CHAPTER 9 - GEOLOGY, HYDROLOGY AND HYDROGEOLOGY

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INTRODUCTION

9.1 Wallingford HydroSolutions Ltd (WHS) has been commissioned by the Applicant to complete this geology, hydrology and hydrogeology chapter for a proposed solar farm, on 3 land parcels, near Sellindge, Kent, NGR: TR 07760 37867, TR 07652 38665 and TR 08379 37401. This assessment comprises of a desk-based assessment of the baseline hydrology, geology and hydrogeology environment for the proposed East Stour solar farm along with any potential impacts and mitigation. Residual effects of the proposed solar farm following the implementation of mitigations are also presented together with their significance in EIA terms.

9.2 In summary this chapter details:

- Main legislation and guidance relevant to this chapter;
- Methodology;
- The baseline environment;
- The potential impacts of the proposed solar farm during construction and operation;
- Proposed mitigation measures;
- Best practice construction and operation guidance to minimise potential impacts; and
- Residual effects.

LEGISLATION, POLICY AND GUIDANCE

Legislation

9.3 The Water Framework Directive (WFD, 2000/60/EC), has the main objectives of protecting, enhancing and restoring Europe's waters, with the aim of achieving 'good' status, establishing a baseline of no deterioration and encouraging the sustainable use of water resources and the water environment. This directive resulted in the Water Environment (Water Framework Directive) (England and Wales) Regulations 2003, which transposed the WFD into law in England and Wales and provided a timetable for its implementation.

9.4 Where relevant, the assessment takes into account the legislative protection afforded to water resources. The main legal and policy framework is set by the following:

- Water Act 2003, as amended;
- Water Act 2014;
- Land Drainage Act 1991, as amended;

- Water Industry Act 1991;
- Water Resources Act 1991 (as amended 2009);
- Environmental Permitting (England and Wales) Regulations (and Amendments) 2016;
- Control of Pollution (Oil Storage) (England) Regulations 2001;
- Environmental Damage (Prevention & Remediation) Regulations 2009;
- The EC Groundwater "Daughter" Directive (2006/118/EC);
- The EC Nitrates Directive (91/676/EEC);
- The Priority Substances Directive 2013/39/EU;
- The Conservation of Habitats and Species Regulations 2010 (which implement the EC Habitats Directive 92/43/EEC);
- The Flood Risk Regulations 2009 (which implemented the EC Flood Directive 2007/60/EC); and
- Flood and Water Management Act 2010.

Water Quality Standards and Objectives

9.5 The water quality of England's rivers is classified by the Environment Agency (EA), which has developed a classification scheme for surface waters following the requirements of the Water Framework Directive, as part of the river basin management plans (RBMP). This classification scheme assesses the quality of aquatic ecosystems within rivers, lakes, estuaries and coastal waters and the extent to which they have been adversely affected.

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

9.7 As part of the river basin management plans, waterbody data are published by the EA containing details of the current waterbody classification, current pressures on the waterbody and measures to address these and classification objectives for 2021 and 2027.

Planning Policy

National Planning Policy Framework

9.8 The National Planning Policy Framework (NPPF) sets out the planning policies for England and describes how these should be applied. The NPPF also sets out the aims for development to contribute towards sustainable development.

9.9 Relevant sections of the NPPF to the water environment include Section 14: 'Meeting the challenge of climate change. This section considers the impact of climate change to flood risk, coastal change and water supply.

9.10 Paragraphs 159 to 169 set out the need to avoid areas at risk of flooding and for developments to be made safe for its lifetime. Where this cannot be achieved, national policy is clear that new development should not be allowed.

9.11 Section 15 of the NPPF: 'Conserving and enhancing the natural environment' is relevant to water quality and sets out the requirement of:

e) preventing new and existing development from contributing to, being put at unacceptable risk from, or being adversely affected by, unacceptable levels of soil, air, water or noise pollution or land instability. Development should, wherever possible, help to improve local environmental conditions such as air and water quality, taking into account relevant information such as river basin management plans.'

