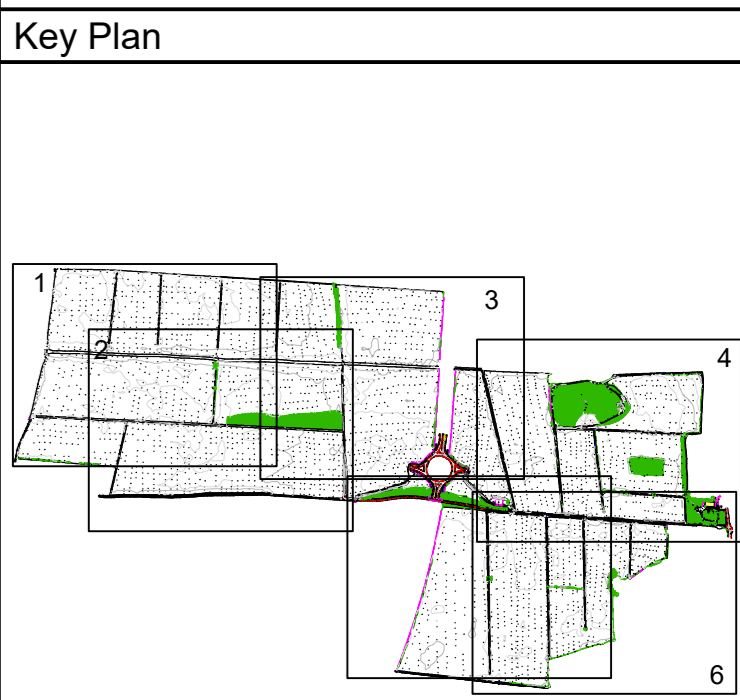


- Notes**
1. Do not scale this drawing. All dimensions must be checked/ verified on site. If in doubt ask.
 2. This drawing is to be read in conjunction with all relevant architects, engineers and specialists drawings and specifications.
 3. All dimensions in metres unless noted otherwise. All levels in metres unless noted otherwise.
 4. Any discrepancies noted on site are to be reported to the engineer immediately.
 5. No scale factor has been applied to this survey, therefore the OS coordinates are to be treated as arbitrary. Please refer to survey station information below for on site control establishment.
 6. All coordinates and height data relate to OSGB36(15). Control stations are coordinated by means of GPS receiving real time corrections via OS smart net.
 7. All manhole data is collected from ground level therefore discrepancies may occur. More accurate data is only achievable via confined space entry.
 8. OS license number: 10022432



- Legend**
- OS Buildings
 - Surveyed Buildings
 - Building
 - Wall
 - Kerb Channel Line
 - Top of Kerb
 - Edge of Surface
 - Top of Bank
 - Bottom of Bank
 - Canopy / Overhang
 - Line Marking
 - Centre Line
 - Watercourse
 - Centre Line
 - Barrier
 - Fence
 - Gate
 - Overhead Powerline
 - Overhead Utilities
 - Contour Lines
 - Inspection Chamber
 - Flow direction and pipe diameter
 - Station and Name
 - BH 1
 - Monitoring Borehole
 - Tree / Bush / Sapling
 - Area of Vegetation/ Extent of Tree Canopy
 - Hedge
 - Body of Water
 - Body of Water from OS
 - Spot Level
 - 50.00
 - Assumed Surface
 - Water Drainage Line
 - Surface Water Drainage Line
- AP Anchor Point FBW Fence Barbed Wire LB Litter Bin
 BG Back Gully FCB Fence Clad Board LP Lamp Post
 BO Bollard FCL Fence Chain Link MH Manhole
 BS Bus Stop FEL Fence Electric MV Service Marker
 BT British Telecom FMP Fence Metal Panel PS Post Box
 C Crest FMB Fence Metal Bar FT Foot
 CL Cover Level FOB Fence Open Board RE Rodding Eye
 CMP Cable Marker FFW Fence Post & Wire SP Stop Post
 CCTV/Security Camera FVM Fence Wire Mesh ST Stop Tap
 CTV Cable TV FFL Finished Floor Level TV Telephone
 Drainage Channel FFP Flagpole TCB Telephone Call Box
 DK Drop Kerb GV Gas Valve THL Threshold Level
 DP Down Pipe GY Gully TL Traffic Light
 Elec Electric Hc Height TS Telegraph Post
 EP Electricity Post IC Inspection Chamber UFS Unstable to Survey
 ER Earth Rod IFL Internal Floor Level WL Water Level
 FH Fire Hydrant IL Level Level WM Water Meter
 FL Floodlight (as a reduced level) WO Wash Out

P2	23.10.24	Watercourse Details Added	DS	SS
P1	10.07.23	Provisional Issue	BC	SS
Rev	Date	Details of Issue / Revision	Drawn	Reviewed

Issues & Revisions

Birmingham | 0121 233 3322
 Leeds | 0113 233 8000
 London | 020 7407 3879
 Manchester | 0161 233 4280
 Nottingham | 0115 924 1100
 www.bwbconsulting.com

Client

Hargreaves Services PLC

Project Title

Lincolnshire Lakes, Scunthorpe

Drawing Title

Existing SitePlan Sheet 6 of 6

Drawn:	B. Connolly	Reviewed:	S. Shreeves
BWB Ref:	221423.00	Date:	10.07.23
Scale:	1:1000		

Information

Project - Originator - Zone - Level - Type - Role - Number	Status	Rev
LIN-BWB-00-06-DR-G-0001	S2	P6

Station Coordinates

Station Name	Eastings (m)	Northings (m)	Height (m)
BT1	48175.553	436237.238	4.109
BT2	48177.791	43615.306	5.715
BT3	48186.029	43626.115	4.254
BWB01	48695.179	439481.027	2.679
BWB02	48676.583	439501.442	2.723
BWB03	48640.018	439511.019	2.944
BWB05	48578.931	439560.844	2.412
BWB06	48560.073	439566.250	2.281

Appendix 2: Illustrative Masterplan

Architects are to be notified of any discrepancies.
 Contractors must check all dimensions on site.
 This drawing is subject to copyright here and is for use on this project only.
 The drawing is to be used solely for the information on which it is based.
 For other information refer to the latest revision of any cross-referenced drawings.
 To be read in conjunction with relevant design standards/specifications.

This is a colour drawing. In order to ensure any subsequent reproduction is viewed correctly it should be printed in full colour.



Rev	Description	Date	By	CD
P1	FIRST ISSUE	06.02.20	TD	CG

Status: PLANNING

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Project: LINCOLNSHIRE LAKES

Client: **Hargreaves Land**

Drawing Title: LINCOLNSHIRE LAKES PA01 - ILLUSTRATIVE MASTERPLAN

Proj Ref	Origin	Date	Level	Type	Scale	Sheet	Total	Status	Rev
7730 - SMR	00 - ZZ	DR	A	2030	S3	P1			
SMR Job Ref	Sheet	Scale	Drawn	TD					
7730-00-2030	A0	1:1500							

Appendix 3: NPPF Flood Risk Vulnerability and Flood Zone Compatibility

Flood Risk Vulnerability Classifications (recreated from the NPPF Planning Practice Guidance)

Vulnerability Classification	Description
Essential infrastructure	<ul style="list-style-type: none"> • Essential transport infrastructure (including mass evacuation routes) which has to cross the area at risk. • Essential utility infrastructure which has to be located in a flood risk area for operational reasons, including infrastructure for electricity supply including generation, storage and distribution systems; including electricity generating power stations, grid and primary substations storage; and water treatment works that need to remain operational in times of flood. • Wind turbines. • Solar farms.
Highly Vulnerable	<ul style="list-style-type: none"> • Police and ambulance stations; fire stations and command centres; telecommunications installations required to be operational during flooding. • Emergency dispersal points. • Basement dwellings. • Caravans, mobile homes and park homes intended for permanent residential use. • Installations requiring hazardous substances consent. (Where there is a demonstrable need to locate such installations for bulk storage of materials with port or other similar facilities, or such installations with energy infrastructure or carbon capture and storage installations, that require coastal or water-side locations, or need to be located in other high flood risk areas, in these instances the facilities should be classified as 'Essential Infrastructure'.)
More Vulnerable	<ul style="list-style-type: none"> • Hospitals • Residential institutions such as residential care homes, children's homes, social services homes, prisons and hostels. • Buildings used for dwelling houses, student halls of residence, drinking establishments, nightclubs and hotels. • Non-residential uses for health services, nurseries and educational establishments. • Landfill* and sites used for waste management facilities for hazardous waste. • Sites used for holiday or short-let caravans and camping, subject to a specific warning and evacuation plan.
Less Vulnerable	<ul style="list-style-type: none"> • Police, ambulance and fire stations which are not required to be operational during flooding. • Buildings used for shops; financial, professional and other services; restaurants, cafes and hot food takeaways; offices; general industry, storage and distribution; non-residential institutions not included in the 'more vulnerable' class; and assembly and leisure. • Land and buildings used for agriculture and forestry. • Waste treatment (except landfill* and hazardous waste facilities). • Minerals working and processing (except for sand and gravel working). • Water treatment works which do not need to remain operational during times of flood. • Sewage treatment works, if adequate measures to control pollution and manage sewage during flooding events are in place. • Car parks.
Water-Compatible Development	<ul style="list-style-type: none"> • Flood control infrastructure. • Water transmission infrastructure and pumping stations. • Sewage transmission infrastructure and pumping stations. • Sand and gravel working. • Docks, marinas and wharves. • Navigation facilities. • Ministry of Defence installations. • Ship building, repairing and dismantling, dockside fish processing and refrigeration and compatible activities requiring a waterside location. • Water-based recreation (excluding sleeping accommodation). • Lifeguard and coastguard stations. • Amenity open space, nature conservation and biodiversity, outdoor sports and recreation and essential facilities such as changing rooms. • Essential ancillary sleeping or residential accommodation for staff required by uses in this category, subject to a specific warning and evacuation plan.

