KEEPING BRITAIN TRADING

IMMINGHAM EASTERN RO-RO TERMINAL

Environmental Statement: Volume 3
Appendix 11.1: Flood Risk Assessment
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AECOM

Immingham Eastern Ro-Ro Terminal

Flood Risk Assessment

Associated British Ports (ABP)

December 2022

Delivering a better world

Quality information

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Revision History

Revision	Revision date	Details	Authorised	Name	Position
2	22/11/2022	Technical review (final)	Y	BM	Associate

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1. Introduction

1.1 Commission

1.1.1 AECOM Limited (AECOM) has been commissioned by Associated British Ports (ABP) (known as 'The Client' hereafter) to produce a Flood Risk Assessment (FRA) to support a Development Consent Order application for the proposed Immingham Eastern Ro-Ro (roll-on roll-off) Terminal (IERRT), a new terminal located at the Port of Immingham (the 'IERRT project'). The IERRT project is located at the Port of Immingham, DN40 2LZ (the 'Site').

1.2 Background

1.2.1 The Site is located on the eastern side of the Port of Immingham, approximately 2.4 km north-east of Immingham. The works are proposed to provide a service for the embarkation and disembarkation of commercial and automotive traffic. The IERRT project will require marine works within the Humber Estuary and landside works on the existing statutory port estate.

1.2.2 The Environment Agency Flood Map for Planning (FMfP) available online[1] (and reproduced as Image 4.2 in this FRA), shows the Site is located in Flood Zone 3a (due to the presence of flood defences along the Port of Immingham and estuary frontage). The definition of flood zones, according to the Planning Practice Guidance2 (PPG), are summarised in Table 1.1 below.

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), however, the National Planning Policy Framework (NPPF) (Ministry for Housing, Communities and Local Government (MHCLG), 2021) sets out the Government's planning policies for England. The NPS for ports makes reference to the guidance supporting the planning system in respect of flooding which includes the Flood Risk and Coastal Change Planning Policy Guidance (PPG) (DLUHC,2022) 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] Environment Agency. Flood Map for Planning. Available at: https://flood-map-for-planning.service.gov.uk/
[2] Communities and Local Government, (2021); Planning Practice Guidance. Available at: http://planningguidance.planningportal.gov.uk

Table 1.1 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)	This zone comprises land where water from rivers or the sea 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

Source: Planning Practice Guidance (2022)

1.3 Scope of services

1.3.1 The aim of this study is to undertake a FRA that is appropriate to the nature and scale of the IERRT project. The FRA determines flood risk posed to the Site and arising as a result of the IERRT project and recommends suitable mitigation measures where required.

1.3.2 The objectives of this report are to:

- Consult with the Environment Agency, North East Lincolnshire Council (in their role as Lead Local Flood Authority (LLFA)), and North East Lindsey Internal Drainage Board (IDB) (via the Witham IDB) in relation to flood risk and their requirements for management of any risk (consultation responses are presented as Annex A);
- Collect and review existing information relating to flood risk posed to the Site from all sources (including tidal, fluvial, surface water, groundwater, artificial sources and sewer and drainage infrastructure);
- Assess the flood risk both to the Site and from the site to the surrounding area under existing and post-development conditions (taking into account climate change); and

- Outline any mitigating measures needed to ensure the IERRT project and its users will be safe for the operation of the IERRT project and to avoid any impacts off site in respect of flood risk.

1.4 Data Sources

1.4.1 The baseline conditions for the Site have been established through a desk study using publicly available information. This information has been utilised to inform the assessment made within the FRA.

1.4.2 Data collected and used to inform this assessment is summarised in Table 1.2.

Table 1.2 Sources of data reviewed

Purpose	Data Source	Comments
Identification of Hydrological Features	1: 10,000 Ordnance Survey (OS) mapping	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[3]	Identifies historical land use change and hydrological features over the last 176 years.
Identification of Existing Flood Risk	Environment Agency FMfP1	Identifies fluvial/ tidal flood inundation extents.
	Environment Agency Long Term Flood Risk Maps[4]	Identification of flood risk from surface water and reservoirs.
	Environment Agency Groundwater Conditions Map[5]	Identification of groundwater designations through geology.
	Grimsby and Ancholme: Catchment Flood Management Plan[6] North East Lincolnshire Council Preliminary Flood Risk Assessment (PFRA)[7] North East Lincolnshire Council Strategic Flood Risk Assessment (SFRA) – 2011[8]	Assesses flood risk across the North East Lincolnshire Council boundary area. Includes flood risk from fluvial/ tidal, sewers, overland flow and groundwater.

[3]Ordnance Survey. Maps from 1857-1986. Available at: http://www.oldmapsonline.org/
[4] Environment Agency. Flood Risk from Surface Water Available at: https://flood-warning-information.service.gov.uk/long-term-flood-risk/map?map=SurfaceWater
[5] Environment Agency. Groundwater. Available at: http://magic.defra.gov.uk/MagicMap.aspx
[6] Environment Agency (2009). Grimsby and Ancholme: Catchment Flood Management Plan. Available at: https://www.gov.uk/government/publications/grimsby-and-ancholme-catchment-flood-management-plan
[7] North East Lincolnshire Council Preliminary Flood Risk Assessment (PFRA). Available at: https://www.nelincs.gov.uk/keeping-our-area-clean-and-safe/flooding/flood-strategies-and-investigations/
[8] North East Lincolnshire Council (2011). Strategic Flood Risk Assessment (SFRA). Available at: https://www.nelincs.gov.uk/planning-and-building-control/planning-policy/the-local-plan/local-plan-background-information/strategic-flood-risk-assessment-2011-sfra/

Purpose	Data Source	Comments
	North East Lincolnshire Council Local Flood Risk Management Strategy (2015) (LFRMS)[9] Consultation with Environment Agency, North East Lincolnshire Council and North East Lindsey IDB (Annex A)	
	British Geological Survey (BGS) records[10] Immingham Eastern Ro-Ro Terminal Phase 1 Desk Study[11]	Provides details of geology and hydrogeology in the vicinity of the Site.
Identification of Historical Flooding	North East Lincolnshire SFRA North East Lincolnshire PFRA Consultation with Environment Agency and North East Lincolnshire Council and North East Lindsey IDB (Annex A to this FRA)	Provides details of historical flooding.
Details of the Proposed Development	Layout Plans (refer to the General Arrangement Plans, engineering drawings and relevant sections at Application Document Reference Number 2.5 and 2.6)	Provides a layout of the IERRT project.
Existing drainage layout and management of surface water post-development	IERRT Drainage Strategy[12] (Annex B to this FRA)	Provides a plan of the existing surface water drainage system and details how surface water will be managed post-development, including restricted discharge rates, proposed discharge locations and attenuation storage.

[9] North East Lincolnshire Council (2015). Local Flood Risk Management Strategy. Available at: https://www.nelincs.gov.uk/keeping-our-area-clean-and-safe/flooding/flood-strategies-and-investigations/
[10] British Geological Survey (BGS) records. Available at: https://www.bgs.ac.uk/map-viewers/geology-of-britain-viewer/
[11] Immingham Eastern Ro-Ro Terminal Phase 1 Desk Study
[12] Jacobs (2022) Drainage Strategy Immingham Eastern Ro-Ro Terminal, Document Reference B2357300-UT-TN-0001

2. Site information

2.1 Site location and context

2.1.1 The Site is located adjacent to the main deep-water shipping channel at the Port of Immingham, approximately 2.4 km north-east of Immingham. The land side IERRT project areas are located within the eastern and south-eastern area of the Port of Immingham, centred on Ordnance Survey (OS) National Grid Reference (NGR) TA 19976 16154, and are predominantly brownfield in nature comprising the operational port facilities or recently vacant land. The IERRT project boundary is presented in Image 2-1).

2.1.2 The most northern section of the Site is located marine side within the Humber Estuary where the proposed terminal jetty will be positioned. The remainder of the northern area is landside and currently comprised of a number of discrete operational areas used in connection with the handling of bulk commodities such as liquid fuels, solid fuels and ores, as well as Ro-Ro freight, that are handled from in-river jetties. These include the Eastern and Western Jetties, the Immingham Oil Terminal (IOT), the Immingham Gas Terminal, Immingham Outer Harbour (IOH) and the Humber International Terminal (HIT).

2.1.3 The landside area of the Site lies adjacent to the Humber Estuary and access is gained via Queens Road through the East Gate of the Port.

2.1.4 Table 2.1 below summarises the key features and current land use of the area surrounding the Site.

Table 2.1 Summary of surrounding land use

Direction	Land use summary
North	The majority of the Port of Immingham lies directly to the north-west of the Site. There are a number of industrial and operational land uses located within this area including electrical sub stations, freight shipping companies, biofuels company, heating oil supplier and several warehouses and liquid storage tanks. The IERRT project marine works are located within the Humber Estuary. To the north-east/ east of the IERRT project marine works lies an existing jetty with associated bulk liquid pipelines and mooring equipment. Beyond this the Humber Estuary continues for approximately 2.5 km.
East	Habrough Marsh Drain is located along the eastern boundary of the Site and beyond this is the land side tank farm that forms part of the APT facility. Further east of the Site the land use comprises industrial use, agricultural fields and the Humber Estuary.
South	Railway sidings are located along the southern border of the Site boundary, running from north-west to south-east. Beyond the railway sidings lies Habrough Marsh Drain and several industries located further to the south of the Site. These include shipping companies, waste management companies, manufacturing plants, power plants and electrical sub stations. The area south of this is predominantly dominated by agricultural fields. The nearest

Direction	Land use summary
	residential properties are on Queen's Road, approximately 200 m south of the Site. The A180 road lies approximately 2.3 km south.
West	Railway lines are located to the south/ south-west of the Site beyond which lies the Habrough Marsh Drain and various industrial and commercial sites. The town of Immingham is located approximately 500 m west/ south-west of the Site. The land beyond the town predominantly consists of agricultural fields.

2.2 Local water features

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

- Tidal River: The Humber Estuary originates at Trent Falls, by the confluence of the tidally influenced rivers Ouse and Trent and flows south-east into the North Sea;
- Environment Agency Main River: Stallingborough North Beck Drain flows into the Humber Estuary approximately 0.9 km south-east of the Site. 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 Stallingborough North Beck discharges by gravity, via a sluice gate, into the Humber Estuary;
- Ordinary Watercourses: Habrough Marsh Drain, an ordinary watercourse under the jurisdiction of the North East Lindsey IDB, drains a significant proportion of Immingham Dock. The watercourse largely skirts the southern and western perimeters of the port estate and flows from west to east adjacent to the southern site boundaries. The watercourse discharges partly to the Humber Estuary and partly to the Stallingborough North Beck through the Immingham Pumping Station, located to the west of Kings Road where the road crosses the watercourse; and
- Numerous drains and small watercourses located in proximity to the Site and the wider Port of Immingham which form part of the North East Lindsey IDB land drainage system for the low-lying coastal area.

2.2.2 There are no other surface water features located in the area local to the Site. Figure 11.1 in Volume 2 of the Environmental Statement (Application Document Reference number 8.3) shows the location and names of various watercourses present within the study area.

2.3 Historical land use and water features

2.3.1 Historical OS mapping dating from 1887 to the present day was reviewed. The earliest known mapping shows undeveloped agricultural land and a sluice prior to the development of Immingham Dock in 1912. The original Dock was enclosed and had an entrance lock. Much of the existing structures have since been removed following changes to the trade through the port. Three pairs of lock gates now provide entrance and exit to the Dock, with the addition of many new structures that extend out to sea. The Stallingborough North Beck Drain and Habrough Marsh Drain watercourses are configured as they exist today.

2.4 Topography

2.4.1 Review of the OS mapping indicates that the Site is generally flat with ground elevation generally between 4.6 m and 5.5 m above ordnance datum (AOD). Levels tend to be higher in the north and west of the Site falling away to the south and east.

2.5 Geology and hydrogeology

2.5.1 Information considered pertinent to the Site has been taken from the Phase 1 Geo-Environmental Report[13] at Appendix 12.1 of Volume 3 of the ES (Application Document Reference number 8.4) and is summarised in Table 2.2.

Table 2.2 Geological and hydrogeological information for the Site

Stratum		Expected Location	Aquifer Status
Artificial	Made Ground (variable composition)	Entire Site. There are also some small areas of infilled ground indicated on mapping. This is congruent with the development history of the Site.	N/A
Superficial	Tidal Flat Deposits – Clay and Silt, consist of unconsolidated sediment, mainly mud and/or sand. They may form the top surface of a deltaic deposit, which is normally a consolidated soft silty clay, with layers of sand, gravel and peat.	The majority of the Site, apart from the bank of the Humber Estuary.	Unproductive Aquifer – Rock layers or drift deposits with low permeability that have negligible significance for water supply or river base flow.
	Beach and Tidal Flat Deposits (undifferentiated) – Clay, Silt, and Sand Composite of 'Beach deposits' and 'Tidal Flat Deposits'. Beach deposits comprise shingle, sand, silt and clay, which may be bedded or chaotic. Beach deposits may be in the form of dunes,	Along the bank of the Humber Estuary.	Secondary Undifferentiated Aquifer – Assigned where it is not possible to attribute either category A or category B to a rock type. Layers have previously been designated as both minor and non-aquifer in different locations due to the variable characteristics of rock type.

[13] AECOM (2022) IERRT Phase 1 Geo-Environmental Report

Stratum		Expected Location	Aquifer Status
	sheets or banks. The Tidal Flat deposits are commonly silt and clay with sand and gravel layers, possible peat layers from the tidal zone.		
	Devensian Till (Glacial Till). Likely comprising a mixture of clay, sand, gravel, and boulders.	Entire Site, underlying the Beach and Tidal Flat deposits.	Unproductive Aquifer – Rock layers or drift deposits with low permeability that have negligible significance for water supply or river base flow.
Solid Geology	Burnham Chalk Formation. White, thinly bedded chalk with common tabular and discontinuous flint bands; sporadic marl seams.	The north-west arm of the Site.	Principal Aquifer – Layers of rock or drift deposits that have high intergranular and/or fracture permeability, meaning they usually provide a high level of water storage. They may support water supply and/or river base flow on a strategic scale.
	Flamborough Chalk Formation. White, well-bedded, flint-free chalk with common marl seams (typically one per metre). Common stylolitic surfaces and pyrite nodules.	The majority of the Site, apart from the north-west arm.	Principal Aquifer

Source: Immingham Eastern Ro-Ro Terminal Phase 1 Desk Study 2022

Groundwater levels

2.5.2 During the GD Pickles Ltd 2020 Ground Investigation[14] at Appendix 12.2 of Volume 3 of the ES, two groundwater bodies were observed and are considered to be perched groundwater within the Made Ground and at the boundary of the Made Ground and Tidal Flat Deposits. Observed groundwater was recorded at 3.6 m below ground level (bgl). The report noted that sub artesian pressures build up underneath Tidal Flat Deposits and Boulder Clay.

2.6 The proposed development

2.6.1 The IERRT project involves the construction of a new terminal within the eastern sector of the Port of Immingham. A visual representation of the IERRT project, for illustrative purposes only, is shown in Image 2.1 and is described further below.

[14] GD Pickles Ltd. (2020). Geoenvironmental Investigation Report

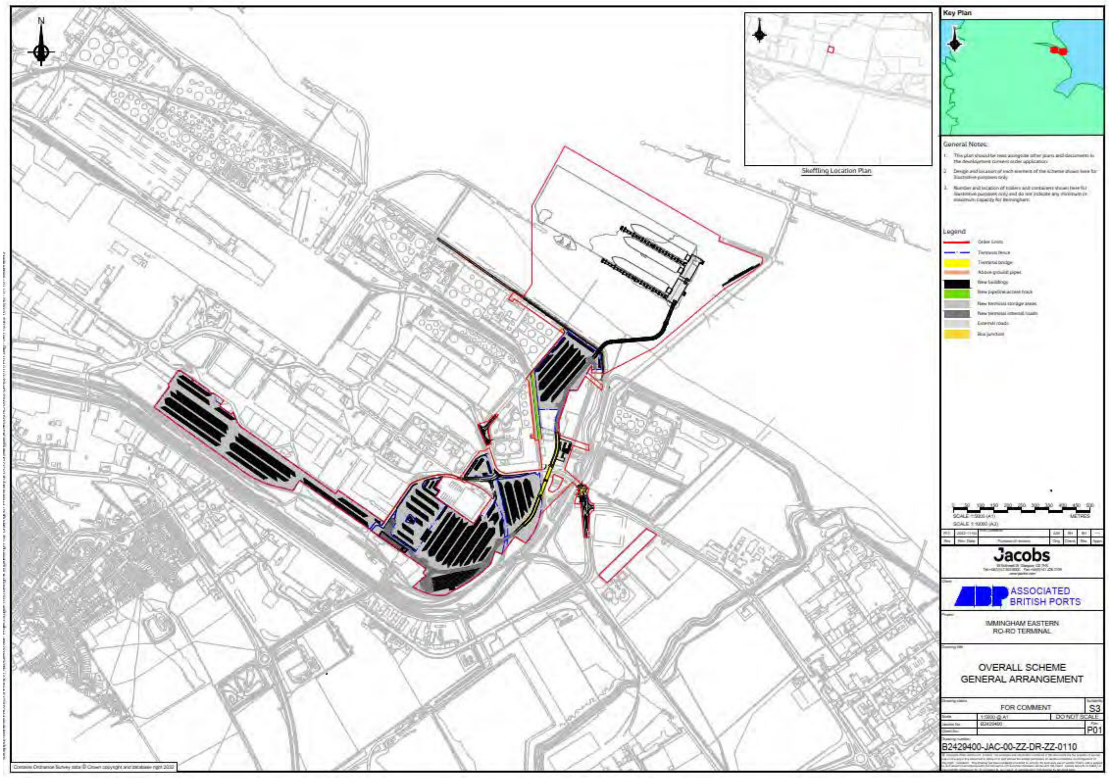


Image 2.1 Visual representation of the proposed development (for illustrative purposes only)

Marine works:

2.6.2 The following provides a brief description of the marine infrastructure of the proposed IERRT project. Further details are described in ES Volume I Chapter 2: Proposed Development (Application Document Reference number: 8.2):

- An open piled approach jetty with abutments will be constructed to provide access for vehicles and wheeled cargo between the shore and the berthing infrastructure. The approach jetty will rise from ground level and cross over the existing sea defence wall and pipelines from the land and extend from the shore across the intertidal area towards the pontoons and berthing infrastructure in a roughly northeastern direction. A roadway, a separate footway, utilities including cable management for the shore power systems, power and lighting, and environmental screens to minimise bird disturbance during operation (see the Nature Conservation and Marine Ecology chapter (Chapter 9) of the ES for further details) will be constructed on the surface of the approach jetty;
- A single linkspan bridge will be constructed, carrying a roadway, a separate footway, lighting, utilities and environmental screens. The linkspan will extend in a generally northerly direction acting as a link between the approach jetty and the floating pontoons allowing vehicles and cargo to transfer:
- Two floating pontoons will be provided, with each one located to accommodate the loading and unloading ramps of berthed ro-ro vessels. Each pontoon will be constructed from steel and/or concrete and

equipped with lighting, power and a small crew shelter. The pontoons will be linked together by a short linking bridge and will provide the resting point for the moored vessels' stern ramp and the linkspan bridges. The pontoons will each be secured in place by two reinforced concrete restraint dolphins which will ensure the pontoons can range up and down freely with the tide;

- Positioned perpendicular to each floating pontoon and extending away in a north westerly direction, two open piled finger piers with concrete decks will be constructed for the ro-ro vessels to berth against. Each pier will include; navigation markers, lighting, shore power infrastructure, cable management and connections for berthed vessels, and water bunkering facilities. The northern finger pier will be constructed with berthing faces (lined with fender panels and equipped with mooring infrastructure such as fixed bollards and/or quick-release hooks) on both its northern and southern elevations. The southern finger pier will be constructed with a berthing face to its northern elevation only (it will also be lined with fender panels and equipped with mooring infrastructure such as fixed bollards and/or quick-release hooks). Therefore, vessels will berth on either side of the northernmost pier (i.e., providing two berths) and one vessel will berth on the northern side of the southernmost pier (i.e., providing one berth); and,
- The proposed development will require a capital dredge of the new berthing area to ensure accessibility and safe mooring for vessels at all states of the tide. For further details regarding the capital dredge, including details of disposal of dredge material, please refer to ES Volume I Chapter 2: Proposed Development.

2.6.3 Landside works are primarily required to improve that part of the project application site's surface so as to provide suitable areas to accommodate wheeled cargo, containers, and heavy goods vehicles (HGVs) either awaiting embarkation or collection, together with essential storage.

2.6.4 Being part of the statutory and operational port estate, the vast majority of the landside area will only require a simple upgrade. This will be achieved through the provision of new pavements and associated infrastructure. Some peripheral parts of the areas which will be used for waiting vehicles/cargo trailers are likely to require additional ground works.

2.6.5 Further built infrastructure is also required within the project application site to facilitate the transport of wheeled cargo within the Terminal, which is explained in more detail below.

2.6.6 The Terminal is proposed to be separated into four distinct areas. These will be known as the North Storage Area, Central Storage Area, South Storage Area, and West Storage Area as shown on Figure 1.3 to the ES (Volume 2). The specific landside works associated with each area is outlined below. Please refer to ES Volume I Chapter 2: Proposed Development for further details;

- North storage area – just over 4ha in size with provision of approximately 238 trailer bays and 38 container (40 ft) ground slots. The bays and parking spaces will consist of paved areas with spaces marked out with painted lines. Construction of a new substation and provision of an area for the siting of frequency converter for ship to shore power provision. The new substation will provide all power to the new berths, and yard including; small power, closed-circuit television (CCTV) and lighting;

- Central storage area – approximately 3.56 ha with provision of 157 trailer bays, 71 staff parking spaces, and 13 equipment parking spaces. The parking spaces and bays will consist of paved areas with spaces marked out with painted lines. A small workshop with fuel station will also be provided. A new level crossing across an ABP controlled railway will also be undertaken to join the South Storage Area and Central Storage Area;
- South storage area – anticipated to cover just over 11 ha and will include provision for approximately 409 trailer bays, 78 pre-gate parking spaces, 80 staff parking spaces, 40 passenger parking spaces, 14 large passenger parking spaces, 18 tugmaster parking spaces, and marshalling/holding lanes for accompanied freight and passenger vehicles. The parking spaces and bays will consist of paved areas with spaces marked out with painted lines. The main terminal building, limited to two storeys in height, will be constructed within the South Storage Area. In addition, ancillary buildings will be constructed including in and out gates, a welfare building for HGV drivers and passengers awaiting embarkation, and inspecting and administrative buildings for the UK Border Force. The buildings themselves will not exceed two storeys in height and will generally resemble the style of buildings that already exist within the port estate; and
- West storage area – anticipated to be approximately 9.6 ha in size and provide approximately 630 trailer bays. The trailer bays will consist of paved areas with spaces marked out with painted lines. In and out gates will also be provided.

2.6.7 A two-lane bridge to ensure contiguous terminal operations between the currently separate North Storage Area and Central Storage Area is required to span Robinson Road – an existing dock road – and an ABP controlled railway line. The bridge has been designed to British Standards and will include lighting and utilities. Works to the south of the North Storage Area also require the demolition of four existing buildings, as well as the demolition of an extension of another building. The facilities provided by two of these buildings and the extension, used by Drurys Engineering Services Limited, will be moved to another existing adjacent building. The other two buildings, used by Malcolm West Forklifts, will be replaced and re-constructed to the east of their current location.

2.6.8 As part of the IERRT project, improvements will also be made to the East Gate entrance to the Port. This is required in order to facilitate the additional movement of vehicles through the East Gate. The existing gate house will be demolished, and the existing entrance road will be widened by approximately 4 m to accommodate an extra inbound lane with a newly constructed security gate house. The new second entry lane will allow a higher volume of traffic (broadly double) to access the Port during each hour assisting the processing of vehicles arriving at the Port of Immingham.

2.6.9 Access to and from the proposed development will be achieved via remotely operated barriers. Rather than operate a gatehouse system, it is currently envisaged that when drivers report in, they will park in the pre-gate parking area and walk on foot to the check-in facilities in the main terminal building with paperwork to be processed. Once check-in has been completed, the drivers will make their way back to their vehicles and enter the terminal through the gates.

2.6.10 For further information on the IERRT project layout please refer to the General Arrangement Plans, engineering drawings and relevant sections at Application Document Reference Number 2.5 and 2.6.

2.6.11 Appropriate drainage (see Drainage Strategy provided as Annex B) and services infrastructure will also be provided throughout the new terminal areas as necessary.

3. Planning policy and guidance

3.1.1 This section of the FRA considers the planning policies and guidance of relevance to the IERRT project with regards to flood risk from all sources and appropriate mitigation measures which should be considered.

3.2 National planning policy context

National Policy Statement for Ports

3.2.1 The NPSfP[15] is the framework for decisions on proposals for new port development that are Nationally Significant Infrastructure Projects (NSIPs). 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).

3.2.2 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).

3.2.3 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).

3.2.4 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*".

3.2.5 The minimum requirements for FRAs are that they should:

- *Be proportionate to the risk and appropriate to the scale, nature and location of the project;*
- *Consider the risk of flooding arising from the project, in addition to the risk of flooding to the project;*
- *Take the impacts of climate change into account, clearly stating the development lifetime over which the assessment has been made;*
- *Be undertaken by competent people, as early as possible in the process of preparing the proposal;*
- *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;*
- *Consider the vulnerability of those using the Site, including arrangements for safe access;*
- *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;*
- *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;*
- *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;*
- *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;*
- *Consider if there is a need to be safe and remain operational during a worst-case flood event over the development's lifetime; and*
- *Be supported by appropriate data and information, including historical information on previous events.*

UK Marine Policy Statement (MPS)

3.2.6 The Marine Policy Statement[16] 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.

3.2.7 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*

[16] HM Government. (2011). UK Marine Policy Statement [Online] Available at: https://www.gov.uk/government/publications/uk-marine-policy-statement/ (accessed December 2021).

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

3.2.8 The first Marine Plans include the East Inshore and East Offshore Marine Plans, which are collectively referred to as 'the East Marine Plans[17]'. These were formally adopted on 2 April 2014. The East Inshore Marine Plan area covers 6,000 km² 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 49,000 km² of area from the 12 nautical mile limit to the border with The Netherlands, Belgium and France.

3.2.9 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)

3.2.10 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."

3.2.11 Policy CC1 is consistent with, and adds marine planning context to, the National Planning Policy Framework (see below) 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.

National Planning Policy Framework

3.2.12 Whilst not the primary planning policy document for NSIP port developments, the NPPF sets out the Government's planning policies for England. The NPPF and associated Planning Policy Guidance (PPG) documents, including the Flood Risk and Coastal Change PPG, last revised in August 2022, states that inappropriate development in areas at risk of flooding should be avoided by directing development away from areas at highest risk (whether existing or future). Where development is necessary in such areas, the development should be made safe for its lifetime without increasing flood risk elsewhere.

[17] Department for Environment, Food and Rural Affairs. (2014). East Inshore and East Offshore Marine Plans

3.2.13 The NPPF and PPG are taken into account in the preparation of local and neighbourhood plans and are a material consideration in planning decisions. It constitutes guidance for local planning authorities (LPAs) and decision-takers, both in drawing up plans and as a material consideration in determining applications.

3.2.14 The NPPF states that "*when determining planning applications, Local Planning Authorities (LPA) should ensure that flood risk is not increased elsewhere. Where appropriate, applications should be supported by a site-specific Flood Risk Assessment. 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 Systems (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.*

3.2.15 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".*

The sequential and exception tests

3.2.16 The overall aim of the Sequential Test is to steer new development to areas designated as Flood Zone 1. Where there are no reasonably available sites in Flood Zone 1 areas, LPAs allocating land in Local Plans or determining planning applications for development at any particular location should take into account the flood risk vulnerability of land uses and consider reasonably available sites in Flood Zone 2 areas, applying the Exception Test if required. Only where there are no reasonably available sites in Flood Zone 1 or 2 areas 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.

3.2.17 For the Exception Test to be passed:

- It must be demonstrated that the development provides wider sustainability benefits to the community that outweigh flood risk, informed by a SFRA where one has been prepared; and

- A site-specific FRA must demonstrate that the development will be safe for its lifetime taking account of the vulnerability of its users, without increasing flood risk elsewhere and, where possible, will reduce flood risk overall.

3.2.18 Where applicable, both elements of the test will have to be passed for development to be allocated or permitted.

Development and flood risk vulnerability

3.2.19 The NPPF considers the vulnerability of different forms of development to flooding and classifies proposed uses accordingly.

3.2.20 Section 7, Paragraph 066 of the PPG illustrates a matrix which identifies which vulnerability classifications are appropriate within each flood zone. This can be seen below in Table 3.1.

Table 3-1 Flood risk vulnerability and flood zone compatibility

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*

3.2.21 The NPSfP, which takes precedent in terms of NSIP developments, states that port development is considered ‘water compatible’.

3.2.22 The Environment Agency FMfP indicates the Site is located in Flood Zone 3, and as such, based on the classification shown in Table 3.1, water compatible development is acceptable within all flood zones.

3.2.23 The coastal plain between Grimsby and East Halton Skitter, including the location of the IERRT project, has been allocated for estuary related development in the NELC Development Plan. The IERRT project is located within an employment zone and will provide jobs to the local community alongside many industrial benefits.

3.2.24 The Planning Statement submitted as part of the IERRT application explains further how the Sequential and Exception Tests apply to the IERRT project and how the project meets the relevant requirements of those tests.

3.3 Local planning policy

North East Lincolnshire Council Local Plan

3.3.1 The IERRT project is located within the administrative area of North East Lincolnshire Council. The existing North East Lincolnshire Local Plan[18] was adopted in 2018 and covers the period 2013 to 2032 and includes policies that are of relevance to coastal protection, flood risk and drainage:

- Policy 6 – *The Council will work with developers and partner organisations to ensure the delivery of infrastructure, services, and community facilities necessary to develop and maintain sustainable communities*; and
- Policy 33 – *Flood Risk. 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.*

  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. *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*.

[18] North East Lincolnshire Council (2018) Local Plan. Available at: https://www.nelincs.gov.uk/planning-and-building-controhttps://www.nelincs.gov.uk/planning-and-building-control/planning-policy/the-local-plan/

3.4 Other relevant policy and guidance

The National Flood and Coastal Erosion Risk Management Strategy for England

3.4.1 The Environment Agency's National Flood and Coastal Erosion Risk Management Strategy for England[19] provides the overarching framework for future action by all risk management authorities to tackle flooding and coastal erosion in England.

3.4.2 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*.

3.4.3 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.

Shoreline Management Plan 3: Flamborough Head to Gibraltar Point

3.4.4 Shoreline Management Plan (SMP) 3: Flamborough Head to Gibraltar Point[20] 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,

[19]Environment Agency (2020) National Flood and Coastal Erosion Risk Management Strategy for England
[20] Scott Wilson (2010) Humber Estuary Coastal Authorities Group Flamborough Head to G braltar Point Shoreline Management Plan. Non-Technical Summary

environmental and financial costs involved, and avoiding adverse impacts on adjacent coastal areas.

3.4.5 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 Flood Risk Management Strategy

3.4.6 The Humber Strategy[21] 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.

3.4.7 The Site is situated within Flood Area 24 (Immingham to West Grimsby) in the Humber Flood Risk Management Strategy (Humber FRMS). In line with the SMP, the preferred management option is "*to HTL for the 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*". It is ABP's intention that the coastal defences (owned by ABP) on site at the Port of Immingham will be maintained and upgraded in order to implement this policy.

Grimsby and Ancholme Catchment Flood Management Plan (CFMP)

3.4.8 In 2009, a CFMP was produced by the Environment Agency for the Grimsby and Ancholme catchment[22] 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 IERRT 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.

3.4.9 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*.

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

3.4.10 As LLFA, North East Lincolnshire Council has a responsibility to develop a LFRMS[23] 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.

[21] Environment Agency (2008) The Humber Flood Risk Management Strategy. Summary Document March 2008, Planning for the rising tides
[22] Environment Agency (2009) Grimsby and Ancholme Catchment Flood Management Plan
[23] North East Lincolnshire Council (2015) North East Lincolnshire Local Flood Risk Management Strategy

3.4.11 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.

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

3.4.12 North and North East Lincolnshire Council 2022 SFRA[24] provides an update on the original SFRA[25] which was published in 2011 to support the assessment of development sites in relation to flood risk. The SFRA has been completed in collaboration with the Environment Agency and North East Lincolnshire Council to provide information on the probability of flooding. The report also takes into account the impacts of climate change.

3.4.13 It is intended that the SFRA will be used by North East Lincolnshire Council'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.

3.4.14 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.

North East Lindsey Drainage Board Byelaws

3.4.15 Internal Drainage Boards (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 North East Lindsey Drainage Board (the 'Board') extends to an area of 11,250 hectares which is formed predominantly of the coastal strip extending from the Humber bridge southwards to Grimsby.

3.4.16 The North East Lindsey Drainage Board Byelaws and Land Drainage Act 1991 allow the Board to take action to ensure that free flow of water is unrestricted.

3.4.17 Watercourses maintained by the Board are cleaned out annually and it is important that access is preserved for machinery to enable this work to be undertaken. The Board'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 a Board maintained watercourse irrespective of any planning permission. The Board's consent will normally be required to undertake works such as:

- Works in, over, under or within 9 m of a Board maintained watercourse;
- Installation of a culvert, weir or other like obstruction within any watercourse; and

[24] North Lincolnshire Council and North East Lincolnshire Council (2022) North and North East Lincolnshire Strategic Flood Risk Assessment
[25] North Lincolnshire Council and North East Lincolnshire Council (2011) North and North East Lincolnshire Strategic Flood Risk Assessment

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

3.4.18 The DCO disapplies the North East Lindsey IDB byelaws specifically for the IERRT project but provides a mechanism for the approval/ consent of the IDB to be obtained for any works that would normally require consent under the North East Lindsey IDB byelaws.

Anglian Water's Policy for Surface Water Drainage

3.4.19 The Policy for Surface Water Drainage document[26] 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.

3.4.20 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.*

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

Non-Statutory Technical Standards for Sustainable Drainage Systems

3.4.22 The Non-statutory Technical Standards for Sustainable Drainage Systems[27] was published by Defra in March 2015 and is the current guidance for the design, maintenance, and operation of SuDS. The standards set out the following:

- *Peak runoff rates should be as close as is reasonably practicable to the greenfield rate, but should never exceed the pre-development runoff rate;*
- *The drainage system should be designed so that flooding does not occur on any part of a development site for a 1 in 30-year (3.33% AEP) rainfall event, and that no flooding of a building (including basement) would occur during a 1 in 100-year (1.0% AEP) rainfall event; and*
- *Pumping should only be used when it is not reasonably practicable to discharge by gravity.*

3.4.23 Further industry good practice guidance on the planning for and design of SuDS is provided by C753 - The SuDS Manual[28].

[26] Anglian Water. (2021). Anglian Water's Surface Water Drainage Policy (Draft). [Online] Available at: https://www.anglianwater.co.uk/siteassets/developers/drainage-services/surface-water-drainage--policy.pdf (accessed December 2021).

[27] Department for Environment, Food and Rural Affairs. (2015). Sustainable drainage systems: non-statutory technical standards

[28] Construction Industry Research and Information Association (CIRIA). (2015).C753 - The SuDS Manual

4. Baseline flood risk assessment

4.1.1 The NPSfP requires the effects of all sources of flood risk to and from a development are considered within a FRA. The FRA should demonstrate how identified risks should be managed so that the development remains safe throughout its lifetime, taking into account climate change.

4.1.2 This review was undertaken using publicly available information to assess the flood risk at the Site.

4.2 Historical flooding

4.2.1 Environment Agency records show historical flooding of Immingham during the January 1953 and December 2013 tidal surge events, presented as Image 4.1 below.

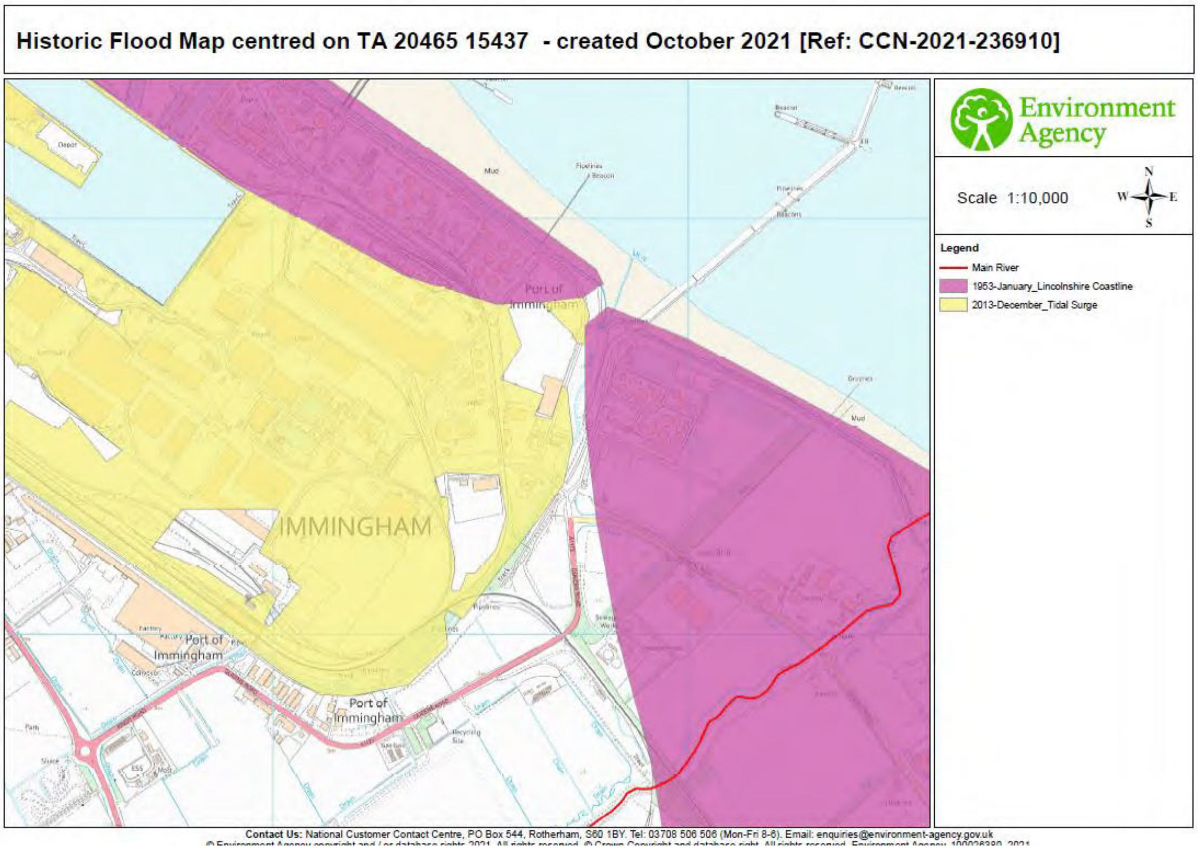


Image 4.1 Environment Agency historic flood map of Immingham

4.2.2 In December 2013, the flooding at the Port of Immingham resulted primarily from inundation of the quayside as water levels rose above the lock/ dock cope levels and filled the enclosed dock basin via the lockpit. In addition, tidal water also overtopped a section of gabion baskets along the frontage on the western part of the Port, approximately 3 km away from the project area (this area has now been repaired), with further slight ingress (backflow) through the drainage system where flap valves failed to close properly (this issue has now been resolved).

4.2.3 Maximum flood depths of up to 0.5 – 1 m were identified at locations across the Port centred around the enclosed dock basin which was the primary source of flooding due to the older, lower outer lockgates allowing water to enter the lockpit and enclosed dock. These outer gates have now been replaced with gates that have a higher crest height and are capable of being held in position against a reverse head of water (reverse head restraint system).

4.2.4 Although the Environment Agency historical flood map suggests that the IERRT project area was flooded during the December 2013 tidal surge event, subsequent surveys undertaken post flood event by ABP indicate that the Site area did not flood during this event.

4.3 Flooding from tidal sources

4.3.1 The Environment Agency FMfP for the Port of Immingham, presented as Image 4.2 below, indicates that the Site is located in Flood Zone 3a[29], as defined in Table 1.1. The map shows the extent of Flood Zone 3 [30], assuming no defences exist. The SFRA states that the main source of flooding in the area is a combination of large waves and high-water levels in the Humber Estuary.

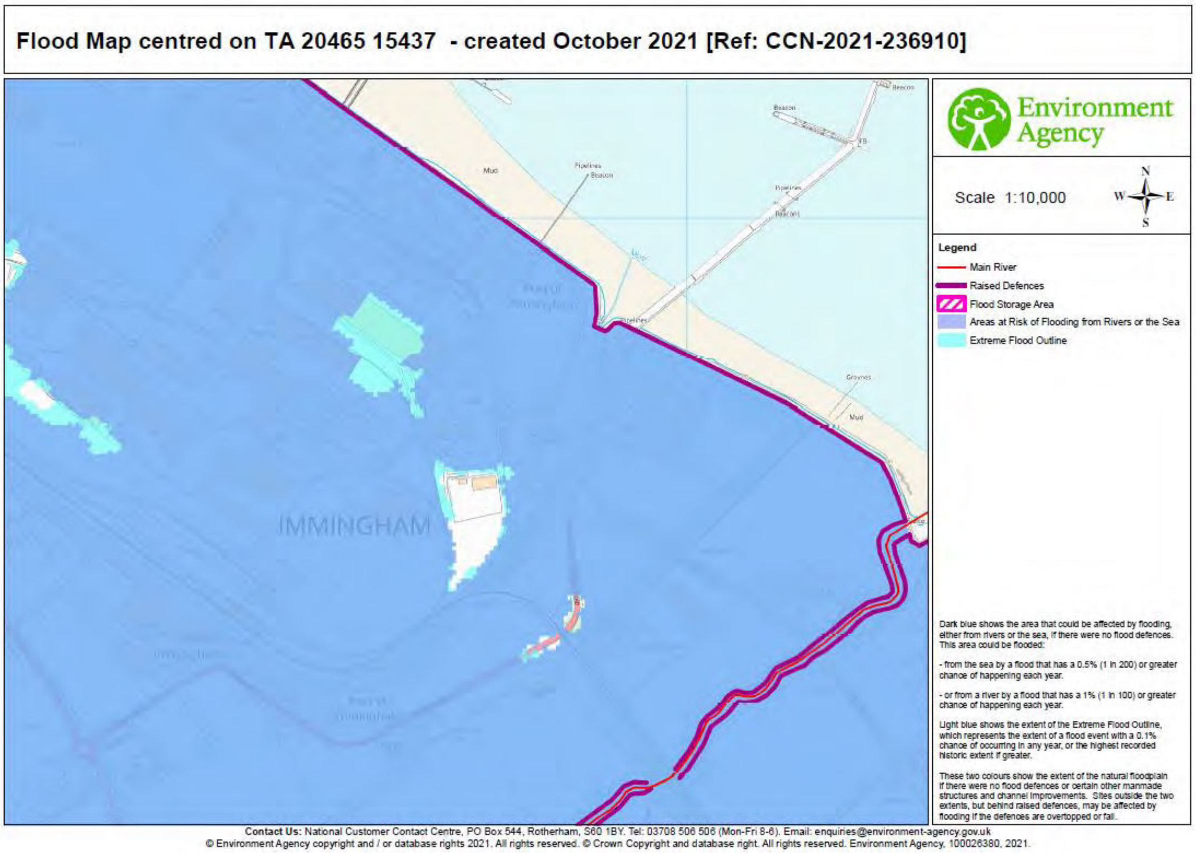


Image 4.2 Environment Agency flood map for Port of Immingham

Extreme water levels

4.3.2 The main risk of flooding for the IERRT project will typically be associated with a storm surge event. Storm surges result from low pressure weather systems, high winds and tidal conditions which change the sea level. Storm surges can

[29] The presence of flood defences negates the presence of Flood Zone 3b.
[30] The EA FMfP does not differentiate between Flood Zone 3a and Flood Zone 3b

lead to extensive flooding over a wide area and are dangerous to people in coastal areas.

4.3.3 Current extreme still tidal water level predictions determined by the Environment Agency for the Port of Immingham are considered to be the most up-to-date and appropriate for this review (Annex A). These are provided in Table 4.1 for a baseline year of 2017.

Table 4.1 Predicted extreme water levels for the Port of Immingham

Return Period (Years)	Annual Exceedance Probability (%)	Extreme Water Level (mODN)
1	100	4.15
2	50	4.25
5	20	4.40
10	10	4.51
20	5	4.62
25	4	4.66
50	2	4.77
75	1.3	4.85
100	1	4.90
200	0.5	5.03
250	0.4	5.06
300	0.33	5.10
500	0.2	5.20
1,000	0.1	5.34
10,000	0.01	5.85

4.3.4 Based on the information in Table 4.1, the extreme still water level for the Port of Immingham is 5.03 m AOD for a 0.5% (1 in 200 year) AEP event and 5.34 m AOD for a 0.1% (1 in 1000 year) AEP event.

4.3.5 The maximum water level currently recorded at the Port of Immingham occurred on 5 December 2013 at 19:00 hours with a level of 5.216 m AOD (equivalent to a 0.133% (1 in 750 year) AEP event) compared to the prediction of 3.689 m AOD, therefore, the meteorological surge effect for this event was 1.527 m.

Flood defences

4.3.6 There are tidal flood defences in place along the entire south bank of the Humber Estuary.

4.3.7 ABP is responsible for the sea walls around its land at the Port of Immingham which consist of concrete sheet piled walls and concrete/stone slab revetment walls topped with rock filled gabion baskets. Information from the Environment Agency show the flood defences, along the Port of Immingham frontage up to Habrough Marsh Drain, have a crest elevation of 5.05 m AOD and a wall height of 0.84 m resulting in a total defence elevation of 5.89m AOD.

4.3.8 Topographic survey of the flood defences, undertaken for ABP in 2018, indicates a varying crest height along the Port of Immingham frontage with levels between 5.52 m AOD and 6.15 m AOD. The crest level of the defences shown on the topographic survey for the section of defences in the location of the proposed jetty are approximately 5.80 m AOD – 6.0 m AOD with a low spot of 5.52 m AOD.

4.3.9 Lock gates are used to control levels within the dock. Both lock structures are protected by an external flood gate. Following a tidal storm surge in December 2013 the standard of protection afforded by the external lock gate to the docks was improved via the installation of new outer lock gates with reverse head restraint capability and a crest height of 6.5m AOD.

4.3.10 To the east of Habrough Marsh Drain, the existing Environment Agency flood defences consist of an earth embankment topped by a concrete wave return wall comprising a smooth concrete or asphalt seaward face.

4.3.11 The Habrough Marsh Drain outfall (hanging gates) are inspected regularly and maintained by the Environment Agency. The Environment Agency replaced the hanging doors 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, via East Riverside and sufficient space is currently provided for access. A crane pad currently provides space for a crane to be used with a works area around the crane for removal of the hanging doors/ recondition works, when maintenance is required.

4.3.12 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 are 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.

4.3.13 In relation to the flood defences located within the Site (Compartment IT3 Immingham and North Killingholme), the North East Lincolnshire Council 2011 SFRA 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”.*

4.3.14 The initial draft Humber Flood Risk Management Strategy (2021 – 2027)[31] 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 is planned from 2022, in continuation of the defence improvements carried out in 2017.

[31] Environment Agency (2021) Humber Flood Risk Management Strategy. Available at: https://www.gov.uk/government/publications/humber-flood-risk-management-strategy (currently out for public consultation until January 2022)

4.3.15 The Environment Agency has confirmed there are currently no ongoing capital projects to reduce or sustain the current flood risk to the Site.

Breach of defences

4.3.16 The Environment Agency has provided breach location and associated breach flood extent maps from the Northern Area Tidal Breach Mapping Study (Annex A to this FRA). The Northern Area Tidal Breach Hazard Mapping project involved a modelled representation of tidal breaches along the east coast and the south bank of the Humber Estuary, with breaches in the hard defences set at 20 m wide and the defences assumed to breach down to the ground level behind the defence. The defences were raised within the model to create reservoir cells, ensuring that the most precautionary volumes of water were driven through the breach opening.

4.3.17 The breach modelling was based on the Still Water Tidal Levels from the Northern Area Tidal Model Analysis 2006 including a 100% AEP (1 in 1) wave height allowance (current year 2006 and 2115) on top of the 0.5% AEP and 0.1% AEP flood events.

4.3.18 The breach locations nearest the Site are located to the north-east of the lock gates access to Immingham Docks and along the frontage between Habrough Marsh Drain and Stallingborough North Beck. The hazard classification methodology used on the Environment Agency hazard mapping is based on flood hazard classification outlined in Flood Risk Assessment Guidance for New Development known as FD2320/TR213[32], presented in Table 4.2.

Table 4.2 Flood hazard classification

Flood Hazard	Classification
Low	**Caution** - Flood zone with shallow flowing water or deep standing water
Moderate	**Dangerous for some** (i.e. Children) – Danger: Flood zone with deep or fast flowing water
Significant	**Dangerous for most people** – Danger: Flood zone with deep fast flowing water
Extreme	**Dangerous for all** – Extreme Danger: Flood zone with deep fast flowing water

Source: DEFRA, 2021

4.3.19 The Environment Agency breach location and flood extent maps are contained in Annex A to the FRA and indicate:

- For a current day (2006) 0.5% and 0.1% AEP breach events the majority of the Site area is not located within the breach flood extent; and
- The east/ north-east of the Site, directly adjacent to the Humber Estuary is located in a hazard area classified as 'Danger to Most' with a maximum water velocity of 0-0.3 m/s for both the 0.5% and 0.1% AEP flood events. Maximum water depth increases from 0.25-0.5 m (0.5% AEP flood event) to a depth of 1-1.6 m (0.1% AEP flood event).

[32] DEFRA (2021) Flood Risk Guidance for New Development. Available at: https://www.gov.uk/flood-and-coastal-erosion-risk-management-research-reports/flood-risk-assessment-guidance-for-new-development

4.3.20 Though a breach of flood defences would represent a significant to extreme hazard, given the Environment Agency undertake condition inspections and maintenance is undertaken when required by the Environment Agency and ABP for the flood defences under their jurisdiction, the likelihood of a breach is low. The NPPF guidance requires that plans and mitigation are put in place to manage the risks if failure should occur. Mitigation measures for the Site are outlined in Section 6 of this FRA.

Overtopping of flood defences

4.3.21 The Environment Agency has provided flood extent maps from the Northern Area Tidal Overtopping Hazard Mapping Study for the 0.5% AEP and the 0.1% AEP overtopping scenarios. The modelling is based on the Still Water Tidal Levels from the Northern Area Tidal Model Analysis 2006 including a 100% AEP (1 in 1) wave height allowance (current year 2006 and 2115).

4.3.22 The extent maps are contained in Annex A and indicate that for both the 2006 0.5% AEP and 0.1% AEP overtopping events:

- The majority of the Site is located outside of a hazard area; and
- The east/ north-east of the Site, directly adjacent to the Humber Estuary is located in a hazard area classified as 'Danger to Most' with a maximum water depth of 1-1.6 m and a maximum water velocity of 0-0.3 m/s.

4.3.23 Though overtopping of the flood defences would represent a significant hazard, given that both the 0.5% AEP and 0.1% AEP extreme tidal water levels are below the crest height of the tidal flood defences, the likelihood of overtopping is low. The NPPF guidance requires that plans and mitigation are put in place to manage the risks should overtopping occur. Mitigation measures for the Site are outlined in Section 6 of this FRA.

4.4 Coastal and estuarial processes

4.4.1 Consideration is given in Chapter 7 (Physical Processes) of the ES (Volume 1, Application Document Reference number 8.2) to the effects on water levels and flow speeds within the Estuary and the consequence of these changes to sediment accretion/ erosion patterns and suspended sediment concentrations (SSC), including the effects of the changes in sediment supply as a result of dredging and disposal operations.

4.4.2 As the local hydrodynamics will remain comparable to the baseline scenario it is considered that there will be no change 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 IERRT project) and off-site (along the frontage of the wider Port of Immingham).

4.5 Fluvial sources

4.5.1 The FMfP (shown in Image 4.2) illustrates that the IERRT project is located predominantly within Flood Zone 3a (high risk) defined as land having a >1%/ 0.5% AEP (greater than a 1 in 100/ 1 in 200 chance in any year) of river or sea flooding. However, this map does not differentiate between the tidal and fluvial sources of risk and the tidal defences are not taken into account.

4.5.2 Mapping in Section 2.4 of the North East Lincolnshire PFRA gives some indication of fluvial flood zones and indicates that the IERRT project is located in Flood Zone 1.

Main river

4.5.3 The Site is not considered to be at risk of flooding from fluvial main rivers. The nearest Environment Agency Main River (fluvial) is the Stallingborough North Beck Drain located approximately 0.9 km south-east of the Site which has flood defences.

4.5.4 The NELC SFRA (Paragraph H.49) notes that hydraulic modelling of the Stallingborough North Beck was undertaken in 2009. The modelling results indicate that the 1.0% AEP (1 in 100) water level varies from 3.37 m AOD at the outfall to 4.40 m AOD at the upstream end of the model located at the B1210 road bridge crossing approximately 3 km upstream. Based on these modelled flood water levels, the average site level of 5 m AOD and intervening topography, flood water would not enter the Site.

4.5.5 Based on the above information, the risk of flooding from fluvial Main River sources is considered to be low.

Ordinary watercourses

4.5.6 Habrough Marsh Drain, designated as an 'Ordinary Watercourse' under the jurisdiction of the North East Lindsey IDB, skirts the southern and western perimeters of the port estate. The watercourse flows from west to east adjacent to the southern Site boundary and discharges partly to the Humber Estuary and partly to the Stallingborough North Beck through the Immingham Pumping Station.

4.5.7 In addition, there are numerous drains and small watercourses beyond the port estate that form part of the North East Lindsey IDB land drainage system for the low- lying coastal area.

4.5.8 Tide-locking is a common problem in watercourses where defences occur. Habrough Marsh Drain is a gravity system with a flapped gravity outfall to the Humber to prevent the incoming tide from entering the channel. When high tides prevent the watercourse from discharging into the Humber Estuary, water levels within the drains will increase temporarily until the tidal level has decreased sufficiently to allow the outfall to operate again.

4.5.9 High levels within the North East Lindsey IDB system are a potential flood risk to the area with high rainfall events aggravated by high water levels in the Humber Estuary.

4.5.10 The SFRA 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*".

4.5.11 Based on the above information, the risk of flooding from fluvial ordinary watercourses sources is considered to be a low risk.

4.6 Surface water (overland flow)

4.6.1 Surface water flooding is caused by overland flow that results from rainfall that fails to drain into the ground through infiltration, instead of travelling 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.

4.6.2 The Environment Agency Risk of Flooding from Surface Water (RoFSW) maps (see Image 4.3) 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. The RoFSW flood map for the IERRT project can be viewed on the Environment Agency website[33]. Risk from surface water flooding is defined in Table 4.3.

Table 4.3: 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 1000 (0.1%)
Low	Each year, the area has a chance of flooding of between 1 in 1000 (0.1%) and 1 in 100 (1%)
Medium	Each year, the area has a chance of flooding of between 1 in 100 (1%) and 1 in 30 (3.3%)
High	Each year, the area has a chance of flooding of greater than 1 in 30 (3.3%)

4.6.3 Mapping shows that the Site is generally at low risk from surface water flooding, classifying the majority of the land to be at ‘very low’ risk of flooding from surface water.

4.6.4 There are small, isolated areas of the Site shown to be at low, medium and high risk of surface water flooding predominantly to the southern corner of the Site and to the west in the area most recently used as a storage area/car park for newly imported vehicles. However, it is considered that these areas shown to be at risk are reflective of areas of low topography where water sits and pools during higher return period storm events.

4.6.5 The risk of flooding from surface water sources is assessed as low.

[33] Flood map for planning - GOV.UK (flood-map-for-planning.service.gov.uk)

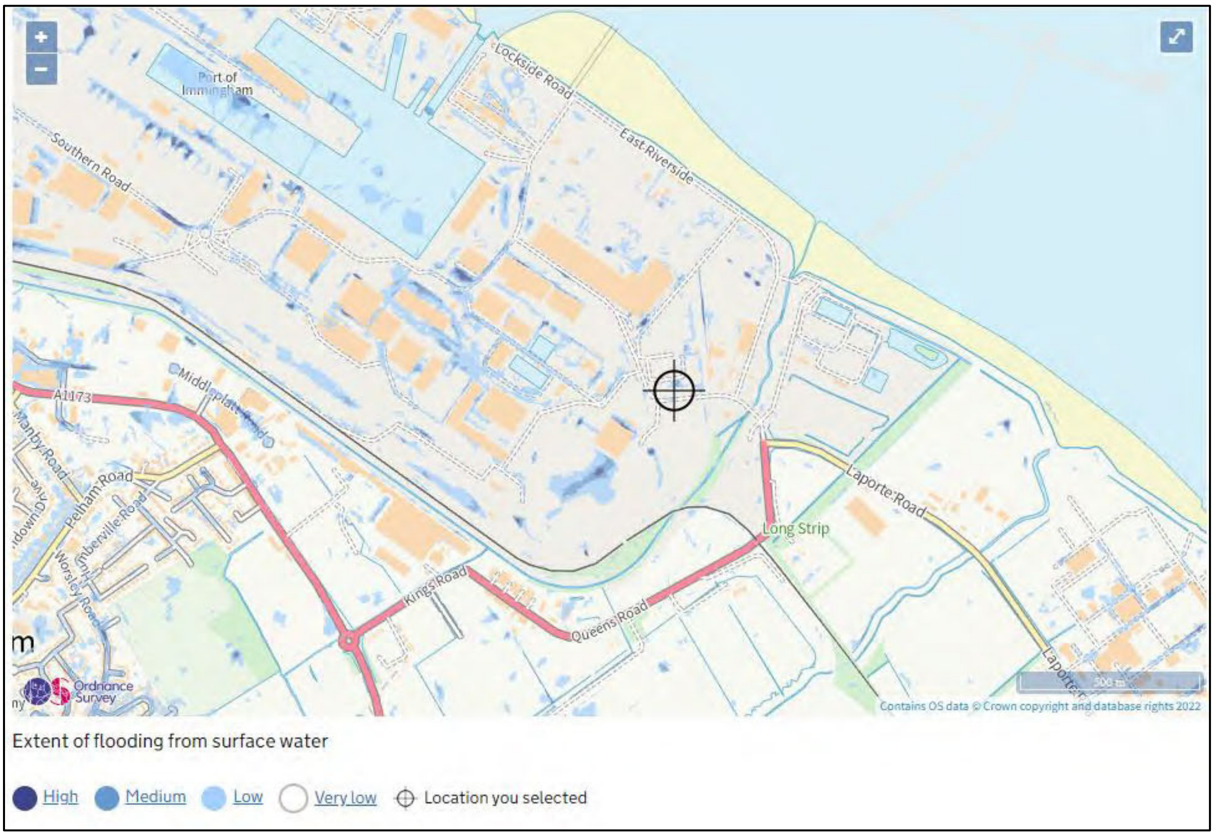


Image 4.3 Environment Agency risk of flooding from surface water

4.7 Artificial waterbodies

4.7.1 Artificial flood sources include raised channels such as canals or storage features such as ponds and reservoirs. The Environment Agency Long-term Flood Risk maps indicate the Site is not located in an area that would flood should a reservoir failure occur.

4.7.2 With the exception of Immingham Dock there are no other significant artificial water sources in proximity to the Site. Flooding from Immingham Dock is assessed in Section 4.3 of this FRA – Tidal Sources.

4.7.3 The risk of flooding to the IERRT project from all artificial waterbodies is therefore considered to be low.

4.8 Groundwater sources

4.8.1 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.

Geology and hydrogeology

4.8.2 The 1:50,000 British Geological Survey (BGS) Map of Britain indicates that most of the Site is mapped on superficial deposits consisting of beach and tidal flats (clay, silt and sand). The bedrock geology mapped underlying the Site comprises of Burnham Chalk Formation and Flamborough Chalk

Formation. Further information is presented in Section 2.5 of this FRA – Geology and Hydrogeology.

Groundwater levels

4.8.3 There are eight historic boreholes located within the Site. Seven of these boreholes are labelled as confidential and therefore data is not accessible. The remaining borehole onsite has a depth of 31.09 m and there is no record of groundwater presence.

4.8.4 The Immingham Eastern Ro-Ro Terminal Phase 1 Geo-environmental and Geotechnical Desk Study[34] (Appendix 12.1 in ES Volume 3 Application Document Reference number: 8.4) includes historical borehole records in proximity to the Site, however although these logs show the geology encountered, groundwater strikes were not recorded.

4.8.5 During the GD Pickles Ltd 2020 Ground Investigation (Appendix 12.2 in ES Volume 3), two groundwater bodies were observed and are considered to be perched groundwater within the Made Ground and at the boundary of the Made Ground and Tidal Flat Deposits. Observed groundwater was recorded at 3.6m bgl.

4.8.6 It is possible 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 area during or after the construction process.

Groundwater flooding

4.8.7 The North East Lincolnshire Council PFRA 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).

4.8.8 Groundwater levels tend to get re-charged during the winter and high groundwater levels can cause flooding as the water table rises. This rise in water table levels can be very slow, dependent on rainfall patterns. There is no reference to groundwater flooding events in in the North East Lincolnshire SFRA for the Eastern Coastal Area where the IERRT project is located.

4.8.9 There are no historical flood records for groundwater flooding within the Site boundary or the wider Port of Immingham area.

4.8.10 Given the limited information on groundwater and potential for groundwater flooding in the area, the risk of flooding from groundwater sources is preliminarily assessed as a medium risk.

4.9 Drainage and sewerage infrastructure

4.9.1 Flooding from drains, sewers and surface water are normally interconnected. Insufficient or reduced drainage capacity within the sewer network can result

[34] AECOM. (2021). Immingham Eastern Ro-Ro Terminal Phase 1 Geo-environmental and Geotechnical Desk Study

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.

Existing drainage infrastructure

4.9.2 Anglian Water asset mapping shows there is no surface water drainage infrastructure for which Anglian Water have responsibility located within the Site. Drainage of surface water and foul water within both the Site and the wider Port of Immingham is privately owned and does not discharge to the wider Anglian Water surface water or foul water drainage network beyond the Port of Immingham.

4.9.3 Foul and surface water management infrastructure at the Port of Immingham is comprehensive and comprises the following:

- Numerous drainage outfalls (flap gate culverts) provide drainage to the Humber Estuary directly, via Immingham Lock or through adjacent drainage channels;
- Pumping pits across the port estate allow drainage water in low elevated areas to be pumped from drainage points into the Humber (either directly or indirectly via Immingham Dock);
- Drain interceptors across the port estate prevent contaminants from entering the drainage systems;
- Sewage treatment plants provide on-site treatment of effluent before being discharged to the Humber Estuary; and
- An extensive network of drainage pipes, channels and manholes.

4.9.4 A surface water drainage system, owned by ABP, is present within the Site. Surface water from the north and south-eastern areas of the Site drain via two existing outfalls to Habrough Marsh Drain.

4.9.5 Surface water from the southern and western areas of the Site drain towards the north-east. Drainage infrastructure within the western area of the Site discharges to an existing pumping station which also receives process water from the Port of Immingham to the west of the site and this gets pumped out into the Humber Estuary, along with treated foul effluent via a 600 mm pumped main.

4.9.6 Surface water from the southern Site area is discharged via an outfall to the internal Immingham Dock.

4.9.7 An Anglian Water rising foul sewer main runs beneath Kings Road flowing south-east then north-east beneath Queens Road and continues flowing north-east, discharging to the Humber Estuary via the Immingham Sea Outfall located at OS NGR TA2141715599, downstream of the Port of Immingham. Neither the rising foul main or the sea outfall are located within the Site and will remain in-situ post development. There are no predicted morphological changes in or around the outfall dues to changes to physical processes in the estuary. Further details are provided in ES Volume I Chapter 7: Physical Processes.

4.9.8 Further information is provided in the Drainage Strategy presented in Annex B to this FRA.

Flood risk from drainage Infrastructure

4.9.9 Anglian Water is the water company that serves the North East Lincolnshire administrative area. As part of the SFRA, 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, shows that the Site is not located in an area that is known to flood from sewer networks.

4.9.10 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.

4.9.11 On the basis of the available information, the Site is considered to be at low risk of flooding from drainage and sewerage infrastructure.

5. Climate change

5.1.1 The Environment Agency published updated climate change guidance in May 2022[35]. The guidance indicates that climate change is likely to increase:

- Peak river flows;
- Peak rainfall intensity;
- Sea level; and
- Wave height and offshore wind speed.

5.2 Sea level allowances

Environment Agency guidance

5.2.1 The Site lies within the Humber River Basin District. Table 5.1 shows the tidal climate change allowances for the catchment. These allowances 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 5.1: Sea Level Allowance for the Humber River Basin District (mm).

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

5.2.2 For the purposes of this assessment a worst-case scenario climate change has been assessed for the next 100 years. This is because the development will, once constructed, become part of the fabric of the Immingham port estate and will, in simple terms, continue to be maintained so that it can be used for port related activities to meet a long-term need. It is, therefore, highly unlikely that the IERRT infrastructure would be demolished after its design life as it is likely to have become an integral part of nationally important infrastructure.

5.2.3 The potential sea level rise, based on the projections in Table 5.1 that should be added to the water levels provided in Table 4.1 are as follows:

- Higher Central: an increase of 0.96 m; and
- Upper End: an increase of 1.3m.

[35] Environment Agency (2021) Flood risk assessments: climate change allowances. Available at: https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances

UK climate projections 2018 (UKCP18) allowance

5.2.4 Published in November 2018, the UK Climate Projections 2018 (UKCP18) is the official source of information on how the climate of the UK may change over the rest of this century. The UKCP18 projections replace the UKCP09 projections.

5.2.5 In coastal locations, where developments are sensitive to flood risk and/ or have a lifetime of at least 100 years, it is recommended that assessment of the impact of both the current allowance in 'Flood risk assessments: climate change allowances' and the 95th percentile of UKCP18 'Representative Concentration Pathway (RCP) 8.5' scenario (high emissions scenario) standard are used to assess the impact of climate change over the lifetime of a proposed development.

5.2.6 Over the next 100 years (covering the service life of the IERRT project and beyond), using the latest UKCP18 relative sea level research and assuming a RCP 8.5 95 percentile scenario, sea levels are expected to increase by 0.52 m.

5.3 Offshore wind speed and extreme wave height allowance

5.3.1 Wave heights may change because of:

- Increased water depths; and
- Changes to the frequency, duration and severity of storms.

5.3.2 Table 5.2 shows the climate change allowances for the English coast.

Table 5.2: Offshore winds speed and extreme wave height allowance for the English Coast

Allowance Category	Total potential change anticipated for '2020s' (2000 to 2055)	Total potential change anticipated for '2080s' (2056 to 2125)
Offshore wind speed allowance	5%	10%
Offshore wind speed sensitivity test	10%	10%
Extreme wave height allowance	5%	10%
Extreme wave height sensitivity test	10%	10%

5.4 Peak river flow allowances

5.4.1 The Site lies within the Grimsby and Ancholme Management Catchment. Table 5.3 shows the climate change allowances for the catchment.

Table 5.3: Peak river flow allowance for the 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%

Peak river flow allowances for different assessments

5.4.2 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 designates port development as 'water compatible' whilst in line with the NPPF the IERRT project is classified as 'compatible activities requiring a waterside location' and is also therefore classed as 'water compatible.'

5.4.3 The vulnerability classification and flood zone designation should be used to decide which peak river flow allowances (allowance category) to use based on assessment year of 2121.

5.4.4 Table 5.4 summarises the peak river flow allowances for the different flood risk vulnerability classifications for each flood zone.

Table 5.4: Environment Agency climate change allowances to apply based upon the flood zone and development land use vulnerability

	Water Compatible	Less Vulnerable	More Vulnerable	Highly Vulnerable	Essential Infrastructure
Flood Zone 1	CA	CA	CA	CA	CA
Flood Zone 2	CA	CA	CA	CA	HCA
Flood Zone 3a	CA	CA	CA	X	HCA
Flood Zone 3b	CA	X	X	X	HCA

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

5.4.5 As the Site is located in Flood Zone 3a and is classified as water compatible, the central climate change allowance should be assessed.

5.5 Peak rainfall intensity allowance

5.5.1 Increased rainfall affects river levels and land and urban drainage systems. Table 5.5 shows anticipated changes in extreme rainfall intensity in small and urban catchments.

5.5.2 The Environment Agency climate change guidance states "*For flood risk assessments assess the upper end allowances for both the 1% and 3.3% annual exceedance probability events for the 2070s epoch (2061 to 2125)*".

Table 5.5. Peak rainfall intensity allowance in small and urban catchments

Louth, Grimsby and Ancholme Management Catchment	Total Potential Change Anticipated for '2050s' (up to 2060)	Total Potential Change Anticipated for '2080s' (2061 to 2125)
3.33% Annual Exceedance Rainfall Event		
Upper End Allowance	35%	35%
Central Allowance	20%	25%
1% Annual Exceedance Rainfall Event		
Upper End Allowance	40%	40%
Central Allowance	20%	25%

5.6 Climate change allowances for the proposed development

5.6.1 Based on planning policy and associated guidance the peak climate change allowances for the lifetime of the IERRT project should be assessed appropriately as shown in Table 5.6.

Table 5.6. Climate change allowances for the proposed development

Proposed Development	
River Basin District	Humber
Management Catchment	Grimsby and Ancholme
Flood Zone	Tidal - Flood Zone 3a
	Fluvial – Flood Zone 1
Flood Risk Vulnerability Classification	Water Compatible
Tidal Climate Change Allowance: Total potential change anticipated for '2100s' (2096 to 2122)	Sea Level Rise Upper End (1.3m)
	Sea Level Rise Higher Central (0.96m)
	Sea Level Rise UKCP18 (0.52m)
Fluvial Climate Change Allowance	2080s Higher Central (12%) 2080s Central (4%)

Proposed Development	
Total potential change anticipated for '2080s' (2070 to 2122)	
Peak Rainfall Intensity Allowance Total Potential Change Anticipated for '2080s' (2061 to 2125)	Upper End 3.33% AEP (35%)
	Upper End 1% AEP (40%)
	Central 3.33% AEP (25%)
	Central 1% AEP (25%)

5.6.2 Further details on peak rainfall intensity climate change allowances used in the design of the surface water drainage system for the IERRT project is provided in the Drainage Strategy presented as Annex B to this FRA.

5.7 H++ allowances

5.7.1 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.

5.7.2 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.

5.7.3 It is not considered necessary to use H++ allowances as part of the assessment of climate change as the IERRT project is considered unlikely to significantly change the landscape or development pattern at the Port of Immingham.

6. Flood risk management measures

6.1 Introduction

6.1.1 The following mitigation measures will be included in the IERRT project to reduce the risk of flooding during extreme events and residual risks should also be considered. These measures will help to reduce the impact of a flood event should it occur.

6.2 Development levels

6.2.1 There are three specific levels that must be considered for developments at risk of flooding:

- Finished floor levels;
- Advisory levels for critical plant/ equipment; and
- Safe refuge level for personnel.

Finished floor levels

6.2.2 The Environment Agency have stated in their consultation response that any new terminal buildings for 'less vulnerable' uses should raise Finished Floor Levels (FFLs) as high as practicable and, if these will be below the predicted flood depth (referring to the relevant Environment Agency 2115 0.5 % AEP tidal breach map presented in Annex A), suitable flood resistance/ resilience measures identified.

6.2.3 Finished floor levels for the IEERT buildings will be raised 300 mm above the surrounding ground level but will remain below the 2115 0.5% AEP breach water level. In line with Environment Agency guidance flood resistant and resilient measures will be incorporated into the building design, as outlined below. The first floor of the terminal building will provide an area of safe refuge, should an extreme flood event occur.

Advisory levels for critical plant/equipment

6.2.4 The minimum installation level for critical plant and machinery should be considered. The NPSfP classifies port development as 'water compatible' and as such the North East Lincolnshire SFRA states "*essential electrical equipment should be raised at least 300mm above the Critical Flood Level and that appropriate mitigation measures/*flood *resilience techniques are incorporated into the development*".

6.2.5 There are no advisory levels for critical plant/ equipment stated in planning policy, however the Environment Agency advise that critical plant/ equipment (to be defined by ABP), should be raised and secured above the expected 0.1% AEP climate change breach scenario floodwater level where it is practicable to do so.

6.2.6 Development defined as critical infrastructure for the IERRT project will be located at existing ground level for operational reasons therefore flood resilience and resistance measures will be put in place (e.g. raised plinths, watertight housing bunding where practicable etc), as with other critical infrastructure within the wider Port of Immingham.

Safe refuge level for personnel

6.2.7 In the event that flooding occurs with such speed that personnel on the Site are not able to evacuate, safe refuge will be provided within the IERRT terminal building to the south of the Site. This will allow any individuals on the Site to wait safely until the flooding subsides or rescue can be affected.

6.2.8 In agreement with the Environment Agency, the safe refuge area(s) will be located above 6.25 m AOD i.e. the flood level corresponding to the 0.1% AEP breach flood event with climate change allowance. Provision for disabled persons to reach these areas should also be considered as part of the design.

6.3 Flood resistant and resilient design

6.3.1 Flood resistant and resilient design can reduce the damage that occurs to buildings from flooding and reduce recovery time.

6.3.2 The following methods of flood resistant and resilient construction will be included in the design of the IERRT project:

- Office and Welfare Facilities - solid floor construction e.g. continuous concrete ground floor slab minimum of 150 mm thick reinforced with mesh on lapped and tapped 1200 gauge visqueen damp proof membrane;
- If technically feasible, electricity supply cables will enter buildings from roof level and wired downwards; electrical sockets to be positioned at least 600 mm above floor level;
- Anti-flood valves will be installed on internal building drainage; and
- Watertight external door construction will be considered, where reasonably practical.

6.4 Emergency evacuation and planning

6.4.1 The Northern Area Tidal Breach Mapping Study outputs provided by the Environment Agency (Annex A to this FRA), suggest that the Site is at risk of being flooded to significant depths (>1.6 m) in the event of a breach in the defences coinciding with the 0.5% AEP climate change flood event. Although the impact to the IERRT project in the event of a breach is high, the probability of a breach occurring is considered to be low.

6.4.2 Developments in flood risk areas must provide safe, dry access and egress to enable evacuation of people, routes for emergency services and flood defence authorities to carry-out the necessary duties during a flood event.

6.4.3 If a flood event was to occur with sufficient warning, i.e. via the Environment Agency Flood Warning Service, it is possible for a full evacuation of the Site to take place in line with a Flood Response Plan that will be provided for the Site (likely to be via an amendment to ABPs existing Emergency Plan for the Port of Immingham which encompasses flood events).

6.4.4 Any ‘no notice’ flooding events (events not notified by the Environment Agency Flood Warning service) following breaches in defences or surface water flooding will require a safe refuge such that all occupants can take immediate action to keep themselves safe without relying on intervention from outside (see paragraph 6.2.7 and 6.2.8 for further details).

6.5 Flood warnings and alerts

6.5.1 The Environment Agency operates a Flood Warning Service[36] for many areas at risk of fluvial and tidal flooding. The service currently consists of three stages:

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

6.5.2 Each code gives an indication of the expected level of danger. Although some members of the public find Flood Alerts useful, they are predominantly targeted towards professional partners, alerting them to expected flooding of low-lying land and roads.

6.5.3 All stages of warning are disseminated via the ‘Flood Warning Service’ 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.

6.5.4 The Floodline number is 0345 988 1188, and it is always kept up to date with the Environment Agency's latest flooding information. 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’ recorded information service, or via their website.

6.5.5 ABP as a Category 2 responder under the Civil Contingencies Act is already subscribed to this service (Humber Resilience Forum alert process) and it is assumed that the IERRT project will receive warnings and alerts as part of this ongoing service.

6.5.6 The Environment Agency aim to issue fluvial Flood Warnings at least 2 hours prior to the onset of flooding mainly based upon actual river level rise. Tidal flood warnings are issued based on forecast information, and therefore the lead time provided is longer. The Environment Agency aim to issue tidal Flood Warnings a minimum of 6 hours in advance but depending on confidence in the forecast they could be issued 24 or even 36 hours in advance.

6.5.7 Tidal flood warnings are triggered by a combination of forecast high water (astronomical tide level plus any additional surge), forecast wind speed, and forecast wind direction. Due to the flood defences in place, it is quite rare that Flood Warnings are issued for tides. It is more common to issue the lower-

[36] Environment Agency. 2018 Flood Warning Service- Flood warnings for England. Available at: https://flood-warning-information.service.gov.uk/warnings

level Flood Alerts, which are issued when the Environment Agency expect wave splash and wind-blown spray to cause localised pooling of water on land but no actual flooding of properties.

6.5.8 Information regarding ‘What to do in the event of a flood?’ will be included in the site health and safety plan and as a controlled site; all personnel entering the Site will be inducted and be aware of all health and safety procedures. In addition, site notices, including methods of evacuation and notification of dry refuge areas, will provide information to the general public using the Immingham Eastern Ro-Ro terminal.

6.6 Continuity of the tidal flood defences

6.6.1 The IERRT project includes the construction of the jetty approach road and pipework over the top of the existing flood defences.

6.6.2 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 and over the duration of the operational lifetime of the development.

6.6.3 ABP has confirmed the following:

- The approach roadway from the shore to the jetty and/ or the transfer facility, will pass over, but will not touch, the flood defences;
- Access to and along the flood defence frontage will not be affected; and
- Environment Agency access, together with the provision of space for a crane to be set up with a works area for removal of the Habrough Marsh Drain pointing doors/ recondition works, when maintenance is required, will be maintained post development.

6.6.4 The flood defences and any future works to the defences will not be impacted as a result of the IERRT project. Sufficient clearance between the flood defences and the jetty approach road will be provided to allow the flood defences to be raised in the future to adapt to climate change and to enable machinery to access the flood defences for inspection/maintenance purposes.

6.7 Habrough Marsh Drain

6.7.1 The IERRT project introduces 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).

6.7.2 Initial mapping of the Habrough Marsh Drain intertidal creek has been undertaken by ABP based on aerial photography overlaid with the proposed route of the jetty approach road. This mapping has been used to ensure the location of the piles required for the approach jetty will be spaced sufficiently wide apart that there is no impact on the creek channel and will be kept under review as design progresses.

6.7.3 Provisions have been put in place with the North East Lindsey IDB in the DCO to safeguard the creek across the intertidal area so the existing discharge is not impeded.

6.7.4 In addition, access to Habrough Marsh Drain, via East Riverside, will remain as the current scenario to allow North East Lindsey IDB access for channel maintenance works.

6.8 Surface water management

6.8.1 A new, separate foul and surface water drainage system will be constructed for the IERRT project. Further details on the design of the drainage system, including attenuation, restricted discharge to Habrough Marsh Drain and accounting for climate change is provided in the Drainage Strategy presented as Annex B to this FRA.

6.8.2 The DCO provides a mechanism for the approval/ consent required for works to or adjacent to Habrough Marsh Drain to be obtained from the IDB..

6.8.3 In addition, protective provisions will be included in the DCO for NELC (as Lead Local Flood Authority) specifically for the IERRT project with the necessary mechanism for providing approval of plans relating to drainage, and oversight in respect of the surface water drainage.

7. Post-development flood risk assessment

7.1.1 The NPSfP requires site specific FRAs to be submitted to accompany applications in order to assess the risk of all sources of flooding to and from a development, and to demonstrate how these flood risks will be managed so that the development remains safe throughout its lifetime, taking climate change into account.

7.2 Coastal and estuarial processes

7.2.1 The marine development of the IERRT project 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 over the operational lifetime of the IERRT project.

7.2.2 Impacts relating to the marine development and changes to the tidal regime for the construction and operational phase are discussed in detail within Chapter 7 (Physical Processes) of the ES.

7.2.3 There is potential for the current hydrodynamic processes to change over the lifetime of the IERRT project. It is possible that flow speeds and wave heights may increase in the area between the berth pocket and the IERRT Site frontage as well as along the wider Port of Immingham frontage. Any change is, however, predicted to be negligible and unlikely to affect the integrity of the flood defences in these areas. It is unlikely that changes to tidal water levels and the rates of erosion or accretion on the foreshore (above natural variations) both on-site (along the frontage of the IERRT Site) and off-site (along the frontage of the wider Port of Immingham) will increase above that which would currently occur when climate change is taken into account.

7.2.4 Impacts on the existing infrastructure (including the Habrough Marsh Drain) have been considered (for both construction and operation phases) within Section 7.8 of the ES.

7.2.5 Based on modelling outputs used to inform the Physical Processes assessment Chapter 7 of the ES states that it is it is 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 during the construction phase.

7.2.6 Once operational, changes to flows, waves and sediment transport pathways are predicted to be generally limited in extent to the proposed IERRT site and immediate vicinity. The predicted impacts for the areas fronting the Habrough Marsh Drain are generally small in magnitude and the Habrough Marsh Drain Outfall is not predicted to be impacted by the development

7.3 Tidal flood risk

7.3.1 As a worst case scenario climate change is assessed for the next 100 years as it is expected the Site and quay will continue to operate with port related development beyond the service life of the IERRT project. As explained previously, this is because the development will, once constructed, become part of the fabric of the Immingham port estate and will, in simple terms, continue to be maintained so that it can be used for port related activities to meet a long-term need. It is, therefore, highly unlikely that the IERRT infrastructure would be demolished after its design life as it is likely to have become an integral part of nationally important infrastructure.

7.3.2 The impact of climate change on peak still tidal water levels is presented in Table 7.1 and shows climate change is projected to increase water levels in the Humber Estuary. Based on the Higher Central Allowance, as set out in the Environment Agency Climate Change Guidance (see Section 5 of this FRA), the total allowance for the impact of climate change on still tidal water levels at Immingham has been calculated as:

- 0.96 m for a climate change horizon of 2122.

7.3.3 The predicted increases in water levels were calculated using an incremental rate of sea level rise from the date the Northern Area Tidal Model Analysis water levels were published in 2017.

Table 7.1: Extreme still water levels for the Port of Immingham, including climate change scenarios (mAOD)

<table>
<tr><th rowspan="3">Year</th><th colspan="4">Annual Probability of Occurrence</th></tr>
<tr><th colspan="2">Based on Environment Agency Guidance Higher Central Allowances</th><th colspan="2">Based on UKCP18 8.5 95 percentile scenario</th></tr>
<tr><th>0.5%</th><th>0.1%</th><th>0.5%</th><th>0.1%</th></tr>
<tr><td>2017</td><td>5.03</td><td>5.34</td><td rowspan="2">5.55</td><td rowspan="2">5.86</td></tr>
<tr><td>2122</td><td>6.00</td><td>6.30</td></tr>
</table>

7.3.4 The allowance for climate change has been added to the 0.5% AEP event maximum still water level value, 5.03m AOD, to consider the maximum increase in still water level over the next 100 years. Therefore, the maximum still water level with climate change, based on the Higher Central Environment Agency Climate Change Allowance is 6.0m AOD.

7.3.5 Based on the Humber FRMS[37] the Environment Agency intends to continue maintaining defences under their ownership for the stretch of the Humber Estuary between North Killingholme and Grimsby, to protect the area in the future. The defences here will be improved as necessary to protect people, businesses and nationally important industry from tidal flooding.

7.3.6 Independent of the application for the IERRT project, ABP have an agreement with the Environment Agency to raise the flood defences under their

[37] Environment Agency (2008) Humber Flood Risk Management Strategy

jurisdiction along the Port of Immingham frontage to a crest height of 6.1 m AOD. It is ABP's intention that the standard of protection afforded by the existing flood defences under their jurisdiction, along both the site frontage and the wider Port of Immingham, will be kept under consideration and reviewed as appropriate to account for climate change in line with 'Hold the line' management policies in the FRMP and SMP. Improvements to the flood defences will, potentially, be undertaken during the construction phase providing increased protection to the site from tidal flood events.

7.3.7 As it is proposed to maintain a standard of defence in this location, it is assumed that the Site will be protected from tidal flood risk for the lifetime of the IERRT project. The risk of direct tidal flooding to the Site is therefore not considered to be significant although a residual risk will remain if overtopping or breach of the defences were to occur.

Breach of the flood defences

7.3.8 Due to the continued condition assessments undertaken by the Environment Agency and the commitment of both the Environment Agency and ABP to maintain the defences under their jurisdiction, the residual flood risk at the Site due to the breaching of the tidal flood defences is not likely to increase due to climate change. However, if a breach event did occur climate change would result in an increase in the depth of floodwater, flow velocity and hazard classification at the Site.

7.3.9 Environment Agency breach mapping for the Year 2115 (presented in Annex A to this FRA) shows:

- For the 2115 0.5% and 0.1% AEP breach event the whole Site, with the exception of small, isolated areas, is located within the breach flood extent;
- The north-east of the Site, directly adjacent to the Humber Estuary is predominantly located in a hazard area classified as 'Danger to Most', however, the area directly behind the flood defences is now classified as 'Danger to All'. Maximum water levels have increased to 1-1.6+ m whilst maximum water velocity remains the same as the baseline flood risk scenario;
- Land to the south and west is located in a hazard area classified as 'Danger to Most' for both the 0.5% and 0.1% AEP breach events with a maximum water velocity of 0-1 m/s for the 0.5% AEP event and 1-1.5 m/s for the 0.1% AEP flood event. Maximum water depth increases from 0.5-1 m (0.5% AEP flood event) to a depth of 0.5-1.6 m (0.1% AEP flood event);
- Environment Agency breach flood water levels for the 0.1% AEP flood event in 2115 indicate an average water level across the Site of 6 m AOD. Water levels are lowest to the southern area of the Site at 5 m AOD.

7.3.10 Over the next 100 years, should a breach in the flood defences occur, the hazard, depth and velocity of floodwater would increase above the current baseline. However, although a breach of flood defences would represent an extreme hazard, the likelihood of a breach occurring remains low.

Overtopping of the flood defences

7.3.11 The extreme tidal water levels for the year 2115 scenario are in general higher than the current flood defence crest levels. These still water levels do not include an allowance for wave height. When wave height is taken into account, the defences would be insufficient to defend the land behind them from these higher return period events in the future. On this basis, the flood risk at the Site due to overtopping of the tidal flood defences will increase with climate change.

7.3.12 Environment Agency overtopping maps for the Year 2115 (presented in Annex A to this FRA) show:

- For both the 0.5% and 0.1% AEP events in 2115 the flood hazard maps show the Site is located in an area classified as 'Danger for All' hazard area with a maximum water depth of 1.6+ m and a maximum flood velocity of 0.3 to 1.0 m/s.

7.3.13 In the HFRMS, outlining the flood risk management plan for the Humber Estuary for the next 25 years and beyond, the Site is located on the boundary of two Flood Areas, Flood Area 23 Halton and Killingholme Marshes and Flood Area 24 Immingham to River Freshney. The proposed management approach in both of these areas is to continue to protect the area and improve the defences that protect existing development.

7.3.14 It is ABP's intention that the standard of protection afforded by the existing flood defences under their jurisdiction, along both the site frontage and the wider Port of Immingham, will be kept under consideration and reviewed as appropriate to account for climate change. It is therefore considered that the existing defences will be maintained to an appropriate standard to keep providing protection to the area and therefore the risk of flooding to the Site from an overtopping will not increase above the existing scenario.

7.4 Fluvial flooding

7.4.1 Based on the Environment Agency peak river flow climate change allowances both the higher central and the central allowances, 12% and 4% respectively, are assessed for the IERRT project.

7.4.2 Under the climate change scenario, water levels within Stallingborough North Beck and Habrough Marsh Drain will increase and as a consequence, there is potential for flood extents along the watercourses to increase. Given the distance of Stallingborough North Drain from the Site and comparing the current modelled flood water levels, as reported in Section 4.5 Fluvial Sources, a 12% increase in peak flood flows is unlikely to impact the Site.

7.4.3 As a proxy, the Environment Agency RoFSW maps, primarily used to represent surface runoff; can also be used to identify flooding from smaller watercourses where there is no associated hydraulic model or modelled flood water data available to inform the assessment. The 1% to 0.1% AEP (low risk) extent can be used as an indication of the impacts or climate change. The mapping shows that the flow from Habrough Marsh Drain stays within bank and do not impact the Site.

7.4.4 It is considered that the risk of fluvial flooding over the next 100 years remains the residual risk associated with tide-locking which is a common problem for the watercourses in proximity to the IERRT project. The occurrence of tide locking is likely to increase in future with rising sea levels and higher peak river flows (expected to increase by 4 - 12% between the current baseline and 2122 (see Table 5.3)), however the risk of flooding from fluvial sources is expected to remain low.

7.4.5 Should an extreme event occur, the mitigation provided to keep the development safe from tidal flooding is sufficient to protect against the much lower water levels associated with a fluvial flood event which may be encountered over the service life of the development.

7.5 Surface water runoff generation and overland flow

7.5.1 Climate change must be taken into account when considering surface water runoff generated by development sites. This is usually represented by increasing the peak rainfall intensities (see Table 5.5). An increase in rainfall intensity will result in an increase in runoff rates and volumes from the development, exacerbated by increased areas of impermeable surface associated with the IERRT project, though the impact of this is expected to be minimal due to the scale of the development and existing infrastructure.

7.5.2 As the rainfall intensities and storm events are likely to increase under the climate change scenario, the risk of flooding from surface water, which is currently considered to be low, is expected to increase at the Site unless mitigation measures are taken. Surface water drainage will be required to ensure that any increase in impermeable surface area compared to the existing site does not increase the risk of flooding from surface water, both on the Site and to the surrounding area. Therefore, design of the drainage infrastructure will need to take this into account in accordance with the NPPF, NELC policies and in consultation with the North East Lindsey IDB.

7.5.3 A Drainage Strategy, presented as Annex B to this FRA, details how surface water runoff will be managed on-site post development. The strategy includes details on surface water attenuation, consideration of climate change, proposed restricted surface water run-off rates and surface water discharge. to the Habrough Marsh Drain, Immingham Dock and the Humber Estuary.

7.6 Artificial waterbodies

7.6.1 There are no canals, reservoirs, lakes or ponds nearby to the Site, therefore the risk of flooding from artificial waterbodies is considered to be 'very low'.

7.6.2 The Port of Immingham dock is considered an artificially enclosed basin. Given the crest level of the lock gates, which have a reverse head system, the dock would only flood if defences breached or were overtopped.

7.7 Groundwater flooding

7.7.1 The predicted increase in the wetness of winters and the intensity of storm events could impact groundwater level fluctuations across the Site, and possibly increase the level of the water table. As the likelihood of groundwater emergence under the climate change scenario is likely to increase, the potential for groundwater flooding to impact the IERRT project may also increase.

7.7.2 Given the lack of data with regards groundwater levels at the Site, the Site is considered to remain at medium risk of groundwater. The presence of hardstanding ground associated with the IERRT project will create an impermeable barrier at the surface. This will prevent groundwater emergence across the Site. Therefore, the risk of groundwater flooding is considered to remain a medium risk over the next 100 years.

7.8 Flooding from drainage infrastructure

7.8.1 It is difficult to precisely predict the impact of climate change on flooding from drainage infrastructure. However, with the projected increases in rainfall intensity, a greater amount of surface water runoff will be generated on site. In order to account for this increase, new drainage and sewer systems will be required on site and should be designed to accommodate flows under climate change scenarios, incorporating SuDS where possible. The risk of flooding from drainage infrastructure will remain low over the service life of the development.

7.8.2 A Drainage Strategy for the IERRT presented as Annex B to this FRA details how surface water runoff will be managed on-site post development.

8. Off-Site impacts and residual risk

8.1 Off-Site impacts

8.1.1 No ground raising is proposed as part of the IERRT project. The IERRT project will utilise existing port areas for HGV/ trailer/ container storage comprising of large, flat parking areas. The only built development is the proposed terminal building, the footprint of the internal bridge that crosses the railway and internal access roads, and the approach road to the jetty that passes above the flood defences. Given the footprint of new development and considering the extent of flooding throughout the Port of Immingham and the wider area should overtopping or breach of flood defences occur, it is unlikely that any increase in tidal flood water level due to loss of floodplain storage will significantly increase the risk of flooding off-site.

