



FLOOD RISK ASSESSMENT
Woodside Day Centre, Uxbridge Road, Hillingdon

Prepared for: London Borough of Hillingdon
Issue 2: 2 October 2018
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Document History

Issue	Date	Description	Prepared By	Checked By
1	31 May 18	First Issue	K Man	J Hanlon
2	2 Oct 18	Issued following client comments	S Haque	J Hanlon

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1.0 Introduction

- 1.1 This Flood Risk Assessment has been prepared by Glanville Consultants on behalf of the London Borough of Hillingdon to accompany a planning application for the proposed redevelopment of Woodside Day Centre at Uxbridge Road.
- 1.2 The purpose of this document is to assess the existing level of flood risk to the site and its surroundings within the context of the development proposals and to outline a surface water drainage strategy.
- 1.3 This appraisal has been prepared in accordance with the National Planning Policy Framework (NPPF), dated March 2012, and the Planning Practice Guidance (PPG) to the NPPF, dated March 2014.
- 1.4 This assessment was undertaken with reference to information provided and/or published by the following bodies:
- Ordnance Survey;
 - British Geological Survey;
 - London Borough of Hillingdon; and
 - Environment Agency.
- 1.5 This document concludes that the site is not at risk of flooding and can be developed safely without increasing flood risk elsewhere and that the development proposals comply with relevant planning policy concerning flood risk. The report demonstrates that suitable provision for the disposal of surface water from the proposed development is capable of being provided.

2.0 The Development Site and Proposal

Location and Site

- 2.1 The site is located at Uxbridge Road, Hillingdon. The postcode is UB4 0RE and the approximate National Grid Reference is 509974E, 181331N. A site location plan is included in Appendix A.
- 2.2 The site currently comprises the existing Woodside Day Centre with associated car parking and landscaping is located at the east, and car parking spaces associated with the properties fronting Swift Close located at the west of the site.
- 2.3 Uxbridge Road is located adjacent to the north-eastern site boundary, with residential flats fronting Swift Close and Addison Way adjacent to the north-west and south-east site boundaries respectively. Residential properties fronting Acacia Avenue bound the site to the south-west.
- 2.4 The topography of the site slopes is generally relatively flat, with the levels varying from around a high point of approximately 38.45mAOD at the west of the existing Day Centre to approximately 37.41mAOD near the north-east site boundary.
- 2.5 A topographical survey of the site is included in Appendix B.

Geological Characteristics

- 2.6 British Geological Survey (BGS) mapping indicates that the bedrock geology underlying the site is likely to be London Clay Formation, consisting of clay, silt and sand. Langley Silt Member deposits, consisting of clay and silt, are indicated to underlie the site.

Existing Drainage

- 2.7 A review of Thames Water records, which have been included in Appendix C, indicate that there are public surface water sewers within the vicinity of the site. A 225mm diameter surface water sewer is located in Uxbridge Road adjacent to the north-east site boundary, flowing in a south-easterly direction.
- 2.8 It is understood that the existing site is likely to discharge surface water run-off to this sewer. It is likely that the existing Day Centre and Swift Close car park will each have a separate connection to the Thames Water infrastructure.

Proposed Development

- 2.9 It is proposed to demolish the existing Woodside Day Centre and construct a new medical centre and 20 residential flats along with associated car park and soft landscaping.
- 2.10 The proposed development drawings are included in Appendix D

3.0 Flood Risk Policy and Guidance

- 3.1 A summary of the national and local policy, legislation and guidance relating to flood risk and surface water drainage relevant to the development proposals is outlined below.

National

National Planning Policy Framework, March 2012

- 3.2 The National Planning Policy Framework (NPPF) and associated planning guidance provide national guidance to planning authorities, developers, the public and the Environment Agency (EA), to ensure flood risk is taken into account at all stages of the planning process.
- 3.3 The planning guidance establishes flood zones as the starting point for the sequential approach identified in the NPPF. The aim of the approach is to steer new development to areas with the lowest probability of flooding. The Flood Zones are defined as follows:
- Flood Zone 1 (Low Probability) comprises land assessed as having a less than 1-in-1,000 annual probability of river or sea flooding (<0.1%).
 - Flood Zone 2 (Medium Probability) comprises land assessed as having between a 1-in-100 and 1-in-1,000 annual probability of river flooding (1% – 0.1%), or between a 1-in-200 and 1-in-1,000 annual probability of sea flooding (0.5% – 0.1%) in any year.
 - Flood Zone 3 (High Probability) comprises land assessed as having a 1-in-100 or greater annual probability of river flooding (>1%), or a 1-in-200 or greater annual probability of flooding from the sea (>0.5%) in any year.
 - Flood Zone 3 is further subdivided into Flood Zones 3a and 3b, where Flood Zone 3b is 'The Functional Floodplain' typically considered to have an annual probability of flooding of 1-in-20 or greater (>5%) in any year.

The Flood and Water Management Act (2010)

- 3.4 The Flood and Water Management Act (2010) places duties on the EA, Local Authorities, developers, and other bodies to manage flood risk. The Act has included checking and approved responsibilities by the Lead Local Flood Authority for Sustainable Drainage Systems (SuDS).

London Borough of Hillingdon (LBH) Strategic Flood Risk Assessment Level 1, November 2008

- 3.5 This SFRA was produced by Scott Wilson to inform the planning process in the London Borough of Hillingdon. The SFRA includes flood maps covering the entire district and summarises the flood risk from each source of flooding in the district.

4.0 Flood Risk Assessment

Sequential and Exceptions Test

- 4.1 According to the Environment Agency flood map for planning (reproduced in Figure 4.1), the site is located in Flood Zone 1, the zone considered at low risk from fluvial flooding with a risk of less than 0.1% in any given year.

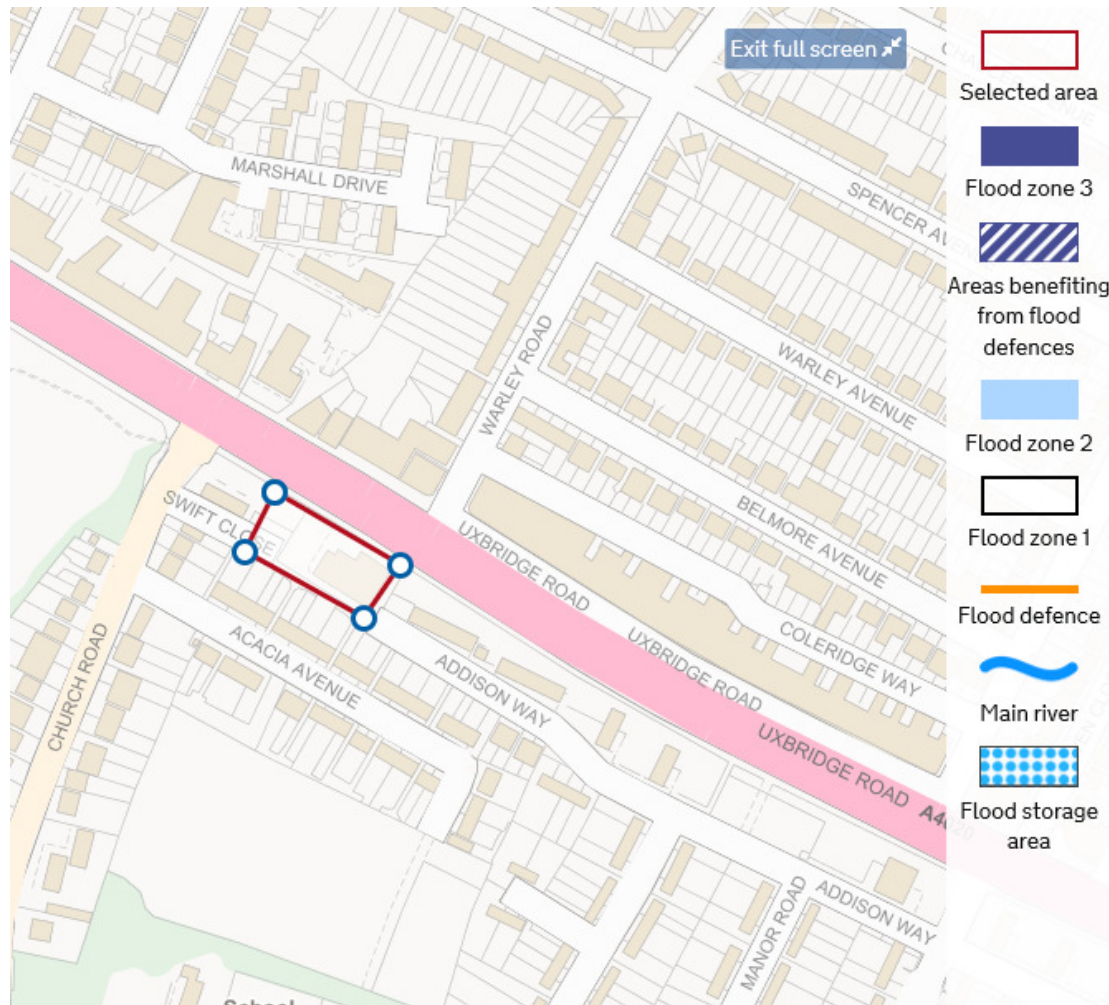


Figure 4.1: Extract from Environment Agency's Flood Map for Planning

- 4.2 The proposed development is considered to be in a suitable zone for development and is considered to meet with the requirements of the sequential test such that the exception test would not be required.

