yes | A Flood Risk Assessment (FRA) has been undertaken in accordance with the Flood Risk Management Guidelines.<br><br>The Flood Risk Assessment has been undertaken in conjunction with the CFRAM plans. |

[2] Offlay County Council. Offlay County Development Plan (2021 – 2027). Available at: https://www.offaly.ie/eng/Services/Planning/County-Development-Plan-2021-2027/Stage-4-Final-Plan/Volume%20I%20Written%20Statement.html

| | | |
|---|---|---|
| *Circular Pl2/2014 or any updated / superseding version."* | | |
| CAEP – 54<br><br>*"It is Council policy to protect Flood Zone A and Flood Zone B from inappropriate development and direct developments/land uses into the appropriate Flood Zone in accordance with The Planning System and Flood Risk Management Guidelines for Planning Authorities 2009 (or any superseding document) and the guidance contained in Development Management Standard DMS-106. Where a development/land use is proposed that is inappropriate within the Flood Zone, then the development proposal will need to be accompanied by a Development Management Justification Test and site specific Flood Risk Assessment in accordance with the criteria set out under with The Planning System and Flood Risk Management Guidelines for Planning Authorities 2009 and Circular PL2/2014 (as updated/superseded). In Flood Zone C, (See DMS-106 where the probability of flooding is low (less than 0.1%, Flood Zone C), site-specific Flood Risk Assessment may be required and the developer."* | Yes | This policy has been considered within the FRA |
| CAEP - 55<br><br>*"It is Council policy to require a Site-specific Flood Risk Assessment (FRA) for all planning applications in areas at risk of flooding (fluvial, pluvial or groundwater), even for developments deemed appropriate in principle to the particular Flood Zone. The detail of these site-specific FRAs will depend on the level of risk and scale of development. A detailed site-specific FRA should quantify the risks, the effects of selected mitigation and the management of any residual risks. The assessments shall consider and provide information on the implications of climate change with regard to flood risk in relevant locations. The 2009 OPW Draft Guidance on Assessment of Potential Future Scenarios for* | Yes | This policy has been considered within the FRA |

| | | |
|---|---|---|
| *Flood Risk Management (or any superseding document) and available information from the CFRAM Studies shall be consulted with to this effect."* | | |
| CAEP-67<br><br>*"It is Council policy to minimise and limit the extent of hard surfacing and paving and require the use of sustainable urban drainage systems (SuDs) where appropriate, for new developments or for extensions to existing developments, in order to reduce the potential impact of existing and predicted flooding risks."* | Yes | A Drainage Impact Assessment has been undertaken in order to design a SuDS scheme. |

## Strategic Flood Risk Assessment for County Offlay

4.24 The Strategic Flood Risk Assessment (SFRA) for County Offaly[3] is contained as an accompanying strategy to the CDP. The aim of the SFRA is to *"provide an appraisal of all sources of flooding within County Offaly and to set out a number of approaches in the plan making process to avoid, reduce and manage flood risk as part of a wider objective to ensure the protection of property, people and infrastructure."*

The SFRA has reviewed flood risk from fluvial, pluvial and groundwater sources. It also considers flooding from drainage systems, reservoirs and canals and other artificial or man-made systems. The study has also considered residual risk associated with various flood alleviation schemes throughout the county. However, the focus of the study is on risk from fluvial and pluvial flooding. Within the SFRA it is shown that where the Proposed Substation Site lies there is no risk of fluvial flooding.

[3] Offaly County Council (2014) *Strategic Flood Risk Assessment*. Available at: https://www.offaly.ie/eng/Services/Planning/Development-Plans/County-Development-Plan-2014-2020/Adopted-Plan-Files/Strategic-Flood-Risk-Assessment.pdf

### Shannon Upper & Lower River Basin (UOM25-26) - Flood Risk Management Plan[4]

4.25 The purpose of this plan is to set out the strategy, including a set of proposed measures, for the cost-effective and sustainable, long-term management of flood risk in the River Basin, including the areas where the flood risk has been determined as being potentially significant.

4.26 The plan identifies a number of communities in the catchment with potentially significant flood risk of which Tullamore, which is close to the Proposed Substation Site, is one. It highlights the Tullamore Scheme which was initiated in 2008 and was constructed from 2012 to 2013. The Scheme comprises flood defence walls and embankments along the Tullamore River and the Barony Stream and provides protection against a 1% AEP (100 year) fluvial event for 100 properties. The Proposed Development will not impact on this scheme or any other proposed within the management plan.

[4] Office for Public Works (2018), Flood Risk Management Plan – Shannon Upper & Lower River Basin (UOM25-26), Available at:

https://s3-eu-west-1.amazonaws.com/docs.floodinfo.opw/floodinfo_docs/Final_FRMPs_For_Publication/FRMP_Final2018_RiverBasin_25_26.pdf

# METHODOLOGY

4.27 Flood planning guidance for Ireland has been produced by the Department of Environment, Heritage and Local Government (now the Department of Housing, Planning, Community and Local Government) in 'The Planning System and Flood Risk Management Guidelines for Planning Authorities[5]' (the "FRM Guidelines") document. This FRA and DIA has been undertaken in accordance with these guidelines.

