



now part of



St Paul's Church
Whitley Wood Lane, Reading
Drainage Impact Assessment

On behalf of: **Dr Mittal and Partners**

Project Ref: 47270/4001 | Rev: - | Date: October 2019

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Revision	Date	Description	Prepared	Reviewed	Approved

This report has been prepared by Peter Brett Associates LLP ('PBA') on behalf of its client to whom this report is addressed ('Client') in connection with the project described in this report and takes into account the Client's particular instructions and requirements. This report was prepared in accordance with the professional services appointment under which PBA was appointed by its Client. This report is not intended for and should not be relied on by any third party (i.e. parties other than the Client). PBA accepts no duty or responsibility (including in negligence) to any party other than the Client and disclaims all liability of any nature whatsoever to any such party in respect of this report.

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1 Introduction

1.1 Scope of Drainage Impact Assessment

- 1.1.1 This Drainage Impact Assessment (DIA) has been prepared by Peter Brett Associates LLP (PBA), now part of Stantec. This report supports a planning application for the redevelopment of land at St. Pauls Church on Whitley Wood Lane in Reading to provide a new church centre, a health centre, 2no. one bedroom flats, and associated car parking.
- 1.1.2 The report is intended to provide sufficient detail of the foul and surface water drainage to allow Reading Borough Council (RBC) as the Local Planning Authority (LPA) and the Lead Local Flood Authority (LLFA) to review the design and confirm its suitability. The report shows the impact of the development on foul and surface water.
- 1.1.3 As the site lies within Flood Zone 1 and is less than 1ha in area, a site-specific Flood Risk Assessment (FRA) report is not required. This DIA includes information on flood risk from all sources and confirms that flood risk is not a significant issue at the site.

1.2 Sources of Information

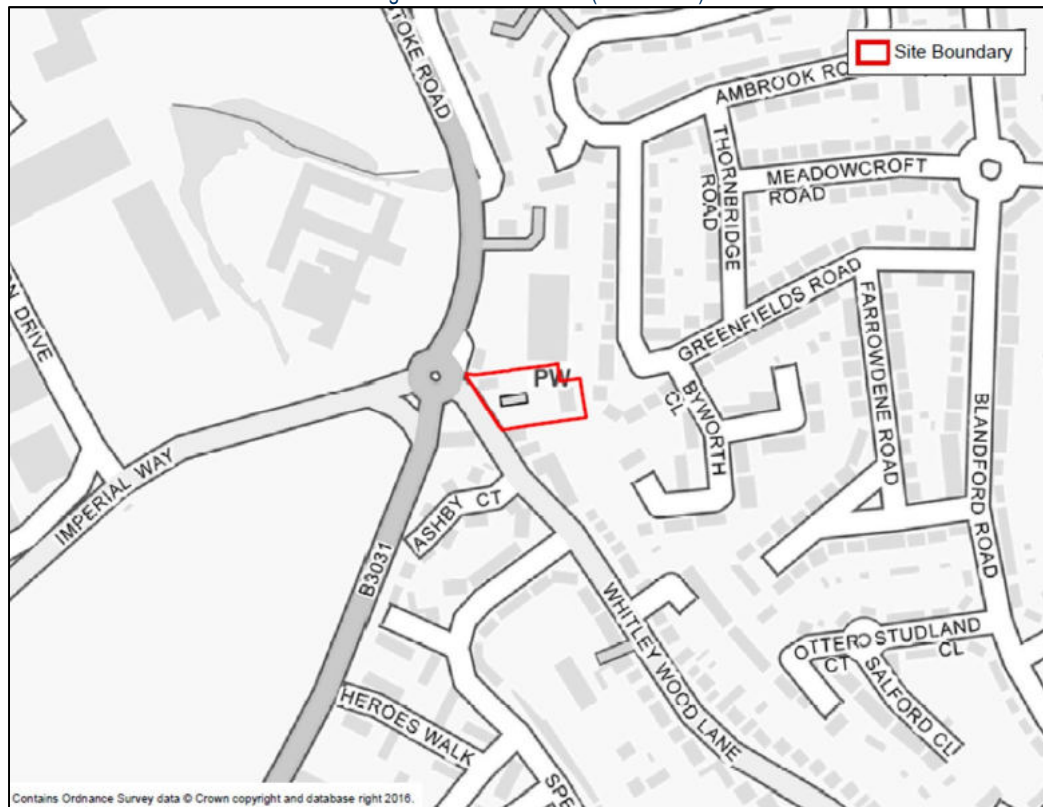
- 1.2.1 The DIA has been prepared and in accordance with the relevant national, regional and local planning policy and statutory authority guidance as follows:
- National policy regarding flood risk as contained within the **National Planning Policy Framework (NPPF)**, updated in February 2019, issued by the Ministry of Housing, Communities and Local Government, with reference to Section 14 'Meeting the challenge of climate change, flooding and coastal change';
 - The **NPPF Planning Practice Guidance (PPG)** released in March 2014 ('Flood Risk and Coastal Change' section) and updated in February 2016 to incorporate the **Environment Agency (EA) 'Flood Risk Assessments: Climate Change Allowances'** guidance;
 - The **CIRIA SuDS Manual C753**, November 2015;
 - The **DEFRA Non-Statutory Technical Standards for Sustainable Drainage Systems**, March 2015, and accompanying **Local Authority SuDS Officer Organisation (LASOO) Practice Guidance** (2016);
 - The RBC **Preliminary Flood Risk Assessment (PFRA)**, prepared by PBA in June 2011;
 - The RBC **Strategic Flood Risk Assessment (SFRA)**, prepared by PBA in June 2017;
 - Local planning policy contained within the **RBC 'Core Strategy'** (alteration adopted January 2015), with particular reference to policy CS35 (Flooding);
 - The draft **RBC Local Plan**, dated May 2017, with specific reference to Policy EN17 'Flooding and Sustainable Drainage Systems'.

2 Site Setting

2.1 Site Description and Topography

- 2.1.1 The 0.32 hectare (ha) site is located on Whitley Wood Lane in the south of Reading, as shown on **PBA Figure 001** in **Appendix A** and **Figure 2.1** (postcode RG2 8PN, site centre OS grid reference 471,810m E; 169,540m N).

Figure 2.1: Site Location (not to scale)



- 2.1.2 The site currently consists of:

- A unit of two semi-detached houses (Nos 1 and 3 Whitley Wood Lane) at the front of the site, facing west;
- A single-storey brick church building in the centre of the site;
- The former church building, currently used as a children's 'Play Barn', in the rear of the site;
- Informal car parking with gravel surfacing, with some areas of asphalt paving in the rear of the site.

- 2.1.3 The site is bordered by a Lidl supermarket to the north, by residences along Greenfields Road to the east, by residences along Whitley Wood Lane to the south and by a roundabout junction with Basingstoke Road (B3031) to the west.

2.2 Site Topography

- 2.2.1 A topographic survey of the site, dated April 2018, is included within **Appendix B**. The survey indicates that the site is effectively flat at approximately 44.0m AOD, with localised variations of less than 0.2m.

2.3 Site Geology and Hydrogeology

- 2.3.1 The British Geological Survey (BGS) 'Geology of Britain' viewer indicates that there are no superficial deposits present at the site. The bedrock is indicated to be of the London Clay Formation (Clay, Silt and Sand).
- 2.3.2 The BGS borehole 'SU76NW42', located at the roundabout adjacent to the site, confirms the presence of London Clay in the area. Boreholes to the north and west of the site also identified a shallow layer of silt and fine gravel deposits present near to the surface, to depths of up to 2m. The boreholes to the north of the site identified groundwater within 0.7m of the surface, however groundwater was not encountered in the boreholes to the west of the site.
- 2.3.3 The Cranfield University 'Soilscapes' online viewer indicates that the site lies above 'loamy soils with naturally high groundwater'.
- 2.3.4 The DEFRA MagicMap online viewer indicates that the site does not lie within an EA 'Groundwater Source Protection Zone'.

2.4 Proposed Development

- 2.4.1 The proposals involve the removal of the existing buildings at the site and the construction of a large two-storey church centre (which will include 2 no. one bedroom flats), a three-storey health centre, and 47 car parking spaces to serve the two buildings.
- 2.4.2 A proposed site plan by DLK Architects is provided in **Appendix C**.

3 Overview of Flood Risk

3.1 Requirement for an FRA

- 3.1.1 The NPPF Section 103 footnote 20 requires that a site-specific Flood Risk Assessment (FRA) is prepared for *'proposals of 1 hectare or greater in Flood Zone 1.....or in an area within Flood Zone 1 which has critical drainage problems.....and may be subject to other sources of flooding.'* This is also confirmed within the 'Flood Risk and Coastal Change' section of the PPG.
- 3.1.2 A site-specific FRA is therefore not required. This section provides a summary of the flood risk to the site, which confirms that the site is at a low to negligible risk of flooding from all sources.

3.2 Environment Agency Information

Flood Zone Map

- 3.2.1 The EA Flood Zone map for the area is provided in **Figure 004** in **Appendix A**. The Flood Zones are defined in Table 1 of the NPPF PPG ('Flood Risk and Coastal Change' section) as follows:
- **Flood Zone 1 'Low Probability'** – Land with less than a 1 in 1000 (<0.1%) annual probability of river or sea flooding;
 - **Flood Zone 2 'Medium Probability'** – Land with between a 1 in 100 (1.0%) and 1 in 1000 (0.1%) annual probability of river flooding, or between a 1 in 200 (0.5%) and 1 in 1000 (0.1%) annual probability of sea flooding;
 - **Flood Zone 3 'High Probability'** – Land with greater than a 1 in 100 (>1.0%) annual probability of flooding from river flooding, or greater than a 1 in 200 (>0.5%) annual probability of flooding from the sea.
- 3.2.2 The map shows that the site is located within Flood Zone 1 'Low Probability'. There are no areas of higher flood risk in the vicinity of the site.

Flood Risk from Surface Water Map

- 3.2.3 The 'Flood Risk from Surface Water' map, is provided in **Figure 005** in **Appendix A**. The mapping assesses flooding resulting from severe rainfall events based on the following three scenarios:
- 1 in 30 (3.3%) annual probability rainfall event ('High' risk);
 - 1 in 100 (1.0%) annual probability rainfall event ('Medium' risk);
 - 1 in 1000 (0.1%) annual probability rainfall event ('Low' risk).
- 3.2.4 Land with a lower than a 1 in 1000 (<0.1%) annual probability of surface water flooding is at 'Very low' risk.
- 3.2.5 **Figure 005** indicates that the site has a 'Very Low' risk of surface water flooding. Whitley Wood Lane adjacent to the site is shown to be at a 'Low' risk.
- 3.2.6 It should be noted that the surface water maps are generated using a generic methodology on a national scale, whereby rainfall is routed over a ground surface model. The analysis does not take account of any specific local information on below-ground drainage infrastructure and infiltration, although an adjustment is included in urban areas to account for the impact of sewerage and a standard infiltration allowance based on soil type.

