Cottam Solar Project

Environmental Statement Appendix 10.1:

Annex C – 10.1.2

Flood Risk Assessment and Drainage Strategy – Cottam 1 North

Prepared by: Delta-Simons

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Cottam
SOLAR PROJECT

Flood Risk Assessment and Drainage Strategy

Annex C - Cottam 1 North

Presented to: Cottam Solar Energy Farm Limited

Issued: December 2022

Delta-Simons Project No: 22-1088.03

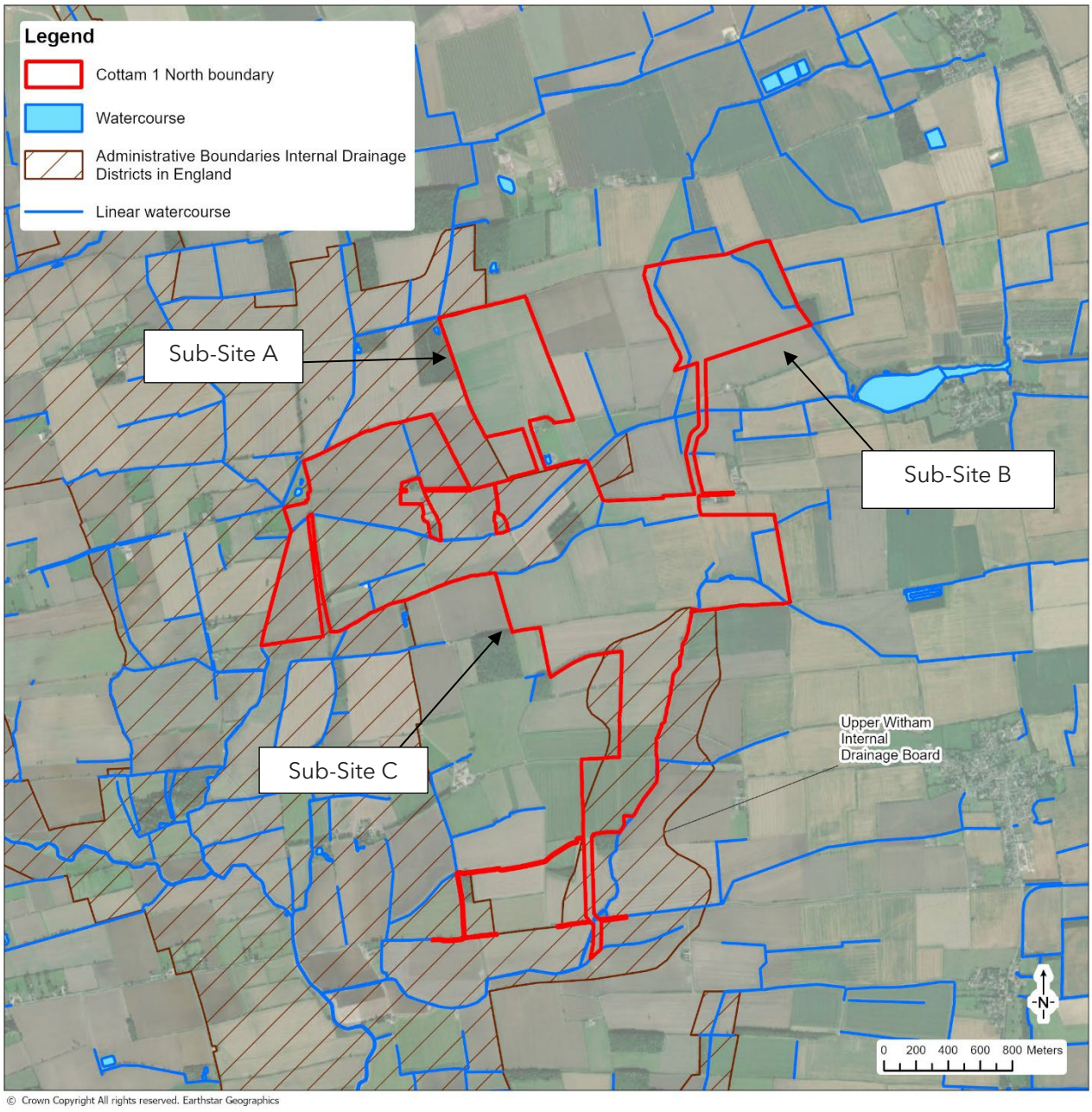
Protecting people and planet

Table of Contents

Annexes

1.0 Site Description

1.1.1 The aim of this section of the report is to outline key environmental information associated with the baseline environment.



Site Location Plan

Co-ordinates	Centred approximately at National Grid Reference (NGR) 492273, 384793.
Site Location	The Cottam 1 North site is located within a rural setting and comprises multiple parcels of agricultural fields, approximately 1.6 km north-west of the village of Ingham.

