ROSCONN STRATEGIC LAND

PROPOSED RESIDENTIAL DEVELOPMENT AT:

LAND OFF RUSH LANE, ELSENHAM

FLOOD RISK ASSESSMENT AND DRAINAGE STRATEGY

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1.0 INTRODUCTION

1.1 Commission

1.1.1 Travis Baker Limited have been commissioned by Rosconn Strategic Land, to prepare a Flood Risk Assessment (FRA) to be submitted with a planning application for the proposed development off Rush Lane, Elsenham.

1.2 Background

1.2.1 The proposal is for the construction of upto 40 new residential dwellings plus associated roads and infrastructure. The application site is an allocated residential site within Uttlesford District Council Local Plan to 2033 dated March 2017.

1.2.2 In accordance with current Environment Agency guidelines, an FRA must be undertaken for all sites over one hectare, located within in flood zone 1 and any site located in flood zone 2 or greater. The FRA must demonstrate the development will be safe for its proposed lifetime. A suitable FRA will also consider the risk of flooding from sources other than fluvial or tidal and make an assessment of the potential of the proposed development to increase flooding elsewhere through changes in the generation and management of surface water.

1.2.3 This document is based on the best available and most up to date flood risk information provided by the Environment Agency. The Environment Agency's Flood Zone Map, an extract of which is reproduced in Figure 2, shows the site to be located in Flood Zone 1.

1.2.4 Areas located within Flood Zone 1 are classified as 'low risk' of flooding from fluvial or tidal sources and have an associated annual probability of flooding of less than 0.1% (1 in 1000) in any year.

1.3 Flood Risk Assessment Methodology

1.3.1 The aim of an FRA is to assess the risks of all forms of flooding to and from a development. The Environment Agency emphasises the need for a risk based approach to be adopted by Local Planning Authorities through the application of the Source-Pathway-Receptor model. Travis Baker's approach to a flood risk assessment is based on the Source-Pathway-Receptor model.

1.3.2 The Source-Pathway-Receptor model firstly identifies the causes or 'sources' of flooding to and from a development. The identification is based on a review of local conditions and consideration of the effects of climate change. The nature and likely extent of flooding arising from any one source is considered, eg whether such flooding is likely to be localised or widespread.

1.3.3 The presence of a flood source does not always imply a risk. The exposure pathway or 'flooding mechanism' determines the risk to the receptor and the effective consequence of exposure. For example, the presence of a sewer does not necessarily increase the risk of flooding unless the sewer is local to the site and ground levels encourage surcharged water to accumulate.

1.3.4 The varying effect of flooding on the 'receptors' depends largely on the sensitivity of the target. Receptors include any people or buildings within the range of the flood source, which are connected to the source by a pathway.

1.3.5 In order for there to be a flood risk all the elements of the model must be present. Furthermore, effective mitigation can be provided by removing one element of the model, for example by removing the pathway or receptor.

1.3.6 A desk based review of available information has been undertaken to establish the likely flooding sources and mechanisms for the site. Once the flood risk has been established, mitigation measures are proposed (where necessary) and residual risks explained.

1.4 Aims and Objectives

The aims and objectives of this FRA are as follows:

- Collect and review existing flood risk data including topographical data, surface water drainage strategy, public sewerage records, ground investigation report, scheme proposals and any relevant Strategic Flood Risk Assessments;
- Assess and interpret available information to identify potential sources of flood risk including groundwater, sewers, surface water and infrastructure failure;
- Summarise the proposed surface water drainage strategy to demonstrate that surface water from the site can be managed in a sustainable manner, including appropriate allowances for climate change;
- Provide recommendations for appropriate flood risk mitigation measures (where applicable);
- Produce an FRA to accompany the planning application for the proposed development.

1.5 Sources of Information

1.5.1 The following information has been used to inform the flood study:

- JCN Development Layout BW289a-PL-02
- Beacon Land Surveys Topographical Survey 18-106-01
- Environment Agency (EA) Flood mapping data
- Uttlesford Strategic Flood Risk Assessment May 2016
- Thames Water Sewer Records

1.6 Consultees

Organisations consulted during the preparation of this report have included:

- Wastewater Services – Thames Water Ltd (TW)

2.0 SITE SETTING

2.1 Site Description

2.1.1 The site is accessed off Rush Lane to the north of the site. The site is approximately 2.28Ha in size and is currently agricultural pasture land. The northern, western and eastern boundary is bordered by other residential properties, whilst land to the south is bounded by the West Anglian Main Line and the Stansted Brook.

2.1.2 The site location plan below identifies the site in context with its surrounding.

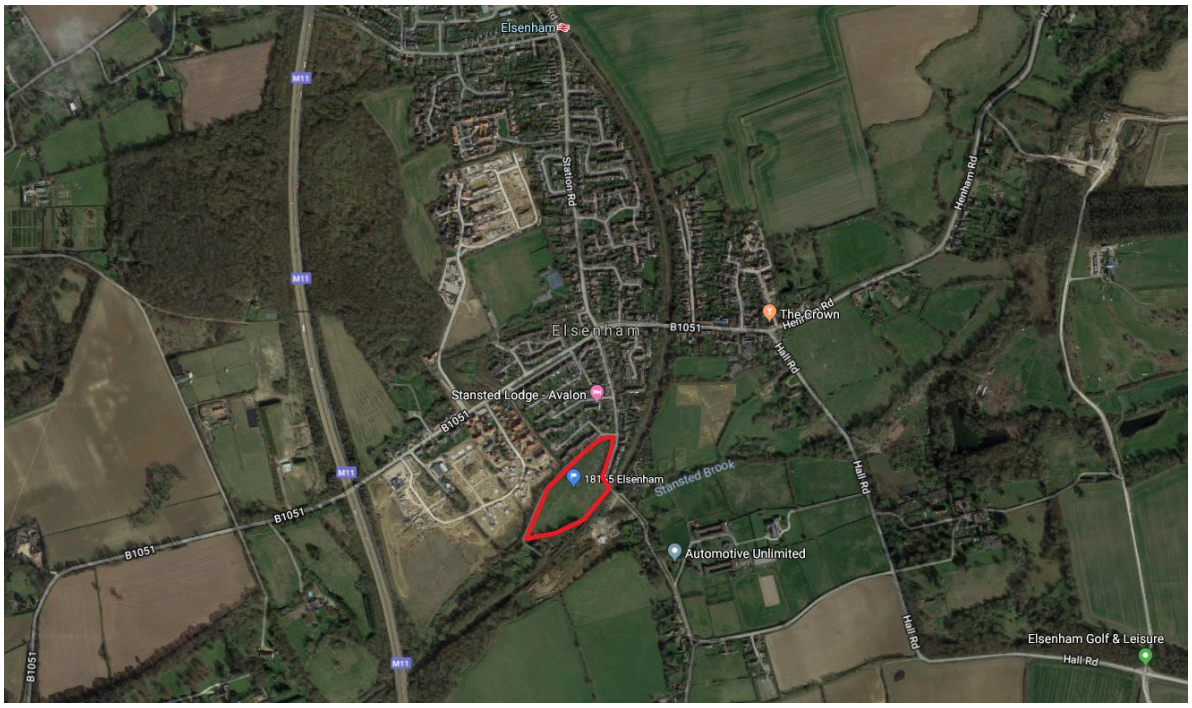

Figure 1 - Site Location Plan

2.2 Topography

2.2.1 A site specific topographical survey has been undertaken and is included within Appendix II of the report. The site falls generally from the north to the south westerly direction, with the lowest ground level at the furthest south western point.

