Proposed Solar PV Development

Byers Gill Solar
EN010139

6.2.10 Environmental Statement Chapter 10 Hydrology and Flood Risk

Planning Act 2008

APFP Regulation 5(2)(a)

Infrastructure Planning (Applications: Prescribed Forms and Procedure) Regulations 2009

Volume 6

February 2024

Revision C01

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10. Hydrology and flood risk

10.1 Introduction

10.1.1. This Environmental Statement (ES) chapter presents the impact assessment and likely significant effects of Byers Gill Solar (the Proposed Development) on hydrology and flood risk.

10.1.2. The Environmental Impact Assessment (EIA) Scoping Report (ES Appendix 4.1) (Document Reference 6.4.4.1) sets out the scope of the hydrology and flood risk assessment. In summary, the following have been assessed in this ES:

- effects of water quality on surface water, groundwater, designated sites and water abstractions; and
- water resources, covering fluvial flood risk and surface water drainage.

10.1.3. This ES chapter:

- details the requirements of principal legislation, policy and guidance relevant to this assessment;
- details the methodology followed for the assessment, and any associated assumptions and limitations;
- describes the existing environment surrounding the Proposed Development; and
- describes the potential effects of the Proposed Development on hydrology and flood risk and details the mitigation measures considered necessary.

10.1.4. This ES chapter is supported by the following appendices:

- ES Appendix 10.1 Flood Risk Assessment and Drainage Strategy (Document Reference 6.4.10.1); and
- ES Appendix 10.2 Water Framework Directive Assessment (Document Reference 6.4.10.2).

10.1.5. This ES chapter is also supported by ES Figures 10.1 to 10.7 (Document Reference 6.3.10.1 to 6.3.10.7).

10.1.6. This ES Chapter should be read in combination with ES Chapter 6 Biodiversity (Document Reference 6.2.6) and ES Chapter 8 Cultural Heritage and Archaeology (Document Reference 6.2.8) to provide a full understanding of the context and the likely impacts of change to water quality on aquatic ecology and a change in groundwater levels on the preservation of buried archaeology. Resilience to impacts from climate change has been assessed within ES Appendix 5.2 Climate Change Resilience (CCR) Assessment (Document Reference 6.4.5.2). The assessment of cumulative effects for Hydrology and Flood Risk can be found in ES Chapter 13 Cumulative Effects (Document Reference 6.2.13).

10.1.7. This ES chapter and the supporting ES Appendices and ES Figures have been prepared by competent experts at Wallingford HydroSolutions. Full details of these competent experts are provided in ES Appendix 1.1 Competent Expert Evidence (Document Reference 6.4.1.1).

10.2 Legislative and policy framework

10.2.1 This section identifies the key legislation, planning policy and guidelines relevant to the scope and methodology for the hydrology and flood risk assessment.

Legislation

10.2.2 The following key legislation is applicable to the assessment:

- Water Act 2003;
- Water Act 2014;
- Land Drainage Act 1991;
- Water Industry Act 1991;
- Water Resources Act 1991;
- Environmental Permitting (England and Wales) Regulations 2016;
- Control of Pollution (Oil Storage) (England) Regulations 2001;
- Environmental Damage (Prevention and Remediation) Regulations 2015;
- The EC Groundwater Directive (2006/118/EC);
- The EC Nitrates Directive (91/676/EEC);
- The EU Priority Substances Directive (2013/39/EU);
- The Conservation of Habitats and Species Regulations 2017 (which implement the EC Habitats Directive 92/43/EEC);
- The Flood Risk Regulations 2009 (which implement the EC Flood Directive 2007/60/EC);
- Flood and Water Management Act 2010; and
- Environment Act 2021.

10.2.3 The Water Framework Directive (2000/60/EC) (WFD), has the main objectives of protecting, enhancing and restoring Europe's waters, with the aim of achieving 'good' status, establishing a baseline of no deterioration and encouraging the sustainable use of water resources and the water environment. This directive resulted in the Water Environment (Water Framework Directive) (England and Wales) Regulations 2017, which transposed the WFD into law in England and Wales and provided a timetable for its implementation.

10.2.4 The water quality of England's rivers is classified by the Environment Agency (EA), which has developed a classification scheme for surface waters following the requirements of the WFD, as part of the River Basin Management Plans (RBMP). This

classification scheme assesses the quality of aquatic ecosystems within rivers, lakes, estuaries and coastal waters and the extent to which they have been adversely affected.

10.2.5 The scheme assesses the condition of each river, lake, estuary and coastal water and assigns it a 'status' from high, good, moderate, poor, and bad. If a water body is classified as high or good status, then it has a healthy ecology which deviates only slightly from natural conditions. Such a water body is an important natural heritage asset and can support a wide range of uses such as recreation, fishing and drinking water supply. If a water body is classified as moderate, poor or bad, then the ecology is adversely affected and the range of uses which can be supported is reduced.

10.2.6 As part of the RBMPs, water body data is published by the EA containing details of the current water body classification, current pressures on the water body and measures to address these and classification objectives for 2021 and 2027.

Policy

10.2.7 Under Section 104 of the Planning Act 2008 (the Act), the Secretary of State (SoS) is directed to determine a Development Consent Order (DCO) application with regard to the relevant National Policy Statement (NPS), the local impact report, matters prescribed in relation to the Proposed Development, and any other matters regarded by the SoS as important and relevant. Following their designation on 17 January 2024, there are three NPSs which are considered to be 'relevant NPS' under Section 104 of the Act:

- Overarching NPS for energy (NPS EN-1)
- NPS for renewable energy infrastructure (NPS EN-3)
- NPS for electricity networks infrastructure (NPS EN-5)

10.2.8 It is considered that other national and local planning policy will be regarded by the SoS as 'important and relevant' to the Proposed Development. A detailed account of the planning policy framework relevant to the Proposed Development is provided in the Planning Statement (Document Reference 7.1). The Policy Compliance Document (Document Reference 7.1.1) evidences how this assessment has been informed by and is in compliance with the NPSs and relevant national and local planning policies. It provides specific reference to relevant sections of the ES which address requirements set out in policy.

Guidance

10.2.9 The following guidance has informed the assessment:

- Design Manual for Roads and Bridges (DMRB) LA113 - Road drainage and the water environment [1];
- The Chartered Institute of Ecology and Environmental Management (CIEEM) Guidelines for Ecological Impact Assessment [2];
- Planning practice guidance on flood risk and coastal change [3];

- The CIRIA Environmental Good Practice on Site [4] ;
- Control of Water Pollution from Construction Sites [5].

10.2.10 Where appropriate, informed professional judgement has been used, primarily in relation to geomorphology, where there is a lack of published guidance to date.

10.3 Scoping and Consultation

10.3.1 This section describes the scope of this hydrology and flood risk assessment, including how the assessment has responded to the Scoping Opinion. A description of the consultation and engagement undertaken with relevant technical stakeholders to develop and agree this scope is also provided.

Scoping

10.3.2 The EIA Scoping Report set out the proposed scope and assessment methodologies to be employed in the EIA and is provided in ES Appendix 4.1 EIA Scoping Report (Document Reference 6.4.4.1).

10.3.3 In response to the EIA Scoping Report, a Scoping Opinion was received from the Planning Inspectorate (PINS) on 6 December 2022 and is provided in ES Appendix 4.2 EIA Scoping Opinion (Document Reference 6.4.4.2)

10.3.4 ES Appendix 4.3 EIA Scoping Opinion Response Matrix (Document Reference 6.4.4.3) contains a table that outlines all matters identified by PINS in the EIA Scoping Opinion and how these have been addressed in the ES or other DCO application documentation.

Consultation

10.3.5 Engagement in relation to hydrology and flood risk has been undertaken with a number of stakeholders throughout the EIA process. The stakeholders consulted were:

- Stockton-on Tees Borough Council Lead Local Flood Authority (LLFA);
- Darlington Borough Council LLFA;
- Environment Agency (EA); and
- Local Property Owners.

10.3.6 The Consultation Report (Document Reference 5.1) submitted alongside the DCO application contains a full account of the previous statutory consultation process and issues raised in feedback. Matters raised regarding the scope, methodology or mitigation considered as part of the hydrology and flood risk assessment were then subject to further discussions directly with stakeholders.

10.3.7 Table 10-1 provides a summary of engagement with relevant stakeholders which has been undertaken to inform the EIA.

