

# Sustainable Drainage Strategy Addendum No.1

Moorlands Farm, West End

December 2022

Prepared for  
Country Homes

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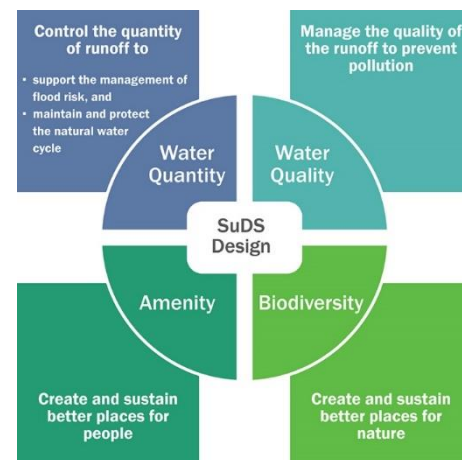
## 1. Sustainable Drainage Strategy

### Introduction

- 1.1 This Sustainable Drainage Strategy Addendum has been produced in response to consultee comments on Eastleigh Borough Council planning application ref. F/22/93835 at Moorlands Farm, Botley Road, West End, Southampton, SO30 3HD.
- 1.2 This report sets out the supporting information to address the consultee comments relating to the sustainable drainage strategy. This addendum is to be read in conjunction with Flood Risk Assessment & Sustainable Drainage Strategy (ref. 21035-FCE-XX-XX-RP-D-0001, dated 13.09.22) by Fernbrook Consulting Engineers

### Sustainable Drainage Design

- 1.3 The proposed surface water management strategy will follow the principles of Sustainable Drainage Design taking account of water quantity (flooding), water quality (pollution), biodiversity (wildlife and plants) and public amenity.



### Pre-development surface water run-off conditions

- 1.4 The developable area of the site area is 1.60 ha, and approximately 0.30 ha is comprised of impermeable area (19%). It is assumed that surface water runoff from the existing impermeable areas is currently conveyed to the watercourse unrestricted via a network of land drains.

- 1.5 To ensure that pre-development runoff rates are not exceeded, the brownfield runoff rates from the site were determined using the Wallingford procedure rational method for an assumed critical 5-minute storm:  $Q = 2.78 \times C \times i \times A$

Where:  $Q$  = Peak discharge (l/s)  
 $C$  = Dimensionless Runoff coefficient  
 $i$  = Rainfall intensity (mm/hr)  
 $A$  = Contributing impermeable areas (ha)

- 1.6 Refer to **Table 1-1** below for calculations.

**Table 1-1 Brownfield runoff rate**

| Rainfall event | Runoff rate (l/s) |
|----------------|-------------------|
| Q1             | 42.4              |
| Q30            | 94.3              |
| Q100           | 120.0             |

### Post-development surface water runoff

- 1.7 In accordance with the Building Act 2000 Clause H3.3 surface water run off not collected for re-use must be discharged in the following hierarchy:
- 1) To ground (infiltration techniques);
  - 2) To a surface water body;
  - 3) To a surface water sewer; or
  - 4) To the combined sewer.
- 1.8 Refer to **Table 1-2** for an assessment of the drainage hierarchy.

**Table 1-2 Drainage Hierarchy Assessment**

| Disposal method                       | Feasible | Comments                                                                                 |
|---------------------------------------|----------|------------------------------------------------------------------------------------------|
| 1 <sup>st</sup> ) Infiltration        | ✗        | The site appears to be underlain by sand over clay, with potential for high groundwater. |
| 2 <sup>nd</sup> ) Watercourse         | ✓        | There is an existing watercourse adjacent to the site's eastern boundary.                |
| 3 <sup>rd</sup> ) Surface Water sewer | ✗        | No surface water sewers in close vicinity.                                               |
| 4 <sup>th</sup> ) Combined sewer      | ✗        | No combined sewers in close vicinity.                                                    |

- 1.9 Based on the drainage hierarchy assessment, the proposed drainage strategy will seek to convey surface water to the Moorgreen Stream along the site's eastern boundary.

## Sustainable Drainage Systems

- 1.10 The proposed strategy will seek to maximise the use of Sustainable Drainage Systems (SuDS) to increase the biodiversity, provide amenity, control discharge volumes, and manage water quality.
- 1.11 The opportunities and constraints for the use of SuDS within the site are assessed in **Table 1-3**. The assessment is based on the management train approach outlined in CIRIA C753 “The SuDS Manual”.

**Table 1-3 SuDS Hierarchy**

| SuDS Component      | Feasible | Comment                                                                                                                                                     |
|---------------------|----------|-------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Green Roofs         | ✓        | Green roofs will be maximised throughout the site.                                                                                                          |
| Swales              | ✓        | Swales could be incorporated in landscaped areas to provide inception storage and improved bio-diversity.                                                   |
| Ponds / Basins      | ✓        | Small basins could be incorporated to provide water quality benefits.                                                                                       |
| Permeable Surfacing | ✓        | Opportunities to utilise permeable paving will be maximised in parking areas and service yards to improve the water quality of the surface water discharge. |
| Tanked systems      | ✓        | Should attenuation be required this could be achieved by use of oversized sewers or geo-cellular storage attenuation below the surface.                     |

- 1.12 Based on the SuDS Hierarchy, the most appropriate SuDS for this development are green roofs, swales, basins and permeable surfaces.
- 1.13 The proposed buildings and access roads will also be set back from the boundaries which will allow for native woodland and hedge buffer planting. A large ecological buffer is proposed in the northern sections of the site which can be planted up with native woodland blocks and an orchard. The increased vegetation will contribute to the sustainable drainage strategy through water interception and infiltration while increasing evapotranspiration potential.

### Peak Flow Control

- 1.14 The proposed drainage will be designed to ensure that flooding does not occur on any part of the site for the 1 in 30 year rainfall event, and any flooding up to the 1 in 100 year plus climate change rainfall event will be contained on site.
- 1.15 In accordance with the NPPF, the proposed strategy will allow for a 25% increase to rainfall intensity to allow for predicted impacts of climate change on surface water runoff for the proposed commercial development.

- 1.16 The proposed drainage strategy will seek to restrict surface water runoff to 50% of the existing 1 in 1 year runoff rate at 21 l/s using a vortex flow controls for all events up to the 1 in 100 year plus 40% climate change rainfall event.
- 1.17 Runoff will be restricted through the provision of 192m<sup>3</sup> attenuation storage within the attenuation basin.
- 1.18 The peak surface water run-off generated from the Site for the 1 year, 30 year and 100 year rainfall events, for the pre and post-development scenarios, is detailed in **Table 1-4** below. Refer to **Appendix A** for full MicroDrainage calculations.

**Table 1-4 Comparison of runoff rates**

| Return Period          | Existing Brownfield Rate (l/s) | Proposed Rate (l/s) | Reduction |
|------------------------|--------------------------------|---------------------|-----------|
| 1 in 1 year            | 42.4                           | 21.0                | -50%      |
| 1 in 30 year           | 94.3                           | 21.0                | -78%      |
| 1 in 100 year          | 120.0                          | 21.0                | -82%      |
| 1 in 100 year + 40% CC | -                              | 21.0                | -         |

- 1.19 Refer to drawing **21035-MA-XX-XX-DR-D-0500** for the Indicative Drainage Strategy illustrating how the Site could be drained in **Appendix A**.
- 1.20 In accordance with the Non-statutory Technical Guidance for Sustainable Drainage Systems, the post-development discharge rate does not exceed the rate of discharge from the development prior to redevelopment. Therefore, the risk of flooding from impermeable areas is assessed as low.

## Urbanisation & Long Term Storage

- 1.21 Based on the industrial development proposals, it is unlikely that the buildings will be extended. Therefore, urban creep has not been considered.
- 1.22 The long term storage requirement can be provided within the permeable paving sub-base.

## Overland Flow Routes

- 1.23 The site will be designed so that exceedance flows above the 1 in 100 year, including climate change rainfall event will be conveyed eastbound towards the Moorgreen Stream via the access roads across the site.
- 1.24 Refer to drawing **21035-MA-XX-XX-DR-D-0502** for the Indicative Exceedance Flow Routes in **Appendix A**.

Water Quality Management

- 1.25
- In accordance with Policy DM6 of the Local Plan Eastleigh Borough Council for sites of 1 hectare or more, or within 100m of the River Itchen SAC or Solent Maritime SAC, SuDS schemes should include at least three above ground forms of naturalised filtration. The strategy includes green roofs, rain gardens, filter drains, permeable paving, a swale and an attenuation pond to provide filtration.
- 1.26
- SuDS will be provided to form a management train in line with the best practice outlined in CIRIA C753 “The SuDS Manual”. Source control techniques rain gardens and permeable paving could manage runoff and reduce the time of concentration within the pipe network, reducing the risk of sewer surcharge and flash flooding, and provide water quality benefits.
- 1.27
- In line with CIRIA C753 The SuDS Manual, Tables 26.2 and 26.3, the pollution hazards indices associated with an industrial development are mitigated by the proposed SuDS. Refer to **Table 1-5** below for the Simple Index Method assessment.

