Great North Road Solar and Biodiversity Park

Environmental Statement

Volume 2 – Chapters

Chapter 9 – Water Resources

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Contents

9.1 INTRODUCTION

1 This chapter of the ES presents an assessment of likely significant effects of the Development on water resources within the wider catchment. The chapter presents the methodology followed and provides a review of the baseline conditions and future baseline conditions (within the operational life of the Development) in a defined study area of the Development and surrounding area. The chapter then presents the results of the assessment (of the Development as designed including embedded mitigation measures) and the impact of the Development on the current baseline environment to determine the anticipated magnitude of impact and significance of effect.

2 Embedded mitigation measures are presented and discussed to minimise the impacts of the Development to an acceptable level (*i.e*. to a residual minor or negligible effect), during the construction, operation and decommissioning phases.

3 The relevant legislation, policy and guidance pertinent to the Water Resources assessment is provided in Section 9.2.2.

4 The Water Resources assessment follows the general approach to undertaking EIA, as detailed in Chapter 2, EIA, [EN010162/APP/6.2.2] of the ES, albeit it has been modified to take account of relevant industry guidelines and best practice (see Section 9.2.2). The methodology for attributing sensitivity of receptors, magnitude of impacts and the significance of effects in relation to water resources is described in Section 9.3.3.1.

5 A summary of the consultation relating to water resources is provided in Table 9.1, which sets out the main key matters raised by the stakeholders and a description of how and where such matters have been addressed in the EIA to date and this ES.

6 The key issues to be considered within this assessment are:

- Potential chemical pollution effects on the hydrological environment;
- Potential erosion and sedimentation effects on the hydrological environment;
- Potential impediments to stream flow;
- Potential effects on private water supplies;
- Potential changes in soil interflow patterns;
- Potential for the compaction of soils; and
- Potential for an increase in runoff and flood risk.

7 The Development is divided into the following Work Areas as described in ES Chapter 5, Development Description [EN010162/APP/6.2.5]:

- Work Area 1: Solar PV;
- Work Area 2: Cable Route;
- Work Area 3: Mitigation/enhancement;
- Work Area 4: Intermediate substations;
- Work Area 5a: BESS;
- Work Area 5b: 400 kV compound;
- Work Area 6: National Grid Staythorpe Substation and connection point;
- Work Area 7: Consented Staythorpe BESS and Connection; and
- Work Area 8: Access Works.

8 This chapter is supported by the following figures provided in the ES Volume 2:

- Figure 9.1 Hydrology Study Areas [EN010162/APP/6.3.9.1];
- Figure 9.2 Solid Geology [EN010162/APP/6.3.9.2];
- Figure 9.3 Superficial Geology [EN010162/APP/6.3.9.3];
- Figure 9.4 Watercourses within CSA [EN010162/APP/6.3.9.4];
- Figure 9.5 Water Framework Directive (WFD) Classifications [EN010162/APP/6.3.9.5];
- Figure 9.6 IDB Maintained Watercourses [EN010162/APP/6.3.9.6];
- Figure 9.7 Drinking Water Protected Area [EN010162/APP/6.3.9.7]; and
- Figure 9.8 Source Protection Zones [EN010162/APP/6.3.9.8].

9 This chapter is also supported by the following Technical Appendices (TAs) provided in Volume 4:

- TA A9.1: Flood Risk Assessment (FRA) [EN010162/APP/6.4.9.1]; and
- TA A9.2: WFD Assessment [EN010162/APP/6.4.9.2].

10 This chapter also references the following Technical Appendices provided in Volume 4:

- TA A5.3: Outline Construction Environmental Management Plan (oCEMP) [EN010162/APP/6.4.5.3].

11 A glossary of terms is provided in Chapter 20 [EN010162/APP/6.2.20].

9.2 CONSULTATION COMMENTS

12 Information and commentary has been provided by a range of organisations during the assessment, and a summary of feedback from key consultees is provided in Table 9.1. Chapter 3: Consultation, [EN010162/APP/6.2.3] summarises the consultation undertaken for the project as a whole, and full responses to all comments made during the statutory consultation process are provided in the Consultation Report [EN010162/APP/5.1]. Responses to consultation on the PEIR are identified as ‘S42’ (Section 42 of the Planning Act 2008). The response to each point raised by consultees is also presented within the table, demonstrating where the design of the Development has changed in response to specific issues indicated by the Environment Agency (EA), the Internal Drainage Board (IDB) and other consultees.

Table 9.1: Consultation

Consultee	Type and Date	Summary of Consultation Response	Applicant's Response
EA	Scoping response 06/12/2023	Transfer of sediment to surface water resources should be **scoped in** for operation as it will take time for the vegetation to establish itself.	Section 9.5.2 discusses sediment transfer during the operational phase. Given that agricultural fields within the Order Limits remain tilled for substantial parts of the year a trial study is unlikely to give representative results of the conditions that would be present during the operational phase of the Development, where land under the PV arrays would be allowed to naturally vegetate and be grazed by livestock. As vegetation becomes established under the PV arrays there is likely to be a decrease in surface water runoff rates and a reduction in the potential for sediment and agricultural chemicals (e.g., phosphates and nitrates) to transfer into the wider hydrological catchment compared to the baseline scenario.
		As the development proposes works in close proximity to the Tidal River Trent, it is necessary to provide a 16-metre buffer to maintain access routes and ensure no damage of flood defences or the banks of the river. Horizontal Directional Drilling (HDD) should have a defined minimum vertical offset from watercourses which should be justified in the context of erosion and climate change throughout the lifetime of development. For	Work Area 3: Mitigation / enhancement is the closest aspect of the Development to the River Trent and abuts the river bank at its closest point.

Consultee	Type and Date	Summary of Consultation Response	Applicant's Response
		works within 16 metres of a main river a Flood Risk Activity Permit is required, see permitting advisory at the end of this section.	
		Table 7.3 states that waterbodies with a WFD chemical status of "Fail" will be categorised as low sensitivity receptors. All waterbodies in have a current chemical status of "Fail". With this current approach there is a risk that all waterbodies will be assessed as low sensitivity receptors. This scenario would not accurately describe the risk to each waterbody. We recommend removing or editing this aspect of Table 7.3.	The sensitivity tables have been updated to include ubiquitous, persistent, bioaccumulative and toxic substances (uPBTs).
		Table 7.4 states that a "High" magnitude of effect will include a "major shift in hydrochemistry or hydrological" that would result in "downgrading WFD Quality classification by two classes". It then goes onto explain that a "Medium" magnitude of effect would include a "non-fundamental change" that downgrades an "EA water quality classification by one class". The Water Environment (Water Framework Directive) (England and Wales) Regulations 2017 sets out an obligation to prevent any deterioration in WFD status, in either overall classification or for specific quality elements. Therefore, any deteriorations caused by the development would result in non-compliance with these regulations and	The criteria for assigning magnitude based on WFD degradation is a well-established method for EIA assessment and has been used on several consented DCO solar sites, including Cleve Hill and Mallard Pass. Both High and Medium magnitude of effects are significant in EIA terms and therefore would be an unacceptable effect. Therefore, no degradation of chemical or ecological status of water receptors should occur which would constitute a downgrading of WFD status.

Consultee	Type and Date	Summary of Consultation Response	Applicant's Response
		should be considered a high magnitude of effect. The EA would not consider the deterioration in class of a water quality element to be a "non- fundamental change". The applicant should review their methods for determining magnitude of effect.	
		Section 7.5.4 (292) describes the raising of electronically sensitive equipment. A 600mm freeboard should be used (instead of 300mm) for raising all electronically sensitive equipment above the highest modelled flood level for the 1% AEP event plus an allowance for climate change (or the breach scenario - whichever is highest).	Work Area 1: Solar PV is no longer located within the floodplain of the River Trent, including the 1 % AEP plus 39 % CC event. The illustrative design shows no solar PV located in Flood Zones 2 or 3. Only Work Area 2: Cables, Work Area 3: Mitigation and grid connections associated with Work Area 6 and Work Area 7 are located within the floodplain, however the works associated are either below ground (cables) or involve the creation of grassland etc which are compatible with the floodplain, will not result in a loss of storage or a perceptible effect on conveyance and will remain operational.
		The applicant does not identify the likely fate of sewage produced during construction. If disposal to public sewer, the applicant should consult with the local water company to ensure that adequate sewer capacity is available, and no adverse effects will occur because of the connection. If treatment and discharge at the site is required, the applicant should consider any potential impacts of this discharge and	As outlined in the oCEMP, sewage generated during construction would be dealt with via 'Porta-a-loo' type facilities. As the Development is not a routinely manned facility, the waste generated during operation is minimal. The disposal of sewage / waste

Consultee	Type and Date	Summary of Consultation Response	Applicant's Response
		confirm that a water discharge activity permit will be sought. If road transport to an offsite disposal facility is required, then the applicant should have regard for this within their waste management procedures.	during operation is considered in Section 9.6.2.3 of this chapter.
		A water discharge activity permit is required to carry out discharges of sewage and trade effluent. Given the size of the development it is unlikely that the Regulatory Position Statement on Temporary dewatering from excavations to surface water can be met and therefore a permit will likely be required to discharge dewatering effluent or surface water run-off generated from areas of exposed soil during construction. Given the timeframe to determine environmental permits we encourage the applicant to engage with us on permit requirements at the earliest possible stage.	Permits will be considered at the construction stage.
PINS	Scoping response 20/12/2023	Based on the operational characteristics of the Proposed Development (energy generation with limited maintenance works), the Inspectorate considers that it is unlikely that sediments (or other physical contaminants) would be transferred to surface waters during operation. The Inspectorate is therefore in agreement that this can be scoped out of further assessment for the operational phase only.	Whilst the authors are in agreement with the Planning Inspectorate, the EA have requested that sediment transfer is considered for the operational phase and accordingly it is assessed in this chapter, along with proposed mitigation measures.

Consultee	Type and Date	Summary of Consultation Response	Applicant's Response
		The ES should however describe any mitigation measures which are in place to reduce sediment movement during operation, including how rapidly these would become effective, for example if reliant on mature vegetation.	
		Based on the operational characteristics of the Proposed Development (energy generation with limited maintenance works), the Inspectorate considers that it is unlikely that chemicals or other pollution would be transferred to surface waters during operation. The Inspectorate is therefore in agreement that this can be scoped out for the operational phase only. The ES should however, as required by other chapters, consider the implications of any runoff or other pollution incidents in the event of a fire or other damage to the battery storage facility or other electrical infrastructure. The ES should however describe any mitigation measures which are in place to reduce the potential for pollution during operation.	The containment of fire suppressant in the rare event of a battery fire is considered in section 9.6.2, whereby the SuDS attenuation structures will serve as dual function to limit the potential for chemical pollution of the hydrology by containing water used to cool the surrounding BESS units.
		Based on the information given in relation to solar panel construction and integrity, and considering ongoing maintenance of the Proposed Development, the Inspectorate is in agreement that an assessment of chemical	Whilst the authors are in agreement with the Planning Inspectorate, potential effects from Solar PV damage / degradation are considered in Section 9.6.2.

Consultee	Type and Date	Summary of Consultation Response	Applicant's Response
		pollution and leaks from solar panels can be scoped out of the assessment. The ES should however describe any mitigation measures which are in place to reduce the potential for pollution during operation.	South Muskham & Little Carlton Parish Council requested that consideration be given to "*chemical pollution resulting in damage argument for scoping out requires further scrutiny given the materials forming the panels and panel degradation over life".* Similarly, Bathley Parish Council stated in their scoping response that "*The Council feels that an evidence-based risk assessment of the potential for chemical pollution from damaged/end of life fixed and single axis tracker panels should be scoped in*."
		Paragraph 264 refers to a drinking water protected area (with reference to hydrology), and paragraphs 278 and 279 refer to Drinking Water Safeguarding Zone and Source Protection Zones (with reference to hydrogeology). It would aid readers' understanding if the ES included definitions of the different zones.	Explanations of the various zones is provided in Section 9.4.5 of this chapter to aid interpretation.
		Paragraph 294 refers to the Newark and Sherwood District Council (NSDC) Strategic Flood Risk Assessment, however with no reference to any equivalent assessment from Nottinghamshire County Council (NCC) (though NCC are referred to as a data source in paragraph 295 but with no additional	NCC do not produce strategic flood risk assessments however the Local flood risk management strategy is referenced and referred to in this chapter. Information regarding localised flood events has been obtained from Section 19 reports (NCC) and has been discussed with residents

Consultee	Type and Date	Summary of Consultation Response	Applicant's Response
		information provided). The ES should utilise all relevant available sources of data from the local authorities and Environment Agency (EA). The ES should also, where possible, consider the implication of any known localised flood events or conditions ie those which may not necessarily be captured by strategic flood modelling.	of communities affected by flooding such as Maplebeck, South Muskham, Egmanton, and Sutton-on-Trent.
NCC	Telephone discussion 23/01/2024	The design of SuDS features draining the BESS area should consider a 40 % climate change allowance rather than 25 %, if possible.	A 40 % CC allowance for Peak Rainfall Intensity will be used for the design of SuDS features at the detailed design phase.
N&SDC	PWS data response	Provided records of PWS within the district.	PWS have been assessed based on the records provided.
EA	S42 19/02/2025	The proposed Battery Energy Storage System (BESS) site will be located on a Secondary A aquifer. The drainage at the BESS site may not sufficiently protect vulnerable controlled water receptors. Risk of firewater pollution to several sensitive water receptors. There are several abstractions in the vicinity of the proposed BESS site which are vulnerable to firewater pollution	As outlined in the FRA (TA A9.1) [EN010162/APP/6.4.9.1] and Outline Fire Safety Management Plan (oFSMP; TA A5.4) [EN010162/APP/6.4.5.4], there is a commitment to contain spent firefighting water used to keep adjacent battery containers cool in the rare event of a battery fire via a formal SuDS system e.g. cellular storage, which would be isolated from discharging to the hydrological environment. Contained spent water can then be tested and then either released to a watercourse or tankered offsite.

Consultee	Type and Date	Summary of Consultation Response	Applicant's Response
			As such, the risk to hydrological receptors such as groundwater and abstractions is reduced. Additionally, as discussed in Section 9.4.3 of this chapter, the geology underlying Work Area 5a and 5b will essentially be impermeable, as demonstrated by infiltration testing at Work Area 4, meaning there is limited potential for spent fire-fighting water to reach groundwater and receptors which rely on groundwater.
		Inappropriate watercourse crossings, culverted crossings for access and cable pipe (flume) for cable crossings are proposed. Culverts Impede flows and therefore may harm ecological processes and increase flood risk. The laying of cable pipes on the bottom of watercourses, as implied by the term "cable pipe (flume)" also impede waterflow and can potentially encourage scour and bed lowering. Cable/pipe bridges, during high flow/flood events, can potentially trap floating debris.	As discussed with the EA in a meeting on 24/03/2025, cable crossings will utilise horizontal directional drilling (HDD) as the default option. Open trench methods will only be utilised on manmade watercourses / ditches and smaller watercourses (less than 2 m width). No pipe flumes will be used. Regarding culverting, clear span bridge crossings will be used where possible and culverts will only be used where a bridging solution is not feasible i.e. field drains / ditches / smaller watercourses (less than 2 m width). A map of the anticipated crossings (cable and tracks) is provided as Figures A5.3.1 and A5.3.2 of the oCEMP (TA A5.3) [EN010162/APP/6.4.5.3].

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			It is anticipated that a bailey bridge solution will be required at three (3 no.) locations across the Order Limits.
		The Pingley/Rundell Dyke is currently proposed to be crossed using open cut trenching techniques. Table 8.7 indicates that the Pingley and Beck is one of the larger and more natural watercourses; therefore open cut trenching may impact the current WFD good status.	As discussed with the EA in a meeting on 24/03/2025, cable crossings will utilise HDD and alternative methods will only be used where there is a technical constraint to the use of HDD or where the cable crosses man-made ditches. Should there be a requirement for vehicles to cross Pingley Dyke then a temporary Bailey bridge will be used.
		Flood risk to the BESS and substation site could be underestimated. The BESS and substation may be at a greater risk of flooding than initially considered. Furthermore, the placement of the BESS and substation could increase flood risk elsewhere if not properly mitigated.	Updated 1D-2D modelling has been undertaken to include an existing culvert under the A617, as outlined in the FRA (TA A9.1) [EN010162/APP/6.4.9.1]. Updated results for the 1 % annual exceedance probability (AEP) + 39 % uplift for climate change (CC) shows that Works Area 5a and 5b are located outside the flood extent. Updated 2D direct rainfall modelling has also been undertaken for Work Area 5a and 5b. Results correlate well with the updated Risk of Flooding Surface Water (2025) dataset[1].

