



# HAZEL COTTAGE

Surface Water Drainage Design

CONCEPT

Soakaway Calculations

*Hernani Neto MSc CEng*

24/04/2020

Audit sheet

| Rev. | Date     | Description                     | Prepared | Verified |
|------|----------|---------------------------------|----------|----------|
| A01  | 12/04/20 | For information                 | HN       | MNB      |
| A02  | 24/04/20 | Appendices A, B, C, D & E added | HN       | MNB      |
|      |          |                                 |          |          |
|      |          |                                 |          |          |
|      |          |                                 |          |          |
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|      |          |                                 |          |          |

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## 1. Introduction

The purpose of this report is to provide guidance on the calculations undertaken and recommend the necessary soakaway capacity.

### Soakaway structure

It generally consists of a square or circular pit filled with a perforated precast concrete ring, proprietary plastic cells or simply infilled with rubble or single size stone.

This pit can fill with rainwater during a storm and the rainwater is allowed to slowly percolate into the surrounding soils. This effectively reduces the quantity of runoff discharged by the drainage system as the rainwater is allowed to recharge into the ground. Other benefits include helping to recharge local aquifers and river base flows and supporting local wetland systems. They also help support underlying soil moisture levels and local vegetation.

As the infiltration rate is always less than the inflow during a storm event, the soakaway must be large enough to contain the surplus rainwater for the design storm event.

Soakaways have to be designed in accordance with BRE Digest 365 and the CIRIA SUDS Manual.

In the UK BS 8582:2013 states that the hydraulic design of soakaways should be undertaken in accordance with either BRE 365 or CIRIA Report 156. These standards (particularly BRE 365) are usually taken to be best practice in the UK. Local and planning requirements generally state that new soakaways should be designed in accordance with these standards.

BRE 365 and the Building Regulations advise that soakaways should not be located closer than 5.0m to any building foundation, which will usually avoid any negative effects from adversely affecting typical building foundations.

### Site Details

Hazel Cottage is in West Sussex with the following address:

Hazel Cottage,  
Church Lane  
Yapton  
West Sussex  
BN18 0EH

## 2. Drainage Design

### Design Criteria & Standards

Calculations undertaken in order to size a Soakaway have been done in accordance with:

- UK Building Regulations Part H (Drainage and Waste Disposal)
- CIBSE Guide G
- BS EN 12056-3
- BRE Digest 365

### Abstract

Where a surface water sewer is not available, it will be required to dispose rainwater into a new soakaway. It needs to be noted that a soakaway is only effective in porous soils and only above water table. Previous site investigation (approximately 65m away from Hazel Cottage) were carried out with perforations of 5 and 6 meters deep (trial and probe holes) and confirming that no presence of water table level was detected within this depth.

### Proposed

Existing Hazel Cottage House arrangement will require modifications to its current layout, as a result of this alterations, rainwater will be collected by 2No new Rainwater pipes, therefore a method of discharging this surface water into a new Soakaway will be required. For Further Details please refer to Soakaway Layout Drawing (Appendix E)

## 3. Rainwater Pipe Calculations

The following rainwater drainage parameters have been defined in accordance with Part H (Drainage and Waste Disposal) of the building regulations:

