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ENVIRONMENT

Richborough
Brascote Lane, Newbold Verdon
Leicestershire
Sustainable Drainage Statement

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Richborough
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Leicestershire
Sustainable Drainage Statement

Birmingham
Livery Place, 35 Livery Street, Colmore Business District, Birmingham, B3 2PB
T: 0121 233 3322

Cambridge
14-16 High Street, Histon, Cambridge
CB24 9JD
T: 01223 235 173

Leeds
Whitehall Waterfront, 2 Riverside Way, Leeds
LS1 4EH
T: 0113 233 8000

London
11 Borough High Street
London, SE1 9SE
T: 0207 407 3879

Manchester
11 Portland Street, Manchester, M1 3HU
0161 233 4260

Market Harborough
12a Woodcock House, Compass Point Market Harborough, Leicestershire, LE16 9HW
T: 01858 455020

Nottingham
Waterfront House, Station Street, Nottingham NG2 3DQ
T: 0115 924 1100

December 2023

DOCUMENT ISSUE RECORD

Document Number:	BLN-BWB-ZZ-XX-RP-CD-0001_SDS
BWB Reference:	BMW-3175-SDS

Revision	Date of Issue	Status	Author:	Checked:	Approved:
P01	15.12.2021	S2	Lucy Reeves BSc (Hons)	Matthew Bailey BSc (Hons)	Catherine Thorpe BSc (Hons) MCInstCES
P02	23.02.22	S2	Lucy Reeves BSc (Hons)	Catherine Thorpe BSc (Hons) MCInstCES	Catherine Thorpe BSc (Hons) MCInstCES
P03	13.12.23	S2	Lucy Reeves BSc (Hons)	Chris Dodd BEng (Hons) IEng MICE	Claire Gardner BSc (Hons) MSc MCIWEM C.WEM ACMI fCMgr

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CONTENTS

1. INTRODUCTION 1
Sustainable Drainage Guidance 2
2. EXISTING CONDITIONS 4
Existing Runoff Rates 5
Existing Runoff Volume 5
3. SURFACE WATER DRAINAGE STRATEGY 6
Drainage Hierarchy 6
Peak Flow Control 7
Attenuated Storage 8
Runoff Volume Control 9
Long Term Storage 10
Sustainable Drainage Systems 11
Residual Risk and Designing for Exceedance 11
4. FOUL WATER DRAINAGE 12
5. MAINTENANCE 13
6. SUMMARY 14

FIGURES

Figure 1.1: Site Location

TABLES

Table 1.1: Site Details
Table 1.2: Peak Rainfall Intensity Allowance in Small and Urban Catchments
Table 2.1: Existing Runoff Rate from the Site
Table 3.1: Catchment Details
Table 3.2: Existing & Proposed Runoff Rates
Table 3.3: Proposed Runoff Rates per Catchment
Table 3.4: Outline Attenuated Storage Requirements
Table 3.5: Runoff Volume Comparison
Table 6.1: Sustainable Drainage Statement Summary

APPENDICES

Appendix 1: Proposed Masterplan
Appendix 2: Topographical Survey
Appendix 3: Severn Trent Water Sewer Records
Appendix 4: Existing Runoff Calculations
Appendix 5: Proposed Storage Volumes
Appendix 6: Illustrative Drainage Strategy
Appendix 7: Severn Trent Water Developer Enquiry

1. INTRODUCTION

1.1 A Sustainable Drainage Statement (SDS) sets out the principles of drainage design for a development and summarises the reasoning behind the chosen design. This includes consideration of national and local guidance, justification of specific flow rates, volumes of attenuated storage, as well as the appropriate level of treatment to be provided to surface water runoff.

1.2 This SDS has been produced by BWB Consulting on behalf of Richborough in respect of a site located off Brascote Lane, Newbold Verdon. The report is intended to support an outline planning application for a proposed residential development. Proposed plans are included as **Appendix 1**.

1.3 A Flood Risk Assessment (FRA) has been produced for the site (reference: BLN-BWB-ZZ-XX-RP-YE-0002_FRA) and this SDS accompanies this overarching document.

1.4 The site is currently comprised of an agricultural field and is therefore considered to be greenfield land. The site is located off Brascote Lane, immediately south of the residential setting of Newbold Verdon. Leicester city centre is located approximately 1.5km east of the site and the village of Newbold Verdon. Brascote Lane forms the western and southern boundaries of the site. The northern site boundary is bordered by the Thurlaston Brook which flows from east to west. The east of the site is surrounded by farmland.

1.5 Key site details are provided in **Table 1.1**, with the site location illustrated within **Figure 1.1**.

Table 1.1: Site Details

Site Name	Land off Brascote Lane
Location	Newbold Verdon
NGR (approx.)	SK 4468 0320
Application Site Area (ha)	14.2 (approx.)
Development Area (ha)	7.9 (approx.)
Development Type	Residential
Lead Local Flood Authority	Leicestershire County Council
Local Planning Authority	Hinckley and Bosworth Borough Council
Environment Agency Area	East Midlands
Sewerage Undertaker	Severn Trent Water

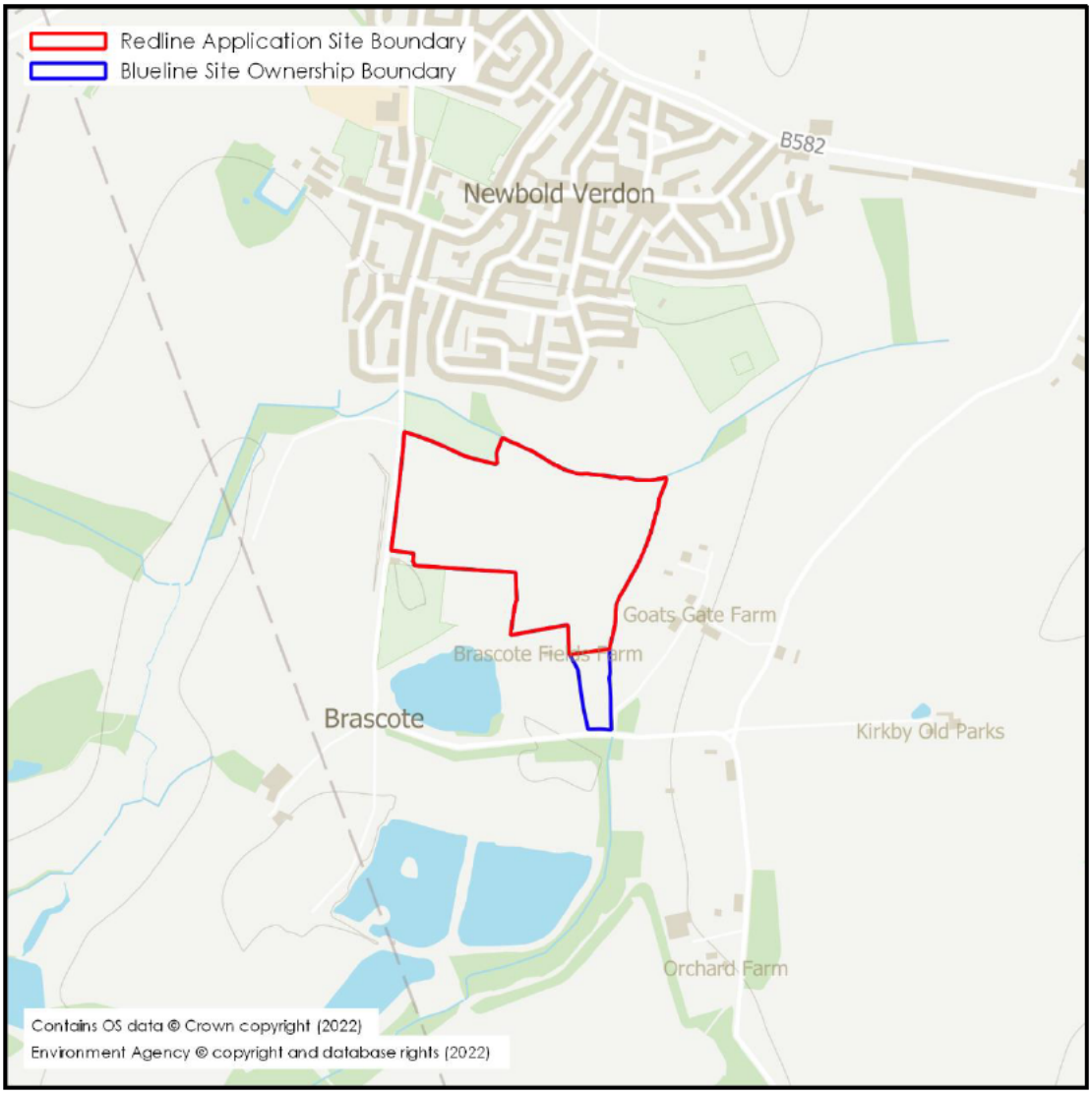


Figure 1.1: Site Location

Sustainable Drainage Guidance

1.6 Sustainable Drainage Systems (SuDS) aim to reduce the impact of development by replicating the natural runoff regime in a sustainable, cost effective manner whilst protecting water quality and reducing pollution. The four key objectives of SuDS design are to achieve improvements in water quantity, water quality, amenity provision and biodiversity.

1.7 Leicestershire County Council, in their role as the Lead Local Flood Authority (LLFA), have published an 'Interim LLFA Guidance Note: Planning and Development in Leicestershire' which serves an interim LLFA surface water and flood risk guidance prior to completion of more comprehensive guidance.

1.8 The guidance notes that calculations for attenuation requirements should allow for up to the 1 in 100 year return period plus the appropriate allowance for climate change.

1.9 Table 2 from the 'Flood risk assessments: climate change allowances'[1], included as **Table 1.2**, shows anticipated changes in extreme rainfall intensity in small and urban catchments. Therefore a 40% climate change allowance should be adopted.

Table 1.2: Peak Rainfall Intensity Allowance in Small and Urban Catchments

Applies across all of England	Total potential change anticipated for the '2020s' (2015 to 2039)	Total potential change anticipated for the '2050s' (2040 to 2069)	Total potential change anticipated for the '2080s' (2070 to 2115)
Upper End	10%	20%	40%
Central	5%	10%	20%

1.10 The local guidance also notes that where applicable, the impacts of 'urban creep' should be included and a 10% increase in the impermeable area should be included within the storage calculations.

1.11 In addition to the LLFA guidance, the Non-Statutory Technical Standards for Sustainable Drainage Systems[2] as published by DEFRA and The SuDS Manual[3] have been utilised to inform the strategy.

[1] https://www gov uk/guidance/flood-risk-assessments-climate-change-allowances
[2] 2015 DEFRA. Non-statutory technical standards for sustainable drainage systems
[3] The SuDS Manual (CIRIA 2015)

2. EXISTING CONDITIONS

2.1 A topographical survey of the site has been undertaken and is included as **Appendix 2**. Ground levels generally fall from south to north. Levels across the southern perimeter of the site boundary range between 128m Above Ordnance Datum (AOD) and 130mAOD. The levels then fall towards the Thurlaston Brook which forms the northern perimeter of the site boundary. Levels along the northern boundary generally range between 123mAOD and 125mAOD. In the wider area, levels to the north are also seen to drain towards the Thurlaston Brook.

2.2 Severn Trent Water (STW) sewer records, included as **Appendix 3**, show the nearest public assets to be located within Brascote Lane, to the north west of the site. A 375mm and 300mm public foul water sewer flow in a southerly and then westerly direction towards a sewerage treatment works (Newbold Verdon STW).

2.3 The accompanying FRA shows that the site is at a low risk of flooding from fluvial and pluvial sources. The site is located entirely within Flood Zone 1, however the Thurlaston Brook, which is located adjacent to the northern site boundary, has not been represented on the EA's Flood Map for Planning and therefore a hydraulic modelling study has been completed by BWB Consulting to provide a detailed understanding of fluvial flooding at the site. The proposed plots are shown to remain wholly unaffected during all modelled events. A 100% blockage scenario of the culvert beneath Brascote Lane, to the north west of the site, has been undertaken as part of the FRA. The proposed residential development is located outside of the extents associated with the blockage during the 1 in 100-year event. Further details can be found within **Section 3** of the FRA.

2.4 A pluvial flow route is shown to be present along the northern site boundary, associated with the Thurlaston Brook. There are also two small areas of localised ponding within the site with depths in these areas predicated to remain below 300mm. No development is proposed in these locations and all residential plots are shown to remain unaffected for all surface water events.

2.5 British Geological Survey (BGS) mapping shows the site to be underlain by Gunthorpe Member (Mudstone), which is designated by the EA as a Secondary B Aquifer. Secondary B Aquifers are predominantly lower permeability layers which may store and yield limited amounts of groundwater due to localised features such as fissures, thin permeable horizons and weathering.

2.6 Superficial Deposits of Glaciofluvial deposits (Sand and Gravel), Oadby Member deposits (Diamicton) and Alluvium deposits (Clay, Silt, Sand and Gravel) have been recorded across the site. The superficial deposits are designated as Secondary A Aquifers and Secondary (undifferentiated) Aquifers. Secondary A Aquifers are permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers and Secondary (undifferentiated) Aquifers are assigned in cases where it has not been possible to attribute either category A or B to a rock type.

2.7 The Hinckley and Bosworth Borough Council Strategic Flood Risk Assessment[4] (SFRA) includes mapping of Areas Susceptible to Groundwater Flooding. The site is located within an area considered to be at a 50-75% susceptibility to groundwater flooding. The FRA identifies that risk of flooding at the site, posed by groundwater is moderate.