Existing Site Conditions	Online mapping (including Google Maps / Google Streetview imagery accessed October 2022) shows that the Site is greenfield comprising agricultural / arable fields.
Topography	Topographic levels to metres Above Ordnance Datum (m AOD) have been derived from a 1 m resolution Environment Agency (EA) composite 'Light Detecting and Ranging' (LiDAR) Digital Terrain Model (DTM). A review of LiDAR ground elevation data shows that the Site slopes from approximately 24 m AOD in the north-east to approximately 8 m AOD in the west. Given the size of the Site the gradients are shallow and the Site is considered to be relatively flat. A LiDAR extract is included in Annex B.
Hydrology	No EA Main Rivers are located within the vicinity of the Site. A series of land drains are shown to run throughout the Site parcels. Flows within the land drains are expected to travel in a south-westerly direction towards the River Till which is located approximately 1.3 km south-west. The Site is partly located within the Upper Witham Internal Drainage Board.
Water Framework Directive Status	The Site is located within the River Till and Fillingham Beck Catchments. Both Catchments have a Cycle 3 2019 Ecological status of Moderate and a Failing chemical status. A summary of the Water Body Classification for the catchments are included as Annexes C and D.
Geology	Reference to the British Geological Survey (BGS) online mapping (1:50,000 scale) indicates that the majority of the Site is underlain by superficial deposits of Till (Mid Pleistocene – Diamicton). Elongated strips of Alluvium comprising clay, silt, sand and gravel are shown in the east and west of Sub-Site B, the north-western corner of Sub-Site A and the north-west of Sub-Site C. The superficial deposits are identified as being underlain by Charmouth Mudstone Formation comprising mudstone across the majority of the Site with the western edge of Sub-Site C underlain by bedrock deposits of Scunthorpe Mudstone Formation (mudstone and limestone – interbedded). The geological mapping is available at a scale of 1:50,000 and as such may not be accurate on a Site-specific basis. There are no BGS Historic Borehole Records available to view within the Site Boundary.
Hydrogeology	According to the EA's Aquifer Designation data, obtained from MAGIC Map's online mapping [accessed October 2022], the Till is classified as a Secondary Undifferentiated Aquifer. Secondary Undifferentiated Aquifers are assigned in 'cases where it has not been possible to attribute either category A or B to a rock type. In most cases, this means that the layer in question has previously been designated as both minor and non-aquifer in different locations due to the variable characteristics of the rock type'. The Alluvium is classified as a Secondary A Aquifer. Secondary A Aquifers are 'permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers. These are generally aquifers formerly classified as minor aquifers';

	The Charmouth Mudstone Formation is classified as a Secondary Undifferentiated Aquifer. The Scunthorpe Mudstone Formation is classified as a Secondary B Aquifer. Secondary B Aquifers are 'predominantly lower permeability layers which may store and yield limited amounts of groundwater due to localised features such as fissures, thin permeable horizons and weathering. These are generally the water-bearing parts of the former non-aquifers'. The EA's 'Source Protection Zones' data, obtained from MAGIC Map's online mapping, indicates that the Site is not located within a Groundwater Source Protection Zone.
Proposed Site Conditions	The proposed development at Cottam 1 North is for a ground mounted solar photo-voltaic plant and associated power stations and access road. An Illustrative Layout Plan is included as Annex E.

2.0 Assessment of Flood Risk

2.1 Tidal Flood Risk

2.1.1 The Site is situated inland at a minimum of 7 m AOD. Therefore, the risk from tidal flooding is considered to be **Negligible.**

2.2 Fluvial Flood Risk

EA Online Flood Maps

2.2.1 A network of land drainage ditches is located within the Site. Flows within the ditches are expected to flow in a south-westerly direction based on local topography. All the land drains are Ordinary Watercourses and are therefore the responsibility of the LLFA and IDB to maintain.