8.1.2 The IERRT project is likely to increase impermeable area above that present on site for the baseline scenario therefore an increase in surface water run-off as a consequence of the IERRT project will occur. Over the next 100 years, climate change will increase the intensity of storm events and surface water run-off rates and volumes will increase. A Drainage Strategy (Annex B to this FRA) outlines how the drainage infrastructure within the Site will be designed to not increase flood risk elsewhere. Provided surface water is managed in accordance with the drainage strategy, the IERRT will not result in any offsite flood risk impacts.

8.2 Residual risk

8.2.1 Over the period of the assessment, the next 100 years, there remains a residual risk of tidal flooding should the flood defences over-top or a breach event occur. The mitigation measures outlined in Section 7 of this FRA detail how this residual risk of flooding can be managed via flood warnings, minimum development levels, flood resistance and resilience measures etc. so that the IERRT project and its occupants remain safe. In addition, the tidal flood defences are inspected twice a year by the Environment Agency to ensure that they remain fit for purpose.

8.2.2 With an increase in tidal water levels and peak fluvial flood water levels, tidelocking of the Habrough Marsh Drain remains a residual risk. It is unlikely that significant flooding would occur over a tidal cycle, however mitigation included on-site to protect against tidal flooding will be sufficient to protect the IERRT project should fluvial flooding from a tidelocking scenario occur.

8.2.3 Failure, blockage or exceedance of the capacity of the drainage systems (including drains and any attenuation features) are a potential residual risk to the Site and the surrounding area. Regular inspection and maintenance will be undertaken to prevent blockages of drainage infrastructure.

8.2.4 Legislation requires that LPAs are responsible for the clear agreements to be put in place for ongoing maintenance requirements for proposed SuDS over the lifetime of the development, however, the proposed drainage system will be privately owned infrastructure and as such it will be ABP who will responsible for the drainage features on-site whilst the Habrough Marsh Drain will continue to fall under the jurisdiction of the North East Lindsey IDB.

8.2.5 Drainage infrastructure will be regularly inspected and maintained to certify its design standard is not compromised over the service life of the IERRT project.

8.2.6 There also remains the risk of surface water flooding in the event of a storm in excess of the 'design storm'. Further information is provided in the Drainage Strategy presented as Annex B to this FRA.

9. Conclusions

9.1.1 AECOM has prepared this FRA on behalf of ABP to support a DCO application for the IERRT project located at the Port of Immingham. The assessment has been undertaken in accordance with the NPSfP, NELC local policy, and in consultation with the Environment Agency and North East Lindsey IDB.

9.1.2 The following conclusions can be made regarding flood risk to the Site and to off-site areas as a result of the IERRT project:

- The FRA has considered all potential sources of flooding to the IERRT 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 25%, increase peak river flows by up to 4-12% and increase sea levels by up to 0.96 m over the next 100 years.
- The Environment Agency FMfP shows the Site is located in Flood Zone 3a (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.
- There are tidal flood defences located along the south bank of the Humber Estuary. Tidal flood defences adjacent to the development 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.
- The North East Lincolnshire SFRA indicates that the principal residual risks in the Immingham area would be a failure or overtopping of the flood defences. The breach assessment identified that the Site is located in an area with a 'Significant to Extreme' hazard rating, representative of water that is both deep and fast flowing and a danger to all whilst the overtopping assessment identified that the Site is currently located in an area with a 'Low to Moderate' hazard rating, but this would increase to an 'Extreme' hazard rating when climate change is taken into account. It is noted, however, that the probability of a breach or overtopping of the defences occurring is considered to be low.
- The risk of flooding from fluvial sources to the IERRT project from both Main River and Ordinary Watercourses is considered to be low over the IERRT project assessment period (100 years). There remains, however, a residual risk of fluvial flooding from Ordinary Watercourses under tidelocking scenarios.
- The NPSfP (and PPG) considers port related development to be classed as 'water compatible' development and is therefore considered appropriate in the planning context for development in Flood Zones 2 and 3, subject to appropriate mitigation measures being implemented for any identified flood risk.
- Based on the conclusions of the ES Chapter 7 (Physical Processes), the marine element of the IERRT project will have no/ little impact of

significance on water levels, flow speed, flood direction, erosion and accretion patterns or wave propagation.

- The Environment Agency RoFSW maps indicate the Site is generally at low risk of flooding from surface water.
- The risk of flooding from artificial sources and drainage infrastructure is considered to be low.
- Given the limited data with regards groundwater levels at the Site, the preliminary assessment of flooding from groundwater sources is considered to be a medium risk;
- Flood resilience and resistance measures for managing the residual flood risk to the IERRT project will be adopted.
- The Site will receive the Environment Agency's Flood Warning Service and sufficient warning of a flood event will allow evacuation of the Site to occur. A Flood Response Plan will be provided for the IERRT project, and should a full evacuation of the Site not be possible, the first floor of the terminal building will provide an area of safe refuge, located above the 0.1% AEP breach flood water level (a water level of approximately 6.25 m AOD) as agreed with the Environment Agency.
- The flood defences and any future works to the defences will not be impacted as a result of the development. Sufficient clearance between the flood defences and the jetty approach road will be provided to allow the flood defences to be raised in the future to adapt to climate change and to enable machinery to access the flood defences.
- Mitigation put in place to manage the residual tidal flood risk (e.g. raised floors 300mm above the ground level) will also manage flood risk from groundwater or surface water sources should an extreme event occur;
- A Drainage Strategy is provided as Annex B to this FRA 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.; and
- It is considered that there will be no off-site impacts as a result of the IERRT project in relation to flood risk.

9.1.3 Based on the findings of this assessment, AECOM considers that the flood risk from all sources, to and from the Site can be mitigated to a level which is low and acceptable.

Annex A Statutory Consultation Responses

Our ref: CCN-2021-236910

[redacted]@aecom.com

Date: 08/11/2021

Dear William

Provision of Flood Risk Information for Immingham Eastern Ro-Ro Terminal.

Thank you for your request to use 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

This site is not considered to be at risk of flooding from main rivers.

The site may be at risk from local ordinary watercourses for which other risk management authorities, such as the Lead Local Flood Authority (ie top tier council) or Internal Drainage Board (where they exist) have responsibility.

5. Tidal Flood Risk Information

The existing tidal defences protecting this site consist of wave walls, revetments and flood doors.

They are in fair 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 February 2016. 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 Frederic Stuhldreer using the email address below.

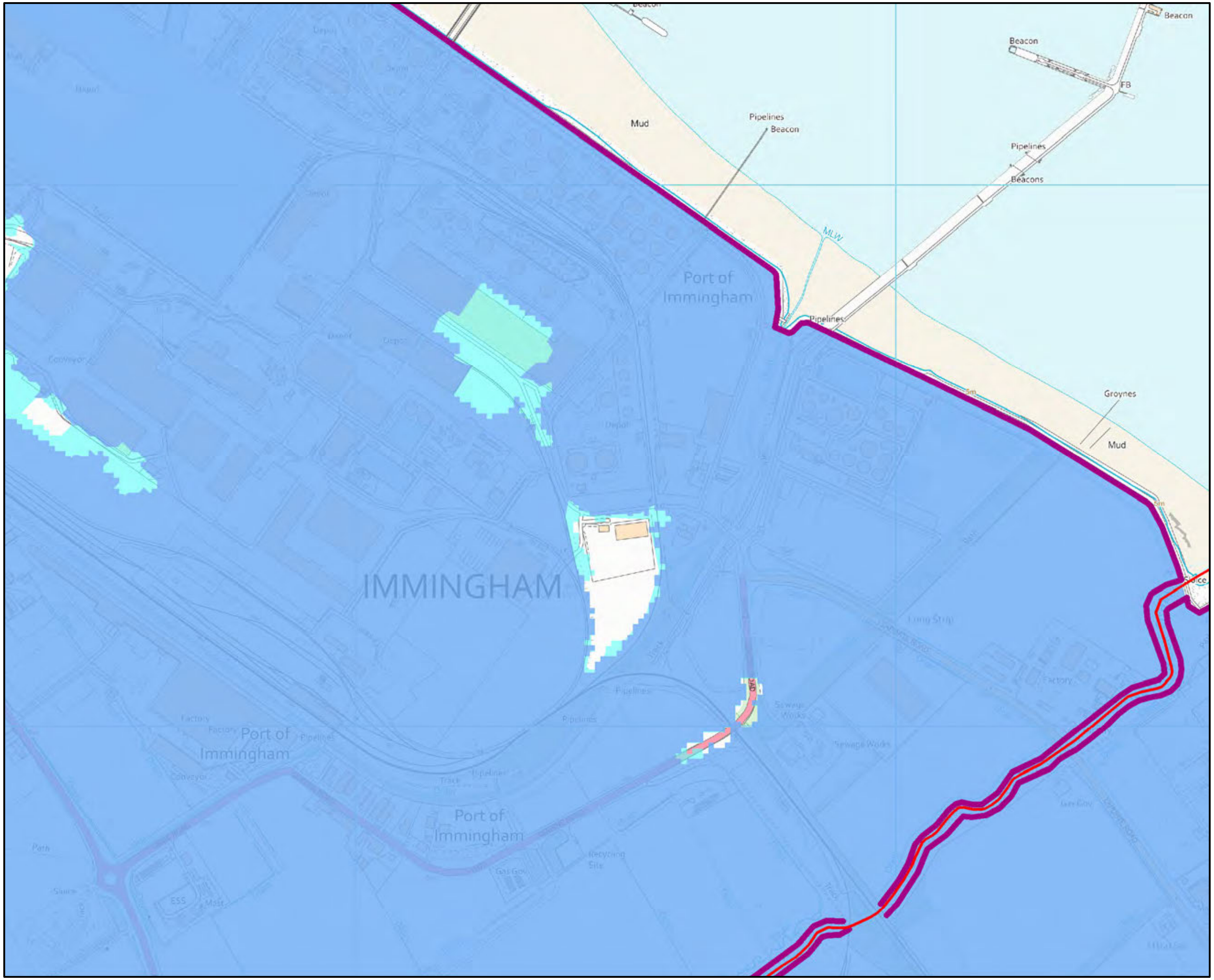
Yours sincerely,

[redacted]

for Paul Payne
South Humber and East Coast Partnerships and Strategic Overview Team Leader
e-mail PSO_Coastal@environment-agency.gov.uk

Enc.
Flood Map
Historic Flood Event Outlines Map
Tidal Level Data Sheets - Map and Tables
Tidal Breach Points – Locations Map
Hazard Mapping – Breaching
Hazard Mapping – Overtopping

Flood Map centred on TA 20465 15437 - created October 2021 [Ref: CCN-2021-236910]



Environment Agency

Scale 1:10,000

N
W E
S

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.

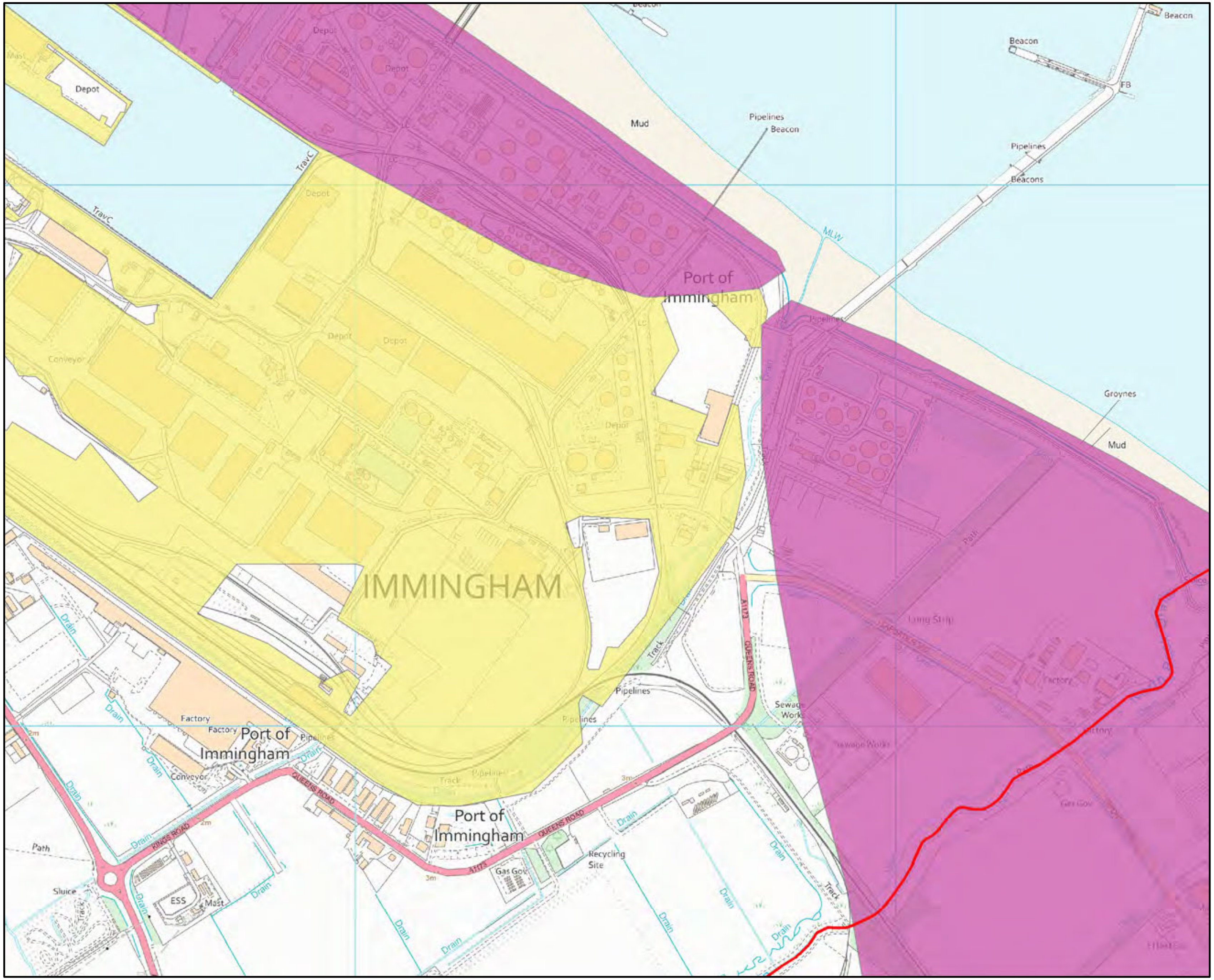
- or from a river by a flood that has a 1% (1 in 100) or greater chance of happening each year.

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.

Contact Us: National Customer Contact Centre, PO Box 544, Rotherham, S60 1BY. Tel: 03708 506 506 (Mon-Fri 8-6). Email: enquiries@environment-agency.gov.uk

Historic Flood Map centred on TA 20465 15437 - created October 2021 [Ref: CCN-2021-236910]



Environment Agency

Scale 1:10,000

N W E S

Legend

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

Contact Us: National Customer Contact Centre, PO Box 544, Rotherham, S60 1BY. Tel: 03708 506 506 (Mon-Fri 8-6). Email: enquiries@environment-agency.gov.uk

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

Environment Agency

Scale 1:550,000

N S W E

▲ East Coast and Wash

See seperate data sheet for predicted flood levels

Created by the Partnerships and Strategic Overview Team, Lincoln

Contact Us: National Customer Contact Centre, PO Box 544, Rotherham, S60 1BY. Tel: 03708 506 506 (Mon-Fri 8-6). Email: enquiries@environment-agency.gov.uk

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

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 [redacted]

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 [redacted]

^ **Modelled Breach Locations**

0 3.5 7 14
Kilometres

This map indicates the location of where we have modelled the consequence of breaches in the defences along the coastline and tidal rivers. We have mapped the 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.

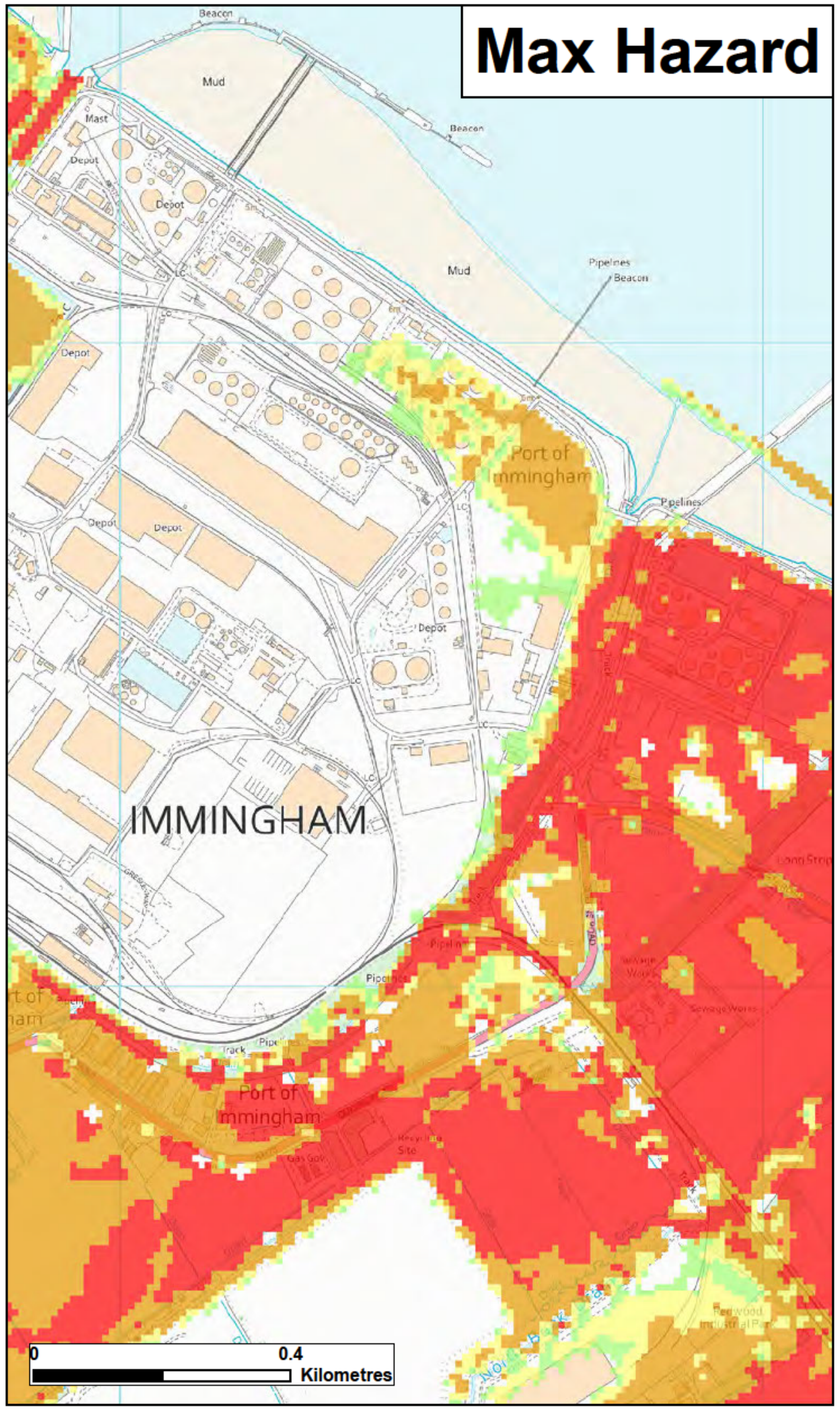
General Enquiries No: 03708 506 506.
Weekday daytime calls cost 5p plus up to 6pm from BT Weekend Unlimited. Mobile and other providers charges may vary

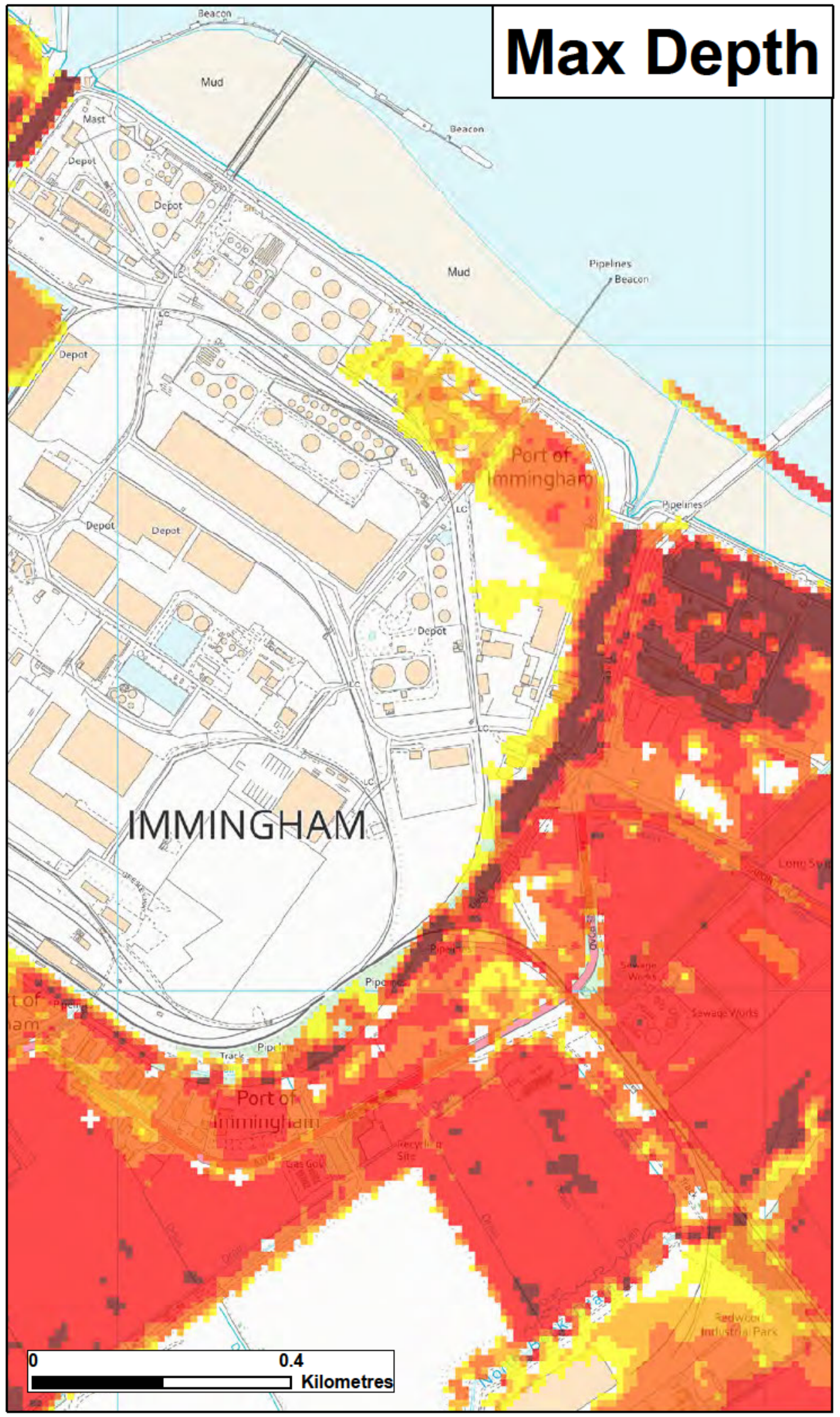
Environment Agency

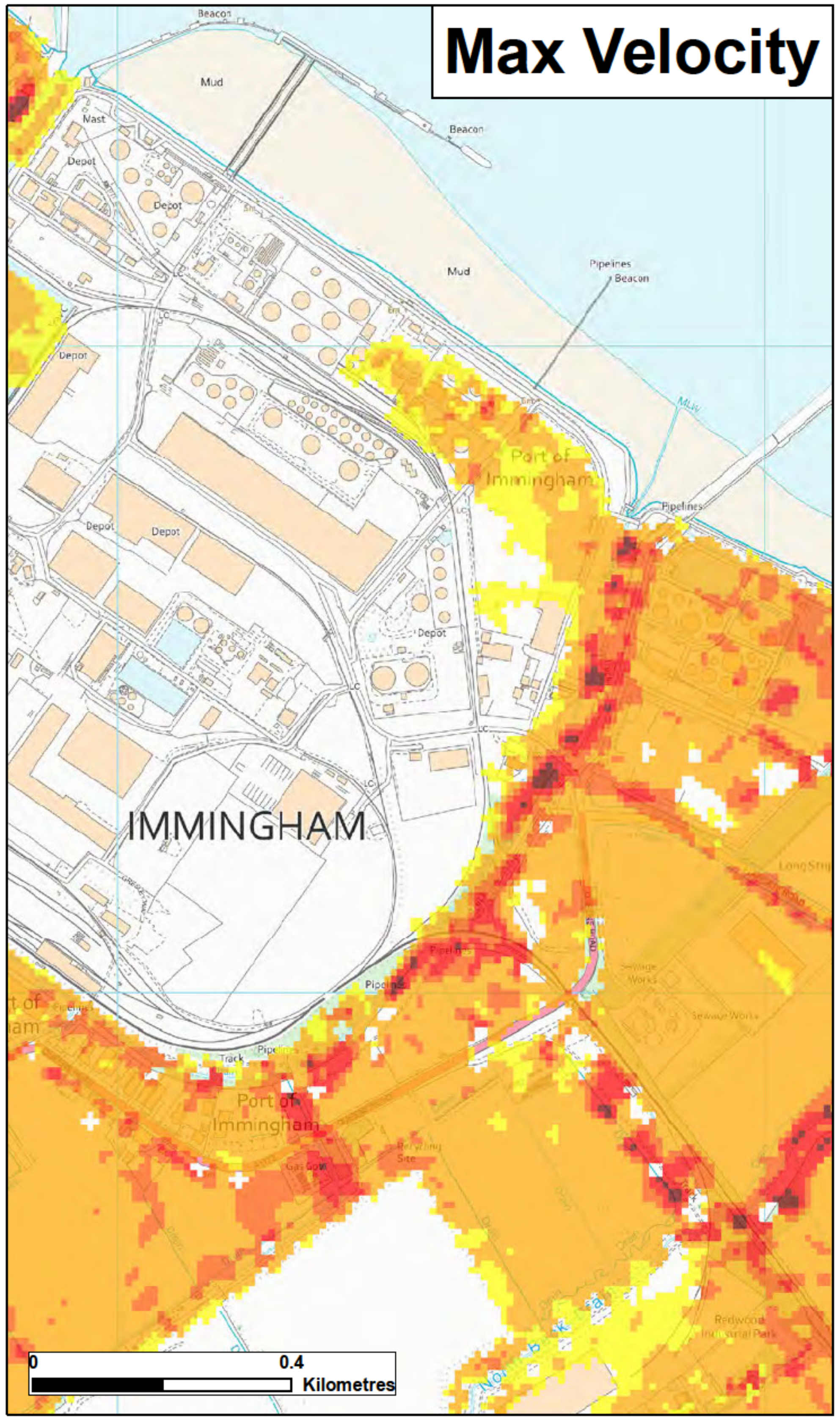
Produced by the Partnership and Strategic Overview Team, Lincoln
General Enquiries No 03708 506 506

Northern Area Tidal Hazard Mapping

Location of Modelled Breaches







★ **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	October 2021	Scenario year	2006	Scenario Annual Chance	0.5% (1 in 200)	CCN Number	CCN-2021-236910

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.

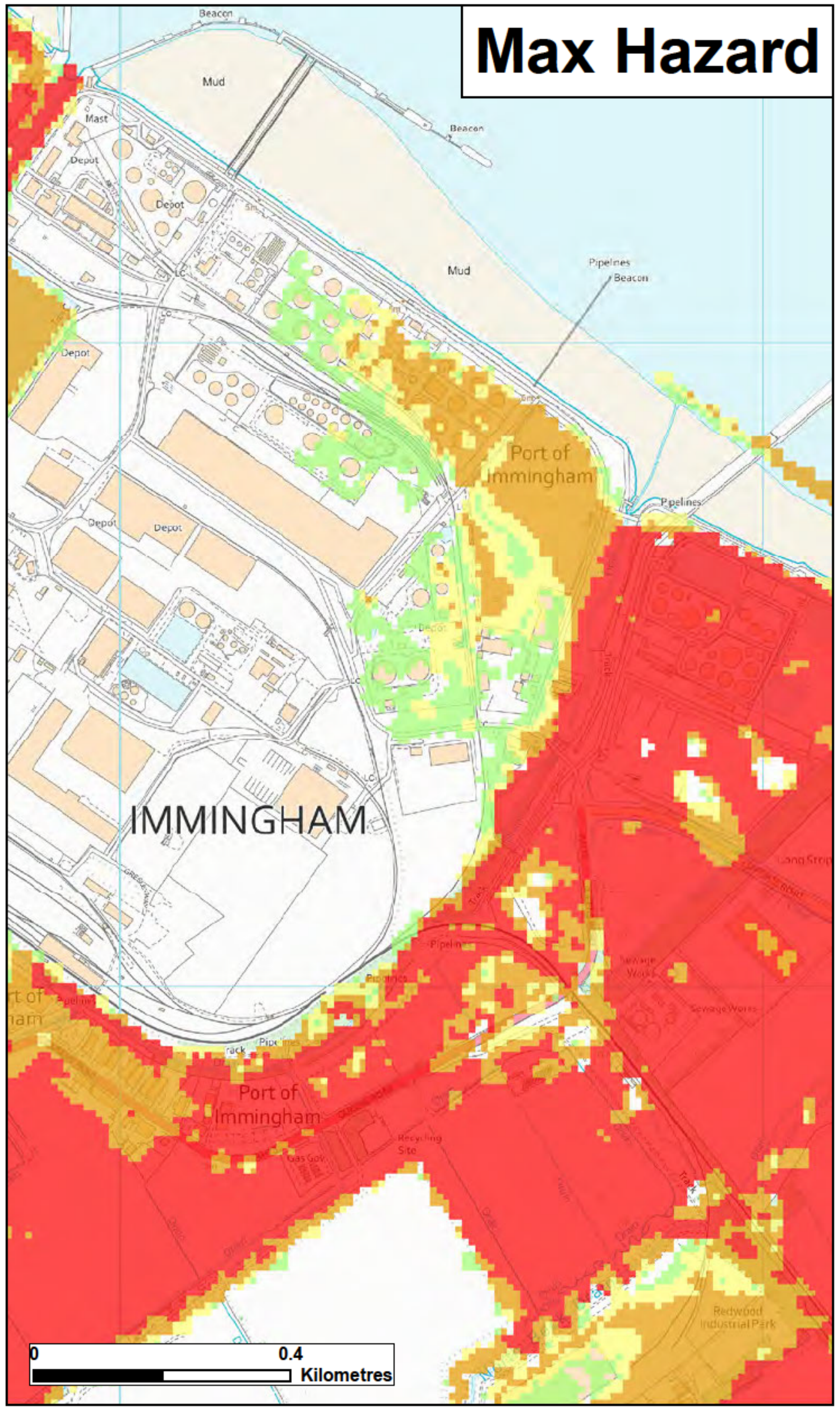
The map only considers the consequences of a breach, it does not make any assumption about the likelihood of a breach occurring. The likelihood of a breach occurring will depend on a number of different factors, including the construction and condition of the defences in the area. A breach is less likely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

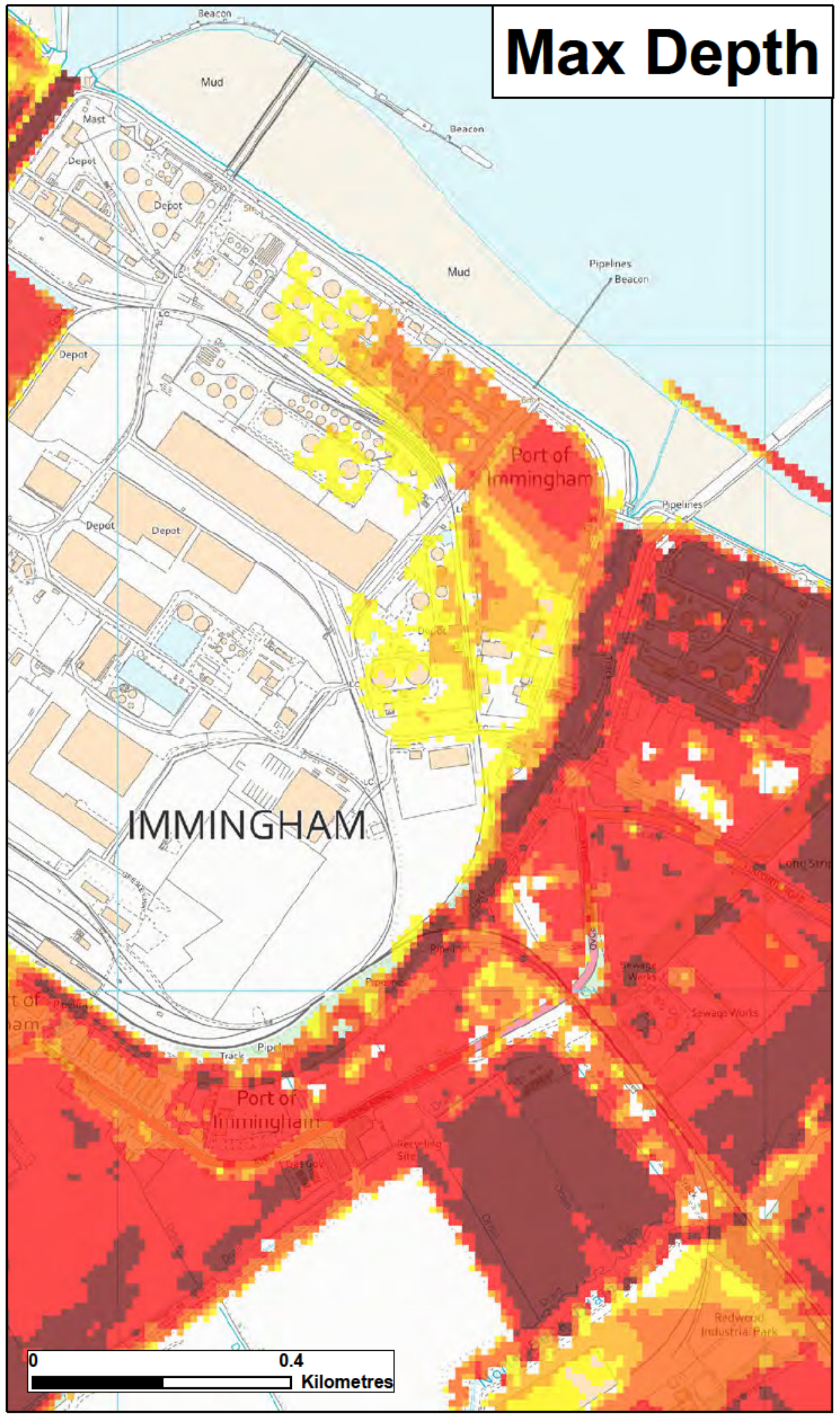
General Enquiries No: 03708 506 506. Weekday Daytime calls cost 5p plus up to 6p per minute from BT Weekend Unlimited. Mobile and other providers' charges may vary

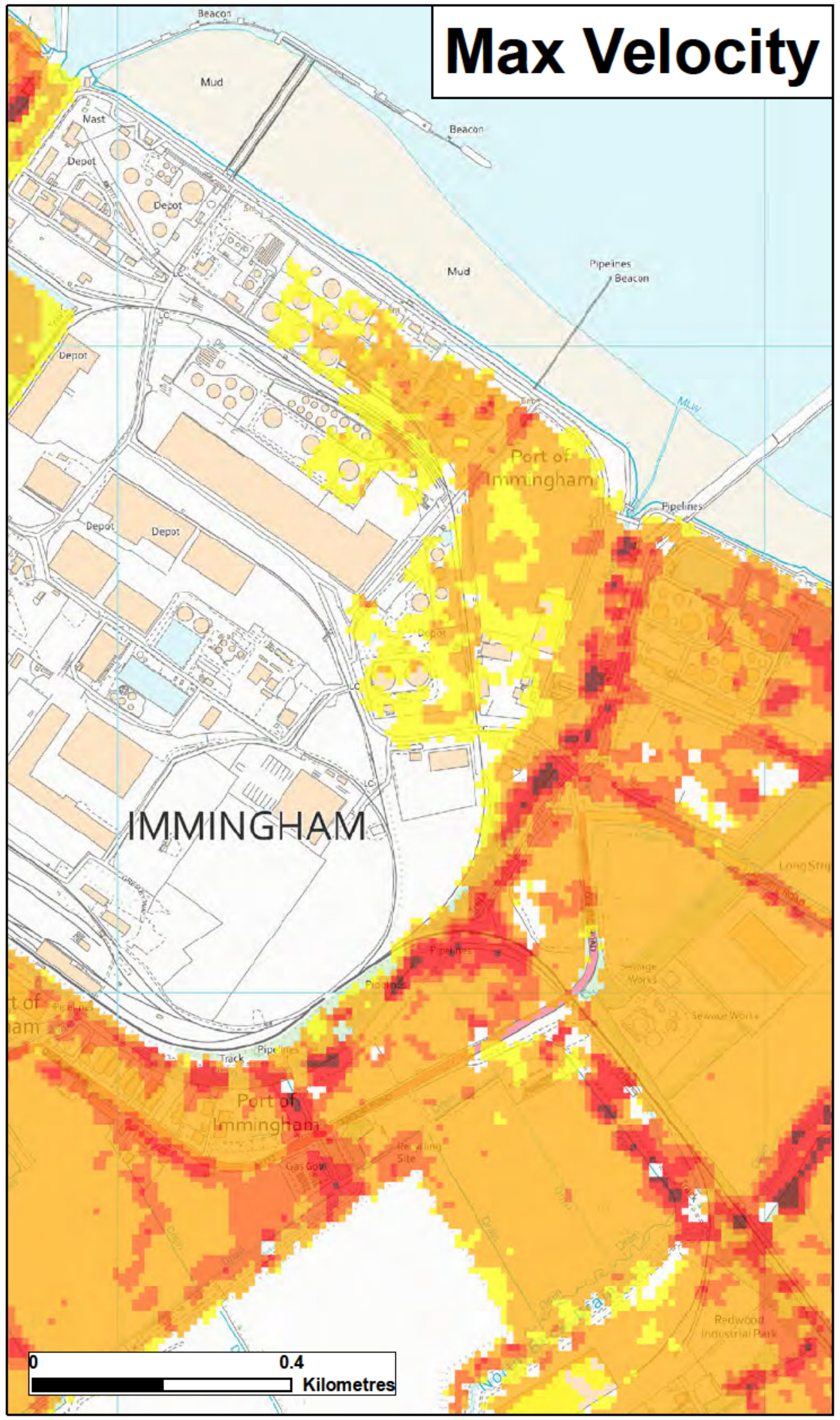
Environment Agency

Lincolnshire and Northamptonshire Hazard mapping

Map Centred on TA 20465 15437







★ **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	October 2021	Scenario year	2006	Scenario Annual Chance	0.1% (1 in 1000)	CCN Number	CCN-2021-236910

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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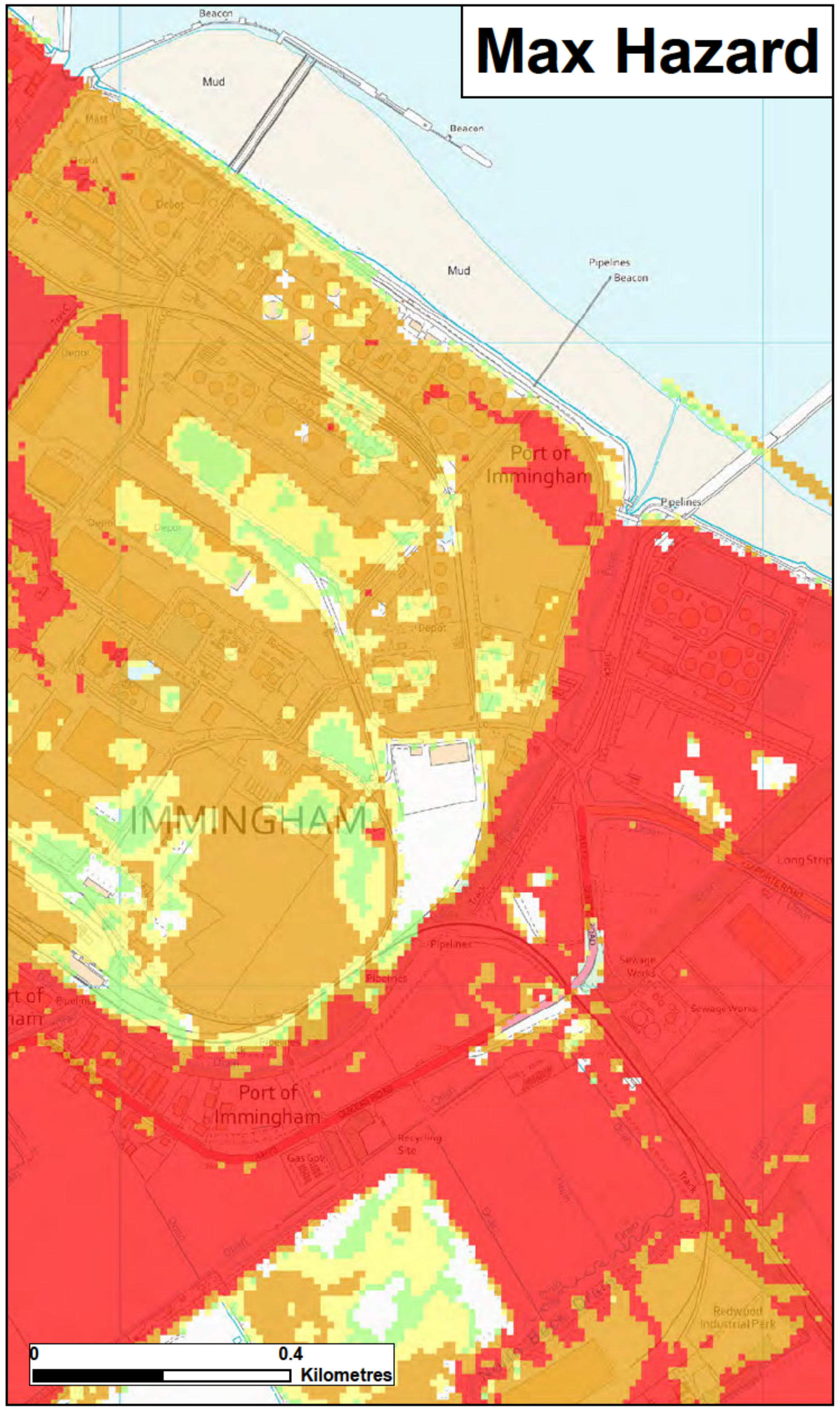
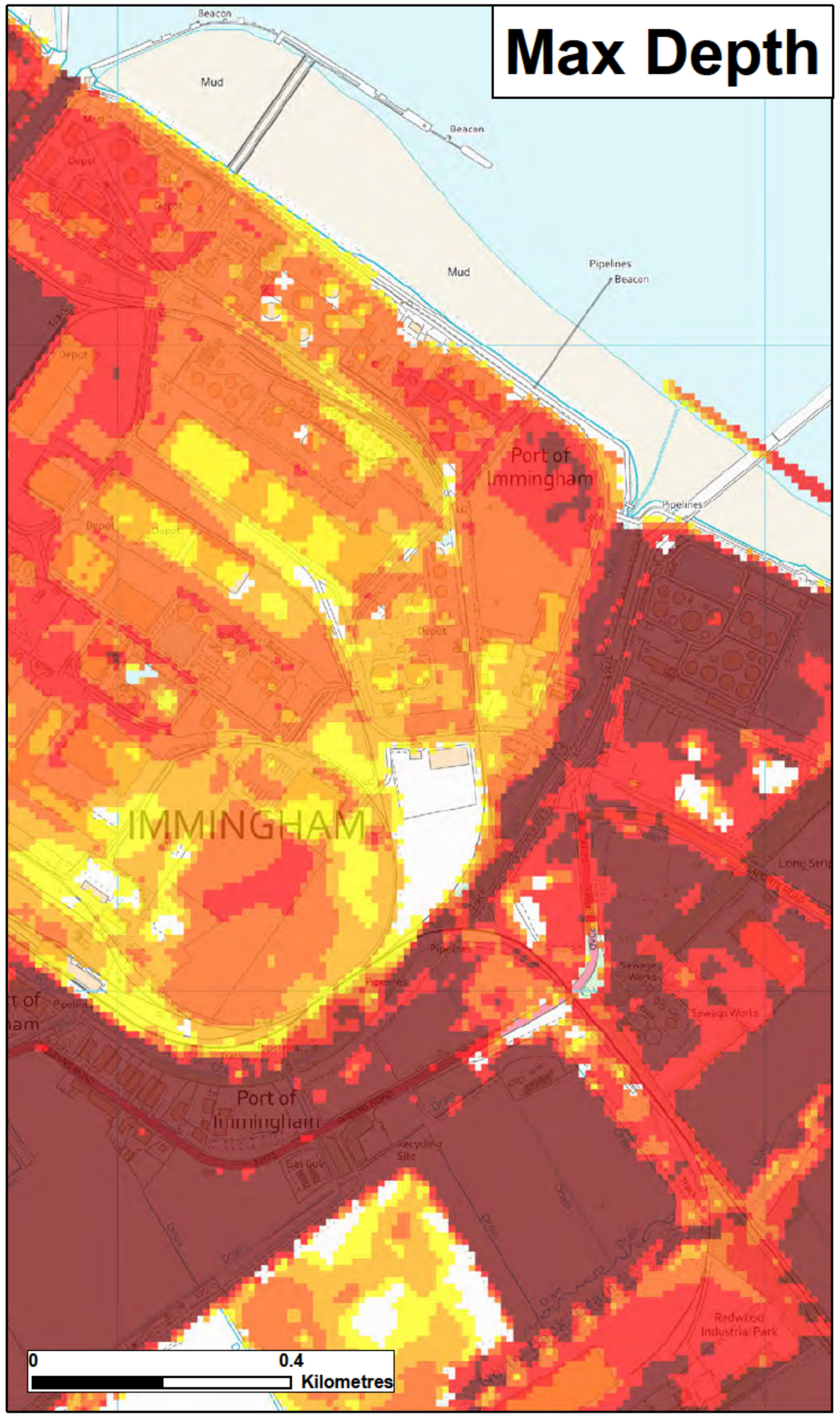
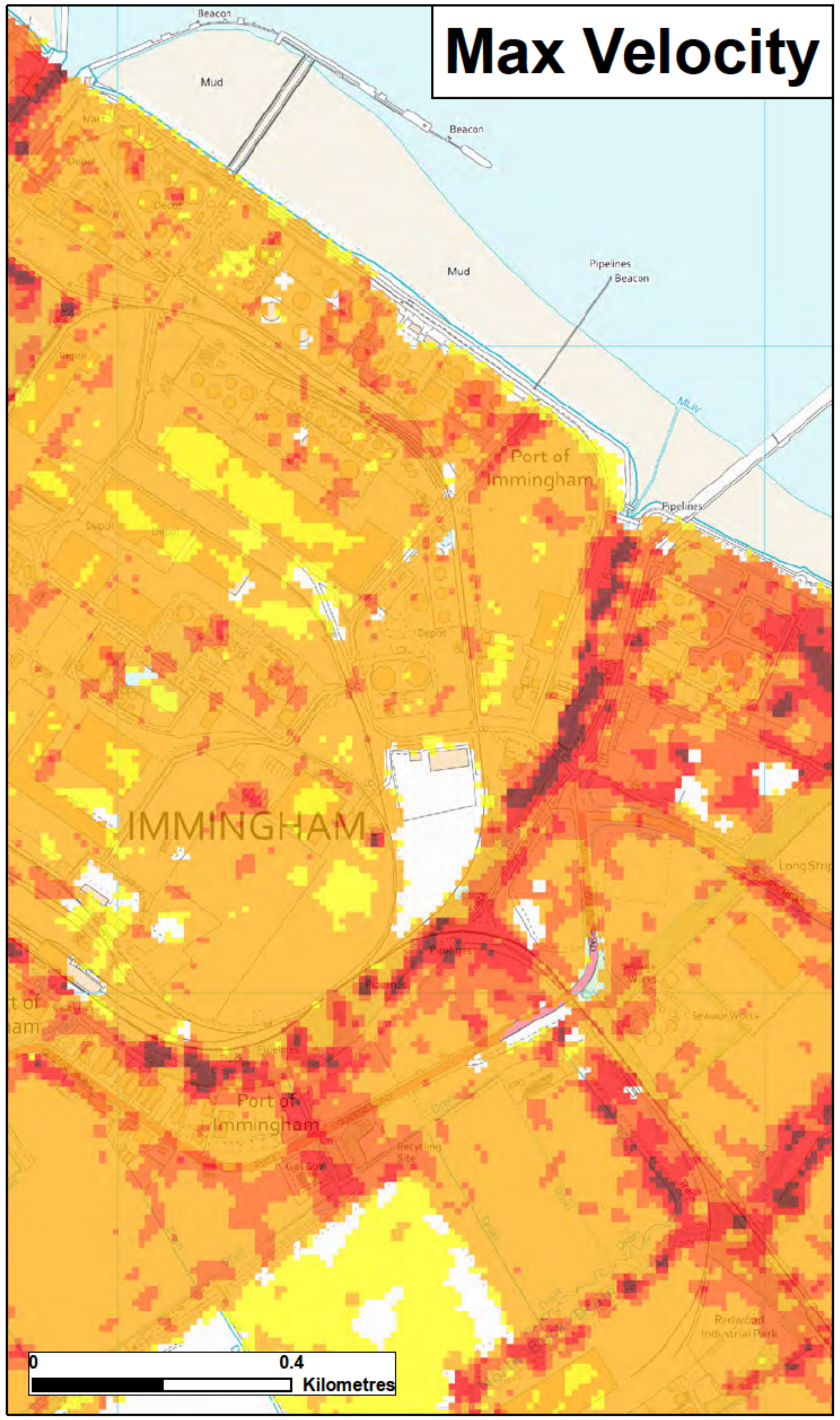
Environment Agency

Lincolnshire and Northamptonshire Hazard mapping

Map Centred on TA 20465 15437







★ **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)
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- 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	October 2021	Scenario year	2115	Scenario Annual Chance	0.5% (1 in 200)	CCN Number	CCN-2021-236910

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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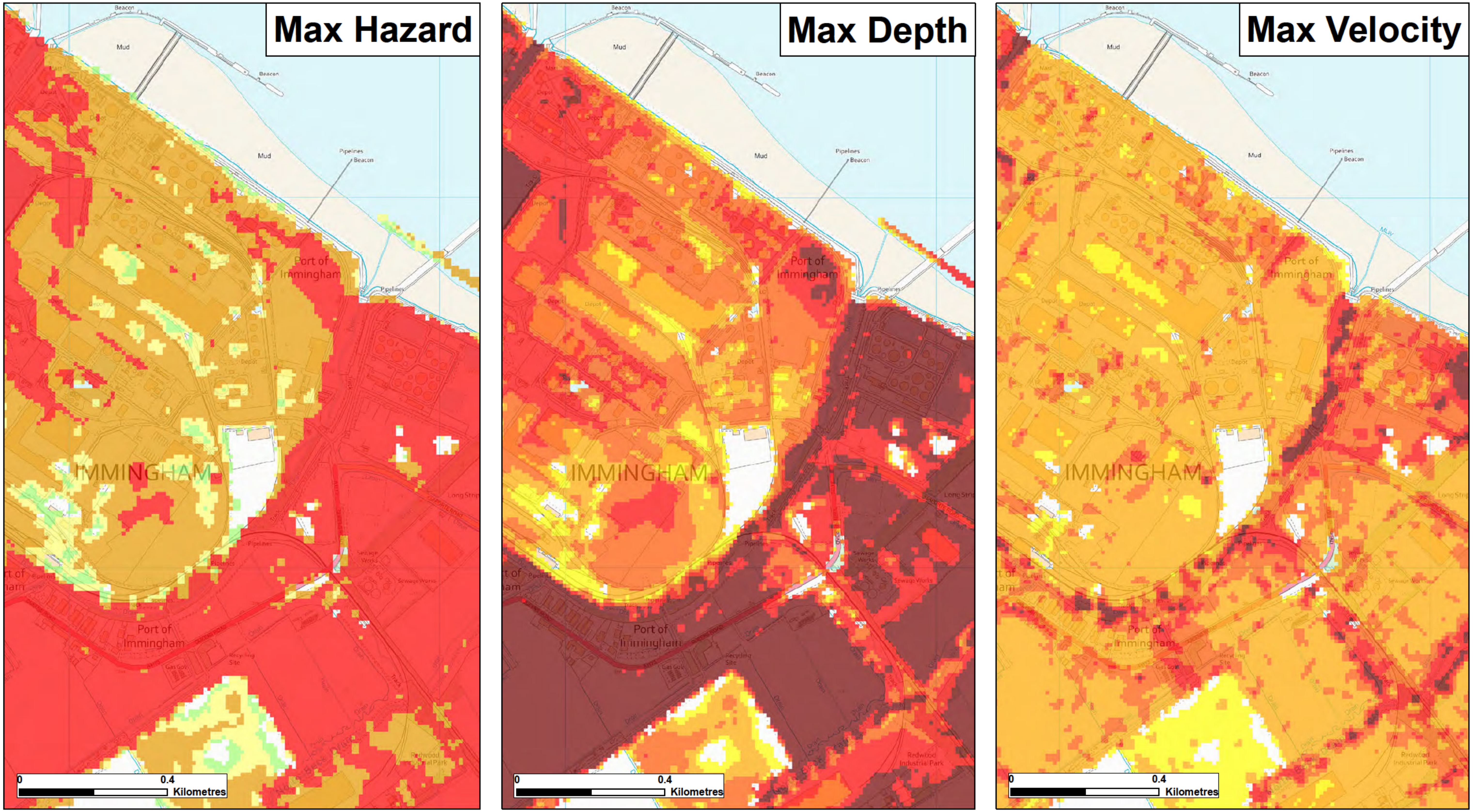
Environment Agency

Lincolnshire and Northamptonshire Hazard mapping

Map Centred on TA 20465 15437



★ **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	October 2021	Scenario year	2115	Scenario Annual Chance	0.1% (1 in 1000)	CCN Number	CCN-2021-236910

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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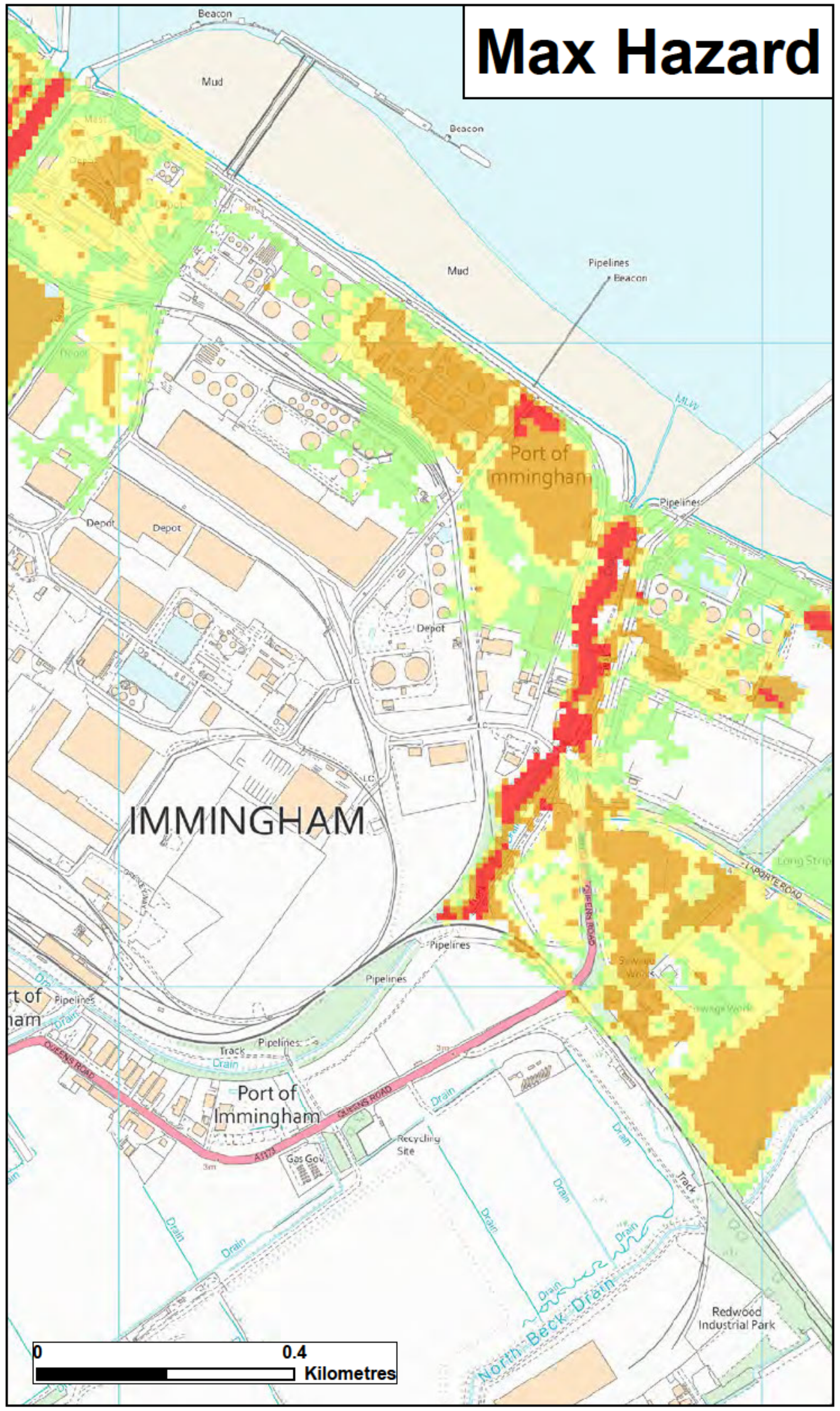

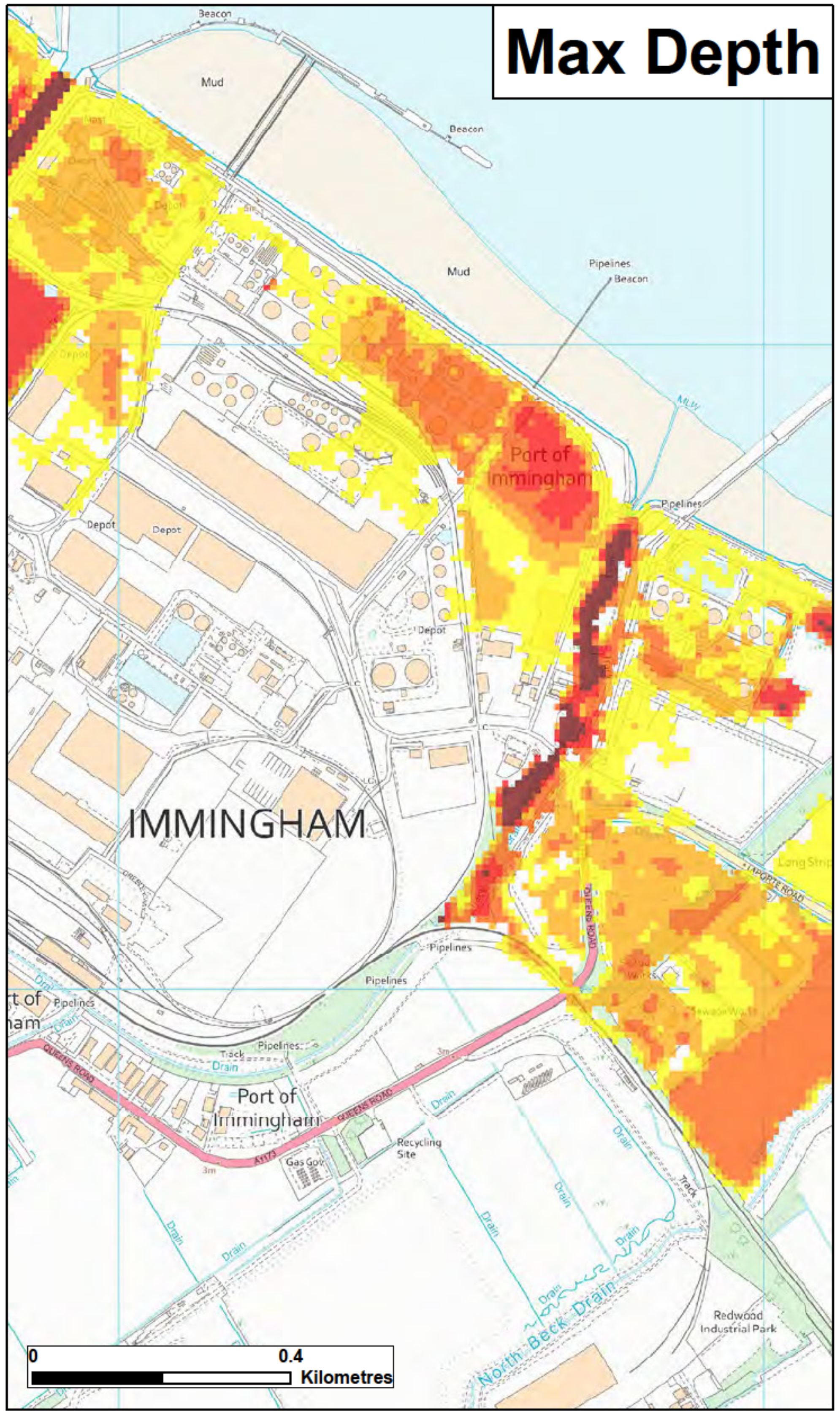

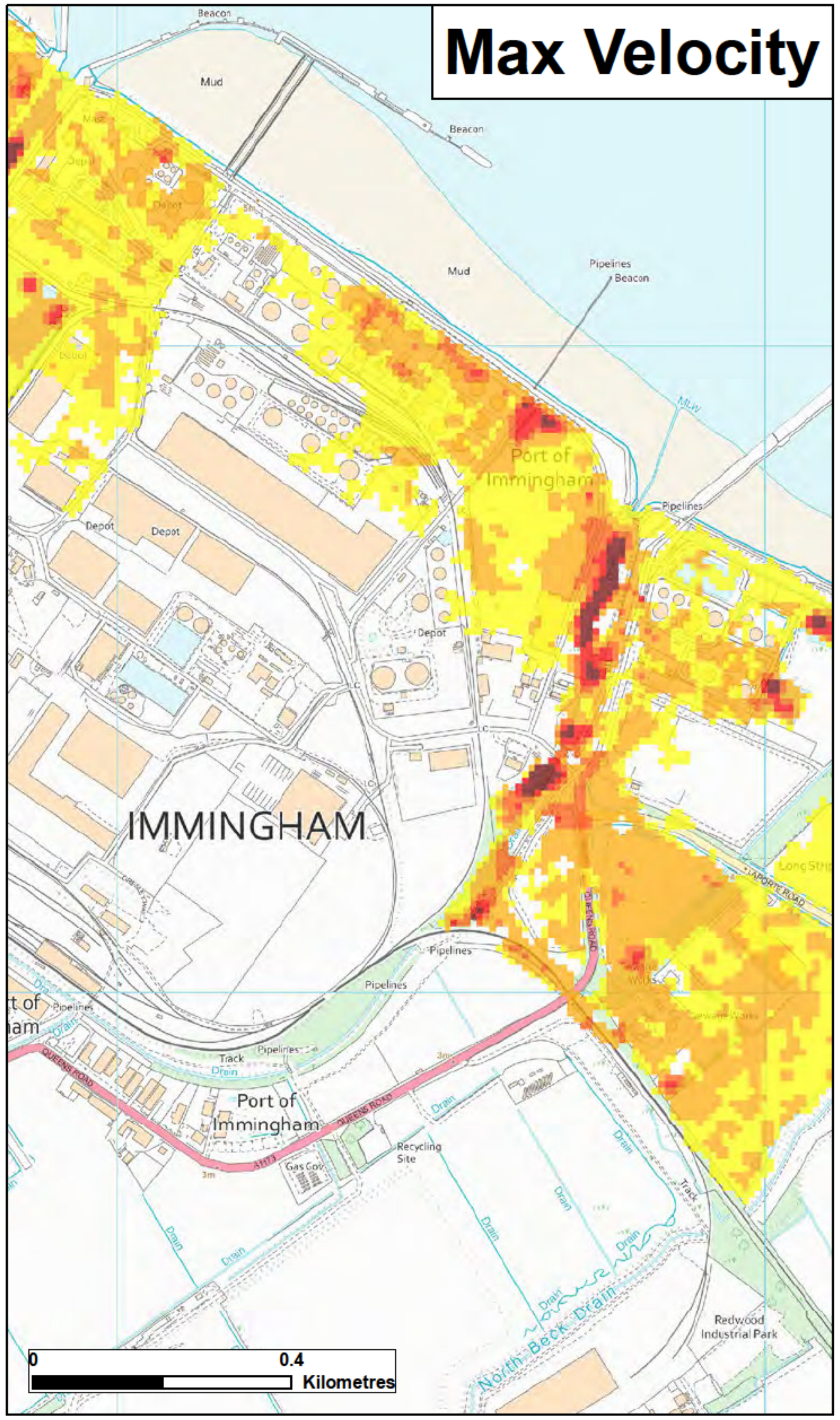

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Max Depth (m)

- 0 - 0.25
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- 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 +

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)

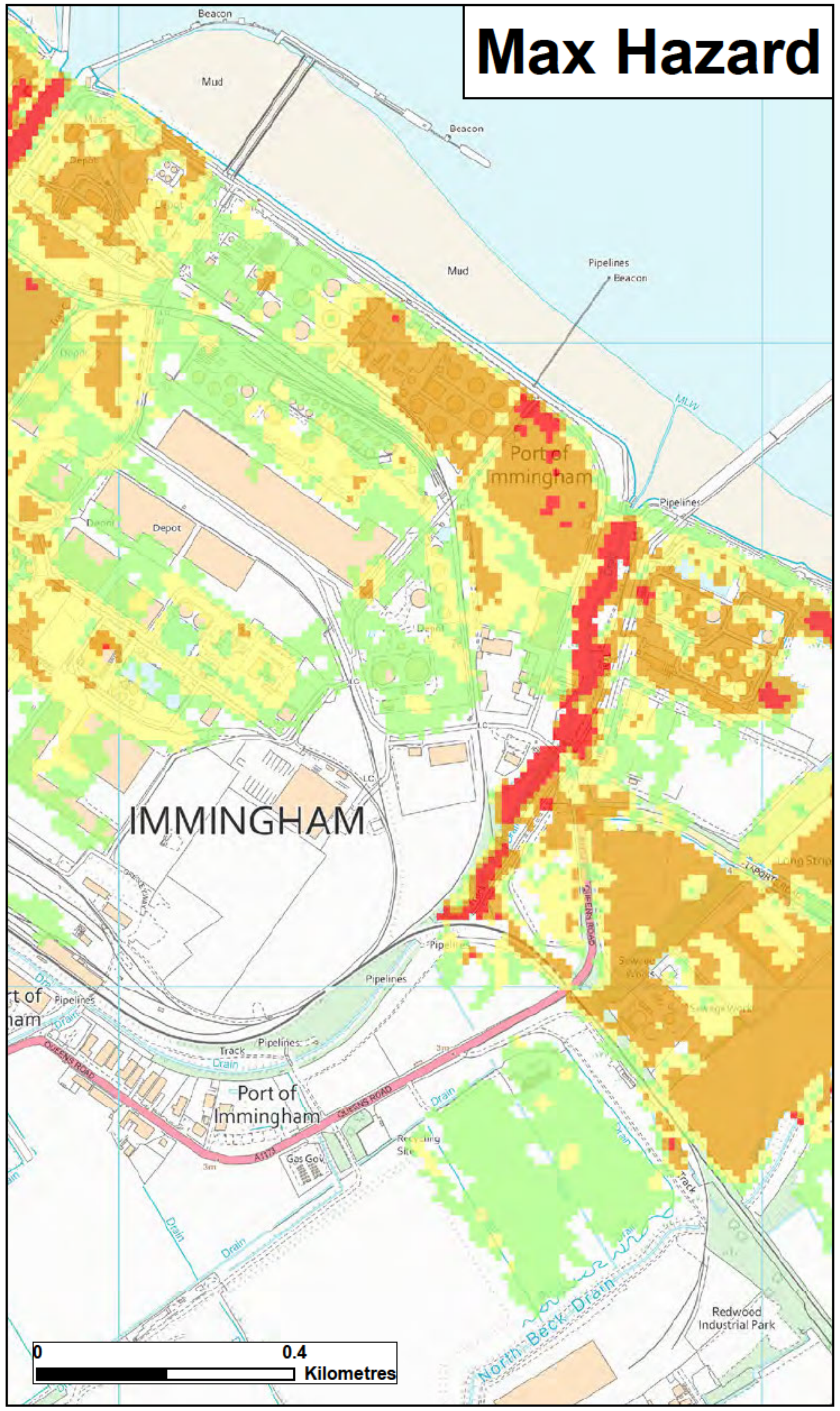
General Enquiries No: 03708 506 506. Weekday Daytime calls cost 5p plus up to 6p per minute from BT Weekend Unlimited. Mobile and other providers' charges may vary

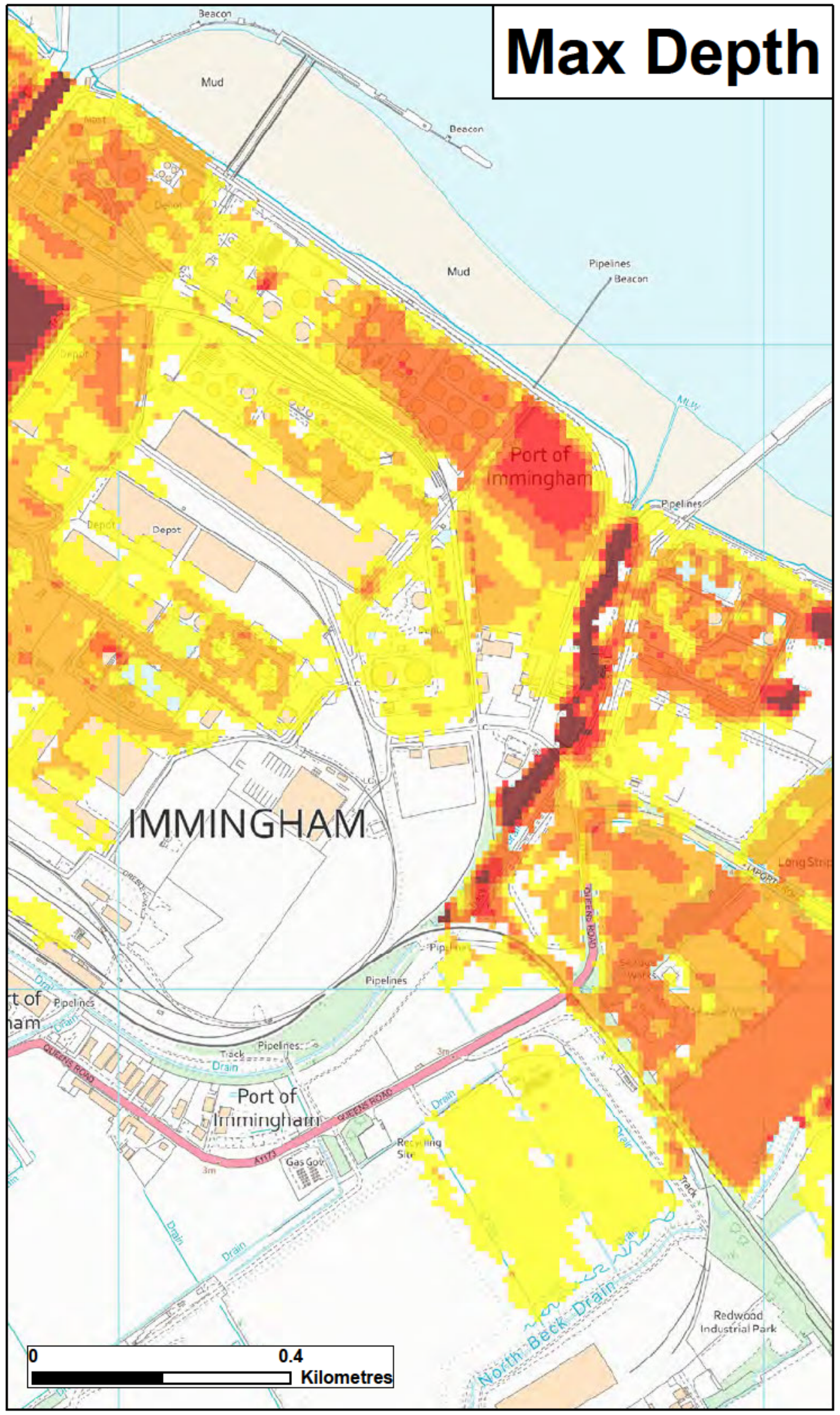
Environment Agency

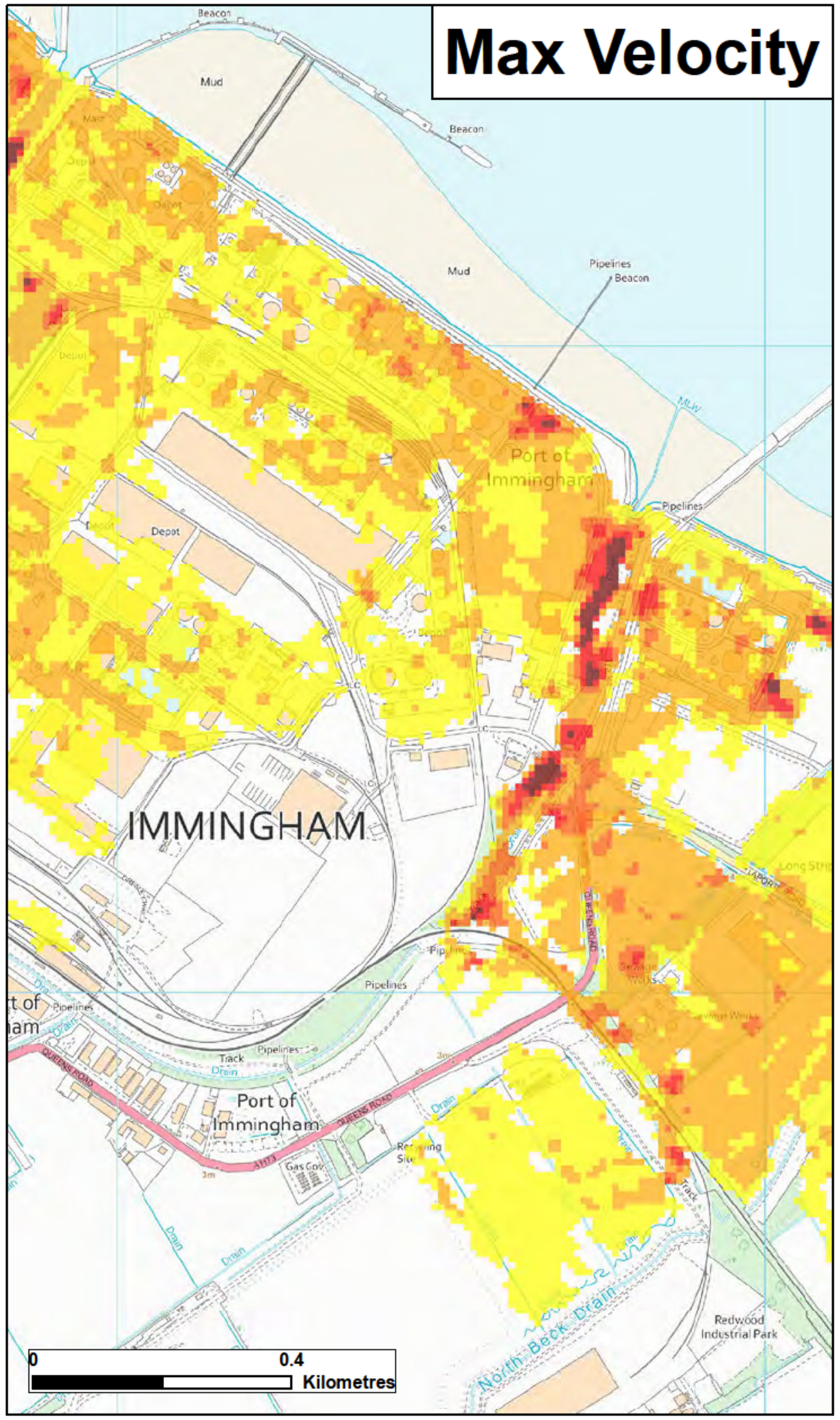
Lincolnshire and Northamptonshire Overtopping Hazard Mapping

Map Centred on TA 20465 15437

Date Printed	October 2021	Scenario year	2006	Scenario Annual Chance	0.5% (1 in 200)	CCN Number	CCN-2021-236910







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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 +

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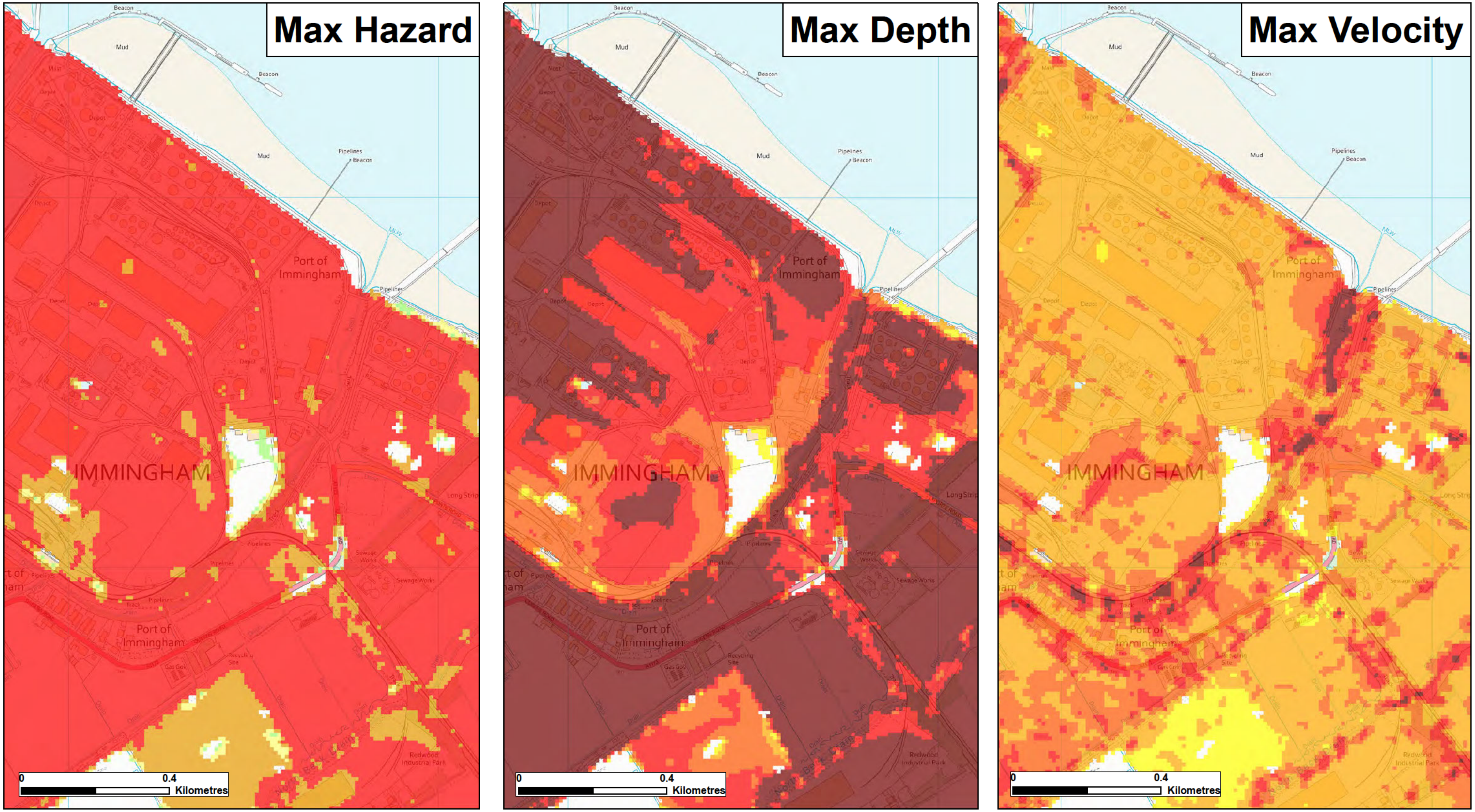
Environment Agency

Lincolnshire and Northamptonshire Overtopping Hazard Mapping

Map Centred on TA 20465 15437

Date Printed	October 2021	Scenario year	2006	Scenario Annual Chance	0.1% (1 in 1000)	CCN Number	CCN-2021-236910



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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 +

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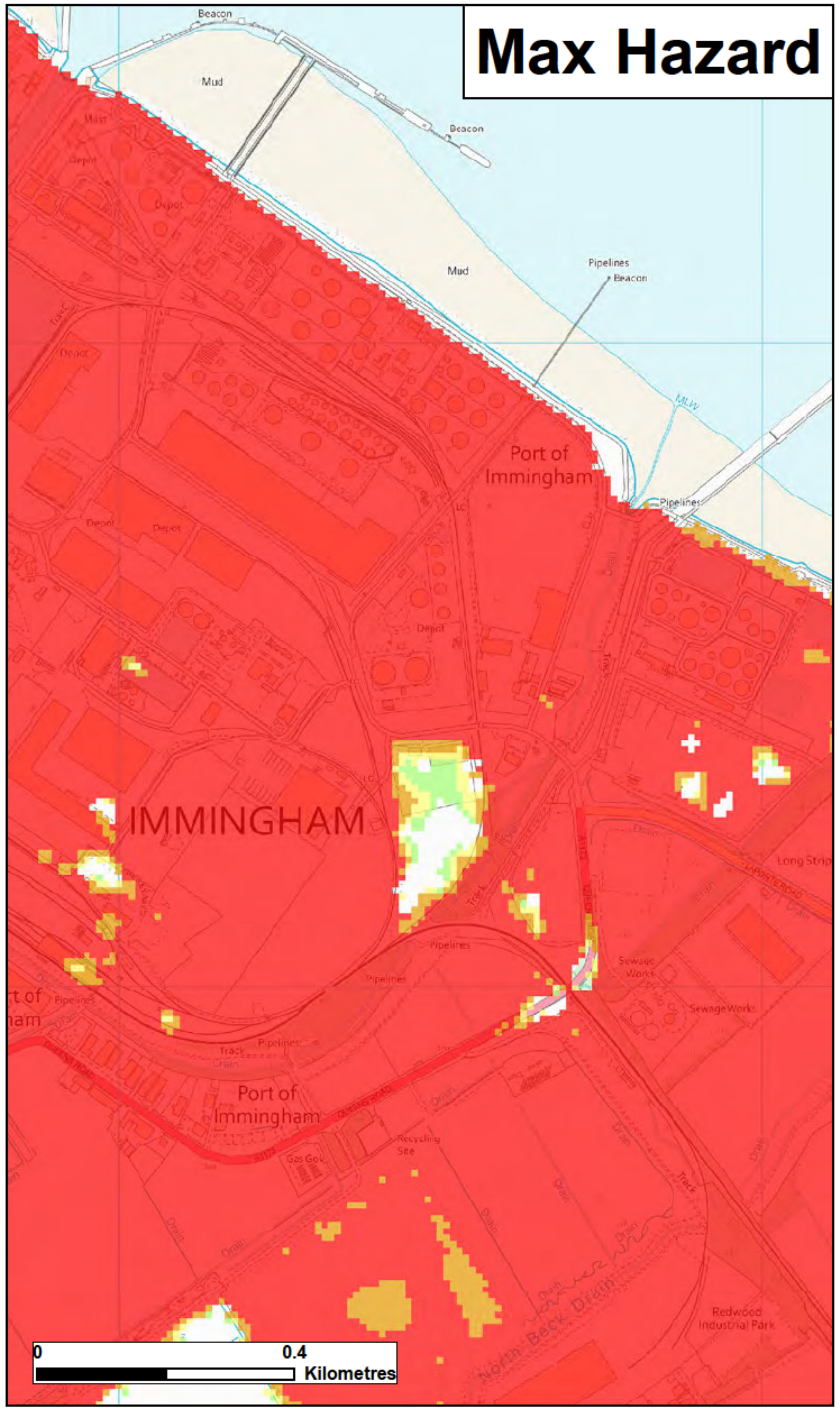
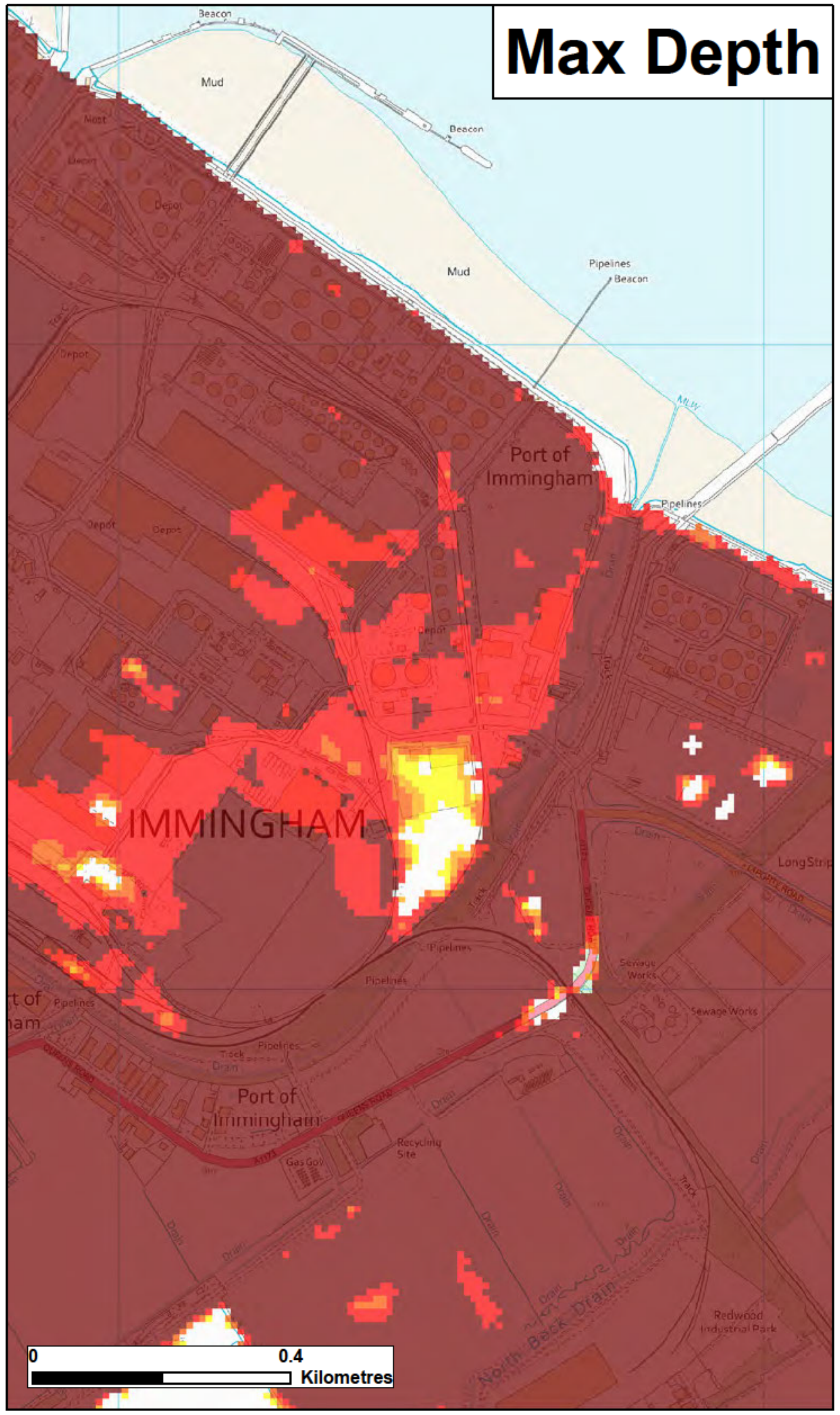
Environment Agency

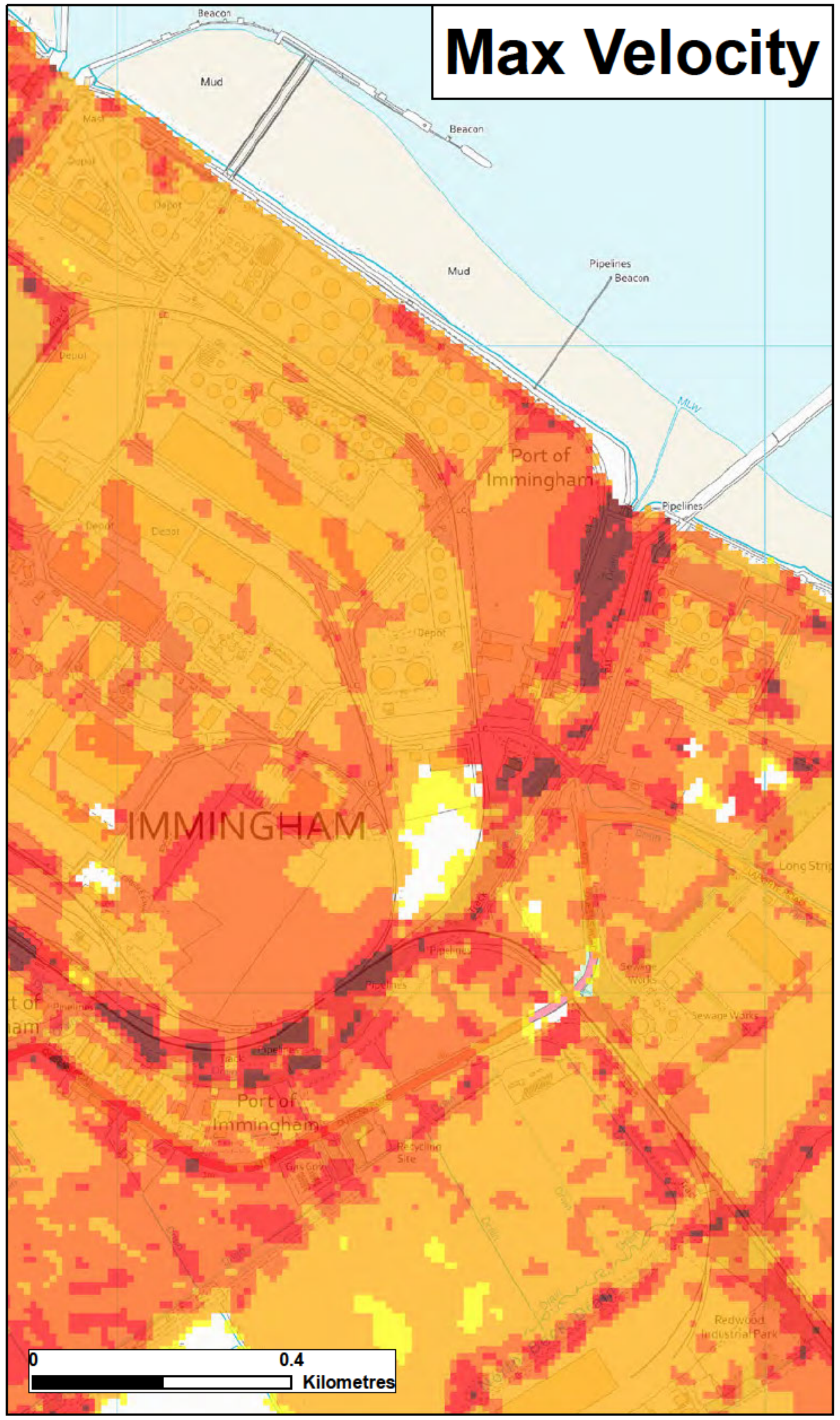
Lincolnshire and Northamptonshire Overtopping Hazard Mapping

Map Centred on TA 20465 15437

Date Printed	October 2021	Scenario year	2115	Scenario Annual Chance	0.5% (1 in 200)	CCN Number	CCN-2021-236910







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 +

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)

Date Printed	October 2021	Scenario year	2115	Scenario Annual Chance	0.1% (1 in 1000)	CCN Number	CCN-2021-236910

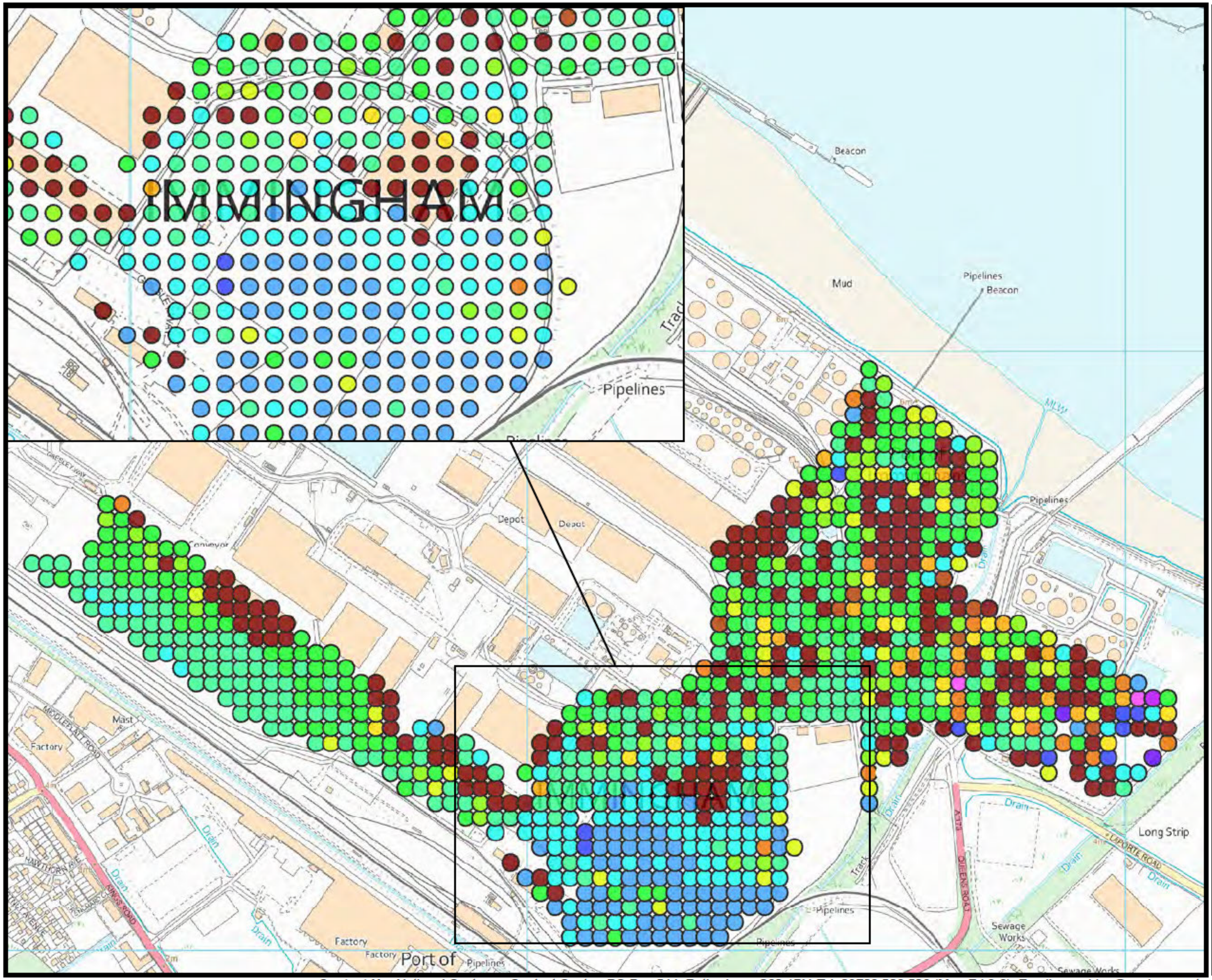
General Enquiries No: 03708 506 506. Weekday Daytime calls cost 5p plus up to 6p per minute from BT Weekend Unlimited. Mobile and other providers' charges may vary

Environment Agency

Lincolnshire and Northamptonshire Overtopping Hazard Mapping

Map Centred on TA 20465 15437

Aproximate flood level (2115 1 in 1000 breach depths and lidar)



Environment Agency

Scale 1:9,000

N W E S

Legend

flood_level_2115_1000b_site_boundary

- 3.50001 - 3.750000
- 3.750001 - 4.000000
- 4.000001 - 4.250000
- 4.250001 - 4.500000
- 4.500001 - 4.750000
- 4.750001 - 5.000000
- 5.000001 - 5.250000
- 5.250001 - 5.500000
- 5.500001 - 5.750000
- 5.750001 - 6.000000
- 6.000001 - 6.250000
- 6.250001 - 6.500000
- 6.500001 - 6.750000
- 6.750001 - 7.000000
- 7.000001 - 7.250000
- 7.250001 - 30.000000

Contact Us: National Customer Contact Centre, PO Box 544, Rotherham, S60 1BY. Tel: 03708 506 506 (Mon-Fri 8-6). Email: enquiries@environment-agency.gov.uk

Somerton, Jo

From:	Coe, Steven [redacted]@environment-agency.gov.uk>
Sent:	27 May 2022 13:24
To:	Somerton, Jo
Cc:	Hewitson, Annette
Subject:	[EXTERNAL] RE: IERRT - Environment Agency Breach Water Level Information and mitigation levels (draft, confidential and legally privileged)

Hi Jo,

I am happy to agree to the approach outlined in your email below.

