

MA11407 FRA-R01

Station Road
Surfleet PE11 4DB

Flood Risk Assessment

January 2021



REVISION

Reference	Revision	Author	Date
MA11407 FRA-R01	Initial Issue for Planning	JMcK	Jan 2021

CONTENTS

1. INTRODUCTION	4
2 THE SITE.....	5
3 CONSULTATIONS	7
4 SEQUENTIAL AND EXCEPTION TESTS.....	9
5 PROPOSED DEVELOPMENT & DRAINAGE STRATEGY	11
6 FLOOD RISK.....	13
7 MITIGATION MEASURES	18
8 CONCLUSIONS.....	21

APPENDICIES

Appendix A – Drawings

Site Location Plan: MA11407/ 001
Proposed Site Layout: 3086-S01 Proposed
Drainage Strategy: MA11407/200

Appendix B – Consultations

Anglian Water Sewer Map

Appendix C – Calculations

UK SUDS Greenfield Run Off Calculations
Infiltration Test Letter
Proposed Peak Foul Flows
Plot Soakaway calculations
Proposed highway drainage calculations.

1. INTRODUCTION

- 1.2 Millward have been appointed to undertake a Flood Risk Assessment (FRA) for a proposed residential development for 10 plots on land adjacent to 72 Station Road, Surfleet PE11 4DB.
- 1.1 The land is immediately to the rear of the proposed residential development of 5 units which front onto Station Road (Planning Approval reference: H17-0798-15).
- 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 the most recent SFRA for South-East Lincolnshire which uses data provided by the South Holland District SFRA.

2 THE SITE

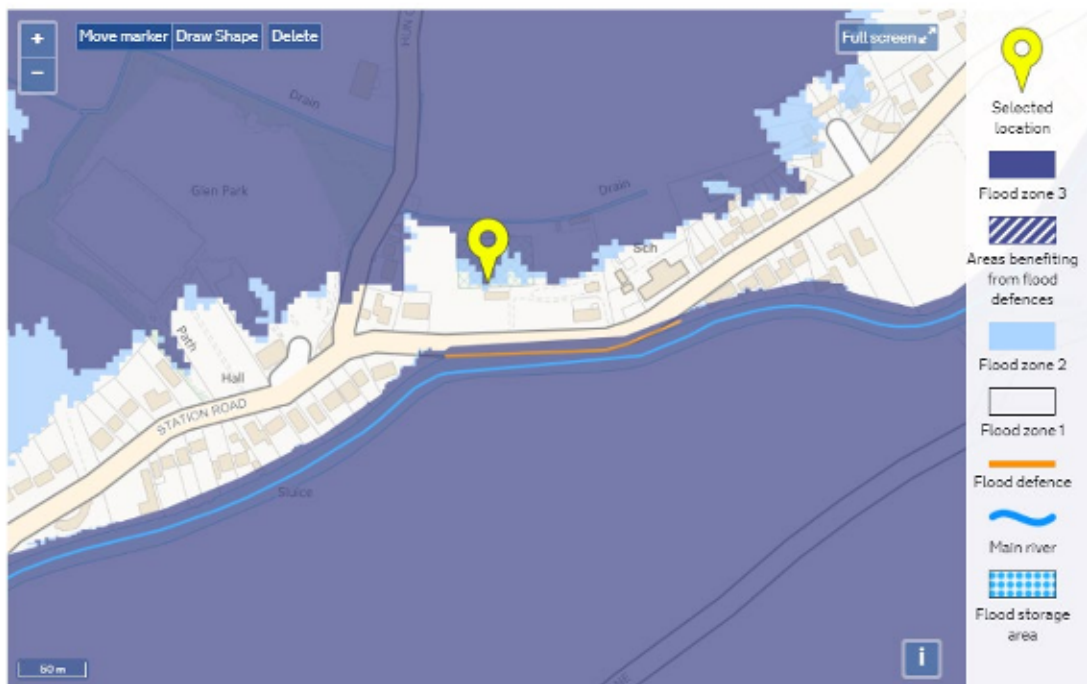
- 2.1 This proposed residential development is located to the north side of Station Road on Brownfield Land in Surfleet, totalling 0.954 Hectares in area. The site is located within the urban extents of Surfleet approximately 5miles north of the centre of Spalding. The site location is shown on drawing MA11407/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 which connects through to Station Road via the planning approved layout (Ref: H17-0798-15).
- 2.3 The site is currently developed as a nursery with the site area for development which includes Glasshouses and arable land for growing of plants. Whilst currently developed land, the Glasshouses do not look to have formal drainage taking the rainwater run-off to any drainage system. Indeed, from a site visit there was no evidence of formal drainage taking the roof drainage of these Glasshouses. 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 and with the topography of the land falling circa 1m to the northern boundary away from Station Road and the River Glen surface water connectivity to the River or the road is unlikely.
- 2.5 There is an existing drainage ditch located to the northern boundary of the site approximately 400mm-600mm deep which drains to the west along the northern boundary.
- 2.6 This ditch then runs north essentially parallel to Hun Gate into the wider ditch network. From the site visit undertaken, the ditch becomes deeper once parallel to Hun Gate.
- 2.7 Existing site levels fall south to north towards this existing ditch and whilst the nursery development may not have had any formal drainage outfalls into the ditch, the land generally falls such that the natural drainage flow routes (either across the surface or within the soil) would be towards this ditch. Therefore, the receptor for surface water run-off is this ditch to the north.

- 2.8 It is concluded that the land will currently drain via natural percolation into the topsoil and sub-soils (if permeable) and ultimately into the drainage ditch to the northern boundary.
- 2.9 Infiltration testing has been undertaken by Bates Environmental which confirms that three tests were undertaken on site in line with the building regulations guidelines. Trial holes were 1m³ with invert 1m below existing ground levels and drained within 90 minutes for each test location. This provides an infiltration rate of 0.669mm/hr (0.185mm/s). No groundwater present on the dates of the 3rd, 4th and 5th February 2021. The letter is contained within Appendix C.
- 2.10 Site levels within the development area vary from circa 5m AOD to the frontage of the site (Southern boundary which is Station Road) to circa 3.42m AOD to the north east corner of the site. The average gradient across the site south to north is circa 1:70 towards the northern boundary ditch.
- 2.11 The site currently has glasshouses and other structures on it but no evidence of formal surface water drainage. Therefore, the site surface water run-off for the existing scenario has been calculated by the HR Wallingford greenfield runoff tool which confirms a Greenfield Run Off Rate (QBAR) of 1.37 l/s (Rounded to 1.4l/s).
- 2.12 Note 1 of the Greenfield run off estimation confirms when QBAR is less than 2 l/s/ha then limiting discharge rates are set at 2.0l/s/ha.
- 2.13 Also ,in accordance with HR Wallingford Greenfield Run Off, a 5 l/s minimum rate applies for surface water discharge. This rate applies for proposed development up to and including the 1 in 100 year event including 40% allowance for climate change.

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 partially within Flood Zone 1 2 and 3 which in accordance with Table 1 of the NPPF Technical Guidance document, is defined as Low Probability, Medium and High Probability of flooding.



- 3.1.3 There are existing flood defences identified to the southern side of Station Road which could potentially protect the site from flooding although the EA mapping does not identify the site as benefiting from flood defences.
- 3.1.4 The EA have confirmed that they only hold basic flood mapping in this area (Product 1) and therefore they have confirmed the hazard mapping in the South Holland SFRA should be assessed and the site specific FRA should be based on the hazard mapping provided within the SFRA.

3.1.5 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. The southern part of the site is contained within Flood Zone 1 with the northern portion of the site within Flood Zone 3. This generally correlates as the topographical survey shows a slight gradient and reduction in levels to the northern boundary adjacent to the existing drainage ditch.

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 southern side 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 is 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) Flood Zone 2 (Medium Probability) and Flood Zone 3 (High Probability) as defined in Table 1 (Flood zones) of the technical guidance document for the NPPF. These flood zones allocations do not take into account the extensive flood defences in the area which protects the whole region.
- 4.1.2 In accordance with the NPPF, the SFRA data refines the information on the probability of flooding, taking other sources of flooding and the impacts of climate change into account. SFRA's provide the basis for applying the Sequential Test.
- 4.1.3 There are very minor pockets of Flood Zone 1 areas which this some of this site is part of.
- 4.1.4 Upon review of the SFRA data and map 5, the site is outside the high risk areas taking the flood defences into account with the high risk area in Surfleet to the south of the development site (south of the watercourse adjacent to Station Road).
- 4.1.5 The SFRA states that (the district overall) allowing for the presence of flood defences and other flood risk management measures, most of the district can be classified as having Medium to Low probability of flooding.
- 4.1.6 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.
- 4.1.7 Table 3, (Flood risk vulnerability and flood zone 'compatibility') confirms that development classified as 'More vulnerable' development in Flood Zone 1 (Low Probability) or Flood Zone 2 (Medium Probability) is considered appropriate without applying the Exception Test.
- 4.1.8 In terms of Sequential Test, there are no areas within a lower flood risk zone in the Surfleet area or the wider region upon review of the SFRA information on actual flood risk taking into account the presence of flood defences and other flood mitigation measures.

- 4.1.9 As the development principle of residential is deemed appropriate in terms of Sequential Test, the Exception Test does not apply.