[1] https://environment.data.gov.uk/explore/b5aaa28d-6eb9-460e-8d6f-43caa71fbe0e?download=true

Consultee	Type and Date	Summary of Consultation Response	Applicant's Response
		This section notes that a sense check for fluvial flows will be undertaken for the credible maximum scenario. There are no details within the FRA, other than the reference to the higher central scenario for the 2080's epoch (plus 39%). It is not clear if the development would remain resilient and operational if upper climate change allowances were to materialise.	Work Area 1: Solar PV is no longer located within the floodplain of the River Trent, including the 1 % AEP plus 39 % CC event. Only Work Area 2: Cables, Work Area 3: Mitigation and connections associated with Work Area 6 and Work Area 7 are located within the floodplain, however the works associated are either below ground (cables) or involve the creation of grassland etc which are compatible with the floodplain, will not result in a loss of storage or a perceptible effect on conveyance and will remain operational.
		The FRA has not clarified if the proposed lifetime of the development is the operational lifetime, or if it includes the construction and decommissioning phases. The FRA needs to clarify the timeline of the development and the complete lifetime. Additionally, delays should be factored into this assessment.	Paragraph 10 of the FRA submitted with the PEIR stated "*the Development is Essential Infrastructure and will have a lifespan of 40 years (decommissioned from 2069)*". The Development has been designed to avoid placing above ground infrastructure within the extent of the 1 % AEP + 39 % CC event i.e. the Higher central climate change allowance for the 2080s epoch. Given that a conservative approach has been adopted for the majority of the epoch in which the Development will operate in and the potential for climate change allowances to change in future, it is considered that the

Consultee	Type and Date	Summary of Consultation Response	Applicant's Response
			Development has been designed appropriately. The commitment in the oOEMP [EN010162/APP/6.4.5.5] states that should the Development lifetime be anticipated to extend into the 2080s epoch, as a result of delays to the construction programme for example, then modelling will be undertaken in year 2069 using the appropriate climate change allowances at the time, in consultation with the EA (and other regulators). Should modelling results show that the Development has the potential to interact with flood depths then the Development design will be altered accordingly to ensure that flood storage and conveyance is maintained for the River Trent. This could involve raising the PV Arrays (subject to negligible loss of storage and conveyance), the removal of the first row of panels on a PV table or removing the mounting system and associated infrastructure from the modelled extent.
		The 1d-2d hydraulic modelling undertaken for the Car and Pingley Dyke suggests the BESS, and substation area, are not at risk from fluvial flooding from these watercourses, and the A617 acts as a barrier to flow.	Updated 1D-2D modelling has been undertaken to include the existing culvert under the A617, as outlined in the FRA (TA A9.1) [EN010162/APP/6.4.9.1].

Consultee	Type and Date	Summary of Consultation Response	Applicant's Response
		There could be some connectivity underneath the A617 at grid reference 475725, 355050. This could mean flood risk on the northeastern side of the A617, the BESS and substation is underestimated. The Detailed River Network (DRN) dataset suggests there is a small culvert underneath the A617 at grid reference 475725, 355050. Confirmation is required of any flow routes underneath the A617, and if there is a culvert underneath the A617 at grid reference 475725, 355050. If any culverts are present under the A617, these will need to be included within the 1d-2d linked model of the Car and Pingley Dyke. The outcome of this assessment would be prudent to assess whether the flood flows from the River Greet and can pass under the A617.	Updated results for the 1 % AEP + 39 % CC shows that Works Area 5a and 5b are located outside the flood extent of Pingley Dyke.
		There is no evidence provided to demonstrate their will be no perceptible loss of flood storage or conveyance during times of flooding, from the solar panel metal support frames. The solar panel support frames could potentially increase flood risk due to loss of floodplain storage and impedance to flow.	Work Area 1: Solar PV has been removed from the floodplain and future floodplain (1 % AEP + 39 % CC), as shown on Plate A9.1.17 of the FRA (TA A9.1) [EN010162/APP/6.4.9.1]. As such, there will be no effect on the conveyance of out of channel flows.

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		Soffit levels for new crossings are not considered. Potential impediments to flood flows, and therefore increased flood risk elsewhere. It is proposed that new crossings will be bridges, but there is no clarification of the design criteria for these. If not designed appropriately, new structures could cause increases to flood risk.	Crossings will be designed following granting of the DCO and the oCEMP (TA A5.3) [EN010162/APP/6.4.5.3] has been updated to commit to the soffit level of any bridges to sit above the design flood level. The design flood level for permanent crossings would be the 1% AEP plus Higher central climate change scenario (39 % CC) and will involve the following parameters: • Soffit height of the crossing will be a minimum of 600 mm above the 1 % AEP + Climate change allowance flood level. • All abutments must be set back a minimum 1 m from the top of bank and as minimal as possible. • Any loss of floodplain due to abutments and ramps will need to be compensated for. • All parapets and railings need to be permeable and as open as possible with a minimum 100 mm spacing. The application is not seeking to disapply the EA's Protective Provisions and, therefore, the design of crossings will need to be approved by the EA prior to the constriction phase.
		The development has not assessed the impact it may have on engineered flood defences and assets (engineered high ground).	Paragraphs 199 to 201 of Chapter 9 of the PEIR assessed the potential effects from the Development on flood defences, including

Consultee	Type and Date	Summary of Consultation Response	Applicant's Response
		Consideration has not been given for access to maintain the assets and respond to emergency incidents. If assets are adversely impacted, this may lead to degradation and a lower standard of protection. If assets cannot be accessed in times of a flood and/or for maintenance, this can increase flood risk.	those classed as Engineered High Ground and concluded effects of Negligible magnitude. Work Area 2: Cables has been removed from the Order Limits in proximity to asset ID 55462 (Engineered High Ground) and asset ID 46099 (Natural High Ground) on the left bank of the River Trent. As such, the Development will not directly interact with flood defences and access to the assets will remain unaffected. An updated assessment of the potential effects from the Development on flood defences is provided in Section 9.6.1.6 of this chapter.
		Both the Environmental Impact Assessment (EIA) scoping and Preliminary Environmental Impact Reports (PEIR) have not considered water supply for consumptive uses in sufficient detail, for any phase of the project. With the exception of dust suppression, the source of supply for water to meet the projects demands is unclear.	As discussed with the EA on 24/03/2025 and 14/04/2025, water for use by the Development during all stages will be procured offsite i.e. not by groundwater abstraction and sourced by means such as rainwater harvesting, tankered, potable supply etc. As sheep grazing is proposed to manage the grassland in Work Area 1 there will be a need to supply them with drinking water. Based on a total flock of 9,600 sheep this equates to 18.7 m^3 per day, which is less than the threshold where a licence is required from the EA. The oCEMP has been updated to reflect this and this addresses the EA's point.

Consultee	Type and Date	Summary of Consultation Response	Applicant's Response
		There is mention of the quality of the rivers ranging from Moderate to Bad, but no detail is provided of what cycle of WFD classifications this has come from.	Section 9.4.7 of this assessment clarifies that the WFD classifications are derived from Cycle 3 – 2022.
		Settlement Lagoons causing silt pollution. Discharge containing elevated levels of suspended solids may cause a deterioration in a waterbody's WFD status.	The oCEMP (TA A5.3) [EN010162/APP/6.4.5.3] has been updated to include water quality monitoring of discharges from settlement lagoons, specifically during wet weather.
		Water quality monitoring requires more details. Surface water run-off, or pumped site drainage, to local watercourses may cause a deterioration in a waterbody's WFD status. Details of the monitoring programme need to include monitoring locations and frequency before, and during the development. This needs to be submitted prior to commencing work on site. Details of the proposed analysis suites are to also be provided. Twice monthly samples need to be collected prior to work commencing (obtain 12 samples over a 6-month period). We suggest that weekly sampling occurs once construction commences, with the view to this reducing to twice monthly after a period of time, based on the results of samples obtained. This would be with the agreement of the local Environment Officer. Results of samples to be provided	The oCEMP (TA A5.3) [EN010162/APP/6.4.5.3] has been updated to reflect the suggested sampling frequency and provision of results.

Consultee	Type and Date	Summary of Consultation Response	Applicant's Response
		monthly to the East Midlands Water Quality email inbox.	
		An outdated WFD classification is used (cycle 2, 2019). An inappropriate understanding of the WFD baseline may lead to an inappropriate assessment of the development's impacts, and mitigation measures. An up-to-date WFD assessment should use Cycle 3, 2022 WFD classifications, which may differ from those seen in 2019, along with the associated reasons for not achieving good status (RNAGs) and RBMP objectives.	Section 9.4.7 of this assessment clarifies that the WFD classifications are derived from Cycle 3 – 2022.
NCC	S42 20/02/2025	The Flood Risk Management Team has reviewed the Flood Risk Assessment (Technical Appendix A9.1) and is broadly satisfied with its content. However, the reference to flood alleviation measures to improve the existing flooding pathways to communities such as Maplebeck is somewhat misleading. Whilst it is recognised that these schemes may be delivered within the order limits of this proposal, they would be secured separately through applications made to the LPA under the Town and Country Planning Act and will not be delivered directly as part of this development. Therefore, it is not	We disagree that the statement that the measures proposed as part of the NG+ scheme are misleading as they are not delivered through the DCO. The plates within the FRA (TA A9.1) [EN010162/APP/6.4.9.1] show the effects of the introduction of grassland under the PV arrays in Work Area 1 and woodland within Work Area 3, and not the NFM measures being delivered separately through the NG+ fund. The cumulative effect of these schemes and the Development is assessed in Section 9.8 of this chapter.

Consultee	Type and Date	Summary of Consultation Response	Applicant's Response
		recommended that these measures form part of the FRA for this application.	

9.3 ASSESSMENT METHODOLOGY AND SIGNIFICANCE CRITERIA

9.3.1 Scope of Assessment

13 The key issues for the assessment of potential hydrological and hydrogeological effects relating to the Development are likely to be:

- Short-term effects arising from the construction phase, such as potential chemical pollution and sedimentation; and
- Permanent effects, including long-term effects that last for the operational phase only.

9.3.2 Relevant Guidance, Legislation and Information

14 The following guidance, legislation and information sources have been considered when carrying out the assessment reported in this chapter:

- National Policy Statement (NPS): Overarching National Policy Statement for Energy (EN-1, November 2023), Section 5.8: Flood Risk. This outlines the requirements for a Flood Risk Assessment (FRA) and the promotion of the use of SuDS[2];
- NPS for Renewable Energy Infrastructure (EN-3, November 2023) provides advice with regards to siting of critical equipment in relation to potential flood risk (Paragraph 2.10.60). It also notes that any development will need to appropriately consider drainage but confirms that as solar arrays *'drain to the existing ground, the impact will not in general be significant'* (paragraph 2.10.84)[3];
- NPS for Electricity Networks Infrastructure (EN-5), Section 2.3 outlines that climate change should be assessed and details of how infrastructure has been designed to be resilient to flooding should be included in the assessment[4];
- National Planning Policy Framework (NPPF) (2024), paragraphs 170 to 182. This states that for development comprising one hectare or above, the vulnerability to flooding, or the potential to add to flooding elsewhere should be assessed in an FRA[5];
- Water Resources Act 1991 (Amendment) (England and Wales) Regulations 2009[6];
- Land Drainage Act 1991 as amended 1994[7];
- Flood and Water Management Act 2010[8];
- Water Act 2003 as amended 2014[9];
- Water Supply Regulations 2016 as amended 2018[10];

[2] https://www.gov.uk/government/publications/overarching-national-policy-statement-for-energy-en-1#:~:text=This%20version%20of%20the%20overarching,nationally%20significant%20infrastructure%20projects%20(%20NSIPs%20)
[3] https://www.gov.uk/government/publications/national-policy-statement-for-renewable-energy-infrastructure-en-3
[4] https://www.gov.uk/government/publications/national-policy-statement-for-electricity-networks-infrastructure-en-5
[5] https://www.gov.uk/government/publications/national-planning-policy-framework--2
[6] https://www.legislation.gov.uk/uksi/2009/3104/contents
[7] https://www.legislation.gov.uk/ukpga/1991/59/contents
[8] https://www.legislation.gov.uk/ukpga/2010/29/contents
[9] https://www.legislation.gov.uk/ukpga/2014/21/contents
[10] https://www.legislation.gov.uk/uksi/2016/614/contents

- The Water Environment (Water Framework Directive) (England and Wales) Regulations 2017[11];
- The Water Resources (Environmental Impact Assessment) (England and Wales) (Amendment) Regulations 2017[12];
- The Groundwater (England and Wales) Regulations 2009[13];
- Groundwater Daughter Directive (2006/118/EC) 2006[14];
- Anti-Pollution Works Regulations 1999[15];
- The Environmental Damage (Prevention and Remediation) (England) Regulations 2015[16];
- Conservation of Habitats and Species Regulations 2017[17];
- Environment Act 1995[18];
- The Environmental Permitting (England and Wales) (Amendment) Regulations 2018[19];
- Newark & Sherwood District Council (N&SDC) Strategic Flood Risk Assessment (SFRA) Update (2016)[20];
- N&SDC ENV 13 SFRA Level 1 Refresh (September 2023)[21];
- Nottinghamshire Local Flood Risk Management Strategy (LFRMS) 2021-2027[22];
- Nottinghamshire County Council (NCC) - Local Flood Risk Management Strategy 2021 – 2027[23];
- The EA - Accounting for residual uncertainty: an update to the fluvial freeboard guide[24];
- The Environment Agency's approach to groundwater protection (2018 v1.2)[25];
- EA - Pollution Prevention Guidelines (EA - PPG) EA - PPG1: Understanding Your Environmental Responsibilities to EA - PPG28: Controlled Burn (archived but still relevant) [26];
- EA - Flood risk activities: environmental permits[27];
- Trent Valley Internal Drainage Board (IDB) Byelaws[28];

[11] https://www.legislation.gov.uk/uksi/2017/407/contents
[12] https://www.legislation.gov.uk/uksi/2017/583/contents
[13] https://www.legislation.gov.uk/ukdsi/2009/9780111480816
[14] https://eur-lex.europa.eu/eli/dir/2006/118/oj/eng
[15] https://www.legislation.gov.uk/uksi/1999/1006/contents/made
[16] https://www.legislation.gov.uk/uksi/2015/810/contents
[17] https://www.legislation.gov.uk/uksi/2017/1012/contents
[18] https://www.legislation.gov.uk/ukpga/1995/25/contents
[19] https://www.legislation.gov.uk/uksi/2018/110/contents/made
[20] https://www.newark-sherwooddc.gov.uk/sfraupdate/
[21] https://www.newark-sherwooddc.gov.uk/planreview-evidence/
[22] https://www.nottinghamshire.gov.uk/media/4346719/nottinghamshire-local-flood-risk-mangement-stategy-2021-27.pdf
[23] https://www.nottinghamshire.gov.uk/media/4346719/nottinghamshire-local-flood-risk-mangement-stategy-2021-27.pdf
[24] https://www.gov.uk/flood-and-coastal-erosion-risk-management-research-reports/accounting-for-residual-uncertainty-an-update-to-the-fluvial-freeboard-guide
[25] https://assets.publishing.service.gov.uk/media/5ab38864e5274a3dc898e29b/Envirnment-Agency-approach-to-groundwater-protection.pdf
[26] https://www.gov.uk/government/collections/pollution-prevention-guidance-ppg
[27] https://www.gov.uk/guidance/flood-risk-activities-environmental-permits
[28] https://www.wmc-idbs.org.uk/

- EA - Lower Trent and Erewash Abstraction Licensing Strategy - A strategy to manage water resources sustainably (September 2020) - LIT 3309[29];
- Construction Industry Research and Information Association (CIRIA) - Containment systems for the prevention of pollution. Secondary, tertiary and other measures for industrial and commercial premises (C736)[30];
- National Fire Chiefs Council (NFCC) – Grid Scale Battery Energy Storage System planning – Guidance for FRS – July 2024 Draft Update[31]; and
- The National Fire Protection Association (NFPA) 855 Standard for the Installation of Stationary Energy Storage Systems[32];
- Good Practice Guide for Environmental Impact Assessment (EIA), 2006 (withdrawn but still considered relevant in the absence of superseding guidance);
- CIRIA C753 'The SuDS Manual' (CIRIA, 2015)[33]; and
- Environmental good practice on site guide (5th edition) C811 (CIRIA, 2023)[34].

