



**SCOTTISHPOWER  
RENEWABLES**

# 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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## Executive Summary

1. The primary Applicant has undertaken a tiered approach to selecting the most suitable Sustainable Drainage System (SuDS) scheme that to manage the Applicant is proposing for surface water at the onshore substations ~~substation and National Grid substation infrastructure site is an~~. The proposed solution has been informed by site specific testing of infiltration only rates. The key parameters of the outline design, if proved practicable. The secondary SuDS scheme that presented within this Outline Operational Drainage Management Plan (OODMP) have been agreed with the Lead Local Flood Authority (LLFA).
- 1.2. Based on this process, with the agreement of the LLFA, the Applicant is proposing is has selected a hybrid infiltration and attenuation design. The Applicant additionally proposes for the onshore substations which will be taken forward to the detailed design phase, and an attenuation only design for completeness. the National Grid infrastructure.
- 2.3. The consideration of all three of these schemes the SuDS solutions is in line with the SuDS drainage hierarchy in Chapter 3 of the CIRIA SuDS Manual (2015), and in line with Suffolk County Council's (SCC) (as Lead Local Flood Authority (LLFA)) SuDS drainage hierarchy.
- 3.4. East Suffolk Council also has two key policies (Policy SCLP9.5: Flood Risk; and Policy SCLP9.6: Sustainable Drainage Systems.11) which relate to flood risk and drainage. These have both been reviewed in the context of the Project and the Project is compliant.
4. ~~In the context of this Project, SuDS refers to infiltration or attenuation with a positive discharge to the Friston Watercourse.~~
5. The Applicant has committed to not increasing flooding to the Projects' infrastructure or to the village of Friston and is surpassing the design standards required as per the CIRIA SuDS Manual (2015). ~~Within this Outline Operational Drainage Management Plan (OODMP) the Applicant proposes a number of options to deliver the SuDS scheme, depending on the final design parameters and the confirmed existing ground conditions.~~
6. All of the SuDS options proposed within this OODMP are conservative as the Applicant adopts various pre-cautionary measures, as listed below:
  - Factor of Safety of 10 applied to infiltration elements of the SuDS basin;
  - 40% allowance for climate change;



- A conservative infiltration rate derived from the lowest rates recorded during the initial infiltration testing; and
- Maximum permitted footprints of the operational infrastructure.

6.7. This ~~plan~~ OODMP also provides an overview of the management measures required for surface water and foul water drainage arising from the operation of the onshore substations and National Grid infrastructure.

7.8. The final surface water drainage design will follow the below stages:

- a) Confirm the final infiltration rate for the ~~site~~ SuDS basins through ~~percolation testing. This will dictate if a further~~ infiltration ~~only scheme is viable;~~ testing within the proposed SuDS basin locations at the time of detailed design, and establish the ground water levels;
- b) Confirm the pre-development greenfield  $Q_{BAR}$  runoff rate calculated through detailed hydraulic modelling. This will become the maximum design discharge rate to the Friston Watercourse for events up to and including a 1 in 100 year (plus 40% to account for climate change) event, and will not be exceeded post-development ~~should~~ where discharge to the Friston Watercourse ~~be~~ is required (see **Appendix 2** for details of the indicative connection to the Friston Watercourse);
- c) Confirm the optimal SuDS basin(s) configuration, size, capacity and location using the above data. ~~This will reflect either~~ The location of the SuDS basins will seek to maximise the infiltration ~~rate, or rates where practicable and reflect~~ both the infiltration rate and the discharge rate to the Friston Watercourse ~~should a hybrid infiltration and attenuation scheme be adopted. During this SuDS design stage, additional factors will be taken into account such as revisions to the substation infrastructure footprint and its detailed.~~ An integrated approach to design; landscaping requirements; of the final SuDS basins will include optimising amenity, biodiversity, water quality and ~~the optimum use of land~~ water quantity benefits.





## 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
FRA	Flood Risk Assessment
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
<a href="#">ODMP</a>	<a href="#">Operational Drainage Management Plan</a>
<a href="#">OODMP</a>	<a href="#">Outline Operational Drainage Management Plan</a>
PPG	Pollution Prevention Guidance
PFRA	Preliminary Flood Risk Assessment
Q <sub>BAR</sub>	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.

# Outline Operational Drainage Management Plan

25<sup>th</sup> March 11<sup>th</sup> June 2021



Onshore substation location	The proposed location of the onshore substation for the proposed East Anglia TWO project.
Sustainable Drainage System	A collection of water management practices <a href="#">and measures</a> that aim to align modern drainage systems with natural water processes. <a href="#">This includes, amongst other measures, infiltration and attenuation.</a>
Q <sub>BAR</sub>	Mean annual flood, the value of the average annual flood event recorded in a river.



# 1 Introduction

## 1.1 Overview

1. This [Outline Operational Drainage Management Plan \(OODMP\)](#) addresses operational surface water and foul water drainage management matters, and supports the Development Consent Order (DCO) application (the [Applications Application](#)) for the East Anglia TWO project ~~and (the East Anglia ONE North project (the Projects Project))~~ 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; [\(subject to a separate DCO application\)](#); National Grid infrastructure; associated landscaping; and surface water management infrastructure. [A separate OODMP has been submitted for the East Anglia ONE North project that contains the same information as this OODMP, as both contain the maximum development scenario and are therefore applicable to both the Project and the East Anglia ONE North project. Given the integrated design of the surface water infrastructure required for the Project and the East Anglia ONE North project, the onshore substations for both projects are considered together \(as 'onshore substations'\) within this OODMP unless otherwise stated.](#)
3. Requirement 41 of the **draft DCO** (document ~~updated at Deadline 8, document reference 3.1~~) requires an [Operational Drainage Management Plan \(ODMP\)](#) in respect of the above works to be submitted to, and approved by, the relevant planning authority, in consultation with [Suffolk County Council \(SCC\) \(as Lead Local Flood Authority \(LLFA\)\)](#) and the Environment Agency ~~and which. The final ODMP~~ must be in line with this OODMP.
4. ~~The primary SuDS solution being proposed by the Applicant is an infiltration only scheme. However, this is reliant upon percolation testing proving this to be a viable solution for the onshore substation and National Grid substation locations. As the viability of an infiltration only scheme is yet to be determined, the Applicant is additionally proposing a hybrid infiltration and attenuation scheme and an attenuation only scheme for completeness.~~
5. ~~The information presented in this document is based on the updated maximum substation footprints. The following Project updates have been submitted to the Examination and are applicable to this plan:~~



- ~~• An updated Outline Landscape Mitigation Plan within the **Outline Landscape and Ecological Management Strategy** (updated version submitted at Deadline 8, document reference 8.7);~~
- ~~• The **Project Update Note** (REP2-007) submitted at Deadline 2 regarding the approximate 10% reduction in the footprint of the substations;~~
- ~~• The **Works Plans (Onshore)** (REP7-005) to reflect the substation footprint reduction; and The **Project Update Note for Deadline 3** (REP3-052) which presents the new location of the National Grid substation sustainable drainage system (SuDS) basin.~~

## 1.2 Purpose

~~6.4.~~ This OODMP presents an overview of the information to be presented within the final ODMP, including:

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

~~7.5.~~ Parameters such as the storage volumes, runoff rates and proposed discharge rates quoted in this OODMP relate to the current design envelope of the ~~Projects~~[Project](#) and will be subject to review during the detailed design of the ~~Projects~~[Project which will seek reductions in infrastructure footprints in line with the \*\*Substations Design Principles Statement\*\* \(document reference ExA.AS-4.D8.V3\).](#)

## 1.3 Basis of Design

~~8.6.~~ The ~~primary SuDS solution being proposed by the Applicant is an~~[infiltration only scheme. However, this is reliant upon percolation testing proving this to be a viable solution for the testing at the proposed SuDS basin locations serving the onshore substation](#)~~substations~~ and National Grid ~~substation locations. As~~[infrastructure to inform the viability of an](#)~~outline SuDS design. Initial infiltration only scheme is yet to be determined~~[testing undertaken in April 2021 \(AS-121\) have been superseded by more comprehensive infiltration testing undertaken in May 2021 \(document reference ExA.AS-2.D11.5.V5\).](#) The results of the infiltration testing have ruled out an infiltration only solution for both the ~~onshore substations and National Grid infrastructure SuDS basins. Following the drainage hierarchy, the Applicant is additionally proposing~~[has therefore adopted a hybrid infiltration and attenuation scheme](#)~~system for the onshore substations~~



and an attenuation only ~~scheme for completeness~~ solution for the National Grid infrastructure respectively, as agreed with the LLFA. Further details of the modelling to support these options are presented in **section 6** and **section 7** of this OODMP.

9.7. The final surface water drainage design will follow the below stages during the detailed design of the Project:

- a) Confirm the final infiltration rates for the site SuDS basins through ~~percolation testing and~~ further infiltration testing within the proposed SuDS basin locations and establish the ground water levels. ~~This will dictate if an infiltration only scheme is viable;~~
- b) Confirm the pre-development greenfield  $Q_{BAR}$  runoff rate calculated through detailed hydraulic modelling. This will become the maximum design discharge rate to the Friston Watercourse for events up to and including a 1 in 100 year (plus 40% to account for climate change) event, and will not be exceeded post-development should discharge to the Friston Watercourse be required (see **Appendix 2** for indicative connection to the Friston Watercourse); and
- e) ~~Confirm the optimal SuDS basin(s)~~ configuration, size, capacity and location using the above data. This The location of the SuDS basins will reflect either seek to maximise the infiltration rate, or rates where practicable and reflect both the infiltration rate and the discharge rate to the Friston Watercourse ~~should a hybrid infiltration and attenuation scheme be adopted. During this SuDS. An integrated approach to design stage, additional factors~~ of the final SuDS basins will be taken into account such as revisions to the substation infrastructure footprint include optimising amenity, biodiversity, water quality and its detailed design; landscaping requirements; and the optimum use of land.



c) water quantity benefits.



## 2 Relevant Legislation, Policy and Guidance

~~10.8.~~ This section sets out the relevant legislation and guidance that have informed the development of this OODMP.

### 2.1 Legislation

#### 2.1.1 Flood and Water Management Act (2010)

~~11.9.~~ 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. ~~Suffolk County Council (SCC)~~ SCC is the LLFA covering the onshore development area and they are required to deliver a strategy for local flood risk management in their area, to investigate flooding and to maintain a register of flood risk assets.

#### 2.1.2 The Electricity Safety, Quality Continuity Regulations 2002

~~12.10.~~ 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

~~13.11.~~ Overarching National Policy Statement EN-1 section 5.7 'Flood Risk' has been followed.

#### 2.2.2 National Planning Policy Framework

~~14.12.~~ 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 East Suffolk Council Policy

~~15.13.~~ The ~~East Suffolk Council (ESC)~~ Suffolk Coastal Local Plan (which was adopted in September 2020) includes two key policies in relation to flood risk and drainage as follows:

- a. Policy SCLP9.5: Flood Risk; and





b. Policy SCLP9.6: Sustainable Drainage Systems.11.

~~16.~~14. Both of the above policies were reviewed in the context of the Project. The onshore substation and National Grid infrastructure locations are within Flood Zone 1, which the Environment Agency classifies as land being at low risk of flooding, having a less than 1 in 1,000 annual probability of river or sea flooding. However, as the site is greater than 1 hectare, and partly within an area that could be affected by surface water conveyance routes, a Flood Risk Assessment (FRA) is still required. The production of the FRA was in accordance with Policy SCLP9.5, whereby there is a requirement to carry out a FRA, specifically meeting the requirements of the Flood Risk National Planning Policy Guidance (and any successor).

#### 2.2.4 Preliminary Flood Risk Assessments

~~17.~~15. A Preliminary Flood Risk Assessment (PFRA) for Suffolk was produced by SCC in June 2011. It was subsequently updated in December 2017.

~~18.~~16. 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).

#### 2.2.5 Strategic Flood Risk Assessments

~~19.~~17. Waveney District Council (WDC) and Suffolk Coastal District Council (SCDC) (now merged to form ESC) jointly commissioned a Level 1 Strategic Flood Risk Assessment (SFRA) in 2008. This was subsequently updated in 2018 (WDC and SCDC 2018).

~~20.~~18. 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).

~~21.~~19. 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.

~~22.~~20. 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)).



### 2.2.6 Suffolk Flood Risk Management Strategy

~~23-21.~~ 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.

~~24-22.~~ Critical Drainage Areas (CDAs) are those that fall within Flood Zone 1 that experience critical drainage problems as notified by the Environment Agency<sup>1</sup>.

~~25-23.~~ 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.

~~26-24.~~ Consideration of CDAs is therefore necessary to inform key flood risk priorities. The FRMS indicates that local authorities should identify CDAs within their SFRA. The Level 1 SFRA (WDC and SCDC 2018) indicated that SCDC and WDC has no defined CDAs.

#### 2.2.6.1 Appendix A – Sustainable Drainage Systems (SuDS)

~~27-25.~~ 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.

~~28-26.~~ It is noted that the Projects are Nationally Significant Infrastructure Projects and require DCOs rather than planning permission.

~~29-27.~~ SCC's FRMS Appendix A – Sustainable Drainage Systems (SuDS) A Local Design Guide summarises the local guidelines for Suffolk and sets out in Section 5 the Suffolk Design Principles, specifically noting that SuDS should:

- Not increase flood risk off site (in all events up to the 1 in 100 year return period);
- Provide adequate standards of flood protection on site - in most cases no flooding inside buildings in events up to a 1 in 100 year return period and no flooding in other areas (apart from designated flood paths / storage areas) in events up to 1 in 30 year return period;
- Take account of the construction, operation and maintenance requirements of both surface and subsurface components, allowing for any

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<sup>1</sup> <https://www.gov.uk/guidance/flood-risk-assessment-in-flood-zone-1-and-critical-drainage-areas>



personnel, vehicle or machinery access required to undertake this work;  
and

- Make allowances for climate change for all return periods.

~~30-28~~. The Suffolk Design Principles also set out requirements related to discharge rates, volume control and climate change allowances.

~~31-29~~. 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. However, SCC has requested that the Applicant design a SuDS which accounts for a 40% increase in rainfall as a result of climate change, therefore 40% has been applied throughout this OODMP. 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

~~32-30~~. 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

~~33-31~~. 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 (4<sup>th</sup> Edition 2016).

### 2.3.3 Design Manual for Roads and Bridges

~~34-32~~. 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

~~35-33.~~ The following Environment Agency guidance notes and documents<sup>2</sup> 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;
- 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.

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<sup>2</sup> These publications were all withdrawn in 2015, however still provide useful information to ensure best practice is achieved.



## 3 Existing Conditions

### 3.1 Overview

~~36-34.~~ This section presents an overview of the existing conditions in and around the onshore substations and National Grid infrastructure [locations](#). In establishing the baseline, existing infiltration rates and greenfield runoff 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 existing runoff rate.

### 3.2 Methodology for Establishing Existing Conditions

~~37-35.~~ This OODMP has been informed by documentation existing at the time of production. During the detailed design the final ODMP will be informed by any ~~new~~ [newly published](#) documentation and will include details of how the existing conditions are established.

~~38-36.~~ 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	Medium
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



Data	Year	Coverage	Confidence
Suffolk County Council Surface Water Flood Risk and Incident Map	2018	Local	High
BMT (2020) Friston Surface Water Study – Technical Report <sup>3</sup>	2020	Local	High

~~39-37.~~ 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

~~40-38.~~ The onshore substations and National Grid infrastructure would be 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 Hydrological Catchment(s)

~~41-39.~~ 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 the flood risk from the Friston Watercourse has been based on historic anecdotal information provided by the

<sup>3</sup> A report commissioned by SCC to determine surface flood water risk to the village of Friston following flooding events in 2019



local community. The Friston Watercourse is designated as Main River by the Environment Agency south of Church Road.

~~42.40.~~ 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 (Appendix 1)**). Therefore, the onshore substations and National Grid infrastructure are at low risk of flooding from fluvial sources.

~~43.41.~~ The final ODMP will include a topographic survey which validates the existing conditions.

### 3.5 Existing Ground Conditions

~~44.42.~~ The onshore substations and National Grid infrastructure locations are underlain by a Principal Aquifer in the Chalk bedrock (**Figure 18.4** (APP-255), included in this document as **Figure 3 (Appendix 1)**). The onshore substations and National Grid infrastructure are also underlain by Secondary (A, B and undifferentiated) aquifers in the superficial crag deposits, as reported in section 20.4.3.5 of **Appendix 20.3 Flood Risk Assessment** (APP-496).

~~45.43.~~ 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.

~~46.44.~~ 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*”.

~~47.45.~~ 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 (Appendix 1)**). 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.

~~48.46.~~ Given the above, the onshore substations and National Grid infrastructure are considered to be at low risk of flooding from groundwater sources.



~~49.47.~~ The final ODMP will be produced to include details of ground investigations which validates the existing conditions.

### 3.6 Background to Historic Flooding

~~50.48.~~ 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.

~~51.49.~~ As the onshore substation and National Grid infrastructure are located within Flood Zone 1, which the Environment Agency classifies as land being at low risk of flooding, a sequential test is not required, as per the UK Government guidance on the sequential test for Applicant (UK Government, 2012, updated 2017). Furthermore, any other potential sources of flood risk will be managed through the adoption of mitigation measures to ensure there is no risk to the Project, or resulting from the Project following development.

~~52.50.~~ 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.

~~53.51.~~ 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).

~~54.52.~~ 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 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) (**Figure 20.3.3 of Appendix 20.3 Flood Risk Assessment** (APP-496), included in this document as **Figure 4 (Appendix 1)**).





~~55-53.~~ 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)).

~~56-54.~~ Subsequent information received from the LLFA (19<sup>th</sup> November 2019) has indicated that more recent surface water flooding events (occurring in October 2019) has affected the area around Friston.

~~57-55.~~ There is a known (variable) risk associated with surface water flooding in proximity to the onshore substation and National Grid infrastructure.

### 3.6.1 Historic Rainfall and Flooding Events

#### 3.6.1.1 Onshore Substations and National Grid Substation

~~58-56.~~ 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.

~~59-57.~~ 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.

~~60-58.~~ 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

~~61-59.~~ SCC appointed BMT in 2019 to undertake an assessment of surface water flood risk in Friston, Suffolk following flooding events (BMT, 2020). BMT produced a hydraulic model<sup>4</sup> with the purpose of assessing both the current and potential future flood risk from surface water including the impact of climate change.

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<sup>4</sup> The Applicant notes that the outputs from the proposed hydraulic model may differ from the Friston Surface Water Study Technical Report (BMT, 2020) as it will be based on site investigation information which will be focused on the substation area and contributing catchments and used to inform the development of the detailed design. The Friston Surface Water Study Technical Report (BMT, 2020) focuses on the local surface water flood risk to the village of Friston.



~~62.~~60. The Friston Surface Water Study Technical Report produced by BMT (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 6<sup>th</sup> 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.

~~63.~~61. The observed event was well documented, with significant flow observed running along Grove Road, Aldeburgh Road, Saxmundham Road and Low Road.

~~64.~~62. 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

~~65.~~63. 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.

~~66.~~64. SCC indicated via email (25<sup>th</sup> September 2020) that the return period for this rainfall event was equivalent to approximately a 1 in 40-year event. Rainfall information or data related to this event, where available, will be reviewed further during the detailed drainage design to understand potential implications for the onshore substation and National Grid infrastructure.

~~67.~~65. No other flooding events with accompanying rainfall data have been identified to understand the significance of key return period events in the area.

### 3.6.1.4 Applicant's Analysis of Results Data in the Friston Surface Water Study Technical Report

~~68.~~66. The Applicant reviewed the Friston Surface Water Study Technical Report (BMT, 2020) upon publication.

~~69.~~67. Following ISH 11, the Applicant analysed the modelling results, which were carried out in the TufLOW specialist modelling software, by assessing the maximum water depths and velocities at 17 key node points, as shown in **Plate 3.1**.



Plate 3.1 Node Location Points Used to Collate the Data in Table 3.3 and Table 3.4



70-68. The outputs of the assessment of these 17 nodes can be seen in **Table 3.3** and **Table 3.4**. **Table 3.3** presents information on maximum water depths and **Table 3.4** shows data on the maximum velocities, both during a 6 hour storm duration.