Flood Zone Compatibility (recreated from the NPPF Planning Practice Guidance)

Flood Zone	Vulnerability Classification				
	Essential infrastructure	Highly Vulnerable	More Vulnerable	Less Vulnerable	Water Compatible
Flood Zone 1 (Low Probability)	Development is appropriate	Development is appropriate	Development is appropriate	Development is appropriate	Development is appropriate
Flood Zone 2 (Medium Probability)	Development is appropriate	To be deemed appropriate an exception test is required to demonstrate: <ul style="list-style-type: none"> The development will be safe for its life time without increasing flood risk elsewhere, and where possible reduce overall flood risk the sustainability benefits of the development to the community outweigh the flood risk. 	Development is appropriate	Development is appropriate	Development is appropriate
Flood Zone 3a (High Probability)	To be deemed appropriate an exception test is required to demonstrate: <ul style="list-style-type: none"> The development will be safe for its life time without increasing flood risk elsewhere, and where possible reduce overall flood risk the sustainability benefits of the development to the community outweigh the flood risk. Additionally, essential infrastructure should be designed and constructed to remain operational and safe in times of flood.	Development should not be permitted	To be deemed appropriate an exception test is required to demonstrate: <ul style="list-style-type: none"> The development will be safe for its life time without increasing flood risk elsewhere, and where possible reduce overall flood risk the sustainability benefits of the development to the community outweigh the flood risk. 	Development is appropriate	Development is appropriate

Flood Zone	Vulnerability Classification				
	Essential infrastructure	Highly Vulnerable	More Vulnerable	Less Vulnerable	Water Compatible
Flood Zone 3b (The Functional Floodplain)	<p>To be deemed appropriate an exception test is required to demonstrate:</p> <ul style="list-style-type: none"> The development will be safe for its life time without increasing flood risk elsewhere, and where possible reduce overall flood risk the sustainability benefits of the development to the community outweigh the flood risk. <p>Additionally, development should be designed and constructed to:</p> <ul style="list-style-type: none"> remain operational and safe for users in times of flood; result in no net loss of floodplain storage; not impede water flows and not increase flood risk elsewhere. 	Development should not be permitted	Development should not be permitted	Development should not be permitted	<p>Development is appropriate if designed and constructed to:</p> <ul style="list-style-type: none"> remain operational and safe for users in times of flood; result in no net loss of floodplain storage; not impede water flows and not increase flood risk elsewhere.

Appendix 4: Hydraulic Modelling Report

ENVIRONMENT

Hargreaves Land Limited
 Planning Application 1 at Lincolnshire Lakes (North)
 Scunthorpe
 Technical Note 1: Hydraulic Modelling

January 2025

Document Number:	LLP1-BWB-ZZ-XX-RP-YE-0002_TN1
BWB Reference:	221638_TN1

Revision	Date of Issue	Status	Author:	Checked:	Approved:
P01	02/02/2024	S2	Rachel Meredith BSc (Hons) MCIWEM	Matthew Day BA (Hons) MSc FRGS MCIWEM C.WEM C.Sci C.Env	Robin Green BSc (Hons)
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The information presented, and conclusions drawn, are based on statistical data and are for guidance purposes only. The study provides no guarantee against flooding of the study site or elsewhere, nor of the absolute accuracy of water levels, flow rates and associated probabilities.

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GLOSSARY & NOTATION

1D – one-dimensional hydraulic model, good for representing the hydraulics of a definitive channel or flow pathway and hydraulic structure.

2D – two-dimensional hydraulic model, good for representing complex flow routing present within the floodplain.

Annual Exceedance Probability (AEP) - the probability (%) of a flood event occurring in any year.

Design flood event - magnitude of the flood adopted for the design of the whole or part of a development, usually defined in relation to the severity of the flood in terms of its return period. Typically, the 1 in 100-year return period event including an allowance for future climate change for fluvial flood events.

DTM – Digital Terrain Model

EA – Environment Agency

ESTRY - a 1D hydraulic modelling software package published by BMT.

Floodplain - any area of land over which water flows or is stored during a flood event.

FRA – Flood Risk Assessment

Hydraulic Model - a mathematical (generally computer based) model of a water/sewer/storm system which is used to analyse the system's hydraulic behaviour.

LiDAR – Light Detection and Ranging aerial survey data

LLFA – Lead Local Flood Authority

mAOD – metres above Ordnance Datum

Return period - a statistical term defining the probability of occurrence of a flood event. Thus a 1 in 50-year flood is one likely to be equalled or exceeded on average only once in a 50-year period: a flood with a 2.0% AEP.

TUFLOW – a 2D fixed grid hydraulic modelling software package published by BMT.

Watercourse – a natural or man-made open channel for the conveyance of water.

Z-line – a break line layer in TUFLOW which can be used to reinforce linear features in the 2D model domain such as a riverbank, flood defence, or channel bed.

Z-Shape – a layer in TUFLOW which can be used to manipulate the 2D model geometry.

1. INTRODUCTION

1.1 BWB Consulting Ltd has been commissioned by Hargreaves Land Limited to prepare a site-specific update to the EA Tidal Trent 2023 model for the purpose of assessing flood risk to a proposed development (the site), known as Lincolnshire Lakes (North), Scunthorpe.

Summary Information

1.2 The site is situated within North Lincolnshire, located approximately 2.7km southwest of Scunthorpe town centre. The site is bisected by Brumby Common Lane. The site is bound to the north and south by greenfield land, to the east by Scotter Road and existing residential development and to the west by the M181 and the A1077 (M). The site location is shown in **Figure 1.1**.

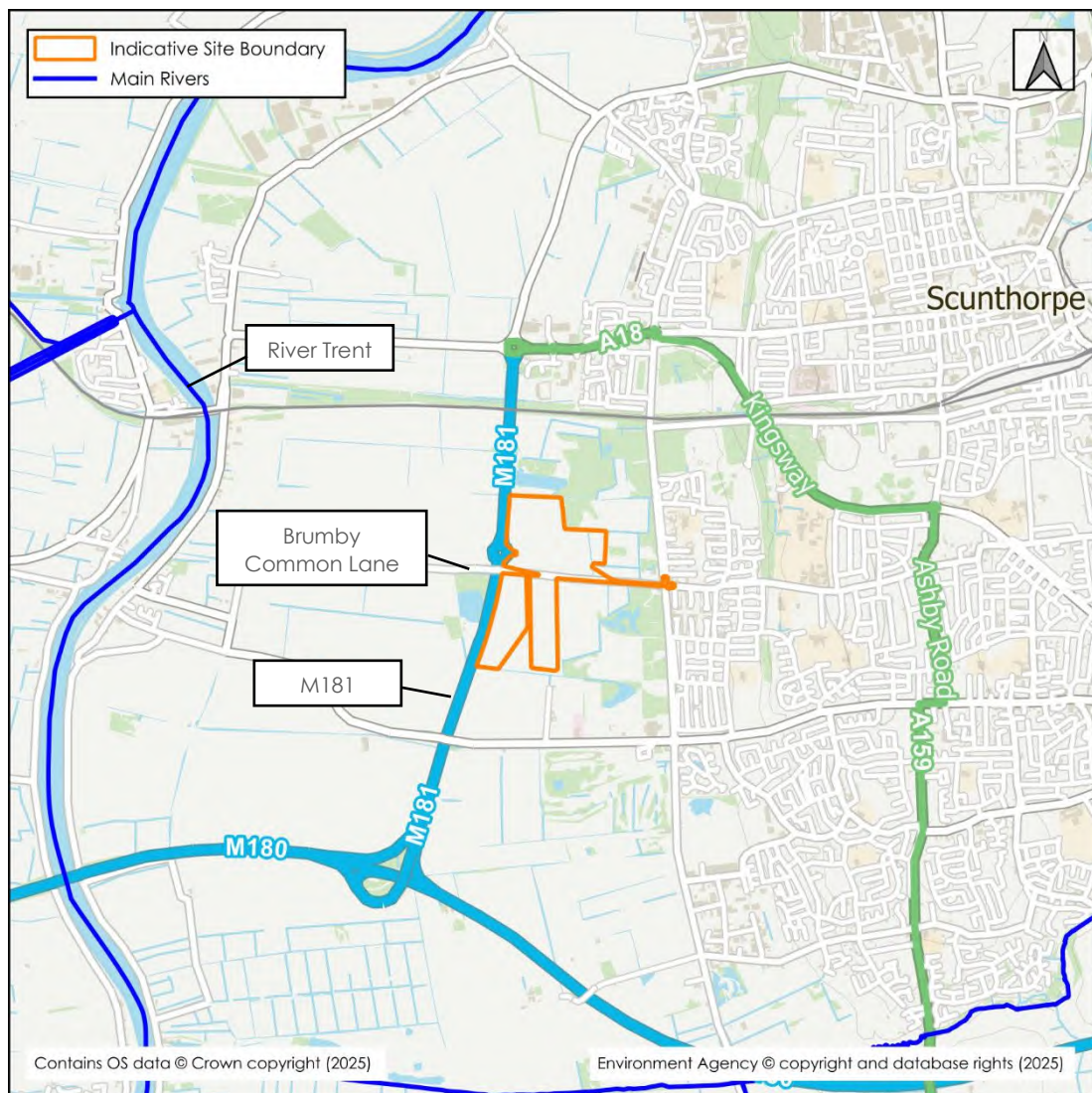


Figure 1.1: Site Location

- 1.3 The River Trent is located approximately 2.1km west of the study site. It generally flows in a northerly direction in proximity to the study site and eventually outfalls to the Humber Estuary approximately 16.5km downstream of the site.

Local Topography

- 1.4 The topographical survey indicates the site is relatively flat with levels ranging from approximately 2m AOD to 4m AOD. A network of minor ditches and drains is present across the site, with depths typically at least 2m according to the topographical survey.
- 1.5 The wider topography has been reviewed using EA LiDAR as shown in **Figure 1.2** and the cross-section in **Figure 1.3**.

