Immingham Green Energy Terminal

TR030008

Volume 6

6.4 Environmental Statement Appendices

Appendix 18.A: Flood Risk Assessment

Planning Act 2008

Regulation 5(2)(a) and 5(2)(e)

Infrastructure Planning (Applications: Prescribed Forms and Procedure) Regulations 2009 (as amended)

May 2024

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Infrastructure Planning

Planning Act 2008

The Infrastructure Planning (Applications: Prescribed Forms and Procedure) Regulations 2009 (as amended)

Immingham Green Energy Terminal

Development Consent Order 2023

6.4 Environmental Statement Appendices

Appendix 18.A: Flood Risk Assessment

Regulation Reference	APFP Regulation 5(2)(a) and (5(2)(e)
Planning Inspectorate Case Reference	TR030008
Application Document Reference	TR030008/APP/6.4
Author	Associated British Ports Air Products BR

Version	Date	Status of Version
Version 1	21 September 2023	DCO Application
Version 2	3 May 2024	Change Application

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1 Flood Risk Assessment

1.1 Introduction

Background

1.1.1 AECOM Limited (AECOM) were commissioned by Associated British Ports ('the Applicant') to prepare a Flood Risk Assessment ("FRA") to support a Development Consent Order ("DCO") application for the proposed Immingham Green Energy Terminal ("IGET") ('the Project').

1.1.2 The Project Site ('the Site') is located on the south bank of the Humber Estuary to the south and south east of the Port of Immingham ('the Port'), off the A1173 Queens Road, in North East Lincolnshire centred at Ordnance Survey National Grid Reference ("OS NGR") TA 20783 15271. The Site is located within the North East Lincolnshire Council ("NELC") administrative boundary, in the ward of Immingham.

1.1.3 The Project is for the construction and operation of a multi-user bulk liquid Green Energy Terminal as well as associated development (collectively termed 'the Project'). The Project will require marine works within the Humber Estuary and landside works on land to the south of the Port of Immingham. More details of the Project are provided in **Section 2**.

1.2 Purpose and Scope of this Document

1.2.1 This FRA forms an appendix to the Environmental Statement ("ES") for the Project; however reference can also be made to supporting information in the following chapters **[TR030008/APP/6.2]:**

a. **Chapter 2: The Project**.
b. **Chapter 3: Need and Alternative.**
c. **Chapter 16: Physical Processes.**
d. **Chapter 18: Water Quality, Coastal Protection, Flood Risk and Drainage.**
e. **Chapter 19: Climate Change.**
f. **Chapter 21: Ground Conditions and Land Quality**.

1.2.2 The Environment Agency Flood Map for Planning ("FMfP") (Ref 1-1) identifies that the landside part of the Site is located entirely within Flood Zone 3a (due to the presence of flood defences along the Port of Immingham and estuary frontage). Flood Zone 3a is defined by the National Planning Policy Framework ("NPPF") (Ref 1-2) and Planning Policy Guidance: Flood risk and coastal change ("PPG") (Ref 1-3)) 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. (See **Table 3.1** for Flood Zone definitions). The marine side of the Project is located within the Humber Estuary.

1.2.3 The primary planning policy document for a nationally significant infrastructure project ("NSIP") harbour development is the National Policy Statement for Ports ("NPSfP") (Ref 1-4), however, the NPPF (Ref 1-2) sets out the Government's planning policies for England. The NPSfP makes reference to the guidance supporting the planning system in respect of flooding which includes the Flood Risk and Coastal Change PPG (Ref 1-3) last revised in August 2022. Paragraph 5.2.4 of the NPSfP and the Flood Risk and Coastal Change PPG specifies that "*planning applications for development proposals located within Flood Zone 2 or 3 (river and sea flooding) should be accompanied by a FRA that identifies and assesses all forms of flooding to and from the development. The FRA should demonstrate how these flood risks will be managed so that the development remains safe throughout its lifetime, taking into account the vulnerability of the project and the potential impact of climate change on flood risk*".

1.2.4 The aim was to undertake a FRA that is appropriate to the nature and scale of the Project, which would meet the necessary requirements of the NPSfP (Ref 1-4) and current planning guidance (see **Section 3**), and which will be sufficient to support the Development Consent Order ("DCO") application for the Project.

1.2.5 In order to meet this aim, the following was undertaken:

a. Consultation with and obtaining data from NELC, the Environment Agency and North East Lindsey Internal Drainage Board ("NELIDB") in regard to the Project, the flood risks posed to the Site and the necessary measures that would be required to protect the Project from flooding.

b. 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.

c. Review of the Project 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. A requirement of the **draft DCO [TR030008/APP/2.1]** ensures compliance with the FRA during construction and operation of the Project - this FRA outlines the relevant mitigation measures to be complied with for the purposes of that requirement and in order for the Project to remain safe, should a flood event occur in **Section 6**.

1.3 Data Sources

1.3.1 The baseline conditions for the Project were established through a desk study and via consultation with the Environment Agency and other key statutory consultees using publicly available information. 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 the FRA

Purpose	Data Source	Comments
Identification of Hydrological Features	1: 10,000 Ordnance Survey ("OS") mapping (MAGIC Interactive Maps) (Ref 1-5)	Identifies the position of the Site, local hydrological features, and riparian owners.
Historical Land Use and Hydrological Features	Historic OS maps dating back from 1842- Present	Identifies historical land use change and hydrological features over the last 176 years.
Identification of Geology	British Geological Survey ("BGS") records (Ref 1-6)	Provides details of geology (bedrock and superficial deposits) and soil type in the vicinity of the Site
	Soilscapes Map (Ref 1-7)	
	Chapter 21: Ground Conditions and Land Quality [TR030008/APP/6.2]	
	Environment Agency Groundwater Vulnerability, Groundwater Source Protection Zone map, and Aquifer Designation maps (Ref 1-8)	Identification of groundwater vulnerability, Groundwater Source Protection Zones and aquifer designations in the vicinity of the Site
	Appendix 21-B Phase II Ground Investigation Interpretative Report [TR030008/APP/6.4]	Provides details of geology and associated groundwater monitoring
Identification of Historical Flooding	NELC Preliminary Flood Risk Assessment ("PFRA") (Ref 1-9).	Provides details of historical flooding
	North and North East Lincolnshire Strategic Flood Risk Assessment 2022 ("SFRA") (Ref 1-11)	
	NELC Local Flood Risk Management Strategy ("LFRMS") (Ref 1-12).	
	DEFRA Data Service Platform with associated mapping. (Ref 1-13)	
	Environment Agency Data Consultation Response (**Annex A**)	
Identification of Existing Flood Risk	1:10,000 OS Mapping Mapped LiDAR Data (Plate 3)(Ref 1-13)	Provides indicative ground levels of the Site and surrounding area.
	FMfP (online and reproduced in Plate 5) (Ref 1-1)	Identifies fluvial/tidal inundation extents.

Purpose	Data Source	Comments
	Environment Agency Long Term Flood Risk Maps (online and reproduced in Plate 6) (Ref 1-14)	Identification of flood risk from surface water runoff from land and reservoirs (artificial sources).
	Grimsby and Ancholme: Catchment Flood Management Plan (Ref 1-15)	Outlines flood risk sources within the plan area and how these may be managed in the future.
	NELC PFRA (Ref 1-9)	Indicative risk of flooding from the local drainage system and minor watercourses within the vicinity of the Site.
	North and North East Lincolnshire 2022 SFRA (Ref 1-11)	Assesses local flood risk from fluvial/tidal, sewers, overland flow, groundwater and artificial sources.
	NELC Local Flood Risk Management Strategy (Ref 1-12)	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 (Ref 1-16)	The Environment Agency's long term plan for managing flood risk from the Humber Estuary.
	Flamborough Head to Gibraltar Point Shoreline Management Plan ("SMP") (Ref 1-17).	Outlines the proposals for how tidal flood risk in the area will be managed by the Environment Agency in the future.
	Environment Agency Data Consultation Response (**Annex A**)	Provides local flood risk data for the area in the vicinity of the Site.
	North East Lindsey Consultation Response (**Annex A**)	
	North East Lindsey IDB Consultation Response (**Annex A**)	
Details of the Project	**Chapter 2: The Project [TR030008/APP/6.2]** Project Layout Plans (**Figures 2.3 – 2.5 [TR030008/APP/6.3]**.)	Chapter 2 provides details of the NSIP and associated development. The Project Layout Plans are illustrative only (see **Works Plans [TR030008/APP/4.2]**.
Surface Water Drainage	Drainage Strategy (**Appendix 18.C: Drainage Strategy [TR030008/APP/6.4]**	Identifies existing site drainage, public drainage systems near the Site and outlines how surface water will be managed on site post-development.

1.4 Consultation with Key Stakeholders

1.4.1 Consultation was undertaken with the Environment Agency, NELIDB, NELC and Anglian Water to inform the FRA for the Project **Chapter 18: Water Quality, Coastal Protection, Flood Risk and Drainage [TR030008/APP/6.2]**. Further consultation has been carried out where required for the Project, including updating data requests. Responses to date are provided in **Annex A** to this report. Any advisory recommendations and consultation responses are summarised and addressed in **Sections 4**, **5** and **6** of this report.

2 Site Description

2.1 Location

2.1.1 The Site is located in North East Lincolnshire on the south bank of the Humber Estuary to the east of the Port and is approximately centred on National Grid Reference ("NGR") 520783 415271.

2.1.2 The land-side works fall within the administrative boundary of NELC whilst the marine-side works, that extend seaward and fall beyond the local authority's boundary, will take place in the bed of the Humber Estuary, which is owned by the Crown Estate and over which the Applicant has the benefit of a long lease. The Project in its entirety covers an area of approximately 121 ha.

2.1.3 The Site location and Site Boundary are shown on **Figure 2.1 [TR030008/APP/6.2]**.

2.2 Parts of the Site

2.2.1 As illustrated on **Figure 2.3 [TR030008/APP/6.3]**, the Site is split up into the following areas:

a. Terminal comprising a jetty and topside infrastructure and related landside infrastructure including jetty access ramps which comprise **Work No.1** and **1a**.

b. A corridor between the jetty and Laporte Road to support a jetty access road, the ammonia import pipeline to the East Site (and a reserved corridor for future pipelines including CO_2) which comprise **Work No. 2**.

c. East Site on which the ammonia storage and hydrogen production would be undertaken, comprising **Work Nos. 3**, **4** and **5**.

d. Pipeline Corridor between the East and West Sites for the transfer of ammonia, hydrogen, nitrogen and utilities comprising **Work No 6**.

e. West Site, where hydrogen production, hydrogen liquefaction, storage and loading would be undertaken, comprising **Work No. 7**.

f. Temporary Construction Areas for laydown and construction compounds (one off Queens Road (**Work No. 8**) and one north of Laporte Road (**Work No.9**).

g. Four areas on Kings Road to enable the temporary modification of overhead cables and temporary removal of signage, lampposts and street furniture (**Work No. 10**).

2.2.2 Each part of the Project is described in further detail in **Chapter 2: The Project [TR030008/APP/6.2]** and is outlined on **Figure 2.3 [TR030008/APP/6.3]**.

2.2.3 The Site is situated to the east of the Port and largely outside of the operational area of the Port. The area surrounding the Port is industrial in nature, being dominated by chemical manufacturing, oil processing and power generation facilities. Residential and commercial properties are present to the south of the Port on Queens Road and lie within, and adjacent to, the Site Boundary. Beyond the industrial facilities, the wider area is largely agricultural. The nearest residential area is the town of Immingham approximately 1km from the western edge of the Site.

2.2.4 The Port lies immediately adjacent to the main deep-water shipping channel which serves the Humber Estuary, thereby enabling access to the Port by some of the largest vessels afloat. The Port has good access for road haulage to the M180 Motorway and from there to the M1 Motorway or the A1, via the M18 Motorway. Access to the Site itself is via the A1173.

2.3 Existing Land Use

2.3.1 The proposed Terminal would extend seawards into the Humber Estuary and the Site is located to the east of the existing Immingham Oil Terminal jetty. This area falls within the boundaries of the Humber Estuary Special Area of Conservation ("SAC"), Special Protection Area ("SPA") and Ramsar Site, which collectively form the Humber European Marine Site ("EMS").

2.3.2 The corridor which links the proposed terminal to the East Site includes a section of woodland known as 'Long Strip' between Laporte Road and the Humber Estuary. A bridleway, Bridleway 36, runs through the eastern edge of the Long Strip, connecting users from Laporte Road to the coastal path that follows the Humber Estuary east to Grimsby.

2.3.3 The East Site itself comprises two parcels of land, which are bisected by Laporte Road. The first parcel of land consists of an area of hardstanding to the north of Laporte Road which is currently in use by the Applicant as a storage area. The second parcel of land is a triangular shaped area of brownfield land that is currently covered by gravel and various stockpiles, which is accessed via Queens Road (A1173) and lies to the south of Laporte Road. The Associated Petroleum Terminals works complex is situated to the north/north-east of the East Site, whilst to the south are various industrial facilities. To the west and north-west is the Port and associated industrial facilities and the 'Immingham Dock East Gate' Port entry point from Queens Road. To the east of the East Site is the Long Strip woodland described above.

2.3.4 The West Site currently comprises three agricultural fields, which are bounded by linear hedgerows and drainage ditches. An electrical sub-station and a gas-fired power generator installation are situated to the north-west. The north-west and western boundaries of the West Site are defined by Kings Road and the A1173. A landfill is located to the south separated by a landscape buffer strip. Queens Road forms the north-eastern boundary of the West Site with a number of residential and residential/commercial properties located within the Site boundary. The east and south-eastern boundary is adjacent to another gas fired power generator installation, a community recycling centre and a large waste gypsum landfill. A short tarmac access road has been constructed from Kings Road into the West Site, associated with an extant planning consent. A series of

overhead power cables run across the middle and southern boundaries of the West Site, with a buried mains water and a buried high-pressure gas pipeline present along the southern boundary.

2.3.5 A proposed underground Pipeline Corridor connects the West Site to the East Site and extends to the Terminal. It runs through an area that has been impacted by industrial development alongside Queens Road and Laporte Road, and also crosses the Grimsby Docks Branch Line.

2.4 Access

2.4.1 The West Site is currently accessed off Kings Road whilst access to the East Site is currently via internal roads from the Port of Immingham, Laporte Road and Queens Road.

2.4.2 There is a Public Right of Way ("PRoW"), Bridleway 36, within the Site which runs through the eastern edge of the strip of woodland and which forms part of the proposed route for the improvements proposed by Natural England to the England Coast Path between the Humber Bridge and Easington (to the north of the Humber) and Mablethorpe to Humber Bridge (to the south of the Humber). Part of the proposed upgraded route is located within the Site.

2.5 Surrounding Land Use

2.5.1 The Site is located on the South Humber Bank which is an area of mixed agricultural and industrial use with residential receptors located within and in close proximity to the Site.

2.5.2 The nearest settlement to the Site is the town of Immingham, which is located approximately 460m west of the Site at its closest point.

2.5.3 The closest residential receptors to the Site include:

a. Seven residential properties located on the west side of Queens Road (1-6 and 31 Queens Road) which are included within the Site boundary. There also understood to be residential uses above other ground floor uses at 7 - 8 (vacant at ground floor) and 18 (office at ground floor) Queens Road. (These properties have been included within the Site boundary as their continued residential use is not considered compatible with the operation of the hydrogen production facility and storage on the West Site).

b. Residential properties on the eastern edge of the Immingham urban area, including Somerton Road, Worsley Road, Dunster Walk, Ings Lane, Oakham Walk, Kendal Road, Chestnut Avenue, Waterworks Street and Spring Street, which at the closest point are located between approximately 460m and 480m west of the West Site.

c. Mauxhall Farm off Stallingborough Road, located approximately 1km south-west of the West Site

d. A number of business/commercial receptors are located close to the Site on Queens Road.

2.6 Topography

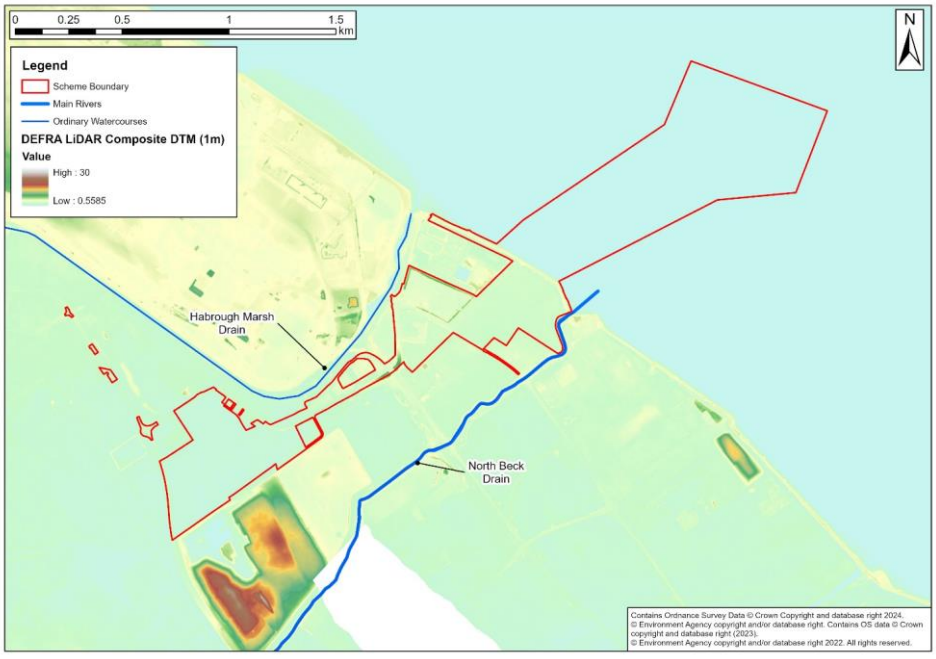
2.6.1 OS mapping and LiDAR Digital Terrain Model ("DTM") of 1m grid resolution, obtained from the DEFRA Data Services Platform (Ref 1-13), was reviewed (presented on Error! Reference source not found.). Please note that there is a d ata anomaly within the dataset, and therefore levels within the area marked in white are assumed to be similar to the surrounding areas.

2.6.2 The topography of the Site is low-lying and flat with many areas being as historically reclaimed land. The Site is generally flat and lies between 1.48 mAOD and 3.83 mAOD. However, there are high spots between 6.21 mAOD and 9.92 mAOD in the pipeline corridor section.

2.6.3 At the East Site (**Works No. 5**), the ground elevations range from 3.0m – 4.0m AOD. At the East Site (**Works No. 3**), ground elevations range from 3.0 m - 4.5m AOD. Both sites gradually slope downwards to the south-east, towards an unnamed drainage ditch running to the north-east.

2.6.4 For the West Site (**Works No. 7**), the ground elevations range from the highest point of 3.0 mAOD at the north-east corner, to 2.0 mAOD at the lowest point in the south-west corner. The ground levels slope towards the southern boundary, and a small drainage ditch.

Plate 1: Topographic Levels (based on LiDAR Data)



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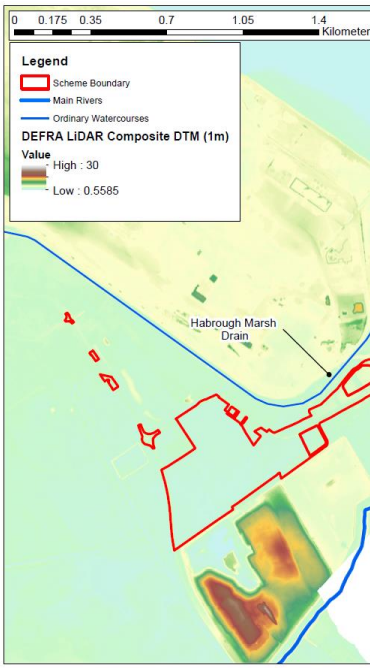


2.7 Hydrology and Flood Risk Management Infrastructure

Surface Watercourses

2.7.1 The following local water features have been identified within or in close proximity to the Site through the inspection of OS 1:10,000 mapping:

a. Tidal River: The Site is located on the Humber Estuary (River Humber) which originates at Trent Falls, by the confluence of the tidally influenced rivers Ouse and Trent and flows south-east into the North Sea.

b. Environment Agency Main River: Stallingborough North Beck Drain (referred to as 'North Beck Drain' throughout the FRA) lies to the east and south of the Site Boundary flowing from east to west. The watercourse flows directly adjacent to the Temporary Construction Compound off Laporte Road (**Work No. 9**) and is located approximately 445m south of the East Site (**Work No. 3**) and 815m south of the West Site (**Work No.7**). The Drain, an embanked upland river, originates at Little London and receives pumped surface water runoff from south, central and east Immingham as well as land drainage run off from West Lindsey. The North Beck Drain discharges by gravity, via a sluice gate, into the Humber Estuary.

c. Ordinary Watercourses: North East Lindsey IDB are operational within the area and have flood risk management responsibilities over the following watercourses:

   i. Habrough Marsh Drain - The watercourse largely skirts the southern and western perimeters of the Port of Immingham estate and flows from west to east to the north of the Site. The Drain is located directly adjacent to the Temporary Construction Area (**Work No. 8**) and the East Site (**Work No.5**) and flows 110m to the east of the West Site (**Work No.7**), 53m north of the Pipeline Corridor (**Work No. 6**). The watercourse drains a significant proportion of Immingham Dock. The watercourse discharges partly to the Humber Estuary (gravity discharge via sluice gates) and partly to the Stallingborough North Beck via the Immingham Pump Drain and the Immingham Pumping Station, (located approximately 715m south of the West Site (**Work No. 7**), to the west of Kings Road where the road crosses the watercourse).

   ii. Immingham Pump Drain, located approximately 213m to the west of the Kings Road/A1173, the drain flows from north to south parallel with the road towards the Stallingborough North Beck Drain. The drain receives flows from Harborough Marsh Drain via a drainage channel running from west to east parallel with Kings Road, approximately 25m north of the West Site (**Work No. 7**), at its closest point, and is pumped into the Stallingborough North Beck Drain via the Immingham Pumping Station.

   iii. A series of minor land drainage ditches are present within and adjacent to the West Site (**Work No. 7**), directly adjacent to the north of the area known as the Long Strip, adjacent to the east and north boundaries of the East Site (**Work No. 3**), within the East Site (**Work No. 5**) and directly adjacent to the southern boundary of the corridor for the jetty access road and pipe-rack supporting the ammonia import pipeline to the East Site

(**Work No. 2**). These watercourses convey surface water run-off discharges from the Site and surrounds to the IDB network and the Humber Estuary.

2.7.2 The Site drains predominantly to the south via the land drainage ditches with flow conveyed directly to the North Beck Drain or to the North Beck Drain via the Immingham Pump Drain. Drainage to the Habrough Marsh Drain, to the north of the Site, is limited.

Flood Risk Management Infrastructure

2.7.3 The Environment Agency's FMfP (Ref 1-1) identifies there to be existing tidal flood defences along the frontage of the landside site extending from north west to south east alongside the Humber Estuary. Information provided by the Environment Agency shows the tidal flood defences protecting this Site consist of a combination of concrete sheet piled walls and concrete/stone slab revetment walls topped with rock filled gabion baskets and earth embankment topped by a concrete wave return wall comprising a smooth concrete or asphalt seaward face. The flood defences are in 'good' condition and reduce the risk of flooding currently up to a 0.5% AEP (1 in 200 chance in any year) event. The Environment Agency inspects these defences annually to ensure defects are identified.

2.7.4 ABP is responsible for the flood defences along the frontage of Immingham Docks. The flood defences along the wider Humber Estuary south bank frontage are maintained by the Environment Agency. However, the Environment Agency is responsible for inspecting the condition of all of the flood defences and have confirmed that the condition of the flood defences adjacent to the Site are classed as 'fair' (Condition Grade 3). The Environment Agency inspects these defences regularly to ensure that any potential defects are identified early.

2.7.5 In relation to the flood defences located within the Site (Compartment IT3 Immingham and North Killingholme), the NELC 2022 SFRA (Ref 1-11) states: "*ignoring freeboard, these defences will protect the area behind against events with a 0.2% annual probability of occurring or better. The standard will remain above the 0.5% annual probability requirement set out in PPS25 for the next 50 years, taking the effect of sea level rise into account*".

2.7.6 The initial draft Humber Flood Risk Management Strategy (2021 – 2027) (Ref 1-18) advises that improvements to Humber Estuary modelling have been completed as part of the developing Humber 2100+ project, which is redefining the strategic approach to managing tidal risk on the Humber. A further phase of improvements to the tidal defences adjacent to the Port of Immingham is planned from 2022, in continuation of the defence improvements carried out in 2017.

2.7.7 The Environment Agency has confirmed that the existing fluvial defences reducing the risk of flooding from main river along the Stallingborough North Beck Drain consist of earth embankments. They are in fair condition and reduce the risk of flooding to a 2% (1 in 50) chance of occurring in any year. The Environment Agency inspect these defences annually to ensure potential defects are identified.

2.7.8 The Habrough Marsh Drain outfall comprises hanging gates and is inspected regularly and maintained by the Environment Agency. The Environment Agency replaced the hanging gates on the Habrough Marsh Drain outfall in April 2022. The North East Lindsey IDB also undertake maintenance work on the Habrough Marsh Drain channel (removal of vegetation and dredging of the channel). The outfall and channel are accessed through the Port of Immingham, via East Riverside and sufficient space is currently provided for access.

2.8 Geology and Hydrogeology

2.8.1 The British Geological Survey, Geology of Britain Viewer (Ref 1-6) 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.

2.8.2 The bedrock underlying the Site is the Flamborough Chalk Formation comprising white, well-bedded, flint-free chalk with common marl seams. Groundwater within the chalk is likely to be confined beneath the overlying low-permeability superficial deposits.

2.8.3 Information in **Chapter 21: Ground Conditions and Land Quality [TR030008/APP/6.2]** confirms that superficial Tidal Flat Deposits of clay and silt and Flamborough Chalk Formation bedrock underlie the Site with further details provided in **Table 2**.

Table 2: Geological and Hydrogeological Information

	Geological Unit	Aquifer Status
Made Ground	Made Ground (Undivided) is located in the western half of the East Site and in the central area of the Pipeline route. Although not mapped across most of the Site, Made Ground is anticipated to be present across the majority of the green hydrogen production facility of the Site.	N/A
Superficial Geology	Beach and Tidal Flat Deposits (clay, silt and sand) are mapped below the north-eastern boundary of the green hydrogen production facility.	Secondary (Undifferentiated) Aquifer: “aquifers where it is not possible to apply either a Secondary A or B definition because of the variable characteristics of the rock type”.
	Tidal Flat Deposits (Clay and Silt) are mapped below the entire site.	Unproductive Aquifer: “aquifers that are largely unable to provide usable water supplies and are unlikely to have surface water and wetland ecosystems dependent on them”.
	Devensian Till (Diamicton) underlies the entire site below the Tidal Flat Deposits	

	Geological Unit	Aquifer Status
Solid Geology	Flamborough Chalk Formation is present beneath the entire Site, underlying the Devensian Till. Burnham Chalk Formation underlies the Flamborough Chalk Formation across the entire site.	Principal Aquifer: "aquifers that provide significant quantities of drinking water. And water for business needs. They may also support rivers, lakes and wetlands".

2.8.4 Soils at the Site are described on the Soilscapes mapping website (Ref 1-7) as "*Loamy and clayey soils of coastal flats with naturally high groundwater*"

2.8.5 Environment Agency groundwater mapping (Ref 1-8) indicates that the Site falls within a Groundwater Source Protection Zone III ("SPZ"). Groundwater SPZs indicate the level of risk to groundwater sources of drinking water from contamination from any activities that may cause pollution to the surrounding area.

2.9 The Project

2.9.1 The design of the Project incorporates a degree of flexibility in the dimensions and configurations of buildings and structures to allow for the future selection of the preferred technology and contractor.

2.9.2 The Project includes the following elements:

a. The NSIP, **Work No. 1**, comprising:

   i. On the marine side, a terminal for liquid bulks: comprising:

      A. A jetty (defined by **Work No. 1a**) including a loading platform, associated dolphins, fenders and walkways, topside infrastructure but not limited to control rooms, marine loading arms, pipe-racks, pipelines and other infrastructure.

      B. A single berth, with a berthing pocket with a depth of up to 14.5m below chart datum.

   ii. Related landside infrastructure including, but not limited to, a jetty access ramp, a flood defence access ramp and works to raise the seawall locally under the jetty access ramp.

b. Associated Development on the landside, comprising:

   i. A corridor between the new jetty and Laporte Road which would support a private road (the 'jetty access road'), pipe-racks, pipelines to enable the ammonia import to the East Site, as well as security gates, a security building, a power distribution building and associated utilities – (**Work No. 2**).

ii. 'East Site - Ammonia Storage' (**Work No. 3**) on which an ammonia storage tank and related plant including an ammonia tank flare would be constructed (**Work No. 3a**) as well as additional buildings (including welfare building, power distribution building and a process instrumentation building), pipe-racks, pipelines, pipes, cable-racks, utilities and other infrastructure.

iii. Construction of a culvert (**Work No. 4**) under Laporte Road for pipelines, pipes and cables and other conducting media linking the two parts of the East Site.

iv. 'East Site – Hydrogen Production Facility' (**Work No. 5**) on which up to three hydrogen production units and associated plant including flue gas stacks and flare stacks would be constructed (**Work No. 5a**) together with additional buildings (including process control building, power distribution buildings, process instrumentation buildings, analyser shelters), pipe-racks, pipelines, pipes, utilities and other infrastructure.

v. Underground pipelines, pipes, cables and other conducting media (**Work No. 6**), between the East and West Sites, for the transfer of ammonia, hydrogen, nitrogen and utilities, with cathodic protection against saline corrosion.

vi. 'West Site' (**Work No. 7**) involving the construction of up to three hydrogen production units with associated flue gas stacks and flare stacks and up to four liquefier units (**Work No. 7a** and **Work No. 7b** combined); hydrogen storage tanks, hydrogen trailer filling stations, a hydrogen vent stack and associated process equipment (**Work No. 7c**); and hydrogen vehicle and trailer filling stations, hydrogen compressors and associated process equipment (**Work No. 7d**). Also additional buildings (including but not limited to control room and workshop building, security and visitor building, contractor building, warehouse, driver administration building, safe haven building, electrical substation and metering station, power distribution buildings, process instrumentation buildings, analyser buildings and additional temporary buildings during construction), process and utility plant including cooling towers and pumps, fire water tank, pipe-racks, pipelines, pipes, cable-racks, utilities and other infrastructure.

vii. Formation of temporary construction and laydown areas on Queens Road (**Work No. 8**) and off Laporte Road (**Work No. 9**).

viii. Temporary removal of street furniture and modification of overhead cables on Kings Road (**Work No. 10**) associated with the transport of large construction components from the Port to the Site.

2.9.3 Each part of the Project is described in further detail in **Chapter 2: The Project [TR030008/APP/6.2]** and an illustrative Project layout is presented in **Figure 2.3 [TR030008/APP/6.3].**

2.10 Construction and Operational Phasing of the Project

2.10.1 Subject to the DCO being granted, there would be a phased approach to the construction of the Project as illustrated in **Figure 2.5 [TR030008/APP/6.3].** Under this scenario, the construction of the Terminal and first phase of the green hydrogen production facility (including works on both the East Site and West Site as outlined above) would comprise the first phase of development, which, subject to securing the relevant consents, is likely to start in early 2025 and last for between two and a half and three years.

2.10.2 The construction phase will include the raising of ground levels within the East Site (ground levels will be raised by 0.3m and 0.6m, respectively, giving approximate finished ground levels of 3.8 mAOD within **Work No.5** and 3.5m AOD within **Work No 3**. In addition, the West Site (**Work No 7**) will be raised by approximately 0.5m, giving a final ground level of 2.5 mAOD. Ground raising is being undertaken to meet drainage strategy requirements (see **Appendix 18.B Drainage Strategy [TR030008/APP/6.4].**

2.10.3 Following completion of the first phase of the construction, a further five phases of hydrogen production would be constructed incrementally to increase the processing capacity as the market for green hydrogen increases. There would be six phases of development in total.

2.10.4 A development scenario has been defined based on a six-phase construction timeline through to full completion of all phases over an indicative eleven-year period. This programme duration is likely to be a worst case as market demand could accelerate the programme, although Phase 1 would always represent the peak of construction, irrespective of the subsequent programme. Further information is provided in **Chapter 2: The Project [TR030008/APP/6.2].**

3 Planning Policy

3.1 Introduction

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

3.2 National Policy

National Policy Statements

3.2.1 Under the Planning Act 2008 (Ref 1-19), the national policy framework for examining and determining applications for a DCO is provided by National Policy Statements ("NPSs"). NPSs are produced by the UK Government to cover the energy, transport, water, waste water and waste sectors and comprise the Government's objectives for the development of Nationally Significant Infrastructure Projects (NSIPs) within each sector.

National Policy Statement for Ports

3.2.2 The NPSfP (Ref 1-4) highlights the Government's recognition of the essential role ports perform in the national economy and the need for new infrastructure. On 14 March 2023, the Secretary of State for Transport announced a review of the NPSfP to ensure it remains fit for purpose in supporting the UK Government's commitments for appropriate development of infrastructure for ports and associated road and rail links. For the avoidance of doubt, the Secretary of State for Transport also set out that "*the existing National Policy Statement for Ports will remain in full effect during the period of the review. Any current or upcoming applications for development consent will be assessed under the current National Policy Statement for Ports*".

3.2.3 The aims of the NPSfP for development and flood risk are to ensure that flood risk from all sources of flooding is taken into account at all stages in the planning process, to avoid inappropriate development in areas at risk of flooding and to direct development away from areas at highest risk. Where new development is, exceptionally, necessary in such areas, including 'water compatible' development, the policy aims to make it safe without increasing flood risk elsewhere and where possible, reducing flood risk overall. Port development is defined as being water compatible development and, therefore, acceptable in high flood risk areas (Paragraph 5.2.3).

3.2.4 The NPSfP states "*all applications for port development of 1 hectare or greater in Flood Zone 1 and all proposals for projects located in Flood Zones 2 and 3 should be accompanied by a flood risk assessment (FRA). This should identify and assess the risks of all forms of flooding to and from the project and demonstrate how these flood risks will be managed, taking climate change into account*" (Paragraph 5.2.4).

3.2.5 The NPSfP notes that the latest set of UK Climate Projections should be used in assessments to ensure the appropriate adaptation measures have been identified. "*Applicants should apply, as a minimum, the emissions scenario that the independent Committee on Climate Change suggests the world is currently most closely following – and the 10%, 50% and 90% estimate ranges. These results should be considered alongside relevant research which is based on the climate change projections such as Environment Agency Flood Maps*" (Paragraph 4.13.7).

3.2.6 Paragraph 5.2.18 of the NPSfP states "*The Government's view is that there is no 'public good' need, on national resilience grounds, to require a higher specification than will secure commercial resilience of the individual facility, notwithstanding that some types of severe weather may affect ports in a region or along a particular stretch of coastline, for example from a storm surge. The NPSfP provides more generally for resilience and diversity of ports provision. Applicants will be in the best position to make a commercial judgement on the required appropriate adaptation measures to reduce the risk from long term climate change as it affects their own facilities*".

3.2.7 The minimum requirements for FRAs are that they should:

a. Be proportionate to the risk and appropriate to the scale, nature and location of the project.

b. Consider the risk of flooding arising from the project, in addition to the risk of flooding to the project.

c. Take the impacts of climate change into account, clearly stating the development lifetime over which the assessment has been made.

d. Be undertaken by competent people, as early as possible in the process of preparing the proposal.

e. Consider both the potential adverse and beneficial effects of flood risk management infrastructure, including raised defences, flow channels, flood storage areas and other artificial features, together with the consequences of their failure.

f. Consider the vulnerability of those using the Site, including arrangements for safe access.

g. Consider and quantify the different types of flooding (whether from natural or human sources and including joint and cumulative effects) and identify flood risk reduction measures, so that assessments are fit for the purpose of the decisions being made.

h. Consider the effects of a range of flooding events, including extreme events on people, property, the natural and historic environment and river and coastal processes.

i. Include the assessment of the remaining (known as 'residual') risk after risk reduction measures have been taken into account and demonstrate that this is acceptable for the particular project.

j. Consider how the ability of water to soak into the ground may change with development, along with how the proposed layout of the project may affect drainage systems.

k. Consider if there is a need to be safe and remain operational during a worst-case flood event over the development's lifetime.

l. Be supported by appropriate data and information, including historical information on previous events.

3.2.8 The NPSfP states "*Preference should be given to locating projects in Flood Zone 1. If there is no reasonably available site in Flood Zone 1, then projects can be located in Flood Zone 2. If there is no reasonably available site in Flood Zones 1 or 2, then essential infrastructure (including nationally significant infrastructure) projects can be located in Flood Zone 3 subject to the Exception Test*" (Paragraph 5.2.13).

3.2.9 If, following application of the above Sequential Test, it is not possible, consistent with wider sustainability objectives, for the project to be located in zones of lower probability of flooding than Flood Zone 3, the Exception Test can be applied. The test provides a method of managing flood risk while still allowing necessary development to occur.

3.2.10 Paragraph 5.2.15 of the NPSfP states "*The Exception Test is only appropriate for use where the Sequential Test alone cannot deliver an acceptable site, taking into account the need for essential infrastructure to remain operational during floods. It may also be appropriate to use it where, as a result of the alternative site(s) at lower risk of flooding being subject to national designations such as landscape, heritage and nature conservation designations, e.g. Areas of Outstanding Natural Beauty (AONBs), Sites of Special Scientific Interest (SSSIs) and World Heritage Sites (WHS), it would not be appropriate to require the development to be located on the alternative site(s)".*

3.2.11 All the three elements of the Exception Test will have to be passed for development to be consented. For the Exception Test to be passed:

a. It must be demonstrated that the project provides wider sustainability benefits to the community that outweigh flood risk.

b. The project should be on developable previously-developed land or, if it is not on previously-developed land, that there are no reasonable alternative sites on developable previously-developed land.

c. An FRA must demonstrate that the project will be safe, without increasing flood risk elsewhere and, where possible, will reduce flood risk overall.

3.2.12 Further details regarding the Sequential and Exception Tests is provided in the NPPF section below.

National Planning Policy Framework (NPPF) (2022)

3.2.13 Section 14 of the NPPF (Ref 1-2) is currently supported by the Flood Risk and Coastal Change PPG (Ref 1-3). These constitute the most up to date guidance for Local Authorities ("LPAs") and decision takers, both in drawing up plans and as a material consideration in determining applications. Section 14 of the NPPF and Flood Risk and Coastal Change PPG provides guidance for planning with respect to flood risk.

3.2.14 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.

3.2.15 The flood zone definitions as presented in Table 1 of the PPG are defined in **Table 3**. As discussed in **Section 1**, the Environment Agency's FMfP identifies that the Site is located wholly within Flood Zone 3.

Table 3: Environment Agency Flood Zone Definitions

Flood Zone	Definition	Risk of Flooding
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%))	Low
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%), or between 1 in 200 and 1 in 1,000 annual probability of sea flooding (0.1-0.5%)	Medium
Flood Zone 3a	Land that has a high probability of flooding (1 in 100 year or greater annual probability of river flooding (>1%), or a 1 in 200 or greater annual probability of flooding from the sea (>0.5%)	High
Flood Zone 3b (Functional Floodplain)	Land where water has to flow or be stored in times of flood. The identification of functional floodplain should take account of local circumstances and not be defined solely on rigid probability parameters. Functional floodplain will normally comprise: • land having a 3.3% or greater annual probability of flooding, with any existing flood risk management infrastructure operating effectively; or • land that is designed to flood (such as a flood attenuation scheme), even if it would only flood in more extreme events (such as 0.1% annual probability of flooding).	Very High

Flood Zone	Definition	Risk of Flooding
	Please note, this zone is not usually included within the FMfP and is calculated where necessary during detailed hydraulic modelling.	

Source: Ref 1-3

3.2.16 The NPPF states that *"when determining planning applications, the LPA should ensure that flood risk is not increased elsewhere. Where appropriate, applications should be supported by a site-specific FRA. Development should only be allowed in areas at risk of flooding where, in light of this assessment (and the Sequential and Exception tests, as applicable), it can be demonstrated that:*

- *within the site, the most vulnerable development is located in areas of lowest flood risk, unless there are overriding reasons to prefer a different location;*
- *the development is appropriately flood resistant and resilient;*
- *it incorporates Sustainable Drainage ("SuDS"), unless there is clear evidence that this would be inappropriate;*
- *any residual risk can be safely managed; and*
- *safe access and escape routes are included where appropriate, as part of an agreed emergency plan.*

Major developments should incorporate SuDS unless there is clear evidence that this would be inappropriate. The systems used should:

- *take account of advice from the Lead Local Flood Authority;*
- *have appropriate proposed minimum operational standards;*
- *have maintenance arrangements in place to ensure an acceptable standard of operation for the lifetime of the development; and*
- *where possible, provide multifunctional benefits".*

Development and Flood Risk Vulnerability

3.2.17 The NPPF (Ref 1-2) considers the vulnerability of different forms of development to flooding and classifies proposed uses accordingly.

