

MA11267-FRA-R01

Fen Road, Holbeach

Finsbury Design Ltd

Flood Risk Assessment

March 2020



REVISION

Reference	Revision	Author	Date
MA11267-R01	Initial Issue	CMN	Mar 2020

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Site Location Plan: MA11267-001

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Appendix B – Consultations

South East Lincolnshire SFRA Mapping

Surface Water Calculations

1 INTRODUCTION

- 1.1 Millward have been appointed to undertake a Flood Risk Assessment (FRA) for proposed a proposed development on Fen Road, Holbeach. The development is to be 6 no residential units.
- 1.2 This FRA is undertaken in accordance with the National Planning Policy Framework and associated Technical Guidance 'Flood Risk and Coastal Change March 2014' (NPPF).
- 1.3 This FRA discusses and provides both a qualitative assessment and quantitative assessment for the residential development in terms of flood risk and future flood risk over the anticipated lifetime of the development.
- 1.4 This FRA has been written with consultation from the EA, Anglian Water and South Lincolnshire County Council.

2 THE SITE

- 2.1 This proposed development is on greenfield land with a site area of approximately 0.802ha (8022m²).
- 2.2 The proposed development proposals consist of 6 no dwellings in total with associated driveways and garages (off road) and garden areas to the rear of the proposed dwellings. The site is to be accessed off Fen Road, north-west of the site.
- 2.3 The current master plan for the site contained within Appendix A.
- 2.4 Site levels vary across the site but generally fall towards the north-east of the site. There are several high spots and low spots on site. Levels at boundaries are as follows: South-west 3.125mAOD, north-west 3.1mAOD, north-east 2.350mAOD and south-east 2.85mAOD.

3 CONSULTATIONS

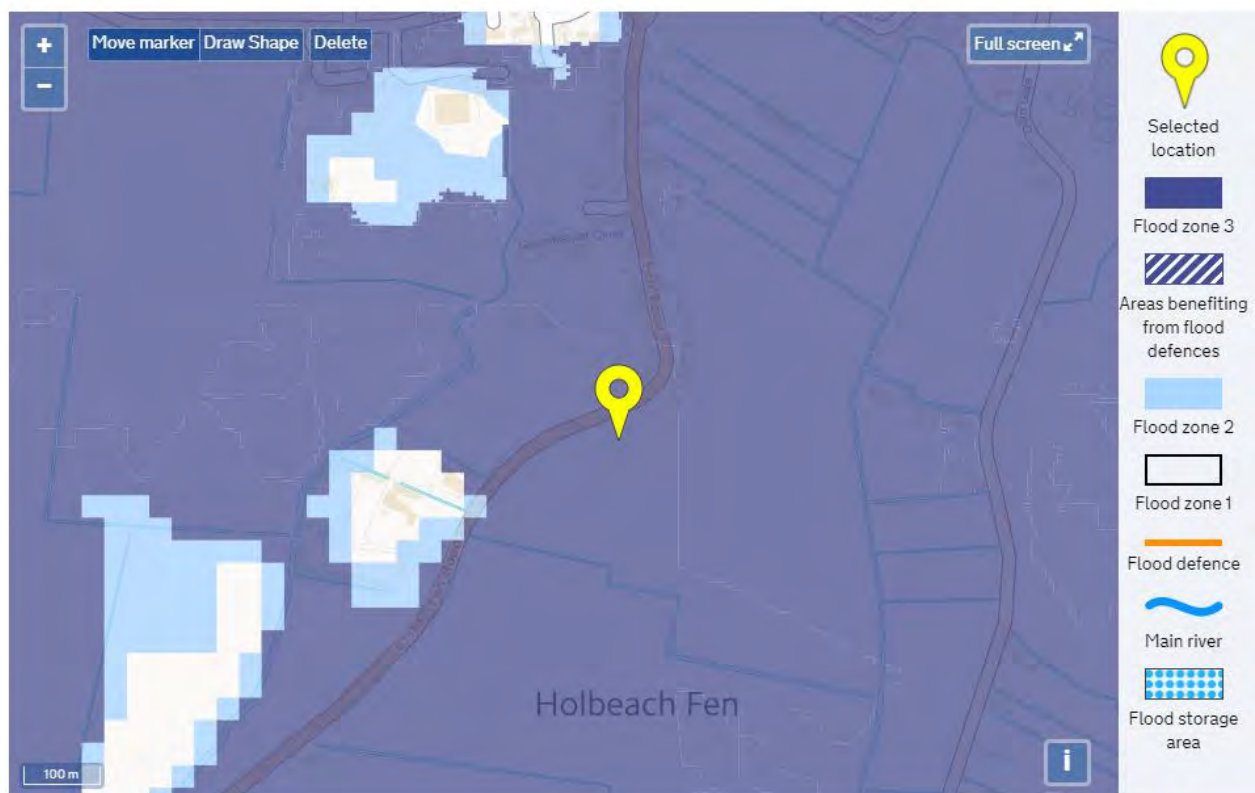
3.1 Environment Agency (EA)

3.1.1 The EA national flood risk maps available on their web site have been interrogated firstly to define in terms of planning what flood zone the site is contained within.

3.1.2 The development site is located within Flood Zone 3 which in accordance with Table 1 of the NPPF Technical Guidance document, is defined as High Probability having a 1 in 100 or greater annual probability of flooding from rivers (>1%), or a 1 in 200 or greater annual probability of flooding from the sea (>0.5%) in any year.

3.1.3 The site and surrounding area benefit from significant tidal and fluvial flood defences.

3.1.4 See the EA Flood Mapping provided below:



3.2 Anglian Water (AW)

3.3 Anglian Water have been consulted and have provided the sewer map in appendix B. The map shows a 150Ø FW pipe flowing from the north-east of the site in Fen Road to the north.

3.3.1 Liaison with AW will be required through their Planning Engineers who will identify reinforcement requirements either on site or on the existing network relating to the foul sewer connection for this site. A pre-planning enquiry has been made and awaiting the results.

3.3.2 Any foul connections to any existing adoptable sewers are subject to a S106 sewer connection agreement which would be undertaken as part of the detailed design of the drainage for the development.

3.4 SFRA

3.4.1 The Strategic Flood Risk Assessment for South East Lincolnshire has been reviewed for the South Holland District area to establish the extent of flooding at a detailed level.

3.4.2 Further details of this data are shown in section 8 of this report.

4 SEQUENTIAL AND EXCEPTION TESTS

4.1 Sequential Test

- 4.1.1 The site has been assessed in line with the NPPF technical guidance. The site is confirmed to be wholly within Flood Zone 3 (High probability) as defined in Table 1 (Flood zones) of the technical guidance document for the NPPF.
- 4.1.2 Table 2, (Flood risk vulnerability classification) of the same document confirms that residential development (buildings used for dwelling houses) is classified as 'More Vulnerable' development.
- 4.1.3 Table 3, (Flood risk vulnerability and flood zone 'compatibility') confirms that development classified as 'More vulnerable' development in Flood Zone 3a requires the exception test' to be carried out.
- 4.1.4 In terms of Sequential Test the site sits wholly within flood zone 3 which is the case for the vast majority of this borough.
- 4.1.5 The SFRA states that the EA flood zones will continue to be used by the Borough Council as the basis on which the Sequential Test is applied. The majority of the Borough Councils area is within Flood Zone 3 and the site has land with a high probability of flooding but within the 'Danger for Some' category.
- 4.1.6 The mapping for the hazard to people is categorised as Danger to Some. The depths expected in this scenario is up to 0.50m and the velocity of the breached water is up to 0.3m/s.
- 4.1.7 Mitigation measures recommended by the SFRA should therefore be included in the detailed design.

4.2 Exception Test

- 4.2.1 The development site would see a greenfield site be developed for residential use which will provide a contribution to the housing targets for the Borough, in a sustainable location (close to the town centre and current amenities of Holbeach) and as such has a wider benefit to the community as a whole.
- 4.2.2 The adjacent site to the north of Fen Road of this site has received planning permission and this site should be considered as part of the wider development.
- 4.2.3 This FRA confirms through the assessment of flood risk from all sources that the development by design can be made safe in terms of flood risk and would not increase the risk of flooding elsewhere.
- 4.2.4 The Exception Test is therefore passed.