4.28 Flood planning policy aims to avoid inappropriate development in flood zones and instead direct it to areas of low risk by adopting a *sequential approach.* A developments vulnerability classification will define which flood zone it is permitted within, with only flood compatible development permitted in areas with a high probability of flooding, unless the development passes a justification test. This is to ensure that residual risks can be successfully managed and that there are no unacceptable impacts on adjacent land. The following indicators are typically used in assessing flood risk and are appropriate for site FRAs:

- Flood probability;
- Flood depth;
- Flood velocity;
- Rate and onset of flooding; and
- Development vulnerability.

4.29 Flood Risk Assessments are required to "*assess all types of flood risk for a new development. FRAs identify the sources of flood risk, the effects of climate change on this, the impact of the development, the effectiveness of flood mitigation and management measures and the residual risks that remain after those measures are put in place. Must be carried out in all areas where flood risk have been identified but level of detail will differ if SFRA at development plan level has been carried out."*[6]

4.30 An assessment of how surface water runoff will be managed should also be addressed within any FRA. Drainage is a material consideration at the planning stage of a development and due consideration must be given to the impact of the Proposed Development on the catchment area. This includes an assessment of potential for both flood risk and pollution. Surface water runoff may need to be assessed in all flood zones. The FRA should demonstrate that the

[5] Department of Environment, Heritage and Local Government (2009) *The Planning System and Flood Risk Management.* Available at: http://www.opw.ie/media/Planning%20System%20and%20Flood%20Risk%20Management%20Guidelines.pdf

[6] Department of Environment, Heritage and Local Government (2009) The Planning System and Flood Risk Management. Available at: http://www.opw.ie/media/Planning%20System%20and%20Flood%20Risk%20Management%20Guidelines.pdf

surface water drainage system takes account of Sustainable Drainage Systems (SuDS) principles.

4.31 In the FRM Guidelines, the likelihood of a flood occurring is established through the identification of Flood Zones which indicate a high, moderate or low risk of flooding from fluvial or tidal sources, as defined as follows:

- *Flood Zone A* - Where the probability of flooding is highest (greater than 1% Annual Exceedance Probability (AEP) or 1 in 100 for river flooding and 0.5% AEP or 1 in 200 for coastal flooding) and where a wide range of receptors would be vulnerable;
- *Flood Zone B* - Where the probability of flooding is moderate (between 0.1% AEP or 1 in 1000 and 1% AEP or 1 in 100 for river flooding and between 0.1% AEP or 1 in 1000 year and 0.5% AEP or 1 in 200 for coastal flooding); and
- *Flood Zone C* - Where the probability of flooding is low (less than 0.1% AEP or 1 in 1000 for both river and coastal flooding).

4.32 The FRM Guidelines provide three land-use vulnerability categories, based on the type of proposed development, which are detailed as follow:

- Highly vulnerable development, which include:
  - Garda, ambulance and fire stations and command centres required to be operational during flooding;
  - Hospitals;
  - Emergency access and egress points;
  - Schools;
  - Dwelling houses, student halls of residence and hostels;
  - Residential institutions such as residential care homes, children's homes and social services homes;
  - Caravans and mobile home parks;
  - Dwelling houses designed, constructed or adapted for the elderly or other people with impaired mobility; and
  - Essential infrastructure, such as primary transport and utilities distribution, including electricity generating power stations and sub-stations, water and sewage treatment,

and potential significant sources of pollution (SEVESO sites, IPPC sites, etc.), in the event of flooding.

- Less vulnerable development, which include:
  - Buildings used for: retail, leisure, warehousing, commercial, industrial and non-residential institutions;
  - Land and buildings used for holiday or short-let caravans and camping, subject to specific warning and evacuation plans;
  - Land and buildings used for agriculture and forestry;
  - Waste treatment (except landfill and hazardous waste);
  - Mineral working and processing; and
  - Local transport infrastructure.
- Water compatible development, which include:
  - Flood control infrastructure;
  - Docks, marinas and wharves;
  - Navigation facilities;
  - Ship building, repairing and dismantling, dockside fish processing and refrigeration and compatible activities requiring a waterside location;
  - Water-based recreationand tourism (excluding sleeping accommodation);
  - Lifeguard and coastguard stations;
  - Amenity open space, outdoor sports and recreation and essential facilities such as changing rooms; and
  - Essential ancillary sleeping or residential accommodation for staff required by uses in this category (subject to a specific warning and evacuation plan).

Table 4 - 2: Matrix of Vulnerability versus Flood Zone

| 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 |

4.33 Where proposed development requires a Justification Test, this must be undertaken to determine if the development can be justified.

