

Calcinotto

# Calcinotto

civil and structural engineers

**114038**

Arthur Hill Swimming Pool  
Kings Road  
Reading  
RG1 4LS

Drainage Strategy Statement for Planning  
For Gleeds & Reading Borough Council

**07<sup>th</sup> July 2021**  
Revision 7.0

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Drainage Strategy Statement for Planning for Gleeds & Reading Borough Council

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## 1 Executive Summary

- 1.1 Calcinotto have been appointed to prepare a Drainage Strategy Statement for drainage proposals in connection with the redevelopment of Arthur Hill Swimming Pool, off Kings Road, in Reading. The postcode is RG1 4LS. The proposed development is for 15 Flats split into Block A and B and Block C and D. Block D is the existing building which is partially being retained, refurbished and extended towards the rear of the site.
- 1.2 Intrusive site investigations were instructed by Gleeds and carried out on site by Structural Soils Ltd. The report summarising the findings is dated 19/08/20 and has reference 735216-1 (00). This concluded no encountered water strikes, soakaways are deemed inappropriate and a CBR of 5% for the design of pavements has been recommended.
- 1.3 This drainage strategy discusses the intended method of disposal for foul water and surface water discharge from the site into the public sewers in Kings Road and Norwood Road (at the rear of the site). The surface water discharge includes flows that are to be managed and controlled on site and a final discharge that is limited to achieve a reduction to 6.8l/s (50% below existing estimated flow rate) which has been confirmed as acceptable by Thames Water.
- 1.4 The surface water design includes permeable paving, attenuation tank and hydro-brake manhole to limit the off-site discharge to 6.8 l/s as discussed above. The intention is to reuse the existing 150mm diameter on site surface water connection that connects into the 225mm diameter Public Sewer in Norwood Road. There is 370m<sup>2</sup> of permeable paving proposed across the site and 40m<sup>2</sup> of soft landscaping. These permeable surfaces make up 38% of the total site area.
- 1.5 The surface water drainage system has been designed using storm return periods which where appropriate including climate change in accordance with current guidelines which are 1:1 year, 1:30 year and 1:100 year events with 0%, 20% and 40% climate change respectively. Storage volumes utilised for each critical storm event have been calculated in Section 5.
- 1.6 Foul water generated by the development will discharge into both the public foul sewer system in Norwood Road via a new manhole connection and into the public foul sewer in Kings Road utilising the existing 150mm diameter connection. The existing foul drainage from the site is shown on the topographical survey in Appendix C.
- 1.7 Reference has been made to the British Geological mapping web site and the Environment Agency web site links to GOV.UK. The Geological survey map site shows the superficial deposits to be that of the Taplow Gravel Member composed of Sand and Gravel and Bedrock geology to be that of a Seaford Chalk Formation and Newhaven Chalk Formation.
- 1.8 The design has been examined in line with the current water quality guidelines outlined in CIRIA C753 SuDS Manual Version 6 and provides sufficient SuDS features to meet these requirements.
- 1.9 This document has been prepared for the use of Gleeds & Reading Borough Council to support the redevelopment of Arthur Hill Swimming Pool, off Kings Road, in Reading. The contents should not be relied upon by others without the written authority of Calcinotto Ltd.
- 1.10 Any drawings and calculations prepared at this time are preliminary and should not be relied upon for construction. The proposals are subject to the Section 106 application which has been submitted to Thames Water.

## 2 Introduction

### 2.1 Site Location

2.1.1 Calcinotto Consulting Engineers have been appointed by Gleeds to prepare a drainage strategy for the re-development of the former Arthur Hill Swimming Pool. The current building comprises a closed and drained swimming pool, changing facilities, fitness area and office/kitchen areas.

2.1.2 The development comprises of 15 new flats along with associated landscaping, car parking and ancillary buildings including a bin storage area and cycle store. The site location is shown on Figure 1 below.

2.1.3 The site under development has an area of 0.108ha. This site has a Post Code of RG1 4LS. The national grid reference for the site is SU 73035 73240. The layout of the site is detailed on the Architects drawing in Appendix A.

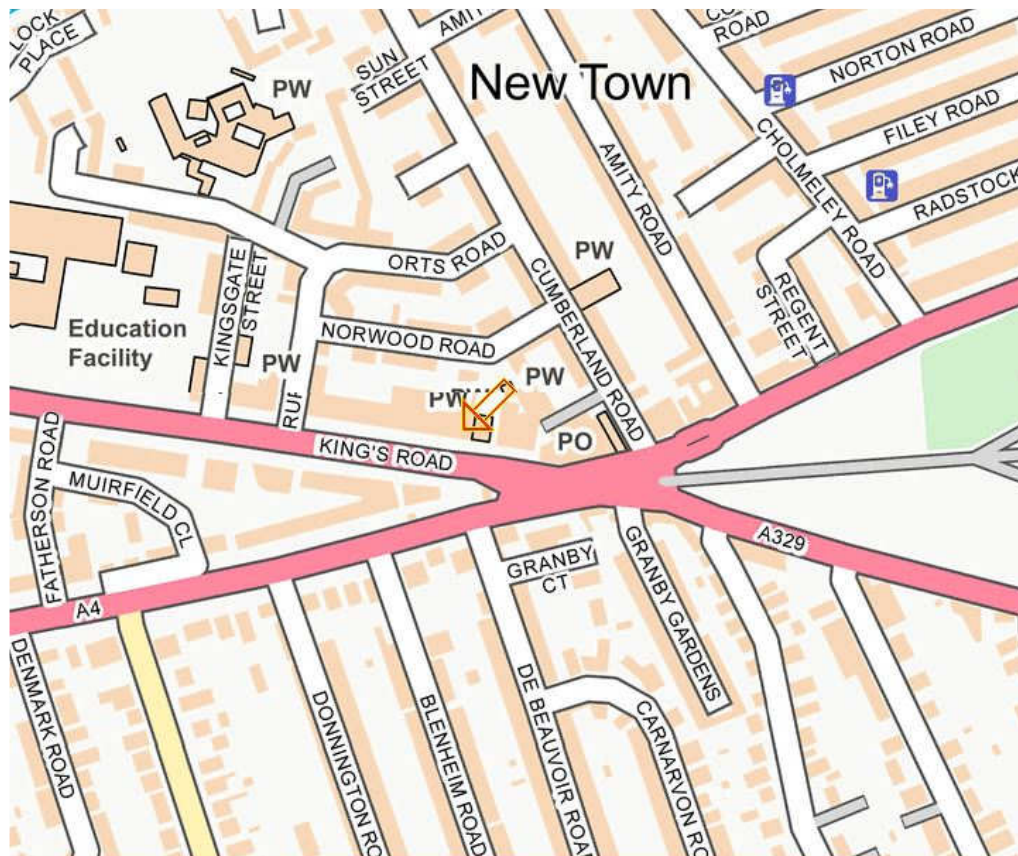


Figure 1 Site Location

2.1.4 This statement is made in support of a proposed drainage strategy to service this re-development. A brief comment on Flood Risk is contained within this statement as the site is less than 1 Hectare and is in Flood Zone 1.

- 2.1.5 Prior to this statement being produced and the outline strategy developed Calcinotto have engaged with Thames Water on drainage related matters and a formal Section 106 Application is currently being processed.

### 3 Existing Site

#### 3.1 Existing Use

3.1.1 The development plot was in its last use a Swimming Pool with fitness facilities, changing rooms and an office. The site is bounded by Kings Road to the South, Norwood Road to the North and residential buildings to the East and West. The site is currently 100% impermeable formed from a mixture of roofs and hardstanding areas.

3.1.2 A copy of the public sewer records has been received from Thames Water, the water company whose area this site falls within. This records the positions of their assets on plans. Private sewers are generally not shown on public sewer records. However, since the Sewer Transfers of October 2011 there are now numerous drainage pipelines that are now public sewers which have yet to make into onto the records all around the country.

3.1.3 Further comment on the local public sewers is included in Section 4 below. A copy of the sewer records is included in Appendix B.

3.1.4 The existing on-site drainage has been investigated on site by way of a utilities and drainage survey carried out by Survey Solutions of which the findings were issued on 26/02/20. This survey was able to prove the routing of the existing foul and surface water drainage from the site. This has been done by lifting covers, rodding and tracing.

#### 3.2 Foul and Surface Water Drainage

3.2.1 A topographic and ground penetrating radar was commissioned from Survey Solutions and the survey was undertaken in February 2020. The survey picked up the positions of manhole covers found on site and has confirmed depths of the identified drains. The survey has also identified the presence of existing services servicing the site, there may be others that were not identifiable at the time of the survey. See a copy of the survey in Appendix C.

3.2.2 The existing foul drainage pipework has been confirmed as being 100mm and 150mm diameter and can be seen to discharge into the public foul sewer in Kings Road. The surface water drainage is confirmed as 150mm diameter pipework that connects into the public surface water sewer in Norwood Road to the North. There is a possibility that the surface water downpipes at the South side of the existing building connect into the on-site foul drainage system however the survey does not confirm this.

#### 3.3 Ground Investigations

3.3.1 From the BGS Openscience website the site is shown to be underlain by superficial deposits of the Taplow Gravel Member composed of Sand and Gravel shown in Figure 2 below. The Bedrock geology is shown to be that of a Seaford Chalk Formation and Newhaven Chalk Formation as shown on Figure 3.

3.3.2 These findings would suggest on first inspection that infiltration to ground would be an acceptable method of disposal of the surface water however this would need to be reinforced by thorough infiltration testing to BRE 365 standards carried out across the site.

3.3.3 A detailed ground investigation has been undertaken for the site by Structural Soils Ltd of which the findings have been summarised in report 735216-1 (00) dated 19/08/20. The site investigation included Window Sample Boreholes, Trial Pits and Core Holes. Across the site there was swimming pool construction, made ground, Taplow Gravel and Chalk, broadly consistent with the BGS Openscience findings. The encountered ground conditions are highlighted within Figure 4 below.

As part of the site investigation, infiltration testing was undertaken in SA1 of which there was insufficient infiltration in this location for the use of soakaways. Further infiltration testing was carried out in SA2 within the Taplow Gravel strata which produced an infiltration rate of  $1.66 \times 10^{-5}$  m/s. However, as the site is in an area of high risk of dissolution features, it is recommended soakaways should be avoided if possible or sited at least 20m away from any foundations or other structures.

CBR testing was undertaken of which a recommended CBR of 5% is suggested for all pavement design across the site.

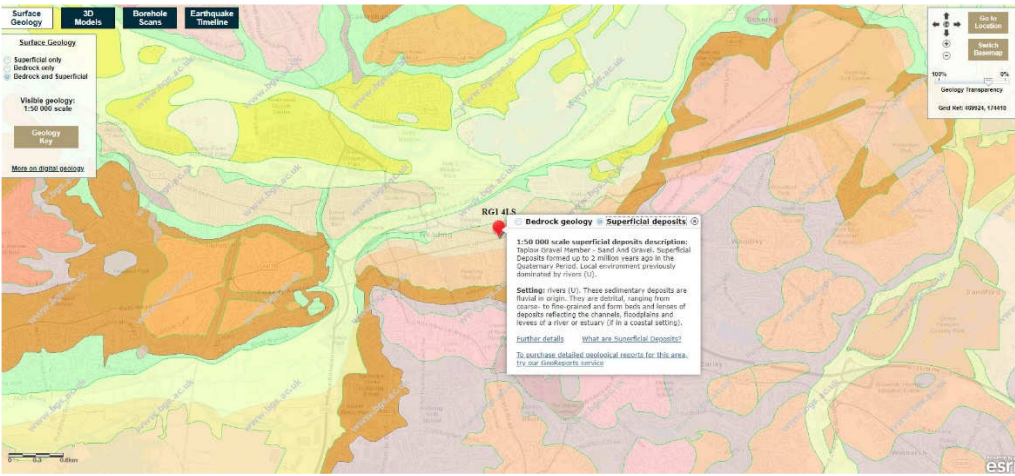


Figure 2 – Superficial Deposits Extract from BGS Openscience data set

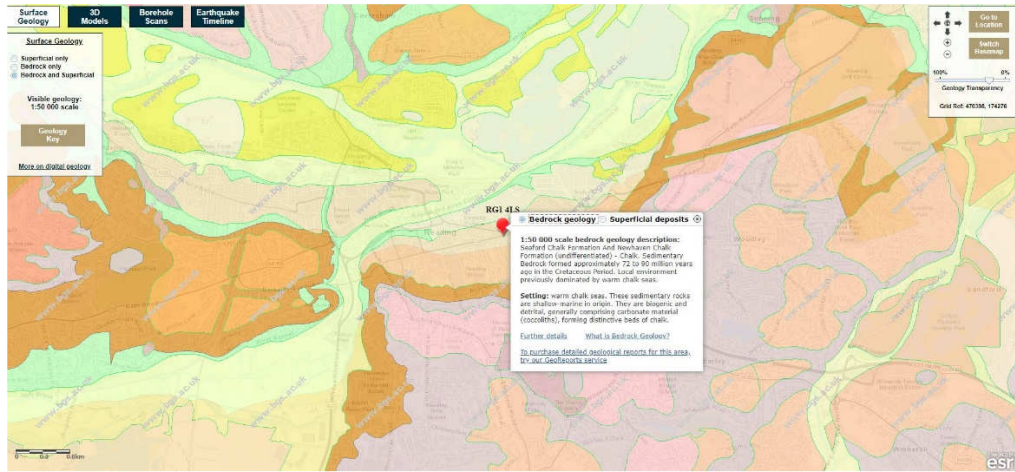


Figure 3 – Bedrock Geology Extract from BGS Openscience data set

| TABLE 12 : SUMMARY OF GROUND CONDITIONS |                                  |                             |                                  |
|-----------------------------------------|----------------------------------|-----------------------------|----------------------------------|
| Strata Encountered                      | Depth to top of stratum<br>m bgl | Range of Thicknesses<br>(m) | Exploratory holes encountered in |
| Swimming Pool Construction              | 0.00                             | 0.28-0.30                   | CS1-CS3                          |
| Made Ground                             | 0.00                             | 0.20-1.00                   | BH1, BH2, SA1 & SA2              |
| Taplow Gravel                           | 0.20-1.00                        | >0.05-3.10                  | BH1/DP1, BH2, SA2 & CS1-CS3      |
| Chalk                                   | ~3.80                            | >1.20                       | DP1                              |

Figure 4. Structural Soils Ltd Encountered Ground Conditions

#### 3.4 Topography

- 3.4.1 A topographical survey has been supplied and was undertaken by Survey Solutions of Reading and survey was undertaken in February 2020. This highlights the general fall of the site from South to North. At the Southern entrance to the site the recorded value is 43.36 and at the South 42.24 at the entrance. The radar survey was also carried out as part of this survey.