5 PROPOSED DEVELOPMENT & DRAINAGE STRATEGY

- 5.1 The proposed development proposals consist of 10no dwellings in total with associated driveways and garages (off road) and garden areas to the front and rear of the proposed dwellings. The site is accessed by a central cul-de-sac access road which then accesses the western and eastern portions of the site via an internal junction. There are two turning heads within the site to enable a refuse or emergency vehicle to turn around meaning that such vehicles can enter and exit the site in a forward gear. The proposed plan layout of the development is shown on the proposed site layout contained within in Appendix A.
- 5.2 The impermeable areas of the proposed site are (0.564Ha) as shown on drawing MA11407/200 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 for the surface water drainage are to utilise permeable driveways to drain the driveway areas via infiltration.
- 5.4 Roof drainage from the dwellings and garages are to rain into a cellular soakaway for each individual plot.
- 5.5 Highway drainage will drain into an infiltration filter strip via a free drain edge. The surface water run-off from the highway will outfall into the existing drainage ditch to the northern boundary of the site. The run off rate will be restricted to 5l/s maximum and the rate controlled by a vortex flow control before outfall into the ditch as shown on drawing MA11407/200 contained within Appendix A.
- 5.6 Utilising microdrainage network and source control software, based upon the proposed impermeable areas (and adding 10% for urban creep of these surfaces) the estimated volume of attenuation if infiltration has been calculated for the 1 in 100 year event including climate change allowance with the outflow restricted to 5 l/s maximum.
- 5.7 Attenuation volume for the highway drainage is within the 600mm pipes before outfall into the watercourse at 5l/s maximum as an over flow at the 1 in 100 year event. The filter strips at the side of the highway utilise infiltration for the lower storm events.

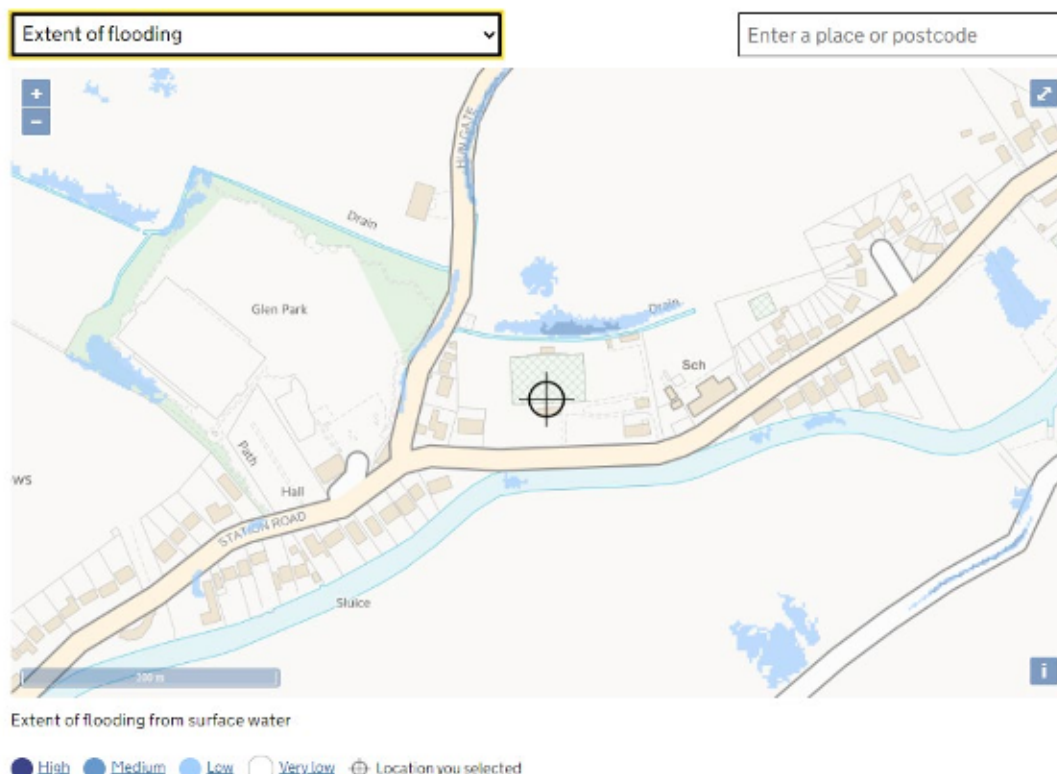
- 5.8 The surface water drainage strategy is preliminary and is subject to detailed design should the site obtain planning, but the preliminary strategy provides evidence that there is a surface drainage solution for this site.
- 5.9 Foul drainage would connect into the existing Anglian Water sewer network to the western boundary of the site with anticipated peak foul flows of circa 1.1 l/s into the existing sewer as shown on drawing MA10478/201 contained within Appendix A. These connections would of course be subject to a S106 connection approval from Anglian water as part of the planning and detailed design process.
- 5.10 The proposed connection point is downstream of the approved connection point to make the proposed system more cost efficient. This is essentially outfalling into the same system but just into the next downstream pipe in the system.

6 FLOOD RISK

6.1 Flooding From Fluvial and Tidal Sources

- 6.1.1 The development area is shown within Low to Medium Probability areas from watercourses and other sources of flooding according to the SFRA maps.
- 6.1.2 The closest area of high risk flooding is to the south of Station Road on lower lying land.
- 6.1.3 The South Holland SFRA 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 SFRA information available.

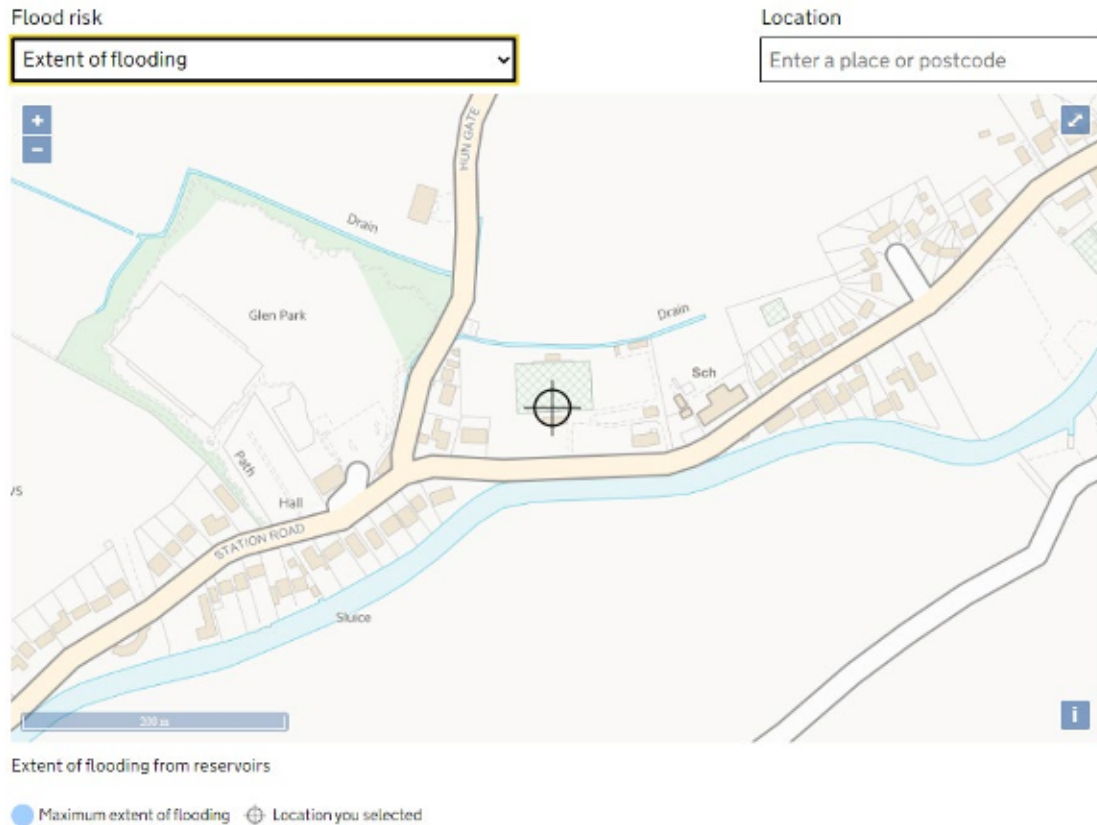
6.2 Flooding From Land / Adjacent Development



- 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 The plan above confirms that there is no apparent risk on the site. Any risk is contained to the north of the development site beyond the watercourse.
- 6.2.4 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.
- 6.2.5 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 potentially 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 south 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 within the site area. Therefore, finished floor levels of the proposed plots should be above the adjacent highway to ensure flow routes are not towards the internals of the dwellings.
- 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 Off-Site Flood Risks

- 6.6.1 The site proposals along with the proposed drainage strategy outlined in Section 5 will intercept drainage run off from the development in filter drains, potential perimeter land drains and attenuation tanks which will be designed to accommodate the 1 in 100 year event scenario (including 40% allowance for climate change) without flooding.
- 6.6.2 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 and there will be an overflow system in place to ensure any exceedance water does not flow into other land.

6.7 Flooding from Climate Change

- 6.7.1 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).
- 6.7.2 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.
- 6.7.3 The SFRA plans show that the existing Station Road is at the limits of anticipated flooding.
- 6.7.4 The proposed site drainage will however be designed not to flood with an allowance of 40% for climate change in line with the NPPF technical guidance document.
- 6.7.5 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 from watercourses (**HIGH**) 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 no lower than the existing Station Road or a minimum of 300mm above existing levels whichever is the higher. 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 Upon review of the topographical survey of the site which includes Station Road to the south, the minimum finished floor level on the site should be 5.0m AOD which matches the level of Station Road.
- 7.1.4 Surface water drainage for the site should be designed to accommodate the 1 in 100 year event storm scenarios including a 40% 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.
- 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 C753.
- 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 From preliminary assessment from the site visit, the ditch should be excavated out to make it deeper and the culvert under the pumping station access should have remedial works undertaken to the headwall area to ensure free flow of water.

- 7.2.5 Where external gradients are flat or towards the dwelling entrances, provision of linear drainage should be provided to all access points.

7.3 Recommended Mitigation Measures

- 7.3.1 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 east of the site. This would form part of a SUDS treatment train in line with CIRIA C753, subject to SAB approvals.
- 7.3.2 It is recommended that FFL to properties should be above any adjacent roads levels where possible.
- 7.3.3 Where external gradients are flat or towards the dwelling entrances, provision of linear drainage should be provided to the level threshold access points only.
- 7.3.4 Plaster work at ground floor to be laid with the boarding horizontal which allows for easy replacement at the lower level without excessive breaking out or cutting of plasterboard.

