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EAST WISBECH BROAD CONCEPT PLAN

Surface Water Drainage Options Report

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Surface Water Drainage Options Report

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Revision and Date	Amendment Details	Revision Prepared By	Revision Approved By

1.0 INTRODUCTION

Brief

1.1 Create Consulting Engineers Ltd was instructed by Fenland District Council to undertake a Surface Water Drainage Options Report to inform an overarching Broad Concept Plan (BCP) for the development of land to the east of Wisbech. This parcel of land has been allocated, within the Fenland District Council (FDC) local plan (2014) and Kings Lynn and West Norfolk Borough Council (KLWNBC) Core Strategy (2011) and Site Allocations & Development Management Policies Plan (2016) as a sustainable urban extension area, envisaged to accommodate development in the order of 1450 residential properties.

Project Context

1.2 The Site comprises approximately 73.0 hectares of arable farmland and orchards interspersed with established woodlands and informal open space.

1.3 The administrative boundary between FDC and KLWNBC runs through the Site as shown on the existing site location plan (Figure 1.1), included at the rear of this report. The existing site layout is shown on Figure 1.2, also included at the rear of this report.

1.4 It is understood that the area of the Site governed by FDC has the capacity to accommodate 900 residential units and the area governed by KLWNBC has capacity for 550 units.

Planning Policy Context

1.5 An assessment of surface water and drainage is required as part of the BCP in order to consider how surface water flows, both within the Site and to surrounding areas, will be managed following development, whilst taking climate change into account.

National Planning Policy Guidance

1.6 The Planning Practice Guidance requires that sustainable drainage systems should be considered as part of the development and included where practicable, in line with the DEFRA Technical Standards[1].

District Council Planning Policy

1.7 The Fenland Local Plan (2014), Kings Lynn and West Norfolk Core Strategy (2011) and Kings Lynn and West Norfolk Site Allocations Development Management Policies Plan (2016)

[1] Technical Standards Accessed Online (November 2017)
https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/415773/sustainable-drainage-technical-standards.pdf

provide guidance on development in the area. The relevant policies identified in these documents are listed below:

Fenland Local Plan:

- Policy LP14 (Part B) Flood Risk and Drainage

Kings Lynn and West Norfolk Core Strategy:

- Policy CS08 Sustainable Development: Flood Risk and Climate Change

Kings Lynn and West Norfolk Site Allocations Development Management Policies Plan:

- Policy F3.1 Wisbech Fringe – Land East of Wisbech (West of Burretgate Road)
- Policy DM21 – Sites in Areas of Flood Risk

1.8 The Level 1 Strategic Flood Risk Assessment (SFRA) for Fenland District Council Area (Scott Wilson, 2011), the adopted Cambridgeshire Flood and Water SPD (Cambridgeshire County Council, 2016) and the Kings Lynn and West Norfolk Strategic Flood Risk Assessment (SFRA) (Faber Maunsell, 2008) provide further detail on the flood risks for the local area and include guidance for developers and applicants on managing flood risk and sustainable drainage around new developments.

1.9 More detailed information from both SFRA's is provided throughout this report. It should be noted that the Kings Lynn and West Norfolk Strategic Flood Risk Assessment (SFRA) is currently being reviewed and a new Level 1 SFRA will be published in January 2018.

Climate Change

1.10 Climate change has important implications for the assessment and management of flood risk. The NPPF requires that climate change is considered when making an assessment of flood risk posed to future development.

1.11 Climate change has the potential to affect all identified sources of flooding at the Site. The likely impacts of climate change include increased severity of rainfall events as well as wetter winters, leading to higher groundwater levels and increased frequency and severity of surface water flooding.

1.12 The influence of climate change on rainfall intensity has been taken into account by this report as an inclusion of 40% has been made for climate change for all rainfall events up to and including the 1 in 100 year event in accordance with NPPF requirements, and 'Flood Risk Assessments: Climate Change Allowances'[2].

[2] Environment Agency (2016) *Flood Risk Assessments: Climate Change Allowances*.

Objectives

1.13 The following specific objectives were set by Create Consulting Engineers Ltd after a review of the available data:

- To appraise the baseline hydrological conditions on and around the development area;
- To review the various SUDS options and comment on their suitability for the proposed development; and,
- To provide a suggested approach for surface water drainage and SUDS for the proposed development.

Constraints and Limitations

1.14 The copyright of this report is vested in Create Consulting Engineers Ltd and the Client, Fenland District Council. The Client, or their appointed representatives, may copy the report for purposes in connection with the development described herein. It shall not be copied by any other party or used for any other purposes without the written consent of Create Consulting Engineers Ltd or the Client.

1.15 Create Consulting Engineers Ltd accept no responsibility whatsoever to other parties to whom this report, or any part thereof, is made known. Any such other parties rely upon the report at their own risk.

1.16 This report addresses the extent of the development area only, which is shown by the Site boundary, as indicated on Figure 1.1.

1.17 The conclusions resulting from this study are not necessarily indicative of future conditions or operating practices at or adjacent to the Site.

1.18 Create Consulting Engineers Ltd has endeavoured to assess all information provided to them during this appraisal. The report summarises information from a number of external sources and cannot offer any guarantees or warranties for the completeness or accuracy or information relied upon. Information from third parties has not been verified by Create Consulting Engineers Ltd unless otherwise stated in this report.

2.0 SOURCES OF INFORMATION

2.1 The information contained in this report is based on a review of existing information and consultation with interested parties.

Records Review

2.2 Key reports and websites reviewed as part of this study are listed in Table 2.1 below.

Document/Website	Publisher	Date
Fluvial/Tidal Flood Maps - https://flood-map-for-planning.service.gov.uk/	GOV.UK	Accessed November 2017
Groundwater Mapping – environment-agency.gov.uk	Environment Agency (EA)	Accessed November 2017
Surface Water and Reservoir Flood Mapping – flood-warning-information.service.gov.uk	GOV.UK	Accessed November 2017
BGS GeoIndex – Geology and borehole records - www.bgs.ac.uk/geoindex	British Geological Survey	Accessed November 2017
Fenland District Council District Strategic Flood Risk Assessment - **http://www.fenland.gov.uk/CHttpHandler.ashx?id=3772&p=0**	Scott Wilson	2010
Kings Lynn and West Norfolk Strategic Flood Risk Assessment	Faber Maunsell	2008
Kings Lynn and West Norfolk Strategic Flood Risk Assessment	Bullen	2005
Wisbech Strategic Flood Risk Assessment Level 2 - **http://www.fenland.gov.uk/article/3588/Wisbech-Strategic-Flood-Risk-Assessment-2**	WSP	2012
Anglian Water Clean and Waste Water Asset Plans (Appendix A)	Anglian Water	June 2017
Open source Lidar Data	Data.gov.uk	November 2017
Internal Drainage Board controlled watercourses map	Kings Lynn Internal Drainage Board	September 2017

Table 2.1: Key Information Sources

Site Walkover

2.3 A site walkover was undertaken by Create Consulting Engineers Ltd on 7th July 2017. A visual examination of the Site from perimeter roads and public rights of way, as well as an assessment of its hydrology and surrounding area was carried out.

Consultation

2.4 The agencies and individuals consulted as part of this exercise and/or had their records reviewed as part of this FRA are listed in Table 2.2.

Consultee	Form of Consultation	Topics Discussed and Actions Agreed
Anglian Water Developer Services.	Request for asset plans via online portal on 6th July 2017	Asset plans were received on 6th July 2017 and are included in Appendix A. These are summarised in full in Chapter 3.
Kings Lynn Internal Drainage Board	Request for information on 7th July 2017 and subsequent correspondence in July 2017	The response received on 11th July 2017 (included in Appendix D) and provided the following: • Map of IDB controlled drains within the Site; and, • Associated levels of drains.

Table 2.2: List of Parties consulted as part of this Assessment

3.0 SITE SETTING

Site Location

3.1 The Site lies on the east side of Wisbech, approximately 1.3 km from Wisbech Town Centre, at Ordnance Survey grid reference 547753E, 309484N.

Description of Site and Surroundings

3.2 The Site comprises undeveloped farmland, consisting predominantly of arable fields and orchards with several agricultural drains bisecting it in various orientations.

3.3 The Site is bounded to the north and west by residential estates. To the south and east by Burrettgate Road, followed by a mix of continuing orchard and arable fields, farmyards and light industrial units. Bordering the Site to the south east corner is Meadowgate Academy.

3.4 The Site is relatively flat when considering its size, with ground levels ranging from 2.0 to 3.0 mAOD, falling generally from west to east across the site. Full level information is included on Figure 3.1 at the rear of this report.

Hydrological Setting

Surface Watercourses

3.5 There are a series of agricultural drains located on the Site that generally drain the land in an easterly direction towards Burrettgate Lane and the A47. These drains are a mix of Ordinary Watercourses and IDB controlled watercourses, which form three separate drainage systems within the Site, as shown on Figure 3.2. Spot heights for which are included within Figure 3.3 at the rear of this report.

3.6 Baxter Dyke drains the northern portion of the Site including Chapnall Field. This is an IDB controlled drain (DRN145P1131) which continues beyond the Site boundary to the northeast. Water draining to this system flows through a series of IDB controlled drains before joining Smiths Lode Drain (DRN145P0102) approximately 5.0 km east of the Site. Smiths Lode Drain continues to the northeast, becoming Black Ditch Level Drain (DRN145P0401) and Goodley Islington School Drain (DRN145P0104), before meeting Islington Pumping Station (PMP145P001) approximately 10.0 km northeast of the Site. This station has a total of five pumps, giving a total pumped capacity of 12.0 m^3/s and a maximum lift of 4.65 m (3 diesel pumps at 2.8 m^3/s and two electric at 1.8 m^3/s capacity). The pumping station then outflows via a short length of dyke to The River Great Ouse.

3.7 The southern section of the Site drains via two separate systems which parallel each other, flowing laterally west to east across the Site.

3.8 Green Lane Drain is an IDB controlled watercourse (DRN145P1126) which receives a number of Ordinary watercourses draining the area of the Site south of Sandy Lane, including Hall Field. This drain continues beyond the Site boundary to the east, connecting with College Drain (DRN145P1101) approximately 1.3 km east of the Site. College Drain continues to the east before joining with Smeeth Lode Drain (DRN145P0102) and turning to the north, approximately 3.4 km from the Site boundary.

3.9 College Drain also forms the southern boundary of the Site, receiving drainage from the area immediately south of the Site up to Green Lane Drain, including land behind Meadowgate Academy. This is also an IDB controlled drain (DRN145P1101) which receives Ordinary watercourses from within the Site before flowing east from the Site boundary, following the course outlined above.

3.10 Both College Drain and Green Lane Drain eventually reach Islington Pumping Station before discharging in to The River Great Ouse.

3.11 The River Great Ouse flows approximately 12.0 km to the east of the Site. This watercourse is also classified as a Main River and flows in a northerly direction before outflowing in to The Wash approximately 18.0 km north of the Site.

3.12 The River Nene runs through Wisbech approximately 1.5 km west of the Site. This watercourse is classified as a Main River by the Environment Agency (EA) and flows in a northerly direction through the centre of Wisbech before discharging into The Wash approximately 17.0 km north of the Site.

Estuaries and Coastal Watercourses

3.13 The River Nene and River Great Ouse in the vicinity of the Site are tidally influenced. The adjacent IDB drains are not directly influenced by tidal events due to the fact they have a pumped outfall. However it is understood downstream tidal events can impact the pumping regime and therefore levels within these IDB drains.

Ground Conditions

3.14 BGS mapping for the Site shows the bedrock geology is comprised of the Ampthill Clay Formation (mudstone) and superficial deposits of Tidal Flat Deposits (clay and silt).

3.15 A borehole investigation, comprising a series of three boreholes, approximately 350.0 m from the western boundary of the Site (TF40NE16) confirms the presence of layers of silty fine sands at depths up to 15.0 meters below ground level (mbgl).

3.16 A further two boreholes located on Lynn Road approximately 650 m northwest of the Site also show silty sands with increasing clay content being described as firm clayey sandy silt (TF41SE33) and firm brown fine sandy very silty clay (TF41SE32).

Groundwater

3.17 Water was found standing at a depth of 1.7 mbgl in Borehole TF40NE16 and at 1.8 mbgl in boreholes TF41SE33 and TF41SE32.

3.18 According to the 1:625,000 scale BGS Hydrogeology map of the UK the Site does not overlie any aquifers. Both the bedrock and superficial deposits are classified as unproductive.

3.19 According to the EA website, the Site does not lie within any Groundwater Source Protection Zones.

Artificial Waterbodies

3.20 There is a small network of three ponds located approximately 100 m to the south east of the Site. There is potential for the Site to hold an existing hydrological link to these ponds via a common watercourse ditch leading south from the south eastern corner of the site, further site investigation will be needed to ascertain the drainage linkages in this area as part of any future drainage design.

3.21 Lemons Pond (WCS145P1101-01 and 02) and Mid Farrow Pond (WCS145P0124-01 and 02) Water Control Structures are located approximately 1.0 km and 2.8 km east of the Site respectively. These are manmade or altered water bodies which provide a measure of off line attenuation controlled by the IDB. These structures may be connected to IDB drain DRN145P1101 College Drain which carries surface water flows from the Site.

3.22 A small number of ponds are also noted leading off Green Lane and Biggs Lane approximately 400 m and 1.4 km east of the Site respectively.

3.23 No other significant artificial water bodies are noted in close proximity the Site.

Public Sewers and Water Supply Mains

3.24 Anglian Water asset plans are included in Appendix A. These show no public foul sewers crossing the Site.

3.25 A surface water sewer enters the Site from the northern boundary, running past Three Trees and back garden boundaries of dwellings along Fundrey Road. This sewer is one of a number of surface water drains which outfall into the Site from the surrounding residential areas to the north and west. A full list of outfalls can be found below including the diameter of the aforementioned outfall, which is the only asset to enter the Site boundary itself.

- Flowing to Baxters Dyke:
  - Three Trees, 225mm pipe passing Manhole 8151; and,
  - Between numbers 125 and 133 Stow Road, 675mm pipe meeting 375mm pipe at Manhole 5653.
- Flowing to Green Lane Drain:
  - Between numbers 23 and 42 Orchard Drive, 150mm pipe passing manhole 4252;
  - Stow Gardens, 225mm pipe passing Manhole 3152; and,
  - Junction of Quaker Lane and Penrose Gardens, 600mm pipe passing Manhole 2952.
- Potentially flowing to College Drain
  - Between 42 Meadowgate Lane and 33 Mansell Road, 375mm pipe meeting 300mm pipe passing Manhole 2851; and,
  - Behind 29 Queen Elizabeth Drive and 63 Falklands Avenue, 675mm pipe passing Manhole 2654.

3.26 The foul sewers that serve both the residential development immediately north and west of the Site (100, 150, 175 and 225mm in diameter) generally follow the road corridors and surface water sewers. There is also a small branch along part of Burrettgate Road to the north east corner of the Site.

3.27 The foul sewers generally follow road layouts along the western Site boundary flowing from both the north and south, towards the middle of the Site boundary, before striking west to pumping station WISMSP, positioned at the junction between Orchard Drive and Money Bank.

Site Drainage

3.28 There are no known private foul water assets located within the Site boundary.

3.29 Surface water flows are assumed to infiltrate and run off overland and flow into the various drains across the Site during extreme rainfall events. Rates of infiltration are likely to be low due to the impermeable, silty nature of the underlying geology as well as the shallow groundwater.

3.30 Calculations included in Appendix B estimate the current Greenfield runoff rates from the Site as shown in Table 3.1.

Rainfall Event	Greenfield runoff rate whole Site
Q 1 year	82.53 l/s
Q 30 year	230.11 l/s
Q 100 year	345.65 l/s

Table 3.1: Greenfield Runoff Rates from the Site for Various Rainfall Events.

Flood Zones, Flood Levels & Defence Protection

3.31 According to the EA flood maps (Appendix A) the Site is located predominantly within Flood Zone 1, as shown in Figure 3.4. This risk zone is assessed by the Environment Agency as having a 1 in 1000 or less (<0.1%) probability of flooding from rivers or the sea in any one year.

3.32 Part of the eastern side of the Site however, surrounding the junction between Sandy Lane and Burrettgate Road, is shown as being within Flood Zone 3. NPPF Technical Guidance states that land within Flood Zone 3 is assessed as having a 1 in 100 (1%) or greater annual probability of river flooding or 1 in 200 (0.5 %) or greater annual probability of flooding from the sea.

3.33 According to available EA mapping and The River Nene Catchment Flood Management Plan (2008) there are flood defences associated with the River Nene located approximately 1.5 km west of the Site. These flood defences include a combination of brick clad concrete and steel floodwalls, flood banks and manually operated flood gates, designed to provide protection up to the 1 in 200 year (0.5%) Annual Exceedance Potential (AEP).

3.34 According to available EA mapping, The Great Ouse Tidal River Strategy (2009) and the Draft Great Ouse Catchment Flood Management Plan (2010) there are flood defences associated with the river Great Ouse, approximately 12.0 km east of the Site boundary. These flood defences include raised earth embankments, designed to accommodate the tidal nature of the river, providing protection up to and exceeding the 1 in 500 year event.

3.35 The Site is not shown to lie within a floodplain, as the presence of defences confines flood flows to the river channels of The Nene and Great Ouse (Wisbech Level 2 SFRA, 2012). Flood maps provided by the EA show areas benefiting from flood defences partially covering the Site, surrounding the junction between Sandy Lane and Burrettgate Road, and extensively over surrounding land to the north and east.

3.36 The Wisbech Level 2 SFRA (2012) report and modelling provides details of the likely effects of the River Nene breaching or overtopping during a flood event and shows that areas to the centre of the site may potentially be affected by flooding to depths of between 0 and 0.25m. This however is considered a residual risk, which is unlikely to significantly affect the site when considering the wider context.

3.37 The Site is therefore considered to be at predominantly low risk of fluvial and tidal flooding. It is envisioned that the small areas of flood risk shown to be in Flood Zone 2 and 3 in the eastern part of the site will be accommodated within the final layout of the Site and managed as part of the Site's drainage and risk management strategy. This would accord with these areas being in the lowest part of the site, which will naturally accommodate gravitational flows.

Flood Mapping – Non Fluvial/Tidal Sources of Flooding

3.38 The EA website confirms that the Site is not located in an area that 'might be flooded if a reservoir were to fail'.

3.39 The EA Surface Water Flood Maps (Figure 3.5) suggest that the majority of the Site is at a 'very low' risk of surface water flooding. This risk category is associated with a probability of flooding from extreme rainfall of less than 1 in 1000 (0.1 %).

3.40 There are a few small areas of 'low' risk across the Site including a larger area to the south east of the Site. This risk category is associated with a probability of flooding from extreme rainfall of between 1 in 1000 (0.1%) and 1 in 100 (1%). Flood velocities however (outside of the bisecting drains) remain below 0.25m/s with depths beyond the various drains also less than 300 mm.

Flood History

3.41 Records from the Fenland District Council Strategic Flood Risk Assessment (2011), the Kings Lynn and West Norfolk Borough Council Strategic Flood Risk Assessment (2005) and the Wisbech Strategic Flood Risk Assessment 2 (2012) show two separate major flooding events in Wisbech in 1978 and 1998. As shown on Figure 9 of Fenland District Council's SFRA the recorded flood extents of both these events are confined to the north west of the town and did not reach the Site.

3.42 Local news reports and archive photos also show Wisbech to have been affected by the tidal surge flooding of 1953. The news articles however concentrate on the centre of Wisbech with no information relating to flood extents available over the site area.

4.0 SUDS OPTIONS

Proposed Scheme

4.1 Proposals for the scheme involve the development of the Site to provide a sustainable urban extension of Wisbech. This is to include approximately 1,450 new dwellings, new primary school and local centre, along with all associated access, infrastructure, public open space, landscaping and parking areas.

Appraisal of SUDS Options and Proposed Surface Water Drainage Strategy

4.2 A summary of the potential SUDS options and their associated suitability for use on the Site is included in Table 4.1.

SUDS Option	Suitability	Comments
Rainwater Harvesting	✓	Rainwater harvesting systems are considered acceptable in principle and would work well for individual dwellings depending on cost implications. A system similar to that provided by Rain Activ would be applicable on the dwelling level basis to act as a means of source control.
Green Roofs / Brown Roofs / Blue Roofs	✓	These would provide an additional level of surface water interception, attenuation in the initial stages of precipitation. Their use would again be dependent on considerations of cost as well as structural design of dwellings.
Infiltration systems including soakaways and porous paving	*	Based on our understanding of the ground conditions within the Site methods such as conventional soakaways are not considered suitable due to the potential for shallow underlying groundwater. Groundwater monitoring and subsequent infiltration testing should be carried out during the later stages or design to confirm whether this is the case. There may be limited possibilities for the use of permeable paving dependent upon seasonal high groundwater levels and shallow infiltration potential.
Porous paving (storage)	✓	In areas where infiltration testing, carried out to BRE Digest 365 standard, has proven to be ineffective, all private drives could be comprised of tanked permeable paving which would provide an additional level of storage and water quality treatment at source.
Swales	✓	Open conveyance of surface water runoff in swales will provide both interception and filtration. These features are considered to be acceptable and should be included where practicable and where the adoptable standards of Cambridgeshire & Norfolk County Council Highways

SUDS Option	Suitability	Comments
		Department and Anglian Water can be met for these types of features.
Filter Strips	✓	Another form of open conveyance of surface water runoff this method is considered acceptable for the Site as part of a wider SUDS scheme.
Filter Drains	✓	These Provide filtration and temporary attenuation in shallow trenches and are useful in hard paved or high use areas. Filter Drains are considered acceptable for the Site as part of a wider SUDS scheme.
Attenuation Basins (above ground storage)	✓	These features are considered to be acceptable and should be included where practicable as part of final surface water outflow controls. In total 14 attenuation basins are proposed with full details of these features are included in Table 4.2.
Below ground storage in cellular systems	X	Based on our understanding of the ground conditions sub surface attenuation methods are unlikely to be suitable for this development, unless appropriate rafting to avoid flotation is used. Also given the attenuation basins will be used this type of system will not be required.
Flow control devices	✓	Flow control devices are considered suitable and are proposed throughout the scheme to restrict runoff (in association with the aforementioned attenuation basins) to greenfield rates. Further details of these flow controls (14 in total) are included in Table 4.2.

Table 4.1: SUDS Options

Key:

✓ *Suitable for use*

* *Possibly suitable for use – should be considered further as part of the detailed design*

X *Unlikely to be suitable for use*

4.3 On the basis of the above appraisal it is evident that a number of source control and conveyance methods are suitable for use. These source control and conveyance methods should be considered as the proposed site layout develops such that they can be incorporated from an early stage. In terms of final outfall attenuation and restriction to greenfield rates the following provides a summary of the proposed method of management and disposal of surface water runoff:

- Surface water flows will be attenuated such that flows from the Site are restricted prior to a discharge into the surrounding ditch system;
- In total 16 surface water outfalls with associated attenuation basins are proposed flowing from the various land parcels (12 in total), delineated by the ditch system intersecting the Site (as detailed by Figure 4.1) and Drawing 1309/02/001A;
- All flow controls have been restricted to the 1 in 1 year greenfield rate (shown in Table 4.2), equivalent to a 60% impermeability of the developed area of each parcel. These

runoff rates have been developed using the 1.2l/s/ha pro-rata runoff rate for the 1 in 1 year greenfield runoff event (greenfield calculations for each parcel are included in Appendix B).

- The assumption that 60% of the site area will become impermeable is not considered fixed, this will need to be varied as the design of the development progresses to accurately reflect the relevant build density for each parcel.
- As development densities become more fixed at the planning and detailed design stage urban creep should be factored in to the proposals as required, in line with LASSO guidance.
- Greenfield run-off from non-developed areas will need to be factored into calculations to ensure adequate capacity is provided for these flows.
- Micro Drainage calculations (included in Appendix C) have been carried out for each development parcel to estimate the required attenuation. As shown by Table 4.2 this attenuation has then been increased by 50% to allow for bank slopes as well as splitting the basins down into a number of smaller features in some instances. The number of features proposed for each parcel is noted on Table 4.2 and is largely due to the minimal falls across the Site, meaning more than one feature per parcel is required in some instances to avoid basins being overly deep such that gravity connections can be achieved.
- It should be noted however that due to only 2.0 m resolution LiDAR being available for this assessment it has not been possible to accurately position attenuation basins and confirm whether gravity connections can be achieved. As the design of the layout progresses it is recommended that a full topographical survey is carried out such that the attenuation basins can be positioned accurately and the need for any pumped outfalls confirmed.
- Also the detailed positions of the attenuation basins will be further influenced as the design progresses and landscaping and highways constraints are understood in more detail.
- All attenuation basins have been sized on the basis of a design standard of 1 in 100 years plus 40% climate change. These calculations are summarised in more detail in Table 4.2 below and Appendix C.
- Source control water quality treatment measures (as detailed in Table 4.1) should be incorporated into the detailed drainage design for each development parcel where possible.
- The ditch network to which the surface water drainage network is proposed to outfall should be appropriately desilted prior to any connections being made (in liaison with the IDB where required) whilst some localised re-profiling may be required to achieve a connection with pipe cover depths being to adoptable standards. Some land raising may also be required to achieve suitable adoptable cover depths whilst some attenuation basins may have to be further split down across the relevant parcel to reduce pipe lengths.
- A 9.0 m easement is required both side of all IDB controlled drains, and has been included throughout for positioning the attenuation basins.

- Finally it should be noted that as the aforementioned source control measures are included within the scheme the scale of the attenuation basins currently proposed can be reduced as these additional measures will introduce an amount of upstream storage.

