Appendix 8 Flood Risk Assessment

Howpark Solar Farm

Eurowind Energy Limited

SLR Project No.: 428.V64539.00001

Howpark Solar Farm

Flood Risk Assessment

Eurowind Energy Limited

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SLR Project No.: 428.V64539.00001

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Basis of Report

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1.0 Introduction

SLR Consulting has been appointed by Eurowind Energy Limited to provide a Flood Risk Assessment to support a planning application for a proposed solar farm development on land to the south of Howpark Wind Farm in the Scottish Borders ("the Site").

The assessment should be read in conjunction with the Planning, Design and Access Statement which includes a detailed description of the proposed development. Figure 1 which accompanies the Planning, Design and Access Statement shows the site location and Figure 2 shows the site layout plan.

1.1 Policy and Guidance

This assessment has been completed in accordance with guidance presented in *Scottish Borders Council's Local Development Plan*. It takes cognisance of *National Planning Framework 4 (NPF4)*[1] and the *Flood Risk Management (Scotland) Act 2009*.

The assessment also references and takes due consideration (where appropriate) of the following principal guidance and policy documents:

- British Standards Institution (2017) Assessing and Managing Flood Risk in Development – Code of Practice, Report BS-8533:2017, December 2017;
- CIRIA (2004) Development and Flood Risk – Guidance for the Construction Industry, Report C624;
- SEPA (2019) Technical Flood Risk Guidance for Stakeholders (Reference: SS-NFR-P-002) May 2019.

1.2 Site Location and Access

The proposed development is located on a parcel of agricultural land which covers four separate field boundaries to the south of Howpark Wind Farm, approximately 2.3km north east of Grantshouse. Access to the Site is afforded from the A1 via an access track which leads directly up towards the proposed development area.

The Site is bound by agricultural land, predominantly arable farming, to the south and west. Howpark Wind Farm bounds the Site to the north, woodland scrub and a caravan park bounds the Site to the east.

A Site location plan is provided as Drawing 01.

1.3 Proposed Development

The proposed development layout is provided in Appendix 01, which identifies two separate areas of the solar photo-voltaic (PV) array that have a combined pitch area of around 16ha. The area for development is generally in the south and western extents of the Site (including arrays and electrical infrastructure).

The solar PV generating station is expected to have an installed capacity of up to 15MW of electricity (Direct Current [DC]) using up to 25,500 PV modules. The PV modules would be arranged in a series of arrays running north to south across the Site and angled to maximise the capture of solar energy. The PV modules would be bolt anchored to a metal frame ('table'), which would be mounted on steel posts driven or screwed into the ground, to a

