East Anglia TWO Offshore Windfarm

Outline Operational Drainage Management Plan

Applicant: East Anglia TWO Limited
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Applicable to
East Anglia TWO

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001	n/a	n/a	Final for Deadline 3
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Glossary of Acronyms

BS	British Standards
BGS	British Geological Survey
BMT	British Maritime Technology
CCS	Construction Consolidation Site
CDA	Critical Drainage Areas
CIRIA	Construction Industry Research and Information Association
DCO	Development Consent Order
DMRB	Design Manual for Roads and Bridges
EIA	Environmental Impact Assessment
ESC	East Suffolk Council
JBA	Jeremy Benn Associates
LLFA	Lead Local Flood Authority
LFRMS	Local Flood Risk Management Strategy
NPPF	National Planning Policy Framework
NPPG	National Planning Practice Guidance
OLMP	Outline Landscape Mitigation Plan
OLEMS	Outline Landscape and Ecological Management Strategy
PPG	Pollution Prevention Guidance
PFRA	Preliminary Flood Risk Assessment
Q_{BAR}	Mean Annual Flood
SCC	Suffolk County Council
SFRA	Strategic Flood Risk Assessment
SuDS	Sustainable Drainage Systems
WDC	Waveney District Council
WFD	Water Framework Directive

Glossary of Terminology

Applicant	East Anglia TWO Limited
Construction consolidation sites	Compounds associated with the onshore works which may include elements such as hard standings, lay down and storage areas for construction materials and equipment, areas for vehicular parking, welfare facilities, wheel washing facilities, workshop facilities and temporary fencing or other means of enclosure.
Development area	The area comprising the onshore development area and the offshore development area (described as the 'order limits' within the Development Consent Order).
East Anglia TWO project	The proposed project consisting of up to 75 wind turbines, up to four offshore electrical platforms, up to one construction, operation and maintenance platform, inter-array cables, platform link cables, up to one operational meteorological mast, up to two offshore export cables, fibre optic cables, landfall infrastructure, onshore cables and ducts, onshore substation, and National Grid infrastructure.
National Grid infrastructure	A National Grid substation, cable sealing end compounds, cable sealing end (with circuit breaker) compound, underground cabling and National Grid overhead line realignment works to facilitate connection to the national electricity grid, all of which will be consented as part of the proposed East Anglia TWO project Development Consent Order but will be National Grid owned assets.
National Grid overhead line realignment works	Works required to upgrade the existing electricity pylons and overhead lines (including cable sealing end compounds and cable sealing end (with circuit breaker) compound) to transport electricity from the National Grid substation to the national electricity grid.
National Grid substation	The substation (including all of the electrical equipment within it) necessary to connect the electricity generated by the proposed East Anglia TWO project to the national electricity grid which will be owned by National Grid but is being consented as part of the proposed East Anglia TWO project Development Consent Order.
National Grid substation location	The proposed location of the National Grid substation.
Onshore development area	The area in which the landfall, onshore cable corridor, onshore substation, landscaping and ecological mitigation areas, temporary construction facilities (such as access roads and construction consolidation sites), and the National Grid infrastructure will be located.
Onshore substation	The East Anglia TWO substation and all of the electrical equipment within the onshore substation and connecting to the National Grid infrastructure.
Onshore substation location	The proposed location of the onshore substation for the proposed East Anglia TWO project.

1 Introduction

1.1 Overview

1. This Outline Operational Drainage Management Plan addresses operational surface water and foul water drainage management matters, and supports the Development Consent Order (DCO) application (the Applications) for the East Anglia TWO project and the East Anglia ONE North project (the Projects) submitted by East Anglia TWO Limited (the Applicant).

2. Works to be undertaken include (amongst other things) the construction of an onshore substation, one for the East Anglia TWO Project (the Project); an onshore substation for the East Anglia ONE North Project; National Grid infrastructure; associated landscaping; and surface water management infrastructure.

3. Requirement 41 of the ***draft DCO*** (~~APP-023~~REP3-011) requires an Operational Drainage Management Plan in respect of the above works to be submitted to, and approved by, the relevant planning authority, in consultation with Suffolk County Council (SCC) and the Environment Agency and which must be in line with this Outline Operational Drainage Management Plan.

4. The Applicant notes comments raised by SCC during issue specific hearing 2 regarding the assumptions presented in the ***SuDS Infiltration Clarification Note*** (REP2-012) submitted at Deadline 2. This note will be updated and re-submitted at Deadline 4.

5. This information presented in this report is based on original substation footprints and worst-case assumptions and is therefore conservative. The following Project updates have been submitted to the Examination but are immaterial to the assessment presented here:

- An updated Outline Landscape Mitigation Plan within the ***Outline Landscape and Ecological Management Strategy*** (~~an updated version has been submitted at Deadline 3, document reference 8.7).~~REP3-030).
- The ***Project Update Note*** (REP2-007) submitted at Deadline 2 regarding the approximate 10% reduction in the footprint of the substations.
- The ***Project Update Note for Deadline 3*** (~~ExA.AS-6.D3.V1~~REP3-052) presents the new location of the National Grid substation sustainable drainage system (SuDS) basin.

1.2 Purpose

6. This Outline Operational Drainage Management Plan presents an overview of the information to be presented within the final Operational Drainage Management Plan, including:

- Operational surface water management: Information on the SuDS measures adopted for the attenuation, treatment and conveying of surface water from the onshore substations and National Grid infrastructure; and
- Operational foul water management: information on waste water arising from the onshore substations and National Grid infrastructure.

7. The storage volumes, runoff off rates, discharge rates etc quoted in this Outline Operational Drainage Management Plan relate to the current design envelope of the Projects and will be subject to review on detail design of the Projects.

2 Relevant Legislation, Policy and Guidance

8. This section sets out the relevant legislation and guidance that have informed the development of this Outline Operational Drainage Management Plan.

2.1 Legislation

2.1.1 Flood and Water Management Act (2010)

9. Under the Flood and Water Management Act (2010), Lead Local Flood Authorities (LLFAs) are responsible for managing the risk of flooding from surface water, groundwater and ordinary watercourses. SCC is the LLFA covering the onshore development area and they are required to deliver a strategy for local flood risk management in their areas, to investigate flooding and to maintain a register of flood risk assets.

2.1.2 The Electricity Safety, Quality Continuity Regulations 2002

10. Regulation 3(4) places obligations on generators and distributors of electricity to, as far as reasonably practicable, prevent enclosed spaces from being contaminated with fluids (including water) which may cause danger. Environments that would be caught by this regulation include customers' premises (e.g. basements or stairwells), and generators' and distributors' own premises (e.g. substations or cable basements).

2.2 Planning Policy

2.2.1 National Policy Statements

11. Overarching National Policy Statement EN-1 section 5.7 'Flood Risk' has been followed.

2.2.2 National Planning Policy Framework

12. The following National Planning Policies have been followed:

- National Planning Policy Framework (NPPF); and
- National Planning Practice Guidance (NPPG) for Flood Risk and Coastal Change.

2.2.3 Preliminary Flood Risk Assessments

13. A Preliminary Flood Risk Assessment (PFRA) for Suffolk was produced by SCC in June 2011. It was subsequently updated in December 2017.

14. The PFRA provides a high-level overview of the potential risk of flooding from local sources and identifies areas at flood risk which may require more detailed studies. PFRAs are used to identify areas that are at risk of significant flooding.

The PFRA is used to inform the Local Flood Risk Management Strategy (LFRMS).

2.2.4 Strategic Flood Risk Assessments

15. Waveney District Council (WDC) and Suffolk Coastal District Council (SCDC) (now merged to form East Suffolk Council (ESC)) jointly commissioned a Level 1 Strategic Flood Risk Assessment (SFRA) in 2008. This was subsequently updated in 2018 (WDC and SCDC 2018).

16. A review of information contained within the Level 1 SFRA has been carried out to inform the understanding of flood risk issues within the onshore development area. This can be found in ***Appendix 20.3 Flood Risk Assessment*** (APP-496).

17. A Level 2 SFRA was prepared on behalf of WDC and SCDC and published in June 2018. The purpose of the Level 2 assessment is to analyse the level of flood risk associated with allocated development sites within their study area, in accordance with the NPPF and the NPPG.

18. Five allocated development sites were identified for assessment in the Level 2 SFRA. These sites were allocated during the ongoing formulation of the WDC Local Plan and are all located in the Lowestoft area. As none of the five allocated development sites are within the onshore development area, the Level 2 SFRA was not considered further by the Applicant (***section 20.3.5*** of ***Appendix 20.3 Flood Risk Assessment*** (APP-496)).

2.2.5 Suffolk Flood Risk Management Strategy

19. SCC's Flood Risk Management Strategy (FRMS) was published in 2016 and it outlines the aims and objectives of SCC as the LLFA and provides their policies based on these aims.

20. Critical Drainage Areas (CDAs) are those that fall within Flood Zone 1 that experience critical drainage problems as notified by the Environment Agency[1].

21. The Town and Country Planning (Development Management Procedure) (England) Order 2015 provides that in granting permission for development, other than minor development, which is to be carried out on land in area within Flood Zone 1 which has critical drainage problems and which has been notified to the local planning authority by the Environment Agency, the local planning authority must consult the Environment Agency.

22. Consideration of CDAs is therefore necessary to inform key flood risk priorities. The FRMS indicates that local authorities should identify CDAs within their SFRA.