Table 10-1 Stakeholder engagement relating hydrology and flood risk

Stakeholder	Comments	Response
Stockton-on-Tees and Darlington LLFA	▪ Meeting held on 10 February 2023. Agree that no formal sustainable drainage systems (SuDS) features such as engineered pipe runs, manholes and storage features are required to attenuate runoff for this development. ▪ Agree that any panels located within the flood zone can be raised above the flood level with no further mitigation.	▪ Agreed
Stockton-on-Tees and Darlington LLFA	▪ Meeting held on 10 February 2023. Consider that the flood depths shown by the pluvial mapping in Panel Area C (Square Wood) are incorrect as the mapping doesn't take into account topography and existing drainage corrects. ▪ Meeting held on 14 November 2023 to discuss the implication of proposing ballast slabs under some panels on the surface water drainage strategy. This has since been addressed in this chapter but a response from both LLFAs is yet to be received.	▪ Pluvial mapping - Agreed ▪ Ballast slabs – Agreed in principle with Darlington. Awaiting response from Stockton-on-Tees
EA	▪ Meeting held on 16 August 2023. Assessment of risk to groundwater flooding and quality could be improved by reviewing available groundwater and contour and level data. ▪ Meeting held on 16 November 2023 following updates made after previous meeting. The updates made were sufficient with some minor comments remaining which have since been addressed.	▪ Agreed, data requested and incorporated into this ES Chapter
Property Owners	▪ Request for information sent to local property owners via letters sent on 25 September 2023 on any private water supplies to inform the hydrology and flood risk assessment.	▪ Data returned via provided forms

10.4 Assessment Methodology

10.4.1 This section outlines the methodology employed for assessing the likely significant effects on hydrology and flood risk from the construction, operation and decommissioning of the Proposed Development.

Baseline methodology

10.4.2 Information used to characterise the baseline environment has primarily been sourced through desk study. Sources used include:

- British Geological Society (BGS) Geology Viewer [6];
- EA Flood Risk Maps [7];
- EA Catchment Data Explorer [8];
- GeoSmart Groundwater Flood Risk Map [9];

- EA Groundwater Contours [10];
- EA Groundwater Levels [11];
- Magic Maps [12]; and
- LiDAR [13].

10.4.3 In addition to the desk study, a site walkover was undertaken on the 16 and 17 February 2023. The aim of the walkover was to ground truth the mapped data and identify any receptors which may not have been picked up as part of the desk study. The walkover also included consultation with landowners to identify unmapped land drainage within the Order Limits.

Assessment of effects

10.4.4 The sensitivity of the baseline environment has been assessed using the criteria defined in Table 10-2. The criteria for the determination of the sensitivity of receptors has been established based upon available guidance, legislation, statutory designation and/or professional judgement.

Table 10-2 Assessment of sensitivity

Receptor Sensitivity	Criteria
High	▪ The receptor has low capacity to absorb change without fundamentally altering its present character. ▪ The receptor is of very high environmental value and/or National or International ecological status (i.e. Site of Special Scientific Interest (SSSI), Special Area of Conservation (SAC) and Ramsar Sites). ▪ Environmental equilibrium is precarious and highly sensitive to change. ▪ Designated fishery or used for other freshwater ecological interests. ▪ Active floodplain. ▪ Land use includes essential infrastructure or highly vulnerable or more vulnerable development (as defined in Annex 3 of the Planning Practice Guidance [3]) ▪ Abstractions for public water supply; or abstractions for private water supply supplying more than 10m3/day for human consumption or serves more than 50 persons. ▪ Watercourse widely used for activities relating to water quality (e.g. fisheries, swimming, etc).
Medium	▪ The receptor has moderate capacity to absorb change without significantly altering its present character. ▪ The receptor has some environmental importance. Local or Regional ecological status (i.e. Good or Moderate water body status or target objective). ▪ Environmental equilibrium is stable and copes well with natural fluctuations. ▪ Contains some flood alleviation features. ▪ Land use includes less vulnerable development (as defined in Annex 3 of the Planning Practice Guidance [3]) ▪ Abstractions for private water supplies supplying less than 10m3/day for human consumption or serves less than 50 persons. ▪ Watercourse is not widely used for activities relating to water quality.

Receptor Sensitivity	Criteria
Low	▪ The receptor is tolerant of change without detriment to its character and is of low environmental value. ▪ Low ecological status (i.e. Poor or Bad water body status and not subject to higher target objectives). ▪ Environmental equilibrium is stable and resilient to changes greater than natural fluctuations. ▪ Land use includes water compatible development (as defined in Annex 3 of the Planning Practice Guidance [3]). ▪ Fish sporadically present or restricted. ▪ Does not contain any flood alleviation features. ▪ No abstractions for private water supply. ▪ Watercourse is not used for activities relating to water quality.

10.4.4 The assessment of impacts as a result of the Proposed Development was then conducted using the following process.

- Examination of infrastructure design, construction, operational and decommissioning methodologies;
- Identification of potential impacts using the criteria presented in Table 10-3, differentiated between short term construction impacts and long term operational and design impacts for each direct and indirect receptor;
- Identification of potential significant effects using the significance criteria outlined in Table 10-4.
- For each potential effect, identification of mitigation measures to avoid, minimise or remedy any adverse impacts and enhance any beneficial impacts; and
- Identification of residual effects following the implementation of mitigation measures, differentiating between short term construction impacts and long term operational and design impacts.

Table 10-3 Assessment of impact magnitude

Magnitude	Change to Baseline Environment
High	▪ The long-term loss of resource and/or quality; partial loss of or damage to key characteristics, features or elements; or ▪ Increase in peak flood level >100mm.
Medium	▪ Long term measurable change in attributes, quality or vulnerability; minor loss of, or alteration to, one or more key characteristics, features or elements; or ▪ Short term loss of resource and/or quality; partial loss of or damage to key characteristics, features or elements; or ▪ Increase in peak flood level >50mm.
Low	▪ Long term very minor loss or detrimental alteration to one or more characteristics, features or elements; or ▪ Short term measurable change in attributes, quality or vulnerability; minor loss of, or alteration to, one (maybe more) key characteristics, features or elements; or ▪ Increase in peak flood level >10mm.
Negligible	▪ Short term very minor loss or detrimental alteration to one or more characteristics, features or elements; or ▪ Negligible change to peak flood level ≤+/-10mm.
No Change	▪ No loss or alteration of characteristics, features or elements.

10.4.5 The significance of effects upon the baseline environment is defined as a function of the sensitivity of receptors and the magnitude of impact on the baseline conditions, as presented in Table 10-4. The significance criteria is based upon the principles of the CIEEM [2] guidelines for ecology impact assessments in the United Kingdom and the DMRB [1].

10.4.6 Moderate or major effects are deemed significant in terms of the EIA Regulations. Effects that are of a minor, negligible change or result in no change are judged to be not significant. Differentiations between categories in Table 10-4 are based upon professional judgement. A moderate or major effect as a result of an impact would require additional mitigation, whereas a minor or negligible effect would not require mitigation; although mitigation may be provided as part of standard good practice in construction, operation and decommissioning.

Table 10-4 Significance of effect

Site Sensitivity	Magnitude of Impact				
	High	**Medium**	**Low**	**Negligible**	**No Change**
High	Major	Major	Moderate	Minor	No change
Medium	Major	Moderate	Minor	Negligible	No change
Low	Moderate	Minor	Negligible	Negligible	No change

10.5 Assessment Assumptions and Limitations

10.5.1 This section provides a description of the assumptions and limitations to the hydrology and flood risk assessment.

10.5.2 The assessment has been undertaken using desk-based information and a site walkover. The assessment is mainly reliant on third party data which has been confirmed by the site visit where possible and is assumed to be correct.

10.5.3 Data on private water supplies has been acquired through liaison with property owners whose properties were identified as being sufficiently close to the Order Limits through a desktop review of mapping. Letters were sent on 25 September 2023 including a questionnaire to fill in with details on any private water supplies. The assessment of private water supplies is therefore limited by the number of landowners who respond, and the amount of information provided. It is also assumed that the data provided by the landowners is correct.

10.6 Study Area

10.6.1 The Proposed Development is located within an area of undulating mixed farmland that is mainly arable but with some improved pasture used for rearing sheep and occasionally cattle.

10.6.2 The key focus of this chapter is flood risk, water quality and groundwater. The study area for each aspect is described below.

- Flood Risk: Any area hydrologically linked to the Order Limits will be assessed;
- Water Quality: Impacts will be investigated up to 1km downstream of the Order Limits, to be extended if there is a protected area reasonably close to the Order Limits; and
- Groundwater: Any principal aquifers or source protection zone (SPZ) with hydrological connectivity to the Order Limits.

10.7 Baseline Conditions

10.7.1 This section provides a description of existing conditions in the study area.

Existing conditions

Surface hydrology and Order Limits drainage

10.7.2 The Proposed Development is located within the Tees catchment in the north-east of England. The Order Limits is drained via three main sub-catchments associated with the River Skerne, Newton Beck and Whitton Beck. The baseline characteristics and each of the sub-catchments are presented in ES Figure 10.1 Hydrological Features (Document Reference 6.3.10.1) and described below.