Table 1-5 Simple Index Method

| Pollution Hazard Indices              |      |        |              |
|---------------------------------------|------|--------|--------------|
| Pollution hazard                      | TSS  | Metals | Hydrocarbons |
| High – Industrial Estates             | 0.8  | 0.8    | 0.9          |
| Pollution Mitigation Indices provided |      |        |              |
| SuDS component                        | TSS  | Metals | Hydrocarbons |
| Basin / Swale                         | 0.5  | 0.6    | 0.6          |
| Downstream Defender                   | 0.25 | 0.2    | 0.4          |
| Sediment Forebay                      | 0.25 | 0.25   | 0.3          |
| Check                                 | +0.2 | +0.25  | +0.4         |

## APPENDIX A – DRAINAGE CALCULATIONS & DRAWINGS

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                  |                                                                                     |                       |        |          |       |            |        |                               |              |         |       |                             |       |                          |    |                             |       |                                      |    |                                       |       |                      |       |                                    |      |                          |       |                                  |     |             |             |             |             |               |             |               |             |     |       |     |       |             |             |             |             |               |             |               |             |     |       |     |       |    |        |      |       |        |      |      |   |     |     |              |      |     |     |       |      |        |      |       |      |      |      |  |        |
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| Innovyze                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Network 2020.1.3 |                                                                                     |                       |        |          |       |            |        |                               |              |         |       |                             |       |                          |    |                             |       |                                      |    |                                       |       |                      |       |                                    |      |                          |       |                                  |     |             |             |             |             |               |             |               |             |     |       |     |       |             |             |             |             |               |             |               |             |     |       |     |       |    |        |      |       |        |      |      |   |     |     |              |      |     |     |       |      |        |      |       |      |      |      |  |        |
| <p align="center"><b><u>STORM SEWER DESIGN by the Modified Rational Method</u></b></p> <p align="center"><b><u>Design Criteria for Storm</u></b></p> <p align="center">Pipe Sizes STANDARD Manhole Sizes STANDARD</p> <p align="center">FSR Rainfall Model - England and Wales</p> <table> <tr> <td>Return Period (years)</td> <td>2</td> <td>PIMP (%)</td> <td>100</td> </tr> <tr> <td>M5-60 (mm)</td> <td>19.700</td> <td>Add Flow / Climate Change (%)</td> <td>0</td> </tr> <tr> <td>Ratio R</td> <td>0.350</td> <td>Minimum Backdrop Height (m)</td> <td>0.200</td> </tr> <tr> <td>Maximum Rainfall (mm/hr)</td> <td>50</td> <td>Maximum Backdrop Height (m)</td> <td>1.500</td> </tr> <tr> <td>Maximum Time of Concentration (mins)</td> <td>30</td> <td>Min Design Depth for Optimisation (m)</td> <td>1.200</td> </tr> <tr> <td>Foul Sewage (l/s/ha)</td> <td>0.000</td> <td>Min Vel for Auto Design only (m/s)</td> <td>1.00</td> </tr> <tr> <td>Volumetric Runoff Coeff.</td> <td>0.750</td> <td>Min Slope for Optimisation (1:X)</td> <td>500</td> </tr> </table> <p align="center">Designed with Level Soffits</p> <p align="center"><b><u>Time Area Diagram for Storm at outfall (pipe 1.007)</u></b></p> <table> <tr> <td><b>Time</b></td> <td><b>Area</b></td> <td><b>Time</b></td> <td><b>Area</b></td> </tr> <tr> <td><b>(mins)</b></td> <td><b>(ha)</b></td> <td><b>(mins)</b></td> <td><b>(ha)</b></td> </tr> <tr> <td>0-4</td> <td>0.127</td> <td>4-8</td> <td>0.035</td> </tr> </table> <p align="center">Total Area Contributing (ha) = 0.162</p> <p align="center">Total Pipe Volume (m<sup>3</sup>) = 118.692</p> <p align="center"><b><u>Time Area Diagram at outfall (pipe 2.005)</u></b></p> <table> <tr> <td><b>Time</b></td> <td><b>Area</b></td> <td><b>Time</b></td> <td><b>Area</b></td> </tr> <tr> <td><b>(mins)</b></td> <td><b>(ha)</b></td> <td><b>(mins)</b></td> <td><b>(ha)</b></td> </tr> <tr> <td>0-4</td> <td>0.354</td> <td>4-8</td> <td>0.187</td> </tr> </table> <p align="center">Total Area Contributing (ha) = 0.541</p> <p align="center">Total Pipe Volume (m<sup>3</sup>) = 11.094</p> <p align="center"><b><u>Network Design Table for Storm</u></b></p> <p align="center">« - Indicates pipe capacity &lt; flow</p> <table> <tr> <td>PN</td> <td>Length</td> <td>Fall</td> <td>Slope</td> <td>I.Area</td> <td>T.E.</td> <td>Base</td> <td>k</td> <td>HYD</td> <td>DIA</td> <td>Section Type</td> <td>Auto</td> </tr> <tr> <td>(m)</td> <td>(m)</td> <td>(1:X)</td> <td>(ha)</td> <td>(mins)</td> <td>Flow</td> <td>(l/s)</td> <td>(mm)</td> <td>SECT</td> <td>(mm)</td> <td></td> <td>Design</td> </tr> </table> <p align="center">©1982-2020 Innovyze</p> |                  |                                                                                     | Return Period (years) | 2      | PIMP (%) | 100   | M5-60 (mm) | 19.700 | Add Flow / Climate Change (%) | 0            | Ratio R | 0.350 | Minimum Backdrop Height (m) | 0.200 | Maximum Rainfall (mm/hr) | 50 | Maximum Backdrop Height (m) | 1.500 | Maximum Time of Concentration (mins) | 30 | Min Design Depth for Optimisation (m) | 1.200 | Foul Sewage (l/s/ha) | 0.000 | Min Vel for Auto Design only (m/s) | 1.00 | Volumetric Runoff Coeff. | 0.750 | Min Slope for Optimisation (1:X) | 500 | <b>Time</b> | <b>Area</b> | <b>Time</b> | <b>Area</b> | <b>(mins)</b> | <b>(ha)</b> | <b>(mins)</b> | <b>(ha)</b> | 0-4 | 0.127 | 4-8 | 0.035 | <b>Time</b> | <b>Area</b> | <b>Time</b> | <b>Area</b> | <b>(mins)</b> | <b>(ha)</b> | <b>(mins)</b> | <b>(ha)</b> | 0-4 | 0.354 | 4-8 | 0.187 | PN | Length | Fall | Slope | I.Area | T.E. | Base | k | HYD | DIA | Section Type | Auto | (m) | (m) | (1:X) | (ha) | (mins) | Flow | (l/s) | (mm) | SECT | (mm) |  | Design |
| Return Period (years)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | 2                | PIMP (%)                                                                            | 100                   |        |          |       |            |        |                               |              |         |       |                             |       |                          |    |                             |       |                                      |    |                                       |       |                      |       |                                    |      |                          |       |                                  |     |             |             |             |             |               |             |               |             |     |       |     |       |             |             |             |             |               |             |               |             |     |       |     |       |    |        |      |       |        |      |      |   |     |     |              |      |     |     |       |      |        |      |       |      |      |      |  |        |
| M5-60 (mm)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | 19.700           | Add Flow / Climate Change (%)                                                       | 0                     |        |          |       |            |        |                               |              |         |       |                             |       |                          |    |                             |       |                                      |    |                                       |       |                      |       |                                    |      |                          |       |                                  |     |             |             |             |             |               |             |               |             |     |       |     |       |             |             |             |             |               |             |               |             |     |       |     |       |    |        |      |       |        |      |      |   |     |     |              |      |     |     |       |      |        |      |       |      |      |      |  |        |
| Ratio R                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | 0.350            | Minimum Backdrop Height (m)                                                         | 0.200                 |        |          |       |            |        |                               |              |         |       |                             |       |                          |    |                             |       |                                      |    |                                       |       |                      |       |                                    |      |                          |       |                                  |     |             |             |             |             |               |             |               |             |     |       |     |       |             |             |             |             |               |             |               |             |     |       |     |       |    |        |      |       |        |      |      |   |     |     |              |      |     |     |       |      |        |      |       |      |      |      |  |        |
| Maximum Rainfall (mm/hr)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 50               | Maximum Backdrop Height (m)                                                         | 1.500                 |        |          |       |            |        |                               |              |         |       |                             |       |                          |    |                             |       |                                      |    |                                       |       |                      |       |                                    |      |                          |       |                                  |     |             |             |             |             |               |             |               |             |     |       |     |       |             |             |             |             |               |             |               |             |     |       |     |       |    |        |      |       |        |      |      |   |     |     |              |      |     |     |       |      |        |      |       |      |      |      |  |        |
| Maximum Time of Concentration (mins)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | 30               | Min Design Depth for Optimisation (m)                                               | 1.200                 |        |          |       |            |        |                               |              |         |       |                             |       |                          |    |                             |       |                                      |    |                                       |       |                      |       |                                    |      |                          |       |                                  |     |             |             |             |             |               |             |               |             |     |       |     |       |             |             |             |             |               |             |               |             |     |       |     |       |    |        |      |       |        |      |      |   |     |     |              |      |     |     |       |      |        |      |       |      |      |      |  |        |
| Foul Sewage (l/s/ha)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | 0.000            | Min Vel for Auto Design only (m/s)                                                  | 1.00                  |        |          |       |            |        |                               |              |         |       |                             |       |                          |    |                             |       |                                      |    |                                       |       |                      |       |                                    |      |                          |       |                                  |     |             |             |             |             |               |             |               |             |     |       |     |       |             |             |             |             |               |             |               |             |     |       |     |       |    |        |      |       |        |      |      |   |     |     |              |      |     |     |       |      |        |      |       |      |      |      |  |        |
| Volumetric Runoff Coeff.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 0.750            | Min Slope for Optimisation (1:X)                                                    | 500                   |        |          |       |            |        |                               |              |         |       |                             |       |                          |    |                             |       |                                      |    |                                       |       |                      |       |                                    |      |                          |       |                                  |     |             |             |             |             |               |             |               |             |     |       |     |       |             |             |             |             |               |             |               |             |     |       |     |       |    |        |      |       |        |      |      |   |     |     |              |      |     |     |       |      |        |      |       |      |      |      |  |        |
| <b>Time</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | <b>Area</b>      | <b>Time</b>                                                                         | <b>Area</b>           |        |          |       |            |        |                               |              |         |       |                             |       |                          |    |                             |       |                                      |    |                                       |       |                      |       |                                    |      |                          |       |                                  |     |             |             |             |             |               |             |               |             |     |       |     |       |             |             |             |             |               |             |               |             |     |       |     |       |    |        |      |       |        |      |      |   |     |     |              |      |     |     |       |      |        |      |       |      |      |      |  |        |
| <b>(mins)</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | <b>(ha)</b>      | <b>(mins)</b>                                                                       | <b>(ha)</b>           |        |          |       |            |        |                               |              |         |       |                             |       |                          |    |                             |       |                                      |    |                                       |       |                      |       |                                    |      |                          |       |                                  |     |             |             |             |             |               |             |               |             |     |       |     |       |             |             |             |             |               |             |               |             |     |       |     |       |    |        |      |       |        |      |      |   |     |     |              |      |     |     |       |      |        |      |       |      |      |      |  |        |
| 0-4                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | 0.127            | 4-8                                                                                 | 0.035                 |        |          |       |            |        |                               |              |         |       |                             |       |                          |    |                             |       |                                      |    |                                       |       |                      |       |                                    |      |                          |       |                                  |     |             |             |             |             |               |             |               |             |     |       |     |       |             |             |             |             |               |             |               |             |     |       |     |       |    |        |      |       |        |      |      |   |     |     |              |      |     |     |       |      |        |      |       |      |      |      |  |        |
| <b>Time</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | <b>Area</b>      | <b>Time</b>                                                                         | <b>Area</b>           |        |          |       |            |        |                               |              |         |       |                             |       |                          |    |                             |       |                                      |    |                                       |       |                      |       |                                    |      |                          |       |                                  |     |             |             |             |             |               |             |               |             |     |       |     |       |             |             |             |             |               |             |               |             |     |       |     |       |    |        |      |       |        |      |      |   |     |     |              |      |     |     |       |      |        |      |       |      |      |      |  |        |
| <b>(mins)</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | <b>(ha)</b>      | <b>(mins)</b>                                                                       | <b>(ha)</b>           |        |          |       |            |        |                               |              |         |       |                             |       |                          |    |                             |       |                                      |    |                                       |       |                      |       |                                    |      |                          |       |                                  |     |             |             |             |             |               |             |               |             |     |       |     |       |             |             |             |             |               |             |               |             |     |       |     |       |    |        |      |       |        |      |      |   |     |     |              |      |     |     |       |      |        |      |       |      |      |      |  |        |
| 0-4                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | 0.354            | 4-8                                                                                 | 0.187                 |        |          |       |            |        |                               |              |         |       |                             |       |                          |    |                             |       |                                      |    |                                       |       |                      |       |                                    |      |                          |       |                                  |     |             |             |             |             |               |             |               |             |     |       |     |       |             |             |             |             |               |             |               |             |     |       |     |       |    |        |      |       |        |      |      |   |     |     |              |      |     |     |       |      |        |      |       |      |      |      |  |        |
| PN                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | Length           | Fall                                                                                | Slope                 | I.Area | T.E.     | Base  | k          | HYD    | DIA                           | Section Type | Auto    |       |                             |       |                          |    |                             |       |                                      |    |                                       |       |                      |       |                                    |      |                          |       |                                  |     |             |             |             |             |               |             |               |             |     |       |     |       |             |             |             |             |               |             |               |             |     |       |     |       |    |        |      |       |        |      |      |   |     |     |              |      |     |     |       |      |        |      |       |      |      |      |  |        |
| (m)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | (m)              | (1:X)                                                                               | (ha)                  | (mins) | Flow     | (l/s) | (mm)       | SECT   | (mm)                          |              | Design  |       |                             |       |                          |    |                             |       |                                      |    |                                       |       |                      |       |                                    |      |                          |       |                                  |     |             |             |             |             |               |             |               |             |     |       |     |       |             |             |             |             |               |             |               |             |     |       |     |       |    |        |      |       |        |      |      |   |     |     |              |      |     |     |       |      |        |      |       |      |      |      |  |        |

