# South Corner Foots Farm,
# Thorpe Road,
# Clacton on Sea, Essex

## Flood Risk Assessment
## & Drainage Strategy

**on behalf of**

**LPB Homes**

**February 2024**

**INTERMODAL TRANSPORTATION**

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**IT2126**

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# 1 INTRODUCTION

1.1 Intermodal Transportation Ltd (ITL) has been commissioned by LPB Homes to prepare a Flood Risk Assessment (FRA) and Drainage Strategy report in support of a planning application for 40 residential dwellings west of Thorpe Road and north of Centenary Way, Clacton-on-Sea, Essex.

1.2 ITL also prepared an FRA for an earlier scheme at the site (application ref: 20/01202/FUL), which included 80 residential dwellings only. The scheme was updated to include 58 residential units and a doctors' surgery. The FRA report for the amended scheme was produced in September 2021. The application was subsequently withdrawn.

1.3 The site falls within the jurisdiction of Tendering District Council (TDC) as the Local Planning Authority (LPA).

1.4 The development site is located in a Flood Zone 1 area in terms of potential flood risk, which is the lowest classification. Therefore, the site is not predicted to be subject to fluvial (river based) or coastal flooding for a 1 in 1000 year or more frequent storm event. This report considers the risks to flooding on the site and downstream as well as including a drainage strategy which outlines the design philosophy for the management of surface water and disposal of foul effluent that would arise from the site, if the residential development is permitted by the LPA.

1.5 Under the Flood and Water Management Act 2010, the Lead Local Flood Authority (LLFA) is Essex County Council (ECC). Where possible, Sustainable Drainage Systems (SuDS) mechanisms are the preferred methods to minimise the run off to existing public sewers or watercourses and would be used for this development.

1.6 Representatives of ITL have visited the site to gain a better understanding of how the site naturally drains at present. A topographical survey has been undertaken for the site area and is included in **Appendix A**. In addition, ITL contacted Anglian Water Services (AWS) to ascertain whether they have existing sewer infrastructure in the vicinity of the site and to establish whether there are options to drain to any existing public sewer systems, refer to **Appendix B** for AWS plans.

1.7 The proposed development site is situated on a greenfield (previously not developed) site and extends to approximately 2.4ha in area.

1.8 The National Planning Policy Framework (NPPF) was first published in March 2012, with the current edition dating from December 2023. This framework document supersedes many planning policy guidance documents including PPS25, which covered land drainage matters. The NPPF sets out the Government's planning policies and, like its predecessor documents, provides guidance for local planning authorities when considering suitable sites for appropriate development in preparing development plans. The NPPF places a greater presumption in favour of sustainable development.

1.9 The technical guidance to NPPF, Flood Risk Section, classifies residential property as 'More Vulnerable' in terms of Flood Risk Vulnerability Classification (Annexe 3). NPPF also defines that developments classified as 'More Vulnerable' are appropriate in Flood Zone 1 (Table 2 Flood Risk Vulnerability and Flood Zone Compatibility).

# 2 SITE LOCATION AND EXISTING CONDITIONS

## Site Location

2.1 The site is located within the Tendring District Council area of Clacton-on-Sea, Essex. The entire site covers an area of approximately 2.4 hectares and is located approximately 3km to the north-east of Clacton town centre. The site is bounded by Thorpe Road to the east and Centenary Way (B1442) to the South. The northern and western boundaries are currently formed of agricultural fields. A new residential development has been constructed to the east of Thorpe Road, opposite the application site.

2.2 The nearest watercourse to the site is a ditch which flows to a main river to the east of the site. The ditch is approximately 750m to the east of the site.

2.3 The site location in the local and wider context is shown on Drawing **IT/2126/DS/001** of this report.

## Existing Conditions

2.4 The area of the development site extends to approximately 2.4 hectares consisting of an agricultural field. The topographical survey carried out on the site shows no significant drainage features within the site area. It does identify very shallow ditches which partially run to the north, east and west of the site. They are approximately 200mm deep but do not appear to be connected to a wider drainage network. The topographical survey identifies the north-west corner of the site as the highest point at 21.08m AOD and the lowest point in the south-east corner at 17.46m AOD.

2.5 AWS were contacted to ascertain whether they have existing sewer infrastructure in the vicinity of the site (refer to **Appendix B** for plans).

2.6 It can be seen from the asset plan there is a public surface water sewer to the east of the site under Thorpe Road. This is a 600mm diameter pipeline flowing south.

2.7 The asset plan shows that there is no public foul sewer immediately adjacent to the site. However, there are 225mm diameter sewers to the south-east of the site under Stephenson Road West and Gorse Lane.

# 3 POLICY AND GUIDANCE

**National Planning Policy Framework (Revised December 2023)**

3.1 The revised National Planning Policy Framework (NPPF) was first published in March 2012. The framework sets out the Government's planning policies for England and how the framework objectives are expected to be applied. The NPPF provides guidance for local planning authorities when preparing development plans and clarifies that there should be a presumption in favour of sustainable development. The NPPF does not propose anything dramatically new in terms of its responsibilities from the preceding PPS 25 guidance where the key principles to be applied by Authorities should:

> include Strategic Flood Risk Assessments as part of the LDF process and include policies to manage flood risk from all sources with wide consultation with all relevant bodies. LPA's should apply a sequential approach to the location of development.
>
> take climatic change into account and avoid increased vulnerability to ensure that risks can be managed where necessary;
>
> inappropriate development should be avoided in areas at risk of flooding by directing development away from areas at highest risk; where development is necessary it should be made safe without increasing flood risk elsewhere;

3.2 The NPPF requires site-specific FRAs, application of the Sequential Test where this has not been undertaken and, for sites that are vulnerable, possible application of the Exception Test.

**Planning Policy Statement 25 'Development and Flood Risk' (March 2010)**

3.3 The last issue of PPS 25 (March 2010) has now been superseded by the NPPF. However, many of the requirements of PPS 25 have been carried forward within the Technical Guidance to the NPPF, but with an emphasis for LPA's to ensure, as far as they are able, that appropriate SuDS mechanisms are required as part of development and, in many cases, for the LPA's to maintain adoptable SuDS systems.

3.4 The Development and Flood Risk Practice Guide (December 2009) provided advice on the practical implementation of PPS 25, and provides additional guidance on what is required at regional and local level. The document is still very relevant given that the NPPF is a more holistic document. The guidance is more helpful in considering regional spatial strategies, sustainability appraisals and local development documents and the roles and responsibilities for those managing individual planning applications. It also gives additional guidance on the importance of regional and strategic FRAs; the application of the sequential approach and Sequential and Exception Tests; surface water management and implementing sustainable drainage and measures to reduce flood risk.

3.5 Whilst the Environment Agency has the lead role in providing advice on flood issues, at a strategic level and in relation to planning applications, the LPA's have a duty to ensure that 'precautionary principles' in relation to flood risk and the location of vulnerable development are adopted, first using a risk based site search sequential review to avoid any risk of fluvial or sea flooding where possible and managing residual (perhaps pluvial) risks elsewhere.

### Flood and Water Management Act, 2010

3.6 The FWMA now places significantly greater responsibility on Local Authorities to manage and lead on local flooding issues. The Act, and supporting Regulations, together bestows more responsibility onto LPA's by requiring Authorities to:

Develop Local Flood Risk Management Strategies (LFRMS);

Implementing requirements of Flood and Water Management legislation;

Preparation of preliminary flood risk assessments and flood risk management plans;

Development and implementation of drainage and flooding management strategies; and

Taking responsibility for approving, adopting, managing and maintaining Sustainable Urban Drainage System (SuDS) where they serve more than one property.

3.7 The FWMA makes provision for a national standard to be prepared on SuDS, and developers will be required to obtain local authority approval for SuDS in accordance with the standards; this may be covered by appropriate conditions which would need to be discharged. Supporting this, the Act requires local authorities to adopt and maintain SuDS, removing any on-going responsibility for developers to maintain SuDS.

3.8 ITL are aware that some Local Authorities have not yet taken on the responsibility to maintain SuDS systems due to differences in opinion between the LLFA and the Highway Authority in terms of maintenance liabilities.

**Sewers for Adoption/ Design and Construction Guide for Developers (April 2020)**

3.9 Detailed design of proposed adoptable sewers should be in accordance with the above documents and the LLFA's design requirement (where feasible and viable) which are the definitive guides for those planning and designing sewers (both surface water and foul water) for subsequent adoption by the relevant water authority. This guidance provides best practice on planning, design, construction and operation of sewers, and their maintenance. The standards do not apply to private systems although the principles of the design requirements would generally be respected to ensure efficient performance of the systems from source to the identified discharge point from the site.

**SuDS Design Guide, Report C753, CIRIA 2015**

3.10 This detailed document provides guidance on the planning, design, construction and maintenance of Sustainable Drainage Systems (SuDS). The guide considers the benefits of managing water quality as well as quantity, amenity and biodiversity in new and existing developments. It presents a wide collection of good practice guidance from the UK and abroad to illustrate options and ideas.

**Essex County Council Sustainable Drainage Systems Design Guide (2020)**

3.11 Essex County Council have published a comprehensive guide to illustrate the approach they would like to see in relation to surface water drainage design based on sustainable urban drainage principles. This document refers heavily to the CIRIA guidance noted above.

**Tendring District Council Strategic Flood Risk Assessment (March 2009)**

3.12 JBA produced a Strategic Food Risk Assessment for Tendering District Council in 2009 to cover the district. This document provides a strategic assessment of historic and possible future flood risks across the district. This documents aims to guide development to suitably consider flood risk by sharing the information gathered about the district.

### Tendring District Council Strategic Flood Risk Assessment Addendum (September 2017)

3.13 The Essex Flood Services Team within Essex Place Services produced a Strategic Flood Risk Addendum report for Tendring District Council in September 2017. This document, to be read in conjunction with the SFRA of March 2009, provides an update on the strategic assessment of historic and possible future flood risks across the district. Together, documents aim to guide development to suitably consider flood risk by sharing the information gathered about the district.

# 4 THE PROPOSED DEVELOPMENT

4.1 The illustrative layout plan for the proposal shows a 40 dwelling residential scheme on land to the north of Centenary Way, Clacton. The proposed site layout plan is contained in **Appendix C** of this report.

4.2 The residential dwellings would vary in size between 2 and 3 bedroom bungalows. Out of the 40 dwellings, 28 would be 3 bedroom bungalows and 12 would be 2 bedroom bungalows.

4.3 Whilst the whole site has an area of 2.4ha, consulting the architect's layout it is possible to calculate that approximately 0.99ha would be impermeable. The impermeable area accounts for the buildings, driveways and roads planned on the site.

4.4 Micro Drainage has been used to calculate the greenfield runoff associated with the site. Given the impermeable site area of 0.99ha, the rates shown in **Table 4.1** were calculated for the 1, 30 and 100 year storm events. Refer to **Appendix D** for the Micro Drainage print out of this.

**Table 4.1 Greenfield Runoff Rates**

| Storm Event | Discharge (l/s) |
|---|---|
| $Q_1$ | 2.9 |
| $Q_{30}$ | 7.7 |
| $Q_{100}$ | 10.9 |

4.5 Vehicular / pedestrian access to the site would be achieved via a new access located off Thorpe Road. The junction would be located approximately midway between the access junction to the Booker cash and carry site and the access junction to the housing development to the north.

4.6 No significant ground remodelling works are proposed. Smaller scale localised earth moving may be required to provide for SuDS, and to accommodate drainage, which would be required at this site.

# 5 DRAINAGE STRATEGY

### Surface Water Drainage

5.1 The hierarchy of disposal methods identifies that discharge to the ground is the first choice, followed by discharge to a watercourse and to a sewer as the third choice. Soakaway tests to BRE Digest 365 were undertaken in 2018 on the boundary of this site as part of the adjacent development. These tests showed that the ground is unsuitable for infiltration with infiltration rates being incalculable. The data available on the British Geological Survey (BGS) website also confirms clay soils which would corroborate the findings of these tests. The nearest ordinary watercourse is located 750m to the east of the site beyond residential properties located on Thorpe Road.

5.2 It is therefore proposed to drain the roofs of each dwelling and the roads to buried cellular attenuation tanks. The cells would accommodate the run-off from all storm events up to a 1 in 100 year + 40% climate change. The 1 in 1 year greenfield run off from the site has been calculated to be 2.9/s, see **Table 4.1**.