[1] https://www.gov.uk/guidance/flood-risk-assessment-in-flood-zone-1-and-critical-drainage-areas

The Level 1 SFRA (WDC and SCDC 2018) indicated that SCDC and WDC has no defined CDAs.

23. SCC's FRMS Appendix A – Sustainable Drainage Systems (SuDS) A Local Design Guide, was published in May 2018. It sets out the guidelines for planning applications for all major developments, including the need for a site-specific drainage strategy. It is noted that the Projects are Nationally Significant Infrastructure Projects and require DCOs rather than planning permission. It summarises the local guidelines for Suffolk and sets out the Suffolk Design Principles, specifically that SuDS should:

- Not increase flood risk off site (in all events up to 100 year return period);
- Provide adequate standards of flood protection on site - in most cases no flooding inside buildings in events up to a 100 year return period and no flooding in other areas (apart from designated flood paths /storage areas) in events up to 30 year return period;
- Take account of the construction, operation and maintenance requirements of both surface and subsurface components, allowing for any personnel, vehicle or machinery access required to undertake this work; and
- Make allowances for climate change for all return periods.

24. The Suffolk Design Principles also set out requirements related to discharge rates, volume control and climate change allowances.

25. The Suffolk Design Principles advise that the drainage system for a site be designed for a 20% increase in rainfall as a result of climate change and that during the design a sensitivity check should be carried out for a 40% increase in rainfall to assess wider flood risk. Further discussion on how elements of the Suffolk Design Principles will be incorporated into the final Projects drainage designs are discussed further in ***section 4***.

2.3 Guidance

2.3.1 British Standards

26. The following British Standards have informed the outline SuDS design for the onshore substations and National Grid infrastructure:

- Drain and sewer systems outside buildings (British Standard EN 752:2017);
- Separator systems for light liquids (British Standard EN 858 1:2002) and
- Gravity drainage systems inside building (British Standard EN 12056 3:2000).

2.3.2 Construction Industry Research and Information Association

27. The following guidance from the Construction Industry Research and Information Association (CIRIA) has informed the outline SuDS design for the onshore substations and National Grid infrastructure:

- CIRIA C753 SuDS Manual (Dec 2015); and
- CIRIA C762 Environmental Good Practice on Site (4th Edition 2016).

2.3.3 Design Manual for Roads and Bridges

28. The following guidance from the Design Manual for Roads & Bridges (DMRB) has informed the outline SuDS design for the onshore substations and National Grid infrastructure:

- DMRB: Vol 4 Section 2 Part 7 HA 107/04 Design of Outfall and Culvert Details; and
- DMRB: Vol 4 Section 2 Part 1 HA 106/04 Drainage of Runoff from Natural Catchments.

2.3.4 Environment Agency Guidance

29. The following Environment Agency guidance notes and documents have informed the outline SuDS design for the onshore substations and National Grid infrastructure:

- Pollution Prevention Guidance (PPG) 1 General Guide to the Prevention of Water Pollution[2];
- PPG3 Use and Design of Oil Separators in Surface Water Systems;
- PPG4 Disposal of Sewage where no Mains Drainage is Available; and
- PPG5 Works in, or liable to affect Watercourses.

[2] This publication was withdrawn on 14 December 2015 however it still provides useful information to ensure best practice is achieved.

3 Existing Conditions

3.1 Overview

30. This section presents an overview of the existing conditions in and around the onshore substations and National Grid infrastructure. In establishing the baseline, existing run-off rates can be identified which will allow the final onshore substations and National Grid infrastructure designs to be optimised in order to avoid exceedance of the baseline rate.

3.2 Methodology for Establishing Existing Conditions

31. The final Operational Drainage Management Plan will include details of how the existing conditions are established. This Outline Operational Drainage Management Plan is informed by existing documentation at the time of production.

32. The data sources used to inform the water resources and flood risk baseline as per ***Chapter 20 Water Resources and Flood Risk*** (APP-068) and ***Appendix 20.3 Flood Risk Assessment*** (APP-496) are outlined in ***Table 3.1***.

Table 3.1 Data Sources

Data	Year	Coverage	Confidence
Environment Agency's Flood Map for Planning	2018	Nationwide	High
Environment Agency's Risk of Flooding from Surface Water	2018	Nationwide	High
Environment Agency's Risk of Flooding from Rivers and Sea	2018	Nationwide	High
Environment Agency's Catchment Data Explorer for Water Framework Directive (WFD) River Basin Districts Management Catchments, Operational Catchments and WFD water bodies	2017	Nationwide	High
Environment Agency fisheries survey data	2017	Local	High
Environment Agency Product 4 Detailed Flood Risk Assessment Map for Knodishall and Thorpeness	2017	Local	High
Environment Agency groundwater and surface water abstractions data	2018	Local	High
Environment Agency priority species data	2018	Local	High
Suffolk County Council River and Sea Flood Risk and Incident Map	2018	Local	High
Suffolk County Council Surface Water Flood Risk and Incident Map	2018	Local	High

33. The Applicant has also adopted the Environment Agency's surface water flood risk definitions for reference in this report. These are summarised in ***Table 3.2***.

Table 3.2 Summary of Environment Agency Flood Risk Definitions

Probability of Surface Water Flooding	Return Periods
Very low	Land with less than 1 in 1,000 annual probability of surface water flooding (<0.1%).
Low	Land with between 1 in 1,000 and 1 in 100 annual probability of surface water flooding (0.1% - 1%).
Medium	Land with between 1 in 100 and 1 in 30 annual probability of surface water flooding (1% - 3.3%).
High	Land with greater than 1 in 30 annual probability of surface water flooding (>3.3%).

3.3 Existing Land Use

34. The onshore substations and National Grid infrastructure are located on agricultural land of Grade 2 (very good) and Grade 3 (good to moderate) quality. This is shown in ***Figure 21.3*** (APP-270) and included in this document as ***Figure 1*** (Appendix 1). Further details on existing land use is presented in ***Chapter 21 Land Use*** (APP-069).

3.4 Topographic Survey

35. The Level 1 SFRA (WDC and SCDC 2018) focussed on fluvial flood risk in a number of key catchments. The onshore substations and National Grid infrastructure are primarily located in the Friston watercourse catchment, a tributary of the River Alde. The Level 1 SFRA does not cover this watercourse specifically and therefore information on flood risk from the Friston watercourse has been based on historic anecdotal information provided by the local community. The Friston Watercourse is designated as Main River by the Environment Agency south of Church Road.

36. A small area of the National Grid infrastructure, associated with modifications to the existing overhead lines, are partially located within the Hundred River catchment. The Level 1 SFRA notes that the Hundred River is a coastal draining river which flows through the low-lying Beachfarm Marshland before entering the sea. However, the flood extent within the Level 1 SFRA also confirms that the National Grid infrastructure is located within Flood Zone 1 along with the onshore substations (***Figure 20.2*** (APP-266) included in this document as ***Figure 2***). Therefore, the onshore substations and National Grid infrastructure are at low risk of flooding from fluvial sources.

37. The final Operational Drainage Management Plan will include a topographic survey which validates the existing conditions.

3.5 Ground Investigations

38. The onshore substations and National Grid infrastructure are underlain by a Principal Aquifer in the Chalk bedrock (***Figure 18.4*** (APP-255), included in this document as ***Figure 3***). Since the submission of the Applications in October 2019, the data on groundwater source protection zones was updated by the Environment Agency on 1st July 2020. The onshore substations and National Grid infrastructure are now no longer underlain by Secondary (A, B and undifferentiated) aquifers in the superficial crag deposits as initially reported in ***section 20.4.3.5*** of ***Appendix 20.3 Flood Risk Assessment*** (APP-496).

39. The Level 1 SFRA (WDC and SCDC 2018) indicated that groundwater flooding is most likely to occur in low-lying areas which are underlain by permeable rock (aquifers), particularly after periods of sustained rainfall.

40. The Level 1 SFRA notes that the British Geological Survey (BGS) Susceptibility to Groundwater Flooding map shows the vast majority of the SFRA study area has a designation of “Limited potential for groundwater flooding to occur”, except in some concentrated areas surrounding the watercourses where the designation given is “Potential for groundwater flooding to occur at surface”.

41. There are five unlicensed (private) abstractions known to the Environment Agency close to (but outside) the onshore development area and a further three observation boreholes in the area (which may also be used for abstraction) (***Figure 18.4*** (APP-255)), included in this document as ***Figure 3***). All but one of the unlicensed abstraction points appear to be related to non-industrial abstractions, therefore any abstraction is likely to have minimal impact on local groundwater resources and therefore minimal effect on the risk of flooding from groundwater sources.

42. Given the above, the onshore substations and National Grid infrastructure are at low risk of flooding from groundwater sources.

43. The final Operational Drainage Management Plan will be produced to include details of ground investigations which validates the existing conditions.

3.6 Background to Historic Flooding

44. The onshore substations and National Grid infrastructure are located within Flood Zone 1, at low risk from fluvial or tidal sources. There has been no history of flooding from these sources identified as part of the FRA for the onshore substations and National Grid infrastructure (***Appendix 20.3 Flood Risk***

Assessment (APP-496)); however, this does not mean that flooding has not occurred in the past.