4.34 The Justification Test has been designed to assess the appropriateness of such developments. The test is comprised of two processes: The Plan-making Justification Test and the Development Management Justification Test. The latter is used at the planning application stage where it is intended to develop land that is at moderate or high risk of flooding for uses or development vulnerable to flooding that would generally be considered inappropriate for that land.

4.35 The FRM Guidelines recommend a staged approach to flood risk assessment. The stages of appraisal and assessment are as follows:

- Stage 1 Flood Risk Identification: *"to identify whether there may be any flooding or surface water management issues related to a plan area or proposed development site that may warrant further investigation."*
- Stage 2 Initial Flood Risk Assessment: "*to confirm sources of flooding that may affect a plan area or proposed development site, to appraise the adequacy of existing information and to determine what surveys and modelling approach is appropriate to match the spatial resolution required and complexity of the flood risk issues. The extent of the risk of flooding should be assessed which may involve preparing indicative flood zone maps. Where existing river or coastal models exist, these should be used broadly to assess the extent of the risk of flooding and potential impact of a development on flooding elsewhere and of the scope of possible mitigation measures*"; and
- Stage 3 Detailed Flood Risk Assessment: *"to assess flood risk issues in sufficient detail and to provide a quantitative appraisal of potential flood risk to a proposed or existing*

*development, of its potential impact on flood risk elsewhere and of the effectiveness of any proposed mitigation measures. This will typically involve use of an existing or construction of a hydraulic model of the river or coastal cell across a wide enough area to appreciate the catchment wide impacts and hydrological processes involved."*

4.36 This report contains the first stage of the flood risk assessment, 'Stage 1 – Flood Risk Identification', in accordance with the FRM Guidelines. The basic requirements for a FRA are outlined within the FRM Guidelines as follows:

- An examination of the current and historical drainage patterns;
- A concept drawing of the development proposal;
- A brief summary of how the drainage design provides SuDS techniques or complies with any drainage strategy for the area identified in the SFRA;
- Summary of SuDS to be incorporated;
- The soil classification for the site; and
- Calculations showing the pre-development peak runoff flow rate for the critical rainfall event and the storage volumes to restrict the runoff to greenfield levels.

4.37 A site walkover survey was also undertaken in order to identify hydrological, geological, flood risk and drainage features within the Proposed Substation Site.

# BASELINE CONDITIONS

4.38 This section presents the information gathered on the existing topographical, geological, hydrological and hydrogeological conditions of the Proposed Substation Site and its immediate surroundings.

## Topography

4.39 A topographical survey was undertaken at the Proposed Substation Site (see **Figure 4.2: Appendix 4A**). The lowest point within the Substation Site of 71.43m AOD is in the southwest corner of the Proposed Substation Site. The high point at 74.62m AOD is in the northeast corner of the Proposed Substation Site. Generally, the Proposed Substation Site slopes gently to the southwest.

## Geology & Soil

4.40 The geological conditions of the Proposed Substation Site were identified utilising the Geological Survey of Ireland ("GSI") Spatial Resources online geological mapping[7] system. It is underlain by Lucan Formation. Lucan Formation consists of dark limestone & shale (`calp); with a thickness ranging from 300m to 800m.

4.41 No boreholes were found within the Proposed Substation Site area.

### Geo-Hazards

4.42 According to the GSI on-line mapping, the classification for landslide susceptibility for this site is **low** (D). There are presently no records of geo-hazards such as landslides within or in close proximity to the Proposed Substation Site.

### Geological Heritage

4.43 The GSI on-line mapping was reviewed to identify sites of geological heritage within the Proposed Substation Site and surrounding area. There is no evidence of any site in the immediate area of the Proposed Substation Site which could be considered suitable for protection.

[7] GSI Spatial Resources Online Map., Available at http://dcenr.maps.arcgis.com/apps/MapSeries/?appid=a30af518e87a4c0ab2fbde2aaac3c228

### Soil

4.44 Different soil types have different capabilities for absorbing water, the efficiency of which is dependent upon their structure and infiltration capacity. The GSI interactive map has been utilised to obtain Teagasc soil data. The Proposed Substation Site is underlain by Cut Peat.

4.45 According to the Wallingford Procedure 'Winter Rain Acceptance Potential' (WRAP) map[8], the soil classification for the site is Class 2. This soil class has a Standard Percentage Runoff (SPR) of 0.3 and should provide good infiltration.

## Hydrology

4.46 According to the Environmental Protection Agency (EPA) Map[9] the Proposed Substation Site and the surrounding area lies within Hydrometric Area No.25, Lower Shannon (Water Framework Directive) Catchment Area and within the Tullamore sub catchment 'SC_010'.