[1] The Scottish Government (2023) National Planning Framework 4, February 2023

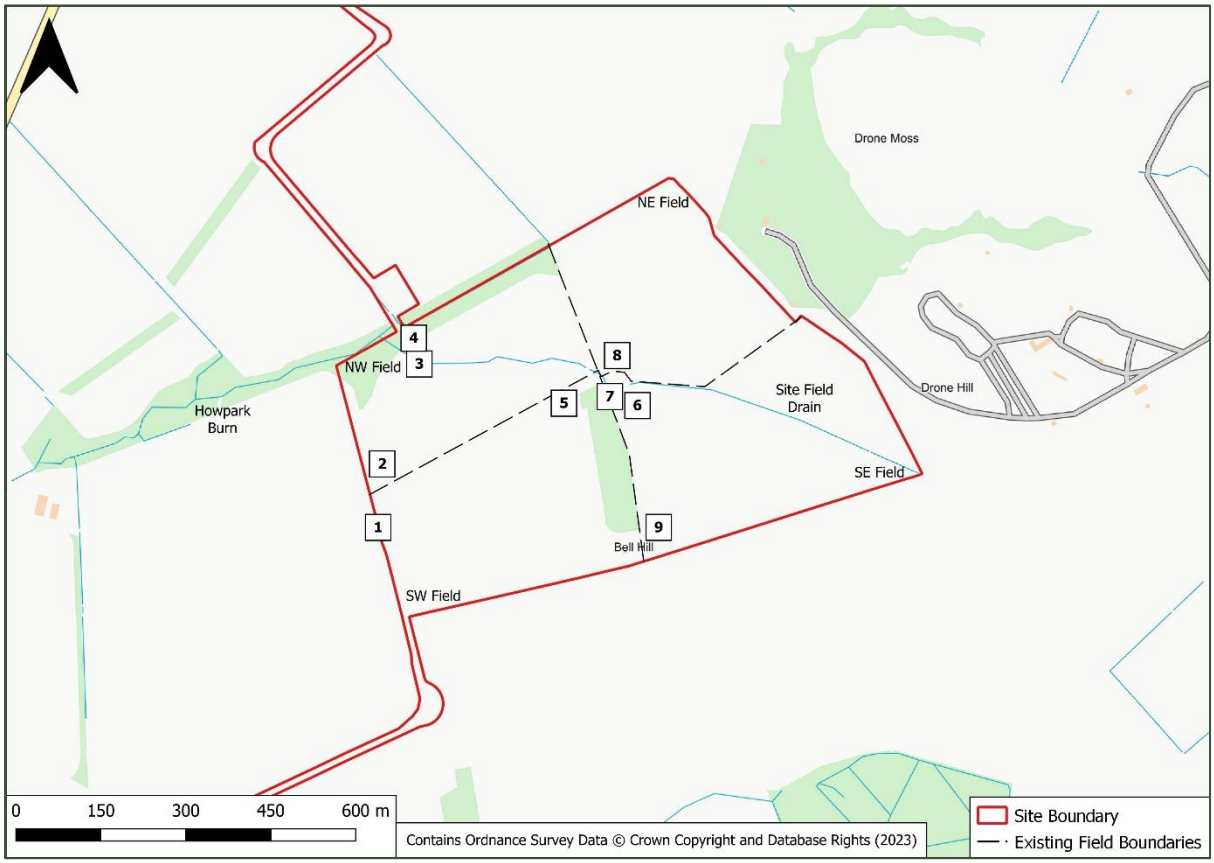
typical depth of 1-3m depending on ground conditions. The base of the PV module is typically raised at least 0.5m above the external ground level.

1.4 Existing Site and Terrain

A Site walkover was undertaken on the 26th July 2022 which supplements the findings of this report.

In the following Site description, reference can be made to the included photographs taken during the Site visit. For ease of reference, the location of these photographs is shown on Figure 1-1.