4.4 For all events beyond the 1 in 100 year plus climate change rainfall event, the situation will be no worse than the existing greenfield scenario, as long as a consideration of exceedance flows is made as part of the detailed drainage design to ensure that any excess surface water runoff would continue to overflow away from the existing and proposed residential properties.

4.5 As development parcels are brought forward the accompanying planning applications should include an appropriate flood risk assessment. This should pay specific regard to the risk of flooding posed by surrounding watercourses and the effect this will have on scheme layouts, final housing densities and positioning of attenuation features.

4.6 A groundwater quality risk assessment will also be required as part of the detailed design, to ensure that proposals do not detrimentally affect sub-surface water quality.

4.7 Each development proposal will be required to consult with Kings Lynn Internal Drainage Board during the design process. Proposals will also be required to gain approval from Kings Lynn Internal Drainage Board for proposed outfalls under Byelaw 3, as the final approving body. This will require outfalls to be restricted to calculated greenfield rates in line with Internal Drainage Board policy whilst runoff volume would also be considered as part of this.

Drainage area (ref to Figure 4.1)	Total Area (ha)	60% Equivalent Impermeable Area (ha)*1	Restricting Greenfield 1 in 1 Year Flow Rate Based on 1.2 l/s/ha (l/s) *2	Total Basin Surface Area Including Additional 50% for Bank Slopes and Multiple Basins (m^2)	Basin Depth (m) *3	Proposed Number of Attenuation Basins
1	5.86	3.52	4.30	4620.00	1.00	1
2	9.24	5.54	6.70	7425.00	1.00	2
3	10.11	6.07	7.30	8100.00	1.00	2
4	2.82	1.69	2.00	2250.00	1.00	1
5	5.56	3.34	4.00	4425.00	1.00	1
6	9.61	5.77	7.00	7620.00	1.00	2
7	3.10	1.86	2.30	2475.00	1.00	1
8	1.25	0.75	1.00	975.00	1.00	1
9	4.02	2.41	2.90	3225.00	1.00	1
10	5.68	3.41	4.10	4650.00	1.00	1
11	2.33	1.40	1.70	1845.00	1.00	1
12	11.50	6.9	8.4	9130.00	1.00	2

Table 4.2: Details of Attenuation Basins

*1The proposed land uses for each parcel have been taken as 100% developable, with an assumed 60% impermeable area. The 60% equivalent impermeable area represents the proposed impermeability of the developed area of each land parcel. Given the lack of a detailed layout such an impermeability factor is commonly used as a conservative estimate. The FSR rainfall estimation method has been used to calculate expected attenuation volumes required.

*2The restricting flow rate is based on the 1 in 1 year equivalent greenfield rate calculated pro-rata from the whole site runoff rate of 1.2 l/s/ha (greenfield runoff calculations for all drainage areas are included in Appendix B). Where the rate is less than 1.0 l/s (i.e. for Area 8) a rate of 1.0 l/s has been used due to constraints in engineering design. Where the Area has more than one attenuation feature (i.e. for Areas 2, 3, 6 and 12) the flow control will be proportioned pro-rata based on the size of each attenuation feature, therefore ensuring the overall greenfield runoff rate will not be exceeded for each parcel.

*5 Basin depths of 1.0 m have been assumed throughout to allow gravity connections to be achieved. As noted earlier in Chapter 4 however a detailed topographic survey should be carried out as the design progresses to aid more detailed basin placement and the need for pumped outfalls. This will also dictate the need for the lining of any attenuations basins when considering seasonal groundwater peaks.

Consideration of Offsite SUDS System

4.8 The use of SUDS is a requirement of national policy as stipulated in the National Planning Policy Framework (NPPF). The NPPF planning practice guidance (para. 051) states the purpose of SUDS is to control surface water runoff as close to source as possible and to mimic natural drainage as closely as possible.

4.9 This is an ethos which is endorsed by Lead Local Flood Authorities and expanded on by the Construction Industry Research and Information Association (Ciria) as part of industry standard guidance relating to the SUDS management train. The SUDS management train is defined by Ciria below and included within the Cambridgeshire Flood and Water SPD:

'The management train concept promotes division of the area to be drained into sub-catchments with different drainage characteristics and land uses, each with its own drainage strategy. Dealing with the water locally not only reduces the quantity that has to be managed at any one point, but also reduces the need for conveying the water off the site….

….Only if the water cannot be managed on site should it be (slowly) conveyed elsewhere. This may be due to the water requiring additional treatment before disposal or the quantities of runoff generated being greater than the capacity of the natural drainage system at that point.'

4.10 The Fenland Local Plan also supports the ethos of the SUDS management train incorporating on-site management of surface water run-off into Policy LP14:

In addition to the requirements of the NPPF and associated technical guide, all applications for relevant developments must include a drainage strategy to demonstrate that:

(a) suitable consideration has been given to surface water drainage;
(b) appropriate arrangements for attenuating surface water run-off can be accommodated within the site; and
(c) issues of ownership and maintenance are addressed. For foul drainage private infrastructure managed by residents groups or management companies should be avoided.

The use of Sustainable Drainage Systems (SuDs) will be required to ensure that runoff from the site (post development) is to Greenfield runoff rates for all previously undeveloped sites and for developed sites (where feasible). This should include sufficient area within the site to accommodate SuDS for the short term management of surface water drainage and where appropriate link to green / blue infrastructure to exploit opportunities for biodiversity, environmental, heritage, social and recreational enhancement and value. Schemes should complement the aims of the Cambridgeshire Green Infrastructure Strategy but should be retained and maintained primarily for the purpose for which they were designed, whilst being sensitive to the multi–functional benefits they can provide.

4.11 The Cambridgeshire Flood and Water SPD states that it is a Building Regulations and PPG requirement that the discharge hierarchy is used when considering proposals. This is defined as:

'Rainwater shall discharge to the following, listed in order of priority:

- *To ground in an adequate soakaway or some other adequate infiltration system; or where that is not reasonably practicable*
- *A watercourse; or where that is not reasonably practicable*
- *A surface water sewer, highway drain or other drainage system: or where that is not reasonably practicable*
- *A combined sewer'*

4.12 Sufficient evidence must therefore be provided to prove that surface water cannot be adequately managed within the site, before off-site SUDS systems are considered, as off-site management is considered contrary to local policy and the ethos of Sustainable drainage systems. However based on this assessment it is evident that surface water can be managed at source and within the boundary of the Site.

4.13 Source control SUDS methods promote water quality improvements and help to minimise the impact of development on the surrounding area. Therefore again on this basis an Offsite system would be deemed inappropriate as the potential water quality benefits would be limited.

4.14 Providing sufficient falls to the proposed drainage system would also be an issue when providing off-site SUDS features. As the site is largely flat, water transmission features such as pipes and ditches will need to deepen with increasing length to maintain design standard flow rates. An off-site location, at some distance from the source of run-off may lead to overly deep end of network SUDS features in order to maintain flow gradients. This may produce public safety concerns and increase development costs.

4.15 It is therefore not advised that the client seek opportunities to provide SUDS in offsite locations due to local and national policy considerations, water quality issues, the scale of proposed development and the hydrological complexity of the Site.

5.0 CONCLUSIONS AND RECOMMENDATIONS

5.1 This assessment has considered the proposed development site positioned to the east of Wisbech, for which 1,450 dwellings are currently allocated. An overview of the Site and surrounding area's hydrogeology, hydrology and associated flood risks has been carried out to inform an appraisal of the potential SUDS options for the development of the Site.

5.2 This appraisal of SUDS options has found a number of source control and conveyance measures are potentially suitable for the scheme, including rainwater harvesting, green roofs, swales, filter strips and filter drains, subject to cost, structural and layout constraints as the scheme develops. For final outflow control a strategy using attenuation basins and flow control devices has been developed on the basis of 12 hydrological areas, which have been delineated based upon the IDB Drains and Ordinary Watercourses intersecting the Site.

5.3 The assessment has included a number of standard assumptions given the incipient phase of development and the associated lack of specific, detailed information. These include:

- An assumed 60% impermeable area for each development parcel, which may change as a result of the final detailed design (dependent upon housing density);
- Use of the FSR method for calculating rainfall volume;
- All outfalls have been restricted to the equivalent 1 in 1 year greenfield run-off rate for the 60% impermeable area of each development parcel;
- All basins have been designed on an assumed 1.0 m water depth;
- All basins have been sized on the basis of the 1 in 100 year plus 40 % climate change storm.

5.4 Infiltration based drainage is assumed to be unsuitable for the scheme given the underlying geology and potential for shallow groundwater. Groundwater monitoring and subsequent infiltration testing should however be carried out as the design progresses to confirm whether any permeable surfacing can be utilised.

5.5 It is recommended that as the design progresses the conclusions of this report are used to inform the layout such that's the various SUDS options can be included where suitable, whilst the attenuation basins proposed can be located in more detail when considering other constraints, including highways and landscaping.

6.0 REFERENCES

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FIGURES

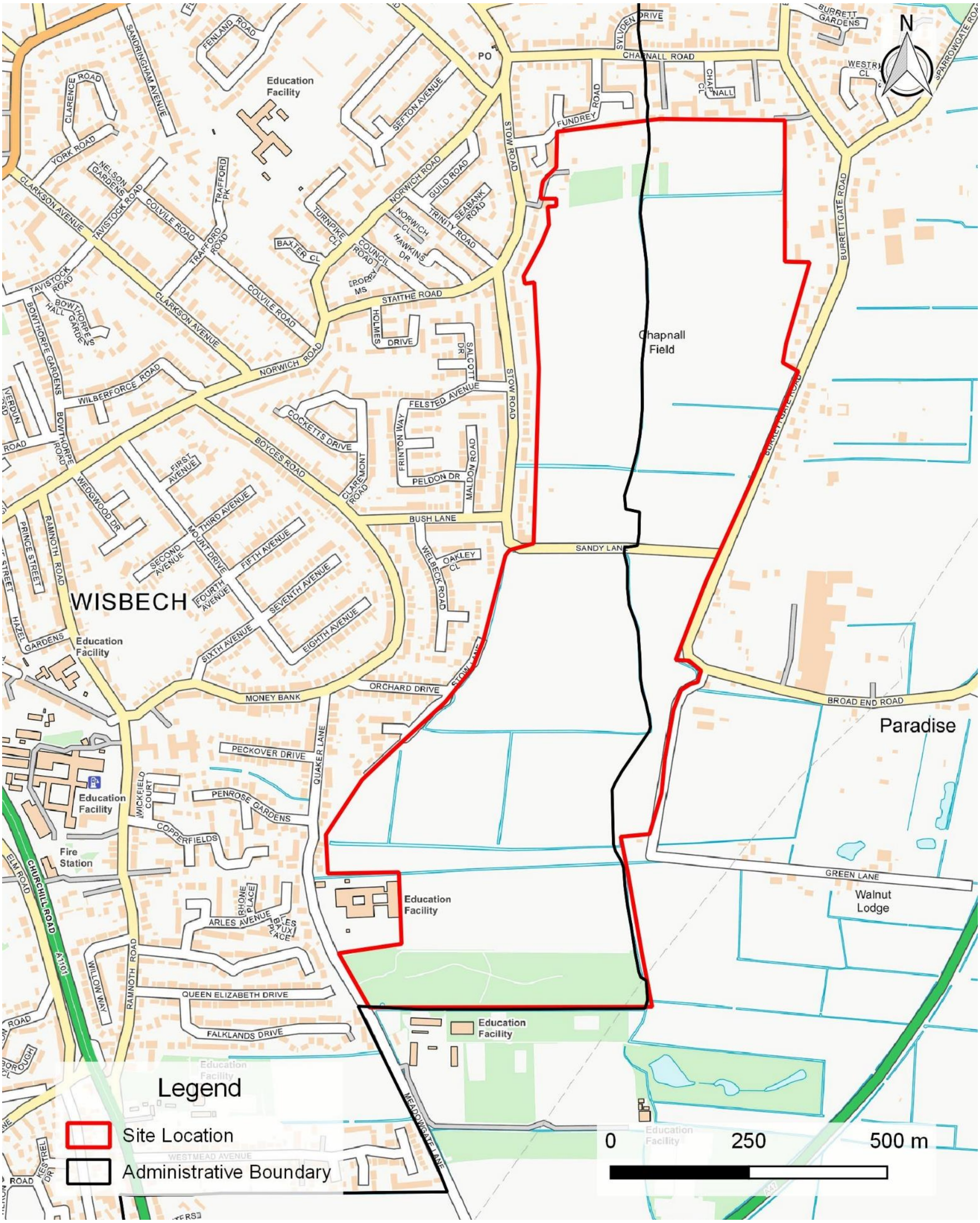

Figure 1.1 Site Location

OS Mapping provided by OS open source mapping data (www.ordnancesurvey.co.uk/opendatadownload), accessed November 2017

Figure 1.2 Existing Site Layout

Satellite image provided by Google Earth, accessed November 2017

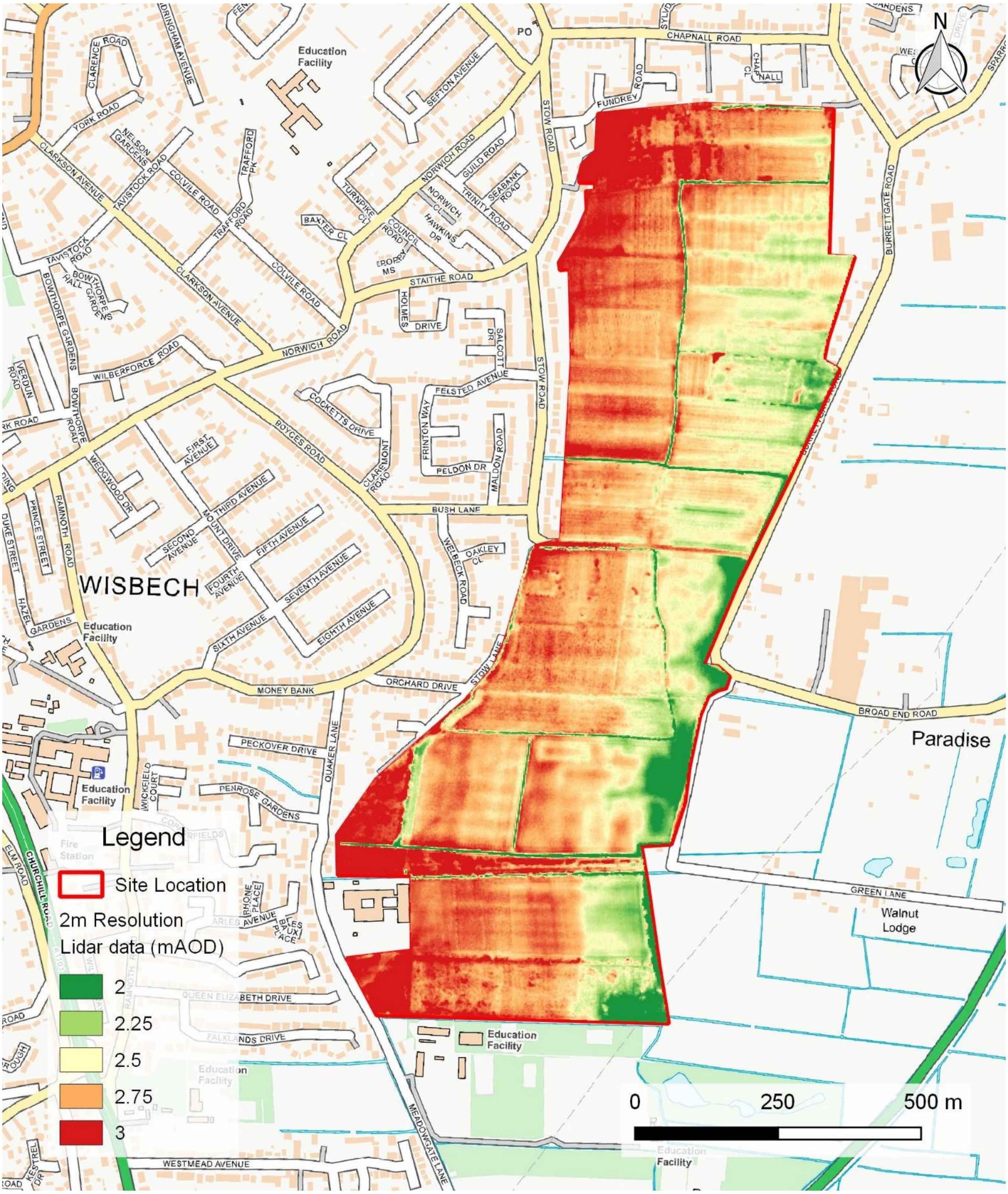

Figure 3.1 2.0 m Resolution LiDAR Topography

Source: Data.gov.uk

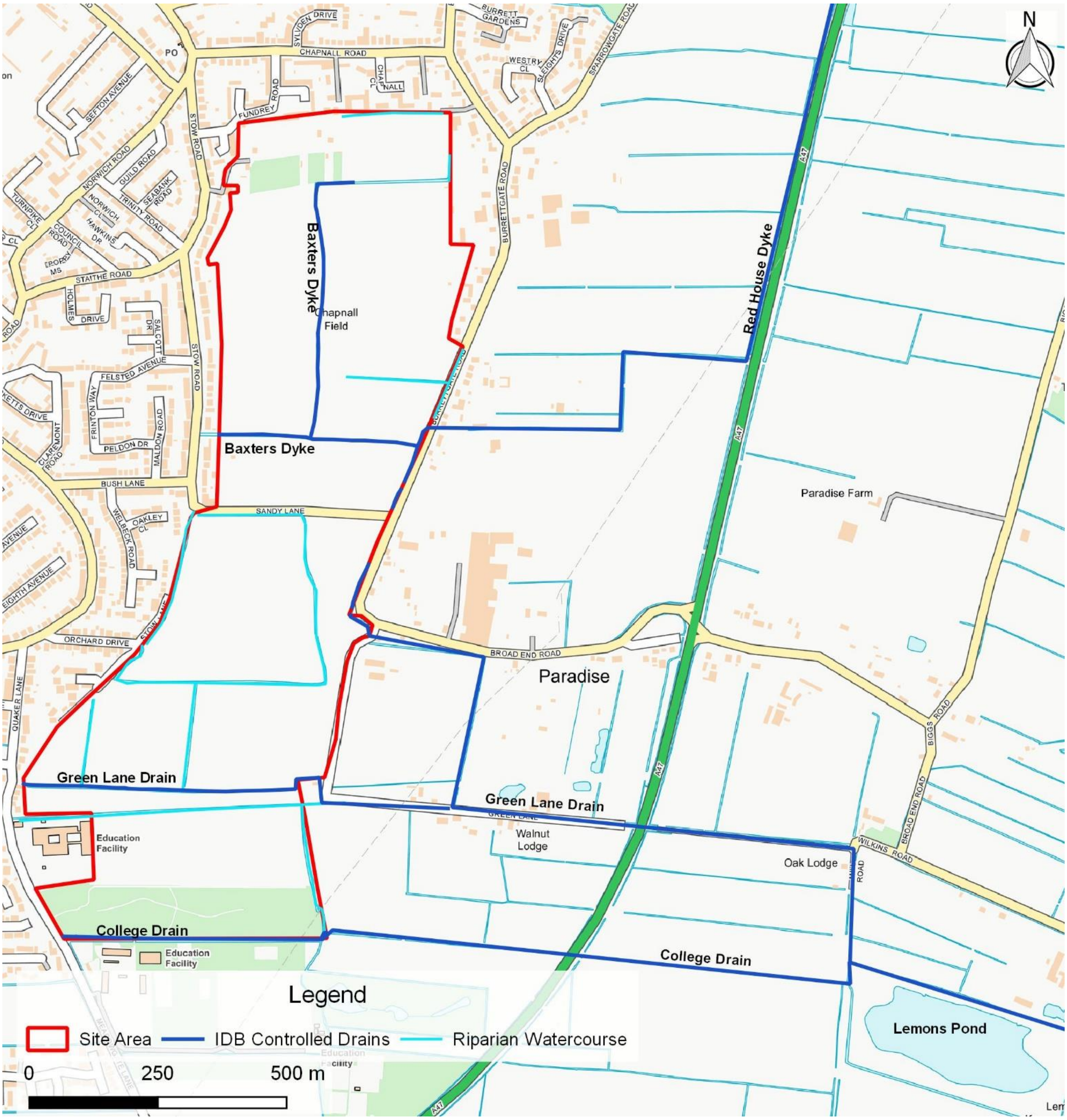

Figure 3.2 IDB and Riparian Watercourses

Source: Kings Lynn Internal Drainage Board

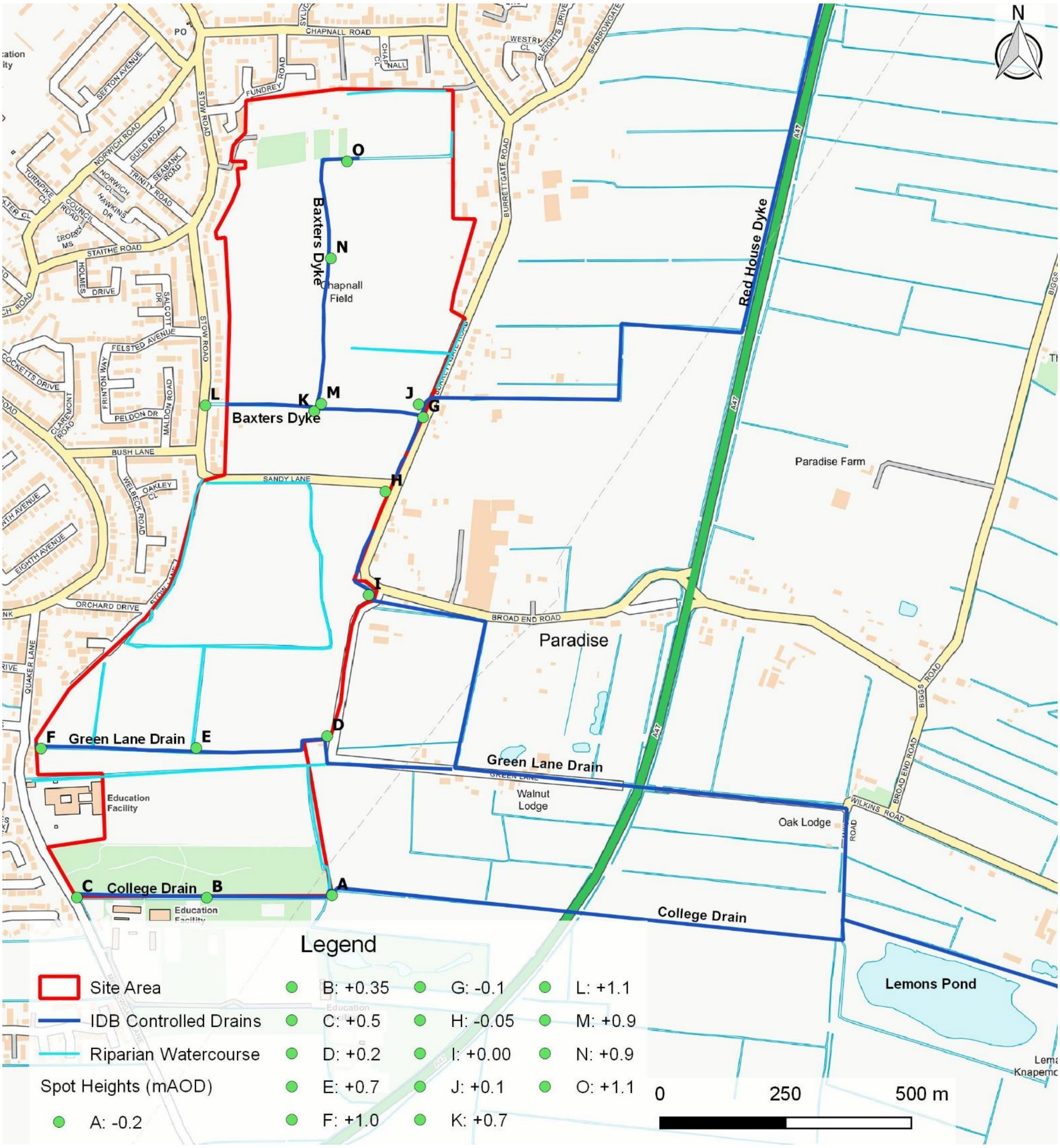

Figure 3.3 Spot Heights within IDB Land Drains

Source: Kings Lynn Internal Drainage Board

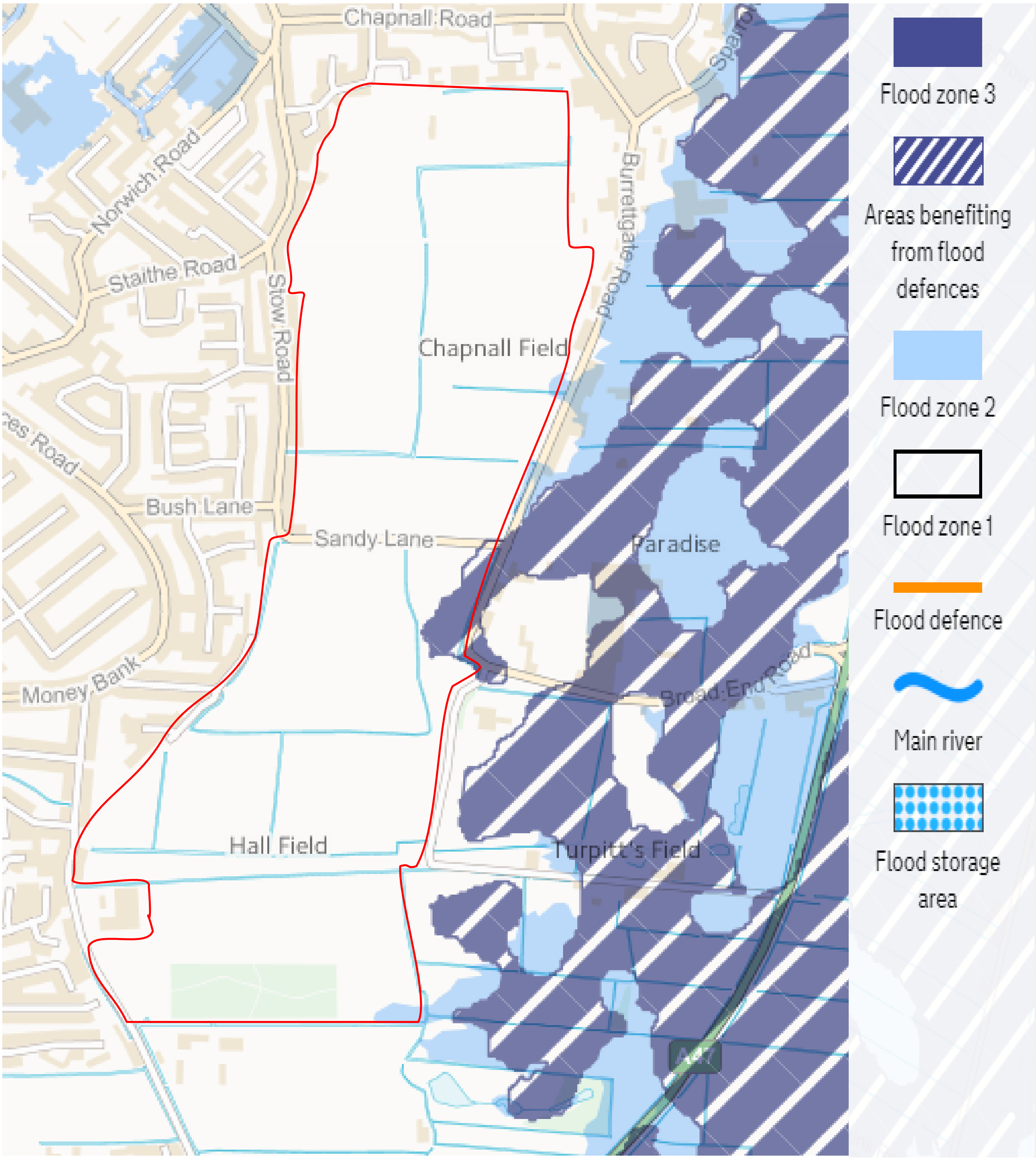

Figure 3.4 Environment Agency Flood Map

Source: Environment Agency Website (accessed November 2017)