4.47 The Proposed Substation Site is contained within the Tullamore_030 river sub basin.

### Local River Network

4.48 The Ballyteige Little Watercourse starts in the southwest corner of the Proposed Substation Site and flows in a western direction before converging with the Wood of O Stream approximately 0.4km west of the Proposed Substation Site. This stream confluences with the Corndarragh Stream approximately 1.8km west of the Proposed Substation Site, and this then connects to the Tullamore River approximately 5km southwest of the Proposed Substation Site.

4.49 **Figure 4.1: Appendix 4A** shows these watercourses in relation the Proposed Substation Site.

### Internal Watercourses

4.50 Due to the relatively flat nature of the Proposed Substation Site, field drains bound most of the fields within the site to collect surface waters and convey to the Ballyteige Little Watercourse.

## Flood Zone Classification

4.51 In 2011, the OPW developed Preliminary Flood Risk Assessment (PFRA) maps as part of the National Catchment Flood Risk Assessment and Management (CFRAM) Programme to

[8] UK Sustainable Drainage and Guidance Tools. Greenfield Runoff Estimation for the Sites. Available at: http://www.uksuds.com/greenfieldrunoff_js.htm

9Environmental Protection Agency. EPA Map Viewer. Available at: http://gis.epa.ie/Envision

illustrate areas affected by flooding from pluvial and fluvial sources, as well as groundwater flood extents and identified areas that required further investigation. The Proposed Substation Site was not chosen as an area which required further investigation and therefore the PFRA and NIFM maps are the source which should define the flood zone.

4.52 The PFRA (**Appendix 4A: Figure 4.3**) and National Indicative Fluvial Mapping (NIFM) show that there is no risk of fluvial or coastal flooding within the Proposed Substation Site and therefore it is wholly contained within Flood Zone C.

## Historic Flooding

4.53 The National Flood Hazard Mapping[10] has identified one source of recurring flooding, approximately 0.8km north of the Proposed Substation Site, this is as a result of low-lying land and heavy rainfall. However, the council have since undertaken remedial works to alleviate the flooding. The Proposed Development will not increase flooding at this point as a drainage design will be included which will keep run off rates at greenfield levels.

4.54 The SFRA document has identified historic flood events within the town of Tullamore, approximately 5km west of the Proposed Development. However, none have been identified within close proximity to the Proposed Substation Site.

## Hydrogeology

4.55 According to the GSI map, the Proposed Substation Site lies within the Geashill Groundwater Body (GWB) [11]. This GWB is located centrally within County Offaly. Elevations range from 40m AOD along the Tullamore River, to 160m AOD along the southern boundary at the junction with the Clonaslee West GWB. The area is relatively flat lying with elevations reducing towards the northwest of the GWB.

4.56 According to the GSI the recharge mechanisms of this GWB are as follows:

*"Diffuse recharge will occur over the GWB via rainfall soaking through the subsoil only where subsoil is shallow or absent, or where subsoils are gravelly and high or moderate permeability. Thick, low permeability subsoils will cause rainfall to runoff, probably to another area within the GWB. In lowland areas where water tables are high, potential recharge may be rejected. A few swallow holes are known in the GWB; point recharge will occur via these features."*

4.57 The underlying bedrock aquifer at the Proposed Substation Site is considered by GSI to be locally important and covers an area of 280km$^2$.

[10] *OPW National Flood Hazard Mapping*. Available at: http://www.floods.ie/View/Default.aspx

[11] GSI. Lusk-Bog of the Ring GWB: Summary of Initial characterisation. Available at: https://secure.dccae.gov.ie/GSI_DOWNLOAD/Groundwater/Reports/GWB/LuskGWB.pdf

4.58 The Ballycommon groundwater well/spring is located circa 1km east of the Proposed Substation Site. This wasn't found during the site visit and the GSI buffer areas are only accurate to 1km. This site is for domestic use only and has a poor yield. The sensitivity of this area from impacts of contamination will be high. During the operational stage of the Proposed Development, there will be a **negligible risk of contamination** due to the nature of a substation. Any risks will come from the construction stage and an outline Construction and Environmental Management Plan (OCEMP) has been submitted alongside this application in order to reduce any potential impact on the environment during the construction and decommissioning phases of the Proposed Development (see **Technical Appendix 7**).

## Groundwater Vulnerability

4.59 Groundwater Vulnerability refers to the intrinsic geological and hydrogeological characteristics that determine the ease at which groundwater may be contaminated by human activities. The more vulnerable the groundwater is, the more easily it can be contaminated by surface water. The GSI Groundwater Vulnerability maps are based upon the type and thickness of subsoils, and the presence of karst features.

4.60 According to the GSI map, the groundwater vulnerability across the Proposed Substation Site is considered to be 'Moderate'. The subsoil permeability is classed as 'Moderate' which indicates its thickness of over 10m, according to **Table 4-3**.