2.3 Local Drainage Features

2.3.1 There are no known surface water drainage features within the application site. The aforementioned Stansted Brook is located along part of the southern boundary of the site and leads to the River Stort in Stansted Mountfitchet.

2.4 Proposed Development

2.4.1 The proposal is for the construction of upto 40 new residential dwellings. The scheme involves formation of a new access off Robin Hood Road and new estate roads to serve the new properties. A copy of the Illustrative Masterplan for the development site is included as Appendix I of the report.

3.0 FLOOD RISK PLANNING POLICY

3.1 National Planning Policy Framework (NPPF)

3.1.1 The NPPF sets out the government's national planning policy for consideration of aspects of flood risk for new developments. To support the NPPF, a technical guidance document as also been published to ensure the NPPF is effectively implemented.

3.1.2 The technical guidance document classifies different forms of development into higher or lower levels of vulnerability depending on the perceived consequences of being flooded. Policy outlines the types of development that may be permitted in areas of differing levels of flood risk. Details of the vulnerability classification for different types of development are listed below.

Vulnerability Classification	Development Type
Essential Infrastructure	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 electricity generating power stations and grid and primary substations; and water treatment works that need to remain operational in times of flood. • Wind turbines.
Highly Vulnerable	Police stations, ambulance stations and fire stations and command centres and 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	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	Police, ambulance and fire stations which are not required to be operational during flooding. • Buildings used for shops, financial, professional and other services, restaurants and cafes, hot food takeaways, offices, general industry, storage and distribution, non–residential institutions not included in "more vulnerable", 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).
Water Compatible	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 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 • Essential ancillary sleeping or residential accommodation for staff required by uses in this category, subject to a specific warning and evacuation plan.

3.2 Sequential Test and Exceptional Test

3.2.1 The Sequential Test is designed to steer new development to areas with the lowest probability of flooding. The exercise compares the Flood Zone of the development area (as discussed in Section 1) against the vulnerability classification of the type of development.

3.2.2 The vulnerability classifications previously outlined indicates that the development type can be classified as 'More Vulnerable'.

3.2.3 The following table summarises the types of development that can be considered appropriate for any given Flood Zone.

	Vulnerability Classification	Essential Infrastructure	Water Compatible	Highly Vulnerable	More Vulnerable	Less Vulnerable
Flood Zone	**Zone 1**	√	√	√	√	√
	Zone 2	√	√	Exception Test required	√	√
	Zone 3a	Exception Test required	√	x	Exception Test required	√
	Zone 3b	Exception Test required	√	x	x	x

√ Appropriate development
x Development should not be permitted

3.2.4 As the site is classed as More Vulnerable and located within Flood Zone 1 it can be considered as appropriate for development. Therefore, the requirement to undertake the Sequential Test and Exceptional Test need not apply.

Figure 2 - Flood Zone Map

4.0 FLOOD RISK – TO DEVELOPMENT

4.1 Fluvial Flood Risk

4.1.1 Current guidance requires that all potential sources of flooding that could affect the proposed development are considered. The current Environment Agency's Flood Zone Map for the site, provided as Figure 2 within the report, indicates that the site lies within Flood Zone 1. The definitions of each zone are outlined in table 4-1.

Table 4-1: Flood Zone Definitions

Flood Zone Definitions		
Flood Zone 1	Low Probability – less than 1 in 1000 annual probability of river or coastal flooding	Appropriate for all land uses
Flood Zone 2	Medium Probability – between 1in 100 and 1 in 1000 annual probability or river flooding or 1 in 200 and 1 in 1000 annual probability of coastal flooding	Essential infrastructure and the water-compatible, less vulnerable and more vulnerable uses are appropriate in this zone. The highly vulnerable uses are only appropriate in this zone if the Exception Test is passed.
Flood Zone 3a	High Probability – having a greater than 1 in 100 year annual probability of river flooding or 1 in 200 year probability of coastal flooding.	The water-compatible and less vulnerable uses of land are appropriate in this zone. The highly vulnerable uses should not be permitted in this zone. The more vulnerable uses and essential infrastructure should only be permitted in this zone if the Exception Test is passed. Essential infrastructure permitted in this zone should be designed and constructed to remain operational and safe for users in times of flood.
Flood Zone 3b	Functional Floodplain - having a greater than 1 in 20 year annual probability of river flooding or 1 in 200 year probability of coastal flooding	Only the water-compatible uses and essential infrastructure that has to be there should be permitted in this zone. It should be designed and constructed to: • 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. Essential infrastructure in this zone should pass the Exception Test.

4.1.2 As the site has probability of annual flooding from fluvial sources of less than 1 in 1000 or 0.1%. The site can be considered to be at a very low risk.

4.2 Tidal Flood Risk

4.2.1 As the site is not coastal or in a low lying area, the risks of tidal flooding have been discounted for the purposes of this assessment.

4.3 Pluvial Flood Risk

4.3.1 In assessing the flood risk to development site, consideration shall be given to the risk of flooding from overland run-off in the event that the local drainage networks capacity is exceeded.

4.3.2 Figure 3 below indicates the perceived risk to the site based on pluvial flood map data obtained from the Environment Agency. The extract indicates that there is very minimal overland flood routes along the south eastern boundary. However, as this area of land is outside the perceived developable area, the pluvial flood risk is considered to be low.

Figure 3 - Extract from EA Surface Water Flood Maps

4.4 Groundwater Flood Risk

4.4.1 Sites susceptible to flooding from groundwater after prolonged or intensive bouts of rain are likely to be in low lying areas, overly aquifers or on steeply sloped sites prone to groundwater seepage.

4.4.2 Uttlesford District Council Strategic Flood Risk Assessment assessed the current flood risk based on the Areas Susceptible to Ground Water Flooding (AStGWF) dataset supplied by the Environment Agency. The SFRA indicates groundwater flood risk within at varying levels across the Elsenham area. The site lies within the southern area of Elsenham which is regard as high risk to groundwater flooding (50% - 75% chance of emergence) and stipulates that further evidence should be sought to assess the flood risk.

4.4.3 BGS borehole data obtained under Open Government License records a number of deep boreholes scattered in the surrounding area from the development site. Underlying materials were consistent across the samples, recorded banded layers of gravel and sands and clays. Groundwater was not encountered in any of the surrounding boreholes, some of which were bored at depths exceeding 35m.

4.4.4 As the site is neither steeply sloping or low lying, the risk of groundwater flooding is considered to be low.

4.5 Flood Risk from Artificial Sources

4.5.1 Artificial flood sources included raised channels such as canals or storage features such as ponds and reservoirs. Flood Data obtained from the EA indicate that the site is not at risk in the event of a catastrophic failure of any artificial waterbody.

4.5.2 Flood data for reservoirs breaches is prepared by the EA and indicates the worst case flood extent in the case of catastrophic failure although reservoirs are well maintained and breaches are extremely rare. Given the above, the risk of flooding from reservoirs is considered to be extremely low.

4.6 Flood Risk from Sewers

4.6.1 Uttlesford SFRA indicates a historic sewer flood incident from a postcode local to the site. However, for data protection reasons, the report cannot specifically identify the flood source, its date of occurrence, its extent or whether the issue has been resolved by the water company.