3.2.18 Section 7, Paragraph 066 of the PPG (Ref 1-3) illustrates a matrix which identifies which vulnerability classifications are appropriate within each flood zone. This can be seen below in **Table 4**.

Table 4: Flood Risk Vulnerability and Flood Zone Compatibility

Flood Zone	Flood Risk Vulnerability Classification				
	Essential Infrastructure	Water Compatible	Highly Vulnerable	More Vulnerable	Less Vulnerable
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

3.2.19 The NPSfP (Ref 1-4), which takes precedent in terms of NSIP developments, states that port related development is considered 'water compatible' (NPSfP Paragraph 5.2.3). For the purposes of this assessment the marine side element of the Project (i.e. the Terminal comprising a jetty and topside infrastructure) is considered to have a vulnerability classification of 'water compatible'.

3.2.20 Under Annex 3 of the NPPF, the land side element or Associated Development is classified as 'Essential Infrastructure' – "*Installations requiring hazardous substances consent. (Where there is a demonstrable need to locate such installations for bulk storage of materials with port or other similar facilities, or such installations with energy infrastructure or carbon capture and storage installations, that require coastal or water-side locations, or need to be located in other high flood risk areas, in these instances the facilities should be classified as 'Essential Infrastructure'*". Further details with regards Site selection, location and need for the Project is provided in **Chapter 3: Need and Alternatives [TR030008/APP/6.2]**.

3.2.21 Under normal conditions it is anticipated that the Project would operate 24 hours a day, seven days a week and 365 days a year with hydrogen product being distributed by road tankers from the West Site. The risk of flooding to the Project from tidal sources is low, however, there is a high residual risk of flooding should overtopping or breach of the flood defences occur over the lifetime of the Project. The probability of such an event occurring is low, however, should a flood event occur (due to overtopping or breach of the flood defences, or a storm surge event) the extent of flooding along the South Humber Bank (refer to mapping in Annex 1) is such that transport connections to and from the Site would be severed. In addition, ammonia loading into the Site would not be possible due to adverse sea conditions. As a consequence, during periods when a flood warning

is in force it is the Applicant's intention to shut down the operation of the whole Site, including the delivery of ammonia, for the duration of the flood warning in order to ensure the safety of the Site and its occupants. Safe shut down of the Site can be done in-situ or remotely. Further information is provided in **Section 6**.

The Sequential Test

3.2.22 A Sequential Test is required to assess flood risks across strategic development sites and both the NPSfP (Ref 1-4) and NPPF (Ref 1-2) 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).

3.2.23 However, Paragraph: 027 the PPG (Ref 1-3) confirms that the Sequential Test would not be required where:

"The site has been allocated for development and subject to the test at the plan making stage (provided the proposed development is consistent with the use for which the site was allocated and provided there have been no significant changes to the known level of flood risk to the site, now or in the future which would have affected the outcome of the test)".

3.2.24 Section 2.1 of NELC's Flood Risk Sequential and Exception Tests' Guidance Note (Ref 1-20) 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*".

3.2.25 The **Planning Statement [TR030008/APP/7.1)** notes that the NELC Local Plan (Ref 1-21) allocates the landside sites (East and West Site) for employment development including use classes B1 (Business) (now Class E, Commercial, Business and Service), B2 (General Industrial) and B8 (Storage and Distribution) uses. However, hydrogen falls within the definition of 'gas' under the Gas Act 1986 and is therefore regulated as part of the gas network. The storage of hydrogen requires an operation licence for hazardous chemicals and the production of green hydrogen involves a chemical process from the electrolysis of water. As the production of green hydrogen is an emerging market, there is not a clear definition in planning terms of its use class. However, Section 3 (5) of The Town and Country Planning (Use Classes) Order 1987 states:

"(5) No class specified in the Schedule includes any use for a purpose which involves the manufacture, processing, keeping or use of a hazardous substance in such circumstances as will result in the presence at one time of a notifiable quantity of that substance in, on, over or under that building or land or any site of which that building or land forms part."

3.2.26 Hydrogen is a hazardous substance and the Project requires Hazardous Substance Consent. Given this and the definition referred to above, this assessment assumes that both the storage and production of hydrogen fall outside of the definition of B2 and B8 use classes and would be Sui Generis. In flood risk terms, this means that the Site is not in accordance with the use for which the Site was allocated for within the NELC Local Plan (Ref 1-21).

3.2.27 Given the above, the Sequential Test to site selection is technically required to ensure compliance with the NPSfP, the NPPF and PPG. Compliance with the Sequential Test is demonstrated in the **Planning, Design and Access Statement (TR030008/APP/7.1)**.

3.2.28 The Environment Agency FMfP (Ref 1-1) indicates the Site is located in Flood Zone 3, and as such, based on the classification shown in **Table 4**, the marine side development (the NSIP) is acceptable as water compatible development and appropriate within all flood zones. The Associated Development, classified as Essential Infrastructure, is also acceptable subject to passing the Exception Test.

Exception Test

3.2.29 As **Table 4** indicates, due to the location of the Project in Flood Zone 3 the application of the Exception Test is required for the landside Associated Development (classified as Essential Infrastructure). As detailed above, the NPSfP (Ref 1-4) Exception Test comprises three elements that must be passed for a project to be allocated or permitted:

a. Element 1: it must be demonstrated that the project provides wider sustainability benefits to the community that outweigh flood risk.

   There are substantial benefits as a result of the Project. These include economic growth and job creation in Immingham, a contribution to achieving net zero, energy security and levelling up, enabling fuel switching from diesel to hydrogen with an associated reduction in carbon emissions and the capacity that the green energy terminal has for future cargoes relating to carbon capture and storage.

b. Element 2: the project should be on developable previously-developed land or, if it is not on previously-developed land, that there are no reasonable alternative sites on developable previously-developed land;

   The East Site and the West Site were identified as the proposed location of for the Associated Development hydrogen production facility and were selected as the most suitable for the following reasons:

   - Availability of sufficient area of predominantly brownfield land for the hydrogen production facility including land for terrestrial pipelines to join with the pipelines on the jetty trestle.
   - The West Site is allocated for employment use (B14, B2, B8) in the North East Lincolnshire Local Plan (Ref 1-12).

   The East Site itself comprises two parcels of land, which are bisected by Laporte Road. The first parcel of land consists of an area of hardstanding to the north of Laporte Road which is currently in use by the Applicant as a storage area. The second parcel of land is a triangular shaped area of brownfield land that is currently covered by gravel and various stockpiles, which is accessed via Queens Road (A1173) and lies to the south of Laporte Road.

3.2.30 The West Site currently comprises three agricultural fields, which are bounded by linear hedgerows and drainage ditches, however, historical mapping shows a Gypsum Disposal Bed denoted partially on the West Site boundary (1951–56) and in 1964, small buildings are shown on the West Site. Further information is provided in **Chapter 2: The Project [TR030008/APP/6.2]**.

3.2.31 The **Planning Statement** (**[TR030008/APP/7.1]**) submitted as part of the DCO application provides further information regarding site allocations, site selection for the Project, the Sequential Test and the evidence required to meet the Exception Test.

Environment Agency Climate Change Guidance (2022)

3.2.32 The Environment Agency published updated climate change allowances in May 2022 (Ref 1-22) to support the NPPF, which supersede all previous allowances written in the previous guidance and are predictions of anticipated change for:

a. Peak river flows by River Management Catchment.

b. Peak rainfall intensity.

c. Sea level rise.

d. Offshore wind speed and extreme wave height.

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

Tidal Climate Change Allowances

3.2.34 The Project lies within the Humber River Basin District. Annual sea level allowances for the Humber River Basin District up to the 2125 are presented in **Table 5**. These allowances are based upon the UK Climate Projections 2018 (UKCP18) (Ref 1-23) and account for slow land movement due to 'glacial isostatic adjustment' from the release of pressure at the end of the last ice age. The northern part of the UK is slowly rising, and the southern part is slowly sinking.

Table 5: Annual Sea level allowances for the Humber River Basin District for each epoch

Allowance Category	'2020s' (2000 to 2035)	'2050s' (2036 to 2065)	'2080s' (2066 to 2095)	'2100s' (2096 to 2125)	Cumulative rise 2000 to 2125
Higher Central	5.5mm	8.4mm	11.1mm	12.4mm	1.15m
Upper End	6.7mm	11mm	15.3mm	17.6mm	1.55m

3.2.35 The NPPF (Ref 1-2) states that for non-residential development a minimum lifetime of 75 years should be considered. Based on projections in **Table 5**, the following potential sea level rises to 2100 (75 years from the commencement of Phase 1 of the Project in 2025) should be assessed:

a. Higher Central: 0.73m

b. Upper End: 0.97m

3.2.36 **Table 10** (**Section 4**) presents the Extreme Tidal Still Water Levels for the tidal gauging stations relevant to the Site provided by the Environment Agency (See **Annex 1**). The calculated sea level increase for the higher central and upper end allowances are added to these tidal still water levels in **Table 11** (**Section 4**) to provide potential still water levels for over the lifetime of the Project.

Peak River Flow Allowances

3.2.37 The Site lies within the Grimsby and Ancholme Management Catchment. **Table 6** shows the climate change allowances for the catchment.

Table 6: Peak River Flow Allowance for the Louth, Grimsby and Ancholme Management Catchment

Allowance Category	Total potential change anticipated for '2020s' (2015 to 2039)	Total potential change anticipated for '2050s' (2040 to 2069)	Total potential change anticipated for '2080s' (2070 to 2115)
Upper End	21%	19%	33%
Higher Central	9%	5%	12%
Central	4%	-1%	4%

3.2.38 For FRAs, the 'Flood Risk Vulnerability Classification' must be used to categorise the development in order to determine its compatibility with the Flood Zone. The NPSfP (Ref 1-4) designates the NSIP (marine side) as 'water compatible' whilst in line with the NPPF the Associated Development is classified as 'Essential Infrastructure'.

3.2.39 The vulnerability classification and flood zone designation should be used to determine which peak river flow allowances (allowance category) to use based on the assessment year of 2100.

3.2.40 **Table 7** summarises the peak river flow allowances for the different flood risk vulnerability classifications for each flood zone.

Table 7: Environment Agency Climate Change Allowances to apply based upon the Flood Zone and Development Land Use Vulnerability

Flood Zone	Flood Risk Vulnerability Classification				
	Essential Infrastructure	Water Compatible	Highly Vulnerable	More Vulnerable	Less Vulnerable
Flood Zone 1	CA	CA	CA	CA	CA
Flood Zone 2	HCA	CA	CA	CA	CA
Flood Zone 3a	HCA	CA	X	CA	CA
Flood Zone 3b (Functional Floodplain)	HCA	CA	X	X	X

CA = Central Allowance; HCA = Higher Central Allowance; X = Development not permitted

3.2.41 As the Site is located in Flood Zone 3a and the NSIP is classified as 'Water Compatible', the central climate change allowance should be assessed. For the Associated Development, classified as 'Essential Infrastructure', the higher central allowance should be assessed. For the purposes of this assessment, the higher of the two climate change allowances (the higher central allowance representing a 12% uplift in peak fluvial flow) has been used to inform the impacts of climate change on the Project.

Peak Rainfall Intensity Allowance

3.2.42 To account for the anticipated changes in rainfall intensity, the Environment Agency's guidance states that for an expected lifespan of 75 years, the Project should assess the 'Upper End' allowance to understand the potential impact and make suitable decisions to mitigate against pluvial flooding.

3.2.43 As the anticipated lifetime of the development is assessed as 75 years, **Table 8** indicates that a +40% allowance for rainfall intensity should be considered as part of this FRA. This has been taken into account in the calculations of surface water run-off rates and volumes in the Outline Drainage Strategy for the Project (refer to **Appendix 18.C: Drainage Strategy [TR030008/APP/6.4]**).

Table 8: Peak Rainfall Intensity Allowance for the Louth, Ancholme and Grimsby Management Catchment

Parameter	Allowance	Total potential change anticipated for '2050s'	Total potential change anticipated for '2070s'
1% annual exceedance rainfall event (2070 – 2115)	Upper End	40%	40%
	Central	20%	25%
3.3% annual exceedance rainfall event (2070 – 2115)	Upper End	25%	35%
	Central	20%	35%

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

a. Likely depth, speed and extent of flooding for each of the assessed climate change allowances.

b. Vulnerability of the proposed development types or land use allocations to flooding.

c. 'Built in' resilience measures used, for example, raised floor levels.

d. Capacity or space in the development to include additional resilience measures in the future, using a 'managed adaptive' approach.

H++ Allowances

3.2.45 There is a reasonable level of certainty that the future impacts of climate change will lie somewhere between the Central and Upper Allowances, as presented above. However, more extreme changes cannot be discounted.

3.2.46 H++ allowances have been developed to represent these more severe climate change impacts. It is proposed that these allowances should be considered when assessing developments which are either very sensitive to flood risk; or, have an expected lifetime beyond the end of the century. For example, infrastructure projects where a development could significantly change the existing development pattern.

3.2.47 Environment Agency guidance (Ref 1-22) states the following allowances should be used for the extreme climate change scenario:

a. The H++ climate change allowance for sea level rise of + 1.9 m (See **Table 11).**

b. The upper end allowance for peak river flow – 33% based on the allowance in **Table 6**).

c. The sensitivity test allowances for offshore wind speed and extreme wave height + 10%; and

d. An additional 2mm for each year on top of sea level rise allowances from 2017 for storm surge.

3.2.48 The H++ scenario is used as a 'sensitivity test'. It can help to assess how sensitive development proposals are to changes in the climate for different future scenarios to ensure developments can be adapted to large-scale climate change over their lifetime.

3.2.49 The H++ scenarios are assessed in the relevant sections in **Section 4**.

UK Marine Policy Statement ("MPS")

3.2.50 The Marine Policy Statement (Ref 1-24) is the framework for preparing marine plans and taking decisions affecting the marine environment. The MPS also sets out the general environmental, social and economic considerations that need to be taken into account in marine planning and provides guidance on the pressures and impacts that decision makers need to consider when planning for and permitting development in the UK marine areas.

3.2.51 Section 2.6.8 of the MPS is relevant to the flood risk and drainage. In particular, paragraph 2.6.8.4 states, amongst other things, that - "*Marine plan authorities should be satisfied that activities and developments will themselves be resilient to risks of coastal change and flooding and will not have an unacceptable impact on coastal change...*". In addition, paragraph 2.6.8.6 notes that "*the impacts of climate change throughout the operational life of a development should be taken into account in assessments*".

East Inshore and East Offshore Marine Plans

3.2.52 The first Marine Plans include the East Inshore and East Offshore Marine Plans (Ref 1-25), which are collectively referred to as 'the East Marine Plans'. These were formally adopted on 2 April 2014. The East Inshore Marine Plan area covers 6,000km² of sea, from MHWS out to the 12 nautical mile limit from Flamborough Head in the north to Felixstowe in the south. The East Offshore Marine Plan covers 49,000km² of area from the 12 nautical mile limit to the border with The Netherlands, Belgium and France.

3.2.53 Section 3.5 states *"The East marine plan areas have a role to play in realising national ambitions with regard to climate change. Adaptation involves modifying infrastructure to better deal with climate change conditions and helping people to determine how to adjust their behaviour/ decisions to enable them to adapt to the challenges of a changing climate."* (Paragraph 230)

3.2.54 Policy CC1 states that:

"*Proposals should take account of:*

- *How they may be impacted upon by, and respond to, climate change over their lifetime; and*
- *How they may impact upon any climate change adaptation measures elsewhere during their lifetime.*

Where detrimental impacts on climate change adaptation measures are identified, evidence should be provided as to how the proposal will reduce such impacts."

3.2.55 Policy CC1 is consistent with, and adds marine planning context to, the NPPF (Ref 1-2) in seeking that new development should be planned to avoid increased vulnerability to the range of impacts arising from climate change. The combination of a low-lying topography, isostatic change, a rise in sea levels and the possibility of an increase in tidal surges in the North Sea are particularly significant for the East Coast.

Non-Statutory SuDS Guidance

3.2.56 Defra published their Sustainable Drainage Systems: Non-Statutory Technical Standards ("NSTS") in March 2015 (Ref 1-26) setting the requirements for the design, construction, maintenance and operation of SuDS. The NSTS are intended to be used alongside the NPPF (Ref 1-2) and PPG (Ref 1-3).

3.2.57 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 **Appendix 18.B: Drainage Strategy [TR030008/APP/6.4]**. Additional guidance is provided for structural integrity, designing for maintenance considerations and construction.

3.2.58 A review of Schedule 3 of the Flood and Water Management Act 2010 was published by the UK Government in January 2023 and recommended implementation of Schedule 3 in England. Schedule 3 requires developers to seek approval from a Sustainable Drainage Approving Board ("SAB"), who must determine whether the application meets the National Standards. DEFRA is currently carrying out further work to draft these standards which each SAB will refer to, and these are expected to be published in 2024.

The National Flood and Coastal Erosion Risk Management Strategy for England

3.2.59 The Environment Agency's National Flood and Coastal Erosion Risk Management Strategy for England (Ref 1-27) provides the overarching framework for future action by all risk management authorities to tackle flooding and coastal erosion in England.

3.2.60 This Strategy sets out practical measures to be implemented by risk management authorities, partners and communities, which will contribute to longer term delivery objectives and the Environment Agency's vision: "*A nation ready for, and resilient to, flooding and coastal change – today, tomorrow and to the year 2100. The Strategy has three core ambitions concerning future risk and investment needs*:

1. *Climate resilient places: working with partners to bolster resilience to flooding and coastal change across the nation, both now and in the face of climate change.*
2. *Today's growth and infrastructure resilient in tomorrow's climate: Making the right investment and planning decisions to secure sustainable growth and environmental improvements, as well as resilient infrastructure.*
3. *A nation ready to respond and adapt to flooding and coastal change: Ensuring local people understand their risk to flooding and coastal change and know their responsibilities and how to take action."*

3.2.61 The Strategy describes what needs to be done by all risk management authorities involved in flood and coastal erosion risk management for the benefit of people and places. This includes the Environment Agency, lead local flood authorities, district councils, internal drainage boards, highways authorities and water and sewerage companies, who must exercise their flood and coastal erosion risk management activities, including plans and strategies, consistently

with the Strategy. Through its 'strategic overview' role the Environment Agency exercises its strategic leadership for all sources of flooding and coastal change. This Strategy seeks to better manage the risks and consequences of flooding from rivers, the sea, groundwater, reservoirs, ordinary watercourses, surface water and sewers and coastal erosion.

3.3 Regional Policy

Shoreline Management Plan 3: Flamborough Head to Gibraltar Point

3.3.1 Shoreline Management Plan ("SMP") 3: Flamborough Head to Gibraltar Point (Ref 1-17) covers the study area. The SMP is a large-scale assessment of the risks associated with coastal processes which seeks to reduce these risks to people and the developed, historic and natural environments. An SMP determines the natural forces which are shaping the shoreline to assess how it is likely to change over the next 100 years, taking account of the condition of existing defences. The SMP develops policies outlining how the shoreline should be managed in the future, balancing the scale of the risks with the social, environmental and financial costs involved, and avoiding adverse impacts on adjacent coastal areas.

3.3.2 The Port of Immingham and adjacent areas are located within SMP Policy Unit L – East Immingham to Humberston Fitties (western section). The preferred management option for this SMP policy unit area is to *"Hold the Line (HTL) for short (by 2025), mid (by 2055) and long term (by 2105) which is to be achieved through maintaining or upgrading the level of protection provided by the existing defences".* The baseline for the impact assessment assumes that the coastal defences on site will be maintained and upgraded as necessary in order to implement the HTL policy over the next 100 years.

Humber River Basin District Flood Risk Management Plan

3.3.3 The Humber River Basin District Flood Risk Management Plan (Ref 1-28) focuses on the more significant areas of flooding within the Humber River Basin District and:

a. Help identify measures (actions) that will reduce the likelihood and consequences of flooding.

b. Improve resilience, plan for, better protect, respond to and recover from flooding and coastal change, while informing the delivery of existing flood programmes.

c. Work in partnership to explore wider resilience measures. These include nature-based solutions, property flood resilience and sustainable drainage systems.

d. Plan and adapt to a changing climate through developing longer-term, adaptive approaches.

3.3.4 The Site is partially located within the Immingham Rivers and Sea Flood Risk Area, which identifies the main flood risk within the Immingham Flood Risk Area is from tidal sources. The Environment Agency has the strategic overview of flood risk across this Flood Risk Area and provide the tactical management and operational delivery for the risk from rivers and the sea, in collaboration with North East Lincolnshire Council (Lead Local Flood Authority) and North East Lindsey IDB.

3.3.5 As part of the plan, defences will be improved near North Killingholme and Stallingborough by 2027. The design of the jetty access road where it passes over the flood defences includes sufficient space for the flood defences to be improved and the defences along the landside frontage, beneath and in close proximity to the jetty access road crossing, will be raised to a height of 7.5m AOD as part of the development proposals.

Humber Flood Risk Management Strategy

3.3.6 The Humber Flood Risk Management Strategy (Ref 1-16) sets out the Environment Agency's vision for managing the risk of flooding from the Humber Estuary to respond to climate change and sea level rise. The Strategy sets out the Environment Agency's general approach to managing the estuary's flood defences.

3.3.7 The Site is situated within Flood Area 24 (Immingham to West Grimsby) in the Humber FRMS, where, in line with the SMP3, defences will be improved as necessary to protect people, businesses and nationally important industry from tidal flooding.

Humber 2100+: A New Strategy

3.3.8 Since the publication of the 2008 Humber Strategy (Ref 1-16), more up-to-date technical information has become available, for example;

a. The December 2013 tidal surge provided better evidence of tidal flood mechanisms and estuarine processes.

b. Updated UK Climate Projections were released in 2018 (UKCP18) (Ref 1-23).

3.3.9 There have also been policy changes that provide new opportunities for funding future tidal risk management schemes.

3.3.10 The Humber 2100+ project (Ref 1-29) is redefining the strategic approach to managing tidal risk on the Humber. It will identify the most sustainable, credible and cost-effective approach to managing tidal flooding over the next 100 years, with a particular focus on the first 25 years, taking into account predicted sea level rise and climate change. The Humber 2100+ partnership is made up of 12 local authorities, the Humber Local Enterprise Partnership ("LEP") and the Environment Agency.

3.3.11 The Humber 2100+ project is considering a range of flood risk management approaches for the Humber, including conventional measures, such as flood defence raising and flood storage, as well as more ambitious solutions such as a tidal barrier.

3.3.12 In spring 2018, the partnership considered a long-list of estuary-wide flood risk management options. Following a detailed evaluation, elements of different options were brought together to form three Strategic Approaches. The Strategic Approaches use a combination of solutions to manage risk in a different way.

a. Managing the tide - using a combination of improved flood defences, existing and additional flood storage, and occasional planned flooding of land. Improved resilience and changes to land use would also be required to adapt to rising sea levels and high tides.

b. Adapting to the tide - by continuing to improve or maintain defences in some areas, and changing land use in others, to allow defences to be deliberately altered or moved back in some locations over time. This would generate greater capacity for flood storage and large scale planned flooding of land and allow us to respond to the fact that it may not be possible or safe to maintain or continue to raise some defences where they are at present. This would be in combination with improved resilience across the estuary.

c. Keeping out the tide – by constructing a tidal surge barrier, most likely in the outer estuary. This would be a complex and long term option. Defences on the seaward side of the barrier would need to be improved, and there would be continued maintenance of defences inland of the barrier in combination with improved resilience across the estuary.

Grimsby and Ancholme Catchment Flood Management Plan ("CFMP")

3.3.13 In 2009, a CFMP was produced by the Environment Agency for the Grimsby and Ancholme catchment (Ref 1-15) addressing the scale and extent of flooding both now and in the future and setting policies for managing flood risk. In the area considered in relation to the Project (Sub-area 4 Immingham, Grimsby and Buck Beck), the CFMP addresses the risk posed by the tidal risk from the Humber Estuary, tide locking of local watercourses and the pumping of drainage channels.

3.3.14 The vision and preferred management policy for the sub-area is Policy option 4: Areas of low, moderate or high flood risk where the Environment Agency are already managing the flood risk effectively but where further actions may be taken to keep pace with climate change.

Anglian Water's Policy for Surface Water Drainage

3.3.15 The Policy for Surface Water Drainage document (Ref 1-30) provides guidance on Anglian Water's position regarding the management of surface water arising from new and redeveloped areas. The document provides a series of design criteria for types of development. The developer must demonstrate that the Site does not increase flood risk both within the development and elsewhere, and that the surface water hierarchy has been considered.

3.3.16 In order of preference, the disposal hierarchy should be in the following order:

1. *Discharge by infiltration into the ground,*
2. *Discharge to an open surface water body,*
3. *Discharge to a surface water sewer, discharge to a combined sewer,*

4. Discharge to a foul sewer.

3.3.17 Surface water design criteria for connections to the existing network are provided, although these are not considered relevant to the Project which will discharge surface water directly into a watercourse/ the sea.

3.4 Local Planning Policy

North East Lincolnshire Local Plan

3.4.1 The North East Lincolnshire Local Plan was adopted in March 2018 (Ref 1-21) and sets out the Council's vision and strategy for development, including why, where and how the Borough will grow. The Plan is a plan for growth and aims to ensure North East Lincolnshire becomes a sustainable location in which people can live, work, and enjoy their recreation, both now and in the future.

3.4.2 The relevant flood risk and surface water management policies are summarised in **Table 9**.

Table 9: Relevant Core Strategy Policies

Policy	Sub-Number	Summary
Policy 33: Flood Risk	1	Development proposals should have regard to the requirements of the flood risk sequential test and, if necessary, the exception test. The regeneration benefits of development in areas of high flood risk should also be considered in light of the Council's Guidance Note on the application of the Sequential and Exception Tests in North East Lincolnshire, and the Environment Agency's Standing Advice
	2	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 flood risk assessment 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;

Policy	Sub-Number	Summary
		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	1	Development proposals that have the potential to impact on surface and ground water should consider the objectives and programme of measures set out in the Humber River Basin Management Plan.
	2	Development proposals should consider how water will be used on the site and ensure that appropriate methods for management are incorporated into the design. Development proposals should demonstrate that: A. adequate and sustainable water supplies are available to support the development proposed; B. provisions are made for the efficient use of water, including is reuse and recycling. Proposals for residential development will be expected to demonstrate that a water efficiency standard of 110 litres per person per day can be achieved; and, C. adequate foul water treatment already exists or can be provided in time to serve the development. Appropriate and sustainable sewerage systems should be provided for the collection and treatment of foul and surface water to ensure new development does not overload the existing sewerage infrastructure, minimising the need to discharge water into sewers, particularly combined sewers.
	3	Where development is proposed within a Source Protection Zone, the potential for any risk to groundwater resources and groundwater quality must be assessed and it must be demonstrated that these would be protected throughout the construction and operational phase of development

Source: <https://www.nelincs.gov.uk/planning-and-building-control/planning-policy/the-local-plan >

North East Lincolnshire Council Local Flood Risk Management Strategy ("LFRMS")

3.4.3 As a LLFA, NELC has a responsibility to develop a LFRMS (Ref 1-12) which sets out a clear plan for future flood risk management in the region, ensuring people, businesses, communities and other risk management authorities have an active role in how flood risk is managed.

3.4.4 The LFRMS sets out how the Council intends to manage local flood risks, as well as contribute to management from non-local sources, and to engage and inform residents on their own responsibilities and enable them to contribute to the management of flood risk.

3.4.5 The LFRMS states "*because of the low lying nature of the borough, which has a large tidal flood plain, some of the watercourses rely on pumping stations to discharge during high tide periods. Those without pumping stations can become tide locked for varying lengths of time*".

3.4.6 With regards flood defences, the LFRMS notes "*The standard of the sea defences, i.e. condition and height, will ultimately determine if an area is to flood and to what extent. Currently it is a breach of the sea defences which has the capacity to cause the most severe flooding but with the predicted sea level rise over the next 100 years the consequences of defence overtopping will gradually worsen until both types could result in flood water depths of well over 2 metres. If no defence improvements are made both of these scenarios become more likely when taking climate change into account*."

North East Lincolnshire Strategic Flood Risk Assessment ("SFRA")

3.4.7 North and North East Lincolnshire Council 2022 SFRA (Ref 1-11) provides an update on the original SFRA which was published in 2011 (Ref 1-10) to support the assessment of development sites in relation to flood risk. The SFRA was completed in consultation with the Environment Agency and NELIDB to provide information on the probability of flooding. The report also takes into account the impacts of climate change.

3.4.8 It is intended that the SFRA will be used by NELC's planning and building control department to inform the application of the Sequential Test when allocating land or determining applications, in line with the NPPF.

3.4.9 The SFRA locates the Site within the Eastern Coastal Area where the main source of flooding is a combination of large waves and high water levels in the Humber Estuary. A more detailed assessment has been undertaken as part of the SFRA for Flood Compartment 1T3 – Immingham and North Killingholme (which contains the Port of Immingham area) which indicates the Immingham area is liable to flooding should a breach of the flood defences occur.

3.4.10 The SFRA contains a flood risk advice matrix developed in partnership with Environment Agency and contains flood risk advice matrix outlining requirements for new development dependent on flood risk vulnerability and flood zone/hazard rating.

3.4.11 For Essential Infrastructure located in a Danger to All Hazard Area the following is required:

a. Planning practice guidance states that Essential Infrastructure should remain operational at times of flood.

b. The application should be supported by a FRA which demonstrates that the development will remain operational in case of a breach in the defences during a 0.1% event (2115 scenario). Critical equipment should be above this flood depth shown on the tidal hazard mapping for this scenario.

c. The FRA should also include confirmation that appropriate mitigation measures/flood resilience techniques have been incorporated into the development.

d. Refer to the following document for information on flood resilience and resistance techniques to be included: 'Improving Flood Performance of New Buildings - Flood Resilient Construction' (Ref 1-31).

e. Single storey buildings should be built with final floor levels ("FFLs") above the predicted flood depth (referring to the tidal hazard map for the 2115 0.5% breach scenario). If this is not practicable an area of safe refuge will need to be provided. An appropriate flood warning and evacuation plan will need to be submitted to and approved by NELC.

f. It is recommended that the applicant seeks advice from the Environment Agency at the pre-application stage.

3.4.12 The following standing advice is given for Water Compatible Development located in a Danger to All Hazard Area:

a. The LPA should check that the proposed development will operate under flood conditions and that appropriate mitigation measures/flood resilience techniques have been incorporated into the development. It is recommended that essential equipment is set above the 0.1% breach event depth in the climate change (2115) scenario.

b. Please refer to the following document for information on flood resilience and resistance techniques to be included: 'Improving Flood Performance of New Buildings - Flood Resilient Construction' (Ref 1-31).

Environment Agency – Lincolnshire and Northamptonshire Area

3.4.13 Under the Environmental Permitting (England and Wales) Regulations 2016 (Ref 18-31), permission must be obtained from the Environment Agency for any proposed activities which will take place:

a. In, over, under or within 8m of a Main River (16m if tidal).

b. On or within 8m of a flood defence structure or culvert (16m if tidal) or on or within 16m of a flood defence.

c. Within 16m of any Main River, flood defence (including a remote defence) or culvert for quarrying or excavation.

d. In a floodplain more than 8m from the river bank, culvert or flood defence structure (16m if tidal) if planning permission has not already been granted for the works.

North East Lindsey Drainage Board Byelaws

3.4.14 IDBs operate in the low-lying fen and valley areas, maintaining pumping stations and drainage channels to ensure that people are safe, and the risk of flooding is greatly reduced. The NELIDB extends to an area of 11,250 hectares which is formed predominantly of the coastal strip extending from the Humber bridge southwards to Grimsby.

3.4.15 The NELIDB Byelaws (Ref 1-33) and Land Drainage Act 1991(Ref 1-34) allow the IDB to take action to ensure that free flow of water is unrestricted.

3.4.16 Watercourses maintained by the IDB are cleaned out annually and it is important that access is preserved for machinery to enable this work to be undertaken. The IDB's Byelaws prevent the erection of any building, structure (whether temporary or permanent) or planting of trees/ shrubs etc. within nine metres either side of an IDB maintained watercourse irrespective of any planning permission without the consent of the IDB. The IDB's consent will also be required to undertake works such as:

a. Works in, over, under or within nine metres of an IDB maintained watercourse.

b. Installation of a culvert, weir or other like obstruction within any watercourse.

c. Any works that increase the flow of surface water or treated foul effluent to any watercourse within the NELIDB's district.

3.4.17 The Applicant is in discussion with the NELIDB about disapplication of the land drainage consent within the DCO. See Article 3 of the **draft DCO [TR0300008/APP/2.1]**.

4 Flood Risk to the Development

4.1 Introduction

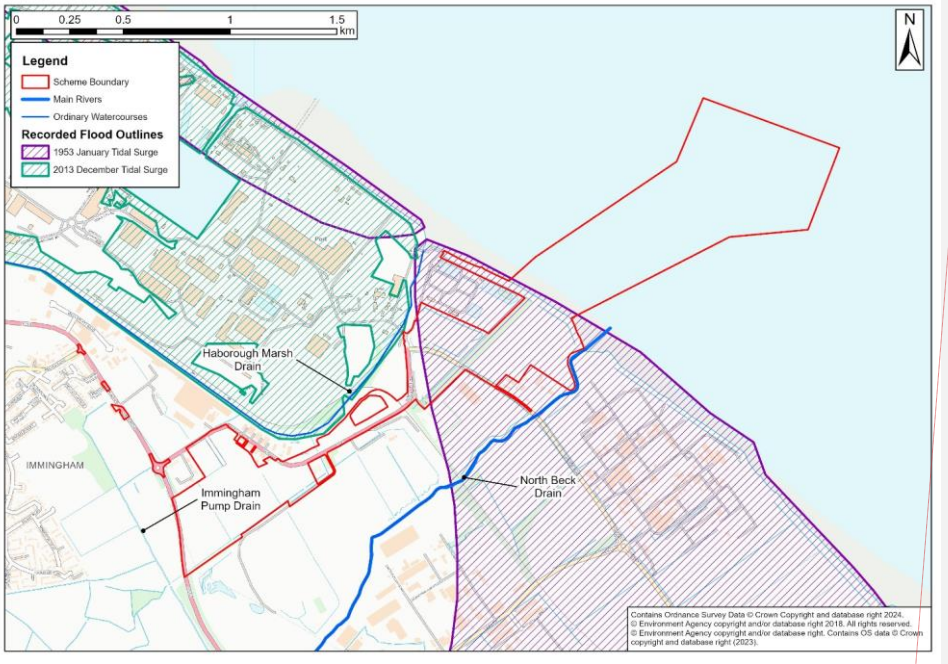
4.1.1 The NPSfP (Ref 1-4), NPPF (Ref 1-2), and PPG (Ref 1-3) requires the effects of all forms and sources of flood risk to and from the Site to be considered within a FRA. There should be demonstration of how these risks should be managed so that the development remains safe throughout its lifetime, taking into account current climate change predictions.

4.1.2 This section discusses these potential risks in relation to tidal, fluvial, surface water run-off, groundwater and man-made/ artificial sources (e.g. canals, reservoirs, pumping station failure). Risks from public foul sewers are also considered. Where risk is deemed 'Medium' or 'High', mitigation measures may be required. Where a flood risk is thought to be 'Low', mitigation measures are not required.

4.2 Historical Flooding Incidents

4.2.1 The Environment Agency provided details of historical flooding events in the local vicinity of the Site. **Plate 2** illustrates that the Temporary Construction Area, the Corridor for the pipeline to the jetty and the jetty access road and the majority of the East Site were flooded during a major tidal flood event in January 1953. The Pipeline Corridor and the West Site were not inundated during this flood event. This event occurred prior to the coastal flood defences being improved, which were installed in response to the 1953 event.

Plate 2: Environment Agency Historical Flood Extents



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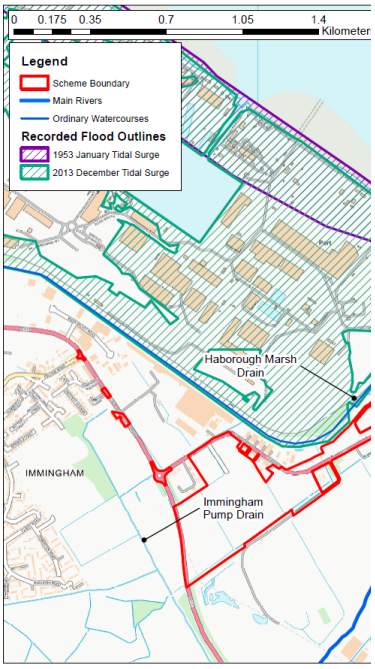


4.2.2 The December 2013 tidal surge is shown to have flooded the Port of Immingham to the north of Habrough Marsh Drain but flood water did not enter the Site during this event.

4.2.3 Map 6 of the 2022 SFRA (Ref 1-11) illustrates no additional records of reported historical flooding incidents in the immediate vicinity of the Site. The nearest reported incidents were located in the industrial estate approximately 1.1km to the north-west. The 'River and Tidal Flood Risk Map' on page 9 of the 2011 PFRA (Ref 1-9) contains no additional records of historical flooding to those in the vicinity of the Site.

4.2.4 No further major historical incidents are recorded in the vicinity on the Chronology of British Hydrological Events website (Ref 1-35).

4.3 Tidal Sources

4.3.1 Tidal flooding occurs during extreme high tide and/or storm surge events which may cause wave overtopping or the unlikely event of a breaching scenario of existing tidal defences. High water levels within tidally influenced estuaries and rivers may also contribute to tidal flooding.

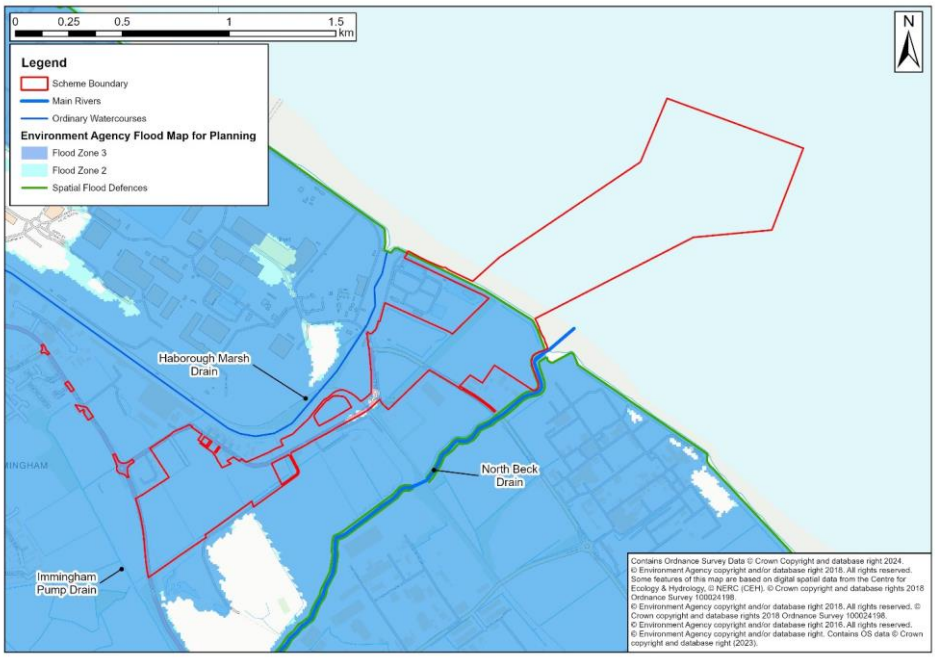
4.3.2 The Site lies on the south bank of the tidal River Humber, which originates at Trent Falls and flows in a south-easterly direction into the North Sea. The Humber Estuary poses the primary and most significant risk of flooding to the Site, but the Site benefits from existing flood defences along the length of the estuary.

Flood Map for Planning

4.3.3 The Environment Agency's 'FMfP' (Ref 1-1) available to view on their website identifies areas subject to potential fluvial/tidal flooding for the present day but does not include the benefits of any existing flood defences or impacts of climate change respectively.

