APPENDIX 14A: Flood Risk Assessment

EP SHB

South Humber Bank Energy Centre

South Marsh Road, Stallingborough, DN41 8BZ

Appendix 14A: Flood Risk Assessment

Applicant: EP SHB Limited
Date: December 2018

DOCUMENT HISTORY

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GLOSSARY

Abbreviation	Description
AEP	Annual Exceedance Probability
CFMP	Catchment Flood Management Plan
CIRIA	Construction Industry Research and Information Association
EA	Environment Agency
EfW	Energy from Waste
EIA	Environmental Impact Assessment
EPH	Energetický a Průmyslový Holding
FGT	Flue Gas Treatment
FRA	Flood Risk Assessment
FZ	Flood Zone
Ha	Hectare
IDB	Internal Drainage Board
IED	Industrial Emissions Directive
LFA	Local Flood Authority
LFRMS	Local Flood Risk Management Strategy
LLFA	Lead Local Flood Authority
LPA	Local Planning Authority
mAOD	Meters Above Ordnance Datum
mODN	Meters Ordnance Datum (Newlyn)
NELC	North East Lincolnshire Council
NPPF	National Planning Policy Framework
NSTS	Non-Statutory Technical Standards for SuDS
PFRA	Preliminary Flood Risk Assessment
PPG	Planning Policy Guidance
RDF	Refuse Derived Fuel
RSS	Regional Spatial Strategy
SFRA	Strategic Flood Risk Assessment
SHB	South Humber Bank
SHBEC	South Humber Bank Energy Centre
SMP	Shoreline Management Plan
SPZ	Source Protection Zone
SuDS	Sustainable Drainage Systems
UK	United Kingdom

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1.0 INTRODUCTION

Background

1.1 AECOM Infrastructure and Environment Ltd (AECOM) were commissioned by EP SHB Ltd (the Applicant) to prepare a Flood Risk Assessment (FRA) for the Proposed Development of the South Humber Bank Energy Centre (SHBEC). The Proposed Development Site (the Site) is located adjacent to the South Humber Bank Power Station (SHBPS) off South Marsh Road, Stallingborough in North East Lincolnshire centred at Ordnance Survey National Grid Reference (OSNGR) 523019, 413263. More details of the existing site are provided in Section 2.0.

1.2 EP SHB is a subsidiary of EP UK Investments (EPUKI), primarily focusing on power generation from conventional and renewable sources. EP SHB Ltd is proposing to develop land located adjacent to and to the east of the existing SHBPS. The Proposed Development is for the construction and operation of a new energy from waste (EfW) (refuse derived fuel (RDF) fired) power plant. EP SHB Ltd is the Applicant and also owner of the Site. More details of the Proposed Development are provided in Section 2.0.

The Purpose and Scope of this Document

1.3 The Environment Agency's 'Flood Map for Planning' (Environment Agency, 2018a) identifies that the Site is located wholly within Flood Zone 3a, defined by the National Planning Policy Framework (NPPF) (Ministry of Housing, Communities and Local Government, 2018) and Planning Policy Guidance: Flood risk and coastal change (PPG) (Ministry of Housing, Communities and Local Government, 2014), as land with a high probability of flooding (>1% Annual Exceedance Probability (AEP)) (1 in 100 or greater annual chance of river flooding), or a >0.5% AEP (1 in 200 or greater annual chance) of flooding from the sea.

1.4 As the Proposed Development comprises an area in excess of one hectare (ha) and is located within Flood Zone 3, a FRA is required to accompany any planning application for the development of the Site, as per the requirements of the NPPF.

1.5 The aim was to undertake a FRA that is appropriate to the nature and scale of the Proposed Development, which would meet the necessary requirements of current planning guidance (see Section 3.0), and which will be sufficient to support the planning application for the Proposed Development. In order to meet this aim, the following was undertaken:

- Consultation with and obtaining data from North East Lincolnshire Council (NELC), the Environment Agency (EA) and North East Lindsey Internal Drainage Board (NELIDB) in regard to the Proposed Development, the flood risks posed to Site and the necessary measures that would be required to protect the Site from flooding;
- Review of publicly available data to determine the flood risks associated with all sources of flooding including the Humber Estuary, Main Rivers, Ordinary Watercourses, (including those under the jurisdiction of the NELIDB), groundwater, artificial sources, surface water runoff/overland flow and drainage and surrounding areas;
- Review of the Proposed Development design in light of the identified flood risks and identification of measures, where necessary, that would manage any residual flood risk to the Site to acceptable levels.

Data Sources

1.6 The baseline conditions for the Site were established through a desk based study and via consultation with the EA and other key statutory consultees. This information has been used to inform the assessment made within the FRA. Data collected during the course of this assessment is detailed in Table 1.

Table 1: Data Sources to Inform this FRA

PURPOSE	SOURCE	COMMENTS
Identification of Hydrological Features	1:10,000 Ordnance Survey (OS) mapping EA 1m resolution LiDAR data (Environment Agency, 2018b)	Identifies the location of local hydrological features and provides topographic elevations.
Identification of Land Use	StreetCheck (2018)	Identifies the type of land use
Identification of Existing Flood Risk	1:10,000 OS mapping	Provides indicative ground levels of the Site and surrounding area
	EA Flood Map for Planning (Environment Agency, 2018a)	Identifies fluvial/ tidal inundation extents
	EA Flood Risk from Surface Water Map (Environment Agency, 2018c)	Identification of flood risk from surface water runoff from land
	EA Flood Risk from Reservoirs Map (Environment Agency, 2018c)	Provides information on the risk of flooding from reservoirs (artificial sources)
	EA Groundwater Vulnerability map (Environment Agency, 2018d)	Identification of groundwater vulnerability designations
	British Geological Survey (BGS) records (BGS, 2018) Soilscapes Map (Cranfield Soil and Agrifood Institute, 2018)	Provides details of geology (bedrock and superficial deposits), soil type and hydrogeology in the vicinity of the Site
	North Lincolnshire Preliminary Flood Risk Assessment (PFRA) (Entec, 2011)	Indicative risk of flooding from the local drainage system and minor watercourses within the vicinity of the Site
	North and North East Lincolnshire Strategic Flood Risk Assessment (SFRA) (North Lincolnshire Council and North East Lincolnshire Council, 2011) and Addendum (North Lincolnshire Council and North East Lincolnshire Council, 2016)	Assesses local flood risk from fluvial/tidal, sewers, overland flow, groundwater and artificial sources

PURPOSE	SOURCE	COMMENTS
	North Lincolnshire Local Flood Risk Management Strategy (LFRMS) (Amec Foster Wheeler, 2016)	Provides details of flood risk within the Borough and which statutory authorities are responsible for the management of local flood risk. The report does not consider flood risk from Main Rivers.
	Humber Flood Risk Management Strategy (HFRMS) (Environment Agency, 2014)	The EA's long term plan for managing flood risk from the Humber Estuary.
	Grimsby and Ancholme Catchment Flood Management Plan (CFMP) (Environment Agency, 2009a)	Outlines flood risk sources within the plan area and how these may be managed in the future.
	Flamborough Head to Gilbraltar Point Shoreline Management Plan (SMP) (Scott Wilson & Humber Estuary Coastal Authorities Group, 2010)	Outlines the proposals for how the tidal flood risk in the area will be managed by the EA in the future.
Identification of Historical Flooding	North Lincolnshire PFRA (Entec, 2011)	Details of historical flooding and local flooding records
	North and North East Lincolnshire SFRA (North Lincolnshire Council and North East Lincolnshire Council, 2011)	
	North Lincolnshire LFRMS (Amec Foster Wheeler, 2016)	
	EA pre-development response	
Details of the Scheme	Proposed Development Design Drawings provided by Fichtner Consulting Engineers	Provides the layout of the Proposed Development
Surface Water Drainage Plans	1:10,000 OS Mapping Existing Site Drainage Plans	Identified existing site drainage, public drainage system near the Site and details of existing surface water runoff from the Site

Consultation with Key Stakeholders

1.7 Consultation was undertaken with the EA, NELIDB, NELC and Anglian Water the as part of this FRA. The data request letters and their responses are provided in Annex 1, Annex 2, Annex 3 and Annex 4 to this report respectively. These advisory recommendations are summarised and addressed in Section 3.0, 5.0 and 6.0.

2.0 SITE DESCRIPTION

Location

2.1 The Site defined by the planning application redline boundary comprises approximately 25 Hectares (ha) and is located approximately 5.6 kilometres (km) north-west of Grimsby in North East Lincolnshire, centred at OSNGR 523019, 413263. Figure 1 illustrates the Site location and hydrological context.

Existing Land Use

2.2 Within the Site there is an area which is defined as the Main Development Area (as illustrated in (see Figure 1). This area within the Site comprises approximately 7 ha of undeveloped vegetated area of grassland and is currently crossed by a number of existing buried services, the route of a series of underground water cooling pipes connecting the SHBPS and the cooling water pumping station located at the far western extent of the Site, and an associated access road to the pumping station. In the central and north-eastern regions of the Main Development Area there are two existing ponds (see 'Pond 1' and 'Pond 2' in Figure 1) some scattered scrubby vegetation and discrete sections of free-standing hedgerow.

2.3 The remainder of the Site comprises the existing SHBPS and areas which will be used for construction laydown areas and the site compound during construction.

Access

2.4 The Site is currently accessed through the main entrance of the SHBPS off South Marsh Road and is intersected by an internal access road which links the power station to the cooling water pumping station in the east of the Site. South Marsh Road provides highway access to the main SHBPS and also to Synthomer (UK) Limited and the NEWLINCS Integrated Waste Management Facility, both located to the north of the Site.

2.5 It is understood that South Marsh Road is also used by the EA to access flood defences along the bank of the Humber Estuary east of the existing pumping station to the east of Site.

2.6 The cooling water pumping station located approximately 60m to the east of the Site associated with the existing SHBPS does not service drainage of surface water runoff generated from rainfall at the Site.

Hydrology and Flood Risk Management Infrastructure

2.7 The Site is located approximately 175 m west of the Humber Estuary. The nearest watercourse is Oldfleet Drain located approximately 140 m to the south of the Site (at its closest point) which is classed by the EA as a Main River. Middle Drain, an Ordinary Watercourse is located approximately 340 m to the north (at its closest point). A series of minor land drainage ditches (also Ordinary Watercourses) run along the northern, western, eastern and southern boundaries of the Site and convey surface water runoff discharges from the greenfield areas of the Site into Middle Drain and Oldfleet Drain towards the Humber Estuary. These land drains are illustrated in more detail in Figure 14.1 in ES Volume II.