A copy of the survey can be found in Appendix C.

#### **4 Public Sewers**

##### **4.1 Water Authority Apparatus**

4.2 An enquiry was opened with Thames water and their asset records plans obtained for the site showing locations of all Public Sewers in the vicinity with their relevant Cover and Invert levels. A copy of their asset plan is in Appendix B. The public sewer manholes have been labelled accordingly on the drainage layout plan in Appendix D.

4.3 To the best of our knowledge, there is shown to be a 225mm diameter public surface water sewer and 225mm diameter public foul sewer in Norwood Road. Within Kings Road, there is an 825mm diameter public surface water sewer and 300mm diameter public foul sewer.

4.4 Based on the topographical information and this asset plan it has been assessed that the on-site surface water and foul drainage connects into the public systems, the foul into the public foul sewer in Kings Road and the surface water into the public surface water sewer in Norwood Road.

4.5 As part of the development the proposed construction works for Building C will be within 3m of the neighbouring Public Sewer shown on the Public Sewer Map in Appendix B running through the Wycliffe Baptist Church site to the East. A build over public sewer enquiry was made to Thames Water and due to the nature of the foundation works it has been confirmed formally that an agreement is not required.

## **5 Proposed Development Philosophy**

### **5.1 Development Proposals Background**

5.2 The site is currently a Brownfield Site that is being redeveloped to create 15 Flats split into Block A and B and Block C and D with associated landscaping, car parking and a bin store. The development will provide new foul and surface water drainage infrastructure to serve the proposed scheme. The existing off-site foul connection and existing off-site surface water connection are intended to be reused as agreed with Thames Water.

### **5.3 Drainage Design Guidelines and Parameters**

5.3.1 In accordance with good practice and guidance separate foul and surface water systems are to be specified for the new development.

5.4 All new private drainage will be designed in accordance with Approved Document H of the National Building Regulations 2000:2015 Edition and BS EN 752:2008.

5.5 All new surface water drainage will be designed to comply with current CIRIA design guidance C697 and C753, using the storm return periods listed below and latest climate change allowances as contained within the Guidance Document dated 19<sup>th</sup> February and updated 12<sup>th</sup> April 2016 – Flood Risk Assessments: Climate Change Allowances.

- 1 in 1 year no climate change
- 1 in 30 year + 20-10% climate change
- 1 in 100 year + 40-20% climate change

5.6 Where appropriate an allowance for Urban Creep can be made but in this instance, it is very unlikely there would be any possibility of any increase in area to the building due site being developed for a specific purpose.

5.6.1 Reading Borough Council as Lead Local Flood Authority (LLFA) will be consulted throughout the process. Their resources have been reviewed to ensure standards for the area are met in the outline strategy produced.

5.6.2 Thames Water have been consulted at this stage to establish an agreed discharge for the surface water into the public surface water system. A confirmed discharge of 6.8 l/s has been agreed as shown in Appendix H and a Section 106 application has been submitted.

### **5.7 Foul Drainage**

5.7.1 The foul drainage network will be a gravity system with the foul drainage from Block C and D draining into the public foul sewer in Kings Road reusing the existing 150mm diameter foul sewer connection. The foul drainage from Block A and B will drain by gravity into the public foul sewer in Norwood Road with a new manhole connection. This connection is awaiting approval from Thames Water through a Section 106 Application.

5.7.2 The peak flow from the new development has been assessed taking into account the type of development proposed. This calculation is within Appendix G and shows an assessed discharge of 4.06l/s at peak into the public foul system.

5.7.3 Thames Water have been contacted through a Pre-Planning Enquiry Application Form to check that there is capacity within the public foul sewer network to accommodate the initially projected 4.06l/s flow from the development. Confirmation has been agreed as shown in Appendix H.

## 5.8 EA Flood Risk Review

- 5.8.1 Before a surface water strategy could be developed, an analysis of the EA flood maps was made to determine if certain flood defence/preventative measures would need to be integrated into the design.
- 5.8.2 Figure 5 taken directly from the GOV.UK website highlights the site sits wholly within flood zone 1 which by definition is designated as Low risk and has a less than 0.1% probability of flooding annually (i.e. <1 in 1000yr).

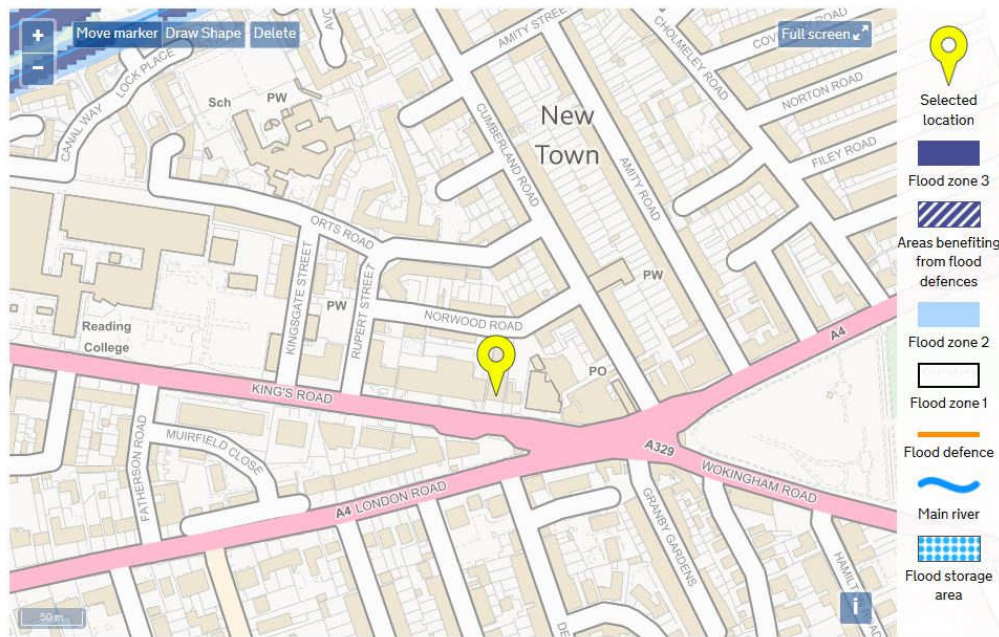


Figure 5. Environment Agency River and Sea flood risk map

- 5.8.3 A review of the GOV.UK low risk surface water flood map in Figure 6 shows there is a low risk probability of surface water flooding which has by definition has between 0.1% and 1% annual probability of occurring. This flooding occurs to the North and South of the existing building which appears to emanate from the heavier surface water flooding in Kings Road and the neighbouring residences to the West. Figure 7 displays the low risk depth of surface water across the site which shows below 300mm to the South of the existing building and over 900mm in some small areas to the North of the building.

Select the type of flood risk information you're interested in. The map will then update.

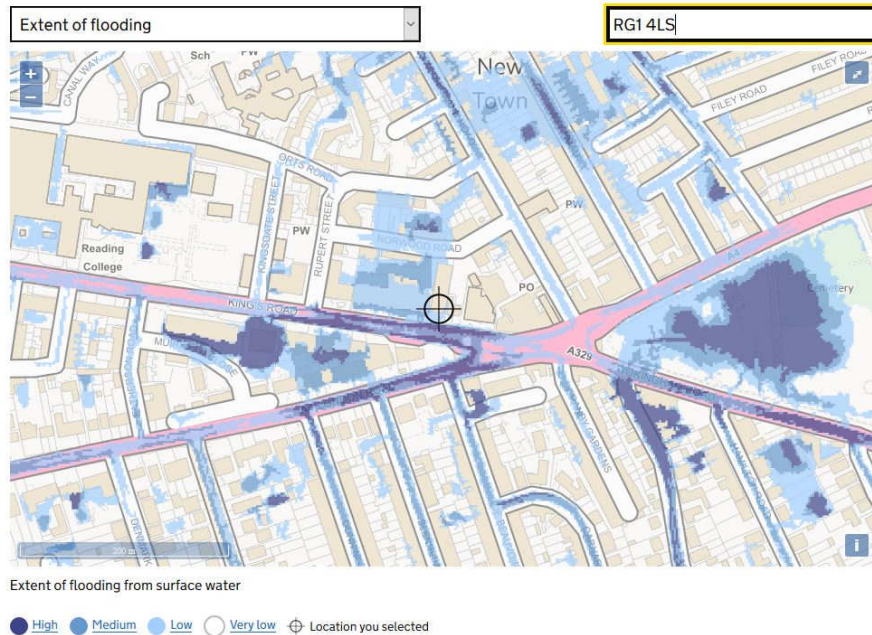


Figure 6. Environment Agency Extent of Surface Water Flooding

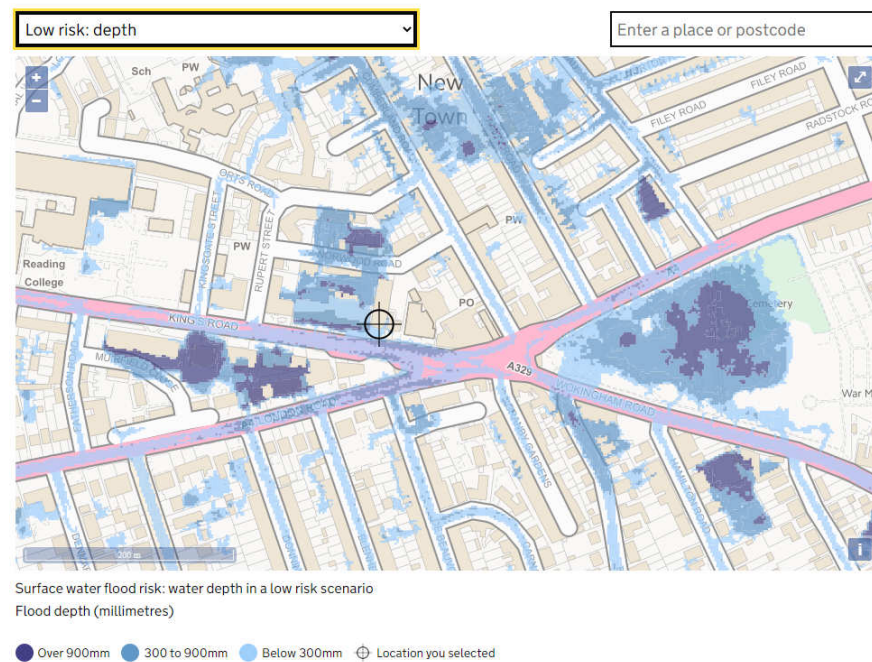


Figure 7. Environment Agency Low Risk Depth of Surface Water Flooding

5.8.4 The Flood Mapping information within this statement 'Contains Public Sector information licensed under the open Government Licence V3.0.'

- 5.8.5 In Accordance with Part H of the Building Regulations the hierarchy for consideration of dealing with surface water run-off is as given in Table 1 below.

| Building Regulations Part H3 (2002):                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>(1) Adequate provision shall be made for rainwater to be carried from the roof of the building.</p> <p>(2) Paved areas around the building shall be so constructed as to be adequately drained.</p> <p>(3) Rainwater from a system provided pursuant to sub-paragraphs (1) or (2) shall discharge to one of the following, listed in order of priority:</p> <p>(a) An adequate soakaway or some other adequate infiltration system; or, where that is not reasonably practicable,</p> <p>(b) A watercourse or, where that is not reasonably practicable,</p> <p>(c) A sewer</p> |

Table 1: Part H3 Hierarchy

## 5.9 Surface Water Design

- 5.9.1 The surface water strategy has been developed using the findings of the British Geological Society (BGS) data from their website together with the information available from Thames Water, Lead Local Flood Authority and Site Investigation by Structural Soils Ltd.
- 5.9.2 Following the above hierarchy, as soakaways are not recommended for this site the next option for a discharge destination is a watercourse. There are no reasonably practical options for consideration and therefore this has been discounted. The final option is for a discharge into a sewer.
- 5.9.3 Consultation with Thames Water through a Pre-Planning Application has identified that a restricted flow rate of 6.8 l/s would be acceptable. This is a 50% betterment of the existing site discharge of 13.6 l/s of which the calculation is within Appendix E.
- 5.9.4 Using the topographical survey by Survey Solutions the current impermeable area is 0.108 Ha which has been used to calculate the Greenfield run-off rate (GRR) for the site.
- 5.9.5 Typically discharge rates from a new development on a greenfield site should be based on an equivalent Greenfield run-off rate (GRR). Determination of the GRR rate is achieved using Microdrainage ICP SuDS method of calculation. The greenfield run-off calculation for this site is as follows:

| Q Bar       | Flow rate l/s |
|-------------|---------------|
| Q Bar Rural | 0.2           |
| Q Bar Urban | 0.6           |
| Q 1 Year    | 0.5           |
| Q 30 Years  | 1.1           |
| Q 100 Years | 1.3           |

Table 2 – Q Bar Flow Rates

- 5.9.6 As the site is brownfield rather than greenfield an enquiry was opened up with Thames Water to determine a required discharge from the site. A formal response has been received from Thames Water in Appendix H confirming a discharge of 6.8l/s into the public surface water sewer.
- 5.9.7 From a review of the available information the swimming pool facility discharges by gravity into public surface water sewer in Norwood Road. There is a possibility some rainwater downpipes at the South side of the existing building discharge into the foul system at the South side of the building however the survey has not confirmed this.
- 5.9.8 A site investigation has been carried out and included a BRE 365 test which confirm that discharge by infiltration to soakaways was not acceptable due to the buildings needing to be a minimum of 20m away from any soakaway. This point is illustrated in Appendix A which shows the site layout. This shows that there will not be sufficient space on site for discharge to soakaway due to a minimum requirement for 5m offset from building to soakaway system in line with building regulation guidance, without even looking at the 20m recommended in the site investigation.
- 5.9.9 Considering the above information, the method of disposal is a restricted discharge into the Public Sewer in Norwood Road, utilising the existing 150mm diameter connection. The surface water network is composed of 100mm, 150mm & 225mm diameter pipework and passes through a 15.0 x 4.0 x 0.4m deep modular crate attenuation tank with a hydro-brake manhole downstream of the tank limiting the discharge to 6.8l/s and allowing the storage to be utilised in the attenuation tank.
- 5.9.10 Tanked permeable paving within the access and parking areas has been put forward for surface water management of these areas. There is 370m<sup>2</sup> of permeable paving proposed in the access and parking areas and 40m<sup>2</sup> of soft landscaping across the entire site which accounts for 38% of the total site area. The use of permeable paving will assist in combating the current low risk surface water flooding shown on the Gov.uk flood maps. How permeable paving assists with water quality will be discussed further in Section 6.0. The permeable paving will be tanked so there will be no additional groundwater discharging into the adjacent public sewers.
- 5.9.11 The surface water system has been designed using Micro-Drainage software and has been tested for the guideline storm events set out by the Local Authority of 1 year, 30-year and 100-year storm events with 0%, 20% and 40% climate change respectively.
- 5.9.12 A summary of how the surface water storage system is utilised for the critical storm events is in Table 3 below.