4.3.4 The FMfP (shown in **Plate 3**) illustrates that the landside Site is wholly located within Flood Zone 3 (high probability) defined as land having a >0.5% AEP (greater than a 1 in 200 chance) of sea flooding (refer to **Table 3**).

Plate 3: Environment Agency Flood Map for Planning



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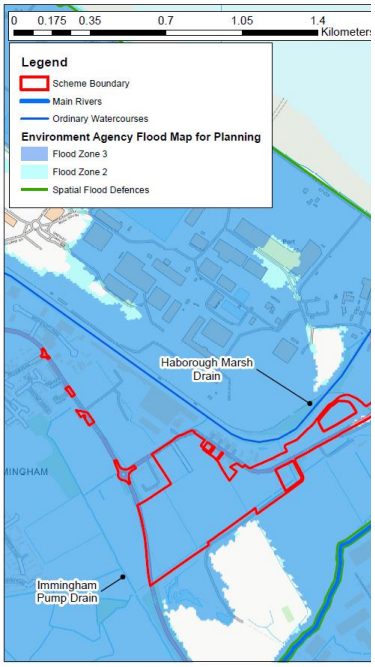


Tidal Flood Defences

4.3.5 **Section 2** provides information on the flood defences along the landside frontage of the Site. The flood defences are in 'good' condition and reduce the potential for flooding currently up to a 0.5% AEP (1 in 200 chance in any year) event. The standard of protection provided by the coastal flood defences takes account of wave height and an allowable overtopping rate.The residual risk of flooding in the event of a defence breach scenario needs to be considered.

4.3.6 As part of the development proposals the current flood defences along the frontage of the Site near the corridor area (**Work No. 2**) would be replaced by a new section of flood defence with a crest level of 7.0m AOD in line with proposals in the Humber Strategy to 'hold the line' and maintain the standard of protection afforded to the Immingham area. In addition, ABP have an agreement with the Environment Agency to raise flood defences under their ownership along the frontage of the Port of Immingham. These planned improvements are however, not reflected in the climate change depth, hazard and velocity maps (**Annex 1**) provided by the Environment Agency. This mapping accounts for climate change with flood defences at current standards of protection.

Modelled Tidal Water Levels

4.3.7 The Environment Agency provided modelled tidal peak water levels for the South Humber Bank area to inform this FRA (**Annex 1**). The Environment Agency's model demonstrated that during a 0.1% AEP (1 in 1000 chance) event based upon the existing (2017) scenario, tidal levels in the Humber Estuary could rise up to 5.97m AOD at the Habrough gauge south east of the Site and 6.01m AOD at the Immingham gauge to the north west of the Site.

4.3.8 Table 10 details the modelled tidal water levels provided by the Environment Agency. These are the current best estimate for extreme still tidal levels in the vicinity of the Site.

Table 10: Coastal Flood Boundary Extreme Still Tidal Levels for Immingham and Habrough Marsh

Annual Exceedance Probability (%)	Extreme Still Tidal Level (m AOD)	
	Immingham (NGR 520440,417625)	Habrough Marsh (NGR 522100,416512)
100%	4.19	4.17
10%	4.62	4.60
2%	5.00	4.97
1%	5.19	5.16
0.5%	5.41	5.38
0.1%	6.01	5.97

4.3.9 Sea level rise over the lifetime of the development has been calculated in line with Environment Agency climate change guidance (Ref 1-22) (see **Section 3**). Based on these calculations' sea level is predicted to rise by 0.73m and 0.97m for the Higher Central and Upper End allowances respectively.

4.3.10 Table 11 presents the Extreme Still Tidal Levels for the Immingham and Habrough Marsh tidal gauges including the sea level allowances for the year 2100. The extreme H++ climate change scenario is also included.

Table 11: Coastal Flood Boundary Extreme Still Tidal Levels for Immingham and Habrough Marsh, including Climate Change

Annual Exceedance Probability (%)	Extreme Still Tidal Level (m AOD)			
	Immingham (NGR 520440,417625)		Habrough Marsh (NGR 522100,416512)	
	Higher Central	Upper End	Higher Central	Upper End
0.5%	6.14	6.38	6.11	6.35
0.1%	6.74	6.98	6.70	6.94
H++	7.31		7.28	

4.3.11 The SMP3 (Ref 1-17), CFMP (Ref 1-15) and Humber Management Strategy (Ref 1-16) guidance documents state that defences will be improved as necessary to protect people, businesses and nationally important industry from tidal flooding along the estuary, including the location of the Site. In addition, the design of the jetty access road where it passes over the flood defences includes sufficient space for the flood defences to be improved and the defences along the landside frontage, beneath and in close proximity to the jetty access road crossing, will be replaced by a new section of flood defence wall with an increased crest height of 7.0m AOD during the construction phase of the Project. Construction would be undertaken in such a way that flood protection would be maintained throughout the works. .

Modelled Overtopping and Breach Failure Water Levels Behind the Defences

4.3.12 The Environment Agency has modelled simulations for breach failure and overtopping scenarios of the tidal flood defences located along the frontage of the landside of the Site. Overtopping was demonstrated during scenarios where the design standard of protection ("SoP") of the defences would be exceeded, and the breach failure scenarios were undertaken along the defences at specific locations. The breach location nearest the Site is located on the frontage of the Temporary Construction Area.

4.3.13 The breach and overtopping scenarios were modelled for the 0.5% AEP and 0.1% AEP events. The scenarios were performed for both the existing (2006) scenario and future (2115) scenario taking into account the effects of a predicted increase in tidal water levels resulting from climate change.

4.3.14 The Environment Agency provided maximum modelled depth, velocity and hazard maps from the Northern Area Tidal Modelling results (refer to **Annex 1**). The corresponding peak flood depth results in the vicinity of the Site are summarised in **Table 12**.

Table 12: Breach and Overtopping Flood Depths taken from the Environment Agency Hazard, Depth Velocity Maps (Annex 1)

		Flood Depth (m) Band	
	Scenario	0.5 % AEP (1 in 200) event	0.1 % AEP (1 in 1000) event
Breach	2006 (Existing)	1 - >1.6	1 - >1.6
	2115 (inc. UKCP09 Climate Change)	>1.6	>1.6
Overtopping	2006 (Existing)	0-0.25 – Construction Laydown Area 0.25 – 1.0 East Site	0 – 0.25 Pipeline Corridor 0.25 – 1.0 Construction Laydown Area, Pipeline to Jetty and jetty access road, East Site
	2115 (inc. UKCP09 Climate Change)	>1.6	>1.6

4.3.15 In April 2023, the Environment Agency also provided the peak water level information (in mAOD) from the hydraulic model for a tidal breach failure event at the nearest modelled breach location to the Site during a 0.5% AEP and 0.1% AEP flood events including allowances for climate change up to the year 2115.

4.3.16 This data illustrated the maximum modelled peak water levels for the Site and are presented in **Table 13**.

Table 13: Environment Agency Modelled Breach Scenario Maximum Peak Flood Level for the Site

		Peak Flood Water Level (mAOD)	
	Scenario	0.5 % AEP (1 in 200) event	0.1 % AEP (1 in 1000) event
Breach	2006 (Existing)	5.5	5.6
	2115 (inc. Climate Change)	5.9	6.0

4.3.17 The peak 0.1% AEP water level resulting from a breach event taking into account the impacts of future climate change up to 2115 is approximately 6.0 mAOD.

4.3.18 This water level estimate has therefore been used to inform the mitigation proposals for elevating critical equipment and provision of a place of safe refuge for occupants at the Site in **Section 6**. This is considered a robust assessment based on the available information.

4.3.19 Additional maps illustrating the flood depth, velocity, hazard classifications and rate of inundation for the largest magnitude event modelled are presented in **Annex 1**. These illustrate that during a 0.1% AEP breach failure event with climate change allowances up to the year 2115, the Site could flood in under 15 minutes of a breach occurring. This emphasises the requirement for the place of safe refuge within the Site.

4.3.20 In the event of a defence overtopping scenario occurring in the present-day, the modelled hazard classifications range from 'Low Hazard' to 'Danger for Most' within the Temporary Construction Area, the East Site and along the Corridor for the pipeline to the Jetty and jetty access road. Environment Agency hazard mapping is provided in **Annex 1**.

4.3.21 In the event of a defence overtopping 0.5% AEP scenario taking into account the impacts of future climate change up to 2115, during the 0.5% AEP and 0.1% AEP breach scenarios occurring during the present day (2006) and 0.1% AEP event with future climate change scenario up to 2115, the modelled hazard classification is 'Danger to All' across the entire Site (See **Annex 1**).

4.3.22 The NPPF (Ref 1-2) requires that plans and mitigation are put in place to manage the risks should breach occur. Mitigation measures for the Site are outlined in **Section 6**.

Summary

4.3.23 Based on the information provided by the Environment Agency, it has been determined that the Site is at a 'low' risk of flooding from tidal sources with the defences in place. If these defences were to overtop or breach during the existing scenario, the Site would be at a 'high' residual risk of flooding during both the 0.5% AEP and 0.1% AEP events.

4.3.24 During a future scenario, taking climate change up to 2115 into account, the impacts are more significant with regards hazard, depth and velocity. The Site is potentially at a 'high' residual risk of flooding as a result of overtopping and breach of the defences during the 0.5% AEP and 0.1% AEP plus climate change events.

4.4 Fluvial Sources

4.4.1 Fluvial flooding occurs when the capacity of a river is exceeded either due to high flows from the catchment draining into the river or a combination of high flows and high tides, which causes raised water levels due to backwater effects.

Flood Map for Planning

4.4.2 A review of the Environment Agency FMfP (shown on **Plate 5**) (Ref 1-1) illustrates that the Site is wholly located within Flood Zone 3 (high probability) 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 3**).

4.4.3 The FMfP (Ref 1-1) does not differentiate between the tidal and fluvial sources of flood risk, however, due to the proximity of the Humber Estuary, it is likely that during a flood event the tidal influence would dominate with limited potential for fluvial flooding.

1.1.1 Mapping in Section 2.4 of the NELC PFRA (Ref 1-9) gives some indication of fluvial flood zones and indicates that the Site is located in Flood Zone 1. Main Rivers

4.4.4 Main rivers are usually larger rivers and streams. They are designated as such and shown on the Main River Map. The Environment Agency carries out maintenance, improvement or construction work on main rivers to manage flood risk.

4.4.5 The closest Main River to the Site is the North Beck Drain, situated to the south and east of the Site Boundary.

Flood Defences

4.4.6 **Section 2** provides information on the flood defences along the North Beck Drain. They are in fair condition and reduce the risk of flooding to a 2% (1 in 50) chance of occurring in any year.

4.4.7 The Environment Agency Asset Management Database (Ref 1-13) identifies that flood defence crest levels along the North Beck Drain are between 3.85m – 3.94 m AOD adjacent to the Site Boundary. These levels indicate that the channel is likely to remain in bank during the 1% AEP event, however the watercourse may become tide-locked, presenting a residual risk.

Modelled Fluvial Flood Water Levels and Extents

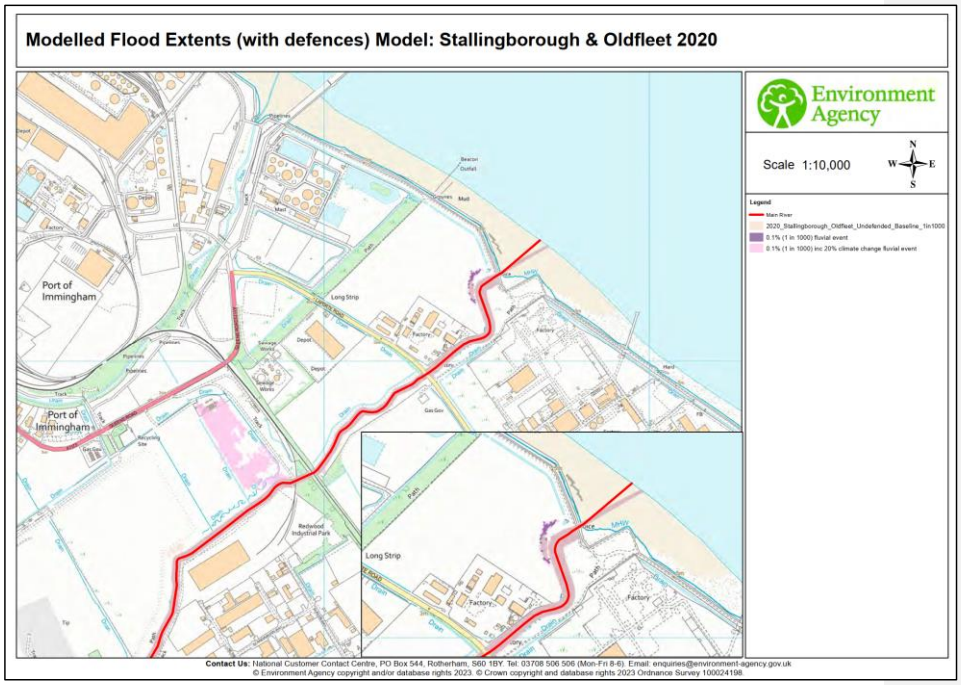
4.4.8 Modelled flood water levels for the North Beck Drain from the Stallingborough and Oldfleet 2020 model have been provided by the Environment Agency and are presented in **Table 14** below. Node locations are provided in **Annex 1**.

Table 14: Modelled Flood Levels for North Beck Drain

Node	Easting	Northing	Annual Exceedance Probability – Maximum Water Levels (m AOD)				
			50% AEP	3.33% AEP	1% AEP	0.5% AEP	0.1% AEP
NOR_0239_3	521484	415196	1.72	2.35	2.52	2.60	3.05
NOR_0431_2	521382	415015	1.72	2.35	2.52	2.60	3.05
NOR_0711_1	521105	414836	1.73	2.36	2.53	2.61	3.06
NOR_1243_1	520717	414503	1.73	2.37	2.54	2.62	3.09
NOR_1676_2	520538	414244	1.74	2.37	2.55	2.63	3.10

4.4.9 For the 1% AEP event, maximum water levels are 2.52 – 2.55 mAOD and approximately 1.3m below the level of the flood defences. The water also remains in channel for the 0.5% AEP flood event. During the 0.1% AEP flood event water remains in channel along the majority of the length of the watercourse, however modelled levels suggest that a small area of **Work No. 9**, towards the south east adjacent to the watercourse, is located within Flood Zone 2. See **Plate 4** below.

Plate 4: Modelled Flood Extents for Stallingborough North Beck (with defences)



4.4.10 Modelled flood water levels, including climate change, from the North Beck Drain from the Stallingborough and Oldfleet 2020 model, presented in **Table 4-6** below, indicate a potential 0.45 m increase in water level during the 1% AEP event with 20% climate change, which is also likely to remain in bank, given the height of the flood defences (see **Paragraph 4.4.8**) in comparison with the modelled flood water levels in **Table 4-5**.

4.4.11 As discussed in **Section 3**, peak river flows are expected to increase in the Louth, Grimsby and Ancholme Management Catchment by 12% in the 2070's epoch therefore the modelled climate change uplifts provided by the Environment Agency for the 20% climate change uplift, presented in **Table 15** below, provide a conservative estimate for the impact of climate change.

Table 15: Modelled Climate Change Flood Levels for North Beck Drain

	Annual Exceedance Probability – Maximum Water Levels (mODN)						
Node	1% AEP	1% AEP + 20% CC	0.5% AEP + 20% CC	0.1% AEP + 20% CC	1% AEP + 30% CC	0.5% AEP + 30% CC	0.1% AEP + 30% CC
NOR_0239_3	2.52	2.97	3.08	3.73	3.07	3.17	3.82
NOR_0431_2	2.52	2.98	3.08	3.73	3.08	3.17	3.81
NOR_0711_1	2.53	2.98	3.08	3.74	3.08	3.17	3.81
NOR_1243_1	2.54	2.99	3.19	3.76	3.09	3.19	3.83
NOR_1676_2	2.55	3.00	3.19	3.78	3.10	3.19	3.83

4.4.12 The climate change modelled flood extents for North Beck, provided by the Environment Agency (**Annex 1**) for a 20% uplift in peak flow indicate that flood water remains in-bank during a 1% AEP plus 20% climate change flood event. During a 0.1% AEP plus 20% climate change flood event, mapping (**Annex 1**) shows a small area of land between Queens Road and the watercourse is flooded, however this flood water does not extend into the Site.

4.4.13 The H++ extreme climate change scenario requires assessment of the Upper End climate change allowance for peak flow which for the Louth, Ancholme and Grimsby Management Catchment is a 33% uplift. **Table 15** includes modelled climate change flood water levels for a 30% uplift in peak flow and can be used as a proxy for the H++ scenario. Mapping provided in **Annex 1** shows an area of land between Queens Road and the watercourse is flooded during a 0.1% AEP plus 30% climate change event, however this flood water does not extend into the Site.

Breach of the Fluvial Flood Defences

4.4.14 The Temporary Construction Area (Work No.9) is located in close proximity to the North Beck Drain and in the unlikely event that the flood defences along the North Beck Drain were breached, Work Area No.9 and the surrounding area would be at residual risk of fluvial flooding. Work Area No.9 will only be present during the construction phase.

4.4.15 The Environment Agency has provided fluvial water levels for the North Beck Drain, see **Table 14**. These have been compared to the ground level of **Work No. 9** and surrounding area to assess the residual fluvial flood risk posed to the Site. Using an average ground level of 2.00m AOD, **Work No.9** may be inundated with floodwater during a fluvial flood event. During the 1% AEP event the Temporary Compound Area and surrounding land may be inundated with floodwater to a maximum water depth of 0.52m, increasing to a depth of 1.05m.

4.4.16 Flood levels within the Temporary Construction Area (**Work No. 9**) and surrounding land from a fluvial defence breach scenario, equalling those contained within **Table 14**, are unlikely to occur due to the spread of the fluvial volume across the wider flood plain. So, flood levels within the Temporary Construction Area and surrounding land due to a fluvial defence breach would be lower than those presented within **Table 14**.

4.4.17 Given the distance between the North Beck Drain and the East Site (**Work No. 3** and **Work No. 5**) and West Site (**Work No. 7**) it is unlikely the breach flood extent would impact these areas.

4.4.18 Whilst the water depths identified for a potential breach event may impact on the **Work No. 9**, the existing flood defences are considered to be in good condition and the Environment Agency inspect these defences regularly to ensure that any potential defects are identified early.

4.4.19 The defences consist of steep grassed banks with the top elevated above ground level by around 1.2m with a wide maintenance strip across the top. It is considered a breach would be difficult to form as generally over topping would need to occur first to cause erosion of the embankment.

4.4.20 The probability of a breach or overtopping occurring is therefore considered to be low and therefore, the residual risk of flooding to the site from fluvial sources can be considered to be low.

Ordinary Watercourses

4.4.21 Ordinary Watercourses include every river, stream, brook, cut, dike/dyke and sluice which does not form part of a Main River network. Where applicable, the Riparian Owner, IDB or LLFA have a lead responsibility for managing the risk of flooding from ordinary watercourses.

4.4.22 NELIDB are operational within the area and have flood risk management responsibilities over Habrough Marsh Drain and Immingham Pump Drain. Habrough Marsh Drain lies immediately north-west of the Site Boundary and coincides with the Port of Immingham boundary. The watercourse flows from west to east adjacent to the Site boundary and discharges partly to the Humber Estuary and when water levels are high, discharges partly to the Stallingborough North Beck through the Immingham Pumping Station.

4.4.23 Immingham Pump Drain lies south-west of the Site Boundary and flows down from Habrough Marsh Drain to Immingham Pumping Station which discharges into the Stallingborough North Beck Drain.

4.4.24 The NELC LFRMS (Ref 1-12) states "*The system serving the areas north and west of Immingham discharges into the Habrough Marsh Drain which has a gravity outfall into the Humber Estuary. During periods of high tide, relief can be given to this drain by opening the Habrough Slide which allows flow to enter the pumped catchment. Likewise, should there be particularly high water levels in the pumped catchment during periods of lower water levels in the Habrough Marsh drain then relief flows from the pumped catchment can enter the Habrough Marsh Drain via the Slide. During flood events the operation of the pumping station is closely monitored*".

4.4.25 High levels within the tidally influenced watercourses are a potential source of flooding to the area due to associated tide-locking when high tides prevent these watercourses discharging into the Humber Estuary. Further information is provided below. The area surrounding the Site is drained via a network of small land drainage ditches that convey surface water from the surrounding greenfield areas located between the Site and Humber Estuary.

Modelled Fluvial Water Levels

4.4.26 Habrough Marsh Drain and the smaller watercourses have no associated hydraulic model or modelled flood water data available to inform the assessment. As a proxy, for catchment areas less than 3km^2, the Environment Agency Risk of Flooding from Surface Water ("RoFSW") maps (Ref 1-14), primarily used to represent surface runoff can also be used to identify flooding from Ordinary Watercourses. RoFSW mapping (**Plate 5**) identifies that the Habrough Marsh Drain largely remains in bank, with small, localised extents out of bank during higher return periods adjacent to the East Site and Pipeline Corridor.

4.4.27 The smaller drains across the Site also largely remain in bank, with small, localised extents out of bank during higher return periods within the West Site and East Site.

4.4.28 The NELC SFRA (Ref 1-11) states that "*the drainage system managed by the North East Lindsey IDB is understood to be able to accommodate events with 0.1% AEP by a combination of storage and pumping, without flooding the surrounding area*".

4.4.29 Correspondence with the NELIDB (**Annex 1**) indicates that when there are high water levels in the Habrough Marsh Drain, the Habrough Slide control structure allows water to discharge via the Immingham Pump Station when the gravity system is tide locked, but only if there is capacity available in the pumped system. The IDB note that the Habrough Marsh Drain during events when it is tide locked backs up with increasing water levels and can cause 'out of bank' flooding. The IDB have not stated if flooding from the Habrough Marsh Drain occurs in proximity to the Site, however, the NELC LFRMS (Ref 1-12) and SFRA (Ref 1-11) indicates that flooding is more prevalent in the upstream region of the watercourse rather than near the Site itself.

4.4.30 There is potential for an increased potential for flooding from the ordinary watercourses over the lifetime of the Project. Both the Higher Central (12% uplift in peak flows) and the Upper End H++ climate change scenario (a 33% uplift in peak flows) may cause localised flooding to the Site; however the flooding is not likely to be extensive and would be shallow in depth. Mitigation measures in place for the tidal flooding scenarios will be sufficient to keep the Site safe, should a flood event occur.

Summary

4.4.31 The potential for fluvial flooding over the lifetime of the Project is considered to be low, given the Stallingborough North Beck Drain defences are high enough to contain the modelled 1% AEP event (including climate change) and with limited and localised impacts during a 0.1% AEP event (including climate change). Flood extents from the Habrough Marsh Drain and smaller surface drains across the Site for the climate change scenarios would likely be localised and shallow in depth and therefore considered a low risk.

4.4.32 There is a residual risk to the Site in the event that the local watercourses become tide-locked, or in the event that the Immingham Pumping Station fails; however the measures outlined in **Section 6** are considered sufficient to mitigate this risk.

4.5 Surface Water Runoff to the Site

Existing Drainage Infrastructure

4.5.1 There is little information regarding existing drainage infrastructure within the Site. The Eastern Site comprises formerly developed brownfield land but appears to have no impermeable surface. Part of this Site is artificially raised and contains a drainage system, assumed to be privately owned.

4.5.2 With the exception of road drainage, the remaining Site area is crossed by local watercourses forming part of the wider managed low land drainage network. It is assumed that the land drains located within and around the perimeter of the Site accept lateral drainage of surface water from the greenfield areas of the Site. However, no level information is available for these drains.

Overland Flow of Rainfall Runoff

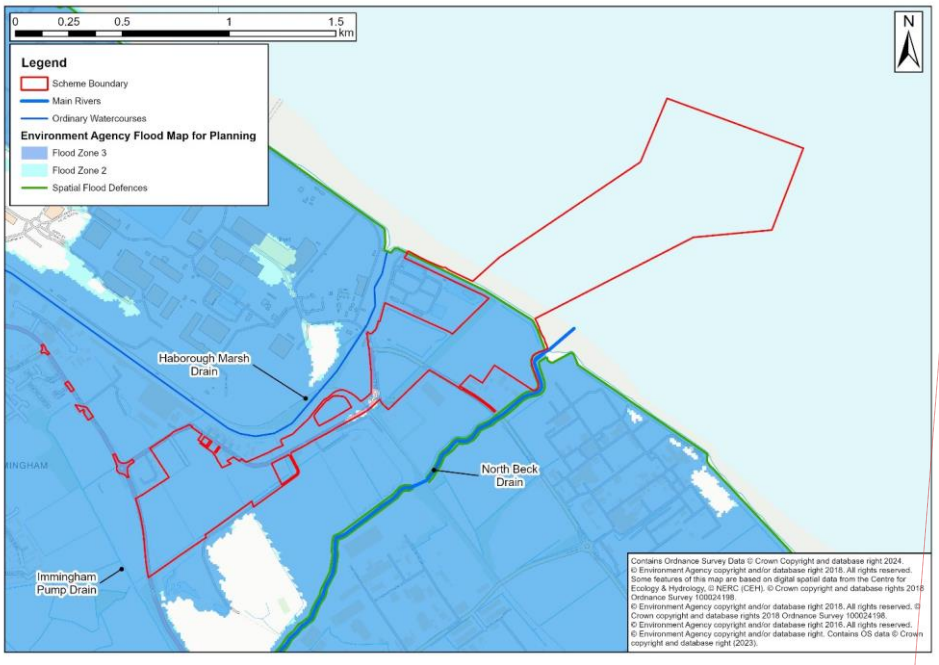
4.5.3 Surface water flooding is caused by overland flow that results from rainfall that fails to drain into the ground through infiltration, and, instead, flows over the ground surface. This can be exacerbated where the permeability of the ground is low due to the type of soil (such as clayey soils) and geology or land use including urban developments with impermeable surfaces.

4.5.4 The Environment Agency RoFSW (Ref 1-14) maps indicate areas at risk from surface water flooding when rainwater does not drain away through the normal drainage systems or soak into the ground, but instead lies on or flows over the ground. As defined by the Environment Agency, the following levels of surface water flood risk can be classified as defined in **Table 16**. The RoFSW flood map for the Site is shown in **Plate 5** below.

Table 16: Definition of risk from surface water flooding

Risk of flooding	Definition
Very Low	Each year, the area has a chance of flooding of less than 1 in 1,000 (0.1% AEP)
Low	Each year, the area has a chance of flooding of between 1 in 1,000 (0.1%AEP) and 1 in 100 (1% AEP)
Medium	Each year, the area has a chance of flooding of between 1 in 100 (1%AEP) and 1 in 30 (3.3% AEP)
High	Each year, the area has a chance of flooding of greater than 1 in 30 (3.3% AEP)

Plate 5: Environment Agency Risk of Flooding from Surface Water Map. (Note: IDB Drain No.8 = Habrough Marsh Drain)



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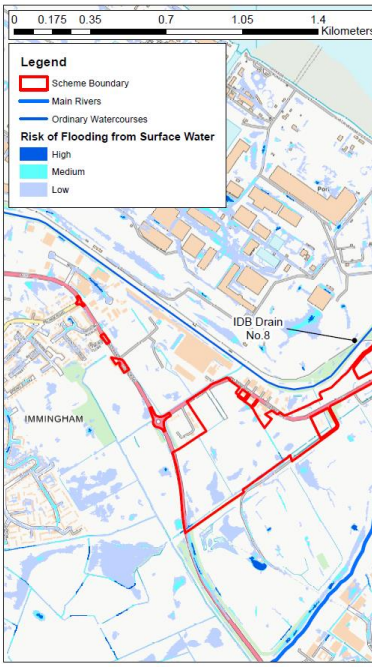


4.5.5 The RoFSW map identifies the vast majority of the Site is shown to be at 'very low' risk of surface water flooding (<0.1% AEP event). Small areas along the roads and along adjacent land drains within the Site are identified to be at a 'low', 'medium' and 'high' risk from surface water flooding (>0.1% AEP, 3.3% to 1% AEP event and >3.3% AEP event respectively).

4.5.6 Within the West Site, there is significant ponding during higher return period events and there are isolated areas at 'low', 'medium' and 'high' risk of surface water flooding within the East Site and temporary construction area. These areas at risk are considered to reflect areas at topographic low points.

4.5.7 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. No overland flow routes into or across the Site have been identified on the RoFSW map.

4.5.8 Climate change must be taken into account when considering surface water runoff generated by development sites. This is usually represented by increasing peak rainfall intensities (**Table 8**). The surface water flood extents for the 'Low Risk' flood event (between a 1% AEP and 0.1% AEP) have been used to represent the impact of climate change. Based on these mapped extents the Site remains at very low to low risk of flooding.

Summary

4.5.9 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, medium and high' in small areas, as shown on Plate 6, but largely 'very low'. Once the site is developed these areas of surface water flooding within the red line boundary will be managed by the surface water drainage system.

4.6 Groundwater Sources

4.6.1 Groundwater flooding can occur when groundwater levels exceed ground surface levels as a result of periods of sustained high rainfall. 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) where the water table is more likely to be at shallow depth.

4.6.2 Groundwater levels tend to get re-charged during the winter and high groundwater levels can cause flooding as the water table rises. The rise in water table levels can be very slow, dependant on rainfall patterns and groundwater flooding can be long lasting (weeks or months). There is no reference to groundwater flooding events or any records of historical groundwater flooding in the NELC SFRA (Ref 1-11) where the Site is located.

4.6.3 The NELC PFRA (Ref 1-9) states "*Generally the risk of flooding from groundwater is in the coastal areas from Immingham to Humberston, i.e. the lower lying parts of the Borough. This is caused by artesian spring flows from confined chalk where high groundwater pressures force an upward flow path through the confining clay*" (page 26).

4.6.4 **Chapter 21: Ground Conditions and Land Quality [TR030008/APP/6.2]** notes there are seventeen BGS boreholes located within the Site Boundary, or within 5m of the Site Boundary. The highest groundwater strike is recorded at 16.5m below ground level (bgl) within the pipeline area. The rest level of groundwater was recorded at the ground surface within the East Site (borehole ref: TA21NW3/D).

4.6.5 Previous ground investigations undertaken at the Site are summarised in **Chapter 21: Ground Conditions and Land Quality [TR030008/APP/6.2]** which indicate that perched groundwater is present within all geological units beneath the Site. Groundwater has previously been encountered in the Tidal Deposits beneath the East Site between 1.63m AOD and 3.97m AOD. Within the corridor area groundwater was struck at between 16 – 18 m below ground level ("bgl") with groundwater seepage encountered in boreholes and test trenches between 1.7m bgl – 4m bgl.

4.6.6 The Immingham Ammonia Import Terminal Ground Investigation Report [**Appendix 21.B Phase II Ground Investigation Interpretative Report [TR030008/APP/6.4]**] provides details of fieldwork undertaken at the Site between 8 November 2022 and 16 February 2023 (with groundwater monitoring continuing to May 2023.

4.6.7 The groundwater level monitoring data indicates that groundwater is present in all geological units beneath the Site. Perched groundwater was encountered within Made Ground, mostly within the East Site. No monitoring boreholes were installed within Made Ground in the West Site. Groundwater levels within Made Ground varied between ground level and 2.5m bgl. The groundwater levels in boreholes screened within Tidal Flat Deposits within the East Site varied between 3.3.97m OD to 1.63m OD. Groundwater levels within Glacial Till Deposits varied between 0.5m OD and 1.06m AOD in the West Site and 1.82m OD and 2.65m OD in the East Site. Groundwater levels within monitoring wells within the Flamborough Chalk Formation varied between 0.72m OD and 3.1m OD in the East Site. All nine Chalk monitoring boreholes installed recorded artesian conditions during the monitoring period, except W-BH17 which recorded slightly lower levels (up to 1.46m bgl) on two occasions.

4.6.8 The groundwater generally flows in a north-easterly direction towards the Humber Estuary.

4.6.9 The direct impact of climate change on groundwater resources is dictated by the changes in rainfall intensity and soil infiltration. During drier seasons, there may be reductions in groundwater recharge that may cause a long-term decline in groundwater storage. Alternatively, groundwater recharge may be stabilised or even increased by frequent and prolonged periods of rainfall. As a precautionary measure, any below ground elements associated with the Project should be designed in such a way as to withstand any upward hydraulic pressures in the event that groundwater levels rise as a result of climate change. Assuming this is the case, any anticipated increase in groundwater levels, as a result of climate change will unlikely increase the risk of groundwater flooding to the Project.

4.6.10 It is possible that groundwater will be encountered in excavations during construction works with limited below ground works expected to take place. However, should localised groundwater emergence occur it is considered this can easily be dealt with by the use of a small pump, and would not increase flood risk from groundwater sources to the Site during or after the construction process.

4.6.11 Given the limited information available and potential for high groundwater levels below the Site, the risk from groundwater flooding is considered to be a 'medium' risk.

4.7 Drainage and Sewerage Infrastructure

4.7.1 Flooding from drains, sewers and surface waters are normally interconnected. Insufficient or reduced drainage capacity within the sewer network can result in drainage capacity being exceeded causing extensive surface water flooding. Likewise, increased volumes of surface water can overload sewers and drains, causing the drainage network to backup and surcharge causing surface water flooding.

4.7.2 The following Anglian Water assets are present in the proximity to the Site:

a. A domestic sewer beneath Kings Road.

b. A trade effluent sewer beneath Queens Road.

c. A domestic sewer beneath the access road to a Water Treatment Works.

d. A Water Treatment Works, located to the south of the Long Strip, accessed off Queens Road.

e. Final effluent sewer from the Water Treatment Works, passing under the Temporary Construction Area (Work Plan 9) and discharging to the Humber Estuary via the Immingham Sea Outfall located at OS NGR TA2141715599, downstream of the Port of Immingham.

4.7.3 There are no predicted morphological changes in or around the Immingham Sea Outfall due to changes to physical processes in the estuary. Further details are provided in **Section 16.8** of **Chapter 16: Physical Processes [TR030008/APP/6.2].**

4.7.4 Anglian Water is the water company that serves the NELC administrative area. As part of the SFRA (Ref 1-11), Anglian Water provided records from their Floods Registers which are used to record flood incidents attributable to their sewer networks, whether that be from foul and/or surface water sewers. The historical mapping, included within the SFRA (Ref 1-11), shows that the Site is not located in an area that is known to flood from sewer networks.

4.7.5 In addition, there are no historical records of flooding from the private drainage system within the wider Port of Immingham and the limited nature of drainage infrastructure within the Site suggests a limited probability of flooding from this source.

Summary

4.7.6 Given the Site is located in an area that is not affected by sewerage flooding and the limited nature of drainage infrastructure within the Site Boundary, the risk of flooding from drainage and sewerage infrastructure is low.

4.8 Flood Risk from Artificial Sources

Canal Systems

4.8.1 Canals do not pose a direct flood risk given they are regulated water bodies with controlled water levels; however, flooding can still occur through a breach or overtopping. Control structures such as weirs or locks could experience a blockage or failure resulting in rising water levels and overtopping. Structural failure could lead to a breach which can potentially be hazardous as they may involve the rapid release of large volumes of water at high velocity.

4.8.2 A review of the Canal and River Network Mapping (Ref 1-36) from the Canal and River Trust indicates there are no active canal systems in proximity to the Site. As such, there is no flood risk posed to the Site from this source.

Reservoirs

4.8.3 Reservoir failure can be particularly dangerous as it causes the release of large volumes of water at a high velocity, which can result in deep and widespread flooding. However, reservoir inspection and design procedures are very rigorous such that the probability of failure is generally regarded as extremely low.

4.8.4 In accordance with the Environment Agency's 'Risk of Flooding from Reservoirs' mapping (Ref 1-14), the Site is situated outside the extent for potential reservoir flooding.

Summary

4.8.5 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.

4.9 Summary of Flood Risks to the Site

4.9.1 **Table 17** below provides a summary of flood risk to the Site and outlines appropriate mitigation measures, where required.

Table 17: Summary of Flood Risks to the Site

Flood Risk Source	Risk of Flooding	Flood Risk Summary	Mitigation Required
Tidal	Low risk of flooding due to presence of flood defences. High residual risk of breach/overtopping of defences	The Site is located entirely within Flood Zone 3 but is provided protection up to and including the 0.5% AEP flood event by the tidal flood defences located along the landside frontage of the Humber Estuary. Should a	Yes

Flood Risk Source	Risk of Flooding	Flood Risk Summary	Mitigation Required
		breach in defences occur, the maximum flood water level at the site for a 0.1% AEP event in the year 2115 is 6 m AOD.	
Fluvial	Low	With the exception of a small area of land to the south of Work No.9 which is located in Flood Zone 2, the Project is predominantly located in Flood Zone 1 (fluvial risk) and is at low risk of fluvial flooding. Flooding from the watercourse occurs during the 0.1% AEP climate change event. Land between the Site and the watercourse is flooded during this event, however the Site is not affected. RoFSW mapping shows there is little risk of flooding from the Habrough Marsh Drain and smaller surface drains across the Site. There is potential for some flooding during the climate change flood events, however flood extents are localised and therefore considered low risk.	No
Surface Water	Low-High	Majority of the Site is at 'very low' risk, with areas of ponding within the West Site and	Yes

Flood Risk Source	Risk of Flooding	Flood Risk Summary	Mitigation Required
		isolated areas within the East Site and temporary construction at 'low', 'medium' and 'high' risk area at higher return period events.	
Groundwater	Medium	Given the groundwater levels within the Made Ground and Tidal Flat Deposits across the East and West Sites and the potential for artesian conditions within both the Glacial Till Deposits and the underlying Chalk aquifer at the West, the risk from groundwater flooding is considered to be medium.	Yes
Drainage and Sewerage Infrastructure	Low	Neither the rising foul main or the Immingham Sea Outfall are located within the Site and will remain in-situ post development. Existing drainage infrastructure is limited within the Site. The Site is not located in an area that is known to flood from sewer networks.	No
Artificial Sources	Low	There are no artificial sources of flood risk, such as reservoirs or canals in close proximity to the Site. It is therefore considered that	No

Flood Risk Source	Risk of Flooding	Flood Risk Summary	Mitigation Required
		there these sources pose very low flood risk to the Site.	

5 Impacts of the Development on Flood Risk

5.1.1 This section of the report considers the potential flood risk, which could result from the design and construction of the Project. The effect on all sources of flood risk is considered. Where risk is deemed 'Medium' or 'High', mitigation measures may be required. Where a flood risk is deemed 'Low', mitigation measures are not required.

5.2 Coastal and Estuarial Processes

5.2.1 The marine development of the Terminal and the associated maintenance dredging operations will change sea bed levels and, in addition to the predicted increases in wave height and peak water levels associated with climate change, has the potential to change the rates of erosion and/ or accretion on the foreshore in proximity to the flood defences and outfalls to the Estuary over the operational lifetime of the Project.

5.2.2 Impacts relating to the marine development and changes to the tidal regime for the construction and operational phase are discussed in detail within **Chapter 16: Physical Processes [TR030008/APP/6.2]**. As part of the assessment, numerical modelling tools and conceptual analyses have been used to predict coastal processes and hydrodynamic effects by comparing the baseline and future environmental conditions created by the Project. This includes predicting the changes to tidal water levels, currents, and waves. It also includes modelling of sediment transport pathways (including assessment of potential changes to erosion and accretion patterns) and the fate of sediment plumes from marine construction and maintenance dredging and disposal activities.

5.2.3 During the construction phase the assessment concludes that overall, the increase in suspended sediment concentration ("SSC") and potential sedimentation in the marine environment is likely to be the same as that which already occurs from existing maintenance dredging in the area (which has been occurring for many years). Moreover, peak increases will remain within the envelope of natural variability in background SSC. In addition, it is considered unlikely that there would be any notable impact on local flows across the adjacent intertidal area and, by association, no likely impact on local accretion or erosion processes.

5.2.4 Across the wider study area (including the existing berths at Immingham Oil Terminal ("IOT"), the rest of the intertidal area along the Immingham frontage, the Habrough Marsh Drain and Immingham Sea outfalls, the offshore banks and channels and the wider estuary up- and down-stream), the Project marine facilities will have no impact on the existing (baseline) accretion and erosion rates over the operation phase of the development.

5.2.5 Changes to flows and waves are predicted to be generally limited in extent to around the Project marine facilities and in the immediate vicinity. The predicted impacts at the existing marine terminals (including IOT, Humber Sea Terminal, Immingham Eastern and Western Jetties, Immingham Outer Harbour and Immingham Gas Terminal) are (where predicted) generally small in magnitude. **Chapter 16: Physical Processes [TR030008/APP/6.2]** states that the Project

marine facilities have no impact on the existing (baseline) accretion and erosion rates along the adjacent foreshore areas fronting the Project site, which include a number of outfalls, including the North Beck Drain and Habrough Marsh Drain. With distance from the Project, the predicted impacts reduce further and are not predicted to occur over the far-field region.