Flood Risk from Reservoirs Map

- 3.2.7 The EA 'Flood Risk from Reservoirs' map confirms that the site is not located within an area at residual risk of reservoir failure/flooding of reservoirs holding greater than 25,000 cubic metres of water.

Historical Flooding Information

- 3.2.8 **Figure 007 in Appendix A** indicates that the site has not, according to available records, been impacted by historic fluvial/tidal flooding.

3.3 Reading Borough Council Information

Preliminary Flood Risk Assessment

- 3.3.1 The RBC Preliminary Flood Risk Assessment (PFRA) was prepared by PBA in 2011 and provides a high-level assessment of flood risk issues within the Borough. This document has been reviewed and key information of relevance to the site has been extracted.
- 3.3.2 No recorded of flooding at the site were identified. Figure 4.1 within the PFRA 'Local information on past floods' indicates that extensive internal and external property flooding has taken place around Boulton Street to the north and south-east of the site.

Strategic Flood Risk Assessment

- 3.3.3 The current RBC Level 1 and Level 2 Strategic Flood Risk Assessments (SFRAs) were prepared in 2017 and provides specific advice to RBC on flood risk issues within the Borough. This study has been reviewed and key information of relevance to the site has been extracted.
- 3.3.4 Map F8 within the SFRA, 'Areas Susceptible to Groundwater Flooding', shows that the site lies within an area with low susceptibility to groundwater flooding. It should be noted that this map indicates susceptibility based on underlying geology across a 1km square grid – it does not indicate the likelihood of groundwater flooding occurring.
- 3.3.5 Map F9 within the SFRA, 'Thames Water Sewer Flooding Incidents', shows that the postcode area containing the site (RG2 8) has 101+ recorded sewer flooding incidences recorded in the Thames Water DG5 register. However, specific locations of such incidences is not available.

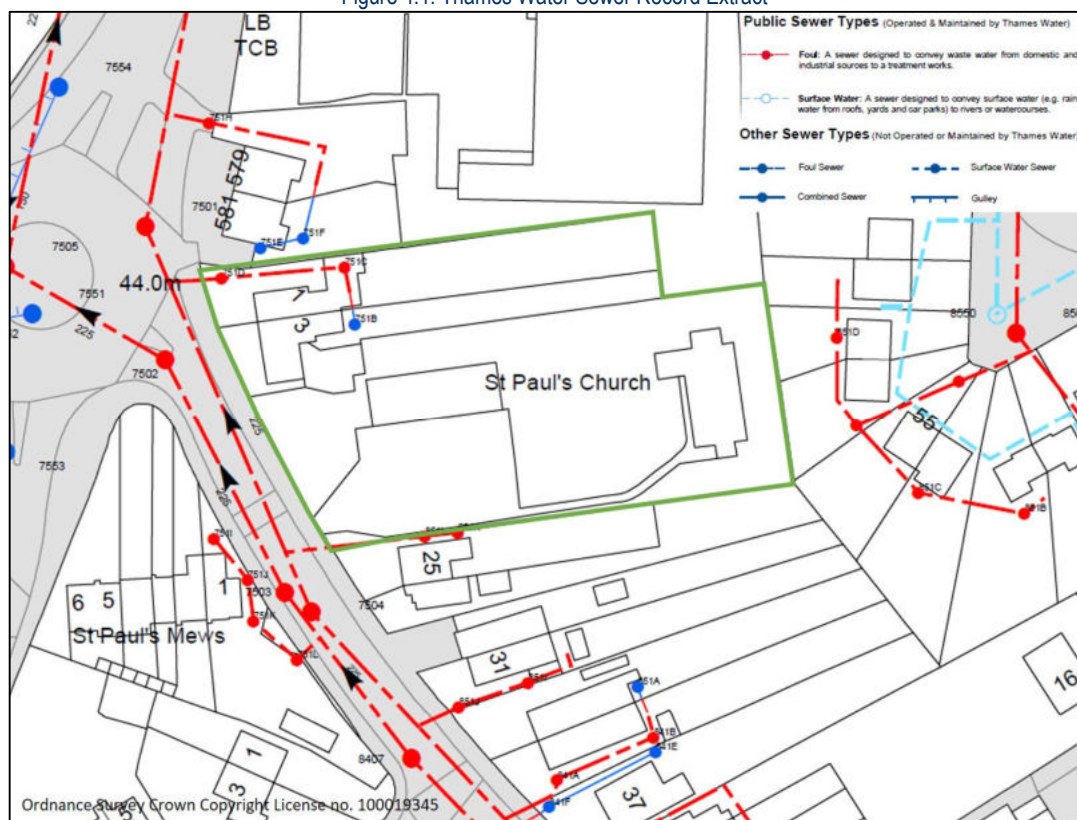
3.4 Summary of Flood Risk

- 3.4.1 This section confirms that the site has a 'low' probability of flooding from all sources, it is not located within a 'Critical Drainage Area' and it has not been recorded as having been impacted by historic flooding.

4 Existing Surface Water Regime

- 4.1.1 The site has an impermeable area of 0.15ha, which consists of the three existing buildings, the car park and external hard standing.
- 4.1.2 The topographic survey of the site, included within **Appendix B**, indicates that there are multiple soakaways within the current site, located around the current church building. However, it is unclear what proportion of the site drains to these soakaways and their condition.
- 4.1.3 Connections from Nos 1 and 3 Whitley Wood Lane and the front of the current church hall building are shown as connecting into the public foul sewers beneath Whitley Wood Lane
- 4.1.4 Whilst surface water falling onto the gravel car parking areas may infiltrate, surface pooling is known to occur after wet weather which suggests that infiltration rates or the performance of the on-site soakaways may not be sufficient.
- 4.1.5 It is unclear how the former church hall building, or the tarmac car parking area to the front of this building, drains.
- 4.1.6 The Thames Water sewer records are provided in **Appendix D** and an extract is shown on **Figure 4.1** below. This shows that the connections to the north of No. 3 Whitley Wood Lane are a public sewer which drains to one of the 225mm diameter foul sewers beneath Whitley Wood Lane. The sewer records also show a private combined connection to the rear of No. 3 Whitley Wood Road that drains to the public sewer within the site.

Figure 4.1: Thames Water Sewer Record Extract



- 4.1.7 The existing impermeable 'brownfield' runoff rates have been calculated using the Modified Rational Method and the existing greenfield runoff rates have been calculated using the ICP SuDS Method within MicroDrainage Source Control (see **Table 4.1**). A copy of the calculations is provided in **Appendix D**.

Return Period	Brownfield Runoff Rate 0.15ha (l/s)	Greenfield Runoff Rate 0.17ha (l/s)	Total Existing Runoff Rate 0.32ha (l/s)
1 in 1 year	11.2	0.6	11.8
1 in 2 year	14.4	0.7	15.1
1 in 30 year	27.0	1.7	28.7
1 in 100 year	35.9	2.4	38.3

Table 4.1: Existing Surface Water Runoff Rates

5 Proposed Surface Water Drainage Strategy

5.1 Discharge Destination

- 5.1.1 The NPPF recognises that flood risk and other environmental damage can be managed by minimising changes in the volume and rate of surface runoff from development sites and recommends that priority is given to the use of SuDS in new development.
- 5.1.2 As the intention of SuDS is to mimic the natural drainage regime of the undeveloped site, the NPPF PPG states the following (consistent with the Building Regulations H3 hierarchy):

“Generally the aim should be to discharge surface runoff as high up the following hierarchy of drainage options as reasonably practicable:

- 1. into the ground (infiltration)*
- 2. to a surface water body*
- 3. to a surface water sewer, highway drain or another drainage system*
- 4. to a combined sewer.”*

- 5.1.3 The hierarchy is considered in order below:

i) Discharge into the ground (infiltration)

- 5.1.4 As discussed in **Section 2.3**, geological mapping indicates that the site lies above clay-rich soils associated with the London Clay Formation, which typically provides very low infiltration rates. However, borehole records indicate that there may also be silt and gravel deposits close to the surface, which may support infiltration at limited rates.
- 5.1.5 The topographic survey in **Appendix B** shows that some of the site currently drains to soakaways. While this suggests that infiltration drainage has previously been found to be viable at the site, the infiltration rates may still be insufficient to drain the increased impermeable area of the proposed development, especially where modern drainage standards are applied. Pooling of surface water is known to occur on the gravel car parking areas within the site which may indicate that the soakaways are not performing efficiently.
- 5.1.6 The site is still operational and therefore intrusive testing cannot be undertaken at this stage. Soakaway testing will be undertaken prior to the detailed design stage, in line with the methods outlined in BRE Digest 365 ‘Soakaway Design’ to confirm the infiltration rates of the underlying soil at the site, so it can be determined whether infiltration drainage can be utilised as the only method of discharging surface water from the site.

ii) Discharge to a surface water body/watercourse

- 5.1.7 The second preference in the hierarchy is discharge to a surface water body (i.e. lake or watercourse).
- 5.1.8 There are no watercourses in the immediate vicinity of the site for disposal of surface water and therefore this option has been discounted.

iii) Discharge to a surface water sewer or highway drain

- 5.1.9 If infiltration rates are insufficient to discharge all runoff from the site, surface water would need to be discharged to the surrounding public surface water sewer network.
- 5.1.10 As there are no public surface water sewers in the vicinity of the site, surface water would need to discharge into one of the public foul sewers beneath Whitley Wood Lane.

- 5.1.11 It is noted that Nos 1 and 3 Whitley Wood Lane within the site already appear to discharge to the public foul sewer. It is intended that the existing sewer connection (MH751D) will be re-used, subject to approval by Thames Water.

5.2 Peak Flow Control – DEFRA Technical Standards S3

- 5.2.1 If infiltration rates are found to be low and discharge to the public sewer is required, the DEFRA 'Non-statutory Technical Standards for SuDS' should be followed for flow and volume control of discharge from the site.

- 5.2.2 The DEFRA standards for peak flow control are as follows:

“S3. For developments which were previously developed, the peak runoff rate from the development to any drain, sewer or surface water body for the 1 in 1 year rainfall event and the 1 in 100 year rainfall event should be as close as reasonably practicable to the greenfield runoff rate from the development for the same rainfall event, but should never exceed the rate of discharge from the development prior to redevelopment for that event.”

