Craig y Perthi Solar Farm

Environmental Statement

Chapter 09: Hydrology and Flood Risk

Prepared for

JBM Solar Projects 25 Limited

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9.0 HYDROLOGY AND FLOOD RISK

9.1 Introduction

9.1.1 This chapter presents an assessment of the potential hydrology and flood risk effects of the Proposed Development on land within the Site and in its immediate vicinity. The Proposed Development is for a solar farm and associated infrastructure, including access tracks, perimeter fences, a substation and landscape enhancements on approximately 240ha of agricultural land.

9.1.2 The development comprises solar arrays on supports driven into the ground, associated containerised infrastructure such as battery storage, substation, control centre and transformer stations and permeable access tracks. The Proposed Development has a lifetime of up to 40 years, after which it will be decommissioned.

9.1.3 This chapter identifies key hydrology and flood risk sensitivities and addresses the direct and indirect effects of the Proposed Development on these. The assessment of effects is made in the context of both existing conditions (baseline conditions) during construction, operation and decommissioning and predicted conditions accounting for proposed mitigation and enhancement measures.

9.1.4 This chapter is supported by a Flood Consequence Assessment (FCA), which has been produced as a standalone document and is included as Appendix 9.1. The FCA assesses the potential flood risk to the Site and sets out mitigation measures to reduce the risk to the Proposed Development and to manage the effect of the Proposed Development on flood risk elsewhere. The FCA is informed by site-specific hydraulic modelling which is contained within Appendix B of Appendix 9.1. The FCA also demonstrates that the Proposed Development meets the aims of the Technical Advice Note (TAN) 15[1], being safe from all sources of flooding during its lifetime and not increasing flood risk elsewhere.

9.1.5 Consultation in relation to hydrology and flood risk at the Site has been undertaken, where required, as part of the EIA process. In addition, a variety of further data

[1] *Planning Policy Wales; Technical Advice Note 15: Development and Flood Risk (https://www.gov.wales/sites/default/files/publications/2018-09/tan15-development-flood-risk.pdf)*

sources have also been consulted, such as published maps. Each data source used where referenced as appropriate.

9.1.6 Although this chapter does not include an assessment of the ground conditions and groundwater flows, the potential effect on groundwater resources as it pertains to drainage has been included for completeness.

9.2 Methodology and Scope of Assessment

Legislation, Policy and Guidance

9.2.1 The national, regional, and local legislation and policy that provides the context for this ES chapter is summarised below.

National Legislation

9.2.2 The Water Framework Directive 2000/60/EC[2] (WFD) establishes a framework for a European wide approach to action in the field of water policy. The aim of the directive is to ensure no deterioration from current status for all inland and near shore watercourses and water bodies (including groundwater) and to ensure attainment of 'Good' status or better, in terms of ecological, but also chemical, biological and physical parameters. It also contains provisions for controlling discharges of dangerous substances to water. The directive is implemented in Wales by the Natural Resources Wales (NRW).

9.2.3 Any activities or developments that could cause detriment to a nearby water resource or prevent the future ability of a water resource to reach its target status, must be mitigated so as to reduce the potential for harm and allow the aims of the WFD to be realised.

9.2.4 The Water Resources Act 1991, sets out the relevant regulatory controls that provide protection to water bodies and water resources. The Water resources act governs water abstraction, discharge to water bodies, water impoundment, conservation and drought provision and was amended by the introduction of the Water Act in 2003.

[2] *Water Framework Directive (WFD) 2000/60/EC (http://ec.europa.eu/environment/water/water-framework/index_en.html)*

Under section 85 of the Water Resources Act it is an offence to "*cause or knowingly permit the discharge or other entry of poisonous, noxious or polluting matters or any solid waste matter into controlled waters (as defined under section 104 of the Act*".

9.2.5 The Groundwater (England and Wales) Regulations 2009 place a duty on the Environment Agency to protect groundwater, by prohibiting discharges of hazardous substances to groundwater and controlling the discharge of non-hazardous substances to groundwater.

9.2.6 The Flood and Water Management Act 2010 clarifies the legislative framework for managing flood risk and coastal erosion in England and Wales and defines the roles and responsibilities of risk management authorities. The act led to the creation of Lead Local Flood Authorities (LLFAs), which have the lead responsibility for managing the risk of flooding from surface water, groundwater and ordinary watercourses.

9.2.7 Schedule 3 of the Flood and Water Management Act was implemented in Wales in January 2019. This places a requirement on developments of more than one dwelling house or where the construction area is 100 square meters or more to include sustainable drainage systems (SuDS) for managing surface water. The SuDS must be designed and built in accordance with Statutory SuDS Standards[3]. They should also be approved by the local authority acting in its SuDS Approving Body (SAB) role.