4.6.2 Modern drainage systems are designed to accommodate the 1 in 30 year annual probability storm event, therefore in any storms greater than this sewers can be expected to surcharge. However, older sewer systems were not subject to these design standards (introduced by Sewers for Adoption) and the risk of flooding from such systems is difficult to quantify.

4.6.3 Thames Water (TW) is responsible for the management of urban drainage and sewerage within the Elsenham area. Details of specific flooding incidents on the public sewerage network cannot be obtained as part of data gathering for Site Specific Flood Risk Assessments due to the rights of the affected property owners being respected under the terms of the Data Protection Act. That said, it is important to highlight that this is not a measure of risk, and sewer failure may occur at any point within the underground system. It is highlighted that issues associated with failures of the underground drainage/sewer systems are often relatively localised and should not preclude development.

4.6.4 Pre-development enquiries have been made to TW to ascertain the extent of the public sewer network across the site and in the surrounding area and whether the current network has capacity to accept the anticipated development flows. TW have not highlighted any known sewer flooding issues that might impact upon the development. The flood risk from sewers is therefore considered to be low.

4.6.5 Details of the TW consultation response and local sewerage infrastructure are included in the Appendix VII.

4.7 Summary

The table below summarises the potential risk to the development from sources outside of the site prior to any mitigation measures.

	Flood Risk				
Potential Sources of Flooding	Low	Moderate	High	None	Description
Fluvial	x				Located in FZ 1
Tidal				x	Inland site
Pluvial	x				Minimal overland routes along the south eastern boundary.
Groundwater	x				No recorded groundwater present on site
Artificial Sources				x	No risk to the site
Sewers	x				No sewers located above the site.

5.0 FLOOD RISK – FROM DEVELOPMENT

5.1 Current Policy

5.1.1 Current Policy states that as well as assessing the risk to a development, a suitable flood risk assessment should consider the risk of flooding arising from a development.

5.1.2 The surface water arrangements for any development site should be such that the volumes and peak flow rates of surface water leaving a developed site are no greater than the rates prior to the proposed development, unless specific off-site arrangements are made and result in the same net effect.

5.2 Climate change

5.2.1 The design of the storm water system will need to take into account the anticipated increase in rainfall intensity as well as the piped drainage system. In accordance with the table below, design flows have been increased by 40% to accommodate the anticipated effects of climate change. Provision is therefore made to manage the risk of climate change in accordance with current government guidance.

5.2.2 Table 5-1: Recommended national precautionary sensitivity ranges for peak rainfall intensities for small and urban catchments.

Applies across all of England	2015-2039	2040 - 2069	2070-2115
Upper End	10%	20%	40%
Central	5%	10%	20%

5.3 Existing Surface Water Runoff

5.3.1 The site falls from a high point towards the north eastern boundary of the site with the Stansted Brook abutting the south western boundary. The site also falls to the south west from the high point.

5.4 Proposed Surface Water Management Principles

5.4.1 New surface water drainage provision will need to be made for all new dwellings and the associated highway infrastructure and under the requirements of the Building Regulations, disposal of surface water run-off by means of ground infiltration shall be investigated as a primary means of disposal before any outfall to a watercourse or sewer shall be considered.

5.4.2 BGS Borehole data obtained under Open Government License indicates that underlying soils near the site are predominantly firm to stiff clays, indicating that ground infiltration is unlikely to be viable. Any in-situ soil testing undertaken at the site shall make an assessment of the soil porosity to confirm this assumption.

5.4.3 The drainage strategy for the site proposes to integrate sustainable drainage features with traditional drainage systems for buildings and roads which will drain to a new attenuation basin to the south western low point of the development site. A controlled outfall will discharge to the outfall in the Stansted Brook that is located along the south western boundary. A discharge into the Brook will be subject to Land Drainage Consent with the local authority.

5.4.4 In accordance with the planning policy, the new development shall ensure that development run-off into the watercourse shall not exceed greenfield conditions. Using the Interim Code of Practice for SUDS recommendations (ICP SUDS) of pro-rata rates based upon the calculation methodology outlined in IH 124 Flood Estimation for Small Catchments, predicted run-off rates for the site are as follows:

5.4.5 Details of the calculation criteria are detailed in Appendix IV, giving the following outputs.

QBAR (l/s)	Q 1 year (l/s)	Q 100 year (l/s)
6.5	5.6	23.1
Where Q= Peak Flow Rate		

5.4.6 A flood storage estimate was carried out to determine attenuation volumes required for a site outfall with a rate restricted to the QBAR, 1 year and 100 year (plus climate change) equivalent. Any detailed proposal that stages out flow rates to the 1, 30 and 100 year equivalents shall demonstrate that the development includes sufficient long term storage to ensure that run-off volumes do not increase the flood risk to the surrounding area. For the purposes of this assessment, flood storage estimates are based upon a restricted discharge rate of QBAR for all design storms. Based on the impermeable catchment of the 9300m², the enclosed hydraulic analysis allows for an additional 10% to allow for the effects of urban creep. The required storage volume of 593m³, for the 100yr critical storm also accommodates a 40% increase in predicted rainfall due to the future effects of climate change. Details of the estimated attenuation volumes are detailed on the Drainage Strategy included as Appendix VI of this report.

5.4.7 In addition, a number of filter strips will serve private drainage from plots and driveways across the development where available to provide further water treatment before final discharge.

5.4.8 Sewers serving multiple properties are to be offered for adoption by TW subject to their design and construction to water company standards. It is not current policy for adoption of the

attenuation basin to be accepted by either TW or the local authority. It is therefore proposed that the pond will be maintained by Management Company funded by resident contribution.

5.4.9 Surface levels shall be designed to ensure that run-off is not directed toward properties or off site in the event that the drainage system fails or its design capacity is exceeded. Exceedance flows shall be directed toward the attenuation basin at the natural low point of the site, ensuring that the flood volumes generated by critical storm events for the 1 in 100 year return period, plus climate change allowance shall be retained on site and not impose a flood risk to any property.

5.4.10 All collected runoff from the site will be conveyed to the outfall via the side slopes and bed of the attenuation basin, benefiting from the treatment benefits of filtrating through the vegetated shallow soils. The attenuation basin is to include a permanent pond immediately upstream of the control chamber to allow for de-sedimentation of any collected run-off prior to its discharge into the downstream system. This ensures that the proposals will provide the two stages of treatment required by C753 SUDS Manual.

5.5 Proposed Foul Drainage

5.5.1 An existing foul water sewer run across the site from the north eastern corner along to the south western corner of the site. A pre-development enquiry has been made to Thames Water to identify the ideal point of connection for the foul water strategy. TW have stated that the foul drainage can connect into the 300mm dia public foul water sewer crossing the site.

5.5.2 The final connection point is proposed on line with the existing sewer between chamber references 3802 and 2801, but will be confirmed at detailed design stage. A copy of the predevelopment enquiry is included within Appendix VII.

5.5.3 All new connections are subject to the approval of Thames Water under Section 106 of the Water Industry Act.

6.0 RESIDUAL RISK

The need to manage residual risks is identified within current guidance. Residual risks are the risks to the proposed development should the existing and/or proposed flood mitigation measures fail to perform as intended. Examples of residual flood risk include:

- The failure of flood management infrastructure such as a breach of a raised flood defence, blockage of a surface water conveyance system, failure of a flap-valve, overtopping of an upstream storage area, or failure of a pumped drainage system;

- A severe flood event that exceeds a flood management design standard.