5.3 The impermeable area of the proposed site has been calculated, each dwelling, plus 10% urban creep allowance, and road area has been considered which gives an area of 1.032ha. The catchment would drain to a high strength buried cellular attenuation tank with a vortex flow control device such as a Hydro Brake controlling the outflow to 3l/s from the tank. The outflow discharged to the Anglian Water public surface water sewer adjacent to the site. A Vortex device is proposed as they are able to limit water to lower rates and are less prone to blockages than, say, an orifice device would be.

5.4 The proposed tank and Hydro Brake arrangement has been analysed and sized using Microdrainage. The tanks have been located to the eastern side of the site to be on the lower side of the development and adjacent to the Anglian Water surface water sewer. The results from Micro Drainage have been included in **Appendix E.**

5.5 The tested storms represent the greatest demand for storage volume. It can be seen from these calculations that for a 1 in 100 year storm + 40% the half drain time of 24 hours has not been achieved but the storage capacity in order to prevent flooding for all storms up to and including the 1 in 100 year storm return period + 40% has been provided. However, further analysis has been undertaken with a 1 in 30 year storm + 40% climate change allowance and a 1 in 10 year storm return period. Reviewing the graphs for the 1 in 30 year storm + 40 % the volume of storm water remaining in the tank 24 hours after the peak is 578m$^3$. From the graph for the 1 in 10 year storm the peak of volume can be seen at 286.m$^3$. Therefore, an additional storage volume for these 2 consecutive storms of 112 m$^3$ is required. This additional storage is proposed as surface depression above the buried crates.

5.6 An indicative drainage layout has been proposed on drawing **IT2126/DS/002RevF** included in the drawings section of this report.

5.7 In exceedance events, the 1 in 100 year + 40 % climate change storm, surface water would surcharge the attenuation tank. However, the FFLs of the dwellings would be set above the external levels of the gardens, flooding of the buildings would not occur. Exceedance paths would be routed away from buildings and towards the south-east end of the development.

### Water Quality

5.8 The measures described should provide an adequate level of quality as well as providing a SuDS compliant scheme. Consideration of water quality treatment is given below. The proposed access road into the development would be expected to experience low traffic levels.

5.9 Consulting the CIRIA SuDS Manual 2015 **Table 26.2** gives pollution hazard indices for different land use classifications. An extract of the table is reproduced in **Table 5.1** showing the relevant pollution hazard indices for this development:

**Table 5.1 Extract of CIRIA SuDS Manual (Table 26.2 on Predicted Pollution Levels)**

| Land Use | Pollution hazard level | Total Suspended Solids (TSS) | Metals | Hydrocarbons |
|---|---|---|---|---|
| Residential roofs | Very low | 0.2 | 0.2 | 0.05 |
| Driveways, low traffic roads (<300 movements/day) | Low | 0.5 | 0.4 | 0.4 |

5.10 The same CIRIA SuDS Manual continues in **Table 26.3** to give a brief overview of the expected level of treatment various SuDS measure are expected to generate. An extract of this table is reproduced in **Table 5.2**.

**Table 5.2: Extract of CIRIA SuDS Manual 2015 Table 26.3 on Predicted Water Quality Improvement of SuDS**

| Type of SuDS component | Total Suspended Solids (TSS) | Metals | Hydrocarbons |
|---|---|---|---|
| 'Storm Shark' (manufacturers provided indices) | 0.5 | 0.4 | 0.8 |

5.11 It is noted from the **Table 5.2** above that the 'Storm Shark' or similar approved device would be sufficient to remove total suspended solids, metals and hydrocarbons from the roads and proposed roofs. This should be considered adequate to improve the quality of runoff.

5.12 A preliminary drainage design has been undertaken for the proposed development and is illustrated on Drawing **IT2126/DS/002RevF**.

### Foul Drainage

5.13 AWS indicates that the foul public sewers are located approximately 60m to the south-east of the site. Given the distances from the site to the nearest public sewer and the topography and proposed layout of the site, pumping would be required. Given the clearance requirements of 15m from a dwelling to a foul pump station and the space available on the proposed site the foul pump has been located in the south-west corner of the site.

5.14 It is proposed that the foul would gravitate from each dwelling to the pump station and a rising main from the pump station would cross the site to make a connection off site to the Anglian Water public sewer. This schematic layout is shown on Drawing **IT2126/DS/002RevF.**

### Approvals

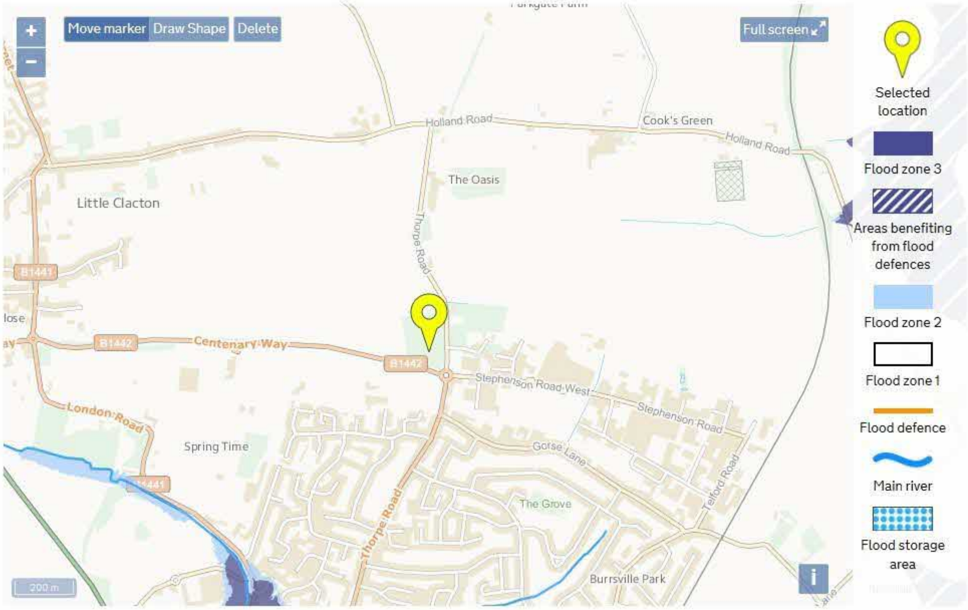
5.15 AWS formal agreement would be required for any connections to their existing Foul and Surface Water sewers Under Section 106 of the Water Industry Act 1991. If any sewers are to be offered up for adoption these would be made under a Section 104 agreement of the same Act. Both the S106 and S104 applications should be made direct to Anglian Water and would attract fees. Adequate time should be allowed in advance of construction to allow the applications to be considered and determined by AWS. ITL would suggest that at least six months is programmed for these activities.

# 6 RISK APPRAISAL

## Flood Risk

6.1 The site is located outside any identified flood plain and is therefore situated in a Flood Zone 1 area, the lowest classification. There are no flood contours shown on the gov.uk Flood Planning Service published web site, an extract of which is provided in **Figure 6.1** below, and shows that there is no likelihood of fluvial (river based) or sea based flooding. Therefore, there is no risk to the development, or the future occupants, arising from fluvial or coastal flooding for any storm up to and including a 1 in 1000 year storm event.

**Figure 6.1 Fluvial / Coastal Flood Risk Zones from gov.uk mapping**



6.2 The gov.uk maps also indicate the risk of surface water flooding. The mapping identifies that the majority of the site has very low flood risk related to surface flooding with the south east corner of the site being at low risk from surface water flooding. **Figure 6.2** is an extract from the gov.uk surface water flood map showing the location of the site in relation to flooding risk.

**Figure 6.2 Surface Water Flood Risk Zone from gov.uk mapping**


[redacted]

6.3 The gov.uk maps identify that the site is not at risk of flooding from a reservoir, as shown in **Figure 6.3.**

**Figure 6.3 Reservoir Water Flood Risk Zone from Gov.uk mapping**


[redacted]

6.4 Tendring District Council Strategic Flood Risk Assessment Addendum (September 2017), gives groundwater flooding maps in Appendix 10. This map indicates that the site is in an area with a <25% probability of flooding due to groundwater.

6.5 The NPPF emphasises that development should be located in the least vulnerable places and that Local Plans should look to the Strategic Flood Risk Assessments (SFRAs) to inform the process and help with the sequential test. Clearly, the site would be unlikely to suffer from fluvial / coastal flooding even for a 1 in 1000 year event. In planning policy terms it can be asserted that the site would be compliant with national policy and local policies in terms of its location from a flood risk perspective.

6.6 As the proposed development is not at risk from fluvial, coastal, pluvial, groundwater or sewer flooding, the main purpose of this assessment is to consider the management of surface water run-off and to ensure that the impact of the development does not affect downstream interests and / or properties. The drainage strategy set out in the previous chapter and shown on drawing **IT2126/DS/002RevF** illustrates how the surface water could be managed on site to prevent flooding within or downstream of the site for storms events of up to and including the 1 in 100 year event with a 40% allowance for climate change.

6.7 Based upon the review and conceptual drainage strategy the risk of flooding either on site or downstream of the site would be negligible.

# 7 MANAGMEMENT & MAINTENACE PLAN

## 7.1 Maintenance Schedule

Maintenance of the drainage system would be carried out by the current developer (LPB Homes) (or any successor management company for the development as appropriate) or their appointed sub-contractor(s). Inspections would initially be funded by the developer but, as land is transferred with house completions, responsibility may be passed to a residents' management company. **Table 7.1** sets out the list of activities and regular inspections that are proposed to ensure that the surface water system is maintained in good working order.

**Table 7.1 Maintenance Schedule – Drainage System**

| | Actions | Plan of Action | Frequency |
|---|---|---|---|
| 1 | **Manholes** | | |
| a | Inspection | Inspection to include manholes, catch pits and silt trap / gullies outlets. To be inspected for debris and integrity of chambers and covers. | 2 Yearly |
| b | Silt Removal | To be monitored and cleaned up when any debris / silt reduces the cross-sectional area of outflowing pipes by 25% or more. | As Required |
| c | Informative | Any man-entry into manholes should be by trained personnel with adequate personal protective equipment.<br>Approved safety procedures must be followed. | |
| 2 | **Attenuation Tanks** | | |
| a | Inspection | Check inlet and any inspection points for sediment build up and vegetation growth. | 2 Yearly |
| b | Sediment removal | Remove sediment from inlet and any other accessible points if required. | As Required |
| 3 | **Flow Control Devices** | | |
| | Inspection | Check free from debris and operating correctly | Quarterly |
| | **Pump Station** | | |
| 4 | Inspection | Inspection and servicing by a suitably qualified contractor | Bi annual or as recommended by the manufacturer |
| | **Storm Shark Water Treatment Device** | | |
| **5** | Waste removal | Removal of any silt or hydrocarbon accumulations | As recommended by the manufacturer |

# 8 CONCLUSIONS

8.1 Intermodal Transportation Ltd (ITL) has been commissioned by LPB Homes to prepare a Drainage Strategy and FRA report in support of a planning application for a development of 40 dwellings at the south corner of Foots Farm, Thorpe Road, Clacton-on-Sea, Essex.

8.2 This report considers the flood risk issues arising from the proposals for residential development on the application site. In this report the requirements of the guidance embodied within the NPPF Framework have been considered.

8.3 The site is currently entirely 'greenfield'. The whole application site extends to approximately 2.4 hectares. The impermeable area of the site, including an urban creep allowance, has been calculated to be 1.03ha. The 1 in 1 year greenfield runoff rate has been calculated to be 2.9/s.

8.4 Where possible discharge of surface water runoff to ground is the preferred method of disposal, followed by controlled discharge to a watercourse with discharge to a piped system being the least favoured method. The evidence available shows that, in this case, the ground is not suitable for the use of infiltration as a method for the disposal of surface water drainage.

8.5 The proposed impermeable areas have been considered with an additional 10% allowance for urban creep applied to buildings. It has been proposed that the catchment would have a high strength buried cellular attenuation tank with a hydrobrake controlling the outflow to 3l/s. The outflows from the tank would be discharged to the adjacent public surface water sewer. The attenuation tank has been sized for the 1 in 100-year storm + 40% climate change allowance. Given the slow half drain time additional surface storage has been provided to account for a 1 in 30 year storm +40% followed by a 1 in 10 year storm.

8.6 Surface Water cleansing would be achieved to the required levels set out in the CIRIA SuDs Manual by using a storm shark downstream of the attenuation tank.

