

Greyfriars Church, Reading

Drainage Strategy and Maintenance Statement

For

Greyfriars Church

Project Number:

12761

November 2019

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1.0 INTRODUCTION

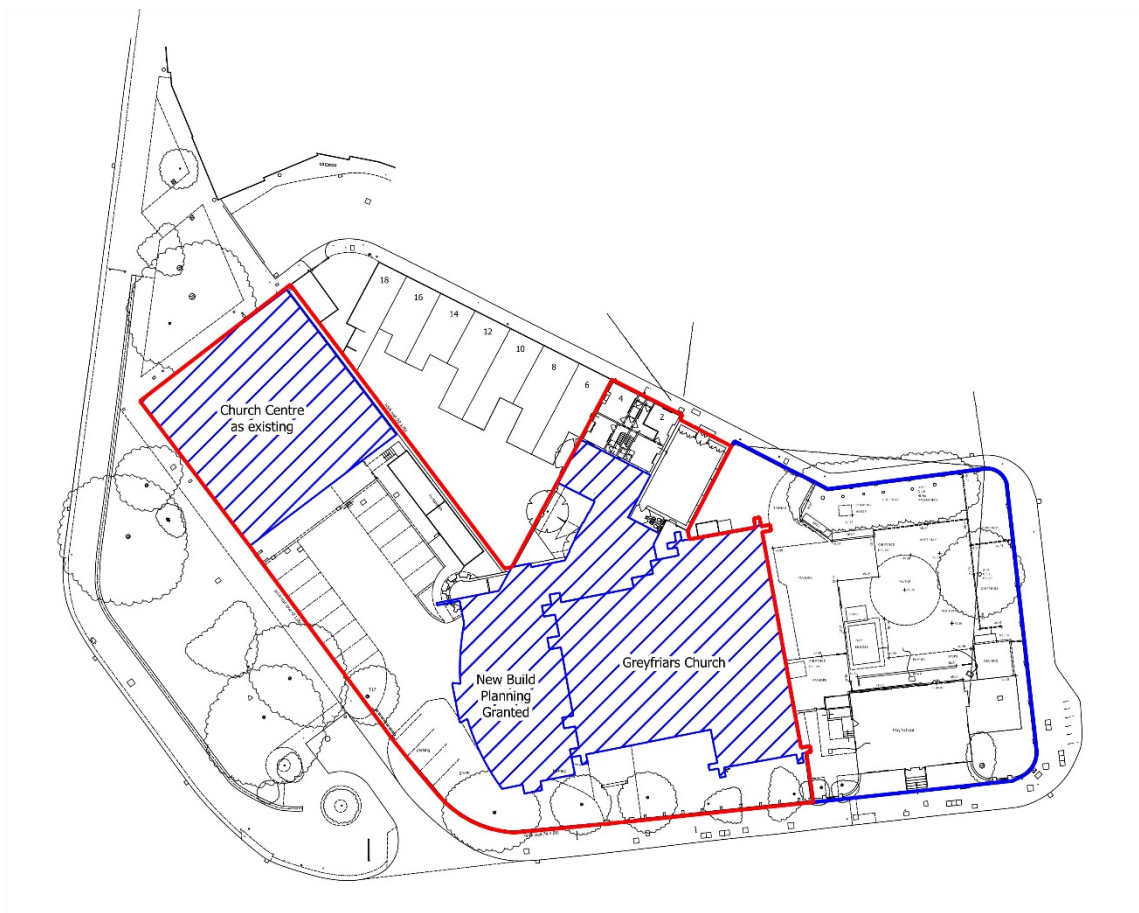
1.1. Brief

1.1.1 CampbellReith have been commissioned by Greyfriars Church (the Client) to prepare a Drainage Strategy and Maintenance Statement for Phase 2 of the proposed redevelopment of Greyfriars Church at Friar Street, Reading, herein referred to as the 'site'. The National Grid Reference for the site is 471192E and 173585N. The nearest postcode to the site is RG1 1EH. The site location and existing site plan is shown in Appendix A.

1.1.2 This Drainage Strategy and Maintenance Statement has been prepared in support of a full Planning Application.

1.2. Site Location

The extract below shows the extents of the Planning Application site boundary.



© Crown copyright. All rights reserved. Ordnance Survey Licence number 100020027.
JBKS Architects Existing Site Plan, drg no GRE-4 151 rev 01 (Nov 2017)

Figure 1.1: Site Boundary

1.3. Proposed Development

1.3.3 The site is to be redeveloped in two phases.

1.3.4 The Client received full planning permission (application no. 190650) for Phase 1 on 8th August 2019.

1.3.5 Phase 1 comprises of:

Demolition of the existing western foyer, and replacement with a larger glazed foyer area and other internal works; and single storey rear extension to no's 2 and 4 Sackville Street to link the church to these buildings, and the change of use of the premise from Sui Generis (Counselling services offices) to Class D1 use (non-residential institution - public worship or religious instruction), and changes to external parking and landscaping.

1.3.6 Phase 2 comprises of:

Demolition of existing Church Hall and construction of a new four-storey Church Centre. Removal of the existing portacabins to facilitate a covered corridor providing an open, free-flowing space to connect Phase 1 and 2.

1.3.7 Refer to Appendix B for the layout of the proposed development.

1.3.8 This report outlines the drainage strategy for Phase 2.

2.0 DESIGN CRITERIA

2.1. Surface Water Drainage Strategy

2.1.1 The surface water drainage system has been designed in accordance with the National Planning Policy Framework (NPPF) and the accompanying Guidance and Technical Standards for SuDS. It also complies with the requirements under Building Regulations Part H.

2.1.2 In accordance with CIRIA SuDS Manual 2015 (Report C753), Building Regulations Part H and in line with the SuDS hierarchy under paragraph 80 of the Planning Policy Guidance underpinning the NPPF, surface water should be managed by:

- 1.) Infiltration to the maximum extent that is practical – where it is safe and acceptable to do so
- 2.) Discharge to watercourses
- 3.) Discharge to surface water sewer, highway drain or another drainage system
- 4.) Discharge to combined sewers (last resort)

2.1.3 Reading Borough Council are the Lead Local Flood Authority (LLFA) for the site and therefore have a responsibility for the strategic management of local flood risk within their region. At the time of writing, Reading Borough Council has no specific surface water or SuDS planning strategy guidance. Therefore, the aforementioned guidance will be adhered to.

2.1.1 As previously discussed, there is an existing planning permission in place for Phase 1 of the development. There are no drainage and/or flooding related conditions related to Phase 1.

2.2. Foul Water Drainage Strategy

2.2.1 The foul drainage system has been designed for Sewers for Adoption 7th Edition and Building Regulations Part H.

3.0 SITE CONTEXT

3.1. Site Description

- 3.1.2 The total site boundary covers an area approximately 0.26 hectares (ha).
- 3.1.3 The existing site is occupied by Greyfriars Church and includes the main Church building; Day Nursery; 2-4 Sackville Street; the Memorial Hall; the Church Centre and a car park. The main Church building is a Grade I listed building and parts of the property date back to the original Franciscan Friary constructed around 1311.
- 3.1.4 The site is bound to the north by the gardens of residential properties along Sackville Street; to the east by Greyfriars Road and to the south by Friar Street. The west of the site is immediately bound by a public footway serving as part of the Caversham Road/A329 dual carriageway roundabout/underpass.
- 3.1.5 Phase 1 relates to the main Church building and 2-4 Sackville Street and Phase 2 relates to the Church Centre and car park. The site predominantly comprises of buildings and hardstanding, and as such is classed as brownfield land.
- 3.1.6 The existing and the proposed impermeable areas are outlined in Table 3.1 below.

Table 3.1: Existing and Proposed Impermeable Area

	Existing (Ha)	Proposed (Ha)
Phase 1	0.078	0.078
Church Centre and car park	0.114	0.114
TOTAL	0.192	0.192

- 3.1.7 As shown, there is no net increase in impermeable area pre and post development of Phase 2.
- #### 3.2. Topography
- 3.2.1 A topographical survey was undertaken by MK Surveys in December 2012 (ref: 17869 GRE-4) and is contained in Appendix C.
- 3.2.2 The site generally slopes from the south-east towards the north-western site boundary. High points are generally located to the east of the site with the level at the rear of the Greyfriars Nursery School measured at approximately 45.93 metres above Ordnance Datum (mAOD). There is a low point at approximately 41.79 mAOD, located on the public footpath just beyond the western boundary of the site.
- #### 3.3. Geology
- 3.3.1 The British Geological Survey (BGS) Online Geology Viewer¹ notes the site to be underlain by superficial deposits of the Taplow Gravel Member (sand and gravel, locally with lenses of silt, clay or peat) into bedrock of the Seaford Chalk Formation (firm white chalk with conspicuous semi-continuous nodular and tabular flint seams) and Newhaven Chalk Formation (soft to medium hard white chalks with marl seams and flint bands).

¹ British Geological Survey (BGS) Online Geology <http://mapapps.bgs.ac.uk/geologyofbritain/home.html>

- 3.3.2 A historical borehole (SU77SW682) is located within 50m of site to the northwest which had no relevant ground conditions recorded. However, it was noted that chalk was present during boring at approximately 6.0m bgl.
- 3.3.3 A second historic borehole (SU77SW99), located 100m north of the site, recorded topsoil to approximately 2.7m bgl overlying clay to 4m bgl. Underlying the clay was an approximately 150mm layer of sand overlying chalk.
- 3.3.4 An unknown veneer of Made Ground associated with the previous and existing development on site is anticipated overlying the gravel.
- 3.3.5 CampbellReith have also had sight of three historical boreholes from 1982 for 35-43 Greyfriars Road. These properties are located 175m northeast of the site. Borehole No. 1 recorded brown gravel and sand from 2.4 bgl to 5.4m bgl overlying chalk. Borehole No. 2 recorded brown gravel and sand from 2.3m bgl to 6.3m bgl overlying chalk. Borehole No. 3 recorded brown gravel and sand from 4.3m bgl to 7m bgl overlying chalk.
- 3.3.6 Ground investigation works have not been undertaken at the time of writing but will be arranged at the earliest opportunity in order to confirm geological assumptions.

3.4. **Hydrology**

- 3.4.1 A desktop review of ordnance survey mapping and a report undertaken by Groundsure in October 2019 (ref: GS-6403563) notes that there are no surface water bodies within 250m of the site. The report also notes that there are no surface water abstractions recorded within 2000m of the site.
- 3.4.2 The River Thames is located approximately 680m to the north-east. The River Kennet is approximately 530m to the south-east.
- 3.4.3 The site is wholly located within Environment Agency (EA) Flood Zone 1.
- 3.4.4 The site is at Very Low Risk of flooding from rivers and the sea.
- 3.4.5 Review of EA mapping indicates that the majority of the site is at Very Low Risk of surface water flooding. However, parts of the public footway beyond the western and south-western extents of the site are classed as having a Low Risk of surface water flooding with surface water flowing from both Friar Street to the south and Caversham Road to the north. There is a small area to the south of the existing Church Centre which is indicated to be at Low Risk of surface water flooding.
- 3.4.6 Conversations with members of the Church have confirmed that there have historically been surface water flood events at the low point of the public footpath to the north-western corner of the existing Church Centre. A site walkover has confirmed visual evidence of past flooding in this area which appears likely to have been caused by over capacity of the Thames Water sewers and/or blockage of the footpath gully. Refer to Appendix D for site photographs.
- 3.4.7 The site is not at risk of flooding from artificial sources including canal and reservoir breach.

3.5. **Hydrogeology**

- 3.5.8 Hydrological mapping indicates that the site is situated above a Principal Aquifer. The superficial deposits are classified as a Secondary Aquifer. The groundwater vulnerability for the site is classed as Major.