5 PROPOSED DEVELOPMENT

- 5.1 The proposed development proposals consist of 6 no dwellings in total with associated driveways and garages (off road) and garden areas to the rear of the proposed dwellings. The site is to be accessed off the south of Fen Road via an adopted road in line with the current master plan for the site contained within Appendix A.
- 5.2 The impermeable areas of the proposed site are 0.32ha. This is an increase in impermeable area on the site, as the previous site is greenfield, which therefore will require mitigation measures in terms of surface water drainage to reduce the surface water run off to acceptable levels as stipulated by the IDB.
- 5.3 The site is essentially split into two housing zones served off a private road each. These private roads will provide the attenuation for the site drainage.
- 5.4 Foul drainage is proposed to drain via gravity into the adopted FWS to the north of the site. This sewer is currently proposed as part of the proposed adjacent development identified as 3MHF03 on drawing MA11267_200 in appendix A.

6 PROPOSED DRAINAGE STRATEGY

- 6.1 The site topography varies across the site. However, site constraints dictate the FFL's and levels across the site. One of these constraints is the invert level of the existing SW drain adjacent to Fen Road to which we would propose the site to connect to. This invert level is fairly shallow compared to existing site levels.
- 6.2 The preliminary drainage strategy shown on drawing MA11267/200 is based upon the current master plan for the site and assumes that private driveways and shared drives will utilise a form of permeable tarmac as part of the strategy.
- 6.3 Roadside filter drains will take the surface water run-off from the proposed carriageways into the outfall north-west of the site into the IDB maintained ditches at restricted discharge rates.
- 6.4 The attenuation storage structure is proposed to be in the form of permeable paving under the private roads. This form of attenuation has been proposed to utilise the limited amount of space that the site layout offers for storage. The roadside filter drains for the adopted road, permeable paved private roads and permeable paved private driveways provide suitable treatment trains for surface water run off before outfall into the IDB watercourse to the west of the site.
- 6.5 The discharge rate for surface water is not to exceed the 5l/s (equivalent to 6.23l/s/ha) limit for the 1 in 100 year event including 40% climate change allowance for this area of the site.
- 6.6 The surface water drainage system to be designed for the site will ensure that there is no flooding from the site in the 1 in 100 year event including a 40% allowance for climate change whilst maintaining the above rates for the corresponding storm events.
- 6.7 A provisional Micro drainage network model has been produced to determine the pipe sizes and also the locations and provisional volumes of attenuation required to accommodate the development surface water run-off of 5.0l/s for this site. Within this model a 6% increase in flow is applied to allow for urban creep (in line with LCC specification). See appendix B.

- 6.8 The volumes at this stage do not take into account the volumes in the underdrained filter drain medium or permeable driveway areas. This would be determined as part of the detailed design process for the drainage of the site.
- 6.9 The drainage of the site is designed to drain into the IDB maintained watercourse to the northern boundary of the site.
- 6.10 As the site is to be raised above adjacent ground levels (in accordance with the identified mitigation measures in Section 8, consideration of inclusion of perimeter land drains (especially at the boundaries of the existing dwellings to the north-east of the site which would intercept any water from the gardens of the proposed dwellings).
- 6.11 The surface water drainage strategy provides the required minimum 1 treatment train for roof areas and two treatment trains for the roads / driveways. (All areas flow through 2 treatment trains in line with CIRIA C697).
- 6.12 The surface water drainage system has scope to be adopted by Anglian Water and Lincolnshire County Council to adopt the filter drain (to be confirmed as part of the detailed design process). However due to the scale of the development LCC may advise to not have the road adopted therefore the drainage would also be designed as private. The proposed system is able to be adopted by both authorities, but a final decision will be made at the detailed design stage.
- 6.13 The existing IDB maintained drain will have a 9m easement to the southern bank which is to be applied for maintenance purposes as shown on drawing MA11267/200 contained within Appendix A.
- 6.14 The consent of the IDB would be required for any works within 9m of the watercourse and any new surface water outfall into the boards system. This would be undertaken as part of the detailed design process for the development proposals.
- 6.15 BGS data has been collected from their website which shows the sites underlying strata to be Mudstone and siltstone. A site investigation has also been carried out for the adjacent site which concludes: *'The results from the programme of in-situ infiltration rate testing have indicated that traditional soakaways and permeable paving are unlikely to be viable for the site'* Therefore, infiltration drainage should be assumed to be the same for this site and is not deemed viable for this site.

- 6.16 In terms of foul drainage, it is proposed to have a gravity foul system within the site which is to discharge into 3FMH03 within Fen Road subject to S106 approval. See appendix A for drawing.
- 6.17 It is known that the existing foul water sewer in Fen Road may not have capacity. Using AW criteria for the site to calculate peak inflow to the sewer. A peak inflow rate of 0.025l/s (based on 6 units) should be considered. Therefore, as part of the development AW will adopt zonal charging to the developer and assess the need for upgrading the existing AW system. A developer enquiry has been made where the and awaiting the results.

7 FLOOD RISK

7.1 Flooding From Fluvial and Tidal Sources

- 7.1.1 The residential development area is shown within Flood Zone 3a as having a 1 in 100 or greater annual probability of flooding from rivers (>1%), or a 1 in 200 or greater annual probability of flooding from the sea (>0.5%) in any year.
- 7.1.2 The South East Lincolnshire Strategic Flood Risk Assessment (March 2017) provides district wide assessment of the flood risk including flood defence breach scenarios which have been assessed. The study area in the SEL SFRA shows the whole site to be within a flood hazard of **Danger for Some** and a flood depth of up to 0.5m. This is based on scenario of 1:100 Fluvial and 1:200 Tidal flood probability in the 2115 year (climate change event).
- 7.1.3 The site has an existing drain running alongside Fen Road to the northern boundary of the site. This watercourse is part of the wider catchment of the South Holland IDB.
- 7.1.4 Holbeach is defended by significant tidal flood defences (South bank of River Welland, North bank of River Nene and alongside the coast) and whilst the Flood Zone is 3a this does not take into account the presence of flood defences.
- 7.1.5 The use of the Residual Flood Extent 2115 1% fluvial, 0.5% Tidal Event Probability maps in the SEL SFRA shows that the site remains at a high probability of flooding despite the presence of these flood defences.
- 7.1.6 As the risk of flooding is high (Flood Zone 3a) and the probability of flooding (due to the flood defences) high the residual risk of flooding from this source is **HIGH**.
- 7.1.7 Therefore, mitigation measures are required to counteract this which involves raised floor levels in line with the Environment Agencies comments relating to mitigation measures in the South East Lincolnshire SFRA (March 2017). The mitigation measures proposed are discussed further in Section 8.

7.2 Flooding From Land / Adjacent Development

- 7.2.1 The source of surface water flood risk to this site is shown to be in an area of the site north-east, where a localised low spot is present and shown on the topography. The Environment Agency long term flood risk mapping confirms this area as a low risk. However, there is no risk of surface water flooding from the boundaries of the site.
- 7.2.2 Any overland flow from adjacent development site is likely to be shallow and any low points within the site should be mitigated at the design stage to prevent localised depressions in the ground which would be at risk of ponding / pooling water from this source.
- 7.2.3 Overall the risk of flooding from this source is considered to be **LOW**.
- 7.2.4 Therefore there are mitigation measures proposed as part of the development layout and levels to mitigate this risk which are discussed in Section 8.

7.3 Flooding From Infrastructure Failure

- 7.3.1 The site is not within an area deemed to be at risk of flooding from reservoirs (according to the data on the EA website).
- 7.3.2 As the site is outside the limits of any deemed flood extents from a reservoir failure, the risk of flooding to the site is considered **LOW**.