National Policy

9.2.8 Planning Policy Wales (PPW) is the national policy framework in Wales. It sets out the land use planning policies of the Welsh Government to ensure the planning system contributed to the delivery of sustainable development.

9.2.9 PPW is supplemented by a series of TANs, Welsh Government Circulars and policy clarification letters, which together provide the planning policy framework for Wales.

[3] Statutory Standards for Sustainable Drainage Systems – designing, constructing, operating and maintaining surface water drainage systems. Welsh Government, 2018. https://www.gov.wales/sites/default/files/publications/2019-06/statutory-national-standards-for-sustainable-drainage-systems.pdf

9.2.10 TAN15 was first published in 2004 and remains the relevant supplementary advice note to PPW on flood risk issues. It is due to be updated later in 2023.

9.2.11 TAN 15 aims to direct new development away from those areas that are at high risk of flooding. Where development has to be considered in higher risk areas, only those sites that can pass tests to demonstrate their justification and flooding consequences are deemed compliant.

9.2.12 The justification and consequence tests in TAN15 are governed by Development Advice Maps (DAMs), which comprise three zones:

i) Zone A – Considered to be at little or no risk of fluvial or tidal/coastal flooding.
ii) Zone B – Areas known to have flooded in the past evidenced by sedimentary deposits.
iii) Zone C – Areas within the extreme river, tidal or coastal flood outline, equal to or greater than a 0.1% (1 in 1,000 year). Zone C is subdivided into two zones.
iv) Zone C1 – Areas of the floodplain which are developed and served by significant infrastructure, including flood defences.
v) Zone C2 – Areas of the floodplain without significant flood defence infrastructure.

9.2.13 TAN15 also defines the vulnerability of different land uses to flooding, using four categories, ‘Emergency services’, ‘Highly vulnerable development’, ‘Less vulnerable development’ and ‘Other’. As explained in the FCA (Appendix 9.1), based on the Inspectors Report for the Gwent Farmers’ Community Solar Scheme Ltd., the proposals are assessed as constituting ‘Other’ development. This is further supported by the Acceptability Criteria for more vulnerable development types (such as ‘Less Vulnerable’) containing many considerations which are of no relevance to a remotely operated solar far, and therefore the Justification Test is not applicable.

9.2.14 Taking a conservative approach, the FCA concludes that even if the proposals would constitute ‘Less vulnerable development’ and therefore subject to the Justification Test, drawing on relevant planning appeal cases, they are deemed appropriate.

Local Planning Policy

9.2.15 The Newport Local Development Plan[4] contains a number of Strategic Policies that form the basis for considering development proposals within the planning system. There are two relevant Strategic Policies, SP3 (Flood Risk) and SP4 (Water Resources).

9.2.16 Policy SP2 largely reflects national policy by requiring development to be located in the lowest risk areas possible and to not increase risk elsewhere. Detailed technical assessments are required so the development is designed to cope with the consequences of flooding over its lifetime. Such detailed assessment has been completed by the FCA, contained in Appendix 9.1.

9.2.17 Policy SP4 requires developments to protect water quality during construction and operation of the development. It also requires the management of surface water runoff through sustainable drainage approaches. The policy also refers to issues such as management of wastewater, abstractions and water consumption, which are not applicable to the proposals.

Assessment Methodology

9.2.18 This section presents the methodology used to assess the potential effects of the Proposed Development the flood risk and drainage of the Site and surrounding area.

9.2.19 To assess the significance of the effects of the Proposed Development on the water environment a set of threshold criteria have been established based on the interaction between the value and sensitivity of the receptor and the magnitude of change. The threshold criteria set out below have been determined based on planning policy and legislation, industry best practice and professional judgement.

Study Area

9.2.20 To select the study area, professional judgement is applied to estimate the likely extent of potential impacts and therefore a zone of influence of impacts.

[4] Newport Local Development Plan 2011-26. Newport City Council, 2016.
https://www.newport.gov.uk/documents/Planning-Documents/LDP-2011-2026/LDP-Adopted-Plan-January-2015.pdf

9.2.21 The FCA was supported by site-specific hydraulic modelling, which is described in Appendix A of the FCA. The study area for this was largely dictated by modelling convention. For example, the hydrology assessment covered the entire catchment for the three principal watercourses (Monk's Ditch, Waltwood Brook and Wilcrick Brook, as described below). The model itself extended to high ground upstream of the Site and 250m downstream of the railway line.

Baseline Methodology

9.2.22 An initial desk-based assessment of the Site was carried out. This assessment collated information from NRW, the LLFA, Ordnance Survey, SoilScapes, the BGS, the Water Watch Wales and Data Map Wales websites.

9.2.23 Topographic data for the Site has been taken from a 1 m LiDAR DTM. A specific survey of the structures on principal watercourses was conducted by MK Surveys in February and March 2023.

