Engena

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Environmental Report- Geology, Hydrology and Hydrogeology

Project	Tye Lane Solar Farm
Project Number	WHS1874
Title	**Tye Lane Environmental Report, Geology, Hydrology and Hydrogeology**
Description	This document describes the geology, hydrology and hydrogeology baseline environment at the proposed site for the Tye Lane solar farm. It includes a summary of the potential impacts of the proposed solar farm during construction and operation along with proposed mitigation measures in order to reduce these impacts.
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Version	2

1 Introduction

Wallingford HydroSolutions Ltd (WHS) has been commissioned by Engena to complete an Environmental Report for a proposed solar farm at Tye Lane, Bramford, NGR: TM 11095 47188. This report comprises of a desk-based assessment of the baseline hydrology, geology and hydrogeology environment for the proposed Tye Lane solar farm along with any potential impacts and mitigation.

In summary this report details:

- The baseline environment
- The potential impacts of the proposed solar farm during construction and operation
- Proposed mitigation measures
- Advice on best practice construction and operation guidance to minimise potential impacts

1.1 Assessment Methodology and data sources

A comprehensive desk-based study will inform the assessment. A range of publicly available data sources will be 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.

The following sources of information are consulted to assess the baseline environment:

- DEFRA 1m LiDAR[1]
- EA designated sites[2]
- British Geological Survey (BGS) online mapping[3]
- UK Soils observatory map viewer[4]
- EA online flood maps[5]
- River basin management plans[6]
- Data request to Suffolk County Council[7]

2 Baseline

2.1 Surface Hydrology, Site Drainage and Flooding

The surface hydrology and site drainage has been reviewed using 1m LiDAR data downloaded from the DEFRA website along with OS mapping. The LiDAR data indicates that the site falls primarily in an easterly direction towards Bramford Common and the River Gipping. A small area of the west of the site drains in a north westerly direction towards an unknown drain which runs adjacent to the site boundary. There is a small pond situated to the immediate south of the western part of the site, the site does not drain in this direction.

A review of the EA online flood maps indicates that the site is situated fully within Flood Zone 1 and is therefore at insignificant risk of fluvial flooding. The site is situated approximately 19km from the coast, given this distance and the sites elevation, the site is not at risk from coastal flooding. The Surface Water Flood Map indicates that the majority of the site is at low risk of surface water flooding, with a small depression in the south of the site shown to be at high risk. Flood risk to the site is considered in more detail in the accompanying Flood Risk Assessment and Outline Drainage Strategy in Appendix 1.

2.2 Geology, Hydrology and Soils

2.2.1 Bedrock Geology

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 bedrock in the form of Newhaven Chalk originating from the Cretaceous period.

2.2.2 Overburden Geology and Soils

The BGS 1:50k Superficial Deposits map shows the site to have superficial deposits of Diamicton of the Lowestoft Formation formed during the Quaternary period in ice age conditions. A small area of the east of the site has superficial deposits of sand and gravel in the Lowestoft Formation.

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[1] DEFRA , January 2021, available: https://environment.data.gov.uk/DefraDataDownload/?Mode=survey
[2] DEFRA Magic Maps, January 2021, available: https://magic.defra.gov.uk/MagicMap.aspx
[3] BGS Geology of Britain Viewer, January 2021, available: https://mapapps.bgs.ac.uk/geologyofbritain/home.html

[4] UKSO UK Soil Observatory, January 2021, available: http://mapapps2.bgs.ac.uk/ukso/home.html
[5] Environment Agency Flood Map for Planning, January 2021, available: https://flood-map-for-planning.service.gov.uk/
[6] Water Framework Directive EA Catchment Data Explorer, January 2021, available: https://environment.data.gov.uk/catchment-planning/
[7] Email correspondence with Suffolk County Council, November 2020.

The Cranfield Soil and Agrifood Institute Soilscapes map shows the west part of the site to have overlying soil deposits of a clayey texture with slightly impeded drainage. The eastern portion of the site has freely draining slightly acid loamy soils.

2.2.3 Hydrogeology

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.

The bedrock aquifer designation map identifies that the site is situated over a principal bedrock 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 to overlay a secondary (undifferentiated) aquifer, an aquifer which has not been assigned to a category A or B Secondary Aquifer, in most instances this means the layer has previously been designated as both a minor and non-aquifer.

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 at the east of the site is medium-high and medium in the west. Therefore, appropriate mitigation will be required to ensure the protection of groundwater in the area. Additional to this, the site is mostly situated within a Zone I source protection area known as an Inner Protection Zone, this is defined by a 50-day travel time for pollution from any point below the water table to reach the abstraction source. Hence appropriate mitigation will be required.

Additionally, the BGS borehole scan map shows a borehole in the centre of the site at NGR: TM 10670 47400 with a depth of 15.8m, water was not identified within this borehole. A borehole situated along Tye Lane to the immediate south of the site (NGR: TM 10940 47070) indicates water to be at a depth of 17.3m.

2.3 Water Quality and Water Use

The Water Framework Directive (WFD) River and Groundwater Body Catchment Cycle 2 dataset has been used to assess the water quality of the watercourses surrounding the site. The development site lies in two separate WFD catchments, the northern half of the site drains into the Somersham Watercourse via The Channel, and the southern portion into the River Gipping within the Gipping (d/s Stowmarket) catchment. Both watercourses are classed as heavily modified.