National Planning Practice Guidance

9.12 The NPPF is supported by the National Planning Practice Guidance (NPPG) (Ministry of Housing, Communities and Local Government, 2019) and provides guidance across a range of topic areas. The section entitled 'Flood Risk and Coastal Change' provides guidance on the 'sequential test' and 'exception test' which must be applied to steer development to areas with the lowest probability of flooding. The document also provides guidance on Flood Risk Assessments (FRA) and sets out flood risk issues from different types of development. Guidance on surface water management including consultation with the Lead Local Flood Authority (LLFA) is also included.

9.13 Guidance on climate change focuses on suitable mitigation and adaptation measures in the planning process. This includes considering availability of water and water infrastructure for the lifetime of a development and designing responses to promote water efficiency and protect water quality.

Guidance

9.14 The assessment of the effects of the Project on the water environment has been undertaken in accordance with the legislation summarised above and the guidance in the Design Manual for Roads and Bridges (DMRB) LA113 – Road Drainage and the Water Environment . Where appropriate, informed professional judgement has been used, primarily in relation to geomorphology, where there is a lack of published guidance to date.

9.15 Flood risk has been assessed in accordance with the requirements of the NPPF and the accompanying online flood risk guidance.

ASSESSMENT METHODOLOGY

Baseline Characterisation

9.16 A comprehensive desk-based study has informed the assessment. A range of publicly available data sources has been used to assess the site's vulnerability by first reviewing the baseline hydrological and hydrogeological environment. This is followed by a review of the potential impacts caused by the development and a summary of recommended mitigation measures to minimise the effect of the development on the baseline environment.

9.17 The following sources of information have been consulted to assess the baseline environment:

- DEFRA 1m LiDAR;
- Environment Agency (EA) designated sites;
- British Geological Survey (BGS) online mapping;

- UK Soils observatory map viewer;
- EA online flood maps;
- River basin management plans; and
- Data request to Kent County Council, the EA, Folkestone and Hythe Borough Council and Ashford Borough Council.

Assessment of Effects

9.18 The sensitivity of the existing baseline environment has been assessed using the criteria defined in **Table 9.1** below. The criteria for the determination of the sensitivity of receptors has been established based upon available guidance, legislation, statutory designation and/or professional judgement. The study area has generally been based on a 1km buffer from the site boundary. The assessment on surface water management is limited to the site boundary however consideration has been given to flood zones within 1km. It is noted that receptors in the receiving environment only need to meet one of the defined criteria below, to be categorised at that associated level of sensitivity

Table 9.1 - *Receptor sensitivity*

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

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

9.19 The assessment of effects on the surface water and groundwater baseline environment was then conducted using the following process:

- Examination of infrastructure design, construction and operational methodologies.
- Identification of potential impacts using the criteria presented in **Table 9.2**, differentiated between short term construction impacts and long term operational and design impacts for each direct and indirect receptor.
- Identification of potential significant effects using the significance criteria outlined in **Table 9.3**.
- For each potential effect, identification of mitigation measures to avoid, minimise or remedy any adverse impacts and enhance any beneficial impacts.
- Identification of residual effects following the implementation of mitigation measures, differentiating between short term construction impacts and long term operational and design impacts.

Table 9.2 - *Magnitude of Impact*

Magnitude	Change to Baseline Environment
Large	The long-term loss of resource and/or quality; partial loss of or damage to key characteristics, features or elements.
Moderate	Long term measurable change in attributes, quality or vulnerability; minor loss of, or alteration to, one or more key characteristics, features or elements; or Short term loss of resource and/or quality; partial loss of or damage to key characteristics, features or elements.
Small	Long term very minor loss or detrimental alteration to one or more characteristics, features or elements; or Short term measurable change in attributes, quality or vulnerability; minor loss of, or alteration to, one (maybe more) key characteristics, features or elements.
Negligible	Short term very minor loss or detrimental alteration to one or more characteristics, features or elements.
No Change	No loss or alteration of characteristics, features or elements.