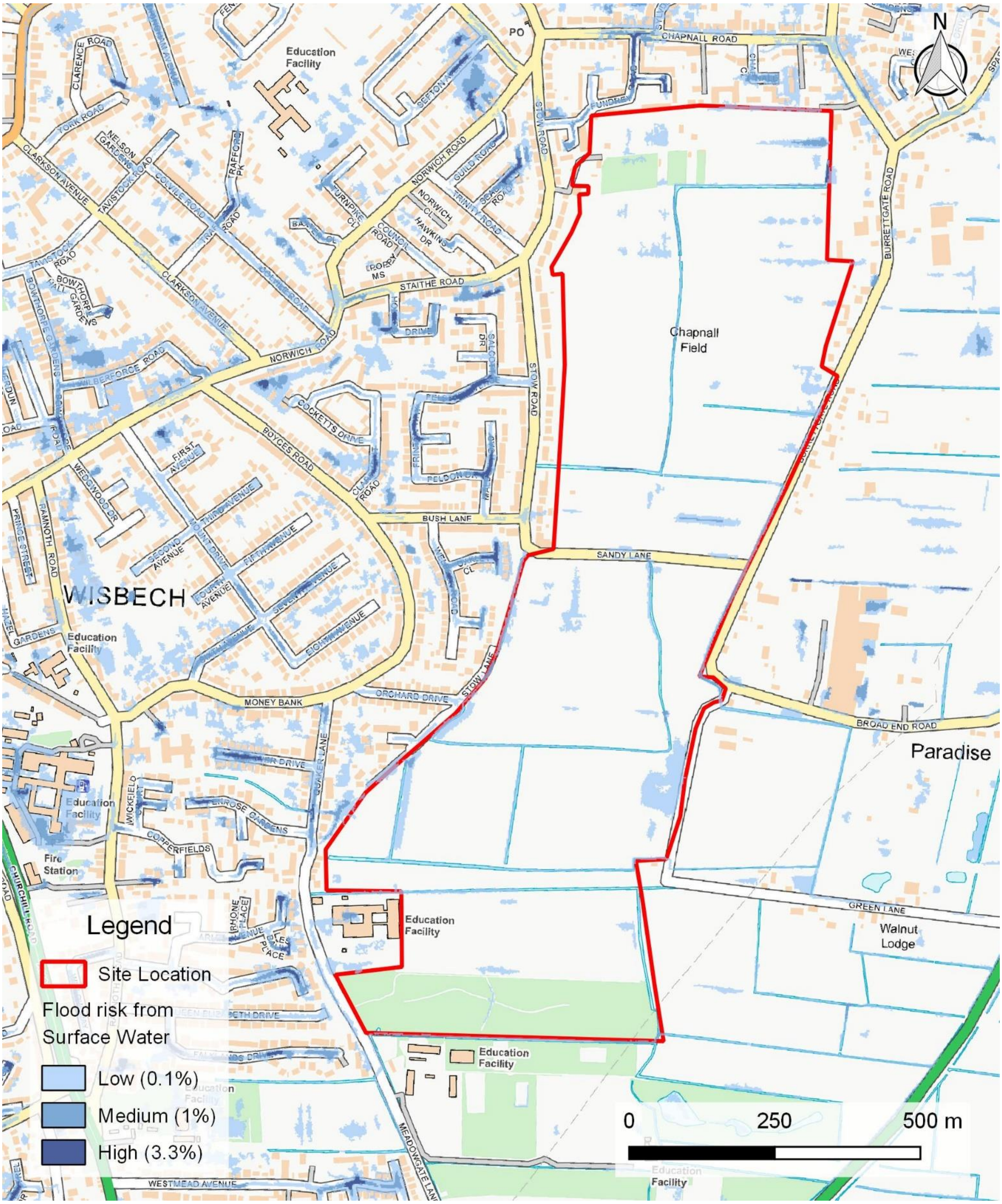

Figure 3.5 Environment Agency Surface Water Flood Map

Source: Environment Agency Website (accessed November 2017)

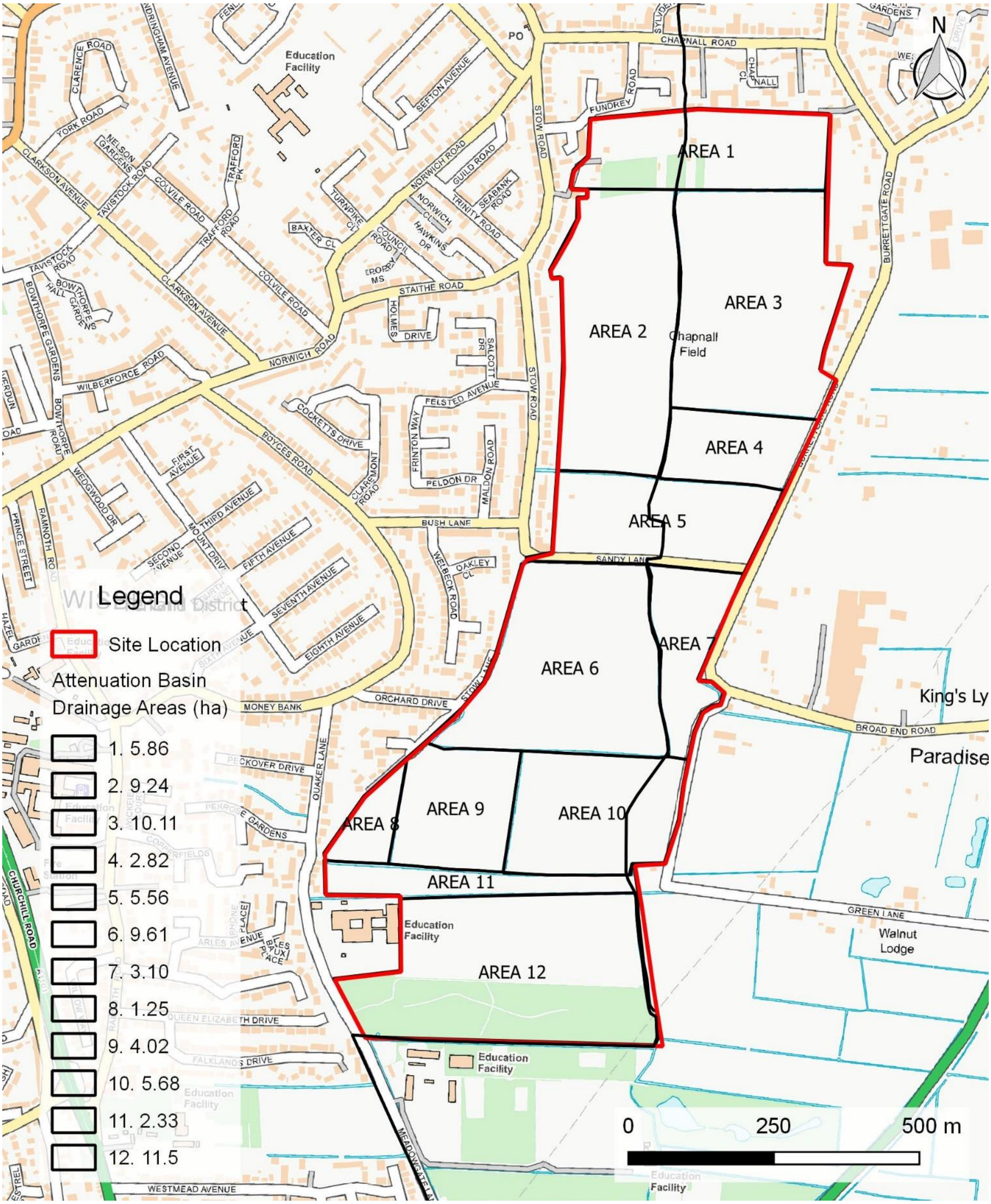

Figure 4.1 Attenuation Basin Drainage Areas

OS Mapping provided by OS open source mapping data (www.ordnancesurvey.co.uk/opendatadownload), accessed November 2017

APPENDICES

APPENDIX A

(c) Crown copyright and database rights 2017 Ordnance Survey 100022432 | Date: 06/07/17 | Scale: 1:1250 | Map Centre: 547929,309977 | Data updated: 01/05/17 | Our Ref: 228649 - 1 | Wastewater Plan A0

- Foul Sewer
- Surface Sewer
- Combined Sewer
- Final Effluent
- Rising Main (Colour denotes effluent type)
- Private Sewer (Colour denotes effluent type)
- Decommissioned Sewer (Colour denotes effluent type)
- Outfall (Colour denotes effluent type)
- Inlet (Colour denotes effluent type)
- Manhole (Colour denotes effluent type)
- Sewage Treatment Works
- Pumping Station

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P17-1309

love every drop anglianwater

Manhole Reference	Easting	Northing	Liquid Type	Cover Level	Invert Level	Depth to Invert
2911	547234	309904	C	3.77	1.88	1.89
2912	547221	309933	C	3.76	1.93	1.83
2913	547213	309979	C	4.14	1.86	2.28
0201	548096	310271	F	-	0.28	-
0202	548060	310269	F	-	0.43	-
0203	548003	310266	F	3.01	0.71	2.3
0204	548002	310285	F	-	1.12	-
0205	548012	310286	F	-	1.31	-
0301	548010	310384	F	-	0.77	-
0302	548055	310384	F	2.8	-0.37	3.17
0303	548060	310367	F	0.55	0.27	0.28
0304	548084	310328	F	3.07	-0.08	3.15
0403	548057	310437	F	1.13	0.56	0.57
1001	548159	310095	F	2.91	0.93	1.98
1002	548167	310030	F	-	1.2	-
1003	548174	310045	F	-	-	-
1101	548161	310130	F	3.02	0.81	2.21
1201	548117	310278	F	2.89	0.15	2.74
1202	548138	310249	F	2.92	0.29	2.63
1203	548176	310203	F	2.89	0.51	2.38
1204	548183	310289	F	2.61	1.78	0.83
1301	548166	310313	F	-	-	-
1302	548142	310358	F	-	-	-
1303	548169	310352	F	2.74	1.3	1.44
1401	548156	310439	F	2.39	0.56	1.83
1402	548186	310439	F	2.5	0.69	1.81
2002	547257	310056	F	4.04	2.43	1.61
2003	547294	310015	F	-	-	-
2101	547258	310174	F	4.2	3.03	1.17
2102	547202	310115	F	3.83	2.72	1.11
2201	548244	310290	F	-	-	-
2201	547278	310283	F	3.9	2.68	1.22
2301	548219	310351	F	-	-	-
2302	548237	310340	F	2.67	0.87	1.8
2303	548231	310319	F	-	-	-
2304	548268	310377	F	-	-	-
2401	548207	310437	F	-	-	-
2402	548274	310418	F	2.32	0.27	2.05
2403	548280	310434	F	-	-	-
2406	548282	310458	F	-	-	-
2501	547286	309540	F	3.73	0.4	3.33
2502	547257	309567	F	3.85	0.49	3.36
2602	547211	309607	F	3.9	1.52	2.38
2701	547219	309792	F	3.24	1.4	1.84
2702	547218	309795	F	3.1	1.41	1.69
2801	547205	309833	F	3.89	1.58	2.31
2802	547210	309817	F	3.5	1.512	1.988
2803	547221	309808	F	3.1	1.462	1.638
2904	547207	309984	F	4.14	1.17	2.97
2905	547298	309956	F	4.1	2.72	1.38
2906	547255	309947	F	4.21	2.43	1.78
2907	547259	309944	F	4.08	2.44	1.64
2914	547210	309910	F	-	-	-
2915	547205	309902	F	-	-	-
2916	547216	309932	F	-	-	-
2917	547206	309929	F	-	-	-
2918	547203	309934	F	-	-	-
2919	547202	309937	F	-	-	-
3000	547310	310029	F	-	-	-
3001	547395	310089	F	-	-	-
3002	547389	310100	F	-	-	-
3003	547392	310093	F	-	-	-
3101	547346	310115	F	4.28	2.62	1.66
3102	547321	310185	F	3.83	2.84	0.99
3104	547343	310103	F	-	-	-
3105	547378	310108	F	-	-	-
3201	547398	310292	F	3.37	2.3	1.07
3202	547392	310275	F	3.65	2.37	1.28
3203	547359	310240	F	3.86	2.53	1.33
3204	547332	310213	F	3.94	2.71	1.23
3301	547326	310347	F	3.92	2.36	1.56
3302	547321	310329	F	3.81	2.38	1.43
3303	547358	310379	F	4.01	2.21	1.8
3501	547318	309501	F	3.68	0.15	3.53
3502	547378	309541	F	3.33	1.82	1.51
3601	547304	309617	F	3.11	0.77	2.34
3602	547305	309639	F	3.04	0.82	2.22
3603	547304	309668	F	3.24	0.87	2.37
3604	547332	309640	F	-	-	-
3605	547342	309641	F	-	-	-
3606	547345	309607	F	-	-	-
3607	547368	309608	F	3.23	1.11	2.12
3701	547302	309734	F	3.72	-	-
3702	547311	309742	F	3.34	1.25	2.09
3704	547333	309753	F	3.7	1.67	2.03
3705	547347	309754	F	-	-	-
3800	547331	309851	F	-	-	-
3801	547318	309850	F	-	-	-
3802	547307	309850	F	-	-	-
3803	547347	309866	F	-	-	-
3900	547354	309966	F	-	-	-
3901	547374	309935	F	-	-	-
3902	547350	309972	F	-	-	-
3903	547339	309979	F	-	-	-
3904	547330	309986	F	-	-	-
4000	547400	310085	F	-	-	-
4101	547414	310177	F	4.11	2.22	1.89
4102	547459	310126	F	-	-	-
4103	547411	310110	F	-	-	-
4201	547480	310240	F	3.73	1.88	1.85
4202	547488	310228	F	3.737	2.017	1.72
4301	547471	310374	F	3.49	1.76	1.73
4302	547460	310388	F	3.47	1.74	1.73
4303	547462	310391	F	-	-	-
4401	547403	310436	F	4.02	1.57	2.45
4402	547401	310429	F	4.01	1.9	2.11
4501	547489	309596	F	-	-	-
4502	547424	309515	F	-	-	-
4503	547426	309510	F	-	-	-
4504	547448	309512	F	-	-	-
4505	547476	309512	F	-	-	-
4601	547437	309615	F	-	-	-
4602	547494	309618	F	2.79	1.54	1.25
4603	547499	309655	F	-	-	-
4701	547416	309745	F	-	-	-
4702	547445	309753	F	2.79	1.67	1.12
4703	547496	309787	F	2.8	1.8	1
4704	547463	309794	F	-	-	-
4801	547457	309823	F	-	-	-
4802	547493	309824	F	2.93	1.95	0.98
4803	547488	309889	F	3.34	-	-
4804	547449	309887	F	-	-	-
4901	547417	309949	F	3.84	2.3	1.54
4902	547468	309955	F	3.42	2.28	1.14
5001	547552	310003	F	4	2.02	1.98
5002	547583	310059	F	4.37	1.87	2.5
5003	547547	310044	F	-	-	-
5004	547540	310036	F	-	-	-
5101	547590	310118	F	4.09	1.75	2.34
5102	547521	310187	F	-	-	-
5203	547564	310221	F	3.55	1.55	2
5204	547595	310230	F	3.549	1.949	1.6
5205	547571	310218	F	3.696	1.546	2.15
5206	547502	310210	F	-	-	-
5207	547516	310218	F	-	-	-
5208	547516	310240	F	-	-	-
5209	547515	310244	F	-	-	-
5210	547518	310229	F	-	-	-
5301	547558	310320	F	4.12	1.3	2.82
5302	547555	310349	F	4.78	1.31	3.47
5303	547530	310306	F	3.99	1.53	2.46
5304	547568	310379	F	4.52	1.16	3.36
5401	547531	310433	F	4.66	1.07	3.59
5501	547555	309546	F	-	-	-
5502	547502	309513	F	-	-	-
5602	547565	309620	F	-	-	-
5702	547572	309705	F	3.35	-	3.35
5801	547558	309883	F	3.37	1.67	1.7
5802	547566	309813	F	3.16	1.48	1.68
5901	547502	309966	F	3.54	2.16	1.38

Manhole Reference	Easting	Northing	Liquid Type	Cover Level	Invert Level	Depth to Invert
5902	547550	309956	F	3.45	1.96	1.49
5903	547554	309983	F	-	-	-
5904	547570	309979	F	-	-	-
6200	547645	310228	F	3.619	1.889	1.73
6201	547601	310222	F	3.513	1.833	1.68
6202	547644	310296	F	3.326	2.286	1.04
6203	547644	310247	F	3.232	1.922	1.31
6204	547678	310240	F	-	-	-
6205	547699	310243	F	-	-	-
6301	547697	310384	F	2.86	-	-
6302	547619	310384	F	3.43	1.33	2.1
6303	547628	310351	F	-	-	-
6304	547619	310357	F	-	-	-
6305	547619	310367	F	-	-	-
6306	547689	310377	F	-	-	-
6307	547689	310358	F	-	-	-
6308	547673	310359	F	-	-	-
6309	547673	310366	F	-	-	-
6310	547657	310359	F	-	-	-
6311	547657	310364	F	-	-	-
6312	547647	310352	F	-	-	-
6313	547641	310359	F	-	-	-
6314	547641	310364	F	-	-	-
6402	547608	310460	F	4.893	3.023	1.87
6403	547632	310400	F	-	-	-
6404	547632	310410	F	-	-	-
6405	547637	310411	F	-	-	-
6406	547648	310410	F	-	-	-
7200	547735	310254	F	3.159	2.449	0.71
7201	547731	310266	F	3.078	2.218	0.86
7202	547711	310245	F	-	-	-
7203	547727	310247	F	-	-	-
7204	547742	310250	F	-	-	-
7205	547771	310253	F	-	-	-
7206	547771	310255	F	-	-	-
7301	547758	310381	F	3.1	1.99	1.11
7303	547715	310383	F	2.868	1.638	1.23
7305	547798	310379	F	-	-	-
7306	547799	310329	F	3.271	2.351	0.92
7307	547715	310329	F	3.053	1.933	1.12
7402	547762	310430	F	3.09	2.15	0.94
8326	547877	310380	F	-	-	-
8327	547838	310381	F	3.07	1.43	1.64
8328	547806	310382	F	-	-	-
8329	547842	310322	F	-	-	-
9326	547937	310381	F	2.92	1.05	1.87
1251	548182	310212	S	2.71	1.72	0.99
1252	548184	310292	S	-	-	-
1351	548168	310314	S	2.62	1.56	1.06
1352	548142	310354	S	2.9	1.64	1.26
1353	548172	310350	S	-	-	-
2051	547291	310046	S	3.914	2.094	1.82
2054	547281	310051	S	4.27	1.91	2.36
2151	547245	310155	S	4.086	2.676	1.41
2152	547209	310111	S	3.92	2.4	1.52
2251	548219	310239	S	-	-	-
2251	547258	310280	S	3.91	2.47	1.44
2252	548258	310264	S	2.36	1.06	1.3
2253	548298	310297	S	-	-	-
2351	548221	310348	S	2.75	1.12	1.63
2352	548238	310337	S	-	-	-
2353	548233	310321	S	2.88	0.81	2.07
2354	548272	310378	S	2.4	0.51	1.89
2451	548278	310415	S	-	-	-
2452	548283	310429	S	2.33	0.33	2
2551	547286	309548	S	3.724	2.444	1.28
2552	547266	309566	S	3.89	2.51	1.38
2553	547249	309582	S	3.818	2.468	1.35
2651	547290	309681	S	3.358	1.568	1.79
2652	547253	309680	S	3.335	1.685	1.65
2653	547293	309641	S	3.011	1.661	1.35
2654	547284	309610	S	3.108	1.748	1.36
2751	547288	309754	S	3.362	1.502	1.86
2753	547277	309785	S	3.199	1.319	1.88
2754	547275	309755	S	3.51	1.61	1.9
2851	547215	309860	S	3.91	1.71	2.2
2852	547203	309827	S	-	-	-
2853	547247	309821	S	3.099	1.549	1.55
2854	547207	309830	S	3.903	1.703	2.2
2855	547210	309821	S	3.569	1.692	1.877
2856	547221	309812	S	3.1	1.636	1.464
2954	547225	309998	S	4.18	1.85	2.33
3051	547349	310002	S	3.952	2.792	1.16
3152	547347	310113	S	4.32	1.98	2.34
3251	547382	310263	S	3.64	2.39	1.25
3252	547351	310235	S	3.933	2.603	1.33
3253	547345	310244	S	3.8	2.25	1.55
3254	547322	310267	S	3.81	2.52	1.29
3255	547324	310220	S	3.766	2.276	1.49
3351	547360	310387	S	3.974	2.814	1.16
3352	547311	310339	S	3.96	2.67	1.29
3451	547371	310460	S	4.069	2.779	1.29
3551	547303	309530	S	-	-	-
3552	547399	309516	S	3.19	1.95	1.24
3651	547372	309612	S	-	-	-
3652	547372	309680	S	2.83	2	0.83
3751	547336	309782	S	3.697	1.447	2.25
3752	547371	309754	S	3.03	1.73	1.3
3851	547316	309896	S	3.327	2.217	1.11
3852	547317	309869	S	3.241	2.151	1.09
3853	547349	309864	S	3.41	2.03	1.38
3854	547384	309869	S	3.246	2.186	1.06
3855	547385	309894	S	3.272	2.252	1.02
4051	547428	310031	S	4.101	2.811	1.29
4052	547420	310019	S	4.046	2.916	1.13
4053	547453	310075	S	3.8	2.43	1.37
4054	547498	310038	S	3.939	2.429	1.51
4151	547455	310160	S	3.767	2.577	1.19
4152	547416	310177	S	4.12	2.11	2.01
4153	547408	310109	S	3.95	2.46	1.49
4154	547492	310112	S	3.595	2.495	1.1
4251	547484	310241	S	3.799	2.269	1.53
4253	547404	310239	S	3.539	2.599	0.94
4351	547760	310388	S	3.2	1.94	1.26
4352	547444	310349	S	3.38	2.62	0.76
4353	547410	310312	S	3.22	2.44	0.78
4354	547467	310374	S	3.515	2.635	0.88
4451	547426	310415	S	3.786	2.866	0.92
4551	547487	309595	S	-	-	-
4651	547439	309619	S	-	-	-
4652	547492	309623	S	2.82	1.99	0.83
4653	547498	309651	S	2.91	1.86	1.05
4751	547493	309781	S	2.83	-	-
4752	547484	309780	S	2.83	-	-
4755	547494	309703	S	3.08	1.7	1.38
4756	547471	309704	S	-	-	-
4757	547467	309781	S	-	-	-
4758	547450	309781	S	3.46	1.3	2.16
4759	547449	309759	S	2.71	1.47	1.24
4760	547418	309748	S	-	-	-
4851	547452	309885	S	-	-	-
4852	547492	309886	S	3.31	1.69	1.62
4853	547496	309821	S	2.99	1.46	1.53
4854	547460	309820	S	-	-	-
4951	547409	309958	S	3.91	2.74	1.17
4952	547495	309977	S	3.887	2.537	1.35
5051	547547	310002	S	4.03	2.3	1.73
5053	547525	310018	S	3.975	2.415	1.56
5151	547530	310151	S	3.233	2.573	0.66
5254	547501	310205	S	3.507	2.627	0.88
5351	547537	310312	S	4.022	2.372	1.65
5352	547531	310314	S	3.397	2.697	0.7
5551	547511	309549	S	-	-	-
5552	547545	309551	S	-	-	-
5553	547555	309559	S	-	-	-
5651	547563	309638	S	3.294	1.044	2.25
5653	547568	309638	S	-	-	-
5654	547562	309620	S	-	-	-
5751	547563	309784	S	2.83	1.68	1.15
5752	547566	309748	S	3.412	1.182	2.23