### Network Results Table

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### Network Design Table for Storm

| PN    | Length<br>(m) | Fall<br>(m) | Slope<br>(1:X) | I.Area<br>(ha) | T.E.<br>(mins) | Base<br>Flow (l/s) | k<br>(mm) | HYD<br>SECT | DIA<br>(mm) | Section Type | Auto<br>Design |
|-------|---------------|-------------|----------------|----------------|----------------|--------------------|-----------|-------------|-------------|--------------|----------------|
| 1.000 | 19.544        | 0.600       | 32.6           | 0.041          | 4.00           | 0.0                | 0.600     | o           | 300         | Pipe/Conduit |                |
| 1.001 | 30.735        | 0.250       | 122.9          | 0.000          | 0.00           | 0.0                | 0.600     | o           | 300         | Pipe/Conduit |                |
| 1.002 | 34.056        | 1.000       | 34.1           | 0.041          | 0.00           | 0.0                | 0.600     | o           | 300         | Pipe/Conduit |                |
| 1.003 | 14.378        | 0.060       | 239.6          | 0.040          | 0.00           | 0.0                | 0.600     | o           | 300         | Pipe/Conduit |                |
| 1.004 | 23.656        | 0.100       | 236.6          | 0.000          | 0.00           | 0.0                | 0.600     | 2 \_ /      | 300         | 1:2 Ditch    |                |
| 1.005 | 21.195        | 0.200       | 106.0          | 0.040          | 0.00           | 0.0                | 0.600     | o           | 300         | Pipe/Conduit |                |
| 1.006 | 3.525         | 0.050       | 70.5           | 0.000          | 0.00           | 0.0                | 0.600     | o           | 300         | Pipe/Conduit |                |
| 1.007 | 2.881         | 0.550       | 5.2            | 0.000          | 0.00           | 0.0                | 0.600     | o           | 300         | Pipe/Conduit |                |
| 2.000 | 34.862        | 0.350       | 99.6           | 0.061          | 4.00           | 0.0                | 0.600     | o           | 300         | Pipe/Conduit |                |
| 2.001 | 34.846        | 0.350       | 99.6           | 0.040          | 0.00           | 0.0                | 0.600     | o           | 300         | Pipe/Conduit |                |
| 2.002 | 38.898        | 0.150       | 259.3          | 0.335          | 0.00           | 0.0                | 0.600     | o           | 300         | Pipe/Conduit |                |
| 2.003 | 29.531        | 0.100       | 295.3          | 0.105          | 0.00           | 0.0                | 0.600     | o           | 300         | Pipe/Conduit |                |
| 2.004 | 13.381        | 0.150       | 89.2           | 0.000          | 0.00           | 0.0                | 0.600     | o           | 300         | Pipe/Conduit |                |
| 2.005 | 5.432         | 0.050       | 108.6          | 0.000          | 0.00           | 0.0                | 0.600     | o           | 300         | Pipe/Conduit |                |