- 5.2.3 The impermeable area at the site will increase from 0.1ha to approximately 0.26ha following the re-development of the site. As the proposals do not involve individual residences the application of an urban creep allowance is not applicable in accordance with the LASOO guidance.

- 5.2.4 The equivalent greenfield runoff rates for the site are provided in **Table 5.1**.

Return Period	Equivalent Greenfield Runoff Rate l/s 0.26ha
1 in 1 year	1.0
Q _{BAR}	1.1
1 in 30 year	2.6
1 in 100 year	3.6

Table 5.1: Equivalent Greenfield Runoff Rates

- 5.2.5 The above runoff rates indicate that the surface water discharge from the site, at the equivalent greenfield runoff rate for the lower return periods, would be too small to be able to manage the risk of blockage to the flow control device to an acceptable level.
- 5.2.6 It is therefore proposed to restrict the runoff rate from the site to the equivalent 1 in 100 year greenfield runoff rate of 3.6 l/s.
- 5.2.7 Restricting surface water from the proposed development in accordance with the above will still provide a significant betterment in comparison to the existing scenario, as shown in **Table 5.2** overleaf.
- 5.2.8 A capacity check application has been sent to Thames Water, setting out this approach and the associated reduction in runoff rates, and a response is awaited.

Return Period	Total Existing Runoff Rate 0.32ha (l/s)	Developed Area Runoff Rate 0.26ha (l/s)	Landscaped Area Runoff Rate 0.06ha (l/s)	Total Proposed Runoff Rate 0.32ha (l/s)	Reduction from Existing (%)
1 in 1 year	11.8	3.6	0.2	3.8	68%
1 in 2 year/Q _{BAR}	15.1	3.6	0.3	3.9	74%
1 in 30 year	28.7	3.6	0.6	4.2	85%
1 in 100 year	38.3	3.6	0.8	4.4	89%

Table 5.2: Runoff Rate Comparison

5.3 Volume Control – DEFRA Technical Standards S5-S6

5.3.1 The DEFRA standards for volume control are as follows:

S5. Where reasonably practicable, for developments which have been previously developed, the runoff volume from the development to any highway drain, sewer or surface water body in the 1 in 100 year, 6 hour rainfall event must be constrained to a value as close as is reasonably practicable to the greenfield runoff volume for the same event, but should never exceed the runoff volume from the development site prior to redevelopment for that event.

S6. Where it is not reasonably practicable to constrain the volume of runoff to any drain, sewer or surface water body in accordance with **S4** or **S5** above, the runoff volume must be discharge at a rate that does not adversely affect flood risk.”

5.3.2 The existing runoff volumes for the site for the 1 in 100 year 360 minute rainfall event is shown in **Table 5.3**. Copies of the calculations are provided in **Appendix D**.

Rainfall Event (6 hours)	Brownfield Runoff Volume 0.15ha (m³)	Greenfield Runoff Volume 0.17ha (m³)	Total Runoff Volume 0.32ha (m³)
1 in 100 year	79.3	44.0	123.3

Table 5.3: Existing Surface Water Runoff Volumes for the 1 in 100 year 360 minute rainfall event

5.3.3 The impermeable area will increase post re-development at the site. It is therefore proposed to restrict the runoff rate from the site to 3.6 l/s which is considered to not adversely affect flood risk in accordance with the above standards.

5.3.4 The proposed runoff volumes from the site are shown in **Table 5.4** and in the calculations/MicroDrainage results in **Appendix E**.

Rainfall Event (6 hours)	Brownfield Runoff Volume Developed Area 0.26ha (m³)	Runoff Volume Landscaped Area 0.06ha (m³)	Total Runoff Volume 0.32ha (m³)
1 in 100 year	113.6	15.5	129.1

Table 5.4: Proposed Surface Water Runoff Volumes for the 360 minute rainfall event

- 5.3.5 The runoff volume has been restricted to as close to the existing runoff volume as is reasonably practicable.

5.4 Flood Risk within the Development – DEFRA Technical Standards S7-S9

- 5.4.1 DEFRA standards for flood risk within the development are as follows:

***S7.** The drainage system must be designed so that, unless an area is designated to hold and/or convey water as part of the design, flooding does not occur on any part of the site for a 1 in 30 year event.*

***S8.** The drainage system must be designed so that, unless an area is designated to hold and/or convey water as part of the design, flooding does not occur during a 1 in 100 year rainfall event in any part of: a building (including a basement) or in any utility plant susceptible to water (e.g. pumping station or electricity substation) within the development.”*

- 5.4.2 The proposed surface water drainage system consists of a lined permeable pavement system with a controlled discharge to the public foul sewer at MH751D within the site as shown on **PBA drawing 47270/4001/001** (see **Appendix E**) and does not flood in the 1 in 30 (3.3%) annual probability rainfall event in accordance with S7.

- 5.4.3 **Table 5.5** shows the climate change allowances for peak rainfall intensity, taken from the EA ‘Flood risk assessment - climate change allowances’ guidance.

Applies across all of England	Total potential change anticipated for 2010 to 2039	Total potential change anticipated for 2040 to 2059	Total anticipated change for 2060 to 2115
Upper End	+10%	+20%	+40%
Central	+5%	+10%	+20%

Table 5.5: Climate change allowances for peak rainfall intensity

- 5.4.4 The proposed development includes residential elements and is considered to have a lifetime of up to 100 years. In accordance with **Table 5.5**, the range of climate change allowances to be considered for the proposed development is 20% to 40%.

- 5.4.5 The proposed surface water drainage system has been designed to accommodate the 1 in 100 (1.0%) +40% allowance for climate change rainfall event (see MicroDrainage results in **Appendix E**).

- 5.4.6 DEFRA standard **S9** states that:

“the design of the site must ensure that so far as is reasonably practicable, flows resulting from rainfall in excess of a 1 in 100 year rainfall event are managed in exceedance routes that minimises the risks to people and property.”

- 5.4.7 Given that the site is relatively flat, excess flows are likely to pool within the site and the topography will not direct them elsewhere.

5.5 Water Quality

- 5.5.1 The SuDS Manual (CIRIA C753, November 2015) introduces slightly different approach compared to the previous version for the water quality management of surface water.

5.5.2 The Manual describes risks posed by the surface water runoff to the receiving environment as a function of:

- The pollution hazard at a particular site (i.e. the pollution source).
- The effectiveness of SuDS treatment components in reducing levels of pollutants to environmentally acceptable levels.
- The sensitivity of the receiving environment.

5.5.3 The recommended approaches for water quality risk management are given in Table 26.1 of the SuDS Manual. The Simple Index approach will be used as a design method for this site.

5.5.4 Table 26.2 of the SuDS Manual provides hazard classification for different land uses, which for this site are as follows:

- Roof area - impermeable surface; and
- Private car parking area and access road surfaces – permeable surface.

5.5.5 To deliver adequate treatment, the selected SuDS components should have a total pollution mitigation index for each contaminant type that equals or exceeds the pollution hazard index for each contaminant type. Therefore, the following will have to be achieved for the surface running off the site.

Total SuDS mitigation index $\geq$ pollution hazard index

5.5.6 The primary source of surface water pollution within the site will be from the access and car parking areas. The pollutant hazard indices for this land use are given in Table 26.2 of the SuDS manual and are tabulated in **Table 5.6**.

Land Use	Destination of Runoff	Pollution Hazard Level	Total Suspended Solids	Metals	Hydrocarbons
Access and car parks	Sewer	Low	0.5	0.4	0.4

Table 5.6: Pollution hazard index and destination of runoff for the proposed site

5.5.7 The access and car parking areas within the site will drain through permeable paving, which provides a good degree of pollutant removal as shown in **Table 5.7**.

Land Use	Destination of Runoff	Total Suspended Solids	Metals	Hydrocarbons
Access and car parks	Sewer	0.7	0.6	0.7

Table 5.7: Pollution mitigation indices

5.5.8 In summary, the SuDS component mitigation indices are greater than or equal to the pollution hazard indices and therefore the required level of treatment is provided before surface water is discharged from the site.

5.6 Maintenance Requirements

- 5.6.1 All those responsible for maintenance should take appropriate health, safety and welfare precautions for all activities including lone working, if relevant and risk assessments should always be undertaken. The site's infrastructure Health and Safety file should be consulted before carrying out any works either inside or outside of the development's boundary and information regarding the location of existing utilities passed onto operatives.
- 5.6.2 The requirements of the Health and Safety at Work Act 1974 and the Construction (Design and Management) Regulations 2015 should be adhered to and any residual risks identified in the Health and Safety File should be managed and information passed onto maintenance operatives through task specific risk assessments.
- 5.6.3 The surface water drainage proposals for the site include the following maintenance measures:
- Cleaning of the roof catchpits/sumps of litter (minimum bi-annual basis/after leaf fall);
 - Brushing/sweeping of permeable pavement (minimum bi-annual basis/after leaf fall);
 - Cleaning/de-silting of inlet sumps to flow control device (bi-annually/annually);
 - Initial monitoring of the drainage system (every month for the first 3 months then annually).
- 5.6.4 The body responsible for the maintenance of the surface water drainage system will be confirmed post planning.