Table 4 - 3: GSI Vulnerability Rating (Groundwater Protection Schemes, DELG/GSI/EPA, 1999[12])

| Vulnerability Rating | Hydrogeological Conditions | | | | |
|---|---|---|---|---|---|
| | Subsoil Permeability (Type and Thickness) | | | Unsaturated Zone | Karst Features |
| | High Permeability (sand/gravel) | Medium Permeability (sandy subsoil) | Low Permeability (Clayey subsoil, slay, peat) | (Sand/gravel aquifers only) | (<30m radius) |
| Extreme (E) | 0 – 3.0m | 0 – 3.0m | 0 – 3.0m | 0 – 3.0m | - |
| High (H) | >3.0m | 3.0 – 10.0m | 3.0 – 5.0m | >3.0m | N/A |
| Moderate (M) | N/A | >10.0m | 5.0 – 10.0m | N/A | N/A |

12 DELG. EPA/GSI (1999) Protection Schemes Guidelines. Available at: https://www.gsi.ie/Programmes/Groundwater/Projects/Protection+Schemes+Guidelines.htm

| | | | | | |
|---|---|---|---|---|---|
| Low (L) | N/A | N/A | >10.0m | N/A | N/A |

# FLOOD RISK ASSESSMENT

## Flooding Mechanisms

4.61 The FRM Guidelines state that the sequential approach is a key tool "*in ensuring that development, particularly new development, is first and foremost directed towards land that is at low risk of flooding.*"

### Fluvial and Coastal Flood Risk

4.62 The PFRA, NIFM and CFRAM flood maps flood maps present no areas within the Proposed Substation Site identified as being at risk of flooding from fluvial or coastal events and therefore the Proposed Substation Site is situated in 'Flood Zone C'.

4.63 The proposed type of development is specified as Highly Vulnerable Development category outlined in The Planning System and Flood Risk Management Guidelines. Using the matrix of vulnerability versus flood zone in Table 4-2, this type of development in this location is deemed appropriate.

### Pluvial Flood Risk

4.64 The FRA Guidelines further state the planning implications of development in each flood zone. For Flood Zone C, it states:

*"Development in this zone is appropriate from a flood risk perspective (subject to assessment of flood hazard from sources other than rivers and the coast) but would need to meet the normal range of other proper planning and sustainable development considerations".*

4.65 In addition to fluvial and coastal flood risk, the PFRA map (see Figure 4.3: Appendix 4A) also indicates areas of flood risk due to pluvial sources. This indicates no areas of pluvial flooding where the substation is to be located within the Proposed Substation Site. In addition, the topographical survey was analysed and due to the sloping land down to the watercourse, it is unlikely any surface water flooding will occur. There is a small area of pluvial flooding where HDD is proposed from the Derrygrogan Solar Farm, however this will be managed by only conducting the HDD when there is no forecast of rain.

### Groundwater Flood Risk

4.66 Groundwater flooding is a "hidden" risk that is often difficult to distinguish from other types of flooding. For example, rising groundwater often forms in low-lying areas which are also susceptible to the accumulation of surface water.

4.67 GSI developed groundwater flood maps for Ireland as part of the 2016-2019 GW Flood project[13]. This mapping does not show any groundwater flooding close to or within the Proposed Substation Site.

4.68 Local groundwater levels often respond to water levels within nearby watercourses. As there is little pluvial flood risk to the Proposed Substation Site, with pluvial flooding due to slight ponding at minor depressions on the ground, groundwater flooding is unlikely to be a significant risk.

4.69 Based on the above, the risk of flooding from groundwater for the part of the Proposed Substation Site outside the predicted floodplain is likely to be low.

## Sequential Approach Summary

4.70 The FRM Guidelines state that the sequential approach is a key tool "*in ensuring that development, particularly new development, is first and foremost directed towards land that is at low risk of flooding.*"

4.71 All essential infrastructure lies outside the flood extent, i.e. within the Flood Zone C area and therefore, the Proposed Development does not require a justification test. A Drainage Impact Assessment has been undertaken to propose a surface water management plan as per the sequential approach.

### Site Access Point

4.72 The access point will be the one used for the adjacent solar development (Planning Ref:2198), however the access will be slightly widened to facilitate the transformer deliveries however all surface water will be directed into the Proposed Substation Site as opposed to the public road network.

[13] GSI Groundwater Flood maps. Available at: https://www.floodinfo.ie/map/floodmaps/#

# DRAINAGE IMPACT ASSESSMENT

## Introduction

4.73 The Planning System and Flood Risk Management Guidelines[14] recognise that surface water arising from a developed site should, as far as is practicable, be managed to mimic the surface water flows arising from the site prior to the Proposed Development, while reducing the flood risk to the Proposed Substation Site itself and elsewhere.

## Methodology

### Catchment Characteristics

4.74 Catchment characteristics were obtained from HR Wallingford UK Sustainable Drainage Greenfield Runoff Estimation Tool and Surface Water storage tool.[15] Catchment sizes were measured using ArcGIS and catchment boundaries were produced based on the site-specific contours.