8 CONCLUSIONS

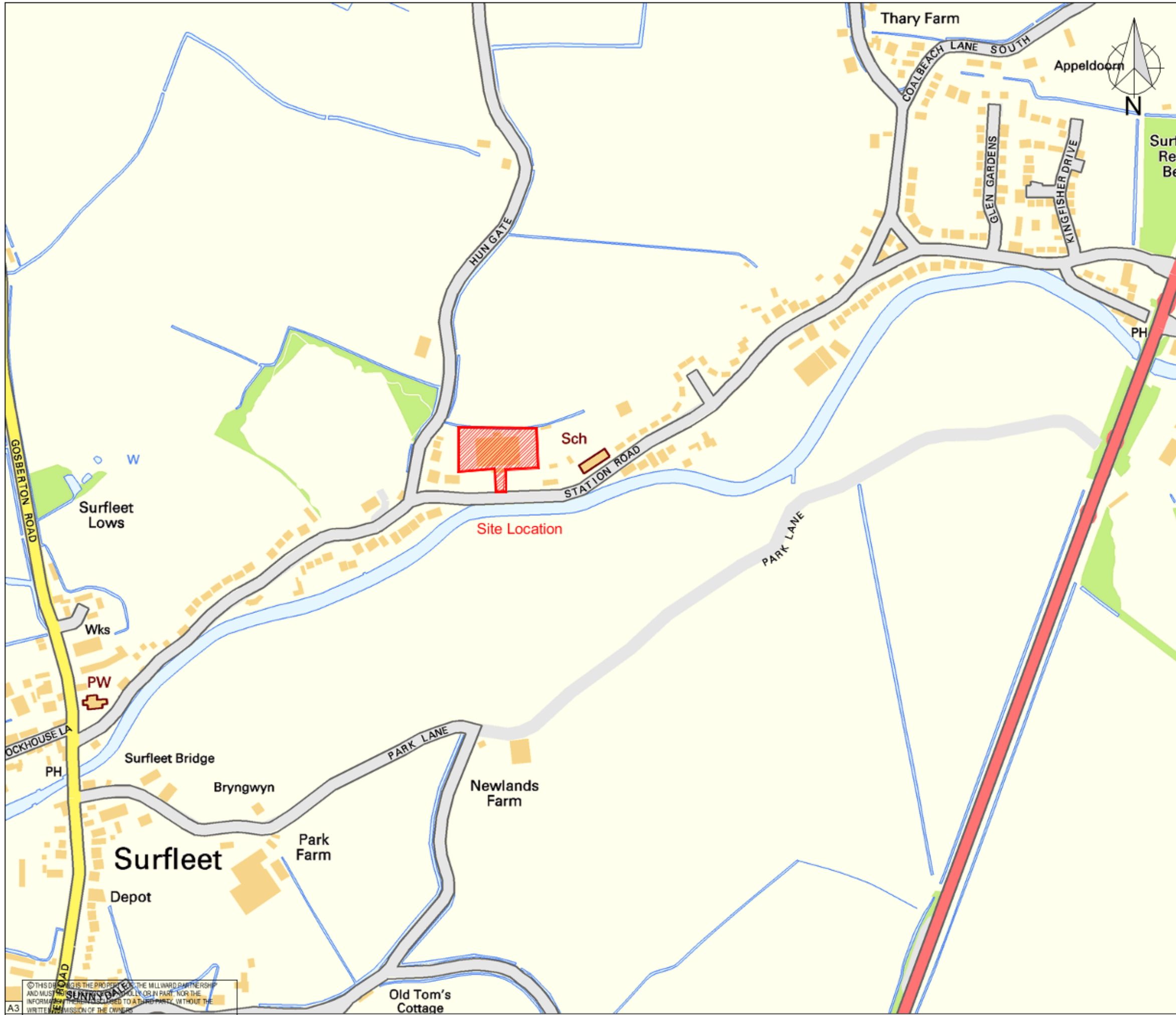
- 8.1 This Flood Risk Assessment serves to review, assess and quantify (where applicable) the sources, or any potential flooding, the pathways of this flooding and potential receptors within the vicinity of the site.
- 8.2 The mitigation measures will provide further protection to the development and 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.
- 8.3 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: MA11407/ 001

Proposed Site Layout: 3086-S01 Proposed

Drainage Strategy: MA11407/200



ASSOCIATED DRAWINGS				
No.	TITLE			

NOTES				

REV	DATE	BY	DETAILS	CHKD

AMENDMENTS	
CLIENT	M Yould

PROJECT	
Proposed Residential Development 72 Station Rd Surfleet	

TITLE	
Site Location Plan	

DRAWING No.	DRAWING STATUS
MA11407/001	PLANNING

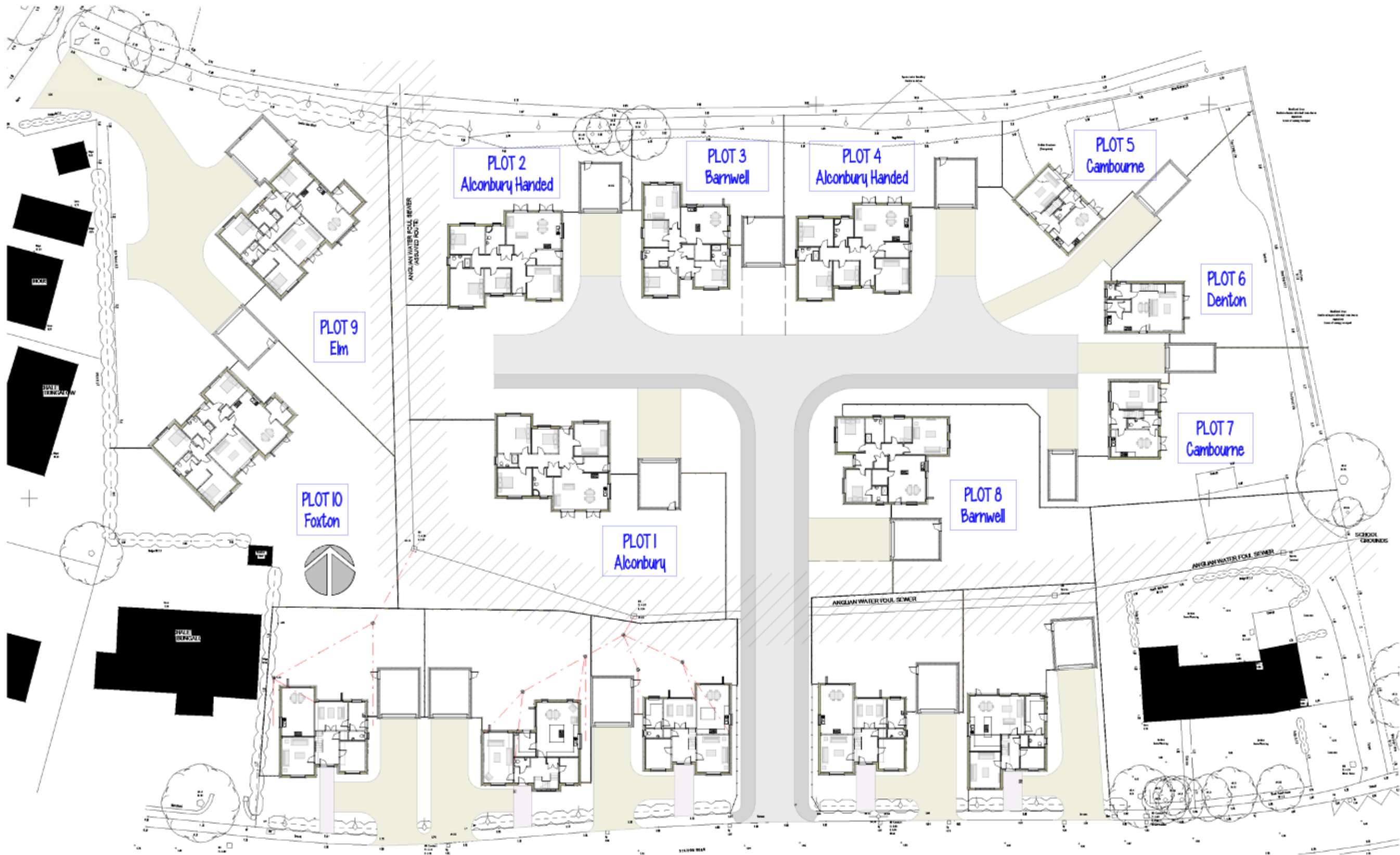
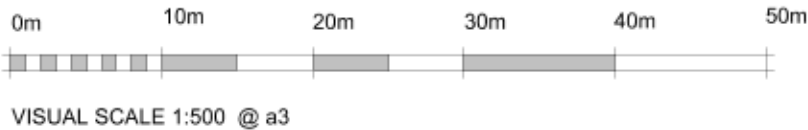
SCALE	DRAWN	ENGINEER
NTS	JMcK	JMcK

DATE	CHECKED	APPROVED BY
Jan 21	JMcK	JMcK



1 Main Hill, Nottingham, NG1 1JQ.
t: 0115 941 4580
w: www.millward.co.uk
e: info@millward.co.uk







ASSOCIATED DRAWINGS	
No.	TITLE
NOTES	

Anglian Water
Foul Sewer Easement (6m)

Infiltration Rate for
soakways and
permeable driveways
0.669m/hr

REV	DATE	BY	DETAILS	CHKD
AMENDMENTS				
CLIENT				
Mr M Yould				
PROJECT				
Proposed Residential Development 72 Station Road Surfleet				
TITLE				
Proposed Drainage Strategy				
DRAWING No:				DRAWING STATUS
MA11407/200				PLANNING