### Network Results Table

| PN    | Rain<br>(mm/hr) | T.C.<br>(mins) | US/IL<br>(m) | Σ I.Area<br>(ha) | Σ Base<br>Flow (l/s) | Foul<br>(l/s) | Add Flow<br>(l/s) | Vel<br>(m/s) | Cap<br>(l/s) | Flow<br>(l/s) |
|-------|-----------------|----------------|--------------|------------------|----------------------|---------------|-------------------|--------------|--------------|---------------|
| 1.000 | 50.00           | 4.12           | 30.350       | 0.041            | 0.0                  | 0.0           | 0.0               | 2.76         | 195.4        | 5.6           |
| 1.001 | 50.00           | 4.48           | 29.750       | 0.041            | 0.0                  | 0.0           | 0.0               | 1.42         | 100.1        | 5.6           |
| 1.002 | 50.00           | 4.69           | 29.500       | 0.082            | 0.0                  | 0.0           | 0.0               | 2.70         | 191.1        | 11.1          |
| 1.003 | 50.00           | 4.93           | 28.600       | 0.122            | 0.0                  | 0.0           | 0.0               | 1.01         | 71.5         | 16.5          |
| 1.004 | 50.00           | 5.16           | 28.550       | 0.122            | 0.0                  | 0.0           | 0.0               | 1.67         | 451.6        | 16.5          |
| 1.005 | 50.00           | 5.39           | 28.450       | 0.162            | 0.0                  | 0.0           | 0.0               | 1.53         | 107.9        | 21.9          |
| 1.006 | 50.00           | 5.42           | 28.250       | 0.162            | 0.0                  | 0.0           | 0.0               | 1.87         | 132.5        | 21.9          |
| 1.007 | 50.00           | 5.43           | 28.200       | 0.162            | 0.0                  | 0.0           | 0.0               | 6.91         | 488.7        | 21.9          |
| 2.000 | 50.00           | 4.37           | 29.750       | 0.061            | 0.0                  | 0.0           | 0.0               | 1.58         | 111.4        | 8.3           |
| 2.001 | 50.00           | 4.74           | 29.400       | 0.101            | 0.0                  | 0.0           | 0.0               | 1.58         | 111.4        | 13.7          |
| 2.002 | 50.00           | 5.40           | 29.050       | 0.436            | 0.0                  | 0.0           | 0.0               | 0.97         | 68.7         | 59.0          |
| 2.003 | 50.00           | 5.95           | 28.900       | 0.541            | 0.0                  | 0.0           | 0.0               | 0.91         | 64.3         | 73.3          |
| 2.004 | 50.00           | 6.08           | 28.800       | 0.541            | 0.0                  | 0.0           | 0.0               | 1.67         | 117.7        | 73.3          |
| 2.005 | 50.00           | 6.14           | 28.650       | 0.541            | 0.0                  | 0.0           | 0.0               | 1.51         | 106.6        | 73.3          |



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### Online Controls for Storm

#### Hydro-Brake® Optimum Manhole: 9, DS/PN: 1.007, Volume (m³): 2.2

Unit Reference MD-SHE-0059-2000-1700-2000  
 Design Head (m) 1.700  
 Design Flow (l/s) 2.0  
 Flush-Flo™ Calculated  
 Objective Minimise upstream storage  
 Application Surface  
 Sump Available Yes  
 Diameter (mm) 59  
 Invert Level (m) 28.200  
 Minimum Outlet Pipe Diameter (mm) 75  
 Suggested Manhole Diameter (mm) 1200

| Control Points            | Head (m) | Flow (l/s) | Control Points            | Head (m) | Flow (l/s) |
|---------------------------|----------|------------|---------------------------|----------|------------|
| Design Point (Calculated) | 1.700    | 2.0        | Kick-Flo®                 | 0.527    | 1.2        |
| Flush-Flo™                | 0.257    | 1.5        | Mean Flow over Head Range | -        | 1.5        |

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

| Depth (m) | Flow (l/s) | Depth (m) | Flow (l/s) | Depth (m) | Flow (l/s) | Depth (m) | Flow (l/s) |
|-----------|------------|-----------|------------|-----------|------------|-----------|------------|
| 0.100     | 1.3        | 1.200     | 1.7        | 3.000     | 2.6        | 7.000     | 3.8        |
| 0.200     | 1.4        | 1.400     | 1.8        | 3.500     | 2.8        | 7.500     | 4.0        |
| 0.300     | 1.4        | 1.600     | 1.9        | 4.000     | 3.0        | 8.000     | 4.1        |
| 0.400     | 1.4        | 1.800     | 2.1        | 4.500     | 3.1        | 8.500     | 4.2        |
| 0.500     | 1.3        | 2.000     | 2.2        | 5.000     | 3.3        | 9.000     | 4.3        |
| 0.600     | 1.3        | 2.200     | 2.2        | 5.500     | 3.4        | 9.500     | 4.4        |
| 0.800     | 1.4        | 2.400     | 2.3        | 6.000     | 3.6        |           |            |
| 1.000     | 1.6        | 2.600     | 2.4        | 6.500     | 3.7        |           |            |

#### Hydro-Brake® Optimum Manhole: 15, DS/PN: 2.004, Volume (m³): 3.9

Unit Reference MD-SHE-0187-1900-1500-1900  
 Design Head (m) 1.500  
 Design Flow (l/s) 19.0  
 Flush-Flo™ Calculated  
 Objective Minimise upstream storage  
 Application Surface  
 Sump Available Yes  
 Diameter (mm) 187  
 Invert Level (m) 28.800



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**Hydro-Brake® Optimum Manhole: 15, DS/PN: 2.004, Volume (m³): 3.9**

Minimum Outlet Pipe Diameter (mm) 225

Suggested Manhole Diameter (mm) 1500

| Control Points            | Head (m) | Flow (l/s) | Control Points            | Head (m) | Flow (l/s) |
|---------------------------|----------|------------|---------------------------|----------|------------|
| Design Point (Calculated) | 1.500    | 19.0       | Kick-Flo®                 | 0.977    | 15.5       |
| Flush-Flo™                | 0.449    | 19.0       | Mean Flow over Head Range | -        | 16.4       |

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

| Depth (m) | Flow (l/s) | Depth (m) | Flow (l/s) | Depth (m) | Flow (l/s) | Depth (m) | Flow (l/s) |
|-----------|------------|-----------|------------|-----------|------------|-----------|------------|
| 0.100     | 6.5        | 1.200     | 17.1       | 3.000     | 26.5       | 7.000     | 39.8       |
| 0.200     | 17.1       | 1.400     | 18.4       | 3.500     | 28.5       | 7.500     | 41.1       |
| 0.300     | 18.5       | 1.600     | 19.6       | 4.000     | 30.4       | 8.000     | 42.4       |
| 0.400     | 19.0       | 1.800     | 20.7       | 4.500     | 32.1       | 8.500     | 43.7       |
| 0.500     | 19.0       | 2.000     | 21.8       | 5.000     | 33.8       | 9.000     | 44.9       |
| 0.600     | 18.7       | 2.200     | 22.8       | 5.500     | 35.4       | 9.500     | 46.1       |
| 0.800     | 17.8       | 2.400     | 23.8       | 6.000     | 36.9       |           |            |
| 1.000     | 15.7       | 2.600     | 24.7       | 6.500     | 38.4       |           |            |



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### Storage Structures for Storm

#### Porous Car Park Manhole: 13, DS/PN: 2.003

|                                      |         |                         |       |
|--------------------------------------|---------|-------------------------|-------|
| Infiltration Coefficient Base (m/hr) | 0.00000 | Width (m)               | 3.0   |
| Membrane Percolation (mm/hr)         | 1000    | Length (m)              | 42.0  |
| Max Percolation (l/s)                | 35.0    | Slope (1:X)             | 100.0 |
| Safety Factor                        | 2.0     | Depression Storage (mm) | 5     |
| Porosity                             | 0.30    | Evaporation (mm/day)    | 3     |
| Invert Level (m)                     | 28.900  | Membrane Depth (mm)     | 0     |