7.4 Flooding From Groundwater

- 7.4.1 There are no confirmed records of groundwater flooding in the vicinity of the site in the SFRA.
- 7.4.2 Overall the risk of flooding from this source is considered to be **LOW**. As there should not be any dwellings in localised low points within the site it is not considered further assessment is required to assess flooding from this source.
- 7.4.3 However, mitigation measures are proposed as part of measures to counteract other sources of flooding which will essentially further reduce any likelihood of flooding from this source.

7.5 Flooding From Sewers

- 7.5.1 It is very well documented that the existing sewer network in Holbeach is essentially close to or exceeding capacity. Therefore, there is a residual risk of flooding to deal with.
- 7.5.2 The site entrance levels are at 3.125mAOD, higher than the cover levels in Fen Road, therefore flows would direct away from the site entrance. The proposed FFL's are anticipated to be higher than the cover levels of the sewers in Fen Road, hence reducing the risk of flooding from infrastructure.
- 7.5.3 Flow velocities and depths are expected to be relatively slow and shallow respectively towards the site and likely to be constrained within the carriageways initially then directed into the IDB maintained drains realistically.
- 7.5.4 Overall taking into account the proximity of the sewers and topography of the area, the risk of flooding from this source is considered to be **LOW**.
- 7.5.5 However, mitigation measures are proposed as part of measures to counteract other sources of flooding which will essentially reduce any likelihood of flooding of properties on the site from this source.

7.6 Off-Site Flood Risks

- 7.6.1 The site proposals along with the proposed drainage strategy outlined in Section 6.1 will intercept drainage run off from the development in filter drains, potential perimeter land drains and permeable paving which will be designed to accommodate the 1 in 100 year event scenario (including 40% allowance for climate change) without flooding of the attenuation features or filter drains.
- 7.6.2 The drainage system which will serve the development will be designed to accommodate the required volume of storage on site and outflow restricted by a stormbrake flow control at the outfall point at the flow rate of 5.0/s.
- 7.6.3 Consideration at the detailed design stage will be given to either a land drain / land drains to intercept any surface water flow from the site which may approach the adjacent or existing site boundaries where there are gardens to the north-east of the site boundary. This would be reviewed at detailed design stage once final proposed floor levels, layout and finished level contours are produced to confirm any flow routes.
- 7.6.4 With regard to risk to areas off site, the residual risk is considered to be **LOW** as the onsite drainage system will be designed to accommodate the extreme events without flooding.

7.7 Flooding From Climate Change

- 7.7.1 The NPPF Technical Guidance Document confirms in Table 5 that peak rainfall intensity is estimated to increase potentially up to 40% over the lifetime of this development (20 years) and peak river flows by 20%.
- 7.7.2 NPPF technical guidance also requires climate change to be considered to fluvial sources. The site lies within the Anglian River Basin where the vulnerability class is more vulnerable therefore the High Central and Upper End allowances should be considered when modelling the fluvial flows. Therefore, a range between 35% and 65% should be used for climate change when modelling the peak river flow and volume. The mapping provided as part of the SFRA is modelled as the 2115 in the 1:100yr fluvial and 1:200 year tidal event. The properties will be raised by 0.5m from existing ground level. This is the mitigation measure advised in the SFRA.

- 7.7.3 Overall the risk of flooding from this source is considered to be **HIGH** and Section 7 discusses the mitigation measures that we would consider need to be applied to manage this potential risk and ensure the development is safe for its lifetime which would reduce the residual risk of flooding even further.

8 MITIGATION MEASURES

8.1 Essential Mitigation Measures

- 8.1.1 The assessment of flood risk in Section 7 of this assessment confirms a **HIGH** risk of flooding from Fluvial / Tidal, sewers and climate change. There is a **LOW** risk of flooding from all other sources including infrastructure failure, groundwater and off site risks.
- 8.1.2 Therefore, there are several essential mitigation measures to be applied as part of the development.
- 8.1.3 Flood depths due to a breach scenario are anticipated to be up to 0.5m based upon the Hazard maps provided by the Environment Agency (EA). Therefore, in line with the EA comments on the South East Lincolnshire SFRA, for depths between 0m and 0.50m, finished floor levels are to be raised 500mm above existing ground levels and flood resilient construction should be considered up to 300mm depth. The minimum finished floor level on this site is 3.525m AOD.
- 8.1.4 Therefore, the finished floor levels of the proposed dwellings are in accordance with the requirements of the Environment Agency and therefore do not require any other flood mitigation measures.
- 8.1.5 Surface water drainage for the site must be designed to accommodate the 1 in 100 year event storm scenarios including a 40% allowance for climate change without any flood waters leaving the development site.

8.2 Recommended Mitigation Measures

- 8.2.1 Permeable tarmac to private driveways and parking areas should be utilised even if infiltration SUDS are not viable as permeable tarmac can be designed into a sealed system before outfall into the drainage ditch to the east of the site. This would form part of a SUDS treatment train in line with CIRIA C753.
- 8.2.2 It is recommended that FFL to properties should be 150mm above external levels.
- 8.2.3 Where external gradients are flat or towards the dwelling entrances, provision of linear drainage should be provided to all access points.

9 CONCLUSIONS

- 9.1 This Flood Risk Assessment serves to review, assess and quantify (where applicable) the sources, or any potential flooding, the pathways of this flooding and potential receptors within the vicinity of the site.
- 9.2 The assessment of flood risk in Section 7 of this assessment confirms a **HIGH** risk of flooding from Fluvial / Tidal, sewers and climate change. There is a **LOW** risk of flooding from adjacent land, infrastructure failure, groundwater and off site.
- 9.3 The mitigation measures will provide further protection to the development and reduce any residual risk (however low) as far as practicable. It is recommended that compliance with the recommendations of this FRA are conditioned as part of any planning permission (unless otherwise agreed in writing at the time of discharge of the planning conditions)
- 9.4 This assessment concludes that the site is suitable for development for residential use without unacceptable risk of flooding from all sources to the site itself and elsewhere for the lifetime of the development.