Figure 1-1: Photograph Locations

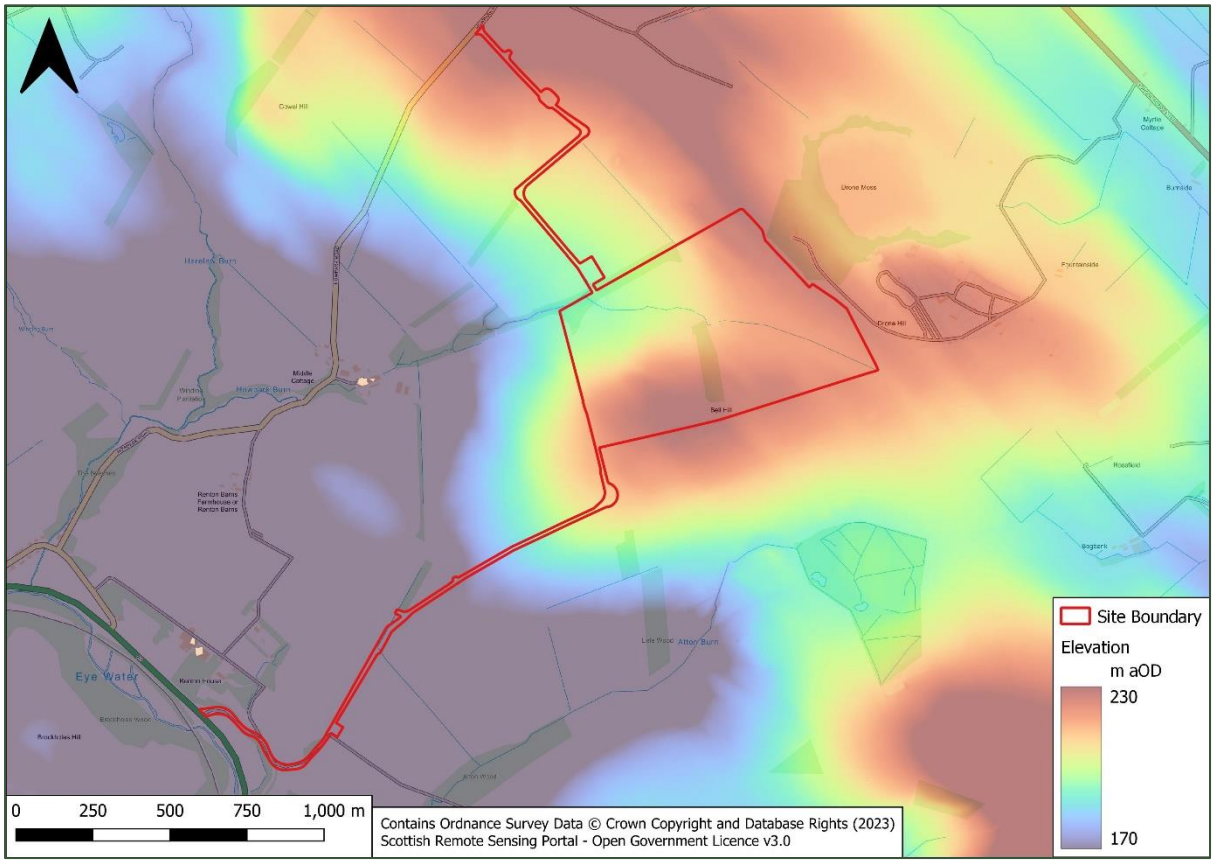


LiDAR data for the Site has been downloaded from the Scottish Remote Sensing Portal[2] and is presented on

Figure 1-2. This elevation data uses a 0.5m Digital Terrain Model (DTM) which is a bare earth model and therefore excludes built features and vegetation.

[2] Scottish Remote Sensing Portal, Scottish Government, https://remotesensingdata.gov.scot/data#/map

Figure 1-2: 0.5m DTM LiDAR Plot of the Site



Ground levels on the Site vary between 190m above Ordnance Datum (aOD) in the north west and 232m aOD in the south west. Topography is undulating with elevation generally falling towards a field drain in the centre of the Site (or its infilled channel) and Howpark Burn to the north west. Bell Hill is a circular hill crest formation present in the south western Site which is elevated at around 232m aOD (Photograph 1). Ground levels from the peak therefore fall in all directions, either towards the field drain and Howpark Burn, or west and south away from the Site.

The field drain flows in a north westerly direction through the south eastern field and discharges into a heavily vegetated pond in the centre of the Site (Photograph 6). The field drain into the pond has a very small upgradient catchment area, which is estimated to extend to approximately 0.17km^2 and largely limited to the Site itself.

OS mapping indicates flows from the pond discharge overland in a north westerly direction towards Howpark Burn. In reality, flows discharging from the pond flow in the channel for a short reach but are then culverted beneath the north western field for an approximate length of 360m. There are two culverts at the outfall into Howpark Burn which appears to convey flows from the upgradient drain. These comprise of concrete and corrugated plastic and measured at 300mm and 225mm diameter respectively. During the walkover the culverts were conveying very minimal flows (Photograph 3 and Photograph 4).

The majority of the Site is located in the Eye Water (Source to Ale Water Confluence) surface water catchment, which flows in a south easterly direction immediately west of the A1, approximately 1.56km from the proposed development area.

A small area along the eastern Site boundary falls within the Ale Water surface water catchment area. Ale water is formed from a number of small watercourses north east of the Site which join at a confluence some 3km south east. Ale Water flows in a south eastern

direction discharging into Eye Water near Eyemouth approximately 10.3km south east of the Site.