Table 3.3 Maximum Water Depths (m) for Baseline Rainfall Events (6 Hour Storm Duration)

Node ID	5yr	20yr	30yr	100yr	100yr (central climate change allowance)	100yr (upper climate change allowance)	1,000yr
1	0.007	0.010	0.011	0.016	0.020	0.023	0.029
2	0.022	0.031	0.034	0.044	0.050	0.057	0.070
3	0.107	0.115	0.118	0.128	0.136	0.144	0.156
4	0.172	0.180	0.183	0.192	0.199	0.205	0.217
5	0.021	0.028	0.030	0.039	0.045	0.051	0.060
6	0.003	0.005	0.006	0.010	0.013	0.016	0.022
7	0.020	0.027	0.030	0.037	0.043	0.048	0.056
8	0.023	0.030	0.033	0.042	0.048	0.055	0.065
9	0.011	0.017	0.019	0.025	0.030	0.034	0.041
10	0.000	0.002	0.003	0.006	0.010	0.014	0.021
11	0.004	0.008	0.010	0.015	0.019	0.023	0.030
12	0.015	0.023	0.026	0.033	0.038	0.043	0.050



Node ID	5yr	20yr	30yr	100yr	100yr (central climate change allowance)	100yr (upper climate change allowance)	1,000yr
13	0.014	0.026	0.029	0.037	0.042	0.047	0.086
14	0.010	0.024	0.027	0.037	0.045	0.051	0.083
15	0.140	0.149	0.151	0.159	0.165	0.170	0.200
16	0.017	0.020	0.021	0.024	0.025	0.027	0.081
17	0.000	0.000	0.000	0.000	0.000	0.000	0.017

**Table 3.4 Maximum Velocities (m/s) for Baseline Rainfall Events**

Node ID	5yr	20yr	30yr	100yr	100yr (central climate change allowance)	100yr (upper climate change allowance)	1,000yr
1	0.122	0.152	0.160	0.191	0.215	0.234	0.265
2	0.030	0.054	0.064	0.101	0.129	0.157	0.211
3	0.037	0.035	0.036	0.035	0.036	0.041	0.066
4	0.017	0.018	0.018	0.028	0.038	0.051	0.076
5	0.112	0.149	0.161	0.201	0.232	0.260	0.302
6	0.078	0.126	0.141	0.191	0.227	0.264	0.334
7	0.136	0.182	0.195	0.237	0.267	0.293	0.330
8	0.034	0.060	0.068	0.101	0.121	0.137	0.163
9	0.192	0.245	0.265	0.312	0.347	0.376	0.417
10	0.023	0.056	0.069	0.099	0.119	0.139	0.170
11	0.091	0.138	0.150	0.194	0.224	0.252	0.292
12	0.089	0.104	0.109	0.132	0.153	0.172	0.204
13	0.031	0.029	0.034	0.034	0.043	0.063	0.238
14	0.022	0.086	0.100	0.150	0.182	0.208	0.342
15	0.027	0.027	0.027	0.027	0.031	0.040	0.084
16	0.055	0.056	0.057	0.057	0.056	0.056	0.379
17	0.021	0.023	0.023	0.024	0.026	0.026	0.447

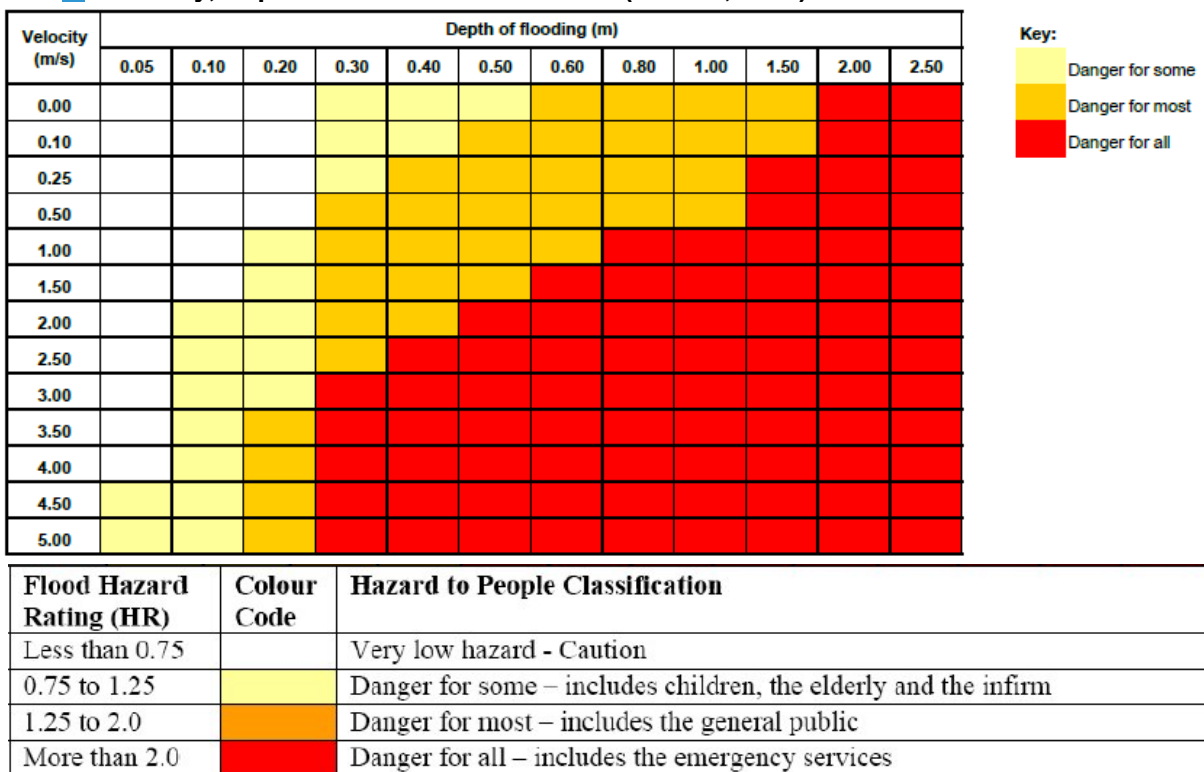


~~71-69.~~ The results shown in **Table 3.3** and **Table 3.4** have confirmed the Applicant's analysis in **Section 3**; that although there is a surface water conveyance route through the National Grid substation location (see **Figure 4** of **Appendix 1**), there is no flood hazard risk.

~~72-70.~~ To demonstrate this, the Applicant refers to Flood Risk Assessment Guidance for New Development Phase 2 Framework and Guidance for Assessing and Managing Flood Risk for New Development – Full Documentation and Tools R&D Technical Report FD2320/TR2 – Flood Risk to People, published by DEFRA and the Environment Agency as part of their Flood and Coastal Defence R&D Programme (October 2005). Within this report a Velocity, Depth and Flood Hazard Matrix is presented which takes into account the depth and velocity of surface water conveyance routes to derive a flood hazard rating (see **Plate 3.2**).

~~73-71.~~ The outputs of the Flood Risk to People report indicate that flood depths below 0.25 m and velocities below 0.5 m/s are considered 'very low hazard'.

**Plate 3.2 Velocity, Depth and Flood Hazard Matrix (DEFRA, 2006)**



~~74-72.~~ When looking at **Plate 3.2** and taking into account the maximum depths and velocities shown in **Table 3.3** and **Table 3.4**, it can be concluded that the flood risk at the onshore substation and National Grid substation locations is <0.75



which is classed as a ‘*very low hazard*’, as per the DEFRA / Environment Agency (2006) Velocity, Depth and Flood Hazard Matrix.

~~75-73.~~ **Table 3.5** uses the below formula provided by DEFRA / Environment Agency (2006):

Depth x (Velocity + Velocity Coefficient) + Debris Factor = Flood Hazard Rating

- The Velocity Coefficient is a fixed value of 0.5.
- The Debris Factor is 0 for all land uses with a flood depth of 0m - 0.25m.

~~76-74.~~ **Table 3.5** summarises the hazard rating for all 17 node points for key return period events. 5 year and 20 year return periods have not been included as they are smaller events than those utilised for surface water flood risk mapping. The two scenarios for 1 in 100 year with climate change allowance are not included as the Applicant is looking to ascertain the current baseline flood risk.

**Table 3.5 Summary of Maximum Depths (m) and Velocities (m/s) in relation to the Flood Hazard Matrix (DEFRA / Environment Agency, 2006)**

Node ID	30yr depth (m)	30yr velocity (m/s)	30yr hazard	100yr depth (m)	100yr velocity (m/s)	100yr hazard	1,000yr depth (m)	1,000yr velocity (m/s)	1,000yr hazard
1	0.011	0.160	0.007	0.016	0.191	0.011	0.029	0.265	0.022
2	0.034	0.064	0.019	0.044	0.101	0.026	0.070	0.211	0.050
3	0.118	0.036	0.063	0.128	0.035	0.068	0.156	0.066	0.088
4	0.183	0.018	0.095	0.192	0.028	0.101	0.217	0.076	0.125
5	0.030	0.161	0.020	0.039	0.201	0.027	0.060	0.302	0.048
6	0.006	0.141	0.004	0.010	0.191	0.007	0.022	0.334	0.018
7	0.030	0.195	0.021	0.037	0.237	0.027	0.056	0.330	0.046
8	0.033	0.068	0.019	0.042	0.101	0.025	0.065	0.163	0.043
9	0.019	0.265	0.015	0.025	0.312	0.020	0.041	0.417	0.038
10	0.003	0.069	0.002	0.006	0.099	0.004	0.021	0.170	0.014
11	0.010	0.150	0.007	0.015	0.194	0.010	0.030	0.292	0.024
12	0.026	0.109	0.016	0.033	0.132	0.021	0.050	0.204	0.035
13	0.029	0.034	0.015	0.037	0.034	0.020	0.086	0.238	0.063
14	0.027	0.100	0.016	0.037	0.150	0.024	0.083	0.342	0.070
15	0.151	0.027	0.080	0.159	0.027	0.084	0.200	0.084	0.117



Node ID	30yr depth (m)	30yr velocity (m/s)	30yr hazard	100yr depth (m)	100yr velocity (m/s)	100yr hazard	1,000yr depth (m)	1,000yr velocity (m/s)	1,000yr hazard
16	0.021	0.057	0.012	0.024	0.057	0.013	0.081	0.379	0.071
17	0.000	0.023	0.000	0.000	0.024	0.000	0.017	0.447	0.016
Av.	0.043	0.099	0.024	0.050	0.124	0.029	0.076	0.254	0.052

~~77-75.~~ **Table 3.5** shows that the average (av.) 30 year, 100 year and 1,000 year hazards are 0.024, 0.029 and 0.052, respectively. All of these average values are towards the lower end of the threshold for the hazard rating that is deemed to be ‘very low hazard’ (i.e. any values less than 0.75). The greatest hazard rating value within the site is 0.125, which is still well below the threshold value. Therefore, even during a 1 in 1,000 year event, there is no flood hazard risk to the onshore substation and National Grid substation locations.

~~78-76.~~ The Applicant notes that the data from the Friston Surface Water Study Technical Report (BMT, 2020) confirms the current understanding of the potential flood risk to the site and does not change any of the material outputs within this OODMP. The above assessment supports the previous conclusions made by the Applicant around the baseline conditions and it can be concluded that there is no flood hazard risk.

### 3.7 Existing Hydrological and Hydrogeological Context

~~79-77.~~ 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

~~80-78.~~ The Friston Surface Water Study Technical Report (BMT, 2020) 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<sup>2</sup> 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.



~~81-79~~. The upstream catchment collects surface water flow before draining into a box culvert which runs along 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

~~82-80~~. The existing ground conditions at the onshore substations and National Grid infrastructure location are described in **section 3.5** 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 section 2.2.2 of the BMT (2020) report which notes 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 Friston Surface Water Study Technical Report (BMT, 2020) also notes that the upper catchment is predominately made up of clay soils. In the village the soils become sandier.

~~83-81~~. To confirm the validity of the above description of the existing ground conditions, as provided in the Friston Surface Water Study Technical Report (BMT, 2020), the final ODMP will include details of the scope, extent and findings of the soil surveys which are required to validate the existing conditions.

### 3.7.3 Background to Catchment Hydraulic Modelling

~~84-82~~. Within the Friston Surface Water Study Technical Report (BMT, 2020) 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.

~~85-83~~. 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 have been reviewed and considered within this OODMP and will be considered further to inform the drainage design for the onshore substations and National Grid infrastructure. The results of the modelling carried out by BMT (2020) supported the existing understanding of flood risk to the onshore substations and National Grid infrastructure.





~~86-84.~~ The final ODMP will be produced to include details of the scope and extent of the catchment hydraulic model required to validate the existing conditions, informed by a series of surveys including, but not limited to, those described in **section 3.5** of this document.

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

~~87-85.~~ 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.

~~88-86.~~ 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 6<sup>th</sup> October 2019, the previous 12 months of rainfall data leading up to the event was obtained for use in the Friston Surface Water Study Technical Report (BMT, 2020) from the Woodbridge rain gauge.

~~89-87.~~ 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

~~90-88.~~ The final ODMP will ~~be produced to include details of~~ reflect the ~~scope, extent and findings of soil surveys~~ further infiltration testing to be undertaken to determine during the ~~existing detailed design stage, which will confirm the infiltration potential of the soils within the catchment~~ proposed SuDS basin locations and allow the optimisation of infiltration within the SuDS basins where practicable.

~~91.~~ ~~Section 4.2~~ provides further background on the process of infiltration and how infiltration rates will be calculated. ~~Section 6~~ estimates infiltration values within the Order limits. However, as detailed percolation testing has not yet been undertaken, these calculations are based on indicative, conservative figures.

### 3.8.1 Infiltration Testing Results

~~89.~~ The Applicant undertook an initial infiltration testing at the proposed SuDS basin locations in April 2021, which were superseded by more comprehensive infiltration testing in May 2021. The full methodology and results of these tests are documented in *Infiltration Test Results (May 2021)* (document reference ExA.AS-2.D11.5.V5). The results of the testing have been shared with the LLFA and are summarised in *Table 3.6*.



**Table 3.6 Summary of May 2021 Infiltration Testing**

<u>Proposed SuDS Basin Location</u>	<u>Test Pit Ref. No.</u>	<u>Test No.</u>	<u>Infiltration Rate (mm/hr)</u>	<u>Average Rate (mm/hr)</u>	<u>Lowest Rate (mm/yr)</u>
<u>National Grid Substation</u>	<u>TP012b</u>	<u>1</u>	<u>36</u>	<u>59</u>	<u>36</u>
		<u>2</u>	<u>46</u>		
		<u>3</u>	<u>95</u>		
	<u>TP013b</u>	<u>1</u>	<u>12</u>	<u>10</u>	<u>7</u>
		<u>2</u>	<u>10</u>		
		<u>3</u>	<u>7</u>		
	<u>TP014c</u>	<u>1</u>	<u>34</u>	<u>30</u>	<u>26</u>
		<u>2</u>	<u>29</u>		
		<u>3</u>	<u>26</u>		
<u>Onshore Substations</u>	<u>TP015b</u>	<u>1</u>	<u>75</u>	<u>76</u>	<u>63</u>
		<u>2</u>	<u>63</u>		
		<u>3</u>	<u>91</u>		
	<u>TP016b</u>	<u>1</u>	<u>46</u>	<u>39</u>	<u>35</u>
		<u>2</u>	<u>35</u>		
		<u>3</u>	<u>36</u>		
	<u>TP017b</u>	<u>1</u>	<u>98</u>	<u>71</u>	<u>50</u>
		<u>2</u>	<u>66</u>		
		<u>3</u>	<u>50</u>		
<u>Between National Grid Substation and Onshore Substations</u>	<u>TP330b</u>	<u>1</u>	<u>8</u>	<u>8</u>	<u>8</u>
		<u>2</u>	-		
		<u>3</u>	-		

90. With the exception of TP017b (Test 1 and Test 2), all test results have been extrapolated to calculated t<sub>25</sub> (the time for the water level to fall to 25% effective storage depth) to aid with the calculation of the infiltration rates at each location. The real-time recording of water depths at each test pit are presented in



[Appendix 1 of Infiltration Test Results \(May 2021\)](#) (document reference [ExA.AS-2.D11.5.V5](#)).

91. The results show a range of infiltration rates at seven different locations. Observations identified that the results at TP012b improved as the tests took place. This mirrors the results achieved at the adjacent TP012a pit (during previous testing in April 2021 (AS-121)), which demonstrates consistency in the soil characteristics. Although this is unusual, as typically the results reduce as the tests progress at that location, it is possible and may be due to the silt washing away in clusters of more gravelly soils, therefore creating more favourable conditions in the infiltration pathway as the three tests progress.
92. For the National Grid substation SuDS basin, the average infiltration rate is considered to be unsuitable for infiltration to be incorporated. Therefore, the Applicant proposes to adopt an attenuation only design for this basin, as agreed with the LLFA.
93. For the onshore substations SuDS basin, the average infiltration rate of the lowest test result for TP015b, TP016b and TP017b is 49.3mm/hr. In order to take a conservative approach at this location, the Applicant has agreed a 40mm/hr infiltration rate with the LLFA for drainage calculations at this outline design stage of the Projects (with storage for a 1 in 30 year return period (plus 40% for climate change)). It has been agreed with the LLFA to progress a hybrid SuDS basin (i.e. a combination of infiltration and attenuation) at this location.
94. Post-consent, the infiltration rate of each SuDS basin will be verified by further BRE-365 compliant infiltration testing, the results of which will be used in the detailed design of the SuDS basins.

### 3.9 Existing Runoff Rate to Friston Watercourse

~~92-95.~~ 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 and Ecological Management Strategy** (~~updated document submitted at Deadline 8,~~ document reference 8.7), are summarised in **Table 3.7** below.

~~93-96.~~ Runoff rates in **Table 3.7** below are expressed using a method based on the Flood Estimation Handbook (1999) 2013 depth duration frequency (DDF) rainfall estimates (FEH 2013) produced by the UK Centre for Ecology and Hydrology. As requested by SCC, the Applicant has provided runoff rates using the FEH 2013 method as it ensures a conservative approach.

~~94-97.~~ Existing runoff from the onshore substations and National Grid infrastructure site will flow overland and into adjacent field drains with some of the water making its way through the catchment to the Friston Watercourse.



**Table 3.7 Pre-Development Runoff Rates (using the FEH 2013 method)**

Design Parameters / Assumptions	Onshore Substations FEH 2013 (Total) (l/s)	National Grid Infrastructure FEH 2013 (Total) (l/s)
2 l/s/ha	17.78	12.9
1 Year Return	6.88	4.81
<b>2 Year Return (<math>Q_{BAR}</math>)<sup>5</sup></b>	<b>7.91</b>	<b>5.52</b>
30 Year Return	19.38	13.53
100 Year Return	28.15	19.66
200 Year Return	33.3	23.25

### 3.10 - Existing Site Characteristics

~~95-98.~~ Currently, there are three natural depressions at the onshore substations and National Grid substation locations (~~as shown in **Appendix 4**, **Appendix 6** and **Appendix 8**~~) which act as natural water storage basins. At this stage of the Project's initial design, the Applicant proposes that one is relocated, and that two will remain where they are currently situated. ~~However, subject to hydraulic catchment modelling it has been raised that the existing depression adjacent to the substations (as shown in **Appendix 4**, **Appendix 6** and **Appendix 8**) may no longer fulfil its function and therefore its volume has been included within the SuDS design calculations in **Section 6** and **Section 7**. This volume has been included as a worst case scenario and will only be accounted for if the hydraulic catchment modelling shows it to be necessary. (see **Appendix 5**). Hydraulic catchment modelling undertaken during the detailed design stage will confirm the functionality of the two remaining depressions and should they be affected will be compensated for within the final surface water drainage design.~~

~~96-99.~~ There is also a natural surface water conveyance route which runs through the National Grid substation location, as show in **Figure 4** of **Appendix 1**. During detailed design the Applicant will ensure that the surface water conveyance route is diverted around the northern perimeter of the National Grid substation. No culverting or piping will be used to divert this flow route, instead the Applicant will seek to work with and refine the natural topography of the area to accommodate the flow, as well as the realignment of existing ordinary watercourses.

<sup>5</sup> Discharge from the onshore substation, National Grid infrastructure, operational access road and permanent access road would be limited to the  $Q_{BAR}$  rate currently calculated as above and to be confirmed during the detailed design stage.  $Q_{BAR}$  is the peak rate of flow from a catchment for the mean annual flood.



~~97.~~ 100. \_\_\_\_\_ The Applicant will ensure that any SuDS design developed will account for and work with these natural, existing features and will be reflected in the final design and positioning of the onshore substations and National Grid infrastructure. In limiting runoff from the Project, the site specific SuDS design will reduce the flood risk to the site and to Friston village.



## 4 Sustainable Drainage Principles for the Projects

### 4.1 Overview

~~98-101.~~ The Applicant has considered the requirements of the ESC Suffolk Coastal Local Plan (adopted September 2020) with regard to Policy SCLP9.6: Sustainable Drainage Systems, noting that the proposed SuDS are also considered as part of the integration into the landscaping scheme and green infrastructure provision for the development, the extent and nature of which is to be finalised at detailed design.

~~99-102.~~ The drainage strategy for the final ODMP will be developed according to the principles of SCC's SuDS hierarchy (2018) and LFRMS (SCC, 2016) as follows:

- i. into the ground (infiltration) (see **section 4.2**);
- ii. to a surface water body (attenuation) (see **section 4.3**);
- iii. to a surface water sewer, highway drain or another drainage system (conveyance) (see **section 4.4**); or
- iv. to a combined sewer.

~~100-103.~~ The first three principles are described in more detail in the subsequent sections.

### 4.2 Infiltration

~~101-104.~~ 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.

~~102-105.~~ 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 ODMP. As part of these investigations, ~~percolation~~[infiltration](#) tests will ~~determine~~[confirm](#) the underlying permeability and the feasibility to dispose of surface water directly to ground or other engineered filtration systems, and to what degree. [Further infiltration testing will be undertaken during the detailed design stage to complement the infiltration testing undertaken in May 2021 which have informed this OODMP.](#)



### 4.3 Attenuation

~~103.~~106. 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.

~~104.~~107. 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 OODMP and agreed in consultation with the LLFA (SCC) and Environment Agency.

~~105.~~108. For the onshore substations and National Grid infrastructure, the storage will be designed to accommodate runoff from a 1 in 100 year<sup>6</sup> storm event plus a 40% allowance for climate change. These measures will limit the runoff to the equivalent of the pre-development greenfield runoff rate (see **Table 3.7**) (established by the methodology within this OODMP and which will be subject to review during the detailed design of the Projects as discussed in **paragraph 5** above) to ensure there is no increased risk of flooding downstream of the discharge.

~~106.~~109. 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

~~107.~~110. 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 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.

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<sup>6</sup> For clarity the '1 in 200' rate from the ES and FRA is comparable to 1 in 100yr + 20% for climate change.



## 4.5 Pollutant Removal

~~408.111.~~ 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.

~~409.112.~~ 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 ODMP. The approach adopted will identify and consider the source and types of pollutants that may occur in the surface and wastewaters and show how these will be managed to prevent pollution of the receiving watercourses.

~~410.113.~~ 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 8** below.

~~411.114.~~ 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.

## 4.6 Application of the SuDS Hierarchy to the Project

~~412.115.~~ The Applicant notes that the application of the SuDS hierarchy (SCC, 2018) is dependent on site-specific conditions which will be applied to identify an optimal drainage solution, ~~and not wholly based on the application of a single hierarchy measure as proposed by Suffolk County Council.~~

~~413.116.~~ **Section 5** presents the surface water drainage commitments the Applicant has made and provides an overview of SuDS whilst presenting indicative assumptions for calculating a range of runoff rates and storage volumes so that the SuDS hierarchy can be applied to the site of the onshore substations and National Grid infrastructure.

~~414.117.~~ In accordance with the SuDS hierarchy, the Applicant presents ~~an assessment of the viability of the primary option comprising an infiltration only scheme in section 6, an assessment of a hybrid scheme,~~ (utilising both infiltration and attenuation, ~~in section 7~~) for the onshore substations in Section 6 and an assessment of an attenuation only scheme ~~in section 8. The hybrid~~





~~scheme and attenuation only scheme have been presented as a contingency approach should for the infiltration only scheme prove unviable following site investigations.~~ National Grid substations in **Section 7**. The final details related to the application of the SuDS hierarchy will be determined during detailed design once site specific ~~percolation~~ infiltration testing and hydraulic modelling has been undertaken.

~~115.~~ **118.** **Section 98** considers foul water drainage produced by the onshore substations and National Grid infrastructure in their operational phase, comprising the foul water from the welfare facilities.

~~116.~~ **119.** **Section 109** presents the Applicant's position on the optimal drainage design for the onshore substations and National Grid infrastructure, during the operational phase.

~~117.~~ **120.** Drainage during the construction phase will be subject to a separate construction phase surface water and drainage management plan to be produced post consent under Requirement 22(2)(a) of the **draft DCO** (document ~~updated at Deadline 8, document~~ reference 3.1).



## 5 Surface Water Drainage

~~118.121.~~ This section presents the surface water drainage commitments the Applicant has made (**section 5.1**), an overview of SuDS ~~system~~ components (**section 5.3**) and the methodology for calculating infiltration rates (**section 5.4**).