15 Consultation drafts of the NPSs have been issued (April 2025) in response to changing climate change policy, however, the content of these with respect to the topic covered in this chapter is materially unchanged from the adopted versions, and hence the adopted versions are referred to elsewhere in this chapter.

9.3.3 Methodology for the Assessment of Effects

16 In the absence of industry standard guidance on assessing effects, the significance of the potential effects of the Development is classified by professional consideration of the sensitivity of the receptor and the magnitude of the potential effect.

17 The approach for the hydrological and hydrogeological impact assessment for the Development has been developed in consultation with the several statutory consultees and Internal Drainage Boards over numerous Town and Country Planning Act applications and DCO applications for solar and energy storage sites.

18 The assessment is based on a source-pathway-receptor methodology, where the sensitivity of the receptors and the magnitude of potential change (effect) upon those receptors is identified within the study areas identified in Section 9.3.5.

19 As the Development is classed as Essential Infrastructure, as per Annex 3: Flood risk vulnerability classification of the NPPF and is expected be

[29] https://assets.publishing.service.gov.uk/media/5f5f6d5e8fa8f51064e88a22/Lower-Trent-and-Erewash-Abstraction-Licensing-Strategy.pdf
[30] https://www.ciria.org/CIRIA/CIRIA/Item_Detail.aspx?iProductCode=C736F
[31] https://nfcc.org.uk/
[32] https://www.nfpa.org/codes-and-standards/all-codes-and-standards/list-of-codes-and-standards/detail?code=855
[33] https://www.ciria.org/CIRIA/CIRIA/Item_Detail.aspx?iProductCode=C753
[34] https://www.ciria.org/ci/iCore/Store/StoreLayouts/Item_Detail.aspx?iProductCode=C811&Category=BOOK

operational between the 2050s and 2080s epochs, the Higher Central band of 23 % will be used for fluvial flows in accordance with the Lower Trent and Erewash Management Catchment peak river flow allowances, as shown in Table 9.2.

Table 9.2: Lower Trent and Erewash Management Catchment peak river flow allowances – shading denotes allowances to be used

Epoch	Central	Higher	Upper
2020s	13 %	18 %	29 %
2050s	17 %	**23 %**	38 %
2080s	29 %	39 %	62 %

20 As the Development is a NSIP the Upper band of 38 % (or 39 %, i.e., the Higher Central allowance for the 2080s epoch as a proxy – shaded cells in Table 9.2) will be used as a stress test for fluvial flows to sense check against a credible maximum scenario, in accordance with Assessing credible maximum scenarios for nationally significant infrastructure projects, new settlements or urban extensions section of the EA's Flood risk assessments: climate change allowances[35].

21 As parts of the Core Study Area (see Section 9.3.5) are located within Flood Zone 2, 3a and 3b, the FRA (TA A9.1) [EN010162/APP/6.4.9.1] demonstrates that, where development is proposed in those areas, it passes the Sequential and Exception tests outlined in the NPPF and NPS. There will be a requirement to raise all electronically sensitive equipment at least 300 mm above the highest modelled flood level for the 1 % annual exceedance probability (AEP) event (plus climate change allowance (23 %)), in accordance with the EA's *Accounting for residual uncertainty: an update to the fluvial freeboard guide*[36], where there is confidence in the flood data or 600 mm where flood data has substantial uncertainty or uses old data.

22 The climate change allowance data has been obtained from the EA Climate Change Allowances for Peak River Flow in England (2022)[37] for the Lower Trent and Erewash Management Catchment.

9.3.3.1 Sensitivity of Receptors

23 The sensitivity of the baseline conditions, including the importance of environmental features on or near to the Development or the sensitivity of potentially affected receptors, will be assessed in line with best practice guidance, legislation, statutory designations and professional judgement.

24 Table 9.2 details the proposed framework for determining the sensitivity of receptors and not all attributes need to be met for a sensitivity category to be defined.

[35] https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances
[36] https://www.gov.uk/flood-and-coastal-erosion-risk-management-research-reports/accounting-for-residual-uncertainty-an-update-to-the-fluvial-freeboard-guide
[37] https://environment-test.data.gov.uk/hydrology/climate-change-allowances/river-flow?mgmtcatid=3052

Table 9.2: Framework for Determining Sensitivity of Receptors

Sensitivity of Receptor	Definition
High	• A watercourse or water body with a WFD Overall Water Body Class of "Good"; • The receptor and associated downstream environment has limited capacity to attenuate fluctuations in hydrochemistry and cannot buffer further changes without profoundly altering its characteristics or natural processes; • The hydrological receptor is designated as having international importance, such as Special Areas of Conservation (SACs) and Special Protection Areas (SPAs); • Groundwater Vulnerability Class of High; • Water abstractions used for the production of mass-produced consumables (food and drink) or for public water supply; • Areas classed as Functional Floodplain (Flood Zone 3b) and flood storage areas not protected by flood defences; and / or • Flood defences.
Medium	• A watercourse or water body with a WFD Overall Water Body Class of "Moderate"; • The receptor and associated downstream environment has some capacity to attenuate fluctuations in hydrochemistry but cannot absorb prolonged changes without profoundly altering its baseline characteristics / natural processes; • The hydrological receptor is of high environmental importance or is designated as having national importance, such as SSSIs; • Areas classed as Flood Zone 3a; • Areas prone to surface water flooding; • Groundwater Vulnerability Class of Medium - High or Medium; and / or • Areas containing geological features of designated regional importance including Regionally Important Geological/geomorphological Sites (RIGS).
Low	• A watercourse or water body with a WFD Overall Water Body Class of "Poor" or "Bad" and / or a Current Chemical Quality classification of "Fail", excluding ubiquitous, persistent, bioaccumulative and toxic substances (uPBTs); • Heavily modified watercourses or manmade drainage ditches; • The receptor is not of regional, national or international environmental importance; • Groundwater Vulnerability Class of Medium – Low or Low; • The hydrological receptor does not support abstractions for public water supply or private water abstractions; • Poor groundwater quality and / or very low permeability make exploitation of groundwater unfeasible; and / or • Areas classed as Flood Zone 2.
Negligible	• The receptor is resistant to change and / or is of little environmental value; • Groundwater Vulnerability Class of Unproductive; and / or

Sensitivity of Receptor	Definition
	• Areas classed as Flood Zone 1.

9.3.3.2 Magnitude of Effect

25 The magnitude of potential effects will be identified through consideration of the Development, the degree of change to baseline conditions predicted as a result of the Development, the duration and reversibility of an effect and professional judgement, best practice guidance and legislation.

26 The criteria for assessing the magnitude of an effect are presented in Table 9.3 and not all definitions need to be met to attribute a magnitude of effect.

Table 9.3: Framework for Determining Magnitude of Effects

Magnitude of Effect	Definition
High	• A major shift in hydrochemistry or hydrological conditions sufficient to negatively change the function of the receptor. This change would result in a downgrading of an WFD Quality classification by two classes, e.g., from “High” to “Moderate”; • A material increase in the probability of flooding onsite and offsite, adding to the extent which requires protection by flood prevention measures or affecting the ability of the functional flood plain to attenuate the effects of flooding by storing flood water (in accordance with NPPF paragraphs 170 to 182) i.e., loss of functional floodplain (Flood Zone 3b) storage; • A permanent or long-term degradation of groundwater quality or a long-term reduction in the available yield; and / or • A greater than 50 % loss of a hydrogeological receptor or peat habitat site, or where there would be complete severance of a site such as to fundamentally affect the integrity of that site (e.g., severing hydrological connectivity).
Medium	• A fundamental change to the hydrochemistry or hydrological environment, resulting in a change in ecological status. This change would result in a downgrading of an EA water quality classification by one class, e.g., from "Good" to "Moderate"; • A loss of between 15 % to 50 % of a hydrogeological receptor or peat habitat site, complete or substantial severance and effects to its integrity as a feature, or disturbance such that the value of that site would be affected, but could still function; • The yield or quality of PWS or PuWS may be temporarily reduced; and / or • A moderate increase or reduction in the probability of flooding onsite and offsite, adding to the area of land which requires protection by flood prevention measures or affecting the ability of the functional flood plain to attenuate the effects of flooding by storing flood water i.e., moderate loss of storage within Flood Zone 3a.

Magnitude of Effect	Definition
Low	• A detectable non-detrimental change to the baseline hydrochemistry or hydrological environment. This change would not reduce the WFD status of the receptor; • Loss of storage within Flood Zone 2; • Interaction with the groundwater table which will marginally alter local ecology or will lead to a slight detectable displacement of groundwater; and / or • A detectable but non-material effect on the receptor or a moderate effect on its integrity as a feature or where there would be a minor severance or disturbance such that the functionality of the receptor would not be affected.
Negligible[38]	• No detectible changes to the baseline hydrochemistry or hydrological environment; and / or • No increase in the probability of flooding onsite and offsite.

9.3.3.3 Significance of Effect

27 The sensitivity of the receptor and the magnitude of the predicted effect will be used as a guide, in addition to professional judgement, to predict the significance of the likely effect. Table 9.4 summarises guideline criteria for assessing the significance of effects.

28 Effects predicted to be of major or moderate significance are considered to be 'significant' in the context of the EIA Regulations and are shaded in light grey in the table.

Table 9.4: Framework for Assessment of the Significance of Effects

Magnitude of Effects	Sensitivity of Resource or Receptor			
	High	**Medium**	**Low**	**Negligible**
High	Major	Moderate	Moderate	Minor
Medium	Moderate	Moderate	Minor	Negligible
Low	Minor	Minor	Negligible	Negligible
Negligible	Negligible	Negligible	Negligible	Negligible

29 This assessment considers the likelihood of an effect occurring with the oCEMP as embedded mitigation and concludes whether the residual or overall significance will be Major, Moderate, Minor or Negligible, before appropriate mitigation (beyond that specified in the oCEMP) has been implemented.

30 The assessment relies on professional judgment to ensure that the effects are appropriately assessed.

[38] Negligible magnitude of change also includes magnitude of effects that are assessed as no change to the baseline scenario

31 A residual effect is considered to be a likely significant effect in accordance with EIA Regulations if assessed as Moderate or Major following the implementation of necessary mitigation measures.

9.3.3.4 Embedded Mitigation

32 Embedded mitigation measures are included within the outline Construction Environmental Management Plan (oCEMP; TA A5.3 [EN010162/APP/6.4.5.3]). The oCEMP comprises good practice construction methods and works that are established and effective measures to which the Applicant will be committed throughout the detailed design process. This will be secured by an appropriate DCO Requirement.

33 The measures outline in the oCEMP are of such effectiveness to be treated as part of the Development for the purposes of this assessment. As such, the assessment of significance of effects of the Development is based on the implementation of the measures in the oCEMP.

34 The measures included in the oCEMP are fundamentally part of the Development design and constitute embedded mitigation.

9.3.4 Assessment of Cumulative Effects

35 A cumulative effect is considered to be an additional effect on a hydrological or hydrogeological resource (*i.e.*, within the same hydrological catchment) arising from the Development in addition to the contribution of other developments likely to affect the hydrological environment. At distances greater than 5 km, developments are unlikely to contribute appreciably to a cumulative hydrological effect due to attenuation, dilution and deposition over distance of potentially polluting chemicals and sediment. Therefore, for the purposes of the assessment of potential cumulative effects on the catchment in which the Development is located, only proposed developments, which require large scale construction / excavation, within approximately 5 km of the Order Limits will be considered.

36 The approach taken to identifying developments with the potential to lead to cumulative effects is set out in ES Chapter 2, EIA [EN010162/APP/6.2.2], with the developments selected for inclusion in Stages 3 and 4 of the cumulative effects assessment in each technical chapter being set out in TA A2.1 [EN010162/APP/6.4.2.1].

9.3.5 Proposed Hydrology Study Areas

37 The study areas are shown on Figure 9.1 [EN010162/APP/6.3.9.1].

38 The Order Limits form the immediate study area, i.e., the Core Study Area (CSA). Where figures within this chapter show the CSA, this also refers to the Order Limits.

39 Baseline data will be used to assess potential effects of the Development on hydrological and hydrogeological resources within a 5 km study area of the Order Limits (‘the Wider Study Area’). This wider study area is based on the hydrological and hydrogeological connectivity of water bodies located downstream of the Development.

40 At distances greater than 5 km, it is considered that solar developments in low lying catchments are unlikely to contribute appreciably to chemical or sedimentation effects due to attenuation, dilution and deposition.

41 The Wider Study Area will also be used for the cumulative assessment.

42 A smaller 1 km study area based upon the Order Limits will be applied to assess Private Water Supplies (PWS) and Public Water Supplies (PuWS) abstractions and will be termed the Water Supplies Study Area (WSSA). The WSSA distance is based on Paragraph 2.15 of guidance issued by the Scottish Environmental Protection Agency (SEPA)[39], in the absence of guidance relating to study area distance issued by the EA or the British Geological Survey (BGS).

43 These study areas are defined based on the author's professional judgement and experience assessing similar scale developments (DCO solar developments) within lowland agricultural environments and similar hydrological catchments in England.

9.3.6 Data Gathering

44 A desk-based approach to identifying receptors was employed, utilising data sets from the regulators and consultees such as the EA, Natural England, the IDB. This also involved data requests to consultees such as NSDC and the EA who provided specific data such as water supplies to supplement the freely available datasets.

45 Severn Trent Water did not respond to consultation.

46 Site walkovers were undertaken in August 2024, October 2024 and February 2025 to ground-truth the location and visible condition of receptors such as surface water and superficial geology.

9.3.7 Assumptions and Limitations

47 Weather conditions during the Site walkovers (14/08/2024 and 10/10/2024) were changeable with extended periods of dry weather for the former walkover while heavy rainfall occurred in the week leading up to the 10/10/2024 walkover. Weather conditions for the 18/02/2025 walkover were dry following a period of rainfall.

48 The weather conditions are not considered to materially affect the understanding of the hydrological regime as watercourses and ditches were visible and flow observed.

49 Where numbers of crossings are stated within this chapter they are based on the Illustrative Layout and provides an indicative worst-case scenario.

50 All data considered necessary to identify and assess the likely significant effects was available.

[39] Land Use Planning System
SEPA Guidance Note 31 Guidance on Assessing the Impacts of Development Proposals on Groundwater Abstractions and Groundwater Dependent Terrestrial Ecosystems [online]. Available at: https://www.sepa.org.uk/media/144266/lups-gu31-guidance-on-assessing-the-impacts-of-development-proposals-on-groundwater-abstractions.pdf [Accessed 28/06/2024].

9.4 CURRENT BASELINE CONDITIONS

9.4.1 Topography and Land Use

51 The land use of the Order Limits, inferred from the desk-top study, was confirmed, during the walkover on 14/08/24, 10/10/2024 and 18/02/2025 and through landowner interviews, to be mainly arable with some pastoral agricultural land.

52 Topography of the CSA varies substantially but generally slopes gently from approximately 6.8 m above ordnance datum (AOD) in the east of the CSA to 92.4 m AOD in the west. Topography slopes to land drains which drain fields to the larger watercourses within the wider hydrological catchment.

53 Approximately 80 % of Work Area 1: Solar PV is on slopes of less than 6 % demonstrating the relatively flat nature of the CSA.

9.4.2 Rainfall

54 The National River Flow Archive (NRFA) reports Average Annual Rainfall (AAR) of 747 mm at North Muskham gauging station, located approximately 425 m east of the CSA.

55 As monthly long term climate data is not freely available from the NRFA, long term average rainfall data (1991 to 2020) has been obtained from the Meteorological Office at the Waddington climate station, which is located approximately 13 km northeast of the CSA and is representative of the regional rainfall. This is shown in Table 9.5.