9.21 The significance of the effects upon the baseline environment is determined by the sensitivity of receptors and the magnitude of change to the baseline conditions, as presented in **Table 9.3**. The significance criteria are based upon the principles of the Chartered Institute of Ecology and Environmental Management's (CIEEM) guidelines for ecology impact assessments in the United Kingdom .

9.22 The impact assessment has been undertaken in accordance with the Town and Country Planning (Environmental Impact Assessment) Regulations 2017, as amended. Moderate or major effects are deemed significant in terms of the EIA regulations. Effects that are of a minor, negligible change or result in No Change are judged to be not significant. Differentiations between categories in the table are based upon professional judgement. A moderate or major effect as a result of an impact would require mitigation, whereas a minor or negligible effect would not require mitigation; although mitigation may be provided as part of standard good practice in construction, operation and decommissioning.

Table 9.3 - *Significance of Effect Criteria*

Sensitivity of receptor	Magnitude of impact				
	Large	Moderate	Small	Negligible	No Change
High	Major	Moderate/ Major	Minor/ Moderate	Negligible/ Minor	None
Medium	Moderate/ Major	Minor/ Moderate	Negligible/ Minor	Negligible	None
Low	Minor/ Moderate	Negligible/ Minor	Negligible	None	None

Assessment Limitations

9.24 The assessment is undertaken using desk-based information. The assessment is therefore reliant on third party data which are assumed to be correct. The assessment of cumulative effects is based on the information available at the time of writing and assumes that all other development would follow best practice techniques and designed in accordance with national policy and guidance. No further assessment limitations have been identified.

BASELINE

Surface Hydrology, Site Drainage and Flood Risk

9.25 The surface hydrology and site drainage has been reviewed using 1m LiDAR data downloaded from the DEFRA website along with OS mapping. The site is split into three sections, separated by the railway line. These are referred to as the Northern, Southern and South-eastern sites. The LiDAR data indicate that the Northern site drains primarily in a south easterly direction towards the railway line and an unnamed brook that flows parallel to the site before joining the East Stour River. A small westward portion drains towards an unnamed ditch network which then joins the East Stour. Just to the south of the Northern site there are lakes present, one of which is used for recreational purposes such as fishing. The Southern site drains in almost all directions due to the summit of the hill being within the site boundary. The site drains to the East Stour River to the north, and to the south it drains towards an unnamed brook that flows north to the East Stour River. The south-eastern site has 3 drainage zones, the southern corner drains south to an unnamed drain, the remaining two drain north to an unnamed drain.

9.26 A review of the EA online flood maps indicates that the Southern site is wholly within Flood Zone 2, however due to the large rise in levels from the river to the summit of the hill (50 to 70mAOD), this indicates an inaccuracy with the flood zone extent for the site. It has been agreed with the EA to use the 51.3m AOD contour as the limit of development for the southern and northern sites. This level reflects the highest level of the water storage area which covers part of the Southern and Northern sites. The northern edge of this site is also within flood zone 3 and there are surface water flow paths draining to the north.

9.27 The Northern site has areas which are within flood zones 2 and 3, and areas with surface water flood risk adjacent to the unnamed brook. The south-eastern site is not within either flood zone 2 or 3, however there are some small surface water flow routes present.

9.28 No part of the site is at risk from coastal or reservoir flooding.

9.29 Flood risk to the site is considered in more detail in the accompanying Flood Risk Assessment and Outline Drainage Strategy in **Appendix 9.1**.

Geology, Hydrology and Soils

Bedrock Geology

9.30 The BGS online mapping service has been used to view the composition and coverage of bedrock geology at the site. The 1:50k resolution mapping indicates that the site is underlain by sedimentary bedrocks in the form of interbedded sandstone and limestone, and mudstone and clay formations originating from the Cretaceous period.

Overburden Geology and Soils

9.31 The BGS 1:50k Superficial Deposits map shows the site to have superficial deposits covering a small area of the northern site, these are Alluvium – Clay, Silt, Sand and Gravel. These were formed during the Quaternary period and are fluvial in origin.