Regards
Steve

Steven Coe MSc MCIWEM
Flood and Coastal Risk Management Senior Advisor
South Humber and East Coast, Partnerships and Strategic Overview Team
Lincolnshire and Northamptonshire Area
[redacted]@environment-agency.gov.uk
External: [redacted] | Mobile: [redacted]

From: Somerton, Jo <joanne.somerton@aecom.com>
Sent: 27 May 2022 06:27
To: Coe, Steven [redacted]@environment-agency.gov.uk>
Subject: IERRT - Environment Agency Breach Water Level Information and mitigation levels (draft, confidential and legally privileged)

Hi Steve
Thank you for your time on Wednesday to discuss the breach water level outputs we received for the IERRT development sent through by your colleague during our initial data consultation.
Based on our discussion, please can you confirm that the Environment Agency will agree to the following with regards mitigation levels for safe refuge:

- We agreed that the majority of the site fell within the 6.0 – 6.25m AOD breach water depth banding for the 0.1% AEP + climate change breach flood event (the predominantly green water level sample points) as shown on the mapping provided by the Environment Agency:
- Safe refuge would be acceptable located on the first floor of the terminal building within the southern section of the site:
- The first floor level of the terminal building would be located above the agreed 6.25m AOD breach flood water level;
- That although the terminal building is located in an area of the site where the 0.1% AEP breach water levels are lower than the agreed 6.25m AOD we discussed that the mapped water levels were associated with the modelled breach location (breach locations nearest the site are located to the north east of the lockgates access to Immingham Docks and along the frontage between Habrough Marsh Drain and Stallingborough North Beck) and that the agreed mitigation level provides a level of comfort should a breach occur in the immediate vicinity of the site.

Kind Regards

[redacted]

Joanne Somerton MSc

Principal Flood Risk Consultant, Water: EUR - UK & Ireland
M +44 [redacted]

AECOM

2 City Walk
Address Line 2
LEEDS, United Kingdom
T +44 [redacted]
aecom.com

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Somerton, Jo

From: Spence, Cathryn
Sent: 15 November 2022 10:39
To: Somerton, Jo
Subject: FW: Immingham Eastern Ro-Ro Terminal - draft, confidential and legally privileged CCN/2022/283954
Attachments: 2010 Tidal Breach Points - location map v2.pdf

From: Coastal L&N, PSO <PSO_Coastal@environment-agency.gov.uk>
Sent: 09 November 2022 10:59
To: Spence, Cathryn [redacted]@aecom.com>
Cc: Lincs & Northants, Customer Enquiries <LNenquiries@environment-agency.gov.uk>
Subject: RE: Immingham Eastern Ro-Ro Terminal - draft, confidential and legally privileged CCN/2022/283954

This Message Is From an External Sender

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Report Suspicious

Hi Cathryn,

The data provided last year in CCN/2021/236910 is still the most up to date information we hold and so I have not created a new one. However, I have attached the latest version of the 2010 Tidal Breach Locations as there has been a slight update to the formatting.

Furthermore, regarding the tidal defences in this location, the wave walls, revetments and flood doors referenced in CCN/2021/236910 are privately maintained and I am currently unaware of their condition/standard of protection. However, the Environment Agency do maintain earth embankments in this location and I see these were not mentioned previously. They are in fair condition and reduce the risk of flooding (at the defence) to a 0.5% (1 in 200) chance of occurring in any year.

Please let me know if you require any more information.

Kind regards,

Frederic Stuhldreer
Flood Risk Officer
FCRM Partnerships and Strategic Overview – South Humber and East Coast

Environment Agency | Ceres House, Searby Road, Lincoln, LN2 4DW

From: Spence, Cathryn [redacted]@aecom.com>
Sent: 13 October 2022 17:04
To: Enquiries, Unit <enquiries@environment-agency.gov.uk>; Coastal L&N, PSO <PSO_Coastal@environment-agency.gov.uk>; Lincs & Northants, Customer Enquiries <LNenquiries@environment-agency.gov.uk>
Cc: Feather, Katie <[redacted]@aecom.com>; Greenwood, Brian [redacted]@clydeco.com>; Carolyn Morgan-Welker [redacted]r@clydeco.com>; Jennie Reynolds [redacted]@adamshendry.co.uk>; TJeynes [redacted]@abports.co.uk>
Subject: Immingham Eastern Ro-Ro Terminal - draft, confidential and legally privileged

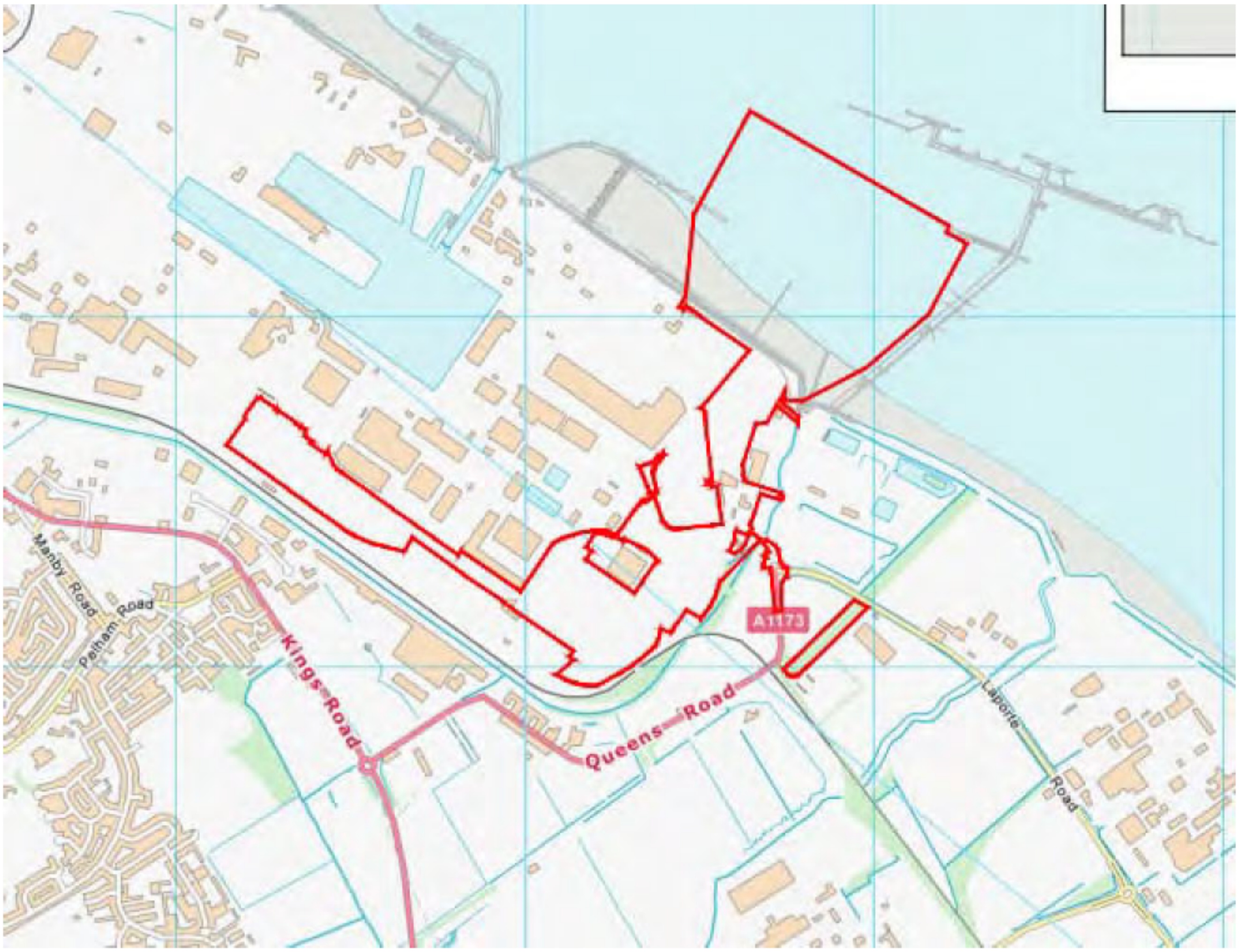
Some people who received this message don't often get email from [redacted]@aecom.com. Learn why this is important

This enquiry is in relation to RFI - Immingham Eastern Ro-Ro Terminal CCN/2021/236910. We submitted an enquiry in late 2021 and received a response from you on the 8 November 2021. The information was provided nearly one year ago and may now be superseded. Could you please provide the most up to date information for the site.

AECOM are assisting Associated British Ports with the Immingham Eastern Ro-Ro Terminal project - please see the Briefing Note and Scoping Report at the below hyperlink for more information:
https://infrastructure.planninginspectorate.gov.uk/projects/yorkshire-and-the-humber/immingham-eastern-ro-ro-terminal/?ipcsection=docs

Please could you provide the following information for the site at OS grid reference TA 20243 15319 and shown in red on image below :

1. Product 4 data (including coastal modelling data, breach modelling)
2. Confirmation on whether the coastal modelling data has incorporated wave overtopping
3. Wave data / statistics in vicinity of the site
4. Historic records of flooding
5. Any information on existing flood defence assets (i.e. location, crest level, if there are operational controls etc.)
6. Any information on existing coastal defence assets (i.e. location, crest level etc.)



Many thanks,

Cathryn

If you receive this email outside of your normal working hours please only respond during your normal working hours.
Cathryn Spence, BGeom BSc CPEng MIEAust
Regional Director, Water, UK
M +[redacted]
[redacted]@aecom.com

AECOM
2 City Walk
Leeds, LS11 9AR, UK
T +4[redacted]
aecom.com

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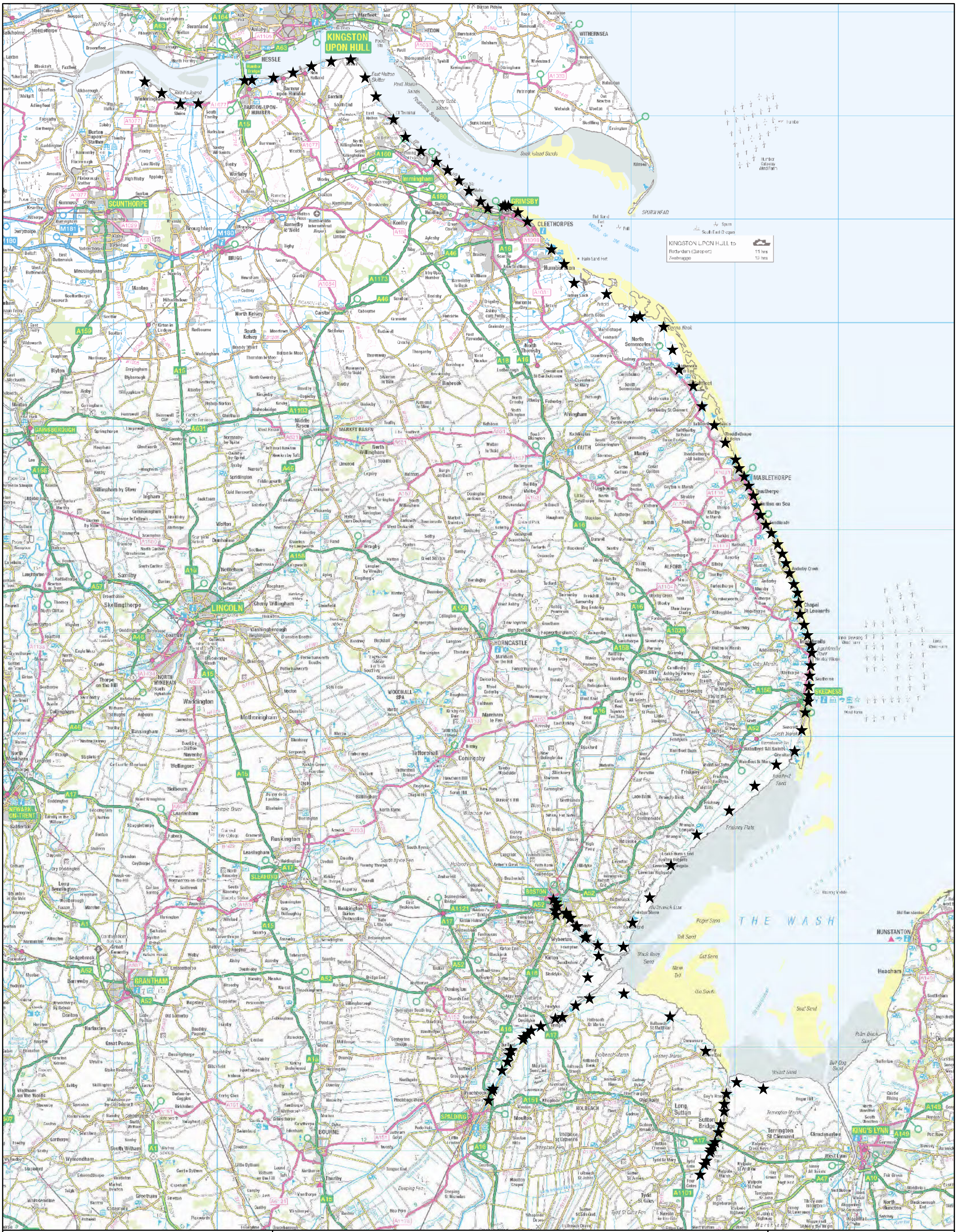


★ **Modelled Breach Locations**

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.

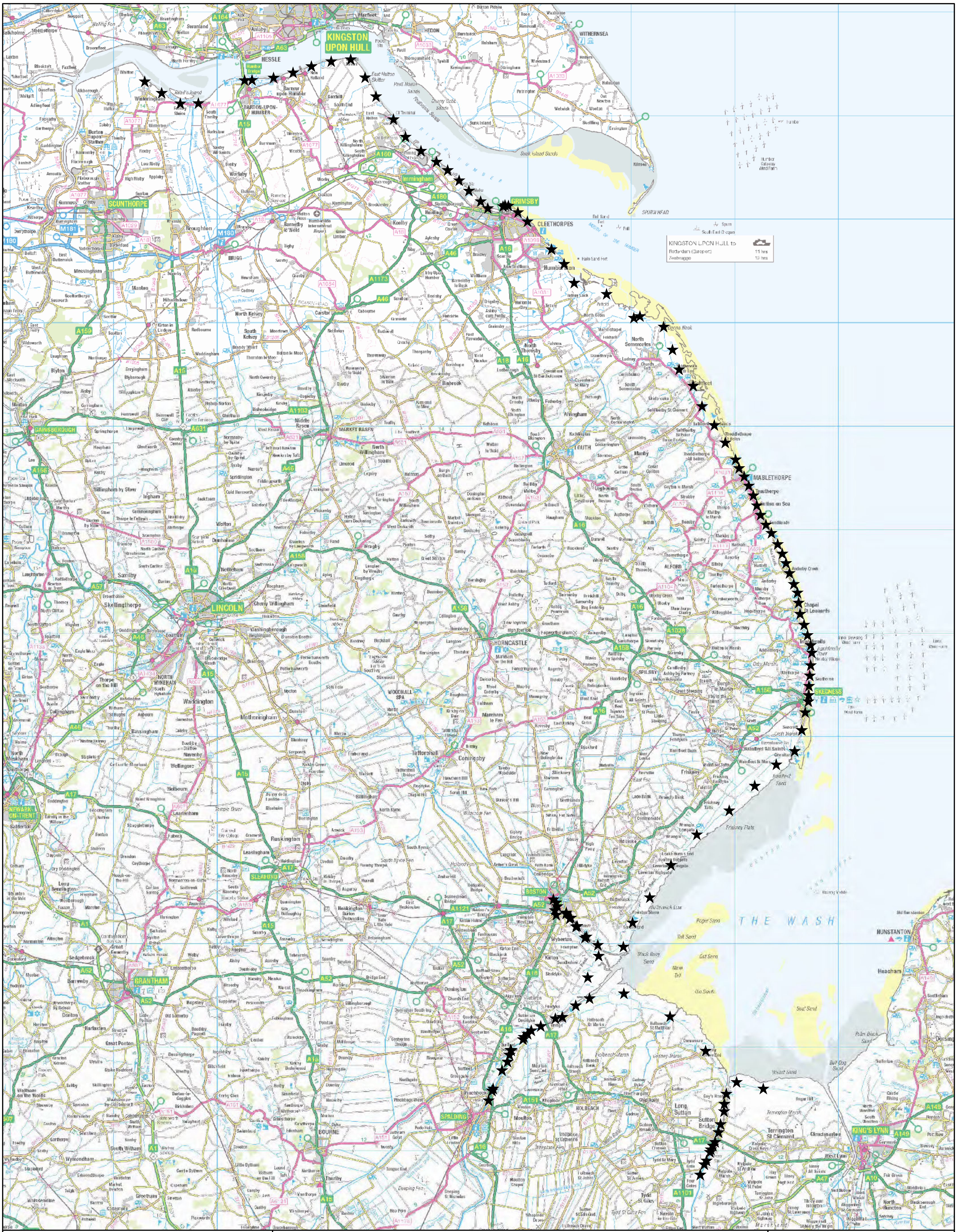
General Enquiries No: 03708 506 506.
Weekday calls cost 5p plus up to 6pm from BT Weekend Unlimited. Mobile and other providers charges may vary.

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



★ **Modelled Breach Locations**

0 3.5 7 14
Kilometers

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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

Somerton, Jo

From:	Guy Hird [redacted]@witham3idb.gov.uk>
Sent:	13 October 2021 17:47
To:	Madge, Will
Cc:	Richard Wright
Subject:	[EXTERNAL] FW: RFI - Immingham Eastern Ro-Ro Terminal
Attachments:	NELDB map.jpg

ND-5814-2021-PLN

Will

Immingham Eastern Ro-Ro Terminal

The location is within the North East Lindsey Drainage Board area and there is a network of Board maintained watercourses near the site, see attached map. Habrough Marsh Drain is a gravity system with a flapped outfall into the Humber within the port site. There is link to the Immingham pumped drainage system which allows flow into it only when they is spare capacity available. High levels within this system have a potential flood risk for the area with high rainfall events aggravated by high water levels in the Humber.. The impact of climate chance will increase the risk.

There is flood risk from the Humber through over topping or breach, the Environment Agency should be contacted for further information.

In December 2013 the tidal surge caused flooding in the port via the dock, ABP should have records of this and any works done as a result of it.

Under the terms of the Board's Byelaws, the prior written consent of the Board is required for any proposed temporary or permanent works or structures in, under, over or within the byelaw distance (7m) of the top of the bank of a Board maintained watercourse. At this location this width is required to be keep clear of all obstructions. Note it is expected that revised Byelaws will be adopted in the near future with a revised distance of 9m.

Under the terms of the Land Drainage Act. 1991 the prior written consent of the Board is required for any proposed temporary or permanent works or structures within any watercourse including infilling or a diversion.

As a brown field site the surface water discharge into the Boards drainage system from any re-development will be expected to be reduced to 70% of the existing ‘actual’ discharge rate.

The proposals show new infrastructure in the Humber near to the gravity outfall of Habrough Marsh Drain, there is concern that this will result in siltation which will impede the discharge. The Flood Risk Assessment should address this and put in place measures to mitigate it.

Regards

Guy Hird
Acting Head of Technical & Engineering Services

Our office is closed to visitors but our staff are still working. Please email or telephone with all enquiries.

enquiries@witham3idb.gov.uk
accounts@witham3idb.gov.uk
planning@witham3idb.gov.uk

consents@witham3idb.gov.uk

Witham First District Internal Drainage Board
Witham Third District Internal Drainage Board
Upper Witham Internal Drainage Board
North East Lindsey Drainage Board

Witham House,
Meadow Lane
North Hykeham,
LINCOLN,
LN6 9QU (*for sat nav use LN6 9TP*)
Tel: [redacted]

Four independent statutory Land Drainage and Flood Risk Management Authorities working in partnership.

www.witham3idb.gov.uk

From: Madge, Will [redacted]@aecom.com>
Sent: 11 October 2021 10:31
To: Richard Wright [redacted]@witham3idb.gov.uk>
Cc: Enquiries <Enquiries@witham3idb.gov.uk>; Planning and Consents <planning@witham3idb.gov.uk>; Cobb, Kirsty <[redacted]@aecom.com>; [redacted]@abports.co.uk; [redacted]@abports.co.uk
Subject: RFI - Immingham Eastern Ro-Ro Terminal

Good Morning,

AECOM are assisting Associated British Ports with the Immingham Eastern Ro-Ro Terminal project - please see the Briefing Note and Scoping Report at the below hyperlink for more information:
https://infrastructure.planninginspectorate.gov.uk/projects/yorkshire-and-the-humber/immingham-eastern-ro-ro-terminal/?ipcsection=docs

Please could you provide the following information in proximity of the site (see maps shown in the Briefing Note):

1. Historic records of flooding
2. Known risks of flooding from any drains/watercourses
3. Any information on existing flood defence assets (i.e. location, crest level, if there are operational controls etc.)

Many thanks,

William Madge BSc (Hons), MCIWEM, C.WEM, CSci
Senior Flood Risk Consultant | Water
M +[redacted]
[redacted]@aecom.com

Click here to connect with me on LinkedIn
[redacted]

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Immingham Pump Drain
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IMMINGHAM
Immingham PS
Mauxhall Farm
Middle Drain Branch 5
Middle Drain
Legend
North_East_Lindsey_IDB_Boundary
North_East_Lindsey_IDB_Extended_Boundary
NEL Drains
EA Main River
Contains OS data © Crown Copyright and database right 2020

Somerton, Jo

From: Freedom Of Information (NELC) <FOI@nelincs.gov.uk>
Sent: 13 October 2021 07:49
To: Madge, Will
Subject: [EXTERNAL] Freedom of information request, Ref- NELC/22975/2122

Dear Sir / Madam

Thank you for your information request, reference number FOI NELC/22975/2122. I wish to confirm that North East Lincolnshire Council holds the following information.

ABP do not report incidents of flooding on their land, primarily because the drainage infrastructure serving the dock estate is nearly all under ABP ownership. The only information held by the Drainage team is:

1. **Historic records of flooding**

   There was extensive flooding of the dock estate during the tidal surge on December 5th 2013.

2. **Known risks of flooding from any drains/ordinary watercourses**

   The only watercourses on ABP land not owned by ABP are the North East Lindsey IDB drains. All information on flood risk from these is held by the IDB.

3. **Any outputs from hydraulic models of drains/ordinary watercourses**

   As above, hydraulic models

If you believe that your request for information has not been handled in accordance with the Freedom of Information Act, you have the right to request an internal review by the Council. Please be clear about which elements of the Council's response or handling of the request you are unhappy with, and would like the Council to address during the internal review process. If following this you are still dissatisfied you may contact the Office of the Information Commissioner. If you wish to request an internal review, please contact me and I will make the necessary arrangements.

Yours sincerely on behalf of North East Lincolnshire Council

Feedback Officer

From: Madge, Will
Sent: 11 October 2021 10:10 AM
Subject: FOI Request - Immingham Eastern Ro-Ro Terminal, NELC/22975/2122

Good Morning,

AECOM are assisting Associated British Ports with the Immingham Eastern Ro-Ro Terminal project - please see the Briefing Note and Scoping Report at the below hyperlink for more information:
https://infrastructure.planninginspectorate.gov.uk/projects/yorkshire-and-the-humber/immingham-eastern-ro-ro-terminal/?ipcsection=docs

Please could you provide the following information in proximity of the site (see maps shown in the Briefing Note):

4. Historic records of flooding
5. Known risks of flooding from any drains/ordinary watercourses

6. Any outputs from hydraulic models of drains/ordinary watercourses

Many thanks,

William Madge BSc (Hons)

Annex B Drainage Strategy

Drainage Strategy

Document no: B2357300 - UT - TN - 0001
Revision no: S3-P03

Associated British Ports
-

Immingham Eastern Ro-Ro Terminal
10 February 2023

Drainage Strategy

Client name:	Associated British Ports		
Project name:	Immingham Eastern Ro-Ro Terminal		
Client reference:	-	**Project no:**	B2429300
Document no:	B2357300 - UT - TN - 0001	**Project manager:**	Claire Nicolson
Revision no:	S3-P03	**Prepared by:**	Helen Heather-Smith
Date:	10 February 2023	**File name:**	IERRT Drainage Strategy - Concept Design_S3-P03.docx
Doc status:	S3		

Document history and status

Revision	Date	Description	Author	Checked	Reviewed	Approved
P01	18/08/2022	For Review and Approval	HHS	TCW	DRK	GP/RH
P02	17/11/2022	For Review and Approval	HHS	TCW	DRK	GP/RH
P03	10/02/2023	For Review and Approval	HHS	TCW	DRK	GP/RH

Distribution of copies

Revision	Issue approved	Date issued	Issued to	Comments

Jacobs U.K. Limited

The West Wing
1 Glass Wharf
Bristol, BS2 0EL
United Kingdom

T +44 (0)[redacted]
[redacted]

Executive summary

Jacobs Engineering has been commissioned by Associated British Ports (ABP) to compile a Drainage Strategy to support the DCO application associated with the proposal to construct a new roll-on/roll-off facility within the Port of Immingham.

A strategy has been developed considering both the existing and proposed infrastructure, together with the logistics associated with operating the terminal, and in accordance with relevant design and constructions guidance and regulations. This has involved the development of three separate surface water drainage networks, corresponding to the three landside development areas, and separated foul provisions.

As per guidance from the local operating authorities, existing drainage outfalls and associated infrastructure, such as the lift and pumping stations, have been reused. It is proposed that any redundant drainage infrastructure, generally comprising conveyance pipework, is to be abandoned. Due to the increased size of the impermeable catchment area within each development site, the existing conveyance networks do not have adequate capacity to sufficiently drain the developments.

Three new surface water drainage networks comprising:

- appropriate diameter conveyance pipework,
- catchpits,
- gullies,
- channel drainage,
- extensive geocellular storage,
- and control structures,

are proposed to serve the numerous identified catchment areas. The structure and location of the components within these networks have been located considering the operational activities of the facility.

Separate foul water provisions are being promoted; the layout and functionality of these shall be subject to development during further design stages.

Contents

Appendices

Tables

Acronyms and abbreviations

ABP	Associated British Ports
AEP	Annual Exceedance Probability
BGS	British Geological Survey
CC	Climate Change
DCG	Design and Construction Guidance
DCO	Development Consent Order
DMRB	Design Manual for Roads and Bridges
FRMS	Flood Risk Management Strategy
IDB	Internal Drainage Board (North East Lindsey Drainage Board)
IL	Invert Level
LLFA	Lead Local Flood Authority
LPA	Local Planning Authority
m AOD	Metres Above Ordnance Datum Newlyn
NPPF	National Planning and Policy Framework
PEIR	Preliminary Environmental Information Report
PPG	Pollution Prevention Guidance
SuDS	Sustainable urban Drainage Systems
UKBF	UK Border Force

Introduction

1.1 Background

1.1.1 Jacobs Engineering was commissioned by Associated British Ports to compile a Drainage Strategy to support the DCO application associated with the proposal to construct a new roll-on/roll-off facility within the Port of Immingham, which is located on the south bank of the Humber Estuary.

The facility will comprise:

- on the marine side:
  - a new jetty infrastructure with up to three berths,
- on the land side:
  - improved hardstanding,
  - a Terminal Building and associated Workshops,
  - a Fuel Station and Gatehouses,
  - UK Border Force Facilities
  - and an internal site bridge which will cross over existing port infrastructure, including an ABP controlled railway track and Robinson Road.

1.1.2 The terminal will be designed to service the embarkation and disembarkation of principally commercial and automotive traffic, and thus the improved areas of hardstanding will be designated waiting and storage areas associated with the facility operations. The site of the new terminal falls within the eastern part of the Port which is located entirely within the administrative boundary of North-East Lincolnshire.

1.2 Objective of the Report

1.2.1 This report has been compiled to describe the surface and foul water drainage strategies associated with the landside development of a concept design. The strategies have been sufficiently developed to support the DCO application and consider the existing and proposed infrastructure, together with the logistics associated with operating the terminal. This report details the applicable design standards and policies, and key design criteria that have been applied in developing a technically viable and compliant concept drainage strategy.

1.3 National Planning Policy

1.3.1 In accordance with the National Planning Statement for Ports (NPSfP) and the National Planning and Policy Framework (NPPF), which encompasses various Planning Practice Guidance (PPG) documents, surface water runoff shall be managed using sustainable drainage systems, unless there is clear evidence that these are inappropriate and shall give consideration to the treatment of pollutants and silt to protect contaminants within surface water runoff from entering surrounding watercourses.

1.4 Design Standards, Reference & Policy

1.4.1 The following design standards, technical guidance and policy documentation were referenced during the development of this drainage strategy:

[Ref. 1] CIRIA C753 – The SUDS Manual, 2015

[Ref. 2] National Planning Statement for Ports, 2012

[Ref. 3] National Planning Policy Framework, 2021

[Ref. 4] Planning Practice Guidance: Flood Risk and Coastal Change, 2022

[Ref. 5] Design and Construction Guidance, Version 2.0, 2020

[Ref. 6] National Highways 'Design Manual for Roads and Bridges' (DMRB)

[Ref. 7] BS EN 752:2017, Drain and sewer systems outside buildings, BSI

[Ref. 8] Guidance: Flood Risk Assessments, Climate Change Allowances – HM Government, 2016 (updated May 2022).

[Ref. 9] CIRIA C737 – Guide to Designing Geocellular Drainage System, 2018

[Ref. 10] Pollution Prevention Guidance (PPG3), 2006 *(Withdrawn)*

[Ref. 11] BS EN 858-1:2002 - Separator systems for light liquids (e.g. oil and petrol)

[Ref. 12] Environment Agency Flood Risk Standing Advice

[Ref. 13] The Flood and Water Management Act, 2010

1.5 Sources of Information

1.5.1 Environment Agency

1.5.1.1 The Environment Agency is the statutory consultee with regards to flood risk and planning. The Flood and Water Management Act 2010 ([Ref. 13) gives the Environment Agency a strategic overview role for all forms of flooding and coastal erosion, and they have a direct responsibility for the prevention, mitigation, and remediation of flood damage for main rivers and coastal areas. The Humber Flood Risk Management Strategy (FRMS) has been prepared by the Environment Agency and outlines their flood risk management strategy for the Humber Estuary. It makes recommendations aimed at ensuring that flood risk is managed in a sustainable way around the estuary and aims to ensure a good standard of protection from tidal flooding is maintained.

1.5.1.2 The Environment Agency has been consulted by ABP in relation to the Preliminary Environmental Information Report (PEIR) and advised with respect to Flood Defence and Drainage in February 2022. In principle the proposed development shall not compromise the flood defences, and any future works necessary to adapt to climate change, and access to and along the flood defences is required to be maintained.

1.5.1.3 Habrough Marsh Drain Outfall is maintained by the Environment Agency and access and working space is to be maintained to facilitate both maintenance and removal of the tidal flood gates. These flood gates protect the Habrough Marsh Drain against tidal inundation and form part of the coastal flood defence. The Habrough Marsh Drain is classified as an Ordinary Watercourse and thus the North East Lincolnshire Council (LLFA) is responsible for the overall management of local flood risk within the catchment; however, as the watercourse has been Scheduled, the Internal Drainage Board (IDB) is responsible for the maintenance and hydraulic performance of the Habrough Marsh Drain and its associated flood risk. The Environment Agency is also responsible for the issuance and subsequent compliance of Environmental Permits associated with the discharge of treated effluent / storm water via sea outfalls.

1.5.2 North East Lincolnshire Council

1.5.2.1 North East Lincolnshire Council is the Local Planning Authority (LPA) and Lead Local Flood authority (LLFA) and thus has responsibility for local flood risk, which includes surface water runoff, groundwater and Ordinary Watercourses. The North East Lincolnshire Strategic Flood Risk Assessment (SFRA), 2010 was produced to provide the information needed by the planning authority to take flood risk into account when making land use allocations and determining planning applications in accordance with the NPPF ([Ref. 3).

1.5.3 Internal Drainage Board (North East Lindsey Drainage Board)

1.5.3.1 Habrough Marsh Drain is classified as an Ordinary Watercourse but has been Scheduled by the Board which uses its permissing powers to maintain it. The IDB has been consulted by ABP in relation to the Preliminary Environmental Information Report (PEIR) and they subsequently advised with respect to functionality of Habrough Marsh Drain and its associated flood risk in February 2022.

1.5.3.2 The IDB advised that the Habrough Marsh Drain is a gravity system with a defended outfall structure which discharges into the Humber Estuary within the bounds of the Port. The Drain is impounded during periods of high tide; however, to facilitate in the control of the water levels, a sluice enables water to be transferred to the drainage channel located to the south of the Port. The sluice links the Habrough Marsh Drain to the Immingham Pumped Drainage System enabling the transfers of flows during periods when pumping capacity is not fully optimised (Appendix C2). The IDB, however, emphasised that high water levels within the Habrough Marsh Drain are considered a potential flood risk, and the operational water levels are observed to be nearing capacity when the runoff associated with high order rainfall events coincides with high tide levels in the Humber Estuary; it is acknowledged that this situation will only be exacerbated through the impact of climate change.

1.5.3.3 The IDB is also responsible for the issuance and subsequent compliance of Land Drainage Consent associated with the discharge of treated effluent / storm water into the drain, and hence is aware that elements of the proposed development site are served by existing surface water drainage infrastructure which discharges directly into the Habrough Marsh Drain. The IDB has advised that as the development is located on a brownfield site, the surface water discharge that is associated with any re-development will be expected to be reduced to 70% of the existing “actual” discharge rate.

1.5.4 Anglian Water

1.5.4.1 Anglian Water are responsible for the disposal of wastewater and the supply of potable water in North East Lincolnshire, and thus the town of Immingham and the wider area. The Port’s wastewater infrastructure within the development site is known to include several Package Treatment Plants, and a dedicated Treated Effluent Pumped Sea Outfall which discharges into the Humber Estuary. These assets are not adopted by Anglian Water and are maintained directly by the Port of Immingham.

Site Overview

2.1 Location

2.1.1 The proposed roll-on/roll-off facility is to be constructed within the Port of Immingham, which is located on the south bank of the Humber Estuary.

2.1.2 The roll-on/roll-off terminal is to be located within the eastern extent of the Port, approximately 2.4 km north-east of the town of Immingham, and will be served by a new jetty, pontoons, and associated finger piers to be constructed in open waters adjacent to the existing jetties within the Humber Estuary.

2.1.3 The Ordnance Survey National Grid Reference for the centre of the site is TA 19976 16154. Refer to DCO drawing B2429400-JAC-00-ZZ-DR-ZZ-0101 for the Site Location Plan.

2.2 Existing Landside Development

2.2.1 The proposed roll-on/roll-off terminal is to be constructed within areas of the Port which are currently used to store bulk commodities such as solid fuels and ores, as well as ro-ro freight being handled from in river jetties. The storage areas are accessed via established infrastructure within the Port and are subdivided by ABP controlled railway sidings. These areas are typically located adjacent to Operational Sheds and Engineering Workshops which complement the operations within the Port.

2.2.2 The existing storage areas are partially paved, and to ensure serviceability these sub-catchments are served by positive drainage systems which either discharge to the Habrough Marsh Drain or directly to the Humber Estuary or Immingham Dock via dedicated pumped outfalls.

2.2.3 Strategic infrastructure is present in the development site including package treatment plants and associated treated effluent pumping stations, as well as dedicated storm water pumping stations.

2.3 Proposed Landside Development

2.3.1 The proposal comprises an operational terminal designed to service the embarkation and disembarkation of principally commercial and automotive traffic associated with the proposed roll-on/roll-off facility, together with a limited designated area to store shipping containers. The terminal will comprise extensive areas of paved hardstanding which will be delineated to create designated waiting and storage areas and marshalling lanes; the storage areas will be accessed via controlled gated access points located adjacent to existing port infrastructure.

2.3.2 The terminal will be developed within the bounds of the existing port, thus will be spilt into three areas, namely the Northern, Southern and Western operational yards. To facilitate traffic movements between the terminal, and the marine side ro-ro approach jetty, it is proposed to construct an overbridge over Robinson Road and the ABP controlled railway sidings.

2.3.3 The existing cargo handling areas will be regraded to facilitate surface water drainage; the site grading shall consider the levels of the existing infrastructure located around the perimeter of the site and the safe working parameters of any operating plant or equipment. The operations within the yards will be facilitated through the provision of the following buildings which will be constructed within the bounds of the development site:

- Terminal Building (Southern Yard)
- Customer Welfare Building (accompanied freight marshalling area, Southern Yard)
- Workshop and Fuel Station / Gatehouse (Southern Yard)
- UK Border Force Customs Building and supporting infrastructure, including Immigration PCP Booths and Marshalling Lanes, Cyclamen Portal, Secondary Examination Building, Holding Facility, and Inspection Areas (Southern Yard)

2.3.4 The total development site is approximately 36.4 Ha which is subdivided as follows:

- Northern Yard – 6.0 Ha

- Southern Yard – 20.8 Ha
- Western Yard – 9.6 Ha

2.3.5 Refer to DCO drawings B2429400-JAC-00-ZZ-DR-ZZ-0202 to 0206 for the proposed development General Arrangements.

2.4 Topography

2.4.1 Site ground levels used to develop the drainage strategy have been based on resolution, open source Lidar data from https://environment.data.gov.uk/DefraDataDownload/?Mode=survey; the site is relatively flat with typical levels varying between +4 and +6 m AOD, which is predominately associated with historic development, including the interlinking railways, and its associated utilisation.

2.42 The site is classified as low-lying in relation to tidal water levels. The banks of the Habrough Marsh Drain, which is located to the east of the Port, are similar to the operational level of the cargo handling areas within the Port, however, the drain is protected against tidal inundation through the provision of tidal gates.

2.5 Geology & Hydrogeology

2.5.1 Open-source data from the British Geological Survey (BGS) shows that the geology underlying Immingham Port typically comprises a bedrock of Cretaceous shallow-marine Chalk which is overlain by superficial Tidal Flat Deposits, formed of shallow-marine Clay and Silt from the Quaternary period. The wider Port site straddles Chalk from two Formations, the Burnham Chalk Formation and the Flamborough Chalk Formation; the development site is located within the Flamborough Formation.

2.5.2 Borehole data from the BGS (trial borehole 17, 1948) suggests that the site stratigraphy consists of topsoil and muds to a depth of around 30 ft (9 m), after which a relatively shallow layer of Peat, Sand and Pebbles may be found, and below which several layers of varying Clays extend to a depth of almost 200 ft (60 m).

2.5.3 Geotechnical investigations undertaken within the bounds of the development site, by GD Pickles Ltd in 2020, confirm that the site is underlain by Made Ground, appearing to typically comprise imported construction or industrial waste consistent with historic land reclamation. Beneath the Made Ground are Tidal Flat Deposits, comprising cohesive clay soils and silt to a depth of approximately 10 m below ground level. The Tidal Flat Deposits overlie Boulder Clay comprising stiff brown sandy clay. Moreover, the nature of the underlying substrata appears to influence the groundwater regime; perched water bodies were observed in the southern area of the site within the Made Ground, at a depth of between 1-2 m below ground level. Groundwater was also observed below the Boulder Clay within a layer of dense Sands and Gravels at an approximate depth of 30 m.

2.5.4 The general ground conditions suggest that the permeability of the substrata will be low, which when combined with the presence of a high groundwater table, limits the opportunity to discharge surface water runoff from areas of hardstanding to the underlying groundwater regime using drainage structures that promote infiltration.. Further geotechnical investigation will be undertaken to facilitate the development of the design.

2.6 Environmental, Archaeological & Contamination

2.6.1 In accordance with Planning Policy, potential sources of contamination and items of historical reference which could affect the underlying groundwater regime are required to be considered when developing the drainage strategy to support the requirements of the proposed developed. The historic use of the site would suggest that there is risk of contamination within the underlying Made Ground and subsoils.

2.6.2 Due to the nature of the underlying substrata and associated groundwater regime a full appraisal of the historic use of the site has not been undertaken on the basis that drainage structures that promote infiltration are not deemed appropriate.

2.7 Catchment Hydrology

2.7.1 The area adjacent to the development site features a network of drainage ditches which aid in the conveyance of surface water runoff and pluvial flows into the Humber Estuary; the extent of the drainage ditch network is presented in Appendix A.

2.7.2 The Habrough Marsh Drain is located adjacent to the Port and bounds the development site to the south and east. The drain is classified by the Environment Agency as an Ordinary Watercourse and flows in an easterly direction before discharging into the Humber Estuary. The drain is defended from tidal inundation through the provision of flood gates which are integral to the flood defence structure constructed along the Humber Estuary.

2.7.3 There is a drainage channel located to the south of the Port linking the Habrough Marsh Drain to the Immingham Pumped Drainage System, via a sluice. This can be opened when there is spare pump capacity, enabling the transfer of fluvial flows to enter the pumped catchment and providing relief to the Habrough Marsh Drain.

2.7.4 The Habrough Marsh Drain historically aids in the drainage of elements of the Port and there are several outfalls located along the length of the drain directly to the east of the port's boundary and immediately upstream of the defended outfall into the Humber Estuary. These outfalls currently serve several positive drainage systems installed within the Port to drain areas of impermeable hardstanding which form the Cargo Handling Areas.

2.7.5 Based on a high-level review of topographical mapping, and drainage records provided by ABP, it is clear that an open ditch passed through the southeast corner of the Port which was culverted under the railway and Robinson Road before it discharged into a tributary of the Habrough Marsh Drain. This open ditch has been backfilled and subsequently replaced with a dedicated pipe network serving the site. The network conveys runoff from a surface water drainage system serving an area of semi-impermeable hardstanding located in the southeast corner of the Port, as well as roof drainage from Shed 26.

Surface Water Drainage

3.1 Surface Water Management Overview

3.1.1 An appropriately developed drainage strategy is a principal planning consideration to ensure developments are effectively and sustainably drained; surface water runoff is captured, and its quantity and quality controlled in a manner that ensures any alteration of natural surface water flow patterns through the development site do not result in an increased flood or pollution risk elsewhere in the catchment.

3.1.2 The strategy shall consider the transfer of flood risk associated with pluvial flooding and where appropriate fluvial flooding within the downstream receiving catchment and will thus be developed with respect to the satisfactory collection, control, treatment and discharge of surface water runoff as reflected in the guidance and non-statutory technical standards for SuDS.

3.1.3 The development is to be undertaken on a brownfield site and the IDB has been consulted and agreed to permit a discharge rate that is limited to 70% of the actual runoff from the predeveloped catchment; this approach will aid in the management of flood risk in the receiving watercourse catchment.

3.2 Design Criteria

3.2.1 Overview

3.2.1.1 The design criteria detailed below follow best practice as stipulated under Planning Policy and align with the redevelopment of predeveloped sites.

3.2.1.2 The design standard relating to the surface water drainage for the areas of hardstanding and associated buildings is the Design and Construction Guidance (2020) ([Ref. 5) and BS EN 752:2017 ([Ref. 7), whilst for the surface water drainage associated with the highway bridge the design standard is the National Highways 'Design Manual for Roads and Bridges' (DMRB) ([Ref. 6).

3.2.2 Discharge Hierarchy

3.2.2.1 The SuDS Manual (2015) ([Ref. 1) specifies a hierarchy of techniques that should be considered for drainage discharge and has been consulted to establish the most suitable approach for the proposed site. Surface water runoff should be discharged to a source that is as high up the following hierarchy as possible:

1. Re-use (rainwater harvesting / greywater recycling)
2. Infiltration
3. To a surface water body (e.g. ordinary watercourse)
4. To a surface water sewer, highway drain, or other drainage system
5. To a combined sewer.

3.2.2.2 To inform the development of an appropriate drainage strategy and enable an assessment of all potential discharge options, as required by both the NPSfP ([Ref. 2) and NPPF ([Ref. 3), reference has been made to British Geological Mapping, the existing surface water drainage systems and associated outfalls, and the proximity of watercourses and drains. The following sections assess the hierarchy in order of priority:

Re-use

3.2.2.3 The vast majority of the development site is to be paved for vehicular trafficking purposes. The quality of the runoff would therefore be inappropriate for re-use on the site due to the risk of hydrocarbon and suspended sediment contamination. It is therefore not proposed to re-use surface water runoff from the development site.

Infiltration

3.2.2.4 Due to the cohesive nature of the underlying sub-strata and high perched groundwater levels (see Section 2.5), infiltration drainage is not considered appropriate and has thus not been promoted, in part, or as a main means of discharging the rainfall induced runoff from the development site. It is intended that attenuation storage features are lined to prevent the ingress of perched groundwater, which would otherwise render the storage provision ineffective.

To a surface water body

3.2.2.5 Where positively drained, all surface water runoff within the site boundary is discharged to an existing surface water body, either to the Habrough Marsh Drain, the Humber Estuary or to Immingham Dock. It is therefore proposed to discharge runoff from the development site to the same water bodies. The positive drainage networks serving the existing site are privately maintained and are located entirely within the Immingham Port boundary prior to their outfall to the associated water body. It is proposed to discharge via existing outfalls and surface water drainage infrastructure, therefore achieving an indirect discharge to a surface water body, without increasing flood risk from sewers outside of the site boundary.

3.2.2.6 The existing drainage located within the bounds of the development site itself is deemed to be hydraulic deficient in relation to the requirements of the proposed development, and thus will largely be abandoned and replaced with new to align with the proposed pavement grading.

3.2.2.7 The existing outfall configurations are as detailed below:

- Habrough Marsh Drain:
    - The surface water runoff from the northeast and southeast sections of the Cargo Handling Areas (Catchments A and D, see drawing B2357300 - 01 - 05 - 11) currently discharge under gravity to headwall structures located on the west bank of the Habrough Marsh Drain; these headwalls and the associated upstream pipework located outside of the Port boundary could be retained for reuse subject to:
        - A full structural CCTV of the pipework.
        - A non-destructive assessment of the headwall structure.
        - A topographical Survey of the outfall pipework and associated headwall structure.
        - The consent of the IDB – Ordinary Watercourse.
- Combined Effluent / Storm Water Pumping Station:
    - The surface water runoff from the southwest section of the Cargo Handling Area (Catchment A, see drawing B2357300 - 01 - 05 - 12) currently discharges under gravity to the Pumping Station which has been designed to accommodate both the treated effluent from an adjacent biodisc package treatment plant and stormwater runoff collected within the Cargo Handling Area, and the catchment located to the north of Robinson Road. Subject to the following, the pumping station could be used to aid in the discharge of surface water collected within the development site directly to the Humber Estuary:
        - The spare capacity within the pumping station and associated rising main.
        - The consent of the Environment Agency with respect to the Environmental Permit.
        - Availability of space within the proposed Yard to accommodate attenuation facilities.
- Storm Water Pumping Station:
    - The surface water runoff from the western section of the Cargo Handling Area (Catchment A, see drawing B2357300 - 01 - 05 - 19) currently discharges under gravity to a relatively new surface water lift station that discharges into a dedicated surface water pumping station which aids in the conveyance of storm water into Immingham Dock. Subject to the following, the surface water pumping station could be used to aid in the conveyance of surface water collected within the development site directly to Immingham Dock and associated Humber Estuary:

- The spare capacity within the lift station and associated rising main.
- The consent of the Environment Agency with respect to the Environmental Permit.
- Availability of space within the proposed Yard to accommodate attenuation facilities.

To a surface water sewer, highway drain, or other drainage system or to a combined sewer.

3.2.2.8 As it is possible to discharge to a surface water body, which is preferable with respect to the discharge hierarchy, discharging to a surface water sewer, highway drain, other drainage system or a combined sewer do not need to be considered.

3.2.3 Discharge Criteria

3.2.3.1 To inform the planning of the development proposal and in particular the development of an associated drainage strategy, the IDB was consulted in relation to the Preliminary Environmental Information Report (PEIR) in February 2022. The consultation acknowledged that the Habrough Marsh Drain serves areas of hardstanding in the Port, however, due to the potential high water levels within the Habrough Marsh Drain, which will only be exacerbated through the impact of climate change, it was stipulated by the IDB that existing surface water outfalls shall only be permitted to discharge up to 70% of the actual runoff from the associated catchment.

3.2.3.2 The discharge methodology promoted within this strategy will thus mimic the existing arrangements for an appropriate range of rainfall events, including an allowance for climate change, whereby the runoff will be discharged at the specified controlled rate to the Habrough Marsh Drain, or into the Humber Estuary or Immingham Dock via existing pumped sea outfalls.

3.2.3.3 The proposed discharge criteria are based on pre-development baseline assessments; these shall be subject to an appropriate climate change allowance and are outlined in Table 1.

Table 1: ***Proposed Discharge Criteria***

Discharge rate limits

Outfall Location	1 in 1 year discharge	1 in 30 year discharge	1 in 100 year discharge
Habrough Marsh Drain	70% of existing modelled 1 in 1 year rate	70% of existing modelled 1 in 30 year rate	70% of existing modelled 1 in 100 year rate
Immingham Dock	No greater than existing	No greater than existing	No greater than existing
Humber Estuary	No discharge restrictions	No discharge restrictions	No discharge restrictions

3.2.4 Hydraulic Performance

3.2.4.1 The hydraulic design parameters applied in the development of the surface water drainage strategy are outlined as follows:

3.2.4.1 Collector systems

3.2.4.1.1 The collector system is to comprise gullies located in the valleys within the pavement; these gullies will be placed at an appropriate spacing, which will align with the serviceable catchment. The spacing of gullies shall ensure a negligible surface water profile on the pavement during low order rainfall events.

3.2.4.1.2 Due to the proposed utilisation of the site, it is considered acceptable to permit short term ponding in the vicinity of the gullies during high intensity rainfall events, however, the spacing shall be sufficient to not result in flooding outside of the site boundary during short-duration and high-intensity 1 in 100-year (+CC) design storm events.

3.2.4.2 Carrier systems

3.2.4.2.1 The surface water drainage system is designed in accordance with DCG (2020) ([Ref. 5), and thus is in compliance with the following criteria:

- No surcharge for the 1 year (+CC) return period.

- No flooding for the 30 year (+CC) return period.

3.2.4.2.2 The building roof drainage shall align with the Building Regulations and thus be in compliance with the following criteria:

- The gutter and rainwater downpipes, which shall be positively connected with the carrier drainage pipework, shall accommodate the runoff associated with a 1 in 10 year (+CC) design storm event.
- Any exceedance flows shall be permitted to cascade down the building's envelope onto the hardstanding where it will be intercepted by the surface water drainage system.

3.2.4.3 On-Site Flood Risk

3.2.4.3.1 The surface water drainage system shall be designed to comply with the following criteria in accordance with site-specific design criteria required by the Port Operator:

- No flooding from the carrier drainage system for events up to the 1 in 30 year (+CC) return period.
- Any flooding during the 1 in 100 year (+CC) design storm event shall be retained within the site in appropriate surface storage areas, not pose a risk to people or property, and be able to quickly drain away after the peak of the design storm event has passed.
- The collector system shall be designed to ensure standing water is contained within the pavement channel; standing water depths up to 100 mm, or an acceptable level for operational activities, are permitted for limited periods.
- No flooding in the vicinity of the Terminal and UK Border Force Buildings will be permitted for events up to 1 in 100 year (+CC) design storm event.

3.2.4.4 Off-Site Flood Risk

3.2.4.4.1 To ensure compliance of Planning Policy the design shall comply with the following criteria:

- Pluvial flows up to the 1 in 100 year (+CC) design storm event shall be retained on site.

3.2.5 Climate Change

3.2.5.1 Projections of future climate change in the UK indicate more frequent, short duration, high intensity rainfall and frequent periods of long duration rainfall. The guidance included in the NPPF ([Ref. 3) and PPG ([Ref. 4) recommends the effects of climate change are considered when developing drainage strategies for new development or redevelopment; the recommended precautionary sensitivity ranges for peak rainfall intensities are outlined in the Flood Risk Assessments: Climate change allowance guidance published by HM Government, May 2022 ([Ref. 8)

3.2.5.2 The development proposal comprises an operational terminal designed to service the embarkation and disembarkation of principally commercial and automotive traffic associated with the proposed roll-on/roll-off facility; this facility is to promote an engineered design standard of 75 years to align with the lifetime of a non-residential development as per PPG ([Ref. 4), thus the recommended national precautionary sensitivity ranges for peak rainfall intensities will be applied accordingly.

3.2.5.3 To account for the potential effects of climate change, a climate change allowance has been included for design storms in accordance with "Flood risk assessments: climate change allowances", HM Government, 2022 ([Ref. 8). The Guidance states that for assets with a development design lifetime of between 2061 and 2100, the central allowance of the 2070s Epoch should be used. The central allowances for the 2070s Epoch for the Louth Grimsby and Ancholme Management Catchment are as follows:

- 3.3% AEP (1 in 30-year return period) **25%**
- 1% AEP (1 in 100-year return period) **25%**

3.2.6 Surcharged Outfall Conditions

3.2.6.1 The drainage strategy has been developed based on the following outfall conditions:

- Discharge into the Humber Estuary via existing Combined Effluent / Storm Water Pumping Station:
    - The performance of the pumping station has not been assessed; a free discharge into the pumping station's wetwell has been assumed. It is assumed that the pumping station has been designed to operate under surcharged outfall conditions and therefore will not impact on the gravity-driven elements of the network. This approach shall be further developed in the next stage of design.
- Discharge into Immingham Dock via existing Surface Water Pumping Station:
    - The performance of the pumping station has not been assessed; a free discharge into the associated lift station's wetwell has been assumed. It is assumed that the pumping station has been designed to operate under surcharged outfall conditions and therefore will not impact on the gravity-driven elements of the network. This approach shall be further developed in the next stage of design.
- Discharge into the Habrough Marsh Drain via existing gravity outfalls:
    - The Habrough Marsh Drain is subject to tidal interaction and during high tides the down stream flood gates are closed to prevent fluvial flooding. The water levels in the drain are monitored by the IDB, and although levels increase during the tidal cycle it is understood that the water remains within the banks. The drainage strategy has been developed to allow for the tidal cycle and application of surcharged conditions.

3.2.6.2 Sensitivity testing has been carried out to assess the hydraulic performance of the drainage networks with a gravity outfall, namely Northern Catchment A and Southern Catchment B and C (drawings B2357300 - 01 - 05 – 01 and 02 respectively), in periods of high water levels in the receiving watercourse (Habrough Marsh Drain). In lieu of a detailed understanding of the range of water levels or tidal influence within the Habrough Marsh Drain, the following sensitivity tests have been carried out:

- Test against a surcharged outfall of +3.7 mAOD (equivalent to bank full with 300 mm freeboard)
- Test against a surcharged outfall of +1.9 mAOD (equivalent to MHWN level in the Humber Estuary)

3.2.6.3 For each sensitivity test, the hydraulic models were run for a range of return periods up to and including the 1 in 30-year +CC event, for durations up to and including 1440 mins (24 hours), and on the assumption that water levels are unlikely to be this high for longer than 24 hours. The networks were not altered from the proposed case with no additional outfall structures, such as a flap valve, added; only the outfall conditions (i.e. water level) were changed. To ascertain if additional outfall structures (overflows) are needed in order to negate the inundation of the drainage system and ensure functionality of control structures, the interaction between the drainage system and fluvial flows in the Habrough Marsh Drain will be fully assessed during future design stages.

3.2.7 Sustainable Drainage Systems (SuDS)

3.2.7.1 The utilisation of sustainable drainage features should be used where possible to provide the required levels of treatment in accordance with policy and best practice. However, for the following reasons, it is proposed to utilise a traditional gully inlet and piped positive drainage network in combination with underground storage facilities and proprietary treatment units:

- The requirement to keep the drainage system as shallow as possible to negate surcharged conditions,
- The lack of infiltration potential due to the underlying ground conditions, which comprise Clay and Made Ground, some of which may be contaminated such that infiltration could cause contaminant migration.

- The potential for high groundwater levels below the finished pavement levels and perched groundwater which could contain contaminants such that infiltration could cause contaminant migration.

3.2.8 Pollution and Water Quality

3.2.8.1 In accordance with NPPF consideration is to be given to pollution control measures to mitigate the risk posed by potential contaminants within surface water runoff from entering local watercourses. Although withdrawn, PPG3 (2006) ([Ref. 10) has been referred to for the selection of appropriate pollution prevention measures in lieu of updated guidance.

3.2.8.2 Potential pollution sources include:

- Motorised vehicles, such as Heavy Goods Vehicles, Tugs and Reachstackers trafficking the site.
- Refuelling activities within the dedicated fuel station.

3.2.8.3 The proposed development site has been subdivided into two areas for the purposes of pollution control:

- Operational Yards:
  - These areas fall under the PPG3 ([Ref. 10) category of "vehicle maintenance area, Goods Vehicle parking or vehicle manoeuvring and therefore shall be treated to Class 1 Full Retention Separator standards to BS EN 858 ([Ref. **11**).
- Fuel Station:
  - This area falls under the PPG3 ([Ref. 10) category of "retail fuel forecourts" and shall therefore be treated via a Full Retention Forecourt Separator designed in accordance with BS EN 858 ([Ref. **11**). The designated refuelling area is required to be contained to capture any significant spillage. The form of containment shall be through the installation of a perimeter channel drain which will enable the storm runoff to drain under normal conditions.

3.3 Existing Surface Water Drainage

3.3.1 Northern Development Site

3.3.1.1 Drainage Catchment

3.3.1.1.1 The northern development site comprises two distinct development areas, a northern area and a southern area as shown in Drawing B2357300-01-05-11. These areas have been subdivided into four drainage catchments within the site boundary, three in the north and one in the south. Further details on these drainage catchments are provided in Table 2.

Table 2: ***Development area drainage catchment information (from geotechnical survey information)***

Northern Development Site

Development Area	Drainage Catchment	Size (Ha)	Comments
Northern Area	Catchment N-A	0.813	Lean-mix concrete surface, graded towards an existing gully and pipe system, which discharges by gravity to the Habrough Marsh Drain
	Catchment N-B	-	Lean-mix concrete surface. Existing grading falls away from existing drainage systems and results in surface ponding. Considered not to

Development Area	Drainage Catchment	Size (Ha)	Comments
			contribute to any existing drainage system
	Catchment N-C	-	-
Drury Ltd. Area	Catchment N-D	-	Catchment consists of building roof and impermeable hardstanding areas, which are collected by gullies and linear channels. Flows discharge to the Habrough Marsh Drain.

3.3.1.2 Drainage System

3.3.1.2.1 Of the four drainage catchments identified in Table 2, available records show that only two include positive drainage systems, namely, Catchment N-A and Catchment N-D.

3.3.1.2.2 Catchment N-A is served by numerous drainage branches which connect into a carrier pipe. Although specific collector systems are not shown within the available records, it may be assumed runoff is intercepted by gullies. The collected runoff is then conveyed via a 525 mm diameter outfall which discharges into the Habrough Marsh Drain. This outfall is relatively close to the tidal flood gates, denoted by a headwall within the bank of the watercourse, and with an assumed invert level of approximately +0.879 mAOD.

3.3.1.2.3 Catchment N-D contains a number of buildings and is served by a combination of gullies, linear drainage channels, and building roof drainage. The building roof drainage comprises down pipes which appear to outfall to the ground surface, where runoff is then intercepted by the collector systems within the pavements. Some of the collected runoff is conveyed via a carrier drain that discharges into a local pumping station located in the vicinity of the south-western corner of Shed 6; the pumping station lifts the flows via a short section of rising main into a section of pipework that conveys the flows under gravity to an outfall structure constructed on the west bank of Habrough Marsh Drain.

3.3.1.3 Proprietary Treatment Facilities and SuDS

3.3.1.3.1 Other than a separator located at the head of a drainage branch which joins the main carrier pipework in Catchment N-D, as detailed on drawing no. B2357300-01-05-11, there is no evidence in the provided drainage records of other proprietary or sustainable urban treatment facilities serving the existing surface water drainage system installed in Catchment N-A.

3.3.1.4 Runoff Assessment

3.3.1.4.1 The performance of the existing drainage serving the predeveloped site has been assessed in relation to the contributing areas; this assessment will inform the allowable discharge rates for the proposed drainage strategy in accordance with the criteria outlined in Sections 3.2.3 and 3.2.4. As this network is to discharge to the Habrough Marsh Drain, the brownfield runoff rates as derived via hydraulic modelling shall be factored to comply with the requirement to reduce discharge rates by 30%. The assessment will not consider an allowance for climate change as the assessment is based on the current "actual" discharge rates.

3.3.1.4.2 As only enabling works are being proposed within the southern catchment area to facilitate the construction of the overbridge, and the existing paving is not being revised, it was not deemed necessary to assess the hydraulic performance of the existing surface water drainage system in Catchment N-D.

3.3.1.5 Hydraulic Performance – Network Modelling

3.3.1.5.1 An assessment of the hydraulic performance of the existing surface water drainage system serving Catchment N-A was undertaken to quantify the actual runoff that discharges into Habrough Marsh Drain. The drainage assessment was conducted by simulating the existing surface water drainage system within the latest version of Innovyze's MicroDrainage suite of software. The simulations were run for the design storm events and input information as detailed below for both summer and winter rainfall profiles.

3.3.1.5.1 Existing Surface Topography

3.3.1.5.1.1 The ground levels incorporated into the network model were based on record topographic survey data (drawing B2429400-JAC-00-ZZ-M2-ZZ-0001), where available; where topographic survey data was not available, LiDAR data was used.

3.3.1.5.2 Existing Surface Permeability

3.3.1.5.2.1 For the purposes of assessing surface water runoff, all buildings and areas of impermeable hardstanding within the bounds of the redevelopment site that are contributing to the network have been assumed to be 100% impermeable. Based on the LiDAR data, the topography of areas adjacent to the network's catchment fall away from the area and have therefore been excluded from this assessment.

Table 3: ***Contributing surface areas used to model the existing surface water drainage system within the redevelopment site***

Northern Development Area

Contributing Surface	PIMP	Area (Ha)
Roofs	100	0.000
Hardstanding (Surfaced)	100	0.813
Total	-	0.813

3.3.1.5.3 Model Input Values

3.3.1.5.3.1 The input values applied to the model are detailed in Table 4. The values are consistent across the development site and therefore apply to each development area.

Table 4: ***Notes on the design criteria and input values used to model the pre-development surface water drainage network in MicroDrainage***

Northern, Southern and Western Development Areas

Model Design Criteria	Value(s)	Notes
Climate change	CC: 0%	Brownfield Runoff Assessment (does not consider an allowance for climate change as the assessment is based on the current "actual" discharge rates).
Design event	1, 30, and 100 years	Design events for 1 in 1, 30, 100 years have been used for modelling to determine allowable discharge rates.
Rainfall data	M5-60: 17 mm Ratio (R): 0.400	Rainfall data for the site location was obtained from the Flood Studies Report (FSR) and through the HR Wallingford online tool.
Volumetric Run-off Coefficient	Summer: 0.75 Winter: 0.84	Standard volumetric runoff coefficients of 0.75 and 0.84 were applied for the summer and winter respectively.
Global manhole headloss	0.5	Default software value
Pipe roughness	0.6 mm	Standard Colebrook-White roughness coefficient for surface water drainage design
MADD factor	2 m^3/ha	Standard MADD factor for surface water drainage design for permeable areas.

Model Design Criteria	Notes
Existing Surface Topography	The ground levels incorporated into the network model were based on record topographic survey data where it was available; where topographic survey data was not available, open source LiDAR data was used (https://environment.data.gov.uk/DefraDataDownload/?Mode=survey).`

Model Design Criteria	Notes
Outfall	All models were conducted with an assumed free discharge (hot start 0 mins and hot start level 0 mm). For sensitivity testing, surcharged conditions were tested as described in Sections 3.4.3.3.1 (North) and 3.4.4.3.1 (South).

3.3.1.5.4 Model Output Files

3.3.1.5.4.1 The MicroDrainage model for the brownfield runoff assessment suggested that the existing peak discharge rates range between 83 and 228 l/s depending on the design storm return period. The simulation results are presented in Appendix B.

3.3.1.5.4.2 Three return periods were tested to correspond with the design criteria associated with the proposed redevelopment; the simulation results are shown in Table 5.

Table 5: *Modelled existing surface water discharge rates*
Northern Development Site – Catchment N-A (model pipe reference S1.006)

Design Storm Event (1: xx)	1 year	30 year	100 year
Modelled Discharge Rate (l/s)	83	193	228

3.3.1.6 Allowable Discharge Rates

3.3.1.6.1 The allowable discharge rate promoted for the brownfield development site, which have been derived in accordance with the IDB's requirements as outlined in Sections 3.2.3 are shown in Table 6:

Table 6: *Allowable discharge rates (30% betterment)*
Northern Development Site – Catchment N-A

Design Storm Event (1: xx)	1 year	30 year	100 year
Allowable Discharge Rate (l/s)	58.0	134.7	159.7

3.3.1.6.2 The allowable discharges rates are based on the evaluation of the limited site records; however, they are considered to be conservative and appropriate to form the basis of the drainage strategy.

3.3.2 Southern Development Site

3.3.2.1 Drainage Catchment

3.3.2.1.1 The southern development site comprises three distinct development areas as shown on drawing no B2357300-01-05-12; these areas have been subdivided into six drainage catchments. Further details of these drainage catchments are provided in Table 7.

Table 7: *Development area drainage catchment information (from survey information)*
Southern Development Site

Development Area	Drainage Catchment	Size (Ha)	Surfacing
Main Area	Catchment S-A	2.082	Deteriorated asphalt with a thin subbase over made ground. A proportion of this area appears to drain to the Combined Treated Effluent / Storm Water Pumping Station
	Catchment S-B	4.326	Mixture of: cement-stabilised Type 1 over made ground; 100-150 mm stone cover over a geotextile over made ground; soil heaps. Land drainage outfalls to Habrough Marsh Drain.

Development Area	Drainage Catchment	Size (Ha)	Surfacing
	Catchment S-C	1.952	Impermeable hardstanding and roof areas associated with Shed 26, positively drained to the Habrough Marsh Drain
Eastern Satellite Area	Catchment S-D	Not positively drained	n/a
	Catchment S-E	Not positively drained	n/a
Northern Satellite Area	Catchment S-F	Not positively drained	n/a

3.3.2.2 Drainage System

3.3.2.2.1 Of the six drainage catchments identified in Table 7, records suggest that only three include positive drainage systems, namely Catchment S-A, Catchment S-B and Catchment S-C.

3.3.2.2.2 Catchment S-A comprises sporadic yard gullies, which convey a proportion of this catchment to the Combined Treated Effluent / Storm Water Pumping Station. Outside of the proposed site boundary the gravity network is 450 mm diameter. Inside the proposed site boundary, the gravity system increases to 600 mm diameter suggesting that this section of pipework has been upsized to accommodate the runoff from within the existing site that is to be developed.

3.3.2.2.3 The pumping station comprises two pumps connected via a 300 mm delivery manifold. This delivery manifold discharges to an existing 600 mm rising main which discharges directly into the Humber Estuary via an in-river outfall structure. The outfall is subject to an Environmental Permit and is permitted to convey both treated wastewater effluent and treated or uncontaminated surface water runoff. The volume of treated effluent discharged into the Humber Estuary is restricted under the terms of the permit, though there is no restriction regarding the discharge of surface water runoff.

3.3.2.2.4 Catchment S-B is served by a surface water drainage system that has been installed along the length of an historic open drain that subdivided the site; the limited records show that the collector system comprises gullies which have been installed at heads of runs within the Cargo Storage Area. Site observations suggest that this network may also acts as a land drain, with evidence of filter media placed along the line of the pipework.

3.3.2.2.5 Catchment S-C serves the building footprint and an area of hardstanding adjacent to Shed 26 and discharges to the downstream end of Catchment S-B. The collected runoff is then conveyed via a 525 mm diameter outfall which passes under the road and railway network that serves the Port, prior to discharging into the Habrough Marsh Drain. This outfall is denoted by a headwall within the bank of the watercourse and has an assumed invert level of approximately +0.4 mAOD.

3.3.2.3 Proprietary Treatment Facilities and SuDS

3.3.2.3.1 There is a requirement within the Environmental Permit that all surface water runoff that discharges into the Humber Estuary via the Combined Treated Effluent / Storm Water Pumping Station is treated or is uncontaminated, however, the provided records show no evidence of proprietary or sustainable drainage treatment facilities serving the existing surface water drainage system installed in the catchment. This is with exception to the runoff generated by Shed 26 in Catchment S-C; there is a separator serving runoff generated within the Shed 26 area.

3.3.2.4 Runoff Assessment

3.3.2.4.1 The performance of the existing drainage serving the predeveloped site has been assessed in relation to the contributing areas; this assessment will inform the allowable discharge rates for the proposed drainage strategy in accordance with the criteria outlined in Sections 3.2.3 and 3.2.4.

Catchment S-A

3.3.2.4.2 The drainage within Catchment S-A discharges to the Humber Estuary and therefore is not subject to a post-development discharge rate restriction (see Section 3.2.3). It is proposed to utilise the existing drainage system and pumping station to drain flows from the proposed development. The existing network has been assessed based on a high-level review of the spare network capacity, however ,in lieu of undertaking a full assessment of the surface water network, the available capacity has been derived based on the difference between the full-bore capacity of the 450 mm diameter pipework immediately outside of the site boundary and the 600 mm diameter outfall pipe within the site boundary and that discharges into the pumping station's wetwell from the contributing catchment. The flows potentially discharged from the existing drainage system via the full bore 450 mm and 600 mm pipes were then compared to the pumping rates based on the pumps systems curves that are available within the records. The calculations are presented in Appendix B.

Catchments S-B and S-C

3.3.2.4.3 The drainage within Catchments S-B and S-C, that discharges via a common outfall into the Habrough Marsh Drain, has been assessed in a similar manner to the assessment undertaken for the northern catchment as detailed in Section 3.3.1.4. The brownfield runoff rates as derived via hydraulic modelling shall be factored to comply with the requirement to reduce discharge rates by 30%., The assessment will not consider an allowance for climate change as the assessment is based on the current "actual" discharge rates.

3.3.2.5 Hydraulic Performance – Network Modelling

3.3.2.5.1 An assessment of the hydraulic performance of the existing surface water drainage system serving Catchments S-B and S-C was undertaken to quantify the actual runoff that discharges into Habrough Marsh Drain.

3.3.2.5.2 The drainage assessment was conducted by simulating the existing surface water drainage system within the latest version of Innovyze's MicroDrainage suite of software. The simulations were run for the design storm events with the following input information for both summer and winter rainfall profiles.

3.3.2.5.1 Existing Surface Permeability

3.3.2.5.1.1 For the purposes of assessing surface water runoff, all buildings and areas of impermeable hardstanding within the bounds of the redevelopment site that are contributing to the network have been assumed to be 100% impermeable. Areas of cement-stabilised Type 1 over made ground, and areas of 100-150 mm stone cover over a geotextile over made ground have been assumed to be 30% impermeable.

Table 8: ***Contributing surface areas used to model the existing surface water drainage system within the redevelopment site***

Southern Development Area

Contributing Surface	PIMP	Area (Ha)
Roofs	100	1.952
Hardstanding (Surfaced)	100	
Hardstanding (Unbound Surfacing)	30	4.326
Total	-	6.278

3.3.2.5.2 Model Input Values

3.3.2.5.2.1 The input values applied to the model are detailed in Table 4, found in Section 3.3.1.5.3. The values are consistent across the development site and therefore apply to each development area.

3.3.2.5.3 Model Output Files

3.3.2.5.3.1 The MicroDrainage model for the brownfield runoff assessment suggested that existing peak discharge rates range between 153 and 283 l/s depending on the design storm return period. The simulation results are presented in Appendix B.

3.3.2.5.3.2 Three return periods were tested to correspond with the design criteria associated with the proposed redevelopment and the simulation results are shown in Table 9.

Table 9: ***Modelled existing surface water discharge rates***

Southern Development Site – Catchment S-A (model pipe reference S1.007)

Design Storm Event (1: xx)	1 year	30 year	100 year
Modelled Discharge Rate (l/s)	153	238	283

3.3.2.6 Allowable Discharge Rates

3.3.2.6.1 The allowable discharge rates promoted for the brownfield development proposal derived in accordance with the IDB's requirements as outlined in Section 3.2.3 are shown in Table 10:

Table 10: ***Allowable discharge rates (30% betterment)***

Southern Development Site – Catchment S-B and S-C

Design Storm Event (1: xx)	1 year	30 year	100 year
Allowable Discharge Rate (l/s)	106.4	165.9	198.1

3.3.2.6.2 The allowable discharges rates are based on the evaluation of the limited site records, however, are considered to be conservative and appropriate to form the basis of the drainage strategy. The available capacity within the Combined Treated Effluent / Storm Water Pumping Station, as detailed within the calculation presented with Appendix B, is summarised below in Table 11:

Table 11: ***Capacity Assessment***

Southern Development Area – Catchment S-A

		Flow rate (l/s)	Velocity (m/s)
Incoming Network	450 mm dia (full bore)	142	-
	600 mm dia (full bore)	302	-
	Available Capacity	160	
Outgoing Network	Pump Capacity (Duty)	75	
	Manifold Pipe (300mm dia – Duty-assist pumping)	150	2

3.3.2.6.3 Considering the information in Table 11, it is possible to draw two conclusions in terms of limiting discharge rates:

- The pipe-full flow from the external catchment is 142 l/s, with a pumping station capacity of 150 l/s. In order to retain the existing pumping station, discharge should be limited to 8 l/s.
- The available capacity within the existing 600 mm diameter pipework on the gravity network is 160 l/s; in order to retain the existing gravity outfall into the existing wet well, discharge should be limited to 160 l/s. This philosophy would risk overloading the existing pumping station, which would necessitate the pumps to be upsized to accommodate the additional flow.

3.3.2.6.4 Restricting the discharge to 8 l/s would result in a significant volume of water needing to be stored within the network. Restricting discharge to 160 l/s would potentially require the existing Combined Treated Effluent / Storm Water Pumping Station to be upgraded to deliver a greater flow rate. The outfall is to the Humber Estuary and therefore increasing the pumping station's discharge flow rate will not affect flood risk in the receiving watercourse (Humber Estuary).

3.3.2.6.5 The existing pumping station delivers flows via a 300 mm diameter manifold pipe, which connects to a 600 mm rising main discharging into the Humber Estuary. It is therefore assumed that this 600 mm diameter rising main would have spare capacity to acceptable increased flows, which may additionally aid in the hydraulic performance of the existing main as flows, and therefore velocities, will be higher and help to mitigate the risk of solids settling out in the main over time.

3.3.2.6.6 It is therefore proposed to limit discharge to the existing wet well to 160 l/s.

3.3.3 Western Development Site

3.3.3.1 Drainage Catchment

3.3.3.1.1 The western development site comprises one development area historically used for vehicle storage and parking, as shown on drawing no B2357300-01-05-19. This area can be subdivided into two drainage catchments. Unlike the other development areas, though, these catchments are not defined by physical features, boundaries, or topography, and are instead defined by the nature of the surfacing. Further details of these drainage catchments are provided in Table 12.

Table 12: ***Development area drainage catchment information (from geotechnical survey information)***
Western Development Site

Development Area	Drainage Catchment	Size (Ha)	Surfacing
Main Area	Catchment W-A	4.216	A mixture of impermeable asphalt surfacing and semi-permeable compacted fill. For the purposes of this assessment, only the impermeable asphalt surface area is reported. Area drains via a gravity drainage network to a pumping station discharging to Immingham Dock.
	Catchment W-B	0.364	A mixture of impermeable asphalt surfacing and semi-permeable compacted fill. For the purposes of this assessment, only the impermeable asphalt surface area is reported. Area is assumed to permit a degree of infiltration into the adjacent ground.

3.3.3.2 Drainage System

3.3.3.2.1 Catchment W-A comprises a daisy-chained pipe and gully arrangement running along the south-western side of the plot. The gullies collect runoff from the catchment and flows are conveyed through the piped system, via and existing separator, to a recently constructed surface water lift station on the north-eastern boundary of the site. The lift station conveys flows to the adjacent Storm Water Pumping Station which is served by a rising main which discharges directly into Immingham Dock.

3.3.3.3 Proprietary Treatment Facilities and SuDS

3.3.3.3.1 The surface water drainage system serving the western development site has recently been updated and incorporates proprietary treatment facilities in the form of a separator upstream of the recently constructed surface water lift station. The location of this separator can be found in drawing B2357300-01-05-19.

3.3.3.4 Runoff Assessment

3.3.3.4.1 The drainage within Catchment W-A discharges to Immingham Dock and therefore is not subject to a post-development discharge rate restriction (see Section 3.2.3). It is proposed to utilise the existing drainage system and pumping station to drain flows from the proposed development, subsequently maintaining the existing peak discharge rate via the existing pumping station. It is proposed to control the flows into the pumping station by replacing the existing lift station with a deeper lift station of equivalent discharge rate.

3.3.3.4.2 In lieu of details of the existing lift station, an assessment has been made with regards to the capacity of the upstream gravity network that feeds it. The assessment has been made on the basis that the existing lift station's pump rate is expected to be approximately equivalent to the peak 1 in 1-year discharge rate from its contributing network. The assessment will not consider an allowance for climate change as the assessment is based on the current "actual" discharge rates.

3.3.3.5 Hydraulic Performance – Network Modelling

3.3.3.5.1 An assessment of the hydraulic performance of the existing surface water drainage system serving Catchment W-A was undertaken to quantify the actual runoff that discharges into the lift station. The drainage assessment was conducted by simulating the existing surface water drainage system within the latest version of Innovyze's MicroDrainage suite of software. The simulations were run for the design storm events with the input values detailed below for both summer and winter rainfall profiles.

3.3.3.5.1 Existing Surface Permeability

3.3.3.5.1.1 For the purposes of assessing surface water runoff, all buildings and areas of impermeable hardstanding within the bounds of the redevelopment site that are contributing to the network have been assumed to be 100% impermeable. In addition, all contributing permeable areas have been conservatively discounted from this assessment. In reality, the existing case flows will be greater as additional flows will contribute from these permeable areas.

Table 13: ***Contributing surface areas used to model the existing surface water drainage system within the redevelopment site***

Western Development Area

Contributing Surface	PIMP	Area (Ha)
Roofs	100	0.000
Hardstanding (Surfaced)	100	4.216
Total	-	4.216

3.3.3.5.2 Model Input Values

3.3.3.5.2.1 The input values applied to the model are detailed in Table 4, found in Section 3.3.1.5.3. The values are consistent across the development site and therefore apply to each development area.

3.3.3.5.3 Model Output Files

3.3.3.5.3.1 The MicroDrainage model for the brownfield runoff assessment suggested that the existing peak discharge rates range between 129.7 and 138.1 l/s depending on the design storm return period. The simulation results are presented in Appendix B.

3.3.3.5.3.2 Three return periods were tested to correspond with the design criteria associated with the proposed redevelopment; the simulation results are shown in Table 14.

Table 14: ***Modelled existing surface water discharge rates***

Western Development Site – Catchment W-A (model pipe reference S1.009)

Design Storm Event (1: xx)	1 year	30 year	100 year
Modelled Discharge Rate (l/s)	129.7	137.9	138.1

3.3.3.6 Allowable Discharge Rates

The assessment has been made on the basis that the existing lift station's pump rate is expected to be approximately equivalent to the peak 1 in 1-year discharge rate from its contributing network. From Table 14, which shows a 1 in 1-year discharge rate of 129.7 l/s, it is proposed to limit the discharge from this catchment to a slightly lower value of 120 l/s, as summarised below in Table 15:

Table 15: ***Allowable discharge rates (30% betterment)***

Western Development Site – Catchment W-A

Design Storm Event (1: xx)	1 year	30 year	100 year
Allowable Discharge Rate (l/s)	120	120	120

The allowable discharges rates are based on the evaluation of the limited site records, however, are considered to be conservative and appropriate to form the basis of the drainage strategy.

3.4 Surface Water Drainage Strategy

3.4.1 Introduction

3.4.1.1 A drainage strategy has been developed to support the proposed terminal development, giving consideration to the legislative requirements, operational layout, existing site drainage and associated outfall arrangements, pollution risk, and the allowable discharge rates as advised by the IDB.

3.4.1.2 The development site has been subdivided into the following areas due the complexities of the existing Port layout, and thus independent drainage strategies have been developed accordingly:

- Site-Wide Activities
- Northern Development Area
- Southern Development Area
- Western Development Area

3.4.1.3 The strategy encompasses the grading of the pavement within the development areas, flood risk mitigation and quality improvements to ensure the transfer of flows into the receptor do not have a negative impact on the environment.

3.4.1.4 The provision of suitable storage on site to mitigate the flood risk resulting from the development of the site will be a key component of the evolution of the site development layout. The provision of large volumes of attenuation within an operational port is challenging, and thus storage options which comprise buried structures is favoured to surface storage features such as detention basins.

3.4.2 Site-Wide Activities

3.4.2.1 Site Grading

3.4.2.1.1 The existing Cargo Handling Areas shall be regraded to ensure the new terminal areas are effectively drained and that surface water runoff, generated through the creation of significant areas of impermeable hardstanding, is retained within the bounds of the development during all design storm events prior to being treated and discharged appropriately.

3.4.2.1.2 The grading of the areas of hardstanding supporting the facility has been undertaken with due regard to the functionality of the facility and has aided in the positioning of drainage collection facilities within the various sub-catchments. The gradients promoted align with the finished surfacing materials to ensure the effective runoff of surface water to negate ponding, and the potential for ice forming on the surface during the colder winter months.

3.4.2.1.3 The grading layout ensures that all areas of hardstanding in general fall away from the envelope of any buildings and that the new pavement levels tie-in with existing topography to negate the transfer of surface water runoff outside the development boundary. Due to the level of the infrastructure located around the perimeter of the site, which is in general at a level of approximately +5 mAOD, and the intent to discharge the runoff generated within the area via existing infrastructure, it is envisaged that ground levels will be raised. The pavement grading has been aligned to suit the allocated trailer parking and container stacking layout, whilst the proposed gradients typically range between 1 in 60 and 1 in 100 in accordance with BS EN

752:2017 ([Ref. 7). The grading typically promotes a ridge and valley arrangement, with both the ridges and the valleys located away from vehicle parking spaces.

3.4.2.1.4 The UK Border Force Examination Buildings incorporate flush thresholds to enable free access to vehicles subject to examination.

3.4.2.1.5 The ABP controlled railway tracks are typically lower than the proposed areas of hardstanding which have been graded to fall away from the tracks to ensure the paving is effectively drained. A new level crossing will facilitate vehicular movements and the grading layout promotes appropriate approach alignments.

3.4.2.1.6The site grading across the Development Area is detailed on drawing no B2357300 - 01 - 05 - 08.

3.4.2.2 Collector systems

3.4.2.2.1 The collector system is to comprise gullies located in the valleys within the pavement; these gullies will be placed at an appropriate spacing, which will align with the serviceable catchment. The spacing of gullies shall ensure a negligible surface water profile on the pavement during low order rainfall events.

3.4.2.2.2 Due to the proposed utilisation of the site, it is considered acceptable to permit short term ponding in the vicinity of the gullies during high intensity rainfall events, however, the spacing shall be sufficient to not result in flooding outside of the site boundary during short-duration and high-intensity 1 in 100-year (+CC) storm events. The spacing of gullies will be carried out during detailed design and have been shown indicatively on drawings B2357300 - 01 - 05 – 01, 02 and 09. The gullies will be connected to a number of lateral branches, typically comprising 225 mm diameter pipework; these shall have a minimum cover of 900 mm.

3.4.2.3 3.4.2.2.3 Channel drains will be placed in remote areas of hardstanding to facilitate connectivity with the main conveyance drainage, and across level building thresholds which have been provided to enable free access to vehicles subject to UK Border Force examination. Storage Structures

3.4.2.3.1 To accommodate the extensive storage volumes with the networks, which are required to balance the flows within the drainage systems during the design events, the strategy includes for the provision of geocellular storage crates. Where feasible, these shall be constructed under the trailer parking areas and be of sufficient long term strength to withstand the anticipated loading. The position of these crates has been selected to ensure that the capacity offered by the 95% void ratio is maximised, whilst chambers shall be constructed either side of the geocellular crates to enable the central distribution pipe to be efficiently maintained. To prevent infiltration and minimise the potential of groundwater mixing, the crates will additionally be lined with an impermeable membrane.

3.4.2.3.2 Development specific details for the promoted storage structures are provided in the following area specific strategies with their indicative locations shown in drawings B2357300 - 01 - 05 – 01, 02 and 09 for the northern, southern, and western areas respectively. The crate configurations will be further developed during detailed design.

3.4.2.4 Hydraulic Performance – Network Modelling

3.4.2.4.1 The surface water drainage system serving the areas of hardstanding within each development were modelled using the latest version of Innovyze's MicroDrainage suite of software. Input values used in the MicroDrainage models are shown in Table 16 for the design criteria. Input values regarding the contributing surfaces for the individual development areas are detailed within the following area specific sections.

3.4.2.4.1 Proposed Surface Topography

3.4.2.4.1.1 Ground levels used for the development of the network models were based on the proposed pavement levels for the new development areas and existing topographical survey data, as represented by Lidar for areas outside of the development sites.

3.4.2.4.1.2 A general arrangement of the proposed site grading for all development areas is detailed in Drawing No B2357300 - 01 - 05 – 08, which is presented in Appendix A.

3.4.2.4.2 Proposed Surface Permeability

3.4.2.4.2.1 For the purposes of assessing surface water runoff, all buildings and areas of impermeable hardstanding within the bounds of the redevelopment site have been assumed to be 100% impermeable.

3.4.2.4.3 Model Input Values

3.4.2.4.3.1 The input values applied to the model are detailed in Table 16.

Table 16: ***Notes on the design criteria and input values used to model the post-development surface water drainage network in MicroDrainage***

Northern Catchment

Model Design Criteria	Value(s)	Notes
Discharge rate and attenuation	**North**: See Table 18 **South**: See Table 21Table 23 **West**: See Table 26	**North:** 30% betterment on current "actual" peak discharge rates. **South: Catchment S-A** – Control to not exceed available capacity within existing gravity inlet to wetwell **South: Catchments S-B and S-C** – 30% betterment on current "actual" peak discharge rates **West:** Limit flows to pump rate from existing lift station
Climate change	CC: 25%	See section 3.2.5, 'Climate Change'
Design event	1, 30, and 100 years	-
Rainfall data	M5-60: 17 mm Ratio (R): 0.400	Rainfall data for the site location was obtained from the Flood Studies Report (FSR) and through the HR Wallingford online tool.
Volumetric Run-off Coefficient	Summer: 0.75 Winter: 0.84	Standard volumetric runoff coefficients of 0.75 and 0.84 were applied for the summer and winter respectively.
Minimum velocities	0.8 m/s	The gradients specified typically promote a minimum velocity at full bore of 0.8 m/s to ensure self-cleansing, whilst maintaining a positive connection to outfalls.
Pipe size	150 mm (Minimum)	A minimum pipe size of 150 mm diameter has been used for conveyance within carrier pipework.
Depth of cover and pipe depths	1.2 m (minimum)	A minimum cover depth of 1.2 m has been maintained where possible to provide adequate protection to the pipes and avoid any clashes with existing and proposed utilities. Where this is not possible, an absolute minimum depth of cover of 0.9 m has been applied.
Chambers	1200 mm diameter	Access chambers have been sized in accordance with Design and Construction Guidance (2020) ([Ref. 5) to facilitate maintenance.
Global manhole headloss	0.5	Default software value
Pipe roughness	0.6 mm	Standard Colebrook-White roughness coefficient for surface water drainage design

3.4.2.5 Proprietary Pollution Prevention Facilities

3.4.2.5.1 Due to the operational nature of the development sites, it is proposed to install Class 1 Full Retention Separators; these separators are designed to achieve a discharge concentration of less than 5 mg/litre of oil under standard test conditions prior to discharge to a watercourse, and thus meet the legislative requirements.