45. The National Grid substation, National Grid Construction Consolidation Site (CCS), cable sealing end compounds and permanent substation operational access road are located in an area with varying risk of surface water flooding. The northern and western boundary around the National Grid substation, including the cable sealing end compounds, and part of the footprint of the National Grid substation, includes areas at both high risk of surface water flooding (i.e. greater than 1 in 30 annual probability of surface water flooding) and medium risk of surface water flooding (i.e. between 1 in 100 and 1 in 30 annual probability of surface water flooding). This flood risk is associated with the drainage of surface water from the north in proximity to Little Moor Farm.

46. The onshore substations and onshore substations CCS are located in areas primarily at very low risk of surface water flooding (i.e. land with less than 1 in 1,000 annual probability of surface water flooding).

47. As part of the onshore substations and National Grid infrastructure a permanent substation operational access road will be built, to serve the onshore substations and National Grid infrastructure. In addition, permanent access tracks to the cable sealing end compounds will be built to the north of the National Grid substation. Parts of the substation operational access road is likely to cross areas at both high risk of surface water flooding (i.e. greater than 1 in 30 annual probability of surface water flooding) and medium risk of surface water flooding (i.e. between 1 in 100 and 1 in 30 annual probability of surface water flooding) (***Figure 20.3.3*** of ***Appendix 20.3 Flood Risk Assessment*** (APP-496), included in this document as ***Figure 4***).

48. The surface water flood risk extends downstream to Friston, where there have been several reports of historical flooding, as provided by local residents. Flood incident records as recorded by the LLFA (received by the Applicant in July 2018) are reported as having a low priority and are generally located along the B1121 Saxmundham Road (***section 20.4.3.6*** of ***Appendix 20.3 Flood Risk Assessment*** (APP-496)). Subsequent information received from the LLFA (19th November 2019) has indicated that more recent surface water flooding events (occurring in October 2019) has affected the area around Friston.

49. There is a known (variable) risk associated with surface water flooding in proximity to the onshore substation and National Grid infrastructure, as discussed further in ***section 52***.

3.6.1 Historic Rainfall and Flooding Events

3.6.1.1 Onshore Substations and National Grid Substation

50. The Product 4 data package (Annex 1 of ***Appendix 20.3 Flood Risk Assessment***) obtained from the Environment Agency does not indicate any records of flooding in the location of the onshore substations or the National Grid infrastructure. The Environment Agency indicate, in their Product 4 data package, that although there are no records of flooding, this does not mean that it has not been subject to flooding, only that no flooding has been reported to them in this location.

51. Information contained within the Level 1 SFRA (WDC and SCDC, 2018) does not show historic flooding to have affected the onshore substation or the National Grid infrastructure location.

52. Within the Level 1 SFRA flood incidents related to foul or surface sewers, groundwater, highways drainage, surface water and other sources were identified. A review of the Level 1 SFRA indicates reports of highway drainage issues in the vicinity of Friston; however, this is outside the area identified for the onshore substation and National Grid infrastructure.

3.6.1.2 Friston

53. SCC appointed British Maritime Technology (BMT) Group Limited in 2019 to undertake an assessment of surface water flood risk in Friston, Suffolk (BMT, 2020). BMT produced a hydrological model with the purpose of assessing both the current and potential future flood risk from surface water including for the impact of climate change.

54. The Friston Surface Water Study Technical Report produced by BMT Group Limited (2020) notes that the village of Friston has a well-documented history of surface water flooding through anecdotal evidence as well as reported incidents, the most recent significant event occurring in October 2019. On 6th October 2019, a storm event triggered large amounts of surface water runoff from both the upstream catchment through Friston, as well as from surrounding fields which drain toward the village centre and the Friston River which flows North-South, in and out of culvert along Low Road, Friston.

55. The observed event was well documented, with significant flow observed running along Grove Road, Aldeburgh Road, Saxmundham Road and Low Road.

56. The model was informed by rainfall data which was supplied from the Thorpeness rainfall gauge which is 5km from Friston.

3.6.1.3 Return Period of October 2019 Event

57. The modelling carried out by BMT on behalf of SCC was assessed against a number of theoretical return period rainfall events and for a variety of different

storm durations. The modelling report by BMT (BMT, 2020) does not appear to have carried out a detailed rainfall analysis or provided a conclusion on the return period for the October 2019 rainfall event. SCC indicated via email (25th September 2020) that the return period for this rainfall event was equivalent to approximately a 1 in 42-year event. Rainfall information or data related to this event, where available, will be reviewed during the detailed drainage design to understand any potential implications for the onshore substation and National Grid infrastructure.

58. No other flooding events with accompanying rainfall data have been identified to understand the significance of key return period events in the area.

3.7 Existing Hydrological and Hydrogeological Context

59. Regionally, the principal groundwater body underlying the onshore development area is the Waveney and East Suffolk Chalk and Crag. WFD classification data (Environment Agency 2016) demonstrate that groundwater is under pressure from abstractions of groundwater and connected surface waters for arable agricultural uses, and from diffuse source pollution from livestock farming. Saline intrusion is not considered to be an issue, as adverse effects on groundwater-dependent terrestrial ecosystems and surface water bodies are not reported.

3.7.1 Existing Friston Catchment

60. The BMT (2020) report notes that the upper reaches of the Friston catchment consist of mainly arable land, with a number of large fields constituting most of the land cover. It also notes that the Friston River drains a catchment area of approximately 11km^2 to the southeast of Saxmundham via an open channel which is culverted in parts before flowing in open channel to its confluence with the tidal River Alde.

61. The upstream catchment collects surface water flow before draining into a box culvert which runs the majority of Low Road (Figure 1-3 of BMT (2020)). Roughly two thirds of the way along Low Road, the watercourse re-emerges into an open channel which is subject to extensive vegetation growth. Downstream of Friston village, adjacent to a pig farm is a flood storage area and downstream of this the channel widens and becomes much flatter with shallower gradients leading to the confluence with the River Alde.

3.7.2 Existing Ground Conditions

62. The existing ground conditions at the onshore substations and National Grid infrastructure location are described in ***section 3.5*** above and are located within an area shown as having a “limited potential for groundwater flooding to occur” (WDC and SCDC 2018). This is supported by the BMT (2020) report which suggests that soil types present in the upper catchment are very permeable, with many perforated pipes used to drain the soils, all of which contribute flow to the

field drainage ditches and feed the lower catchment. The superficial geology is glacial till and eroded fluvial deposits. The upper catchment is predominately made up of clay soils. In the village the soils become sandier.

63. The final Operational Drainage Management Plan will be produced to include details of the scope and extent of the soil surveys (as part of the surveys described under ***section 3.4***) required to validate the existing conditions.

3.7.3 Background to Catchment Hydraulic Modelling

64. Within the Friston Surface Water Study Technical Report (BMT Group Limited, 2020) report it was noted that previously 1D-2D hydraulic modelling of the Friston Catchment was carried out by Jeremy Benn Associates Consulting, on behalf of the Environment Agency, for a wider flood risk mapping study and the results summarised in the report Essex, Norfolk and Suffolk Survey and Model Build: Friston River, (JBA Consulting, November 2016). However, it is noted that the JBA model does not extend further north than Church Road, and therefore does not reflect the entire hydrological catchment or include the proposed area for the onshore substations and National Grid infrastructure.

65. Subsequently BMT developed a 2D model to investigate surface water runoff in the Friston catchment and the flooding to Friston in October 2019. The results of this modelling will be considered to inform the drainage design for the onshore substations and National Grid infrastructure.

66. The final Operational Drainage Management Plan will be produced to include details of the scope and extent of the catchment hydraulic model required to validate the existing conditions, informed by the surveys to be undertaken and described in ***section 3*** of this document.

3.7.4 Presence of Existing Gauges in the Catchment (Rainfall and Flow)

67. Rain gauges are located at Thorpeness which is located 5km east from the Friston catchment and Woodbridge which is located approximately 6km northeast of Friston.

68. For the Friston Surface Water Study (BMT, 2020), BMT noted that antecedent rainfall was not included within the Thorpeness data pack, which is a key requirement to calculate the initial soil moisture of the catchment leading up to rainfall events. To determine this for the rainfall event of 6th October 2019, the previous 12 months of rainfall data leading up to the event was obtained from the Woodbridge Rain Gauge.

69. Due to the nature of the flood risk in the catchment there are no flow or level gauges that would be beneficial to understanding the surface water flood risk in the upper Friston catchment.

3.8 Existing Infiltration Potential

70. The final Operational Drainage Management Plan will be produced to include details of the scope and extent of soil surveys required to determine the existing infiltration potential of the soils within the catchment.

3.9 Existing Run-Off Rate to Friston Watercourse

71. The existing pre-development greenfield runoff rates from the onshore substations and National Grid infrastructure location, used to inform the concept design of the ***Outline Landscape Mitigation Plan General Arrangement*** (~~APP-401) (~~updated version submitted at Deadline ~~3 as~~4, document reference ~~8.7),~~ExA.AS-14.D4.V1) , are summarised in ***Table 3.3*** below.

72. Runoff rates in ***Table 3.3*** below are expressed under two methods. The first is based on the Flood Estimation Handbook (FEH) produced by the UK Centre for Ecology and Hydrology. The second is 'IH124' which was developed by the Institute of Hydrology[3]. Although shown to be slightly less accurate than more recent FEH based methods, the IH124 method is still considered to be an acceptable approach for assessing greenfield runoff rates. The Applicant has provided runoff rates under both methods as requested by the Councils.

73. Existing runoff from the onshore substations and National Grid infrastructure will flow overland and into adjacent field drains with some of the water making its way through the catchment to the Friston watercourse.