6.1 Assessment of Flooding Consequences

6.1.1 It is considered that the measures described in Section 5.4 provide adequate protection against flooding. In the unlikely event that an extreme rainfall event exceeds the capacity of the rainwater collection systems, ground modelling will ensure that overland flows are directed away from the buildings. Wherever applicable, external levels shall generally be 150mm lower than finish floor levels at ground floor.

6.1.2 Although risk of groundwater flooding is considered to be low, some consideration of groundwater should be made in the development drainage strategy wherever retaining structures are proposed.

6.1.3 It is therefore considered that the consequences of flooding and the possibility of flooding are minimal and acceptable within the standards set.

6.2 Access and Egress

6.2.1 Current guidance required that, where required, safe access and escape is available to/from new developments in flood risk areas.

6.2.2 As the development affected area is situated within flood zone 1 and is of a type compatible with this flood zone, and therefore not at risk of flooding from any watercourse, dry access has not been considered in further detail.

7.0 CONCLUSIONS

Following the completion of this flood risk assessment, in line with the recommendations of current guidance, the following conclusions can be made:

7.1 Flood Risk – To Development

7.1.1 This flood risk assessment concluded that the proposed development is at a low risk of flooding from tidal, fluvial, overland flow, drainage flooding, groundwater flooding and flooding from artificial sources. Under normal circumstances the site is at low risk of flooding as having a less than 1 in 1,000 annual probability of river or sea flooding in any year (<0.1%).

7.2 Flood Risk – From the Development

7.2.1 The proposed development represents an increase in impermeable, positively drained areas over the pre-development condition. Flood risk to the site and the surrounding area would increase without the mitigation measures proposed in Section 7.3 being put in place.

7.3 Flood Mitigation Measures

7.3.1 The proposed development will discharge to the local drainage network at rates equivalent to greenfield conditions. The surface water drainage system shall be designed to ensure that flood storage volumes are retained onsite for critical storm events up to the 1 in 100 year return period plus an allowance for the effects of climate change.

7.3.2 To further mitigate the flood risk to properties in the event of a failure within in the drainage system, surface levels will be designed to ensure that flood flows are not directed toward dwellings. The design shall make due consideration of the existing surface water flow paths from off site that traverse to study site. External levels surrounding dwellings shall generally 150mm below ground floor levels.

7.3.3 Based on the impermeable catchment of the 9300m², the enclosed hydraulic analysis allows for an additional 10% to allow for the effects of urban creep. The required storage volume of 593m³, for the 100yr critical storm also accommodates a 40% increase in predicted rainfall due to the future effects of climate change.

7.4 Residual Risk – Flood Consequences

7.4.1 It is considered that the proposed development will not result in any detrimental impact onto the existing surrounding properties.

7.4.2 It is considered that the proposed drainage scheme will neither result in nor cause an increase of flood risk to surrounding properties or the development site.

7.4.3 It is therefore considered that Planning Consent should not be withheld on flood risk grounds.

Appendix I – Site Masterplan

JCN DESIGN & PLANNING

Accommodation Schedule

Private Dwellings

	No	Variant	Reference	Beds	Storey	M4(2)	M4(3)
1B	2		WO	2	1	✓	
3 Beds	3		CS	3	2	✓	
	4	9	HI	3	2	✓	
	2		FM	3	2	✓	
4 Beds	2		PG	4	2	✓	
	2	13	LU	4	2	✓	
	5		AR	4	2	✓	
	4		JE	4	2	✓	
	24						

Affordable Dwellings

	No	Variant	Reference	Beds	Storey	M4(2)	M4(3)
2 Beds	2	9	2B Disable Dwelling	2	1		✓
	7		BA	2	2	✓	
3 Beds	6	7	TI	3	2	✓	
	1		PW	3	2	✓	
	16						
Total	40						

ROSCONN STRATEGIC LAND

Project:-
Land West of Robinhood Road
Elsenham
CM22 6TF

Description:-
Development Layout

Date:- August 2023

Drawing Scale:- 1-500 - A1

Drawing number:- BW289a-PL-02

Revision:- D

Appendix II – Topographic Survey

Survey Key:-

BO	Bollard
BB	Belisha Beacon
BT	BT Cover
CB	Telephone Control Box
CH	Coal Hole
CO	Unidentified Cover
Conc	Concrete
EP	Electricity Pole
FH	Fire Hydrant
FT	Face Profile Target
FW	Foul Water Drain Cover
GU	Drainage Gully Cover
GV	Gas Valve
Gas	Gas Cover
IC	Inspection Chamber Cover
LB	Letter Box
LP	Lamp Post
MC	Metal Drainage Channel
MH	Manhole Cover (round)
MP	Marker Post
Rwp	Rain Water Pipe
SV	Water Stop Valve
SW	Storm Water Drain Cover
TCB	Telephone Call Box
TL	Traffic Light
TP	Telegraph Pole
TV	Cable TV Cover
WM	Water Meter Cover

- STN 57.08 — Survey Control Station
- TP 154.87 — Trial Pit
- BH 154.87 — Borehole
- WL 154.87 31/01/10 — Water Level (with date measured)
- + 154.87 — Spot Level
- 154.87 — Tree (spread to scale)

Linetypes

- Fenceline
- Electricity Transmission Line
- Hedge
- Rock Face
- Embankment Slope
- 100.00 — Contour Lines
- Gas Pipeline
- Water Pipeline

Building Internals - Specific Codes

- Ceil + 154.87 — Structural Ceiling Level
- F.Ceil + 154.87 — False / Suspended Ceiling Level
- + 154.87 — Floor Level
- USB + 154.87 — Underside of Beam / Openings Level