### 5.1 Commitments

~~119.122.~~ When considering pre and post development surface water drainage the Applicant commits to the following:

- ~~If an~~ Maximising infiltration ~~only design where it~~ is shown to be practicable through ~~percolation~~ further infiltration testing undertaken at the detailed design stage, establishment of the ground water levels and consideration of other land use such as landscaping, biodiversity and access, ~~then an infiltration only SuDS design will be adopted~~;
- ~~If~~ Where attenuation is required ~~for any element of the SuDS design, then~~ there will be no increase in the pre-development greenfield Q<sub>BAR</sub> run-off rate to the receiving Friston Watercourse catchment;
- Any reduction or removal of existing storage depressions, if ~~required~~ any, will be offset and accommodated within the final SuDS design;
- Existing watercourses and flow routes will be appropriately managed to ensure continued conveyance around the northern perimeter of the National Grid substation site; and
- Application of an appropriate Factor of Safety (FoS) ~~for infiltration elements of the SuDS (currently the FoS applied within 10 for the OODMP is 10.~~ purpose of this OODMP).

### 5.2 Factor of Safety

~~123.~~ For the purposes of this OODMP the Applicants has adopted a FoS of 10 to the infiltration element of the proposed onshore substations hybrid infiltration and attenuation SuDS basin. The Applicant will discuss this matter further with the LLFA during detailed design.

### 5.25.3 Sustainable Drainage System Components

~~120.124.~~ The existing topography of the onshore ~~substations~~ substation and National Grid infrastructure locations ~~is located on~~ naturally sloping land, with gradients falling away towards the field drains to the west and south ~~west of the site~~, so there is natural conveyance in these general directions. The surface water



drainage system will be designed to utilise and support this natural change in elevation.

~~121.~~125. The overall drainage layout will be produced in the final ODMP following detailed design post-consent; the key components of this are described below.

#### ~~5.2.1~~5.3.1 Substation Operational Access Road

~~122.~~126. As part of the ~~onshore substations and National Grid infrastructure~~ Projects 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.

~~123.~~127. Should there be a need for the permanent substation operational access road to be located over an existing surface water flood storage basin, either it will be relocated to an alternative suitable location (as shown in **Appendix 4**, ~~Appendix 6 and Appendix 85~~) or the existing volume reduction will be offset and accommodated within the final SuDS design.

#### ~~5.2.2~~5.3.2 SuDS Detention / Infiltration Basins

~~124.~~128. 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. This layout will be informed by the detailed design of the Projects; collation of existing ground conditions data (**section 3**); including further infiltration testing; the production of a catchment hydraulic model (**section 3.7.3**); and agreement through consultation with the LLFA (SCC) of an appropriate infiltration rate and discharge rate into the Friston Watercourse as necessary (**section 5.4**) (based on the existing greenfield runoff rate).

~~125.~~129. In addition, the Applicant retains the option to install further infiltration or attenuation measures along the existing conveyance route during the detailed design phase. The purpose of this is 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. This is in addition to the surface water drainage strategy currently proposed.

~~126.~~130. 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



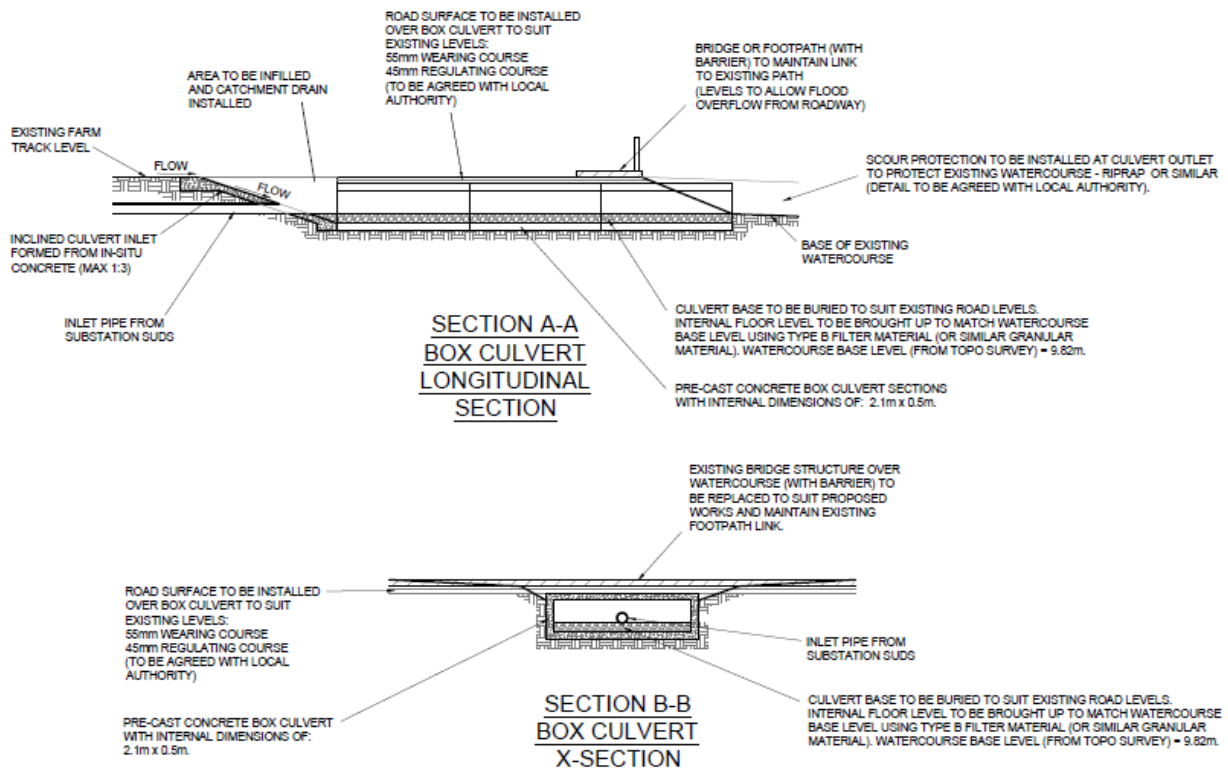
include the size, volume and location of this basin. Trees or shrubs will not be planted inside or within 5m of the footprint of the SuDS basins.

~~127.131.~~ 131. As none of the proposed ~~detention~~ SuDS basins will be larger than 25,000m<sup>3</sup> ~~or are currently designed to be raised above the surrounding ground level,~~ they will not fall under the Reservoirs Act (1975). Nevertheless, they will be appropriately designed in line with current standards and undergo regular inspection and maintenance by a suitably qualified engineer, as summarised in **section 5.5.**

### 5.2.35.3.3 Outfall Pipe

~~128.132.~~ 132. ~~A new~~ New outfall pipe(s) will be installed to manage runoff from the onshore substations and National Grid infrastructure. ~~This~~ The outfall ~~pipe is~~ pipes ~~are~~ are proposed to run Southwards from the site, then to be located below ground, beneath the existing track and connect to the existing Friston Watercourse ~~in the vicinity of~~ at Church Road. An indicative design for the cross section of the outfall pipe can be ~~seen in Plate 3 (see found in Appendix 2. This shows two outfall pipes although the final detail design will confirm whether a single outfall pipe is sufficient. The route adopted for full figure including connection to the Friston Watercourse).~~ outfall pipe will be established during the detailed design stage.

**Plate 3. Indicative Cross Sections of the proposed Box Culvert for the Connection to the Friston Watercourse**





#### 5.35.4 ~~Infiltration Rate or~~ Infiltration Rate and Discharge Rate to the Friston Watercourse

~~129.133.~~ 133. The infiltration rate and/~~or~~ discharge rate to the Friston Watercourse will be calculated based on the results of site-specific geotechnical surveys and infiltration testing (~~as per section 3.4 and 3.5~~). The acceptable discharge rate will be informed by the engineering design work during the detailed design of the Projects; collation of data on the existing site conditions (**section 3**); and the production of a catchment hydraulic model (**section 3.7.3**). ~~If as presented within this OODMP,~~ discharge to the Friston Watercourse is required, this discharge rate will be set at the existing greenfield runoff rate established through the catchment hydraulic model. This will be agreed in consultation with the LLFA (SCC) and included as part of the design presented within the final ODMP.

~~130.134.~~ ~~Section 6 and section 7 provide~~ Section 7 provides further details regarding the embedded flexibility of the development area and the ability to adopt reduced discharge rates (<7.91l/s and <5.52l/s for the onshore substations and National Grid substation respectively) ~~to be reflected in the SuDS detailed design, if attenuation is required.~~ The reduced discharge rates reflect the potential variability of the existing greenfield runoff rates which will be established from the catchment hydraulic model.

#### 5.45.5 Inspection and Maintenance

~~131.135.~~ 135. Inspection and 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).

~~132.136.~~ 136. The maintenance of the operational drainage will be secured through the approved final ~~Operational Drainage Management Plan.~~ ODMP. The undertaker will ensure that appropriate and clear responsibilities are set out within the approved plan. Given the importance of the infrastructure, maintenance is likely to remain with the operator of the onshore substation.

~~133.137.~~ 137. If separate provision is made for the National Grid infrastructure then maintenance may pass to that entity in respect of that infrastructure. The appropriate time to resolve these matters is once the detailed design has been completed.

~~134.138.~~ 138. The SuDS features will be included in a routine inspection and 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** (~~updated version submitted at Deadline 8,~~ document reference 8.7) to ensure they remain in effective



operation. This will include checking of the various inlets and outfalls and other structures, if required, for ongoing function and integrity. There will be a need for 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.

~~135-139.~~ 139. The maintenance schedule for the various surface water features will be included in the final ODMP once the final design has been confirmed.

140. Any additional inspection or maintenance works required on the Friston watercourse (Main River) due to the Project, will be addressed by way of an agreement with the Environment Agency prior to commencement of Work Nos 30 and 41. This is a common process for promoters of a wide range of developments which connect their surface water drainage to a main river. The *Statement of Common Ground with the Environment Agency* (REP8-124) will be updated to reflect this at Deadline 12.

#### **5.55.6 Ordinary Watercourse Consent**

~~136.~~ Land Drainage Consent associated with temporary and permanent works at the Projects' and National Grid infrastructure 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 Infiltration Only Scheme~~

### ~~6.1 Guidance~~

~~137. SCC's SuDS guidance (2018) has informed the illustrative infiltration design. Section 5 of the guidance (Suffolk Design Principles) indicates that "soakage rates need to be above 5-10mm/hr for infiltration to be the sole means of drainage" (i.e. the first option within the surface water drainage hierarchy).~~

~~141. As agreed in Table 13 in the **Statement of Common Ground with SCC and ESC** (updated document submitted at Deadline 8,~~



## 6 Onshore Substations SuDS Design

### 6.1 Basis of Outline Design

142. Based on the pre-development greenfield runoff rate established in [section 3.9](#) and the onshore substation footprints presented in [Table 6.1](#), the design parameters for the onshore substations are summarised in [Table 6.2](#).

~~138. Based on the infiltration rates (established by the May 2021 infiltration tests, (document reference ExA.[SoCGAS-2.D8.V4](#)),[D11.5.V5](#))) the Applicant has therefore tested the SuDS design at an adopted a conservative infiltration rate of ~~10mm~~[40mm](#)/hr, which is deemed to be a reasonable worst-case feasible applied to the hybrid element for the onshore substations SuDS basin, informed by the results of the initial testing campaign (see [section 3.8.1](#)) and as agreed with the LLFA. The Applicant will undertake further infiltration ~~rate~~.~~

~~139. Additionally, a half drain time of 24 hours has been considered within the calculations below, as per SCC guidance.~~

### 6.2 Modelling Design Parameters

~~140. The following parameters have been modelled:~~

- ~~• Infiltration rate of 10mm/hr;~~
- ~~• 100% impermeable surface area for the onshore substations and National Grid infrastructure areas of hardstanding (see [Table 6.1](#));~~
- ~~• 100% impermeable area for the permanent operational access road (see [Table 6.1](#));~~
- ~~• Requirement to provide replacement volume [testing](#) as a result of the potential removal [part](#) of the existing natural depression adjacent to the substations (see [Appendix 4](#), [Appendix 6](#) and [Appendix 8](#)); and~~
- ~~• Attenuation of water during the 1 in 100 year plus 40% climate change scenario.~~

~~141. An additional, secondary assessment was also undertaken, as requested by SCC. This included the parameters set out in paragraph 147 and additionally considered attenuation of water during a 1 in 10 year storm event (plus 40% climate change scenario), 24 hours after the initial 1 in 100 year (plus 40% climate change scenario) storm event.~~

~~142. The modelling has used Flood Estimation Handbook (FEH) (1999) 2013 DDF rainfall data produced by the UK Centre for Ecology and Hydrology<sup>7</sup>.~~

<sup>7</sup><https://fehweb.ceh.ac.uk/>





~~143. A FoS of 10 has also been incorporated in the calculations for the indicative infiltration design. This is a conservative approach based on the guidance set out in Table 25.2 of the CIRIA SuDS Manual (2015), the nature of the Projects and in line with requests from SCC.~~

~~144.143. The design parameters of the onshore substation and National Grid infrastructure are summarised in **Table 6.1**, [detailed design process](#).~~

**Table 6.1 Onshore Substation ~~Infiltration~~[Hybrid](#) Design Impermeable Areas (all parameters ~~are assume~~ 100% impermeable ~~surface~~)**

Component	East Anglia TWO (m <sup>2</sup> )	East Anglia ONE North (m <sup>2</sup> )	National Grid Infrastructure (m <sup>2</sup> )
Overall substation operational footprint	32,300	32,300	44,950
Operational access road	13,600		N/A
<del>Overall cable sealing end compound operational footprint</del>	N/A		10,000
<del>Permanent access road to cable sealing end compound</del>	N/A		1,850
<del>SuDS</del> <a href="#">Infiltration / attenuation</a> basin footprint (including perimeter access track)	<del>27,383</del> <a href="#">12,880</a>		17,508
<b>Total impermeable area</b>	<del>105,583</del> <a href="#">91,080</a>		<b>74,308</b>

## 6.2 Results

~~145.144.~~ From the ~~above~~,[information within \*\*Table 6.1\*\*](#), infiltration [and attenuation](#) storage requirements can be calculated and are summarised below in **Table 6.2** (see **Appendix 3** for all calculations).



Table 6.2 **InfiltrationHybrid** Storage Requirements and Provision

Infiltration Storage (m <sup>3</sup> )	East Anglia TWO (m <sup>3</sup> )	East Anglia TWO and East Anglia ONE North Combined (m <sup>3</sup> )	National Grid Infrastructure (m <sup>3</sup> )	Total (m <sup>3</sup> )
<b>Storage Required</b>				
Infiltration storage for 1 in 100 year (+40% for climate change)		12,760,623	9,082	21,842
Additional attenuation storage for 1 in 10 year (+40% for climate change)		6,944,018	4,995	11,939
Potential offset of existing depression adjacent to proposed substation	3,300		N/A	3,300
<b>Total Storage Required</b>		<b>23,004,640</b>	<b>14,077</b>	<b>37,081</b>
<b>Total Storage Provided<sup>8</sup></b>		<b>23,152,109</b>	<b>14,236</b>	<b>37,388</b>

## Results

~~146.145.~~ The Applicant notes SCC's comments at Deadline 3 (REP3-101) and Deadline 4 (REP4-064) regarding the need for an infiltration only design to achieve a half drain time of 24 hours under a 1 in 100 year plus 40% for climate change scenario. As shown in **Appendix 3**, when applying a FoS of 10 ~~to~~ for the ~~parameters detailed in section 6.2, infiltration element of the drainage onshore substations SuDS basin (see Table 6.1), the half drain~~ time is in exceedance of ~~7 days~~ 24 hours and therefore does not meet SCC's specification for an infiltration only design. ~~Pre-construction ground investigations including infiltration testing will be conducted in order to determine whether the baseline infiltration rate is greater than 10mm/hr. This will inform the extent to which infiltration measures can be prioritised and incorporated into the final SuDS design.~~

146. As the half drain time exceeded 24 hours, a secondary assessment ~~was~~ has been undertaken, as requested by SCC. ~~This considered, which requires the SuDS basin to accommodate a 1 in 10 year storm event 24 hours after a 1 in 100 year storm event (both accounting for plus 40% climate change scenario and a FoS of 10).~~ 24 hours after the initial 1 in 100 year (plus 40% climate change scenario)

<sup>8</sup> Figures do not include freeboard, perimeter access track and additional storage between track and basin top, however do include the volume of the existing depression adjacent to the proposed Western substation. Design figure for the 1 in 100 year storm (+40% climate change).



storm event This assessment ~~did not achieve a~~achieved the 24 hour half drain time, ~~and concluded a half drain time of 8,592 minutes, which is approximately 6 days (see~~ by virtue of the remaining capacity provided within the SuDS basin.

147. ~~Appendix 3 for all~~ provides detailed calculations). ~~of the above figures and the plan in Appendix 5 presents an indicative layout for the infiltration and attenuation basin.~~

148. By limiting the runoff from the onshore substations to the  $Q_{BAR}$  pre-development greenfield runoff rate for all events up to and including the 1 in 100 year plus 40% allowance for climate change, it is considered that both the peak flows and total flows from the onshore substations have been taken into consideration.

### 6.3 Conclusion

~~148. When looking at both of the assessments undertaken within section 6.3, it has been confirmed that for both the 1 in 100 year storm event and a 1 in 10 year storm event 24 hours after an initial 1 in 100 year storm event, using an infiltration rate of 10mm/hr, the 24 hour half drain time cannot be achieved.~~

~~149. Therefore, this model has proved that an infiltration rate of 10mm/hr would mean that an infiltration only design for the site is unviable.~~

~~150. However, the Applicant recognises that this is a worst-case, assumed infiltration rate and therefore this infiltration rate will differ once percolation testing has been undertaken. If percolation testing, which will be undertaken post consent, concludes a higher infiltration rate, this model will be re-run and a site-specific conclusion drawn. If percolation testing proves an infiltration only scheme to be viable, it will be adopted.~~

~~151. As the assumed infiltration rate of 10mm/hr indicates an infiltration only scheme to currently be unviable, the Applicant presents a scheme utilising both infiltration and attenuation as well as an attenuation only scheme. This is in line with the SuDS drainage hierarchy (SCC, 2018), discussed in section 6.1.~~

~~152. Section 7 presents a scheme using both infiltration and attenuation elements, with infiltration being the primary drainage source. All attenuation elements discharge to the Friston Watercourse.~~

~~153. Section 8 goes on to consider an attenuation only scheme based on the use of attenuation features and discharge to the Friston Watercourse. Both the hybrid infiltration and attenuation scheme (section 7) and attenuation only scheme (section 8) consider peak flows and total flows.~~



|



## ~~7 Hybrid Infiltration and Attenuation Scheme~~

149. In conclusion, a hybrid infiltration and attenuation scheme for the onshore substations can be accommodated within the site based on the agreed conservative 40mm/hr infiltration rate and a discharge using the FEH 2013 greenfield run-off rate.

150. The final design of this SuDS basin will be undertaken during the detailed design stage.



# 7 National Grid Substation SuDS

## Design

### 7.1 Basis of Outline Design

~~154-151.~~ Based on the pre-development greenfield runoff rate established in **section 3.9** and the ~~onshore substation and~~ National Grid infrastructure footprints in ~~Table 7.1~~ **Table 7.1**, the design parameters for the ~~onshore substations and~~ National Grid infrastructure are summarised in ~~Table 7.2~~ **Table 7.2**.

~~155.~~ Within this section, the same worst-case infiltration rate of 10mm/hr, as assumed above will be adopted, as agreed in Table 13 in the **Statement of Common Ground with SCG and ESC** (updated document submitted at Deadline 8, document reference ExA.SoCG-2.D8.V4).

**Table 7.1 Onshore National Grid Substation Hybrid Attenuation Design Impermeable Areas (all parameters are 100% impermeable)**

Component	East Anglia TWO (m <sup>2</sup> )	East Anglia ONE North (m <sup>2</sup> )	National Grid Infrastructure (m <sup>2</sup> )
Overall substation operational footprint	32,300	32,300	44,950
<del>Operational access road</del>		13,600	N/A
Overall cable sealing end compounds operational footprint	N/A		10,000
Permanent access road to cable sealing end compounds	N/A		1,850
<del>Infiltration/Attenuation Basin Footprint</del> basin footprint (including perimeter access track)			19,306 <del>10,602</del> 44,570
<b>Total impermeable area</b>			<del>97,506</del> <b>67,402</b> <del>69,122</del>

### 7.2 Results

~~156-152.~~ From the information within ~~Table 7.1, infiltration and~~ **Table 7.1**, attenuation storage requirements can be calculated and are summarised below in ~~Table 7.2~~ **Table 7.2** (see **Appendix 54** for all calculations).



**Table 7.2 Hybrid National Grid Attenuation Storage Requirements and Provision**

Storage (m <sup>3</sup> ) Component	East Anglia TWO (m <sup>3</sup> )	East Anglia ONE North (m <sup>3</sup> )	National Grid Infrastructure (m <sup>3</sup> )	Total (m <sup>3</sup> )
<b>Storage Required</b>				
Infiltration storage for 1 in 100 year (+40% for climate change)	8,715		5,268	13,983
Attenuation storage using FEH 2013 rainfall method			<del>3,918</del> <u>8,023</u>	<del>3,783</del> <u>7,701</u>
Additional attenuation storage for 1 in 10 year (+40% for climate change) <u>Total storage required</u>			<del>6,556</del> <u>8,023</u>	<del>4,633</del> <u>11,189</u>
Potential offset of existing depression adjacent to proposed substation	3,300		N/A	3,300
<b>Total Storage Required</b>	<b>22,489</b>		<b>13,684</b>	<b>36,173</b>
<b>Total Storage Provided</b> <u>storage provided</u> <sup>9</sup>			<del>23,127</del> <u>8,041</u>	<del>13,786</del> <u>36,913</u>

~~157. In **Table 7.2** the additional secondary test of a 1 in 10 year storm event (plus 40% climate change scenario), 24 hours after the initial 1 in 100 year (plus 40% climate change scenario) storm event has been included as the initial 1 in 100 year (plus 40% climate change scenario) did not have a 24 hour half drain time.~~

~~158.153. As shown in **Table 7.2**, the estimated storage requirements for an infiltration only scheme are slightly larger than the storage required for a hybrid scheme. **Appendix 5** **Appendix 4** provides detailed calculations of the above figures and [the plan in Appendix 65](#) shows an indicative layout of the ~~infiltration and~~ ~~basins~~ basin.~~

~~159.154. By limiting the runoff from the **Project** [National Grid substation](#) to the Q<sub>BAR</sub> pre-development greenfield runoff rate for all events up to and including the 1 in 100 year plus 40% allowance for climate change, it is considered that both the peak flows and total flows from the ~~proposed development~~ [National Grid substation](#) have been taken into consideration.~~

~~160. This is in accordance with the guidance set out in the **SCC FRMS Appendix A – Sustainable Drainage Systems (SuDS) A Local Design Guide Section 5 Suffolk Design Principles** in the table entitled Volume Control that:~~

<sup>9</sup> Figures do not include freeboard, perimeter access track and additional storage between track and basin top, however, they do include the volume of the existing depression adjacent to the proposed substation [Design figure for the 1 in 100 year storm \(+40% climate change\)](#).