Photograph 1: View of Bell Hill facing South

Photograph 2: View from North West Field facing North East

Photograph 3: Culvert Outfall of Field Drain Facing South East

Photograph 4: View of Field Drain discharging towards Howpark Burn facing North

Photograph 5: View from Central Site facing West

Photograph 6: View of Pond facing North

Photograph 7: Field Drain Channel facing South at Pond

Photograph 8: View of North Eastern Field facing North

Photograph 9: View of South Eastern Field facing East

1.5 Geotechnical Setting

A review of the British Geological Survey (BGS) Onshore Geoindex[3] data (1:50,000 scale Bedrock Geology, Superficial Deposits, Linear Features, Artificial Ground and Borehole Records) highlights the following:

- the Site is underlain by sedimentary strata termed the Gala Group (wacke sandstone, mudstone and siltstone);
- bedrock geology is exposed across Bell Hill and much of the south western and eastern boundary Site;
- superficial deposits, where present, largely comprise of till deposits (diamicton) with alluvium (sand, silt and gravel) noted along the banks of the open field drain within the south eastern extent of the Site.

1.6 Historical Land Use

A review of the earliest available historical mapping[4] dating from the late 19th century indicates that at the time the Site was located in agricultural fields, similar to present day conditions.

[3] BGS Onshore Geoindex available online at http://mapapps2.bgs.ac.uk/geoindex/home.html last accessed 25/08/22

[4] National Library of Scotland georeferenced maps available online at https://maps.nls.uk/ last accessed 25/08/2022

1.7 Flood Risk Terminology

Probabilistic flood risks are typically expressed by the probability of the occurrence of a flood event (maximum flood height or other such indicator) of stated magnitude or greater in any one year – termed the Annual Exceedance Probability (AEP). This may be expressed as a percentage (such as 1%, 0.5%, etc.) of the equivalent chance of occurrence (1:100, 1:200, etc.). For convenience, the latter approach is used in this report.

Where flood events have a Climate Change factor included, the flood event is denoted in this report by "+CC". For example, the 1:200 AEP flood event with Climate Change included is denoted "1:200+CC".

2.0 Flood Risk Review – Source of Information

2.1 National Floodplain Mapping and Risk Assessment

Strategic level information regarding the current flood risk at the Site has been obtained from SEPA via the online Indicative Flood Map[5].

2.2 Mapping and Terrain Data

Aerial imagery, the Site walkover and publicly available topographic LiDAR data referred to above have been used to assess the context of the application Site and its immediate surroundings.

2.3 Planning Considerations

The relevant sections of National Planning Framework 4 (NPF4) and the current Local Plan (Scottish Borders Local Development Plan 2016) have been reviewed to inform this assessment.

2.4 Flood History and Records

There are no internet records of fluvial flooding in this area. With reference to the Fourth Estuary Flood Risk Management Plan, the Site is not located within a Potentially Vulnerable Area (PVA) with regards to flood risk.

3.0 Planning Context

3.1 National Planning Framework 4

National Planning Framework 4 (NPF4) was introduced in February 2023 and supersedes National Planning Framework 3 (NPF3) and Scottish Planning Policy (SPP) 2014. Flood risk is addressed in Policy 22 of NPF4, which states the following:

a) Development proposals at risk of flooding or in a flood risk area will only be supported if they are for:

i. essential infrastructure where the location is required for operational reasons;

ii. water compatible uses;

[5] Scottish Environment Protection Agency (2016) Online Interactive Flood Map Tool, available at https://map.sepa.org.uk/floodmap/map.htm, last accessed 26/08/2022.

iii. redevelopment of an existing building or site for an equal or less vulnerable use; or.

iv. redevelopment of previously used sites in built up areas where the LDP has identified a need to bring these into positive use and where proposals demonstrate that long term safety and resilience can be secured in accordance with relevant SEPA advice.

The protection offered by an existing formal flood protection scheme or one under construction can be taken into account when determining flood risk. In such cases, it will be demonstrated by the applicant that:

- *all risks of flooding are understood and addressed;*
- *there is no reduction in floodplain capacity, increased risk for others, or a need for future flood protection schemes;*
- *the development remains safe and operational during floods;*
- *flood resistant and resilient materials and construction methods are used; and*
- *future adaptations can be made to accommodate the effects of climate change.*

Additionally, for development proposals meeting criteria part iv), where flood risk is managed at the site rather than avoided these will also require:

- *the first occupied/utilised floor, and the underside of the development if relevant, to be above the flood risk level and have an additional allowance for freeboard; and*
- *that the proposal does not create an island of development and that safe access/ egress can be achieved.*

b) Small scale extensions and alterations to existing buildings will only be supported where they will not significantly increase flood risk.

