Chapter 7 – Hydrology and Flood Risk

Cossans Solar & BESS EIA Report

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Acronyms and Abbreviations

AOD	Above Ordnance Datum
BGS	British Geological Survey
CEMP	Construction Environmental Management Plan
CIRIA	Construction Industry Research and Information Association
DS	Downstream of the Site
DWPA	Drinking Water Protected Area
EC	European Commission
FEH	Flood Estimation Handbook
FRDA	Flood Risk and Drainage Assessment
FWMP	Firewater Management Plan
GPPs	Guidance for Pollution Prevention
GWDTE	Ground Water Dependent Terrestrial Ecosystem
IHDTM	Integrated Hydrological Digital Terrain Model
LDP	Local Development Plan
NPF4	National Planning Framework 4
PAN	Planning Advice Notes
PWS	Private Water Supply
SAAR	Standard average annual rainfall
SAC	Special Areas of Conservation
SEPA	Scottish Environmental Protection Agency
SFRA	Strategic Flood Risk Assessment
SSSI	Special Site of Scientific Interest
SuDS	Sustainable Urban Drainage Systems
US	Upstream of the Site
WFD	Water Framework Directive

7. Hydrology and Flood Risk

7.1 Executive Summary

7.1.1 This chapter considers the effects of the Proposed Development on hydrology, and flood risk.

7.1.2 The chapter highlights and considers the topics relevant policy standards at an international, national and local scale.

7.1.3 Baseline hydrology and flood risk has been established through a desk study and survey work.

7.1.4 The Dean Water flows east to west approximately 50m south of the Site. The Ballindarg Burn flows north to south through the centre of the Site before discharging into the Dean Water. The Kerbet Water flows south to north and discharges into the Dean Water 50m south of the Proposed Development. The Site sits within the Dean Water catchment with surface water eventually draining into the Dean Water.

7.1.5 The desk study has determined flood risk to the Site to be low to high due to fluvial sources and no to low risk from all other sources.

7.1.6 The Site is underlain by a moderately productive bedrock aquifer.

7.1.7 The River Tay Special Area of Conservation is located to the south of the site and associated with the Dean Water.

7.1.8 Mitigations that are part of the of the Proposed Development design process have been included in the assessment. These include provision of a Flood Mitigation Design and Drainage Strategy for the operational development and provision of a Construction Environmental Management Plan (CEMP) to minimise and mitigate any adverse effects during construction.

7.1.9 A number of potential impacts on receptors associated with the construction, operational and decommissioning phases of the Proposed Development were identified. These included impacts on hydrology, hydrogeology and flood risk. With the proposed mitigation measures in place, these impacts result in effects of negligible adverse significance and therefore not significant in EIA terms.

7.2 Introduction

7.2.1 This chapter considers the potential effects of the Proposed Development on the hydrology and flood risk of the Proposed Development and local area.

7.2.2 Specifically, this chapter considers the potential impact of the Proposed Development during the construction, operational and maintenance, and decommissioning phases. This chapter:

- Presents the existing environmental baseline established from desk studies and site-specific surveys;
- Identifies any assumptions and limitations encountered in compiling the environmental information;
- Presents the potential environmental impacts on hydrology, hydrogeology and flood risk receptors arising from the Proposed Development, and reaches a conclusion on the likely significant effects based on the information gathered and the analysis and assessments undertaken; and
- Highlights any necessary monitoring and/or mitigation measures that are recommended to prevent, minimise, reduce or offset the likely significant adverse environmental effects of the Proposed Development on identified receptors.

7.2.3 This chapter is supported by the following figures and technical appendices:

- **Figure 7.1: Hydrological Overview**
- **Technical Appendix 7.1: Flood Risk and Drainage Assessment**
- **Technical Appendix 7.2: Firewater Management Plan**

7.3 Legislation, Policy & Guidance

7.3.1 The following section lists the relevant legislation, policy and guidelines that have been taken into consideration during the assessment of hydrology and flood risk effects.

Legislation

7.3.2 Relevant legislation and guidance documents have been reviewed and taken into account as part of this assessment. Of particular relevance are:

- Directive 2007/60/EC on the assessment and management of flood risks (European Commission (EC), 2007);
- 2000/60/EC Water Framework Directive (WFD) (EC, 2000);
- Environmental Protection Act (UK Government, 1990);
- Environment Act (UK Government, 2021);
- The Water Environment and Water Services (Scotland) Act (Scottish Executive, 2003);
- Flood Risk Management (Scotland) Act (Scottish Executive, 2009);

- The Water Environment (Controlled Activities) (Scotland) Regulations as amended (Scottish Government, 2011);
- Environmental Authorisations (Scotland) Regulations (Scottish Government, 2018);
- Directive 2006/118/EC Groundwater Directive (GWD) (EC, 2006);
- Flood and Water Management Act (UK Government, 2010); and
- Land Drainage Act (UK Government, 1991).

Planning Policy

7.3.3 The Planning Statement associated with this Section 36 application sets out the planning policy framework that is relevant to the EIA. This section considers the relevant aspects of National Planning Framework 4 (NPF4), Planning Advice Notes (PAN), the Angus Council Local Development Plan (LDP) and other relevant guidance. Of relevance to the assessment presented within this chapter, regard has been had to the following policies:

7.3.4 NPF4 (2023) provides planning guidance and polices regarding sustainable development, tackling climate change and achieving net zero. Policies relevant to this chapter include:

- Policy 2 (Climate Mitigation and Adaptation);
- Policy 4 (Natural Places);
- Policy 11 (Energy);
- Policy 20 (Blue and Green Infrastructure); and
- Policy 22 (Flood Risk and Water Management).