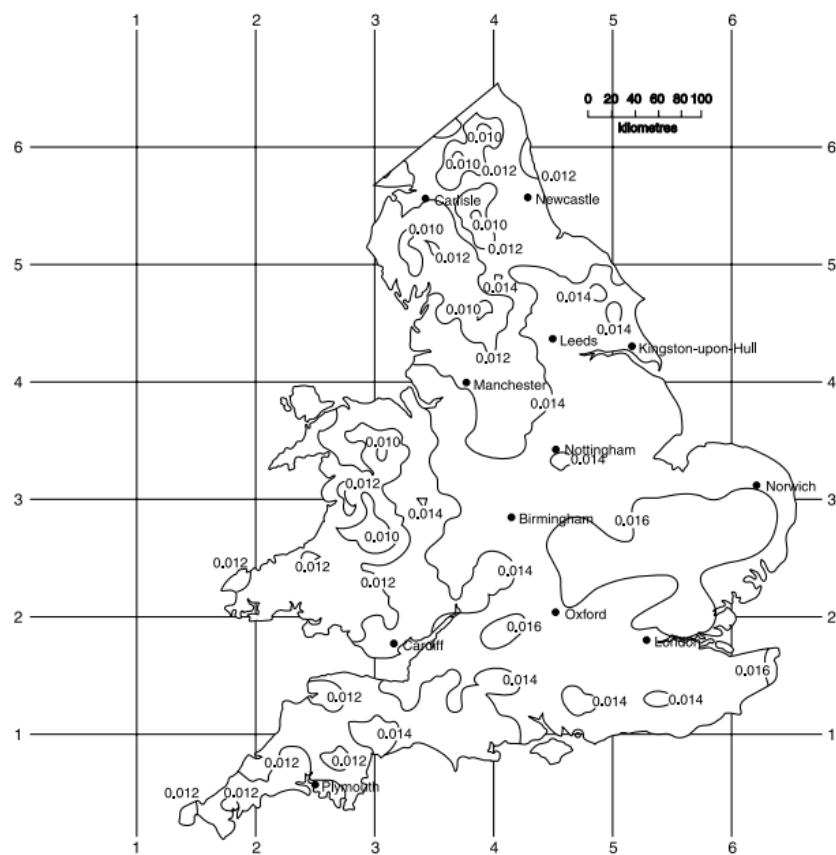


Figure 1: Diagram from Part H of the building regulations showing rainfall intensity throughout England and Wales.

| Rainwater Drainage Parameters      |                          |
|------------------------------------|--------------------------|
| Proposed Rainwater Catchment Area: | approx. 50m <sup>2</sup> |
| Rainfall intensity:                | 0.014l/s/m <sup>2</sup>  |

Total flow rate of the surface area of the roof can be calculated as:

**Q= (AxPxR)/3600s**

(Based on Rainfall intensity for South East Area 0.014l/m2/s)

Where:

Q = Quantity of Water (l/s) to be drained

A = Effective area to be drained (m2)

P = Surface Permeability Factor (Taking between 0.75 - 0.85) = 0.80

R =50.4l/m2/h = 0.014l/m2/s (Based on Rainfall intensity for South East Area)

New Extension roof (Ground Floor) Surface water flow rate

Q = (50 x 0.80 x 50.4) / 3600s

Q = 0.56l/s

According with Approved Document H, Table 2 of Section 1, 2No Rainwater pipes of 75mm diameter pipe can cope with total gravitational water flow of 0.56l/s

Note: The BRE 365 Method does not include a variable Factor of Safety.

4. Soakaway Calculations – Non-Infiltration Test Method

Arriving at this section with defined total design Flow rate in accordance with Current Building Regulations, Soakaway capacity can be determined by applying a rainfall intensity of at least 75mm/h (as most extreme conditions) with the following formula:

**C= (A x R) / 3**

Where:

C = Capacity in m3

A = Area to be Drained

R = Rainfall (in metres per hour)

C= (50 x 0.075) / 3 = 1.25m3

It is recommended to round the capacity to 1.5m3.

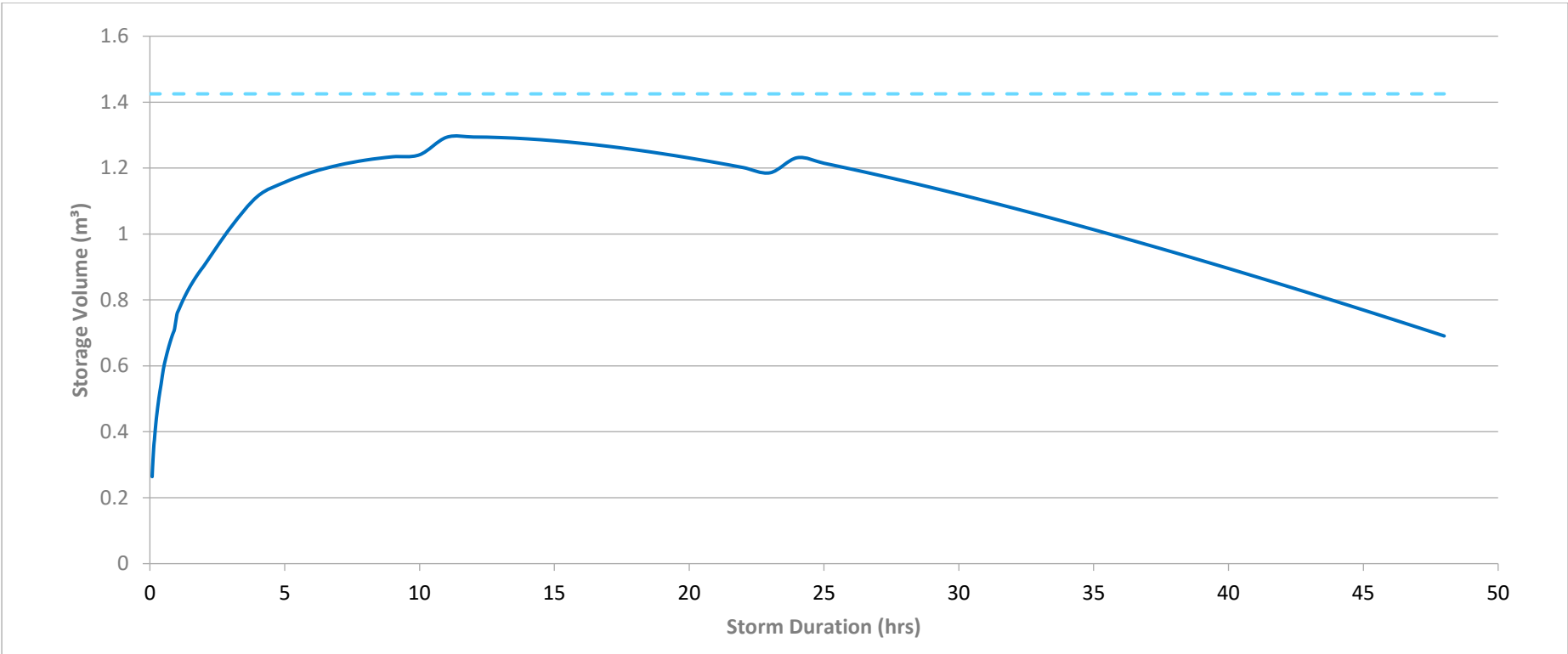
Please note: For test infiltration method, please refer to external documents as referenced in this report. Calculations of this section were undertaken to compare Soakaway required volumes, using traditional calculation methods.