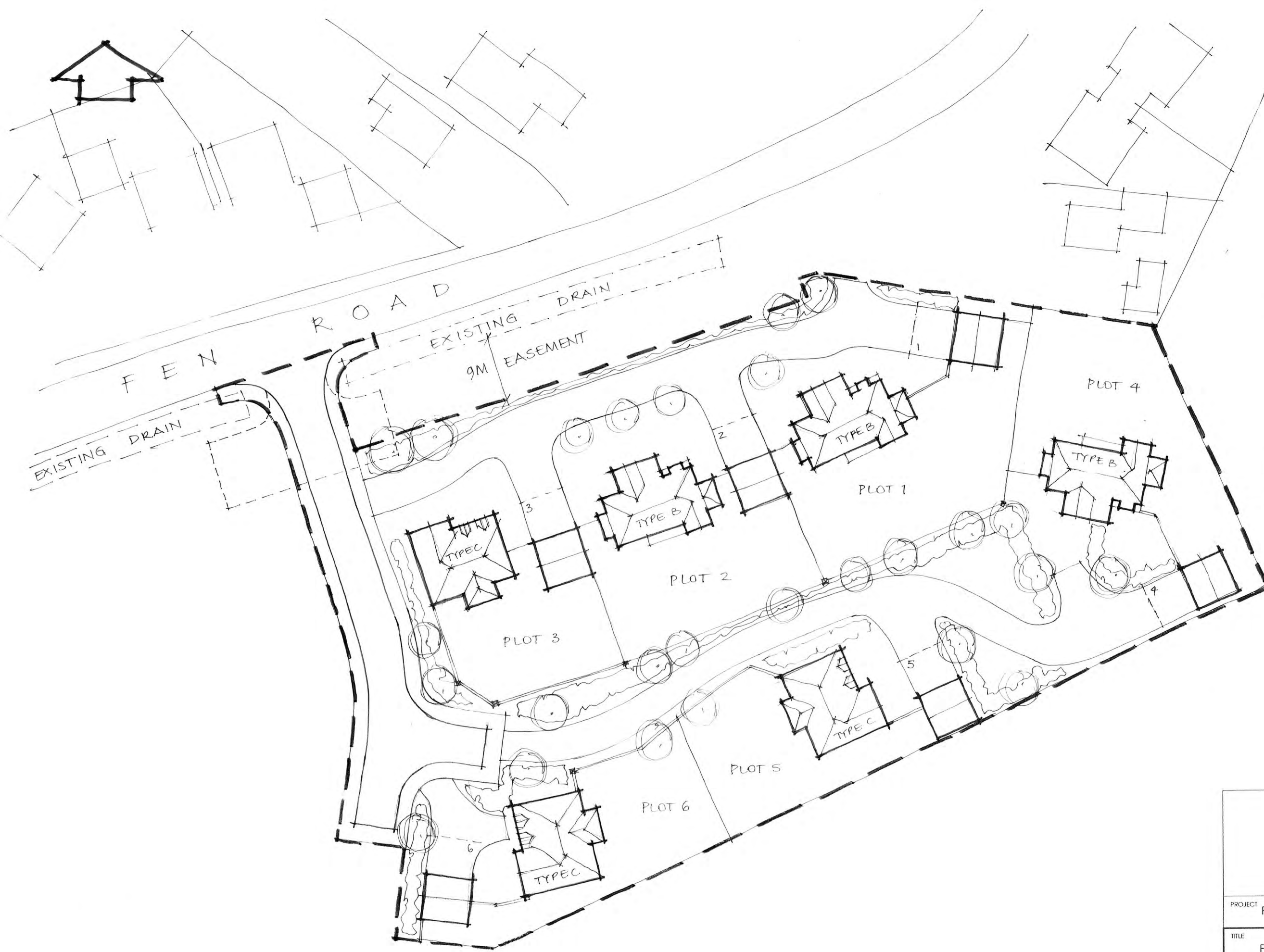
Appendix A – Drawings

Site Layout Plan: 1285-004

Site Plan and Location Plan: MA11267-001

Topographical Survey: AS2344/1

Drainage Strategy: MA11267-200



SCHEDULE		
TYPE B		3no
TYPE C		3
TOTAL		6units

NKW DESIGN

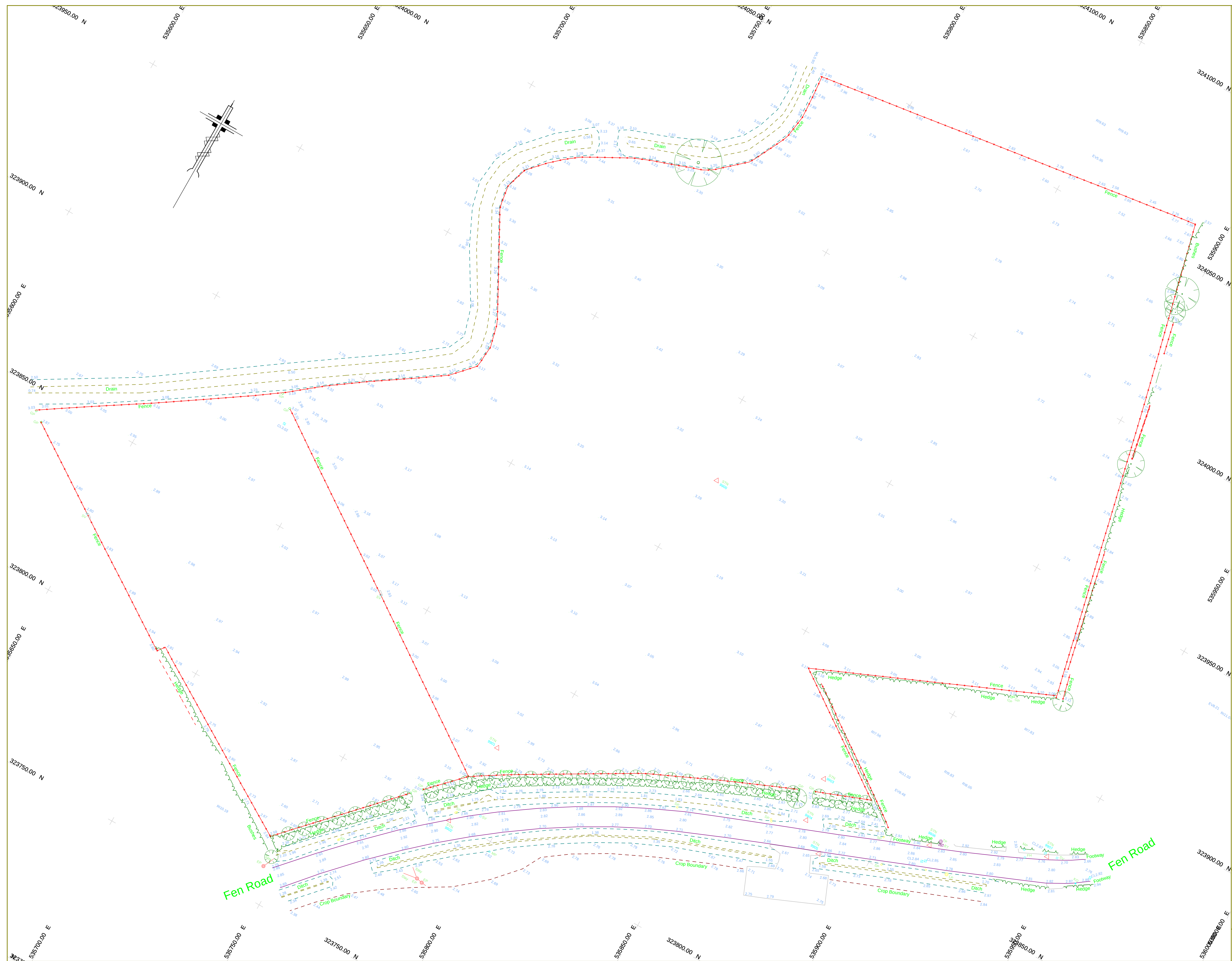
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PROJECT FEN ROAD, HOLBEACH

TITLE
PLANNING LAYOUT

SCALE 1:500 @ A3	DATE MAR 2020	DRAWN NKW
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DRAWING NUMBER 1285-004	REVISION
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KEY:

	BUILDING
	FENCE
	HEDGE
	CHANNEL
	WALL
	BANK EDGE
	STORM DRAINAGE
	FOUL DRAINAGE
	CHANGE OF SURFACE
	OVERHEAD ELECTRIC
	OVERHEAD TELEPHONE
	TREE
	BOREHOLE
	MANHOLE

CONTROL STATION

B	BOLLARD	RE	ROD EYE
BIN	BIN	RI	RIDGE
BT	BRITISH TELECOM	SP	SIGN POST
CR	CROWN CREEP	STAY	STAY
CTV	CABLE TELEVISION	TBM	BENCH MARK
EA	EARTH	TH	THRESHOLD
EL	ELECTRIC BOX	TL	TRAFFIC LIGHT
EP	ELECTRIC POLE	VC	VENT COLUMN
EV	SAVES	TP	TELEGRAPH POLE
FH	FIRE HYDRANT	TS	TRAFFIC SIGNAL
G	GULLY	W	WATER METER
GA	GAS VALVE	VP	VENT PIPE
IC	INSPECTION CHAMBER	WL	WATER LEVEL
IL	INVERT LEVEL	WR	WATER METER
KO	KERB OFFSET	WT	WALL TOP
LP	LAMP POST		
MP	MARKER POST		
PB	POST BOX		

- NOTES:***

 1. Survey plotted to OS National Grid.
 2. All levels related to OS Datum.
 3. GPS/GLONASS ETRS89 observations transformed to OSG836 using OSTN02 Transformation.
 4. ETRS89 ellipsoid heights converted to heights above mean sea level using National Geoid Model OSGM02.