7.3.5 In addition, the following policies have been considered:

- Angus Council LDP (AC, 2016a);
- PAN 61 Planning and Sustainable Urban Drainage Systems (SuDS) (Scottish Executive, 2001);
- Online Planning Advice for Flood Risk (Scottish Executive, 2015a);
- Angus Strategic Flood Risk Assessment (SFRA) 2015 (AC, 2015); and
- Tay Estuary and Montrose Basin Local Flood Risk Management Plan (AC, 2016b).

Guidance

7.3.6 Cognisance has been taken of the following best practice guidelines/guidance etc:

- Regulatory Method (WAT-RM-08) – SuDS (SEPA, 2019);
- Sewers for Scotland 4th Edition (Scottish Water, 2019);
- CIRA SuDS Manual C753 (CIRIA, 2015);
- Guidance for Pollution Prevention (GPPs) (NatRegs, various dates);

- Assigning Groundwater Assessment Criteria for Pollutant Inputs WAT-PS-10-01) (SEPA, 2024c);
- Environmental Quality Standards and Standards for Discharges to Surface Waters, Supporting Guidance (WAT-SG-53) (SEPA, 2020);
- Guidance on Assessing the Impacts of Development on Groundwater Abstractions (SEPA, 2024b);
- Guidance on Assessing the Impacts of Developments on Groundwater Dependent Terrestrial Ecosystems (SEPA , 2024a);
- Flood Risk and Surface Water Drainage Requirements (AC, 2023);
- Construction Industry Research and Information Association (CIRIA) guidance documents and research manuals (various); and Sustainable Drainage Systems: Non-Statutory Technical Standards (UK Government, 2015); and
- The River Basin Management Plan for the Scotland River Basin District: 2015-2027 (Scottish Government, 2015b).
- National Fire Chiefs Council, Grid Scale Battery Energy Storage System Planning – Guidance for FRS (2023)

7.4 Assessment Methods & Significance Criteria

7.4.1 The assessment comprises professional judgement and has been conducted using quantitative analyses. It has been informed by statutory and general guidelines as well as a walkover of the Site. Relevant legislation, policies, and best practice guidance have been applied in both the assessment process and the development of mitigation measures.

7.4.2 The assessment covers the construction phase, operational phase and decommissioning phase of the Proposed Development.

7.4.3 The Proposed Development will cause an increase in impermeable surfacing which will increase surface runoff rate and volume in comparison to the Site pre-development if not appropriately managed. The Proposed Development could increase the risk of pollutants entering the local water environment via the ground and runoff. Therefore, the assessment aims to set out appropriate mitigation (where required) in accordance with industry best practice to neutralise potential impacts or provide benefits where possible. The Site will be constructed on greenfield land, this is taken into account for establishment of the baseline.

Study Area

7.4.4 The study area will incorporate the land within the red line boundary, within a wider study area of 1km for hydrological, and flood risk receptors near the site. This study

area has been selected based on the scale of the Proposed Development and the author's professional judgement.

7.4.5 Where there are potential effects identified on sensitive hydrological receptors, the downstream effects of these are also considered which may extend out with the above described 1km study area.

Desk Study

7.4.6 A desk assessment has been conducted to determine the characteristics of the catchment including the baseline geological, hydrological and hydrogeological conditions of the Site for the Proposed Development.

7.4.7 The desk-based review of baseline information comprised:

- Identification of the geology and hydrogeology from British Geological Survey (BGS) maps;
- The gathering and reviewing of hydrogeological information relating to the Site, including Scottish Environment Protection Agency (SEPA) flood risk data.

Site Visit

7.4.8 This Chapter is informed by a detailed field survey work which included:

- Hydrological reconnaissance to map catchment, drainage flow paths, potential flood risk sources etc;
- Hydrological survey works to identify springs and possible sub-surface flow routes; and
- Review of potential flood risk sources and anecdotal evidence gathering for any historical flood events.

Assessment of Significance

7.4.9 The assessment of effects considers the impacts of construction, operation and decommissioning to hydrological and flood risk receptors of the Proposed Development.

7.4.10 The evaluation of effects takes into account the following:

- Surface water runoff management during construction and operation;
- Quality of discharge to receiving environments and the risk of pollution; and
- Impacts of potential contaminated land on sensitive receptors

7.4.11 The assessment of effects considers the sensitivity of the receptors (refer to **Table 7-1**) in combination with the magnitude of the impact (refer to **Table 7-2**) which combined show the significance of the effect (refer to **Table 7-3**).

Table 7-1: Sensitivity of Receptor

Sensitivity of Receptor	Definition
High	• Areas with geomorphological or hydrological features considered to be of national interest, for example Aquatic Natura 2000 sites, Special Areas of Conservation (SAC), Special Sites of Scientific Interest (SSSI)s, RAMSARs. • Superficial deposits which are highly permeable / absent allowing free transportation of contaminants to surrounding surface waters and groundwater. • Wetland / watercourse of High or Good Ecological Potential. • Raised or blanket bog with average peat depth ≥ 1. • Proposed infrastructure is within a 'flood risk area' as set out within Policy 22 of NPF4. • Proposed development infrastructure is located within the 100m / 250m SEPA groundwater Private Water Supply (PWS) source buffers. • Surface water abstraction catchment in direct continuity with proposed development with proposed development infrastructure within 250m of the source. • Ground Water Dependent Terrestrial Ecosystem (GWDTE) within 10m radius of all activities, 100m of subsurface activities less than 1m in depth and 250m of all subsurface activities deeper than 1m with high value / dependency. • Highly sensitive or vulnerable receptors to contaminants. • Proposed development is within a Drinking Water Protected Area (DWPA) catchment.
Medium	• Areas with geomorphological or hydrological features considered to be of regional importance e.g. GCR sites • Superficial deposits with medium permeability allowing limited transport of contaminants to surrounding surface waters and groundwater. • Wetland/watercourse of Moderate Ecological Potential. • Peat with average depths between 0.5-1m. • Proposed infrastructure is directly adjacent to a 'flood risk area' as set out within Policy 22 of NPF4. • PWS intake in direct continuity with proposed development and proposed infrastructure within 500m distance of the source. • GWDTE within 10m radius of all activities, 100m subsurface activities less than 1m in depth and 250m of all subsurface activities deeper than 1m with medium value / dependency. • Sensitive or vulnerable receptors to contaminants. • Proposed development is not located within a DWPA catchment but is located upgradient of a DWPA catchment.
Low	• Superficial deposits with low permeability likely to inhibit transportation of contaminants. • Wetland/watercourse of Poor or Bad Ecological Potential or no WFD classification. • Peat with average depth <0.5m.