### Greenfield Runoff and Stormwater Storage

4.75 Greenfield runoff rates and stormwater storage requirements have been obtained using the following tools:

- HR Wallingford UK Sustainable Drainage Greenfield Runoff Estimation Tool (using IH124[16] methodology due to the small-scale nature of the catchment).
- Flow – Causeway Drainage design software (using IH124[17] methodology due to the small-scale nature of the catchment).
- The areas of permeable and impermeable surfaces have been estimated and are based upon the Proposed Development layout (**Figure 4 of Volume 2: Planning Application Drawings** for the layout of the Proposed Development).

[14] Department of the Environment, Heritage and Local Government (2009) *The Planning System and Flood Risk Management Guidelines for Planning Authorities.* Available at: http://www.environ.ie/sites/default/files/migrated-files/en/Publications/DevelopmentandHousing/Planning/FileDownLoad%2C21709%2Cen.pdf

[15] HR Wallingford. Available at: http://www.uksuds.com/drainage-calculation-tools/surface-water-storage

[16] Institute of Hydrology (1994). *Flood estimation for small catchments. Report No IH124*, Wallingford.

[17] Institute of Hydrology (1994). *Flood estimation for small catchments. Report No IH124*, Wallingford.

4.76 Where applicable, the surface water drainage criteria from the Greater Dublin Strategic Drainage Study (GDSDS)[18] was applied.

## Greenfield Runoff rates

4.77 The IH124 methodology is used for calculating the Greenfield runoff rates. This is recommended by the Institute of Hydrology for catchments below 200ha.[19]

4.78 The IH124 equation estimates Qbar with the following equation:

$$Qbar - rural = 0.00108\ x\ (0.01\ x\ AREA)0.89\ x\ SAAR1.17\ x\ SPR2.17, m3/s$$

where:

- Qbar-rural is the mean annual flood flow from a rural catchment (approximately 2-3-year return period).
- AREA is the area of the catchment in ha.
- SAAR is the standard average annual rainfall for the period 1961 to 1990, available from the Flood Studies Report.
- SPR is Standard Percentage Runoff coefficient for the SOIL category.

4.79 The GDSDS[20] states that the IH124 method is an accepted method used for determining peak flow rates for small catchments.

## Calculating storage estimates

4.80 The storage estimates are calculated using the inputs below:

- Return Period
- Climate Change
- Impermeable Area

[18] *Greater Dublin Strategic Drainage Study* (2005). Accessed at http://www.dublincity.ie/main-menu-services-water-waste-and-environment-drainage-services/new-development-policy

[19] Institute of Hydrology (1994). *Flood estimation for small catchments. Report No IH124*, Wallingford.

[20] Greater Dublin Strategic Drainage Study (2005). *Volume 2 Chapter 6 – Storm water Drainage Design*. Available at: http://www.dublincity.ie/sites/default/files/content//WaterWasteEnvironment/WasteWater/Drainage/GreaterDublinStrategicDrainageStudy/Documents/Vol%202%20-%20Chapter%206%20-%20Stormwater%20Drainage%20Design.pdf

- Peak Discharge

4.81 The return period and climate change are combined with the Flood Studies Report (FSR) parameters and storm durations to generate the rainfall used. The result from these calculations is that attenuation storage is required for the Proposed Substation Site due to the additional runoff generated by the Proposed Development.

## Site and Project Descriptions

4.82 The area of the substation compound is approximately 92.1m x 64.8m (Eirgrid) and 83.5m x 44.5m (Customer). The majority of the compound will be made up of crushed aggregate which will be compacted to create a surface, however, will still have permeable properties and rainwater will soak into the ground beneath at the same rate that it presently does. The access tracks within the Eirgrid substation compound will be made up of concrete and have been included within the table below.

4.83 The main areas of impermeable development are outlined within **Table 4-4**, however there are other small areas of impermeable development which are much smaller areas and wouldn't require being included in the formal drainage regime. To cater for these areas, a betterment factor of 20% has been included in the calculations.

Table 4 - 4: Extent of less permeable areas created by the Proposed Development

| Building | Total Area ($m^2$) |
|---|---|
| 1 x Transformer Station and Fire Wall (Abnormal Shape) | 295.3 |
| 1 x Eirgrid Substation (25.0m x 18.0m) | 450.0 |
| 2 x IPP Switchroom (19.5m x 6.5m) | 253.5 |
| Eirgrid Substation Concrete Access Tracks | 346.8 |
| 2 x Harmonic Filter (6.6m x 3.4m) | 44.9 |
| 1 x Toilet (2.0m x 3.8m) | 7.6 |
| 2 x Grid Code Compliance (6.9m x 3.3m) | 45.5 |
| Total Impermeable Area | 1443.6 |
| Site Area ($m^2$) | 111,664.6 |

4.84 In its current greenfield state, the Proposed Substation Site is considered to be 100% undeveloped. As a result of the Proposed Development, the extent of hardstanding introduced will be approximately 1443.6m$^2$ or 1.3% of the total site area.