| Storm Return Period | Storage Volume m <sup>3</sup> within Tank | Worst Seasonal Storm Duration for Storage |
|---------------------|-------------------------------------------|-------------------------------------------|
| 1 in 1yr            | 3.12                                      | 30 Winter                                 |
| 1 in 30yr + (20%)   | 12.36                                     | 30 Winter                                 |
| 1 in 100yr + (40%)  | 23.46                                     | 60 Winter                                 |

**Table 3. Attenuation Tank Storage Volume used & Critical Storm Event**

- 5.9.13 In the event of an exceedance event or drainage failure the surface water will emerge out of the last manhole formed on the existing surface water pipeline and run onto Norwood Road however the drainage strategy provides sufficient storage for all critical storm events.
- 5.9.14 A list of the SuDS components considered in the drainage strategy proposed have been compiled in Table 4 below.

| SUDS                            | Viability | Rationale                                                                                                     |
|---------------------------------|-----------|---------------------------------------------------------------------------------------------------------------|
| Living Roofs                    | No        | Living roofs are not being considered for roof areas.                                                         |
| Ponds/Wetlands/Detention Basins | No        | Detention basins are not being used due to tight site constraints.                                            |
| Swales/Filter Drains            | Yes       | Swale not included due to site constraints.                                                                   |
| Soakaways                       | No        | Site investigation recommends soakaways to be 20m away from the building which is not feasible for this site. |
| Porous Paving (Infiltration)    | No        | Infiltration rates are not suitable.                                                                          |
| Porous Paving (Attenuation)     | Yes       | Used to aid water quality and for additional storage.                                                         |
| Attenuation/ Source Control     | Yes       | Attenuation Tank specified to provide below ground storage up to the 1 in 100 year + 40% climate change.      |

Table 4. SuDS Component Viability and Rationale

- 5.9.15 The strategy design shown to date is sufficient to show and prove a workable solution, based on the sites individual site constraints, can be implemented to provide a full working solution.
- 5.9.16 The drainage strategy proposed is shown on drawing 114038-CAL-XX-XX-DR-D-0100 in Appendix D and the Micro-Drainage surface water calculations in Appendix F.

## 6 Water Quality

- 6.1.1 Adequate treatment must be delivered to the water run-off to remove pollutants through SuDS devices, which are able to provide pollution mitigation. Pollution Hazards and the SuDS Mitigation have been indexed in the specialised literature CIRIA 753 'The SuDS Manual'. This is determined by the following restriction:

$$\text{Total SuDS Mitigation Index} \geq \text{Pollution Hazard Index}$$

- 6.1.2 The Pollution hazard Indices are summarised in Table 5 – Summary of Pollution Hazard Indices for different land Use Below:

| POLLUTION HAZARD INDICES FOR DIFFERENT LAND USE CLASSIFICATIONS                                                                                                              |                        |                              |        |              |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------|------------------------------|--------|--------------|
| Land Use                                                                                                                                                                     | Pollution Hazard Level | Total Suspended Solids (TSS) | Metals | Hydrocarbons |
| Residential Roofs                                                                                                                                                            | Very Low               | 0.2                          | 0.2    | 0.05         |
| Individual property driveways, residential car parks, low traffic roads                                                                                                      | Low                    | 0.5                          | 0.4    | 0.4          |
| Commercial yard and delivery areas, non-residential car parking with frequent change (e.g. hospitals, retail), all roads except low traffic roads and trunk roads/motorways. | Medium                 | 0.7                          | 0.6    | 0.7          |

Table 5 – Summary of Pollution Hazard Indices for different Land Use

- 6.1.3 The Mitigation Indices direct from the CIRIA C753 SuDS Manual Version 6 of the proposed SuDS techniques are summarised in Table 6 – Indicative SuDS Mitigation Indices below.

| INDICATIVE SuDS MITIGATION INDICES FOR DISCHARGES TO SURFACE WATER |                              |        |              |
|--------------------------------------------------------------------|------------------------------|--------|--------------|
| SuDS Component                                                     | Total Suspended Solids (TSS) | Metals | Hydrocarbons |
| Permeable Pavement                                                 | 0.7                          | 0.6    | 0.7          |
| Cellular System                                                    | -                            | -      | -            |

Table 6 – Indicative SuDS Mitigation Indices

6.1.4 Where there is more than one mitigation indices, the total SuDS mitigation in calculations is as follows:

$$\text{Total SuDS Mitigation Index} = \text{Mitigation Index (1)} + 0.5 \text{ Mitigation Index (2)}$$

6.1.5 In the case of the permeable paving within the hardstanding areas, the upper layers of the construction are proven to intercept and break down any possible contaminants from oil and fuel spillages through microbial action.

6.1.6 In addition to the above, catchpit chambers have been specified upstream of the attenuation features which will intercept debris and small oil spillages/leaks.

6.1.7 Using the above SuDS features will ensure sufficient protection to the Water Environment by reducing the amount of pollution in run off as a whole in line with the Water Framework Directive.

6.1.8 The total SuDS mitigation index for the permeable pavement provides sufficient pollution mitigation indices to combat the pollution present for this low risk site.

## 7 Conclusion

- 7.1.1 An outline strategy for foul and surface water drainage systems for the Arthur Hill Swimming Pool re-development is indicated on the schematic drainage layout drawing 114038-CAL-XX-XX-DR-D-0100 in Appendix D.
- 7.1.2 On-site investigations have been undertaken by way of lifting inspection covers, rodding and which confirms routing of the existing drainage network. The foul drainage system currently discharges by gravity into the Public foul sewer in Kings Road and the surface water by gravity into the public surface water sewer in Norwood Road. Public sewer locations, sizes and depths have been confirmed by the Thames Water asset plan in Appendix B and used to produce the outline drainage strategy in Appendix D.
- 7.1.3 The site within Flood Zone 1 as confirmed by the GOV.UK flood mapping website which by definition has less than 1 in 1000 annual probability of river or sea flooding. Inspection of the GOV.UK surface water flooding map has confirmed low risk surface water flooding within the site extents that has low risk depths of less than 300mm South of the existing building and over 900mm in small areas to the North of the building. To counteract this surface water flooding, permeable paving should aid in a solution that aims to reduce this surface water flooding, currently there is no use of permeable surfacing used across the existing site.
- 7.1.4 An assessment on Water Quality has been made in Section 6.0 which concludes there is sufficient SuDS features within the proposed scheme to minimise pollutants within the surface water system.
- 7.1.5 Geotechnical Investigations carried out by Structural Soils Ltd has deemed soakaways as inappropriate for this site however permeable paving is thought to be appropriate as this will assist with water quality purposes.
- 7.1.6 The surface water drainage scheme includes proposals to limit surface water run-off from the development to 6.8l/s for the critical storm events of 1 in 1 year, 1 in 30 year and 1 in 100 year with 0%, 20% and 40% climate change respectively. This discharge rate has been confirmed with Thames Water which would achieve a 50% betterment on the existing discharge from the site. A combination of permeable paving and soft landscaping accounting for 38% of the total site area will provide effective water management and improve water quality across the site.
- 7.1.7 A proposed foul discharge calculation of 4.06l/s has been confirmed as appropriate by Thames Water. Block A and B are intended to discharge by gravity into the public sewer in Norwood Road by forming a new manhole connection in Norwood Road subject to the Section 106 agreement with Thames Water. Block C and D are to discharge again by gravity into the public sewer in Kings Road, utilising the existing 150mm diameter on site connection.
- 7.1.8 The proposed drainage strategy detailed within this statement for foul and surface water disposal is sufficiently detailed and demonstrates a workable solution is achievable whilst ensuring alignment with Thames Water and Reading Borough Council is achieved and provides betterment to the existing site drainage by ensuring separation of foul and surface water systems and reducing the surface water discharge into the public sewer system. On that basis the drainage provision on site will be adequate without increasing the flood risk to properties off site.

A Architect Plan



**NOTES**

This drawing to be read in accordance with the specification/Bill of Materials and related drawings.

No Dimensions to be scaled from this drawing. All stated dimensions to be verified on site and the Architect notified of any discrepancies.

Scale: 1:100 or as indicated



**LEGEND**

- BOUNDARY BASED ON EXISTING SURVEY, TITLE PLAN, SUBJECT TO LEGAL AGREEMENT AND CONFIRMATION BY ALL PARTIES.
- TOPO SURVEY SHOWS NO EXISTING TREE TO BE REMOVED.
- HIGHWAYS ARRANGEMENT IS SHOWN FOR INDICATIVE PURPOSES ONLY. REFER TO HIGHWAY ENGINEERS DRAWINGS FOR DETAILED PROPOSALS.
- PROPOSED WORKS SUBJECT TO AGREEMENT WITH LOCAL HIGHWAYS AUTHORITY.

**KEY:**

- APPLICATION BOUNDARY
- ▲ BUILDING ACCESS

|      |                  |            |          |
|------|------------------|------------|----------|
| Rev. | Description      | Date       | Initials |
| 1    | Issue for Tender | 18/08/2021 | AM/DR    |

**TENDER ISSUE**

**Saunders**  
Architecture + Urban Design

|                                            |              |            |       |
|--------------------------------------------|--------------|------------|-------|
| Description: Arthur Hill Road Regeneration |              |            |       |
| Client                                     | SA           | 18/08/2021 | AM/DR |
| Project Name                               | GA Site Plan | 18/08/2021 | AM/DR |
| Scale                                      | 1:100        | 18/08/2021 | AM/DR |
| Drawing No                                 | 8129 / 1200  | 18/08/2021 | AM/DR |

B Thames Water Public Sewer Record Plan

The map displays a residential area in London with a proposed bus route highlighted by a red dashed line with arrows. The route starts at the top left, passes through Haven Court, and continues along NORWOOD ROAD, KING'S ROAD, and LONDON ROAD, ending near GRANBY COURT. Key landmarks include St Stephens Court, Wycliffe Baptist Church, The Warehouse, Baths, Club, Upin Arms (PH), PCs, and Crown Colonnade. Various bus stop zones are marked with numbers, and distances are indicated along the route, such as 44.2m, 43.6m, and 43.8m. The map also shows other streets like Crossway Point, Shelter, and Granby Court.

The width of the displayed area is 200 m and the centre of the map is located at OS coordinates 473033,173222

The position of the apparatus shown on this plan is given without obligation and warranty, and the accuracy cannot be guaranteed. Service pipes are not shown but their presence should be anticipated. No liability of any kind whatsoever is accepted by Thames Water for any error or omission. The actual position of mains and services must be verified and established on site before any works are undertaken.

Based on the Ordnance Survey Map with the Sanction of the controller of H.M. Stationery Office, License no. 100019345 Crown Copyright Reserved.

NB. Levels quoted in metres Ordnance Newlyn Datum. The value -9999.00 indicates that no survey information is available

| Manhole Reference                                                                                                                                                                                                                                                                                                                                                                                                      | Manhole Cover Level | Manhole Invert Level |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|----------------------|
| 0201                                                                                                                                                                                                                                                                                                                                                                                                                   | 42.49               | 40.42                |
| 031D                                                                                                                                                                                                                                                                                                                                                                                                                   | n/a                 | n/a                  |
| 021C                                                                                                                                                                                                                                                                                                                                                                                                                   | n/a                 | n/a                  |
| 0203                                                                                                                                                                                                                                                                                                                                                                                                                   | n/a                 | n/a                  |
| 021B                                                                                                                                                                                                                                                                                                                                                                                                                   | n/a                 | n/a                  |
| 0164                                                                                                                                                                                                                                                                                                                                                                                                                   | 43.75               | 41.54                |
| 021A                                                                                                                                                                                                                                                                                                                                                                                                                   | n/a                 | n/a                  |
| 0108                                                                                                                                                                                                                                                                                                                                                                                                                   | 43.79               | n/a                  |
| 1155                                                                                                                                                                                                                                                                                                                                                                                                                   | 43.85               | 41.62                |
| 1301                                                                                                                                                                                                                                                                                                                                                                                                                   | 42.12               | 38.71                |
| 11TX                                                                                                                                                                                                                                                                                                                                                                                                                   | n/a                 | n/a                  |
| 111D                                                                                                                                                                                                                                                                                                                                                                                                                   | n/a                 | n/a                  |
| 0150                                                                                                                                                                                                                                                                                                                                                                                                                   | 44.02               | 42.24                |
| 011B                                                                                                                                                                                                                                                                                                                                                                                                                   | n/a                 | n/a                  |
| 111E                                                                                                                                                                                                                                                                                                                                                                                                                   | n/a                 | n/a                  |
| 111C                                                                                                                                                                                                                                                                                                                                                                                                                   | n/a                 | n/a                  |
| 111G                                                                                                                                                                                                                                                                                                                                                                                                                   | n/a                 | n/a                  |
| 111F                                                                                                                                                                                                                                                                                                                                                                                                                   | n/a                 | n/a                  |
| 9255                                                                                                                                                                                                                                                                                                                                                                                                                   | 43.46               | 41.09                |
| 911D                                                                                                                                                                                                                                                                                                                                                                                                                   | n/a                 | n/a                  |
| 911C                                                                                                                                                                                                                                                                                                                                                                                                                   | n/a                 | n/a                  |
| 911E                                                                                                                                                                                                                                                                                                                                                                                                                   | n/a                 | n/a                  |
| 9202                                                                                                                                                                                                                                                                                                                                                                                                                   | 43.56               | 40.2                 |
| 011A                                                                                                                                                                                                                                                                                                                                                                                                                   | n/a                 | n/a                  |
| 0162                                                                                                                                                                                                                                                                                                                                                                                                                   | 43.56               | 41.1                 |
| 0163                                                                                                                                                                                                                                                                                                                                                                                                                   | 43.59               | 41.21                |
| 0161                                                                                                                                                                                                                                                                                                                                                                                                                   | 43.85               | 41.4                 |
| 0160                                                                                                                                                                                                                                                                                                                                                                                                                   | 43.74               | 41.89                |
| 0159                                                                                                                                                                                                                                                                                                                                                                                                                   | 43.87               | 41.93                |
| 0109                                                                                                                                                                                                                                                                                                                                                                                                                   | 43.84               | 40.71                |
| 0250                                                                                                                                                                                                                                                                                                                                                                                                                   | 42.46               | 40.95                |
| 031E                                                                                                                                                                                                                                                                                                                                                                                                                   | n/a                 | n/a                  |
| 0202                                                                                                                                                                                                                                                                                                                                                                                                                   | 42.48               | 40.12                |
| 9152                                                                                                                                                                                                                                                                                                                                                                                                                   | 44.04               | 42.24                |
| 9153                                                                                                                                                                                                                                                                                                                                                                                                                   | 44.07               | 41.77                |
| 9102                                                                                                                                                                                                                                                                                                                                                                                                                   | 44.05               | 40.33                |
| The position of the apparatus shown on this plan is given without obligation and warranty, and the accuracy cannot be guaranteed. Service pipes are not shown but their presence should be anticipated. No liability of any kind whatsoever is accepted by Thames Water for any error or omission. The actual position of mains and services must be verified and established on site before any works are undertaken. |                     |                      |