3.5.9 The site hydrogeology is summarised in Table 3.2.

Table 3.2: Summary of Hydrogeology

Type	Description
Bedrock (Seaford Chalk Member and Newhaven Chalk Formation)	Principal Aquifer
Superficial (Taplow Gravel)	Secondary Aquifer
Soil Leaching Potential	Major Aquifer / High Leaching Potential (HU)
Source Protection Zone	None recorded within 1000m of the site
Groundwater Abstractions	One recorded within 100m of the site (groundwater/potable)

3.5.10 The site is considered to have Moderate – High sensitivity with respect to hydrogeology.

3.5.11 Groundwater levels beneath the site are currently unknown and are subject to confirmation through site investigation.

3.5.12 Ground investigation works will confirm the suitability infiltration based drainage systems on site in accordance with BRE 365.

3.6. Existing Drainage

3.6.13 A CCTV and utility survey/topographical survey was undertaken by MK Surveys in December 2012 (ref: 17869 GRE-4). The survey drawing is contained in Appendix C.

3.6.14 Thames Water are the incumbent sewerage utility provider for the area. The utility survey confirms foul water, surface water and combined sewer are present on the site. Thames Water Asset Records have been requested but were not available at the time of writing.

3.6.15 Two Thames Water surface water sewers (1 No. 375mm diameter and 1 No. unknown diameter) and a foul water sewer (1 No. 225mm diameter) run adjacent to the south-western site boundary and beyond the western site extent.

3.6.16 A 100mm diameter surface water sewer from the site discharges into the 375mm diameter Thames Water surface water sewer. A 100mm diameter combined sewer from the site discharges into the 225mm diameter Thames Water foul water sewer. Connections are made from the site to the Thames Water under the public footpath to the south-west of the site.

3.6.17 The car park is drained via gullies and slot drainage along the north-western extents.

3.6.18 Surface water flows from the site are currently unrestricted and discharge to the Thames Water surface water and foul water sewers.

3.6.19 Verbal feedback suggests the presence of an underground soakaway at the north-east corner of the main Church building and the Memorial Hall. However, several site walkovers have been unable to locate any evidence of a soakaway.

3.7. Brownfield Runoff Rates

3.7.20 The brownfield runoff rates were calculated using MicroDrainage by considering the existing impermeable area of the whole site and modelling the 100mm diameter surface water pipe identified on the survey undertaken by MK Surveys. Refer to Appendix E for the supporting calculations. The calculated brownfield rates are summarised in Table 3.3 below.

Table 3.3: Brownfield Runoff Rates

Return Period	Brownfield Runoff Rate (litres/second)
1 in 2 year	14.30
1 in 30 year	14.90
1 in 100 year	15.00

- 3.7.21 For the 1 in 30 year storm event, approximately 9 m³ of flooding occurred under existing drainage conditions within the model.
- 3.7.22 For the 1 in 100 year storm event, approximately 18 m³ of flooding occurred under existing drainage conditions within the model.
- 3.7.23 It is assumed that the 100mm pipe is throttling the flow as the capacity in the existing system is insufficient. As the flows from the site are currently unrestricted, the MicroDrainage model suggests that the throttling action of the outflow pipe causes flooding in approximately the 1 in 10 year return period and greater. This would be reinforced by the EA mapping which marks this area of the site as at Low Risk from surface water flooding.
- 3.7.24 Therefore, the brownfield runoff rate currently discharging into the Thames Water surface water sewers can reasonably be taken to be in the order of 15 L/s.
- 3.7.25 It should be noted that a proportion of the existing Church Roof currently drains via a combined sewer which in turn connects to the Thames Water foul drainage network. Therefore, in practice, during large storm events there will actually be a greater total discharge from the site than 15 L/s.

4.0 SURFACE WATER

4.1. Surface Water Strategy

- 4.1.1 As part of the Phase 2 drainage strategy, the surface water runoff from Phase 1 has also been considered and managed.
- 4.1.2 There is an existing combined sewer which runs through the car park. As part of the Phase 2 strategy, this combined sewer will be removed and replaced with separate foul water and surface water drainage. This will reduce the burden on the existing Thames Water foul sewer.
- 4.1.3 The new Church Centre extends south east circa 3.7m – 4.7m further than the existing Church Centre. The structure of the new Church Centre therefore clashes with the existing surface water connection from the site to the Thames Water surface sewer that runs adjacent to the south-western site boundary and beyond the western site extent. This connection will therefore need to be made redundant and a new connection formed. The new connection will be subject to a Section 106 Agreement with Thames Water.
- 4.1.4 Following the SuDS discharge hierarchy, it is best practice to discharge surface water to the ground via infiltration where possible. As mentioned previously, no intrusive site investigation has been undertaken at the time of writing. A desktop assessment of the underlying soil conditions does however suggest that infiltration may be viable as a means of surface water disposal. As part of the ground investigation, the viability of infiltration as a means of surface water disposal will be confirmed via infiltration tests to BRE 365.
- 4.1.5 Until the viability of infiltration has been confirmed, two alternative drainage strategies have been produced. Option A assumes a favourable infiltration rate and Option B assumes an unfavourable infiltration rate. The option taken forward is subject to the results of the ground investigation.

4.2. Option A (infiltration)

- 4.2.6 For the purpose of design, an infiltration rate of 1×10^{-4} m/s has been assumed. From a desktop assessment of the underlying soil conditions, this is considered to be appropriate. Once the results of the ground investigation are available, the design will need to be reviewed and updated.
- 4.2.7 Infiltration into the surrounding ground will be achieved by using an infiltration device beneath the car park.
- 4.2.8 The target strata for the formation level of the infiltration device is brown sand and gravel. As discussed in Section 3.3, based on historical borehole information from 35-43 Greyfriars Road, the likely depth of the target strata is 2.3m – 7.00m bgl.
- 4.2.9 Storm events up to and including the 1 in 30 year return period will be contained within the infiltration device with no discharge off site. A high level overflow from the soakaway will allow storm events beyond the 1 in 30 year event to discharge into the existing Thames Water sewer. The overflow discharge rate will be restricted to no more than the brownfield rate of 15 L/s. Storm events up to and including the 1 in 100 year return period with a 40% allowance for climate change will be managed on site with no flooding.
- 4.2.10 A catch pit will be installed directly upstream of the soakaway to intercept any silt and sediment which may make its way into the soakaway and the existing Thames Water sewer network. This will help reduce the risk of clogging or blockage of the system.

4.2.11 By utilising infiltration, the volume and rate of discharge from the site will be notably improved when compared with existing conditions and attenuation has been provided for storm events which previously would risk flooding the site. The burden on the existing Thames Water sewer network has also been reduced.

4.2.12 The half drain time of the soakaway will be less than 24 hours. Please refer to calculations in Appendix F for details.

4.3. **Option B (no infiltration)**

4.3.13 For the purpose of design, it is assumed infiltration is not viable. Attenuation of surface water will be achieved by using cellular storage beneath the car park.

4.3.14 Storm events up to and including the 1 in 100 year event with a 40% allowance for climate change will be contained within cellular storage. The outfall in the existing Thames Water sewer will be via a flow control device with the discharge rate restricted to the brownfield rate of 15 L/s.

4.3.15 A catch pit will be installed directly upstream of the cellular storage to intercept any silt and sediment which may make its way into the cellular storage and the existing Thames Water sewer network. This will help reduce the risk of clogging or blockage of the system.

4.3.16 By introducing a flow control and cellular storage, the volume of surface water generated and discharge from the site is being managed and attenuation has been provided for storm events which previously would risk flooding the site. The burden on the existing Thames Water sewer network has also been reduced.

4.3.17 Please refer to calculations in Appendix F for details.

4.4. **Surface Water Volume**

4.4.1 As shown in Table 3.1 the total impermeable area of Phase 2 contributing to the drainage network has not been increased as a result of the development.

4.4.2 Surface water flows on site are currently unrestricted. Therefore, any surface water attenuation provided as part of the proposals will create significant betterment when compared with existing conditions with attenuation provided for storm events which would previously risk flooding the site. The burden on the existing Thames Water sewer network has also been reduced.

4.4.3 In Option A and Option B, the volume of surface water up to and including the 1 in 100 year return period storm including an allowance for 40% climate change will be contained on site with no flooding.

4.5. **Surface Water Quality**

4.5.1 The SuDS components within the surface water drainage strategy have been designed in accordance with the guidance set-out in the SuDS Manual C753.

4.5.2 Treatment within SuDS components is essential for frequent low intensity and duration rainfall events, where urban contaminants are being mobilised and washed off urban surfaces and the aggregated contribution to the total pollutant load to the receiving surface water body is potentially high. For rainfall events greater than the 1 in 1 return period, the pollutants become diluted and the environmental risks will be reduced which means that the SuDS treatment process becomes less crucial. Treatment effectiveness is strongly linked to the hydraulic control of runoff, in particular velocity control and retention time.

- 4.5.3 Table 26.2 of the CIRIA SuDS Manual provides the pollution hazard indices for different land use classifications applicable to the site as shown in the table below.

Table 4.1: CIRIA Pollution hazard indices for different land use classifications

Land Use	Pollution Hazard Level	Total Suspended Solids (TSS)	Metals	Hydro-carbons
Individual property driveways, residential car parks, low traffic roads, car parks with infrequent change	Low	0.5	0.4	0.4

- 4.5.4 Surface water runoff from the site will be from a small car park with very infrequent change and runoff from rooftops. Therefore the level of pollution associated with the site is deemed to be low.
- 4.5.5 The use of proprietary products such as catchpits/silt traps will be utilised to remove any solids from the flow prior to discharge into the cellular storage/infiltration device. As per table 26.3 in the CIRIA SuDS Manual, the use of such devices will result in acceptable levels of pollution mitigation and provide sufficient water quality for receiving waterbodies/sewers.
- 4.5.6 Due to the size and projected use of the car park it is not considered necessary to install petrol interceptors as part of this scheme.

5.0 FOUL WATER

5.1. Foul Water Drainage Strategy

- 5.1.1 The foul water for Phase 2 will be generated from toilets, hand basins and sinks from the new Church Centre. Foul water will be conveyed via gravity towards the existing Thames Water foul water sewer that runs adjacent to the south-western site boundary and beyond the western site extent.
- 5.1.2 There is an existing combined sewer which runs through the car park. As part of the Phase 2 strategy, this combined sewer will be removed and replaced with separate foul water and surface water drainage. This will reduce the burden on the existing Thames Water foul water sewer.
- 5.1.3 The new Church Centre extends south east circa 3.7m – 4.7m further than the existing Church Centre. The structure of the new Church Centre therefore clashes with the existing foul water connection from the site to the Thames Water foul sewer that runs adjacent to the south-western site boundary and beyond the western site extent. This connection will therefore need to be made redundant and a new connection formed. The new connection will be subject to a Section 106 Agreement with Thames Water.
- 5.1.4 The Phase 2 foul water flows are presented in Table 5.1 below. The rates have been calculated using the Unit Discharge Method.

Table 5.1: Summary of Foul Design Loads

	Net Discharge from units (L/s)	Estimated foul flow rate (L/s)	Total Volume of flow (m ³ /day)
Phase 1 Existing	38.9	3.1	269
Phase 2 Existing	21.0	2.3	198
Phase 2 Proposed	41.5	3.2	278
TOTAL foul flow		6.3	

- 5.1.5 As can be seen in the table above, there is an increase of around 0.9 L/s between the current and proposed Phase 2 Church Hall foul water flows. However, this is not anticipated to cause any capacity issues within the 225mm Thames Water sewer due to the removal of surface water runoff from the sewer as explained in Section 5.1.2 above.
- 5.1.6 The foul water strategy and calculations are presented in in Appendix F.