## Existing Drainage Arrangements

### Existing Runoff Rates

4.85 The existing runoff rates and hydrological characteristics of the Proposed Development are detailed in **Table 4-5** below (there are no hardstanding areas on the site at present).

Table 4 - 5: Pre-Development Greenfield runoff rates.

| Site Make Up | Green Field |
|---|---|
| Greenfield Method | IH124 |
| Positively Drained Area (ha) | 0.144 |
| SAAR (mm) | 1074 |
| Soil Index | 2 |
| Standard Percentage Runoff | 0.3 |
| Region | Ireland |
| | **Runoff rate (l/s)** |
| QBar | 0.4 |
| 1 year | 0.3 |
| 1 in 30 year | 0.7 |
| 1 in 100 year | 0.9 |

4.86 The limiting discharge rate will be the QBar greenfield rate, as detailed in **Table 4-5**. The proposal is for infiltration drainage with no discharge; however, this will be confirmed post consent once infiltration testing has been undertaken.

### Post Development Runoff Rate

4.87 The surface water runoff rate resulting from the Proposed Development has been based on the areas of hardstanding introduced, which will have a lower permeability than the existing greenfield composition.

4.88 Surface water runoff was derived using the Modified Rational Method as outlined within the methodology.

4.89 Using this approach, the runoff rate for the 1-in-100-year, 360-minute storm event, inclusive of the 20% climate change allowance would be **27m³**if left unmanaged.

## Proposed Drainage Arrangements

4.90 The SuDS Manual[21] is the current best practice guidance on the use of SuDS. It promotes the use of a hierarchical approach to managing runoff. This approach is outlined below:

- 1. Prevention - Preventing runoff by reducing impermeable areas.
- 2. Source Control - Effective control of runoff at or very near its source.
- 3. Site Control- Planned management of water in a local area or site.
- 4. Regional Control - Designing a system that can efficiently manage the runoff from a site, or several sites.

4.91 The use of SuDS is generally accepted to have greater benefits than conventional drainage systems and these include:[22]

- Manage runoff volumes and flow rates from hard surfaces, reducing the impact of urbanisation on flooding
- Provide opportunities for using runoff where it falls
- Protect or enhance water quality (reducing pollution from runoff)
- Protect natural flow regimes in watercourses
- Are sympathetic to the environment and the needs of the local community

21 CIRIA (2015). Report C753, The SuDS Manual

22 Susdrain. Sustainable drainage. Accessed http://www.susdrain.org/delivering-suds/using-suds/background/sustainable-drainage.html

- Provide an attractive habitat for wildlife in urban watercourses
- Provide opportunities for evapotranspiration from vegetation and surface water
- Encourage natural groundwater/aquifer recharge (where appropriate)

4.92 The surface water drainage strategy for the Proposed Development seeks to provide a sustainable and integrated surface water management scheme for the whole Proposed Substation Site and aims to ensure no increase in downstream flood risk by managing discharges from the Proposed Development to the local water environment in a controlled manner.

4.93 To comply with current policies, guidance and best practice, the volume and quality of surface water runoff discharged off-site from the Proposed Development at this Proposed Substation Site will need to be controlled using SuDS.

4.94 In compliance with the above, the drainage strategy has been developed to meet the following key principles;

- Mimic existing (greenfield) drainage arrangements as far as possible;
- Avoid increases in the greenfield rate, volume and frequency of offsite discharge;
- Avoid significant deterioration in water quality of discharges and no detrimental impact in downstream water quality;
- Achieve the above criteria for all storms up to and including the 100-year event; and
- Incorporate an allowance for climate change (20%).

## Indicative Surface Water Storage Requirements

4.95 Indicative storm water storage volumes have been estimated using Causeway's Drainage Design Flow software. The storage calculations include up to the critical storm 100-year return period event (including a 20% allowance for climate change) and the design limits discharge rates back to greenfield runoff rates. The results are enclosed in **Appendix 4B.** These are estimated from the new surfaces added to the Proposed Development.

- Attenuation storage limits the rate of surface runoff discharge from the Proposed Development to match the pre-development greenfield runoff rates;
- All storage calculations have been given a climate change allowance factor of 20% that has been added to the rain depths.
- A betterment allowance of 20% has been included.

Table 4 - 6: Storage Estimates

| Storage Estimates | |
|---|---|
| Return Period (years) | 100 years |
| Climate Change (%) | 20 |
| Impermeable Area (ha) | 0.144 |
| Peak Discharge (l/s) | 0.400 |
| **Total storage Requirement ($m^3$)** | $111m^3$ |

### Proposed Drainage Strategy

4.96 It is proposed to construct a network of rainwater harvesting tanks and two soakaway pits/infiltration drains within the Proposed Substation Site. The idea is to capture any overland flow in the SuDS device before infiltrating into the surrounding soils.