2.8 Fluvial flood defences are present along Oldfleet Drain upstream of the Site, located approximately 270 m south-west, upstream of the railway line. According to the

information provided by the EA, these reduce the risk of flooding up to a 1% AEP (1 in 100 chance) event.

2.9 Middle Drain discharges via a pumping station located approximately 550 m north of the Site, and Oldfleet Drain that outfalls via a flapped culvert into the estuary approximately 450 m south-east of the Site. The tidal outfall of Oldfleet Drain comprises a flapped twin culvert through the raised coastal flood defence that enables runoff to discharge whilst tide levels are low enough and the flaps are open. Two additional outfalls from a land drain alongside the raised sea defence between the Site and the Middle Drain pumping station comprise two 150 mm diameter un-flapped pipes.

2.10 The EA's 'Flood Map for Planning' (see Annex 1) identifies there to be existing tidal flood defences located approximately 160 m to the east of Site, extending from north-west to south-east alongside the Humber Estuary and reduce the risk of flooding up to a 0.5% AEP (1 in 200 chance) event.

Surrounding Land Use

2.11 There is a third body of standing water (see Figure 1) located approximately 80 m to the east of the Site next to the cooling water pumping station associated with the SHBPS. This is a holding chamber for water in and out of the cooling pipes.

2.12 The Site is located on the South Humber Bank which is an area of mixed agricultural and industrial use with no residential receptors located in close proximity to the Site (within 500 m). The closest residential properties (individual receptors) are located approximately 1 km to the west and south-west; these are:

- Poplar Farm (located on South Marsh Road); and
- Primrose Cottage (accessed via Station Road, north of the A180).

2.13 The nearest settlement is the village of Stallingborough located over 2 km to the south-west.

Topography

2.14 A review of 1 m resolution LiDAR data published by the EA (Environment Agency, 2018b) identified that the Site is situated on generally flat land with levels ranging between 1.90 metres Above Ordnance Datum (mAOD) and 4.25 mAOD (see Figure 2). The levels of the Site gently fall from west to east, towards the Humber Estuary.

Geology

2.15 The British Geological Survey, Geology of Britain Viewer (BGS, 2018) was used to identify the bedrock and superficial deposits beneath the Site. The Superficial Deposits present beneath the Site are identified as tidal flat deposits (clay and silt) possibly underlain by glacial deposits. These are designated as unproductive strata with low permeability; however permeable sand layers are likely to contain groundwater.

2.16 The Bedrock underlying the Site is the Flamborough Chalk Formation and is designated as a 'Principal Aquifer', defined as "*layers of rock or drift deposits that…usually provide a high level of water storage. They may support water supply and/or river base flow on a strategic scale*". Available groundwater monitoring data indicates that groundwater within the Chalk is likely to be confined beneath the overlying low-permeability superficial deposits.

2.17 There are no geological faults identified beneath the Site.

2.18 Soils at the Site are described on the Cranfield Soil and Agrifood Institute's Soilscapes mapping website as *"loamy and clayey soils of coastal flats with naturally high groundwater"*.

2.19 The Site is not located within an EA designated groundwater Source Protection Zone (SPZ) (Environment Agency, 2018d). The nearest SPZs to the site are located approximately 1.2 km to the south-west and north-west and are associated with potable water abstractions from the Chalk aquifer. The nearest Inner Zone (Zone 1) Groundwater Source is located in Healing, approximately 1.6 km to the south-west. Groundwater within the chalk is likely to be confined beneath the overlying superficial deposits.

2.20 The Site is located in an area defined as a 'Major Aquifer – High' vulnerability category on the EA's Groundwater Vulnerability Map (Environment Agency, 2018d).

2.21 These classifications will be taken into account in detail when the proposed surface water runoff mitigation measures (see Section 5.0) are developed further at the detailed design stage.

The Proposed Development

2.22 EP SHB Ltd propose to develop the Site to construct and operate a new EfW (refuse derived fuel (RDF) fired) power plant with a maximum gross electrical output of up to 49.9 MW.

2.23 The building envelope of the Proposed Development is approximately 210 m long and 110 m wide at its greatest extent. The nominal design capacity of the facility is 616,500 tonnes per annum of RDF based on a design net calorific value (NCV) of 11 MJ/kg and average availability. It is expected that the Proposed Development will be capable of maintaining the maximum electrical output while combusting fuel in a range of NCVs between 9 and 14 MJ/kg.

Proposed Access

2.24 It is proposed that the Site will be accessed from the A180 via the A1173, Kiln Lane, Hobson Way and South Marsh Road via a new access from South Marsh Road to the east of the existing SHBPS entrance. The Proposed Development will maintain access to the pumping station for SHBPS via a redirected roadway.

Proposed Development Drawings

2.25 A set of drawings illustrating the Proposed Development proposals are provided in Volume II of the Environmental Statement (ES). These include:

- Site Location Plan — Figure 1.1
- Proposed Development Site Layout Plan — Figure 4.1

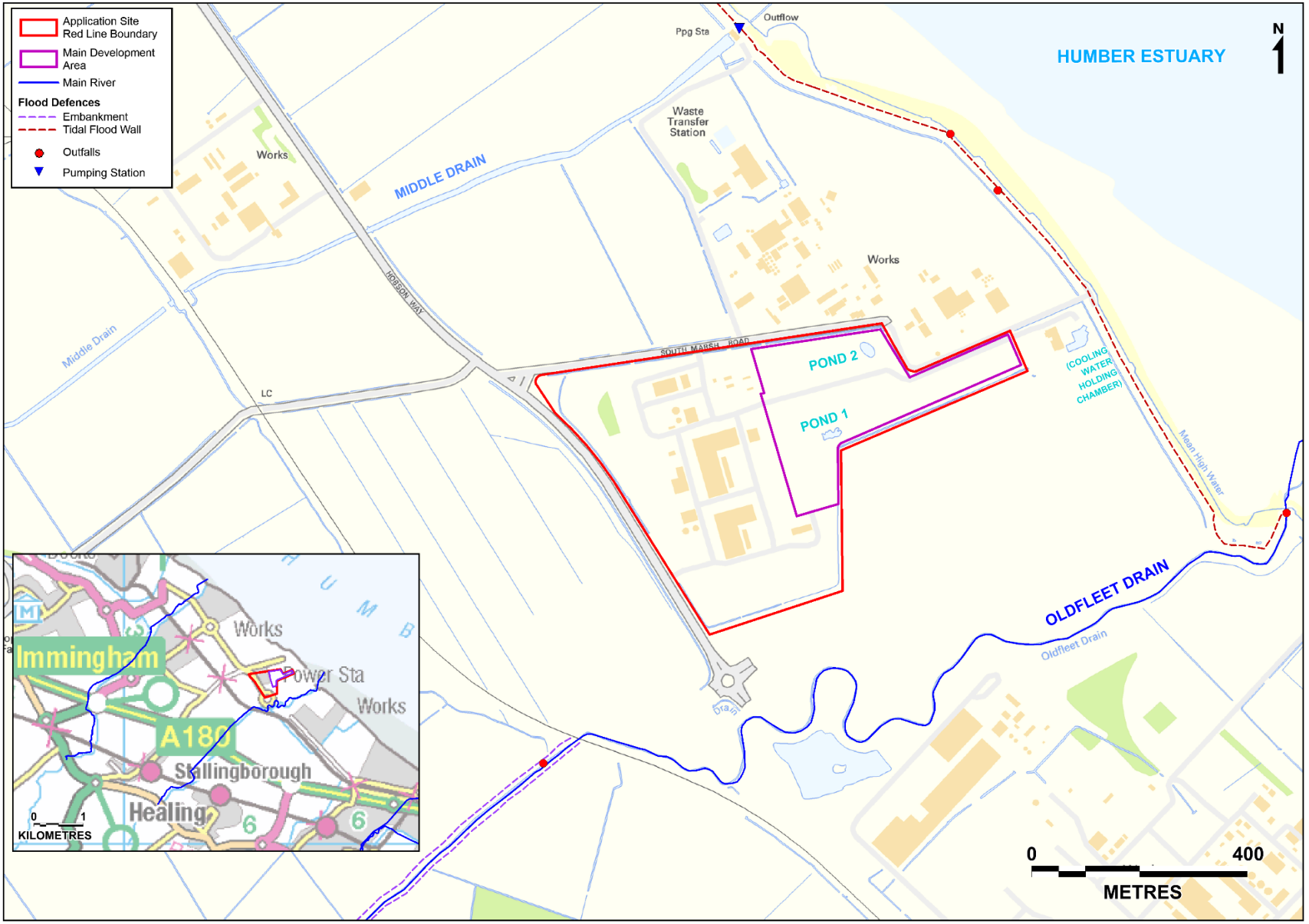

Figure 1: Site Location Plan – South Humber Bank Energy Centre

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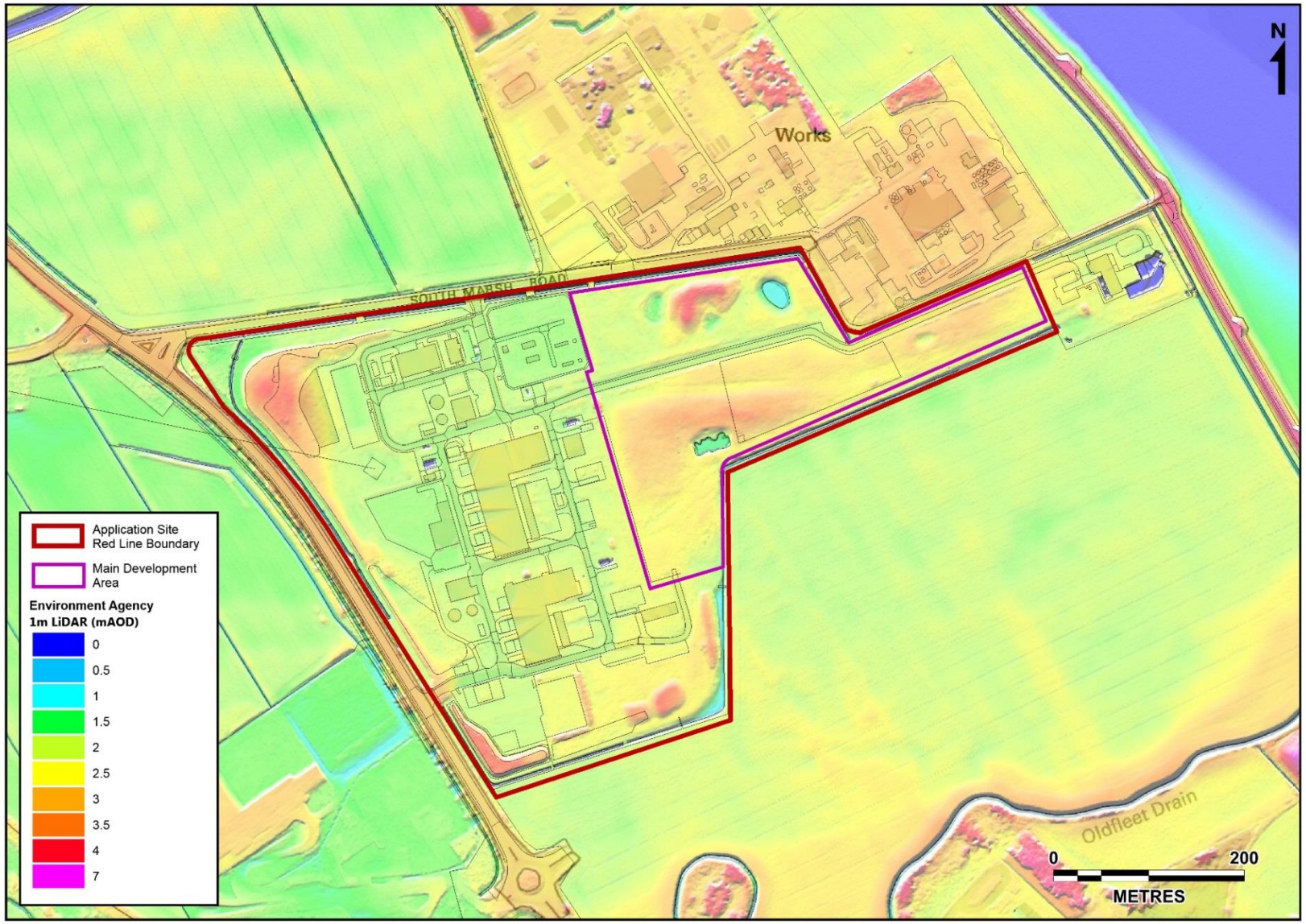