[3] https://www.uksuds.com/FAQRetrieve.aspx?ID=55033

Table 3.3 Pre-Development Run-Off Rates (comparison of IH124 and FEH methods)

Design Parameters / Assumptions	Onshore Substations IH124 (Total) (l/s)	Onshore Substations FEH (Total) (l/s)	National Grid Infrastructure IH124 (Total) (l/s)	National Grid Infrastructure FEH (Total) (l/s)
2 l/s/ha	17.~~2~~78		12.9	
1 Year Return	~~19.55~~18.01	6.~~88~~34	13.05	4.59
2 Year Return (Q_{BAR})[4]	**~~22.47~~20.70**	**7.~~91~~29**	**15.00**	**5.28**
30 Year Return	~~55.06~~50.73	~~19.38~~17.85	36.75	12.93
100 Year Return	~~80.01~~73.71	~~28.16~~25.94	53.40	18.8
200 Year Return	~~94.62~~87.16	~~33.3~~30.683	63.16	22.23

[4] Discharge from the onshore substation and National Grid infrastructure would be limited to the Q_{BAR} rate currently calculated as above~~.~~ but which will be confirmed during the detailed design stage. Q_{BAR} is the peak rate of flow from a catchment for the mean annual flood.

4 Sustainable Drainage Principles for the Projects

4.1 Overview

74. The drainage strategy for the final Operational Drainage Management Plan will be developed according to the principles of SCC's sustainable drainage system (SuDS) discharge hierarchy and LFRMS (SCC, 2016) as follows:

i. into the ground (infiltration);

ii. to a surface water body;

iii. to a surface water sewer, highway drain or another drainage system; or

iv. to a combined sewer.

75. The Applicants note that the application of the SuDS hierarchy is an iterative process dependent on site-specific conditions to identify an optimal drainage solution.

~~75.~~76. The surface water drainage strategy adopted for the Projects will incorporate both infiltration and attenuation prior to discharge to a surface water body. In utilising a combination of infiltration and controlled surface water discharge, reduced surface water flows will be routed to the surface water body than would otherwise occur and groundwater recharge will occur. Connection to the surface water body (i.e. Friston watercourse) allows for design flexibility which will be influenced by pre-construction infiltration testing, detailed design of the onshore substations, National Grid infrastructure and the operational surface water drainage system itself.

4.2 Infiltration

~~76.~~77. Infiltration refers to allowing or encouraging water to soak into the ground, through the natural hydrologic processes. This is normally the most desirable solution for disposal of surface water from rainfall (and is the first principle of SCC's SuDS discharge hierarchy) as it does not create any additional runoff and contributes directly to the recharge of the underlying groundwater.

~~77.~~78. Pre-construction ground investigations of the onshore substations and National Grid infrastructure ground conditions will be undertaken and will inform the detailed design of the Projects and the final Operational Drainage Management Plan. As part of these investigations, percolation tests will determine the underlying permeability and the feasibility to dispose of surface water directly to ground or other engineered filtration systems, and to what degree.

4.3 Attenuation

~~78.~~79. Attenuation storage controls the rate of runoff by limiting the peak flow from the development into the receiving watercourse or drainage system. This is typically achieved through the use of a temporary storage facility, with a restricted outlet. The attenuation is sufficiently sized to detain the runoff for a given return period, but will then allow the water to discharge, at a controlled rate, back to the receiving watercourse (in this case the Friston watercourse), over an extended period.

~~79.~~80. Changes in surface water runoff as a result of the increase in impermeable area from the onshore substations and National Grid infrastructure will be attenuated and discharged at a controlled rate. Requirements relating to attenuation and discharge rates will be established in line with the principles set out in this Outline Operational Drainage Management Plan and agreed in consultation with the LLFA (SCC) and Environment Agency.

~~80.~~81. For the onshore substations and National Grid infrastructure, the storage will be designed to accommodate runoff from a 1 in 100 year[5] storm event plus a 20% additional allowance for climate change. These measures will limit the runoff to the equivalent of the pre-~~existing~~development greenfield~~ (undeveloped)~~ runoff rate (see ***Table***) (established by the methodology within this Outline Operational Drainage Management Plan and which will be subject to review on detail design of the Projects as discussed in paragraph 5 above) and not increasing risk of flooding downstream of the discharge.

~~81.~~82. A sensitivity check will be carried out for a 1 in 100 year storm event with a 40% allowance for climate change to ensure there is no off-site flooding for this storm event.

~~82.~~83. Whilst the site is operational, drainage from the substation operational access road will continue to be managed and attenuated via the National Grid basin.

4.4 Conveyance

~~83.~~84. Conveyance is the process of transferring surface runoff from one place to another to manage the flow and to link the various SuDS components together. Rainfall collected in impermeable areas such as the substation operational access road or roofs, will where possible be conveyed utilising SuDS methods (such as swales). In areas where this is not feasible, rainfall will be carried via underground pipes within the drainage system to the various elements of the

[5] For clarity the '1 in 200' rate from the ES and FRA is comparable to 1 in 100yr + 20% for climate change.

SuDS system to allow attenuation to take place. Similarly, perforated filter drains will collect water percolating through permeable areas and convey the same to the SuDS attenuation features.

4.5 Pollutant Removal

~~84.~~85. Precautionary measures will be incorporated within the surface water and foul water design to ensure that in the unlikely event of pollutants entering the surface water system from the onshore substations or National Grid infrastructure, these will either be removed or suitably treated prior to discharge, to ensure there is no wider adverse environmental impact. A review of the pollutant removal measures will be carried out in accordance with CIRIA C753 SuDS Manual (CIRIA, 2015). Further details will be set out in the final Operational Drainage Management Plan. The approach adopted will identify and consider the source and types of pollutants that may occur in the surface and waste waters and show how these will be managed to prevent pollution of the receiving watercourses.

~~85.~~86. The normal surface water drainage is unlikely to contain elevated suspended solids, or other pollutants, in the operational phase but the drainage design includes the provision to detain and therefore aid in the settlement of any solids in the SuDS basins. The requirements for the management of foul or waste water is further described in ***section 7*** below.

~~86.~~87. In the operational phase, surface water collected from within the transformer bunds, or other oil-filled plant, has the potential to contain oil residues. Water from these areas will be discharged to the surface water drainage system, only after passing through a Class 1 full retention oil interceptor, provided with an oil detection and automatic device which will prevent any discharge in the case of a sudden unexpected influx of oil.

5 Surface Water Drainage

~~87.~~88. This section presents the indicative assumptions for calculating runoff rates and volumes (***section 1.1***), an overview of SuDS system components (***section 5.2***) and the methodology for calculating infiltration rates (***section 5.3***).

~~5.1 Runoff Rates and Volumes~~

5.1 Onshore Substation and National Grid Infrastructure Footprints

~~88.~~89. The onshore substations and National Grid infrastructure worst case concept design adopted to inform the ***Outline Landscape Mitigation Plan General Arrangement*** (~~APP-401) (~~updated ~~and~~version submitted at Deadline ~~3 as~~4, document reference ~~8.7~~ExA.AS-14.D4.V1), is summarised in ***Table 5.1*** below. The Applicant considers these design parameters presented to be appropriate for the pre-design stage and will refine the parameters further on detailed design of the Projects.

Table 5.1 Onshore Substations ~~Location Design Parameters~~and National Grid Infrastructure Footprints (all assumed to be 100% impermeable)

Equipment	East Anglia TWO (m²)	East Anglia ONE North (m²)	National Grid Infrastructure (m²)
Overall substation operational footprint	~~36,100~~ ~~*(100% impermeable)*~~32,300	~~36,100~~ ~~*(100% impermeable)*~~32,300	44,950 ~~(100% impermeable)~~
Operational access road	13,600 ~~*(100% impermeable)*~~		N/A
Overal cable sealing end compounds and cable sealing end with circuit breaker compound operational footprint	N/A		10,000 ~~*(100% impermeable)*~~
Permanent access road to sealing end compound	N/A		1,850 ~~*(100% impermeable)*~~
SuDS Basin Footprint (including perimeter access track)	10,710 ~~*(100% impermeable)*~~		7,620 ~~*(100% impermeable)*~~
Total impermeable area	~~**96,510**~~**88,910**		**64,420**

~~89.~~90. The impermeable area of each component will be further refined as the detail design process progresses post consent, and the figures in the above table will be updated accordingly. Runoff rates and volumes for the onshore substations and National Grid infrastructure will be calculated based on these final design parameters and assumptions and presented within the final Operational Drainage Management Plan.

5.2 Sustainable Drainage System Components

~~90.~~91. The existing topography of the onshore substations and National Grid infrastructure is located on naturally sloping land, with gradients falling away towards the field drains to the west and south west of the site, so the natural surface water flows in these general directions. The surface water drainage system will be designed to utilise and support this natural change in elevation.

~~91.~~92. The overall drainage layout will be produced in the final Operational Drainage Management Plan following detailed design post-consent; the key components of this are described below.

5.2.1 Substation Operational Access Road

~~92.~~93. As part of the onshore substations and National Grid infrastructure a permanent substation operational access road will be built to connect Saxmundham Road to the onshore substations and National Grid infrastructure. Parts of the substation operational access road are likely to cross areas at both high risk of surface water flooding (i.e. greater than 1 in 30 annual probability of surface water flooding) and medium risk of surface water flooding (i.e. between 1 in 100 and 1 in 30 annual probability of surface water flooding). For the purposes of the current concept design and assessment it has been assumed that the substation operational access road is 100% impermeable.

