

H17-0798-15

FRA.

MA10160-FRA-R02

Proposed Residential Development
Station Road, Surfleet

Mr. and Mrs. Needham

Flood Risk Assessment

September 2015

millward

- Civil & Structural Engineering
- Environmental & Geotechnical
- Flood Risk & Drainage
- Highways & Infrastructure
- Structural Inspections
- Transportation

REVISION

Reference	Revision	Author	Date
MA10160-FRA-R01	Initial Issue for planning	JMcK	August 2015
MA10160-FRA-R02	Revised Issue following EA comments	JMcK	September 2015

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1. INTRODUCTION

- 1.1 Millward have been appointed to undertake a Flood Risk Assessment (FRA) for a proposed residential development on land adjacent to Station Road, Surfleet, PE11 4BW.
- 1.2 This FRA is undertaken in accordance with the National Planning Policy Framework and associated Technical Guidance Document March 2012 (NPPF).
- 1.3 This FRA discusses and provides both a qualitative assessment and quantitative assessment for the residential development in terms of flood risk, future flood risk over the anticipated lifetime of the development and reference to the sequential and exception test using a precautionary and risk based approach.



2 THE SITE

- 2.1 This proposed residential development is located to the north side of Station Road on Brownfield Land in Surfleet, totalling 0.284 Hectares (2,835m²) in area. The site is located within the urban extents of Surfleet approximately 5miles north of the centre of Spalding. The site location is shown on drawing MA10160/SK01 contained within Appendix A.
- 2.2 Vehicular access to the development will be via Station Road as per the architects drawing contained within Appendix A.
- 2.3 The site was previously developed as a nursery with the site area for development technically arable land for growing of plants. Whilst part of a previous development there has not been any physical development on the land such as impermeable areas of buildings. Therefore for the purpose of analysis for surface water run-off, the site is classed as Greenfield.
- 2.4 There is no evidence that the site is or has been formally drained into the existing adopted sewer system on Station Road and with the topography of the land falling away circa 1m to the north away from Station Road and the River Glen surface water connectivity to the River or the road is unlikely.
- 2.5 It is concluded that the land will currently drain via natural percolation into the sub soils and surface water run off would be north towards the other areas of the nursery and glasshouses.
- 2.6 Site levels within the development area vary from circa 7m AOD to the frontage of the site (Southern boundary) to circa 6m AOD to the rear of the site (Northern boundary), giving an average gradient across the site of circa 1:50 (2%).



- 2.7 The site is currently 100% permeable and therefore the site surface water run-off has been calculated by the ICP SUDS method, which confirms a Greenfield run-off rate of 0.4 l/s for the 1 in 1 year event. The WinDES results are contained within Appendix C.



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 contained wholly within Flood Zone 1 which in accordance with Table 1 of the NPPF Technical Guidance document, is defined as Low Probability having less than a 1 in 1000 chance (<0.1%) of flooding from rivers or the sea in any one year.
- 3.1.3 Therefore further EA consultation has not taken place for this development as the development is in the lowest flood zone in terms of planning.
- 3.1.4 The Environment Agency standing advice note for sites within Flood Zone 1 greater than 1 hectare in size requires a flood risk assessment to be undertaken which should concentrate on dealing with the proposed surface water run-off from the site and how the run-off is dealt with and controlled. Whilst this site is less than 1 hectare the assessment of this site remains in line with this standing advice.

3.2 Anglian Water (AW)

- 3.2.1 As part of this assessment AW sewer plans have been obtained to determine the location of sewers in the vicinity of the site which is shown in Appendix B.
- 3.2.2 To the north of the site there is a 150mm diameter foul sewer and rising main which from the records MH7501, 7502, and 6501 are 1.69m to 2.18m depth.
- 3.2.3 There are no surface water sewers in the vicinity of the site whatsoever.



- 3.2.4 The foul connection to the existing adopted sewer are subject to a S106 application which would be undertaken as part of the detailed design of the drainage for the development.