Figure 2: Site Topography at the South Humber Bank Energy Centre – EA 1m LiDAR

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3.0 PLANNING POLICY

3.1 The Sections below consider the planning policies and guidance of relevance to the Site with regards to the flood risks from all sources and appropriate mitigation measures which should be considered.

National Policy

National Planning Policy Framework (NPPF) (2018)

3.2 The NPPF (Secretary of State for Ministry of Housing, Communities and Local Government, 2018) is currently supported by the PPG (Ministry of Housing, Communities and Local Government, 2014). These constitute the most up to date guidance for Local Planning Authorities (LPAs) and decision-takers, both in drawing up plans and as a material consideration in determining applications. Section 10 of the NPPF and PPG provides guidance for planning with respect to flood risk.

3.3 The NPPF advocates a 'Sequential' approach for the planning process in order to steer development to areas with the lowest possible risk of flooding. The guidance states that only where there are no reasonably available sites in Flood Zones 1 or 2 should the suitability of sites in Flood Zone 3 be considered, taking into account the flood risk vulnerability of land uses and applying the Exception Test if required.

3.4 The Flood Zone definitions as presented in Table 1 of the PPG are defined in Table 2 below.

Table 2: NPPF PPG Flood Zone Definitions

FLOOD ZONE	DEFINITION
Flood Zone 1	Land that has a low probability of flooding (less than 1 in 1,000 annual probability of river or sea flooding (<0.1% AEP)
Flood Zone 2	Land that has a medium probability of flooding (between 1 in 100 and 1 in 1,000 annual probability of river flooding (0.1-1% AEP), or between 1 in 200 and 1 in 1,000 annual probability of sea flooding (0.1-0.5% AEP)
Flood Zone 3a	Land that has a high probability of flooding (1 in 100 year or greater annual probability of river flooding (>1% AEP), or a 1 in 200 or greater annual probability of flooding from the sea (>0.5% AEP)
Flood Zone 3b (Functional floodplain)	Land where water has to flow or be stored in times of flood (Not separately distinguished from Zone 3a on the Flood Map).

3.5 As discussed in Section 1.0, the EA's 'Flood Map for Planning' (Environment Agency, 2018a) identifies that the Site is located wholly within Flood Zone 3a.

Sequential Test

3.6 A Sequential Test is required to assess flood risks across strategic development sites and the NPPF PPG recommends that the test be applied at all stages of the planning process to direct new development to areas with the lowest probability of flooding (Flood Zone 1). However, the PPG also confirms that:

"The Sequential Test does not need to be applied for individual developments on sites which have been allocated in development plans through the Sequential Test"

3.7 Section 2.1 of NELC's Flood Risk Sequential and Exception Tests' Guidance Note (North East Lincolnshire Council, 2016) states that the Sequential Test is not required when:

"The Council has already sequentially tested the site as part of an allocation for development within the development plan"

3.8 The Site is located within Flood Zone 3 as defined in the Environment Agency's 'Flood Map for Planning' (see Section 1.3) and the Proposed Development is for power generation, which while not a formal B-class use is an important type of employment use as identified in the Local Plan 2013 to 2032 (NELC, 2018) (see Section 3.29) (paragraphs 12.17-12.19).

3.9 The Local Plan process considered the most appropriate sites allocated for such uses taking into account flood risk. The Site has been allocated as an 'existing employment area' being part of the operational area of the existing SHBPS, and is therefore safeguarded for such uses. It is also in close proximity to a number of sites allocated for 'proposed employment'. It is therefore considered that the Local Plan allocation process has dealt with the Sequential Test and that this is a suitable and preferred site, in flood risk terms, for the Proposed Development.

3.10 According to Table 2 of the PPG, the Proposed Development of a Power Station comprises the vulnerability classification of 'Essential Infrastructure'. Table 3 within the PPG (replicated in Table 3 below) provides a matrix identifying which vulnerability classifications are appropriate within each Flood Zone.

Table 3: NPPF PPG flood risk vulnerability and flood zone 'compatibility'

	FLOOD RISK VULNERABILITY CLASSIFICATION				
	ESSENTIAL INFRA-STRUCTURE	**WATER COMPAT-IBLE**	**HIGHLY VULNER-ABLE**	**MORE VULNER-ABLE**	**LESS VULNER-ABLE**
Flood Zone 1	✓	✓	✓	✓	✓
Flood Zone 2	✓	✓	Exception Test required	✓	✓
Flood Zone 3a	Exception Test required	✓	×	Exception Test required	✓
Flood Zone 3b 'Functional Floodplain'	Exception Test required	✓	×	×	×
Key: ✓ Development is appropriate × Development should not be permitted.					

Exception Test

3.11 As Table 3 indicates, application of the Exception Test is required for this Site. The PPG states that for the Exception Test to be passed:

- It must be demonstrated that the development provides wider sustainability benefits to the community that outweigh flood risk, informed by a Strategic Flood Risk Assessment where one has been prepared; and
- A site-specific FRA must demonstrate that the development will be safe for its lifetime taking account of the vulnerability of its users, without increasing flood risk elsewhere and, where possible, will reduce flood risk overall.

3.12 Both elements of the test will have to be passed for development to be allocated or permitted.

Environment Agency Climate Change Guidance (2016)

3.13 The EA published updated climate change allowances in February 2016 (Environment Agency, 2016) to support the NPPF, which supersede all previous allowances written in the 'PPG: Flood Risk & Coastal Change' and are predictions of anticipated change for:

- Peak river flow by River Basin District;
- Peak rainfall intensity;
- Sea level rise; and,
- Offshore wind speed and extreme wave height.

3.14 These should be considered within a FRA in regard to future impacts from climate change on site specific planning applications. The EA's guidance (Environment Agency, 2016) outlines how and when allowances should be applied for FRAs.

Tidal Climate Change Allowances

3.15 Table 4 is an extract replicated from Table 3 of the EA guidance (Environment Agency, 2016) detailing the anticipated rise in sea levels up to 2115.

Table 4: Sea level allowance for each epoch in millimetres (mm) per year with cumulative sea level rise for each epoch in brackets (use 1990 baseline)

AREA OF ENGLAND	1990 TO 2025	2026 TO 2055	2056 TO 2085	2086 TO 2115	CUMULATIVE RISE 1990 TO 2115 (metres (m))
East, East Midlands, London, South East	4 (140 mm)	8.5 (255 mm)	12 (360 mm)	15 (450 mm)	1.21 m

Fluvial Climate Change Allowances

3.16 For proposed developments in areas of fluvial flood risk, the flood risk vulnerability classification, flood zone and lifetime of development are of particular importance to determine the correct climate change allowance as detailed in Table 5.

Table 5: EA Climate Change Allowances to apply based upon the Flood Zone and Development Lane Use Vulnerability

	WATER COMPAT-IBLE	LESS VULNER-ABLE	MORE VULNER-ABLE	HIGHLY VULNER-ABLE	ESSENTIAL INFRA-STRUCTUR E
Flood Zone 2	NA	CA	Assess CA & HCA	Assess HCA & UEA	Assess HCA & UEA
Flood Zone 3a	CA	Assess CA & HCA	Assess HCA & UEA	✘	UEA
Flood Zone 3b	CA	✘	✘	✘	UEA
NA = No Allowance; CA = Central Allowance; HCA = Higher Central Allowance; UEA = Upper End Allowance; ✘ = Development not permitted					

3.17 As the Proposed Development is defined as ‘Essential Infrastructure’ from the vulnerability classifications in Table 2 of the NPPF, the corresponding percentages that should be assessed at sites within the Humber River Basin District are listed in

3.18 Table 6. The +50% allowance for climate change is therefore applicable to the Proposed Development.

Table 6: EA Peak River Flow Climate Change Allowances for the Humber River Basin District

	TOTAL POTENTIAL CHANGE ANTICIPATED FOR THE '2020s' (2015 TO 2039)	TOTAL POTENTIAL CHANGE ANTICIPATED FOR THE '2050s' (2040 TO 2069)	TOTAL POTENTIAL CHANGE ANTICIPATED FOR THE '2080s' (2070 TO 2115)
Upper End Allowance	20%	30%	50%
Higher Central Allowance	15%	20%	30%
Central Allowance	10%	15%	20%

Pluvial Climate Change Allowances

3.19 To account for the anticipated changes in rainfall intensity, the EA's guidance (as shown in Table 7) states that a FRA for an expected lifespan of the Proposed Development should assess the 'Upper End' allowance to understand the potential impact and make suitable decisions to mitigate against pluvial flooding.