Fluvial Flood Risk

- 4.3 As highlighted above, the site is located in Flood Zone 1. As such the site is considered to be at lowest possible risk of fluvial flooding.

Surface Water Flooding

- 4.4 Environment Agency surface water flood maps indicate that the entirety of the site (circled red) is at very low risk of surface water flooding. This is highlighted on the extract below.

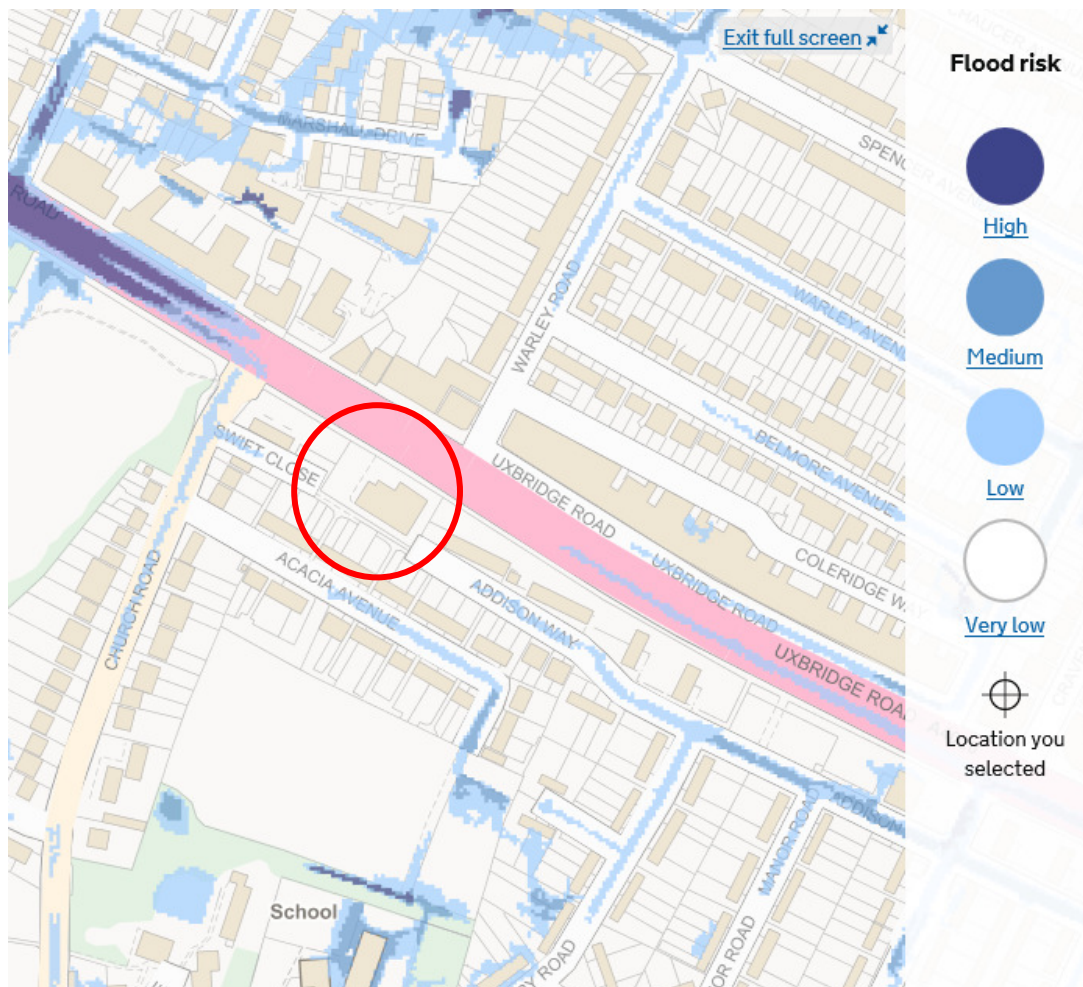


Figure 4.2: Extract from Environment Agency's Flood Map for Surface Water

- 4.5 There is no anecdotal evidence to suggest that surface water flooding has occurred on the site. As such, surface water flooding is not considered to be an issue which would prevent the development of the site.

Groundwater Flooding

- 4.6 Figure 4 of the SFRA shows mapping of 'Other Sources of Flood Risk' in the London Borough of Hillingdon. The mapping indicates there have been no recorded incidents of groundwater flooding within or in the vicinity of the site.
- 4.7 There is no anecdotal evidence to suggest that groundwater flooding has occurred on the site. It is therefore concluded that the risk of groundwater flooding is very low and is not considered to be an issue which would prevent the development of the site.

Sewer Flooding

- 4.8 The SFRA includes historic flooding data from Thames Water which details the number of total number of properties flooded by overloaded sewers per postcode within the district within the last ten years of the document being produced. There were no properties indicated to have flooded due to overloaded sewers within the section of the postcode (UB4) which contains the proposed site.
- 4.9 Also there are no anecdotal reports or evidence to suggest incidents of sewer flooding occurring on the site. It is therefore concluded that the risk of sewer flooding is low and is not considered to be an issue that would prevent the development of the site.

Reservoir Flooding

- 4.10 Environment Agency maps also indicate potential extents of flooding from reservoirs and this confirms that the site is not in an area considered at risk from this source.

Historic Flooding

- 4.11 There have been no recorded incidents of historical flooding indicated within the SFRA that shows major flooding that has affected the area within or in the vicinity of the site in the past.

Summary

- 4.12 The site is considered to be at low risk from all sources of flooding examined.

Mitigation Measures

- 4.13 Given that the site is located within Flood Zone 1, the lowest risk of flood zone, flood compensation or resilience measures will not be required to mitigate against the risk of fluvial flooding.
- 4.14 Given that the development is located wholly within an area outside of the floodplain and is not located within an EA defined dry island, the site is considered to be accessible to other areas outside of the floodplain in times of flooding.

5.0 Surface Water Drainage Strategy

- 5.1 This section of the report presents the outline surface water drainage strategy for the proposed development.

Sustainable Drainage Systems

- 5.2 New development can provide opportunities to incorporate Sustainable Drainage Systems (SuDS). In general, there are many types of SuDS that can potentially be considered for incorporation within new developments and these are detailed in CIRIA Report C753 'The SuDS Manual' (2015) and the emerging National Standards produced in support of The Flood and Water Management Act 2010.
- 5.3 The Building Regulations part H3 stipulates that rainwater from roofs and paved areas is carried away from surface to discharge to one of the following, listed in order of priority:
- a) an adequate soakaway or some other adequate infiltration system; where that is not practical;
 - b) a watercourse; or, where that is not practical
 - c) a sewer.
- 5.4 In this instance, the high clay content of sub-soils will likely prohibit the implementation of infiltration type drainage. There are however surface water sewers in the vicinity of the site and it is considered likely that the existing site drains by this method. It is therefore proposed to connect surface water to the local sewer and utilise sustainable drainage techniques to reduce surface water run-off through limiting discharge and providing suitable attenuation.
- 5.5 With consideration for the site confines and hydrogeological context, various forms of SuDS have been examined in the below table:

SuDS Type	Design Consideration	Appropriateness
Rainwater Harvesting	Limited future usage potential as gardens not proposed	x
Filter Drains / Swales / Bio retention	Insufficient space for this form of drainage	x
Pervious Pavements	Is considered suitable in parking areas and provides benefits in terms of improving water quality and potential value reduction via evaporation	✓
Attenuation Storage	This form of storage can be incorporated	✓
Detention Basins / Ponds / Wetlands	Insufficient space	x

- 5.6 As noted previously the existing roofs and hardstanding areas on-site is considered likely to drain to the existing surface water sewer in Uxbridge Road. Based on a rainfall rate of 50mm/hr, surface water run-off could be in the region of 30l/s.
- 5.7 In order to account for the potential effects of climate change, it is proposed to restrict this discharge as part of the future development to 60% of the rate estimated above to 18l/s.

5.8 It is therefore proposed to reuse the two existing connections to the surface water sewer and limit discharge to 9l/s in each connection using a suitable flow control device.

5.9 The two outfalls from the site will retain a catchment area that is similar to the existing situation, the surface water strategies in the two catchments are as follows.

South-eastern Catchment

5.10 Surface water run-off from the proposed development roofs and a proportion of the car park for the new medical centre will drain to an assumed surface water outfall at the east of the site, at a rate restricted as specified above employing a Hydrobrake flow control device, before being discharged to the Thames Water infrastructure.

5.11 Surface water run-off collected from this catchment will be attenuated within a new geocellular storage crate located underneath the proposed car park, which will be designed to provide sufficient attenuation storage to cater for a 1-in-100 year + 40% storm event without flooding from surface water. Copies of associated MicroDrainage calculations are provided in Appendix E.

5.12 Car parking spaces will be constructing as porous paving will offer a first level of treatment before conveying surface run-off to the geocellular storage crate. It should be noted that the additional attenuation provided within the porous paving sub-base has not been considered within the calculations for this catchment to ensure the design of the crate is robust.

North-western Catchment

5.13 Surface water run-off from the remainder of the proposed medical centre car park and the new Swift Close car park will drain to an assumed surface water outfall at the west of the site, at a rate restricted as specified above using a Hydrobrake flow control device, before being discharged to the Thames Water infrastructure.