6.0 SCHEDULE OF MAINTENANCE

6.1. Introduction

6.1.1 The maintenance of SuDS features is vital ensuring that they work as efficiently as they set out to do. Maintenance activities can be broadly defined as:

- Regular maintenance – basic tasks carried out regularly
- Occasional maintenance – tasks that are required periodically but on a much less frequent basis
- Remedial maintenance – tasks required when a fault needs rectifying and often includes unforeseen events

6.1.2 The above and below ground SuDS components will remain privately owned and will be maintained by Greyfriars Church post development.

6.1.3 During construction, it is the responsibility of the Principal Contractor to ensure the relevant management and maintenance requirements outlined below are implemented. The principal contractor will retain responsibility during construction up to the handing over.

6.2. Soakaways

Construction

6.2.1 Construction vehicles and equipment not directly involved in the construction of the soakaways will be kept away from these areas. The construction activities should not clog the infiltration system or compact the underlying soils. Silt fences, staged excavation works and temporary drainage swales/bunds to divert runoff away from exposed areas will be utilised, as appropriate, to manage the risks associated with, and to intercept the discharge of sediment laden runoff from discharging into the soakaway.

6.2.2 Excavations for the pervious pavement installation should aim to be undertaken in times of dry weather, when possible, to prevent mobilisation of sediments from exposed surfaces during rainfall events.

Maintenance Schedule

6.2.3 Table 6.1 shows the operation and maintenance requirements for the detention basins, taken from the CIRIA C753 SuDS Manual.

Table 6.1: Operation and maintenance requirements for soakaways

Maintenance Schedule	Required Action	Typical frequency
Regular maintenance	Inspect for sediment and debris in pre-treatment components and floor of inspection tube or chamber and inside of concrete manhole rings	Annually
	Cleaning of gutters and filters on downpipes	Annually (or as required based on inspections)
	Trimming any roots that may be causing blockages	Annually (or as required)
Occasional Maintenance	Remove sediment and debris from pre-treatment components and floor of inspection tube or chamber and inside of concrete manhole rings	As required, based on inspections

Remedial Action	Reconstruct soakaway and/ or replace or clean void fill, if performance deteriorates or failure occurs	As required
	Replacement of clogged geotextile (will require reconstruction of soakaway)	As required
Monitoring	Inspect silt traps and note rate of sediment accumulation	Monthly in the first year and then annually
	Check soakaway to ensure emptying is occurring	Annually

6.3. **Proprietary Treatment Systems**

- 6.3.1 The proprietary treatment systems include conventional pipework, gullies, catchpits, manholes, channels and headwalls.

Construction

- 6.3.2 During construction the principal contractor must ensure that preventative measures have been put in place as to not allow the construction runoff drain into the system. Measures must be taken to ensure debris from the construction site does not block the components. Routine inspections should be undertaken ensuring that the drainage is functioning properly. Outfalls must be constructed to the correct level and all joints must be correctly sealed. During construction backfill should be correctly installed as specified as per the manufactures' recommendations.

Maintenance Schedule

- 6.3.3 The maintenance schedule for the aforementioned SuDS have been adopted from the SuDS Manual C753 and are summarised in Table 6.2.

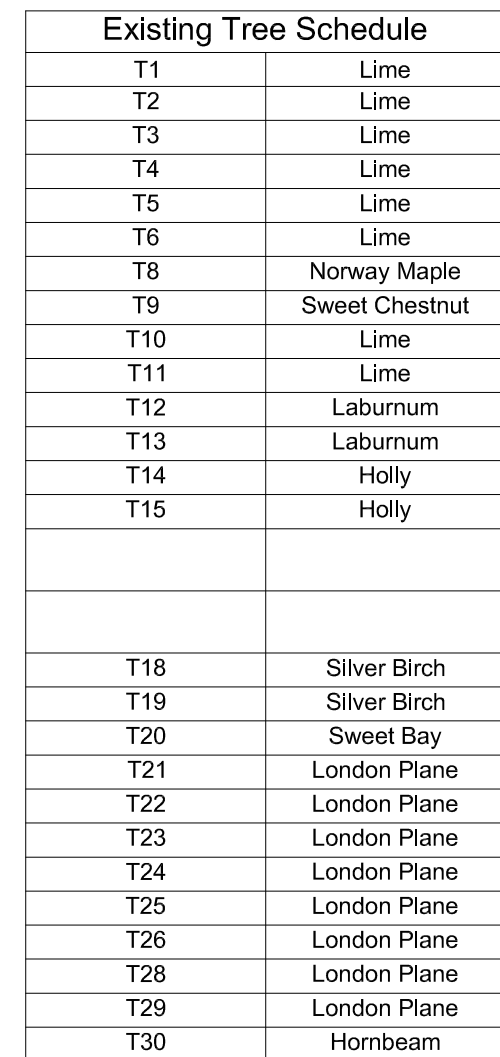
Table 6.2: Proprietary Treatment Systems

Maintenance Schedule	Required Action	Typical Frequency
Regular maintenance	Remove litter and debris	Monthly (or as required)
	Monitoring	Inspect monthly
Occasional maintenance	Sediment management	Annually or as required
Remedial maintenance	Structure rehabilitation/repair	As required

7.0 CONCLUSION

- 7.1.4 CampbellReith have prepared this drainage strategy and maintenance statement to support a Planning Application for Phase 2 at Greyfriars Church, Reading.
- 7.1.5 The surface water drainage strategy has been designed in accordance with the NPPF and accompanying guidance and technical standards for SuDS.
- 7.1.6 A desktop assessment of the underlying soil conditions suggests that infiltration may be viable as a means of surface water disposal. As part of the ground investigation, the viability of infiltration as a means of surface water disposal will be confirmed via infiltration tests to BRE 365.
- 7.1.7 Until the viability of infiltration has been confirmed, two alternative drainage strategies have been produced. Option A assumes a favourable infiltration rate and Option B assumes an unfavourable infiltration rate. The option taken forward is subject to the results of the ground investigation.
- 7.1.8 In both options, the volume of surface water generated and discharge from the site is being managed and attenuation has been provided for storm events which previously would risk flooding the site. The burden on the existing Thames Water sewer network has also been reduced.
- 7.1.9 In accordance with the CIRIA Pollution Hazard Indices the proposed development is considered a Low pollution hazard. The use of the proposed SuDS is suitable to effectively treat suspended solids and metals.
- 7.1.10 The foul water from the development will be disposed of via gravity to the existing Thames Water foul water sewer that runs adjacent to the south-western site boundary and beyond the western site extent.
- 7.1.11 As part of the proposals, the existing combined water sewer which flows through the site will be split into separate foul and surface water sewers. This will reduce the demand on the existing foul water network and will reduce the likelihood of surcharge from storm water creating foul/combined flooding during storm events.
- 7.1.12 The maintenance of SuDS features is vital ensuring that they work as efficiently as they set out to do. The onsite below ground SuDS components will be maintained by the Church.

Appendix A: Site Location and Existing Site Layout



1 No deviation may be made from the
1 details shown on this drawing without
1 prior permission of the architects. Any
discrepancy found between this
drawing and another document
should be referred immediately to the
architects. IF IN ANY DOUBT ASK.

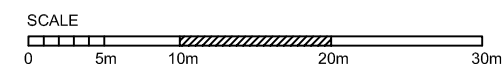
2 This drawing is to be removed from
2 currency immediately a revised version
is issued.

3 All rights described in chapter IV of the
Copyright, Desings and Patents Act of
3 1988 have been generally asserted.

JBKS Architects
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Suite 1, Parkwood Stud, London Road,
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Tel: (01844) 350101

Job	Greysfriars Church Centre, Reading		
title	Existing Site Plan		
scale	1:500	@	A3
date	September 2019		
no	GRE CENT 151		00

1 Existing Site Plan



Appendix B: Proposed Layout



NOTES

No deviation may be made from the details shown on this drawing without prior permission of the architects. Any discrepancy found between this drawing and any other document should be referred immediately to the architects. **IF IN ANY DOUBT ASK.**

This drawing is to be removed from currency immediately a revised version is issued.

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REVISIONS			
PLANNING			
JBKS Architects © architects urban designers landscape and product designers Suite 1, Parkwood Stud, London Road, Aston Rowant, Oxon, OX49 5SP Tel: (01844) 350101			
Job	Greystones Church Centre, Reading		
title	Proposed Block plan		
scale	1:500	@	A3
date	September 2019		
no	GRE CENT 171		00

Appendix C: Topographical and Utility Survey

KEY

GENERAL		TELECOM POLE	
(ACP)	ASSUMED CONNECTION POINT	VP	VENT PIPE
BN	LITTER BIN	WM	WATER METER
CHW	CHEMICAL WATER	WO	WASH OUT
COW	CABLE ON WALL	WR	WATER RISER
CW	COMBINED WATER	WVWELL	WET WELL
DIS	DISUSED	DEPTHS	
DK	DROP KERB	d	ELECTRONICALLY DERIVED
EOT	END OF TRACE	Pd	PASSIVELY DERIVED
FO	FIBRE OPTIC	Pd	DEPTH TO CROWN
FP	FOOTPATH	Id	DEPTH TO INVERT
FW	FOUL WATER	Sd	DEPTH TO SOFFIT
GP	GATE POST	MATERIALS	
GPR	GROUND PENETRATING RADAR	AC	ASBESTOS CEMENT
HV	HIGH VOLTAGE	ALK	ALKATHENE
KV	KILO VOLT	BK	BRICK
LB	LETTER BOX	CI	CAST IRON
LV	LOW VOLTAGE	CO	CONCRETE
NDI	NO DEPTH INFORMATION	DI	DUCTILE IRON
NFI	NO FURTHER INFORMATION	HDPE	HIGH DENSITY PE
NPV	NO PIPES VISIBLE	MDPE	MEDIUM DENSITY PE
OSBM	ORDNANCE SURVEY BENCHMARK	PE	POLYETHYLENE
POW	PIPE ON WALL	PER	PERFORATED
RED	REDUNDANT SERVICE	PVC	POLYVINYL CHLORIDE
RMAIN	RISING MAIN	SI	SPUN IRON
RW	RETAINING WALL	ST	STEEL
SA	SURVEY ABANDONED	URIB	ULTRA RIB
SW	SURFACE WATER	VC	VITRIFIED CLAY
UTL	UNABLE TO LIFT	FENCES	
UTS	UNABLE TO SURVEY	BW	BARBED WIRE FENCE
VL	WATER LEVEL	CB	CLOSED BOARDED FENCE
WD	BACK DROP LEVEL	CPL	CONCRETE PANEL FENCE
BL	BASE LEVEL	CI	CORRUGATED IRON FENCE
CL	COVER LEVEL	CNP	CHAIN LINK FENCE
FL	FLOOR LEVEL	CL	CHAIN LINK FENCE
IL	INVERT LEVEL	IR	IRON RAILINGS
RL	ROOF LEVEL	PR	POST AND RAIL FENCE
SOF	SOFFIT LEVEL	PW	POST AND WIRE FENCE
WL	WATER LEVEL	WM	WIRE MESH FENCE

LEVELS	
BD	BACK DROP LEVEL
BL	BASE LEVEL
CL	COVER LEVEL
FL	FLOOR LEVEL
IL	INVERT LEVEL
RL	ROOF LEVEL
SOF	SOFFIT LEVEL
WL	WATER LEVEL