Table 7: EA Peak Rainfall Intensity Climate Change Allowances across England

	TOTAL POTENTIAL CHANGE ANTICIPATED FOR THE '2020s' (2015 TO 2039)	TOTAL POTENTIAL CHANGE ANTICIPATED FOR THE '2050s' (2040 TO 2069)	TOTAL POTENTIAL CHANGE ANTICIPATED FOR THE '2080s' (2070 TO 2115)
Upper End Allowance	10%	20%	40%
Central Allowance	5%	10%	20%

3.20 Therefore, a +40% allowance for climate change for peak rainfall intensity is applicable to the Proposed Development at the Site. This has been taken into account in the calculations of surface water runoff rates and volumes in the Outline Drainage Strategy for the Proposed Development (refer to ES Appendix 14B in ES Volume III).

3.21 When assessing a range of allowances for peak river flow or rainfall intensity, the following must be considered:

- likely depth, speed and extent of flooding for each of the assessed climate change allowances;
- vulnerability of the proposed development types or land use allocations to flooding;
- 'built in' resilience measures used, for example, raised floor levels; and
- capacity or space in the development to include additional resilience measures in the future, using a 'managed adaptive' approach.

Non-Statutory SuDS Guidance

3.22 Defra published their Sustainable Drainage Systems: Non-Statutory Technical Standards (NSTS) in March 2015 (Defra, 2015) setting the requirements for the design, construction, maintenance and operation of SuDS. The NSTS are intended to be used alongside the NPPF and PPG.

3.23 The NSTS that are mainly relevant to the consideration of flood risk to and from development relate to runoff destinations, peak flow control and volume control. These standards are summarised in Table 1 of the SHBEC Outline Drainage Strategy (refer to ES Appendix 14B in ES Volume III). Additional guidance is provided for structural integrity, designing for maintenance considerations and construction.

Regional Policy

Grimsby and Ancholme Catchment Flood Management Plans (2009)

3.24 The role of Catchment Flood Management Plans are to identify flood risk management policies which will assist all key decision makers in the catchment to deliver sustainable flood risk management for the long term. The Site is located within the Grimsby and Ancholme CFMP study area. The region specific CFMP (Environment Agency, 2009b) considers all types of inland flooding, from rivers, ground water, surface water and tidal flooding, but not flooding directly from the sea (coastal flooding).

3.25 The report identifies Oldfleet Drain (Main River) to be a main source of fluvial flood risk to the Humber Trade Zone Industrial Area, where the Site is located.

Flamborough Head to Gibraltar Point Shoreline Management Plan (SMP) (2010)

3.26 The Site is potentially vulnerable to tidal flooding from the Humber Estuary and the Site location falls into 'Sub Area 4: Immingham, Grimsby and Buck Beck' of the local Flamborough Head to Gilbraltar Point SMP (Scott Wilson & Humber Estuary Coastal Authorities Group, 2010).

3.27 The purpose of a Shoreline Management Plan is to identify the most sustainable approach to managing the flood and coastal erosion risks to the coastline in the short-term (0 to 20 years), medium term (20 to 50 years) and long term (50 to 100 years).

3.28 The report identifies the Site to be an area of low to high flood risk where the LLFA and the EA are already working towards managing the risk. However it is also an area that will be affected by climate change due to the low lying land and its coastal location, and so will need ongoing maintenance and defence improvements.

Humber Flood Risk Management Strategy (HFRMS) (2008)

3.29 The Site lies within 'Area 24 - Immingham to West Grimsby' of the Humber FRMS (Environment Agency, 2008) This FRMS contains policies to manage the risk of flooding in this area which include those in the list below:

- defences here will be improved as necessary to protect the large number of people, businesses and nationally important industry from tidal flooding.
- develop plans to improve the defences near North Killingholme and Stallingborough within the next five years.
- work closely with other authorities and developers to ensure we manage the risk effectively together.

- aiming to avoid any new development immediately behind the existing defences in case they have to be moved in the future.

Local Policy

North East Lincolnshire Local Plan (2018)

3.30 The North East Lincolnshire Local Plan 2013 to 2032 (North East Lincolnshire Council, 2018) was adopted in March 2018. The following policies from the Local Plan are considered relevant in regard to flood risk to the Proposed Development:

- **SO2 – Climate Change**: Address the causes and effects of climate change by promoting development that minimises natural resource and energy use; reduces waste and encourages recycling; reduces pollution; brings about opportunities for sustainable transport use; responds to increasing flood risk; and, incorporates sustainable construction practices. Promote appropriate distribution of development and the role of green infrastructure in mitigating aspects of flood risk. Recognise the increased stress on habitats and species that climate change causes.
- **Policy 33 – Flood Risk**: In order to minimise flood risk impacts and mitigate against the likely effects of climate change, development proposals should demonstrate that:
    a) where appropriate, a site specific FRA has been undertaken, which takes account of the best available information related to all potential forms of flooding;
    b) there is no unacceptable increased risk of flooding to the development site or to existing properties;
    c) the development will be safe during its lifetime;
    d) Sustainable Drainage Systems (SuDS) have been incorporated into the development unless their use has been deemed inappropriate;
    e) opportunities to provide natural flood management and mitigation through green infrastructure have been assessed and justified, based upon sound evidence, and, where appropriate, incorporated, particularly in combination with delivery of other aspects of green infrastructure in an integrated approach across the site;
    f) arrangements for the adoption, maintenance and management of any mitigation measures have been established and the necessary agreements are in place;
    g) access to any watercourse or flood defence asset for maintenance, clearance, repair or replacement is not adversely affected; and,
    h) the restoration, improvement or provision of additional flood defence infrastructure represents an appropriate response to local flood risk, and does not conflict with other Plan policies.
- **Policy 34 – Water Management**: Development proposals should consider how water will be used on the site and ensure that appropriate methods for management are incorporated into the design, considering the objectives and programme of measures set out by the Humber River Basin Management Plan.

North and North East Lincolnshire Strategic Flood Risk Assessment (2011) and Addendum (2016)

3.31 The North and North East Lincolnshire SFRA (North Lincolnshire Council and North East Lincolnshire Council, 2011) was written in 2011 and provides the LPAs with information to make objective judgements about flooding, both when making decisions on land allocations for development plans and when determining planning applications for development in their areas.

3.32 The SFRA provides a series of maps detailing the hydrological features in the vicinity of the Site, identifying the responsibilities for these by the NELIDB (Significant Ordinary Watercourses) and the EA (Main Rivers), and presents records of historical flooding incidents in the vicinity. The SFRA identifies the South Humber Bank as a strategic employment site as defined in the NELC Local Plan, and also provides site-specific guidance for developers to consider in regard to mitigation of any identified flood risks from all sources.

3.33 An Addendum to the SFRA was completed in April 2016 containing updated maps for a tidal defence breach hazard scenario provided by the EA. No specific policies are presented in relation to the Site.

North and North East Lincolnshire Preliminary Flood Risk Assessment (2011)

3.34 The North and North East Lincolnshire PFRA (Entec, 2011) was a high level screening exercise that compiled information on significant local flood risk from past and future floods, based on readily available information at the time. The PFRA also included the identification of 'flood risk areas', and outlines the responsibilities of key stakeholders.

3.35 Local flood risk was defined in the PFRA as flood risk originating from sources other than Main Rivers, the sea and large reservoirs; principally meaning flood risk from surface water runoff, groundwater and Ordinary Watercourses. This main definition of 'local flood risk' was further clarified:

a) it includes lakes and ponds;

b) it does not consider flooding from sewers unless this is wholly or partly caused by rainwater or other precipitation entering or otherwise affecting the system;

c) it does not include flooding from water supply systems (for example burst water mains); and

d) it considers the interaction with flooding from main rivers, the sea and sewers.

North East Lincolnshire Local Flood Risk Management Strategy (LFRMS)

3.36 As the Lead Local Flood Authority (LLFA), NELC is responsible for managing flood risk from 'local' sources. Their LFRMS (North East Lincolnshire Council, 2015) report presents the summary of North Lincolnshire's preferred strategy for managing flood risk from the following 'local' sources:

- surface run-off;
- groundwater; and
- Ordinary Watercourses (generally small rivers and streams).

3.37 The LFRMS contains a list of objectives for the strategy, which included:

- Objective 1 – to improve the understanding (of both communities and flood risk management partners) of the roles and responsibilities for flood risk management in North Lincolnshire;
- Objective 2 – to improve the understanding of local flood risk;
- Objective 3 – to reduce the risk of flooding from local sources in the communities;
- Objective 4 – seek to implement flood risk management actions that contribute to wider social, economic and environmental outcomes and sustainable development;
- Objective 5 – create a strong collaborative approach across stakeholders to address risks from all sources of flooding;
- Objective 6 – raise public awareness and engage with local people about local flood risks, and help the communities to manage their own risks;
- Objective 7 – contribute to planning and development decisions to ensure new development is appropriate; and
- Objective 8 – contribute to effective emergency flood response.

3.38 The LFRMS refers to the South Humber bank as the 'energy estuary', and states that managing flood risk will be important in ensuring that these businesses can operate in a safe environment. Disruption from flooding could lead to significant disruption to these businesses which could affect the local economy.

3.39 It continues to state that in order to develop stronger communities NELC aims to establish a new relationship with the community to promote a culture of independence. The LFRMS acknowledges that communities will also need to play a greater role than before in reducing their own flood risks, becoming more resilient and ensuring that they are prepared for flooding without relying on the Council to provide all the solutions.

North East Lincolnshire Council SuDS Guide (2016)

3.40 The NELC SuDS Guide (North East Lincolnshire Council, 2016) provides introductory advice on how best to approach the development of SuDS proposals within schemes. The report is designed to reiterate the wide range of industry guidance already available and to highlight the importance of SuDS. It states the aims of SuDS as being to:

- reduce the risk and impacts of flooding;
- remove pollutants from urban runoff at source;
- provide amenity benefits; and
- contribute to improving and enhancing biodiversity.

3.41 The guidance also provides information on the criteria needed to support planning application submissions and reiterates that under the NPPF, all major developments must incorporate SuDS and must ultimately succeed in all four of the aims listed above.

3.42 The guide acknowledges each site will warrant a different approach to the composition of SuDS applied, dependent on many factors such as, topography, shape, size and underlying permeability. The LPA offers pre-application advice on development proposals, and therefore it is recommended prior to the detailed design process, the LLFA (NELC) be consulted.

4.0 FLOOD RISK SOURCES

Introduction

4.1 The NPPF requires the effects of all forms and sources of flood risk to and from the Site to be considered within a FRA. There should be demonstration of how these risks should be managed so that the development remains safe throughout its lifetime, taking into account current climate change predictions.

4.2 This Section discusses these potential risks in relation to tidal, fluvial, surface water runoff, groundwater and man-made/artificial sources (e.g. canals, reservoirs, pumping station failure).

Historical Flooding Incidents

4.3 The EA provided details of historical flooding events in the local vicinity to the Site. Annex 1 contains a map illustrates that the Site was flooded during a major tidal flood event in January 1953. This event occurred prior to the coastal flood defences being improved in response to the 1953 event.