8.7 Foul drainage of the development would be achieved by a gravity sewer serving each plot and draining to a pump station located in the south-west corner of the site. A rising main is proposed from this pump station discharging to an AWS public sewer approximately 60 m to the south-east of the site is proposed.

8.8 AWS agreement would be required for any connections to their existing foul and surface water sewers Under Section 106 of the Water Industry Act 1991. If any sewers are to be offered up for adoption these would be made under a Section 104 agreement of the same Act. Both the S106 and S104 applications should be made direct to AWS and would attract fees.

8.9 The site is outside any identified flood plain and is thereby situated in a Flood Zone 1 area, the lowest classification. The flooding information shown on the gov.uk Flood Planning Service published web site confirms that the area local to the site is not at risk from flooding. Therefore, there is little risk to the development, or the future occupants, arising from fluvial or coastal flooding for any storm up to and including a 1 in 1000 year storm event.

8.10 The gov.uk website also shows that the development site is at low risk of flooding from surface water and reservoirs.

8.11 Tendring District Council Strategic Flood Risk Assessment Addendum (September 2017), indicates that the site is in an area with a <25% probability of flooding due to groundwater. Also, local information indicates that the ground is impermeable. Therefore, for this site the risk from groundwater flooding is considered to be low. With no sewers under the site, they do not present a flood risk either.

8.12 The drainage assessment that has been carried out demonstrates that the site is suitable for residential development in drainage terms, based upon reasonable assumptions. It is expected that further detailed modelling work would be required at the post-planning consent stage, but it can be confidently stated that a drainage scheme could be developed that would not create any flooding off site for the worst case 1 in 100 year + 40% climate change probability event and is a sustainable system for this site.

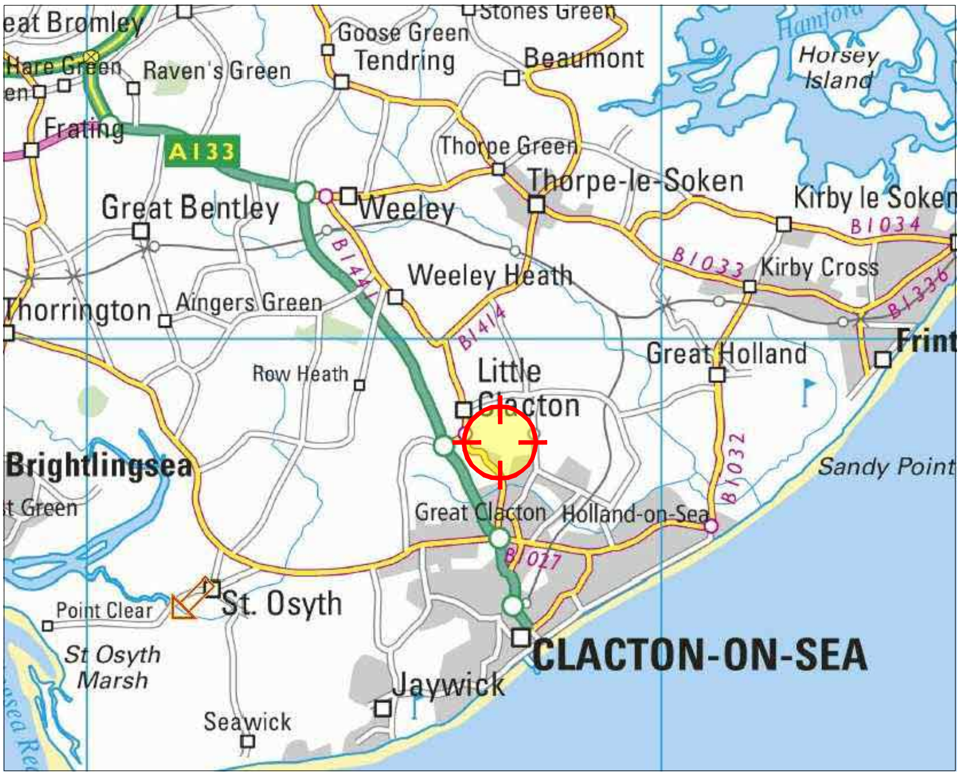
8.13 Hence, it can be concluded that there would be no flood risk affecting property or the welfare of residents and the public arising from the development of the site and that surface water discharge from the development can be adequately managed to ensure no additional risk of flooding both on site and off site, even under extreme conditions. Sufficient details have been provided to satisfy the requirements of the policy guidance and with the imposition of a suitable planning condition the Local Lead Flood Authority and Water Authority’s interests can be protected pending final detailed design and subsequent discharge of the condition.

8.14 It is therefore concluded that the development site is not at risk to fluvial, coastal or pluvial flooding and the development proposal is able to be drained satisfactorily. It is therefore considered that from a critical drainage perspective the development proposal should not be denied planning consent.

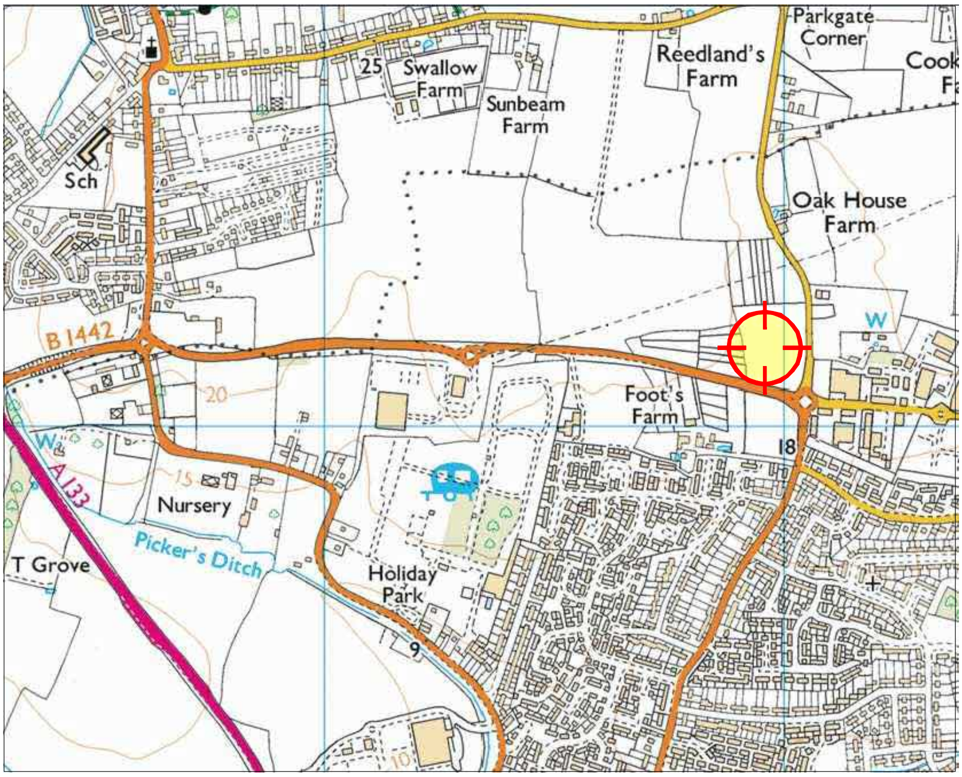
# Drawings

N

# WIDER CONTEXT



# LOCAL CONTEXT



⊕ SITE LOCATION

Rev | Description | Date

IT Project:
PROPOSED RESIDENTIAL DEVELOPMENT, SOUTH CORNER FOOTS FARM, CLACTON

Rev:
-

Drawing Title:
SITE LOCATION IN THE LOCAL AND WIDER CONTEXT

Sheet 1 of 1

Client:
LPB HOMES

Drawn By:
DS

Approved By:
JB

Drawing No:
IT2126/DS/001

CAD File:
IT2126_TA_01.DWG

A4

Notes:
Dimensions should not be scaled from this drawing. The contents of this drawing are confidential, should you receive this drawing in error please return it to Intermodal Transportation at the address printed.

Date:
MARCH 2020

Scale:
NTS

Intermodal
TRANSPORTATION
Hunters Court
Debden Road
Saffron Walden
Essex CB11 4AA

Tel: [redacted]
Fax: [redacted]
e: [redacted]

Proposed main section of cellular attenuation tank
IL - 16.50
(main section = 56.5m x 8.5m x 0.8m)

Proposed cellular attenuation tank - side section to fit around proposed landscaping
IL - 16.50
(side section plan area of 84.5m$^2$)

300-400mm depressions to be provided above each tank, in the landscaping areas, to allow for 1 in 30 + 40% CC allowance followed by a 1 in 10 year storm. Side slopes to be 1 in 3.

Proposed main southern cellular attenuation tank
IL - 16.50
main section(28.5m x 10m x 0.8m)

Proposed side southern cellular attenuation tank, to fit around proposed landscaping
IL - 16.50
plan area 149m$^2$

Hydrobrake
discharge rate - 3l/s
0.8m head

'Stormshark' water treatment unit

Existing MH
CL 18.52
IL 15.94

15m exclusion zone around pumping station from habitable buildings

Foul rising main to discharge to existing Anglian Water foul sewer

Existing MH
CL 17.25
IL 15.50

DRAINAGE STRATEGY ONLY: NOT FOR CONSTRUCTION

Key:

- -·-·- Proposed FW Sewer
- — — Proposed SW Sewer
- — — Existing Anglian Water SW Sewer
- /-/-/ Proposed foul rising main
- ➡ Exceedance route
- ▨ Proposed foul pumping station

Drawing Title:
DRAINAGE STRATEGY

Rev:
F

| Rev | Description | Reviewer | Date |
|---|---|---|---|
| F | Layout Plan Updated | DS | 02.02.24 |
| E | Amended tank layout to suit planting | RW | 30.01.24 |
| D | Amended to suit new layout | RW | 23.01.24 |
| C | Amended to suit new layout | LS | 19.12.23 |
| B | Amended to suit new layout | LS | 03.08.21 |

IT Project:
SOUTH CORNER FOOTS FARM, THORPE ROAD, CLACTON ON SEA
Sheet 1 of 1

Client:
LPB HOMES

A2

Drawing No:
IT2126DS/002

CAD File:
IT2126_DS_Series Rev F.dwg

Date:
MAR 2020

Scale:
1:500

Drawn by:
AS

Approved by:
PM

Notes:
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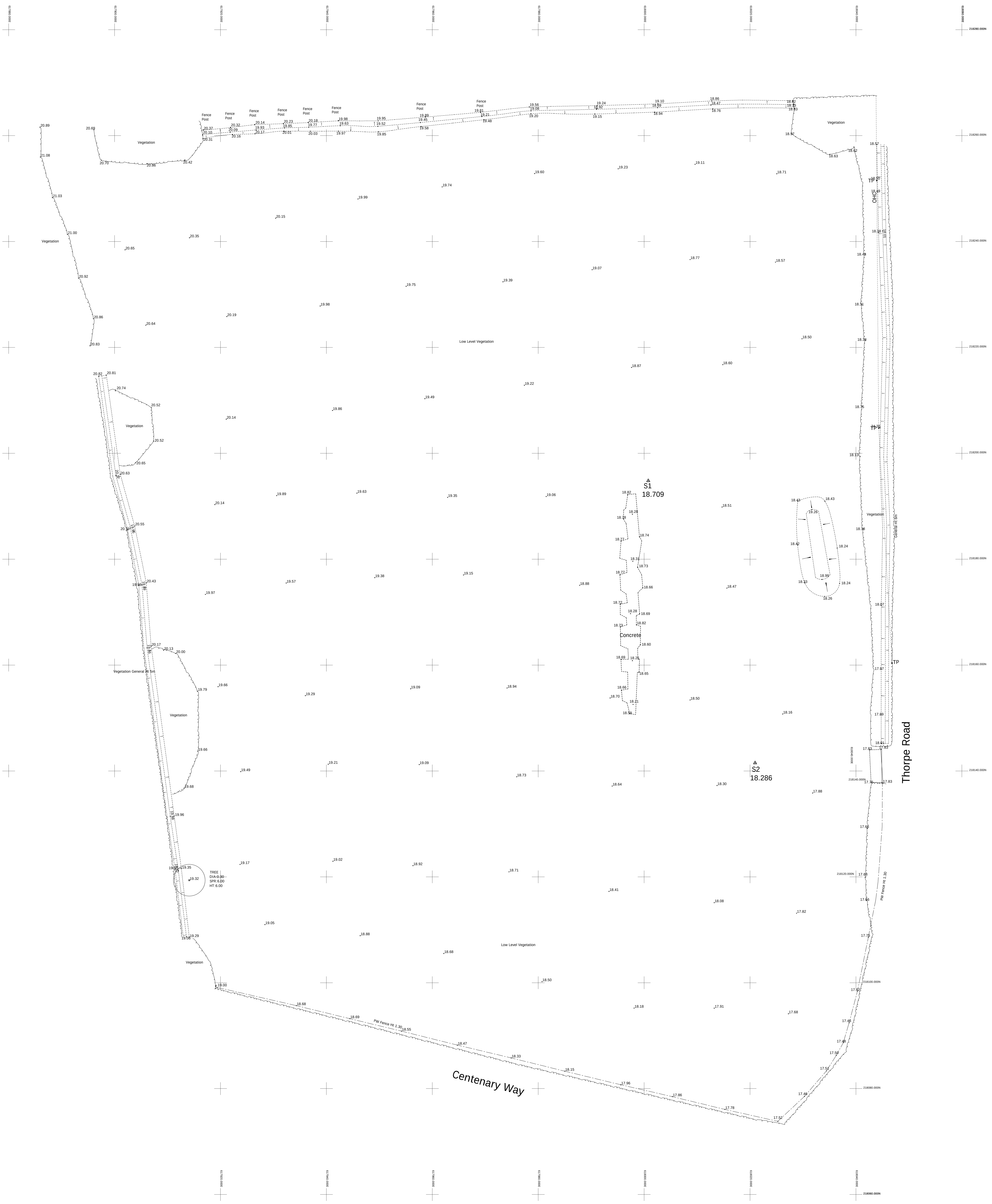
# Appendix A