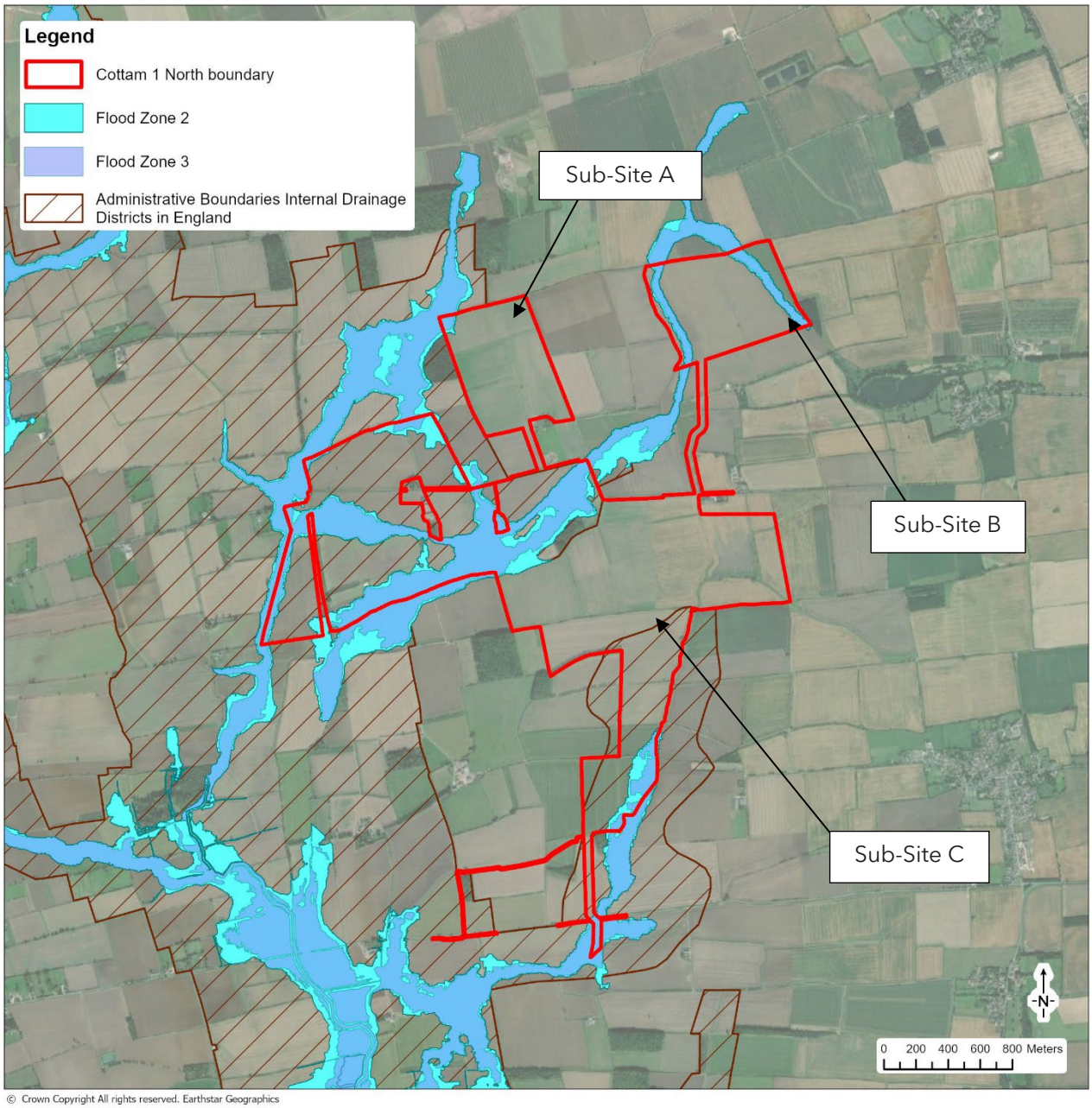


Figure 1: EA's Flood Map for Planning

2.2.2 The majority of the Site is situated in Flood Zone 1. The eastern and western boundaries of Sub-Site B are within the extents of Flood Zone 3. A minor extent of the north-western corner of Sub-Site A is located in Flood Zone 3. Sub-Site C is covered by the extents of Flood Zone 3 in the western and in the south-eastern corner.

2.2.3 Fluvial flooding could occur if the land drains overtopped their banks during or following an extreme rainfall event.

Consultation

2.2.4 The EA, LLFA and IDB were consulted to obtain modelled flood information for the Site. None of the authorities were able to provide flood data.

2.2.5 In the absence of modelled flood data, the 0.1% annual probability surface water flood scenario can be used as a proxy for the 1% AEP + Climate Change (CC) fluvial event. A map depicting flood depths associated with the 0.1% annual probability scenario is included as Annex F.

2.2.6 The map indicates that no flooding with a depth greater than 0.9 m is present across any of the Site parcels. Flooding with a depth between 0.6 – 0.9 m is present along the western boundary of Sub-Site B and the north-western corner of Sub-Site A.

Summary

2.2.7 It can therefore be concluded that the Site is at **Low** risk of fluvial flooding, the proposed solar panels will be raised above surrounding ground levels with associated power infrastructure appropriately waterproofed.

2.3 Surface Water Flood Risk

2.3.1 The EA's Long-Term Flood Risk Map (Figure 2) indicates that Surface Water flooding with a High Risk (>3.3% Annual Probability) of occurrence is present across the Site, predominantly within Sub-Site B and Sub-Site C.