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 within Flood Zone 1 (Low 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 1 is considered appropriate.'
- 4.1.4 In terms of Sequential Test there are no areas within a lower flood risk zone as zone 1 is the lowest risk zone.
- 4.1.5 As the development principle of residential is deemed appropriate in terms of Sequential Test, the Exception Test does not apply.



5 PROPOSED DEVELOPMENT

- 5.1 The proposed development proposals consist of 5no detached dwellings in total with associated driveways and garages (off road) and garden areas to the rear of the proposed dwellings. The site is accessed by a central cul-de-sac access road with a turning head at the western end for service vehicles. The proposed plan layout of the development is shown on the sketch layout contained within in Appendix A.
- 5.2 The impermeable areas of the proposed site are 45% (0.129Ha) as shown on drawing MA10160/200 contained in Appendix A which is an increase in impermeable area on the site, which therefore will require mitigation measures in terms of surface water drainage to reduce the surface water run off to equivalent Greenfield rates.
- 5.3 The proposals will also look into provision of permeable paving solutions to the driveways and potentially soakaways for roof drainage subject to on site percolation testing of the soil strata. Therefore on site testing would be required before detailed design of any drainage system to determine if soakaways are potentially viable at this site. However this is unlikely due to ground conditions and therefore the drainage strategy for this site assumes infiltration is not feasible.
- 5.4 Foul drainage would connect into the existing Anglian Water sewer network to the northern boundary of the site with anticipated peak foul flows of less than 1 l/s (Circa 0.2 l/s peak for all the plots) into the existing sewer. These connections would of course be subject to approval from Anglian water as part of the planning and detailed design process.



6 FLOOD RISK

6.1 Flooding From Watercourses

- 6.1.1 The development area is shown within Flood Zone 1 (Less than a 1 in 1000 (0.1%) chance of flooding in any one year – Low Probability in line with the NPPF) from watercourses.
- 6.1.2 The closest area of flood zone 3 is located to the north in the nursery area to the north of the site which is reasonably close to the site.
- 6.1.3 The South Holland SFRA (2010 update) provides district wide assessment of the flood risk including flood defence breach scenarios which have been assessed.
- 6.1.4 The SFRA shows the site is not at risk of flooding in the present day scenario
- 6.1.5 The risk of flooding to the development area from fluvial sources is considered to be **LOW** probability as the site is situated in the lowest flood zone from this source when assessing the site against the information available.

6.2 Flooding From Land / Adjacent Development

- 6.2.1 The main risk of flooding to this site is from the impermeable surfaces within the adjacent residential area to the east and west of the site, along with the Station Road carriageway which due to failure of the existing adopted drainage systems or intense rainfall saturating the soil resulting in run off over land instead of infiltration or interception by drainage infrastructure.
- 6.2.2 Any overland flow from adjacent development site is likely to be shallow and there are no low points within the site which would create a localised depression in the ground which would be at risk of ponding / pooling water from this source.



6.2.3 Any flooding from this source would be sheet flooding, shallow in depth. Flood flow routes from the existing properties would not be towards the development site. Station Road flood flow routes would potentially be towards the site but volumes of water from this source would be low.

6.2.4 Overall the risk of flooding from this source is considered to be **LOW**.

6.3 Flooding From Infrastructure Failure

6.3.1 The site is not within an area deemed to be at risk of flooding from reservoirs (according to the data on the EA website).

6.3.2 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**.

6.4 Flooding From Groundwater

6.4.1 There are no confirmed records of groundwater flooding in the vicinity of the site in the SFRA.

6.4.2 The site is underlain by Oxford Clay and therefore the chances of groundwater being an issue is remote as these soils are predominantly impermeable which would stop any rise in groundwater reaching the surface.

6.4.3 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.

6.5 Flooding From Sewers

6.5.1 There are existing adopted foul sewers to the north of the development site which are 150mm diameter and connect to an existing pumping station to the north west of the site.



- 6.5.2 If any of these sewers were to flood, the water flow routes would be away from the development flowing in a northerly direction. The pump station is also lower than the site and if this was to fail flood flow routes of any foul water would be away from the site also
- 6.5.3 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**.