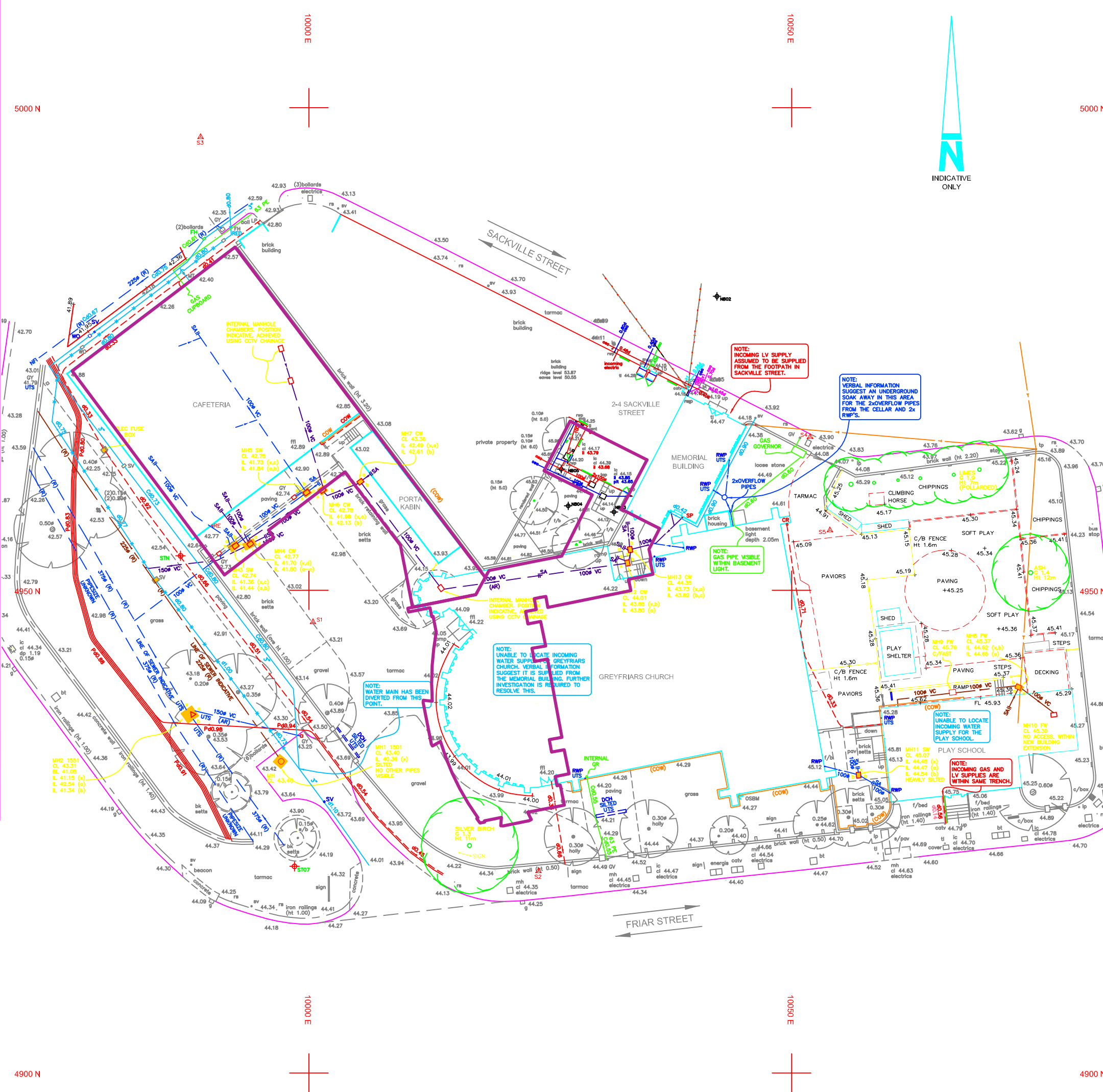
APPARATUS	
AV	AIR VENT
BB	BELISHA BEACON
BO	BOLLARD
BOL	BOLLARD LIGHT
BS	BUS STOP
BT	BT INSPECTION COVER
CATV	CABLE TELEVISION
CB	CONTROL BOX
CPIT	CATCH PIT
CR	CABLE RISER
DCH	DRAINAGE CHANNEL
EB	ELECTRIC CONTROL BOX
EP	ELECTRIC POLE
ER	EARTH ROD
FFP	FUEL TANK FILL POINT
FH	FIRE HYDRANT
GR	GAS RISER
QV	GAS VALVE
QY	GULLY
IC	INSPECTION COVER
INT	INTERCEPTOR
KOB	KERB OUTLET
LD	LOOP DETECTOR
LH	LAMP HOLE
LP	LAMP POST
MP	MANHOLE
MT	METER
MWELL	MONITORING WELL
PO	POST
PTG	PIPE TO GROUND
PU	PUMP
RS	ROAD SIGN
RWP	RAIN WATER PIPE
SC	STOP COOK
ST	SOIL PIPE
ST	STAY CABLE
SV	SOIL VENT PIPE
SV	SOIL VALVE
TGB	TELEPHONE CALL BOX
TL	TRAFFIC LIGHT
TLC	TRAFFIC LIGHT COVER

SERVICE TYPE	
CATV/DATA	
ELECTRICITY (HV)	
ELECTRICITY (LV)	
FUEL	
GAS	
OVERHEAD ELECTRIC	
OVERHEAD TELECOM	
CHEMICAL SEWER	
FOUL SEWER	
TELECOM	
UNKNOWN SERVICE	
WATER	

CAUTIONARY NOTES

- Electromagnetic techniques have been used in the location of underground services, the results are not infallible and trial excavations must be carried out in order to confirm identification, position and in particular depth of the service, where these are critical.
- Ground Penetrating Radar (GPR) techniques have been used in the location of non metallic services (including fibre optic) wherever record information or surface scanning indicates the existence of a particular service. The interpretation of these results is not infallible and success will depend on a number of factors including soil type, ground water levels and surface conditions, hence trial excavations must be carried out in order to confirm identification, position and in particular depth of the service, where these are critical.
- Depths derived via electromagnetic detection are usually taken to the centre of the conductor (cable, metallic pipe) and those derived via Ground Penetrating Radar are usually to the top of the service.
- Where cable routes cannot be individually selected for tracing, any one trace could be a single cable or a cluster of cables.
- The locations of 'pot-ended' cables are often difficult to detect and although we will make all reasonable efforts to locate or transpire this information from records, we cannot guarantee that 'pot-ended' cables do not exist on this site.
- Drainage information has been obtained without man entry into the chamber and MK Surveys presume that sewers are straight between chambers.
- Pipe / Duct sizes are shown from visual inspection or taken from record information. Pipe sizes are recorded in millimetres and depths in metres.
- Water and Gas services to individual properties are often of a size that cannot be detected using Electromagnetic or GPR investigation, whenever possible the route will be added from surface evidence (pipe risers, valves, etc), but this should be viewed as a guide only.
- MK Surveys cannot confirm when services are redundant and unless there is surface evidence of a redundant service, cannot guarantee being able to locate all redundant services.
- Wherever possible the results of our investigations will be cross referenced with record information and where there is further information available and this cannot be detected on site, the information will be added to the drawing and indicated as such (R). However it should be noted that the completeness and accuracy of the records cannot be guaranteed.
- The utility information has been compiled from non-intrusive survey techniques; it always remains possible that there are additional services within the survey boundary that we have not been able to detect. We recommend that care is taken on site and that all service records are used in conjunction with this survey.
- The responsibility for avoiding damage to assets and services on site shall be that of the persons proposing to excavate within the surveyed area, who shall be liable to the asset owner and any third party who may be affected in any way for any loss or damage.

ALWAYS EXERCISE CAUTION WHEN EXCAVATING.



- Notes:**
- GRID AND LEVELS BASED UPON TOPOGRAPHICAL SURVEY PRODUCED BY MIDLAND SURVEYS LTD DRAWING No. 5905/1. SUPPLIED BY CLIENT.
 - MK SURVEYS HAVE UPDATED TOPOGRAPHICAL SURVEY IN THE AREA OF THE PLAY SCHOOL.
 - UTILITY AND SERVICE INFORMATION ADDED TO TOPOGRAPHICAL SURVEY PRODUCED BY MIDLAND SURVEYS LTD. DRAWING No. 5905/1. DATE JAN 2003. NO SITE VERIFICATION CARRIED OUT BY MK SURVEYS UNLESS SPECIFIC TO UTILITIES.
 - DRAINAGE INFORMATION HAS BEEN DETERMINED WITHOUT MAN ENTRY INTO CHAMBERS AND WHILST EVERY EFFORT HAS BEEN MADE TO CORRECTLY IDENTIFY THIS INFORMATION, IT SHOULD ALWAYS BE CHECKED IN AREAS THAT ARE CRITICAL TO THE FUTURE PROPOSAL.
 - ALL SEWERS ARE PRESUMED TO BE STRAIGHT BETWEEN CHAMBERS.

Coordinate Table			
Station	Description	Easting	Northing
S1	HHH Nail	10000.414	4946.715
S2	HHH Nail	10023.777	4920.905
S3	HHH Nail	9968.771	4996.961
S4	HHH Nail	10051.920	4965.897
S5	HHH Nail	10053.972	4956.227
ST07	Road Nail	9998.506	4921.403
			44.330

GREYFRIARS CHURCH, FRIAR STREET, READING EXTERNAL UNDERGROUND SERVICES SURVEY REPORT

Date: 11th December 2012
Job No: 17869

General
Record information was obtained from Openreach (telecom), Scottish and Southern Energy (electric), Scotia (gas), Thames Water (water mains/sewers) and Virgin Media (CATV). Additional record information was requested from Linesearch however no apparatus was affected.

Abbreviations Key

RD - Radiodetection. The RD8000 is an electromagnetic detector, which can transmit a signal onto a metallic service, and locate it from the surface.
GPR - Ground Penetrating Radar. Used to scan the variations in ground signature from the surface by radar. Success is dependent on favourable ground conditions.
HV - High Voltage. Any electricity cables 11kV and above.
LV - Low Voltage. Any electricity cables below 11kV.

Drainage
Drainage was lifted with pipe sizes and invert levels recorded. Wherever possible the chamber sizes have been recorded and positioned on the drawing. All connections from gullies, external rainwater pipes and external soil stacks have been proven wherever possible into manholes and sewer runs. We were unable to CCTV survey manholes 1501 and 1551 as they were too deep and heavily silted at time of survey. Record information has been added to the drawing where necessary. The outfall for manhole 11 could not be proven as the 1000 VC pipe was heavily blocked at time of survey.

Water
Water pipes are plastic/metallic and have therefore been located using both GPR/RD methods with depths recorded to the pipe. Due to the small size of the pipes the location and the depth can easily be misinterpreted, and therefore trial excavations are recommended to confirm these locations. The Thames water main (west) has been re-diverted however the old main is still present (assumed redundant). We were unable to locate the incoming supply for the Greyfriars Church. Verbal information suggests it is supplied from the memorial building. The incoming supply for the Play School is supplied from Friar street.

Gas
Gas pipes are plastic and have therefore been located using GPR methods with radar-derived depths recorded to the top of the pipe. Due to the small size of the pipes the location and the depth can easily be misinterpreted, and therefore trial excavations are recommended to confirm these locations.

Electricity
Electricity cables on site have been traced with electronically derived depths recorded. There was no access to the local SSE sub stations therefore the HV routes were located using the power sweep function on the RD receiver. This method of location only allows for an average depth and position recording, therefore in areas where PD is indicated trial excavations are recommended to confirm position, depth and number of cables in any one sweep.

Telecom
All telecom ducts have been traced with depths recorded. Due to laws protecting British Telecom apparatus all ducts have been located using remote detection techniques only and compared with record information. Chamber sizes have been recorded using GPR techniques wherever possible. For further information regarding BT apparatus please contact Openreach directly.