3.4.2.5.2 The separators will be installed in the downstream sections of the drainage systems to ensure the entirety of the development sites are effectively treated. Due to capacity limitations of the proprietary separators, a number of separators have been specified across the network. The location of the separators will facilitate access for regular maintenance and thus ensure the long term performance of the proprietary treatment facilities. Indicative locations are shown on drawings in drawings B2357300 - 01 - 05 – 01, 02 and 09 for the northern, southern, and western areas respectively.

3.4.2.5.3 In addition, the fuel station, located within the southern network, is proposed to be protected by the inclusion of a perimeter drain discharging via a Class 1 Full Retention Forecourt Separator, which has 7600 litres capacity to deal with a significant spillage.

3.4.3 Northern Development Area

3.4.3.1 Main Conveyance Drainage System

3.4.3.1.1 The drainage conveyance system is to comprise pipework ranging between 225 to 900 mm diameter. The downstream section of the conveyance drain shall connect into the existing 525 mm diameter outfall pipework within the bounds of the development site. This outfall discharges via an existing headwall structure located on the west bank of the Habrough Marsh Drain; the invert level is assumed to be +0.879 mAOD.

3.4.3.1.2 The pipework is typically installed with a depth of cover of between 1.2 and 2.7 m and is supported by appropriately sized catchpits installed at intervals no greater than 90 m in accordance with the DCG, Version 2.0, 2020 ([Ref. 5).

Flow Control

3.4.3.1.3 To ensure compliance of the allowable discharge rates for the assessed design storm events, as discussed with the Internal Drainage Board, it is proposed to construct a Flow Control Chamber upstream of the point of connection with the existing outfall. This chamber will incorporate two orifice plates at different levels, designed to limit the varying pass forward flows for all storm events. The diameters of the orifice plates were established through an iterative process within MicroDrainage:

- 170 mm diameter orifice plate at +1.400 mAOD (utilised for all storm events)
- 208 mm diameter orifice plate at +2.565 mAOD (utilised during the 1 in 30 year and higher order design storm events)

3.4.3.1.4 The flow control chamber will be in an accessible location to facilitate maintenance; the provision of a bypass arrangement shall be assessed during detailed design as the risk of exceedance flows being transferred to the Habrough Marsh Drain in relation to the upstream catchment should a blockage occur will be required to be evaluated.

Storage Structures

3.4.3.1.5 To accommodate the extensive storage volumes with the network, the strategy includes for the provision of geocellular storage crates as detailed in Section 3.4.2.3. Quick storage estimate calculations using the Source Control module of MicroDrainage show that up to 3000 m^3 of storage would be required to accommodate rainfall during a 1 in 100 year storm event within the northern development area.

3.4.3.1.6 Within the model, approximately 1300 m^3 of storage has been provided via geocellular crating, with additional storage provided within the network pipework. This extensive volume of crating has been located throughout the network to create ten separate storage areas and ensure the individual storage volumes are fully utilised. A minimum cover depth of 1.5 m to the top of the geocellular crating has been maintained throughout, with the height of the crate volumes therefore ranging between 0.3 and 1.5 m dependent on the depth of the drainage network at their location. Accordingly, the base level of the separate storage volumes also varies between +3.2 and +1.8 mAOD.

3.4.3.1.7 A general arrangement of the proposed drainage system is detailed in Drawing No B2357300 - 01 - 05 – 01, which is presented in Appendix A.

3.4.3.2 Contributing Areas & Runoff Assessment

3.4.3.2.1 It is standard practice to assess both existing and proposed runoff from the contribution areas within a brownfield development site to inform the drainage design with regards to the application of SuDS and the management of discharged flow rates; this may be as a result of a change in land designation, change in catchment area where the site is currently positively drained, or the inclusion of climate change.

3.4.3.2.2 The development site is in part currently served by a positive drainage system which discharges to the Habrough Marsh Drain; it is proposed to retain the outfall, and thus the runoff from the existing drainage system has been assessed and the allowable discharge rates for all design storm events are detailed in Section 3.2.3. The runoff assessment associated with the proposed catchment area and permeable sub-catchments is detailed below.

Proposed Catchment Area

3.4.3.2.3 The proposed development site covers an area of approximately 4.735 ha, which is to be paved with an impermeable material; there are no buildings within this catchment.

3.4.3.2.4 Details of the contributing areas is summarised in Table 17 and detailed in Drawing B2357300 - 01 - 05 - 11.

Table 17: ***Contributing surface areas used to model the proposed surface water drainage system within the redevelopment site***

Northern Development Area

Contributing Surface	PIMP	Area (Ha)
Impermeable	100	4.735
Semi-permeable	30	0.0
Permeable	20	0.0

Runoff Rate Assessment

3.4.3.2.5 An assessment of pre and post development discharge rates has been undertaken based on the requirements of the Internal Drainage Board; the derived allowable discharge rate are detailed in Section 3.3.1.6 and are replicated in Table 18 below.

Table 18: ***Allowable discharge rates (30% betterment)***

Northern Development Site – Catchment N-A

Design Storm Event (1: xx)	1 year	30 year	100 year
Allowable Discharge Rate (l/s)	58.0	134.7	159.7

3.4.3.3 Hydraulic Performance - Model Output

3.4.3.3.1 The drainage networks have been modelled using the latest version of Innovyze's MicroDrainage suite of software. The simulation results are presented in Appendix B with a summary of the modelled discharge rates presented in Table 19.

Table 19: ***Hydraulic performance compared with respect to the design criteria***

Northern Development Site – Catchment N-A

Design Storm Event (1: xx)	1 year	30 year	100 year
Allowable Discharge Rate (l/s)	58.0	134.7	159.7
Model Output (l/s)	57.1	127.2	154.9

3.4.3.3.2 The simulation results demonstrate that the drainage system adequately meets the hydraulic design criteria outlined in Sections 3.2.3 and 3.2.4. The results show no surcharging within the network with the exception of immediately upstream of the flow control, for the 1 in 1 year return period event, including a 25% allowance for climate change. The results also show no flooding resulting from a 1 in 30 year return period event, including a 25% (Central) allowance for climate change. The system has also been checked against the 1 in 100 year return period event, including a 25% (Central) allowance for climate change, and has been found to fulfil the requirements of the stipulated design criteria. No flooding is observed for this event and therefore no further calculation is required to determine the extent of surface flooding.

3.4.3.3.1 Sensitivity Testing

3.4.3.3.3.1 Sensitivity testing has been carried out to assess the hydraulic performance of the drainage networks with a gravity outfall in periods of high water levels in the receiving watercourse (Habrough Marsh Drain). For each sensitivity test, the model was run for a range of return periods up to and including the 1 in 30-year +CC event, for durations up to and including 1440 mins (24 hours), on the assumption that water levels are unlikely to be this high for longer than 24 hours. The sensitivity testing showed:

- +3.7 mAOD surcharged outfall level (head from IL of 2.821 m)
  - Northern Catchment N-A showed no flooding for events up to and including the 1 in 25-year event. Flooding began to appear for the 30-year event.
- +1.9 mAOD surcharged outfall level (head from IL of 1.021 m)
  - Northern Catchment N-A showed no flooding for all events up to and including the 30-year event

3.4.3.4 Exceedance Flows

3.4.3.4.1 The surface water network is designed to ensure that the development is free from flooding for all events up to the 1 in 30 year event, +25% climate change allowance in accordance with the requirements of Design and Construction Guidance, Version 2.0, 2020 ([Ref. 5). The model has also been used to assess the flood extents for all events up to the 1 in 100 year event, +25% climate change to inform flood depths within the compound to ensure operations are not impaired; no flooding occurs for the 1 in 100 year event, +25% climate change.

3.4.3.2.2 In the event of a storm event in excess of the design return period, or in the event or a blockage in the network, flood waters will be retained within the bounds of the development site due to the pavement grading. Once this storage volume is exceeded, flood water will overtop the envelope of the catchment and be intercepted by adjacent surface water drainage networks, or the Habrough Marsh Drain. A full appraisal shall be undertaken during detailed design using the digital terrain mode; this is required to satisfy the requirements of PPG ([Ref. 4) where surface water flooding is deemed to be a Design Flood Event.

3.4.4 Southern Development Area

3.4.4.1 Main Conveyance Drainage System

3.4.4.1.1 The conveyance drainage system is sub-divided into two drainage systems due to the extent of the catchment.

<u>Drainage Catchment S-A</u>

3.4.4.1.2 The drainage system serving the western sub-catchment is to discharge into the existing Combined Treated Effluent / Storm Water Pumping Station and is to comprise a positive drainage conveyance system comprising 225 to 600 mm diameter pipework. The downstream section of the conveyance drain shall connect into the existing 600 mm diameter main inlet pipe located to the north of the pumping station’s wetwell.

<u>Flow Control</u>

3.4.4.1.3 As outlined in Section 3.3.2.6, it is proposed to restrict the discharge from Catchment S-A into the existing gravity wetwell inlet pipework to a combined 160 l/s, for all return periods. This is on the basis that the available capacity within the existing 600 mm diameter pipework on the gravity network is 160 l/s. This philosophy would risk overloading the existing pumping station. It is therefore proposed to upsize the existing Combined Treated Effluent / Storm Water Pumping Station to accommodate the additional flow. Since the outfall is to the Humber Estuary, increasing the pumping station's discharge flow rate will not affect flood risk in the receiving watercourse (Humber Estuary). The existing pumping station delivers flows via a 300 mm diameter manifold pipe, which is assumed to connect to a 600 mm rising main discharging into the Humber Estuary. It is therefore assumed that this 600 mm diameter rising main would have spare capacity to acceptable increased flows, which may additionally aid in the hydraulic performance of the existing main as flows and therefore velocities will be higher, helping to mitigate the risk of solids settling out in the main over time.

3.4.4.1.4 To ensure the inflow does not exceed the capacity of the existing gravity inlet pipe to the pumping station it is proposed to install two Flow Control Chambers upstream and either side of the point of connection with the existing inlet pipe. These chambers will incorporate hydrobrakes designed to limit pass forward flows for all storm events, the combined flow not exceeding the allowable discharge rate determined in Section 3.3.2.6:

- Hydrobrake at +2.421 mAOD, limiting flows to 110 l/s, for the eastern side of the Catchment S-A network
- Hydrobrake at +2.666 mAOD, limiting flows to 50 l/s, for the western side of the Catchment S-A network

3.4.4.1.5 The chambers will be in accessible locations to facilitate maintenance. The provision of a bypass arrangement shall be assessed during detailed design as the risk of flooding the wetwell in relation to the upstream catchment should a blockage occur will be required to be evaluated.

3.4.4.1.6 The pipework installed within each catchment is typically installed with a depth of cover of between 0.9 and 2.4 m and is supported by appropriately sized catchpits installed at intervals no greater than 90 m in accordance with the Design and Construction Guidance, Version 2.0, 2020 ([Ref. 5).

<u>Drainage Catchments S-B and S-C</u>

3.4.4.1.7 The drainage system serving the eastern sub-catchment is to discharge into the Habrough Marsh Drain and is to comprise a positive drainage conveyance system comprising 225 to 900 mm diameter pipework. The downstream section of the conveyance drain shall connect into the existing 525 mm diameter outfall pipework within the bounds of the development site. This outfall discharges via an existing headwall structure located on the west bank of the Habrough Marsh Drain; the invert level is assumed to be +0.4 mAOD.

<u>Flow Control</u>

3.4.4.1.8 To ensure compliance of the allowable discharge rate as discussed with the Internal Drainage Board it is proposed to construct a Flow Control Chamber upstream of the point of connection with the existing outfall. This chamber will incorporate a 300 mm diameter orifice plate at +0.575 mAOD that is designed to limit pass forward flows for all storm events. The chamber will be in an accessible location to facilitate maintenance; the provision of a bypass arrangement shall be assessed during detailed design as the risk of exceedance flows being transferred to the Habrough Marsh Drain in relation to the upstream catchment should a blockage occur will be required to be evaluated.

3.4.4.1.9 Due to space constraints, two intermediate flow control chambers have been added at strategic points within the network. Both control chambers incorporate a single hydrobrake to limit flows to the downstream network and to reduce the surcharging within the network where the existing Shed 26 drainage converges, to avoid detrimentally affecting the performance of the Shed 26 drainage network. Upstream of each intermediate control chamber, the balance of flow is proposed to be stored within buried geocellular storage crates. The hydrobrakes have been detailed as follows:

- Hydrobrake at +1.530 mAOD, limiting flows to 50 l/s from the proposed network serving south of Shed 26
- Hydrobrake at +3.004 mAOD, limiting flows to 5 l/s from the proposed network serving the fuelling station area north of Shed 26

3.4.4.1.10 The pipework installed within each catchment is typically installed with a depth of cover of between 1.2 and 3.2 m and is supported by appropriately sized catchpits installed at intervals no greater than 90 m in accordance with the Design and Construction Guidance, Version 2.0, 2020 ([Ref. 5).

Storage

3.4.4.1.11 To accommodate the storage volumes with the two catchment networks, the strategy includes for the provision of geocellular storage crates as detailed in Section 3.4.2.3. Quick storage estimate calculations using the Source Control module of MicroDrainage suggest that around 3500 m^3 of storage would be required within the Catchments to accommodate rainfall during a 1 in 100 year storm event.

3.4.4.1.12 This volume of storage has been provided through five individual geocellular crate structures, located across the two networks and separated to ensure their volumes are fully utilised. Of these structures, two are in Catchment S-A, one is in Catchment S-B, and two are in Catchment S-C.

3.4.4.1.13 Within Catchment S-A, a minimum cover depth of 1.3 m to the top of the crating has been maintained with the height of the crate volumes at 0.9 m to suit the comparatively shallow depth of the pumped drainage network; the base level of the two structures does not go below +2.4 mAOD.

3.4.4.1.14 The gravity network within Catchments S-B and S-C is however generally deeper, allowing for deeper crate heights from 0.3 to 1.8 m. Accordingly, a minimum cover depth of 1.5 m to the top of the geocellular crating could be maintained whilst the base levels of the structures ranging from +3.0 to +0.5 mAOD.

3.4.4.2 Contributing Areas & Runoff Assessment

3.4.4.2.1 It is standard practice to assess both existing and proposed runoff from the contribution areas within a brownfield development site to inform the drainage design with regards to the application of SuDS and the management of discharged flow rates; this may be as a result of a change in land designation, change in catchment area where the site is currently positively drained, or the inclusion of climate change.

3.4.4.2.2 The conveyance drainage system is sub-divided into two drainage systems due to the extent of the catchment as outlined in Section 3.4.4.1.

Drainage Catchment S-A

3.4.4.2.3 The development site is in part currently served by a positive drainage system. However, due to the extent of the catchment, limited drainage has been installed and none currently discharges into the Combined Pumping Station.

3.4.4.2.4 It is proposed to upgrade the pump sets serving the Combined Pumping Station, and thus the allowable discharge rates for all design storm events are detailed in Section 3.3.2.6. The runoff assessment associated with the proposed catchment area and the associated impermeable and permeable sub-catchments is detailed below.

Proposed Catchment Area

3.4.4.2.5 The proposed development site covers an area of approximately 3.588 ha, which is to be paved with an impermeable material; there are a number of buildings within this catchment, which will also be impermeable.

3.4.4.2.6 Details of the contributing areas is summarised in Table 20 and detailed in Drawing B2357300 - 01 - 05 - 02.

Table 20: ***Contributing surface areas used to model the proposed surface water drainage system within the redevelopment site***

Southern Development Area – Catchment S-A

Contributing Surface	PIMP	Area (Ha)
Impermeable	100	3.588
Semi-permeable	30	0.0
Permeable	20	0.0

Runoff Rate Assessment

3.4.4.2.7 An assessment of pre and post development discharge rates has been undertaken based on the spare capacity within the existing gravity inlet to the Combined Treated Effluent / Storm Water Pumping Station; the derived allowable discharge rate are detailed in Section 3.3.2.6.

Table 21: ***Allowable discharge rates***

Southern Development Site – Catchment S-A

Design Storm Event (1: xx)	1 year	30 year	100 year
Allowable Discharge Rate (l/s)	160	160	160

<u>**Drainage Catchments S-B and S-C**</u>

3.4.4.2.8 The development site is in part currently served by a positive drainage system which discharges to the Habrough Marsh Drain; it is proposed to retain the outfall, and thus the runoff from the existing drainage system has been assessed and the allowable discharge rates for all design storm events are detailed in Section 3.3.2.6.

3.4.4.2.9 The runoff assessment associated with the proposed catchment area and the associated impermeable and permeable sub-catchments is detailed below.

<u>Proposed Catchment Area</u>

3.4.4.2.10 The proposed development site covers an area of approximately 12.850 ha, which is to be paved with an impermeable material; there are a number of buildings within this catchment, which will also be impermeable.

3.4.4.2.11 Details of the contributing areas is summarised in Table 22 and detailed in Drawing B2357300 - 01 - 05 - 11.

Table 22: ***Contributing surface areas used to model the proposed surface water drainage system within the redevelopment site***

Southern Development Area – Catchments S-B and S-C

Contributing Surface	PIMP	Area (Ha)
Impermeable	100	12.850
Semi-permeable	30	0.0
Permeable	20	0.0

<u>Runoff Rate Assessment</u>

3.4.4.2.12 An assessment of pre and post development discharge rates has been undertaken based on the requirements of the Internal Drainage Board; the derived allowable discharge rate are detailed in Section 3.3.2.6 and are replicated in Table 23 below.

Table 23: ***Allowable discharge rates (30% betterment)***

Southern Development Site – Catchments S-B and S-C

Design Storm Event (1: xx)	1 year	30 year	100 year
Permitted Discharge Rate (l/s)	106.4	165.9	198.1

3.4.4.3 Hydraulic Performance - Model Output

3.4.4.3.1 The drainage networks have been modelled using the latest version of Innovyze's MicroDrainage suite of software. The simulation results are presented in Appendix B with a summary of the modelled discharge rates presented in Table 24.

Table 24: ***Hydraulic performance compared with respect to the design criteria***

Southern Development Site – Catchments S-B and S-C

Design Storm Event (1: xx)	1 year	30 year	100 year
Allowable Discharge Rate (l/s)	106.4	165.9	198.1
Model Output (l/s)	93.0	165.3	189.4

Catchment S-A

3.4.4.3.2 The simulation results demonstrate that the drainage system adequately meets the hydraulic design criteria outlined in Sections 3.2.3 and 3.2.4. The results show no surcharging within the proposed network for the 1 in 1 year return period event, including a 25% allowance for climate change. The results also show no flooding resulting from a 1 in 30 year return period event, including a 25% (Central) allowance for climate change.

3.4.4.3.3 The system has also been checked against the 1 in 100 year return period event, including a 25% (Central) allowance for climate change and has been found to fulfil the requirements of the stipulated design criteria. Small volumes of flooding are observed for this event at various locations predominantly at heads of runs. The largest volume of flooding within the proposed network is 5.272 m^3 in pipe 8.000. This volume of flooding corresponds to a depth of flooding of 34 mm across the 46 m length of valley. At a 1 in 100 pavement gradient, this flooded area would have a total width of 6.8 m. Flooding is predominantly reported during short duration, high intensity storm events as a direct result of conveyance capacity restrictions in the pipework. As such, this flooding will quickly drain down after the storm's peak has passed.

Catchments S-B and S-C

3.4.4.3.4 The simulation results demonstrate that the drainage system adequately meets the hydraulic design criteria outlined in Sections 3.2.3 and 3.2.4. The results show no surcharging within the proposed network for the 1 in 1 year return period event, including a 25% allowance for climate change. Flooding is noted in pipe 26.000, which is the existing connection from Shed 26, which is not to be modified as part of the works. The flow controls within the network have been strategically located such that the hydraulic performance of pipe 26.000 is not detrimentally impacted by the works. The results also show no flooding resulting from a 1 in 30 year return period event, including a 25% (Central) allowance for climate change. As with the 1 in 1 year results, flooding is noted in pipe 26.000.

3.4.4.3.5 The system has also been checked against the 1 in 100 year return period event, including a 25% (Central) allowance for climate change and has been found to fulfil the requirements of the stipulated design criteria. Small volumes of flooding are observed for this event at various locations predominantly at heads of runs. The largest volume of flooding within the proposed network is 8.144 m^3 in pipe 11.000. This volume of flooding corresponds to a depth of flooding of 36 mm across the 62 m length of valley. At a 1 in 100 pavement gradient, this flooded area would have a total width of 7.25 m. Flooding is predominantly reported during short duration, high intensity storm events as a direct result of conveyance capacity restrictions in the pipework. As such, this flooding will quickly drain down after the storm's peak has passed. Flooding is again noted in pipe 26.000 during this event, which is the existing connection from Shed 26, which is not to be modified as part of the works.

3.4.4.3.1 Sensitivity Testing

3.4.4.3.1.1 Sensitivity testing has been carried out to assess the hydraulic performance of the drainage networks with a gravity outfall in periods of high water levels in the receiving watercourse (Habrough Marsh Drain). For each sensitivity test, the model was run for a range of return periods up to and including the 1 in 30-year +CC event, for durations up to and including 1440 mins (24 hours), on the assumption that water levels are unlikely to be this high for longer than 24 hours. The sensitivity testing showed:

- +3.7 mAOD surcharged outfall level (head from IL of 3.292 m)
  - Southern Catchments S-B and S-C showed no flooding for all events up to and including the 30-year event
- +1.9 mAOD surcharged outfall level (head from IL of 1.592 m)
  - Southern Catchments S-B and S-C showed no flooding for all events up to and including the 30-year event

3.4.4.4 Exceedance Flows

3.4.4.4.1 The surface water network is designed to ensure that the development is free from flooding for all events up to the 1 in 30 year event, +25% climate change allowance in accordance with the requirements of DCG, Version 2.0, 2020 ([Ref. 5). The model has also been used to assess the flood extents for all design storm events up to the 1 in 100 year event, +25% climate change to inform flood depths within the compound to ensure operations are not impaired; small volumes of flooding occur for the 1 in 100 year event, +25% climate change, all of which are contained within the pavement valleys as intended.

3.4.4.4.2 In the event of a storm event in excess of the design return period, or in the event or a blockage in the network, flood waters will be retained within the bounds of the development site due to the pavement grading. Once this storage volume is exceeded, flood water will overtop the envelope of the catchment and be intercepted by adjacent surface water drainage networks, or the adjacent railway track. A full appraisal shall be undertaken during detailed design using the digital terrain model; this is required to satisfy the requirements of PPG ([Ref. 4) where surface water flooding is deemed to be a Design Flood Event.

3.4.5 Western Development Area

3.4.5.1 Main Conveyance Drainage System

3.4.5.1.1 The drainage system serving the catchment is to discharge into the existing Stormwater Pumping Station and is to comprise a positive drainage conveyance system comprising 225 to 1200 mm diameter pipework. The downstream section of the conveyance drain shall discharge into the inlet to a proposed lift station which is served by a small section of rising main that lifts the flows into the storm water pumping station. The proposed lift station is to replace the existing lift station on a like-for-like basis in terms of pumping rates on the basis that the downstream stormwater pumping station is capable of dealing with this inflow. The lift station is required to be replaced due to the vertical alignment of the proposed conveyance drainage which is deeper than the existing drainage arrangement.

<u>Flow Control</u>

3.4.5.1.2 To ensure the inflow does not exceed the capacity of the like-for-like replacement lift station, the pumping capacity has been estimated and used as the allowable discharge rate (see Section 3.3.3.6). To control flows to the allowable discharge rate it is proposed to construct a Flow Control Chamber upstream of the lift station. This chamber will incorporate a hydrobrake at +0.792 mAOD and limit the pass forward flow to 120 l/s. Excess flows conveyed in the drainage system are required to be stored within the network.

<u>Storage</u>

3.4.5.1.3 To accommodate the extensive storage volumes with the network, the strategy includes for the provision of geocellular storage crates as detailed in Section 3.4.2.3. Quick storage estimate calculations using the Source Control module of MicroDrainage show that up to around 4000 m^3 of storage would be required to accommodate rainfall during a 1 in 100 year storm event within the northern development area.

3.4.5.1.4 Within the model, approximately 3000 m^3 of storage has been provided via geocellular crating. This extensive volume of crating has been located throughout the network to create three separate storage areas and ensure the individual storage volumes are fully utilised. A minimum cover depth of 1.4 m to the top of the geocellular crating has been maintained throughout, with the height of the crate volumes therefore ranging between 0.3 and 1.2 m dependent on the depth of the drainage network at their location. Accordingly, the base level of the separate storage volumes also varies between +3.0 and +2.0 mAOD.

3.4.5.1.5 The pipework installed within the catchment is typically installed with a depth of cover of between 1.2 and 3.8 m and is supported by appropriately sized catchpits installed at intervals of no greater than 90 m in accordance with the DCG, Version 2.0, 2020 ([Ref. 5).

3.4.5.1.6 A general arrangement of the proposed drainage systems is detailed in Drawing No B2357300 - 01 - 05 – 09, which is presented in Appendix A.

3.4.5.2 Contributing Areas & Runoff Assessment

3.4.5.2.1 It is standard practice to assess both existing and proposed runoff from the contribution areas within a brownfield development site to inform the drainage design with regards to the application of SuDS and the management of discharged flow rates; this may be as a result of a change in land designation, change in catchment area where the site is currently positively drained, or the inclusion of climate change.

3.4.5.2.2 The development site is in part currently served by a positive drainage system, however, due to the extent of the catchment limited drainage has been installed; all runoff is discharged to the stormwater lift station.

3.4.5.2.3 It is proposed to maintain the flows rate from the lift station; the allowable discharge rates for all design storm events are detailed in Section 3.3.3.6. The runoff assessment associated with the proposed catchment area and the associated impermeable and permeable sub-catchments is detailed below.

Proposed Catchment Area

3.4.5.2.4 The proposed development site covers an area of approximately 9.570 ha, which is to be paved with an impermeable material; there are no buildings within this catchment. Details of the contributing areas is summarised in Table 25 and detailed in B2357300 - 01 - 05 - 09.

Table 25: ***Contributing surface areas used to model the proposed surface water drainage system within the redevelopment site***

Western Development Area

Contributing Surface	PIMP	Area (Ha)
Impermeable	100	9.570
Semi-permeable	30	0.0
Permeable	20	0.0

Runoff Rate Assessment

3.4.5.2.5 An assessment of pre and post development discharge rates has been undertaken based on maintaining the existing pump rate for the replacement lift station; the derived allowable discharge rate are detailed in Section 3.3.3.6.

Table 26: ***Allowable discharge rates***

Western Development Site

Design Storm Event (1: xx)	1 year	30 year	100 year
Allowable Discharge Rate (l/s)	120	120	120

3.4.5.3 Hydraulic Performance - Model Output

3.4.5.3.1 The drainage networks have been modelled using the latest version of Innovyze's MicroDrainage suite of software. The simulation results are presented in Appendix B with a summary of the modelled discharge rates presented in Table 27

Table 27: ***Hydraulic performance compared with respect to the design criteria***

Western Development Site

Design Storm Event (1: xx)	1 year	30 year	100 year
Allowable Discharge Rate (l/s)	120	120	120
Model Output (l/s)	119.5	119.5	119.5

3.4.5.3.2 The simulation results demonstrate that the drainage system adequately meets the hydraulic design criteria outlined in Sections 3.2.3 and 3.2.4. The results show no surcharging within the network with the exception of immediately upstream of the flow control, for the 1 in 1 year return period event, including a 25% allowance for climate change. The results also show no flooding resulting from a 1 in 30 year return period event, including a 25% (Central) allowance for climate change.

3.4.5.3.3 The system has also been checked against the 1 in 100 year return period event, including a 25% (Central) allowance for climate change and has been found to fulfil the requirements of the stipulated design criteria. Small volumes of flooding are observed for this event at various locations predominantly at heads of runs. The largest volume of flooding within the proposed network is 7.766 m^3 in pipe 7.000. This volume of flooding corresponds to a depth of flooding of 60 mm across the 22.378 m length of valley. At a 1 in 100 pavement gradient, this flooded area would have a total width of 12 m. Flooding is predominantly reported during short duration, high intensity storm events as a direct result of conveyance capacity restrictions in the pipework. As such, this flooding will quickly drain down after the storm's peak has passed.

3.4.5.4 Exceedance Flows

3.4.5.4.1 The surface water network is designed to ensure that the development is free from flooding for all events up to the 1 in 30 year event, +25% climate change allowance in accordance with the requirements of DCG, Version 2.0, 2020 ([Ref. 5). The model has also been used to assess the flood extents for all events up to the 1 in 100 year event, +25% climate change to inform flood depths within the compound to ensure operations are not impaired; small volumes of flooding occur for the 1 in 100 year event, +25% climate change, all of which are contained within the pavement valleys as intended.

3.4.5.4.2 In the event of a storm event in excess of the design return period, or in the event or a blockage in the network, flood waters will be retained within the bounds of the development site due to the pavement grading. Once this storage volume is exceeded, flood water will overtop the envelope of the catchment and be intercepted by adjacent surface water drainage networks, or the adjacent railway track. A full appraisal shall be undertaken during detailed design using the digital terrain model; this is required to satisfy the requirements of PPG ([Ref. 4) where surface water flooding is deemed to be a Design Flood Event.

3.5 Enabling Works

3.5.1 The existing Drury Ltd. site does not fall under the development scope. However, although no new drainage infrastructure is being proposed, to enable the construction of the proposed overbridge foundations, two sections of the existing surface water drainage network will need relocating. These sections are located at either end of the bridge structure.

3.5.2 For the northern end of the bridge structure, enabling works are to include:

- The abandonment and demolition of one existing manhole;
- The abandonment and demolition of one existing surface water pumping station (pumped manhole);
- The abandonment and demolition of a section of existing pipework, including some carrier pipework and portions of multiple connections;
- The construction of new pipework, providing connection between the remaining existing pipework and continuing the conveyance of collected runoff within the wider network;
- The construction of four new manholes, to connect the new pipework into the existing network, continue the conveyance of collected runoff within the wider network, and provide maintenance access;
- The construction of a new like-for-like pumping station (pumped manhole), to replace and replicate the existing station;
- The construction of a new rising main, to replace and replicate the existing rising main connection.

3.5.3 For the southern end of the bridge structure, enabling works are to include:

- The abandonment and demolition of one existing manhole;
- The abandonment and demolition of a section of existing pipework, including some carrier pipework and an existing connection;
- The construction of new pipework, to replicate an existing connection and continue the conveyance of collected runoff within the wider network;
- The construction of two new manholes, to connect the new pipework into the existing network and continue the conveyance of collected runoff within the wider network;
- The construction of one new inspection chamber, to provide maintenance access.

3.5.4 These works are detailed in Drawing B2357300 01 - 05 – 07, which is presented in Appendix A.

Foul Water Drainage Strategy

4.1 The development proposal includes for the construction of buildings and facilities as detailed below:

- Terminal Building
- Customer Welfare Building
- Workshop and Fuel Station
- UK Border Force Customs Building and supporting infrastructure, including Immigration PCP Booths and Marshalling Lanes, Cyclamen Portal, Secondary Examination Building, Holding Facility, and Inspection Areas
- Workshop and Office buildings for Malcom West Forklifts
- Substation
- Frequency Converter Building for Shore Power System

4.2 There are numerous buildings within the Port and it is assumed that these are served by dedicated wastewater drainage systems which are not adopted or served by a public sewerage system, and thus are the responsibility of the Port. Based on available records the wastewater drainage systems discharge to package treatment plants or cesspits. The treated effluent is conveyed to Pumping Stations that discharge to the Humber Estuary whilst the cesspits will require emptying via tanker. The Combined Treated Effluent / Stormwater Pumping Station in the bounds of the development site is subject to an Environmental Permit which limits the daily volume of treated effluent that is discharged into the Humber Estuary.

4.3 It is proposed to provide wastewater infrastructure to support the buildings; however, the layout and functionality shall be subject to development during detailed design. The proposed strategy is to treat the wastewater local to the building via a package treatment plant and convey the treated effluent to one of the combined pumping stations that discharge the treated effluent directly to the Humber Estuary, or to the Habrough Marsh Drain via the proposed surface water drainage networks. The increase in the volume of treated effluent discharged into the Humber Estuary will be subject to the agreement of the Environment Agency, and similarly any discharge into the Habrough Marsh Drain shall be subject to the consent of the IDB.

4.4 Indicative drainage arrangements associated with the buildings or facilities that incorporate welfare facilities are shown on Drawing No. B2357300 - 01 - 05 – 04 which is presented in Appendix A.

Conclusion

5.1 Jacobs has been commissioned to compile a Drainage Strategy associated with the construction of a new roll-on/roll-off facility within the Port of Immingham, located on the south bank of the Humber Estuary. A strategy comprising the following elements has therefore been developed to support the DCO application and considers the existing and proposed infrastructure, together with the logistics associated with operating the terminal:

- **Design**: The surface water drainage network has been developed in accordance with Design and Construction Guidance (2020) ([Ref. 5), Building Regulations, Planning Policy and Climate change guidance published by HM Government in May 2022 ([Ref. 8). Additional site-specific criteria relating to the allowable presence and impact of flooding have also been considered.
- **SuDS**: Due to the underlying ground conditions, potentially high groundwaters, and potential presence of contaminants, SuDS features have not been deemed appropriate for the development.
- **Grading**: Grading of the development Yards has been undertaken with due regard to the functionality of the facilities and ensures the effective runoff and collection of surface water. Additionally, the layout ensures that new pavement levels tie-in with existing topography and the railway level crossing is retained. The grading typically promotes a ridge and valley arrangement.
- **Collector systems**: The collector system is to comprise highway gullies located in the valleys within the pavement, the spacings of which will be carried out during detailed design with due consideration for flow widths and ponding depth in relation to the functionality of the facility. Channel drains will be placed in remote areas of hardstanding to facilitate connectivity with the main conveyance drainage, and across level building thresholds which have been provided to enable free access to vehicles subject to UK Border Force examination.
- **Conveyance**: A positive drainage conveyance system comprising 225 to 900 mm diameter pipework is being promoted, typically installed with a minimum cover depth of 0.9 m and supported by appropriately sized catchpits.
- **Discharge rates and flow control**: The existing discharge arrangements are to be mimicked for an appropriate range of rainfall events (1, 30 and 100 years), including an allowance for climate change. For outfalls into the Habrough Marsh Drain, the IDB have stipulated a 30% betterment in relation to the 'actual' existing discharge. To ensure compliance, the construction of a Flow Control Chamber upstream of each network's outfall is being promoted. Flows are being controlled using hydrobrakes and orifice plates as deemed appropriate.
- **Outfalls**: As per guidance form the IDB, existing surface water outfalls have been utilised for all development areas. All of these ultimately discharge into the Humber Estuary, via either the Habrough Marsh Drain or Immingham Dock.
- **Proprietary pollution prevention**: Due to the operational nature of the development sites, it is proposed to install a number of Class 1 Full Retention Separators across the surface water drainage network to ensure appropriate and effective treatment. In addition, the Fuel Station is proposed to be contained by the inclusion of a perimeter drain and Class 1 Forecourt Separator.
- **Storage**: To accommodate the extensive storage volumes required with the network, the strategy includes for the provision of geocellular storage crates located to facilitate full utilisation and constructability. The geocellular storage crates shall be of sufficient long term strength to withstand the anticipated loads and be lined to prevent groundwater interaction.
- **Exceedance flows**: The northern catchment remains free from flooding during the 1:100 year design storm event, +25% CC. Small volumes of flooding have however been shown to occur within the Southern and Western catchments. These flood volumes are contained within the catchment, within the pavement valleys, as per design. During extreme events in excess of the design period, runoff will overtop the catchment envelope and be intercepted by adjacent drainage infrastructure.
- **Foul water**: The development proposal includes for the construction of a number of General and Operational Buildings. It is proposed to provide wastewater infrastructure to support the buildings

incorporating welfare facilities, however, their layout and functionality shall be subject to development during detailed design.

5.2 The hydraulic performance of the promoted drainage proposals has been computationally modelled and demonstrate that the drainage system adequately meets the hydraulic design criteria as detailed.

Appendix A. Drawings

A1 Site Location Plan - B2357400 - JAC - 00 - ZZ - 0101

General Arrangements

A2 Enabling Works - B2357300 - 01 - 05 – 07

A3 Grading Plan - B2357300 - 01 - 05 – 08

A4 Foul Water - B2357300 - 01 - 05 – 04

A5 Northern Yard: Existing - B2357300 - 01 - 05 – 011

A6 Southern Yard: Existing - B2357300 - 01 - 05 – 012

A7 Western Yard: Existing - B2357300 - 01 - 05 – 019

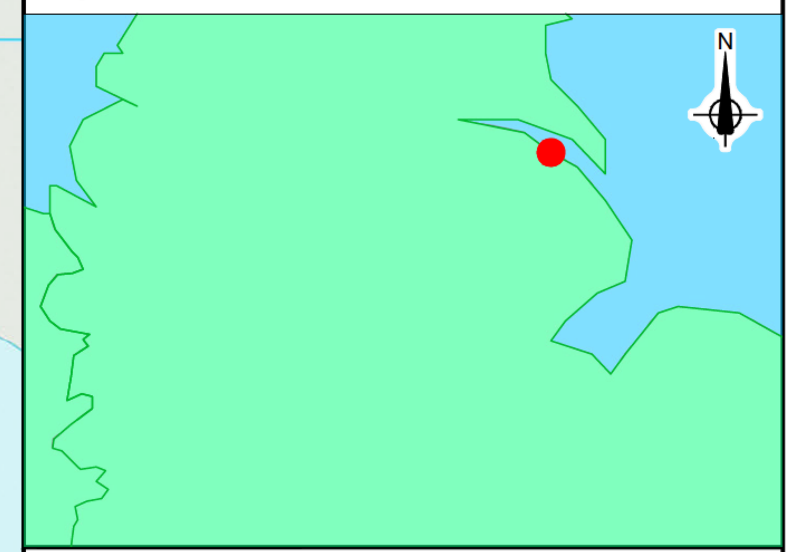
A8 Northern Yard: Proposed - B2357300 - 01 - 05 – 01

A9 Southern Yard: Proposed – B2357300 – 01 – 05 – 02

A10 Western Yard: Proposed - B2357300 - 01 - 05 – 09

\\ukfsp02\Maritime\PROJECTS\Ports(VT)\B2429400 ABP Project Suga\1100 Design & Engineering\1102 Drawings\01 Preliminary\02 DCO Drawings\B2429400-JAC-00-ZZ-DR-ZZ-0101 P02.dwg - 09/02/2023 15:18:47 - 0101 - HillsRJ

Key Plan



General Notes

1. This plan should be read alongside other plans and documents in the development consent order application.
2. All dimensions are in metres unless noted otherwise.

Key

Order limits

0 100 200 300 400 500 600 700 800 900 1000

SCALE 1:10000 (A1) METRES

SCALE 1:20000 (A3)

Rev	Rev. Date	Purpose of revision	Orig	Check	Rev	Apprv
P02	February 2023	Submission Version	TH	RH	RH	CN
P01	January 2023	Submission Version	AJM	RH	RH	CN

Jacobs

95 Bothwell St, Glasgow, G2 7HX
Tel:+44(0)141 243 8000 Fax:+44(0)141 226 3109
www.jacobs.com

Client

ABP | ASSOCIATED BRITISH PORTS

Project

IMMINGHAM EASTERN RO-RO TERMINAL

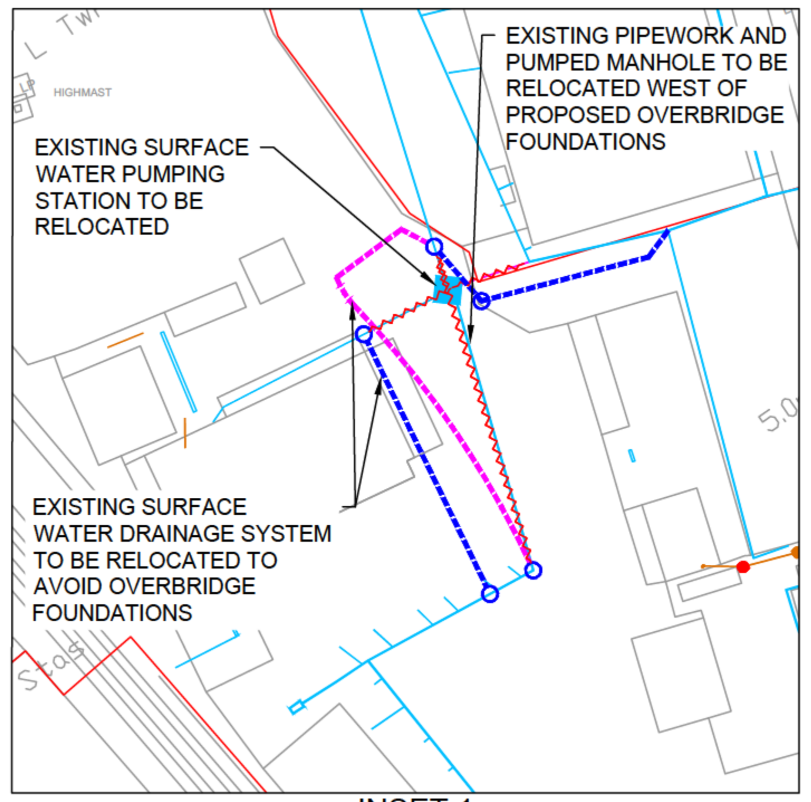
Drawing title

LOCATION PLAN REGULATION 5(2)(o)

Drawing status	SUBMISSION VERSION	Suitability S4
Scale	1:10000 @ A1	
Jacobs No.	B2429400	Rev P02
Client No.		

Drawing number

B2429400-JAC-00-ZZ-DR-ZZ-0101



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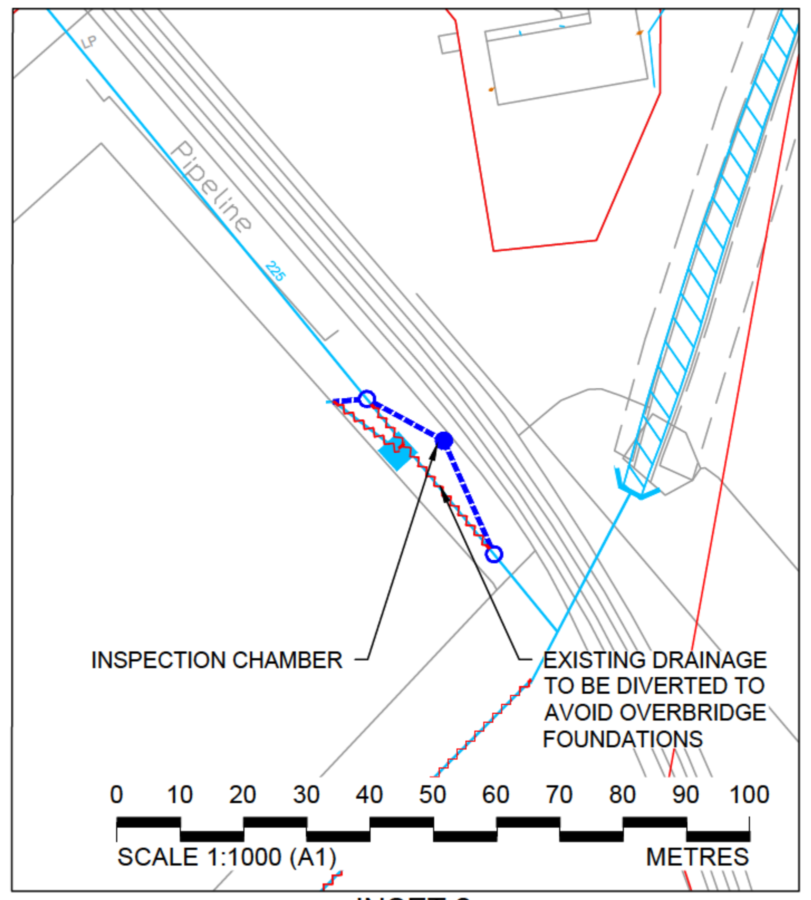
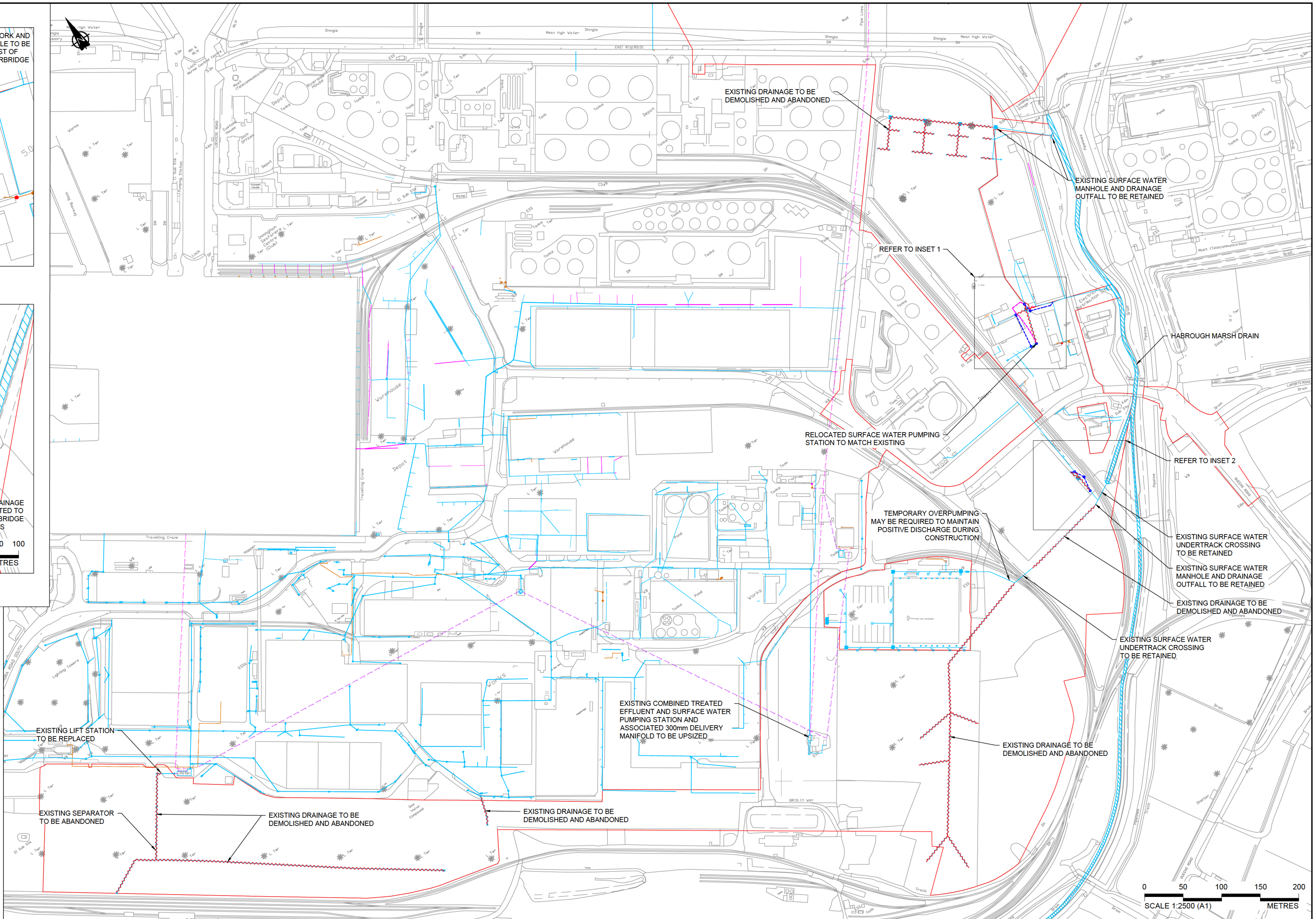
Scale 1:1000



INSET 2
Scale 1:1000



LEGEND:

- EXISTING FOUL WATER MANHOLE
- EXISTING FOUL WATER PIPELINE
- EXISTING FOUL WATER RISING MAIN
- EXISTING SURFACE WATER MANHOLE
- EXISTING SURFACE WATER PIPELINE
- EXISTING SURFACE WATER GULLY
- EXISTING SURFACE WATER RISING MAIN
- EXISTING SURFACE WATER OUTFALL
- WATERCOURSE
- PROPOSED ABANDONMENT
- SITE DEVELOPMENT BOUNDARY
- PROPOSED SURFACE WATER RISING MAIN
- PROPOSED SURFACE WATER MANHOLE
- PROPOSED SURFACE WATER PIPELINE

NOTES:

1. THIS GENERAL ARRANGEMENT SHOULD BE READ ALONGSIDE OTHER PLANS AND DOCUMENTS IN THE DEVELOPMENT CONSENT ORDER APPLICATION.
2. DO NOT SCALE FROM THIS DRAWING.
3. ALL DIMENSIONS IN METERS UNLESS NOTED OTHERWISE.
4. ALL LEVELS TO ORDNANCE DATUM UNLESS NOTED OTHERWISE.
5. EXISTING FOUL AND SURFACE WATER DRAINAGE INFORMATION EXTRACTED FROM RECORDS HELD BY ABP.
6. WORKS REQUIRED PRIOR TO CONSTRUCTION WORKS OF DRAINAGE, SURFACING AND POTABLE WATER SYSTEMS.

Rev	Rev. Date	Purpose of revision	Drawn	Checkd	Rev'd	Apprv'd
P01	2022-08-17	CONCEPT DESIGN	AJM	TCW	DRK	GP
0	2019-07-19	FIRST ISSUE	AJM	----	----	----

JACOBS

Client
ASSOCIATED BRITISH PORTS

Project
PROJECT SUGAR
CONCEPT DESIGN

Drawing title
FOUL AND SURFACE WATER DRAINAGE ENABLING WORKS

Drawing status	CONCEPT DESIGN
Suitability	S3
Scale	AS SHOWN @ A1
	DO NOT SCALE
Jacobs No.	B2357300 - 01
Rev	P01
Client no.	
Drawing number	B2357300 - 01 - 05 - 07

NOTES:

1. THIS GENERAL ARRANGEMENT SHOULD BE READ ALONGSIDE OTHER PLANS AND DOCUMENTS IN THE DEVELOPMENT CONSENT ORDER APPLICATION.
2. DO NOT SCALE FROM THIS DRAWING.
3. ALL DIMENSIONS IN METERS UNLESS NOTED OTHERWISE.
4. ALL LEVELS TO ORDNANCE DATUM UNLESS NOTED OTHERWISE.
5. EXISTING FOUL AND SURFACE WATER DRAINAGE INFORMATION EXTRACTED FROM RECORDS HELD BY ABP.
6. THE PAVEMENT SHALL BE ARRANGED IN A RIDGE AND VALLEY ARRANGEMENT AND GRADIENTS SHALL TYPICALLY BE BETWEEN 1 IN 60 AND 1 IN 100.
7. EXISTING LEVELS TAKEN FROM ENVIRONMENT AGENCY OPEN SOURCE LIDAR DATA.

Rev	Rev. Date	Purpose of revision	Drawn	Checkd	Rev'd	Apprv'd
P02	2023-02-10	CONCEPT DESIGN - UPDATED SITE LAYOUT	HHS	TCW	DRK	GP
P01	2022-08-17	CONCEPT DESIGN	AJM	TCW	DRK	GP
0	2019-07-19	FIRST ISSUE	AJM	----	----	----

JACOBS

Client

ASSOCIATED BRITISH PORTS

Project

PROJECT SUGAR
CONCEPT DESIGN

Drawing title

SITE-WIDE PAVEMENT GRADING PLAN

Drawing status: CONCEPT DESIGN

Suitability: S3

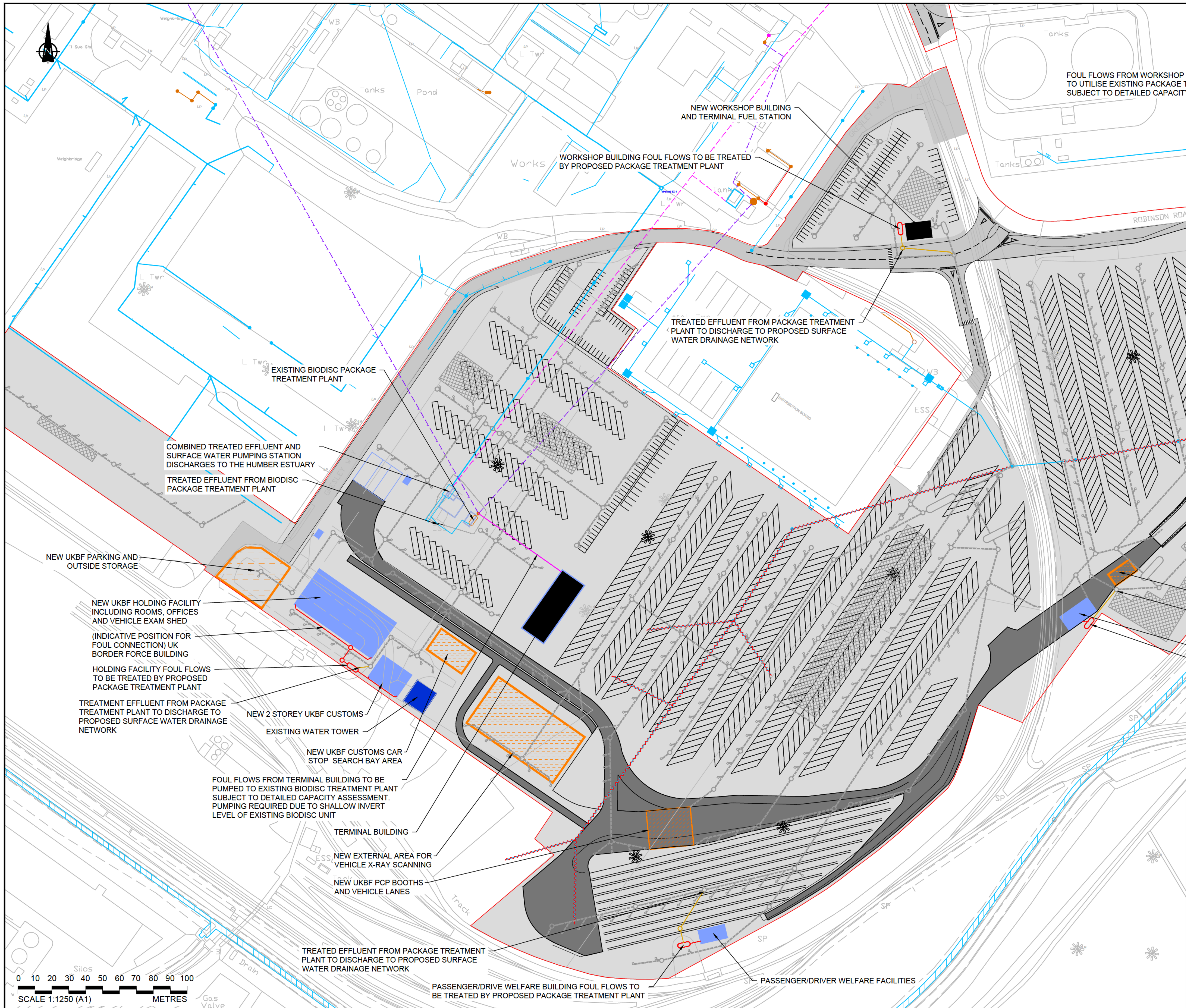
Scale: 1:2500 @ A1 — DO NOT SCALE

Jacobs No.: B2357300 - 01

Client no.:

Rev: P02

Drawing number: B2357300 - 01 - 05 - 08



LEGEND:

EXISTING CESS PITS / PACKAGE TREATMENT PLANTS	NEW UKBF BUILDINGS
EXISTING FOUL WATER MANHOLE	PROPOSED FOUL MANHOLE
EXISTING FOUL WATER PIPELINE	PROPOSED FOUL WATER PIPELINE
EXISTING FOUL WATER RISING MAIN	PROPOSED FOUL WATER RISING MAIN
EXISTING SURFACE WATER MANHOLE	PROPOSED TREATED EFFLUENT PIPE
EXISTING SURFACE WATER PIPELINE	PROPOSED FOUL WATER PACKAGE TREATMENT PLANT
EXISTING SURFACE WATER GULLY	PROPOSED ABANDONMENT
EXISTING SURFACE WATER RISING MAIN	PROPOSED SURFACE WATER RISING MAIN
EXISTING SURFACE WATER OUTFALL	PROPOSED SURFACE WATER MANHOLE
WATERCOURSE	PROPOSED SURFACE WATER PIPELINE
SITE DEVELOPMENT BOUNDARY	PROPOSED GULLY (INDICATIVE)
OPERATIONAL BUILDINGS	PROPOSED HEADWALL
GENERAL BUILDINGS	PROPOSED ATTENUATION TANK

NOTES:

1. THIS GENERAL ARRANGEMENT SHOULD BE READ ALONGSIDE OTHER PLANS AND DOCUMENTS IN THE DEVELOPMENT CONSENT ORDER APPLICATION.
2. DO NOT SCALE FROM THIS DRAWING.
3. ALL DIMENSIONS IN METERS UNLESS NOTED OTHERWISE.
4. ALL LEVELS TO ORDNANCE DATUM UNLESS NOTED OTHERWISE.
5. EXISTING FOUL AND SURFACE WATER DRAINAGE INFORMATION EXTRACTED FROM RECORDS HELD BY ABP.

Rev	Rev. Date	Purpose of revision	Drawn	Checkd	Rev'd	Apprv'd
P02	2023-02-10	CONCEPT DESIGN - UPDATED SITE LAYOUT	HHS	TCW	DRK	GP
P01	2022-08-17	CONCEPT DESIGN	AJM	TCW	DRK	GP
0	2019-07-19	FIRST ISSUE	AJM	---	---	----

\\uksfpp02\Maritime\PROJECTS\Ports(VT)\B2429400 ABP Project Sugar\1100 Design & Engineering\1102 Drawings\01 Preliminary\01 Concept Design 2019\2022 Update - Drainage\B2357300 - 01 - 05 - 04 Foul Water GA - South.dwg - 10/02/2023 11:03:30 - Layout1 - HEATHEHJ

JACOBS

Client: ASSOCIATED BRITISH PORTS

Project: PROJECT SUGAR CONCEPT DESIGN

Drawing title: FOUL WATER DRAINAGE GENERAL ARRANGEMENT SOUTHERN YARD

Drawing status: CONCEPT DESIGN

Suitability: S3

Scale: 1:1250 A1 — DO NOT SCALE

Jacobs No.: B2357300 - 01

Client no.:

Rev: P02

Drawing number: B2357300 - 01 - 05 - 04

NOTES:

1. THIS GENERAL ARRANGEMENT SHOULD BE READ ALONGSIDE OTHER PLANS AND DOCUMENTS IN THE DEVELOPMENT CONSENT ORDER APPLICATION.
2. CATCHMENT INFORMATION CAN BE FOUND IN THE DRAINAGE STRATEGY.
3. DO NOT SCALE FROM THIS DRAWING.
4. ALL DIMENSIONS IN METERS UNLESS NOTED OTHERWISE.
5. ALL LEVELS TO ORDNANCE DATUM UNLESS NOTED OTHERWISE.
6. EXISTING FOUL AND SURFACE WATER DRAINAGE INFORMATION EXTRACTED FROM RECORDS HELD BY ABP.

Rev	Rev. Date	Purpose of revision	Drawn	Checkd	Rev'd	Appr'd
P01	2022-08-17	CONCEPT DESIGN	AJM	TCW	DRK	GP

JACOBS

Client

ASSOCIATED BRITISH PORTS

Project

PROJECT SUGAR
CONCEPT DESIGN

Drawing title

SURFACE WATER EXISTING DRAINAGE GENERAL ARRANGEMENT NORTHERN YARD

Drawing status: CONCEPT DESIGN

Suitability: S3

Scale: 1:1250 A1

DO NOT SCALE

Jacobs No.: B2357300 - 01

Rev: P01

Client no.

Drawing number: B2357300 - 01 - 05 - 11

LEGEND:

- EXISTING CESS PITS / PACKAGE TREATMENT PLANTS
- EXISTING FOUL WATER MANHOLE
- EXISTING FOUL WATER PIPELINE
- EXISTING FOUL WATER RISING MAIN
- EXISTING SURFACE WATER MANHOLE
- EXISTING SURFACE WATER PIPELINE
- EXISTING SURFACE WATER GULLY
- EXISTING SURFACE WATER RISING MAIN
- EXISTING SURFACE WATER OUTFALL
- WATERCOURSE
- SITE DEVELOPMENT BOUNDARY
- CONTRIBUTING AREA DETERIORATED ASPHALT SURFACE
- CONTRIBUTING AREA IMPERMEABLE SURFACE
- CONTRIBUTING AREA COMPACTED HARDCORE SURFACE
- DN225 PIPE DIAMETER FROM RECORDS
- DN225 PIPE DIAMETER ASSUMED
- INDICATIVE LIMIT OF SUB-CATCHMENTS

NOTES:

1. THIS GENERAL ARRANGEMENT SHOULD BE READ ALONGSIDE OTHER PLANS AND DOCUMENTS IN THE DEVELOPMENT CONSENT ORDER APPLICATION.
2. CATCHMENT INFORMATION CAN BE FOUND IN THE DRAINAGE STRATEGY.
3. DO NOT SCALE FROM THIS DRAWING.
4. ALL DIMENSIONS IN METERS UNLESS NOTED OTHERWISE.
5. ALL LEVELS TO ORDNANCE DATUM UNLESS NOTED OTHERWISE.
6. EXISTING FOUL AND SURFACE WATER DRAINAGE INFORMATION EXTRACTED FROM RECORDS HELD BY ABP.

Rev	Rev. Date	Purpose of revision	Drawn	Checkd	Rev'd	Apprv'd
P01	2022-08-17	CONCEPT DESIGN	AJM	TCW	DRK	GP

JACOBS

Client

ASSOCIATED BRITISH PORTS

Project

PROJECT SUGAR
CONCEPT DESIGN

Drawing title

SURFACE WATER EXISTING DRAINAGE GENERAL ARRANGEMENT SOUTHERN YARD

Drawing status: CONCEPT DESIGN

Suitability: S3

Scale: 1:1250 A1 — DO NOT SCALE

Jacobs No.: B2357300 - 01

Client no.:

Rev: P01

Drawing number: B2357300 - 01 - 05 - 12

\\ukfsfp02\Maritime\PROJECTS\Ports(VT)\B2429400 ABP Project Suga\1100 Design & Engineering\1102 Drawings\01 Preliminary\01 Concept Design 2019\2022 Update - Drainage\B2357300 - 01 - 05 - 12 Existing Surface Water GA - South.dwg - 17/08/2022 09:30:11 - Layout1 - MidwinterAJ

NOTES:

1. THIS GENERAL ARRANGEMENT SHOULD BE READ ALONGSIDE OTHER PLANS AND DOCUMENTS IN THE DEVELOPMENT CONSENT ORDER APPLICATION.
2. CATCHMENT INFORMATION CAN BE FOUND IN THE DRAINAGE STRATEGY.
3. DO NOT SCALE FROM THIS DRAWING.
4. ALL DIMENSIONS IN METERS UNLESS NOTED OTHERWISE.
5. ALL LEVELS TO ORDNANCE DATUM UNLESS NOTED OTHERWISE.
6. EXISTING FOUL AND SURFACE WATER DRAINAGE INFORMATION EXTRACTED FROM RECORDS HELD BY ABP.

Rev	Rev. Date	Purpose of revision	Drawn	Checkd	Rev'd	Apprv'd
P01	2022-08-17	CONCEPT DESIGN	AJM	TCW	DRK	GP

JACOBS

Client

ABP ASSOCIATED BRITISH PORTS

Project

PROJECT SUGAR
CONCEPT DESIGN

Drawing title

SURFACE WATER EXISTING DRAINAGE GENERAL ARRANGEMENT WESTERN YARD

Drawing status	CONCEPT DESIGN
Suitability	S3
Scale	1:1250 A1
	DO NOT SCALE
Jacobs No.	B2357300 - 01
Client no.	
Rev	P01
Drawing number	B2357300 - 01 - 05 - 19

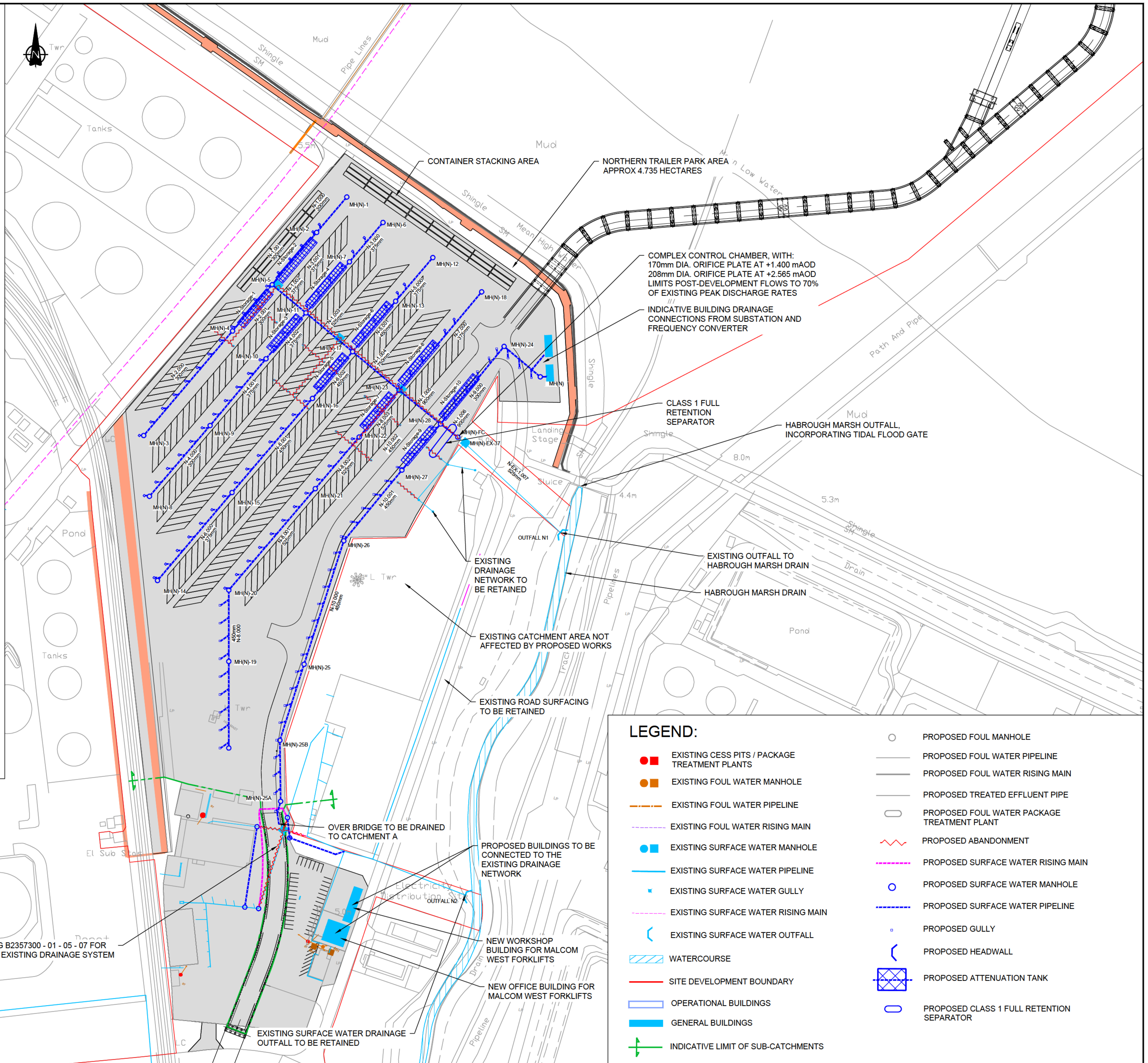
\\ukfsp02\Maritime\PROJECTS\Ports(VT)\B2429400 ABP Project Sugar\1100 Design & Engineering\1102 Drawings\01 Preliminary\01 Concept Design 2019\2022 Update - Drainage\B2357300 - 01 - 05 - 19 Existing Surface Water GA - West.dwg - 17/08/2022 10:19:50 - Layout1 - Midwinter/AJ

PIPE SCHEDULE

PIPE NO.	DIA. (mm)	GRADIENT (1 in X)	UPSTREAM			DOWNSTREAM		
			USCL (mAOD)	USIL (mAOD)	US COVER DEPTH (m)	DSCL (mAOD)	DSIL (mAOD)	DS COVER DEPTH (m)
1.000	300	167	5.000	3.500	1.200	5.000	3.307	1.393
1.001	300	95	5.000	3.307	1.393	5.000	2.967	1.733
2.000	300	167	5.000	3.575	1.125	5.000	3.092	1.608
2.001	300	242	5.000	3.092	1.608	5.000	2.967	1.733
1.002	375	321	5.000	2.892	1.733	5.000	2.815	1.810
3.000	375	167	5.000	3.425	1.200	5.000	3.226	1.399
3.001	375	53	5.000	3.151	1.474	5.000	2.525	2.100
4.000	300	164	5.000	3.500	1.200	5.000	3.181	1.519
4.001	375	242	5.000	3.106	1.519	5.000	2.889	1.736
4.002	375	83	5.000	2.889	1.736	5.000	2.525	2.100
1.003	450	225	5.000	2.300	2.250	5.000	2.150	2.400
5.000	375	167	5.000	3.425	1.200	5.000	3.218	1.407
5.001	450	41	5.000	3.068	1.482	5.000	2.225	2.325
6.000	375	145	5.000	3.425	1.200	5.000	2.980	1.645
6.001	450	321	5.000	2.905	1.645	5.000	2.676	1.874
6.002	450	58	5.000	2.676	1.874	5.000	2.150	2.400
1.004	750	387	5.000	1.850	2.400	5.000	1.761	2.489
7.000	375	60	5.000	3.209	1.416	5.000	2.300	2.325
8.000	450	167	5.000	3.350	1.200	5.000	3.093	1.457
8.001	525	241	5.000	3.018	1.457	5.000	2.718	1.757
8.002	525	169	5.000	2.718	1.757	5.000	2.468	2.007
8.003	525	95	5.000	2.468	2.007	5.000	2.150	2.325
1.005	900	499	5.000	1.611	2.489	5.000	1.554	2.546
9.000	300	26	5.000	3.385	1.315	5.000	2.000	2.700
10.000	450	164	5.000	3.350	1.200	5.000	2.908	1.642
10.001	450	200	5.000	2.908	1.642	5.000	2.629	1.921
10.002	450	39	5.000	2.629	1.921	5.000	1.850	2.700
1.006	900	TO SUIT	5.000	1.400	2.700	4.000	1.360	1.740
EX-1.007	525	Existing	4.000	1.086	2.389	5.000	0.879	3.596

STORAGE SCHEDULE

Reference	Base Level (mAOD)	Plan Area (m2)	Storage Depth (m)	Effective Volume (m3)	Depth of Cover (m)
N-Storage-1	3.200	125	0.300	36	1.500
N-Storage-2	3.200	150	0.300	43	1.500
N-Storage-3	2.600	125	0.900	107	1.500
N-Storage-4	2.600	150	0.900	128	1.500
N-Storage-5	2.100	125	1.200	143	1.700
N-Storage-6	2.100	150	1.200	171	1.700
N-Storage-7	2.000	125	1.200	143	1.800
N-Storage-8	2.000	150	1.200	171	1.800
N-Storage-9	1.800	125	1.500	178	1.700
N-Storage-10	1.800	150	1.500	214	1.700



LEGEND:

- EXISTING CESS PITS / PACKAGE TREATMENT PLANTS
- EXISTING FOUL WATER MANHOLE
- EXISTING FOUL WATER PIPELINE
- EXISTING FOUL WATER RISING MAIN
- EXISTING SURFACE WATER MANHOLE
- EXISTING SURFACE WATER PIPELINE
- EXISTING SURFACE WATER GULLY
- EXISTING SURFACE WATER RISING MAIN
- EXISTING SURFACE WATER OUTFALL
- WATERCOURSE
- SITE DEVELOPMENT BOUNDARY
- OPERATIONAL BUILDINGS
- GENERAL BUILDINGS
- INDICATIVE LIMIT OF SUB-CATCHMENTS
- PROPOSED FOUL MANHOLE
- PROPOSED FOUL WATER PIPELINE
- PROPOSED FOUL WATER RISING MAIN
- PROPOSED TREATED EFFLUENT PIPE
- PROPOSED FOUL WATER PACKAGE TREATMENT PLANT
- PROPOSED ABANDONMENT
- PROPOSED SURFACE WATER RISING MAIN
- PROPOSED SURFACE WATER MANHOLE
- PROPOSED SURFACE WATER PIPELINE
- PROPOSED GULLY
- PROPOSED HEADWALL
- PROPOSED ATTENUATION TANK
- PROPOSED CLASS 1 FULL RETENTION SEPARATOR

NOTES:

1. THIS GENERAL ARRANGEMENT SHOULD BE READ ALONGSIDE OTHER PLANS AND DOCUMENTS IN THE DEVELOPMENT CONSENT ORDER APPLICATION.
2. DO NOT SCALE FROM THIS DRAWING.
3. ALL DIMENSIONS IN METERS UNLESS NOTED OTHERWISE.
4. ALL LEVELS TO ORDNANCE DATUM UNLESS NOTED OTHERWISE.
5. EXISTING FOUL AND SURFACE WATER DRAINAGE INFORMATION EXTRACTED FROM RECORDS HELD BY ABP.
6. ALL PAVED AREAS TO BE DRAINED VIA TRAPPED GULLIES; THE ARRANGEMENT IS INDICATIVE.
7. THE SURFACE WATER RUNOFF FROM AREAS OF HARDSTANDING SUBJECT TO VEHICULAR MOVEMENTS SHALL BE TREATED VIA A CLASS 1 FULL RETENTION SEPARATOR.
8. THE TRAILER PARKING AREAS SHALL BE GRADED TO ENSURE THE SURFACE WATER RUNOFF IS DIRECTED TO DRAINAGE CHANNELS.

Rev	Rev. Date	Purpose of revision	Drawn	Checkd	Rev'd	Apprv'd
P01	2022-08-17	CONCEPT DESIGN	AJM	TCW	DRK	GP
0	2019-07-19	FIRST ISSUE	AJM	----	----	----

JACOBS

Client

ABP ASSOCIATED BRITISH PORTS

Project

PROJECT SUGAR
CONCEPT DESIGN

Drawing title

SURFACE WATER DRAINAGE
GENERAL ARRANGEMENT
NORTHERN YARD

Drawing status: CONCEPT DESIGN

Suitability: S3

Scale: 1:1250 A1 — DO NOT SCALE

Jacobs No.: B2357300 - 01

Rev: P01

Client no.

Drawing number: B2357300 - 01 - 05 - 01

\\ukstp002\Maritime\PROJECTS\Ports(VT)\B2429400 ABP Project Sugar\1100 Design & Engineering\1102 Drawings\01 Preliminary\01 Concept Design 2019\2022 Update - Drainage\B2357300 - 01 - 05 - 01 Surface Water GA - North.dwg - 17/08/2022 14:55:28 - Layout1 - MidwinterAJ

NOTES:
1. THIS GENERAL ARRANGEMENT SHOULD BE READ ALONGSIDE OTHER PLANS AND DOCUMENTS IN THE DEVELOPMENT CONSENT ORDER APPLICATION.
2. DO NOT SCALE FROM THIS DRAWING.
3. ALL DIMENSIONS IN METERS UNLESS NOTED OTHERWISE.
4. ALL LEVELS TO ORDNANCE DATUM UNLESS NOTED OTHERWISE.
5. EXISTING FOUL AND SURFACE WATER DRAINAGE INFORMATION EXTRACTED FROM RECORDS HELD BY ABP.
6. ALL PAVED AREAS TO BE DRAINED VIA TRAPPED GULLIES; THE ARRANGEMENT IS INDICATIVE.
7. THE SURFACE WATER RUNOFF FROM AREAS OF HARDSTANDING SUBJECT TO VEHICULAR MOVEMENTS SHALL BE TREATED VIA A CLASS 1 FULL RETENTION SEPARATOR.
8. THE TRAILER PARKING AREAS SHALL BE GRADED TO ENSURE THE SURFACE WATER RUNOFF IS DIRECTED TO DRAINAGE CHANNELS.
9. REFER TO DRAWING B2357300 - 01 - 05 - 10 FOR THE PROPOSED SURFACE WATER DRAINAGE NETWORK PIPE SCHEDULE.

Rev	Rev. Date	Purpose of revision	Drawn	Checkd	Rev'd	Apprv'd
P02	2023-02-10	CONCEPT DESIGN - UPDATED SITE LAYOUT	HHS	TCW	DRK	GP
P01	2022-08-17	CONCEPT DESIGN	AJM	TCW	DRK	GP
0	2019-07-19	FIRST ISSUE	AJM	---	---	---

JACOBS

Client
ABP ASSOCIATED BRITISH PORTS

Project
PROJECT SUGAR
CONCEPT DESIGN

Drawing title
SURFACE WATER DRAINAGE
GENERAL ARRANGEMENT
SOUTHERN YARD

Drawing status	CONCEPT DESIGN	Suitability S3
Scale	1:1250 A1	DO NOT SCALE
Jacobs No.	B2357300 - 01	Rev P02
Client no.		
Drawing number	B2357300 - 01 - 05 - 02	

\\ukstfp02\Maritime\PROJECTS\Ports(VT)\B2429400 ABP Project Sugar\1100 Design & Engineering\1102 Drawings\01 Preliminary\01 Concept Design 2019\2022 Update - Drainage\B2357300 - 01 - 05 - 02 Surface Water GA - South.dwg - 10/02/2023 11:18:35 - Layout1 - HEATHEHJ

PIPE SCHEDULE

PIPE NO.	DIA. (mm)	GRADIENT (1 in X)	UPSTREAM			DOWNSTREAM		
			USCL (mAOD)	USIL (mAOD)	US COVER DEPTH (m)	DSCL (mAOD)	DSIL (mAOD)	DS Cover Depth (m)
1.000	375	321	4.770	3.195	1.200	4.770	3.001	1.394
1.001	450	500	4.770	2.926	1.394	4.770	2.802	1.518
1.002	525	502	4.770	2.727	1.518	4.770	2.603	1.642
1.003	525	500	4.770	2.603	1.642	4.770	2.465	1.780
1.004	600	492	4.770	2.390	1.780	4.770	2.239	1.931
1.005	600	506	4.770	2.239	1.931	4.770	2.108	2.062
1.006	600	501	4.770	2.108	2.062	4.770	1.973	2.197
1.007	675	502	4.770	1.898	2.197	4.770	1.762	2.333
1.008	675	500	4.770	1.762	2.333	4.770	1.580	2.515
2.000	300	231	4.760	3.260	1.200	4.760	2.821	1.639
2.001	300	200	4.760	2.821	1.639	4.770	2.650	1.820
1.009	750	547	4.770	1.505	2.515	4.770	1.304	2.716
3.000	375	200	4.730	3.155	1.200	4.730	2.807	1.548
3.001	525	501	4.730	2.657	1.548	4.730	2.518	1.687
3.002	600	278	4.730	2.442	1.688	4.730	2.191	1.939
4.000	375	300	5.300	3.725	1.200	5.000	3.398	1.227
4.001	375	300	5.000	3.398	1.227	5.000	3.298	1.327
4.002	450	300	5.000	3.223	1.327	4.730	2.901	1.379
4.003	600	116	4.730	2.751	1.379	4.730	2.191	1.939
3.003	750	247	4.730	2.041	1.939	4.790	1.893	2.147
5.000	375	335	5.950	3.290	2.285	5.500	3.095	2.030
5.001	450	444	5.500	3.020	2.030	4.790	2.874	1.466
5.002	450	500	4.790	2.874	1.466	4.790	2.743	1.597
5.003	600	220	4.790	2.593	1.597	4.790	2.297	1.893
6.000	300	335	4.790	3.290	1.200	4.790	3.084	1.406
6.001	375	444	4.790	3.009	1.406	4.790	2.854	1.561
6.002	450	500	4.790	2.779	1.561	4.790	2.641	1.699
6.003	600	154	4.790	2.491	1.699	4.790	2.043	2.147
3.004	900	300	4.790	1.743	2.147	4.970	1.685	2.385
3.005	900	502	4.970	1.685	2.385	4.970	1.555	2.515
3.006	900	502	4.970	1.550	2.520	4.970	1.420	2.650
3.007	900	381	4.970	1.420	2.650	4.770	1.369	2.501
7.000	300	231	4.760	3.260	1.200	5.350	3.163	1.887
7.001	300	230	5.350	3.163	1.887	5.100	3.078	1.722
7.002	300	204	5.100	3.078	1.722	5.400	2.853	2.247
7.003	375	235	5.400	2.778	2.247	5.700	2.553	2.772
7.004	450	337	5.700	2.478	2.772	6.500	2.320	3.730
7.005	450	311	6.500	2.320	3.730	5.950	2.111	3.389
7.006	450	311	5.950	2.111	3.389	4.770	1.902	2.418
1.010	1200	502	4.770	0.854	2.716	4.760	0.792	2.768
1.011	450	503	4.760	0.792	3.518	5.000	0.742	3.808

STORAGE SCHEDULE

REFERENCE	BASE LEVEL (mAOD)	PLAN AREA (m2)	STORAGE DEPTH (m)	EFFECTIVE VOLUME (m3)	DEPTH OF COVER (m)
W-Storage-1	2.000	1285	1.200	1465	1.560
W-Storage-2	2.000	1280	1.200	1459	1.560
W-Storage-3	3.000	200	0.300	57	1.470

LEGEND:

- EXISTING FOUL WATER MANHOLE
- EXISTING FOUL WATER PIPELINE
- EXISTING FOUL WATER RISING MAIN
- EXISTING SURFACE WATER MANHOLE
- EXISTING SURFACE WATER PIPELINE
- EXISTING SURFACE WATER GULLY
- EXISTING SURFACE WATER RISING MAIN
- EXISTING SURFACE WATER OUTFALL
- WATERCOURSE
- SITE DEVELOPMENT BOUNDARY
- OPERATIONAL BUILDINGS
- GENERAL BUILDINGS
- PROPOSED FOUL MANHOLE
- PROPOSED FOUL WATER PIPELINE
- PROPOSED FOUL WATER RISING MAIN
- PROPOSED TREATED EFFLUENT PIPE
- PROPOSED FOUL WATER PACKAGE TREATMENT PLANT
- PROPOSED ABANDONMENT
- PROPOSED SURFACE WATER RISING MAIN
- PROPOSED SURFACE WATER MANHOLE
- PROPOSED SURFACE WATER PIPELINE
- PROPOSED GULLY
- PROPOSED HEADWALL
- PROPOSED ATTENUATION TANK
- PROPOSED CLASS 1 FULL RETENTION SEPARATOR

NOTES:

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Rev	Rev. Date	Purpose of revision	Drawn	Checkd	Rev'd	Apprv'd
P01	2022-08-17	CONCEPT DESIGN	AJM	TCW	DRK	GP

JACOBS

Client: ABP ASSOCIATED BRITISH PORTS

Project: PROJECT SUGAR CONCEPT DESIGN

Drawing title: SURFACE WATER DRAINAGE GENERAL ARRANGEMENT WESTERN YARD

Drawing status: CONCEPT DESIGN

Suitability: S3

Scale: 1:1250 @ A1 — DO NOT SCALE

Jacobs No.: B2357300 - 01

Rev: P01

Client no.:

Drawing number: B2357300 - 01 - 05 - 09

PIPE No.	DIA. (mm)	GRADIENT (1 IN X)	UPSTREAM			DOWNSTREAM		
			USCL (mAOD)	USIL (mAOD)	US COVER DEPTH (m)	DSCL (mAOD)	DSIL (mAOD)	DS COVER DEPTH (m)
1.000	300	379	4.740	3.240	1.200	4.740	3.148	1.292
1.001	375	343	4.740	3 073	1.292	4.740	2.975	1.390
1.002	600	434	4.740	2.750	1.390	4.830	2.602	1.628
2.000	300	213	4.830	3.330	1.200	4.830	3.047	1.483
2.001	375	273	4.830	2 972	1.483	4.830	2.752	1.703
1.003	600	499	4.830	2.602	1.628	4.830	2.520	1.710
3.000	300	301	4.830	3.330	1.200	4.830	3.207	1.323
3.001	450	500	4.830	3 057	1.323	4.830	2.946	1.434
3.002	525	500	4.830	2 871	1.434	4.830	2.760	1.545
1.004	750	500	4.830	2.370	1.710	5.000	2.320	1.930
4.000	300	301	4.830	3.330	1.200	4.830	3.211	1.319
4.001	450	500	4.830	3 061	1.319	4.830	2.954	1.426
4.002	525	502	4.830	2.879	1.426	4.830	2.772	1.533
4.003	525	295	4.830	2.772	1.533	4.915	2.700	1.691
5.000	300	250	4.400	3.100	1.000	4.700	3.037	1.363
5.001	300	250	4.700	3 037	1.363	4.915	2.976	1.639
4.004	525	204	4.915	2.700	1.690	5.000	2.628	1.848
1.005	750	504	5 000	2.320	1.930	4.830	2.252	1.828
6.000	225	261	4.930	3 505	1.200	4.930	3.351	1.354
7.000	225	183	4.930	3 505	1.200	4.930	3.351	1.354
6.001	225	188	4.930	3 351	1.354	4.820	3.240	1.355
8.000	225	260	4.820	3 395	1.200	4.820	3.240	1.355
9.000	225	173	4.820	3 395	1.200	4.820	3.240	1.355
6.002	300	95	4.820	3.165	1.355	4.970	3.079	1.591
6.003	375	500	4.970	3.004	1.591	4.985	2.943	1.667
6.004	375	500	4.985	2 943	1.667	5.000	2.876	1.749
10 000	225	200	4.970	3 545	1.200	5.000	3.448	1.327
6.005	375	500	5 000	2.876	1.749	5.000	2.742	1.883
6.006	375	500	5 000	2.742	1.883	4.580	2.617	1.588
11 000	375	397	4.450	2 875	1.200	4.450	2.715	1.360
11.001	450	369	4.450	2.640	1.360	4.450	2.502	1.498
12 000	300	262	4.450	2.950	1.200	4.450	2.783	1.367
12.001	375	329	4.450	2.708	1.367	4.450	2.577	1.498
11.002	525	252	4.450	2.427	1.498	4.580	2.286	1.769
13 000	375	219	4.550	2 975	1.200	4.580	2.675	1.530
13.001	375	298	4.580	2.675	1.530	4.580	2.605	1.600
13.002	450	300	4.580	2.530	1.600	4.580	2.363	1.767
14 000	225	261	4.580	3.155	1.200	4.580	2.988	1.367
14.001	300	376	4.580	2 913	1.367	4.580	2.797	1.483
11.003	675	503	4.580	2.136	1.769	4.580	2.069	1.836
15 000	225	261	4.580	3.155	1.200	4.580	2.988	1.367
15.001	300	376	4.580	2 913	1.367	4.580	2.797	1.483
16 000	300	371	4.580	2.947	1.333	4.580	2.781	1.499
11 004	825	495	4.580	1.919	1.836	4.750	1.883	2.042
11.005	825	499	4.750	1.883	2.042	4.750	1.708	2.217
11 006	825	500	4.750	1.708	2.217	4.650	1.589	2.236
17 000	225	200	4.580	2.600	1.755	4.580	2.272	2.083
18 000	225	200	4.580	3.155	1.200	4.580	3.106	1.249
17.001	225	200	4.580	2 272	2.083	4.650	2.228	2.197
11.007	825	504	4.650	1.589	2.236	4.615	1.530	2.260
19 000	225	261	4.580	3.155	1.200	4.580	3.062	1.293
19.001	300	261	4.580	2.987	1.293	4.580	2.820	1.460
19.002	300	379	4.580	2.820	1.460	4.580	2.705	1.575
20.000	225	194	4.580	3.155	1.200	4.580	3.012	1.343
20.001	300	266	4.580	2.937	1.343	4.580	2.797	1.483
19.003	300	178	4.580	2.705	1.575	4.580	2.512	1.768
21.000	525	313	4.550	2.745	1.280	4.680	2.636	1.519
21.001	525	103	4.680	2.636	1.519	4.580	2.287	1.768
19 004	600	500	4.580	2 212	1.768	4.580	2.080	1.900
19.005	750	500	4.580	1.930	1.900	4.580	1.798	2.032
19 006	750	351	4.580	1.798	2.032	4.750	1.714	2.286
22.000	300	300	4.550	3.050	1.200	4.550	2.925	1.325
22.001	375	350	4.550	2.850	1.325	4.550	2.749	1.426
22.002	450	504	4.550	2.674	1.426	4.550	2.613	1.488
23.000	375	301	4.550	2 975	1.200	4.550	2.805	1.370
23.001	375	300	4.550	2 805	1.370	4.550	2.665	1.510
23.002	450	500	4.550	2.590	1.510	4.550	2.477	1.623
22.003	450	500	4.550	2.477	1.623	4.565	2.397	1.718
22.004	525	499	4.565	2 322	1.718	4.580	2.246	1.809
22.005	525	501	4.580	2.246	1.809	4.580	2.128	1.927
22.006	600	501	4.580	2 053	1.927	4.580	1.935	2.045
24.000	225	200	4.550	3.125	1.200	4.550	2.949	1.376
24.001	300	275	4.550	2.874	1.376	4.700	2.664	1.736
24.002	375	502	4.700	2.589	1.736	4.580	2.445	1.760
25.000	300	250	4.400	3.100	1.000	4.580	2.963	1.317
22.007	675	500	4.580	1.860	2.045	4.750	1.810	2.265
19.007	750	500	4.750	1.714	2.286	4.615	1.634	2.231
11 008	450	496	4.615	1.530	2.635	4.580	1.470	2.660
EX-6 007	525	407	4.580	1.471	2.584	4.830	1.395	2.910
6.008	525	499	4.830	1.395	2.910	4.830	1.255	3.050
6.009	525	413	4.830	1.255	3.050	4.830	1.215	3.091
6.010	525	400	4.830	1.215	3.09	4.830	1.152	3.153
1.006	900	501	4.830	0.799	3.131	4.830	0.697	3.233
1.007	900	499	4.830	0.697	3.233	4.740	0.575	3.265
27.000	300	200	4.830	3.330	1.200	4.830	3.102	1.428
27.001	300	150	4.830	3.102	1.428	4.740	3.025	1.415
EX-1 008	525	300	4.740	0 575	3.640	3.000	0.408	2.067

PIPE SCHEDULE - SOUTH EAST

STORAGE SCHEDULE - SOUTH EAST

REFERENCE	BASE LEVEL (mAOD)	PLAN AREA (m2)	STORAGE DEPTH (m)	EFFECTIVE VOLUME (m3)	DEPTH OF COVER (m)
SE-Storage-1	1.53	2500	1.5	3563	1.585
SE-Storage-2	3	500	0.3	143	1.67
SE-Storage-3	0.575	1250	1.8	2138	2.365

STORAGE SCHEDULE - SOUTH WEST

REFERENCE	BASE LEVEL (mAOD)	PLAN AREA (m2)	STORAGE DEPTH (m)	EFFECTIVE VOLUME (m3)	DEPTH OF COVER (m)
SW-Storage-1	2.666	500	0.9	428	1.334
SW-Storage-2	2.421	700	0.9	599	1.579

PIPE SCHEDULE - SOUTH WEST

PIPE No.	DIA. (mm)	GRADIENT (1 IN X)	UPSTREAM			DOWNSTREAM		
			USCL (mAOD)	USIL (mAOD)	US COVER DEPTH (m)	DSCL (mAOD)	DSIL (mAOD)	DS COVER DEPTH (m)
EX-1.002	600	321	5.240	2.505	2.135	5.240	2.392	2.248
2.000	300	250	4.900	3.603	0.997	4.900	3.404	1.196
3.000	300	251	4.750	3.550	0.900	4.750	3.461	0.989
3.001	300	250	4.750	3.461	0.989	4.900	3.289	1.311
3.002	300	251	4.900	3.289	1.311	4.900	3.179	1.421
3.003	300	251	4.900	3.179	1.421	4.900	3.122	1.478
2.001	300	250	4.900	3.122	1.478	4.900	2.95	1.650
4.000	300	249	4.900	3.700	0.900	4.900	3.56	1.040
2.002	450	352	4.900	2.800	1.650	4.900	2.666	1.784
5.000	225	209	4.750	3.625	0.900	4.900	3.376	1.299
6.000	225	209	4.900	3.775	0.900	4.900	3.644	1.031
5.001	300	280	4.900	3.301	1.299	4.900	3.098	1.502
7.000	300	157	4.900	3.700	0.900	4.900	3.53	1.070
2.003	525	518	4.900	2.666	1.709	5.240	2.64	2.075
8.000	225	209	4.750	3.625	0.900	4.900	3.319	1.356
9.000	300	209	4.900	3.700	0.900	4.900	3.489	1.111
8.001	300	296	4.900	3.244	1.356	4.900	3.051	1.549
10.000	300	250	4.700	3.352	1.048	4.900	3.073	1.527
11.000	300	250	4.750	3.511	0.939	4.750	3.284	1.166
11.001	300	251	4.750	3.284	1.166	4.750	3.2	1.250
11.002	450	404	4.750	3.050	1.250	4.750	3.003	1.297
11.003	450	402	4.750	3.003	1.297	4.900	2.923	1.527
12.000	225	170	4.900	3.475	1.200	4.900	3.241	1.434
10.001	525	494	4.900	2.848	1.527	4.900	2.821	1.554
13.000	225	170	4.900	3.475	1.200	4.900	3.345	1.330
10.002	525	498	4.900	2.821	1.554	4.900	2.747	1.628
14.000	300	209	4.900	3.700	0.900	4.900	3.575	1.025
15.000	225	209	4.900	3.775	0.900	4.900	3.715	0.960
10.003	525	500	4.900	2.747	1.628	4.900	2.642	1.733
16.000	225	209	4.700	3.575	0.900	4.700	3.264	1.211
17.000	225	88	4.700	3.575	0.900	4.700	3.264	1.211
16.001	225	129	4.700	3.264	1.211	4.900	2.942	1.733
10.004	600	500	4.900	2.567	1.733	4.900	2.516	1.784
8.002	600	459	4.900	2.421	1.879	5.240	2.392	2.248
EX-1.003	600	315	5.240	2.392	2.248	5.240	2.26	2.380

NOTES:

1. DRAWING TO BE READ IN CONJUNCTION WITH DRAWING B2357300 - 01 - 05 - 02.

Rev	Rev. Date	Purpose of revision	Drawn	Checkd	Rev'd	Apprv'd
P02	2023-02-10	CONCEPT DESIGN - UPDATED SITE LAYOUT	HHS	TCW	DRK	GP
P01	2022-08-17	CONCEPT DESIGN	AJM	TCW	DRK	GP

JACOBS

Client

ASSOCIATED BRITISH PORTS

Project

PROJECT SUGAR
CONCEPT DESIGN

Drawing title

SURFACE WATER DRAINAGE
SCHEDULES
SOUTHERN YARD

Drawing status: CONCEPT DESIGN

Suitability: S3

Scale: 1:1250 A1 — DO NOT SCALE

Jacobs No.: B2357300 - 01

Rev: P02

Client no.