6.6 Flooding From Climate Change

- 6.6.1 The NPPF Technical Guidance Document confirms in Table 5 that peak rainfall intensity is estimated to increase up to 30% over the lifetime of this development (100 years) and peak river flows by 20%. Tidal aspects extreme wave heights could increase between 5% and 10%. Sea level rises in this area over the lifetime of the development would be anticipated to be circa 1.2m (to year 2115).
- 6.6.2 The South Holland SFRA assesses the risk of flooding from Tidal and Fluvial events at year 2115. The plans show that the actual flood depth could be between 0 and 0.5m in depth for this general area. The site is located towards the outer extents of the limits of flooding and therefore levels in the region of 250mm should be expected which is mid-range for the area identified.
- 6.6.3 The SFRA plans show that the existing Station Road is at the limits of anticipated flooding.
- 6.6.4 The proposed site drainage will however be designed not to flood with an allowance of 30% for climate change in line with the NPPF technical guidance document.
- 6.6.5 Overall the risk of flooding from the effects of climate change is considered to be **MEDIUM**.



7 MITIGATION MEASURES

7.1 Essential Mitigation Measures

- 7.1.1 The assessment of flood risk in Section 6 of this assessment confirms a **LOW** risk of flooding from all sources of flooding except for the potential implications of climate change which is considered a **MEDIUM** risk primarily from tidal sources.
- 7.1.2 The finished floor levels of the properties should be set at a minimum of 500mm above existing site levels, with flood resilient construction incorporated to a height of 300mm above the maximum predicted flood depth. This will ensure that the floor levels of the dwellings are above any anticipated flood levels expected to occur over the lifetime of the development.
- 7.1.3 Any measures implemented should be in line with the current government guidance document 'Improving the flood performance of new buildings' May 2007 (ISBN 978 1 85946 287 4).
- 7.1.4 Surface water drainage for the site should be designed to accommodate the 1 in 100 year event storm scenarios including a 30% allowance for climate change.

7.2 Recommended Mitigation Measures

- 7.2.1 All dwellings should have concrete ground floors with damp proof membranes as they are regarded as the most flood resilient floor types with effective connections between the dpc and dpm. The dpm should be between the surface screed and the concrete slab as this enables the concrete floor to dry out quickly and would also protect against any rising groundwater (unlikely) should flood risk from this source increase over the lifetime of the development.

- 7.2.2 Permeable paving to private driveways and parking areas should be utilised even if infiltration SUDS are not viable as permeable paving can be designed into a sealed system before outfall into the drainage ditch to the north of the site. This would form part of a SUDS treatment train in line with CIRIA C697.
- 7.2.3 Further investigations will be required as part of the detailed design of the drainage outfall which may require off site mitigation works to this existing drainage ditch to ensure free flow of the ditch.
- 7.2.4 Where external gradients are flat or towards the dwelling entrances, provision of linear drainage should be provided to all access points.

8 CONCLUSIONS

- 8.1 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.
- 8.2 The assessment of flood risk undertaken for this development confirms that the risk of flooding is **LOW** from all sources of flooding except for tidal sources with climate change applied which is **MEDIUM**.
- 8.3 The site is not at risk of flooding from any source present day and is situated within Flood Zone 1. Therefore safe access and egress to the properties is available if required.
- 8.4 Taking into account climate change there is a residual risk of flood water depths up to 0.5m depth and therefore mitigation measures are essential as outlined in Section 7.
- 8.5 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.
- 8.6 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 Location Plan: MA10160/SK01