## TOPOGRAPHICAL SURVEY



| rev | date | by | description |
|---|---|---|---|

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client: LPB Homes

project:
South Corner
Foots Farm, Thorpe Road
Clacton on Sea

drawing title: Topographical Survey

scale: 1:250@A0 1:500@A2
drawn by: CLS
date: 17/06/2019
checked: -
drawing no: 1546/01
revisions:

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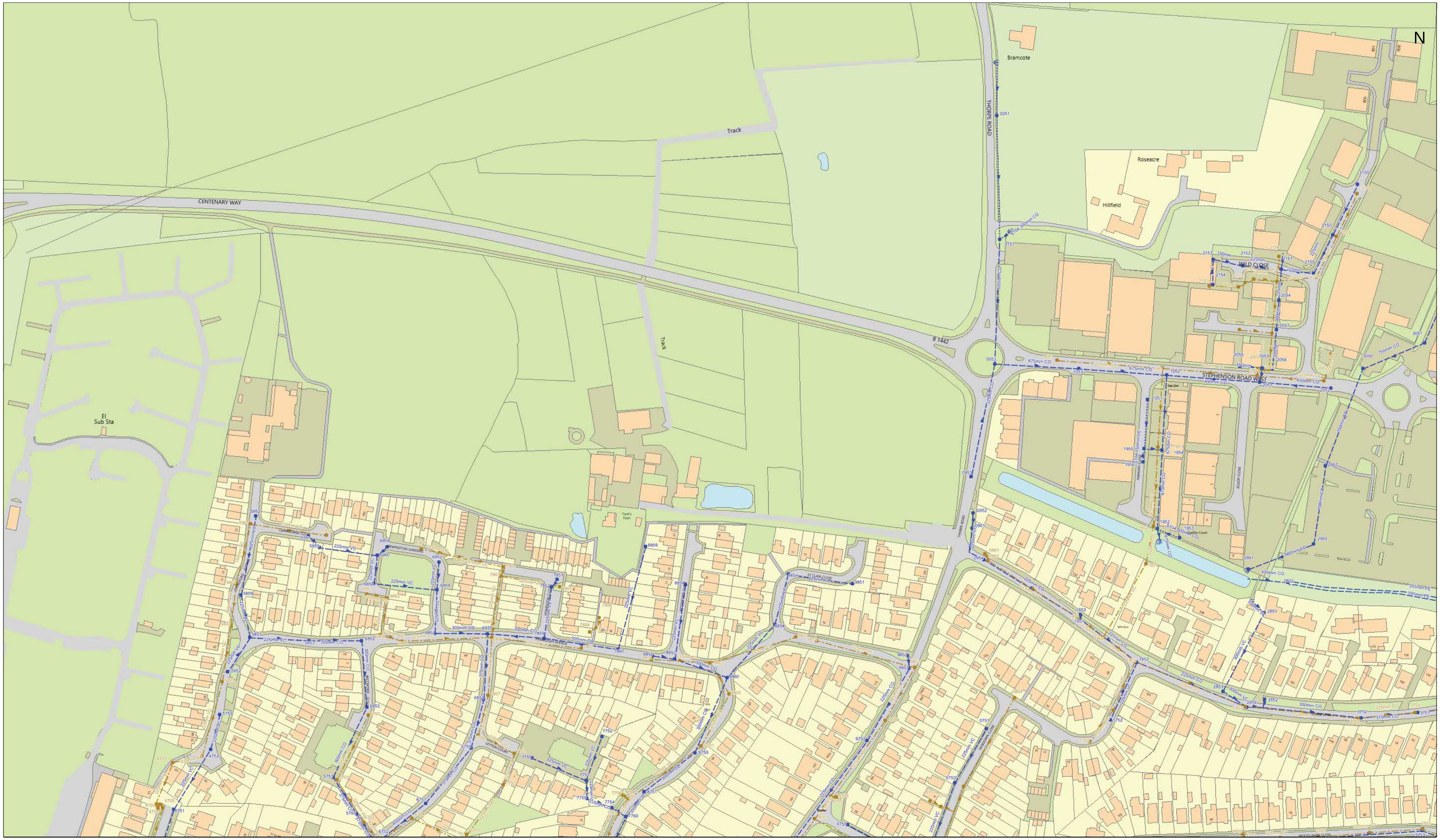
A0
SHEET

# Appendix B

## ANGLIAN WATER ASSET PLAN



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Date: 26/10/17 Scale: 1:2500 Map Centre: 617858,218009 Title: G2271946-3

COMMERCIALDW
DRAINAGE AND WATER ENQUIRY

Foul Sewer
Surface Sewer
Combined Sewer
Final Effluent

Decommissioned Sewer (colour denotes effluent type)
Private Sewer (colour denotes effluent type)
Rising Main (colour denotes effluent type)

● Manhole (colour denotes effluent type)
Public Pumping Station
Private Pumping Station
Decommissioned Pumping Station

🟥 Public Sewage Treatment Works
▨ Private Sewage Treatment Works
Outfall
Inlet

GEODESYS
Land and property information

This plan is provided by Anglian Water pursuant its obligations under the Water Industry Act 1991 sections 198 or 199. It must be used in conjunction with any search results attached. The information on this plan is based on data currently recorded but position must be regarded as approximate. Service pipes, private sewers and drains are generally not shown. Users of this map are strongly advised to commission their own survey of the area shown on the plan before carrying out any works. The actual position of all apparatus MUST be established by trial holes. No liability whatsoever, including liability for negligence, is accepted by Anglian Water for any error or inaccuracy or omission, including the failure to accurately record, or record at all, the location of any water main, discharge pipe, sewer or disposal main or any item of apparatus. This information is valid for the date printed. This plan is produced by Anglian Water Services Limited (c) Crown copyright and database rights 2017 Ordnance Survey 100022432.This map is to be used for the purposes of viewing the location of Anglian Water plant only. Any other uses of the map data or further copies is not permitted. This notice is not intended to exclude or restrict liability for death or personal injury resulting from negligence.

| Manhole Reference | Liquid Type | Cover Level | Invert Level | Depth to Invert |
|---|---|---|---|---|
| 0001 | F | 16.91 | 16.26 | 0.65 |
| 0701 | F | 16.065 | 14.715 | 1.35 |
| 0702 | F | - | - | - |
| 0703 | F | - | - | - |
| 0801 | F | 16.828 | 15.928 | 0.9 |
| 0901 | F | - | 17.3 | - |
| 0902 | F | 17.08 | 15.35 | 1.73 |
| 1001 | F | 17.8 | 15.95 | 1.85 |
| 1702 | F | 16.503 | 15.083 | 1.42 |
| 1801 | F | 16.16 | 14.17 | 1.99 |
| 1802 | F | 16.209 | 14.039 | 2.17 |
| 1803 | F | 15.906 | 13.876 | 2.03 |
| 1804 | F | 16.252 | 14.662 | 1.59 |
| 1901 | F | 15.6 | 14.57 | 1.03 |
| 1902 | F | 15.75 | 14.71 | 1.04 |
| 1903 | F | 17.3 | 15.33 | 1.97 |
| 2001 | F | 18.23 | 16.7 | 1.53 |
| 2002 | F | 18.49 | 17.15 | 1.34 |
| 2003 | F | - | - | - |
| 2004 | F | - | - | - |
| 2005 | F | - | - | - |
| 2006 | F | - | - | - |
| 2007 | F | - | - | - |
| 2100 | F | - | - | - |
| 2101 | F | - | - | - |
| 2102 | F | - | - | - |
| 2103 | F | - | - | - |
| 2104 | F | - | - | - |
| 2105 | F | - | - | - |
| 2106 | F | - | - | - |
| 2702 | F | 16.03 | 14.635 | 1.395 |
| 2703 | F | 15.676 | 14.316 | 1.36 |
| 2801 | F | 15.553 | 13.393 | 2.16 |
| 3100 | F | - | - | - |
| 3701 | F | 14.274 | 12.284 | 1.99 |
| 3702 | F | 14.802 | 12.652 | 2.15 |
| 3703 | F | 15.27 | 13.9 | 1.37 |
| 4701 | F | 15.577 | 14.077 | 1.5 |
| 4702 | F | 15.436 | 13.836 | 1.6 |
| 4703 | F | 15.325 | 13.715 | 1.61 |
| 4705 | F | 15.205 | 13.655 | 1.55 |
| 4707 | F | - | - | - |
| 5701 | F | 14.079 | 12.709 | 1.37 |
| 5801 | F | 16.766 | 15.126 | 1.64 |
| 5802 | F | 16.576 | 14.616 | 1.96 |
| 5803 | F | 16.084 | 14.384 | 1.7 |
| 5901 | F | 17.601 | 15.531 | 2.07 |
| 5902 | F | 17.396 | 16.476 | 0.92 |
| 6701 | F | 14.907 | 13.467 | 1.44 |
| 6702 | F | 13.867 | 12.467 | 1.4 |
| 6704 | F | 13.938 | 12.278 | 1.66 |
| 6706 | F | 14.63 | 12.333 | 2.297 |
| 6707 | F | - | - | 2.485 |
| 6801 | F | 16.868 | 15.418 | 1.45 |
| 6802 | F | 16.813 | 15.83 | 0.983 |
| 6804 | F | 15.977 | 14.247 | 1.73 |
| 6805 | F | 15.468 | 13.058 | 2.41 |
| 6806 | F | 15.296 | 12.616 | 2.68 |
| 6807 | F | 14.862 | 12.462 | 2.4 |
| 6808 | F | 16.233 | 14.443 | 1.79 |
| 6901 | F | 17.333 | 15.873 | 1.46 |
| 6902 | F | 17.125 | 15.235 | 1.89 |
| 7701 | F | 13.94 | 12.26 | 1.68 |
| 7702 | F | 13.727 | 12.097 | 1.63 |
| 7704 | F | 13.068 | 11.758 | 1.31 |
| 7705 | F | 12.745 | 11.595 | 1.15 |
| 7706 | F | 13.244 | 11.934 | 1.31 |
| 7801 | F | 16.001 | 13.801 | 2.2 |
| 7802 | F | 14.736 | 12.826 | 1.91 |
| 7803 | F | 16.381 | 13.511 | 2.87 |
| 7804 | F | - | - | - |
| 7805 | F | - | - | - |
| 7806 | F | - | - | - |
| 7807 | F | - | - | - |
| 7901 | F | 16.394 | 14.646 | 1.748 |
| 8701 | F | 14.692 | 12.042 | 2.65 |
| 8801 | F | 15.23 | 13.24 | 1.99 |
| 8802 | F | 16.048 | 12.808 | 3.24 |
| 8803 | F | 15.777 | 12.687 | 3.09 |
| 9701 | F | 14.615 | 12.495 | 2.12 |
| 9703 | F | 15.234 | 14.23 | 1.004 |
| 9704 | F | 16.495 | 13.475 | 3.02 |
| 9705 | F | 15.171 | 12.921 | 2.25 |
| 9801 | F | 17.431 | 13.951 | 3.48 |
| 9802 | F | 17.464 | 14.714 | 2.75 |
| 9803 | F | 17.496 | 15.086 | 2.41 |
| 0051 | S | 17.25 | 15.5 | 1.75 |
| 0151 | S | 18.12 | 15.94 | 2.18 |
| 0251 | S | - | - | - |
| 0751 | S | 16.56 | 15.74 | 0.82 |
| 0752 | S | 15.987 | 15.147 | 0.84 |
| 0951 | S | 17.737 | - | - |
| 0952 | S | 17.649 | 15.679 | 1.97 |
| 0953 | S | 17.688 | 16.238 | 1.45 |
| 0954 | S | 17.152 | 14.982 | 2.17 |
| 1051 | S | - | - | - |
| 1052 | S | 17.8 | 15 | 2.8 |
| 1053 | S | 17.25 | 15.25 | 2 |
| 1752 | S | 16.397 | 14.977 | 1.42 |
| 1851 | S | 16.167 | 13.827 | 2.34 |
| 1852 | S | 15.898 | 13.478 | 2.42 |
| 1853 | S | 16.164 | 15.234 | 0.93 |
| 1952 | S | 15.75 | 13.94 | 1.81 |
| 1953 | S | - | - | - |
| 1954 | S | 17.3 | 14.47 | 2.83 |
| 1955 | S | - | - | 2.1 |
| 1956 | S | - | - | - |
| 2051 | S | 18.25 | 16.01 | 2.24 |
| 2052 | S | 18.5 | 16.57 | 1.93 |
| 2053 | S | - | - | - |
| 2054 | S | - | - | - |
| 2055 | S | - | - | - |
| 2056 | S | - | - | - |
| 2057 | S | - | - | - |
| 2150 | S | - | - | - |
| 2151 | S | - | - | - |
| 2152 | S | - | - | - |
| 2153 | S | - | - | - |
| 2154 | S | - | - | - |
| 2155 | S | - | - | - |
| 2802 | S | - | - | - |
| 2851 | S | 15.329 | 13.709 | 1.62 |
| 2852 | S | 15.488 | 13.818 | 1.67 |
| 2853 | S | 15.605 | 13.265 | 2.34 |
| 2856 | S | 15.518 | 12.948 | 2.57 |
| 2950 | S | - | - | - |
| 2951 | S | - | - | - |
| 2952 | S | - | - | - |
| 3050 | S | - | - | - |
| 3051 | S | - | - | - |
| 3150 | S | - | - | - |
| 3751 | S | 14.253 | 11.713 | 2.54 |
| 3752 | S | 14.774 | 12.134 | 2.64 |
| 3753 | S | 15.291 | 13.871 | 1.42 |
| 4751 | S | 15.179 | 13.849 | 1.33 |
| 4752 | S | 15.625 | 14.355 | 1.27 |
| 5751 | S | 14.085 | 12.885 | 1.2 |
| 5759 | S | 15.85 | 14.56 | 1.29 |
| 5760 | S | 13.962 | 12.522 | 1.44 |
| 5851 | S | 16.191 | 14.671 | 1.52 |
| 5852 | S | 16.085 | 14.865 | 1.22 |
| 5853 | S | 15.661 | 14.231 | 1.43 |
| 5859 | S | 16.823 | 14.893 | 1.93 |
| 5951 | S | 17.309 | 16.479 | 0.83 |