Manhole Reference	Easting	Northing	Liquid Type	Cover Level	Invert Level	Depth to Invert
5753	547566	309711	S	3.563	1.263	2.3
5754	547566	309705	S	3.447	1.227	2.22
5755	547501	309781	S	-	-	1.56
5851	547556	309857	S	3.429	1.419	2.01
5951	547506	309970	S	3.569	2.509	1.06
5952	547545	309931	S	3.317	1.787	1.53
6151	547607	310182	S	3.27	2.71	0.56
6251	547601	310219	S	3.534	2.654	0.88
6252	547652	310258	S	3.178	2.458	0.72
6253	547641	310230	S	3.498	2.558	0.94
6254	547668	310232	S	3.243	1.853	1.39
6352	547639	310389	S	3.331	2.561	0.77
7251	547736	310241	S	3.267	1.797	1.47
7352	547735	310380	S	2.922	1.882	1.04
7353	547726	310380	S	2.76	1.87	0.89
7354	547730	310328	S	3.075	1.775	1.3
7451	547790	310452	S	2.962	2.102	0.86
7452	547764	310428	S	2.907	2.047	0.86
7453	547763	310424	S	2.933	2.013	0.92
8151	547801	310184	S	3.083	1.463	1.62
8251	547802	310249	S	3.036	1.496	1.54
8351	547806	310375	S	3.151	2.261	0.89

Manhole Reference	Easting	Northing	Liquid Type	Cover Level	Invert Level	Depth to Invert

Manhole Reference	Easting	Northing	Liquid Type	Cover Level	Invert Level	Depth to Invert

Manhole Reference	Easting	Northing	Liquid Type	Cover Level	Invert Level	Depth to Invert

Date: 06/07/17

Scale: 1:1250

Map Centre: 547908,309070

Data updated: 01/05/17

Our Ref: 228649 - 2

Wastewater Plan A0

Foul Sewer
Surface Sewer
Combined Sewer
Final Effluent
Rising Main (Colour denotes effluent type)
Private Sewer (Colour denotes effluent type)
Decommissioned Sewer (Colour denotes effluent type)

Outfall (Colour denotes effluent type)
Inlet (Colour denotes effluent type)
Manhole (Colour denotes effluent type)
Sewage Treatment Works
Pumping Station

charlotte.catchpole@createconsultingengineers.co.uk

P17-1309 2

love every drop
anglianwater

Manhole Reference	Easting	Northing	Liquid Type	Cover Level	Invert Level	Depth to Invert
1401	547188	309419	F	3.47	2.32	1.15
1501	547181	308593	F	-	-	-
1502	547187	309537	F	4.06	3.08	0.98
1604	547182	308619	F	2.86	0.71	2.15
1704	547183	308757	F	2.73	1.46	1.27
1705	547189	308775	F	3.04	1.38	1.66
1806	547183	308845	F	3.15	1.01	2.14
1901	547198	308901	F	3.46	0.34	3.12
2001	547212	309051	F	2.83	-0.16	2.99
2101	547220	309122	F	3.12	-0.3	3.42
2102	547210	309112	F	3.09	0.93	2.16
2201	547231	309229	F	3.41	-0.69	4.1
2202	547272	309252	F	3.57	-0.84	4.41
2203	547280	309243	F	3.09	-0.81	3.9
2301	547215	309321	F	3.68	1.9	1.78
2302	547258	309354	F	3.75	2.31	1.44
2401	547220	309445	F	3.72	2.59	1.13
2402	547255	309471	F	3.85	2.85	1
2501	547255	308597	F	-	-	-
2501	547286	309540	F	3.73	0.4	3.33
2502	547288	308591	F	-	-	-
2601	547253	308619	F	2.72	1.43	1.29
2602	547269	308620	F	3.09	1.61	1.48
2603	547267	308653	F	-	-	-
2604	547249	308686	F	-	-	-
2701	547227	308780	F	3.19	1.12	2.07
2801	547203	308852	F	3.22	0.88	2.34
2901	547200	308930	F	3.42	0.27	3.15
2902	547208	308958	F	3.05	0.15	2.9
2903	547209	308995	F	2.85	0.03	2.82
3101	547342	309163	F	-	-	-
3102	547388	309164	F	2.92	0.74	2.18
3201	547367	309237	F	3.02	-0.59	3.61
3202	547340	309293	F	4.02	-0.53	4.55
3301	547363	309330	F	3.99	-0.4	4.39
3302	547365	309394	F	3.78	-0.2	3.98
3303	547304	309389	F	3.91	2.56	1.35
3401	547349	309450	F	3.95	0.01	3.94
3501	547318	309501	F	3.68	0.15	3.53
3502	547378	309541	F	3.33	1.82	1.51
4201	547455	309231	F	3.1	-0.2	3.3
4202	547498	309282	F	3.17	-0.05	3.22
4301	547496	309357	F	2.93	0.66	2.27
4302	547482	309365	F	2.88	0.37	2.51
4303	547448	309367	F	9.91	7.28	2.63
4304	547443	309354	F	10	7.655	2.345
4305	547440	309307	F	10.19	8.13	2.06
4401	547433	309440	F	-	-	-
4402	547408	309486	F	3.03	0.91	2.12
4502	547424	309515	F	-	-	-
4503	547426	309510	F	-	-	-
4504	547448	309512	F	-	-	-
4505	547476	309512	F	-	-	-
5301	547520	309347	F	-	-	-
5302	547520	309355	F	-	-	-
5401	547543	309441	F	-	-	-
5501	547555	309546	F	-	-	-
5502	547502	309513	F	-	-	-
1254	547191	309298	S	3.69	2.2	1.49
1656	547181	308681	S	-	-	-
1755	547181	308760	S	2.74	1.75	0.99
1756	547185	308776	S	3.07	1.7	1.37
1856	547186	308842	S	3.156	1.676	1.48
1951	547194	308901	S	3.423	1.563	1.86
2251	547228	309225	S	3.46	2.41	1.05
2252	547268	309247	S	3.46	2.41	1.05
2351	547223	309323	S	3.7	2.606	1.094
2352	547270	309358	S	3.785	2.875	0.91
2451	547200	309424	S	3.619	2.869	0.75
2452	547234	309451	S	3.87	3.14	0.73
2551	547286	309548	S	3.724	2.444	1.28
2651	547221	308622	S	-	-	-
2652	547265	308623	S	2.81	1.15	1.66
2653	547217	308655	S	-	-	-
2654	547259	308659	S	3.51	1.2	2.31
2656	547246	308683	S	2.99	1.36	1.63
2752	547236	308700	S	2.92	1.64	1.28
2851	547202	308848	S	3.29	1.47	1.82
2952	547204	308966	S	2.944	1.354	1.59
3151	547355	309160	S	2.84	2.34	0.5
3152	547388	309161	S	-	-	-
3252	547369	309240	S	3.69	2.88	0.81
3253	547310	309268	S	3.89	2.58	1.31
3353	547308	309388	S	3.978	3.188	0.79
3354	547365	309324	S	3.92	2.76	1.16
3355	547368	309394	S	3.74	2.92	0.82
3451	547362	309425	S	4.027	2.877	1.15
3452	547335	309486	S	3.77	-	-89
3551	547303	309530	S	-	-	-
3552	547399	309516	S	3.19	1.95	1.24
3651	547305	308627	S	-	-	-
4251	547437	309305	S	10.2	9.12	1.08
4252	547419	309237	S	2.948	2.098	0.85
4351	547441	309358	S	10	8.9	1.1
4352	547490	309363	S	2.94	1.72	1.22
4353	547491	309387	S	-	-	-
4451	547443	309400	S	2.96	1.89	1.07
4452	547435	309441	S	-	-	1.02
4453	547426	309460	S	2.86	1.69	1.17
4454	547480	309478	S	2.82	1.56	1.26
5451	547513	309451	S	-	-	-
5452	547514	309480	S	-	-	-
5551	547511	309549	S	-	-	-
5552	547545	309551	S	-	-	-

Manhole Reference	Easting	Northing	Liquid Type	Cover Level	Invert Level	Depth to Invert

Manhole Reference	Easting	Northing	Liquid Type	Cover Level	Invert Level	Depth to Invert

Manhole Reference	Easting	Northing	Liquid Type	Cover Level	Invert Level	Depth to Invert

Manhole Reference	Easting	Northing	Liquid Type	Cover Level	Invert Level	Depth to Invert

Manhole Reference	Easting	Northing	Liquid Type	Cover Level	Invert Level	Depth to Invert

APPENDIX B

IoH 124 Calculation of Greenfield Runoff Rate

Date: 31-Aug-17

East Wisbeach - Whole Site

By: TF

OS Location 547700E 30960N

SAAR 566 mm

Site area = 71 ha

0.71 km^2

Soil WRA Class 2

Soil Type SPR Value 0.3

$Qbar_{rural} = 0.00108 \times (AREA)^{0.89} X (SAAR)^{1.17} X (SOIL)^{2.17}$

Qbar = 0.097 m^3/s

From Regional Growth Curve Factor

Region: 5

Return period	1	2	5	10	25	30	50	100	500
Growth Factor	0.85	0.89	1.29	1.65	2.25	2.37	2.83	3.56	5.02

Q_1 =	0.083 m^3/s	=	82.53 l/s	=	1.162 l/s/ha
Q_2 =	0.086 m^3/s	=	86.41 l/s	=	1.217 l/s/ha
Q_5 =	0.125 m^3/s	=	125.25 l/s	=	1.764 l/s/ha
Q_{10} =	0.160 m^3/s	=	160.20 l/s	=	2.256 l/s/ha
Q_{25} =	0.218 m^3/s	=	218.46 l/s	=	3.077 l/s/ha
Q_{30} =	0.230 m^3/s	=	230.11 l/s	=	3.241 l/s/ha
Q_{50} =	0.275 m^3/s	=	274.78 l/s	=	3.870 l/s/ha
Q_{100} =	0.346 m^3/s	=	345.65 l/s	=	4.868 l/s/ha
Q_{500} =	0.487 m^3/s	=	487.41 l/s	=	6.865 l/s/ha

IoH 124 Calculation of Greenfield Runoff Rate

Date: 31-Aug-17

East Wisbech - Area 9

By: TF

OS Location 547700E 309600N

SAAR 566 mm
Site area = 50 ha
0.5 km^2
Soil WRA Class 2
Soil Type SPR Value 0.3

$Qbar_{rural} = 0.00108 \times (AREA)^{0.89} X (SAAR)^{1.17} X (SOIL)^{2.17}$

Qbar-50ha = 0.071 m^3/s

From Regional Growth Curve Factor

Region: 5

Return period	1	2	5	10	25	30	50	100	500
Growth Factor	0.85	0.89	1.29	1.65	2.25	2.37	2.83	3.56	5.02

Q_1 50ha =	0.060 m^3/s	=	60.41 l/s	=	1.208 l/s/ha
Q_2 50ha =	0.063 m^3/s	=	63.25 l/s	=	1.265 l/s/ha
Q_5 50ha =	0.092 m^3/s	=	91.67 l/s	=	1.833 l/s/ha
Q_{10} 50ha =	0.117 m^3/s	=	117.26 l/s	=	2.345 l/s/ha
Q_{25} 50ha =	0.160 m^3/s	=	159.90 l/s	=	3.198 l/s/ha
Q_{30} 50ha =	0.168 m^3/s	=	168.42 l/s	=	3.368 l/s/ha
Q_{50} 50ha =	0.201 m^3/s	=	201.11 l/s	=	4.022 l/s/ha
Q_{100} 50ha =	0.253 m^3/s	=	252.99 l/s	=	5.060 l/s/ha
Q_{500} 50ha =	0.357 m^3/s	=	356.75 l/s	=	7.135 l/s/ha

Factored for Development Impermeable Area

Site area = 4.02 ha

Q_{bar} site =	0.006 m^3/s	=	5.71 l/s	=	1.42 l/s/ha
Q_1 site =	0.005 m^3/s	=	4.86 l/s	=	1.21 l/s/ha
Q_2site =	0.005 m^3/s	=	5.09 l/s	=	1.26 l/s/ha
Q_5site =	0.007 m^3/s	=	7.37 l/s	=	1.83 l/s/ha
Q_{10} site =	0.009 m^3/s	=	9.43 l/s	=	2.35 l/s/ha
Q_{25} site =	0.013 m^3/s	=	12.86 l/s	=	3.20 l/s/ha
Q_{30} site =	0.014 m^3/s	=	13.54 l/s	=	3.37 l/s/ha
Q_{50} site =	0.016 m^3/s	=	16.17 l/s	=	4.02 l/s/ha
Q_{100} site =	0.020 m^3/s	=	20.34 l/s	=	5.06 l/s/ha
Q_{500} site =	0.029 m^3/s	=	28.68 l/s	=	7.13 l/s/ha

Note: For greenfield site, the critical duration is generally not relevant and the prediction of the peak rate of runoff using IH124 does not require consideration of storm duration.

IoH 124 Calculation of Greenfield Runoff Rate

East Wisbech - Area 10

Date: 31-Aug-17
By: TF

OS Location 547700E 309600N

SAAR	566	mm
Site area =	50	ha
	0.5	km^2
Soil WRA Class	2	
Soil Type SPR Value	0.3	

$Qbar_{rural} = 0.00108 \times (AREA)^{0.89} X (SAAR)^{1.17} X (SOIL)^{2.17}$

Qbar-50ha = 0.071 m^3/s

From Regional Growth Curve Factor

Region: 5

Return period	1	2	5	10	25	30	50	100	500
Growth Factor	0.85	0.89	1.29	1.65	2.25	2.37	2.83	3.56	5.02

Q_1 50ha =	0.060 m^3/s	=	60.41 l/s	=	1.208 l/s/ha
Q_2 50ha =	0.063 m^3/s	=	63.25 l/s	=	1.265 l/s/ha
Q_5 50ha =	0.092 m^3/s	=	91.67 l/s	=	1.833 l/s/ha
Q_{10} 50ha =	0.117 m^3/s	=	117.26 l/s	=	2.345 l/s/ha
Q_{25} 50ha =	0.160 m^3/s	=	159.90 l/s	=	3.198 l/s/ha
Q_{30} 50ha =	0.168 m^3/s	=	168.42 l/s	=	3.368 l/s/ha
Q_{50} 50ha =	0.201 m^3/s	=	201.11 l/s	=	4.022 l/s/ha
Q_{100} 50ha =	0.253 m^3/s	=	252.99 l/s	=	5.060 l/s/ha
Q_{500} 50ha =	0.357 m^3/s	=	356.75 l/s	=	7.135 l/s/ha

Factored for Development Impermeable Area

Site area = 5.68 ha

Q_{bar} site =	0.008 m^3/s	=	8.07 l/s	=	1.42 l/s/ha
Q_1 site =	0.007 m^3/s	=	6.86 l/s	=	1.21 l/s/ha
Q_2site =	0.007 m^3/s	=	7.18 l/s	=	1.26 l/s/ha
Q_5site =	0.010 m^3/s	=	10.41 l/s	=	1.83 l/s/ha
Q_{10} site =	0.013 m^3/s	=	13.32 l/s	=	2.35 l/s/ha
Q_{25} site =	0.018 m^3/s	=	18.16 l/s	=	3.20 l/s/ha
Q_{30} site =	0.019 m^3/s	=	19.13 l/s	=	3.37 l/s/ha
Q_{50} site =	0.023 m^3/s	=	22.85 l/s	=	4.02 l/s/ha
Q_{100} site =	0.029 m^3/s	=	28.74 l/s	=	5.06 l/s/ha
Q_{500} site =	0.041 m^3/s	=	40.53 l/s	=	7.13 l/s/ha

Note: For greenfield site, the critical duration is generally not relevant and the prediction of the peak rate of runoff using IH124 does not require consideration of storm duration.

IoH 124 Calculation of Greenfield Runoff Rate

East Wisbech - Area 11

Date: 31-Aug-17
By: TF

OS Location	547700E	309600N
SAAR	566	mm
Site area =	50	ha
	0.5	km^2
Soil WRA Class	2	
Soil Type SPR Value	0.3	

$$Qbar_{rural} = 0.00108 \times (AREA)^{0.89} \times (SAAR)^{1.17} \times (SOIL)^{2.17}$$

Qbar-50ha = 0.071 m^3/s

From Regional Growth Curve Factor

Region: 5

Return period	1	2	5	10	25	30	50	100	500
Growth Factor	0.85	0.89	1.29	1.65	2.25	2.37	2.83	3.56	5.02

Q_1 50ha =	0.060 m^3/s	=	60.41 l/s	=	1.208	l/s/ha
Q_2 50ha =	0.063 m^3/s	=	63.25 l/s	=	1.265	l/s/ha
Q_5 50ha =	0.092 m^3/s	=	91.67 l/s	=	1.833	l/s/ha
Q_{10} 50ha =	0.117 m^3/s	=	117.26 l/s	=	2.345	l/s/ha
Q_{25} 50ha =	0.160 m^3/s	=	159.90 l/s	=	3.198	l/s/ha
Q_{30} 50ha =	0.168 m^3/s	=	168.42 l/s	=	3.368	l/s/ha
Q_{50} 50ha =	0.201 m^3/s	=	201.11 l/s	=	4.022	l/s/ha
Q_{100} 50ha =	0.253 m^3/s	=	252.99 l/s	=	5.060	l/s/ha
Q_{500} 50ha =	0.357 m^3/s	=	356.75 l/s	=	7.135	l/s/ha

Factored for Development Impermeable Area

Site area = 2.33 ha

Q_{bar} site =	0.003 m^3/s	=	3.31 l/s	=	1.42	l/s/ha
Q_1 site =	0.003 m^3/s	=	2.81 l/s	=	1.21	l/s/ha
Q_2site =	0.003 m^3/s	=	2.95 l/s	=	1.26	l/s/ha
Q_5site =	0.004 m^3/s	=	4.27 l/s	=	1.83	l/s/ha
Q_{10} site =	0.005 m^3/s	=	5.46 l/s	=	2.35	l/s/ha
Q_{25} site =	0.007 m^3/s	=	7.45 l/s	=	3.20	l/s/ha
Q_{30} site =	0.008 m^3/s	=	7.85 l/s	=	3.37	l/s/ha
Q_{50} site =	0.009 m^3/s	=	9.37 l/s	=	4.02	l/s/ha
Q_{100} site =	0.012 m^3/s	=	11.79 l/s	=	5.06	l/s/ha
Q_{500} site =	0.017 m^3/s	=	16.62 l/s	=	7.13	l/s/ha

Note: For greenfield site, the critical duration is generally not relevant and the prediction of the peak rate of runoff using IH124 does not require consideration of storm duration.

IoH 124 Calculation of Greenfield Runoff Rate

East Wisbech - Area 12

Date: 31-Aug-17
By: TF

OS Location 547700E 309600N

SAAR 566 mm
Site area = 50 ha
0.5 km^2
Soil WRA Class 2
Soil Type SPR Value 0.3

$Qbar_{rural} = 0.00108 \times (AREA)^{0.89} \times (SAAR)^{1.17} \times (SOIL)^{2.17}$

Qbar-50ha = 0.071 m^3/s

From Regional Growth Curve Factor

Region: 5

Return period	1	2	5	10	25	30	50	100	500
Growth Factor	0.85	0.89	1.29	1.65	2.25	2.37	2.83	3.56	5.02

Q_1 50ha =	0.060 m^3/s	=	60.41 l/s	=	1.208 l/s/ha
Q_2 50ha =	0.063 m^3/s	=	63.25 l/s	=	1.265 l/s/ha
Q_5 50ha =	0.092 m^3/s	=	91.67 l/s	=	1.833 l/s/ha
Q_{10} 50ha =	0.117 m^3/s	=	117.26 l/s	=	2.345 l/s/ha
Q_{25} 50ha =	0.160 m^3/s	=	159.90 l/s	=	3.198 l/s/ha
Q_{30} 50ha =	0.168 m^3/s	=	168.42 l/s	=	3.368 l/s/ha
Q_{50} 50ha =	0.201 m^3/s	=	201.11 l/s	=	4.022 l/s/ha
Q_{100} 50ha =	0.253 m^3/s	=	252.99 l/s	=	5.060 l/s/ha
Q_{500} 50ha =	0.357 m^3/s	=	356.75 l/s	=	7.135 l/s/ha

Factored for Development Impermeable Area

Site area = 11.5 ha

Q_{bar} site =	0.016 m^3/s	=	16.34 l/s	=	1.42 l/s/ha
Q_1 site =	0.014 m^3/s	=	13.89 l/s	=	1.21 l/s/ha
Q_2site =	0.015 m^3/s	=	14.55 l/s	=	1.26 l/s/ha
Q_5site =	0.021 m^3/s	=	21.08 l/s	=	1.83 l/s/ha
Q_{10} site =	0.027 m^3/s	=	26.97 l/s	=	2.35 l/s/ha
Q_{25} site =	0.037 m^3/s	=	36.78 l/s	=	3.20 l/s/ha
Q_{30} site =	0.039 m^3/s	=	38.74 l/s	=	3.37 l/s/ha
Q_{50} site =	0.046 m^3/s	=	46.26 l/s	=	4.02 l/s/ha
Q_{100} site =	0.058 m^3/s	=	58.19 l/s	=	5.06 l/s/ha
Q_{500} site =	0.082 m^3/s	=	82.05 l/s	=	7.13 l/s/ha

Note: For greenfield site, the critical duration is generally not relevant and the prediction of the peak rate of runoff using IH124 does not require consideration of storm duration.

IoH 124 Calculation of Greenfield Runoff Rate

Date: 31-Aug-17

East Wisbech - Area 1

By: TF

OS Location 547700E 309600N

SAAR 566 mm
Site area = 50 ha
0.5 km^2
Soil WRA Class 2
Soil Type SPR Value 0.3

$Qbar_{rural} = 0.00108 \times (AREA)^{0.89} X (SAAR)^{1.17} X (SOIL)^{2.17}$

Qbar-50ha = 0.071 m^3/s

From Regional Growth Curve Factor

Region: 5

Return period	1	2	5	10	25	30	50	100	500
Growth Factor	0.85	0.89	1.29	1.65	2.25	2.37	2.83	3.56	5.02

Q_1 50ha =	0.060 m^3/s	=	60.41 l/s	=	1.208 l/s/ha
Q_2 50ha =	0.063 m^3/s	=	63.25 l/s	=	1.265 l/s/ha
Q_5 50ha =	0.092 m^3/s	=	91.67 l/s	=	1.833 l/s/ha
Q_{10} 50ha =	0.117 m^3/s	=	117.26 l/s	=	2.345 l/s/ha
Q_{25} 50ha =	0.160 m^3/s	=	159.90 l/s	=	3.198 l/s/ha
Q_{30} 50ha =	0.168 m^3/s	=	168.42 l/s	=	3.368 l/s/ha
Q_{50} 50ha =	0.201 m^3/s	=	201.11 l/s	=	4.022 l/s/ha
Q_{100} 50ha =	0.253 m^3/s	=	252.99 l/s	=	5.060 l/s/ha
Q_{500} 50ha =	0.357 m^3/s	=	356.75 l/s	=	7.135 l/s/ha

Factored for Development Impermeable Area

Site area = 5.86 ha

Q_{bar} site =	0.008 m^3/s	=	8.33 l/s	=	1.42 l/s/ha
Q_1 site =	0.007 m^3/s	=	7.08 l/s	=	1.21 l/s/ha
Q_2site =	0.007 m^3/s	=	7.41 l/s	=	1.26 l/s/ha
Q_5site =	0.011 m^3/s	=	10.74 l/s	=	1.83 l/s/ha
Q_{10} site =	0.014 m^3/s	=	13.74 l/s	=	2.35 l/s/ha
Q_{25} site =	0.019 m^3/s	=	18.74 l/s	=	3.20 l/s/ha
Q_{30} site =	0.020 m^3/s	=	19.74 l/s	=	3.37 l/s/ha
Q_{50} site =	0.024 m^3/s	=	23.57 l/s	=	4.02 l/s/ha
Q_{100} site =	0.030 m^3/s	=	29.65 l/s	=	5.06 l/s/ha
Q_{500} site =	0.042 m^3/s	=	41.81 l/s	=	7.13 l/s/ha

Note: For greenfield site, the critical duration is generally not relevant and the prediction of the peak rate of runoff using IH124 does not require consideration of storm duration.