Table 9.5: Long-term average rainfall data (1981 to 2000), Waddington gauging station

Month	Rainfall (mm)
Jan	48.1
Feb	38.4
Mar	36.3
Apr	44.6
May	48.0
Jun	59.8
Jul	54.0
Aug	59.5
Sep	50.4
Oct	62.4
Nov	56.6
Dec	54.6

9.4.3 Solid Geology

56 British Geological Survey (BGS) 1:50,000 mapping indicates that the majority of the CSA is underlain by mudstone (with bands of siltstone, Dolomitic) of the Mercia Mudstone Group.

57 A minor area around Staythorpe is underlain by mudstone from the Gunthorpe Member and an area in proximity to Eakring, which is underlain by Siltstone, Mudstone and Sandstone of the Tarporley Siltstone Formation.

58 Borehole logs in the northern section of the CSA, north of Moorhouse, indicate an absence of superficial cover with siltstone, sandstone and mudstone very close to the surface.

59 Infiltration testing was undertaken in Work Area 4: Substations and the results show the underlying solid geology (mudstone) is essentially impermeable, as outlined in Appendix B of the FRA (TA A9.1) [EN010162/APP/6.4.9.1].

60 BGS borehole logs at Work Area 5a: BESS Compound, in the southern extent of the CSA, suggest mudstone at a depth of 9.5 m below ground level (BGL), As Work Area 5a has similar geology in Work Area 4, it is expected that Work Area 5a will not permit infiltration.

61 Three north-west to south-east faults are inferred to the north of the CSA.

62 An illustration of solid geology is shown on Figure 9.2 [EN010162/APP/6.3.9.2].

9.4.4 Superficial Geology

63 BGS superficial data does not record superficial deposits across the majority of the CSA; however, where superficial deposits are present, they comprise areas of Alluvium - clay, silt, sand and gravel, and areas of sand and gravel from the Holme Pierrepont Sand and Gravel Member in the eastern section of the CSA.

64 During the walkover of the CSA in August 2024, topsoil in Fields 73 and 454 and 497 was very dry and cracked as a result of a period of prolonged dry weather. Soils were observed to be gravelly sandy deposits, as shown in Plate 9.1. Further information on soils is provided in chapter 17, Agricultural Land [EN010162/APP/6.2.17].

Plate 9.1: Dry / cracked arable soils south and west of Maplebeck (12/08/2024)

65 Soils in the north of the CSA, in Fields 47, 199 and 195, were observed to be clay dominated, as shown in Plate 9.2.

Plate 9.2: Compacted clay soils in north of CSA (10/10/2024)

66 Similarly, soils were observed to be clay dominated in the central section of the CSA (Field 233), as shown in Plate 9.3. Field numbers can be found on Figure 5.1 [EN010162/APP/6.3.5.1].

Plate 9.3: Compacted clay soils in centre of CSA (18/02/2025)

67 An illustration of superficial geology within the CSA is shown on Figure 9.3.

9.4.5 Hydrogeology

68 The BGS Geoindex 1:625,000 Hydrogeology map shows that the CSA is underlain by aquifers identified as Triassic Rocks (undifferentiated), which is a "*Low productivity aquifer and flow is virtually all through fractures and other discontinuities, yielding up to 40l/s in Lincolnshire. Copious springs at outcrops, and is brackish at confined depths*".

69 Figure 0703 - C – 2: SuDS Infiltration Feasibility Plan of the Newark and Sherwood District Council Level 1 SFRA identifies that the majority of the CSA is underlain by the Mercia Mudstone Group for which infiltration is not

feasible. The eastern section of the CSA is underlain by rocks for which infiltration feasibility is uncertain.

70 Infiltration testing was undertaken within Work Area 4 and disposal of surface water to ground is not feasible due to the impermeability of the underlying geology (see Appendix B of TA9.1, FRA [EN010162/APP/6.4.9.1]).

71 The CSA is not located within a Drinking Water Safeguard Zone (Groundwater). Drinking Water Safeguard Zones are catchment areas that influence the water quality for their respective Drinking Water Protected Area. They are identified where the protected area has been assigned as being "at risk" of failing the drinking water protection objectives of the water environment.

72 There are two areas identified as Source Protection Zones (SPZ) within the CSA. SPZs show the level of risk to the source from contamination. This could be from any activity that might cause pollution in the area. For example, storing pollutants like petrol underground, soakaways from septic tanks to the ground. The closer the activity, the greater the risk.

73 The western section of the CSA bisects SPZ 1, 2 and 3, approximately 250 m west of Caunton, associated with the Severn Trent borehole abstraction from the Triassic Sandstone.

74 A section in the west of the CSA is located within SPZ 3, associated with the Severn Trent abstraction at Ompton Pumping Station, which draws water from the Triassic Sandstone underlying the confining Mercia Mudstone.

75 SPZs are shown on Figure 9.8.

76 The Lower Trent Erewash - Secondary Combined groundwater unit (ID GB40402G990300) underlying the CSA has an overall status of Good[40].

9.4.6 Contaminated Land

77 The EA's Permitted Waste Sites - Authorised Landfill Site Boundaries dataset identifies that no active landfill sites are present within the CSA.

78 The EA's Historic Landfill Sites dataset identifies two former landfills (Debdale Hill and Debdale Tip) recorded as accepting commercial and household waste within the CSA at NGR X 475042 Y 361182.

79 The East Coast Mainline railway line bisects the CSA in a northwest to southeast orientation and has the potential for sources of contamination.

80 A full assessment of contaminated land is provided in Chapter 10, Ground Conditions and Land Contamination [EN010162/APP/6.2.10].

9.4.7 Surface Hydrology

81 The CSA is located within the primary catchment of the River Trent, which borders the south-east of the Order Limits at its nearest point.

82 The CSA is drained by a network of ordinary watercourses and drainage ditches, which ultimately discharge to the River Trent, as shown on Figure 9.4.

[40] https://environment.data.gov.uk/catchment-planning/OperationalCatchment/1127

83 The western section of the CSA is drained by The Beck, draining from west to east before its confluence with the River Trent approximately 700 m east of the CSA.

84 The northern section of the CSA is drained by Moorhouse Beck, which drains from southwest to north-east, before its confluence with Goosemoore Dyke approximately 1 km north-east of the CSA.

85 Moorhouse Beck is carried in culvert under the A1 via a twin rectangular structure, as shown in Plate 9.5, while the public footpath is carried over the watercourse by a beam deck bridge, as shown in Plate 9.6.

Plate 9.5: Moorhouse Beck culvert at A1

Plate 9.6: Beam deck bridge over Moorhouse Beck

86 Moorhouse Beck has steep banks with evidence of erosion and deposition, as shown in Plate 9.7, partly due to the meandering nature of the watercourse.

Plate 9.7: Erosion and deposition within Moorhouse Beck

87 Car / Pingley Dyke is located in the southern section of the CSA and appears typical of watercourses which drain agricultural land i.e. with a relatively straight and uniform channel, as shown in Plate 9.8.

Plate 9.8: Pingley Dyke

88 Pingley Dyke has several large agricultural access crossings which consist of large diameter (approximately 3 m) circular culverts, as shown in Plate 9.9.

Plate 9.9: Typical culvert crossing on Pingley Dyke

89 Pingley Dyke is also carried in culvert under Staythorpe Road, as shown in Plate 9.10, before its confluence with Rundell Dyke, approximately 300 m north of the Order Limits.

Pate 9.10: Culvert carrying Pingley Dyke under Staythorpe Road

90 The Beck rises beyond Field 81 in the east of the CSA and flows from west to east before discharging to the River Trent. At its closest point to Work Area 1 (Field 78), The Beck was observed to be free flowing following a period of prolonged rainfall in the week preceding the October 2024 Site walkover.

91 Vegetation wrack marks were observed on the watercourse banks, indicating that the channel has capacity to accept and convey relatively high flows without becoming bankful, as shown in Plate 9.11.

Plate 9.11: The Beck in proximity to Field 62

92 Crow Lane Feeder Drain was observed in proximity to Work Area 3 – Field 232, draining from south to north, to be slowly conveying flow, despite prolonged rainfall prior to the site walkover in October 2024, and this is likely to be contributing to the establishment of Duckweed on the watercourse surface, as shown in Plate 9.12.

Plate 9.12 Crow Lane Feeder Drain east of Work Area 3 – Field 232

Conversely, Cromwell Drain which drains south to north adjacent to Field 19 was observed to be free flowing and turbid, as shown in Plate 9.13.

Plate 9.13: Cromwell Drain northeast of Field 19 (Work Area 3)

93 Watercourses within the CSA have an overall Water Framework Directive (WFD) overall classification (Cycle 3 – 2022) of Moderate (e.g., The Beck, Moorhouse Beck and Pingley Dyke), while watercourses within the Wider Study Area have classifications ranging from Moderate (River Trent) to Bad (The Fleet), as shown on Figure 9.5.

94 The State of our Rivers Report[41] estimates that nearly two thirds of river stretches fail Water Framework Directive health status due to agriculture and rural land management.

95 The IDB have identified watercourses and assets within the CSA which fall under their maintenance remit, including The Beck and Moorhouse Beck.

96 IDB maintained watercourses are shown on Figure 9.6.

97 Information provided by the EA available on the Defra Multi-Agency Geographic Information for the Countryside (MAGIC) Map viewer shows that the northeastern section of the CSA lies within a Drinking Water Safeguard Zone for surface water (ID: GB104028058480 Trent from Carlton-on-Trent to Laughton Drain), as shown in Figure 9.7.

9.4.8 Site Drainage

98 The hydrological regime within the CSA is typical of lowland agricultural plains and is drained by man-made ditches of slow running water; and the

41 The Rivers Trust. Available at: https://theriverstrust.org/rivers-report-2024 [accessed on 29/05/2025].

CSA is located within the catchment of Trent Valley IDB. These ditches drain to several natural watercourses and in turn the wider hydrological system.

9.4.9 Subsurface Drainage

99 Several land parcels within the CSA are served by a network of sub-surface agricultural land drains, typically in a herringbone arrangement, which discharge to field drains.

100 During the October 2024 site walkover, only one land drain was observed discharging into field drains within Work Area 3 (within Field 192).

101 One land drain was observed discharging into Pingley Dyke, 220 m northeast of Work Area 2 (Field 210).

9.4.10 Surface Water Continuity

102 Watercourses and surface drainage ditches within the CSA appear to be relatively continuous and free from natural blockages (such as trees / brash), although some watercourses such as The Beck are heavily vegetated or, promoting the growth of weeds.

103 Few manmade flow controls and crossings were observed along the watercourses within the CSA.

9.4.11 Groundwater Abstractions

104 Consultation with Severn Trent Water (no response to consultation) and the EA was carried out on 05/12/2023 to identify public water abstractions within the WSSA.

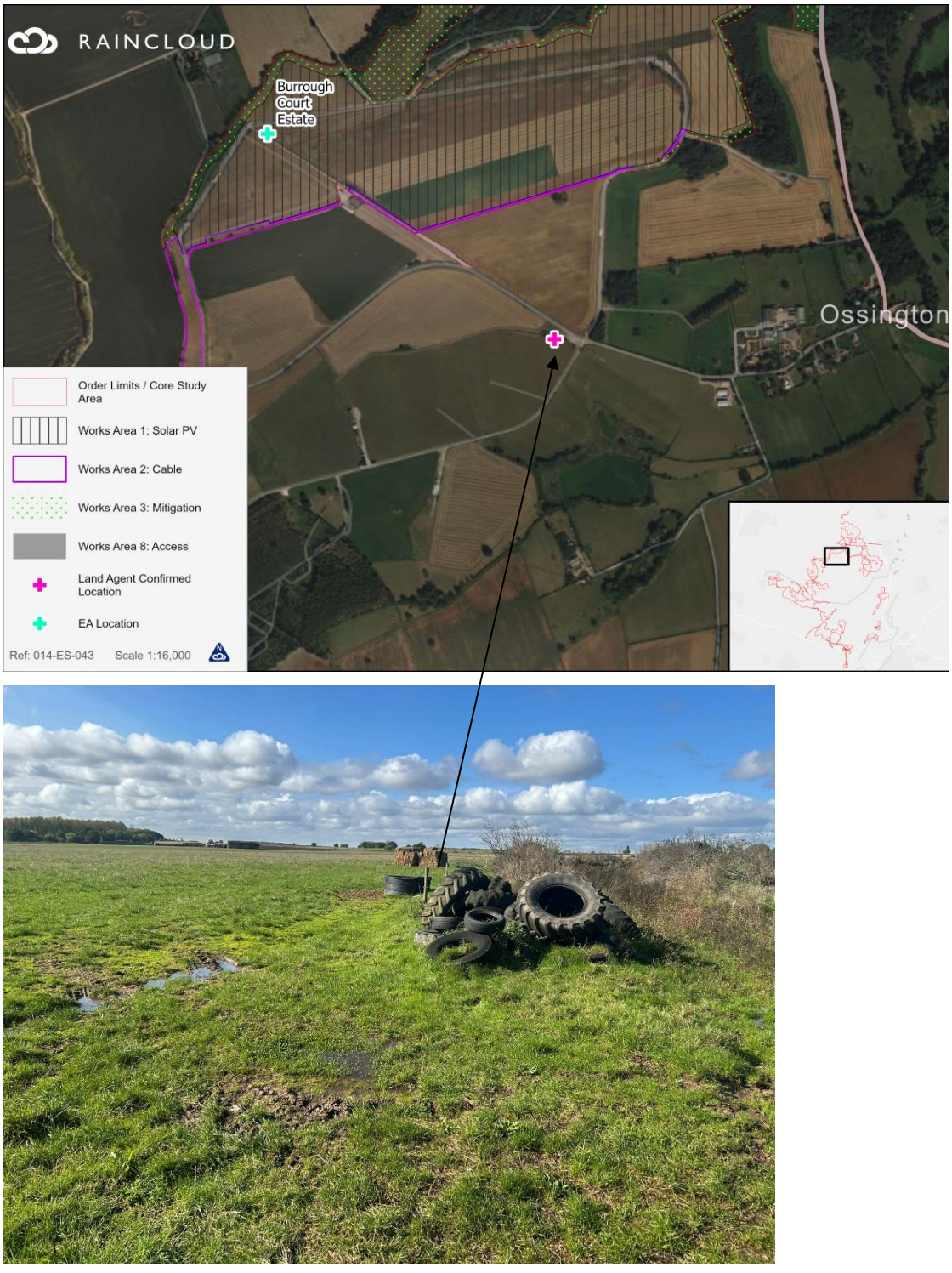
105 The EA identified three abstractions, as outlined in Table 9.6.

Table 9.6: EA-registered PuWS

PuWS Name	EA Reference	Approximate distance and direction from the Work Area	Source	Status
Burrough Court Estate	T/55/85118/LG	Within Work Area 1*	Groundwater	Active
Manor Farm	T/69/85035/LG	965 m NE from Work Area 3	Groundwater	Surrendered
Woodside Farm	T/68/85055/LG	444 m SW from Work Area 3	Groundwater	Revoked

*The land agent for supply ID T/55/85118/LG “Burrough Court Estate” has confirmed that the correct location for the borehole is approximately 875 m southeast of the location supplied by the EA, approximately 360 m south of Work Area 2 (Field 54) and 265 m south of Work Area 8 as shown on Plate 9.13. The other location shown in Table 9.6 is understood to be correct.

Plate 9.14: Burrough Court Estate Abstraction



106 Plates 9.15 and 9.16 show the locations of the abstractions at Manor Farm and Woodside Farm.

Plate 9.15: Abstraction at Manor Farm

Plate 9.16: Abstraction at Woodside Farm

107 BGS borehole record ID 20790507[42] indicates that the groundwater abstraction at Woodside Farm is a pumped abstraction at 4 m^3 / hour at a

[42] https://api.bgs.ac.uk/sobi-scans/v1/borehole/scans/items/20790507

depth between 11 to 21 m below ground level (BGL), corresponding to the depth at which Mercia Mudstone is encountered.

108 Severn Trent Water operate groundwater abstractions at Caunton and near (Ompton Pumping Station) Eakring, associated with the SPZs outlined in Section 9.4.5.