5.2.2 SuDS Detention / Infiltration Basins

~~93.~~94. SuDS detention / infiltration basins (provided as part of the SuDS) will be included at the onshore substations and National Grid infrastructure in the overall drainage layout following the detailed design of the Projects, collation of existing ground conditions data (***section 3***), the production of a catchment hydraulic model (***section 3.6.3***) and agreement through consultation with the LLFA (SCC) of an appropriate infiltration rate and discharge rate into the Friston watercourse as necessary (***section 5.3***).

~~94.~~95. In addition, the Applicant retains the option to install further attenuation measures along the existing surface water flow route during the detailed design phase to reduce water in-flow rates to the onshore substation and National Grid infrastructure area and potentially reduce flood risk for the village of Friston, in addition to the surface water drainage strategy currently proposed.

95.96. The specifications of this additional 'surface water management SuDS basin' will require development of an appropriate catchment hydraulic model. The detailed design of the onshore substations and National Grid infrastructure will include the size, volume and location of this basin.

5.2.3 Outfall Pipe

96.97. A new outfall pipe will be installed to manage runoff from the onshore substations and National Grid infrastructure to the existing Friston watercourse in the vicinity of Church Lane.

97.98. It will be necessary to connect this pipe into the Friston watercourse via a new connection and associated underground structure.

5.3 Infiltration Rate or Discharge Rate to the Friston Watercourse

98.99. The infiltration rate or discharge rate to the Friston watercourse will be calculated based on the results of site specific geotechnical and infiltration surveys (as per ***section 3.4***. The acceptable discharge rate will be informed by the engineering design work during the detailed design of the Projects; collation of existing condition data (***section 3***); and the production of a catchment hydraulic model (***section 3.6.3***). This will be agreed in consultation with the LLFA (SCC) and included as part of the design presented within the final Operational Drainage Management Plan. Please see ***section 6*** for further details regarding the ability of the proposed SuDS design to accommodate a reduced discharge rate (<7.29l/s and 5.28l/s for the onshore substations and National Grid substation respectively).

5.4 Maintenance

99.100. Maintenance of the onshore substations and National Grid infrastructure drainage systems (to the point of connection to the Friston watercourse) will be the responsibility of the site operator during the operational phase of the Projects (until the site is decommissioned).

100.101. The SuDS facilities will be included in a routine maintenance schedule carried out for the onshore substations and National Grid infrastructure, along with the landscape maintenance as described in the ***Outline Landscape and Ecological Management Strategy*** (APP-584) (updated andversion submitted at Deadline 3 as4, document reference 8.7ExA.AS-14.D4.V1) to ensure they remain in effective operation. This will include checking of the various inlets and outfalls and the occasional cutting and removal of the vegetative growth on the inner slopes of any basins and swales and appropriate maintenance of any trees in the wet woodland area of the basins.

101.102. The maintenance schedule for the various surface water features will be included in the final Operational Drainage Management Plan.

5.5 Ordinary Watercourse Consent

~~102.~~103. Land Drainage Consent associated with temporary and permanent works at the Projects' and NG onshore substations would be applied for separately to Land Drainage Consent for temporary construction works along the onshore cable route. An application for Land Drainage Consent in respect of the onshore substations and National Grid infrastructure works will be submitted to the LLFA post-consent and will include details of the measures to be implemented in relation to any affected Ordinary Watercourses.

6 Ability to Accommodate Reduced Discharge Rate

104. As discussed above, the SuDS basin will be designed to provide attenuation and a controlled onward flow, limiting the outfall discharge rates to that of the pre-development greenfield run off rate. This is designed to ensure there is no detrimental impact on the receiving watercourse as a result of increased storm related flows from the development of the onshore substations and National Grid infrastructure and the introduction of an increased impermeable area.

105. The existing greenfield run off rate will be confirmed during the detailed design stage in line with this Outline Operational Drainage Management Plan.

106. For the purpose of establishing a realistic indicative SuDS attenuation basin design and existing greenfield run off rate, in compliance with the relevant guidelines set out in ***section 2*** of this document, the Applicants have assessed the storage requirements based on the footprints outlined in ***section 5.1***.

107. As demonstrated by the design assumptions in ***Appendix 2***: SUDS Design Summary Assumptions, these attenuation storage requirements as summarised in ***Table 6.1*** below would allow the discharge rate to be limited to the Q_{BAR} pre-development greenfield runoff rate of 7.29l/s and 5.28l/s for the onshore substations and the National Grid substation respectively. These runoff rates would be adopted for discharge to the Friston Watercourse.

Table 6.1 Attenuation storage basin components and volumes. Note figures presented for EA2 and EA1N substations are total combined.

Attenuation storage basins	East Anglia TWO (m^3)	East Anglia ONE North (m^3)	National Grid Infrastructure (m^3)
Design	5,928		4,070
Freeboard	2,712		1,886
Perimeter Access Track	1,030		709
Total storage volume required (inc. Freeboard and access track)	**9,670**		**6,664**

108. The storage volume required for the onshore substations' basin and National Grid infrastructure basin is 9,670m^3 and 6,664m^3 respectively. This will have footprints of 11,280m^2 and 7,668m^2 respectively (see ***Appendix 2: SUDS Design Summary Assumptions***).

109. Should the abovementioned Q_{BAR} rates reduce as a result establishing the actual Q_{BAR} rate during the detailed design process (i.e. with reference to the results of detailed hydrological modelling), the discharge rate to the Friston Watercourse would be reduced by the Applicants accordingly. This would require an increase in capacity of the SuDS attenuation basins.

110. ***Table 6.2*** and ***Table*** 6.3 below demonstrate that larger storage basins can be accommodated within the Order Limits and in conjunction with the ***Outline Landscape Mitigation Plan*** (an updated version has been submitted at Deadline 4, document reference ExA.AS-14.D4.V1)should this be required.

Table 6.2 Onshore Substations Q_{BAR} flexibility, storage requirements and Order Limit capacity

Discharge Rate (l/s)	Storage Requirement (m³)	Minimum Storage Increase Required (m³)	Storage Capacity in Existing Outline Basin Design?	Accomodated within Order Limits?
7.5	8,930	n/a	Y	Y
7.3 (Q_{BAR})	**8,954**		**Y**	**Y**
7.0	8,989		Y	Y
6.5	9,050		Y	Y
6.0	9,111		Y	Y
5.5	9,174		Y	Y
5.0	9,263		Y	Y
4.5	9,357		Y	Y
4.0	9,453		Y	Y
3.5	9,561		Y	Y

Table 6.3 National Grid Substation Q_{BAR} flexibility, storage requirements and Order Limit capacity

Discharge Rate (l/s)	Storage Requirement (m³)	Minimum Storage Increase Required (m³)	Within Existing Outline Basin Design?	Accomodated within Order Limits?
5.5	6,439	n/a	Y	Y
5.3 (Q_{BAR})	**6,463**		**Y**	**Y**
5.0	6,501		Y	Y
4.5	6,564		Y	Y
4.0	6,628		Y	Y
3.5	6,717	52	Requires increase original base area by 35m²	Y
3.0	6,818	153	Requires increase original base area by 110m²	Y
2.5	6,933	268	Requires increase original base area by 210m²	Y

~~6~~7 Foul Water Drainage

~~6.1~~7.1 Introduction

~~103.~~111. The waste waters produced by the onshore substations and National Grid substation in their operational phase comprise the foul water from the welfare facilities. A sustainable approach will be adopted, which is considered appropriate for each type of wastewater and so is in line with the overall drainage strategy. It is noted that foul water drainage is not a matter for the LLFA but is included within this Outline Operational Drainage Management Plan for completeness. The final Operational Drainage Management Plan will confirm the foul water drainage solution adopted.

~~6.2~~7.2 Onshore Substations and National Grid Substation Foul Water

~~104.~~112. As a first preference, foul drainage at the onshore substations and National Grid substation will be collected through a mains connection to the existing ~~Local Authority~~ sewer system (where a suitable connection is available) or collected in a septic tank located within the onshore development area and periodically transported off site for disposal at a licensed facility. It is acknowledged that the use of a septic tank may not be appropriate at some locations, and that alternative options would be considered in consultation with the Environment Agency if mains collections are not achievable.

~~105.~~113. Site surveys will inform the approach to be taken for the management of foul water. Subject to permeability, foul water from the onshore substations and National Grid substation will be collected via a piped drainage system and conveyed to be held in a sealed cess tank. Alternatively, a septic tank and soakaway system could be considered if practicable. The location of the building drainage system and cess tank will be confirmed at the detailed design stage and in the final plan.

~~106.~~114. If foul water cannot be discharged on site, the cess tank will be designed to have sufficient storage capacity to contain the wastewater generated by the welfare facilities, for a minimum period of three months, sized to minimise the frequency of emptying required. A tank with a capacity to accommodate 8.3m^3 would be sufficient for this period, allowing for a 20% factor of safety. The cess tank will also be fitted with a monitoring device and high-level alarm system to alert maintenance staff to the need for emptying. The cess tank will be situated adjacent to the substation operational access road near the substation entrance to provide ease of access for a tanker for the routine emptying of contents and their disposal to a suitably licenced waste water treatment and disposal facility.