Proposed Drainage Strategy: MA10160/200

Proposed Site Layout



ASSOCIATED DRAWINGS			
NO.	DATE	BY	REVISION

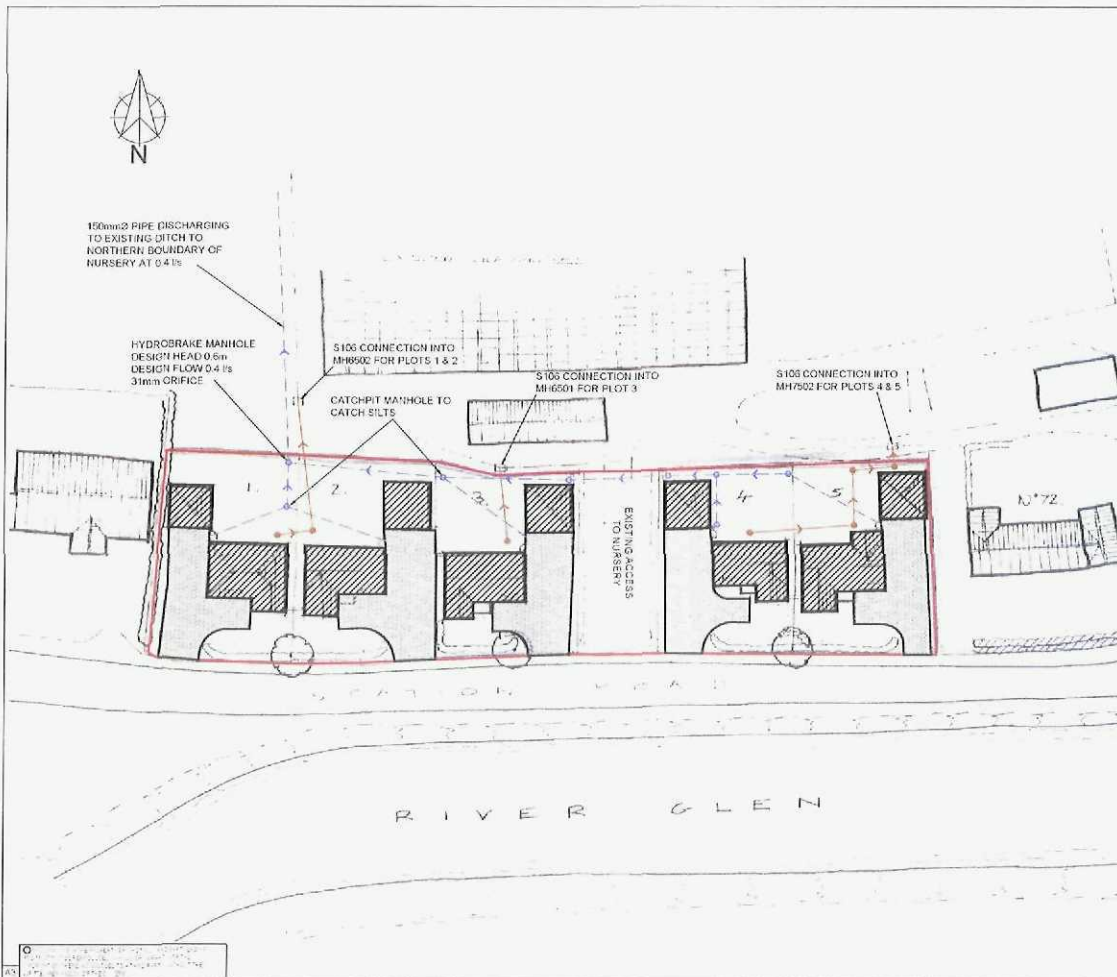
NOTES	

NO.	DATE	BY	DETAILS	CHG.

AMENDMENTS	

CLIENT	LarkfleetHomes
PROJECT	Land off Station Road Surfleet
TITLE	SITE LOCATION PLAN
PREPARED BY	MATTHEW J. SAGG
CHECKED BY	
DATE	June 2015

millward 1000 Hill Road Northampton NN4 6JG Tel: 01603 254000 Email: info@millward.co.uk Website: www.millward.co.uk	



ASSOCIATED DRAWINGS			
NO.	TITLE	DATE	BY

NOTES	
KEY	
	PRIVATE PERMEABLE PAVING (654m ²)
	DWELLING / GARAGE ROOF AREAS (635m ²)
NB ROOF AREAS DRAIN INTO PERMEABLE PAVING	