Initial Survey Date:	4 JUL 2018
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[illegible]

Rev:	<i>Amendments:</i>	<i>Date:</i>

Client:

ASHWOOD HOMES

Project Title:

**FEN ROAD
HOLBEACH
LINCOLNSHIRE**

Drawing Title:

UGL SURVEY

Scale: 1:500	Date: 10 JUL 2018
Drawing No: AS2344/1	Rev: A1
C.A.D. Title: ASHWOODHOLBEACH040718	
Drawn By: D.J.SMITH	

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ASSOCIATED DRAWINGS	
No.	TITLE

NOTES	

REV	DATE	BY	DETAILS	CHKD
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AMENDMENTS	

CLIENT	
Finsbury Design Ltd	

PROJECT	Fen Road, Holbeach Lincolnshire
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TITLE	Site Location Plan
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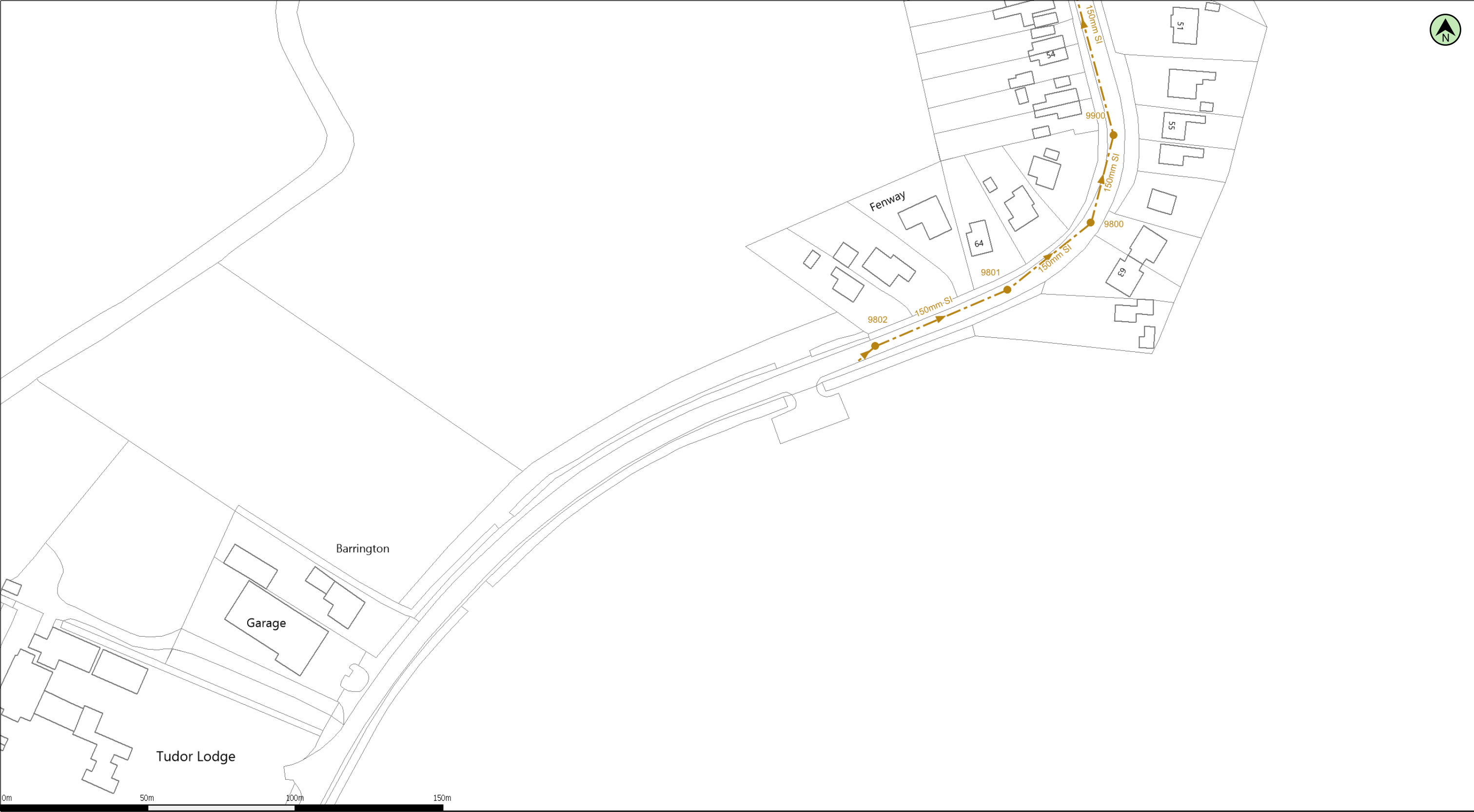
DRAWING No:	MA11267-001	DRAWING STATUS	PRELIMINARY
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SCALE	1:200@A1	DRAWN	CMN	ENGINEER	CMN
DATE	25/03/20	CHECKED	JMcK	APPROVED BY	JMcK



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(c) Crown copyright and database rights 2018 Ordnance Survey 100022432 Date: 26/01/18 Scale: 1:1250 Map Centre: 535857,323836 Data updated: 04/01/18 Our Ref: 250783 - 1 Wastewater Plan A3

This plan is provided by Anglian Water pursuant its obligations under the Water Industry Act 1991 sections 198 or 199. It must be used in conjunction with any search results attached. The information on this plan is based on data currently recorded but position must be regarded as approximate. Service pipes, private sewers and drains are generally not shown. Users of this map are strongly advised to commission their own survey of the area shown on the plan before carrying out any works. The actual position of all apparatus MUST be established by trial holes. No liability whatsoever, including liability for negligence, is accepted by Anglian Water for any error or inaccuracy or omission, including the failure to accurately record, or record at all, the location of any water main, discharge pipe, sewer or disposal main or any item of apparatus. This information is valid for the date printed. This plan is produced by Anglian Water Services Limited (c) Crown copyright and database rights 2018 Ordnance Survey 100022432. This map is to be used for the purposes of viewing the location of Anglian Water plant only. Any other uses of the map data or further copies is not permitted. This notice is not intended to exclude or restrict liability for death or personal injury resulting from negligence.

Foul Sewer					
Surface Sewer		Outfall*		Sewage Treatment Works	
Combined Sewer				Public Pumping Station	
Final Effluent		Inlet*		Decommissioned Pumping Station	
Rising Main*					
Private Sewer*		Manhole*			
Decommissioned Sewer*					

*(Colour denotes effluent type)

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Appendix B – Consultations

South East Lincolnshire SFRA Mapping Surface Water Calculations

The Millward Partnership		Page 1
1 Malin Hill Nottingham NG1 1JQ	Fen Road Holbeach 6 Dwellings SWS Planning	
Date 25/03/2020 15:06 File MA11267-SWS-Planning Re...	Designed by JMcK Checked by	
XP Solutions	Network 2017.1.2	

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Storm

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - England and Wales			
Return Period (years)	2	PIMP (%)	100
M5-60 (mm)	19.000	Add Flow / Climate Change (%)	0
Ratio R	0.418	Minimum Backdrop Height (m)	0.000
Maximum Rainfall (mm/hr)	50	Maximum Backdrop Height (m)	20.000
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

Time Area Diagram for Storm

Time (mins)	Area (ha)	Time (mins)	Area (ha)
0-4	0.231	4-8	0.090

Total Area Contributing (ha) = 0.321

Total Pipe Volume (m³) = 4.132

Network Design Table for 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
S1.000	21.456	0.215	99.8	0.095	5.00	0.0	0.600	o	150	Pipe/Conduit	
S1.001	14.512	0.073	198.8	0.068	0.00	0.0	0.600	o	300	Pipe/Conduit	
S1.002	18.123	0.091	199.2	0.017	0.00	0.0	0.600	o	300	Pipe/Conduit	
S2.000	10.617	0.107	99.2	0.117	5.00	0.0	0.600	o	150	Pipe/Conduit	
S1.003	13.730	0.069	199.0	0.013	0.00	0.0	0.600	o	300	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	I.Area (ha)	Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S1.000	50.00	5.36	2.317	0.095	0.0	0.0	0.0	1.01	17.8	12.8
S1.001	50.00	5.57	1.952	0.163	0.0	0.0	0.0	1.11	78.6	22.0
S1.002	50.00	5.85	1.879	0.179	0.0	0.0	0.0	1.11	78.5	24.3
S2.000	50.00	5.18	2.045	0.117	0.0	0.0	0.0	1.01	17.8	15.9
S1.003	50.00	6.05	1.788	0.310	0.0	0.0	0.0	1.11	78.5	42.0