9.2.24 Hydraulic modelling of the network of watercourses has been carried out using industry standard flow estimation and hydraulic modelling software packages. This work draws on ground level data as defined by LiDAR, augmented by a survey of key structures completed by MK Surveys in February and March 2023 and site land use as defined by Ordnance Survey (OS) Mastermap data. The dimensions of culverts beneath the South Wales Main Line railway were provided by Network Rail.

9.2.25 A site visit was undertaken in November 2022 to aid hydraulic model ground truthing and to record any potentially relevant features of hydrology and flood risk interest.

9.2.26 The MAGIC website[5] (magic.defra.gov.uk) was reviewed to identify relevant statutory and non-statutory designations in the vicinity of the Site. This identified the presence of the Gwent Level – Redwick and Llandevenny SSSI as the only relevant designation at the Site.

9.2.27 The Planning and Environment Decisions (PEDW) EIA Scoping Direction included Reen and Ditch habitat surveys undertaken by NRW (or its predecessors) in 2011 and 2017. Within the vicinity of the Site, the surveys were limited to ditches and reens

[5] *MAGIC Mapping (https://magic.defra.gov.uk/)*

in the SSSI, with four IDD reens surveyed and two Main River surveys. The surveys grouped the reens within field blocks. They used key performance indicators (KPIs), to assess 'favourable' or 'unfavourable' condition based on the proportion of reens in the blocks overshaded by hedgerows. For Main Rivers to be favourable, submerged vascular plants need to cover at least at least 60% of survey points. For IDD viewed reens, such plants need to be in at least 50% of survey points.

9.2.28 No intrusive ground investigations have been carried out.

Assessment of Significance / Assessment Criteria

9.2.29 The significance criteria used to assess the potential effects of the Proposed Development are set out below. There are three stages to the assessment of the effect on water resources are as follows:

i) The sensitivity of the receptor (High to Negligible) based on a number of attributes such as local flood risk and water resource quality (Table 9.1).
ii) The magnitude of change on the receptor, which is determined based on Table 9.2 and the assessor's knowledge of the project.
iii) An overall Significance of Effect, as set out in Table 9.3.

9.2.30 The sensitivity of receptor criteria has been derived accounting for: flood risk function; relevant statutory and non-statutory habitat designations; ecological and chemical status of surface waterbodies, as defined by the WFD and the groundwater aquifer classifications and source protection zones. The sensitivity has been defined to range from High to Negligible, the criteria and examples of which and are set out in Table 9.1.

Table 9.1 Derivation of sensitivity of receptor

Sensitivity of Receptor	Criteria	Example
High	Receptor has very limited capacity to tolerate changes to hydrology, water quality or flood risk. Water resource with a high quality and rarity at a national or regional level with high sensitivity to hydrological change and limited potential for substitution.	Waterbody or associated defences which serve a defined flood risk function. Sites of Special Scientific Interest (SSSIs), Ramsar sites, Special Areas of Conservation (SAC), Special Protection Areas (SPA). Surface water bodies with a High overall status as defined by the WFD. Principal Aquifers within Groundwater Source Protection Zones 1.

Sensitivity of Receptor	Criteria	Example
Medium	Receptor has limited capacity to tolerate changes to hydrology, water quality or flood risk. Water resource with a high quality and rarity at a local scale or water resource with a medium quality and rarity at a regional or national scale.	Waterbody that serves and important flood risk function or is upstream of areas at high risk of flooding. Local Nature Reserves (LNR), Sites of Nature Conservation Interest (SNCI). Surface water bodies with a WFD Good ecological status and Good chemical status. Principal Aquifers within Groundwater Source Protection Zones 2-4. Secondary aquifers within Groundwater Source Protection Zones.
Low	Receptor has moderate capacity to tolerate changes to hydrology, water quality of flood risk. Water resource with a low quality and rarity at a local scale.	Waterbody that serves limited flood risk function. Surface water bodies with a WFD ecological status ranging from Poor to Moderate and/or a Good chemical status. Areas defined by BGS as Low Productivity Aquifer.
Negligible	Receptor is generally not sensitive to changes to hydrology, water quality of flood risk. Water resource with very low quality and rarity at a local scale.	Surface Water bodies with a WFD Bad ecological status and\or Fail chemical status. Ground defined by BGS as ‘rocks with essentially no groundwater’.

