

# Surface Water Drainage and SuDS Strategy Report

Ex24/296/11

Sulby Croft, Heathlands Road

Wokingham

RG40 3AR



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# Revisions and Additional Material

## Document History and Status

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## Document Details

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| Project Director | Ben Norman       |
| Report Author    | Mathan Rengasamy |
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## Preamble

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## 1.0 Introduction

- 1.0.2 JMS Engineers have been appointed to prepare a surface water drainage strategy and SuDS report to discharge planning conditions for the development at Sulby Croft, Heathlands Road, Wokingham, RG40 3AR.
- 1.0.3 This report will review and aim to meet the requirements as set out by the local planning authority. The report will include a surface water drainage strategy and will consider the use of Sustainable Drainage Systems (SuDS) wherever possible.

## 2.0 Location & Existing Conditions

- 2.0.1 The application site is in Heathlands Road, Wokingham.
- 2.0.2 The site is specifically located at Heathlands Road, Wokingham and currently has a total impermeable area of 0.020ha. The existing site is a residential building and is accessed from Heathlands Road, adjacent to the eastern frontage.
- 2.0.3 The British Geological Survey (BGS) information shows the site is located on the superficial deposit of River Terrace Deposits, 6 of Sand and Gravel as shown in [Figure 1](#). The bedrock shown in [Figure 2](#) shows the site over Bagshot Formation of Sand.

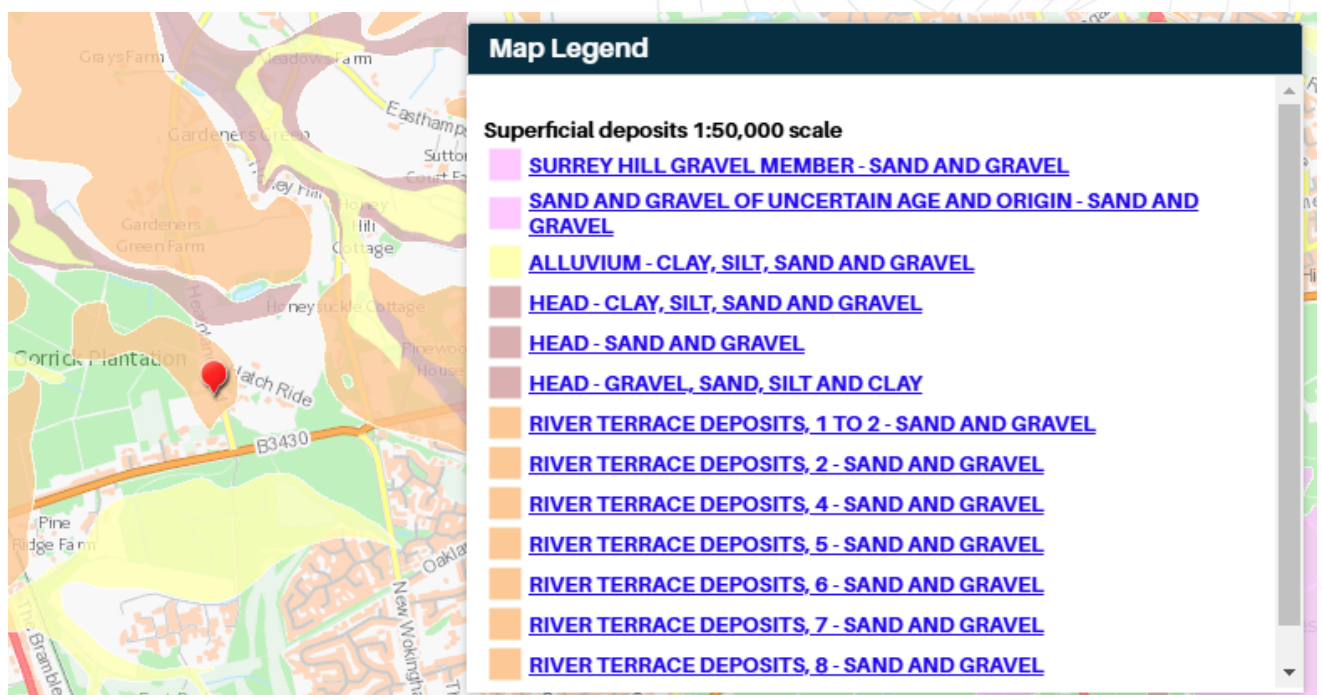


Figure 1 Superficial Deposits

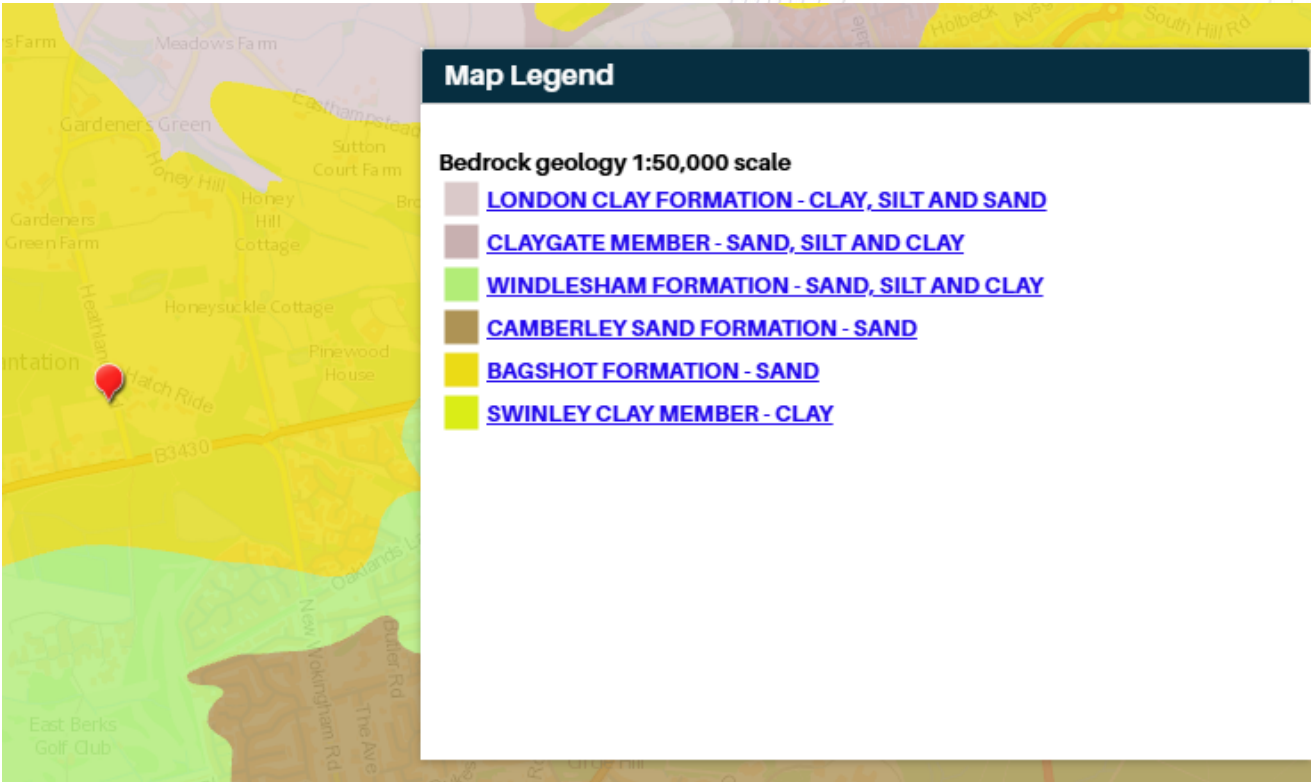


Figure 2 Bedrock Geology

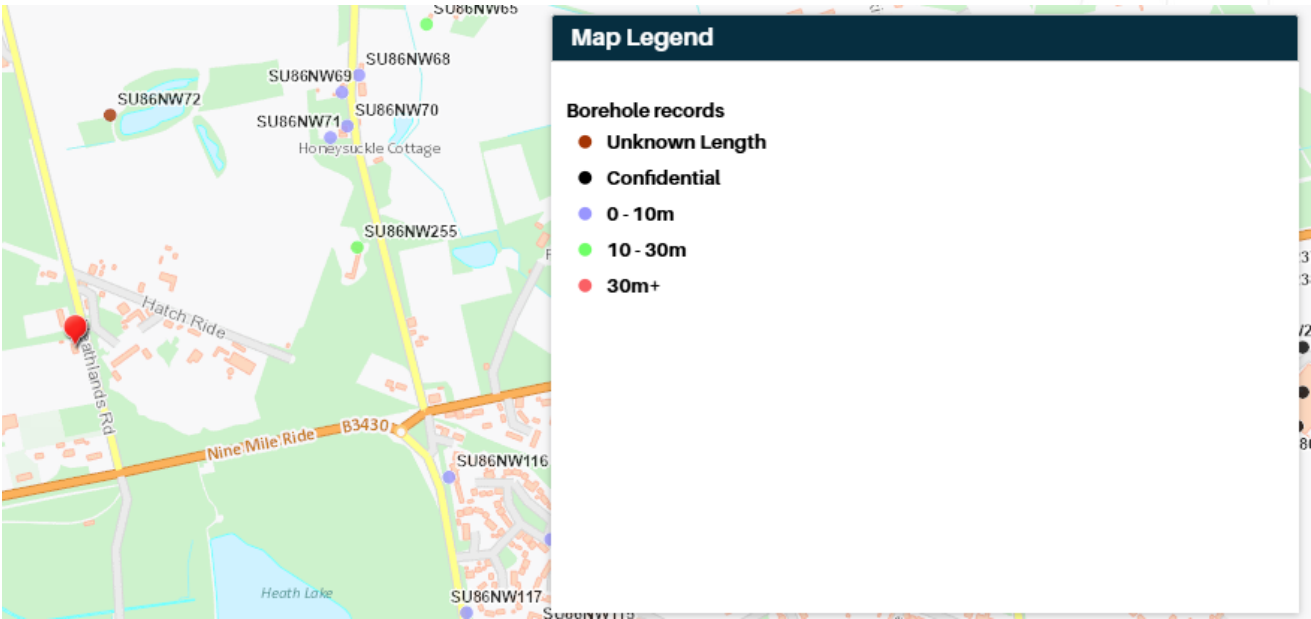


Figure 3 Local Borehole Location Plan

## 2.1 Site Proposals

- 2.1.1 Proposals are for the extensions of an existing residential building with the two-storey rear and a single storey side extension with associated private parking and landscaping. Therefore, the total impermeable area for the proposed site is 0.082ha. The proposals at the time of writing can be seen in [Appendix A](#).

## 2.2 Existing Drainage Regime

- 2.2.1 The existing site is a brownfield site. It is assumed that the surface water is draining to the greenfield areas in the site and infiltrating to the ground.

- 2.2.2 The Modified Rational Method is used to consider the average existing runoff as set out below:  
Section 24.5 of CIRIA 753 states that a value of 35mm/hr and 50mm/hr can be used for rainfall intensity.

$I = 44.919, 108.840, 142.958$  for 1,30 and 100 years respectively

$$Q(l/s) = C_v \times C_r \times 2.78 \times I \text{ (mm/hr)} \times A \text{ (ha)}$$

Where:

$A = 0.020$

$C_v = 0.75$

$C_r = 1.3$

$I = 50$  (Max. value)

**$Q = 2.71$  l/s**

- 2.2.3 Table 1 below, shows the existing peak runoff rate for the existing site when considering the 60min duration.

|                                      | QBAR | 1:1 Year Storm Event | 1:30 Year Storm Event | 1:100 Year Storm Event | 1:100 Year Storm Event (+40% Climate Change) |
|--------------------------------------|------|----------------------|-----------------------|------------------------|----------------------------------------------|
| Greenfield Runoff Rate (l/s)         | 0.2  | 0.2                  | 0.5                   | 0.7                    | -                                            |
| Existing Site Peak Runoff Rate (l/s) | -    | 2.43                 | 5.90                  | 7.8                    | -                                            |

**Table 1: Greenfield runoff and existing peak runoff rate**

## 3.0 SuDS Considerations

- 3.0.1 Consideration of SuDS is a planning requirement for new developments. SuDS are designed to replicate the natural course of drainage as closely as possible with a view to reducing the impact of flooding, removing pollutants at source and combining water management with green space.

Developments should utilise SuDS where possible and ensure that surface water run-off is managed as close to its source as possible in line with the following hierarchy:

1. Into ground (infiltration).
2. To a surface water body.
3. To a surface water sewer.
4. To a combined sewer.

- 3.0.2 Sustainable Drainage Systems should be included in the design in order to manage surface water flood risk. SuDS should be inspired by natural drainage processes and manage water as close to its source as possible whilst offering pollution control and landscape benefits.

### 3.1 *National and Local Planning Policy*

- 3.1.1 For this development, Wokingham Borough Council are the Local Planning Authority and set out the requirements in relation to the drainage strategy and SuDS.
- 3.1.2 The Local Plan of 2023-2040 of Wokingham Borough council of section 6 of Climatic change and Energy sets out the policies of “CE1 & CE3- Environmental standards for residential development” and section 10 of Flooding and drainage sets out the policies of “FD1- Development and flood risk (from all sources) and FD2- Sustainable drainage” are the Current Local Plan policies for climate change and flood risk.

### 3.2 *SuDS Incorporation*

- 3.2.1 The ground conditions do appear to support the use of surface water disposal by infiltration. On that basis, following the hierarchy, proposals are to discharge surface water runoff to the ground by infiltration technics.
- 3.2.2 Table 7.1 below from the SuDS Manual reproduced as **figure 5** sets out the various components that may be considered in providing SuDS.
- 3.2.3 In accordance with the requirements of the Local planning Policy of Policy CE1 and CE3, all developments will be required to submit a SuDS strategy, taking into account climate change allowances.

| Component Type                                                                                          | Description                                                                                                                                            | Collection Mechanism | Design Criteria            |                              |              |                           |                     |                          | Further Information (Chapter Ref) |
|---------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------|----------------------------|------------------------------|--------------|---------------------------|---------------------|--------------------------|-----------------------------------|
|                                                                                                         |                                                                                                                                                        |                      | Water Quantity (Chapter 3) |                              |              | Water Quality (Chapter 4) | Amenity (Chapter 5) | Biodiversity (Chapter 6) |                                   |
|                                                                                                         |                                                                                                                                                        |                      | Peak Runoff Rate           | Runoff Volumes               |              |                           |                     |                          |                                   |
|                                                                                                         |                                                                                                                                                        |                      |                            | Small Events (Interceptions) | Large Events |                           |                     |                          |                                   |
| Rainwater Harvesting Systems                                                                            | Systems that collect runoff from the roof of a building or other paved surface for use                                                                 | P                    |                            | ●                            | ●            |                           | ●                   |                          | 11                                |
| Green roofs                                                                                             | Planted soil layers on the roof of buildings that slow and store runoff                                                                                | S                    | ○                          | ●                            |              | ●                         | ●                   | ●                        | 12                                |
| Infiltration systems                                                                                    | Systems that collect and store runoff, allowing it to infiltrate into the ground                                                                       | P                    | ●                          | ●                            | ●            | ●                         | ●                   | ●                        | 13                                |
| Proprietary treatment systems                                                                           | Subsurface structures design to provide treatment to runoff                                                                                            | P                    |                            |                              |              | ●                         |                     |                          | 14                                |
| Filter strips                                                                                           | Grass strips hat promote sedimentation and filtration as runoff is conveyed over the surface                                                           | L                    |                            | ●                            |              | ●                         | ○                   | ○                        | 15                                |
| Filter drains                                                                                           | Shallow stone-filled trenches that provide attenuation, conveyance and treatment of runoff                                                             | L                    | ●                          | ○                            |              | ●                         | ○                   | ○                        | 16                                |
| Swales                                                                                                  | Shallow landscaped depressions that allow runoff to pond temporarily on the surface, before filtering through vegetation and underlying soils          | L                    | ●                          | ●                            | ●            | ●                         | ●                   | ●                        | 17                                |
| Bioretention systems                                                                                    | Trees with soil-filled tree pits, tree planters or structural soils used to collect, store and treat runoff                                            | P                    | ●                          | ●                            | ●            | ●                         | ●                   | ●                        | 18                                |
| Trees                                                                                                   | Structural paving through which runoff can soak and subsequently be stored in the sub-base beneath, and/or allowed to infiltrate into the ground below | P                    | ●                          | ●                            |              | ●                         | ●                   | ●                        | 19                                |
| Pervious pavements                                                                                      | Structural paving through which runoff can soak and subsequently be stored in the sub-base beneath, and/or allowed to infiltrate into the ground below | S                    | ●                          | ●                            | ●            | ●                         | ○                   | ○                        | 20                                |
| Attenuation storage tanks                                                                               | Large, below-ground voided spaces used to temporarily store runoff before infiltration-controlled release or use                                       | P                    | ●                          |                              |              |                           |                     |                          | 21                                |
| Detention basins                                                                                        | Vegetated depressions that store and treat runoff                                                                                                      | P                    | ●                          | ●                            |              | ●                         | ●                   | ●                        | 22                                |
| Ponds and wetlands                                                                                      | Permanent pools of water used to facilitate treatment of runoff – runoff can also be stored in an attenuation zone above the pool                      | P                    | ●                          |                              |              | ●                         | ●                   | ●                        | 23                                |
| P-Point L-Lateral S-Surface                                                                             |                                                                                                                                                        |                      |                            |                              |              |                           |                     |                          |                                   |
| ● – likely valuable contribution to delivery of design criterion                                        |                                                                                                                                                        |                      |                            |                              |              |                           |                     |                          |                                   |
| ○ - some potential contribution to delivery of design criterion, if specifically included in the design |                                                                                                                                                        |                      |                            |                              |              |                           |                     |                          |                                   |