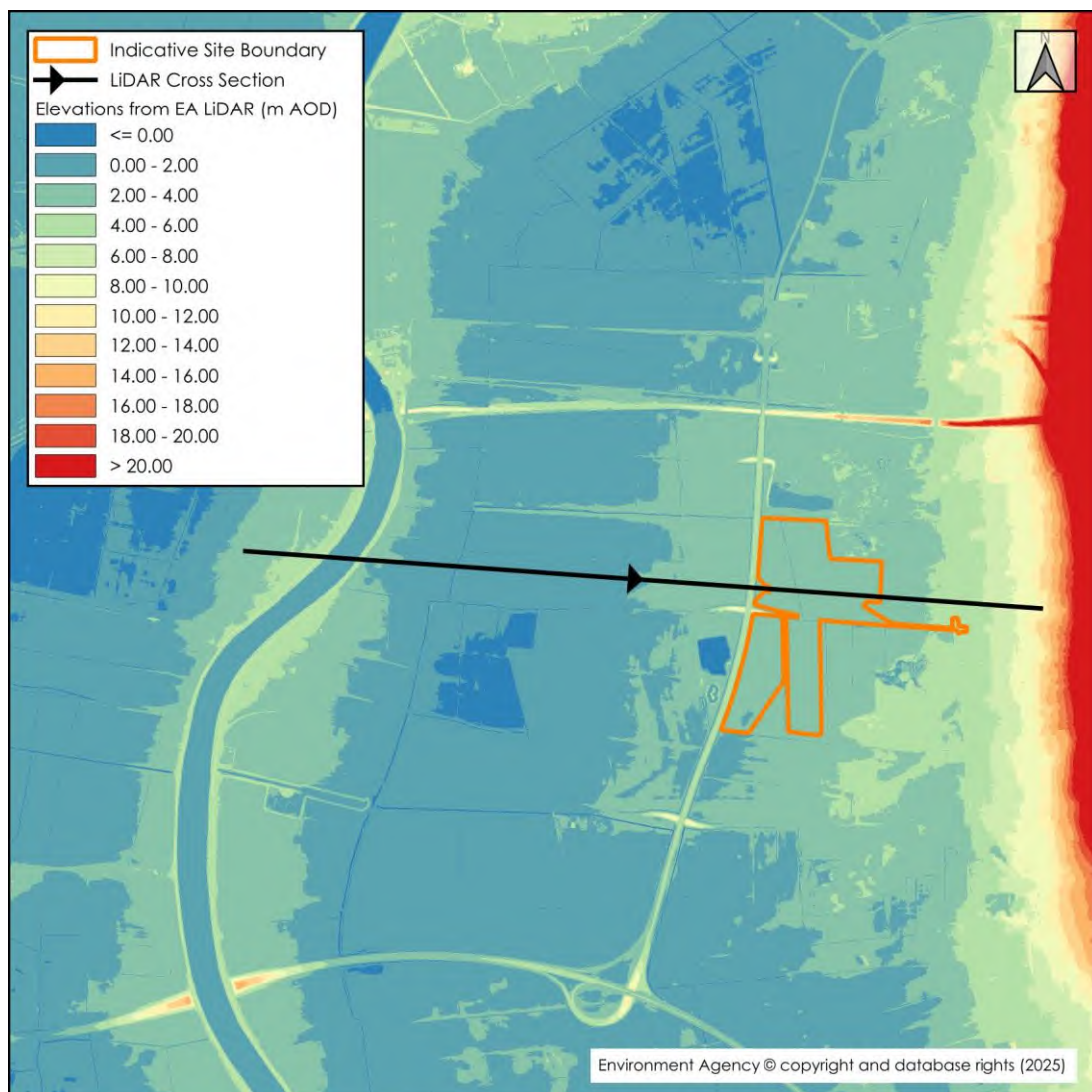


Figure 1.2: Local Topography from EA LiDAR

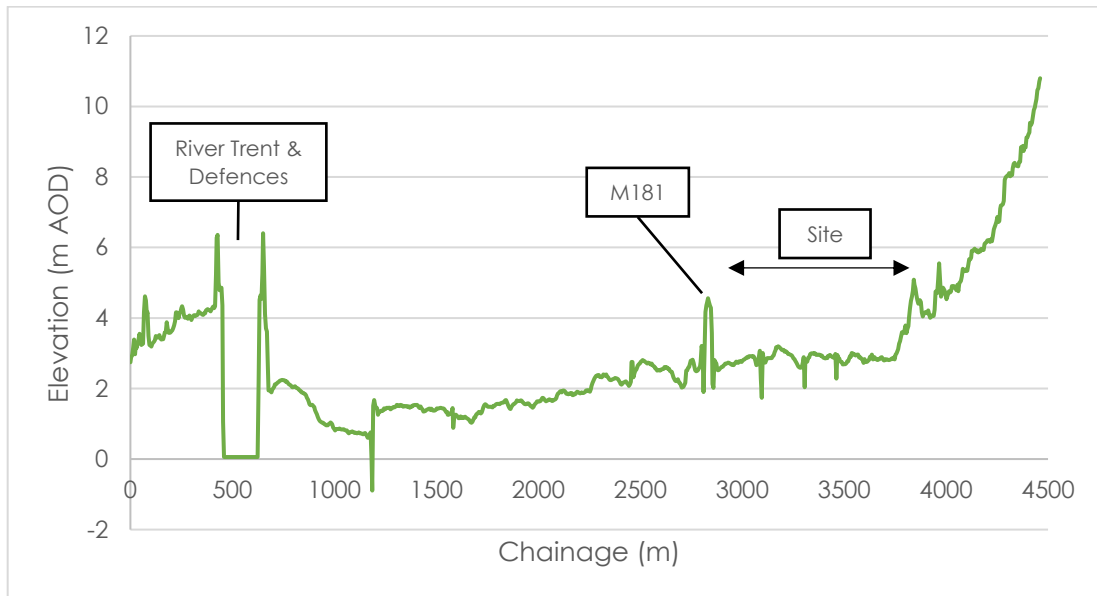


Figure 1.3: Cross-Section through EA LiDAR at Location in Figure 1.2

Previous Studies and Available Information

Flood Map for Planning

- 1.6 The EA Flood Map for Planning, included in **Figure 1.4**, shows the site to be located across Flood Zones 1-3. The Flood Zone 3 extents are also classified as areas at reduced risk of flooding due to river/sea defences.
- 1.7 The Flood Zone 2 extent appears to be hand drawn and correlates with an EA Recorded Flood Outline attributed to flooding of the River Trent in 1947. This event was caused by channel capacity exceedance prior to the presence of raised defences.
- 1.8 The EA also provided Product 4 data for the site including mapping of nearby defences. The closest defence assets to the site are on the right bank of the River Trent and include walls and embankments. The EA Spatial Flood Defence mapping suggests a 1 in 100-year design standard of protection associated with the closest defences.

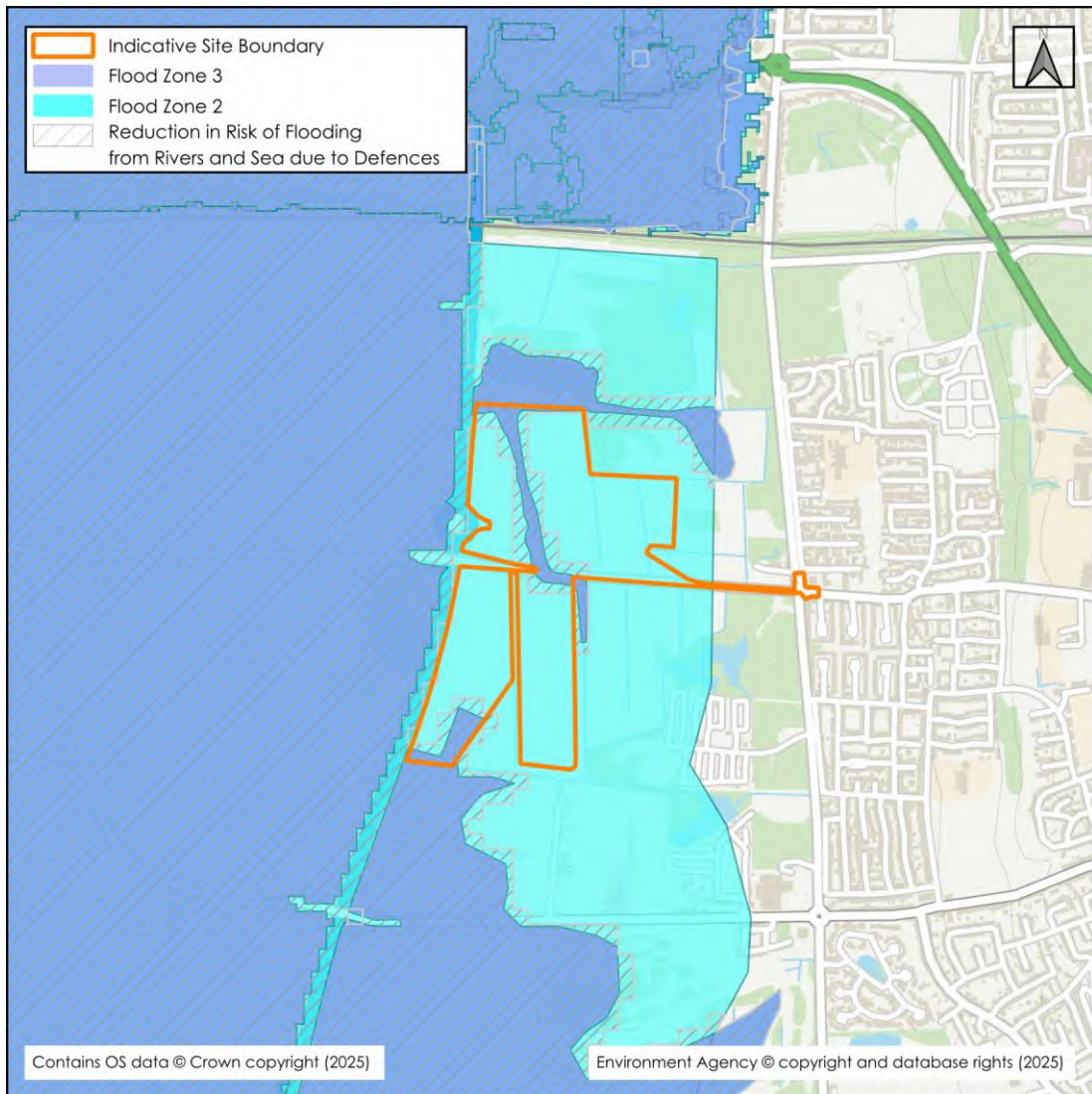


Figure 1.4: Flood Map for Planning

Tidal Trent 2023 Model

- 1.9 The EA provided the Tidal Trent 2023 model¹ for use in this study. The model was updated by Jacobs in 2023 with updates for the latest Extreme Water Level data and to understand the risk from potential breaches of defences.
- 1.10 The Tidal Trent 2023 model takes the form of a dynamically linked 1D-2D model. Generally, the in-channel conditions and hydraulic structures are modelled within a 1D Flood Modeller domain and the floodplain within a 2D TUFLOW domain. Flood Modeller version 5.1 and TUFLOW version 2020-10-AB-iDP-w64 were used in the Tidal Trent 2023 study. The model domain and features in proximity to the site are included in **Figure 1.5**.