Some of these symbols may not appear on this drawing

Notes:-

Survey is tied to Ordnance grid and level datums by GPS Smartnet

Contours are shown at 0.5m Intervals # Highlighted at 2m Intervals

BeaconLandSurveys
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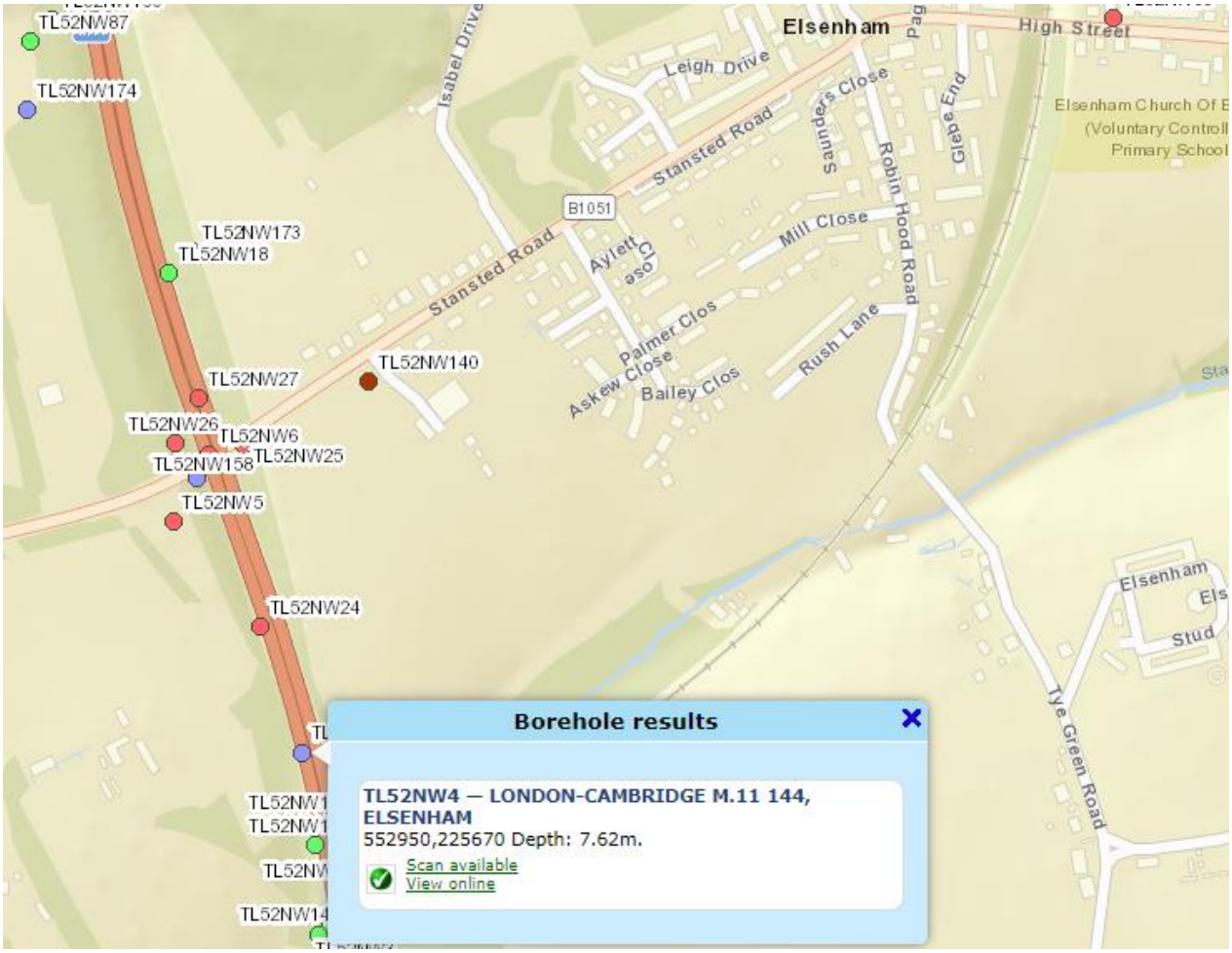
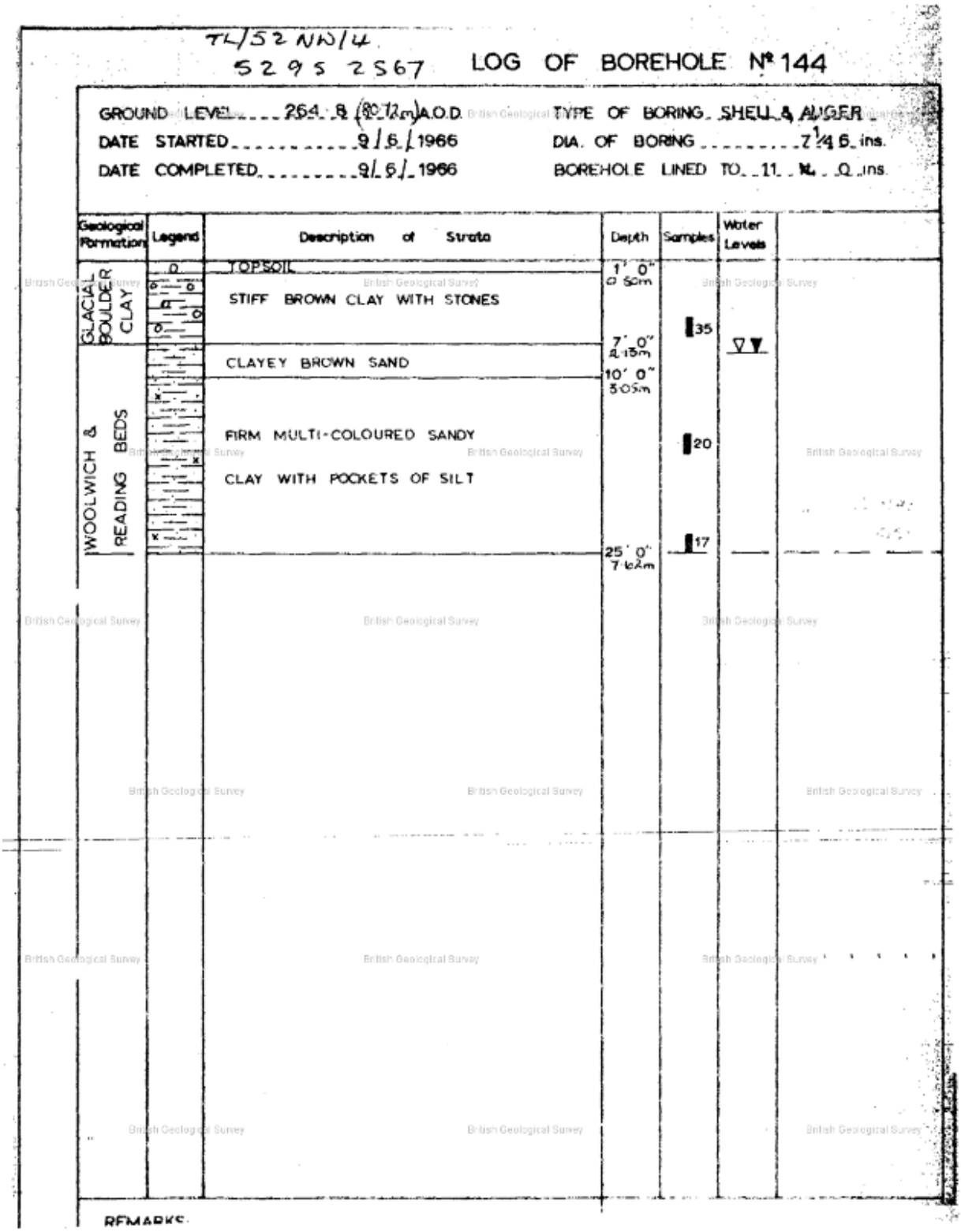
Project:
Land at Rush Lane
Elsenham
Bishops Stortford

Drawing:
Site Survey

Scales:	Drawn/Sheet Size:
1:500	mjs/A0
Date: Sept 2018	Drawing No: 18-106-01

Appendix III – BGS Borehole Log




TL/52 NW/4
5295 2567
LOG OF BOREHOLE Nº 144
GROUND LEVEL 264.8 (80.72m) A.O.D.
TYPE OF BORING SHELL & AUGER
DATE STARTED 9/6/1966
DIA. OF BORING 7 1/4 6 ins.
DATE COMPLETED 9/6/1966
BOREHOLE LINED TO 11 N. 0 ins.
Geological Formation
Legend
Description of Strata
Depth
Samples
Water Levels
GLACIAL BOULDER CLAY
WOOLWICH & READING BEDS
TOPSOIL
1' 0" 0.30m
STIFF BROWN CLAY WITH STONES
7' 0" 2.13m
CLAYEY BROWN SAND
10' 0" 3.05m
FIRM MULTI-COLOURED SANDY CLAY WITH POCKETS OF SILT
25' 0" 7.62m
35
20
17
REMARKS