9.2.31 The magnitude of change is based on the potential effects on water resource attributes as set out in Table 9.2.

Table 9.2 Derivation of magnitude of change

Importance	Criteria	Example
High - Negative	Results in substantial negative effect on attributes of a water resource.	Increase in flood risk to highly vulnerable land uses (as defined by NPPG) or nationally significant infrastructure. Effects that would cause a change to WFD status of a waterbody or have a significant effect on groundwater resources.
Medium - Negative	Results in negative effect on attributes of a water resource.	Increase in flood risk to more vulnerable land use (as defined by NPPG) or locally significant infrastructure. Effects that may cause a change to WFD status of a waterbody or have a moderate effect on groundwater resources.
Low - Negative	Results in minor negative effect on	Increase in flood risk to less vulnerable or water compatible land uses (as defined by NPPG).

Importance	Criteria	Example
	attributes of a water resource.	Effects to a waterbody, but insufficient to change its WFD status.
Negligible	Results in an effect on attribute of a water resource but of insufficient magnitude to affect the use /integrity.	Effects that would have a negligible effect on water quality. Minor increase in flood risk to undeveloped land.
Low - Beneficial	Results in minor positive effect on attributes of a water resource.	Decrease in flood risk to less vulnerable or water compatible land uses (as defined by NPPF). Improvements to a waterbody, but insufficient to change its WFD status.
Medium – Beneficial	Results in positive effect on attributes of a water resource.	Decrease in flood risk to more vulnerable land use (as defined by NPPG) or locally significant infrastructure. Effects that may cause a change to WFD status of a waterbody or have a moderate effect on groundwater resources
High - Beneficial	Results in substantial positive effect on attributes of a water resource.	Significant decrease in flood risk to highly vulnerable land uses (as defined by NPPG) or nationally significant infrastructure. Effects that would cause an improvement to WFD status of a waterbody or have a significant effect on groundwater resources.

9.2.32 The significance scale that has been applied is included in Chapter 2: Approach to EIA. The scale includes seven different classifications ranging from ‘Major Beneficial’ to ‘Major Adverse.

9.2.33 The significance scale is derived from the interaction of the receptor sensitivity and the magnitude of change criteria. The shading in Table 9.3 indicates those significance ratings that are deemed to be ‘significant’ effects.

Table 9.3 Significance Matrix

		Sensitivity of Receptor			
		High	Medium	Low	Negligible
Magnitude of Change	High -Negative	Major adverse	Major adverse	Moderate adverse	Negligible
	Medium - Negative	Major adverse	Moderate adverse	Minor to Moderate Adverse	Negligible
	Low –	Moderate adverse	Minor to Moderate adverse	Minor adverse	Negligible
	Negative	Negligible	Negligible	Negligible	Negligible
	Negligible	Moderate Beneficial	Minor to Moderate Beneficial	Minor Beneficial	Negligible
	Low – Beneficial	Major Beneficial	Moderate Beneficial	Minor to Moderate Beneficial	Negligible
	Medium - Beneficial	Major Beneficial	Major Beneficial	Moderate	Negligible

Limitations

9.2.34 Detailed information about the condition of the soil and site geology on the Site was not available and consequently the assessment of the hydrological response to rainfall is based on freely available datasets on soil and geology and site observations.

9.2.35 Hydraulic modelling work carried out for the Site which is reliant on a number of assumptions. Sensitivity testing has been carried out which indicates that the model outputs are not particularly sensitive to key assumptions such as flows.

Scope of Assessment

9.2.36 This Chapter of the ES is limited to the effect of the Proposed Development on the hydrological response of the Site: principally the effect on rainfall falling on the Site and the quantity and quality of runoff and the effect on water passing through the Site in defined watercourses. It does not consider the ecology of the habitats, which is covered in other chapters.

9.2.37 Consultation has been undertaken with NRW and Newport City Council as the LLFA and SAB. The engagement focussed on the management of flood risk and drainage on the Site, rather than water quality.

9.2.38 This assessment predominantly focusses on the Site area itself. However, the study area extends beyond the Site boundary where potential significant iterations apply. For example, The Monk's Ditch is located outside of the Site boundary but is a principal watercourse in terms of WFD designations, so was included in the assessment.

9.2.39 The proposed cable route will be a buried service, with no discernible impact on ground levels or cover once installed. Furthermore, it will be located beneath existing highways for much of its route. As a result, it will have negligible impact on hydrology or flood risk so is outside the scope of this assessment.

9.3 Baseline

Site Description and Context

9.3.1 The Site is currently agricultural land, which is understood to be a mix of pasture and arable uses. The proposed cable route would follow existing roads, along predominantly adopted highways.

9.3.2 The topography of the Site is varied, which in turn determines its hydrological landscape. The northern and western parts of the Site are characterised by steep slopes, dropping down to flatter, lower-lying parts in the south and east.

9.3.3 The land slopes from north to south from an elevation of approximately 40 mAOD at Waltwood Hill in the north to approximately 5 mAOD in the south. The southern part of the Site is bounded by the South Wales Main Line railway. A separate railway runs parallel to the South Wales Main Line railway in the south, assumed to service the Spencer Steelworks. Both railway lines are raised above ground levels to levels generally ranging between 6 and 7 mAOD.