9.4.12 Private Water Supplies

109 Consultation with NSDC was undertaken on 5th December 2023 to identify PWS located within the WSSA.

110 NSDC confirmed three PWS within WSSA, and none are located within the Order Limits, as outlined in Table 9.7.

Table 9.7: PWS within the WSSA

PWS Name	Source	Approximate distance and direction from the Order Limits
Caunton Lodge Farm	Borehole[43] – groundwater. A BGS borehole (ID: 239551) records a water strike at 128 m BGL, rising to 35 m BGL	260 m north of Work Area 1 (Field 442)
The Gables x 2 (Hockerton Housing Project)	Rainwater Harvesting[44]	260 m and 825 m southeast of the passing place through Hockerton

111 The locations of the supplies are shown in Plate 9.17 and 9.18.

[43] Confirmed by resident via telephone conversation
[44] Hockerton Housing Project [online] Available at: https://www.hockertonhousingproject.org.uk/water-systems/rainwater-harvesting/ [Accessed 27/06/2024]. Also confirmed by resident at Public Consultation Event 14/01/2025.

Plate 9.17: Caunton Lodge Farm PWS location

Plate 9.18: Hockerton Housing Project PWS locations

9.4.13 Designations

112 Designations located within the proposed Wider Study Area (i.e., 5 km from the CSA) are outlined in Table 9.8.

Table 9.8: Designations within the Wider Study Area

Designation	Qualifying Interest	Approximate distance and direction from the CSA	Hydrological Link to Development?
Eakring and Maplebeck Meadows Site of Special Scientific Interest (SSSI)	Neutral grasslands	Immediately adjacent (north)	Yes – downslope from the Development
Mather Wood SSSI	Ash-oak-maple woodland	40 m south	Potential for near-surface water linkage via root uptake
Laxton Sykes SSSI	Neutral grasslands	370 m northwest	Potential link via unnamed tributary of Moorhouse Beck
Redgate Woods and Mansey Common SSSI	Broad-leaved semi-natural woodland and neutral grassland	480 m west	No – upslope of the Development
Roe Wood SSSI	Semi-natural broad-leaved woodland	1.1 km south	No – located on separate slope to Development and separated by a watercourse
Farndon Ponds Local Nature Reserve (LNR)	Wetland habitat	1.3 km south	No – separated by River Trent
Southwell Trail LNR	Various	2.2 km south-east	No – separated by intervening topography
Besthorpe Meadows SSSI	Alluvial grasslands	2.4 km east	No – separated by River Trent
Devon Park Pastures LNR	Terrestrial and Inland Waters	2.6 km south-east	No – separated by River Trent
Rufford Country Park LNR	Various	3.5 north-west	No – separated by intervening topography

Designation	Qualifying Interest	Approximate distance and direction from the CSA	Hydrological Link to Development?
Besthorpe Warren SSSI	Dry acid grassland vegetation	3.6 km east	No – separated by River Trent
Wellow Park SSSI	Semi-natural woodland	3.7 km north-west	No – separated by intervening topography
Kirton Wood SSSI	Ash-wych elm woods	4.0 km north	No – separated by intervening topography and Moorhouse Beck

113 With the exception of Eakring and Maplebeck Meadows SSSI, Mather Wood SSSI and Laxton Sykes SSSI, all hydrologically dependent designations are considered to be hydrologically disconnected from the Order Limits or are of sufficient distance (more than 5 km) so as to remain unaffected by the Development.

114 As such, effects on designations have been scoped out of this assessment, with the exception of Eakring and Maplebeck Meadows SSSI, Mather Wood SSSI and Laxton Sykes SSSI.

115 Designations are shown on Figure A8.1.1 in TA A8.1 [EN010162/APP/6.4.8.1].

9.4.14 Flooding

9.4.14.1 Fluvial

116 Whilst the majority of the CSA (89.99 %) is located within Flood Zone 1, areas approximately 10.1 % of the CSA classified as Flood Zone 2 and 3 associated with out of channel flows from the River Trent, The Beck and Moorhouse Beck.

117 Work Area 1: Solar PV, Work Area 4: Substations and Work Area 5a and 5b are located outside of Flood Zones 2 and 3, based on the illustrative design.

118 The left bank of the River Trent is flanked by embankments and naturally high ground which have a Standard of Protection between 1:2 and 1:10 (50 % AEP and 10 % AEP).

119 The EA Asset Management Database[45] shows that the defences adjacent to the River Trent have not been accounted for in the Flood Map for Planning.

120 Despite the presence of flood defences flanking the River Trent, only a small section of the CSA in proximity to South Muskham is classified as having a Reduction in the risk of Flooding from Rivers and Sea.

121 Plate 9.1.3 within the FRA (TA A9.1 [EN010162/APP/6.4.9.1]) shows areas classified as Flood Zones 2 and 3.

[45] https://environment.data.gov.uk/asset-management/index.html

9.4.14.2 Tidal

122 The River Trent is tidally influenced downstream of Cromwell Weir, which is located approximately 988 m east of Work Area 3 - Field 282.

123 The combined flood defence breach dataset from the Tidal Trent Flood Study (Jacobs, 2023) shows that the 1 % AEP + 62 % CC marginally encroaches into the CSA (Fields 16, and 18). This represents 0.08 % of the Order Limits.

124 All work areas, with the exception of Work Area 3: Mitigation (i.e., grassland etc.) have been located to avoid tidal flooding.

9.4.14.3 Pluvial

125 The EA pluvial datasets (Risk of Flooding from Surface Water), show that the majority (89.3 %) of the CSA is located outside areas classified as at risk of flooding for the 1 % AEP event.

126 There are isolated areas within the CSA which are modelled to flood during the 1 % AEP and are shown on Plate 7 of the FRA, which shows that the deepest pluvial flooding depths are largely confined to depressions in landform, such as the floodplain associated with Moorhouse Beck in the north of the CSA and east of Maplebeck, associated with the floodplain of The Beck.

127 Pluvial flooding is discussed in detail in Section A9.1.2.3 of TA A9.1: FRA [EN010162/APP/6.4.9.1].

9.4.15 Future Baseline

128 The future baseline of the CSA without the implementation of the Development would be unlikely to change substantially. The Order Limits would continue to be intensively managed for agricultural purposes. In addition, irrespective of the implementation of the Development, other permitted developments outside of the Order Limits are likely to be ongoing. These developments are assessed for potential cumulative effects in this chapter.

129 There would be a natural evolution, including as a result of climate change. This may include impacts on rainfall, watercourse quality and increased flood risk.

130 The effects of climate change on water resource receptors have been assessed in this chapter by the inclusion of allowances for climate change in flood depth criteria.

9.4.16 Sensitivity of Receptors to Construction Effects

The sensitivities of the identified receptors in Section 9.4, and their relationship to the potential effects from all phases of the Development, are outlined in Table 9.9.

Table 9.9 Sensitivity of Hydrological Receptors

Receptor	Potential Effects	Sensitivity	Comment
Watercourses and Drainage Ditches	Increased runoff, erosion and sedimentation, stream flow impediments and pollution as a result of construction groundworks and chemical handling / storage.	Medium	The receiving waterbody (River Trent) in which the Development is located has a WFD Overall Water Body Class of "Moderate", Ecological classification of "Moderate" and a Chemical classification of "Good" (excluding uPBTs). Watercourses downstream of the Development within the WSA are not designated as having international importance.
Groundwater	Pollution as a result of erosion and sedimentation from construction activities and uncontained spills from chemical handling / storage.	High	Considered High sensitivity as hydrocarbon pollution in bedrock fissures has a lengthy attenuation period. Groundwater unit classified as having 'Good' status under WFD. Groundwater is also used for potable and agricultural supply.
Near-surface water	Diversion of near-surface flows as a result of track construction and the installation of hardstanding.	Medium	Considered Medium sensitivity as near-surface water supplies flow to the drains within the CSA, which drain to the River Trent.
PWS	Pollution as a result of erosion and sedimentation from construction activities and uncontained spills from chemical handling / storage. Depletion or displacement of PWS source as a result of Development infrastructure.	Medium	Considered Medium sensitivity as the individual supplies support abstraction for up to 25 people.

Receptor	Potential Effects	Sensitivity	Comment
PuWS	Pollution as a result of erosion and sedimentation from construction activities and uncontained spills from chemical handling / storage. Depletion or displacement of PWS source as a result of Development infrastructure.	High	Considered High sensitivity as the supplies support abstraction public supply.
Flood Defences	Structural degradation leading to a reduced standard of protection through construction practices.	High	Considered High sensitivity as defences protect people and assets.

9.5 DEVELOPMENT DESIGN MITIGATION

131 Embedded Development design measures are set out within the Outline Construction Environmental Management Plan (oCEMP; TA A5.3 [EN010162/APP/6.4.5.3]). The oCEMP provides a framework for a final CEMP, to be provided for approval as secured under the DCO, which will set out specific measures which relate to this Development. The measures will consist of good practice methods and works that are established and effective, to which the Applicant will be committed through the DCO Requirements.

132 While the oCEMP is an outline document and will evolve to take account of consultee feedback and detailed design prior to the construction phase, the effectiveness of the measures set out in the oCEMP has been witnessed during the construction of large-scale renewable energy sites for them to be treated as part of the Development for this assessment.

133 Measures and practices provided in the oCEMP will be adopted and incorporated into a working document to be agreed with statutory consultees and the planning authority following consent by way of an appropriately worded Requirement, secured in the DCO. For ease of reference throughout this chapter, reference to specific sections in the oCEMP, detailing the appropriate embedded mitigation measures, are provided.

134 Proposals for decommissioning are set out in the Outline Decommissioning and Restoration Plan (oDRP) (TA A5.6 [EN010162/APP/6.4.5.6]). This sets out that the solar PV arrays and the BESS will be decommissioned and the

areas restored, and the substations and other electrical infrastructure may or may not remain in place. A final DRP will be developed in accordance with the oDRP before commencement of decommissioning. The oDRP makes provision for a Decommissioning Environmental Management Plan (DEMP) including measures for the minimisation of risks to water resources, similar to those set out in the oCEMP [EN010162/APP/6.4.5.3]

135 Accordingly, the identification of likely significant effects from the Development is considered following implementation of the measures in TA A5.3: oCEMP [EN010162/APP/6.4.5.3] and oDRP [EN010162/APP/6.4.5.6].

136 The author, the Raincloud Hydrology team, has provided services for a large number of pre-construction, under construction and operational solar farm developments (including DCO applications for Cleve Hill Solar Park, Longfield Solar Park and Mallard Pass Solar Farm), which adopted the approach outlined in this Section. and the author has worked closely with statutory agencies such as the EA, Natural England, other regulatory bodies and Local Authorities to advance appropriate survey and assessment methods.

137 This approach has received positive comments from consultees for proposing appropriate embedded design on a project specific basis.

138 The following mitigation measures relating to the hydrological environment are embedded into the design and construction of the Development:

- 10 m watercourse edge buffers for all construction works (i.e. solar PV and associated infrastructure, construction compounds, BESS and substations) with the exception of watercourse crossings for cables and access tracks;
- 10 m buffer of IDB maintained watercourses;
- HDD for watercourses;
- The Development will utilise existing access roads and tracks already in place where possible, and this will help to minimise ground disturbance and requirements for further watercourse crossings;
- Watercourse crossings will take one of several forms depending on the nature of works, habitat sensitivity, and other environmental and technical design considerations. HDD will be the default option for watercourse crossings by cables and is the least invasive, most sensitive method, although it may not be suitable or necessary in some locations, such as for small field drains. In such locations, watercourse crossings will take one of the following forms, which are listed in order of least to most impact and are likely to be appropriate, respectively, for the most to least sensitive features:
  - Single-span structures that do not interfere with the channel (banksides, bed or water column);
  - Span structures with in-stream supports or pre-cast structures with natural bed;
  - Closed culverts with artificial invert; and
  - Open trench with over-pumping.
- Crossings will be designed as part of detailed design, post-consent, and the oCEMP commits to the soffit level of any bridges sitting above the design flood level. The design flood level for permanent crossings would

be the 1 % AEP plus Higher central climate change scenario (39 % CC) and will involve the following parameters:

- Soffit height of the bridge will be a minimum of 600 mm above the 1 % AEP + Climate change allowance flood level;
- All abutments must be set back a minimum 1m from the top of the bank and as minimal as possible;
- Any loss of floodplain due to abutments and ramps will need to be compensated for, as outlined in the oCEMP;
- All parapets and railings need to be permeable and open as possible with a minimum 100 mm spacing; and

- The Development has been redesigned to avoid placing Works Areas 1, 4 and 5a and 5b within the 1 % AEP + 39 % CC extent for the River Trent and the 0.5 % AEP tidal events (plus climate change (23 %) in accordance with Table 2 of Accounting for residual uncertainty: an update to the fluvial freeboard guide, Table 2 of the Engineering Design Standard[46], EDS 07-0106 Substation Flood Protection (2016)[47] and Energy Networks' Associations Engineering Technical Report 138 (ETR138)[48].

139 These measures are outlined in the oCEMP.

140 The fields within the Order Limits are used for arable and pastoral farming. The Development does not include the application of nitrates or phosphates to the land, which is carried out periodically via the current land use, and this cessation may lead to improvements in surface water quality, compared to the baseline scenario.

141 Access will be taken from existing access points, where suitable, and would initially be asphalt followed by graded Type 2 or 3 washed / clean aggregate or just use graded Type 2 or 3 washed / clean aggregate. Where new access points are required the bellmouth will typically be asphalt and would be limited in extent. This limits the potential for increased surface water runoff rates and sedimentation effects during rainfall events.

142 As outlined in TA A9.1, Flood Risk Assessment (FRA) [EN010162/APP/6.4.9.1], Appendix C, Sequential Test, the Development has been sequentially designed to locate the most electrically sensitive infrastructure (*e.g.*, PV arrays, the substation compounds, inverters and transformers) outside of Flood Zones 2 and 3 to mitigate against the risk of flooding.

143 The oCEMP describes water management measures to control surface water runoff and drain hardstanding and other structures during the construction, operation and decommissioning of the Development. A Pollution Prevention Plan (PPP) will also form part of a final CEMP.

9.5.1 Good Practice

144 Good practice will be followed in all aspects of construction, operation and decommissioning, specifically through the PPP.

[46] https://www.neso.energy/document/33241/download
[47] https://media.umbraco.io/uk-power-networks/vjli4axl/eds-07-0106-substation-flood-protection.pdf
[48] https://www.ena-eng.org/enadocs/D0C3XTRACT/ENA_ET_138_Extract_180902050400.pdf

145 The PPP will outline measures to be employed to avoid or mitigate potential pollution for all phases of the Development and will also include an Incident Plan to be followed should a pollution event occur. This plan will be produced following consultation and agreement with EA and all appropriate personnel working on the construction site will be trained in its use.

146 Method statements will also be applied, which will follow the principles laid out in relevant CIRIA guidance and the principles of the archived EA Pollution Prevention Guidelines.

9.6 ASSESSMENT OF LIKELY EFFECTS

147 The potential effects of the Development on hydrological receptors have been assessed for the construction, operation and decommissioning phases. Effects occurring during construction and decommissioning are considered to be short-term effects due to the duration of these phases (up to 2 years in total, though less in any one location due to phasing of the works), while those occurring as a result of the operational phase are considered to be long-term effects (up to 40 years).

9.6.1 Potential Construction Effects

148 The nature and magnitude of effects on water resources that could result from construction activities are assessed in the following paragraphs.

149 The assessment of the nature and magnitude of effects that could result from construction activities is based on the information within Chapter 5, Development Description [EN010162/APP/6.2.5].

9.6.1.1 Chemical Pollution

150 Potential effects involved with the management of construction are a risk management issue, with the effects being assessed on the basis that the risk be realised. Should the Development progress as described in Chapter 5, Development Description [EN010162/APP/6.2.5], *i.e.*, with no spills, then there would be no effects.

151 Potential risks include the spillage or leakage of chemicals, fresh concrete, foul water, fuel, coolant or oil, during use or storage onsite. These pollutants have the potential to adversely affect subsurface and surface water quality, and groundwater.

Surface Water Resources / Watercourses

152 Watercourses, drainage ditches and water bodies could be at risk from a pollution incident during construction and these receptors are considered to be of Medium sensitivity.