IoH 124 Calculation of Greenfield Runoff Rate

East Wisbech - Area 2

Date: 31-Aug-17
By: TF

OS Location 547700E 309600N

SAAR 566 mm
Site area = 50 ha
0.5 km^2
Soil WRA Class 2
Soil Type SPR Value 0.3

$Qbar_{rural} = 0.00108 \times (AREA)^{0.89} \times (SAAR)^{1.17} \times (SOIL)^{2.17}$

Qbar-50ha = 0.071 m^3/s

From Regional Growth Curve Factor

Region: 5

Return period	1	2	5	10	25	30	50	100	500
Growth Factor	0.85	0.89	1.29	1.65	2.25	2.37	2.83	3.56	5.02

Q_1 50ha =	0.060 m^3/s	=	60.41 l/s	=	1.208 l/s/ha
Q_2 50ha =	0.063 m^3/s	=	63.25 l/s	=	1.265 l/s/ha
Q_5 50ha =	0.092 m^3/s	=	91.67 l/s	=	1.833 l/s/ha
Q_{10} 50ha =	0.117 m^3/s	=	117.26 l/s	=	2.345 l/s/ha
Q_{25} 50ha =	0.160 m^3/s	=	159.90 l/s	=	3.198 l/s/ha
Q_{30} 50ha =	0.168 m^3/s	=	168.42 l/s	=	3.368 l/s/ha
Q_{50} 50ha =	0.201 m^3/s	=	201.11 l/s	=	4.022 l/s/ha
Q_{100} 50ha =	0.253 m^3/s	=	252.99 l/s	=	5.060 l/s/ha
Q_{500} 50ha =	0.357 m^3/s	=	356.75 l/s	=	7.135 l/s/ha

Factored for Development Impermeable Area

Site area = 9.24 ha

Q_{bar} site =	0.013 m^3/s	=	13.13 l/s	=	1.42 l/s/ha
Q_1 site =	0.011 m^3/s	=	11.16 l/s	=	1.21 l/s/ha
Q_2site =	0.012 m^3/s	=	11.69 l/s	=	1.26 l/s/ha
Q_5site =	0.017 m^3/s	=	16.94 l/s	=	1.83 l/s/ha
Q_{10} site =	0.022 m^3/s	=	21.67 l/s	=	2.35 l/s/ha
Q_{25} site =	0.030 m^3/s	=	29.55 l/s	=	3.20 l/s/ha
Q_{30} site =	0.031 m^3/s	=	31.12 l/s	=	3.37 l/s/ha
Q_{50} site =	0.037 m^3/s	=	37.17 l/s	=	4.02 l/s/ha
Q_{100} site =	0.047 m^3/s	=	46.75 l/s	=	5.06 l/s/ha
Q_{500} site =	0.066 m^3/s	=	65.93 l/s	=	7.13 l/s/ha

Note: For greenfield site, the critical duration is generally not relevant and the prediction of the peak rate of runoff using IH124 does not require consideration of storm duration.

IoH 124 Calculation of Greenfield Runoff Rate

Date: 31-Aug-17

East Wisbech - Area 3

By: TF

OS Location 547700E 309600N

SAAR 566 mm
Site area = 50 ha
0.5 km^2
Soil WRA Class 2
Soil Type SPR Value 0.3

$Qbar_{rural} = 0.00108 \times (AREA)^{0.89} \times (SAAR)^{1.17} \times (SOIL)^{2.17}$

Qbar-50ha = 0.071 m^3/s

From Regional Growth Curve Factor

Region: 5

Return period	1	2	5	10	25	30	50	100	500
Growth Factor	0.85	0.89	1.29	1.65	2.25	2.37	2.83	3.56	5.02

Q_1 50ha =	0.060 m^3/s	=	60.41 l/s	=	1.208 l/s/ha
Q_2 50ha =	0.063 m^3/s	=	63.25 l/s	=	1.265 l/s/ha
Q_5 50ha =	0.092 m^3/s	=	91.67 l/s	=	1.833 l/s/ha
Q_{10} 50ha =	0.117 m^3/s	=	117.26 l/s	=	2.345 l/s/ha
Q_{25} 50ha =	0.160 m^3/s	=	159.90 l/s	=	3.198 l/s/ha
Q_{30} 50ha =	0.168 m^3/s	=	168.42 l/s	=	3.368 l/s/ha
Q_{50} 50ha =	0.201 m^3/s	=	201.11 l/s	=	4.022 l/s/ha
Q_{100} 50ha =	0.253 m^3/s	=	252.99 l/s	=	5.060 l/s/ha
Q_{500} 50ha =	0.357 m^3/s	=	356.75 l/s	=	7.135 l/s/ha

Factored for Development Impermeable Area

Site area = 10.11 ha

Q_{bar} site =	0.014 m^3/s	=	14.37 l/s	=	1.42 l/s/ha
Q_1 site =	0.012 m^3/s	=	12.21 l/s	=	1.21 l/s/ha
Q_2site =	0.013 m^3/s	=	12.79 l/s	=	1.26 l/s/ha
Q_5site =	0.019 m^3/s	=	18.54 l/s	=	1.83 l/s/ha
Q_{10} site =	0.024 m^3/s	=	23.71 l/s	=	2.35 l/s/ha
Q_{25} site =	0.032 m^3/s	=	32.33 l/s	=	3.20 l/s/ha
Q_{30} site =	0.034 m^3/s	=	34.06 l/s	=	3.37 l/s/ha
Q_{50} site =	0.041 m^3/s	=	40.67 l/s	=	4.02 l/s/ha
Q_{100} site =	0.051 m^3/s	=	51.15 l/s	=	5.06 l/s/ha
Q_{500} site =	0.072 m^3/s	=	72.13 l/s	=	7.13 l/s/ha

Note: For greenfield site, the critical duration is generally not relevant and the prediction of the peak rate of runoff using IH124 does not require consideration of storm duration.

IoH 124 Calculation of Greenfield Runoff Rate

East Wisbech - Area 4

Date: 31-Aug-17
By: TF

OS Location 547700E 309600N

SAAR 566 mm
Site area = 50 ha
0.5 km^2
Soil WRA Class 2
Soil Type SPR Value 0.3

$Qbar_{rural} = 0.00108 \times (AREA)^{0.89} \times (SAAR)^{1.17} \times (SOIL)^{2.17}$

Qbar-50ha = 0.071 m^3/s

From Regional Growth Curve Factor

Region: 5

Return period	1	2	5	10	25	30	50	100	500
Growth Factor	0.85	0.89	1.29	1.65	2.25	2.37	2.83	3.56	5.02

Q_1 50ha =	0.060 m^3/s	=	60.41 l/s	=	1.208 l/s/ha
Q_2 50ha =	0.063 m^3/s	=	63.25 l/s	=	1.265 l/s/ha
Q_5 50ha =	0.092 m^3/s	=	91.67 l/s	=	1.833 l/s/ha
Q_{10} 50ha =	0.117 m^3/s	=	117.26 l/s	=	2.345 l/s/ha
Q_{25} 50ha =	0.160 m^3/s	=	159.90 l/s	=	3.198 l/s/ha
Q_{30} 50ha =	0.168 m^3/s	=	168.42 l/s	=	3.368 l/s/ha
Q_{50} 50ha =	0.201 m^3/s	=	201.11 l/s	=	4.022 l/s/ha
Q_{100} 50ha =	0.253 m^3/s	=	252.99 l/s	=	5.060 l/s/ha
Q_{500} 50ha =	0.357 m^3/s	=	356.75 l/s	=	7.135 l/s/ha

Factored for Development Impermeable Area

Site area = 2.82 ha

Q_{bar} site =	0.004 m^3/s	=	4.01 l/s	=	1.42 l/s/ha
Q_1 site =	0.003 m^3/s	=	3.41 l/s	=	1.21 l/s/ha
Q_2site =	0.004 m^3/s	=	3.57 l/s	=	1.26 l/s/ha
Q_5site =	0.005 m^3/s	=	5.17 l/s	=	1.83 l/s/ha
Q_{10} site =	0.007 m^3/s	=	6.61 l/s	=	2.35 l/s/ha
Q_{25} site =	0.009 m^3/s	=	9.02 l/s	=	3.20 l/s/ha
Q_{30} site =	0.009 m^3/s	=	9.50 l/s	=	3.37 l/s/ha
Q_{50} site =	0.011 m^3/s	=	11.34 l/s	=	4.02 l/s/ha
Q_{100} site =	0.014 m^3/s	=	14.27 l/s	=	5.06 l/s/ha
Q_{500} site =	0.020 m^3/s	=	20.12 l/s	=	7.13 l/s/ha

Note: For greenfield site, the critical duration is generally not relevant and the prediction of the peak rate of runoff using IH124 does not require consideration of storm duration.

IoH 124 Calculation of Greenfield Runoff Rate

East Wisbech - Area 5

Date: 31-Aug-17
By: TF

OS Location 547700E 309600N

SAAR	566	mm
Site area =	50	ha
	0.5	km^2
Soil WRA Class	2	
Soil Type SPR Value	0.3	

$$Qbar_{rural} = 0.00108 \times (AREA)^{0.89} \times (SAAR)^{1.17} \times (SOIL)^{2.17}$$

Qbar-50ha = 0.071 m^3/s

From Regional Growth Curve Factor

Region: 5

Return period	1	2	5	10	25	30	50	100	500
Growth Factor	0.85	0.89	1.29	1.65	2.25	2.37	2.83	3.56	5.02

Q_1 50ha =	0.060 m^3/s	=	60.41	l/s	=	1.208	l/s/ha
Q_2 50ha =	0.063 m^3/s	=	63.25	l/s	=	1.265	l/s/ha
Q_5 50ha =	0.092 m^3/s	=	91.67	l/s	=	1.833	l/s/ha
Q_{10} 50ha =	0.117 m^3/s	=	117.26	l/s	=	2.345	l/s/ha
Q_{25} 50ha =	0.160 m^3/s	=	159.90	l/s	=	3.198	l/s/ha
Q_{30} 50ha =	0.168 m^3/s	=	168.42	l/s	=	3.368	l/s/ha
Q_{50} 50ha =	0.201 m^3/s	=	201.11	l/s	=	4.022	l/s/ha
Q_{100} 50ha =	0.253 m^3/s	=	252.99	l/s	=	5.060	l/s/ha
Q_{500} 50ha =	0.357 m^3/s	=	356.75	l/s	=	7.135	l/s/ha

Factored for Development Impermeable Area

Site area = 5.56 ha

Q_{bar} site =	0.008 m^3/s	=	7.90	l/s	=	1.42	l/s/ha
Q_1 site =	0.007 m^3/s	=	6.72	l/s	=	1.21	l/s/ha
Q_2site =	0.007 m^3/s	=	7.03	l/s	=	1.26	l/s/ha
Q_5site =	0.010 m^3/s	=	10.19	l/s	=	1.83	l/s/ha
Q_{10} site =	0.013 m^3/s	=	13.04	l/s	=	2.35	l/s/ha
Q_{25} site =	0.018 m^3/s	=	17.78	l/s	=	3.20	l/s/ha
Q_{30} site =	0.019 m^3/s	=	18.73	l/s	=	3.37	l/s/ha
Q_{50} site =	0.022 m^3/s	=	22.36	l/s	=	4.02	l/s/ha
Q_{100} site =	0.028 m^3/s	=	28.13	l/s	=	5.06	l/s/ha
Q_{500} site =	0.040 m^3/s	=	39.67	l/s	=	7.13	l/s/ha

Note: For greenfield site, the critical duration is generally not relevant and the prediction of the peak rate of runoff using IH124 does not require consideration of storm duration.

IoH 124 Calculation of Greenfield Runoff Rate

East Wisbech - Area 6

Date: 31-Aug-17
By: TF

OS Location 547700E 309600N

SAAR 566 mm
Site area = 50 ha
0.5 km^2
Soil WRA Class 2
Soil Type SPR Value 0.3

$$Qbar_{rural} = 0.00108 \times (AREA)^{0.89} \times (SAAR)^{1.17} \times (SOIL)^{2.17}$$

Qbar-50ha = 0.071 m^3/s

From Regional Growth Curve Factor

Region: 5

Return period	1	2	5	10	25	30	50	100	500
Growth Factor	0.85	0.89	1.29	1.65	2.25	2.37	2.83	3.56	5.02

Q_1 50ha =	0.060 m^3/s	=	60.41 l/s	=	1.208 l/s/ha
Q_2 50ha =	0.063 m^3/s	=	63.25 l/s	=	1.265 l/s/ha
Q_5 50ha =	0.092 m^3/s	=	91.67 l/s	=	1.833 l/s/ha
Q_{10} 50ha =	0.117 m^3/s	=	117.26 l/s	=	2.345 l/s/ha
Q_{25} 50ha =	0.160 m^3/s	=	159.90 l/s	=	3.198 l/s/ha
Q_{30} 50ha =	0.168 m^3/s	=	168.42 l/s	=	3.368 l/s/ha
Q_{50} 50ha =	0.201 m^3/s	=	201.11 l/s	=	4.022 l/s/ha
Q_{100} 50ha =	0.253 m^3/s	=	252.99 l/s	=	5.060 l/s/ha
Q_{500} 50ha =	0.357 m^3/s	=	356.75 l/s	=	7.135 l/s/ha

Factored for Development Impermeable Area

Site area = 9.61 ha

Q_{bar} site =	0.014 m^3/s	=	13.66 l/s	=	1.42 l/s/ha
Q_1 site =	0.012 m^3/s	=	11.61 l/s	=	1.21 l/s/ha
Q_2site =	0.012 m^3/s	=	12.16 l/s	=	1.26 l/s/ha
Q_5site =	0.018 m^3/s	=	17.62 l/s	=	1.83 l/s/ha
Q_{10} site =	0.023 m^3/s	=	22.54 l/s	=	2.35 l/s/ha
Q_{25} site =	0.031 m^3/s	=	30.73 l/s	=	3.20 l/s/ha
Q_{30} site =	0.032 m^3/s	=	32.37 l/s	=	3.37 l/s/ha
Q_{50} site =	0.039 m^3/s	=	38.65 l/s	=	4.02 l/s/ha
Q_{100} site =	0.049 m^3/s	=	48.62 l/s	=	5.06 l/s/ha
Q_{500} site =	0.069 m^3/s	=	68.57 l/s	=	7.13 l/s/ha

Note: For greenfield site, the critical duration is generally not relevant and the prediction of the peak rate of runoff using IH124 does not require consideration of storm duration.

IoH 124 Calculation of Greenfield Runoff Rate

Date: 31-Aug-17
East Wisbech - Area 7
By: TF

OS Location 547700E 309600N

SAAR 566 mm
Site area = 50 ha
0.5 km^2
Soil WRA Class 2
Soil Type SPR Value 0.3

$$Qbar_{rural} = 0.00108 \times (AREA)^{0.89} \times (SAAR)^{1.17} \times (SOIL)^{2.17}$$

Qbar-50ha = 0.071 m^3/s

From Regional Growth Curve Factor

Region: 5

Return period	1	2	5	10	25	30	50	100	500
Growth Factor	0.85	0.89	1.29	1.65	2.25	2.37	2.83	3.56	5.02

Q_1 50ha =	0.060 m^3/s	=	60.41 l/s	=	1.208 l/s/ha
Q_2 50ha =	0.063 m^3/s	=	63.25 l/s	=	1.265 l/s/ha
Q_5 50ha =	0.092 m^3/s	=	91.67 l/s	=	1.833 l/s/ha
Q_{10} 50ha =	0.117 m^3/s	=	117.26 l/s	=	2.345 l/s/ha
Q_{25} 50ha =	0.160 m^3/s	=	159.90 l/s	=	3.198 l/s/ha
Q_{30} 50ha =	0.168 m^3/s	=	168.42 l/s	=	3.368 l/s/ha
Q_{50} 50ha =	0.201 m^3/s	=	201.11 l/s	=	4.022 l/s/ha
Q_{100} 50ha =	0.253 m^3/s	=	252.99 l/s	=	5.060 l/s/ha
Q_{500} 50ha =	0.357 m^3/s	=	356.75 l/s	=	7.135 l/s/ha

Factored for Development Impermeable Area

Site area = 3.1 ha

Q_{bar} site =	0.004 m^3/s	=	4.41 l/s	=	1.42 l/s/ha
Q_1 site =	0.004 m^3/s	=	3.75 l/s	=	1.21 l/s/ha
Q_2site =	0.004 m^3/s	=	3.92 l/s	=	1.26 l/s/ha
Q_5site =	0.006 m^3/s	=	5.68 l/s	=	1.83 l/s/ha
Q_{10} site =	0.007 m^3/s	=	7.27 l/s	=	2.35 l/s/ha
Q_{25} site =	0.010 m^3/s	=	9.91 l/s	=	3.20 l/s/ha
Q_{30} site =	0.010 m^3/s	=	10.44 l/s	=	3.37 l/s/ha
Q_{50} site =	0.012 m^3/s	=	12.47 l/s	=	4.02 l/s/ha
Q_{100} site =	0.016 m^3/s	=	15.69 l/s	=	5.06 l/s/ha
Q_{500} site =	0.022 m^3/s	=	22.12 l/s	=	7.13 l/s/ha

Note: For greenfield site, the critical duration is generally not relevant and the prediction of the peak rate of runoff using IH124 does not require consideration of storm duration.

IoH 124 Calculation of Greenfield Runoff Rate

East Wisbech - Area 8

Date: 31-Aug-17
By: TF

OS Location 547700E 309600N

SAAR	566	mm
Site area =	50	ha
	0.5	km^2
Soil WRA Class	2	
Soil Type SPR Value	0.3	

$Qbar_{rural} = 0.00108 \times (AREA)^{0.89} X (SAAR)^{1.17} X (SOIL)^{2.17}$

Qbar-50ha = 0.071 m^3/s

From Regional Growth Curve Factor

Region: 5

Return period	1	2	5	10	25	30	50	100	500
Growth Factor	0.85	0.89	1.29	1.65	2.25	2.37	2.83	3.56	5.02

Q_1 50ha =	0.060 m^3/s	=	60.41 l/s	=	1.208 l/s/ha
Q_2 50ha =	0.063 m^3/s	=	63.25 l/s	=	1.265 l/s/ha
Q_5 50ha =	0.092 m^3/s	=	91.67 l/s	=	1.833 l/s/ha
Q_{10} 50ha =	0.117 m^3/s	=	117.26 l/s	=	2.345 l/s/ha
Q_{25} 50ha =	0.160 m^3/s	=	159.90 l/s	=	3.198 l/s/ha
Q_{30} 50ha =	0.168 m^3/s	=	168.42 l/s	=	3.368 l/s/ha
Q_{50} 50ha =	0.201 m^3/s	=	201.11 l/s	=	4.022 l/s/ha
Q_{100} 50ha =	0.253 m^3/s	=	252.99 l/s	=	5.060 l/s/ha
Q_{500} 50ha =	0.357 m^3/s	=	356.75 l/s	=	7.135 l/s/ha

Factored for Development Impermeable Area

Site area = 1.25 ha

Q_{bar} site =	0.002 m^3/s	=	1.78 l/s	=	1.42 l/s/ha
Q_1 site =	0.002 m^3/s	=	1.51 l/s	=	1.21 l/s/ha
Q_2site =	0.002 m^3/s	=	1.58 l/s	=	1.26 l/s/ha
Q_5site =	0.002 m^3/s	=	2.29 l/s	=	1.83 l/s/ha
Q_{10} site =	0.003 m^3/s	=	2.93 l/s	=	2.35 l/s/ha
Q_{25} site =	0.004 m^3/s	=	4.00 l/s	=	3.20 l/s/ha
Q_{30} site =	0.004 m^3/s	=	4.21 l/s	=	3.37 l/s/ha
Q_{50} site =	0.005 m^3/s	=	5.03 l/s	=	4.02 l/s/ha
Q_{100} site =	0.006 m^3/s	=	6.32 l/s	=	5.06 l/s/ha
Q_{500} site =	0.009 m^3/s	=	8.92 l/s	=	7.13 l/s/ha

Note: For greenfield site, the critical duration is generally not relevant and the prediction of the peak rate of runoff using IH124 does not require consideration of storm duration.

APPENDIX C

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

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	1.783	0.283	4.3	870.9	O K
30 min Summer	1.869	0.369	4.3	1135.3	O K
60 min Summer	1.957	0.457	4.3	1408.8	O K
120 min Summer	2.048	0.548	4.3	1687.8	O K
180 min Summer	2.101	0.601	4.3	1850.3	O K
240 min Summer	2.137	0.637	4.3	1962.9	O K
360 min Summer	2.186	0.686	4.3	2112.2	O K
480 min Summer	2.221	0.721	4.3	2222.0	O K
600 min Summer	2.248	0.748	4.3	2305.3	O K
720 min Summer	2.270	0.770	4.3	2371.5	O K
960 min Summer	2.302	0.802	4.3	2470.5	O K
1440 min Summer	2.342	0.842	4.3	2591.9	O K
2160 min Summer	2.369	0.869	4.3	2677.5	O K
2880 min Summer	2.378	0.878	4.3	2705.2	O K
4320 min Summer	2.369	0.869	4.3	2676.2	O K
5760 min Summer	2.344	0.844	4.3	2600.8	O K
7200 min Summer	2.321	0.821	4.3	2528.1	O K
8640 min Summer	2.298	0.798	4.3	2456.7	O K
10080 min Summer	2.275	0.775	4.3	2387.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	132.402	0.0	362.7	19
30 min Summer	86.432	0.0	367.5	34
60 min Summer	53.779	0.0	730.9	64
120 min Summer	32.379	0.0	711.8	124
180 min Summer	23.772	0.0	689.0	184
240 min Summer	18.994	0.0	665.0	244
360 min Summer	13.738	0.0	631.5	364
480 min Summer	10.928	0.0	613.6	484
600 min Summer	9.143	0.0	605.1	604
720 min Summer	7.900	0.0	602.5	724
960 min Summer	6.269	0.0	605.7	962
1440 min Summer	4.519	0.0	603.6	1442
2160 min Summer	3.253	0.0	1222.1	2160
2880 min Summer	2.574	0.0	1213.7	2880
4320 min Summer	1.848	0.0	1173.6	4320
5760 min Summer	1.459	0.0	2438.4	5136
7200 min Summer	1.215	0.0	2346.0	5840
8640 min Summer	1.045	0.0	2254.5	6656
10080 min Summer	0.920	0.0	2168.9	7368

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

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Winter	1.817	0.317	4.3	975.7	O K
30 min Winter	1.913	0.413	4.3	1272.0	O K
60 min Winter	2.013	0.513	4.3	1578.8	O K
120 min Winter	2.115	0.615	4.3	1892.7	O K
180 min Winter	2.174	0.674	4.3	2076.3	O K
240 min Winter	2.215	0.715	4.3	2203.1	O K
360 min Winter	2.270	0.770	4.3	2371.2	O K
480 min Winter	2.310	0.810	4.3	2495.6	O K
600 min Winter	2.341	0.841	4.3	2590.6	O K
720 min Winter	2.366	0.866	4.3	2666.5	O K
960 min Winter	2.403	0.903	4.3	2781.3	O K
1440 min Winter	2.450	0.950	4.3	2925.2	O K
2160 min Winter	2.485	0.985	4.3	3034.2	O K
2880 min Winter	2.499	0.999	4.3	3078.4	O K
4320 min Winter	2.498	0.998	4.3	3073.5	O K
5760 min Winter	2.476	0.976	4.3	3006.6	O K
7200 min Winter	2.445	0.945	4.3	2911.5	O K
8640 min Winter	2.416	0.916	4.3	2819.8	O K
10080 min Winter	2.388	0.888	4.3	2734.6	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Winter	132.402	0.0	367.1	19
30 min Winter	86.432	0.0	366.3	34
60 min Winter	53.779	0.0	724.7	64
120 min Winter	32.379	0.0	687.4	124
180 min Winter	23.772	0.0	649.7	182
240 min Winter	18.994	0.0	630.3	242
360 min Winter	13.738	0.0	617.7	360
480 min Winter	10.928	0.0	621.9	480
600 min Winter	9.143	0.0	629.7	598
720 min Winter	7.900	0.0	634.7	716
960 min Winter	6.269	0.0	639.4	952
1440 min Winter	4.519	0.0	636.3	1426
2160 min Winter	3.253	0.0	1290.1	2120
2880 min Winter	2.574	0.0	1283.4	2820
4320 min Winter	1.848	0.0	1239.1	4152
5760 min Winter	1.459	0.0	2497.2	5472
7200 min Winter	1.215	0.0	2436.5	6632
8640 min Winter	1.045	0.0	2383.4	6912
10080 min Winter	0.920	0.0	2317.6	7776

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	0.416	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 3.520

Time (mins) From:	To:	Area (ha)
0	4	3.520

Model Details

Storage is Online Cover Level (m) 2.500

Tank or Pond Structure

Invert Level (m) 1.500

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	3080.0	1.000	3080.0

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0098-4300-1000-4300
Design Head (m)	1.000
Design Flow (l/s)	4.3
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	98
Invert Level (m)	1.500
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.000	4.3	Kick-Flo®	0.636	3.5
Flush-Flo™	0.298	4.3	Mean Flow over Head Range	-	3.7

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	3.2	1.200	4.7	3.000	7.2	7.000	10.7
0.200	4.2	1.400	5.0	3.500	7.7	7.500	11.1
0.300	4.3	1.600	5.3	4.000	8.2	8.000	11.4
0.400	4.2	1.800	5.6	4.500	8.7	8.500	11.8
0.500	4.1	2.000	5.9	5.000	9.1	9.000	12.1
0.600	3.7	2.200	6.2	5.500	9.6	9.500	12.4
0.800	3.9	2.400	6.5	6.000	10.0		
1.000	4.3	2.600	6.7	6.500	10.4		