Sensitivity of Receptor	Definition
	• PWS intake in direct continuity with proposed development but proposed infrastructure is within 1000m in distance from source • No sensitive receptors vulnerable to contaminants.

7.4.12 The sensitivity criteria have been established based on a ranking of factors related to the quality of the aquatic and hydrogeological environment. These include international and national designations, water quality data, the status of watercourses from the WFD review conducted by SEPA, consultations, site visits, and the professional judgment of the assessment team.

7.4.13 The assessment of effects on hydrology and flood risk receptors has been conducted using a range of tables to log potential construction and operation impacts. Based on guideline criteria for impact magnitudes (set out in **Table 7-2**), effects will be predicted for the Proposed Development.

Table 7-2: Impact Magnitude

Sensitivity of Receptor	Definition
High	Significant change or the complete loss of key features of the baseline resource that cause post development characteristics or quality to be fundamentally and irreversibly changed e.g. development resulting in increased flood risk, PWS source pollution (during and post construction), groundwater or surface water quality or permanent changes to local surface and groundwater flow regimes.
Medium	Change or loss of key features of the baseline resource that cause post development characteristics or quality to be partially modified e.g. instream permanent bridge supports, temporary or non-material changes to local surface / groundwater flow regime, increased pollution potential / alteration of source volumes to remote PWS during construction only and localised change in groundwater or surface water quality.
Low	Small changes to the baseline resource, which can be identified but the intrinsic characteristics or quality of the baseline situation would have similarities to pre-development conditions e.g. culverting of very small (unmapped) watercourses / drains, temporary and / or very localised change in local surface / groundwater flow regime, very localised and temporary change in groundwater and surface water quality. Possible although very remote potential for change in PWS source quality / quantity.
Negligible	A very slight change from baseline conditions, which is hardly identifiable, and is similar to the 'no-change' situation e.g. new site drainage discharge from developed SuDS scheme to receiving watercourse, new land drainage measures to maintain hydraulic continuity between upgradient and downgradient of development site and no / negligible development in PWS source catchment.

7.4.14 In relation to the significance of the predicted effects the sensitivities of the baseline resource have been evaluated. A significance matrix was developed to establish a consistent framework for assessment, which is presented in **Table 7-3**.

Table 7-3: Effect Significance Matrix

		Magnitude of Change			
		High	**Medium**	**Low**	**Negligible**
Sensitivity of Receptor	High	Major	Major	Moderate	Minor
	Medium	Major	Moderate	Minor	Negligible
	Low	Moderate	Minor	Negligible	Negligible
	Negligible	Minor	Negligible	Negligible	Negligible

7.4.15 With reference to the Guidelines for Environmental Impact Assessment (as updated) (CIEEM, 2018) and based on professional judgement, effects of moderate or major significance are regarded as significant in terms of EIA. Unless stated otherwise, this chapter assumes that all effects will be adverse.

Limitations to Assessment

7.4.16 The Flood Estimation Handbook (FEH) Web service (UKCEH, 2024) does not analyse catchments less than 0.5km^2 and does not account for any in-channel artificial modifications to watercourses (e.g. culverting, weirs etc).

7.5 Baseline

Current Baseline

Climate

7.5.1 The nearest Met Office station is Mylnefied approximately 21km north-east of the Site. The station is located at a lower elevation (26m Above Ordnance Datum (AOD)) than the Site (52 to 65mAOD). The climate period averages are based on data covering the period from 1991-2020.

7.5.2 The standardised annual average rainfall (SAAR) of the region is 748.69mm (average rainfall from 1991-2020 for Mylnefield climate station) (Met Office, 2025). This value falls under the national average for Scotland (average Met Office statistics for 1981-2010 is 1570.9mm) (Met Office, 2025). The FEH data (refer to **Table 7-4**) at the Site indicates a slightly higher SAAR value than the average at the Mylnefield station.

Land Use

7.5.3 The Site is situated in a largely rural area. The land within the Proposed Development and its surroundings are comprised of agricultural land. The eastern section of the Site is bounded by an unnamed minor road. The residential properties of Haughs of Cossans House and Cottage are located just south of the Site.

7.5.4 The location of the Proposed Development is an area of variable elevation with slopes up to the west and east of the Site and an area of lower elevation in the centre of the Site.

Historic Land Use

7.5.5 According to National Library Historic Side by Side mapping (series: Great Britain: 25,000 (Outline), 1945-65) the Site has always been historically agricultural and natural land neighboured by the Haughs of Cossans House and Cottage to the south.

Designated Sites

7.5.6 There is one designated site of relevance to hydrology and flood risk within 1km of the Site. The River Tay SAC (associated with the Dean Water) runs through the wider study area. The nearest designated site with the exception of the River Tay SAC is the Forfar Loch Country Park 1.5km east of the Site. Beyond this, the Forest Muir exists approximately 4.4km north of the Site.