Figure 4 CIRIA Table 7.1 SuDS Components

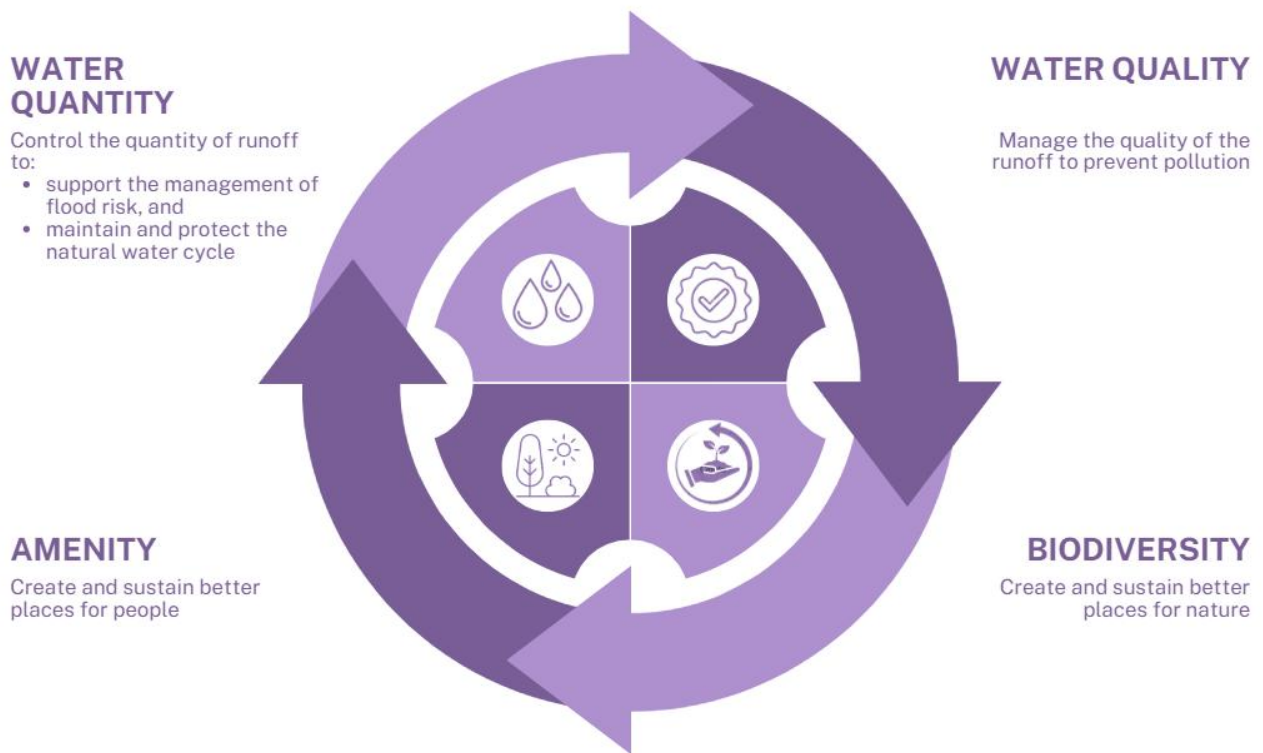


Figure 5 CIRIA SuDS Pillars

- 3.2.4 The above table gives examples of various SuDS components, which may offer SuDS elements in accordance with the requirements. The driveway and parking areas of the development offers an opportunity for the use of permeable surfacing which can be implemented within the design allowing it to infiltrate to the ground.
- 3.2.5 The proposed site layout offers the opportunity to apply a range of SuDS measures in accordance with the table above. Proposals are as follows:
- **Pervious pavement**– located at the parking area of the site, subsequently be allowing to penetrate the surface water generated by extreme storm events in the sub-base and infiltrate to the ground.
  - **Infiltration systems** - Systems that collect and store runoff, allowing it to infiltrate into the ground.
  - **Rainwater Harvesting Systems** – Offering benefits in terms of water quantity and amenity. It is used for landscaping areas.
  - **Bioretention systems** – The table above shows that bioretention systems offer numerous SuDS benefits at source. Contributions are made towards water quantity, quality, amenity and biodiversity.
- 3.2.6 A driveway and parking area serving the dwelling includes a permeable surface which offers an element of source control. Runoff is slowed and filtered as it passes through, therefore improving water quality and quantity.
- 3.2.7 In accordance with Table 26.2 of CIRIA Report C753, (figure 7, below) the pollution hazard level can be classified as ‘very low’ and ‘Low’. Using table 26.3 of the same document (figure 8), the mitigation indices values for permeable surfacing exceed the pollution hazard values taken from the previous table. This ensures that proposals offer enough pollution risk mitigation.

| Land use                                                                                                                                                                                                                                                                                                  | Pollution hazard level | Total suspended solids (TSS) | Metals                                                                     | Hydrocarbons |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------|------------------------------|----------------------------------------------------------------------------|--------------|
| Residential Roofs                                                                                                                                                                                                                                                                                         | Very low               | 0.2                          | 0.2                                                                        | 0.05         |
| Other roofs (typically commercial/industrial roofs)                                                                                                                                                                                                                                                       | Low                    | 0.3                          | 0.2 (up to 0.8 where there is potential for metals to leach from the roof) | 0.05         |
| Individual property driveways, residential car parks, low traffic roads (eg cul de sacs, homezones and general access roads) and non-residential car parking with infrequent change (eg schools, offices) ie <300 traffic movements/day                                                                   | Low                    | 0.5                          | 0.4                                                                        | 0.4          |
| Commercial yard and delivery areas, non-residential car parking with frequent change (eg hospitals, retail), all roads except low traffic roads and trunk roads/motorways                                                                                                                                 | Medium                 | 0.7                          | 0.6                                                                        | 0.7          |
| Sites with heavy pollution (eg haulage yards, lorry parks, highly frequented lorry approaches to industrial estates, waste sites), sites where chemicals and fuels (other than domestic fuel oil) are to be delivered, handled, stored, used or manufactured; industrial sites; trunk roads and motorways | High                   | 0.8                          | 0.8                                                                        | 0.9          |

Figure 6 Extract from Table 26.2 CIRIA SuDS Manual Pollution hazard indices for different land use classifications

| Mitigation Indices     |     |        |              |
|------------------------|-----|--------|--------------|
| Type of SuDS component | TSS | Metals | Hydrocarbons |
| Filter Strip           | 0.4 | 0.4    | 0.5          |
| Filter drain           | 0.4 | 0.4    | 0.4          |
| Swale                  | 0.5 | 0.6    | 0.6          |
| Bioretention system    | 0.8 | 0.8    | 0.8          |
| Permeable pavement     | 0.7 | 0.6    | 0.7          |
| Detention basin        | 0.5 | 0.5    | 0.6          |
| Pond                   | 0.7 | 0.7    | 0.5          |
| Wetland                | 0.8 | 0.8    | 0.8          |

Figure 7 Extract from Table 26.3 CIRIA SuDS Manual 2015 Indicative SuDS mitigation indices for discharges to surface waters

3.2.8 The above proposals ensure that an ‘at source’ SuDS measure is applied, and betterment is provided in terms of surface water runoff velocity and quality. Pollution indices from different land types can be found per as per table 26.15 CIRIA SuDS Manual 2015, below.

| Land use surface type (Lust)                  | Impermeability<br>(IMP <sub>REF</sub> )                                                                                                                                                                                                             | Total suspended solids<br>pollution index<br>(PI <sub>TSS</sub> ) | Organic pollution index<br>(PI <sub>Org</sub> ) | Hydrocarbon<br>pollution index<br>(PI <sub>PAD</sub> ) | Metals Pollution<br>index (PI) |
|-----------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------|-------------------------------------------------|--------------------------------------------------------|--------------------------------|
| <b>Roofs</b>                                  |                                                                                                                                                                                                                                                     |                                                                   |                                                 |                                                        |                                |
| • Industrial / Commercial                     | 1.0                                                                                                                                                                                                                                                 | 0.3                                                               | 0.3-0.4                                         | 0.2                                                    | 0.4-0.8                        |
| • Residential                                 | 0.9                                                                                                                                                                                                                                                 | 0.4-0.5                                                           | 0.6-0.7                                         | 0.1                                                    | 0.2-0.5                        |
| <b>Highways</b>                               |                                                                                                                                                                                                                                                     |                                                                   |                                                 |                                                        |                                |
| • Motorways                                   | 0.8-0.9                                                                                                                                                                                                                                             | 0.9                                                               | 0.7                                             | 0.9                                                    | 0.8                            |
| • Major arterial highways                     | 0.7-0.8                                                                                                                                                                                                                                             | 0.8                                                               | 0.7                                             | 0.8                                                    | 0.8                            |
| • Urban distributor roads                     | 0.6-0.7                                                                                                                                                                                                                                             | 0.7-0.8                                                           | 0.5                                             | 0.8                                                    | 0.7                            |
| • Residential Street                          | 0.4-0.6                                                                                                                                                                                                                                             | 0.4                                                               | 0.6                                             | 0.6                                                    | 0.6                            |
| • Pavements                                   | 0.5-0.6                                                                                                                                                                                                                                             | 0.4                                                               | 0.6                                             | 0.3                                                    | 0.3                            |
| <b>Car Parks / Hardstanding</b>               |                                                                                                                                                                                                                                                     |                                                                   |                                                 |                                                        |                                |
| • Industrial/Commercial                       | 0.6-0.8                                                                                                                                                                                                                                             | 0.6-0.7                                                           | 0.6-0.7                                         | 0.7                                                    | 0.4-0.5                        |
| • Driveways (Residential)                     | 0.5                                                                                                                                                                                                                                                 | 0.5                                                               | 0.6                                             | 0.4                                                    | 0.3                            |
| <b>Open Areas</b>                             |                                                                                                                                                                                                                                                     |                                                                   |                                                 |                                                        |                                |
| • Gardens (All types)                         | 0.1                                                                                                                                                                                                                                                 | 0.3                                                               | 0.2-0.3                                         | 0                                                      | 0.01                           |
| • Parks/Golf Courses                          | 0.2                                                                                                                                                                                                                                                 | 0.2-0.3                                                           | 0.2                                             | 0                                                      | 0.02                           |
| • Grassed Areas (including verges, all types) | 0.1                                                                                                                                                                                                                                                 | 0.2-0.3                                                           | 0.2-0.3                                         | 0.05                                                   | 0.05                           |
| Note                                          |                                                                                                                                                                                                                                                     |                                                                   |                                                 |                                                        |                                |
| 1                                             | Pollution index values are based on reported land use type EMC distributions and impact potential thresholds from House et al (1991), Luker and Montague (1994), Butler and Clark (1995), D'Arcy et al (2000), Mitchell (2005) and Moy et al (2003) |                                                                   |                                                 |                                                        |                                |

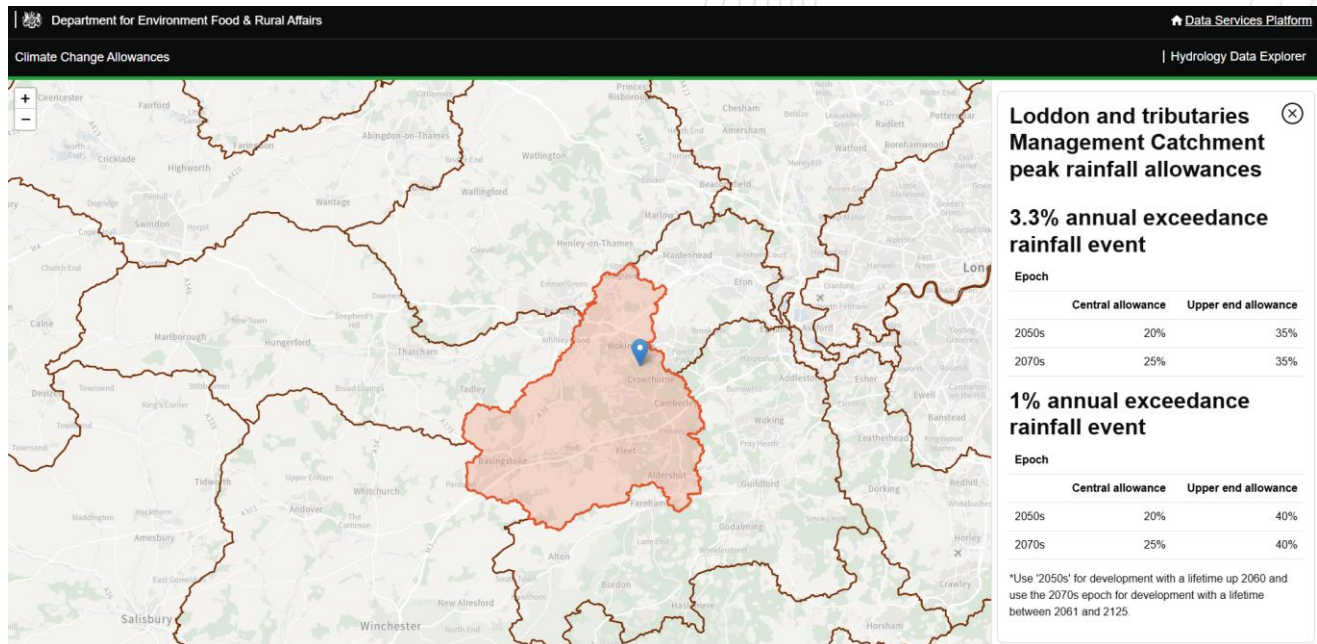
**Figure 8: Impermeability and pollution indices for different land use types**

3.2.9 Pervious surfacing and cellular soakaway is proposed. A cellular soakaway is located at the rear of the property, it is included in the design to provide necessary storage attenuation for all storm events.

3.2.10 The above proposals ensure that at least one SuDS measure is applied, and betterment is provided in terms of surface water runoff velocity, quality and quantity.

### 3.3 Climate change

- 3.3.1 The appended drainage calculation allows for a 1:100-year storm plus 40% climate change, this has been sourced from the [DEFRA Hydrology Data Explorer for Climate Change Allowances](#), as per **figure 9**, below.



**Figure 9 : Climate change allowances for peak rainfall in England by catchment area**

### 3.4 Preliminary Surface Water Drainage Maintenance Schedules

- 3.4.1 This section of the report gives guidance on the maintenance of the drainage system and outlines who will be responsible. The proposed development comprises of site clearance, parking, drainage and supporting infrastructure. The SuDS systems will aim to control runoff in terms of velocity and quality.
- 3.4.2 The rainwater from the roofs is collected via rainwater pipes and will be carried to the network. The maintenance of the collection system is the responsibility of the developer, see **Table 2** below

| Maintenance Schedule | Required Action                                                                                                                                             | Recommended Frequency                         |
|----------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------|
| Regular Maintenance  | Inspection of silt trap chamber and removal of debris when necessary                                                                                        | Quarterly or as required following monitoring |
| Remedial actions     | Check for blockages in manholes and pipes. Rodding and jetting of pipes to be carried out. CCTV survey can be carried out to inspect condition of pipework. | Quarterly or as required following monitoring |
| Monitoring           | Inspect collection apparatus for debris and litter. Remove where necessary to prevent blockages in the system                                               | Monthly or after periods of heavy rainfall    |

**Table 2: System storage operation and maintenance requirements (rainwater pipes and chambers)**

3.4.3 Maintenance of the permeable surfacing will be the responsibility of the developer, see **Table 3** below.

| Maintenance Schedule   | Required Action                                                                                                                                                                                                             | Recommended Frequency                                                                                                                                                                                        |
|------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Regular Maintenance    | Sweeping. [NOTE: Any jointing material between the blocks that is lost or displaced as a result of sweeping must be replaced.<br><br>New jointing material must be the same type as that removed or a suitable replacement] | 3 no. times a year: - <ul style="list-style-type: none"> <li>At the end of Winter;</li> <li>Mid-summer; and</li> <li>After autumn leaf fall.</li> </ul> Also as required based on site specific observations |
| Occasional Maintenance | Stabilise and mow contributing and adjacent areas to prevent excess sediment being washed into the paving                                                                                                                   | As required                                                                                                                                                                                                  |
| Remedial actions       | Remedial work to any depressions, rutting and cracked or broken blocks considered detrimental to the structural performance or a hazard to users                                                                            | As required                                                                                                                                                                                                  |
|                        | Rehabilitation of surface and underlying sand a geo-textile                                                                                                                                                                 | As required (if local distortion or settlement occurs as a result of wash out of bedding)                                                                                                                    |
| Monitoring             | Inspect for evidence for weed growth or deposits affecting run off. If required, take remedial action                                                                                                                       | Monthly for 3 no. months after installation, then during regular maintenance visits                                                                                                                          |

**Table 3: System storage operation and maintenance requirements (Permeable Surfacing)**

3.4.4 The maintenance of the Cellular soakaway is the responsibility of the developer, see **Table 4** below.

**Table 4: System Storage operation and maintenance requirements (Cellular Soakaway)**

| Maintenance Schedule | Required Action                                                                                                                                                                       | Recommended Frequency                                                                |
|----------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|
| Regular Maintenance  | Remove litter, debris and grass cuttings from upstream chamber to prevent being washed into the tank. Inspection of the chamber and the removal of any sediment/debris when required. | Quarterly or as required following monitoring                                        |
| Monitoring           | Inspect for evidence of deposits affecting run off                                                                                                                                    | Monthly for 3 no. months after installation, then during regular maintenance visits. |
|                      |                                                                                                                                                                                       |                                                                                      |

- 3.4.5 Rainwater Harvesting – Surface Water runoff is to be directed to the rainwater harvesting unit for irrigation purposes. Maintenance of the unit will be the responsibility of the developer see **Table 5** below.

| Maintenance Schedule   | Required Action                                                                                                                                                                                                                        | Recommended Frequency                     |
|------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------|
| Regular Maintenance    | Inspection of the tank for debris and sediment build-up, inlets/outlets/withdrawal devices, overflow areas, pumps, filters, Cleaning of tank, inlets, outlets, gutters, withdrawal devices and roof drain filters of silts and debris. | Annually (and following poor performance) |
| Occasional Maintenance | Cleaning and/or replacement of filters                                                                                                                                                                                                 | Three monthly (or as required)            |
| Remedial actions       | Repair of overflow erosion damage or tank damage. Pump repairs structural performance.                                                                                                                                                 | As required                               |

**Table 5: System Storage operation and maintenance requirements (Rainwater Harvesting)**

- 3.4.7 The design life of the development is likely to exceed the design life of each of the SuDS components listed above. During the routine inspections of any drainage components, it may become apparent that they have reached the end of their functional lifetime. In the interest of sustainability, repairs should be the first-choice solution where practicable. If this is not the case, then it will be necessary for the property owners to undertake complete replacement of the component in question.