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

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	1.772	0.272	4.1	843.8	O K
30 min Summer	1.855	0.355	4.1	1100.0	O K
60 min Summer	1.940	0.440	4.1	1365.0	O K
120 min Summer	2.028	0.528	4.1	1635.4	O K
180 min Summer	2.078	0.578	4.1	1793.0	O K
240 min Summer	2.114	0.614	4.1	1902.1	O K
360 min Summer	2.160	0.660	4.1	2047.4	O K
480 min Summer	2.195	0.695	4.1	2154.5	O K
600 min Summer	2.221	0.721	4.1	2235.9	O K
720 min Summer	2.242	0.742	4.1	2300.8	O K
960 min Summer	2.274	0.774	4.1	2398.0	O K
1440 min Summer	2.312	0.812	4.1	2518.2	O K
2160 min Summer	2.340	0.840	4.1	2604.9	O K
2880 min Summer	2.350	0.850	4.1	2635.5	O K
4320 min Summer	2.343	0.843	4.1	2614.2	O K
5760 min Summer	2.321	0.821	4.1	2543.8	O K
7200 min Summer	2.298	0.798	4.1	2474.2	O K
8640 min Summer	2.276	0.776	4.1	2405.8	O K
10080 min Summer	2.255	0.755	4.1	2339.0	O K
15 min Winter	1.805	0.305	4.1	945.2	O K
30 min Winter	1.898	0.398	4.1	1232.4	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	132.402	0.0	344.8	19
30 min Summer	86.432	0.0	349.9	34
60 min Summer	53.779	0.0	696.4	64
120 min Summer	32.379	0.0	679.7	124
180 min Summer	23.772	0.0	660.0	184
240 min Summer	18.994	0.0	639.7	244
360 min Summer	13.738	0.0	605.0	364
480 min Summer	10.928	0.0	584.7	484
600 min Summer	9.143	0.0	573.7	604
720 min Summer	7.900	0.0	568.8	724
960 min Summer	6.269	0.0	569.5	962
1440 min Summer	4.519	0.0	567.6	1442
2160 min Summer	3.253	0.0	1152.5	2160
2880 min Summer	2.574	0.0	1143.1	2880
4320 min Summer	1.848	0.0	1106.2	4320
5760 min Summer	1.459	0.0	2305.7	5248
7200 min Summer	1.215	0.0	2218.4	5976
8640 min Summer	1.045	0.0	2132.6	6664
10080 min Summer	0.920	0.0	2052.6	7464
15 min Winter	132.402	0.0	349.1	19
30 min Winter	86.432	0.0	349.0	34

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

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
60 min Winter	1.993	0.493	4.1	1529.7	O K
120 min Winter	2.092	0.592	4.1	1833.8	O K
180 min Winter	2.149	0.649	4.1	2011.9	O K
240 min Winter	2.189	0.689	4.1	2135.1	O K
360 min Winter	2.242	0.742	4.1	2298.7	O K
480 min Winter	2.281	0.781	4.1	2419.8	O K
600 min Winter	2.310	0.810	4.1	2512.5	O K
720 min Winter	2.334	0.834	4.1	2586.7	O K
960 min Winter	2.371	0.871	4.1	2699.2	O K
1440 min Winter	2.417	0.917	4.1	2841.2	O K
2160 min Winter	2.452	0.952	4.1	2950.5	O K
2880 min Winter	2.467	0.967	4.1	2997.0	O K
4320 min Winter	2.467	0.967	4.1	2998.8	O K
5760 min Winter	2.448	0.948	4.1	2939.8	O K
7200 min Winter	2.420	0.920	4.1	2852.3	O K
8640 min Winter	2.391	0.891	4.1	2761.3	O K
10080 min Winter	2.365	0.865	4.1	2680.6	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
60 min Winter	53.779	0.0	691.2	64
120 min Winter	32.379	0.0	659.4	124
180 min Winter	23.772	0.0	623.6	182
240 min Winter	18.994	0.0	601.9	242
360 min Winter	13.738	0.0	585.0	360
480 min Winter	10.928	0.0	584.9	480
600 min Winter	9.143	0.0	591.8	598
720 min Winter	7.900	0.0	596.5	716
960 min Winter	6.269	0.0	601.1	952
1440 min Winter	4.519	0.0	598.4	1426
2160 min Winter	3.253	0.0	1214.6	2120
2880 min Winter	2.574	0.0	1208.6	2820
4320 min Winter	1.848	0.0	1167.8	4152
5760 min Winter	1.459	0.0	2358.5	5472
7200 min Winter	1.215	0.0	2302.2	6696
8640 min Winter	1.045	0.0	2253.2	7000
10080 min Winter	0.920	0.0	2192.3	7864

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	0.416	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 3.410

Time From:	(mins) To:	Area (ha)
0	4	3.410

Model Details

Storage is Online Cover Level (m) 2.500

Tank or Pond Structure

Invert Level (m) 1.500

Depth (m)	**Area (m²)**	**Depth (m)**	**Area (m²)**
0.000	3100.0	1.000	3100.0

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0096-4100-1000-4100
Design Head (m)	1.000
Design Flow (l/s)	4.1
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	96
Invert Level (m)	1.500
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	**Head (m)**	**Flow (l/s)**
Design Point (Calculated)	1.000	4.1
Flush-Flo™	0.294	4.1
Kick-Flo®	0.629	3.3
Mean Flow over Head Range	-	3.6

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

Depth (m)	**Flow (l/s)**	**Depth (m)**	**Flow (l/s)**	**Depth (m)**	**Flow (l/s)**	**Depth (m)**	**Flow (l/s)**
0.100	3.1	1.200	4.5	3.000	6.8	7.000	10.2
0.200	4.0	1.400	4.8	3.500	7.4	7.500	10.6
0.300	4.1	1.600	5.1	4.000	7.8	8.000	10.9
0.400	4.0	1.800	5.4	4.500	8.3	8.500	11.2
0.500	3.9	2.000	5.7	5.000	8.7	9.000	11.5
0.600	3.5	2.200	5.9	5.500	9.1	9.500	11.8
0.800	3.7	2.400	6.2	6.000	9.5		
1.000	4.1	2.600	6.4	6.500	9.9		

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

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	1.782	0.282	1.6	346.4	O K
30 min Summer	1.867	0.367	1.6	451.6	O K
60 min Summer	1.956	0.456	1.6	560.4	O K
120 min Summer	2.046	0.546	1.6	671.7	O K
180 min Summer	2.099	0.599	1.6	736.5	O K
240 min Summer	2.135	0.635	1.6	781.2	O K
360 min Summer	2.183	0.683	1.6	840.2	O K
480 min Summer	2.218	0.718	1.6	883.7	O K
600 min Summer	2.245	0.745	1.6	916.7	O K
720 min Summer	2.267	0.767	1.6	942.9	O K
960 min Summer	2.298	0.798	1.6	982.1	O K
1440 min Summer	2.338	0.838	1.6	1030.3	O K
2160 min Summer	2.365	0.865	1.6	1064.2	O K
2880 min Summer	2.374	0.874	1.6	1075.2	O K
4320 min Summer	2.365	0.865	1.6	1063.8	O K
5760 min Summer	2.340	0.840	1.6	1033.6	O K
7200 min Summer	2.317	0.817	1.6	1004.7	O K
8640 min Summer	2.294	0.794	1.6	976.6	O K
10080 min Summer	2.272	0.772	1.6	949.5	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	132.402	0.0	135.7	19
30 min Summer	86.432	0.0	135.8	34
60 min Summer	53.779	0.0	268.5	64
120 min Summer	32.379	0.0	253.0	124
180 min Summer	23.772	0.0	239.8	184
240 min Summer	18.994	0.0	233.7	244
360 min Summer	13.738	0.0	230.4	364
480 min Summer	10.928	0.0	233.1	484
600 min Summer	9.143	0.0	236.1	604
720 min Summer	7.900	0.0	238.1	724
960 min Summer	6.269	0.0	240.1	962
1440 min Summer	4.519	0.0	239.6	1442
2160 min Summer	3.253	0.0	483.1	2160
2880 min Summer	2.574	0.0	481.4	2880
4320 min Summer	1.848	0.0	466.2	4320
5760 min Summer	1.459	0.0	934.6	5240
7200 min Summer	1.215	0.0	908.8	5904
8640 min Summer	1.045	0.0	886.0	6656
10080 min Summer	0.920	0.0	859.7	7368

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

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Winter	1.816	0.316	1.6	388.1	O K
30 min Winter	1.911	0.411	1.6	506.0	O K
60 min Winter	2.011	0.511	1.6	628.1	O K
120 min Winter	2.112	0.612	1.6	753.2	O K
180 min Winter	2.172	0.672	1.6	826.0	O K
240 min Winter	2.212	0.712	1.6	876.4	O K
360 min Winter	2.267	0.767	1.6	943.2	O K
480 min Winter	2.307	0.807	1.6	992.7	O K
600 min Winter	2.338	0.838	1.6	1030.5	O K
720 min Winter	2.362	0.862	1.6	1060.7	O K
960 min Winter	2.400	0.900	1.6	1106.4	O K
1440 min Winter	2.446	0.946	1.7	1163.8	O K
2160 min Winter	2.482	0.982	1.7	1207.5	O K
2880 min Winter	2.496	0.996	1.7	1225.5	O K
4320 min Winter	2.495	0.995	1.7	1224.5	O K
5760 min Winter	2.475	0.975	1.7	1198.8	O K
7200 min Winter	2.445	0.945	1.7	1162.0	O K
8640 min Winter	2.415	0.915	1.6	1125.9	O K
10080 min Winter	2.389	0.889	1.6	1093.2	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Winter	132.402	0.0	136.5	19
30 min Winter	86.432	0.0	134.5	34
60 min Winter	53.779	0.0	262.0	64
120 min Winter	32.379	0.0	239.2	124
180 min Winter	23.772	0.0	233.1	182
240 min Winter	18.994	0.0	234.2	242
360 min Winter	13.738	0.0	241.1	360
480 min Winter	10.928	0.0	245.8	480
600 min Winter	9.143	0.0	248.8	598
720 min Winter	7.900	0.0	250.8	716
960 min Winter	6.269	0.0	252.6	952
1440 min Winter	4.519	0.0	251.4	1426
2160 min Winter	3.253	0.0	509.6	2120
2880 min Winter	2.574	0.0	506.9	2820
4320 min Winter	1.848	0.0	489.3	4152
5760 min Winter	1.459	0.0	973.9	5472
7200 min Winter	1.215	0.0	961.3	6632
8640 min Winter	1.045	0.0	940.9	6920
10080 min Winter	0.920	0.0	914.1	7856

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	0.416	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 1.400

Time From:	**(mins) To:**	**Area (ha)**
0	4	1.400

Model Details

Storage is Online Cover Level (m) 2.500

Tank or Pond Structure

Invert Level (m) 1.500

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	1230.0	1.000	1230.0

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0062-1700-1000-1700
Design Head (m)	1.000
Design Flow (l/s)	1.7
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	62
Invert Level (m)	1.500
Minimum Outlet Pipe Diameter (mm)	75
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.000	1.7	Kick-Flo®	0.549	1.3
Flush-Flo™	0.270	1.6	Mean Flow over Head Range	-	1.4

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	1.4	1.200	1.8	3.000	2.8	7.000	4.2
0.200	1.6	1.400	2.0	3.500	3.0	7.500	4.3
0.300	1.6	1.600	2.1	4.000	3.2	8.000	4.4
0.400	1.5	1.800	2.2	4.500	3.4	8.500	4.6
0.500	1.4	2.000	2.3	5.000	3.6	9.000	4.7
0.600	1.3	2.200	2.4	5.500	3.7	9.500	4.8
0.800	1.5	2.400	2.5	6.000	3.9		
1.000	1.7	2.600	2.6	6.500	4.0		

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

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	1.781	0.281	8.3	1707.5	O K
30 min Summer	1.866	0.366	8.3	2226.1	O K
60 min Summer	1.954	0.454	8.3	2762.7	O K
120 min Summer	2.044	0.544	8.3	3310.6	O K
180 min Summer	2.097	0.597	8.3	3629.7	O K
240 min Summer	2.133	0.633	8.3	3850.8	O K
360 min Summer	2.181	0.681	8.3	4145.5	O K
480 min Summer	2.217	0.717	8.3	4363.4	O K
600 min Summer	2.244	0.744	8.3	4529.2	O K
720 min Summer	2.266	0.766	8.3	4661.3	O K
960 min Summer	2.299	0.799	8.3	4859.8	O K
1440 min Summer	2.339	0.839	8.3	5105.6	O K
2160 min Summer	2.368	0.868	8.3	5284.4	O K
2880 min Summer	2.379	0.879	8.3	5349.1	O K
4320 min Summer	2.373	0.873	8.3	5309.9	O K
5760 min Summer	2.351	0.851	8.3	5176.0	O K
7200 min Summer	2.329	0.829	8.3	5045.2	O K
8640 min Summer	2.308	0.808	8.3	4914.5	O K
10080 min Summer	2.286	0.786	8.3	4785.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	132.402	0.0	703.5	19
30 min Summer	86.432	0.0	713.4	34
60 min Summer	53.779	0.0	1420.2	64
120 min Summer	32.379	0.0	1390.0	124
180 min Summer	23.772	0.0	1356.5	184
240 min Summer	18.994	0.0	1322.8	244
360 min Summer	13.738	0.0	1258.9	364
480 min Summer	10.928	0.0	1215.7	484
600 min Summer	9.143	0.0	1189.4	604
720 min Summer	7.900	0.0	1173.8	724
960 min Summer	6.269	0.0	1163.9	962
1440 min Summer	4.519	0.0	1153.8	1442
2160 min Summer	3.253	0.0	2363.9	2160
2880 min Summer	2.574	0.0	2326.9	2880
4320 min Summer	1.848	0.0	2234.6	4320
5760 min Summer	1.459	0.0	4712.5	5136
7200 min Summer	1.215	0.0	4522.6	5840
8640 min Summer	1.045	0.0	4333.4	6656
10080 min Summer	0.920	0.0	4151.8	7368

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

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Winter	1.814	0.314	8.3	1912.8	O K
30 min Winter	1.910	0.410	8.3	2494.0	O K
60 min Winter	2.009	0.509	8.3	3095.9	O K
120 min Winter	2.110	0.610	8.3	3711.5	O K
180 min Winter	2.169	0.669	8.3	4072.1	O K
240 min Winter	2.210	0.710	8.3	4321.9	O K
360 min Winter	2.265	0.765	8.3	4653.6	O K
480 min Winter	2.305	0.805	8.3	4899.4	O K
600 min Winter	2.336	0.836	8.3	5087.6	O K
720 min Winter	2.361	0.861	8.3	5238.3	O K
960 min Winter	2.398	0.898	8.3	5466.9	O K
1440 min Winter	2.446	0.946	8.3	5755.8	O K
2160 min Winter	2.483	0.983	8.3	5979.0	O K
2880 min Winter	2.498	0.998	8.4	6074.6	O K
4320 min Winter	2.499	0.999	8.4	6081.0	O K
5760 min Winter	2.480	0.980	8.3	5963.7	O K
7200 min Winter	2.451	0.951	8.3	5789.0	O K
8640 min Winter	2.423	0.923	8.3	5618.3	O K
10080 min Winter	2.397	0.897	8.3	5459.4	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Winter	132.402	0.0	712.2	19
30 min Winter	86.432	0.0	711.6	34
60 min Winter	53.779	0.0	1411.7	64
120 min Winter	32.379	0.0	1359.0	124
180 min Winter	23.772	0.0	1299.3	182
240 min Winter	18.994	0.0	1255.8	242
360 min Winter	13.738	0.0	1217.1	360
480 min Winter	10.928	0.0	1208.2	480
600 min Winter	9.143	0.0	1216.5	598
720 min Winter	7.900	0.0	1225.1	716
960 min Winter	6.269	0.0	1231.9	952
1440 min Winter	4.519	0.0	1220.9	1426
2160 min Winter	3.253	0.0	2487.9	2120
2880 min Winter	2.574	0.0	2468.6	2820
4320 min Winter	1.848	0.0	2369.8	4152
5760 min Winter	1.459	0.0	4836.7	5472
7200 min Winter	1.215	0.0	4699.8	6632
8640 min Winter	1.045	0.0	4579.7	6912
10080 min Winter	0.920	0.0	4444.1	7776

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	0.416	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 6.900

Time From:	(mins) To:	Area (ha)
0	4	6.900

Model Details

Storage is Online Cover Level (m) 2.500

Tank or Pond Structure

Invert Level (m) 1.500

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	6085.0	1.000	6085.0

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0134-8400-1000-8400
Design Head (m)	1.000
Design Flow (l/s)	8.4
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	134
Invert Level (m)	1.500
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.000	8.4	Kick-Flo®	0.662	6.9
Flush-Flo™	0.301	8.3	Mean Flow over Head Range	-	7.2

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	4.8	1.200	9.1	3.000	14.1	7.000	21.2
0.200	8.1	1.400	9.8	3.500	15.2	7.500	21.9
0.300	8.3	1.600	10.5	4.000	16.2	8.000	22.6
0.400	8.2	1.800	11.1	4.500	17.1	8.500	23.2
0.500	8.0	2.000	11.6	5.000	18.0	9.000	23.9
0.600	7.5	2.200	12.2	5.500	18.8	9.500	24.5
0.800	7.6	2.400	12.7	6.000	19.6		
1.000	8.4	2.600	13.2	6.500	20.4		

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

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	1.777	0.277	6.7	1370.9	O K
30 min Summer	1.861	0.361	6.7	1787.2	O K
60 min Summer	1.948	0.448	6.7	2218.0	O K
120 min Summer	2.037	0.537	6.7	2657.7	O K
180 min Summer	2.089	0.589	6.7	2913.8	O K
240 min Summer	2.124	0.624	6.7	3091.2	O K
360 min Summer	2.172	0.672	6.7	3327.6	O K
480 min Summer	2.208	0.708	6.7	3502.3	O K
600 min Summer	2.234	0.734	6.7	3635.3	O K
720 min Summer	2.256	0.756	6.7	3741.2	O K
960 min Summer	2.288	0.788	6.7	3900.2	O K
1440 min Summer	2.328	0.828	6.7	4097.2	O K
2160 min Summer	2.357	0.857	6.7	4240.1	O K
2880 min Summer	2.367	0.867	6.7	4291.7	O K
4320 min Summer	2.361	0.861	6.7	4259.8	O K
5760 min Summer	2.338	0.838	6.7	4150.0	O K
7200 min Summer	2.317	0.817	6.7	4041.8	O K
8640 min Summer	2.295	0.795	6.7	3934.6	O K
10080 min Summer	2.273	0.773	6.7	3828.4	O K
15 min Winter	1.810	0.310	6.7	1535.8	O K
30 min Winter	1.905	0.405	6.7	2002.4	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	132.402	0.0	564.3	19
30 min Summer	86.432	0.0	572.5	34
60 min Summer	53.779	0.0	1139.6	64
120 min Summer	32.379	0.0	1114.6	124
180 min Summer	23.772	0.0	1086.4	184
240 min Summer	18.994	0.0	1058.0	244
360 min Summer	13.738	0.0	1004.5	364
480 min Summer	10.928	0.0	968.8	484
600 min Summer	9.143	0.0	947.5	604
720 min Summer	7.900	0.0	935.3	724
960 min Summer	6.269	0.0	928.8	962
1440 min Summer	4.519	0.0	922.7	1442
2160 min Summer	3.253	0.0	1886.1	2160
2880 min Summer	2.574	0.0	1860.1	2880
4320 min Summer	1.848	0.0	1791.6	4320
5760 min Summer	1.459	0.0	3768.9	5240
7200 min Summer	1.215	0.0	3619.4	5912
8640 min Summer	1.045	0.0	3470.9	6656
10080 min Summer	0.920	0.0	3329.6	7456
15 min Winter	132.402	0.0	571.4	19
30 min Winter	86.432	0.0	571.1	34

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

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
60 min Winter	2.002	0.502	6.7	2485.5	O K
120 min Winter	2.102	0.602	6.7	2979.7	O K
180 min Winter	2.160	0.660	6.7	3269.2	O K
240 min Winter	2.201	0.701	6.7	3469.6	O K
360 min Winter	2.255	0.755	6.7	3735.8	O K
480 min Winter	2.295	0.795	6.7	3933.0	O K
600 min Winter	2.325	0.825	6.7	4084.0	O K
720 min Winter	2.349	0.849	6.7	4205.0	O K
960 min Winter	2.387	0.887	6.7	4388.3	O K
1440 min Winter	2.433	0.933	6.7	4620.1	O K
2160 min Winter	2.470	0.970	6.7	4799.0	O K
2880 min Winter	2.485	0.985	6.7	4875.8	O K
4320 min Winter	2.486	0.986	6.7	4880.5	O K
5760 min Winter	2.467	0.967	6.7	4786.3	O K
7200 min Winter	2.438	0.938	6.7	4645.4	O K
8640 min Winter	2.410	0.910	6.7	4503.9	O K
10080 min Winter	2.384	0.884	6.7	4374.7	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
60 min Winter	53.779	0.0	1132.4	64
120 min Winter	32.379	0.0	1087.7	124
180 min Winter	23.772	0.0	1036.7	182
240 min Winter	18.994	0.0	1000.1	242
360 min Winter	13.738	0.0	968.0	360
480 min Winter	10.928	0.0	961.3	480
600 min Winter	9.143	0.0	968.8	598
720 min Winter	7.900	0.0	976.1	716
960 min Winter	6.269	0.0	982.2	952
1440 min Winter	4.519	0.0	975.2	1426
2160 min Winter	3.253	0.0	1984.4	2120
2880 min Winter	2.574	0.0	1971.2	2820
4320 min Winter	1.848	0.0	1897.2	4152
5760 min Winter	1.459	0.0	3860.9	5472
7200 min Winter	1.215	0.0	3756.0	6696
8640 min Winter	1.045	0.0	3665.2	6920
10080 min Winter	0.920	0.0	3560.8	7864

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	0.416	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 5.540

Time From:	**(mins) To:**	**Area (ha)**
0	4	5.540

Model Details

Storage is Online Cover Level (m) 2.500

Tank or Pond Structure

Invert Level (m) 1.500

Depth (m)	**Area (m²)**	**Depth (m)**	**Area (m²)**
0.000	4950.0	1.000	4950.0

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0121-6700-1000-6700
Design Head (m)	1.000
Design Flow (l/s)	6.7
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	121
Invert Level (m)	1.500
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	**Head (m)**	**Flow (l/s)**
Design Point (Calculated)	1.000	6.7
Flush-Flo™	0.297	6.7
Kick-Flo®	0.652	5.5
Mean Flow over Head Range	-	5.8

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

Depth (m)	**Flow (l/s)**	**Depth (m)**	**Flow (l/s)**	**Depth (m)**	**Flow (l/s)**	**Depth (m)**	**Flow (l/s)**
0.100	4.3	1.200	7.3	3.000	11.2	7.000	16.8
0.200	6.5	1.400	7.8	3.500	12.1	7.500	17.4
0.300	6.7	1.600	8.3	4.000	12.9	8.000	17.9
0.400	6.6	1.800	8.8	4.500	13.6	8.500	18.5
0.500	6.4	2.000	9.3	5.000	14.3	9.000	19.0
0.600	6.0	2.200	9.7	5.500	15.0	9.500	19.5
0.800	6.0	2.400	10.1	6.000	15.6		
1.000	6.7	2.600	10.5	6.500	16.2		

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

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	1.778	0.278	7.3	1502.1	O K
30 min Summer	1.863	0.363	7.3	1958.3	O K
60 min Summer	1.950	0.450	7.3	2430.4	O K
120 min Summer	2.039	0.539	7.3	2912.4	O K
180 min Summer	2.091	0.591	7.3	3193.2	O K
240 min Summer	2.127	0.627	7.3	3387.7	O K
360 min Summer	2.175	0.675	7.3	3647.1	O K
480 min Summer	2.211	0.711	7.3	3838.9	O K
600 min Summer	2.238	0.738	7.3	3985.0	O K
720 min Summer	2.260	0.760	7.3	4101.4	O K
960 min Summer	2.292	0.792	7.3	4276.5	O K
1440 min Summer	2.332	0.832	7.3	4493.8	O K
2160 min Summer	2.362	0.862	7.3	4652.7	O K
2880 min Summer	2.372	0.872	7.3	4711.2	O K
4320 min Summer	2.367	0.867	7.3	4680.0	O K
5760 min Summer	2.345	0.845	7.3	4562.3	O K
7200 min Summer	2.323	0.823	7.3	4445.7	O K
8640 min Summer	2.302	0.802	7.3	4329.9	O K
10080 min Summer	2.281	0.781	7.3	4215.1	O K
15 min Winter	1.812	0.312	7.3	1682.8	O K
30 min Winter	1.906	0.406	7.3	2194.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	132.402	0.0	612.8	19
30 min Summer	86.432	0.0	621.8	34
60 min Summer	53.779	0.0	1238.1	64
120 min Summer	32.379	0.0	1211.9	124
180 min Summer	23.772	0.0	1182.3	184
240 min Summer	18.994	0.0	1152.6	244
360 min Summer	13.738	0.0	1095.8	364
480 min Summer	10.928	0.0	1056.8	484
600 min Summer	9.143	0.0	1033.3	604
720 min Summer	7.900	0.0	1019.6	724
960 min Summer	6.269	0.0	1011.4	962
1440 min Summer	4.519	0.0	1003.9	1442
2160 min Summer	3.253	0.0	2054.5	2160
2880 min Summer	2.574	0.0	2025.1	2880
4320 min Summer	1.848	0.0	1948.3	4320
5760 min Summer	1.459	0.0	4101.2	5248
7200 min Summer	1.215	0.0	3938.6	5912
8640 min Summer	1.045	0.0	3777.1	6656
10080 min Summer	0.920	0.0	3623.4	7456
15 min Winter	132.402	0.0	620.5	19
30 min Winter	86.432	0.0	620.5	34