5.14 The surface water collected on the access to the car park from Swift Close will drain as existing and as such will not be considered within the calculations.

5.15 The car parking spaces and proportion of the access roads within this catchment are proposed to be constructed using porous paving, which will provide sufficient attenuation storage to cater for a 1-in-100 year +40% storm event in its sub-base without flooding from surface water. Copies of associated MicroDrainage calculations are provided in Appendix F.

Both Catchments

5.16 As noted previously, the use of porous paving will provide effective water quality improvements for the whole site by degrading pollutants which may have been contained in the surface water run-off. As such, the requirement for a petrol interceptor within the site is negated.

5.17 A plan showing the outline proposed drainage strategy including preliminary sizing of SuDS features based on the strategy as described above is included in Appendix G. A more detailed drainage strategy will be developed at detailed design stage.

- 5.18 This proposal will limit discharge to appropriate rates, increase the volume of surface water storage on the site and will not increase the risk of flooding either to the site or elsewhere.

6.0 Conclusion

Summary

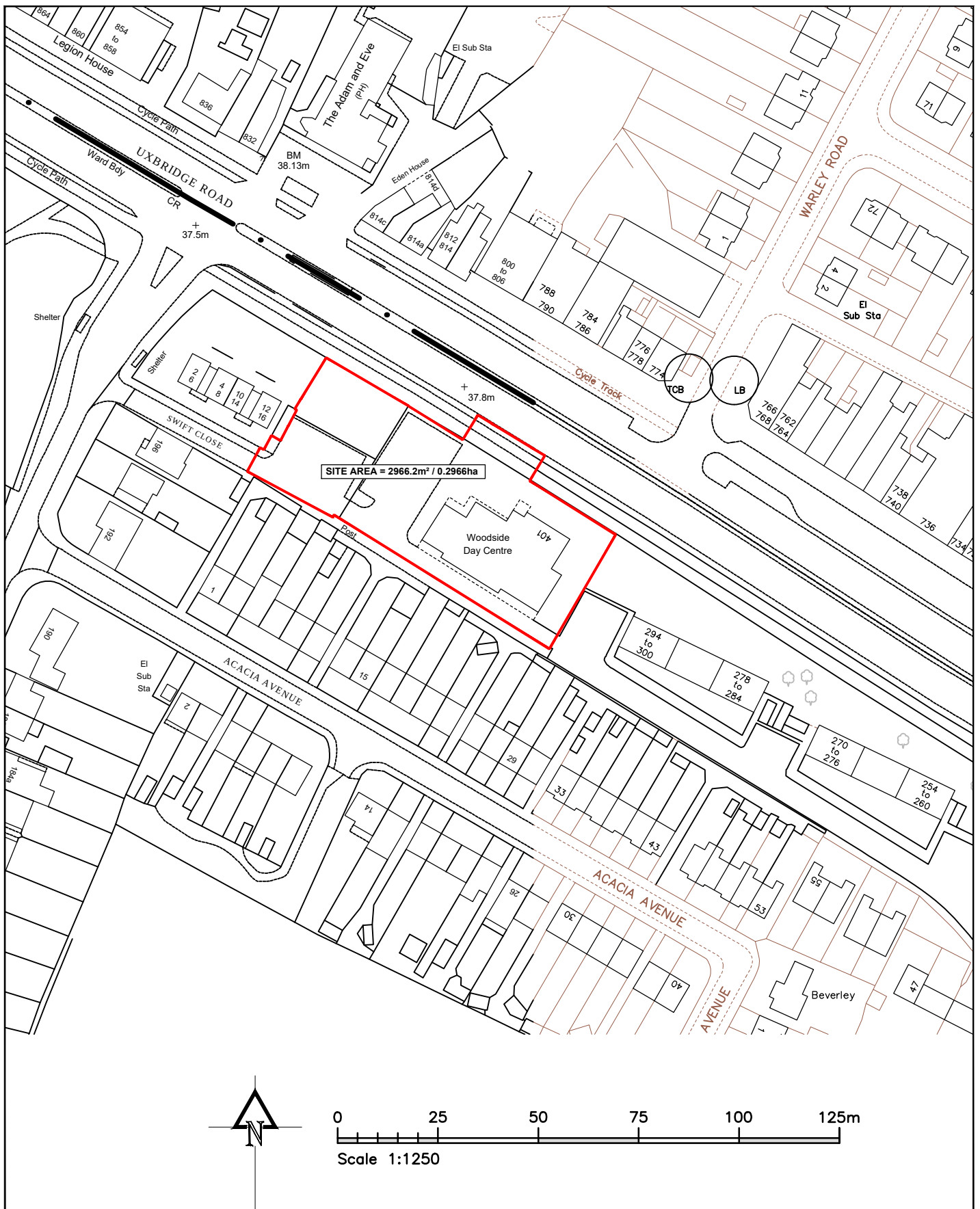
- 6.1 This Flood Risk Assessment has been prepared by Glanville Consultants on behalf of the London Borough of Hillingdon to accompany a planning application for the proposed redevelopment of Woodside Day Centre at Uxbridge Road
- 6.2 This assessment has been prepared in accordance with the National Planning Policy Framework (NPPF), Planning Practice Guidance (PPG), and with reference to the Royal Borough of Windsor and Maidenhead Strategic Flood Risk Assessment.
- 6.3 The development site is considered to be at low risk from any potential sources of flooding.
- 6.4 The development is located within Flood Zone 1, which the NPPF considers to be the suitable for all forms of development in terms of flood risk.
- 6.5 A surface water drainage strategy is proposed based on the principles of SuDS surface water management train outlined in the document produced by CIRIA C753 'The SuDS Manual' (2015).
- 6.6 Information from the British Geological Survey indicates that infiltration is unlikely to be effective at this site. Therefore a surface water drainage strategy is proposed which discharges run-off from the site into the existing surface water sewer system at a restricted rate. To ensure flood risk is not increased elsewhere, the proposed discharge rate from the site is reduced to 60% of the calculated existing.
- 6.7 The surface water drainage system will be designed to collect, store and infiltrate surface water run-off where possible for all events up to and including the 1-in-100 year event including an allowance for a 40% increase in rainfall intensities as a result of climate change.
- 6.8 This report demonstrates that sufficient space for SuDS has been provided within the masterplan, and that the proposed drainage strategy can be delivered.

Conclusion

- 6.9 In conclusion, this report has demonstrated that the proposed residential development:
- is in accordance with the National Planning Policy Framework;
 - will not be at an unacceptable risk from fluvial flooding;
 - will not increase flood risk elsewhere; and
 - will employ a surface water drainage strategy based on the principles of sustainable drainage.
- 6.10 On this basis, the proposals are considered to fully comply with National, Regional and Local planning policy.