The Millward Partnership		Page 3
1 Malin Hill Nottingham NG1 1JQ	Fen Road Holbeach 6 Dwellings SWS Planning	
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Manhole Schedules for Storm

MH Name	MH CL (m)	MH Depth (m)	MH Connection	MH Diam., L*W (mm)	PN	Pipe Out Invert Level (m)	Diameter (mm)	PN	Pipes In Invert Level (m)	Diameter (mm)	Backdrop (mm)
S1	3.425	1.108	Open Manhole	600	S1.000	2.317	150				
S2	3.445	1.493	Open Manhole	1500	S1.001	1.952	300	S1.000	2.102	150	
S3	3.370	1.491	Open Manhole	1500	S1.002	1.879	300	S1.001	1.879	300	
S4	3.550	1.505	Open Manhole	600	S2.000	2.045	150				
S5	3.280	1.492	Open Manhole	1500	S1.003	1.788	300	S1.002	1.788	300	
								S2.000	1.938	150	
S6	3.210	1.491	Open Manhole	1500	S1.004	1.719	300	S1.003	1.719	300	
S7	2.750	1.052	Open Manhole	0		OUTFALL		S1.004	1.698	300	

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PIPELINE SCHEDULES for Storm

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
S1.000	o	150	S1	3.425	2.317	0.958	Open Manhole	600
S1.001	o	300	S2	3.445	1.952	1.193	Open Manhole	1500
S1.002	o	300	S3	3.370	1.879	1.191	Open Manhole	1500
S2.000	o	150	S4	3.550	2.045	1.355	Open Manhole	600
S1.003	o	300	S5	3.280	1.788	1.192	Open Manhole	1500
S1.004	o	300	S6	3.210	1.719	1.191	Open Manhole	1500

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
S1.000	21.456	99.8	S2	3.445	2.102	1.193	Open Manhole	1500
S1.001	14.512	198.8	S3	3.370	1.879	1.191	Open Manhole	1500
S1.002	18.123	199.2	S5	3.280	1.788	1.192	Open Manhole	1500
S2.000	10.617	99.2	S5	3.280	1.938	1.192	Open Manhole	1500
S1.003	13.730	199.0	S6	3.210	1.719	1.191	Open Manhole	1500
S1.004	4.077	194.1	S7	2.750	1.698	0.752	Open Manhole	0

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Setting Out Information - Site Coordinates (Storm)

PN	USMH Name	Dia/Len (mm)	Width (mm)	US Easting (m)	US Northing (m)	Layout (North)
S1.000	S1	600		535913.352	323791.567	
S1.001	S2	1500		535891.898	323791.863	
S1.002	S3	1500		535890.000	323806.250	
S2.000	S4	600		535893.547	323825.970	
S1.003	S5	1500		535883.326	323823.099	
S1.004	S6	1500		535878.760	323836.048	
PN	DSMH Name	Dia/Len (mm)	Width (mm)	DS Easting (m)	DS Northing (m)	Layout (North)
S1.004	S7	0		535874.901	323837.360	

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Area Summary for Storm

Pipe Number	PIMP Type	PIMP Name	PIMP (%)	Gross Area (ha)	Imp. Area (ha)	Pipe Total (ha)
1.000	User	-	100	0.053	0.053	0.053
	User	-	100	0.013	0.013	0.067
	User	-	100	0.007	0.007	0.074
	User	-	100	0.007	0.007	0.081
	User	-	100	0.013	0.013	0.095
1.001	User	-	100	0.030	0.030	0.030
	User	-	100	0.010	0.010	0.040
	User	-	100	0.014	0.014	0.054
	User	-	100	0.014	0.014	0.068
1.002	User	-	100	0.017	0.017	0.017
2.000	User	-	100	0.046	0.046	0.046
	User	-	100	0.013	0.013	0.058
	User	-	100	0.012	0.012	0.070
	User	-	100	0.014	0.014	0.084
	User	-	100	0.011	0.011	0.095
	User	-	100	0.014	0.014	0.109
	User	-	100	0.008	0.008	0.117
1.003	User	-	100	0.013	0.013	0.013
1.004	User	-	100	0.011	0.011	0.011
				Total	Total	Total
				0.321	0.321	0.321

Surcharged Outfall Details for Storm

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
---------------------	--------------	--------------	--------------	------------------	----------	--------

S1.004 S7 2.750 1.698 1.690 0 0

Datum (m) 1.690 Offset (mins) 0

Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)
720	1.000	2880	1.000	5040	1.000	7200	1.000	9360	1.000
1440	1.000	3600	1.000	5760	1.000	7920	1.000	10080	1.000
2160	1.000	4320	1.000	6480	1.000	8640	1.000		

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<u>Simulation Criteria for Storm</u> Volumetric Runoff Coeff 0.750 Additional Flow - % of Total Flow 6.000 Areal Reduction Factor 1.000 MADD Factor * 10m³/ha Storage 0.000 Hot Start (mins) 0 Inlet Coefficient 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 <u>Synthetic Rainfall Details</u> Rainfall Model FSR Profile Type Summer Return Period (years) 2 Cv (Summer) 0.750 Region England and Wales Cv (Winter) 0.840 M5-60 (mm) 19.000 Storm Duration (mins) 30 Ratio R 0.418		
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Online Controls for Storm

Hydro-Brake® Optimum Manhole: S6, DS/PN: S1.004, Volume (m³): 3.5

Unit Reference	MD-SHE-0103-5000-1200-5000
Design Head (m)	1.200
Design Flow (l/s)	5.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	103
Invert Level (m)	1.719
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.200	5.0
Flush-Flo™	0.354	5.0
Kick-Flo®	0.745	4.0
Mean Flow over Head Range	-	4.4

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	3.4	1.200	5.0	3.000	7.7	7.000	11.5
0.200	4.7	1.400	5.4	3.500	8.3	7.500	11.8
0.300	5.0	1.600	5.7	4.000	8.8	8.000	12.2
0.400	5.0	1.800	6.0	4.500	9.3	8.500	12.6
0.500	4.9	2.000	6.3	5.000	9.8	9.000	12.9
0.600	4.7	2.200	6.6	5.500	10.2	9.500	13.3
0.800	4.1	2.400	6.9	6.000	10.7		
1.000	4.6	2.600	7.2	6.500	11.1		

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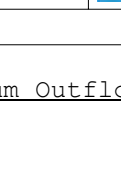
Storage Structures for Storm

Porous Car Park Manhole: S1, DS/PN: S1.000

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	4.0
Membrane Percolation (mm/hr)	1000	Length (m)	134.0
Max Percolation (l/s)	148.9	Slope (1:X)	500.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	2.317	Membrane Depth (mm)	200

Porous Car Park Manhole: S4, DS/PN: S2.000

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	4.0
Membrane Percolation (mm/hr)	1000	Length (m)	114.0
Max Percolation (l/s)	126.7	Slope (1:X)	500.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	2.037	Membrane Depth (mm)	200

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1 year Return Period Summary of Critical Results by Maximum Outflow (Rank 1) for Storm

Simulation Criteria

Areal Reduction Factor 1.000	Additional Flow - % of Total Flow 6.000
Hot Start (mins) 0	MADD Factor * 10m³/ha Storage 0.000
Hot Start Level (mm) 0	Inlet Coeffiecient 0.800
Manhole Headloss Coeff (Global) 0.500	Flow per Person per Day (1/per/day) 0.000
Foul Sewage per hectare (1/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 0.418
Region England and Wales Cv (Summer)	0.750	
M5-60 (mm)	19.000 Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	450.0
Analysis Timestep 2.5 Second Increment (Extended)	
DTS Status	OFF
DVD Status	OFF
Inertia Status	OFF