#### Tank or Pond Manhole: 15, DS/PN: 2.004

Invert Level (m) 28.800

| Depth (m) | Area (m <sup>2</sup> ) | Depth (m) | Area (m <sup>2</sup> ) |
|-----------|------------------------|-----------|------------------------|
| 0.000     | 34.0                   | 1.500     | 257.0                  |

| Simulation Criteria                 |                                                                                                     |
|-------------------------------------|-----------------------------------------------------------------------------------------------------|
| Areal Reduction Factor              | 1.000                                                                                               |
| Hot Start (mins)                    | 0                                                                                                   |
| Hot Start Level (mm)                | 0                                                                                                   |
| Manhole Headloss Coeff (Global)     | 0.500                                                                                               |
| Foul Sewage per hectare (1/s)       | 0.000                                                                                               |
| Additional Flow - % of Total Flow   | 0.000                                                                                               |
| MADD Factor * 10m <sup>3</sup> /ha  | 2.000                                                                                               |
| Inlet Coeffiecient                  | 0.800                                                                                               |
| Flow per Person per Day (1/per/day) | 0.000                                                                                               |
| Number of Input Hydrographs 0       |                                                                                                     |
| Number of Offline Controls 0        |                                                                                                     |
| Number of Time/Area Diagrams 0      |                                                                                                     |
| Number of Online Controls 2         |                                                                                                     |
| Number of Storage Structures 2      |                                                                                                     |
| Number of Real Time Controls 0      |                                                                                                     |
| Synthetic Rainfall Details          |                                                                                                     |
| Rainfall Model                      | FSR                                                                                                 |
| Region England and Wales            | Cv (Summer) 0.750                                                                                   |
| M5-60 (mm)                          | 19.700 Cv (Winter) 0.840                                                                            |
| Ratio R                             | 0.350                                                                                               |
| Margin for Flood Risk               | Warning (mm) 300.0                                                                                  |
| Analysis Timestep                   | 2.5 Second Increment (Extended)                                                                     |
| DTS Status                          | ON                                                                                                  |
| DVD Status                          | OFF                                                                                                 |
| Inertia Status                      | OFF                                                                                                 |
| Profile(s)                          | Summer and Winter                                                                                   |
| Duration(s) (mins)                  | 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080 |
| Return Period(s) (years)            | 1, 30, 100                                                                                          |
| Climate Change (%)                  | 0, 0, 25                                                                                            |

|       |               |            |                  |                   |                        |                    |                       |                  | Water        |
|-------|---------------|------------|------------------|-------------------|------------------------|--------------------|-----------------------|------------------|--------------|
| PN    | US/MH<br>Name | Storm      | Return<br>Period | Climate<br>Change | First (X)<br>Surcharge | First (Y)<br>Flood | First (Z)<br>Overflow | Overflow<br>Act. | Level<br>(m) |
| 1.000 | 1             | 15 Winter  | 1                | +0%               |                        |                    |                       |                  | 30.386       |
| 1.001 | 2             | 15 Summer  | 1                | +0%               |                        |                    |                       |                  | 29.799       |
| 1.002 | 3             | 15 Winter  | 1                | +0%               |                        |                    |                       |                  | 29.547       |
| 1.003 | 4             | 120 Winter | 1                | +0%               | 1/60 Winter            |                    |                       |                  | 28.924       |
| 1.004 | 5             | 120 Winter | 1                | +0%               |                        |                    |                       |                  | 28.927       |
| 1.005 | 6             | 120 Winter | 1                | +0%               | 1/15 Summer            |                    |                       |                  | 28.927       |
| 1.006 | 7             | 180 Winter | 1                | +0%               | 1/15 Summer            |                    |                       |                  | 29.062       |
| 1.007 | 9             | 180 Winter | 1                | +0%               | 1/15 Summer            |                    |                       |                  | 29.101       |
| 2.000 | 10            | 15 Winter  | 1                | +0%               | 100/15 Summer          |                    |                       |                  | 29.808       |
| 2.001 | 11            | 15 Winter  | 1                | +0%               | 30/15 Summer           |                    |                       |                  | 29.471       |
| 2.002 | 12            | 15 Winter  | 1                | +0%               | 30/15 Summer           | 100/15 Winter      |                       |                  | 29.251       |
| 2.003 | 13            | 30 Winter  | 1                | +0%               | 30/15 Summer           |                    |                       |                  | 29.159       |



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

| PN    | US/MH<br>Name | Surcharged Flooded |                |                | Half Drain        |                | Pipe          | Status     | Level<br>Exceeded |
|-------|---------------|--------------------|----------------|----------------|-------------------|----------------|---------------|------------|-------------------|
|       |               | Depth<br>(m)       | Volume<br>(m³) | Flow /<br>Cap. | Overflow<br>(l/s) | Time<br>(mins) | Flow<br>(l/s) |            |                   |
| 1.000 | 1             | -0.264             | 0.000          | 0.03           |                   |                | 5.8           | OK         |                   |
| 1.001 | 2             | -0.251             | 0.000          | 0.06           |                   |                | 5.7           | OK         |                   |
| 1.002 | 3             | -0.253             | 0.000          | 0.06           |                   |                | 10.2          | OK         |                   |
| 1.003 | 4             | 0.024              | 0.000          | 0.08           |                   |                | 5.0           | SURCHARGED |                   |
| 1.004 | 5             | -1.073             | 0.000          | 0.00           |                   |                | 4.3           | OK         |                   |
| 1.005 | 6             | 0.177              | 0.000          | 0.06           |                   |                | 5.9           | SURCHARGED |                   |
| 1.006 | 7             | 0.512              | 0.000          | 0.06           |                   |                | 3.6           | SURCHARGED |                   |
| 1.007 | 9             | 0.601              | 0.000          | 0.01           |                   |                | 1.4           | SURCHARGED |                   |
| 2.000 | 10            | -0.242             | 0.000          | 0.08           |                   |                | 8.5           | OK         |                   |
| 2.001 | 11            | -0.229             | 0.000          | 0.12           |                   |                | 12.7          | OK         |                   |
| 2.002 | 12            | -0.099             | 0.000          | 0.76           |                   |                | 48.4          | OK         | 1                 |
| 2.003 | 13            | -0.041             | 0.000          | 0.83           |                   | 13             | 48.2          | OK         |                   |



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Network 2020.1.3

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

|       | US/MH |        | Return Climate | First (X) | First (Y) | First (Z) | Overflow | Water Level |
|-------|-------|--------|----------------|-----------|-----------|-----------|----------|-------------|
| PN    | Name  | Storm  | Period Change  | Surcharge | Flood     | Overflow  | Act.     | (m)         |
| 2.004 | 15 30 | Winter | 1              | +0%       | 1/15      | Winter    |          | 29.136      |
| 2.005 | 17 30 | Winter | 1              | +0%       |           |           |          | 28.763      |

|       | US/MH | Depth  | Volume | Flow/ Overflow | Half Drain  | Pipe       |            | Level    |
|-------|-------|--------|--------|----------------|-------------|------------|------------|----------|
| PN    | Name  | (m)    | (m³)   | Cap. (l/s)     | Time (mins) | Flow (l/s) | Status     | Exceeded |
| 2.004 | 15    | 0.036  | 0.000  | 0.19           |             | 18.7       | SURCHARGED |          |
| 2.005 | 17    | -0.187 | 0.000  | 0.31           |             | 18.7       | OK         |          |





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

| PN    | US/MH<br>Name | Surcharged Flooded |                |                               | Half Drain Pipe |               | Status     | Level<br>Exceeded |
|-------|---------------|--------------------|----------------|-------------------------------|-----------------|---------------|------------|-------------------|
|       |               | Depth<br>(m)       | Volume<br>(m³) | Flow / Overflow<br>Cap. (l/s) | Time<br>(mins)  | Flow<br>(l/s) |            |                   |
| 1.000 | 1             | -0.242             | 0.000          | 0.08                          |                 | 14.1          | OK         |                   |
| 1.001 | 2             | -0.222             | 0.000          | 0.15                          |                 | 14.0          | OK         |                   |
| 1.002 | 3             | -0.220             | 0.000          | 0.16                          |                 | 28.1          | OK         |                   |
| 1.003 | 4             | 0.471              | 0.000          | 0.16                          |                 | 9.5           | SURCHARGED |                   |
| 1.004 | 5             | -0.629             | 0.000          | 0.00                          |                 | 9.2           | OK         |                   |
| 1.005 | 6             | 0.621              | 0.000          | 0.07                          |                 | 6.2           | SURCHARGED |                   |
| 1.006 | 7             | 1.004              | 0.000          | 0.06                          |                 | 3.8           | SURCHARGED |                   |
| 1.007 | 9             | 1.103              | 0.000          | 0.01                          |                 | 1.7           | SURCHARGED |                   |
| 2.000 | 10            | -0.055             | 0.000          | 0.19                          |                 | 19.4          | OK         |                   |
| 2.001 | 11            | 0.275              | 0.000          | 0.30                          |                 | 31.0          | SURCHARGED |                   |
| 2.002 | 12            | 0.595              | 0.000          | 1.81                          |                 | 115.6         | SURCHARGED | 1                 |
| 2.003 | 13            | 0.383              | 0.000          | 1.08                          | 50              | 62.9          | SURCHARGED |                   |