~~“SCC recommend that for all sites discharging to a watercourse, the final permitted discharge rate for the entire site is 2l/s/ha or Qbar for all events up to the 1 in 100 + Climate Change event (Approach 2) — this then accounts for any volume control needed as per section 3.2 in EA document.”~~

~~161. The ability to accommodate a reduction in pre-development discharge rates is discussed further in **section 8.1**.~~

### ~~7.11.1~~ **Conclusion**

~~162. In conclusion, a hybrid infiltration and attenuation scheme can be accommodated within the site, based on the 10mm/hr infiltration rate and discharge using the FEH 2013 greenfield run-off rate.~~

~~163. As the 24 hour drain time was not viable the Applicant assessed the storage required for a secondary 1 in 10 year storm event (plus 40% climate change scenario), 24 hours after the initial 1 in 100 year (plus 40% climate change scenario) storm event, as requested by SCC. By adopting these parameters it has been confirmed that sufficient storage can be provided within the Order Limits for the hybrid scheme.~~





## 8 ~~Attenuation Only Scheme~~

164. ~~Based on the pre-development greenfield runoff rate established in **section 3.9** and the onshore substation and National Grid infrastructure footprints in **Table 8.1**, the design parameters for the onshore substations and National Grid infrastructure are summarised in **Table 8.2**.~~

**Table 8.1 Onshore Substation Attenuation Design Impermeable Areas (all parameters are 100% impermeable)**

Component	East Anglia TWO (m <sup>2</sup> )	East Anglia ONE North (m <sup>2</sup> )	National Grid Infrastructure (m <sup>2</sup> )
Overall substation operational footprint	32,300	32,300	44,950
Operational access road	13,600		N/A
Overall cable sealing end compounds operational footprint	N/A		40,000
Permanent access road to cable sealing end compounds	N/A		1,850
Attenuation Basin Footprint (including perimeter access track)	18,300		40,602
<b>Total impermeable area</b>	<b>96,500</b>		<b>67,402</b>

165. ~~From the information within **Table 8.1**, attenuation storage requirements can be calculated and are summarised below in **Table 8.2** (see **Appendix 7** for all calculations).~~

**Table 8.2 Attenuation Storage Requirements and Provision**

Attenuation Storage (m <sup>3</sup> )	East Anglia TWO (m <sup>3</sup> )	East Anglia ONE North (m <sup>3</sup> )	National Grid Infrastructure (m <sup>3</sup> )	Total (m <sup>3</sup> )
<b>Storage Required</b>				
Attenuation storage using FEH 2013 rainfall method	11,593		8,025	19,618
Potential offset of existing depression	3,300		N/A	3,300



Attenuation Storage (m <sup>3</sup> )	East Anglia TWO (m <sup>3</sup> )	East Anglia ONE North (m <sup>3</sup> )	National Grid Infrastructure (m <sup>3</sup> )	Total (m <sup>3</sup> )
adjacent to proposed substation				
<b>Total Storage Required</b>	14,893		8,024	22,917
<b>Total Storage Provided<sup>10</sup></b>	<b>14,962</b>		<b>8,041</b>	<b>23,032</b>

~~166. As shown in **Table 8.2**, the estimated storage requirements for an infiltration only scheme is larger than the storage required for an attenuation only scheme. **Appendix 7** provides detailed calculations of the above figures and **Appendix 8** shows an indicative layout of the attenuation basins.~~

~~167. By limiting the runoff from the proposed development to the  $Q_{BAR}$  pre-development greenfield runoff rate for all events up to and including the 1 in 100 year plus 40% allowance for climate change, it is considered that both the peak flows and total flows from the proposed development have been taken into consideration.~~

~~168. This is in accordance with the guidance set out in the SCC FRMS Appendix A – Sustainable Drainage Systems (SuDS) A Local Design Guide Section 5 Suffolk Design Principles in the table entitled Volume Control that:~~

~~*“SCC recommend that for all sites discharging to a watercourse, the final permitted discharge rate for the entire site is 2l/s/ha or  $Q_{bar}$  for all events up to the 1 in 100 + Climate Change event (Approach 2) – this then accounts for any volume control needed as per section 3.2 in EA document.”*~~

### **8.17.3 Ability to Accommodate Reduction in Pre-development Discharge Rate**

~~169-155.~~ 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 runoff 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.

<sup>10</sup> Figures do not include freeboard, perimeter access track and additional storage between track and basin top, however, they do include the volume of the existing depression adjacent to the proposed substation



- ~~170.~~156. The existing greenfield runoff rate will be confirmed during the detailed design stage in line with this OODMP and will not be exceeded post-development.
- ~~171.~~157. For the purpose of establishing a realistic indicative SuDS attenuation basin design and existing greenfield runoff rate, in compliance with the relevant guidelines set out in **section 2** of this document, the Applicant has assessed the storage requirements based on the footprints in **Table 7.1** and **Table 7.2**.
- ~~172.~~158. As demonstrated by the design assumptions in **Appendix 7.4**, these attenuation storage requirements, as summarised in **Table 7.2**, would allow the discharge rate to be limited to the  $Q_{BAR}$  pre-development greenfield runoff rate of 7.91l/s and 5.52l/s for the ~~onshore substations and the~~ National Grid substation respectively. Once detailed hydraulic modelling has been undertaken post consent, the actual  $Q_{BAR}$  pre-development greenfield runoff rate will be confirmed, and these runoff rates adopted for discharge to the Friston Watercourse.
- ~~173.~~159. Should the  $Q_{BAR}$  rates stated in paragraph **158** reduce as a result of establishing the actual  $Q_{BAR}$  rate during the detailed design process (i.e. with reference to the results of detailed hydraulic modelling), the discharge rate to the Friston Watercourse would be reduced by the Applicant accordingly. This would require an increase in capacity of the SuDS attenuation ~~basins~~basin.
- ~~174.~~160. ~~Table 8.3 and Table 8.4 demonstrate~~ Table 7.3 demonstrates that a larger storage ~~basins~~basin can be accommodated within the Order limits and in conjunction with the landscaping proposed within the **Outline Landscape and Ecological Management Strategy** (~~updated version submitted at Deadline 8,~~ document reference 8.7), should this be required.
- ~~175.~~161. ~~Table 8.3 and Table 8.4 also show~~ Table 7.3 also shows that there is flexibility to design a surface water management scheme to reflect the actual pre-development greenfield runoff rates, whilst considering factors such as landscaping, ecology and optimal land use. ~~Note that in both Table 8.3 and Table 8.4,~~ Note that in Table 7.3, there are no  $Q_{BAR}$  rates below 5l/s, as these are generally taken to be the lower limits for discharge due to the technical design constraints related to the risk of blockage to outlets and ensuring that pipes etc can self-cleanse; however, the practicalities associated with this parameter would need to be subject to further consideration during the detailed design.



~~Table 8.3 Onshore Substations  $Q_{BAR}$  Flexibility, Storage Requirements and Order Limit Capacity~~

Discharge Rate (l/s)	Storage Requirement (m <sup>3</sup> )	Storage Capacity in Existing Outline Basin Design?	Accommodated within Order Limits?
7.9 ( $Q_{BAR}$ )	14,893	Y	Y
7.5	14,945	Y	Y
7.0	15,029	Y	Y
6.5	15,113	Y	Y
6.0	15,199	Y	Y
5.5	15,283	Y	Y
5.0	15,379	Y	Y

~~Table 8.4~~ [Table 7.3](#) National Grid Substation  $Q_{BAR}$  Flexibility, Storage Requirements and Order Limit Capacity

Discharge Rate (l/s)	Storage Requirement (m <sup>3</sup> )	Within Existing Outline Basin Design?	Accommodated within Order Limits?
5.5 ( $Q_{BAR}$ )	8,024	Y	Y
5.0	8,088	Y	Y



## **7.4 Conclusion**

162. In conclusion, an attenuation scheme for the National Grid infrastructure can be accommodated within the site based on the discharge using the FEH 2013 greenfield run-off rate.
163. The final design of this SuDS basin will be undertaken during the detailed design stage.



## 98 Foul Water Drainage

### 9.18.1 Introduction

~~176.164.~~ The wastewater 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 which is also 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 OODMP for completeness. The final ODMP will confirm the foul water drainage solution to be adopted.

### 9.28.2 Onshore Substations and National Grid Substation Foul Water

~~177.165.~~ As a first preference, foul drainage at the onshore substations and National Grid substation will be collected through a mains connection to the existing 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.

~~178.166.~~ 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 ODMP.

~~179.167.~~ 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<sup>3</sup> 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 wastewater treatment and disposal facility.



### **9.38.3 Maintenance**

~~180-168.~~ 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 off valves, sensors and alarms to ensure they are all functioning correctly. All maintenance activities shall also be recorded.



## 109 Summary

~~181.169.~~ This OODMP 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, hydrology and hydrogeological setting and considers the ways in which the potential impacts of surface and foul water from the onshore substations and National Grid infrastructure, once operational, will be minimised.

~~182.170.~~ 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. This forms the cornerstone of the Applicant's surface water drainage solution.

~~171.~~ ~~As discussed in section 6, although an~~ The Applicant has undertaken a tiered approach to selecting the most suitable Sustainable Drainage System (SuDS) to manage the surface water at the onshore substation and National Grid infrastructure site. The proposed solution has been informed by site specific testing of infiltration only scheme is currently proving unviable due to the worst case 10mm/hr rates. The key parameters of the outline design presented within this OODMP have been agreed with the LLFA.

~~183.172.~~ The Applicant has shared infiltration rate assumed, this is a worst-case scenario and is likely to change once percolation testing has been undertaken. If testing data (Infiltration Test Results (May 2021), document reference ExA.AS-2.D11.5.V5)) with the LLFA who has agreed that current results are insufficient to adopt an infiltration only design proves viable once percolation solution at this stage. Further infiltration testing has been will be undertaken and ground water levels are established, it will be implemented as part of the final SuDS detailed design process to confirm final infiltration rates and inform the micro siting of the SuDS basins and maximise the use of infiltration where practicable.

~~184.173.~~ As outlined in section 7 and section 8 section 6, a hybrid infiltration and attenuation scheme and an attenuation only scheme have both has proved viable and are for the onshore substations and is considered acceptable as a means of surface water management in line with the SuDS hierarchy (SCC, 2018). Although it is not the Applicant's preference to adopt either of these schemes, they have been presented to provide a comprehensive assessment should an infiltration only scheme not prove practicable. The LLFA are in agreement with this approach.





~~174.~~ ~~As presented in **section 7** and **section 8**, if a hybrid infiltration and attenuation, or an attenuation only scheme were to be adopted, there~~ For the National Grid infrastructure the attenuation only solution is presented in **section 7**. The LLFA are in agreement with this approach. There is flexibility in the outline attenuation design to accommodate a reduced  $Q_{BAR}$  rate and increased storage capacity within the Order limits if required. ~~Ground~~

~~185.~~175. Further ground investigations at the location of the onshore substations and National Grid infrastructure will be undertaken and will inform the final ODMF. ~~Percolation~~This will include infiltration tests ~~will be undertaken as part of the detailed design process to determine~~confirm the underlying permeability ~~and the feasibility of adopting an infiltration,~~ to allow final design of the hybrid infiltration ~~and~~ attenuation ~~or attenuation only SuDS design~~scheme with a connection to the Friston Watercourse. This process is summarised below in **Plate 3**.

~~186.~~ ~~The uncontaminated waters from roofs and hardstanding (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 either infiltration, hybrid infiltration and attenuation or attenuation of the uncontaminated waters and therefore potentially a controlled onward flow. If an onward flow is required, the  $Q_{BAR}$  discharge rate will be limited to that of the pre-development greenfield runoff rate. This is designed to ensure there would be 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.~~

~~187.~~176. ~~In addition, it~~ is recognised that the onshore substations and National Grid infrastructure are situated within an area of existing conveyance routes and watercourses. The Applicant is committed to ensuring that these flow routes are appropriately managed and will ensure continued conveyance around the northern perimeter of the National Grid substation. The Applicant also recognises that there are existing surface water flood storage depressions ~~(as shown in **Appendix 4**, **Appendix 6** and **Appendix 8**)~~ and commits to offsetting any reduction in volume within the final drainage scheme. This process will be influenced by the detailed design process of the onshore substations and National Grid infrastructure.

~~188.~~177. 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.

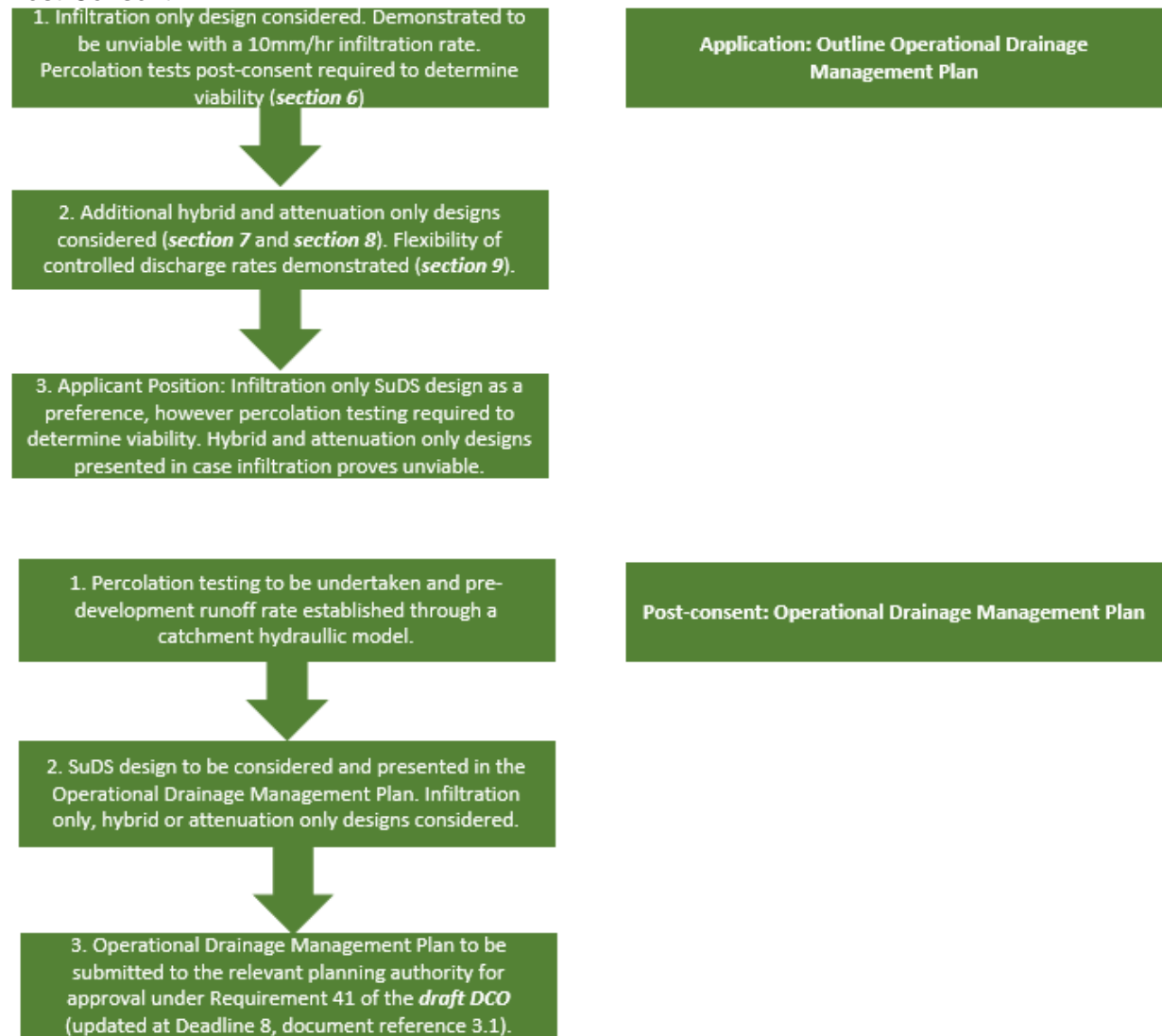


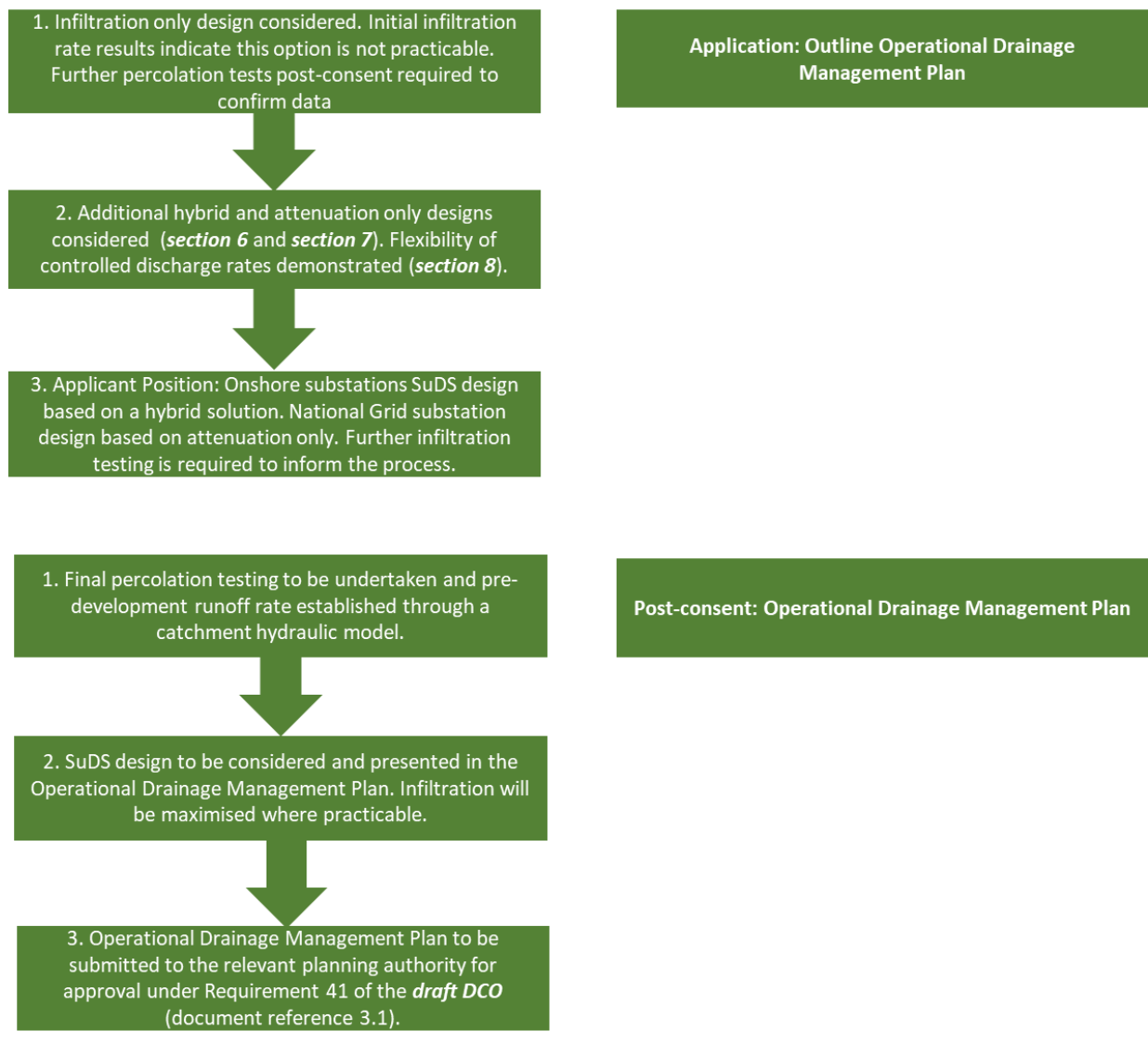
~~189-178.~~ Additional sensors, auto shut off valves and alarms will also be added to the drainage equipment installed as appropriate, to provide operators with a warning of any potential problem with pollution control equipment installed, to ensure they can take appropriate action. All equipment and the SuDS elements will be included in routine maintenance to ensure they remain fully effective.

179. The Applicant will be responsible for the maintenance of the SuDS system to the point of discharge to the Friston Watercourse. Any additional inspection or maintenance works required on the Friston watercourse (Main River) due to the Project, will be addressed by way of an agreement with the Environment Agency prior to commencement of Work Nos 30 and 41. This is a common process for promoters of a wide range of developments which connect their surface water drainage to a main river.