4.97 The underground piped system connect the Eirgrid building and IPP switchrooms to rainwater harvesting tanks, which overflow into soakaway pits/infiltration drains. As the transformers will hold a volume of oil, the system will include a class 1 full retention separator. The soakaway pits and rainwater harvesting tanks will be designed to hold a total volume of $111m^3$ with the detailed design of the structure being submitted to the council for review prior to the construction period.

4.98 A permanent toilet is proposed within the Eirgrid building and IPP compound and will be utilised by maintenance staff of substation. Each toilet will be off grid toilet with a foul holding tank which will be emptied when required by an approved contractor.

4.99 Additional drainage measures to be implemented on-site include the following:

- Laydown areas: Laydown areas are to be unpaved and constructed from local stone. Temporary swales or similar shall be utilised to collect runoff from access tracks with discharge to ground through percolation areas. Where swales are utilised, frequent checks of dams formed from gravels and other excavated material should be undertaken.

## Designing for Exceedance Events

4.100 Overland flow routes will not be altered by the construction of the Proposed Development as it is not proposed to significantly vary ground levels. The outline drainage design has been

designed so that flooding will not occur for up to and including the 1-in-100-year storm event (including 20% climate change consideration).

4.101 Should an exceedance of this 1 in 100-year critical storm event occur, surface water will flow the same way as at present, into the surrounding fields. There are no sensitive receptors near to the SuDS schemes and therefore it is unlikely that any would be affected in an exceedance event.

## Long Term Maintenance of SuDS

4.102 The long-term management and maintenance of the proposed SuDS will be the responsibility of the site owner and/or operators. These responsibilities include:

### Soakaway Pits

- Litter/debris removal
- Grass cutting and removal of cuttings
- Clearing of inlets, culverts and outlets from debris and sediment
- Repair of eroded or damaged areas.

# SUMMARY & CONCLUSIONS

4.103 The FRA and DIA requirements are set out by the Department of Environment, Heritage and Local Government in 'The Planning System and Flood Risk Management Guidelines for Planning Authorities' document.

4.104 The Guidance aims to avoid inappropriate development in flood zones and instead direct it to areas of low risk by adopting a sequential approach.

4.105 The PFRA, NIFM and CFRAM flood maps flood maps present no areas within the Proposed Substation Site identified as being at risk of flooding from fluvial or coastal events and therefore the Proposed Substation Site is situated in 'Flood Zone C'.

4.106 The proposed type of development is specified as Highly Vulnerable Development category outlined in The Planning System and Flood Risk Management Guidelines. The access track can be classed as 'Water Compatible Development', whilst the substation has been classed as 'Highly Vulnerable Development'. Both are appropriate for Flood Zone C.

4.107 In addition to fluvial and coastal flood risk, the PFRA map also indicates areas of flood risk due to pluvial sources. This indicates no areas of pluvial flooding within the substation area of the Proposed Substation Site. In addition, the topographical survey was analysed and due to the sloping land down to the watercourse, it is unlikely any surface water flooding will occur. There is a small area of pluvial flooding where HDD is proposed from the Derrygrogan Solar Farm, however this will be managed by only conducting the HDD when there is no forecast of rain.

4.108 It is proposed to construct a network of rainwater harvesting tanks and two soakaway pits/infiltration drains within the Proposed Substation Site. The idea is to capture any overland flow in the SuDS device before infiltrating into the surrounding soils.

4.109 The underground piped system connects the Eirgrid building and IPP switchroom to rainwater harvesting tanks, which overflow into soakaway pits/infiltration drains. As the transformer will hold a volume of oil, the system will include a class 1 full retention separator. The soakaway pits/infiltration drains and rainwater harvesting tanks will be designed to hold a total volume of 111m$^3$ with the detailed design of the structure being submitted to the council for review prior to the construction period.

4.110 A permanent toilet is proposed within the Eirgrid building and IPP switchrooms and will be utilised by maintenance staff of substation. Each toilet will be off grid toilet with a foul holding tank which will be emptied when required by an approved contractor.

4.111 Additional drainage measures to be implemented on-site include the following:

- Laydown areas: laydown areas are to be unpaved and constructed from local stone. Temporary swales or similar shall be utilised to collect runoff from access tracks with

discharge to ground through percolation areas. Where swales are utilised, frequent checks of dams formed from gravels and other excavated material should be undertaken.

4.112 The FRA and DIA have therefore demonstrated that the Proposed Development will **not increase flood risk** away from the Proposed Substation Site during the construction, operation and decommissioning phases. The Proposed Development is therefore considered to be acceptable in planning policy terms.

# APPENDICES

## Appendix 4A: Figures

- Figure 4.1: Watercourses and Photo Locations
- Figure 4.2: Topographical Survey
- Figure 4.3: Preliminary Flood Risk Assessment (PFRA) Map
- Figure 4.4: Outline SuDS Design

## Appendix 4B: Flow Output


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