153 Buffer distances between proposed construction works and watercourses and drainage ditches have been implemented for all works other than watercourse crossings by cables and access tracks, to reduce the potential for chemical pollutants to be transferred to the water environment.

154 Measures such as absorbent spill pads / kits and other measures highlighted within Sections A5.3.9.2.1 and A5.3.9.3.1 of the oCEMP [EN010162/APP/6.4.5.3] will effectively limit the uncontrolled release of chemicals to minor fugitive releases (if at all). These would be minimised

through best practice construction methods such as vehicle speed limits and regular vehicle and machine maintenance.

155 Therefore, effects on watercourses and drainage ditches of Medium sensitivity, and designations of High sensitivity, are of Negligible magnitude and therefore to have a **Negligible** significance of effect.

156 This is **Not Significant** in terms of the EIA Regulations.

Groundwater and near-surface water

157 Groundwater could be at risk from a pollution incident during the construction phase.

158 Pollutants interacting with bedrock also have the potential to alter the pH of the groundwater resource. Chemical and pH alterations to bedrock are difficult to rectify due to the fractured nature of the rock and the lengthy attenuation and dispersal of chemicals.

159 The mounting poles for the solar PV modules will be piled into the ground at a superficial level (anticipated to be driven into the ground to a depth of approximately 1 to 2 m) and will have limited potential to release pollutants into groundwater, as the groundwater resource under the CSA is associated with the Sherwood Sandstone Group at approximately 100 m BGL.

160 Plate 9.19 shows the thin nature and footprint of a piled PV mounting pile.

Plate 9.19: PV mounting pile and physical footprint [49]

161 Should concrete feet be required for isolated areas in Works Area 1: Solar PV, these will be pre-cast and no concrete will be poured in-situ onsite, as outline din Section A5.3.9.2.3 of the oCEMP [EN010162/APP/6.4.5.3].

162 Work Area 4: Intermediate Substations and Work Area 5b: 400 kV compound is the only infrastructure during the construction phase which has any potential to impact the groundwater resource, due to the absence of both concrete pouring and substantial excavation associated with other infrastructure which makes up the Development.

163 Due to the underlying geology at Work Area 4 and Work Area 5a: BESS compound consisting of clay-based strata (Alluvium) which acts as a barrier to infiltration (and subsequently the transfer of pollutants) with groundwater

[49] Photograph Credit: Rob Sutton – Cotswold Archaeology

at depths likely to be greater than 2 m (BGS Water Well Reference: SK75/81), groundwater is unlikely to be present near the surface, meaning there is limited potential for pollutants to come into contact with groundwater. Measures such as spill pads, impermeable geotextile membranes and measures described within Section A5.3.9.3.1 of the oCEMP will effectively limit the uncontained release of chemicals to minor fugitive releases.

164 Therefore, effect of pollutants from the Development on groundwater and as such, receptors which rely on groundwater such as abstractions and associated SPZs (High Sensitivity), is considered to be of Negligible magnitude and therefore to have a **Negligible** significance of effect. This is **Not Significant** in terms of the EIA Regulations.

9.6.1.2 Erosion and sedimentation

Surface Hydrology

165 Erosion and sedimentation can occur from excavations, ground disturbance (such as soil stripping), de-watering, and overburden stockpiling, the largest element of which would be with the construction of the Work Area 4: Intermediate Substations and Work Area 5a: BESS and Work Area 5b: 400 kV Compound. Sediment entering watercourses and drainage ditches has the potential to affect water quality, ecology and flood storage capacity.

166 As a result of embedded mitigation in the design of the Development, overland flow generation is likely to be minimal and any silt generated during construction will be entrained within cut off ditches before reaching watercourses and land drains. Embedded mitigation contributing to this includes the decision to seed Work Area 1: Solar PV with a suitable grass or wildflower mix, measures to be set out within the oSMP (TA A17.2 [EN010162/APP/6.4.17.2]), the overland distance between construction areas and drainage ditches and the relatively flat topography within the fields which comprise Work Area 1: Solar PV.

167 Excavated soil that is required to be stored for future reinstatement purposes, whether just for the construction phase or whether for the operation phase, would be managed in accordance with a Soil Management Plan (SMP) which will be finalised post-consent at detailed design stage, and will be based on the Outline SMP submitted as TA A17.2 [EN010162/APP/6.4.17.2]. This will be secured by a DCO Requirement. The oSMP includes a section on the management of drainage around excavated soils to minimise risk of erosion of the stored soils.

168 Measures such as silt traps and buffer strips will minimise sedimentation and erosion; further details of these measures are outlined Section A5.3.9.1.1 in the oCEMP.

169 Other construction drainage measures, such as the use of settlement lagoons, swales and interception bunds, outlined in Section A5.3.9.1.3 of the oCEMP will limit the potential for sediment entering watercourses.

170 Where new crossings and upgrades to existing crossings are required then works will be isolated from the water environment by coffer dams and over pumping (see Section A5.3.9.4..1 of TA A5.3, oCEMP). This will limit the potential for sediment and siltation to be transferred into the watercourses or transferred downstream through direct disturbance.

171 Therefore, effects on watercourses and drainage ditches of Medium sensitivity is considered to be of Negligible magnitude and therefore to have a **Negligible** significance of effect. This is **Not Significant** in terms of the EIA Regulations.

Sub-surface Hydrology

172 Sediment has the potential to change near-surface water flows within superficial geology deposits by creating a physical barrier within naturally occurring drainage micropores. Sediment entering near-surface water in superficial deposits also has the potential to impact on groundwater quality within bedrock deposits.

173 The implementation of managed vegetation growth will assist in promoting the retention of soil (at the surface) and increasing the strength of the soil mass (at depth) and reducing the potential for sediment to enter sub-surface hydrology compared to the baseline scenario of tilled agricultural fields.

174 Additionally, measures described in the oSMP (TA A17.2, [EN010162/APP/6.4.17.2]), such as ground membrane layers and stockpiled areas, will effectively prevent sediment entering sub-surface water in superficial deposits.

175 For these reasons, the magnitude of this effect will be Negligible. Given the High sensitivity of near-surface water and groundwater and Negligible magnitude of impact, the significance of the effect associated with erosion and sedimentation is considered to be **Negligible**. This is **Not Significant** in terms of the EIA Regulations.

176 The potential effects of erosion and sedimentation on sub-surface hydrology of Medium sensitivity are considered to be of Negligible magnitude and therefore have a **Negligible** significance of effect.

177 This is **Not Significant** in terms of the EIA Regulations.

9.6.1.3 Impediments to Flow

178 The access tracks will require the installation of new watercourse crossings and the upgrade or reuse of existing crossings across all sections of the CSA.

179 The illustrative design indicates that 20 access track crossings and 21 fence line crossings of watercourses are required. It should be noted that some of the fence crossings will utilise track crossing locations.

180 The use of the existing access routes which serve the existing agricultural operations will minimise the requirement to install new watercourse crossings, therefore minimising the potential for impediments to flow and anticipated crossings are shown of Figures A5.3.1 and A5.3.2 of the TA5.3: oCEMP [EN010162/APP/6.4.5.3].

181 The minimisation of the number of proposed watercourse crossings and the re-use of the existing watercourse crossings reduces one of the main activities that could give rise to impediment of flows. Beam deck bridges and Bailey bridges will be used where deemed necessary to reduce the potential for impediments to flow. Additionally, measures described in Section A5.3.9.5.4 of TA5.3: oCEMP [EN010162/APP/6.4.5.3], such as the use of arch culverts, where appropriate, are likely to prevent impediments to flow

being created. Culvert design is described in Section A5.3.9.5.4 of the oCEMP [EN010162/APP/6.4.5.3], detailed design will be carried out at the construction phase and will be agreed with Trent Valley IDB, the LLFA and the EA.

182 No drainage ditch diversions are proposed as part of the Development.

183 Work Area 2: Cables will cross watercourses and drains. The type of crossings will be determined during the detailed design phase and the watercourses will be crossed using a HDD method. Smaller waterways such as anthologically made field drains may be crossed by open cut with a temporary diversion, damming or pumping, as outlined in Section A5.3.9.4.1 the oCEMP [EN010162/APP/6.4.5.3].

184 Soil stripping will be required for the hardstanding areas adjacent to the cable trench and sedimentation effects could occur during the excavation of the cable trench. As outlined Section A5.3.9.1.4 in the oCEMP [EN010162/APP/6.4.5.3], any silty water generated will be subject to settlement processes through drainage mitigation measures (silt traps, silt fencing etc.) and channelled into vegetated areas, to allow the settlement of solids.

185 Excavated soil that is required to be stored for future reinstatement purposes, whether just for the construction phase or whether for the operation phase, would be managed in accordance with a Soil Management Plan (SMP) which will be finalised post-consent at detailed design stage, and will be based on the oSMP submitted as TA A17.2 [EN010162/APP/6.4.17.2]. This will be secured by a DCO Requirement. The oSMP includes a section on the management of drainage around excavated soils to minimise risk of erosion of the stored soils.

186 All in-stream engineering works will be carried out in accordance with the EA's Flood risk activities: environmental permits, IDB Byelaws and detailed method statements for each location will be submitted in support of applications for licences required.

187 Crossings which require the flume technique will be designed to be large enough to accommodate increases in water flow resulting from heavy rainfall events.

188 Outline methods to cross watercourses are provided in Section A5.3.9.5.4 of the oCEMP [EN010162/APP/6.4.5.3] and detailed method statements and plans will be provided to the EA and the IDB for all in-stream construction works and all temporary watercourse diversions will be discussed in detail prior to the construction phase. The application for the Development does not seek to disapply the EA or IDB Protective Provisions and therefore crossing design will need to be approved by each regulatory body and be appropriately designed to minimise effects to an acceptable level.

189 For these reasons, the magnitude of this effect will be negligible. Given the Medium sensitivity of the watercourses and surface water, effects associated with erosion and sedimentation are assessed as being of **Negligible** significance.

190 This is **Not Significant** in terms of the EIA Regulations.

9.6.1.4 Compaction of Soils

191 The movement of construction traffic, in the absence of construction good practice, can lead to compaction of the soil. This can reduce soil permeability, potentially leading to increased runoff rates and increased erosion. The superficial geology underlying the Development is generally of low permeability and is in agricultural use, so the effects of compaction would not result in a substantial increase in runoff from existing conditions.

192 In order to maintain or improve on the current level, it is necessary to ensure that construction methods do not seriously disrupt the established drainage network and that no areas are surcharged, either by water discharge or spoil.

193 Maintenance of existing drainage infrastructure should be prioritised to avoid compaction of soils; therefore, all existing drainage network channels will be maintained through measures such as plastic spanning under the access tracks to ensure conveyance of flows.

194 Existing access tracks will be used in preference to making new ones, where practicable, further reducing the potential for soil compaction.

195 Depending on weather conditions during construction, temporary roadways (*e.g.,* plastic or metal track matting) may be utilised to access parts of the Order Limits to avoid excessive soil disturbance or compaction, as outlined in Section A5.3.11.3.2.3 the oCEMP [EN010162/APP/6.4.5.3].

196 Therefore, effect of soil compaction on surface water and subsurface water of Medium sensitivity is considered to be of Negligible magnitude and therefore to have a **Negligible** significance of effect. This is **Not Significant** in terms of the EIA Regulations.

9.6.1.5 Changes in Soil Interflow Patterns

197 Some excavations, such as those for the substation compounds, may need temporary sub-surface water controls, such as physical cut-offs or de-watering. These temporarily divert flows away from the excavation, and temporarily lower the local water table and sub-surface water levels in the superficial geology. Localised temporary changes to soil interflow patterns may therefore arise.

198 Foundations for the substation and hardstandings also have the potential to change sub-surface water flow by creating physical barriers within naturally occurring drainage macropores in soil.

199 No substantial impediments to near-surface water flow will be created as the detailed site drainage design will take into account any severance of saturated areas to ensure hydrological connectivity is maintained.

200 The Development will involve the installation of arrays of photovoltaic cells arranged on mounting racks.

201 The mounting system posts will be driven into the ground to a depth of approximately 1 to 2 m.

202 It is considered that installing mounting system posts to a depth of 2 m will have a negligible effect on the displacement or change in sub-surface water

flow underlying the Development, due to the thin nature of the supporting frame, as shown in Plate 9.20.

Plate 9.20 Typical thin Mounting System driven into ground

203 As outlined in section 9.4.10, there are several agricultural fields which are served by a subsurface network of drainage pipes.

204 The installation of the mounting system has the potential to damage this network by piercing the pipework and impairing its functionality through blockage. In the absence of good construction practice, such as a watching brief and pipe reinstatement, the artificial drainage network is likely to still be able to function, as water would gravitate around mounting system and drain to the existing outfalls.

205 Cable trench excavations may require temporary sub-surface water controls, such as physical cut-offs or de-watering. Such controls temporarily divert flows away from the excavation, de-watering temporarily lowers the local water table and subsurface water levels in superficial geology deposits. Localised temporary changes to soil interflow patterns may therefore arise. Cable trench excavation also has the potential to change subsurface water flow by creating physical barriers within naturally occurring drainage macropores in soil.

206 Given the shallow excavation depths of the cable trench (between 1.5 m and 2 m depth) and narrow width (a maximum working area of approximately 30 m width) no substantial impediments to subsurface water flow will be created and site drainage design will take into account any severance of saturated areas to ensure hydrological connectivity is maintained.

207 There are field drains across the CSA which could be damaged when installing substations cable trenches. This will be apparent at the time, and during wetter conditions could lead to drainage into the excavated trenches

and foundations. This would be pumped to other parts of the field. In fields that are proposed to continue in agricultural use during the Development's operation phase, remedial field drain works would be installed along the cable trench wherever field drains are damaged, to maintain the current functionality of drainage system. Consequently, effects on near-surface water (Medium sensitivity receptor) are considered to be of Negligible magnitude and therefore **Negligible** significance. This is **Not Significant** in terms of the EIA Regulations.

9.6.1.6 Flood Risk

208 The EA Flood Map for Planning shows that the Order Limits are mostly located in Flood Zone (FZ) 1 (89.99 %), while 10.01 % lies in FZ 2 and FZ 3, as shown in Plate 3 of TA A9.1, FRA [EN010162/APP/6.4.9.1].

209 The only works proposed within FZ 2 and FZ 3 are Work Areas 2: Cables, Work Area 3: Mitigation/enhancement, Work Area 6: Consented Staythorpe BESS and Work Area 7: National Grid Staythorpe Substation.

210 The FRA concludes that the risk of the Development flooding from all sources is **Low** to **Negligible** and **Not Significant** in terms of the EIA Regulations.

Flood Defences

211 No Works Areas will directly interact with flood defences, as shown in Plate A9.1.5 of the FRA [EN010162/APP/6.4.9.1].

212 Work Area 3: Mitigation is located approximately 10 m north of the Ollerton Road Embankment defence at its closest point. As discussed in Section 12.4.5, Chapter 12, Noise and Vibration, [EN010162/APP/6.2.12] cosmetic damage in light buildings would only occur at a distance of 3 m. Work Area 3 involves the creation of grassland etc. and no piling is proposed and therefore the structural integrity of defences will not be impacted by vibration.

213 Any tree planting within Work Area 3 will be located at least 8 m from flood defences, as shown in TA A5.1, Outline Landscape and Ecological Management Plan (oLEMP) [EN010162/APP/6.4.5.1].

214 On the basis that the delivery route is maintained and improved as appropriate, traffic induced vibration is not anticipated. It is also notable that all routes already have HGV movements, so the maximum vibration levels at any flood defences will be no greater than they are now, although would be more frequent.

215 Therefore, effects on flood defences (High sensitivity receptor) are considered to be of Negligible magnitude and therefore of **Negligible** significance. This is **Not Significant** in terms of the EIA Regulations.

216 Access to the Development during construction will be designed to limit the need for new interior access tracks, limiting the need for new hardstanding.

217 Areas of hardstanding (i.e., the BESS Compound) will be served by a drainage system which incorporates Sustainable Drainage Systems (SuDS) mechanisms to prevent an increase in surface water runoff from the baseline conditions. These measures are outlined in TA A9.1, FRA [EN010162/APP/6.4.9.1], and are to be implemented at an early stage of the construction phase to prevent an increase in surface water runoff associated

with the areas of hardstanding during the construction phase. This is secured by a DCO Requirement.