**Plate 3. Flow Chart Summarising the Applicant’s Application of the SuDS Hierarchy and Strategy Post-Consent**







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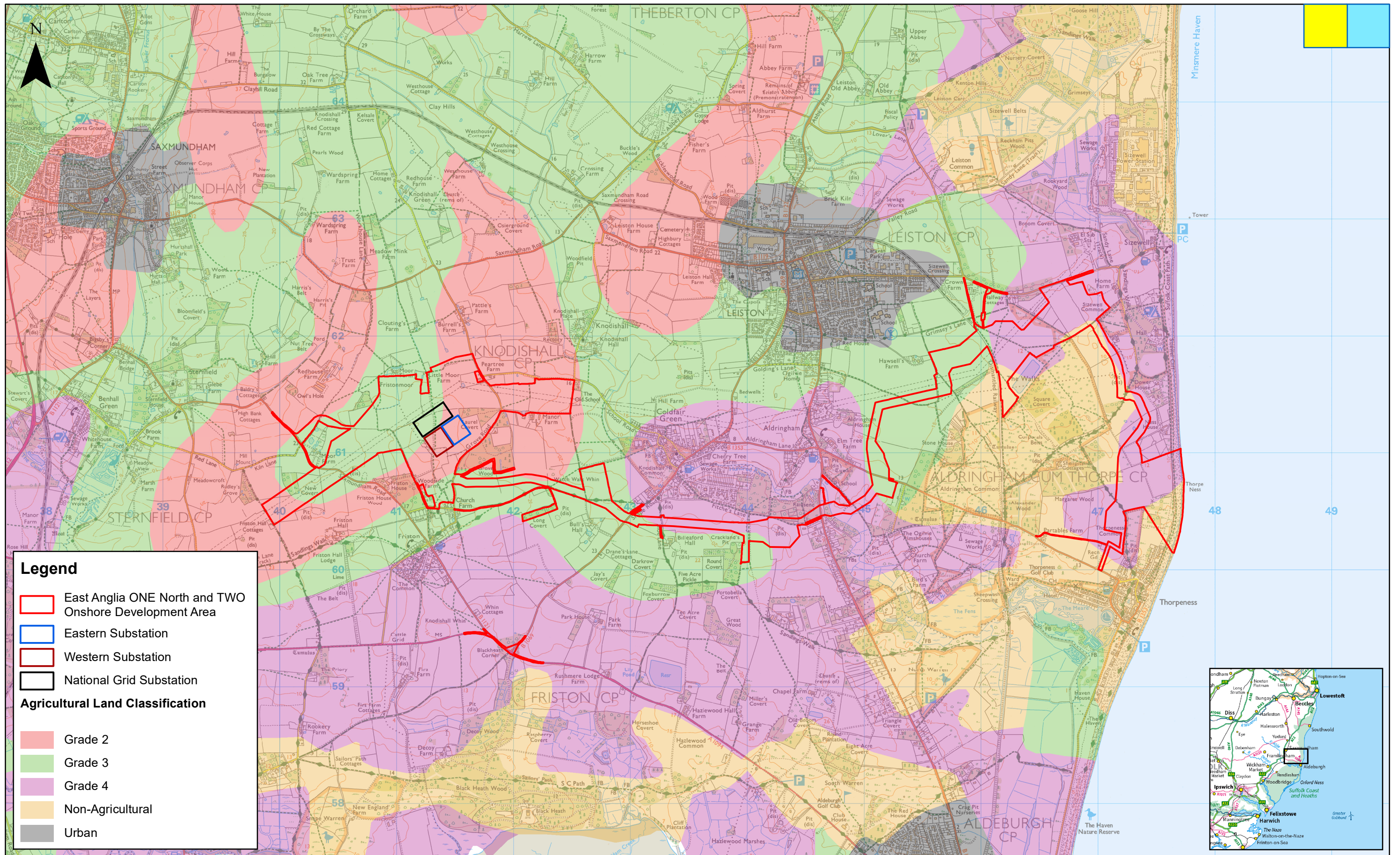
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# Appendix 1: Figures Showing Existing Site Conditions

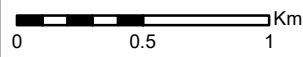


- Legend**
- East Anglia ONE North and TWO Onshore Development Area
  - Eastern Substation
  - Western Substation
  - National Grid Substation
- Agricultural Land Classification**
- Grade 2
  - Grade 3
  - Grade 4
  - Non-Agricultural
  - Urban



5	10/06/2021	AB	Fifth Issue.		
4	22/02/2021	AB	Fourth Issue.	Prepared:	AB
3	04/12/2020	AB	Third Issue.	Checked:	PB
<b>Rev</b>	<b>Date</b>	<b>By</b>	<b>Comment</b>	<b>Approved:</b>	<b>FM</b>

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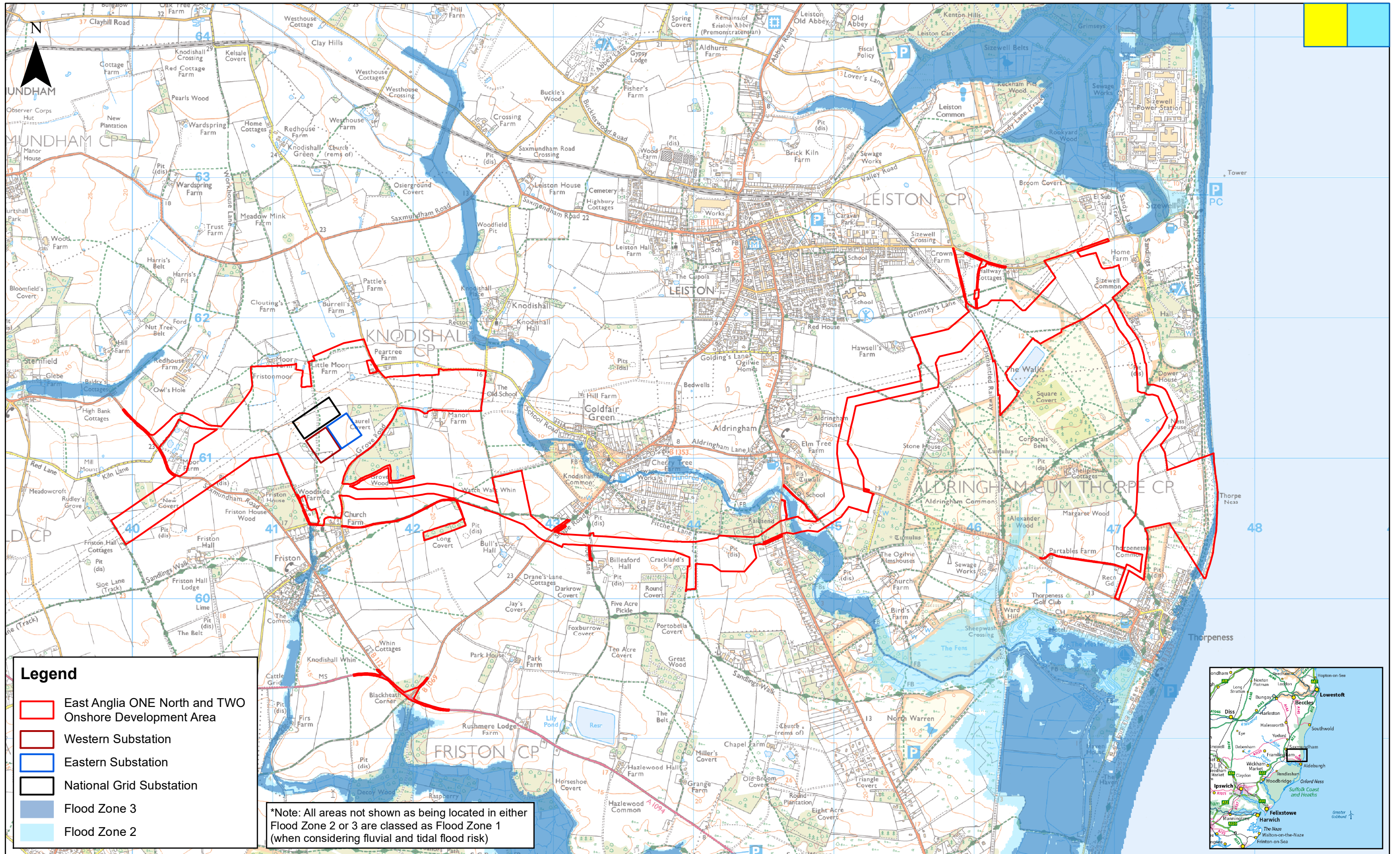


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This map has been produced to the latest known information at the time of issue, and has been produced for your information only. Please consult with the SPR Onshore GIS team to ensure the content is still current before using the information contained on this map. To the fullest extent permitted by law, we accept no responsibility or liability (whether in contract, tort (including negligence) or otherwise in respect of any errors or omissions in the information contained in the map and shall not be liable for any loss, damage or expense caused by such errors or omissions.

## East Anglia ONE North and TWO Outline Operational Drainage Management Plan Agricultural Land Classification

<b>Drg No</b>	EA1N-EA2-DEV-DRG-IBR-001128	
<b>Rev</b>	5	Coordinate System: BNG
<b>Date</b>	10/06/21	Datum: OSGB36
<b>Figure</b>	1	



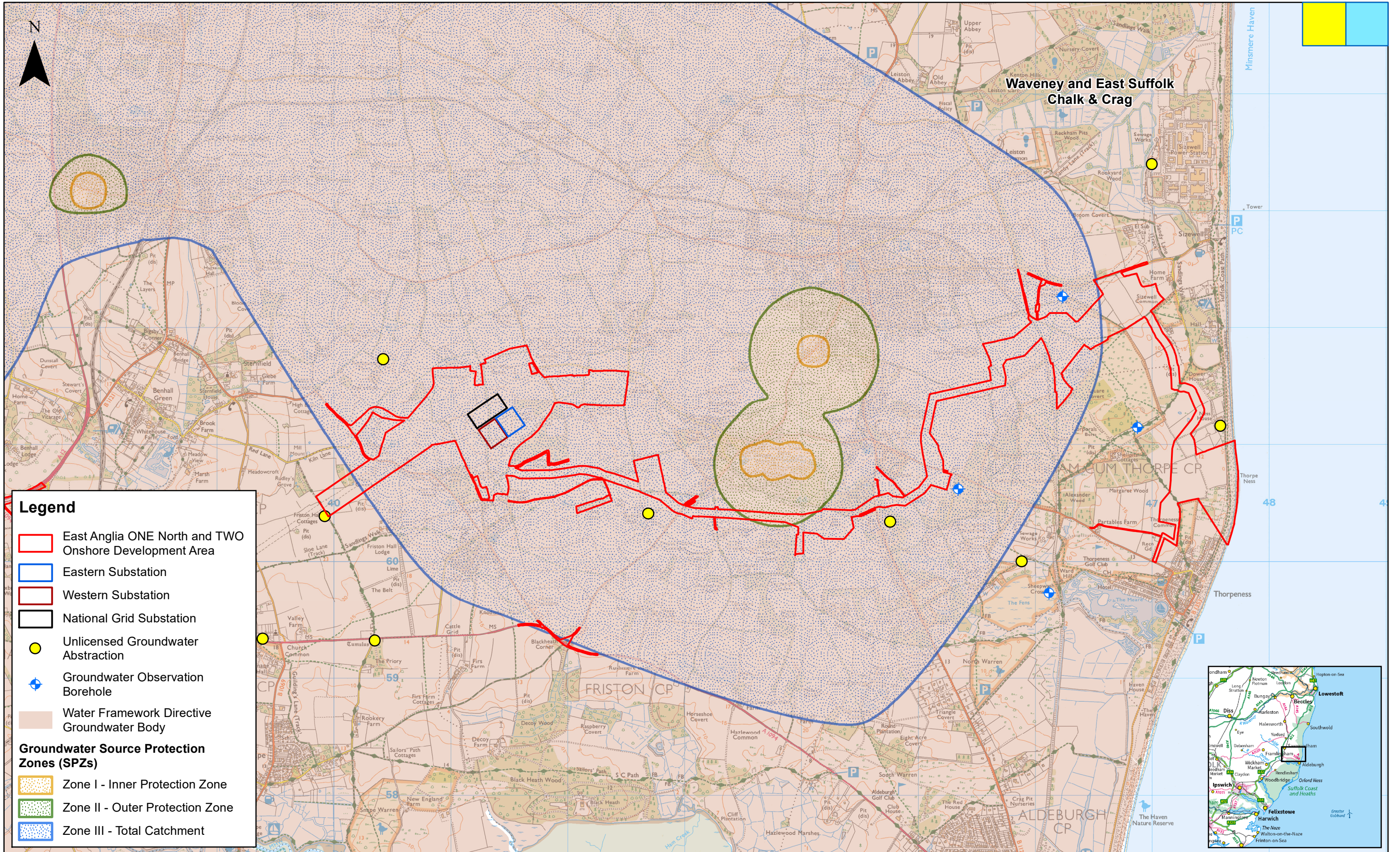


5	10/06/2021	AB	Fifth Issue.		
4	22/02/2021	AB	Fourth Issue.	Prepared:	AB
3	04/12/2020	AB	Third Issue.	Checked:	PB
<b>Rev</b>	<b>Date</b>	<b>By</b>	<b>Comment</b>	<b>Approved:</b>	<b>FM</b>

1:25,000	Scale @ A3	0	0.5	1	Km
<small>Source: © Environment Agency, 2021. © Crown copyright and database rights 2021. Ordnance Survey 0100031673.          This map has been produced to the latest known information at the time of issue, and has been produced for your information only.          Please consult with the SPR Onshore GIS team to ensure the content is still current before using the information contained on this map.          To the fullest extent permitted by law, we accept no responsibility or liability (whether in contract, tort (including negligence) or otherwise in respect of any errors or omissions in the information contained in the map and shall not be liable for any loss, damage or expense caused by such errors or omissions.</small>					

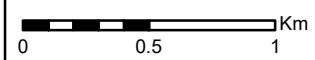
**East Anglia ONE North and TWO**  
 Outline Operational Drainage Management Plan  
 Environment Agency Flood Zones

<b>Drg No</b>	EA1N-EA2-DEV-DRG-IBR-001129	
<b>Rev</b>	5	Coordinate System: BNG
<b>Date</b>	10/06/21	Datum: OSGB36
<b>Figure</b>	2	



5	10/06/2021	AB	Fifth Issue.		
4	22/02/2021	AB	Fourth Issue.	Prepared:	AB
3	04/12/2020	AB	Third Issue.	Checked:	PB
<b>Rev</b>	<b>Date</b>	<b>By</b>	<b>Comment</b>	<b>Approved:</b>	<b>FM</b>

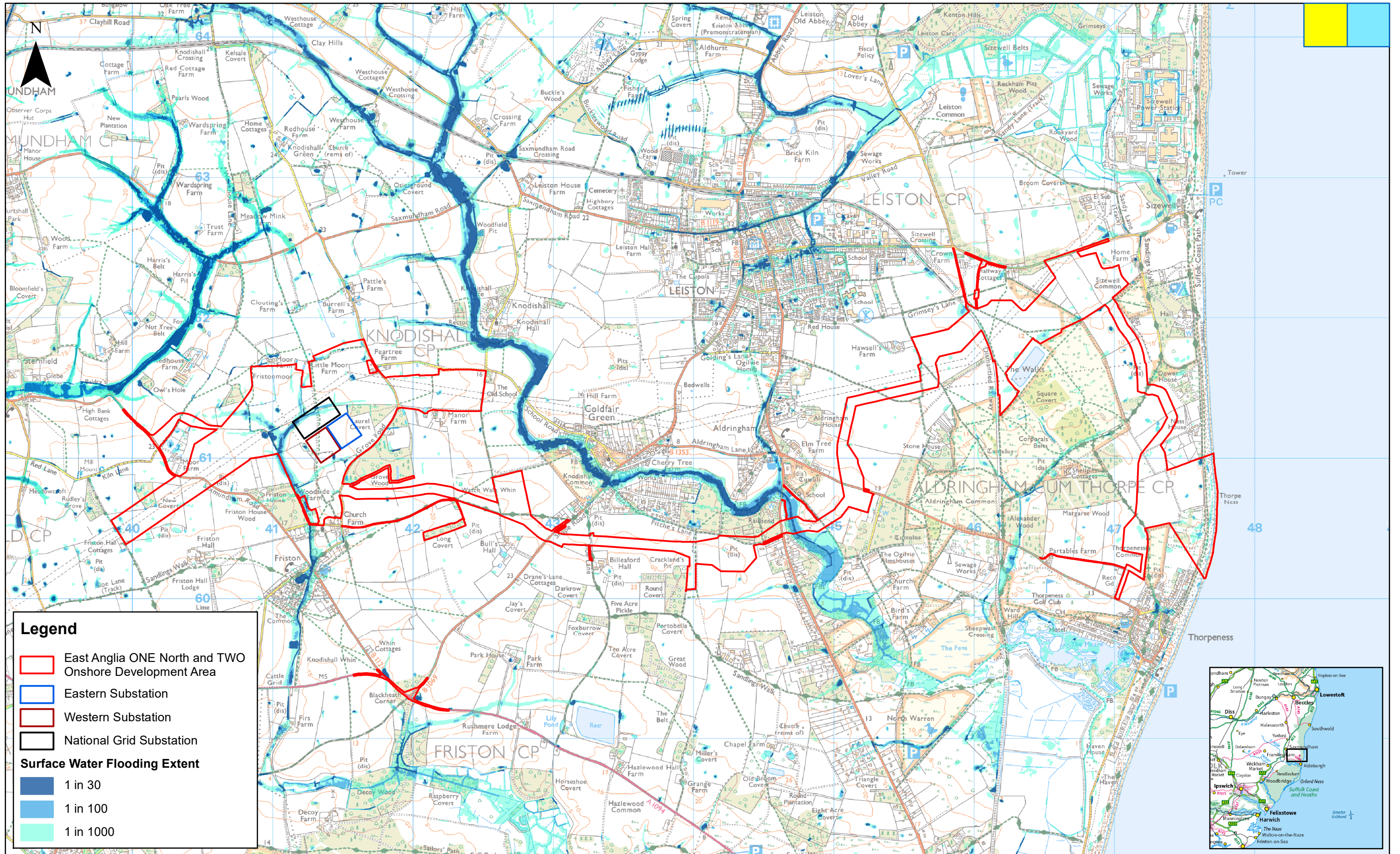
1:30,000  
Scale @ A3



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**East Anglia ONE North and TWO**  
Outline Operational Drainage Management Plan  
Groundwater Receptors

<b>Drg No</b>	EA1N-EA2-DEV-DRG-IBR-001130	
<b>Rev</b>	5	Coordinate System: BNG
<b>Date</b>	10/06/21	Datum: OSGB36
<b>Figure</b>	3	



5	10/06/2021	AB	Fifth Issue.		
4	22/02/2021	AB	Fourth Issue.	Prepared:	AB
3	04/12/2020	AB	Third Issue.	Checked:	PB
Rev	Date	By	Comment	Approved:	FM

1:25,000	Scale @ A3	0	0.5	1
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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	5	Coordinate System: BNG
Date	10/06/21	Datum: OSGB36
Figure	4	

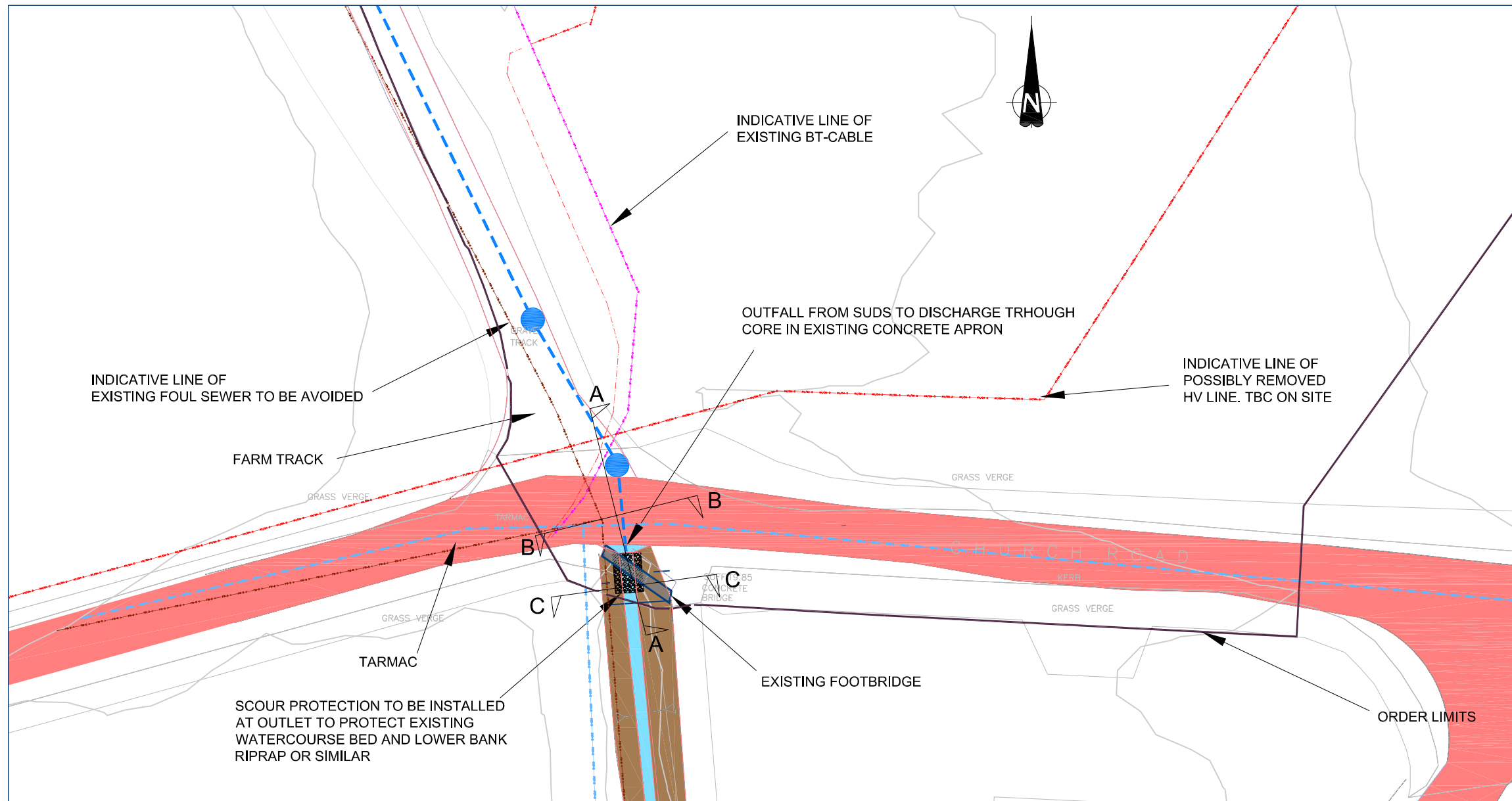


## Appendix 2: SuDS Outfall Concept Design to the Friston Watercourse

DO NOT SCALE FROM THIS DRAWING

General Notes

- 1) This drawing is to read in conjunction with the relevant specification and all other relevant drawings issued by the engineer and architect.
- 2) All dimensions and levels to be checked on site and the engineer notified of any discrepancies prior to commencement of work.
- 3) All switched off, frozen, or not schedules to print layers within electronic issues of this drawing should be disregarded.
- 4) All dimensions are in metres unless noted otherwise. All levels are in metres.
- 5) Utilities indicated for information only. Exact locations to be confirmed on site prior to works commencing.