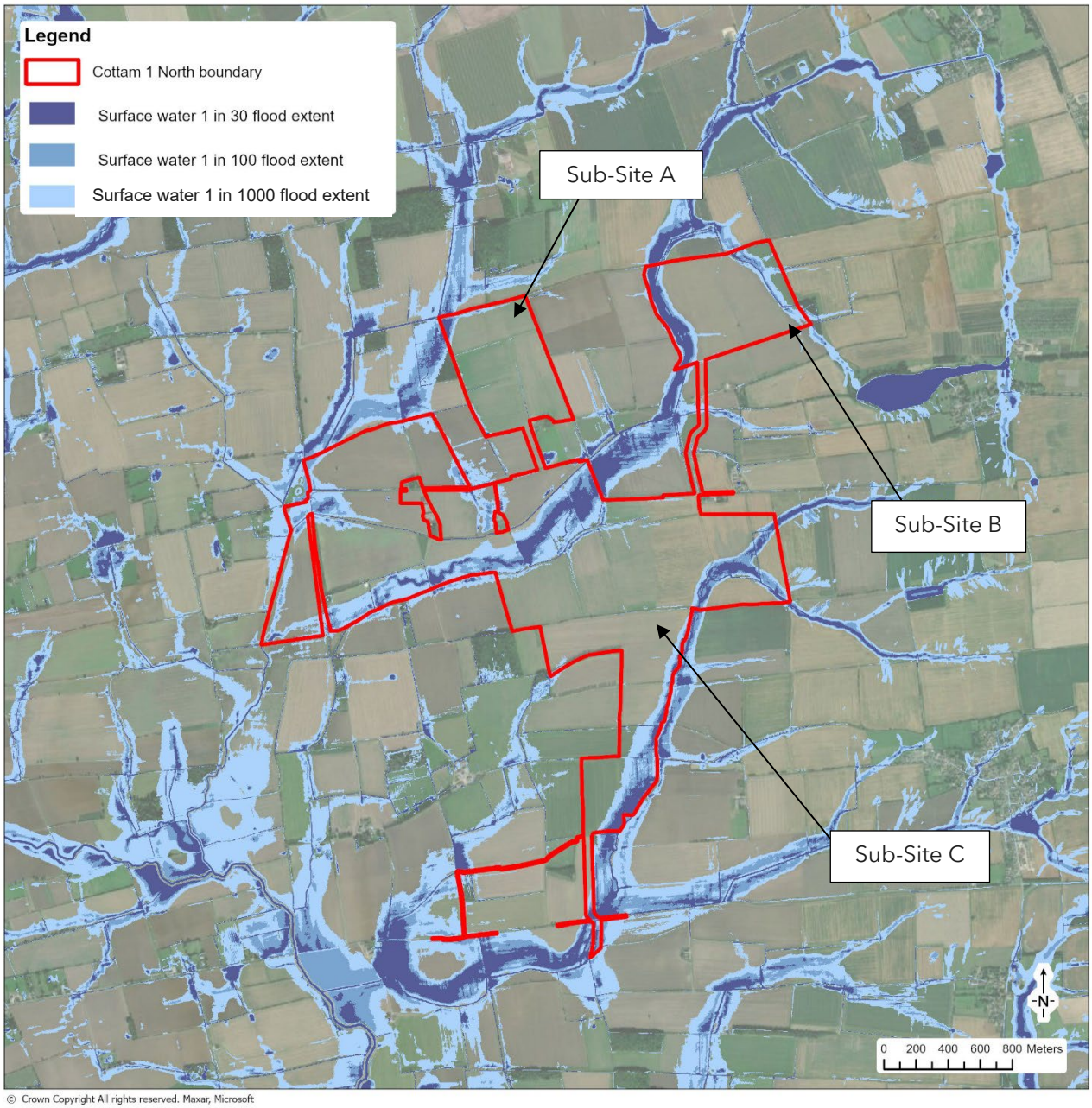


Figure 2: EA's Long-Term Flood Risk Map (Flood Risk from Surface Water)

2.3.2 As describe in the fluvial section above, the surface water flooding extents largely match the courses of the land drainage ditches which flow throughout the Site. During the Low risk (0.1% annual probability) scenario, flooding with depths between 0.6 – 0.9 m is present along the western boundary of Sub-Site B and the north-western corner of Sub-Site A.

2.3.3 There is no indication within relevant third party reports (listed in Paragraph 1.4 'Sources of Information' on the Flood Risk Assessment and Drainage Strategy) to suggest that the Site has historically experienced surface water flooding.

2.3.4 Based on the above and considering the embedded mitigation as part of the design of the solar panels, the overall risk of surface water flooding is considered to be **Low.** The proposed solar panels will be raised above surrounding ground levels and will be appropriately waterproofed thereby reducing the potential to be impacted in the event of surface water flooding.

2.3.5 The impact of the development on surface water risk is covered in Section 5.0 of the Covering Report to ensure that surface water risk is not exacerbated through appropriate SuDS measures.

2.4 Groundwater Flood Risk

2.4.1 There is no information within relevant third party reports (listed in Paragraph 1.4 'Sources of Information' on the Flood Risk Assessment and Drainage Strategy) to suggest that the Site has experienced historical groundwater flooding.

2.4.2 No buildings other than the supporting unstaffed infrastructure and no basement levels are identified on plans which may otherwise be at increased risk from groundwater seepage.

2.4.3 It can therefore be concluded that the risk of groundwater flooding is **Low** and no specific mitigation measures are required.

2.5 Artificial Sources Flood Risk

Sewer Flooding

2.5.1 No site-specific incidents of sewer flooding have been identified from relevant third party reports.

2.5.2 On the basis of the Site's rural setting the presence of sewerage infrastructure is unlikely.

2.5.3 It can therefore be concluded that the risk of sewer flooding is **Low**.

Reservoir and Canal Flooding

2.5.4 There are no canals within the vicinity of the Site. Therefore, the risk from canal flooding is considered to be **Negligible**.

2.5.5 The EA 'Flood Risk from Reservoirs' map shows that the is partly within the extents of a reservoir flood event.

2.5.6 The EA states within their Preliminary Flood Risk Assessment for England (dated October 2018) that 'reservoir flooding is extremely unlikely to happen'. All large reservoirs must be inspected and supervised by reservoir panel engineers. As the enforcement authority for the Reservoirs Act 1975 in England, the EA ensure that reservoirs are inspected regularly, and essential safety work is carried out. It can therefore be concluded that the risk from reservoir flooding is considered to be **Low.**

2.6 Summary of Flood Risk

2.6.1 It can be concluded that the risk to the Site from all sources of flooding is **Negligible to Low**, however it would be prudent to include the below mitigation measures.

2.7 Embedded Mitigation

2.7.1 8m easements have been established around all watercourses, including Main Rivers and Ordinary Watercourses and 9 m from IDB assets.

2.7.2 Either fixed or tracker panels will be utilised throughout the Sites.

2.7.3 The minimum height of the lowest part of the fixed solar panel units will be 0.6 m above ground level.

2.7.4 The tracker solar panel units will be mounted on raised frames (usually raised a minimum of 0.4 m) when on maximum rotation angle) and will therefore be raised above surrounding ground levels and fitted with a tracking system. During times of flooding, solar panels may be stowed by the tracking system algorithm onto a horizontal plane, to the minimum post height of 2.3 m above ground level. This ensures that all sensitive and electrical equipment on the solar panel is raised to a minimum of 2.3 m above ground level in the horizontal position.

2.7.5 Fixed panels should be located within areas of the Site which are located in Flood Zone 1 whereas tracker panels can be located in areas that are within Flood Zones 2 and 3 on the basis of the additional flood protection offered by their potential to be stowed horizontally.