CATV
All CATV covers have been lifted with ducts traced between. Electronically derived depths have been recorded along the traced routes. The number of ducts along any one trace has been recorded, and indicated adjacent to the draw pit chambers. Please note that empty ducts cannot always be traced and are therefore assumed or added to the drawing from the record information wherever necessary.

SEE CAUTIONARY NOTES WITHIN THE UTILITY KEY

Revision	Description	Date
R1	Depth of basement light added to north facing wall of Greyfriars Church.	15/01/2013

40 years old in 2012
mksurveys
www.mksurveys.co.uk
Tel 01908 503551
Tel 01908 504079
Tel 01562 545050
Tel 02476 017060
Tel 01403 884654
Milton Keynes
Oxford
Kidderminster
Nuneaton
Hinckley
enquiries@mksurveys.co.uk
midsurveys@mksurveys.co.uk
nuneaton@mksurveys.co.uk
hinckley@mksurveys.co.uk

Greyfriars Church

Greyfriars Church Friar Street Reading

CCTV and Utility Survey/Topographical Survey Update

Scale	Sheet Size	Sheet Number	Date
1:200	A1	1	December 2012
Project Number	Rev	Surveyed By	Approved By
17869	-	OF/MR/JAG	GL / JS

Appendix D: Site Photographs



Image 1: View looking North towards A329 from NW corner of Church Hall.
Dark lines on wall and paving slabs show signs of past surface water flooding.



Image 2: Existing footway gully.
Clear signs of surface water visible on paving and surface of wall.

Greyfriars Church, Reading

Client: Greyfriars Church

Site Photographs

Footway Gully and Evidence of Flooding

Job Number: 12761
Date: 05/11/2019
Drawn by: AJH
Checked by: MC
Drg No: XXXX
Status/Revision: A
File location: J:\12750-12999\12761 - Greyfriars Church\DOCS\CR Docs\Reports\Drainage Strategy\Appendix D - Site Photographs
Revision History: A, First Issue, 05/11/19

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consulting engineers

LONDON 020 7340 1700 • MANCHESTER 0161 819 3060
REDHILL 01737 784 500 • BIRMINGHAM 0121 766 8009
BRISTOL 0117 916 1066 • www.campbellreith.com

Appendix E: Brownfield Calculations

CampbellReith		Page 1
Raven House 29 Linkfield Lane Surrey RH1 1SS	12761 - Greyfriars Church Brownfield Calc.	
Date 26/09/2019 15:18	Designed by NP	
File 12761 - Brownfield Rate.mdx	Checked by	
XP Solutions	Network 2018.1	

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Storm

Pipe Sizes STANDARD Manhole Sizes STANDARD

FEH Rainfall Model	
Return Period (years)	30
FEH Rainfall Version	2013
Site Location	GB 471350 174150 SU 71350 74150
Data Type	Catchment
Maximum Rainfall (mm/hr)	50
Maximum Time of Concentration (mins)	30
Foul Sewage (l/s/ha)	0.000
Volumetric Runoff Coeff.	0.750
PIMP (%)	100
Add Flow / Climate Change (%)	0
Minimum Backdrop Height (m)	0.200
Maximum Backdrop Height (m)	1.500
Min Design Depth for Optimisation (m)	1.200
Min Vel for Auto Design only (m/s)	1.00
Min Slope for Optimisation (1:X)	500

Designed with Level Inverts

Time Area Diagram for Storm

Time (mins)	Area (ha)	Time (mins)	Area (ha)
0-4	0.153	4-8	0.016

Total Area Contributing (ha) = 0.169

Total Pipe Volume (m³) = 0.175

Area Summary for Storm

Pipe Number	PIMP Type	PIMP Name	PIMP (%)	Gross Area (ha)	Imp. Area (ha)	Pipe Total (ha)
1.000	-	-	100	0.169	0.169	0.169
1.001	-	-	100	0.000	0.000	0.000
				Total	Total	Total
				0.169	0.169	0.169

CampbellReith		Page 3
Raven House 29 Linkfield Lane Surrey RH1 1SS	12761 - Greyfriars Church Brownfield Calc.	
Date 26/09/2019 15:18 File 12761 - Brownfield Rate.mdx	Designed by NP Checked by	
XP Solutions	Network 2018.1	

2 year Return Period Summary of Critical Results by Maximum Outflow (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 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 FEH Data Type Catchment
 FEH Rainfall Version 2013 Cv (Summer) 0.750
 Site Location GB 471350 174150 SU 71350 74150 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, 240, 360, 480, 960, 1440
 Return Period(s) (years) 2, 30, 100
 Climate Change (%) 0, 0, 0

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water	Surcharged	Flooded
									Level (m)	Depth (m)	Volume (m³)
S1.000	S1	15 Winter	2	+0%	2/15 Summer	30/15 Summer			42.698	0.618	0.000
S1.001	S2	15 Winter	2	+0%	2/15 Summer				42.050	0.570	0.000

PN	US/MH Name	Pipe		Status	Level Exceeded
		Flow / Cap.	Overflow (l/s)		
S1.000	S1	2.09	15.4	FLOOD RISK	17
S1.001	S2	1.91	14.3	SURCHARGED	

CampbellReith		Page 4
Raven House 29 Linkfield Lane Surrey RH1 1SS	12761 - Greyfriars Church Brownfield Calc.	
Date 26/09/2019 15:18 File 12761 - Brownfield Rate.mdx	Designed by NP Checked by	
XP Solutions	Network 2018.1	

30 year Return Period Summary of Critical Results by Maximum Outflow (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 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 FEH Data Type Catchment
 FEH Rainfall Version 2013 Cv (Summer) 0.750
 Site Location GB 471350 174150 SU 71350 74150 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, 240, 360, 480, 960, 1440
 Return Period(s) (years) 2, 30, 100
 Climate Change (%) 0, 0, 0

US/MH		Return	Climate	First (X)	First (Y)	First (Z)	Overflow	Water	Surcharged	Flooded	
PN	Name	Storm	Period	Change	Surcharge	Flood	Overflow	Act.	Level (m)	Depth (m)	Volume (m³)
S1.000	S1 15 Summer		30	+0%	2/15 Summer	30/15 Summer			42.789	0.709	9.345
S1.001	S2 30 Winter		30	+0%	2/15 Summer				42.121	0.641	0.000

				Pipe			
		US/MH	Flow / Overflow	Flow	Level		
PN	Name	Cap.	(l/s)	(l/s)	Status	Exceeded	
S1.000	S1	2.27		16.7	FLOOD	17	
S1.001	S2	1.99		14.9	SURCHARGED		

CampbellReith		Page 5
Raven House 29 Linkfield Lane Surrey RH1 1SS	12761 - Greyfriars Church Brownfield Calc.	
Date 26/09/2019 15:18	Designed by NP	
File 12761 - Brownfield Rate.mdx	Checked by	
XP Solutions	Network 2018.1	

100 year Return Period Summary of Critical Results by Maximum Outflow (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 FEH Data Type Catchment
 FEH Rainfall Version 2013 Cv (Summer) 0.750
 Site Location GB 471350 174150 SU 71350 74150 Cv (Winter) 0.840

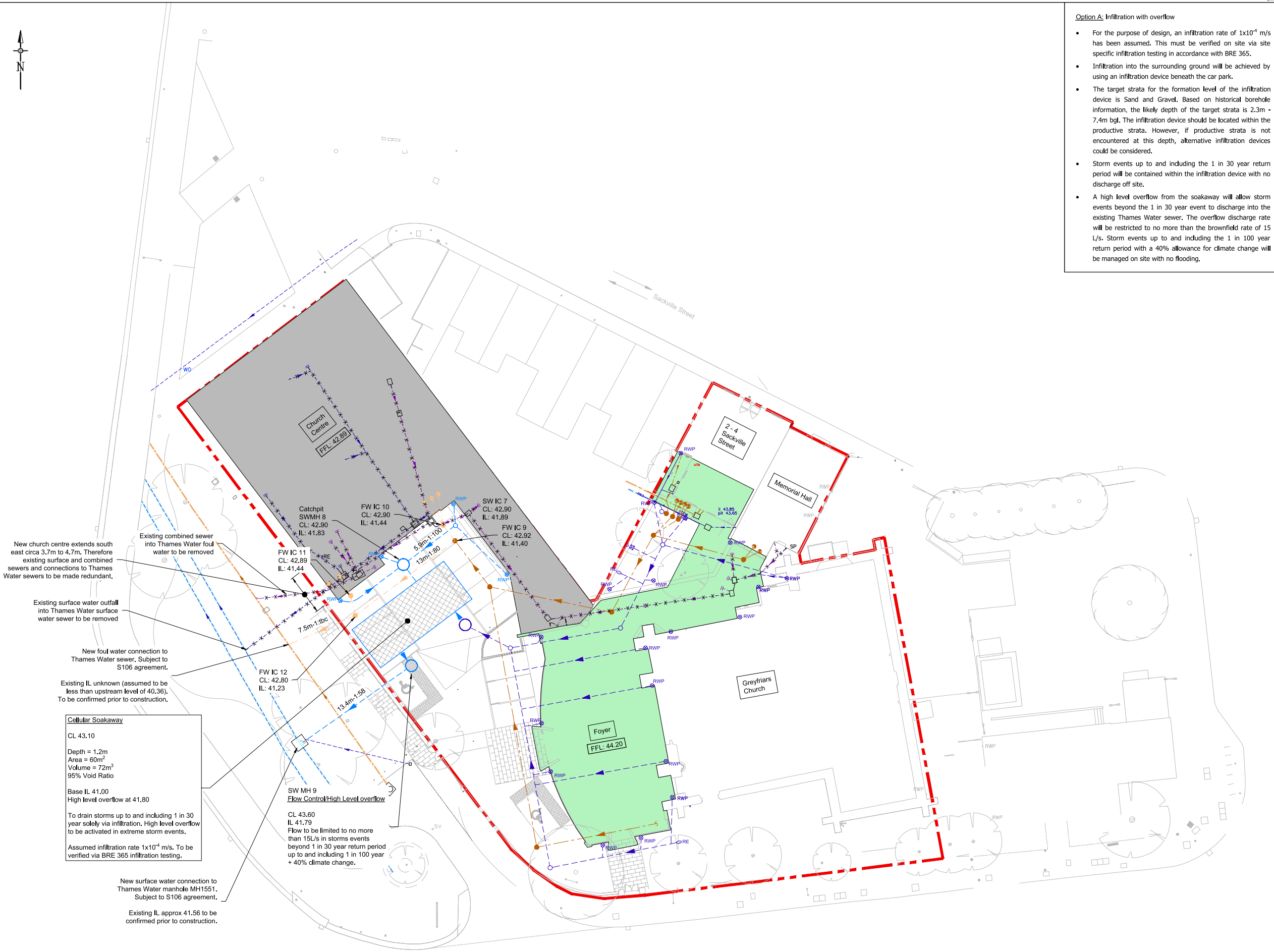
Margin for Flood Risk Warning (mm) 300.0 DVD Status OFF
 Analysis Timestep Fine Inertia Status OFF
 DTS Status ON

Profile(s) Summer and Winter
 Duration(s) (mins) 15, 30, 60, 120, 240, 360, 480, 960, 1440
 Return Period(s) (years) 2, 30, 100
 Climate Change (%) 0, 0, 0

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water	Surcharged	Flooded
									Level (m)	Depth (m)	Volume (m³)
S1.000	S1	15 Winter	100	+0%	2/15 Summer	30/15 Summer			42.798	0.718	18.328
S1.001	S2	30 Winter	100	+0%	2/15 Summer				42.126	0.646	0.000

PN	US/MH Name	Pipe		Status	Level Exceeded
		Flow / Cap.	Overflow (l/s)		
S1.000	S1	2.26	16.6	FLOOD	17
S1.001	S2	2.00	15.0	SURCHARGED	

Appendix F: Proposed Drainage Layout and Supporting Calculations



Cellular Soakaway
CL 43.10
Depth = 1.2m
Area = 60m²
Volume = 72m³
95% Void Ratio
Base IL 41.00
High level overflow at 41.80
To drain storms up to and including 1 in 30 year solely via infiltration. High level overflow to be activated in extreme storm events.
Assumed infiltration rate 1x10⁻⁴ m/s. To be verified via BRE 365 infiltration testing.