SCALE	1:250 at A1	DRAWN	JMcK	ENGINEER	JMcK
DATE	Jan 21	CHECKED	JMcK	APPROVED BY	JMcK



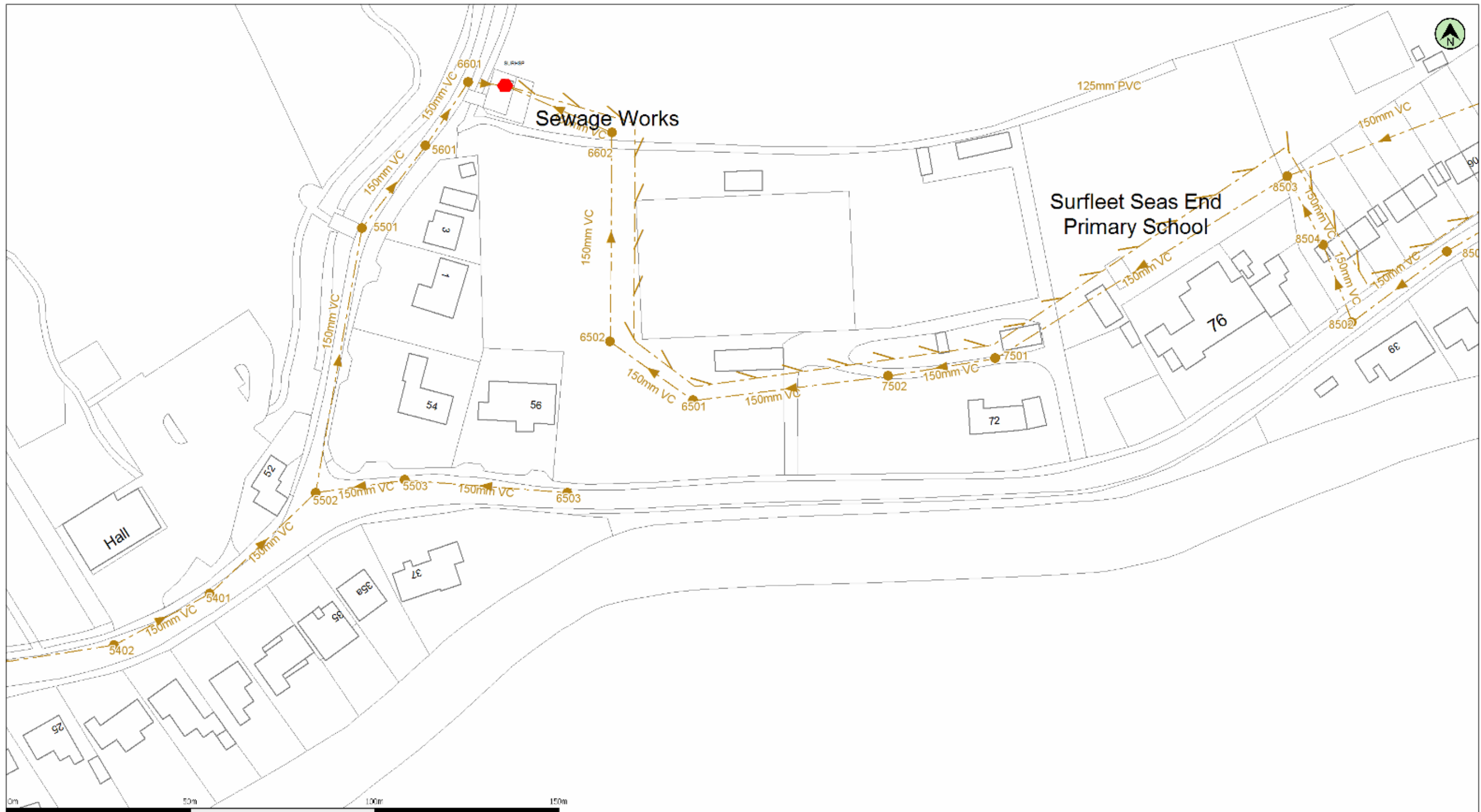
1 Main Hill, Nottingham, NG1 1JQ.
t: 0115 941 4560
w: www.millward.co.uk
e: info@millward.co.uk



Different through Design

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: 525680,328528

Data updated: 15/06/15

Our Ref: 151177 - 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 2015 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	---	Outfall	⬅
Surface Sewer	---	(Colour denotes effluent type)	
Combined Sewer	---	Inlet	➡
Final Effluent	---	(Colour denotes effluent type)	
Rising Main	7-7-7-7	Manhole	●
(Colour denotes effluent type)		(Colour denotes effluent type)	
Private Sewer	---	Sewage Treatment Works	□
(Colour denotes effluent type)		Pumping Station	●
Decommissioned Sewer	---		
(Colour denotes effluent type)			

jason@millward.co.uk
MA10160



Appendix C – Calculations

UK SUDS Greenfield Run Off Calculations

Infiltration Test Letter

Proposed Peak Foul Flows

Plot Soakaway calculations

Proposed highway drainage calculations.

Calculated by:	Jason McKellar
Site name:	MA11407
Site location:	Station Rd Surfleet

This is an estimation of the greenfield runoff rates that are used to meet normal best practice criteria in line with Environment Agency guidance "Rainfall runoff management for developments", SC030219 (2013), the SuDS Manual C753 (Ciria, 2015) and the non-statutory standards for SuDS (Defra, 2015). This information on greenfield runoff rates may be the basis for setting consents for the drainage of surface water runoff from sites.

Site Details

Latitude:	52.83991° N
Longitude:	0.13542° W
Reference:	778989706
Date:	Jan 31 2021 14:02

Runoff estimation approach

IH124

Site characteristics

Total site area (ha):	0.954
-----------------------	-------

Methodology

Q_{BAR} estimation method:	Calculate from SPR and SAAR
SPR estimation method:	Calculate from SOIL type

Soil characteristics

	Default	Edited
SOIL type:	2	2
HOST class:	N/A	N/A
SPR/SPRHOST:	0.3	0.3

Hydrological characteristics

	Default	Edited
SAAR (mm):	560	560
Hydrological region:	5	5
Growth curve factor 1 year:	0.87	0.87
Growth curve factor 30 years:	2.45	2.45
Growth curve factor 100 years:	3.56	3.56
Growth curve factor 200 years:	4.21	4.21

Notes

(1) Is $Q_{BAR} < 2.0$ l/s/ha?

When Q_{BAR} is < 2.0 l/s/ha then limiting discharge rates are set at 2.0 l/s/ha.

(2) Are flow rates < 5.0 l/s?

Where flow rates are less than 5.0 l/s consent for discharge is usually set at 5.0 l/s if blockage from vegetation and other materials is possible. Lower consent flow rates may be set where the blockage risk is addressed by using appropriate drainage elements.

(3) Is $SPR/SPRHOST \leq 0.3$?

Where groundwater levels are low enough the use of soakaways to avoid discharge offsite would normally be preferred for disposal of surface water runoff.

Greenfield runoff rates

	Default	Edited
Q_{BAR} (l/s):	1.34	1.34
1 in 1 year (l/s):	1.17	1.17
1 in 30 years (l/s):	3.28	3.28
1 in 100 year (l/s):	4.77	4.77
1 in 200 years (l/s):	5.64	5.64

This report was produced using the greenfield runoff tool developed by HR Wallingford and available at www.uksuds.com. The use of this tool is subject to the UK SuDS terms and conditions and licence agreement, which can both be found at www.uksuds.com/terms-and-conditions.htm. The outputs from this tool are estimates of greenfield runoff rates. The use of these results is the responsibility of the users of this tool. No liability will be accepted by HR Wallingford, the Environment Agency, CEH, Hydrosolutions or any other organisation for the use of this data in the design or operational characteristics of any drainage scheme.



58 64 Station Street, Donington, Spalding, Lincs, PE11 4UJ
Tel: 0800 043 37 11 Fax: 01775 822 983
www.bates-environmental.co.uk

F.A.O M Yould

Re: Needhams Nursery, Station Road, Surfleet

08th February 2021

As requested on the 03rd, 04th & 05th of February 2021 we carried out the percolation tests as detailed below. The tests were carried out by I Bates on behalf of Bates Environmental Ltd. He has over 30 years experience carrying out these tests and within the drainage sector. The test were carried out in accordance with Building regulations and Environmental Agency guidelines.

Evenly spaced throughout the above detailed site.

After carrying out 3 trial holes spread across the site over three days during dry and normal weather using the standard calculation the findings are for a drainage field area of

90 minutes (5,400 Seconds) Average over the three holes over the three days.

As per 5.3 Part H building regs equates to = 22.5m² (Total)

Please note soakaways should be 5 m from any property and 2.5m from any boundary.

As Per 5.3, Part H we would also recommend that each section of roof has its own soakaway.

A handwritten signature in black ink, appearing to read "S Bates".