C Topographical Survey

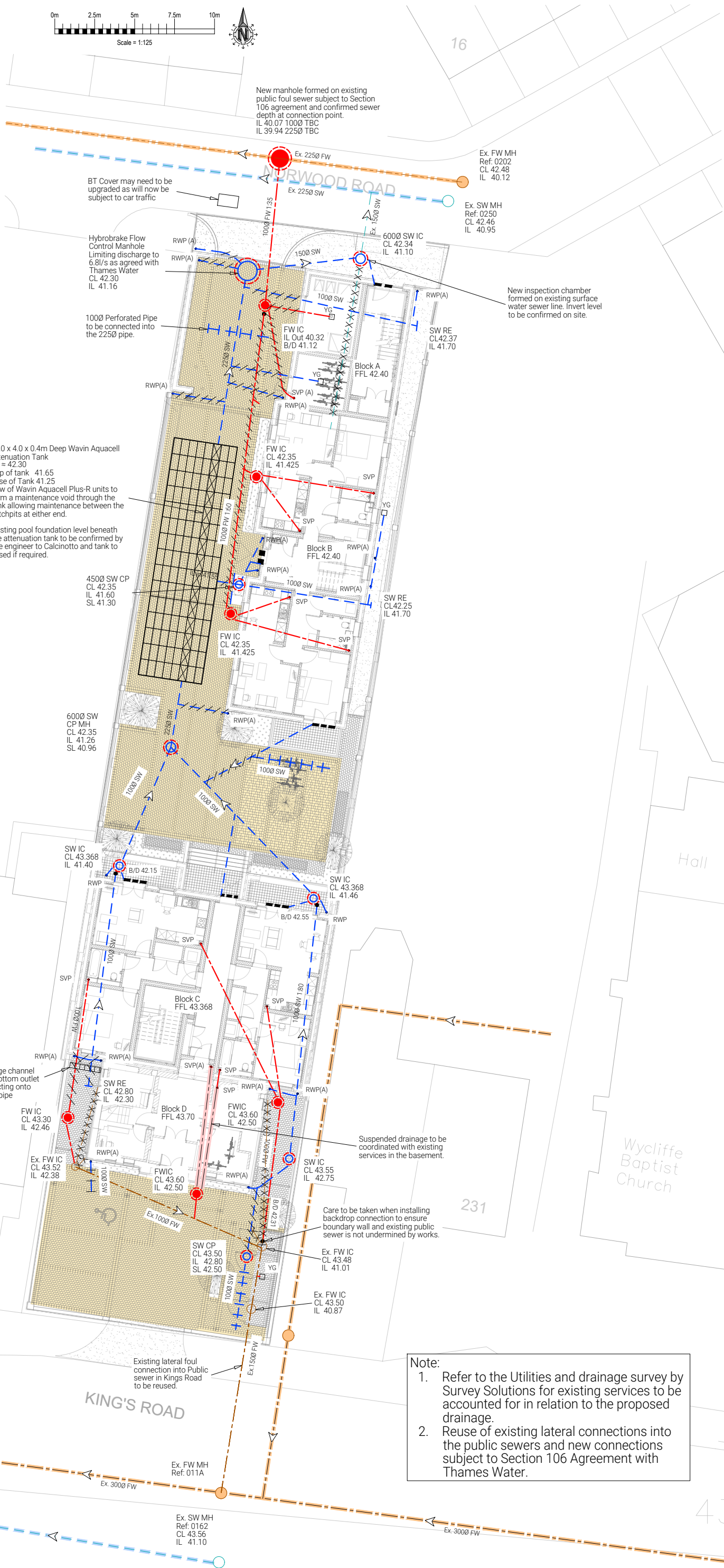
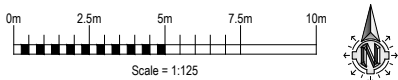


D     Drainage Layout

Drainage Legend

- Existing Private SW Sewer (& Manhole)
- Existing Private FW Sewer (& Manhole)
- Existing Public SW Sewer (& Manhole)
- Existing Public FW Sewer (& Manhole)
- Proposed SW Sewer (& Manhole/Catchpit)
- Proposed FW Sewer (& Manhole)
- RWP Rainwater Collection Pipe
- RWP(A) Rainwater collection Pipe (with Access)
- RE Rodding Eye (Refer to plan for invert level)
- Proposed Suspended FW Drain
- Drainage Channel
- Threshold Drainage Channel (to Architects Spec)
- SVP Soil & Vent Pipe
- YG Yard Gully (To Architects Specification)
- Perforated Distributor Pipe
- Locally lowered Perforated Collection Pipe
- Pipeline to be Removed / Abandoned
- Tanked Permeable Paving
- Attenuation Tank

Refer to architects / M&E drawings for exact positions of internal connections and RWP's.



Notes:

- This drawing is to be read in conjunction with all of the relevant architects, engineers and specialist sub-contractor drawings and specifications.
- Any discrepancies between the engineers and the architects drawings to be referred to the architect before proceeding. Drawings must not be scaled.
- All private drainage is to be in accordance with BS EN 752-1-2-3-4, BS EN 1295-1, BS EN 1610 and all relevant sections of approved document H of the building regulations (2015 Edition).
- All adoptable drainage is to be in accordance with 'Sewers for Adoption 7th Edition', where appropriate.
- All materials for adoptable drainage are to be Kitemarked as appropriate.
- All adoptable manhole covers and frames are to be 150mm deep minimum and the covers badged as appropriate i.e. FW or SW.
- For adoptable drainage, a reinforced concrete cover slab is to be provided where the effective cover to the crown of the adopted pipe(s) is less than 0.9m in verges or 1.2m in carriageways and / or footpaths. Where effective cover is 1.0m or less in carriageways and / or footpaths, pipework will need to be ductile iron (ie. Stanton Pam St. Gobain type 'Integral'). (Applies during and after construction).
- All adopted foul drainage to be laid with a minimum of 1.2m cover depth to soffit. Unless specifically identified otherwise with relevant protective measures.
- Pipework Type - Flexibly jointed extra strength vitrified clay, to BS EN 295-1, Hepworth 'Supersieve' or equivalent.
- Pipework Type - Plastic i.e. PVC-U, to BS EN 1401-1 Osma or equivalent. (Private pipework to be type SN4 and all adoptable pipework to be type SN8.)
- Pipework Type - Cast iron, to BS EN 877 - Ductile iron to BS EN 598.
- Pipework Type - Concrete, to BS EN 1916 and BS 5911-1.
- Precast concrete manholes and fittings shall be to BS 5911 parts 3 and 4 and BS EN 1917.
- Whenever pipework passes through foundations, walls or connects to manholes, flexible pipe joints are to be provided within 150mm of the face of the structure. 600mm pipe length to then be used to form a rocker pipe.
- Whenever pipework passes through screen walls, footings or retaining walls, lintels are to be provided.
- Where pipelines pass within 1.0m of buildings or walls the foundations are to be taken down below the bottom of the trench. Where pipelines are more than 1.0m away from foundations the trench shall be backfilled with concrete up to a point that meets a 45° angle line taken from the bottom corner of the nearest foundation.
- The contractors attention is drawn to the need to ensure that any trenches excavated through previously compacted or filled areas, in particular under the building footprint and immediately around the outside, are re-compacted to ensure that localised differential settlement does not occur.
- Where pipelines cross with less than 300mm of clearance, each is to be surrounded with grade ST4 mass concrete for a distance not less than 1.0m centered on the crossing point. The length of surround should be extended as necessary to within 150mm of the next nearest flexible joints.
- For private drainage, concrete protection is to be provided where the effective cover to the crown of the pipe(s) is less than 1.2m in trafficked areas and 0.6m in soft landscaped or pedestrianised areas. (Applies during and after construction).
- The contractor is to ensure that suitable protective measures are taken to ensure that the drainage pipework and fittings are not damaged by site traffic prior to any over-site filling operations being completed.
- Chamber annotation references are as follows:  
AC - Denotes a polypropylene or vitrified clay access chamber, depth not exceeding 600mm, diameter not exceeding 300mm.  
IC - Denotes a polypropylene inspection chamber, depth not exceeding 3.0m, diameter not exceeding 600mm. Standard diameter 450mm unless specified otherwise.  
MH - Denotes a manholes constructed from either brick, polypropylene or P.C.C. sections. Chamber depth to be in excess of 1.2m.  
B/D - Denotes a backdrop connection.  
CP - Denotes a catchpit chamber.
- The top run of each private foul drainage network is to be laid to falls no slacker than 1:40. The head of each run is to be vented to atmosphere in accordance with approved document H.
- All foul and surface water drainage pipelines are to be 100mm dia min and laid at a gradient no slacker than 1:80, unless stated otherwise.
- The contractor is to ensure that all pipework connections are arranged to direct flows down or into the main channel in the direction of the main flow. Any oblique or perpendicular chamber connections are to be directed into the mainline channel via appropriate benching. All chambers must include a connection via the main channel to ensure that a flush through is achieved.
- The contractor is to ensure that when preformed polypropylene manhole bases are used, they are orientated such that the main flow is directed through the main channel of the base. This should be achieved by using long radius bends outside of the manhole when necessary.
- Where new connections are to be made into existing manholes or sewers, all invert levels, pipe orientation and sizes should be checked on-site prior to the commencement of the works, with any variance reported to the engineer once identified. Where new connections are to be made either on or off-site, the contractor is to check the line and level of any existing services / mains, to ensure that no clashes exist prior to the works commencing.
- Any and all new connections into a public sewer are to be inspected by the local water authority and carried out fully in accordance with their requirements. The contractor is to allow for obtaining the appropriate 'Section Agreements' as well as paying all necessary fees.
- The contractor is to allow for obtaining the appropriate road opening licence/s from the local highway authority and paying all necessary fees. All reinstatement works within the public highway are to be carried out in accordance with the requirements of the local highway authority.
- Drainage channel(s) to be ACO or equivalent. For installation guidance refer to the manufacturer's specification. Refer to landscape architects details for surface treatments around units where applicable. All drainage channels are to be constructed with in-built falls where possible. Relevant units are to be incorporated to provide the necessary length of channel gradient from the head of the run to the sump unit.
- Permeable paving surface finish to the architects spec. Any alteration to the extents of the permeable paving may have an adverse affect upon the Surface water drainage design and must therefore be discussed with the engineer.
- Modular crate attenuation tank system(s) to be Wavin Aquacell Core-R & PPlus-R units or Polytype Polystorm. Any other system offered will need to be provided with a separate warranty for design and installation.

|      |          |                                                                                                  |
|------|----------|--------------------------------------------------------------------------------------------------|
| T3   | 07.07.21 | Updated to Reading Borough Council comments.                                                     |
| T2   | 23.02.21 | Updated pipe size to Thames Water comment                                                        |
| T1   | 05.02.21 | Tender                                                                                           |
| P5   | 16.12.20 | New site plan & Updated to Architects & Reading Council comments                                 |
| P4   | 11.12.20 | New site plan                                                                                    |
| P3   | 28.09.20 | Additional public sewer info, build near to a public sewer agreement text added & scale adjusted |
| P2   | 10.07.20 | Updated Architects Plan                                                                          |
| P1   | 09.07.20 | Planning                                                                                         |
| Rev. | Date     | Description                                                                                      |

Note:

- Refer to the Utilities and drainage survey by Survey Solutions for existing services to be accounted for in relation to the proposed drainage.
- Reuse of existing lateral connections into the public sewers and new connections subject to Section 106 Agreement with Thames Water.