## 4.0 Surface Water Strategy

The surface water strategy is based upon the SuDS implementation as outlined above and the Local Planning Authority of Stafford Borough Council Local Plan policies of Policy 42 and policy 43 hierarchy for surface water disposal as follows:

### A. Store rainwater for later use:

Rainwater harvesting is proposed for non-potable purposes.

### B. Use infiltration techniques, such as porous surfaces:

The ground conditions appear to support the use of infiltration techniques. Permeable paving and cellular soakaway are proposed.

### C. Attenuate rainwater in ponds or open water features for gradual release:

The site layout does not offer the opportunity for open water attenuation features.

### D. Permanent storage structure water features for gradual release:

All runoff generated by the proposed development is to be draining into the cellular soakaway via various SuDS features. Permeable surfacing is proposed in order to provide SuDS benefits.

Surface water from the roof and surfaced areas will be directed through the drainage network towards soakaway proposed in the site and allowing it to infiltrate in the ground.

### E. Direct rainwater direct to the watercourse:

Not applicable.

### F. Discharge rainwater to a surface water sewer/drain:

Not applicable.

### G. Discharge rainwater to combined sewer:

Not applicable.

### H. Discharge rainwater to foul sewer:

Not applicable.

Proposed drainage layout and construction details supporting the above can be found in [Appendix C](#). Supporting calculations can be found in [Appendix B](#).

## 4.1 *Surface Water Management During Construction*

- 4.1.1 Consideration for surface water needs to be taken during the construction process, and how it is managed, including flood risk and pollution control.
- 4.1.2 Generally, there are three options for managing surface water during construction
- Build, use and remediate permanent surface water drainage system
  - Install, use and remove a temporary surface water drainage system
  - Utilise existing drainage system with pollution control measures (brownfield sites only)
- 4.1.3 For this developed site, it is recommended to build, use and remediate the permanent surface water drainage system.
- 4.1.4 Project and Site Managers should sign up for the Met Office weather warning system and take appropriate action. <https://www.metoffice.gov.uk/public/weather/warnings>
- 4.1.5 Consideration of the following legislation and guidance should be made for a construction surface water management plan:

| Legislation and Guidance                                                                             |
|------------------------------------------------------------------------------------------------------|
| The Water Environment (England and Wales) Regulation 2009                                            |
| Land Drainage Act 1991                                                                               |
| SEPA Engineering in the Water Environment Good Practice Guide Temporary Construction Methods         |
| Control of Water Pollution from Construction Sites – Guide to Good Practice (SP156)                  |
| Control of Water Pollution from Construction Sites – Guidance for Consultants and Contractors (C532) |
| Control of Water Pollution from Linear Construction Projects – Technical Guidance (C648)             |
| Control of Water Pollution from Linear Construction Projects – Site Guide (C649)                     |
| Environmental Good Practice – Site Guide (C650)                                                      |
| Site Handbook for the Construction of SuDS (C698)                                                    |
| The SuDS Manual (C753)                                                                               |
| BS 8582:2013 Code of Practice for Surface Water Management for Development Sites                     |

**Figure 10 Legislation and Guidance for Surface Water Construction Management**

## 4.2 *Designing for Exceedance*

- 4.2.1 Consideration should be given to external levels to ensure they are set above overland flood risk levels, and low points are created to direct water away from the building footprints during exceedance events.
- 4.2.2 CIRIA document C635 *Designing for exceedance in urban drainage – good practice* states that “at present there are no guidelines on the return period of event (extreme event) that should be used for design exceedance”. However, Section 3.4 also states that “it is suggested that return periods of 1 in 30, to 1 in 100-year events would form a suitable framework for most applications”.
- 4.2.3 In accordance with the above, the system has been modelled using a 1 in 100-year event inclusive of climate change.

## 5.0 Conclusions

- 5.0.1 The proposed site is a brownfield site.
- 5.0.2 Surface water disposal via infiltration is considered feasible owing to the underlying soils.
- 5.0.3 Permeable surfacing and infiltration methods are proposed to provide SuDS measures as required.
- 5.0.4 The drainage strategy and SuDS measures in this report are in accordance with the requirements of the local and national policies.

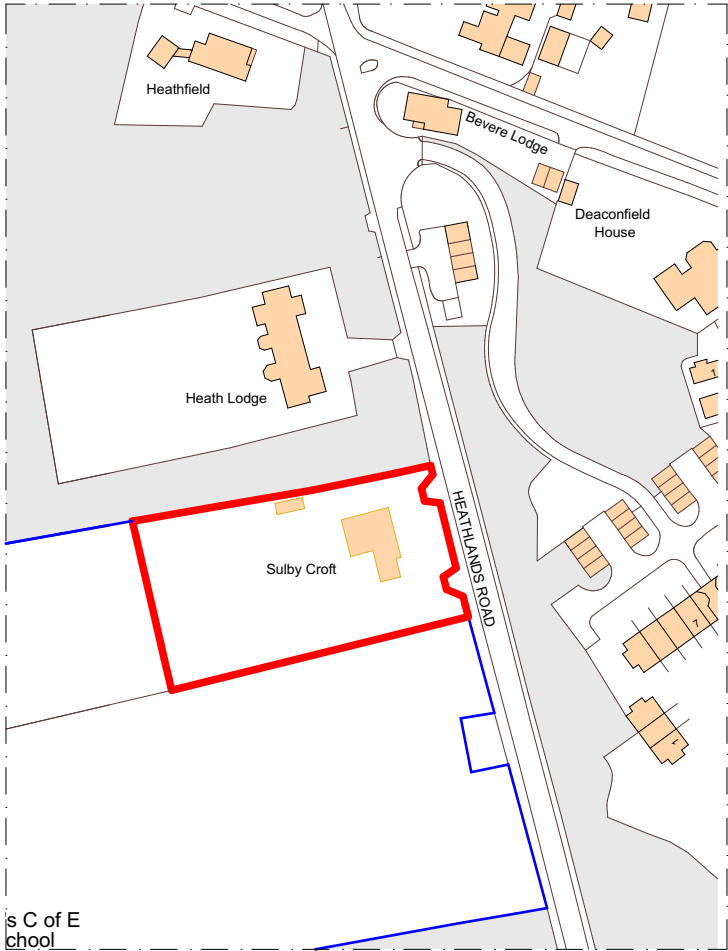
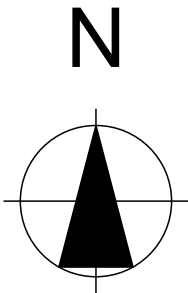
## 6.0 Appendices

### *Appendix A– Architectural Plans*

Notes:

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All dimensions to be checked on site and any discrepancies to be reported before work commences.



1:2000 Location Plan

Site Area: 3 456.47  
Existing Footprint: 193.3 m2

Drawing Title:  
**Location Plan**

**THE KEEN PARTNERSHIP**

The Courtyard  
Edinburgh Road  
Reading RG30 2UA  
Tel: 0118 9510 855  
Fax: 0118 9510 866  
chris@keenpartnership.co.uk  
www.keenpartnership.co.uk

Job Title:  
**Soulby Croft RG40 3AR**



Drawing Date:  
**6.04.23**

Issue Date:  
**09/10/2024**

Status:  
**Planning Drawings**

Drawn By:  
**PD**

Scale:  
**@A4**

Job No:  
**#Pln**

Drawing No:  
**9230-100**

Rev:



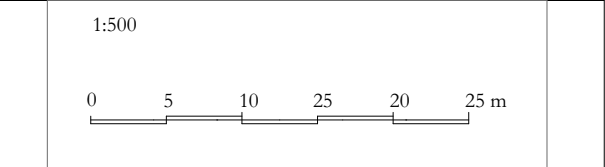
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All dimensions to be checked on site and any discrepancies to be reported before work commences.

**Notes:**

Site Area: 3 456.47  
Existing Footprint: 193.3 m2  
Demolish Footprint: 0  
Proposed Footprint: 574.4 m2  
Existing GIA: 330.7m2  
Proposed GIA: 804.8m2

| Date | Rev | Comments | By | Chk'd |
|------|-----|----------|----|-------|
|      |     |          |    |       |



**THE KEEN PARTNERSHIP**

The Courtyard  
Edinburgh Road  
Reading RG30 2UA  
Tel: 0118 9510 855  
Fax: 0118 9510 866  
chris@keenpartnership.co.uk  
www.keenpartnership.co.uk

**cabe**  
chartered association  
of building engineers

**RICS**

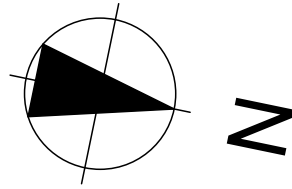
Job Title:

**Soulby Croft RG40 3AR**

Drawing Title:

**Existing Block & Proposed Block Plan**

|                                  |                                     |                      |
|----------------------------------|-------------------------------------|----------------------|
| Drawing Date:<br><b>6.04.23</b>  | Status:<br><b>Planning Drawings</b> |                      |
| Issue Date:<br><b>09/10/2024</b> | Drawn By:<br><b>PD</b>              | Scale:<br><b>@A3</b> |
| Drawing No:<br><b>9230-101</b>   |                                     | Rev:                 |



Air Source Heat Pump Location

Surface and foul water tanks

Existing inspection chamber surface water

existing chamber foul

1:100

Proposed Ground Floor Plan

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All dimensions to be checked on site and any discrepancies to be reported before work commences.

Notes:

Site Area: 3 456.47  
Existing Footprint: 193.3 m2  
Demolish Footprint: 0  
Proposed Footprint: 574.4 m2  
Existing GIA: 330.7m2  
Proposed GIA: 804.8m2

1:100

0 1 2 3 4 5 m

THE  
KEEN  
PARTNERSHIP  
The Courtyard  
Edinburgh Road  
Reading RG30 2UA  
Tel: 0118 9510 855  
Fax: 0118 9510 866  
chris@keenpartnership.co.uk  
www.keenpartnership.co.uk



Client:

..

Job Title:

Drawing Title:

Proposed Ground Floor Plan

Drawing Date:

09/10/2024

Status:

Planning Drawings

Drawn By:

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Scale:

@A1

Job No:

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Drawing No:

9230-107

Rev:

A

*Appendix B – Proposed Drainage Calculations*

|                                                                                                                                                                                                                                                                                                                                                                                     |                                       |                                                                                     |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------|-------------------------------------------------------------------------------------|
| JMS Chelmsford Ltd                                                                                                                                                                                                                                                                                                                                                                  |                                       | Page 1                                                                              |
| BIC110 - The MedBIC<br>Alan Cherry Drive<br>Chelmsford CM1 1SQ                                                                                                                                                                                                                                                                                                                      |                                       |  |
| Date 10/12/2024 15:28<br>File                                                                                                                                                                                                                                                                                                                                                       | Designed by MathanKumar<br>Checked by |                                                                                     |
| XP Solutions                                                                                                                                                                                                                                                                                                                                                                        |                                       |                                                                                     |
| Source Control 2018.1                                                                                                                                                                                                                                                                                                                                                               |                                       |                                                                                     |
| <div>ICP SUDS Mean Annual Flood</div> <div>Input</div> <div>Return Period (years) 100                      Soil 0.400<br/>Area (ha) 0.061                      Urban 0.000<br/>SAAR (mm) 700 Region Number Region 6</div> <div>Results 1/s</div> <div>QBAR Rural 0.2<br/>QBAR Urban 0.2</div> <div>Q100 years 0.7</div> <div>Q1 year 0.2<br/>Q30 years 0.5<br/>Q100 years 0.7</div> |                                       |                                                                                     |
| ©1982-2018 Innovyze                                                                                                                                                                                                                                                                                                                                                                 |                                       |                                                                                     |