The Somersham watercourse has an overall status of moderate, with moderate ecological status and failed chemical status. The Gipping catchment has an overall classification of poor with poor ecological status and failed chemical status. Both watercourses are prevented from reaching good status due to pollution from rural areas, towns, cities and transport, pollution from wastewater and physical modifications to the watercourse.

The site lies within a drinking water safeguard zone for surface water and a Nitrate Vulnerable Zone.

The surrounding land use is predominantly agricultural. Water use within the vicinity of the site has been assessed using the EA's abstraction licence database available on the ArcGIS website[8]. A borehole is located to the immediate south of the site boundary at NGR: TM 11165 46986 which is used as a public water supply extracting a daily maximum quantity of 13,000l. The borehole is owned by Anglian Water. There is also a borehole situated approximately 600m north of the site at approximately NGR: TM 11095 48031, the borehole is privately owned by Flower Grange LTD and is used for agricultural farming and domestic purposes with a maximum daily quantity of 21l.

Additionally, liaison with Babergh and Mid Suffolk District Councils[9] indicated the presence of a private water supply at Copenhagen Cottage, Tye Lane, IP8 4NP, just to the north of the site boundary. The water supply is known to supply a single domestic dwelling and the depth of the supply is unknow.

2.4 Ground Water Dependant Terrestrial Ecosystems (GWDTE)

The EA's GWDTE dataset indicates that there are no GWDTE within the immediate vicinity, or immediately downstream, of the site.

3 Potential Impacts

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 and operational phases.

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
- Security fence
- Underground DC Cable
- Overhead Lines
- Control room and customer cabin
- District Network Operator (DNO) equipment
- Two substations
- Grid connection route

3.1 Potential Impacts on Soil

There is a risk of soil compaction mainly during the construction phase due to the footprint of the proposed access track and increased run-off due to impermeable building areas. If the soils become compact, the soakaway potential decreases, leading to increases surface water runoff, this potentially increases the flashiness of the catchment during high rainfall events.

Due to the small footprint of the solar panel frames in direct contact with the soil, and the relatively small area of proposed impermeable surfaces relative to the site area, the impacts on soil are considered to be low.

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[8] https://www.arcgis.com/home/item.html?id=fc92e5a3c298491aae8e566280f48d77
[9] Email liaison with Babergh and Mid Suffolk District Councils, November 2020.

Excavation of the topsoil will likely be required to lay the proposed track. 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 and grid connection route could potentially result in erosion of the subsoil and siltation of runoff. However, given the shallow depth of excavations, the risk is low.

3.2 Potential Impacts on Water Quality

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.

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.

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.

Given the depth of groundwater at the site and the nature of the proposed development, the solar farm is not expected to negatively impact upon groundwater.

3.3 Potential Impacts on Surface Hydrology and Drainage

The proposed development will result in the increase of impermeable areas through the construction of the proposed access track, substations and control and customer cabins. 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. The proposed impermeable area is very small relative to the size of the development site and unlikely to lead to a significant increase in flood risk.

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. It is recommended that vegetation is maintained under the solar panels.

4 Mitigation Measures

4.1 Mitigation Measures for Soils

When constructing the access track, it is recommended that the lengths of open excavations are controlled and replaced with gravel material as soon as possible to reduce the risk of erosion/siltation. Gravel material should 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 can be used to capture any sediment, preventing this from entering any watercourses draining the site.

Underground cabling should be designed and installed to ensure a low risk of pollution from this activity. Excavations required for cable installation should be undertaken in a manner as to minimise time which subsoil layers are exposed. The ground should be restored as quickly as possible following construction and existing vegetation replanted. The grid connection route will be underground with two road crossings directionally drilled, the trench will be 600mm wide and each section filled on the same day as excavated, this will result in negligible impact to the water quality of surrounding watercourses.

The layout of the panels should be designed to minimise the risk of local scour problems. For example, the panels are angled with a 25° tilt to allow water to drip from the panels along the length of each row. This will prevent saturation of the soil in concentrated areas.

The areas used for the construction of infrastructure and panel infrastructure should be selected to minimise compaction of the soil where possible. Additionally, a traffic management plan should be adopted to minimise the concentration of soil compaction.

4.2 Mitigation Measures for Water Quality

All fuel, lubricants and chemicals should 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 should be within the bunded area or have secondary containment provided.

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

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

The aforementioned mitigation measures for soils are also relevant for ensuring minimal impacts upon water quality. The proposed soil mitigation measures will help to prevent increased siltation of surface water runoff reaching water supplies and rivers.

4.3 Mitigation measures for surface hydrology and drainage

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 is to be adopted utilising SuDS to control and increase the quality of surface water runoff.

The proposed infrastructure should be located outside of the areas indicated to be at risk of surface water flooding to ensure existing surface water drainage routes are not impeded. See the associated Flood Risk Assessment and Outline Drainage strategy for details on the proposed surface water management.

5 Residual Impacts

Residual impacts have been assessed by reviewing the proposed mitigation measures against the potential impacts outlined above. It is considered that all of the potential impacts can be managed appropriately through good practice construction methods and sustainable design. However, some residual risks remain, and have been outlined in Table 1.

Table 1- Residual Risk

Risk	Proposed Mitigation	Residual Risk
Siltation of runoff	Silt traps, soil bunds, grass buffer strips	Low

Change in overland flow paths resulting in downstream flooding	Sustainable design of panels with adequate spacing, located outside of flood risk areas	Low
Pollution/contamination of groundwater and surface runoff	Vehicle refuelling offsite/ minimising extent and time subsoil exposed	Low
Soil compaction	Traffic and construction management plan	Low
Overall		Low