S Bates BSc (Hons) NEBOSH

Manager

Bates Environmental Ltd

The Millward Partnership				Page 1																																																																																																																																																																																																																			
1 Malin Hill Nottingham NG1 1JQ		MA11407 Station Rd Surfleet House Soakaway																																																																																																																																																																																																																					
Date 12/02/2021 12:04 File MA11407-Plot 1 PD.SRCX		Designed by JMcK Checked by																																																																																																																																																																																																																					
XP Solutions		Source Control 2017.1.2																																																																																																																																																																																																																					
<u>Summary of Results for 100 year Return Period (+40%)</u> Half Drain Time : 86 minutes. <table><thead><tr><th>Storm Event</th><th>Max Level (m)</th><th>Max Depth (m)</th><th>Max Infiltration (l/s)</th><th>Max Volume (m³)</th><th>Status</th></tr></thead><tbody><tr><td>15 min Summer</td><td>4.027</td><td>0.227</td><td>0.7</td><td>4.3</td><td>O K</td></tr><tr><td>30 min Summer</td><td>4.081</td><td>0.281</td><td>0.7</td><td>5.3</td><td>O K</td></tr><tr><td>60 min Summer</td><td>4.111</td><td>0.311</td><td>0.7</td><td>5.9</td><td>O K</td></tr><tr><td>120 min Summer</td><td>4.108</td><td>0.308</td><td>0.7</td><td>5.9</td><td>O K</td></tr><tr><td>180 min Summer</td><td>4.092</td><td>0.292</td><td>0.7</td><td>5.6</td><td>O K</td></tr><tr><td>240 min Summer</td><td>4.073</td><td>0.273</td><td>0.7</td><td>5.2</td><td>O K</td></tr><tr><td>360 min Summer</td><td>4.031</td><td>0.231</td><td>0.7</td><td>4.4</td><td>O K</td></tr><tr><td>480 min Summer</td><td>3.995</td><td>0.195</td><td>0.7</td><td>3.7</td><td>O K</td></tr><tr><td>600 min Summer</td><td>3.962</td><td>0.162</td><td>0.7</td><td>3.1</td><td>O K</td></tr><tr><td>720 min Summer</td><td>3.933</td><td>0.133</td><td>0.7</td><td>2.5</td><td>O K</td></tr><tr><td>960 min Summer</td><td>3.888</td><td>0.088</td><td>0.7</td><td>1.7</td><td>O K</td></tr><tr><td>1440 min Summer</td><td>3.849</td><td>0.049</td><td>0.7</td><td>0.9</td><td>O K</td></tr><tr><td>2160 min Summer</td><td>3.836</td><td>0.036</td><td>0.5</td><td>0.7</td><td>O K</td></tr><tr><td>2880 min Summer</td><td>3.829</td><td>0.029</td><td>0.4</td><td>0.5</td><td>O K</td></tr><tr><td>4320 min Summer</td><td>3.821</td><td>0.021</td><td>0.3</td><td>0.4</td><td>O K</td></tr><tr><td>5760 min Summer</td><td>3.817</td><td>0.017</td><td>0.2</td><td>0.3</td><td>O K</td></tr><tr><td>7200 min Summer</td><td>3.814</td><td>0.014</td><td>0.2</td><td>0.3</td><td>O K</td></tr><tr><td>8640 min Summer</td><td>3.812</td><td>0.012</td><td>0.2</td><td>0.2</td><td>O K</td></tr><tr><td>10080 min Summer</td><td>3.811</td><td>0.011</td><td>0.2</td><td>0.2</td><td>O K</td></tr><tr><td>15 min Winter</td><td>4.057</td><td>0.257</td><td>0.7</td><td>4.9</td><td>O K</td></tr></tbody></table> <table><thead><tr><th>Storm Event</th><th>Rain (mm/hr)</th><th>Flooded Volume (m³)</th><th>Time-Peak (mins)</th></tr></thead><tbody><tr><td>15 min Summer</td><td>130.597</td><td>0.0</td><td>17</td></tr><tr><td>30 min Summer</td><td>85.825</td><td>0.0</td><td>32</td></tr><tr><td>60 min Summer</td><td>53.779</td><td>0.0</td><td>60</td></tr><tr><td>120 min Summer</td><td>32.595</td><td>0.0</td><td>92</td></tr><tr><td>180 min Summer</td><td>24.012</td><td>0.0</td><td>124</td></tr><tr><td>240 min Summer</td><td>19.224</td><td>0.0</td><td>158</td></tr><tr><td>360 min Summer</td><td>13.954</td><td>0.0</td><td>226</td></tr><tr><td>480 min Summer</td><td>11.125</td><td>0.0</td><td>290</td></tr><tr><td>600 min Summer</td><td>9.325</td><td>0.0</td><td>352</td></tr><tr><td>720 min Summer</td><td>8.069</td><td>0.0</td><td>412</td></tr><tr><td>960 min Summer</td><td>6.417</td><td>0.0</td><td>522</td></tr><tr><td>1440 min Summer</td><td>4.640</td><td>0.0</td><td>736</td></tr><tr><td>2160 min Summer</td><td>3.350</td><td>0.0</td><td>1100</td></tr><tr><td>2880 min Summer</td><td>2.656</td><td>0.0</td><td>1468</td></tr><tr><td>4320 min Summer</td><td>1.912</td><td>0.0</td><td>2200</td></tr><tr><td>5760 min Summer</td><td>1.513</td><td>0.0</td><td>2888</td></tr><tr><td>7200 min Summer</td><td>1.261</td><td>0.0</td><td>3672</td></tr><tr><td>8640 min Summer</td><td>1.086</td><td>0.0</td><td>4304</td></tr><tr><td>10080 min Summer</td><td>0.957</td><td>0.0</td><td>5016</td></tr><tr><td>15 min Winter</td><td>130.597</td><td>0.0</td><td>17</td></tr></tbody></table>						Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status	15 min Summer	4.027	0.227	0.7	4.3	O K	30 min Summer	4.081	0.281	0.7	5.3	O K	60 min Summer	4.111	0.311	0.7	5.9	O K	120 min Summer	4.108	0.308	0.7	5.9	O K	180 min Summer	4.092	0.292	0.7	5.6	O K	240 min Summer	4.073	0.273	0.7	5.2	O K	360 min Summer	4.031	0.231	0.7	4.4	O K	480 min Summer	3.995	0.195	0.7	3.7	O K	600 min Summer	3.962	0.162	0.7	3.1	O K	720 min Summer	3.933	0.133	0.7	2.5	O K	960 min Summer	3.888	0.088	0.7	1.7	O K	1440 min Summer	3.849	0.049	0.7	0.9	O K	2160 min Summer	3.836	0.036	0.5	0.7	O K	2880 min Summer	3.829	0.029	0.4	0.5	O K	4320 min Summer	3.821	0.021	0.3	0.4	O K	5760 min Summer	3.817	0.017	0.2	0.3	O K	7200 min Summer	3.814	0.014	0.2	0.3	O K	8640 min Summer	3.812	0.012	0.2	0.2	O K	10080 min Summer	3.811	0.011	0.2	0.2	O K	15 min Winter	4.057	0.257	0.7	4.9	O K	Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)	15 min Summer	130.597	0.0	17	30 min Summer	85.825	0.0	32	60 min Summer	53.779	0.0	60	120 min Summer	32.595	0.0	92	180 min Summer	24.012	0.0	124	240 min Summer	19.224	0.0	158	360 min Summer	13.954	0.0	226	480 min Summer	11.125	0.0	290	600 min Summer	9.325	0.0	352	720 min Summer	8.069	0.0	412	960 min Summer	6.417	0.0	522	1440 min Summer	4.640	0.0	736	2160 min Summer	3.350	0.0	1100	2880 min Summer	2.656	0.0	1468	4320 min Summer	1.912	0.0	2200	5760 min Summer	1.513	0.0	2888	7200 min Summer	1.261	0.0	3672	8640 min Summer	1.086	0.0	4304	10080 min Summer	0.957	0.0	5016	15 min Winter	130.597	0.0	17
Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status																																																																																																																																																																																																																		
15 min Summer	4.027	0.227	0.7	4.3	O K																																																																																																																																																																																																																		
30 min Summer	4.081	0.281	0.7	5.3	O K																																																																																																																																																																																																																		
60 min Summer	4.111	0.311	0.7	5.9	O K																																																																																																																																																																																																																		
120 min Summer	4.108	0.308	0.7	5.9	O K																																																																																																																																																																																																																		
180 min Summer	4.092	0.292	0.7	5.6	O K																																																																																																																																																																																																																		
240 min Summer	4.073	0.273	0.7	5.2	O K																																																																																																																																																																																																																		
360 min Summer	4.031	0.231	0.7	4.4	O K																																																																																																																																																																																																																		
480 min Summer	3.995	0.195	0.7	3.7	O K																																																																																																																																																																																																																		
600 min Summer	3.962	0.162	0.7	3.1	O K																																																																																																																																																																																																																		
720 min Summer	3.933	0.133	0.7	2.5	O K																																																																																																																																																																																																																		
960 min Summer	3.888	0.088	0.7	1.7	O K																																																																																																																																																																																																																		
1440 min Summer	3.849	0.049	0.7	0.9	O K																																																																																																																																																																																																																		
2160 min Summer	3.836	0.036	0.5	0.7	O K																																																																																																																																																																																																																		
2880 min Summer	3.829	0.029	0.4	0.5	O K																																																																																																																																																																																																																		
4320 min Summer	3.821	0.021	0.3	0.4	O K																																																																																																																																																																																																																		
5760 min Summer	3.817	0.017	0.2	0.3	O K																																																																																																																																																																																																																		
7200 min Summer	3.814	0.014	0.2	0.3	O K																																																																																																																																																																																																																		
8640 min Summer	3.812	0.012	0.2	0.2	O K																																																																																																																																																																																																																		
10080 min Summer	3.811	0.011	0.2	0.2	O K																																																																																																																																																																																																																		
15 min Winter	4.057	0.257	0.7	4.9	O K																																																																																																																																																																																																																		
Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)																																																																																																																																																																																																																				
15 min Summer	130.597	0.0	17																																																																																																																																																																																																																				
30 min Summer	85.825	0.0	32																																																																																																																																																																																																																				
60 min Summer	53.779	0.0	60																																																																																																																																																																																																																				
120 min Summer	32.595	0.0	92																																																																																																																																																																																																																				
180 min Summer	24.012	0.0	124																																																																																																																																																																																																																				
240 min Summer	19.224	0.0	158																																																																																																																																																																																																																				
360 min Summer	13.954	0.0	226																																																																																																																																																																																																																				
480 min Summer	11.125	0.0	290																																																																																																																																																																																																																				
600 min Summer	9.325	0.0	352																																																																																																																																																																																																																				
720 min Summer	8.069	0.0	412																																																																																																																																																																																																																				
960 min Summer	6.417	0.0	522																																																																																																																																																																																																																				
1440 min Summer	4.640	0.0	736																																																																																																																																																																																																																				
2160 min Summer	3.350	0.0	1100																																																																																																																																																																																																																				
2880 min Summer	2.656	0.0	1468																																																																																																																																																																																																																				
4320 min Summer	1.912	0.0	2200																																																																																																																																																																																																																				
5760 min Summer	1.513	0.0	2888																																																																																																																																																																																																																				
7200 min Summer	1.261	0.0	3672																																																																																																																																																																																																																				
8640 min Summer	1.086	0.0	4304																																																																																																																																																																																																																				
10080 min Summer	0.957	0.0	5016																																																																																																																																																																																																																				
15 min Winter	130.597	0.0	17																																																																																																																																																																																																																				
©1982-2017 XP Solutions																																																																																																																																																																																																																							