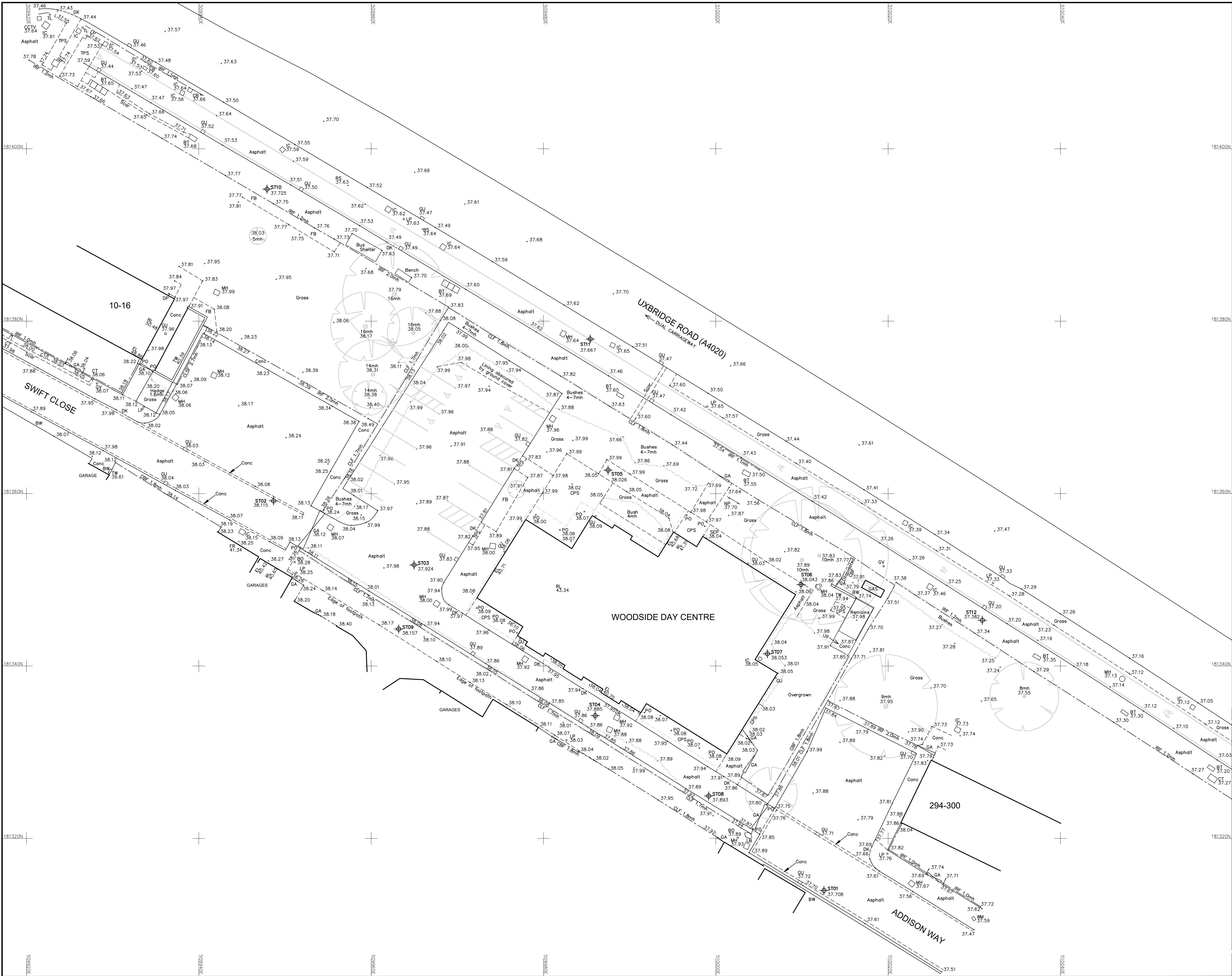
Appendices

Appendix A
Site Location Plan



 HILLINGDON LONDON	NOTES: - DO NOT SCALE FROM THIS DRAWING. The Contractor must verify all dimensions at the site before setting out, commencing work, or making any shop drawings. Any discrepancies must be reported to the Contract Administrator before proceeding.			
	-	-	-	-
	Rev	Revision notes	Initials	Date
	Project WOODSIDE DAY CENTRE SITE, UXBRIDGE ROAD, UB3		Scale 1:1250 □ A4	Drawn by DB
RESIDENTS SERVICES, CAPITAL PROGRAMME 2E/10, CIVIC CENTRE, UXBRIDGE, UB8 1UW Tel: 01895 250 111 Fax: 01895 277 224	Description SITE LOCATION PLAN		Date DEC 17	Checked by
	Drawing No. 2017/D/232/P/01			Rev.

Appendix B
Topographical Survey



NOTES

Survey has been undertaken to an accuracy commensurate with a scale of 1:200.

Plan co-ordinates are based on Modified Ordnance Survey National Grid from GNSS derived co-ordinates of ST01, rotated and scaled to ST02 and with a site scale factor of 1.0000.

Levels are above ODN (Ordnance Datum Newlyn) based on GNSS observations to the National GPS Network, transformed using OSGM15.

Levels on kerb lines are channel levels unless specified.

ABBREVIATIONS

ACU	Air Conditioning Unit	IRS	Illuminated Road Sign
AL	Access Ladder	KO	Kerb Outlet
AR	Assumed Route	LB	Litter Bin
AV	Air Valve	LP	Lamp Post
BB	Bellish Beacon	MH	Manhole
BH	Borehole	MK	Marker Post
BL	Basement Light	MS	Multi-Stemmed Tree
BO	Bollard	NO	(No. of Stems)
BP	Block Paving	NB	Notice Board
BRW	Brick Retaining Wall	NP	Street Name Plate
BS	Bus Stop	OHW	Overhead Wire
BSh	Bus Shelter	OSBM	OS Bench Mark
BT	British Telecom IC	P	Pillar
BW	Brick Wall	PB	Post Box
BWF	Barbed Wire Fence	PC	Pedestrian Crossing
CB	Control Box	PCF	Post & Chain Fence
CBF	Close Board Fence	PF	Palisade Fence
CCTV	Closed Circuit Television	PK	Portakabin
CIF	Corrugated Iron Fence	Pi	Planter
CL	Cover Level	PL	Plinth
CLF	Chain Link Fence	PM	Parking Meter
CLSF	Chain Link Security Fence	PO	Post
Conc	Concrete	PRF	Post & Rail Fence
Co	Column	PSF	Palisade Security Fence
CPS	Concrete Paving Slabs	PWF	Post & Wire Fence
CPF	Chestnut Paling Fence	RE	Rodding Eye
CP	Concrete Plinth	RH	Road Hump
CR	Cycle Rack	RL	Ridge Level
CRW	Concrete Retaining Wall	RS	Road Sign
CS	Cobbles/stones	RW	Retaining Wall
CT	Cable TV IC	SEP	Service Entry Point
CW	Concrete Wall	SL	Soffit Level
DC	Duct Covers	SM	Sump Level
DCH	Drainage Channel	SP	Stand Pipe
DK	Drop Kerb	SRW	Stone Retaining Wall
DP	Down Pipe	SW	Stone Wall
DPC	Damp-Proof Course Level	SWMH	Surface Water Manhole
EIC	Electricity IC	SY	Stay Wire
EL	Eaves Level (at Drip Edge)	TCB	Telephone Call Box
EP	Electricity Pole	TDR	Traffic Direction Restrictor
ER	Earthing Rod	THL	Threshold Level
FB	Flower Bed	TK	Top of Kerb Level
FFL	Finished Floor Level	TL	Traffic Light
FH	Fire Hydrant	TM	Ticket Machine
FL	Flood Light	TP	Telegraph Pole
FP	Fuel Pump	TPS	Tackle Paving Slabs
FR	Flat Roof	TW	Top of Wall
FWMH	Foul Water Manhole	UTL	Unable To Lift:
GA	Gale	UTL(1)	Covered
GB	Grill Box	UTL(2)	Immovable
GC	Grasscrete	UTL(3)	Damaged
GP	Gate Post	UTL(4)	Bolled Down
GR	Guard Rail	UTL(5)	Traffic Management
GU	Gully	VP	Vent Pipe
GV	Gas Valve	WB	Wheel Barrier
HW	Head Wall	WL	Water Level
IB	Illuminated Bollard	WM	Water Meter
IC	Inspection Cover	WO	Washout
IL	Invert Level	WV	Water Valve
IRF	Iron Railing Fence	VDL	Vehicle Detector Loop

CONTROL STATION INFORMATION

STATION	EASTING	NORTHING	LEVEL	TYPE
ST01	510012.549	181313.964	37.708	Nail
ST02	509948.676	181359.156	38.115	Nail
ST03	509964.980	181351.722	37.924	Nail
ST04	509996.003	181334.239	37.885	Nail
ST05	509987.499	181362.716	38.028	Nail
ST06	510009.883	181349.448	38.043	Nail
ST07	510005.991	181341.417	38.053	Nail
ST08	509999.180	181324.928	37.893	Nail
ST09	509963.193	181344.288	38.157	Nail
ST10	509947.916	181395.318	37.725	Nail
ST11	509985.431	181377.917	37.667	Nail
ST12	510030.929	181345.300	37.382	Nail

-	First Issue	03/08/18	DH	AB
P1	Preliminary Issue	23/07/18	DH	JHJ
Rev.	Description	Date	Svyr	Chkd



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Client :

FAITHFUL+GOULD

Project :

WOODSIDE DAY CENTRE
UXBRIDGE

Title :

SITE SURVEY

Project Engineer :	DH	Scale :	1:200 @ A1
Project Director :	JHJ	Date :	JULY 2018

Status :

Drawing No.	8180507/4101	Rev
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Appendix C
Thames Water Records

Asset Location Search Sewer Map - ALS/ALS Standard/2018 3783273



The width of the displayed area is 500 m and the centre of the map is located at OS coordinates 509986,181362

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.



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		Gully
	Culverted Watercourse		Proposed
			Abandoned Sewer

Appendix D
Proposed Development Drawings

- clinical rooms
- admin areas & non clinical
- staff areas
- waiting
- lobby
- circulation
- public wc & baby areas
- plant rooms and support
- vertical access to residential areas