2.7.6 Electrical infrastructure associated with the panels can be adequately waterproofed to withstand the effect of flooding. Where possible the sensitive electrical equipment has been located in parts of the Site that are within Flood Zone 1. Where this hasn't been possible, equipment will be raised 0.6 m above the 0.1% AEP flood level or where this is not possible as high as practicable.

Flood Warnings and Evacuation

2.7.7 Flood Warnings / Flood Alerts do partly cover this area therefore Site management should sign up to the free EA Floodline service to receive flood alerts.

2.7.8 Access to the Site will be required relatively infrequently, typically by technicians for maintenance and inspection works or Site management. Such works can be scheduled as to avoid the site during times of flood.

2.8 Residual Risks

2.8.1 A residual risk is an exceedance event, such as the 1 in 1000 year (0.1% AEP) flood event that would overtop the land drains and potentially impact the Site. As the probability of a 1 in 1000 year flood event occurring is 0.1% in any given year, the probability is low and, therefore, no further mitigation beyond what is proposed is required.

2.8.2 In the event of the defences failing or an exceedance event occurring, the residual risk to people working within the Site can be managed through the implementation of an appropriate Site management plan, which recognises the residual risks and details what action is to be taken by staff in the event of a flood to put occupants in a place of safety.

2.9 Impact on Off-Site Flood Risk

2.9.1 The solar panels will be mounted on frames and raised above ground level allowing flood water to flow freely underneath. Therefore, there will be no loss of floodplain volume as a result of the proposed development and no increase in flood risk elsewhere.

2.9.2 The supporting infrastructure is insignificant in size and should not increase flood risk elsewhere.

2.9.3 Surface water management has been considered in Section 5.0 of the Covering Report.

3.0 Conclusions and Recommendations

3.1 Conclusions

3.1.1 The proposed development is for a ground mounted solar farm and associated infrastructure and access roads.

Flood Risk

3.1.2 The EA 'Flood Map for Planning' map shows that the Site is partly located within Flood Zones 2 and 3.

3.1.3 The risk of flooding from all sources has been assessed and the flood risk to the Site is considered to be **Negligible to Low** and therefore does not require Site-specific mitigation measures.

3.1.4 The solar panels will be mounted on raised frames and therefore raised above surrounding ground level allowing flood water to flow freely underneath. Therefore, there will be no loss of floodplain volume as a result of the proposed development.

Drainage Strategy

3.1.5 The proposed development is free draining through perimeter gaps around all panels, allowing for infiltration as existing within the grassland/vegetation surrounding and beneath the panels. There will be minimal increase in impermeable area meaning the proposals will not increase surface water flood risk elsewhere.

3.1.6 Any surface water exceeding the infiltration capacity of the surrounding strata will naturally drain to the surrounding Land Drains in line with the existing scenario.

3.1.7 The heavily managed agricultural land will be replaced with wildflowers and grassland. This will help to reduce run off rates by increasing the roughness of the ground, helping to increase infiltration by reducing compaction, and improve water quality by reducing erosion and mobilisation of pollutants. As a result, runoff rates may be reduced following development when compared to the existing greenfield scenario.

3.2 Recommendations

3.2.1 The recommendations below have been taken into account in the design of the Illustrative Site Layout:

- 8m easements have been established around all watercourses, including Main Rivers and Ordinary Watercourses and 9 m from IDB assets;
- All service cabling should be designed and installed to be flood resilient / water compatible. This should be achieved in accordance with appropriate design standards and best practise guidance; and
- Locate sensitive electrical equipment in parts of the Site shown to remain flood free or have depths of flooding below 0.6 m.

Annex A – Limitations

Limitations

The recommendations contained in this Report represent Delta-Simons professional opinions, based upon the information listed in the Report, exercising the duty of care required of an experienced Environmental Consultant. Delta-Simons does not warrant or guarantee that the Site is free of hazardous or potentially hazardous materials or conditions.

Delta-Simons obtained, reviewed and evaluated information in preparing this Report from the Client and others. Delta-Simons conclusions, opinions and recommendations has been determined using this information. Delta-Simons does not warrant the accuracy of the information provided to it and will not be responsible for any opinions which Delta-Simons has expressed, or conclusions which it has reached in reliance upon information which is subsequently proven to be inaccurate.

This Report was prepared by Delta-Simons for the sole and exclusive use of the Client and for the specific purpose for which Delta-Simons was instructed. Nothing contained in this Report shall be construed to give any rights or benefits to anyone other than the Client and Delta-Simons, and all duties and responsibilities undertaken are for the sole and exclusive benefit of the Client and not for the benefit of any other party. In particular, Delta-Simons does not intend, without its written consent, for this Report to be disseminated to anyone other than the Client or to be used or relied upon by anyone other than the Client. Use of the Report by any other person is unauthorised and such use is at the sole risk of the user. Anyone using or relying upon this Report, other than the Client, agrees by virtue of its use to indemnify and hold harmless Delta-Simons from and against all claims, losses and damages (of whatsoever nature and howsoever or whensoever arising), arising out of or resulting from the performance of the work by the Consultant.