9.32 The Cranfield Soil and Agrifood Institute Soilscapes map shows the site to have overlying soil deposits of slowly permeable seasonally wet slightly acid but base-rich loamy and clayey soils, with some freely draining slightly acid but base-rich soils in the north of the northern site.

Hydrogeology

9.33 The hydrogeology of the site was assessed using DEFRA's magic mapping service which provides a range of authoritative geographic information on the natural environment including groundwater and aquifer designations.

9.34 The bedrock aquifer designation map identifies that the southern site is situated over a principal bedrock aquifer. The northern site is partly over principal aquifer and partly over secondary aquifer, the remaining areas and south-eastern site are over an unproductive aquifer. Principal aquifers are defined as layers of rock that have high intergranular fracture permeability, indicating that they usually provide a high level of water storage. The superficial drift Aquifer Designation Map shows the site is not over a superficial aquifer.

9.35 The groundwater vulnerability maps show the vulnerability of groundwater to pollutants discharged into the ground based upon the hydrological, geological and hydrogeological soil properties. Groundwater vulnerability is largely controlled by the thickness and permeability of the subsoil, for example thin, permeable soils would mean that groundwater can become more easily contaminated without appropriate mitigation. The vulnerability classification for part of the northern and southern sites is high. Therefore, appropriate mitigation will be required to ensure the protection of groundwater in those areas.

9.36 Additionally, the BGS borehole scan map shows a borehole at the northern site at NGR: TR 07720 38820 with a depth of approximately 10 m, water was not identified in this borehole. Borehole records for the southern site are unavailable due to them being confidential.

Water Quality and Water Use

9.37 The site does not lie within a drinking water safeguard zone, or a source protection zone, but does lie within a nitrate vulnerable zone. The Water Framework Directive (WFD) River and Groundwater Body Catchment Cycle 2 dataset has been used to assess the water quality of the East Stour River into which the site drains. The East Stour River is a WFD waterbody with ID GB107040019640, it is not classed as a heavily modified water body.

9.38 The East Stour River has an overall status of moderate, as of 2019, with moderate ecological status and failed chemical status. This is due to a moderate biological class for Macrophytes and Phytobenthos, moderate physico-chemical for Phosphate, and fails chemically for Polybrominated diphenyl ethers (PBDE) and Mercury and its compounds. The watercourse is prevented from reaching good status due to phosphate pollution from water industry wastewater, agricultural and rural land management, industry and urban and transport.

9.39 The surrounding land use is predominantly agricultural with some small isolated urban conurbations. The M20 motorway lies to the north of the site and the Channel Tunnel railway line between the northern and southern sites. It is likely that abstractions are associated with agricultural uses in close proximity to the site or private domestic water supplies. The EA and the borough council were consulted to obtain further information on private domestic water supplies (PWS) that could be impacted by the development. Ashford Borough Council responded that only one PWS was in proximity to the sites, being approximately 1.3km from the site at E 608070 N 140050. Folkestone and Hythe Borough Council of which the boundary is close to the site did not respond within the timeframe of the ES being written. The EA also did not respond within the timeframe of the project.

Ground Water Dependent Terrestrial Ecosystems (GWDTE)

9.40 The EA's GWDTE dataset indicates that there are no GWDTE in the vicinity of the site which could be impacted by the development due to the large distance to the nearest sites. The nearest is Gibbins Brook which is a tributary of the East Stour River that is upstream of the site, and as such is not hydraulically connected to the site.

Baseline Sensitivity

9.41 The sensitivity of the baseline receptors has been assessed as follows based on the criteria outlined in **Table 9.4**.