REV	DATE	BY	DETAILS	APPD

AMENDMENTS	

PROJECT	
PROPOSED RESIDENTIAL DEVELOPMENT STATION ROAD, SURFLEET	

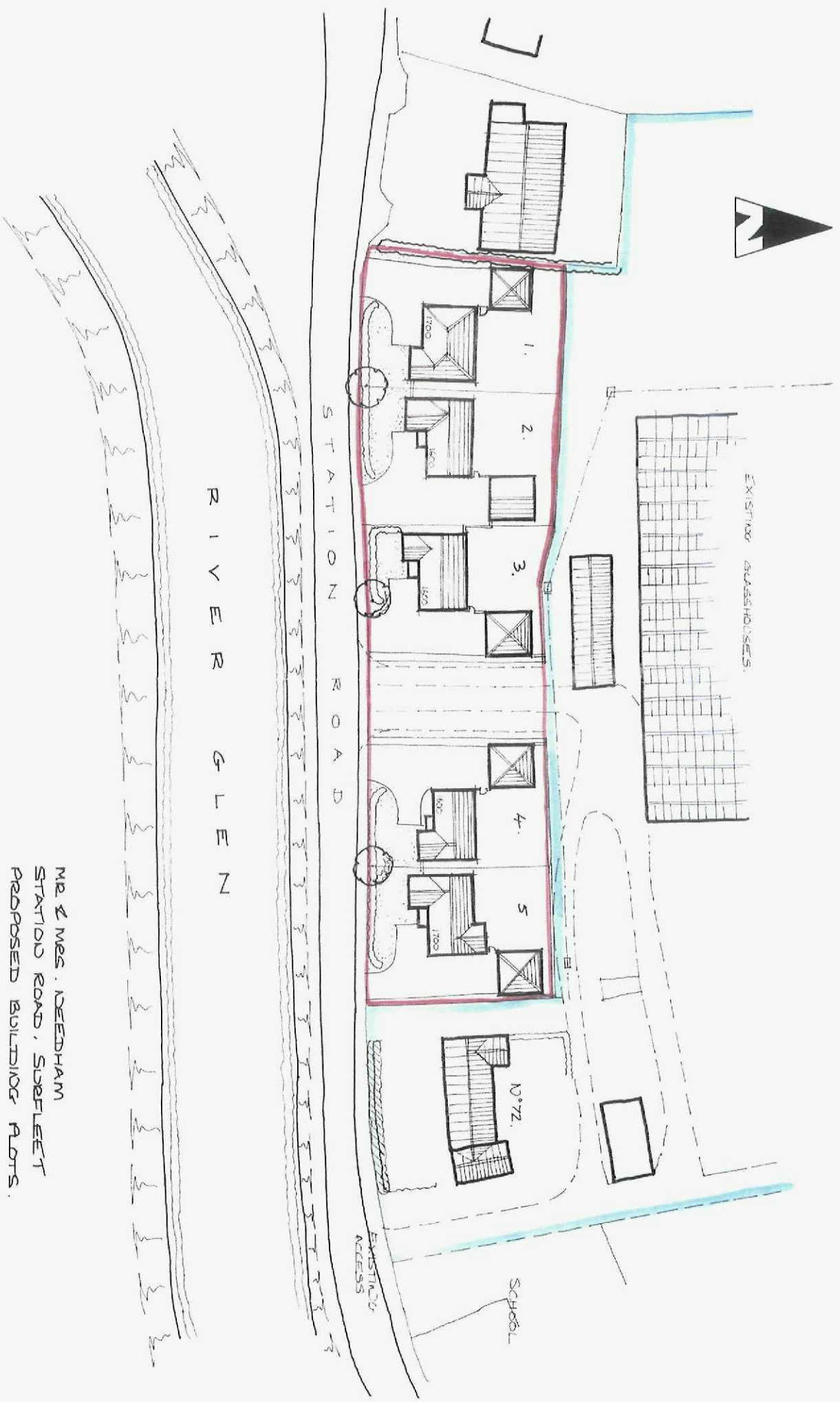
TITLE	
PROPOSED DRAINAGE STRATEGY	

DRAWING NO.		DRAWING TITLE	
MA 10165 1200		PLANS 1/20	

SCALE	DATE	DESIGNER	CHECKER	APPROVER
1:500 (A3)	01/04/15	MAK	MAK	MAK

millward	

MR & MRS. DEEDHAM
STATION ROAD, SUBFLEET
PROPOSED BUILDING PLOTS.
SKETCH LAYOUT - 5 NO PLOTS
1:500 @ A3 . NOV 2014



Appendix B – Consultations

Anglian Water Sewer Map



(c) Crown copyright and database rights 2015 Ordnance Survey 100022432

Date: 30/07/15

Scale: 1:1000

Map Centre: 525600,328528

Data updated: 15/06/15

Our Ref: 151177 - 1

Wastewater Plan A3

This plan is provided by Anglian Water pursuant to obligations under the Water Industry Act 1991 sections 188 or 199. It must be used in conjunction with any search results obtained. 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 an apparatus MUST be confirmed 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 represent 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 2015 Ordnance Survey 100022432 This map is to be used for the purposes of viewing the location of Anglian Water Point 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
Combined Sewer
Final Effluent
Rising Man
Private Sewer
Decommissioned Sewer

(Colour denotes effluent type)
(Colour denotes effluent type)
(Colour denotes effluent type)
(Colour denotes effluent type)
(Colour denotes effluent type)
(Colour denotes effluent type)
(Colour denotes effluent type)

Outfall
Inlet
Manhole
Sewage Treatment Works
Pumping Station

(Colour denotes effluent type)
(Colour denotes effluent type)
(Colour denotes effluent type)
(Colour denotes effluent type)
(Colour denotes effluent type)

Jason@milward.co.uk
MA10160

love every drop
anglianwater

Manhole Reference	Liquid Type	Cover Level	Invert Level	Depth to Invert
5401	F	4.528	1.99	2.538
5402	F	4.312	2.14	2.172
5501	F	3.507	1.475	2.032
5502	F	4.733	1.84	2.893