9.3.4 Part of the lower lying areas of the Site are located within the Caldicot and Wentlooge Level Internal Drainage District (IDD), a low-lying area characterised by a network of watercourses and reens. The IDD area also houses the Gwent Levels – Redwick and Llandevenny SSSI.

9.3.5 There are three principal watercourses local to the Site. The Monks Ditch flows to the west of the Site draining approximately 18 km^2 of land upstream of the railway lines. The watercourse referred to as the Waltwood Brook commences at a reservoir

on Waltwood Hill and flows through part of the western portion of the Site. The Wilcrick Brook drains approximately 7 km^2 of land upstream of the railway lines and flows through the eastern portion of the Site. All watercourses are culverted where they flow beneath the raised railways lines.

9.3.6 With regard to Water Framework Directive classification, the Site lies within the 'Monks Ditch – Wainbridge to Source' waterbody, which is part of the Usk Management Catchment area of the Severn River Basin District. The Monks Ditch has an overall status of Moderate. It has an ecological status of Moderate and chemical status of High.

9.3.7 In addition to the above, the Site contains a network of reens and ditches, particularly in lower lying parts of the Site, that are presumed to assist with the drainage of agricultural fields.

9.3.8 No specific water quality monitoring data is available for the watercourse network outside of the Monk's Ditch. However, it is presumed that conditions within the local watercourses, particularly the reens, are likely to be impacted by the local land management and agricultural activities. In particular, they are likely to be susceptible to leaching of fertilisers, herbicides or similar as well as siltation from ploughing or similar activities.

9.3.9 The NRW Reen and Ditch Habitat Surveys identified that the four IDD reens surveyed passed the favourable KPIs in 2011, with two reens deteriorating to unfavourable in 2017. One Main River reach failed in 2011 but had improved in 2017.

9.3.10 Comments from NRW contained within the EIA Scoping Direction (Appendix 2.3) note that there may be ridge and furrow formations on the landscape as well as grip features (shallow surface ditches in the fields). No significant or obvious such features were identified during the site walkover or by analysis of LiDAR data across the site. However, the potential presence of these features has been accounted for in the assessment methodology

9.3.11 The DAM Zones classify low-lying parts of the Site to be in within Zone C1 - Areas of the floodplain that are developed and served by significant infrastructure, including flood defences. This classification includes the risk of tidal flooding and flooding from watercourses.

9.3.12 British Geological Survey data[6] shows the Site to be underlain by mudstone bedrock geology, with some parts interbedded by siltstone and limestone. Lower lying areas within the IDD area, as well as adjacent to the Monks Ditch, are underlain by tidal deposits superficial strata, which compromise of clays and silts. Therefore, the geology beneath the Site is likely to be impermeable.

9.3.13 BGS data defines the Site as being underlain by a 'Low productivity aquifer' or 'Rocks with essentially no groundwater'. The site is not located in a Source Protection Zone.

9.3.14 Cranfield Soil and Agrifood 'Soilscapes' mapping[7] shows soils at the Site to have impeded drainage or be naturally wet with high groundwater.

9.3.15 As summarised by the Agricultural Land Classification report (Appendix 3.4), the Site comprises pasture, crops and temporary grass land cover. Large parts of the Site are in arable use, growing single crops in large stands. It is understood that the current practice is to leave fields bare following harvest. The lack of vegetation and associated reduction in soil biological activity negatively effects soil structure and reduces its ability to infiltrate water resulting in increased runoff rates. The lack of soil armouring also increases the formation of surface crusts, which increases runoff rates and/or causes erosion of the soil surface carrying pollutants into the local drainage network.

9.3.16 Other parts of the Site are used as grazing land. Observations showed compaction of the ground in certain locations, which affects the ability of the land to accept rainfall. Livestock are generally prevented from accessing the watercourse by fences adjacent to the banks of watercourses. However, there were some locations where poaching was evident. In addition, even with the presence of fences, there is still a risk of pollution from animal faeces being deposited adjacent to the watercourses.

9.3.17 Furthermore, it is common practice for agricultural land in the area to utilise land drains (typically 50 – 100mm diameter) to assist with drainage and water management.

[6] British Geological Survey; 50,000 scale digital geology (bedrock and superficial geology layers)
[7] Cranfield Soil and Agrifood Institute; Soilscapes mapping (https://www.landis.org.uk/soilscapes/)

9.3.18 The southeastern part of the Site is located within the Gwent Level – Redwick and Llandevenny SSSI. The citation of this SSSI refers to the definition of the area as wet pasture and the management of water levels and the reen network providing suitable habitat for the qualifying species, as explained in greater detail within Chapter 6 Ecology of this ES. [8]

9.4 Assessment of Effects

Embedded Mitigation

9.4.1 This section details mitigation measures that are incorporated into the construction or operation of the Proposed Development.