c) Development proposals will:

i. not increase the risk of surface water flooding to others, or itself be at risk.

ii. manage all rain and surface water through sustainable urban drainage systems (SUDS), which should form part of and integrate with proposed and existing blue green infrastructure. All proposals should presume no surface water connection to the combined sewer;

iii. seek to minimise the area of impermeable surface.

d) Development proposals will be supported if they can be connected to the public water mains. If connection is not feasible, the applicant will need to demonstrate that water for drinking water purposes will be sourced from a sustainable water source that is resilient to periods of water scarcity.

e) Development proposals which create, expand or enhance opportunities for natural flood risk management, including blue and green infrastructure, will be supported.

NPF4 defines an area at risk of flooding as follows:

For planning purposes, at risk of flooding or in a flood risk area means land or built form with an annual probability of being flooded of greater than 0.5% (1:200 AEP) which must include an appropriate allowance for future climate change.

This risk of flooding is indicated on SEPA's future flood maps or may need to be assessed in a flood risk assessment. An appropriate allowance for climate change should be taken from the latest available guidance and evidence available for application in Scotland. The

calculated risk of flooding can take account of any existing, formal flood protection schemes in determining the risk to the site.

Where the risk of flooding is less than this threshold, areas will not be considered 'at risk of flooding' for planning purposes, but this does not mean there is no risk at all, just that the risk is sufficiently low to be acceptable for the purpose of planning. This includes areas where the risk of flooding is reduced below this threshold due to a formal flood protection scheme.

3.2 Scottish Borders Council (SBC) Local Development Plan (2016)

Scottish Borders Council (SBC) Local Development Plan[6] sets out the Council's land use strategy and provides the basis for assessing planning applications in the area.

Within the Local Development Plan, there are several policies that provide general reference to the consideration of flooding:

Policy EP15: Development Affecting the Water Environment

Development proposals that seek to bring improvement to the quality of the water environment will be supported. Where a proposal would result in significant adverse effect on the water environment through impact on its natural or physical characteristics, or its use for recreation or existing river engineering works, it will be refused. Decision making will be guided by an assessment of:

a) pollution of surface or underground water, including water supply catchment areas, as a result of the nature of any surface or waste water discharge or leachate, including from the disturbance of contaminated land;
b) flood risk within the Site or wider river catchment;
c) proposals for river engineering works that may be required for fisheries management, flood defences or erosion control;
d) compliance with current best practice on Sustainable Urban Drainage (SUDS) including avoidance of flooding, pollution, extensive canalisation and culverting of watercourses.

Policy IS8: Flooding

At all times, avoidance will be the first principal of managing flood risk. In general terms, new development should therefore be located in areas free from significant flood risk. Development will not be permitted if it would be at significant risk of flooding from any source or would materially increase the probability of flooding elsewhere. The ability of functional flood plains to convey and store floodwater should be protected, and development should be located away from them.

Within certain defined risk categories, particularly where the risk is greater than 0.5% annual flooding probability of 1 in 200 year flood risk, some forms of development will generally not be acceptable. These include:

a) development comprising essential civil infrastructure such as hospitals, fire stations, emergency depots etc. schools, care homes, ground-based electrical and telecommunications equipment unless subject to an appropriate long term flood risk management strategy;
b) additional built development in undeveloped and sparsely developed areas.

[6] Scottish Borders Local Development Plan, Scottish Borders Council, Adopted May 2016

Other forms of development will be subject to an assessment of the risk and mitigation measures.

Developers will be required to provide, including if necessary at planning permission in principal stage:

a) a competent flood risk assessment, including all sources of flooding, and taking account of climate change; and
b) a report of the measures that are proposed to mitigate the flood risk

The information used to assess the acceptability of development will include:

a) information and advice from consultation with the council's flood team and the Scottish Environment Protection Agency;
b) flood risk maps provided by the Scottish Environment Protection Agency which indicate the extent of the flood plain;
c) historical records and flood studies held by the council and other agencies, including past flood risk assessment reports carried out by consultants and associated comments from SEPA, also held by the council;
d) SEPA's Land Use Vulnerability Guidance

4.0 Flood Risk Screening

A screening assessment has been undertaken at the Site to identify whether there are any potential sources of flooding that warrant detailed assessment and further mitigation.