4.4 Map 6 of the 2011 SFRA illustrates no records of reported historical flooding incidents in the immediate vicinity of the Site. The nearest reported incidents were located in the industrial estate approximately 1.1 km to the north-west. The 'River and Tidal Flood Risk Map' on page 9 of the 2011 PFRA contains no additional records of historical flooding to these in the vicinity of the Site.

4.5 No further major historical incidents are recorded in the vicinity on the Chronology of British Hydrological Events website (University of Dundee, 2018).

Tidal Sources

4.6 The Humber Estuary is located approximately 175 m to the east of the Site. The Humber Estuary poses the primary and most significant risk of flooding to the Site, but the Site benefits from existing flood defences.

Flood Map for Planning

4.7 The EA's 'Flood Map for Planning' available to view on their website (Environment Agency, 2018) identifies areas subject to fluvial/tidal flood risk for the present day but does not include the benefits or impacts of any existing flood defences or climate change respectively.

4.8 A copy of the Flood Map provided by the EA is provided in Annex 1. This illustrates that the site is wholly located within Flood Zone 3 ('high' risk) defined as land having a >0.5% Annual Exceedance Probability (AEP) (greater than a 1 in 200 chance) of sea flooding (see Table 2).

Tidal Flood Defences

4.9 In accordance with the NPPF, the requirements are to ensure any proposed developments are built to withstand tidal flooding up to a 1% AEP (1 in 100 chance) event taking into account the potential impacts of climate change.

4.10 The EA's 'Flood Map for Planning' (refer to Annex 1) identifies there to be existing tidal flood defences located approximately 160 m to the east of site, extending from north-

west to south-east alongside the Humber Estuary. According to the additional information provided by the EA (refer to Annex 1), the tidal defences protecting this Site consist of concrete floodwalls. They are in 'good' condition and reduce the risk of flooding up to a 0.5% AEP (1 in 200 chance in any year) event. The EA inspects these defences routinely to ensure potential defects are identified. The residual risk of flooding in the event of a defence breach scenario needs to be considered.

Modelled Tidal Water Levels

4.11 The EA provided modelled tidal peak water levels for the South Humber Bank area to inform this FRA (refer to Annex 1). The EA's model demonstrated that during a 0.1% AEP (1 in 1000 chance) event based upon the existing (2014) scenario, tidal levels in the Humber Estuary could rise up to 5.27 mODN at the Grimsby gauge to the south-east of Site, and 5.47 mODN at the Haborough gauge north-west of Site.

4.12 Table 8 details the modelled tidal water levels provided by the EA (refer to Annex 1). These are the current best estimate for extreme tide levels in the vicinity.

Table 8: EA Modelled Flood Levels at Grimsby and Haborough Marsh

				ANNUAL CHANCE (1 IN X / % AEP) OF TIDE LEVEL (mODN)					
EA Node Ref	**Location**	**Easting**	**Northing**	**1 (>99%)**	**10 (10%)**	**50 (2%)**	**100 (1%)**	**200 (0.5%)**	**1000 (0.1%)**
H060	Grimsby	527878	411346	4.10	4.43	4.70	4.82	4.95	5.27
H080	Habor-ough Marsh	520790	415740	4.26	4.61	4.88	5.01	5.14	5.47

Modelled Overtopping and Breach Failure Water Levels Behind the Defences

4.13 The EA has modelled simulations for breaching and overtopping scenarios of the tidal flood defences located approximately 160 m east of the Site. The breach and overtopping scenarios were modelled for the 0.5% AEP (1 in 200 chance) and 0.1% AEP (1 in 1000 chance) events. The scenarios were performed for the 2006 and 2115 scenarios, demonstrating both the existing and future scenario taking into account the effects of a predicted 20% increase in flow resulting from climate change, respectively.

4.14 Overtopping was included during scenarios where the design standard of protection (SoP) of the defences would be exceeded and the breach scenarios were undertaken in defences at specific locations. The EA provided maximum modelled depth, velocity and hazard maps (refer to Annex 1) and the results in the vicinity of the Site are summarised in Table 9. These include results for the nearest modelled breach location to the Site (located approximately 270 m north of the Site). The 30% - 50% climate change scenario flood depth information has not been made available by the EA.

Table 9: EA Modelled Flood Level Depth Bands at the Site

		FLOOD DEPTH (m) BAND	
	Scenario	**0.5 % AEP (1 in 200)**	**0.1 % AEP (1 in 1000)**
Breach	2006 (Existing)	0.25 - >1.6	0.5 - >1.6
	2115 (inc. 20% Climate Change)	1.0 – 2.75	1.0 – 2.75
Overtopping	2006 (Existing)	0 – 1.6	0 - > 1.6
	2115 (inc. 20% Climate Change)	1 - > 1.6	>1.6

4.15 At present, only flood depth information has been provided by the Environment Agency in banded ranges (as presented in Table 9 and in Annex 1). The modelled water levels (in mAOD) that produced these depth results will be further clarified at the detailed design stage when the Environment Agency are able to provide the modelled outputs for the area.

4.16 However, using the depth information provided in comparison with 1 m resolution LiDAR ground level data, it has been estimated by AECOM that the peak 0.1% AEP water level resulting from a breach event is approximately 4.55 mAOD. This estimate has been used to inform the mitigation proposals for elevating critical equipment and a safe place of refuge for occupants at the Site in Section 6.0. This is considered a robust assessment based on the available information and can be updated if any further information becomes available.

4.17 In the event of such an overtopping scenario occurring in the present-day scenario, the modelled hazard classifications range from ‘Low Hazard’ to ‘Danger to Some’ in the central-southern area of the Site and along the southern boundary.

4.18 In the event of such an overtopping scenario taking into account the future climate change up to 2115, or a breach scenario occurring during the present day or future scenario, the modelled hazard classifications range from small areas with ‘Danger to Most’ to largely ‘Danger to All’ across the entire Site.

Summary

4.19 Based on the information provided by the EA, it has been determined that during the existing scenario the Site is at a ‘low’ risk of flooding from tidal sources with the defences in place, or resulting from overtopping of the defences during events that exceed a 0.5% AEP (1 in 200 chance) of flooding. If the defences were to fail and breach during the existing scenario, the Site would be at a ‘high’ risk of flooding during either the 0.5% or 0.1% AEP (1 in 1000 chance) events.

4.20 During a future scenario resulting from climate change up to 2115 however, the impacts are more significant. The Site is potentially at a ‘high’ *residual* risk of flooding as a result of overtopping during events that exceed a 0.5% AEP (1 in 200 chance) of flooding, or in the event that the defences were to breach during either the 0.5% or 0.1% AEP (1 in 1000 chance) events.

Fluvial Sources

4.21 A review of OS mapping identified that the nearest watercourse is Oldfleet Drain (Main River) located approximately 140 m to the south of the (at its closest point) which flows in a north-easterly direction. Middle Drain, a Significant Ordinary Watercourse as defined by the SFRA, managed by the NELIDB, is located approximately 340 m to the north (at its closest point). A series of minor land drainage ditches (also Ordinary Watercourses) run along the northern, western, eastern and southern boundaries of the Site and convey surface water runoff discharges from the greenfield areas of the Site to Oldfleet Drain and Middle Drain. These watercourses all pose a potential risk of fluvial flooding to the Site.

Flood Map for Planning

4.22 The EA's 'Flood Map for Planning' (Environment Agency, 2018a) (refer to Annex 1) illustrates that the Site is wholly located within Flood Zone 3 (high risk) defined as land having a >1%/0.5% AEP (greater than a 1 in 100 / 1 in 200 chance in any year) of river or sea flooding respectively (see Table 2). However, this map does not differentiate between the tidal/fluvial sources of risk and the tidal defences are not taken into account.

Modelled Fluvial Water Levels & Extents

4.23 The site specific information provided by the EA (refer to Annex 1) illustrates the Site to have a 'very low' risk of fluvial flooding as the Site is located outside of the modelled defended 0.1% AEP (1 in 1000 chance) flood extent for Oldfleet Drain and Middle Drain derived from the 'Oldfleet Drain and Stallingborough North Beck Model' (April 2009). No modelled flood extents are available specifically for the land drains. However Oldfleet Drain is considered to be the primary source of fluvial flood risk.

4.24 The EA also provided modelled peak fluvial flood levels for three model nodes along Oldfleet Drain alongside the Site from this model. The modelled defended 1% AEP (1 in 100 chance) event peak water levels at all three nodes are all 2.58 mODN. This flood level is replicated for all modelled events up to the 0.1% AEP (1 in 1000 chance) event plus a 20% allowance for climate change (however, the 30% - 50% climate change scenarios have not been modelled by the EA). The model demonstrated that peak flows would reach a maximum of 4.34 m^3/s during a 0.1% AEP (1 in 1000 chance) event.

Fluvial Flood Defences

4.25 The EA's 'Flood Map for Planning' (refer to Annex 1) identifies there to be existing fluvial flood defences upstream of the Site, located approximately 270 m south-west along Oldfleet Drain, upstream of the railway line. According to the information provided by the EA, these fluvial flood defences comprise earth embankments. Their condition is 'fair' and will reduce the risk of flooding up to a 1% AEP (1 in 100 chance) event. The EA regularly inspect the defences to ensure potential defects are identified.

4.26 Alongside the site (downstream of the railway line to the sea), the EA confirmed that the Oldfleet Drain channel capacity is sufficient to convey flows in excess of a 1% AEP (1 in 100 chance) event.

Un-modelled Land Drains

4.27 The proposed access from South Marsh Road will cross the land drainage ditch in the north-eastern corner of the Main Development Area (Land Drain 1 in Figure 14.1 presented in the ES Volume II). The design will comprise either a new culvert or a clear-span bridge. There is subsequently the potential for an increased risk of fluvial flooding from this watercourse as a culvert could reduce the conveyance capacity of the drain, potentially causing floodwater to back up westwards along the drain. However, the bed levels of the drain are relatively flat and so the scale of any water level afflux on the upstream face of the bridge would be very limited. This would likely only impact a short, very localised reach of the watercourse and as the adjacent ground levels of the Site and South Marsh Road are relatively flat, any additional flood water overtopping the banks would continue to follow its existing route eastwards.

4.28 During the detailed design phase, a detailed assessment of the local topography (though acquisition of detailed survey along the drain) and of the small catchment hydrology will be undertaken to determine the flow capacity of and flow estimates likely to be conveyed along the drain respectively to inform the adequate sizing and levels of a culvert/clear-span bridge necessary to prevent any obstruction to flow.

Summary

4.29 Based on the information provided by the EA, it has been determined that the Site is at a ‘very low’ risk of fluvial flooding from Oldfleet Drain or Middle Drain.