Drawing number

B2357300 - 01 - 05 - 10

Appendix B. Calculations

B1 Combined Effluent Pumping Station Capacity Assessment

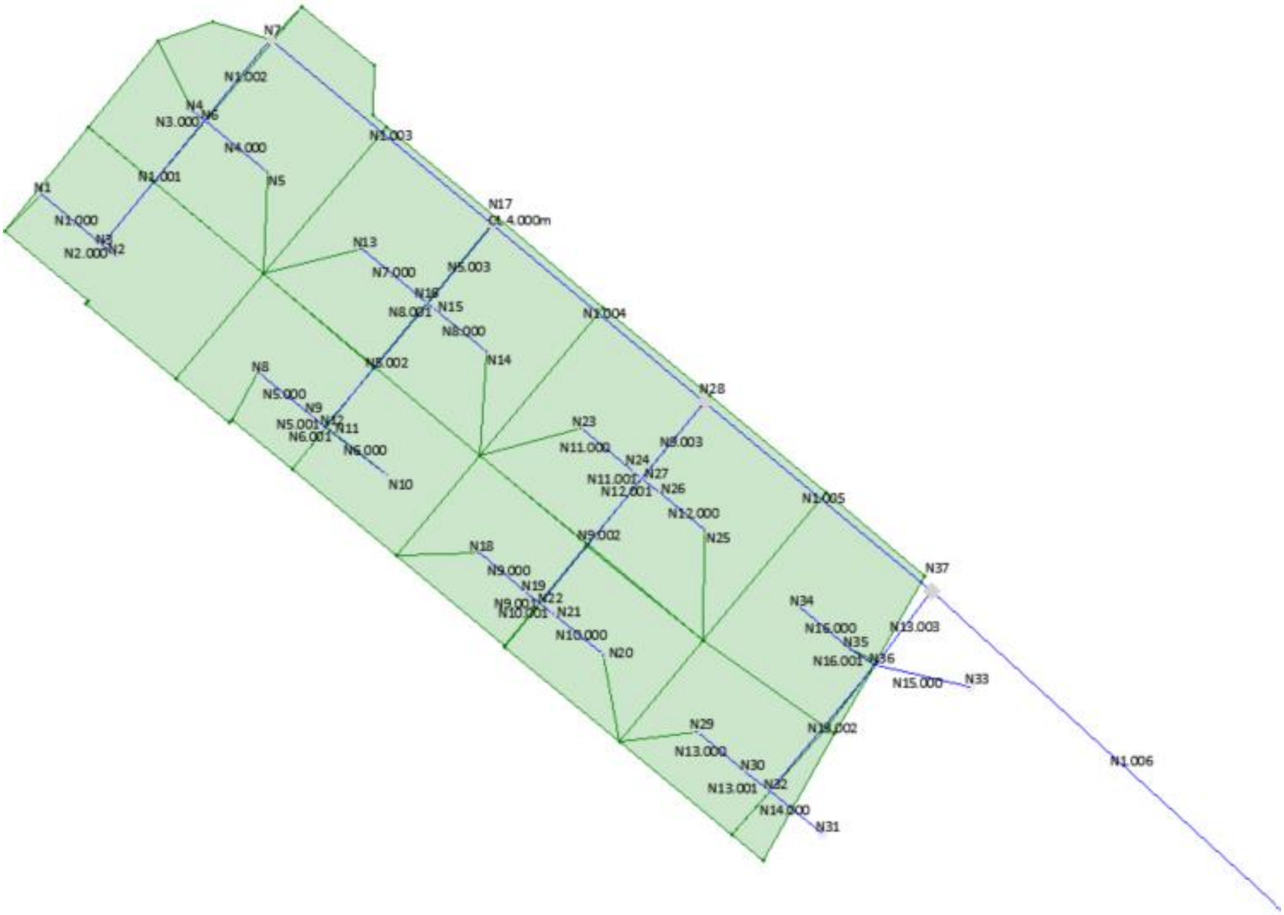
450mm diameter incoming gravity pipework

600mm diameter incoming gravity pipework

MicroDrainage Model Outputs

B2 Northern Yard: Existing

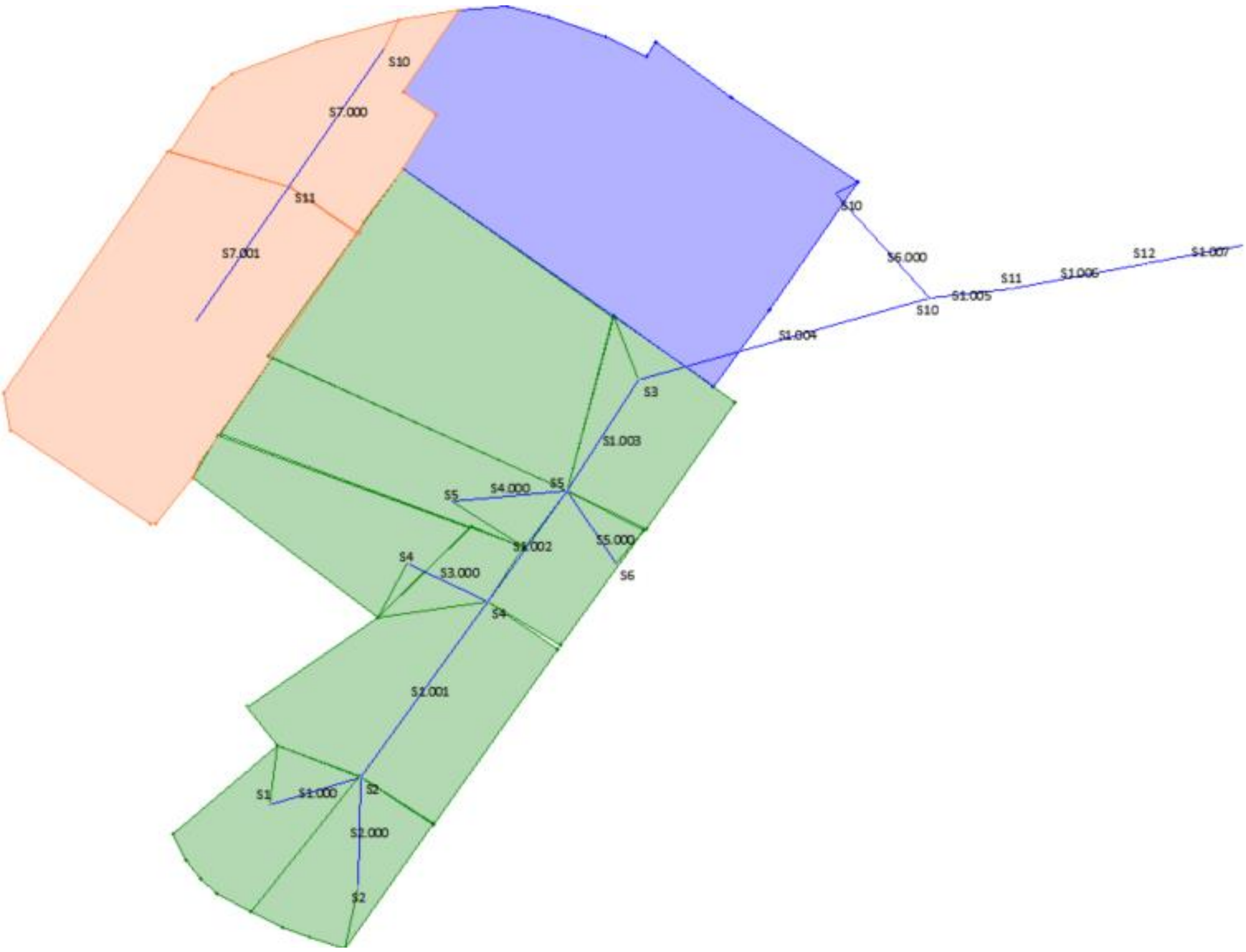
Network Schematic



Output Simulation Files

B3 Southern Yard: Existing

Network Schematic



Output Simulation Files: Gravity (Catchments S-B and S-C)

Output Simulation Files: Pumped (Catchment S-A)

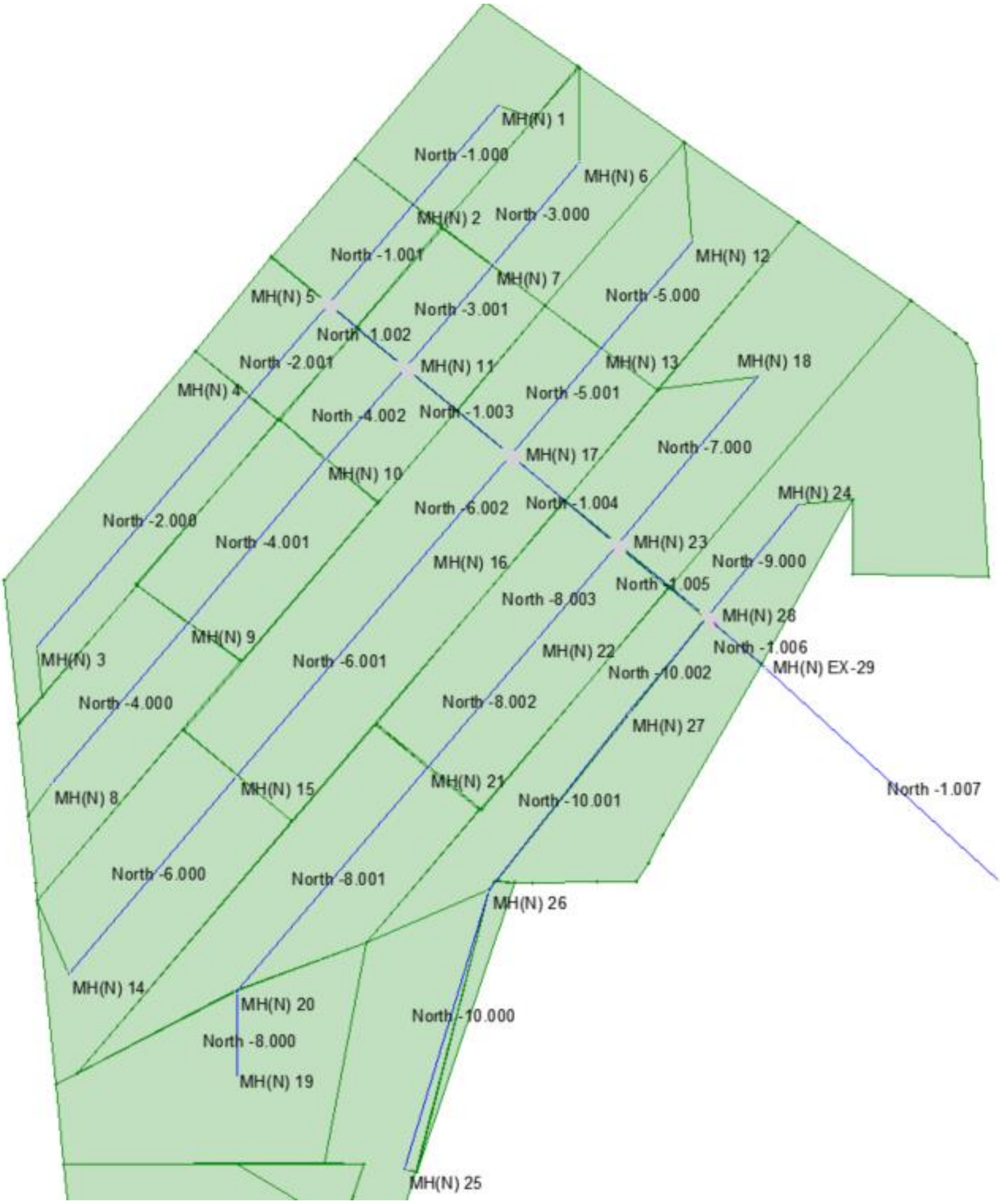
B4 Western Yard: Existing

Network Schematic

Output Simulation Files

B5 Northern Yard: Proposed

Network Schematic



Output Simulation Files

Sensitivity Testing: Surcharged Outfall at +1.9 mAOD

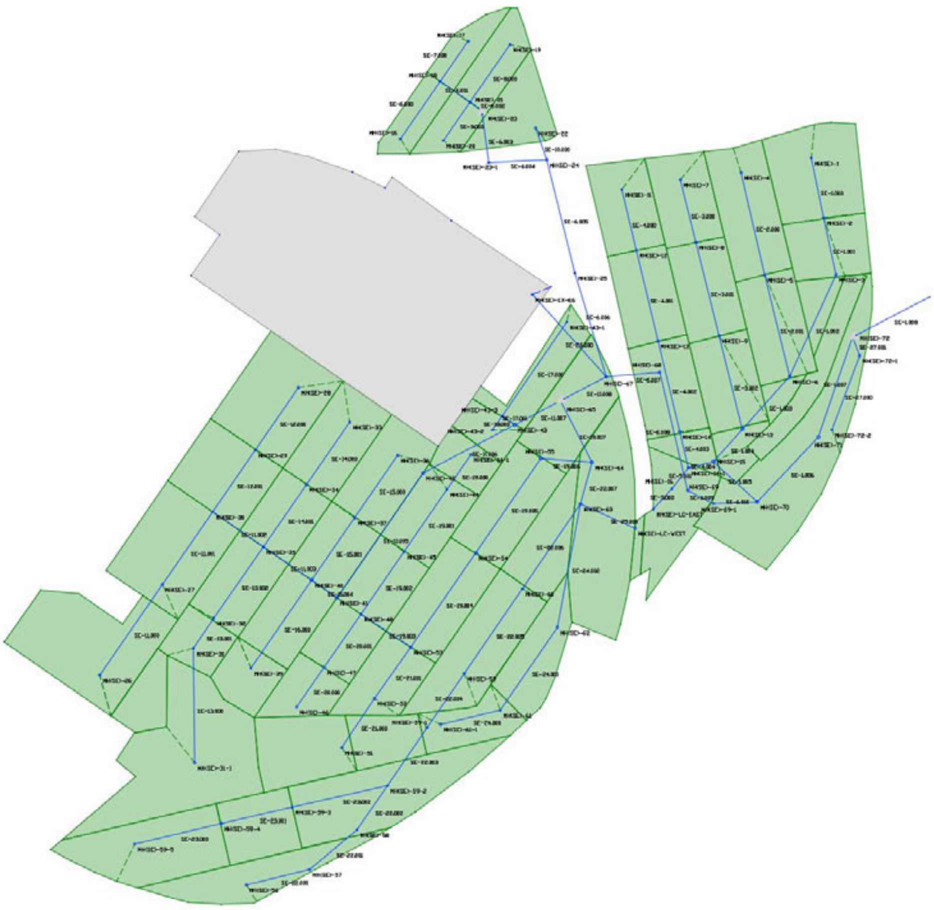
Sensitivity Testing: Surcharged Outfall at +3.7 mAOD

B6 Southern Yard: Proposed

Network Schematic: Pumped Catchment (S-A)

Output Simulation Files

Network Schematic: Pumped Catchment (S-B&C)



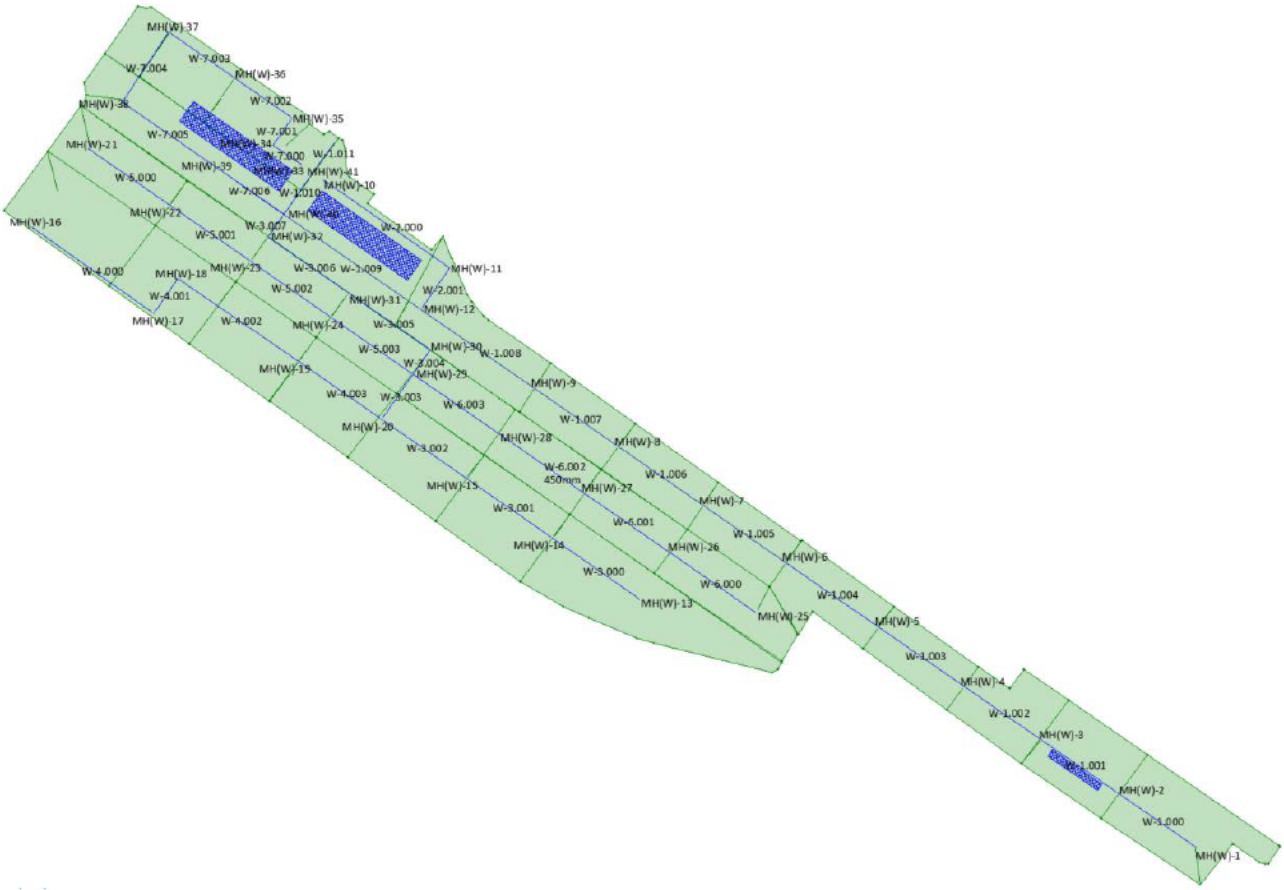
Output Simulation Files

Sensitivity Testing: Surcharged Outfall at +1.9 mAOD

Sensitivity Testing: Surcharged Outfall at +3.7 mAOD

B7 Western Yard: Proposed

Network Schematic



Output Simulation Files

JACOBS — **Calculation title sheet**

Project title:	**Immingham Eastern Ro-Ro Terminal**	**Project code:**	**B2429300**
Calculation title:	**Combined Effluent Pumping Station Capacity Assessment**	**Serial no:**	
Project manager:	**Claire Nicolson**	**No. of sheets:**	**1**

Status:				**Created by:**	**HHS**
Schematic		Preliminary		**Date:**	**5-Aug-22**
Tender		Other (state)	**Concept Design**	**Verified by:**	**TCW**
Final for Construction				**Date:**	**5-Aug-22**

Levels of verification:

1	Self-check and approval	☐	3B	Comparison with similar proven designs and approval	☐
2	Review and approval	☑	4	External check and internal approval	☐
3	Detailed check and approval	☐	5	Other verification as stated in the Management Plan	☐
3A	Alternative calculations and approval	☐		**Numerical Check**	

Approved by:	**DRK**
Date:	**17-Aug-22**
Computer analysis:	
Yes: ☐	No: ☑
Program(s):	
Hardware:	

Contents (continue on calculation sheet if necessary)

NB: Calculations should state or refer to design input data and methodology

CONTENTS AMENDMENT RECORD

Sheet(s)	Rev.	Date	Description	Created	Verified	Approved

File Name: Southern Catchment 450 Pipe Flow.xlsx

Path: \\uksfpp02\Water\we\Urban Water Market Sectors\Urban Water UK\Projects\ABP Nordic\Working Folder\Drainage Strategy\MicroDrainage

JACOBS **Calculation sheet**

Calculation title:	Combined Effluent Pumping Station Capacity Assessment	Created by:	HHS	Project code:	B2429300
		Date:	05/08/2022	Serial no:	
Subject:	450mm diameter incoming gravity pipework	Verified by:	TCW	Sheet no:	1
		Date:	05/08/2022	Revision:	P01

References/Results

This calculation sheet uses the Colebrook - White formula to calculate pipe flows for full and partially full pipes assuming that there are no affects of downstream controls

Colebrook-White Formula -

$$V = -2\sqrt{(2gDS)}Log\left(\frac{K_s}{3.70} + \frac{2.51v}{D\sqrt{(2gDS)}}\right)$$

V = Velocity (m/s)
g = Gravitational acceleration (9.81m/s²)
D = Pipe Diameter (mm)
S = Hydraulic Gradient
Ks = Effective pipe roughness (0.6 for surface sewers and 1.5 for foul sewers typically)
v = Kinematic Viscosity of fluid

Data inputs -

Pipe Diameter	450	mm
Gradient	523	
Pipe Roughness	0.6	

Gradient from existing drainage record invert levels around pipework

Results -

Percent Depth	Depth of flow (mm)	Proportional Depth	Hydraulic Radius	Velocity (m/s)	Flow (l/s)	Pipe full Velocity (m/s)	Pipe Full Capacity (l/s)
5%	23	0.05	0.014966	0.2433	0.7473	0.8943	142.2323
10%	45	0.1	0.028584	0.373	3.0874	0.8943	142.2323
15%	68	0.15	0.04208	0.4793	7.2473	0.8943	142.2323
20%	90	0.2	0.054266	0.5643	12.7782	0.8943	142.2323
25%	113	0.25	0.066233	0.6406	20.0432	0.8943	142.2323
30%	135	0.3	0.076923	0.7044	28.2669	0.8943	142.2323
35%	158	0.35	0.087288	0.7629	38.0102	0.8943	142.2323
40%	180	0.4	0.096402	0.8121	48.2447	0.8943	142.2323
45%	203	0.45	0.105067	0.8572	59.6931	0.8943	142.2323
50%	225	0.5	0.1125	0.8947	71.1479	0.8943	142.2323
55%	248	0.55	0.119337	0.9284	83.42	0.8943	142.2323
60%	270	0.6	0.12494	0.9554	95.192	0.8943	142.2323
65%	293	0.65	0.129759	0.9782	107.2588	0.8943	142.2323
70%	315	0.7	0.133306	0.9948	118.2957	0.8943	142.2323
75%	338	0.75	0.135799	1.0064	128.9649	0.8943	142.2323
80%	360	0.8	0.136887	1.0114	137.9538	0.8943	142.2323
85%	383	0.85	0.136441	1.0093	145.5854	0.8943	142.2323
90%	405	0.9	0.134117	0.9986	150.5548	0.8943	142.2323
95%	428	0.95	0.128739	0.9734	152.0136	0.8943	142.2323
100%	450	1	0.1125	0.8947	142.2959	0.8943	142.2323

JACOBS — **Calculation title sheet**

Project title:	**Immingham Eastern Ro-Ro Terminal**	**Project code:**	**B2429400**
Calculation title:	**Combined Effluent Pumping Station Capacity Assessment**	**Serial no:**	
Project manager:	**Claire Nicolson**	**No. of sheets:**	**1**
Status:		**Created by:**	**HHS**
Schematic	Preliminary	**Date:**	**5-Aug-22**
Tender	Other (state): **Concept Design**	**Verified by:**	**TCW**
Final for Construction		**Date:**	**5-Aug-22**

Levels of verification:

1	Self-check and approval	☐	3B	Comparison with similar proven designs and approval	☐
2	Review and approval	☑	4	External check and internal approval	☐
3	Detailed check and approval	☐	5	Other verification as stated in the Management Plan	☐
3A	Alternative calculations and approval	☐		**Numerical Check**	

Approved by:	**DRK**	
Date:	**17-Aug-22**	
Computer analysis:		
Yes: ☐	No: ☑	
Program(s):		
Hardware:		

Contents (continue on calculation sheet if necessary)

NB: Calculations should state or refer to design input data and methodology

CONTENTS AMENDMENT RECORD

Sheet(s)	Rev.	Date	Description	Created	Verified	Approved

File Name: Southern Catchment 600 Pipe Flow.xlsx
Path: \\uksfpp02\Water\we\Urban Water Market Sectors\Urban Water UK\Projects\ABP Nordic\Working Folder\Drainage Strategy\MicroDrainage

JACOBS Calculation sheet

Calculation title:	Combined Effluent Pumping Station Capacity Assessment	Created by:	HHS	Project code:	B2429300
		Date:	05/08/2022	Serial no:	
Subject:	600mm diameter incoming gravity pipework	Verified by:	TCW	Sheet no:	1
		Date:	05/08/2022	Revision:	P01

References/Results

This calculation sheet uses the Colebrook - White formula to calculate pipe flows for full and partially full pipes assuming that there are no affects of downstream controls

Colebrook-White Formula -

$$V = -2\sqrt{(2gDS)}Log\left(\frac{K_s}{3.70} + \frac{2.51v}{D\sqrt{(2gDS)}}\right)$$

V = Velocity (m/s)
g = Gravitational acceleration (9.81m/s²)
D = Pipe Diameter (mm)
S = Hydraulic Gradient
K_s = Effective pipe roughness (0.6 for surface sewers and 1.5 for foul sewers typically)
v = Kinematic Viscosity of fluid

Data inputs -

Pipe Diameter	600	mm
Gradient	523	
Pipe Roughness	0.6	

Results -

Percent Depth	Depth of flow (mm)	Proportional Depth	Hydraulic Radius	Velocity (m/s)	Flow (l/s)	Pipe full Velocity (m/s)	Pipe Full Capacity (l/s)
5%	30	0.05	0.019531	0.2904	1.5349	1.0701	302.5636
10%	60	0.1	0.038112	0.4497	6.6174	1.0701	302.5636
15%	90	0.15	0.055727	0.5739	15.2628	1.0701	302.5636
20%	120	0.2	0.072355	0.6776	27.2779	1.0701	302.5636
25%	150	0.25	0.087975	0.7667	42.3806	1.0701	302.5636
30%	180	0.3	0.102565	0.8443	60.2329	1.0701	302.5636
35%	210	0.35	0.116095	0.9125	80.4761	1.0701	302.5636
40%	240	0.4	0.128536	0.9724	102.6982	1.0701	302.5636
45%	270	0.45	0.139851	1.025	126.4868	1.0701	302.5636
50%	300	0.5	0.15	1.0706	151.3525	1.0701	302.5636
55%	330	0.55	0.158932	1.1098	176.8373	1.0701	302.5636
60%	360	0.6	0.166587	1.1427	202.4067	1.0701	302.5636
65%	390	0.65	0.172889	1.1693	227.4877	1.0701	302.5636
70%	420	0.7	0.177741	1.1895	251.4635	1.0701	302.5636
75%	450	0.75	0.181012	1.203	273.6424	1.0701	302.5636
80%	480	0.8	0.182516	1.2092	293.215	1.0701	302.5636
85%	510	0.85	0.18196	1.2069	309.1456	1.0701	302.5636
90%	540	0.9	0.178822	1.194	320.0257	1.0701	302.5636
95%	570	0.95	0.171871	1.165	323.2386	1.0701	302.5636
100%	600	1	0.15	1.0706	302.705	1.0701	302.5636

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Northern

Pipe Sizes STANDARD Manhole Sizes ECC

FSR Rainfall Model - England and Wales

Return Period (years)	5	PIMP (%)	100
M5-60 (mm)	17.000	Add Flow / Climate Change (%)	0
Ratio R	0.400	Minimum Backdrop Height (m)	0.200
Maximum Rainfall (mm/hr)	50	Maximum Backdrop Height (m)	1.500
Maximum Time of Concentration (mins)	30	Min Design Depth for Optimisation (m)	1.200
Foul Sewage (l/s/ha)	0.000	Min Vel for Auto Design only (m/s)	1.00
Volumetric Runoff Coeff.	0.750	Min Slope for Optimisation (1:X)	500

Designed with Level Soffits

Simulation Criteria for Northern

Volumetric Runoff Coeff	0.750	Additional Flow - % of Total Flow	0.000
Areal Reduction Factor	1.000	MADD Factor * 10m³/ha Storage	2.000
Hot Start (mins)	0	Inlet Coeffiecient	0.800
Hot Start Level (mm)	0	Flow per Person per Day (l/per/day)	0.000
Manhole Headloss Coeff (Global)	0.500	Run Time (mins)	60
Foul Sewage per hectare (l/s)	0.000	Output Interval (mins)	1

Number of Input Hydrographs	0	Number of Storage Structures	0
Number of Online Controls	0	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Profile Type	Summer
Return Period (years)	30	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	17.000	Storm Duration (mins)	30
Ratio R	0.400		

1 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Northern

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs	0	Number of Storage Structures	0
Number of Online Controls	0	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Ratio R	0.400
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	17.000	Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	300.0	DVD Status	OFF
Analysis Timestep	Fine	Inertia Status	OFF
DTS Status	ON		

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years)	1, 30, 100
Climate Change (%)	0, 0, 0

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
N1.000	N1	15 Winter	1	+0%					2.645
N2.000	N2	15 Summer	1	+0%					2.575
N1.001	N3	15 Winter	1	+0%					2.508
N3.000	N4	15 Winter	1	+0%	100/15 Summer				2.236
N4.000	N5	15 Winter	1	+0%	30/15 Summer				2.268
N1.002	N6	15 Winter	1	+0%					2.230
N1.003	N7	15 Winter	1	+0%					2.050
N5.000	N8	15 Winter	1	+0%					2.639
N5.001	N9	15 Winter	1	+0%					2.586
N6.000	N10	15 Winter	1	+0%					2.636
N6.001	N11	15 Winter	1	+0%					2.580
N5.002	N12	15 Winter	1	+0%					2.576
N7.000	N13	15 Winter	1	+0%					2.351
N8.000	N14	15 Winter	1	+0%	30/15 Summer				2.122
N8.001	N15	15 Winter	1	+0%	30/15 Summer				2.091
N5.003	N16	15 Winter	1	+0%	30/15 Summer				2.088
N1.004	N17	15 Winter	1	+0%	100/15 Summer				1.814
N9.000	N18	15 Winter	1	+0%					2.637

1 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Northern

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
N1.000	N1	-0.155	0.000	0.21			9.3	OK	
N2.000	N2	-0.225	0.000	0.00			0.0	OK	
N1.001	N3	-0.165	0.000	0.16			9.3	OK*	
N3.000	N4	-0.174	0.000	0.11			4.3	OK	
N4.000	N5	-0.142	0.000	0.27			9.4	OK	
N1.002	N6	-0.102	0.000	0.57			23.0	OK*	
N1.003	N7	-0.182	0.000	0.32			22.4	OK	
N5.000	N8	-0.161	0.000	0.18			6.0	OK	
N5.001	N9	-0.150	0.000	0.22			5.9	OK	
N6.000	N10	-0.164	0.000	0.16			5.4	OK	
N6.001	N11	-0.155	0.000	0.18			5.4	OK	
N5.002	N12	-0.140	0.000	0.31			11.3	OK	
N7.000	N13	-0.149	0.000	0.24			8.5	OK	
N8.000	N14	-0.148	0.000	0.24			8.0	OK	
N8.001	N15	-0.116	0.000	0.27			7.9	OK	
N5.003	N16	-0.110	0.000	0.52			27.5	OK*	
N1.004	N17	-0.211	0.000	0.39			48.5	OK	
N9.000	N18	-0.163	0.000	0.17			5.6	OK	

1 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Northern

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
N9.001	N19	15 Winter	1	+0%					2.584
N10.000	N20	15 Winter	1	+0%					2.639
N10.001	N21	15 Winter	1	+0%					2.586
N9.002	N22	15 Winter	1	+0%					2.577
N11.000	N23	15 Winter	1	+0%	100/15 Summer				2.250
N11.001	N24	15 Winter	1	+0%	100/15 Summer				2.168
N12.000	N25	15 Winter	1	+0%	100/15 Summer				2.254
N12.001	N26	15 Winter	1	+0%	100/15 Summer				2.173
N9.003	N27	15 Winter	1	+0%	30/15 Summer				2.081
N1.005	N28	15 Winter	1	+0%	100/15 Winter				1.563
N13.000	N29	15 Winter	1	+0%					2.640
N13.001	N30	15 Winter	1	+0%					2.584
N14.000	N31	15 Winter	1	+0%					2.265
N13.002	N32	15 Winter	1	+0%					2.266
N15.000	N33	15 Summer	1	+0%					2.605
N16.000	N34	15 Winter	1	+0%					2.158
N16.001	N35	15 Winter	1	+0%	100/15 Summer				2.164
N13.003	N36	15 Winter	1	+0%	100/15 Summer				2.139
N1.006	N37	15 Winter	1	+0%					1.309

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
N9.001	N19	-0.155	0.000	0.20			5.5	OK	
N10.000	N20	-0.161	0.000	0.18			5.9	OK	
N10.001	N21	-0.152	0.000	0.22			5.9	OK	
N9.002	N22	-0.143	0.000	0.29			11.5	OK*	
N11.000	N23	-0.150	0.000	0.24			8.1	OK	
N11.001	N24	-0.169	0.000	0.14			8.1	OK	
N12.000	N25	-0.146	0.000	0.26			8.8	OK	
N12.001	N26	-0.167	0.000	0.15			8.8	OK	
N9.003	N27	-0.084	0.000	0.71			28.5	OK*	
N1.005	N28	-0.255	0.000	0.38			73.7	OK	
N13.000	N29	-0.160	0.000	0.18			6.1	OK	
N13.001	N30	-0.154	0.000	0.21			6.2	OK	
N14.000	N31	-0.225	0.000	0.00			0.0	OK	
N13.002	N32	-0.159	0.000	0.19			7.0	OK	
N15.000	N33	-0.225	0.000	0.00			0.0	OK	
N16.000	N34	-0.222	0.000	0.00			0.0	OK	
N16.001	N35	-0.154	0.000	0.22			7.0	OK	
N13.003	N36	-0.127	0.000	0.39			13.8	OK	
N1.006	N37	-0.302	0.000	0.36			82.9	OK	

30 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Northern

Simulation Criteria

Areal Reduction Factor 1.000 Additional Flow - % of Total Flow 0.000
Hot Start (mins) 0 MADD Factor * 10m³/ha Storage 2.000
Hot Start Level (mm) 0 Inlet Coeffiecient 0.800
Manhole Headloss Coeff (Global) 0.500 Flow per Person per Day (l/per/day) 0.000
Foul Sewage per hectare (l/s) 0.000

Number of Input Hydrographs 0 Number of Storage Structures 0
Number of Online Controls 0 Number of Time/Area Diagrams 0
Number of Offline Controls 0 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FSR Ratio R 0.400
Region England and Wales Cv (Summer) 0.750
M5-60 (mm) 17.000 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0 DVD Status OFF
Analysis Timestep Fine Inertia Status OFF
DTS Status ON

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years) 1, 30, 100
Climate Change (%) 0, 0, 0

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
N1.000	N1	15 Winter	30	+0%					2.690
N2.000	N2	15 Summer	30	+0%					2.575
N1.001	N3	15 Winter	30	+0%					2.545
N3.000	N4	15 Winter	30	+0%	100/15 Summer				2.406
N4.000	N5	15 Winter	30	+0%	30/15 Summer				2.439
N1.002	N6	15 Summer	30	+0%					2.332
N1.003	N7	15 Winter	30	+0%					2.131
N5.000	N8	15 Winter	30	+0%					2.679
N5.001	N9	15 Winter	30	+0%					2.644
N6.000	N10	15 Winter	30	+0%					2.675
N6.001	N11	15 Winter	30	+0%					2.641
N5.002	N12	15 Winter	30	+0%					2.636
N7.000	N13	15 Winter	30	+0%					2.402
N8.000	N14	15 Winter	30	+0%	30/15 Summer				2.309
N8.001	N15	15 Winter	30	+0%	30/15 Summer				2.283
N5.003	N16	15 Winter	30	+0%	30/15 Summer				2.275
N1.004	N17	15 Winter	30	+0%	100/15 Summer				1.934
N9.000	N18	15 Winter	30	+0%					2.676

30 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Northern

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
N1.000	N1	-0.110	0.000	0.51			22.8	OK	
N2.000	N2	-0.225	0.000	0.00			0.0	OK	
N1.001	N3	-0.128	0.000	0.38			22.6	OK*	
N3.000	N4	-0.004	0.000	0.25			9.8	OK	
N4.000	N5	0.029	0.000	0.63			22.0	SURCHARGED	
N1.002	N6	0.000	0.000	1.27			50.7	SURCHARGED*	
N1.003	N7	-0.101	0.000	0.75			51.9	OK	
N5.000	N8	-0.121	0.000	0.43			14.6	OK	
N5.001	N9	-0.092	0.000	0.54			14.3	OK	
N6.000	N10	-0.125	0.000	0.39			13.3	OK	
N6.001	N11	-0.094	0.000	0.44			13.1	OK	
N5.002	N12	-0.080	0.000	0.74			27.4	OK	
N7.000	N13	-0.098	0.000	0.60			20.7	OK	
N8.000	N14	0.039	0.000	0.54			18.2	SURCHARGED	
N8.001	N15	0.076	0.000	0.62			18.5	SURCHARGED	
N5.003	N16	0.077	0.000	1.21			64.3	SURCHARGED*	
N1.004	N17	-0.091	0.000	0.91			113.7	OK	
N9.000	N18	-0.124	0.000	0.41			13.7	OK	

30 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Northern

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
N9.001	N19	15 Winter	30	+0%					2.640
N10.000	N20	15 Winter	30	+0%					2.680
N10.001	N21	15 Winter	30	+0%					2.641
N9.002	N22	15 Winter	30	+0%					2.634
N11.000	N23	15 Winter	30	+0%	100/15 Summer				2.347
N11.001	N24	15 Winter	30	+0%	100/15 Summer				2.321
N12.000	N25	15 Winter	30	+0%	100/15 Summer				2.351
N12.001	N26	15 Winter	30	+0%	100/15 Summer				2.323
N9.003	N27	15 Winter	30	+0%	30/15 Summer				2.312
N1.005	N28	15 Winter	30	+0%	100/15 Winter				1.703
N13.000	N29	15 Winter	30	+0%					2.682
N13.001	N30	15 Winter	30	+0%					2.630
N14.000	N31	15 Winter	30	+0%					2.303
N13.002	N32	15 Winter	30	+0%					2.309
N15.000	N33	15 Summer	30	+0%					2.605
N16.000	N34	15 Winter	30	+0%					2.250
N16.001	N35	15 Winter	30	+0%	100/15 Summer				2.250
N13.003	N36	15 Winter	30	+0%	100/15 Summer				2.236
N1.006	N37	15 Winter	30	+0%					1.466

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
N9.001	N19	-0.099	0.000	0.48			13.5	OK	
N10.000	N20	-0.120	0.000	0.44			14.6	OK	
N10.001	N21	-0.097	0.000	0.53			14.4	OK	
N9.002	N22	-0.086	0.000	0.70			27.9	OK*	
N11.000	N23	-0.053	0.000	0.56			18.9	OK	
N11.001	N24	-0.016	0.000	0.30			17.8	OK	
N12.000	N25	-0.049	0.000	0.62			20.8	OK	
N12.001	N26	-0.017	0.000	0.33			19.3	OK	
N9.003	N27	0.147	0.000	1.62			64.8	SURCHARGED*	
N1.005	N28	-0.115	0.000	0.89			171.5	OK	
N13.000	N29	-0.118	0.000	0.45			15.1	OK	
N13.001	N30	-0.108	0.000	0.52			15.1	OK	
N14.000	N31	-0.187	0.000	0.01			0.2	OK	
N13.002	N32	-0.116	0.000	0.47			17.4	OK	
N15.000	N33	-0.225	0.000	0.00			0.0	OK	
N16.000	N34	-0.130	0.000	0.02			0.6	OK	
N16.001	N35	-0.068	0.000	0.63			20.1	OK	
N13.003	N36	-0.030	0.000	1.00			35.2	OK	
N1.006	N37	-0.145	0.000	0.83			192.5	OK	

100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Northern

Simulation Criteria

Areal Reduction Factor 1.000 Additional Flow - % of Total Flow 0.000
Hot Start (mins) 0 MADD Factor * 10m³/ha Storage 2.000
Hot Start Level (mm) 0 Inlet Coeffiecient 0.800
Manhole Headloss Coeff (Global) 0.500 Flow per Person per Day (l/per/day) 0.000
Foul Sewage per hectare (l/s) 0.000

Number of Input Hydrographs 0 Number of Storage Structures 0
Number of Online Controls 0 Number of Time/Area Diagrams 0
Number of Offline Controls 0 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FSR Ratio R 0.400
Region England and Wales Cv (Summer) 0.750
M5-60 (mm) 17.000 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0 DVD Status OFF
Analysis Timestep Fine Inertia Status OFF
DTS Status ON

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years) 1, 30, 100
Climate Change (%) 0, 0, 0

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
N1.000	N1	15 Winter	100	+0%					2.710
N2.000	N2	15 Winter	100	+0%					2.576
N1.001	N3	15 Winter	100	+0%					2.586
N3.000	N4	15 Winter	100	+0%	100/15 Summer				2.519
N4.000	N5	15 Winter	100	+0%	30/15 Summer				2.566
N1.002	N6	15 Summer	100	+0%					2.332
N1.003	N7	15 Winter	100	+0%					2.229
N5.000	N8	15 Winter	100	+0%					2.703
N5.001	N9	15 Winter	100	+0%					2.674
N6.000	N10	15 Winter	100	+0%					2.698
N6.001	N11	15 Winter	100	+0%					2.670
N5.002	N12	15 Winter	100	+0%					2.664
N7.000	N13	15 Winter	100	+0%					2.460
N8.000	N14	15 Winter	100	+0%	30/15 Summer				2.461
N8.001	N15	15 Winter	100	+0%	30/15 Summer				2.428
N5.003	N16	15 Winter	100	+0%	30/15 Summer				2.416
N1.004	N17	15 Winter	100	+0%	100/15 Summer				2.067
N9.000	N18	15 Winter	100	+0%					2.697

100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Northern

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
N1.000	N1	-0.090	0.000	0.66			29.4	OK	
N2.000	N2	-0.224	0.000	0.00			0.0	OK	
N1.001	N3	-0.087	0.000	0.48			28.5	OK*	
N3.000	N4	0.109	0.000	0.32			12.6	SURCHARGED	
N4.000	N5	0.156	0.000	0.82			28.4	SURCHARGED	
N1.002	N6	0.000	0.000	1.63			65.2	SURCHARGED*	
N1.003	N7	-0.003	0.000	0.92			63.5	OK	
N5.000	N8	-0.097	0.000	0.55			18.7	OK	
N5.001	N9	-0.062	0.000	0.69			18.4	OK	
N6.000	N10	-0.102	0.000	0.50			17.0	OK	
N6.001	N11	-0.065	0.000	0.57			16.8	OK	
N5.002	N12	-0.052	0.000	0.94			34.8	OK	
N7.000	N13	-0.040	0.000	0.76			26.6	OK	
N8.000	N14	0.191	0.000	0.69			23.3	SURCHARGED	
N8.001	N15	0.221	0.000	0.76			22.6	SURCHARGED	
N5.003	N16	0.218	0.000	1.49			79.7	SURCHARGED*	
N1.004	N17	0.042	0.000	1.07			133.0	SURCHARGED	
N9.000	N18	-0.103	0.000	0.52			17.5	OK	

100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Northern

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
N9.001	N19	15 Winter	100	+0%					2.669
N10.000	N20	15 Winter	100	+0%					2.701
N10.001	N21	15 Winter	100	+0%					2.670
N9.002	N22	15 Winter	100	+0%					2.660
N11.000	N23	15 Winter	100	+0%	100/15 Summer				2.499
N11.001	N24	15 Winter	100	+0%	100/15 Summer				2.466
N12.000	N25	15 Winter	100	+0%	100/15 Summer				2.506
N12.001	N26	15 Winter	100	+0%	100/15 Summer				2.470
N9.003	N27	15 Winter	100	+0%	30/15 Summer				2.453
N1.005	N28	15 Winter	100	+0%	100/15 Winter				1.829
N13.000	N29	15 Winter	100	+0%					2.699
N13.001	N30	15 Winter	100	+0%					2.650
N14.000	N31	15 Winter	100	+0%					2.364
N13.002	N32	15 Winter	100	+0%					2.364
N15.000	N33	15 Summer	100	+0%					2.605
N16.000	N34	15 Winter	100	+0%					2.329
N16.001	N35	15 Winter	100	+0%	100/15 Summer				2.329
N13.003	N36	15 Winter	100	+0%	100/15 Summer				2.310
N1.006	N37	15 Winter	100	+0%					1.531

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
N9.001	N19	-0.070	0.000	0.62			17.2	OK	
N10.000	N20	-0.099	0.000	0.56			18.7	OK	
N10.001	N21	-0.068	0.000	0.68			18.4	OK	
N9.002	N22	-0.060	0.000	0.89			35.5	OK*	
N11.000	N23	0.099	0.000	0.68			22.9	SURCHARGED	
N11.001	N24	0.129	0.000	0.37			21.9	SURCHARGED	
N12.000	N25	0.106	0.000	0.75			25.0	SURCHARGED	
N12.001	N26	0.130	0.000	0.41			24.0	SURCHARGED	
N9.003	N27	0.288	0.000	2.04			81.4	SURCHARGED*	
N1.005	N28	0.011	0.000	1.06			203.2	SURCHARGED	
N13.000	N29	-0.101	0.000	0.58			19.5	OK	
N13.001	N30	-0.088	0.000	0.67			19.4	OK	
N14.000	N31	-0.126	0.000	0.02			0.7	OK	
N13.002	N32	-0.061	0.000	0.58			21.7	OK	
N15.000	N33	-0.225	0.000	0.00			0.0	OK	
N16.000	N34	-0.051	0.000	0.03			1.0	OK	
N16.001	N35	0.011	0.000	0.76			24.4	SURCHARGED	
N13.003	N36	0.044	0.000	1.25			44.2	SURCHARGED	
N1.006	N37	-0.080	0.000	0.99			228.2	OK	

Simulation Criteria for Storm

Volumetric Runoff Coeff	0.750	Additional Flow - % of Total Flow	0.000
Areal Reduction Factor	1.000	MADD Factor * 10m³/ha Storage	2.000
Hot Start (mins)	0	Inlet Coeffiecient	0.800
Hot Start Level (mm)	0	Flow per Person per Day (l/per/day)	0.000
Manhole Headloss Coeff (Global)	0.500	Run Time (mins)	60
Foul Sewage per hectare (l/s)	0.000	Output Interval (mins)	1

Number of Input Hydrographs	0	Number of Storage Structures	0
Number of Online Controls	0	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Profile Type	Summer
Return Period (years)	30	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	17.000	Storm Duration (mins)	30
Ratio R	0.400		

1 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

Areal Reduction Factor 1.000 Additional Flow - % of Total Flow 0.000
Hot Start (mins) 0 MADD Factor * 10m³/ha Storage 2.000
Hot Start Level (mm) 0 Inlet Coeffiecient 0.800
Manhole Headloss Coeff (Global) 0.500 Flow per Person per Day (l/per/day) 0.000
Foul Sewage per hectare (l/s) 0.000

Number of Input Hydrographs 0 Number of Storage Structures 0
Number of Online Controls 0 Number of Time/Area Diagrams 0
Number of Offline Controls 0 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FSR Ratio R 0.400
Region England and Wales Cv (Summer) 0.750
M5-60 (mm) 17.000 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0 DVD Status OFF
Analysis Timestep Fine Inertia Status OFF
DTS Status ON

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years) 1, 30, 100
Climate Change (%) 0, 0, 0

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.
S1.000	S1	15 Winter	1	+0%	30/15 Summer	30/15 Summer		
S2.000	S2	15 Winter	1	+0%	30/15 Summer	30/15 Summer		
S1.001	S2	15 Winter	1	+0%	1/15 Summer	30/15 Summer		
S3.000	S4	15 Winter	1	+0%	30/15 Summer	30/15 Winter		
S1.002	S4	15 Winter	1	+0%	1/15 Summer			
S4.000	S5	15 Winter	1	+0%	100/15 Summer			
S5.000	S6	15 Winter	1	+0%				
S1.003	S5	15 Winter	1	+0%	30/15 Winter			
S1.004	S3	15 Winter	1	+0%	30/15 Winter			
S6.000	S10	15 Winter	1	+0%	1/15 Summer	1/15 Summer		
S1.005	S10	30 Winter	1	+0%	30/15 Summer			
S1.006	S11	30 Winter	1	+0%	30/15 Summer			
S1.007	S12	30 Winter	1	+0%	30/15 Summer			
S7.000	S10	15 Winter	1	+0%	100/15 Summer			
S7.001	S11	15 Winter	1	+0%	30/15 Summer			

1 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status
S1.000	S1	3.122	-0.153	0.000	0.22			11.0	OK
S2.000	S2	3.006	-0.019	0.000	0.34			9.8	OK
S1.001	S2	2.986	0.160	0.000	1.02			29.7	SURCHARGED
S3.000	S4	2.646	-0.129	0.000	0.29			15.0	OK
S1.002	S4	2.629	0.130	0.000	1.30			37.5	SURCHARGED
S4.000	S5	2.643	-0.132	0.000	0.36			18.5	OK
S5.000	S6	2.609	-0.166	0.000	0.15			8.4	OK
S1.003	S5	1.944	-0.275	0.000	0.44			86.7	OK
S1.004	S3	1.823	-0.275	0.000	0.40			83.3	OK
S6.000	S10	4.709	1.284	8.671	2.10			81.4	FLOOD
S1.005	S10	1.681	-0.144	0.000	0.84			155.6	OK
S1.006	S11	1.581	-0.169	0.000	0.79			153.9	OK
S1.007	S12	1.461	-0.166	0.000	0.80			152.8	OK
S7.000	S10	3.196	-0.254	0.000	0.36			54.4	OK
S7.001	S11	2.958	-0.305	0.000	0.47			147.9	OK

PN	US/MH Name	Level Exceeded
S1.000	S1	9
S2.000	S2	14
S1.001	S2	7
S3.000	S4	6
S1.002	S4	
S4.000	S5	
S5.000	S6	
S1.003	S5	
S1.004	S3	
S6.000	S10	33
S1.005	S10	
S1.006	S11	
S1.007	S12	
S7.000	S10	
S7.001	S11	

30 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs	0	Number of Storage Structures	0
Number of Online Controls	0	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Ratio R	0.400
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	17.000	Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	300.0	DVD Status	OFF
Analysis Timestep	Fine	Inertia Status	OFF
DTS Status	ON		

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years)	1, 30, 100
Climate Change (%)	0, 0, 0

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.
S1.000	S1	15 Winter	30	+0%	30/15 Summer	30/15 Summer		
S2.000	S2	15 Winter	30	+0%	30/15 Summer	30/15 Summer		
S1.001	S2	15 Winter	30	+0%	1/15 Summer	30/15 Summer		
S3.000	S4	15 Winter	30	+0%	30/15 Summer	30/15 Winter		
S1.002	S4	15 Winter	30	+0%	1/15 Summer			
S4.000	S5	15 Winter	30	+0%	100/15 Summer			
S5.000	S6	15 Winter	30	+0%				
S1.003	S5	15 Winter	30	+0%	30/15 Winter			
S1.004	S3	15 Winter	30	+0%	30/15 Winter			
S6.000	S10	30 Winter	30	+0%	1/15 Summer	1/15 Summer		
S1.005	S10	30 Winter	30	+0%	30/15 Summer			
S1.006	S11	30 Winter	30	+0%	30/15 Summer			
S1.007	S12	30 Winter	30	+0%	30/15 Summer			
S7.000	S10	15 Winter	30	+0%	100/15 Summer			
S7.001	S11	15 Winter	30	+0%	30/15 Summer			

30 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status
S1.000	S1	4.253	0.978	3.302	0.65			32.8	FLOOD
S2.000	S2	4.014	0.989	13.540	1.54			44.0	FLOOD
S1.001	S2	4.251	1.425	0.698	1.52			44.3	FLOOD
S3.000	S4	3.750	0.975	0.315	0.55			28.3	FLOOD
S1.002	S4	3.665	1.166	0.000	2.46			71.0	SURCHARGED
S4.000	S5	2.714	-0.061	0.000	0.85			44.1	OK
S5.000	S6	2.647	-0.128	0.000	0.37			20.3	OK
S1.003	S5	2.224	0.005	0.000	1.04			204.6	SURCHARGED
S1.004	S3	2.102	0.004	0.000	0.91			188.0	SURCHARGED
S6.000	S10	4.870	1.445	169.991	2.20			85.2	FLOOD
S1.005	S10	1.962	0.137	0.000	1.30			241.8	SURCHARGED
S1.006	S11	1.838	0.088	0.000	1.22			239.3	SURCHARGED
S1.007	S12	1.653	0.026	0.000	1.25			237.7	SURCHARGED
S7.000	S10	3.450	0.000	0.000	0.84			126.5	OK
S7.001	S11	3.306	0.043	0.000	1.11			347.3	SURCHARGED

PN	US/MH Name	Level Exceeded
S1.000	S1	9
S2.000	S2	14
S1.001	S2	7
S3.000	S4	6
S1.002	S4	
S4.000	S5	
S5.000	S6	
S1.003	S5	
S1.004	S3	
S6.000	S10	33
S1.005	S10	
S1.006	S11	
S1.007	S12	
S7.000	S10	
S7.001	S11	

100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs	0	Number of Storage Structures	0
Number of Online Controls	0	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Ratio R	0.400
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	17.000	Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	300.0	DVD Status	OFF
Analysis Timestep	Fine	Inertia Status	OFF
DTS Status	ON		

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years)	1, 30, 100
Climate Change (%)	0, 0, 0

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.
S1.000	S1	15 Winter	100	+0%	30/15 Summer	30/15 Summer		
S2.000	S2	30 Winter	100	+0%	30/15 Summer	30/15 Summer		
S1.001	S2	15 Winter	100	+0%	1/15 Summer	30/15 Summer		
S3.000	S4	15 Winter	100	+0%	30/15 Summer	30/15 Winter		
S1.002	S4	15 Summer	100	+0%	1/15 Summer			
S4.000	S5	15 Winter	100	+0%	100/15 Summer			
S5.000	S6	15 Winter	100	+0%				
S1.003	S5	15 Winter	100	+0%	30/15 Winter			
S1.004	S3	30 Winter	100	+0%	30/15 Winter			
S6.000	S10	60 Winter	100	+0%	1/15 Summer	1/15 Summer		
S1.005	S10	30 Winter	100	+0%	30/15 Summer			
S1.006	S11	30 Winter	100	+0%	30/15 Summer			
S1.007	S12	30 Winter	100	+0%	30/15 Summer			
S7.000	S10	15 Winter	100	+0%	100/15 Summer			
S7.001	S11	15 Winter	100	+0%	30/15 Summer			

100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status
S1.000	S1	4.258	0.983	8.770	0.74			37.4	FLOOD
S2.000	S2	4.029	1.004	28.521	1.58			45.2	FLOOD
S1.001	S2	4.254	1.428	4.234	1.55			45.3	FLOOD
S3.000	S4	3.754	0.979	4.044	0.63			32.7	FLOOD
S1.002	S4	3.712	1.213	0.000	2.49			71.8	FLOOD RISK
S4.000	S5	3.004	0.229	0.000	1.00			51.7	SURCHARGED
S5.000	S6	2.662	-0.113	0.000	0.48			26.2	OK
S1.003	S5	2.472	0.253	0.000	1.21			236.5	SURCHARGED
S1.004	S3	2.380	0.282	0.000	1.06			217.7	SURCHARGED
S6.000	S10	4.970	1.545	269.722	2.26			87.5	FLOOD
S1.005	S10	2.159	0.334	0.000	1.57			293.1	SURCHARGED
S1.006	S11	1.980	0.230	0.000	1.46			286.0	SURCHARGED
S1.007	S12	1.715	0.088	0.000	1.49			283.0	SURCHARGED
S7.000	S10	3.746	0.296	0.000	1.09			163.3	SURCHARGED
S7.001	S11	3.496	0.233	0.000	1.45			453.1	SURCHARGED

PN	US/MH Name	Level Exceeded
S1.000	S1	9
S2.000	S2	14
S1.001	S2	7
S3.000	S4	6
S1.002	S4	
S4.000	S5	
S5.000	S6	
S1.003	S5	
S1.004	S3	
S6.000	S10	33
S1.005	S10	
S1.006	S11	
S1.007	S12	
S7.000	S10	
S7.001	S11	

Simulation Criteria for Storm

Volumetric Runoff Coeff	0.750	Additional Flow - % of Total Flow	0.000
Areal Reduction Factor	1.000	MADD Factor * 10m³/ha Storage	2.000
Hot Start (mins)	0	Inlet Coeffiecient	0.800
Hot Start Level (mm)	0	Flow per Person per Day (l/per/day)	0.000
Manhole Headloss Coeff (Global)	0.500	Run Time (mins)	60
Foul Sewage per hectare (l/s)	0.000	Output Interval (mins)	1

Number of Input Hydrographs	0	Number of Storage Structures	0
Number of Online Controls	0	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Profile Type	Summer
Return Period (years)	30	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	18.700	Storm Duration (mins)	30
Ratio R	0.400		

1 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

Areal Reduction Factor 1.000 Additional Flow - % of Total Flow 0.000
Hot Start (mins) 0 MADD Factor * 10m³/ha Storage 2.000
Hot Start Level (mm) 0 Inlet Coeffiecient 0.800
Manhole Headloss Coeff (Global) 0.500 Flow per Person per Day (l/per/day) 0.000
Foul Sewage per hectare (l/s) 0.000

Number of Input Hydrographs 0 Number of Storage Structures 0
Number of Online Controls 0 Number of Time/Area Diagrams 0
Number of Offline Controls 0 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FSR Ratio R 0.400
Region England and Wales Cv (Summer) 0.750
M5-60 (mm) 17.000 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0 DVD Status OFF
Analysis Timestep Fine Inertia Status OFF
DTS Status ON

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years) 1, 30, 100
Climate Change (%) 0, 0, 0

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.
S1.000	S1	30 Winter	1	+0%	1/15 Summer	30/15 Summer		
S1.001	S2	30 Winter	1	+0%	1/15 Summer	1/15 Winter		
S1.002	S3	30 Winter	1	+0%	1/15 Summer	1/15 Summer		
S1.003	S4	30 Winter	1	+0%	1/15 Summer	1/15 Winter		
S1.004	S5	30 Winter	1	+0%	1/15 Summer	30/15 Summer		
S2.000	S6	30 Winter	1	+0%	1/15 Summer	30/15 Summer		
S2.001	S7	30 Winter	1	+0%	1/15 Summer	1/15 Summer		
S1.005	S8	30 Winter	1	+0%	1/15 Summer	30/15 Summer		
S1.006	SSEPARATOR	30 Winter	1	+0%	1/15 Summer			
S1.007	S10	30 Winter	1	+0%	1/15 Summer			
S1.008	S11	30 Winter	1	+0%	1/15 Summer			
S1.009	S12	30 Winter	1	+0%	1/15 Summer			
S3.000	S13	15 Winter	1	+0%	30/15 Summer	100/15 Summer		
S3.001	S14	15 Winter	1	+0%	30/15 Summer	100/15 Winter		

1 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status
S1.000	S1	4.551	0.618	0.000	0.82			10.0	FLOOD RISK
S1.001	S2	4.503	0.869	3.029	1.19			14.6	FLOOD
S1.002	S3	4.506	1.151	6.504	0.55			16.8	FLOOD
S1.003	S4	4.603	1.917	3.407	1.24			36.5	FLOOD
S1.004	S5	4.545	1.988	0.000	1.37			40.3	FLOOD RISK
S2.000	S6	4.819	0.811	0.000	0.80			44.4	FLOOD RISK
S2.001	S7	4.615	1.222	15.258	1.39			75.2	FLOOD
S1.005	S8	4.336	1.912	0.000	2.51			133.8	FLOOD RISK
S1.006	SSEPARATOR	3.869	1.523	0.000	2.53			132.0	SURCHARGED
S1.007	S10	3.489	1.205	0.000	2.50			130.8	SURCHARGED
S1.008	S11	3.078	0.861	0.000	2.38			130.0	SURCHARGED
S1.009	S12	2.481	0.369	0.000	2.39			129.7	SURCHARGED
S3.000	S13	3.583	-0.142	0.000	0.11			3.6	OK
S3.001	S14	3.578	-0.087	0.000	0.69			36.6	OK

PN	US/MH Name	Level Exceeded
S1.000	S1	18
S1.001	S2	40
S1.002	S3	40
S1.003	S4	32
S1.004	S5	21
S2.000	S6	28
S2.001	S7	39
S1.005	S8	14
S1.006	SSEPARATOR	
S1.007	S10	
S1.008	S11	
S1.009	S12	
S3.000	S13	2
S3.001	S14	1

30 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs	0	Number of Storage Structures	0
Number of Online Controls	0	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Ratio R	0.400
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	17.000	Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	300.0	DVD Status	OFF
Analysis Timestep	Fine	Inertia Status	OFF
DTS Status	ON		

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years)	1, 30, 100
Climate Change (%)	0, 0, 0

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow
S1.000	S1	30 Winter	30	+0%	1/15 Summer	30/15 Summer	
S1.001	S2	120 Winter	30	+0%	1/15 Summer	1/15 Winter	
S1.002	S3	120 Winter	30	+0%	1/15 Summer	1/15 Summer	
S1.003	S4	60 Winter	30	+0%	1/15 Summer	1/15 Winter	
S1.004	S5	30 Winter	30	+0%	1/15 Summer	30/15 Summer	
S2.000	S6	30 Winter	30	+0%	1/15 Summer	30/15 Summer	
S2.001	S7	60 Winter	30	+0%	1/15 Summer	1/15 Summer	
S1.005	S8	15 Winter	30	+0%	1/15 Summer	30/15 Summer	
S1.006	SSEPARATOR	15 Summer	30	+0%	1/15 Summer		
S1.007	S10	15 Summer	30	+0%	1/15 Summer		
S1.008	S11	15 Winter	30	+0%	1/15 Summer		
S1.009	S12	15 Summer	30	+0%	1/15 Summer		
S3.000	S13	15 Winter	30	+0%	30/15 Summer	100/15 Summer	
S3.001	S14	15 Winter	30	+0%	30/15 Summer	100/15 Winter	

30 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)
S1.000	S1		4.685	0.752	6.962	0.76			9.3
S1.001	S2		4.539	0.905	39.147	2.04			24.9
S1.002	S3		4.557	1.202	57.413	0.91			28.0
S1.003	S4		4.673	1.987	72.788	1.51			44.4
S1.004	S5		4.633	2.076	33.182	1.85			54.5
S2.000	S6		5.022	1.014	62.403	0.74			41.4
S2.001	S7		4.784	1.391	183.727	1.61			87.3
S1.005	S8		4.617	2.193	16.761	2.94			156.7
S1.006	SSEPARATOR		4.128	1.782	0.000	2.85			148.2
S1.007	S10		3.702	1.418	0.000	2.75			143.8
S1.008	S11		3.233	1.016	0.000	2.55			138.9
S1.009	S12		2.547	0.435	0.000	2.54			137.9
S3.000	S13		4.257	0.532	0.000	0.34			11.1
S3.001	S14		4.246	0.581	0.000	1.69			89.9

PN	US/MH Name	Status	Level Exceeded
S1.000	S1	FLOOD	18
S1.001	S2	FLOOD	40
S1.002	S3	FLOOD	40
S1.003	S4	FLOOD	32
S1.004	S5	FLOOD	21
S2.000	S6	FLOOD	28
S2.001	S7	FLOOD	39
S1.005	S8	FLOOD	14
S1.006	SSEPARATOR	SURCHARGED	
S1.007	S10	SURCHARGED	
S1.008	S11	SURCHARGED	
S1.009	S12	SURCHARGED	
S3.000	S13	FLOOD RISK	2
S3.001	S14	SURCHARGED	1

100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs	0	Number of Storage Structures	0
Number of Online Controls	0	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Ratio R	0.400
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	17.000	Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	300.0	DVD Status	OFF
Analysis Timestep	Fine	Inertia Status	OFF
DTS Status	ON		

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years)	1, 30, 100
Climate Change (%)	0, 0, 0

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow
S1.000	S1	30 Winter	100	+0%	1/15 Summer	30/15 Summer	
S1.001	S2	180 Winter	100	+0%	1/15 Summer	1/15 Winter	
S1.002	S3	180 Winter	100	+0%	1/15 Summer	1/15 Summer	
S1.003	S4	60 Winter	100	+0%	1/15 Summer	1/15 Winter	
S1.004	S5	60 Winter	100	+0%	1/15 Summer	30/15 Summer	
S2.000	S6	60 Winter	100	+0%	1/15 Summer	30/15 Summer	
S2.001	S7	60 Winter	100	+0%	1/15 Summer	1/15 Summer	
S1.005	S8	30 Winter	100	+0%	1/15 Summer	30/15 Summer	
S1.006	SSEPARATOR	15 Summer	100	+0%	1/15 Summer		
S1.007	S10	15 Winter	100	+0%	1/15 Summer		
S1.008	S11	15 Summer	100	+0%	1/15 Summer		
S1.009	S12	15 Winter	100	+0%	1/15 Summer		
S3.000	S13	15 Winter	100	+0%	30/15 Summer	100/15 Summer	
S3.001	S14	15 Winter	100	+0%	30/15 Summer	100/15 Winter	

100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)
S1.000	S1		4.690	0.757	12.356	0.79			9.6
S1.001	S2		4.563	0.929	62.558	2.06			25.1
S1.002	S3		4.585	1.230	85.378	1.03			31.6
S1.003	S4		4.708	2.022	107.604	1.49			43.9
S1.004	S5		4.660	2.103	59.719	1.80			53.0
S2.000	S6		5.067	1.059	107.235	0.74			41.1
S2.001	S7		4.874	1.481	273.515	1.62			87.9
S1.005	S8		4.642	2.218	41.830	2.86			152.4
S1.006	SSEPARATOR		4.141	1.795	0.000	2.92			152.1
S1.007	S10		3.710	1.426	0.000	2.77			144.8
S1.008	S11		3.237	1.020	0.000	2.55			139.2
S1.009	S12		2.550	0.438	0.000	2.55			138.1
S3.000	S13		4.530	0.805	2.082	1.03			33.9
S3.001	S14		4.590	0.925	0.054	2.00			106.6

PN	US/MH Name	Status	Level Exceeded
S1.000	S1	FLOOD	18
S1.001	S2	FLOOD	40
S1.002	S3	FLOOD	40
S1.003	S4	FLOOD	32
S1.004	S5	FLOOD	21
S2.000	S6	FLOOD	28
S2.001	S7	FLOOD	39
S1.005	S8	FLOOD	14
S1.006	SSEPARATOR	SURCHARGED	
S1.007	S10	SURCHARGED	
S1.008	S11	SURCHARGED	
S1.009	S12	SURCHARGED	
S3.000	S13	FLOOD	2
S3.001	S14	FLOOD	1

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Storm

Pipe Sizes STANDARD Manhole Sizes ECC

FSR Rainfall Model - England and Wales

Return Period (years)	30	PIMP (%)	100
M5-60 (mm)	17.000	Add Flow / Climate Change (%)	0
Ratio R	0.400	Minimum Backdrop Height (m)	0.200
Maximum Rainfall (mm/hr)	50	Maximum Backdrop Height (m)	1.500
Maximum Time of Concentration (mins)	30	Min Design Depth for Optimisation (m)	1.200
Foul Sewage (l/s/ha)	0.000	Min Vel for Auto Design only (m/s)	1.00
Volumetric Runoff Coeff.	0.750	Min Slope for Optimisation (1:X)	500

Designed with Level Soffits

1 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

Areal Reduction Factor 1.000 Additional Flow - % of Total Flow 0.000
Hot Start (mins) 0 MADD Factor * 10m³/ha Storage 2.000
Hot Start Level (mm) 0 Inlet Coeffiecient 0.800
Manhole Headloss Coeff (Global) 0.500 Flow per Person per Day (l/per/day) 0.000
Foul Sewage per hectare (l/s) 0.000

Number of Input Hydrographs 0 Number of Storage Structures 5
Number of Online Controls 1 Number of Time/Area Diagrams 0
Number of Offline Controls 0 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FSR Ratio R 0.400
Region England and Wales Cv (Summer) 0.750
M5-60 (mm) 17.000 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0
Analysis Timestep 2.5 Second Increment (Extended)
DTS Status OFF
DVD Status ON
Inertia Status ON

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720
Return Period(s) (years) 1, 2, 5, 10, 15, 20, 25, 30
Climate Change (%) 25, 25, 25, 25, 25, 25, 25, 25

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.
N-1.000	MH(N)-1	15 Winter	1	+25%				
N-1.001	MH(N)-2	15 Winter	1	+25%				
N-2.000	MH(N)-3	15 Winter	1	+25%	25/15 Winter			
N-2.001	MH(N)-4	15 Winter	1	+25%	10/15 Summer			
N-1.002	MH(N)-5	15 Winter	1	+25%	30/15 Winter			
N-3.000	MH(N)-6	15 Winter	1	+25%				
N-3.001	MH(N)-7	15 Winter	1	+25%				
N-4.000	MH(N)-8	15 Winter	1	+25%				
N-4.001	MH(N)-9	15 Winter	1	+25%	30/15 Winter			
N-4.002	MH(N)-10	15 Winter	1	+25%				
N-1.003	MH(N)-11	15 Winter	1	+25%	5/60 Winter			
N-5.000	MH(N)-12	15 Winter	1	+25%				
N-5.001	MH(N)-13	15 Winter	1	+25%				
N-6.000	MH(N)-14	15 Winter	1	+25%				
N-6.001	MH(N)-15	15 Winter	1	+25%	15/15 Summer			
N-6.002	MH(N)-16	15 Winter	1	+25%	20/180 Winter			
N-1.004	MH(N)-17	240 Winter	1	+25%	2/60 Winter			
N-7.000	MH(N)-18	15 Winter	1	+25%				

1 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status
N-1.000	MH(N)-1	3.605	-0.195	0.000	0.26			20.3	OK
N-1.001	MH(N)-2	3.419	-0.188	0.000	0.30			31.2	OK
N-2.000	MH(N)-3	3.708	-0.167	0.000	0.38			31.2	OK
N-2.001	MH(N)-4	3.266	-0.126	0.000	0.63			40.5	OK
N-1.002	MH(N)-5	3.130	-0.137	0.000	0.72		4	69.5	OK
N-3.000	MH(N)-6	3.533	-0.267	0.000	0.18			24.6	OK
N-3.001	MH(N)-7	3.250	-0.276	0.000	0.15			38.0	OK
N-4.000	MH(N)-8	3.623	-0.177	0.000	0.34			28.0	OK
N-4.001	MH(N)-9	3.273	-0.208	0.000	0.40			47.1	OK
N-4.002	MH(N)-10	3.030	-0.234	0.000	0.30			58.3	OK
N-1.003	MH(N)-11	2.607	-0.143	0.000	0.80		3	150.3	OK
N-5.000	MH(N)-12	3.538	-0.262	0.000	0.19			26.9	OK
N-5.001	MH(N)-13	3.162	-0.356	0.000	0.09			42.0	OK
N-6.000	MH(N)-14	3.550	-0.250	0.000	0.23			36.3	OK
N-6.001	MH(N)-15	3.125	-0.230	0.000	0.46			77.1	OK
N-6.002	MH(N)-16	2.815	-0.311	0.000	0.21			76.8	OK
N-1.004	MH(N)-17	2.588	-0.012	0.000	0.06		123	28.7	OK
N-7.000	MH(N)-18	3.319	-0.265	0.000	0.18			44.6	OK

PN	US/MH Name	Level Exceeded
N-1.000	MH(N)-1	
N-1.001	MH(N)-2	
N-2.000	MH(N)-3	
N-2.001	MH(N)-4	
N-1.002	MH(N)-5	
N-3.000	MH(N)-6	
N-3.001	MH(N)-7	
N-4.000	MH(N)-8	
N-4.001	MH(N)-9	
N-4.002	MH(N)-10	
N-1.003	MH(N)-11	
N-5.000	MH(N)-12	
N-5.001	MH(N)-13	
N-6.000	MH(N)-14	
N-6.001	MH(N)-15	
N-6.002	MH(N)-16	
N-1.004	MH(N)-17	
N-7.000	MH(N)-18	

1 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow
N-8.000	MH(N)-19	15 Winter	1	+25%	25/15 Winter		
N-8.001	MH(N)-20	15 Winter	1	+25%	25/15 Winter		
N-8.002	MH(N)-21	15 Winter	1	+25%	20/120 Winter		
N-8.003	MH(N)-22	15 Winter	1	+25%	10/120 Winter		
N-1.005	MH(N)-23	240 Winter	1	+25%	1/180 Winter		
N-9.000	MH(N)-24	15 Winter	1	+25%			
N-10.000	MH(N)-25	15 Winter	1	+25%			
N-10.001	MH(N)-26	15 Winter	1	+25%	25/15 Summer		
N-10.002	MH(N)-27	15 Winter	1	+25%	20/120 Winter		
N-1.006	MH(N)-28	180 Winter	1	+25%	1/15 Summer		
N-1.007	MH(N)-EX-37	180 Winter	1	+25%	1/15 Summer		

PN	US/MH Name	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)
N-8.000	MH(N)-19		3.565	-0.235	0.000	0.45			101.0
N-8.001	MH(N)-20		3.268	-0.275	0.000	0.44			127.3
N-8.002	MH(N)-21		2.971	-0.272	0.000	0.47			152.1
N-8.003	MH(N)-22		2.688	-0.305	0.000	0.37			152.9
N-1.005	MH(N)-23		2.511	0.000	0.000	0.07		145	43.0
N-9.000	MH(N)-24		3.485	-0.200	0.000	0.24			48.6
N-10.000	MH(N)-25		3.505	-0.295	0.000	0.25			58.8
N-10.001	MH(N)-26		3.121	-0.237	0.000	0.45			93.5
N-10.002	MH(N)-27		2.769	-0.310	0.000	0.21			93.9
N-1.006	MH(N)-28		2.506	0.581	0.000	0.28		197	42.7
N-1.007	MH(N)-EX-37		1.919	0.308	0.000	0.18			42.7

PN	US/MH Name	Status	Level Exceeded
N-8.000	MH(N)-19	OK	
N-8.001	MH(N)-20	OK	
N-8.002	MH(N)-21	OK	
N-8.003	MH(N)-22	OK	
N-1.005	MH(N)-23	SURCHARGED	
N-9.000	MH(N)-24	OK	
N-10.000	MH(N)-25	OK	
N-10.001	MH(N)-26	OK	
N-10.002	MH(N)-27	OK	
N-1.006	MH(N)-28	SURCHARGED	
N-1.007	MH(N)-EX-37	SURCHARGED	

2 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs	0	Number of Storage Structures	5
Number of Online Controls	1	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Ratio R	0.400
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	17.000	Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	300.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	OFF
DVD Status	ON
Inertia Status	ON

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720
Return Period(s) (years)	1, 2, 5, 10, 15, 20, 25, 30
Climate Change (%)	25, 25, 25, 25, 25, 25, 25, 25

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.
N-1.000	MH(N)-1	15 Winter	2	+25%				
N-1.001	MH(N)-2	15 Winter	2	+25%				
N-2.000	MH(N)-3	15 Winter	2	+25%	25/15 Winter			
N-2.001	MH(N)-4	15 Winter	2	+25%	10/15 Summer			
N-1.002	MH(N)-5	15 Winter	2	+25%	30/15 Winter			
N-3.000	MH(N)-6	15 Winter	2	+25%				
N-3.001	MH(N)-7	15 Winter	2	+25%				
N-4.000	MH(N)-8	15 Winter	2	+25%				
N-4.001	MH(N)-9	15 Winter	2	+25%	30/15 Winter			
N-4.002	MH(N)-10	15 Winter	2	+25%				
N-1.003	MH(N)-11	180 Winter	2	+25%	5/60 Winter			
N-5.000	MH(N)-12	15 Winter	2	+25%				
N-5.001	MH(N)-13	15 Winter	2	+25%				
N-6.000	MH(N)-14	15 Winter	2	+25%				
N-6.001	MH(N)-15	15 Winter	2	+25%	15/15 Summer			
N-6.002	MH(N)-16	15 Winter	2	+25%	20/180 Winter			
N-1.004	MH(N)-17	180 Winter	2	+25%	2/60 Winter			
N-7.000	MH(N)-18	15 Winter	2	+25%				

2 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status
N-1.000	MH(N)-1	3.621	-0.179	0.000	0.34			26.3	OK
N-1.001	MH(N)-2	3.437	-0.170	0.000	0.39			40.4	OK
N-2.000	MH(N)-3	3.730	-0.145	0.000	0.49			40.4	OK
N-2.001	MH(N)-4	3.300	-0.092	0.000	0.81			52.4	OK
N-1.002	MH(N)-5	3.179	-0.088	0.000	0.94		4	89.9	OK
N-3.000	MH(N)-6	3.548	-0.252	0.000	0.23			31.7	OK
N-3.001	MH(N)-7	3.265	-0.261	0.000	0.20			48.9	OK
N-4.000	MH(N)-8	3.643	-0.157	0.000	0.44			36.2	OK
N-4.001	MH(N)-9	3.301	-0.180	0.000	0.51			61.0	OK
N-4.002	MH(N)-10	3.052	-0.212	0.000	0.39			75.4	OK
N-1.003	MH(N)-11	2.693	-0.057	0.000	0.31		47	57.6	OK
N-5.000	MH(N)-12	3.554	-0.246	0.000	0.25			34.7	OK
N-5.001	MH(N)-13	3.173	-0.345	0.000	0.12			54.3	OK
N-6.000	MH(N)-14	3.569	-0.231	0.000	0.30			47.1	OK
N-6.001	MH(N)-15	3.163	-0.192	0.000	0.59			99.7	OK
N-6.002	MH(N)-16	2.835	-0.291	0.000	0.27			99.3	OK
N-1.004	MH(N)-17	2.669	0.069	0.000	0.11		145	54.7	SURCHARGED
N-7.000	MH(N)-18	3.334	-0.250	0.000	0.24			57.6	OK

PN	US/MH Name	Level Exceeded
N-1.000	MH(N)-1	
N-1.001	MH(N)-2	
N-2.000	MH(N)-3	
N-2.001	MH(N)-4	
N-1.002	MH(N)-5	
N-3.000	MH(N)-6	
N-3.001	MH(N)-7	
N-4.000	MH(N)-8	
N-4.001	MH(N)-9	
N-4.002	MH(N)-10	
N-1.003	MH(N)-11	
N-5.000	MH(N)-12	
N-5.001	MH(N)-13	
N-6.000	MH(N)-14	
N-6.001	MH(N)-15	
N-6.002	MH(N)-16	
N-1.004	MH(N)-17	
N-7.000	MH(N)-18	

2 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow
N-8.000	MH(N)-19	15 Winter	2	+25%	25/15 Winter		
N-8.001	MH(N)-20	15 Winter	2	+25%	25/15 Winter		
N-8.002	MH(N)-21	15 Winter	2	+25%	20/120 Winter		
N-8.003	MH(N)-22	15 Winter	2	+25%	10/120 Winter		
N-1.005	MH(N)-23	180 Winter	2	+25%	1/180 Winter		
N-9.000	MH(N)-24	15 Winter	2	+25%			
N-10.000	MH(N)-25	15 Winter	2	+25%			
N-10.001	MH(N)-26	15 Winter	2	+25%	25/15 Summer		
N-10.002	MH(N)-27	15 Winter	2	+25%	20/120 Winter		
N-1.006	MH(N)-28	180 Winter	2	+25%	1/15 Summer		
N-1.007	MH(N)-EX-37	180 Winter	2	+25%	1/15 Summer		

PN	US/MH Name	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)
N-8.000	MH(N)-19		3.602	-0.198	0.000	0.58			130.7
N-8.001	MH(N)-20		3.311	-0.232	0.000	0.57			164.8
N-8.002	MH(N)-21		3.015	-0.228	0.000	0.60			197.2
N-8.003	MH(N)-22		2.723	-0.270	0.000	0.47			197.7
N-1.005	MH(N)-23		2.666	0.155	0.000	0.14		165	89.6
N-9.000	MH(N)-24		3.500	-0.185	0.000	0.31			62.9
N-10.000	MH(N)-25		3.530	-0.270	0.000	0.32			76.2
N-10.001	MH(N)-26		3.157	-0.201	0.000	0.58			120.9
N-10.002	MH(N)-27		2.788	-0.291	0.000	0.27			121.3
N-1.006	MH(N)-28		2.663	0.738	0.000	0.32		205	48.9
N-1.007	MH(N)-EX-37		1.921	0.310	0.000	0.21			48.9

PN	US/MH Name	Status	Level Exceeded
N-8.000	MH(N)-19	OK	
N-8.001	MH(N)-20	OK	
N-8.002	MH(N)-21	OK	
N-8.003	MH(N)-22	OK	
N-1.005	MH(N)-23	SURCHARGED	
N-9.000	MH(N)-24	OK	
N-10.000	MH(N)-25	OK	
N-10.001	MH(N)-26	OK	
N-10.002	MH(N)-27	OK	
N-1.006	MH(N)-28	SURCHARGED	
N-1.007	MH(N)-EX-37	SURCHARGED	

5 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs	0	Number of Storage Structures	5
Number of Online Controls	1	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Ratio R	0.400
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	17.000	Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	300.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	OFF
DVD Status	ON
Inertia Status	ON

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720
Return Period(s) (years)	1, 2, 5, 10, 15, 20, 25, 30
Climate Change (%)	25, 25, 25, 25, 25, 25, 25, 25

WARNING: Half Drain Time has not been calculated as the structure is too full.