218 Topsoil removal is likely to be very limited for Work Areas 1 to 4 and Work Areas 6 to 8.

219 In terms of the creation of the tracks and bases for fixed infrastructure, these are small areas running through the CSA, and all areas will be surrounded by other undeveloped land so the potential for any runoff to leave the site will be minimal.

220 Work Area 5a and b: BESS / 400 kV Compound is the largest area to be stripped. That area will have a drainage system in place at an early stage in the construction process, as described in TA A9.1, FRA [EN010162/APP/6.4.9.1]. There are wide strips of undeveloped land around the BESS Compound which will buffer the potential for runoff.

221 An oSMP, provided as A17.2 [EN010162/APP/6.4.17.2], sets out the methodology for minimising any effects, such as rutting, on farmland. Rutting of farmland by farm traffic is a common occurrence already, as shown in Plates 9.2 and 9.3 of this chapter, as inevitably there will be times when farming activities in fields have to take place when indentations occur. In all cases and at all times, however, these are localised effects in usually central parts of fields, and any excess water that follows a rut will then run out over unrutted land and drain naturally. Therefore, the risk is not increased by the Development relative to the baseline.

222 Overall, there should not be a situation whereby, even in an intense summer storm, there is the potential for runoff created by, or even increased by, the installation works in the fields associated with the Development.

223 Therefore, the effect of surface water runoff and floods on the receiving watercourses of High sensitivity are considered to be of Negligible magnitude and to have a **Negligible** significance of effect. This is **Not Significant** in terms of the EIA Regulations.

9.6.1.7 Effects on Private Water Supplies and other Abstractions

Private Water Supplies

224 PWS could be at risk of experiencing a reduction in the quality or quantity of water serving a property from the construction of the Development.

225 The only physical installation works in proximity (260 m to the south of the PWS) to Caunton Lodge Farm is the installation of PV Arrays (Work Area 1), which involves insertion of the mounting poles to a depth of up to 2 m BGL into the superficial geology cover.

226 Other activities within Work Area 1 will include the installation of cabling, fences and inverters, which will also require shallow excavation.

227 Given that the borehole is anticipated to abstract from a depth of 128 m BGL associated with groundwater from the Sherwood Sandstone Group (Bunter) geology, (see adjacent BGS borehole SK76SW28) there will be no direct interaction on the groundwater resource being utilised for the supply.

228 The poles will be made from high-grade galvanised steel and as such, there will be limited potential for degradation or biproducts to be leached to the soils and percolate to groundwater.

229 Borehole logs show mudstone, of low permeability, to a depth of 81 m BGL, which will effectively sever the potential pollution pathway from the Development to the PWS source.

230 Measures outlined in Section A5.3.9.3.1 of the oCEMP [EN010162/APP/6.4.5.3] to manage the handling of chemicals and fuels will limit the potential for spillage or leakages to minimal fugitive releases (if any).

231 As the two PWS at the Gables (Hockerton Housing Project) use rainwater harvesting as their source of supply, the Development will not interact with these PWS and there will be no effects.

232 As such, the effects on PWS of Medium sensitivity will be of Negligible magnitude and therefore of **Negligible** significance.

233 This is **Not Significant** in terms of the EIA Regulations.

Public Supplies

234 PuWS could also be at risk of experiencing a reduction in water quality or quantity during the construction phase of the Development if groundwater is affected.

235 Groundwater was encountered at 4.5 m BGL[50] within the boreholes at Caunton, however the EA confirmed that Caunton abstracts from the Triassic Sandstone, expected to be at 150 m below ground level. At this depth it is unlikely that subsurface water will be influenced by minor traffic / access works for junction improvements. The Triassic Sandstone layer is confined by low permeability Mercia Mudstone, effectively severing the portal pollution pathway from the Development.

236 There is a potential for chemical effects from oil and fuel spillages or leakage, however these are at no greater than risk of occurring than from the baseline scenario as the highway network is utilised by public vehicles.

237 The abstraction at Ompton Pumping Station has Work Areas 1 to 3 and 8 within the catchment of the abstraction i.e. in SPZ 3. The Ompton Pumping Station abstracts from several boreholes sunk into the Bunter Sandstone approximately 60 m BGL.

238 Given that the borehole is anticipated to abstract from a depth of 60 m BGL associated with groundwater from the Sherwood Sandstone Group (Bunter) geology (see adjacent BGS borehole SK99SE121), there will be no direct effects on the groundwater resource being utilised for the supply.

239 Measures outlined in Section A5.3.9.3.1 of the oCEMP [EN010162/APP/6.4.5.3] to manage the handling of chemicals and fuels will limit the potential for spillage or leakages to minimal fugitive releases (if any).

[50] https://api.bgs.ac.uk/sobi-scans/v1/borehole/scans/items/239566

240 As outlined in the oCEMP, where works are carried out within proximity to water distribution infrastructure, a 'Watching Brief' will be conducted during works by a Hydrologist or Engineer.

241 The Watching Brief should be used to clearly mark and demarcate any sensitive areas around the pipes which serve the property and aim to isolate pipes from construction works and avoid impact on the pipe infrastructure.

242 Employees will be briefed on the pipework and locations and be briefed on any controls and conditions put in place prior to the commencement of works.

243 Should any works cross the pipes then measures will be implemented to prevent damage to the pipes, such as laying of steel matting or concrete above the pipework.

244 As such, the effects on PuWS of High sensitivity will be of Negligible magnitude and therefore of **Negligible** significance.

245 This is **Not Significant** in terms of the EIA Regulations.

EA Licenced Abstractions

246 The EA provided details of three licensed groundwater abstractions.

247 Borough Courte Estate borehole is located approximately 260 m southeast of Work Area 8, Access. BGS records (BGS Ref: SK76SW27) show the borehole struck water at 150 m BGL, associated with the Sherwood Sandstone Group (Bunter). The Triassic Sandstone layer is confined by low permeability Mercia Mudstone, effectively severing the portal pollution pathway from the Development.

248 The borehole at Woodside Farm is a pumped abstraction at 4 m^3 / hour at a depth between 11 to 21 m BGL, corresponding to the depth at which Mercia Mudstone is encountered and is located approximately 475 m south of Work Area 1. Clays at the supply to a depth of 30 m[51] which will limit the potential transfer of pollutants to the source.

249 No details of the supply at Manor Farm are available. The borehole is listed as being approximately 375 m northeast of Work Area 8. It is unlikely that subsurface water will be influenced by minor traffic / access works for junction improvements. Given the substantial distance between the Development infrastructure and the abstraction point, clays at the supply to a depth of 30 m[52] which will limit the potential transfer of pollutants to the source and the embedded mitigation in the Development design it is considered that the Development will not impact upon the quality or quantity of water abstracted at this supply.

250 Similar to private abstractions, the quality or quantity of groundwater is not anticipated to be affected by the PV arrays, either directly or indirectly.

251 Measures outlined in Section A5.3.9 of the oCEMP [EN010162/APP/6.4.5.3] to manage the handling of chemicals and fuels will limit the potential for spillage or leakages to minimal fugitive releases (if any), as set out in section 9.6.1.1.

[51] https://api.bgs.ac.uk/sobi-scans/v1/borehole/scans/items/20790507
[52] https://api.bgs.ac.uk/sobi-scans/v1/borehole/scans/items/239372

252 Therefore, potential effects of the works on the EA registered abstraction receptors of High Sensitivity are considered to be of Negligible magnitude and therefore to have a **Negligible** significance of effect. This is **Not Significant** in terms of the EIA Regulations.

9.6.1.8 WFD

253 TA A9.2, WFD Assessment, [EN010162/APP/6.4.9.2] concludes that with the implementation of measures in the oCEMP [EN010162/APP/6.4.5.3] there will be no degradation in the WFD status (chemical or ecological) of waterbodies which interact with the Development.

9.6.2 Potential Operation Phase Effects

254 Potential effects associated with the operation of the Development are:

- Increased or decreased surface water runoff rates;
- Continued or decreased erosion and sedimentation from runoff from areas of hardstanding and areas under the PV Arrays;
- Alterations to natural flow pathways from runoff from areas of hardstanding;
- Reduced chemical loading of watercourses associated with the cessation of fertiliser / nitrate application;
- A risk of a pollution event from minor spills caused by maintenance vehicles;
- Risk of pollution from infrastructure damage; and
- A risk of a pollution event in the rare event of a battery fire.

255 The nature of these effects, with the exception of a battery fire (discussed in Section 9.6.2.2), has been discussed in relation to the construction phase. However, as there should be substantially less activity and ground disturbance within the Order Limits during the operation phase, it is expected that the magnitude of impact of many of these effects will be far less than in the construction phase. This is with the exception of rainfall runoff from the PV Arrays, which is expected to remain the same as during the construction phase, as the arrays will start to be in place early during the construction phase.

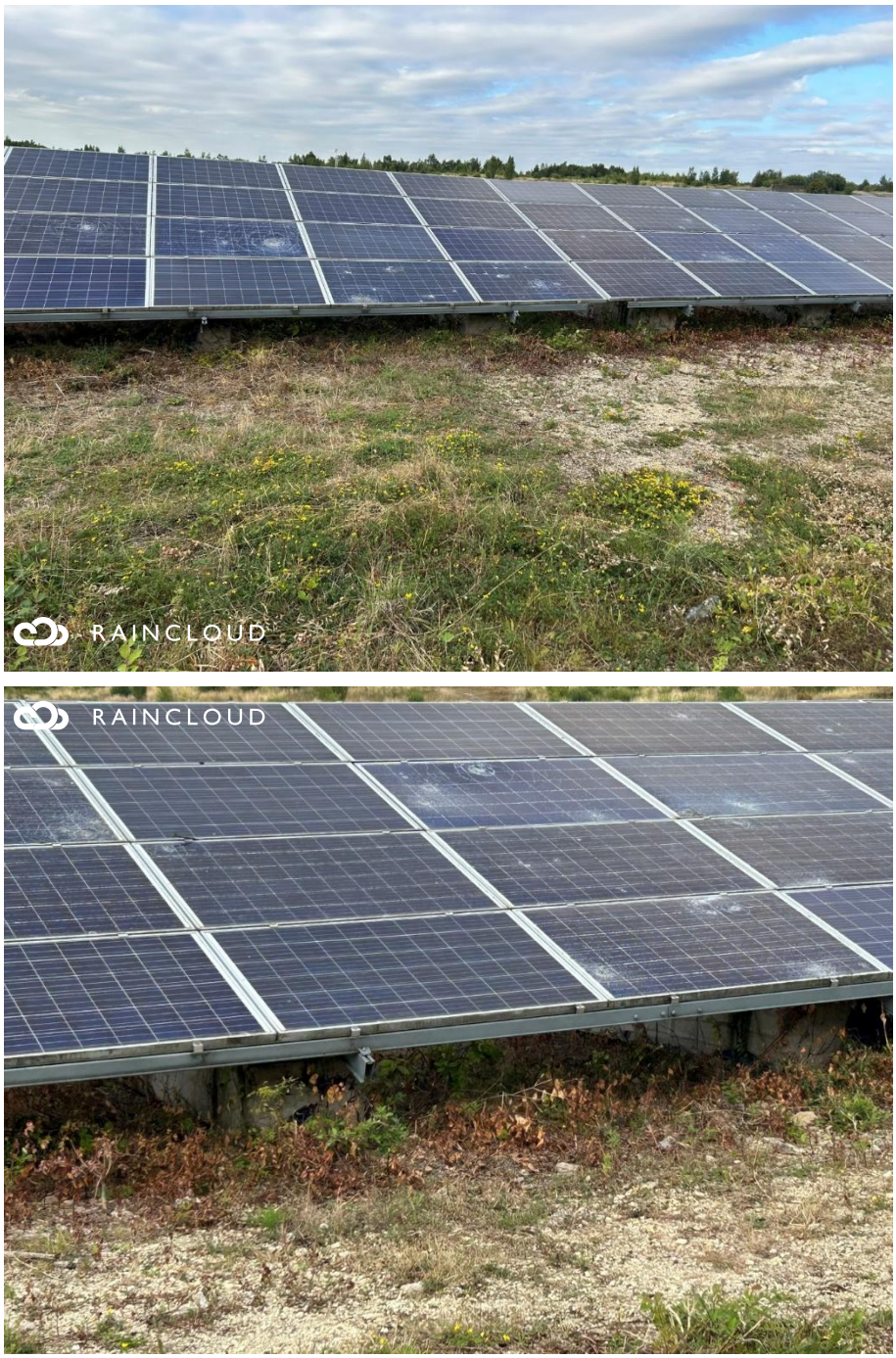
9.6.2.1 Chemical pollution from Solar PV Modules

256 Whilst the Planning Inspectorate stated that chemical pollution from PV Arrays during operation should be scoped out of the assessment, South Muskham & Little Carlton Parish Council stated in their response to Scoping that "*The chemical pollution resulting in damage argument for scoping out requires further scrutiny given the materials forming the panels and panel degradation over life*".

257 As such, chemical pollution from damaged PV modules / leakages from the PV modules has been assessed.

258 Raincloud staff have undertaken site walkovers on operational solar farms where vandalism has resulted in the PV module surface being breached through impact from projectiles, as shown in Plate 9.21.

Plate 9.21: Vandalised PV Arrays, Thorne Solar Farm, Doncaster (2024)

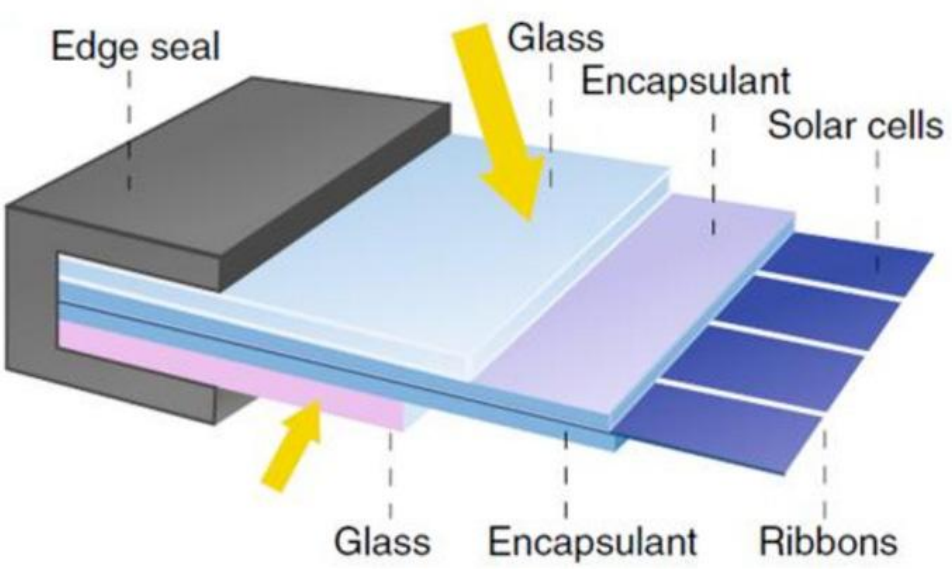


259 The extensive impact from heavy and sharp projectiles shown in Plate 9.21 did not penetrate the backsheet of the PV module.

260 The PV modules at Thorne Solar Farm are monofacial laminated between two sheets of sealed transparent encapsulant, covered in tempered glass, fitted with another layer of plastic or glass at the back, and sealed in an aluminium frame / backsheet.

261 The Development will not utilise this composition and will use bifacial as illustrated in Plate 9.22.

Plate 9.22: Typical configurations of PV module [53]



262 As such, to the composition of the surface of the PV modules, they are likely to remain intact both at the surface and underside near the mounting system, even in the event of damage / impact and not leak. As such, there is limited potential to transfer chemicals to the hydrological environment. This is supported by the Solar Energy Industries Association (SEIA)[54] who conclude that even in the event of the glass breaking and is left unrepaired, it would take years to extract any type of substance from the broken panels.

263 The likelihood of leakage is further reduced by the fact that the proposed panels are now bifacial (glass on glass) modules, without backsheets (such as shown in Plate 9.22). There are therefore fewer possible chemicals that could leak, in the unlikely event that any form of leakage did occur.