DO NOT SCALE FROM THIS DRAWING

GEA = 63.9m²
GIA = 52.8m²

GEA = 854.8m²
G/A = 815.3m²

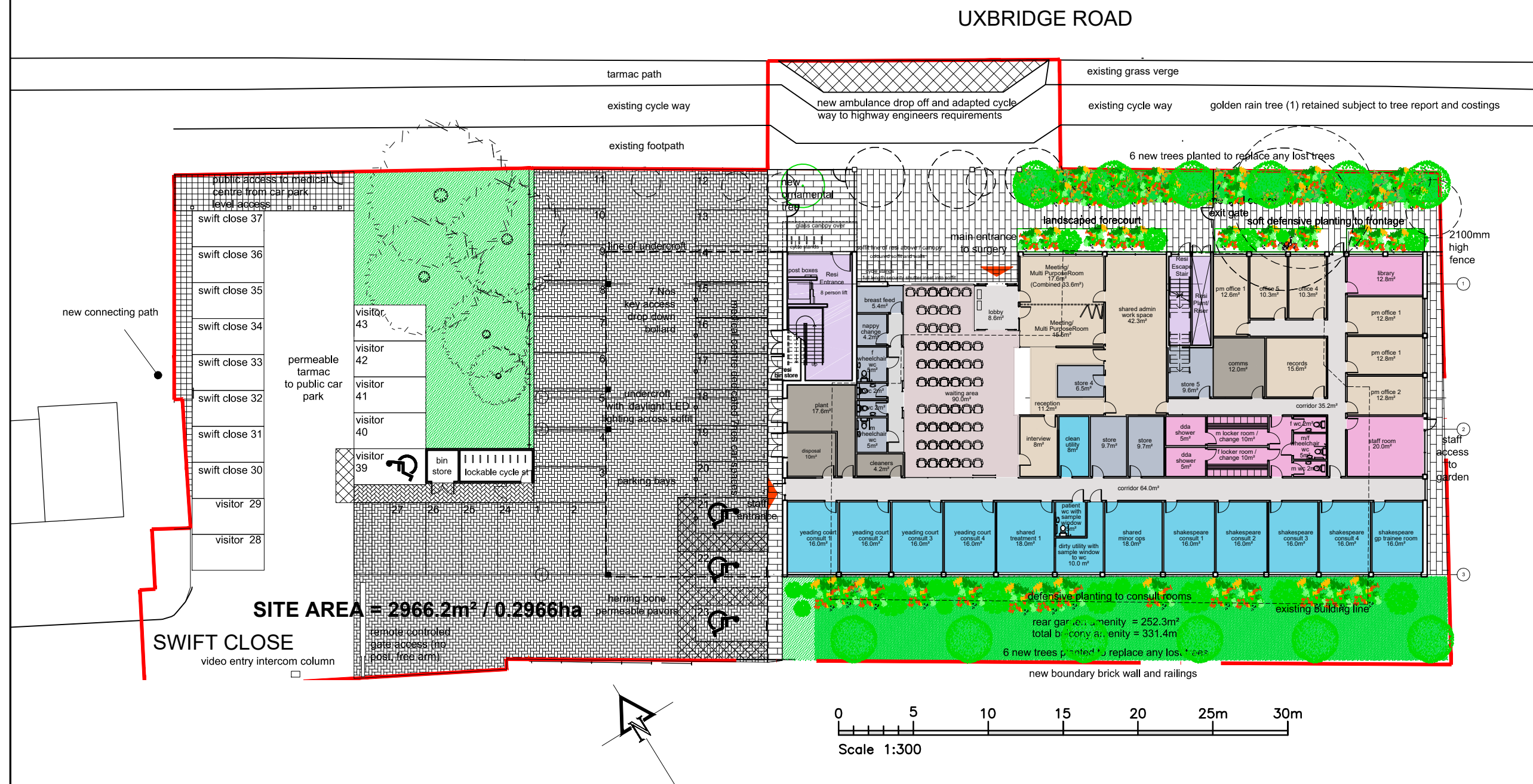
GEA = 890.0m²
G/A = 840.7m²

1 x 2B-4P Flat @ 73.8m²
2 x 2B-4P Flat @ 70.0m²
1 x 4B-5P Flat @ 95.5m²
2 x 1B-2P Flat @ 50.5m²
3 x 2B-3P Flat @ 64.3m²
1 x 2B-3P Flat @ 62.0m²

TOTAL AMENITY REQUIRED
= 490.0m²

$$= 0,0\text{m}^2$$
$$= 252,3 \text{ m}^2$$
$$= 331,4 \text{ m}^2$$
$$= 568.2 \text{ m}^2$$

20 car spaces for flats inclusive 2 dda bays
7 bays dedicated for medical centre
inclusive of 1 dda car space
7 dedicated bays for swift close
1 dedicated dda space for swift close
8 visitor car parking spaces in total
TOTAL CAR PARKING SPACES = 43



Rev	Revision notes	Initials	Date
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PROJECT
WOODSIDE DAY CENTRE SITE
UXBRIDGE ROAD
UB3

DESCRIPTION
PROPOSED SITE PLAN - MEDICAL CENTRE

SCALE 1:200 ☐ A3	DRAWN BY DB	CHECKED BY SV	DATE DEC 2017
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DRAWING No.
2017/D/232/P/03

REV

Appendix E
South-eastern Catchment

Glanville Consultants

Cornerstone House
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Didcot OX11 7AD

Date 04/06/2018 12:11
File CRATE WOODSIDE.SRCX

Innovyze

Designed by kman
Checked by

Source Control 2017.1.2

Page 1



Summary of Results for 100 year Return Period (+40%)

Half Drain Time : 54 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	99.127	0.527	0.0	9.0	9.0	40.1	O K
30 min Summer	99.255	0.655	0.0	9.0	9.0	49.8	O K
60 min Summer	99.314	0.714	0.0	9.0	9.0	54.3	O K
120 min Summer	99.298	0.698	0.0	9.0	9.0	53.1	O K
180 min Summer	99.250	0.650	0.0	9.0	9.0	49.4	O K
240 min Summer	99.193	0.593	0.0	9.0	9.0	45.1	O K
360 min Summer	99.069	0.469	0.0	9.0	9.0	35.6	O K
480 min Summer	98.969	0.369	0.0	9.0	9.0	28.0	O K
600 min Summer	98.890	0.290	0.0	9.0	9.0	22.0	O K
720 min Summer	98.832	0.232	0.0	8.9	8.9	17.6	O K
960 min Summer	98.763	0.163	0.0	8.7	8.7	12.4	O K
1440 min Summer	98.724	0.124	0.0	6.8	6.8	9.4	O K
2160 min Summer	98.699	0.099	0.0	5.1	5.1	7.5	O K
2880 min Summer	98.686	0.086	0.0	4.0	4.0	6.5	O K
4320 min Summer	98.671	0.071	0.0	2.9	2.9	5.4	O K
5760 min Summer	98.662	0.062	0.0	2.3	2.3	4.7	O K
7200 min Summer	98.656	0.056	0.0	1.9	1.9	4.3	O K
8640 min Summer	98.652	0.052	0.0	1.6	1.6	3.9	O K
10080 min Summer	98.648	0.048	0.0	1.4	1.4	3.7	O K
15 min Winter	99.200	0.600	0.0	9.0	9.0	45.6	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	139.514	0.0	47.0	20
30 min Summer	91.395	0.0	61.6	33
60 min Summer	57.005	0.0	76.9	56
120 min Summer	34.338	0.0	92.7	88
180 min Summer	25.183	0.0	101.9	124
240 min Summer	20.089	0.0	108.4	158
360 min Summer	14.576	0.0	118.0	222
480 min Summer	11.607	0.0	125.3	282
600 min Summer	9.719	0.0	131.2	338
720 min Summer	8.404	0.0	136.1	394
960 min Summer	6.676	0.0	144.1	502
1440 min Summer	4.819	0.0	156.0	738
2160 min Summer	3.472	0.0	168.7	1100
2880 min Summer	2.749	0.0	178.1	1468
4320 min Summer	1.976	0.0	192.0	2204
5760 min Summer	1.562	0.0	202.3	2912
7200 min Summer	1.300	0.0	210.6	3672
8640 min Summer	1.119	0.0	217.5	4360
10080 min Summer	0.986	0.0	223.5	5136
15 min Winter	139.514	0.0	52.6	20

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Cornerstone House 62 Foxhall Road Didcot OX11 7AD							
Date 04/06/2018 12:11 File CRATE WOODSIDE.SRCX			Designed by kman Checked by				
Innovyze			Source Control 2017.1.2				
Summary of Results for 100 year Return Period (+40%)							
Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
30 min Winter	99.345	0.745	0.0	9.0	9.0	56.6	O K
60 min Winter	99.919	1.319	0.0	11.4	11.4	61.3	Flood Risk
120 min Winter	99.391	0.791	0.0	9.0	9.0	60.1	O K
180 min Winter	99.320	0.720	0.0	9.0	9.0	54.7	O K
240 min Winter	99.236	0.636	0.0	9.0	9.0	48.4	O K
360 min Winter	99.046	0.446	0.0	9.0	9.0	33.9	O K
480 min Winter	98.900	0.300	0.0	9.0	9.0	22.8	O K
600 min Winter	98.804	0.204	0.0	8.9	8.9	15.5	O K
720 min Winter	98.754	0.154	0.0	8.6	8.6	11.7	O K
960 min Winter	98.726	0.126	0.0	7.0	7.0	9.5	O K
1440 min Winter	98.700	0.100	0.0	5.1	5.1	7.6	O K
2160 min Winter	98.682	0.082	0.0	3.7	3.7	6.2	O K
2880 min Winter	98.671	0.071	0.0	2.9	2.9	5.4	O K
4320 min Winter	98.659	0.059	0.0	2.1	2.1	4.5	O K
5760 min Winter	98.652	0.052	0.0	1.7	1.7	4.0	O K
7200 min Winter	98.647	0.047	0.0	1.4	1.4	3.6	O K
8640 min Winter	98.644	0.044	0.0	1.2	1.2	3.3	O K
10080 min Winter	98.641	0.041	0.0	1.1	1.1	3.1	O K
Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)			
30 min Winter	91.395	0.0	69.0	33			
60 min Winter	57.005	0.0	86.1	54			
120 min Winter	34.338	0.0	103.8	94			
180 min Winter	25.183	0.0	114.2	132			
240 min Winter	20.089	0.0	121.4	170			
360 min Winter	14.576	0.0	132.2	236			
480 min Winter	11.607	0.0	140.3	292			
600 min Winter	9.719	0.0	146.9	342			
720 min Winter	8.404	0.0	152.4	384			
960 min Winter	6.676	0.0	161.4	500			
1440 min Winter	4.819	0.0	174.8	738			
2160 min Winter	3.472	0.0	189.0	1100			
2880 min Winter	2.749	0.0	199.5	1444			
4320 min Winter	1.976	0.0	215.0	2192			
5760 min Winter	1.562	0.0	226.6	2944			
7200 min Winter	1.300	0.0	235.9	3584			
8640 min Winter	1.119	0.0	243.7	4392			
10080 min Winter	0.986	0.0	250.3	4984			
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<u>Rainfall Details</u> <table> <tr> <td>Rainfall Model</td> <td>FSR</td> <td>Winter Storms</td> <td>Yes</td> </tr> <tr> <td>Return Period (years)</td> <td>100</td> <td>Cv (Summer)</td> <td>0.750</td> </tr> <tr> <td>Region</td> <td>England and Wales</td> <td>Cv (Winter)</td> <td>0.840</td> </tr> <tr> <td>M5-60 (mm)</td> <td>20.100</td> <td>Shortest Storm (mins)</td> <td>15</td> </tr> <tr> <td>Ratio R</td> <td>0.405</td> <td>Longest Storm (mins)</td> <td>10080</td> </tr> <tr> <td>Summer Storms</td> <td>Yes</td> <td>Climate Change %</td> <td>+40</td> </tr> </table> <u>Time Area Diagram</u> Total Area (ha) 0.180 <table> <thead> <tr> <th>Time (mins)</th> <th>Area</th> <th>Time (mins)</th> <th>Area</th> </tr> <tr> <th>From: To:</th> <th>(ha)</th> <th>From: To:</th> <th>(ha)</th> </tr> </thead> <tbody> <tr> <td>0 4</td> <td>0.090</td> <td>4 8</td> <td>0.090</td> </tr> </tbody> </table>			Rainfall Model	FSR	Winter Storms	Yes	Return Period (years)	100	Cv (Summer)	0.750	Region	England and Wales	Cv (Winter)	0.840	M5-60 (mm)	20.100	Shortest Storm (mins)	15	Ratio R	0.405	Longest Storm (mins)	10080	Summer Storms	Yes	Climate Change %	+40	Time (mins)	Area	Time (mins)	Area	From: To:	(ha)	From: To:	(ha)	0 4	0.090	4 8	0.090
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Model Details