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Client  
Gleeds (Reading Borough Council)  
Project Title  
Arthur Hill Swimming Pool  
Drawing Title  
Drainage Layout

Drawing Status  
For Tender

|                |        |        |           |
|----------------|--------|--------|-----------|
| Originator No. | Rev by | Chk by | Scale     |
| 114038         | JH     | PW     | 1:125 @A1 |

PROJECT | ORIGINATOR | ZONE | LEVEL | TYPE | ROLE | NO.  
114038-CAL-XX-XX-DR-D-0100

Revision  
T3

E Existing Surface Water Calculations

|                                                          |                                                                         |                                                                                    |
|----------------------------------------------------------|-------------------------------------------------------------------------|------------------------------------------------------------------------------------|
| Calcinotto                                               |                                                                         | Page 1                                                                             |
| Jonsen House<br>43 Commercial Road<br>Poole BH14 0HU     | 114038-CAL-XX-XX-CA-D-002<br>Arthur Road Swimming Pool<br>Flow Estimate |  |
| Date 15/06/2020 11:52<br>File 114038 - Flow Estimate.MDX | Designed by GEB<br>Checked by GEB                                       |                                                                                    |
| XP Solutions                                             | Network 2018.1.1                                                        |                                                                                    |

## STORM SEWER DESIGN by the Modified Rational Method

### Design Criteria for Storm

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - England and Wales

|                                      |        |                                       |       |
|--------------------------------------|--------|---------------------------------------|-------|
| Return Period (years)                | 1      | PIMP (%)                              | 100   |
| M5-60 (mm)                           | 18.700 | Add Flow / Climate Change (%)         | 0     |
| Ratio R                              | 0.400  | Minimum Backdrop Height (m)           | 0.200 |
| Maximum Rainfall (mm/hr)             | 50     | Maximum Backdrop Height (m)           | 1.500 |
| Maximum Time of Concentration (mins) | 30     | Min Design Depth for Optimisation (m) | 1.200 |
| Foul Sewage (l/s/ha)                 | 0.000  | Min Vel for Auto Design only (m/s)    | 1.00  |
| Volumetric Runoff Coeff.             | 0.750  | Min Slope for Optimisation (1:X)      | 500   |

Designed with Level Soffits

### Time Area Diagram for Storm

| Time<br>(mins) | Area<br>(ha) | Time<br>(mins) | Area<br>(ha) |
|----------------|--------------|----------------|--------------|
| 0-4            | 0.106        | 4-8            | 0.002        |

Total Area Contributing (ha) = 0.108

Total Pipe Volume (m<sup>3</sup>) = 0.177

|                                                          |                                                                         |                                                                                    |
|----------------------------------------------------------|-------------------------------------------------------------------------|------------------------------------------------------------------------------------|
| Calcinotto                                               |                                                                         | Page 2                                                                             |
| Jonsen House<br>43 Commercial Road<br>Poole BH14 0HU     | 114038-CAL-XX-XX-CA-D-002<br>Arthur Road Swimming Pool<br>Flow Estimate |  |
| Date 15/06/2020 11:52<br>File 114038 - Flow Estimate.MDX | Designed by GEB<br>Checked by GEB                                       |                                                                                    |
| XP Solutions                                             | Network 2018.1.1                                                        |                                                                                    |

PIPELINE SCHEDULES for Storm

Upstream Manhole

| PN     | Hyd<br>Sect | Diam<br>(mm) | MH<br>Name | C.Level<br>(m) | I.Level<br>(m) | D.Depth<br>(m) | MH<br>Connection | MH DIAM., L*W<br>(mm) |
|--------|-------------|--------------|------------|----------------|----------------|----------------|------------------|-----------------------|
| S1.000 | o           | 150          | S-01       | 5.000          | 4.000          | 0.850          | Open Manhole     | 450                   |
| S1.001 | o           | 150          | S-02       | 5.000          | 3.875          | 0.975          | Open Manhole     | 450                   |

Downstream Manhole

| PN     | Length<br>(m) | Slope<br>(1:X) | MH<br>Name | C.Level<br>(m) | I.Level<br>(m) | D.Depth<br>(m) | MH<br>Connection | MH DIAM., L*W<br>(mm) |
|--------|---------------|----------------|------------|----------------|----------------|----------------|------------------|-----------------------|
| S1.000 | 5.000         | 40.0           | S-02       | 5.000          | 3.875          | 0.975          | Open Manhole     | 450                   |
| S1.001 | 5.000         | 40.0           | S          | 5.000          | 3.750          | 1.100          | Open Manhole     | 0                     |

|                                                          |                                                                         |                                                                                    |
|----------------------------------------------------------|-------------------------------------------------------------------------|------------------------------------------------------------------------------------|
| Calcinotto                                               |                                                                         | Page 3                                                                             |
| Jonsen House<br>43 Commercial Road<br>Poole BH14 0HU     | 114038-CAL-XX-XX-CA-D-002<br>Arthur Road Swimming Pool<br>Flow Estimate |  |
| Date 15/06/2020 11:52<br>File 114038 - Flow Estimate.MDX | Designed by GEB<br>Checked by GEB                                       |                                                                                    |
| XP Solutions                                             | Network 2018.1.1                                                        |                                                                                    |

Area Summary for Storm

| Pipe<br>Number | PIMP<br>Type | PIMP<br>Name | PIMP<br>(%) | Gross<br>Area (ha) | Imp.<br>Area (ha) | Pipe Total<br>(ha) |
|----------------|--------------|--------------|-------------|--------------------|-------------------|--------------------|
| 1.000          | -            | -            | 100         | 0.054              | 0.054             | 0.054              |
| 1.001          | -            | -            | 100         | 0.054              | 0.054             | 0.054              |
|                |              |              |             | Total              | Total             | Total              |
|                |              |              |             | 0.108              | 0.108             | 0.108              |

|                                                          |                                                                         |                                                                                    |
|----------------------------------------------------------|-------------------------------------------------------------------------|------------------------------------------------------------------------------------|
| Calcinotto                                               |                                                                         | Page 4                                                                             |
| Jonsen House<br>43 Commercial Road<br>Poole BH14 0HU     | 114038-CAL-XX-XX-CA-D-002<br>Arthur Road Swimming Pool<br>Flow Estimate |  |
| Date 15/06/2020 11:52<br>File 114038 - Flow Estimate.MDX | Designed by GEB<br>Checked by GEB                                       |                                                                                    |
| XP Solutions                                             | Network 2018.1.1                                                        |                                                                                    |

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

Simulation Criteria

Areal Reduction Factor 1.000      Additional Flow - % of Total Flow 0.000  
 Hot Start (mins) 0      MADD Factor \* 10m³/ha Storage 2.000  
 Hot Start Level (mm) 0      Inlet Coeffiecient 0.800  
 Manhole Headloss Coeff (Global) 0.500      Flow per Person per Day (l/per/day) 0.000  
 Foul Sewage per hectare (l/s) 0.000  
  
 Number of Input Hydrographs 0      Number of Offline Controls 0      Number of Time/Area Diagrams 0  
 Number of Online Controls 0      Number of Storage Structures 0      Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model      FSR M5-60 (mm) 18.800      Cv (Summer) 0.750  
 Region England and Wales      Ratio R 0.400      Cv (Winter) 0.840  
  
 Margin for Flood Risk Warning (mm) 300.0      DVD Status OFF  
 Analysis Timestep      Fine Inertia Status OFF  
 DTS Status      ON

Profile(s)      Summer and Winter  
 Duration(s) (mins)      15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320  
 Return Period(s) (years)      1, 10, 30, 100  
 Climate Change (%)      0, 0, 20, 40

| PN     | US/MH Name | Storm     | Return Period | Climate Change | First (X) Surge | First (Y) Flood | First (Z) Overflow | Overflow Act. | Water Level (m) | Surcharged Depth (m) | Flooded Volume (m³) |
|--------|------------|-----------|---------------|----------------|-----------------|-----------------|--------------------|---------------|-----------------|----------------------|---------------------|
| S1.000 | S-01       | 15 Winter | 1             | +0%            | 10/15 Summer    | 100/15 Summer   |                    |               | 4.060           | -0.090               | 0.000               |
| S1.001 | S-02       | 15 Winter | 1             | +0%            | 10/15 Summer    |                 |                    |               | 3.960           | -0.065               | 0.000               |

|        |            | Pipe        |                |                 |                |
|--------|------------|-------------|----------------|-----------------|----------------|
| PN     | US/MH Name | Flow / Cap. | Overflow (l/s) | Pipe Flow (l/s) | Level Exceeded |
| S1.000 | S-01       | 0.34        |                | 7.6             | OK 2           |
| S1.001 | S-02       | 0.61        |                | 13.6            | OK             |

|                                                          |                                                                         |                                                                                    |
|----------------------------------------------------------|-------------------------------------------------------------------------|------------------------------------------------------------------------------------|
| Calcinotto                                               |                                                                         | Page 5                                                                             |
| Jonsen House<br>43 Commercial Road<br>Poole BH14 0HU     | 114038-CAL-XX-XX-CA-D-002<br>Arthur Road Swimming Pool<br>Flow Estimate |  |
| Date 15/06/2020 11:52<br>File 114038 - Flow Estimate.MDX | Designed by GEB<br>Checked by GEB                                       |                                                                                    |
| XP Solutions                                             | Network 2018.1.1                                                        |                                                                                    |

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

Simulation Criteria

Areal Reduction Factor 1.000

Additional Flow - % of Total Flow 0.000

Hot Start (mins) 0

MADD Factor \* 10m³/ha Storage 2.000

Hot Start Level (mm) 0

Inlet Coeffiecient 0.800

Manhole Headloss Coeff (Global) 0.500

Flow per Person per Day (l/per/day) 0.000

Foul Sewage per hectare (l/s) 0.000

Number of Input Hydrographs 0

Number of Offline Controls 0

Number of Time/Area Diagrams 0

Number of Online Controls 0

Number of Storage Structures 0

Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FSR M5-60 (mm) 18.800

Cv (Summer) 0.750

Region England and Wales

Ratio R 0.400

Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0

DVD Status OFF

Analysis Timestep Fine

Inertia Status OFF

DTS Status ON

Profile(s) Summer and Winter

Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320

Return Period(s) (years) 1, 10, 30, 100

Climate Change (%) 0, 0, 20, 40

| PN     | US/MH Name | Storm     | Return Period | Climate Change | First (X) Surge | First (Y) Flood | First (Z) Overflow | Overflow Act. | Water Level (m) | Surcharged Depth (m) | Flooded Volume (m³) |
|--------|------------|-----------|---------------|----------------|-----------------|-----------------|--------------------|---------------|-----------------|----------------------|---------------------|
| S1.000 | S-01       | 15 Winter | 10            | +0%            | 10/15 Summer    | 100/15 Summer   |                    |               | 4.159           | 0.009                | 0.000               |
| S1.001 | S-02       | 15 Winter | 10            | +0%            | 10/15 Summer    |                 |                    |               | 4.106           | 0.081                | 0.000               |

|        |            | Pipe        |                |                 |            |                |  |
|--------|------------|-------------|----------------|-----------------|------------|----------------|--|
| PN     | US/MH Name | Flow / Cap. | Overflow (l/s) | Pipe Flow (l/s) | Status     | Level Exceeded |  |
| S1.000 | S-01       | 0.64        |                | 14.1            | SURCHARGED | 2              |  |
| S1.001 | S-02       | 1.28        |                | 28.2            | SURCHARGED |                |  |

|                                                          |                                                                         |                                                                                    |
|----------------------------------------------------------|-------------------------------------------------------------------------|------------------------------------------------------------------------------------|
| Calcinotto                                               |                                                                         | Page 6                                                                             |
| Jonsen House<br>43 Commercial Road<br>Poole BH14 0HU     | 114038-CAL-XX-XX-CA-D-002<br>Arthur Road Swimming Pool<br>Flow Estimate |  |
| Date 15/06/2020 11:52<br>File 114038 - Flow Estimate.MDX | Designed by GEB<br>Checked by GEB                                       |                                                                                    |
| XP Solutions                                             | Network 2018.1.1                                                        |                                                                                    |

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

Simulation Criteria

Areal Reduction Factor 1.000      Additional Flow - % of Total Flow 0.000  
 Hot Start (mins) 0      MADD Factor \* 10m³/ha Storage 2.000  
 Hot Start Level (mm) 0      Inlet Coeffiecient 0.800  
 Manhole Headloss Coeff (Global) 0.500      Flow per Person per Day (l/per/day) 0.000  
 Foul Sewage per hectare (l/s) 0.000

Number of Input Hydrographs 0      Number of Offline Controls 0      Number of Time/Area Diagrams 0  
 Number of Online Controls 0      Number of Storage Structures 0      Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model      FSR M5-60 (mm) 18.800 Cv (Summer) 0.750  
 Region England and Wales      Ratio R 0.400 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0      DVD Status OFF  
 Analysis Timestep Fine Inertia Status OFF  
 DTS Status ON

Profile(s)      Summer and Winter  
 Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320  
 Return Period(s) (years) 1, 10, 30, 100  
 Climate Change (%) 0, 0, 20, 40

| PN     | US/MH Name | Storm     | Return Period | Climate Change | First (X) Surge | First (Y) Flood | First (Z) Overflow | Overflow Act. | Water Level (m) | Surcharged Depth (m) | Flooded Volume (m³) |
|--------|------------|-----------|---------------|----------------|-----------------|-----------------|--------------------|---------------|-----------------|----------------------|---------------------|
| S1.000 | S-01       | 15 Winter | 30            | +20%           | 10/15 Summer    | 100/15 Summer   |                    |               | 4.477           | 0.327                | 0.000               |
| S1.001 | S-02       | 15 Winter | 30            | +20%           | 10/15 Summer    |                 |                    |               | 4.361           | 0.336                | 0.000               |

|        |            | Pipe        |                |                 |            |                |  |
|--------|------------|-------------|----------------|-----------------|------------|----------------|--|
| PN     | US/MH Name | Flow / Cap. | Overflow (l/s) | Pipe Flow (l/s) | Status     | Level Exceeded |  |
| S1.000 | S-01       | 0.95        |                | 21.0            | SURCHARGED | 2              |  |
| S1.001 | S-02       | 1.88        |                | 41.7            | SURCHARGED |                |  |

|                                                          |                                                                         |                                                                                    |
|----------------------------------------------------------|-------------------------------------------------------------------------|------------------------------------------------------------------------------------|
| Calcinotto                                               |                                                                         | Page 7                                                                             |
| Jonsen House<br>43 Commercial Road<br>Poole BH14 0HU     | 114038-CAL-XX-XX-CA-D-002<br>Arthur Road Swimming Pool<br>Flow Estimate |  |
| Date 15/06/2020 11:52<br>File 114038 - Flow Estimate.MDX | Designed by GEB<br>Checked by GEB                                       |                                                                                    |
| XP Solutions                                             | Network 2018.1.1                                                        |                                                                                    |

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

Simulation Criteria

Areal Reduction Factor 1.000
Additional Flow - % of Total Flow 0.000

Hot Start (mins) 0
MADD Factor \* 10m³/ha Storage 2.000

Hot Start Level (mm) 0
Inlet Coeffiecient 0.800

Manhole Headloss Coeff (Global) 0.500
Flow per Person per Day (l/per/day) 0.000

Foul Sewage per hectare (l/s) 0.000

Number of Input Hydrographs 0
Number of Offline Controls 0
Number of Time/Area Diagrams 0

Number of Online Controls 0
Number of Storage Structures 0
Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FSR M5-60 (mm) 18.800
Cv (Summer) 0.750

Region England and Wales
Ratio R 0.400
Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0
DVD Status OFF