Groundwater Sources

4.30 Groundwater flooding can occur when groundwater levels rise above ground surface levels. The underlying geology has a major influence on where this type of flooding takes place; it is most likely to occur in low-lying areas underlain by permeable rocks (aquifers).

4.31 The EA’s ‘Areas Susceptible to Groundwater Flooding’ map is illustrated (refer to Annex 2 of the Joint Lincolnshire Flood Risk and Drainage Management Strategy (Lincolnshire County Council, 2012). The map is divided into 1 km^2 grid-squares in which a percentage is given for what proportion of the 1 km^2 is considered to be susceptible to groundwater emergence. This map illustrates that the Site lies within a 1 km grid square of which up to 25% of the area is considered to potentially be at risk of groundwater emergence.

4.32 In 2006, RSK Group was commissioned by Centrica in 2006 to undertake a ground investigation as part of the design phase for a Site Protection and Monitoring Program (SPMP) for the SHBPS. The following summary from the ground investigation is based on the document ‘Site Protection and Monitoring Programme Review for South Humber Bank Power Station’ (September 2011). This document states that the intrusive ground investigation inferred that groundwater flowed towards the south-east and recorded resting groundwater depths across a monitoring well network ranging from 0.22 m below casing top (bct) to 1.55 m bct.

4.33 The risk of groundwater flooding within the Main Development Area is therefore considered to be ‘low’ to ‘medium’.

Surface Water Runoff to the Site

Overland Flow of Rainfall Runoff

4.34 The EA 'Flood Risk from Surface Water' map available on their website (Environment Agency, 2018c) identifies the vast majority of the Site to be at a 'very low' risk from surface water flooding (<0.1% AEP event). Small areas along the roads and along adjacent land drains within the Site are identified to be at a 'low', 'medium' and 'high' risk from surface water flooding (>0.1% AEP, 3.3% to 1% AEP event and >3.3% AEP event respectively). The Proposed Development area within the Site is illustrated as being predominantly at a 'very low' risk from surface water flooding, with very small areas at 'low risk' at the topographic low points.

4.35 Additionally, this information is supported by the fact that there are no significantly raised ground levels adjacent to the Site that could generate sufficient rates/volumes of surface water runoff to pose a risk of overland flow coming into the Site.

4.36 The risk of surface water flooding within the Main Development Area within the Site from elsewhere is therefore considered to be 'low' to 'very low'.

Existing Drainage Infrastructure

4.37 The existing surface water drainage infrastructure within Site is illustrated in drawing 'Surface, foul, oily water HRSG blowdown services DRGDS2506' provided in the SHBEC Outline Drainage Strategy (refer to Appendix 14B in ES Volume III) and consists of a series of surface water drainage features servicing the existing man-made facilities of the SHBPS.

4.38 The effluent from the boiler facilities of the SHBPS discharge into effluent basins with buried outlet pipes connected to the cooling water pumping station at the far eastern extent of the Site. Surface water from the rooftop and access road areas of the Site that is already developed is currently collected via gullies and conveyed into these effluent basins via buried surface water pipelines. A body of standing water located to the east of the Site next to the cooling water pumping station is a holding channel for water in and out of the cooling pipes (see Figure 1). The combined water is discharged via this holding channel into the Humber Estuary.

4.39 It is assumed that the land drains located around the perimeter of the Site accept lateral drainage of surface water from the greenfield areas of the Site. No level information however has been provided for these drains.

4.40 The drawing also identifies that the settlement pond (see 'Pond 1' in (see Figure 1) located within the centre of the area proposed for development appears to have historically received surface water inflows from the Site, but this drain has now been abandoned.

4.41 An additional pond 'Pond 2' (see Figure 1) is located within the Main Development Area. No information is currently available for this study to determine how the two ponds are now fed, but it is assumed that both ponds are static/hydrologically unconnected to the local land drains and collect direct rainwater and runoff from the surrounding higher ground levels within the Site boundary.

4.42 A review of OS mapping and the EA's 1m LiDAR data identified that these ponds are elevated at the lowest ground levels within the Site, and the holding chamber to the east is also elevated at lower ground elevations that the Site (i.e. they are not elevated above any adjacent ground levels so do not create a pathway of flooding towards the Site).

4.43 These three waterbodies are therefore considered to pose a 'very low' risk of surface water flooding to the Main Development Area.

Summary

4.44 The risk to the Site from overland flow of surface water generated adjacent to the Site, or from waterbodies located within the Site is considered to be 'low' in small areas, but largely 'very low'.

Artificial Sources

Reservoirs

4.45 The EA defines a reservoir as an artificial body of water which can hold >25,000 cubic meters or more of water, above ground level as specified in The Reservoirs Act (1975) (HMSO, 1975).

4.46 The closest reservoir to the Site is located approximately 13 km south-east of Site north of Rothwell, west of Cuxwold. The EA 'Flood Risk from Reservoirs' map (Environment Agency, 2018c) illustrates that there is very low flood risk to Site from reservoirs in the event of a breach scenario.

Canals

4.47 There are no canals in close proximity to the Site, and therefore it is considered that there is no flood risk posed to the Site from this source.

Summary

4.48 There are no artificial sources of flood risk, such as reservoirs or canals in close proximity to the Site. It is therefore considered that there these sources pose very low flood risk to the Site.

5.0 MANAGEMENT OF SURFACE WATER FROM THE SITE

5.1 This Section summarises the approach taken in the SHBEC Outline Drainage Strategy (refer to Appendix 14B in ES Volume III) to define the scale of surface water runoff at the Site, and the choice of surface water management measures investigated.

Policy & Guidance

5.2 The NPPF (Secretary of State for Ministry of Housing, Communities and Local Government, 2018), the EA, the NSTS SuDS Guidance (Defra, 2015) the NELC Local Plan (North East Lincolnshire Council, 2018) and the NELC SuDS Guide (North East Lincolnshire Council, 2016) require that new developments should not increase flood risk to the site and the surrounding area. Therefore surface water runoff rates discharging from the propped development at the Site should not exceed the existing runoff rates.

5.3 General advisory recommendations of the EA require the existing greenfield runoff rates to be maintained from any proposed development using SuDS where practicable to provide adequate storage up to the 1% Annual Exceedance Probability) (AEP) event (1 in 100 chance in any year) including an allowance for climate change. More information on the EA's requirements can be found in Section 2.0 of the SHBEC Outline Drainage Strategy (refer to Appendix 14B in ES Volume III).

5.4 Following consultation with the NELIDB and NELC (refer to Annex 2 and Annex 3 respectively), they provided the following comments:

- no development should be commenced until the LPA has approved in writing a scheme to their satisfaction for the provision, implementation and future maintenance of a surface water drainage system;
- the Board would support the use of SuDS and the drainage policies of NELC;
- any discharge should be limited to the greenfield rate, however Middle Drain Pump Station was designed to allow for areas of development (to the design standard of the day). Any potential increase in discharge would be subject to the drainage system being able to convey the flows (modelling required) and a development charge payable to the Board; and
- under the terms of the Land Drainage Act. 1991 the prior written consent of the Board is required for any proposed temporary or permanent works or structures within any watercourse including infilling or a diversion.

5.5 Anglian Water's (AW) consultation response (refer to Annex 4) surface water drainage policy requires that the disposal hierarchy should be followed:

- discharge by infiltration to the ground;
- discharge to an open surface water body;
- discharge to a surface water sewer;
- discharge to a combined sewer;
- discharge to a foul sewer; and
- discharge rates and volumes are to be limited to the equivalent greenfield runoff rate (with on-site attenuation for all events up to the 1 in 100 (1% AEP) rainfall event plus climate change). Flooding must also not occur on any part of the development for the 1 in 30 year (3.3% AEP) rainfall event.

5.6 The scoping consultation response from AW stated that the use of SuDS for the development is encouraged and provided a guidance document on the use of SuDS and an overview of the adoption policy should a developer seek to connect into an AW asset.

5.7 The detailed design of the drainage scheme should take these considerations into account.

Existing Surface Water Runoff Rates

5.8 The existing surface water greenfield runoff rates for the Main Development Area within the Site (7.3 Ha) were calculated. The detailed calculation parameters used for the runoff rates can be found in Section 3.0 of the SHBEC Outline Drainage Strategy (Appendix 14B of the ES).

5.9 Table 10 details the existing runoff rates calculated during the 1%, 3.3% and >99% AEP events.

Table 10: Calculated Greenfield Surface Water Runoff Rates for the Main Development Area within the Site (7.3 ha)

RAINFALL EVENT (AEP / 1 IN X YEARS)	GREENFIELD RUNOFF RATE (REFH2) (l/s/ha)	TOTAL RUNOFF FROM THE EXISTING SITE (7.3 ha) (l/s)
>99% (1 in 1)	0.5	3.7
3.3% (1 in 30)	1.2	8.8
1% (1 in 100)	1.6	11.5

Un-attenuated Proposed Surface Water Runoff Rates

5.10 The runoff rate from the proposed land use within the Main Development Area will increase due to an increase in impermeable area (hard-standing and roofing). The anticipated un-attenuated surface runoff rates, assuming up to 6.5 ha will all be changed to impermeable land use, were calculated in the SHBEC Outline Drainage Strategy (refer to ES Appendix 14B in ES Volume III), and replicated in Table 11 below.

Table 11: Calculated Impermeable Surface Water Runoff Rates for the Proposed Land Use within the Main Development Area within the Site (up to 6.5 ha) – Un-attenuated

FLOOD EVENT (% AEP / 1 IN X YEARS)	TOTAL RUNOFF (l/s) FOR A RANGE OF RAINFALL DURATIONS								
	15 mins	30 mins	1 hr	2 hr	3 hr	5 hr	12 hr	24 hr	48 hr
50% (2)	440	289	181	127	100	71	39	23	14
20% (5)	775	503	316	201	151	104	53	31	18
10% (10)	1008	660	416	254	188	127	63	36	21
3.3% (30)	1390	917	579	340	247	163	80	45	26
2% (50)	1561	1036	656	381	275	181	88	50	28
1% (100)	1811	1207	766	439	316	207	100	57	32
1% (100) + 20% CC	2173	1448	919	527	379	248	120	68	38
1% (100) + 40% CC	2535	1690	1072	615	442	290	140	80	45

Surface Water Volume Attenuation Requirements

5.11 In order to ensure that flood risk is not increased elsewhere, in accordance with the NPPF, EA, NELC and NELIDB requirements, discharge of surface water runoff from the Main Development Area within the Site will be restricted to the existing greenfield runoff rate to prevent an increased risk of flooding downstream. The SHBEC Outline Drainage Strategy (refer to ES Appendix 14B in ES Volume III) identifies that a surface water attenuation solution will be implemented on Site to ensure the greenfield runoff rates presented in Table 10 are not exceeded up to a 1% AEP (1 in 100) event including an allowance for climate change.