~~6.3~~7.3 Maintenance

~~107.~~115. The equipment provided to treat the foul and wastewater from the onshore substations and National Grid substation will be included in routine maintenance schedules to ensure they remain fully effective. This would include the routine emptying (if required) and maintenance of the cess tank to remove sewage from site and regular checks on the oil interceptors, auto shut valves, sensors and alarms to ensure they are all functioning correctly. All maintenance activities shall also be recorded.

~~7~~8 Summary

~~108.~~116. This Outline Operational Drainage Management Plan identifies the different elements of the surface water and foul water arising from the operation of the onshore substations and National Grid infrastructure. In considering and outlining how these will be managed and controlled, it addresses the location of the development, the hydrology and hydrogeological setting and considers the ways in which the potential impacts of water from the onshore substations and National Grid infrastructure once operational will be minimised.

~~109.~~117. The overall strategy adopted must therefore be able to ensure that, through the introduction and implementation of suitable control measures, there will be no measurable impacts on the receiving water catchment.

~~110.~~118. An outline drainage scheme has been developed, using a combination of sustainable and conventional drainage to manage the various flows. The uncontaminated waters from roofs, hard standing (including the substation operational access road and water percolating through permeable construction (platform)) will be collected and routed to a detention basin. This basin will be designed to provide attenuation and a controlled onward flow, ~~holding the initial storm flush and then~~ limiting the outfall discharge rates to that of the pre-~~existing green fields~~development greenfield run off rate. This is designed to ensure there is no detrimental impact on the receiving watercourse as a result of increased storm related flows from the development of the onshore substations and National Grid infrastructure and the introduction of an increased area of impermeable drainage.

119. As presented in ***section 6***, there is flexibility in the outline attenuation design to accommodate a reduced Q_{BAR} rate and an increased storage capacity within the order limits if required. Note that this is for an attenuation only scheme. Ground investigations at the location of the onshore substations and National Grid infrastructure will be undertaken and will inform the final Operational Drainage Management Plan. Percolation tests will be undertaken as part of the detailed design process to determine the underlying permeability and the feasibility of a combined infiltration/attenuation SuDS design with a connection to the Friston watercourse.

~~111.~~120. Finally, the treatment and management of foul water is considered and outlined. As a first preference, foul drainage at the onshore substations and National Grid substation will be collected through a mains connection to the existing Local Authority sewer system. Alternatively, foul sewage will be contained in a sealed cess tank and tankered off-site for disposal, potentially with a soakaway system incorporated depending on ground permeability.

~~112.~~121. Additional sensors, auto shut valves and alarms will also be added to the drainage equipment installed as appropriate, to provide operators with a warning of any potential problem with pollution control equipment installed, to ensure they can take appropriate action. All equipment and the SuDS elements will be included in routine maintenance to ensure they remain fully effective.

~~8~~9 References

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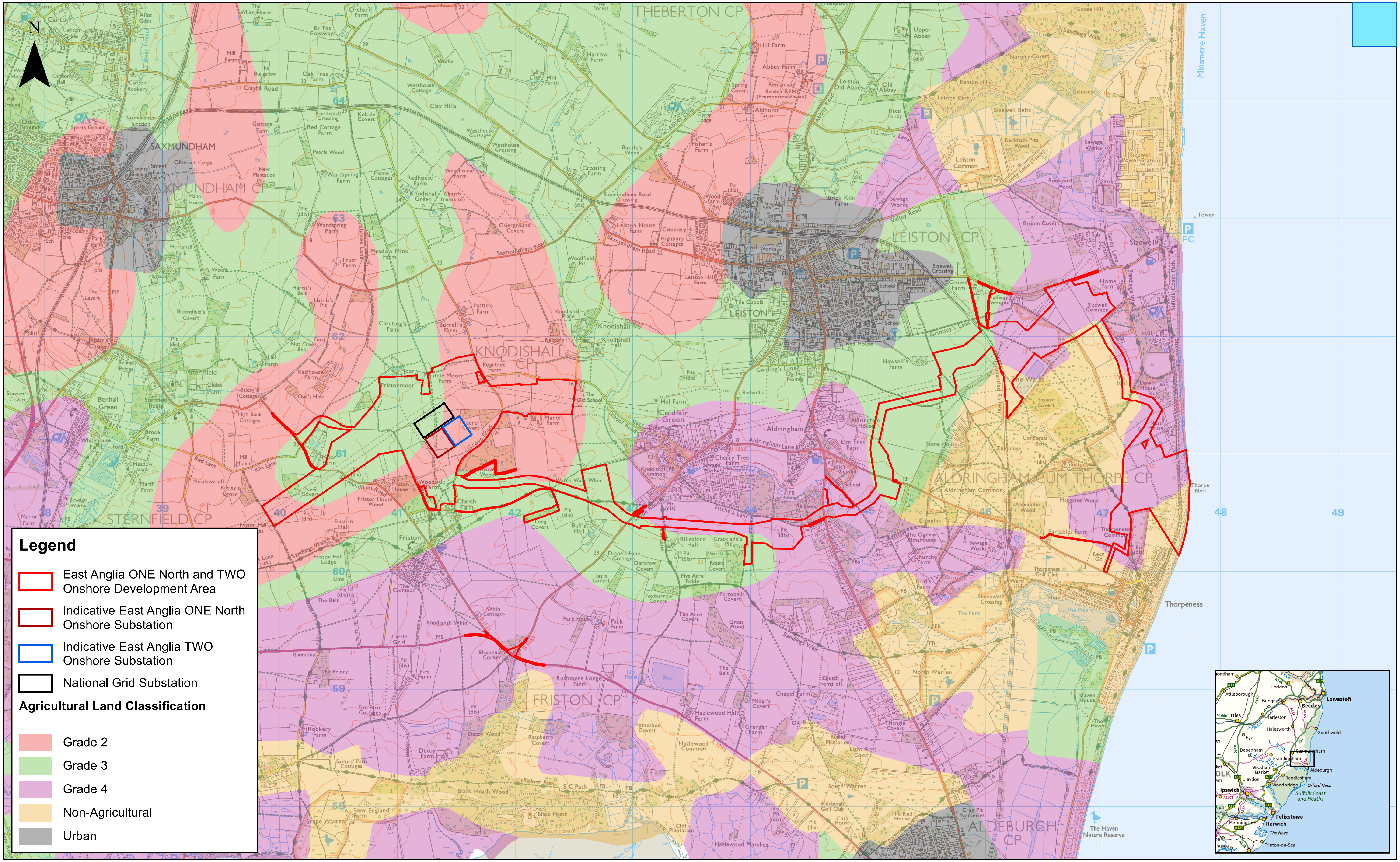
Appendix 1: Figures



SCOTTISHPOWER RENEWABLES

Rev	Date	By	Comment		
3	04/12/2020	AB	Third Issue.		
2	05/11/2020	AB	Second Issue.	Prepared:	AB
1	10/08/2020	AB	First Issue.	Checked:	TF
				Approved:	FM

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Scale @ A3

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East Anglia ONE North and TWO

Outline Operational Drainage Management Plan

Agricultural Land Classification

Drg No	EA1N-EA2-DEV-DRG-IBR-001128
Rev	3
Date	04/12/20
Figure	1

Coordinate System: BNG
Datum: OSGB36

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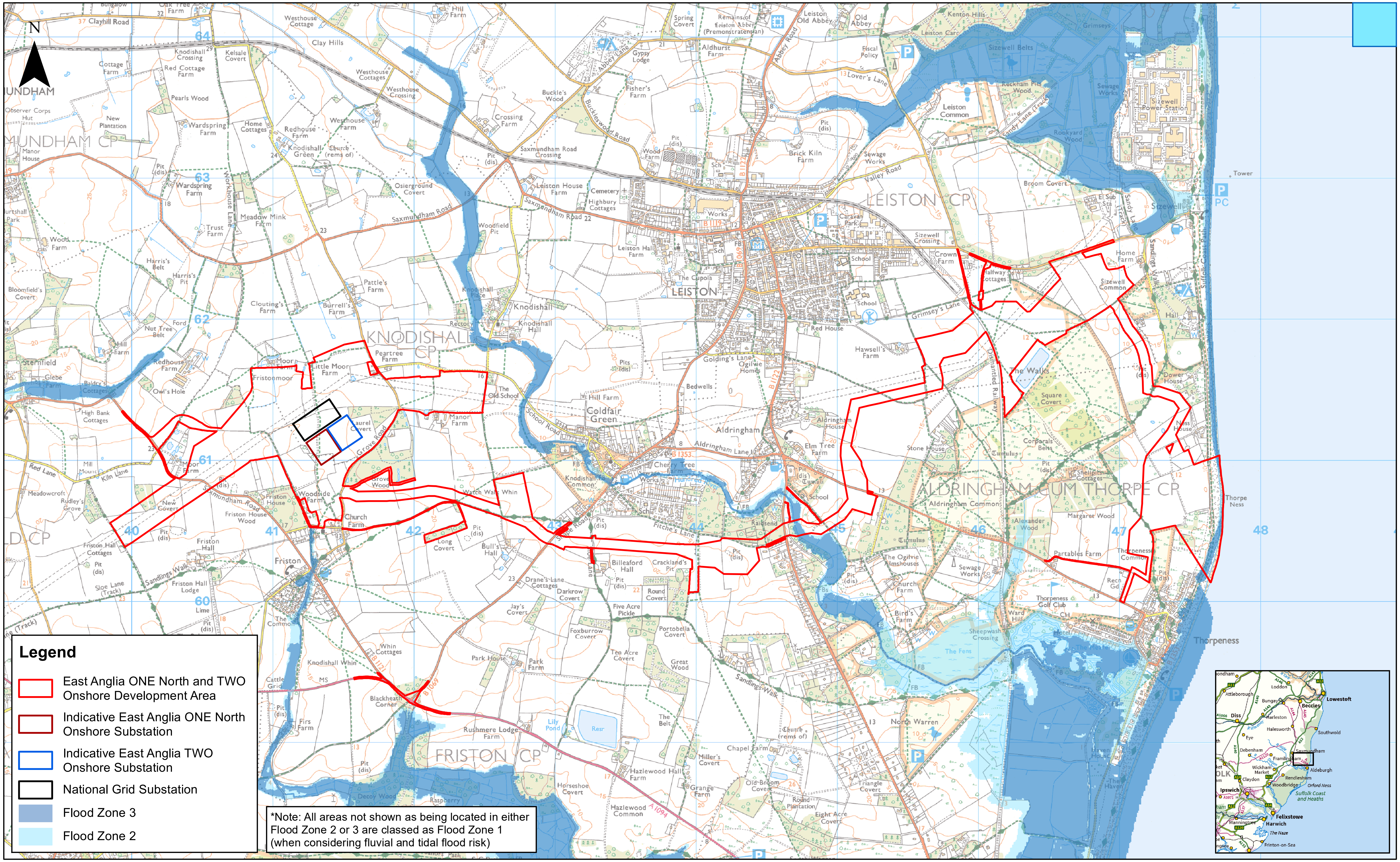