2.8 Given the greenfield nature of the site, it is likely that the existing drainage regime initially consists of infiltration into the ground, followed by rapid surface water runoff which will follow the existing topography and flow towards the Thurlaston Brook when infiltration potential is exceeded.

Existing Runoff Rates

2.9 An assessment of the existing surface water runoff rates per hectare has been undertaken and is summarised within **Table 2.1**. Calculations are included within **Appendix 4**.

2.10 The runoff rates have been estimated using the IH124 method, with appropriate prorated adjustments for a site of less than 50ha, as recommended in Interim Code of Practice for Sustainable Drainage[5]. This was undertaken within Micro Drainage, which makes the necessary adjustments for small sites automatically.

Table 2.1: Existing Runoff Rate from the Site

Return Period (Yrs.)	Runoff Rate (l/s)
1	3.6
Mean Annual Flow Rate (QBAR)	4.4
30	8.6
100	11.3

Existing Runoff Volume

2.11 An assessment of the existing surface water runoff rates from the development area (7.9ha) has been made for a 1 in 100-year, 6 hour storm.

2.12 As the existing site is permeable, the runoff volume has been calculated using the Source Control module within Micro Drainage to be 2080m^3, results are included within **Appendix 4**.

[4] Level 1 Strategic Flood Risk Assessment (JBA Consulting July 2019)
[5] The National SUDS Working Group (2004) Interim Code of Practice for Sustainable Drainage

3. SURFACE WATER DRAINAGE STRATEGY

3.1 The site has an approximate total area of 14.2ha. The proposed approximate development area of 7.9ha has been measured from the masterplan, included as **Appendix 1**. A conservative 65% of the measured development area is assumed to be impermeable (5.1ha) and a 10% increase to the proposed impermeable area will be applied to account for urban creep (5.7ha).

3.2 The site has been divided into two catchments based upon topography and development aspirations. Details of the catchments are presented in **Table 3.1**.

Table 3.1: Catchment Details

Catchment	Developable Area (ha)	Impermeable Area (ha)	Impermeable Area + 10% Urban Creep (ha)
1	5.3	3.4	3.8
2	2.6	1.7	1.9
Total	**7.9**	**5.1**	**5.7**

Drainage Hierarchy

3.3 The Planning Policy Guidance[6] and the SuDS Manual identify that surface water runoff from a development should be disposed of as high up the following hierarchy as reasonably practicable:

i. into the ground (infiltration);
ii. to a surface water body;
iii. to a surface water sewer, highway drain, or another drainage system;
iv. to a combined sewer.

3.4 The aim of this is approach is to manage surface water runoff close to where it falls and mimic natural drainage as closely as possible.

3.5 It is assumed, based on the underlying mudstone bedrock, that infiltration is unlikely to be feasible for the majority of the site. A Phase 1 Desk Study Report carried out by PJS Geotechnical Engineers in October 2021 (reference: PJSG21-47-RT-01) notes that the underlying geology would suggest that the site is likely to be unsuitable for soakaway drainage if mudstone bedrock is encountered at shallow depth.

[6] Planning Practice Guidance. http //planningguidance planningportal.gov.uk/.

3.6 Due to the close proximity of the Thurlaston Brook, it is proposed to discharge surface water from the site to this watercourse. Given the existing topography, a gravity connection to the watercourse is considered to be viable, mimicking the pre-development conditions.

3.7 As the scheme progresses, it is recommended that infiltration testing is undertaken within the site in accordance with BRE365 Digest Guidance. If infiltration is found to be a suitable method of discharging surface water from the development, this strategy should be revised in accordance with the above hierarchy.

Peak Flow Control

3.8 In order to comply with the Non-Statutory Technical Standards for Sustainable Drainage Systems S2-S3[7], runoff from greenfield developments should not exceed the equivalent greenfield rates for the 1 and 100-year return period events.

3.9 To comply with the peak flow control criterion, it is proposed to restrict the 1 in 1-year discharge rate from the development to the receiving watercourse at the equivalent greenfield 1 in 1-year rate. All other rainfall events will be restricted to the equivalent greenfield QBAR rate up to the 1 in 100-year plus climate change event. This is summarised within **Table 3.2**.

Table 3.2: Existing & Proposed Runoff Rates

Return Period (Yr.)	Existing Runoff Rate (l/s/ha)	Total Existing Runoff Rate (7.9ha) (l/s)	Proposed Discharge Rate (l/s)
1	3.6	28.4	34.8
QBAR	4.4	34.8	
30	8.6	67.9	
100	11.3	89.3	
100 + 40%	-		

3.10 The proposed discharge rate has been pro-rated between the two catchments and is detailed within **Table 3.3**.

Table 3.3: Proposed Runoff Rates per Catchment

Catchment	QBAR Greenfield Discharge Rate (l/s)
1	23.3
2	11.4
Total	**34.7**

[7] 2015 DEFRA. Non-statutory technical standards for sustainable drainage systems

Attenuated Storage

3.11 As the development proposals require a restricted runoff rate, it will be necessary to provide attenuated storage to balance the excess volume in a safe manner within the site.

3.12 The surface water storage should be located within the site in a position where it can receive runoff from the development and discharge from the site by gravity, and also in a position where it is hydraulically isolated from any fluvial floodplain or external surface water floodplain/overland flow route that may be present in the site.

3.13 Sufficient storage for events up to the 1 in 100-year storm with a 40% allowance for climate change should be provided, and a 10% allowance should be applied to the current proposed development area to allow for urban creep over the lifetime of the development, in line with Leicestershire County Council's local guidance.

3.14 After considering the site constraints and development aspirations it is suggested that the necessary surface water storage volumes are found within a series of detention basins located at the lowest elevations of the site.

3.15 Catchment 1 and Catchment 2 have been split into sub-catchments with detention basins serving each sub-catchment. Each catchment has a singular outfall with the overall discharge rate not exceeding the rate detailed within **Table 3.3**.

3.16 For the purpose of this outline assessment, it has been assumed that the basins will accommodate all of the necessary storage, but it may be possible to redistribute a portion of the storage within other drainage components during the detailed design of the development (e.g.: in the pipe network, swales, filter drains, etc).

3.17 A simulation has been run using Micro Drainage 'Source Control' to identify the necessary storage provision. Using a restriction, as detailed within **Table 3.3**, the volume of attenuated storage required for the development has been calculated for storm events up to the 100-year + 40% storm. The results are summarised in **Table 3.4** and calculations are included as **Appendix 5**.

Table 3.4: Outline Attenuated Storage Requirements

Rainfall Method	Critical Storm	Maximum Volume (m^3)
Catchment 1a		
FSR	600 min Winter	532.4
FEH	600 min Winter	573.1
Catchment 1b		
FSR	600 min Winter	461.4
FEH	480 min Winter	497.4

Catchment 1c		
FSR	360 min Winter	1375.2
FEH	360 min Winter	1496.6
Catchment 2a		
FSR	360 min Winter	942.5
FEH	360 min Winter	1032.5
Catchment 2b		
FSR	120 min Winter	117.7
FEH	120 min Winter	121.5
Total		**3721.1**

3.18 Based on the above calculations, it is estimated that a minimum of 3,721m³ of attenuation is required within the development. It is envisaged that the final required attenuated storage volume will be determined during the detailed design stage, once the development layout and drainage areas are fixed.

Runoff Volume Control

3.19 The Non-Statutory Technical Standards for Sustainable Drainage Systems S4-S6[8] states that where reasonably practical the runoff volume from a development for the 1 in 100-year 6 hour rainfall event should not exceed the runoff volume prior to development or redevelopment. Additionally, if practicable on previously developed sites, the runoff volume should not exceed the equivalent greenfield runoff volume. Where it is not reasonably practicable to constrain the volume of runoff from a development at or below the existing volume, then the runoff must be discharged in a manner that does not adversely affect flood risk, i.e.:

i. The additional runoff volume resulting from the development (the 'long term storage volume') should be discharged separately from the site at a rate of 2l/s/ha or less. Or,

ii. All the runoff volume from the development should be discharged at a rate equivalent to the mean annual flow rate (QBAR) rate under greenfield conditions or less. Or,

iii. All the runoff volume from the development should be discharged at a rate of 2l/s/ha or less.

[8] 2015 DEFRA. Non-statutory technical standards for sustainable drainage systems

3.20 An estimate of the post-development runoff volume from the 1 in 100-year 6 hour storm can be derived from the Micro Drainage calculations, included as **Appendix 5**. The existing and post-development runoff volumes are compared within **Table 3.5**.

Table 3.5: Runoff Volume Comparison

Existing Volume (m^3)	Proposed Volume (m^3)	Difference (m^3)
2,080	4,081	+2,001

3.21 The 1 in 100-year 6 hour storm runoff volume from the site has been shown to increase as a result of the proposed development. However, as the runoff volume from the development will be discharged at a rate equivalent to the mean annual flow rate (QBAR) rate under greenfield conditions, the volume control criteria will be met.

Long Term Storage

3.22 It is proposed to discharge the runoff from the development at a rate equivalent to the mean annual flow rate (QBAR) rate under greenfield conditions. Therefore, provision for long term storage is not required.

Sustainable Drainage Systems

3.23 Surface water runoff will be stored within a series of detention basins located within the centre of the site and to the north of the site. The basins have been designed to be 1m deep with a 300mm freeboard in the 1 in 100-year + 40% event. The ultimate outfall for the basins is Thurlaston Brook located along the northern boundary of the site. Water will discharge at a controlled rate via a vortex flow control.

3.24 Tree pits and a green corridor featuring a swale has been incorporated into the drainage design. The swales will connect into the proposed surface water drainage system. This will improve the amenity and ecological value of the development, as well as providing treatment prior to discharge.

3.25 The detention basins should be appropriately planted to provide a primary level of treatment through filtration. Further levels of treatment could also be provided in the form of rain gardens, permeable paving or similar. It is envisaged that the treatment stages will be determined during the detailed design stage once the development layout and drainage areas are fixed.

3.26 Where possible, the swales and detention basins should be unlined to allow for any residual infiltration. The viability of having unlined swales and detention basins will be confirmed following seasonal groundwater monitoring within the proposed development site.

3.27 The interception volume (defined as the first 5mm of most of the majority of all rainfall events) of 285m^3 shall be contained within the storage provided to prevent contamination from high level pollutant concentrations.

3.28 An Illustrative Drainage Strategy is included as **Appendix 6** (reference: BLN-BWB-ZZ-XX-DR-CD-0001) and demonstrates how the required storage volume can be achieved within the site boundary.

Residual Risk and Designing for Exceedance

3.29 It is recommended that the final layout uses the proposed road infrastructure to provide drainage exceedance (overland flood flow) routes through the development and towards the basins for events in excess of the capacity of the drainage system.

3.30 If the capacity of the attenuated storage is exceeded, ground levels should be profiled to direct overland flows towards the north towards Thurlaston Brook.

3.31 In addition to the volume of storage provided within the main attenuation, there will be capacity within upstream pipes, manholes and additional SuDS features which has not been accounted for at this stage and a further level of redundancy to the network will therefore be provided.

3.32 A 400mm freeboard has been provided in the 1 in 100 year plus 40% climate change scenario.

4. FOUL WATER DRAINAGE

4.1 It is proposed to drain used water from the development separately to surface water. As the site is currently undeveloped, a new connection will be required. It is therefore proposed that foul water from the development will outfall to the existing STW public sewer network at the closest connection point available.

4.2 The nearest adopted gravity foul sewer is a 375mm asset located within a grass verge near Brascote Lane at manhole reference 4309. A Pre-Development Enquiry was submitted to STW and is included as **Appendix 7**. STW have confirmed that it will be necessary to undertake a hydraulic assessment of the site to understand the impact on the receiving Sewerage Treatment Works.

4.3 A review of existing ground levels suggests that a gravity connection to this sewer for the whole site is not possible. Therefore, to connect into this sewer, a foul pumping station will be required. A foul pumping station should be in the lowest developable area of the site to achieve a gravity connection from the site to the pumping station.

4.4 Based on the size of the development, it is anticipated that the pumping station will be a 'Type 3' pumping station, as outlined within the DCG. Type 3 pumping stations have typical compound dimensions of 8m x 12m and require to be accessed by an adoptable highway. Type 3 pumping stations require a 15m easement between the compound's wet well and the nearest habitable building.

4.5 The suggested pumping station location and connection point is shown on the Illustrative Drainage Strategy included as **Appendix 6.**

4.6 A S106 (Water Industry Act 1991) application should be made to STW for approval prior to a connection being made.

5. MAINTENANCE

5.1 The proposed drainage system should be designed in accordance with the Design and Construction Guidance (DCG) and be offered up for adoption to STW. If any parts of the drainage network remain unadopted, or until the point that they are, an appropriate maintenance company should be appointed. Any drainage features within private curtilage will be the responsibility of the homeowner.

5.2 Requirements for ongoing maintenance of the drainage network should form part of the Operation and Maintenance manual for the site and should be undertaken by the site management. Any specialist or proprietary products that are specified at detailed design should have a manufacturer specific maintenance regime which should be included within the document.