5503	F	4.721	3.222	1.499
5601	F	3.279	1.336	1.943
6501	F	4.101	1.919	2.182
6502	F	3.971	1.769	2.202
6503	F	4.843	3.509	1.334
6601	F	3.224	1.215	2.009
6602	F	2.756	1.472	1.284
7501	F	4.024	2.334	1.69
7502	F	3.839	2.189	1.65
8501	F	4.949	3.094	1.855
8502	F	5.231	2.934	2.297
8503	F	3.931	2.754	1.177
8504	F	4.41	2.83	1.58

Manhole Reference	Liquid Type	Cover Level	Invert Level	Depth to Invert
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Manhole Reference	Liquid Type	Cover Level	Invert Level	Depth to Invert
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Appendix C – WinDES Calculation Results

ICP SUDS Greenfield Run Off Calculation

Proposed Peak Foul Flows

Source Control Surface water drainage – permeable paving calculations

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2nd Floor Station Road Surfleet

3-7 Middle Pavement ICP SUDS

Nottingham NG1 7DX Greenfield Run Off

Date July 2015 Designed By JMcK

File Checked By

Micro Drainage Source Control W.12.4



ICP SUDS Mean Annual Flood

Input

Return Period (years)	1	Soil	0.300
Area (ha)	0.284	Urban	0.000
SAAR (mm)	567	Region Number	Region 5

Results l/s

QBAR Rural	0.4
QBAR Urban	0.4

Q1 year	0.4
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Q1 year	0.4
Q30 years	1.0
Q100 years	1.4

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3-7 Middle Pavement	Foul Drainage Flows	
Nottingham NG1 7DX		
Date July 2015	Designed By JMcK	
File MA10160 Foul Flow...	Checked By	
Micro Drainage	Network W.12.4	

FOUL SEWERAGE DESIGN

Design Criteria for Foul - Main

Pipe Sizes STANDARD Manhole Sizes STANDARD

Industrial Flow (l/s/ha)	0.00	Add Flow / Climate Change (%)	0
Industrial Peak Flow Factor	0.00	Minimum Backdrop Height (m)	0.200
Flow Per Person (l/per/day)	222.00	Maximum Backdrop Height (m)	1.500
Persons per House	3.00	Min Design Depth for Optimisation (m)	1.200
Domestic (l/s/ha)	0.00	Min Vel for Auto Design only (m/s)	0.75
Domestic Peak Flow Factor	6.00	Min Slope for Optimisation (1:X)	500