7.5.7 River Tay SAC includes the Dean Water which runs approximately 50m south of the Site boundary and therefore within the wider 1km study area. The River Tay SAC is designated for its clear-water lakes or lochs with aquatic vegetation and poor to moderate nutrient levels and its resident ecology which include sea lamprey, brook lamprey, river lamprey, Atlantic salmon and otters. The Proposed Development is within the Dean Water catchment and therefore the Proposed Development is in hydraulic connectivity with the River Tay SAC.

7.5.8 Forfar Loch Country Park is out with the wider 1km study area and is situated approximately 1.5km east of the Site. The Loch is sufficiently upstream of the Site and therefore not in hydrological connection.

7.5.9 Forest Muir SSSI is designated as it is one of the very few remaining unimproved areas of lowland heathland in Angus which supports a high diversity of plants and animals. Therefore, it is not considered to have high sensitivity to the hydrology of the area. Forest Muir is also not in the surface water catchment of the Dean Water. Therefore, there is no hydrological connection between the Proposed Development and Forest Muir SSSI.

Geology

Superficial

7.5.10 Review of the BGS online 1:50,000 superficial deposits map (BGS, 2025) indicates that underlying the east and west of the Site are glaciofluvial deposits comprised of gravel, sand and silt. The centre of the Site is underlain by lacustrine deposits comprised of clay, silt and sand.

7.5.11 Review of the Carbon and Peatland Mapping indicates that there is some Class 4 peatland (defined as "*Area unlikely to be associated with peatland habitats or wet and acidic type. Area unlikely to include carbon-rich soils."*) across the north and centre of the Site.

7.5.12 National Soil Mapping identifies the underlying component soils of the Site to be a combination of brown earths, alluvial soils and Humus-iron podzols.

Bedrock

7.5.13 Review of the BGS online 1:50,000 bedrock map indicates that the underlying bedrock geology of the entire site and surrounding area is made up of the Dundee Flagstone Formation comprised of sandstone, siltstone and mudstone.

Hydrogeology

7.5.14 Review of the BGS online 1:625,000 hydrogeology map indicates that the entirety of the site and surrounding area is underlain by the Arbuthnott-Garvock Group rock unit characterised by moderately productive aquifer summarised as '*sandstones, in places flaggy, with siltstones, mudstones and conglomerates and interbedded lavas, locally yield moderate amounts of groundwater'*.

7.5.15 The entirety of the Site and the surrounding area is part of the Strathmore groundwater body (ID: 150681). It is 573km^2 in area. Review of SEPA's Water Environment Hub (SEPA, 2025) indicates the WFD status of the underlying groundwater body is 'poor'.

Hydrology

7.5.16 The Site sits within the Dean Water catchment. The Dean Water is classified as a heavily modified water body and the WFD status of this watercourse is 'moderate' (SEPA, 2023).

7.5.17 Review of the Flood Estimation Handbook (FEH) Web Service and other available mapping shows that the Ballindarg Burn runs north to south through the centre of the Site. There are also a variety of minor watercourses/ field drains running through the Site. The Site is in the natural surface water catchment of the Dean Water (119.06km^2) which runs east to west approximately 200m south of the Site. The Site naturally drains to the Dean Water directly or via the Ballindarg Burn or other small watercourses / drains. The Kerbet Water runs south to north and discharges into the Dean Water some 300m south of the western extent of the Site.

7.5.18 The Loch of Forfar is approximately 1.5km northeast upstream of the Site.

7.5.19 A hydrological summary and catchment characteristics of the Dean Water upstream of the Site (US), the Bllindarg Burn, Kerbet Water and the Dean Water downstream of the site (DS) are shown in **Table 7-4** below. The data shown is taken from the FEH Web Service and the catchment has been delineated from the NGR: NO 39650 48800, a point just downstream of the site along the Dean Water.

Table 7-4: Hydrological Summary

Waterbody Catchment	Area (km^2)	SAAR (mm)	URBEXT2000 (%)	PROPWET	SPRHOST (%)	ALTBAR (m)
Dean Water (DS)	119.06	830	0.0209	0.37	39.25	124
Ballindarg Burn	33.35	832	0.0134	0.42	37.48	106

Waterbody Catchment	Area (km^2)	SAAR (mm)	URBEXT2000 (%)	PROPWET	SPRHOST (%)	ALTBAR (m)
Kerbet Water	146	838	0.0007	0.36	41.38	146
Dean Water (US)	17.7	802	0.0787	0.36	36.3	83

7.5.20 PROPWET represents a measure of the proportion of time that catchment soils are defined as wet (the FEH defines 'wet' as being when soil moisture deficits are less than 6 mm). PROPWET values range from over 80% in the wettest catchments to less than 20% in the driest parts of the country. The values for the catchments in Table 7-4 are therefore in the low-mid range.

8.5.24 SAAR6190 is a measure of average annual rainfall in the standard period (1961-1990) in mm. In Scotland, SAAR values can vary from ~600mm in drier parts of the country (east coast / Moray) to ~ 3500mm in the highlands and islands, west coast and northwest highlands. The values for the catchments in Table 7-4are therefore in the low-mid range.

7.5.21 URBEXT2000 is an index of urban and suburban land cover in 2000 expresses as a fraction. The values for the catchments in **Table 7-4** indicate that local catchments are largely rural.

7.5.22 SPRHOST is a standard percentage runoff (%) associated with each HOST soil class. This can be used to derive SPRHOST over a catchment. SPRHOST can be derived from flow data where available. The values for the catchments in Table 7-4indicate that local catchments have a moderate to high runoff potential.

7.5.23 ALTBAR is a measure of mean catchment altitude (m above sea level), derived from the Integrated Hydrological Digital Terrain Model (IHDTM). The values for the catchments in Table 7-4 indicate that local catchments are considered lowland.