5.3 It is envisaged that the Operation and Maintenance manual will be developed at the detailed design stage, but some examples are included below.

i. All drainage features should be located in open areas which are readily accessible.
ii. Gullies should be inspected and de-silted at least once a year, where necessary.
iii. Pipes, manholes and silt traps should be inspected and de-silted at least once a year, where necessary.
iv. If permeable paving is incorporated within the layout, it should be swept a minimum of every 6 months to maintain flow capacity of the joints between blocks.
v. The surface water attenuation areas will be predominantly dry and the base will be seeded with a wildflower grass seed mix that can tolerate wet ground conditions.
vi. Regular inspections of the attenuation basin should be undertaken to remove litter/debris, invasive/colonising vegetation and silt build up as necessary. Inlet and outlet structures to be regularly inspected, with remedial work as required to maintain water flows and prevent silt/vegetation build up.
vii. Vegetation/grass with the attenuation basin should be maintained appropriately to allow establishment and promote habitat formation, without impeding the operation of the inlet and outlet structure.
viii. Flow controls should be inspected every 6 months, litter/debris and silt build up should be removed as necessary.

6. SUMMARY

6.1 This statement and supporting appendices demonstrate that the drainage design for the development will comply with the relevant local and national standards, specifically the hierarchy of discharge, runoff rate and volume criterion.

6.2 This SDS is intended to support an outline planning application and as such the level of detail included is commensurate and subject to the nature of the proposals.

Table 6.1: Sustainable Drainage Statement Summary

		Existing Site	Proposed Development
Site Area (ha)		14.2	
Impermeable Area (ha)		-	5.7
Outfall Location		Watercourse	Watercourse
Peak Runoff Rate (l/s)	QBAR	34.8	34.7
	1 in 30-Year	67.9	
	1 in 100-Year	89.3	
	1 in 100-Year + CC	-	
Runoff Volume (100yr RP 6 hour Storm)		2,080m²	4,081m²
Volume Control		-	Discharge rate limited to QBAR
Proposed Storage Volume		-	3,721m³
Interception Volume		-	285m³
Flow Control Type		-	Vortex
SuDS Features		-	Detention Basin Swales Tree Pits
Maintenance Responsibility		-	Management Company/Sewerage Company

6.3 It is envisaged that the final drainage strategy will be determined during the detailed design stage, as the development layout is finalised.

APPENDICES

Appendix 1: Proposed Masterplan

Key

- Application site boundary
- Other land under control of applicant
- Existing (retained) trees & hedgerow
- Proposed tree/hedge removal
- Indicative proposed planting
- Potential for fruit-tree planting
- Areas of new publicly-accessible open space
- Potential for equipped area of children's play (with min 20m development offset shown)
- Potential for children's play ar and/or event along a trim-trai (with min 5m development offset shown)
- Indicative marginal wildflower and grassland planting
- Indicative surface water attenuation basin
- Existing Public Right of Way
- Proposed pedestrian/cycle routes
- Proposed vehicular access from Brascote Lane
- Visual link with the spire of The Church of St. James
- Potential for improvements at Windmill pub
- Indicative dwellings (and associated garages)

Richborough Estates

nineteen47
CHARTERED TOWN PLANNERS & URBAN DESIGNERS

Project
Brascote Lane, Newbold Verdon

Drawing Title
Illustrative Layout

Project Code	Drawing Nr	Rev
n1741	006	C

Date	Drawing Scale
10.08.2022	1:1,250 @ A1

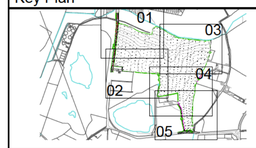
Appendix 2: Topographical Survey

Station Coordinates			
Station Name	Eastings (m)	Northings (m)	Height (m)
BWB01	444426.770	303328.244	122.988
BWB02	444421.393	303216.789	127.180
BWB03	444415.262	303163.558	128.736

Notes

1. Do not scale this drawing. All dimensions must be checked/ verified on site. If in doubt ask.
2. This drawing is to be read in conjunction with all relevant architects, engineers and specialists drawings and specifications.
3. All dimensions in metres unless noted otherwise. All levels in metres unless noted otherwise.
4. Any discrepancies noted on site are to be reported to the engineer immediately.
5. No scale factor has been applied to this survey, therefore the os coordinates are to be treated as arbitrary. Please refer to survey station information below for on site control establishment.
6. All coordinates and height data relate to OSGB36(15). Control stations are coordinated by means of GPS receiving real time corrections via OS smart net.
7. All manhole data is collected from ground level therefore discrepancies may occur. More accurate data is only achievable via confined space entry.
8. OS license number: 100022432

Key Plan



Legend

OS Buildings
Surveyed Buildings
Building
Wall
Kerb Channel Line
Top of Kerb
Edge of Surface
Top of Bank
Bottom of Banks
Canopy / Overhang
Line Marking
Centre Line
Watercourse Centre Line
Barrier
Fence
Gate
Overhead Powerline
Overhead Utilities
Contour Lines
Inspection Chamber
0.25 / 1 — Flow direction and pipe diameter
Station and Name
BH 1 — Monitoring Borehole
Tree / Bush / Sapling
Area of Vegetation/ Extent of Tree Canopy
Hedge
Body of Water
Body of Water from OS
50.00 — Spot Level
Assumed Surface Water Drainage Line
Surface Water Drainage Line

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C	Crest	FMR	Fence Metal Railing	PT	Post
CL	Cover Level	FOB	Fence Open Board	RE	Rodding Eye
CMP	Cattle Marker Post	FPW	Fence Post & Wire	SP	Sign Post
		FSP	Fence Steel Palisade	ST	Stop Tap
CCTV	Security Camera	FWM	Fence Wire Mesh	SV	Stop Valve
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Elec	Electric	Ht	Height	UTS	Unable to Survey
EP	Electricity Post	IC	Inspection Chamber	WL	Water Level
ER	Earth Rod	IFL	Internal Floor Level	WM	Water Meter
FH	Fire Hydrant	IL	Invert Level (as a reduced level)	WO	Wash Out
FL	Floodlight				

Rev	Date	Details of issue / revision	Drw	Rev
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Client

Richborough Estates Ltd

Project Title

Brascote Lane
Newbold Verdon

Drawing Title

Existing Site 2D Plan
Sheet 1 of 5

Drawn:	S.D.Shreeves	Reviewed:	D.Smith
BWB Ref:	BMW3175	Date: 08.07.21	Scale@A1: 1:500

Drawing Status

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Project - Originator - Zone - Level - Type - Role - Number	Status	Rev
BLN-BWB-00-01-DR-G-001	S2	P1

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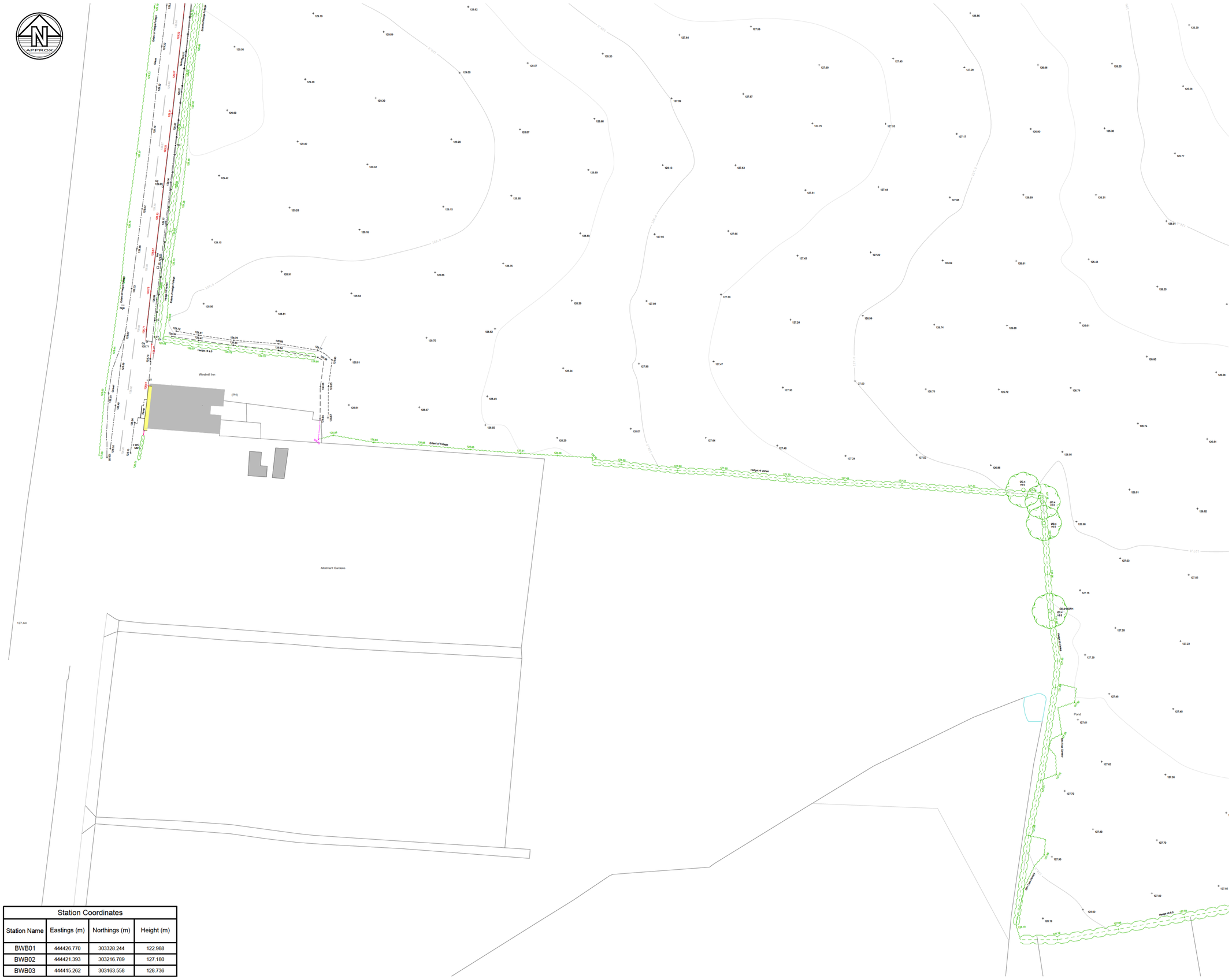

Station Coordinates			
Station Name	Eastings (m)	Northings (m)	Height (m)
BWB01	444426.770	303328.244	122.988
BWB02	444421.393	303216.789	127.180
BWB03	444415.262	303163.558	128.736

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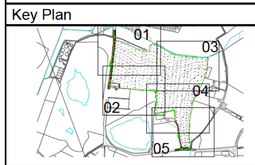

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Top of Kerb
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Line Marking
Centre Line
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Body of Water from OS
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Assumed Surface Water Drainage Line
Surface Water Drainage Line

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BG	Back Gully	FCB	Fence Closed Board	LP	Lamp Post
BO	Bollard	FCL	Fence Chain Link	MH	Manhole
BS	Bus Stop	FEL	Fence Electric	Mkr	Service Marker
BT	British Telecom	FMP	Fence Metal Panel	PB	Post Box
C	Crest	FMR	Fence Metal Railing	PT	Post
CL	Cover Level	FOB	Fence Open Board	RE	Rodding Eye
CMP	Cable Marker Post	FPW	Fence Post & Wire	SP	Sign Post
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Elec	Electric	Ht	Height	UTS	Unable to Survey
EP	Electricity Post	IC	Inspection Chamber	Wl.	Water Level
ER	Earth Rod	IFL	Internal Floor Level	WM	Water Meter
FH	Fire Hydrant	IL	Invert Level (as a reduced level)	WO	Wash Out
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Rev	Date	Details of issue / revision	Drw	Rev
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Client

Richborough Estates Ltd

Project Title

Brascote Lane
Newbold Verdon

Drawing Title

Existing Site 2D Plan
Sheet 2 of 5

Drawn:	S.D.Shreeves	Reviewed:	D.Smith
BWB Ref:	BMW3175	Date:	08.07.21
Scale@A1:	1:500		

Drawing Status

PRELIMINARY

Project - Originator - Zone - Level - Type - Role - Number	Status	Rev
BLN-BWB-00-02-DR-G-001	S2	P1

Station Coordinates			
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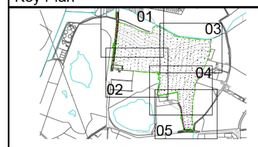

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Sheet 3 of 5

Drawn:	S.D.Shreeves	Reviewed:	D.Smith
BWB Ref:	BMW3175	Date: 08.07.21	Scale@A1: 1:500

Drawing Status

PRELIMINARY

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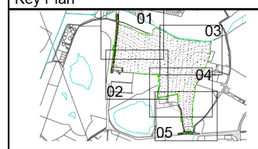

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Top of Kerb
Edge of Surface
Top of Bank
Bottom of Bank
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Line Marking
Centre Line
Watercourse Centre Line
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Brascote Lane
Newbold Verdon

Drawing Title

Existing Site 2D Plan
Sheet 4 of 5

Drawn:	S.D.Shreeves	Reviewed:	D.Smith
BWB Ref:	BMW3175	Date:	08.07.21
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Drawing Status

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Project - Originator - Zone - Level - Type - Role - Number	Status	Rev
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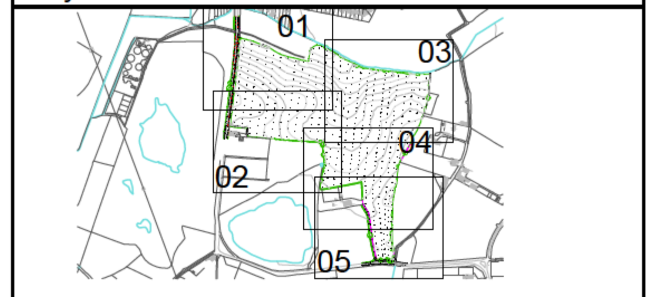