Designed with Level Soffits

Network Design Table for Foul - Main

PN	Length (m)	Fall (m)	Slope (1:X)	Area (ha)	Houses	DWF (l/s)	k (mm)	HYD SECT	DIA (mm)
1.000	10.000	0.067	150.0	0.000	5	0.0	1.500	o	150

Network Results Table

PN	US/IL (m)	Σ Area (ha)	Σ DWF (l/s)	Σ Hse	Add Flow (l/s)	P.Dep (mm)	P.Vel (m/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
1.000	4.500	0.000	0.0	5	0.0	14	0.27	0.71	12.6	0.2

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Nottingham NG1 7DX	Prelim Strategy	
Date July 2015	Designed By JMcK	
File MA10160 Permeable...	Checked By	
Micro Drainage	Source Control W.12.4	

Summary of Results for 100 year Return Period (+30%)

Half Drain Time : 2003 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max E Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	6.381	0.181	0.0	0.3	0.3	25.9	O K
30 min Summer	6.437	0.237	0.0	0.3	0.3	34.8	O K
60 min Summer	6.494	0.294	0.0	0.3	0.3	44.0	O K
120 min Summer	6.552	0.352	0.0	0.3	0.3	53.1	O K
180 min Summer	6.584	0.384	0.0	0.3	0.3	58.2	O K
240 min Summer	6.604	0.404	0.0	0.3	0.3	61.5	O K
360 min Summer	6.629	0.429	0.0	0.4	0.4	65.5	O K
480 min Summer	6.646	0.446	0.0	0.4	0.4	68.1	O K
600 min Summer	6.656	0.456	0.0	0.4	0.4	69.7	O K
720 min Summer	6.663	0.463	0.0	0.4	0.4	70.8	O K
960 min Summer	6.669	0.469	0.0	0.4	0.4	71.8	O K
1440 min Summer	6.665	0.465	0.0	0.4	0.4	71.2	O K
2160 min Summer	6.652	0.452	0.0	0.4	0.4	69.1	O K
2880 min Summer	6.638	0.438	0.0	0.4	0.4	66.9	O K
4320 min Summer	6.609	0.409	0.0	0.4	0.4	62.3	O K
5760 min Summer	6.582	0.382	0.0	0.3	0.3	58.0	O K
7200 min Summer	6.558	0.358	0.0	0.3	0.3	54.1	O K
8640 min Summer	6.535	0.335	0.0	0.3	0.3	50.4	O K

Storm Event	Rain (mm/hr)	Time-Peak (mins)
15 min Summer	121.269	27
30 min Summer	79.695	42
60 min Summer	49.937	72
120 min Summer	30.267	130
180 min Summer	22.297	190
240 min Summer	17.851	250
360 min Summer	12.957	368
480 min Summer	10.330	486
600 min Summer	8.659	606
720 min Summer	7.492	724
960 min Summer	5.959	962
1440 min Summer	4.309	1376
2160 min Summer	3.110	1712
2880 min Summer	2.466	2084
4320 min Summer	1.775	2904
5760 min Summer	1.405	3752
7200 min Summer	1.171	4552
8640 min Summer	1.008	5368