| JMS Chelmsford Ltd                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     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-|------|-----|-----------------|-------|-------|-----|------|-----|-----------------|-------|-------|-----|------|-----|------------------|-------|-------|-----|------|-----|---------------|-------|-------|-----|------|-----|----------------|-----------------|---------------------------|---------------------|---------------|---------|-----|----|---------------|--------|-----|----|---------------|--------|-----|----|----------------|--------|-----|-----|----------------|--------|-----|-----|----------------|--------|-----|-----|----------------|--------|-----|-----|----------------|--------|-----|-----|----------------|-------|-----|-----|----------------|-------|-----|-----|----------------|-------|-----|-----|-----------------|-------|-----|------|-----------------|-------|-----|------|-----------------|-------|-----|------|-----------------|-------|-----|------|-----------------|-------|-----|------|-----------------|-------|-----|------|-----------------|-------|-----|------|------------------|-------|-----|------|---------------|---------|-----|----|
| BIC110 - The MedBIC<br>Alan Cherry Drive<br>Chelmsford CM1 1SQ                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         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| Date 09/12/2024 16:57<br>File Infiltration Calc 100 Y...                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               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| XP Solutions                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           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      |       |     |      |               |         |     |    |
| <p><u>Summary of Results for 100 year Return Period (+40%)</u></p> <p>Half Drain Time : 1386 minutes.</p> <table><thead><tr><th>Storm<br/>Event</th><th>Max<br/>Level<br/>(m)</th><th>Max<br/>Depth<br/>(m)</th><th>Max<br/>Infiltration<br/>(l/s)</th><th>Max<br/>Volume<br/>(m³)</th><th>Status</th></tr></thead><tbody><tr><td>15 min Summer</td><td>8.789</td><td>0.274</td><td>0.3</td><td>19.5</td><td>O K</td></tr><tr><td>30 min Summer</td><td>8.873</td><td>0.358</td><td>0.3</td><td>25.5</td><td>O K</td></tr><tr><td>60 min Summer</td><td>8.959</td><td>0.444</td><td>0.3</td><td>31.6</td><td>O K</td></tr><tr><td>120 min Summer</td><td>9.043</td><td>0.528</td><td>0.3</td><td>37.6</td><td>O K</td></tr><tr><td>180 min Summer</td><td>9.088</td><td>0.573</td><td>0.3</td><td>40.8</td><td>O K</td></tr><tr><td>240 min Summer</td><td>9.116</td><td>0.601</td><td>0.3</td><td>42.8</td><td>O K</td></tr><tr><td>360 min Summer</td><td>9.147</td><td>0.632</td><td>0.3</td><td>45.0</td><td>O K</td></tr><tr><td>480 min Summer</td><td>9.164</td><td>0.649</td><td>0.3</td><td>46.3</td><td>O K</td></tr><tr><td>600 min Summer</td><td>9.173</td><td>0.658</td><td>0.3</td><td>46.9</td><td>O K</td></tr><tr><td>720 min Summer</td><td>9.176</td><td>0.661</td><td>0.3</td><td>47.1</td><td>O K</td></tr><tr><td>960 min Summer</td><td>9.171</td><td>0.656</td><td>0.3</td><td>46.8</td><td>O K</td></tr><tr><td>1440 min Summer</td><td>9.149</td><td>0.634</td><td>0.3</td><td>45.2</td><td>O K</td></tr><tr><td>2160 min Summer</td><td>9.116</td><td>0.601</td><td>0.3</td><td>42.8</td><td>O K</td></tr><tr><td>2880 min Summer</td><td>9.083</td><td>0.568</td><td>0.3</td><td>40.5</td><td>O K</td></tr><tr><td>4320 min Summer</td><td>9.024</td><td>0.509</td><td>0.3</td><td>36.3</td><td>O K</td></tr><tr><td>5760 min Summer</td><td>8.970</td><td>0.455</td><td>0.3</td><td>32.4</td><td>O K</td></tr><tr><td>7200 min Summer</td><td>8.921</td><td>0.406</td><td>0.3</td><td>28.9</td><td>O K</td></tr><tr><td>8640 min Summer</td><td>8.875</td><td>0.360</td><td>0.3</td><td>25.7</td><td>O K</td></tr><tr><td>10080 min Summer</td><td>8.833</td><td>0.318</td><td>0.3</td><td>22.7</td><td>O K</td></tr><tr><td>15 min Winter</td><td>8.822</td><td>0.307</td><td>0.3</td><td>21.9</td><td>O K</td></tr></tbody></table> <table><thead><tr><th>Storm<br/>Event</th><th>Rain<br/>(mm/hr)</th><th>Flooded<br/>Volume<br/>(m³)</th><th>Time-Peak<br/>(mins)</th></tr></thead><tbody><tr><td>15 min Summer</td><td>128.336</td><td>0.0</td><td>19</td></tr><tr><td>30 min Summer</td><td>84.360</td><td>0.0</td><td>34</td></tr><tr><td>60 min Summer</td><td>52.892</td><td>0.0</td><td>64</td></tr><tr><td>120 min Summer</td><td>32.091</td><td>0.0</td><td>124</td></tr><tr><td>180 min Summer</td><td>23.662</td><td>0.0</td><td>182</td></tr><tr><td>240 min Summer</td><td>18.958</td><td>0.0</td><td>242</td></tr><tr><td>360 min Summer</td><td>13.760</td><td>0.0</td><td>362</td></tr><tr><td>480 min Summer</td><td>10.974</td><td>0.0</td><td>482</td></tr><tr><td>600 min Summer</td><td>9.199</td><td>0.0</td><td>602</td></tr><tr><td>720 min Summer</td><td>7.961</td><td>0.0</td><td>720</td></tr><tr><td>960 min Summer</td><td>6.333</td><td>0.0</td><td>960</td></tr><tr><td>1440 min Summer</td><td>4.580</td><td>0.0</td><td>1196</td></tr><tr><td>2160 min Summer</td><td>3.307</td><td>0.0</td><td>1560</td></tr><tr><td>2880 min Summer</td><td>2.622</td><td>0.0</td><td>1964</td></tr><tr><td>4320 min Summer</td><td>1.888</td><td>0.0</td><td>2808</td></tr><tr><td>5760 min Summer</td><td>1.494</td><td>0.0</td><td>3624</td></tr><tr><td>7200 min Summer</td><td>1.245</td><td>0.0</td><td>4400</td></tr><tr><td>8640 min Summer</td><td>1.073</td><td>0.0</td><td>5184</td></tr><tr><td>10080 min Summer</td><td>0.946</td><td>0.0</td><td>5952</td></tr><tr><td>15 min Winter</td><td>128.336</td><td>0.0</td><td>19</td></tr></tbody></table> |                     |                                       |                              |                                                                                     |        | Storm<br>Event | Max<br>Level<br>(m) | Max<br>Depth<br>(m) | Max<br>Infiltration<br>(l/s) | Max<br>Volume<br>(m³) | Status | 15 min Summer | 8.789 | 0.274 | 0.3 | 19.5 | O K | 30 min Summer | 8.873 | 0.358 | 0.3 | 25.5 | O K | 60 min Summer | 8.959 | 0.444 | 0.3 | 31.6 | O K | 120 min Summer | 9.043 | 0.528 | 0.3 | 37.6 | O K | 180 min Summer | 9.088 | 0.573 | 0.3 | 40.8 | O K | 240 min Summer | 9.116 | 0.601 | 0.3 | 42.8 | O K | 360 min Summer | 9.147 | 0.632 | 0.3 | 45.0 | O K | 480 min Summer | 9.164 | 0.649 | 0.3 | 46.3 | O K | 600 min Summer | 9.173 | 0.658 | 0.3 | 46.9 | O K | 720 min Summer | 9.176 | 0.661 | 0.3 | 47.1 | O K | 960 min Summer | 9.171 | 0.656 | 0.3 | 46.8 | O K | 1440 min Summer | 9.149 | 0.634 | 0.3 | 45.2 | O K | 2160 min Summer | 9.116 | 0.601 | 0.3 | 42.8 | O K | 2880 min Summer | 9.083 | 0.568 | 0.3 | 40.5 | O K | 4320 min Summer | 9.024 | 0.509 | 0.3 | 36.3 | O K | 5760 min Summer | 8.970 | 0.455 | 0.3 | 32.4 | O K | 7200 min Summer | 8.921 | 0.406 | 0.3 | 28.9 | O K | 8640 min Summer | 8.875 | 0.360 | 0.3 | 25.7 | O K | 10080 min Summer | 8.833 | 0.318 | 0.3 | 22.7 | O K | 15 min Winter | 8.822 | 0.307 | 0.3 | 21.9 | O K | Storm<br>Event | Rain<br>(mm/hr) | Flooded<br>Volume<br>(m³) | Time-Peak<br>(mins) | 15 min Summer | 128.336 | 0.0 | 19 | 30 min Summer | 84.360 | 0.0 | 34 | 60 min Summer | 52.892 | 0.0 | 64 | 120 min Summer | 32.091 | 0.0 | 124 | 180 min Summer | 23.662 | 0.0 | 182 | 240 min Summer | 18.958 | 0.0 | 242 | 360 min Summer | 13.760 | 0.0 | 362 | 480 min Summer | 10.974 | 0.0 | 482 | 600 min Summer | 9.199 | 0.0 | 602 | 720 min Summer | 7.961 | 0.0 | 720 | 960 min Summer | 6.333 | 0.0 | 960 | 1440 min Summer | 4.580 | 0.0 | 1196 | 2160 min Summer | 3.307 | 0.0 | 1560 | 2880 min Summer | 2.622 | 0.0 | 1964 | 4320 min Summer | 1.888 | 0.0 | 2808 | 5760 min Summer | 1.494 | 0.0 | 3624 | 7200 min Summer | 1.245 | 0.0 | 4400 | 8640 min Summer | 1.073 | 0.0 | 5184 | 10080 min Summer | 0.946 | 0.0 | 5952 | 15 min Winter | 128.336 | 0.0 | 19 |
| Storm<br>Event                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         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                                          | Status |                |                     |                     |                              |                       |        |               |       |       |     |      |     |               |       |       |     |      |     |               |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                 |       |       |     |      |     |                 |       |       |     |      |     |                 |       |       |     |      |     |                 |       |       |     |      |     |                 |       |       |     |      |     |                 |       |       |     |      |     |                 |       |       |     |      |     |                  |       |       |     |      |     |               |       |       |     |      |     |                |                 |                           |                     |               |         |     |    |               |        |     |    |               |        |     |    |                |        |     |     |                |        |     |     |                |        |     |     |                |        |     |     |                |        |     |     |                |       |     |     |                |       |     |     |                |       |     |     |                 |       |     |      |                 |       |     |      |                 |       |     |      |                 |       |     |      |                 |       |     |      |                 |       |     |      |                 |       |     |      |                  |       |     |      |               |         |     |    |
| 15 min Summer                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | 8.789               | 0.274                                 | 0.3                          | 19.5                                                                                | O K    |                |                     |                     |                              |                       |        |               |       |       |     |      |     |               |       |       |     |      |     |               |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                 |       |       |     |      |     |                 |       |       |     |      |     |                 |       |       |     |      |     |                 |       |       |     |      |     |                 |       |       |     |      |     |                 |       |       |     |      |     |                 |       |       |     |      |     |                  |       |       |     |      |     |               |       |       |     |      |     |                |                 |                           |                     |               |         |     |    |               |        |     |    |               |        |     |    |                |        |     |     |                |        |     |     |                |        |     |     |                |        |     |     |                |        |     |     |                |       |     |     |                |       |     |     |                |       |     |     |                 |       |     |      |                 |       |     |      |                 |       |     |      |                 |       |     |      |                 |       |     |      |                 |       |     |      |                 |       |     |      |                  |       |     |      |               |         |     |    |
| 30 min Summer                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | 8.873               | 0.358                                 | 0.3                          | 25.5                                                                                | O K    |                |                     |                     |                              |                       |        |               |       |       |     |      |     |               |       |       |     |      |     |               |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                 |       |       |     |      |     |                 |       |       |     |      |     |                 |       |       |     |      |     |                 |       |       |     |      |     |                 |       |       |     |      |     |                 |       |       |     |      |     |                 |       |       |     |      |     |                  |       |       |     |      |     |               |       |       |     |      |     |                |                 |                           |                     |               |         |     |    |               |        |     |    |               |        |     |    |                |        |     |     |                |        |     |     |                |        |     |     |                |        |     |     |                |        |     |     |                |       |     |     |                |       |     |     |                |       |     |     |                 |       |     |      |                 |       |     |      |                 |       |     |      |                 |       |     |      |                 |       |     |      |                 |       |     |      |                 |       |     |      |                  |       |     |      |               |         |     |    |
| 60 min Summer                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | 8.959               | 0.444                                 | 0.3                          | 31.6                                                                                | O K    |                |                     |                     |                              |                       |        |               |       |       |     |      |     |               |       |       |     |      |     |               |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                 |       |       |     |      |     |                 |       |       |     |      |     |                 |       |       |     |      |     |                 |       |       |     |      |     |                 |       |       |     |      |     |                 |       |       |     |      |     |                 |       |       |     |      |     |                  |       |       |     |      |     |               |       |       |     |      |     |                |                 |                           |                     |               |         |     |    |               |        |     |    |               |        |     |    |                |        |     |     |                |        |     |     |                |        |     |     |                |        |     |     |                |        |     |     |                |       |     |     |                |       |     |     |                |       |     |     |                 |       |     |      |                 |       |     |      |                 |       |     |      |                 |       |     |      |                 |       |     |      |                 |       |     |      |                 |       |     |      |                  |       |     |      |               |         |     |    |
| 120 min Summer                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | 9.043               | 0.528                                 | 0.3                          | 37.6                                                                                | O K    |                |                     |                     |                              |                       |        |               |       |       |     |      |     |               |       |       |     |      |     |               |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                 |       |       |     |      |     |                 |       |       |     |      |     |                 |       |       |     |      |     |                 |       |       |     |      |     |                 |       |       |     |      |     |                 |       |       |     |      |     |                 |       |       |     |      |     |                  |       |       |     |      |     |               |       |       |     |      |     |                |                 |                           |                     |               |         |     |    |               |        |     |    |               |        |     |    |                |        |     |     |                |        |     |     |                |        |     |     |                |        |     |     |                |        |     |     |                |       |     |     |                |       |     |     |                |       |     |     |                 |       |     |      |                 |       |     |      |                 |       |     |      |                 |       |     |      |                 |       |     |      |                 |       |     |      |                 |       |     |      |                  |       |     |      |               |         |     |    |
| 180 min Summer                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | 9.088               | 0.573                                 | 0.3                          | 40.8                                                                                | O K    |                |                     |                     |                              |                       |        |               |       |       |     |      |     |               |       |       |     |      |     |               |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                 |       |       |     |      |     |                 |       |       |     |      |     |                 |       |       |     |      |     |                 |       |       |     |      |     |                 |       |       |     |      |     |                 |       |       |     |      |     |                 |       |       |     |      |     |                  |       |       |     |      |     |               |       |       |     |      |     |                |                 |                           |                     |               |         |     |    |               |        |     |    |               |        |     |    |                |        |     |     |                |        |     |     |                |        |     |     |                |        |     |     |                |        |     |     |                |       |     |     |                |       |     |     |                |       |     |     |                 |       |     |      |                 |       |     |      |                 |       |     |      |                 |       |     |      |                 |       |     |      |                 |       |     |      |                 |       |     |      |                  |       |     |      |               |         |     |    |
| 240 min Summer                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | 9.116               | 0.601                                 | 0.3                          | 42.8                                                                                | O K    |                |                     |                     |                              |                       |        |               |       |       |     |      |     |               |       |       |     |      |     |               |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                 |       |       |     |      |     |                 |       |       |     |      |     |                 |       |       |     |      |     |                 |       |       |     |      |     |                 |       |       |     |      |     |                 |       |       |     |      |     |                 |       |       |     |      |     |                  |       |       |     |      |     |               |       |       |     |      |     |                |                 |                           |                     |               |         |     |    |               |        |     |    |               |        |     |    |                |        |     |     |                |        |     |     |                |        |     |     |                |        |     |     |                |        |     |     |                |       |     |     |                |       |     |     |                |       |     |     |                 |       |     |      |                 |       |     |      |                 |       |     |      |                 |       |     |      |                 |       |     |      |                 |       |     |      |                 |       |     |      |                  |       |     |      |               |         |     |    |
| 360 min Summer                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | 9.147               | 0.632                                 | 0.3                          | 45.0                                                                                | O K    |                |                     |                     |                              |                       |        |               |       |       |     |      |     |               |       |       |     |      |     |               |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                 |       |       |     |      |     |                 |       |       |     |      |     |                 |       |       |     |      |     |                 |       |       |     |      |     |                 |       |       |     |      |     |                 |       |       |     |      |     |                 |       |       |     |      |     |                  |       |       |     |      |     |               |       |       |     |      |     |                |                 |                           |                     |               |         |     |    |               |        |     |    |               |        |     |    |                |        |     |     |                |        |     |     |                |        |     |     |                |        |     |     |                |        |     |     |                |       |     |     |                |       |     |     |                |       |     |     |                 |       |     |      |                 |       |     |      |                 |       |     |      |                 |       |     |      |                 |       |     |      |                 |       |     |      |                 |       |     |      |                  |       |     |      |               |         |     |    |
| 480 min Summer                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | 9.164               | 0.649                                 | 0.3                          | 46.3                                                                                | O K    |                |                     |                     |                              |                       |        |               |       |       |     |      |     |               |       |       |     |      |     |               |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                 |       |       |     |      |     |                 |       |       |     |      |     |                 |       |       |     |      |     |                 |       |       |     |      |     |                 |       |       |     |      |     |                 |       |       |     |      |     |                 |       |       |     |      |     |                  |       |       |     |      |     |               |       |       |     |      |     |                |                 |                           |                     |               |         |     |    |               |        |     |    |               |        |     |    |                |        |     |     |                |        |     |     |                |        |     |     |                |        |     |     |                |        |     |     |                |       |     |     |                |       |     |     |                |       |     |     |                 |       |     |      |                 |       |     |      |                 |       |     |      |                 |       |     |      |                 |       |     |      |                 |       |     |      |                 |       |     |      |                  |       |     |      |               |         |     |    |
| 600 min Summer                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | 9.173               | 0.658                                 | 0.3                          | 46.9                                                                                | O K    |                |                     |                     |                              |                       |        |               |       |       |     |      |     |               |       |       |     |      |     |               |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                 |       |       |     |      |     |                 |       |       |     |      |     |                 |       |       |     |      |     |                 |       |       |     |      |     |                 |       |       |     |      |     |                 |       |       |     |      |     |                 |       |       |     |      |     |                  |       |       |     |      |     |               |       |       |     |      |     |                |                 |                           |                     |               |         |     |    |               |        |     |    |               |        |     |    |                |        |     |     |                |        |     |     |                |        |     |     |                |        |     |     |                |        |     |     |                |       |     |     |                |       |     |     |                |       |     |     |                 |       |     |      |                 |       |     |      |                 |       |     |      |                 |       |     |      |                 |       |     |      |                 |       |     |      |                 |       |     |      |                  |       |     |      |               |         |     |    |
| 720 min Summer                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | 9.176               | 0.661                                 | 0.3                          | 47.1                                                                                | O K    |                |                     |                     |                              |                       |        |               |       |       |     |      |     |               |       |       |     |      |     |               |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                 |       |       |     |      |     |                 |       |       |     |      |     |                 |       |       |     |      |     |                 |       |       |     |      |     |                 |       |       |     |      |     |                 |       |       |     |      |     |                 |       |       |     |      |     |                  |       |       |     |      |     |               |       |       |     |      |     |                |                 |                           |                     |               |         |     |    |               |        |     |    |               |        |     |    |                |        |     |     |                |        |     |     |                |        |     |     |                |        |     |     |                |        |     |     |                |       |     |     |                |       |     |     |                |       |     |     |                 |       |     |      |                 |       |     |      |                 |       |     |      |                 |       |     |      |                 |       |     |      |                 |       |     |      |                 |       |     |      |                  |       |     |      |               |         |     |    |
| 960 min Summer                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | 9.171               | 0.656                                 | 0.3                          | 46.8                                                                                | O K    |                |                     |                     |                              |                       |        |               |       |       |     |      |     |               |       |       |     |      |     |               |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                 |       |       |     |      |     |                 |       |       |     |      |     |                 |       |       |     |      |     |                 |       |       |     |      |     |                 |       |       |     |      |     |                 |       |       |     |      |     |                 |       |       |     |      |     |                  |       |       |     |      |     |               |       |       |     |      |     |                |                 |                           |                     |               |         |     |    |               |        |     |    |               |        |     |    |                |        |     |     |                |        |     |     |                |        |     |     |                |        |     |     |                |        |     |     |                |       |     |     |                |       |     |     |                |       |     |     |                 |       |     |      |                 |       |     |      |                 |       |     |      |                 |       |     |      |                 |       |     |      |                 |       |     |      |                 |       |     |      |                  |       |     |      |               |         |     |    |
| 1440 min Summer                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | 9.149               | 0.634                                 | 0.3                          | 45.2                                                                                | O K    |                |                     |                     |                              |                       |        |               |       |       |     |      |     |               |       |       |     |      |     |               |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                 |       |       |     |      |     |                 |       |       |     |      |     |                 |       |       |     |      |     |                 |       |       |     |      |     |                 |       |       |     |      |     |                 |       |       |     |      |     |                 |       |       |     |      |     |                  |       |       |     |      |     |               |       |       |     |      |     |                |                 |                           |                     |               |         |     |    |               |        |     |    |               |        |     |    |                |        |     |     |                |        |     |     |                |        |     |     |                |        |     |     |                |        |     |     |                |       |     |     |                |       |     |     |                |       |     |     |                 |       |     |      |                 |       |     |      |                 |       |     |      |                 |       |     |      |                 |       |     |      |                 |       |     |      |                 |       |     |      |                  |       |     |      |               |         |     |    |
| 2160 min Summer                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        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                                          | O K    |                |                     |                     |                              |                       |        |               |       |       |     |      |     |               |       |       |     |      |     |               |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                 |       |       |     |      |     |                 |       |       |     |      |     |                 |       |       |     |      |     |                 |       |       |     |      |     |                 |       |       |     |      |     |                 |       |       |     |      |     |                 |       |       |     |      |     |                  |       |       |     |      |     |               |       |       |     |      |     |                |                 |                           |                     |               |         |     |    |               |        |     |    |               |        |     |    |                |        |     |     |                |        |     |     |                |        |     |     |                |        |     |     |                |        |     |     |                |       |     |     |                |       |     |     |                |       |     |     |                 |       |     |      |                 |       |     |      |                 |       |     |      |                 |       |     |      |                 |       |     |      |                 |       |     |      |                 |       |     |      |                  |       |     |      |               |         |     |    |
| 2880 min Summer                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        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                                          | O K    |                |                     |                     |                              |                       |        |               |       |       |     |      |     |               |       |       |     |      |     |               |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                 |       |       |     |      |     |                 |       |       |     |      |     |                 |       |       |     |      |     |                 |       |       |     |      |     |                 |       |       |     |      |     |                 |       |       |     |      |     |                 |       |       |     |      |     |                  |       |       |     |      |     |               |       |       |     |      |     |                |                 |                           |                     |               |         |     |    |               |        |     |    |               |        |     |    |                |        |     |     |                |        |     |     |                |        |     |     |                |        |     |     |                |        |     |     |                |       |     |     |                |       |     |     |                |       |     |     |                 |       |     |      |                 |       |     |      |                 |       |     |      |                 |       |     |      |                 |       |     |      |                 |       |     |      |                 |       |     |      |                  |       |     |      |               |         |     |    |
| 4320 min Summer                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        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                                          | O K    |                |                     |                     |                              |                       |        |               |       |       |     |      |     |               |       |       |     |      |     |               |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                 |       |       |     |      |     |                 |       |       |     |      |     |                 |       |       |     |      |     |                 |       |       |     |      |     |                 |       |       |     |      |     |                 |       |       |     |      |     |                 |       |       |     |      |     |                  |       |       |     |      |     |               |       |       |     |      |     |                |                 |                           |                     |               |         |     |    |               |        |     |    |               |        |     |    |                |        |     |     |                |        |     |     |                |        |     |     |                |        |     |     |                |        |     |     |                |       |     |     |                |       |     |     |                |       |     |     |                 |       |     |      |                 |       |     |      |                 |       |     |      |                 |       |     |      |                 |       |     |      |                 |       |     |      |                 |       |     |      |                  |       |     |      |               |         |     |    |
| 5760 min Summer                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        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                                          | O K    |                |                     |                     |                              |                       |        |               |       |       |     |      |     |               |       |       |     |      |     |               |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                 |       |       |     |      |     |                 |       |       |     |      |     |                 |       |       |     |      |     |                 |       |       |     |      |     |                 |       |       |     |      |     |                 |       |       |     |      |     |                 |       |       |     |      |     |                  |       |       |     |      |     |               |       |       |     |      |     |                |                 |                           |                     |               |         |     |    |               |        |     |    |               |        |     |    |                |        |     |     |                |        |     |     |                |        |     |     |                |        |     |     |                |        |     |     |                |       |     |     |                |       |     |     |                |       |     |     |                 |       |     |      |                 |       |     |      |                 |       |     |      |                 |       |     |      |                 |       |     |      |                 |       |     |      |                 |       |     |      |                  |       |     |      |               |         |     |    |
| 7200 min Summer                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        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                                          | O K    |                |                     |                     |                              |                       |        |               |       |       |     |      |     |               |       |       |     |      |     |               |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                 |       |       |     |      |     |                 |       |       |     |      |     |                 |       |       |     |      |     |                 |       |       |     |      |     |                 |       |       |     |      |     |                 |       |       |     |      |     |                 |       |       |     |      |     |                  |       |       |     |      |     |               |       |       |     |      |     |                |                 |                           |                     |               |         |     |    |               |        |     |    |               |        |     |    |                |        |     |     |                |        |     |     |                |        |     |     |                |        |     |     |                |        |     |     |                |       |     |     |                |       |     |     |                |       |     |     |                 |       |     |      |                 |       |     |      |                 |       |     |      |                 |       |     |      |                 |       |     |      |                 |       |     |      |                 |       |     |      |                  |       |     |      |               |         |     |    |
| 8640 min Summer                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | 8.875               | 0.360                                 | 0.3                          | 25.7                                                                                | O K    |                |                     |                     |                              |                       |        |               |       |       |     |      |     |               |       |       |     |      |     |               |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                 |       |       |     |      |     |                 |       |       |     |      |     |                 |       |       |     |      |     |                 |       |       |     |      |     |                 |       |       |     |      |     |                 |       |       |     |      |     |                 |       |       |     |      |     |                  |       |       |     |      |     |               |       |       |     |      |     |                |                 |                           |                     |               |         |     |    |               |        |     |    |               |        |     |    |                |        |     |     |                |        |     |     |                |        |     |     |                |        |     |     |                |        |     |     |                |       |     |     |                |       |     |     |                |       |     |     |                 |       |     |      |                 |       |     |      |                 |       |     |      |                 |       |     |      |                 |       |     |      |                 |       |     |      |                 |       |     |      |                  |       |     |      |               |         |     |    |
| 10080 min Summer                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | 8.833               | 0.318                                 | 0.3                          | 22.7                                                                                | O K    |                |                     |                     |                              |                       |        |               |       |       |     |      |     |               |       |       |     |      |     |               |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                 |       |       |     |      |     |                 |       |       |     |      |     |                 |       |       |     |      |     |                 |       |       |     |      |     |                 |       |       |     |      |     |                 |       |       |     |      |     |                 |       |       |     |      |     |                  |       |       |     |      |     |               |       |       |     |      |     |                |                 |                           |                     |               |         |     |    |               |        |     |    |               |        |     |    |                |        |     |     |                |        |     |     |                |        |     |     |                |        |     |     |                |        |     |     |                |       |     |     |                |       |     |     |                |       |     |     |                 |       |     |      |                 |       |     |      |                 |       |     |      |                 |       |     |      |                 |       |     |      |                 |       |     |      |                 |       |     |      |                  |       |     |      |               |         |     |    |
| 15 min Winter                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | 8.822               | 0.307                                 | 0.3                          | 21.9                                                                                | O K    |                |                     |                     |                              |                       |        |               |       |       |     |      |     |               |       |       |     |      |     |               |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                 |       |       |     |      |     |                 |       |       |     |      |     |                 |       |       |     |      |     |                 |       |       |     |      |     |                 |       |       |     |   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      |       |     |      |               |         |     |    |
| Storm<br>Event                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | Rain<br>(mm/hr)     | Flooded<br>Volume<br>(m³)             | Time-Peak<br>(mins)          |                                                                                     |        |                |                     |                     |                              |                       |        |               |       |       |     |      |     |               |       |       |     |      |     |               |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                 |       |       |     |      |     |                 |       |       |     |      |     |                 |       |       |     |      |     |                 |       |       |     |      |     |                 |       |       |     |      |     |                 |       |       |     |      |     |                 |       |       |     |      |     |                  |       |       |     |      |     |               |       |       |     |      |     |                |                 |                           |                     |               |         |     |    |               |        |     |    |               |        |     |    |                |        |     |     |                |        |     |     |                |        |     |     |                |        |     |     |                |        |     |     |                |       |     |     |                |       |     |     |                |       |     |     |                 |       |     |      |                 |       |     |      |                 |       |     |      |                 |       |     |      |                 |       |     |      |                 |       |     |      |                 |       |     |      |                  |       |     |      |               |         |     |    |
| 15 min Summer                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | 128.336             | 0.0                                   | 19                           |                                                                                     |        |                |                     |                     |                              |                       |        |               |       |       |     |      |     |               |       |       |     |      |     |               |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                 |       |       |     |      |     |                 |       |       |     |      |     |                 |       |       |     |      |     |                 |       |       |     |      |     |                 |       |       |     |      |     |                 |       |       |     |      |     |                 |       |       |     |      |     |                  |       |       |     |      |     |               |       |       |     |      |     |                |                 |                           |                     |               |         |     |    |               |        |     |    |               |        |     |    |                |        |     |     |                |        |     |     |                |        |     |     |                |        |     |     |                |        |     |     |                |       |     |     |                |       |     |     |                |       |     |     |                 |       |     |      |                 |       |     |      |                 |       |     |      |                 |       |     |      |                 |       |     |      |                 |       |     |      |                 |       |     |      |                  |       |     |      |               |         |     |    |