5.2.6 As the local hydrodynamics will remain comparable to the baseline scenario it is considered that there will be negligible changes to wave heights, tidal water levels and the rates of erosion or accretion on the foreshore (above natural variations) both on-site (along the frontage of the project) and off-site (along wider frontage of the Port of Immingham).

5.3 Impact on Tidal Flooding

5.3.1 Given that the landside Site (Associated Development) is located behind tidal flood defences which protect the Site up to the design flood event, the Project's potential to impact on tidal flooding relates to the residual flood risk should overtopping or a breach in the flood defences occur.

Alteration of Flood Flow Paths

5.3.2 The hazard, depth and velocity mapping provided by the Environment Agency (**Annex A**) shows the extent of flooding should a breach event occur. It is unlikely, given the extent and depth of flooding along the South Humber Bank should a breach occur, that the Project will increase the risk of flooding off-site to surrounding land as these areas are likely to be flooded to the same depth as the Site. As such, the impact of the Project on tidal flooding is considered to be low and no further mitigation is required.

Impact on Floodplain Storage

5.3.3 As part of the Drainage Strategy design (**Appendix 18.B: Drainage Strategy [TR030008/APP/6.4]**) ground levels within the East Site will be raised by 0.3m and 0.6m, respectively, giving approximate finished ground levels of 3.8m AOD and 3.5m AOD. In addition, the West Site will be raised by approximately 0.5m, giving a final ground level of 2.5m AOD.

5.3.4 The proposed ground levels are located below the breach flood water levels for both the 0.5% AEP and 0.1% AEP 2115 flood events, approximately 5.9m AOD and 6m AOD respectively, and therefore floodplain storage will be lost which could potentially increase the risk of flooding off-site.

5.3.5 Compensatory storage for the loss of floodplain behind tidal flood defences is not required given that the risk is a residual risk and the extensive nature of flooding should an overtopping or a breach of the flood defences occur. It is unlikely, given the extent and depth of flooding along the South Humber Bank should a breach occur, that the Project will increase the risk of flooding off-site to surrounding land as these areas are likely to be flooded to the same depth as the Site. Any increase in flood water level is likely to be insignificant.

5.3.6 As such, the impact of the Project on tidal flooding is considered to be low and no further mitigation is required.

5.4 Impact on Fluvial Flooding

5.4.1 It is possible that the Project could have an impact on fluvial flooding, including Main Rivers and Ordinary Watercourses. This is due to an alteration of flood mechanism and flows and through an increase in the amount of surface water runoff generated by the Site. As such, the impact of the Project on fluvial flooding has been assessed in relation to these potential issues.

Impact on Drainage Channel Capacity and Conveyance

5.4.2 Where the jetty access road has been identified to cross a land drainage ditch, culverts have been proposed along the jetty access road and piperack route. No culverts are proposed along the Main Rivers. The access road is likely to require three new culverted crossings, as detailed on **Figure 2.5 [TR030008/APP/6.3]**. Culvert design has yet to be completed, however it is anticipated that these will be pre-cast, open bottom structures. The construction of the jetty access road has the potential to increase the risk of flooding from the land drainage ditches it will cross along the proposed route.

5.4.3 The design philosophy to size the new culverts is to match or exceed the existing cross section of the relevant land drain. The final design of the culverts will be undertaken in consultation with NELIDB. The final designs will ensure that flows up and downstream of the proposed culvert locations are not adversely affected.

5.4.4 The proposed culverts will be sized appropriately so that there is no decrease in channel capacity or conveyance along the drains to prevent any obstruction to flow within the channel. Given culvert calculations have not been undertaken at the time of writing this FRA, as a precautionary measure, the impact of the proposed culverts on fluvial flood risk is considered moderate, however it is considered that at the detailed design stage it can be demonstrated that there is no adverse impact, the risk of fluvial flooding will remain low.

Impact on Floodplain Storage

5.4.5 The predominant risk of flooding is from tidal sources and fluvial flood extent mapping in the NELC PFRA (Ref 18-8) indicates that the Site is located in Flood Zone 1, therefore the Project will not result in the loss of fluvial floodplain storage. Modelled flood levels and extents provided by the Environment Agency for North Beck indicate the Site is not at risk of flooding during climate change scenarios, including the H++ scenario. Smaller ordinary watercourses and land drains have the potential to flood localised areas of the Site to shallow depths but would not increase flood risk off site.

5.4.6 Based on the Environment Agency Stallingborough North Beck model results a small area to the south east of the Temporary Construction Area (**Work No. 9),** adjacent to the watercourse, is located in Flood Zone 2. During the construction phase no temporary buildings, plant or materials will be located within this area of fluvial floodplain to allow storage of flood water should high flows occur on the North Beck.

5.4.7 As such the impact of the Project on fluvial floodplain storage is considered low and no mitigation measures are required.

Impact on Additional Surface Water Runoff

5.4.8 The Project will significantly increase the total impermeable surface area when compared to the current scenario, preventing infiltration and inhibiting natural drainage. This may increase surface water runoff generated by the Site and could impact the risk of flooding from fluvial sources, in the event that additional runoff discharges into the surrounding land drainage system and local watercourses.

5.4.9 The proposed surface water drainage strategy (**Appendix 18.B: Drainage Strategy [TR030008/APP/6.4]**) is designed to accommodate up to and including the 1% AEP plus 40% pluvial climate allowance and new outfalls to the land drains adjacent to the Site will discharge at a restricted rate. Surface water from the East Site will be restricted for all storm events to 70% of the current discharge rate, whilst surface water from the West Site will discharge at the current greenfield run-off rate, providing an overall betterment in surface water runoff.

5.4.10 Assuming the discharges are restricted in line with NELIDB requirements as detailed above, the risk of the Project on additional surface water runoff, and subsequent risk of fluvial flooding caused by increased flows to nearby watercourses, is considered low and no further mitigation is required.

Deleted:

5.5 Impact on Surface Water Flooding

5.5.1 The Project will increase the impermeable surface area due to the introduction of new roads, walkways and built infrastructure within the East and West Sites. The changes to the impermeable surface area may increase runoff and effect the conveyance of surface water, with the potential to impact flood risk from surface water sources.

5.5.2 There are no surface water flow paths identified within the Site Boundary which the Project could impede, however, topographical reprofiling of the Site is proposed to allow the new surface water drainage system to drain via gravity to the surrounding land drains. Ground levels within the Hydrogen Production Unit and the Ammonia Storage Sites (East Site) will be raised by approximately 0.3m and 0.6m, respectively, giving finished ground levels of 3.8m AOD and 3.6m AOD. In addition, the West Site will be raised to a final ground level of approximately 2.5 mAOD. As such, new slopes will be created to allow the existing surrounding site levels to tie into the proposed levels in both the East and West Sites. No changes to the ground level within the Pipeline Corridor or the Corridor for the pipeline to the jetty and jetty access road areas of the Site are proposed.

5.5.3 The creation of slopes and increase of impermeable surface areas may increase surface water flow rates on site, however the Project will include a surface water drainage strategy able to accommodate up to and including the 1% AEP plus 40% climate change event with no surface water flooding. A combination of permeable gravel beds and retention basins will be used on the East and West Sites to manage surface water runoff. Retention basins will provide temporary attenuation before flows are restricted to 70% of the existing discharge rates from the East Site and to current greenfield runoff rates for the West Site, for all storm events (as agreed with the NELIDB) and discharged to the surrounding land

drains via new discharge outfalls. Permeable gravel beds will provide an element of attenuation storage in addition to suitable water quality management. Further information can be found in **Appendix 18.B: Drainage Strategy** (**[TR030008/APP/6.4]**).

5.5.4 As such, the impact on surface water flooding from the Project is considered to be low and no further mitigation is required.

5.6 Groundwater Flooding

5.6.1 The Project will include the installation of a surface water and foul drainage network and the Laporte Road Culvert (an underground culvert, containing pipelines and cables and other conducting media, under Laporte Road, to link infrastructure in the East Site). No significant below ground structures are proposed. All below ground elements must be designed to prevent water ingress and withstand hydrostatic ground water pressures. Given the size of this surface water drainage network relative to the surrounding groundwater catchment, the ability of the Project to impact sub-surface flow regimes or groundwater storage capabilities is considered to be low. However, given the observed ground water levels within the Made Ground and Tidal Flat Deposits and the potential for artesian conditions, the risk of flooding remains a medium risk.

5.7 Impact on Drainage and Sewerage Infrastructure

5.7.1 During construction, the drainage approach for Temporary Construction Area (**Work No. 8**) would allow for a filter drain system to be installed to collect surface water run-off along the perimeter. The run-off would then be taken to an oil interceptor, silt buster or similar to treat run-off to an acceptable quality level.

5.7.2 The ground within Temporary Construction Area (**Work No. 9**) will be covered with breathable heavy duty ground mat protection to prevent any undue environmental impact. This will allow the Temporary Construction Area to continue to drain at current greenfield runoff rates.

5.7.3 Temporary sewerage connections to the temporary contractor offices located within **Work Nos. 5, 7** and **8** will be required during construction of the Project.

5.7.4 The sewerage at the Terminal and at the jetty access road security building will be removed via road tanker and no new sewerage connections are envisaged.

5.7.5 The Proposed Development will require the following new sewer connections:

a. A new domestic sewer connection which will connect from the West Site into the domestic sewer beneath Kings Road.

b. A new trade effluent connection which will connect from the West Site into the trade effluent sewer beneath Queens Road.

c. A new domestic sewer connection which will connect from the south side of the East Site into the existing domestic sewer located beneath the access road to the water treatment works abutting the East Site.

5.7.6 Discussions are ongoing with Anglian Water regarding the provision of the required potable and non-potable water and receipt of domestic sewerage and trade effluent water. The impact of the Project on sewer and sewerage infrastructure flood risk is considered low and no mitigation is required.

5.8 Impact on Flooding from Artificial Sources

5.8.1 There are no canal systems in close proximity of the Project. Therefore, the impact of the Project on flood risk from canals is considered to be low and no mitigation is required.

5.8.2 The Project would not involve any works that would impact flooding from reservoirs, therefore the impact of the Project on flood risk from reservoirs is considered to be low and no mitigation is required.

5.9 Impact on Flood Risk Management Infrastructure

5.9.1 Formal flood defences are located within the Site along the frontage of the landside Site to the Humber Estuary. The following works for the jetty access road and piperack, in proximity to the flood defences is proposed:

a. Appropriate topside infrastructure installed on the jetty to load and unload vessels including marine loading arms, gangway, piping, maintenance access roadways and access ramps, wastewater collection and drainage and supporting utilities for handling liquid bulk shipments. The pipework would run along the jetty, over the existing seawall, to a connection point with the landside pipework.

b. flood defences along the landside frontage, beneath and in close proximity to the jetty access road crossing will be replaced by a new section of flood defence wall with an increased crest height of 7.0m AOD during the construction phase of the Project. Construction would be undertaken in such a way in such a way that flood protection would be maintained throughout the works.

c. Infrastructure to enable the Environment Agency ongoing access to the sea wall for flood defence monitoring and maintenance activities.

5.9.2 An illustrative layout of the pipe-rack and jetty access road are illustrated in **Figure 2.5 [TR030008/APP/6.3].**

5.9.3 The construction of the jetty access road and piperack will be undertaken in such a way that would not compromise the structural integrity of the flood defences. See **Section 6.9** for further information.

5.10 Summary of Flood Risks to the Site

5.10.1 **Table 18** below provides a summary of impacts of the Project on flood risk and outlines appropriate mitigation measures, where required.

Table 18: Summary of Flood Risks from the Site

Flood Risk Source	Risk of Flooding	Flood Risk Summary	Mitigation Required
Tidal	Low (High residual risk of flooding for a breach/overtopping event)	The Project is at high residual risk of flooding should a breach of the flood defences occur with the site inundated to 6m AOD for a 2115 0.1% AEP breach flood event. Given the area of the flood extent along the South Bank of the Humber, the Project will not impact floodplain storage or alter flood flow routes at these high return periods. The potential impact of the Project associated with the loss of floodplain storage and alteration of flood flow routes is considered low.	No
Fluvial	Low	With the exception of a small area of the Temporary Construction Area (**Work No. 9**) located in Flood Zone 2 (fluvial risk from North Beck Drain) the Project is located in fluvial Flood Zone 1 and will not impact floodplain storage or alteration of flood flow routes. With appropriate sizing, the proposed culverts will maintain the capacity and conveyance of the drainage channels along the jetty access road route. The impermeable surface area of the Site will increase which could affect surface water runoff generation to nearby watercourses. The drainage strategy has been designed to accommodate a 1% AEP event, plus 40% climate change allowance where flows at the outfall will be restricted to 70% of the current runoff rate. The potential impact of the Project associated with the loss of floodplain storage, alteration of flood flow routes and of addition surface water generation is considered low.	No
Surface Water	Low	The Project could lead to an increase in surface water runoff as a result of the total area of impermeable surfaces and localised topographical re-profiling on site. However, the drainage strategy is based on achieving a reduction to 70% of the existing runoff rates and has been designed to accommodate a 1% AEP event, plus 40% climate change allowance. The impact of the Project on surface water flood risk is considered low and no mitigation is required	No

Flood Risk Source	Risk of Flooding	Flood Risk Summary	Mitigation Required
Groundwater	Medium	Although the Project will comprise of below ground infrastructure, associated with the drainage system, the scale is small and considered unlikely to impact sub-surface flow regimes. However, given the observed groundwater levels beneath the East and West Sites and the potential for artesian conditions within both the Glacial Till Deposits and the underlying Chalk aquifer at the West Site, the risk from groundwater flooding is considered to be medium.	Yes
Drainage and Sewerage Infrastructure	Low	Neither the rising foul main or the sea outfall are located within the Site and will remain in-situ post development. The Site is not located in an area that is known to flood from sewer networks.	No
Artificial Sources	Low	There are no artificial sources of flood risk, such as reservoirs or canals in close proximity to the Site. It is therefore considered that these sources pose very low flood risk to the Site.	No
Flood Risk Management Infrastructure	Low	Construction works will be undertaken in such a way that the integrity of the flood defences is not compromised.	Yes

6 Mitigation of Future and Residual Flood Risks and Off-Site Impacts

6.1 Introduction

6.1.1 Consideration should be given to measures that protect the Project 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.

6.1.2 A requirement of the draft DCO requires compliance with the FRA. This section of the assessment outlines mitigation measures to be complied with for the purposes of that requirement and in order for the Project to remain safe, should a flood event occur.

6.2 Site Operation and Shutdown

6.2.1 It is anticipated that the Site would operate 24 hours a day, seven days a week and 365 days a year with hydrogen product being distributed by road tankers from the West Site. In the event of a severe flood event (due to overtopping or breach of the flood defences or should a storm surge occur) the extent of flooding along the South Humber Bank is such that road transport connections would be inoperable. In addition, ammonia loading into the Site would not be possible due to sea conditions, therefore the Site would be unable to operate during a flood event.

6.2.2 In the event of extreme weather and a flood warning being in place the Applicant's approach will be to shut the facility down, make equipment safe and relocate road tankers present on the Site elsewhere. This would be undertaken on a precautionary basis once a flood warning is received, in advance of anticipated cases of extreme weather and continue for the duration of the flood warning being in place. The Project can be remotely shut down safely without operator intervention if needed. The Project would also shut down automatically in the event of power trip or instrument failure. Site operation under three different flood risk scenarios is presented in **Annex 2**.

6.2.3 This section therefore provides recommendations in accordance with the guidance provided in the NPPF (Ref 1-2), SFRA (Ref 1-11) and by the Environment Agency on how the Applicant can design their development to withstand predicted tidal flood levels and mitigate the impact. The following mitigation measures were considered to protect the Project within the Site in accordance with the legislative and regulatory authority requirements:

a. Flood resistance and resilience measures.
b. Flood warnings and alerts.
c. Emergency access and egress.
d. Place of Safe Refuge.

e. Flood emergency response plans.

f. Design capacity exceedance.

6.3 Flood Resistance and Resilience Measures

6.3.1 The following flood resilience and resistance mitigation measures will be included in the design of the Project to increase flood resilience, noting the site will be operationally shut down during extreme weather **(Section 6.2.1** above) to ensure the safety of people:

a. Flood resistant/resilient design.

b. Raising external ground levels.

c. Elevating critical plant equipment and/or internal finished floor levels above the peak flood inundation level.

Flood Resistant and Resilient Design

6.3.2 The NELC SFRA (Ref 1-11) 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 designed internal floor levels are elevated above the modelled breach peak flood event.

6.3.3 CIRIA Report C688 'Flood Resilience and Resistance from Critical Infrastructure' (Ref 1-37) 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 an 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*".

6.3.4 The following measures will be included in the design of the Project, if technically feasible:

a. Pipelines and storage tanks designed to withstand the water pressures associated with high return period event flooding.

b. Tanks and equipment designed in such a way to ensure the infrastructure remains secure should flooding occur.

c. Pollution control considered to prevent/reduce the chance of any fuel/ material stored on site leaking.

d. Electrical supply entering the Site from height and down to required connections.

e. Protecting wiring for operation control of the Project, telephone, internet and other services by suitable insulation in the distribution ducts to prevent damage.

f. Flood proofing including the use of flood resistant building materials, use of water-resistant coatings, use of galvanised and stainless steel fittings and raising electrical sockets and switches.

g. 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.

h. Incorporating water resistant services within the buildings, i.e. avoid services using ferrous materials.

i. Provide access to all spaces to permit drying and cleaning.

j. Carefully consider the usage and layout of ground floor areas to minimise the potential impact on business operations following a flood.

k. All buried structures designed to resist buoyant uplift and suitable waterproofing measures to development located below ground i.e. tanking below ground storage areas etc.

l. Boundary walls and fencing could be designed with higher water resistance materials and/or effective seals to minimise water penetration for low depth, short duration floods.

m. Site drainage design following such guidance as CIRIA C635 (Ref 1-37) to minimise the risk from exceedance flows and any overland flow entering the Project buildings.

n. Design of the Site or building curtilage to direct or divert floodwater away from buildings.

Raising External Ground Levels

6.3.5 As part of the Drainage Strategy design (refer to **Appendix 18.B: Drainage Strategy ([TR030008/APP/6.4]**) ground levels within the East Site will be raised by 0.3m and 0.6m, respectively, giving finished ground levels of 3.8 mAOD and 3.5 mAOD. In addition, the West Site will be raised by approximately 0.5m, giving a final ground level of 2.5 mAOD.

6.3.6 Given the extensive nature of flooding should an overtopping or a breach of the flood defences occur. It is unlikely, given the extent and depth of flooding along the South Humber Bank should a breach occur (with a water level of 6m AOD for a 0.1% AEP breach event in 2115 at the Site), that the Project will increase the risk of flooding off-site to adjacent land users as these areas are likely to be flooded to the same depth as the Site.

6.3.7 As this is also a residual risk of flooding, no flood volume compensation will be required for the building footprints etc beneath this water level in accordance with the NPPF/PPG.

Advisory Levels for Critical Equipment

6.3.8 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 defined by Environment Agency North Area Modelling to be approximately 6m AOD. This estimation is based on the worst-case scenario of a breach occurring in the immediate vicinity of the Site.

6.3.9 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.

6.3.10 It is the intention of the Applicant to shut down the operation of the facility should extreme weather be forecasted and a flood warning is put in place. However, the following pieces of critical equipment, associated with ammonia storage, have been identified:

a. Boil off gas and flare system.

b. Control systems and electrical switch gear.

c. Pressure relief system.

d. Pressure control feedback and liquid level control (alarm and trip).

6.3.11 It is proposed that the boil off gas and flare system associated with the ammonia storage tank will be constructed in such a way that it remains above the breach flood water level or will be protected from flooding whilst the control and pressure relief systems, electrical switch gear, and alarm and trips for the pressure control feedback and liquid level control will be located at height above the maximum flood level, where associated with the ammonia tank storage area.

6.3.12 Recovery from a flood event would require full cleaning and removal of debris, appropriate mechanical inspections and a full restoration of utilities. At this point the normal plant start up process for the facility would be employed as documented in the Applicant's site procedures.

6.4 Flood Warnings and Alerts

6.4.1 The Environment Agency operates a Flood Warning Service for many areas at high risk of tidal and fluvial flooding. The service currently consists of three stages:

a. **Flood Alert** – flooding is possible and that you need to be prepared.

b. **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.

c. **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.

6.4.2 Designated Environment Agency Flood Alert codes are assigned to areas along the South Humber Bank at risk of flooding from tidal and fluvial sources. Each code gives an indication of the expected level of danger. Flood Alerts are predominantly targeted towards professional partners, alerting them to expected flooding of low-lying land and roads.

6.4.3 All stages of warning are disseminated via the 'Floodline Warning 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 0345 988 1188, and it is always kept up to date with the Environment Agency's latest flooding information.

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

6.4.5 Tidal flood warnings are issued based on forecast information, and therefore the lead time provided is longer. The Environment Agency aim to issue fluvial and tidal Flood Warnings a minimum of six hours in advance but depending on confidence in the forecast they could be issued 24 or even 36 hours in advance, providing sufficient time to close down operations and evacuate the Site.

6.4.6 For any proposed commercial or industrial developments within a designated floodplain (as in the case of the Project), 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 from egress) prior to inundation. They should also enable sufficient time to allow the shutting down of the operation and implement protection measures for any equipment on site through sealing all external doors to prevent flood inflow into such buildings as a precaution. All procedures would be detailed in the Site's emergency plan (see **Section 6.7**).

6.4.7 The Site is located within a designated Environment Agency Flood Alert Area covering tidal flooding of areas near the South Humber Bank and within designated EA Flood Warning Areas ("FWA") covering the wider area at risk of tidal flooding. Due to the 24 hour a day nature of the operations at the Site, the Site will be registered with the Flood Warnings Direct Service and monitoring of the warnings will be adopted at the Site to mitigate the residual risk of tidal/fluvial flooding in the event of a defence failure in the vicinity.

6.5 Emergency Access and Egress to/ from Site

6.5.1 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.

6.5.2 For developments located in areas at flood risk the Environment Agency consider 'safe' access and egress to be in accordance with the PPG (Ref 1-3), and FRA Guidance for new Developments FD2320 (Ref 1-39), where the requirements for safe access and egress from developments are as follows in order of preference:

a. Safe, dry route for people and vehicles.

b. Safe, dry route for people.

c. 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.

d. 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.

6.5.3 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 Environment Agency's breach modelling has illustrated that the Site and immediate surrounding area is located in a "Danger to All'' hazard area during the event of a breach.

6.5.4 The Applicant proposes to shut down the operation and evacuate the Site upon receipt of a flood warning. However, should the evacuation of the Site be deemed to be unsafe, occupants will be directed to the designated place of safe refuge provided on Site.

6.6 Place of Safe Refuge

6.6.1 Places of safe refuge are generally considered to be 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.

6.6.2 In the event of a flood warning being in place it is proposed to shut down the whole Hydrogen Production Facility until such time the flood warning is not in effect. It is currently proposed that the control room buildings within the West Site (**Work No. 7**) and East Site (**Work No. 5**) will be designated as an area of safe refuge. An additional refuge area is provided within the Toxic Safe Haven building located within the West Site (**Work No. 7**), close to Queens Road. The East Site (**Work No.3**) is normally an un-manned site. The areas, to be designated within the Emergency Plan, will provide a safe and secure space with adequate facilities to provide a place of safe refuge for the small number of 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 Environment Agency's modelled 0.1% AEP (1 in 1000 chance) event defence breach maximum flood level, defined by the Environment Agency North Area Tidal Modelling to be approximately 6m AOD.

6.7 Flood Warning and Emergency Plan

6.7.1 Once operational, the Site will operate and be manned 24 hours, seven 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 and the Project in the event of a defence failure.

6.7.2 A Flood Emergency Response Plan will 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.

6.7.3 The Flood Emergency Response Plan will be prepared in consultation with the Environment Agency and LLFA. This will define access and egress routes from the Site and will ensure that the Project is registered to receive flood warnings from the Environment Agency'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.

6.7.4 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 place of safe 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.

6.7.5 The Applicant proposes to shut down the operation of the Site during periods of extreme weather when flood warnings are in place and shut down procedures will be detailed in the Flood Emergency Response Plan. The plan will be regularly reviewed and at that time assessment of any changes needed in line with changes in policy and guidance will be undertaken. Site induction procedures will be implemented and flooding scenarios will be regularly used in the annual test.

6.8 Drainage System Failure, Capacity Exceedance and Maintenance

6.8.1 Following completion, 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.

6.8.2 In order to reduce risks, maintenance of the drainage system will be incorporated in general site management and will remain the responsibility of the Applicant. 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 operator 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 (Ref 1-40).

6.8.3 CIRIA C635 (Ref 1-38) 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.

6.9 Continuity of the Tidal Flood Defences

6.9.1 The Environment Agency require assurance that the integrity of any existing flood defence on site, whether maintained by the Environment Agency or other parties, would be maintained at all times during the construction of new jetty access road and piperack and over the duration of the operational lifetime of the development.

6.9.2 The approach ramp which connects the landside to the jetty approach will bridge over the existing tidal flood defences. The current design solution will maintain pedestrian access along the bridleway and ensures a clearance of 1.99m to the underside of the jetty. To futureproof the tidal flood defence below the jetty, this section of the flood defence will be replaced with a new section of flood defence wall with an increased crest height of 7.0 mAOD prior to the jetty spans being installed. This may require that a secondary containment will be required for the duration of the wall replacement.

6.9.3 The jetty ramp will include a turnout ramp which will provide vehicle access to the northern side of the tidal flood defence allowing Environment Agency access for the inspection and maintenance of the defences.

6.9.4 During the construction period piling will be located a sufficient distance away from the flood defence and designed so that the defence is not adversely affected.

6.9.5 There is one pile proposed through the embankment at the rear of the flood defences. The following surveys and monitoring would be undertaken:

a. A pre, post and a year post construction topographical survey of the defence at monitoring points (cross sections).

b. A pre, post and a year post construction photographic survey of the defence (landward, crest, wall and seaward face).

c. During construction monitoring and notification procedures for structural movement.

6.9.6 Any structural movement or damage to the embankment will be rectified and the Environment Agency notified.

6.9.7 On the landward side, temporary works and contingency measures will be put in place, as necessary, for the construction of the proposed the ramps and new section of flood defence to ensure the continuity of the flood defence throughout the works. The contractor will be required to provide a contingency plan for deployable or temporary flood defence works methods, approved by the Environment Agency, prior to the commencement of the works, or through structuring the works in such a way that the existing defence wall can remain in-situ until the new structure is completed. In accordance with requirement 13 in Schedule 2 of the **draft DCO [TR030008/APP/2.1]**, the authorised project outside of the UK marine area must be carried out and operated in accordance

with the approved flood risk assessment, unless otherwise approved by the relevant planning authority.

6.9.8 Further information will be provided and consultation with the Environment Agency undertaken when the design and construction method are finalised. In addition to the above, mitigation measures will include a combination of detailed weather forecasting with construction works only undertaken at low tide.

6.9.9 The flood defences and any future works to the defences will not be impacted as a result of the Project. Sufficient clearance between the flood defences and the jetty access road and piperack will be incorporated to enable machinery to access the flood defences for inspection/maintenance purposes.

6.9.10 The Applicant is in discussion with the Environment Agency about disapplication of the Flood Risk Activity Permits required within the DCO (see **draft DCO [TR0300008/APP/2.1]**).

6.10 Stallingborough North Beck Drain

6.10.1 The Environment Agency require an 8m clear strip from the landward toe of the fluvial defence along the watercourse to allow for maintenance and access. Any compound or storage area located within the Temporary Construction Area (Work No.9) would therefore be located further than 8m from the landward toe.

6.11 Habrough Marsh Drain

6.11.1 The Project includes new infrastructure to the intertidal area along the frontage of the Habrough Marsh Drain outfall (a creek that passes across the intertidal area to the estuary).

6.11.2 As noted in Section 5.2, during construction and operation of the Project it is considered that there would not be any notable impact on local flows across the adjacent intertidal area and, by association, no likely impact on local accretion or erosion processes.

6.11.3 Across the wider study area, including the rest of the intertidal area along the Immingham frontage and the Habrough Marsh Drain, the Project marine facilities have no impact on the existing (baseline) accretion and erosion rates over the operation phase of the development.

6.11.4 Given that the rates of accretion along the foreshore are unlikely to change it is unlikely that there will be an impact on the Habrough Marsh Drain in terms of increased siltation reducing the discharge at the outfall of the watercourse.

6.12 Culverting of Land Drainage Ditches

6.12.1 Where the jetty access road has been identified to cross land drainage ditches, culverts are proposed along the route of the jetty access road and piperack. The access road is likely to require three new culverted crossings at the following locations:

a. The highway connection to Laporte Road.

b. Access road entrance to cleared longstrip.

c. At the jetty ramp.

6.12.2 The design philosophy to size the new culverts is to match or exceed the existing cross section of the relevant land drain. Culvert design has yet to be completed, however it is anticipated that these will be pre-cast open bottom structures. The final design of the culverts will be confirmed at detailed design stage and need to ensure the flows up and downstream are not adversely affected.

6.12.3 The Applicant is in discussion with the NELIDB about disapplication of the land drainage consent provisions within the DCO (see **draft DCO [TR0300008/APP/2.1]**).

6.12.4 The assessment to confirm the culvert sizes should include the following:

a. Cross-section of the upstream and downstream extent of the channel and culvert.

b. Flow calculations to confirm that the capacity is sufficient up to and including the 1% AEP plus climate change event.

c. Where flow calculations indicate an issue, the culvert design must be reconfigured to ensure there is no detriment to flows and flood risk nor prevents maintenance of the adjacent open watercourse.

d. Production of final dimensions of culverts.

6.12.5 Construction of the culverts will require temporary bunding and a pumping system to 'over pump' downstream of the construction area. Once a dry, safe working environment has been established, the precast units will be installed to form the culvert. Upon completion of the works the bunding structure and pumping system will be removed.

6.12.6 The section of the land drainage ditch along the piperack location will be restored (the current concrete liner has deteriorated) and vegetation along the land drain growing within the channel will be removed. The watercourse will be overlaid with metal meshing/gridding to allow access to the piperack along the route of the watercourse whilst retaining the open nature of the watercourse. ABP, as riparian owners will be responsible for the maintenance of the watercourse post development.

6.12.7 The design of the culverts and proposals for the works to the land drain will be undertaken in consultation with the NELIBD.

7 Conclusions

7.1.1 This FRA has been completed in accordance with the NPSfP (Ref 1-4), the NPPF (Ref 1-2) and associated PPG (Ref 1-3) and in line with local policy and stakeholder requirements.

7.2 Summary of Flood Risk

a. The FRA has considered all potential sources of flooding both to and from the Project, including tidal, fluvial, groundwater, land drainage, overland flow, artificial sources, and sewer drainage arrangements. Climate change has also been considered, which is expected to increase the peak rainfall intensity by up to 40%, increase peak river flows by up to 12% and increase sea levels by up to 0.97m over the next 100 years.

b. The Environment Agency FMfP (Ref 1-1) shows the Site is located in Flood Zone 3 (not taking into account the presence of flood defences), therefore without the presence of flood defences the Site would be at high risk of tidal flooding from the Humber Estuary.

c. There are tidal flood defences located along the south bank of the Humber Estuary. Tidal flood defences adjacent to the Site provide a standard of protection up to and including the 0.5% AEP event (based on the Still Water Level, not taking into account tidal surges or wave height) therefore the actual risk of flooding from tidal sources is considered low.

d. The North East Lincolnshire SFRA (Ref 1-11) indicates that the principal residual risks in the Immingham area would be a failure or overtopping of the flood defences. Hazard, depth and velocity mapping indicates that should the flood defences fail the Site would be flooded in under 15 minutes. The depth of flooding across the Site during a 2115 0.5% AEP and 0.1% AEP breach flood event is 5.9m AOD and 6.0m AOD respectively.

e. Hazard, depth and velocity mapping indicates the Project is located in an area with a hazard classification of ‘Danger to All’ across the entire Site for a 0.1% AEP overtopping flood event, representative of water that is both deep and fast flowing.

f. A review of the NPSfP (Ref 1-4) suggests the marine side development (the NSIP) is considered as port related ‘Water Compatible Development’. In accordance with the PPG, ‘Water Compatible’ development is permitted in Flood Zone 3. Under the NPPF (Ref 1-2) and associated PPG (Ref 1-3) the landside development (Associated Development) is defined as ‘Essential Infrastructure’. Essential Infrastructure located in Flood Zone 3 must pass both the Sequential and Exceptions Test.

g. The risk of flooding from fluvial sources to and from the Project from both Main River and Ordinary Watercourses is considered to be low over the lifetime of the development (75 years). There remains, however, a residual risk of fluvial flooding from Ordinary Watercourses under tidelocking scenarios when high sea levels prevent discharge from the watercourses for short durations.

h. Based on the conclusions in **Chapter 16: Physical Processes [TR030008/APP/6.2],** the marine element of the Project will have a negligible impact on water levels, flow speed, flood direction, erosion and accretion patterns or wave propagation.

i. Given the observed groundwater levels across the East and West Sites and the potential for artesian conditions the risk to the Site from groundwater sources is considered to be medium. Mitigation is required for the proposed drainage network and Laporte Road Culvert, such as dry proofing and considerations for the prevention of water ingress and upward hydraulic pressure. Monitoring of groundwater is also recommended during both the construction phase and post development.

j. The risk of flooding to the Site from drainage and sewerage infrastructure, canals and reservoirs are considered low.

k. The impact of the Site from all sources e.g. fluvial, surface water, groundwater, canals, reservoirs, sewer and water supply infrastructure are considered to be low.

l. A Drainage Strategy is provided as **Appendix 18.B [TR030008/APP/6.4]** detailing how surface water runoff will be managed on-site post development. The strategy includes details on surface water attenuation, consideration of climate change and proposed restricted surface water run-off rates.

m. In the event of extreme weather and a flood warning being in place the Applicant's approach will be to shut the facility down, make equipment safe and relocate road tankers elsewhere. This would be undertaken on a precautionary basis several days in advance of extreme weather and continue for the duration of the flood warning being in place.

n. The Site will receive the Environment Agency's Flood Warning Service and sufficient warning of a flood event will allow closure and evacuation of the Site to occur. A Flood and Emergency Response Plan will be provided for the Project and should a full evacuation of the Site not be possible, an area of safe refuge will be allocated, located above the 0.1% AEP breach flood water level (a water level of approximately 6.0 mAOD).

o. Critical infrastructure has been identified and these items will be elevated above the estimated peak flood level.

p. Flood resilience and resistance measures for managing the residual flood risk to the Project will be adopted.

q. Sufficient clearance between the flood defences and the jetty approach road and piperack will be provided to allow the flood defences to be raised during the construction period in line with climate change and an access ramp provided to enable the Environment Agency to access the flood defences for inspection/maintenance purposes. Construction works will be undertaken in such a way as to not compromise the integrity of the flood defences. .

r. Proposed culverting of sections of land drains to allow access along the jetty access road and piperack corridor will be sized appropriately to prevent changes in channel capacity and conveyance.

s. It is considered that there will be no off-site impacts as a result of the Project in relation to flood risk.

7.3 Conclusion

7.3.1 This study has demonstrated that it will be possible to manage flood risks to and from the Project in compliance with the NPSfP (Ref 1-4), NPPF (Ref 1-2) and accompanying PPG (Ref 1-3).

8 References

Ref 1-1 Environment Agency (2022) Flood Maps for Planning

Ref 1-2 UK Government Policy Paper (2022). National Planning Policy Framework (2022)

Ref 1-3 Department for Levelling Up, Housing & Communities (2022) National Planning Practice Guidance. Flood Risk and Coastal Change

Ref 1-4 Department for Transport (2012). National Policy Statement for Ports.

Ref 1-5 Natural England (2020). Multi-Agency Geographic Information for the Countryside (MAGIC) Interactive Map. Available at: https:// magic.defra.gov.uk/

Ref 1-6 British Geological Society (2022) BGS Geology Viewer - British Geological Survey

Ref 1-7 Cranfield Environment Centre (2022) Soilscapes Soilscapes soil types viewer - Cranfield Environment Centre. Cranfield University (landis.org.uk)

Ref 1-8 Environment Agency (2022) Groundwater Maps.

Ref 1-9 North East Lincolnshire Council (2011). North East Lincolnshire Preliminary Flood Risk Assessment.

Ref 1-10 North Lincolnshire and North East Lincolnshire Councils (2011). North and North East Lincolnshire Strategic Flood Risk Assessment.

Ref 1-11 North Lincolnshire and North East Lincolnshire Council (2022). Strategic Flood Risk Assessment 2022

Ref 1-12 North East Lincolnshire Council (2015). North East Lincolnshire Local Flood Risk Management Strategy

Ref 1-13 DEFRA (2022) Data Services Platform. Available online at: ttps://environment.data.gov.uk

Ref 1-14 Environment Agency (2022) Long-term Information Service Check the long term flood risk for an area in England

Ref 1-15 Environment Agency (2009). Grimsby and Ancholme Catchment Flood Management Plan

Ref 1-16 Environment Agency (2008) Humber Flood Risk Management Strategy

Ref 1-17 Various Authors including Lead Authority East Riding of Yorkshire Council, (2011). Flamborough Head to Gibraltar Point Shoreline Management Plan.

Ref 1-18 Environment Agency (2022) Draft Humber FRMP 2021-27.

Ref 1-19 H M Government (2008) The Planning Act 2008.

Ref 1-20 North East Lincolnshire Council (2013) Flood Risk Sequential and Exception Tests' Guidance Note.

Ref 1-21 North East Lincolnshire Council (2018) NELC Local Plan Development Plan.

Ref 1-22 Environment Agency (2022). Flood Risk Assessments: climate change allowances.

Ref 1-23 Met Office (2018) UK Climate Projections (UKCP).

Ref 1-24 HM Government (2011). UK Marine Policy Statement.

Ref 1-25 Department for Environment, Food and Rural Affairs (2014). East Inshore and East Offshore Marine Plans.

Ref 1-26 DEFRA 2015. Non-statutory Technical Standards for Sustainable Drainage Systems (SuDS) (2015).

Ref 1-27 National Flood and Coastal Erosion Risk Management Strategy for England.

Ref 1-28 Environment Agency (2022) Humber Basin Flood Risk Management Plan.

Ref 1-29 Environment Agency (2022) The Humber Strategy (Humber 2100+).

Ref 1-30 Anglian Water. (2021). Anglian Water's Surface Water Drainage Policy (Draft).

Ref 1-31 Environment Agency (2007) Improving Flood Performance of New Buildings - Flood Resilient Construction'.

Ref 1-32 The Stationary Office Limited (2016). Environmental Permitting (England and Wales) Regulations 2016.

Ref 1-33 North East Lindsey IDB (2021) North East Lindsey Drainage Board Bylaws.

Ref 1-34 HM Government 1991. Land Drainage Act (1991).

Ref 1-35 University of Dundee (2022) Chronology of British Hydrological Events website.

Ref 1-36 Canals and River Trust (2023) Canal and River Network Mapping. Available at: Canal Map UK | UK Canal Network | Canal & River Trust (canalrivertrust.org.uk).

Ref 1-37 CIRIA (2010) Flood Resilience and Resistance from Critical Infrastructure. Report C688.

Ref 1-38 CIRIA (2006) Designing for Exceedance in Urban Drainage good practice (C635).

Ref 1-39 DEFRA (2005) Flood risk assessment guidance for new development (FD2320).

Ref 1-40 CIRIA (2015) The SuDs Manual. (Ciria 753F).

Annex 1 Flood Risk Data

[redacted]

Our ref: CCN-2022-275567

Date: 24/08/2022

Dear [redacted]

Provision of Flood Risk Information for site at Immingham.

Thank you for your request for our flood risk information for the above site. The information is set out below and attached. It is important you read any contextual notes on the maps provided.

If you are preparing a Flood Risk Assessment (FRA) for this site, please note this information may not be sufficient by itself to produce an adequate FRA to demonstrate the development is safe over its lifetime. Additional information may be required to carry out an appropriate assessment of all risk, such as consequence of a breach in defences.

We aim to review our information on a regular basis, so if you are using this data more than twelve months from the date of this letter, please contact us again to check it is still valid.

1. Flood Map

The attached map includes the current Flood Map for your area. The Flood Map indicates the area at risk of flooding, **assuming no flood defences exist**, for a flood with a 0.5% chance of occurring in any year for flooding from the sea, or a 1% chance of occurring for fluvial (river) flooding. It also shows the extent of the Extreme Flood Outline which represents the extent of a flood with a 0.1% chance of occurring in any year, or the highest recorded historic extent if greater.