Table 9.4 - *Baseline Sensitivity*

Receptor	Sensitivity
Surface Water quality	Medium
Groundwater (quality and quantity)	High
Private water supplies	High
Soil	Medium
Superficial and bedrock geology	Low

Future Baseline

9.43 Under a future baseline scenario the environment is likely to respond to a change in climate and a change in land use. Although the effects of climate change are unknown it is likely that UK winters will become milder and wetter and the intensity and frequency of storms will increase. To incorporate this uncertainty we have included a climate change allowance of 40% to the rainfall estimate which is used to inform the storage volume within the outline drainage strategy. The 40% allowance for climate change is the upper end potential change for the 2080's, as prescribed by the EA . Given the 40yr design life of the scheme, this is considered to be a conservative allowance.

POTENTIAL IMPACTS

9.44 The proposed solar farm may induce a series of potential adverse impacts upon the baseline hydrology, hydrogeology and geological environment within the vicinity of the proposed works. Impacts may arise during the construction/ decommissioning and operational phases.

9.45 In order to assess the potential impacts of the proposed scheme the proposed infrastructure must be reviewed relative to the baseline environment. The following infrastructure is proposed:

- Construction of a maintenance/ access track;
- Perimeter stock proof post and wire fencing;
- Trenching, ducting and installation of underground DC Cable;
- 1 Spare building;
- 1 Store building;
- 1 Welfare block;
- Installation of panel frames and ground anchors;
- 20 x Inverter units; and
- Landscape planting.

Construction & Decommissioning

Potential Impacts on Soil, Geology

9.46 Potential impacts from decommissioning would be similar to those considered for construction, although reduced where tracks are left in situ.

9.47 There is a risk of soil compaction across the whole of the site through operation of machinery and plant to install the panel arrays. However, the access tracks to be constructed will be the most heavily trafficked areas, these tracks will be constructed from permeable materials, therefore, a small impact on soil in these areas is foreseen. There will likely be a minor increase in run-off due to this soil compaction and the development of impermeable building areas. If the soils become compact, the soakaway potential decreases, leading to increased surface water runoff, this potentially increases the flashiness of the catchment during high rainfall events and potentially reduces groundwater recharge temporarily.

9.48 Excavation of the topsoil will likely be required to lay the proposed access tracks. This can often have a direct impact on the exposed subsoil or rock due to increased risk of erosion. This poses a risk during high rainfall events due to increased siltation of runoff and potentially the surrounding watercourses. Furthermore, excavations during the installation of the underground DC cables could potentially result in erosion of the subsoil and siltation of runoff. However, given the shallow depth of excavations, the predicted impacts are expected to be small.

9.49 The potential impact on soils of medium sensitivity could be up to small magnitude. This would result in a potential negligible effect which is not considered to be significant. The potential impact on geology of low sensitivity could be small. This would result in a potential effect of negligible (not significant).

Potential Impacts on Surface and Groundwater Quality

9.50 The primary short-term construction impacts include the potential for reductions in water quality through siltation of the surrounding watercourses due to soil erosion and accidental release of pollutants leading to changes in in-stream hydrochemistry.

9.51 The construction work across the site that will expose surface soils, such as soil stockpiles, could occur adjacent to the natural land drainage ditches of the site. There is the potential for sediment loaded run-off to enter these ditches directly, which could increase siltation in the East Stour River.

9.52 There is a low risk of chemical spillages/ leakages from the proposed development and any cabling associated with the substation. However, if this were to occur, it would have the potential to soak through the subsoil and into the groundwater, or alternatively be entrained with surface water runoff into the watercourses surrounding the site.

9.53 There is also the risk of contamination from any fuel spillages from construction vehicles. This risk is considered low, providing that refuelling occurs off site and appropriate emergency plans are put in place to deal with potential spill events.

9.54 The depth of groundwater at one location at the site (>10m) indicates groundwater is deep, however this is not considered to be reliably representative of the entire site. Due to there being a principal aquifer underlying parts of the southern and northern sites, these would be considered a high sensitivity receptor and there is the potential for contamination from chemical pollutants to these aquifers.

9.55 The PWS in proximity to the site lies in a different surface water catchment to the site and therefore the site is very unlikely to be in the zone of groundwater contribution to the PWS. There is considered to be no possible mechanism where pollution at the site could impact the PWS.