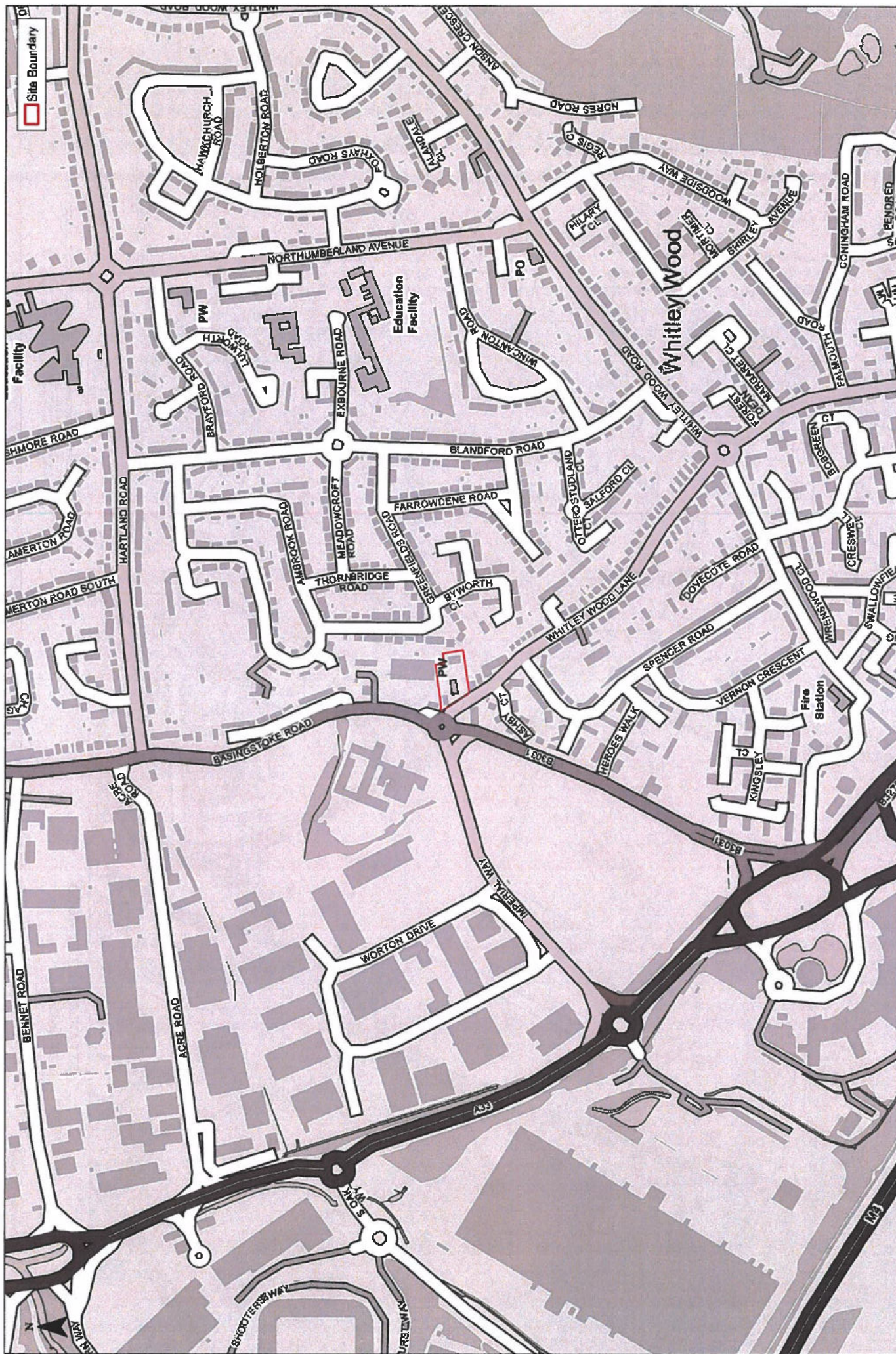
6 Summary

- 6.1.1 This Drainage Impact Assessment (DIA) has been prepared by Peter Brett Associates LLP (PBA), now part of Stantec, to support a planning application for the redevelopment of land at St Pauls Church on Whitley Wood Lane in Reading.
- 6.1.2 The hierarchy of surface water drainage options detailed in the NPPF PPG (and consistent with the Building Regulations H3) has been considered as follows:
- **Infiltration:** The available geological information indicates that the site lies directly above the London Clay Formation. Due to the low infiltration rates of clay-rich soils, it is considered very unlikely that infiltration drainage would be suitable at the site. Intrusive site testing cannot be undertaken at this stage as the site is still operational. The suitability for infiltration drainage at the site will be reviewed following intrusive site testing at the detailed design stage;
 - **Watercourse:** There are no watercourses in the vicinity of the site, so the option of discharging to an open watercourse is also not viable;
 - **Sewer:** There are no surface water sewers in the area. A combined connection is shown to the public foul sewer spur within the site. It is therefore proposed to discharge via existing arrangements to the public foul sewer at a controlled runoff rate.
- 6.1.3 The proposed surface water drainage strategy consists of lined permeable pavement beneath the car park and external hardstanding around buildings, and a controlled discharge to the existing public sewer manhole within the site at 3.6 l/s, resulting in a reduction of over 65% in peak runoff rates from the site for a range of rainfall events.
- 6.1.4 In conclusion, the principles advocated by relevant national, regional and local planning policy guidance in relation to surface water and foul drainage have been satisfactorily addressed.

Appendix A PBA Maps

Figure 001	Site Location
Figure 004	EA Flood Zone
Figure 005	EA Surface Water Flood Risk
Figure 007	EA Recorded Historic Flood Extents

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 	Client: Dr Mittal & Partners	ST PAULS WHITLEY WOOD Site Location	Figure 001 Rev A Checklist: DM Drawn: HG Date: 22/08/2019 1:5,000 @ A3 0 250 500 m Continued: Outline Survey data © Crown copyright and database right 2016
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 new part of 	Client: Dr Mittal & Partners	ST PAULS WHITLEY WOOD EA Flood Zone	0 250 500 m Contour Elevation: 100m Contour Interval: 1m Flood Zone 1: 100m Flood Zone 2: 100m Flood Zone 3: 100m <table><tr><td>Date: 05/09/2019</td><td>1:5,000 @ A3</td></tr><tr><td>Drawn: HQ</td><td>Checked: DM</td></tr><tr><td colspan="2">Figure 004</td></tr><tr><td colspan="2">Rev A</td></tr></table>	Date: 05/09/2019	1:5,000 @ A3	Drawn: HQ	Checked: DM	Figure 004		Rev A	
Date: 05/09/2019	1:5,000 @ A3										
Drawn: HQ	Checked: DM										
Figure 004											
Rev A											



Site Boundary

Risk of Flooding from Surface Water

- High – 1 in 30 Annual Probability
- Medium – 1 in 100 Annual Probability
- Low – 1 in 1000 Annual Probability
- Very Low - Less than 1 in 1000 Annual Probability

	Client	Dr Mittal & Partners	ST PAULS WHITLEY WOOD EA Surface Water Flood Risk	Date 05/09/2019 Drawn: HG Checked: DM Figure 006 Rev A
	Scale	1:5,000 @ A3		



	Client: Dr Mittal & Partners	ST PAULS WHITLEY WOOD EA Recorded Historic Flood Extents	0 250 500 m Scale: 1:5,000 @ A3 Date: 05/09/2019 Drawn: HG Checked: DM Figure: 007 Rev: A
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Appendix B Topographic Survey

Drawing 6883/01

Site Survey by Groundsurveys Ltd.

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Appendix C Development Proposals

Drawing 1861/P01 by DLK Architects dated July 2019

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Appendix D Existing Drainage Information

Thames Water sewer asset records

Runoff rates and volumes

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	St Pauls Church, Whitley Wood Lane, Reading		JOB No:	47270	SHEET:	1 of 1
	Surface Water Drainage		DATE:	04/09/2019	BY:	DM
	Existing Brownfield Runoff Rates & Volumes (1ha)				CHECKED:	EE

Calculation based on 'Modified Rational Method', HR Wallingford.

Assumes that water travels across the site at 1m/s from the furthest point to the connection with the existing network

Data

M5-60min 18 mm Q=2.78CiA
r 0.40

Calculation - 1 in 1 Year

Catchment Area	Impermeable Area ha	Duration (D) min	Z1	M5-Dmin mm	Z2	M1-Dmin mm	i mm/hr	Impermeable Runoff l/s
1	1.000	15	0.60	10.80	0.62	6.70	26.8	74.5
Total								74.5 l/s
Total								74.5 l/s/ha

Note: Duration relates to time of concentration for the catchment including allowance for time of entry

$\frac{D}{Z1}$	$\frac{M5}{Z2 \text{ for 1 in 1yr}}$
5 0.35	5 0.620
10 0.55	10 0.610
15 0.60	15 0.620

Calculation - 1 in 2 Year

Catchment Area	Impermeable Area ha	Duration (D) min	Z1	M5-Dmin mm	Z2	M1-Dmin mm	i mm/hr	Impermeable Runoff l/s
1	1.000	15	0.60	10.80	0.80	8.64	34.6	96.1
Total								96.1 l/s
Total								96.1 l/s/ha

Note: Duration relates to time of concentration for the catchment including allowance for time of entry

$\frac{D}{Z1}$	$\frac{M5}{Z2 \text{ for 1 in 2yr}}$
5 0.35	5 0.790
10 0.55	10 0.790
15 0.60	15 0.800

Calculation - 1 in 30 Year

Catchment Area	Impermeable Area ha	Duration (D) min	Z1	M5-Dmin mm	Z2	M1-Dmin mm	i mm/hr	Impermeable Runoff l/s
1	1.000	15	0.60	10.80	1.50	16.20	64.8	180.1
Total								180.1 l/s
Total								180.1 l/s/ha

Note: Duration relates to time of concentration for the catchment including allowance for time of entry

$\frac{D}{Z1}$	$\frac{M5}{Z2 \text{ for 1 in 30yr}}$
5 0.35	5 1.450
10 0.55	10 1.490
15 0.60	15 1.500

Calculation - 1 in 100 Year

Catchment Area	Impermeable Area ha	Duration (D) min	Z1	M5-Dmin mm	Z2	M100-Dmin mm	i mm/hr	Impermeable Runoff l/s
1	1.000	15	0.60	10.80	1.99	21.49	86.0	239.0
Total								239.0 l/s
Total								239.0 l/s/ha

Note: Duration relates to time of concentration for the catchment including allowance for time of entry

$\frac{D}{Z1}$	$\frac{M5}{Z2 \text{ for 1 in 100yr}}$
5 0.35	5 1.790
10 0.55	10 1.910
15 0.60	15 1.990

Brownfield Runoff Volumes

Rainfall intensities derived from MicroDrainage (v. 2016.1) rainfall profiles for the 360 min storm

1 in 100 Year

Rainfall Intensity 11.0 mm/hr

Rainfall Depth 66.0 mm

Volume 528.4 m³

Peter Brett Associates LLP		Page 1
Caversham Bridge House Waterman Place Reading Berkshire RG1 8DN	St Pauls Church Whitley Wood Greenfield Runoff 1ha	
Date 01/09/2019 File	Designed by DM Checked by EE	
Micro Drainage Source Control 2018.1		

ICP SUDS Mean Annual Flood

Input

Return Period (years)	100	SAAR (mm)	700	Urban	0.000
Area (ha)	1.000	Soil	0.450	Region Number	Region 6

Results l/s

QBAR Rural	4.4
QBAR Urban	4.4
Q100 years	14.0
Q1 year	3.7
Q30 years	10.0
Q100 years	14.0