Flooding

7.5.24 Potential flood sources affecting the Proposed Development are summarised in **Table 7-5**. According to the Angus Council SFRA there have been multiple historic flood events in Forfar (approximately 3km east of the Site) in December 2012 and January 2013. These flood events were attributed to surface water flooding issues related to the height of water levels in Forfar Loch. It is also noted in the SFRA that Angus Council has since undertaken works to lower water levels. During Storm Babet in October 2023, the local area experienced severe flooding and the Site experienced flooding.

Table 7-5: Pre-development flood risk from all sources of flooding

Flood Source	Potential Risk	Description
Coastal Flooding	No risk	The Site is located sufficiently inland (>20km) from tidally influenced waters of the Tay Estuary and the coast at some 60mAOD. A review of the SEPA Coastal Flood map indicates that the Site is outside the mapped coastal flooding extent.

Flood Source	Potential Risk	Description
		Therefore, there is less than 0.1% risk in any given year of coastal flooding at the Site.
Fluvial Flooding	Low to High Risk	A review of SEPA's Fluvial Flood Map for the Site indicates that the central area of the Site as well as areas along the southern Site boundary are at low to high risk (0.1-10% per year) of flooding from fluvial sources. The eastern and western extents of the Site are indicated to be outside mapped fluvial flooding extent. It is noted that SEPA flood maps are only indicative and are modelled on a regional scale, this reduces their accuracy when defining flood extents at a local level. Therefore, a site-specific flood model was required and considered as part of the Flood Risk and Drainage Assessment (FRDA) appended in **Technical Appendix 7.1**.
Groundwater Flooding	Low Risk	A review of SEPA's Groundwater Flood Map shows that the Site and surrounding area are located in an area identified to be at low risk of groundwater flooding. Despite Angus Council SFRA describing groundwater as a significant part of flooding issues in the area, the historic floods in Forfar have been accounted to surface water, and Forfar has not been flagged as an area at particular risk from groundwater flooding. Therefore, it is considered that the Proposed Development is at 'Low Risk' of groundwater flooding.
Surface Water (pluvial) Flooding	Low Risk	A review of SEPA's Surface Water Flood Map shows that there are pockets of low to high risk of surface water flooding across the Site associated with the fluvial flooding extents. The most prolific of these areas is at an area along the north Site boundary which lies at the foot of slopes to the south and west and is therefore a topographic depression which is also noted in the fluvial flood extents. Other small pockets of surface water flooding exist across the Site, however, these are in small topographic depressions and are highly localised. It is to be noted that the surface water flooding is interlinked with fluvial flooding therefore any risk of flooding from land sources is encompassed within the fluvial assessment. Therefore, it is considered that there is Low Risk of flooding to the Site from land.
Sewers/ Drainage Systems	No Risk	After a review of the Scottish Water GIS Extranet, due to the rural nature of the Site there are no existing sewers or drainage systems present in proximity to the Site.
Infrastructure	No Risk	A review of the SEPAS's Flood Map indicates that the Site is out with the maximum extent of flooding from reservoirs.

Coal Mining

7.5.25 The Interactive Coal Authority Map (Mining Remediation Authority, 2023) indicates that the Site does not lie within a Coal Mining Reporting Area. Therefore, coal mining falls outside the scope of this assessment.

Future Baseline

Climate Change

7.5.26 Regardless of the Proposed Development, peak rainfall intensity, sea levels and peak river flow are all projected to rise in the future. This projection is based on climate change forecasts and various scenarios of carbon dioxide emissions into the atmosphere, with different allowances for distinct time periods over the next century.

7.5.27 The potential fluvial flood risk to the Site from the Ballindarg Burn, Dean Water and Kerbet Water could be increased by rising peak level flow. Peak rainfall could increase surface water flooding. Climate change has been appropriately factored into the proposed drainage design, flood model and scenarios for Proposed Development (refer to **Technical Appendix 7.1**).

7.5.28 **Table 7-6** below sets out the climate change allowances for the River Tay Basin Region as described by SEPA.

Table 7-6: Climate Change uplift for the Tay Basin

Descriptor	Time Frame	Projected Allowance
Peak River Flow	Total Change to 2100	53%
Peak Rainfall Intensity	Total Change to 2100	39%

Future Development

7.5.29 In the absence of the Proposed Development no significant changes to the hydrology and flood risk of the Site are expected to occur.

7.6 Scope of the Assessment

Spatial Scope

7.6.1 The study area will incorporate the land within the red line boundary, within a wider study area of 1km for hydrological and flood risk receptors near the site. This study area has been selected based on the scale of the Proposed Development and the author's professional judgement.

7.6.2 Where there are potential effects identified on sensitive hydrological receptors, the downstream effects of these are also considered which may extend out with the above described 1km study area.

Temporal Scope

7.6.3 This assessment assesses the Proposed Development over its entire lifetime from construction through to operational and decommissioning.

Receptors Requiring Assessment

7.6.4 The following receptors are considered for assessment:

- Hydrology (surface water) is considered to have **low** sensitivity reflecting the watercourses within the study area and the 'moderate' condition of the Dean Water to which the other watercourses that drain the Site discharge (Ballindarg Burn and Kerbet Water);
- The designated site River Tay SAC is considered to have **high** sensitivity reflecting the hydraulic connection between the SAC and the Site. The River Tay SAC in relation to the Proposed Development is essentially the Dean Water and therefore will be affected by the same risk and mitigation as the watercourse. As such, the designated site will be further assessed as part of the hydrology (surface water) receptor.
- Flood risk is concluded to have a **high** sensitivity as it has been concluded that the Site is at **low** to **high** risk of flooding from fluvial sources (as discussed in **Section 7.5**) and therefore within a 'flood risk area' as set out within Policy 22 of NPF4. As such, the flood risk of the Site requires further assessment; and
- Hydrogeology (groundwater) is considered to have a **medium** sensitivity reflecting the 'poor' WFD status and high productivity of the underlying groundwater body and the moderate permeability of the underlying superficial deposits.