2nd Floor Station Road Surfleet

3-7 Middle Pavement Permeable Pavement

Nottingham NG1 7DX Prelim Strategy

Date July 2015 Designed By JMcK

File MA10160 Permeable... Checked By

Micro Drainage Source Control W.12.4



Summary of Results for 100 year Return Period (+30%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max E Outflow (l/s)	Max Volume (m³)	Status
10080 min Summer	6.513	0.313	0.0	0.3	0.3	47.0	O K
15 min Winter	6.402	0.202	0.0	0.3	0.3	29.4	O K
30 min Winter	6.465	0.265	0.0	0.3	0.3	39.4	O K
60 min Winter	6.530	0.330	0.0	0.3	0.3	49.7	O K
120 min Winter	6.595	0.395	0.0	0.3	0.3	60.0	O K
180 min Winter	6.631	0.431	0.0	0.4	0.4	65.8	O K
240 min Winter	6.655	0.455	0.0	0.4	0.4	69.6	O K
360 min Winter	6.684	0.484	0.0	0.4	0.4	74.2	O K
480 min Winter	6.704	0.504	0.0	0.4	0.4	77.3	Flood Risk
600 min Winter	6.717	0.517	0.0	0.4	0.4	79.4	Flood Risk
720 min Winter	6.725	0.525	0.0	0.4	0.4	80.8	Flood Risk
960 min Winter	6.735	0.535	0.0	0.4	0.4	82.3	Flood Risk
1440 min Winter	6.736	0.536	0.0	0.4	0.4	82.5	Flood Risk
2160 min Winter	6.719	0.519	0.0	0.4	0.4	79.8	Flood Risk
2880 min Winter	6.703	0.503	0.0	0.4	0.4	77.2	Flood Risk
4320 min Winter	6.665	0.465	0.0	0.4	0.4	71.2	O K
5760 min Winter	6.627	0.427	0.0	0.4	0.4	65.1	O K
7200 min Winter	6.591	0.391	0.0	0.3	0.3	59.5	O K
8640 min Winter	6.559	0.359	0.0	0.3	0.3	54.2	O K

Storm Event	Rain (mm/hr)	Time-Peak (mins)
10080 min Summer	0.889	6160
15 min Winter	121.269	27
30 min Winter	79.695	41
60 min Winter	49.937	70
120 min Winter	30.267	128
180 min Winter	22.297	186
240 min Winter	17.851	244
360 min Winter	12.957	362
480 min Winter	10.330	478
600 min Winter	8.659	594
720 min Winter	7.492	710
960 min Winter	5.959	938
1440 min Winter	4.309	1378
2160 min Winter	3.110	1800
2880 min Winter	2.466	2220
4320 min Winter	1.775	3156
5760 min Winter	1.405	4040
7200 min Winter	1.171	4912
8640 min Winter	1.008	5792

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2nd Floor Station Road Surfleet

3-7 Middle Pavement Permeable Pavement

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Date July 2015 Designed By JMCK

File MA10160 Permeable... Checked By

Micro Drainage Source Control W.12.4



Summary of Results for 100 year Return Period (+30%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max E Outflow (l/s)	Max Volume (m ³)	Status
10080 min Winter	6.528	0.328	0.0	0.3	0.3	49.4	O K

Storm Event	Rain (mm/hr)	Time-Peak (mins)
10080 min Winter	0.889	6656

2nd Floor	Station Road Surfleet
3-7 Middle Pavement	Permeable Pavement
Nottingham NG1 7DX	Prelim Strategy
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Model Details

Storage is Online Cover Level (m) 7.000

Porous Car Park Structure

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	29.8
Membrane Percolation (mm/hr)	1000	Length (m)	17.8
Max Percolation (l/s)	147.3	Slope (1:X)	500.0
Safety Factor	1.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	6.200	Cap Volume Depth (m)	0.600

Hydro-Brake® Outflow Control

Design Head (m)	0.600	Diameter (mm)	31
Design Flow (l/s)	0.4	Invert Level (m)	6.200
Hydro-Brake® Type Md6 SW Only			

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	0.2	1.200	0.6	3.000	0.9	7.000	1.5
0.200	0.3	1.400	0.6	3.500	1.0	7.500	1.5
0.300	0.3	1.600	0.7	4.000	1.1	8.000	1.6
0.400	0.3	1.800	0.7	4.500	1.2	8.500	1.6
0.500	0.4	2.000	0.8	5.000	1.2	9.000	1.6
0.600	0.4	2.200	0.8	5.500	1.3	9.500	1.7
0.800	0.5	2.400	0.8	6.000	1.3		
1.000	0.5	2.600	0.9	6.500	1.4		