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Peter Brett Associates LLP		Page 1
Caversham Bridge House Waterman Place Reading Berkshire RG1 8DN	St Pauls Church, Whitley Wood Greenfield Runoff Volume 1ha	
Date 01/09/2019 File	Designed by DM Checked by EE	
Micro Drainage Source Control 2018.1		

Greenfield Runoff Volume

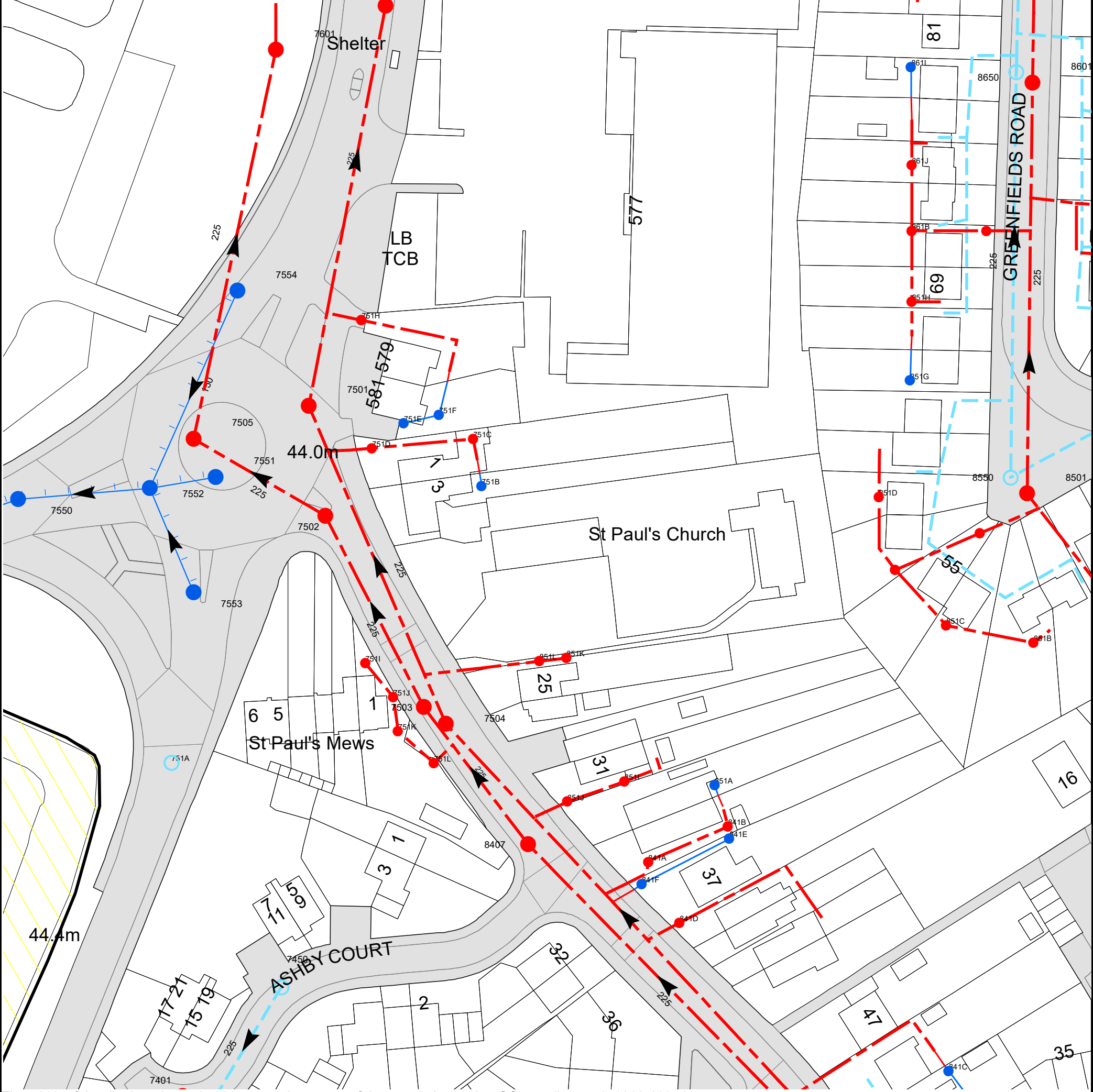
FSR Data

Return Period (years)	100
Storm Duration (mins)	360
Region	England and Wales
M5-60 (mm)	18.000
Ratio R	0.400
Areal Reduction Factor	1.00
Area (ha)	1.000
SAAR (mm)	700
CWI	105.000
Urban	0.000
SPR	47.000

Results

Percentage Runoff (%)	45.29
Greenfield Runoff Volume (m³)	258.938

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The width of the displayed area is 200 m and the centre of the map is located at OS coordinates 471810,169548
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
851B	n/a	n/a
8552	n/a	n/a
8501	43.67	42.29
8550	43.57	41.93
n/a	n/a	n/a
8601	43.36	42.14
8650	43.31	41.77
7450	44.09	42.99
841F	n/a	n/a
841A	n/a	n/a
841D	n/a	n/a
841C	n/a	n/a
8407	44.01	41.91
841E	n/a	n/a
841B	n/a	n/a
851J	n/a	n/a
851A	n/a	n/a
851I	n/a	n/a
751L	n/a	n/a
751K	n/a	n/a
7504	44.14	n/a
7503	44.04	41.82
751J	n/a	n/a
851L	n/a	n/a
851K	n/a	n/a
851C	n/a	n/a
8551	n/a	n/a
851D	n/a	n/a
751B	n/a	n/a
751C	n/a	n/a
751E	n/a	n/a
751F	n/a	n/a
851G	n/a	n/a
851H	n/a	n/a
861B	n/a	n/a
861J	n/a	n/a
861I	n/a	n/a
751A	n/a	n/a
751I	n/a	n/a
7553	n/a	n/a
7502	44.02	41.59
7550	43.8	42.07
7552	n/a	n/a
7551	44.02	42.37
751D	n/a	n/a
7505	43.94	41.53
7501	43.89	41.99
751H	n/a	n/a
7554	n/a	n/a
7601	43.56	41.33
7603	43.39	41.79
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.		



ALS Sewer Map Key

Public Sewer Types (Operated & Maintained by Thames Water)

	Foul: A sewer designed to convey waste water from domestic and industrial sources to a treatment works.
	Surface Water: A sewer designed to convey surface water (e.g. rain water from roofs, yards and car parks) to rivers or watercourses.
	Combined: A sewer designed to convey both waste water and surface water from domestic and industrial sources to a treatment works.
	Trunk Surface Water
	Trunk Foul
	Storm Relief
	Trunk Combined
	Vent Pipe
	Bio-solids (Sludge)
	Proposed Thames Surface Water Sewer
	Proposed Thames Water Foul Sewer
	Gallery
	Foul Rising Main
	Surface Water Rising Main
	Combined Rising Main
	Sludge Rising Main
	Proposed Thames Water Rising Main
	Vacuum

Notes:

- 1) All levels associated with the plans are to Ordnance Datum Newlyn.
- 2) All measurements on the plans are metric.
- 3) Arrows (on gravity fed sewers) or flecks (on rising mains) indicate direction of flow.
- 4) Most private pipes are not shown on our plans, as in the past, this information has not been recorded.
- 5) 'na' or '0' on a manhole level indicates that data is unavailable.

Sewer Fittings

A feature in a sewer that does not affect the flow in the pipe. Example: a vent is a fitting as the function of a vent is to release excess gas.

	Air Valve
	Dam Chase
	Fitting
	Meter
	Vent Column

Operational Controls

A feature in a sewer that changes or diverts the flow in the sewer. Example: A hydrobrake limits the flow passing downstream.

	Control Valve
	Drop Pipe
	Ancillary
	Weir

End Items

End symbols appear at the start or end of a sewer pipe. Examples: an Undefined End at the start of a sewer indicates that Thames Water has no knowledge of the position of the sewer upstream of that symbol, Outfall on a surface water sewer indicates that the pipe discharges into a stream or river.

	Outfall
	Undefined End
	Inlet

Other Symbols

Symbols used on maps which do not fall under other general categories

	Public/Private Pumping Station
	Change of characteristic indicator (C.O.C.I.)
	Invert Level
	Summit

Areas

Lines denoting areas of underground surveys, etc.

	Agreement
	Operational Site
	Chamber
	Tunnel
	Conduit Bridge

Other Sewer Types (Not Operated or Maintained by Thames Water)

	Foul Sewer
	Surface Water Sewer
	Combined Sewer
	Gulley
	Culverted Watercourse
	Proposed
	Abandoned Sewer

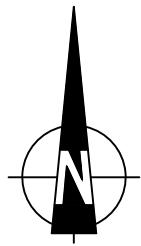
- 6) The text appearing alongside a sewer line indicates the internal diameter of the pipe in millimetres. Text next to a manhole indicates the manhole reference number and should not be taken as a measurement. If you are unsure about any text or symbology present on the plan, please contact a member of Property Insight on 0845 070 9148.

Appendix E Proposed Drainage Information

PBA drawing 47270/4001/001

MicroDrainage schedule and results

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MH 7501

MH 7510

MH 7504

**CONSTRUCTION (DESIGN & MANAGEMENT) REGULATIONS 2015
(CDM REGULATIONS 2015)**

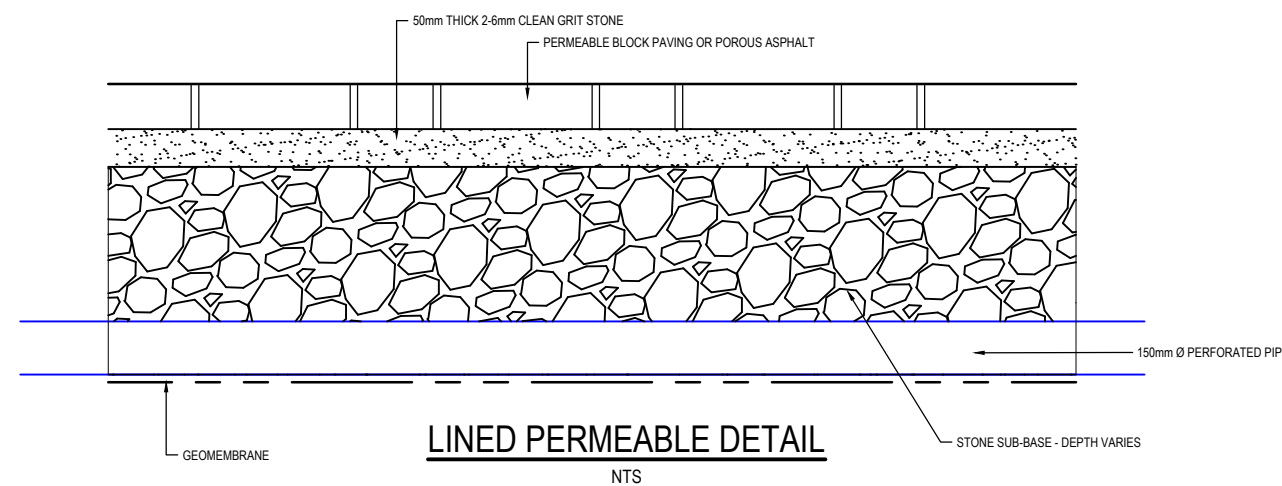
THE PROPOSED CONCEPTUAL FLOOD RISK MITIGATION MEASURES ARE BASED ON THE FOLLOWING INFORMATION AVAILABLE AT THE TIME:

- TOPOGRAPHIC SURVEY FROM GROUNDSURVEYS LTD. DRAWING NUMBER 6883-01 DATED APRIL 2018
- PROPOSALS TAKEN FROM DLK ARCHITECTS DRAWING NUMBER 1861/P01 DATED JULY 2019.