River Skerne sub-catchment

10.7.3 The River Skerne sub-catchment is 180km^2 in size and drains the western extent of the Order Limits (the majority of Panel Area A and the north-west section of Panel Area B). A number of unnamed tributaries drain the site into the River Skerne which continues to flow through Darlington and ultimately flows into the River Tees approximately 10km south of the Proposed Development Site. The River Skerne, is designated as a WFD water body (see section 10.7.21 for more details on WFD classifications) and is classified by the EA as a main river.

10.7.4 No protected areas are located within this sub-catchment however the mouth of the River Tees is designated as a SSSI, Special Protection Area (SPA) and Ramsar site (see below). The land use of the catchment is predominantly arable and horticultural with sub-urban areas including Newton Aycliffe.

Newton Beck sub-catchment

10.7.5 The Newton Beck sub-catchment is 3km^2 in size and drains a small section of the southern extent of the Proposed Development (the eastern extent of Panel Area A and small sections to the west of Panel Area B and C). The Newton Beck runs south for approximately 2km until confluence with the River Skerne. A number of unnamed tributaries drain the site into the Newton Beck, all of which are classified as ordinary watercourses.

10.7.6 Within this catchment is Newton Ketton Meadow SSSI which is designated due to it being one of the few remaining unimproved traditional hay meadows on the coastal plains between the River Tees and the River Tyne. This SSSI is located 110m south east from the Proposed Development.

10.7.7 The land use of the catchment is predominantly improved grassland and arable and horticulture with a few properties surrounding Newton Ketton.

Bishopton Beck/Whitton Beck sub-catchment

10.7.8 The Bishopton Beck/Whitton Beck sub-catchment is 50km^2 in size and drains the eastern section of the Proposed Development (all of Panel Areas D, E, F and G and the eastern sections of Panel Areas B and C). Several tributaries including Byers' Gill and

Little Stainton Beck drain the Order Limits into Bishopton Beck which is a WFD water body.

10.7.9 The Bishopton Beck flows generally in an easterly direction through the village of Bishopton. Bishopton Beck is classified by the EA as a main river. The Beck drains into the river Tees which flows thorough the Teesmouth and Cleveland Coast SPA, Ramsar site and SSSI, which is located 20km east from the Proposed Development. The Teesmouth and Cleveland Coast SPA covers 1,247ha and is home to a variety of rare species of invertebrates and birds.

Topography

10.7.10 As shown in ES Figure 10.2 Topgraphy (Document Reference 6.3.10.2), the Proposed Development is located on top of Whinny Hill at approximately 109.8m above Ordnance Datum at its highest point which slopes away gently in all directions. The majority of the Order Limits drains to the east, south and west. A description of each of the Panel Areas within the Proposed Development is as follows:

- Panel Area A: Slopes west towards the bottom of the valley and into the River Skerne;
- Panel Area B: The is the highest point of the Proposed Development as it sits atop Whinny Hill, and the slope descends in a southerly direction;
- Panel Area C: Panel Area C is situated around Byers' Gill Wood and is situated at the bottom of Whinny Hill. This section is significantly less steep than both Panel Area A and B, and the slope runs south east;
- Panel Area D: This area lies to the east of Whinny Hill, and is less steep than Panel Area A or B, however, there is still a clear southern slope across the site.
- Panel Area E: Situated to the west of Bishopton, Panel Area E is fairly flat and slopes towards Bishopton Beck in the east.
- Panel Area F: Situated to the north east of Bishopton, Panel Area F sits on top of a smaller hill and slopes downwards in all directions from the centre. Ultimately, Panel Area F drains into Bishopton Beck to the north.

Designated sites

10.7.11 Newton Ketton Meadow is a SSSI located within the Newton Beck sub-catchment located approximately 100m south of the Proposed Development, across agricultural farmland (ES Figure 10.1 (Document Reference 6.3.10.1)). Due to drainage from the Newton Beck Sub-catchment being from north to south, it can be considered that the Order Limits and the SSSI are hydrologically linked.

10.7.12 Teesmouth and Cleveland Coast is a Ramsar site, SPA and SSSI which is located 20km east from the Proposed Development. The Order Limits drains via several tributaries into the River Tees which flows through the Teesmouth and Cleveland Coast site. As the Teesmouth and Cleveland Coast site is a tidal habitat being feed from rivers which

drain the Order Limits it can, despite the distance, be considered to be hydrologically linked. Multiple other tributaries also drain into the River Tees.

10.7.13 The Proposed Development is situated within a moderate Countryside Stewardship Water Quality Priority Area meaning incentives are offered to adopt less pollutive agricultural practices. The Proposed Development site is also located in Nitrate Vulnerable Zones (NVZs) S245 and S243. NVZs are designated in areas where high levels of nitrates are measured in watercourses which generally originate from agricultural practices and industrial pollution.

Geology and hydrogeology

Solid geology

10.7.14 Due to the size of the Proposed Development, it is underlain by a number of different types of bedrock as shown in ES Figure 10.3 Solid Geology (Document Reference 6.3.10.3). Information gathered from the BGS Geology Viewer [6] indicates that bedrock deposits present are bands of Dolostone, Mudstone, Limestones and Sandstone. The eastern extent of the Order Limits is predominantly underlain by Roxby formation Mudstone with smaller parcels of limestone and sandstone present. The central and western extent of the Order Limits is predominantly Ford formation Dolostone, with bandings of Limestone present, running through the central zone.

Superficial geology

10.7.15 Information gathered from the BGS Geology Viewer indicates that the Proposed Development is underlain by a layer of Diamicton (Till). Small pockets of clay, silt, sand and gravel are also present as shown in ES Figure 10.4 Superficial Geology (Document Reference 6.3.10.4). A large pocket of sand and gravel is present in the eastern extent of the Order Limits at E: 436365.9, N: 521467. Clay, silt and gravel is present in smaller parcels across the entire extent of the Order Limits.

Soils

10.7.16 Information obtained from Magic Maps [12] shows that the Proposed Development is underlain by clayey soils, described as "slowly permeable seasonally wet slightly acid but base-rich loamy and clayey soils". An Agricultural Land Classification (ALC) survey has been undertaken which states that the majority of soil types present are brown / dark greyish brown clay or medium / heavy clay loam. The ALC results are described in ES Appendix 9.1 Agricultural Land Classification (Document Reference 6.4.9.1).

Hydrogeology

10.7.17 The Proposed Development is underlain by a Principal Aquifer [8] associated with the Permian Limestone deposits. Groundwater Vulnerability across the majority of the Proposed Development is Medium, with sporadic pockets of low groundwater vulnerability at Panel Areas A, B, C, D, and F.

10.7.18 There are a number of borehole records [14] within the Order Limits, a borehole at Little Stainton Beck at NGR: 434294, 521076 indicates 5m of clay overlying a sandy silt. No water was encountered in the clay, however, the silt is reported as wet and is likely to be the underlying aquifer. A borehole at Little Stainton Village struck water at 5.8m depth, and 5.8m of dry clay was recorded overlying sand and then a finely laminated silt at a depth of 21m. A further borehole to the east of the Proposed Development near Newton Beck also indicates 5m of clay overlaying a 'Very clayey' pebbly sand. A borehole at Great Stainton Church, north of Byers' Gill Wood again shows similar records. At this borehole clay was identified for 7m depth, then 'Clayey' sandy silt was encountered at 7m depth with 'very little water' and further clay until 18.3m depth.

Groundwater dependant terrestrial ecosystems

10.7.19 A UK Habitats Classification survey has been undertaken for the Proposed Development; full details of which can be found in ES Chapter 6 Biodiversity (Document Reference 6.2.6). The UK Habitats Classification survey indicates a few areas classified as Holcus-Juncus neutral grassland, located mainly along the banks of watercourses, including Newton Beck and other unnamed watercourses. Holcus-Juncus is described as neutral grassland with Yorkshire Fog and Rushes. This category is equivalent to National Vegetation Classification (NVC) community MG10 which, according to relevant guidance [15] is classified as a moderately groundwater dependant habitat.

10.7.20 Based on the location of these habitat throughout the Order Limits and their association with surface water features, it is considered most likely that these habitats are surface water fed rather than groundwater fed. Therefore, no assessment on groundwater dependant terrestrial ecosystems will be undertaken in this chapter.