| Manhole Reference | Liquid Type | Cover Level | Invert Level | Depth to Invert |
|---|---|---|---|---|
| 5952 | S | 17.721 | 16.161 | 1.56 |
| 5959 | S | 17.269 | 16.169 | 1.1 |
| 6751 | S | 14.058 | 11.468 | 2.59 |
| 6759 | S | 14.531 | 12.361 | 2.17 |
| 6851 | S | 15.706 | 13.906 | 1.8 |
| 6852 | S | 15.99 | 14.18 | 1.81 |
| 6853 | S | 15.049 | 13.659 | 1.39 |
| 6854 | S | 14.857 | 12.927 | 1.93 |
| 6855 | S | 15.309 | 13.379 | 1.93 |
| 6856 | S | 16.792 | 15.452 | 1.34 |
| 6859 | S | 16.41 | 15.01 | 1.4 |
| 6952 | S | 16.887 | 15.607 | 1.28 |
| 6959 | S | 17.388 | 15.738 | 1.65 |
| 6960 | S | 17.245 | 15.545 | 1.7 |
| 7751 | S | 13.364 | 12.144 | 1.22 |
| 7752 | S | 13.804 | 12.424 | 1.38 |
| 7754 | S | 13.013 | 11.543 | 1.47 |
| 7755 | S | - | - | - |
| 7759 | S | 13.78 | 12.65 | 1.13 |
| 7760 | S | 12.867 | 11.277 | 1.59 |
| 7851 | S | 15.976 | 14.416 | 1.56 |
| 7852 | S | 15.877 | 14.297 | 1.58 |
| 7859 | S | 14.988 | 13.798 | 1.19 |
| 7860 | S | 14.86 | 14.1 | 0.76 |
| 8751 | S | 13.294 | 11.694 | 1.6 |
| 8759 | S | 14.499 | 12.629 | 1.87 |
| 8851 | S | 15.244 | 13.894 | 1.35 |
| 8852 | S | 15.569 | 13.629 | 1.94 |
| 8854 | S | 17.305 | 14.535 | 2.77 |
| 8859 | S | 16.498 | 15.148 | 1.35 |
| 8860 | S | 16.127 | 13.397 | 2.73 |
| 8959 | S | 16.616 | 15.706 | 0.91 |
| 9752 | S | 16.166 | 14.596 | 1.57 |
| 9759 | S | 14.907 | 14.117 | 0.79 |
| 9851 | S | 17.928 | 15.338 | 2.59 |
| 9852 | S | 17.621 | 16.861 | 0.76 |
| 9853 | S | 17.415 | 15.955 | 1.46 |
| 9854 | S | 17.528 | 14.828 | 2.7 |

| Manhole Reference | Liquid Type | Cover Level | Invert Level | Depth to Invert |
|---|---|---|---|---|

| Manhole Reference | Liquid Type | Cover Level | Invert Level | Depth to Invert |
|---|---|---|---|---|

# Appendix C

## ARCHITECT’S LAYOUT DRAWING

JCN DESIGN & PLANNING

**Accommodation Schedule**

| No | Name | Ref | Beds | Storey | Type | ft² |
|---|---|---|---|---|---|---|
| 12 | Type A | A | 2B3P | 1 | Bungalow | 730 |
| 15 | Type B | B | 3B4P | 1 | Bungalow | 884 |
| 12 | Type C | C | 3B6P | 1 | Bungalow | 1189 |
| 1 | Type D | D | 3B5P | 1 | Bungalow | 1075 |
| **40** | | | | | | |

**Surface Finishes**

| | |
|---|---|
| | Front Grass |
| | Rear Grass |
| | Public Realm |
| 🟥 | Feature Paved Space |
| ▨ | Block Paving |
| ▨ | Tegular Paving Pennant Grey |
| ▦ | Access Path |
| ■ | Road |
| ■ | Footpath |
| ▦ | 1.2m Wide Hoggin Path |
| ● | Existing trees, hedges to be retained |
| 🟩 | EXISTING NATIVE HEDGES TO BE RETAINED |
| ⊕ | Proposed Standard Trees<br>Diameter of circle shows width of tree canopy at maturity |
| 🟩 | Proposed ornamental hedge |
| ▨ | Proposed native hedge & whip planting<br>Hedges planted planted in rows at 400mm centres, most hedgaes double staggered row. Whips planted at 1m centres. |
| ▨ | Proposed Shrubs |
| ▨ | Spring bulbs in grass |
| — | 1.2m High hoop topped railing with 2 pedestrian 0.9m wide gates and one 1.8m wide maintenance gate with pedestrian access. |

Project:-

Land at Foots Farm,
Thorpe Road,
Clacton on Sea,
Essex

Description:-

## Development Layout

| Date | Drawing Scale:- |
|---|---|
| Sept 2023 | 1-500 @ A1 |
| Drawing number:- | Revision:- |
| MA019-PL-02 | A |

www.jcndesign.co.uk

# Appendix D

## GREENFIELD RUNOFF CALCULATIONS

## ICP SUDS Mean Annual Flood

Input

| | | | | | |
|---|---|---|---|---|---|
| Return Period (years) | 1 | SAAR (mm) | 550 | Urban | 0.000 |
| Area (ha) | 1.030 | Soil | 0.450 | Region Number | Region 6 |

| **Results** | **l/s** |
|---|---|
| QBAR Rural | 3.4 |
| QBAR Urban | 3.4 |
| | |
| Q1 year | 2.9 |
| | |
| Q1 year | 2.9 |
| Q30 years | 7.7 |
| Q100 years | 10.9 |

# Appendix E

MICRO DRAINAGE CALCULATIONS

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

Half Drain Time : 2182 minutes.

| Storm Event | Max Level (m) | Max Depth (m) | Max Infiltration (l/s) | Max Control (l/s) | Max Σ Outflow (l/s) | Max Volume (m³) | Status |
|---|---|---|---|---|---|---|---|
| 15 min Summer | 16.767 | 0.267 | 0.0 | 3.0 | 3.0 | 251.1 | O K |
| 30 min Summer | 16.850 | 0.350 | 0.0 | 3.0 | 3.0 | 329.2 | O K |
| 60 min Summer | 16.936 | 0.436 | 0.0 | 3.0 | 3.0 | 410.1 | O K |
| 120 min Summer | 17.023 | 0.523 | 0.0 | 3.0 | 3.0 | 491.6 | O K |
| 180 min Summer | 17.071 | 0.571 | 0.0 | 3.0 | 3.0 | 537.4 | O K |
| 240 min Summer | 17.103 | 0.603 | 0.0 | 3.0 | 3.0 | 567.2 | O K |
| 360 min Summer | 17.143 | 0.643 | 0.0 | 3.0 | 3.0 | 604.4 | O K |
| 480 min Summer | 17.169 | 0.669 | 0.0 | 3.0 | 3.0 | 629.2 | O K |
| 600 min Summer | 17.187 | 0.687 | 0.0 | 3.0 | 3.0 | 645.8 | O K |
| 720 min Summer | 17.199 | 0.699 | 0.0 | 3.0 | 3.0 | 657.1 | O K |
| 960 min Summer | 17.212 | 0.712 | 0.0 | 3.0 | 3.0 | 669.5 | O K |
| 1440 min Summer | 17.214 | 0.714 | 0.0 | 3.0 | 3.0 | 671.4 | O K |
| 2160 min Summer | 17.193 | 0.693 | 0.0 | 3.0 | 3.0 | 651.8 | O K |
| 2880 min Summer | 17.171 | 0.671 | 0.0 | 3.0 | 3.0 | 630.6 | O K |
| 4320 min Summer | 17.125 | 0.625 | 0.0 | 3.0 | 3.0 | 587.9 | O K |
| 5760 min Summer | 17.080 | 0.580 | 0.0 | 3.0 | 3.0 | 545.7 | O K |
| 7200 min Summer | 17.035 | 0.535 | 0.0 | 3.0 | 3.0 | 503.2 | O K |
| 8640 min Summer | 16.985 | 0.485 | 0.0 | 3.0 | 3.0 | 456.2 | O K |

| Storm Event | Rain (mm/hr) | Flooded Volume (m³) | Discharge Volume (m³) | Time-Peak (mins) |
|---|---|---|---|---|
| 15 min Summer | 131.351 | 0.0 | 211.4 | 27 |
| 30 min Summer | 86.314 | 0.0 | 249.0 | 41 |
| 60 min Summer | 54.074 | 0.0 | 392.7 | 72 |
| 120 min Summer | 32.762 | 0.0 | 459.1 | 130 |
| 180 min Summer | 24.128 | 0.0 | 475.9 | 190 |
| 240 min Summer | 19.312 | 0.0 | 473.3 | 250 |
| 360 min Summer | 14.018 | 0.0 | 464.9 | 368 |
| 480 min Summer | 11.175 | 0.0 | 457.4 | 488 |
| 600 min Summer | 9.366 | 0.0 | 451.1 | 606 |
| 720 min Summer | 8.105 | 0.0 | 445.7 | 726 |
| 960 min Summer | 6.446 | 0.0 | 436.4 | 964 |
| 1440 min Summer | 4.660 | 0.0 | 421.5 | 1442 |
| 2160 min Summer | 3.364 | 0.0 | 878.6 | 1880 |
| 2880 min Summer | 2.667 | 0.0 | 863.0 | 2256 |
| 4320 min Summer | 1.920 | 0.0 | 784.9 | 3032 |
| 5760 min Summer | 1.519 | 0.0 | 1121.2 | 3872 |
| 7200 min Summer | 1.266 | 0.0 | 1166.8 | 4696 |
| 8640 min Summer | 1.090 | 0.0 | 1204.5 | 5456 |