5.12 The minimum achievable discharge from outfall control structures, for example a HydroBrake, is usually 5 l/s. Consultation with the NELIDB (see Annex 2) concluded with an agreement in principle that a maximum discharge rate of 5 l/s during the 1 in 1 year event into their land drainage network is acceptable for the total runoff from the Main Development Area within the Site following completion of the Proposed Development.

5.13 The storage volumes of the attenuation solution required relating to the existing greenfield runoff rates are detailed in Table 12. The areas required for the storage solution needed in order to accommodate these volumes under two different scenarios (free discharge, and no discharge resulting from high tide levels) are also provided. This assumed the depth of the storage area is 2 m, reflective of the depth of the land drains around the perimeter of the Site.

Table 12: Calculated Surface Water Runoff Attenuation Volumes and Areas for Ponds Required for the Main Development Area of the Site (assuming up to 6.5 ha impermeable land use)

SCENARIO	RAINFALL EVENT (AEP / 1 IN X YEAR)	TOTAL STORAGE VOLUME (m^3) – MINIMUM	TOTAL STORAGE VOLUME (m^3) – MAXIMUM	TOTAL STORAGE PLAN AREA (ASSUMING 2 m DEPTH) (m^2) - MINIMUM	TOTAL STORAGE PLAN AREA (ASSUMING 2 m DEPTH) (m^2) - MAXIMUM
Free Discharge	1% (1 in 100) + 40% CC	7535	7935	3768	3968
No Discharge	1% (1 in 100) + 40% CC	8106		4053	

5.14 These storage volumes are preliminary estimates, and further detailed surface water modelling will be undertaken as part of a detailed design phase to more accurately assess the storage volume requirements once the exact extent of proposed impermeable area is confirmed.

Proposed Surface Water Attenuation Solution

Consideration of Appropriate SuDS Techniques

5.15 In line with the NPPF, Defra, EA, NELC and NELIDB advisory recommendations, best practice guidelines and local planning policy, SuDS techniques detailed in the CIRIA SuDS Manual (Ciria, 2007) should be used as a preferential option. A summary of potential SuDS techniques which could be used at the Site are found in Table 5 of the SHBEC Outline Drainage Strategy (Appendix 14B of the ES). This is not an exhaustive list of techniques and so other options could be explored at the detailed drainage design stage.

Attenuation Storage

5.16 Surface water runoff is to be collected on site and conveyed to a surface water attenuation pond SuDS feature via the use of drainage gullies, ditches/swales where possible. Site topography is conducive for flows to be gravity drained to a surface water attenuation area located at the eastern edge of the Main Development Area within the Site (see Figure 2) where opportunity is presented for attenuation based SuDS. The extent of this basin illustrated in Figure 2 will accommodate the total storage plan area required (as presented in Table 12) assuming a 2 m depth.

5.17 It is proposed that the discharge from this attenuation pond will outfall into one of the existing NELIDB land drainage ditches located along the southern or northern boundary of the Site using a flow control mechanism such as a Hydro-Brake to limit the discharge to greenfield rates to 5 l/s/Ha (i.e. so that there will be no change to the existing surface water runoff rate into the drainage ditch). The detailed drainage design stage will confirm that the bed levels of the local land drains into which the attenuation solution will discharge are appropriate relative to the bed levels of the storage solution to ensure

they are positively drained by gravity (i.e. to confirm that no additional pumping is required).

5.18 As the Middle Drain pumping station discharges into the tidal Humber Estuary, it may be the case that during some high-tide events, discharges into either the southern or northern drains become restricted. Design for this will be allowed for during the detailed design phase of the project. To illustrate the effect that this may have on the storage volume, a conservative assumption that no discharge is allowed into the drain during the duration of the critical storm has been applied. An indicative storage volume for this scenario was calculated, and is also presented in Table 12.

5.19 The design proposals include the removal of two of the existing ponds within the Main Development Area of the Site (see 'Pond 1' and 'Pond 2' in Figure 1). It is assumed that these do not currently service a drainage purpose to areas outside of the Site; therefore it is assumed that their removal does not have an impact on the drainage strategy of the SHBEC. If further investigation as part of the detailed drainage phase identifies that the ponds are serving a drainage purpose to the wider area their design parameters will have to be evaluated and fully addressed.

5.20 A detailed drainage design stage will confirm the storage volumes required once the exact impermeable area of the Main Development Area is confirmed, and it will confirm the exact location and feasibility of the outfall from the pond into the existing land drainage network following further consultation with the NELIDB to obtain their agreement.

6.0 MITIGATION OF RESIDUAL FLOOD RISKS AND OFF-SITE IMPACTS

6.1 Consideration should be given to measures that protect the Proposed Development from the residual risk of flooding in the event that the existing tidal defences fail in the vicinity of the Site, or in the event of heavy rainfall that could result in surface water flooding at the Site if the design capacity of the drainage network is exceeded.

6.2 The EA have recommended a series of flood mitigation measures to reduce this risk to occupiers and equipment within the Site (Annex 1). EP SHB Ltd do not intend on building their own new flood defences but wish to build their Proposed Development to the requirements expected in order to prevent flood damage to their own assets and to prevent displacement of flood water that could negatively impact land uses elsewhere off site, following agreement with the EA.

6.3 This Section therefore provides recommendations in accordance with the guidance provided in the NPPF, SFRA and by the EA on how EP SHB Ltd can design their development to withstand predicted tidal flood levels and mitigate the impact. The following mitigation measures were considered to protect the Proposed Development within the Site in accordance with the legislative and regulatory authority requirements:

- flood resistance and resilience measures;
- flood Emergency Response Plans
- flood Warnings and Alerts;
- emergency access and egress;
- design capacity exceedance.

Flood Resistance and Resilience Measures

6.4 The following flood resilience and resistance mitigation measures were considered to ensure the operation of the development is maintained during inundation, and to ensure the safety of people:

- flood resistant/resilient design.
- raising external ground levels; and
- elevating critical plant equipment and/or internal finished floor levels above the peak flood inundation level.

6.5 The NELC SFRA (North Lincolnshire Council and North East Lincolnshire Council, 2011) states that FRAs should demonstrate that a proposal will be safe for its lifetime, including taking into account the potential impacts of climate change. This includes a requirement to demonstrate that the design internal finished floor levels are elevated above the modelled breach event peak flood level.

6.6 CIRIA Report C688 ‘Flood Resilience and Resistance for Critical Infrastructure’ (Ciria, 2010), states that “Flood resilience involves designing an infrastructure asset, or adapting an existing infrastructure asset so that although it comes into contact with floodwater during floods, no permanent damage is caused, structural integrity is maintained and, if operational disruption does occur, normal operation can resume rapidly after a flood has receded. Flood resistance involves designing an infrastructure asset, or adapting and existing infrastructure asset so that floodwater is excluded during flood events and normal operation can continue with no disruption occurring to the essential services the asset provides”.

6.7 The following measures are potentially appropriate for inclusion in the Proposed Development:

- pipelines and storage tanks designed to withstand the water pressures associated with high return period event flooding;
- tanks securely tethered in such a way to ensure the infrastructure remains secure should flooding occur;
- electrical supply entering the Proposed Development from height and down to required connections;
- use of flood barriers on access points;
- protecting wiring for operational control of the Proposed Development, telephone, internet and other services by suitable insulation in the distribution ducts to prevent damage;
- materials with low permeability up to 0.3m and accept water passage through building at higher water depths;
- flood proofing including the use of flood resistant building materials, use of water resistant coatings, use of galvanised and stainless steel fixings and raising electrical sockets and switches;
- utilising floor materials that are able to withstand exposure to floodwater without significant deterioration and that can be easily cleaned, e.g. concrete-based or stone;
- incorporating water resistant services within the buildings, i.e. avoid services using ferrous materials;
- design development to drain water away after flooding;
- provide access to all spaces to permit drying and cleaning;
- carefully considering the usage and layout of ground floor areas to minimise the potential impact on business operations following a flood; and
- suitable waterproofing measures to development located below ground i.e. tanking below ground storage areas etc.

6.8 The following measures are potentially appropriate for inclusion in the design/layout of the Proposed Development:

- boundary walls and fencing could be designed with high water resistance materials and/or effective seals to minimise water penetration for low depth, short duration floods;
- tanks can be bunded to a level higher than the 0.5% AEP plus climate change breach flood level;
- pollution control considered to prevent/ reduce the chance of any fuel/ material stored on site leaking;
- site drainage and landscape design following such guidance as CIRIA C635 (Ciria, 20006) to minimise the risk from exceedance flows and any overland flow entering the Proposed Development buildings;
- landscaping of the Site or building curtilage to direct or divert floodwater away from buildings; and

- sustainable drainage systems (SuDS) designed to manage surface water flood risk and water quality.

6.9 There are no proposals to raise land for the purposes of protecting the Proposed Development. Therefore, flood water will not be displaced and this will not pose an increased risk of flooding off-site to adjacent land uses. No flood volume compensation is therefore required.

6.10 The predicted peak flood level for the Site following a breach in the tidal flood defences during a 0.1% AEP (1 in 1000 chance) flood event including climate change up to 2115 is estimated by AECOM to be around 4.55 mAOD. This estimation is based on the worst case scenario of a breach occurring in the immediate vicinity of the Site. It is therefore recommended that in order to protect all critical equipment assets on site, where possible these items are elevated above the estimated peak flood level. This could either comprise being located on elevated internal floor levels or on platforms upon stilts. However, where this is not possible, alternative mitigation such as localised flood resistance and resilience measures or the storage of critical spares could be arranged.

6.11 Relevant pieces of critical equipment include:

- electrical equipment, switchboards and control panels;
- transformers;
- main boiler feed pumps;
- condensate extraction pumps;
- primary air fan; and
- induced draught fan.

6.12 EP SHB Ltd has confirmed that items of critical plant for which spares can be kept on Site will be identified, and storage of those items on Site will be implemented to reduce the potential recovery time in the event of a major flood event.

Flood Emergency Response Plan

6.13 When operational the Proposed Development, will be operational and manned 24 hours, 7 days a week. The Site is at a high residual risk of flooding and therefore a system should be put in place to safeguard the workers at the Site in the event of defence failure.

6.14 It is recommended that a Flood Emergency Response Plan be developed to ensure the residual risk to the site is sufficiently managed and mitigated. A management system will be implemented to respond to a variety of emergency situations both during normal hours (24/7) and over holiday periods.