Annex B – LiDAR Plan

Legend

Cottam 1 North boundary

Contours

LiDAR

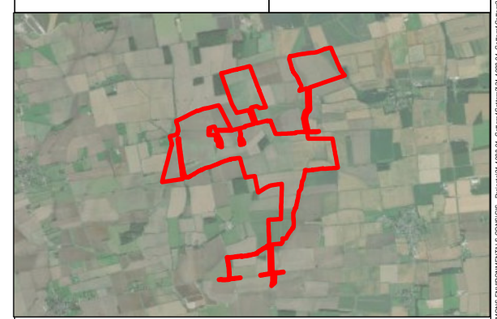
70.96

3.13

0 200 400 600 800 Meters

N

Figure	LIDAR & Contours				
Job	Cottam 1 North				
Client	Island Green Power				
Appendix	B	Revision	A	Date	02/12/2022
Drawn	KH	Checked	EB	Scale	1:18,800 @ A3
Job No.	21-1088.03			Central GR	491899E 384698N



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Annex C – River Till Water Body Catchment Water Body Classification Summary

Classification Item	Cycle 2 2019 Classification	Cycle 3 2019 Classification	Cycle 3 Objectives		
Ecological	N/A	Moderate	Moderate	2015	Disproportionately expensive: Disproportionate burdens; Disproportionately expensive: Unfavourable balance of costs and benefits
Biological quality elements	N/A	Poor	Moderate	2027 - Low confidence	Disproportionately expensive: Disproportionate burdens; Disproportionately expensive: Unfavourable balance of costs and benefits
Fish	N/A	Poor	Moderate	2027 - Low confidence	Disproportionately expensive: Disproportionate burdens; Disproportionately expensive: Unfavourable balance of costs and benefits
Invertebrates	N/A	Good	Good	2015	
Macrophytes and Phytobenthos Combined	N/A		Not assessed	2015	Disproportionately expensive: Disproportionate burdens; Disproportionately expensive: Unfavourable balance of costs and benefits
Physico-chemical quality elements	N/A	Moderate	Moderate	2015	Disproportionately expensive: Disproportionate burdens; Disproportionately expensive: Unfavourable balance of costs and benefits
Acid Neutralising Capacity	N/A	High	Good	2015	
Ammonia (Phys-Chem)	N/A	High	Good	2015	
Dissolved oxygen	N/A	Poor	Good	2015	
Phosphate	N/A	Poor	Moderate	2027 - Low confidence	Disproportionately expensive: Disproportionate burdens; Disproportionately expensive: Unfavourable balance of costs and benefits
Temperature	N/A	High	Good	2015	
pH	N/A	High	Good	2015	
Hydromorphological Supporting Elements	N/A	Supports good	Supports good	2015	
Hydrological Regime	N/A	Supports good	Supports good	2015	

Supporting elements (Surface Water)	N/A	Good	Good	2015	
Mitigation Measures Assessment	N/A	Good	Good	2015	
Specific pollutants	N/A	High	High	2015	
Copper	N/A	High	High	2015	
Mecoprop	N/A	High	High	2015	
Chemical	N/A	Fail	Good	2063	Natural conditions: Chemical status recovery time; Technically infeasible: No known technical solution is available
Priority hazardous substances	N/A	Fail	Good	2063	Natural conditions: Chemical status recovery time; Technically infeasible: No known technical solution is available
Benzo(a)pyrene	N/A	Good	Good	2015	
Dioxins and dioxin-like compounds	N/A	Good	Good	2015	
Heptachlor and cis-Heptachlor epoxide	N/A	Good	Good	2015	
Hexabromocyclododecane (HBCDD)	N/A	Good	Good	2015	
Hexachlorobenzene	N/A	Good	Good	2015	
Hexachlorobutadiene	N/A	Good	Good	2015	
Mercury and Its Compounds	N/A	Fail	Good	2040	Natural conditions: Chemical status recovery time
Perfluorooctane sulphonate (PFOS)	N/A	Fail	Good	2039	Technically infeasible: No known technical solution is available
Polybrominated diphenyl ethers (PBDE)	N/A	Fail	Good	2063	Natural conditions: Chemical status recovery time
Priority substances	N/A	Good	Good	2015	
Cypermethrin (Priority)	N/A	Good	Good	2015	
Fluoranthene	N/A	Good	Good	2015	