AT THIS CONCEPT DESIGN STAGE IT HAS NOT BEEN POSSIBLE TO ELIMINATE ALL THE HEALTH & SAFETY RISKS AND RESIDUAL RISKS TO THE PROPOSED GROUND WORKS, FOR EXAMPLE, IN RELATION TO THE LOCATION OF UNDERGROUND UTILITIES, GROUND CONDITIONS AND SLOPE STABILITY.

SUCH RESIDUAL RISKS NEED TO BE MITIGATED FOR BY THE CLIENT AND COMMUNICATED TO FUTURE DESIGN TEAMS SO THAT AN ATTEMPT CAN BE MADE TO DESIGN THEM OUT AS THE DETAILED DESIGN IS PROGRESSED AND SITE CONSTRAINTS ARE FULLY UNDERSTOOD.

ANY RISKS THAT ARE NOT DESIGNED OUT DURING THE DETAILED DESIGN STAGE MUST BE COMMUNICATED FURTHER TO THE CONSTRUCTION TEAM AND END USER SO THAT ADEQUATE MITIGATION MEASURES CAN BE PLANNED FOR AND MANAGED.



NOTES:

1. ALL DIMENSIONS ARE IN METRES UNLESS OTHERWISE SPECIFIED.
2. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL OTHER RELEVANT DRAWINGS & SPECIFICATIONS.
3. THIS DRAWING IS FOR USE IN PLANNING APPLICATION SUBMISSION ONLY.

KEY:

- EXISTING FOUL DRAINAGE
- EXISTING DRAINAGE TO BE ABANDONED
- PROPOSED SURFACE WATER DRAINAGE (SOLID)
- PROPOSED PERFORATED PIPES
- SITE BOUNDARY
- PERMEABLE PAVING
- EXISTING BUILDINGS TO BE DEMOLISHED
- EXISTING FOUL MANHOLES

Mark	Revision	Date	Drawn	Chkd	Appd

SCALING NOTE: Do not scale from this drawing. If in doubt, ask.
UTILITIES NOTE: The position of any existing public or private sewers, utility services, plant or apparatus shown on this drawing is believed to be correct, but no warranty to this is expressed or implied. Other such plant or apparatus may also be present but not shown. The Contractor is therefore advised to undertake their own investigation where the presence of any existing sewers, services, plant or apparatus may affect their operations.

Drawing Issue Status
FOR INFORMATION

ST. PAULS CHURCH, WHITLEY WOOD LANE

**PROPOSED SURFACE WATER DRAINAGE
PLAN**

Client
**DR MITTAL AND
PARTNERS**

Date of 1st Issue 01.10.2019	Designed EE	Drawn CS
A2 Scale 1:200	Checked EE	Approved -

Drawing Number
47270/4001/001

Revision
-



Brett Consulting Ltd		Page 2
Caversham Bridge House Waterman Place Reading RG1 8DN	47270 St Pauls Church Proposed Surface Water	
Date 30/09/2019 13:47 File 47270_ST PAULS CHURCH S...	Designed by eedney Checked by EE	
XP Solutions	Network 2018.1	

PIPELINE SCHEDULES for Storm

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
1.000	o	150	1.0	44.050	43.540	0.360	Open Manhole	450
1.001	o	150	1.1	44.000	43.490	0.360	Open Manhole	450
1.002	o	150	1.2	44.000	43.450	0.400	Open Manhole	450
2.000	o	150	2.0	44.000	43.520	0.330	Open Manhole	450
2.001	o	150	2.1	44.000	43.490	0.360	Open Manhole	450
1.003	o	150	1.3	44.000	43.405	0.445	Open Manhole	1200
3.000	o	150	3.0	44.050	43.540	0.360	Open Manhole	450
1.004	o	225	1.4	44.050	43.280	0.545	Open Manhole	1200
4.000	o	150	4.0	44.000	43.490	0.360	Open Manhole	450
4.001	o	150	4.1	44.000	43.450	0.400	Open Manhole	450
4.002	o	150	4.2	44.000	43.415	0.435	Open Manhole	450
1.005	o	150	1.5	44.000	43.230	0.620	Open Manhole	1200
1.006	o	150	1.6	43.800	43.030	0.620	Open Manhole	450

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
1.000	15.404	308.1	1.1	44.000	43.490	0.360	Open Manhole	450
1.001	13.142	328.6	1.2	44.000	43.450	0.400	Open Manhole	450
1.002	14.453	321.2	1.3	44.000	43.405	0.445	Open Manhole	1200
2.000	9.026	300.0	2.1	44.000	43.490	0.360	Open Manhole	450
2.001	8.426	99.1	1.3	44.000	43.405	0.445	Open Manhole	1200
1.003	14.974	299.5	1.4	44.050	43.355	0.545	Open Manhole	1200
3.000	10.968	59.3	1.4	44.050	43.355	0.545	Open Manhole	1200
1.004	14.115	282.3	1.5	44.000	43.230	0.545	Open Manhole	1200
4.000	8.485	212.1	4.1	44.000	43.450	0.400	Open Manhole	450
4.001	11.589	331.1	4.2	44.000	43.415	0.435	Open Manhole	450
4.002	10.748	97.7	1.5	44.000	43.305	0.545	Open Manhole	1200
1.005	19.674	98.4	1.6	43.800	43.030	0.620	Open Manhole	450
1.006	16.131	64.5		43.920	42.780	0.990	Open Manhole	0

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Caversham Bridge House Waterman Place Reading RG1 8DN	47270 St Pauls Church Proposed Surface Water	
Date 30/09/2019 13:47 File 47270_ST PAULS CHURCH S...	Designed by eedney Checked by EE	
XP Solutions Network 2018.1		

Free Flowing Outfall Details for Storm

Outfall Pipe Number	Outfall C. Level Name (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
1.006	43.920	42.780	0.000	0	0

Simulation Criteria for Storm

Volumetric Runoff Coeff	0.840	Additional Flow - % of Total Flow	0.000
Areal Reduction Factor	1.000	MADD Factor * 10m³/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)	720
Foul Sewage per hectare (l/s)	0.000	Output Interval (mins)	6

Number of Input Hydrographs	0	Number of Storage Structures	8
Number of Online Controls	1	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Profile Type	Summer
Return Period (years)	100	Cv (Summer)	0.840
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	18.000	Storm Duration (mins)	360
Ratio R	0.400		

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Caversham Bridge House Waterman Place Reading RG1 8DN	47270 St Pauls Church Proposed Surface Water	
Date 30/09/2019 13:47 File 47270_ST PAULS CHURCH S...	Designed by eedney Checked by EE	
XP Solutions	Network 2018.1	

Online Controls for Storm

Hydro-Brake® Optimum Manhole: 1.5, DS/PN: 1.005, Volume (m³): 1.6

Unit Reference	MD-SHE-0090-3600-1000-3600
Design Head (m)	1.000
Design Flow (l/s)	3.6
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	90
Invert Level (m)	43.230
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.000	3.6
Flush-Flo™	0.300	3.6
Kick-Flo®	0.631	2.9
Mean Flow over Head Range	-	3.1

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	2.8	1.200	3.9	3.000	6.0	7.000	9.0
0.200	3.5	1.400	4.2	3.500	6.5	7.500	9.3
0.300	3.6	1.600	4.5	4.000	6.9	8.000	9.5
0.400	3.5	1.800	4.7	4.500	7.3	8.500	9.8
0.500	3.4	2.000	5.0	5.000	7.6	9.000	10.1
0.600	3.1	2.200	5.2	5.500	8.0	9.500	10.4
0.800	3.2	2.400	5.4	6.000	8.3		
1.000	3.6	2.600	5.6	6.500	8.6		

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Caversham Bridge House Waterman Place Reading RG1 8DN	47270 St Pauls Church Proposed Surface Water	
Date 30/09/2019 13:47 File 47270_ST PAULS CHURCH S...	Designed by eedney Checked by EE	
XP Solutions	Network 2018.1	

Storage Structures for Storm

Porous Car Park Manhole: 1.0, DS/PN: 1.000

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	10.0
Membrane Percolation (mm/hr)	1000	Length (m)	16.0
Max Percolation (l/s)	44.4	Slope (1:X)	0.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	43.540	Cap Volume Depth (m)	0.380

Porous Car Park Manhole: 1.1, DS/PN: 1.001

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	10.0
Membrane Percolation (mm/hr)	1000	Length (m)	20.0
Max Percolation (l/s)	55.6	Slope (1:X)	0.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	43.490	Cap Volume Depth (m)	0.380

Porous Car Park Manhole: 1.2, DS/PN: 1.002

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	12.5
Membrane Percolation (mm/hr)	1000	Length (m)	20.0
Max Percolation (l/s)	69.4	Slope (1:X)	0.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	43.450	Cap Volume Depth (m)	0.420

Porous Car Park Manhole: 2.0, DS/PN: 2.000

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	10.0
Membrane Percolation (mm/hr)	1000	Length (m)	5.0
Max Percolation (l/s)	13.9	Slope (1:X)	0.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	43.520	Cap Volume Depth (m)	0.350

Porous Car Park Manhole: 1.3, DS/PN: 1.003

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	10.0
Membrane Percolation (mm/hr)	1000	Length (m)	17.0
Max Percolation (l/s)	47.2	Slope (1:X)	0.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	43.405	Cap Volume Depth (m)	0.460