| 30 min Summer                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | 84.360              | 0.0                                   | 34                           |                                                                                     |        |                |                     |                     |                              |                       |        |               |       |       |     |      |     |               |       |       |     |      |     |               |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                 |       |       |     |      |     |                 |       |       |     |      |     |                 |       |       |     |      |     |                 |       |       |     |      |     |                 |       |       |     |      |     |                 |       |       |     |      |     |                 |       |       |     |      |     |                  |       |       |     |      |     |               |       |       |     |      |     |                |                 |                           |                     |               |         |     |    |               |        |     |    |               |        |     |    |                |        |     |     |                |        |     |     |                |        |     |     |                |        |     |     |                |        |     |     |                |       |     |     |                |       |     |     |                |       |     |     |                 |       |     |      |                 |       |     |      |                 |       |     |      |                 |       |     |      |                 |       |     |      |                 |       |     |      |                 |       |     |      |                  |       |     |      |               |         |     |    |
| 60 min Summer                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          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                                          |        |                |                     |                     |                              |                       |        |               |       |       |     |      |     |               |       |       |     |      |     |               |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                 |       |       |     |      |     |                 |       |       |     |      |     |                 |       |       |     |      |     |                 |       |       |     |      |     |                 |       |       |     |      |     |                 |       |       |     |      |     |                 |       |       |     |      |     |                  |       |       |     |      |     |               |       |       |     |      |     |                |                 |                           |                     |               |         |     |    |               |        |     |    |               |        |     |    |                |        |     |     |                |        |     |     |                |        |     |     |                |        |     |     |                |        |     |     |                |       |     |     |                |       |     |     |                |       |     |     |                 |       |     |      |                 |       |     |      |                 |       |     |      |                 |       |     |      |                 |       |     |      |                 |       |     |      |                 |       |     |      |                  |       |     |      |               |         |     |    |
| 120 min Summer                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         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                                          |        |                |                     |                     |                              |                       |        |               |       |       |     |      |     |               |       |       |     |      |     |               |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                 |       |       |     |      |     |                 |       |       |     |      |     |                 |       |       |     |      |     |                 |       |       |     |      |     |                 |       |       |     |      |     |                 |       |       |     |      |     |                 |       |       |     |      |     |                  |       |       |     |      |     |               |       |       |     |      |     |                |                 |                           |                     |               |         |     |    |               |        |     |    |               |        |     |    |                |        |     |     |                |        |     |     |                |        |     |     |                |        |     |     |                |        |     |     |                |       |     |     |                |       |     |     |                |       |     |     |                 |       |     |      |                 |       |     |      |                 |       |     |      |                 |       |     |      |                 |       |     |      |                 |       |     |      |                 |       |     |      |                  |       |     |      |               |         |     |    |
| 180 min Summer                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         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                                          |        |                |                     |                     |                              |                       |        |               |       |       |     |      |     |               |       |       |     |      |     |               |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                 |       |       |     |      |     |                 |       |       |     |      |     |                 |       |       |     |      |     |                 |       |       |     |      |     |                 |       |       |     |      |     |                 |       |       |     |      |     |                 |       |       |     |      |     |                  |       |       |     |      |     |               |       |       |     |      |     |                |                 |                           |                     |               |         |     |    |               |        |     |    |               |        |     |    |                |        |     |     |                |        |     |     |                |        |     |     |                |        |     |     |                |        |     |     |                |       |     |     |                |       |     |     |                |       |     |     |                 |       |     |      |                 |       |     |      |                 |       |     |      |                 |       |     |      |                 |       |     |      |                 |       |     |      |                 |       |     |      |                  |       |     |      |               |         |     |    |
| 240 min Summer                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         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                                          |        |                |                     |                     |                              |                       |        |               |       |       |     |      |     |               |       |       |     |      |     |               |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                 |       |       |     |      |     |                 |       |       |     |      |     |                 |       |       |     |      |     |                 |       |       |     |      |     |                 |       |       |     |      |     |                 |       |       |     |      |     |                 |       |       |     |      |     |                  |       |       |     |      |     |               |       |       |     |      |     |                |                 |                           |                     |               |         |     |    |               |        |     |    |               |        |     |    |                |        |     |     |                |        |     |     |                |        |     |     |                |        |     |     |                |        |     |     |                |       |     |     |                |       |     |     |                |       |     |     |                 |       |     |      |                 |       |     |      |                 |       |     |      |                 |       |     |      |                 |       |     |      |                 |       |     |      |                 |       |     |      |                  |       |     |      |               |         |     |    |
| 360 min Summer                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         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                                          |        |                |                     |                     |                              |                       |        |               |       |       |     |      |     |               |       |       |     |      |     |               |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                 |       |       |     |      |     |                 |       |       |     |      |     |                 |       |       |     |      |     |                 |       |       |     |      |     |                 |       |       |     |      |     |                 |       |       |     |      |     |                 |       |       |     |      |     |                  |       |       |     |      |     |               |       |       |     |      |     |                |                 |                           |                     |               |         |     |    |               |        |     |    |               |        |     |    |                |        |     |     |                |        |     |     |                |        |     |     |                |        |     |     |                |        |     |     |                |       |     |     |                |       |     |     |                |       |     |     |                 |       |     |      |                 |       |     |      |                 |       |     |      |                 |       |     |      |                 |       |     |      |                 |       |     |      |                 |       |     |      |                  |       |     |      |               |         |     |    |
| 480 min Summer                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         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                                          |        |                |                     |                     |                              |                       |        |               |       |       |     |      |     |               |       |       |     |      |     |               |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                 |       |       |     |      |     |                 |       |       |     |      |     |                 |       |       |     |      |     |                 |       |       |     |      |     |                 |       |       |     |      |     |                 |       |       |     |      |     |                 |       |       |     |      |     |                  |       |       |     |      |     |               |       |       |     |      |     |                |                 |                           |                     |               |         |     |    |               |        |     |    |               |        |     |    |                |        |     |     |                |        |     |     |                |        |     |     |                |        |     |     |                |        |     |     |                |       |     |     |                |       |     |     |                |       |     |     |                 |       |     |      |                 |       |     |      |                 |       |     |      |                 |       |     |      |                 |       |     |      |                 |       |     |      |                 |       |     |      |                  |       |     |      |               |         |     |    |
| 600 min Summer                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         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                                          |        |                |                     |                     |                              |                       |        |               |       |       |     |      |     |               |       |       |     |      |     |               |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                 |       |       |     |      |     |                 |       |       |     |      |     |                 |       |       |     |      |     |                 |       |       |     |      |     |                 |       |       |     |      |     |                 |       |       |     |      |     |                 |       |       |     |      |     |                  |       |       |     |      |     |               |       |       |     |      |     |                |                 |                           |                     |               |         |     |    |               |        |     |    |               |        |     |    |                |        |     |     |                |        |     |     |                |        |     |     |                |        |     |     |                |        |     |     |                |       |     |     |                |       |     |     |                |       |     |     |                 |       |     |      |                 |       |     |      |                 |       |     |      |                 |       |     |      |                 |       |     |      |                 |       |     |      |                 |       |     |      |                  |       |     |      |               |         |     |    |
| 720 min Summer                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         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                                          |        |                |                     |                     |                              |                       |        |               |       |       |     |      |     |               |       |       |     |      |     |               |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                 |       |       |     |      |     |                 |       |       |     |      |     |                 |       |       |     |      |     |                 |       |       |     |      |     |                 |       |       |     |   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      |       |     |      |               |         |     |    |
| 960 min Summer                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         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                                          |        |                |                     |                     |                              |                       |        |               |       |       |     |      |     |               |       |       |     |      |     |               |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                 |       |       |     |      |     |                 |       |       |     |      |     |                 |       |       |     |      |     |                 |       |       |     |      |     |                 |       |       |     |   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      |       |     |      |               |         |     |    |
| 1440 min Summer                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        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                                          |        |                |                     |                     |                              |                       |        |               |       |       |     |      |     |               |       |       |     |      |     |               |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                 |       |       |     |      |     |                 |       |       |     |      |     |                 |       |       |     |      |     |                 |       |       |     |      |     |                 |       |       |     |   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      |       |     |      |               |         |     |    |
| 2160 min Summer                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        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                                          |        |                |                     |                     |                              |                       |        |               |       |       |     |      |     |               |       |       |     |      |     |               |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                 |       |       |     |      |     |                 |       |       |     |      |     |                 |       |       |     |      |     |                 |       |       |     |      |     |                 |       |       |     |      |     |                 |       |       |     |      |     |                 |       |       |     |      |     |                  |       |       |     |      |     |               |       |       |     |      |     |                |                 |                           |                     |               |         |     |    |               |        |     |    |               |        |     |    |                |        |     |     |                |        |     |     |                |        |     |     |                |        |     |     |                |        |     |     |                |       |     |     |                |       |     |     |                |       |     |     |                 |       |     |      |                 |       |     |      |                 |       |     |      |                 |       |     |      |                 |       |     |      |                 |       |     |      |                 |       |     |      |                  |       |     |      |               |         |     |    |
| 2880 min Summer                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        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                                          |        |                |                     |                     |                              |                       |        |               |       |       |     |      |     |               |       |       |     |      |     |               |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                 |       |       |     |      |     |                 |       |       |     |      |     |                 |       |       |     |      |     |                 |       |       |     |      |     |                 |       |       |     |   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      |       |     |      |               |         |     |    |
| 4320 min Summer                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        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                                          |        |                |                     |                     |                              |                       |        |               |       |       |     |      |     |               |       |       |     |      |     |               |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                 |       |       |     |      |     |                 |       |       |     |      |     |                 |       |       |     |      |     |                 |       |       |     |      |     |                 |       |       |     |   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      |       |     |      |               |         |     |    |
| 5760 min Summer                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | 1.494               | 0.0                                   | 3624                         |                                                                                     |        |                |                     |                     |                              |                       |        |               |       |       |     |      |     |               |       |       |     |      |     |               |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                 |       |       |     |      |     |                 |       |       |     |      |     |                 |       |       |     |      |     |                 |       |       |     |      |     |                 |       |       |     |      |     |                 |       |       |     |      |     |                 |       |       |     |      |     |                  |       |       |     |      |     |               |       |       |     |      |     |                |                 |                           |                     |               |         |     |    |               |        |     |    |               |        |     |    |                |        |     |     |                |        |     |     |                |        |     |     |                |        |     |     |                |        |     |     |                |       |     |     |                |       |     |     |                |       |     |     |                 |       |     |      |                 |       |     |      |                 |       |     |      |                 |       |     |      |                 |       |     |      |                 |       |     |      |                 |       |     |      |                  |       |     |      |               |         |     |    |
| 7200 min Summer                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        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                                          |        |                |                     |                     |                              |                       |        |               |       |       |     |      |     |               |       |       |     |      |     |               |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                 |       |       |     |      |     |                 |       |       |     |      |     |                 |       |       |     |      |     |                 |       |       |     |      |     |                 |       |       |     |      |     |                 |       |       |     |      |     |                 |       |       |     |      |     |                  |       |       |     |      |     |               |       |       |     |      |     |                |                 |                           |                     |               |         |     |    |               |        |     |    |               |        |     |    |                |        |     |     |                |        |     |     |                |        |     |     |                |        |     |     |                |        |     |     |                |       |     |     |                |       |     |     |                |       |     |     |                 |       |     |      |                 |       |     |      |                 |       |     |      |                 |       |     |      |                 |       |     |      |                 |       |     |      |                 |       |     |      |                  |       |     |      |               |         |     |    |
| 8640 min Summer                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        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                                          |        |                |                     |                     |                              |                       |        |               |       |       |     |      |     |               |       |       |     |      |     |               |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                 |       |       |     |      |     |                 |       |       |     |      |     |                 |       |       |     |      |     |                 |       |       |     |      |     |                 |       |       |     |      |     |                 |       |       |     |      |     |                 |       |       |     |      |     |                  |       |       |     |      |     |               |       |       |     |      |     |                |                 |                           |                     |               |         |     |    |               |        |     |    |               |        |     |    |                |        |     |     |                |        |     |     |                |        |     |     |                |        |     |     |                |        |     |     |                |       |     |     |                |       |     |     |                |       |     |     |                 |       |     |      |                 |       |     |      |                 |       |     |      |                 |       |     |      |                 |       |     |      |                 |       |     |      |                 |       |     |      |                  |       |     |      |               |         |     |    |
| 10080 min Summer                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | 0.946               | 0.0                                   | 5952                         |                                                                                     |        |                |                     |                     |                              |                       |        |               |       |       |     |      |     |               |       |       |     |      |     |               |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                 |       |       |     |      |     |                 |       |       |     |      |     |                 |       |       |     |      |     |                 |       |       |     |      |     |                 |       |       |     |      |     |                 |       |       |     |      |     |                 |       |       |     |      |     |                  |       |       |     |      |     |               |       |       |     |      |     |                |                 |                           |                     |               |         |     |    |               |        |     |    |               |        |     |    |                |        |     |     |                |        |     |     |                |        |     |     |                |        |     |     |                |        |     |     |                |       |     |     |                |       |     |     |                |       |     |     |                 |       |     |      |                 |       |     |      |                 |       |     |      |                 |       |     |      |                 |       |     |      |                 |       |     |      |                 |       |     |      |                  |       |     |      |               |         |     |    |
| 15 min Winter                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | 128.336             | 0.0                                   | 19                           |                                                                                     |        |                |                     |                     |                              |                       |        |               |       |       |     |      |     |               |       |       |     |      |     |               |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                |       |       |     |      |     |                 |       |       |     |      |     |                 |       |       |     |      |     |                 |       |       |     |      |     |                 |       |       |     |      |     |                 |       |       |     |      |     |                 |       |       |     |      |     |                 |       |       |     |      |     |                  |       |       |     |      |     |               |       |       |     |      |     |                |                 |                           |                     |               |         |     |    |               |        |     |    |               |        |     |    |                |        |     |     |                |        |     |     |                |        |     |     |                |        |     |     |                |        |     |     |                |       |     |     |                |       |     |     |                |       |     |     |                 |       |     |      |                 |       |     |      |                 |       |     |      |                 |       |     |      |                 |       |     |      |                 |       |     |      |                 |       |     |      |            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| ©1982-2018 Innovyze                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    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   |     |                 |       |       |     |      |     |                 |       |       |     |      |     |                  |       |       |     |      |     |               |       |       |     |      |     |                |                 |                           |                     |               |         |     |    |               |        |     |    |               |        |     |    |                |        |     |     |                |        |     |     |                |        |     |     |                |        |     |     |                |        |     |     |                |       |     |     |                |       |     |     |                |       |     |     |                 |       |     |      |                 |       |     |      |                 |       |     |      |                 |       |     |      |                 |       |     |      |                 |       |     |      |                 |       |     |      |            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| JMS Chelmsford Ltd                                             |                     |                           |                                       |                       | Page 2                                                                              |
| BIC110 - The MedBIC<br>Alan Cherry Drive<br>Chelmsford CM1 1SQ |                     |                           |                                       |                       |  |
| Date 09/12/2024 16:57<br>File Infiltration Calc 100 Y...       |                     |                           | Designed by MathanKumar<br>Checked by |                       |                                                                                     |
| XP Solutions                                                   |                     |                           | Source Control 2018.1                 |                       |                                                                                     |
| <u>Summary of Results for 100 year Return Period (+40%)</u>    |                     |                           |                                       |                       |                                                                                     |
| Storm<br>Event                                                 | Max<br>Level<br>(m) | Max<br>Depth<br>(m)       | Max<br>Infiltration<br>(l/s)          | Max<br>Volume<br>(m³) | Status                                                                              |
| 30 min Winter                                                  | 8.916               | 0.401                     | 0.3                                   | 28.6                  | O K                                                                                 |
| 60 min Winter                                                  | 9.013               | 0.498                     | 0.3                                   | 35.5                  | O K                                                                                 |
| 120 min Winter                                                 | 9.109               | 0.594                     | 0.3                                   | 42.3                  | O K                                                                                 |
| 180 min Winter                                                 | 9.161               | 0.646                     | 0.3                                   | 46.0                  | O K                                                                                 |
| 240 min Winter                                                 | 9.194               | 0.679                     | 0.3                                   | 48.4                  | O K                                                                                 |
| 360 min Winter                                                 | 9.231               | 0.716                     | 0.3                                   | 51.0                  | O K                                                                                 |
| 480 min Winter                                                 | 9.254               | 0.739                     | 0.3                                   | 52.7                  | O K                                                                                 |
| 600 min Winter                                                 | 9.267               | 0.752                     | 0.4                                   | 53.6                  | O K                                                                                 |
| 720 min Winter                                                 | 9.274               | 0.759                     | 0.4                                   | 54.1                  | O K                                                                                 |
| 960 min Winter                                                 | 9.275               | 0.760                     | 0.4                                   | 54.2                  | O K                                                                                 |
| 1440 min Winter                                                | 9.254               | 0.739                     | 0.3                                   | 52.6                  | O K                                                                                 |
| 2160 min Winter                                                | 9.211               | 0.696                     | 0.3                                   | 49.6                  | O K                                                                                 |
| 2880 min Winter                                                | 9.168               | 0.653                     | 0.3                                   | 46.5                  | O K                                                                                 |
| 4320 min Winter                                                | 9.083               | 0.568                     | 0.3                                   | 40.5                  | O K                                                                                 |
| 5760 min Winter                                                | 9.003               | 0.488                     | 0.3                                   | 34.8                  | O K                                                                                 |
| 7200 min Winter                                                | 8.931               | 0.416                     | 0.3                                   | 29.6                  | O K                                                                                 |
| 8640 min Winter                                                | 8.865               | 0.350                     | 0.3                                   | 24.9                  | O K                                                                                 |
| 10080 min Winter                                               | 8.805               | 0.290                     | 0.3                                   | 20.7                  | O K                                                                                 |
| Storm<br>Event                                                 | Rain<br>(mm/hr)     | Flooded<br>Volume<br>(m³) | Time-Peak<br>(mins)                   |                       |                                                                                     |
| 30 min Winter                                                  | 84.360              | 0.0                       | 33                                    |                       |                                                                                     |
| 60 min Winter                                                  | 52.892              | 0.0                       | 64                                    |                       |                                                                                     |
| 120 min Winter                                                 | 32.091              | 0.0                       | 122                                   |                       |                                                                                     |
| 180 min Winter                                                 | 23.662              | 0.0                       | 180                                   |                       |                                                                                     |
| 240 min Winter                                                 | 18.958              | 0.0                       | 240                                   |                       |                                                                                     |
| 360 min Winter                                                 | 13.760              | 0.0                       | 356                                   |                       |                                                                                     |
| 480 min Winter                                                 | 10.974              | 0.0                       | 472                                   |                       |                                                                                     |
| 600 min Winter                                                 | 9.199               | 0.0                       | 588                                   |                       |                                                                                     |
| 720 min Winter                                                 | 7.961               | 0.0                       | 700                                   |                       |                                                                                     |
| 960 min Winter                                                 | 6.333               | 0.0                       | 924                                   |                       |                                                                                     |
| 1440 min Winter                                                | 4.580               | 0.0                       | 1342                                  |                       |                                                                                     |
| 2160 min Winter                                                | 3.307               | 0.0                       | 1668                                  |                       |                                                                                     |
| 2880 min Winter                                                | 2.622               | 0.0                       | 2132                                  |                       |                                                                                     |
| 4320 min Winter                                                | 1.888               | 0.0                       | 3028                                  |                       |                                                                                     |
| 5760 min Winter                                                | 1.494               | 0.0                       | 3912                                  |                       |                                                                                     |
| 7200 min Winter                                                | 1.245               | 0.0                       | 4752                                  |                       |                                                                                     |
| 8640 min Winter                                                | 1.073               | 0.0                       | 5528                                  |                       |                                                                                     |
| 10080 min Winter                                               | 0.946               | 0.0                       | 6256                                  |                       |                                                                                     |
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|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------|-------------------------------------------------------------------------------------|----------------|-----|---------------|-----|-----------------------|-----|-------------|-------|--------|-------------------|-------------|-------|------------|--------|-----------------------|----|---------|-------|----------------------|-------|---------------|-----|------------------|-----|-------------|--|------|-------|-----|------|---|---|-------|
| BIC110 - The MedBIC<br>Alan Cherry Drive<br>Chelmsford CM1 1SQ                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                       |  |                |     |               |     |                       |     |             |       |        |                   |             |       |            |        |                       |    |         |       |                      |       |               |     |                  |     |             |  |      |       |     |      |   |   |       |
| Date 09/12/2024 16:57<br>File Infiltration Calc 100 Y...                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | Designed by MathanKumar<br>Checked by |                                                                                     |                |     |               |     |                       |     |             |       |        |                   |             |       |            |        |                       |    |         |       |                      |       |               |     |                  |     |             |  |      |       |     |      |   |   |       |
| XP Solutions <div>Source Control 2018.1</div>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                       |                                                                                     |                |     |               |     |                       |     |             |       |        |                   |             |       |            |        |                       |    |         |       |                      |       |               |     |                  |     |             |  |      |       |     |      |   |   |       |
| <div style="text-align: center;"> <u>Rainfall Details</u> </div> <table> <tr> <td>Rainfall Model</td> <td>FSR</td> <td>Winter Storms</td> <td>Yes</td> </tr> <tr> <td>Return Period (years)</td> <td>100</td> <td>Cv (Summer)</td> <td>0.750</td> </tr> <tr> <td>Region</td> <td>England and Wales</td> <td>Cv (Winter)</td> <td>0.840</td> </tr> <tr> <td>M5-60 (mm)</td> <td>18.700</td> <td>Shortest Storm (mins)</td> <td>15</td> </tr> <tr> <td>Ratio R</td> <td>0.400</td> <td>Longest Storm (mins)</td> <td>10080</td> </tr> <tr> <td>Summer Storms</td> <td>Yes</td> <td>Climate Change %</td> <td>+40</td> </tr> </table> <div style="text-align: center;"> <u>Time Area Diagram</u> </div> <p>Total Area (ha) 0.082</p> <table> <thead> <tr> <th colspan="2">Time (mins)</th> <th>Area</th> </tr> <tr> <th>From:</th> <th>To:</th> <th>(ha)</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>4</td> <td>0.082</td> </tr> </tbody> </table> |                                       |                                                                                     | 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) | 18.700 | Shortest Storm (mins) | 15 | Ratio R | 0.400 | Longest Storm (mins) | 10080 | Summer Storms | Yes | Climate Change % | +40 | Time (mins) |  | Area | From: | To: | (ha) | 0 | 4 | 0.082 |
| 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)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | 18.700                                | Shortest Storm (mins)                                                               | 15             |     |               |     |                       |     |             |       |        |                   |             |       |            |        |                       |    |         |       |                      |       |               |     |                  |     |             |  |      |       |     |      |   |   |       |
| Ratio R                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | 0.400                                 | Longest Storm (mins)                                                                | 10080          |     |               |     |                       |     |             |       |        |                   |             |       |            |        |                       |    |         |       |                      |       |               |     |                  |     |             |  |      |       |     |      |   |   |       |
| Summer Storms                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | Yes                                   | Climate Change %                                                                    | +40            |     |               |     |                       |     |             |       |        |                   |             |       |            |        |                       |    |         |       |                      |       |               |     |                  |     |             |  |      |       |     |      |   |   |       |
| Time (mins)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                       | Area                                                                                |                |     |               |     |                       |     |             |       |        |                   |             |       |            |        |                       |    |         |       |                      |       |               |     |                  |     |             |  |      |       |     |      |   |   |       |
| From:                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | To:                                   | (ha)                                                                                |                |     |               |     |                       |     |             |       |        |                   |             |       |            |        |                       |    |         |       |                      |       |               |     |                  |     |             |  |      |       |     |      |   |   |       |
| 0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | 4                                     | 0.082                                                                               |                |     |               |     |                       |     |             |       |        |                   |             |       |            |        |                       |    |         |       |                      |       |               |     |                  |     |             |  |      |       |     |      |   |   |       |
| <div>©1982-2018 Innovyze</div>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                       |                                                                                     |                |     |               |     |                       |     |             |       |        |                   |             |       |            |        |                       |    |         |       |                      |       |               |     |                  |     |             |  |      |       |     |      |   |   |       |