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- Building
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- Top of Bank
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Existing Site 2D Plan Sheet 5 of 5

Drawn:	S.D.Shreeves		Reviewed:	D.Smith	
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Drawing Status

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BLN-BWB-00-05-DR-G-001	S2	P1

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Appendix 3: Severn Trent Water Sewer Records

SEVERN
TRENT

Public Foul Gravity/Lateral Drain		Highway Drain		Manhole Foul	
Public Combined Gravity/Lateral Drain		Overflow Pipe		Manhole Surface	
Public Surface Water Gravity/Lateral Drain		Disposal Pipe		Abandoned Pipe	
Pressure Foul		Culverted Water Course		Section 104 sewers are shown in green	
Pressure Combined		Pumping Station		Private sewers are shown in magenta	
Pressure Surface Water		Fitting			

SEVERN
TRENT

A A P U B A H A Y W A A V A A A A U

S S S
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S 0 9 S S S S S
S 0
S S S
S S B
S S
S S
S
S
S Y S
9 0 0
S S S
0 S S S
S S S
S S S S
S S S
9 0 S
0 S S S
S S
S S S
Y S 0
S S
A
S S S
S
B S
S B B S S 0
S S
9 S S B B S

Appendix 4: Existing Runoff Calculations

ICP SUDS Mean Annual Flood

Input

Return Period (years)	1	Soil	0.450
Area (ha)	1.000	Urban	0.000
SAAR (mm)	700	Region Number	Region 4

Results	**l/s**
QBAR Rural	4.4
QBAR Urban	4.4
Q1 year	3.6
Q1 year	3.6
Q30 years	8.6
Q100 years	11.3

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Greenfield Runoff Volume

FEH Data

Return Period (years)	100
Storm Duration (mins)	360
FEH Rainfall Version	1999
Site Location	GB 443900 302500 SK 43900 02500
C (1km)	-0.028
D1 (1km)	0.361
D2 (1km)	0.333
D3 (1km)	0.293
E (1km)	0.309
F (1km)	2.371
Areal Reduction Factor	1.00
Area (ha)	7.900
SAAR (mm)	650
CWI	96.000
SPR Host	40.150
URBEXT (1990)	0.0848

Results

Percentage Runoff (%)	39.15
Greenfield Runoff Volume (m^3)	2079.958

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Appendix 5: Proposed Storage Volumes

Cascade Summary of Results for Catchment 1a Storage 100yr 40CC FEH.SRCX

Upstream Structures	Outflow To	Overflow To
(None)	(None)	Catchment 1b Storage 100yr 40CC FEH.SRCX

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	125.119	0.319	4.8	200.9	O K
30 min Summer	125.206	0.406	4.8	262.8	O K
60 min Summer	125.290	0.490	4.8	325.1	O K
120 min Summer	125.385	0.585	4.8	400.0	O K
180 min Summer	125.438	0.638	4.8	442.4	O K
240 min Summer	125.469	0.669	4.8	468.7	O K
360 min Summer	125.500	0.700	4.8	495.0	O K
480 min Summer	125.509	0.709	4.8	502.5	O K
600 min Summer	125.507	0.707	4.8	500.6	O K
720 min Summer	125.499	0.699	4.8	493.6	O K
960 min Summer	125.474	0.674	4.8	473.0	O K
1440 min Summer	125.427	0.627	4.8	433.5	O K
2160 min Summer	125.364	0.564	4.8	383.0	O K
2880 min Summer	125.304	0.504	4.8	336.4	O K
4320 min Summer	125.210	0.410	4.8	265.9	O K
5760 min Summer	125.138	0.338	4.8	214.4	O K
7200 min Summer	125.084	0.284	4.8	177.3	O K
8640 min Summer	125.043	0.243	4.8	149.9	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	137.200	0.0	196.1	26
30 min Summer	90.160	0.0	257.7	41
60 min Summer	56.420	0.0	333.6	70
120 min Summer	35.420	0.0	418.9	130
180 min Summer	26.689	0.0	473.3	188
240 min Summer	21.665	0.0	511.8	248
360 min Summer	15.913	0.0	562.9	366
480 min Summer	12.640	0.0	595.0	484
600 min Summer	10.515	0.0	617.3	602
720 min Summer	9.018	0.0	633.7	720
960 min Summer	7.042	0.0	655.6	858
1440 min Summer	4.929	0.0	671.0	1090
2160 min Summer	3.446	0.0	740.8	1492
2880 min Summer	2.683	0.0	769.0	1880
4320 min Summer	1.912	0.0	820.5	2640
5760 min Summer	1.522	0.0	875.5	3400
7200 min Summer	1.293	0.0	928.9	4104
8640 min Summer	1.142	0.0	983.5	4768

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Cascade Summary of Results for Catchment 1a Storage 100yr 40CC FEH.SRCX

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
10080 min Summer	125.013	0.213	4.8	129.9	O K
15 min Winter	125.154	0.354	4.8	225.5	O K
30 min Winter	125.250	0.450	4.8	295.2	O K
60 min Winter	125.342	0.542	4.8	365.9	O K
120 min Winter	125.447	0.647	4.8	450.3	O K
180 min Winter	125.505	0.705	4.8	499.0	O K
240 min Winter	125.541	0.741	4.8	529.8	O K
360 min Winter	125.577	0.777	4.8	561.8	O K
480 min Winter	125.589	0.789	4.8	572.7	O K
600 min Winter	125.590	0.790	4.8	573.1	O K
720 min Winter	125.584	0.784	4.8	567.7	O K
960 min Winter	125.561	0.761	4.8	547.4	O K
1440 min Winter	125.503	0.703	4.8	497.5	O K
2160 min Winter	125.427	0.627	4.8	433.4	O K
2880 min Winter	125.352	0.552	4.8	373.8	O K
4320 min Winter	125.206	0.406	4.8	263.2	O K
5760 min Winter	125.097	0.297	4.8	186.1	O K
7200 min Winter	125.020	0.220	4.8	134.7	O K
8640 min Winter	124.970	0.170	4.7	102.2	O K
10080 min Winter	124.938	0.138	4.6	82.4	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
10080 min Summer	1.035	0.0	1038.7	5456
15 min Winter	137.200	0.0	219.8	26
30 min Winter	90.160	0.0	287.9	40
60 min Winter	56.420	0.0	373.8	70
120 min Winter	35.420	0.0	469.1	128
180 min Winter	26.689	0.0	529.6	186
240 min Winter	21.665	0.0	572.3	244
360 min Winter	15.913	0.0	628.5	358
480 min Winter	12.640	0.0	662.9	474
600 min Winter	10.515	0.0	686.0	588
720 min Winter	9.018	0.0	701.9	700
960 min Winter	7.042	0.0	717.9	914
1440 min Winter	4.929	0.0	700.3	1148
2160 min Winter	3.446	0.0	829.8	1604
2880 min Winter	2.683	0.0	861.2	2076
4320 min Winter	1.912	0.0	919.3	2848
5760 min Winter	1.523	0.0	980.7	3568
7200 min Winter	1.293	0.0	1040.6	4192
8640 min Winter	1.142	0.0	1102.0	4848
10080 min Winter	1.035	0.0	1164.3	5448

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Cascade Rainfall Details for Catchment 1a Storage 100yr 40CC FEH.SRCX

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	2013
Site Location	GB 443900 302500 SK 43900 02500
Data Type	Catchment
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.750
Cv (Winter)	0.840
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.800

Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)
0	4	0.267	4	8	0.267	8	12	0.267

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Cascade Model Details for Catchment 1a Storage 100yr 40CC FEH.SRCX

Storage is Online Cover Level (m) 126.000

Tank or Pond Structure

Invert Level (m) 124.800

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	571.3	1.200	1085.9

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0106-4800-0800-4800
Design Head (m)	0.800
Design Flow (l/s)	4.8
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	106
Invert Level (m)	124.800
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.800	4.8
Flush-Flo™	0.241	4.8
Kick-Flo®	0.534	4.0
Mean Flow over Head Range	-	4.1

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	3.6	1.200	5.8	3.000	8.9	7.000	13.3
0.200	4.8	1.400	6.2	3.500	9.6	7.500	13.8
0.300	4.8	1.600	6.6	4.000	10.2	8.000	14.2
0.400	4.6	1.800	7.0	4.500	10.8	8.500	14.6
0.500	4.3	2.000	7.4	5.000	11.3	9.000	15.0
0.600	4.2	2.200	7.7	5.500	11.9	9.500	15.4
0.800	4.8	2.400	8.0	6.000	12.4		
1.000	5.3	2.600	8.3	6.500	12.9		

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Cascade Summary of Results for Catchment 1a Storage 100yr 40CC FSR.SRCX

Upstream Structures	Outflow To	Overflow To
(None)	(None)	Catchment 1b Storage 100yr 40CC FSR.SRCX

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	125.126	0.326	4.8	205.7	O K
30 min Summer	125.214	0.414	4.8	268.8	O K
60 min Summer	125.299	0.499	4.8	332.1	O K
120 min Summer	125.375	0.575	4.8	391.8	O K
180 min Summer	125.412	0.612	4.8	421.3	O K
240 min Summer	125.432	0.632	4.8	437.8	O K
360 min Summer	125.454	0.654	4.8	456.2	O K
480 min Summer	125.463	0.663	4.8	463.7	O K
600 min Summer	125.465	0.665	4.8	464.9	O K
720 min Summer	125.461	0.661	4.8	462.1	O K
960 min Summer	125.449	0.649	4.8	451.7	O K
1440 min Summer	125.422	0.622	4.8	430.0	O K
2160 min Summer	125.381	0.581	4.8	396.6	O K
2880 min Summer	125.338	0.538	4.8	362.1	O K
4320 min Summer	125.246	0.446	4.8	292.3	O K
5760 min Summer	125.167	0.367	4.8	234.9	O K
7200 min Summer	125.099	0.299	4.8	187.4	O K
8640 min Summer	125.043	0.243	4.8	149.7	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	140.425	0.0	200.7	26
30 min Summer	92.166	0.0	263.4	41
60 min Summer	57.587	0.0	340.5	70
120 min Summer	34.732	0.0	410.8	130
180 min Summer	25.480	0.0	451.9	188
240 min Summer	20.325	0.0	480.4	248
360 min Summer	14.772	0.0	523.2	366
480 min Summer	11.770	0.0	555.0	484
600 min Summer	9.861	0.0	580.2	602
720 min Summer	8.530	0.0	601.0	720
960 min Summer	6.780	0.0	633.3	840
1440 min Summer	4.898	0.0	668.2	1090
2160 min Summer	3.532	0.0	759.4	1496
2880 min Summer	2.798	0.0	801.8	1908
4320 min Summer	2.012	0.0	863.5	2680
5760 min Summer	1.591	0.0	915.0	3408
7200 min Summer	1.325	0.0	952.3	4112
8640 min Summer	1.141	0.0	983.1	4768

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Cascade Summary of Results for Catchment 1a Storage 100yr 40CC FSR.SRCX

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
10080 min Summer	125.000	0.200	4.8	121.6	O K
15 min Winter	125.161	0.361	4.8	230.9	O K
30 min Winter	125.259	0.459	4.8	301.9	O K
60 min Winter	125.352	0.552	4.8	373.7	O K
120 min Winter	125.436	0.636	4.8	441.2	O K
180 min Winter	125.477	0.677	4.8	475.2	O K
240 min Winter	125.500	0.700	4.8	494.9	O K
360 min Winter	125.527	0.727	4.8	517.9	O K
480 min Winter	125.539	0.739	4.8	528.7	O K
600 min Winter	125.544	0.744	4.8	532.4	O K
720 min Winter	125.543	0.743	4.8	531.7	O K
960 min Winter	125.532	0.732	4.8	522.4	O K
1440 min Winter	125.498	0.698	4.8	493.4	O K
2160 min Winter	125.446	0.646	4.8	449.4	O K
2880 min Winter	125.388	0.588	4.8	402.1	O K
4320 min Winter	125.251	0.451	4.8	296.2	O K
5760 min Winter	125.131	0.331	4.8	209.4	O K
7200 min Winter	125.035	0.235	4.8	144.7	O K
8640 min Winter	124.969	0.169	4.7	102.1	O K
10080 min Winter	124.930	0.130	4.5	77.3	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
10080 min Summer	1.005	0.0	1008.4	5448
15 min Winter	140.425	0.0	225.0	26
30 min Winter	92.166	0.0	294.0	40
60 min Winter	57.587	0.0	381.5	70
120 min Winter	34.732	0.0	460.0	128
180 min Winter	25.480	0.0	505.8	184
240 min Winter	20.325	0.0	537.5	242
360 min Winter	14.772	0.0	584.8	358
480 min Winter	11.770	0.0	619.6	474
600 min Winter	9.861	0.0	646.8	586
720 min Winter	8.530	0.0	668.5	698
960 min Winter	6.780	0.0	698.9	912
1440 min Winter	4.898	0.0	699.7	1146
2160 min Winter	3.532	0.0	850.6	1608
2880 min Winter	2.798	0.0	897.9	2076
4320 min Winter	2.012	0.0	967.3	2896
5760 min Winter	1.591	0.0	1024.9	3584
7200 min Winter	1.325	0.0	1066.8	4256
8640 min Winter	1.141	0.0	1101.5	4848
10080 min Winter	1.005	0.0	1130.3	5352