The Millward Partnership				Page 2	
1 Malin Hill		MA11407			
Nottingham		Station Rd Surfleet			
NG1 1JQ		House Soakaway			
Date 12/02/2021 12:04		Designed by JMcK			
File MA11407-Plot 1 PD.SRCX		Checked by			
XP Solutions		Source Control 2017.1.2			
<u>Summary of Results for 100 year Return Period (+40%)</u>					
Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
30 min Winter	4.121	0.321	0.7	6.1	O K
60 min Winter	4.161	0.361	0.7	6.9	O K
120 min Winter	4.157	0.357	0.7	6.8	O K
180 min Winter	4.134	0.334	0.7	6.4	O K
240 min Winter	4.104	0.304	0.7	5.8	O K
360 min Winter	4.041	0.241	0.7	4.6	O K
480 min Winter	3.985	0.185	0.7	3.5	O K
600 min Winter	3.936	0.136	0.7	2.6	O K
720 min Winter	3.895	0.095	0.7	1.8	O K
960 min Winter	3.850	0.050	0.7	0.9	O K
1440 min Winter	3.837	0.037	0.5	0.7	O K
2160 min Winter	3.827	0.027	0.4	0.5	O K
2880 min Winter	3.821	0.021	0.3	0.4	O K
4320 min Winter	3.815	0.015	0.2	0.3	O K
5760 min Winter	3.812	0.012	0.2	0.2	O K
7200 min Winter	3.810	0.010	0.2	0.2	O K
8640 min Winter	3.809	0.009	0.1	0.2	O K
10080 min Winter	3.808	0.008	0.1	0.1	O K
Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)		
30 min Winter	85.825	0.0	31		
60 min Winter	53.779	0.0	60		
120 min Winter	32.595	0.0	98		
180 min Winter	24.012	0.0	136		
240 min Winter	19.224	0.0	174		
360 min Winter	13.954	0.0	244		
480 min Winter	11.125	0.0	310		
600 min Winter	9.325	0.0	368		
720 min Winter	8.069	0.0	424		
960 min Winter	6.417	0.0	502		
1440 min Winter	4.640	0.0	738		
2160 min Winter	3.350	0.0	1100		
2880 min Winter	2.656	0.0	1452		
4320 min Winter	1.912	0.0	2176		
5760 min Winter	1.513	0.0	2896		
7200 min Winter	1.261	0.0	3640		
8640 min Winter	1.086	0.0	4280		
10080 min Winter	0.957	0.0	5080		
©1982-2017 XP Solutions					

The Millward Partnership		Page 3
1 Malin Hill Nottingham NG1 1JQ	MA11407 Station Rd Surfleet House Soakaway	
Date 12/02/2021 12:04 File MA11407-Plot 1 PD.SRCX	Designed by JMcK Checked by	
XP Solutions	Source Control 2017.1.2	

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	19.000	Shortest Storm (mins)	15
Ratio R	0.400	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.020

Time (mins)	Area
From:	To: (ha)

0	4	0.020
---	---	-------

Time Area Diagram

Total Area (ha) 0.000

Time (mins)	Area
From:	To: (ha)

0	4	0.000
---	---	-------

The Millward Partnership		Page 4
1 Malin Hill Nottingham NG1 1JQ	MA11407 Station Rd Surfleet House Soakaway	
Date 12/02/2021 12:04 File MA11407-Plot 1 PD.SRCX	Designed by JMcK Checked by	
XP Solutions	Source Control 2017.1.2	

Model Details

Storage is Online Cover Level (m) 4.800

Cellular Storage Structure

Invert Level (m) 3.800 Safety Factor 5.0
Infiltration Coefficient Base (m/hr) 0.66900 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m ²)	Inf. Area (m ²)	Depth (m)	Area (m ²)	Inf. Area (m ²)
0.000	20.0	20.0	0.401	0.0	29.6
0.400	20.0	29.6			

The Millward Partnership Ltd		Page 1
2nd Floor 3-7 Middle Pavement Nottingham NG1 7DX	Station Road Surfleet Proposed Foul Flows	
Date Jan2017 File	Designed By JMcK 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	23	0.0	1.500	o	150

Network Results Table

PN	US/IL (m)	E Area (ha)	E DWF (l/s)	E Hse	Add Flow (l/s)	P.Dep (mm)	P.Vel (m/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
1.000	3.500	0.000	0.0	23	0.0	30	0.43	0.71	12.6	1.1

The Millward Partnership		Page 1
1 Malin Hill Nottingham NG1 1JQ	MA11407 Station Rd Surfleet House Soakaway	
Date 12/02/2021 12:04 File MA11407-Plot 1 PD.SRCX	Designed by JMcK Checked by	
XP Solutions	Source Control 2017.1.2	

Summary of Results for 100 year Return Period (+40%)

Half Drain Time : 86 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
15 min Summer	4.027	0.227	0.7	4.3	O K
30 min Summer	4.081	0.281	0.7	5.3	O K
60 min Summer	4.111	0.311	0.7	5.9	O K
120 min Summer	4.108	0.308	0.7	5.9	O K
180 min Summer	4.092	0.292	0.7	5.6	O K
240 min Summer	4.073	0.273	0.7	5.2	O K
360 min Summer	4.031	0.231	0.7	4.4	O K
480 min Summer	3.995	0.195	0.7	3.7	O K
600 min Summer	3.962	0.162	0.7	3.1	O K
720 min Summer	3.933	0.133	0.7	2.5	O K
960 min Summer	3.888	0.088	0.7	1.7	O K
1440 min Summer	3.849	0.049	0.7	0.9	O K
2160 min Summer	3.836	0.036	0.5	0.7	O K
2880 min Summer	3.829	0.029	0.4	0.5	O K
4320 min Summer	3.821	0.021	0.3	0.4	O K
5760 min Summer	3.817	0.017	0.2	0.3	O K
7200 min Summer	3.814	0.014	0.2	0.3	O K
8640 min Summer	3.812	0.012	0.2	0.2	O K
10080 min Summer	3.811	0.011	0.2	0.2	O K
15 min Winter	4.057	0.257	0.7	4.9	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
15 min Summer	130.597	0.0	17
30 min Summer	85.825	0.0	32
60 min Summer	53.779	0.0	60
120 min Summer	32.595	0.0	92
180 min Summer	24.012	0.0	124
240 min Summer	19.224	0.0	158
360 min Summer	13.954	0.0	226
480 min Summer	11.125	0.0	290
600 min Summer	9.325	0.0	352
720 min Summer	8.069	0.0	412
960 min Summer	6.417	0.0	522
1440 min Summer	4.640	0.0	736
2160 min Summer	3.350	0.0	1100
2880 min Summer	2.656	0.0	1468
4320 min Summer	1.912	0.0	2200
5760 min Summer	1.513	0.0	2888
7200 min Summer	1.261	0.0	3672
8640 min Summer	1.086	0.0	4304
10080 min Summer	0.957	0.0	5016
15 min Winter	130.597	0.0	17

The Millward Partnership				Page 2	
1 Malin Hill		MA11407			
Nottingham		Station Rd Surfleet			
NG1 1JQ		House Soakaway			
Date 12/02/2021 12:04		Designed by JMcK			
File MA11407-Plot 1 PD.SRCX		Checked by			
XP Solutions		Source Control 2017.1.2			
<u>Summary of Results for 100 year Return Period (+40%)</u>					
Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
30 min Winter	4.121	0.321	0.7	6.1	O K
60 min Winter	4.161	0.361	0.7	6.9	O K
120 min Winter	4.157	0.357	0.7	6.8	O K
180 min Winter	4.134	0.334	0.7	6.4	O K
240 min Winter	4.104	0.304	0.7	5.8	O K
360 min Winter	4.041	0.241	0.7	4.6	O K
480 min Winter	3.985	0.185	0.7	3.5	O K
600 min Winter	3.936	0.136	0.7	2.6	O K
720 min Winter	3.895	0.095	0.7	1.8	O K
960 min Winter	3.850	0.050	0.7	0.9	O K
1440 min Winter	3.837	0.037	0.5	0.7	O K
2160 min Winter	3.827	0.027	0.4	0.5	O K
2880 min Winter	3.821	0.021	0.3	0.4	O K
4320 min Winter	3.815	0.015	0.2	0.3	O K
5760 min Winter	3.812	0.012	0.2	0.2	O K
7200 min Winter	3.810	0.010	0.2	0.2	O K
8640 min Winter	3.809	0.009	0.1	0.2	O K
10080 min Winter	3.808	0.008	0.1	0.1	O K
Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)		
30 min Winter	85.825	0.0	31		
60 min Winter	53.779	0.0	60		
120 min Winter	32.595	0.0	98		
180 min Winter	24.012	0.0	136		
240 min Winter	19.224	0.0	174		
360 min Winter	13.954	0.0	244		
480 min Winter	11.125	0.0	310		
600 min Winter	9.325	0.0	368		
720 min Winter	8.069	0.0	424		
960 min Winter	6.417	0.0	502		
1440 min Winter	4.640	0.0	738		
2160 min Winter	3.350	0.0	1100		
2880 min Winter	2.656	0.0	1452		
4320 min Winter	1.912	0.0	2176		
5760 min Winter	1.513	0.0	2896		
7200 min Winter	1.261	0.0	3640		
8640 min Winter	1.086	0.0	4280		
10080 min Winter	0.957	0.0	5080		
©1982-2017 XP Solutions					

The Millward Partnership		Page 3
1 Malin Hill Nottingham NG1 1JQ	MA11407 Station Rd Surfleet House Soakaway	
Date 12/02/2021 12:04 File MA11407-Plot 1 PD.SRCX	Designed by JMcK Checked by	
XP Solutions	Source Control 2017.1.2	