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Network 2020.1.3

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

|       | US/MH |        | Return Climate | First (X) | First (Y) | First (Z) | Overflow | Water  |
|-------|-------|--------|----------------|-----------|-----------|-----------|----------|--------|
| PN    | Name  | Storm  | Period Change  | Surcharge | Flood     | Overflow  | Act.     | Level  |
|       |       |        |                |           |           |           |          | (m)    |
| 2.004 | 15 60 | Winter | 30             | +0%       | 1/15      | Winter    |          | 29.561 |
| 2.005 | 17 15 | Summer | 30             | +0%       |           |           |          | 28.764 |

|       | US/MH | Depth  | Volume | Flow/ Overflow | Half Drain  | Pipe       |            | Level    |
|-------|-------|--------|--------|----------------|-------------|------------|------------|----------|
| PN    | Name  | (m)    | (m³)   | Cap. (l/s)     | Time (mins) | Flow (l/s) | Status     | Exceeded |
| 2.004 | 15    | 0.461  | 0.000  | 0.20           |             | 18.9       | SURCHARGED |          |
| 2.005 | 17    | -0.186 | 0.000  | 0.31           |             | 18.9       | OK         |          |





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Network 2020.1.3

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

| PN    | US/MH<br>Name | Surcharged Flooded |                             |                | Half Drain        |                | Pipe          | Status     | Level<br>Exceeded |
|-------|---------------|--------------------|-----------------------------|----------------|-------------------|----------------|---------------|------------|-------------------|
|       |               | Depth<br>(m)       | Volume<br>(m <sup>3</sup> ) | Flow /<br>Cap. | Overflow<br>(l/s) | Time<br>(mins) | Flow<br>(l/s) |            |                   |
| 1.000 | 1             | -0.227             | 0.000                       | 0.13           |                   |                | 22.8          | OK         |                   |
| 1.001 | 2             | -0.199             | 0.000                       | 0.25           |                   |                | 22.7          | OK         |                   |
| 1.002 | 3             | -0.084             | 0.000                       | 0.04           |                   |                | 6.6           | OK         |                   |
| 1.003 | 4             | 0.819              | 0.000                       | 0.21           |                   |                | 12.4          | FLOOD RISK |                   |
| 1.004 | 5             | -0.281             | 0.000                       | 0.00           |                   |                | 12.3          | FLOOD RISK |                   |
| 1.005 | 6             | 0.969              | 0.000                       | 0.06           |                   |                | 6.1           | FLOOD RISK |                   |
| 1.006 | 7             | 1.367              | 0.000                       | 0.06           |                   |                | 3.7           | FLOOD RISK |                   |
| 1.007 | 9             | 1.464              | 0.000                       | 0.01           |                   |                | 1.9           | FLOOD RISK |                   |
| 2.000 | 10            | 1.089              | 0.000                       | 0.26           |                   |                | 26.2          | FLOOD RISK |                   |



Innovyze

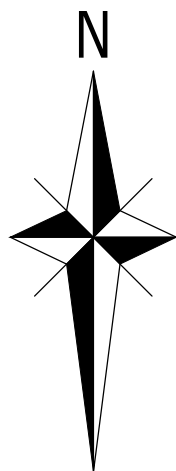
Network 2020.1.3

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

| PN    | US/MH |            | Return Period | Climate Change | First (X) Surchage | First (Y) Flood | First (Z) Overflow | Overflow Act. | Water Level |
|-------|-------|------------|---------------|----------------|--------------------|-----------------|--------------------|---------------|-------------|
|       | Name  | Storm      |               |                |                    |                 |                    |               | (m)         |
| 2.001 | 11    | 15 Winter  | 100           | +25%           | 30/15 Summer       |                 |                    |               | 31.107      |
| 2.002 | 12    | 15 Winter  | 100           | +25%           | 30/15 Summer       | 100/15 Winter   |                    |               | 31.050      |
| 2.003 | 13    | 30 Winter  | 100           | +25%           | 30/15 Summer       |                 |                    |               | 30.077      |
| 2.004 | 15    | 120 Winter | 100           | +25%           | 1/15 Winter        |                 |                    |               | 29.975      |
| 2.005 | 17    | 15 Winter  | 100           | +25%           |                    |                 |                    |               | 28.764      |

| PN    | US/MH |           | Surcharged Flooded |            | Flow/ Overflow Cap. | Half Drain Time (mins) | Pipe       |            | Level Exceeded |
|-------|-------|-----------|--------------------|------------|---------------------|------------------------|------------|------------|----------------|
|       | Name  | Depth (m) | Volume (m³)        | Flow (l/s) |                     |                        | Flow (l/s) | Status     |                |
| 2.001 | 11    | 1.407     | 0.000              | 0.43       |                     |                        | 43.9       | FLOOD RISK |                |
| 2.002 | 12    | 1.700     | 0.036              | 2.85       |                     |                        | 181.2      | FLOOD      | 1              |
| 2.003 | 13    | 0.877     | 0.000              | 2.21       |                     |                        | 128.8      | SURCHARGED |                |
| 2.004 | 15    | 0.875     | 0.000              | 0.20       |                     |                        | 18.9       | SURCHARGED |                |
| 2.005 | 17    | -0.186    | 0.000              | 0.31       |                     |                        | 18.9       | OK         |                |

| SUDS MANAGEMENT TRAIN - NORTH CATCHMENT |                                                |
|-----------------------------------------|------------------------------------------------|
| SUB-CATCHMENT                           | SUDS MANAGEMENT TRAIN                          |
| ROOF                                    | 1st - GREEN ROOF / RAIN GARDEN / FILTER DRAIN  |
|                                         | 2nd - ATTENUATION BASIN                        |
|                                         | 3rd - DOWNSTREAM DEFENDER                      |
|                                         | 4th - BIO-RETENTION FOREBAY                    |
| ACCESS ROAD                             | 1st - FILTER DRAIN / PERMEABLE PAVING SUB-BASE |
|                                         | 2nd - ATTENUATION BASIN                        |
|                                         | 3rd - DOWNSTREAM DEFENDER                      |
|                                         | 4th - BIO-RETENTION FOREBAY                    |



NOTES

1. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH THE RELEVANT SPECIFICATION AND ALL OTHER RELATED DRAWINGS ISSUED BY THE ENGINEER.
2. DO NOT SCALE FROM THIS DRAWING. WORK FROM FIGURED DIMENSIONS ONLY. TO CHECK THAT THIS DRAWING HAS BEEN PRINTED TO THE INTENDED SCALE THIS BAR SHOULD BE 50mm LONG @ A1 OR 25mm LONG @ A3.
3. ALL DIMENSIONS SHOWN ON THIS DRAWING ARE IN METRES, UNLESS OTHERWISE STATED.
4. ALL DIMENSIONS, LEVELS AND SURVEY GRID CO-ORDINATES ARE TO BE CHECKED ON SITE AND THE ENGINEER NOTIFIED IMMEDIATELY OF ANY DISCREPANCIES PRIOR TO THE COMMENCEMENT OF THE WORKS.
5. NO DEVIATION FROM THE DETAILS SHOWN ON THIS DRAWING IS PERMITTED WITHOUT PRIOR PERMISSION FROM THE ENGINEER.
6. THIS DRAWING HAS BEEN BASED ON "ILLUSTRATIVE SITE PLAN", DRAWING No. 7912\_D01 REV J, DATED 25.11.22 BY RADLEY HOUSE PARTNERSHIP.
7. THIS DRAWING HAS BEEN BASED ON "SITE SURVEY", DRAWING No. H16-07, BY KND SURVEYS, DATED 9th AUGUST 2007.
8. PROPOSED DRAINAGE WITHIN ROOT PROTECTION AREA TO BE CONSTRUCTED USING NO DIG TECHNIQUES IN ACCORDANCE WITH BS 5837. EXCAVATE/INSTALL DRAINAGE IN ROOT ZONES UNDER THE SUPERVISION OF A SUITABLY QUALIFIED ARBORICULTURALIST TO PREVENT ROOT DAMAGE.