Appendix IV – Rural Run-off Calculation

ICP SUDS

ICP SUDS Input (FSR Method)

Return Period (Years)	2
Area (ha)	2.280
SAAR (mm)	600
Soil	0.400
Growth Curve	(None)

Map

Calculate

Partly Urbanised Catchment (QBAR)

Urban	0.000
Region	Region 5

Return Period Flood

Region	QBAR (l/s)	Q (2yrs) (l/s)	Q (1 yrs) (l/s)	Q (30 yrs) (l/s)	Q (100 yrs) (l/s)
Region 1	6.5	5.9	5.5	12.2	16.1
Region 2	6.5	5.9	5.6	12.3	17.0
Region 3	6.5	6.1	5.6	11.4	13.5
Region 4	6.5	5.8	5.4	12.7	16.6
Region 5	6.5	5.8	5.6	15.6	23.1
Region 6/Region 7	6.5	5.7	5.5	14.7	20.7
Region 8	6.5	5.7	5.1	12.3	15.7
Region 9	6.5	6.0	5.7	11.4	14.1
Region 10	6.5	6.0	5.6	11.0	13.5
Ireland National	6.5	6.2	5.5	10.3	11.9
Ireland East	6.5	6.2	5.5	10.6	12.3
Ireland South	6.5	6.2	5.5	10.3	11.9
Ireland West	6.5	6.2	5.5	10.0	11.5
Ireland Greater Dublin	6.5	6.0	5.5	13.8	16.9

Appendix V – MicroDrainage Flood Storage Estimates

Storage Estimates – based on QBAR 6.5 l/s

Design Settings

Rainfall Methodology	FSR	Maximum Time of Concentration (mins)	30.00
Return Period (years)	1	Maximum Rainfall (mm/hr)	50.0
Additional Flow (%)	0	Minimum Velocity (m/s)	1.00
FSR Region	England and Wales	Connection Type	Level Soffits
M5-60 (mm)	20.000	Minimum Backdrop Height (m)	0.200
Ratio-R	0.400	Preferred Cover Depth (m)	1.200
CV	0.750	Include Intermediate Ground	✓
Time of Entry (mins)	5.00	Enforce best practice design rules	✓

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Diameter (mm)	Easting (m)	Northing (m)	Depth (m)
1	0.018	5.00	85.780	1200	553444.083	226017.183	1.280
2	0.093	5.00	84.840	1200	553430.671	225999.184	1.240
3	0.017	5.00	83.980	1500	553430.524	225976.502	1.280
4	0.079	5.00	84.500	1500	553414.531	225975.216	1.975
5	0.067	5.00	84.830	1500	553390.619	225971.648	2.580
6	0.051	5.00	84.140	1500	553372.043	225963.384	2.340
7	0.094	5.00	82.400	1500	553341.706	225942.300	2.050
8	0.067	5.00	81.826	1350	553339.109	225928.712	1.776
9	0.025	5.00	80.503	1350	553356.669	225907.401	1.903
10	0.191	5.00	79.563	1500	553367.604	225888.111	3.063
11	0.025	5.00	77.850	1800	553365.111	225871.515	1.420
12			77.850	1800	553348.079	225860.611	1.450
13			77.850	1350	553349.161	225856.457	1.965
14			74.300	1200	553347.001	225844.128	0.275

Links (Results)

Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)	Pro Depth (mm)	Pro Velocity (m/s)
1.000	2.630	104.6	2.4	1.055	1.015	0.018	0.0	23	1.091
1.001	2.616	104.0	15.0	1.015	1.055	0.111	0.0	58	1.876
1.003	1.029	40.9	17.3	1.055	1.675	0.128	0.0	102	0.989
1.004	1.127	79.6	28.1	1.675	2.130	0.207	0.0	123	1.031
1.005	3.030	482.0	37.1	2.130	1.890	0.274	0.0	84	1.831
1.006	4.040	642.5	44.0	1.890	1.600	0.325	0.0	79	2.352
1.007	3.000	477.1	56.8	1.600	1.326	0.419	0.0	104	2.049
1.008	4.675	743.5	65.9	1.326	1.453	0.486	0.0	89	2.929
1.009	6.283	999.2	69.3	1.453	2.613	0.511	0.0	80	3.685
1.010	1.308	208.1	94.2	2.613	0.970	0.702	0.0	212	1.277
1.011	1.136	607.1	95.4	0.595	0.625	0.727	0.0	219	0.838
1.012	7.073	1124.9	95.4	1.000	1.515	0.727	0.0	87	4.383
1.013	5.309	211.1	91.4	1.740	0.050	0.727	0.0	103	5.120

Simulation Settings

Rainfall Methodology	FSR	Winter CV	0.840
FSR Region	England and Wales	Analysis Speed	Normal
M5-60 (mm)	20.000	Skip Steady State	✓
Ratio-R	0.400	Drain Down Time (mins)	240
Summer CV	0.750	Additional Storage (m³/ha)	0.0

Simulation Settings

Check Discharge Rate(s)	✓	100 year 360 minute (m³)
Check Discharge Volume	✓	

Storm Durations

15	30	60	120	180	240	360	480	600	720	960	1440

Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)
1	0	5	0
30	0	5	0
100	40	5	0

Pre-development Discharge Rate

Site Makeup	Greenfield	Growth Factor 30 year	1.95
Greenfield Method	IH124	Growth Factor 100 year	2.48
Positively Drained Area (ha)		Betterment (%)	0
SAAR (mm)		QBar	
Soil Index	1	Q 1 year (l/s)	
SPR	0.10	Q 30 year (l/s)	
Region	1	Q 100 year (l/s)	
Growth Factor 1 year	0.85		

Pre-development Discharge Volume

Site Makeup	Greenfield	Return Period (years)	100
Greenfield Method	FSR/FEH	Climate Change (%)	0
Positively Drained Area (ha)		Storm Duration (mins)	360
Soil Index	1	Betterment (%)	0
SPR	0.10	PR	
CWI		Runoff Volume (m³)	

Node 13 Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Replaces Downstream Link	✓	Sump Available	✓
Invert Level (m)	75.885	Product Number	CTL-SHE-0105-6500-1965-6500
Design Depth (m)	1.965	Min Outlet Diameter (m)	0.150
Design Flow (l/s)	6.5	Min Node Diameter (mm)	1200

Node 13 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	76.400
Side Inf Coefficient (m/hr)	0.00000	Porosity	1.00	Time to half empty (mins)	248