Environmental Measures Embedded into the Development Proposals

7.6.5 Embedded mitigation proposals are those mitigation measures that are inherent to the Proposed Development. Embedded mitigation includes all mitigation usually assumed to be in place during construction, operation and decommissioning, and is generally regarded as industry standard or Best Practice. Construction and environmental management plans are introduced in **Chapter 3: Proposed Development Description** with an outline Construction Environmental Management Plan (CEMP) provided **in Technical Appendix 3.1: Outline CEMP**.

7.6.6 Best practice and standard mitigation techniques to be adopted in the interest of protecting the local hydrology/ hydrogeology, water environment and ground conditions include:

- Maintaining a suitable buffer to local watercourses;
- Incorporation of suitable drainage design measures and principles ensure that discharge rates and water quality is controlled to appropriate standards prior to discharge to the water environment. This will ensure that the receiving water environment is not adversely affected by drainage and run off from the Site;
- Ensuring any construction / operational wastewater drainage is disposed of appropriately;
- A Construction Environmental Management Plan (CEMP) will mitigate effects on local hydrology/hydrogeology, water environment and ground conditions. The CEMP will prevent adverse impact downstream of the Site during the construction phase to people, property and the environment. It is important to note that the outline CEMP is a "live" document, which will undergo periodic review and updates. The relevant mitigation measures for controlling water quality impacts during construction, as part of the outline CEMP, are outlined in **Section 7.7** below;

- All earthmoving works or similar operations will be completed in agreement with British Standards Institution (BSI) Code of Practice for Earth Works BS6031:2009;
- All Site discharges and temporary water abstractions will be regulated under the CAR licensing regime, and all required licenses will be obtained from SEPA before any operations commence on-site; and
- Although it is acknowledged that the ideal approach to minimise runoff is to schedule construction and dismantling during the driest period of the year, however managing heavy rainfall during construction is always a possibility, leading to surface water runoff during the construction phase. As a result, Site management will review the local weather forecast daily and ensure all Site personnel are informed of their responsibilities, including maintaining the pollution control system during wet weather or halting sensitive operations when adverse weather conditions do occur.

7.6.7 To ensure the Proposed Development can be developed in accordance with NPF4 Policy 22 (Flood Risk and Water Management), it must be demonstrated that the site is suitable protected against flooding and does not increase flood risk to others. **Technical Appendix 7.1** provides further details of the detailed flooding assessment undertaken and the flood mitigation proposed to protect the Proposed Development. The findings of the assessment and its outcomes are summarised as follows:

- A detailed technical assessment of fluvial flooding at the Site has been undertaken in the form of a detailed Site-specific Hydraulic Flood Modelling Study to accurately assess the potential flood risk to the Site.
- The technical assessment developed consisted of a 2D hydraulic model using the Hydrologic Engineering Centre's River Analysis System (HEC-RAS).
- During the 200-year plus climate change event, flood depths within the site vary between approximately 0m – 1.3m with the maximum flood depth within the site being approximately 1.3m located along the northern boundary of the centre of the site. However, the majority of the flooding of the site is under 0.9m.
- The proposed site design has been developed to ensure all ground based equipment (battery storage and invertor stations) are located outside all modelled flood extents. Solar panels are to be raised 1.2m above ground levels and only located in areas of flood depths of 0.9m or less. This approach ensures all panels will be elevated at least 300mm above design flood levels.

7.6.8 With respect to battery energy developments, NFCC guidance requires appropriate measures to be implemented to ensure that any risk of battery fires can be managed appropriately. As such, it is standard practice that all BESS developments consider the risk of battery fire and implement appropriate measures to minimise the risk of fires starting and ensure if a fire were to break out, it can be safely managed and that any risks to the local water environment area managed. The includes:

- Preparation of a Safety Management Plan to establish key principles of safe design, operation and emergency protocols.
- Site design in accordance with NFCC guidance to minimise risk of fire spreading.

- Preparation of firewater management plan (FWMP) to ensure a suitable fire fighting supply is available and potential contaminated firewater runoff is managed.
- A FWMP has been prepared (**Technical Appendix 7.2**) which outlines full containment measures within the proposed drainage systems and provision of a water supply system through water tanks and fire hydrants.

CEMP

7.6.9 Below are measures of mitigation that will ensure water quality impacts are controlled during the construction phase. These mitigation measures consider the Water Resources Act 1991 (UK Government, 1991) and the CIRIA C532 (CIRIA, 2001). Additionally, good practice guidelines outlined in the relevant GPPs have been adhered to.

7.6.10 General mitigation measures during construction:

- Conducting a pollution risk assessment of the Site;
- Identifying all Controlled Waters that may be affected by the works;
- Implementing a pollution control system during earthworks and construction; and
- Maintain risk management by monitoring construction procedures.

7.6.11 Excavation mitigation measures include:

- Precaution to avoid services and existing culverts;
- Preventing runoff from entering excavations; and
- Ensure dewatering of these areas is directed away from the water environment.

7.6.12 Concrete Mitigation measure include:

- Control of surface water runoff and water quality testing;
- Designated wash out facilities;
- Covering of freshly laid concrete to prevent runoff; and
- Emergency response plans in the event of a concrete spillage.

7.6.13 Sediment Management Mitigation measures include:

- Control of stockpiles and excavations via sediment interception measures at bases;
- Suitable topsoil storage; and
- Introduction of a traffic management plan.

7.6.14 Surface water runoff generated during the works would be properly managed and treated to avoid any adverse impact on the environment, especially controlled waters. Standard techniques, such as settlement units, would be used to remove oils and suspended particles from the water before discharge. The treated runoff

would be directed to a suitable location, with an approved discharge consent in place before work begins.