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.
N-1.000	MH(N)-1	15 Winter	5	+25%				
N-1.001	MH(N)-2	15 Winter	5	+25%				
N-2.000	MH(N)-3	15 Winter	5	+25%	25/15 Winter			
N-2.001	MH(N)-4	15 Winter	5	+25%	10/15 Summer			
N-1.002	MH(N)-5	15 Winter	5	+25%	30/15 Winter			
N-3.000	MH(N)-6	15 Winter	5	+25%				
N-3.001	MH(N)-7	15 Winter	5	+25%				
N-4.000	MH(N)-8	15 Winter	5	+25%				
N-4.001	MH(N)-9	15 Winter	5	+25%	30/15 Winter			
N-4.002	MH(N)-10	15 Winter	5	+25%				
N-1.003	MH(N)-11	180 Winter	5	+25%	5/60 Winter			
N-5.000	MH(N)-12	15 Winter	5	+25%				
N-5.001	MH(N)-13	15 Winter	5	+25%				
N-6.000	MH(N)-14	15 Winter	5	+25%				
N-6.001	MH(N)-15	15 Winter	5	+25%	15/15 Summer			

5 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status
N-1.000	MH(N)-1	3.640	-0.160	0.000	0.43			34.0	OK
N-1.001	MH(N)-2	3.458	-0.149	0.000	0.50			52.2	OK
N-2.000	MH(N)-3	3.757	-0.118	0.000	0.63			52.3	OK
N-2.001	MH(N)-4	3.359	-0.033	0.000	1.00			64.7	OK
N-1.002	MH(N)-5	3.212	-0.055	0.000	1.00		4	96.0	OK
N-3.000	MH(N)-6	3.566	-0.234	0.000	0.30			40.9	OK
N-3.001	MH(N)-7	3.281	-0.245	0.000	0.26			63.2	OK
N-4.000	MH(N)-8	3.667	-0.133	0.000	0.57			46.9	OK
N-4.001	MH(N)-9	3.334	-0.147	0.000	0.66			79.1	OK
N-4.002	MH(N)-10	3.078	-0.186	0.000	0.50			97.4	OK
N-1.003	MH(N)-11	2.842	0.092	0.000	0.38		83	71.8	SURCHARGED
N-5.000	MH(N)-12	3.574	-0.226	0.000	0.32			44.9	OK
N-5.001	MH(N)-13	3.189	-0.329	0.000	0.16			70.2	OK
N-6.000	MH(N)-14	3.591	-0.209	0.000	0.39			60.8	OK
N-6.001	MH(N)-15	3.212	-0.143	0.000	0.77			129.0	OK

PN	US/MH Name	Level Exceeded
N-1.000	MH(N)-1	
N-1.001	MH(N)-2	
N-2.000	MH(N)-3	
N-2.001	MH(N)-4	
N-1.002	MH(N)-5	
N-3.000	MH(N)-6	
N-3.001	MH(N)-7	
N-4.000	MH(N)-8	
N-4.001	MH(N)-9	
N-4.002	MH(N)-10	
N-1.003	MH(N)-11	
N-5.000	MH(N)-12	
N-5.001	MH(N)-13	
N-6.000	MH(N)-14	
N-6.001	MH(N)-15	

5 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow
N-6.002	MH(N)-16	15 Winter	5	+25%	20/180 Winter		
N-1.004	MH(N)-17	180 Winter	5	+25%	2/60 Winter		
N-7.000	MH(N)-18	15 Winter	5	+25%			
N-8.000	MH(N)-19	15 Winter	5	+25%	25/15 Winter		
N-8.001	MH(N)-20	15 Winter	5	+25%	25/15 Winter		
N-8.002	MH(N)-21	15 Winter	5	+25%	20/120 Winter		
N-8.003	MH(N)-22	180 Winter	5	+25%	10/120 Winter		
N-1.005	MH(N)-23	180 Winter	5	+25%	1/180 Winter		
N-9.000	MH(N)-24	15 Winter	5	+25%			
N-10.000	MH(N)-25	15 Winter	5	+25%			
N-10.001	MH(N)-26	15 Winter	5	+25%	25/15 Summer		
N-10.002	MH(N)-27	180 Winter	5	+25%	20/120 Winter		
N-1.006	MH(N)-28	180 Winter	5	+25%	1/15 Summer		
N-1.007	MH(N)-EX-37	180 Winter	5	+25%	1/15 Summer		

PN	US/MH Name	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)
N-6.002	MH(N)-16		2.860	-0.266	0.000	0.35			128.4
N-1.004	MH(N)-17		2.835	0.235	0.000	0.16		177	78.1
N-7.000	MH(N)-18		3.354	-0.230	0.000	0.31			74.5
N-8.000	MH(N)-19		3.650	-0.150	0.000	0.76			169.0
N-8.001	MH(N)-20		3.363	-0.180	0.000	0.74			213.2
N-8.002	MH(N)-21		3.070	-0.173	0.000	0.78			253.0
N-8.003	MH(N)-22		2.844	-0.149	0.000	0.16			67.7
N-1.005	MH(N)-23		2.832	0.321	0.000	0.15		194	100.0
N-9.000	MH(N)-24		3.518	-0.167	0.000	0.40			81.4
N-10.000	MH(N)-25		3.557	-0.243	0.000	0.42			98.5
N-10.001	MH(N)-26		3.204	-0.154	0.000	0.75			156.4
N-10.002	MH(N)-27		2.832	-0.247	0.000	0.09			40.8
N-1.006	MH(N)-28		2.828	0.903	0.000	0.36			54.6
N-1.007	MH(N)-EX-37		1.924	0.313	0.000	0.24			54.6

PN	US/MH Name	Status	Level Exceeded
N-6.002	MH(N)-16	OK	
N-1.004	MH(N)-17	SURCHARGED	
N-7.000	MH(N)-18	OK	
N-8.000	MH(N)-19	OK	
N-8.001	MH(N)-20	OK	
N-8.002	MH(N)-21	OK	
N-8.003	MH(N)-22	OK	

5 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Status	Level Exceeded
N-1.005	MH(N)-23	SURCHARGED	
N-9.000	MH(N)-24	OK	
N-10.000	MH(N)-25	OK	
N-10.001	MH(N)-26	OK	
N-10.002	MH(N)-27	OK	
N-1.006	MH(N)-28	SURCHARGED	
N-1.007	MH(N)-EX-37	SURCHARGED	

10 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs	0	Number of Storage Structures	5
Number of Online Controls	1	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Ratio R	0.400
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	17.000	Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	300.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	OFF
DVD Status	ON
Inertia Status	ON

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720
Return Period(s) (years)	1, 2, 5, 10, 15, 20, 25, 30
Climate Change (%)	25, 25, 25, 25, 25, 25, 25, 25

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.
N-1.000	MH(N)-1	15 Winter	10	+25%				
N-1.001	MH(N)-2	15 Winter	10	+25%				
N-2.000	MH(N)-3	15 Winter	10	+25%	25/15 Winter			
N-2.001	MH(N)-4	15 Winter	10	+25%	10/15 Summer			
N-1.002	MH(N)-5	15 Winter	10	+25%	30/15 Winter			
N-3.000	MH(N)-6	15 Winter	10	+25%				
N-3.001	MH(N)-7	15 Winter	10	+25%				
N-4.000	MH(N)-8	15 Winter	10	+25%				
N-4.001	MH(N)-9	15 Winter	10	+25%	30/15 Winter			
N-4.002	MH(N)-10	15 Winter	10	+25%				
N-1.003	MH(N)-11	240 Winter	10	+25%	5/60 Winter			
N-5.000	MH(N)-12	15 Winter	10	+25%				
N-5.001	MH(N)-13	15 Winter	10	+25%				
N-6.000	MH(N)-14	15 Winter	10	+25%				
N-6.001	MH(N)-15	15 Winter	10	+25%	15/15 Summer			
N-6.002	MH(N)-16	240 Winter	10	+25%	20/180 Winter			
N-1.004	MH(N)-17	240 Winter	10	+25%	2/60 Winter			
N-7.000	MH(N)-18	15 Winter	10	+25%				

10 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status
N-1.000	MH(N)-1	3.653	-0.147	0.000	0.50			39.3	OK
N-1.001	MH(N)-2	3.481	-0.126	0.000	0.62			64.3	OK
N-2.000	MH(N)-3	3.777	-0.098	0.000	0.73			60.6	OK
N-2.001	MH(N)-4	3.439	0.047	0.000	1.20			77.5	SURCHARGED
N-1.002	MH(N)-5	3.233	-0.034	0.000	1.00		4	96.0	OK
N-3.000	MH(N)-6	3.579	-0.221	0.000	0.34			47.3	OK
N-3.001	MH(N)-7	3.299	-0.227	0.000	0.32			78.6	OK
N-4.000	MH(N)-8	3.683	-0.117	0.000	0.66			54.3	OK
N-4.001	MH(N)-9	3.378	-0.103	0.000	0.83			99.0	OK
N-4.002	MH(N)-10	3.107	-0.157	0.000	0.63			122.9	OK
N-1.003	MH(N)-11	2.976	0.226	0.000	0.34		113	63.7	SURCHARGED
N-5.000	MH(N)-12	3.586	-0.214	0.000	0.38			51.9	OK
N-5.001	MH(N)-13	3.205	-0.313	0.000	0.20			87.8	OK
N-6.000	MH(N)-14	3.605	-0.195	0.000	0.45			70.4	OK
N-6.001	MH(N)-15	3.298	-0.057	0.000	0.97			162.1	OK
N-6.002	MH(N)-16	2.972	-0.154	0.000	0.09			33.3	OK
N-1.004	MH(N)-17	2.969	0.369	0.000	0.16		212	80.8	SURCHARGED
N-7.000	MH(N)-18	3.366	-0.218	0.000	0.36			86.3	OK

PN	US/MH Name	Level Exceeded
N-1.000	MH(N)-1	
N-1.001	MH(N)-2	
N-2.000	MH(N)-3	
N-2.001	MH(N)-4	
N-1.002	MH(N)-5	
N-3.000	MH(N)-6	
N-3.001	MH(N)-7	
N-4.000	MH(N)-8	
N-4.001	MH(N)-9	
N-4.002	MH(N)-10	
N-1.003	MH(N)-11	
N-5.000	MH(N)-12	
N-5.001	MH(N)-13	
N-6.000	MH(N)-14	
N-6.001	MH(N)-15	
N-6.002	MH(N)-16	
N-1.004	MH(N)-17	
N-7.000	MH(N)-18	

10 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow
N-8.000	MH(N)-19	15 Winter	10	+25%	25/15 Winter		
N-8.001	MH(N)-20	15 Winter	10	+25%	25/15 Winter		
N-8.002	MH(N)-21	15 Winter	10	+25%	20/120 Winter		
N-8.003	MH(N)-22	120 Winter	10	+25%	10/120 Winter		
N-1.005	MH(N)-23	240 Winter	10	+25%	1/180 Winter		
N-9.000	MH(N)-24	15 Winter	10	+25%			
N-10.000	MH(N)-25	15 Winter	10	+25%			
N-10.001	MH(N)-26	15 Winter	10	+25%	25/15 Summer		
N-10.002	MH(N)-27	240 Winter	10	+25%	20/120 Winter		
N-1.006	MH(N)-28	240 Winter	10	+25%	1/15 Summer		
N-1.007	MH(N)-EX-37	240 Winter	10	+25%	1/15 Summer		

PN	US/MH Name	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)
N-8.000	MH(N)-19		3.683	-0.117	0.000	0.87			195.7
N-8.001	MH(N)-20		3.419	-0.124	0.000	0.88			253.5
N-8.002	MH(N)-21		3.125	-0.118	0.000	0.94			307.6
N-8.003	MH(N)-22		3.016	0.023	0.000	0.25			105.5
N-1.005	MH(N)-23		2.965	0.454	0.000	0.15		231	94.9
N-9.000	MH(N)-24		3.530	-0.155	0.000	0.47			94.3
N-10.000	MH(N)-25		3.576	-0.224	0.000	0.48			114.0
N-10.001	MH(N)-26		3.256	-0.102	0.000	0.92			192.1
N-10.002	MH(N)-27		2.966	-0.113	0.000	0.09			38.7
N-1.006	MH(N)-28		2.962	1.037	0.000	0.39		248	58.8
N-1.007	MH(N)-EX-37		1.926	0.315	0.000	0.25			58.8

PN	US/MH Name	Status	Level Exceeded
N-8.000	MH(N)-19	OK	
N-8.001	MH(N)-20	OK	
N-8.002	MH(N)-21	OK	
N-8.003	MH(N)-22	SURCHARGED	
N-1.005	MH(N)-23	SURCHARGED	
N-9.000	MH(N)-24	OK	
N-10.000	MH(N)-25	OK	
N-10.001	MH(N)-26	OK	
N-10.002	MH(N)-27	OK	
N-1.006	MH(N)-28	SURCHARGED	
N-1.007	MH(N)-EX-37	SURCHARGED	

15 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs	0	Number of Storage Structures	5
Number of Online Controls	1	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Ratio R	0.400
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	17.000	Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	300.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	OFF
DVD Status	ON
Inertia Status	ON

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720
Return Period(s) (years)	1, 2, 5, 10, 15, 20, 25, 30
Climate Change (%)	25, 25, 25, 25, 25, 25, 25, 25

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.
N-1.000	MH(N)-1	15 Winter	15	+25%				
N-1.001	MH(N)-2	15 Winter	15	+25%				
N-2.000	MH(N)-3	15 Winter	15	+25%	25/15 Winter			
N-2.001	MH(N)-4	15 Winter	15	+25%	10/15 Summer			
N-1.002	MH(N)-5	15 Winter	15	+25%	30/15 Winter			
N-3.000	MH(N)-6	15 Winter	15	+25%				
N-3.001	MH(N)-7	15 Winter	15	+25%				
N-4.000	MH(N)-8	15 Winter	15	+25%				
N-4.001	MH(N)-9	15 Winter	15	+25%	30/15 Winter			
N-4.002	MH(N)-10	15 Winter	15	+25%				
N-1.003	MH(N)-11	240 Winter	15	+25%	5/60 Winter			
N-5.000	MH(N)-12	15 Winter	15	+25%				
N-5.001	MH(N)-13	15 Winter	15	+25%				
N-6.000	MH(N)-14	15 Winter	15	+25%				
N-6.001	MH(N)-15	15 Winter	15	+25%	15/15 Summer			
N-6.002	MH(N)-16	240 Winter	15	+25%	20/180 Winter			
N-1.004	MH(N)-17	240 Winter	15	+25%	2/60 Winter			
N-7.000	MH(N)-18	15 Winter	15	+25%				

15 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status
N-1.000	MH(N)-1	3.661	-0.139	0.000	0.55			42.8	OK
N-1.001	MH(N)-2	3.491	-0.116	0.000	0.67			70.0	OK
N-2.000	MH(N)-3	3.792	-0.083	0.000	0.80			65.9	OK
N-2.001	MH(N)-4	3.473	0.081	0.000	1.30			84.3	SURCHARGED
N-1.002	MH(N)-5	3.247	-0.020	0.000	1.00		5	96.0	OK
N-3.000	MH(N)-6	3.586	-0.214	0.000	0.37			51.5	OK
N-3.001	MH(N)-7	3.306	-0.220	0.000	0.35			85.7	OK
N-4.000	MH(N)-8	3.695	-0.105	0.000	0.72			59.1	OK
N-4.001	MH(N)-9	3.396	-0.085	0.000	0.91			107.8	OK
N-4.002	MH(N)-10	3.120	-0.144	0.000	0.69			133.6	OK
N-1.003	MH(N)-11	3.066	0.316	0.000	0.35		131	66.2	SURCHARGED
N-5.000	MH(N)-12	3.594	-0.206	0.000	0.41			56.6	OK
N-5.001	MH(N)-13	3.211	-0.307	0.000	0.22			95.7	OK
N-6.000	MH(N)-14	3.615	-0.185	0.000	0.49			76.8	OK
N-6.001	MH(N)-15	3.371	0.016	0.000	1.03			172.4	SURCHARGED
N-6.002	MH(N)-16	3.064	-0.062	0.000	0.10			36.5	OK
N-1.004	MH(N)-17	3.058	0.458	0.000	0.17		235	83.1	SURCHARGED
N-7.000	MH(N)-18	3.373	-0.211	0.000	0.39			94.0	OK

PN	US/MH Name	Level Exceeded
N-1.000	MH(N)-1	
N-1.001	MH(N)-2	
N-2.000	MH(N)-3	
N-2.001	MH(N)-4	
N-1.002	MH(N)-5	
N-3.000	MH(N)-6	
N-3.001	MH(N)-7	
N-4.000	MH(N)-8	
N-4.001	MH(N)-9	
N-4.002	MH(N)-10	
N-1.003	MH(N)-11	
N-5.000	MH(N)-12	
N-5.001	MH(N)-13	
N-6.000	MH(N)-14	
N-6.001	MH(N)-15	
N-6.002	MH(N)-16	
N-1.004	MH(N)-17	
N-7.000	MH(N)-18	

15 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow
N-8.000	MH(N)-19	15 Winter	15	+25%	25/15 Winter		
N-8.001	MH(N)-20	15 Winter	15	+25%	25/15 Winter		
N-8.002	MH(N)-21	120 Winter	15	+25%	20/120 Winter		
N-8.003	MH(N)-22	120 Winter	15	+25%	10/120 Winter		
N-1.005	MH(N)-23	240 Winter	15	+25%	1/180 Winter		
N-9.000	MH(N)-24	15 Winter	15	+25%			
N-10.000	MH(N)-25	15 Winter	15	+25%			
N-10.001	MH(N)-26	15 Winter	15	+25%	25/15 Summer		
N-10.002	MH(N)-27	240 Winter	15	+25%	20/120 Winter		
N-1.006	MH(N)-28	240 Winter	15	+25%	1/15 Summer		
N-1.007	MH(N)-EX-37	240 Winter	15	+25%	1/15 Summer		

PN	US/MH Name	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)
N-8.000	MH(N)-19		3.705	-0.095	0.000	0.95			213.2
N-8.001	MH(N)-20		3.448	-0.095	0.000	0.96			276.1
N-8.002	MH(N)-21		3.240	-0.003	0.000	0.36			117.1
N-8.003	MH(N)-22		3.111	0.118	0.000	0.27			113.0
N-1.005	MH(N)-23		3.054	0.543	0.000	0.16		247	102.3
N-9.000	MH(N)-24		3.537	-0.148	0.000	0.51			102.7
N-10.000	MH(N)-25		3.588	-0.212	0.000	0.53			124.2
N-10.001	MH(N)-26		3.287	-0.071	0.000	0.99			206.2
N-10.002	MH(N)-27		3.066	-0.013	0.000	0.09			42.0
N-1.006	MH(N)-28		3.051	1.126	0.000	0.41		261	61.5
N-1.007	MH(N)-EX-37		1.927	0.316	0.000	0.27			61.5

PN	US/MH Name	Status	Level Exceeded
N-8.000	MH(N)-19	OK	
N-8.001	MH(N)-20	OK	
N-8.002	MH(N)-21	OK	
N-8.003	MH(N)-22	SURCHARGED	
N-1.005	MH(N)-23	SURCHARGED	
N-9.000	MH(N)-24	OK	
N-10.000	MH(N)-25	OK	
N-10.001	MH(N)-26	OK	
N-10.002	MH(N)-27	OK	
N-1.006	MH(N)-28	SURCHARGED	
N-1.007	MH(N)-EX-37	SURCHARGED	

20 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs	0	Number of Storage Structures	5
Number of Online Controls	1	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Ratio R	0.400
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	17.000	Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	300.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	OFF
DVD Status	ON
Inertia Status	ON

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720
Return Period(s) (years)	1, 2, 5, 10, 15, 20, 25, 30
Climate Change (%)	25, 25, 25, 25, 25, 25, 25, 25

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.
N-1.000	MH(N)-1	15 Winter	20	+25%				
N-1.001	MH(N)-2	15 Winter	20	+25%				
N-2.000	MH(N)-3	15 Winter	20	+25%	25/15 Winter			
N-2.001	MH(N)-4	15 Winter	20	+25%	10/15 Summer			
N-1.002	MH(N)-5	15 Winter	20	+25%	30/15 Winter			
N-3.000	MH(N)-6	15 Winter	20	+25%				
N-3.001	MH(N)-7	15 Winter	20	+25%				
N-4.000	MH(N)-8	15 Winter	20	+25%				
N-4.001	MH(N)-9	15 Winter	20	+25%	30/15 Winter			
N-4.002	MH(N)-10	240 Winter	20	+25%				
N-1.003	MH(N)-11	240 Winter	20	+25%	5/60 Winter			
N-5.000	MH(N)-12	15 Winter	20	+25%				
N-5.001	MH(N)-13	15 Winter	20	+25%				
N-6.000	MH(N)-14	15 Winter	20	+25%				
N-6.001	MH(N)-15	15 Winter	20	+25%	15/15 Summer			
N-6.002	MH(N)-16	240 Winter	20	+25%	20/180 Winter			
N-1.004	MH(N)-17	240 Winter	20	+25%	2/60 Winter			
N-7.000	MH(N)-18	15 Winter	20	+25%				

20 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status
N-1.000	MH(N)-1	3.668	-0.132	0.000	0.58			45.5	OK
N-1.001	MH(N)-2	3.499	-0.108	0.000	0.71			74.4	OK
N-2.000	MH(N)-3	3.840	-0.035	0.000	0.83			68.4	OK
N-2.001	MH(N)-4	3.494	0.102	0.000	1.37			88.4	SURCHARGED
N-1.002	MH(N)-5	3.257	-0.010	0.000	1.00		5	96.0	OK
N-3.000	MH(N)-6	3.592	-0.208	0.000	0.40			54.7	OK
N-3.001	MH(N)-7	3.311	-0.215	0.000	0.37			91.1	OK
N-4.000	MH(N)-8	3.703	-0.097	0.000	0.77			62.8	OK
N-4.001	MH(N)-9	3.411	-0.070	0.000	0.96			114.4	OK
N-4.002	MH(N)-10	3.138	-0.126	0.000	0.15			29.0	OK
N-1.003	MH(N)-11	3.134	0.384	0.000	0.36		146	67.7	SURCHARGED
N-5.000	MH(N)-12	3.600	-0.200	0.000	0.43			60.1	OK
N-5.001	MH(N)-13	3.216	-0.302	0.000	0.23			101.7	OK
N-6.000	MH(N)-14	3.622	-0.178	0.000	0.52			81.6	OK
N-6.001	MH(N)-15	3.409	0.054	0.000	1.09			183.6	SURCHARGED
N-6.002	MH(N)-16	3.130	0.004	0.000	0.10			38.4	SURCHARGED
N-1.004	MH(N)-17	3.126	0.526	0.000	0.17		246	86.3	SURCHARGED
N-7.000	MH(N)-18	3.379	-0.205	0.000	0.41			99.9	OK

PN	US/MH Name	Level Exceeded
N-1.000	MH(N)-1	
N-1.001	MH(N)-2	
N-2.000	MH(N)-3	
N-2.001	MH(N)-4	
N-1.002	MH(N)-5	
N-3.000	MH(N)-6	
N-3.001	MH(N)-7	
N-4.000	MH(N)-8	
N-4.001	MH(N)-9	
N-4.002	MH(N)-10	
N-1.003	MH(N)-11	
N-5.000	MH(N)-12	
N-5.001	MH(N)-13	
N-6.000	MH(N)-14	
N-6.001	MH(N)-15	
N-6.002	MH(N)-16	
N-1.004	MH(N)-17	
N-7.000	MH(N)-18	

20 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow
N-8.000	MH(N)-19	15 Winter	20	+25%	25/15 Winter		
N-8.001	MH(N)-20	15 Winter	20	+25%	25/15 Winter		
N-8.002	MH(N)-21	180 Winter	20	+25%	20/120 Winter		
N-8.003	MH(N)-22	180 Winter	20	+25%	10/120 Winter		
N-1.005	MH(N)-23	240 Winter	20	+25%	1/180 Winter		
N-9.000	MH(N)-24	15 Winter	20	+25%			
N-10.000	MH(N)-25	15 Winter	20	+25%			
N-10.001	MH(N)-26	15 Winter	20	+25%	25/15 Summer		
N-10.002	MH(N)-27	240 Winter	20	+25%	20/120 Winter		
N-1.006	MH(N)-28	240 Winter	20	+25%	1/15 Summer		
N-1.007	MH(N)-EX-37	240 Winter	20	+25%	1/15 Summer		

PN	US/MH Name	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)
N-8.000	MH(N)-19		3.758	-0.042	0.000	0.99			221.3
N-8.001	MH(N)-20		3.520	-0.023	0.000	0.99			283.6
N-8.002	MH(N)-21		3.329	0.086	0.000	0.29			93.4
N-8.003	MH(N)-22		3.187	0.194	0.000	0.21			87.2
N-1.005	MH(N)-23		3.122	0.611	0.000	0.17		260	110.3
N-9.000	MH(N)-24		3.543	-0.142	0.000	0.54			109.2
N-10.000	MH(N)-25		3.597	-0.203	0.000	0.56			132.0
N-10.001	MH(N)-26		3.354	-0.004	0.000	1.00			208.6
N-10.002	MH(N)-27		3.123	0.044	0.000	0.10			44.5
N-1.006	MH(N)-28		3.118	1.193	0.000	0.42		277	63.9
N-1.007	MH(N)-EX-37		1.928	0.317	0.000	0.28			63.9

PN	US/MH Name	Status	Level Exceeded
N-8.000	MH(N)-19	OK	
N-8.001	MH(N)-20	OK	
N-8.002	MH(N)-21	SURCHARGED	
N-8.003	MH(N)-22	SURCHARGED	
N-1.005	MH(N)-23	SURCHARGED	
N-9.000	MH(N)-24	OK	
N-10.000	MH(N)-25	OK	
N-10.001	MH(N)-26	OK	
N-10.002	MH(N)-27	SURCHARGED	
N-1.006	MH(N)-28	SURCHARGED	
N-1.007	MH(N)-EX-37	SURCHARGED	

25 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs	0	Number of Storage Structures	5
Number of Online Controls	1	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Ratio R	0.400
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	17.000	Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	300.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	OFF
DVD Status	ON
Inertia Status	ON

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720
Return Period(s) (years)	1, 2, 5, 10, 15, 20, 25, 30
Climate Change (%)	25, 25, 25, 25, 25, 25, 25, 25

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.
N-1.000	MH(N)-1	15 Winter	25	+25%				
N-1.001	MH(N)-2	15 Winter	25	+25%				
N-2.000	MH(N)-3	15 Winter	25	+25%	25/15 Winter			
N-2.001	MH(N)-4	15 Winter	25	+25%	10/15 Summer			
N-1.002	MH(N)-5	15 Winter	25	+25%	30/15 Winter			
N-3.000	MH(N)-6	15 Winter	25	+25%				
N-3.001	MH(N)-7	15 Winter	25	+25%				
N-4.000	MH(N)-8	15 Winter	25	+25%				
N-4.001	MH(N)-9	15 Winter	25	+25%	30/15 Winter			
N-4.002	MH(N)-10	240 Winter	25	+25%				
N-1.003	MH(N)-11	240 Winter	25	+25%	5/60 Winter			
N-5.000	MH(N)-12	15 Winter	25	+25%				
N-5.001	MH(N)-13	15 Winter	25	+25%				
N-6.000	MH(N)-14	15 Winter	25	+25%				
N-6.001	MH(N)-15	15 Winter	25	+25%	15/15 Summer			
N-6.002	MH(N)-16	240 Winter	25	+25%	20/180 Winter			
N-1.004	MH(N)-17	240 Winter	25	+25%	2/60 Winter			
N-7.000	MH(N)-18	15 Winter	25	+25%				

25 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status
N-1.000	MH(N)-1	3.673	-0.127	0.000	0.61			47.7	OK
N-1.001	MH(N)-2	3.506	-0.101	0.000	0.75			78.0	OK
N-2.000	MH(N)-3	3.888	0.013	0.000	0.86			71.0	SURCHARGED
N-2.001	MH(N)-4	3.511	0.119	0.000	1.41			91.6	SURCHARGED
N-1.002	MH(N)-5	3.266	-0.001	0.000	1.00		6	96.0	OK
N-3.000	MH(N)-6	3.596	-0.204	0.000	0.42			57.4	OK
N-3.001	MH(N)-7	3.315	-0.211	0.000	0.39			95.5	OK
N-4.000	MH(N)-8	3.710	-0.090	0.000	0.80			65.9	OK
N-4.001	MH(N)-9	3.437	-0.044	0.000	0.98			117.2	OK
N-4.002	MH(N)-10	3.191	-0.073	0.000	0.16			30.5	OK
N-1.003	MH(N)-11	3.186	0.436	0.000	0.37		156	69.0	SURCHARGED
N-5.000	MH(N)-12	3.605	-0.195	0.000	0.46			63.0	OK
N-5.001	MH(N)-13	3.219	-0.299	0.000	0.24			106.6	OK
N-6.000	MH(N)-14	3.628	-0.172	0.000	0.55			85.5	OK
N-6.001	MH(N)-15	3.439	0.084	0.000	1.15			192.7	SURCHARGED
N-6.002	MH(N)-16	3.182	0.056	0.000	0.11			40.0	SURCHARGED
N-1.004	MH(N)-17	3.178	0.578	0.000	0.18		257	87.5	SURCHARGED
N-7.000	MH(N)-18	3.384	-0.200	0.000	0.43			104.8	OK

PN	US/MH Name	Level Exceeded
N-1.000	MH(N)-1	
N-1.001	MH(N)-2	
N-2.000	MH(N)-3	
N-2.001	MH(N)-4	
N-1.002	MH(N)-5	
N-3.000	MH(N)-6	
N-3.001	MH(N)-7	
N-4.000	MH(N)-8	
N-4.001	MH(N)-9	
N-4.002	MH(N)-10	
N-1.003	MH(N)-11	
N-5.000	MH(N)-12	
N-5.001	MH(N)-13	
N-6.000	MH(N)-14	
N-6.001	MH(N)-15	
N-6.002	MH(N)-16	
N-1.004	MH(N)-17	
N-7.000	MH(N)-18	

25 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow
N-8.000	MH(N)-19	15 Winter	25	+25%	25/15 Winter		
N-8.001	MH(N)-20	15 Winter	25	+25%	25/15 Winter		
N-8.002	MH(N)-21	180 Winter	25	+25%	20/120 Winter		
N-8.003	MH(N)-22	180 Winter	25	+25%	10/120 Winter		
N-1.005	MH(N)-23	240 Winter	25	+25%	1/180 Winter		
N-9.000	MH(N)-24	15 Winter	25	+25%			
N-10.000	MH(N)-25	15 Winter	25	+25%			
N-10.001	MH(N)-26	15 Winter	25	+25%	25/15 Summer		
N-10.002	MH(N)-27	240 Winter	25	+25%	20/120 Winter		
N-1.006	MH(N)-28	240 Winter	25	+25%	1/15 Summer		
N-1.007	MH(N)-EX-37	240 Winter	25	+25%	1/15 Summer		

PN	US/MH Name	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)
N-8.000	MH(N)-19		3.827	0.027	0.000	1.03			229.4
N-8.001	MH(N)-20		3.563	0.020	0.000	1.02			293.0
N-8.002	MH(N)-21		3.388	0.145	0.000	0.30			98.0
N-8.003	MH(N)-22		3.244	0.251	0.000	0.22			90.8
N-1.005	MH(N)-23		3.174	0.663	0.000	0.17		276	111.3
N-9.000	MH(N)-24		3.548	-0.137	0.000	0.56			114.4
N-10.000	MH(N)-25		3.604	-0.196	0.000	0.59			138.4
N-10.001	MH(N)-26		3.385	0.027	0.000	1.06			221.0
N-10.002	MH(N)-27		3.174	0.095	0.000	0.10			46.2
N-1.006	MH(N)-28		3.170	1.245	0.000	0.46		291	68.6
N-1.007	MH(N)-EX-37		1.930	0.319	0.000	0.30			68.6

PN	US/MH Name	Status	Level Exceeded
N-8.000	MH(N)-19	SURCHARGED	
N-8.001	MH(N)-20	SURCHARGED	
N-8.002	MH(N)-21	SURCHARGED	
N-8.003	MH(N)-22	SURCHARGED	
N-1.005	MH(N)-23	SURCHARGED	
N-9.000	MH(N)-24	OK	
N-10.000	MH(N)-25	OK	
N-10.001	MH(N)-26	SURCHARGED	
N-10.002	MH(N)-27	SURCHARGED	
N-1.006	MH(N)-28	SURCHARGED	
N-1.007	MH(N)-EX-37	SURCHARGED	

30 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

Areal Reduction Factor 1.000 Additional Flow - % of Total Flow 0.000
Hot Start (mins) 0 MADD Factor * 10m³/ha Storage 2.000
Hot Start Level (mm) 0 Inlet Coeffiecient 0.800
Manhole Headloss Coeff (Global) 0.500 Flow per Person per Day (l/per/day) 0.000
Foul Sewage per hectare (l/s) 0.000

Number of Input Hydrographs 0 Number of Storage Structures 5
Number of Online Controls 1 Number of Time/Area Diagrams 0
Number of Offline Controls 0 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FSR Ratio R 0.400
Region England and Wales Cv (Summer) 0.750
M5-60 (mm) 17.000 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0
Analysis Timestep 2.5 Second Increment (Extended)
DTS Status OFF
DVD Status ON
Inertia Status ON

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720
Return Period(s) (years) 1, 2, 5, 10, 15, 20, 25, 30
Climate Change (%) 25, 25, 25, 25, 25, 25, 25, 25

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.
N-1.000	MH(N)-1	15 Winter	30	+25%				
N-1.001	MH(N)-2	15 Winter	30	+25%				
N-2.000	MH(N)-3	15 Winter	30	+25%	25/15 Winter			
N-2.001	MH(N)-4	15 Winter	30	+25%	10/15 Summer			
N-1.002	MH(N)-5	15 Winter	30	+25%	30/15 Winter			
N-3.000	MH(N)-6	15 Winter	30	+25%				
N-3.001	MH(N)-7	15 Winter	30	+25%				
N-4.000	MH(N)-8	15 Winter	30	+25%				
N-4.001	MH(N)-9	15 Winter	30	+25%	30/15 Winter			
N-4.002	MH(N)-10	240 Winter	30	+25%				
N-1.003	MH(N)-11	240 Winter	30	+25%	5/60 Winter			
N-5.000	MH(N)-12	15 Winter	30	+25%				
N-5.001	MH(N)-13	15 Winter	30	+25%				
N-6.000	MH(N)-14	15 Winter	30	+25%				
N-6.001	MH(N)-15	15 Winter	30	+25%	15/15 Summer			
N-6.002	MH(N)-16	240 Winter	30	+25%	20/180 Winter			
N-1.004	MH(N)-17	240 Winter	30	+25%	2/60 Winter			
N-7.000	MH(N)-18	15 Winter	30	+25%				

30 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status
N-1.000	MH(N)-1	3.677	-0.123	0.000	0.63			49.6	OK
N-1.001	MH(N)-2	3.511	-0.096	0.000	0.78			81.1	OK
N-2.000	MH(N)-3	3.931	0.056	0.000	0.89			73.4	SURCHARGED
N-2.001	MH(N)-4	3.526	0.134	0.000	1.45			94.1	SURCHARGED
N-1.002	MH(N)-5	3.271	0.004	0.000	1.14		6	109.0	SURCHARGED
N-3.000	MH(N)-6	3.600	-0.200	0.000	0.43			59.6	OK
N-3.001	MH(N)-7	3.319	-0.207	0.000	0.40			99.2	OK
N-4.000	MH(N)-8	3.716	-0.084	0.000	0.84			68.4	OK
N-4.001	MH(N)-9	3.481	0.000	0.000	1.00			119.3	SURCHARGED
N-4.002	MH(N)-10	3.234	-0.030	0.000	0.16			31.8	OK
N-1.003	MH(N)-11	3.226	0.476	0.000	0.37		163	69.9	SURCHARGED
N-5.000	MH(N)-12	3.609	-0.191	0.000	0.47			65.5	OK
N-5.001	MH(N)-13	3.222	-0.296	0.000	0.25			110.8	OK
N-6.000	MH(N)-14	3.633	-0.167	0.000	0.57			88.9	OK
N-6.001	MH(N)-15	3.466	0.111	0.000	1.19			200.1	SURCHARGED
N-6.002	MH(N)-16	3.224	0.098	0.000	0.11			41.2	SURCHARGED
N-1.004	MH(N)-17	3.220	0.620	0.000	0.17		265	85.1	SURCHARGED
N-7.000	MH(N)-18	3.388	-0.196	0.000	0.45			108.9	OK

PN	US/MH Name	Level Exceeded
N-1.000	MH(N)-1	
N-1.001	MH(N)-2	
N-2.000	MH(N)-3	
N-2.001	MH(N)-4	
N-1.002	MH(N)-5	
N-3.000	MH(N)-6	
N-3.001	MH(N)-7	
N-4.000	MH(N)-8	
N-4.001	MH(N)-9	
N-4.002	MH(N)-10	
N-1.003	MH(N)-11	
N-5.000	MH(N)-12	
N-5.001	MH(N)-13	
N-6.000	MH(N)-14	
N-6.001	MH(N)-15	
N-6.002	MH(N)-16	
N-1.004	MH(N)-17	
N-7.000	MH(N)-18	

30 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow
N-8.000	MH(N)-19	15 Winter	30	+25%	25/15 Winter		
N-8.001	MH(N)-20	15 Winter	30	+25%	25/15 Winter		
N-8.002	MH(N)-21	180 Winter	30	+25%	20/120 Winter		
N-8.003	MH(N)-22	180 Winter	30	+25%	10/120 Winter		
N-1.005	MH(N)-23	240 Winter	30	+25%	1/180 Winter		
N-9.000	MH(N)-24	15 Winter	30	+25%			
N-10.000	MH(N)-25	15 Winter	30	+25%			
N-10.001	MH(N)-26	15 Winter	30	+25%	25/15 Summer		
N-10.002	MH(N)-27	240 Winter	30	+25%	20/120 Winter		
N-1.006	MH(N)-28	240 Winter	30	+25%	1/15 Summer		
N-1.007	MH(N)-EX-37	240 Winter	30	+25%	1/15 Summer		

PN	US/MH Name	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)
N-8.000	MH(N)-19		3.879	0.079	0.000	1.06			237.0
N-8.001	MH(N)-20		3.598	0.055	0.000	1.05			301.1
N-8.002	MH(N)-21		3.439	0.196	0.000	0.31			101.5
N-8.003	MH(N)-22		3.295	0.302	0.000	0.22			93.5
N-1.005	MH(N)-23		3.216	0.705	0.000	0.15		292	95.9
N-9.000	MH(N)-24		3.552	-0.133	0.000	0.59			118.9
N-10.000	MH(N)-25		3.611	-0.189	0.000	0.61			143.8
N-10.001	MH(N)-26		3.413	0.055	0.000	1.10			230.3
N-10.002	MH(N)-27		3.217	0.138	0.000	0.11			47.5
N-1.006	MH(N)-28		3.212	1.287	0.000	0.50		294	74.8
N-1.007	MH(N)-EX-37		1.933	0.322	0.000	0.32			74.8

PN	US/MH Name	Status	Level Exceeded
N-8.000	MH(N)-19	SURCHARGED	
N-8.001	MH(N)-20	SURCHARGED	
N-8.002	MH(N)-21	SURCHARGED	
N-8.003	MH(N)-22	SURCHARGED	
N-1.005	MH(N)-23	SURCHARGED	
N-9.000	MH(N)-24	OK	
N-10.000	MH(N)-25	OK	
N-10.001	MH(N)-26	SURCHARGED	
N-10.002	MH(N)-27	SURCHARGED	
N-1.006	MH(N)-28	SURCHARGED	
N-1.007	MH(N)-EX-37	SURCHARGED	

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Storm

Pipe Sizes STANDARD Manhole Sizes ECC

FSR Rainfall Model - England and Wales

Return Period (years)	30	PIMP (%)	100
M5-60 (mm)	17.000	Add Flow / Climate Change (%)	0
Ratio R	0.400	Minimum Backdrop Height (m)	0.200
Maximum Rainfall (mm/hr)	50	Maximum Backdrop Height (m)	1.500
Maximum Time of Concentration (mins)	30	Min Design Depth for Optimisation (m)	1.200
Foul Sewage (l/s/ha)	0.000	Min Vel for Auto Design only (m/s)	1.00
Volumetric Runoff Coeff.	0.750	Min Slope for Optimisation (1:X)	500

Designed with Level Soffits

1 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

Areal Reduction Factor 1.000 Additional Flow - % of Total Flow 0.000
Hot Start (mins) 0 MADD Factor * 10m³/ha Storage 2.000
Hot Start Level (mm) 0 Inlet Coeffiecient 0.800
Manhole Headloss Coeff (Global) 0.500 Flow per Person per Day (l/per/day) 0.000
Foul Sewage per hectare (l/s) 0.000

Number of Input Hydrographs 0 Number of Storage Structures 5
Number of Online Controls 1 Number of Time/Area Diagrams 0
Number of Offline Controls 0 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FSR Ratio R 0.400
Region England and Wales Cv (Summer) 0.750
M5-60 (mm) 17.000 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0
Analysis Timestep 2.5 Second Increment (Extended)
DTS Status OFF
DVD Status ON
Inertia Status ON

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720
Return Period(s) (years) 1, 2, 5, 10, 15, 20, 25, 30
Climate Change (%) 25, 25, 25, 25, 25, 25, 25, 25

WARNING: Half Drain Time has not been calculated as the structure is too full.

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.
N-1.000	MH(N)-1	15 Winter	1	+25%	5/720 Winter	30/480 Winter		
N-1.001	MH(N)-2	15 Winter	1	+25%	5/600 Winter	30/480 Winter		
N-2.000	MH(N)-3	15 Winter	1	+25%	5/720 Winter	30/480 Winter		
N-2.001	MH(N)-4	15 Winter	1	+25%	5/480 Winter	30/480 Winter		
N-1.002	MH(N)-5	15 Winter	1	+25%	5/360 Winter	30/600 Winter		
N-3.000	MH(N)-6	15 Winter	1	+25%	5/720 Winter	30/480 Winter		
N-3.001	MH(N)-7	15 Winter	1	+25%	5/600 Winter	30/480 Winter		
N-4.000	MH(N)-8	15 Winter	1	+25%	5/720 Winter	30/480 Winter		
N-4.001	MH(N)-9	15 Winter	1	+25%	5/600 Winter	30/480 Winter		
N-4.002	MH(N)-10	720 Winter	1	+25%	5/360 Winter	30/480 Winter		
N-1.003	MH(N)-11	720 Winter	1	+25%	1/180 Winter			
N-5.000	MH(N)-12	15 Winter	1	+25%	5/720 Winter	30/600 Winter		
N-5.001	MH(N)-13	15 Winter	1	+25%	5/600 Winter			
N-6.000	MH(N)-14	15 Winter	1	+25%	5/720 Winter	30/480 Winter		
N-6.001	MH(N)-15	15 Winter	1	+25%	5/480 Winter	30/480 Winter		

1 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status
N-1.000	MH(N)-1	3.605	-0.195	0.000	0.26			20.3	OK
N-1.001	MH(N)-2	3.419	-0.188	0.000	0.30			31.2	OK
N-2.000	MH(N)-3	3.708	-0.167	0.000	0.38			31.2	OK
N-2.001	MH(N)-4	3.266	-0.126	0.000	0.63			40.5	OK
N-1.002	MH(N)-5	3.130	-0.137	0.000	0.72		4	69.5	OK
N-3.000	MH(N)-6	3.533	-0.267	0.000	0.18			24.6	OK
N-3.001	MH(N)-7	3.250	-0.276	0.000	0.15			38.0	OK
N-4.000	MH(N)-8	3.623	-0.177	0.000	0.34			28.0	OK
N-4.001	MH(N)-9	3.273	-0.208	0.000	0.40			47.1	OK
N-4.002	MH(N)-10	3.062	-0.202	0.000	0.03			6.2	OK
N-1.003	MH(N)-11	3.062	0.312	0.000	0.09			17.0	SURCHARGED
N-5.000	MH(N)-12	3.538	-0.262	0.000	0.19			26.9	OK
N-5.001	MH(N)-13	3.162	-0.356	0.000	0.09			42.0	OK
N-6.000	MH(N)-14	3.550	-0.250	0.000	0.23			36.3	OK
N-6.001	MH(N)-15	3.125	-0.230	0.000	0.46			77.1	OK

PN	US/MH Name	Level Exceeded
N-1.000	MH(N)-1	3
N-1.001	MH(N)-2	3
N-2.000	MH(N)-3	3
N-2.001	MH(N)-4	3
N-1.002	MH(N)-5	1
N-3.000	MH(N)-6	3
N-3.001	MH(N)-7	2
N-4.000	MH(N)-8	3
N-4.001	MH(N)-9	3
N-4.002	MH(N)-10	3
N-1.003	MH(N)-11	
N-5.000	MH(N)-12	
N-5.001	MH(N)-13	
N-6.000	MH(N)-14	3
N-6.001	MH(N)-15	3

1 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow
N-6.002	MH(N)-16	720 Winter	1	+25%	2/480 Winter		
N-1.004	MH(N)-17	720 Winter	1	+25%	1/120 Summer		
N-7.000	MH(N)-18	15 Winter	1	+25%	5/600 Winter		
N-8.000	MH(N)-19	15 Winter	1	+25%	5/720 Winter	30/480 Winter	
N-8.001	MH(N)-20	15 Winter	1	+25%	5/600 Winter	30/480 Winter	
N-8.002	MH(N)-21	720 Winter	1	+25%	2/720 Winter	30/600 Winter	
N-8.003	MH(N)-22	720 Winter	1	+25%	1/600 Winter		
N-1.005	MH(N)-23	720 Winter	1	+25%	1/60 Winter		
N-9.000	MH(N)-24	15 Winter	1	+25%	5/720 Winter		
N-10.000	MH(N)-25	15 Winter	1	+25%	5/720 Winter	30/480 Winter	
N-10.001	MH(N)-26	15 Winter	1	+25%	5/480 Winter		
N-10.002	MH(N)-27	720 Winter	1	+25%	2/480 Winter		
N-1.006	MH(N)-28	720 Winter	1	+25%	1/15 Summer		
N-1.007	MH(N)-EX-37	720 Winter	1	+25%	1/15 Summer		

PN	US/MH Name	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)
N-6.002	MH(N)-16		3.062	-0.064	0.000	0.02			8.3
N-1.004	MH(N)-17		3.062	0.462	0.000	0.04			21.3
N-7.000	MH(N)-18		3.319	-0.265	0.000	0.18			44.6
N-8.000	MH(N)-19		3.565	-0.235	0.000	0.45			101.0
N-8.001	MH(N)-20		3.268	-0.275	0.000	0.44			127.3
N-8.002	MH(N)-21		3.062	-0.181	0.000	0.05			16.1
N-8.003	MH(N)-22		3.062	0.069	0.000	0.04			15.8
N-1.005	MH(N)-23		3.062	0.551	0.000	0.03			22.4
N-9.000	MH(N)-24		3.485	-0.200	0.000	0.24			48.6
N-10.000	MH(N)-25		3.505	-0.295	0.000	0.25			58.8
N-10.001	MH(N)-26		3.121	-0.237	0.000	0.45			93.5
N-10.002	MH(N)-27		3.062	-0.017	0.000	0.02			9.7
N-1.006	MH(N)-28		3.062	1.137	0.000	0.02			3.0
N-1.007	MH(N)-EX-37		3.062	1.451	0.000	0.00			0.0

PN	US/MH Name	Status	Level Exceeded
N-6.002	MH(N)-16	OK	
N-1.004	MH(N)-17	SURCHARGED	
N-7.000	MH(N)-18	OK	
N-8.000	MH(N)-19	OK	3
N-8.001	MH(N)-20	OK	3
N-8.002	MH(N)-21	OK	1
N-8.003	MH(N)-22	SURCHARGED	

1 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Status	Level Exceeded
N-1.005	MH(N)-23	SURCHARGED	
N-9.000	MH(N)-24	OK	
N-10.000	MH(N)-25	OK	3
N-10.001	MH(N)-26	OK	
N-10.002	MH(N)-27	OK	
N-1.006	MH(N)-28	SURCHARGED	
N-1.007	MH(N)-EX-37	SURCHARGED	

2 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

Areal Reduction Factor 1.000 Additional Flow - % of Total Flow 0.000
Hot Start (mins) 0 MADD Factor * 10m³/ha Storage 2.000
Hot Start Level (mm) 0 Inlet Coeffiecient 0.800
Manhole Headloss Coeff (Global) 0.500 Flow per Person per Day (l/per/day) 0.000
Foul Sewage per hectare (l/s) 0.000

Number of Input Hydrographs 0 Number of Storage Structures 5
Number of Online Controls 1 Number of Time/Area Diagrams 0
Number of Offline Controls 0 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FSR Ratio R 0.400
Region England and Wales Cv (Summer) 0.750
M5-60 (mm) 17.000 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0
Analysis Timestep 2.5 Second Increment (Extended)
DTS Status OFF
DVD Status ON
Inertia Status ON

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720
Return Period(s) (years) 1, 2, 5, 10, 15, 20, 25, 30
Climate Change (%) 25, 25, 25, 25, 25, 25, 25, 25

WARNING: Half Drain Time has not been calculated as the structure is too full.

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.
N-1.000	MH(N)-1	15 Winter	2	+25%	5/720 Winter	30/480 Winter		
N-1.001	MH(N)-2	15 Winter	2	+25%	5/600 Winter	30/480 Winter		
N-2.000	MH(N)-3	15 Winter	2	+25%	5/720 Winter	30/480 Winter		
N-2.001	MH(N)-4	15 Winter	2	+25%	5/480 Winter	30/480 Winter		
N-1.002	MH(N)-5	720 Winter	2	+25%	5/360 Winter	30/600 Winter		
N-3.000	MH(N)-6	15 Winter	2	+25%	5/720 Winter	30/480 Winter		
N-3.001	MH(N)-7	15 Winter	2	+25%	5/600 Winter	30/480 Winter		
N-4.000	MH(N)-8	15 Winter	2	+25%	5/720 Winter	30/480 Winter		
N-4.001	MH(N)-9	15 Winter	2	+25%	5/600 Winter	30/480 Winter		
N-4.002	MH(N)-10	720 Winter	2	+25%	5/360 Winter	30/480 Winter		
N-1.003	MH(N)-11	720 Winter	2	+25%	1/180 Winter			
N-5.000	MH(N)-12	15 Winter	2	+25%	5/720 Winter	30/600 Winter		
N-5.001	MH(N)-13	720 Winter	2	+25%	5/600 Winter			
N-6.000	MH(N)-14	15 Winter	2	+25%	5/720 Winter	30/480 Winter		
N-6.001	MH(N)-15	720 Winter	2	+25%	5/480 Winter	30/480 Winter		

2 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status
N-1.000	MH(N)-1	3.621	-0.179	0.000	0.34			26.3	OK
N-1.001	MH(N)-2	3.437	-0.170	0.000	0.39			40.4	OK
N-2.000	MH(N)-3	3.730	-0.145	0.000	0.49			40.4	OK
N-2.001	MH(N)-4	3.300	-0.092	0.000	0.81			52.4	OK
N-1.002	MH(N)-5	3.251	-0.016	0.000	0.09			8.8	OK
N-3.000	MH(N)-6	3.548	-0.252	0.000	0.23			31.7	OK
N-3.001	MH(N)-7	3.265	-0.261	0.000	0.20			48.9	OK
N-4.000	MH(N)-8	3.643	-0.157	0.000	0.44			36.2	OK
N-4.001	MH(N)-9	3.301	-0.180	0.000	0.51			61.0	OK
N-4.002	MH(N)-10	3.251	-0.013	0.000	0.04			7.6	OK
N-1.003	MH(N)-11	3.251	0.501	0.000	0.10			19.1	SURCHARGED
N-5.000	MH(N)-12	3.554	-0.246	0.000	0.25			34.7	OK
N-5.001	MH(N)-13	3.252	-0.266	0.000	0.01			5.0	OK
N-6.000	MH(N)-14	3.569	-0.231	0.000	0.30			47.1	OK
N-6.001	MH(N)-15	3.252	-0.103	0.000	0.06			10.2	OK

PN	US/MH Name	Level Exceeded
N-1.000	MH(N)-1	3
N-1.001	MH(N)-2	3
N-2.000	MH(N)-3	3
N-2.001	MH(N)-4	3
N-1.002	MH(N)-5	1
N-3.000	MH(N)-6	3
N-3.001	MH(N)-7	2
N-4.000	MH(N)-8	3
N-4.001	MH(N)-9	3
N-4.002	MH(N)-10	3
N-1.003	MH(N)-11	
N-5.000	MH(N)-12	
N-5.001	MH(N)-13	
N-6.000	MH(N)-14	3
N-6.001	MH(N)-15	3

2 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow
N-6.002	MH(N)-16	720 Winter	2	+25%	2/480 Winter		
N-1.004	MH(N)-17	720 Winter	2	+25%	1/120 Summer		
N-7.000	MH(N)-18	15 Winter	2	+25%	5/600 Winter		
N-8.000	MH(N)-19	15 Winter	2	+25%	5/720 Winter	30/480 Winter	
N-8.001	MH(N)-20	15 Winter	2	+25%	5/600 Winter	30/480 Winter	
N-8.002	MH(N)-21	720 Winter	2	+25%	2/720 Winter	30/600 Winter	
N-8.003	MH(N)-22	720 Winter	2	+25%	1/600 Winter		
N-1.005	MH(N)-23	720 Winter	2	+25%	1/60 Winter		
N-9.000	MH(N)-24	15 Winter	2	+25%	5/720 Winter		
N-10.000	MH(N)-25	15 Winter	2	+25%	5/720 Winter	30/480 Winter	
N-10.001	MH(N)-26	720 Winter	2	+25%	5/480 Winter		
N-10.002	MH(N)-27	720 Winter	2	+25%	2/480 Winter		
N-1.006	MH(N)-28	720 Winter	2	+25%	1/15 Summer		
N-1.007	MH(N)-EX-37	720 Winter	2	+25%	1/15 Summer		

PN	US/MH Name	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)
N-6.002	MH(N)-16		3.252	0.126	0.000	0.03			10.1
N-1.004	MH(N)-17		3.252	0.652	0.000	0.05			23.4
N-7.000	MH(N)-18		3.334	-0.250	0.000	0.24			57.6
N-8.000	MH(N)-19		3.602	-0.198	0.000	0.58			130.7
N-8.001	MH(N)-20		3.311	-0.232	0.000	0.57			164.8
N-8.002	MH(N)-21		3.252	0.009	0.000	0.06			19.6
N-8.003	MH(N)-22		3.252	0.259	0.000	0.04			18.7
N-1.005	MH(N)-23		3.252	0.741	0.000	0.04			23.4
N-9.000	MH(N)-24		3.500	-0.185	0.000	0.31			62.9
N-10.000	MH(N)-25		3.530	-0.270	0.000	0.32			76.2
N-10.001	MH(N)-26		3.252	-0.106	0.000	0.06			11.8
N-10.002	MH(N)-27		3.252	0.173	0.000	0.03			11.7
N-1.006	MH(N)-28		3.252	1.327	0.000	0.02			3.2
N-1.007	MH(N)-EX-37		3.252	1.641	0.000	0.00			0.0

PN	US/MH Name	Status	Level Exceeded
N-6.002	MH(N)-16	SURCHARGED	
N-1.004	MH(N)-17	SURCHARGED	
N-7.000	MH(N)-18	OK	
N-8.000	MH(N)-19	OK	3
N-8.001	MH(N)-20	OK	3
N-8.002	MH(N)-21	SURCHARGED	1
N-8.003	MH(N)-22	SURCHARGED	

2 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Status	Level Exceeded
N-1.005	MH(N)-23	SURCHARGED	
N-9.000	MH(N)-24	OK	
N-10.000	MH(N)-25	OK	3
N-10.001	MH(N)-26	OK	
N-10.002	MH(N)-27	SURCHARGED	
N-1.006	MH(N)-28	SURCHARGED	
N-1.007	MH(N)-EX-37	SURCHARGED	

5 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs	0	Number of Storage Structures	5
Number of Online Controls	1	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Ratio R	0.400
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	17.000	Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	300.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	OFF
DVD Status	ON
Inertia Status	ON

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720
Return Period(s) (years)	1, 2, 5, 10, 15, 20, 25, 30
Climate Change (%)	25, 25, 25, 25, 25, 25, 25, 25

WARNING: Half Drain Time has not been calculated as the structure is too full.

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.
N-1.000	MH(N)-1	720 Winter	5	+25%	5/720 Winter	30/480 Winter		
N-1.001	MH(N)-2	720 Winter	5	+25%	5/600 Winter	30/480 Winter		
N-2.000	MH(N)-3	720 Winter	5	+25%	5/720 Winter	30/480 Winter		
N-2.001	MH(N)-4	720 Winter	5	+25%	5/480 Winter	30/480 Winter		
N-1.002	MH(N)-5	720 Winter	5	+25%	5/360 Winter	30/600 Winter		
N-3.000	MH(N)-6	720 Winter	5	+25%	5/720 Winter	30/480 Winter		
N-3.001	MH(N)-7	720 Winter	5	+25%	5/600 Winter	30/480 Winter		
N-4.000	MH(N)-8	720 Winter	5	+25%	5/720 Winter	30/480 Winter		
N-4.001	MH(N)-9	720 Winter	5	+25%	5/600 Winter	30/480 Winter		
N-4.002	MH(N)-10	720 Winter	5	+25%	5/360 Winter	30/480 Winter		
N-1.003	MH(N)-11	720 Winter	5	+25%	1/180 Winter			
N-5.000	MH(N)-12	720 Winter	5	+25%	5/720 Winter	30/600 Winter		
N-5.001	MH(N)-13	720 Winter	5	+25%	5/600 Winter			
N-6.000	MH(N)-14	720 Winter	5	+25%	5/720 Winter	30/480 Winter		
N-6.001	MH(N)-15	720 Winter	5	+25%	5/480 Winter	30/480 Winter		

5 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status
N-1.000	MH(N)-1	3.879	0.079	0.000	0.04			2.9	SURCHARGED
N-1.001	MH(N)-2	3.879	0.272	0.000	0.04			4.6	SURCHARGED
N-2.000	MH(N)-3	3.879	0.004	0.000	0.06			4.6	SURCHARGED
N-2.001	MH(N)-4	3.879	0.487	0.000	0.10			6.2	SURCHARGED
N-1.002	MH(N)-5	3.878	0.611	0.000	0.11			10.9	SURCHARGED
N-3.000	MH(N)-6	3.877	0.077	0.000	0.02			3.4	SURCHARGED
N-3.001	MH(N)-7	3.877	0.351	0.000	0.02			5.6	SURCHARGED
N-4.000	MH(N)-8	3.878	0.078	0.000	0.05			4.0	SURCHARGED
N-4.001	MH(N)-9	3.878	0.397	0.000	0.06			7.4	SURCHARGED
N-4.002	MH(N)-10	3.878	0.614	0.000	0.05			9.3	SURCHARGED
N-1.003	MH(N)-11	3.877	1.127	0.000	0.11			20.6	SURCHARGED
N-5.000	MH(N)-12	3.876	0.076	0.000	0.03			3.7	SURCHARGED
N-5.001	MH(N)-13	3.875	0.357	0.000	0.01			6.2	SURCHARGED
N-6.000	MH(N)-14	3.876	0.076	0.000	0.03			5.1	SURCHARGED
N-6.001	MH(N)-15	3.876	0.521	0.000	0.07			12.5	SURCHARGED

PN	US/MH Name	Level Exceeded
N-1.000	MH(N)-1	3
N-1.001	MH(N)-2	3
N-2.000	MH(N)-3	3
N-2.001	MH(N)-4	3
N-1.002	MH(N)-5	1
N-3.000	MH(N)-6	3
N-3.001	MH(N)-7	2
N-4.000	MH(N)-8	3
N-4.001	MH(N)-9	3
N-4.002	MH(N)-10	3
N-1.003	MH(N)-11	
N-5.000	MH(N)-12	
N-5.001	MH(N)-13	
N-6.000	MH(N)-14	3
N-6.001	MH(N)-15	3

5 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow
N-6.002	MH(N)-16	720 Winter	5	+25%	2/480 Winter		
N-1.004	MH(N)-17	720 Winter	5	+25%	1/120 Summer		
N-7.000	MH(N)-18	720 Winter	5	+25%	5/600 Winter		
N-8.000	MH(N)-19	720 Winter	5	+25%	5/720 Winter	30/480 Winter	
N-8.001	MH(N)-20	720 Winter	5	+25%	5/600 Winter	30/480 Winter	
N-8.002	MH(N)-21	720 Winter	5	+25%	2/720 Winter	30/600 Winter	
N-8.003	MH(N)-22	720 Winter	5	+25%	1/600 Winter		
N-1.005	MH(N)-23	720 Winter	5	+25%	1/60 Winter		
N-9.000	MH(N)-24	720 Winter	5	+25%	5/720 Winter		
N-10.000	MH(N)-25	720 Winter	5	+25%	5/720 Winter	30/480 Winter	
N-10.001	MH(N)-26	720 Winter	5	+25%	5/480 Winter		
N-10.002	MH(N)-27	720 Winter	5	+25%	2/480 Winter		
N-1.006	MH(N)-28	720 Winter	5	+25%	1/15 Summer		
N-1.007	MH(N)-EX-37	720 Winter	5	+25%	1/15 Summer		

PN	US/MH Name	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)
N-6.002	MH(N)-16		3.876	0.750	0.000	0.03			11.9
N-1.004	MH(N)-17		3.876	1.276	0.000	0.05			26.2
N-7.000	MH(N)-18		3.875	0.291	0.000	0.03			6.2
N-8.000	MH(N)-19		3.878	0.078	0.000	0.06			14.2
N-8.001	MH(N)-20		3.877	0.334	0.000	0.07			19.3
N-8.002	MH(N)-21		3.877	0.634	0.000	0.07			23.4
N-8.003	MH(N)-22		3.876	0.883	0.000	0.05			22.5
N-1.005	MH(N)-23		3.875	1.364	0.000	0.04			27.9
N-9.000	MH(N)-24		3.875	0.190	0.000	0.03			6.7
N-10.000	MH(N)-25		3.876	0.076	0.000	0.04			8.4
N-10.001	MH(N)-26		3.876	0.518	0.000	0.07			14.5
N-10.002	MH(N)-27		3.875	0.796	0.000	0.03			13.6
N-1.006	MH(N)-28		3.874	1.949	0.000	0.09			13.8
N-1.007	MH(N)-EX-37		3.706	2.095	0.000	0.06			13.8

PN	US/MH Name	Status	Level Exceeded
N-6.002	MH(N)-16	SURCHARGED	
N-1.004	MH(N)-17	SURCHARGED	
N-7.000	MH(N)-18	SURCHARGED	
N-8.000	MH(N)-19	SURCHARGED	3
N-8.001	MH(N)-20	SURCHARGED	3
N-8.002	MH(N)-21	SURCHARGED	1
N-8.003	MH(N)-22	SURCHARGED	

5 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Status	Level Exceeded
N-1.005	MH(N)-23	SURCHARGED	
N-9.000	MH(N)-24	SURCHARGED	
N-10.000	MH(N)-25	SURCHARGED	3
N-10.001	MH(N)-26	SURCHARGED	
N-10.002	MH(N)-27	SURCHARGED	
N-1.006	MH(N)-28	SURCHARGED	
N-1.007	MH(N)-EX-37	FLOOD RISK	

10 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs	0	Number of Storage Structures	5
Number of Online Controls	1	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Ratio R	0.400
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	17.000	Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	300.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	OFF
DVD Status	ON
Inertia Status	ON

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720
Return Period(s) (years)	1, 2, 5, 10, 15, 20, 25, 30
Climate Change (%)	25, 25, 25, 25, 25, 25, 25, 25

WARNING: Half Drain Time has not been calculated as the structure is too full.

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.
N-1.000	MH(N)-1	720 Winter	10	+25%	5/720 Winter	30/480 Winter		
N-1.001	MH(N)-2	720 Winter	10	+25%	5/600 Winter	30/480 Winter		
N-2.000	MH(N)-3	720 Winter	10	+25%	5/720 Winter	30/480 Winter		
N-2.001	MH(N)-4	720 Winter	10	+25%	5/480 Winter	30/480 Winter		
N-1.002	MH(N)-5	720 Winter	10	+25%	5/360 Winter	30/600 Winter		
N-3.000	MH(N)-6	720 Winter	10	+25%	5/720 Winter	30/480 Winter		
N-3.001	MH(N)-7	720 Winter	10	+25%	5/600 Winter	30/480 Winter		
N-4.000	MH(N)-8	720 Winter	10	+25%	5/720 Winter	30/480 Winter		
N-4.001	MH(N)-9	720 Winter	10	+25%	5/600 Winter	30/480 Winter		
N-4.002	MH(N)-10	720 Winter	10	+25%	5/360 Winter	30/480 Winter		
N-1.003	MH(N)-11	720 Winter	10	+25%	1/180 Winter			
N-5.000	MH(N)-12	720 Winter	10	+25%	5/720 Winter	30/600 Winter		
N-5.001	MH(N)-13	720 Winter	10	+25%	5/600 Winter			
N-6.000	MH(N)-14	720 Winter	10	+25%	5/720 Winter	30/480 Winter		
N-6.001	MH(N)-15	720 Winter	10	+25%	5/480 Winter	30/480 Winter		

10 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status
N-1.000	MH(N)-1	4.095	0.295	0.000	0.04			3.3	SURCHARGED
N-1.001	MH(N)-2	4.093	0.486	0.000	0.05			5.4	SURCHARGED
N-2.000	MH(N)-3	4.097	0.222	0.000	0.06			5.3	SURCHARGED
N-2.001	MH(N)-4	4.094	0.702	0.000	0.11			7.2	SURCHARGED
N-1.002	MH(N)-5	4.091	0.824	0.000	0.13			12.6	SURCHARGED
N-3.000	MH(N)-6	4.091	0.291	0.000	0.03			4.0	SURCHARGED
N-3.001	MH(N)-7	4.090	0.564	0.000	0.03			6.5	SURCHARGED
N-4.000	MH(N)-8	4.095	0.295	0.000	0.06			4.6	SURCHARGED
N-4.001	MH(N)-9	4.093	0.612	0.000	0.07			8.6	SURCHARGED
N-4.002	MH(N)-10	4.091	0.827	0.000	0.05			10.6	SURCHARGED
N-1.003	MH(N)-11	4.089	1.339	0.000	0.11			21.3	SURCHARGED
N-5.000	MH(N)-12	4.087	0.287	0.000	0.03			4.4	SURCHARGED
N-5.001	MH(N)-13	4.086	0.568	0.000	0.02			7.2	SURCHARGED
N-6.000	MH(N)-14	4.091	0.291	0.000	0.04			6.0	SURCHARGED
N-6.001	MH(N)-15	4.090	0.735	0.000	0.09			14.4	SURCHARGED

PN	US/MH Name	Level Exceeded
N-1.000	MH(N)-1	3
N-1.001	MH(N)-2	3
N-2.000	MH(N)-3	3
N-2.001	MH(N)-4	3
N-1.002	MH(N)-5	1
N-3.000	MH(N)-6	3
N-3.001	MH(N)-7	2
N-4.000	MH(N)-8	3
N-4.001	MH(N)-9	3
N-4.002	MH(N)-10	3
N-1.003	MH(N)-11	
N-5.000	MH(N)-12	
N-5.001	MH(N)-13	
N-6.000	MH(N)-14	3
N-6.001	MH(N)-15	3

10 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow
N-6.002	MH(N)-16	720 Winter	10	+25%	2/480 Winter		
N-1.004	MH(N)-17	720 Winter	10	+25%	1/120 Summer		
N-7.000	MH(N)-18	720 Winter	10	+25%	5/600 Winter		
N-8.000	MH(N)-19	720 Winter	10	+25%	5/720 Winter	30/480 Winter	
N-8.001	MH(N)-20	720 Winter	10	+25%	5/600 Winter	30/480 Winter	
N-8.002	MH(N)-21	720 Winter	10	+25%	2/720 Winter	30/600 Winter	
N-8.003	MH(N)-22	720 Winter	10	+25%	1/600 Winter		
N-1.005	MH(N)-23	720 Winter	10	+25%	1/60 Winter		
N-9.000	MH(N)-24	720 Winter	10	+25%	5/720 Winter		
N-10.000	MH(N)-25	720 Winter	10	+25%	5/720 Winter	30/480 Winter	
N-10.001	MH(N)-26	720 Winter	10	+25%	5/480 Winter		
N-10.002	MH(N)-27	720 Winter	10	+25%	2/480 Winter		
N-1.006	MH(N)-28	720 Winter	10	+25%	1/15 Summer		
N-1.007	MH(N)-EX-37	720 Winter	10	+25%	1/15 Summer		

PN	US/MH Name	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)
N-6.002	MH(N)-16		4.087	0.961	0.000	0.04			13.0
N-1.004	MH(N)-17		4.085	1.485	0.000	0.05			26.1
N-7.000	MH(N)-18		4.085	0.501	0.000	0.03			7.3
N-8.000	MH(N)-19		4.094	0.294	0.000	0.07			16.5
N-8.001	MH(N)-20		4.091	0.548	0.000	0.08			22.3
N-8.002	MH(N)-21		4.088	0.845	0.000	0.09			27.9
N-8.003	MH(N)-22		4.086	1.093	0.000	0.07			27.9
N-1.005	MH(N)-23		4.083	1.572	0.000	0.04			26.7
N-9.000	MH(N)-24		4.084	0.399	0.000	0.04			7.8
N-10.000	MH(N)-25		4.088	0.288	0.000	0.04			9.7
N-10.001	MH(N)-26		4.086	0.728	0.000	0.08			16.7
N-10.002	MH(N)-27		4.083	1.004	0.000	0.04			15.9
N-1.006	MH(N)-28		4.081	2.156	0.000	0.21			32.0
N-1.007	MH(N)-EX-37		3.714	2.103	0.000	0.14			32.0

PN	US/MH Name	Status	Level Exceeded
N-6.002	MH(N)-16	SURCHARGED	
N-1.004	MH(N)-17	SURCHARGED	
N-7.000	MH(N)-18	SURCHARGED	
N-8.000	MH(N)-19	SURCHARGED	3
N-8.001	MH(N)-20	SURCHARGED	3
N-8.002	MH(N)-21	SURCHARGED	1
N-8.003	MH(N)-22	SURCHARGED	

10 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Status	Level Exceeded
N-1.005	MH(N)-23	SURCHARGED	
N-9.000	MH(N)-24	SURCHARGED	
N-10.000	MH(N)-25	SURCHARGED	3
N-10.001	MH(N)-26	SURCHARGED	
N-10.002	MH(N)-27	SURCHARGED	
N-1.006	MH(N)-28	SURCHARGED	
N-1.007	MH(N)-EX-37	FLOOD RISK	

15 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

Areal Reduction Factor 1.000
Additional Flow - % of Total Flow 0.000
Hot Start (mins) 0
MADD Factor * 10m³/ha Storage 2.000
Hot Start Level (mm) 0
Inlet Coeffiecient 0.800
Manhole Headloss Coeff (Global) 0.500
Flow per Person per Day (l/per/day) 0.000
Foul Sewage per hectare (l/s) 0.000

Number of Input Hydrographs 0
Number of Storage Structures 5
Number of Online Controls 1
Number of Time/Area Diagrams 0
Number of Offline Controls 0
Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FSR
Ratio R 0.400
Region England and Wales
Cv (Summer) 0.750
M5-60 (mm) 17.000
Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0
Analysis Timestep 2.5 Second Increment (Extended)
DTS Status OFF
DVD Status ON
Inertia Status ON

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720
Return Period(s) (years) 1, 2, 5, 10, 15, 20, 25, 30
Climate Change (%) 25, 25, 25, 25, 25, 25, 25, 25

WARNING: Half Drain Time has not been calculated as the structure is too full.

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.
N-1.000	MH(N)-1	720 Winter	15	+25%	5/720 Winter	30/480 Winter		
N-1.001	MH(N)-2	720 Winter	15	+25%	5/600 Winter	30/480 Winter		
N-2.000	MH(N)-3	720 Winter	15	+25%	5/720 Winter	30/480 Winter		
N-2.001	MH(N)-4	720 Winter	15	+25%	5/480 Winter	30/480 Winter		
N-1.002	MH(N)-5	720 Winter	15	+25%	5/360 Winter	30/600 Winter		
N-3.000	MH(N)-6	720 Winter	15	+25%	5/720 Winter	30/480 Winter		
N-3.001	MH(N)-7	720 Winter	15	+25%	5/600 Winter	30/480 Winter		
N-4.000	MH(N)-8	720 Winter	15	+25%	5/720 Winter	30/480 Winter		
N-4.001	MH(N)-9	720 Winter	15	+25%	5/600 Winter	30/480 Winter		
N-4.002	MH(N)-10	720 Winter	15	+25%	5/360 Winter	30/480 Winter		
N-1.003	MH(N)-11	720 Winter	15	+25%	1/180 Winter			
N-5.000	MH(N)-12	720 Winter	15	+25%	5/720 Winter	30/600 Winter		
N-5.001	MH(N)-13	720 Winter	15	+25%	5/600 Winter			
N-6.000	MH(N)-14	720 Winter	15	+25%	5/720 Winter	30/480 Winter		
N-6.001	MH(N)-15	720 Winter	15	+25%	5/480 Winter	30/480 Winter		

15 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status
N-1.000	MH(N)-1	4.427	0.627	0.000	0.05			3.6	SURCHARGED
N-1.001	MH(N)-2	4.425	0.818	0.000	0.06			5.9	SURCHARGED
N-2.000	MH(N)-3	4.430	0.555	0.000	0.07			5.8	SURCHARGED
N-2.001	MH(N)-4	4.426	1.034	0.000	0.12			7.9	SURCHARGED
N-1.002	MH(N)-5	4.423	1.156	0.000	0.14			13.5	SURCHARGED
N-3.000	MH(N)-6	4.422	0.622	0.000	0.03			4.4	SURCHARGED
N-3.001	MH(N)-7	4.421	0.895	0.000	0.03			7.1	SURCHARGED
N-4.000	MH(N)-8	4.428	0.628	0.000	0.06			5.0	SURCHARGED
N-4.001	MH(N)-9	4.425	0.944	0.000	0.08			9.4	SURCHARGED
N-4.002	MH(N)-10	4.422	1.158	0.000	0.06			11.4	SURCHARGED
N-1.003	MH(N)-11	4.419	1.669	0.000	0.11			21.5	SURCHARGED
N-5.000	MH(N)-12	4.416	0.616	0.000	0.03			4.8	SURCHARGED
N-5.001	MH(N)-13	4.415	0.897	0.000	0.02			7.8	SURCHARGED
N-6.000	MH(N)-14	4.422	0.622	0.000	0.04			6.5	SURCHARGED
N-6.001	MH(N)-15	4.420	1.065	0.000	0.09			15.5	SURCHARGED

PN	US/MH Name	Level Exceeded
N-1.000	MH(N)-1	3
N-1.001	MH(N)-2	3
N-2.000	MH(N)-3	3
N-2.001	MH(N)-4	3
N-1.002	MH(N)-5	1
N-3.000	MH(N)-6	3
N-3.001	MH(N)-7	2
N-4.000	MH(N)-8	3
N-4.001	MH(N)-9	3
N-4.002	MH(N)-10	3
N-1.003	MH(N)-11	
N-5.000	MH(N)-12	
N-5.001	MH(N)-13	
N-6.000	MH(N)-14	3
N-6.001	MH(N)-15	3

15 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow
N-6.002	MH(N)-16	720 Winter	15	+25%	2/480 Winter		
N-1.004	MH(N)-17	720 Winter	15	+25%	1/120 Summer		
N-7.000	MH(N)-18	720 Winter	15	+25%	5/600 Winter		
N-8.000	MH(N)-19	720 Winter	15	+25%	5/720 Winter	30/480 Winter	
N-8.001	MH(N)-20	720 Winter	15	+25%	5/600 Winter	30/480 Winter	
N-8.002	MH(N)-21	720 Winter	15	+25%	2/720 Winter	30/600 Winter	
N-8.003	MH(N)-22	720 Winter	15	+25%	1/600 Winter		
N-1.005	MH(N)-23	720 Winter	15	+25%	1/60 Winter		
N-9.000	MH(N)-24	720 Winter	15	+25%	5/720 Winter		
N-10.000	MH(N)-25	720 Winter	15	+25%	5/720 Winter	30/480 Winter	
N-10.001	MH(N)-26	720 Winter	15	+25%	5/480 Winter		
N-10.002	MH(N)-27	720 Winter	15	+25%	2/480 Winter		
N-1.006	MH(N)-28	720 Winter	15	+25%	1/15 Summer		
N-1.007	MH(N)-EX-37	720 Winter	15	+25%	1/15 Summer		

PN	US/MH Name	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)
N-6.002	MH(N)-16		4.416	1.290	0.000	0.04			14.9
N-1.004	MH(N)-17		4.413	1.813	0.000	0.06			28.0
N-7.000	MH(N)-18		4.413	0.829	0.000	0.03			7.9
N-8.000	MH(N)-19		4.426	0.626	0.000	0.08			18.0
N-8.001	MH(N)-20		4.422	0.879	0.000	0.08			24.4
N-8.002	MH(N)-21		4.418	1.175	0.000	0.09			30.4
N-8.003	MH(N)-22		4.414	1.421	0.000	0.07			30.3
N-1.005	MH(N)-23		4.411	1.900	0.000	0.06			36.4
N-9.000	MH(N)-24		4.412	0.727	0.000	0.04			8.5
N-10.000	MH(N)-25		4.417	0.617	0.000	0.04			10.6
N-10.001	MH(N)-26		4.415	1.057	0.000	0.09			18.1
N-10.002	MH(N)-27		4.411	1.332	0.000	0.04			18.0
N-1.006	MH(N)-28		4.408	2.483	0.000	0.31			46.8
N-1.007	MH(N)-EX-37		3.721	2.110	0.000	0.20			46.8

PN	US/MH Name	Status	Level Exceeded
N-6.002	MH(N)-16	SURCHARGED	
N-1.004	MH(N)-17	SURCHARGED	
N-7.000	MH(N)-18	SURCHARGED	
N-8.000	MH(N)-19	SURCHARGED	3
N-8.001	MH(N)-20	SURCHARGED	3
N-8.002	MH(N)-21	SURCHARGED	1
N-8.003	MH(N)-22	SURCHARGED	

15 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Status	Level Exceeded
N-1.005	MH(N)-23	SURCHARGED	
N-9.000	MH(N)-24	SURCHARGED	
N-10.000	MH(N)-25	SURCHARGED	3
N-10.001	MH(N)-26	SURCHARGED	
N-10.002	MH(N)-27	SURCHARGED	
N-1.006	MH(N)-28	SURCHARGED	
N-1.007	MH(N)-EX-37	FLOOD RISK	

20 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

Areal Reduction Factor 1.000 Additional Flow - % of Total Flow 0.000
Hot Start (mins) 0 MADD Factor * 10m³/ha Storage 2.000
Hot Start Level (mm) 0 Inlet Coeffiecient 0.800
Manhole Headloss Coeff (Global) 0.500 Flow per Person per Day (l/per/day) 0.000
Foul Sewage per hectare (l/s) 0.000

Number of Input Hydrographs 0 Number of Storage Structures 5
Number of Online Controls 1 Number of Time/Area Diagrams 0
Number of Offline Controls 0 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FSR Ratio R 0.400
Region England and Wales Cv (Summer) 0.750
M5-60 (mm) 17.000 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0
Analysis Timestep 2.5 Second Increment (Extended)
DTS Status OFF
DVD Status ON
Inertia Status ON

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720
Return Period(s) (years) 1, 2, 5, 10, 15, 20, 25, 30
Climate Change (%) 25, 25, 25, 25, 25, 25, 25, 25

WARNING: Half Drain Time has not been calculated as the structure is too full.

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.
N-1.000	MH(N)-1	720 Winter	20	+25%	5/720 Winter	30/480 Winter		
N-1.001	MH(N)-2	720 Winter	20	+25%	5/600 Winter	30/480 Winter		
N-2.000	MH(N)-3	720 Winter	20	+25%	5/720 Winter	30/480 Winter		
N-2.001	MH(N)-4	720 Winter	20	+25%	5/480 Winter	30/480 Winter		
N-1.002	MH(N)-5	720 Winter	20	+25%	5/360 Winter	30/600 Winter		
N-3.000	MH(N)-6	720 Winter	20	+25%	5/720 Winter	30/480 Winter		
N-3.001	MH(N)-7	720 Winter	20	+25%	5/600 Winter	30/480 Winter		
N-4.000	MH(N)-8	720 Winter	20	+25%	5/720 Winter	30/480 Winter		
N-4.001	MH(N)-9	720 Winter	20	+25%	5/600 Winter	30/480 Winter		
N-4.002	MH(N)-10	720 Winter	20	+25%	5/360 Winter	30/480 Winter		
N-1.003	MH(N)-11	720 Winter	20	+25%	1/180 Winter			
N-5.000	MH(N)-12	720 Winter	20	+25%	5/720 Winter	30/600 Winter		
N-5.001	MH(N)-13	720 Winter	20	+25%	5/600 Winter			
N-6.000	MH(N)-14	720 Winter	20	+25%	5/720 Winter	30/480 Winter		
N-6.001	MH(N)-15	720 Winter	20	+25%	5/480 Winter	30/480 Winter		

20 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status
N-1.000	MH(N)-1	4.717	0.917	0.000	0.05			3.8	FLOOD RISK
N-1.001	MH(N)-2	4.715	1.108	0.000	0.06			6.2	FLOOD RISK
N-2.000	MH(N)-3	4.721	0.846	0.000	0.07			6.2	FLOOD RISK
N-2.001	MH(N)-4	4.716	1.324	0.000	0.13			8.4	FLOOD RISK
N-1.002	MH(N)-5	4.711	1.444	0.000	0.15			14.2	FLOOD RISK
N-3.000	MH(N)-6	4.711	0.911	0.000	0.03			4.6	FLOOD RISK
N-3.001	MH(N)-7	4.710	1.184	0.000	0.03			7.5	FLOOD RISK
N-4.000	MH(N)-8	4.719	0.919	0.000	0.07			5.3	FLOOD RISK
N-4.001	MH(N)-9	4.715	1.234	0.000	0.08			10.0	FLOOD RISK
N-4.002	MH(N)-10	4.711	1.447	0.000	0.06			11.9	FLOOD RISK
N-1.003	MH(N)-11	4.707	1.957	0.000	0.12			21.6	FLOOD RISK
N-5.000	MH(N)-12	4.704	0.904	0.000	0.04			5.1	FLOOD RISK
N-5.001	MH(N)-13	4.702	1.184	0.000	0.02			8.7	FLOOD RISK
N-6.000	MH(N)-14	4.711	0.911	0.000	0.04			6.9	FLOOD RISK
N-6.001	MH(N)-15	4.708	1.353	0.000	0.10			16.4	FLOOD RISK

PN	US/MH Name	Level Exceeded
N-1.000	MH(N)-1	3
N-1.001	MH(N)-2	3
N-2.000	MH(N)-3	3
N-2.001	MH(N)-4	3
N-1.002	MH(N)-5	1
N-3.000	MH(N)-6	3
N-3.001	MH(N)-7	2
N-4.000	MH(N)-8	3
N-4.001	MH(N)-9	3
N-4.002	MH(N)-10	3
N-1.003	MH(N)-11	
N-5.000	MH(N)-12	
N-5.001	MH(N)-13	
N-6.000	MH(N)-14	3
N-6.001	MH(N)-15	3

20 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow
N-6.002	MH(N)-16	720 Winter	20	+25%	2/480 Winter		
N-1.004	MH(N)-17	720 Winter	20	+25%	1/120 Summer		
N-7.000	MH(N)-18	720 Winter	20	+25%	5/600 Winter		
N-8.000	MH(N)-19	720 Winter	20	+25%	5/720 Winter	30/480 Winter	
N-8.001	MH(N)-20	720 Winter	20	+25%	5/600 Winter	30/480 Winter	
N-8.002	MH(N)-21	720 Winter	20	+25%	2/720 Winter	30/600 Winter	
N-8.003	MH(N)-22	720 Winter	20	+25%	1/600 Winter		
N-1.005	MH(N)-23	720 Winter	20	+25%	1/60 Winter		
N-9.000	MH(N)-24	720 Winter	20	+25%	5/720 Winter		
N-10.000	MH(N)-25	720 Winter	20	+25%	5/720 Winter	30/480 Winter	
N-10.001	MH(N)-26	720 Winter	20	+25%	5/480 Winter		
N-10.002	MH(N)-27	720 Winter	20	+25%	2/480 Winter		
N-1.006	MH(N)-28	720 Winter	20	+25%	1/15 Summer		
N-1.007	MH(N)-EX-37	720 Winter	20	+25%	1/15 Summer		

PN	US/MH Name	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)
N-6.002	MH(N)-16		4.704	1.578	0.000	0.04			16.2
N-1.004	MH(N)-17		4.700	2.100	0.000	0.05			27.2
N-7.000	MH(N)-18		4.700	1.116	0.000	0.03			8.4
N-8.000	MH(N)-19		4.715	0.915	0.000	0.09			19.1
N-8.001	MH(N)-20		4.711	1.168	0.000	0.09			25.6
N-8.002	MH(N)-21		4.706	1.463	0.000	0.10			31.6
N-8.003	MH(N)-22		4.701	1.708	0.000	0.08			31.5
N-1.005	MH(N)-23		4.697	2.186	0.000	0.07			44.2
N-9.000	MH(N)-24		4.698	1.013	0.000	0.04			9.1
N-10.000	MH(N)-25		4.705	0.905	0.000	0.05			11.3
N-10.001	MH(N)-26		4.702	1.344	0.000	0.09			19.5
N-10.002	MH(N)-27		4.697	1.618	0.000	0.04			19.4
N-1.006	MH(N)-28		4.693	2.768	0.000	0.38			56.7
N-1.007	MH(N)-EX-37		3.725	2.114	0.000	0.25			56.7

PN	US/MH Name	Status	Level Exceeded
N-6.002	MH(N)-16	FLOOD RISK	
N-1.004	MH(N)-17	FLOOD RISK	
N-7.000	MH(N)-18	FLOOD RISK	
N-8.000	MH(N)-19	FLOOD RISK	3
N-8.001	MH(N)-20	FLOOD RISK	3
N-8.002	MH(N)-21	FLOOD RISK	1
N-8.003	MH(N)-22	FLOOD RISK	

20 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Status	Level Exceeded
N-1.005	MH(N)-23	SURCHARGED	
N-9.000	MH(N)-24	SURCHARGED	
N-10.000	MH(N)-25	FLOOD RISK	3
N-10.001	MH(N)-26	FLOOD RISK	
N-10.002	MH(N)-27	SURCHARGED	
N-1.006	MH(N)-28	SURCHARGED	
N-1.007	MH(N)-EX-37	FLOOD RISK	

25 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs	0	Number of Storage Structures	5
Number of Online Controls	1	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Ratio R	0.400
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	17.000	Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	300.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	OFF
DVD Status	ON
Inertia Status	ON

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720
Return Period(s) (years)	1, 2, 5, 10, 15, 20, 25, 30
Climate Change (%)	25, 25, 25, 25, 25, 25, 25, 25

WARNING: Half Drain Time has not been calculated as the structure is too full.

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.
N-1.000	MH(N)-1	720 Winter	25	+25%	5/720 Winter	30/480 Winter		
N-1.001	MH(N)-2	720 Winter	25	+25%	5/600 Winter	30/480 Winter		
N-2.000	MH(N)-3	720 Winter	25	+25%	5/720 Winter	30/480 Winter		
N-2.001	MH(N)-4	720 Winter	25	+25%	5/480 Winter	30/480 Winter		
N-1.002	MH(N)-5	720 Winter	25	+25%	5/360 Winter	30/600 Winter		
N-3.000	MH(N)-6	720 Winter	25	+25%	5/720 Winter	30/480 Winter		
N-3.001	MH(N)-7	720 Winter	25	+25%	5/600 Winter	30/480 Winter		
N-4.000	MH(N)-8	720 Winter	25	+25%	5/720 Winter	30/480 Winter		
N-4.001	MH(N)-9	720 Winter	25	+25%	5/600 Winter	30/480 Winter		
N-4.002	MH(N)-10	720 Winter	25	+25%	5/360 Winter	30/480 Winter		
N-1.003	MH(N)-11	720 Winter	25	+25%	1/180 Winter			
N-5.000	MH(N)-12	720 Winter	25	+25%	5/720 Winter	30/600 Winter		
N-5.001	MH(N)-13	720 Winter	25	+25%	5/600 Winter			
N-6.000	MH(N)-14	720 Winter	25	+25%	5/720 Winter	30/480 Winter		
N-6.001	MH(N)-15	720 Winter	25	+25%	5/480 Winter	30/480 Winter		

25 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status
N-1.000	MH(N)-1	4.965	1.165	0.000	0.05			4.0	FLOOD RISK
N-1.001	MH(N)-2	4.963	1.356	0.000	0.06			6.6	FLOOD RISK
N-2.000	MH(N)-3	4.970	1.095	0.000	0.08			6.5	FLOOD RISK
N-2.001	MH(N)-4	4.964	1.572	0.000	0.14			8.8	FLOOD RISK
N-1.002	MH(N)-5	4.959	1.692	0.000	0.15			14.7	FLOOD RISK
N-3.000	MH(N)-6	4.958	1.158	0.000	0.04			4.9	FLOOD RISK
N-3.001	MH(N)-7	4.957	1.431	0.000	0.03			7.9	FLOOD RISK
N-4.000	MH(N)-8	4.967	1.167	0.000	0.07			5.6	FLOOD RISK
N-4.001	MH(N)-9	4.963	1.482	0.000	0.09			10.4	FLOOD RISK
N-4.002	MH(N)-10	4.958	1.694	0.000	0.06			12.3	FLOOD RISK
N-1.003	MH(N)-11	4.954	2.204	0.000	0.12			21.8	FLOOD RISK
N-5.000	MH(N)-12	4.950	1.150	0.000	0.04			5.3	FLOOD RISK
N-5.001	MH(N)-13	4.948	1.430	0.000	0.02			10.3	FLOOD RISK
N-6.000	MH(N)-14	4.958	1.158	0.000	0.05			7.3	FLOOD RISK
N-6.001	MH(N)-15	4.955	1.600	0.000	0.10			17.4	FLOOD RISK

PN	US/MH Name	Level Exceeded
N-1.000	MH(N)-1	3
N-1.001	MH(N)-2	3
N-2.000	MH(N)-3	3
N-2.001	MH(N)-4	3
N-1.002	MH(N)-5	1
N-3.000	MH(N)-6	3
N-3.001	MH(N)-7	2
N-4.000	MH(N)-8	3
N-4.001	MH(N)-9	3
N-4.002	MH(N)-10	3
N-1.003	MH(N)-11	
N-5.000	MH(N)-12	
N-5.001	MH(N)-13	
N-6.000	MH(N)-14	3
N-6.001	MH(N)-15	3

25 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow
N-6.002	MH(N)-16	720 Winter	25	+25%	2/480 Winter		
N-1.004	MH(N)-17	720 Winter	25	+25%	1/120 Summer		
N-7.000	MH(N)-18	720 Winter	25	+25%	5/600 Winter		
N-8.000	MH(N)-19	720 Winter	25	+25%	5/720 Winter	30/480 Winter	
N-8.001	MH(N)-20	720 Winter	25	+25%	5/600 Winter	30/480 Winter	
N-8.002	MH(N)-21	720 Winter	25	+25%	2/720 Winter	30/600 Winter	
N-8.003	MH(N)-22	720 Winter	25	+25%	1/600 Winter		
N-1.005	MH(N)-23	720 Winter	25	+25%	1/60 Winter		
N-9.000	MH(N)-24	720 Winter	25	+25%	5/720 Winter		
N-10.000	MH(N)-25	720 Winter	25	+25%	5/720 Winter	30/480 Winter	
N-10.001	MH(N)-26	720 Winter	25	+25%	5/480 Winter		
N-10.002	MH(N)-27	720 Winter	25	+25%	2/480 Winter		
N-1.006	MH(N)-28	720 Winter	25	+25%	1/15 Summer		
N-1.007	MH(N)-EX-37	720 Winter	25	+25%	1/15 Summer		

PN	US/MH Name	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)
N-6.002	MH(N)-16		4.950	1.824	0.000	0.05			17.1
N-1.004	MH(N)-17		4.946	2.346	0.000	0.06			30.2
N-7.000	MH(N)-18		4.946	1.362	0.000	0.04			8.8
N-8.000	MH(N)-19		4.963	1.163	0.000	0.09			20.0
N-8.001	MH(N)-20		4.958	1.415	0.000	0.09			26.8
N-8.002	MH(N)-21		4.952	1.709	0.000	0.10			33.6
N-8.003	MH(N)-22		4.947	1.954	0.000	0.08			33.4
N-1.005	MH(N)-23		4.942	2.431	0.000	0.08			50.8
N-9.000	MH(N)-24		4.944	1.259	0.000	0.05			9.5
N-10.000	MH(N)-25		4.951	1.151	0.000	0.05			11.8
N-10.001	MH(N)-26		4.948	1.590	0.000	0.10			20.4
N-10.002	MH(N)-27		4.942	1.863	0.000	0.05			20.2
N-1.006	MH(N)-28		4.938	3.013	0.000	0.43			65.3
N-1.007	MH(N)-EX-37		3.729	2.118	0.000	0.28			65.2

PN	US/MH Name	Status	Level Exceeded
N-6.002	MH(N)-16	FLOOD RISK	
N-1.004	MH(N)-17	FLOOD RISK	
N-7.000	MH(N)-18	FLOOD RISK	
N-8.000	MH(N)-19	FLOOD RISK	3
N-8.001	MH(N)-20	FLOOD RISK	3
N-8.002	MH(N)-21	FLOOD RISK	1
N-8.003	MH(N)-22	FLOOD RISK	

25 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Status	Level Exceeded
N-1.005	MH(N)-23	FLOOD RISK	
N-9.000	MH(N)-24	FLOOD RISK	
N-10.000	MH(N)-25	FLOOD RISK	3
N-10.001	MH(N)-26	FLOOD RISK	
N-10.002	MH(N)-27	FLOOD RISK	
N-1.006	MH(N)-28	FLOOD RISK	
N-1.007	MH(N)-EX-37	FLOOD RISK	

30 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

Areal Reduction Factor 1.000 Additional Flow - % of Total Flow 0.000
Hot Start (mins) 0 MADD Factor * 10m³/ha Storage 2.000
Hot Start Level (mm) 0 Inlet Coeffiecient 0.800
Manhole Headloss Coeff (Global) 0.500 Flow per Person per Day (l/per/day) 0.000
Foul Sewage per hectare (l/s) 0.000

Number of Input Hydrographs 0 Number of Storage Structures 5
Number of Online Controls 1 Number of Time/Area Diagrams 0
Number of Offline Controls 0 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FSR Ratio R 0.400
Region England and Wales Cv (Summer) 0.750
M5-60 (mm) 17.000 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0
Analysis Timestep 2.5 Second Increment (Extended)
DTS Status OFF
DVD Status ON
Inertia Status ON

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720
Return Period(s) (years) 1, 2, 5, 10, 15, 20, 25, 30
Climate Change (%) 25, 25, 25, 25, 25, 25, 25, 25

WARNING: Half Drain Time has not been calculated as the structure is too full.