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Cascade Rainfall Details for Catchment 1a Storage 100yr 40CC FSR.SRCX

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)	20.300	Shortest Storm (mins)	15
Ratio R	0.400	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.800

Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)
0	4	0.267	4	8	0.267	8	12	0.267

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Cascade Model Details for Catchment 1a Storage 100yr 40CC FSR.SRCX

Storage is Online Cover Level (m) 126.000

Tank or Pond Structure

Invert Level (m) 124.800

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	571.3	1.200	1085.9

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0106-4800-0800-4800
Design Head (m)	0.800
Design Flow (l/s)	4.8
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	106
Invert Level (m)	124.800
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.800	4.8
Flush-Flo™	0.241	4.8
Kick-Flo®	0.534	4.0
Mean Flow over Head Range	-	4.1

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	3.6	1.200	5.8	3.000	8.9	7.000	13.3
0.200	4.8	1.400	6.2	3.500	9.6	7.500	13.8
0.300	4.8	1.600	6.6	4.000	10.2	8.000	14.2
0.400	4.6	1.800	7.0	4.500	10.8	8.500	14.6
0.500	4.3	2.000	7.4	5.000	11.3	9.000	15.0
0.600	4.2	2.200	7.7	5.500	11.9	9.500	15.4
0.800	4.8	2.400	8.0	6.000	12.4		
1.000	5.3	2.600	8.3	6.500	12.9		

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Cascade Summary of Results for Catchment 1b Storage 100yr 40CC FEH.SRCX

Upstream Structures	Outflow To	Overflow To
Catchment 1a Storage 100yr 40CC FEH.SRCX	(None)	Catchment 1c Storage 100yr 40CC FEH.SRCX

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	124.613	0.313	4.4	175.6	O K
30 min Summer	124.697	0.397	4.4	229.6	O K
60 min Summer	124.776	0.476	4.4	283.9	O K
120 min Summer	124.866	0.566	4.4	348.9	O K
180 min Summer	124.915	0.615	4.4	385.6	O K
240 min Summer	124.944	0.644	4.4	408.2	O K
360 min Summer	124.972	0.672	4.4	430.3	O K
480 min Summer	124.980	0.680	4.4	436.0	O K
600 min Summer	124.977	0.677	4.4	433.6	O K
720 min Summer	124.968	0.668	4.4	426.6	O K
960 min Summer	124.944	0.644	4.4	407.9	O K
1440 min Summer	124.897	0.597	4.4	372.1	O K
2160 min Summer	124.835	0.535	4.4	325.5	O K
2880 min Summer	124.775	0.475	4.4	282.9	O K
4320 min Summer	124.683	0.383	4.4	220.8	O K
5760 min Summer	124.613	0.313	4.4	175.8	O K
7200 min Summer	124.561	0.261	4.4	143.6	O K
8640 min Summer	124.522	0.222	4.4	120.6	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	137.200	0.0	172.5	26
30 min Summer	90.160	0.0	226.9	41
60 min Summer	56.420	0.0	292.4	70
120 min Summer	35.420	0.0	367.3	130
180 min Summer	26.689	0.0	415.0	188
240 min Summer	21.665	0.0	448.9	248
360 min Summer	15.913	0.0	494.0	366
480 min Summer	12.640	0.0	522.4	484
600 min Summer	10.515	0.0	542.4	602
720 min Summer	9.018	0.0	557.2	720
960 min Summer	7.042	0.0	577.7	838
1440 min Summer	4.929	0.0	596.9	1084
2160 min Summer	3.446	0.0	648.7	1480
2880 min Summer	2.683	0.0	673.4	1852
4320 min Summer	1.912	0.0	718.5	2604
5760 min Summer	1.522	0.0	766.2	3352
7200 min Summer	1.293	0.0	813.0	4040
8640 min Summer	1.142	0.0	860.8	4760

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Cascade Summary of Results for Catchment 1b Storage 100yr 40CC FEH.SRCX

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
10080 min Summer	124.494	0.194	4.3	103.9	O K
15 min Winter	124.647	0.347	4.4	197.1	O K
30 min Winter	124.739	0.439	4.4	258.0	O K
60 min Winter	124.826	0.526	4.4	319.5	O K
120 min Winter	124.925	0.625	4.4	393.0	O K
180 min Winter	124.979	0.679	4.4	435.2	O K
240 min Winter	125.011	0.711	4.4	461.6	O K
360 min Winter	125.045	0.745	4.4	488.8	O K
480 min Winter	125.055	0.755	4.4	497.4	O K
600 min Winter	125.054	0.754	4.4	497.0	O K
720 min Winter	125.048	0.748	4.4	491.5	O K
960 min Winter	125.024	0.724	4.4	472.3	O K
1440 min Winter	124.968	0.668	4.4	427.1	O K
2160 min Winter	124.892	0.592	4.4	368.3	O K
2880 min Winter	124.814	0.514	4.4	310.6	O K
4320 min Winter	124.673	0.373	4.4	214.2	O K
5760 min Winter	124.568	0.268	4.4	147.7	O K
7200 min Winter	124.496	0.196	4.4	105.2	O K
8640 min Winter	124.451	0.151	4.2	79.6	O K
10080 min Winter	124.424	0.124	4.1	65.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
10080 min Summer	1.035	0.0	909.3	5448
15 min Winter	137.200	0.0	193.5	26
30 min Winter	90.160	0.0	253.7	40
60 min Winter	56.420	0.0	327.7	70
120 min Winter	35.420	0.0	411.3	128
180 min Winter	26.689	0.0	464.5	184
240 min Winter	21.665	0.0	502.2	242
360 min Winter	15.913	0.0	552.0	358
480 min Winter	12.640	0.0	583.1	474
600 min Winter	10.515	0.0	604.3	586
720 min Winter	9.018	0.0	619.6	698
960 min Winter	7.042	0.0	638.3	912
1440 min Winter	4.929	0.0	637.6	1142
2160 min Winter	3.446	0.0	726.5	1604
2880 min Winter	2.683	0.0	754.2	2048
4320 min Winter	1.912	0.0	805.2	2812
5760 min Winter	1.523	0.0	858.3	3512
7200 min Winter	1.293	0.0	910.7	4176
8640 min Winter	1.142	0.0	964.5	4760
10080 min Winter	1.035	0.0	1019.2	5352

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Cascade Rainfall Details for Catchment 1b Storage 100yr 40CC FEH.SRCX

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	2013
Site Location	GB 443900 302500 SK 43900 02500
Data Type	Catchment
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.750
Cv (Winter)	0.840
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.700

Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)
0	4	0.233	4	8	0.233	8	12	0.233

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Cascade Model Details for Catchment 1b Storage 100yr 40CC FEH.SRCX

Storage is Online Cover Level (m) 125.500

Tank or Pond Structure

Invert Level (m) 124.300

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	498.1	1.200	1072.6

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0102-4400-0800-4400
Design Head (m)	0.800
Design Flow (l/s)	4.4
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	102
Invert Level (m)	124.300
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.800	4.4
Flush-Flo™	0.239	4.4
Kick-Flo®	0.529	3.6
Mean Flow over Head Range	-	3.8

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	3.4	1.200	5.3	3.000	8.2	7.000	12.2
0.200	4.4	1.400	5.7	3.500	8.8	7.500	12.6
0.300	4.3	1.600	6.1	4.000	9.3	8.000	13.0
0.400	4.2	1.800	6.4	4.500	9.9	8.500	13.4
0.500	3.9	2.000	6.7	5.000	10.4	9.000	13.7
0.600	3.9	2.200	7.0	5.500	10.9	9.500	14.1
0.800	4.4	2.400	7.3	6.000	11.3		
1.000	4.9	2.600	7.6	6.500	11.8		

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Cascade Summary of Results for Catchment 1b Storage 100yr 40CC FSR.SRCX

Upstream Structures	Outflow To	Overflow To
Catchment 1a Storage 100yr 40CC FSR.SRCX	(None)	Catchment 1c Storage 100yr 40CC FSR.SRCX

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	124.620	0.320	4.4	179.8	O K
30 min Summer	124.704	0.404	4.4	234.9	O K
60 min Summer	124.785	0.485	4.4	290.0	O K
120 min Summer	124.857	0.557	4.4	341.7	O K
180 min Summer	124.891	0.591	4.4	367.1	O K
240 min Summer	124.909	0.609	4.4	381.1	O K
360 min Summer	124.929	0.629	4.4	396.3	O K
480 min Summer	124.936	0.636	4.4	402.1	O K
600 min Summer	124.937	0.637	4.4	402.3	O K
720 min Summer	124.933	0.633	4.4	399.1	O K
960 min Summer	124.920	0.620	4.4	389.3	O K
1440 min Summer	124.893	0.593	4.4	369.0	O K
2160 min Summer	124.851	0.551	4.4	337.8	O K
2880 min Summer	124.805	0.505	4.4	304.0	O K
4320 min Summer	124.717	0.417	4.4	243.2	O K
5760 min Summer	124.640	0.340	4.4	192.7	O K
7200 min Summer	124.574	0.274	4.4	151.8	O K
8640 min Summer	124.522	0.222	4.4	120.5	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	140.425	0.0	176.7	26
30 min Summer	92.166	0.0	231.9	41
60 min Summer	57.587	0.0	298.5	70
120 min Summer	34.732	0.0	360.2	130
180 min Summer	25.480	0.0	396.3	188
240 min Summer	20.325	0.0	421.3	248
360 min Summer	14.772	0.0	458.9	366
480 min Summer	11.770	0.0	487.1	484
600 min Summer	9.861	0.0	509.5	602
720 min Summer	8.530	0.0	528.0	720
960 min Summer	6.780	0.0	557.4	832
1440 min Summer	4.898	0.0	593.9	1082
2160 min Summer	3.532	0.0	664.9	1488
2880 min Summer	2.798	0.0	702.2	1880
4320 min Summer	2.012	0.0	756.3	2644
5760 min Summer	1.591	0.0	800.7	3400
7200 min Summer	1.325	0.0	833.4	4104
8640 min Summer	1.141	0.0	860.5	4760

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Cascade Summary of Results for Catchment 1b Storage 100yr 40CC FSR.SRCX

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
10080 min Summer	124.482	0.182	4.3	97.1	O K
15 min Winter	124.654	0.354	4.4	201.9	O K
30 min Winter	124.747	0.447	4.4	263.9	O K
60 min Winter	124.836	0.536	4.4	326.4	O K
120 min Winter	124.914	0.614	4.4	385.0	O K
180 min Winter	124.952	0.652	4.4	414.4	O K
240 min Winter	124.973	0.673	4.4	431.1	O K
360 min Winter	124.997	0.697	4.4	450.4	O K
480 min Winter	125.008	0.708	4.4	458.9	O K
600 min Winter	125.011	0.711	4.4	461.4	O K
720 min Winter	125.009	0.709	4.4	460.0	O K
960 min Winter	124.998	0.698	4.4	450.4	O K
1440 min Winter	124.964	0.664	4.4	423.5	O K
2160 min Winter	124.911	0.611	4.4	382.4	O K
2880 min Winter	124.851	0.551	4.4	337.9	O K
4320 min Winter	124.714	0.414	4.4	241.5	O K
5760 min Winter	124.598	0.298	4.4	166.6	O K
7200 min Winter	124.509	0.209	4.4	113.0	O K
8640 min Winter	124.451	0.151	4.2	79.5	O K
10080 min Winter	124.419	0.119	4.0	62.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
10080 min Summer	1.005	0.0	882.8	5440
15 min Winter	140.425	0.0	198.0	26
30 min Winter	92.166	0.0	259.2	40
60 min Winter	57.587	0.0	334.4	70
120 min Winter	34.732	0.0	403.3	128
180 min Winter	25.480	0.0	443.6	184
240 min Winter	20.325	0.0	471.5	242
360 min Winter	14.772	0.0	513.3	358
480 min Winter	11.770	0.0	544.3	474
600 min Winter	9.861	0.0	568.7	586
720 min Winter	8.530	0.0	588.7	696
960 min Winter	6.780	0.0	618.5	910
1440 min Winter	4.898	0.0	636.7	1140
2160 min Winter	3.532	0.0	744.8	1604
2880 min Winter	2.798	0.0	786.4	2072
4320 min Winter	2.012	0.0	847.3	2852
5760 min Winter	1.591	0.0	897.0	3568
7200 min Winter	1.325	0.0	933.7	4184
8640 min Winter	1.141	0.0	964.1	4760
10080 min Winter	1.005	0.0	989.4	5256

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Cascade Rainfall Details for Catchment 1b Storage 100yr 40CC FSR.SRCX

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)	20.300	Shortest Storm (mins)	15
Ratio R	0.400	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.700

Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)
0	4	0.233	4	8	0.233	8	12	0.233

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Cascade Model Details for Catchment 1b Storage 100yr 40CC FSR.SRCX

Storage is Online Cover Level (m) 125.500

Tank or Pond Structure

Invert Level (m) 124.300

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	498.1	1.200	1072.6

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0102-4400-0800-4400
Design Head (m)	0.800
Design Flow (l/s)	4.4
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	102
Invert Level (m)	124.300
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.800	4.4
Flush-Flo™	0.239	4.4
Kick-Flo®	0.529	3.6
Mean Flow over Head Range	-	3.8