Analysis Timestep Fine
Inertia Status OFF

DTS Status ON

Profile(s) Summer and Winter

Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320

Return Period(s) (years) 1, 10, 30, 100

Climate Change (%) 0, 0, 20, 40

| PN     | US/MH Name | Storm     | Return Period | Climate Change | First (X) Surge | First (Y) Flood | First (Z) Overflow | Overflow Act. | Water Level (m) | Surcharged Depth (m) | Flooded Volume (m³) |
|--------|------------|-----------|---------------|----------------|-----------------|-----------------|--------------------|---------------|-----------------|----------------------|---------------------|
| S1.000 | S-01       | 15 Winter | 100           | +40%           | 10/15 Summer    | 100/15 Summer   |                    |               | 5.000           | 0.850                | 0.307               |
| S1.001 | S-02       | 15 Summer | 100           | +40%           | 10/15 Summer    |                 |                    |               | 4.827           | 0.802                | 0.000               |

|        |            | Pipe        |                |                 |            |                |  |
|--------|------------|-------------|----------------|-----------------|------------|----------------|--|
| PN     | US/MH Name | Flow / Cap. | Overflow (l/s) | Pipe Flow (l/s) | Status     | Level Exceeded |  |
| S1.000 | S-01       | 1.41        |                | 31.1            | FLOOD      | 2              |  |
| S1.001 | S-02       | 2.66        |                | 59.0            | FLOOD RISK |                |  |

F Proposed Surface Water Calculations

|                                                      |                                                                                         |                                                                                    |
|------------------------------------------------------|-----------------------------------------------------------------------------------------|------------------------------------------------------------------------------------|
| Calcinotto                                           |                                                                                         | Page 1                                                                             |
| Jonsen House<br>43 Commercial Road<br>Poole BH14 0HU | 114038-CA-XX-XX-CA-D-005<br>Arthur Hill Swimming Pool<br>SW Network - 1:100+40% 6.8 l/s |  |
| Date 02/12/2020 11:28                                | Designed by JH                                                                          |                                                                                    |
| File 114038 - SW Network - 20-12-01.MDX              | Checked by GEB                                                                          |                                                                                    |
| XP Solutions                                         | Network 2018.1.1                                                                        |                                                                                    |

## STORM SEWER DESIGN by the Modified Rational Method

### Design Criteria for Storm

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - England and Wales

|                                      |        |                                       |       |
|--------------------------------------|--------|---------------------------------------|-------|
| Return Period (years)                | 1      | PIMP (%)                              | 100   |
| M5-60 (mm)                           | 18.900 | Add Flow / Climate Change (%)         | 0     |
| Ratio R                              | 0.400  | Minimum Backdrop Height (m)           | 0.200 |
| Maximum Rainfall (mm/hr)             | 50     | Maximum Backdrop Height (m)           | 1.500 |
| Maximum Time of Concentration (mins) | 30     | Min Design Depth for Optimisation (m) | 1.200 |
| Foul Sewage (l/s/ha)                 | 0.000  | Min Vel for Auto Design only (m/s)    | 1.00  |
| Volumetric Runoff Coeff.             | 0.750  | Min Slope for Optimisation (1:X)      | 500   |

Designed with Level Soffits

### Time Area Diagram for Storm

| Time<br>(mins) | Area<br>(ha) | Time<br>(mins) | Area<br>(ha) |
|----------------|--------------|----------------|--------------|
| 0-4            | 0.070        | 4-8            | 0.025        |

Total Area Contributing (ha) = 0.095

Total Pipe Volume (m³) = 2.092

### Network Design Table for Storm

« - Indicates pipe capacity < flow

| PN     | Length<br>(m) | Fall<br>(m) | Slope<br>(1:X) | I.Area<br>(ha) | T.E.<br>(mins) | Base<br>Flow (l/s) | k<br>(mm) | HYD<br>SECT | DIA<br>(mm) | Section Type | Auto<br>Design                                                                        |
|--------|---------------|-------------|----------------|----------------|----------------|--------------------|-----------|-------------|-------------|--------------|---------------------------------------------------------------------------------------|
| S1.000 | 7.728         | 0.000       | 0.0            | 0.016          | 4.00           | 0.0                | 0.600     | o           | 100         | Pipe/Conduit |  |
| S1.001 | 15.428        | 0.250       | 61.7           | 0.000          | 0.00           | 0.0                | 0.600     | o           | 100         | Pipe/Conduit |  |
| S1.002 | 12.987        | 0.165       | 78.7           | 0.013          | 0.00           | 0.0                | 0.600     | o           | 100         | Pipe/Conduit |  |
| S2.000 | 15.617        | 0.280       | 55.8           | 0.007          | 4.00           | 0.0                | 0.600     | o           | 100         | Pipe/Conduit |  |
| S2.001 | 8.985         | 0.115       | 78.1           | 0.007          | 0.00           | 0.0                | 0.600     | o           | 100         | Pipe/Conduit |  |
| S1.003 | 12.795        | 0.050       | 255.9          | 0.020          | 0.00           | 0.0                | 0.600     | o           | 225         | Pipe/Conduit |  |
| S1.004 | 18.253        | 0.050       | 365.1          | 0.000          | 0.00           | 0.0                | 0.600     | o           | 225         | Pipe/Conduit |  |
| S1.005 | 6.391         | 0.060       | 106.5          | 0.005          | 0.00           | 0.0                | 0.600     | o           | 225         | Pipe/Conduit |  |

### Network Results Table

| PN     | Rain<br>(mm/hr) | T.C.<br>(mins) | US/IL<br>(m) | Σ I.Area<br>(ha) | Σ Base<br>Flow (l/s) | Foul<br>(l/s) | Add Flow<br>(l/s) | Vel<br>(m/s) | Cap<br>(l/s) | Flow<br>(l/s) |
|--------|-----------------|----------------|--------------|------------------|----------------------|---------------|-------------------|--------------|--------------|---------------|
| S1.000 | 48.22           | 5.85           | 42.600       | 0.016            | 0.0                  | 0.0           | 0.0               | 0.07         | 0.5<         | 2.1           |
| S1.001 | 47.24           | 6.12           | 42.600       | 0.016            | 0.0                  | 0.0           | 0.0               | 0.98         | 7.7          | 2.1           |
| S1.002 | 46.35           | 6.36           | 41.550       | 0.029            | 0.0                  | 0.0           | 0.0               | 0.87         | 6.8          | 3.6           |
| S2.000 | 50.00           | 4.25           | 42.600       | 0.007            | 0.0                  | 0.0           | 0.0               | 1.03         | 8.1          | 0.9           |
| S2.001 | 50.00           | 4.42           | 41.500       | 0.014            | 0.0                  | 0.0           | 0.0               | 0.87         | 6.8          | 1.9           |
| S1.003 | 45.45           | 6.63           | 41.260       | 0.063            | 0.0                  | 0.0           | 0.0               | 0.81         | 32.3         | 7.8           |
| S1.004 | 44.00           | 7.08           | 41.210       | 0.063            | 0.0                  | 0.0           | 0.0               | 0.68         | 27.0         | 7.8           |
| S1.005 | 43.74           | 7.16           | 41.160       | 0.068            | 0.0                  | 0.0           | 0.0               | 1.27         | 50.4         | 8.1           |

|                                                                  |                                                                                         |                                                                                    |
|------------------------------------------------------------------|-----------------------------------------------------------------------------------------|------------------------------------------------------------------------------------|
| Calcinotto                                                       |                                                                                         | Page 2                                                                             |
| Jonsen House<br>43 Commercial Road<br>Poole BH14 0HU             | 114038-CA-XX-XX-CA-D-005<br>Arthur Hill Swimming Pool<br>SW Network - 1:100+40% 6.8 l/s |  |
| Date 02/12/2020 11:28<br>File 114038 - SW Network - 20-12-01.MDX | Designed by JH<br>Checked by GEB                                                        |                                                                                    |
| XP Solutions                                                     | Network 2018.1.1                                                                        |                                                                                    |

Network Design Table for Storm

| PN     | Length<br>(m) | Fall<br>(m) | Slope<br>(1:X) | I.Area<br>(ha) | T.E.<br>(mins) | Base<br>Flow (l/s) | k<br>(mm) | HYD<br>SECT | DIA<br>(mm) | Section Type | Auto<br>Design                                                                      |
|--------|---------------|-------------|----------------|----------------|----------------|--------------------|-----------|-------------|-------------|--------------|-------------------------------------------------------------------------------------|
| S3.000 | 6.914         | 0.300       | 23.0           | 0.022          | 4.00           | 0.0                | 0.600     | o           | 100         | Pipe/Conduit |  |
| S1.006 | 4.071         | 0.100       | 40.7           | 0.005          | 0.00           | 0.0                | 0.600     | o           | 150         | Pipe/Conduit |  |

Network Results Table

| PN     | Rain<br>(mm/hr) | T.C.<br>(mins) | US/IL<br>(m) | Σ I.Area<br>(ha) | Σ Base<br>Flow (l/s) | Foul<br>(l/s) | Add Flow<br>(l/s) | Vel<br>(m/s) | Cap<br>(l/s) | Flow<br>(l/s) |
|--------|-----------------|----------------|--------------|------------------|----------------------|---------------|-------------------|--------------|--------------|---------------|
| S3.000 | 50.00           | 4.07           | 41.400       | 0.022            | 0.0                  | 0.0           | 0.0               | 1.62         | 12.7         | 3.0           |
| S1.006 | 43.61           | 7.20           | 41.100       | 0.095            | 0.0                  | 0.0           | 0.0               | 1.58         | 28.0         | 11.2          |

Manhole Schedules for Storm

| MH Name | MH CL (m) | MH Depth (m) | MH Connection | MH Diam., L*W (mm) | PN     | Pipe Out Invert Level (m) | Diameter (mm) | PN     | Pipes In Invert Level (m) | Diameter (mm) | Backdrop (mm) |
|---------|-----------|--------------|---------------|--------------------|--------|---------------------------|---------------|--------|---------------------------|---------------|---------------|
| S-PP-01 | 43.500    | 0.900        | Open Manhole  | 1                  | S1.000 | 42.600                    | 100           |        |                           |               |               |
| S-01-CP | 43.550    | 0.950        | Open Manhole  | 450                | S1.001 | 42.600                    | 100           | S1.000 | 42.600                    | 100           |               |
| S-02    | 43.218    | 1.668        | Open Manhole  | 450                | S1.002 | 41.550                    | 100           | S1.001 | 42.350                    | 100           | 800           |
| S-06    | 43.550    | 0.950        | Open Manhole  | 450                | S2.000 | 42.600                    | 100           |        |                           |               |               |
| S-07    | 43.218    | 1.718        | Open Manhole  | 450                | S2.001 | 41.500                    | 100           | S2.000 | 42.320                    | 100           | 820           |
| S-03-CP | 42.250    | 0.990        | Open Manhole  | 600                | S1.003 | 41.260                    | 225           | S1.002 | 41.385                    | 100           |               |
|         |           |              |               |                    |        |                           |               | S2.001 | 41.385                    | 100           |               |
| S-TANK  | 42.250    | 1.040        | Open Manhole  | 1                  | S1.004 | 41.210                    | 225           | S1.003 | 41.210                    | 225           |               |
| S-04-CP | 42.150    | 0.990        | Open Manhole  | 600                | S1.005 | 41.160                    | 225           | S1.004 | 41.160                    | 225           |               |
| S-PP-02 | 42.300    | 0.900        | Open Manhole  | 1                  | S3.000 | 41.400                    | 100           |        |                           |               |               |
| S-05-FC | 42.150    | 1.050        | Open Manhole  | 1200               | S1.006 | 41.100                    | 150           | S1.005 | 41.100                    | 225           |               |
|         |           |              |               |                    |        |                           |               | S3.000 | 41.100                    | 100           |               |
| S       | 42.400    | 1.400        | Open Manhole  | 0                  |        | OUTFALL                   |               | S1.006 | 41.000                    | 150           |               |

|                                                      |                                                                                         |                                                                                    |
|------------------------------------------------------|-----------------------------------------------------------------------------------------|------------------------------------------------------------------------------------|
| Calcinotto                                           |                                                                                         | Page 4                                                                             |
| Jonsen House<br>43 Commercial Road<br>Poole BH14 0HU | 114038-CA-XX-XX-CA-D-005<br>Arthur Hill Swimming Pool<br>SW Network - 1:100+40% 6.8 l/s |  |
| Date 02/12/2020 11:28                                | Designed by JH                                                                          |                                                                                    |
| File 114038 - SW Network - 20-12-01.MDX              | Checked by GEB                                                                          |                                                                                    |
| XP Solutions                                         | Network 2018.1.1                                                                        |                                                                                    |

### PIPELINE SCHEDULES for Storm

#### Upstream Manhole

| PN     | Hyd<br>Sect | Diam<br>(mm) | MH<br>Name | C.Level<br>(m) | I.Level<br>(m) | D.Depth<br>(m) | MH<br>Connection | MH DIAM., L*W<br>(mm) |
|--------|-------------|--------------|------------|----------------|----------------|----------------|------------------|-----------------------|
| S1.000 | o           | 100          | S-PP-01    | 43.500         | 42.600         | 0.800          | Open Manhole     | 1                     |
| S1.001 | o           | 100          | S-01-CP    | 43.550         | 42.600         | 0.850          | Open Manhole     | 450                   |
| S1.002 | o           | 100          | S-02       | 43.218         | 41.550         | 1.568          | Open Manhole     | 450                   |
| S2.000 | o           | 100          | S-06       | 43.550         | 42.600         | 0.850          | Open Manhole     | 450                   |
| S2.001 | o           | 100          | S-07       | 43.218         | 41.500         | 1.618          | Open Manhole     | 450                   |
| S1.003 | o           | 225          | S-03-CP    | 42.250         | 41.260         | 0.765          | Open Manhole     | 600                   |
| S1.004 | o           | 225          | S-TANK     | 42.250         | 41.210         | 0.815          | Open Manhole     | 1                     |
| S1.005 | o           | 225          | S-04-CP    | 42.150         | 41.160         | 0.765          | Open Manhole     | 600                   |
| S3.000 | o           | 100          | S-PP-02    | 42.300         | 41.400         | 0.800          | Open Manhole     | 1                     |
| S1.006 | o           | 150          | S-05-FC    | 42.150         | 41.100         | 0.900          | Open Manhole     | 1200                  |