6.15 A Flood Emergency Response Plan will be prepared in consultation with the EA. This will define access and egress routes from the site and will ensure that the development is registered to receive flood warnings from the EA's 'Floodline Warnings Direct service to inform if there is a risk of flooding from a tidal storm surge type event which could result in overtopping or breach of defences. This will include the recommendation of at least one Flood Warden for the plant.

6.16 As the Flood Emergency Response Plan will be set up to manage the residual risk of flooding, careful consideration will be undertaken as to what action will be taken at each level of warning. The plan will define how occupants of the Site will be evacuated to an appropriate safe place of refuge should there be a real risk of flooding if a defence

breach were to occur, as the safety of all occupants is essential. However, it is also important to ensure that the Site is only evacuated when it is really necessary.

Flood Warnings and Alerts

6.17 The EA operates a Flood Warning Service (Environment Agency, 2018e) for many areas at risk of fluvial and tidal flooding. The service currently consists of three stages:

- **Flood Alert -** flooding is possible and that you need to be prepared;
- **Flood Warning -** flooding is expected and that you should take immediate action. Action should be taken when a flood warning is issued and not wait for a severe flood warning; and
- **Severe Flood Warning -** there is severe flooding and danger to life. These are issued when flooding is posing significant risk to life or disruption to communities.

6.18 Designated EA Flood Alert codes are assigned to areas. Each code gives an indication of the expected level of danger. Although some members of the public find Flood Watches useful, they are predominantly targeted towards professional partners, alerting them to expected flooding of low lying land and roads.

6.19 All stages of warning are disseminated via the 'Floodline Warnings Direct', which is a free service that provides warnings to registered customers by telephone, mobile, email, SMS text message and fax. Local radio, TV, loudhailers, sirens and Floodline are also used to deliver flood warning messages. The Floodline number is 0845 988 1188, and it is always kept up to date with the EA's latest flooding information.

6.20 More detailed information on the likely extent and time scale of these warnings can be obtained by request from the EA, by their 'Quickdial' recorded information service, or via their website.

6.21 For any proposed commercial or industrial developments within a designated floodplain (as in the case of the Site), a system for monitoring flood warnings should be developed with designated responsible persons (site managers) able to monitor and disseminate the warnings. This will provide more time to enable emergency access and egress of staff occupants away from the local area which may become flooded during a flood event (including routes for egress) prior to inundation. They should also enable sufficient time to implement protection measures for any equipment on site through sealing all external doors to prevent flood inflow into such buildings as a precaution.

6.22 The Site is located within a designated EA Flood Alert Area (short code **053WAT600SHBa** covering tidal flooding of areas near the South Humber Bank from Winteringham to Humberston).

6.23 The Site is located within two designated EA Flood Warning Areas (FWA) (short code names **053FWTIMM2** covering the wider area at risk of tidal flooding from Immingham to Pyewipe, and **053FWTGRIM1** covering low-lying areas in Grimsby and Pyewipe). Due to the 24 hour a day nature of the operations at the Site, the Site will be registered with the EA's Flood Warnings Direct service and monitoring of the warnings is adopted at the Site to mitigate the residual risk of tidal/fluvial flooding in the event of defence failure in the vicinity.

Emergency Access and Egress to/from the Site

6.24 An emergency access and egress route is a route that is 'safe' for use by occupiers without the intervention of the emergency services or others. A route can only be completely 'safe' in flood risk terms if it is dry at all times.

6.25 For developments located in areas at flood risk, the EA consider 'safe' access and egress to be in accordance with paragraph 039 of the NPPF PPG, and 'FRA Guidance for new Developments FD2320' (Defra and Environment Agency, 2005), where the requirements for safe access and egress from new developments are as follows in order of preference:

- safe, dry route for people and vehicles;
- safe, dry route for people;
- if a dry route for people is not possible, a route for people where the flood hazard (in terms of depth and velocity of flooding) is low and should not cause risk to people; and
- if a dry route for vehicles is not possible, a route for vehicles where the flood hazard (in terms of depth and velocity of flooding) is low to permit access for emergency vehicles.

6.26 For 'essential infrastructure' development', it is considered that dry access and egress from the Site will be desirable during times of extreme floods. However, areas behind sea defences are at particular risk from rapid onset of fast-flowing and deep water flooding, with little or no warning if defences are overtopped or breached. The EA's breach modelling (see Section 4.0) has illustrated that the Site and immediate surrounding area is located in an area of 'high' hazard during the event of a breach The Site will be evacuated upon receipt of a flood warning unless it is unsafe to do so, in which case a place of safe refuge will be provided and sought on site.

Place of Safe Refuge

6.27 Safe places of refuge are generally considered an acceptable approach to flood risk management in areas adjacent to sea defences as in the event of a defence breach, inundation is likely to be rapid and therefore evacuation from the Site and local area can sometimes be an unsafe option.

6.28 The main buildings for the Proposed Development include a minimum of a three floors. It is currently proposed that the control room will be allocated and adapted to provide adequate facilities to provide a place of safe refuge including welfare facilities for all employees occupying the Site in the extremely unlikely event that the sea defences were to breach. The internal finished floor level of this refuge area will be elevated above the EA's modelled 0.1% AEP (1 in 1000 chance) event defence breach maximum flood level, estimated by AECOM to be around 4.55 mAOD.

Drainage System Failure, Capacity Exceedance and Maintenance

6.29 Following the completion of the Proposed Development, an additional residual risk relates to maintenance of the on-site drainage infrastructure. Failure, blockage and capacity exceedance above that of the design events for the drainage system are a potential risk to the Site and the surrounding area.

6.30 In order to reduce the risks, maintenance of the system will be incorporated in general site management and will remain the responsibility of EP SHB Ltd. A manual will be prepared detailing each drainage feature on site, the maintenance required, timescales for maintenance and who is responsible for undertaking the maintenance. It is expected the Site owners will ultimately be responsible for maintenance of the site drainage system including all pipes, discharge structures and any SuDS implemented on site in accordance with the recommendations in the SuDS Manual.

6.31 CIRIA C635 (Ciria, 2006) provides guidance on measures that can be incorporated into the detailed design of developments to steer surface water that has exceeded the capacity of the drainage system away from buildings and route it towards the intended point of attenuation and discharge (for example along swales and roads using raised kerbing and through parking areas). The overspill feature of the surface water attenuation solution on the Site will be designed to convey water towards either of the land drains found along the southern or northern boundary of the Site, in the event of overtopping.

7.0 SUMMARY & CONCLUSIONS

Flood Risk Summary

Tidal Sources

7.1 Based on the information provided by the EA, it has been determined that during the existing scenario the Site is at a 'low' risk of flooding from tidal sources resulting from overtopping of the defences during events that exceed a 0.5% AEP (1 in 200 chance) of flooding. If these defences were to fail and breach during the existing scenario, the Site would be at a 'high' risk of flooding during either the 0.5% or 0.1% AEP (1 in 1000 chance) events.

7.2 During a future scenario resulting from climate change up to 2115 however, the impacts are more significant. The Site is potentially at a 'high' residual risk of flooding as a result of the defences overtopping during events that exceed a 0.5% AEP (1 in 200 chance) of flooding, or in the event that the defences were to breach during either the 0.5% or 0.1% AEP (1 in 1000 chance) events.

7.3 Appropriate mitigation measures are therefore required to be implemented at the Site to mitigate this residual risk and ensure the occupiers of the site are safe and critical equipment can continue to function at the site in the event of such inundation.

Fluvial Sources

7.4 The information provided by the EA (see Annex 1), identifies the Proposed Development area within the Site to be at 'very low' risk of fluvial flooding from Oldfleet Drain or Middle Drain.

7.5 The new access at the north-eastern corner of the Main Development Area has the potential to increase the risk of flooding from Land Drain 1. During the detailed design phase, a detailed assessment will be undertaken to determine the flow capacity of and flow estimates likely to be conveyed along the drain to inform the adequate sizing and levels of a culvert/clear-span bridge necessary to prevent any obstruction to floodwater.

Surface Water Runoff to the Site

7.6 The risk of surface water flooding within the Main Development Area within the Site from elsewhere or generated within the site is considered to be 'low' to 'very low'.

Groundwater

7.7 The risk of groundwater flooding within the Proposed Development area within the Site is therefore considered to be 'low' to 'medium'.

Artificial Sources

7.8 There are no artificial sources of flood risk, such as canals or reservoirs in close proximity to the Site. It is therefore considered that there are no flood risks posed to the Site from these sources.

Management of Surface Water Runoff from the Site

7.9 In order to ensure that the development does not increase the flood risk elsewhere, surface water discharge from the Main Development Area within the Site will be

restricted to the existing greenfield runoff rate in accordance with the requirements of the NPPF, EA and NELIDB. Surface water runoff attenuation will be provided to ensure existing greenfield runoff rates are maintained up to the 1% AEP event plus a 40% allowance for climate change.

7.10 It is proposed that a surface water attenuation pond SuDS feature will be located at the eastern edge of the Main Development Area within the Site. It is proposed that the discharge rates from this attenuation pond will be controlled through a system such as a HydroBrake and released into existing ditch along either the southern or northern boundary of the Site. Water will then continue to follow the existing drainage mechanism connecting into a further drain along the western boundary of Site, before out-falling into the Humber Estuary either via two existing flapped outfalls from this land drain, through Middle Drain pumping station, or via the Oldfleet flapped outfall.

7.11 The detailed drainage design will confirm the storage volumes required once the exact impermeable area of the proposed land use is confirmed, and it will confirm the exact location and feasibility of the outfall from the pond into the existing land drainage network.

Residual Risk Mitigation Measures

7.12 The predicted peak flood level for at the Site during a 0.1% AEP (1 in 1000 chance) flood event due to a breach in the tidal flood defences is estimated by AECOM to be around 4.55 mAOD. This estimated water level however is provisional at this time until the Environment Agency are able to confirm their modelled peak water levels in the vicinity from their model.

7.13 In accordance with the recommendations made by the EA during consultation, it is therefore proposed that an internal floor level providing a safe place of refuge for the occupiers within the control room of the Proposed Development will be elevated above a level of 4.55 mAOD.

7.14 In accordance with the recommendations made by the EA during consultation, EP SHB Ltd does not intend to raise any existing ground levels of the Main Development Area within the Site, but elevate all critical equipment assets (or otherwise ensure they are adequately protected) above a level of 4.55 mAOD.

7.15 A number of additional mitigation strategies will be considered during the design process for the Proposed Development to ensure the operation of Site is maintained in the event of a flood. These strategies include, developing a Flood Emergency Response Plan and signing up to the Flood Warnings provided by the EA, providing flood resistance and resilience measures into the design of the buildings, and designing for failure, maintenance and capacity exceedance of the surface water drainage network.

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