|                                                                |                                       |                                                                                     |
|----------------------------------------------------------------|---------------------------------------|-------------------------------------------------------------------------------------|
| JMS Chelmsford Ltd                                             |                                       | Page 4                                                                              |
| BIC110 - The MedBIC<br>Alan Cherry Drive<br>Chelmsford CM1 1SQ |                                       |  |
| Date 09/12/2024 16:57<br>File Infiltration Calc 100 Y...       | Designed by MathanKumar<br>Checked by |                                                                                     |
| XP Solutions                                                   | Source Control 2018.1                 |                                                                                     |

Model Details

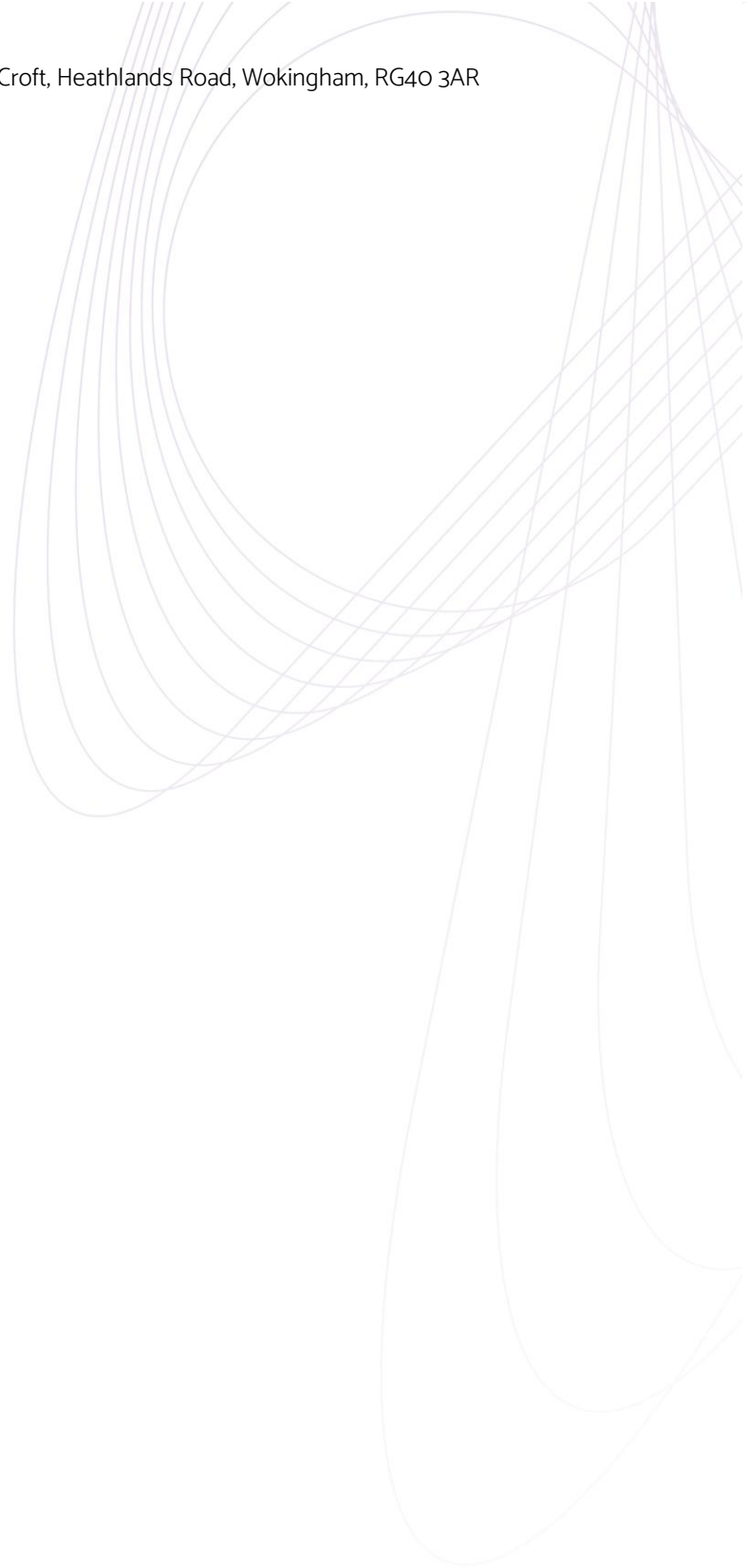
Storage is Online Cover Level (m) 10.000