¹ Hydraulic Modelling Report Tidal Trent Re-runs (Jacobs, March 2023)

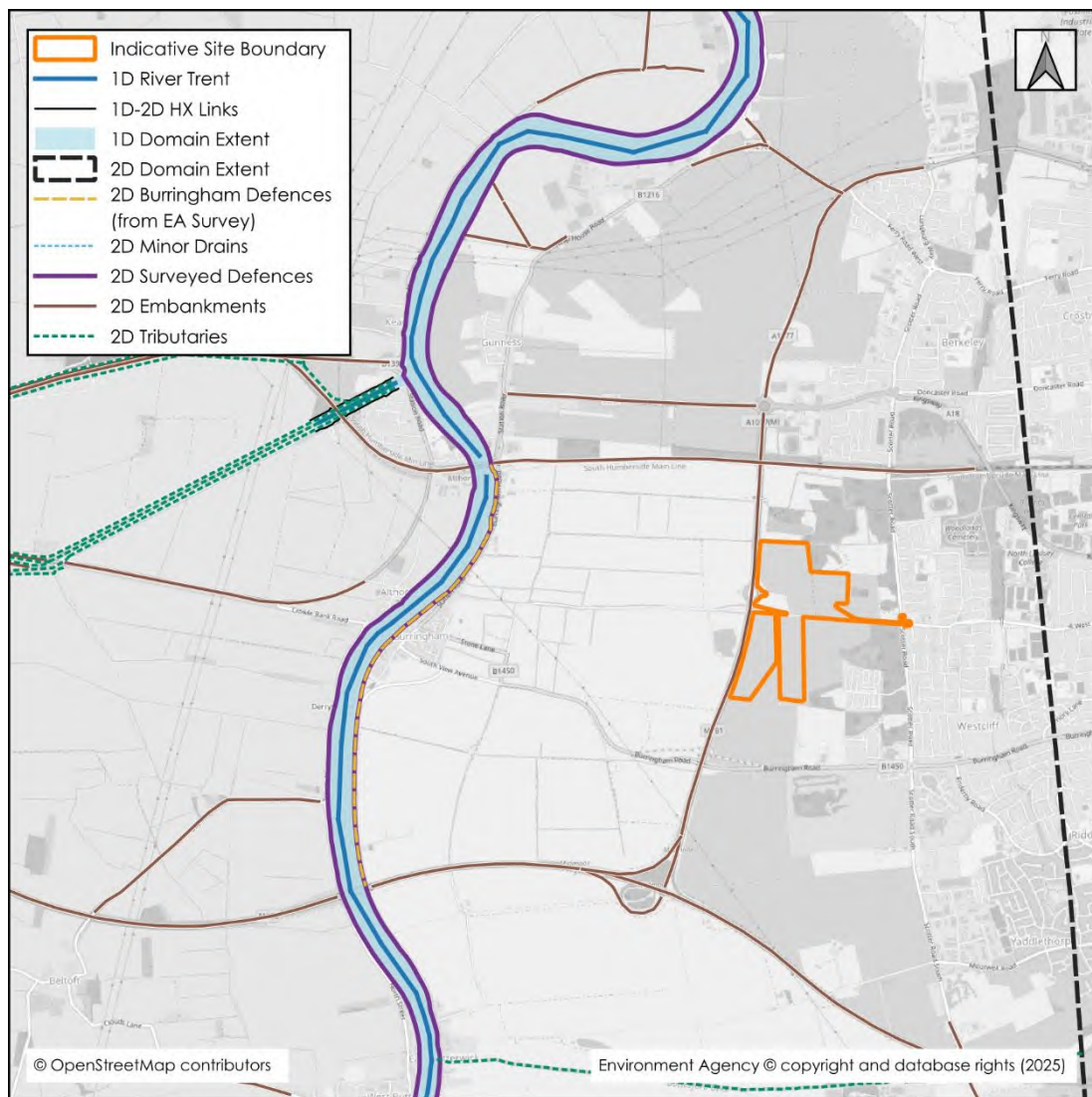


Figure 1.5: Tidal Trent 2023 Model Schematic

- 1.11 In proximity to the site, major roads are reinforced with 2D Z-Shapes and the River Trent defences are also reinforced. The defences in closest proximity to the site at Burringham are noted to be modelled based on surveyed information from the EA within the accompanying model report.
- 1.12 During a meeting in November 2024, the EA confirmed that a new breach location had been simulated which was not provided as part of the original Tidal Trent 2023 model issue. Therefore, the EA provided the associated model files for Breach 43 and noted that the study should incorporate the breach with the most conservative results at the study site. This is discussed further in **Section 5**.

Aims and Objectives

- 1.13 The aim of this study is to assess the flood risk to the study site using the Trent Tidal 2023 model as a basis with an update to include the site-specific topographical survey. To achieve this aim, the following objectives were identified:

- Undertake a review of the model hydrology for latest climate change.
- Incorporate the site-specific topographical survey into the model to improve the representation of the existing flood risk to the site.
- Simulate the model under key return period events.
- Simulate the model under residual risk scenario with breach.

2. CLIMATE CHANGE REVIEW

The Design Flood

- 2.1 The Planning Practice Guidance identifies that new developments should be designed to provide adequate flood risk management, mitigation, and resilience against the 'design flood' for their lifetime.
- 2.2 This is a flood event of a given annual flood probability, which is generally taken as fluvial (river) flooding likely to occur with a 1% annual probability (a 1 in 100 chance each year), or tidal flooding with a 0.5% annual probability (1 in 200 chance each year), against which the suitability of a proposed development is assessed and mitigation measures, if any, are designed.

Climate Change

Peak River Flow

- 2.3 Predicted future changes in peak river flows caused by climate change are provided by the EA, with a range of projections applied to regionalised 'River Basin Districts' which are further subdivided into Management Catchments.
- 2.4 The site falls within the Lower Trent and Erewash Management Catchment of the Humber River Basin District. **Table 2.1** identifies the relevant peak river flow climate change allowances for this Management Catchment.

Table 2.1: Peak River Flow Climate Change Allowances for the Lower Trent and Erewash Management Catchment within the Humber River Basin District

Allowance Category	Total potential change anticipated for the '2020s' (2015 to 2039)	Total potential change anticipated for the '2050s' (2040 to 2069)	Total potential change anticipated for the '2080s' (2070 to 2125)
Upper End	29%	38%	62%
Higher Central	18%	23%	39%
Central	13%	17%	29%

- 2.5 When determining the appropriate allowance for use in the site-specific FRA and therefore the hydraulic modelling exercise, the Flood Zone classification, flood risk vulnerability and the anticipated lifespan of the development should be considered.
- 2.6 The site is located across Flood Zones 1-3, the proposed development is classified as 'More Vulnerable', and it has an anticipated lifespan of at least 100 years. Therefore, the Central allowance for the '2080s' epoch will be considered.
- 2.7 Therefore, the 1 in 100-year + 29% event should be used within the hydraulic modelling when considering river flows.

- 2.8 When determining the potential off-site impacts of a proposed development its vulnerability is not critical, instead the land use in the wider floodplain needs to be considered. In their online guidance, the EA advise that generally it is appropriate to use the central allowance. Therefore, the 1 in 100-year + 29% will be used to calculate any off-site impacts.
- 2.9 The Tidal Trent 2023 model includes river inflows for the 1 in 100-year + 29% event and therefore no changes were required to account for the latest peak river flow climate change allowances.

Sea Level Rise

- 2.10 It is predicted that future changes in climate change will result in the global sea level continuing to rise, which will change the frequency and magnitude of high-water events. Predicted future changes in sea levels are also provided by the EA, with a range of projections applied to River Basin Districts. The relevant sea level allowances for the Humber River Basin District are summarised in **Table 2.2**.

Table 2.2: Sea Level Allowances for the Humber River Basin District for each epoch in mm per year

Allowance		2000 to 2035 (mm)	2036 to 2065 (mm)	2066 to 2095 (mm)	2096 to 2125 (mm)	Cumulative Rise 2000 to 2125 (m)
Higher Central	Per Year	5.5	8.4	11.1	12.4	-
	Total	193	252	333	372	1.15
Upper End	Per Year	6.7	11	15.3	17.6	-
	Total	235	330	459	528	1.55

- 2.11 The climate change guidance states that for an FRA both the Higher Central and Upper End allowances should be assessed in order to understand the range of impact. With a development horizon of at least 100 years, the sea level rise up to 2125 needs to be considered for both the Higher Central and Upper End allowances.
- 2.12 The Tidal Trent 2023 model includes tidal surge water levels up to the year 2121. Therefore, an uplift was applied to ensure the peaks met the latest allowances for the development lifetime (up to 2125) at 12.4mm/year in the Higher Central event and 17.6mm/year in the Upper End event. The peak levels are summarised in **Table 2.3**.

Table 2.3: 1 in 200-year 2123 Tidal Surge Water Levels

	Higher Central	Upper End
Uplift (mm/year)	12.4	17.6
2125 Peak Level (m AOD)	6.99	7.37

3. HYDRAULIC MODEL ALTERATIONS

3.1 The Tidal Trent 2023 modelling approach was retained for this update. The only changes made to the baseline model were as follows:

- The site topographical survey was incorporated as a DTM overlying the LiDAR within the 2D domain.
- The tidal inflows were updated to account for the minor uplift to account for the latest sea level rise climate change allowances.
- TUFLOW version 2023-03-AC-iDP-w64 and Flood Modeller version 7 were used in all simulations.

Simulations

3.2 The updated baseline model was simulated against the following key return period events:

- Fluvial Dominated (with 1 in 2-year Tidal Surge)
 - 1 in 30-year
 - 1 in 100-year
 - 1 in 100-year + 29% (Central Peak River Flow Allowance)
 - 1 in 1000-year
- Tidal Dominated (with 1 in 2-year Fluvial flows)
 - 1 in 200-year
 - 1 in 200-year 2125 Higher Central
 - 1 in 200-year 2125 Upper End

Stability & Simulation Parameters

3.3 The Flood Modeller and TUFLOW parameters were retained from the Tidal Trent 2023 model.

3.4 In a similar manner to the Tidal Trent 2023 model received from the EA, 2D Negative Depths were reported in all fluvial and tidal events. A review of the results identified these were located at least 3km from the site boundary and therefore the negative depths are not expected to impact results at the study site.