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

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
60 min Winter	2.004	0.504	7.3	2723.5	O K
120 min Winter	2.105	0.605	7.3	3265.2	O K
180 min Winter	2.163	0.663	7.3	3582.5	O K
240 min Winter	2.204	0.704	7.3	3802.3	O K
360 min Winter	2.258	0.758	7.3	4094.4	O K
480 min Winter	2.298	0.798	7.3	4310.8	O K
600 min Winter	2.329	0.829	7.3	4476.6	O K
720 min Winter	2.354	0.854	7.3	4609.5	O K
960 min Winter	2.391	0.891	7.3	4811.2	O K
1440 min Winter	2.438	0.938	7.3	5066.5	O K
2160 min Winter	2.475	0.975	7.3	5264.8	O K
2880 min Winter	2.491	0.991	7.3	5350.8	O K
4320 min Winter	2.493	0.993	7.3	5359.6	O K
5760 min Winter	2.474	0.974	7.3	5259.6	O K
7200 min Winter	2.446	0.946	7.3	5108.1	O K
8640 min Winter	2.417	0.917	7.3	4954.4	O K
10080 min Winter	2.392	0.892	7.3	4815.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
60 min Winter	53.779	0.0	1230.8	64
120 min Winter	32.379	0.0	1184.2	124
180 min Winter	23.772	0.0	1131.0	182
240 min Winter	18.994	0.0	1091.3	242
360 min Winter	13.738	0.0	1056.2	360
480 min Winter	10.928	0.0	1048.2	480
600 min Winter	9.143	0.0	1055.7	598
720 min Winter	7.900	0.0	1063.5	716
960 min Winter	6.269	0.0	1069.9	952
1440 min Winter	4.519	0.0	1061.5	1426
2160 min Winter	3.253	0.0	2162.1	2120
2880 min Winter	2.574	0.0	2146.7	2820
4320 min Winter	1.848	0.0	2064.2	4152
5760 min Winter	1.459	0.0	4205.5	5472
7200 min Winter	1.215	0.0	4091.2	6696
8640 min Winter	1.045	0.0	3991.6	6920
10080 min Winter	0.920	0.0	3876.2	7864

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	0.416	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 6.070

Time From:	**(mins) To:**	**Area (ha)**
0	4	6.070

Model Details

Storage is Online Cover Level (m) 2.500

Tank or Pond Structure

Invert Level (m) 1.500

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	5400.0	1.000	5400.0

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0126-7300-1000-7300
Design Head (m)	1.000
Design Flow (l/s)	7.3
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	126
Invert Level (m)	1.500
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.000	7.3
Flush-Flo™	0.301	7.3
Kick-Flo®	0.658	6.0
Mean Flow over Head Range	-	6.3

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	4.5	1.200	7.9	3.000	12.2	7.000	18.3
0.200	7.1	1.400	8.5	3.500	13.2	7.500	19.0
0.300	7.3	1.600	9.1	4.000	14.0	8.000	19.6
0.400	7.2	1.800	9.6	4.500	14.8	8.500	20.1
0.500	7.0	2.000	10.1	5.000	15.6	9.000	20.7
0.600	6.5	2.200	10.6	5.500	16.3	9.500	21.2
0.800	6.6	2.400	11.0	6.000	17.0		
1.000	7.3	2.600	11.4	6.500	17.7		

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

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	1.779	0.279	1.9	418.2	O K
30 min Summer	1.863	0.363	1.9	545.1	O K
60 min Summer	1.951	0.451	1.9	676.4	O K
120 min Summer	2.040	0.540	1.9	810.5	O K
180 min Summer	2.092	0.592	1.9	888.7	O K
240 min Summer	2.129	0.629	1.9	942.9	O K
360 min Summer	2.176	0.676	1.9	1014.6	O K
480 min Summer	2.212	0.712	1.9	1067.3	O K
600 min Summer	2.238	0.738	1.9	1107.5	O K
720 min Summer	2.260	0.760	1.9	1139.4	O K
960 min Summer	2.291	0.791	1.9	1187.2	O K
1440 min Summer	2.331	0.831	1.9	1246.2	O K
2160 min Summer	2.359	0.859	1.9	1288.6	O K
2880 min Summer	2.369	0.869	1.9	1303.3	O K
4320 min Summer	2.361	0.861	1.9	1292.0	O K
5760 min Summer	2.338	0.838	1.9	1256.3	O K
7200 min Summer	2.314	0.814	1.9	1221.0	O K
8640 min Summer	2.291	0.791	1.9	1186.8	O K
10080 min Summer	2.269	0.769	1.9	1153.7	O K
15 min Winter	1.812	0.312	1.9	468.5	O K
30 min Winter	1.907	0.407	1.9	610.8	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	132.402	0.0	164.8	19
30 min Summer	86.432	0.0	166.9	34
60 min Summer	53.779	0.0	331.7	64
120 min Summer	32.379	0.0	320.9	124
180 min Summer	23.772	0.0	307.3	184
240 min Summer	18.994	0.0	295.1	244
360 min Summer	13.738	0.0	282.8	364
480 min Summer	10.928	0.0	278.1	484
600 min Summer	9.143	0.0	277.9	604
720 min Summer	7.900	0.0	280.0	724
960 min Summer	6.269	0.0	282.5	962
1440 min Summer	4.519	0.0	282.2	1442
2160 min Summer	3.253	0.0	569.2	2160
2880 min Summer	2.574	0.0	567.7	2880
4320 min Summer	1.848	0.0	550.8	4320
5760 min Summer	1.459	0.0	1122.3	5352
7200 min Summer	1.215	0.0	1085.8	5976
8640 min Summer	1.045	0.0	1051.2	6736
10080 min Summer	0.920	0.0	1019.6	7464
15 min Winter	132.402	0.0	166.7	19
30 min Winter	86.432	0.0	166.2	34

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

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
60 min Winter	2.005	0.505	1.9	758.1	O K
120 min Winter	2.106	0.606	1.9	909.1	O K
180 min Winter	2.165	0.665	1.9	997.2	O K
240 min Winter	2.205	0.705	1.9	1058.1	O K
360 min Winter	2.259	0.759	1.9	1139.0	O K
480 min Winter	2.299	0.799	1.9	1198.9	O K
600 min Winter	2.330	0.830	1.9	1244.7	O K
720 min Winter	2.354	0.854	1.9	1281.4	O K
960 min Winter	2.391	0.891	1.9	1337.0	O K
1440 min Winter	2.438	0.938	1.9	1407.2	O K
2160 min Winter	2.474	0.974	2.0	1461.1	O K
2880 min Winter	2.489	0.989	2.0	1484.1	O K
4320 min Winter	2.490	0.990	2.0	1484.8	O K
5760 min Winter	2.470	0.970	2.0	1455.6	O K
7200 min Winter	2.442	0.942	1.9	1412.4	O K
8640 min Winter	2.411	0.911	1.9	1366.9	O K
10080 min Winter	2.385	0.885	1.9	1327.4	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
60 min Winter	53.779	0.0	327.7	64
120 min Winter	32.379	0.0	305.2	124
180 min Winter	23.772	0.0	289.4	182
240 min Winter	18.994	0.0	283.4	242
360 min Winter	13.738	0.0	283.5	360
480 min Winter	10.928	0.0	289.0	480
600 min Winter	9.143	0.0	292.6	598
720 min Winter	7.900	0.0	295.0	716
960 min Winter	6.269	0.0	297.4	952
1440 min Winter	4.519	0.0	296.4	1426
2160 min Winter	3.253	0.0	600.8	2120
2880 min Winter	2.574	0.0	598.2	2820
4320 min Winter	1.848	0.0	578.9	4152
5760 min Winter	1.459	0.0	1155.9	5480
7200 min Winter	1.215	0.0	1138.3	6696
8640 min Winter	1.045	0.0	1115.5	7008
10080 min Winter	0.920	0.0	1085.3	7864

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	0.416	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 1.690

Time From:	(mins) To:	Area (ha)
0	4	1.690

Model Details

Storage is Online Cover Level (m) 2.500

Tank or Pond Structure

Invert Level (m) 1.500

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	1500.0	1.000	1500.0

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0067-2000-1000-2000
Design Head (m)	1.000
Design Flow (l/s)	2.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	67
Invert Level (m)	1.500
Minimum Outlet Pipe Diameter (mm)	100
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.000	2.0
Flush-Flo™	0.296	1.9
Kick-Flo®	0.599	1.6
Mean Flow over Head Range	-	1.7

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	1.6	1.200	2.2	3.000	3.3	7.000	4.9
0.200	1.9	1.400	2.3	3.500	3.5	7.500	5.1
0.300	1.9	1.600	2.5	4.000	3.8	8.000	5.2
0.400	1.9	1.800	2.6	4.500	4.0	8.500	5.4
0.500	1.8	2.000	2.7	5.000	4.2	9.000	5.5
0.600	1.6	2.200	2.9	5.500	4.4	9.500	5.7
0.800	1.8	2.400	3.0	6.000	4.6		
1.000	2.0	2.600	3.1	6.500	4.7		

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

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	1.780	0.280	4.0	826.4	O K
30 min Summer	1.865	0.365	4.0	1077.4	O K
60 min Summer	1.953	0.453	4.0	1337.0	O K
120 min Summer	2.043	0.543	4.0	1601.9	O K
180 min Summer	2.095	0.595	4.0	1756.3	O K
240 min Summer	2.132	0.632	4.0	1863.3	O K
360 min Summer	2.180	0.680	4.0	2005.4	O K
480 min Summer	2.215	0.715	4.0	2110.0	O K
600 min Summer	2.242	0.742	4.0	2189.5	O K
720 min Summer	2.264	0.764	4.0	2252.8	O K
960 min Summer	2.296	0.796	4.0	2347.6	O K
1440 min Summer	2.335	0.835	4.0	2464.5	O K
2160 min Summer	2.364	0.864	4.0	2548.4	O K
2880 min Summer	2.374	0.874	4.0	2577.4	O K
4320 min Summer	2.366	0.866	4.0	2554.7	O K
5760 min Summer	2.342	0.842	4.0	2485.0	O K
7200 min Summer	2.319	0.819	4.0	2416.8	O K
8640 min Summer	2.297	0.797	4.0	2349.9	O K
10080 min Summer	2.274	0.774	4.0	2284.6	O K
15 min Winter	1.814	0.314	4.0	925.8	O K
30 min Winter	1.909	0.409	4.0	1207.1	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	132.402	0.0	337.2	19
30 min Summer	86.432	0.0	341.3	34
60 min Summer	53.779	0.0	678.7	64
120 min Summer	32.379	0.0	660.1	124
180 min Summer	23.772	0.0	638.2	184
240 min Summer	18.994	0.0	615.2	244
360 min Summer	13.738	0.0	583.8	364
480 min Summer	10.928	0.0	567.4	484
600 min Summer	9.143	0.0	560.1	604
720 min Summer	7.900	0.0	558.5	724
960 min Summer	6.269	0.0	562.2	962
1440 min Summer	4.519	0.0	560.5	1442
2160 min Summer	3.253	0.0	1134.2	2160
2880 min Summer	2.574	0.0	1128.2	2880
4320 min Summer	1.848	0.0	1091.6	4320
5760 min Summer	1.459	0.0	2259.8	5248
7200 min Summer	1.215	0.0	2176.7	5912
8640 min Summer	1.045	0.0	2095.8	6664
10080 min Summer	0.920	0.0	2021.5	7456
15 min Winter	132.402	0.0	341.1	19
30 min Winter	86.432	0.0	340.1	34

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

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
60 min Winter	2.008	0.508	4.0	1498.3	O K
120 min Winter	2.109	0.609	4.0	1796.3	O K
180 min Winter	2.168	0.668	4.0	1970.7	O K
240 min Winter	2.209	0.709	4.0	2091.2	O K
360 min Winter	2.263	0.763	4.0	2251.2	O K
480 min Winter	2.303	0.803	4.0	2369.7	O K
600 min Winter	2.334	0.834	4.0	2460.3	O K
720 min Winter	2.359	0.859	4.0	2532.8	O K
960 min Winter	2.396	0.896	4.0	2642.7	O K
1440 min Winter	2.443	0.943	4.0	2781.1	O K
2160 min Winter	2.479	0.979	4.0	2887.3	O K
2880 min Winter	2.494	0.994	4.0	2932.0	O K
4320 min Winter	2.494	0.994	4.0	2932.2	O K
5760 min Winter	2.474	0.974	4.0	2873.1	O K
7200 min Winter	2.445	0.945	4.0	2786.5	O K
8640 min Winter	2.415	0.915	4.0	2698.3	O K
10080 min Winter	2.388	0.888	4.0	2619.3	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
60 min Winter	53.779	0.0	672.4	64
120 min Winter	32.379	0.0	636.5	124
180 min Winter	23.772	0.0	600.6	182
240 min Winter	18.994	0.0	582.6	242
360 min Winter	13.738	0.0	571.7	360
480 min Winter	10.928	0.0	577.0	480
600 min Winter	9.143	0.0	584.2	598
720 min Winter	7.900	0.0	588.9	716
960 min Winter	6.269	0.0	593.3	952
1440 min Winter	4.519	0.0	590.5	1426
2160 min Winter	3.253	0.0	1198.5	2120
2880 min Winter	2.574	0.0	1192.4	2820
4320 min Winter	1.848	0.0	1151.7	4152
5760 min Winter	1.459	0.0	2317.4	5472
7200 min Winter	1.215	0.0	2267.0	6696
8640 min Winter	1.045	0.0	2220.1	6992
10080 min Winter	0.920	0.0	2159.2	7864

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	0.416	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 3.340

Time From:	(mins) To:	Area (ha)
0	4	3.340

Model Details

Storage is Online Cover Level (m) 2.500

Tank or Pond Structure

Invert Level (m) 1.500

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	2950.0	1.000	2950.0

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0095-4000-1000-4000
Design Head (m)	1.000
Design Flow (l/s)	4.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	95
Invert Level (m)	1.500
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.000	4.0
Flush-Flo™	0.294	4.0
Kick-Flo®	0.629	3.2
Mean Flow over Head Range	-	3.5

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	3.0	1.200	4.3	3.000	6.7	7.000	10.0
0.200	3.9	1.400	4.7	3.500	7.2	7.500	10.3
0.300	4.0	1.600	5.0	4.000	7.6	8.000	10.6
0.400	3.9	1.800	5.3	4.500	8.1	8.500	10.9
0.500	3.8	2.000	5.5	5.000	8.5	9.000	11.2
0.600	3.4	2.200	5.8	5.500	8.9	9.500	11.5
0.800	3.6	2.400	6.0	6.000	9.3		
1.000	4.0	2.600	6.2	6.500	9.6		

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

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	1.781	0.281	7.0	1427.8	O K
30 min Summer	1.866	0.366	7.0	1861.4	O K
60 min Summer	1.955	0.455	7.0	2310.0	O K
120 min Summer	2.045	0.545	7.0	2768.0	O K
180 min Summer	2.097	0.597	7.0	3034.8	O K
240 min Summer	2.134	0.634	7.0	3219.6	O K
360 min Summer	2.182	0.682	7.0	3465.8	O K
480 min Summer	2.218	0.718	7.0	3647.5	O K
600 min Summer	2.245	0.745	7.0	3785.7	O K
720 min Summer	2.267	0.767	7.0	3895.7	O K
960 min Summer	2.299	0.799	7.0	4060.8	O K
1440 min Summer	2.340	0.840	7.0	4265.0	O K
2160 min Summer	2.369	0.869	7.0	4412.5	O K
2880 min Summer	2.379	0.879	7.0	4464.8	O K
4320 min Summer	2.372	0.872	7.0	4428.9	O K
5760 min Summer	2.349	0.849	7.0	4313.9	O K
7200 min Summer	2.327	0.827	7.0	4201.8	O K
8640 min Summer	2.305	0.805	7.0	4090.3	O K
10080 min Summer	2.284	0.784	7.0	3980.3	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	132.402	0.0	590.0	19
30 min Summer	86.432	0.0	597.4	34
60 min Summer	53.779	0.0	1188.7	64
120 min Summer	32.379	0.0	1160.8	124
180 min Summer	23.772	0.0	1129.8	184
240 min Summer	18.994	0.0	1098.3	244
360 min Summer	13.738	0.0	1042.4	364
480 min Summer	10.928	0.0	1008.0	484
600 min Summer	9.143	0.0	988.3	604
720 min Summer	7.900	0.0	977.9	724
960 min Summer	6.269	0.0	975.1	962
1440 min Summer	4.519	0.0	968.2	1442
2160 min Summer	3.253	0.0	1975.6	2160
2880 min Summer	2.574	0.0	1951.6	2880
4320 min Summer	1.848	0.0	1878.4	4320
5760 min Summer	1.459	0.0	3941.5	5240
7200 min Summer	1.215	0.0	3785.8	5904
8640 min Summer	1.045	0.0	3631.5	6656
10080 min Summer	0.920	0.0	3485.2	7368

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

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Winter	1.815	0.315	7.0	1599.5	O K
30 min Winter	1.911	0.411	7.0	2085.5	O K
60 min Winter	2.010	0.510	7.0	2588.6	O K
120 min Winter	2.111	0.611	7.0	3103.5	O K
180 min Winter	2.170	0.670	7.0	3404.9	O K
240 min Winter	2.211	0.711	7.0	3613.6	O K
360 min Winter	2.266	0.766	7.0	3890.6	O K
480 min Winter	2.306	0.806	7.0	4095.7	O K
600 min Winter	2.337	0.837	7.0	4252.8	O K
720 min Winter	2.362	0.862	7.0	4378.5	O K
960 min Winter	2.399	0.899	7.0	4569.0	O K
1440 min Winter	2.447	0.947	7.0	4809.4	O K
2160 min Winter	2.483	0.983	7.0	4994.5	O K
2880 min Winter	2.499	0.999	7.0	5073.0	O K
4320 min Winter	2.499	0.999	7.0	5075.6	O K
5760 min Winter	2.479	0.979	7.0	4975.3	O K
7200 min Winter	2.450	0.950	7.0	4827.1	O K
8640 min Winter	2.422	0.922	7.0	4681.7	O K
10080 min Winter	2.395	0.895	7.0	4547.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Winter	132.402	0.0	596.9	19
30 min Winter	86.432	0.0	595.5	34
60 min Winter	53.779	0.0	1180.1	64
120 min Winter	32.379	0.0	1130.5	124
180 min Winter	23.772	0.0	1075.1	182
240 min Winter	18.994	0.0	1039.8	242
360 min Winter	13.738	0.0	1010.6	360
480 min Winter	10.928	0.0	1007.6	480
600 min Winter	9.143	0.0	1017.5	598
720 min Winter	7.900	0.0	1025.1	716
960 min Winter	6.269	0.0	1031.3	952
1440 min Winter	4.519	0.0	1023.5	1426
2160 min Winter	3.253	0.0	2082.8	2120
2880 min Winter	2.574	0.0	2068.3	2820
4320 min Winter	1.848	0.0	1989.3	4152
5760 min Winter	1.459	0.0	4042.9	5472
7200 min Winter	1.215	0.0	3934.8	6632
8640 min Winter	1.045	0.0	3840.6	6920
10080 min Winter	0.920	0.0	3729.6	7776

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	0.416	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 5.770

Time From:	**(mins) To:**	**Area (ha)**
0	4	5.770

Model Details

Storage is Online Cover Level (m) 2.500

Tank or Pond Structure

Invert Level (m) 1.500

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	5080.0	1.000	5080.0

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0124-7000-1000-7000
Design Head (m)	1.000
Design Flow (l/s)	7.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	124
Invert Level (m)	1.500
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.000	7.0	Kick-Flo®	0.653	5.7
Flush-Flo™	0.296	7.0	Mean Flow over Head Range	-	6.0

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	4.4	1.200	7.6	3.000	11.7	7.000	17.6
0.200	6.8	1.400	8.2	3.500	12.6	7.500	18.2
0.300	7.0	1.600	8.7	4.000	13.5	8.000	18.8
0.400	6.9	1.800	9.2	4.500	14.2	8.500	19.3
0.500	6.7	2.000	9.7	5.000	15.0	9.000	19.9
0.600	6.2	2.200	10.1	5.500	15.7	9.500	20.4
0.800	6.3	2.400	10.6	6.000	16.3		
1.000	7.0	2.600	11.0	6.500	17.0		

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

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	1.779	0.279	2.3	460.1	O K
30 min Summer	1.864	0.364	2.3	599.8	O K
60 min Summer	1.951	0.451	2.3	744.2	O K
120 min Summer	2.040	0.540	2.3	891.3	O K
180 min Summer	2.092	0.592	2.3	977.0	O K
240 min Summer	2.128	0.628	2.3	1036.2	O K
360 min Summer	2.176	0.676	2.3	1114.7	O K
480 min Summer	2.210	0.710	2.3	1172.3	O K
600 min Summer	2.237	0.737	2.3	1215.9	O K
720 min Summer	2.258	0.758	2.3	1250.5	O K
960 min Summer	2.289	0.789	2.3	1302.0	O K
1440 min Summer	2.327	0.827	2.3	1364.7	O K
2160 min Summer	2.353	0.853	2.3	1407.9	O K
2880 min Summer	2.361	0.861	2.3	1420.8	O K
4320 min Summer	2.350	0.850	2.3	1402.2	O K
5760 min Summer	2.324	0.824	2.3	1359.9	O K
7200 min Summer	2.300	0.800	2.3	1319.5	O K
8640 min Summer	2.276	0.776	2.3	1280.0	O K
10080 min Summer	2.253	0.753	2.3	1241.9	O K
15 min Winter	1.812	0.312	2.3	515.5	O K
30 min Winter	1.907	0.407	2.3	672.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	132.402	0.0	192.8	19
30 min Summer	86.432	0.0	196.3	34
60 min Summer	53.779	0.0	390.6	64
120 min Summer	32.379	0.0	381.3	124
180 min Summer	23.772	0.0	368.9	184
240 min Summer	18.994	0.0	355.7	244
360 min Summer	13.738	0.0	337.8	364
480 min Summer	10.928	0.0	328.3	484
600 min Summer	9.143	0.0	323.9	604
720 min Summer	7.900	0.0	322.8	724
960 min Summer	6.269	0.0	324.9	962
1440 min Summer	4.519	0.0	324.8	1442
2160 min Summer	3.253	0.0	655.1	2160
2880 min Summer	2.574	0.0	651.4	2880
4320 min Summer	1.848	0.0	632.6	4320
5760 min Summer	1.459	0.0	1310.9	5136
7200 min Summer	1.215	0.0	1262.0	5840
8640 min Summer	1.045	0.0	1213.0	6656
10080 min Summer	0.920	0.0	1166.6	7368
15 min Winter	132.402	0.0	195.4	19
30 min Winter	86.432	0.0	196.0	34

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

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
60 min Winter	2.005	0.505	2.3	834.0	O K
120 min Winter	2.106	0.606	2.3	999.7	O K
180 min Winter	2.165	0.665	2.3	1096.5	O K
240 min Winter	2.205	0.705	2.3	1163.3	O K
360 min Winter	2.259	0.759	2.3	1251.7	O K
480 min Winter	2.298	0.798	2.3	1317.1	O K
600 min Winter	2.328	0.828	2.3	1366.9	O K
720 min Winter	2.353	0.853	2.3	1406.7	O K
960 min Winter	2.389	0.889	2.3	1466.7	O K
1440 min Winter	2.434	0.934	2.3	1541.4	O K
2160 min Winter	2.468	0.968	2.3	1597.2	O K
2880 min Winter	2.481	0.981	2.3	1618.9	O K
4320 min Winter	2.478	0.978	2.3	1613.4	O K
5760 min Winter	2.455	0.955	2.3	1575.4	O K
7200 min Winter	2.423	0.923	2.3	1523.1	O K
8640 min Winter	2.393	0.893	2.3	1472.9	O K
10080 min Winter	2.364	0.864	2.3	1426.3	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
60 min Winter	53.779	0.0	387.8	64
120 min Winter	32.379	0.0	367.6	124
180 min Winter	23.772	0.0	347.0	182
240 min Winter	18.994	0.0	336.5	242
360 min Winter	13.738	0.0	329.8	360
480 min Winter	10.928	0.0	332.2	480
600 min Winter	9.143	0.0	336.5	598
720 min Winter	7.900	0.0	339.4	716
960 min Winter	6.269	0.0	342.3	952
1440 min Winter	4.519	0.0	341.4	1426
2160 min Winter	3.253	0.0	689.8	2120
2880 min Winter	2.574	0.0	687.3	2820
4320 min Winter	1.848	0.0	666.0	4152
5760 min Winter	1.459	0.0	1337.5	5472
7200 min Winter	1.215	0.0	1304.9	6632
8640 min Winter	1.045	0.0	1277.1	6912
10080 min Winter	0.920	0.0	1243.6	7768

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	0.416	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 1.860

Time (mins) From:	To:	Area (ha)
0	4	1.860

Model Details

Storage is Online Cover Level (m) 2.500

Tank or Pond Structure

Invert Level (m) 1.500

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	1650.0	1.000	1650.0

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0072-2300-1000-2300
Design Head (m)	1.000
Design Flow (l/s)	2.3
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	72
Invert Level (m)	1.500
Minimum Outlet Pipe Diameter (mm)	100
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.000	2.3
Flush-Flo™	0.307	2.3
Kick-Flo®	0.625	1.9
Mean Flow over Head Range	-	2.0

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	1.9	1.200	2.5	3.000	3.8	7.000	5.7
0.200	2.2	1.400	2.7	3.500	4.1	7.500	5.9
0.300	2.3	1.600	2.9	4.000	4.4	8.000	6.0
0.400	2.3	1.800	3.0	4.500	4.6	8.500	6.2
0.500	2.2	2.000	3.2	5.000	4.8	9.000	6.4
0.600	2.0	2.200	3.3	5.500	5.1	9.500	6.6
0.800	2.1	2.400	3.4	6.000	5.3		
1.000	2.3	2.600	3.6	6.500	5.5		