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	3.4	1.200	5.3	3.000	8.2	7.000	12.2
0.200	4.4	1.400	5.7	3.500	8.8	7.500	12.6
0.300	4.3	1.600	6.1	4.000	9.3	8.000	13.0
0.400	4.2	1.800	6.4	4.500	9.9	8.500	13.4
0.500	3.9	2.000	6.7	5.000	10.4	9.000	13.7
0.600	3.9	2.200	7.0	5.500	10.9	9.500	14.1
0.800	4.4	2.400	7.3	6.000	11.3		
1.000	4.9	2.600	7.6	6.500	11.8		

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Cascade Summary of Results for Catchment 1c Storage 100yr 40CC FEH.SRCX

Upstream Structures	Outflow To	Overflow To
Catchment 1b Storage 100yr 40CC FEH.SRCX	(None)	(None)
Catchment 1a Storage 100yr 40CC FEH.SRCX		

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	123.624	0.324	23.2	571.4	O K
30 min Summer	123.715	0.415	23.2	744.4	O K
60 min Summer	123.802	0.502	23.2	914.3	O K
120 min Summer	123.899	0.599	23.2	1111.6	O K
180 min Summer	123.951	0.651	23.2	1218.0	O K
240 min Summer	123.978	0.678	23.2	1275.8	O K
360 min Summer	123.997	0.697	23.2	1314.8	O K
480 min Summer	123.991	0.691	23.2	1302.5	O K
600 min Summer	123.980	0.680	23.2	1278.3	O K
720 min Summer	123.966	0.666	23.2	1249.2	O K
960 min Summer	123.934	0.634	23.2	1183.8	O K
1440 min Summer	123.863	0.563	23.2	1037.9	O K
2160 min Summer	123.769	0.469	23.2	849.7	O K
2880 min Summer	123.693	0.393	23.2	702.4	O K
4320 min Summer	123.589	0.289	23.2	506.4	O K
5760 min Summer	123.530	0.230	22.6	399.0	O K
7200 min Summer	123.503	0.203	21.2	350.4	O K
8640 min Summer	123.487	0.187	19.3	322.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	137.200	0.0	549.1	26
30 min Summer	90.160	0.0	730.0	40
60 min Summer	56.420	0.0	950.7	70
120 min Summer	35.420	0.0	1197.3	128
180 min Summer	26.689	0.0	1354.7	186
240 min Summer	21.665	0.0	1467.1	244
360 min Summer	15.913	0.0	1616.9	362
480 min Summer	12.640	0.0	1712.3	448
600 min Summer	10.515	0.0	1780.0	502
720 min Summer	9.018	0.0	1831.4	564
960 min Summer	7.042	0.0	1904.9	690
1440 min Summer	4.929	0.0	1995.5	946
2160 min Summer	3.446	0.0	2125.2	1328
2880 min Summer	2.683	0.0	2204.7	1704
4320 min Summer	1.912	0.0	2345.9	2388
5760 min Summer	1.522	0.0	2512.6	3064
7200 min Summer	1.293	0.0	2665.1	3752
8640 min Summer	1.142	0.0	2820.1	4496

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Cascade Summary of Results for Catchment 1c Storage 100yr 40CC FEH.SRCX

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
10080 min Summer	123.476	0.176	17.9	302.5	O K
15 min Winter	123.661	0.361	23.2	641.7	O K
30 min Winter	123.763	0.463	23.2	837.2	O K
60 min Winter	123.860	0.560	23.2	1030.6	O K
120 min Winter	123.969	0.669	23.2	1256.1	O K
180 min Winter	124.026	0.726	23.2	1376.5	O K
240 min Winter	124.058	0.758	23.2	1444.7	O K
360 min Winter	124.082	0.782	23.2	1496.6	O K
480 min Winter	124.079	0.779	23.2	1490.2	O K
600 min Winter	124.063	0.763	23.2	1457.1	O K
720 min Winter	124.044	0.744	23.2	1415.7	O K
960 min Winter	124.006	0.706	23.2	1334.0	O K
1440 min Winter	123.917	0.617	23.2	1146.9	O K
2160 min Winter	123.777	0.477	23.2	865.0	O K
2880 min Winter	123.666	0.366	23.2	651.0	O K
4320 min Winter	123.532	0.232	22.7	402.2	O K
5760 min Winter	123.489	0.189	19.7	326.2	O K
7200 min Winter	123.469	0.169	17.0	289.9	O K
8640 min Winter	123.456	0.156	15.1	267.2	O K
10080 min Winter	123.447	0.147	13.8	250.8	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
10080 min Summer	1.035	0.0	2974.7	5152
15 min Winter	137.200	0.0	618.4	26
30 min Winter	90.160	0.0	820.4	40
60 min Winter	56.420	0.0	1066.6	68
120 min Winter	35.420	0.0	1342.6	126
180 min Winter	26.689	0.0	1518.8	182
240 min Winter	21.665	0.0	1644.6	240
360 min Winter	15.913	0.0	1812.3	354
480 min Winter	12.640	0.0	1919.0	462
600 min Winter	10.515	0.0	1994.7	564
720 min Winter	9.018	0.0	2052.1	590
960 min Winter	7.042	0.0	2134.1	738
1440 min Winter	4.929	0.0	2234.1	1044
2160 min Winter	3.446	0.0	2381.6	1436
2880 min Winter	2.683	0.0	2471.3	1792
4320 min Winter	1.912	0.0	2631.3	2424
5760 min Winter	1.523	0.0	2815.2	3064
7200 min Winter	1.293	0.0	2986.4	3760
8640 min Winter	1.142	0.0	3160.8	4504
10080 min Winter	1.035	0.0	3336.2	5240

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Cascade Rainfall Details for Catchment 1c Storage 100yr 40CC FEH.SRCX

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	2013
Site Location	GB 443900 302500 SK 43900 02500
Data Type	Catchment
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.750
Cv (Winter)	0.840
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Climate Change %	+40

Time Area Diagram

Total Area (ha) 2.300

Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)
0	4	0.767	4	8	0.767	8	12	0.767

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Cascade Model Details for Catchment 1c Storage 100yr 40CC FEH.SRCX

Storage is Online Cover Level (m) 124.500

Tank or Pond Structure

Invert Level (m) 123.300

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	1665.1	1.200	2476.4

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0214-2330-0800-2330
Design Head (m)	0.800
Design Flow (l/s)	23.3
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	214
Invert Level (m)	123.300
Minimum Outlet Pipe Diameter (mm)	300
Suggested Manhole Diameter (mm)	1500

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.800	23.3
Flush-Flo™	0.333	23.2
Kick-Flo®	0.614	20.6
Mean Flow over Head Range	-	18.9

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	7.3	1.200	28.3	3.000	43.9	7.000	66.3
0.200	20.9	1.400	30.4	3.500	47.4	7.500	68.6
0.300	23.2	1.600	32.5	4.000	50.5	8.000	70.7
0.400	23.1	1.800	34.4	4.500	53.5	8.500	72.5
0.500	22.4	2.000	36.1	5.000	56.3	9.000	74.6
0.600	20.9	2.200	37.8	5.500	59.0	9.500	76.7
0.800	23.3	2.400	39.5	6.000	61.5		
1.000	25.9	2.600	41.0	6.500	63.9		

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Cascade Summary of Results for Catchment 1c Storage 100yr 40CC FSR.SRCX

Upstream Structures	Outflow To	Overflow To
Catchment 1b Storage 100yr 40CC FSR.SRCX	(None)	(None)
Catchment 1a Storage 100yr 40CC FSR.SRCX		

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	123.631	0.331	23.2	585.1	O K
30 min Summer	123.724	0.424	23.2	761.5	O K
60 min Summer	123.812	0.512	23.2	934.3	O K
120 min Summer	123.888	0.588	23.2	1087.9	O K
180 min Summer	123.921	0.621	23.2	1156.8	O K
240 min Summer	123.936	0.636	23.2	1187.9	O K
360 min Summer	123.946	0.646	23.2	1206.8	O K
480 min Summer	123.941	0.641	23.2	1197.7	O K
600 min Summer	123.935	0.635	23.2	1184.2	O K
720 min Summer	123.926	0.626	23.2	1167.3	O K
960 min Summer	123.906	0.606	23.2	1125.7	O K
1440 min Summer	123.859	0.559	23.2	1028.4	O K
2160 min Summer	123.786	0.486	23.2	882.6	O K
2880 min Summer	123.719	0.419	23.2	751.7	O K
4320 min Summer	123.613	0.313	23.2	550.7	O K
5760 min Summer	123.544	0.244	22.8	423.8	O K
7200 min Summer	123.507	0.207	21.7	358.1	O K
8640 min Summer	123.487	0.187	19.3	321.9	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	140.425	0.0	562.6	26
30 min Summer	92.166	0.0	746.8	40
60 min Summer	57.587	0.0	970.7	70
120 min Summer	34.732	0.0	1173.7	128
180 min Summer	25.480	0.0	1292.8	186
240 min Summer	20.325	0.0	1375.5	244
360 min Summer	14.772	0.0	1500.2	362
480 min Summer	11.770	0.0	1593.8	436
600 min Summer	9.861	0.0	1668.9	494
720 min Summer	8.530	0.0	1731.8	558
960 min Summer	6.780	0.0	1834.0	684
1440 min Summer	4.898	0.0	1982.8	946
2160 min Summer	3.532	0.0	2178.8	1340
2880 min Summer	2.798	0.0	2299.8	1712
4320 min Summer	2.012	0.0	2470.2	2424
5760 min Summer	1.591	0.0	2626.2	3104
7200 min Summer	1.325	0.0	2732.3	3752
8640 min Summer	1.141	0.0	2819.0	4496

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Cascade Summary of Results for Catchment 1c Storage 100yr 40CC FSR.SRCX

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
10080 min Summer	123.472	0.172	17.5	295.9	O K
15 min Winter	123.669	0.369	23.2	657.1	O K
30 min Winter	123.772	0.472	23.2	856.5	O K
60 min Winter	123.871	0.571	23.2	1053.0	O K
120 min Winter	123.957	0.657	23.2	1230.1	O K
180 min Winter	123.994	0.694	23.2	1309.4	O K
240 min Winter	124.012	0.712	23.2	1347.0	O K
360 min Winter	124.025	0.725	23.2	1375.2	O K
480 min Winter	124.023	0.723	23.2	1370.1	O K
600 min Winter	124.012	0.712	23.2	1347.6	O K
720 min Winter	124.001	0.701	23.2	1322.3	O K
960 min Winter	123.976	0.676	23.2	1269.8	O K
1440 min Winter	123.911	0.611	23.2	1134.6	O K
2160 min Winter	123.797	0.497	23.2	905.3	O K
2880 min Winter	123.696	0.396	23.2	707.7	O K
4320 min Winter	123.552	0.252	22.9	439.7	O K
5760 min Winter	123.496	0.196	20.5	338.8	O K
7200 min Winter	123.472	0.172	17.4	295.3	O K
8640 min Winter	123.456	0.156	15.1	267.1	O K
10080 min Winter	123.444	0.144	13.4	246.1	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
10080 min Summer	1.005	0.0	2887.5	5152
15 min Winter	140.425	0.0	633.5	26
30 min Winter	92.166	0.0	839.1	40
60 min Winter	57.587	0.0	1089.0	68
120 min Winter	34.732	0.0	1316.2	126
180 min Winter	25.480	0.0	1449.5	182
240 min Winter	20.325	0.0	1542.2	240
360 min Winter	14.772	0.0	1681.7	352
480 min Winter	11.770	0.0	1786.4	460
600 min Winter	9.861	0.0	1870.4	560
720 min Winter	8.530	0.0	1940.8	584
960 min Winter	6.780	0.0	2054.7	734
1440 min Winter	4.898	0.0	2220.2	1042
2160 min Winter	3.532	0.0	2441.6	1448
2880 min Winter	2.798	0.0	2577.8	1820
4320 min Winter	2.012	0.0	2770.5	2468
5760 min Winter	1.591	0.0	2942.4	3064
7200 min Winter	1.325	0.0	3061.7	3760
8640 min Winter	1.141	0.0	3159.5	4496
10080 min Winter	1.005	0.0	3238.4	5248

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Cascade Rainfall Details for Catchment 1c Storage 100yr 40CC FSR.SRCX

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)	20.300	Shortest Storm (mins)	15
Ratio R	0.400	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 2.300

Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)
0	4	0.767	4	8	0.767	8	12	0.767

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Cascade Model Details for Catchment 1c Storage 100yr 40CC FSR.SRCX

Storage is Online Cover Level (m) 124.500

Tank or Pond Structure

Invert Level (m) 123.300

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	1665.1	1.200	2476.4

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0214-2330-0800-2330
Design Head (m)	0.800
Design Flow (l/s)	23.3
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	214
Invert Level (m)	123.300
Minimum Outlet Pipe Diameter (mm)	300
Suggested Manhole Diameter (mm)	1500

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.800	23.3
Flush-Flo™	0.333	23.2
Kick-Flo®	0.614	20.6
Mean Flow over Head Range	-	18.9

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	7.3	1.200	28.3	3.000	43.9	7.000	66.3
0.200	20.9	1.400	30.4	3.500	47.4	7.500	68.6
0.300	23.2	1.600	32.5	4.000	50.5	8.000	70.7
0.400	23.1	1.800	34.4	4.500	53.5	8.500	72.5
0.500	22.4	2.000	36.1	5.000	56.3	9.000	74.6
0.600	20.9	2.200	37.8	5.500	59.0	9.500	76.7
0.800	23.3	2.400	39.5	6.000	61.5		
1.000	25.9	2.600	41.0	6.500	63.9		

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Cascade Summary of Results for Catchment 2a Storage 100yr 40CC FEH.SRCX