**SW MH 9
Flow Control/High Level overflow**
CL 43.60
IL 41.79
Flow to be limited to no more than 15L/s in storms events beyond 1 in 30 year return period up to and including 1 in 100 year + 40% climate change.

New foul water connection to Thames Water sewer, Subject to S106 agreement.
Existing IL unknown (assumed to be less than upstream level of 40.36). To be confirmed prior to construction.

New surface water connection to Thames Water manhole MH1551. Subject to S106 agreement.
Existing IL approx 41.56 to be confirmed prior to construction.

Option A: Infiltration with overflow

- For the purpose of design, an infiltration rate of 1x10⁻⁴ m/s has been assumed. This must be verified on site via site specific infiltration testing in accordance with BRE 365.
- Infiltration into the surrounding ground will be achieved by using an infiltration device beneath the car park.
- The target strata for the formation level of the infiltration device is Sand and Gravel. Based on historical borehole information, the likely depth of the target strata is 2.3m - 7.4m bgl. The infiltration device should be located within the productive strata. However, if productive strata is not encountered at this depth, alternative infiltration devices could be considered.
- Storm events up to and including the 1 in 30 year return period will be contained within the infiltration device with no discharge off site.
- A high level overflow from the soakaway will allow storm events beyond the 1 in 30 year event to discharge into the existing Thames Water sewer. The overflow discharge rate will be restricted to no more than the brownfield rate of 15 L/s. Storm events up to and including the 1 in 100 year return period with a 40% allowance for climate change will be managed on site with no flooding.

Notes

- Do not scale from this drawing on print or electronically. Work from figured dimensions only.
- No deviation from the details on this drawing is allowed without CampbellReith's prior permission in writing.
- Read this drawing with all Architect's, Service Engineer's and CampbellReith's relevant details, specifications and drawings.
- All work is to be done in accordance with the relevant specifications issued by CampbellReith, British Standard Codes of Practice, Statutory Requirements and the Contract Documents.
- Drawing status:**
P: Preliminary Evolving drawings for approvals, tenders, billings etc.
C: Construction Fully developed drawings issued under instructions for construction.
- Only status C drawings to be used for construction.
- Suitability code:
Work in progress
S0 - Work in progress
Shared (Non-contractual)
S1 - For coordination, **S2** - For information, **S3** - For internal review and comment, **S4** - For construction approval.
Documentation (For contractors purposes)
D1 - For Costing, **D2** - For Tender, **D3** - For contractor design, **D4** - for manufacture/procurement.
Construction
A - For construction, **B** - For construction but with comments (i.e. areas in abeyance), **CR** - Construction Record (Final Construction ONLY. Any deviations to that which is on site is not the liability of CampbellReith)

Legend

- Proposed Phase 1 Building
- Proposed Phase 2 Building
- Proposed Drainage**
 - Storm water sewer
 - Storm water manhole
 - Storm water inspection chamber
 - Foul water sewer
 - Foul water manhole
 - Foul water inspection chamber
- Abandoned Drainage**
 - Aco channel
 - Rodding eye
 - Gully
 - Rain water pipe
 - Floor gully
 - Soil vent pipe
 - Sub stack
- Cellular soakaway**
- Existing Drainage**
 - Foul sewer
 - Surface sewer
 - Combined sewer
 - Underground chambers
 - Public Foul sewer
 - Public Surface sewer

P2	Issued for planning	06/11/19	AJH
P1	Issued for information	24/10/19	SVB
Rev	Description	Date	By

CampbellReith
consulting engineers

London 020 7340 1700 Manchester 0161 819 3060
Surrey 01737 784 500 Birmingham 01675 467 484
Bristol 0117 916 1066 Dubai 00 971 4345 7088
www.campbellreith.com

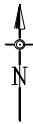
Job Title	Greyfriars Church, Reading
Client	Greyfriars Church

**Proposed Drainage Layout
Option A
Infiltration**

Drawn by	Date made	Scale @ A1	Checked by	Suitability	CR Project
SVB	24/10/19	1:200	MC	S2	12761

Project No.	Originator	Volume	Lvl/Loc	Type	Role	Number	Rev
12761	CRH	XX	XX	DR	C	5050	P2





Option B: Attenuation and controlled discharge

- For the purpose of design, it is assumed infiltration is not viable. Attenuation of surface water will be achieved by using cellular storage beneath the car park.
- Storm events up to and including the 1 in 100 year event with a 40% allowance for climate change will be contained within cellular storage. The outfall to the existing Thames Water sewer will be via a flow control device with the discharge rate restricted to the brownfield rate of 15 L/s.

Notes

- Do not scale from this drawing on print or electronically. Work from figured dimensions only.
- No deviation from the details on this drawing is allowed without CampbellReith's prior permission in writing.
- Read this drawing with all Architect's, Service Engineer's and CampbellReith's relevant details, specifications and drawings.
- All work is to be done in accordance with the relevant specifications issued by CampbellReith, British Standard Codes of Practice, Statutory Requirements and the Contract Documents.
- Drawing status:**
P: Preliminary Evolving drawings for approvals, tenders, billings etc.
C: Construction Fully developed drawings issued under instructions for construction.
- Only status **C** drawings to be used for construction.
- Suitability code:
Work in progress
S0 - Work in progress
Shared (Non-contractual)
S1 - For coordination, **S2** - For information, **S3** - For internal review and comment, **S4** - For construction approval.
Documentation (For contractors purposes)
D1 - For Costing, **D2** - For Tender, **D3** - For contractor design, **D4** - for manufacture/procurement.
Construction
A - For construction, **B** - For construction but with comments (i.e. areas in abeyance), **CR** - Construction Record (Final Construction ONLY). Any deviations to that which is on site is not the liability of CampbellReith)

Legend

- Proposed Phase 1 Building
- Proposed Phase 2 Building
- Proposed Drainage**
 - Storm water sewer
 - Storm water manhole
 - Storm water inspection chamber
 - Foul water sewer
 - Foul water manhole
 - Foul water inspection chamber
- Abandoned Drainage
 - Aco channel
 - Rodding eye
 - Gully
 - Rain water pipe
 - Floor gully
 - Soil vent pipe
 - Sub stack
- Cellular Attenuation Tank
- Existing Drainage**
 - Foul sewer
 - Surface sewer
 - Combined sewer
 - Underground chambers
 - Public Foul sewer
 - Public Surface sewer

New church centre extends south east circa 3.7m to 4.7m. Therefore existing surface and combined sewers and connections to Thames Water sewers to be made redundant.

Existing surface water outfall into Thames Water surface water sewer to be removed

New foul water connection to Thames Water sewer, Subject to S106 agreement.

Existing IL unknown (assumed to be less than upstream level of 40.36). To be confirmed prior to construction.

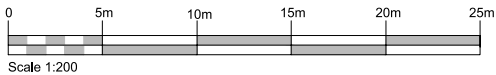
Cellular Storage
CL 43.10
Depth = 0.8m
Area = 67.5m²
Volume = 54m³
95% Void Ratio
Base IL = 41.80

SW MH 9
Flow Control Chamber

CL 43.60
IL 41.79
Flow to be limited to no more than 15L/s.

New surface water connection to Thames Water manhole MH1551. Subject to S106 agreement.

Existing IL approx 41.56 to be confirmed prior to construction.



CampbellReith
consulting engineers

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Job Title
Greyfriars Church, Reading

Client
Greyfriars Church

**Proposed Drainage Layout
Option B
Non-Infiltration**

Drawn by	Date made	Scale @ A1	Checked by	Suitability	CR Project
SVB	24/10/19	1:200	MC	S2	12761

Project No.	Originator	Volume	Lvl/Loc	Type	Role	Number	Rev
12761	CRH	XX	XX	DR	C	5051	P1

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Raven House 29 Linkfield Lane Surrey RH1 1SS	12761 Greyfriars Church Proposed SW	
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File 12761 - Proposed SW (Option A2...	Checked by	
XP Solutions	Network 2018.1	

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Storm

Pipe Sizes 11465 Manhole Sizes 11465

FEH Rainfall Model

Return Period (years)	100
FEH Rainfall Version	2013
Site Location GB 471350 174150 SU 71350 74150	
Data Type	Catchment
Maximum Rainfall (mm/hr)	50
Maximum Time of Concentration (mins)	30
Foul Sewage (l/s/ha)	0.000
Volumetric Runoff Coeff.	0.750
PIMP (%)	100
Add Flow / Climate Change (%)	0
Minimum Backdrop Height (m)	0.200
Maximum Backdrop Height (m)	1.500
Min Design Depth for Optimisation (m)	1.200
Min Vel for Auto Design only (m/s)	1.00
Min Slope for Optimisation (1:X)	500

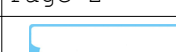
Designed with Level Soffits

Network Design Table for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
S1.000	12.464	0.124	100.5	0.056	5.00	0.0	0.600	o	150	Pipe/Conduit	
S1.001	19.087	0.926	20.6	0.022	0.00	0.0	0.600	o	150	Pipe/Conduit	
S2.000	8.062	0.081	99.5	0.030	5.00	0.0	0.600	o	150	Pipe/Conduit	
S2.001	10.761	0.269	40.0	0.060	0.00	0.0	0.600	o	150	Pipe/Conduit	
S3.000	21.049	1.350	15.6	0.024	5.00	0.0	0.600	o	150	Pipe/Conduit	
S1.002	9.231	0.231	40.0	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S1.000	50.00	5.21	42.850	0.056	0.0	0.0	0.0	1.00	17.7	7.6
S1.001	50.00	5.35	42.726	0.078	0.0	0.0	0.0	2.23	39.4	10.6
S2.000	50.00	5.13	42.150	0.030	0.0	0.0	0.0	1.01	17.8	4.1
S2.001	50.00	5.25	42.069	0.090	0.0	0.0	0.0	1.60	28.2	12.2
S3.000	50.00	5.14	43.150	0.024	0.0	0.0	0.0	2.56	45.3	3.2
S1.002	50.00	5.42	41.800	0.192	0.0	0.0	0.0	2.08	82.5	26.0

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Area Summary for Storm

Pipe Number	PIMP Type	PIMP Name	PIMP (%)	Gross Area (ha)	Imp. Area (ha)	Pipe Total (ha)
1.000	-	-	100	0.056	0.056	0.056
1.001	-	-	100	0.022	0.022	0.022
2.000	-	-	100	0.030	0.030	0.030
2.001	-	-	100	0.060	0.060	0.060
3.000	-	-	100	0.024	0.024	0.024
1.002	-	-	100	0.000	0.000	0.000
				Total	Total	Total
				0.192	0.192	0.192

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)
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S1.002	STW MH 1551	43.300	41.569	0.000	0	0
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Simulation Criteria for Storm

Volumetric Runoff Coeff	0.750	Additional Flow - % of Total Flow	0.000
Areal Reduction Factor	1.000	MADD Factor * 10m ³ /ha Storage	2.000
Hot Start (mins)	0	Inlet Coefficient	0.800
Hot Start Level (mm)	0	Flow per Person per Day (l/per/day)	0.000
Manhole Headloss Coeff (Global)	0.500	Run Time (mins)	60
Foul Sewage per hectare (l/s)	0.000	Output Interval (mins)	1