#### Downstream Manhole

| PN     | Length<br>(m) | Slope<br>(1:X) | MH<br>Name | C.Level<br>(m) | I.Level<br>(m) | D.Depth<br>(m) | MH<br>Connection | MH DIAM., L*W<br>(mm) |
|--------|---------------|----------------|------------|----------------|----------------|----------------|------------------|-----------------------|
| S1.000 | 7.728         | 0.0            | S-01-CP    | 43.550         | 42.600         | 0.850          | Open Manhole     | 450                   |
| S1.001 | 15.428        | 61.7           | S-02       | 43.218         | 42.350         | 0.768          | Open Manhole     | 450                   |
| S1.002 | 12.987        | 78.7           | S-03-CP    | 42.250         | 41.385         | 0.765          | Open Manhole     | 600                   |
| S2.000 | 15.617        | 55.8           | S-07       | 43.218         | 42.320         | 0.798          | Open Manhole     | 450                   |
| S2.001 | 8.985         | 78.1           | S-03-CP    | 42.250         | 41.385         | 0.765          | Open Manhole     | 600                   |
| S1.003 | 12.795        | 255.9          | S-TANK     | 42.250         | 41.210         | 0.815          | Open Manhole     | 1                     |
| S1.004 | 18.253        | 365.1          | S-04-CP    | 42.150         | 41.160         | 0.765          | Open Manhole     | 600                   |
| S1.005 | 6.391         | 106.5          | S-05-FC    | 42.150         | 41.100         | 0.825          | Open Manhole     | 1200                  |
| S3.000 | 6.914         | 23.0           | S-05-FC    | 42.150         | 41.100         | 0.950          | Open Manhole     | 1200                  |
| S1.006 | 4.071         | 40.7           | S          | 42.400         | 41.000         | 1.250          | Open Manhole     | 0                     |

|                                                                  |                                                                                         |                                                                                    |
|------------------------------------------------------------------|-----------------------------------------------------------------------------------------|------------------------------------------------------------------------------------|
| Calcinotto                                                       |                                                                                         | Page 5                                                                             |
| Jonsen House<br>43 Commercial Road<br>Poole BH14 0HU             | 114038-CA-XX-XX-CA-D-005<br>Arthur Hill Swimming Pool<br>SW Network - 1:100+40% 6.8 l/s |  |
| Date 02/12/2020 11:28<br>File 114038 - SW Network - 20-12-01.MDX | Designed by JH<br>Checked by GEB                                                        |                                                                                    |
| XP Solutions                                                     | Network 2018.1.1                                                                        |                                                                                    |

#### Area Summary for Storm

| Pipe Number | PIMP Type | PIMP Name | PIMP (%) | Gross Area (ha) | Imp. Area (ha) | Pipe Total (ha) |
|-------------|-----------|-----------|----------|-----------------|----------------|-----------------|
| 1.000       | -         | -         | 100      | 0.016           | 0.016          | 0.016           |
| 1.001       | -         | -         | 100      | 0.000           | 0.000          | 0.000           |
| 1.002       | -         | -         | 100      | 0.013           | 0.013          | 0.013           |
| 2.000       | -         | -         | 100      | 0.007           | 0.007          | 0.007           |
| 2.001       | -         | -         | 100      | 0.007           | 0.007          | 0.007           |
| 1.003       | -         | -         | 100      | 0.020           | 0.020          | 0.020           |
| 1.004       | -         | -         | 100      | 0.000           | 0.000          | 0.000           |
| 1.005       | -         | -         | 100      | 0.005           | 0.005          | 0.005           |
| 3.000       | -         | -         | 100      | 0.022           | 0.022          | 0.022           |
| 1.006       | -         | -         | 100      | 0.005           | 0.005          | 0.005           |
|             |           |           |          | Total           | Total          | Total           |
|             |           |           |          | 0.095           | 0.095          | 0.095           |

#### Free Flowing Outfall Details for Storm

| Outfall Pipe Number | Outfall Name | C. Level (m) | I. Level (m) | Min I. Level (m) | D,L (mm) | W (mm) |
|---------------------|--------------|--------------|--------------|------------------|----------|--------|
| S1.006              | S            | 42.400       | 41.000       | 0.000            | 0        | 0      |

|                                                                  |                                                                                         |                                                                                    |
|------------------------------------------------------------------|-----------------------------------------------------------------------------------------|------------------------------------------------------------------------------------|
| Calcinotto                                                       |                                                                                         | Page 6                                                                             |
| Jonsen House<br>43 Commercial Road<br>Poole BH14 0HU             | 114038-CA-XX-XX-CA-D-005<br>Arthur Hill Swimming Pool<br>SW Network - 1:100+40% 6.8 l/s |  |
| Date 02/12/2020 11:28<br>File 114038 - SW Network - 20-12-01.MDX | Designed by JH<br>Checked by GEB                                                        |                                                                                    |
| XP Solutions                                                     | Network 2018.1.1                                                                        |                                                                                    |

Online Controls for Storm

Hydro-Brake® Optimum Manhole: S-05-FC, DS/PN: S1.006, Volume (m³): 1.5

|                                   |                            |
|-----------------------------------|----------------------------|
| Unit Reference                    | MD-SHE-0129-6800-0510-6800 |
| Design Head (m)                   | 0.510                      |
| Design Flow (l/s)                 | 6.8                        |
| Flush-Flo™                        | Calculated                 |
| Objective                         | Minimise upstream storage  |
| Application                       | Surface                    |
| Sump Available                    | Yes                        |
| Diameter (mm)                     | 129                        |
| Invert Level (m)                  | 41.100                     |
| Minimum Outlet Pipe Diameter (mm) | 150                        |
| Suggested Manhole Diameter (mm)   | 1200                       |

| Control Points            | Head (m) | Flow (l/s) | Control Points            | Head (m) | Flow (l/s) |
|---------------------------|----------|------------|---------------------------|----------|------------|
| Design Point (Calculated) | 0.510    | 6.8        | Kick-Flo®                 | 0.387    | 6.0        |
| Flush-Flo™                | 0.199    | 6.8        | Mean Flow over Head Range | -        | 5.5        |

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

| Depth (m) | Flow (l/s) | Depth (m) | Flow (l/s) | Depth (m) | Flow (l/s) | Depth (m) | Flow (l/s) | Depth (m) | Flow (l/s) |
|-----------|------------|-----------|------------|-----------|------------|-----------|------------|-----------|------------|
| 0.100     | 4.6        | 0.800     | 8.4        | 2.000     | 12.9       | 4.000     | 18.0       | 7.000     | 23.6       |
| 0.200     | 6.8        | 1.000     | 9.3        | 2.200     | 13.5       | 4.500     | 19.1       | 7.500     | 24.4       |
| 0.300     | 6.6        | 1.200     | 10.2       | 2.400     | 14.1       | 5.000     | 20.1       | 8.000     | 25.3       |
| 0.400     | 6.1        | 1.400     | 10.9       | 2.600     | 14.7       | 5.500     | 20.9       | 8.500     | 26.0       |
| 0.500     | 6.7        | 1.600     | 11.6       | 3.000     | 15.7       | 6.000     | 21.8       | 9.000     | 26.8       |
| 0.600     | 7.3        | 1.800     | 12.3       | 3.500     | 16.9       | 6.500     | 22.7       | 9.500     | 27.5       |

|                                |
|--------------------------------|
| 114038-CA-XX-XX-CA-D-005       |
| Arthur Hill Swimming Pool      |
| SW Network - 1:100+40% 6.8 l/s |



Micro  
Drainage

|                |
|----------------|
| Designed by JH |
|----------------|

Checked by GEB

Network 2018.1.1

Infiltration Blanket Manhole: S-PP-01, DS/PN: S1.000

Cellular Storage Manhole: S-TANK, DS/PN: S1.004

| Depth (m) | Area (m <sup>2</sup> ) | Inf. Area (m <sup>2</sup> ) | Depth (m) | Area (m <sup>2</sup> ) | Inf. Area (m <sup>2</sup> ) | Depth (m) | Area (m <sup>2</sup> ) | Inf. Area (m <sup>2</sup> ) |
|-----------|------------------------|-----------------------------|-----------|------------------------|-----------------------------|-----------|------------------------|-----------------------------|
| 0.000     | 60.0                   | 60.0                        | 0.400     | 60.0                   | 72.4                        | 0.401     | 0.0                    | 72.4                        |

|                          |                  |         |                      |       |
|--------------------------|------------------|---------|----------------------|-------|
| Infiltration Coefficient | Base (m/hr)      | 0.00000 | Diameter/Width (m)   | 27.6  |
|                          | Safety Factor    | 2.0     | Length (m)           | 10.0  |
|                          | Porosity         | 0.30    | Cap Volume Depth (m) | 0.350 |
|                          | Invert Level (m) | 41.840  |                      |       |

|                                                      |                                                                                         |                                                                                    |
|------------------------------------------------------|-----------------------------------------------------------------------------------------|------------------------------------------------------------------------------------|
| Calcinotto                                           |                                                                                         | Page 8                                                                             |
| Jonsen House<br>43 Commercial Road<br>Poole BH14 0HU | 114038-CA-XX-XX-CA-D-005<br>Arthur Hill Swimming Pool<br>SW Network - 1:100+40% 6.8 l/s |  |
| Date 02/12/2020 11:28                                | Designed by JH                                                                          |                                                                                    |
| File 114038 - SW Network - 20-12-01.MDX              | Checked by GEB                                                                          |                                                                                    |
| XP Solutions                                         | Network 2018.1.1                                                                        |                                                                                    |

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

| Simulation Criteria             |       |                                     |       |
|---------------------------------|-------|-------------------------------------|-------|
| Areal Reduction Factor          | 1.000 | Additional Flow - % of Total Flow   | 0.000 |
| Hot Start (mins)                | 0     | MADD Factor * 10m³/ha Storage       | 2.000 |
| Hot Start Level (mm)            | 0     | Inlet Coefficient                   | 0.800 |
| Manhole Headloss Coeff (Global) | 0.500 | Flow per Person per Day (l/per/day) | 0.000 |
| Foul Sewage per hectare (l/s)   | 0.000 |                                     |       |
| Number of Input Hydrographs     | 0     | Number of Offline Controls          | 0     |
| Number of Online Controls       | 1     | Number of Time/Area Diagrams        | 0     |
|                                 |       | Number of Storage Structures        | 3     |
|                                 |       | Number of Real Time Controls        | 0     |

| Synthetic Rainfall Details         |                                 |             |                   |
|------------------------------------|---------------------------------|-------------|-------------------|
| Rainfall Model                     | FSR M5-60 (mm)                  | 18.900      | Cv (Summer) 0.750 |
| Region                             | England and Wales               | Ratio R     | 0.400             |
|                                    |                                 | Cv (Winter) | 0.840             |
| Margin for Flood Risk Warning (mm) |                                 |             | 300.0             |
| Analysis Timestep                  | 2.5 Second Increment (Extended) |             |                   |
| DTS Status                         |                                 |             | ON                |
| DVD Status                         |                                 |             | ON                |
| Inertia Status                     |                                 |             | OFF               |

|                          |                                                                            |
|--------------------------|----------------------------------------------------------------------------|
| Profile(s)               | Summer and Winter                                                          |
| Duration(s) (mins)       | 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320 |
| Return Period(s) (years) | 1, 30, 100                                                                 |
| Climate Change (%)       | 0, 20, 40                                                                  |

|        |         |           |        |         |               |           |           |          | Water  | Surcharged | Flooded |
|--------|---------|-----------|--------|---------|---------------|-----------|-----------|----------|--------|------------|---------|
|        | US/MH   |           | Return | Climate | First (X)     | First (Y) | First (Z) | Overflow | Level  | Depth      | Volume  |
| PN     | Name    | Storm     | Period | Change  | Surcharge     | Flood     | Overflow  | Act.     | (m)    | (m)        | (m³)    |
| S1.000 | S-PP-01 | 15 Summer | 1      | +0%     | 30/15 Summer  |           |           |          | 42.669 | -0.031     | 0.000   |
| S1.001 | S-01-CP | 15 Summer | 1      | +0%     | 100/15 Summer |           |           |          | 42.638 | -0.062     | 0.000   |
| S1.002 | S-02    | 15 Winter | 1      | +0%     | 30/15 Summer  |           |           |          | 41.604 | -0.046     | 0.000   |
| S2.000 | S-06    | 15 Winter | 1      | +0%     |               |           |           |          | 42.624 | -0.076     | 0.000   |
| S2.001 | S-07    | 15 Winter | 1      | +0%     | 100/15 Summer |           |           |          | 41.536 | -0.064     | 0.000   |
| S1.003 | S-03-CP | 15 Winter | 1      | +0%     | 100/15 Summer |           |           |          | 41.340 | -0.145     | 0.000   |
| S1.004 | S-TANK  | 30 Winter | 1      | +0%     | 100/15 Summer |           |           |          | 41.262 | -0.173     | 0.000   |
| S1.005 | S-04-CP | 30 Winter | 1      | +0%     | 30/15 Summer  |           |           |          | 41.210 | -0.175     | 0.000   |
| S3.000 | S-PP-02 | 15 Winter | 1      | +0%     | 30/15 Summer  |           |           |          | 41.435 | -0.065     | 0.000   |
| S1.006 | S-05-FC | 30 Winter | 1      | +0%     | 30/15 Summer  |           |           |          | 41.198 | -0.052     | 0.000   |

| Pipe   |            |             |                |                 |                |
|--------|------------|-------------|----------------|-----------------|----------------|
| PN     | US/MH Name | Flow / Cap. | Overflow (l/s) | Pipe Flow (l/s) | Level Exceeded |
| S1.000 | S-PP-01    | 0.82        |                | 2.3             | OK             |
| S1.001 | S-01-CP    | 0.31        |                | 2.3             | OK             |
| S1.002 | S-02       | 0.57        |                | 3.7             | OK             |
| S2.000 | S-06       | 0.13        |                | 1.0             | OK             |
| S2.001 | S-07       | 0.28        |                | 1.8             | OK             |
| S1.003 | S-03-CP    | 0.27        |                | 7.6             | OK             |
| S1.004 | S-TANK     | 0.12        |                | 2.9             | OK             |
| S1.005 | S-04-CP    | 0.09        |                | 3.2             | OK             |
| S3.000 | S-PP-02    | 0.27        |                | 3.1             | OK             |
| S1.006 | S-05-FC    | 0.23        |                | 4.5             | OK             |

|                                                      |                                                                                         |                                                                                    |
|------------------------------------------------------|-----------------------------------------------------------------------------------------|------------------------------------------------------------------------------------|
| Calcinotto                                           |                                                                                         | Page 9                                                                             |
| Jonsen House<br>43 Commercial Road<br>Poole BH14 0HU | 114038-CA-XX-XX-CA-D-005<br>Arthur Hill Swimming Pool<br>SW Network - 1:100+40% 6.8 l/s |  |
| Date 02/12/2020 11:28                                | Designed by JH                                                                          |                                                                                    |
| File 114038 - SW Network - 20-12-01.MDX              | Checked by GEB                                                                          |                                                                                    |
| XP Solutions                                         | Network 2018.1.1                                                                        |                                                                                    |