REVISION	DETAILS	DATE	DRN	CHK'D	APP'D

CLIENT	Haskoning DHV UK Limited
--------	--------------------------

PROJECT	East Anglia Offshore Wind EA1N & EA2
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DRAWING TITLE	SUDS Basin Alternative Outfall Church Lane Culvert Surface Water Diversion Concept
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DRG No.	ED11892-GE-3016	REV	-
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DRG SIZE	A3	SCALE	NTS	DATE	11/06/2021
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DRAWN BY	IA	CHECKED BY	SH	APPROVED BY	SH
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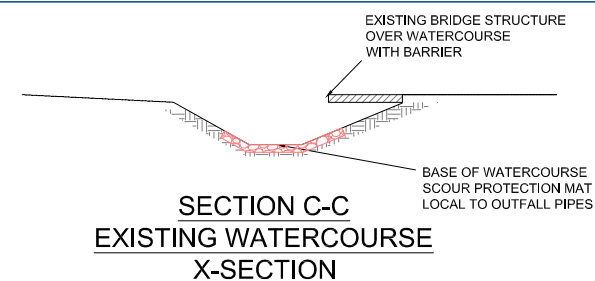
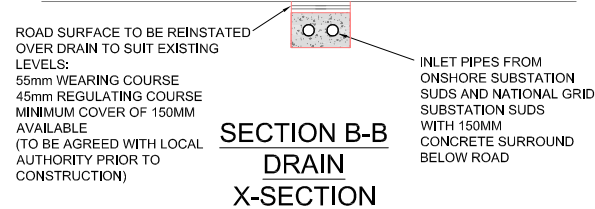
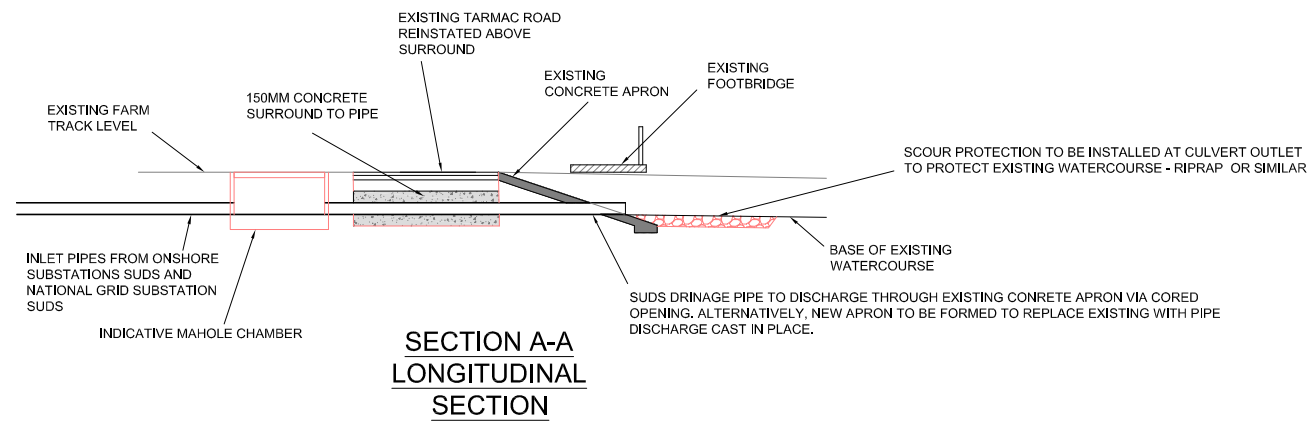
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<input type="checkbox"/> BIRMINGHAM	<input type="checkbox"/> LEEDS
<input type="checkbox"/> BOLTON	<input type="checkbox"/> LONDON
<input type="checkbox"/> CARDIFF	<input type="checkbox"/> MANCHESTER
<input type="checkbox"/> CARLISLE	<input type="checkbox"/> NEWCASTLE UPON TYNE
<input type="checkbox"/> EDINBURGH	<input type="checkbox"/> STOKE ON TRENT

**Drainage Systems**

	Foul Drainage
	Proposed Surface Water Drainage
<b>Electrical Systems</b>	
	High Voltage
	High Voltage Overhead
	Low Voltage
<b>Telecom Systems</b>	
	British Telecom
<b>Water Systems</b>	
	Potable Supply





# Appendix 3: Onshore Substations Hybrid Scheme Model Outputs

SUDS Design Summary - Hybrid Design - Safety Factor 10 - EA2 / EA1N Only - 09.06.21				
<b>Notes:</b>				
1. SUDS design proposal to attenuate surface water flows from hardstanding areas associated with EA2 / EA1N and National Grid substations (including access roads and cable sealing compounds).				
2. Separate SUDS required for EA2/EA1N project substations and National Grid infrastructure.				
3. EA2/EA1N project substations and access roads discharge to SUDS Basin then to ground via infiltration with overflow 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. NG substation and sealing end compounds discharge to SUDS Basin then to ground via infiltration with overflow 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. Infiltration rates estimated as 40mm/hr.				
6. 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.				
7. Pre Development discharge rates estimated using FEH method - HR Wallingford Greenfield Runoff Rate Estimation Online Tool.				
8. SUDS sizing estimated using FEH13 Rainfall and Micro Drainage design software.				
9. Safety factor of 10 used in initial design for 24 hour half drain down.				
10. Additional SUDS to be provided as source control / treatment during detailed design.				
Design Parameters / Assumptions	EA2	EA1N	National Grid	Change Notes
<b>Hardstanding (all footprints assumed 100% impermeable)</b>				
Substation operational footprint	32,300 m <sup>2</sup>	32,300 m <sup>2</sup>	-	
Operational access road		13,600 m <sup>2</sup>	-	
Cable sealing end compound operational footprint		-	-	
Permanent access road to sealing end compound		-	-	
SUDS Basin Footprint (including perimeter access track)		12,880 m <sup>2</sup>	-	
<b>Total</b>		<b>91,080 m<sup>2</sup></b>	-	
<b>Pre-Development Run-Off Rates (calculated from HR Wallingford Greenfield Runoff Rate Estimation Online Tool)</b>				
2 l/s/ha		18.22 l/s	-	
		<b>FEH</b>	-	
1 Year Return		6.49 l/s	-	
<b>2 Year Return (Q<sub>24h</sub>)</b>		<b>7.46 l/s</b>	-	
30 Year Return		18.29 l/s	-	
100 Year Return		26.57 l/s	-	
200 Year Return		31.43 l/s	-	
<b>Untenuated Flow Discharging to SUDS from Harstanding (calculated from FEH13 Rainfall using Micro Drainage design software)</b>				
		<b>FEH13</b>	-	
1 Year Return + 40% CC		N/A	-	
2 Year Return + 40% CC		68.0 l/s	-	
30 Year Return + 40% CC		173.0 l/s	-	
100 Year Return + 40% CC		285.5 l/s	-	
200 Year Return + 40% CC		362.3 l/s	-	
<b>Attenuated Post Development Run-Off Rates</b>				
Limited to pre-development (2-year FEH) run-off rate. Provides betterment over 2 l/s/ha rate and IH124 rate.				
<b>Pre / Post Development Reduction In Run-Off Rates (pre development rates minus attenuated post development rates)</b>				
1 Year Return		N/A	-	
2 Year Return		60.54 l/s	-	
30 Year Return		165.54 l/s	-	
100 Year Return		267.21 l/s	-	
200 Year Return		346.65 l/s	-	
<b>Design Infiltration Rates</b>				
40mm/hr				
<b>Design Storm Event</b>				
1 in 100 year + 40% climate change as per SCC guidance.				
<b>Attenuation Storage Required (calculated from FEH13 Rainfall using Micro Drainage design software)</b>				
All Hardstanding Areas		<b>FEH13</b>	-	
Infiltration Only (up to 1:30 YR + 40% CC)		6,622.2 m <sup>3</sup>	-	
Detention Only (up to 1:100 YR +40% CC)		3,017.5 m <sup>3</sup>	-	
<b>Total storage required</b>		<b>9,639.7 m<sup>3</sup></b>	-	
<b>Attenuation Dimensions</b>				
Design Top area		10,847 m <sup>2</sup>	-	
Freeboard Top area		11,311 m <sup>2</sup>	-	
Perimeter access track top area		12,714 m <sup>2</sup>	-	
Basin Top area		12,880 m <sup>2</sup>	-	
Base area		9,370 m <sup>2</sup>	-	
Design storage depth		1.0 m	-	
Design freeboard + 0.3m		0.3 m	-	
Overall depth		1.5 m	-	
Side slopes		1 in 4	-	
<b>Attenuation Storage Provided</b>				
<b>Detention Basins</b>				
Hybrid Basin Design		10,108.5 m <sup>3</sup>	-	
Freeboard		3,323.70 m <sup>3</sup>	-	
Perimeter access track		1,201.25 m <sup>3</sup>	-	
Additional storage between track and basin top		1,279.70 m <sup>3</sup>	-	
<b>Total (design)</b>		<b>10,108.50 m<sup>3</sup></b>	-	
Total (inc. freeboard, access track etc)		15,913.15 m <sup>3</sup>	-	
<b>Design storage required &lt; attenuation storage provided?</b>		<b>YES = OK</b>	-	
<b>Discharge Location</b>	Existing watercourse in Church Lane via new outfall pipe as per existing drainage regime. Provides additional betterment over existing arrangement by reducing flood flows down existing farm track.			Design flows up to 1:100 year + 40% CC are attenuated within the basin design depth - including allowance for loss of existing depression adjacent to EA1N substation.  Additional 300mm freeboard provided provided over and above design capacity with another 200mm to the top of the basin

Calculated by:

Site name:

Site location:

## Site Details

Latitude:

Longitude:

Reference:

Date:

This is an estimation of the greenfield runoff rates that are used to meet normal best practice criteria in line with Environment Agency guidance "Rainfall runoff management for developments", SC030219 (2013), the SuDS Manual C753 (Ciria, 2015) and the non-statutory standards for SuDS (Defra, 2015). This information on greenfield runoff rates may be the basis for setting consents for the drainage of surface water runoff from sites.

## Runoff estimation approach

## Site characteristics

Total site area (ha):

## Methodology

Q<sub>MED</sub> estimation method:

BFI and SPR method:

HOST class:

BFI / BFIHOST:

Q<sub>MED</sub> (l/s):

Q<sub>BAR</sub> / Q<sub>MED</sub> factor:

## Hydrological characteristics

	Default	Edited
SAAR (mm):	585	585
Hydrological region:	5	5
Growth curve factor 1 year:	0.87	0.87
Growth curve factor 30 years:	2.45	2.45
Growth curve factor 100 years:	3.56	3.56
Growth curve factor 200 years:	4.21	4.21

## Notes

### (1) Is Q<sub>BAR</sub> < 2.0 l/s/ha?

When Q<sub>BAR</sub> is < 2.0 l/s/ha then limiting discharge rates are set at 2.0 l/s/ha.

### (2) Are flow rates < 5.0 l/s?

Where flow rates are less than 5.0 l/s consent for discharge is usually set at 5.0 l/s if blockage from vegetation and other materials is possible. Lower consent flow rates may be set where the blockage risk is addressed by using appropriate drainage elements.

### (3) Is SPR/SPRHOST ≤ 0.3?

Where groundwater levels are low enough the use of soakaways to avoid discharge offsite would normally be preferred for disposal of surface water runoff.

## Greenfield runoff rates

	Default	Edited
Q <sub>BAR</sub> (l/s):	<input type="text"/>	7.46
1 in 1 year (l/s):	<input type="text"/>	6.49
1 in 30 years (l/s):	<input type="text"/>	18.29
1 in 100 year (l/s):	<input type="text"/>	26.57
1 in 200 years (l/s):	<input type="text"/>	31.43

This report was produced using the greenfield runoff tool developed by HR Wallingford and available at www.uksuds.com. The use of this tool is subject to the UK SuDS terms and conditions and licence agreement, which can both be found at www.uksuds.com/terms-and-conditions.htm. The outputs from this tool are estimates of greenfield runoff rates. The use of these results is the responsibility of the users of this tool. No liability will be accepted by HR Wallingford, the Environment Agency, CEH, Hydrosolutions or any other organisation for the use of this data in the design or operational characteristics of any drainage scheme.



Unit 5, Newton Business Park  
 Newton Chambers Road  
 Sheffield S35 2PH

East Anglia  
 EA2/EA1N  
 Infiltration 1:30 YR +40%



Date 01/06/2021  
 File Project Subs - Basin - FEH 2YR ...

Designed by CS  
 Checked by

XP Solutions

Source Control 2018.1

Summary of Results for 30 year Return Period (+40%)

Half Drain Time : 4572 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Overflow (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	14.671	0.171	11.0	0.0	11.0	1625.9	O K
30 min Summer	14.726	0.226	11.2	0.0	11.2	2158.4	O K
60 min Summer	14.784	0.284	11.3	0.0	11.3	2717.7	O K
120 min Summer	14.857	0.357	11.6	0.0	11.6	3439.4	O K
180 min Summer	14.903	0.403	11.7	0.0	11.7	3896.1	O K
240 min Summer	14.937	0.437	11.8	0.0	11.8	4228.9	O K
360 min Summer	14.983	0.483	12.0	0.0	12.0	4690.8	O K
480 min Summer	15.013	0.513	12.1	0.0	12.1	4995.2	O K
600 min Summer	15.034	0.534	12.2	0.0	12.2	5209.4	O K
720 min Summer	15.050	0.550	12.2	0.0	12.2	5367.1	O K
960 min Summer	15.070	0.570	12.3	0.0	12.3	5574.4	O K
1440 min Summer	15.089	0.589	12.4	0.0	12.4	5765.0	O K
2160 min Summer	15.089	0.589	12.4	0.0	12.4	5772.7	O K
2880 min Summer	15.079	0.579	12.3	0.0	12.3	5662.7	O K
4320 min Summer	15.049	0.549	12.2	0.0	12.2	5365.4	O K
5760 min Summer	15.027	0.527	12.1	0.0	12.1	5137.8	O K
7200 min Summer	14.500	0.000	0.0	0.0	0.0	0.0	O K
8640 min Summer	14.500	0.000	0.0	0.0	0.0	0.0	O K
10080 min Summer	14.500	0.000	0.0	0.0	0.0	0.0	O K
15 min Winter	14.692	0.192	11.0	0.0	11.0	1821.8	O K
30 min Winter	14.753	0.253	11.2	0.0	11.2	2418.9	O K
60 min Winter	14.817	0.317	11.5	0.0	11.5	3046.9	O K
120 min Winter	14.900	0.400	11.7	0.0	11.7	3859.0	O K
180 min Winter	14.951	0.451	11.9	0.0	11.9	4375.1	O K
240 min Winter	14.989	0.489	12.0	0.0	12.0	4751.9	O K
360 min Winter	15.041	0.541	12.2	0.0	12.2	5277.7	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Overflow Volume (m³)	Time-Peak (mins)
15 min Summer	95.704	0.0	0.0	19
30 min Summer	63.672	0.0	0.0	34
60 min Summer	40.264	0.0	0.0	64
120 min Summer	25.669	0.0	0.0	124
180 min Summer	19.516	0.0	0.0	184
240 min Summer	15.988	0.0	0.0	244
360 min Summer	11.965	0.0	0.0	364
480 min Summer	9.667	0.0	0.0	484
600 min Summer	8.156	0.0	0.0	604
720 min Summer	7.080	0.0	0.0	722
960 min Summer	5.637	0.0	0.0	962
1440 min Summer	4.057	0.0	0.0	1442
2160 min Summer	2.888	0.0	0.0	2160
2880 min Summer	2.266	0.0	0.0	2880
4320 min Summer	1.613	0.0	0.0	3712
5760 min Summer	1.274	0.0	0.0	4440
7200 min Summer	-0.012	0.0	0.0	0
8640 min Summer	-0.010	0.0	0.0	0
10080 min Summer	-0.008	0.0	0.0	0
15 min Winter	95.704	0.0	0.0	19
30 min Winter	63.672	0.0	0.0	34
60 min Winter	40.264	0.0	0.0	64
120 min Winter	25.669	0.0	0.0	122
180 min Winter	19.516	0.0	0.0	182
240 min Winter	15.988	0.0	0.0	242
360 min Winter	11.965	0.0	0.0	360

Unit 5, Newton Business Park  
 Newton Chambers Road  
 Sheffield S35 2PH

East Anglia  
 EA2/EA1N  
 Infiltration 1:30 YR +40%



Date 01/06/2021

Designed by CS

File Project Subs - Basin - FEH 2YR ...

Checked by

XP Solutions

Source Control 2018.1

Summary of Results for 30 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Overflow (l/s)	Max Outflow (l/s)	Max Volume (m <sup>3</sup> )	Status
480 min Winter	15.075	0.575	12.3	0.0	12.3	5627.3	O K
600 min Winter	15.099	0.599	12.4	0.0	12.4	5876.0	O K
720 min Winter	15.117	0.617	12.5	0.0	12.5	6061.1	O K
960 min Winter	15.142	0.642	12.5	0.0	12.5	6310.5	O K
1440 min Winter	15.166	0.666	12.6	0.0	12.6	6559.5	O K
2160 min Winter	15.172	0.672	12.6	0.0	12.6	6622.2	O K
2880 min Winter	15.165	0.665	12.6	0.0	12.6	6554.1	O K
4320 min Winter	15.139	0.639	12.5	0.0	12.5	6280.1	O K
5760 min Winter	15.109	0.609	12.4	0.0	12.4	5977.0	O K
7200 min Winter	14.500	0.000	0.0	0.0	0.0	0.0	O K
8640 min Winter	14.500	0.000	0.0	0.0	0.0	0.0	O K
10080 min Winter	14.500	0.000	0.0	0.0	0.0	0.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m <sup>3</sup> )	Overflow Volume (m <sup>3</sup> )	Time-Peak (mins)
480 min Winter	9.667	0.0	0.0	478
600 min Winter	8.156	0.0	0.0	596
720 min Winter	7.081	0.0	0.0	714
960 min Winter	5.637	0.0	0.0	952
1440 min Winter	4.057	0.0	0.0	1414
2160 min Winter	2.888	0.0	0.0	2116
2880 min Winter	2.266	0.0	0.0	2792
4320 min Winter	1.613	0.0	0.0	4068
5760 min Winter	1.274	0.0	0.0	4720
7200 min Winter	-0.012	0.0	0.0	0
8640 min Winter	-0.010	0.0	0.0	0
10080 min Winter	-0.008	0.0	0.0	0

Unit 5, Newton Business Park  
 Newton Chambers Road  
 Sheffield S35 2PH  
 Date 01/06/2021  
 File Project Subs - Basin - FEH 2YR ...

East Anglia  
 EA2/EA1N  
 Infiltration 1:30 YR +40%  
 Designed by CS  
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Source Control 2018.1

Rainfall Details

Rainfall Model	FEH	Winter Storms	Yes
Return Period (years)	30	Cv (Summer)	0.750
FEH Rainfall Version	2013	Cv (Winter)	0.840
Site Location	GB 641300 260300 TM 41300 60300	Shortest Storm (mins)	15
Data Type	Catchment	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 9.108

Time (mins)		Area
From:	To:	(ha)
0	4	9.108

Unit 5, Newton Business Park  
 Newton Chambers Road  
 Sheffield S35 2PH

East Anglia  
 EA2/EA1N  
 Infiltration 1:30 YR +40%



Date 01/06/2021  
 File Project Subs - Basin - FEH 2YR ...

Designed by CS  
 Checked by

XP Solutions

Source Control 2018.1

Model Details

Storage is Online Cover Level (m) 16.000

Infiltration Basin Structure

Invert Level (m) 14.500 Safety Factor 10.0  
 Infiltration Coefficient Base (m/hr) 0.04000 Porosity 1.00  
 Infiltration Coefficient Side (m/hr) 0.04000

Depth (m)	Area (m <sup>2</sup> )	Depth (m)	Area (m <sup>2</sup> )	Depth (m)	Area (m <sup>2</sup> )	Depth (m)	Area (m <sup>2</sup> )	Depth (m)	Area (m <sup>2</sup> )
0.000	9370.0	1.000	10847.0	1.300	11311.0	1.400	12714.0	1.500	12880.0

Weir Overflow Control

Discharge Coef 0.544 Width (m) 100.000 Invert Level (m) 15.175

Unit 5, Newton Business Park  
 Newton Chambers Road  
 Sheffield S35 2PH



Date 09/06/2021 15:42  
 File Project Subs - Hybrid - (FEH13 ...

Designed by csneddon  
 Checked by

XP Solutions

Source Control 2018.1

Cascade Summary of Results for Project Subs - Basin - FEH 2YR - FEH13 100 YR + 40% CC - Inf Only 40mm.SRCX

**Upstream Outflow To Structures**

**Overflow To**

(None) (None) Project Subs - Basin - FEH 2YR - FEH13 100 YR + 40% CC - Detention Only.SRCX

Half Drain Time : 4718 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Overflow (l/s)	Max Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	14.718	0.218	11.1	0.0	11.1	2078.8	O K
30 min Summer	14.793	0.293	11.4	0.0	11.4	2803.0	O K
60 min Summer	14.868	0.368	11.6	0.0	11.6	3548.7	O K
120 min Summer	14.960	0.460	11.9	0.0	11.9	4466.5	O K
180 min Summer	15.024	0.524	12.1	0.0	12.1	5112.4	O K
240 min Summer	15.074	0.574	12.3	0.0	12.3	5619.9	O K
360 min Summer	15.150	0.650	12.6	0.0	12.6	6396.0	O K
480 min Summer	15.181	0.681	12.7	74.3	87.0	6716.3	O K
600 min Summer	15.182	0.682	12.7	94.5	107.2	6722.8	O K
720 min Summer	15.183	0.683	12.7	116.2	128.9	6732.5	O K
960 min Summer	15.184	0.684	12.7	151.6	164.3	6749.8	O K
1440 min Summer	15.185	0.685	12.7	164.0	176.7	6754.1	O K
2160 min Summer	15.184	0.684	12.7	139.5	152.1	6742.8	O K
2880 min Summer	15.182	0.682	12.7	105.2	117.9	6728.0	O K
4320 min Summer	15.180	0.680	12.7	64.8	77.5	6707.6	O K
5760 min Summer	15.179	0.679	12.7	39.1	51.8	6691.9	O K
7200 min Summer	14.500	0.000	0.0	0.0	0.0	0.0	O K
8640 min Summer	14.500	0.000	0.0	0.0	0.0	0.0	O K
10080 min Summer	14.500	0.000	0.0	0.0	0.0	0.0	O K
15 min Winter	14.744	0.244	11.2	0.0	11.2	2329.0	O K
30 min Winter	14.827	0.327	11.5	0.0	11.5	3141.0	O K
60 min Winter	14.912	0.412	11.8	0.0	11.8	3978.0	O K
120 min Winter	15.014	0.514	12.1	0.0	12.1	5009.9	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Overflow Volume (m³)	Time-Peak (mins)
15 min Summer	122.248	0.0	0.0	19
30 min Summer	82.572	0.0	0.0	34
60 min Summer	52.458	0.0	0.0	64
120 min Summer	33.215	0.0	0.0	124
180 min Summer	25.480	0.0	0.0	184
240 min Summer	21.109	0.0	0.0	244
360 min Summer	16.158	0.0	0.0	364
480 min Summer	13.321	0.0	295.9	458
600 min Summer	11.410	0.0	731.6	466
720 min Summer	10.016	0.0	1068.2	504
960 min Summer	8.080	0.0	1531.5	616
1440 min Summer	5.860	0.0	1992.6	866
2160 min Summer	4.154	0.0	2133.8	1272
2880 min Summer	3.224	0.0	2021.8	1688
4320 min Summer	2.228	0.0	1496.2	2548
5760 min Summer	1.712	0.0	928.2	3504
7200 min Summer	-0.012	0.0	0.0	0
8640 min Summer	-0.010	0.0	0.0	0
10080 min Summer	-0.008	0.0	0.0	0
15 min Winter	122.248	0.0	0.0	19
30 min Winter	82.572	0.0	0.0	34
60 min Winter	52.458	0.0	0.0	64
120 min Winter	33.215	0.0	0.0	124

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Cascade Summary of Results for Project Subs - Basin - FEH 2YR - FEH13 100 YR + 40% CC - Inf Only 40mm.SRCX