Rev	Date	By	Comment
3	04/12/2020	AB	Third Issue.
2	05/11/2020	AB	Second Issue.
1	10/08/2020	AB	First Issue.

Prepared: AB
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SCOTTISHPOWER RENEWABLES

East Anglia ONE North and TWO

Outline Operational Drainage Management Plan

Environment Agency Flood Zones

Drg No	EA1N-EA2-DEV-DRG-IBR-001129
Rev	3
Date	04/12/20
Figure	2

Coordinate System: BNG
Datum: OSGB36

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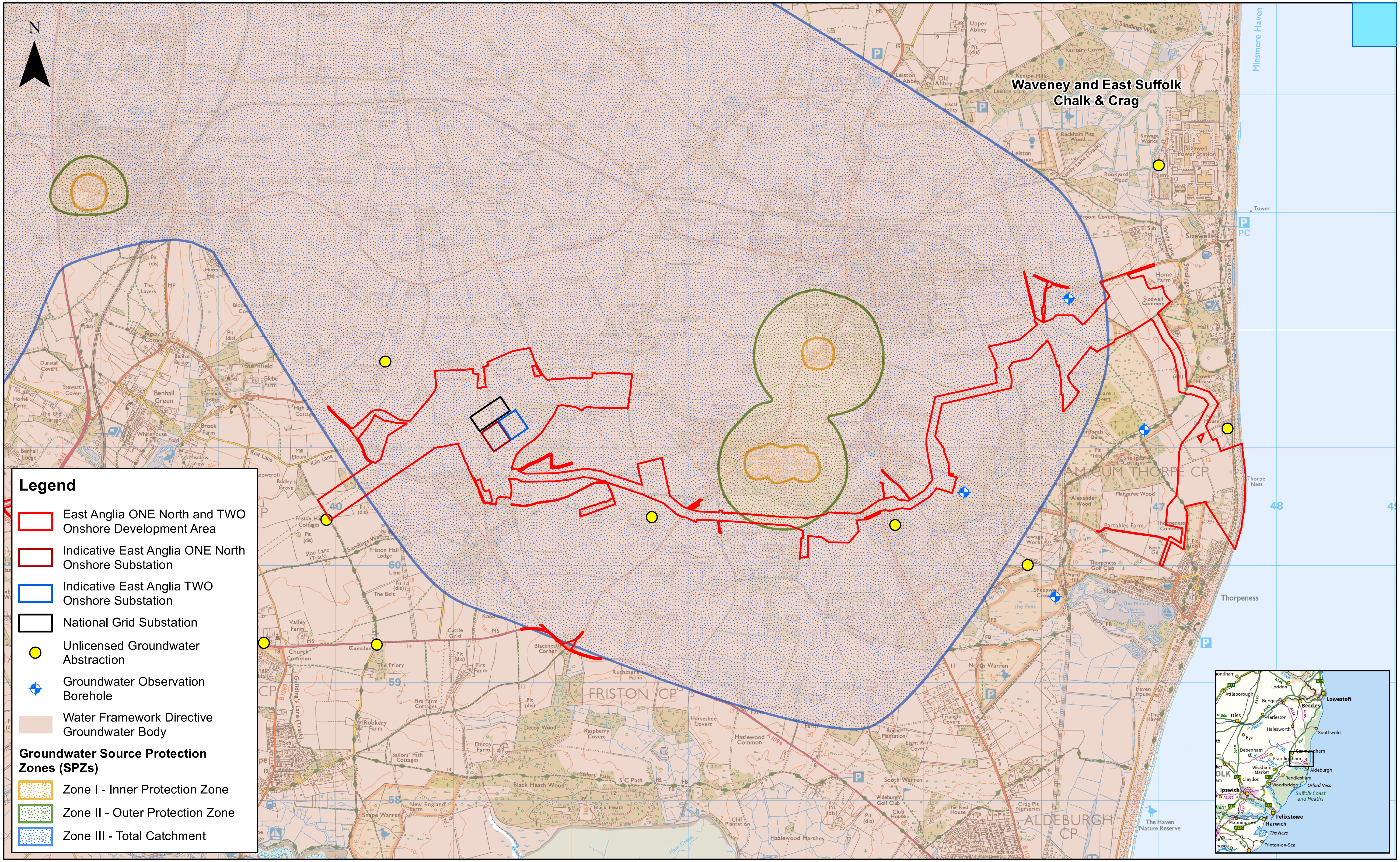

Rev	Date	By	Comment		
3	04/12/2020	AB	Third Issue.		
2	05/11/2020	AB	Second Issue.	Prepared:	AB
1	10/08/2020	AB	First Issue.	Checked:	TF
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SCOTTISHPOWER RENEWABLES

East Anglia ONE North and TWO

Outline Operational Drainage Management Plan

Groundwater Receptors

Drg No	EA1N-EA2-DEV-DRG-IBR-001130
Rev	3
Date	04/12/20
Figure	3

Coordinate System: BNG
Datum: OSGB36

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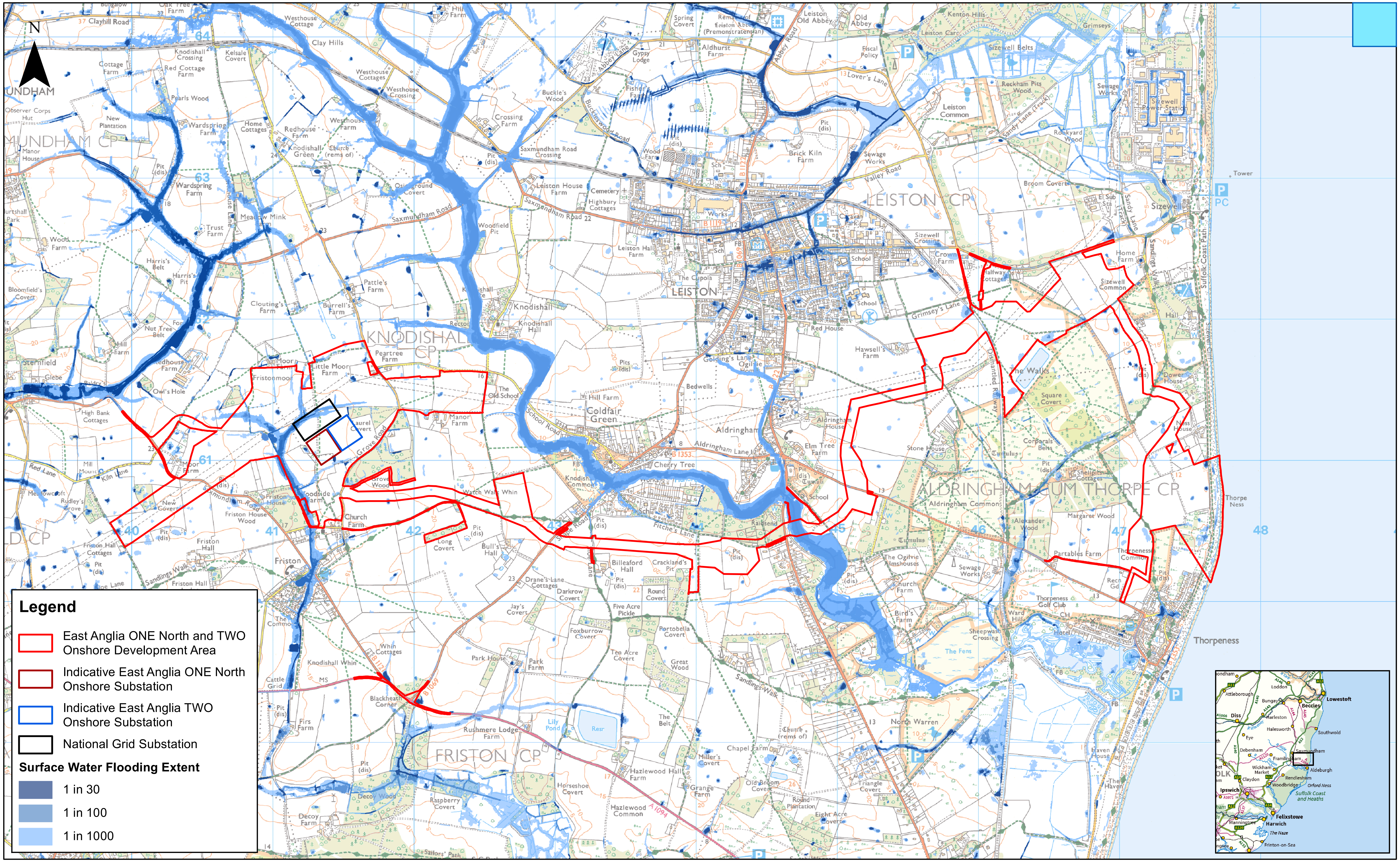