In conclusion, both methods, Soakaway calculations – Non-Infiltration Test Method and Trial Hole Infiltration test results are both valid, a 1.5m3 Soakaway capacity is enough for the site.

Required Dimensions of Soakaway for Hazel Cottage:

- Geocellular Units
- Dimensions: 1500mm(L) x 1000mm(W) x 1000mm(D)

5. Soakaway Chart – Non-Infiltration Test Method Results



## Appendix A - Trial Hole Plan



## **Appendix B – Hazel Cottage – Infiltration Letter Report V2**

Please refer to external document.

## **Appendix C – Hazel Cottage: Time vs Depth**

Please refer to external document.

## **Appendix D – Hazel Cottage Soakaway Size Results (BRE Digest 365)**

Please refer to external document.

## **Appendix E – Hazel Cottage – Soakaway Layout Drawing**

Northdown House  
Ashford Road  
Harrietsham  
Maidstone  
Kent, ME17 1QW

B Keogh Construction Limited  
Ellingham Yard  
Ellingham Way  
Ashford  
Kent  
TN23 6NF

t: 01622 858545  
f: 01622 858544  
w: [www.cet-testing.com](http://www.cet-testing.com)

For the attention of Mr B Keogh

## Geotechnical Department

Our ref: 1039409

6<sup>th</sup> December 2019

Dear Sirs,

### RE: HAZEL COTTAGE

Further to our attendance at the above site on 21<sup>st</sup> November 2019 to carry out a single trial pit infiltration test, please find attached the engineer's log for the nominated position TP01.

The infiltration test was carried out in general accordance with BRE 365 "Soakaway design" except that the pit was filled once only from an outside tap and subsequently monitored for over five hours.

Calculations based upon the in situ data indicate that for preliminary design purposes an unfactored infiltration rate of  $9.8 \times 10^{-6}$  m/s may be assumed for the cohesive River Terrace Deposits. However, it should be noted that the pit was filled only once and that additional tests would have resulted in a lower infiltration value. In light of this the value suggested within this letter report should be considered conservatively.

We trust that the attached and the above are of assistance and that you will not hesitate to contact us should you have any queries.

Yours faithfully

A handwritten signature in dark ink, appearing to read 'J. Lott', with a stylized flourish at the end.