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.
N-1.000	MH(N)-1	720 Winter	30	+25%	5/720 Winter	30/480 Winter		
N-1.001	MH(N)-2	720 Winter	30	+25%	5/600 Winter	30/480 Winter		
N-2.000	MH(N)-3	720 Winter	30	+25%	5/720 Winter	30/480 Winter		
N-2.001	MH(N)-4	720 Winter	30	+25%	5/480 Winter	30/480 Winter		
N-1.002	MH(N)-5	600 Winter	30	+25%	5/360 Winter	30/600 Winter		
N-3.000	MH(N)-6	600 Winter	30	+25%	5/720 Winter	30/480 Winter		
N-3.001	MH(N)-7	600 Winter	30	+25%	5/600 Winter	30/480 Winter		
N-4.000	MH(N)-8	720 Winter	30	+25%	5/720 Winter	30/480 Winter		
N-4.001	MH(N)-9	600 Winter	30	+25%	5/600 Winter	30/480 Winter		
N-4.002	MH(N)-10	600 Winter	30	+25%	5/360 Winter	30/480 Winter		
N-1.003	MH(N)-11	600 Winter	30	+25%	1/180 Winter			
N-5.000	MH(N)-12	600 Winter	30	+25%	5/720 Winter	30/600 Winter		
N-5.001	MH(N)-13	600 Winter	30	+25%	5/600 Winter			
N-6.000	MH(N)-14	600 Winter	30	+25%	5/720 Winter	30/480 Winter		
N-6.001	MH(N)-15	600 Winter	30	+25%	5/480 Winter	30/480 Winter		

30 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status
N-1.000	MH(N)-1	5.002	1.202	2.395	0.08			6.0	FLOOD
N-1.001	MH(N)-2	5.000	1.393	0.298	0.07			6.9	FLOOD
N-2.000	MH(N)-3	5.005	1.130	4.980	0.14			11.8	FLOOD
N-2.001	MH(N)-4	5.000	1.608	0.431	0.19			12.2	FLOOD
N-1.002	MH(N)-5	5.000	1.733	0.015	0.18			17.6	FLOOD
N-3.000	MH(N)-6	5.000	1.200	0.387	0.04			5.8	FLOOD
N-3.001	MH(N)-7	5.000	1.474	0.029	0.04			9.5	FLOOD
N-4.000	MH(N)-8	5.004	1.204	4.109	0.11			9.4	FLOOD
N-4.001	MH(N)-9	5.001	1.520	1.105	0.11			12.5	FLOOD
N-4.002	MH(N)-10	5.000	1.736	0.068	0.08			14.8	FLOOD
N-1.003	MH(N)-11	4.999	2.249	0.000	0.15			27.5	FLOOD RISK
N-5.000	MH(N)-12	5.000	1.200	0.012	0.05			6.4	FLOOD
N-5.001	MH(N)-13	4.997	1.479	0.000	0.02			10.4	FLOOD RISK
N-6.000	MH(N)-14	5.002	1.202	1.659	0.06			8.7	FLOOD
N-6.001	MH(N)-15	5.000	1.645	0.263	0.12			20.8	FLOOD

PN	US/MH Name	Level Exceeded
N-1.000	MH(N)-1	3
N-1.001	MH(N)-2	3
N-2.000	MH(N)-3	3
N-2.001	MH(N)-4	3
N-1.002	MH(N)-5	1
N-3.000	MH(N)-6	3
N-3.001	MH(N)-7	2
N-4.000	MH(N)-8	3
N-4.001	MH(N)-9	3
N-4.002	MH(N)-10	3
N-1.003	MH(N)-11	
N-5.000	MH(N)-12	
N-5.001	MH(N)-13	
N-6.000	MH(N)-14	3
N-6.001	MH(N)-15	3

30 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow
N-6.002	MH(N)-16	600 Winter	30	+25%	2/480 Winter		
N-1.004	MH(N)-17	600 Winter	30	+25%	1/120 Summer		
N-7.000	MH(N)-18	600 Winter	30	+25%	5/600 Winter		
N-8.000	MH(N)-19	720 Winter	30	+25%	5/720 Winter	30/480 Winter	
N-8.001	MH(N)-20	600 Winter	30	+25%	5/600 Winter	30/480 Winter	
N-8.002	MH(N)-21	600 Winter	30	+25%	2/720 Winter	30/600 Winter	
N-8.003	MH(N)-22	600 Winter	30	+25%	1/600 Winter		
N-1.005	MH(N)-23	600 Winter	30	+25%	1/60 Winter		
N-9.000	MH(N)-24	600 Winter	30	+25%	5/720 Winter		
N-10.000	MH(N)-25	600 Winter	30	+25%	5/720 Winter	30/480 Winter	
N-10.001	MH(N)-26	720 Winter	30	+25%	5/480 Winter		
N-10.002	MH(N)-27	720 Winter	30	+25%	2/480 Winter		
N-1.006	MH(N)-28	600 Winter	30	+25%	1/15 Summer		
N-1.007	MH(N)-EX-37	600 Winter	30	+25%	1/15 Summer		

PN	US/MH Name	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)
N-6.002	MH(N)-16		4.997	1.871	0.000	0.06			20.5
N-1.004	MH(N)-17		4.994	2.394	0.000	0.08			37.8
N-7.000	MH(N)-18		4.996	1.412	0.000	0.04			10.6
N-8.000	MH(N)-19		5.005	1.205	5.402	0.09			20.8
N-8.001	MH(N)-20		5.001	1.458	0.786	0.11			31.9
N-8.002	MH(N)-21		5.000	1.757	0.021	0.12			38.5
N-8.003	MH(N)-22		4.996	2.003	0.000	0.09			38.2
N-1.005	MH(N)-23		4.991	2.480	0.000	0.09			57.2
N-9.000	MH(N)-24		4.997	1.312	0.000	0.06			11.4
N-10.000	MH(N)-25		5.000	1.200	0.251	0.06			14.2
N-10.001	MH(N)-26		4.998	1.640	0.000	0.10			20.9
N-10.002	MH(N)-27		4.991	1.912	0.000	0.05			20.9
N-1.006	MH(N)-28		4.987	3.062	0.000	0.47			70.3
N-1.007	MH(N)-EX-37		3.731	2.120	0.000	0.30			70.1

PN	US/MH Name	Status	Level Exceeded
N-6.002	MH(N)-16	FLOOD RISK	
N-1.004	MH(N)-17	FLOOD RISK	
N-7.000	MH(N)-18	FLOOD RISK	
N-8.000	MH(N)-19	FLOOD	3
N-8.001	MH(N)-20	FLOOD	3
N-8.002	MH(N)-21	FLOOD	1
N-8.003	MH(N)-22	FLOOD RISK	

30 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Status	Level Exceeded
N-1.005	MH(N)-23	FLOOD RISK	
N-9.000	MH(N)-24	FLOOD RISK	
N-10.000	MH(N)-25	FLOOD	3
N-10.001	MH(N)-26	FLOOD RISK	
N-10.002	MH(N)-27	FLOOD RISK	
N-1.006	MH(N)-28	FLOOD RISK	
N-1.007	MH(N)-EX-37	FLOOD RISK	

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Storm

Pipe Sizes STANDARD Manhole Sizes ECC

FSR Rainfall Model - England and Wales

Return Period (years)	30	PIMP (%)	100
M5-60 (mm)	17.000	Add Flow / Climate Change (%)	0
Ratio R	0.400	Minimum Backdrop Height (m)	0.200
Maximum Rainfall (mm/hr)	50	Maximum Backdrop Height (m)	1.500
Maximum Time of Concentration (mins)	30	Min Design Depth for Optimisation (m)	1.200
Foul Sewage (l/s/ha)	0.000	Min Vel for Auto Design only (m/s)	1.00
Volumetric Runoff Coeff.	0.750	Min Slope for Optimisation (1:X)	500

Designed with Level Soffits

Simulation Criteria for Storm

Volumetric Runoff Coeff	0.750	Additional Flow - % of Total Flow	0.000
Areal Reduction Factor	1.000	MADD Factor * 10m³/ha Storage	2.000
Hot Start (mins)	0	Inlet Coeffiecient	0.800
Hot Start Level (mm)	0	Flow per Person per Day (l/per/day)	0.000
Manhole Headloss Coeff (Global)	0.500	Run Time (mins)	60
Foul Sewage per hectare (l/s)	0.000	Output Interval (mins)	1

Number of Input Hydrographs	0	Number of Storage Structures	5
Number of Online Controls	1	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Profile Type	Summer
Return Period (years)	30	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	17.000	Storm Duration (mins)	30
Ratio R	0.400		

1 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs	0	Number of Storage Structures	5
Number of Online Controls	1	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Ratio R	0.400
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	17.000	Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	300.0	DVD Status	OFF
Analysis Timestep	Fine	Inertia Status	OFF
DTS Status	ON		

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years)	1, 30, 100
Climate Change (%)	25, 25, 25

WARNING: Half Drain Time has not been calculated as the structure is too full.

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.
N-1.000	MH(N)-1	15 Winter	1	+25%				
N-1.001	MH(N)-2	15 Winter	1	+25%				
N-2.000	MH(N)-3	15 Winter	1	+25%	30/15 Summer			
N-2.001	MH(N)-4	15 Winter	1	+25%	30/15 Summer			
N-1.002	MH(N)-5	15 Winter	1	+25%	30/15 Winter			
N-3.000	MH(N)-6	15 Winter	1	+25%				
N-3.001	MH(N)-7	15 Winter	1	+25%				
N-4.000	MH(N)-8	15 Winter	1	+25%	100/15 Summer			
N-4.001	MH(N)-9	15 Winter	1	+25%	100/15 Summer			
N-4.002	MH(N)-10	15 Winter	1	+25%	100/60 Winter			
N-1.003	MH(N)-11	15 Winter	1	+25%	30/15 Summer			
N-5.000	MH(N)-12	15 Winter	1	+25%				
N-5.001	MH(N)-13	15 Winter	1	+25%				
N-6.000	MH(N)-14	15 Winter	1	+25%	100/15 Summer			
N-6.001	MH(N)-15	15 Winter	1	+25%	30/15 Summer			

1 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status
N-1.000	MH(N)-1	3.605	-0.195	0.000	0.26			20.3	OK
N-1.001	MH(N)-2	3.419	-0.188	0.000	0.30			31.2	OK
N-2.000	MH(N)-3	3.708	-0.167	0.000	0.38			31.2	OK
N-2.001	MH(N)-4	3.266	-0.126	0.000	0.63			40.5	OK
N-1.002	MH(N)-5	3.130	-0.137	0.000	0.72		4	69.5	OK
N-3.000	MH(N)-6	3.533	-0.267	0.000	0.18			24.6	OK
N-3.001	MH(N)-7	3.250	-0.276	0.000	0.15			38.0	OK
N-4.000	MH(N)-8	3.623	-0.177	0.000	0.34			28.0	OK
N-4.001	MH(N)-9	3.273	-0.208	0.000	0.40			47.1	OK
N-4.002	MH(N)-10	3.030	-0.234	0.000	0.30			58.3	OK
N-1.003	MH(N)-11	2.607	-0.143	0.000	0.80		3	150.3	OK
N-5.000	MH(N)-12	3.538	-0.262	0.000	0.19			26.9	OK
N-5.001	MH(N)-13	3.162	-0.356	0.000	0.09			42.0	OK
N-6.000	MH(N)-14	3.550	-0.250	0.000	0.23			36.3	OK
N-6.001	MH(N)-15	3.125	-0.230	0.000	0.46			77.1	OK

PN	US/MH Name	Level Exceeded
N-1.000	MH(N)-1	
N-1.001	MH(N)-2	
N-2.000	MH(N)-3	
N-2.001	MH(N)-4	
N-1.002	MH(N)-5	
N-3.000	MH(N)-6	
N-3.001	MH(N)-7	
N-4.000	MH(N)-8	
N-4.001	MH(N)-9	
N-4.002	MH(N)-10	
N-1.003	MH(N)-11	
N-5.000	MH(N)-12	
N-5.001	MH(N)-13	
N-6.000	MH(N)-14	
N-6.001	MH(N)-15	

1 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.
N-6.002	MH(N)-16	15 Winter	1	+25%	100/30 Winter			
N-1.004	MH(N)-17	60 Winter	1	+25%	30/15 Summer			
N-7.000	MH(N)-18	15 Winter	1	+25%				
N-8.000	MH(N)-19	15 Winter	1	+25%	30/15 Summer			
N-8.001	MH(N)-20	15 Winter	1	+25%	30/15 Summer			
N-8.002	MH(N)-21	15 Winter	1	+25%	30/15 Winter			
N-8.003	MH(N)-22	15 Winter	1	+25%	30/60 Winter			
N-1.005	MH(N)-23	60 Winter	1	+25%	30/15 Summer			
N-9.000	MH(N)-24	15 Winter	1	+25%				
N-10.000	MH(N)-25	15 Winter	1	+25%	100/15 Summer			
N-10.001	MH(N)-26	15 Winter	1	+25%	30/15 Summer			
N-10.002	MH(N)-27	15 Winter	1	+25%	100/30 Winter			
N-1.006	MH(N)-28	60 Winter	1	+25%	1/15 Summer			
N-1.007	MH(N)-EX-37	60 Winter	1	+25%				

PN	US/MH Name	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)
N-6.002	MH(N)-16	2.815	-0.311	0.000	0.21			76.8
N-1.004	MH(N)-17	2.388	-0.212	0.000	0.20		44	97.1
N-7.000	MH(N)-18	3.319	-0.265	0.000	0.18			44.6
N-8.000	MH(N)-19	3.565	-0.235	0.000	0.45			101.0
N-8.001	MH(N)-20	3.268	-0.275	0.000	0.44			127.3
N-8.002	MH(N)-21	2.971	-0.272	0.000	0.47			152.1
N-8.003	MH(N)-22	2.688	-0.305	0.000	0.37			152.9
N-1.005	MH(N)-23	2.385	-0.126	0.000	0.18		58	115.9
N-9.000	MH(N)-24	3.485	-0.200	0.000	0.24			48.6
N-10.000	MH(N)-25	3.505	-0.295	0.000	0.25			58.8
N-10.001	MH(N)-26	3.121	-0.237	0.000	0.45			93.5
N-10.002	MH(N)-27	2.769	-0.310	0.000	0.21			93.9
N-1.006	MH(N)-28	2.380	0.455	0.000	0.38			57.1
N-1.007	MH(N)-EX-37	1.262	-0.349	0.000	0.25			57.1

PN	US/MH Name	Status	Level Exceeded
N-6.002	MH(N)-16	OK	
N-1.004	MH(N)-17	OK	
N-7.000	MH(N)-18	OK	
N-8.000	MH(N)-19	OK	
N-8.001	MH(N)-20	OK	
N-8.002	MH(N)-21	OK	
N-8.003	MH(N)-22	OK	

1 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Status	Level Exceeded
N-1.005	MH(N)-23	OK	
N-9.000	MH(N)-24	OK	
N-10.000	MH(N)-25	OK	
N-10.001	MH(N)-26	OK	
N-10.002	MH(N)-27	OK	
N-1.006	MH(N)-28	SURCHARGED	
N-1.007	MH(N)-EX-37	OK	

30 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs	0	Number of Storage Structures	5
Number of Online Controls	1	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Ratio R	0.400
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	17.000	Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	300.0	DVD Status	OFF
Analysis Timestep	Fine	Inertia Status	OFF
DTS Status	ON		

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years)	1, 30, 100
Climate Change (%)	25, 25, 25

WARNING: Half Drain Time has not been calculated as the structure is too full.

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.
N-1.000	MH(N)-1	15 Winter	30	+25%				
N-1.001	MH(N)-2	15 Winter	30	+25%				
N-2.000	MH(N)-3	15 Winter	30	+25%	30/15 Summer			
N-2.001	MH(N)-4	15 Winter	30	+25%	30/15 Summer			
N-1.002	MH(N)-5	15 Winter	30	+25%	30/15 Winter			
N-3.000	MH(N)-6	15 Winter	30	+25%				
N-3.001	MH(N)-7	15 Winter	30	+25%				
N-4.000	MH(N)-8	15 Winter	30	+25%	100/15 Summer			
N-4.001	MH(N)-9	15 Winter	30	+25%	100/15 Summer			
N-4.002	MH(N)-10	15 Winter	30	+25%	100/60 Winter			
N-1.003	MH(N)-11	120 Winter	30	+25%	30/15 Summer			
N-5.000	MH(N)-12	15 Winter	30	+25%				
N-5.001	MH(N)-13	15 Winter	30	+25%				
N-6.000	MH(N)-14	15 Winter	30	+25%	100/15 Summer			
N-6.001	MH(N)-15	15 Winter	30	+25%	30/15 Summer			

30 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status
N-1.000	MH(N)-1	3.677	-0.123	0.000	0.63			49.6	OK
N-1.001	MH(N)-2	3.511	-0.096	0.000	0.78			81.1	OK
N-2.000	MH(N)-3	3.930	0.055	0.000	0.89			73.3	SURCHARGED
N-2.001	MH(N)-4	3.525	0.133	0.000	1.45			94.0	SURCHARGED
N-1.002	MH(N)-5	3.271	0.004	0.000	1.13		6	108.9	SURCHARGED
N-3.000	MH(N)-6	3.600	-0.200	0.000	0.43			59.6	OK
N-3.001	MH(N)-7	3.319	-0.207	0.000	0.40			99.2	OK
N-4.000	MH(N)-8	3.716	-0.084	0.000	0.84			68.4	OK
N-4.001	MH(N)-9	3.481	0.000	0.000	1.00			119.4	OK
N-4.002	MH(N)-10	3.137	-0.127	0.000	0.77			148.4	OK
N-1.003	MH(N)-11	3.041	0.291	0.000	0.66		64	123.1	SURCHARGED
N-5.000	MH(N)-12	3.609	-0.191	0.000	0.47			65.5	OK
N-5.001	MH(N)-13	3.222	-0.296	0.000	0.25			110.8	OK
N-6.000	MH(N)-14	3.633	-0.167	0.000	0.57			88.9	OK
N-6.001	MH(N)-15	3.464	0.109	0.000	1.19			199.8	SURCHARGED

PN	US/MH Name	Level Exceeded
N-1.000	MH(N)-1	
N-1.001	MH(N)-2	
N-2.000	MH(N)-3	
N-2.001	MH(N)-4	
N-1.002	MH(N)-5	
N-3.000	MH(N)-6	
N-3.001	MH(N)-7	
N-4.000	MH(N)-8	
N-4.001	MH(N)-9	
N-4.002	MH(N)-10	
N-1.003	MH(N)-11	
N-5.000	MH(N)-12	
N-5.001	MH(N)-13	
N-6.000	MH(N)-14	
N-6.001	MH(N)-15	

30 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow
N-6.002	MH(N)-16	120 Winter	30	+25%	100/30 Winter		
N-1.004	MH(N)-17	120 Winter	30	+25%	30/15 Summer		
N-7.000	MH(N)-18	15 Winter	30	+25%			
N-8.000	MH(N)-19	15 Winter	30	+25%	30/15 Summer		
N-8.001	MH(N)-20	15 Winter	30	+25%	30/15 Summer		
N-8.002	MH(N)-21	15 Winter	30	+25%	30/15 Winter		
N-8.003	MH(N)-22	120 Winter	30	+25%	30/60 Winter		
N-1.005	MH(N)-23	120 Winter	30	+25%	30/15 Summer		
N-9.000	MH(N)-24	15 Winter	30	+25%			
N-10.000	MH(N)-25	15 Winter	30	+25%	100/15 Summer		
N-10.001	MH(N)-26	15 Winter	30	+25%	30/15 Summer		
N-10.002	MH(N)-27	120 Winter	30	+25%	100/30 Winter		
N-1.006	MH(N)-28	120 Winter	30	+25%	1/15 Summer		
N-1.007	MH(N)-EX-37	120 Winter	30	+25%			

PN	US/MH Name	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)
N-6.002	MH(N)-16		3.033	-0.093	0.000	0.19			70.2
N-1.004	MH(N)-17		3.026	0.426	0.000	0.16		124	79.0
N-7.000	MH(N)-18		3.388	-0.196	0.000	0.45			108.9
N-8.000	MH(N)-19		3.879	0.079	0.000	1.06			236.9
N-8.001	MH(N)-20		3.597	0.054	0.000	1.05			300.8
N-8.002	MH(N)-21		3.264	0.021	0.000	1.07			348.8
N-8.003	MH(N)-22		3.028	0.035	0.000	0.31			131.1
N-1.005	MH(N)-23		3.018	0.507	0.000	0.16		140	100.4
N-9.000	MH(N)-24		3.552	-0.133	0.000	0.59			118.9
N-10.000	MH(N)-25		3.611	-0.189	0.000	0.61			143.8
N-10.001	MH(N)-26		3.411	0.053	0.000	1.10			230.0
N-10.002	MH(N)-27		3.019	-0.060	0.000	0.18			81.1
N-1.006	MH(N)-28		3.009	1.084	0.000	0.85			127.2
N-1.007	MH(N)-EX-37		1.364	-0.247	0.000	0.55			127.2

PN	US/MH Name	Status	Level Exceeded
N-6.002	MH(N)-16	OK	
N-1.004	MH(N)-17	SURCHARGED	
N-7.000	MH(N)-18	OK	
N-8.000	MH(N)-19	SURCHARGED	
N-8.001	MH(N)-20	SURCHARGED	
N-8.002	MH(N)-21	SURCHARGED	
N-8.003	MH(N)-22	SURCHARGED	

30 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Status	Level Exceeded
N-1.005	MH(N)-23	SURCHARGED	
N-9.000	MH(N)-24	OK	
N-10.000	MH(N)-25	OK	
N-10.001	MH(N)-26	SURCHARGED	
N-10.002	MH(N)-27	OK	
N-1.006	MH(N)-28	SURCHARGED	
N-1.007	MH(N)-EX-37	OK	

100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs	0	Number of Storage Structures	5
Number of Online Controls	1	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Ratio R	0.400
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	17.000	Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	300.0	DVD Status	OFF
Analysis Timestep	Fine	Inertia Status	OFF
DTS Status	ON		

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years)	1, 30, 100
Climate Change (%)	25, 25, 25

WARNING: Half Drain Time has not been calculated as the structure is too full.

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.
N-1.000	MH(N)-1	15 Winter	100	+25%				
N-1.001	MH(N)-2	15 Winter	100	+25%				
N-2.000	MH(N)-3	15 Winter	100	+25%	30/15 Summer			
N-2.001	MH(N)-4	15 Winter	100	+25%	30/15 Summer			
N-1.002	MH(N)-5	120 Winter	100	+25%	30/15 Winter			
N-3.000	MH(N)-6	15 Winter	100	+25%				
N-3.001	MH(N)-7	120 Winter	100	+25%				
N-4.000	MH(N)-8	15 Winter	100	+25%	100/15 Summer			
N-4.001	MH(N)-9	15 Winter	100	+25%	100/15 Summer			
N-4.002	MH(N)-10	120 Winter	100	+25%	100/60 Winter			
N-1.003	MH(N)-11	120 Winter	100	+25%	30/15 Summer			
N-5.000	MH(N)-12	15 Winter	100	+25%				
N-5.001	MH(N)-13	120 Winter	100	+25%				
N-6.000	MH(N)-14	15 Winter	100	+25%	100/15 Summer			
N-6.001	MH(N)-15	15 Winter	100	+25%	30/15 Summer			

100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status
N-1.000	MH(N)-1	3.712	-0.088	0.000	0.82			64.0	OK
N-1.001	MH(N)-2	3.574	-0.033	0.000	0.97			101.2	OK
N-2.000	MH(N)-3	4.301	0.426	0.000	1.10			91.1	SURCHARGED
N-2.001	MH(N)-4	3.674	0.282	0.000	1.75			113.3	SURCHARGED
N-1.002	MH(N)-5	3.355	0.088	0.000	0.83		36	80.1	SURCHARGED
N-3.000	MH(N)-6	3.629	-0.171	0.000	0.56			76.9	OK
N-3.001	MH(N)-7	3.358	-0.168	0.000	0.17			41.5	OK
N-4.000	MH(N)-8	3.967	0.167	0.000	1.02			83.8	SURCHARGED
N-4.001	MH(N)-9	3.614	0.133	0.000	1.27			150.8	SURCHARGED
N-4.002	MH(N)-10	3.362	0.098	0.000	0.35			68.8	SURCHARGED
N-1.003	MH(N)-11	3.350	0.600	0.000	0.72		84	135.8	SURCHARGED
N-5.000	MH(N)-12	3.640	-0.160	0.000	0.61			84.5	OK
N-5.001	MH(N)-13	3.377	-0.141	0.000	0.10			45.9	OK
N-6.000	MH(N)-14	3.911	0.111	0.000	0.71			110.3	SURCHARGED
N-6.001	MH(N)-15	3.691	0.336	0.000	1.50			252.1	SURCHARGED

PN	US/MH Name	Level Exceeded
N-1.000	MH(N)-1	
N-1.001	MH(N)-2	
N-2.000	MH(N)-3	
N-2.001	MH(N)-4	
N-1.002	MH(N)-5	
N-3.000	MH(N)-6	
N-3.001	MH(N)-7	
N-4.000	MH(N)-8	
N-4.001	MH(N)-9	
N-4.002	MH(N)-10	
N-1.003	MH(N)-11	
N-5.000	MH(N)-12	
N-5.001	MH(N)-13	
N-6.000	MH(N)-14	
N-6.001	MH(N)-15	

100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow
N-6.002	MH(N)-16	120 Winter	100	+25%	100/30 Winter		
N-1.004	MH(N)-17	120 Winter	100	+25%	30/15 Summer		
N-7.000	MH(N)-18	15 Winter	100	+25%			
N-8.000	MH(N)-19	15 Winter	100	+25%	30/15 Summer		
N-8.001	MH(N)-20	15 Winter	100	+25%	30/15 Summer		
N-8.002	MH(N)-21	15 Winter	100	+25%	30/15 Winter		
N-8.003	MH(N)-22	120 Winter	100	+25%	30/60 Winter		
N-1.005	MH(N)-23	120 Winter	100	+25%	30/15 Summer		
N-9.000	MH(N)-24	15 Winter	100	+25%			
N-10.000	MH(N)-25	15 Winter	100	+25%	100/15 Summer		
N-10.001	MH(N)-26	15 Winter	100	+25%	30/15 Summer		
N-10.002	MH(N)-27	120 Winter	100	+25%	100/30 Winter		
N-1.006	MH(N)-28	120 Winter	100	+25%	1/15 Summer		
N-1.007	MH(N)-EX-37	120 Winter	100	+25%			

PN	US/MH Name	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)
N-6.002	MH(N)-16		3.414	0.288	0.000	0.24			86.7
N-1.004	MH(N)-17		3.403	0.803	0.000	0.20		144	99.5
N-7.000	MH(N)-18		3.418	-0.166	0.000	0.58			140.5
N-8.000	MH(N)-19		4.434	0.634	0.000	1.28			285.4
N-8.001	MH(N)-20		4.014	0.471	0.000	1.30			372.2
N-8.002	MH(N)-21		3.474	0.231	0.000	1.38			450.2
N-8.003	MH(N)-22		3.408	0.415	0.000	0.39			163.8
N-1.005	MH(N)-23		3.401	0.890	0.000	0.21			135.0
N-9.000	MH(N)-24		3.583	-0.102	0.000	0.76			153.4
N-10.000	MH(N)-25		3.880	0.080	0.000	0.74			174.6
N-10.001	MH(N)-26		3.628	0.270	0.000	1.39			290.7
N-10.002	MH(N)-27		3.408	0.329	0.000	0.23			100.5
N-1.006	MH(N)-28		3.393	1.468	0.000	1.04			155.7
N-1.007	MH(N)-EX-37		1.407	-0.204	0.000	0.67			154.9

PN	US/MH Name	Status	Level Exceeded
N-6.002	MH(N)-16	SURCHARGED	
N-1.004	MH(N)-17	SURCHARGED	
N-7.000	MH(N)-18	OK	
N-8.000	MH(N)-19	SURCHARGED	
N-8.001	MH(N)-20	SURCHARGED	
N-8.002	MH(N)-21	SURCHARGED	
N-8.003	MH(N)-22	SURCHARGED	

100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Status	Level Exceeded
N-1.005	MH(N)-23	SURCHARGED	
N-9.000	MH(N)-24	OK	
N-10.000	MH(N)-25	SURCHARGED	
N-10.001	MH(N)-26	SURCHARGED	
N-10.002	MH(N)-27	SURCHARGED	
N-1.006	MH(N)-28	SURCHARGED	
N-1.007	MH(N)-EX-37	OK	

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Proposed Storm

Pipe Sizes STANDARD Manhole Sizes ECC

FSR Rainfall Model - England and Wales

Return Period (years)	30	Foul Sewage (l/s/ha)	0.000	Maximum Backdrop Height (m)	1.500
M5-60 (mm)	17.000	Volumetric Runoff Coeff.	0.750	Min Design Depth for Optimisation (m)	1.200
Ratio R	0.400	PIMP (%)	100	Min Vel for Auto Design only (m/s)	0.80
Maximum Rainfall (mm/hr)	50	Add Flow / Climate Change (%)	0	Min Slope for Optimisation (1:X)	500
Maximum Time of Concentration (mins)	30	Minimum Backdrop Height (m)	0.200		

Designed with Level Soffits

Network Design Table for Proposed Storm

« - Indicates pipe capacity < flow

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
SE-1.000	34.890	0.092	379.2	0.272	5.00	0.0	0.600	o	300	Pipe/Conduit	
SE-1.001	33.567	0.098	342.5	0.221	0.00	0.0	0.600	o	375	Pipe/Conduit	
SE-1.002	64.269	0.148	434.3	0.000	0.00	0.0	0.600	o	600	Pipe/Conduit	
SE-2.000	60.376	0.283	213.3	0.257	5.00	0.0	0.600	o	300	Pipe/Conduit	
SE-2.001	60.143	0.220	273.4	0.243	0.00	0.0	0.600	o	375	Pipe/Conduit	
SE-1.003	40.913	0.082	498.9	0.000	0.00	0.0	0.600	o	600	Pipe/Conduit	
SE-3.000	36.985	0.123	300.7	0.176	5.00	0.0	0.600	o	300	Pipe/Conduit	
SE-3.001	55.477	0.111	499.8	0.189	0.00	0.0	0.600	o	450	Pipe/Conduit	
SE-3.002	55.477	0.111	499.8	0.251	0.00	0.0	0.600	o	525	Pipe/Conduit	
SE-1.004	25.000	0.050	500.0	0.000	0.00	0.0	0.600	o	750	Pipe/Conduit	
SE-4.000	35.820	0.119	301.0	0.177	5.00	0.0	0.600	o	300	Pipe/Conduit	
SE-4.001	53.730	0.107	500.0	0.185	0.00	0.0	0.600	o	450	Pipe/Conduit	
SE-4.002	53.730	0.107	502.1	0.192	0.00	0.0	0.600	o	525	Pipe/Conduit	
SE-4.003	21.384	0.073	294.9	0.061	0.00	0.0	0.600	o	525	Pipe/Conduit	
SE-5.000	15.829	0.063	250.0	0.199	5.00	0.0	0.600	o	300	Pipe/Conduit	
SE-5.001	15.266	0.061	250.0	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
SE-4.004	14.815	0.073	204.4	0.000	0.00	0.0	0.600	o	525	Pipe/Conduit	
SE-1.005	34.248	0.068	503.6	0.137	0.00	0.0	0.600	o	750	Pipe/Conduit	
SE-6.000	40.178	0.154	260.9	0.092	5.00	0.0	0.600	o	225	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
SE-1.000	50.00	5.73	3.240	0.272	0.0	0.0	0.0	0.80	56.6	36.9
SE-1.001	50.00	6.30	3.073	0.493	0.0	0.0	0.0	0.97	107.5	66.8
SE-1.002	50.00	7.22	2.750	0.493	0.0	0.0	0.0	1.16	328.6	66.8
SE-2.000	50.00	5.94	3.330	0.257	0.0	0.0	0.0	1.07	75.8	34.8
SE-2.001	50.00	6.86	2.972	0.500	0.0	0.0	0.0	1.09	120.5	67.7
SE-1.003	50.00	7.85	2.602	0.993	0.0	0.0	0.0	1.08	306.3	134.5
SE-3.000	50.00	5.68	3.330	0.176	0.0	0.0	0.0	0.90	63.7	23.8
SE-3.001	50.00	6.71	3.057	0.365	0.0	0.0	0.0	0.90	143.5	49.4
SE-3.002	50.00	7.64	2.871	0.616	0.0	0.0	0.0	1.00	215.4	83.4
SE-1.004	50.00	8.19	2.370	1.609	0.0	0.0	0.0	1.24	549.9	217.9
SE-4.000	50.00	5.66	3.330	0.177	0.0	0.0	0.0	0.90	63.7	24.0
SE-4.001	50.00	6.65	3.061	0.362	0.0	0.0	0.0	0.90	143.5	49.0
SE-4.002	50.00	7.56	2.879	0.554	0.0	0.0	0.0	0.99	214.9	75.1
SE-4.003	50.00	7.83	2.772	0.615	0.0	0.0	0.0	1.30	281.2	83.3
SE-5.000	50.00	5.27	3.100	0.199	0.0	0.0	0.0	0.99	70.0	27.0
SE-5.001	50.00	5.52	3.037	0.199	0.0	0.0	0.0	0.99	70.0	27.0
SE-4.004	50.00	7.99	2.700	0.814	0.0	0.0	0.0	1.56	338.4	110.3
SE-1.005	50.00	8.65	2.320	2.560	0.0	0.0	0.0	1.24	547.9	346.7
SE-6.000	50.00	5.83	3.505	0.092	0.0	0.0	0.0	0.80	32.0	12.5

Network Design Table for Proposed Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
SE-7.000	28.186	0.154	183.0	0.083	5.00	0.0	0.600	o	225	Pipe/Conduit	
SE-6.001	20.864	0.111	188.0	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
SE-8.000	40.339	0.155	260.3	0.124	5.00	0.0	0.600	o	225	Pipe/Conduit	
SE-9.000	26.843	0.155	173.2	0.082	5.00	0.0	0.600	o	225	Pipe/Conduit	
SE-6.002	8.156	0.086	94.8	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
SE-6.003	30.316	0.061	500.0	0.000	0.00	0.0	0.600	o	375	Pipe/Conduit	
SE-6.004	33.388	0.067	500.0	0.000	0.00	0.0	0.600	o	375	Pipe/Conduit	
SE-10.000	19.301	0.097	200.0	0.151	5.00	0.0	0.600	o	225	Pipe/Conduit	
SE-6.005	67.013	0.134	500.0	0.000	0.00	0.0	0.600	o	375	Pipe/Conduit	
SE-6.006	62.384	0.125	500.0	0.000	0.00	0.0	0.600	o	375	Pipe/Conduit	
SE-11.000	63.458	0.160	396.6	0.487	5.00	0.0	0.600	o	375	Pipe/Conduit	
SE-11.001	50.895	0.138	368.8	0.314	0.00	0.0	0.600	o	450	Pipe/Conduit	
SE-12.000	43.771	0.167	262.1	0.309	5.00	0.0	0.600	o	300	Pipe/Conduit	
SE-12.001	43.117	0.131	329.1	0.220	0.00	0.0	0.600	o	375	Pipe/Conduit	
SE-11.002	35.463	0.141	251.5	0.000	0.00	0.0	0.600	o	525	Pipe/Conduit	
SE-13.000	65.749	0.300	219.2	0.522	5.00	0.0	0.600	o	375	Pipe/Conduit	
SE-13.001	20.866	0.070	298.1	0.102	0.00	0.0	0.600	o	375	Pipe/Conduit	
SE-13.002	50.101	0.167	300.0	0.174	0.00	0.0	0.600	o	450	Pipe/Conduit	
SE-14.000	43.633	0.167	261.3	0.207	5.00	0.0	0.600	o	225	Pipe/Conduit	
SE-14.001	43.633	0.116	376.1	0.149	0.00	0.0	0.600	o	300	Pipe/Conduit	
SE-11.003	33.711	0.067	503.1	0.000	0.00	0.0	0.600	o	675	Pipe/Conduit	
SE-15.000	43.615	0.167	261.2	0.205	5.00	0.0	0.600	o	225	Pipe/Conduit	
SE-15.001	43.615	0.116	376.0	0.150	0.00	0.0	0.600	o	300	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
SE-7.000	50.00	5.49	3.505	0.083	0.0	0.0	0.0	0.96	38.3	11.2
SE-6.001	50.00	6.20	3.351	0.175	0.0	0.0	0.0	0.95	37.8	23.7
SE-8.000	50.00	5.83	3.395	0.124	0.0	0.0	0.0	0.81	32.0	16.8
SE-9.000	50.00	5.45	3.395	0.082	0.0	0.0	0.0	0.99	39.4	11.2
SE-6.002	50.00	6.28	3.165	0.382	0.0	0.0	0.0	1.61	114.1	51.7
SE-6.003	50.00	6.91	3.004	0.382	0.0	0.0	0.0	0.80	88.7	51.7
SE-6.004	50.00	7.60	2.943	0.382	0.0	0.0	0.0	0.80	88.7	51.7
SE-10.000	50.00	5.35	3.545	0.151	0.0	0.0	0.0	0.92	36.6	20.4
SE-6.005	50.00	8.99	2.876	0.533	0.0	0.0	0.0	0.80	88.7	72.1
SE-6.006	50.00	10.29	2.742	0.533	0.0	0.0	0.0	0.80	88.7	72.1
SE-11.000	50.00	6.17	2.875	0.487	0.0	0.0	0.0	0.90	99.8	65.9
SE-11.001	50.00	6.98	2.640	0.801	0.0	0.0	0.0	1.05	167.4	108.4
SE-12.000	50.00	5.75	2.950	0.309	0.0	0.0	0.0	0.97	68.3	41.8
SE-12.001	50.00	6.48	2.708	0.528	0.0	0.0	0.0	0.99	109.7	71.6
SE-11.002	50.00	7.40	2.427	1.329	0.0	0.0	0.0	1.41	304.8	180.0
SE-13.000	50.00	5.90	2.975	0.522	0.0	0.0	0.0	1.22	134.7	70.7
SE-13.001	50.00	6.23	2.675	0.625	0.0	0.0	0.0	1.04	115.3	84.6
SE-13.002	50.00	6.95	2.530	0.799	0.0	0.0	0.0	1.17	185.8	108.2
SE-14.000	50.00	5.90	3.155	0.207	0.0	0.0	0.0	0.80	32.0	28.0
SE-14.001	50.00	6.81	2.913	0.356	0.0	0.0	0.0	0.80	56.9	48.2
SE-11.003	50.00	7.88	2.136	2.484	0.0	0.0	0.0	1.16	415.7	336.4
SE-15.000	50.00	5.90	3.155	0.205	0.0	0.0	0.0	0.80	32.0	27.8
SE-15.001	50.00	6.81	2.913	0.355	0.0	0.0	0.0	0.80	56.9	48.1

Network Design Table for Proposed Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
SE-16.000	61.503	0.166	370.5	0.284	5.00	0.0	0.600	o	300	Pipe/Conduit	
SE-11.004	17.826	0.036	495.2	0.000	0.00	0.0	0.600	o	825	Pipe/Conduit	
SE-11.005	87.286	0.175	498.8	0.000	0.00	0.0	0.600	o	825	Pipe/Conduit	
SE-11.006	59.507	0.119	500.1	0.000	0.00	0.0	0.600	o	825	Pipe/Conduit	
SE-17.000	65.551	0.328	200.0	0.141	5.00	0.0	0.600	o	225	Pipe/Conduit	
SE-18.000	9.758	0.049	200.0	0.075	5.00	0.0	0.600	o	225	Pipe/Conduit	
SE-17.001	8.847	0.044	200.0	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
SE-11.007	29.755	0.059	504.3	0.000	0.00	0.0	0.600	o	825	Pipe/Conduit	
SE-19.000	24.297	0.093	260.8	0.085	5.00	0.0	0.600	o	225	Pipe/Conduit	
SE-19.001	43.610	0.167	261.1	0.170	0.00	0.0	0.600	o	300	Pipe/Conduit	
SE-19.002	43.610	0.115	379.2	0.150	0.00	0.0	0.600	o	300	Pipe/Conduit	
SE-20.000	27.782	0.143	194.3	0.000	5.00	0.0	0.600	o	225	Pipe/Conduit	
SE-20.001	37.265	0.140	266.2	0.242	0.00	0.0	0.600	o	300	Pipe/Conduit	
SE-19.003	34.369	0.193	178.1	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
SE-21.000	34.088	0.109	312.7	0.206	5.00	0.0	0.600	o	525	Pipe/Conduit	
SE-21.001	36.058	0.349	103.3	0.163	0.00	0.0	0.600	o	525	Pipe/Conduit	
SE-19.004	65.941	0.132	499.6	0.223	0.00	0.0	0.600	o	600	Pipe/Conduit	
SE-19.005	65.941	0.132	499.6	0.228	0.00	0.0	0.600	o	750	Pipe/Conduit	
SE-19.006	29.513	0.084	351.3	0.219	0.00	0.0	0.600	o	750	Pipe/Conduit	
SE-22.000	37.512	0.125	300.0	0.198	5.00	0.0	0.600	o	300	Pipe/Conduit	
SE-22.001	35.430	0.101	350.0	0.000	0.00	0.0	0.600	o	375	Pipe/Conduit	
SE-22.002	31.001	0.062	504.1	0.000	0.00	0.0	0.600	o	450	Pipe/Conduit	
SE-23.000	51.137	0.170	300.8	0.294	5.00	0.0	0.600	o	375	Pipe/Conduit	
SE-23.001	41.934	0.140	300.0	0.154	0.00	0.0	0.600	o	375	Pipe/Conduit	
SE-23.002	56.296	0.113	500.0	0.344	0.00	0.0	0.600	o	450	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
SE-16.000	50.00	6.26	2.947	0.284	0.0	0.0	0.0	0.81	57.3	38.5
SE-11.004	50.00	8.10	1.919	3.124	0.0	0.0	0.0	1.33	709.6	423.0
SE-11.005	50.00	9.20	1.883	3.124	0.0	0.0	0.0	1.32	707.0	423.0
SE-11.006	50.00	9.95	1.708	3.124	0.0	0.0	0.0	1.32	706.1	423.0
SE-17.000	50.00	6.19	2.600	0.141	0.0	0.0	0.0	0.92	36.6	19.1
SE-18.000	50.00	5.18	3.155	0.075	0.0	0.0	0.0	0.92	36.6	10.2
SE-17.001	50.00	6.35	2.272	0.216	0.0	0.0	0.0	0.92	36.6	29.3
SE-11.007	50.00	10.33	1.589	3.340	0.0	0.0	0.0	1.32	703.0	452.3
SE-19.000	50.00	5.50	3.155	0.085	0.0	0.0	0.0	0.80	32.0	11.5
SE-19.001	50.00	6.25	2.987	0.255	0.0	0.0	0.0	0.97	68.4	34.5
SE-19.002	50.00	7.16	2.820	0.405	0.0	0.0	0.0	0.80	56.6	54.8
SE-20.000	50.00	5.50	3.155	0.000	0.0	0.0	0.0	0.93	37.2	0.0
SE-20.001	50.00	6.14	2.937	0.242	0.0	0.0	0.0	0.96	67.8	32.8
SE-19.003	50.00	7.65	2.705	0.647	0.0	0.0	0.0	1.18	83.1«	87.7
SE-21.000	50.00	5.45	2.745	0.206	0.0	0.0	0.0	1.26	273.0	27.9
SE-21.001	50.00	5.72	2.636	0.369	0.0	0.0	0.0	2.20	477.0	50.0
SE-19.004	50.00	8.66	2.212	1.239	0.0	0.0	0.0	1.08	306.1	167.8
SE-19.005	50.00	9.55	1.930	1.467	0.0	0.0	0.0	1.25	550.1	198.7
SE-19.006	50.00	9.88	1.798	1.686	0.0	0.0	0.0	1.49	657.0	228.3
SE-22.000	50.00	5.69	3.050	0.198	0.0	0.0	0.0	0.90	63.8	26.8
SE-22.001	50.00	6.31	2.850	0.198	0.0	0.0	0.0	0.96	106.3	26.8
SE-22.002	50.00	6.88	2.674	0.198	0.0	0.0	0.0	0.90	142.9	26.8
SE-23.000	50.00	5.82	2.975	0.294	0.0	0.0	0.0	1.04	114.8	39.8
SE-23.001	50.00	6.49	2.805	0.448	0.0	0.0	0.0	1.04	115.0	60.6
SE-23.002	50.00	7.53	2.590	0.792	0.0	0.0	0.0	0.90	143.5	107.2

Network Design Table for Proposed Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
SE-22.003	40.186	0.080	500.0	0.000	0.00	0.0	0.600	o	450	Pipe/Conduit	
SE-22.004	37.906	0.076	498.8	0.115	0.00	0.0	0.600	o	525	Pipe/Conduit	
SE-22.005	59.139	0.118	501.2	0.291	0.00	0.0	0.600	o	525	Pipe/Conduit	
SE-22.006	59.139	0.118	501.2	0.167	0.00	0.0	0.600	o	600	Pipe/Conduit	
SE-24.000	35.267	0.176	200.0	0.129	5.00	0.0	0.600	o	225	Pipe/Conduit	
SE-24.001	57.844	0.210	275.4	0.176	0.00	0.0	0.600	o	300	Pipe/Conduit	
SE-24.002	72.256	0.144	501.8	0.000	0.00	0.0	0.600	o	375	Pipe/Conduit	
SE-25.000	34.362	0.137	250.0	0.412	5.00	0.0	0.600	o	300	Pipe/Conduit	
SE-22.007	24.808	0.050	500.0	0.000	0.00	0.0	0.600	o	675	Pipe/Conduit	
SE-19.007	39.872	0.080	500.0	0.000	0.00	0.0	0.600	o	750	Pipe/Conduit	
SE-11.008	29.753	0.060	495.9	0.000	0.00	0.0	0.600	o	450	Pipe/Conduit	
SE-26.000	63.522	0.380	167.2	1.947	5.00	0.0	0.600	o	225	Pipe/Conduit	
SE-6.007	30.912	0.076	406.7	0.000	0.00	0.0	0.600	o	525	Pipe/Conduit	
SE-6.008	69.903	0.140	499.3	0.000	0.00	0.0	0.600	o	525	Pipe/Conduit	
SE-6.009	16.722	0.041	412.9	0.000	0.00	0.0	0.600	o	525	Pipe/Conduit	
SE-6.010	25.231	0.063	400.0	0.000	0.00	0.0	0.600	o	525	Pipe/Conduit	
SE-1.006	51.147	0.102	501.4	0.000	0.00	0.0	0.600	o	900	Pipe/Conduit	
SE-1.007	60.917	0.122	499.3	0.000	0.00	0.0	0.600	o	900	Pipe/Conduit	
SE-27.000	45.574	0.228	200.0	0.504	5.00	0.0	0.600	o	300	Pipe/Conduit	
SE-27.001	11.492	0.077	150.0	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
SE-1.008	50.144	0.167	300.3	0.000	0.00	0.0	0.600	o	525	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
SE-22.003	50.00	8.27	2.477	0.990	0.0	0.0	0.0	0.90	143.5	134.1
SE-22.004	50.00	8.91	2.322	1.105	0.0	0.0	0.0	1.00	215.6	149.6
SE-22.005	50.00	9.90	2.246	1.396	0.0	0.0	0.0	0.99	215.1	189.1
SE-22.006	50.00	10.81	2.053	1.564	0.0	0.0	0.0	1.08	305.6	211.7
SE-24.000	50.00	5.64	3.125	0.129	0.0	0.0	0.0	0.92	36.6	17.5
SE-24.001	50.00	6.66	2.874	0.305	0.0	0.0	0.0	0.94	66.6	41.3
SE-24.002	50.00	8.16	2.589	0.305	0.0	0.0	0.0	0.80	88.6	41.3
SE-25.000	50.00	5.58	3.100	0.412	0.0	0.0	0.0	0.99	70.0	55.8
SE-22.007	50.00	11.17	1.860	2.281	0.0	0.0	0.0	1.17	417.0	308.8
SE-19.007	50.00	11.70	1.714	3.967	0.0	0.0	0.0	1.24	549.9	537.1
SE-11.008	50.00	12.25	1.530	7.307	0.0	0.0	0.0	0.91	144.1«	989.4
SE-26.000	50.00	6.05	3.200	1.947	0.0	0.0	0.0	1.01	40.1«	263.6
SE-6.007	50.00	12.71	1.471	9.786	0.0	0.0	0.0	1.10	239.1«	1325.1
SE-6.008	50.00	13.88	1.395	9.786	0.0	0.0	0.0	1.00	215.5«	1325.1
SE-6.009	50.00	14.14	1.255	9.786	0.0	0.0	0.0	1.10	237.3«	1325.1
SE-6.010	50.00	14.52	1.215	9.786	0.0	0.0	0.0	1.11	241.1«	1325.1
SE-1.006	50.00	15.13	0.799	12.346	0.0	0.0	0.0	1.39	885.8«	1671.8
SE-1.007	50.00	15.86	0.697	12.346	0.0	0.0	0.0	1.40	887.7«	1671.8
SE-27.000	50.00	5.69	3.330	0.504	0.0	0.0	0.0	1.11	78.3	68.3
SE-27.001	50.00	5.83	3.102	0.504	0.0	0.0	0.0	1.28	90.6	68.3
SE-1.008	50.00	16.51	0.575	12.850	0.0	0.0	0.0	1.29	278.7«	1740.1

Area Summary for Proposed Storm

Pipe Number	PIMP Type	PIMP Name	PIMP (%)	Gross Area (ha)	Imp. Area (ha)	Pipe Total (ha)
1.000	User	-	100	0.272	0.272	0.272
1.001	User	-	100	0.158	0.158	0.158
	User	-	100	0.063	0.063	0.221
1.002	-	-	100	0.000	0.000	0.000
2.000	User	-	100	0.257	0.257	0.257
2.001	User	-	100	0.207	0.207	0.207
	User	-	100	0.035	0.035	0.243
1.003	-	-	100	0.000	0.000	0.000
3.000	User	-	100	0.176	0.176	0.176
3.001	User	-	100	0.189	0.189	0.189
3.002	User	-	100	0.185	0.185	0.185
	User	-	100	0.066	0.066	0.251
1.004	-	-	100	0.000	0.000	0.000
4.000	User	-	100	0.177	0.177	0.177
4.001	User	-	100	0.185	0.185	0.185
4.002	User	-	100	0.192	0.192	0.192
4.003	User	-	100	0.061	0.061	0.061
5.000	User	-	100	0.199	0.199	0.199
5.001	-	-	100	0.000	0.000	0.000
4.004	-	-	100	0.000	0.000	0.000
1.005	User	-	100	0.137	0.137	0.137
6.000	User	-	100	0.092	0.092	0.092
7.000	User	-	100	0.083	0.083	0.083
6.001	-	-	100	0.000	0.000	0.000
8.000	User	-	100	0.124	0.124	0.124
9.000	User	-	100	0.082	0.082	0.082
6.002	-	-	100	0.000	0.000	0.000
6.003	-	-	100	0.000	0.000	0.000
6.004	-	-	100	0.000	0.000	0.000
10.000	User	-	100	0.151	0.151	0.151
6.005	-	-	100	0.000	0.000	0.000
6.006	-	-	100	0.000	0.000	0.000
11.000	User	-	100	0.393	0.393	0.393
	User	-	100	0.094	0.094	0.487
11.001	User	-	100	0.314	0.314	0.314
12.000	User	-	100	0.309	0.309	0.309
12.001	User	-	100	0.220	0.220	0.220
11.002	-	-	100	0.000	0.000	0.000
13.000	User	-	100	0.522	0.522	0.522
13.001	User	-	100	0.102	0.102	0.102
13.002	User	-	100	0.174	0.174	0.174
14.000	User	-	100	0.207	0.207	0.207
14.001	User	-	100	0.149	0.149	0.149
11.003	-	-	100	0.000	0.000	0.000
15.000	User	-	100	0.205	0.205	0.205
15.001	User	-	100	0.150	0.150	0.150
16.000	User	-	100	0.172	0.172	0.172
	User	-	100	0.112	0.112	0.284
11.004	-	-	100	0.000	0.000	0.000
11.005	-	-	100	0.000	0.000	0.000
11.006	-	-	100	0.000	0.000	0.000
17.000	User	-	100	0.141	0.141	0.141
18.000	User	-	100	0.075	0.075	0.075
17.001	-	-	100	0.000	0.000	0.000
11.007	-	-	100	0.000	0.000	0.000
19.000	User	-	100	0.085	0.085	0.085
19.001	User	-	100	0.170	0.170	0.170
19.002	User	-	100	0.150	0.150	0.150
20.000	-	-	100	0.000	0.000	0.000
20.001	User	-	100	0.115	0.115	0.115
	User	-	100	0.127	0.127	0.242
19.003	-	-	100	0.000	0.000	0.000
21.000	User	-	100	0.206	0.206	0.206
21.001	User	-	100	0.163	0.163	0.163
19.004	User	-	100	0.223	0.223	0.223
19.005	User	-	100	0.228	0.228	0.228
19.006	User	-	100	0.219	0.219	0.219
22.000	User	-	100	0.198	0.198	0.198
22.001	-	-	100	0.000	0.000	0.000
22.002	-	-	100	0.000	0.000	0.000
23.000	User	-	100	0.294	0.294	0.294
23.001	User	-	100	0.154	0.154	0.154
23.002	User	-	100	0.344	0.344	0.344
22.003	-	-	100	0.000	0.000	0.000
22.004	User	-	100	0.115	0.115	0.115
22.005	User	-	100	0.291	0.291	0.291
22.006	User	-	100	0.167	0.167	0.167
24.000	User	-	100	0.129	0.129	0.129
24.001	User	-	100	0.176	0.176	0.176
24.002	-	-	100	0.000	0.000	0.000
25.000	User	-	100	0.394	0.394	0.394
	User	-	100	0.018	0.018	0.412
22.007	-	-	100	0.000	0.000	0.000
19.007	-	-	100	0.000	0.000	0.000

Area Summary for Proposed Storm

Pipe Number	PIMP Type	PIMP Name	PIMP (%)	Gross Area (ha)	Imp. Area (ha)	Pipe Total (ha)
11.008	-	-	100	0.000	0.000	0.000
26.000	User	-	100	1.947	1.947	1.947
6.007	-	-	100	0.000	0.000	0.000
6.008	-	-	100	0.000	0.000	0.000
6.009	-	-	100	0.000	0.000	0.000
6.010	-	-	100	0.000	0.000	0.000
1.006	-	-	100	0.000	0.000	0.000
1.007	-	-	100	0.000	0.000	0.000
27.000	User	-	100	0.504	0.504	0.504
27.001	-	-	100	0.000	0.000	0.000
1.008	-	-	100	0.000	0.000	0.000
				Total	Total	Total
				12.850	12.850	12.850

Surcharged Outfall Details for Proposed Storm

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
SE-1.008	MH(SE)-	3.000	0.408	0.000	0	0

Datum (m) 0.000 Offset (mins) 0

Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)
630	1.900	3150	1.900	5670	1.900	8190	1.900	10710	1.900	13230	1.900	15750	1.900	18270	1.900
1260	1.900	3780	1.900	6300	1.900	8820	1.900	11340	1.900	13860	1.900	16380	1.900	18900	1.900
1890	1.900	4410	1.900	6930	1.900	9450	1.900	11970	1.900	14490	1.900	17010	1.900	19530	1.900
2520	1.900	5040	1.900	7560	1.900	10080	1.900	12600	1.900	15120	1.900	17640	1.900	20160	1.900

Simulation Criteria for Proposed Storm

Volumetric Runoff Coeff	0.750	Manhole Headloss Coeff (Global)	0.500	Inlet Coeffiecient	0.800
Areal Reduction Factor	1.000	Foul Sewage per hectare (l/s)	0.000	Flow per Person per Day (l/per/day)	0.000
Hot Start (mins)	0	Additional Flow - % of Total Flow	0.000	Run Time (mins)	60
Hot Start Level (mm)	0	MADD Factor * 10m³/ha Storage	2.000	Output Interval (mins)	1

Number of Input Hydrographs	0	Number of Offline Controls	0	Number of Time/Area Diagrams	0
Number of Online Controls	3	Number of Storage Structures	3	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	M5-60 (mm)	17.000	Cv (Summer)	0.750
Return Period (years)	30	Ratio R	0.400	Cv (Winter)	0.840
Region	England and Wales	Profile Type	Summer	Storm Duration (mins)	30

Online Controls for Proposed Storm

Hydro-Brake® Optimum Manhole: MH(SE)-23, DS/PN: SE-6.003, Volume (m³): 2.7

Unit Reference	MD-SHE-0105-5000-1000-5000	Sump Available	Yes
Design Head (m)	1.000	Diameter (mm)	105
Design Flow (l/s)	5.0	Invert Level (m)	3.004
Flush-Flo™	Calculated	Minimum Outlet Pipe Diameter (mm)	150
Objective	Minimise upstream storage	Suggested Manhole Diameter (mm)	1200
Application	Surface		

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.000	5.0	Kick-Flo®	0.637	4.1
Flush-Flo™	0.296	5.0	Mean Flow over Head Range	-	4.3

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	3.6	0.600	4.3	1.600	6.2	2.600	7.8	5.000	10.6	7.500	12.9
0.200	4.8	0.800	4.5	1.800	6.6	3.000	8.4	5.500	11.1	8.000	13.3
0.300	5.0	1.000	5.0	2.000	6.9	3.500	9.0	6.000	11.6	8.500	13.7
0.400	4.9	1.200	5.4	2.200	7.2	4.000	9.6	6.500	12.1	9.000	14.1
0.500	4.7	1.400	5.8	2.400	7.5	4.500	10.1	7.000	12.5	9.500	14.5

Hydro-Brake® Optimum Manhole: MH(SE)-65, DS/PN: SE-11.008, Volume (m³): 39.6

Unit Reference	MD-SHE-0266-5000-3000-5000
Design Head (m)	3.000
Design Flow (l/s)	50.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	266
Invert Level (m)	1.530
Minimum Outlet Pipe Diameter (mm)	300
Suggested Manhole Diameter (mm)	Site Specific Design (Contact Hydro International)

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	3.000	50.0	Kick-Flo®	1.829	39.4
Flush-Flo™	0.863	50.0	Mean Flow over Head Range	-	43.6

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	8.5	0.600	48.8	1.600	44.9	2.600	46.7	5.000	64.0	7.500	77.9
0.200	27.4	0.800	49.9	1.800	40.4	3.000	50.0	5.500	67.0	8.000	80.4
0.300	41.9	1.000	49.8	2.000	41.1	3.500	53.9	6.000	69.9	8.500	82.8
0.400	45.3	1.200	49.0	2.200	43.1	4.000	57.5	6.500	72.7	9.000	85.2
0.500	47.5	1.400	47.5	2.400	44.9	4.500	60.8	7.000	75.4	9.500	87.4

Orifice Manhole: MH(SE)-72, DS/PN: SE-1.008, Volume (m³): 48.9

Diameter (m) 0.300 Discharge Coefficient 0.600 Invert Level (m) 0.575

Storage Structures for Proposed Storm

Cellular Storage Manhole: MH(SE)-23, DS/PN: SE-6.003

Invert Level (m) 3.004 Infiltration Coefficient Side (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Base (m/hr) 0.00000 Safety Factor 2.0

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	500.0	0.0	0.300	500.0	0.0	0.301	0.0	0.0

Cellular Storage Manhole: MH(SE)-65, DS/PN: SE-11.008

Invert Level (m) 1.530 Infiltration Coefficient Side (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Base (m/hr) 0.00000 Safety Factor 2.0

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	2500.0	0.0	1.500	2500.0	0.0	1.501	0.0	0.0

Cellular Storage Manhole: MH(SE)-72, DS/PN: SE-1.008

Invert Level (m) 0.575 Infiltration Coefficient Side (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Base (m/hr) 0.00000 Safety Factor 2.0

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	1250.0	0.0	1.800	1250.0	0.0	1.801	0.0	0.0

1 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Proposed Storm

Simulation Criteria

Areal Reduction Factor 1.000 Manhole Headloss Coeff (Global) 0.500 MADD Factor * 10m³/ha Storage 2.000
Hot Start (mins) 0 Foul Sewage per hectare (l/s) 0.000 Inlet Coeffiecient 0.800
Hot Start Level (mm) 0 Additional Flow - % of Total Flow 0.000 Flow per Person per Day (l/per/day) 0.000

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 3 Number of Storage Structures 3 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FSR M5-60 (mm) 17.000 Cv (Summer) 0.750
Region England and Wales Ratio R 0.400 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0 DTS Status ON Inertia Status OFF
Analysis Timestep Fine DVD Status OFF

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440
Return Period(s) (years) 1, 5, 10, 20, 30
Climate Change (%) 25, 25, 25, 25, 25

PN	US/MH Name	Event	US/CL (m)	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Maximum Vol (m³)	Maximum Velocity (m/s)	Pipe Flow (l/s)	Status
SE-1.000	MH(SE)-1	15 minute 1 year Winter I+25%	4.740	3.439	-0.101	0.000	0.74		0.220	0.8	38.8	OK
SE-1.001	MH(SE)-2	15 minute 1 year Winter I+25%	4.740	3.300	-0.148	0.000	0.68		0.982	0.9	65.1	OK
SE-1.002	MH(SE)-3	15 minute 1 year Winter I+25%	4.740	2.969	-0.381	0.000	0.21		0.328	0.7	62.4	OK
SE-2.000	MH(SE)-4	15 minute 1 year Winter I+25%	4.830	3.485	-0.145	0.000	0.50		0.170	1.0	36.1	OK
SE-2.001	MH(SE)-5	15 minute 1 year Winter I+25%	4.830	3.178	-0.169	0.000	0.56		0.537	1.1	63.6	OK
SE-1.003	MH(SE)-6	15 minute 1 year Winter I+25%	4.830	2.900	-0.302	0.000	0.44		6.995	0.9	114.3	OK
SE-3.000	MH(SE)-7	15 minute 1 year Winter I+25%	4.830	3.470	-0.160	0.000	0.43		0.153	0.8	25.4	OK
SE-3.001	MH(SE)-8	15 minute 1 year Winter I+25%	4.830	3.247	-0.260	0.000	0.35		0.249	0.8	46.5	OK
SE-3.002	MH(SE)-9	15 minute 1 year Winter I+25%	4.830	3.096	-0.300	0.000	0.38		1.644	0.8	74.7	OK
SE-1.004	MH(SE)-10	15 minute 1 year Winter I+25%	4.830	2.803	-0.317	0.000	0.45		4.973	0.7	182.6	OK
SE-4.000	MH(SE)-11	15 minute 1 year Winter I+25%	4.830	3.471	-0.159	0.000	0.44		0.153	0.8	25.6	OK
SE-4.001	MH(SE)-12	15 minute 1 year Winter I+25%	4.830	3.251	-0.260	0.000	0.35		0.248	0.8	46.3	OK
SE-4.002	MH(SE)-13	15 minute 1 year Winter I+25%	4.830	3.095	-0.309	0.000	0.34		1.432	0.8	65.3	OK
SE-4.003	MH(SE)-14	15 minute 1 year Winter I+25%	4.830	2.984	-0.313	0.000	0.32		3.099	0.9	71.0	OK
SE-5.000	MH(SE)-LC-EAST	15 minute 1 year Winter I+25%	4.400	3.250	-0.150	0.000	0.49		0.164	0.8	28.8	OK
SE-5.001	MH(SE)-16	15 minute 1 year Winter I+25%	4.700	3.186	-0.151	0.000	0.49		0.528	0.8	29.0	OK
SE-4.004	MH(SE)-14-1	15 minute 1 year Winter I+25%	4.915	2.923	-0.302	0.000	0.38		1.513	1.1	93.8	OK
SE-1.005	MH(SE)-15	15 minute 1 year Winter I+25%	5.000	2.761	-0.309	0.000	0.65		6.295	1.0	282.0	OK
SE-6.000	MH(SE)-16	15 minute 1 year Winter I+25%	4.930	3.611	-0.119	0.000	0.43		0.114	0.7	13.1	OK
SE-7.000	MH(SE)-17	15 minute 1 year Winter I+25%	4.930	3.596	-0.134	0.000	0.34		0.098	0.8	12.0	OK
SE-6.001	MH(SE)-18	15 minute 1 year Winter I+25%	4.930	3.491	-0.085	0.000	0.70		0.867	0.9	24.2	OK
SE-8.000	MH(SE)-19	15 minute 1 year Winter I+25%	4.820	3.522	-0.098	0.000	0.58		0.138	0.8	17.6	OK
SE-9.000	MH(SE)-20	15 minute 1 year Winter I+25%	4.820	3.485	-0.135	0.000	0.33		0.096	0.8	11.9	OK
SE-6.002	MH(SE)-21	15 minute 1 year Winter I+25%	4.820	3.354	-0.111	0.000	0.72		0.820	1.1	52.6	OK
SE-6.003	MH(SE)-23	360 minute 1 year Winter I+25%	4.970	3.100	-0.279	0.000	0.04		45.474	0.4	3.2	OK
SE-6.004	MH(SE)-23-1	15 minute 1 year Winter I+25%	4.985	2.998	-0.320	0.000	0.02		0.237	0.3	1.4	OK
SE-10.000	MH(SE)-22	15 minute 1 year Winter I+25%	4.970	3.681	-0.089	0.000	0.66		0.149	0.9	21.9	OK
SE-6.005	MH(SE)-24	15 minute 1 year Winter I+25%	5.000	3.002	-0.249	0.000	0.23		0.765	0.6	19.1	OK
SE-6.006	MH(SE)-25	15 minute 1 year Winter I+25%	5.000	2.862	-0.255	0.000	0.22		0.881	0.6	18.6	OK
SE-11.000	MH(SE)-26	15 minute 1 year Winter I+25%	4.450	3.123	-0.127	0.000	0.70		0.275	0.9	66.0	OK
SE-11.001	MH(SE)-27	15 minute 1 year Winter I+25%	4.450	2.911	-0.179	0.000	0.65		2.166	1.0	99.1	OK
SE-12.000	MH(SE)-28	15 minute 1 year Winter I+25%	4.450	3.139	-0.111	0.000	0.69		0.208	1.0	44.0	OK
SE-12.001	MH(SE)-29	15 minute 1 year Winter I+25%	4.450	2.940	-0.143	0.000	0.68		0.911	1.0	68.7	OK
SE-11.002	MH(SE)-30	15 minute 1 year Winter I+25%	4.450	2.737	-0.215	0.000	0.62		3.880	1.3	162.2	OK
SE-13.000	MH(SE)-31-1	15 minute 1 year Winter I+25%	4.550	3.187	-0.163	0.000	0.58		0.234	1.2	73.5	OK
SE-13.001	MH(SE)-31	15 minute 1 year Winter I+25%	4.580	2.944	-0.106	0.000	0.86		2.474	1.0	83.5	OK
SE-13.002	MH(SE)-32	15 minute 1 year Winter I+25%	4.580	2.784	-0.196	0.000	0.60		1.011	1.1	100.5	OK
SE-14.000	MH(SE)-33	15 minute 1 year Winter I+25%	4.580	3.337	-0.043	0.000	0.95		0.200	0.9	29.0	OK
SE-14.001	MH(SE)-34	15 minute 1 year Winter I+25%	4.580	3.132	-0.081	0.000	0.87		0.657	0.8	46.3	OK
SE-11.003	MH(SE)-35	15 minute 1 year Winter I+25%	4.580	2.640	-0.171	0.000	0.88		7.967	1.0	295.0	OK
SE-15.000	MH(SE)-36	15 minute 1 year Winter I+25%	4.580	3.335	-0.045	0.000	0.94		0.198	0.9	28.8	OK
SE-15.001	MH(SE)-37	15 minute 1 year Winter I+25%	4.580	3.131	-0.082	0.000	0.87		0.654	0.8	46.3	OK
SE-16.000	MH(SE)-39	15 minute 1 year Winter I+25%	4.580	3.146	-0.101	0.000	0.76		0.219	0.8	41.3	OK
SE-11.004	MH(SE)-40	15 minute 1 year Winter I+25%	4.580	2.535	-0.209	0.000	0.91		8.478	0.9	363.2	OK
SE-11.005	MH(SE)-41	15 minute 1 year Winter I+25%	4.750	2.343	-0.365	0.000	0.55		4.918	1.2	348.3	OK
SE-11.006	MH(SE)-42	15 minute 1 year Winter I+25%	4.750	2.189	-0.344	0.000	0.54		22.363	1.1	324.4	OK
SE-17.000	MH(SE)-43-1	15 minute 1 year Winter I+25%	4.580	2.725	-0.100	0.000	0.55		0.135	0.9	19.4	OK
SE-18.000	MH(SE)-43-2	15 minute 1 year Winter I+25%	4.580	3.250	-0.130	0.000	0.36		0.101	0.7	11.0	OK
SE-17.001	MH(SE)-43-3	15 minute 1 year Winter I+25%	4.580	2.454	-0.043	0.000	0.99		0.761	0.9	29.7	OK
SE-11.007	MH(SE)-43	1440 minute 1 year Winter I+25%	4.650	2.060	-0.354	0.000	0.05		15.263	0.4	26.4	OK
SE-19.000	MH(SE)-44-1	15 minute 1 year Winter I+25%	4.580	3.258	-0.122	0.000	0.42		0.111	0.7	12.3	OK
SE-19.001	MH(SE)-44	15 minute 1 year Winter I+25%	4.580	3.141	-0.146	0.000	0.50		0.316	0.9	32.2	OK
SE-19.002	MH(SE)-45	15 minute 1 year Winter I+25%	4.580	3.048	-0.072	0.000	0.90		1.617	0.9	47.9	OK
SE-20.000	MH(SE)-46	15 minute 1 year Summer I+25%	4.580	3.155	-0.225	0.000	0.00		0.000	0.0	0.0	OK
SE-20.001	MH(SE)-47	15 minute 1 year Winter I+25%	4.580	3.085	-0.152	0.000	0.47		0.260	0.9	29.7	OK
SE-19.003	MH(SE)-48	15 minute 1 year Winter I+25%	4.580	2.940	-0.065	0.000	0.97		2.541	1.3	74.1	OK
SE-21.000	MH(SE)-51	15 minute 1 year Winter I+25%	4.550	2.871	-0.399	0.000	0.13		0.173	0.8	29.7	OK
SE-21.001	MH(SE)-52	15 minute 1 year Winter I+25%	4.680	2.758	-0.403	0.000	0.12		0.728	1.3	49.9	OK
SE-19.004	MH(SE)-53	15 minute 1 year Winter I+25%	4.580	2.517	-0.295	0.000	0.50		1.267	1.0	137.1	OK
SE-19.005	MH(SE)-54	15 minute 1 year Winter I+25%	4.580	2.284	-0.396	0.000	0.31		4.065	0.8	147.3	OK

1 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Proposed Storm

PN	US/MH Name	Event	US/CL (m)	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Maximum Vol (m³)	Maximum Velocity (m/s)	Pipe Flow (l/s)	Status
SE-19.006	MH(SE)-55	15 minute 1 year Winter I+25%	4.580	2.215	-0.333	0.000	0.30		13.422	0.7	152.2	OK
SE-22.000	MH(SE)-56	15 minute 1 year Winter I+25%	4.550	3.200	-0.150	0.000	0.48		0.164	0.8	28.4	OK
SE-22.001	MH(SE)-57	15 minute 1 year Winter I+25%	4.550	2.989	-0.236	0.000	0.29		0.300	0.8	27.8	OK
SE-22.002	MH(SE)-58	15 minute 1 year Winter I+25%	4.550	2.842	-0.282	0.000	0.21		0.539	0.6	26.0	OK
SE-23.000	MH(SE)-59-5	15 minute 1 year Winter I+25%	4.550	3.142	-0.208	0.000	0.39		0.183	0.9	41.7	OK
SE-23.001	MH(SE)-59-4	15 minute 1 year Winter I+25%	4.550	3.008	-0.172	0.000	0.56		1.693	1.0	58.4	OK
SE-23.002	MH(SE)-59-3	15 minute 1 year Winter I+25%	4.550	2.883	-0.157	0.000	0.69		1.939	0.9	90.8	OK
SE-22.003	MH(SE)-59-2	15 minute 1 year Winter I+25%	4.550	2.802	-0.125	0.000	0.86		6.928	0.9	109.8	OK
SE-22.004	MH(SE)-59-1	15 minute 1 year Winter I+25%	4.565	2.650	-0.197	0.000	0.62		3.191	0.8	115.1	OK
SE-22.005	MH(SE)-59	15 minute 1 year Winter I+25%	4.580	2.565	-0.206	0.000	0.66		4.373	1.0	128.7	OK
SE-22.006	MH(SE)-60	15 minute 1 year Winter I+25%	4.580	2.369	-0.284	0.000	0.49		4.203	0.9	133.8	OK
SE-24.000	MH(SE)-61-1	15 minute 1 year Winter I+25%	4.550	3.245	-0.105	0.000	0.54		0.130	0.9	18.6	OK
SE-24.001	MH(SE)-61	15 minute 1 year Winter I+25%	4.550	3.048	-0.126	0.000	0.61		0.357	0.9	38.5	OK
SE-24.002	MH(SE)-62	15 minute 1 year Winter I+25%	4.700	2.766	-0.198	0.000	0.46		0.482	0.7	38.3	OK
SE-25.000	MH(SE)-LC-WEST	15 minute 1 year Winter I+25%	4.400	3.331	-0.069	0.000	0.94		0.255	1.0	60.2	OK
SE-22.007	MH(SE)-63	15 minute 1 year Winter I+25%	4.580	2.253	-0.282	0.000	0.56		7.266	0.9	176.8	OK
SE-19.007	MH(SE)-64	15 minute 1 year Winter I+25%	4.750	2.192	-0.272	0.000	0.73		11.497	1.1	327.8	OK
SE-11.008	MH(SE)-65	1440 minute 1 year Winter I+25%	4.615	2.060	0.080	0.000	0.22		1276.290	0.4	27.8	SURCHARGED
SE-26.000	MH(SE)-EX-66	30 minute 1 year Winter I+25%	4.700	4.732	1.307	31.517	2.11		33.208	2.1	82.0	FLOOD
SE-6.007	MH(SE)-67	1440 minute 1 year Winter I+25%	4.580	1.958	-0.038	0.000	0.23		5.028	0.7	46.3	OK
SE-6.008	MH(SE)-68	1440 minute 1 year Winter I+25%	4.830	1.954	0.034	0.000	0.23		6.903	0.7	46.0	SURCHARGED
SE-6.009	MH(SE)-69	1440 minute 1 year Winter I+25%	4.830	1.949	0.169	0.000	0.28		15.804	0.6	44.7	SURCHARGED
SE-6.010	MH(SE)-69-1	1440 minute 1 year Winter I+25%	4.830	1.946	0.206	0.000	0.23		4.367	0.7	44.3	SURCHARGED
SE-1.006	MH(SE)-70	1440 minute 1 year Winter I+25%	4.830	1.942	0.243	0.000	0.09		8.017	0.5	63.8	SURCHARGED
SE-1.007	MH(SE)-71	1440 minute 1 year Winter I+25%	4.830	1.940	0.343	0.000	0.08		34.543	0.5	61.5	SURCHARGED
SE-27.000	MH(SE)-72-2	15 minute 1 year Winter I+25%	4.830	3.576	-0.054	0.000	0.98		0.273	1.2	71.7	OK
SE-27.001	MH(SE)-72-1	15 minute 1 year Winter I+25%	4.830	3.351	-0.051	0.000	1.00		1.634	1.1	69.3	OK
SE-1.008	MH(SE)-72	1440 minute 1 year Winter I+25%	4.740	1.938	0.838	0.000	0.09		1659.388	0.2	21.7	SURCHARGED

5 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Proposed Storm

Simulation Criteria

Areal Reduction Factor 1.000   Manhole Headloss Coeff (Global) 0.500   MADD Factor * 10m³/ha Storage 2.000
Hot Start (mins) 0   Foul Sewage per hectare (l/s) 0.000   Inlet Coeffiecient 0.800
Hot Start Level (mm) 0   Additional Flow - % of Total Flow 0.000   Flow per Person per Day (l/per/day) 0.000

Number of Input Hydrographs 0   Number of Offline Controls 0   Number of Time/Area Diagrams 0
Number of Online Controls 3   Number of Storage Structures 3   Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model   FSR   M5-60 (mm) 17.000   Cv (Summer) 0.750
Region England and Wales   Ratio R 0.400   Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0   DTS Status ON   Inertia Status OFF
Analysis Timestep Fine   DVD Status OFF

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440
Return Period(s) (years)	1, 5, 10, 20, 30
Climate Change (%)	25, 25, 25, 25, 25

PN	US/MH Name	Event	US/CL (m)	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Maximum Vol (m³)	Maximum Velocity (m/s)	Pipe Flow (l/s)	Status
SE-1.000	MH(SE)-1	15 minute 5 year Winter I+25%	4.740	3.587	0.047	0.000	1.22		0.387	0.9	63.9	SURCHARGED
SE-1.001	MH(SE)-2	15 minute 5 year Winter I+25%	4.740	3.454	0.006	0.000	1.07		2.497	1.0	102.9	SURCHARGED
SE-1.002	MH(SE)-3	15 minute 5 year Winter I+25%	4.740	3.081	-0.269	0.000	0.33		0.864	0.8	97.1	OK
SE-2.000	MH(SE)-4	15 minute 5 year Winter I+25%	4.830	3.550	-0.080	0.000	0.84		0.243	1.2	60.4	OK
SE-2.001	MH(SE)-5	15 minute 5 year Winter I+25%	4.830	3.266	-0.081	0.000	0.94		1.426	1.2	105.7	OK
SE-1.003	MH(SE)-6	15 minute 5 year Winter I+25%	4.830	3.042	-0.160	0.000	0.67		14.758	0.9	175.2	OK
SE-3.000	MH(SE)-7	15 minute 5 year Winter I+25%	4.830	3.524	-0.106	0.000	0.72		0.213	0.9	42.2	OK
SE-3.001	MH(SE)-8	15 minute 5 year Winter I+25%	4.830	3.312	-0.195	0.000	0.59		0.631	0.9	77.4	OK
SE-3.002	MH(SE)-9	15 minute 5 year Winter I+25%	4.830	3.176	-0.220	0.000	0.62		3.412	0.9	121.3	OK
SE-1.004	MH(SE)-10	15 minute 5 year Winter I+25%	4.830	2.970	-0.150	0.000	0.69		11.807	0.8	284.2	OK
SE-4.000	MH(SE)-11	15 minute 5 year Winter I+25%	4.830	3.525	-0.105	0.000	0.72		0.215	0.9	42.6	OK
SE-4.001	MH(SE)-12	15 minute 5 year Winter I+25%	4.830	3.316	-0.195	0.000	0.59		0.626	0.9	77.2	OK
SE-4.002	MH(SE)-13	15 minute 5 year Winter I+25%	4.830	3.170	-0.234	0.000	0.56		3.063	0.9	108.1	OK
SE-4.003	MH(SE)-14	15 minute 5 year Winter I+25%	4.830	3.060	-0.237	0.000	0.53		5.189	1.0	117.9	OK
SE-5.000	MH(SE)-LC-EAST	15 minute 5 year Winter I+25%	4.400	3.311	-0.089	0.000	0.82		0.233	0.9	48.2	OK
SE-5.001	MH(SE)-16	15 minute 5 year Winter I+25%	4.700	3.246	-0.091	0.000	0.83		0.844	0.9	48.6	OK
SE-4.004	MH(SE)-14-1	15 minute 5 year Winter I+25%	4.915	3.001	-0.224	0.000	0.62		2.401	1.2	154.6	OK
SE-1.005	MH(SE)-15	15 minute 5 year Winter I+25%	5.000	2.931	-0.139	0.000	1.00		10.592	1.1	435.2	OK
SE-6.000	MH(SE)-16	15 minute 5 year Winter I+25%	4.930	3.657	-0.073	0.000	0.72		0.166	0.8	21.7	OK
SE-7.000	MH(SE)-17	15 minute 5 year Winter I+25%	4.930	3.633	-0.097	0.000	0.56		0.139	0.9	19.9	OK
SE-6.001	MH(SE)-18	15 minute 5 year Winter I+25%	4.930	3.593	0.017	0.000	1.06		2.094	1.0	36.4	SURCHARGED
SE-8.000	MH(SE)-19	15 minute 5 year Winter I+25%	4.820	3.582	-0.038	0.000	0.96		0.206	0.9	29.3	OK
SE-9.000	MH(SE)-20	15 minute 5 year Winter I+25%	4.820	3.516	-0.104	0.000	0.54		0.131	0.9	19.9	OK
SE-6.002	MH(SE)-21	15 minute 5 year Winter I+25%	4.820	3.468	0.003	0.000	1.05		2.662	1.2	77.2	SURCHARGED
SE-6.003	MH(SE)-23	240 minute 5 year Winter I+25%	4.970	3.155	-0.224	0.000	0.05		71.949	0.4	4.1	OK
SE-6.004	MH(SE)-23-1	15 minute 5 year Winter I+25%	4.985	3.043	-0.275	0.000	0.04		0.452	0.4	3.1	OK
SE-10.000	MH(SE)-22	15 minute 5 year Winter I+25%	4.970	3.785	0.015	0.000	1.11		0.266	0.9	36.6	SURCHARGED
SE-6.005	MH(SE)-24	15 minute 5 year Winter I+25%	5.000	3.043	-0.208	0.000	0.39		1.254	0.7	32.2	OK
SE-6.006	MH(SE)-25	15 minute 5 year Winter I+25%	5.000	2.901	-0.216	0.000	0.37		1.648	0.7	31.2	OK
SE-11.000	MH(SE)-26	15 minute 5 year Winter I+25%	4.450	3.327	0.077	0.000	1.17		0.506	1.1	109.3	SURCHARGED
SE-11.001	MH(SE)-27	15 minute 5 year Winter I+25%	4.450	3.105	0.015	0.000	0.98		6.245	1.1	149.5	SURCHARGED
SE-12.000	MH(SE)-28	15 minute 5 year Winter I+25%	4.450	3.300	0.050	0.000	1.12		0.391	1.0	71.4	SURCHARGED
SE-12.001	MH(SE)-29	15 minute 5 year Winter I+25%	4.450	3.097	0.014	0.000	1.07		2.761	1.0	107.2	SURCHARGED
SE-11.002	MH(SE)-30	15 minute 5 year Winter I+25%	4.450	2.988	0.036	0.000	0.91		12.249	1.3	238.6	SURCHARGED
SE-13.000	MH(SE)-31-1	15 minute 5 year Winter I+25%	4.550	3.363	0.013	0.000	0.92		0.433	1.3	116.5	SURCHARGED
SE-13.001	MH(SE)-31	15 minute 5 year Winter I+25%	4.580	3.108	0.058	0.000	1.36		5.734	1.2	132.8	SURCHARGED
SE-13.002	MH(SE)-32	15 minute 5 year Winter I+25%	4.580	2.999	0.019	0.000	0.91		2.551	1.2	152.9	SURCHARGED
SE-14.000	MH(SE)-33	15 minute 5 year Winter I+25%	4.580	3.670	0.290	0.000	1.46		0.577	1.1	44.4	SURCHARGED
SE-14.001	MH(SE)-34	15 minute 5 year Winter I+25%	4.580	3.294	0.081	0.000	1.34		1.916	1.0	71.3	SURCHARGED
SE-11.003	MH(SE)-35	15 minute 5 year Winter I+25%	4.580	2.867	0.056	0.000	1.33		15.727	1.3	448.0	SURCHARGED
SE-15.000	MH(SE)-36	15 minute 5 year Winter I+25%	4.580	3.664	0.284	0.000	1.45		0.570	1.1	44.1	SURCHARGED
SE-15.001	MH(SE)-37	15 minute 5 year Winter I+25%	4.580	3.293	0.080	0.000	1.35		1.910	1.0	71.8	SURCHARGED
SE-16.000	MH(SE)-39	15 minute 5 year Winter I+25%	4.580	3.332	0.085	0.000	1.25		0.430	1.0	68.4	SURCHARGED
SE-11.004	MH(SE)-40	15 minute 5 year Winter I+25%	4.580	2.744	0.000	0.000	1.41		12.749	1.1	561.9	OK
SE-11.005	MH(SE)-41	15 minute 5 year Winter I+25%	4.750	2.495	-0.213	0.000	0.85		7.270	1.3	535.0	OK
SE-11.006	MH(SE)-42	15 minute 5 year Winter I+25%	4.750	2.352	-0.181	0.000	0.82		33.913	1.2	492.2	OK
SE-17.000	MH(SE)-43-1	15 minute 5 year Winter I+25%	4.580	2.842	0.017	0.000	0.89		0.268	1.0	31.6	SURCHARGED
SE-18.000	MH(SE)-43-2	15 minute 5 year Winter I+25%	4.580	3.283	-0.097	0.000	0.61		0.140	0.8	18.5	OK
SE-17.001	MH(SE)-43-3	15 minute 5 year Winter I+25%	4.580	2.562	0.065	0.000	1.63		1.666	1.2	48.6	SURCHARGED
SE-11.007	MH(SE)-43	1440 minute 5 year Winter I+25%	4.650	2.270	-0.144	0.000	0.07		25.389	0.5	37.3	OK
SE-19.000	MH(SE)-44-1	15 minute 5 year Winter I+25%	4.580	3.456	0.076	0.000	0.67		0.335	0.8	19.8	SURCHARGED
SE-19.001	MH(SE)-44	15 minute 5 year Winter I+25%	4.580	3.424	0.137	0.000	0.70		1.407	0.9	44.9	SURCHARGED
SE-19.002	MH(SE)-45	15 minute 5 year Winter I+25%	4.580	3.349	0.229	0.000	1.26		3.590	1.0	66.9	SURCHARGED
SE-20.000	MH(SE)-46	15 minute 5 year Winter I+25%	4.580	3.204	-0.176	0.000	0.01		0.050	0.2	0.3	OK
SE-20.001	MH(SE)-47	15 minute 5 year Winter I+25%	4.580	3.214	-0.023	0.000	0.78		0.910	1.0	48.8	OK
SE-19.003	MH(SE)-48	15 minute 5 year Winter I+25%	4.580	3.162	0.157	0.000	1.37		5.846	1.5	104.5	SURCHARGED
SE-21.000	MH(SE)-51	15 minute 5 year Winter I+25%	4.550	2.911	-0.359	0.000	0.21		0.231	0.9	49.7	OK
SE-21.001	MH(SE)-52	15 minute 5 year Winter I+25%	4.680	2.797	-0.364	0.000	0.20		1.282	1.5	83.6	OK
SE-19.004	MH(SE)-53	15 minute 5 year Winter I+25%	4.580	2.614	-0.198	0.000	0.76		2.644	1.1	209.0	OK
SE-19.005	MH(SE)-54	15 minute 5 year Winter I+25%	4.580	2.496	-0.184	0.000	0.45		12.221	0.9	216.7	OK

5 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Proposed Storm

PN	US/MH Name	Event	US/CL (m)	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Maximum Vol (m³)	Maximum Velocity (m/s)	Pipe Flow (l/s)	Status
SE-19.006	MH(SE)-55	15 minute 5 year Winter I+25%	4.580	2.467	-0.081	0.000	0.40		25.361	0.7	205.2	OK
SE-22.000	MH(SE)-56	15 minute 5 year Winter I+25%	4.550	3.261	-0.089	0.000	0.81		0.233	0.9	47.5	OK
SE-22.001	MH(SE)-57	15 minute 5 year Winter I+25%	4.550	3.036	-0.189	0.000	0.49		0.551	0.9	46.4	OK
SE-22.002	MH(SE)-58	15 minute 5 year Winter I+25%	4.550	2.982	-0.142	0.000	0.30		2.102	0.6	36.8	OK
SE-23.000	MH(SE)-59-5	15 minute 5 year Winter I+25%	4.550	3.210	-0.140	0.000	0.65		0.261	1.0	69.6	OK
SE-23.001	MH(SE)-59-4	15 minute 5 year Winter I+25%	4.550	3.159	-0.021	0.000	0.81		4.417	1.0	85.3	OK
SE-23.002	MH(SE)-59-3	15 minute 5 year Winter I+25%	4.550	3.084	0.044	0.000	1.05		4.721	0.9	137.8	SURCHARGED
SE-22.003	MH(SE)-59-2	15 minute 5 year Winter I+25%	4.550	2.967	0.040	0.000	1.31		12.309	1.1	167.4	SURCHARGED
SE-22.004	MH(SE)-59-1	15 minute 5 year Winter I+25%	4.565	2.793	-0.054	0.000	0.93		5.704	0.9	172.5	OK
SE-22.005	MH(SE)-59	15 minute 5 year Winter I+25%	4.580	2.699	-0.072	0.000	0.99		6.956	1.0	193.3	OK
SE-22.006	MH(SE)-60	15 minute 5 year Winter I+25%	4.580	2.571	-0.082	0.000	0.73		10.334	0.9	198.9	OK
SE-24.000	MH(SE)-61-1	15 minute 5 year Winter I+25%	4.550	3.296	-0.054	0.000	0.90		0.188	1.0	31.1	OK
SE-24.001	MH(SE)-61	15 minute 5 year Winter I+25%	4.550	3.155	-0.019	0.000	0.99		1.007	1.0	62.5	OK
SE-24.002	MH(SE)-62	15 minute 5 year Winter I+25%	4.700	2.831	-0.133	0.000	0.74		1.083	0.8	62.1	OK
SE-25.000	MH(SE)-LC-WEST	15 minute 5 year Winter I+25%	4.400	3.568	0.168	0.000	1.51		0.523	1.4	96.9	SURCHARGED
SE-22.007	MH(SE)-63	15 minute 5 year Winter I+25%	4.580	2.495	-0.040	0.000	0.86		15.529	1.0	272.8	OK
SE-19.007	MH(SE)-64	15 minute 5 year Winter I+25%	4.750	2.442	-0.022	0.000	1.00		20.224	1.2	448.7	OK
SE-11.008	MH(SE)-65	1440 minute 5 year Winter I+25%	4.615	2.269	0.289	0.000	0.24		1781.883	0.4	29.9	SURCHARGED
SE-26.000	MH(SE)-EX-66	30 minute 5 year Winter I+25%	4.700	4.823	1.398	123.365	2.17		125.053	2.1	84.2	FLOOD
SE-6.007	MH(SE)-67	1440 minute 5 year Winter I+25%	4.580	2.068	0.072	0.000	0.28		5.327	0.7	55.7	SURCHARGED
SE-6.008	MH(SE)-68	1440 minute 5 year Winter I+25%	4.830	2.056	0.136	0.000	0.28		7.330	0.7	54.9	SURCHARGED
SE-6.009	MH(SE)-69	1440 minute 5 year Winter I+25%	4.830	2.039	0.259	0.000	0.33		15.955	0.6	52.5	SURCHARGED
SE-6.010	MH(SE)-69-1	1440 minute 5 year Winter I+25%	4.830	2.029	0.289	0.000	0.26		4.486	0.7	51.7	SURCHARGED
SE-1.006	MH(SE)-70	1440 minute 5 year Winter I+25%	4.830	2.018	0.319	0.000	0.11		8.210	0.4	80.8	SURCHARGED
SE-1.007	MH(SE)-71	1440 minute 5 year Winter I+25%	4.830	2.012	0.415	0.000	0.11		34.727	0.5	79.6	SURCHARGED
SE-27.000	MH(SE)-72-2	15 minute 5 year Winter I+25%	4.830	4.018	0.388	0.000	1.48		0.772	1.6	108.7	SURCHARGED
SE-27.001	MH(SE)-72-1	15 minute 5 year Winter I+25%	4.830	3.498	0.096	0.000	1.55		3.198	1.5	107.2	SURCHARGED
SE-1.008	MH(SE)-72	1440 minute 5 year Winter I+25%	4.740	2.006	0.906	0.000	0.24		1740.827	0.3	59.2	SURCHARGED

10 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Proposed Storm

Simulation Criteria

Areal Reduction Factor 1.000 Manhole Headloss Coeff (Global) 0.500 MADD Factor * 10m³/ha Storage 2.000
Hot Start (mins) 0 Foul Sewage per hectare (l/s) 0.000 Inlet Coeffiecient 0.800
Hot Start Level (mm) 0 Additional Flow - % of Total Flow 0.000 Flow per Person per Day (l/per/day) 0.000

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 3 Number of Storage Structures 3 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FSR M5-60 (mm) 17.000 Cv (Summer) 0.750
Region England and Wales Ratio R 0.400 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0 DTS Status ON Inertia Status OFF
Analysis Timestep Fine DVD Status OFF

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440
Return Period(s) (years)	1, 5, 10, 20, 30
Climate Change (%)	25, 25, 25, 25, 25