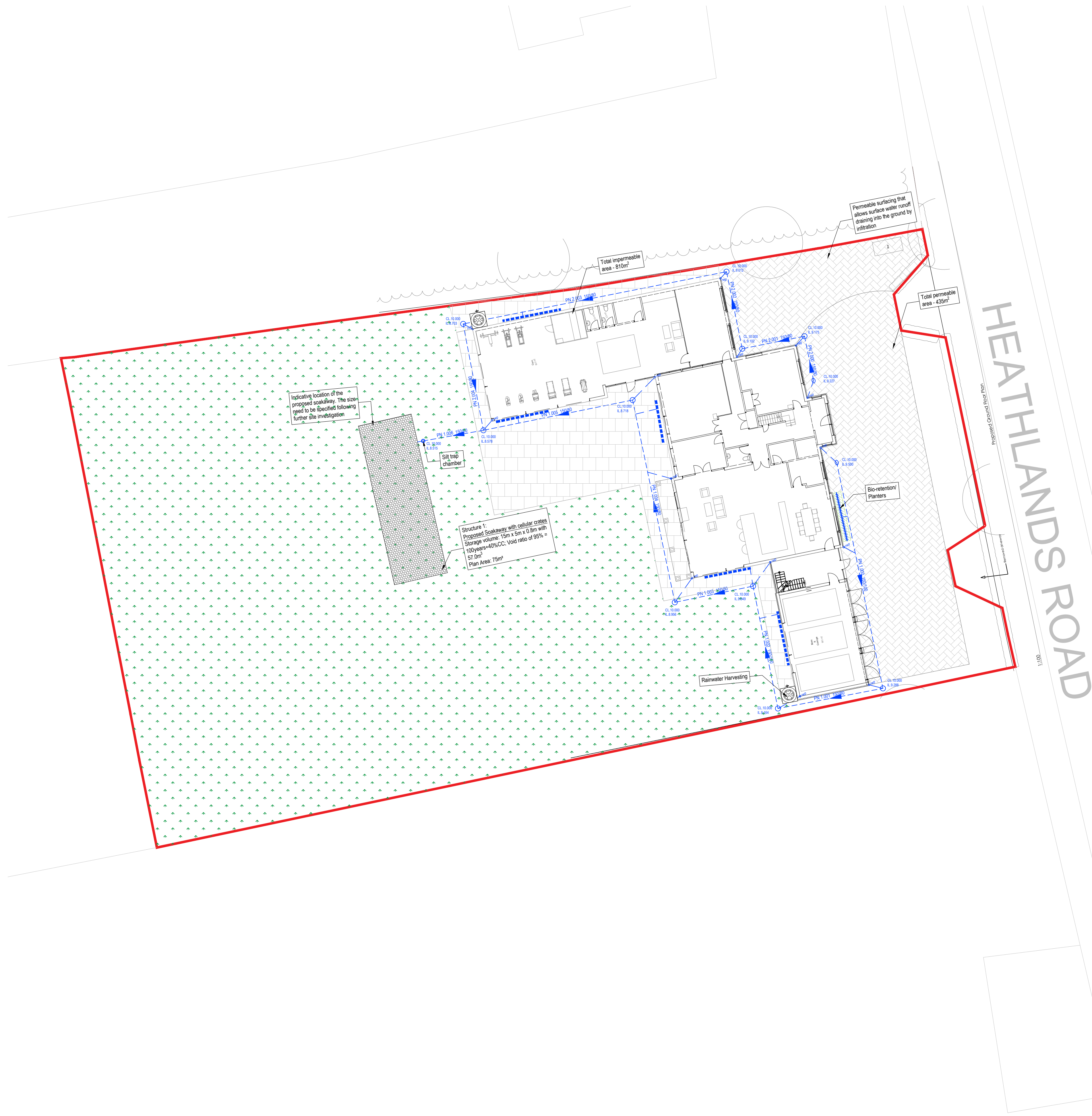
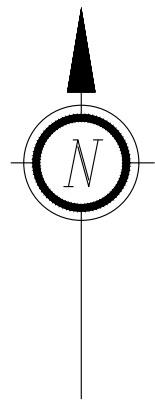
Cellular Storage Structure

Invert Level (m) 8.515 Safety Factor 3.0  
 Infiltration Coefficient Base (m/hr) 0.03600 Porosity 0.95  
 Infiltration Coefficient Side (m/hr) 0.03600

| Depth (m) | Area (m <sup>2</sup> ) | Inf. Area (m <sup>2</sup> ) | Depth (m) | Area (m <sup>2</sup> ) | Inf. Area (m <sup>2</sup> ) |
|-----------|------------------------|-----------------------------|-----------|------------------------|-----------------------------|
| 0.000     | 75.0                   | 75.0                        | 0.801     | 0.0                    | 107.0                       |
| 0.800     | 75.0                   | 107.0                       |           |                        |                             |

*Appendix C – Drainage Strategy Plan*





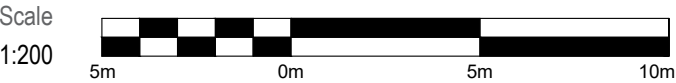
- General Notes:**
1. Do not scale this drawing. All dimensions are in metres unless otherwise noted. Any discrepancies are to be recorded and reported to the engineers immediately.
  2. This drawing is to be read in conjunction with all other engineers and architects drawings, and the specification.
  3. All work is to be to the satisfaction of the engineer and local authority building control.
  4. The contractor is responsible for and must take all necessary precautions to ensure the stability of the works at all times during construction.
  5. All workmanship and materials are to be to current British Standards.
  6. All services are to be located and protected as necessary by the contractor prior to the commencement of the works.
  7. Any existing details which are shown on this drawing are for guidance only and are to be checked on site by the contractor. Any variations are to be recorded and reported to the engineer immediately.
  8. All highway works are to be in accordance with the local authorities design guide and specification.
  9. Prior to the occupation of the first dwelling, street nameplates shall be erected in accordance with the highway authority and to the wording agreed with the planning authority.
  10. During construction works on site, all roads and footpaths are to be swept and kept clear of obstructions, this is to include existing highways as appropriate to ensure safe passage of all road users.
  11. Provision shall be made for the installation of all mains services including ducting prior to the laying of the road base-course.
  12. All road markings and signs are to be in accordance with 'the traffic signs regulations and directions' 2016.
  13. All sewer works are to be in accordance with sewers for adoption 6th edition.
  14. All private connections to adoptable sewers should be a minimum of 100mm diameter (foul) and 150mm diameter (surface) made in vitrified clay connecting soffit to soffit.

- Soakaways**
1. The proposed soakaways have been designed based on an assumed infiltration rate typical of the ground conditions encountered.
  2. The proposed soakaways have been designed for a 1 in 100 year storm plus 40% climate change.
  3. The proposed soakaways must be located at least 5m away from any building or structure.

| Drainage Key                                     |                                  |                                                                          |
|--------------------------------------------------|----------------------------------|--------------------------------------------------------------------------|
| Surface Water Manhole Text                       | CL.00.00<br>IL.00.00<br>BD.00.00 | Existing combined Water Manhole Text<br>CL.00.00<br>IL.00.00<br>BD.00.00 |
| Surface Water Pipe                               | PN 1.000 100/80                  | Existing foul Sewer                                                      |
| Existing Inspection chamber 480mm Ø >600mm Depth |                                  | Site Boundary                                                            |
| Inspection chamber 225mm Ø <600mm Depth          |                                  | Rainwater Harvesting / Waterbutt                                         |
| Rain Water Pipe                                  | rwp                              | Permeable Surfacing                                                      |
| Gully                                            | G                                | Bio-retention area / Planting                                            |
| Channel Drain                                    |                                  |                                                                          |
| Perforated Pipe                                  |                                  |                                                                          |
| Rodding Eye                                      | RE<br>IL.00.00                   |                                                                          |

Note:  
The contractors are to check all dimensions, drain runs and general conditions on site before works commence

Note:  
All works to be carried out in accordance with current building regulations, British Standards, Code of Practice and Local Authority requirements



|                                                                                                                                                                                                             |       |                    |          |             |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|--------------------|----------|-------------|
| P1 Preliminary Issue                                                                                                                                                                                        |       | MKR                | BN       | 05.12.2024  |
| Issue                                                                                                                                                                                                       | Notes | Drawn              | Approved | Date        |
| <div><div></div><div></div></div> |       |                    |          |             |
| Issuing Office:<br>JMS East Anglia (Ipswich): Unit 27, Brightwell Barns<br>Brightwell, Suffolk, United Kingdom, IP10 0BJ, Tel: 01473 487047                                                                 |       |                    |          |             |
| Project<br>Soulby Croft, Heathlands Road<br>Wokingham, RG40 3AR                                                                                                                                             |       |                    |          |             |
| Drawing Title<br>Proposed Private Drainage<br>Layout                                                                                                                                                        |       |                    |          |             |
| Project No.<br>EX24/296/11                                                                                                                                                                                  |       | Drawing No.<br>201 |          | Issue<br>P1 |
| PRELIMINARY                                                                                                                                                                                                 |       |                    |          |             |

Private Drainage Notes:

1. Formation of trench beds and inspection chambers

- i) Excavate immediately before laying beds and pipes or base slabs for inspection chambers.
- ii) Remove all mud, rock projections, boulders and hard spots and replace with well compacted selected fill. Localised soft spots are to be hardened by tamping in granular bedding material.
- iii) If oil contamination is found adjacent to trench, the trench profile is to be cut back by 150mm from the face of bedding material and replaced with crushed concrete.

2. Concrete and mortar

- i) The concrete used to surround pipes and in the construction of gullies and inspection chambers is to be grade C20P (unless noted otherwise) and mixed using SRPC unless directed otherwise by the engineer or local authority. Sulphate resisting cement is to be used for in-situ or precast concrete and mortars to foul drains.

3. Covers and frames

All inspection chamber cover and frames are to be laid to have the top surface in alignment with both the longitudinal and transverse gradients of adjacent roads, drives, footways and verges. They are otherwise to be laid level. All cover levels as shown on the drainage layout/longsection are approximate. Actual cover levels are to be determined on site from the position in the road, drive, footpath or otherwise.

4. Pipes to as follows:

| Pipe dia. (mm)                  | Type | Remark     |
|---------------------------------|------|------------|
| 100 Internal<br>(110 NOM. dia.) | uPVC | BS EN 1401 |
| 150 Internal<br>(160 NOM. dia.) | uPVC | BS EN 1401 |

5. The contractor/developer is to ensure that all of the works comply with the following:

- i) BS 8301: 1985 (code of practice for building drainage)

- ii) The Building Regulations: Approved Document H 2002

- iii) NHBC Technical requirements

- iv) BRE Digest No. 363

6. The storage and installation of all proprietary drainage items used are to be strictly in accordance with the manufacturers instructions.

7. All uPVC items as specified on this drawing are to comply with BS EN 1401.

8. Mortar

Mortar shall be mixed only as and when required, the relevant proportions indicated in the following table, until its colour and consistency are uniform. The constituent materials shall be accurately gauged, allowance being made for bulking of sand.

| Alternative Nominal Mixes by Volume |             |                              |
|-------------------------------------|-------------|------------------------------|
| Cement:Lime:Sand                    | Cement:Sand | Cement:Sand with plasticiser |
| 1 : ¼ : 3                           | 1 : 3       | 1 : 2 ½ to 3                 |

9. Ready-mixed lime: Sand for mortar and ready-to-use retarded mortar shall comply with the relevant provisions of BS 4721 and to be of category 1.12 and designation (i) respectively.

10. All mortar shall be conveyed fresh to the works as required for use. Mortar which has begun to set or which has been site-mixed for a period of more than 1 hour shall not be used. Plasticising and set retarding mortar admixtures shall comply with BS 4887: part 1 and 2, respectively and shall be supplied with instructions for use.

11. Crushed natural stone and shall comply in all respects with BS 1200.

Pipe Bedding Notes:

Mortar

1. Mortar shall be mixed only as and when required, the relevant proportions indicated in the following table, until its colour and consistency are uniform. The constituent materials shall be accurately gauged, allowance being made for bulking of sand.

| Alternative Nominal Mixes By Volume |             |                              |
|-------------------------------------|-------------|------------------------------|
| Cement:Lime:Sand                    | Cement:Sand | Cement:Sand with Plasticiser |
| 1 : ¼ : 3                           | 1 : 3       | 1 : 2 ½ to 3                 |

2. Ready-mixed lime:sand for mortar and ready-to-use retarded mortar shall comply with the relevant provisions of BS 4721 and to be of category 1.12 and designation (i) respectively.

3. All mortar shall be conveyed fresh to the works as required for use. Mortar which has begun to set or which has been site-mixed for a period of more than one hour shall not be used. Plasticising and set retarding mortar admixtures shall comply with BS 4887: part 1 and 2, respectively and shall be supplied with instructions for use.

4. Fine aggregate for mortar shall be washed natural sand or crushed natural stone and shall comply in all respects with BS 1200.

5. 20mm thick Flexcel, or similar approved filler to be used to form a flexible joint to the concrete surround at the leading edge of a sleeved coupling. Dimensions shown are irrespective of type or diameter of pipe. The surrounds must terminate at a pipe joint.

6. If pipes are surrounded in concrete, the joints are to be protected from the the ingress of concrete by wrapping them in polythene sheet or building paper.

General fill material

May be of selected locally excavated material or imported. It shall be uniform readily compacted material free from stones larger than 40mm dia. lumps of clay over 100mm, timber, frozen material, vegetable matter, tree roots and building rubbish. The material shall be placed and compacted in layers not exceeding 300mm loose depth. Mechanical compaction equipment shall not be used until there is a minimum of 450mm of compacted material above the crown of the pipe.

Selected fill material

To be free from stones larger than 40mm dia. lumps of clay over 100mm, timber, frozen material, vegetable matter, tree roots and building rubbish. The material shall be placed uniformly on each side of the pipe in layers not exceeding 100mm. Each layer being compacted by hand tamping. Care to be taken not to displace the pipe from its correct line and level.

Private Drainage Notes:

1. Inspection chamber covers and frames as follows:-

Brickwork and pre-cast concrete:

- i) Private drives accepting vehicle traffic: BS EN124 class D400, 600mm clear opening, solid top cover and frame.
- ii) Footpaths, verges and gardens: BS EN124 class B125, 600mm clear opening, solid top cover and frame.

Polypropylene:

- iii) Areas accepting vehicle traffic: Class B
- iv) Soft landscaped areas: Class C

2. Mortar haunching to inspection chamber and frames.

3. i) For use with brick inspection chambers in non adopted roads, private drives, footways and verges; heavy duty (150mm nominal thickness) precast reinforced concrete cover slab to BS 5911, bedded on 10mm thick mortar bed; or 150mm grade C25P in-situ concrete (reinforced with A393 mesh to BS 4483) cover slab. Other locations inaccessible to vehicles; light duty (75mm nominal thickness) precast reinforced concrete cover slab to BS 5911, bedded on 10mm thick mortar bed; or 100mm grade C25P in-situ concrete (reinforced with A193 mesh to BS 4483) cover slab.
- ii) For use with precast concrete inspection chambers in non adopted roads, private drives, footways and verges; heavy duty (150mm nominal thickness) precast reinforced concrete cover slab to BS 5911, of size and type to suit chamber sections.

Other locations inaccessible to vehicles; light duty (75mm nominal thickness) precast reinforced concrete cover slab to BS 5911, of size and type to suit chamber sections.

4. With precast or brick inspection chambers, cover slabs with a clear opening of 600x600mm are required. Offset to suit chosen face for step rungs.

5. 215mm thick walls in Class B engineering bricks to BS 3921 layered in English bond with frogs up. Inner faces to be plumb and in true alignment. Brick course to be level. Flush jointing to brickwork inner faces and precast concrete chamber sections to BS 5911.

6. All step rungs to BS 1247

- i) General purpose pattern (with 230mm tail) to be built into chamber wall of brick inspection chambers.

- ii) Precast concrete manhole pattern "let in" to chamber wall of precast inspection chambers. All step rungs to be horizontally and vertically staggered as shown on section x-x. Step rungs are not required to either type of inspection chamber where depth to soffit is less than 750mm.

7. Mass concrete infill.

8. Benching to rise vertically from edges of channel to a height not less than pipe (full section) soffit level. Steel float smooth hard surface with cement mortar 1:1 mix, 25mm thick.

9. 50mm min. thick mortar bed to half round channels.

10. 150mm min. thick mass concrete base slab (grade C20P) to precast, uPVC and brick types of inspection chamber.

11. 75mm thick lean mix concrete blinding.

12. Minimum of 2, and maximum of 4 courses of 215mm thick engineering bricks (Class B) to underside of cover & frame, built off cover slab, may be required to facilitate road or drive construction.

13. A brick relieving arch shall be turned over all pipes where they pass through the walls of a brick inspection chamber.

14. Pipes entering inspection chambers shall have a flexible joint within 150mm of the outer face of the brickwork or concrete surround.