A summary of the potential sources of flooding and a review of the potential risks posed by each source to the Site is summarised in Table 4-1.

Table 4-1: Flood Risk Screening

Source of Flood Risk	Description	Flood Risk Assessment
Tidal	• The Site is remote from the coast and situated at an elevation of at least 190m aOD. • SEPA flood mapping indicates that the Site is not at risk from coastal flooding. • It is therefore considered that the Site is not at tidal flood risk.	Negligible Risk
Fluvial	• A field drain flows through the centre of the Site in a north westerly direction to discharge into Howpark Burn along the north western Site boundary. • SEPA flood mapping indicates that Site is not at risk from fluvial flooding for any of the modelled flood events. • Areas of higher flood risk are noted in SEPA flood mapping along Howpark Burn to the west of the Site, approximately 1.3km downstream of the confluence with the on-site field drain. • The mapping provided by SEPA assumes that the on-site drain is free flowing and not constricted. In reality, the drain downstream of the central pond flows through two culverts in parallel (300mm and 225mm in diameter) before re-opening in the north western part of the Site. There is therefore potential for flows to back up into the catchment when the culverts become surcharged. • Using an estimated catchment area of 0.17km^2 and the ReFH2 Method[7], approximately 366l/s of flow in this watercourse is expected in a 200-year rainfall event plus 39% climate change uplift (peak rainfall intensity uplift for the Forth catchment) and 383l/s during a 1000-year event. • The Hazen-Williams equation can be used to estimate the flow capacity of a culvert / pipe system. Using an estimated slope of 0.042, as well as the pipe construction and diameter (concrete at 300mm diameter; corrugated plastic at 225mm diameter), the maximum flow capacity through the 300mm culvert is calculated at 212l/s, and 129l/s for the 225mm diameter culvert[8]. As there are some assumptions with this equation, it cannot be explicitly stated that the calculated values of flow through the pipe are exact. However, using these flow estimations there is not sufficient capacity within the system (341l/s) to convey all flows for events up to and including 1000-years (383l/s). • The field drain on Site is culverted between the pond and its confluence with Howpark Burn. Analysis of these culverts detailed in the fluvial flood risk section demonstrates sufficient capacity	Negligible Risk

[7] Environment Agency, Estimating flood peaks and hydrographs for small catchments: Phase 1, Project: SC090031, May 2012

[8] Using a roughness coefficient of 100 for the concrete culvert, and 130 for the corrugated plastic culvert.

Source of Flood Risk	Description	Flood Risk Assessment
	within the system to convey flows for all rainfall events up to and including the 200-year event plus 39% climate change. • Flooding from this culvert could therefore occur during extreme rainfall scenarios where the flow capacity in the culvert is exceeded or in the incident of blockage, both of which would result in flood water backing up into the upgradient catchment. A flood level of around 209m aOD would be required for flows to overtop the culvert and discharge downstream, following the original course of the channel in a north westerly direction to the confluence. • No development is proposed along the original course of the channel which may be flooded / convey flows during a blockage event. Similarly, development upgradient of the culvert is raised above the design flood level of 209m aOD, and therefore would remain flood free. • The risk of flooding from fluvial sources is therefore very low.	
Pluvial (i.e. direct rainfall)	• The Site is located in agricultural fields on sloping ground. Any rainwater falling directly on the Site will drain into the field drain and Howpark Burn, or south and west away from the Site (falling topography at Bell Hill). • It is therefore considered that the Site is not at pluvial flood risk.	Negligible Risk
Surface Water Flows	• SEPA surface water flood risk mapping indicates medium-high likelihood of surface water flooding on a small area of the Site within the field drain. These flows are therefore fluvial in nature and represent elevated water levels in the drain. As detailed above, fluvial flooding at the Site is not expected. • It is therefore considered that the Site is not at surface water flood risk.	Negligible Risk
Groundwater	• SEPA flood mapping indicates that the Site is not at risk from any groundwater flooding. • The topography of the Site and proximity to the watercourses indicate that there is a low risk that groundwater would rise above ground level at the proposed development such as to present a flood risk. • Underground cabling required as part of the development would be cased and jointed to withstand groundwater ingress or effects. • Based on these considerations, there is negligible risk of flooding from groundwater rise at the Site.	Negligible Risk