9.4.2 The construction compounds would be formed from permeable gravel (or similar) material, which would allow water to percolate into the ground as per the existing situation and thus negate impacts on local drainage. Permeable gravel also acts as a filtration substrate to clean water passing through it. The compound would include a lay-down area for deliveries and be located close to an existing highway, which would minimise the movements across the Site and therefore potential impact on drainage, soil erosion, compaction or pollution.

9.4.3 The panels themselves would be the most significant infrastructure across the Site. They would be constructed by piling the stanchions into the ground without the need for significant earthworks. This would allow the movement of surface and sub-surface water to continue across the Site.

9.4.4 It has been recommended in the FCA (Appendix 9.1) that the potential flood risk and drainage effects of the construction stage of the Proposed Development are considered as part of a Construction Environmental Management Plan (CEMP).

9.4.5 The following measures have been recommended for consideration as part of the ongoing process to develop a CEMP:

i) Use of low tyre pressure machinery to reduce compaction.
ii) A delivery and construction schedule that minimises repeat journeys.

[8] *MAGIC Mapping (https://magic.defra.gov.uk/)*

iii) Temporary measures such as sediment traps using geotextiles, straw and temporary bunding to minimise the risk of pollution.

9.4.6 Operation precautions would be taken in any areas where there is increased risk of hydrocarbon/chemical spillage. Any relevant fuels, lubricants or chemicals would be stored in accordance with the appropriate NRW Technical Guidance Notes with an impermeable base and suitable bunding to prevent discharge.

9.4.7 Runoff from the containerised infrastructure would be directed to gravel bases, which would allow water to soak into the ground as per existing drainage and therefore mitigate the potential increase in runoff associated with the Proposed Development. The approach is discussed in the FCA (Appendix 9.1) in Sections 7 and 8 and illustrated in drawings contained within Appendix D of Appendix 9.1.

9.4.8 The maintenance of drainage features would be essential so that the surface water drainage system operates effectively. Maintenance activities include:

iv) Regular inspections of downpipes and gravel bases;
v) Removal of sediment – if required following inspections inspection; and
vi) Repair damaged membranes

9.4.9 Access routes would utilise or enhance existing watercourse crossings wherever possible. However, the Proposed Development may require access crossings over some watercourses across the Site. These are proposed to be clear span in order to preserve the existing channel capacity.

9.4.10 Battery, inverter and storage containers, which are spread across the Site, would be sited on gravel beds 0.3m deep allowing for distribution of runoff and infiltration into the ground below, minimising the potential increase in surface water runoff.

9.4.11 In accordance with NRW and LLFA requirements, no infrastructure will be located within 12 m of the top of bank of a watercourse within the SSSI and 7 m from a watercourse outside of the SSSI. This will allow a buffer strip between all development and the watercourses to help absorb pollutants or sediment in the extremely unlikely event of a spillage or erosion event.

9.4.12 With the above embedded mitigation in place, no significant residual effects are expected on hydrology and flood risk during the construction or operational phase. The drainage features are expected to result in a minor beneficial effect. The proposals therefore meet the requirements of relevant legislation and policy.

Construction Phase

9.4.13 Construction compounds are proposed to be located outside areas predicted to be at risk of flooding to significantly reduce the impact on site operations if flooding were to occur. This would also minimise the risk of pollutants entering floodwater.

9.4.14 During construction of the Proposed Development there is potential for soil compaction and erosion through vehicular movement. Soil compaction can lead to reduced soil porosity, soil water storage and infiltration and hydraulic as a result, increase surface water runoff and reduce water quality. The removal of vegetation can compound these effects. Even with the embedded mitigation, notably the CEMP in place, these changes have the potential to increase downstream flood risk, erosion and pollution of surface water bodies. Trenching for the cables could also increase the rate of runoff from the Site.

9.4.15 Accidental spills from machinery and the dispersion of construction materials and debris also have the potential to cause pollution of water resources. However, with the embedded mitigation in place, the chance for such spills to cause negative effects is minimal.

9.4.16 In 2021, the WFD assessment assigned the receiving watercourses ‘Moderate’ for ecological status and ‘High’ for chemical status, with part of the Site and its watercourse located within a SSSI. The sensitivity of the receptor in terms of surface water pollution is therefore assessed as being Medium. When compared with the existing land use, the Magnitude of Change in pollution potential is considered to be Low – Negative. The significance of the effect of construction (soil compaction and accidental spills) on pollution is therefore considered to be Minor to Moderate Adverse.