Porous Car Park Manhole: 1.4, DS/PN: 1.004

Infiltration Coefficient Base (m/hr)	0.00000	Max Percolation (l/s)	50.0
Membrane Percolation (mm/hr)	1000	Safety Factor	2.0

Brett Consulting Ltd		Page 6																																																																
Caversham Bridge House Waterman Place Reading RG1 8DN	47270 St Pauls Church Proposed Surface Water																																																																	
Date 30/09/2019 13:47 File 47270_ST PAULS CHURCH S...	Designed by eedney Checked by EE																																																																	
XP Solutions Network 2018.1																																																																		
<u>Porous Car Park Manhole: 1.4, DS/PN: 1.004</u> <table><tr><td>Porosity</td><td>0.30</td><td>Slope (1:X)</td><td>0.0</td></tr><tr><td>Invert Level (m)</td><td>43.540</td><td>Depression Storage (mm)</td><td>5</td></tr><tr><td>Width (m)</td><td>10.0</td><td>Evaporation (mm/day)</td><td>3</td></tr><tr><td>Length (m)</td><td>18.0</td><td>Cap Volume Depth (m)</td><td>0.380</td></tr></table> <u>Porous Car Park Manhole: 4.2, DS/PN: 4.002</u> <table><tr><td>Infiltration Coefficient Base (m/hr)</td><td>0.00000</td><td>Width (m)</td><td>5.0</td></tr><tr><td>Membrane Percolation (mm/hr)</td><td>1000</td><td>Length (m)</td><td>18.0</td></tr><tr><td>Max Percolation (l/s)</td><td>25.0</td><td>Slope (1:X)</td><td>300.0</td></tr><tr><td>Safety Factor</td><td>2.0</td><td>Depression Storage (mm)</td><td>5</td></tr><tr><td>Porosity</td><td>0.30</td><td>Evaporation (mm/day)</td><td>3</td></tr><tr><td>Invert Level (m)</td><td>43.415</td><td>Cap Volume Depth (m)</td><td>0.400</td></tr></table> <u>Porous Car Park Manhole: 1.5, DS/PN: 1.005</u> <table><tr><td>Infiltration Coefficient Base (m/hr)</td><td>0.00000</td><td>Width (m)</td><td>10.0</td></tr><tr><td>Membrane Percolation (mm/hr)</td><td>1000</td><td>Length (m)</td><td>17.0</td></tr><tr><td>Max Percolation (l/s)</td><td>47.2</td><td>Slope (1:X)</td><td>0.0</td></tr><tr><td>Safety Factor</td><td>2.0</td><td>Depression Storage (mm)</td><td>5</td></tr><tr><td>Porosity</td><td>0.30</td><td>Evaporation (mm/day)</td><td>3</td></tr><tr><td>Invert Level (m)</td><td>43.500</td><td>Cap Volume Depth (m)</td><td>0.350</td></tr></table>			Porosity	0.30	Slope (1:X)	0.0	Invert Level (m)	43.540	Depression Storage (mm)	5	Width (m)	10.0	Evaporation (mm/day)	3	Length (m)	18.0	Cap Volume Depth (m)	0.380	Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	5.0	Membrane Percolation (mm/hr)	1000	Length (m)	18.0	Max Percolation (l/s)	25.0	Slope (1:X)	300.0	Safety Factor	2.0	Depression Storage (mm)	5	Porosity	0.30	Evaporation (mm/day)	3	Invert Level (m)	43.415	Cap Volume Depth (m)	0.400	Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	10.0	Membrane Percolation (mm/hr)	1000	Length (m)	17.0	Max Percolation (l/s)	47.2	Slope (1:X)	0.0	Safety Factor	2.0	Depression Storage (mm)	5	Porosity	0.30	Evaporation (mm/day)	3	Invert Level (m)	43.500	Cap Volume Depth (m)	0.350
Porosity	0.30	Slope (1:X)	0.0																																																															
Invert Level (m)	43.540	Depression Storage (mm)	5																																																															
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Caversham Bridge House Waterman Place Reading RG1 8DN	47270 St Pauls Church Proposed Surface Water	
Date 30/09/2019 13:48 File 47270_ST PAULS CHURCH S...	Designed by eedney Checked by EE	
XP Solutions	Network 2018.1	

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

US/MH		
PN	Name	Status
1.000	1.0	OK
1.001	1.1	OK
1.002	1.2	OK
2.000	2.0	OK
2.001	2.1	OK
1.003	1.3	OK
3.000	3.0	OK
1.004	1.4	OK
4.000	4.0	OK
4.001	4.1	OK
4.002	4.2	OK
1.005	1.5	SURCHARGED
1.006	1.6	OK

Brett Consulting Ltd			Page 3																																																																																																																																																																		
Caversham Bridge House Waterman Place Reading RG1 8DN		47270 St Pauls Church Proposed Surface Water																																																																																																																																																																			
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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 Storage Structures 8																																																																																																																																																																			
Number of Online Controls 1		Number of Time/Area Diagrams 0																																																																																																																																																																			
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Synthetic Rainfall Details																																																																																																																																																																					
Rainfall Model		FSR		Ratio R 0.400																																																																																																																																																																	
Region England and Wales		Cv (Summer) 0.750																																																																																																																																																																			
M5-60 (mm)		18.000		Cv (Winter) 0.840																																																																																																																																																																	
Margin for Flood Risk Warning (mm) 0.0		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, 5760, 7200, 8640, 10080																																																																																																																																																																			
Return Period(s) (years)		1, 30, 100																																																																																																																																																																			
Climate Change (%)		0, 0, 0																																																																																																																																																																			
<table><thead><tr><th></th><th>US/MH</th><th></th><th></th><th></th><th>Duration</th><th>US/CL</th><th>Water</th><th>Surcharged</th><th>Flooded</th></tr><tr><th>PN</th><th>Name</th><th>Event</th><th></th><th></th><th>(mins)</th><th>(m)</th><th>Level</th><th>Depth</th><th>Volume</th></tr><tr><th></th><th></th><th></th><th></th><th></th><th></th><th></th><th>(m)</th><th>(m)</th><th>(m³)</th></tr></thead><tbody><tr><td>1.000</td><td>1.0</td><td>180 minute 30 year Winter I+0%</td><td></td><td></td><td>180</td><td>44.050</td><td>43.594</td><td>-0.096</td><td>0.000</td></tr><tr><td>1.001</td><td>1.1</td><td>180 minute 30 year Winter I+0%</td><td></td><td></td><td>180</td><td>44.000</td><td>43.594</td><td>-0.046</td><td>0.000</td></tr><tr><td>1.002</td><td>1.2</td><td>120 minute 30 year Winter I+0%</td><td></td><td></td><td>120</td><td>44.000</td><td>43.596</td><td>-0.004</td><td>0.000</td></tr><tr><td>2.000</td><td>2.0</td><td>15 minute 30 year Winter I+0%</td><td></td><td></td><td>15</td><td>44.000</td><td>43.630</td><td>-0.040</td><td>0.000</td></tr><tr><td>2.001</td><td>2.1</td><td>15 minute 30 year Winter I+0%</td><td></td><td></td><td>15</td><td>44.000</td><td>43.642</td><td>0.002</td><td>0.000</td></tr><tr><td>1.003</td><td>1.3</td><td>60 minute 30 year Winter I+0%</td><td></td><td></td><td>60</td><td>44.000</td><td>43.605</td><td>0.050</td><td>0.000</td></tr><tr><td>3.000</td><td>3.0</td><td>15 minute 30 year Winter I+0%</td><td></td><td></td><td>15</td><td>44.050</td><td>43.621</td><td>-0.069</td><td>0.000</td></tr><tr><td>1.004</td><td>1.4</td><td>120 minute 30 year Winter I+0%</td><td></td><td></td><td>120</td><td>44.050</td><td>43.601</td><td>0.096</td><td>0.000</td></tr><tr><td>4.000</td><td>4.0</td><td>120 minute 30 year Winter I+0%</td><td></td><td></td><td>120</td><td>44.000</td><td>43.605</td><td>-0.035</td><td>0.000</td></tr><tr><td>4.001</td><td>4.1</td><td>120 minute 30 year Winter I+0%</td><td></td><td></td><td>120</td><td>44.000</td><td>43.604</td><td>0.004</td><td>0.000</td></tr><tr><td>4.002</td><td>4.2</td><td>120 minute 30 year Winter I+0%</td><td></td><td></td><td>120</td><td>44.000</td><td>43.601</td><td>0.036</td><td>0.000</td></tr><tr><td>1.005</td><td>1.5</td><td>120 minute 30 year Winter I+0%</td><td></td><td></td><td>120</td><td>44.000</td><td>43.598</td><td>0.218</td><td>0.000</td></tr><tr><td>1.006</td><td>1.6</td><td>960 minute 30 year Summer I+0%</td><td></td><td></td><td>960</td><td>43.800</td><td>43.072</td><td>-0.108</td><td>0.000</td></tr></tbody></table>							US/MH				Duration	US/CL	Water	Surcharged	Flooded	PN	Name	Event			(mins)	(m)	Level	Depth	Volume								(m)	(m)	(m³)	1.000	1.0	180 minute 30 year Winter I+0%			180	44.050	43.594	-0.096	0.000	1.001	1.1	180 minute 30 year Winter I+0%			180	44.000	43.594	-0.046	0.000	1.002	1.2	120 minute 30 year Winter I+0%			120	44.000	43.596	-0.004	0.000	2.000	2.0	15 minute 30 year Winter I+0%			15	44.000	43.630	-0.040	0.000	2.001	2.1	15 minute 30 year Winter I+0%			15	44.000	43.642	0.002	0.000	1.003	1.3	60 minute 30 year Winter I+0%			60	44.000	43.605	0.050	0.000	3.000	3.0	15 minute 30 year Winter I+0%			15	44.050	43.621	-0.069	0.000	1.004	1.4	120 minute 30 year Winter I+0%			120	44.050	43.601	0.096	0.000	4.000	4.0	120 minute 30 year Winter I+0%			120	44.000	43.605	-0.035	0.000	4.001	4.1	120 minute 30 year Winter I+0%			120	44.000	43.604	0.004	0.000	4.002	4.2	120 minute 30 year Winter I+0%			120	44.000	43.601	0.036	0.000	1.005	1.5	120 minute 30 year Winter I+0%			120	44.000	43.598	0.218	0.000	1.006	1.6	960 minute 30 year Summer I+0%			960	43.800	43.072	-0.108	0.000
	US/MH				Duration	US/CL	Water	Surcharged	Flooded																																																																																																																																																												
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1.000	1.0	180 minute 30 year Winter I+0%			180	44.050	43.594	-0.096	0.000																																																																																																																																																												
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1.003	1.3	60 minute 30 year Winter I+0%			60	44.000	43.605	0.050	0.000																																																																																																																																																												
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1.004	1.4	120 minute 30 year Winter I+0%			120	44.050	43.601	0.096	0.000																																																																																																																																																												
4.000	4.0	120 minute 30 year Winter I+0%			120	44.000	43.605	-0.035	0.000																																																																																																																																																												
4.001	4.1	120 minute 30 year Winter I+0%			120	44.000	43.604	0.004	0.000																																																																																																																																																												
4.002	4.2	120 minute 30 year Winter I+0%			120	44.000	43.601	0.036	0.000																																																																																																																																																												
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1.006	1.6	960 minute 30 year Summer I+0%			960	43.800	43.072	-0.108	0.000																																																																																																																																																												
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Caversham Bridge House Waterman Place Reading RG1 8DN	47270 St Pauls Church Proposed Surface Water	
Date 30/09/2019 13:48 File 47270_ST PAULS CHURCH S...	Designed by eedney Checked by EE	
XP Solutions		
Network 2018.1		