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

| Storm Event | Max Level (m) | Max Depth (m) | Max Infiltration (l/s) | Max Control (l/s) | Max Σ Outflow (l/s) | Max Volume (m³) | Status |
|---|---|---|---|---|---|---|---|
| 10080 min Summer | 16.939 | 0.439 | 0.0 | 3.0 | 3.0 | 413.1 | O K |
| 15 min Winter | 16.799 | 0.299 | 0.0 | 3.0 | 3.0 | 281.5 | O K |
| 30 min Winter | 16.893 | 0.393 | 0.0 | 3.0 | 3.0 | 369.3 | O K |
| 60 min Winter | 16.989 | 0.489 | 0.0 | 3.0 | 3.0 | 460.3 | O K |
| 120 min Winter | 17.087 | 0.587 | 0.0 | 3.0 | 3.0 | 552.3 | O K |
| 180 min Winter | 17.142 | 0.642 | 0.0 | 3.0 | 3.0 | 603.9 | O K |
| 240 min Winter | 17.178 | 0.678 | 0.0 | 3.0 | 3.0 | 638.0 | O K |
| 360 min Winter | 17.224 | 0.724 | 0.0 | 3.0 | 3.0 | 680.9 | O K |
| 480 min Winter | 17.255 | 0.755 | 0.0 | 3.0 | 3.0 | 710.0 | O K |
| 600 min Winter | 17.276 | 0.776 | 0.0 | 3.0 | 3.0 | 730.1 | O K |
| 720 min Winter | 17.291 | 0.791 | 0.0 | 3.0 | 3.0 | 744.2 | O K |
| 960 min Winter | 17.310 | 0.810 | 0.0 | 3.0 | 3.0 | 761.1 | O K |
| 1440 min Winter | 17.323 | 0.823 | 0.0 | 3.0 | 3.0 | 769.5 | O K |
| 2160 min Winter | 17.300 | 0.800 | 0.0 | 3.0 | 3.0 | 752.7 | O K |
| 2880 min Winter | 17.269 | 0.769 | 0.0 | 3.0 | 3.0 | 723.5 | O K |
| 4320 min Winter | 17.212 | 0.712 | 0.0 | 3.0 | 3.0 | 669.5 | O K |
| 5760 min Winter | 17.150 | 0.650 | 0.0 | 3.0 | 3.0 | 611.4 | O K |
| 7200 min Winter | 17.087 | 0.587 | 0.0 | 3.0 | 3.0 | 552.0 | O K |
| 8640 min Winter | 17.019 | 0.519 | 0.0 | 3.0 | 3.0 | 487.9 | O K |

| Storm Event | Rain (mm/hr) | Flooded Volume (m³) | Discharge Volume (m³) | Time-Peak (mins) |
|---|---|---|---|---|
| 10080 min Summer | 0.961 | 0.0 | 1234.5 | 6248 |
| 15 min Winter | 131.351 | 0.0 | 230.7 | 27 |
| 30 min Winter | 86.314 | 0.0 | 252.4 | 41 |
| 60 min Winter | 54.074 | 0.0 | 434.0 | 70 |
| 120 min Winter | 32.762 | 0.0 | 478.6 | 128 |
| 180 min Winter | 24.128 | 0.0 | 474.2 | 188 |
| 240 min Winter | 19.312 | 0.0 | 469.1 | 246 |
| 360 min Winter | 14.018 | 0.0 | 461.8 | 362 |
| 480 min Winter | 11.175 | 0.0 | 456.9 | 480 |
| 600 min Winter | 9.366 | 0.0 | 453.3 | 596 |
| 720 min Winter | 8.105 | 0.0 | 450.5 | 714 |
| 960 min Winter | 6.446 | 0.0 | 446.9 | 944 |
| 1440 min Winter | 4.660 | 0.0 | 444.3 | 1396 |
| 2160 min Winter | 3.364 | 0.0 | 911.8 | 2040 |
| 2880 min Winter | 2.667 | 0.0 | 882.3 | 2364 |
| 4320 min Winter | 1.920 | 0.0 | 815.3 | 3248 |
| 5760 min Winter | 1.519 | 0.0 | 1255.4 | 4200 |
| 7200 min Winter | 1.266 | 0.0 | 1305.8 | 5120 |
| 8640 min Winter | 1.090 | 0.0 | 1347.1 | 6048 |

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

```
          Storm          Max    Max       Max         Max       Max      Max   Status
          Event         Level  Depth  Infiltration  Control Σ Outflow  Volume
                         (m)    (m)       (l/s)       (l/s)     (l/s)    (m³)

     10080 min Winter  16.943  0.443          0.0        3.0       3.0   416.7    O K
```

```
          Storm          Rain   Flooded  Discharge  Time-Peak
          Event        (mm/hr)  Volume    Volume     (mins)
                                 (m³)      (m³)

     10080 min Winter    0.961     0.0     1381.5       6752
```

## 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) | 19.100 | Shortest Storm (mins) | 15 |
| Ratio R | 0.400 | Longest Storm (mins) | 10080 |
| Summer Storms | Yes | Climate Change % | +40 |

## Time Area Diagram

Total Area (ha) 1.032

| **Time From:** | **(mins) To:** | **Area (ha)** | **Time From:** | **(mins) To:** | **Area (ha)** | **Time From:** | **(mins) To:** | **Area (ha)** |
|---|---|---|---|---|---|---|---|---|
| 0 | 4 | 0.344 | 4 | 8 | 0.344 | 8 | 12 | 0.344 |

## Model Details

Storage is Online Cover Level (m) 17.800

## Cellular Storage Structure

Invert Level (m) 16.500 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

| **Depth (m)** | **Area (m²)** | **Inf. Area (m²)** |
|---|---|---|
| 0.000 | 990.0 | 990.0 |
| 0.800 | 990.0 | 1164.4 |
| 0.900 | 0.0 | 1164.4 |

## Hydro-Brake® Optimum Outflow Control

Unit Reference MD-SHE-0085-3000-0800-3000
Design Head (m) 0.800
Design Flow (l/s) 3.0
Flush-Flo™ Calculated
Objective Minimise upstream storage
Application Surface
Sump Available Yes
Diameter (mm) 85
Invert Level (m) 16.500
Minimum Outlet Pipe Diameter (mm) 100
Suggested Manhole Diameter (mm) 1200

| **Control Points** | **Head (m)** | **Flow (l/s)** |
|---|---|---|
| Design Point (Calculated) | 0.800 | 3.0 |
| Flush-Flo™ | 0.239 | 3.0 |
| Kick-Flo® | 0.517 | 2.5 |
| Mean Flow over Head Range | - | 2.6 |

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)** |
|---|---|
| 0.100 | 2.6 |
| 0.200 | 3.0 |
| 0.300 | 3.0 |
| 0.400 | 2.9 |
| 0.500 | 2.6 |
| 0.600 | 2.6 |
| 0.800 | 3.0 |
| 1.000 | 3.3 |
| 1.200 | 3.6 |
| 1.400 | 3.9 |
| 1.600 | 4.1 |
| 1.800 | 4.4 |
| 2.000 | 4.6 |
| 2.200 | 4.8 |
| 2.400 | 5.0 |
| 2.600 | 5.2 |
| 3.000 | 5.5 |
| 3.500 | 6.0 |
| 4.000 | 6.3 |
| 4.500 | 6.7 |
| 5.000 | 7.0 |
| 5.500 | 7.4 |
| 6.000 | 7.7 |
| 6.500 | 8.0 |
| 7.000 | 8.3 |
| 7.500 | 8.5 |
| 8.000 | 8.8 |
| 8.500 | 9.0 |
| 9.000 | 9.3 |
| 9.500 | 9.6 |

## Summary of Results for 30 year Return Period (+40%)

Half Drain Time : 1627 minutes.

| Storm Event | Max Level (m) | Max Depth (m) | Max Infiltration (l/s) | Max Control (l/s) | Max Σ Outflow (l/s) | Max Volume (m³) | Status |
|---|---|---|---|---|---|---|---|
| 15 min Summer | 16.706 | 0.206 | 0.0 | 3.0 | 3.0 | 193.3 | O K |
| 30 min Summer | 16.767 | 0.267 | 0.0 | 3.0 | 3.0 | 251.0 | O K |
| 60 min Summer | 16.830 | 0.330 | 0.0 | 3.0 | 3.0 | 310.4 | O K |
| 120 min Summer | 16.894 | 0.394 | 0.0 | 3.0 | 3.0 | 370.2 | O K |
| 180 min Summer | 16.930 | 0.430 | 0.0 | 3.0 | 3.0 | 404.1 | O K |
| 240 min Summer | 16.954 | 0.454 | 0.0 | 3.0 | 3.0 | 426.7 | O K |
| 360 min Summer | 16.985 | 0.485 | 0.0 | 3.0 | 3.0 | 455.7 | O K |
| 480 min Summer | 17.005 | 0.505 | 0.0 | 3.0 | 3.0 | 474.7 | O K |
| 600 min Summer | 17.018 | 0.518 | 0.0 | 3.0 | 3.0 | 487.6 | O K |
| 720 min Summer | 17.028 | 0.528 | 0.0 | 3.0 | 3.0 | 496.3 | O K |
| 960 min Summer | 17.037 | 0.537 | 0.0 | 3.0 | 3.0 | 505.1 | O K |
| 1440 min Summer | 17.036 | 0.536 | 0.0 | 3.0 | 3.0 | 503.7 | O K |
| 2160 min Summer | 17.017 | 0.517 | 0.0 | 3.0 | 3.0 | 486.7 | O K |
| 2880 min Summer | 16.996 | 0.496 | 0.0 | 3.0 | 3.0 | 466.2 | O K |
| 4320 min Summer | 16.952 | 0.452 | 0.0 | 3.0 | 3.0 | 425.1 | O K |
| 5760 min Summer | 16.910 | 0.410 | 0.0 | 3.0 | 3.0 | 385.4 | O K |
| 7200 min Summer | 16.870 | 0.370 | 0.0 | 3.0 | 3.0 | 348.1 | O K |
| 8640 min Summer | 16.833 | 0.333 | 0.0 | 3.0 | 3.0 | 313.5 | O K |

| Storm Event | Rain (mm/hr) | Flooded Volume (m³) | Discharge Volume (m³) | Time-Peak (mins) |
|---|---|---|---|---|
| 15 min Summer | 101.382 | 0.0 | 166.2 | 27 |
| 30 min Summer | 66.035 | 0.0 | 212.0 | 41 |
| 60 min Summer | 41.154 | 0.0 | 301.3 | 70 |
| 120 min Summer | 24.915 | 0.0 | 363.2 | 130 |
| 180 min Summer | 18.389 | 0.0 | 399.2 | 190 |
| 240 min Summer | 14.764 | 0.0 | 423.4 | 248 |
| 360 min Summer | 10.784 | 0.0 | 452.6 | 368 |
| 480 min Summer | 8.630 | 0.0 | 464.8 | 486 |
| 600 min Summer | 7.256 | 0.0 | 463.9 | 606 |
| 720 min Summer | 6.295 | 0.0 | 457.5 | 726 |
| 960 min Summer | 5.029 | 0.0 | 443.3 | 964 |
| 1440 min Summer | 3.660 | 0.0 | 416.3 | 1440 |
| 2160 min Summer | 2.660 | 0.0 | 721.6 | 1780 |
| 2880 min Summer | 2.120 | 0.0 | 760.6 | 2112 |
| 4320 min Summer | 1.539 | 0.0 | 790.1 | 2896 |
| 5760 min Summer | 1.225 | 0.0 | 904.6 | 3688 |
| 7200 min Summer | 1.026 | 0.0 | 946.4 | 4464 |
| 8640 min Summer | 0.887 | 0.0 | 980.6 | 5200 |