Water quality

10.7.21 The WFD River and Groundwater Bodies Catchment Cycle 3 (2022-2027) datasets have been used to assess the status and vulnerability of nearby watercourses in terms of water quality and ecological health. The Proposed Development is located within the Northumbria River Basin District RBMPs and in the following WFD catchments:

- Skerne from Demons Beck to Tees (ID GB103025072596);
- Bishopton Beck from Source to Billingham Beck (ID: GB103025072280); and
- Billingham Beck from Bishopton Beck to Brierle (ID: GB103025072360).

10.7.22 A summary of the overall, chemical, and ecological status of the waterbodies and catchments is provided in Table 10-5 with the exact locations of the WFD Catchments shown in ES Figure 10.5 (Document Reference 6.3.10.5).

Table 10-5 WFD indicators for surface waterbodies

Water body	Chemical	Ecological	Overall status	Objective
Skerne from Demons Beck to Tees	Fail	Poor	Poor	Ecological: Good by 2027 Chemical: Good by 2063

Water body	Chemical	Ecological	Overall status	Objective
Bishopton Beck from Source to Billingham Beck	Fail	Poor	Poor	Ecological: Good by 2027 Chemical: Good by 2063
Billingham Beck from Bishopton Beck to Brierle	Fail	Poor	Poor	Ecological: Good by 2027 Chemical: Good by 2063

10.7.23 Due to their proximity to each other, the WFD waterbodies all have similar reasons for not achieving a good ecological status, including poor soil management and sewage discharge (both continuous and intermediate). There is also very little confidence in any of these WFD waterbodies achieving a good ecological status by 2027 due to this being "disproportionately expensive" and having a "disproportionate burden". For the WFD waterbodies within the River Skerne, a chemical rating of Good by 2063 is "technically infeasible" [16].

10.7.24 Data published for the Northumbria River Basin District RBMP [17] predicted a gradual overall improvement in the ecological and chemical status of surface water bodies in the river basin district by 2021.

10.7.25 A WFD assessment is presented in ES Appendix 10.2 (Document Reference 6.4.10.2) which describes the WFD water bodies in greater detail and assesses the effects of the Proposed Development on WFD water bodies.

Water Use

10.7.26 The following sections present the details of water use within the catchments draining the site.

Source protection zones

10.7.27 SPZ are defined around large and public potable groundwater abstraction sites and are in place to provide additional protection to safeguard drinking water quality. Zones are defined by groundwater travel time to an abstraction. An SPZ 1 is located adjacent to the Site Area at E: 433751, N: 521596. The zone is partly within the Order Limits, on the boundary of a field in which no infrastructure is proposed. The Proposed Development is situated within an SPZ 2 which is located through the centre of the Order Limits and an SPZ 3 located in the western extent of the Order Limits. SPZ 2 (Outer Protection Zone) is defined by the 400-day travel time from a point below the water tables. It can also be defined as the time necessary for any chemical pollutant to be attenuated in the groundwater to ensure any groundwater abstracted can meet Drinking Water Standards set for potable water without requiring treatment. and SPZ 3 is defined as the total area needed to support the abstraction or discharge from the protected groundwater source. The location of the SPZ is shown in ES Figure 10.1 (Document Reference 6.3.19.1).

Drinking water protection zones

10.7.28 The Proposed Development is not within nor drains through a Drinking Water Safeguard Groundwater Zone[1] .

Private water supplies

10.7.29 Stockton-on-Tees Borough Council and Darlington Borough Council were contacted regarding their records of any properties served by a private water supply (PWS) within the vicinity of the Proposed Development. Eight PWS were identified within the draining sub-catchments with information provided on the source location and type. The location of these identified PWS is shown on ES Figure 10.1 (Document Reference 6.3.10.1). None of the PWS locations provided by Stockton-on-Tees Borough Council and Darlington Borough Council are within the drainage pathway of the Proposed Development and therefore are not included in this assessment.

10.7.30 A desk-study identified 30 potential PWS properties sufficiently close to the Order Limits to investigate further. Letters and questionnaires notifying residents of this assessment were issued on 25 September 2023. The questionnaire asked residents for details of their water supply, and if on a PWS, the source, type, treatment, location (to mark on accompanying map), number of people the supply serves and source history (including issues associated with the quantity and quality).

10.7.31 A total of 7 questionnaires have been returned to date. Of these, three confirmed they are connected to the mains whilst the remaining four properties have confirmed connection to a PWS.

- Property 1 (E: 432887, N: 520605) is supplied by a borehole inside a building which is fenced off. It is untreated and supplies water for 4 people. The water is clear with no instances of issues with water quality or shortages noted. The surrounding land use is agricultural.
- Property 2 (E: 433289, N: 521878) is supplied by mains but use a spring and surface water PWS to supply a pond in a wildlife wetland area (E: 433548, N: 521705). The source is not protected and is untreated. No issues with water quality are noted but shortages are noted during dry weather. The area in the vicinity of the spring is used for cattle grazing whilst the surface water area is used for arable farming.

[1] DEFRA, Drinking Water Safeguard Zones (Groundwater), https://environment.data.gov.uk/dataset/6288b7b0-d465-11e4-b13c-f0def148f590 Accessed 08/03/2023.

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- Property 3 (E: 433505, N: 521411) is supplied by a borehole and also note the presence of the public water supply boreholes adjacent to the property located within SPZ 1.
- Property 4 (E: 433851, N: 520069) is supplied by surface water opposite the Little Stainton crossroads (E: 433937, N: 519494) downslope of the Order Limits. It supplies water for 3 people, issues with quality and shortage have sometimes occurred with the method of treatment unknown.

Abstraction licences

10.7.32 The EA was contacted to obtain information about other abstraction licenses within the area surrounding the Proposed Development. The information received shows that one abstraction is located within Byers Gill Wood, outside of the Order Limits. The abstraction is owned by Anglian Water and is a groundwater potable public water supply. The location of the abstraction is shown in ES Figure 10.1 Hydrological Features (Document Reference 6.3.10.1).

Flood risk

10.7.33 An FRA and Drainage Strategy is provided in ES Appendix 10.1 (Document Reference 6.4.10.1) and includes a review of all sources of flooding relevant to the Proposed Development. A summary of the flood risk conditions is provided in this chapter.

Fluvial

10.7.34 Flood risk to the Proposed Development has been assessed by reviewing the EA online flood maps [18]. The EA flood maps consider the risk associated with the fluvial and tidal flood events during an undefended scenario, i.e., the presence of the fluvial or tidal defences are not considered.

10.7.35 The EA flood maps indicate that the Proposed Development is largely situated within Flood Zone 1, which is defined as an area having less than a 1 in 1,000 annual exceedance probability of flooding from main rivers. Therefore, the Proposed Development is not considered to be at a significant risk of river flooding.

10.7.36 Two areas within the Order Limits are located within Flood Zone 3 associated with Little Station Beck (Panel Area D at E: 434159, N: 521023) and Bishopton Beck (Panel Area F at E: 436070, N: 521592) respectively. Flood Zone 3 is defined as an area having less than a 1 in 100 annual exceedance probability of flooding from main rivers. The flood extent associated with the Bishopton Beck is immediately adjacent to the proposed solar PV modules in Panel Area F but conservatively has been assumed to encroach upon the solar PV modules. The Flood Zone for Little Stainton Beck indicates the flooding occurs at a sharp turn in the watercourse.

10.7.37 The flood depths associated with these areas have been estimated from the EA Flood Maps using LiDAR data. The flood depth at Little Stainton Beck associated with Flood Zone 3 is estimated to be approximately 1m. At Bishopton Beck the estimated depth is

also 1m. No new above watercourse crossings or ground raising are proposed in Flood Zones 2 or 3.

10.7.38 The cable route crosses Flood Zone 3 at two additional locations associated with the Bishopton Beck and one of its tributaries. The cables will be underground and go underneath the watercourse with no ground raising or above ground watercourse crossings proposed. Therefore, these will not impact flood risk at these locations and will not be included in this assessment.

10.7.39 It should be noted that EA fluvial flood maps do not generally consider watercourses where the contributing catchment is less than 5km^2, therefore the minor tributaries around and within the Order Limits are not represented by these maps. The Surface Water Mapping should therefore be consulted to establish a representation of fluvial flood risk within the Order Limits, and this is detailed in ES Figure 10.6 (Document Reference 6.3.10.6).

10.7.40 Existing flood risk within the Order Limits is shown on ES Figure 10.6 and 10.7 (Document Reference 6.3.10.6 and 6.3.10.7).