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

PN	Pipe		Status
	US/MH Name	Flow (l/s)	
1.000	1.0	0.8	OK
1.001	1.1	0.9	OK
1.002	1.2	1.8	OK
2.000	2.0	5.6	OK
2.001	2.1	15.7	SURCHARGED
1.003	1.3	3.4	SURCHARGED
3.000	3.0	11.6	OK
1.004	1.4	6.3	SURCHARGED
4.000	4.0	1.4	OK
4.001	4.1	2.1	SURCHARGED
4.002	4.2	1.0	SURCHARGED
1.005	1.5	3.6	SURCHARGED
1.006	1.6	3.6	OK

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Caversham Bridge House Waterman Place Reading RG1 8DN				47270 St Pauls Church Proposed Surface Water																																																																																																																							
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File 47270_ST PAULS CHURCH S...				Checked by EE																																																																																																																							
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 Storage Structures 8 Number of Online Controls 1 Number of Time/Area Diagrams 0 Number of Offline Controls 0 Number of Real Time Controls 0 Synthetic Rainfall Details Rainfall Model FSR Ratio R 0.400 Region England and Wales Cv (Summer) 0.750 M5-60 (mm) 18.000 Cv (Winter) 0.840 Margin for Flood Risk Warning (mm) 0.0 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, 5760, 7200, 8640, 10080 Return Period(s) (years) 1, 30, 100 Climate Change (%) 0, 0, 0																																																																																																																											
<table><tr><th>PN</th><th>US/MH Name</th><th>Event</th><th>Duration (mins)</th><th>US/CL (m)</th><th>Water Level (m)</th><th>Surcharged Depth (m)</th><th>Flooded Volume (m³)</th></tr><tr><td>1.000</td><td>1.0</td><td>180 minute 100 year Winter I+0%</td><td>180</td><td>44.050</td><td>43.651</td><td>-0.039</td><td>0.000</td></tr><tr><td>1.001</td><td>1.1</td><td>180 minute 100 year Winter I+0%</td><td>180</td><td>44.000</td><td>43.652</td><td>0.012</td><td>0.000</td></tr><tr><td>1.002</td><td>1.2</td><td>180 minute 100 year Winter I+0%</td><td>180</td><td>44.000</td><td>43.653</td><td>0.053</td><td>0.000</td></tr><tr><td>2.000</td><td>2.0</td><td>30 minute 100 year Winter I+0%</td><td>30</td><td>44.000</td><td>43.693</td><td>0.023</td><td>0.000</td></tr><tr><td>2.001</td><td>2.1</td><td>30 minute 100 year Winter I+0%</td><td>30</td><td>44.000</td><td>43.683</td><td>0.043</td><td>0.000</td></tr><tr><td>1.003</td><td>1.3</td><td>120 minute 100 year Winter I+0%</td><td>120</td><td>44.000</td><td>43.657</td><td>0.102</td><td>0.000</td></tr><tr><td>3.000</td><td>3.0</td><td>120 minute 100 year Winter I+0%</td><td>120</td><td>44.050</td><td>43.659</td><td>-0.031</td><td>0.000</td></tr><tr><td>1.004</td><td>1.4</td><td>120 minute 100 year Winter I+0%</td><td>120</td><td>44.050</td><td>43.655</td><td>0.150</td><td>0.000</td></tr><tr><td>4.000</td><td>4.0</td><td>120 minute 100 year Winter I+0%</td><td>120</td><td>44.000</td><td>43.659</td><td>0.019</td><td>0.000</td></tr><tr><td>4.001</td><td>4.1</td><td>120 minute 100 year Winter I+0%</td><td>120</td><td>44.000</td><td>43.657</td><td>0.057</td><td>0.000</td></tr><tr><td>4.002</td><td>4.2</td><td>120 minute 100 year Winter I+0%</td><td>120</td><td>44.000</td><td>43.654</td><td>0.089</td><td>0.000</td></tr><tr><td>1.005</td><td>1.5</td><td>120 minute 100 year Winter I+0%</td><td>120</td><td>44.000</td><td>43.651</td><td>0.271</td><td>0.000</td></tr><tr><td>1.006</td><td>1.6</td><td>960 minute 100 year Summer I+0%</td><td>960</td><td>43.800</td><td>43.072</td><td>-0.108</td><td>0.000</td></tr></table>												PN	US/MH Name	Event	Duration (mins)	US/CL (m)	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	1.000	1.0	180 minute 100 year Winter I+0%	180	44.050	43.651	-0.039	0.000	1.001	1.1	180 minute 100 year Winter I+0%	180	44.000	43.652	0.012	0.000	1.002	1.2	180 minute 100 year Winter I+0%	180	44.000	43.653	0.053	0.000	2.000	2.0	30 minute 100 year Winter I+0%	30	44.000	43.693	0.023	0.000	2.001	2.1	30 minute 100 year Winter I+0%	30	44.000	43.683	0.043	0.000	1.003	1.3	120 minute 100 year Winter I+0%	120	44.000	43.657	0.102	0.000	3.000	3.0	120 minute 100 year Winter I+0%	120	44.050	43.659	-0.031	0.000	1.004	1.4	120 minute 100 year Winter I+0%	120	44.050	43.655	0.150	0.000	4.000	4.0	120 minute 100 year Winter I+0%	120	44.000	43.659	0.019	0.000	4.001	4.1	120 minute 100 year Winter I+0%	120	44.000	43.657	0.057	0.000	4.002	4.2	120 minute 100 year Winter I+0%	120	44.000	43.654	0.089	0.000	1.005	1.5	120 minute 100 year Winter I+0%	120	44.000	43.651	0.271	0.000	1.006	1.6	960 minute 100 year Summer I+0%	960	43.800	43.072	-0.108	0.000
PN	US/MH Name	Event	Duration (mins)	US/CL (m)	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)																																																																																																																				
1.000	1.0	180 minute 100 year Winter I+0%	180	44.050	43.651	-0.039	0.000																																																																																																																				
1.001	1.1	180 minute 100 year Winter I+0%	180	44.000	43.652	0.012	0.000																																																																																																																				
1.002	1.2	180 minute 100 year Winter I+0%	180	44.000	43.653	0.053	0.000																																																																																																																				
2.000	2.0	30 minute 100 year Winter I+0%	30	44.000	43.693	0.023	0.000																																																																																																																				
2.001	2.1	30 minute 100 year Winter I+0%	30	44.000	43.683	0.043	0.000																																																																																																																				
1.003	1.3	120 minute 100 year Winter I+0%	120	44.000	43.657	0.102	0.000																																																																																																																				
3.000	3.0	120 minute 100 year Winter I+0%	120	44.050	43.659	-0.031	0.000																																																																																																																				
1.004	1.4	120 minute 100 year Winter I+0%	120	44.050	43.655	0.150	0.000																																																																																																																				
4.000	4.0	120 minute 100 year Winter I+0%	120	44.000	43.659	0.019	0.000																																																																																																																				
4.001	4.1	120 minute 100 year Winter I+0%	120	44.000	43.657	0.057	0.000																																																																																																																				
4.002	4.2	120 minute 100 year Winter I+0%	120	44.000	43.654	0.089	0.000																																																																																																																				
1.005	1.5	120 minute 100 year Winter I+0%	120	44.000	43.651	0.271	0.000																																																																																																																				
1.006	1.6	960 minute 100 year Summer I+0%	960	43.800	43.072	-0.108	0.000																																																																																																																				
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Caversham Bridge House Waterman Place Reading RG1 8DN	47270 St Pauls Church Proposed Surface Water	
Date 30/09/2019 13:48 File 47270_ST PAULS CHURCH S...	Designed by eedney Checked by EE	
XP Solutions	Network 2018.1	

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

Pipe			
US/MH		Flow	
PN	Name	(l/s)	Status
1.000	1.0	1.1	OK
1.001	1.1	1.0	SURCHARGED
1.002	1.2	1.7	SURCHARGED
2.000	2.0	4.3	SURCHARGED
2.001	2.1	16.7	SURCHARGED
1.003	1.3	3.1	SURCHARGED
3.000	3.0	4.7	OK
1.004	1.4	6.0	SURCHARGED
4.000	4.0	1.9	SURCHARGED
4.001	4.1	2.8	SURCHARGED
4.002	4.2	1.4	SURCHARGED
1.005	1.5	3.6	SURCHARGED
1.006	1.6	3.6	OK

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Caversham Bridge House Waterman Place Reading RG1 8DN	47270 St Pauls Church Proposed Surface Water	
Date 30/09/2019 13:49 File 47270_ST PAULS CHURCH S...	Designed by eedney Checked by EE	
XP Solutions	Network 2018.1	

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

Pipe			
US/MH		Flow	
PN	Name	(l/s)	Status
1.000	1.0	1.0	SURCHARGED
1.001	1.1	0.9	SURCHARGED
1.002	1.2	1.6	SURCHARGED
2.000	2.0	7.0	SURCHARGED
2.001	2.1	20.5	SURCHARGED
1.003	1.3	2.8	SURCHARGED
3.000	3.0	20.2	SURCHARGED
1.004	1.4	5.9	SURCHARGED
4.000	4.0	2.0	SURCHARGED
4.001	4.1	3.0	SURCHARGED
4.002	4.2	1.7	SURCHARGED
1.005	1.5	3.6	SURCHARGED
1.006	1.6	3.6	OK