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	338.0	0.0	1.350	975.5	0.0

Results for 1 year +5% A Critical Storm Duration. Lowest mass balance: 92.28%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	1	10	84.525	0.025	2.7	0.0280	0.0000	OK
15 minute winter	2	10	83.660	0.060	16.4	0.0678	0.0000	OK
15 minute winter	3	11	82.812	0.112	18.8	0.1974	0.0000	OK
15 minute winter	4	11	82.658	0.133	29.8	0.2344	0.0000	OK
15 minute winter	5	11	82.341	0.091	39.2	0.1611	0.0000	OK
15 minute winter	6	11	81.881	0.081	46.4	0.1431	0.0000	OK
15 minute winter	7	11	80.468	0.118	59.7	0.2083	0.0000	OK
15 minute winter	8	11	80.148	0.098	69.2	0.1404	0.0000	OK
15 minute winter	9	11	78.681	0.081	72.9	0.1163	0.0000	OK
15 minute winter	10	11	76.730	0.230	99.6	0.4071	0.0000	OK
15 minute winter	11	11	76.627	0.197	103.6	0.5018	0.0000	OK
60 minute winter	12	47	76.568	0.168	66.5	0.4281	0.0000	OK
120 minute winter	13	112	76.559	0.674	88.1	60.9405	0.0000	SURCHARGED
15 minute summer	14	1	74.025	0.000	5.8	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute winter	1	1.000	2	2.7	0.514	0.025	0.1215	
15 minute winter	2	1.001	3	16.3	1.177	0.157	0.3178	
15 minute winter	3	1.003	4	18.5	0.978	0.452	0.3034	
15 minute winter	4	1.004	5	29.9	1.030	0.375	0.7013	
15 minute winter	5	1.005	6	39.3	1.861	0.082	0.4296	
15 minute winter	6	1.006	7	46.6	1.795	0.072	0.9670	
15 minute winter	7	1.007	8	59.9	2.053	0.126	0.4046	
15 minute winter	8	1.008	9	69.4	3.098	0.093	0.6199	
15 minute winter	9	1.009	10	73.0	1.499	0.073	1.1207	
15 minute winter	10	1.010	11	100.1	1.349	0.481	1.2455	
15 minute winter	11	1.011	12	103.8	1.669	0.171	1.3074	
60 minute winter	12	1.012	13	102.5	1.181	0.091	0.4570	
120 minute winter	13	Hydro-Brake®	14	5.8				101.8

Results for 30 year +5% A Critical Storm Duration. Lowest mass balance: 92.28%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	1	10	84.538	0.038	6.5	0.0428	0.0000	OK
15 minute winter	2	10	83.696	0.096	40.3	0.1088	0.0000	OK
15 minute winter	3	11	82.936	0.236	46.1	0.4166	0.0000	SURCHARGED
15 minute winter	4	11	82.767	0.242	72.3	0.4279	0.0000	OK
15 minute winter	5	11	82.398	0.148	95.6	0.2608	0.0000	OK
15 minute winter	6	11	81.926	0.126	113.2	0.2229	0.0000	OK
15 minute winter	7	11	80.546	0.196	145.6	0.3468	0.0000	OK
15 minute winter	8	11	80.209	0.159	169.1	0.2280	0.0000	OK
15 minute winter	9	11	78.727	0.127	178.0	0.1814	0.0000	OK
15 minute winter	10	11	76.937	0.437	243.7	0.7728	0.0000	OK
180 minute winter	11	180	76.839	0.409	60.9	1.0396	0.0000	OK
180 minute winter	12	180	76.839	0.439	113.7	1.1162	0.0000	OK
180 minute winter	13	180	76.839	0.954	149.5	195.1817	0.0000	SURCHARGED
15 minute summer	14	1	74.025	0.000	5.8	0.0000	0.0000	OK

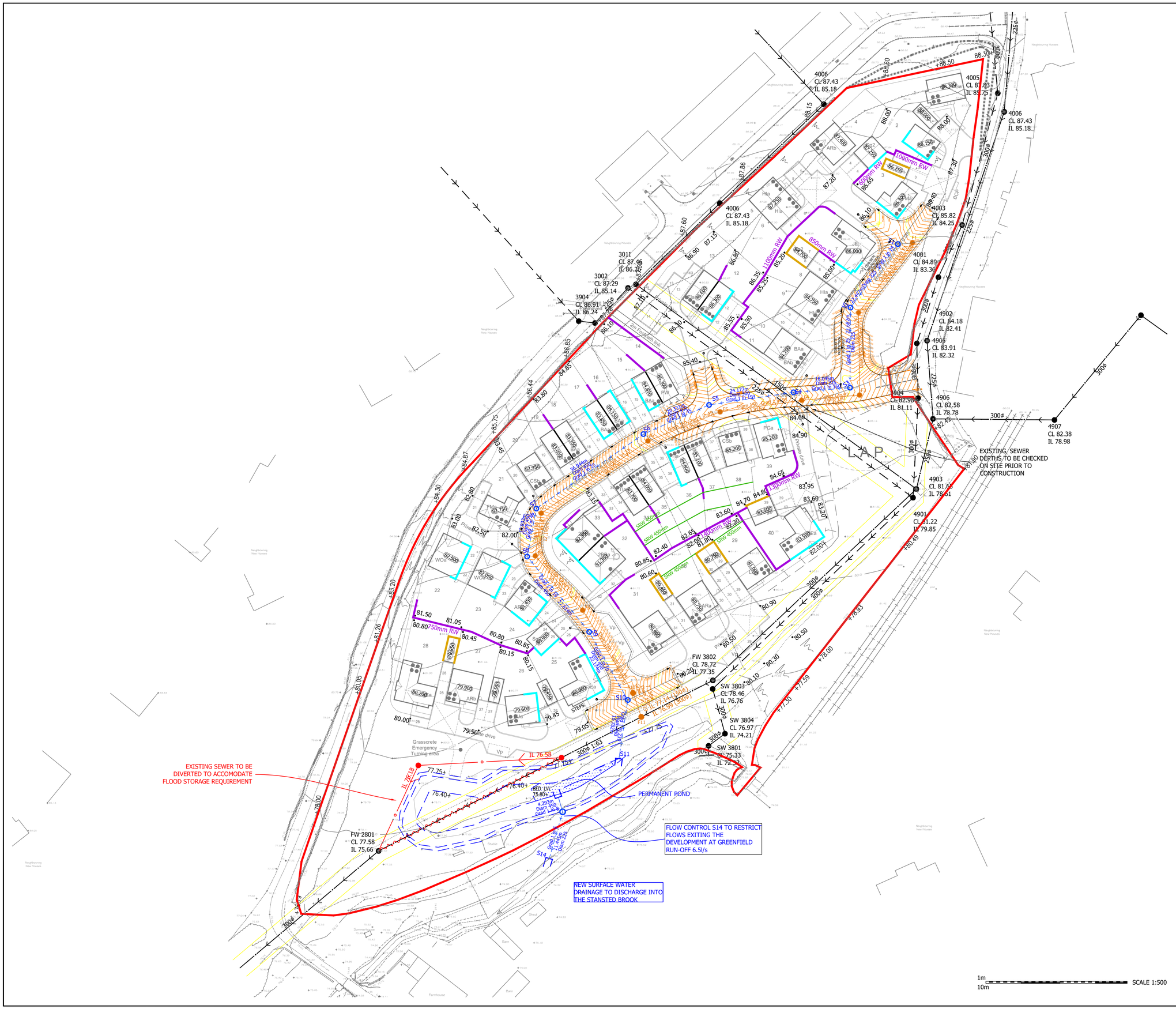
Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute winter	1	1.000	2	6.5	0.652	0.062	0.2310	
15 minute winter	2	1.001	3	40.0	1.388	0.384	0.6345	
15 minute winter	3	1.003	4	44.9	1.177	1.098	0.5883	
15 minute winter	4	1.004	5	72.7	1.275	0.913	1.3750	
15 minute winter	5	1.005	6	95.8	2.354	0.199	0.8287	
15 minute winter	6	1.006	7	113.5	2.226	0.177	1.8975	
15 minute winter	7	1.007	8	146.2	2.512	0.307	0.8064	
15 minute winter	8	1.008	9	169.5	3.917	0.228	1.1980	
15 minute winter	9	1.009	10	178.3	1.750	0.178	2.1486	
15 minute winter	10	1.010	11	244.3	1.723	1.174	2.3461	
180 minute winter	11	1.011	12	75.4	1.091	0.124	5.5714	
180 minute winter	12	1.012	13	149.5	1.153	0.133	0.6779	
180 minute winter	13	Hydro-Brake®	14	5.8				124.4