Upstream Structures	Outflow To	Overflow To
(None)	(None)	Catchment 2b Storage 100yr 40CC FEH.SRCX

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	124.774	0.474	15.0	396.3	O K
30 min Summer	124.889	0.589	15.0	517.2	O K
60 min Summer	124.993	0.693	15.0	635.7	O K
120 min Summer	125.102	0.802	15.0	770.4	O K
180 min Summer	125.156	0.856	15.0	839.9	O K
240 min Summer	125.184	0.884	15.0	877.4	O K
360 min Summer	125.201	0.901	15.0	900.5	O K
480 min Summer	125.192	0.892	15.0	887.9	O K
600 min Summer	125.175	0.875	15.0	865.2	O K
720 min Summer	125.156	0.856	15.0	840.5	O K
960 min Summer	125.117	0.817	15.0	789.2	O K
1440 min Summer	125.038	0.738	15.0	689.9	O K
2160 min Summer	124.918	0.618	15.0	549.9	O K
2880 min Summer	124.818	0.518	15.0	441.4	O K
4320 min Summer	124.664	0.364	15.0	290.4	O K
5760 min Summer	124.565	0.265	14.9	202.6	O K
7200 min Summer	124.509	0.209	14.5	155.9	O K
8640 min Summer	124.482	0.182	14.0	133.6	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	137.200	0.0	402.4	26
30 min Summer	90.160	0.0	530.3	40
60 min Summer	56.420	0.0	672.5	70
120 min Summer	35.420	0.0	845.0	128
180 min Summer	26.689	0.0	955.3	186
240 min Summer	21.665	0.0	1034.1	244
360 min Summer	15.913	0.0	1139.4	362
480 min Summer	12.640	0.0	1206.6	470
600 min Summer	10.515	0.0	1254.5	518
720 min Summer	9.018	0.0	1291.0	578
960 min Summer	7.042	0.0	1343.6	702
1440 min Summer	4.929	0.0	1409.2	974
2160 min Summer	3.446	0.0	1485.8	1364
2880 min Summer	2.683	0.0	1542.3	1732
4320 min Summer	1.912	0.0	1646.0	2428
5760 min Summer	1.522	0.0	1752.3	3112
7200 min Summer	1.293	0.0	1859.6	3752
8640 min Summer	1.142	0.0	1969.5	4416

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Cascade Summary of Results for Catchment 2a Storage 100yr 40CC FEH.SRCX

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
10080 min Summer	124.468	0.168	13.0	122.9	O K
15 min Winter	124.822	0.522	15.0	445.5	O K
30 min Winter	124.947	0.647	15.0	582.1	O K
60 min Winter	125.060	0.760	15.0	716.7	O K
120 min Winter	125.179	0.879	15.0	870.4	O K
180 min Winter	125.238	0.938	15.0	952.3	O K
240 min Winter	125.271	0.971	15.0	998.5	O K
360 min Winter	125.295	0.995	15.0	1032.5	O K
480 min Winter	125.290	0.990	15.0	1026.1	O K
600 min Winter	125.273	0.973	15.0	1001.2	O K
720 min Winter	125.249	0.949	15.0	967.6	O K
960 min Winter	125.204	0.904	15.0	904.3	O K
1440 min Winter	125.105	0.805	15.0	774.1	O K
2160 min Winter	124.942	0.642	15.0	576.4	O K
2880 min Winter	124.791	0.491	15.0	413.2	O K
4320 min Winter	124.574	0.274	14.9	209.5	O K
5760 min Winter	124.481	0.181	13.9	132.9	O K
7200 min Winter	124.457	0.157	12.0	114.1	O K
8640 min Winter	124.443	0.143	10.7	102.9	O K
10080 min Winter	124.433	0.133	9.7	95.7	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
10080 min Summer	1.035	0.0	2081.7	5144
15 min Winter	137.200	0.0	451.3	26
30 min Winter	90.160	0.0	594.3	40
60 min Winter	56.420	0.0	753.5	68
120 min Winter	35.420	0.0	946.7	126
180 min Winter	26.689	0.0	1070.2	184
240 min Winter	21.665	0.0	1158.4	240
360 min Winter	15.913	0.0	1276.3	354
480 min Winter	12.640	0.0	1351.5	464
600 min Winter	10.515	0.0	1405.1	570
720 min Winter	9.018	0.0	1445.9	660
960 min Winter	7.042	0.0	1504.7	748
1440 min Winter	4.929	0.0	1577.6	1056
2160 min Winter	3.446	0.0	1664.3	1476
2880 min Winter	2.683	0.0	1727.8	1848
4320 min Winter	1.912	0.0	1844.5	2472
5760 min Winter	1.523	0.0	1962.8	3008
7200 min Winter	1.293	0.0	2083.0	3744
8640 min Winter	1.142	0.0	2206.3	4416
10080 min Winter	1.035	0.0	2332.5	5144

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Cascade Rainfall Details for Catchment 2a Storage 100yr 40CC FEH.SRCX

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	2013
Site Location	GB 443900 302500 SK 43900 02500
Data Type	Catchment
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.750
Cv (Winter)	0.840
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Climate Change %	+40

Time Area Diagram

Total Area (ha) 1.600

Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)
0	4	0.533	4	8	0.533	8	12	0.533

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Cascade Model Details for Catchment 2a Storage 100yr 40CC FEH.SRCX

Storage is Online Cover Level (m) 125.700

Tank or Pond Structure

Invert Level (m) 124.300

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	676.1	1.400	1845.8

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0175-1500-1000-1500
Design Head (m)	1.000
Design Flow (l/s)	15.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	175
Invert Level (m)	124.300
Minimum Outlet Pipe Diameter (mm)	225
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.000	15.0
Flush-Flo™	0.323	15.0
Kick-Flo®	0.704	12.7
Mean Flow over Head Range	-	12.7

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	6.2	1.200	16.3	3.000	25.3	7.000	38.0
0.200	14.4	1.400	17.6	3.500	27.2	7.500	39.3
0.300	15.0	1.600	18.7	4.000	29.0	8.000	40.6
0.400	14.9	1.800	19.8	4.500	30.7	8.500	41.8
0.500	14.6	2.000	20.8	5.000	32.3	9.000	43.0
0.600	14.1	2.200	21.8	5.500	33.9	9.500	44.1
0.800	13.5	2.400	22.7	6.000	35.3		
1.000	15.0	2.600	23.6	6.500	36.7		

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Cascade Summary of Results for Catchment 2a Storage 100yr 40CC FSR.SRCX

Upstream Structures	Outflow To	Overflow To
(None)	(None)	Catchment 2b Storage 100yr 40CC FSR.SRCX

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	124.781	0.481	15.0	403.7	O K
30 min Summer	124.897	0.597	15.0	526.3	O K
60 min Summer	125.002	0.702	15.0	646.3	O K
120 min Summer	125.087	0.787	15.0	750.7	O K
180 min Summer	125.121	0.821	15.0	794.8	O K
240 min Summer	125.136	0.836	15.0	813.4	O K
360 min Summer	125.142	0.842	15.0	821.7	O K
480 min Summer	125.133	0.833	15.0	810.5	O K
600 min Summer	125.122	0.822	15.0	795.8	O K
720 min Summer	125.110	0.810	15.0	780.1	O K
960 min Summer	125.084	0.784	15.0	747.3	O K
1440 min Summer	125.029	0.729	15.0	679.4	O K
2160 min Summer	124.937	0.637	15.0	570.9	O K
2880 min Summer	124.850	0.550	15.0	475.2	O K
4320 min Summer	124.699	0.399	15.0	322.9	O K
5760 min Summer	124.588	0.288	14.9	221.7	O K
7200 min Summer	124.517	0.217	14.6	162.0	O K
8640 min Summer	124.481	0.181	14.0	133.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	139.667	0.0	409.8	26
30 min Summer	91.679	0.0	539.3	40
60 min Summer	57.296	0.0	683.0	70
120 min Summer	34.570	0.0	824.7	128
180 min Summer	25.370	0.0	908.0	186
240 min Summer	20.243	0.0	966.1	244
360 min Summer	14.710	0.0	1053.1	362
480 min Summer	11.721	0.0	1118.8	456
600 min Summer	9.820	0.0	1171.7	508
720 min Summer	8.495	0.0	1216.1	570
960 min Summer	6.752	0.0	1288.4	698
1440 min Summer	4.878	0.0	1394.7	974
2160 min Summer	3.518	0.0	1517.1	1368
2880 min Summer	2.787	0.0	1602.2	1740
4320 min Summer	2.005	0.0	1726.0	2464
5760 min Summer	1.585	0.0	1824.4	3120
7200 min Summer	1.320	0.0	1899.3	3760
8640 min Summer	1.137	0.0	1961.5	4416

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Cascade Summary of Results for Catchment 2a Storage 100yr 40CC FSR.SRCX

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
10080 min Summer	124.464	0.164	12.6	119.2	O K
15 min Winter	124.830	0.530	15.0	453.8	O K
30 min Winter	124.956	0.656	15.0	592.3	O K
60 min Winter	125.069	0.769	15.0	728.3	O K
120 min Winter	125.162	0.862	15.0	848.1	O K
180 min Winter	125.201	0.901	15.0	901.3	O K
240 min Winter	125.219	0.919	15.0	926.0	O K
360 min Winter	125.231	0.931	15.0	942.5	O K
480 min Winter	125.227	0.927	15.0	936.7	O K
600 min Winter	125.214	0.914	15.0	919.0	O K
720 min Winter	125.197	0.897	15.0	895.7	O K
960 min Winter	125.167	0.867	15.0	854.8	O K
1440 min Winter	125.095	0.795	15.0	761.8	O K
2160 min Winter	124.965	0.665	15.0	603.6	O K
2880 min Winter	124.830	0.530	15.0	453.9	O K
4320 min Winter	124.609	0.309	15.0	240.1	O K
5760 min Winter	124.490	0.190	14.3	140.1	O K
7200 min Winter	124.460	0.160	12.3	116.3	O K
8640 min Winter	124.442	0.142	10.7	102.5	O K
10080 min Winter	124.430	0.130	9.4	93.5	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
10080 min Summer	1.002	0.0	2013.5	5144
15 min Winter	139.667	0.0	459.5	26
30 min Winter	91.679	0.0	604.3	40
60 min Winter	57.296	0.0	765.3	68
120 min Winter	34.570	0.0	923.9	126
180 min Winter	25.370	0.0	1017.2	182
240 min Winter	20.243	0.0	1082.3	240
360 min Winter	14.710	0.0	1179.7	354
480 min Winter	11.721	0.0	1253.2	464
600 min Winter	9.820	0.0	1312.3	566
720 min Winter	8.495	0.0	1362.0	606
960 min Winter	6.752	0.0	1442.9	744
1440 min Winter	4.878	0.0	1561.4	1054
2160 min Winter	3.518	0.0	1699.4	1492
2880 min Winter	2.787	0.0	1794.9	1856
4320 min Winter	2.005	0.0	1934.0	2516
5760 min Winter	1.585	0.0	2043.6	3064
7200 min Winter	1.320	0.0	2127.5	3744
8640 min Winter	1.137	0.0	2197.3	4416
10080 min Winter	1.002	0.0	2256.2	5144

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Cascade Rainfall Details for Catchment 2a Storage 100yr 40CC FSR.SRCX

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)	20.200	Shortest Storm (mins)	15
Ratio R	0.400	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 1.600

Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)
0	4	0.533	4	8	0.533	8	12	0.533

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Cascade Model Details for Catchment 2a Storage 100yr 40CC FSR.SRCX

Storage is Online Cover Level (m) 125.700

Tank or Pond Structure

Invert Level (m) 124.300

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	676.1	1.400	1845.8

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0175-1500-1000-1500
Design Head (m)	1.000
Design Flow (l/s)	15.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	175
Invert Level (m)	124.300
Minimum Outlet Pipe Diameter (mm)	225
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.000	15.0
Flush-Flo™	0.323	15.0
Kick-Flo®	0.704	12.7
Mean Flow over Head Range	-	12.7

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	6.2	1.200	16.3	3.000	25.3	7.000	38.0
0.200	14.4	1.400	17.6	3.500	27.2	7.500	39.3
0.300	15.0	1.600	18.7	4.000	29.0	8.000	40.6
0.400	14.9	1.800	19.8	4.500	30.7	8.500	41.8
0.500	14.6	2.000	20.8	5.000	32.3	9.000	43.0
0.600	14.1	2.200	21.8	5.500	33.9	9.500	44.1
0.800	13.5	2.400	22.7	6.000	35.3		
1.000	15.0	2.600	23.6	6.500	36.7		

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Cascade Summary of Results for Catchment 2b Storage 100yr 40CC FEH.SRCX