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, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
S1.000	S1	30 Winter	1	+0%	1/960 Summer				2.387
S1.001	S2	30 Winter	1	+0%	1/15 Winter				2.273
S1.002	S3	30 Winter	1	+0%	1/15 Summer				2.263
S2.000	S4	30 Summer	1	+0%	1/30 Winter				2.188
S1.003	S5	30 Summer	1	+0%	1/15 Summer				2.232
S1.004	S6	5760 Summer	1	+0%	1/15 Summer				2.617

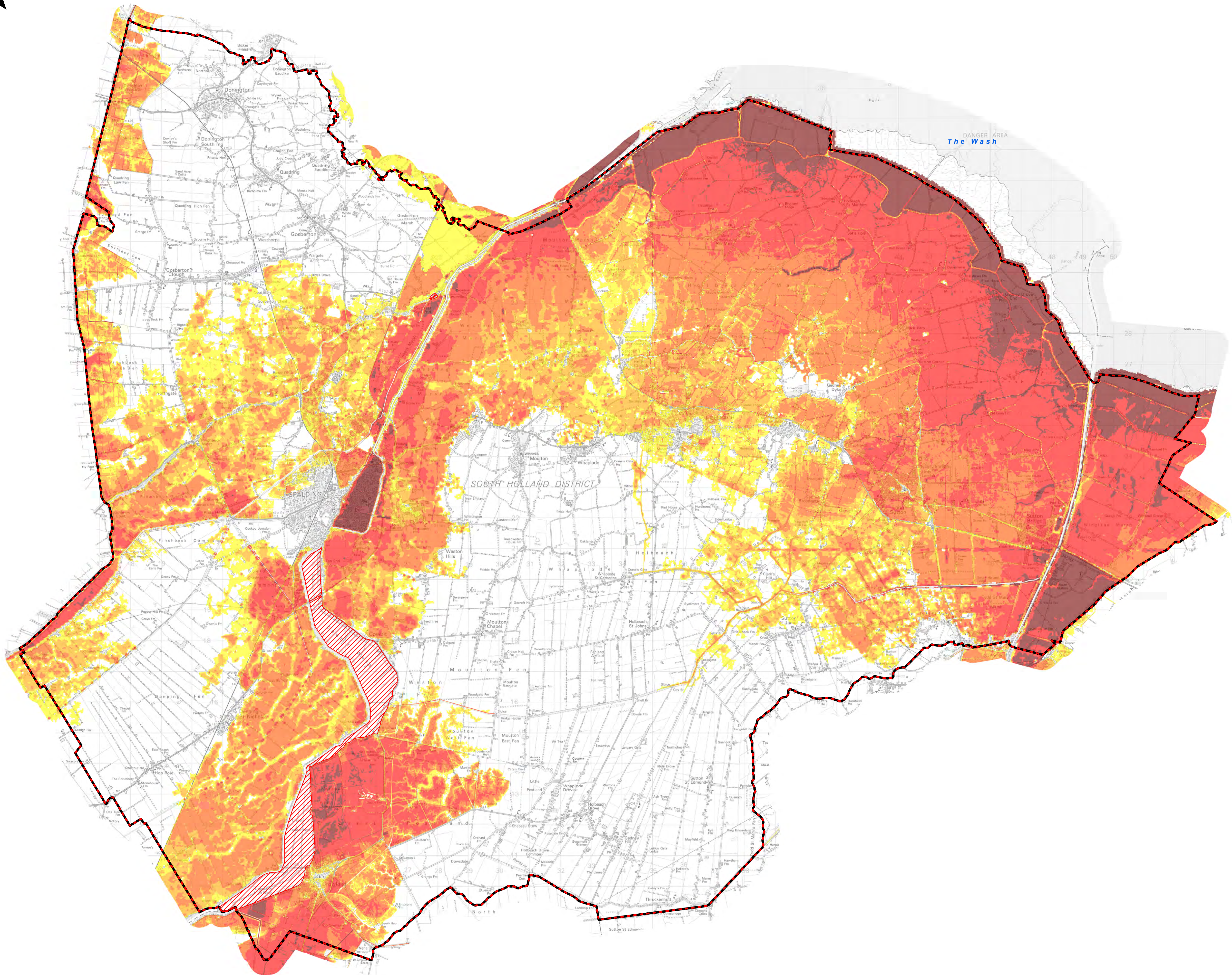
PN	US/MH Name	Depth (m)	Volume (m³)	Flow / Cap.	Overflow (1/s)	Pipe Flow (1/s)	Status	Level Exceeded
S1.000	S1	-0.080	0.000	0.44		7.4	OK	
S1.001	S2	0.021	0.000	0.18		11.7	SURCHARGED	
S1.002	S3	0.084	0.000	0.19		12.6	SURCHARGED	
S2.000	S4	-0.007	0.000	0.50		8.0	OK	
S1.003	S5	0.144	0.000	0.13		8.6	SURCHARGED	

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30 year Return Period Summary of Critical Results by Maximum Outflow (Rank 1) for Storm

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Overflow Cap. (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
S1.004	S6	0.412	0.000	0.10	5.0	SURCHARGED	



NOTES

1. The potential flooding consequences shown on this map primarily relate to flooding from the sea and main rivers taking into account the presence of current flood risk management measures such as flood defences.
2. This update only included new flood risk information from River Welland (Fluvial), River Glen (Fluvial) and Tidal hazard mapping (River Welland, River Nene and the Wash sea defences). No new information from the Internal Drainage Boards and associated systems was used for this update.
3. In addition to the potential flood extents shown on this map, there may be shallow flooding in low-lying rural areas
4. The consequences designated as being a Residual Risk arise from direct overtopping of defences, where this would occur, together with breach failure which is assumed could occur at any point along the defences.
5. Functional Floodplain encompasses areas where water is intended to flow or be stored in times of flood.
6. Land outside South Holland District is not considered.
7. This map shows the extents only of the flooding probability bands relevant to the map Title

Map Legend

Peak Depth	
0m - 0.25m	
0.25m - 0.5m	
0.5m - 1m	
1m - 2m	
2m +	
Functional Floodplain	
South Holland District Boundary	

2	Feb 17	Modelling and Mapping Update
1	Dec 16	Modelling and Mapping Update
REV	DATE	REMARKS

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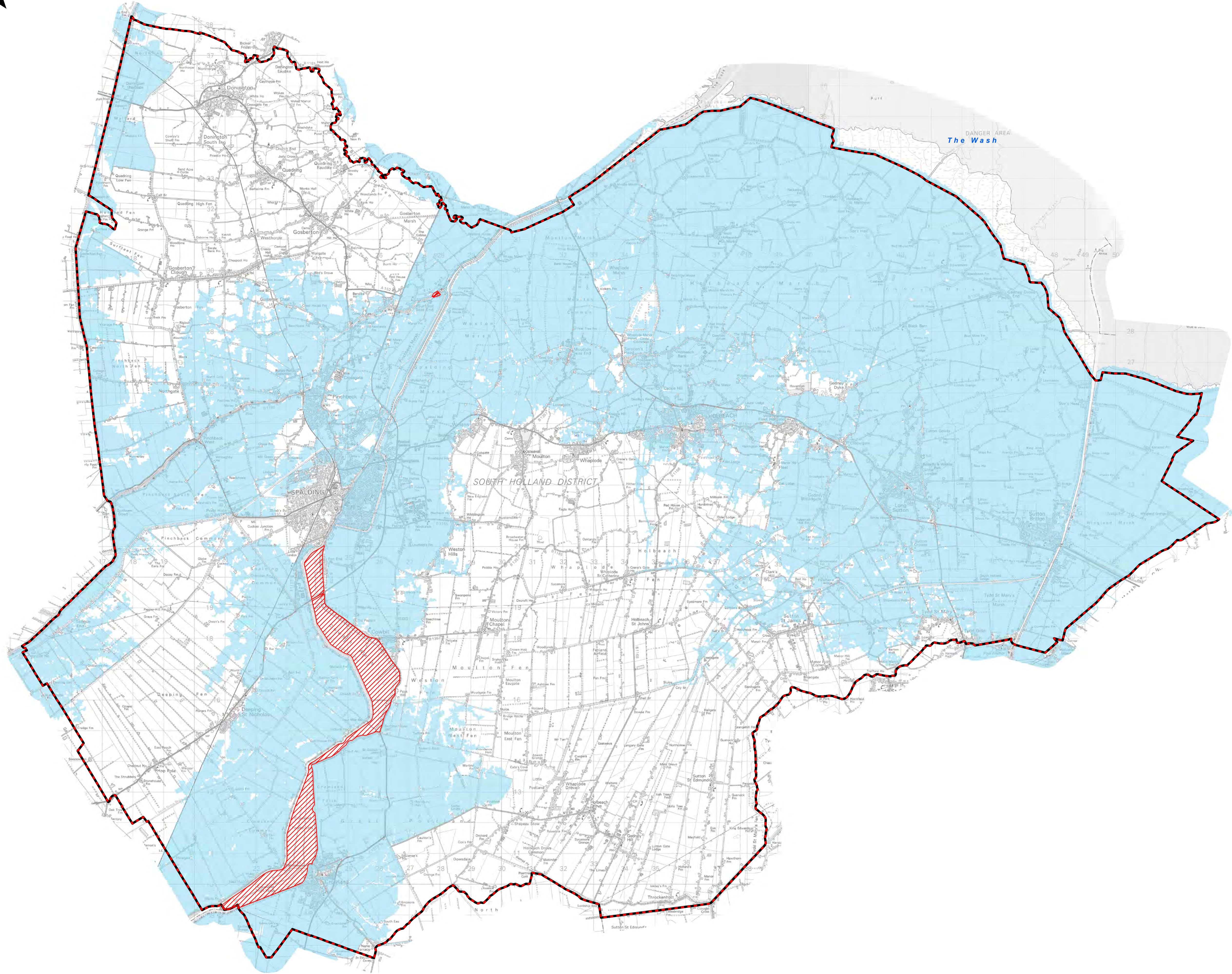