SCOTTISHPOWER RENEWABLES

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3	04/12/2020	AB	Third Issue.
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East Anglia ONE North and TWO

Outline Operational Drainage Management Plan

Surface Water Flood Risk

Drg No	EA1N-EA2-DEV-DRG-IBR-001133	
Rev	3	Coordinate System: BNG
Date	04/12/20	Datum: OSGB36
Figure	4	

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Appendix ~~A~~2: SUDS Design Summary Assumptions

SUDS Design Summary

Notes:

1. SUDS design proposal to attenuate surface water flows from hardstanding areas associated with EA2 and EA1N onshore substations and and National Grid substation (including access roads and cable sealing compounds).

2. Separate SUDS required for EA2/EA1N onshore substations and National Grid infrastructure.

3. EA2 and EA1N onshore substations and access roads discharge to SUDS Basin with outfall to existing ditch in Church Lane at pre-development run-off rate. To mimic existing drainage regime and achieve no net increase in flows to receiving watercourse.

4. National Grid substation and sealing end compounds discharge to SUDS Basin with outfall to existing ditch in field at pre-development run-off rate. To mimic existing drainage regime and achieve no net increase in flows to receiving watercourse.

5. SUDS design undertaken in line with national and local guidance set out in The SUDS Manual (C753) & Suffolk County Council Sustainable Drainage Systems (SUDS) a Local Design Guide.

6. Pre Development discharge rates estimated using HR Wallingford Greenfield Runoff Rate Estimation Online Tool.

7. SUDS sizing estimated using FSR Rainfall and Micro Drainage design software.

8. Additional SUDS to be provided as source control / treatment during detailed design.

Design Parameters / Assumptions	**EA2**	**EA1N**	**National Grid**		**Change Notes**
Hardstanding (all footprints assumed 100% impermeable)					01.12.20 Updated with areas of SUDS basin footprint (including perimeter access tracks) - original total in brackets. 05.01.21 Reduced project substation footprints from 36,100m² to 32,300m² for each substation (previous total 96,510m²).
Substation operational footprint	32,300 m²	32,300 m²	44,950 m²		
Operational access road	13,600 m²		-		
Cable sealing end compound operational footprint	-		10,000 m²		
Permanent access road to sealing end compound	-		1,850 m²		
SUDS Basin Footprint (including perimeter access track)	10,710 m²		7,620 m²		
Total	**88,910 (85,800) m²**		**64,420 (56,800) m²**		
Pre-Development Run-Off Rates (calculated from HR Wallingford Greenfield Runoff Rate Estimation Online Tool)					01.12.20 Updated to suit increased contribution areas as above (original figures in brackets) 05.01.21 Updated to suit reduced project subsation contribution areas as above (original figures in brackets)
2 l/s/ha	17.78 (17.2) l/s		12.9 (11.4) l/s		
	IH124	**FEH**	**IH124**	**FEH**	
1 Year Return	18.01 (17.38) l/s	6.34 (6.12) l/s	13.05 (11.51) l/s	4.59 (4.05) l/s	
2 Year Return (Q_{BAR})	20.70 (19.98) l/s	**7.29 (7.03) l/s**	15.00 (13.23) l/s	**5.28 (4.66) l/s**	
30 Year Return	50.73 (48.95) l/s	17.85 (17.23) l/s	36.75 (32.41) l/s	12.93 (11.4) l/s	
100 Year Return	73.71 (71.13) l/s	25.94 (25.03) l/s	53.40 (47.09) l/s	18.8 (16.57) l/s	
200 Year Return	87.16 (84.12) l/s	30.68 (29.6) l/s	63.16 (55.68) l/s	22.23 (19.60) l/s	
Unttenuated Flow Discharging to SUDS from Harstanding (calculated from FSR / FEH13 Rainfall using Micro Drainage design software)					01.12.20 Updated to suit increased contribution areas as above (original figures in brackets) 05.01.21 Updated to suit reduced project subsation contribution areas as above (original figures in brackets)
	FSR	**FEH13**	**FSR**	**FEH13**	
1 Year Return + 20% CC	49.4 (35.9) l/s	N/A	46.9 (31.8) l/s	N/A	
2 Year Return + 20% CC	66.6 (47.1) l/s	90.9 (56.4) l/s	62.8 (42.7) l/s	75.4 (50.3) l/s	
30 Year Return + 20% CC	172.9 (117.8) l/s	240.0 (141.3) l/s	165 (109.7) l/s	196.8 (129.5) l/s	
100 Year Return + 20% CC	264.0 (154.9) l/s	368.5 (197.9) l/s	251 (148.0) l/s	300.3 (163.0) l/s	
200 Year Return + 20% CC	336.7 (173.4) l/s	458.6 (270.8) l/s	320.2 (162.8) l/s	384.0 (232.7) l/s	
Attenuated Post Development Run-Off Rates	**Limited to pre-development (2-year FEH) run-off rate. Provides betterment over 2 l/s/ha rate and IH124 rate.**				No change
Pre / Post Development Reduction In Run-Off Rates (pre development rates minus attenuated post development rates)					01.12.20 Updated to suit increased contribution areas as above (original figures in brackets) 05.01.21 Updated to suit reduced project subsation contribution areas as above (original figures in brackets)
1 Year Return	N/A		N/A		
2 Year Return	83.61 (49.37) l/s		70.12 (45.64) l/s		
30 Year Return	232.71 (134.27) l/s		191.52 (124.84) l/s		
100 Year Return	361.21 (190.87) l/s		295.02 (158.34) l/s		
200 Year Return	451.31 (263.77) l/s		378.72 (228.04) l/s		
Design Storm Event	**1 in 100 year + 20% climate change as per SCC guidance.**				No change
Attenuation Storage Required (calculated from FSR / FEH13 Rainfall using Micro Drainage design software)					01.12.20 Updated to suit increased contribution areas as above (original figures in brackets) 05.01.21 Updated to suit reduced project subsation contribution areas as above (original figures in brackets)
	FSR	**FEH13**	**FSR**	**FEH13**	
All Hardstanding Areas	**7,185.1 (5,496.2) m³**	**8,954.4 (8,633.5) m³**	**5160.3 (4,579.7) m³**	**6,445.6 (5,702.9) m³**	
Attenuation Dimensions					01.12.20 Added areas for perimeter access track. Access track falls towards top of basin providing an additional 0.1m depth of storage.
Detention Basins					
Design Top area (0.7m Deep)	8,986 m²		6,237 m²		
Freeboard Top area (1m Deep)	9,329 m²		6,520 m²		
Perimeter access track top area (1.1m Deep)	11,280 m²		7,668 m²		
Base area	7,950 m²		5,390 m²		
Design storage depth	0.7 m		0.7 m		
Design freeboard + 0.3m (1.0m Deep)	0.3 m		0.3 m		
Overall depth	1 m		1 m		
Side slopes	1 in 4		1 in 4		
Attenuation Storage Provided					01.12.20 Added additional storage volume from perimter access track. Access track falls towards top of basin providing an additional 0.1m depth of storage.
Detention Basins					
Design	5,927.6 m³		4,069.5 m³		
Freeboard	2,711.9 m³		1,885.5 m³		
Perimeter access track	1,030.45 m³		709.40 m³		
Total (design)	**5,927.6 m³**		**4,069.5 m³**		
Total (inc. freeboard and access track)	**9,669.95 m³**		**6,664.4 m³**		
Design storage required < attenuation storage provided?	**YES = OK**	**YES = OK**	**YES = OK**	**YES = OK**	
Exceeedance Design Check	**1 in 100 year + 40% climate change. 40% sensitivity check as per SCC guidance.**				No change
Attenuation Storage Required (calculated from FSR / FEH13 Rainfall using Micro Drainage design software)					01.12.20 Updated to suit increased contribution areas as above (original figures in brackets) 05.01.21 Updated to suit reduced project subsation contribution areas as above (original figures in brackets)
	FSR	**FEH13**	**FSR**	**FEH13**	
All Hardstanding Areas	**8,570.9 (8,298.6) m³**	**11,374.1 (10,669.3) m³**	**6,162.0 (5,523.3) m³**	**7,599.8 (6,755.7) m³**	
Exceedence storage required < attenuation storage provided?	**YES = OK**	**NO = FLOOD**	**YES = OK**	**NO = FLOOD**	
Discharge Location	**Existing watercourse in Church Lane via new outfall pipe as per existing drainage regime. Provides additional betterment over existing arrangment by reducing flood flows down existing farm track.**		**Friston watercourse provides betterment over existing by attenuating flows from greater return period storms.**		**Exceedence flows will overspill basin and discharge to existing ditch / water course as per existing drainage regime.**