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

#### Simulation Criteria

Areal Reduction Factor 1.000 Additional Flow - % of Total Flow 0.000  
 Hot Start (mins) 0 MADD Factor \* 10m<sup>3</sup>/ha Storage 2.000  
 Hot Start Level (mm) 0 Inlet Coefficient 0.800  
 Manhole Headloss Coeff (Global) 0.500 Flow per Person per Day (l/per/day) 0.000  
 Foul Sewage per hectare (l/s) 0.000  
 Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0  
 Number of Online Controls 1 Number of Storage Structures 3 Number of Real Time Controls 0

#### Synthetic Rainfall Details

Rainfall Model FSR M5-60 (mm) 18.900 Cv (Summer) 0.750  
 Region England and Wales Ratio R 0.400 Cv (Winter) 0.840  
 Margin for Flood Risk Warning (mm) 300.0  
 Analysis Timestep 2.5 Second Increment (Extended)  
 DTS Status ON  
 DVD Status ON  
 Inertia Status OFF  
 Profile(s) Summer and Winter  
 Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960,  
 1440, 2160, 2880, 4320  
 Return Period(s) (years) 1, 30, 100  
 Climate Change (%) 0, 20, 40

|        |         |           |        |         |               |           |           |          | Water  | Surcharged | Flooded |
|--------|---------|-----------|--------|---------|---------------|-----------|-----------|----------|--------|------------|---------|
| US/MH  |         |           | Return | Climate | First (X)     | First (Y) | First (Z) | Overflow | Level  | Depth      | Volume  |
| PN     | Name    | Storm     | Period | Change  | Surcharge     | Flood     | Overflow  | Act.     | (m)    | (m)        | (m³)    |
| S1.000 | S-PP-01 | 15 Summer | 30     | +20%    | 30/15 Summer  |           |           |          | 42.811 | 0.111      | 0.000   |
| S1.001 | S-01-CP | 15 Summer | 30     | +20%    | 100/15 Summer |           |           |          | 42.675 | -0.025     | 0.000   |
| S1.002 | S-02    | 15 Winter | 30     | +20%    | 30/15 Summer  |           |           |          | 42.049 | 0.399      | 0.000   |
| S2.000 | S-06    | 15 Winter | 30     | +20%    |               |           |           |          | 42.642 | -0.058     | 0.000   |
| S2.001 | S-07    | 15 Winter | 30     | +20%    | 100/15 Summer |           |           |          | 41.575 | -0.025     | 0.000   |
| S1.003 | S-03-CP | 15 Winter | 30     | +20%    | 100/15 Summer |           |           |          | 41.431 | -0.054     | 0.000   |
| S1.004 | S-TANK  | 30 Winter | 30     | +20%    | 100/15 Summer |           |           |          | 41.416 | -0.019     | 0.000   |
| S1.005 | S-04-CP | 15 Winter | 30     | +20%    | 30/15 Summer  |           |           |          | 41.413 | 0.028      | 0.000   |
| S3.000 | S-PP-02 | 15 Winter | 30     | +20%    | 30/15 Summer  |           |           |          | 41.565 | 0.065      | 0.000   |
| S1.006 | S-05-FC | 15 Winter | 30     | +20%    | 30/15 Summer  |           |           |          | 41.419 | 0.169      | 0.000   |

|        |            | Pipe                 |            |            |                |
|--------|------------|----------------------|------------|------------|----------------|
| PN     | US/MH Name | Flow / Overflow Cap. | Flow (l/s) | Status     | Level Exceeded |
| S1.000 | S-PP-01    | 2.41                 | 6.6        | SURCHARGED |                |
| S1.001 | S-01-CP    | 0.90                 | 6.6        | OK         |                |
| S1.002 | S-02       | 1.80                 | 11.6       | SURCHARGED |                |
| S2.000 | S-06       | 0.37                 | 2.9        | OK         |                |
| S2.001 | S-07       | 0.92                 | 5.8        | OK         |                |
| S1.003 | S-03-CP    | 0.91                 | 25.3       | OK         |                |
| S1.004 | S-TANK     | 0.28                 | 6.9        | OK         |                |
| S1.005 | S-04-CP    | 0.19                 | 6.6        | SURCHARGED |                |
| S3.000 | S-PP-02    | 0.75                 | 8.6        | SURCHARGED |                |
| S1.006 | S-05-FC    | 0.34                 | 6.8        | SURCHARGED |                |



G      Foul Calculation

### Calculation of Wastewater Flows For Drain Systems to BS EN 12056-2:2000

Date: 15-Jun-20  
 Project: Arthur Hill Swimming Pool  
 Project No: 114038  
 Element: Proposed Foul Water Calculations

Please select the type of building ( $K_{DU}$ )

Dwelling, guesthouse, office (intermittent use)

0.50

$K_{DU}$  = frequency factor (dimensionless)

Please fill in the number of appliances

|                            | No. | System I | System II | System III | System IV |
|----------------------------|-----|----------|-----------|------------|-----------|
| Wash Basin, Bidet          | 15  | 7.50     | 4.50      | 4.50       | 4.50      |
| Shower without plug        | 6   | 3.60     | 2.40      | 2.40       | 2.40      |
| Shower with plug           | 0   | 0.00     | 0.00      | 0.00       | 0.00      |
| Single urinal with cistern | 2   | 1.60     | 1.00      | 0.80       | 1.00      |
| Urinal with flushing valve | 0   | 0.00     | 0.00      | 0.00       | 0.00      |
| Slab urinal                | 0   | 0.00     | 0.00      | 0.00       | 0.00      |
| Bath                       | 9   | 7.20     | 5.40      | 11.70      | 4.50      |
| Kitchen Sink               | 15  | 12.00    | 9.00      | 19.50      | 7.50      |
| Dishwasher (household)     | 0   | 0.00     | 0.00      | 0.00       | 0.00      |
| Washing machine up to 6kg  | 0   | 0.00     | 0.00      | 0.00       | 0.00      |
| Washing machine up to 12kg | 0   | 0.00     | 0.00      | 0.00       | 0.00      |
| WC with 4.0l cistern       | 0   | 0.00     | 0.00      | 0.00       | 0.00      |
| WC with 6.0l cistern       | 15  | 30.00    | 27.00     | 27.00      | 30.00     |
| WC with 7.5l cistern       | 0   | 0.00     | 0.00      | 0.00       | 0.00      |
| WC with 9.0l cistern       | 0   | 0.00     | 0.00      | 0.00       | 0.00      |
| Floor Gully DN50           | 0   | 0.00     | 0.00      | 0.00       | 0.00      |
| Floor Gully DN70           | 0   | 0.00     | 0.00      | 0.00       | 0.00      |
| Floor Gully DN 100         | 0   | 0.00     | 0.00      | 0.00       | 0.00      |
| <b>Total DU =</b>          |     | 61.90    | 49.30     | 65.90      | 49.90     |

DU = discharge unit (a characteristic value of the rate of wastewater outflow of a sanitary appliance) (dimensionless)

Q = wastewater design flow rate, in litres per second

$$Q = K_{DU} \times \sqrt{\sum DU}$$

Flow(Q) = 3.93 3.51 4.06 3.53 l/s

Updated to BS EN 12056-2:2000

| Table C.2 - Typical<br>Values of discharge units (DU)<br>BS EN 752-4 |      |      |      |
|----------------------------------------------------------------------|------|------|------|
|                                                                      | Low  | Med  | High |
| Washbasin, show                                                      | 0.30 | 0.45 | 0.60 |
| Urinal                                                               | 0.30 | 0.55 | 0.80 |
| Bath, Kitchen Sink                                                   | 0.80 | 1.05 | 1.30 |
| Dishwasher                                                           | 0.20 | 0.50 | 0.80 |
| Household Wash                                                       | 0.50 | 0.55 | 0.80 |
| Commercial Wash                                                      | 1.00 | 1.25 | 1.50 |
| WCs (4.0l to 9.0l cistern)                                           | 1.20 | 1.85 | 2.50 |
| Floor Drains (DN 50)                                                 | 0.6  | 1.3  | 2    |

| Table 3 - Typical Frequency factors<br>BS EN 12056-2:2000 |      |
|-----------------------------------------------------------|------|
| Type of Building                                          | KDU  |
| Dwelling, guesthouse, office (intermittent use)           | 0.50 |
| Hospital, school, restaurant, hotel (frequent use)        | 0.70 |
| Toilets and/or shower open to the public (congested use)  | 1.00 |
| Laboratory buildings (special use)                        | 1.20 |

| Designed | Checked | Date       |
|----------|---------|------------|
| JH       | MR      | 15/06/2020 |

| Table 2 - Typical<br>Values of discharge units (DU)<br>BS EN 12056-2:2000 and Good Building Guide 76 |          |           |            |               |
|------------------------------------------------------------------------------------------------------|----------|-----------|------------|---------------|
| Appliance                                                                                            | System I | System II | System III | System IV     |
| Wash Basin, Bidet                                                                                    | 0.5      | 0.3       | 0.3        | 0.3           |
| Shower without plug                                                                                  | 0.6      | 0.4       | 0.4        | 0.4           |
| Shower with plug                                                                                     | 0.8      | 0.5       | 1.3        | 0.5           |
| Single urinal with cistern                                                                           | 0.8      | 0.5       | 0.4        | 0.5           |
| Urinal with flushing valve                                                                           | 0.5      | 0.3       | 0.3        | 0.3           |
| Slab urinal                                                                                          | 0.2      | 0.2       | 0.2        | 0.2           |
| Bath                                                                                                 | 0.8      | 0.6       | 1.3        | 0.5           |
| Kitchen Sink                                                                                         | 0.8      | 0.6       | 1.3        | 0.5           |
| Dishwasher (household)                                                                               | 0.8      | 0.6       | 0.2        | 0.5           |
| Washing machine up to 6kg                                                                            | 0.8      | 0.6       | 0.6        | 0.5           |
| Washing machine up to 12kg                                                                           | 1.5      | 1.2       | 1.2        | 1.0           |
| WC with 4.0l cistern                                                                                 | 1.8      | 1.8       | 1.8        | Not Permitted |
| WC with 6.0l cistern                                                                                 | 2.0      | 1.8       | 1.8        | 2.0           |
| WC with 7.5l cistern                                                                                 | 2.0      | 1.8       | 1.8        | 2.0           |
| WC with 9.0l cistern                                                                                 | 2.5      | 2.0       | 2.0        | 2.5           |
| Floor Gully DN50                                                                                     | 0.8      | 0.9       | 0.9        | 0.6           |
| Floor Gully DN70                                                                                     | 1.5      | 0.9       | 0.9        | 1.0           |
| Floor Gully DN 100                                                                                   | 2.0      | 1.2       | 1.2        | 1.3           |

(Per Person)

|                                                                                                                                                                                                                                                                                                                                              |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>System I - Single discharge stack system with partly filled branch discharge pipes</b><br>Sanitary appliances are connected to partly filled branch discharge pipes. The partly filled branch discharge pipes are designed with a filling degree of 0.5 (50 %) and are connected to a single discharge stack.                             |
| <b>System II - Single discharge stack system with small bore discharge branch pipes</b><br>Sanitary appliances are connected to small bore branch discharge pipes. The small bore branch discharge pipes are designed with a filling degree of 0.7 (70 %) and are connected to a single discharge stack.                                     |
| <b>System III - Single discharge stack system with full bore branch discharge pipes</b><br>Sanitary appliances are connected to full bore branch discharge pipes. The full bore branch discharge pipes are designed with a filling degree of 1.0 (100 %) and each branch discharge pipe is separately connected to a single discharge stack. |
| <b>System IV - Separate discharge stack system</b><br>Drainage systems type I, II and III may also be divided into a black water stack serving WC's and urinals and a grey water stack serving all other appliances.                                                                                                                         |

| Table 2 - Typical<br>Values of discharge units (DU)<br>BS EN 12056-2:2000 |               |           |               |               |
|---------------------------------------------------------------------------|---------------|-----------|---------------|---------------|
| Appliance                                                                 | System I      | System II | System III    | System IV     |
| Wash Basin, Bidet                                                         | 0.5           | 0.3       | 0.3           | 0.3           |
| Shower without plug                                                       | 0.6           | 0.4       | 0.4           | 0.4           |
| Shower with plug                                                          | 0.8           | 0.5       | 1.3           | 0.5           |
| Single urinal with cistern                                                | 0.8           | 0.5       | 0.4           | 0.5           |
| Urinal with flushing valve                                                | 0.5           | 0.3       | Not Permitted | 0.3           |
| Slab urinal                                                               | 0.2           | 0.2       | 0.2           | 0.2           |
| Bath                                                                      | 0.8           | 0.6       | 1.3           | 0.5           |
| Kitchen Sink                                                              | 0.8           | 0.6       | 1.3           | 0.5           |
| Dishwasher (household)                                                    | 0.8           | 0.6       | 0.2           | 0.5           |
| Washing machine up to 6kg                                                 | 0.8           | 0.6       | 0.6           | 0.5           |
| Washing machine up to 12kg                                                | 1.5           | 1.2       | 1.2           | 1.0           |
| WC with 4.0l cistern                                                      | Not Permitted | 1.8       | Not Permitted | Not Permitted |
| WC with 6.0l cistern                                                      | 2.0           | 1.8       | Not Permitted | 2.0           |
| WC with 7.5l cistern                                                      | 2.0           | 1.8       | Not Permitted | 2.0           |
| WC with 9.0l cistern                                                      | 2.5           | 2.0       | Not Permitted | 2.5           |
| Floor Gully DN50                                                          | 0.8           | 0.9       | Not Permitted | 0.6           |
| Floor Gully DN70                                                          | 1.5           | 0.9       | Not Permitted | 1.0           |
| Floor Gully DN 100                                                        | 2.0           | 1.2       | Not Permitted | 1.3           |