3.5 The cumulative mass error remained within +/-2% in all modelled events which is within the acceptable tolerance and aligns with the Tidal Trent 2023 model received from the EA. The cumulative mass error for the baseline simulations is shown in **Figure 3.1**.

3.6 The Flood Modeller convergence remains within tolerance in all modelled events, in a similar manner to the Tidal Trent 2023 model provided by the EA. The Flood Modeller Convergence in the fluvial dominated 1 in 100-year + 29% event is shown in **Figure 3.2** as an example.

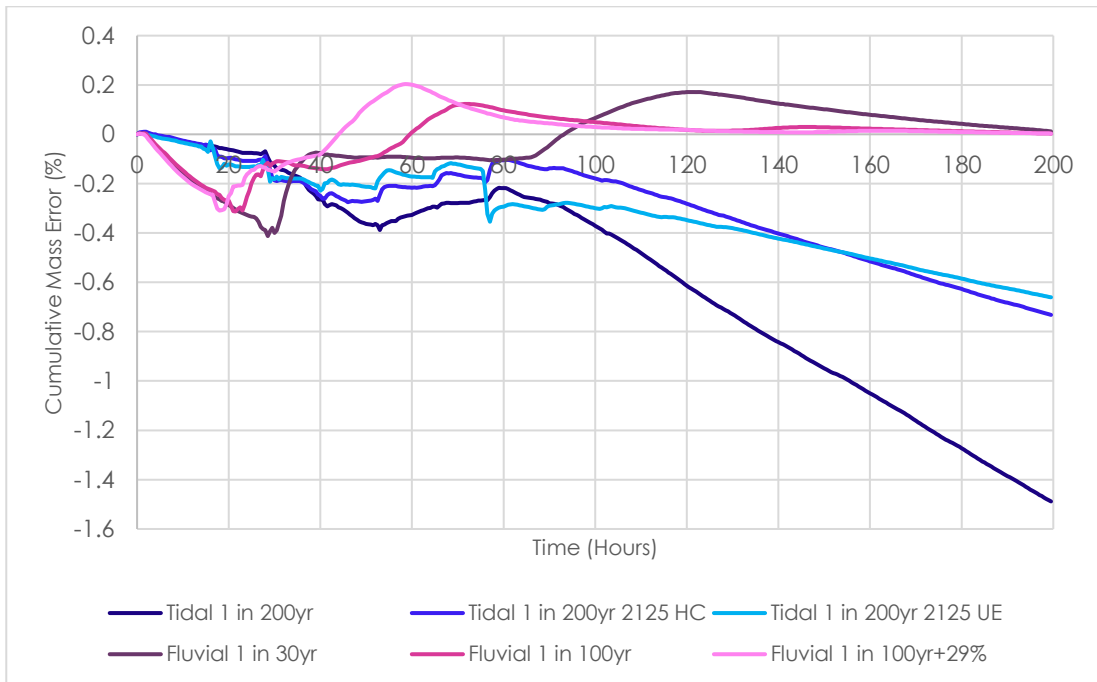


Figure 3.1: Cumulative Mass Error (%)

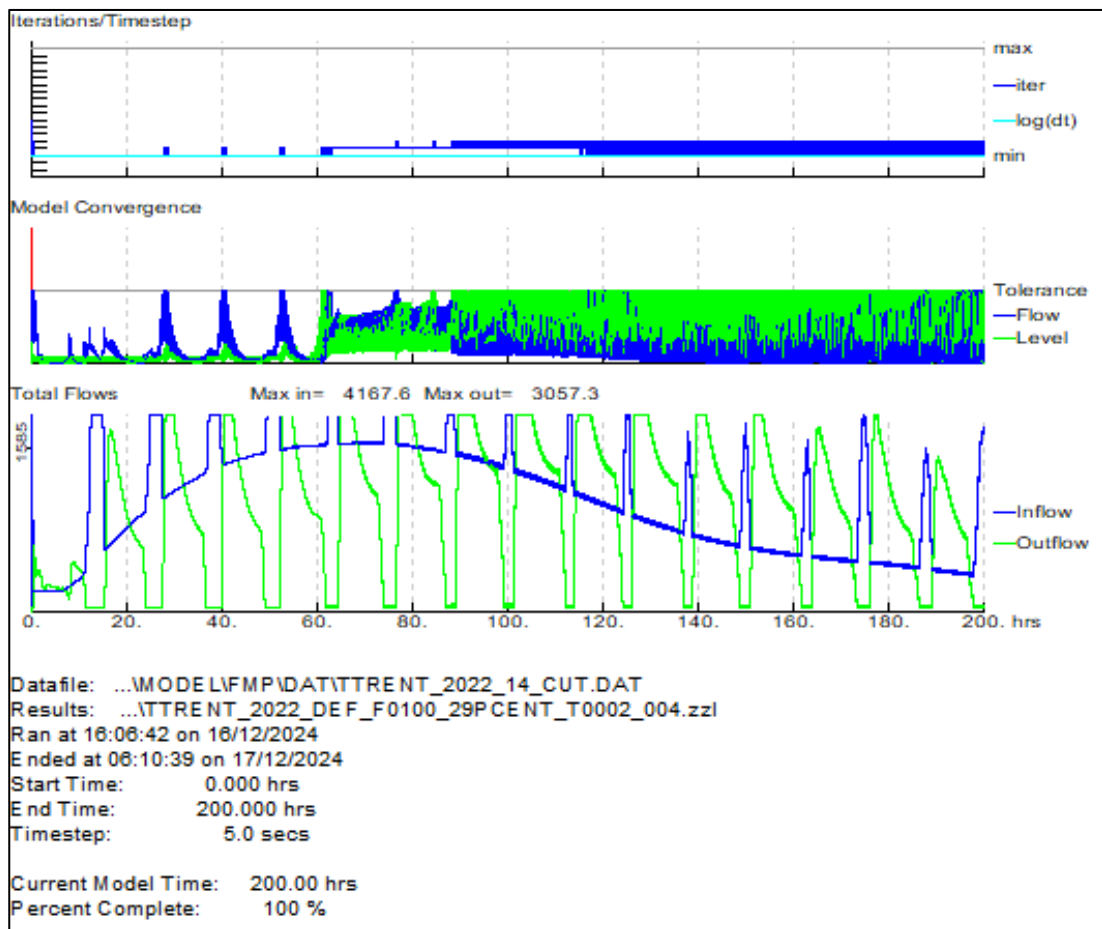


Figure 3.2: Flood Modeller Convergence (Fluvial 1 in 100-year + 29%)

4. BASELINE MODEL RESULTS - DEFENDED

Fluvial Dominated

- 4.1 The baseline fluvial model results at the site are shown in **Figure 4.1** with peak flood levels at key 1D node locations summarised in **Table 4.1**.

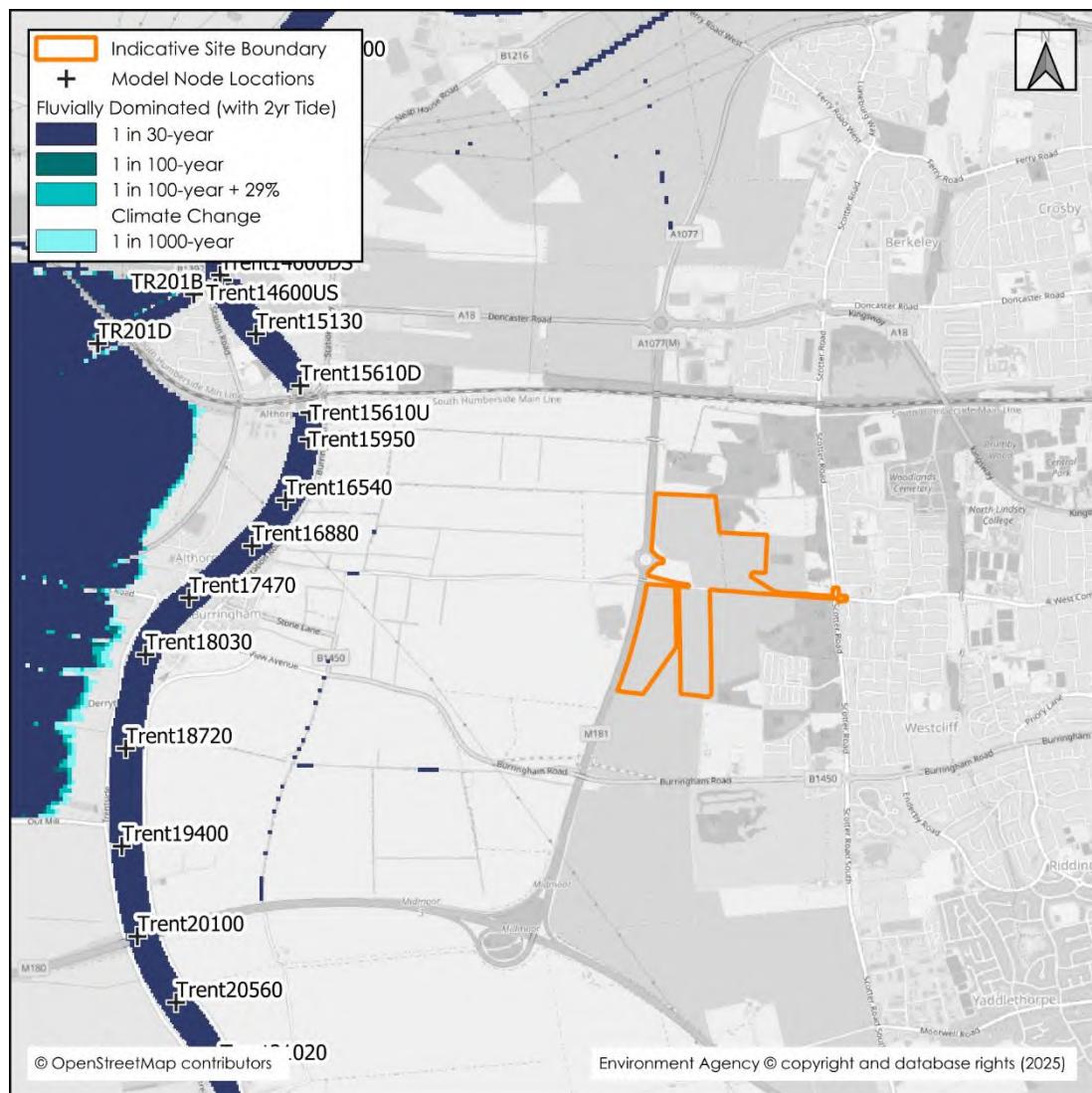


Figure 4.1: Fluvial Dominated Floodplain Extents

- 4.2 The site is removed from the fluvial dominated floodplain in all modelled events. The modelled floodplain extents including the 1 in 100-year + 29% design event, remain within the River Trent channel in proximity to the site. This is expected to be as a result of the defences on the right bank of the River Trent with modelled crest levels of 6.1m AOD to 6.47m AOD (taken from EA survey based on the accompanying model report).