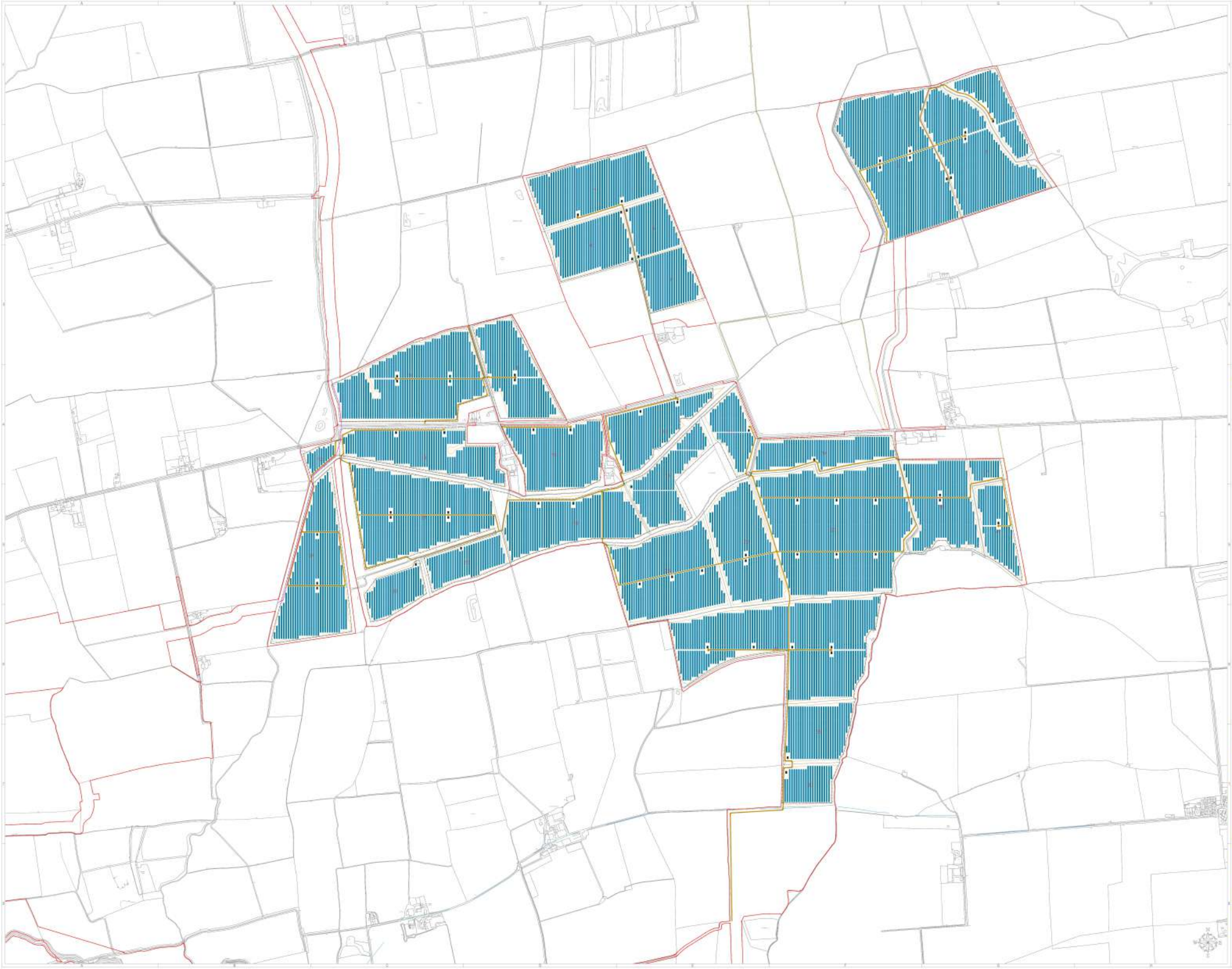
Other Pollutants	N/A	Does not require assessment	Does not require assessment	2015	

Annex D – Fillingham Beck Water Body Catchment Classification Summary

Classification Item	Cycle 3 2019 Classification	Cycle 3 Objectives		
	Status	Status	Year	Reasons
Ecological	Moderate	Good	2027 - Low confidence	Disproportionately expensive: Disproportionate burdens; Good status prevented by A/HMWB designated use: Action to get biological element to good would have significant adverse impact on use
Biological quality elements	Moderate	Moderate	2015	Disproportionately expensive: Disproportionate burdens; Good status prevented by A/HMWB designated use: Action to get biological element to good would have significant adverse impact on use
Invertebrates	Moderate	Moderate	2015	Good status prevented by A/HMWB designated use: Action to get biological element to good would have significant adverse impact on use
Macrophytes and Phytobenthos Combined		Not assessed	2015	Disproportionately expensive: Disproportionate burdens
Physico-chemical quality elements	Moderate	Good	2027 - Low confidence	Disproportionately expensive: Disproportionate burdens
Ammonia (Phys-Chem)	High	Good	2015	
Dissolved oxygen	High	Good	2015	
Phosphate	Poor	Good	2027 - Low confidence	Disproportionately expensive: Disproportionate burdens
Temperature	High	Good	2015	
pH	High	Good	2015	
Hydromorphological Supporting Elements	Supports good	Supports good	2015	
Hydrological Regime	Supports good	Supports good	2015	
Supporting elements (Surface Water)	Good	Good	2027 - Low confidence	Disproportionately expensive: Disproportionate burdens
Mitigation Measures Assessment	Good	Good	2027 - Low confidence	Disproportionately expensive: Disproportionate burdens
Specific pollutants		Not assessed	2015	
Chemical	Good	Good	2063	Natural conditions: Chemical status recovery time

Priority hazardous substances	Does not require assessment	Good	2063	Natural conditions: Chemical status recovery time
Benzo(a)pyrene		Good	2015	
Dioxins and dioxin-like compounds		Good	2015	
Heptachlor and cis-Heptachlor epoxide		Good	2015	
Hexabromocyclododecane (HBCDD)		Good	2015	
Hexachlorobenzene		Good	2015	
Hexachlorobutadiene		Good	2015	
Mercury and Its Compounds		Good	2040	Natural conditions: Chemical status recovery time
Perfluorooctane sulphonate (PFOS)		Good	2015	
Polybrominated diphenyl ethers (PBDE)		Good	2063	Natural conditions: Chemical status recovery time
Priority substances	Does not require assessment	Good	2015	
Cypermethrin (Priority)		Good	2015	
Fluoranthene		Good	2015	
Other Pollutants	Does not require assessment	Does not require assessment	2015	

Annex E – Illustrative Site Layout Plan



General Legend

Project Boundary
Fence
Development Area
High Voltage Electrical Cable
Bonding Electrodes
Power Stations
Maintenance Tracks
Culvert
Offline Footpath
Flood Embankment
Acoustic Barrier
CCTV

Project: Cottam 1 North Solar Project

Project Location: Land near Coates, Lincolnshire, LN1 2QW

Ownership: Cottam Solar Project Limited

Document Title: Layout

Sheet Format: A0 "1189 x 841"