7.7 Assessment of Potential Effects

Construction Effects

Changes to Groundwater

7.7.1 As previously mentioned in **Section 7.6**, the centre of the Site is comprised of clay deposits, whilst the eastern and western parts of the Site are comprised of sand, silt and gravel. Therefore, transmission of runoff to the underlying bedrock aquifer is likely to be partially inhibited by the presence of clay and silt. The aquifer is considered to have moderate productivity (refer to **Section 7.6**).

7.7.2 Construction activities are largely limited to stockpiling and creation of temporary hardstanding areas/ compounds. Although identified as moderate productivity, groundwater at the Site has a moderate recharge rate (refer to **Section 7.6**). Therefore, the potential for interaction with the groundwater is low given that no deep foundations or excavations are required and given the Site geology.

7.7.3 Furthermore, as noted in **Section 7.7**, good construction practices would be set out in the CEMP and fully implemented to minimise the risk of pollution to hydrogeological receptors.

7.7.4 With consideration of embedded mitigation, the magnitude of change to hydrogeology is considered **negligible** on a receptor with **medium** sensitivity. As a result, there is potential for a short-term effect of **negligible** adverse significance and therefore **not significant**.

Pollution Impact from Sediment Run-off/ Transport or Chemical Contaminated Run-off

7.7.5 Surface runoff containing silt and other sediments, particularly during or after rainfall, could potentially flow into the Site drains on the Proposed Development. This silt and sediment laden runoff is expected to originate from excavations, exposed ground, and temporary stockpiles. Pollutants from construction such as oils, fuel and cement could also be carried into the surface drainage system due to mechanical leaks or spills. In the absence of any mitigation, an increase in pollutants may temporarily impact water quality and hydrological and ecological function of the receiving watercourses both at the Site as well as downstream.

7.7.6 As mentioned in **Section 7.7**, standard construction practice measures would be set out in a CEMP and fully implemented to minimise the risk of pollution to surface watercourses.

7.7.7 With consideration of embedded mitigation, the magnitude of change to the local hydrology, is considered **negligible** on a receptor with **low** sensitivity. As a result, there is potential for a direct, temporary, short-term effect of **negligible** adverse significance and therefore **not significant**.

7.7.8 With consideration of embedded mitigation, the magnitude of change to the designated site (River Tay SAC), is deemed **negligible** on a receptor with **high** sensitivity. As a result, there is potential for an indirect, temporary, short-term effect of **minor** adverse significance and therefore **not significant**.

Direct Discharge of Untreated Foul Drainage

7.7.9 Unless appropriately sited and managed, there is a potential for direct discharge of untreated foul sewage from welfare facilities during construction to impact hydrological and hydrogeological receptors within the wider study area.

7.7.10 Appropriate welfare facilities shall be provided on Site, and details will be outlined within the CEMP regarding the disposal of collected wastewater to ensure this does not discharge to the water environment untreated.

7.7.11 With consideration of embedded mitigation, the magnitude of change to the local hydrology, is deemed **negligible** on a receptor with **low** sensitivity. As a result, there is potential for a direct, temporary, short-term effect of **negligible** adverse significance and therefore **not significant**.

7.7.12 With consideration of embedded mitigation, the magnitude of change to the designated site (River Tay SAC), is deemed **negligible** on a receptor with **high** sensitivity. As a result, there is potential for a indirect, temporary, short-term effect of **minor** adverse significance and therefore **not significant**.

Operational Effects

Flood Risk

7.7.13 The Proposed Development has the potential to increase surface water runoff. If not managed appropriately, this has the potential to impact on the local hydrology and flood risk within the Site.

7.7.14 Provision of a permanent surface water drainage strategy shall provide appropriate attenuation and runoff control measures for operational runoff prior to discharge to the water environment.

7.7.15 The Proposed Development has the potential to increase flood risk to offsite receptors if infrastructure results in the displacement of floodwaters.

7.7.16 By implementing the proposed flood mitigation design, the Proposed Development shall be suitably protected against flooding whilst ensuring no increase in flood risk to offsite receptors

7.7.17 With consideration of embedded mitigation, the magnitude of change to local flood risk is deemed **negligible** on a receptor with **high** sensitivity. As a result, there is potential for a direct temporary, long-term effect of **minor** adverse significance and therefore **not significant**.

Pollution Impact from Sediment Run-off/ Transport or Chemical Contaminated Run-off

7.7.18 Surface water runoff containing silt and other sediment from developed areas has the potential to impact hydrological and hydrogeological receptors at the Site. Silt and sediment-laden runoff is predicted to be significantly lower during the operational phase than during the construction phase but may still occur due to the presence of developed areas. This has the potential to impact on the water quality and ecological function of the receiving watercourses and local groundwater body in the absence of any mitigation. Additionally, pollutants such as oils and fuel may be mobilised through mechanical leaks or spillage and impact the local water environment. Further potential risks are associated with the unlikely event of a battery fire and potentially contaminated firewater runoff entering the local water environment.

7.7.19 Provision of a permanent surface water drainage strategy shall provide appropriate attenuation and runoff control measures for operational runoff prior to discharge to the water environment. Additionally, the FWMP ensures full containment of any potentially contaminated firewater runoff from the development.

7.7.20 With consideration of embedded mitigation, the magnitude of change to the local hydrology, is deemed **negligible** on a receptor with **low** sensitivity. As a result, there is potential for a direct, temporary, long-term effect of **negligible** adverse significance and therefore **not significant**.

7.7.21 With consideration of embedded mitigation, the magnitude of change to the designated site (River Tay SAC), is deemed **negligible** on a receptor with **high** sensitivity. As a result, there is potential for an indirect, temporary, long-term effect of **minor** adverse significance and therefore **not significant**.