Storage is Online Cover Level (m) 100.000

Cellular Storage Structure

Invert Level (m) 98.600 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m ²)	Inf. Area (m ²)	Depth (m)	Area (m ²)	Inf. Area (m ²)
0.000	80.0	0.0	0.801	0.0	0.0
0.800	80.0	0.0			

Hydro-Brake® Optimum Outflow Control

Unit Reference MD-SHE-0142-9000-0800-9000
Design Head (m) 0.800
Design Flow (l/s) 9.0
Flush-Flo™ Calculated
Objective Minimise upstream storage
Application Surface
Sump Available Yes
Diameter (mm) 142
Invert Level (m) 98.600
Minimum Outlet Pipe Diameter (mm) 225
Suggested Manhole Diameter (mm) 1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.800	9.0
Flush-Flo™	0.257	9.0
Kick-Flo®	0.562	7.6
Mean Flow over Head Range	-	7.6

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	5.1	1.200	10.9	3.000	16.8	7.000	25.3
0.200	8.9	1.400	11.7	3.500	18.1	7.500	26.1
0.300	8.9	1.600	12.5	4.000	19.3	8.000	26.9
0.400	8.7	1.800	13.2	4.500	20.4	8.500	27.7
0.500	8.3	2.000	13.9	5.000	21.5	9.000	28.5
0.600	7.9	2.200	14.5	5.500	22.5	9.500	29.3
0.800	9.0	2.400	15.1	6.000	23.5		
1.000	10.0	2.600	15.7	6.500	24.4		

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Appendix F
North-western Catchment