Surface water

10.7.41 A review of the EA surface water flood risk map indicates that the majority of the Proposed Development is at low risk of surface water flooding, with a chance of flooding of less than 0.1% (1 in 1,000 year) (ES Figure 10.7 (Document Reference 6.3.10.7)). Surface water flooding with a 3.3% annual exceedance probability (AEP) is modelled to occur at several locations on-site including south of Panel Area A and at various locations within Panel Area C around Byers Gill Wood. Depths of 1.5m and 1.3m have been estimated at Panel Area B01 and D02 respectively. The Panel Area numbers are shown on ES Appendix 10.1 Flood Risk Assessment and Drainage Strategy, Figure 1.2 (Document Reference 6.4.10.1).

10.7.42 Flooding correlating to larger return periods (0.1% AEP and 1.0% AEP) are located at the same locations as the 3.3% AEP event although cover a larger extent. Sections of the Little Stainton Beck flood for higher return periods causing flooding in the southern section of Panel Area D and the eastern section of Panel Area C.

10.7.43 An area of an 3m flood depth has been estimated at Panel Area C (C06) around Square Wood; see Figure 3.2 of ES Appendix 10.1 Flood Risk Assessment and Drainage Strategy, (Document Reference 6.4.10.1). Detailed assessment of the surface water flood risk at this location was carried out, and this included reviewing of data collected during a site visit, topographic data and aerial imagery.

10.7.44 Based on a review of the LiDAR ground level data, the topography is sloping downwards and is not obstructed or blocked anywhere. This was verified as part of a site visit, and there was no barrier to flow identified at the location. Further, the extensive drainage system installed at this location by the current landowner is not included in the EA flood maps. Therefore, there is reasonable evidence to believe that

the depth has been inaccurately represented and the mapped flood extent is not accurate. It is not anticipated that flooding to such extreme depths would occur in this area.

Groundwater

10.7.45 Results from the GeoSmart Groundwater Flood Risk Map [9] indicate that the majority of the Order Limits is at negligible risk of groundwater flooding with small pockets of low and moderate groundwater flood risk (mostly around Panel Area F). However no electrical infrastructure have been located within these zones. The map was provided as a shapefile and can be seen in ES Appendix 10.1 Flood Risk Assessment and Drainage Strategy, Figure 5.1 (Document Reference 6.4.10.1).

10.7.46 The western part of the Order Limits is considered to be at medium risk of surface water/groundwater interaction with the underlying aquifer which supports Anglian Water's potable water supply at Great Stainton. It was also noted that Panel Area D lies close to the public water supply borehole and a known/ possible foot and mouth disinfectant site (South Shields Farm).

10.7.47 Results from the assessment of the EA groundwater contours [10] and groundwater gauge data [11] determined that the subsurface infrastructure will not interact with the groundwater table. Note that these contours are for the bedrock, there are no shallow groundwater data within this dataset. The vast majority of the Order Limits is located at least 10m above the groundwater table (including critical infrastructure) with only a few solar PV modules and associated below ground cabling being in areas with groundwater depths between 7 and 10m, nearer to the River Skerne and Bishopton Beck. This is still relatively deep and so based on this data the outlying infrastructure would not intercept the water table. The minimum depth estimated was 3.5m, which is deeper than the proposed 1.0m deep solar PV module piles as set out in ES Chapter 2 The Proposed Development (Document Reference 6.2.2). It has therefore been concluded that the Proposed Development will be located above the bedrock groundwater table and will not intercept subsurface flow routes.

Reservoir failure

10.7.48 There are several small reservoirs surrounding the Proposed Development (ES Figure 10.1 (Document Reference 6.3.10.1)) and runoff from the Order Limits may drain into Bishopton Lake. According to data from the EA, the eastern extent of the Order Limits, surrounding Bishopton and Carlton, is at significant risk of flooding from reservoir failure. However, it should be noted that reservoir flooding is a rare event with a very low probability of occurrence. Current reservoir regulation, which has been further enhanced by the Flood and Water Management Act 2010, aims to make sure that all reservoirs are properly maintained and monitored to detect and repair any problem. Therefore, the risk of reservoir flooding is not considered to be high in this area.

Sewer

10.7.49 As the Order Limits are greenfield no sewage pipes are expected to run across it and consequently the risk of sewer flooding is considered negligible.

Baseline summary and sensitivity

10.7.50 Table 10-6 provides a summary of the sensitivity of baseline features within the Order Limits.

Table 10-6 Baseline Sensitivity

Receptors	Sensitivity
Surface Water	
River Skerne	▪ Medium
Newton Beck	▪ Medium
Bishopton Beck	▪ Medium
Designated Sites	
Newton Ketton Meadows SSSI	▪ High
Teesmouth and Cleveland Coast SPA, Ramsar and SSSI	▪ High
Groundwater	
Principal Aquifer	▪ High
NVZ S245 and S243	▪ High
SPZ	▪ High
Water Supplies	
Public water supply	▪ High
Private water supply	▪ Medium
Flood Risk	
Residential properties	▪ High
Farmland	▪ Medium

Future Baseline

10.7.51 The general approach to defining future baseline for the Proposed Development is described in ES Chapter 4 Approach to EIA (Document Reference 6.2.4).

10.7.52 The baseline environment is unlikely to change from the current baseline under the "do nothing" scenario in terms of land use. However, climate is likely to prove more variable, with observed historical and predicted future changes in global climate due to a combination of both natural and human causes. The changes in rainfall attributed to climate change have been incorporated into the assessment of flood risk and are included in the assessment presented in ES Appendix 10.1 FRA and Drainage Strategy (Document Reference 6.4.10.1).

10.8 Potential impacts

10.8.1 Based on the design of the Proposed Development during operation and associated construction and decommissioning activities, the Proposed Development has the potential to impact on hydrology and flood risk during construction, operation and decommissioning.

Construction

10.8.2 During the construction of the Proposed Development, there is a risk of increased pollution from construction activities and vehicles. Chemical spills from construction vehicles or leaks caused by damaged solar PV modules during installation have the potential to run-off into the watercourses draining the site and enter designated sites downstream or percolate down and contaminate groundwater supplies. There is also a risk of chemical pollutants flowing overland through Newton Ketton Meadows, the nearest SSSI site.

10.8.3 The regular use of heavy construction vehicles in certain areas can also lead to soil compaction. This may result in reduced percolation and increased overland flow. This can increase flood risk downstream and result in soil erosion within the Order Limits causing increased sedimentation in the watercourses. Installation of impermeable foundations also has the potential to increase the surface water runoff of the site resulting in flooding downstream.

10.8.4 An increase in temporary impermeable area during construction due to the addition of construction buildings and less permeable gravel tracks can lead to a temporary reduction in floodplain storage volume. As a result of this, flooding can increase within the Order Limits and downstream.

10.8.5 During minor excavation for foundations or track construction the ground disturbance could lead to exposed soils which can be washed into nearby watercourses during periods of heavy rain. This could result in increased sedimentation and pollution of the watercourses that are hydrologically linked to the Order Limits.

10.8.6 The proposed layout of access tracks would result in 2 new crossings over watercourses (minor tributaries of the River Skerne and Little Stainton Brook) and the adoption of 7 existing crossings. The construction or modification of crossings could lead to sediment, pollutants from machinery and construction materials entering the watercourse with minimal overland flow to act as a natural filter.

Operation

10.8.7 During operation, the potential impacts from the Proposed Development are mainly related to pollution from maintenance vehicles and activities, and through increased surface water run-off.

10.8.8 Fuel or oil spills from maintenance vehicles have the potential run-off into the watercourses draining the site and enter designated sites downstream or percolate down and contaminate groundwater supplies. There is also a risk of it flowing overland through Ketton Meadows (one of the SSSI sites). Similarly, maintenance activities such as the repair of damaged solar PV modules could result in contaminated runoff from entering the surface or groundwater system.

10.8.9 Maintenance vehicles accessing the Proposed Development can also lead to soil compaction in certain areas, resulting in reduced percolation and increased overland flow. This can increase flood risk downstream and also result in soil erosion within the Order Limits. As such, causing increased sedimentation in the watercourses.

10.8.10 Soil compaction and increased hardstanding could cause an alternation in natural flow pathways. This could increase the speed at which surface water runoff enters watercourses and could result in increased flooding.

10.8.11 During operation, a long-term increase in impermeable area, due to the construction of Battery Energy Storage Systems (BESS), inverters, transformers, and a sub-station can lead to increases in flood risk. The impermeable areas would limit infiltration and may result in small increases in runoff rates and peak flood flows across the Order Limits. The infrastructure at the Proposed Development may also alter flow paths of smaller watercourses and therefore impact flood risk and flood routes.

10.8.12 If subsurface structures, primarily foundations, were to intersect with the groundwater aquifer this could result in an impact on water quantity and quality by altering flow paths and causing in-class deterioration through the mobilisation of chemicals within the ground such as nitrates, sulphates and pesticides/herbicides. Similarly, if formal infiltration SuDS were to be installed as a part of the proposed drainage strategy, noting this has not been proposed, this would increase the risk of mobilising chemicals within the ground and groundwater. Due to the interaction between surface water and groundwater, particularly along the River Skerne, the mobilisation of these chemicals are a water quality concern to both sources.