Results for 100 year +40% CC +5% A Critical Storm Duration. Lowest mass balance: 92.28%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	1	10	84.551	0.051	11.9	0.0576	0.0000	OK
15 minute winter	2	11	83.989	0.389	73.2	0.4400	0.0000	SURCHARGED
15 minute winter	3	11	83.517	0.817	77.9	1.4433	0.0000	SURCHARGED
15 minute winter	4	11	83.053	0.528	125.8	0.9326	0.0000	SURCHARGED
15 minute winter	5	10	82.455	0.205	167.2	0.3617	0.0000	OK
15 minute winter	6	11	81.969	0.169	200.0	0.2991	0.0000	OK
15 minute winter	7	10	80.634	0.284	260.1	0.5013	0.0000	OK
15 minute winter	8	10	80.274	0.224	300.7	0.3199	0.0000	OK
15 minute winter	9	11	78.781	0.181	316.3	0.2587	0.0000	OK
15 minute winter	10	11	77.483	0.983	437.9	1.7378	0.0000	SURCHARGED
360 minute winter	11	352	77.202	0.772	64.5	1.9657	0.0000	OK
360 minute winter	12	352	77.202	0.802	89.9	2.0421	0.0000	SURCHARGED
360 minute winter	13	352	77.202	1.317	109.8	425.2391	0.0000	SURCHARGED
15 minute summer	14	1	74.025	0.000	5.8	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute winter	1	1.000	2	11.8	0.707	0.113	0.5218	
15 minute winter	2	1.001	3	67.3	1.692	0.647	0.9021	
15 minute winter	3	1.003	4	77.1	1.939	1.884	0.6381	
15 minute winter	4	1.004	5	125.6	1.786	1.577	1.6545	
15 minute winter	5	1.005	6	167.3	2.690	0.347	1.2657	
15 minute winter	6	1.006	7	199.2	2.496	0.310	2.9480	
15 minute winter	7	1.007	8	258.5	2.821	0.542	1.2717	
15 minute winter	8	1.008	9	300.8	4.400	0.405	1.8981	
15 minute winter	9	1.009	10	317.2	2.484	0.317	2.4165	
15 minute winter	10	1.010	11	435.6	2.749	2.093	2.6590	
360 minute winter	11	1.011	12	63.2	0.815	0.104	10.5958	
360 minute winter	12	1.012	13	109.8	0.926	0.098	0.6802	
360 minute winter	13	Hydro-Brake®	14	5.8				188.4

Appendix VI – Surface Water Drainage Strategy



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3. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL OTHER RELEVANT DRAWINGS RELATING TO THIS PROJECT.
4. ALL DIMENSIONS SHOULD BE CHECKED ON SITE PRIOR TO CONSTRUCTION. ANY DISCREPANCIES SHOULD BE IMMEDIATELY NOTIFIED IN WRITING TO TRAVIS BAKER LIMITED.
5. THE CONTRACTOR SHALL PRIOR TO CONSTRUCTION CHECK AND VERIFY THAT THE DETAILS SHOWN ON THIS DRAWING ARE FULLY COMPATIBLE WITH ANY AS CONSTRUCTED DIMENSIONS OR LEVELS. ANY DISCREPANCIES TO BE REPORTED IMMEDIATELY IN WRITING TO TRAVIS BAKER LIMITED.
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KEY

- SITE BOUNDARY
- ADOPTABLE SURFACE WATER SEWER
- ADOPTABLE FOUL WATER SEWER
- ATTENUATION BASIN
- EXISTING THAMES WATER SURFACE WATER SEWER
- EXISTING THAMES WATER FOUL WATER SEWER
- EXISTING GROUND LEVEL
- EXISTING GROUND LEVEL
- INDICATIVE FINISHED FLOOR LEVELS
- THAMES WATER SEWER EASEMENT 3m EITHER SIDE FOR PIPES UPTO 449mm DIAMETER
- INDICATIVE RETAINING WALL AND HEIGHT
- EXPOSED BRICKWORK FOR PLOTS
- TANKING
- EMBANKMENT
- CONCRETE PROTECTION REQUIRED
- SLEEPER RETAINING WALL (WITH RETAINED HEIGHT)

REV	DESCRIPTION	DATE	BY	AUTH
G	UPDATED TO SUIT NEW SITE LAYOUT	19.09.23	ID	TW
F	UPDATED TO NEW PLANNING LAYOUT	21.07.23	ID	TW
E	BASIN UPDATED	26.03.19	TW	TW
D	OUTFALL LOCATION AMENDED	15.01.19	TW	TW
C	BASIN UPDATED/SEWER DIVERSION INCLUDED	14.01.19	TW	TW
B	UPDATED TO NEW LAYOUT	09.01.19	TW	TW
A	UPDATED TO NEW LAYOUT	20.12.18	JG	JG

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Geo-Environmental
Civil and Structural Engineering

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CLIENT
ROSCONN STRATEGIC LAND

PROJECT
LAND OFF RUSH LANE, ELSENHAM

TITLE
INDICATIVE DRAINAGE STRATEGY

DRAWN	AUTHORISED	SCALE	DATE
JG	JG	1:500@A1	31.10.18

PROJECT NO.	DRAWING NO.	REV
18165	002	G

STATUS.
PRELIMINARY

Appendix VII – Stakeholder Correspondence

Jason Gates
Travis Baker East Midlands Limited
39 Stoney Street
Nottingham
NG1 1LX

Wastewater pre-planning
Our ref DS6054836

14 November 2018

Pre-planning enquiry: Confirmation of sufficient capacity

Dear Mr. Gates,

Thank you for providing information on your development at Land South Of, Rush Lane, Elsenham, Bishop-S Stortford, Essex, CM22 6TF for *Development proposal for 44 houses, foul discharge by gravity between TL53253802 and TL53252801, surface water discharge into Stanstead Brook by gravity.*

We have completed the assessment of the foul water flows and surface water run-off based on the information submitted in your application with the purpose of assessing sewerage capacity within the existing Thames Water sewer network.

Foul Water

If your proposals progress in line with the details you've provided, we're pleased to confirm that there will be sufficient sewerage capacity in the adjacent foul water sewer network to serve your development.

This confirmation is valid for 12 months or for the life of any planning approval that this information is used to support, to a maximum of three years.

You'll need to keep us informed of any changes to your design – for example, an increase in the number or density of homes. Such changes could mean there is no longer sufficient capacity.

Surface Water

Surface water discharge into Stanstead Brook.

What happens next?

Please make sure you submit your connection application, giving us at least 21 days' notice of the date you wish to make your new connection/s.

If you've any further questions, please contact me on 0203 577 9018 / 07747 640 273.

Yours sincerely

David Stamateris

Adoptions Engineer

Thames Water