Tidal Dominated

- 4.3 The baseline tidal model results at the site are shown in **Figure 4.2** with peak flood levels at key 1D node locations summarised in **Table 4.1**.

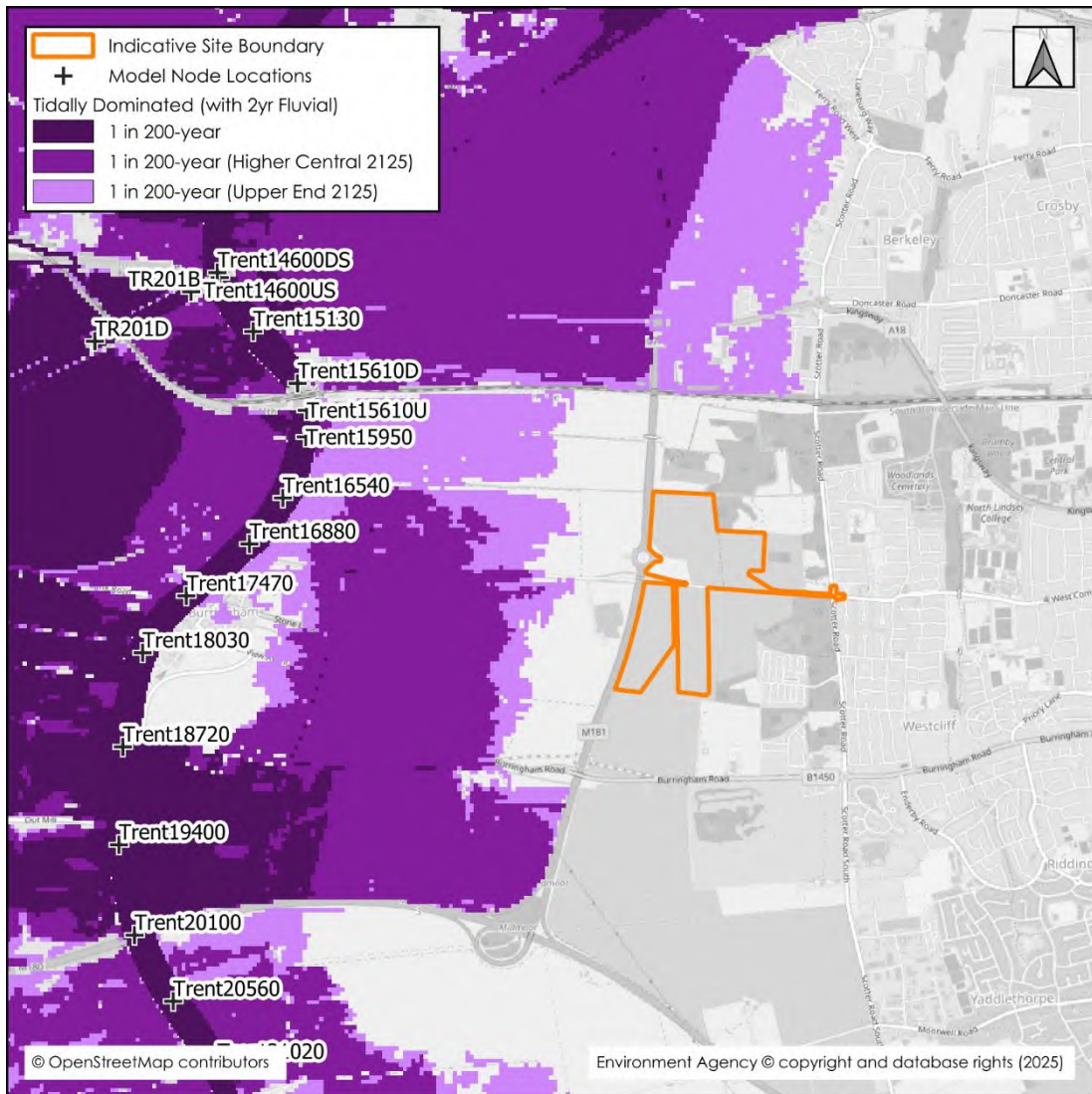


Figure 4.2: Tidal Dominated Floodplain Extents

4.4 The site is also removed from the tidal dominated floodplain extents in all modelled events. The floodplain does exceed the right bank of the River Trent in proximity to the site location; however, the M181 is a topographical barrier as shown in **Figure 1.3** and the floodplain extents remain within the land to the west of the M181 close to the site.

Summary

- 4.5 A summary of the baseline 1D flood levels at key locations close to the site is included in **Table 4.1**.

Table 4.1: Baseline Peak 1D Flood Levels Summary

Node	Fluvial Dominated				Tidal Dominated		
	1 in 30-year	1 in 100-year	1 in 100-year + 29%	1 in 1000-year	1 in 200-year	1 in 200-year 2123 Higher Central	1 in 200-year 2123 Upper End
Trent 18030	5.57	5.72	5.72	5.71	6.20	6.40	6.45
Trent 17470	5.56	5.71	5.71	5.69	6.20	6.41	6.47
Trent 16880	5.56	5.69	5.70	5.68	6.21	6.45	6.53
Trent 16540	5.55	5.69	5.69	5.67	6.20	6.45	6.53
Trent 15950	5.54	5.67	5.68	5.65	6.20	6.48	6.57

5. BREACH SCENARIO

- 5.1 As outlined in **Section 1**, the EA Flood Map for Planning and Product 4 data note the presence of defences in the form of walls and embankments on the right bank of the River Trent in proximity to the site.
- 5.2 The Tidal Trent 2023 model includes numerous breach locations. The EA noted during a meeting in November 2024 that an additional breach location had been modelled which should also be considered for the study site. The locations were reviewed to identify the most suitable for the study site. The previous nearest breach location to the site was Breach 6 ('BR6') at Burringham approximately 2.5km west of the study site; however, the most conservative results were based on Breach 43 at Keadby Bridge, approximately 2km northwest of the study site.

Hydraulic Model Updates

- 5.3 The hydraulic model was therefore updated to include the 2D variable Z-Shape to represent Breach 43 to understand the residual risk in this scenario. The parameters were retained from the Tidal Trent 2023 model. No further changes were made.
- 5.4 The model was simulated for the same return period events as in the baseline scenario.

Breach Scenario Results

Fluvial Dominated

- 5.5 The breach scenario fluvial dominated model results at the site are shown in **Figure 5.1**.
- 5.6 The site is removed from the breach scenario floodplain extents in the fluvial dominated events up to, and including, the 1 in 100-year + 29% design event. The nearest floodplain extents are located to the west of the M181, at least 400m from the study site.

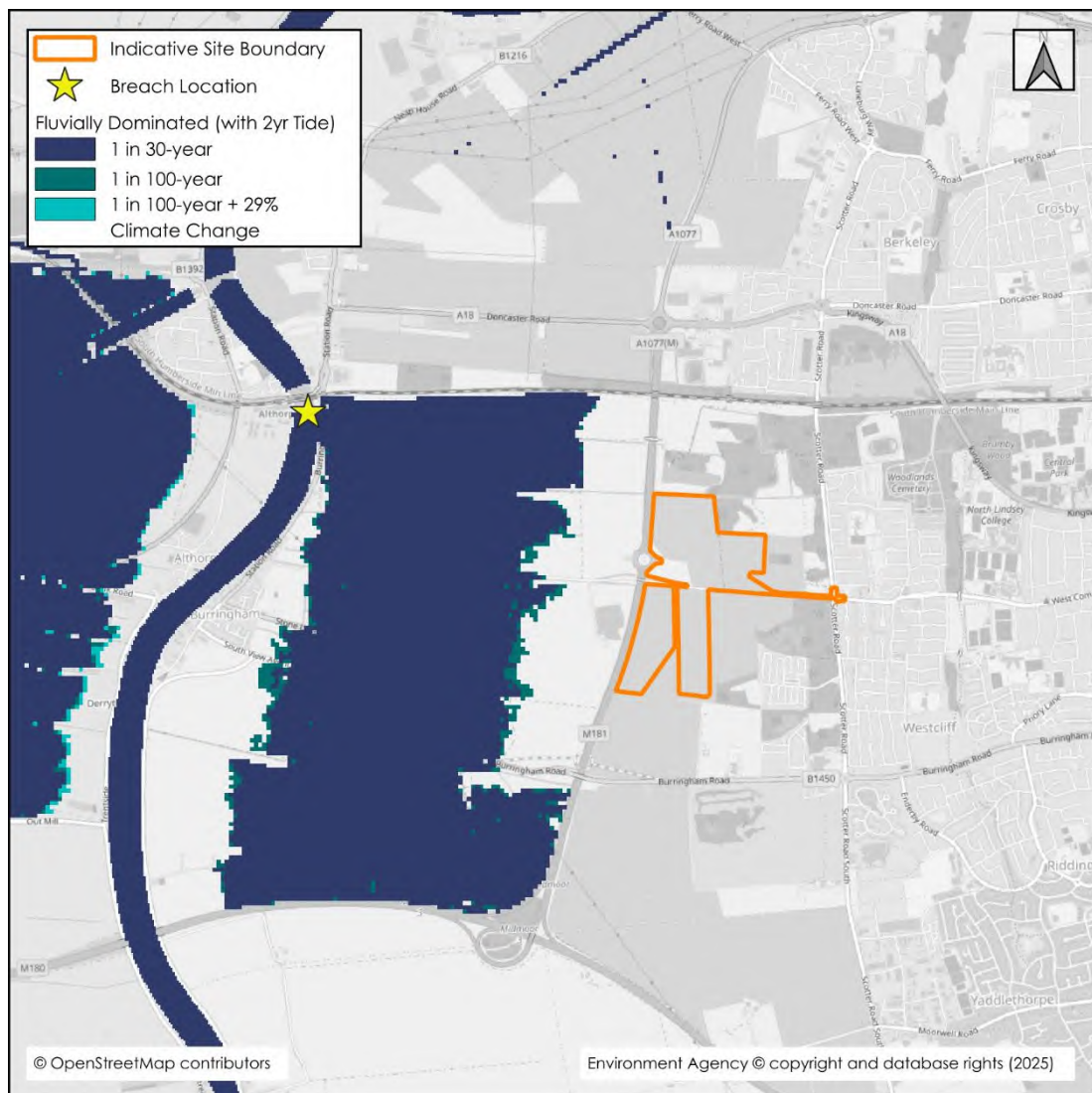


Figure 5.1: Fluvial Dominated Floodplain Extents – Breach Scenario

Tidal Dominated

- 5.7 The breach scenario tidal dominated model results at the site are shown in **Figure 5.2**.
- 5.8 The site is also removed from the breach scenario floodplain extents in the tidal dominated events up to, and including, the 1 in 200-year 2125 Higher Central climate change allowance event.
- 5.9 The floodplain extents reach the southwest of the site with a peak flood level of approximately 2.5m AOD in the extreme 1 in 200-year 2125 Upper End climate change allowance event.