10.8.13 In some fields due to archaeological constraints, solar panels will be mounted on ballast slabs that sit on the surface instead of on piles that would penetrate the ground. The presence of multiple slabs could increase the effective impermeable area of the site and limit infiltration or result in small increases in runoff rates and peak flood flows across the Order Limits.

10.8.14 Due to the change of use from agriculture to solar PV modules and grassland, there is likely to be a reduction in the chemical loading of waterways due to cessation of the

use of nitrate. This could help reduce the amount of nitrates entering nearby watercourses which can be beneficial ecological receptors and the overall health of the watercourse.

10.8.15 Where the 2 new watercourse crossings are proposed, if not adequately designed there is the potential for long term erosion of the stream bed which could impact the natural morphology as well as increased risk of sediment pollution.

Decommissioning

10.8.16 Chemical spills from vehicles used in decommissioning activities, as well as leaks from damaged solar PV modules could occur during the decommissioning phase which have the potential to run-off into the watercourses draining the site and enter designated sites downstream or percolate down and contaminate groundwater supplies. There is also a risk of it flowing overland through Newton Ketton Meadows SSSI.

10.8.17 Vehicles can also lead to soil compaction potentially resulting in reduced percolation and increased overland flow. This can increase flood risk downstream and result in soil erosion onsite, causing increased sedimentation in watercourses.

10.8.18 During decommissioning, there may be a temporary increase in the impermeable area within the Order Limits and the flow pathways may be altered. Therefore, there may be a long term impact upon flood risk and flow routes if the Order Limits is not returned to pre-development conditions.

10.8.19 Removal of structures associated with the supporting infrastructure of the Proposed Development may lead to exposed soils which can be washed into nearby watercourses during periods of rain. Resulting in increased sedimentation and pollution of the watercourses.

10.9 Embedded mitigation

10.9.1 The Proposed Development has been designed to avoid and prevent adverse environmental effects on hydrology and flood risk through the process of design development and consideration of good design principles [19].

10.9.2 Mitigation measures incorporated in the design and construction of the Proposed Development, considering the potential impacts, are reported as embedded mitigation in ES Chapter 2 The Proposed Development (Document Reference 6.2.2).The effects of the Proposed Development are assessed considering embedded mitigation is in place and are reported in Section 10.10.

10.9.3 Where required further mitigation is deemed required as a result of a potentially significant effect, this is termed essential mitigation. Essential mitigation is set out as part of the assessment of effects in Section 10.10.

10.9.4 A further definition of these classifications of mitigation and how they are considered in the EIA is provided in Section 4.5 in ES Chapter 4 Approach to EIA (Document Reference 6.2.4).

10.10 Assessment of likely significant effects

10.10.1 This section presents the likely effects on hydrology and flood risk resulting from the construction, operation and decommissioning of the Proposed Development.

10.10.2 The assessment of effects takes into account the potential impacts to each receptor (as set out in Section 10.8) following the implementation of embedded mitigation (as set out in Section 10.9). Where required to mitigate potentially significant effects, essential mitigation measures are outlined as part of the assessment, and the overall significance of residual effects set out.

Construction

Watercourses

10.10.3 As described in Section 10.8 there is a potential risk of increased pollution to watercourses during the construction phase. Chemical spills from construction vehicles or leaks caused by solar PV modules damaged during installation could run-off into the watercourses together with siltation from excavations. The construction methodology for installation of the solar PV modules involves piling the stilts into the ground with no large scale excavations. A flat area of land is required to install the sub-station, BESS, inverters, transformers and switchgear and some minor excavation may be required. This supporting infrastructure will sit on a concrete base with a gravel apron. The access tracks will be constructed of permeable material and will be undertaken early on in the construction phase.

10.10.4 Embedded mitigation would greatly reduce the impact upon watercourses during construction. However essential mitigation is also deemed necessary to avoid a potentially significant effect to watercourses.

10.10.5 An 8m buffer zone around the watercourses within the vicinity of the Order Limits will be applied in which construction activities will be restricted. This will for example prevent vehicular movement in close proximity to water bodies.

10.10.6 A sustainable approach to the drainage of the Proposed Development has been developed as essential mitigation ensuring that runoff and sediment management control measures would be implemented. These are outlined in ES Appendix 10.1 FRA and Drainage Strategy (Document Reference 6.4.10.1).

10.10.7 Taking into consideration the low level of construction excavation and embedded and essential mitigation measures, the impact magnitude of increased pollution to watercourses has been assessed as negligible. All watercourses, taking into account their NVZ and WFD status together with their water use, have been assessed to be of

medium sensitivity. Therefore, the significance of effect on the watercourses draining the site from the risk of construction activities affecting water quality is negligible, which is not significant.

Designated sites

10.10.8 There is a potential risk of increased pollution to designated sites during the construction phase. As with the watercourses draining the Order Limits, there is a risk of pollution from construction vehicles, leaks caused by solar PV modules damaged during installation and from excavation.

10.10.9 Embedded mitigation would greatly reduce the magnitude of the impact to designated sites. However essential mitigation is also deemed necessary to avoid a potentially significant effect to designated sites.

10.10.10 A sustainable approach to the drainage of the Proposed Development has been developed as essential mitigation ensuring that off-site water is not compromised and runoff and sediment management control measures would be implemented. These are outlined in ES Appendix 10.1 FRA and Drainage Strategy (Document Reference 6.4.10.1).

10.10.11 The Newton Ketton SSSI is located approximately 100m to the south of the Proposed Development and is not directly linked to the Order Limits via a watercourse. Therefore, the potential hydrological link between any construction activities and the SSSI would be through surface water run-off over vegetated fields, which in itself will act as a mitigation buffer and treatment for any entrained pollution in surface water.

10.10.12 The Teesmouth and Cleveland Coast SPA, Ramsar and SSSI site is located approximately 5.4km east of the Order Limits. Both embedded and essential mitigation will ensure chemical loading into the watercourses is not increased and therefore will also not increase at the designated sites. Additionally, they are considered to be far enough downstream such that if any pollution should enter the watercourses draining the Order Limits, the flow will be suitably diluted by the time it reaches the designated site.

10.10.13 Taking into consideration the low level of construction excavation and implementation of both embedded and essential mitigation, together with the overland flow linkage between the Proposed Development and the Newton Ketton SSSI, the impact magnitude of increased pollution to designated sites overall has been assessed as negligible. All designated sites have been assessed to be of high sensitivity. Therefore, the significance of effect on the designated sites draining the Order Limits from the risk of construction activities affecting water quality is minor, which is not significant.

Groundwater

10.10.14 There is a potential risk of increased groundwater pollution during the construction phase. Chemical spills from construction vehicles or leaks caused by panels damaged

during installation could percolate down and contaminate groundwater supplies within the Principal Aquifer.

10.10.15 Embedded mitigation would greatly reduce the impact upon groundwater during construction. However essential mitigation is also deemed necessary to avoid a potentially significant effect to groundwater.

10.10.16 Because the EA groundwater data assessed includes bedrock groundwater contours but not shallow groundwater data, as specified in the Outline CEMP (Document Reference 6.4.2.6), the full CEMP will include a requirement for the FRA and drainage strategy to be refined if shallow groundwater is encountered during site construction work.

10.10.17 A sustainable approach to the drainage of the Proposed Development has been developed as essential mitigation ensuring that runoff and sediment management control measures would be implemented. These are outlined in ES Appendix 10.1 FRA and Drainage Strategy (Document Reference 6.4.10.1).

10.10.18 Taking into consideration the low volume of construction excavation and the implementation of both embedded and essential mitigation measures, the impact magnitude of increased pollution to groundwater has been assessed as negligible. The groundwater body has been assessed to be of high sensitivity due to the SPZ and abstraction for potable water. Therefore, the significance of effect on groundwater from the risk of construction activities affecting water quality is minor, which is not significant.

Water Supplies

10.10.19 There is a potential risk of pollution to PWS and public water supplies during the construction phase. Fuel spills from the refuelling of vehicles and machinery could percolate into the groundwater and impact upon the water supplies as a result. A number of PWS locations have been identified and one Anglian Water public water supply located outside the Order Limits, see Section 10.7. Three of the PWS are inside the drainage pathway of the site, two of which use boreholes and the remaining one is a spring feeding a wildlife wetland. The public water supply is a borehole extracting from groundwater.