## Summary of Results for 30 year Return Period (+40%)

| Storm Event | Max Level (m) | Max Depth (m) | Max Infiltration (l/s) | Max Control (l/s) | Max Σ Outflow (l/s) | Max Volume (m³) | Status |
|---|---|---|---|---|---|---|---|
| 10080 min Summer | 16.800 | 0.300 | 0.0 | 3.0 | 3.0 | 281.8 | O K |
| 15 min Winter | 16.731 | 0.231 | 0.0 | 3.0 | 3.0 | 216.8 | O K |
| 30 min Winter | 16.799 | 0.299 | 0.0 | 3.0 | 3.0 | 281.6 | O K |
| 60 min Winter | 16.871 | 0.371 | 0.0 | 3.0 | 3.0 | 348.5 | O K |
| 120 min Winter | 16.943 | 0.443 | 0.0 | 3.0 | 3.0 | 416.3 | O K |
| 180 min Winter | 16.984 | 0.484 | 0.0 | 3.0 | 3.0 | 455.3 | O K |
| 240 min Winter | 17.012 | 0.512 | 0.0 | 3.0 | 3.0 | 481.8 | O K |
| 360 min Winter | 17.049 | 0.549 | 0.0 | 3.0 | 3.0 | 516.2 | O K |
| 480 min Winter | 17.073 | 0.573 | 0.0 | 3.0 | 3.0 | 538.8 | O K |
| 600 min Winter | 17.089 | 0.589 | 0.0 | 3.0 | 3.0 | 554.1 | O K |
| 720 min Winter | 17.100 | 0.600 | 0.0 | 3.0 | 3.0 | 564.5 | O K |
| 960 min Winter | 17.113 | 0.613 | 0.0 | 3.0 | 3.0 | 576.4 | O K |
| 1440 min Winter | 17.116 | 0.616 | 0.0 | 3.0 | 3.0 | 579.8 | O K |
| 2160 min Winter | 17.097 | 0.597 | 0.0 | 3.0 | 3.0 | 561.4 | O K |
| 2880 min Winter | 17.071 | 0.571 | 0.0 | 3.0 | 3.0 | 537.4 | O K |
| 4320 min Winter | 17.013 | 0.513 | 0.0 | 3.0 | 3.0 | 482.1 | O K |
| 5760 min Winter | 16.944 | 0.444 | 0.0 | 3.0 | 3.0 | 417.6 | O K |
| 7200 min Winter | 16.881 | 0.381 | 0.0 | 3.0 | 3.0 | 358.8 | O K |
| 8640 min Winter | 16.825 | 0.325 | 0.0 | 3.0 | 3.0 | 305.5 | O K |

| Storm Event | Rain (mm/hr) | Flooded Volume (m³) | Discharge Volume (m³) | Time-Peak (mins) |
|---|---|---|---|---|
| 10080 min Summer | 0.785 | 0.0 | 1007.2 | 5960 |
| 15 min Winter | 101.382 | 0.0 | 185.5 | 26 |
| 30 min Winter | 66.035 | 0.0 | 231.0 | 41 |
| 60 min Winter | 41.154 | 0.0 | 337.0 | 70 |
| 120 min Winter | 24.915 | 0.0 | 403.9 | 128 |
| 180 min Winter | 18.389 | 0.0 | 440.1 | 186 |
| 240 min Winter | 14.764 | 0.0 | 460.5 | 246 |
| 360 min Winter | 10.784 | 0.0 | 471.3 | 362 |
| 480 min Winter | 8.630 | 0.0 | 465.3 | 478 |
| 600 min Winter | 7.256 | 0.0 | 458.0 | 596 |
| 720 min Winter | 6.295 | 0.0 | 450.9 | 710 |
| 960 min Winter | 5.029 | 0.0 | 437.9 | 940 |
| 1440 min Winter | 3.660 | 0.0 | 415.6 | 1388 |
| 2160 min Winter | 2.660 | 0.0 | 801.4 | 2012 |
| 2880 min Winter | 2.120 | 0.0 | 832.2 | 2280 |
| 4320 min Winter | 1.539 | 0.0 | 804.0 | 3204 |
| 5760 min Winter | 1.225 | 0.0 | 1013.3 | 4032 |
| 7200 min Winter | 1.026 | 0.0 | 1060.2 | 4832 |
| 8640 min Winter | 0.887 | 0.0 | 1099.1 | 5616 |

## Summary of Results for 30 year Return Period (+40%)

| Storm Event | Max Level (m) | Max Depth (m) | Max Infiltration (l/s) | Max Control (l/s) | Max Σ Outflow (l/s) | Max Volume (m³) | Status |
|---|---|---|---|---|---|---|---|
| 10080 min Winter | 16.775 | 0.275 | 0.0 | 3.0 | 3.0 | 258.5 | O K |

| Storm Event | Rain (mm/hr) | Flooded Volume (m³) | Discharge Volume (m³) | Time-Peak (mins) |
|---|---|---|---|---|
| 10080 min Winter | 0.785 | 0.0 | 1130.1 | 6272 |

## Rainfall Details

| | | | |
|---|---|---|---|
| Rainfall Model | FSR | Winter Storms | Yes |
| Return Period (years) | 30 | Cv (Summer) | 0.750 |
| Region | England and Wales | Cv (Winter) | 0.840 |
| M5-60 (mm) | 19.100 | Shortest Storm (mins) | 15 |
| Ratio R | 0.400 | Longest Storm (mins) | 10080 |
| Summer Storms | Yes | Climate Change % | +40 |

## Time Area Diagram

Total Area (ha) 1.032

| Time From: | (mins) To: | Area (ha) | Time From: | (mins) To: | Area (ha) | Time From: | (mins) To: | Area (ha) |
|---|---|---|---|---|---|---|---|---|
| 0 | 4 | 0.344 | 4 | 8 | 0.344 | 8 | 12 | 0.344 |

## Model Details

Storage is Online Cover Level (m) 17.800

## Cellular Storage Structure

| | | | |
|---|---|---|---|
| Invert Level (m) | 16.500 | Safety Factor | 2.0 |
| Infiltration Coefficient Base (m/hr) | 0.00000 | Porosity | 0.95 |
| Infiltration Coefficient Side (m/hr) | 0.00000 | | |

| Depth (m) | Area (m²) | Inf. Area (m²) | Depth (m) | Area (m²) | Inf. Area (m²) |
|---|---|---|---|---|---|
| 0.000 | 990.0 | 990.0 | 0.900 | 0.0 | 1164.4 |
| 0.800 | 990.0 | 1164.4 | | | |

## Hydro-Brake® Optimum Outflow Control

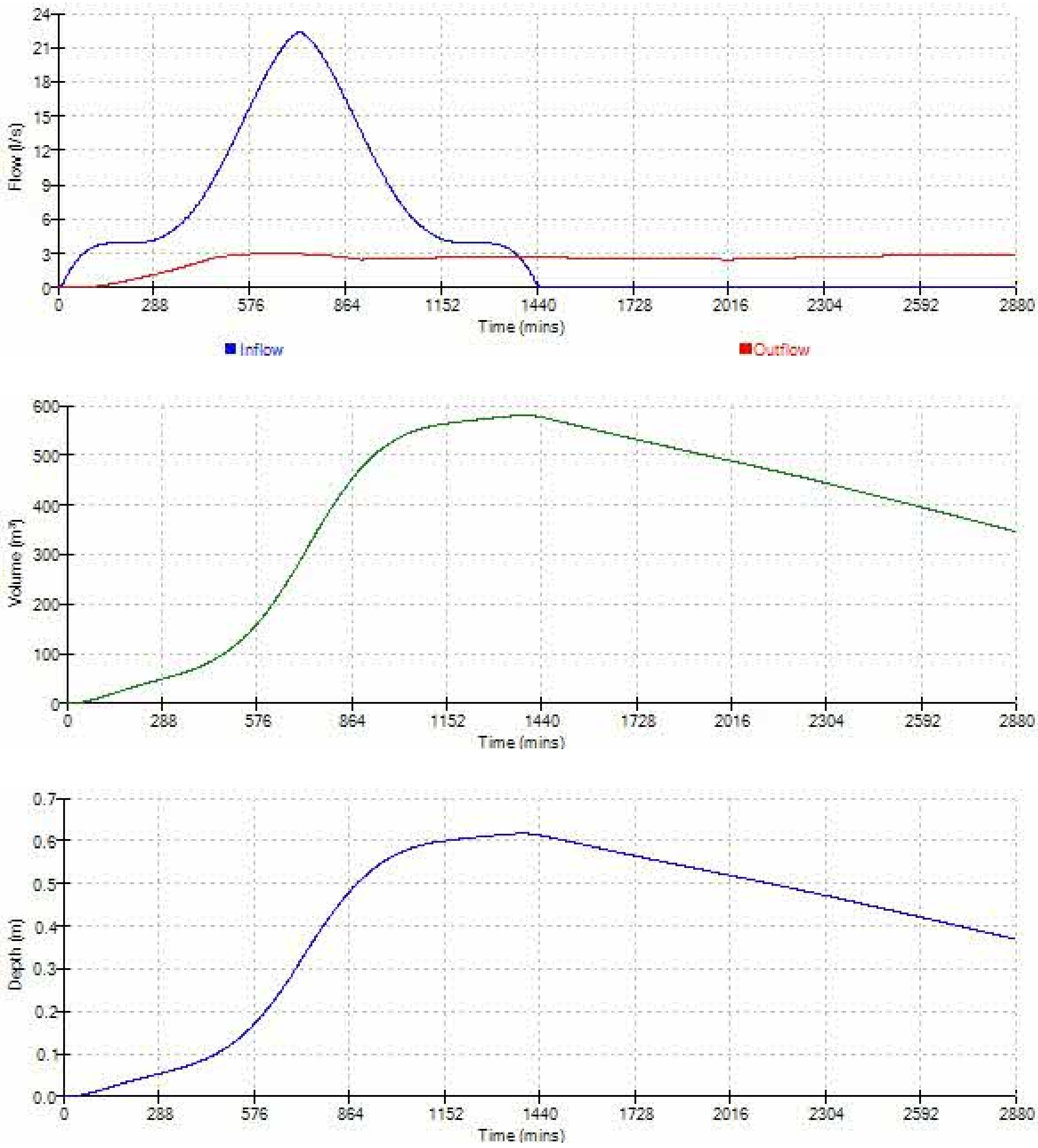
| | |
|---|---|
| Unit Reference | MD-SHE-0085-3000-0800-3000 |
| Design Head (m) | 0.800 |
| Design Flow (l/s) | 3.0 |
| Flush-Flo™ | Calculated |
| Objective | Minimise upstream storage |
| Application | Surface |
| Sump Available | Yes |
| Diameter (mm) | 85 |
| Invert Level (m) | 16.500 |
| Minimum Outlet Pipe Diameter (mm) | 100 |
| Suggested Manhole Diameter (mm) | 1200 |

| Control Points | Head (m) | Flow (l/s) | Control Points | Head (m) | Flow (l/s) |
|---|---|---|---|---|---|
| Design Point (Calculated) | 0.800 | 3.0 | Kick-Flo® | 0.517 | 2.5 |
| Flush-Flo™ | 0.239 | 3.0 | Mean Flow over Head Range | - | 2.6 |

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 | 2.6 | 1.200 | 3.6 | 3.000 | 5.5 | 7.000 | 8.3 |
| 0.200 | 3.0 | 1.400 | 3.9 | 3.500 | 6.0 | 7.500 | 8.5 |
| 0.300 | 3.0 | 1.600 | 4.1 | 4.000 | 6.3 | 8.000 | 8.8 |
| 0.400 | 2.9 | 1.800 | 4.4 | 4.500 | 6.7 | 8.500 | 9.0 |
| 0.500 | 2.6 | 2.000 | 4.6 | 5.000 | 7.0 | 9.000 | 9.3 |
| 0.600 | 2.6 | 2.200 | 4.8 | 5.500 | 7.4 | 9.500 | 9.6 |
| 0.800 | 3.0 | 2.400 | 5.0 | 6.000 | 7.7 | | |
| 1.000 | 3.3 | 2.600 | 5.2 | 6.500 | 8.0 | | |

## Event: 1440 min Winter



## Summary of Results for 10 year Return Period

Half Drain Time : 816 minutes.