In some locations, such as around the fens and the large coastal floodplains, showing the area at risk of flooding assuming no defences may give a slightly misleading picture in that if there were no flood defences, water would spread out across these large floodplains. This flooding could cover large areas of land but to relatively shallow depths and could leave pockets of locally slightly higher land as isolated dry islands. It is important to understand the actual risk of the flooding to these dry islands, particularly in the event of defence failure.

The Flood Map also shows the location of formal raised flood defences and flood storage reservoirs. It represents areas at risk of flooding for present day only and does not take account of climate change.

The Flood Map only indicates the extent and likelihood of flooding from rivers or the sea. It should also be remembered flooding may occur from other sources such as surface water sewers, road drainage, etc.

2. Historic Flood Event Outlines

A copy of the Historic Flood Event Outlines Map showing the extent of previous recorded flooding in your area is attached. This only covers information we hold and it is possible recent flooding may have occurred which we are currently investigating, therefore this information may be subject to change. It is possible other flooding may have occurred which other organisations, such as the Lead Local Flood Authority (ie top tier council), Local Authority or Internal Drainage Board (where they exist), may have records.

3. Schemes in the area

There are no ongoing capital projects to reduce or sustain the current flood risk to this site.

4. Fluvial Flood Risk Information

4.1 Fluvial Defence Information

The existing fluvial defences reducing the risk of flooding from main river to this site consist of earth embankments. They are in fair condition and reduce the risk of flooding (at the defence) to a 2% (1 in 50) chance of occurring in any year. We inspect these defences routinely to ensure potential defects are identified.

4.2 Fluvial Modelled Levels and Flows

Available modelled fluvial flood levels and flows for the model nodes shown on the attached map are set out in the data table attached. This data is taken from the model named on the data table, which is the most up-to-date model currently available.

Please note these levels are “in-channel” levels and therefore may not represent the flood level on the floodplain, particularly where the channel is embanked or has raised defences.

Our models may not have the most up to date climate change allowances. In time we will update our models for the latest allowances. You should refer to 'Flood risk assessments: climate change allowances' to check if the allowances modelled are appropriate for the type of development you are proposing and its location. You may need to undertake further assessment of future flood risk using different allowances to ensure your assessment of future flood risk is based on best available evidence.

4.3 Fluvial Modelled Flood Extents

Please find attached a map showing available modelled flood extents, taking into account flood defences, for your area. This data is taken from the model named on the map, which is the most up-to-date model currently available.

In some cases the flood extents shown may not be from main river, but may be from other sources such as IDB lowland drainage networks.

4.4 Fluvial Hazard Mapping

For certain locations we have carried out modelling to map the maximum values of flood depth, velocity and hazard rating (danger to people) resulting from overtopping and / or breaching of defences at specific locations for a number of scenarios.

At present this information is available for fluvial flood risk in Northampton, Lincoln, Wainfleet and some isolated rural locations.

The number of locations we have this information for is expected to increase in time.

At present this site is not covered by any fluvial hazard mapping.

5. Tidal Flood Risk Information

5.1 Tidal Defence Information

The existing tidal defences protecting this site consist of earth embankments.

They are in good condition and reduce the risk of flooding (at the defence) to a 0.5% (1 in 200) chance of occurring in any year. We inspect these defences routinely to ensure potential defects are identified.

Refer to paragraph 3 for details of any ongoing capital projects to reduce the flood risk to this site.

5.2 Tidal Flood Levels

The attached data sheets show our current best estimate for extreme tide levels.

Please read the information notes on the data sheets.

5.3 Tidal Hazard Mapping

For certain locations we have carried out modelling to map the maximum values of flood depth, velocity and hazard rating (danger to people) resulting from overtopping and / or breaching of defences at specific locations for a number of scenarios.

At present this information is available along the full coastal / tidal floodplain, except the tidal Witham Haven in Boston (upstream of Hobhole) where only breaching and not overtopping has been modelled and the tidal River Welland upstream of Fosdyke Bridge where neither breaching nor overtopping are available.

The number of locations we have this information for is expected to increase in time.

The attached maps show the maximum values of flood depth, velocity and hazard rating (danger to people) resulting from breaching of the defences at specific locations for the scenarios below. For some locations the breach mapping also includes flooding from overtopping if this is expected in that scenario. The location of modelled tidal breaches is shown on a separate attached map.

5.3.1 Tidal Hazard Mapping - Breaches

- Year 2006 0.5% (1 in 200) chance
- Year 2006 0.1% (1 in 1000) chance
- Year 2115 0.5% (1 in 200) chance
- Year 2115 0.1% (1 in 1000) chance

5.3.2 Tidal Hazard Mapping - Overtopping

The attached maps show the maximum values of flood depth, velocity and hazard rating (danger to people) resulting from simulated overtopping of defences for the following scenarios:

- Year 2006 0.5% (1 in 200) chance
- Year 2006 0.1% (1 in 1000) chance
- Year 2115 0.5% (1 in 200) chance
- Year 2115 0.1% (1 in 1000) chance

6. Development Planning

If you would like local guidance on preparing a flood risk assessment for a planning application, please contact our Sustainable Places team at LNplanning@environment-agency.gov.uk. It will help if you mention this data request and attach your site location plan.

We provide free preliminary advice; additional/detailed advice, review of draft FRAs and meetings are chargeable at a rate set to cover our costs, currently £100 (plus VAT) per hour of staff time. Further details are available on our website at https://www.gov.uk/guidance/developers-get-environmental-advice-on-your-planning-proposals.

General advice on flood risk assessment for planning applications can be found on GOV.UK at https://www.gov.uk/guidance/flood-risk-assessment-for-planning-applications

Climate change will increase flood risk due to overtopping of defences. Please note, unless specified otherwise, the climate change data included has an allowance for 20% increase in flow. Updated guidance on how climate change could affect flood risk to new development - 'Flood risk assessments: climate change allowances' was published on GOV.UK in **July 2021**. The appropriate updated climate change allowance should be applied in a Flood Risk Assessment.

You should also consult the Strategic Flood Risk Assessment produced by your local planning authority.

7. Data Licence and Other Supporting Information

We respond to requests for recorded information we hold under the Freedom of Information Act 2000 (FOIA) and the associated Environmental Information Regulations 2004 (EIR).

This information is provided in accordance with the Open Government Licence which can be found here: http://www.nationalarchives.gov.uk/doc/open-government-licence/version/3/

Further information on flood risk can be found on the GOV.UK website at:
https://www.gov.uk/browse/environment-countryside/flooding-extreme-weather

8. Other Flood Risk Management Authorities

The information provided with this letter relates to flood risk from main river or the sea. Additional information may be available from other risk management authorities, such as the Lead Local Flood Authority (ie top tier council) or Internal Drainage Board (where they exist).

I hope we have correctly interpreted your request. If you have any queries or would like to discuss the content of this letter further please contact Emily Kent using the email address below and quoting our CCN reference number above.

Yours sincerely,

[redacted]
Flood Officer

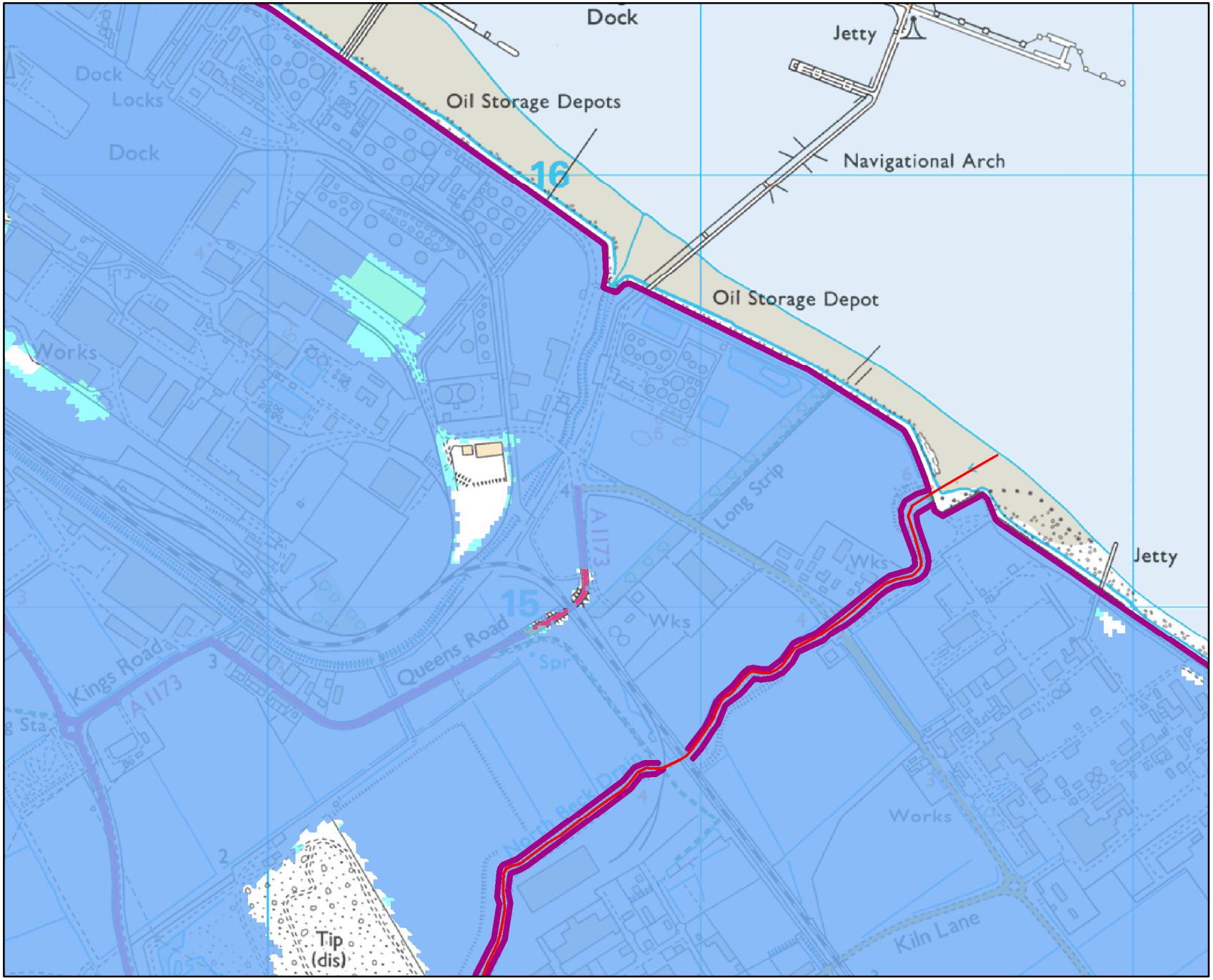
for [redacted]nd East Coast Partnerships and Strategic Overview Team Leader
e-mail PSO_Coastal@environment-agency.gov.uk

Enc.
Flood Map
Historic Flood Event Outlines Map
Modelled Node Points Map
Modelled Fluvial Levels and Flows Data Sheet
Modelled Flood Extent Maps
Tidal Level Data Sheets - Map and Tables
Tidal Breach Points – Locations Map
Hazard Mapping – Breaching
Hazard Mapping – Overtopping

Ceres House, Searby Road, Lincoln, LN2 4DW
Customer services line: 03708 506 506
Email: enquiries@environment-agency.gov.uk
www.gov.uk/environment-agency

Calls to 03 numbers cost the same as calls to standard geographic (ie numbers beginning with 01 or 02)

Flood Map centred on TA 20783 15271 - created August 2022 [Ref: CCN-2022-275567]



Environment Agency

Scale 1:12,500

N
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Legend

- Main River
- Raised Defences
- Flood Storage Area
- Areas at Risk of Flooding from Rivers or the Sea
- Extreme Flood Outline

Dark blue shows the area that could be affected by flooding, either from rivers or the sea, if there were no flood defences. This area could be flooded:

- from the sea by a flood that has a 0.5% (1 in 200) or greater chance of happening each year.

- or from a river by a flood that has a 1% (1 in 100) or greater chance of happening each year.

Light blue shows the extent of the Extreme Flood Outline, which represents the extent of a flood event with a 0.1% chance of occurring in any year, or the highest recorded historic extent if greater.

These two colours show the extent of the natural floodplain if there were no flood defences or certain other manmade structures and channel improvements. Sites outside the two extents, but behind raised defences, may be affected by flooding if the defences are overtopped or fail.

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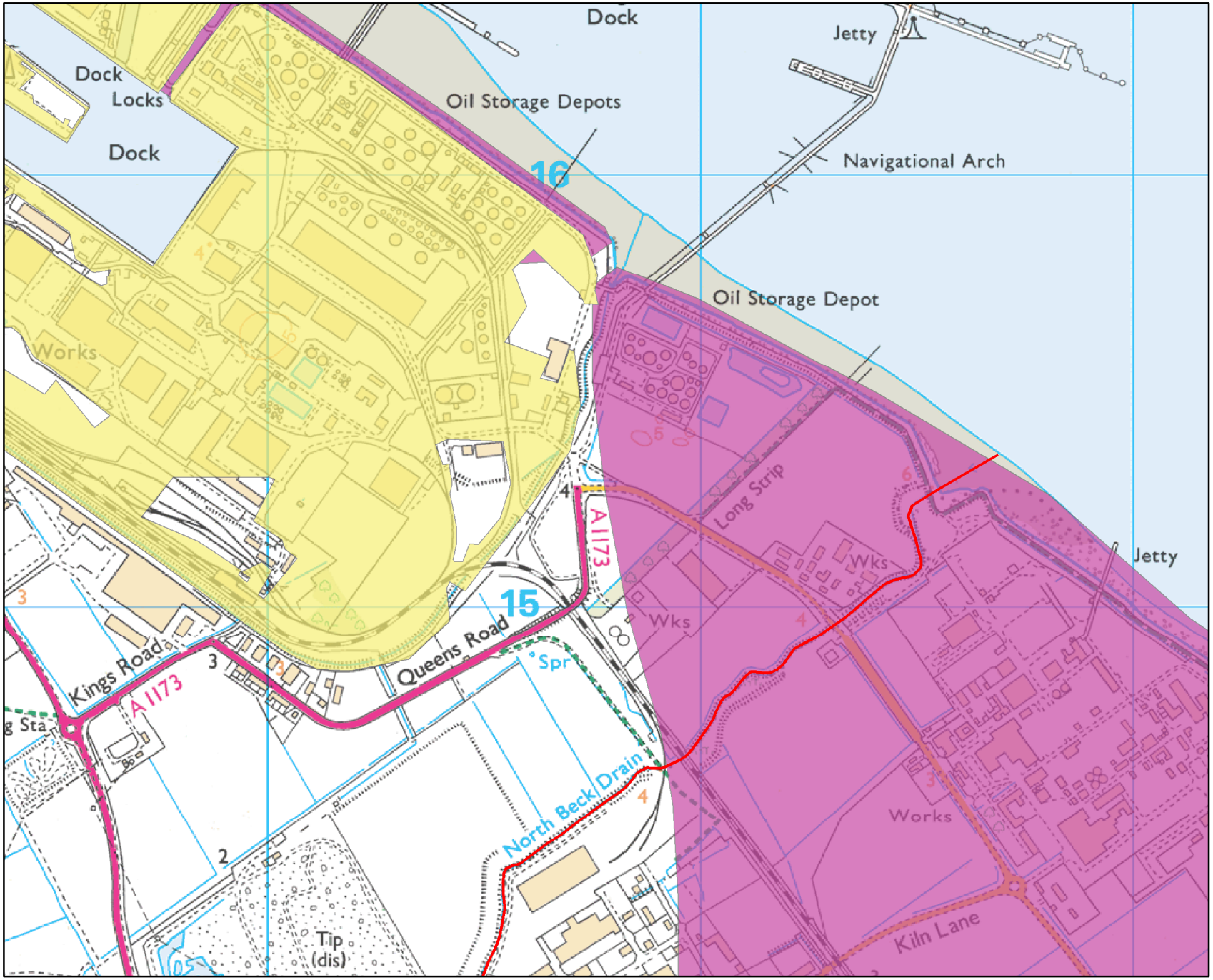
Historic Flood Extent Map centred on TA 20783 15271 - created August 2022 [Ref: CCN-2022-275567]



Environment Agency

Scale 1:12,500

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Legend

- Main River
- 1953-January_Lincolnshire Coastline
- 2013-December_Tidal Surge

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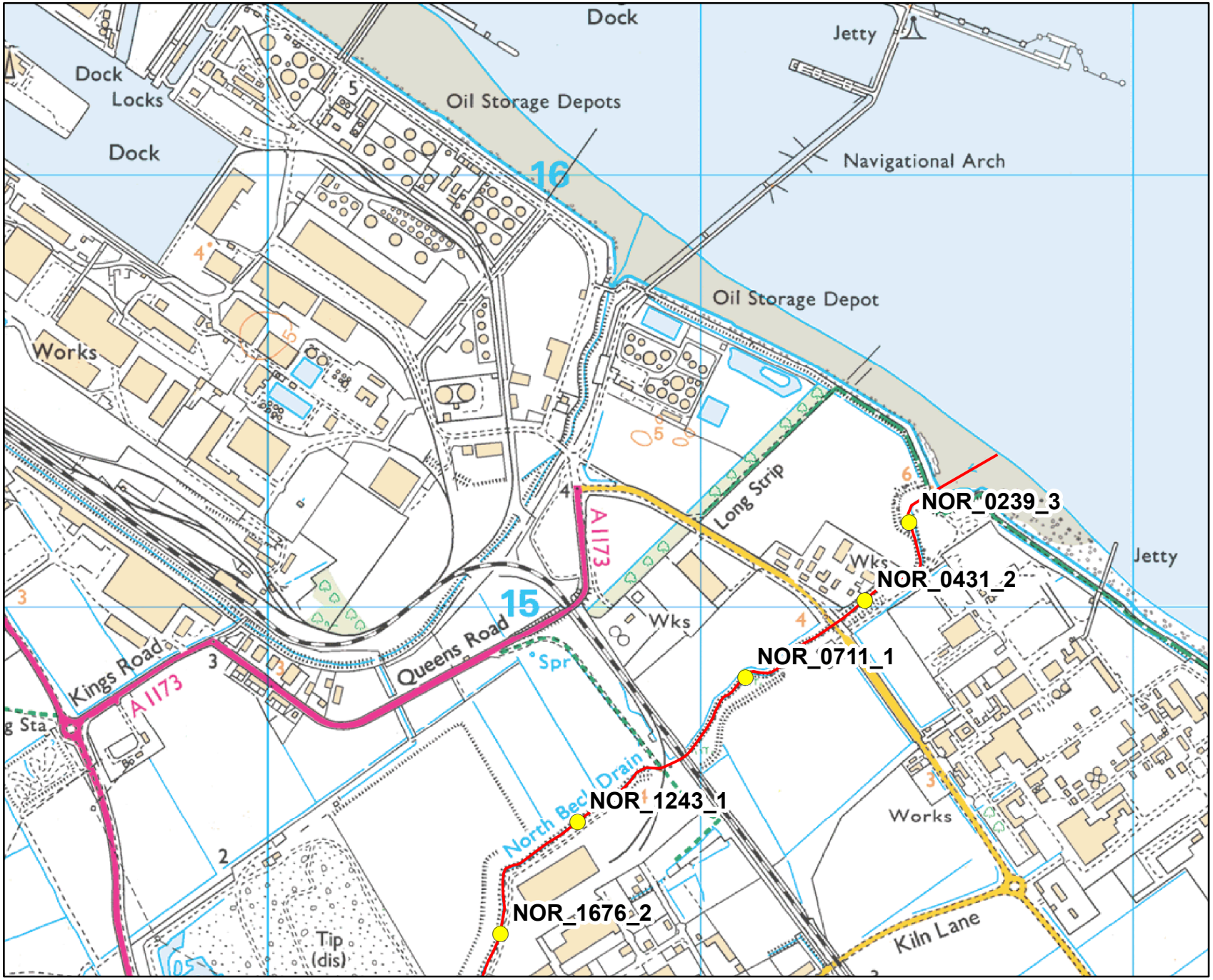
Modelled Node Point Map centred on TA 20783 15271 - created August 2022 [Ref: CCN-2022-275567]



Environment Agency

Scale 1:12,500

N
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Legend

- Level and Flow Node Point
- Main River

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Fluvial Flood Levels (mODN)

The fluvial flood levels for the model nodes shown on the attached map are set out in the table below. They are measured in metres above Ordnance Datum Newlyn (mODN).

			Annual Exceedance Probability - Maximum Water Levels (mODN)									
Node Label	Easting	Northing	50% (1 in 2)	20% (1 in 5)	10% (1 in 10)	5% (1 in 20)	4% (1 in 25)	3.33% (1 in 30)	2% (1 in 50)	1.33% (1 in 75)	1% (1 in 100)	1% (1 in 100) inc 20% Climate Change
NOR_0239_3	521484	415196	1.72	2.01	2.16	2.29	2.32	2.35	2.43	2.47	2.52	2.97
NOR_0431_2	521382	415015	1.72	2.01	2.17	2.29	2.32	2.35	2.42	2.47	2.52	2.98
NOR_0711_1	521105	414836	1.73	2.02	2.17	2.29	2.33	2.36	2.43	2.48	2.53	2.98
NOR_1243_1	520717	414503	1.73	2.03	2.18	2.30	2.34	2.37	2.46	2.51	2.54	2.99
NOR_1676_2	520538	414244	1.74	2.03	2.19	2.31	2.34	2.37	2.46	2.51	2.55	3.00

1% (1 in 100) inc 30% Climate Change	1% (1 in 100) inc 50% Climate Change	0.5% (1 in 200)	0.5% (1 in 200) inc 20% Climate Change	0.5% (1 in 200) inc 30% Climate Change	0.5% (1 in 200) inc 50% Climate Change	0.1% (1 in 1000)	0.1% (1 in 1000) inc 20% Climate Change	0.1% (1 in 1000) inc 30% Climate Change
3.07	3.23	2.60	3.08	3.17	3.34	2.17	3.73	3.82
3.08	3.23	2.60	3.08	3.17	3.34	2.17	3.73	3.81
3.08	3.24	2.61	3.08	3.17	3.35	2.17	3.74	3.81
3.09	3.25	2.62	3.09	3.19	3.36	2.18	3.76	3.83
3.10	3.26	2.63	3.10	3.19	3.37	2.20	3.78	3.85

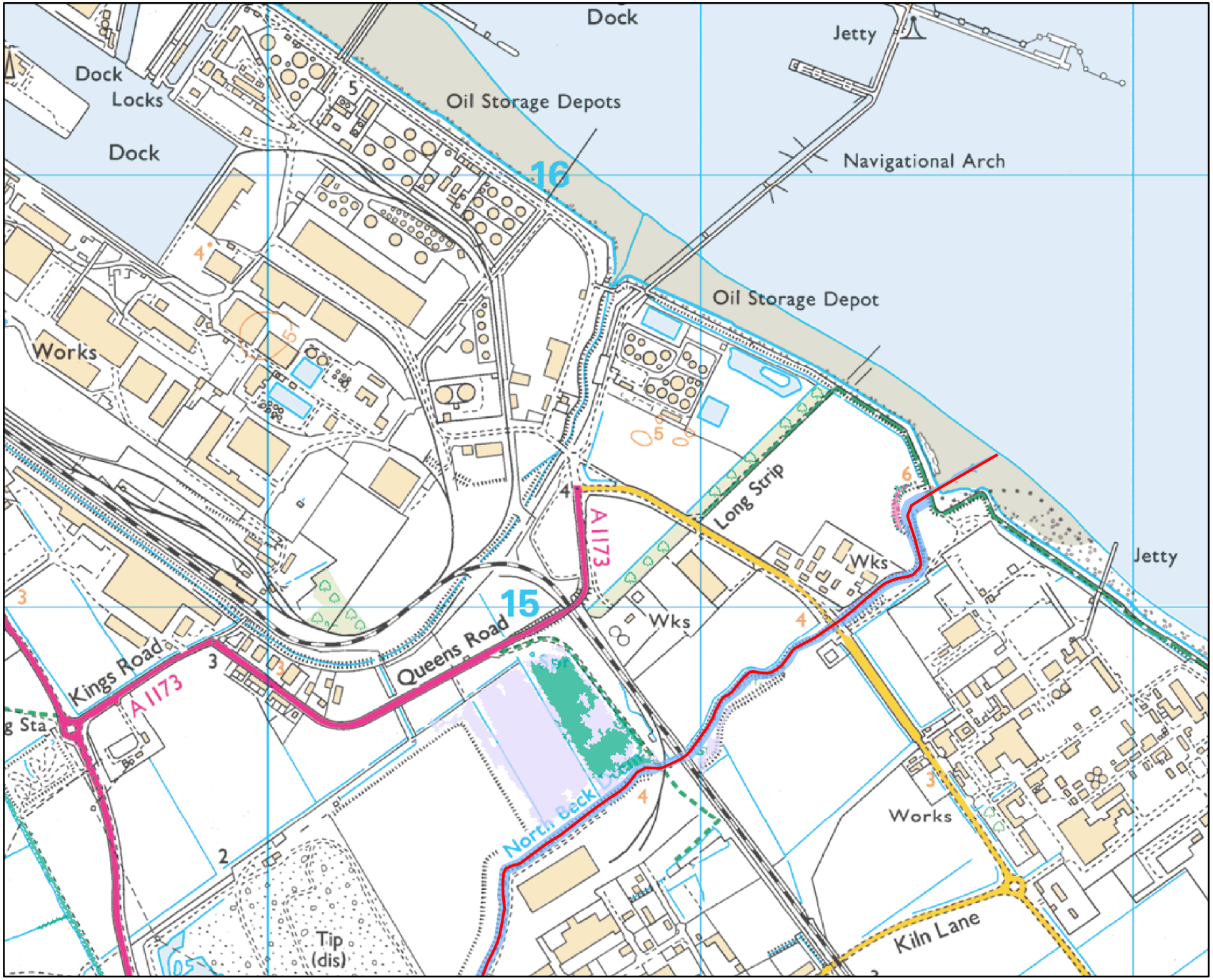
Fluvial Flood Flows (m^3/s)

The fluvial flood flows for the model nodes shown on the attached map are set out in the table below. They are measured in metres cubed per second (m^3/s).

			Annual Exceedance Probability - Maximum Flows (m^3/s)									
Node Label	**Easting**	**Northing**	**50% (1 in 2)**	**20% (1 in 5)**	**10% (1 in 10)**	**5% (1 in 20)**	**4% (1 in 25)**	**3.33% (1 in 30)**	**2% (1 in 50)**	**1.33% (1 in 75)**	**1% (1 in 100)**	**1% (1 in 100) inc 20% Climate Change**
NOR_0239_3	521484	415196	4.46	5.57	6.18	6.72	6.90	7.06	7.54	7.86	8.09	10.82
NOR_0431_2	521382	415015	3.62	4.67	5.25	5.78	5.95	6.09	6.52	6.80	7.00	9.40
NOR_0711_1	521105	414836	2.88	3.85	4.41	4.92	5.07	5.20	5.60	5.86	6.03	8.17
NOR_1243_1	520717	414503	2.11	2.96	3.47	3.94	4.08	4.20	4.55	4.78	4.93	6.75
NOR_1676_2	520538	414244	1.75	2.51	2.97	3.40	3.53	3.63	3.95	4.16	4.30	5.89

1% (1 in 100) inc 30% Climate Change	**1% (1 in 100) inc 50% Climate Change**	**0.5% (1 in 200)**	**0.5% (1 in 200) inc 20% Climate Change**	**0.5% (1 in 200) inc 30% Climate Change**	**0.5% (1 in 200) inc 50% Climate Change**	**0.1% (1 in 1000)**	**0.1% (1 in 1000) inc 20% Climate Change**	**0.1% (1 in 1000) inc 30% Climate Change**
11.37	12.30	8.58	11.40	11.92	12.95	3.32	15.61	16.07
9.92	10.78	7.45	9.94	10.42	11.42	3.36	14.20	14.70
8.65	9.49	6.45	8.68	9.14	10.11	3.44	12.95	13.52
7.22	8.03	5.30	7.24	7.70	8.63	3.57	12.21	12.72
6.32	7.08	4.63	6.34	6.77	7.64	3.61	11.51	12.00

Climate Change Modelled Flood Extents (with defences)
Model: Stallingborough & Oldfleet 2020 [CCN-2022-275567]



Environment Agency

Scale 1:12,500

N
W E
S

Legend

- Main River
- 2020_Stallingb_Oldfleet_Def_1in100_CC20pc
- 2020_Stallingb_Oldfleet_Def_1in200_CC20pc
- 2020_Stallingb_Oldfleet_Def_1in1000_CC20pc
- 2020_Stallingb_Oldfleet_Def_1in1000_CC30pc

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East Coast and Wash - 2018 Coastal Flood Boundary [CFB] Dataset
Key Node Points

Environment Agency

Scale 1:550,000

N
W E
S

▲ East Coast and Wash

See seperate data sheet for predicted flood levels

Created by the Partnerships and Strategic Overview Team, Lincoln

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East Coast and Wash: Immingham to the West Lighthouse

2018 Coastal Flood Boundary Extreme Sea Levels

CFB Ref	Location	Easting	Northing	Annual Chance (1 in x) of Tide Level in metres ODN																	
				1			10			50			100			200			300			1000		
				Confidence Bound			Confidence Bound			Confidence Bound			Confidence Bound			Confidence Bound			Confidence Bound			Confidence Bound		
				2.5%	50%	97.5%	2.5%	50%	97.5%	2.5%	50%	97.5%	2.5%	50%	97.5%	2.5%	50%	97.5%	2.5%	50%	97.5%	2.5%	50%	97.5%
3888	Immingham	520440	417625	4.16	4.17	4.19	4.50	4.53	4.62	4.73	4.80	5.00	4.83	4.93	5.19	4.93	5.06	5.41	4.98	5.14	5.55	5.15	5.38	6.01
3890	Haborough Marsh	522100	416512	4.14	4.15	4.17	4.48	4.51	4.60	4.70	4.77	4.97	4.80	4.90	5.16	4.90	5.03	5.38	4.94	5.10	5.51	5.11	5.34	5.97
3898	Grimsby	529295	413162	3.98	3.99	4.01	4.31	4.34	4.43	4.53	4.60	4.80	4.61	4.71	4.97	4.71	4.84	5.19	4.74	4.90	5.31	4.88	5.11	5.74
3906	Buck Beck	534709	407369	3.87	3.88	3.90	4.19	4.23	4.31	4.41	4.50	4.68	4.50	4.61	4.86	4.61	4.75	5.10	4.64	4.82	5.22	4.80	5.05	5.66
3910	Tetney	538035	405537	3.85	3.86	3.89	4.17	4.22	4.30	4.40	4.50	4.67	4.49	4.61	4.86	4.60	4.75	5.10	4.63	4.82	5.21	4.80	5.06	5.66
3918	Donna Nook	544641	401997	3.82	3.83	3.86	4.14	4.19	4.27	4.38	4.48	4.65	4.47	4.60	4.85	4.58	4.74	5.10	4.63	4.82	5.22	4.81	5.08	5.68
3928	Saltfleet	549131	393360	3.78	3.79	3.82	4.11	4.16	4.26	4.36	4.46	4.64	4.47	4.59	4.86	4.57	4.74	5.11	4.63	4.83	5.25	4.83	5.11	5.74
3942	Boygrift	555131	380860	3.72	3.74	3.77	4.06	4.11	4.22	4.33	4.43	4.65	4.43	4.57	4.87	4.56	4.73	5.13	4.62	4.83	5.28	4.85	5.15	5.82
3968	Gibraltar Point	557652	356181	4.16	4.17	4.20	4.51	4.56	4.67	4.76	4.85	5.08	4.85	4.97	5.27	4.94	5.10	5.49	4.99	5.18	5.63	5.14	5.41	6.09
3992_14	Hobhole	535990	340116	4.96	4.97	5.01	5.40	5.44	5.56	5.66	5.76	5.98	5.78	5.90	6.20	5.88	6.04	6.44	5.92	6.11	6.57	6.03	6.31	6.99
	Grand Sluice*	532366	344510	4.93	4.94	4.98	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3
3992_9	Boston Barrier	532754	342852	4.93	4.94	4.98	5.41	5.45	5.57	5.73	5.83	6.05	5.85	5.97	6.27	5.93	6.09	6.49	5.94	6.13	6.59	5.98	6.26	6.94
3992_5	Fosdyke Bridge	531886	332234	4.87	4.88	4.92	5.31	5.35	5.47	5.58	5.68	5.90	5.71	5.83	6.13	5.82	5.98	6.38	5.87	6.06	6.52	6.01	6.29	6.97
4008	West Lighthouse	550094	329971	4.87	4.88	4.91	5.21	5.26	5.37	5.46	5.56	5.78	5.56	5.68	5.98	5.66	5.82	6.21	5.71	5.90	6.35	5.86	6.14	6.81
-	Marsh Road	525988	324065	-	5.04	-	-	5.44	-	-	5.73	-	-	5.85	-	-	5.98	-	-	-	-	-	-	-
-	Wisbech	546110	309940	-	4.83	-	-	5.25	-	-	5.53	-	-	5.66	-	-	5.78	-	-	-	-	-	-	-
-	Dog-in-a-Doublet	527200	299287	-	3.67	-	-	4.00	-	-	4.22	-	-	4.32	-	-	4.42	-	-	-	-	-	-	-

See next page for notes

Customer services line: 03708 506 506
Calls to 03 numbers cost the same as calls to standard geographic numbers
(i.e. numbers beginning with 01 or 02)

Email: enquiries@environment-agency.gov.uk
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East Coast and Wash: Immingham to the West Lighthouse

2018 Coastal Flood Boundary Extreme Sea Levels

NOTES:

The following notes apply to all CFB sites (ie all on table excluding Marsh Road, Wisbech, Dog-in-a-Doublet)

- The base date for the data is 2017.
- The levels are still water levels. Depending on the use of the data it may be necessary to consider wave heights and / or joint probability analysis of water level and other variables.
- Levels for other annual chance probabilities are available if required.
- For additional information relating to the 2018 Coastal Flood Boundary Extreme Sea Levels or to access the full dataset for the above sites or intermediate locations refer to the Defra Metadata Catalogue at https://deframetadata.com/geonetwork/srv/eng/catalog.search#/metadata/84a5c7c0-d465-11e4-b0bd-f0def148f590

The following notes apply to all Marsh Road, Wisbech, Dog-in-a-Doublet

- The base date for the data is 2006
- The levels are still water levels. Depending on the use of the data it may be necessary to consider wave heights and / or joint probability analysis of water level and other variables.
- Levels for other annual chance probabilities are available if required.
- These levels will be updated as their respective tidal river models are updated.

The following notes apply to Grand Sluice

- The data is based on CFB 2018 data for Boston Barrier site, capped at 5.3mAOD to reflect use of the barrier.
- The base date for the data is 2017
- The levels are still water levels. Depending on the use of the data it may be necessary to consider wave heights and / or joint probability analysis of water level and other variables.
- For additional information relating to the 2018 Coastal Flood Boundary Extreme Sea Levels or to access the full dataset for the above sites or intermediate locations refer to the Defra Metadata Catalogue at https://deframetadata.com/geonetwork/srv/eng/catalog.search#/metadata/84a5c7c0-d465-11e4-b0bd-f0def148f590

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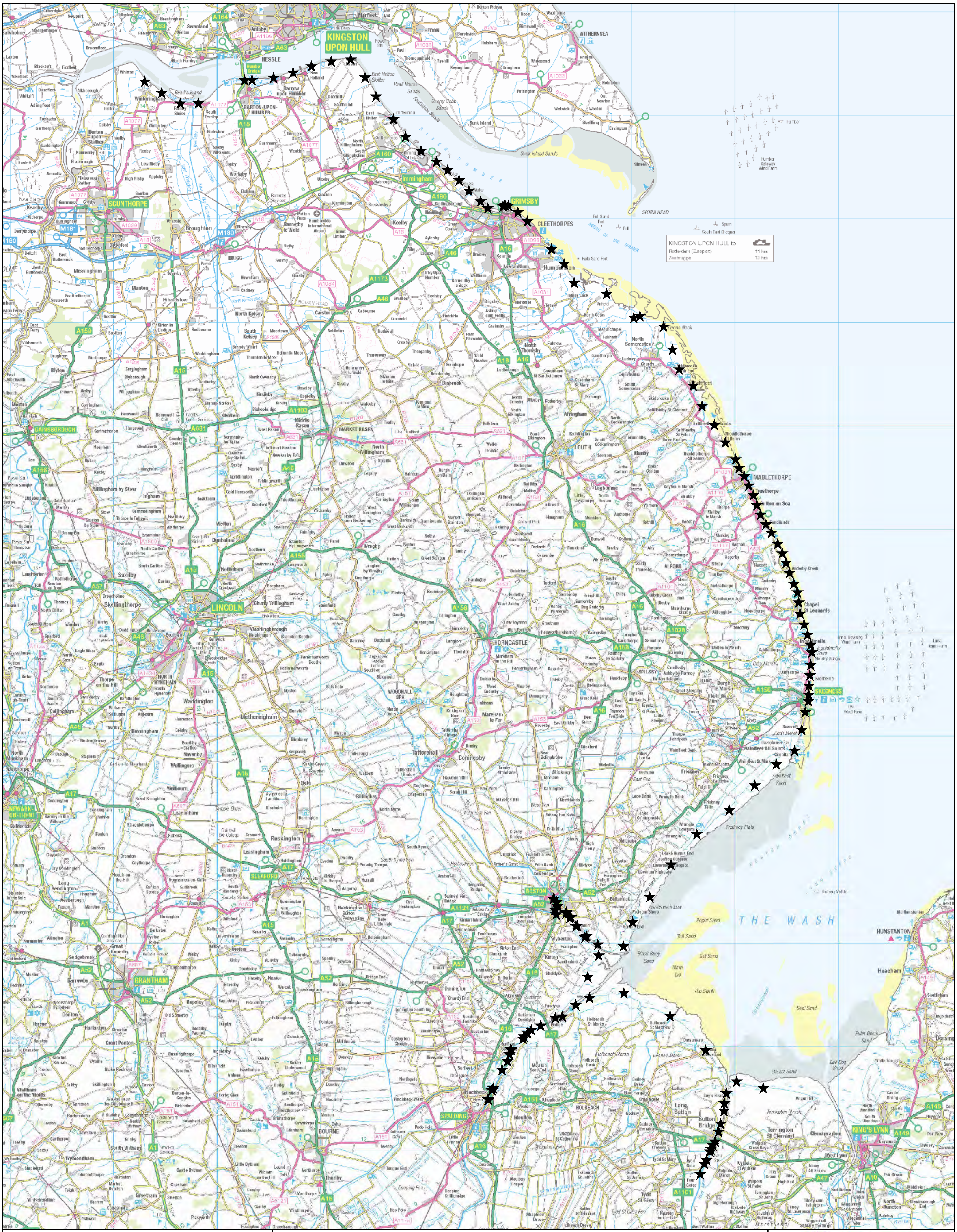

★ **Modelled Breach Locations**

0 3.5 7 14
Kilometers

This map idicates the location of where we have modelled the consequence of breaches in the defences along the coastline and tidal rivers. We have mapped the maximum values of Hazard Rating (Danger to People), Depth and Velocity.

We have not assumed that all breaches occur at the same time, but have modelled each breach individually and overlaid the results to find the maximum values.

Our modelling only considers the consequences of a breach, it does not make any assumption about the likelihood of a breach occurring. Our defences generally provide a good standard of flood defence but a risk of breaching remains.

Please contact the Environment Agency for information on how these maps are used in the management of flood risk.

General Enquiries No: 03708 506 506.
Weekday calls cost 5p plus up to 6pm from BT Weekend Unlimited. Mobile and other providers charges may vary.