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	19.000	Shortest Storm (mins)	15
Ratio R	0.400	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.020

Time (mins)	Area
From:	To: (ha)

0	4	0.020
---	---	-------

Time Area Diagram

Total Area (ha) 0.000

Time (mins)	Area
From:	To: (ha)

0	4	0.000
---	---	-------

The Millward Partnership		Page 4
1 Malin Hill Nottingham NG1 1JQ	MA11407 Station Rd Surfleet House Soakaway	
Date 12/02/2021 12:04 File MA11407-Plot 1 PD.SRCX	Designed by JMcK Checked by	
XP Solutions	Source Control 2017.1.2	

Model Details

Storage is Online Cover Level (m) 4.800

Cellular Storage Structure

Invert Level (m) 3.800 Safety Factor 5.0
Infiltration Coefficient Base (m/hr) 0.66900 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m ²)	Inf. Area (m ²)	Depth (m)	Area (m ²)	Inf. Area (m ²)
0.000	20.0	20.0	0.401	0.0	29.6
0.400	20.0	29.6			

The Millward Partnership		Page 1
1 Malin Hill Nottingham NG1 1JQ	72 Station Rd Surfleet SWS Planninf Rev-	
Date 12/02/2021 12:49 File MAl1407-PLANNING INFILT...	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	0.400	Minimum Backdrop Height (m)	0.200
Maximum Rainfall (mm/hr)	50	Maximum Backdrop Height (m)	1.500
Maximum Time of Concentration (mins)	30	Min Design Depth for Optimisation (m)	1.200
Foul Sewage (l/s/ha)	0.000	Min Vel for Auto Design only (m/s)	1.00
Volumetric Runoff Coeff.	0.750	Min Slope for Optimisation (1:X)	500

Designed with Level Soffits

Time Area Diagram for Storm

Time (mins)	Area (ha)	Time (mins)	Area (ha)
0-4	0.119	4-8	0.125

Total Area Contributing (ha) = 0.244

Total Pipe Volume (m³) = 47.379

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	41.109	0.083	495.3	0.163	5.00	0.0	0.600	o	600	Pipe/Conduit	
S1.001	16.211	0.039	415.7	0.000	0.00	0.0	0.600	o	600	Pipe/Conduit	
S2.000	42.812	0.086	497.8	0.040	5.00	0.0	0.600	o	600	Pipe/Conduit	
S1.002	29.403	0.059	498.4	0.041	0.00	0.0	0.600	o	600	Pipe/Conduit	
S1.003	9.643	0.020	482.2	0.000	0.00	0.0	0.600	o	600	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL E (m)	I.Area (ha)	E Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S1.000	50.00	5.63	2.853	0.163	0.0	0.0	0.0	1.09	307.5	22.1
S1.001	50.00	5.86	2.770	0.163	0.0	0.0	0.0	1.19	335.9	22.1
S2.000	50.00	5.66	2.817	0.040	0.0	0.0	0.0	1.08	306.7	5.5
S1.002	50.00	6.31	2.731	0.244	0.0	0.0	0.0	1.08	306.5	33.1
S1.003	50.00	6.46	2.672	0.244	0.0	0.0	0.0	1.10	311.7	33.1

The Millward Partnership		Page 2
1 Malin Hill Nottingham NG1 1JQ	72 Station Rd Surfleet SWS Planninf Rev-	
Date 12/02/2021 12:49 File MA11407-PLANNING INFILT...	Designed by JMcK Checked by	
XP Solutions	Network 2017.1.2	

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
S1.004	26.043	0.053	491.4	0.000	0.00	0.0	0.600	o	600	Pipe/Conduit	
S1.005	2.349	0.024	97.9	0.000	0.00	0.0	0.600	o	600	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL E (m)	I.Area (ha)	E Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S1.004	50.00	6.85	2.652	0.244	0.0	0.0	0.0	1.09	308.7	33.1
S1.005	50.00	6.87	2.599	0.244	0.0	0.0	0.0	2.46	696.1	33.1

The Millward Partnership		Page 3
1 Malin Hill Nottingham NG1 1JQ	72 Station Rd Surfleet SWS Planninf Rev-	
Date 12/02/2021 12:49 File MA11407-PLANNING INFILT...	Designed by JMcK Checked by	
XP Solutions	Network 2017.1.2	

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	600	S1	5.000	2.853	1.547	Open Manhole	1500
S1.001	o	600	S2	4.800	2.770	1.430	Open Manhole	1500
S2.000	o	600	S3	4.800	2.817	1.383	Open Manhole	1500
S1.002	o	600	S4	4.800	2.731	1.469	Open Manhole	1500
S1.003	o	600	S5	4.800	2.672	1.528	Open Manhole	1500
S1.004	o	600	S6	4.800	2.652	1.548	Open Manhole	1500
S1.005	o	600	S7	3.800	2.599	0.601	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	41.109	495.3	S2	4.800	2.770	1.430	Open Manhole	1500
S1.001	16.211	415.7	S4	4.800	2.731	1.469	Open Manhole	1500
S2.000	42.812	497.8	S4	4.800	2.731	1.469	Open Manhole	1500
S1.002	29.403	498.4	S5	4.800	2.672	1.528	Open Manhole	1500
S1.003	9.643	482.2	S6	4.800	2.652	1.548	Open Manhole	1500
S1.004	26.043	491.4	S7	3.800	2.599	0.601	Open Manhole	1500
S1.005	2.349	97.9	S	3.600	2.575	0.425	Open Manhole	0

The Millward Partnership		Page 4
1 Malin Hill Nottingham NG1 1JQ	72 Station Rd Surfleet SWS Planninf Rev-	
Date 12/02/2021 12:49 File MA11407-PLANNING INFILT...	Designed by JMcK Checked by	
XP Solutions	Network 2017.1.2	

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	1500		525691.401	328514.445	
S1.001	S2	1500		525691.234	328555.554	
S2.000	S3	1500		525732.324	328571.761	
S1.002	S4	1500		525689.511	328571.674	
S1.003	S5	1500		525660.108	328571.796	
S1.004	S6	1500		525650.468	328572.036	
S1.005	S7	1500		525650.184	328598.077	
PN	DSMH Name	Dia/Len (mm)	Width (mm)	DS Easting (m)	DS Northing (m)	Layout (North)
S1.005	S	0		525649.299	328600.254	

The Millward Partnership		Page 5
1 Malin Hill Nottingham NG1 1JQ	72 Station Rd Surfleet SWS Planninf Rev-	
Date 12/02/2021 12:49 File MA11407-PLANNING INFILT...	Designed by JMcK Checked by	
XP Solutions	Network 2017.1.2	

Area Summary for Storm

Pipe Number	PIMP Type	PIMP Name	PIMP (%)	Gross Area (ha)	Imp. Area (ha)	Pipe Total (ha)
1.000	User	-	100	0.011	0.011	0.011
	User	-	100	0.008	0.008	0.020
	User	-	100	0.003	0.003	0.023
	User	-	100	0.011	0.011	0.034
	User	-	100	0.011	0.011	0.045
	User	-	100	0.004	0.004	0.048
	User	-	100	0.012	0.012	0.060
	User	-	100	0.003	0.003	0.063
	User	-	100	0.008	0.008	0.072
	User	-	100	0.012	0.012	0.083
	User	-	100	0.003	0.003	0.087
	User	-	100	0.003	0.003	0.090
	User	-	100	0.011	0.011	0.102
	User	-	100	0.020	0.020	0.122
	User	-	100	0.042	0.042	0.163
1.001	-	-	100	0.000	0.000	0.000
2.000	User	-	100	0.040	0.040	0.040
1.002	User	-	100	0.041	0.041	0.041
1.003	-	-	100	0.000	0.000	0.000
1.004	-	-	100	0.000	0.000	0.000
1.005	-	-	100	0.000	0.000	0.000
				Total	Total	Total
				0.244	0.244	0.244

Free Flowing Outfall Details for Storm

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

S1.005	S	3.600	2.575	0.000	0	0
--------	---	-------	-------	-------	---	---

Simulation Criteria for Storm

Volumetric Runoff Coeff	0.750	Additional Flow - % of Total Flow	6.000
Areal Reduction Factor	1.000	MADD Factor * 10m ³ /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	3
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 Return Period (years) 2

The Millward Partnership		Page 6
1 Malin Hill Nottingham NG1 1JQ	72 Station Rd Surfleet SWS Planninf Rev-	
Date 12/02/2021 12:49 File MA11407-PLANNING INFILT...	Designed by JMcK Checked by	
XP Solutions	Network 2017.1.2	

Synthetic Rainfall Details

Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	19.000	Cv (Winter)	0.840
Ratio R	0.400	Storm Duration (mins)	30
Profile Type	Summer		

The Millward Partnership		Page 7
1 Malin Hill Nottingham NG1 1JQ	72 Station Rd Surfleet SWS Planninf Rev-	
Date 12/02/2021 12:49 File MA11407-PLANNING INFILT...	Designed by JMcK Checked by	
XP Solutions	Network 2017.1.2	

Storage Structures for Storm

Filter Drain Manhole: S2, DS/PN: S1.001

Infiltration Coefficient Base (m/hr) 0.66900	Pipe Diameter (m) 0.600
Infiltration Coefficient Side (m/hr) 0.00000	Pipe Depth above Invert (m) 0.000
Safety Factor 5.0	Number of Pipes 1
Porosity 0.30	Slope (1:X) 500.0
Invert Level (m) 2.770	Cap Volume Depth (m) 0.000
Trench Width (m) 1.0	Cap Infiltration Depth (m) 0.000
Trench Length (m) 41.0	

Filter Drain Manhole: S3, DS/PN: S2.000

Infiltration Coefficient Base (m/hr) 0.66900	Pipe Diameter (m) 0.600
Infiltration Coefficient Side (m/hr) 0.00000	Pipe Depth above Invert (m) 0.000
Safety Factor 5.0	Number of Pipes 1
Porosity 0.30	Slope (1:X) 500.0
Invert Level (m) 2.817	Cap Volume Depth (m) 0.000
Trench Width (m) 1.0	Cap Infiltration Depth (m) 0.000
Trench Length (m) 42.0	