9.4.17 The Site provides a flood risk function by virtue of storing volumes of flood water upstream of the South Wales Main Line railway, the sensitivity of the receptor in terms of flood risk is considered to be Medium. When compared with the existing

land use, the Magnitude of Change in flood risk terms (through potential increase in site runoff rates) is considered to be Low – Negative. The significance of the effect of construction on local flood risk is therefore considered to be Minor to Moderate Adverse.

9.4.18 The Site is defined by BGS as either a 'Low Productivity Aquifer' or 'Rocks with Essentially no Groundwater' and as such, the sensitivity of the groundwater receptor to the effects of construction through pollution or reduced infiltration is considered to be Low. With the embedded mitigation in place, the magnitude of change is considered to be Negligible. The significance of the effect of construction on groundwater resources is therefore considered to be Negligible.

9.4.19 The effects of construction would be short term and are not expected to continue once the construction stage is complete.

Operational Phase

Cessation of Intensive Agricultural Activities – Beneficial Effects

9.4.20 Across the Site, the cessation of agricultural activities would have beneficial effects in terms of runoff rates and water quality. Stocking densities of grazing animals would be reduced as would the use of machinery, leading to less compaction. The reduction in the application of herbicides and fertilisers would also result in a reduction of pollution of groundwater and surface water resources.

9.4.21 The Proposed Development would allow the establishment of a healthy soil ecosystem, an increase in organic matter content, and associated improvements in soil structure, especially in areas which were formally ploughed and left to bare earth following harvest, and those areas where overgrazing and trafficking has caused compaction and erosion. The solar panels would also protect the ground from intense rainfall whilst vegetation is becoming established and should reduce the formation of surface crusts.

9.4.22 The sensitivity of the receptor in terms of surface water pollution is assessed as being Medium. When compared with the existing land use, the Magnitude of Change in pollution potential is considered to be Low – Beneficial. The significance of the change of land use on pollution is therefore considered to be Minor to Moderate Beneficial.

9.4.23 The sensitivity of the receptor in terms of flood risk is considered to be Medium. When compared with the existing land use, the Magnitude of Change in flood risk terms through a decrease in runoff rates is considered to be Low – Beneficial. The significance of the change of land use on flood risk is therefore considered to be Minor to Moderate Beneficial.

9.4.24 The entire site is defined by BGS as 'Low Productivity Aquifer' or 'Rocks With Essentially no Groundwater' and as such, the sensitivity of the groundwater receptor is considered to be Low. The magnitude of change is considered to be Negligible. The significance of the land use change on groundwater resources is to be Negligible.

9.4.25 Further details of the positive effects of the change of land use of Site are set out the FCA (Appendix 9.1).

9.4.26 With the Proposed Development in place, it is anticipated that conditions in the Redwick and Llandevenny SSSI would remain suitable for wet pasture to support the qualifying species.

Proposed Solar Panels – Effect on Hydrology and Flood Risk

9.4.27 The main part of the Site would be taken up by solar panels, which are considered to have a negligible effect on runoff rates. Rows of solar panels would be separated by gaps of up to 10 m and the solar arrays themselves have thermal expansion gaps. The concentration of runoff from the solar panels would therefore be spatially localised, draining between the expansion gaps.

9.4.28 Once rainfall has exceeded the interception capacity of vegetation it would initially take up any available depression storage and soil moisture deficit before moving laterally through the soil and percolating downwards. If the incident rainfall exceeds the rate of soakage into the ground, it would move laterally above the soil and soak into areas which are within the 'rain shadow' of the panels.

9.4.29 The velocity of water falling from the panels would be significantly less than the velocity of unimpeded rainfall. Soils would therefore be less susceptible to erosion.

9.4.30 Where located in areas of risk, the panels would be raised at least above the predicted 1 in 100 year + 25% flood level and with an allowance for freeboard. The

only infrastructure below the flood level would be the panel supports which occupy a negligible space and therefore the panels would not affect floodplain storage or the conveyance of flood flows.

9.4.31 The sensitivity of the receptor in terms of flood risk is considered to be Medium. When compared with the existing land use, the Magnitude of Change in flood risk terms is considered to be Negligible. The significance of the change in flood risk is therefore considered to be Negligible.

Proposed Infrastructure

9.4.32 There are a number of a number of battery, inverter and storage containers proposed across the Site. These containers are located in areas at low risk of flooding. As explained above, runoff from the roofs of the containers would be directed to their gravel bases, where it will soak into the ground in line with the current drainage process.

9.4.33 The sensitivity of the flood risk receptor is considered to be Medium. When compared with the existing land use, the Magnitude of Change in flood risk terms (through increasing runoff rates) is considered to be Negligible. The significance of the change in flood risk from runoff is therefore considered to be Negligible.