Source of Flood Risk	Description	Flood Risk Assessment
Sewers and Artificial Drainage Systems and Water Supply	• The Site is currently undeveloped, and it is therefore unlikely for there to be any sewerage networks present on Site. • Sewers and water mains may be present along road networks local to the Site, including the A1, A1107 and Howpark Road. The Site is raised, or upgradient of, all of these road networks and therefore it is unlikely for flood flows derived from sewers and water mains to propagate onto Site. • It is therefore considered that there is negligible risk of flooding from sewers and artificial drainage systems.	Negligible Risk
Infrastructure Failure (i.e. reservoirs, canals, culvert blockages etc.)	• The Site is not reliant on any flood defences. • There are no identified dams or other retained water bodies up-slope of the Site. • Based on these considerations, there is negligible risk of flooding from infrastructure failure.	Negligible Risk

5.0 Flood Risk

5.1 Freeboard Provisions in the Development

A freeboard should be applied to the adopted design flood level to arrive at suitable design development levels.

Freeboard allows for both uncertainty in the hydrology and hydraulic modelling that is used to derive flood levels, and other physical processes not allowed for in the design flood estimation, such as minor wave or wind effects, super-elevation of water surfaces, and settlement of defence structures[9].

SEPA advises a minimum freeboard of 600mm for fluvial flood risk in certain cases.

Guidance such as Improving the flood performance of new buildings – Flood resilient construction[10] referenced by the Building Standards for Scotland suggest that freeboard related to uncertainties alone should be around 300mm.

Whilst flooding is not envisaged for the proposed development area, the PV modules would be raised approximately 900mm above the external ground level, which is greater than the freeboard allowances recommended by SEPA.

5.2 Access and Egress

In a large flood event, the Site is not predicted to be inundated by flood water. Therefore, in an emergency access and egress can be taken by the proposed access track to the A1.

It is noted that based on SEPA flood mapping, sections of the A1 in both directions may be flooded from Eye Water during extreme flood events. However, the Site would not be regularly manned and therefore should not require access during periods of local flooding. The only exception to this would be in an emergency where safe refuge could be provided on the Site for the anticipated short duration when access may be cut.

5.3 Flood Risk and Impact to Other Developments

It is not considered that the use of PV arrays increases the rates of runoff from the Site and therefore the proposed development would have negligible impact on flood risk locally. Existing access tracks are being used and the new access tracks would comprise of permeable crushed stone. Vegetative planting will be improved beneath and between the PV arrays increasing interception storage from the existing arable / grassland regime.

The proposed solar panels would intercept precipitation and shed this onto the ground along the lower edge of each array (the ‘drip-line’). Runoff from each solar panel would continue to infiltrate into the underlying soils locally, in much the same way as existing conditions. During significant rainfall events, runoff would effectively flow in accordance with local topography into the watercourses which pass through the Site.

Based on the above, it is considered that the proposed development will not have any impact on flood risk to other areas of development adjacent to, or downstream of the works.

[9] Environment Agency, Fluvial Freeboard Guidance Note, Report W187, C624, 2000.