15. Channel junctions within brick or precast concrete inspection chambers to be half round channel sections.

16. Backfill material to be as detailed above for normal pipe bedding.

17. Following the flexible joint from either a precast or brick inspection chamber (note 14 above) a 'rocker' pipe of 600mm length shall be installed.

18. Precast concrete inspection chambers may (if chosen for use) have a purpose made base units.

19. Where precast concrete inspection chambers are constructed wholly above the water table, joints are to be sealed with mortar. In waterlogged ground or where the water table is above the base slab, joints are to be water tight using a mastic sealant or rubber rings of a type suitable to the chamber units.

Minimum Dimensions for Access Fittings and Inspection Chambers

| Type                                                               | Depth to invert from cover level (m)            | Internal dimensions           |                     | Cover dimensions              |                                                |
|--------------------------------------------------------------------|-------------------------------------------------|-------------------------------|---------------------|-------------------------------|------------------------------------------------|
|                                                                    |                                                 | Length (mm) x width (mm)      | Circular dia. (mm)  | Length (mm) x width (mm)      | Circular dia. (mm)                             |
| Rodding eye                                                        |                                                 | As drain but 100 min.         |                     |                               | Same size as pipework.1                        |
| Access fitting<br>Small<br>150 dia.<br>150x100<br>Large<br>225x100 | 0.6 or less, except where situated in a chamber | 150x100<br>225x100            | 150<br>225          | 150x100.1<br>225x100.1        | Same size as access fitting                    |
| Inspection chamber<br>shallow<br>Deep                              | 0.6 or less<br>1.2 or less<br>>1.2              | 225x100<br>450x450<br>450x450 | 190.2<br>450<br>450 | MIN. 430x430<br>MAX 300x300.3 | 190.1<br>430<br>access restricted to max 350.3 |

NOTES

1. The clear opening may be reduced by 20mm in order to provide proper support for the cover and frame.
2. Drains up to 150mm.
3. A larger clear opening cover may be used in conjunction with a restricted access. the size is restricted for health and safety reasons to deter entry.

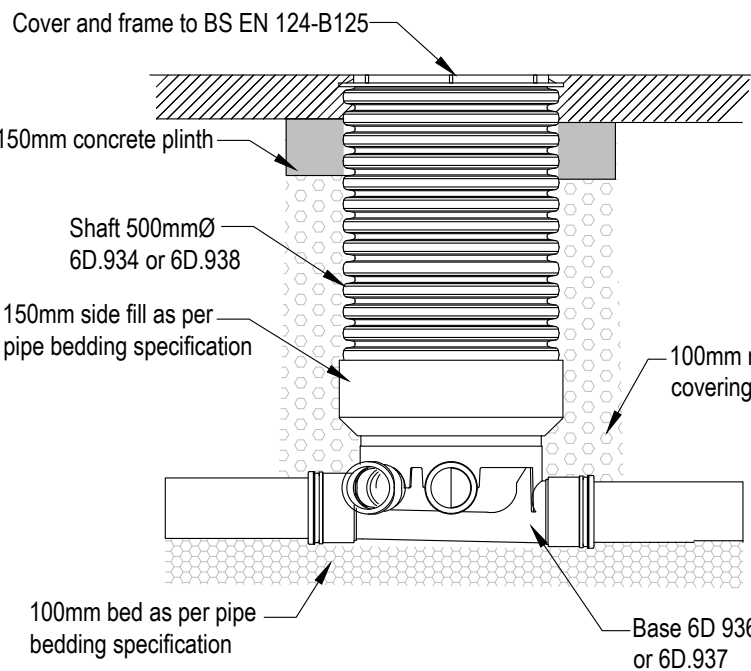
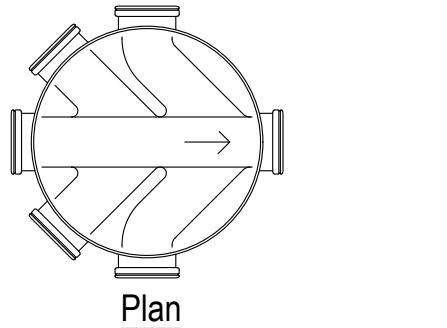
Materials for Access Points

| Material                                                                                  | British Standard                                             |
|-------------------------------------------------------------------------------------------|--------------------------------------------------------------|
| 1. Inspection chambers and manholes.                                                      |                                                              |
| Clay brick & blocks<br>Vitrified clay<br>Concrete-precast<br>Concrete-in situ<br>Plastics | BS 3921<br>BS EN 295, BS 65<br>BS 5911<br>BS 8110<br>BS 7158 |
| 2. Rodding eyes and access fittings (excludes covers and frames).                         | As pipes refer to materials for below ground drainage        |

Materials for Below Ground Drainage

| Material                                                | British Standard                                   |
|---------------------------------------------------------|----------------------------------------------------|
| 1. Rigid pipes:                                         |                                                    |
| Vitrified clay<br>Concrete<br>Grey iron<br>Ductile iron | BS 65, BS EN 295<br>BS 5911<br>BS 437<br>BS EN 598 |
| 2. Flexible pipes:                                      |                                                    |
| UPVC<br>PP<br>Structure walled<br>Plastic pipes         | BS EN 1401*<br>BS EN 1852*<br>BS EN 13476          |

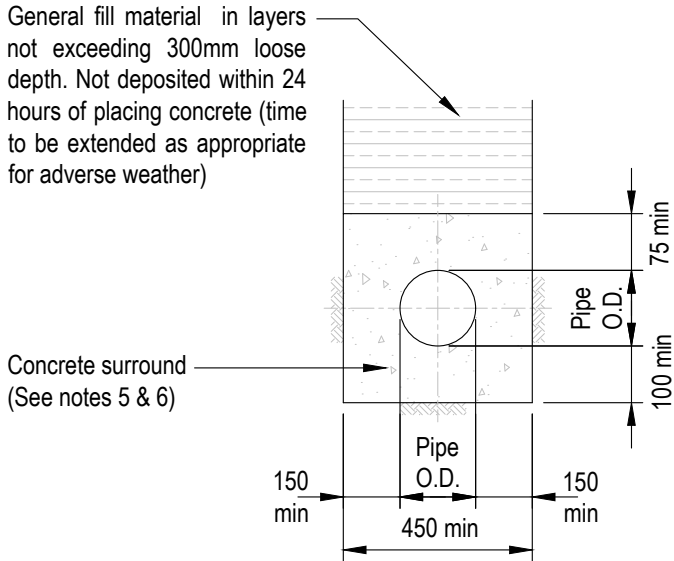
\*Application area code "UD" should normally be specified  
Note:  
Some of these materials may not be suitable for conveying trade effluent.



Polypropylene Shallow Inspection Chamber  
Ø450mm (Light Loading B125)

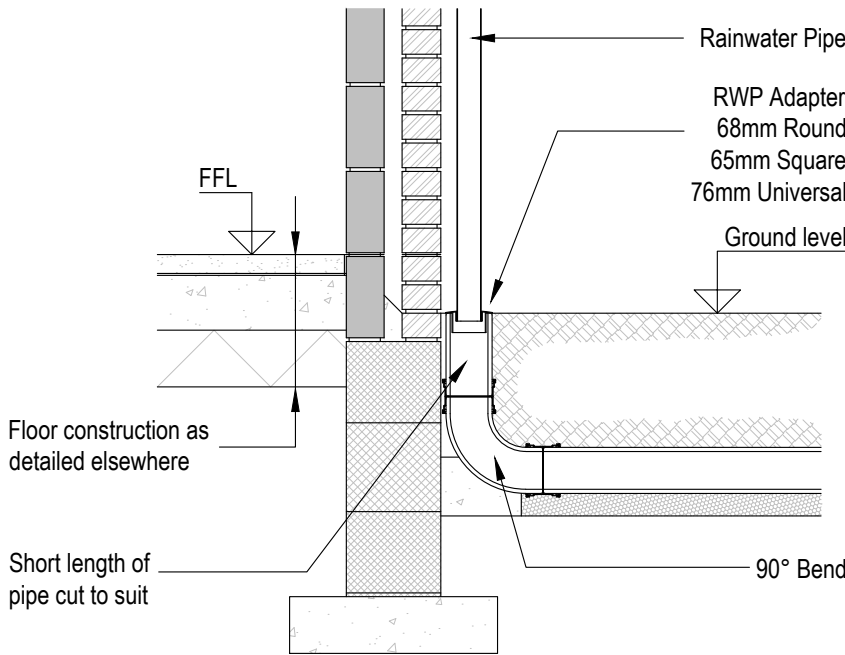
Scale 1:20

Note:  
3m maximum depth. Up to Ø150mm pipework for 450mm shaft, or up to 300mm pipework on 500mm shaft. B125 maximum Loading, suitable for car parks and private drives



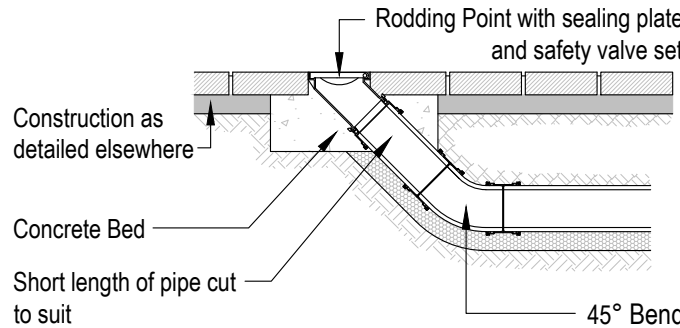
Concrete Surround Pipe Bedding

Scale 1:20



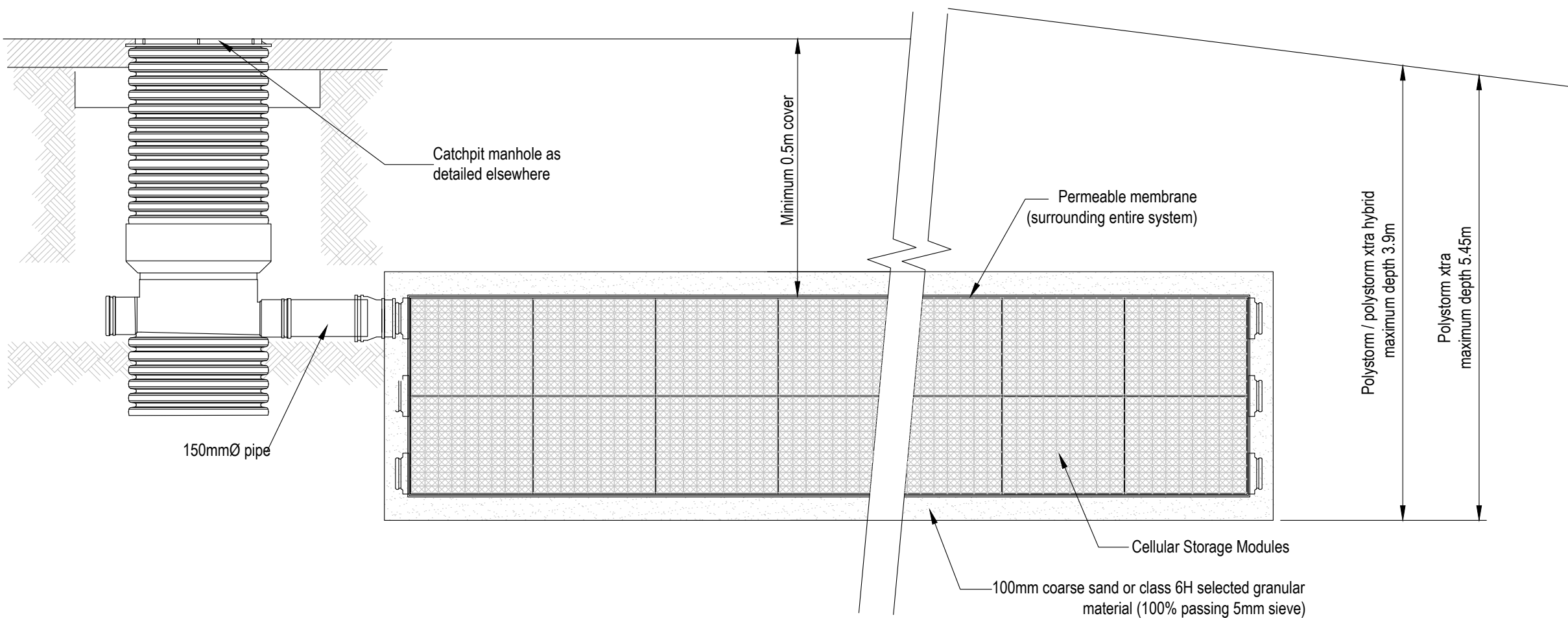
External RWP Connection

Scale 1:20



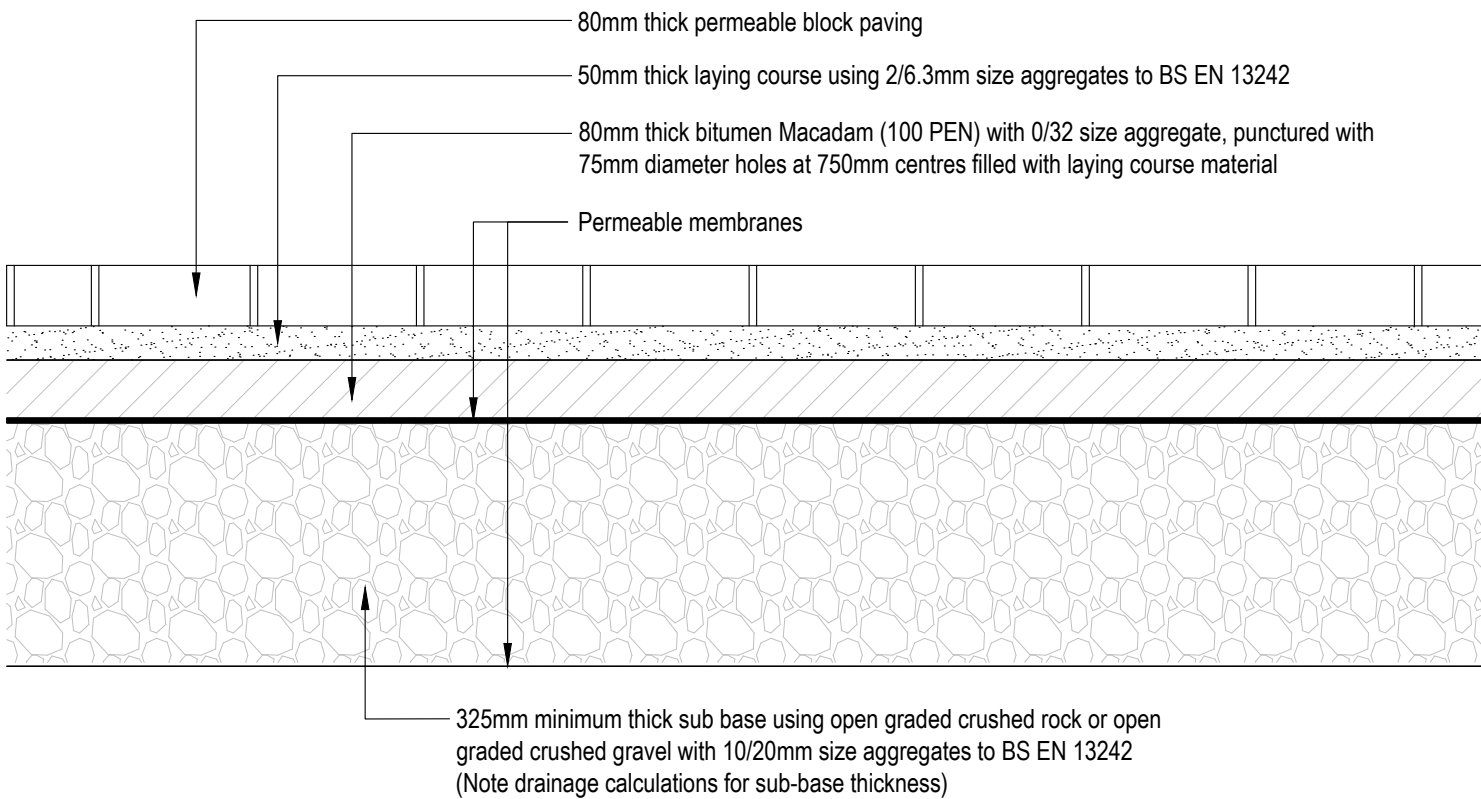
Rodding Point

Scale 1:20



Private Crate Infiltration System - Typical Section  
150mmØ Pipe

Scale 1:20



Typical Permeable Paving Construction Detail

Scale 1:10

Scale

As Shown

|                                                                                                                                             |       |                                                                                       |          |             |            |
|---------------------------------------------------------------------------------------------------------------------------------------------|-------|---------------------------------------------------------------------------------------|----------|-------------|------------|
| PT   Preliminary Issue                                                                                                                      |       | MKR                                                                                   |          | BN          | 05.12.2024 |
| Issue                                                                                                                                       | Notes | Drawn                                                                                 | Approved | Date        |            |
|                                                        |       |  |          |             |            |
| Issuing Office:<br>JMS East Anglia (Ipswich): Unit 27, Brightwell Barns<br>Brightwell, Suffolk, United Kingdom, IP10 0BJ, Tel: 01473 487047 |       |                                                                                       |          |             |            |
| Project<br>Souby Croft, Heathlands Road<br>Wokingham, RG40 3AR                                                                              |       |                                                                                       |          |             |            |
| Drawing Title<br>Drainage Construction Details                                                                                              |       |                                                                                       |          |             |            |
| Project No.<br>EX24/296/11                                                                                                                  |       | Drawing No.<br>202                                                                    |          | Issue<br>P1 |            |
| PRELIMINARY                                                                                                                                 |       |                                                                                       |          |             |            |