10.10.20 Embedded mitigation would greatly reduce the impact upon groundwater during construction. However essential mitigation is also deemed necessary to avoid a potentially significant effect to water supplies.

10.10.21 A sustainable approach to the drainage of the Proposed Development has been developed as essential mitigation ensuring that that off-site water is not compromised and runoff and sediment management control measures would be implemented. These are outlined in ES Appendix 10.1 FRA and Drainage Strategy (Document Reference 6.4.10.1).

10.10.22 Further, no new proposed access tracks are within 100m radius of the location of the identified PWSs. Only solar PV panels are proposed within these zones.

10.10.23 Taking into consideration the low volume of construction excavation and the implementation of embedded and essential mitigation measures, the impact magnitude for PWS has been assessed as negligible resulting in a negligible effect which is not significant.

10.10.24 In relation to the public water supply (high sensitivity), the embedded and essential mitigations considered, and magnitude of impact would be the same as for the groundwater assessment above (also high sensitivity). The impact magnitude on public water supplies would be negligible resulting in a minor adverse effect, which is not significant.

Flood risk

10.10.25 There is potential risk of increased flood risk downstream as a result of the use of heavy construction vehicles in certain areas which leads to soil compaction and increased overland flow.

10.10.26 Embedded mitigation would greatly reduce the impact upon flood risk during construction. However essential mitigation is also deemed necessary to avoid a potentially significant effect to flood risk.

10.10.27 A sustainable approach to the drainage of the Proposed Development has been developed as essential mitigation ensuring that that off-site water is not compromised and runoff and sediment management control measures would be implemented. These are outlined in ES Appendix 10.1 FRA and Drainage Strategy (Document Reference 6.4.10.1).

10.10.28 Further, temporary land take areas (construction compound with car parking, temporary storage area, temporary laydown areas, welfare facilities etc.) within the Order Limits will be fully reinstated following construction to reduce areas of semi-impermeable surfaces. Temporary land take areas will be cleared of hardcore, re-graded with soil to a natural profile and re-vegetated.

10.10.29 Taking into consideration the implementation of embedded and essential mitigation measures, the impact magnitude of increased flood risk has been assessed as negligible. Flood risk of nearby receptors (including residential dwellings and farmland) has been assessed to be of high to medium sensitivity. Therefore, the significance of effect of the risk of increased flood risk during construction is minor adverse to negligible, which is not significant.

10.10.30 Further information on flood risk and drainage solutions for the Proposed Development is presented in ES Appendix 10.1 FRA and Drainage Strategy (Document Reference 6.4.10.1).

Operation

Watercourses

10.10.31 There is a potential risk of increased pollution during operation. Fuel or oil spills from maintenance vehicles have the potential to run-off into the watercourses draining the Order Limits. Similarly, maintenance activities such as the repair of damaged solar PV modules could result in contaminated runoff entering watercourses.

10.10.32 Embedded mitigation would greatly reduce the impact upon watercourses, however essential mitigation is also deemed necessary to avoid a potentially significant effect upon watercourses.

10.10.33 During the operation of the Proposed Development vehicular access would be limited to maintenance activities. Equipment will be provided to contain and clean up any spills of fuel or lubricants as required. Regular inspection of the tracks would occur to ensure no unacceptable erosion is taking place, with appropriate practicable remedial action taken, should erosion be noted. No vehicle cleaning or refuelling would take place within the site and drip trays would be placed underneath any stationary maintenance vehicles.

10.10.34 Permeable access tracks will help to reduce site erosion caused by traffic.

10.10.35 Vegetation will be maintained under the drip line of all solar PV modules to reduce erosion. If livestock is to be used to maintain sward length stock will be rotated and vegetation shall be maintained at all times. No feeding or livestock tending will take place within the watercourse buffer zones.

10.10.36 In addition to embedded and essential mitigation there is a low likelihood of fuel spills due to the low quantity of maintenance vehicles which reduces the magnitude of impact

10.10.37 The change in land use from productive agricultural land to solar PV panels will result in the reduction in the use of spray chemicals and fertilisers. This could result in a reduction in the amount of phosphates and nitrates entering the draining watercourses. This could result in a beneficial effect in relation to the NVZ status of catchments S245 and S243.

10.10.38 Taking into consideration the implementation of embedded and essential mitigation measures the overall impact magnitude of increased pollution to watercourses has been assessed as negligible. All watercourses, taking into account their NVZ and WFD status together with their water use, have been assessed to be of medium sensitivity. Therefore, the significance of effect on the watercourses draining the Order Limits from the risk of maintenance activities on water quality is negligible, which is not significant.

Designated sites

10.10.39 As outlined for watercourses, there is also a potential risk of increased pollution to designated sites during operation.

10.10.40 Embedded mitigation would greatly reduce the impact upon designated sites, however essential mitigation is also deemed necessary to avoid a potentially significant effect upon designated sites.

10.10.41 During the operation of the Proposed Development vehicular access would be limited to maintenance activities. Equipment will be provided to contain and clean up any spills of fuel or lubricants as required. Regular inspection of the tracks would occur to ensure no unacceptable erosion is taking place, with appropriate practicable remedial action taken, should erosion be noted. No vehicle cleaning or refuelling would take place within the site and drip trays would be placed underneath any stationary maintenance vehicles.

10.10.42 Permeable access tracks will help to reduce site erosion caused by traffic.

10.10.43 Vegetation will be maintained under the drip line of all solar PV modules to reduce erosion. If livestock is to be used to maintain sward length stock will be rotated and vegetation shall be maintained at all times. No feeding or livestock tending will take place within the watercourse buffer zones.

10.10.44 In addition to essential mitigation, the distance of the designated sites from the Proposed Development and the presence of intervening vegetation would also reduce the magnitude of impact.

10.10.45 Taking into consideration the implementation of embedded and essential mitigation the impact magnitude of increased pollution to designated sites has been assessed as negligible. All designated sites have been assessed to be of high sensitivity. Therefore, the significance of effect on the designated sites draining the site from the risk of maintenance activities on water quality is minor, which is not significant.

Groundwater

10.10.46 There is a potential risk of increased groundwater pollution during the operational phase. Fuel or oil spills from maintenance vehicles have the potential to percolate into the groundwater. Similarly, maintenance activities such as the repair of damaged solar PV modules could result in contaminated water percolating into the groundwater.

10.10.47 Embedded mitigation would greatly reduce the impact upon ground water, however essential mitigation is also deemed necessary to avoid a potentially significant effect upon ground water.

10.10.48 During the operation of the Proposed Development vehicular access would be limited to maintenance activities. Equipment will be provided to contain and clean up any spills of fuel or lubricants as required. Regular inspection of the tracks would occur to

ensure no unacceptable erosion is taking place, with appropriate practicable remedial action taken, should erosion be noted. No vehicle cleaning or refuelling would take place within the site and drip trays would be placed underneath any stationary maintenance vehicles.

10.10.49 Permeable access tracks will help to reduce site erosion caused by traffic.

10.10.50 Vegetation will be maintained under the drip line of all solar PV modules to reduce erosion. If livestock is to be used to maintain sward length stock will be rotated and vegetation shall be maintained at all times. No feeding or livestock tending will take place within the watercourse buffer zones.

10.10.51 There is a potential risk to groundwater quality and quantity during the operational phase if formal infiltration SuDS were proposed and if subsurface infrastructure were to interact with the groundwater table. The assessment of available data on groundwater levels and ground levels against the solar PV module pile depth of 1.0m concluded that this risk was minimal. Formal infiltration SuDS have also not been proposed as a part of the drainage strategy.

10.10.52 Taking into consideration the low level of construction excavation and the implementation of embedded and essential mitigation measures, the impact magnitude of increased pollution to groundwater has been assessed as negligible. The groundwater body has been assessed to be of high sensitivity. Therefore, the significance of effect on the groundwater body draining the Order Limits from the risk of maintenance activities on water quality is minor, which is not significant.

Water Supplies

10.10.53 There is a potential risk of pollution to water supplies during the operation phase. Fuel spills from the refuelling of vehicles and machinery could percolate into the groundwater and impact upon the PWS as a result. A number of PWS locations have been identified outside the Order Limits, see Section 10.7. Three of the PWSs are inside the drainage pathway of the site, two of which use boreholes and the remaining one is a spring feeding a wildlife wetland. One public water supply is located close to the Panel Area C in Byers Gill Wood.

10.10.54 Embedded mitigation would greatly reduce the impact upon water supplies, however essential mitigation is also deemed necessary to avoid a potentially significant effect upon water supplies.

10.10.55 During the operation of the Proposed Development vehicular access would be limited to maintenance activities. Equipment will be provided to contain and clean up any spills of fuel or lubricants as required. Regular inspection of the tracks would occur to ensure no unacceptable erosion is taking place, with appropriate practicable remedial action taken, should erosion be noted. No vehicle cleaning or refuelling would take place within the site and drip trays would be placed underneath any stationary maintenance vehicles.