Environment Agency

Produced by the Partnership and Strategic Overview Team, Lincoln
General Enquiries No: 03708 506 506

Northern Area Tidal Hazard Mapping

Location of Modelled Breaches

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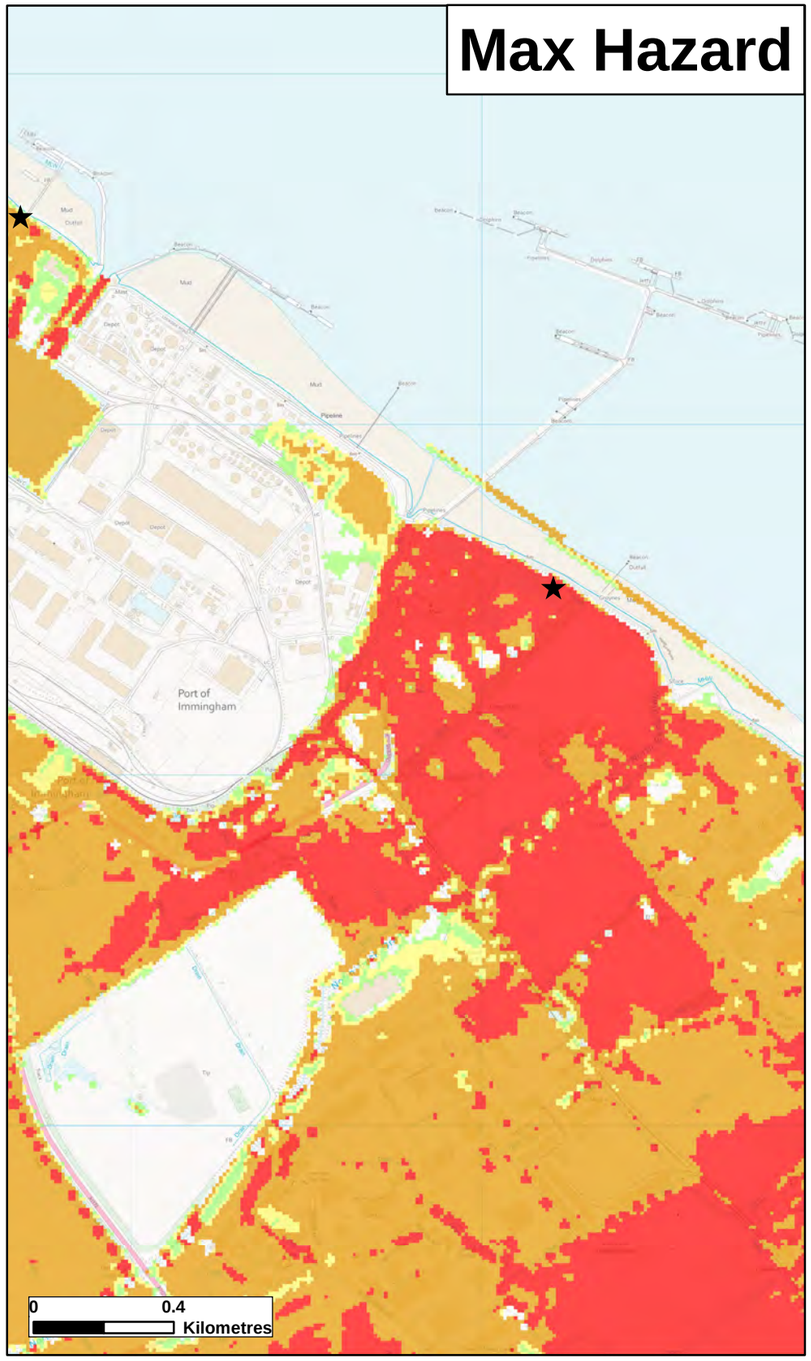
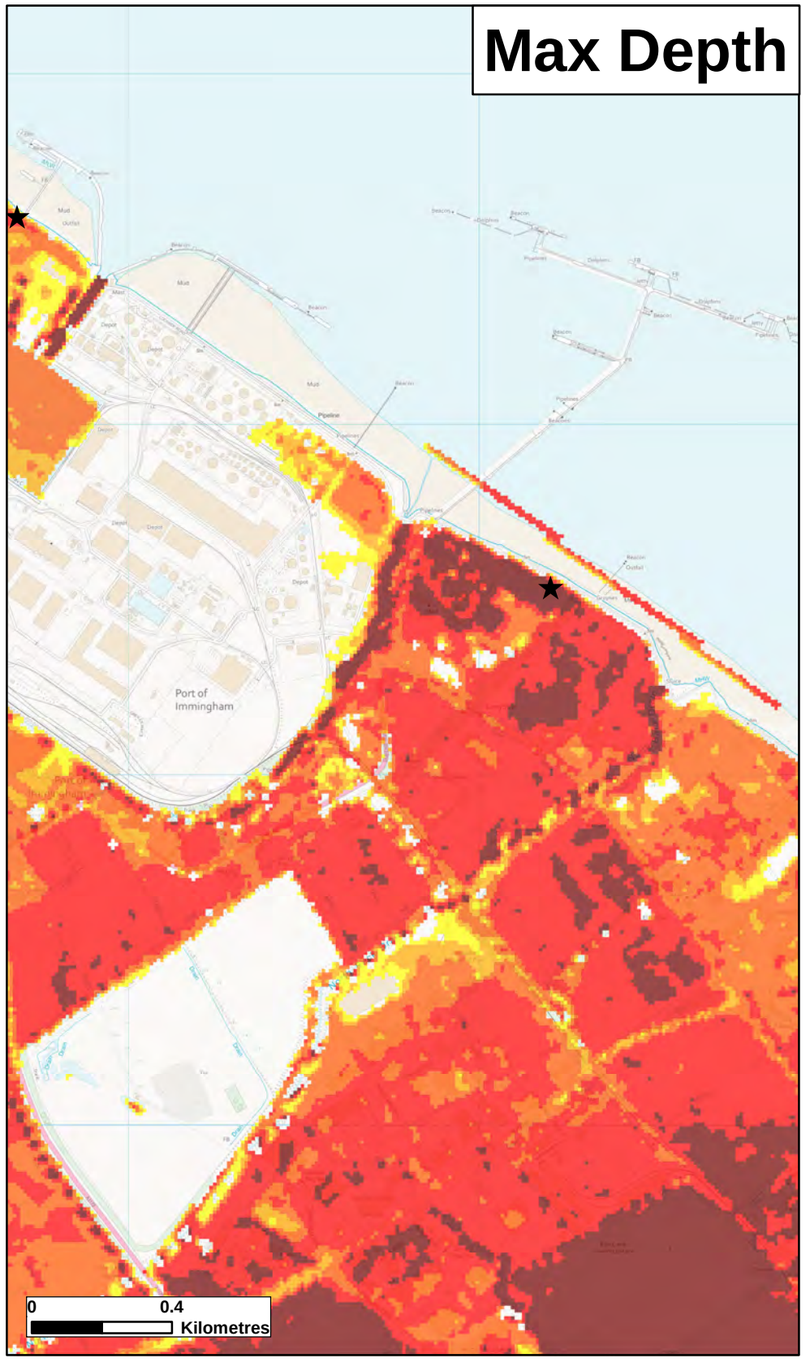
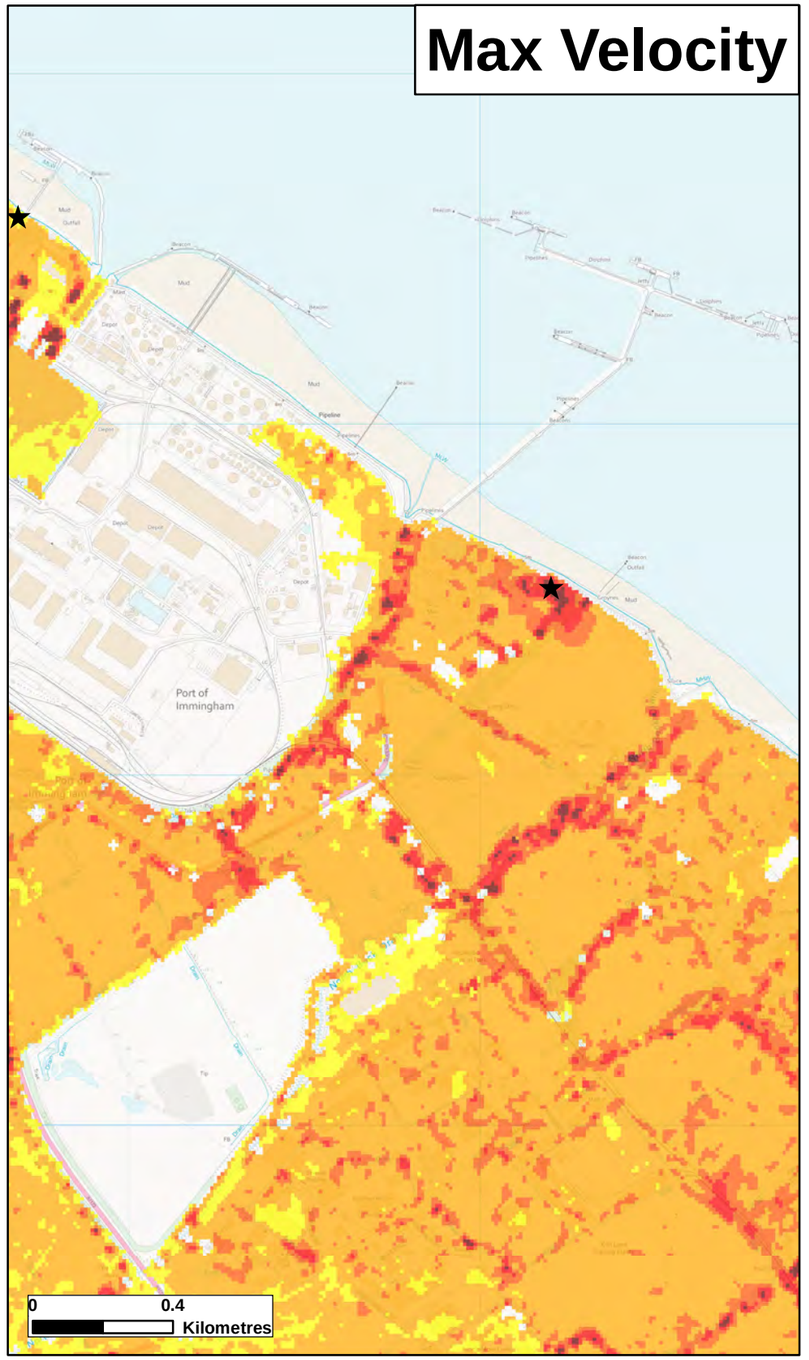
Max Hazard



Max Depth



Max Velocity



★ **Modelled Breach Locations** - see also the accompanying plan "Location of Modelled Breaches"

Max Hazard
(Flood Risk to People : FD2320)

- Less than 0.75 (Low Hazard)
- Between 0.75 and 1.25 (Danger for Some)
- Between 1.25 and 2.0 (Danger for Most)
- Greater than 2.0 (Danger for All)

Max Depth (m)

- 0 - 0.25
- 0.25 - 0.50
- 0.50 - 1.0
- 1.0 - 1.6
- 1.6 +

Max Velocity (m/s)

- 0 - 0.3
- 0.3 - 1.0
- 1.0 - 1.5
- 1.5 - 2.5
- 2.5 +

Date Printed	August 2022	**Scenario year**	2006	**Scenario Annual Chance**	0.5% (1 in 200)	**CCN Number**	CCN-2022-275567

This map shows the level of flood hazard to people (called a hazard rating) if our flood defences are breached at certain locations, for a range of scenarios. The hazard rating depends on the depth and velocity of floodwater, and maximum values of these are also mapped.

The map is based on computer modelling of simulated breaches at specific locations. Each breach has been modelled individually and the results combined to create this map. Multiple breaches, other combinations of breaches, different sized tidal surges or flood flows may all give different results.

The map only considers the consequences of a breach, it does not make any assumption about the likelihood of a breach occurring. The likelihood of a breach occurring will depend on a number of different factors, including the construction and condition of the defences in the area. A breach is less likely where defences are of a good standard, but a risk of breaching remains.

General Enquiries No: 03708 506 506. Weekday Daytime calls cost 5p plus up to 6p per minute from BT Weekend Unlimited. Mobile and other providers' charges may vary

Environment Agency

Lincolnshire and Northamptonshire Hazard mapping

Map Centred on TA 20783 15271

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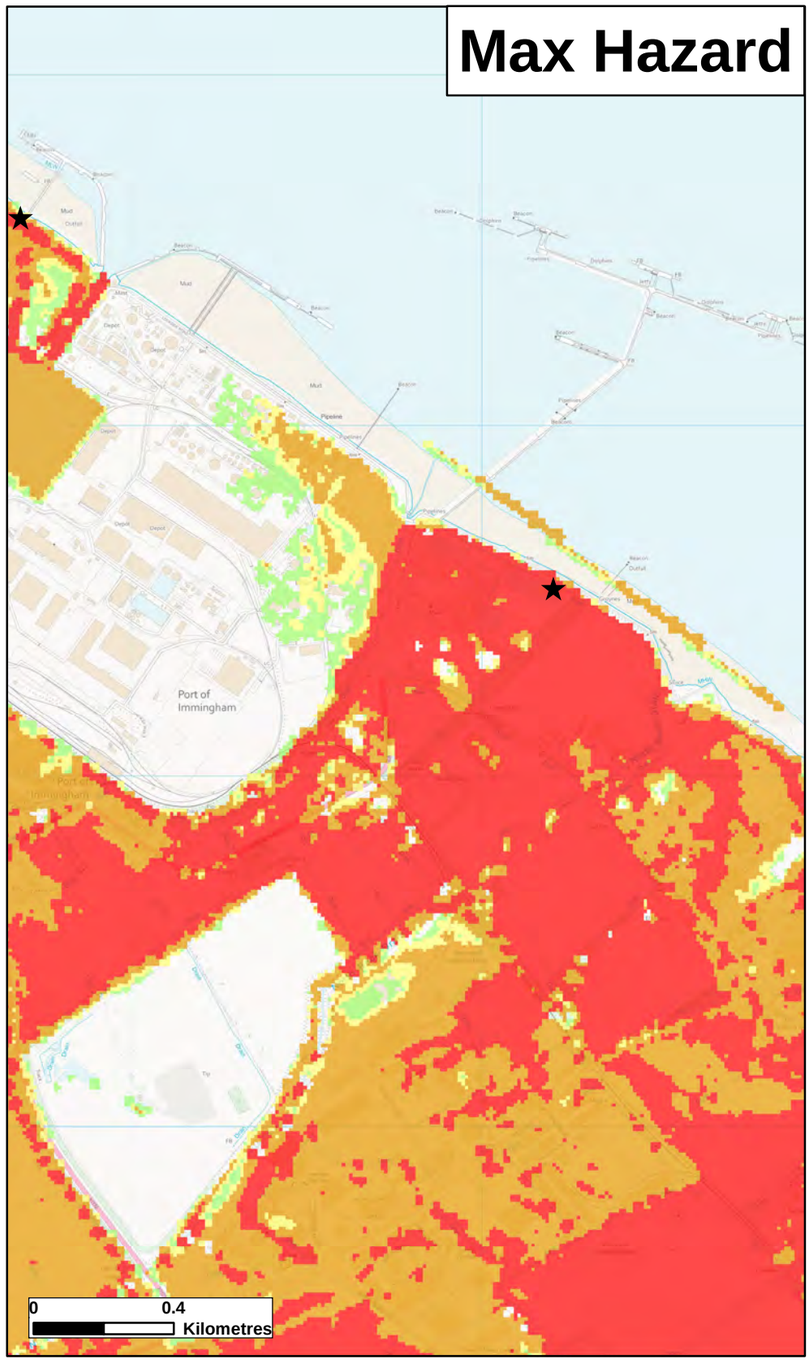
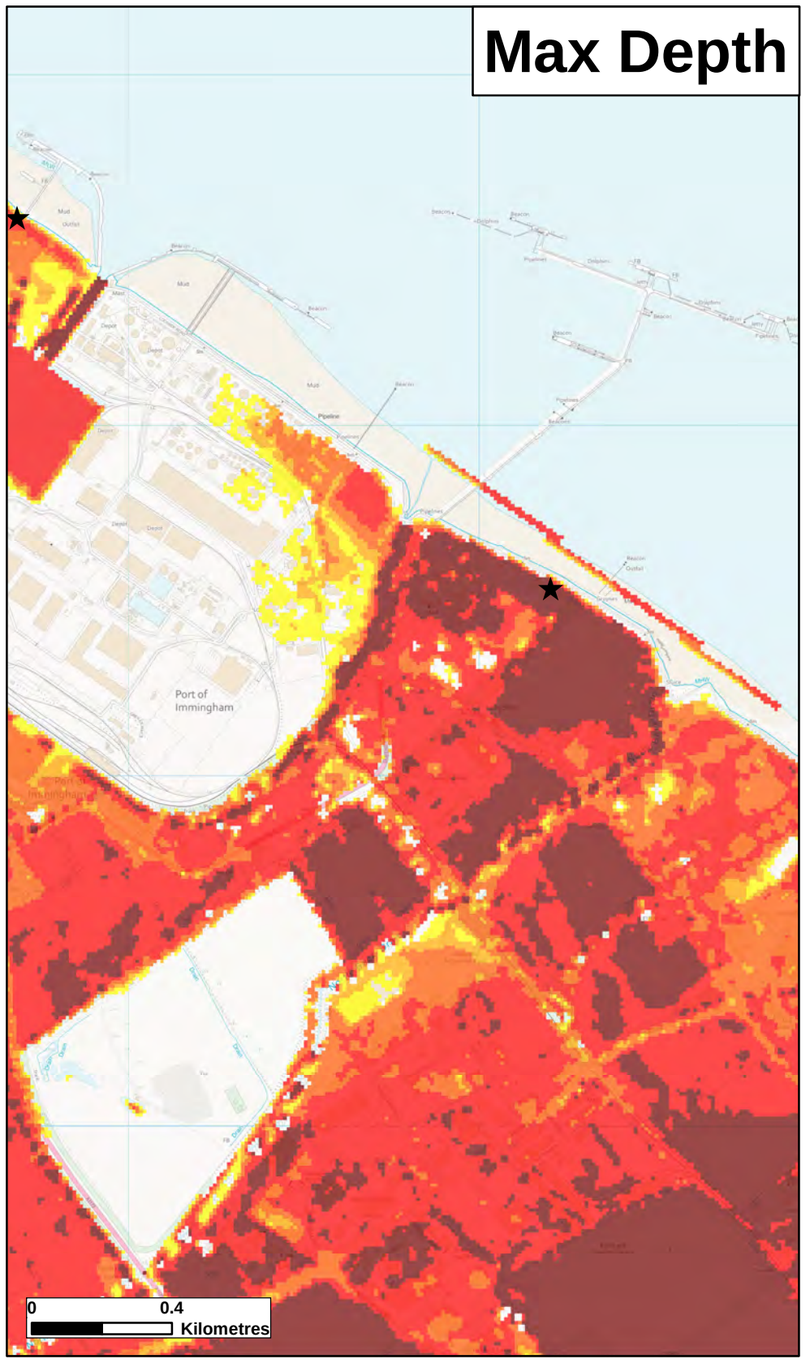
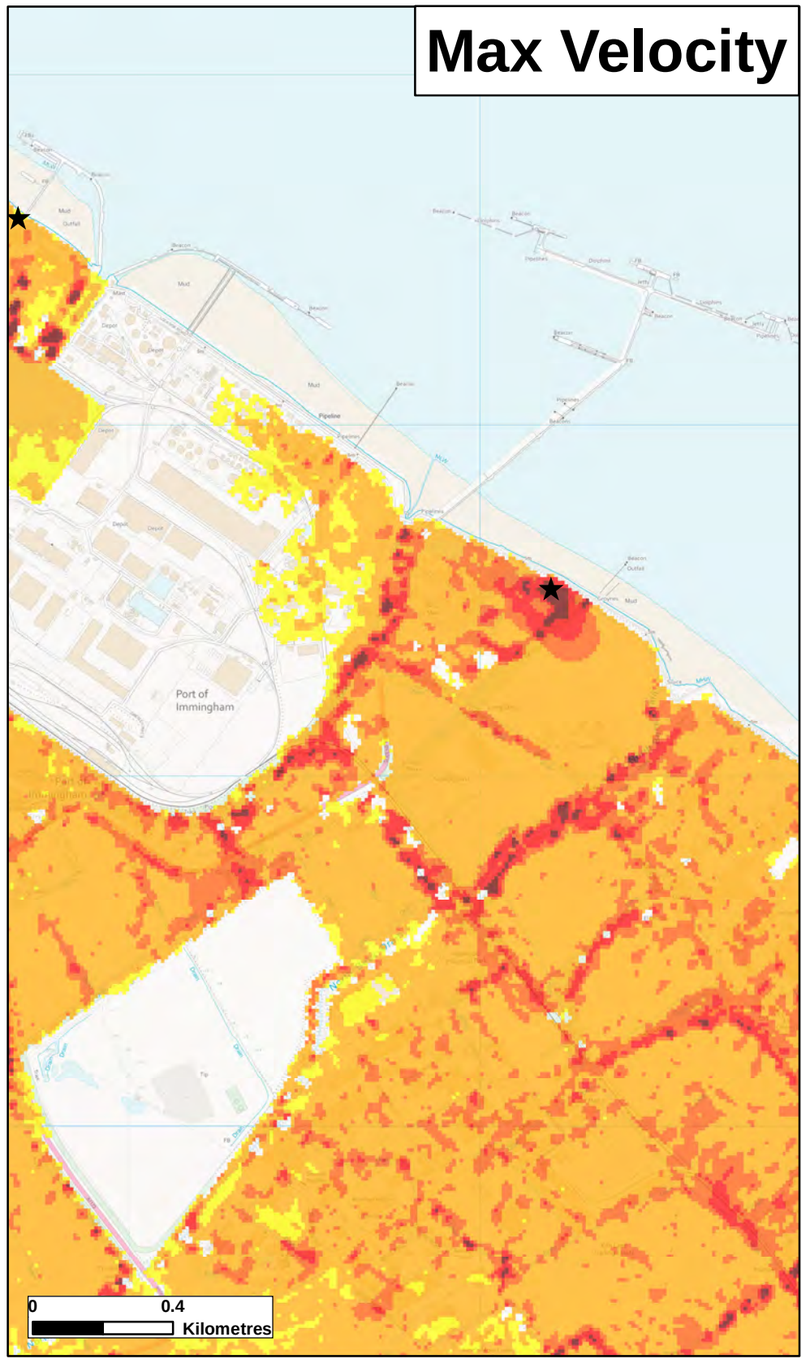
Max Hazard



Max Depth



Max Velocity



★ **Modelled Breach Locations** - see also the accompanying plan "Location of Modelled Breaches"

Max Hazard (Flood Risk to People : FD2320)	Max Depth (m)	Max Velocity (m/s)
Less than 0.75 (Low Hazard)	0 - 0.25	0 - 0.3
Between 0.75 and 1.25 (Danger for Some)	0.25 - 0.50	0.3 - 1.0
Between 1.25 and 2.0 (Danger for Most)	0.50 - 1.0	1.0 - 1.5
Greater than 2.0 (Danger for All)	1.0 - 1.6	1.5 - 2.5
	1.6 +	2.5 +

Date Printed	August 2022	**Scenario year**	2006	**Scenario Annual Chance**	0.1% (1 in 1000)	**CCN Number**	CCN-2022-275567

This map shows the level of flood hazard to people (called a hazard rating) if our flood defences are breached at certain locations, for a range of scenarios. The hazard rating depends on the depth and velocity of floodwater, and maximum values of these are also mapped.

The map is based on computer modelling of simulated breaches at specific locations. Each breach has been modelled individually and the results combined to create this map. Multiple breaches, other combinations of breaches, different sized tidal surges or flood flows may all give different results.

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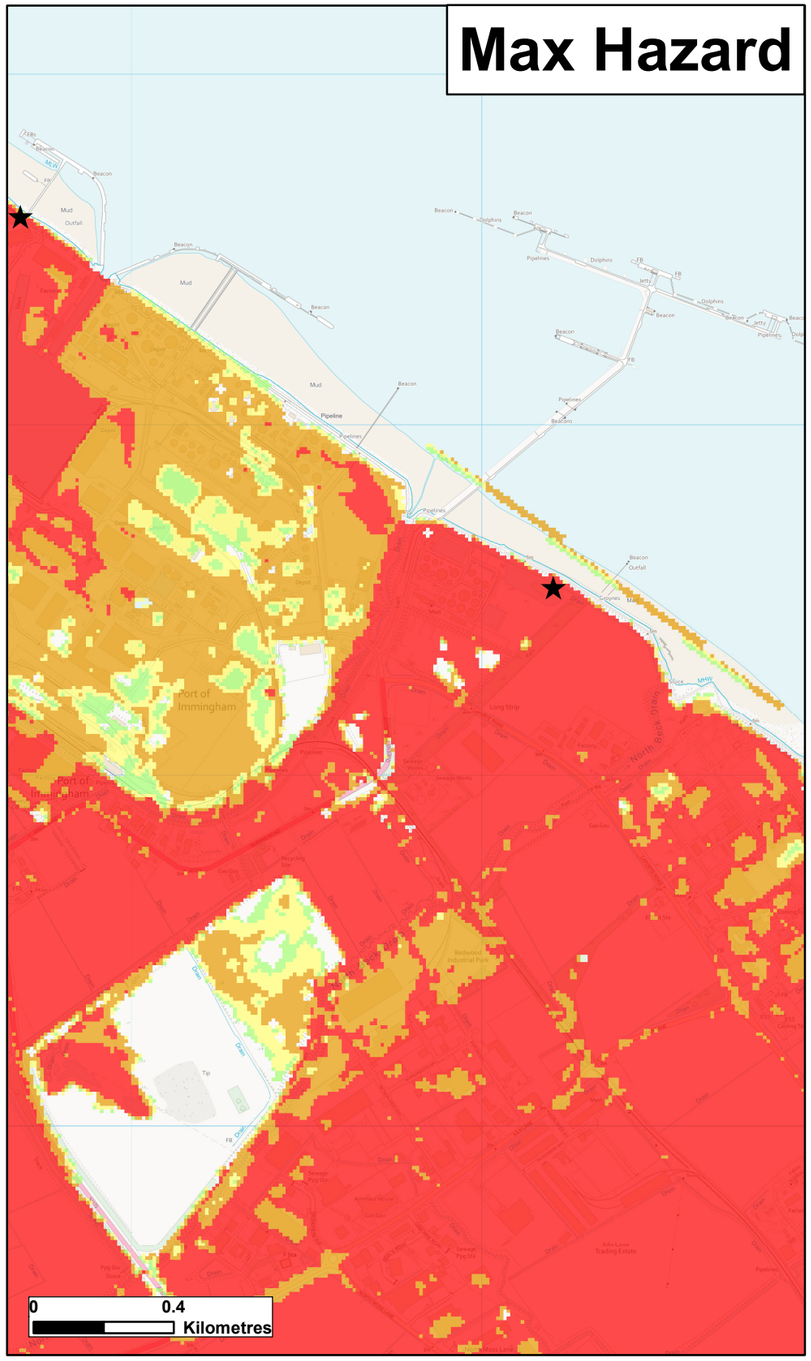
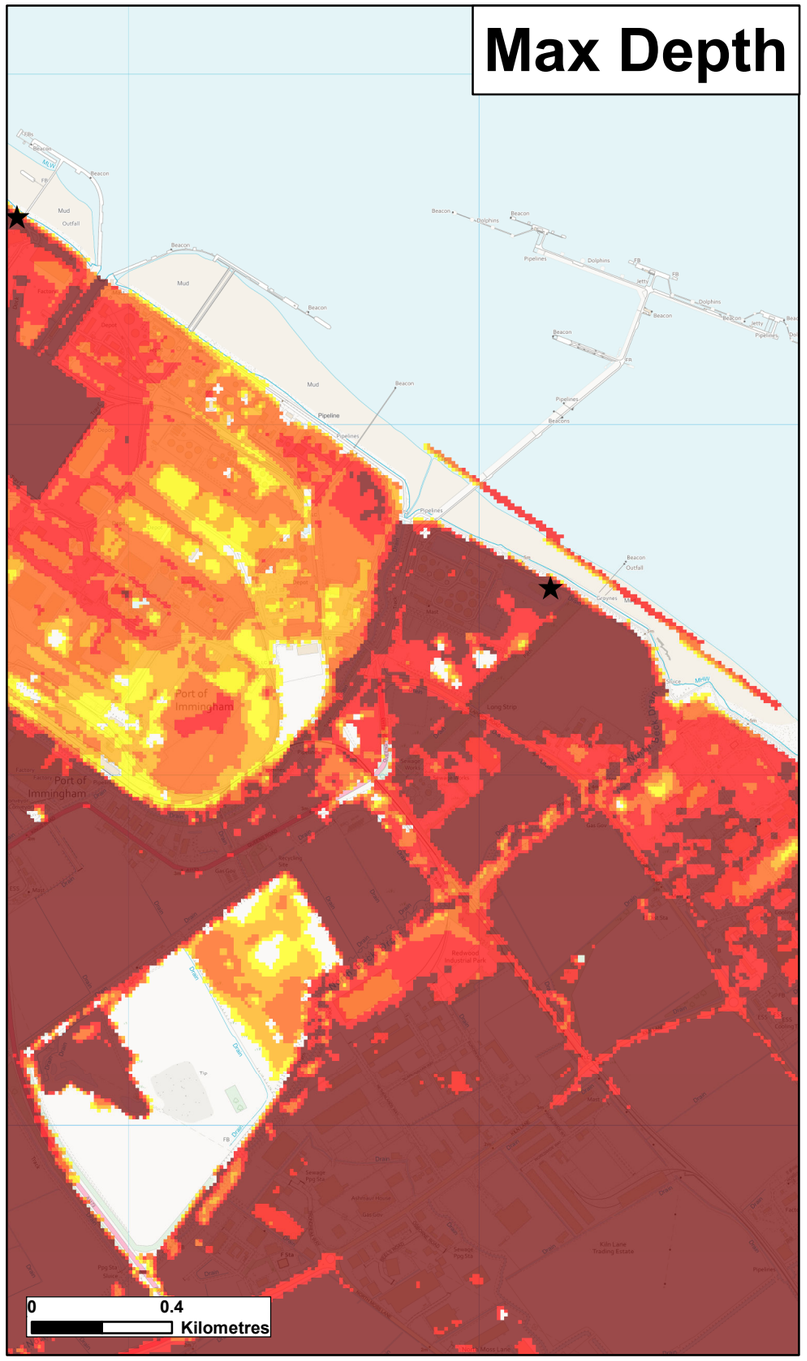
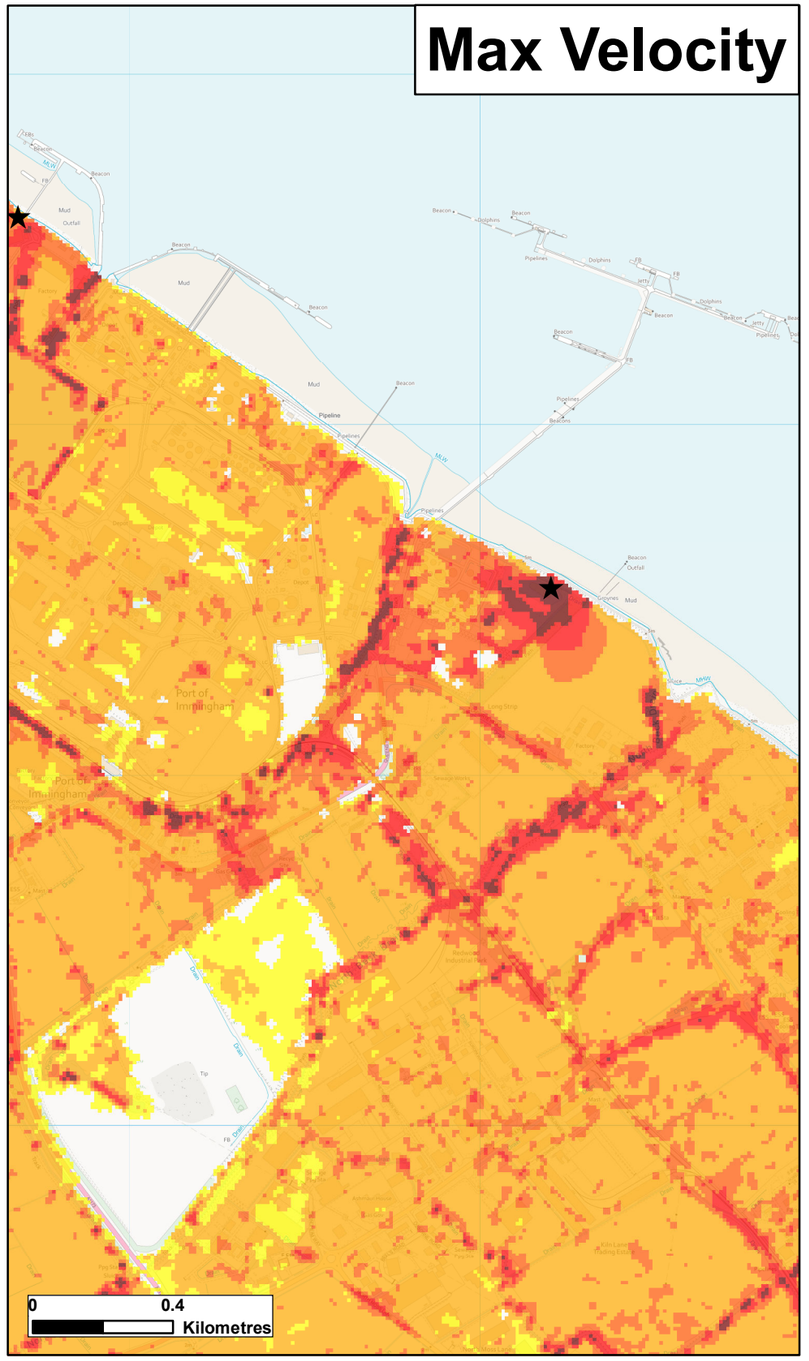
Max Hazard



Max Depth



Max Velocity



★ **Modelled Breach Locations** - see also the accompanying plan "Location of Modelled Breaches"

Max Hazard
(Flood Risk to People : FD2320)

- Less than 0.75 (Low Hazard)
- Between 0.75 and 1.25 (Danger for Some)
- Between 1.25 and 2.0 (Danger for Most)
- Greater than 2.0 (Danger for All)

Max Depth (m)

- 0 - 0.25
- 0.25 - 0.50
- 0.50 - 1.0
- 1.0 - 1.6
- 1.6 +

Max Velocity (m/s)

- 0 - 0.3
- 0.3 - 1.0
- 1.0 - 1.5
- 1.5 - 2.5
- 2.5 +

Date Printed	August 2022	Scenario year	2115	Scenario Annual Chance	0.5% (1 in 200)	CCN Number	CCN-2022-275567

This map shows the level of flood hazard to people (called a hazard rating) if our flood defences are breached at certain locations, for a range of scenarios. The hazard rating depends on the depth and velocity of floodwater, and maximum values of these are also mapped.

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Environment Agency

Lincolnshire and Northamptonshire Hazard mapping

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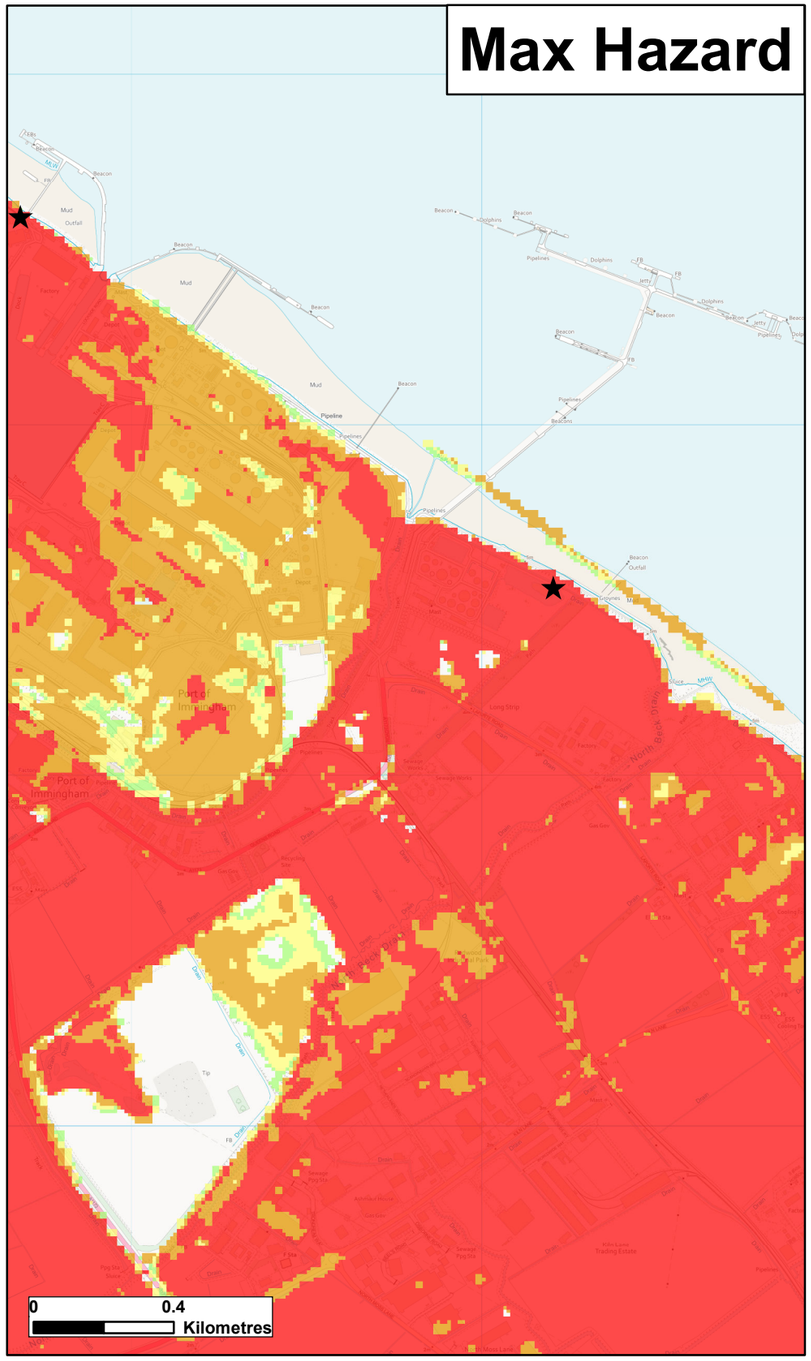

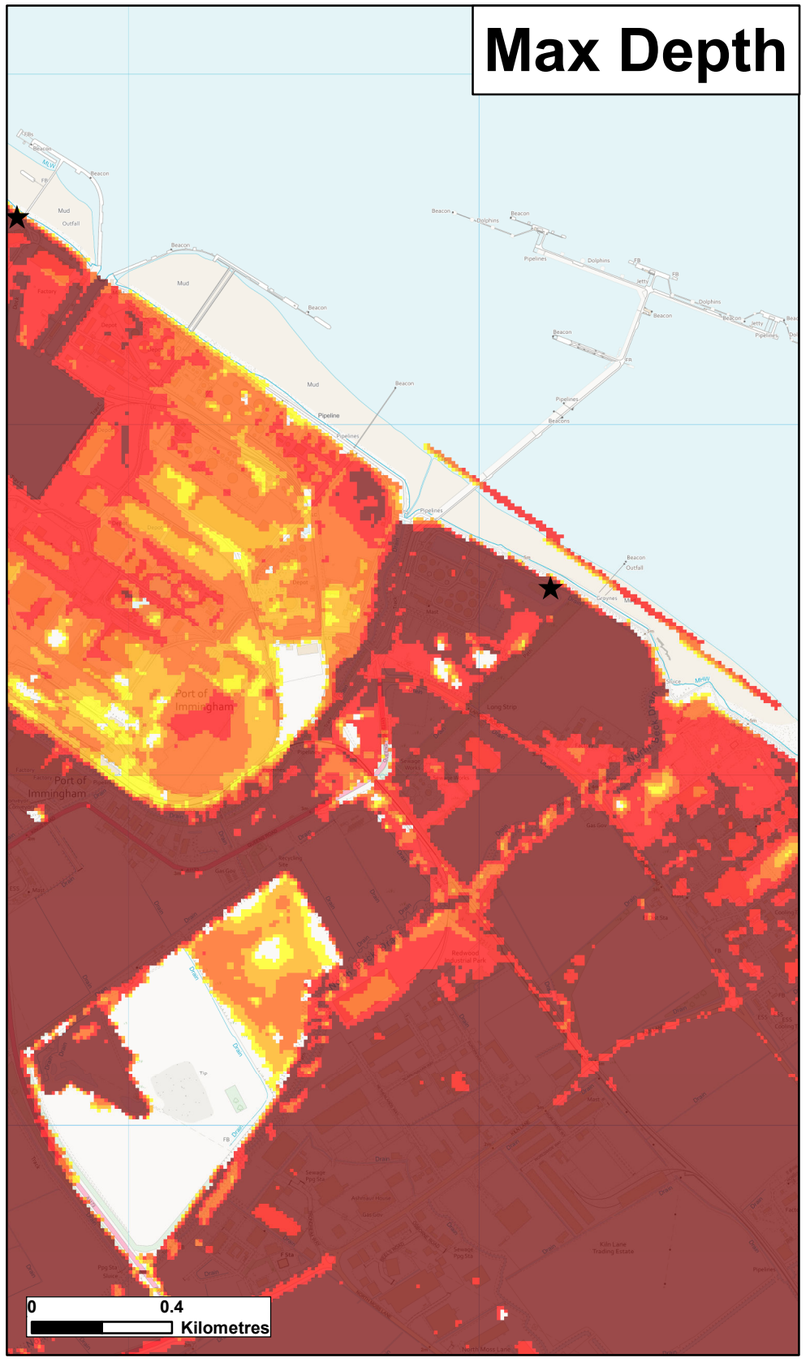

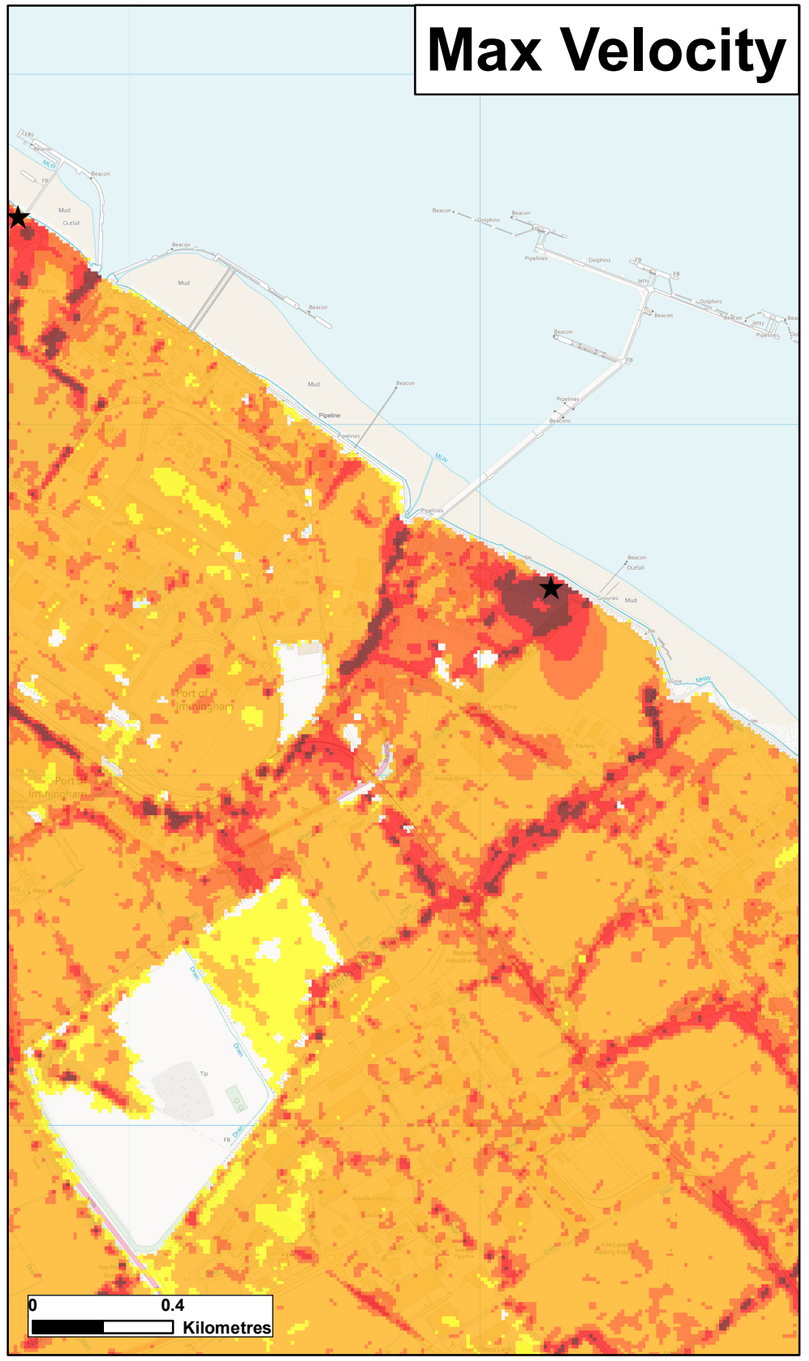

★ **Modelled Breach Locations** - see also the accompanying plan "Location of Modelled Breaches"

Max Hazard
(Flood Risk to People : FD2320)

- Less than 0.75 (Low Hazard)
- Between 0.75 and 1.25 (Danger for Some)
- Between 1.25 and 2.0 (Danger for Most)
- Greater than 2.0 (Danger for All)

Max Depth (m)

- 0 - 0.25
- 0.25 - 0.50
- 0.50 - 1.0
- 1.0 - 1.6
- 1.6 +

Max Velocity (m/s)

- 0 - 0.3
- 0.3 - 1.0
- 1.0 - 1.5
- 1.5 - 2.5
- 2.5 +

Date Printed	August 2022	Scenario year	2115	Scenario Annual Chance	0.1% (1 in 1000)	CCN Number	CCN-2022-275567

This map shows the level of flood hazard to people (called a hazard rating) if our flood defences are breached at certain locations, for a range of scenarios. The hazard rating depends on the depth and velocity of floodwater, and maximum values of these are also mapped.