**Jamie Lott** MGeol

**Geotechnical Engineer**

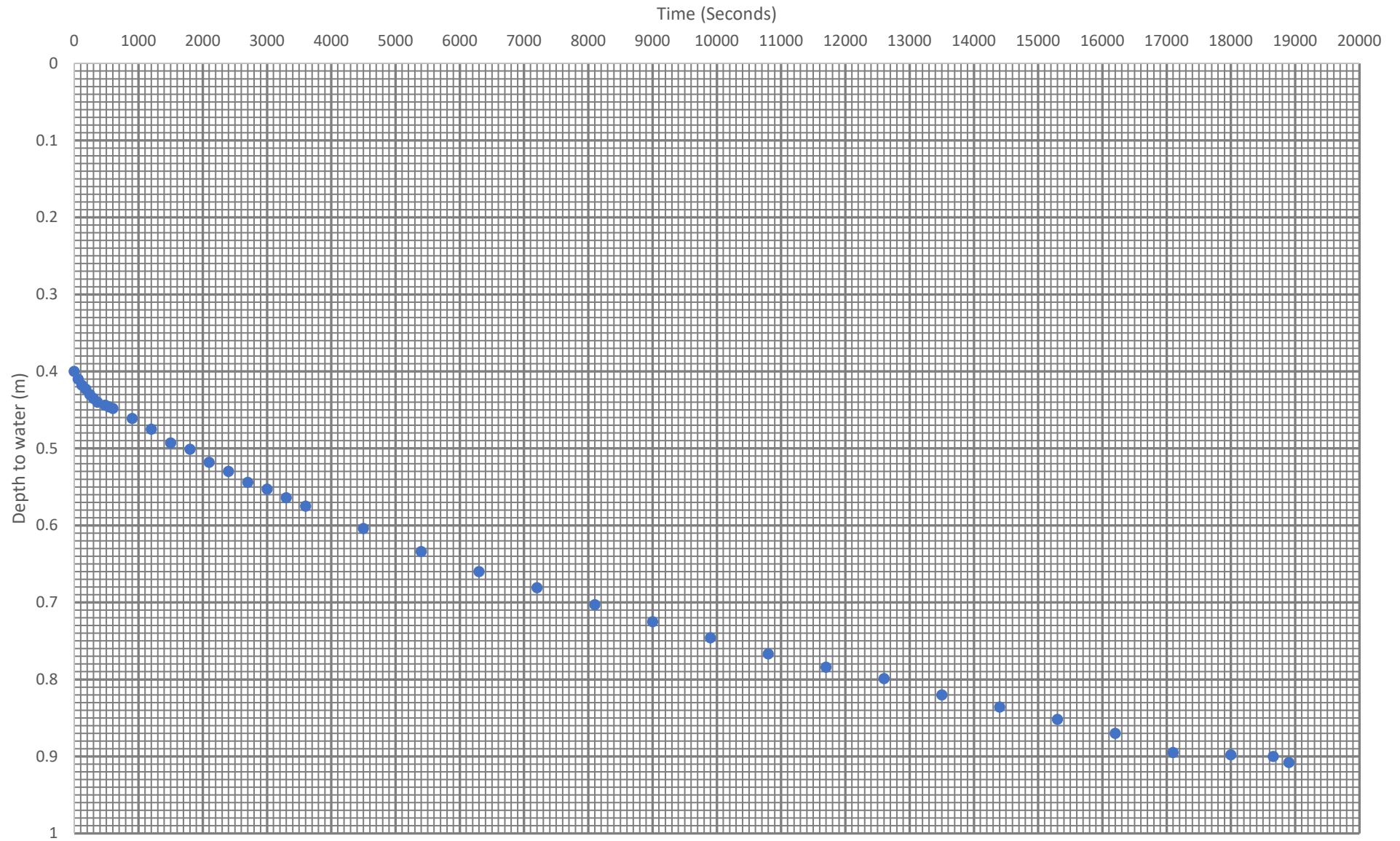
For and on behalf of CET Infrastructure

Enc. Engineer's log for TP01

|                        |      |                      |                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                          |                          |                                                        |        |
|------------------------|------|----------------------|----------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------|--------------------------------------------------------|--------|
| Client: <b>B Keogh</b> |      |                      | Depth (m) 1.10       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | Plant used: Hand Tools                                                                                                                                                                                                                                                                                                                                   |                          | <b>TRIAL PIT NUMBER</b><br><b>TP01</b><br>Sheet 1 of 1 |        |
| Width (m) 1.10         |      | Length (m) 1.10      |                      | Method of Excavation:                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                                                                                                                                                                                                                                          | Shoring: None            |                                                        |        |
| Co-ordinates           |      | Ground Level (m AOD) |                      | Hand Dug                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                                                                                                                                                                                                                                                                                                                                          | Date Started: 21/11/2019 |                                                        |        |
| Samples/In Situ Tests  |      |                      | Change of Strata     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | Description of Strata                                                                                                                                                                                                                                                                                                                                    |                          |                                                        | Legend |
| Depth (m)              | Type | Test/Field Records   | Reduced Level (mAOD) | Depth & (Thickness) (m)                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                                                                                                                                                                                                                                                                                                          |                          |                                                        |        |
|                        |      |                      |                      | (0.25) Firm, dark brown, slightly fine sandy, slightly gravelly CLAY. Gravel is angular to rounded, fine to coarse flint, brick and chalk.<br>0.25<br>(0.30) (Made Ground)<br>0.55 Firm, brown, slightly gravelly CLAY. Gravel is sub-angular to rounded flint.<br>(River Terrace Deposits)<br>(0.55) Firm, orange brown, slightly fine to coarse sandy, slightly gravelly CLAY with low cobble content. Gravel and cobbles are fine to coarse rounded flint.<br>1.10 (River Terrace Deposits) | <br><br><br> |                          |                                                        |        |
|                        |      |                      |                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | End of Trial Pit at 1.10m                                                                                                                                                                                                                                                                                                                                |                          |                                                        |        |

|                                                                                                                                                            |                                                                                     |                                                                                         |  |                                                                                       |
|------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------|--|---------------------------------------------------------------------------------------|
| General Remarks:<br>1. Trial pit dug by client.<br>2. Trial pit remained stable throughout soakaway test.<br>3. Roots observed to 1.1m below ground level. |                                                                                     |                                                                                         |  |                                                                                       |
| Ref:                                                                                                                                                       | <b>1039409</b>                                                                      | <b>TRIAL PIT RECORD</b><br>Scale 1:25<br>See Key Sheet for explanation of symbols, etc. |  |  |
| Logged:                                                                                                                                                    | JL                                                                                  |                                                                                         |  |                                                                                       |
| Checked:                                                                                                                                                   |  | <b>Hazel Cottage</b>                                                                    |  | <b>FIG A1</b>                                                                         |
| Appr'd:                                                                                                                                                    |  |                                                                                         |  |                                                                                       |

# Hazel Cottage: Time vs Depth



|          |                                      |                                                                  |           |          |                   |
|----------|--------------------------------------|------------------------------------------------------------------|-----------|----------|-------------------|
|          |                                      | <b>Hazel Cottage,<br/>Church Lane<br/>Yapton<br/>West Sussex</b> |           | Revision | <b>A02</b>        |
|          |                                      | Job No:                                                          |           | Page:    | <b>C/01</b>       |
|          |                                      | Prepared By:                                                     | <b>HN</b> | Date:    | <b>25/04/2020</b> |
| Section: | <b>Soakway Size (BRE Digest 365)</b> |                                                                  |           |          |                   |

| SUMMARY OF CALCULATIONS                                |   |             |                |
|--------------------------------------------------------|---|-------------|----------------|
| critical design rainfall duration 't <sub>crit</sub> ' | = | 600         | min            |
| required storage volume 'V <sub>req</sub> '            | = | 1.17        | m <sup>3</sup> |
| provided storage volume 'V <sub>prov</sub> '           | = | 1.62        | m <sup>3</sup> |
| utilisation factor                                     | = | <b>0.73</b> | <b>.OK</b>     |
| required time to discharge 50% 't <sub>50</sub> '      | = | 6.97        | hours          |
| utilisation factor                                     | = | <b>0.29</b> | <b>.OK</b>     |

| GENERAL DATA                                               |                          |
|------------------------------------------------------------|--------------------------|
| site location:                                             | <b>England and Wales</b> |
| soakaway type:                                             | <b>geocellular units</b> |
| impermeable area drained to soakaway 'A' [m <sup>2</sup> ] | <b>50</b>                |
| 60 min rainfall depth of 5 year return period 'R' [mm]     | <b>17</b>                |
| M5-60 to M5-2d rainfall ratio 'r'                          | <b>0.20</b>              |
| allowance for climate change:                              | <b>10%</b>               |

| SOAKAWAY DATA                                       |             |
|-----------------------------------------------------|-------------|
| soakaway width 'W' [m]                              | <b>1.50</b> |
| soakaway length 'L' [m]                             | <b>1.00</b> |
| total depth from ground level 'D <sub>b</sub> ' [m] | <b>1.50</b> |
| depth to drain invert level 'D <sub>d</sub> ' [m]   | <b>0.30</b> |
| soakaway effective depth 'D <sub>eff</sub> ' [m]    | 1.20        |
| free volume in infill aggregate [%]                 | <b>90</b>   |

| SOIL INFILTRATION DATA                                                   |                                                               |
|--------------------------------------------------------------------------|---------------------------------------------------------------|
| allowance for infiltration through soakaway base:                        | <b>20%</b>                                                    |
| available on-site infiltration test results:                             | <input checked="" type="radio"/> Yes <input type="radio"/> No |
| use soakage trial pit table below                                        |                                                               |
| internal surface area of trial pit 'a <sub>p50</sub> ' [m <sup>2</sup> ] | 3.08                                                          |
| storage volume between 75-25% 'V <sub>p</sub> ' [m <sup>3</sup> ]        | 0.48                                                          |
| time for water to fall from 75-25% 't <sub>p</sub> ' [min]               | 264.38                                                        |
| soil infiltration rate 'f' [m/s]                                         | 9.79E-06                                                      |

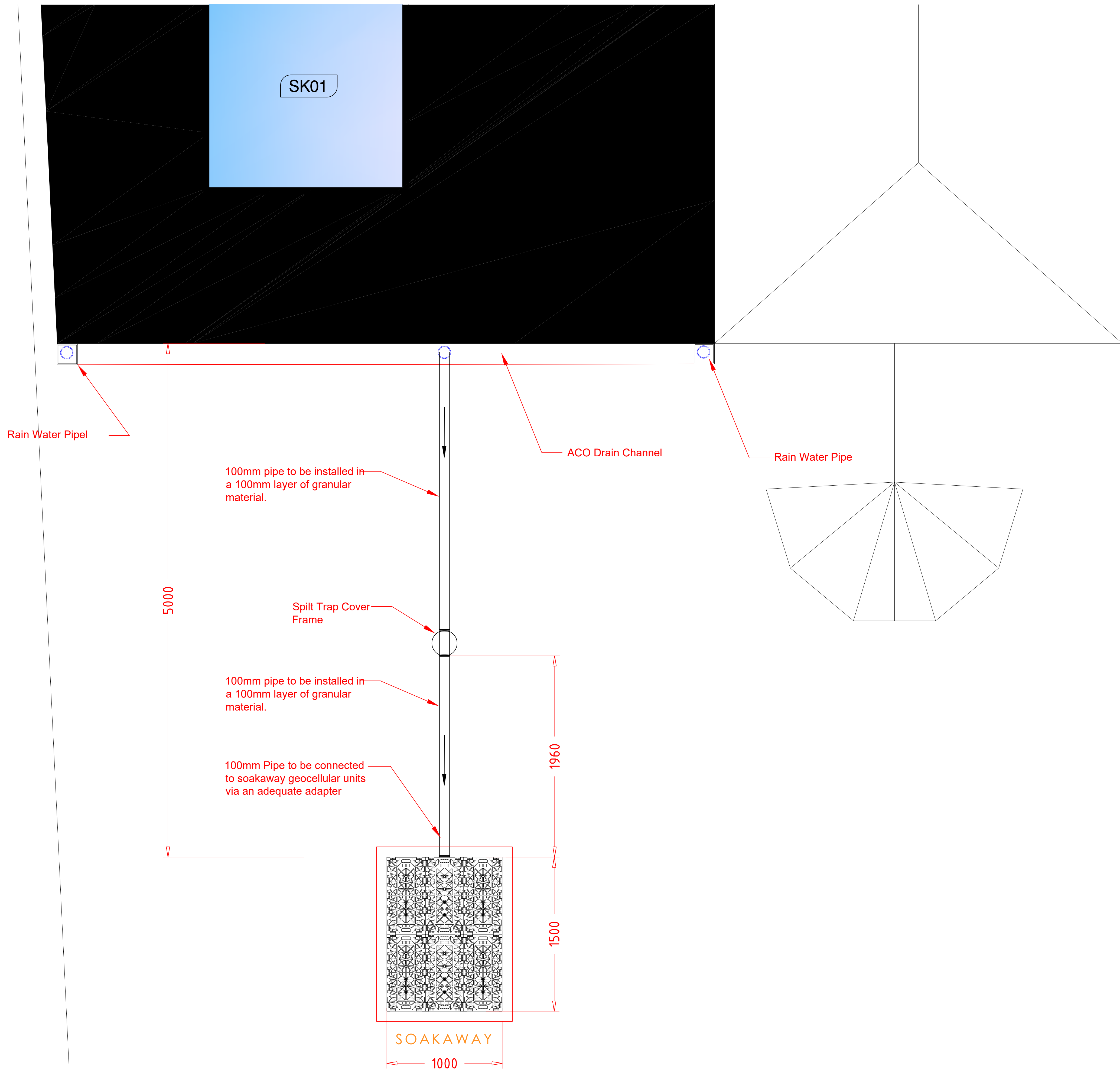
| SOAKAGE TRIAL PIT DATA                                     |             |
|------------------------------------------------------------|-------------|
| soakage trial pit width 'W <sub>t</sub> ' [m]              | <b>1.10</b> |
| soakage trial pit length 'L <sub>t</sub> ' [m]             | <b>1.10</b> |
| total depth from ground level 'D <sub>tb</sub> ' [m]       | <b>1.10</b> |
| depth to pipe invert level 'D <sub>tp</sub> ' [m]          | <b>0.25</b> |
| soakage trial pit effective depth 'D <sub>teff</sub> ' [m] | 0.85        |
| free volume in infill aggregate [%]                        | <b>93</b>   |
| NOTE: faces of excavation assumed to be vertical           |             |

| REQUIRED STORAGE CAPACITY PER RAINFALL DURATION |                    |                     |             |                |                          |             |                |                          |             |                |                          |                                         |                                    |
|-------------------------------------------------|--------------------|---------------------|-------------|----------------|--------------------------|-------------|----------------|--------------------------|-------------|----------------|--------------------------|-----------------------------------------|------------------------------------|
| rainfall duration [min]                         | rainfall factor Z1 | M5-D rainfalls [mm] | M1-D        |                |                          | M2-D        |                |                          | M3-D        |                |                          | outflow from soakaway [m <sup>3</sup> ] | required storage [m <sup>3</sup> ] |
|                                                 |                    |                     | Z2          | rainfalls [mm] | inflow [m <sup>3</sup> ] | Z2          | rainfalls [mm] | inflow [m <sup>3</sup> ] | Z2          | rainfalls [mm] | inflow [m <sup>3</sup> ] |                                         |                                    |
| 5                                               | 0.28               | 4.82                | 0.62        | 3.28           | 0.16                     | 0.79        | 4.19           | 0.21                     | 0.89        | 4.72           | 0.24                     | 0.01                                    | 0.23                               |
| 10                                              | 0.42               | 7.20                | 0.62        | 4.87           | 0.24                     | 0.79        | 6.25           | 0.31                     | 0.89        | 7.08           | 0.35                     | 0.02                                    | 0.33                               |
| 15                                              | 0.53               | 9.01                | 0.61        | 6.07           | 0.30                     | 0.79        | 7.83           | 0.39                     | 0.90        | 8.90           | 0.45                     | 0.03                                    | 0.42                               |
| 30                                              | 0.72               | 12.30               | 0.61        | 8.31           | 0.42                     | 0.79        | 10.75          | 0.54                     | 0.90        | 12.17          | 0.61                     | 0.06                                    | 0.55                               |
| 60                                              | 1.00               | 17.00               | 0.63        | 11.74          | 0.59                     | 0.80        | 15.03          | 0.75                     | 0.90        | 16.83          | 0.84                     | 0.12                                    | 0.73                               |
| 120                                             | 1.34               | 22.78               | 0.65        | 16.32          | 0.82                     | 0.82        | 20.44          | 1.02                     | 0.91        | 22.69          | 1.13                     | 0.23                                    | 0.90                               |
| 240                                             | 1.80               | 30.60               | 0.68        | 22.93          | 1.15                     | 0.83        | 27.96          | 1.40                     | 0.91        | 30.65          | 1.53                     | 0.47                                    | 1.07                               |
| 360                                             | 2.16               | 36.78               | 0.69        | 28.06          | 1.40                     | 0.84        | 33.85          | 1.69                     | 0.92        | 37.09          | 1.85                     | 0.70                                    | 1.16                               |
| <b>600</b>                                      | <b>2.70</b>        | <b>45.90</b>        | <b>0.71</b> | <b>35.94</b>   | <b>1.80</b>              | <b>0.85</b> | <b>42.71</b>   | <b>2.14</b>              | <b>0.93</b> | <b>46.75</b>   | <b>2.34</b>              | <b>1.16</b>                             | <b>1.17</b>                        |
| 1440                                            | 3.83               | 65.17               | 0.74        | 53.35          | 2.67                     | 0.86        | 61.80          | 3.09                     | 0.93        | 66.67          | 3.33                     | 2.79                                    | 0.54                               |

\* Z2 is growth factor from M5 rainfalls

| SOAKAGE TRIAL PIT INFILTRATION TEST RESULTS |                      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
|---------------------------------------------|----------------------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|
| water level measurement N°:                 |                      | 1    | 2    | 3    | 4    | 5    | 6    | 7    | 8    | 9    | 10   | 11   | 12   | 13   | 14   | 15   | 16   | 17   | 18   | 19   |
| Soakage Trial 1                             | time [min] =         | 0    | 30   | 50   | 75   | 90   | 120  | 135  | 150  | 165  | 180  | 195  | 210  | 225  | 240  | 255  | 270  | 285  | 300  | 315  |
|                                             | depth to water [m] = | 0.40 | 0.50 | 0.55 | 0.60 | 0.64 | 0.68 | 0.71 | 0.73 | 0.75 | 0.76 | 0.78 | 0.80 | 0.82 | 0.84 | 0.85 | 0.87 | 0.89 | 0.90 | 0.91 |
| Soakage Trial 2                             | time [min] =         |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
|                                             | depth to water [m] = |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
| Soakage Trial 3                             | time [min] =         |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
|                                             | depth to water [m] = |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |





Status  
A01 For Approval

- NOTES:
1. This drawing shall be read in conjunction with all other contract documentation. Please consider the environment before printing this drawing.
  2. All services routes are approximate, the contractor shall be responsible for determining the exact routes and positions of all installed proposed services and equipment.
  3. Soakaway to be sited 5m away from house.
  4. The exact sizes and shape of the soakaway to be determined as per "Hazel Cottage Soakaway Size Results (BRE Digest 365)".
  5. Maximum installation depth 1.5m
  6. Silt trap to be installed according to the manufacturer specifications.
  7. All pipes to be 100mm Diameter.
  8. All surface drainage system to be in accordance with current Building Regulations approved document Part H and the satisfaction to the building control inspectors.
  9. No other areas shall be connected to the designated Soakaway.

Site:  
Hazel Cottage,  
Church Lane  
Yapton  
West Sussex  
BN18 0EH

Drawing Title:  
Surface Water Layout

Date:  
15/04/2020

Drawing:  
1001

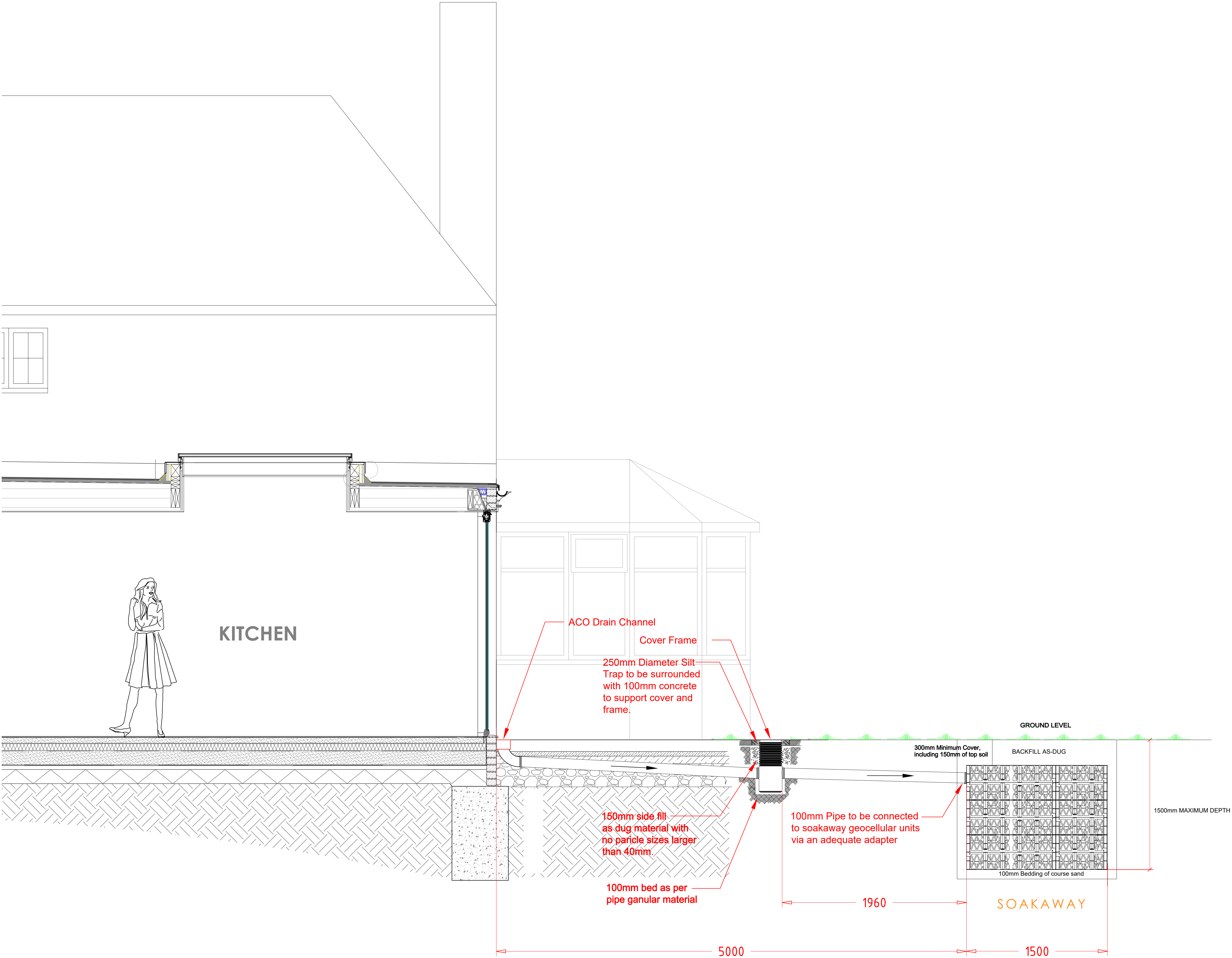
Designed by:  
HN

Checked by:  
MNB

Layout:  
A01

Approved by:

Scale:  
1:20



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A01 For Approval

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Site:  
Hazel Cottage,  
Church Lane  
Yapton  
West Sussex  
BN18 0EH

Drawing Title:  
Surface Water Layout - Section Details

Date:  
15/04/2020

Drawing:  
1002

Designed by:  
HN

Checked by:  
MNB

Revision:  
A01

Approved by:

Scale A1@:  
1:20