9.56 The potential impact on surface water receptors of medium sensitivity could be up to small. This would result in a potential negligible effect. The potential impact on groundwater receptors of high sensitivity could be up to large. This would result in a potential effect of major and significant. The potential impact on private water supply receptors of high sensitivity would be no change. This would result in a potential effect of none (no change).

Potential Impacts on Drainage and Flood Risk

9.57 The impact from construction will be limited for flood risk in terms of the short time scale of this phase, however there are temporary impacts that could arise. If temporary units or stockpiles are located in surface water preferential flow routes then blocking these routes could cause an increase in flood risk. If they are located in the fluvial flood plain (the Aldington flood storage area) then flood storage volume would be effectively removed temporarily. At the latter stages of construction when impermeable areas have been built, this could cause an increase in flood risk, resulting from greater runoff rates.

9.58 The flood risk receptors for the site are residential housing up and downstream of the site, Church Lane and the Sellindge electrical stations. The potential impact on these receptors of high sensitivity could be up to moderate. This would result in a potential effect of moderate significance.

Operation

Potential Impacts on Soil and Geology

9.59 Lack of infiltration over a longer time scale through the introduction of impermeable infrastructure, could lower the aquifer recharge rate in the area, part of the southern and northern sites are overlying a principal bedrock aquifer. Due to the small area of the permanent infrastructure, and given retained vegetation surrounding the panels, this is assumed to be a small impact. There is potential for soil erosion from surface water runoff if vegetation cover is not maintained across the site. We consider that there will be no impacts to geology as this receptor will not be exposed during this phase.

9.60 The potential impact on the soil receptors of medium sensitivity could be up to small. This would result in a potential effect of minor (not significant).

Potential Impacts on Surface and Groundwater Quality

9.61 There is potential for improvement of surface water quality resulting from the change of land use away from agriculture, which is currently a contributing factor to the moderate WFD status of the East Stour River. This is especially important given the site lies in a Nitrate Vulnerable Zone.

9.62 During operation there is a risk of spillage of chemicals from maintenance vehicles which could infiltrate into the soil or be entrained with surface water runoff into the local watercourses. There is also a risk of increased siltation if vegetation cover is not maintained surrounding the panel array. Due to there being a principal aquifer underlying parts of the southern and northern sites, these would be considered a high sensitivity receptor and there is the potential for contamination from chemical pollutants to these aquifers from maintenance vehicles, although this is predicted to be lower risk than during the construction phase.

9.63 The potential impact on surface water receptors of medium sensitivity could be up to small. This would result in a potential effect of negligible. The potential impact on groundwater receptors of high sensitivity could be up to small. This would result in a potential effect of minor. The potential impact on private water supply receptors of high sensitivity would be none (no change). This would result in a potential effect of none (no change).

9.64 No significant impacts are predicted overall.

Potential Impacts on Drainage and Flood Risk

9.65 The proposed development would result in the increase of impermeable areas through the construction of inverter, welfare and store blocks. The access track is to be constructed from permeable materials. An increase in impermeable area on site, leads to a reduction in infiltration and an increase in surface water runoff. This means rainwater can reach rivers faster, carrying a larger volume of water, subsequently increasing downstream flood risk.

9.66 The proposed solar panels themselves are thought to have a limited impact on the surface water runoff regime of the site as, due to the tilt of the panels that are raised above ground, rainwater can still reach the existing vegetation underneath.

9.67 The potential impact on the flood risk receptors of high sensitivity for the site (noted in Section 5.1) without mitigation could be up to moderate. This would result in a potential effect of moderate. This is significant.

MITIGATION MEASURES

Mitigation Measures for Soils, Geology

9.68 When constructing the access track, the lengths of open excavations would be controlled and replaced with gravel material as soon as possible to reduce the risk of erosion/siltation. These would be constructed on existing tracks that are already compacted, where possible. Gravel material will be used as opposed to tarmac to allow a level of infiltration through permeable tracks, better representing the baseline soil conditions. If scour or siltation could occur on steeper sections of the site, silt traps, soil bunds and grass filter strips will be used to capture any sediment, preventing this from entering any watercourses draining the site.