The map is based on computer modelling of simulated breaches at specific locations. Each breach has been modelled individually and the results combined to create this map. Multiple breaches, other combinations of breaches, different sized tidal surges or flood flows may all give different results.

The map only considers the consequences of a breach, it does not make any assumption about the likelihood of a breach occurring. The likelihood of a breach occurring will depend on a number of different factors, including the construction and condition of the defences in the area. A breach is less likely where defences are of a good standard, but a risk of breaching remains.

General Enquiries No: 03708 506 506. Weekday Daytime calls cost 5p plus up to 6p per minute from BT Weekend Unlimited. Mobile and other providers' charges may vary

Environment Agency

Lincolnshire and Northamptonshire Hazard mapping

Map Centred on TA 20783 15271

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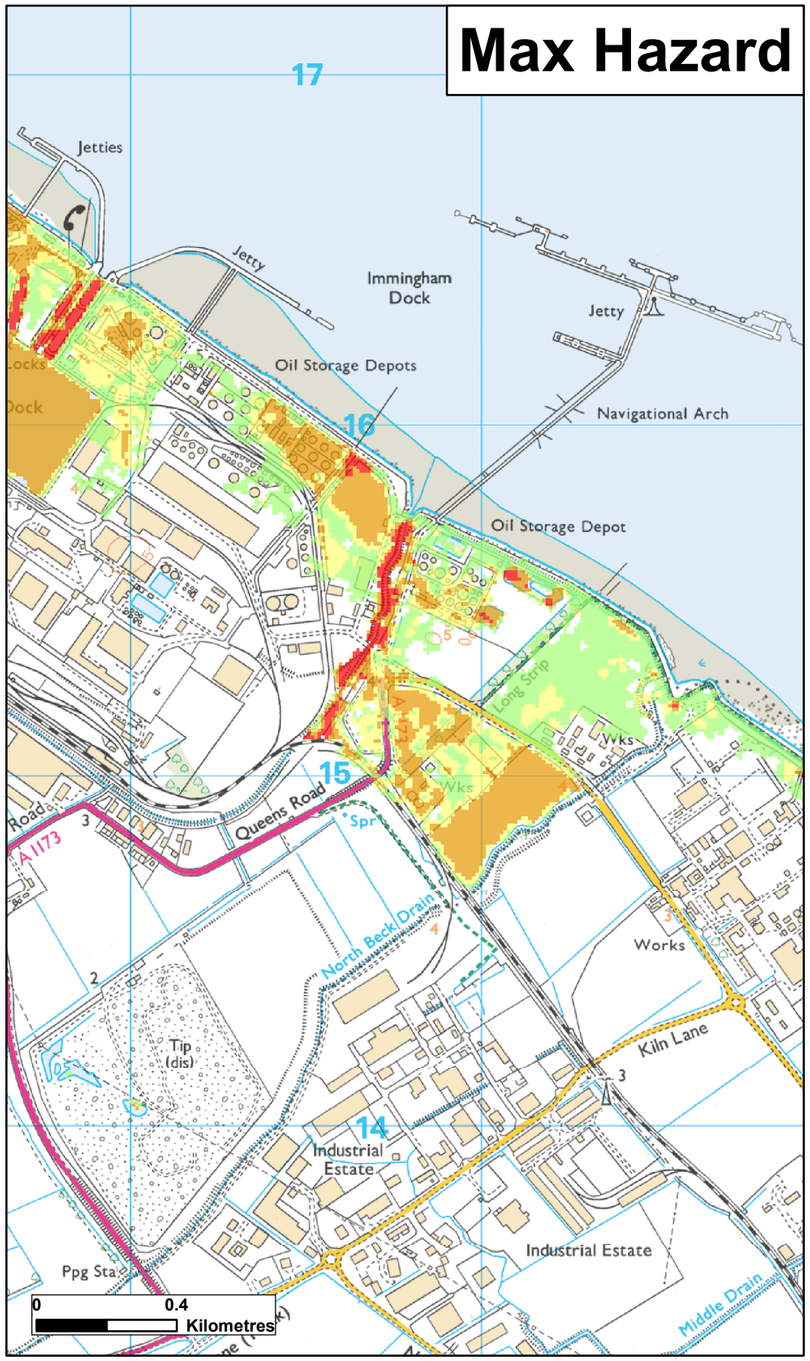

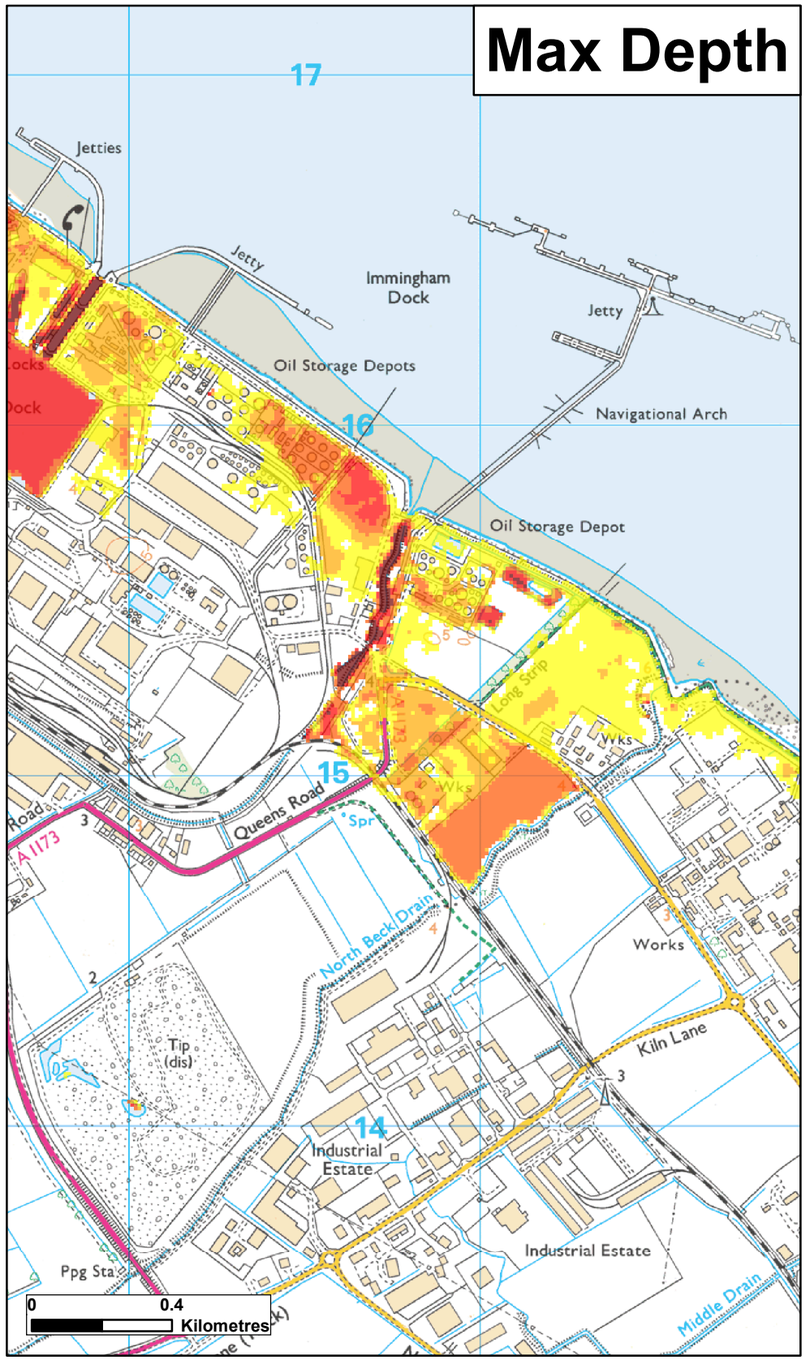

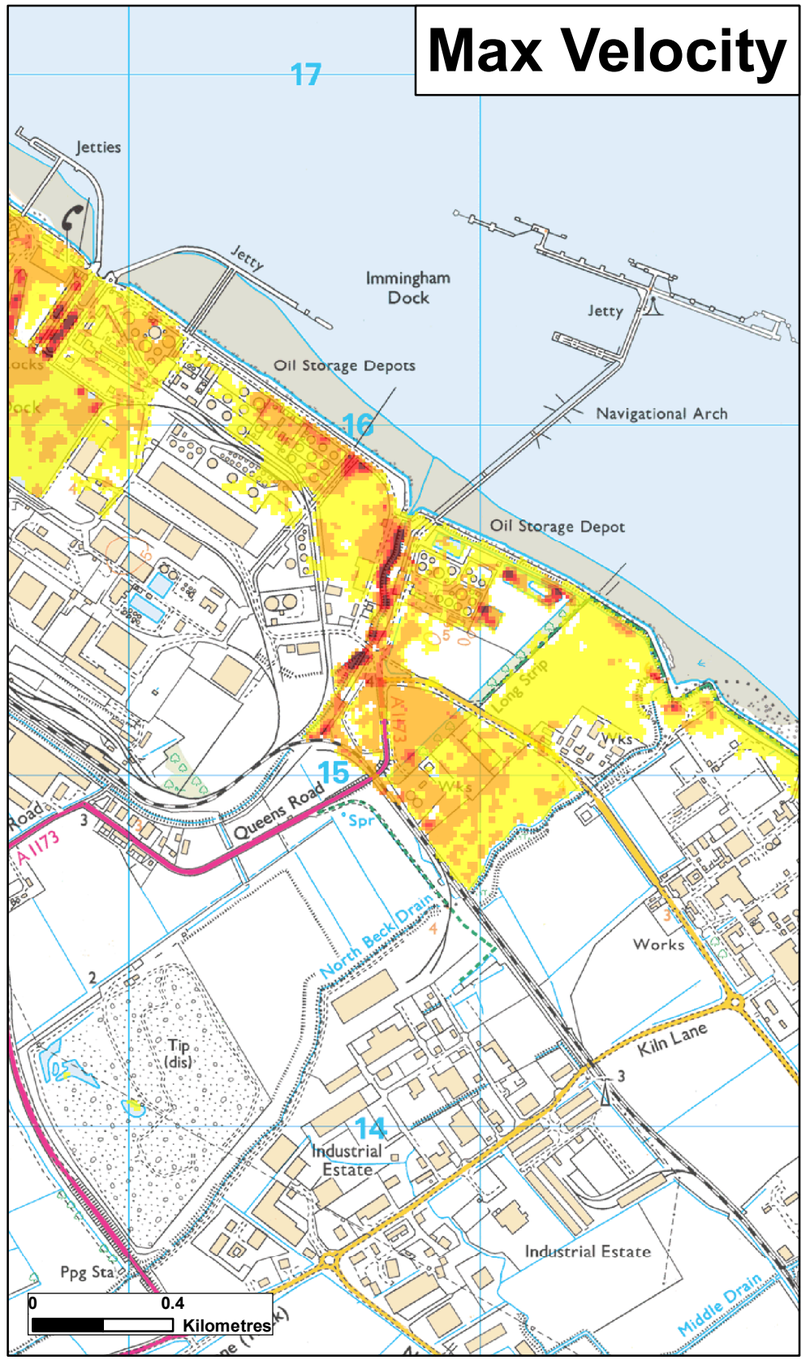

Max Hazard
(Flood Risk to People : FD2320)

- Less than 0.75 (Low Hazard)
- Between 0.75 and 1.25 (Danger for Some)
- Between 1.25 and 2.0 (Danger for Most)
- Greater than 2.0 (Danger for All)

Max Depth (m)

- 0 - 0.25
- 0.25 - 0.50
- 0.50 - 1.0
- 1.0 - 1.6
- 1.6 +

Max Velocity (m/s)

- 0 - 0.3
- 0.3 - 1.0
- 1.0 - 1.5
- 1.5 - 2.5
- 2.5 +

Date Printed	August 2022	Scenario year	2006	Scenario Annual Chance	0.5% (1 in 200)	CCN Number	CCN-2022-275567

The map is based on computer modelling of simulated overtopping of the main coastal defences for specific tidal scenarios. It does not include overtopping along the following tidal rivers which are currently being investigated: Witham Haven (upstream of Hobhole), and Welland (upstream of Fosdyke Bridge)

The map only considers the consequences of overtopping of the defences, and does not show the possible consequences of breaches of the tidal defences. Separate maps of the flood extent from just breaching of the defences are available.

For future climate change scenarios it is assumed that defences remain at 2006 heights.

These maps do not replace the flood zone maps used in the National Planning Policy Framework (NPPF)

General Enquiries No: 03708 506 506. Weekday Daytime calls cost 5p plus up to 6p per minute from BT Weekend Unlimited. Mobile and other providers' charges may vary

Environment Agency

Lincolnshire and Northamptonshire Overtopping Hazard Mapping

Map Centred on TA 20783 15271

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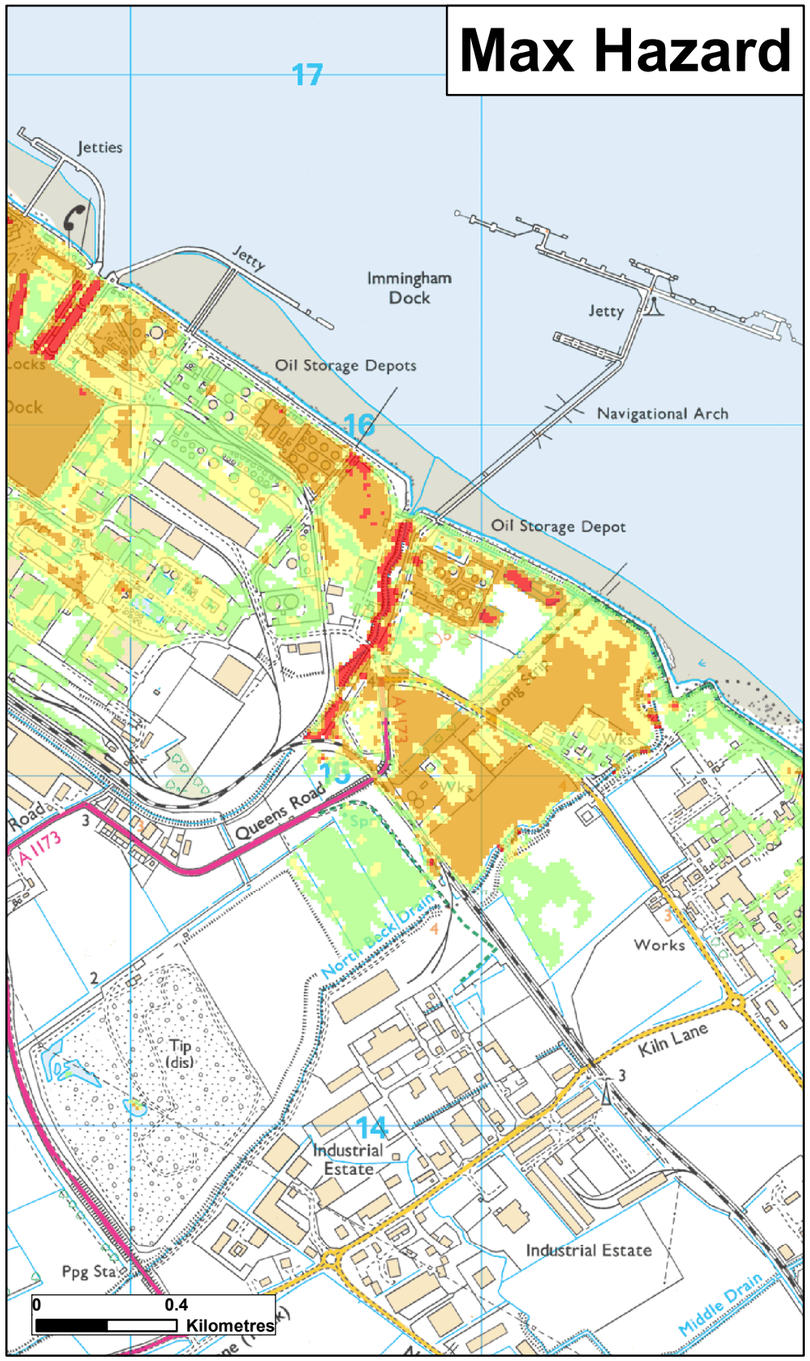

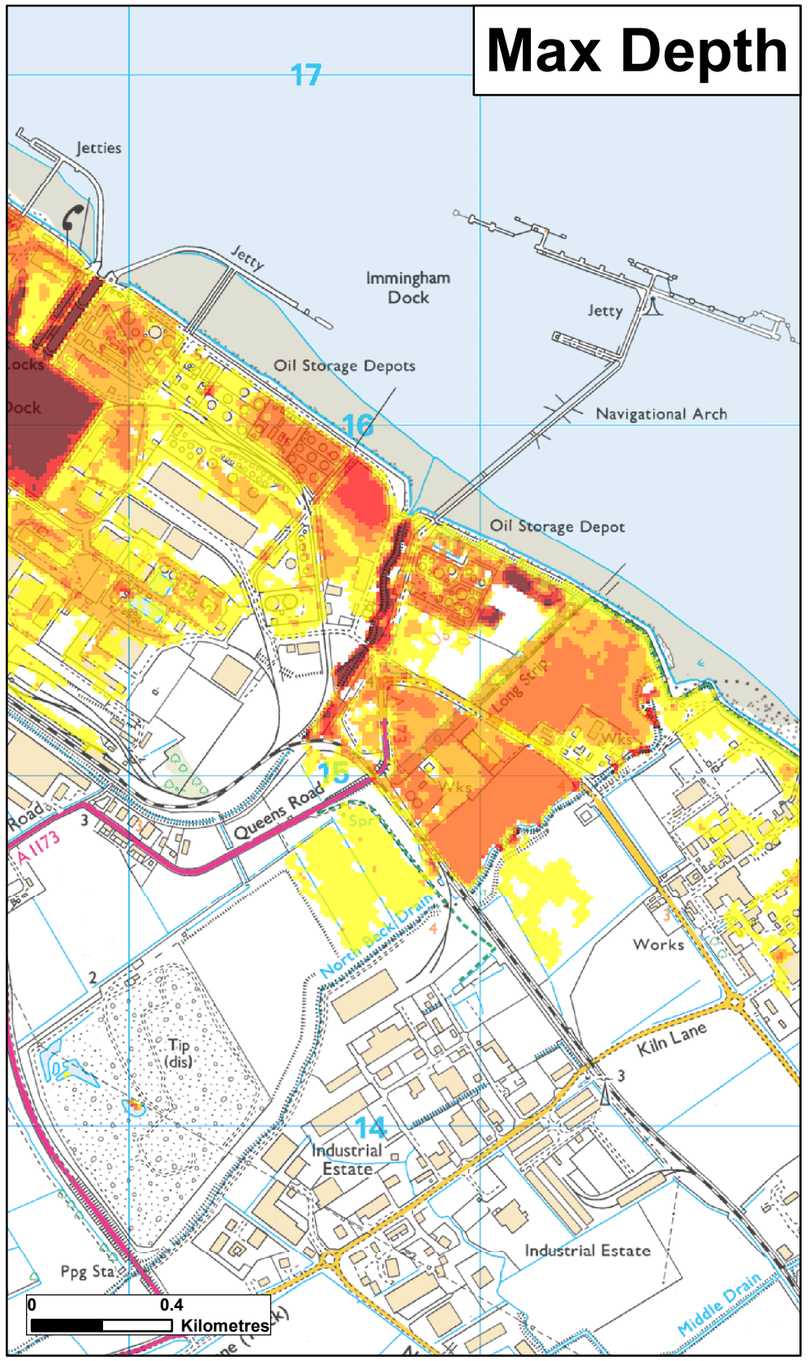

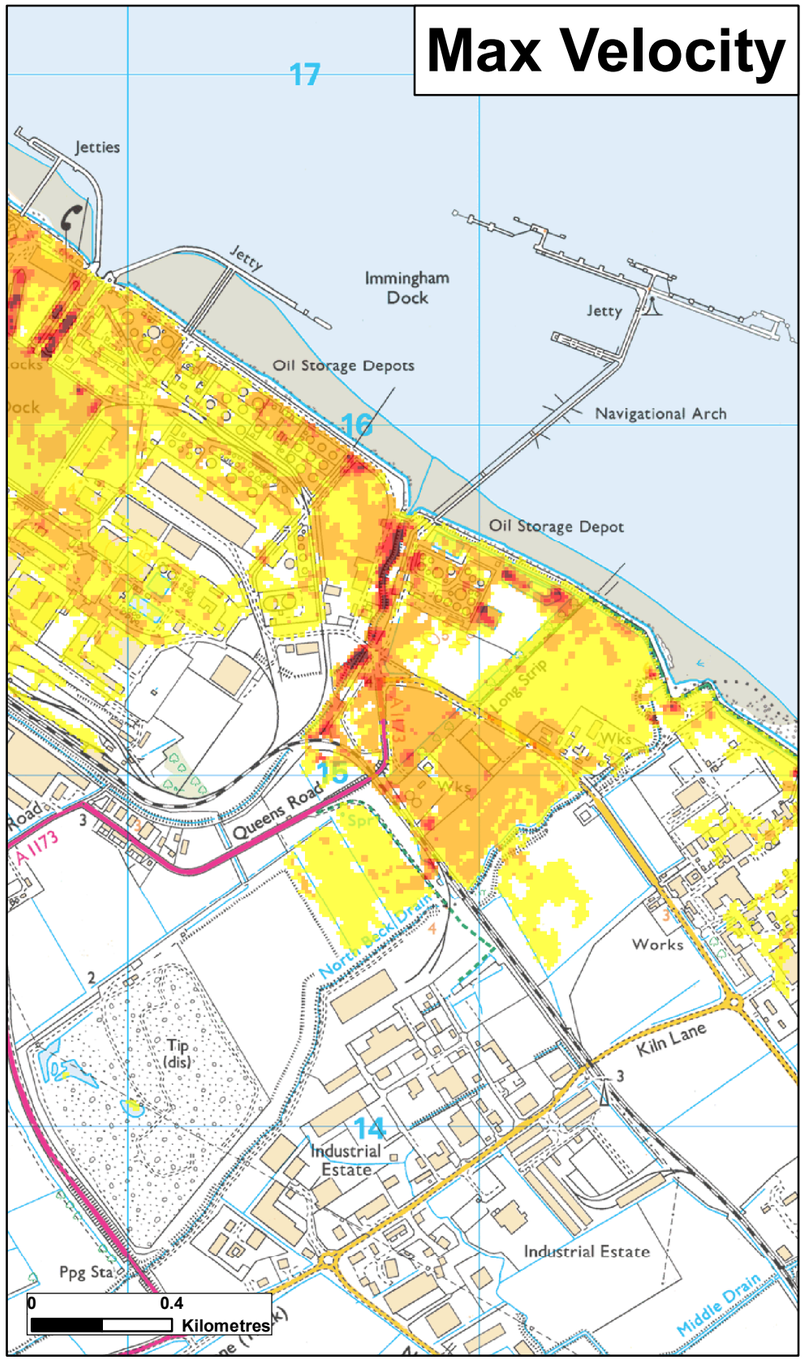

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- 1.6 +

Max Velocity (m/s)

- 0 - 0.3
- 0.3 - 1.0
- 1.0 - 1.5
- 1.5 - 2.5
- 2.5 +

Date Printed	August 2022	Scenario year	2006	Scenario Annual Chance	0.1% (1 in 1000)	CCN Number	CCN-2022-275567

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Environment Agency

Lincolnshire and Northamptonshire Overtopping Hazard Mapping

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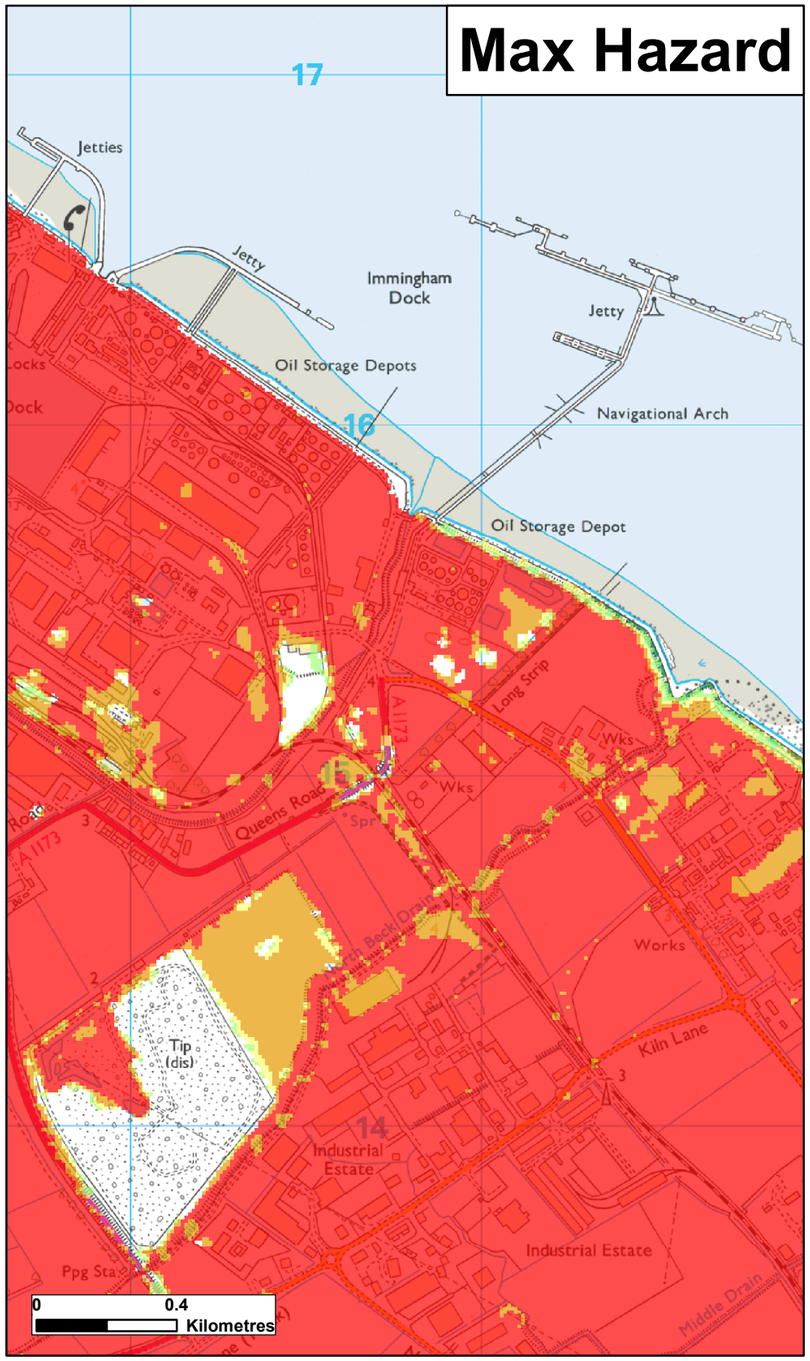

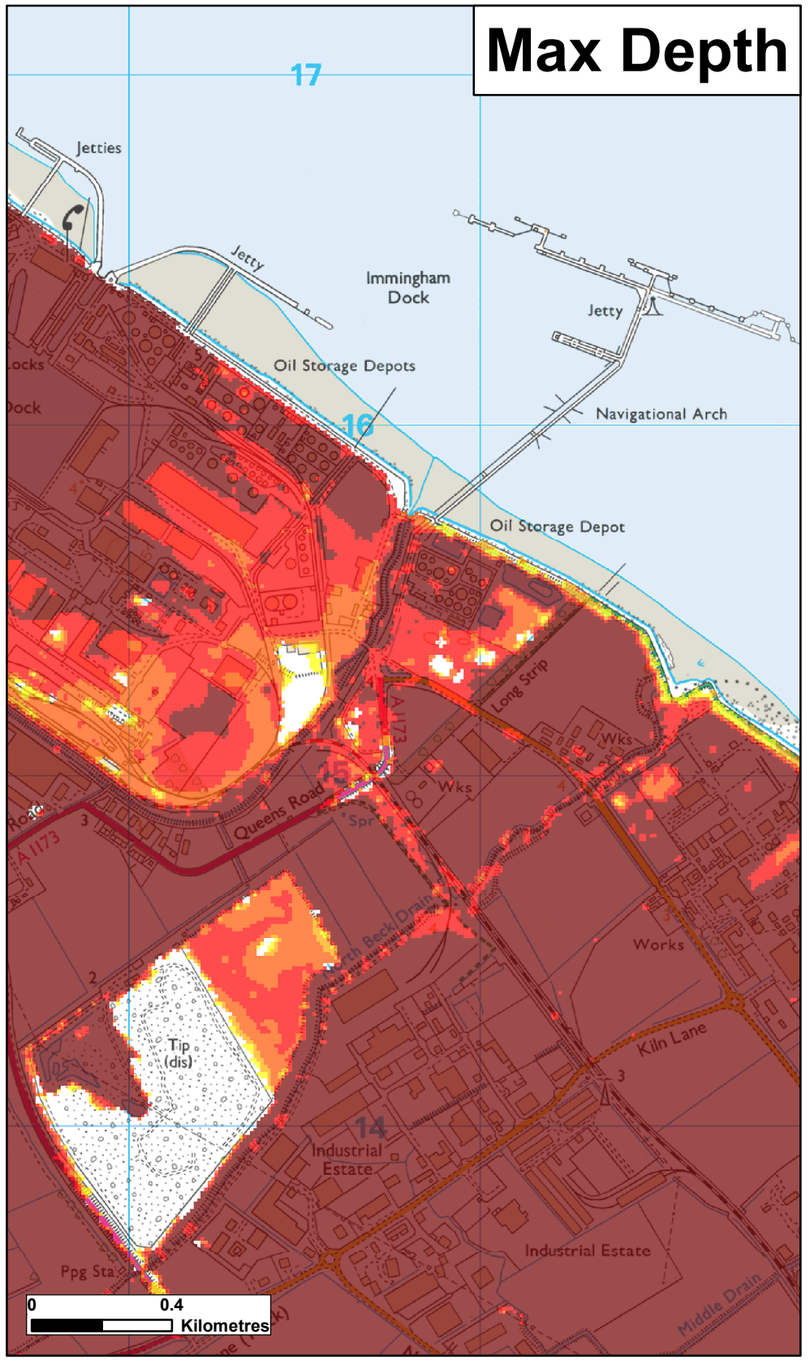

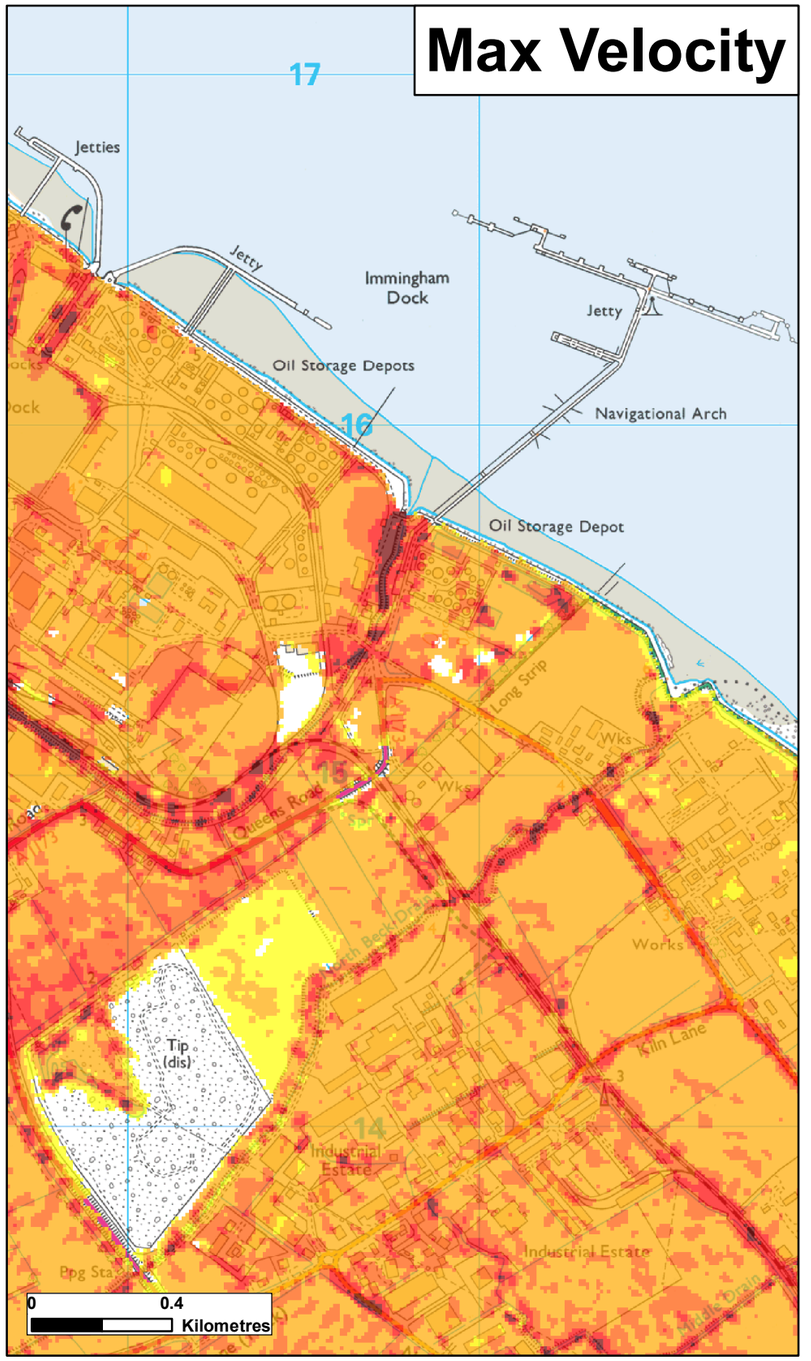

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- 0 - 0.3
- 0.3 - 1.0
- 1.0 - 1.5
- 1.5 - 2.5
- 2.5 +

Date Printed	August 2022	Scenario year	2115	Scenario Annual Chance	0.5% (1 in 200)	CCN Number	CCN-2022-275567

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The map only considers the consequences of overtopping of the defences, and does not show the possible consequences of breaches of the tidal defences. Separate maps of the flood extent from just breaching of the defences are available.

For future climate change scenarios it is assumed that defences remain at 2006 heights.