10.10.56 Permeable access tracks will help to reduce site erosion caused by traffic.

10.10.57 Vegetation will be maintained under the drip line of all solar PV modules to reduce erosion. If livestock is to be used to maintain sward length stock will be rotated and vegetation shall be maintained at all times. No feeding or livestock tending will take place within the watercourse buffer zones.

10.10.58 Taking into consideration the low volume of construction excavation and the implementation of embedded and essential mitigation the impact magnitude for PWS has been assessed as negligible resulting in a negligible effect. For the public water supply the assessment of effect would remain as minor and not significant as per the groundwater assessment above.

Flood risk

10.10.59 There is potential risk of increased flood risk downstream as a result of the use of maintenance vehicles in certain areas which leads to areas of soil compaction, increased overland flow, soil erosion and alteration of flow pathways on site. The impact of this have been addressed and reduced in the FRA and Drainage Strategy (ES Appendix 10.1 (Document Reference 6.4.10.1)), which includes a proposed drainage scheme and maintenance plan ensuring that surface water run-off is managed as per existing site conditions.

10.10.60 Similarly, the long term impacts associated with construction within the fluvial flood plain would be limited as there would be no reduction in flood plain or interruption of flows as the solar PV modules would be raised above the fluvial flood depth.

10.10.61 Embedded mitigation would greatly reduce the impact upon flood risk, however essential mitigation is also deemed necessary to avoid a potentially significant effect upon water supplies.

10.10.62 Permeable access tracks will be used to reduce soil compaction across the Proposed Development and ensure free drainage. The access track permeability will act to maximise infiltration across the site.

10.10.63 Vegetation will be maintained under the drip line of all solar PV modules to ensure greenfield drainage is maintained. If livestock is to be used to maintain sward length stock will be rotated and vegetation shall be maintained at all times.

10.10.64 Where ballast slabs are proposed under solar panels due to archaeological constraints, these will sit underneath the solar panels and will therefore not result in effective additional impermeable area for rainfall. To further mitigate, the slabs will sit upon a 100m thick, porous subbase with a permeable geotextile underneath allowing runoff the pass under the slabs and over the natural ground. More detail can be found in ES Appendix 10.1 FRA and Drainage Strategy (Document Reference 6.4.10.1).

10.10.65 Taking into consideration the implementation of embedded and essential mitigation measures the impact magnitude of increased flood risk has been assessed as negligible.

Flood risk of nearby receptors (including residential dwellings and farmland) has been assessed to be of high to medium sensitivity. Therefore, the significance of effect of the risk of increased flood risk during operation is minor to negligible, which is not significant.

10.10.66 Further information on flood risk and drainage solutions for the Proposed Development is presented in ES Appendix 10.1 FRA and Drainage Strategy (Document Reference 6.4.10.1).

Enhancement opportunities

10.10.67 Enhancement measures are over and above what is required to mitigate the adverse effects of the Proposed Development.

10.10.68 There will be increased vegetation on site, both in the 8m perimeter buffer zone and under the solar PV modules. See Figure 2.20 Landscape Concept Masterplan (Document Reference 6.3.2.20). The 8m zone is the area between the watercourse and the fencing. Infrastructure has been offset a further 2m from the fencing such that it is approximately 10m away from the watercourse. This will reduce erosion and sedimentation risk while also increasing the biodiversity of the area.

10.10.69 A buffer zone around Little Stainton Beck has been incorporated into the design to allow the watercourse to maintain natural course and allow space for geomorphic movements due to increase future flows.

Decommissioning

10.10.70 The likely effects during decommissioning are anticipated to be no worse than those experienced during the construction phase. The same construction mitigation, both embedded and essential would be employed which would reduce the impacts to nearby receptors. As such, the assessment of effects remains the same as the construction phase.

10.11 Monitoring

10.11.1 Long term monitoring of the Proposed Development will occur, this includes the monitoring and maintenance of vegetation beneath the solar PV panels to ensure that erosion is not increased and grass will be cut to a minimum height of 50mm through ES Appendix 2.14 Outline Landscape and Ecology Management Plan (LEMP). Litter and debris will be removed from Gravel Aprons surrounding buildings within the Order Limits and silt accumulation will be inspected and appropriately removed to ensure no blockage to infiltration capacity occurs. These drainage maintenance activities are outlined in ES Appendix 10.1 FRA and Drainage Strategy (Document Reference 6.4.10.1).

10.12 Summary

10.12.1 Table 10-7 provides a summary of the identified impacts, mitigation and likely effects of the Proposed Development on hydrology and flood risk. The table has been subdivided into effects for construction, operation and decommissioning.

Table 10-7 Hydrology and Flood Risk Assessment Summary

Impact	Embedded/Essential Mitigation and how secured	Receptor Sensitivity	Magnitude of impact	Significance of effect
Construction and Decommissioning				
Potential risk of increased pollution to watercourses	▪ ES Appendix 2.6 Outline CEMP (Document Reference 6.4.2.6) includes the following measures: ▪ No large scale excavations proposed; ▪ Runoff and sediment control measures including minimal soil disturbance measures; ▪ 10m buffer zone surrounding watercourses including 2m between fence and infrastructure; ▪ Subsurface infrastructure will be too shallow to interact with the water table; and ▪ Equipment to contain and clean up fuel spills. See also ES Appendix 2.9 Outline Pollution and Spillage Response Plan (Document Reference 6.4.2.9). ▪ The production of a Construction Surface Water Management Plan (CSWMP). Outline principles of a CSWMP are included in the CEMP.	▪ Medium	▪ Negligible	▪ Negligible
Pollution may increase due to runoff from vehicles and solar PV modules and increased sediment transport		▪ High	▪ Negligible	▪ Minor Adverse
Risk of increased pollution as a result of operation and maintenance activities		▪ High	▪ Negligible	▪ Minor Adverse
Risk of pollutants percolating into groundwater		▪ High	▪ Negligible	▪ Minor Adverse
Potential risk to PWS and public water supply during operation and construction as a result of pollution from vehicles and solar PV panels	▪ Pollution control and mitigation measures as described above.	▪ PWS – Medium ▪ Public Water Supply - High	▪ Negligible	▪ PWS – Negligible ▪ Public Water Supply – Minor Adverse
Potential risk of increased flood risk downstream as a result of soil compaction and increased overland flow	▪ Run-off control measures; and ▪ Proposed drainage scheme and surface water management plan is detailed in the FRA and Drainage Strategy (ES Appendix 10.1 (Document Reference 6.4.10.1)).	▪ High	▪ Negligible	▪ Minor Adverse to negligible
Potential risk of altered flow pathways during operation		▪ High	▪ Negligible	▪ Minor Adverse to negligible

Impact	Embedded/Essential Mitigation and how secured	Receptor Sensitivity	Magnitude of impact	Significance of effect
Operation				
Potential risk of increased pollution to watercourses	▪ No large scale excavations proposed; ▪ Runoff and sediment control measures including minimal soil disturbance measures; ▪ 10m buffer zone surrounding watercourses including 2m between fence and infrastructure; ▪ Subsurface infrastructure will be too shallow to interact with the water table; ▪ Formal infiltration SuDS have not been proposed; and ▪ Equipment to contain and clean up fuel spills. See also ES Appendix 2.9 Outline Pollution and Spillage Response Plan (Document Reference 6.4.2.9).	▪ Medium	▪ Negligible	▪ Negligible
Pollution may increase due to runoff from vehicles and solar PV modules and increased sediment transport		▪ High	▪ Negligible	▪ Minor Adverse
Risk of increased pollution as a result of operation and maintenance activities		▪ High	▪ Negligible	▪ Minor Adverse
Risk of pollutants percolating into groundwater		▪ High	▪ Negligible	▪ Minor Adverse
Potential risk to PWS and public water supply during operation and construction as a result of pollution from vehicles and solar PV panels	▪ Pollution control and mitigation measures as described above.	▪ PWS – Medium ▪ Public Water Supply - High	▪ Negligible	▪ PWS – Negligible ▪ Public Water Supply – Minor
Potential risk of increased flood risk downstream as a result of soil compaction and increased overland flow	▪ Run-off control measures; and ▪ Proposed drainage scheme and surface water management plan is detailed in the FRA and Drainage Strategy (ES Appendix 10.1 (Document Reference 6.4.10.1)).	▪ High	▪ Negligible	▪ Minor Adverse to negligible
Potential risk of altered flow pathways during operation		▪ High	▪ Negligible	▪ Minor Adverse to negligible

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