9.69 Underground cabling should be designed and installed to ensure a low risk of pollution from this activity. Excavations required for cable installation will be undertaken in a manner as to minimise time which subsoil layers are exposed. Soil stockpiles would be managed to contain sediment to that locality, preventing input to watercourses. The ground will be restored as quickly as possible following construction and existing vegetation replanted.

9.70 The layout of the panels would be designed to minimise the risk of local scour problems. For example, the panels would be angled with approximately a 20° tilt to allow water to drip from the panels along the length of each row. This will prevent high velocity flow of rainwater from scouring the soil below the panels.

9.71 Maintaining vegetation under and around panels will be undertaken, which will work to reverse the compaction of soil over time. Additionally, a traffic management plan would be adopted to minimise the concentration of soil compaction. The reduction of soil compaction through these methods would minimise any loss of groundwater recharge.

Mitigation Measures for Surface and Groundwater Quality

9.72 All fuel, lubricants and chemicals would be stored within bund containment areas, with the capacity to store at least 10% more volume than the maximum storage volume required. Furthermore, any filling points will be within the bunded area or have secondary containment provided.

9.73 Refuelling, cleaning and routine maintenance of vehicles will be carried out off-site. Drip trays or absorbent mats will be placed under standing plant. Spill kits and other necessary equipment will be provided to contain and clean up any spills of fuel, lubricants or other chemicals.

9.74 All solid and liquid waste materials would be properly disposed of in controlled landfill sites away from the site. Welfare facilities would be provided on site and any effluent contained within a sealed unit which would be appropriately disposed of offsite.

9.75 The aforementioned mitigation measures for soils are also relevant for ensuring minimal impacts upon water quality from increased siltation. The proposed soil mitigation measures will help to prevent increased siltation of surface water runoff reaching the local watercourses.

Mitigation measures for Drainage and Flood risk

9.76 The impact of the solar panels on the existing drainage is expected to be minimal due to their design. However due to the small increase in impermeable area on site from the associated operational infrastructure, a conservative approach to drainage will be adopted utilising extensive planting and targeted SuDS to control and increase the quality of surface water runoff.

9.77 The proposed built infrastructure, where surface water flow would be impeded, are located outside of the areas indicated to be at risk of surface water flooding to ensure existing surface water drainage routes are not impeded. Due to the design of the panel ground anchors, we would not expect them to impede the surface water drainage routes. The additional surface water run-off resulting from impermeable surfaces on the site will be attenuated by extensive planting and captured at strategic locations using cut-off swales (**Figure 9.1, ES Volume 3, Figures**). These will be designed to provide long term storage for runoff resulting from the rainfall events on the site. There will be the possibility of infiltration into the soil or evaporation of water whilst stored. It will be necessary that vegetation is maintained under and around the solar panels to attenuate runoff.

9.78 All of the infrastructure of the site will be placed outside of the flood exclusion zone, defined in the FRA and Drainage strategy (**Appendix 9.1**) from the embankment level of the Aldington Flood Storage Area. This will ensure that no storage volume is displaced, and flood flows will not be impeded.

9.79 See the associated Flood Risk Assessment and Outline Drainage strategy (**Appendix 9.1**) for further details on the proposed surface water management.

RESIDUAL EFFECTS

9.80 Residual effects have been assessed by reviewing the proposed mitigation measures against the potential effects outlined above. It is considered that all of the potential impacts can be managed appropriately through mitigation measures, good practice construction methods and sustainable design. **Table 9.5** and **Table 9.6** outline how the proposed mitigation results in no significant effects for each of the potential impacts from construction, decommissioning and operation of the site respectively. It can be concluded from this that there will be no significant effects on the drainage, flood risk, geology, soils, water quality and hydrogeology receptors associated with the site when all mitigation is employed.