These maps do not replace the flood zone maps used in the National Planning Policy Framework (NPPF)

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Environment Agency

Lincolnshire and Northamptonshire Overtopping Hazard Mapping

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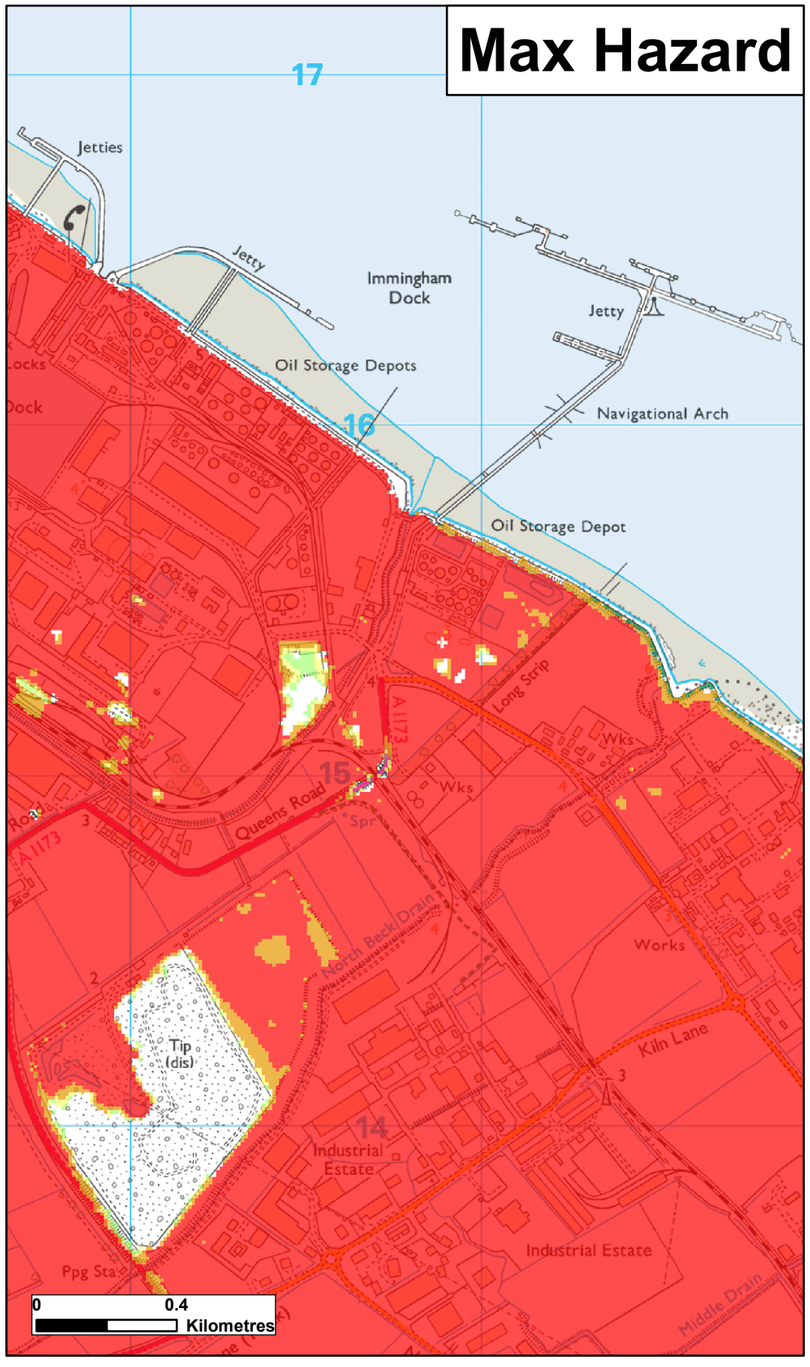
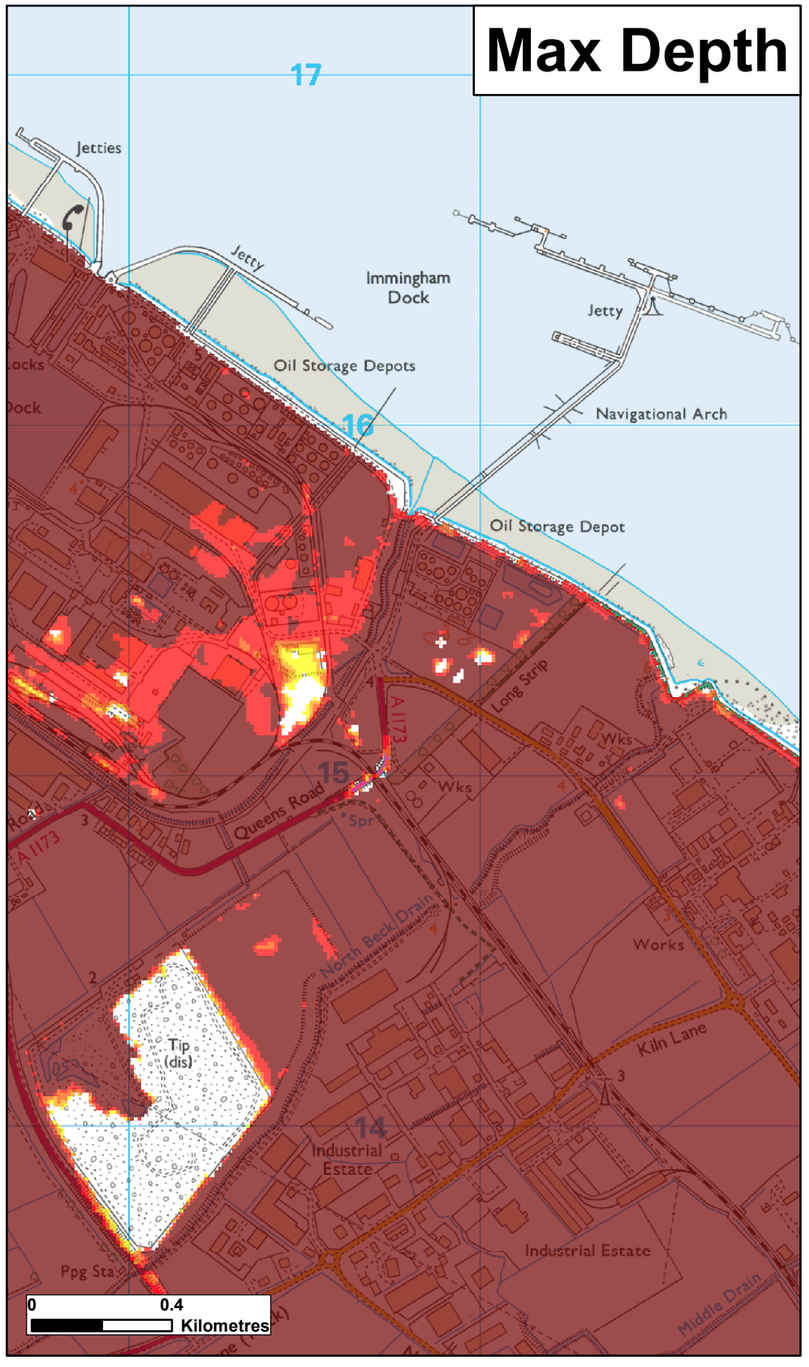
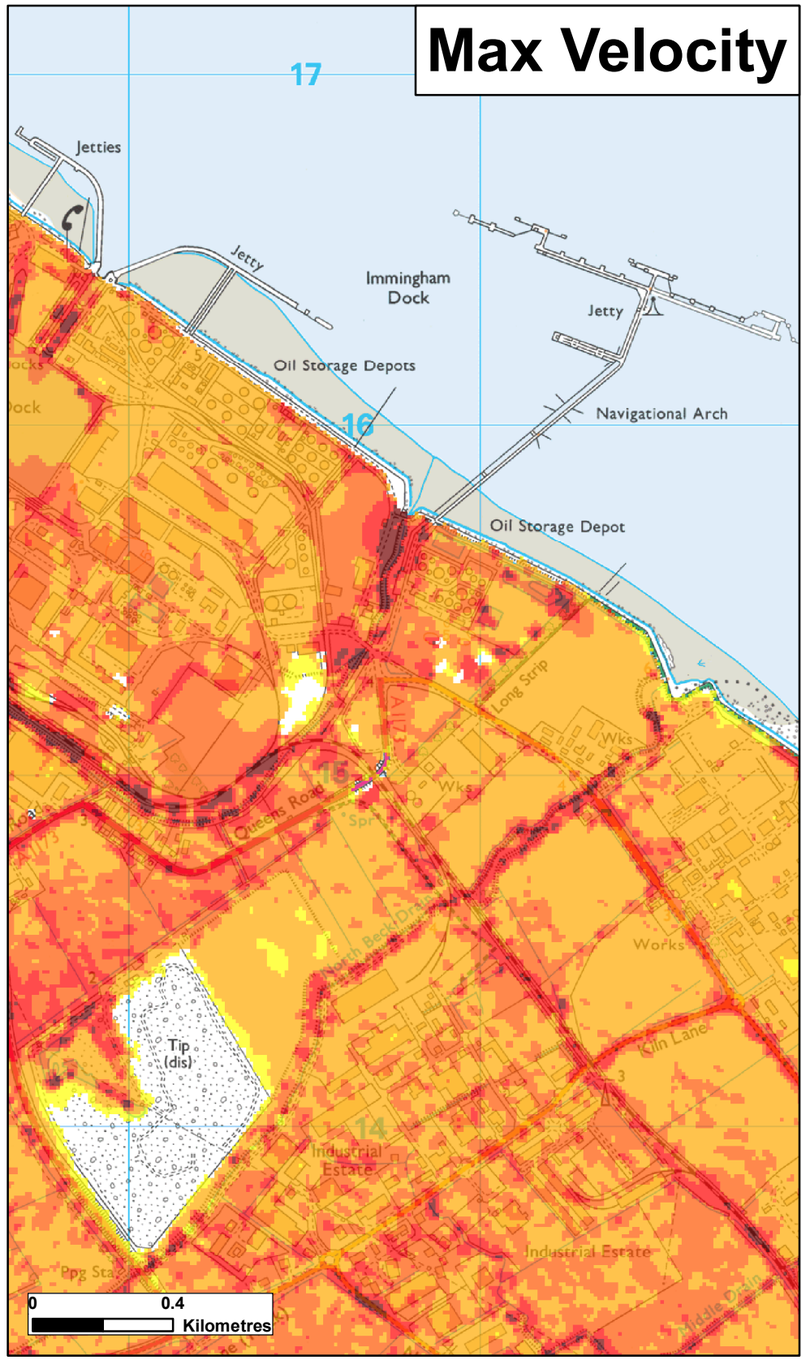
Max Hazard



Max Depth



Max Velocity



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Max Velocity (m/s)

- 0 - 0.3
- 0.3 - 1.0
- 1.0 - 1.5
- 1.5 - 2.5
- 2.5 +

Date Printed	August 2022	Scenario year	2115	Scenario Annual Chance	0.1% (1 in 1000)	CCN Number	CCN-2022-275567

The map is based on computer modelling of simulated overtopping of the main coastal defences for specific tidal scenarios. It does not include overtopping along the following tidal rivers which are currently being investigated: Witham Haven (upstream of Hobhole), and Welland (upstream of Fosdyke Bridge)

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Environment Agency

Lincolnshire and Northamptonshire Overtopping Hazard Mapping

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[redacted]

Our ref: AN/2023/134155/01-L01
Your ref: TR030008

Date: 27 March 2023

Dear [redacted]

Immingham Green Energy Terminal
Dock Offices, Immingham Dock, Immingham, DN40 2LZ

Thank you for your enquiry regarding additional flood risk information to feed into your site-specific mitigation assessment. We hope you will find the following information useful.

The maximum breach flood water level for the site for the various scenarios are set out below:

Scenario	Approximate Maximum Flood Level (mAOD)
2006 0.5% AEP	5.5
2006 0.1% AEP	5.6
2115 0.5% AEP	5.9
2115 0.1% AEP	6

With regards to the question on time for inundation, we can provide details of the approximate time to inundation from a breach in the flood defences at the locations we have modelled. It should be noted that the time to inundate will be significantly reduced if a breach was to occur in the defences within the site boundary.

Scenario	Approximate time to inundation from modelled locations.
2006 0.5% AEP	Less than 2 hours
2006 0.1% AEP	Less than 2 hours
2115 0.5% AEP	Less than 2 hours
2115 0.1% AEP	Less than 2 hours

We can also confirm that the data provided under request reference CCN-2022-275567 is still the most up to date information held by the Environment Agency on flood risk for the site.

Should you require any additional information, or wish to discuss these matters further, please do not hesitate to contact me on the number below.

Yours sincerely

[redacted]

Principal Planning Adviser

[redacted]

End

[redacted]

Our ref: AN/2023/133938/03-L01
Your ref: TR030008

Date: 25 August 2023

Dea[redacted]

Immingham Green Energy Terminal - Review of Draft Flood Risk Assessment

Thank you for providing a copy of the draft flood risk assessment (FRA) for our review on 11 August 2023.

We have the following comments to make on this, which we hope you will find useful.

Section 1.3: Data Sources
Throughout the document reference is made to the 2011 North East Lincolnshire Strategic Flood Risk Assessment (SFRA); these references should be revised to reflect the updated 2022 SFRA.

Section 2.7: Hydrology and Flood Risk Management Infrastructure
Surface Watercourses: paragraph 2.7.1, 2nd bullet point - the Main River that lies to the east and south of the site boundary flowing from east to west is the Stallingborough North Beck.

We require an 8m clear strip from the landward toe of the fluvial defence to allow for maintenance and access. Any compound or storage would need to be further than 8m from the landward toe.

There is a small area of Work No. 9 which is covered by the 0.1% defended and undefended fluvial extents from the Stallingborough North Beck. We request that nothing is located within this area of the fluvial floodplain to allow storage in case of high flows on the Stallingborough North Beck. Maps may have already been provided to show this area but if these are required, please let us know and we will provide them.

Section 3.2: Development and Flood Risk Vulnerability
Paragraph 3.2.21 - we support the intention to shut down the facility during periods when there is a flood warning in place. We also welcome the confirmation that the site can be shut down in situ or remotely.

Section 3.4: North East Lincolnshire Strategic Flood Risk Assessment
Paragraph 3.4.11, 5th bullet point - we do not normally comment on or approve the adequacy of flood emergency response procedures accompanying development

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www.gov.uk/environment-agency

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proposals, as we do not carry out these roles during a flood. Our involvement with this development during an emergency will be limited to delivering flood warnings to occupants/users covered by our flood warning network. This paragraph should be updated to reflect that an appropriate flood warning and evacuation plan will need to be submitted to and approved by North East Lincolnshire Council.

Section 4.4: Fluvial Sources

Paragraph 4.4.8 - an assessment of the residual risk of a breach in the fluvial defences should be made in this FRA, particularly in relation to the temporary construction area (Work No. 9).

It has been noted that the modelled flood levels for the Stallingborough North Beck in Table 4-5 show the wrong levels for the 1 in 1000 (0.1%) AEP. This appears to be an error in the model outputs that has since been rectified. A new table with updated levels can be found below, which will allow a more accurate assessment of the residual risk from a breach of the fluvial defences to be made.

Node	Easting	Northing	Annual Exceedance Probability – Maximum Water Levels (m AOD)				
			50% AEP	3.33% AEP	1% AEP	0.5% AEP	0.1% AEP
NOR_0239_3	521484	415196	1.72	2.35	2.52	2.60	3.05
NOR_0431_2	521382	415015	1.72	2.35	2.52	2.60	3.05
NOR_0711_1	521105	414836	1.73	2.36	2.53	2.61	3.06
NOR_1243_1	520717	414503	1.73	2.37	2.54	2.62	3.09
NOR_1676_2	520538	414244	1.74	2.37	2.55	2.63	3.10

Section 5: Impacts of the Development on Flood Risk

Paragraph 5.2.5 states that there will be a '*small*' impact on "*the adjacent foreshore areas fronting the Project site, which include a number of outfalls, including the Habrough Marsh Drain*". However, previous paragraphs indicate that Chapter 16: Physical Processes [TR030008/APP/6.2] concludes that there will be no likely impact on existing accretion rates. Could this be clarified, please? Any increase in sedimentation to the Stallingborough North Beck Outfall and the Habrough Marsh Drain Outfall would require mitigation to ensure flow is not affected.

Paragraphs 5.3.2 and 5.3.3 appear to contradict each other – could you please correct them as appropriate?

Paragraph 5.3.4 – we note that reference was made in the Preliminary Environmental Information Report (PEIR) addendum for land raising to the West Site but not the East Site. We require a full assessment of land raising and the potential impacts to third parties from tidal sources. This could entail rerunning the individual hazard mapping breach to show where the displaced flood water would go and the impacts of this.

In the current overall site layout, the West Site is not within an area at risk from fluvial flooding from the Main Rivers. However, the site may be at risk from local ordinary watercourses for which other risk management authorities, such as the Lead Local Flood Authority or Internal Drainage Board have responsibility. The FRA should assess the impacts of land raising on the displacement of flood water from non-Main River sources and whether any floodplain compensatory storage is required. The FRA has currently only assessed the floodplain compensation from Main River flooding.

Cont/d..

Section 6: Mitigation of Future and Residual Flood Risks and Off-Site Impacts
Paragraph 6.3.1 - we support the inclusion of the flood resilience and resistance mitigation measures included in this paragraph.

Paragraph 6.6.2 - we also support the use of an area of safe refuge. However, it is worth noting that the flood refuge platform would only serve as an area of safe refuge for the control room building itself and its immediate vicinity. The occupants of the rest of the site could have to walk through deep flood water to reach the control room building, which could pose a risk to life. Adding additional areas of safe refuge across the site would provide more options for staff if safe evacuation couldn't be achieved.

Paragraph 6.9.3 - this suggests that the existing flood wall will be extended so the existing wall will remain in place. We are of the understanding that the wall will be replaced as it could be difficult to raise the existing wall. Therefore, a secondary containment may be required for the duration of the wall replacement.

Paragraph 6.9.5 - the most recent drawings seen by the Environment Agency show a pile through the slope of the embankment. This should be updated in the FRA with the mitigation that the embankment will be monitored and if there is any structural movement or damage to the embankment the damage will be rectified, and we must be notified.

Paragraph 6.9.6 - we would like to see a contingency plan for the construction of the new flood wall as part of the Development Consent Order submission. There should be a form of continuity of defence at all times to ensure that flood risk is managed throughout.

We hope you will find the above comments useful in finalising your FRA for submission but should you require any additional information, or wish to discuss these matters further, please contact either Vicki Dutchburn on 02030 255058, or myself at the number below.

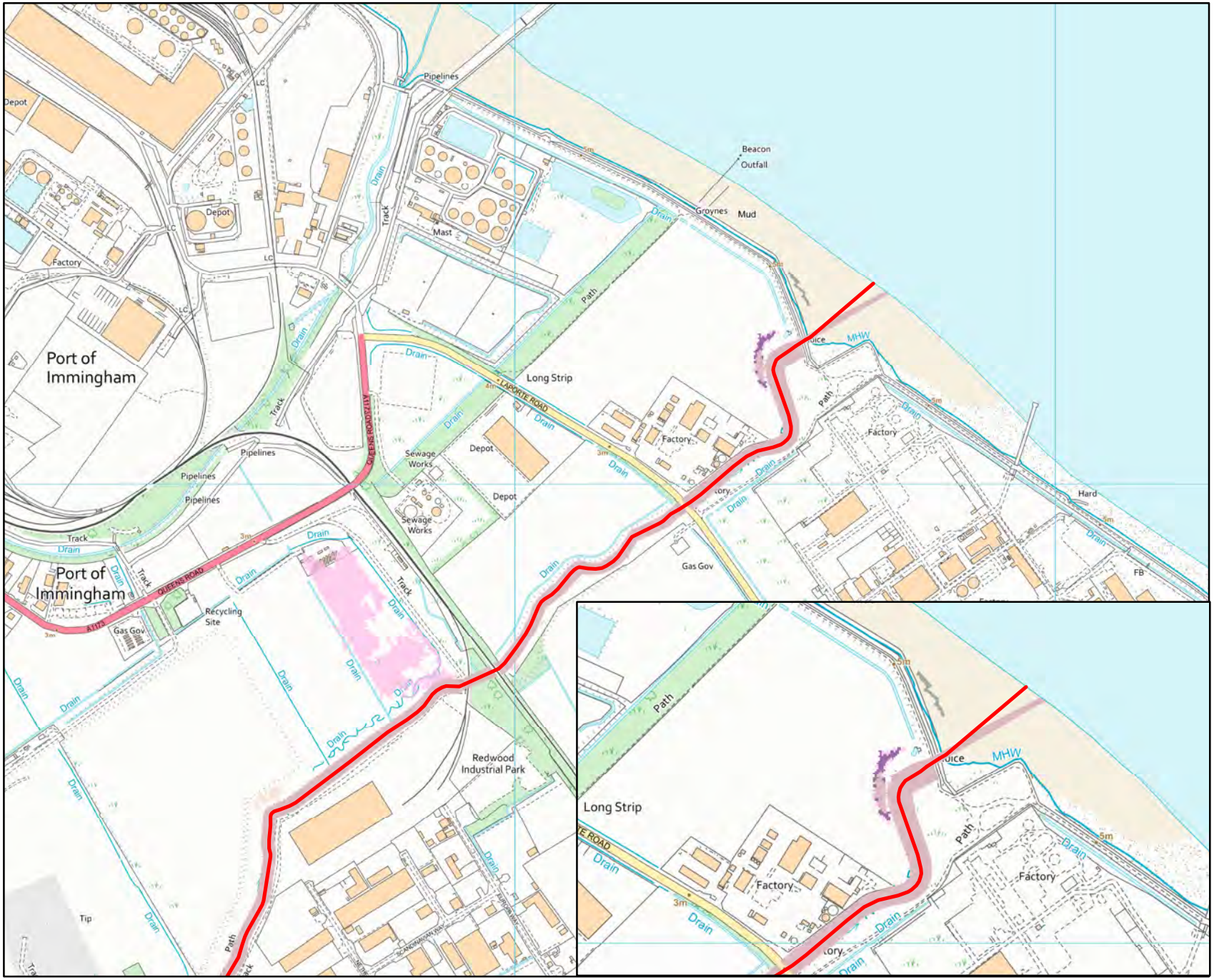
Yours faithfully

[redacted]
Principal Planning Adviser

[redacted]

End

Modelled Flood Extents (with defences) Model: Stallingborough & Oldfleet 2020



Environment Agency

Scale 1:10,000

N W E S

Legend

- Main River
- 2020_Stallingborough_Oldfleet_Undefended_Baseline_1in1000
- 0.1% (1 in 1000) fluvial event
- 0.1% (1 in 1000) inc 20% climate change fluvial event

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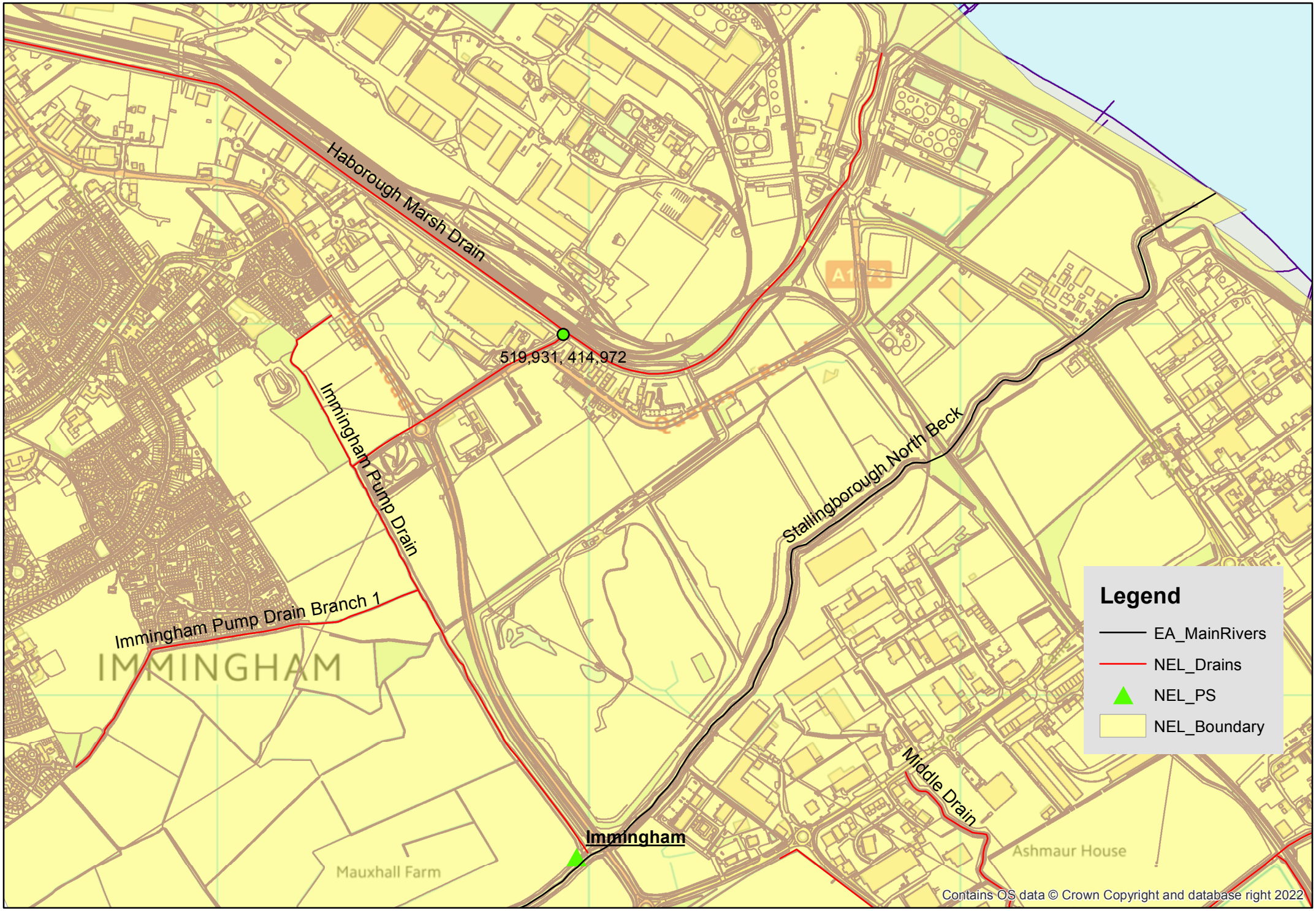
Haborough Marsh Drain
519,931, 414,972
Immingham Pump Drain
Immingham Pump Drain Branch 1
Stallingborough North Beck
Middle Drain
Immingham
IMMINGHAM
Mauxhall Farm
Ashmaur House
Legend
EA_MainRivers
NEL_Drains
NEL_PS
NEL_Boundary
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Annex 2 Site Operation Flood Risk Scenarios

ID 18 FLOOD RISK ASSESMENT OUTLINE
WATER FLOOD RISK ASSESSMENT

Rev 0
Date 01/05/2023
Author S Bradley

Flood Risk Assessment

Flood defence in the area surrounding the Air Products IGET Facility is provided by the Environment Agency, and a comprehensive inspection process assures the integrity of these tidal defences. From publicly available sources the probability of a flood event occurring at Air Products IGET site is low.

The Humber Flood strategy Humber 2100 (https://consult.environment-agency.gov.uk/humber/strategyreview/) points out that the estuary area in which the plant is located is low lying and despite the presence of tidal flood defences, tidal flood risk 'is a reality'.

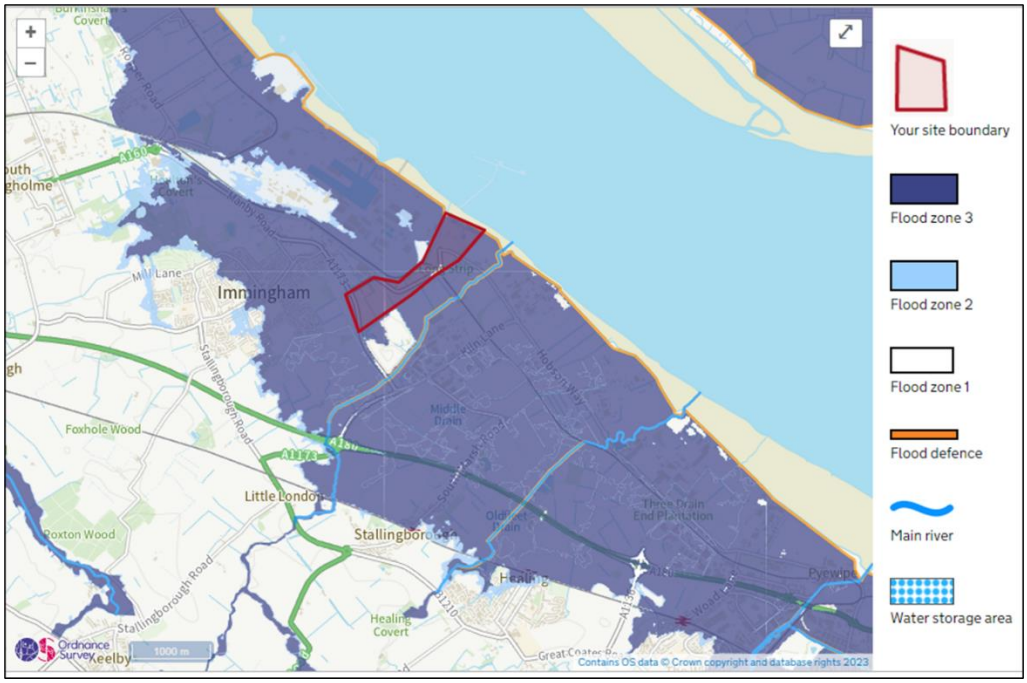
Environment Agency Flood Map for Planning

With flood defences in place the Site is considered low risk which means that each year this area has a chance of flooding of between 0.1% and 1%. The flood zone extents are shown in Figure 1.

Noting that this information is suitable for identifying:

- which parts of countries or counties are at risk, or have the most risk
- areas likely to flood first, deepest or most frequently
- it is very unlikely to be reliable for a local area and extremely unlikely to be reliable for identifying individual properties at risk and does not take into account any flood defences

Figure 1 Flood Zone Extent Map



Historical data
Flood events such as the 2013 tidal surge have impacted the area.

Air Products (AP) has over 750 production sites around the world, so looking at flood event data for Air Products and the industrial gases industry in general.

Two AP UK sites have been impacted by flooding in the last 20 years, in both cases by river flooding. The plant and equipment were shutdown safely and no product releases occurred.

In the most extreme case, our Louisiana liquid hydrogen plant was impacted by Hurricane Katrina. In this case the plant was safely shutdown in advance in response to flood/severe weather warnings and plant integrity was maintained despite catastrophic damage to the surrounding area.

Our other plants in the gulf coast area have been subject to floods, extreme winds, and tidal surges. In no case was there any product lost or major accident scenarios triggered or significant damage to process equipment or product tanks.

Looking at accident databases for our industry such as the EIGA database there are no incidents of flooding causing a major accident hazard.

Generic lessons can be learnt from other industries, however industrial gases are significant differences to oil and gas, chemicals and waste businesses as our major accident hazards derive from refrigerated or compressed gases not hazardous liquids. These refrigerated or compressed gases contained in fixed high integrity containers and the only major hazard impacts are short term and localised.

Flood Protection Philosophy
The IGET facility is designed to receive refrigerated liquid ammonia by ship, which is transferred via pipeline to an ammonia storage facility on the East site. This ammonia will be transferred by pipeline and processed into hydrogen on both the East and West sites and stored as liquid hydrogen on the West site The hydrogen product will then be distributed by road tanker from the West site. ***In the event of severe flood that breaches defences the road connections would be cut/ inoperable (see Figure 1). In addition, ammonia loading from ships at the jetty would not be possible due to sea conditions.***

Therefore, in the event of extreme weather or tidal surge warning, Air Products philosophy will be to shut the facility down, make equipment safe and relocate road tankers elsewhere. This will be done on a precautionary basis several days in advance of the extreme weather.

Scenarios
Air Products has assessed the flood risk and mitigations under three scenarios:

1. Tidal or other flooding where the flood establishes more slowly;
2. Tidal surge type event where the flood defences have been breached or overwhelmed, so as well as the floodwater there is the possibility of fast-moving debris; and
3. Flooding where the surrounding area only is impacted.

Risk	Scenario	Description or additional information	Potential consequence	Safeguard, Mitigation and recovery	Overall risk
Accumulation of water low lying areas	1,2		Deeper water and additional issues accessing site areas	The sites are flat with no significant underground features other than the drainage and systems and so there are no special considerations for site topography.	Low
Impact of debris on plant and equipment	2	There are items of movable equipment, including road tankers on site. As the IGET plant is supplying liquid by road tanker these could be items swept in from surrounding areas	Damage to equipment and releases	**As above in the event of severe weather warning the Site will be shut down , made safe and personnel and mobile equipment evacuated or anchored.** There is fencing and road barriers which would provide limited protection from debris. The main safeguard for the residual risk is the high integrity design the tanks and equipment. Given the low probability and lack of significant damage under even extreme conditions, no additional protection is considered necessary.	Low

Risk	Scenario	Description or additional information	Potential consequence	Safeguard, Mitigation and recovery	Residual risk
Damage to safety critical equipment and utilities	1,2	Impact of flood water on equipment and plant. The process equipment is long life high integrity process plants largely made up of high integrity tanks and equipment that is built to withstand extreme weather conditions such as hurricane, earthquakes and significant debris impacts, in line with what is appropriate for that location.	Product releases	The plant is designed to shut down in the event of loss of power or utilities or control systems. The plant can be shut down remotely but needs on site operator intervention to start up Transformers and critical control infrastructure (PDC buildings) will be located above maximum flood level On the West site the safety systems are all passive, so no power or intervention is needed for these systems to activate. On the East site where the ammonia tank is located the boil off compressor and flare need to continue in operation to prevent an additional ammonia release and will be either located above flood level or suitably protected . In the event this fails there could be an release, but the ammonia release would not be abated.	Medium

Risk	Scenario	Description or additional information	Potential consequence	Safeguard, Mitigation and recovery	Residual risk
Site is cut off ,	1,2,3	The IGET plant can be remotely shut down. The West site plant operations are staffed 24/ 7, how-ever with the majority of people(drivers, maintenance, office staff) being present only during the day	Employees or contractors are stranded, or Site cannot be accessed for necessary activities	**In the event of severe weather warning the Site will be shut down , made safe and personnel and mobile equipment evacuated.** Remote shut down is possible. Plant can be shut down safely without operator intervention or shuts down automatically in the event of power trip or instrument failure. Ensure flood warnings are available for OSC, operations staff, and line manager so that site can be evacuated. Control room building will be designed as a suitable safe haven for a small number of people.	Low

Risk	Scenario	Description or additional information	Potential consequence	Safeguard, Mitigation and recovery	Residual risk
Recovery from floods	1,2	Recovery planning	Products release due to flood damage on start up	Recovery from flood would require full cleaning and removal of debris, appropriate mechanical inspections and a full restoration of utilities, and that the point the normal plant start up and shut down process would be employed , as documented in our site procedures. These conditions are already required for plant start up. As the automated site gate would likely be inoperative another manual gate will be provided for site access which would be kept secure in normal operation and not used	Not applicable to MAH
Climate change impacts	1,2,3	As climate change continues flood events are expected to be more frequent and more severe	Probability of an event	The emergency plan has an annual review and at that time we will assess if any changes are needed, for example by considering changes in the Humber Strategy.	Low
The correct action is not taken in a flooding event	1,2,3	Does everyone know what to do?	Harm to people, product release	Actions will be included in the major emergency plan, Flood scenarios will be regularly used in the annual test.	Low

Assessment of Potential impact of flooding on Air Products operations

Reviewing the hazard scenario document e identified where the initiating event could be a flood or storm surge in addition to the other external events already identified in the based hazop, (hurricane, earthquake etc) , documented in Table 2.

Our operating safety philosophy is that air separation plants are designed to trip safely (cease operating). Sites are designed with on-site storage/back-up to meet customer needs for agreed durations in event of plant trip for whatever reason. So the Hazop considers and addresses causes, consequences, protections and mitigation ONLY for hazards to people or environment created by process deviations. We exclude events that do not create a hazard. Our process vessels are all high integrity pressure vessels designed to cope with foreseeable weather, flood, or earthquake events, so products loss is very unlikely.

In the event of storm or flooding events causing loss of power would just lead to plant shutdown to a fail-safe situation, which is design intent. However also in this case in line with the flood protection philosophy (see above) plant would be shut down in the case of forecast of extreme weather event.

Table 2

#	Hazard description	Applicable to site Y/N	Flood relevant
1	Storage rupture	Y	Y
2	tanker tow away	Y	N
3	pipe work failure	Y	Y
4	fire	Y	N
5	HPU failure	Y	N
6	Toxic cylinder failure	Y	Y
7	cylinder fire	N	N
8	Diesel tank rupture	Y	Y
9	Acetylene cylinder explosion	Y	N
10	Flammable Tube trailer rupture / pipe work failure	Y	Y
11	Pipeline failure	Y	N

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For the other protective systems and measures

- Plant and site shut down.
    - The plant can be shut down remotely but needs on site operator intervention to start up
    - Safety systems are all passive eon the west site
- Ammonia tank area
    - Boil off gas and flare system will have flood protection.
- Preventative Maintenance Inspection & test regimes-
    - Clearly damage could be caused by floods, and short-term preventive maintenance would be suspended but these would be adjusted, and an appropriate inspection would be required before plant start up
- Traffic plan, Site security fencing and Physical protection from ground vehicles and flood emergency plan to remove all vehicles from site.
    - These would help mitigate flood impacts in scenario 2
- Control systems and electrical switchgear
    - Located above maximum flood levels.
- Pressure relief system
    - is located at height.
- Pressure control feedback (alarm and trip), Liquid level control (alarm and trip)
    - could be impacted by water but are located at height.
    - all designed to fail safe.

Whist there are potential Major Accident Hazard Scenarios that could take place as a result of flooding, and storm surges there are sufficient mitigations in place to prevent releases that could lead to a major accident.

Hydrogen

Properties of Hydrogen

Hydrogen is not significantly reactive. Hydrogen is not corrosive but depending on temperature, pressure and other conditions it can cause embrittlement of certain steels. From the chemical point of view, hydrogen is a reducing agent. Hydrogen is flammable and therefore presents a possible explosion hazard.

Hydrogen is easily ignited; its minimum ignition energy is very low (19μJ). In practice hydrogen venting or leaking to atmosphere, particularly from a pressure source can ignite due to electrostatic or selfigniting impurities in the hydrogen.

Hydrogen burns with a hot flame. Burning hydrogen produces no soot. Therefore, the flame is pale, colourless and almost invisible in daylight.

The heat radiated by a hydrogen flame is relatively low (only 10 percent that of propane). Therefore, a hydrogen flame gives little warning of its presence either by sight or heat. The range of flammability both in air and oxygen is wide (4-75%).

Confined mixtures of hydrogen and air or oxygen explode very strongly and can detonate (typical explosivity range in air is 16-56%). An unconfined gas cloud explosion of hydrogen is very unlikely to occur and to date such a detonation has not been observed. Hydrogen flames, especially those emanating from a high-pressure source, are extremely difficult to extinguish. The preferred method of extinguishing a hydrogen flame is to shut off the flow

Ammonia

Ammonia is both toxic and flammable , The consequences of an ammonia release are potential toxic effects to personnel

Properties of Ammonia

https://pubchem.ncbi.nlm.nih.gov/compound/Ammonia#section=Drug-Warnings [hyperlink removed]

- A peer-reviewed paper on our 'Red Squirrel' Ammonia Field Experiments, to be published in the AIChE Process Safety Progress (PSP) Journal, is now available via Open Access from the Wiley publishing company. It can be better viewed in pdf format (from this link): https://aiche.onlinelibrary.wiley.com/doi/full/10.1002/prs.12454 [hyperlink removed]
- At room temperature, ammonia is a colorless, highly irritating gas with a pungent, suffocating odor.
- In pure form, it is known as anhydrous ammonia and is hygroscopic (readily absorbs moisture).
- Ammonia has alkaline properties and is corrosive.
- Ammonia gas dissolves easily in water to form ammonium hydroxide, a caustic solution and weak base.
- Ammonia gas is easily compressed and forms a clear liquid under pressure.
- Ammonia is not highly flammable
- ERPG
    - RPG-3 is the maximum airborne concentration below which nearly all individuals could be exposed for up to 1 hour without experiencing or developing life-threatening health effects.
    - ERPG-2 is the maximum airborne concentration below which nearly all individuals could be exposed for up to 1 hour without experiencing or developing irreversible or other

serious health effects or symptoms which could impair an individual's ability to take protective action.
    - ERPG-1 is the maximum airborne concentration below which nearly all individuals could be exposed for up to 1 hour without experiencing more than mild, transient adverse health effects or without perceiving a clearly defined objectionable odor.
- **AEGLs (Acute Exposure Guideline Levels)**

Final AEGLs for Ammonia (7664-41-7)			
Exposure Period	**AEGL-1**	**AEGL-2**	**AEGL-3**
10 minutes	30 ppm	220 ppm	2700 ppm
30 minutes	30 ppm	220 ppm	1600 ppm
60 minutes	30 ppm	160 ppm	1100 ppm
4 hours	30 ppm	110 ppm	550 ppm
8 hours	30 ppm	110 ppm	390 ppm

- (NAC/NRC, 2022)
- **ERPGs (Emergency Response Planning Guidelines)**

Chemical	ERPG-1	ERPG-2	ERPG-3
Ammonia (7664-41-7)	25 ppm ✪	150 ppm	1500 ppm

- ✪ indicates that odor should be detectable near ERPG-1.
- (AIHA, 2020)