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Summary of Results for 100 year Return Period (+40%) Half Drain Time : 26 minutes. <table><tr><th>Storm Event</th><th>Max Level (m)</th><th>Max Depth (m)</th><th>Max Infiltration (l/s)</th><th>Max Control (l/s)</th><th>Max E Outflow (l/s)</th><th>Max Volume (m³)</th><th>Status</th></tr><tr><td>15 min Summer</td><td>99.802</td><td>0.102</td><td>0.0</td><td>5.5</td><td>5.5</td><td>9.6</td><td>Flood Risk</td></tr><tr><td>30 min Summer</td><td>99.820</td><td>0.120</td><td>0.0</td><td>7.0</td><td>7.0</td><td>11.3</td><td>Flood Risk</td></tr><tr><td>60 min Summer</td><td>99.828</td><td>0.128</td><td>0.0</td><td>7.6</td><td>7.6</td><td>12.1</td><td>Flood Risk</td></tr><tr><td>120 min Summer</td><td>99.823</td><td>0.123</td><td>0.0</td><td>7.2</td><td>7.2</td><td>11.6</td><td>Flood Risk</td></tr><tr><td>180 min Summer</td><td>99.814</td><td>0.114</td><td>0.0</td><td>6.5</td><td>6.5</td><td>10.7</td><td>Flood Risk</td></tr><tr><td>240 min Summer</td><td>99.805</td><td>0.105</td><td>0.0</td><td>5.8</td><td>5.8</td><td>9.9</td><td>Flood Risk</td></tr><tr><td>360 min Summer</td><td>99.793</td><td>0.093</td><td>0.0</td><td>4.7</td><td>4.7</td><td>8.7</td><td>Flood Risk</td></tr><tr><td>480 min Summer</td><td>99.784</td><td>0.084</td><td>0.0</td><td>4.0</td><td>4.0</td><td>7.9</td><td>Flood Risk</td></tr><tr><td>600 min Summer</td><td>99.777</td><td>0.077</td><td>0.0</td><td>3.5</td><td>3.5</td><td>7.3</td><td>Flood Risk</td></tr><tr><td>720 min Summer</td><td>99.772</td><td>0.072</td><td>0.0</td><td>3.1</td><td>3.1</td><td>6.8</td><td>Flood Risk</td></tr><tr><td>960 min Summer</td><td>99.765</td><td>0.065</td><td>0.0</td><td>2.6</td><td>2.6</td><td>6.1</td><td>Flood Risk</td></tr><tr><td>1440 min Summer</td><td>99.755</td><td>0.055</td><td>0.0</td><td>1.9</td><td>1.9</td><td>5.2</td><td>Flood Risk</td></tr><tr><td>2160 min Summer</td><td>99.747</td><td>0.047</td><td>0.0</td><td>1.4</td><td>1.4</td><td>4.4</td><td>Flood Risk</td></tr><tr><td>2880 min Summer</td><td>99.742</td><td>0.042</td><td>0.0</td><td>1.1</td><td>1.1</td><td>3.9</td><td>Flood Risk</td></tr><tr><td>4320 min Summer</td><td>99.735</td><td>0.035</td><td>0.0</td><td>0.8</td><td>0.8</td><td>3.3</td><td>Flood Risk</td></tr><tr><td>5760 min Summer</td><td>99.731</td><td>0.031</td><td>0.0</td><td>0.7</td><td>0.7</td><td>2.9</td><td>Flood Risk</td></tr><tr><td>7200 min Summer</td><td>99.728</td><td>0.028</td><td>0.0</td><td>0.5</td><td>0.5</td><td>2.6</td><td>Flood Risk</td></tr><tr><td>8640 min Summer</td><td>99.726</td><td>0.026</td><td>0.0</td><td>0.5</td><td>0.5</td><td>2.5</td><td>Flood Risk</td></tr><tr><td>10080 min Summer</td><td>99.725</td><td>0.025</td><td>0.0</td><td>0.4</td><td>0.4</td><td>2.3</td><td>Flood Risk</td></tr><tr><td>15 min Winter</td><td>99.815</td><td>0.115</td><td>0.0</td><td>6.6</td><td>6.6</td><td>10.8</td><td>Flood Risk</td></tr></table> <table><tr><th>Storm Event</th><th>Rain (mm/hr)</th><th>Flooded Volume (m³)</th><th>Discharge Volume (m³)</th><th>Time-Peak (mins)</th></tr><tr><td>15 min Summer</td><td>139.514</td><td>0.0</td><td>11.9</td><td>17</td></tr><tr><td>30 min Summer</td><td>91.395</td><td>0.0</td><td>16.1</td><td>26</td></tr><tr><td>60 min Summer</td><td>57.005</td><td>0.0</td><td>20.5</td><td>42</td></tr><tr><td>120 min Summer</td><td>34.338</td><td>0.0</td><td>25.1</td><td>74</td></tr><tr><td>180 min Summer</td><td>25.183</td><td>0.0</td><td>27.7</td><td>106</td></tr><tr><td>240 min Summer</td><td>20.089</td><td>0.0</td><td>29.5</td><td>136</td></tr><tr><td>360 min Summer</td><td>14.576</td><td>0.0</td><td>32.2</td><td>196</td></tr><tr><td>480 min Summer</td><td>11.607</td><td>0.0</td><td>34.2</td><td>258</td></tr><tr><td>600 min Summer</td><td>9.719</td><td>0.0</td><td>35.9</td><td>318</td></tr><tr><td>720 min Summer</td><td>8.404</td><td>0.0</td><td>37.2</td><td>378</td></tr><tr><td>960 min Summer</td><td>6.676</td><td>0.0</td><td>39.4</td><td>500</td></tr><tr><td>1440 min Summer</td><td>4.819</td><td>0.0</td><td>42.5</td><td>740</td></tr><tr><td>2160 min Summer</td><td>3.472</td><td>0.0</td><td>45.7</td><td>1104</td></tr><tr><td>2880 min Summer</td><td>2.749</td><td>0.0</td><td>47.9</td><td>1472</td></tr><tr><td>4320 min Summer</td><td>1.976</td><td>0.0</td><td>51.0</td><td>2204</td></tr><tr><td>5760 min Summer</td><td>1.562</td><td>0.0</td><td>53.1</td><td>2912</td></tr><tr><td>7200 min Summer</td><td>1.300</td><td>0.0</td><td>54.5</td><td>3672</td></tr><tr><td>8640 min Summer</td><td>1.119</td><td>0.0</td><td>55.6</td><td>4376</td></tr><tr><td>10080 min Summer</td><td>0.986</td><td>0.0</td><td>56.3</td><td>5104</td></tr><tr><td>15 min Winter</td><td>139.514</td><td>0.0</td><td>13.5</td><td>18</td></tr></table>				Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max E Outflow (l/s)	Max Volume (m³)	Status	15 min Summer	99.802	0.102	0.0	5.5	5.5	9.6	Flood Risk	30 min Summer	99.820	0.120	0.0	7.0	7.0	11.3	Flood Risk	60 min Summer	99.828	0.128	0.0	7.6	7.6	12.1	Flood Risk	120 min Summer	99.823	0.123	0.0	7.2	7.2	11.6	Flood Risk	180 min Summer	99.814	0.114	0.0	6.5	6.5	10.7	Flood Risk	240 min Summer	99.805	0.105	0.0	5.8	5.8	9.9	Flood Risk	360 min Summer	99.793	0.093	0.0	4.7	4.7	8.7	Flood Risk	480 min Summer	99.784	0.084	0.0	4.0	4.0	7.9	Flood Risk	600 min Summer	99.777	0.077	0.0	3.5	3.5	7.3	Flood Risk	720 min Summer	99.772	0.072	0.0	3.1	3.1	6.8	Flood Risk	960 min Summer	99.765	0.065	0.0	2.6	2.6	6.1	Flood Risk	1440 min Summer	99.755	0.055	0.0	1.9	1.9	5.2	Flood Risk	2160 min Summer	99.747	0.047	0.0	1.4	1.4	4.4	Flood Risk	2880 min Summer	99.742	0.042	0.0	1.1	1.1	3.9	Flood Risk	4320 min Summer	99.735	0.035	0.0	0.8	0.8	3.3	Flood Risk	5760 min Summer	99.731	0.031	0.0	0.7	0.7	2.9	Flood Risk	7200 min Summer	99.728	0.028	0.0	0.5	0.5	2.6	Flood Risk	8640 min Summer	99.726	0.026	0.0	0.5	0.5	2.5	Flood Risk	10080 min Summer	99.725	0.025	0.0	0.4	0.4	2.3	Flood Risk	15 min Winter	99.815	0.115	0.0	6.6	6.6	10.8	Flood Risk	Storm 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60 min Summer	99.828	0.128	0.0	7.6	7.6	12.1	Flood Risk																																																																																																																																																																																																																																																																													
120 min Summer	99.823	0.123	0.0	7.2	7.2	11.6	Flood Risk																																																																																																																																																																																																																																																																													
180 min Summer	99.814	0.114	0.0	6.5	6.5	10.7	Flood Risk																																																																																																																																																																																																																																																																													
240 min Summer	99.805	0.105	0.0	5.8	5.8	9.9	Flood Risk																																																																																																																																																																																																																																																																													
360 min Summer	99.793	0.093	0.0	4.7	4.7	8.7	Flood Risk																																																																																																																																																																																																																																																																													
480 min Summer	99.784	0.084	0.0	4.0	4.0	7.9	Flood Risk																																																																																																																																																																																																																																																																													
600 min Summer	99.777	0.077	0.0	3.5	3.5	7.3	Flood Risk																																																																																																																																																																																																																																																																													
720 min Summer	99.772	0.072	0.0	3.1	3.1	6.8	Flood Risk																																																																																																																																																																																																																																																																													
960 min Summer	99.765	0.065	0.0	2.6	2.6	6.1	Flood Risk																																																																																																																																																																																																																																																																													
1440 min Summer	99.755	0.055	0.0	1.9	1.9	5.2	Flood Risk																																																																																																																																																																																																																																																																													
2160 min Summer	99.747	0.047	0.0	1.4	1.4	4.4	Flood Risk																																																																																																																																																																																																																																																																													
2880 min Summer	99.742	0.042	0.0	1.1	1.1	3.9	Flood Risk																																																																																																																																																																																																																																																																													
4320 min Summer	99.735	0.035	0.0	0.8	0.8	3.3	Flood Risk																																																																																																																																																																																																																																																																													
5760 min Summer	99.731	0.031	0.0	0.7	0.7	2.9	Flood Risk																																																																																																																																																																																																																																																																													
7200 min Summer	99.728	0.028	0.0	0.5	0.5	2.6	Flood Risk																																																																																																																																																																																																																																																																													
8640 min Summer	99.726	0.026	0.0	0.5	0.5	2.5	Flood Risk																																																																																																																																																																																																																																																																													
10080 min Summer	99.725	0.025	0.0	0.4	0.4	2.3	Flood Risk																																																																																																																																																																																																																																																																													
15 min Winter	99.815	0.115	0.0	6.6	6.6	10.8	Flood Risk																																																																																																																																																																																																																																																																													
Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)																																																																																																																																																																																																																																																																																
15 min Summer	139.514	0.0	11.9	17																																																																																																																																																																																																																																																																																
30 min Summer	91.395	0.0	16.1	26																																																																																																																																																																																																																																																																																
60 min Summer	57.005	0.0	20.5	42																																																																																																																																																																																																																																																																																
120 min Summer	34.338	0.0	25.1	74																																																																																																																																																																																																																																																																																
180 min Summer	25.183	0.0	27.7	106																																																																																																																																																																																																																																																																																
240 min Summer	20.089	0.0	29.5	136																																																																																																																																																																																																																																																																																
360 min Summer	14.576	0.0	32.2	196																																																																																																																																																																																																																																																																																
480 min Summer	11.607	0.0	34.2	258																																																																																																																																																																																																																																																																																
600 min Summer	9.719	0.0	35.9	318																																																																																																																																																																																																																																																																																
720 min Summer	8.404	0.0	37.2	378																																																																																																																																																																																																																																																																																
960 min Summer	6.676	0.0	39.4	500																																																																																																																																																																																																																																																																																
1440 min Summer	4.819	0.0	42.5	740																																																																																																																																																																																																																																																																																
2160 min Summer	3.472	0.0	45.7	1104																																																																																																																																																																																																																																																																																
2880 min Summer	2.749	0.0	47.9	1472																																																																																																																																																																																																																																																																																
4320 min Summer	1.976	0.0	51.0	2204																																																																																																																																																																																																																																																																																
5760 min Summer	1.562	0.0	53.1	2912																																																																																																																																																																																																																																																																																
7200 min Summer	1.300	0.0	54.5	3672																																																																																																																																																																																																																																																																																
8640 min Summer	1.119	0.0	55.6	4376																																																																																																																																																																																																																																																																																
10080 min Summer	0.986	0.0	56.3	5104																																																																																																																																																																																																																																																																																
15 min Winter	139.514	0.0	13.5	18																																																																																																																																																																																																																																																																																
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Glanville Consultants				Page 2			
Cornerstone House 62 Foxhall Road Didcot OX11 7AD							
Date 04/06/2018 09:43 File PP WOODSIDE.SRCX							
			Designed by kman Checked by				
Innovyze			Source Control 2017.1.2				
Summary of Results for 100 year Return Period (+40%)							
Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
30 min Winter	99.833	0.133	0.0	7.9	7.9	12.5	Flood Risk
60 min Winter	99.836	0.136	0.0	8.1	8.1	12.9	Flood Risk
120 min Winter	99.823	0.123	0.0	7.2	7.2	11.6	Flood Risk
180 min Winter	99.809	0.109	0.0	6.1	6.1	10.3	Flood Risk
240 min Winter	99.799	0.099	0.0	5.2	5.2	9.3	Flood Risk
360 min Winter	99.784	0.084	0.0	4.0	4.0	8.0	Flood Risk
480 min Winter	99.775	0.075	0.0	3.3	3.3	7.1	Flood Risk
600 min Winter	99.769	0.069	0.0	2.8	2.8	6.5	Flood Risk
720 min Winter	99.764	0.064	0.0	2.5	2.5	6.0	Flood Risk
960 min Winter	99.756	0.056	0.0	2.0	2.0	5.3	Flood Risk
1440 min Winter	99.747	0.047	0.0	1.4	1.4	4.5	Flood Risk
2160 min Winter	99.740	0.040	0.0	1.0	1.0	3.8	Flood Risk
2880 min Winter	99.735	0.035	0.0	0.8	0.8	3.3	Flood Risk
4320 min Winter	99.730	0.030	0.0	0.6	0.6	2.8	Flood Risk
5760 min Winter	99.726	0.026	0.0	0.5	0.5	2.5	Flood Risk
7200 min Winter	99.724	0.024	0.0	0.4	0.4	2.2	Flood Risk
8640 min Winter	99.722	0.022	0.0	0.3	0.3	2.1	Flood Risk
10080 min Winter	99.721	0.021	0.0	0.3	0.3	1.9	Flood Risk
Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)			
30 min Winter	91.395	0.0	18.2	27			
60 min Winter	57.005	0.0	23.2	44			
120 min Winter	34.338	0.0	28.3	78			
180 min Winter	25.183	0.0	31.2	108			
240 min Winter	20.089	0.0	33.3	140			
360 min Winter	14.576	0.0	36.3	202			
480 min Winter	11.607	0.0	38.6	262			
600 min Winter	9.719	0.0	40.4	322			
720 min Winter	8.404	0.0	41.9	382			
960 min Winter	6.676	0.0	44.4	506			
1440 min Winter	4.819	0.0	47.9	752			
2160 min Winter	3.472	0.0	51.6	1124			
2880 min Winter	2.749	0.0	54.1	1476			
4320 min Winter	1.976	0.0	57.6	2204			
5760 min Winter	1.562	0.0	60.1	2936			
7200 min Winter	1.300	0.0	61.9	3680			
8640 min Winter	1.119	0.0	63.2	4400			
10080 min Winter	0.986	0.0	64.2	5048			
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Cornerstone House 62 Foxhall Road Didcot OX11 7AD																																						
Date 04/06/2018 09:43 File PP WOODSIDE.SRCX	Designed by kman Checked by																																					
Innovyze		Source Control 2017.1.2																																				
<u>Rainfall Details</u> <table> <tr> <td>Rainfall Model</td> <td>FSR</td> <td>Winter Storms</td> <td>Yes</td> </tr> <tr> <td>Return Period (years)</td> <td>100</td> <td>Cv (Summer)</td> <td>0.750</td> </tr> <tr> <td>Region</td> <td>England and Wales</td> <td>Cv (Winter)</td> <td>0.840</td> </tr> <tr> <td>M5-60 (mm)</td> <td>20.100</td> <td>Shortest Storm (mins)</td> <td>15</td> </tr> <tr> <td>Ratio R</td> <td>0.405</td> <td>Longest Storm (mins)</td> <td>10080</td> </tr> <tr> <td>Summer Storms</td> <td>Yes</td> <td>Climate Change %</td> <td>+40</td> </tr> </table> <u>Time Area Diagram</u> Total Area (ha) 0.052 <table> <thead> <tr> <th>Time (mins)</th> <th>Area</th> <th>Time (mins)</th> <th>Area</th> </tr> <tr> <th>From: To:</th> <th>(ha)</th> <th>From: To:</th> <th>(ha)</th> </tr> </thead> <tbody> <tr> <td>0 4</td> <td>0.026</td> <td>4 8</td> <td>0.026</td> </tr> </tbody> </table>			Rainfall Model	FSR	Winter Storms	Yes	Return Period (years)	100	Cv (Summer)	0.750	Region	England and Wales	Cv (Winter)	0.840	M5-60 (mm)	20.100	Shortest Storm (mins)	15	Ratio R	0.405	Longest Storm (mins)	10080	Summer Storms	Yes	Climate Change %	+40	Time (mins)	Area	Time (mins)	Area	From: To:	(ha)	From: To:	(ha)	0 4	0.026	4 8	0.026
Rainfall Model	FSR	Winter Storms	Yes																																			
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From: To:	(ha)	From: To:	(ha)																																			
0 4	0.026	4 8	0.026																																			
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Cornerstone House 62 Foxhall Road Didcot OX11 7AD		
Date 04/06/2018 09:43 File PP WOODSIDE.SRCX	Designed by kman Checked by	
Innovyze Source Control 2017.1.2		