Groundwater Changes

7.7.22 Groundwater flow can be disrupted by the construction of building foundations. Foundations can act as impermeable barriers blocking flow. However, operational requirements only include the creation of temporary hardstanding areas/ compounds. In addition, although identified as high productivity, groundwater at the Site has a moderate recharge rate (refer to **Section 7.6**). Therefore, the potential for interaction with the groundwater is low given that no deep foundations or excavations are required and the Site geology.

7.7.23 With consideration of embedded mitigation, the magnitude of change to hydrogeology is considered **negligible** on a receptor with **medium** sensitivity. As a result, there is potential for a long-term effect of **negligible** adverse significance and therefore **not significant**.

Decommissioning Effects

7.7.24 This assessment assumes that the operational lifespan of the Proposed Development would be 42 years, after which it would be appropriately decommissioned. The potential effects of the decommissioning stage on identified

receptors are considered to be fewer than those at construction stage and typically of a lesser magnitude in terms of scale and effect.

7.8 Mitigation

7.8.1 There are no additional mitigation methods or enhancements being considered as any potential impacts will have been mitigated through site design (including flood mitigation) and preparation of a drainage strategy along with the implementation of a CEMP.

7.9 Assessment of Residual Effects

7.10 There is not considered to be any other residual effects, and as such will not be considered.

7.11 Assessment of Cumulative Effects

7.11.1 There are two consented solar developments, Suttieside Solar Farm and Craiganthro Solar Farm, identified as possible cumulative effects (operational phase only) of the Proposed Development.

7.11.2 Suttieside Solar Farm is located approximately 4250m northeast from the Proposed Development. Runoff from the solar farm will drain downgradient east as it is within the natural surface water catchment of the Lemno Water. Therefore, the hydrology of Suttieside Solar Farm will not have a significant cumulative effect on the hydrology and flood risk of the Proposed Development.

7.11.3 Craiganthro Solar Farm is located approximately 4250m southeast of the Proposed Development. Surface runoff from this site will likely shed downgradient south of the Site into the Spittal Burn (approximately 1km south of the site), which some 3km downstream discharges into the Kerbet Water which is hydrologically associated with the Site (refer to **Technical Appendix 7.1**). The Kerbet Water discharges into the Dean Water some 300m south of the Site and 5.5km downstream of where the Spittal Burn joins the Kerbet Water. Therefore, the hydrology of the Craiganthro Solar Farm could potentially have a cumulative effect on the Proposed Development. However, due to the location of the Kerbet Water and distance and river reach between the Proposed Development and Craiganthro Solar Farm being large, the cumulative effect is expected to be Negligible in the long-term.

7.11.4 Therefore, it is unlikely that the Proposed Development will have significant cumulative impact on the local hydrology and flood risk.

7.12 Summary

7.12.1 Information on hydrology and flood risk within the Study Area has been collected through a combination of desktop review and on-site surveys.

7.12.2 The Dean Water flows east to west approximately 50m south of the Site. The Ballindarg Burn flows north to south through the centre of the Site before

discharging into the Dean Water. The Kerbet Water flows south to north and discharges into the Dean Water 50m south of the Proposed Development. The Site sits within the Dean Water catchment with surface water eventually draining into the Dean Water.

7.12.3 The desk study has determined flood risk to the Site to be low to high due to fluvial sources and no to low risk from all other sources.

7.12.4 The site is underlain by a moderately productive bedrock aquifer.

7.12.5 The River Tay Special Area of Conservation is located to the south of the site and associated with the Dean Water.

7.12.6 Mitigation measures that are part of the of the Proposed Development design process have been included in the assessment. These include provision of a Flood Mitigation Design and Drainage Strategy for the operational development and provision of a CEMP to minimise and mitigate any adverse effects during construction.

7.12.7 A number of potential impacts on receptors associated with the construction, operational and decommissioning phases of the Proposed Development were identified. These included impacts on hydrology, hydrogeology and flood risk. With the proposed mitigation measures in place, these impacts result in effects of negligible adverse significance and therefore not significant in EIA terms.

Table 7-7: Summary Table

Description of Effect	Significance of Potential Effect		Mitigation Measures	Significance of Residual Effect	
	Significance	Beneficial / Adverse		Significance	Beneficial / Adverse
During Construction & Decommissioning					
Changes to groundwater	*Negligible*	*Adverse*	*None required (refer to embedded mitigation)*	*Negligible*	*Adverse*
Pollution impact from sediment run-off/ transport to hydrology	*Negligible*	*Adverse*	*None required (refer to embedded mitigation)*	*Negligible*	*Adverse*
Pollution impact from sediment run-off/ transport to designated sites	*Minor*	*Adverse*	*None required (refer to embedded mitigation)*	*Negligible*	*Adverse*
Direct discharge of untreated foul drainage to hydrology	*Negligible*	*Adverse*	*None required (refer to embedded mitigation)*	*Minor*	*Adverse*
Direct discharge of untreated foul drainage to designated sites	*Minor*	*Adverse*	*None required (refer to embedded mitigation)*	*Negligible*	*Adverse*
During Operation					
Flood Risk	*Minor*	*Adverse*	*None required (refer to embedded mitigation)*	*Minor*	*Adverse*
Pollution impact from sediment run-off/ transport or chemical contaminated run-off to hydrology	*Negligible*	*Adverse*	*None required (refer to embedded mitigation)*	*Minor*	*Adverse*
Pollution impact from sediment run-off/	*Minor*	*Adverse*	*None required (refer to embedded mitigation)*	*Negligble*	*Adverse*

Description of Effect	Significance of Potential Effect		Mitigation Measures	Significance of Residual Effect	
	Significance	Beneficial / Adverse		Significance	Beneficial / Adverse
transport or chemical contaminated run-off to designated sites					
Long-term groundwater changes	*Negligble*	*Adverse*	*None required (refer to embedded mitigation)*	*Minor*	*Adverse*
Cumulative Effects					
None.					

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