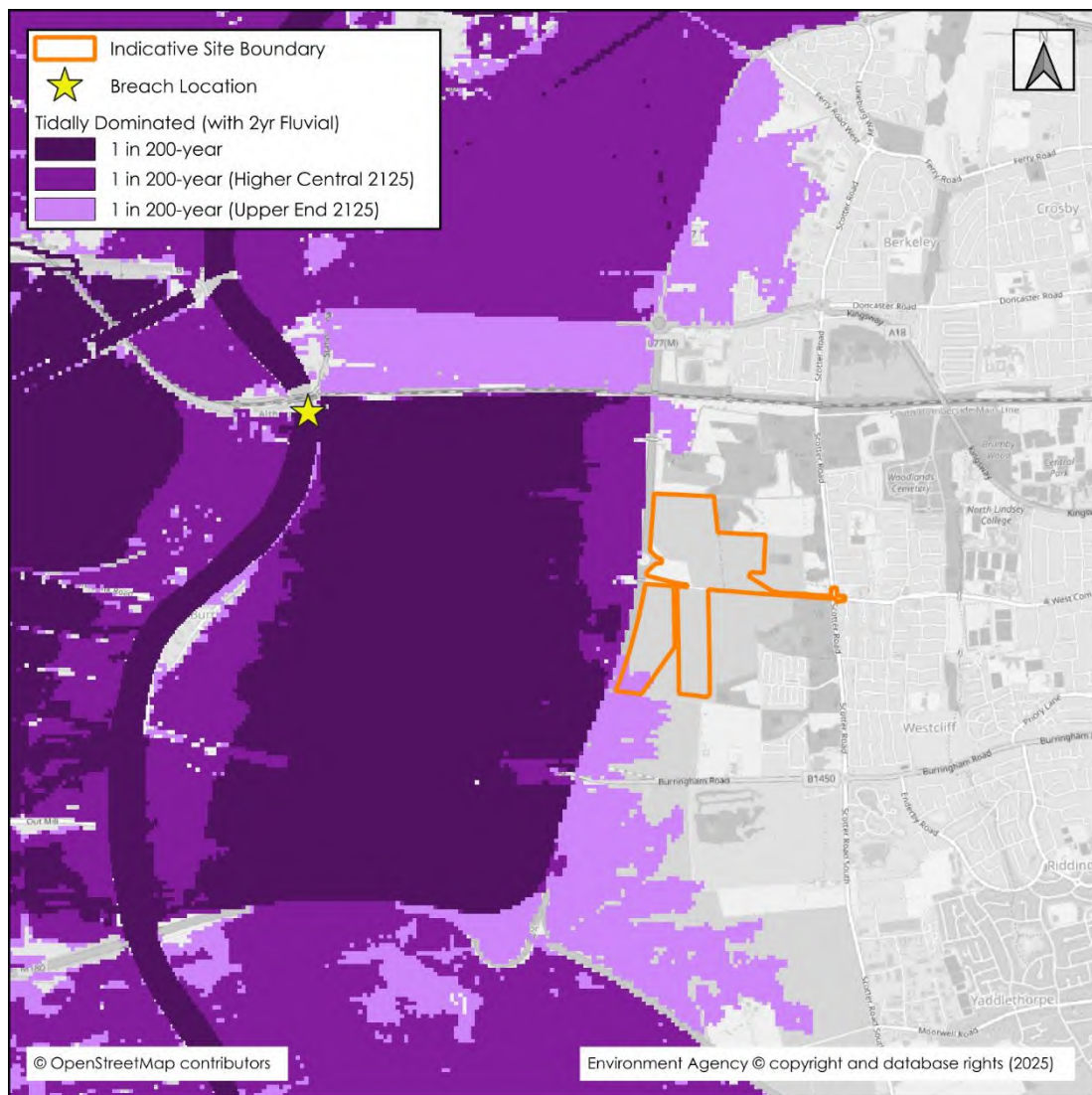


Figure 5.2: Tidal Dominated Floodplain Extents – Breach Scenario

6. SUMMARY

- 6.1 BWB Consulting Ltd has been commissioned by Hargreaves Land Limited to prepare a site-specific update to the EA Tidal Trent 2023 model for the purpose of assessing flood risk to a proposed development, known as Lincolnshire Lakes (North), Scunthorpe.
- 6.2 The model hydrology was retained including the peak river flow climate change allowance which met the current EA guidance. The tidal inflows were updated to account for a minor uplift in sea level rise up to 2125 to account for the development lifetime.
- 6.3 The site is removed from the modelled floodplain extents in the fluvial scenario (with 1 in 2-year tidal surge) including up to the 1 in 100-year + 29% design event.
- 6.4 The site is also removed from the modelled floodplain extents in the tidal scenario (with 1 in 2-year fluvial inflow) including in the 1 in 200-year 2125 Upper End climate change event.
- 6.5 A breach scenario was also applied in accordance with the EA Tidal Trent 2023 model methodology. Breach 43 at Keadby Bridge was used as the results were conservative at the study site. The site was removed from the breach scenario floodplain extents for the modelled fluvial events. In the extreme tidal dominated 1 in 200-year 2125 Upper End climate change event, the floodplain reaches the southern extent of the site, posing a residual risk. This is discussed further in the accompanying FRA alongside mitigation measures for the residual risk.

Limitations

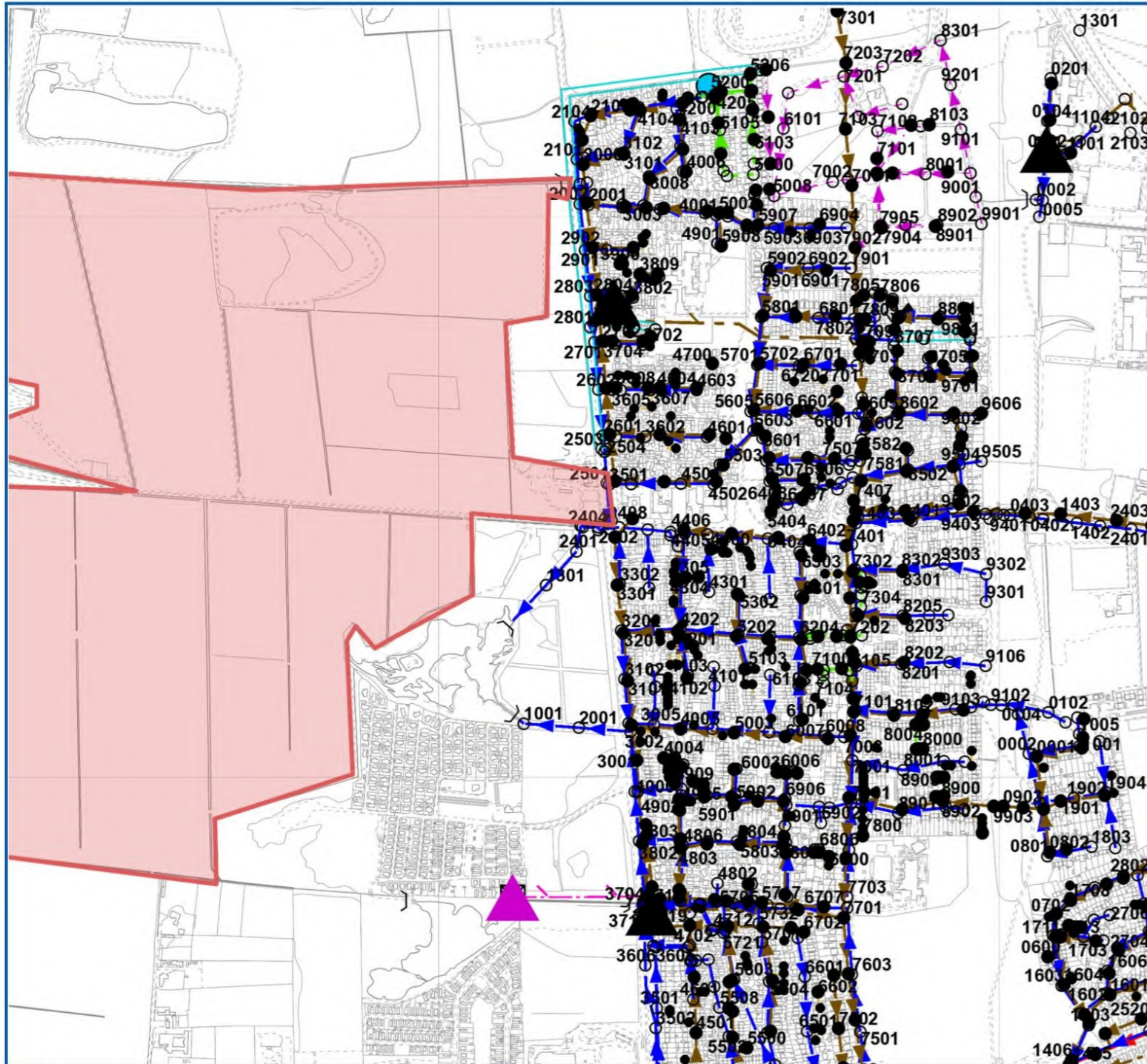
- 6.6 The EA provided the Tidal Trent 2023 model for use in this study. Any limitations and assumptions associated with the Tidal Trent 2023 model are carried forward to this study.
- 6.7 The hydraulic modelling exercise has made use of the available data at the time of construction and simulation.
- 6.8 The model contains no formal representation of the conveyance within minor watercourses or ditches other than that captured by the model grid and within the reinforced 2D elements.
- 6.9 The topographical survey did not include details of crossings beneath the M181 in proximity to the site; however, aerial imagery suggests there may be culverted connections which are not represented in the hydraulic model.
- 6.10 The modelling exercise has been undertaken to produce a good representation of fluvial flood risk from the Tidal Trent at the proposed development site. It has not been designed to more accurately map the wider floodplain.