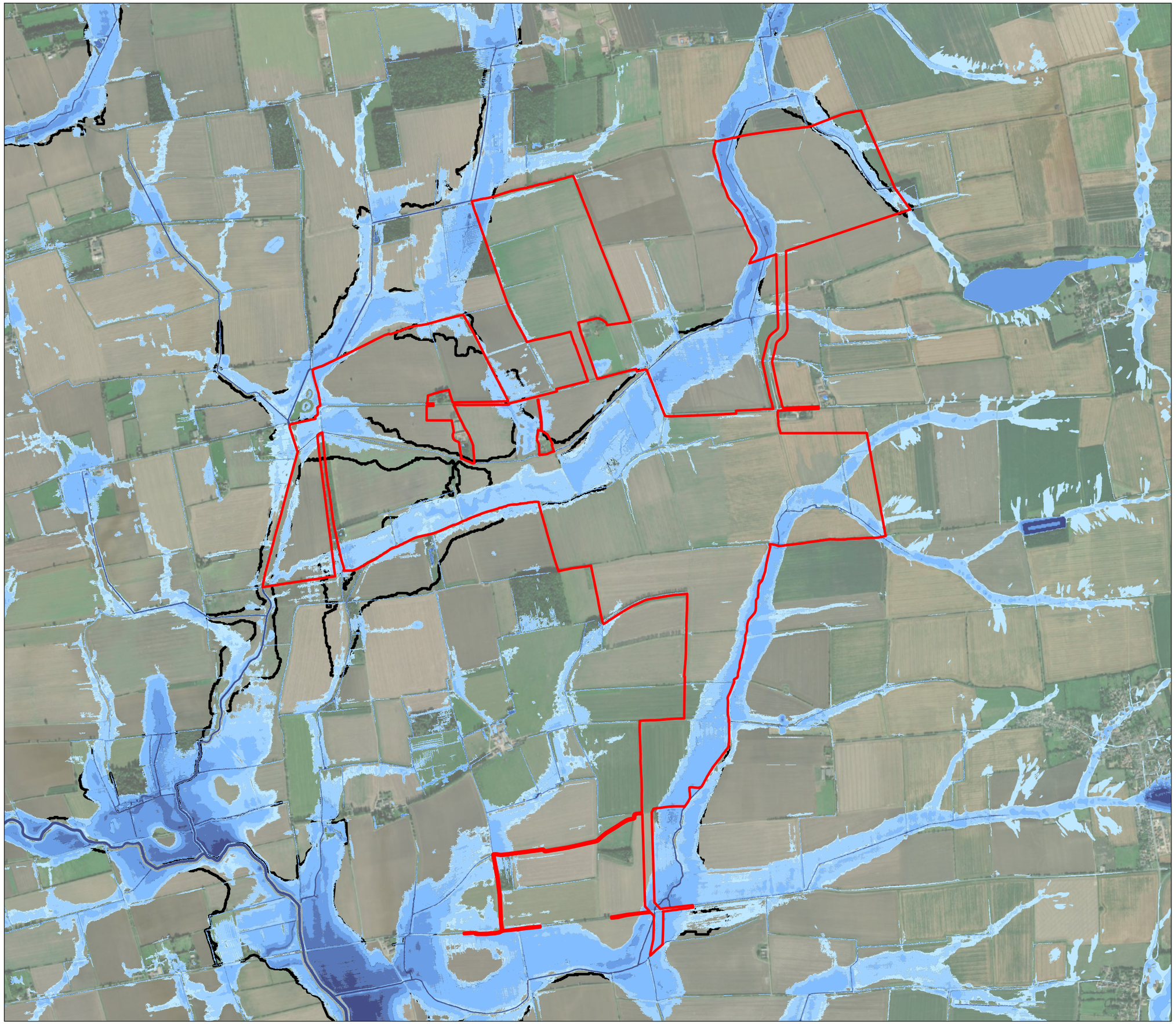
Scale: 1:5000

Document amendments				Comments
v.1	12/01/2023	A.A.		Preliminary Layout
v.2	14/04/2023	A.A.		Updated Layout
v.3	18/08/2023	A.A.		Final Layout
v.4	14/12/2023	A.A.		Updated Application Boundary

Company: Ireland Green Power UK Limited
Unit 20.2, Gods Studios
189 Munster Road, London, SW6 6AW

0 100 200 300

Annex F – 0.1% Annual Probability Event Surface Water Proxy Map



Legend

Cottam 1 North boundary

Risk of Flooding from Surface Water (Depth 1 in 1000)

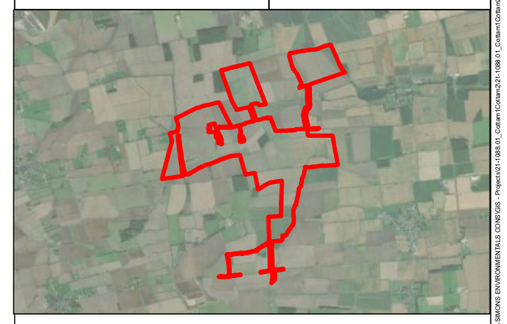
- Below 150mm
- 150-300mm
- 300-600mm
- 600-900mm
- 900-1200mm
- Over 1200mm

Flood Zone 2

0 200 400 600 800 Meters

N

Figure	0.1% Annual Probability Scenario Depth Map		
Job	Cottam 1 North		
Client	Island Green Power		
Appendix F	Revision A	Date 02/12/2022	
Drawn KH	Checked EB	Scale 1:18,800 @ A3	
Job No. 21-1088.03		Central GR 491899E 384698N	



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