CUMULATIVE EFFECTS

9.81 A proposed battery energy storage facility has been proposed by EDF Renewables and is located within the southern extent of the northern site (Figure 3.1). If construction of the proposed battery storage facility would take place at the same time as the proposed solar farm there could be increased construction activity which could mobilise sediment and increase the risk of pollution of watercourses. Similarly, there would be an increased risk of spillage of construction materials/fuels. Considering the low level and unintrusive nature of construction activities related to the proposed solar farm, as well as the proposed battery storage facility, it is not likely significant cumulative effects would occur. During operation it is likely both developments would only have a negligible effect in terms of changes in water quality and as such no significant effects are likely during operation.

9.82 In terms of flood risk, the proposed battery storage facility would result in an additional impermeable area within the site boundary. It is assumed that the design and construction techniques of the proposed battery storage facility will take this into account and will provide appropriate attenuation or SuDS as required, in line with national policy and guidance. Therefore no significant cumulative effect in relation to flood risk during construction or operation is likely to occur.

Table 9.5 - *Residual Risk – Construction and Decommissioning*

Potential Effect	Proposed Mitigation	Residual Effect
Soil – negligible	Reducing exposure time and extent.	Negligible – soil erosion will be reduced; however, some soil will have to be displaced for construction. Not significant effect.
Geology – negligible	Reducing exposure time and extent.	Negligible – erosion of geology will be reduced, but not eliminated. Not significant effect.
Groundwater quantity – negligible	Traffic management plan.	None – Mitigation will reduce compaction of soil on site, thereby mitigating impact upon recharge, Not significant effect.
Surface water quality – negligible	The below mitigation for groundwater quality all applies to surface water quality. Additionally, minimising extent and time subsoil exposed, silt traps, soil bunds, grass buffer strips.	None – mitigations will reduce siltation and prevent chemical pollution of surface water, impact reduced to negligible resulting in no effect. Not significant effect.
Groundwater quality - major	Vehicle refuelling offsite, spill kits carried, welfare facilities with sealed tanks, waste materials disposed of correctly off site, bunded chemical storage areas.	Negligible – chemical spillage risk is greatly reduced following mitigation methods, impact reduced to negligible. Not significant effect.
Private water supply - none	None proposed (no mechanism for impact to source of supply).	None – no effect possible.
Flood risk up/ downstream – moderate	Building infrastructure out of fluvial flood risk zones. Construction of swales within outline drainage strategy. Using permeable track design. Wildflower grass seeding across site, replacing current arable land use. Introduction of hedgerows and grass buffer strips. Building infrastructure (excluding panel arrays) out of pluvial flood risk zones. Sustainable design of panels with adequate spacing.	Negligible – Impact reduced to negligible. Not significant effect.

Table 9.6 - *Residual Risk - Operation*

Potential Effect	Proposed Mitigation	Residual Effect
Soil - minor	Vegetation is maintained across the site and depressions along drip lines will attenuate runoff.	Negligible – soil erosion risk greatly reduced with mitigation. Impact reduced to small. Not significant effect.
Groundwater quantity – minor	Traffic management plan, maintenance of vegetation around panels.	Negligible – Compaction reduced through mitigation. Impact reduced to negligible. Not significant effect.
Surface water quality – negligible	The below mitigation for groundwater quality all applies to surface water quality. Maintenance of grass buffer strips.	None – mitigations will reduce siltation and prevent chemical pollution of surface water, impact reduced to negligible. Not significant effect.
Groundwater quality - minor	Spill kits carried, welfare facilities with sealed tanks, waste materials disposed of correctly off site.	Negligible – chemical spillage risk is greatly reduced following mitigation methods, impact reduced to negligible. Not significant effect.
Private water supply - none	None proposed (no mechanism for impact to source of supply).	None – no effect possible. Not significant effect.
Flood risk up/ downstream - moderate	Correct maintenance of swales, hedgerows and grass buffer strips.	Negligible – Mitigation will ensure site drainage retains greenfield runoff rates, Impact reduced to negligible. Not significant effect.

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