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Appendix 5: Severn Trent Water Sewer Records



Reference	Cover Level	Invert Level Upstream	Invert Level Downstream	Purpose	Material	Pipe Shape	Max Size	Min Size	Gradient	Year Laid
SE87096100	8.7119	6.27	<UNK>	F	VC	C	150	<UNK>	0	31/12/1899 00:00:00
SE87096100	8.7119	5.99	5.66	F	VC	C	<UNK>	<UNK>	233.979	31/12/1899 00:00:00
SE87096405	<UNK>	<UNK>	<UNK>	F	VC	<UNK>	<UNK>	<UNK>	0	31/12/1899 00:00:00
SE87105010	<UNK>	<UNK>	<UNK>	S	U	C	750	<UNK>	<UNK>	04/03/2020 00:00:00
SE88101103	41.9879	39.97	39.64	S	VC	C	225	<UNK>	96.45	31/12/1899 00:00:00
SE87085501	6.109	4.08	3.83	F	VC	C	225	<UNK>	186.4	31/12/1899 00:00:00
SE87086707	8.5159	6.66	5.3	F	VC	C	225	<UNK>	82.2	31/12/1899 00:00:00
SE87095001	5.8689	3.96	3.47	F	VC	C	150	<UNK>	100.31	31/12/1899 00:00:00
SE87097501	9.2309	7.02	6.71	S	VC	C	225	<UNK>	83.65	31/12/1899 00:00:00
SE87103002	5.6519	3.63	3.31	F	VC	C	150	<UNK>	116.41	31/12/1899 00:00:00
SE88090401	34.462	30.95	25.841	S	VC	C	300	<UNK>	4.69	31/12/1899 00:00:00
SE87098711	14.4399	<UNK>	<UNK>	<UNK>	<UNK>	<UNK>	<UNK>	<UNK>	<UNK>	31/12/1899 00:00:00
SE87099706	18.107	16.99	16.51	S	VC	C	150	<UNK>	52.29	31/12/1899 00:00:00
SE88100004	40.4739	<UNK>	<UNK>	S	CO	C	1200	<UNK>	0	31/12/1899 00:00:00
SE87095605	6.689	4.9	4.69	S	CO	C	575	<UNK>	163.19	31/12/1899 00:00:00
SE87099402	21.684	17.84	17.36	S	CO	C	375	<UNK>	38.13	31/12/1899 00:00:00
SE87096200	<UNK>	<UNK>	<UNK>	F	VC	<UNK>	150	<UNK>	<UNK>	20/10/2022 00:00:00
SE87097303	9.133	7.14	6.85	S	CO	C	375	<UNK>	151.41	31/12/1899 00:00:00
SE87095901	7.762	6.4	5.65	F	VC	C	150	<UNK>	108.24	31/12/1899 00:00:00
SE87086709	7.8	5.68	5.02	F	VC	C	225	<UNK>	111.55	31/12/1899 00:00:00
SE88080901	36.75	33.66	29.491	F	VC	C	<UNK>	<UNK>	8.7	31/12/1899 00:00:00
SE87098301	13.17	11.04	7.65	F	VC	C	225	<UNK>	26.28	31/12/1899 00:00:00
SE87085504	7.1599	5.19	4.85	F	VC	C	225	<UNK>	266.38	31/12/1899 00:00:00
SE88081704	40.096	38.15	37.72	S	VC	C	225	<UNK>	94.09	31/12/1899 00:00:00
SE88081700	<UNK>	<UNK>	<UNK>	F	U	U	100	<UNK>	<UNK>	31/12/1899 00:00:00
SE87105009	8.93	7.51	6.88	F	VC	C	150	<UNK>	73.05	31/12/1899 00:00:00
SE87096901	8.9619	7.43	6.41	F	VC	C	225	<UNK>	98.33	31/12/1899 00:00:00
SE87084804	<UNK>	<UNK>	2.45	F	VC	C	<UNK>	<UNK>	0	31/12/1899 00:00:00
SE87085905	5.517	3.88	3.499	S	CO	C	600	<UNK>	134.61	31/12/1899 00:00:00

LEGEND

Operational Site	Combined Effluent Manhole	Combined Unsurveyed Pipe	Combined Vacuum Sewer	Foul Lateral Drain	Lamp Post
Waste Water Pump	Surface Water Effluent Manhole	Foul Unsurveyed Pipe	S104 Surface Water Vacuum Sewer	S104 Surface Water Lateral Drain	Sewerage Air Valve
Transfered Asset	Dual Manhole	Transfered Surface Water Sewer	S104 Combined Vacuum Sewer	S104 Combined Lateral Drain	Sewerage Chemical Injection Point
S24	Foul Single Manhole	Transfered Combined Sewer	S104 Foul Vacuum Sewer	S104 Foul Lateral Drain	Sewerage Hatch Box
S104	Combined Single Manhole	Transfered Foul Sewer	Private Surface Water Vacuum Sewer	Private Surface Water Lateral Drain	Sewerage Pressure Washout
S102	Surface Water Single Manhole	Disposal Pipe	Private Combined Vacuum Sewer	Private Combined Lateral Drain	Vent Column
Null Private	Twirl Manhole	Overflow Pipe	Private Foul Vacuum Sewer	Private Foul Lateral Drain	Waste Water Outfall
Null	Foul Adopted Manhole	Culverted Water Course	Surface Water Siphon	Transfered Surface Water Lateral Dia	Control Valve
None	Combined Adopted Manhole	Waste Internal Site Pipe	Combined Siphon	Transfered Combined Lateral Drain	Hydrobrake
Highway Drain	Surface Adopted Manhole	Sewer Service Connection	Foul Siphon	Transfered Foul Lateral Drain	Panstock
Adopted Sewer	Transfered Manhole	Gravity Sewer Others	Private Surface Water Siphon	Ancillary	Sewerage Isolation Valve
Storage	Unsurveyed Manhole	Pressure Sewer Pipe	Private Combined Siphon	Balancing Lagoon	Sewerage Non Return Valve
DS	Gravity Sewer Pipe	Surface Water Pressure Sewer	Private Foul Siphon	Grease Trap	Interceptor
Disposal Site	Foul Gravity Sewer	Combined Pressure Sewer	S104 Surface Water Siphon	Screen	Chamber
Off-Line Waste Water Storage	Combined Gravity Sewer	Foul Pressure Sewer	S104 Combined Siphon	Flushing Chamber	Scalaway
On-Line Waste Water Storage	Surface Water Gravity Sewer	S104 Surface Water Pressure Sewer	S104 Foul Siphon	Overflow	Fitting
Wet Well	S104 Combined Gravity Sewer	S104 Combined Pressure Sewer	Surface Water Unsurveyed Pipe	Blind Shaft	Facility Connector
Waste Water Process Structure	S104 Foul Gravity Sewer	Private Surface Water Pressure Sewer	Foul Unsurveyed Pipe	Head Node	
Sewage Treatment Point	Private Surface Water Gravity Sewer	Private Combined Pressure Sewer	Disposal Pipe		
Sewage Treatment Structure	Private Foul Gravity Sewer	Private Foul Pressure Sewer	Service Pipe		
Sludge Treatment Point	Private Surface Water Vacuum Sewer	Surface Water Lateral Drain			
Sludge Treatment Structure	Surface Water Unsurveyed Pipe	Combined Lateral Drain			
Manhole	Foul Effluent Manhole				

MATERIALS

- NONE
- AC - ASBESTOS CEME
- BR - BRICK
- CC - CONCRETE BOX CULVERT
- CI - CAST IRON
- CO - CONCRETE
- CSB - CONCRETE SEGMENTS (BOLTED)
- CSU - CONCRETE SEGMENTS (UNBOLTED)
- DI - DUCTILE IRON
- GRP - GLASS REINFORCED PLASTIC
- MAC - MASONRY IN REGULAR COURSES
- MAR - MASONRY RANDOMLY COURSED
- PE - POLYETHYLENE
- PF - PITCH
- PP - POLYPROPYLENE
- PSC - PLASTIC STEEL COMPOSITE
- PVC - POLYVINYL CHLORIDE
- RPM - REINFORCED PLASTIC MATRIX
- SI - SPUN (GREY) IRON
- ST - STEEL
- U - UNKNOWN
- VC - VITRIFIED CLAY
- XXX - OTHER

CATEGORIES

- W - WEIR
- C - CASCADE
- DB - DAMBOARD
- SE - SIDE ENTRY
- FV - FLAP VALVE
- BD - BACK DROP
- S - SIPHON
- D - HIGHWAY DRAIN
- S104 - SECTION 104

SHAPE

- C - CIRCULAR
- E - EGG SHAPED
- O - OTHER
- R - RECTANGLE
- S - SQUARE
- T - TRAPEZOIDAL
- U - UNKNOWN

PURPOSE

- C - COMBINED
- E - FINAL EFFLUENT
- F - FOUL
- L - SLUDGE
- S - SURFACE WATER

SEVERN TRENT

Severn Trent Water Limited
 Asset Data Management
 PO Box 5344
 Coventry
 CV3 9FT
 Telephone: 0345 601 6616

SEWER RECORD (Tabular)

O/S Map Scale: 1:10,000
 This map is centred upon:
 Date of Issue: 13-07-23
 X: 487250.28 Y: 409430.31

Disclaimer Statement

- Do not scale off this Map.
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