| Storm Event | Max Level (m) | Max Depth (m) | Max Infiltration (l/s) | Max Control (l/s) | Max Σ Outflow (l/s) | Max Volume (m³) | Status |
|---|---|---|---|---|---|---|---|
| 15 min Summer | 16.615 | 0.115 | 0.0 | 2.8 | 2.8 | 108.5 | O K |
| 30 min Summer | 16.648 | 0.148 | 0.0 | 2.9 | 2.9 | 139.2 | O K |
| 60 min Summer | 16.681 | 0.181 | 0.0 | 3.0 | 3.0 | 170.3 | O K |
| 120 min Summer | 16.714 | 0.214 | 0.0 | 3.0 | 3.0 | 201.0 | O K |
| 180 min Summer | 16.731 | 0.231 | 0.0 | 3.0 | 3.0 | 217.7 | O K |
| 240 min Summer | 16.743 | 0.243 | 0.0 | 3.0 | 3.0 | 228.3 | O K |
| 360 min Summer | 16.756 | 0.256 | 0.0 | 3.0 | 3.0 | 240.4 | O K |
| 480 min Summer | 16.762 | 0.262 | 0.0 | 3.0 | 3.0 | 246.2 | O K |
| 600 min Summer | 16.764 | 0.264 | 0.0 | 3.0 | 3.0 | 248.3 | O K |
| 720 min Summer | 16.765 | 0.265 | 0.0 | 3.0 | 3.0 | 249.3 | O K |
| 960 min Summer | 16.765 | 0.265 | 0.0 | 3.0 | 3.0 | 249.6 | O K |
| 1440 min Summer | 16.762 | 0.262 | 0.0 | 3.0 | 3.0 | 246.1 | O K |
| 2160 min Summer | 16.750 | 0.250 | 0.0 | 3.0 | 3.0 | 235.1 | O K |
| 2880 min Summer | 16.736 | 0.236 | 0.0 | 3.0 | 3.0 | 221.5 | O K |
| 4320 min Summer | 16.706 | 0.206 | 0.0 | 3.0 | 3.0 | 193.5 | O K |
| 5760 min Summer | 16.679 | 0.179 | 0.0 | 3.0 | 3.0 | 168.3 | O K |
| 7200 min Summer | 16.657 | 0.157 | 0.0 | 2.9 | 2.9 | 147.2 | O K |
| 8640 min Summer | 16.638 | 0.138 | 0.0 | 2.9 | 2.9 | 129.9 | O K |

| Storm Event | Rain (mm/hr) | Flooded Volume (m³) | Discharge Volume (m³) | Time-Peak (mins) |
|---|---|---|---|---|
| 15 min Summer | 57.175 | 0.0 | 90.4 | 26 |
| 30 min Summer | 36.942 | 0.0 | 119.6 | 41 |
| 60 min Summer | 22.913 | 0.0 | 165.6 | 70 |
| 120 min Summer | 13.862 | 0.0 | 201.6 | 128 |
| 180 min Summer | 10.252 | 0.0 | 224.1 | 188 |
| 240 min Summer | 8.254 | 0.0 | 240.8 | 246 |
| 360 min Summer | 6.063 | 0.0 | 265.3 | 364 |
| 480 min Summer | 4.869 | 0.0 | 283.7 | 482 |
| 600 min Summer | 4.106 | 0.0 | 298.4 | 584 |
| 720 min Summer | 3.571 | 0.0 | 310.7 | 628 |
| 960 min Summer | 2.864 | 0.0 | 330.2 | 754 |
| 1440 min Summer | 2.097 | 0.0 | 355.6 | 1012 |
| 2160 min Summer | 1.534 | 0.0 | 418.6 | 1424 |
| 2880 min Summer | 1.229 | 0.0 | 446.2 | 1824 |
| 4320 min Summer | 0.898 | 0.0 | 485.4 | 2604 |
| 5760 min Summer | 0.719 | 0.0 | 529.7 | 3352 |
| 7200 min Summer | 0.605 | 0.0 | 556.1 | 4104 |
| 8640 min Summer | 0.525 | 0.0 | 577.7 | 4768 |

## Summary of Results for 10 year Return Period

| Storm Event | Max Level (m) | Max Depth (m) | Max Infiltration (l/s) | Max Control (l/s) | Max Σ Outflow (l/s) | Max Volume (m³) | Status |
|---|---|---|---|---|---|---|---|
| 10080 min Summer | 16.623 | 0.123 | 0.0 | 2.8 | 2.8 | 116.1 | O K |
| 15 min Winter | 16.629 | 0.129 | 0.0 | 2.8 | 2.8 | 121.6 | O K |
| 30 min Winter | 16.666 | 0.166 | 0.0 | 2.9 | 2.9 | 156.2 | O K |
| 60 min Winter | 16.703 | 0.203 | 0.0 | 3.0 | 3.0 | 191.4 | O K |
| 120 min Winter | 16.741 | 0.241 | 0.0 | 3.0 | 3.0 | 226.3 | O K |
| 180 min Winter | 16.761 | 0.261 | 0.0 | 3.0 | 3.0 | 245.7 | O K |
| 240 min Winter | 16.775 | 0.275 | 0.0 | 3.0 | 3.0 | 258.2 | O K |
| 360 min Winter | 16.790 | 0.290 | 0.0 | 3.0 | 3.0 | 273.1 | O K |
| 480 min Winter | 16.799 | 0.299 | 0.0 | 3.0 | 3.0 | 281.0 | O K |
| 600 min Winter | 16.803 | 0.303 | 0.0 | 3.0 | 3.0 | 284.9 | O K |
| 720 min Winter | 16.804 | 0.304 | 0.0 | 3.0 | 3.0 | 286.2 | O K |
| 960 min Winter | 16.802 | 0.302 | 0.0 | 3.0 | 3.0 | 284.1 | O K |
| 1440 min Winter | 16.795 | 0.295 | 0.0 | 3.0 | 3.0 | 277.0 | O K |
| 2160 min Winter | 16.775 | 0.275 | 0.0 | 3.0 | 3.0 | 258.8 | O K |
| 2880 min Winter | 16.752 | 0.252 | 0.0 | 3.0 | 3.0 | 236.9 | O K |
| 4320 min Winter | 16.706 | 0.206 | 0.0 | 3.0 | 3.0 | 193.4 | O K |
| 5760 min Winter | 16.666 | 0.166 | 0.0 | 2.9 | 2.9 | 156.5 | O K |
| 7200 min Winter | 16.636 | 0.136 | 0.0 | 2.8 | 2.8 | 127.9 | O K |
| 8640 min Winter | 16.614 | 0.114 | 0.0 | 2.7 | 2.7 | 107.1 | O K |

| Storm Event | Rain (mm/hr) | Flooded Volume (m³) | Discharge Volume (m³) | Time-Peak (mins) |
|---|---|---|---|---|
| 10080 min Summer | 0.466 | 0.0 | 594.3 | 5456 |
| 15 min Winter | 57.175 | 0.0 | 102.5 | 26 |
| 30 min Winter | 36.942 | 0.0 | 134.9 | 40 |
| 60 min Winter | 22.913 | 0.0 | 186.3 | 68 |
| 120 min Winter | 13.862 | 0.0 | 226.5 | 126 |
| 180 min Winter | 10.252 | 0.0 | 251.6 | 184 |
| 240 min Winter | 8.254 | 0.0 | 270.1 | 242 |
| 360 min Winter | 6.063 | 0.0 | 297.3 | 356 |
| 480 min Winter | 4.869 | 0.0 | 317.6 | 470 |
| 600 min Winter | 4.106 | 0.0 | 333.8 | 582 |
| 720 min Winter | 3.571 | 0.0 | 347.1 | 690 |
| 960 min Winter | 2.864 | 0.0 | 367.9 | 882 |
| 1440 min Winter | 2.097 | 0.0 | 392.8 | 1100 |
| 2160 min Winter | 1.534 | 0.0 | 469.2 | 1556 |
| 2880 min Winter | 1.229 | 0.0 | 500.2 | 1992 |
| 4320 min Winter | 0.898 | 0.0 | 544.6 | 2808 |
| 5760 min Winter | 0.719 | 0.0 | 593.8 | 3528 |
| 7200 min Winter | 0.605 | 0.0 | 623.6 | 4248 |
| 8640 min Winter | 0.525 | 0.0 | 648.0 | 4848 |

## Summary of Results for 10 year Return Period

| Storm Event | Max Level (m) | Max Depth (m) | Max Infiltration (l/s) | Max Control (l/s) | Max Σ Outflow (l/s) | Max Volume (m³) | Status |
|---|---|---|---|---|---|---|---|
| 10080 min Winter | 16.601 | 0.101 | 0.0 | 2.6 | 2.6 | 94.8 | O K |

| Storm Event | Rain (mm/hr) | Flooded Volume (m³) | Discharge Volume (m³) | Time-Peak (mins) |
|---|---|---|---|---|
| 10080 min Winter | 0.466 | 0.0 | 667.3 | 5544 |

## Rainfall Details

| | | | |
|---|---|---|---|
| Rainfall Model | FSR | Winter Storms | Yes |
| Return Period (years) | 10 | Cv (Summer) | 0.750 |
| Region | England and Wales | Cv (Winter) | 0.840 |
| M5-60 (mm) | 19.100 | Shortest Storm (mins) | 15 |
| Ratio R | 0.400 | Longest Storm (mins) | 10080 |
| Summer Storms | Yes | Climate Change % | +0 |

## Time Area Diagram

Total Area (ha) 1.032

| Time From: | (mins) To: | Area (ha) | Time From: | (mins) To: | Area (ha) | Time From: | (mins) To: | Area (ha) |
|---|---|---|---|---|---|---|---|---|
| 0 | 4 | 0.344 | 4 | 8 | 0.344 | 8 | 12 | 0.344 |

## Model Details

Storage is Online Cover Level (m) 17.800

## Cellular Storage Structure

| | | | |
|---|---|---|---|
| Invert Level (m) | 16.500 | Safety Factor | 2.0 |
| Infiltration Coefficient Base (m/hr) | 0.00000 | Porosity | 0.95 |
| Infiltration Coefficient Side (m/hr) | 0.00000 | | |

| Depth (m) | Area (m²) | Inf. Area (m²) | Depth (m) | Area (m²) | Inf. Area (m²) |
|---|---|---|---|---|---|
| 0.000 | 990.0 | 990.0 | 0.900 | 0.0 | 1164.4 |
| 0.800 | 990.0 | 1164.4 | | | |

## Hydro-Brake® Optimum Outflow Control

| | |
|---|---|
| Unit Reference | MD-SHE-0085-3000-0800-3000 |
| Design Head (m) | 0.800 |
| Design Flow (l/s) | 3.0 |
| Flush-Flo™ | Calculated |
| Objective | Minimise upstream storage |
| Application | Surface |
| Sump Available | Yes |
| Diameter (mm) | 85 |
| Invert Level (m) | 16.500 |
| Minimum Outlet Pipe Diameter (mm) | 100 |
| Suggested Manhole Diameter (mm) | 1200 |

| Control Points | Head (m) | Flow (l/s) | Control Points | Head (m) | Flow (l/s) |
|---|---|---|---|---|---|
| Design Point (Calculated) | 0.800 | 3.0 | Kick-Flo® | 0.517 | 2.5 |
| Flush-Flo™ | 0.239 | 3.0 | Mean Flow over Head Range | - | 2.6 |

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 | 2.6 | 1.200 | 3.6 | 3.000 | 5.5 | 7.000 | 8.3 |
| 0.200 | 3.0 | 1.400 | 3.9 | 3.500 | 6.0 | 7.500 | 8.5 |
| 0.300 | 3.0 | 1.600 | 4.1 | 4.000 | 6.3 | 8.000 | 8.8 |
| 0.400 | 2.9 | 1.800 | 4.4 | 4.500 | 6.7 | 8.500 | 9.0 |
| 0.500 | 2.6 | 2.000 | 4.6 | 5.000 | 7.0 | 9.000 | 9.3 |
| 0.600 | 2.6 | 2.200 | 4.8 | 5.500 | 7.4 | 9.500 | 9.6 |
| 0.800 | 3.0 | 2.400 | 5.0 | 6.000 | 7.7 | | |
| 1.000 | 3.3 | 2.600 | 5.2 | 6.500 | 8.0 | | |

## Event: 720 min Winter