CDM NOTES

THE ATTENTION OF THE CLIENT, PRINCIPAL DESIGNER, PRINCIPAL CONTRACTOR, DESIGNERS AND CONTRACTORS IS DRAWN TO THE FOLLOWING POTENTIAL RISKS IN CONJUNCTION WITH THE PROPOSED ON-SITE AND OFF-SITE WORKS AS DESIGNED FOR THIS PROJECT:

1. WORKS IN THE VICINITY OF LIVE SERVICES INCLUDING GAS, ELECTRICITY AND BT WILL BE NECESSARY AND THE ADVICE OF ALL STATUTORY SERVICE COMPANIES MUST BE SOUGHT BEFORE ANY WORKS COMMENCE.
2. WORKS WITHIN AND ADJUTING THE EXISTING HIGHWAY WILL ENTAIL TRAFFIC HAZARDS AND ALL APPROPRIATE SAFETY MEASURES INCLUDING BARRIERS, SIGNS AND LIGHTING MUST BE UNDERTAKEN TO THE APPROVAL OF THE LOCAL AUTHORITY, THE HIGHWAY AUTHORITY AND THE POLICE DEPARTMENT.
3. HAZARDOUS MATERIALS INCLUDING CEMENT AND BITUMINOUS MATERIALS ARE SPECIFIED AND THE MANUFACTURERS ADVICE ON SAFE HANDLING PROCEDURES MUST BE OBTAINED AND MADE CLEAR TO ALL OPERATIVES.
4. THE CONTRACTOR WILL BE RESPONSIBLE FOR LOCATING ALL EXISTING SERVICES WITHIN THE VICINITY OF THE WORKS HAND DUG AND ENSURE THESE ARE PROTECTED THROUGHOUT THE DURATION OF THE WORKS. ALL UTILITY PLANT SHOULD BE CLEARLY MARKED ON THE GROUND PRIOR TO COMMENCEMENT OF THE WORKS.
5. THE CONTRACTOR MUST ENSURE ALL WORKING AREAS ARE FULLY SECURE.

KEY

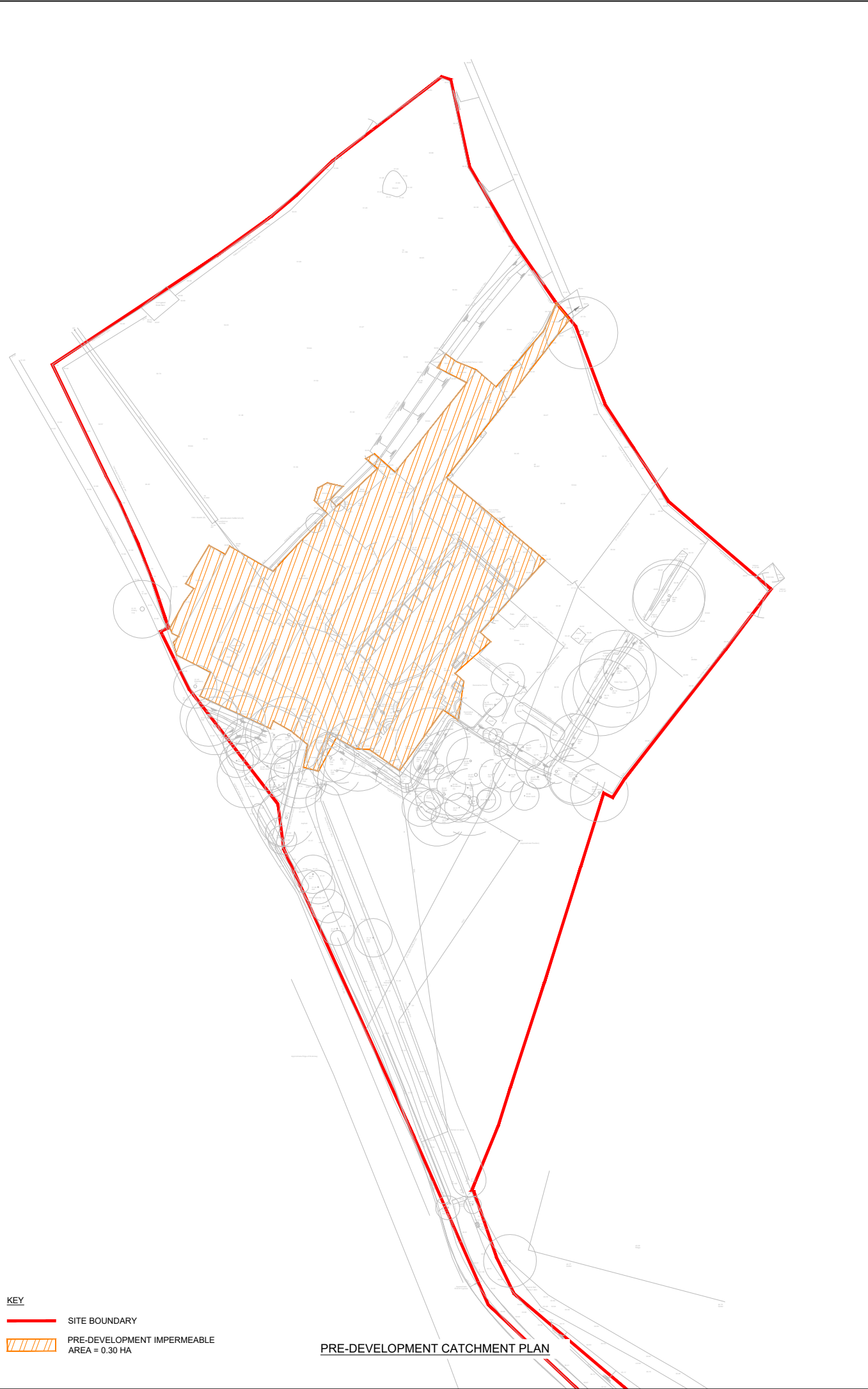
- SITE BOUNDARY
- INDICATIVE RAINWATER DOWNPIPE
- INDICATIVE SURFACE WATER SEWER
- INDICATIVE ROAD GULLY
- INDICATIVE PERFORATED PIPE / FILTER DRAIN
- INDICATIVE PERMEABLE PAVING
- INDICATIVE GREEN ROOF
- INDICATIVE RAIN GARDEN
- INDICATIVE FRENCH DRAIN
- INDICATIVE MESH SURFACE WITH WILDFLOWERS/ GRASSLAND
- INDICATIVE SWALE / BASIN
- INDICATIVE HEADWALL
- INDICATIVE SAFETY FENCING / KNEE RAIL
- INDICATIVE OVERLAND FLOW ROUTE
- INDICATIVE FOUL SEWER
- INDICATIVE COMBINED SEWER
- INDICATIVE EXOLUM PIPELINE
- INDICATIVE EXOLUM PIPELINE EASEMENT

| SUDS MANAGEMENT TRAIN - SOUTH CATCHMENT |                                                |
|-----------------------------------------|------------------------------------------------|
| SUB-CATCHMENT                           | SUDS MANAGEMENT TRAIN                          |
| ROOF                                    | 1st - RAIN GARDEN                              |
|                                         | 2nd - SWALE                                    |
|                                         | 3rd - DOWNSTREAM DEFENDER                      |
|                                         | 4th - BIO-RETENTION FOREBAY                    |
| ACCESS ROAD                             | 1st - FILTER DRAIN / PERMEABLE PAVING SUB-BASE |
|                                         | 2nd - SWALE                                    |
|                                         | 3rd - DOWNSTREAM DEFENDER                      |
|                                         | 4th - BIO-RETENTION FOREBAY                    |

FOR INFORMATION ONLY

|     |                 |     |     |     |          |
|-----|-----------------|-----|-----|-----|----------|
| P03 | FOR INFORMATION | DR  | CR  | DR  | 12.12.22 |
| P02 | FOR INFORMATION | DR  | CR  | DR  | 13.09.22 |
| P01 | FOR INFORMATION | DR  | CR  | DR  | 16.08.22 |
| Rev | Description     | Drm | Chk | App | Date     |

|                                                                                                                                                                                                                           |                  |                   |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------|-------------------|
| <div><div><div></div><div></div><div></div></div><div>FERNBROOK</div><div>CONSULTING ENGINEERS</div></div> <div>The Finbury Business Centre<br/>40 Bowling Green Lane<br/>London<br/>EC1R 0NE<br/>info@fernbrook.co</div> |                  |                   |
| Client                                                                                                                                                                                                                    | COUNTRY HOMES    |                   |
| Project Title:<br>MOORLANDS FARM, WEST END                                                                                                                                                                                |                  |                   |
| Drawing Title:<br>INDICATIVE SURFACE WATER<br>& FOUL DRAINAGE STRATEGY                                                                                                                                                    |                  |                   |
| A1 Scale<br>1:500                                                                                                                                                                                                         | Date<br>AUG 22   | Designed by<br>DR |
| Drawn by<br>DR                                                                                                                                                                                                            | Checked by<br>CR | Approved by<br>DR |
| Drawing Number<br>21035-FCE-XX-XX-DR-D-0500                                                                                                                                                                               | Rev<br>P03       |                   |



**NOTES**

- THIS DRAWING IS TO BE READ IN CONJUNCTION WITH THE RELEVANT SPECIFICATION AND ALL OTHER RELATED DRAWINGS ISSUED BY THE ENGINEER.
- DO NOT SCALE FROM THIS DRAWING. WORK FROM FIGURED DIMENSIONS ONLY. TO CHECK THAT THIS DRAWING HAS BEEN PRINTED TO THE INTENDED SCALE THIS BAR SHOULD BE 50mm LONG @ A1 OR 25mm LONG @ A3.
- THIS DRAWING HAS BEEN BASED ON "ILLUSTRATIVE SITE PLAN", DRAWING No. 7912\_D01\_H, DATED 08.09.22 BY RADLEY HOUSE PARTNERSHIP.
- THIS DRAWING HAS BEEN BASED ON "SITE SURVEY", DRAWING No. H16-07, BY KND SURVEYS, DATED 9th AUGUST 2007.