Model Details

Storage is Online Cover Level (m) 100.000

Porous Car Park Structure

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	31.4
Membrane Percolation (mm/hr)	1000	Length (m)	10.0
Max Percolation (l/s)	87.2	Slope (1:X)	0.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	99.700	Membrane Depth (m)	0

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0148-9000-0300-9000
Design Head (m)	0.300
Design Flow (l/s)	9.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	148
Invert Level (m)	99.700
Minimum Outlet Pipe Diameter (mm)	225
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.300	9.0
Flush-Flo™	0.197	9.0
Kick-Flo®	0.272	8.6
Mean Flow over Head Range	-	6.3

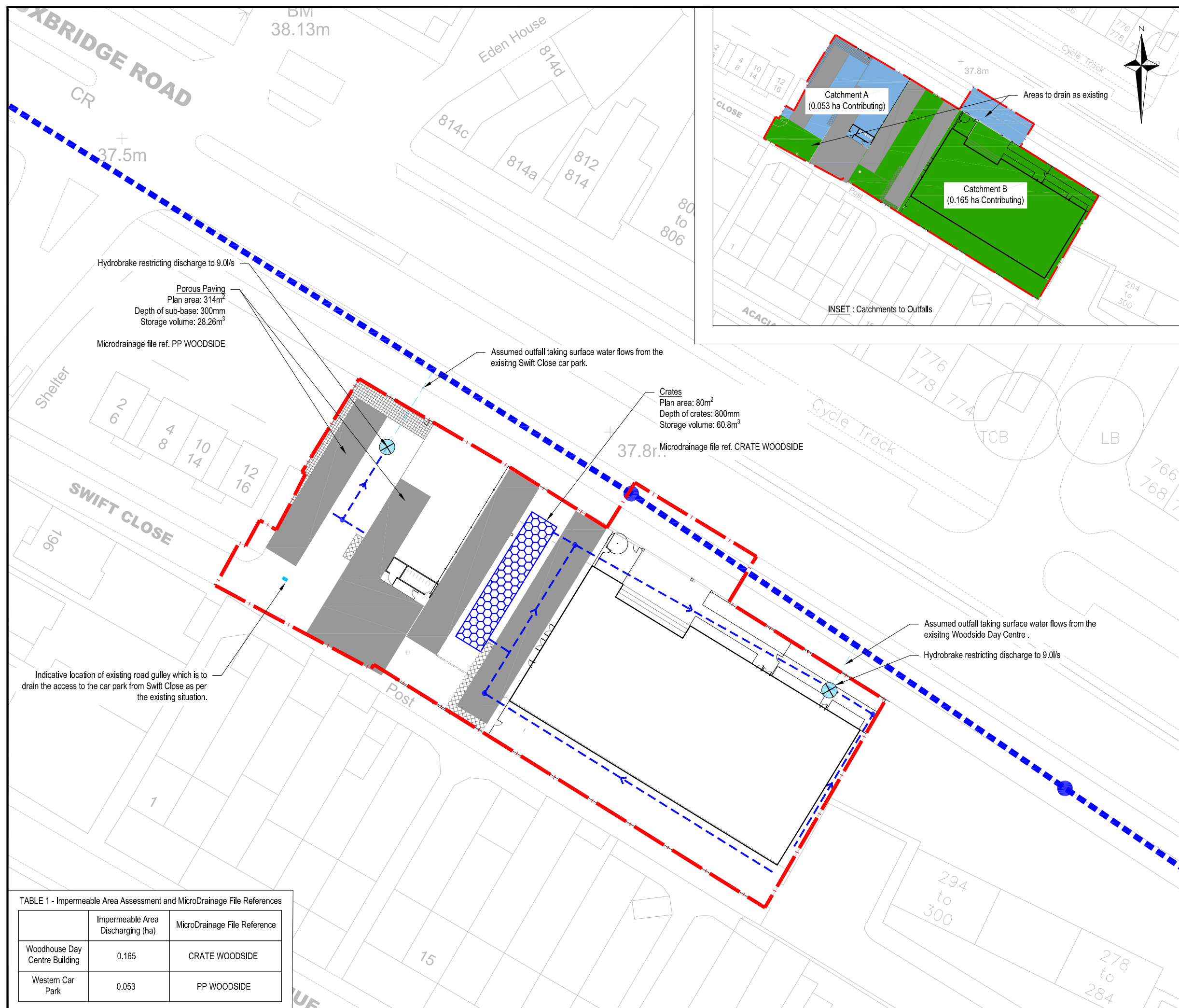
The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	5.3	1.200	17.3	3.000	26.9	7.000	40.9
0.200	9.0	1.400	18.7	3.500	28.8	7.500	42.4
0.300	9.0	1.600	19.9	4.000	30.8	8.000	43.8
0.400	10.3	1.800	21.0	4.500	32.7	8.500	45.1
0.500	11.4	2.000	22.1	5.000	34.5	9.000	46.4
0.600	12.5	2.200	23.2	5.500	36.2	9.500	47.7
0.800	14.3	2.400	24.2	6.000	37.8		
1.000	15.9	2.600	25.1	6.500	39.4		

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Appendix G

Indicative Surface Water Drainage Strategy



NOTES

DRAINAGE NOTES

KEY

P1	Preliminary Issue	04.06.18 KFM	JH
Rev.	Description	Date	Chk

Client : London Borough of Hillingdon

Title : Indicative Surface Water Drainage Strategy

Drawing No.	CV8180204/SK02	Rev	P1
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TABLE 1 - Impermeable Area Assessment and MicroDrainage File References



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- Civil Engineering
- Transport & Highways
- Geomatics (Land Surveying)
- Building Surveying
- BIM