264 A programme of regular maintenance, inspection and CCTV deterrent will ensure that faulty or damaged PV panels are replaced promptly, further reducing the risk of a transfer of chemicals to the hydrological environment.

265 This, therefore, represents a Negligible magnitude of impact on watercourses, drainage ditches and waterbodies of High Sensitivity and therefore result in a Negligible significance of effect.

266 This is Not Significant in terms of the EIA Regulations.

9.6.2.2 Chemical pollution from Battery Fire

267 Regarding the potential transfer of pollutants from a battery fire in Work Area 5a, watercourses and groundwater could be at risk of pollution through the application of firefighting water as a suppressant. Due to the composition of commercial battery units, an Outline Fire Safety Management Plan (oFSMP) is included as TA A5.4 [EN010162/APP/6.4.5.4].

268 As outlined in the oFSMP [EN010162/APP/6.4.5.4], the Development operator will follow the accepted strategy of allowing a battery related fire to

[53] Reproduced from Radovan Kopecek, Libal J. Bifacial Photovoltaics 2021: Status, Opportunities and Challenges. Energies. 2021;14(8):2076-2076. https://www.mdpi.com/1996-1073/14/8/2076
[54] https://www.seia.org/blog/why-you-dont-need-worry-about-broken-solar-panels

self-consume, reducing unnecessary risk of injury to site and firefighting personnel.

269 Should a fire occur, the affected enclosure will be allowed to self-consume until the fire is extinguished through consumption of the combustible materials within the battery container / enclosure. The firefighting procedure will be to apply water to adjacent BESS enclosures to keep them cool and further prevent their overheating.

270 As water will not be directly applied to an affected BESS container, there is reduced potential for firefighting water to become contaminated and the volume of water required during a firefighting event is, therefore, reduced.

271 As outlined in TA A9.1, FRA, [EN010162/APP/6.4.9.1] based on recommendations in NFPA 855 Standard for the Installation of Stationary Energy Storage Systems and the NFCC Grid Scale Energy Storage System Planning – Guidance for Fire and Rescue Services, a burn time of 2 hours and a requirement of 1,900 l/min of fire suppression water has been used to calculate the volume of fire suppressant water required to be stored onsite in the event of a container fire.

272 This equates to 228 m^3 of storage.

273 Draft NFCC guidance requires a reduced fire suppression volume of 1,500 l/m equating to 180 m^3, however this has not been adopted at the time of writing.

274 The SuDS structure will be sized to accommodate the worst case of either the 1 % AEP + 40 % CC or the full fire suppressant volume.

275 A penstock will be placed on the outlet of the SuDS unit and would be closed in the event of BESS containers needing to be cooled during a fire event. It would remain closed until testing of the captured water has taken place. Water will then either be removed offsite by tankers to a licenced facility or discharged to an onsite drain subject to agreement with the EA and the IDB.

276 There will also be a lined holding basin available for spent firefighting water to be pumped to in the event of a battery fire during heavy rainfall. As such, the SuDS system will not reach capacity during such an event.

277 Additionally, due to the underlying geology at the Work Area 5a: BESS compound consisting of clay-based strata (Alluvium) which acts as a barrier to infiltration (and subsequently the transfer of pollutants) with groundwater at depths likely to be greater than 2 m (BGS Water Well Reference: SK75/81), groundwater is unlikely to be present near the surface, meaning there is limited potential for pollutants to come into contact with groundwater.

278 As a result, the magnitude and significance of all effects associated with chemical pollution for the operation of the Development are assessed as being Negligible, and Not Significant in terms of the EIA Regulations.

9.6.2.3 Foul Water

279 A decision regarding the storage method for foul water prior to disposal will depend on the number of staff likely to be onsite during the operational phase and the frequency of visits. The decision will be made prior to the construction phase by the appointed principal construction contractor and will be part of the detailed design, in discussion with the EA.

280 Due to the presence of mudstones at Work Area 4 and 5a and 5b it is not anticipated that a septic tank solution will be viable. As such, the Development will utilise a containment system, expected to be either a cesspit or Portaloo-type facilities which will be inspected and emptied on a regular basis.

281 As a result, the magnitude and significance of all effects associated with foul water are assessed as being Negligible, and Not Significant in terms of the EIA Regulations.

9.6.2.4 Cable Leakage

282 Regarding cables, the underground cables require minimal maintenance, although faults do occur which require the use of test equipment to locate the fault and potentially excavation to cut out and replace the faulted section with new joint bays required to be installed for the joints.

283 A small number of ad hoc and planned maintenance site visits will be undertaken during the operational phase of the Development. These maintenance visits are not expected to involve excavation works beyond the foundations of buildings (such as the substation) or below the cables. As such, there will be no interaction with the underlying groundwater unit and no direct effects are predicted on the hydrogeology resource.

284 Underground cable would not be expected to be replaced in this timescale and would be expected to only require limited repairs until aged 50 years or more[55].[56].

285 Therefore, the magnitude of this effect is considered to be Negligible on the High sensitivity receptors. As such, there will be Negligible predicted significance on surface water and groundwater during the operational phase of the Development.

286 This is Not Significant in terms of the EIA Regulations.

9.6.2.5 Increase in Surface Water Runoff

287 The PV Arrays have the potential to concentrate rainfall under the drip lines (regular gaps between PV tables). Once the rainfall has fallen off a PV Array, the water will be able to spread and flow along the ground under the PV Arrays. Given the topography of the CSA is generally flat lying it is likely that rain falling on each row of solar panels would flow evenly into the rain-shadow of the row below, so as to mobilise the same percentage of the ground for infiltration as was available before the panels were installed. As a result, there is unlikely to be an increase in runoff as a result of the PV Arrays.

288 Plate 9.23 shows that in practice, the vegetation proposed to be sown in Work Area 1 will act to bind the soil under the PV drip lines and allow runoff

[55] https://publications.parliament.uk/pa/cm200405/cmselect/cmtrdind/89/89we07.htm#:~:text=%E2%80%94%20The%20annual%20national%20injury%20rates%20for,0.24%20per%201%2C000%20km%20for%20underground%20cables.&text=There%20is%20290%2C000%20km%20of%20overhead%20lines,0.24%20per%201%2C000%20km%20for%20underground%20cables.

[56] https://distribution.epri.com/underground/public/failures/#:~:text=each%20underground%20system.-,The%20spread%20of%20the%20data%20shows%20the%20diversity%20in%20failure,failures%20%2F%20100%20miles%20%2F%20year.

to be evenly distributed under the PV arrays and not cause erosion / gullying.

Plate 9.23: Operational solar farm with established vegetation and drip lines

289 Plate 9.24 shows examples of poor practice vegetation establishment at solar farms, as a result of vehicular movements on poorly seeded ground, which required remedial action to reduce runoff[57].

[57] L. Nevins – As-built drainage reviews 2015.

Plate 9.24: Poor practice vegetation establishment examples on solar sites

290 As set out in the oLEMP (TA A5.1 [EN010162/APP/6.4.5.1]), the area under the PV Arrays will be seeded with a suitable grass/flower mix to prevent rilling (incisions in soil caused by concentrated water flow) and an increase in surface water runoff rates. With the implementation of suitable planting, the ground cover is unlikely to generate surface water runoff rates beyond the baseline scenario.

291 The FRA [EN010162/APP/6.4.9.1] identifies that the installation of PV Arrays does not have the potential to substantially increase surface water runoff rates compared to the baseline scenario as vegetation under the drip lines establishes and acts to slow the transfer of runoff to the hydrological catchment downslope.

292 This is evidenced 2D direct rainfall analysis outlined in TA A9.1, FRA [EN010162/APP/6.4.9.1].

293 Land under the PV Arrays would be allowed to naturally vegetate following sowing with a suitable seed mix and would be managed by livestock grazing.

294 As outlined in Kampherbeek *et al*. (2023)[58], using sheep for vegetation maintenance on solar farms can assist in improving biodiversity and soil activity, if grazing pressure is not too high. Sheep can create micro-climates with their hooves in the soil (through compaction), spread seeds with their wool, and spread diaspores from some plants with their hooves and faeces. Therefore, there needs to be a balance between biomass management and livestock stocking rate to ensure the grass mix is maintained and soil cohesion is managed, especially following periods of heavy or prolonged rainfall. Management of vegetation within the Order Limits is set out in the oLEMP [EN010162/APP/6.4.5.1].

295 As vegetation becomes fully established under the PV arrays there is likely to be a decrease in surface water runoff rates and a reduction in the potential for sediment and agricultural chemicals (e.g., phosphates and nitrates) to transfer into the wider hydrological catchment compared to the baseline scenario.

296 Therefore, the magnitude of this effect is considered to be Negligible on watercourses and drainage ditches of Medium sensitivity. As such, there will be Negligible predicted significance on surface water during the operational phase of the Development.

297 This is Not Significant in terms of the EIA Regulations.

9.6.3 Decommissioning

298 Proposals for decommissioning are set out in the Outline Decommissioning and Restoration Plan (oDRP) (TA A5.6 [EN010162/APP/6.4.5.6]). This sets out that the solar PV arrays and the BESS will be decommissioned and the areas restored, and the substations and other electrical infrastructure may or may not remain in place. A final DRP will be developed in accordance with the oDRP before commencement of decommissioning. The oDRP makes provision for a Decommissioning Environmental Management Plan (DEMP) including measures for the minimisation of risks to water resources, similar to those set out in the oCEMP [EN010162/APP/6.4.5.3].

299 Potential effects of decommissioning the Development are similar in nature to those during construction, as some ground-work would be required to remove foundations and hardstanding. These effects would be lesser in magnitude than during construction, e.g., cables would not be excavated. Where infrastructure may be left in place, e.g., substations, drainage features would also remain where this is compatible with the DEMP.

300 As such, the effects of decommissioning activities receptors of High and Medium Sensitivity are considered to be of Negligible magnitude and therefore to have a **Negligible** significance of effect, as per the construction phase assessment. This is **Not Significant** in terms of the EIA Regulations.

[58] A preliminary investigation of the effect of solar panels and rotation frequency on the grazing behaviour of sheep (*Ovis aries*) grazing dormant pasture. Kampherbeek *et al*. (2023). Applied Animal Behaviour Science. Volume 258, January 2023, 105799

9.7 MITIGATION MEASURES AND RESIDUAL EFFECTS

301 With the embedded design measures described in TA5.3 [EN010162/APP/6.4.5.3] and similar measures for the decommissioning phase in place, all identified potential effects have been assessed as being of negligible significance, and therefore not significant in terms of the EIA Regulations.

302 No further mitigation is proposed.

9.8 CUMULATIVE EFFECTS ASSESSMENT

9.8.1 Methodology

303 A cumulative effect is considered to be an additional effect on hydrological receptors (within the same hydrological catchment) arising from the Development in addition to the combination of other developments likely to affect the hydrological environment.

304 The approach to assessing cumulative effects is outlined in Chapter 2, Environmental Impact Assessment [EN010162/APP/6.2.2]. Cumulative developments to be taken forward to Stages 3 and 4 (assessment) are set out in TA A2.1 [EN010162/APP/6.4.2.1]. The stage 3 and 4 assessments for cumulative effect on water resources are assessed in this Section.

305 At distances greater than 5 km, it is considered that solar and battery storage schemes are unlikely to contribute to a cumulative hydrological effect due to attenuation and dilution over distance of potentially polluting chemicals. Therefore, for the purposes of the assessment of potential cumulative effects on the immediate catchment and hydrological regime, only proposed developments, which require large scale construction / excavation, within approximately 5 km of the Order Limits have been considered.

306 As outlined in the assessment for the Development, there are no significant effects.

307 The greatest potential for cumulative effects arises when the construction phase of another development overlaps with the construction phase of the Development. Cumulative effects are considered to have the potential to be significant only where such an overlap may exist, as activities such as excavation works, concrete pouring in the construction phase that could be potentially detrimental to the hydrological environment are greatly reduced during the operational phase of developments.

9.8.2 Construction Phase

308 Measures presented within the oCEMP [EN010162/APP/6.4.5.3] will limit the potential for sediment and pollutants to be transferred from the Development, meaning there is very limited potential for the Development to contribute to a cumulative effect on water quality.

309 The increase in flow rates is of **Negligible** magnitude for the Development.

310 Therefore, cumulative effects during the construction phase on all receptors (High and Medium Sensitivity) are considered to be of **Negligible** magnitude and therefore of **Negligible** significance.

311 This is **Not Significant** in terms of the EIA Regulations.

9.8.3 Operational Phase

312 During the operational phase there is the potential for the Development to overlap with the proposed NFM / NG+ projects (as described in Section 2.3.8.3 of ES Chapter 2, EIA, [EN010162/APP/6.2.2]), which aim to slow the transfer of surface water runoff and reduce the depth of flooding within communities downstream of the Development through the implementation of natural flood management measures such as leaky dams, grassland and bunds.

313 Trent Rivers Trust and Raincloud have modelled the results of introducing NFM measures in the main flow pathways draining Maplebeck, which show a reduction of up to 10 cm of depth at certain properties.

314 As outlined in the FRA [EN010162/APP/6.4.9.1], the Development will include grassland under the PV arrays and other forms of vegetation and scattered trees in Work Area 3, which will act to slow surface water flow compared to the arable baseline and will lead to a slight betterment in flood depths in areas such as Maplebeck.

315 The Development does not, therefore, have the potential to have a cumulative effect on reducing surface water runoff rates and in turn the reduction in the maximum flood depth at properties within Maplebeck (of Medium sensitivity). As such the magnitude of effect will be Low and therefore of **Minor** significance.

316 This is **Not Significant** in terms of the EIA Regulations.

9.9 SUMMARY OF LIKELY EFFECTS

317 This chapter has identified no likely significant adverse effects, following the embedded measures (outlined in TA A5.3: oCEMP [EN010162/APP/6.4.5.3]) in the design of the Development. Table 9.11 summarises the predicted effects of the Development on water resources.

Table 9.11: Predicted effects of the Development

Receptor	Potential Effect	Significance of Effect	Mitigation Proposed	Residual Significance
Construction				
Watercourses, drainage ditches, and near-surface water	Chemical Pollution	Negligible	None	Negligible
Watercourses, drainage ditches, and near-surface water	Erosion and Sedimentation	Negligible	None	Negligible
Watercourses and drainage ditches	Impediments to Flow	Negligible	None	Negligible
Near-surface water	Changes in Soil Interflow Patterns	Negligible	None	Negligible
Watercourses, drainage ditches, and near-surface water	Migration of Pollutants from Contaminated Land	Negligible	None	Negligible
Watercourses and drainage ditches	Increase in Runoff	Negligible	None	Negligible
PWS, PuWS and EA abstractions	Changes in quality or quantity of supply	Negligible	None	Negligible
Operation				
Watercourses, drainage ditches, coastal waters and near-surface water	Chemical Pollution (e.g. PV cell leakage)	Negligible	None	Negligible
Watercourses, drainage ditches, and Near-surface water	Increased Runoff Rates / Volume	Negligible	None	Negligible
Watercourses, drainage ditches, and near-surface water	Erosion and Sedimentation	Negligible	None	Negligible

Receptor	Potential Effect	Significance of Effect	Mitigation Proposed	Residual Significance
Near-surface water	Alterations to natural flow pathways	Negligible	None	Negligible
Watercourses, drainage ditches, and Near-surface water	Risk of a Pollution Event from Minor Spills from Maintenance Vehicles	Negligible	None	Negligible
Decommissioning				
Watercourses, drainage ditches, and Near-surface water	Chemical Pollution	Negligible	None	Negligible
Watercourses, drainage ditches, and near-surface water	Erosion and Sedimentation	Negligible	None	Negligible
Near-surface water	Changes in Soil Interflow Patterns	Negligible	None	Negligible
Cumulative				
Watercourses, drainage ditches and areas prone to surface water flooding	Decreased Runoff Rates / Volume	Low	None	Minor

9.10 STATEMENT OF SIGNIFICANCE

318 This chapter has assessed the likely significant effects of the Development on water resources. Development has been assessed as having Minor to Negligible significant effect on these receptors.

319 Given that only effects of moderate significance or greater are considered significant in terms of the EIA Regulations, the potential effects on water resources are considered to be not significant.