**FOR INFORMATION ONLY**

|     |                 |     |     |     |          |
|-----|-----------------|-----|-----|-----|----------|
| P03 | FOR INFORMATION | DR  | CR  | DR  | 12.12.22 |
| P02 | FOR INFORMATION | DR  | CR  | DR  | 13.09.22 |
| P01 | FOR INFORMATION | DR  | CR  | DR  | 16.08.22 |
| Rev | Description     | Drm | Chk | App | Date     |

**FERNBROOK**  
CONSULTING ENGINEERS

The Finbury Business Centre  
40 Bowling Green Lane  
London  
EC1R 0NE  
info@fernbrook.co

Client

**COUNTRY HOMES**

Project Title:

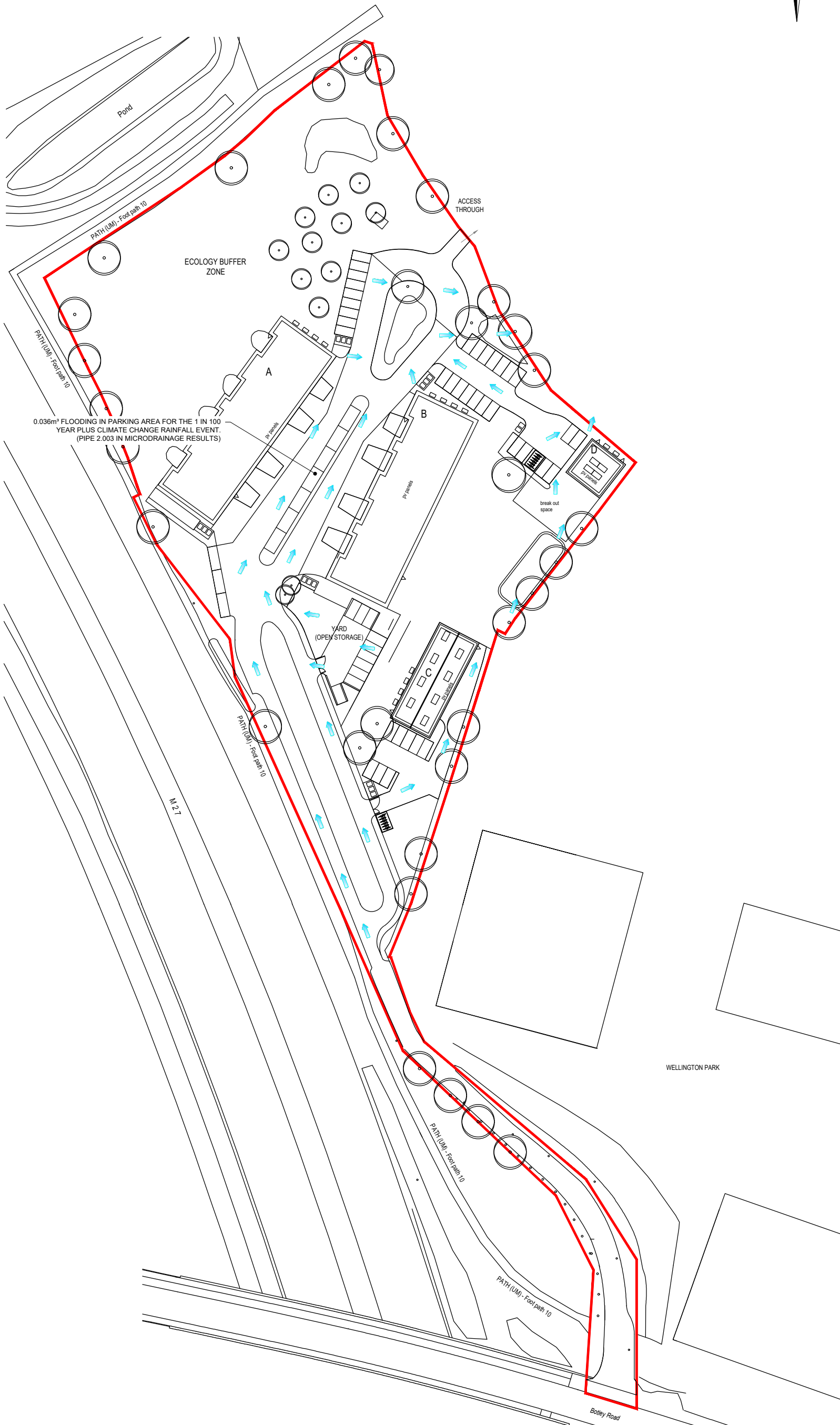
**MOORLANDS FARM, WEST END**

Drawing Title:

**INDICATIVE SURFACE WATER DRAINAGE CATCHMENT AREAS**

|                           |            |             |
|---------------------------|------------|-------------|
| A1 Scale                  | Date       | Designed by |
| 1:500                     | AUG 2022   | DR          |
| Drawn by                  | Checked by | Approved by |
| DR                        | CR         | DR          |
| Drawing Number            | Rev        |             |
| 21035-FCE-XX-XX-DR-D-0501 | P03        |             |

WELLINGTON PARK



- NOTES
1. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH THE RELEVANT SPECIFICATION AND ALL OTHER RELATED DRAWINGS ISSUED BY THE ENGINEER.
  2. DO NOT SCALE FROM THIS DRAWING. WORK FROM FIGURED DIMENSIONS ONLY. TO CHECK THAT THIS DRAWING HAS BEEN PRINTED TO THE INTENDED SCALE THIS BAR SHOULD BE 50mm LONG @ A1 OR 25mm LONG @ A3.
  3. ALL DIMENSIONS SHOWN ON THIS DRAWING ARE IN METRES, UNLESS OTHERWISE STATED.
  4. ALL DIMENSIONS, LEVELS AND SURVEY GRID CO-ORDINATES ARE TO BE CHECKED ON SITE AND THE ENGINEER NOTIFIED IMMEDIATELY OF ANY DISCREPANCIES PRIOR TO THE COMMENCEMENT OF THE WORKS.
  5. NO DEVIATION FROM THE DETAILS SHOWN ON THIS DRAWING IS PERMITTED WITHOUT PRIOR PERMISSION FROM THE ENGINEER.
  6. THIS DRAWING HAS BEEN BASED ON "ILLUSTRATIVE SITE PLAN", DRAWING No. 7912\_D01 REV J, DATED 25.11.22 BY RADLEY HOUSE PARTNERSHIP.

- KEY
- SITE BOUNDARY
  - INDICATIVE OVERLAND FLOW ROUTE

FOR INFORMATION  
ONLY

|                                                                                                                                                                                                                                                                        |             |                                   |     |     |          |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|-----------------------------------|-----|-----|----------|
| P01 FOR INFORMATION                                                                                                                                                                                                                                                    |             | DR                                | CR  | DR  | 12.12.22 |
| Rev                                                                                                                                                                                                                                                                    | Description | Drn                               | Chk | App | Date     |
| <div><div><div><div></div><div></div><div></div></div><div>FERNBROOK</div><div>CONSULTING ENGINEERS</div></div><div><div>The Finsbury Business Centre</div><div>40 Dowling Green Lane</div><div>London</div><div>EC1R 0NE</div><div>info@ferbrook.co</div></div></div> |             |                                   |     |     |          |
| Client                                                                                                                                                                                                                                                                 |             | COUNTRY HOMES                     |     |     |          |
| Project Title:                                                                                                                                                                                                                                                         |             | MOORLANDS FARM, WEST END          |     |     |          |
| Drawing Title:                                                                                                                                                                                                                                                         |             | INDICATIVE EXCEEDANCE FLOW ROUTES |     |     |          |
| A1 Scale                                                                                                                                                                                                                                                               | Date        | Designed by                       |     |     |          |
| 1:500                                                                                                                                                                                                                                                                  | DEC 22      | DR                                |     |     |          |
| Drawn by                                                                                                                                                                                                                                                               | Checked by  | Approved by                       |     |     |          |
| DR                                                                                                                                                                                                                                                                     | CR          | DR                                |     |     |          |
| Drawing Number                                                                                                                                                                                                                                                         |             | 21035-FCE-XX-XX-DR-D-0502         |     |     | Rev      |
|                                                                                                                                                                                                                                                                        |             |                                   |     |     | P01      |