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Overflow (l/s)	Max Outflow (l/s)	Max Volume (m³)	Status
180 min Winter	15.086	0.586	12.3	0.0	12.3	5738.3	O K
240 min Winter	15.142	0.642	12.5	0.0	12.5	6311.1	O K
360 min Winter	15.184	0.684	12.7	139.5	152.1	6743.9	O K
480 min Winter	15.187	0.687	12.7	217.0	229.7	6774.4	O K
600 min Winter	15.189	0.689	12.7	274.7	287.4	6795.5	O K
720 min Winter	15.189	0.689	12.7	289.8	302.5	6800.1	O K
960 min Winter	15.189	0.689	12.7	274.7	287.4	6799.2	O K
1440 min Winter	15.187	0.687	12.7	231.0	243.7	6780.0	O K
2160 min Winter	15.185	0.685	12.7	176.8	189.5	6758.4	O K
2880 min Winter	15.184	0.684	12.7	139.5	152.1	6743.2	O K
4320 min Winter	15.181	0.681	12.7	84.2	96.9	6720.5	O K
5760 min Winter	15.180	0.680	12.7	64.8	77.5	6706.7	O K
7200 min Winter	14.500	0.000	0.0	0.0	0.0	0.0	O K
8640 min Winter	14.500	0.000	0.0	0.0	0.0	0.0	O K
10080 min Winter	14.500	0.000	0.0	0.0	0.0	0.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Overflow Volume (m³)	Time-Peak (mins)
180 min Winter	25.480	0.0	0.0	182
240 min Winter	21.109	0.0	0.0	242
360 min Winter	16.158	0.0	513.4	324
480 min Winter	13.321	0.0	1172.6	346
600 min Winter	11.410	0.0	1672.1	404
720 min Winter	10.016	0.0	2060.4	464
960 min Winter	8.080	0.0	2600.8	594
1440 min Winter	5.860	0.0	3158.8	850
2160 min Winter	4.154	0.0	3379.0	1236
2880 min Winter	3.223	0.0	3315.1	1664
4320 min Winter	2.228	0.0	2849.2	2504
5760 min Winter	1.712	0.0	2278.2	3392
7200 min Winter	-0.012	0.0	0.0	0
8640 min Winter	-0.010	0.0	0.0	0
10080 min Winter	-0.008	0.0	0.0	0

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Cascade Rainfall Details for Project Subs - Basin - FEH 2YR - FEH13 100 YR + 40% CC - Inf Only  
40mm.SRCX

Rainfall Model	FEH	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
FEH Rainfall Version	2013	Cv (Winter)	0.840
Site Location	GB 641300 260300 TM 41300 60300	Shortest Storm (mins)	15
Data Type	Catchment	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 9.108

<b>Time (mins)</b>	<b>Area</b>
<b>From: To:</b>	<b>(ha)</b>

0	4	9.108
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Cascade Model Details for Project Subs - Basin - FEH 2YR - FEH13 100 YR + 40% CC - Inf Only  
 40mm.SRCX

Storage is Online Cover Level (m) 16.000

Infiltration Basin Structure

Invert Level (m) 14.500 Safety Factor 10.0  
 Infiltration Coefficient Base (m/hr) 0.04000 Porosity 1.00  
 Infiltration Coefficient Side (m/hr) 0.04000

Depth (m)	Area (m <sup>2</sup> )	Depth (m)	Area (m <sup>2</sup> )	Depth (m)	Area (m <sup>2</sup> )	Depth (m)	Area (m <sup>2</sup> )	Depth (m)	Area (m <sup>2</sup> )
0.000	9370.0	1.000	10847.0	1.300	11311.0	1.400	12714.0	1.500	12880.0

Weir Overflow Control

Discharge Coef 0.544 Width (m) 100.000 Invert Level (m) 15.175



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Cascade Summary of Results for Project Subs - Basin - FEH 2YR - FEH13 100 YR + 40% CC - Detention Only.SRCX

**Upstream Structures**

**Outflow To Overflow To**

Project Subs - Basin - FEH 2YR - FEH13 100 YR + 40% CC - Inf Only 40mm.SRCX (None) (None)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m <sup>3</sup> )	Status
15 min Summer	15.190	0.000	0.0	0.0	O K
30 min Summer	15.190	0.000	0.0	0.0	O K
60 min Summer	15.190	0.000	0.0	0.0	O K
120 min Summer	15.190	0.000	0.0	0.0	O K
180 min Summer	15.190	0.000	0.0	0.0	O K
240 min Summer	15.190	0.000	0.0	0.0	O K
360 min Summer	15.190	0.000	0.0	0.0	O K
480 min Summer	15.218	0.028	0.5	294.5	O K
600 min Summer	15.259	0.069	2.7	717.9	O K
720 min Summer	15.289	0.099	4.8	1031.3	O K
960 min Summer	15.327	0.137	7.3	1433.5	O K
1440 min Summer	15.360	0.170	7.5	1784.2	O K
2160 min Summer	15.361	0.171	7.5	1794.2	O K
2880 min Summer	15.340	0.150	7.4	1574.8	O K
4320 min Summer	15.298	0.108	5.5	1124.5	O K
5760 min Summer	15.263	0.073	2.9	760.6	O K
7200 min Summer	15.190	0.000	0.0	0.0	O K
8640 min Summer	15.190	0.000	0.0	0.0	O K
10080 min Summer	15.190	0.000	0.0	0.0	O K
15 min Winter	15.190	0.000	0.0	0.0	O K
30 min Winter	15.190	0.000	0.0	0.0	O K
60 min Winter	15.190	0.000	0.0	0.0	O K
120 min Winter	15.190	0.000	0.0	0.0	O K
180 min Winter	15.190	0.000	0.0	0.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m <sup>3</sup> )	Discharge Volume (m <sup>3</sup> )	Time-Peak (mins)
15 min Summer	122.248	0.0	0.0	0
30 min Summer	82.572	0.0	0.0	0
60 min Summer	52.458	0.0	0.0	0
120 min Summer	33.215	0.0	0.0	0
180 min Summer	25.480	0.0	0.0	0
240 min Summer	21.109	0.0	0.0	0
360 min Summer	16.158	0.0	0.0	0
480 min Summer	13.321	0.0	60.5	512
600 min Summer	11.410	0.0	262.3	626
720 min Summer	10.016	0.0	449.2	740
960 min Summer	8.080	0.0	694.9	976
1440 min Summer	5.860	0.0	809.1	1452
2160 min Summer	4.154	0.0	1451.3	2168
2880 min Summer	3.224	0.0	1304.8	2884
4320 min Summer	2.228	0.0	783.7	3584
5760 min Summer	1.712	0.0	651.8	4584
7200 min Summer	-0.012	0.0	0.0	0
8640 min Summer	-0.010	0.0	0.0	0
10080 min Summer	-0.008	0.0	0.0	0
15 min Winter	122.248	0.0	0.0	0
30 min Winter	82.572	0.0	0.0	0
60 min Winter	52.458	0.0	0.0	0
120 min Winter	33.215	0.0	0.0	0
180 min Winter	25.480	0.0	0.0	0

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Cascade Summary of Results for Project Subs - Basin - FEH 2YR - FEH13 100 YR + 40% CC - Detention Only.SRCX

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
240 min Winter	15.190	0.000	0.0	0.0	O K
360 min Winter	15.239	0.049	1.4	509.0	O K
480 min Winter	15.299	0.109	5.6	1142.5	O K
600 min Winter	15.343	0.153	7.4	1605.9	O K
720 min Winter	15.377	0.187	7.5	1962.9	O K
960 min Winter	15.422	0.232	7.5	2451.5	O K
1440 min Winter	15.466	0.276	7.5	2920.8	O K
2160 min Winter	15.475	0.285	7.5	3017.5	O K
2880 min Winter	15.459	0.269	7.5	2840.8	O K
4320 min Winter	15.398	0.208	7.5	2189.9	O K
5760 min Winter	15.350	0.160	7.4	1679.6	O K
7200 min Winter	15.190	0.000	0.0	0.0	O K
8640 min Winter	15.190	0.000	0.0	0.0	O K
10080 min Winter	15.190	0.000	0.0	0.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
240 min Winter	21.109	0.0	0.0	0
360 min Winter	16.158	0.0	159.1	386
480 min Winter	13.321	0.0	539.4	494
600 min Winter	11.410	0.0	830.3	612
720 min Winter	10.016	0.0	984.7	728
960 min Winter	8.080	0.0	1006.3	964
1440 min Winter	5.860	0.0	868.5	1432
2160 min Winter	4.154	0.0	1963.8	2124
2880 min Winter	3.223	0.0	1781.4	2800
4320 min Winter	2.228	0.0	1395.1	4052
5760 min Winter	1.712	0.0	1884.5	4520
7200 min Winter	-0.012	0.0	0.0	0
8640 min Winter	-0.010	0.0	0.0	0
10080 min Winter	-0.008	0.0	0.0	0

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Cascade Rainfall Details for Project Subs - Basin - FEH 2YR - FEH13 100 YR + 40% CC - Detention  
Only.SRCX

Rainfall Model	FEH	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
FEH Rainfall Version	2013	Cv (Winter)	0.840
Site Location	GB 641300 260300 TM 41300 60300	Shortest Storm (mins)	15
Data Type	Catchment	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.000

<b>Time (mins)</b>		<b>Area</b>
<b>From:</b>	<b>To:</b>	<b>(ha)</b>
0	4	0.000

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Cascade Model Details for Project Subs - Basin - FEH 2YR - FEH13 100 YR + 40% CC - Detention Only.SRCX

Storage is Online Cover Level (m) 16.000

Tank or Pond Structure

Invert Level (m) 15.190

Depth (m)	Area (m <sup>2</sup> )	Depth (m)	Area (m <sup>2</sup> )	Depth (m)	Area (m <sup>2</sup> )	Depth (m)	Area (m <sup>2</sup> )	Depth (m)	Area (m <sup>2</sup> )
0.000	10378.0	0.310	10847.0	0.610	11311.0	0.710	12714.0	0.810	12880.0

Hydro-Brake® Optimum Outflow Control

Unit Reference MD-SHE-0137-7500-0310-7500  
 Design Head (m) 0.310  
 Design Flow (l/s) 7.5  
 Flush-Flo™ Calculated  
 Objective Minimise upstream storage  
 Application Surface  
 Sump Available Yes  
 Diameter (mm) 137  
 Invert Level (m) 15.190  
 Minimum Outlet Pipe Diameter (mm) 150  
 Suggested Manhole Diameter (mm) 1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.310	7.5	Kick-Flo®	0.273	7.1
Flush-Flo™	0.187	7.5	Mean Flow over Head Range	-	5.4

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	4.9	0.800	11.7	2.000	18.1	4.000	25.2	7.000	33.4
0.200	7.5	1.000	13.0	2.200	19.0	4.500	26.7	7.500	34.6
0.300	7.4	1.200	14.2	2.400	19.8	5.000	28.2	8.000	35.8
0.400	8.4	1.400	15.3	2.600	20.5	5.500	29.6	8.500	36.9
0.500	9.4	1.600	16.3	3.000	22.0	6.000	30.9	9.000	38.0
0.600	10.2	1.800	17.2	3.500	23.5	6.500	32.2	9.500	39.0



# Appendix 4: National Grid Substation Attenuation ~~Only~~ Scheme Model Outputs

SUDS Design Summary				
<b>Notes:</b>				
1. SUDS design proposal to attenuate surface water flows from hardstanding areas associated with EA2 / EA1N and National Grid substations (including access roads and cable sealing compounds).				
2. Separate SUDS required for EA2/EA1N project substations and National Grid infrastructure.				
3. EA2/EA1N project 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. NG 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 FEH method - HR Wallingford Greenfield Runoff Rate Estimation Online Tool.				
7. SUDS sizing estimated using FEH13 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
<b>Hardstanding (all footprints assumed 100% impermeable)</b>				
Substation operational footprint	32,300 m <sup>2</sup>	32,300 m <sup>2</sup>	44,950 m <sup>2</sup>	01.12.20 Updated with areas of SUDS basin footprint (including perimeter access tracks)
Operational access road	13,600 m <sup>2</sup>	-	-	05.01.21 Reduced project substation footprints from 36,100m <sup>2</sup> to 32,300m <sup>2</sup> for each substation (previous total 96,510m <sup>2</sup> ).
Cable sealing end compound operational footprint	-	-	10,000 m <sup>2</sup>	
Permanent access road to sealing end compound	-	-	1,850 m <sup>2</sup>	
SUDS Basin Footprint (including perimeter access track)	18,300 m <sup>2</sup>	-	10,602 m <sup>2</sup>	02.02.21 Amended design to store 1:100 YR + 40% exceedance within 1m design depth.
<b>Total</b>	<b>96,500 m<sup>2</sup></b>	-	<b>67,402 m<sup>2</sup></b>	10.02.21 Added note on additional volume allowed for existing depression adjacent EA1N substation.
<b>Additional Volumes</b>				
Existing depression adjacent EA1N substation. Estimated volume to be allowed for in SUDS design (see additional design requirements below).	3,300 m <sup>3</sup>	-	-	
<b>Pre-Development Run-Off Rates (calculated from HR Wallingford Greenfield Runoff Rate Estimation Online Tool)</b>				
2 l/s/ha	19.30 l/s	-	13.48 l/s	01.12.20 Updated to suit increased contribution areas as above
	FEH	-	FEH	05.01.21 Updated to suit reduced project substation contribution areas as above
1 Year Return	6.88 l/s	-	4.81 l/s	
<b>2 Year Return (Q<sub>max</sub>)</b>	<b>7.91 l/s</b>	-	<b>5.52 l/s</b>	
30 Year Return	19.38 l/s	-	13.53 l/s	02.02.21 Amended design to store 1:100 YR + 40% exceedance within 1m design depth.
100 Year Return	28.15 l/s	-	19.66 l/s	
200 Year Return	33.30 l/s	-	23.25 l/s	
<b>Untenuated Flow Discharging to SUDS from Hardstanding (calculated from FEH13 Rainfall using Micro Drainage design software)</b>				
	FEH13	-	FEH13	01.12.20 Updated to suit increased contribution areas as above
1 Year Return + 40% CC	N/A	-	N/A	05.01.21 Updated to suit reduced project substation contribution areas as above
2 Year Return + 40% CC	68.0 l/s	-	79.2 l/s	
30 Year Return + 40% CC	173.0 l/s	-	204.8 l/s	02.02.21 Amended design to store 1:100 YR + 40% exceedance within 1m design depth.
100 Year Return + 40% CC	285.5 l/s	-	310.2 l/s	
200 Year Return + 40% CC	362.3 l/s	-	389.5 l/s	
<b>Attenuated Post Development Run-Off Rates</b>				
	Limited to pre-development (2-year FEH) run-off rate. Provides betterment over 2 l/s/ha rate and IH124 rate.			No change
<b>Pre / Post Development Reduction In Run-Off Rates (pre development rates minus attenuated post development rates)</b>				
1 Year Return	N/A	-	N/A	01.12.20 Updated to suit increased contribution areas as above
2 Year Return	60.09 l/s	-	73.68 l/s	05.01.21 Updated to suit reduced project substation contribution areas as above
30 Year Return	165.09 l/s	-	199.28 l/s	
100 Year Return	277.59 l/s	-	304.68 l/s	02.02.21 Amended design to store 1:100 YR + 40% exceedance within 1m design depth.
200 Year Return	354.39 l/s	-	383.6 l/s	
<b>Design Storm Event</b>				
	1 in 100 year + 40% climate change as per SCC guidance.			02.02.21 Updated to 1:100 year + 40% CC
<b>Attenuation Storage Required (calculated from FEH13 Rainfall using Micro Drainage design software)</b>				
	FEH13	-	FEH13	01.12.20 Updated to suit increased contribution areas as above
		-		05.01.21 Updated to suit reduced project substation contribution areas as above
		-		02.02.21 Amended design to store 1:100 YR + 40% exceedance within 1m design depth.
All Hardstanding Areas	11,593.4 m <sup>3</sup>	-	8,024.5 m <sup>3</sup>	
<b>Attenuation Dimensions</b>				
<b>Detention Basins</b>				
Design Top area (1.0m Deep)	15,861 m <sup>2</sup>	-	8,721 m <sup>2</sup>	01.12.20 Added areas for perimeter access track. Access track falls towards top of basin providing an additional 0.1m depth of storage.
Freeboard Top area (1.3m Deep)	16,421 m <sup>2</sup>	-	9,149 m <sup>2</sup>	
Perimeter access track top area (1.4m Deep)	18,106 m <sup>2</sup>	-	10,449 m <sup>2</sup>	
Basin Top area (1.5m Deep)	18,303 m <sup>2</sup>	-	10,602 m <sup>2</sup>	02.02.21 Amended design to store 1:100 YR + 40% exceedance within 1m design depth.
Basin area	14,062 m <sup>2</sup>	-	7,960 m <sup>2</sup>	
Design storage depth	1.0 m	-	1.0 m	
Design freeboard + 0.3m (1.3m Deep)	0.3 m	-	0.3 m	
Overall depth	1.5 m	-	1.5 m	
Side slopes	1 in 4	-	1 in 4	
<b>Attenuation Storage Provided</b>				
<b>Detention Basins</b>				
Design	14,961.5 m <sup>3</sup>	-	8,040.5 m <sup>3</sup>	01.12.20 Added additional storage volume from perimeter access track. Access track falls towards top of basin providing an additional 0.1m depth of storage.
Freeboard	4,842.3 m <sup>3</sup>	-	2,880.5 m <sup>3</sup>	
Perimeter access track	1,726.35 m <sup>3</sup>	-	979.90 m <sup>3</sup>	
Additional storage between track and basin top	1,820.45 m <sup>3</sup>	-	1,052.55 m <sup>3</sup>	02.02.21 Amended design to store 1:100 YR + 40% exceedance within 1m design depth.
<b>Total (design)</b>	<b>14,961.5 m<sup>3</sup></b>	-	<b>8,040.5 m<sup>3</sup></b>	
Total (inc. freeboard, access track etc)	23,350.6 m <sup>3</sup>	-	12,753.45 m <sup>3</sup>	
<b>Design storage required &lt; attenuation storage provided?</b>	<b>YES = OK</b>	-	<b>YES = OK</b>	
<b>Additional Design Requirements</b>				
Offset removal of depression adjacent EA1N substation by allowing additional storage in basin design depth. Additional storage required:	3,300 m <sup>3</sup>	-	N/A	02.02.21 Added to show allowance for existing depression included in basin design.
Surplus storage available within basin design depth (1.0m)	3,368.1 m <sup>3</sup>	-	N/A	
<b>Design storage required &lt; attenuation storage provided?</b>	<b>YES = OK</b>	-	<b>N/A</b>	
<b>Discharge Location</b>				
	Existing watercourse in Church Lane via new outfall pipe as per existing drainage regime. Provides additional betterment over existing arrangement by reducing flood flows down existing farm track.	-	Existing ditch in field. Provides betterment over existing by attenuating flows from greater return period storms.	Design flows up to 1:100 year + 40% CC are attenuated within the basin design depth (1m).  Additional 300mm freeboard provided over and above design capacity with another 300mm to the top of the basin from the bottom edge of the access track (total 1.5m depth).

Calculated by:

Site name:

Site location:

**Site Details**

Latitude:

Longitude:

Reference:

Date:

This is an estimation of the greenfield runoff rates that are used to meet normal best practice criteria in line with Environment Agency guidance "Rainfall runoff management for developments", SC030219 (2013), the SuDS Manual C753 (Ciria, 2015) and the non-statutory standards for SuDS (Defra, 2015). This information on greenfield runoff rates may be the basis for setting consents for the drainage of surface water runoff from sites.

**Runoff estimation approach**

**Site characteristics**

Total site area (ha):

**Methodology**

Q<sub>MED</sub> estimation method:

BFI and SPR method:

HOST class:

BFI / BFIHOST:

Q<sub>MED</sub> (l/s):

Q<sub>BAR</sub> / Q<sub>MED</sub> factor:

**Notes**
**(1) Is Q<sub>BAR</sub> < 2.0 l/s/ha?**

When Q<sub>BAR</sub> is < 2.0 l/s/ha then limiting discharge rates are set at 2.0 l/s/ha.

**(2) Are flow rates < 5.0 l/s?**

Where flow rates are less than 5.0 l/s consent for discharge is usually set at 5.0 l/s if blockage from vegetation and other materials is possible. Lower consent flow rates may be set where the blockage risk is addressed by using appropriate drainage elements.

**(3) Is SPR/SPRHOST ≤ 0.3?**

Where groundwater levels are low enough the use of soakaways to avoid discharge offsite would normally be preferred for disposal of surface water runoff.

**Hydrological characteristics**

	Default	Edited
SAAR (mm):	585	585
Hydrological region:	5	5
Growth curve factor 1 year:	0.87	0.87
Growth curve factor 30 years:	2.45	2.45
Growth curve factor 100 years:	3.56	3.56
Growth curve factor 200 years:	4.21	4.21

**Greenfield runoff rates**

	Default	Edited
Q <sub>BAR</sub> (l/s):	<input type="text"/>	7.91
1 in 1 year (l/s):	<input type="text"/>	6.88
1 in 30 years (l/s):	<input type="text"/>	19.38
1 in 100 year (l/s):	<input type="text"/>	28.15
1 in 200 years (l/s):	<input type="text"/>	33.3

Calculated by:

Site name:

Site location:

## Site Details

Latitude:

Longitude:

Reference:

Date:

This is an estimation of the greenfield runoff rates that are used to meet normal best practice criteria in line with Environment Agency guidance "Rainfall runoff management for developments", SC030219 (2013), the SuDS Manual C753 (Ciria, 2015) and the non-statutory standards for SuDS (Defra, 2015). This information on greenfield runoff rates may be the basis for setting consents for the drainage of surface water runoff from sites.

## Runoff estimation approach

## Site characteristics

Total site area (ha):

## Methodology

Q<sub>MED</sub> estimation method:

BFI and SPR method:

HOST class:

BFI / BFIHOST:

Q<sub>MED</sub> (l/s):

Q<sub>BAR</sub> / Q<sub>MED</sub> factor:

## Notes

### (1) Is Q<sub>BAR</sub> < 2.0 l/s/ha?

When Q<sub>BAR</sub> is < 2.0 l/s/ha then limiting discharge rates are set at 2.0 l/s/ha.

### (2) Are flow rates < 5.0 l/s?

Where flow rates are less than 5.0 l/s consent for discharge is usually set at 5.0 l/s if blockage from vegetation and other materials is possible. Lower consent flow rates may be set where the blockage risk is addressed by using appropriate drainage elements.

### (3) Is SPR/SPRHOST ≤ 0.3?

Where groundwater levels are low enough the use of soakaways to avoid discharge offsite would normally be preferred for disposal of surface water runoff.

## Hydrological characteristics

	Default	Edited
SAAR (mm):	585	585
Hydrological region:	5	5
Growth curve factor 1 year:	0.87	0.87
Growth curve factor 30 years:	2.45	2.45
Growth curve factor 100 years:	3.56	3.56
Growth curve factor 200 years:	4.21	4.21

## Greenfield runoff rates

	Default	Edited
Q <sub>BAR</sub> (l/s):	<input type="text"/>	5.52
1 in 1 year (l/s):	<input type="text"/>	4.81
1 in 30 years (l/s):	<input type="text"/>	13.53
1 in 100 year (l/s):	<input type="text"/>	19.66
1 in 200 years (l/s):	<input type="text"/>	23.25

This report was produced using the greenfield runoff tool developed by HR Wallingford and available at [www.uksuds.com](http://www.uksuds.com). The use of this tool is subject to the UK SuDS terms and conditions and licence agreement, which can both be found at [www.uksuds.com/terms-and-conditions.htm](http://www.uksuds.com/terms-and-conditions.htm). The outputs from this tool are estimates of greenfield runoff rates. The use of these results is the responsibility of the users of this tool. No liability will be accepted by HR Wallingford, the Environment Agency, CEH, Hydrosolutions or any other organisation for the use of this data in the design or operational characteristics of any drainage scheme.