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	1	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FEH	Summer Storms	Yes
Return Period (years)	100	Winter Storms	Yes
FEH Rainfall Version	2013	Cv (Summer)	0.750
Site Location GB 471350 174150 SU 71350 74150		Cv (Winter)	0.840
Data Type	Catchment	Storm Duration (mins)	30

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Online Controls for Storm

Hydro-Brake® Optimum Manhole: S3, DS/PN: S1.002, Volume (m³): 2.2

Unit Reference	MD-SHE-0182-1500-0400-1500
Design Head (m)	0.400
Design Flow (l/s)	15.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	182
Invert Level (m)	41.800
Minimum Outlet Pipe Diameter (mm)	225
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.400	15.0	Kick-Flo®	0.355	14.2
Flush-Flo™	0.248	15.0	Mean Flow over Head Range	-	10.8

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	6.4	0.800	20.8	2.000	32.3	4.000	45.2	7.000	59.4
0.200	14.8	1.000	23.2	2.200	33.8	4.500	47.4	7.500	61.5
0.300	14.8	1.200	25.3	2.400	35.3	5.000	50.1	8.000	63.6
0.400	15.0	1.400	27.2	2.600	36.7	5.500	52.6	8.500	65.5
0.500	16.7	1.600	29.0	3.000	39.3	6.000	54.9	9.000	67.5
0.600	18.2	1.800	30.7	3.500	42.3	6.500	57.2	9.500	69.3

Storage Structures for Storm

Complex Manhole: S3, DS/PN: S1.002

Cellular Storage

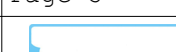
Invert Level (m) 41.000 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.36000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.36000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	60.0	60.0	0.800	60.0	60.0	0.801	0.0	60.0

Cellular Storage

Invert Level (m) 41.800 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	60.0	0.0	0.400	60.0	0.0	0.401	0.0	0.0

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2 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 Time/Area Diagrams 0
 Number of Online Controls 1 Number of Storage Structures 1 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FEH Data Type Catchment
 FEH Rainfall Version 2013 Cv (Summer) 0.750
 Site Location GB 471350 174150 SU 71350 74150 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, 240, 360, 480, 960, 1440
 Return Period(s) (years) 2, 30, 100
 Climate Change (%) 0, 0, 40

										Water Surcharged
PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surchage	First (Y) Flood	First (Z) Overflow	Overflow Act.	Level (m)	Depth (m)
S1.000	S1	15 Winter	2	+0%	30/15 Summer				42.930	-0.070
S1.001	S2	15 Winter	2	+0%	100/15 Summer				42.784	-0.092
S2.000	S3	15 Winter	2	+0%	30/15 Summer	100/15 Winter			42.207	-0.093
S2.001	S3	15 Winter	2	+0%	30/15 Summer				42.145	-0.074
S3.000	S4	15 Winter	2	+0%					43.180	-0.120
S1.002	S3	120 Winter	2	+0%	100/30 Winter				41.255	-0.770

		Flooded		Pipe			
PN	US/MH Name	Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
S1.000	S1	0.000	0.54		8.7	OK	
S1.001	S2	0.000	0.31		11.6	OK	
S2.000	S3	0.000	0.30		4.7	OK	1
S2.001	S3	0.000	0.50		12.6	OK	
S3.000	S4	0.000	0.09		3.7	OK	
S1.002	S3	0.000	0.00		0.0	OK	

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Raven House 29 Linkfield Lane Surrey RH1 1SS	12761 Greyfriars Church Proposed SW	
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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 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 1 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FEH Data Type Catchment
 FEH Rainfall Version 2013 Cv (Summer) 0.750
 Site Location GB 471350 174150 SU 71350 74150 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, 240, 360, 480, 960, 1440
 Return Period(s) (years) 2, 30, 100
 Climate Change (%) 0, 0, 40

								Water Surcharged	
PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surchage	First (Y) Flood	First (Z) Overflow	Overflow Act.	Level (m)
S1.000	S1	15 Winter	30	+0%	30/15 Summer				43.053
S1.001	S2	15 Winter	30	+0%	100/15 Summer				42.824
S2.000	S3	15 Winter	30	+0%	30/15 Summer	100/15 Winter			42.366
S2.001	S3	15 Winter	30	+0%	30/15 Summer				42.335
S3.000	S4	15 Winter	30	+0%					43.196
S1.002	S3	120 Winter	30	+0%	100/30 Winter				41.729

		Flooded		Pipe		Level	
PN	US/MH Name	Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Exceeded
S1.000	S1	0.000	1.21		19.4	SURCHARGED	
S1.001	S2	0.000	0.73		26.9	OK	
S2.000	S3	0.000	0.71		10.9	SURCHARGED	1
S2.001	S3	0.000	1.20		30.3	SURCHARGED	
S3.000	S4	0.000	0.20		8.6	OK	
S1.002	S3	0.000	0.00		0.0	OK	

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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 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 1 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FEH Data Type Catchment
 FEH Rainfall Version 2013 Cv (Summer) 0.750
 Site Location GB 471350 174150 SU 71350 74150 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, 240, 360, 480, 960, 1440
 Return Period(s) (years) 2, 30, 100
 Climate Change (%) 0, 0, 40

									Water	Surcharged
	US/MH		Return	Climate	First (X)	First (Y)	First (Z)	Overflow	Level	Depth
PN	Name	Storm	Period	Change	Surcharge	Flood	Overflow	Act.	(m)	(m)
S1.000	S1 15 Winter		100	+40%	30/15 Summer				43.560	0.560
S1.001	S2 15 Winter		100	+40%	100/15 Summer				43.116	0.240
S2.000	S3 15 Winter		100	+40%	30/15 Summer	100/15 Winter			43.000	0.700
S2.001	S3 15 Winter		100	+40%	30/15 Summer				42.936	0.717
S3.000	S4 15 Winter		100	+40%					43.212	-0.088
S1.002	S3 60 Winter		100	+40%	100/30 Winter				42.131	0.106

Flooded				Pipe		Level	
PN	US/MH Name	Volume (m³)	Flow / Cap.	Overflow (l/s)	Flow (l/s)	Status	Exceeded
S1.000	S1	0.000	1.89		30.5	FLOOD RISK	
S1.001	S2	0.000	1.12		41.2	SURCHARGED	
S2.000	S3	0.168	1.22		18.8	FLOOD	1
S2.001	S3	0.000	1.90		48.0	FLOOD RISK	
S3.000	S4	0.000	0.36		15.2	OK	
S1.002	S3	0.000	0.22		15.0	SURCHARGED	

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Raven House 29 Linkfield Lane Surrey RH1 1SS	12761 Greyfriars Church Proposed SW (Option B)	
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XP Solutions	Network 2018.1	

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Storm

Pipe Sizes 11465 Manhole Sizes 11465

FEH Rainfall Model

Return Period (years)	100
FEH Rainfall Version	2013
Site Location GB 471350 174150 SU 71350 74150	
Data Type	Catchment
Maximum Rainfall (mm/hr)	50
Maximum Time of Concentration (mins)	30
Foul Sewage (l/s/ha)	0.000
Volumetric Runoff Coeff.	0.750
PIMP (%)	100
Add Flow / Climate Change (%)	0
Minimum Backdrop Height (m)	0.200
Maximum Backdrop Height (m)	1.500
Min Design Depth for Optimisation (m)	1.200
Min Vel for Auto Design only (m/s)	1.00
Min Slope for Optimisation (1:X)	500

Designed with Level Soffits

Network Design Table for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
S1.000	12.464	0.124	100.5	0.056	5.00	0.0	0.600	o	150	Pipe/Conduit	
S1.001	19.087	0.851	22.4	0.022	0.00	0.0	0.600	o	150	Pipe/Conduit	
S2.000	8.062	0.081	99.5	0.030	5.00	0.0	0.600	o	225	Pipe/Conduit	
S2.001	10.761	0.269	40.0	0.060	0.00	0.0	0.600	o	225	Pipe/Conduit	
S3.000	21.049	1.275	16.5	0.024	5.00	0.0	0.600	o	150	Pipe/Conduit	
S1.002	9.231	0.231	40.0	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S1.000	50.00	5.21	42.850	0.056	0.0	0.0	0.0	1.00	17.7	7.6
S1.001	50.00	5.36	42.726	0.078	0.0	0.0	0.0	2.14	37.7	10.6
S2.000	50.00	5.10	42.150	0.030	0.0	0.0	0.0	1.31	52.1	4.1
S2.001	50.00	5.19	42.069	0.090	0.0	0.0	0.0	2.07	82.5	12.2
S3.000	50.00	5.14	43.150	0.024	0.0	0.0	0.0	2.49	44.0	3.2
S1.002	50.00	5.43	41.800	0.192	0.0	0.0	0.0	2.08	82.5	26.0

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XP Solutions	Network 2018.1	

Area Summary for Storm

Pipe Number	PIMP Type	PIMP Name	PIMP (%)	Gross Area (ha)	Imp. Area (ha)	Pipe Total (ha)
1.000	-	-	100	0.056	0.056	0.056
1.001	-	-	100	0.022	0.022	0.022
2.000	-	-	100	0.030	0.030	0.030
2.001	-	-	100	0.060	0.060	0.060
3.000	-	-	100	0.024	0.024	0.024
1.002	-	-	100	0.000	0.000	0.000
				Total	Total	Total
				0.192	0.192	0.192

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)
---------------------	--------------	--------------	--------------	------------------	----------	--------

S1.002	STW MH 1551	43.300	41.569	0.000	0	0
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Simulation Criteria for Storm

Volumetric Runoff Coeff	0.750	Additional Flow - % of Total Flow	0.000
Areal Reduction Factor	1.000	MADD Factor * 10m ³ /ha Storage	2.000
Hot Start (mins)	0	Inlet Coefficient	0.800
Hot Start Level (mm)	0	Flow per Person per Day (l/per/day)	0.000
Manhole Headloss Coeff (Global)	0.500	Run Time (mins)	60
Foul Sewage per hectare (l/s)	0.000	Output Interval (mins)	1

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	1	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FEH	Summer Storms	Yes
Return Period (years)	100	Winter Storms	Yes
FEH Rainfall Version	2013	Cv (Summer)	0.750
Site Location GB 471350 174150 SU 71350 74150		Cv (Winter)	0.840
Data Type	Catchment	Storm Duration (mins)	30

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Online Controls for Storm

Hydro-Brake® Optimum Manhole: S3, DS/PN: S1.002, Volume (m³): 2.4

Unit Reference	MD-SHE-0177-1500-0800-1500
Design Head (m)	0.800
Design Flow (l/s)	15.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	177
Invert Level (m)	41.800
Minimum Outlet Pipe Diameter (mm)	225
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.800	15.0	Kick-Flo®	0.590	13.0
Flush-Flo™	0.288	15.0	Mean Flow over Head Range	-	12.5

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	6.3	0.800	15.0	2.000	23.2	4.000	32.4	7.000	42.4
0.200	14.7	1.000	16.7	2.200	24.3	4.500	34.3	7.500	43.9
0.300	15.0	1.200	18.2	2.400	25.3	5.000	36.1	8.000	45.3
0.400	14.7	1.400	19.6	2.600	26.3	5.500	37.8	8.500	46.4
0.500	14.2	1.600	20.9	3.000	28.2	6.000	39.4	9.000	47.8
0.600	13.1	1.800	22.1	3.500	30.4	6.500	40.9	9.500	49.1

Storage Structures for Storm

Tank or Pond Manhole: S3, DS/PN: S1.002

Invert Level (m) 41.800

Depth (m)	Area (m ²)	Depth (m)	Area (m ²)	Depth (m)	Area (m ²)
0.000	68.2	0.800	68.2	0.801	0.0