PN	US/MH Name	Event	US/CL (m)	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Maximum Vol (m³)	Maximum Velocity (m/s)	Pipe Flow (l/s)	Status
SE-1.000	MH(SE)-1	15 minute 10 year Winter I+25%	4.740	3.712	0.172	0.000	1.39		0.528	1.1	72.7	SURCHARGED
SE-1.001	MH(SE)-2	15 minute 10 year Winter I+25%	4.740	3.523	0.075	0.000	1.34		2.820	1.2	128.8	SURCHARGED
SE-1.002	MH(SE)-3	15 minute 10 year Winter I+25%	4.740	3.214	-0.136	0.000	0.40		2.417	0.8	117.3	OK
SE-2.000	MH(SE)-4	15 minute 10 year Winter I+25%	4.830	3.649	0.019	0.000	0.93		0.356	1.2	67.1	SURCHARGED
SE-2.001	MH(SE)-5	15 minute 10 year Winter I+25%	4.830	3.392	0.045	0.000	1.10		3.201	1.2	123.6	SURCHARGED
SE-1.003	MH(SE)-6	15 minute 10 year Winter I+25%	4.830	3.186	-0.016	0.000	0.73		22.164	0.9	190.5	OK
SE-3.000	MH(SE)-7	15 minute 10 year Winter I+25%	4.830	3.545	-0.085	0.000	0.83		0.238	0.9	48.8	OK
SE-3.001	MH(SE)-8	15 minute 10 year Winter I+25%	4.830	3.362	-0.145	0.000	0.73		0.981	0.9	96.6	OK
SE-3.002	MH(SE)-9	15 minute 10 year Winter I+25%	4.830	3.238	-0.158	0.000	0.80		4.974	1.0	154.9	OK
SE-1.004	MH(SE)-10	15 minute 10 year Winter I+25%	4.830	3.115	-0.005	0.000	0.73		18.789	0.7	298.2	OK
SE-4.000	MH(SE)-11	15 minute 10 year Winter I+25%	4.830	3.547	-0.083	0.000	0.84		0.239	0.9	49.3	OK
SE-4.001	MH(SE)-12	15 minute 10 year Winter I+25%	4.830	3.365	-0.146	0.000	0.74		0.972	0.9	96.5	OK
SE-4.002	MH(SE)-13	15 minute 10 year Winter I+25%	4.830	3.221	-0.183	0.000	0.71		4.277	1.0	137.5	OK
SE-4.003	MH(SE)-14	15 minute 10 year Winter I+25%	4.830	3.140	-0.157	0.000	0.64		7.445	1.0	141.4	OK
SE-5.000	MH(SE)-LC-EAST	15 minute 10 year Winter I+25%	4.400	3.335	-0.065	0.000	0.94		0.260	1.0	55.8	OK
SE-5.001	MH(SE)-16	15 minute 10 year Winter I+25%	4.700	3.270	-0.067	0.000	0.96		0.959	1.0	56.2	OK
SE-4.004	MH(SE)-14-1	15 minute 10 year Winter I+25%	4.915	3.108	-0.117	0.000	0.77		3.928	1.2	190.4	OK
SE-1.005	MH(SE)-15	15 minute 10 year Winter I+25%	5.000	3.070	0.000	0.000	1.06		13.634	1.1	459.9	OK
SE-6.000	MH(SE)-16	15 minute 10 year Winter I+25%	4.930	3.730	0.000	0.000	0.79		0.248	0.8	23.9	OK
SE-7.000	MH(SE)-17	15 minute 10 year Winter I+25%	4.930	3.699	-0.031	0.000	0.63		0.214	0.9	22.5	OK
SE-6.001	MH(SE)-18	15 minute 10 year Winter I+25%	4.930	3.653	0.077	0.000	1.18		2.757	1.0	40.6	SURCHARGED
SE-8.000	MH(SE)-19	15 minute 10 year Winter I+25%	4.820	3.675	0.055	0.000	1.08		0.311	0.9	32.8	SURCHARGED
SE-9.000	MH(SE)-20	15 minute 10 year Winter I+25%	4.820	3.551	-0.069	0.000	0.62		0.171	1.0	22.7	OK
SE-6.002	MH(SE)-21	15 minute 10 year Winter I+25%	4.820	3.497	0.032	0.000	1.24		2.981	1.3	91.3	SURCHARGED
SE-6.003	MH(SE)-23	240 minute 10 year Winter I+25%	4.970	3.183	-0.196	0.000	0.06		85.094	0.4	4.5	OK
SE-6.004	MH(SE)-23-1	15 minute 10 year Winter I+25%	4.985	3.055	-0.263	0.000	0.04		0.549	0.4	3.4	OK
SE-10.000	MH(SE)-22	15 minute 10 year Winter I+25%	4.970	3.827	0.057	0.000	1.29		0.313	1.1	42.5	SURCHARGED
SE-6.005	MH(SE)-24	15 minute 10 year Winter I+25%	5.000	3.058	-0.193	0.000	0.44		1.433	0.7	36.8	OK
SE-6.006	MH(SE)-25	15 minute 10 year Winter I+25%	5.000	2.913	-0.204	0.000	0.43		1.902	0.7	35.8	OK
SE-11.000	MH(SE)-26	15 minute 10 year Winter I+25%	4.450	3.491	0.241	0.000	1.27		0.691	1.2	119.5	SURCHARGED
SE-11.001	MH(SE)-27	15 minute 10 year Winter I+25%	4.450	3.282	0.192	0.000	1.16		7.596	1.2	176.1	SURCHARGED
SE-12.000	MH(SE)-28	15 minute 10 year Winter I+25%	4.450	3.473	0.223	0.000	1.23		0.586	1.2	78.7	SURCHARGED
SE-12.001	MH(SE)-29	15 minute 10 year Winter I+25%	4.450	3.272	0.189	0.000	1.27		3.630	1.2	127.8	SURCHARGED
SE-11.002	MH(SE)-30	15 minute 10 year Winter I+25%	4.450	3.102	0.150	0.000	1.10		13.412	1.4	287.5	SURCHARGED
SE-13.000	MH(SE)-31-1	15 minute 10 year Winter I+25%	4.550	3.527	0.177	0.000	1.03		0.618	1.3	131.3	SURCHARGED
SE-13.001	MH(SE)-31	15 minute 10 year Winter I+25%	4.580	3.250	0.200	0.000	1.45		7.460	1.3	141.2	SURCHARGED
SE-13.002	MH(SE)-32	15 minute 10 year Winter I+25%	4.580	3.102	0.122	0.000	1.01		2.810	1.2	171.2	SURCHARGED
SE-14.000	MH(SE)-33	15 minute 10 year Winter I+25%	4.580	3.892	0.512	0.000	1.67		0.828	1.3	50.8	SURCHARGED
SE-14.001	MH(SE)-34	15 minute 10 year Winter I+25%	4.580	3.392	0.179	0.000	1.59		2.205	1.2	84.6	SURCHARGED
SE-11.003	MH(SE)-35	15 minute 10 year Winter I+25%	4.580	2.930	0.119	0.000	1.56		16.953	1.5	525.2	SURCHARGED
SE-15.000	MH(SE)-36	15 minute 10 year Winter I+25%	4.580	3.885	0.505	0.000	1.66		0.820	1.3	50.5	SURCHARGED
SE-15.001	MH(SE)-37	15 minute 10 year Winter I+25%	4.580	3.392	0.179	0.000	1.62		2.204	1.2	86.1	SURCHARGED
SE-16.000	MH(SE)-39	15 minute 10 year Winter I+25%	4.580	3.419	0.172	0.000	1.45		0.528	1.1	78.9	SURCHARGED
SE-11.004	MH(SE)-40	15 minute 10 year Winter I+25%	4.580	2.773	0.029	0.000	1.66		13.098	1.3	665.0	SURCHARGED
SE-11.005	MH(SE)-41	15 minute 10 year Winter I+25%	4.750	2.708	0.000	0.000	1.00		10.073	1.3	627.5	OK
SE-11.006	MH(SE)-42	15 minute 10 year Winter I+25%	4.750	2.513	-0.020	0.000	0.92		43.756	1.2	551.5	OK
SE-17.000	MH(SE)-43-1	15 minute 10 year Winter I+25%	4.580	2.965	0.140	0.000	1.02		0.407	1.0	36.0	SURCHARGED
SE-18.000	MH(SE)-43-2	15 minute 10 year Winter I+25%	4.580	3.297	-0.083	0.000	0.70		0.154	0.8	21.4	OK
SE-17.001	MH(SE)-43-3	15 minute 10 year Winter I+25%	4.580	2.596	0.099	0.000	1.85		1.957	1.4	55.2	SURCHARGED
SE-11.007	MH(SE)-43	15 minute 10 year Winter I+25%	4.650	2.386	-0.028	0.000	1.00		30.236	1.1	530.3	OK
SE-19.000	MH(SE)-44-1	15 minute 10 year Winter I+25%	4.580	3.873	0.493	0.000	0.70		0.806	0.8	20.6	SURCHARGED
SE-19.001	MH(SE)-44	15 minute 10 year Winter I+25%	4.580	3.831	0.544	0.000	0.83		1.867	0.9	53.3	SURCHARGED
SE-19.002	MH(SE)-45	15 minute 10 year Winter I+25%	4.580	3.706	0.586	0.000	1.57		3.994	1.2	82.9	SURCHARGED
SE-20.000	MH(SE)-46	15 minute 10 year Winter I+25%	4.580	3.504	0.124	0.000	0.05		0.389	0.3	1.8	SURCHARGED
SE-20.001	MH(SE)-47	15 minute 10 year Winter I+25%	4.580	3.510	0.273	0.000	0.92		1.699	1.0	57.9	SURCHARGED
SE-19.003	MH(SE)-48	15 minute 10 year Winter I+25%	4.580	3.399	0.394	0.000	1.74		6.326	1.9	133.0	SURCHARGED
SE-21.000	MH(SE)-51	15 minute 10 year Winter I+25%	4.550	2.926	-0.344	0.000	0.25		0.251	0.9	57.6	OK
SE-21.001	MH(SE)-52	15 minute 10 year Winter I+25%	4.680	2.818	-0.343	0.000	0.25		1.579	1.6	103.7	OK
SE-19.004	MH(SE)-53	15 minute 10 year Winter I+25%	4.580	2.705	-0.107	0.000	0.95		4.748	1.1	263.1	OK
SE-19.005	MH(SE)-54	15 minute 10 year Winter I+25%	4.580	2.573	-0.107	0.000	0.53		15.172	1.0	257.0	OK

10 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Proposed Storm

PN	US/MH Name	Event	US/CL (m)	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Maximum Vol (m³)	Maximum Velocity (m/s)	Pipe Flow (l/s)	Status
SE-19.006	MH(SE)-55	15 minute 10 year Winter I+25%	4.580	2.529	-0.019	0.000	0.52		27.655	0.8	264.8	OK
SE-22.000	MH(SE)-56	15 minute 10 year Winter I+25%	4.550	3.284	-0.066	0.000	0.93		0.260	1.0	55.0	OK
SE-22.001	MH(SE)-57	15 minute 10 year Winter I+25%	4.550	3.105	-0.120	0.000	0.54		1.204	0.9	51.9	OK
SE-22.002	MH(SE)-58	15 minute 10 year Winter I+25%	4.550	3.078	-0.046	0.000	0.34		3.393	0.6	41.7	OK
SE-23.000	MH(SE)-59-5	15 minute 10 year Winter I+25%	4.550	3.420	0.070	0.000	0.69		0.498	1.0	73.4	SURCHARGED
SE-23.001	MH(SE)-59-4	15 minute 10 year Winter I+25%	4.550	3.349	0.169	0.000	0.98		6.100	1.0	102.6	SURCHARGED
SE-23.002	MH(SE)-59-3	15 minute 10 year Winter I+25%	4.550	3.214	0.174	0.000	1.29		5.199	1.1	170.4	SURCHARGED
SE-22.003	MH(SE)-59-2	15 minute 10 year Winter I+25%	4.550	3.061	0.134	0.000	1.50		13.735	1.2	191.7	SURCHARGED
SE-22.004	MH(SE)-59-1	15 minute 10 year Winter I+25%	4.565	2.886	0.039	0.000	1.06		6.729	0.9	197.3	SURCHARGED
SE-22.005	MH(SE)-59	15 minute 10 year Winter I+25%	4.580	2.801	0.030	0.000	1.11		8.306	1.0	215.6	SURCHARGED
SE-22.006	MH(SE)-60	15 minute 10 year Winter I+25%	4.580	2.647	-0.006	0.000	0.82		12.223	0.9	222.3	OK
SE-24.000	MH(SE)-61-1	15 minute 10 year Winter I+25%	4.550	3.462	0.112	0.000	0.99		0.376	1.0	34.3	SURCHARGED
SE-24.001	MH(SE)-61	15 minute 10 year Winter I+25%	4.550	3.289	0.115	0.000	1.21		1.754	1.1	76.7	SURCHARGED
SE-24.002	MH(SE)-62	15 minute 10 year Winter I+25%	4.700	2.868	-0.096	0.000	0.88		1.554	0.9	74.0	OK
SE-25.000	MH(SE)-LC-WEST	15 minute 10 year Winter I+25%	4.400	3.666	0.266	0.000	1.73		0.635	1.6	111.0	SURCHARGED
SE-22.007	MH(SE)-63	15 minute 10 year Winter I+25%	4.580	2.551	0.016	0.000	1.07		17.257	1.0	341.3	SURCHARGED
SE-19.007	MH(SE)-64	15 minute 10 year Winter I+25%	4.750	2.495	0.031	0.000	1.35		21.467	1.4	605.0	SURCHARGED
SE-11.008	MH(SE)-65	1440 minute 10 year Winter I+25%	4.615	2.375	0.395	0.000	0.30		2039.409	0.4	37.4	SURCHARGED
SE-26.000	MH(SE)-EX-66	30 minute 10 year Winter I+25%	4.700	4.864	1.439	164.227	2.19		165.918	2.1	85.1	FLOOD
SE-6.007	MH(SE)-67	1440 minute 10 year Winter I+25%	4.580	2.138	0.142	0.000	0.29		5.430	0.7	58.2	SURCHARGED
SE-6.008	MH(SE)-68	1440 minute 10 year Winter I+25%	4.830	2.123	0.203	0.000	0.29		7.434	0.7	57.4	SURCHARGED
SE-6.009	MH(SE)-69	1440 minute 10 year Winter I+25%	4.830	2.102	0.322	0.000	0.34		16.045	0.6	54.7	SURCHARGED
SE-6.010	MH(SE)-69-1	1440 minute 10 year Winter I+25%	4.830	2.090	0.350	0.000	0.28		4.573	0.7	54.0	SURCHARGED
SE-1.006	MH(SE)-70	1440 minute 10 year Winter I+25%	4.830	2.076	0.377	0.000	0.12		8.357	0.4	85.6	SURCHARGED
SE-1.007	MH(SE)-71	1440 minute 10 year Winter I+25%	4.830	2.069	0.472	0.000	0.11		34.872	0.5	84.7	SURCHARGED
SE-27.000	MH(SE)-72-2	15 minute 10 year Winter I+25%	4.830	4.224	0.594	0.000	1.68		1.006	1.8	123.3	SURCHARGED
SE-27.001	MH(SE)-72-1	15 minute 10 year Winter I+25%	4.830	3.553	0.151	0.000	1.77		3.474	1.7	122.6	SURCHARGED
SE-1.008	MH(SE)-72	1440 minute 10 year Winter I+25%	4.740	2.062	0.962	0.000	0.29		1806.885	0.4	72.4	SURCHARGED

20 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Proposed Storm

Simulation Criteria

Areal Reduction Factor 1.000   Manhole Headloss Coeff (Global) 0.500   MADD Factor * 10m³/ha Storage 2.000
Hot Start (mins) 0   Foul Sewage per hectare (l/s) 0.000   Inlet Coeffiecient 0.800
Hot Start Level (mm) 0   Additional Flow - % of Total Flow 0.000   Flow per Person per Day (l/per/day) 0.000

Number of Input Hydrographs 0   Number of Offline Controls 0   Number of Time/Area Diagrams 0
Number of Online Controls 3   Number of Storage Structures 3   Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model   FSR   M5-60 (mm) 17.000   Cv (Summer) 0.750
Region England and Wales   Ratio R 0.400   Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0   DTS Status ON   Inertia Status OFF
Analysis Timestep Fine   DVD Status OFF

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440
Return Period(s) (years) 1, 5, 10, 20, 30
Climate Change (%) 25, 25, 25, 25, 25

PN	US/MH Name	Event	US/CL (m)	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Maximum Vol (m³)	Maximum Velocity (m/s)	Pipe Flow (l/s)	Status
SE-1.000	MH(SE)-1	15 minute 20 year Winter I+25%	4.740	3.835	0.295	0.000	1.62		0.667	1.2	84.2	SURCHARGED
SE-1.001	MH(SE)-2	15 minute 20 year Winter I+25%	4.740	3.585	0.137	0.000	1.55		2.955	1.4	148.8	SURCHARGED
SE-1.002	MH(SE)-3	15 minute 20 year Winter I+25%	4.740	3.247	-0.103	0.000	0.44		2.857	0.8	129.5	OK
SE-2.000	MH(SE)-4	15 minute 20 year Winter I+25%	4.830	3.815	0.185	0.000	1.06		0.543	1.2	76.3	SURCHARGED
SE-2.001	MH(SE)-5	15 minute 20 year Winter I+25%	4.830	3.475	0.128	0.000	1.22		4.194	1.3	137.8	SURCHARGED
SE-1.003	MH(SE)-6	15 minute 20 year Winter I+25%	4.830	3.213	0.011	0.000	0.92		23.235	0.9	241.8	SURCHARGED
SE-3.000	MH(SE)-7	15 minute 20 year Winter I+25%	4.830	3.570	-0.060	0.000	0.96		0.265	1.0	56.6	OK
SE-3.001	MH(SE)-8	15 minute 20 year Winter I+25%	4.830	3.394	-0.113	0.000	0.85		1.351	0.9	111.3	OK
SE-3.002	MH(SE)-9	15 minute 20 year Winter I+25%	4.830	3.278	-0.118	0.000	0.92		5.999	1.0	178.2	OK
SE-1.004	MH(SE)-10	15 minute 20 year Winter I+25%	4.830	3.140	0.020	0.000	0.94		19.850	0.9	385.2	SURCHARGED
SE-4.000	MH(SE)-11	15 minute 20 year Winter I+25%	4.830	3.574	-0.056	0.000	0.97		0.270	1.0	57.0	OK
SE-4.001	MH(SE)-12	15 minute 20 year Winter I+25%	4.830	3.398	-0.113	0.000	0.85		1.328	0.9	111.2	OK
SE-4.002	MH(SE)-13	15 minute 20 year Winter I+25%	4.830	3.258	-0.146	0.000	0.81		5.195	1.0	157.3	OK
SE-4.003	MH(SE)-14	15 minute 20 year Winter I+25%	4.830	3.180	-0.117	0.000	0.69		8.562	1.0	153.6	OK
SE-5.000	MH(SE)-LC-EAST	15 minute 20 year Winter I+25%	4.400	3.408	0.008	0.000	1.07		0.343	0.9	63.3	SURCHARGED
SE-5.001	MH(SE)-16	15 minute 20 year Winter I+25%	4.700	3.337	0.000	0.000	1.03		1.285	0.9	60.6	OK
SE-4.004	MH(SE)-14-1	15 minute 20 year Winter I+25%	4.915	3.140	-0.085	0.000	0.84		4.387	1.3	208.3	OK
SE-1.005	MH(SE)-15	15 minute 20 year Winter I+25%	5.000	3.092	0.022	0.000	1.36		14.036	1.3	591.5	SURCHARGED
SE-6.000	MH(SE)-16	15 minute 20 year Winter I+25%	4.930	3.854	0.124	0.000	0.86		0.390	0.8	26.1	SURCHARGED
SE-7.000	MH(SE)-17	15 minute 20 year Winter I+25%	4.930	3.810	0.080	0.000	0.69		0.339	1.0	24.7	SURCHARGED
SE-6.001	MH(SE)-18	15 minute 20 year Winter I+25%	4.930	3.750	0.174	0.000	1.36		3.057	1.2	46.5	SURCHARGED
SE-8.000	MH(SE)-19	15 minute 20 year Winter I+25%	4.820	3.773	0.153	0.000	1.21		0.422	1.0	37.0	SURCHARGED
SE-9.000	MH(SE)-20	15 minute 20 year Winter I+25%	4.820	3.607	-0.013	0.000	0.70		0.234	1.0	25.6	OK
SE-6.002	MH(SE)-21	15 minute 20 year Winter I+25%	4.820	3.542	0.077	0.000	1.43		3.450	1.5	104.7	SURCHARGED
SE-6.003	MH(SE)-23	240 minute 20 year Winter I+25%	4.970	3.215	-0.164	0.000	0.06		100.698	0.4	4.8	OK
SE-6.004	MH(SE)-23-1	15 minute 20 year Winter I+25%	4.985	3.069	-0.249	0.000	0.05		0.706	0.4	3.7	OK
SE-10.000	MH(SE)-22	15 minute 20 year Winter I+25%	4.970	3.882	0.112	0.000	1.49		0.375	1.2	49.1	SURCHARGED
SE-6.005	MH(SE)-24	15 minute 20 year Winter I+25%	5.000	3.074	-0.177	0.000	0.51		1.619	0.8	42.4	OK
SE-6.006	MH(SE)-25	15 minute 20 year Winter I+25%	5.000	2.928	-0.189	0.000	0.49		2.199	0.8	41.2	OK
SE-11.000	MH(SE)-26	15 minute 20 year Winter I+25%	4.450	3.776	0.526	0.000	1.39		1.013	1.3	130.0	SURCHARGED
SE-11.001	MH(SE)-27	15 minute 20 year Winter I+25%	4.450	3.492	0.402	0.000	1.33		7.834	1.3	202.4	SURCHARGED
SE-12.000	MH(SE)-28	15 minute 20 year Winter I+25%	4.450	3.740	0.490	0.000	1.34		0.888	1.3	85.8	SURCHARGED
SE-12.001	MH(SE)-29	15 minute 20 year Winter I+25%	4.450	3.480	0.397	0.000	1.41		3.876	1.4	141.2	SURCHARGED
SE-11.002	MH(SE)-30	15 minute 20 year Winter I+25%	4.450	3.281	0.329	0.000	1.27		13.729	1.6	331.4	SURCHARGED
SE-13.000	MH(SE)-31-1	15 minute 20 year Winter I+25%	4.550	3.794	0.444	0.000	1.13		0.920	1.4	143.5	SURCHARGED
SE-13.001	MH(SE)-31	15 minute 20 year Winter I+25%	4.580	3.458	0.408	0.000	1.69		8.009	1.5	164.1	SURCHARGED
SE-13.002	MH(SE)-32	15 minute 20 year Winter I+25%	4.580	3.275	0.295	0.000	1.17		3.009	1.3	198.2	SURCHARGED
SE-14.000	MH(SE)-33	15 minute 20 year Winter I+25%	4.580	4.130	0.750	0.000	1.91		1.097	1.5	58.2	SURCHARGED
SE-14.001	MH(SE)-34	15 minute 20 year Winter I+25%	4.580	3.484	0.271	0.000	1.80		2.327	1.4	95.8	SURCHARGED
SE-11.003	MH(SE)-35	15 minute 20 year Winter I+25%	4.580	3.067	0.256	0.000	1.78		18.885	1.7	601.0	SURCHARGED
SE-15.000	MH(SE)-36	15 minute 20 year Winter I+25%	4.580	4.121	0.741	0.000	1.89		1.087	1.5	57.8	SURCHARGED
SE-15.001	MH(SE)-37	15 minute 20 year Winter I+25%	4.580	3.484	0.271	0.000	1.84		2.327	1.4	97.9	SURCHARGED
SE-16.000	MH(SE)-39	15 minute 20 year Winter I+25%	4.580	3.531	0.284	0.000	1.65		0.654	1.3	90.0	SURCHARGED
SE-11.004	MH(SE)-40	15 minute 20 year Winter I+25%	4.580	2.848	0.104	0.000	1.90		14.063	1.4	759.4	SURCHARGED
SE-11.005	MH(SE)-41	15 minute 20 year Winter I+25%	4.750	2.758	0.050	0.000	1.15		10.491	1.4	723.1	SURCHARGED
SE-11.006	MH(SE)-42	15 minute 20 year Winter I+25%	4.750	2.566	0.033	0.000	1.11		45.618	1.3	667.3	SURCHARGED
SE-17.000	MH(SE)-43-1	15 minute 20 year Winter I+25%	4.580	3.124	0.299	0.000	1.16		0.587	1.1	41.1	SURCHARGED
SE-18.000	MH(SE)-43-2	15 minute 20 year Winter I+25%	4.580	3.312	-0.068	0.000	0.81		0.172	0.9	24.8	OK
SE-17.001	MH(SE)-43-3	15 minute 20 year Winter I+25%	4.580	2.639	0.142	0.000	2.10		2.319	1.6	62.7	SURCHARGED
SE-11.007	MH(SE)-43	1440 minute 20 year Winter I+25%	4.650	2.503	0.089	0.000	0.09		33.087	0.5	47.4	SURCHARGED
SE-19.000	MH(SE)-44-1	15 minute 20 year Winter I+25%	4.580	4.177	0.797	0.000	0.80		1.150	0.7	23.4	SURCHARGED
SE-19.001	MH(SE)-44	15 minute 20 year Winter I+25%	4.580	4.131	0.844	0.000	0.94		2.206	1.0	60.1	SURCHARGED
SE-19.002	MH(SE)-45	15 minute 20 year Winter I+25%	4.580	3.976	0.856	0.000	1.75		4.299	1.3	92.8	SURCHARGED
SE-20.000	MH(SE)-46	15 minute 20 year Winter I+25%	4.580	3.725	0.345	0.000	0.07		0.640	0.3	2.6	SURCHARGED
SE-20.001	MH(SE)-47	15 minute 20 year Winter I+25%	4.580	3.734	0.497	0.000	1.00		1.952	1.0	62.8	SURCHARGED
SE-19.003	MH(SE)-48	15 minute 20 year Winter I+25%	4.580	3.591	0.586	0.000	1.98		6.543	2.2	150.9	SURCHARGED
SE-21.000	MH(SE)-51	15 minute 20 year Winter I+25%	4.550	2.950	-0.320	0.000	0.28		0.286	0.9	66.0	OK
SE-21.001	MH(SE)-52	15 minute 20 year Winter I+25%	4.680	2.869	-0.292	0.000	0.29		2.405	1.6	118.5	OK
SE-19.004	MH(SE)-53	15 minute 20 year Winter I+25%	4.580	2.821	0.009	0.000	1.05		7.773	1.1	289.5	SURCHARGED
SE-19.005	MH(SE)-54	15 minute 20 year Winter I+25%	4.580	2.655	-0.025	0.000	0.61		17.921	1.0	292.4	OK

20 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Proposed Storm

PN	US/MH Name	Event	US/CL (m)	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Maximum Vol (m³)	Maximum Velocity (m/s)	Pipe Flow (l/s)	Status
SE-19.006	MH(SE)-55	15 minute 20 year Winter I+25%	4.580	2.594	0.046	0.000	0.60		29.512	0.8	306.2	SURCHARGED
SE-22.000	MH(SE)-56	15 minute 20 year Winter I+25%	4.550	3.366	0.016	0.000	1.07		0.351	0.9	62.9	SURCHARGED
SE-22.001	MH(SE)-57	15 minute 20 year Winter I+25%	4.550	3.315	0.090	0.000	0.56		2.987	0.9	53.5	SURCHARGED
SE-22.002	MH(SE)-58	15 minute 20 year Winter I+25%	4.550	3.287	0.163	0.000	0.40		4.468	0.6	49.0	SURCHARGED
SE-23.000	MH(SE)-59-5	15 minute 20 year Winter I+25%	4.550	3.658	0.308	0.000	0.75		0.767	1.0	80.3	SURCHARGED
SE-23.001	MH(SE)-59-4	15 minute 20 year Winter I+25%	4.550	3.572	0.392	0.000	1.11		6.377	1.1	116.7	SURCHARGED
SE-23.002	MH(SE)-59-3	15 minute 20 year Winter I+25%	4.550	3.426	0.386	0.000	1.49		5.439	1.3	196.5	SURCHARGED
SE-22.003	MH(SE)-59-2	15 minute 20 year Winter I+25%	4.550	3.268	0.341	0.000	1.69		14.391	1.4	215.3	SURCHARGED
SE-22.004	MH(SE)-59-1	15 minute 20 year Winter I+25%	4.565	3.048	0.201	0.000	1.21		7.221	1.1	224.7	SURCHARGED
SE-22.005	MH(SE)-59	15 minute 20 year Winter I+25%	4.580	2.944	0.173	0.000	1.27		8.905	1.2	247.8	SURCHARGED
SE-22.006	MH(SE)-60	15 minute 20 year Winter I+25%	4.580	2.747	0.094	0.000	0.94		13.393	1.0	256.7	SURCHARGED
SE-24.000	MH(SE)-61-1	15 minute 20 year Winter I+25%	4.550	3.630	0.280	0.000	1.16		0.565	1.0	39.9	SURCHARGED
SE-24.001	MH(SE)-61	15 minute 20 year Winter I+25%	4.550	3.407	0.233	0.000	1.39		1.952	1.3	87.7	SURCHARGED
SE-24.002	MH(SE)-62	15 minute 20 year Winter I+25%	4.700	2.907	-0.057	0.000	0.98		2.084	0.9	82.3	OK
SE-25.000	MH(SE)-LC-WEST	15 minute 20 year Winter I+25%	4.400	3.801	0.401	0.000	1.99		0.787	1.8	127.8	SURCHARGED
SE-22.007	MH(SE)-63	15 minute 20 year Winter I+25%	4.580	2.636	0.101	0.000	1.28		19.687	1.1	406.7	SURCHARGED
SE-19.007	MH(SE)-64	15 minute 20 year Winter I+25%	4.750	2.554	0.090	0.000	1.58		22.314	1.6	710.0	SURCHARGED
SE-11.008	MH(SE)-65	1440 minute 20 year Winter I+25%	4.615	2.501	0.521	0.000	0.35		2340.053	0.4	43.0	SURCHARGED
SE-26.000	MH(SE)-EX-66	30 minute 20 year Winter I+25%	4.700	4.914	1.489	213.716	2.22		215.407	2.2	86.2	FLOOD
SE-6.007	MH(SE)-67	1440 minute 20 year Winter I+25%	4.580	2.218	0.222	0.000	0.30		5.545	0.7	59.8	SURCHARGED
SE-6.008	MH(SE)-68	1440 minute 20 year Winter I+25%	4.830	2.200	0.280	0.000	0.30		7.545	0.7	58.9	SURCHARGED
SE-6.009	MH(SE)-69	1440 minute 20 year Winter I+25%	4.830	2.176	0.396	0.000	0.36		16.151	0.6	58.2	SURCHARGED
SE-6.010	MH(SE)-69-1	1440 minute 20 year Winter I+25%	4.830	2.161	0.421	0.000	0.30		4.676	0.7	58.2	SURCHARGED
SE-1.006	MH(SE)-70	1440 minute 20 year Winter I+25%	4.830	2.145	0.446	0.000	0.12		8.532	0.4	90.4	SURCHARGED
SE-1.007	MH(SE)-71	1440 minute 20 year Winter I+25%	4.830	2.136	0.539	0.000	0.12		35.043	0.5	90.0	SURCHARGED
SE-27.000	MH(SE)-72-2	15 minute 20 year Winter I+25%	4.830	4.486	0.856	0.000	1.91		1.301	2.0	139.9	SURCHARGED
SE-27.001	MH(SE)-72-1	15 minute 20 year Winter I+25%	4.830	3.622	0.220	0.000	2.01		3.714	2.0	139.1	SURCHARGED
SE-1.008	MH(SE)-72	1440 minute 20 year Winter I+25%	4.740	2.128	1.028	0.000	0.35		1885.251	0.4	86.5	SURCHARGED

30 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Proposed Storm

Simulation Criteria

Areal Reduction Factor 1.000 Manhole Headloss Coeff (Global) 0.500 MADD Factor * 10m³/ha Storage 2.000
Hot Start (mins) 0 Foul Sewage per hectare (l/s) 0.000 Inlet Coeffiecient 0.800
Hot Start Level (mm) 0 Additional Flow - % of Total Flow 0.000 Flow per Person per Day (l/per/day) 0.000

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 3 Number of Storage Structures 3 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FSR M5-60 (mm) 17.000 Cv (Summer) 0.750
Region England and Wales Ratio R 0.400 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0 DTS Status ON Inertia Status OFF
Analysis Timestep Fine DVD Status OFF

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440
Return Period(s) (years) 1, 5, 10, 20, 30
Climate Change (%) 25, 25, 25, 25, 25

PN	US/MH Name	Event	US/CL (m)	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Maximum Vol (m³)	Maximum Velocity (m/s)	Pipe Flow (l/s)	Status
SE-1.000	MH(SE)-1	15 minute 30 year Winter I+25%	4.740	3.923	0.383	0.000	1.76		0.767	1.3	91.8	SURCHARGED
SE-1.001	MH(SE)-2	15 minute 30 year Winter I+25%	4.740	3.631	0.183	0.000	1.68		3.006	1.5	161.7	SURCHARGED
SE-1.002	MH(SE)-3	15 minute 30 year Winter I+25%	4.740	3.304	-0.046	0.000	0.47		3.532	0.9	140.2	OK
SE-2.000	MH(SE)-4	15 minute 30 year Winter I+25%	4.830	3.943	0.313	0.000	1.13		0.688	1.2	81.7	SURCHARGED
SE-2.001	MH(SE)-5	15 minute 30 year Winter I+25%	4.830	3.553	0.206	0.000	1.30		4.673	1.4	146.8	SURCHARGED
SE-1.003	MH(SE)-6	15 minute 30 year Winter I+25%	4.830	3.267	0.065	0.000	0.99		24.354	0.9	260.1	SURCHARGED
SE-3.000	MH(SE)-7	15 minute 30 year Winter I+25%	4.830	3.636	0.006	0.000	1.02		0.341	1.0	60.3	SURCHARGED
SE-3.001	MH(SE)-8	15 minute 30 year Winter I+25%	4.830	3.413	-0.094	0.000	0.91		1.555	1.0	119.3	OK
SE-3.002	MH(SE)-9	15 minute 30 year Winter I+25%	4.830	3.317	-0.079	0.000	0.98		6.900	1.0	189.9	OK
SE-1.004	MH(SE)-10	15 minute 30 year Winter I+25%	4.830	3.185	0.065	0.000	1.02		21.613	0.9	416.4	SURCHARGED
SE-4.000	MH(SE)-11	15 minute 30 year Winter I+25%	4.830	3.638	0.008	0.000	1.04		0.343	0.9	61.1	SURCHARGED
SE-4.001	MH(SE)-12	15 minute 30 year Winter I+25%	4.830	3.416	-0.095	0.000	0.91		1.527	1.0	119.7	OK
SE-4.002	MH(SE)-13	15 minute 30 year Winter I+25%	4.830	3.286	-0.118	0.000	0.87		5.864	1.0	168.9	OK
SE-4.003	MH(SE)-14	15 minute 30 year Winter I+25%	4.830	3.225	-0.072	0.000	0.74		9.669	1.0	164.8	OK
SE-5.000	MH(SE)-LC-EAST	15 minute 30 year Winter I+25%	4.400	3.439	0.039	0.000	1.18		0.378	1.0	69.6	SURCHARGED
SE-5.001	MH(SE)-16	15 minute 30 year Winter I+25%	4.700	3.347	0.010	0.000	1.18		1.317	1.0	69.3	SURCHARGED
SE-4.004	MH(SE)-14-1	15 minute 30 year Winter I+25%	4.915	3.184	-0.041	0.000	0.90		5.008	1.2	221.5	OK
SE-1.005	MH(SE)-15	15 minute 30 year Winter I+25%	5.000	3.132	0.062	0.000	1.46		14.671	1.4	634.0	SURCHARGED
SE-6.000	MH(SE)-16	15 minute 30 year Winter I+25%	4.930	3.946	0.216	0.000	0.90		0.493	0.8	27.4	SURCHARGED
SE-7.000	MH(SE)-17	15 minute 30 year Winter I+25%	4.930	3.893	0.163	0.000	0.73		0.433	0.9	25.8	SURCHARGED
SE-6.001	MH(SE)-18	15 minute 30 year Winter I+25%	4.930	3.819	0.243	0.000	1.48		3.146	1.3	50.7	SURCHARGED
SE-8.000	MH(SE)-19	15 minute 30 year Winter I+25%	4.820	3.845	0.225	0.000	1.31		0.504	1.0	39.8	SURCHARGED
SE-9.000	MH(SE)-20	15 minute 30 year Winter I+25%	4.820	3.651	0.031	0.000	0.74		0.284	1.0	27.0	SURCHARGED
SE-6.002	MH(SE)-21	15 minute 30 year Winter I+25%	4.820	3.574	0.109	0.000	1.56		3.746	1.6	114.6	SURCHARGED
SE-6.003	MH(SE)-23	240 minute 30 year Winter I+25%	4.970	3.238	-0.141	0.000	0.06		111.633	0.4	4.9	OK
SE-6.004	MH(SE)-23-1	15 minute 30 year Winter I+25%	4.985	3.079	-0.239	0.000	0.05		0.810	0.4	3.8	OK
SE-10.000	MH(SE)-22	15 minute 30 year Winter I+25%	4.970	3.921	0.151	0.000	1.62		0.420	1.3	53.5	SURCHARGED
SE-6.005	MH(SE)-24	15 minute 30 year Winter I+25%	5.000	3.084	-0.167	0.000	0.55		1.739	0.8	46.0	OK
SE-6.006	MH(SE)-25	15 minute 30 year Winter I+25%	5.000	2.938	-0.179	0.000	0.54		2.386	0.8	44.7	OK
SE-11.000	MH(SE)-26	15 minute 30 year Winter I+25%	4.450	3.985	0.735	0.000	1.47		1.250	1.3	137.8	SURCHARGED
SE-11.001	MH(SE)-27	15 minute 30 year Winter I+25%	4.450	3.697	0.607	0.000	1.41		8.066	1.4	215.5	SURCHARGED
SE-12.000	MH(SE)-28	15 minute 30 year Winter I+25%	4.450	3.939	0.689	0.000	1.39		1.112	1.3	88.9	SURCHARGED
SE-12.001	MH(SE)-29	15 minute 30 year Winter I+25%	4.450	3.680	0.597	0.000	1.48		4.103	1.4	148.6	SURCHARGED
SE-11.002	MH(SE)-30	15 minute 30 year Winter I+25%	4.450	3.452	0.500	0.000	1.37		13.973	1.7	356.5	SURCHARGED
SE-13.000	MH(SE)-31-1	15 minute 30 year Winter I+25%	4.550	4.004	0.654	0.000	1.19		1.158	1.4	150.4	SURCHARGED
SE-13.001	MH(SE)-31	15 minute 30 year Winter I+25%	4.580	3.661	0.611	0.000	1.78		8.239	1.6	173.8	SURCHARGED
SE-13.002	MH(SE)-32	15 minute 30 year Winter I+25%	4.580	3.454	0.474	0.000	1.26		3.212	1.4	213.2	SURCHARGED
SE-14.000	MH(SE)-33	15 minute 30 year Winter I+25%	4.580	4.296	0.916	0.000	2.03		1.285	1.6	61.8	FLOOD RISK
SE-14.001	MH(SE)-34	15 minute 30 year Winter I+25%	4.580	3.549	0.336	0.000	1.93		2.401	1.5	102.4	SURCHARGED
SE-11.003	MH(SE)-35	15 minute 30 year Winter I+25%	4.580	3.211	0.400	0.000	1.91		19.894	1.8	643.9	SURCHARGED
SE-15.000	MH(SE)-36	15 minute 30 year Winter I+25%	4.580	4.286	0.906	0.000	2.05		1.273	1.6	62.5	FLOOD RISK
SE-15.001	MH(SE)-37	15 minute 30 year Winter I+25%	4.580	3.547	0.334	0.000	1.96		2.398	1.5	104.2	SURCHARGED
SE-16.000	MH(SE)-39	15 minute 30 year Winter I+25%	4.580	3.611	0.364	0.000	1.78		0.745	1.4	96.9	SURCHARGED
SE-11.004	MH(SE)-40	15 minute 30 year Winter I+25%	4.580	2.970	0.226	0.000	2.02		16.510	1.5	806.3	SURCHARGED
SE-11.005	MH(SE)-41	15 minute 30 year Winter I+25%	4.750	2.841	0.133	0.000	1.22		10.940	1.5	769.5	SURCHARGED
SE-11.006	MH(SE)-42	15 minute 30 year Winter I+25%	4.750	2.613	0.080	0.000	1.20		47.256	1.4	720.4	SURCHARGED
SE-17.000	MH(SE)-43-1	15 minute 30 year Winter I+25%	4.580	3.238	0.413	0.000	1.25		0.715	1.2	44.4	SURCHARGED
SE-18.000	MH(SE)-43-2	15 minute 30 year Winter I+25%	4.580	3.322	-0.058	0.000	0.89		0.184	0.9	27.0	OK
SE-17.001	MH(SE)-43-3	15 minute 30 year Winter I+25%	4.580	2.672	0.175	0.000	2.27		2.585	1.7	67.7	SURCHARGED
SE-11.007	MH(SE)-43	1440 minute 30 year Winter I+25%	4.650	2.591	0.177	0.000	0.10		33.668	0.5	51.3	SURCHARGED
SE-19.000	MH(SE)-44-1	15 minute 30 year Winter I+25%	4.580	4.391	1.011	0.000	0.85		1.393	0.8	25.1	FLOOD RISK
SE-19.001	MH(SE)-44	15 minute 30 year Winter I+25%	4.580	4.342	1.055	0.000	1.01		2.445	1.0	64.4	FLOOD RISK
SE-19.002	MH(SE)-45	15 minute 30 year Winter I+25%	4.580	4.166	1.046	0.000	1.87		4.514	1.4	99.1	SURCHARGED
SE-20.000	MH(SE)-46	15 minute 30 year Winter I+25%	4.580	3.884	0.504	0.000	0.09		0.819	0.2	3.2	SURCHARGED
SE-20.001	MH(SE)-47	15 minute 30 year Winter I+25%	4.580	3.893	0.656	0.000	1.07		2.133	1.0	66.8	SURCHARGED
SE-19.003	MH(SE)-48	15 minute 30 year Winter I+25%	4.580	3.728	0.723	0.000	2.12		6.698	2.3	161.4	SURCHARGED
SE-21.000	MH(SE)-51	15 minute 30 year Winter I+25%	4.550	2.967	-0.303	0.000	0.31		0.310	0.9	71.6	OK
SE-21.001	MH(SE)-52	15 minute 30 year Winter I+25%	4.680	2.894	-0.267	0.000	0.30		2.853	1.7	123.3	OK
SE-19.004	MH(SE)-53	15 minute 30 year Winter I+25%	4.580	2.854	0.042	0.000	1.15		8.429	1.2	316.5	SURCHARGED
SE-19.005	MH(SE)-54	15 minute 30 year Winter I+25%	4.580	2.699	0.019	0.000	0.67		18.998	1.0	323.1	SURCHARGED

30 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Proposed Storm

PN	US/MH Name	Event	US/CL (m)	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Maximum Vol (m^3)	Maximum Velocity (m/s)	Pipe Flow (l/s)	Status
SE-19.006	MH(SE)-55	15 minute 30 year Winter I+25%	4.580	2.647	0.099	0.000	0.68		30.148	0.8	343.6	SURCHARGED
SE-22.000	MH(SE)-56	15 minute 30 year Winter I+25%	4.550	3.555	0.205	0.000	1.16		0.565	1.0	68.7	SURCHARGED
SE-22.001	MH(SE)-57	15 minute 30 year Winter I+25%	4.550	3.502	0.277	0.000	0.57		3.299	0.9	54.7	SURCHARGED
SE-22.002	MH(SE)-58	15 minute 30 year Winter I+25%	4.550	3.471	0.347	0.000	0.42		4.677	0.6	51.9	SURCHARGED
SE-23.000	MH(SE)-59-5	15 minute 30 year Winter I+25%	4.550	3.865	0.515	0.000	0.80		1.001	1.0	84.9	SURCHARGED
SE-23.001	MH(SE)-59-4	15 minute 30 year Winter I+25%	4.550	3.786	0.606	0.000	1.17		6.619	1.2	123.2	SURCHARGED
SE-23.002	MH(SE)-59-3	15 minute 30 year Winter I+25%	4.550	3.628	0.588	0.000	1.59		5.667	1.4	209.5	SURCHARGED
SE-22.003	MH(SE)-59-2	15 minute 30 year Winter I+25%	4.550	3.451	0.524	0.000	1.82		14.599	1.5	233.1	SURCHARGED
SE-22.004	MH(SE)-59-1	15 minute 30 year Winter I+25%	4.565	3.198	0.351	0.000	1.31		7.435	1.1	243.4	SURCHARGED
SE-22.005	MH(SE)-59	15 minute 30 year Winter I+25%	4.580	3.070	0.299	0.000	1.39		9.086	1.3	271.2	SURCHARGED
SE-22.006	MH(SE)-60	15 minute 30 year Winter I+25%	4.580	2.838	0.185	0.000	1.03		13.625	1.0	282.0	SURCHARGED
SE-24.000	MH(SE)-61-1	15 minute 30 year Winter I+25%	4.550	3.749	0.399	0.000	1.26		0.700	1.1	43.4	SURCHARGED
SE-24.001	MH(SE)-61	15 minute 30 year Winter I+25%	4.550	3.484	0.310	0.000	1.50		2.039	1.4	95.0	SURCHARGED
SE-24.002	MH(SE)-62	15 minute 30 year Winter I+25%	4.700	2.964	0.000	0.000	1.01		2.988	0.9	84.5	OK
SE-25.000	MH(SE)-LC-WEST	15 minute 30 year Winter I+25%	4.400	3.898	0.498	0.000	2.16		0.897	2.0	138.6	SURCHARGED
SE-22.007	MH(SE)-63	15 minute 30 year Winter I+25%	4.580	2.704	0.169	0.000	1.42		21.566	1.3	450.6	SURCHARGED
SE-19.007	MH(SE)-64	15 minute 30 year Winter I+25%	4.750	2.604	0.140	0.000	1.76		22.701	1.8	790.5	SURCHARGED
SE-11.008	MH(SE)-65	1440 minute 30 year Winter I+25%	4.615	2.590	0.610	0.000	0.37		2550.901	0.4	45.2	SURCHARGED
SE-26.000	MH(SE)-EX-66	60 minute 30 year Winter I+25%	4.700	4.947	1.522	247.421	2.24		249.112	2.2	87.0	FLOOD
SE-6.007	MH(SE)-67	1440 minute 30 year Winter I+25%	4.580	2.275	0.279	0.000	0.32		5.627	0.7	63.9	SURCHARGED
SE-6.008	MH(SE)-68	1440 minute 30 year Winter I+25%	4.830	2.255	0.335	0.000	0.32		7.624	0.7	63.9	SURCHARGED
SE-6.009	MH(SE)-69	1440 minute 30 year Winter I+25%	4.830	2.228	0.448	0.000	0.40		16.226	0.6	63.9	SURCHARGED
SE-6.010	MH(SE)-69-1	1440 minute 30 year Winter I+25%	4.830	2.212	0.472	0.000	0.33		4.748	0.7	64.0	SURCHARGED
SE-1.006	MH(SE)-70	1440 minute 30 year Winter I+25%	4.830	2.194	0.495	0.000	0.13		8.657	0.4	95.9	SURCHARGED
SE-1.007	MH(SE)-71	1440 minute 30 year Winter I+25%	4.830	2.185	0.588	0.000	0.13		35.166	0.5	95.9	SURCHARGED
SE-27.000	MH(SE)-72-2	15 minute 30 year Winter I+25%	4.830	4.670	1.040	0.000	2.05		1.510	2.1	150.3	FLOOD RISK
SE-27.001	MH(SE)-72-1	15 minute 30 year Winter I+25%	4.830	3.673	0.271	0.000	2.16		3.774	2.1	149.5	SURCHARGED
SE-1.008	MH(SE)-72	1440 minute 30 year Winter I+25%	4.740	2.175	1.075	0.000	0.38		1941.805	0.5	95.1	SURCHARGED

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Storm

Pipe Sizes STANDARD Manhole Sizes ECC

FSR Rainfall Model - England and Wales

Return Period (years)	30	PIMP (%)	100
M5-60 (mm)	17.000	Add Flow / Climate Change (%)	0
Ratio R	0.400	Minimum Backdrop Height (m)	0.200
Maximum Rainfall (mm/hr)	50	Maximum Backdrop Height (m)	1.500
Maximum Time of Concentration (mins)	30	Min Design Depth for Optimisation (m)	1.200
Foul Sewage (l/s/ha)	0.000	Min Vel for Auto Design only (m/s)	0.85
Volumetric Runoff Coeff.	0.750	Min Slope for Optimisation (1:X)	500

Designed with Level Soffits

Simulation Criteria for Storm

Volumetric Runoff Coeff	0.750	Additional Flow - % of Total Flow	0.000
Areal Reduction Factor	1.000	MADD Factor * 10m³/ha Storage	2.000
Hot Start (mins)	0	Inlet Coeffiecient	0.800
Hot Start Level (mm)	0	Flow per Person per Day (l/per/day)	0.000
Manhole Headloss Coeff (Global)	0.500	Run Time (mins)	60
Foul Sewage per hectare (l/s)	0.000	Output Interval (mins)	1

Number of Input Hydrographs	0	Number of Storage Structures	2
Number of Online Controls	1	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Profile Type	Summer
Return Period (years)	30	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	17.000	Storm Duration (mins)	30
Ratio R	0.400		

1 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

Areal Reduction Factor 1.000 Additional Flow - % of Total Flow 0.000
Hot Start (mins) 0 MADD Factor * 10m³/ha Storage 2.000
Hot Start Level (mm) 0 Inlet Coeffiecient 0.800
Manhole Headloss Coeff (Global) 0.500 Flow per Person per Day (l/per/day) 0.000
Foul Sewage per hectare (l/s) 0.000

Number of Input Hydrographs 0 Number of Storage Structures 2
Number of Online Controls 1 Number of Time/Area Diagrams 0
Number of Offline Controls 0 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FSR Ratio R 0.400
Region England and Wales Cv (Summer) 0.750
M5-60 (mm) 17.000 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0 DVD Status OFF
Analysis Timestep Fine Inertia Status OFF
DTS Status ON

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years) 1, 30, 100
Climate Change (%) 25, 25, 25

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.
S1.000	S1	15 Winter	1	+25%	30/15 Summer			
S1.001	S2	15 Winter	1	+25%	100/15 Summer			
S1.002	S3	30 Winter	1	+25%	100/15 Summer			
S1.003	S4	30 Winter	1	+25%	100/15 Summer			
S1.004	S5	30 Winter	1	+25%	30/30 Winter			
S1.005	S6	30 Winter	1	+25%	30/30 Winter			
S1.006	S7	30 Winter	1	+25%	30/30 Winter			
S1.007	S8	30 Winter	1	+25%	30/30 Summer			
S1.008	S9	60 Winter	1	+25%	30/15 Summer			
S2.000	S10	15 Winter	1	+25%	30/15 Summer			
S2.001	S11	15 Winter	1	+25%	100/15 Summer			
S1.009	S10	60 Winter	1	+25%	30/15 Summer			
S3.000	S11	15 Summer	1	+25%	100/15 Summer			
S3.001	S12	15 Winter	1	+25%	30/15 Summer			
S3.002	S13	15 Winter	1	+25%	30/15 Summer			
S4.000	S14	15 Summer	1	+25%	30/15 Summer			
S4.001	S15	15 Winter	1	+25%	30/15 Summer	100/15 Winter		
S4.002	S16	15 Winter	1	+25%	30/15 Summer			

1 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
S1.000	S1	3.409	-0.161	0.000	0.59			63.8	OK	
S1.001	S2	3.127	-0.249	0.000	0.40		10	56.1	OK	
S1.002	S3	2.950	-0.302	0.000	0.35			72.9	OK	
S1.003	S4	2.841	-0.287	0.000	0.42			87.9	OK	
S1.004	S5	2.655	-0.335	0.000	0.37			105.3	OK	
S1.005	S6	2.526	-0.313	0.000	0.43			118.6	OK	
S1.006	S7	2.401	-0.307	0.000	0.48			131.4	OK	
S1.007	S8	2.249	-0.324	0.000	0.35			139.1	OK	
S1.008	S9	2.222	-0.215	0.000	0.34			136.5	OK	
S2.000	S10	3.415	-0.145	0.000	0.47			33.0	OK	
S2.001	S11	2.963	-0.158	0.000	0.45			32.6	OK	
S1.009	S10	2.211	-0.044	0.000	0.31			159.3	OK	
S3.000	S11	3.155	-0.375	0.000	0.00			0.0	OK	
S3.001	S12	2.938	-0.244	0.000	0.54			113.6	OK	
S3.002	S13	2.698	-0.344	0.000	0.37			149.1	OK	
S4.000	S14	3.725	-0.375	0.000	0.00			0.0	OK	
S4.001	S15	3.610	-0.163	0.000	0.61			67.2	OK	1
S4.002	S16	3.494	-0.179	0.000	0.65			119.0	OK	

1 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.
S4.003	S17	15 Winter	1	+25%	100/15 Summer			
S3.003	S18	15 Winter	1	+25%	30/15 Summer	100/1440 Winter		
S5.000	S19	15 Winter	1	+25%	30/15 Summer			
S5.001	S20	15 Winter	1	+25%	30/15 Summer			
S5.002	S21	15 Winter	1	+25%	30/15 Summer			
S5.003	S22	15 Winter	1	+25%	100/15 Summer			
S6.000	S23	15 Winter	1	+25%	30/15 Summer	100/15 Summer		
S6.001	S24	15 Winter	1	+25%	30/15 Summer			
S6.002	S25	15 Winter	1	+25%	30/15 Summer			
S6.003	S26	15 Winter	1	+25%	30/15 Winter			
S3.004	S27	15 Winter	1	+25%	30/15 Summer	100/1440 Winter		
S3.005	S28	15 Winter	1	+25%	30/15 Summer			
S3.006	S29	30 Winter	1	+25%	30/15 Summer			
S3.007	S30	60 Winter	1	+25%	30/15 Summer			
S7.000	S31	15 Winter	1	+25%	30/15 Summer	100/15 Summer		
S7.001	S32	15 Winter	1	+25%	30/15 Summer			
S7.002	S31	15 Winter	1	+25%	30/15 Summer			
S7.003	S32	15 Winter	1	+25%	30/15 Summer			
S7.004	S33	15 Winter	1	+25%	30/15 Summer			
S7.005	S34	15 Winter	1	+25%	30/15 Summer			
S7.006	S35	15 Winter	1	+25%	30/15 Summer			
S1.010	S36	60 Winter	1	+25%	1/15 Summer			
S1.011	S37	60 Winter	1	+25%	1/15 Summer			

PN	US/MH Name	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status
S4.003	S17	2.955	-0.396	0.000	0.25			153.7	OK
S3.003	S18	2.473	-0.318	0.000	0.52			287.6	OK
S5.000	S19	3.532	-0.133	0.000	0.69			73.9	OK
S5.001	S20	3.294	-0.176	0.000	0.64			95.2	OK
S5.002	S21	3.189	-0.134	0.000	0.81			113.5	OK
S5.003	S22	2.817	-0.376	0.000	0.30			132.4	OK
S6.000	S23	3.500	-0.090	0.000	0.75			44.9	OK
S6.001	S24	3.263	-0.121	0.000	0.75			69.9	OK
S6.002	S25	3.049	-0.180	0.000	0.67			93.8	OK
S6.003	S26	2.680	-0.411	0.000	0.21			114.6	OK
S3.004	S27	2.394	-0.249	0.000	0.87			526.7	OK
S3.005	S28	2.337	-0.248	0.000	0.75			510.4	OK
S3.006	S29	2.205	-0.245	0.000	0.54			454.8	OK
S3.007	S30	2.195	-0.125	0.000	0.61			337.0	OK
S7.000	S31	3.368	-0.192	0.000	0.27			17.6	OK
S7.001	S32	3.286	-0.177	0.000	0.27			17.3	OK
S7.002	S31	3.250	-0.128	0.000	0.61			44.1	OK
S7.003	S32	3.028	-0.125	0.000	0.75			91.1	OK

1 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status
S7.004	S33	2.721	-0.207	0.000	0.55			88.7	OK
S7.005	S34	2.543	-0.227	0.000	0.48			86.3	OK
S7.006	S35	2.363	-0.199	0.000	0.59			105.7	OK
S1.010	S36	2.190	0.136	0.000	0.51			551.5	SURCHARGED
S1.011	S37	2.183	0.941	0.000	0.89		50	119.5	SURCHARGED

PN	US/MH Name	Level Exceeded
S4.003	S17	
S3.003	S18	
S5.000	S19	
S5.001	S20	
S5.002	S21	
S5.003	S22	
S6.000	S23	4
S6.001	S24	
S6.002	S25	
S6.003	S26	
S3.004	S27	
S3.005	S28	
S3.006	S29	
S3.007	S30	
S7.000	S31	3
S7.001	S32	
S7.002	S31	
S7.003	S32	
S7.004	S33	
S7.005	S34	
S7.006	S35	
S1.010	S36	
S1.011	S37	

30 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

Areal Reduction Factor 1.000 Additional Flow - % of Total Flow 0.000
Hot Start (mins) 0 MADD Factor * 10m³/ha Storage 2.000
Hot Start Level (mm) 0 Inlet Coeffiecient 0.800
Manhole Headloss Coeff (Global) 0.500 Flow per Person per Day (l/per/day) 0.000
Foul Sewage per hectare (l/s) 0.000

Number of Input Hydrographs 0 Number of Storage Structures 2
Number of Online Controls 1 Number of Time/Area Diagrams 0
Number of Offline Controls 0 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FSR Ratio R 0.400
Region England and Wales Cv (Summer) 0.750
M5-60 (mm) 17.000 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0 DVD Status OFF
Analysis Timestep Fine Inertia Status OFF
DTS Status ON

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years) 1, 30, 100
Climate Change (%) 25, 25, 25

WARNING: Half Drain Time has not been calculated as the structure is too full.

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
S1.000	S1	15 Winter	30	+25%	30/15 Summer				3.782
S1.001	S2	15 Winter	30	+25%	100/15 Summer				3.345
S1.002	S3	30 Winter	30	+25%	100/15 Summer				3.195
S1.003	S4	30 Winter	30	+25%	100/15 Summer				3.120
S1.004	S5	30 Winter	30	+25%	30/30 Winter				3.007
S1.005	S6	60 Winter	30	+25%	30/30 Winter				2.922
S1.006	S7	120 Winter	30	+25%	30/30 Winter				2.847
S1.007	S8	120 Winter	30	+25%	30/30 Summer				2.835
S1.008	S9	120 Winter	30	+25%	30/15 Summer				2.825
S2.000	S10	15 Winter	30	+25%	30/15 Summer				3.757
S2.001	S11	15 Winter	30	+25%	100/15 Summer				3.115
S1.009	S10	120 Winter	30	+25%	30/15 Summer				2.813
S3.000	S11	15 Winter	30	+25%	100/15 Summer				3.411
S3.001	S12	15 Winter	30	+25%	30/15 Summer				3.412
S3.002	S13	15 Winter	30	+25%	30/15 Summer				3.275

30 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
S1.000	S1	0.212	0.000	1.39			151.4	SURCHARGED	
S1.001	S2	-0.031	0.000	0.99		9	139.1	OK	
S1.002	S3	-0.056	0.000	0.83			173.6	OK	
S1.003	S4	-0.007	0.000	0.98			205.6	OK	
S1.004	S5	0.016	0.000	0.84			236.1	SURCHARGED	
S1.005	S6	0.083	0.000	0.81			222.5	SURCHARGED	
S1.006	S7	0.139	0.000	0.68			187.9	SURCHARGED	
S1.007	S8	0.262	0.000	0.51			204.8	SURCHARGED	
S1.008	S9	0.388	0.000	0.59			238.4	SURCHARGED	
S2.000	S10	0.197	0.000	1.12			79.0	SURCHARGED	
S2.001	S11	-0.006	0.000	1.00			71.9	OK	
S1.009	S10	0.558	0.000	0.59			301.3	SURCHARGED	
S3.000	S11	-0.119	0.000	0.01			1.3	OK	
S3.001	S12	0.230	0.000	1.27			266.1	SURCHARGED	
S3.002	S13	0.233	0.000	0.79			316.6	SURCHARGED	

30 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.
S4.000	S14	15 Winter	30	+25%	30/15 Summer			
S4.001	S15	15 Winter	30	+25%	30/15 Summer	100/15 Winter		
S4.002	S16	15 Winter	30	+25%	30/15 Summer			
S4.003	S17	15 Winter	30	+25%	100/15 Summer			
S3.003	S18	15 Winter	30	+25%	30/15 Summer	100/1440 Winter		
S5.000	S19	15 Winter	30	+25%	30/15 Summer			
S5.001	S20	15 Winter	30	+25%	30/15 Summer			
S5.002	S21	15 Winter	30	+25%	30/15 Summer			
S5.003	S22	15 Winter	30	+25%	100/15 Summer			
S6.000	S23	15 Winter	30	+25%	30/15 Summer	100/15 Summer		
S6.001	S24	15 Winter	30	+25%	30/15 Summer			
S6.002	S25	15 Winter	30	+25%	30/15 Summer			
S6.003	S26	15 Winter	30	+25%	30/15 Winter			
S3.004	S27	15 Winter	30	+25%	30/15 Summer	100/1440 Winter		
S3.005	S28	15 Winter	30	+25%	30/15 Summer			
S3.006	S29	120 Winter	30	+25%	30/15 Summer			
S3.007	S30	120 Winter	30	+25%	30/15 Summer			
S7.000	S31	15 Winter	30	+25%	30/15 Summer	100/15 Summer		
S7.001	S32	15 Winter	30	+25%	30/15 Summer			
S7.002	S31	15 Winter	30	+25%	30/15 Summer			
S7.003	S32	15 Winter	30	+25%	30/15 Summer			
S7.004	S33	15 Winter	30	+25%	30/15 Summer			
S7.005	S34	15 Winter	30	+25%	30/15 Summer			
S7.006	S35	120 Winter	30	+25%	30/15 Summer			
S1.010	S36	120 Winter	30	+25%	1/15 Summer			
S1.011	S37	120 Winter	30	+25%	1/15 Summer			

PN	US/MH Name	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status
S4.000	S14	4.374	0.274	0.000	0.02			2.1	SURCHARGED
S4.001	S15	4.380	0.607	0.000	1.51			167.0	SURCHARGED
S4.002	S16	4.185	0.512	0.000	1.50			274.7	SURCHARGED
S4.003	S17	3.279	-0.072	0.000	0.56			346.1	OK
S3.003	S18	3.177	0.386	0.000	1.06			591.8	SURCHARGED
S5.000	S19	4.578	0.913	0.000	1.55			164.9	SURCHARGED
S5.001	S20	4.076	0.605	0.000	1.47			218.4	SURCHARGED
S5.002	S21	3.712	0.389	0.000	1.89			265.0	SURCHARGED
S5.003	S22	3.134	-0.059	0.000	0.66			293.6	OK
S6.000	S23	4.518	0.928	0.000	1.65			98.1	FLOOD RISK
S6.001	S24	3.931	0.547	0.000	1.67			154.2	SURCHARGED
S6.002	S25	3.435	0.206	0.000	1.47			206.7	SURCHARGED
S6.003	S26	3.106	0.015	0.000	0.44			235.3	SURCHARGED
S3.004	S27	3.048	0.405	0.000	1.68			1018.8	SURCHARGED
S3.005	S28	2.892	0.307	0.000	1.47			997.6	SURCHARGED

30 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status
S3.006	S29	2.817	0.367	0.000	0.62			522.0	SURCHARGED
S3.007	S30	2.810	0.490	0.000	0.94			523.1	SURCHARGED
S7.000	S31	4.345	0.785	0.000	0.61			39.5	SURCHARGED
S7.001	S32	4.306	0.843	0.000	0.68			43.0	SURCHARGED
S7.002	S31	4.271	0.893	0.000	1.37			99.6	SURCHARGED
S7.003	S32	3.836	0.683	0.000	1.83			220.9	SURCHARGED
S7.004	S33	3.139	0.211	0.000	1.28			205.0	SURCHARGED
S7.005	S34	2.919	0.149	0.000	1.08			192.3	SURCHARGED
S7.006	S35	2.809	0.248	0.000	0.63			112.2	SURCHARGED
S1.010	S36	2.803	0.749	0.000	0.86			919.4	SURCHARGED
S1.011	S37	2.797	1.555	0.000	0.89			119.5	SURCHARGED

PN	US/MH Name	Level Exceeded
S4.000	S14	
S4.001	S15	1
S4.002	S16	
S4.003	S17	
S3.003	S18	
S5.000	S19	
S5.001	S20	
S5.002	S21	
S5.003	S22	
S6.000	S23	4
S6.001	S24	
S6.002	S25	
S6.003	S26	
S3.004	S27	
S3.005	S28	
S3.006	S29	
S3.007	S30	
S7.000	S31	3
S7.001	S32	
S7.002	S31	
S7.003	S32	
S7.004	S33	
S7.005	S34	
S7.006	S35	
S1.010	S36	
S1.011	S37	

100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

Areal Reduction Factor 1.000 Additional Flow - % of Total Flow 0.000
Hot Start (mins) 0 MADD Factor * 10m³/ha Storage 2.000
Hot Start Level (mm) 0 Inlet Coeffiecient 0.800
Manhole Headloss Coeff (Global) 0.500 Flow per Person per Day (l/per/day) 0.000
Foul Sewage per hectare (l/s) 0.000

Number of Input Hydrographs 0 Number of Storage Structures 2
Number of Online Controls 1 Number of Time/Area Diagrams 0
Number of Offline Controls 0 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FSR Ratio R 0.400
Region England and Wales Cv (Summer) 0.750
M5-60 (mm) 17.000 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0 DVD Status OFF
Analysis Timestep Fine Inertia Status OFF
DTS Status ON

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years) 1, 30, 100
Climate Change (%) 25, 25, 25

WARNING: Half Drain Time has not been calculated as the structure is too full.

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
S1.000	S1	30 Winter	100	+25%	30/15 Summer				4.571
S1.001	S2	30 Winter	100	+25%	100/15 Summer				4.392
S1.002	S3	30 Winter	100	+25%	100/15 Summer				4.222
S1.003	S4	30 Winter	100	+25%	100/15 Summer				4.082
S1.004	S5	30 Winter	100	+25%	30/30 Winter				3.872
S1.005	S6	30 Winter	100	+25%	30/30 Winter				3.690
S1.006	S7	30 Winter	100	+25%	30/30 Winter				3.479
S1.007	S8	180 Winter	100	+25%	30/30 Summer				3.217
S1.008	S9	180 Winter	100	+25%	30/15 Summer				3.210
S2.000	S10	15 Winter	100	+25%	30/15 Summer				4.157
S2.001	S11	15 Winter	100	+25%	100/15 Summer				3.217
S1.009	S10	180 Winter	100	+25%	30/15 Summer				3.201
S3.000	S11	30 Winter	100	+25%	100/15 Summer				4.304
S3.001	S12	30 Winter	100	+25%	30/15 Summer				4.307
S3.002	S13	30 Winter	100	+25%	30/15 Summer				4.128

100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
S1.000	S1	1.001	0.000	1.41			153.5	FLOOD RISK	
S1.001	S2	1.016	0.000	1.32		16	184.3	SURCHARGED	
S1.002	S3	0.970	0.000	1.12			234.1	SURCHARGED	
S1.003	S4	0.954	0.000	1.30			271.6	SURCHARGED	
S1.004	S5	0.882	0.000	1.12			316.1	SURCHARGED	
S1.005	S6	0.851	0.000	1.28			351.1	SURCHARGED	
S1.006	S7	0.771	0.000	1.40			385.9	SURCHARGED	
S1.007	S8	0.645	0.000	0.54			214.8	SURCHARGED	
S1.008	S9	0.773	0.000	0.62			252.7	SURCHARGED	
S2.000	S10	0.597	0.000	1.39			98.0	SURCHARGED	
S2.001	S11	0.096	0.000	1.28			92.1	SURCHARGED	
S1.009	S10	0.946	0.000	0.62			318.2	SURCHARGED	
S3.000	S11	0.774	0.000	0.03			3.4	SURCHARGED	
S3.001	S12	1.125	0.000	1.33			277.5	SURCHARGED	
S3.002	S13	1.086	0.000	0.93			373.1	SURCHARGED	

100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.
S4.000	S14	15 Winter	100	+25%	30/15 Summer			
S4.001	S15	15 Winter	100	+25%	30/15 Summer	100/15 Winter		
S4.002	S16	15 Winter	100	+25%	30/15 Summer			
S4.003	S17	30 Winter	100	+25%	100/15 Summer			
S3.003	S18	30 Winter	100	+25%	30/15 Summer	100/1440 Winter		
S5.000	S19	15 Winter	100	+25%	30/15 Summer			
S5.001	S20	15 Winter	100	+25%	30/15 Summer			
S5.002	S21	15 Winter	100	+25%	30/15 Summer			
S5.003	S22	30 Winter	100	+25%	100/15 Summer			
S6.000	S23	15 Winter	100	+25%	30/15 Summer	100/15 Summer		
S6.001	S24	30 Winter	100	+25%	30/15 Summer			
S6.002	S25	30 Winter	100	+25%	30/15 Summer			
S6.003	S26	30 Winter	100	+25%	30/15 Winter			
S3.004	S27	30 Winter	100	+25%	30/15 Summer	100/1440 Winter		
S3.005	S28	30 Winter	100	+25%	30/15 Summer			
S3.006	S29	180 Winter	100	+25%	30/15 Summer			
S3.007	S30	180 Winter	100	+25%	30/15 Summer			
S7.000	S31	15 Winter	100	+25%	30/15 Summer	100/15 Summer		
S7.001	S32	15 Winter	100	+25%	30/15 Summer			
S7.002	S31	15 Winter	100	+25%	30/15 Summer			
S7.003	S32	15 Winter	100	+25%	30/15 Summer			
S7.004	S33	15 Winter	100	+25%	30/15 Summer			
S7.005	S34	15 Winter	100	+25%	30/15 Summer			
S7.006	S35	180 Winter	100	+25%	30/15 Summer			
S1.010	S36	180 Winter	100	+25%	1/15 Summer			
S1.011	S37	180 Winter	100	+25%	1/15 Summer			

PN	US/MH Name	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status
S4.000	S14	5.001	0.901	0.000	0.04			5.0	FLOOD RISK
S4.001	S15	5.001	1.228	1.155	1.73			191.1	FLOOD
S4.002	S16	4.761	1.088	0.000	1.87			341.5	FLOOD RISK
S4.003	S17	4.129	0.778	0.000	0.57			350.0	SURCHARGED
S3.003	S18	3.977	1.187	0.000	1.23			683.7	SURCHARGED
S5.000	S19	5.433	1.768	0.000	1.95			208.3	SURCHARGED
S5.001	S20	4.699	1.228	0.000	1.85			275.0	SURCHARGED
S5.002	S21	4.354	1.030	0.000	2.34			328.2	SURCHARGED
S5.003	S22	3.914	0.721	0.000	0.74			330.6	SURCHARGED
S6.000	S23	4.797	1.207	7.387	1.61			95.6	FLOOD
S6.001	S24	4.438	1.054	0.000	1.81			167.2	SURCHARGED
S6.002	S25	4.119	0.890	0.000	1.64			230.7	SURCHARGED
S6.003	S26	3.870	0.779	0.000	0.51			272.1	SURCHARGED
S3.004	S27	3.784	1.141	0.000	2.09			1268.9	SURCHARGED
S3.005	S28	3.516	0.931	0.000	1.82			1237.0	SURCHARGED

100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status
S3.006	S29	3.207	0.757	0.000	0.61			508.1	SURCHARGED
S3.007	S30	3.199	0.879	0.000	0.91			507.3	SURCHARGED
S7.000	S31	4.768	1.208	7.766	1.30			83.8	FLOOD
S7.001	S32	4.868	1.405	0.000	1.38			87.8	SURCHARGED
S7.002	S31	4.892	1.514	0.000	1.60			116.2	FLOOD RISK
S7.003	S32	4.597	1.443	0.000	2.17			262.2	SURCHARGED
S7.004	S33	3.671	0.743	0.000	1.54			246.4	SURCHARGED
S7.005	S34	3.328	0.558	0.000	1.30			232.6	SURCHARGED
S7.006	S35	3.200	0.638	0.000	0.57			101.7	SURCHARGED
S1.010	S36	3.194	1.140	0.000	0.86			922.0	SURCHARGED
S1.011	S37	3.188	1.946	0.000	0.89			119.5	SURCHARGED

PN	US/MH Name	Level Exceeded
S4.000	S14	
S4.001	S15	1
S4.002	S16	
S4.003	S17	
S3.003	S18	
S5.000	S19	
S5.001	S20	
S5.002	S21	
S5.003	S22	
S6.000	S23	4
S6.001	S24	
S6.002	S25	
S6.003	S26	
S3.004	S27	
S3.005	S28	
S3.006	S29	
S3.007	S30	
S7.000	S31	3
S7.001	S32	
S7.002	S31	
S7.003	S32	
S7.004	S33	
S7.005	S34	
S7.006	S35	
S1.010	S36	
S1.011	S37	

Appendix C. Documents

C1 Environmental Permit

C2 Immingham Drainage Channel Plan (Plan Courtesy of North East Lindsey Drainage Board)

WIMS NO / EDRM CASE REFERENCE:

PRNTS18163

PERMIT NO / EDRM OTHER REFERENCE:

ADDITIONAL REF:

Consent to Discharge

Water Resources Act 1991
Section 88, Schedule 10
(as amended by the
Environment Act 1995)

ENVIRONMENT AGENCY

Modification of Consent to Discharge

WATER RESOURCES ACT REGISTER DATE ENTRY FIRST MADE

13 JAN 2006

Consent Modification Number: **PRNTS/18163A**

Reference Number: **PRNTS/18484**

To: **Immingham Outflow Ltd ("the Consent Holder")**
Immingham Dock
Immingham
North East Lincolnshire
DN20 2NS

WHEREAS the Environment Agency ("the Agency") in pursuance of its powers under the Water Resources Act 1991 Schedule 10 (as amended by the Environment Act 1995) **GRANTED CONSENT** to the making of a discharge of **TRADE EFFLUENT consisting of SITE DRAINAGE and/or BIOLOGICALLY TREATED SEWAGE EFFLUENT,**

From: Premises at Immingham Dock, Immingham, North East Lincolnshire

To: The River Humber

on 27 May 2005; **NOW** the Agency in pursuance of its powers under the Water Resources Act 1991 (as amended by the Environment Act 1995) **GIVES NOTICE** that Consent **PRNTS/18163** is hereby modified in accordance with the details specified in the following schedule:

Trade Effluent **PRNTS/18163A 01**

Subject to the provisions of Paragraphs 7 and 8 of Schedule 10 of the Water Resources Act 1991 (as amended by the Environment Act 1995), no notice shall be served by the Agency, altering this notice of modification, without the agreement in writing of the Consent Holder, during a period of 4 years from the date this notice is served.

This Modification of Consent is issued on: 12 December 2005.

This Modification of Consent takes effect on: 12 December 2005

Signed [redacted]

Simon Nugent, Team Leader, Regulatory Water Quality

NOTE: The specified conditions are now replaced by the conditions in the schedule attached herewith. Consent PRNTS/18163 is updated accordingly.

01 Conditions of Consent for trade effluent consisting of site drainage and/or biologically treated sewage effluent

1 Conditions to be modified and replaced

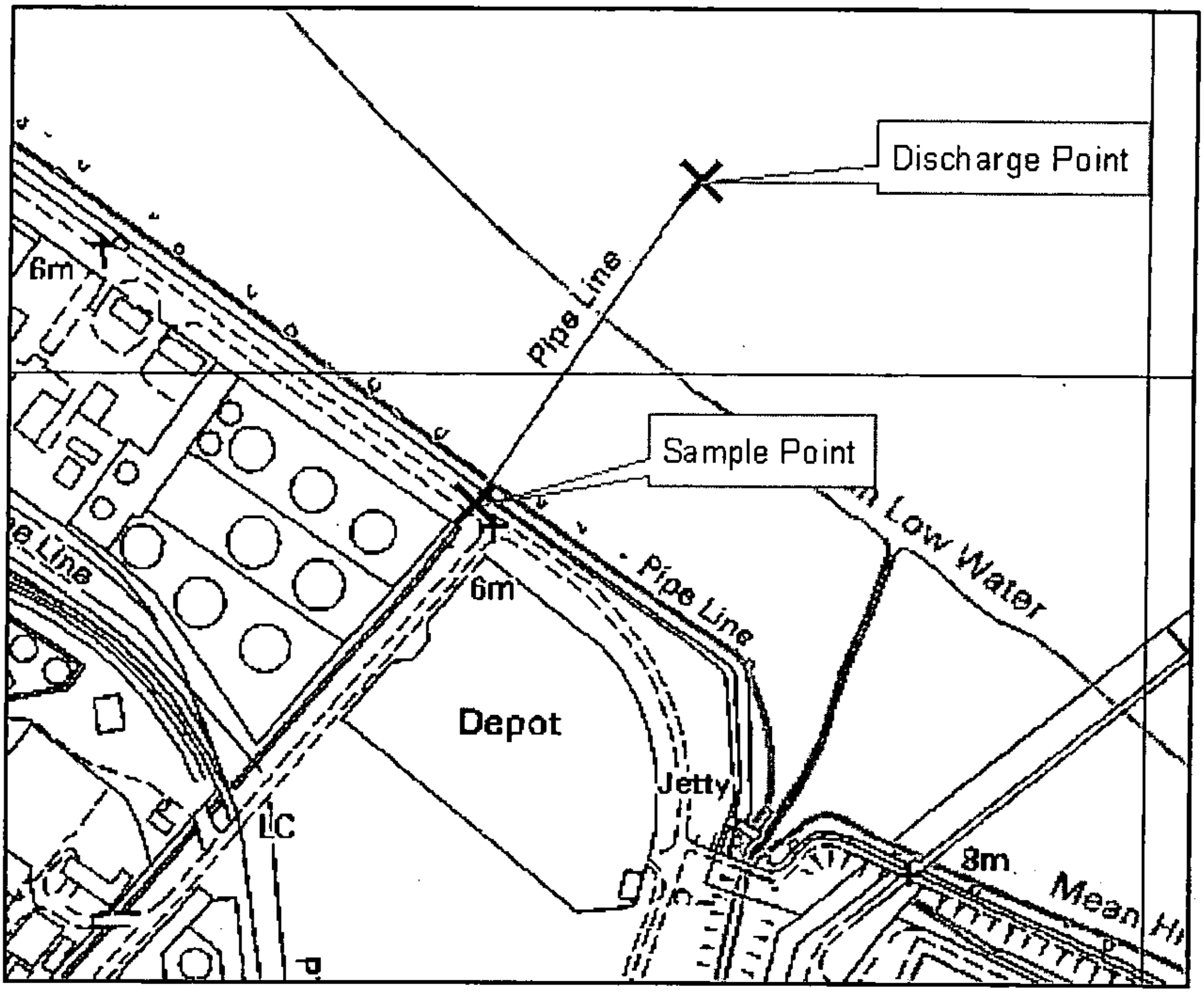
Condition 1.3.2 in Consent **PRNTS/18163** is hereby modified to read as follows:

1.3.2 An appropriately labelled sample point shall be provided and maintained at National Grid Reference TA 2064 1593, as shown marked 'Sample point ' on the Site Plan attached to this consent, so that a representative sample of the Discharge may be obtained. The Consent Holder shall ensure that all constituents of the Discharge pass through the said sampling point at all times and in any legal proceedings it shall, for the purposes of Section 10 of the Rivers (Prevention of Pollution) Act 1961, be presumed, until the contrary is shown, that any sample of the Discharge taken at the said sampling point is a sample of what was being discharged into controlled waters.

2 Other conditions of the Consent

All other conditions of the consent remain in force. Consent **PRNTS/18163** is updated accordingly.

Site Plan


Discharge Point
Pipe Line
6m
Sample Point
Low Water
Pipe Line
6m
Depot
Jetty
LC
8m
Mean Hi

ENVIRONMENT AGENCY

Consent to Discharge

Water Resources Act 1991 (as amended by the Environment Act 1995)

Consent Holder(s)	**Immingham Outflow Ltd** **Immingham Dock** **Immingham** **North East Lincolnshire** **DN20 2NS**

Consent to Discharge from	**Premises at Immingham Dock** **Immingham** **North East Lincolnshire**
Consent Number	**PRNTS/18163**

Environment Agency Anglian Region
Waterside House, Waterside North, Lincoln, LN2 5HA
Tel 08708 506506 Fax: 01522 785878

Consent to Discharge

Water Resources Act 1991
Section 88, Schedule 10
(as amended by the
Environment Act 1995)

ENVIRONMENT AGENCY

Consent to Discharge

Consent Number
PRNTS/18163

To:

Immingham Outflow Ltd ("the Consent Holder")
Immingham Dock
Immingham
North East Lincolnshire
DN20 2NS

The Environment Agency ("the Agency") in pursuance of its powers under the Water Resources Act 1991(as amended by the Environment Act 1995) hereby consents to the making of a discharge:

Of:
Trade effluent consisting of site drainage and/or biologically treated sewage effluent ("the Discharge")

At:
Premises at Immingham Dock, Immingham, North East Lincolnshire

To:
The River Humber

Subject to the conditions set out in this notice of Consent to Discharge.

Subject to the provisions of Paragraphs 7 and 8 of Schedule 10 of the Water Resources Act 1991(as amended by the Environment Act 1995), no notice shall be served by the Agency, altering this consent, without the agreement of the Consent Holder, during a period of 4 years from the date this notice is issued.

This Consent is issued on:	27 May 2005
This Consent takes effect on:	27 May 2005

Signed

[redacted]

Simon J Nugent
Team Leader Water Quality Regulatory

1 Conditions of Consent for trade effluent consisting of site drainage and/or biologically treated sewage effluent

1.1 Nature of Discharge

1.1.1 (a) The Discharge shall not contain any poisonous, noxious, or polluting matter or solid waste matter.

(b) Provided that the Discharge hereby consented is made in accordance with the following conditions of this consent, such discharge shall not be taken to be in breach of condition (a) above by reason of containing substances or having properties identified in and controlled by these conditions.

1.1.2 The Discharge shall consist solely of trade effluent comprising site drainage, boiler blowdown, cooling tower blowdown, vehicle washing, and container washing as specified in the application, and/or biologically treated sewage effluent from an appropriately sized and designed sewage treatment plant installed, operated and maintained in accordance with the manufacturer's instructions as updated from time to time.

1.2 Place of Discharge

1.2.1 The Discharge shall be made in the manner and at the place specified as:

a discharging to the River Humber;

b at National Grid Reference TA 2076 1610;

c shown marked "Discharge Point" on Site Plan attached to this consent.

1.3 Sampling Point Requirements

1.3.1 A sampling point with facilities enabling fully representative samples of the discharge of **biologically treated sewage effluent** to be readily and safely taken at all times shall be installed by the Consent Holder immediately downstream of the treatment plant. The Consent Holder shall ensure that all constituents of the biologically treated sewage effluent discharge pass through the said sampling point at all times and in any legal proceedings it shall, for the purposes of Section 10 of the Rivers (Prevention of Pollution) Act 1961, be presumed, until the contrary is shown, that any sample of the discharge taken by the Agency at the said sampling point is a sample of what was passing into controlled waters from the said treatment plant.

1.3.2 A sample point shall be provided and maintained at National Grid Reference TA 2027 1544 as shown marked "Sample Point" on the Site Plan attached to this consent, so that a representative sample of the Discharge may be obtained. The Consent Holder shall ensure that all constituents of the Discharge pass through the said sampling point at all times and in any legal proceedings it shall, for the purposes of Section 10 of the Rivers (Prevention of Pollution) Act 1961, be presumed, until the contrary is shown that any sample of the Discharge taken at the said sampling point is a sample of what was discharging into controlled waters.

1.4 Volume

1.4.1 The volume of biologically treated sewage effluent discharged shall not exceed 10 cubic metres per day.

1.5 Composition

1.5.1 As far as is reasonably practicable, the discharge shall not contain any matter to such an extent as to cause the receiving waters, or any waters of which the receiving waters are a tributary, to be poisonous or injurious to fish in those waters, or to the spawning grounds, spawn or food of fish in those waters, or otherwise cause damage to the ecology of those waters, or to have any other adverse environmental impact.

1.5.2 No biocides or any other chemicals shall be added to the discharge without the prior written agreement of the Agency.

1.5.3 No other processes should be carried out on site which generate an effluent other than those specified in the application without the prior written agreement of the Agency.

1.5.4 The discharge shall not contain more than 10 milligrammes per litre of total hydrocarbon.

1.5.5 The discharge shall not contain more than 300 milligrammes per litre of chemical oxygen demand.

1.5.6 The discharge shall not contain more than 200 milligrammes per litre of suspended solids (measured after drying at 105°C).

1.5.7 The discharge shall have a pH value of not less than 6.0 nor greater than 8.5.

1.5.8 The discharge shall contain no visible oil or grease.

1.6 Flow measurement

1.6.1

a At the request of the Agency, the Consent Holder shall install, operate and maintain a means of flow measuring to a specification and at a location required by the Agency, to enable the daily volume and/or instantaneous flow of the discharge to be recorded.

b The Consent Holder shall calibrate, operate and maintain the flow monitoring and recording system to a standard agreed or specified by the Agency. The flow and maintenance records shall be provided to the Agency as and when requested.

1.7 Maintenance

1.7.1 The discharge pipe, onsite interceptors and pumping equipment shall all be maintained in an efficient and operational condition

1.8 Recording and Reporting

1.8.1

a The Consent Holder shall establish and operate a documented maintenance programme and record all non-routine actions undertaken that may have adversely affected effluent quality. Copies of the programme shall be made available for inspection by the Agency's officers at all reasonable times.

b On request the Consent Holder shall supply the Agency with a written report on the maintenance and all non-routine actions that may have adversely affected effluent quality

c The Consent Holder shall as soon as reasonably practicable report to the Agency all non-routine actions that may have adversely affected effluent quality.

1.9 Listed substances

1.9.1 The Consent Holder shall notify the Agency forthwith in writing if any change occurs on site that may increase or introduce into the effluent any "dangerous substance" (set out in Annex 1 to this notice as updated from time to time and notified to the Consent Holder in writing), and any other substance considered by the Consent Holder as having or likely to have a significant effect on the receiving waters.

1.10 Dangerous Substance List II Condition

1.10.1

a The quantity of List II Substances (as defined in the Dangerous Substances Directive 76/464/EEC) in the Discharge shall not increase above the levels in the discharge on the date of effect of this Consent where no specific level is authorised; and.

b notwithstanding **a** above, the Discharge shall not contain quantities of any List II Substance such as to cause or contribute to the concentration of that substance in the receiving water exceeding the relevant Environmental Quality Standard (EQS).

1.11 Operational Surveillance and Audit

1.11.1

a The Consent Holder shall maintain a record of any changes in processes that may result in a change in the Dangerous Substances composition of the effluent discharge.

b The Consent Holder, at a time scale and frequency agreed by the Agency, shall undertake and record an audit to identify any additions or changes to the concentrations and loads of Dangerous Substances in the effluent since the date of issue of the Consent.

c The audit procedure is to be previously agreed in writing by the Agency.

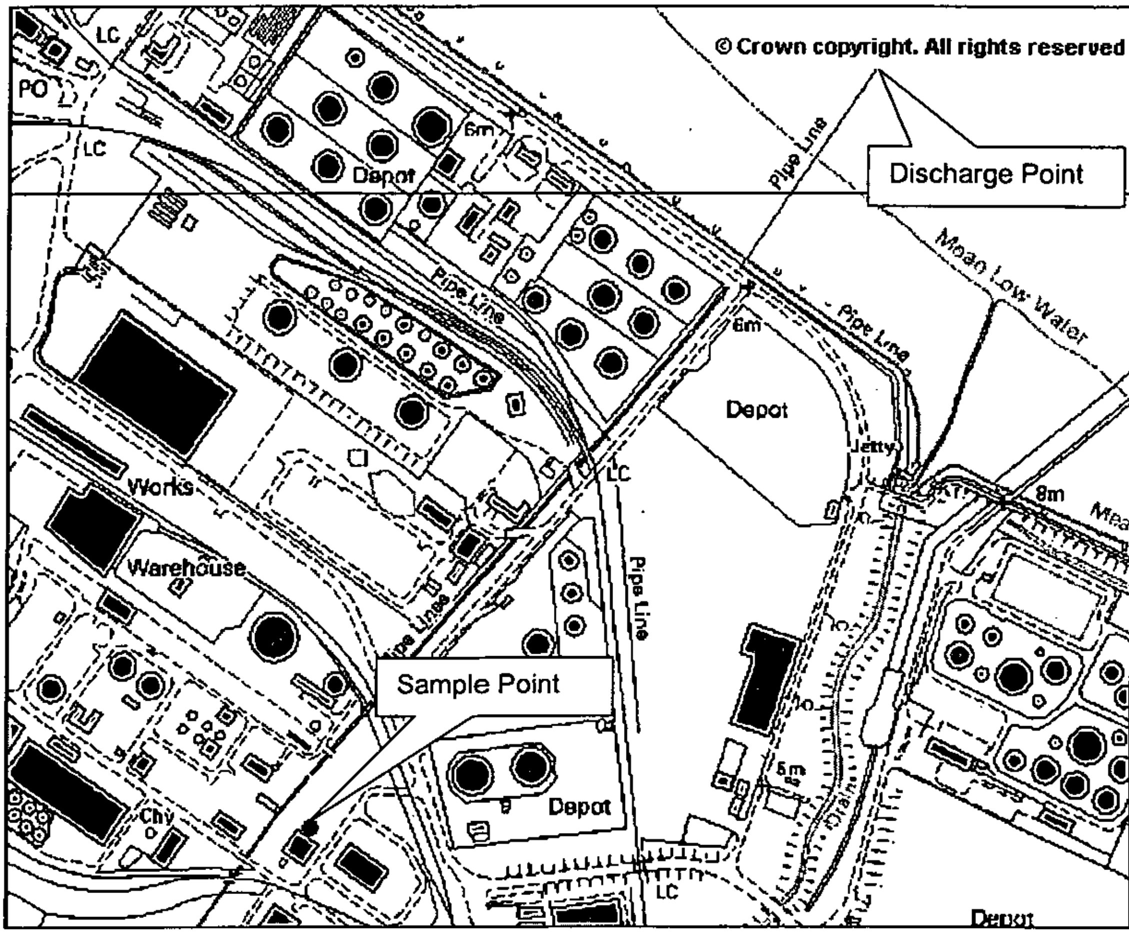
d The records kept in accordance with paragraphs a and b above shall be made available to the Agency on request.

1.12 Monitoring

1.12.1 The Consent Holder shall carry out an effluent-monitoring programme as directed in writing by the Agency.

1.12.2 The results of the monitoring programme shall be submitted to the Agency in a format and at a frequency, as directed in writing by the Agency.

2 Site plan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Discharge Point
Sample Point
Depot
Works
Warehouse
Pipe Line
Mean Low Water
Jetty
LC
PO
Chy
6m
8m

Annex 1 Dangerous substances

1.	Mercury and its compounds	2.	Cadmium and its compounds
3.	Hexachlorocyclohexane (lindane and related compounds)	4.	Carbon tetrachloride
5.	DDT (the isomers of 1,1,1-trichloro-2,2 bis{p-chlorophenyl} ethane)		
6.	Pentachlorophenol (PCP)	7.	Aldrin
8.	Dieldrin	9.	Endrin
10.	Isodrin	11.	Hexachlorobenzene (HCB)
12.	Hexachlorobutadiene (HCBD)	13.	Chloroform
14.	Polychlorinated biphenyls	15.	Dichlorvos
16.	1,2-Dichloroethane	17.	Trichlorobenzene
18.	Atrazine	19.	Simazine
20.	Tributyltin compounds	21.	Triphenyltin compounds
22.	Trifluralin	23.	Fenitrothion
24.	Azinphos-methyl	25.	Malathion
26.	Endosulfan	27.	Lead
28.	Chromium	29.	Zinc
30.	Copper	31.	Nickel
32.	Arsenic	33.	*Iron
34.	*pH if outside the range 5.5 to 9.0	35.	*Boron
36.	Vanadium	37.	PCSD'S
38.	Cyfluthrin	39.	Sulcofuron
40.	Flucofuron	41.	Permethrin
42.	4-Chloro-3-methyl-phenol	43.	2-Chlorophenol
44.	2,4-Dichlorophenol	45.	2,4-D (ester)
46.	2,4-D (non ester)	47.	1,1,1-Trichloroethane
48.	1,1,2-Trichloroethane	49.	Bentazone
50.	Benzene	51.	Biphenyl
52.	Chloronitrotoluenes	53.	Demeton
54.	Dimethoate	55.	Linuron
56.	MCPA	57.	Mecoprop
58.	Mevinphos	59.	Napthalene
60.	Omethoate	61.	Toluene
62.	Trizaphos	63.	Xylene
64.	Cyanide	65.	Azinphos-ethyl
66.	Fenthion	67.	Parathion
68.	Parathion-methyl	69.	Trichloroethylene
70.	Tetrachloroethylene	71.	Dioxins
72.	PAHs	73.	Nonyl phenol
74.	Nonyl phenyl ethoxylate	75.	Di-ethylhexyl phthalate
76.	Bisphenol-A	77.	Diazinon
78.	Chlorfenvinphos	79.	Chlorotoluron
80.	Isoproturon	81.	Diuron
82.	Propetamphos	83.	Flumethrin
84.	Amitraz	85.	High-Cis Cypermethrin
86.	Cyromazine	87.	Deltamethrin
88.	Cypermethrin		

This list is applicable as at 1 December 1998 and will be updated as and when changes to the relevant legislative requirements occur.

*Notification to the Agency by the Consent holder is only required in respect of changes to trade effluents likely to cause significant changes to the pH value, and/or iron or boron concentrations, of the crude sewage.

South Killingholme Drain
Habrough Marsh Drain Branch 4
Habrough Marsh Drain
Immingham Pump Drain
Immingham PS
Middle Drain Branch 5
Middle Drain
IMMINGHAM
Mauxhall Farm
Ashmaur House
A1173
Legend
North_East_Lindsey_IDB_Boundary
North_East_Lindsey_IDB_Extended_Boundary
NEL Drains
EA Main River
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