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UPDATE OF STRATEGIC
FLOOD RISK ASSESSMENT

Residual Peak Depth
District - Year 2115
1% Fluvial / 0.5% Tidal Event Probability

DATE OF ISSUE: Feb 2017	REV NO: 2
SCALE: 1 : 60,000 @ A1	MAP NO:



NOTES

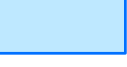
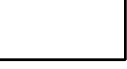
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4. The consequences designated as being a Residual Risk arise from direct overtopping of defences, where this would occur, together with breach failure which is assumed could occur at any point along the defences.
5. The potential flooding consequences relate to flood probability bandings as follows:

Probability Band	Annual probability of Flooding	
	from a river (fluvial)	from the sea (tidal)
Low	<0.1%	<0.1%
Medium	1%-0.1%	0.5%-0.1%
High	>1%	>0.5%

6. Functional Floodplain encompasses areas where water is intended to flow or be stored in times of flood.
7. Land outside South Holland District is not considered.
8. This map shows the extents only of the flooding probability bands relevant to the map Title

Map Legend

Flooding Probability bands :

- High 
- Low or medium, but reliant on protection by flood defences for this standard 
- Functional Floodplain 
- South Holland District Boundary 

2	Feb 17	Modelling and Mapping Update
1	Dec 16	Modelling and Mapping Update
REV	DATE	REMARKS

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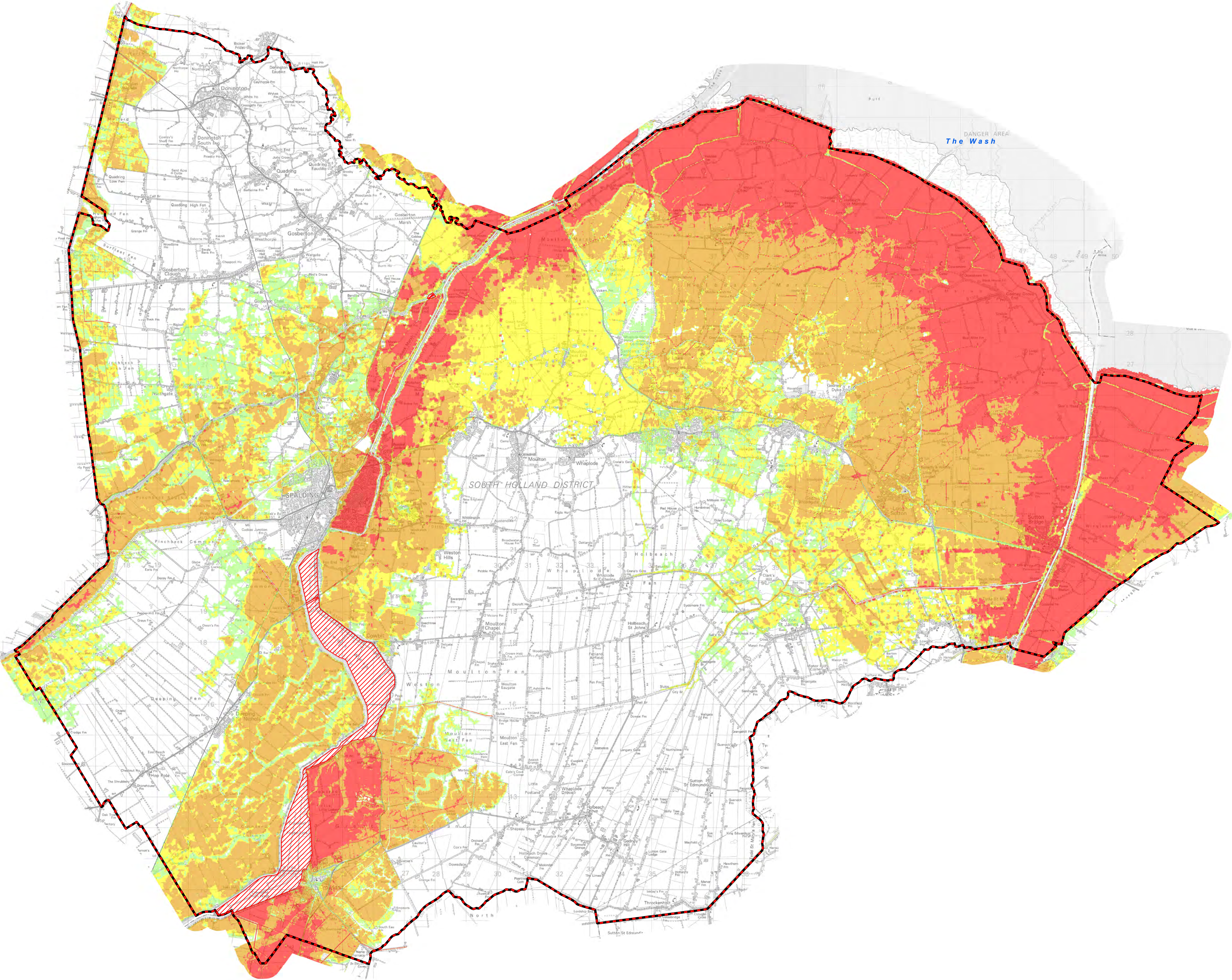
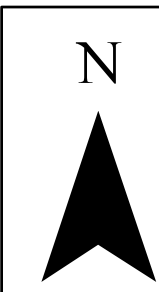
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UPDATE OF STRATEGIC
FLOOD RISK ASSESSMENT
Residual Risk Extent
District - Year 2115
1% Fluvial / 0.5% Tidal Event Probability

DATE OF ISSUE: Feb 2017	REV NO: 2
SCALE: 1 : 60,000 @ A1	MAP NO:



NOTES

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6. Land outside South Holland District is not considered.
7. This map shows the extents only of the flooding probability bands relevant to the map Title

Map Legend

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)	

Functional Floodplain

South Holland District Boundary

2	Feb 17	Modelling and Mapping Update
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UPDATE OF STRATEGIC
FLOOD RISK ASSESSMENT

Residual Flood Hazard
District - Year 2115
1% Fluvial / 0.5% Tidal Event Probability

DATE OF ISSUE: Feb 2017	REV NO: 2
SCALE: 1 : 60,000 @ A1	MAP NO: