

# 11 Appendices

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**Appendix A.2 – Environment Agency Correspondence**

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**Appendix A.4 – Surface Water Management Calculations**

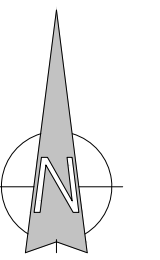
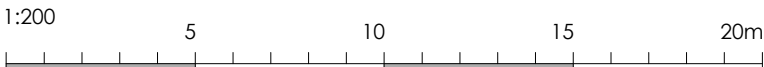
**Appendix A.5 – Indicative Drainage Layout**

**Appendix A.6 – Maintenance Schedules**

## **Appendix A.1 – Drawings**



DO NOT SCALE FROM THIS DRAWING  
ALL DIMENSIONS TO BE VERIFIED BY THE CONTRACTOR ON SITE



Preliminary

| REV | DESCRIPTION | DATE | BY | CHKD |
|-----|-------------|------|----|------|
|-----|-------------|------|----|------|

## TURNER JACKSON+DAY ASSOCIATES

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client details  
**Mile Property Group Ltd**

project details  
**Custom House**  
**The Terrace, Gravesend, DA12 2DE**

drawing title  
**Proposed Site and Roof Plan**

date scale drawn by checked by  
**Feb'21 1:200@A1 NS**

| project no. | drawing no. | revision |
|-------------|-------------|----------|
| <b>1735</b> | <b>020</b>  |          |

Proposed Site and Roof Plan













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## Appendix A.2 – Environment Agency Flood Report

Ms Kirsty Thomas  
Herrington Consulting Ltd.  
Barham Business Park (Unit 6)  
Elham Valley Road  
Barham  
Canterbury  
CT4 6DQ

**Our ref:** KT/2020/127776/01-L01  
**Your ref:** 2813/KT  
**Date:** 13 January 2021

Dear Ms Thomas

**ENVPAC/1/KSL/00360**

**Custom House, The Terrace, Gravesend, DA12 2DE**

Thank you for consulting us on the above pre-application. We have reviewed the submitted pre-application letter, dated 4 December 2020. We would like to offer the following advice.

The application site lies partially within Flood Zone 3, which is considered to be 'High Risk'. Under the National Planning Policy Framework (NPPF) the development is classified as 'more vulnerable'.

As stated within your letter, a Flood Risk Assessment (FRA) will be required to be submitted alongside any planning application.

The Thames Estuary 2100 (TE2100) defence level at this location is 6.90 metres Above Ordnance Datum (AOD) for the epoch from 2040 to 2070 and 8.00m AOD for the epoch from 2070 to 2170. Please be aware that we are currently re-modelling the flood levels for the Thames Estuary as part of the 10 year review of the Thames Estuary 2100 Plan. However, the results from this study will not be available for a number of months.

The applicant will need to demonstrate how the site will be protected for the lifetime of the development. This should include demonstration that the existing defence crest level meets the requirement for 2040, as well as how the defences will be upgraded to achieve the defence level of 6.90m AOD by 2040 (if required) and 8.0m AOD by 2070. We are happy to discuss this further if you have any questions.

Page 17 of the submitted letter states that "the open space to the north of the outbuildings are constrained by the flood wall anchors which project back into the property." We note that an extension is proposed towards the north of the site and we would like to understand how close this would be to the anchors as it is currently unclear from the information provided at present.

We note from our records that there is a flood gate within this site. Please confirm if this is the case so we can provide further advice.

We would advise that finished floor levels should be situated to a minimum of 300mm above the 1 in 200 year plus climate change breach flood level for residential non-sleeping accommodation and a minimum of 600mm above the 1 in 200 year plus climate change breach flood level for sleeping accommodation. Due to the proximity of the site to the river we would also advise the applicant to consider the in-channel level as well as the breach level. The finished floor levels proposed on page 2 of the submitted letter follow the principles of the above guidance. However, the letter also states that “as the proposals comprise the conversion of existing buildings, which lie within a listed curtilage and are constrained by the existing ceiling height and need for accessible access, the opportunity to raise floors to the levels stated is severely limited.”

Firstly, we would ask the applicant to include the finished floor levels on any floor plans they submit so we can be clear what the finished floor levels will be across the site, on the ground and first floor. Secondly, if the current ground floor finished floor levels are already below the breach level then the applicant should look at options such as having accommodation split over two storeys. If the first floor was 600mm above the 1 in 200 year plus climate change breach flood level this would allow internal safe refuge for the occupants of the dwelling and could be considered. Please be aware that if a future planning application included any self-contained flats with finished floor levels entirely below the breach level we would raise an objection to this.

We are pleased with the recommendation to incorporate flood resilience into the design where possible. Information on flood resilience can be found on the following link [http://www.planningportal.gov.uk/uploads/br/flood\\_performance.pdf](http://www.planningportal.gov.uk/uploads/br/flood_performance.pdf).

We are pleased with the recommendation that occupants register with the Environment Agency's flood warning service, 'FloodLine', so that they may prepare themselves in case of a flood event. This can be done by calling 0345 988 1188 to register.

The FRA should also consider safe dry access and egress. Please be aware that we do not normally comment on or approve the adequacy of flood emergency response procedures, as we do not carry out these roles during a flood. Our involvement with this development during an emergency will be limited to delivering flood warnings to occupants/users covered by our flood warning network. Any evacuation plan should provide suitable access and egress from the site and would need to be approved by the Local Planning Authority's Emergency Planning Department.

Landscaping close to the Thames should aim for a biodiversity net gain by providing ecologically beneficial landscaping such as native species, and flowering plants for pollinators.

If any flood defences require alteration or raising, we would need to see an improved interface between the river and the terrestrial environment. So where it is feasible to provide estuary edge habitats or other beneficial features we do require these for the benefit of the Thames.

The Estuary Edges website is available with ideas for how to improve habitats, and provide enhancements: <https://www.estuaryedges.co.uk/>

Please do not hesitate to contact us should you require any further information.

Yours sincerely

**Ms Laura Edwards**

**Planning Advisor**

Direct dial 02084749079

Direct email [KSLPLANNING@environment-agency.gov.uk](mailto:KSLPLANNING@environment-agency.gov.uk)

Ms Kirsty Thomas  
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Barham Business Park (Unit 6)  
Elham Valley Road  
Barham  
Canterbury  
CT4 6DQ

**Our ref:** KT/2020/127776/02-L01  
**Your ref:** 2813/KT  
**Date:** 17 February 2021

Dear Ms Thomas

**Custom House, The Terrace, Gravesend, DA12 2DE**

We have reviewed the Herrington Consulting Limited letter dated 20 January 2021, and offer the following advice.

The application site lies partially within Flood Zone 3, which is 'High Risk'. Under the National Planning Policy Framework (NPPF) residential development is generally classified as 'More Vulnerable' but self-contained basement dwellings are classified as 'Highly Vulnerable'.

**Flood Defence**

The proposal is for a change of use to residential. This would increase the flood risk vulnerability of the development and significantly increase the dependence on the flood defence wall and the flood gate. The extent of any extensions or external building alterations is currently unclear.

Whether proposals include elements within 16 metres of the flood defence walls or not we expect the applicant to demonstrate how the site and its residents will be safe in flood risk terms for the development lifetime. The lifetime of residential development is taken to be 100-years. This should include how the defences will remain structurally sound and how they will be upgraded for climate change induced sea level rise in line with the Thames Estuary 2100 Plan.

This requires the applicant to either construct replacement flood defences with a 100-year design life, or provide a suitable structural survey, including intrusive investigation, to demonstrate that the residual life of any elements of the flood defences that are to be retained is in line with the 100-year development lifetime, along with a suitable scheme of remedial works where that is not the case.

Given the age of the existing flood wall, it appears less likely that the structure can be shown to have a remaining life of 100-years.

If the applicant chooses to undertake a river wall survey, including intrusive investigation, we would suggest that we are first consulted over the scope of the

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Email: [enquiries@environment-agency.gov.uk](mailto:enquiries@environment-agency.gov.uk)  
[www.gov.uk/environment-agency](http://www.gov.uk/environment-agency)

proposed survey to reduce the risk of abortive work.

The applicant also needs to demonstrate how the flood defence crest level will be raised to 8 metres Above Ordnance Datum in order to protect the site for its lifetime, taking account of sea level rise. That could be achieved by raising the defences now as part of the development, or proving how it can be raised, along with a robust funding strategy to undertake the needed defence raising.

The northern extent of the buildings abutting the eastern boundary are only about 4.5 metres from the visible part of the flood defence structure. That proximity may affect the ability to raise or renew the tidal defences.

We also expect applicants to show how a replacement flood defence could be formed with the development in place without needing to encroach towards the river, even when a new defence is formed as part of a development. This can be called a contingency or future proofing option. Again the extent of any northern building extension is currently uncertain.

Services in the northern part of the site could hinder future flood defence works. Please can you provide any details of existing and proposed services that are available.

It is important to prevent flood defence structures being compromised during construction work. Ground anchors running landward from their origin soon reach a depth where they are difficult to locate. This creates a legacy problem as the installation of deep foundations may risk damaging existing ground anchors. Where there is uncertainty over the location of ground anchors we need to take a precautionary approach. On page 13 of the letter dated 04 December 2020, it states that, *'The open space to the north of the outbuildings are constrained by the flood wall anchors which project back into the property.'* At present we have no information on the nature and depth of any foundations proposed for any building extensions. Please provide details of the location, nature and depth of any proposed new foundations and also the worst case location of all ground anchors, in terms of the potential for a clash.

Flood gates are weak points in the line of the flood defences. We therefore seek to have existing flood gates removed and replaced with a section of fixed flood defence wall wherever possible as part of re-developments. You have stated that the flood gate will be retained. Please provide information about what the flood gate will need to be opened for post development, and the ongoing arrangements for its management and operation.

### **Sleeping Accommodation**

Although it may not be possible for each dwelling to have safe access and egress during the 1 in 200-year modelled breach flood levels factored for climate change, every dwelling must have all sleeping accommodation set no lower than 600mm above the 1 in 200 year plus climate change breach flood level. This is to provide its own temporary safe refuge and reduce the risk to people who are sleeping.

It is not clear how the above requirement can be met for the single story elements including the northern most part of the workshop building.

We would oppose any basement dwelling where there is any threshold or water entry level at or below the modelled breach flood level. We would also oppose the dwellings being dependent on flood doors or any other active / movable flood exclusion features. Please can you provide details and photos to show the presence or absence of pathways or openings into the buildings that could allow floodwater to enter below the modelled breach flood level.

Please can you also provide the revised floor plan drawings, with all post-development floor levels. We can then confirm if the proposals are acceptable.

The buildings that are proposed to be converted are historic and close to the tidal defences. In the unlikely but high consequence event of a failure of the tidal defences the buildings could be subjected to high water velocities and deep flood water. How does the applicant propose to establish whether the structures would remain intact and able to provide temporary safe refuge to residents in the event of a breach flood event at the site?

### **Flood Warning Service**

Lastly, we wanted to highlight something in your previous letter, dated 4 December 2020, that we hadn't expanded on before. On page 3, you state that, *'The Thames catchment is also served by a well-established flood warning system, and it is expected that there could be at least 12 hours warning of conditions which may result in a failure of the defences.'*

Although we are we are pleased with the recommendation that occupants register with the Environment Agency's flood warning service, 'FloodLine', so that they may prepare themselves in case of a flood event. If a defence failure occurred near the site there could be little or zero warning. Therefore, we recommend that this statement is clarified within the subsequent Flood Risk Assessment.

Please do not hesitate to contact us should you require any further information.

Yours sincerely

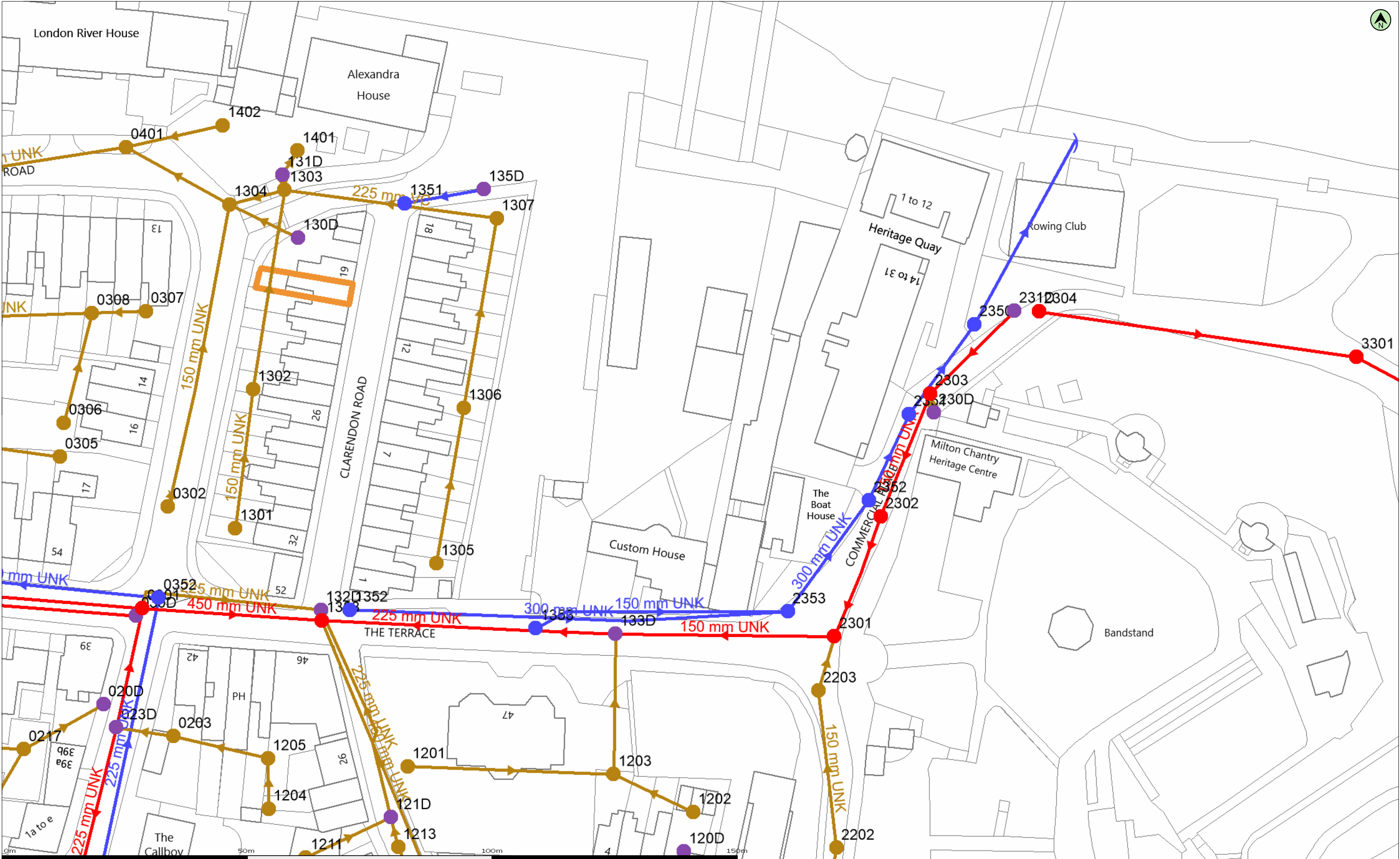
**Ms Laura Edwards**  
**Planning Advisor**

Direct dial 02084749079

Direct email [KSLPLANNING@environment-agency.gov.uk](mailto:KSLPLANNING@environment-agency.gov.uk)

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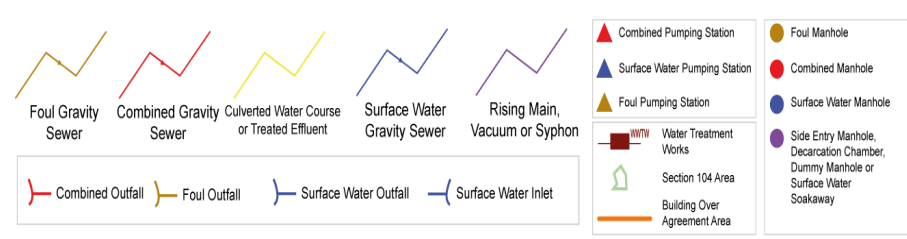
## Appendix A.3 – Southern Water Asset Location Data



(c) Crown copyright and database rights 2020 Ordnance Survey 100031673 Date: 15/07/20 Scale: 1:500 Map Centre: 565198,174345 Data updated: 15/06/20 Our Ref: 416424 - 1 Wastewater Plan A2

The positions of pipes shown on this plan are believed to be correct, but Southern Water Services Ltd accept no responsibility in the event of inaccuracy. The actual positions should be determined on site. This plan is produced by Southern Water Services Ltd (c) Crown copyright and database rights 2020 Ordnance Survey 100031673. This map is to be used for the purposes of viewing the location of Southern Water plant only. Any other uses of the map data or further copies is not permitted.

WARNING: BAC pipes are constructed of Bonded Asbestos Cement.  
WARNING: Unknown (UNK) materials may include Bonded Asbestos Cement.



|                                  |  |
|----------------------------------|--|
| flood@herringtonconsulting.co.uk |  |
| 2813/KB                          |  |
|                                  |  |





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## Appendix A.4 – Surface Water Management Calculations

### Design Settings

|                                      |        |                                    |               |
|--------------------------------------|--------|------------------------------------|---------------|
| Rainfall Methodology                 | FEH-13 | Minimum Velocity (m/s)             | 1.00          |
| Return Period (years)                | 100    | Connection Type                    | Level Soffits |
| Additional Flow (%)                  | 40     | Minimum Backdrop Height (m)        | 0.200         |
| CV                                   | 0.750  | Preferred Cover Depth (m)          | 0.700         |
| Time of Entry (mins)                 | 4.00   | Include Intermediate Ground        | ✓             |
| Maximum Time of Concentration (mins) | 30.00  | Enforce best practice design rules | x             |
| Maximum Rainfall (mm/hr)             | 200.0  |                                    |               |

### Nodes

| Name  | Area (ha) | T of E (mins) | Cover Level (m) | Diameter (mm) | Easting (m) | Northing (m) | Depth (m) |
|-------|-----------|---------------|-----------------|---------------|-------------|--------------|-----------|
| 1     | 0.055     | 4.00          | 7.600           | 1200          | 565172.609  | 174327.320   | 0.925     |
| 2     | 0.009     | 4.00          | 6.700           | 1200          | 565188.702  | 174338.897   | 0.925     |
| 3     | 0.039     | 4.00          | 5.600           | 1200          | 565191.160  | 174361.517   | 0.925     |
| 4     | 0.032     | 4.00          | 4.630           | 1200          | 565192.945  | 174378.919   | 0.925     |
| 5     | 0.042     | 4.00          | 5.440           | 1200          | 565203.077  | 174333.000   | 0.925     |
| 6     | 0.021     | 4.00          | 5.250           | 1200          | 565206.000  | 174348.982   | 0.925     |
| 7     | 0.028     | 4.00          | 4.800           | 1200          | 565209.001  | 174365.068   | 1.000     |
| 8     | 0.025     | 4.00          | 4.500           | 1200          | 565212.862  | 174386.006   | 1.000     |
| 9     | 0.044     | 4.00          | 4.200           | 1500          | 565200.530  | 174387.008   | 1.000     |
| 9_OUT |           |               | 4.140           | 1200          | 565202.282  | 174399.932   | 0.970     |

### Links

| Name | US Node | DS Node | Length (m) | ks (mm) / n | US IL (m) | DS IL (m) | Fall (m) | Slope (1:X) | Dia (mm) | T of C (mins) | Rain (mm/hr) |
|------|---------|---------|------------|-------------|-----------|-----------|----------|-------------|----------|---------------|--------------|
| 1    | 1       | 2       | 19.825     | 0.600       | 6.675     | 5.775     | 0.900    | 22.0        | 225      | 4.12          | 198.4        |
| 2    | 2       | 3       | 22.753     | 0.600       | 5.775     | 4.675     | 1.100    | 20.7        | 225      | 4.25          | 198.4        |
| 3    | 3       | 4       | 17.493     | 0.600       | 4.675     | 3.705     | 0.970    | 18.0        | 225      | 4.34          | 198.4        |
| 4    | 4       | 9       | 11.089     | 0.600       | 3.705     | 3.200     | 0.505    | 22.0        | 225      | 4.41          | 198.4        |
| 5    | 5       | 6       | 16.247     | 0.600       | 4.515     | 4.325     | 0.190    | 85.5        | 225      | 4.19          | 198.4        |
| 6    | 6       | 7       | 16.364     | 0.600       | 4.325     | 3.875     | 0.450    | 36.4        | 225      | 4.32          | 198.4        |
| 7    | 7       | 8       | 21.291     | 0.600       | 3.800     | 3.500     | 0.300    | 71.0        | 300      | 4.51          | 198.4        |
| 8    | 8       | 9       | 12.373     | 0.600       | 3.500     | 3.250     | 0.250    | 49.5        | 300      | 4.60          | 198.4        |
| 9    | 9       | 9_OUT   | 13.042     | 0.600       | 3.200     | 3.170     | 0.030    | 434.7       | 150      | 4.80          | 198.4        |

| Name | Vel (m/s) | Cap (l/s) | Flow (l/s) | US Depth (m) | DS Depth (m) | Σ Area (ha) | Σ Add Inflow (l/s) | Pro Depth (mm) | Pro Velocity (m/s) |
|------|-----------|-----------|------------|--------------|--------------|-------------|--------------------|----------------|--------------------|
| 1    | 2.800     | 111.3     | 41.1       | 0.700        | 0.700        | 0.055       | 0.0                | 94             | 2.594              |
| 2    | 2.889     | 114.9     | 48.2       | 0.700        | 0.700        | 0.064       | 0.0                | 102            | 2.766              |
| 3    | 3.095     | 123.1     | 77.3       | 0.700        | 0.700        | 0.103       | 0.0                | 130            | 3.266              |
| 4    | 2.804     | 111.5     | 101.1      | 0.700        | 0.775        | 0.134       | 0.0                | 168            | 3.161              |
| 5    | 1.415     | 56.2      | 31.4       | 0.700        | 0.700        | 0.042       | 0.0                | 120            | 1.451              |
| 6    | 2.176     | 86.5      | 47.0       | 0.700        | 0.700        | 0.062       | 0.0                | 118            | 2.220              |
| 7    | 1.868     | 132.1     | 68.4       | 0.700        | 0.700        | 0.091       | 0.0                | 153            | 1.884              |
| 8    | 2.240     | 158.3     | 87.2       | 0.700        | 0.650        | 0.116       | 0.0                | 159            | 2.292              |
| 9    | 0.476     | 8.4       | 221.4      | 0.850        | 0.820        | 0.294       | 0.0                | 150            | 0.485              |

### Pipeline Schedule

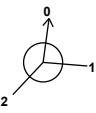
| Link | Length<br>(m) | Slope<br>(1:X) | Dia<br>(mm) | Link<br>Type | US CL<br>(m) | US IL<br>(m) | US Depth<br>(m) | DS CL<br>(m) | DS IL<br>(m) | DS Depth<br>(m) |
|------|---------------|----------------|-------------|--------------|--------------|--------------|-----------------|--------------|--------------|-----------------|
| 1    | 19.825        | 22.0           | 225         | Circular     | 7.600        | 6.675        | 0.700           | 6.700        | 5.775        | 0.700           |
| 2    | 22.753        | 20.7           | 225         | Circular     | 6.700        | 5.775        | 0.700           | 5.600        | 4.675        | 0.700           |
| 3    | 17.493        | 18.0           | 225         | Circular     | 5.600        | 4.675        | 0.700           | 4.630        | 3.705        | 0.700           |
| 4    | 11.089        | 22.0           | 225         | Circular     | 4.630        | 3.705        | 0.700           | 4.200        | 3.200        | 0.775           |
| 5    | 16.247        | 85.5           | 225         | Circular     | 5.440        | 4.515        | 0.700           | 5.250        | 4.325        | 0.700           |
| 6    | 16.364        | 36.4           | 225         | Circular     | 5.250        | 4.325        | 0.700           | 4.800        | 3.875        | 0.700           |
| 7    | 21.291        | 71.0           | 300         | Circular     | 4.800        | 3.800        | 0.700           | 4.500        | 3.500        | 0.700           |
| 8    | 12.373        | 49.5           | 300         | Circular     | 4.500        | 3.500        | 0.700           | 4.200        | 3.250        | 0.650           |
| 9    | 13.042        | 434.7          | 150         | Circular     | 4.200        | 3.200        | 0.850           | 4.140        | 3.170        | 0.820           |

| Link | US<br>Node | Dia<br>(mm) | Node<br>Type | MH<br>Type | DS<br>Node | Dia<br>(mm) | Node<br>Type | MH<br>Type |
|------|------------|-------------|--------------|------------|------------|-------------|--------------|------------|
| 1    | 1          | 1200        | Manhole      | Adoptable  | 2          | 1200        | Manhole      | Adoptable  |
| 2    | 2          | 1200        | Manhole      | Adoptable  | 3          | 1200        | Manhole      | Adoptable  |
| 3    | 3          | 1200        | Manhole      | Adoptable  | 4          | 1200        | Manhole      | Adoptable  |
| 4    | 4          | 1200        | Manhole      | Adoptable  | 9          | 1500        | Manhole      | Adoptable  |
| 5    | 5          | 1200        | Manhole      | Adoptable  | 6          | 1200        | Manhole      | Adoptable  |
| 6    | 6          | 1200        | Manhole      | Adoptable  | 7          | 1200        | Manhole      | Adoptable  |
| 7    | 7          | 1200        | Manhole      | Adoptable  | 8          | 1200        | Manhole      | Adoptable  |
| 8    | 8          | 1200        | Manhole      | Adoptable  | 9          | 1500        | Manhole      | Adoptable  |
| 9    | 9          | 1500        | Manhole      | Adoptable  | 9_OUT      | 1200        | Manhole      | Adoptable  |

### Manhole Schedule

| Node | Easting<br>(m) | Northing<br>(m) | CL<br>(m) | Depth<br>(m) | Dia<br>(mm) | Connections                                                                          | Link | IL<br>(m) | Dia<br>(mm) |     |
|------|----------------|-----------------|-----------|--------------|-------------|--------------------------------------------------------------------------------------|------|-----------|-------------|-----|
| 1    | 565172.609     | 174327.320      | 7.600     | 0.925        | 1200        |  |      |           |             |     |
|      |                |                 |           |              |             | 0                                                                                    | 1    | 6.675     | 225         |     |
| 2    | 565188.702     | 174338.897      | 6.700     | 0.925        | 1200        |  | 1    | 1         | 5.775       | 225 |
|      |                |                 |           |              |             | 0                                                                                    | 2    | 5.775     | 225         |     |
| 3    | 565191.160     | 174361.517      | 5.600     | 0.925        | 1200        |  | 1    | 2         | 4.675       | 225 |
|      |                |                 |           |              |             | 0                                                                                    | 3    | 4.675     | 225         |     |
| 4    | 565192.945     | 174378.919      | 4.630     | 0.925        | 1200        |  | 1    | 3         | 3.705       | 225 |
|      |                |                 |           |              |             | 0                                                                                    | 4    | 3.705     | 225         |     |
| 5    | 565203.077     | 174333.000      | 5.440     | 0.925        | 1200        |  |      |           |             |     |
|      |                |                 |           |              |             | 0                                                                                    | 5    | 4.515     | 225         |     |
| 6    | 565206.000     | 174348.982      | 5.250     | 0.925        | 1200        |  | 1    | 5         | 4.325       | 225 |
|      |                |                 |           |              |             | 0                                                                                    | 6    | 4.325     | 225         |     |

### Manhole Schedule

| Node  | Easting<br>(m) | Northing<br>(m) | CL<br>(m) | Depth<br>(m) | Dia<br>(mm) | Connections                                                                        | Link | IL<br>(m) | Dia<br>(mm) |     |
|-------|----------------|-----------------|-----------|--------------|-------------|------------------------------------------------------------------------------------|------|-----------|-------------|-----|
| 7     | 565209.001     | 174365.068      | 4.800     | 1.000        | 1200        |  | 1    | 6         | 3.875       | 225 |
| 8     | 565212.862     | 174386.006      | 4.500     | 1.000        | 1200        |  | 1    | 7         | 3.500       | 300 |
| 9     | 565200.530     | 174387.008      | 4.200     | 1.000        | 1500        |  | 1    | 8         | 3.250       | 300 |
|       |                |                 |           |              |             |                                                                                    | 2    | 4         | 3.200       | 225 |
|       |                |                 |           |              |             |                                                                                    | 0    | 9         | 3.200       | 150 |
| 9_OUT | 565202.282     | 174399.932      | 4.140     | 0.970        | 1200        |  | 1    | 9         | 3.170       | 150 |

### Simulation Settings

|                      |        |                            |      |                         |   |
|----------------------|--------|----------------------------|------|-------------------------|---|
| Rainfall Methodology | FEH-13 | Skip Steady State          | x    | Check Discharge Rate(s) | x |
| Summer CV            | 0.750  | Drain Down Time (mins)     | 60   | Check Discharge Volume  | x |
| Analysis Speed       | Normal | Additional Storage (m³/ha) | 20.0 |                         |   |

### Storm Durations

15 | 30 | 60 | 120 | 180 | 240 | 360

| Return Period (years) | Climate Change (CC %) | Additional Area (A %) | Additional Flow (Q %) |
|-----------------------|-----------------------|-----------------------|-----------------------|
| 2                     | 40                    | 0                     | 0                     |
| 10                    | 40                    | 0                     | 0                     |
| 30                    | 40                    | 0                     | 0                     |
| 100                   | 40                    | 0                     | 0                     |

### Node 9 Online Orifice Control

|                          |   |                  |       |                       |       |
|--------------------------|---|------------------|-------|-----------------------|-------|
| Flap Valve               | x | Invert Level (m) | 3.200 | Discharge Coefficient | 0.600 |
| Replaces Downstream Link | ✓ | Diameter (m)     | 0.001 |                       |       |

### Node 9 Soakaway Storage Structure

|                             |         |                           |        |                 |       |
|-----------------------------|---------|---------------------------|--------|-----------------|-------|
| Base Inf Coefficient (m/hr) | 0.00000 | Invert Level (m)          | 3.200  | Depth (m)       | 0.850 |
| Side Inf Coefficient (m/hr) | 0.00000 | Time to half empty (mins) |        | Inf Depth (m)   |       |
| Safety Factor               | 2.0     | Pit Width (m)             | 10.500 | Number Required | 1     |
| Porosity                    | 0.95    | Pit Length (m)            | 20.000 |                 |       |

**Results for 2 year +40% CC Critical Storm Duration. Lowest mass balance: 99.47%**

| Node Event        | US<br>Node | Peak<br>(mins) | Level<br>(m) | Depth<br>(m) | Inflow<br>(l/s) | Node<br>Vol (m³) | Flood<br>(m³) | Status     |
|-------------------|------------|----------------|--------------|--------------|-----------------|------------------|---------------|------------|
| 15 minute summer  | 1          | 10             | 6.724        | 0.049        | 11.4            | 0.1136           | 0.0000        | OK         |
| 15 minute summer  | 2          | 10             | 5.827        | 0.052        | 13.4            | 0.0690           | 0.0000        | OK         |
| 15 minute summer  | 3          | 10             | 4.738        | 0.063        | 21.5            | 0.1247           | 0.0000        | OK         |
| 15 minute summer  | 4          | 9              | 3.796        | 0.091        | 28.1            | 0.1648           | 0.0000        | OK         |
| 15 minute summer  | 5          | 10             | 4.577        | 0.062        | 8.7             | 0.1254           | 0.0000        | OK         |
| 15 minute summer  | 6          | 10             | 4.386        | 0.061        | 13.0            | 0.0966           | 0.0000        | OK         |
| 15 minute summer  | 7          | 10             | 3.878        | 0.078        | 18.9            | 0.1331           | 0.0000        | OK         |
| 15 minute summer  | 8          | 10             | 3.584        | 0.084        | 24.1            | 0.1376           | 0.0000        | OK         |
| 360 minute summer | 9          | 424            | 3.562        | 0.362        | 13.5            | 73.1781          | 0.0000        | SURCHARGED |
| 15 minute summer  | 9_OUT      | 1              | 3.170        | 0.000        | 0.0             | 0.0000           | 0.0000        | OK         |

| Link Event<br>(Outflow) | US<br>Node | Link    | DS<br>Node | Outflow<br>(l/s) | Velocity<br>(m/s) | Flow/Cap | Link<br>Vol (m³) | Discharge<br>Vol (m³) |
|-------------------------|------------|---------|------------|------------------|-------------------|----------|------------------|-----------------------|
| 15 minute summer        | 1          | 1       | 2          | 11.4             | 1.719             | 0.102    | 0.1315           |                       |
| 15 minute summer        | 2          | 2       | 3          | 13.4             | 1.676             | 0.117    | 0.1824           |                       |
| 15 minute summer        | 3          | 3       | 4          | 21.5             | 1.851             | 0.175    | 0.2080           |                       |
| 15 minute summer        | 4          | 4       | 9          | 28.5             | 2.807             | 0.256    | 0.1306           |                       |
| 15 minute summer        | 5          | 5       | 6          | 8.7              | 0.993             | 0.155    | 0.1424           |                       |
| 15 minute summer        | 6          | 6       | 7          | 13.0             | 1.536             | 0.150    | 0.1386           |                       |
| 15 minute summer        | 7          | 7       | 8          | 18.9             | 1.227             | 0.143    | 0.3283           |                       |
| 15 minute summer        | 8          | 8       | 9          | 24.0             | 1.557             | 0.152    | 0.1908           |                       |
| 360 minute summer       | 9          | Orifice | 9_OUT      | 0.0              |                   |          |                  | 0.0                   |

**Results for 10 year +40% CC Critical Storm Duration. Lowest mass balance: 99.47%**

| Node Event        | US Node | Peak (mins) | Level (m) | Depth (m) | Inflow (l/s) | Node Vol (m³) | Flood (m³) | Status     |
|-------------------|---------|-------------|-----------|-----------|--------------|---------------|------------|------------|
| 15 minute summer  | 1       | 10          | 6.749     | 0.074     | 24.6         | 0.1706        | 0.0000     | OK         |
| 15 minute summer  | 2       | 10          | 5.852     | 0.077     | 28.9         | 0.1023        | 0.0000     | OK         |
| 15 minute summer  | 3       | 10          | 4.770     | 0.095     | 46.3         | 0.1876        | 0.0000     | OK         |
| 15 minute summer  | 4       | 9           | 3.841     | 0.136     | 60.4         | 0.2473        | 0.0000     | OK         |
| 15 minute summer  | 5       | 10          | 4.609     | 0.094     | 18.8         | 0.1917        | 0.0000     | OK         |
| 15 minute summer  | 6       | 10          | 4.419     | 0.094     | 28.1         | 0.1480        | 0.0000     | OK         |
| 15 minute summer  | 7       | 10          | 3.920     | 0.120     | 40.9         | 0.2038        | 0.0000     | OK         |
| 360 minute summer | 8       | 392         | 3.841     | 0.341     | 9.3          | 0.5555        | 0.0000     | SURCHARGED |
| 360 minute summer | 9       | 400         | 3.841     | 0.641     | 23.9         | 129.4854      | 0.0000     | SURCHARGED |
| 15 minute summer  | 9_OUT   | 1           | 3.170     | 0.000     | 0.0          | 0.0000        | 0.0000     | OK         |

| Link Event (Outflow) | US Node | Link    | DS Node | Outflow (l/s) | Velocity (m/s) | Flow/Cap | Link Vol (m³) | Discharge Vol (m³) |
|----------------------|---------|---------|---------|---------------|----------------|----------|---------------|--------------------|
| 15 minute summer     | 1       | 1       | 2       | 24.6          | 2.119          | 0.221    | 0.2302        |                    |
| 15 minute summer     | 2       | 2       | 3       | 28.9          | 2.075          | 0.252    | 0.3175        |                    |
| 15 minute summer     | 3       | 3       | 4       | 46.2          | 2.295          | 0.375    | 0.3549        |                    |
| 15 minute summer     | 4       | 4       | 9       | 61.0          | 2.993          | 0.547    | 0.2873        |                    |
| 15 minute summer     | 5       | 5       | 6       | 18.8          | 1.198          | 0.334    | 0.2550        |                    |
| 15 minute summer     | 6       | 6       | 7       | 28.1          | 1.878          | 0.325    | 0.2450        |                    |
| 15 minute summer     | 7       | 7       | 8       | 41.0          | 1.463          | 0.310    | 0.5962        |                    |
| 15 minute summer     | 8       | 8       | 9       | 52.3          | 1.891          | 0.330    | 0.3421        |                    |
| 360 minute summer    | 9       | Orifice | 9_OUT   | 0.0           |                |          |               | 0.0                |

**Results for 30 year +40% CC Critical Storm Duration. Lowest mass balance: 99.47%**

| Node Event        | US Node | Peak (mins) | Level (m) | Depth (m) | Inflow (l/s) | Node Vol (m³) | Flood (m³) | Status     |
|-------------------|---------|-------------|-----------|-----------|--------------|---------------|------------|------------|
| 15 minute summer  | 1       | 10          | 6.762     | 0.087     | 33.2         | 0.2016        | 0.0000     | OK         |
| 15 minute summer  | 2       | 10          | 5.865     | 0.090     | 38.9         | 0.1201        | 0.0000     | OK         |
| 15 minute summer  | 3       | 10          | 4.789     | 0.114     | 62.4         | 0.2250        | 0.0000     | OK         |
| 360 minute summer | 4       | 424         | 4.043     | 0.338     | 14.4         | 0.6135        | 0.0000     | SURCHARGED |
| 15 minute summer  | 5       | 10          | 4.628     | 0.113     | 25.4         | 0.2296        | 0.0000     | OK         |
| 15 minute summer  | 6       | 10          | 4.437     | 0.112     | 38.0         | 0.1774        | 0.0000     | OK         |
| 360 minute summer | 7       | 416         | 4.043     | 0.243     | 9.7          | 0.4132        | 0.0000     | OK         |
| 360 minute summer | 8       | 416         | 4.043     | 0.543     | 12.4         | 0.8859        | 0.0000     | SURCHARGED |
| 360 minute summer | 9       | 408         | 4.043     | 0.843     | 30.7         | 170.4349      | 0.0000     | FLOOD RISK |
| 15 minute summer  | 9_OUT   | 1           | 3.170     | 0.000     | 0.0          | 0.0000        | 0.0000     | OK         |

| Link Event (Outflow) | US Node | Link    | DS Node | Outflow (l/s) | Velocity (m/s) | Flow/Cap | Link Vol (m³) | Discharge Vol (m³) |
|----------------------|---------|---------|---------|---------------|----------------|----------|---------------|--------------------|
| 15 minute summer     | 1       | 1       | 2       | 33.2          | 2.289          | 0.298    | 0.2876        |                    |
| 15 minute summer     | 2       | 2       | 3       | 38.9          | 2.220          | 0.339    | 0.3989        |                    |
| 15 minute summer     | 3       | 3       | 4       | 62.3          | 2.400          | 0.506    | 0.4514        |                    |
| 15 minute summer     | 4       | 4       | 9       | 82.0          | 3.035          | 0.735    | 0.3705        |                    |
| 15 minute summer     | 5       | 5       | 6       | 25.4          | 1.278          | 0.451    | 0.3228        |                    |
| 15 minute summer     | 6       | 6       | 7       | 38.0          | 2.019          | 0.439    | 0.3081        |                    |
| 15 minute summer     | 7       | 7       | 8       | 55.4          | 1.555          | 0.419    | 0.7580        |                    |
| 15 minute summer     | 8       | 8       | 9       | 70.6          | 2.026          | 0.446    | 0.4930        |                    |
| 360 minute summer    | 9       | Orifice | 9_OUT   | 0.0           |                |          |               | 0.0                |

**Results for 100 year +40% CC Critical Storm Duration. Lowest mass balance: 99.47%**

| Node Event        | US Node | Peak (mins) | Level (m) | Depth (m) | Inflow (l/s) | Node Vol (m³) | Flood (m³) | Status     |
|-------------------|---------|-------------|-----------|-----------|--------------|---------------|------------|------------|
| 15 minute summer  | 1       | 10          | 6.777     | 0.102     | 43.4         | 0.2359        | 0.0000     | OK         |
| 15 minute summer  | 2       | 10          | 5.880     | 0.105     | 51.0         | 0.1396        | 0.0000     | OK         |
| 15 minute summer  | 3       | 10          | 4.817     | 0.142     | 81.8         | 0.2795        | 0.0000     | OK         |
| 180 minute summer | 4       | 132         | 4.218     | 0.513     | 33.3         | 0.9313        | 0.0000     | SURCHARGED |
| 15 minute summer  | 5       | 10          | 4.649     | 0.134     | 33.2         | 0.2733        | 0.0000     | OK         |
| 15 minute summer  | 6       | 10          | 4.459     | 0.134     | 49.7         | 0.2111        | 0.0000     | OK         |
| 120 minute summer | 7       | 120         | 4.211     | 0.411     | 29.2         | 0.6985        | 0.0000     | SURCHARGED |
| 120 minute summer | 8       | 120         | 4.205     | 0.705     | 37.5         | 1.1496        | 0.0000     | FLOOD RISK |
| 360 minute summer | 9       | 216         | 4.200     | 1.000     | 41.6         | 172.3217      | 65.5766    | FLOOD      |
| 15 minute summer  | 9_OUT   | 1           | 3.170     | 0.000     | 0.0          | 0.0000        | 0.0000     | OK         |

| Link Event (Outflow) | US Node | Link    | DS Node | Outflow (l/s) | Velocity (m/s) | Flow/Cap | Link Vol (m³) | Discharge Vol (m³) |
|----------------------|---------|---------|---------|---------------|----------------|----------|---------------|--------------------|
| 15 minute summer     | 1       | 1       | 2       | 43.5          | 2.446          | 0.391    | 0.3524        |                    |
| 15 minute summer     | 2       | 2       | 3       | 51.1          | 2.322          | 0.445    | 0.5059        |                    |
| 15 minute summer     | 3       | 3       | 4       | 81.3          | 2.339          | 0.661    | 0.5789        |                    |
| 15 minute summer     | 4       | 4       | 9       | 103.9         | 3.034          | 0.932    | 0.4410        |                    |
| 15 minute summer     | 5       | 5       | 6       | 33.2          | 1.347          | 0.590    | 0.4004        |                    |
| 15 minute summer     | 6       | 6       | 7       | 49.7          | 2.142          | 0.575    | 0.3797        |                    |
| 15 minute summer     | 7       | 7       | 8       | 72.4          | 1.632          | 0.548    | 0.9442        |                    |
| 15 minute summer     | 8       | 8       | 9       | 92.3          | 2.092          | 0.583    | 0.6500        |                    |
| 120 minute summer    | 9       | Orifice | 9_OUT   | 0.0           |                |          |               | 0.0                |

### Design Settings

|                                      |        |                                    |               |
|--------------------------------------|--------|------------------------------------|---------------|
| Rainfall Methodology                 | FEH-13 | Minimum Velocity (m/s)             | 1.00          |
| Return Period (years)                | 100    | Connection Type                    | Level Soffits |
| Additional Flow (%)                  | 40     | Minimum Backdrop Height (m)        | 0.200         |
| CV                                   | 0.750  | Preferred Cover Depth (m)          | 0.700         |
| Time of Entry (mins)                 | 4.00   | Include Intermediate Ground        | ✓             |
| Maximum Time of Concentration (mins) | 30.00  | Enforce best practice design rules | x             |
| Maximum Rainfall (mm/hr)             | 200.0  |                                    |               |

### Nodes

| Name  | Area (ha) | T of E (mins) | Cover Level (m) | Diameter (mm) | Easting (m) | Northing (m) | Depth (m) |
|-------|-----------|---------------|-----------------|---------------|-------------|--------------|-----------|
| 1     | 0.055     | 4.00          | 7.600           | 1200          | 565172.609  | 174327.320   | 0.925     |
| 2     | 0.009     | 4.00          | 6.700           | 1200          | 565188.702  | 174338.897   | 0.925     |
| 3     | 0.039     | 4.00          | 5.600           | 1200          | 565191.160  | 174361.517   | 0.925     |
| 4     | 0.032     | 4.00          | 4.630           | 1200          | 565192.945  | 174378.919   | 0.925     |
| 5     | 0.042     | 4.00          | 5.440           | 1200          | 565203.077  | 174333.000   | 0.925     |
| 6     | 0.021     | 4.00          | 5.250           | 1200          | 565206.000  | 174348.982   | 0.925     |
| 7     | 0.028     | 4.00          | 4.800           | 1200          | 565209.001  | 174365.068   | 1.000     |
| 8     | 0.025     | 4.00          | 4.500           | 1200          | 565212.862  | 174386.006   | 1.000     |
| 9     | 0.044     | 4.00          | 4.200           | 1500          | 565200.530  | 174387.008   | 1.000     |
| 9_OUT |           |               | 4.140           | 1200          | 565202.282  | 174399.932   | 0.970     |

### Links

| Name | US Node | DS Node | Length (m) | ks (mm) / n | US IL (m) | DS IL (m) | Fall (m) | Slope (1:X) | Dia (mm) | T of C (mins) | Rain (mm/hr) |
|------|---------|---------|------------|-------------|-----------|-----------|----------|-------------|----------|---------------|--------------|
| 1    | 1       | 2       | 19.825     | 0.600       | 6.675     | 5.775     | 0.900    | 22.0        | 225      | 4.12          | 198.4        |
| 2    | 2       | 3       | 22.753     | 0.600       | 5.775     | 4.675     | 1.100    | 20.7        | 225      | 4.25          | 198.4        |
| 3    | 3       | 4       | 17.493     | 0.600       | 4.675     | 3.705     | 0.970    | 18.0        | 225      | 4.34          | 198.4        |
| 4    | 4       | 9       | 11.089     | 0.600       | 3.705     | 3.200     | 0.505    | 22.0        | 225      | 4.41          | 198.4        |
| 5    | 5       | 6       | 16.247     | 0.600       | 4.515     | 4.325     | 0.190    | 85.5        | 225      | 4.19          | 198.4        |
| 6    | 6       | 7       | 16.364     | 0.600       | 4.325     | 3.875     | 0.450    | 36.4        | 225      | 4.32          | 198.4        |
| 7    | 7       | 8       | 21.291     | 0.600       | 3.800     | 3.500     | 0.300    | 71.0        | 300      | 4.51          | 198.4        |
| 8    | 8       | 9       | 12.373     | 0.600       | 3.500     | 3.250     | 0.250    | 49.5        | 300      | 4.60          | 198.4        |
| 9    | 9       | 9_OUT   | 13.042     | 0.600       | 3.200     | 3.170     | 0.030    | 434.7       | 150      | 4.80          | 198.4        |

| Name | Vel (m/s) | Cap (l/s) | Flow (l/s) | US Depth (m) | DS Depth (m) | Σ Area (ha) | Σ Add Inflow (l/s) | Pro Depth (mm) | Pro Velocity (m/s) |
|------|-----------|-----------|------------|--------------|--------------|-------------|--------------------|----------------|--------------------|
| 1    | 2.800     | 111.3     | 41.1       | 0.700        | 0.700        | 0.055       | 0.0                | 94             | 2.594              |
| 2    | 2.889     | 114.9     | 48.2       | 0.700        | 0.700        | 0.064       | 0.0                | 102            | 2.766              |
| 3    | 3.095     | 123.1     | 77.3       | 0.700        | 0.700        | 0.103       | 0.0                | 130            | 3.266              |
| 4    | 2.804     | 111.5     | 101.1      | 0.700        | 0.775        | 0.134       | 0.0                | 168            | 3.161              |
| 5    | 1.415     | 56.2      | 31.4       | 0.700        | 0.700        | 0.042       | 0.0                | 120            | 1.451              |
| 6    | 2.176     | 86.5      | 47.0       | 0.700        | 0.700        | 0.062       | 0.0                | 118            | 2.220              |
| 7    | 1.868     | 132.1     | 68.4       | 0.700        | 0.700        | 0.091       | 0.0                | 153            | 1.884              |
| 8    | 2.240     | 158.3     | 87.2       | 0.700        | 0.650        | 0.116       | 0.0                | 159            | 2.292              |
| 9    | 0.476     | 8.4       | 221.4      | 0.850        | 0.820        | 0.294       | 0.0                | 150            | 0.485              |

### Pipeline Schedule

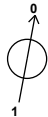
| Link | Length<br>(m) | Slope<br>(1:X) | Dia<br>(mm) | Link<br>Type | US CL<br>(m) | US IL<br>(m) | US Depth<br>(m) | DS CL<br>(m) | DS IL<br>(m) | DS Depth<br>(m) |
|------|---------------|----------------|-------------|--------------|--------------|--------------|-----------------|--------------|--------------|-----------------|
| 1    | 19.825        | 22.0           | 225         | Circular     | 7.600        | 6.675        | 0.700           | 6.700        | 5.775        | 0.700           |
| 2    | 22.753        | 20.7           | 225         | Circular     | 6.700        | 5.775        | 0.700           | 5.600        | 4.675        | 0.700           |
| 3    | 17.493        | 18.0           | 225         | Circular     | 5.600        | 4.675        | 0.700           | 4.630        | 3.705        | 0.700           |
| 4    | 11.089        | 22.0           | 225         | Circular     | 4.630        | 3.705        | 0.700           | 4.200        | 3.200        | 0.775           |
| 5    | 16.247        | 85.5           | 225         | Circular     | 5.440        | 4.515        | 0.700           | 5.250        | 4.325        | 0.700           |
| 6    | 16.364        | 36.4           | 225         | Circular     | 5.250        | 4.325        | 0.700           | 4.800        | 3.875        | 0.700           |
| 7    | 21.291        | 71.0           | 300         | Circular     | 4.800        | 3.800        | 0.700           | 4.500        | 3.500        | 0.700           |
| 8    | 12.373        | 49.5           | 300         | Circular     | 4.500        | 3.500        | 0.700           | 4.200        | 3.250        | 0.650           |
| 9    | 13.042        | 434.7          | 150         | Circular     | 4.200        | 3.200        | 0.850           | 4.140        | 3.170        | 0.820           |

| Link | US<br>Node | Dia<br>(mm) | Node<br>Type | MH<br>Type | DS<br>Node | Dia<br>(mm) | Node<br>Type | MH<br>Type |
|------|------------|-------------|--------------|------------|------------|-------------|--------------|------------|
| 1    | 1          | 1200        | Manhole      | Adoptable  | 2          | 1200        | Manhole      | Adoptable  |
| 2    | 2          | 1200        | Manhole      | Adoptable  | 3          | 1200        | Manhole      | Adoptable  |
| 3    | 3          | 1200        | Manhole      | Adoptable  | 4          | 1200        | Manhole      | Adoptable  |
| 4    | 4          | 1200        | Manhole      | Adoptable  | 9          | 1500        | Manhole      | Adoptable  |
| 5    | 5          | 1200        | Manhole      | Adoptable  | 6          | 1200        | Manhole      | Adoptable  |
| 6    | 6          | 1200        | Manhole      | Adoptable  | 7          | 1200        | Manhole      | Adoptable  |
| 7    | 7          | 1200        | Manhole      | Adoptable  | 8          | 1200        | Manhole      | Adoptable  |
| 8    | 8          | 1200        | Manhole      | Adoptable  | 9          | 1500        | Manhole      | Adoptable  |
| 9    | 9          | 1500        | Manhole      | Adoptable  | 9_OUT      | 1200        | Manhole      | Adoptable  |

### Manhole Schedule

| Node | Easting<br>(m) | Northing<br>(m) | CL<br>(m) | Depth<br>(m) | Dia<br>(mm) | Connections                                                                          | Link | IL<br>(m) | Dia<br>(mm) |     |
|------|----------------|-----------------|-----------|--------------|-------------|--------------------------------------------------------------------------------------|------|-----------|-------------|-----|
| 1    | 565172.609     | 174327.320      | 7.600     | 0.925        | 1200        |  |      |           |             |     |
|      |                |                 |           |              |             | 0                                                                                    | 1    | 6.675     | 225         |     |
| 2    | 565188.702     | 174338.897      | 6.700     | 0.925        | 1200        |  | 1    | 1         | 5.775       | 225 |
|      |                |                 |           |              |             | 0                                                                                    | 2    | 5.775     | 225         |     |
| 3    | 565191.160     | 174361.517      | 5.600     | 0.925        | 1200        |  | 1    | 2         | 4.675       | 225 |
|      |                |                 |           |              |             | 0                                                                                    | 3    | 4.675     | 225         |     |
| 4    | 565192.945     | 174378.919      | 4.630     | 0.925        | 1200        |  | 1    | 3         | 3.705       | 225 |
|      |                |                 |           |              |             | 0                                                                                    | 4    | 3.705     | 225         |     |
| 5    | 565203.077     | 174333.000      | 5.440     | 0.925        | 1200        |  |      |           |             |     |
|      |                |                 |           |              |             | 0                                                                                    | 5    | 4.515     | 225         |     |
| 6    | 565206.000     | 174348.982      | 5.250     | 0.925        | 1200        |  | 1    | 5         | 4.325       | 225 |
|      |                |                 |           |              |             | 0                                                                                    | 6    | 4.325     | 225         |     |

### Manhole Schedule

| Node  | Easting<br>(m) | Northing<br>(m) | CL<br>(m) | Depth<br>(m) | Dia<br>(mm) | Connections                                                                                   | Link | IL<br>(m) | Dia<br>(mm) |     |
|-------|----------------|-----------------|-----------|--------------|-------------|-----------------------------------------------------------------------------------------------|------|-----------|-------------|-----|
| 7     | 565209.001     | 174365.068      | 4.800     | 1.000        | 1200        | <div></div> | 1    | 6         | 3.875       | 225 |
| 8     | 565212.862     | 174386.006      | 4.500     | 1.000        | 1200        | <div></div> | 1    | 7         | 3.500       | 300 |
| 9     | 565200.530     | 174387.008      | 4.200     | 1.000        | 1500        | <div></div> | 1    | 8         | 3.250       | 300 |
|       |                |                 |           |              |             |                                                                                               | 2    | 4         | 3.200       | 225 |
|       |                |                 |           |              |             |                                                                                               | 0    | 9         | 3.200       | 150 |
| 9_OUT | 565202.282     | 174399.932      | 4.140     | 0.970        | 1200        | <div></div> | 1    | 9         | 3.170       | 150 |

### Simulation Settings

|                      |        |                            |      |                         |   |
|----------------------|--------|----------------------------|------|-------------------------|---|
| Rainfall Methodology | FEH-13 | Skip Steady State          | x    | Check Discharge Rate(s) | x |
| Summer CV            | 0.750  | Drain Down Time (mins)     | 60   | Check Discharge Volume  | x |
| Analysis Speed       | Normal | Additional Storage (m³/ha) | 20.0 |                         |   |

### Storm Durations

15 | 30 | 60 | 120 | 180 | 240 | 360

| Return Period (years) | Climate Change (CC %) | Additional Area (A %) | Additional Flow (Q %) |
|-----------------------|-----------------------|-----------------------|-----------------------|
| 2                     | 40                    | 0                     | 0                     |
| 10                    | 40                    | 0                     | 0                     |
| 30                    | 40                    | 0                     | 0                     |
| 100                   | 40                    | 0                     | 0                     |

### Node 9 Online Orifice Control

|                          |   |                  |       |                       |       |
|--------------------------|---|------------------|-------|-----------------------|-------|
| Flap Valve               | x | Invert Level (m) | 3.200 | Discharge Coefficient | 0.600 |
| Replaces Downstream Link | ✓ | Diameter (m)     | 0.150 |                       |       |

### Node 9 Soakaway Storage Structure

|                             |         |                           |        |                 |       |
|-----------------------------|---------|---------------------------|--------|-----------------|-------|
| Base Inf Coefficient (m/hr) | 0.00000 | Invert Level (m)          | 3.200  | Depth (m)       | 0.850 |
| Side Inf Coefficient (m/hr) | 0.00000 | Time to half empty (mins) | 34     | Inf Depth (m)   |       |
| Safety Factor               | 2.0     | Pit Width (m)             | 10.500 | Number Required | 1     |
| Porosity                    | 0.95    | Pit Length (m)            | 20.000 |                 |       |

**Results for 2 year +40% CC Critical Storm Duration. Lowest mass balance: 99.91%**

| Node Event        | US Node | Peak (mins) | Level (m) | Depth (m) | Inflow (l/s) | Node Vol (m³) | Flood (m³) | Status |
|-------------------|---------|-------------|-----------|-----------|--------------|---------------|------------|--------|
| 15 minute summer  | 1       | 10          | 6.724     | 0.049     | 11.4         | 0.1136        | 0.0000     | OK     |
| 15 minute summer  | 2       | 10          | 5.827     | 0.052     | 13.4         | 0.0690        | 0.0000     | OK     |
| 15 minute summer  | 3       | 10          | 4.738     | 0.063     | 21.5         | 0.1247        | 0.0000     | OK     |
| 15 minute summer  | 4       | 9           | 3.796     | 0.091     | 28.1         | 0.1653        | 0.0000     | OK     |
| 15 minute summer  | 5       | 10          | 4.577     | 0.062     | 8.7          | 0.1254        | 0.0000     | OK     |
| 15 minute summer  | 6       | 10          | 4.386     | 0.061     | 13.0         | 0.0966        | 0.0000     | OK     |
| 15 minute summer  | 7       | 10          | 3.878     | 0.078     | 18.9         | 0.1331        | 0.0000     | OK     |
| 15 minute summer  | 8       | 10          | 3.584     | 0.084     | 24.1         | 0.1376        | 0.0000     | OK     |
| 120 minute summer | 9       | 76          | 3.337     | 0.137     | 27.2         | 27.7627       | 0.0000     | OK     |
| 15 minute summer  | 9_OUT   | 1           | 3.170     | 0.000     | 7.0          | 0.0000        | 0.0000     | OK     |

| Link Event (Outflow) | US Node | Link    | DS Node | Outflow (l/s) | Velocity (m/s) | Flow/Cap | Link Vol (m³) | Discharge Vol (m³) |
|----------------------|---------|---------|---------|---------------|----------------|----------|---------------|--------------------|
| 15 minute summer     | 1       | 1       | 2       | 11.4          | 1.719          | 0.102    | 0.1315        |                    |
| 15 minute summer     | 2       | 2       | 3       | 13.4          | 1.676          | 0.117    | 0.1824        |                    |
| 15 minute summer     | 3       | 3       | 4       | 21.5          | 1.843          | 0.175    | 0.2085        |                    |
| 15 minute summer     | 4       | 4       | 9       | 28.5          | 2.817          | 0.256    | 0.1284        |                    |
| 15 minute summer     | 5       | 5       | 6       | 8.7           | 0.993          | 0.155    | 0.1424        |                    |
| 15 minute summer     | 6       | 6       | 7       | 13.0          | 1.536          | 0.150    | 0.1386        |                    |
| 15 minute summer     | 7       | 7       | 8       | 18.9          | 1.227          | 0.143    | 0.3283        |                    |
| 15 minute summer     | 8       | 8       | 9       | 24.0          | 1.557          | 0.152    | 0.1908        |                    |
| 120 minute summer    | 9       | Orifice | 9_OUT   | 11.3          |                |          |               | 45.7               |

**Results for 10 year +40% CC Critical Storm Duration. Lowest mass balance: 99.91%**

| Node Event        | US<br>Node | Peak<br>(mins) | Level<br>(m) | Depth<br>(m) | Inflow<br>(l/s) | Node<br>Vol (m³) | Flood<br>(m³) | Status     |
|-------------------|------------|----------------|--------------|--------------|-----------------|------------------|---------------|------------|
| 15 minute summer  | 1          | 10             | 6.749        | 0.074        | 24.6            | 0.1706           | 0.0000        | OK         |
| 15 minute summer  | 2          | 10             | 5.852        | 0.077        | 28.9            | 0.1022           | 0.0000        | OK         |
| 15 minute summer  | 3          | 10             | 4.770        | 0.095        | 46.3            | 0.1874           | 0.0000        | OK         |
| 15 minute summer  | 4          | 9              | 3.842        | 0.137        | 60.4            | 0.2484           | 0.0000        | OK         |
| 15 minute summer  | 5          | 10             | 4.609        | 0.094        | 18.8            | 0.1917           | 0.0000        | OK         |
| 15 minute summer  | 6          | 10             | 4.419        | 0.094        | 28.1            | 0.1480           | 0.0000        | OK         |
| 15 minute summer  | 7          | 10             | 3.920        | 0.120        | 40.9            | 0.2038           | 0.0000        | OK         |
| 15 minute summer  | 8          | 10             | 3.632        | 0.132        | 52.2            | 0.2146           | 0.0000        | OK         |
| 120 minute summer | 9          | 76             | 3.456        | 0.256        | 53.2            | 51.8209          | 0.0000        | SURCHARGED |
| 15 minute summer  | 9_OUT      | 1              | 3.170        | 0.000        | 17.2            | 0.0000           | 0.0000        | OK         |

| Link Event<br>(Outflow) | US<br>Node | Link    | DS<br>Node | Outflow<br>(l/s) | Velocity<br>(m/s) | Flow/Cap | Link<br>Vol (m³) | Discharge<br>Vol (m³) |
|-------------------------|------------|---------|------------|------------------|-------------------|----------|------------------|-----------------------|
| 15 minute summer        | 1          | 1       | 2          | 24.6             | 2.119             | 0.221    | 0.2302           |                       |
| 15 minute summer        | 2          | 2       | 3          | 28.9             | 2.076             | 0.252    | 0.3172           |                       |
| 15 minute summer        | 3          | 3       | 4          | 46.2             | 2.287             | 0.375    | 0.3561           |                       |
| 15 minute summer        | 4          | 4       | 9          | 61.0             | 3.006             | 0.547    | 0.2793           |                       |
| 15 minute summer        | 5          | 5       | 6          | 18.8             | 1.198             | 0.334    | 0.2550           |                       |
| 15 minute summer        | 6          | 6       | 7          | 28.1             | 1.878             | 0.325    | 0.2450           |                       |
| 15 minute summer        | 7          | 7       | 8          | 41.0             | 1.463             | 0.310    | 0.5961           |                       |
| 15 minute summer        | 8          | 8       | 9          | 52.3             | 1.891             | 0.330    | 0.3421           |                       |
| 120 minute summer       | 9          | Orifice | 9_OUT      | 20.0             |                   |          |                  | 92.4                  |

**Results for 30 year +40% CC Critical Storm Duration. Lowest mass balance: 99.91%**

| Node Event       | US Node | Peak (mins) | Level (m) | Depth (m) | Inflow (l/s) | Node Vol (m³) | Flood (m³) | Status     |
|------------------|---------|-------------|-----------|-----------|--------------|---------------|------------|------------|
| 15 minute summer | 1       | 10          | 6.762     | 0.087     | 33.2         | 0.2016        | 0.0000     | OK         |
| 15 minute summer | 2       | 10          | 5.865     | 0.090     | 38.9         | 0.1201        | 0.0000     | OK         |
| 15 minute summer | 3       | 10          | 4.789     | 0.114     | 62.4         | 0.2248        | 0.0000     | OK         |
| 15 minute summer | 4       | 9           | 3.872     | 0.167     | 81.5         | 0.3023        | 0.0000     | OK         |
| 15 minute summer | 5       | 10          | 4.628     | 0.113     | 25.4         | 0.2296        | 0.0000     | OK         |
| 15 minute summer | 6       | 10          | 4.437     | 0.112     | 38.0         | 0.1774        | 0.0000     | OK         |
| 15 minute summer | 7       | 10          | 3.944     | 0.144     | 55.3         | 0.2445        | 0.0000     | OK         |
| 15 minute summer | 8       | 10          | 3.659     | 0.159     | 70.6         | 0.2588        | 0.0000     | OK         |
| 60 minute summer | 9       | 43          | 3.550     | 0.350     | 107.7        | 70.7220       | 0.0000     | SURCHARGED |
| 15 minute summer | 9_OUT   | 1           | 3.170     | 0.000     | 21.4         | 0.0000        | 0.0000     | OK         |

| Link Event (Outflow) | US Node | Link    | DS Node | Outflow (l/s) | Velocity (m/s) | Flow/Cap | Link Vol (m³) | Discharge Vol (m³) |
|----------------------|---------|---------|---------|---------------|----------------|----------|---------------|--------------------|
| 15 minute summer     | 1       | 1       | 2       | 33.2          | 2.289          | 0.298    | 0.2876        |                    |
| 15 minute summer     | 2       | 2       | 3       | 38.9          | 2.222          | 0.339    | 0.3987        |                    |
| 15 minute summer     | 3       | 3       | 4       | 62.3          | 2.399          | 0.506    | 0.4523        |                    |
| 15 minute summer     | 4       | 4       | 9       | 82.0          | 3.054          | 0.735    | 0.3652        |                    |
| 15 minute summer     | 5       | 5       | 6       | 25.4          | 1.278          | 0.451    | 0.3227        |                    |
| 15 minute summer     | 6       | 6       | 7       | 38.0          | 2.019          | 0.439    | 0.3081        |                    |
| 15 minute summer     | 7       | 7       | 8       | 55.4          | 1.556          | 0.419    | 0.7580        |                    |
| 15 minute summer     | 8       | 8       | 9       | 70.6          | 2.026          | 0.446    | 0.4613        |                    |
| 60 minute summer     | 9       | Orifice | 9_OUT   | 24.6          |                |          |               | 94.4               |

**Results for 100 year +40% CC Critical Storm Duration. Lowest mass balance: 99.91%**

| Node Event        | US<br>Node | Peak<br>(mins) | Level<br>(m) | Depth<br>(m) | Inflow<br>(l/s) | Node<br>Vol (m³) | Flood<br>(m³) | Status     |
|-------------------|------------|----------------|--------------|--------------|-----------------|------------------|---------------|------------|
| 15 minute summer  | 1          | 10             | 6.777        | 0.102        | 43.5            | 0.2359           | 0.0000        | OK         |
| 15 minute summer  | 2          | 10             | 5.880        | 0.105        | 51.0            | 0.1395           | 0.0000        | OK         |
| 15 minute summer  | 3          | 10             | 4.817        | 0.142        | 81.8            | 0.2797           | 0.0000        | OK         |
| 15 minute summer  | 4          | 10             | 4.046        | 0.341        | 106.5           | 0.6192           | 0.0000        | SURCHARGED |
| 15 minute summer  | 5          | 10             | 4.649        | 0.134        | 33.2            | 0.2733           | 0.0000        | OK         |
| 15 minute summer  | 6          | 10             | 4.459        | 0.134        | 49.7            | 0.2111           | 0.0000        | OK         |
| 15 minute summer  | 7          | 10             | 3.972        | 0.172        | 72.3            | 0.2915           | 0.0000        | OK         |
| 15 minute summer  | 8          | 10             | 3.690        | 0.190        | 92.2            | 0.3099           | 0.0000        | OK         |
| 120 minute summer | 9          | 78             | 3.671        | 0.471        | 94.3            | 95.1677          | 0.0000        | SURCHARGED |
| 15 minute summer  | 9_OUT      | 1              | 3.170        | 0.000        | 25.7            | 0.0000           | 0.0000        | OK         |

| Link Event<br>(Outflow) | US<br>Node | Link    | DS<br>Node | Outflow<br>(l/s) | Velocity<br>(m/s) | Flow/Cap | Link<br>Vol (m³) | Discharge<br>Vol (m³) |
|-------------------------|------------|---------|------------|------------------|-------------------|----------|------------------|-----------------------|
| 15 minute summer        | 1          | 1       | 2          | 43.5             | 2.447             | 0.391    | 0.3524           |                       |
| 15 minute summer        | 2          | 2       | 3          | 51.1             | 2.323             | 0.445    | 0.5060           |                       |
| 15 minute summer        | 3          | 3       | 4          | 81.4             | 2.325             | 0.661    | 0.5791           |                       |
| 15 minute summer        | 4          | 4       | 9          | 104.3            | 3.058             | 0.935    | 0.4410           |                       |
| 15 minute summer        | 5          | 5       | 6          | 33.2             | 1.347             | 0.590    | 0.4004           |                       |
| 15 minute summer        | 6          | 6       | 7          | 49.7             | 2.142             | 0.575    | 0.3797           |                       |
| 15 minute summer        | 7          | 7       | 8          | 72.4             | 1.632             | 0.548    | 0.9441           |                       |
| 15 minute summer        | 8          | 8       | 9          | 92.4             | 2.120             | 0.583    | 0.6225           |                       |
| 120 minute summer       | 9          | Orifice | 9_OUT      | 29.6             |                   |          |                  | 165.1                 |

## Appendix A.5 – Indicative Drainage Layout



House

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  2. ALL WORK IS TO BE CARRIED OUT IN ACCORDANCE WITH THE RELEVANT BRITISH STANDARDS, EUROPEAN NORMS, CODES OF PRACTICE AND BUILDING PRACTICE.
  3. ALL DIMENSIONS ARE TO BE CHECKED BY THE CONTRACTOR PRIOR TO STARTING THE WORKS ON SITE. ANY DISCREPANCIES ARE TO BE REPORTED TO THE ENGINEER IMMEDIATELY.
  4. ALL DRAINAGE SYSTEMS WILL NEED TO BE INSTALLED AND DESIGNED FOR SUITABLE LOADING REQUIREMENTS.
  5. THE CONTRACTOR SHALL OBTAIN PRIOR APPROVAL AND ALL NECESSARY LICENCES FROM THE THE HIGHWAY AUTHORITY AND/OR SEWERAGE UNDERTAKER BEFORE CARRYING OUT ANY WORKS.

**KEY:**

- CL: XX.XX IL: XX.XX MH
- SURFACE WATER DRAIN
- SURFACE WATER MANHOLE
- FLOW CONTROL DEVICE
- GEOCELLULAR STORAGE

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| Rev | Description   | Author | Checked | Date     |
|-----|---------------|--------|---------|----------|
| P2  | Layout update | EC     | SMB     | 15/06/21 |
| P1  | First issue   | EC     | SMB     | 28/04/21 |

CLIENT  
MILE PROPERTY GROUP

PROJECT  
SWMS - The Terrace, Gravesend

| SCALE | PROJ REF | ORIGINATOR | CHECKED BY |
|-------|----------|------------|------------|
| 1:200 | 2813     | EC         | SMB        |

DWG REF: INDICATIVE DRAINAGE LAYOUT  
DWG No.: HC-2813-501

## Appendix A.6 – Maintenance Schedules

### Operation and Maintenance Schedule – Geo-Cellular Storage System

| Maintenance Schedule | Required Action                                                                                                                                                                                                     | Typical Frequency                                                       |
|----------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------|
| Regular maintenance  | Inspect and identify any areas that are not operating correctly. If required, take remedial action.                                                                                                                 | Monthly for 3 months then annually                                      |
|                      | Remove debris and sediment from the catchment surface, wherever it presents a risk to the performance of the drainage system,                                                                                       | Monthly, or as required based on inspection frequencies.                |
|                      | Remove sediment from pre-treatment structures (e.g. sediment traps) and from internal forebays                                                                                                                      | Annually or as required based on inspection frequencies                 |
| Remedial Actions     | Repair; inlets, outlets, overflow pipes, and vent mechanisms                                                                                                                                                        | As required, based on inspections                                       |
|                      | Replace tank or geotextile if significant damage is observed or geotextile is torn.                                                                                                                                 | As required                                                             |
| Monitoring           | Inspect and check all inlets, outlets, vents, and overflows to ensure that they are in good condition and operating as designed.                                                                                    | Following installation, and annually hereafter                          |
|                      | Survey inside of tank, and at any sediment trap mechanisms, for sediment build-up and remove sediment if necessary. Use inspections to develop a regular maintenance and inspection procedure for sediment removal. | Every 5 years, or as required if inspections show high siltation rates. |

*General Operation and Maintenance Table for Geo-Cellular Storage Systems*