9.4.34 Access crossings would be formed over some of the watercourses, but embedded mitigation would ensure they are span bridges designed to maintain existing channel capacities. The sensitivity of the receptor is considered to be Low (agricultural land). The Magnitude of Change is considered to be Negligible. The significance of the change in flood risk from the proposed access crossings is therefore considered to be Negligible.

9.5 Cumulative Effects

9.5.1 The fundamental aspect of PPW and TAN15 is to ensure that development sites manage flood risks within their area and mitigate impacts to third parties. As a result, there is limited opportunity for cumulative impacts.

9.5.2 The impacts from the Proposed Development will be negligible, or minor to moderate beneficial. Therefore, the impacts on third parties would likewise be negligible or minor beneficial.

9.5.3 Of the sites to be considered by the cumulative impacts, all but two are either located in a different catchment or lie downstream of the Site. The two identified sites located upstream are operational solar energy schemes who would be delivering similar overall benefits to runoff as described in this chapter. Therefore, the impact to the Proposed Development would be negligible or minor beneficial.

9.5.4 As a result of the above, no further mitigation is required as a result of cumulative impacts.

9.6 Mitigation

9.6.1 This section details any additional mitigation measures that are not embedded as part of the Proposed Development.

Construction

9.6.2 Where the soil has been disturbed as part of the construction, soil will be adequately prepared for seeding. Tillage (mechanical loosening) may be advisable where the soil is compacted. A native seed mix should be used which allows for rapid establishment of ground cover.

Table 9.3 Mitigation

Ref	Measure to avoid, reduce or manage any adverse effects and/or to deliver beneficial effects	How measure would be secured		
		By Design	**By S.106**	**By Condition**
1	Construction Environmental Management Plan and associated mitigation measures.			X
2	Siting battery, inverter and storage containers on 0.3m of gravel to allow for distributions of runoff and infiltration into the ground below.	X		
3	Raising of solar panels above the 1 in 100 year +25% flood level	X		
4	Designing access crossings to be clear-span to preserve channel capacity.	X		

Operation

9.6.3 The embedded mitigation is sufficient to deliver the overall benefits on hydrology and flood risk arising from the scheme during operation Therefore, no additional mitigation measures are required.

9.7 Residual Effects and Conclusion

9.7.1 With the proposed embedded and additional mitigation in place, negative impacts on the hydrological features local to the Site would be managed to result in negligible impacts during construction.

9.7.2 During operation, the Proposed Development will have overall Minor to Moderate benefits on soil erosion as well as the rate and quality of surface water runoff.

Table 9.1 Summary of Effects and mitigation

Receptor	Impact	Embedded Mitigation	Assessment	Proposed Mitigation	Residual Effect	Monitoring requirements
Watercourses (reens, Main Rivers and Ordinary Watercourses)	Pollution caused by soil compaction from construction traffic	Construction Traffic Management Plan	Minor to Moderate adverse (temporary)	Tillage and reseeding	Negligible	Construction Traffic Management Plan to be implemented and monitored for effectiveness. Secured through an appropriate condition.
	Accidental spills	Construction Environmental Management Plan	Negligible	None	Negligible	Construction Traffic Management Plan to be implemented and monitored for effectiveness. Secured through an appropriate condition.
Flood risk	Increased runoff from soil compaction	Construction Environmental Management Plan	Minor to Moderate Adverse	Tillage and reseeding	Negligible	Construction Traffic Management Plan to be implemented and monitored for effectiveness. Secured through an appropriate condition.
Groundwater	Leached pollution or reduced infiltration	Construction Traffic Management Plan	Negligible	None	Negligible	Construction Traffic Management Plan to be implemented and monitored for effectiveness. Secured through an appropriate condition.
Watercourses (reens, Main Rivers and Ordinary Watercourses)	Reduced soil erosion from agricultural practices	Change of land use to grass cover	Minor to Moderate Beneficial	None	Minor to Moderate Beneficial	None
	Reduced migration of pollutants to waterbodies	Change of land use and reduction in intensive agricultural practices	Minor to Moderate Beneficial	None	Minor to Moderate Beneficial	None
Flood risk	Reduction in runoff/ overland flows	Change in land use practices	Minor to Moderate Beneficial	None	Minor to Moderate Beneficial	None
	Runoff from dispersed hardstanding	Use of gravel beds to	Negligible	None	Negligible	None

Receptor	Impact	Embedded Mitigation	Assessment	Proposed Mitigation	Residual Effect	Monitoring requirements
		accommodate runoff				
	Access crossings increasing flood risk	Use span bridges designed to maintain channel capacity	Negligible	None	Negligible	None
Groundwater	Improved infiltration to recharge groundwaters	Change in land use practices	Negligible	None	Negligible	None