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2 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 Time/Area Diagrams 0
 Number of Online Controls 1 Number of Storage Structures 1 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FEH Data Type Catchment
 FEH Rainfall Version 2013 Cv (Summer) 0.750
 Site Location GB 471350 174150 SU 71350 74150 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, 240, 360, 480, 960, 1440
 Return Period(s) (years) 2, 30, 100
 Climate Change (%) 0, 0, 40

PN	US/MH		Return Period	Climate Change	First (X) Surge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level	Surcharged Depth	Flooded Volume
	Name	Storm							(m)	(m)	(m³)
S1.000	S1	15 Winter	2	+0%	30/15 Summer				42.930	-0.070	0.000
S1.001	S2	15 Winter	2	+0%	100/15 Summer				42.786	-0.090	0.000
S2.000	S3	15 Winter	2	+0%	100/15 Summer				42.201	-0.174	0.000
S2.001	S3	15 Winter	2	+0%	100/15 Summer				42.134	-0.160	0.000
S3.000	S4	15 Winter	2	+0%					43.180	-0.120	0.000
S1.002	S3	30 Winter	2	+0%	30/15 Summer				41.946	-0.079	0.000

PN	US/MH Name	Pipe Flow / Overflow		Pipe Flow (l/s)	Level Status
		Cap.	(l/s)		
S1.000	S1	0.54		8.7	OK
S1.001	S2	0.33		11.6	OK
S2.000	S3	0.12		4.7	OK
S2.001	S3	0.18		12.6	OK
S3.000	S4	0.09		3.7	OK
S1.002	S3	0.16		11.2	OK

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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 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 1 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FEH Data Type Catchment
 FEH Rainfall Version 2013 Cv (Summer) 0.750
 Site Location GB 471350 174150 SU 71350 74150 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, 240, 360, 480, 960, 1440
 Return Period(s) (years) 2, 30, 100
 Climate Change (%) 0, 0, 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	S1	15 Winter	30	+0%	30/15 Summer				43.053	0.053	0.000
S1.001	S2	15 Winter	30	+0%	100/15 Summer				42.827	-0.049	0.000
S2.000	S3	15 Winter	30	+0%	100/15 Summer				42.229	-0.146	0.000
S2.001	S3	15 Winter	30	+0%	100/15 Summer				42.180	-0.114	0.000
S3.000	S4	15 Winter	30	+0%					43.196	-0.104	0.000
S1.002	S3	30 Winter	30	+0%	30/15 Summer				42.169	0.144	0.000

				Pipe		
	US/MH	Flow /	Overflow	Flow		Level
PN	Name	Cap.	(l/s)	(l/s)	Status	Exceeded
S1.000	S1	1.21		19.4	SURCHARGED	
S1.001	S2	0.76		26.9	OK	
S2.000	S3	0.27		10.7	OK	
S2.001	S3	0.48		33.5	OK	
S3.000	S4	0.21		8.6	OK	
S1.002	S3	0.22		14.9	SURCHARGED	

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XP Solutions	Network 2018.1	

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 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 1 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FEH Data Type Catchment
 FEH Rainfall Version 2013 Cv (Summer) 0.750
 Site Location GB 471350 174150 SU 71350 74150 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, 240, 360, 480, 960, 1440
 Return Period(s) (years) 2, 30, 100
 Climate Change (%) 0, 0, 40

PN	US/MH		Return Period	Climate Change	First (X) Surge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level	Surcharged Depth	Flooded Volume
	Name	Storm							(m)	(m)	(m³)
S1.000	S1	15 Winter	100	+40%	30/15 Summer				43.634	0.634	0.000
S1.001	S2	15 Winter	100	+40%	100/15 Summer				43.242	0.366	0.000
S2.000	S3	60 Winter	100	+40%	100/15 Summer				42.597	0.222	0.000
S2.001	S3	60 Winter	100	+40%	100/15 Summer				42.594	0.300	0.000
S3.000	S4	15 Winter	100	+40%					43.213	-0.087	0.000
S1.002	S3	60 Winter	100	+40%	30/15 Summer				42.584	0.559	0.000

PN	US/MH		Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)		Status	Level Exceeded
	Name							
S1.000	S1		1.78		28.6		FLOOD RISK	
S1.001	S2		1.08		38.2		SURCHARGED	
S2.000	S3		0.23		9.0		SURCHARGED	
S2.001	S3		0.38		26.3		SURCHARGED	
S3.000	S4		0.37		15.2		OK	
S1.002	S3		0.22		14.9		SURCHARGED	

Project Title:	Greyfriars Phase 1 Proposed
Calculations:	Foul Water Flow Rate Based on Appliances

Formula for calculating Foul Water Flow rate:

$$(Q_{ww}) = K\sqrt{\sum DU}$$

Q_{ww} = Foul water (waste water) flow in l/s

K = frequency factor

$\sum DU$ = Sum of discharge units (l/s)

Values and calculation taken from BS EN 12056-2:2000, Part 2
Sanitary Pipework, Layout and Calculation

Frequency Factor

Usage of Appliances	k
Intermittent i.e. dwelling, guesthouse, office	0.5
Frequent i.e. hospital, school, restaurant, hotel	0.7
Congested i.e. toilets/showers open to public	1
Special i.e. laboratory	1.2

Discharge Unit	DU
Wash basin, bidet	0.5
Kitchen sink	0.8
Urinal with cistern	0.8
Urinal with flushing valve	0.5
Slab urinal	0.2
WC with 6l cistern	2.0
WC with 7.5l cistern	2.0
WC with 9l cistern	2.5
Shower without plug	0.6
Shower with plug	0.8
Bath	0.8
Dishwasher (household)	0.8
Washing machine (0-6kg)	0.8
Washing machine (6-12kg)	1.5
Floor gully DN50	0.8
Floor gully DN70	1.5
Floor gully DN100	2.0
None	

Location	Discharge Unit	Rate	No. of Units	Total DU
Sackville St.	WC with 7.5l cistern	2	12	24
Sackville St.	Wash basin, bidet	0.5	10	5
Sackville St.	Urinal with flushing valve	0.5	3	1.5
Sackville St.	Wash basin, bidet	0.5	2	1
Sackville St.	Kitchen sink	0.8	3	2.4
Memorial Hall	WC with 7.5l cistern	2	2	4
Memorial Hall	Wash basin, bidet	0.5	2	1
	None	0		0
	None	0		0
Net discharge from Units ($\sum DU$ in l/s) =				38.9

Note, items listed taken from proposed floor plan provided by Client (JBKS Architects dwg 08/11/17, Rev 02, project ref GRE-4 176)

Calculate foul flow rate with a frequency of usage being: Intermittent

$$(Q_{ww}) = K\sqrt{\sum DU} = 0.5 \times (38.9)^{0.5} = 3.118$$

Therefore, estimated foul flow rates is 3.1 l/s = 269.4 m³/day

All areas marked as this colour to be complete by you, all others values not to be changed

Project Title:	Greyfriars Phase 2 Existing
Calculations:	Foul Water Flow Rate Based on Appliances

Formula for calculating Foul Water Flow rate:

$$(Q_{ww}) = K\sqrt{\sum DU}$$

Q_{ww} = Foul water (waste water) flow in l/s

K = frequency factor

$\sum DU$ = Sum of discharge units (l/s)

Values and calculation taken from BS EN 12056-2:2000, Part 2
Sanitary Pipework, Layout and Calculation

Frequency Factor

Usage of Appliances	k
Intermittent i.e. dwelling, guesthouse, office	0.5
Frequent i.e. hospital, school, restaurant, hotel	0.7
Congested i.e. toilets/showers open to public	1
Special i.e. laboratory	1.2

Discharge Unit	DU
Wash basin, bidet	0.5
Kitchen sink	0.8
Urinal with cistern	0.8
Urinal with flushing valve	0.5
Slab urinal	0.2
WC with 6l cistern	2.0
WC with 7.5l cistern	2.0
WC with 9l cistern	2.5
Shower without plug	0.6
Shower with plug	0.8
Bath	0.8
Dishwasher (household)	0.8
Washing machine (0-6kg)	0.8
Washing machine (6-12kg)	1.5
Floor gully DN50	0.8
Floor gully DN70	1.5
Floor gully DN100	2.0
None	

Location	Discharge Unit	Rate	No. of Units	Total DU
Ground Floor	WC with 7.5l cistern	2	7	14
Ground Floor	Wash basin, bidet	0.5	7	3.5
Ground Floor	Urinal with flushing valve	0.5	3	1.5
Ground Floor	Shower without plug	0.6	2	1.2
Ground Floor	Kitchen sink	0.8	1	0.8
	None	0		0
	None	0		0
	None	0		0
	None	0		0
Net discharge from Units ($\sum DU$ in l/s) =				21

Note, items listed taken from proposed floor plan provided by Client (JBKS Architects dwg September 2019, Rev -, project ref GRE CENT 152)

Calculate foul flow rate with a frequency of usage being: Intermittent

$$(Q_{ww}) = K\sqrt{\sum DU} = 0.5 \times (21)^{0.5} = 2.291$$

Therefore, estimated foul flow rates is 2.3 l/s = 198.0 m³/day

All areas marked as this colour to be complete by you, all others values not to be changed

Project Title:	Greyfriars Phase 2 Proposed
Calculations:	Foul Water Flow Rate Based on Appliances

Formula for calculating Foul Water Flow rate:

$$(Q_{ww}) = K\sqrt{\sum DU}$$

Q_{ww} = Foul water (waste water) flow in l/s

K = frequency factor

$\sum DU$ = Sum of discharge units (l/s)

Values and calculation taken from BS EN 12056-2:2000, Part 2
Sanitary Pipework, Layout and Calculation

Frequency Factor

Usage of Appliances	k
Intermittent i.e. dwelling, guesthouse, office	0.5
Frequent i.e. hospital, school, restaurant, hotel	0.7
Congested i.e. toilets/showers open to public	1
Special i.e. laboratory	1.2

Discharge Unit	DU
Wash basin, bidet	0.5
Kitchen sink	0.8
Urinal with cistern	0.8
Urinal with flushing valve	0.5
Slab urinal	0.2
WC with 6l cistern	2.0
WC with 7.5l cistern	2.0
WC with 9l cistern	2.5
Shower without plug	0.6
Shower with plug	0.8
Bath	0.8
Dishwasher (household)	0.8
Washing machine (0-6kg)	0.8
Washing machine (6-12kg)	1.5
Floor gully DN50	0.8
Floor gully DN70	1.5
Floor gully DN100	2.0
None	

Location	Discharge Unit	Rate	No. of Units	Total DU
Ground Floor	WC with 7.5l cistern	2	8	16
Ground Floor	Wash basin, bidet	0.5	8	4
Ground Floor	Kitchen sink	0.8	1	0.8
Second Floor	WC with 7.5l cistern	2	3	6
Second Floor	Wash basin, bidet	0.5	3	1.5
Second Floor	Kitchen sink	0.8	2	1.6
Third Floor	WC with 7.5l cistern	2	4	8
Third Floor	Wash basin, bidet	0.5	4	2
Third Floor	Kitchen sink	0.8	2	1.6
Net discharge from Units ($\sum DU$ in l/s) =				41.5

Note, items listed taken from proposed floor plan provided by Client (JBKS Architects dwg September 2019, Rev -, project ref GRE CENT173-174)

Calculate foul flow rate with a frequency of usage being: Intermittent

$$(Q_{ww}) = K\sqrt{\sum DU} = 0.5 \times (41.5)^{0.5} = 3.221$$

Therefore, estimated foul flow rates is 3.2 l/s = 278.3 m³/day

All areas marked as this colour to be complete by you, all others values not to be changed

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