Filter Drain Manhole: S4, DS/PN: S1.002

Infiltration Coefficient Base (m/hr) 0.66900	Pipe Diameter (m) 0.600
Infiltration Coefficient Side (m/hr) 0.00000	Pipe Depth above Invert (m) 0.000
Safety Factor 5.0	Number of Pipes 1
Porosity 0.30	Slope (1:X) 500.0
Invert Level (m) 2.731	Cap Volume Depth (m) 0.000
Trench Width (m) 1.0	Cap Infiltration Depth (m) 0.000
Trench Length (m) 29.0	

The Millward Partnership		Page 8
1 Malin Hill Nottingham NG1 1JQ	72 Station Rd Surfleet SWS Planninf Rev-	
Date 12/02/2021 12:49 File MA11407-PLANNING INFILT...	Designed by JMcK Checked by	
XP Solutions	Network 2017.1.2	

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

Simulation Criteria

Areal Reduction Factor 1.000 Additional Flow - % of Total Flow 6.000
Hot Start (mins) 0 MADD Factor * 10m³/ha Storage 0.000
Hot Start Level (mm) 0 Inlet Coefficient 0.800
Manhole Headloss Coeff (Global) 0.500 Flow per Person per Day (l/per/day) 0.000
Foul Sewage per hectare (l/s) 0.000

Number of Input Hydrographs 0 Number of Storage Structures 3
Number of Online Controls 1 Number of Time/Area Diagrams 0
Number of Offline Controls 0 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FSR Ratio R 0.400
Region England and Wales Cv (Summer) 0.750
M5-60 (mm) 19.000 Cv (Winter) 0.840

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

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600,
720, 960, 1440, 2160, 2880, 4320, 5760,
7200, 8640, 10080
Return Period(s) (years) 1, 30, 100
Climate Change (%) 0, 0, 40

US/MH		Return	Climate	First (X)	First (Y)	First (Z)	Overflow	Water
PN	Name			Surcharge	Flood	Overflow	Act.	Level (m)
S1.000	S1 15 Winter	1	+0%					2.979
S1.001	S2 15 Winter	1	+0%					2.891
S2.000	S3 15 Winter	1	+0%					2.880
S1.002	S4 30 Winter	1	+0%	100/60 Winter				2.879
S1.003	S5 30 Winter	1	+0%	100/60 Winter				2.878
S1.004	S6 30 Winter	1	+0%	100/30 Winter				2.877
S1.005	S7 30 Winter	1	+0%	100/30 Summer				2.876

US/MH		Depth	Volume	Flow /	Overflow	Pipe	Level
PN	Name			Cap.	(l/s)	Flow	Exceeded
S1.000	S1	-0.474	0.000	0.08		22.1	OK
S1.001	S2	-0.479	0.000	0.07		15.6	OK
S2.000	S3	-0.537	0.000	0.01		3.1	OK
S1.002	S4	-0.452	0.000	0.05		13.2	OK

The Millward Partnership		Page 9
1 Malin Hill Nottingham NG1 1JQ	72 Station Rd Surfleet SWS Planninf Rev-	
Date 12/02/2021 12:49 File MA11407-PLANNING INFILT...	Designed by JMcK Checked by	
XP Solutions	Network 2017.1.2	

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

PN	US/MH Name	Surcharged		Flooded		Pipe		Level Exceeded
		Depth (m)	Volume (m³)	Flow / Cap.	Overflow (l/s)	Flow (l/s)	Status	
S1.003	S5	-0.394	0.000	0.07		10.2	OK	
S1.004	S6	-0.375	0.000	0.04		8.8	OK	
S1.005	S7	-0.323	0.000	0.02		4.8	OK	

The Millward Partnership		Page 10
1 Malin Hill Nottingham NG1 1JQ	72 Station Rd Surfleet SWS Planninf Rev-	
Date 12/02/2021 12:49 File MA11407-PLANNING INFILT...	Designed by JMcK Checked by	
XP Solutions	Network 2017.1.2	

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

Simulation Criteria

Areal Reduction Factor 1.000 Additional Flow - % of Total Flow 6.000
 Hot Start (mins) 0 MADD Factor * 10m³/ha Storage 0.000
 Hot Start Level (mm) 0 Inlet Coefficient 0.800
 Manhole Headloss Coeff (Global) 0.500 Flow per Person per Day (l/per/day) 0.000
 Foul Sewage per hectare (l/s) 0.000

Number of Input Hydrographs 0 Number of Storage Structures 3
 Number of Online Controls 1 Number of Time/Area Diagrams 0
 Number of Offline Controls 0 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FSR Ratio R 0.400
 Region England and Wales Cv (Summer) 0.750
 M5-60 (mm) 19.000 Cv (Winter) 0.840

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

Profile(s) Summer and Winter
 Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600,
 720, 960, 1440, 2160, 2880, 4320, 5760,
 7200, 8640, 10080
 Return Period(s) (years) 1, 30, 100
 Climate Change (%) 0, 0, 40

									Water
	US/MH		Return	Climate	First (X)	First (Y)	First (Z)	Overflow	Level
PN	Name	Storm	Period	Change	Surcharge	Flood	Overflow	Act.	(m)
S1.000	S1	15 Winter	30	+0%					3.054
S1.001	S2	60 Winter	30	+0%					3.046
S2.000	S3	60 Winter	30	+0%					3.045
S1.002	S4	60 Winter	30	+0%	100/60 Winter				3.045
S1.003	S5	60 Winter	30	+0%	100/60 Winter				3.044
S1.004	S6	60 Winter	30	+0%	100/30 Winter				3.043
S1.005	S7	60 Winter	30	+0%	100/30 Summer				3.041

US/MH		Depth	Volume	Flow /	Overflow	Pipe	Level
PN	Name						
PN	Name	(m)	(m ³)	Cap.	(l/s)	(l/s)	Status Exceeded
S1.000	S1	-0.399	0.000	0.21		54.2	OK
S1.001	S2	-0.324	0.000	0.09		18.8	OK
S2.000	S3	-0.372	0.000	0.01		2.7	OK
S1.002	S4	-0.286	0.000	0.06		15.3	OK

The Millward Partnership		Page 11
1 Malin Hill Nottingham NG1 1JQ	72 Station Rd Surfleet SWS Planninf Rev-	
Date 12/02/2021 12:49 File MA11407-PLANNING INFILT...	Designed by JMcK Checked by	
XP Solutions	Network 2017.1.2	

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

PN	US/MH Name	Surcharged		Flooded		Pipe		Level Exceeded
		Depth (m)	Volume (m³)	Flow / Cap.	Overflow (l/s)	Flow (l/s)	Status	
S1.003	S5	-0.228	0.000	0.07		10.8	OK	
S1.004	S6	-0.209	0.000	0.04		9.1	OK	
S1.005	S7	-0.158	0.000	0.02		5.0	OK	

The Millward Partnership		Page 12
1 Malin Hill Nottingham NG1 1JQ	72 Station Rd Surfleet SWS Planninf Rev-	
Date 12/02/2021 12:49 File MA11407-PLANNING INFILT...	Designed by JMcK Checked by	
XP Solutions	Network 2017.1.2	

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

Simulation Criteria

Areal Reduction Factor 1.000 Additional Flow - % of Total Flow 6.000
 Hot Start (mins) 0 MADD Factor * 10m³/ha Storage 0.000
 Hot Start Level (mm) 0 Inlet Coefficient 0.800
 Manhole Headloss Coeff (Global) 0.500 Flow per Person per Day (l/per/day) 0.000
 Foul Sewage per hectare (l/s) 0.000

Number of Input Hydrographs 0 Number of Storage Structures 3
 Number of Online Controls 1 Number of Time/Area Diagrams 0
 Number of Offline Controls 0 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FSR Ratio R 0.400
 Region England and Wales Cv (Summer) 0.750
 M5-60 (mm) 19.000 Cv (Winter) 0.840

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

Profile(s) Summer and Winter
 Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600,
 720, 960, 1440, 2160, 2880, 4320, 5760,
 7200, 8640, 10080
 Return Period(s) (years) 1, 30, 100
 Climate Change (%) 0, 0, 40

US/MH		Storm	Return Period	Climate Change	First (X) Surge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level
PN	Name								(m)
S1.000	S1	60 Winter	100	+40%					3.373
S1.001	S2	60 Winter	100	+40%					3.361
S2.000	S3	60 Winter	100	+40%					3.351
S1.002	S4	60 Winter	100	+40%	100/60 Winter				3.352
S1.003	S5	60 Winter	100	+40%	100/60 Winter				3.351
S1.004	S6	60 Winter	100	+40%	100/30 Winter				3.350
S1.005	S7	60 Winter	100	+40%	100/30 Summer				3.349

US/MH		Depth (m)	Surcharged Volume (m ³)	Flooded Flow / Cap. (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
PN	Name						
S1.000	S1	-0.080	0.000	0.20	52.4	OK	
S1.001	S2	-0.009	0.000	0.14	29.5	OK	
S2.000	S3	-0.066	0.000	0.01	2.6	OK	
S1.002	S4	0.021	0.000	0.08	20.3	SURCHARGED	

The Millward Partnership		Page 13
1 Malin Hill Nottingham NG1 1JQ	72 Station Rd Surfleet SWS Planninf Rev-	
Date 12/02/2021 12:49 File MA11407-PLANNING INFILT...	Designed by JMcK Checked by	
XP Solutions	Network 2017.1.2	

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

PN	US/MH Name	Surcharged		Flooded		Pipe		Status	Level Exceeded
		Depth (m)	Volume (m³)	Flow / Cap.	Overflow (l/s)	Flow (l/s)			
S1.003	S5	0.079	0.000	0.09		13.3		SURCHARGED	
S1.004	S6	0.098	0.000	0.04		10.7		SURCHARGED	
S1.005	S7	0.150	0.000	0.02		5.0		SURCHARGED	