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

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	1.785	0.285	0.8	185.6	O K
30 min Summer	1.872	0.372	0.8	241.9	O K
60 min Summer	1.962	0.462	0.8	300.3	O K
120 min Summer	2.053	0.553	0.8	359.8	O K
180 min Summer	2.106	0.606	0.8	394.2	O K
240 min Summer	2.143	0.643	0.8	417.9	O K
360 min Summer	2.191	0.691	0.8	449.2	O K
480 min Summer	2.226	0.726	0.9	472.0	O K
600 min Summer	2.253	0.753	0.9	489.3	O K
720 min Summer	2.274	0.774	0.9	503.0	O K
960 min Summer	2.305	0.805	0.9	523.3	O K
1440 min Summer	2.342	0.842	0.9	547.5	O K
2160 min Summer	2.367	0.867	0.9	563.5	O K
2880 min Summer	2.373	0.873	0.9	567.3	O K
4320 min Summer	2.357	0.857	0.9	557.1	O K
5760 min Summer	2.332	0.832	0.9	540.7	O K
7200 min Summer	2.308	0.808	0.9	525.0	O K
8640 min Summer	2.284	0.784	0.9	509.9	O K
10080 min Summer	2.262	0.762	0.9	495.6	O K
15 min Winter	1.820	0.320	0.8	207.9	O K
30 min Winter	1.917	0.417	0.8	271.1	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	132.402	0.0	70.2	19
30 min Summer	86.432	0.0	67.5	34
60 min Summer	53.779	0.0	128.4	64
120 min Summer	32.379	0.0	124.0	124
180 min Summer	23.772	0.0	126.9	184
240 min Summer	18.994	0.0	130.3	244
360 min Summer	13.738	0.0	134.3	364
480 min Summer	10.928	0.0	136.9	484
600 min Summer	9.143	0.0	138.5	604
720 min Summer	7.900	0.0	139.6	724
960 min Summer	6.269	0.0	140.5	962
1440 min Summer	4.519	0.0	139.7	1442
2160 min Summer	3.253	0.0	281.1	2160
2880 min Summer	2.574	0.0	279.4	2880
4320 min Summer	1.848	0.0	269.1	4280
5760 min Summer	1.459	0.0	527.0	4904
7200 min Summer	1.215	0.0	519.4	5688
8640 min Summer	1.045	0.0	507.1	6400
10080 min Summer	0.920	0.0	490.5	7168
15 min Winter	132.402	0.0	69.7	19
30 min Winter	86.432	0.0	64.0	34

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

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
60 min Winter	2.018	0.518	0.8	336.5	O K
120 min Winter	2.120	0.620	0.8	403.3	O K
180 min Winter	2.180	0.680	0.8	442.1	O K
240 min Winter	2.221	0.721	0.9	468.9	O K
360 min Winter	2.276	0.776	0.9	504.4	O K
480 min Winter	2.316	0.816	0.9	530.5	O K
600 min Winter	2.347	0.847	0.9	550.4	O K
720 min Winter	2.371	0.871	0.9	566.3	O K
960 min Winter	2.408	0.908	1.0	590.1	O K
1440 min Winter	2.453	0.953	1.0	619.4	O K
2160 min Winter	2.486	0.986	1.0	640.8	O K
2880 min Winter	2.498	0.998	1.0	648.5	O K
4320 min Winter	2.491	0.991	1.0	644.4	O K
5760 min Winter	2.466	0.966	1.0	627.7	O K
7200 min Winter	2.434	0.934	1.0	606.9	O K
8640 min Winter	2.407	0.907	1.0	589.4	O K
10080 min Winter	2.379	0.879	0.9	571.5	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
60 min Winter	53.779	0.0	124.9	64
120 min Winter	32.379	0.0	128.5	124
180 min Winter	23.772	0.0	134.0	182
240 min Winter	18.994	0.0	137.5	242
360 min Winter	13.738	0.0	141.6	360
480 min Winter	10.928	0.0	144.2	478
600 min Winter	9.143	0.0	145.8	596
720 min Winter	7.900	0.0	146.8	716
960 min Winter	6.269	0.0	147.6	952
1440 min Winter	4.519	0.0	146.2	1426
2160 min Winter	3.253	0.0	296.1	2120
2880 min Winter	2.574	0.0	293.6	2796
4320 min Winter	1.848	0.0	281.6	4148
5760 min Winter	1.459	0.0	559.2	5416
7200 min Winter	1.215	0.0	550.8	5912
8640 min Winter	1.045	0.0	537.5	6744
10080 min Winter	0.920	0.0	520.2	7664

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	0.416	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.750

Time From:	**(mins) To:**	**Area (ha)**
0	4	0.750

Model Details

Storage is Online Cover Level (m) 2.500

Tank or Pond Structure

Invert Level (m) 1.500

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	650.0	1.000	650.0

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0047-1000-1000-1000
Design Head (m)	1.000
Design Flow (l/s)	1.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	47
Invert Level (m)	1.500
Minimum Outlet Pipe Diameter (mm)	75
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.000	1.0
Flush-Flo™	0.205	0.8
Kick-Flo®	0.415	0.7
Mean Flow over Head Range	-	0.8

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	0.8	1.200	1.1	3.000	1.6	7.000	2.4
0.200	0.8	1.400	1.2	3.500	1.8	7.500	2.5
0.300	0.8	1.600	1.2	4.000	1.9	8.000	2.6
0.400	0.7	1.800	1.3	4.500	2.0	8.500	2.7
0.500	0.7	2.000	1.4	5.000	2.1	9.000	2.7
0.600	0.8	2.200	1.4	5.500	2.2	9.500	2.8
0.800	0.9	2.400	1.5	6.000	2.3		
1.000	1.0	2.600	1.5	6.500	2.3		

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

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	1.777	0.277	2.9	596.3	O K
30 min Summer	1.862	0.362	2.9	777.3	O K
60 min Summer	1.949	0.449	2.9	964.5	O K
120 min Summer	2.037	0.537	2.9	1155.5	O K
180 min Summer	2.089	0.589	2.9	1266.8	O K
240 min Summer	2.125	0.625	2.9	1343.9	O K
360 min Summer	2.173	0.673	2.9	1446.1	O K
480 min Summer	2.208	0.708	2.9	1521.3	O K
600 min Summer	2.234	0.734	2.9	1578.4	O K
720 min Summer	2.255	0.755	2.9	1623.8	O K
960 min Summer	2.287	0.787	2.9	1691.8	O K
1440 min Summer	2.326	0.826	2.9	1775.3	O K
2160 min Summer	2.353	0.853	2.9	1834.6	O K
2880 min Summer	2.363	0.863	2.9	1854.4	O K
4320 min Summer	2.354	0.854	2.9	1836.1	O K
5760 min Summer	2.330	0.830	2.9	1784.2	O K
7200 min Summer	2.306	0.806	2.9	1733.5	O K
8640 min Summer	2.283	0.783	2.9	1684.1	O K
10080 min Summer	2.261	0.761	2.9	1636.0	O K
15 min Winter	1.811	0.311	2.9	668.0	O K
30 min Winter	1.905	0.405	2.9	870.9	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	132.402	0.0	244.0	19
30 min Summer	86.432	0.0	247.6	34
60 min Summer	53.779	0.0	492.6	64
120 min Summer	32.379	0.0	479.7	124
180 min Summer	23.772	0.0	463.7	184
240 min Summer	18.994	0.0	446.7	244
360 min Summer	13.738	0.0	423.6	364
480 min Summer	10.928	0.0	411.7	484
600 min Summer	9.143	0.0	406.3	604
720 min Summer	7.900	0.0	405.2	724
960 min Summer	6.269	0.0	408.1	962
1440 min Summer	4.519	0.0	407.6	1442
2160 min Summer	3.253	0.0	823.2	2160
2880 min Summer	2.574	0.0	819.5	2880
4320 min Summer	1.848	0.0	794.8	4320
5760 min Summer	1.459	0.0	1643.2	5248
7200 min Summer	1.215	0.0	1583.2	5912
8640 min Summer	1.045	0.0	1524.5	6664
10080 min Summer	0.920	0.0	1470.3	7456
15 min Winter	132.402	0.0	247.1	19
30 min Winter	86.432	0.0	246.9	34

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

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
60 min Winter	2.003	0.503	2.9	1080.9	O K
120 min Winter	2.103	0.603	2.9	1295.9	O K
180 min Winter	2.161	0.661	2.9	1421.6	O K
240 min Winter	2.202	0.702	2.9	1508.4	O K
360 min Winter	2.255	0.755	2.9	1623.6	O K
480 min Winter	2.295	0.795	2.9	1708.9	O K
600 min Winter	2.325	0.825	2.9	1774.0	O K
720 min Winter	2.349	0.849	2.9	1826.2	O K
960 min Winter	2.386	0.886	2.9	1905.0	O K
1440 min Winter	2.432	0.932	2.9	2004.1	O K
2160 min Winter	2.467	0.967	2.9	2079.6	O K
2880 min Winter	2.482	0.982	2.9	2110.9	O K
4320 min Winter	2.481	0.981	2.9	2109.3	O K
5760 min Winter	2.461	0.961	2.9	2065.2	O K
7200 min Winter	2.431	0.931	2.9	2001.3	O K
8640 min Winter	2.401	0.901	2.9	1936.3	O K
10080 min Winter	2.374	0.874	2.9	1878.3	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
60 min Winter	53.779	0.0	488.4	64
120 min Winter	32.379	0.0	462.1	124
180 min Winter	23.772	0.0	435.6	182
240 min Winter	18.994	0.0	422.2	242
360 min Winter	13.738	0.0	414.1	360
480 min Winter	10.928	0.0	417.9	480
600 min Winter	9.143	0.0	423.2	598
720 min Winter	7.900	0.0	426.8	716
960 min Winter	6.269	0.0	430.2	952
1440 min Winter	4.519	0.0	428.9	1426
2160 min Winter	3.253	0.0	868.7	2120
2880 min Winter	2.574	0.0	865.1	2820
4320 min Winter	1.848	0.0	837.4	4152
5760 min Winter	1.459	0.0	1681.3	5472
7200 min Winter	1.215	0.0	1644.8	6696
8640 min Winter	1.045	0.0	1611.7	7000
10080 min Winter	0.920	0.0	1568.8	7864

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	0.416	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 2.410

Time From:	(mins) To:	Area (ha)
0	4	2.410

Model Details

Storage is Online Cover Level (m) 2.500

Tank or Pond Structure

Invert Level (m) 1.500

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	2150.0	1.000	2150.0

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0081-2900-1000-2900
Design Head (m)	1.000
Design Flow (l/s)	2.9
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	81
Invert Level (m)	1.500
Minimum Outlet Pipe Diameter (mm)	100
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.000	2.9
Flush-Flo™	0.299	2.9
Kick-Flo®	0.623	2.3
Mean Flow over Head Range	-	2.5

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	2.4	1.200	3.2	3.000	4.8	7.000	7.2
0.200	2.8	1.400	3.4	3.500	5.2	7.500	7.4
0.300	2.9	1.600	3.6	4.000	5.5	8.000	7.7
0.400	2.9	1.800	3.8	4.500	5.8	8.500	7.9
0.500	2.7	2.000	4.0	5.000	6.1	9.000	8.1
0.600	2.4	2.200	4.2	5.500	6.4	9.500	8.3
0.800	2.6	2.400	4.3	6.000	6.7		
1.000	2.9	2.600	4.5	6.500	6.9		

APPENDIX D

Graham Sinclair

From: Jhrujh#Gdqq#?JhrujhC zop d1ruj1xnA
Sent: 44#Mxo|#534:#49=45
To: Judkdp #Vlqfodlu
Cc: Jduhwk#P duwlq
Subject: UH=#Hdvw#Z lvehfk#EFS#Lqfhswlrq#P hhwlqj#0#Vxuidfh#Z dwhu#Gudlqdjh#Uhsruw#0#:0#3:04:
Attachments: ^Xqwlwohg`1sgi

Graham

Please find attached plan with approximate downstream, midpoint and upstream bed levels for the Board-maintained watercourses crossing/adjacent to the BCP site. You will note that there are significant variations in both the levels and gradients of these drains, with many of them having little or no scope for lowering the bed levels without large-scale, expensive improvement schemes being undertaken downstream.

If you wish to discuss issues around potential outfalls further in due course, please let me know.

Kind regards

George Dann
Planning Officer, King's Lynn Drainage Board
e: george@wlma.org.uk

Water Management Alliance
Kettlewell House, Austin Fields Industrial Estate, King's Lynn, Norfolk, PE30 1PH, UK
t: +44 (0)1553 819600 | **f:** +44 (0)1553 819639 | **e:** info@wlma.org.uk | www.wlma.org.uk

Consisting of:
Broads Drainage Board, East Suffolk Drainage Board, King's Lynn Drainage Board, Norfolk Rivers Drainage Board and South Holland Drainage Board in association with Pevensey & Cuckmere Water Level Management Board

Defenders of the Lowland Environment

From: Graham Sinclair [mailto:Graham.Sinclair@createconsultingengineers.co.uk]
Sent: 07 July 2017 16:47
To: 'Gareth Martin' <gmartin@fenland.gov.uk>; 'Wendy Otter' <wotter@fenland.gov.uk>; 'Peter Jermany' <Peter.Jermany@West-Norfolk.gov.uk>; George Dann <George@wlma.org.uk>
Subject: RE: East Wisbech BCP Inception Meeting - Surface Water Drainage Report - 7- 07-17

Hi All,

It was good to meet with you this morning. As discussed if you could send through the following information when available it would be greatly appreciated.

Gareth/Wendy/Peter:

- Preliminary highways access/layout plans;
- High accuracy LiDAR data if it can be obtained free of charge;
- Land ownership plan; and,
- Any ecology/landscaping information as and when it is forthcoming.

George:

- Any level information you may have for the board controlled drains within the site boundary (I will submit a data request for the GIS layers of the IDB watercourses early next week).

If any of the above could be sent through in CAD/GIS format that would be brilliant, however PDF is no problem if this is not possible.

Many thanks,

Graham.

Graham Sinclair
Principal Consultant – Flood Risk and Hydrology
Create Consulting Engineers Ltd
15 Princes Street|Norwich|NR3 1AF
T 01603 877 010

From: Gareth Martin [mailto:gmartin@fenland.gov.uk]
Sent: 05 July 2017 12:02
To: Wendy Otter <wotter@fenland.gov.uk>; Peter Jermany <Peter.Jermany@West-Norfolk.gov.uk>; George Dann <George@wlma.org.uk>; Graham Sinclair <Graham.Sinclair@createconsultingengineers.co.uk>
Subject: East Wisbech BCP Inception Meeting - Surface Water Drainage Report - 7- 07-17

Hi all,

Please find attached a draft Agenda for Friday's meeting.

The headings will provide the basis for discussion and if you think other matters need to be added now please let me know, although we can discuss on Friday anyway.

Refreshments will be provided. Look forward to seeing you all on Friday.

Kind regards,

Gareth

DD: 01354 622439

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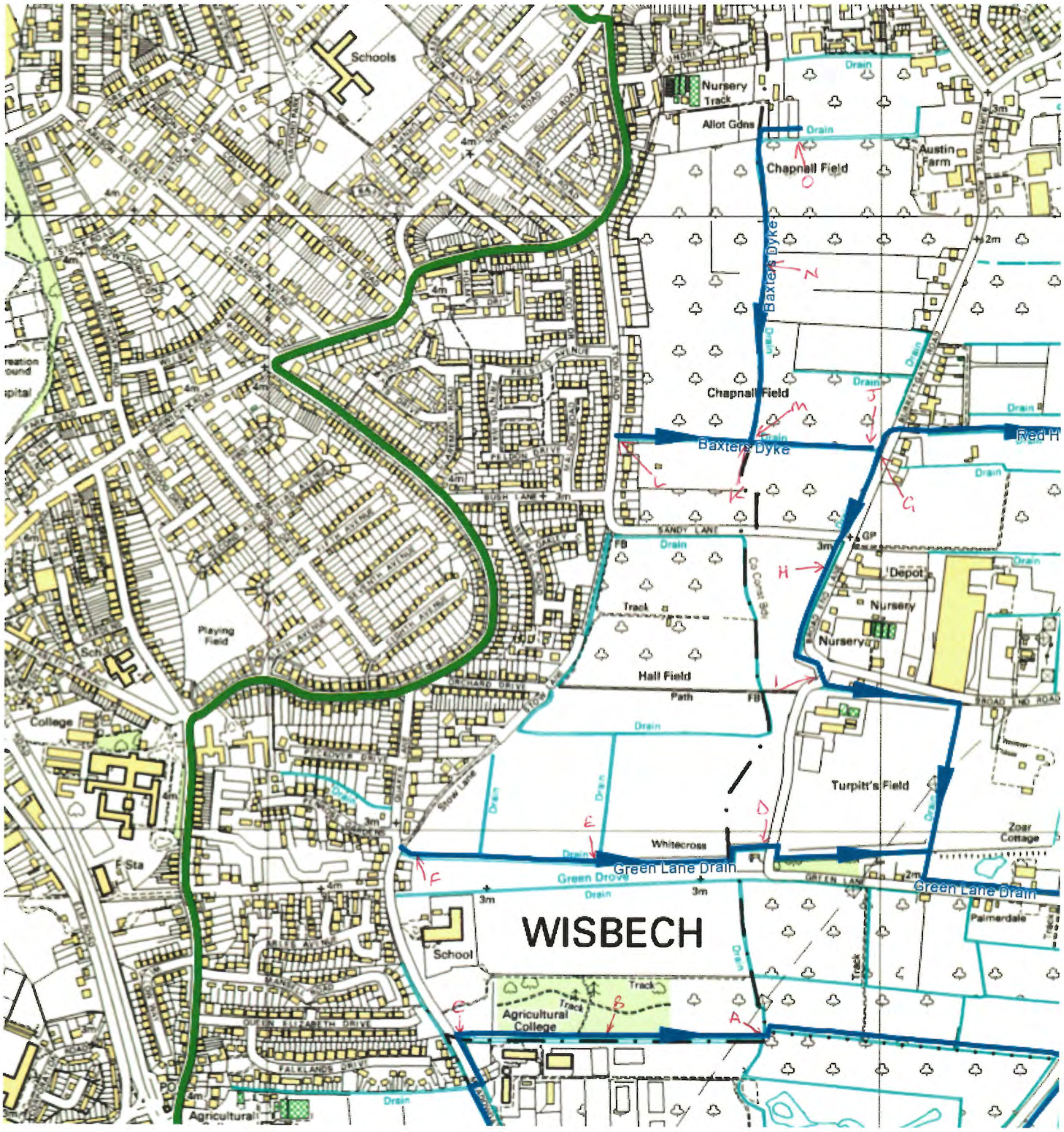


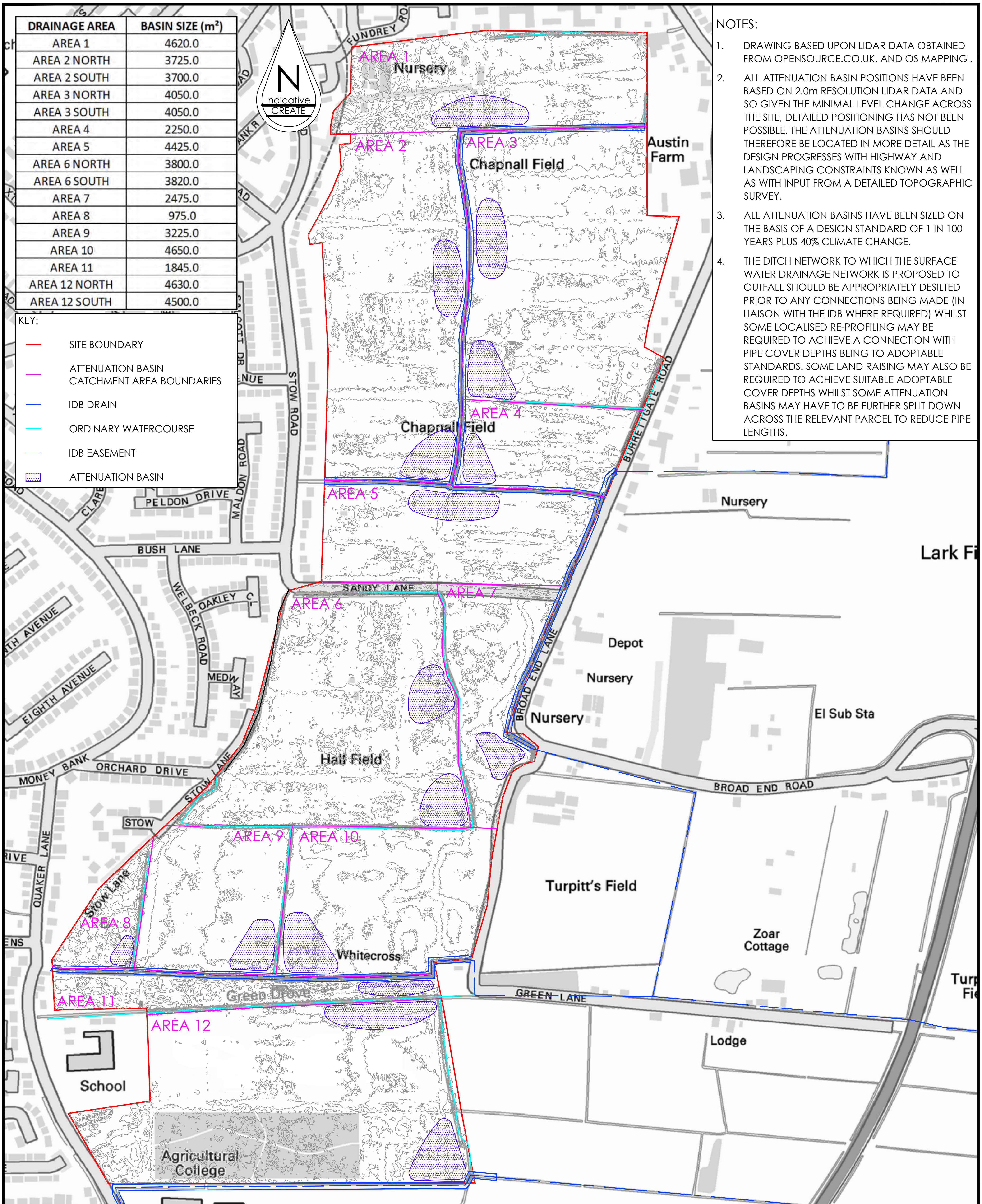
A -0.20m
B +0.35m
C +0.50m
D +0.20m
E +0.70m
F +1.00m
G -0.10m
H -0.05m
I +0.00m
J +0.10m
K +0.70m
L +1.10m
M +0.90m
N +0.90m
O +1.10m

PLANS

DRAINAGE AREA	BASIN SIZE (m^2)
AREA 1	4620.0
AREA 2 NORTH	3725.0
AREA 2 SOUTH	3700.0
AREA 3 NORTH	4050.0
AREA 3 SOUTH	4050.0
AREA 4	2250.0
AREA 5	4425.0
AREA 6 NORTH	3800.0
AREA 6 SOUTH	3820.0
AREA 7	2475.0
AREA 8	975.0
AREA 9	3225.0
AREA 10	4650.0
AREA 11	1845.0
AREA 12 NORTH	4630.0
AREA 12 SOUTH	4500.0

KEY:

- SITE BOUNDARY
- ATTENUATION BASIN CATCHMENT AREA BOUNDARIES
- IDB DRAIN
- ORDINARY WATERCOURSE
- IDB EASEMENT
- ATTENUATION BASIN



NOTES:

1. DRAWING BASED UPON LIDAR DATA OBTAINED FROM OPENSOURCE.CO.UK. AND OS MAPPING .
2. ALL ATTENUATION BASIN POSITIONS HAVE BEEN BASED ON 2.0m RESOLUTION LIDAR DATA AND SO GIVEN THE MINIMAL LEVEL CHANGE ACROSS THE SITE, DETAILED POSITIONING HAS NOT BEEN POSSIBLE. THE ATTENUATION BASINS SHOULD THEREFORE BE LOCATED IN MORE DETAIL AS THE DESIGN PROGRESSES WITH HIGHWAY AND LANDSCAPING CONSTRAINTS KNOWN AS WELL AS WITH INPUT FROM A DETAILED TOPOGRAPHIC SURVEY.
3. ALL ATTENUATION BASINS HAVE BEEN SIZED ON THE BASIS OF A DESIGN STANDARD OF 1 IN 100 YEARS PLUS 40% CLIMATE CHANGE.
4. THE DITCH NETWORK TO WHICH THE SURFACE WATER DRAINAGE NETWORK IS PROPOSED TO OUTFALL SHOULD BE APPROPRIATELY DESILTED PRIOR TO ANY CONNECTIONS BEING MADE (IN LIAISON WITH THE IDB WHERE REQUIRED) WHILST SOME LOCALISED RE-PROFILING MAY BE REQUIRED TO ACHIEVE A CONNECTION WITH PIPE COVER DEPTHS BEING TO ADOPTABLE STANDARDS. SOME LAND RAISING MAY ALSO BE REQUIRED TO ACHIEVE SUITABLE ADOPTABLE COVER DEPTHS WHILST SOME ATTENUATION BASINS MAY HAVE TO BE FURTHER SPLIT DOWN ACROSS THE RELEVANT PARCEL TO REDUCE PIPE LENGTHS.

REV	DATE	AMENDMENT DETAILS	DRAWN	APPROVED
A	16.11.17	UPDATED FOLLOWING CLIENT REVIEW	WL	GS

PROJECT EAST WISBECH, NORFOLK	DATE 14.09.17	DRAWING STATUS INFORMATION
DRAWING TITLE INDICATIVE ATTENUATION BASIN SIZES & POSITIONS	SCALE(S) 1:5000	DESIGNED GS / DRAWN WL / CHECKED GS / APPROVED BWA
	JOB No 1309	
CLIENT FENLAND DISTRICT COUNCIL	DRAWING No 02/001	REVISION A

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ORIGINAL SHEET SIZE - A3 Portrait

DO NOT SCALE