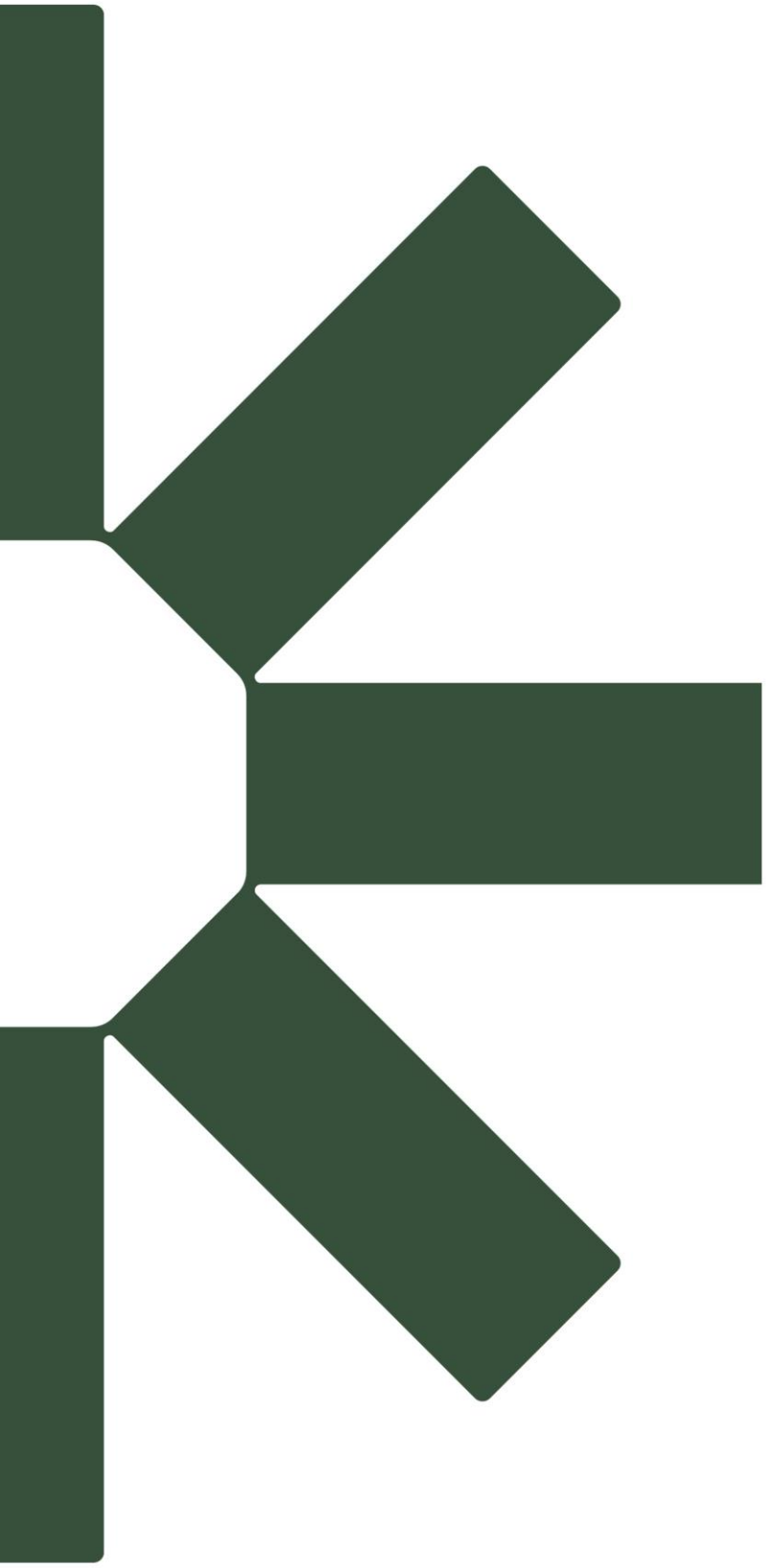
[10] Environment Agency, Improving the flood performance of new buildings – Flood resilient construction, 2007.

6.0 Conclusions

SLR Consulting has been appointed by Eurowind Energy Limited to provide a Flood Risk Assessment to support a planning application for a proposed solar farm development on land to the south of Howpark Wind Farm, Scottish Borders, Scotland.

This flood risk assessment has analysed the potential risk of flooding to the Site from a range of different sources. This flood risk screening has not identified any significant flood risks which may threaten the proposed development. There is a risk associated with exceedance of the culvert capacity or blockage of the culvert which may result in fluvial flooding. However, analysis of this risk indicates that water would overtop at 209m aOD and flow along the original channel course away from the PV modules. No development is proposed in this flood flow pathway nor would backing up of flood flows result in flooding at the base of the module, which are typically raised by at least 0.5m above ground level.

Consequently, as the flood risk screening determined all potential sources of flooding as negligible, no freeboard provisions are required as part of the development beyond those implemented in the Site master planning (raising of modules). There is no change to the flood risk and associated impact to other developments as the solar farm proposes no increase in impermeable area, with all access and egress tracks existing.



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