Unit 5, Newton Business Park  
 Newton Chambers Road  
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East Anglia  
 EA2 / EA1N  
 Project Substations 1:100 +40%



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Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	14.656	0.156	7.4	2207.9	O K
30 min Summer	14.709	0.209	7.7	2979.7	O K
60 min Summer	14.764	0.264	7.9	3779.5	O K
120 min Summer	14.832	0.332	7.9	4772.5	O K
180 min Summer	14.881	0.381	7.9	5478.1	O K
240 min Summer	14.918	0.418	7.9	6037.5	O K
360 min Summer	14.977	0.477	7.9	6904.4	O K
480 min Summer	15.021	0.521	7.9	7561.3	O K
600 min Summer	15.054	0.554	7.9	8067.1	O K
720 min Summer	15.081	0.581	7.9	8468.9	O K
960 min Summer	15.119	0.619	7.9	9049.5	O K
1440 min Summer	15.164	0.664	7.9	9720.7	O K
2160 min Summer	15.191	0.691	7.9	10139.6	O K
2880 min Summer	15.200	0.700	7.9	10283.5	O K
4320 min Summer	15.197	0.697	7.9	10236.3	O K
5760 min Summer	15.186	0.686	7.9	10063.4	O K
7200 min Summer	14.500	0.000	0.0	0.0	O K
8640 min Summer	14.500	0.000	0.0	0.0	O K
10080 min Summer	14.500	0.000	0.0	0.0	O K
15 min Winter	14.674	0.174	7.5	2473.0	O K
30 min Winter	14.734	0.234	7.8	3337.8	O K
60 min Winter	14.796	0.296	7.9	4234.2	O K
120 min Winter	14.872	0.372	7.9	5347.6	O K
180 min Winter	14.925	0.425	7.9	6139.5	O K
240 min Winter	14.968	0.468	7.9	6767.9	O K
360 min Winter	15.033	0.533	7.9	7742.5	O K
480 min Winter	15.082	0.582	7.9	8482.3	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	122.248	0.0	570.5	19
30 min Summer	82.572	0.0	649.4	34
60 min Summer	52.458	0.0	1325.0	64
120 min Summer	33.215	0.0	1338.4	124
180 min Summer	25.480	0.0	1327.0	184
240 min Summer	21.109	0.0	1310.8	244
360 min Summer	16.158	0.0	1277.5	364
480 min Summer	13.321	0.0	1245.8	484
600 min Summer	11.410	0.0	1215.4	604
720 min Summer	10.016	0.0	1185.5	724
960 min Summer	8.080	0.0	1128.9	964
1440 min Summer	5.860	0.0	1035.1	1444
2160 min Summer	4.154	0.0	2145.4	2164
2880 min Summer	3.224	0.0	2064.3	2884
4320 min Summer	2.228	0.0	1942.5	4324
5760 min Summer	1.712	0.0	4249.0	5760
7200 min Summer	-0.012	0.0	-101.3	0
8640 min Summer	-0.010	0.0	-101.3	0
10080 min Summer	-0.008	0.0	-101.3	0
15 min Winter	122.248	0.0	618.5	19
30 min Winter	82.572	0.0	660.7	34
60 min Winter	52.458	0.0	1341.4	64
120 min Winter	33.215	0.0	1339.4	124
180 min Winter	25.480	0.0	1321.0	182
240 min Winter	21.109	0.0	1300.9	242
360 min Winter	16.158	0.0	1261.5	362
480 min Winter	13.321	0.0	1220.1	482

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Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m <sup>3</sup> )	Status
600 min Winter	15.120	0.620	7.9	9053.9	O K
720 min Winter	15.150	0.650	7.9	9509.5	O K
960 min Winter	15.193	0.693	7.9	10169.9	O K
1440 min Winter	15.243	0.743	7.9	10931.8	O K
2160 min Winter	15.274	0.774	7.9	11415.0	O K
2880 min Winter	15.286	0.786	7.9	11593.4	O K
4320 min Winter	15.285	0.785	7.9	11579.2	O K
5760 min Winter	15.275	0.775	7.9	11430.3	O K
7200 min Winter	14.500	0.000	0.0	0.0	O K
8640 min Winter	14.500	0.000	0.0	0.0	O K
10080 min Winter	14.500	0.000	0.0	0.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m <sup>3</sup> )	Discharge Volume (m <sup>3</sup> )	Time-Peak (mins)
600 min Winter	11.410	0.0	1176.1	600
720 min Winter	10.016	0.0	1130.5	720
960 min Winter	8.080	0.0	1069.2	956
1440 min Winter	5.860	0.0	1055.8	1428
2160 min Winter	4.154	0.0	2181.7	2140
2880 min Winter	3.223	0.0	2147.0	2852
4320 min Winter	2.228	0.0	2041.2	4240
5760 min Winter	1.712	0.0	4252.5	5648
7200 min Winter	-0.012	0.0	-113.5	0
8640 min Winter	-0.010	0.0	-113.5	0
10080 min Winter	-0.008	0.0	-113.5	0

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Rainfall Details

Rainfall Model	FEH	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
FEH Rainfall Version	2013	Cv (Winter)	0.840
Site Location	GB 641300 260300 TM 41300 60300	Shortest Storm (mins)	15
Data Type	Catchment	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 9.650

Time (mins)		Area
From:	To:	(ha)
0	4	9.650

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### Model Details

Storage is Online Cover Level (m) 16.000

### Tank or Pond Structure

Invert Level (m) 14.500

Depth (m)	Area (m <sup>2</sup> )	Depth (m)	Area (m <sup>2</sup> )	Depth (m)	Area (m <sup>2</sup> )	Depth (m)	Area (m <sup>2</sup> )	Depth (m)	Area (m <sup>2</sup> )
0.000	14062.0	1.000	15861.0	1.300	16421.0	1.400	18106.0	1.500	18303.0

### Hydro-Brake® Optimum Outflow Control

Unit Reference MD-SHE-0131-7900-1000-7900  
 Design Head (m) 1.000  
 Design Flow (l/s) 7.9  
 Flush-Flo™ Calculated  
 Objective Minimise upstream storage  
 Application Surface  
 Sump Available Yes  
 Diameter (mm) 131  
 Invert Level (m) 14.500  
 Minimum Outlet Pipe Diameter (mm) 150  
 Suggested Manhole Diameter (mm) 1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.000	7.9	Kick-Flo®	0.660	6.5
Flush-Flo™	0.299	7.9	Mean Flow over Head Range	-	6.8

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	4.7	0.800	7.1	2.000	10.9	4.000	15.2	7.000	19.9
0.200	7.7	1.000	7.9	2.200	11.4	4.500	16.1	7.500	20.6
0.300	7.9	1.200	8.6	2.400	11.9	5.000	16.9	8.000	21.2
0.400	7.8	1.400	9.2	2.600	12.4	5.500	17.7	8.500	21.8
0.500	7.6	1.600	9.9	3.000	13.3	6.000	18.5	9.000	22.4
0.600	7.1	1.800	10.4	3.500	14.3	6.500	19.2	9.500	23.0

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Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	15.356	0.206	5.4	1541.5	O K
30 min Summer	15.426	0.276	5.5	2080.4	O K
60 min Summer	15.498	0.348	5.5	2638.6	O K
120 min Summer	15.586	0.436	5.5	3331.1	O K
180 min Summer	15.647	0.497	5.5	3823.1	O K
240 min Summer	15.696	0.546	5.5	4213.2	O K
360 min Summer	15.770	0.620	5.5	4818.6	O K
480 min Summer	15.826	0.676	5.5	5278.3	O K
600 min Summer	15.868	0.718	5.5	5630.9	O K
720 min Summer	15.902	0.752	5.5	5909.3	O K
960 min Summer	15.949	0.799	5.5	6308.5	O K
1440 min Summer	16.003	0.853	5.5	6760.3	O K
2160 min Summer	16.034	0.884	5.5	7028.8	O K
2880 min Summer	16.043	0.893	5.5	7108.4	O K
4320 min Summer	16.035	0.885	5.5	7039.1	O K
5760 min Summer	16.017	0.867	5.5	6887.7	O K
7200 min Summer	15.150	0.000	0.0	0.0	O K
8640 min Summer	15.150	0.000	0.0	0.0	O K
10080 min Summer	15.150	0.000	0.0	0.0	O K
15 min Winter	15.380	0.230	5.4	1726.8	O K
30 min Winter	15.458	0.308	5.5	2330.5	O K
60 min Winter	15.538	0.388	5.5	2956.2	O K
120 min Winter	15.636	0.486	5.5	3733.1	O K
180 min Winter	15.705	0.555	5.5	4285.7	O K
240 min Winter	15.759	0.609	5.5	4724.6	O K
360 min Winter	15.841	0.691	5.5	5406.2	O K
480 min Winter	15.903	0.753	5.5	5921.3	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	122.248	0.0	451.4	19
30 min Summer	82.572	0.0	468.2	34
60 min Summer	52.458	0.0	941.7	64
120 min Summer	33.215	0.0	928.6	124
180 min Summer	25.480	0.0	908.6	184
240 min Summer	21.109	0.0	886.6	244
360 min Summer	16.158	0.0	831.7	364
480 min Summer	13.321	0.0	775.6	484
600 min Summer	11.410	0.0	767.8	604
720 min Summer	10.016	0.0	777.8	724
960 min Summer	8.080	0.0	787.4	964
1440 min Summer	5.860	0.0	784.3	1444
2160 min Summer	4.154	0.0	1617.8	2164
2880 min Summer	3.224	0.0	1592.7	2884
4320 min Summer	2.228	0.0	1513.7	4320
5760 min Summer	1.712	0.0	3104.0	5760
7200 min Summer	-0.012	0.0	-70.8	0
8640 min Summer	-0.010	0.0	-70.8	0
10080 min Summer	-0.008	0.0	-70.8	0
15 min Winter	122.248	0.0	460.4	19
30 min Winter	82.572	0.0	471.1	34
60 min Winter	52.458	0.0	941.7	64
120 min Winter	33.215	0.0	918.4	124
180 min Winter	25.480	0.0	889.2	182
240 min Winter	21.109	0.0	852.0	242
360 min Winter	16.158	0.0	779.2	362
480 min Winter	13.321	0.0	790.8	482

Unit 5, Newton Business Park  
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East Anglia  
 EA2 / EA1N  
 NG Substations 1:100 + 40%



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Summary of Results for 100 year Return Period (+40%)

<b>Storm Event</b>	<b>Max Level (m)</b>	<b>Max Depth (m)</b>	<b>Max Control (l/s)</b>	<b>Max Volume (m<sup>3</sup>)</b>	<b>Status</b>
600 min Winter	15.950	0.800	5.5	6317.4	O K
720 min Winter	15.987	0.837	5.5	6631.2	O K
960 min Winter	16.040	0.890	5.5	7083.0	O K
1440 min Winter	16.100	0.950	5.5	7599.9	O K
2160 min Winter	16.137	0.987	5.5	7917.0	O K
<b>2880 min Winter</b>	<b>16.149</b>	<b>0.999</b>	<b>5.5</b>	<b>8022.2</b>	<b>O K</b>
4320 min Winter	16.144	0.994	5.5	7977.2	O K
5760 min Winter	16.128	0.978	5.5	7839.9	O K
7200 min Winter	15.150	0.000	0.0	0.0	O K
8640 min Winter	15.150	0.000	0.0	0.0	O K
10080 min Winter	15.150	0.000	0.0	0.0	O K

<b>Storm Event</b>	<b>Rain (mm/hr)</b>	<b>Flooded Volume (m<sup>3</sup>)</b>	<b>Discharge Volume (m<sup>3</sup>)</b>	<b>Time-Peak (mins)</b>
600 min Winter	11.410	0.0	807.2	600
720 min Winter	10.016	0.0	817.9	720
960 min Winter	8.080	0.0	827.6	954
1440 min Winter	5.860	0.0	823.1	1428
2160 min Winter	4.154	0.0	1701.0	2140
<b>2880 min Winter</b>	<b>3.223</b>	<b>0.0</b>	<b>1673.0</b>	<b>2852</b>
4320 min Winter	2.228	0.0	1587.5	4236
5760 min Winter	1.712	0.0	3274.2	5640
7200 min Winter	-0.012	0.0	-79.3	0
8640 min Winter	-0.010	0.0	-79.3	0
10080 min Winter	-0.008	0.0	-79.3	0

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Rainfall Details

Rainfall Model	FEH	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
FEH Rainfall Version	2013	Cv (Winter)	0.840
Site Location	GB 641300 260300 TM 41300 60300	Shortest Storm (mins)	15
Data Type	Catchment	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 6.740

<b>Time (mins)</b>		<b>Area</b>
<b>From:</b>	<b>To:</b>	<b>(ha)</b>
0	4	6.740

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Source Control 2018.1

Model Details

Storage is Online Cover Level (m) 16.650

Tank or Pond Structure

Invert Level (m) 15.150

Depth (m)	Area (m <sup>2</sup> )	Depth (m)	Area (m <sup>2</sup> )	Depth (m)	Area (m <sup>2</sup> )	Depth (m)	Area (m <sup>2</sup> )	Depth (m)	Area (m <sup>2</sup> )
0.000	7360.0	1.000	8721.0	1.300	9149.0	1.400	10449.0	1.500	10602.0

Hydro-Brake® Optimum Outflow Control

Unit Reference MD-SHE-0111-5520-1000-5520  
 Design Head (m) 1.000  
 Design Flow (l/s) 5.5  
 Flush-Flo™ Calculated  
 Objective Minimise upstream storage  
 Application Surface  
 Sump Available Yes  
 Diameter (mm) 111  
 Invert Level (m) 15.150  
 Minimum Outlet Pipe Diameter (mm) 150  
 Suggested Manhole Diameter (mm) 1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.000	5.5	Kick-Flo®	0.644	4.5
Flush-Flo™	0.298	5.5	Mean Flow over Head Range	-	4.8

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	3.8	0.800	5.0	2.000	7.6	4.000	10.5	7.000	13.8
0.200	5.4	1.000	5.5	2.200	7.9	4.500	11.2	7.500	14.2
0.300	5.5	1.200	6.0	2.400	8.3	5.000	11.7	8.000	14.7
0.400	5.4	1.400	6.4	2.600	8.6	5.500	12.3	8.500	15.1
0.500	5.2	1.600	6.8	3.000	9.2	6.000	12.8	9.000	15.5
0.600	4.8	1.800	7.2	3.500	9.9	6.500	13.3	9.500	15.9





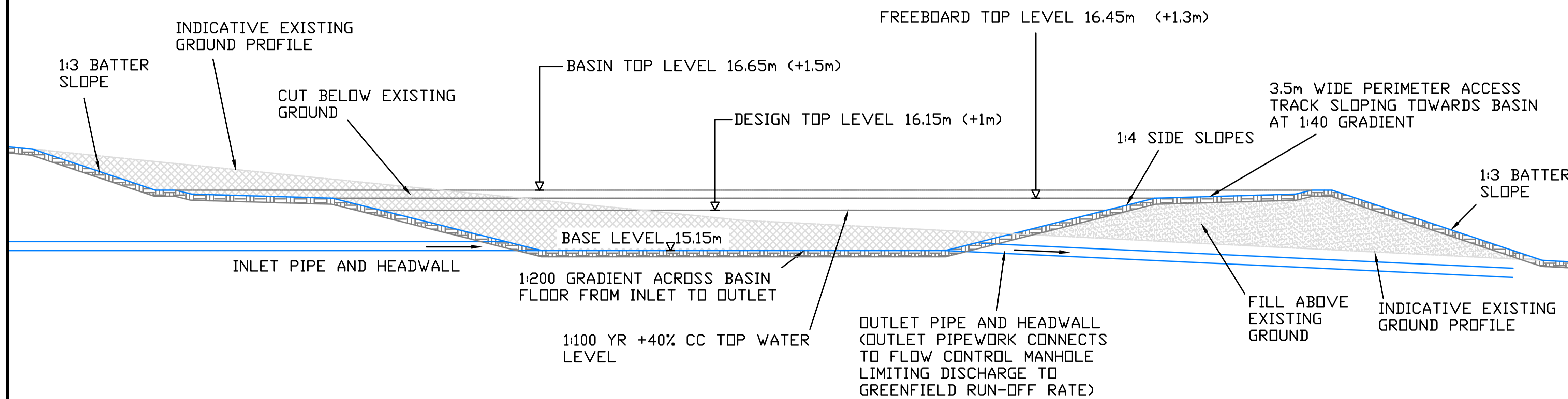
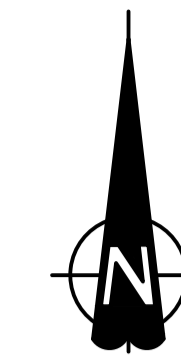
**Appendix ~~8~~:5: Plan and Cross  
Sections of Indicative Attenuation  
~~Only Scheme Figures~~ SuDS Basins**



DO NOT SCALE FROM THIS DRAWING

NOTES:

DETENTION BASINS ARE SHOWN INDICATIVELY FOR ILLUSTRATION PURPOSES ONLY. DETAILED DESIGN OF BASINS WOULD BE REQUIRED TO CONFIRM EXACT ELEVATIONS, SHAPES AND LOCATIONS AS APPROPRIATE AND AS PART OF THE MASTERPLANNING PROCESS.



TYPICAL DETENTION BASIN CROSS SECTION  
(NATIONAL GRID)

E	FINAL ISSUE	11.06.21	GM	CS	SH
D	REMOVED DETENTION BASIN FOR PROJECT SUBSTATIONS.	10.06.21	CS	CS	SH
C	UPDATED TO SHOW LEVELS FOR NG / PROJECT BASINS.	08.06.21	CS	CS	SH
B	UPDATED TO SHOW INDICATIVE EXISTING GROUND PROFILE AND BATTER SLOPES.	24.02.21	CS	CS	SH
A	FIRST ISSUE	10.02.21	CS	CS	SH

REVISION	DETAILS	DATE	DRN	CHK'D	APP'D
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CLIENT  
**Haskoning DHV UK Limited**

PROJECT  
**EAST ANGLIA OFFSHORE WIND  
EA1N & EA2**

DRAWING TITLE  
**DETENTION BASIN  
1 IN 100 YR + 40% CC DESIGN  
TYPICAL BASIN CROSS SECTION**

DRG No. **ED11892-C-SK12** REV **E**

DRG SIZE **A3** SCALE **NTS** DATE **FEB'21**

DRAWN BY **CS** CHECKED BY **CS** APPROVED BY **SH**

**wardell armstrong**

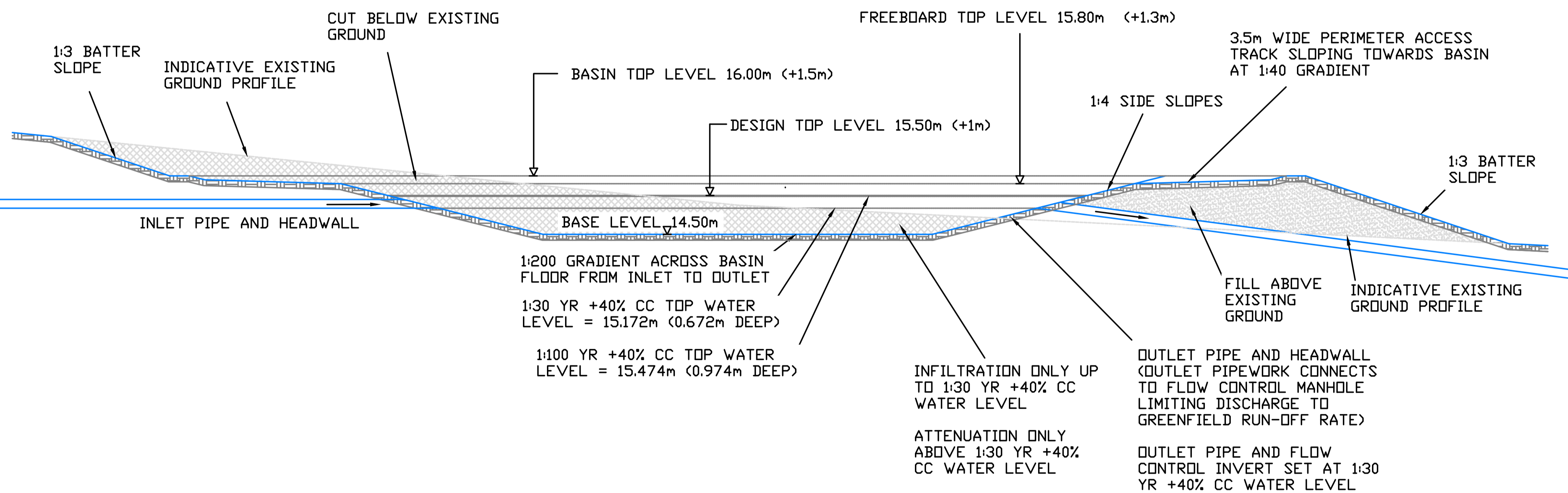
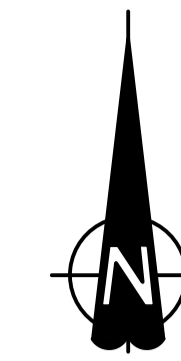
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NOTES:

HYBRID DETENTION / INFILTRATION BASINS ARE SHOWN INDICATIVELY FOR ILLUSTRATION PURPOSES ONLY. DETAILED DESIGN OF BASINS WOULD BE REQUIRED TO CONFIRM EXACT ELEVATIONS, SHAPES AND LOCATIONS AS APPROPRIATE AND AS PART OF THE MASTERPLANNING PROCESS.



TYPICAL HYBRID DETENTION / INFILTRATION BASIN CROSS SECTION  
(PROJECT SUBSTATIONS)

D	FINAL ISSUE	11.06.21	GM	CS	SH
C	UPDATED DESIGN AND ADDED LEVELS PROJECT BASINS.	10.06.21	CS	CS	SH
B	UPDATED DESIGN AND ADDED LEVELS PROJECT BASINS.	08.06.21	CS	CS	SH
A	FIRST ISSUE	23.03.21	CS	CS	SH
REVISION	DETAILS	DATE	DRN	CHKD	APPD

CLIENT	Haskoning DHV UK Limited				
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PROJECT	EAST ANGLIA OFFSHORE WIND EA1N & EA2				
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DRAWING TITLE	DETENTION / INFILTRATION BASIN HYBRID 1 IN 100 YR + 40% CC DESIGN TYPICAL BASIN CROSS SECTION				
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DRG No.	ED11892-C-SK15	REV	D		
DRG SIZE	A3	SCALE	NTS	DATE	MAR'21
DRAWN BY	CS	CHECKED BY	CS	APPROVED BY	SH

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