Upstream Structures	Outflow To	Overflow To
Catchment 2a Storage 100yr 40CC FEH.SRCX	(None)	(None)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	124.236	0.336	11.4	66.7	O K
30 min Summer	124.304	0.404	11.4	85.2	O K
60 min Summer	124.348	0.448	11.4	98.3	O K
120 min Summer	124.374	0.474	11.4	106.1	O K
180 min Summer	124.374	0.474	11.4	106.2	O K
240 min Summer	124.364	0.464	11.4	103.1	O K
360 min Summer	124.329	0.429	11.4	92.5	O K
480 min Summer	124.287	0.387	11.4	80.5	O K
600 min Summer	124.245	0.345	11.4	69.1	O K
720 min Summer	124.205	0.305	11.4	58.8	O K
960 min Summer	124.136	0.236	11.4	42.7	O K
1440 min Summer	124.060	0.160	10.8	26.9	O K
2160 min Summer	124.025	0.125	8.1	20.3	O K
2880 min Summer	124.007	0.107	6.4	17.2	O K
4320 min Summer	123.988	0.088	4.6	13.8	O K
5760 min Summer	123.978	0.078	3.7	12.0	O K
7200 min Summer	123.971	0.071	3.2	10.9	O K
8640 min Summer	123.966	0.066	2.8	10.1	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	137.200	0.0	76.8	23
30 min Summer	90.160	0.0	101.1	36
60 min Summer	56.420	0.0	126.8	62
120 min Summer	35.420	0.0	159.2	102
180 min Summer	26.689	0.0	180.0	136
240 min Summer	21.665	0.0	194.8	170
360 min Summer	15.913	0.0	214.6	236
480 min Summer	12.640	0.0	227.3	300
600 min Summer	10.515	0.0	236.4	364
720 min Summer	9.018	0.0	243.3	422
960 min Summer	7.042	0.0	253.3	536
1440 min Summer	4.929	0.0	265.9	752
2160 min Summer	3.446	0.0	279.0	1108
2880 min Summer	2.683	0.0	289.6	1472
4320 min Summer	1.912	0.0	309.5	2204
5760 min Summer	1.522	0.0	328.8	2936
7200 min Summer	1.293	0.0	349.0	3672
8640 min Summer	1.142	0.0	369.7	4384

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Cascade Summary of Results for Catchment 2b Storage 100yr 40CC FEH.SRCX

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
10080 min Summer	123.963	0.063	2.5	9.6	O K
15 min Winter	124.270	0.370	11.4	75.7	O K
30 min Winter	124.344	0.444	11.4	97.0	O K
60 min Winter	124.394	0.494	11.4	112.7	O K
120 min Winter	124.421	0.521	11.4	121.5	O K
180 min Winter	124.418	0.518	11.4	120.6	O K
240 min Winter	124.404	0.504	11.4	115.9	O K
360 min Winter	124.355	0.455	11.4	100.3	O K
480 min Winter	124.290	0.390	11.4	81.3	O K
600 min Winter	124.226	0.326	11.4	64.1	O K
720 min Winter	124.167	0.267	11.4	49.6	O K
960 min Winter	124.080	0.180	11.2	30.8	O K
1440 min Winter	124.031	0.131	8.5	21.3	O K
2160 min Winter	124.004	0.104	6.1	16.5	O K
2880 min Winter	123.989	0.089	4.7	14.0	O K
4320 min Winter	123.974	0.074	3.4	11.4	O K
5760 min Winter	123.965	0.065	2.7	9.9	O K
7200 min Winter	123.959	0.059	2.3	9.0	O K
8640 min Winter	123.955	0.055	2.0	8.4	O K
10080 min Winter	123.953	0.053	1.8	7.9	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
10080 min Summer	1.035	0.0	391.1	5064
15 min Winter	137.200	0.0	86.1	24
30 min Winter	90.160	0.0	113.2	37
60 min Winter	56.420	0.0	142.0	62
120 min Winter	35.420	0.0	178.3	114
180 min Winter	26.689	0.0	201.6	144
240 min Winter	21.665	0.0	218.2	182
360 min Winter	15.913	0.0	240.4	258
480 min Winter	12.640	0.0	254.6	324
600 min Winter	10.515	0.0	264.8	384
720 min Winter	9.018	0.0	272.5	440
960 min Winter	7.042	0.0	283.7	536
1440 min Winter	4.929	0.0	297.8	754
2160 min Winter	3.446	0.0	312.5	1108
2880 min Winter	2.683	0.0	324.4	1472
4320 min Winter	1.912	0.0	346.6	2204
5760 min Winter	1.523	0.0	368.3	2936
7200 min Winter	1.293	0.0	390.9	3600
8640 min Winter	1.142	0.0	414.1	4408
10080 min Winter	1.035	0.0	438.1	5056

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Cascade Rainfall Details for Catchment 2b Storage 100yr 40CC FEH.SRCX

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	2013
Site Location	GB 443900 302500 SK 43900 02500
Data Type	Catchment
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.750
Cv (Winter)	0.840
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.300

Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)
0	4	0.100	4	8	0.100	8	12	0.100

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Cascade Model Details for Catchment 2b Storage 100yr 40CC FEH.SRCX

Storage is Online Cover Level (m) 124.900

Tank or Pond Structure

Invert Level (m) 123.900

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	143.4	1.000	586.8

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0160-1140-0600-1140
Design Head (m)	0.600
Design Flow (l/s)	11.4
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	160
Invert Level (m)	123.900
Minimum Outlet Pipe Diameter (mm)	225
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.600	11.4
Flush-Flo™	0.247	11.4
Kick-Flo®	0.462	10.1
Mean Flow over Head Range	-	9.2

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	5.7	1.200	15.8	3.000	24.5	7.000	36.8
0.200	11.3	1.400	17.0	3.500	26.4	7.500	38.1
0.300	11.3	1.600	18.1	4.000	28.1	8.000	39.3
0.400	10.8	1.800	19.2	4.500	29.8	8.500	40.6
0.500	10.5	2.000	20.2	5.000	31.3	9.000	41.7
0.600	11.4	2.200	21.1	5.500	32.8	9.500	42.9
0.800	13.0	2.400	22.0	6.000	34.2		
1.000	14.5	2.600	22.9	6.500	35.4		

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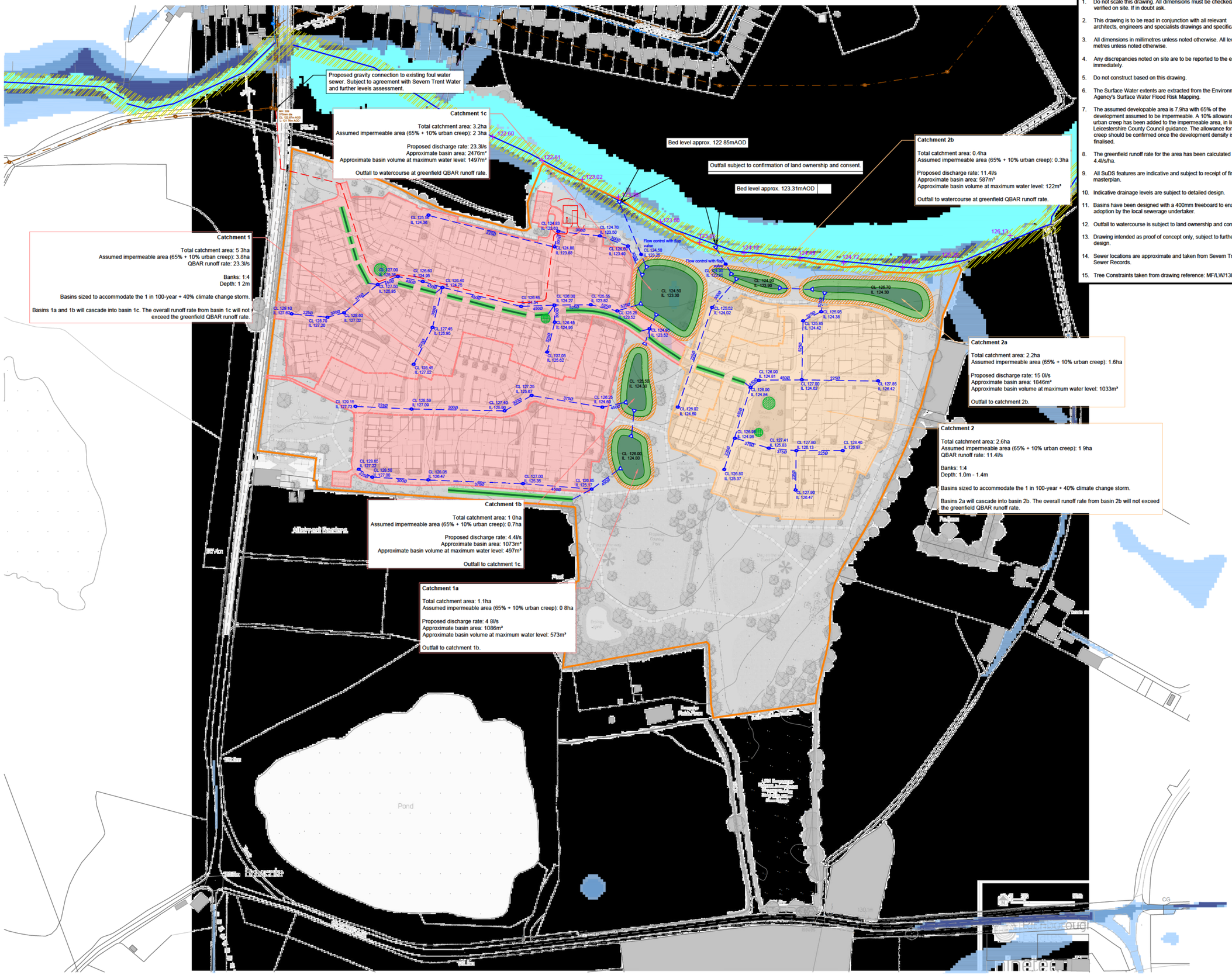
Appendix 6: Illustrative Drainage Strategy



Notes

1. Do not scale this drawing. All dimensions must be checked/ verified on site. If in doubt ask.
2. This drawing is to be read in conjunction with all relevant architects, engineers and specialists drawings and specifications.
3. All dimensions in millimetres unless noted otherwise. All levels in metres unless noted otherwise.
4. Any discrepancies noted on site are to be reported to the engineer immediately.
5. Do not construct based on this drawing.
6. The Surface Water extents are extracted from the Environment Agency's Surface Water Flood Risk Mapping.
7. The assumed developable area is 7.9ha with 65% of the development assumed to be impermeable. A 10% allowance for urban creep has been added to the impermeable area, in line with Leicestershire County Council guidance. The allowance for urban creep should be confirmed once the development density is finalised.
8. The greenfield runoff rate for the area has been calculated at 4.4l/s/ha.
9. All SuDS features are indicative and subject to receipt of final masterplan.
10. Indicative drainage levels are subject to detailed design.
11. Basins have been designed with a 400mm freeboard to enable adoption by the local sewerage undertaker.
12. Outfall to watercourse is subject to land ownership and consent.
13. Drawing intended as proof of concept only, subject to further design.
14. Sewer locations are approximate and taken from Severn Trent Sewer Records.
15. Tree Constraints taken from drawing reference: MF/LW/13085 01.

Legend

- Illustrative Site Location
- Watercourse
- Illustrative 16m Watercourse Easement

Surface Water Flood Risk
- High Risk
- Medium Risk
- Low Risk

- Modelled Flood Extent (1000-year)
- 124.99 Modelled Flood Level (1 in 100-year + 28%CC)

Indicative Drainage Catchments
- Catchment 1
- Catchment 2
- Detention Basin
- 3m SuDS Easement
- Illustrative Outfall Sewer
- Headwall
- Flow Control
- Indicative Swale/Rain Garden
- Indicative Tree Pits
- Proposed Pumping Station
- Proposed Foul Connection Route
- Proposed Surface Water Sewer
- Existing Surface Water Sewer
- Existing Foul Water Sewer
- Existing Overflow Sewer

Rev	Date	Details of issue / revision	Drw	Rev
P08	07.12 23	MASTERPLAN UPDATES	LR	CMD
P07	08.06 22	UPDATES FOLLOWING LLFA COMMENTS	LR	CT
P06	22.02 22	MASTERPLAN UPDATES	LR	CT
P05	15.12 21	MASTERPLAN UPDATES	LR	MB
P04	06.12 21	MASTERPLAN UPDATES	LR	CT
P03	03.11 21	TREE CONSTRAINTS PLAN ADDED	LR	CT
P02	07.10 21	FOUL NETWORK ADDED	LR	CT
P01	04.08 21	PRELIM NARY ISSUE	LR	CT

Issues & Revisions

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Client
Richborough Estates

Project Title
Brascote Lane, Newbold Verdon

Drawing Title
Illustrative Drainage Strategy

Drawn:	L. Reeves		Reviewed:	C. Thorpe	
BWB Ref:	BMW3175	Date:	04 08.21	Scale@A2:	1:2000

Drawing Status
PRELIMINARY

Project - Originator - Zone - Level - Type - Role - Number	Status	Rev
BLN-BWB-ZZ-XX-DR-CD-0001	S2	P08

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Appendix 7: Severn Trent Water Developer Enquiry

WONDERFUL ON TAP

Severn Trent Water Ltd
Regis Road
Wolverhampton
WV6 8RU

Tel: 0345 2667930
www.stwater.co.uk
net dev west@severntrent co uk

Contact: Sadeq Hadi

Your ref:
Our ref: 1019696

1st October 2021

Lucy Reeves
BWB Consulting Ltd
35 Livery Street
Birmingham
B3 2PB

Dear Lucy Reeves,

Proposed development for 250 houses @ Newbold Verdon, Leicester

I refer to your Development Enquiry Request in respect of the above site. Please find enclosed the sewer records that are included in the fee together with the Supplementary Guidance Notes (SGN) referred to below.

Protective Strips

Due to recent change in legislation on 1st October 2011, there could be sewers, which have transferred over to the Company that are not shown on the statutory sewer records, but are located on your clients land. These sewers will have protective strips that we will not allow to be built over. The sewers could be identified whilst the land is being surveyed. If this is the case, please contact us for further guidance upon discovery.

Foul Water Drainage

The available sewer (375mm in Diameter) is located north west of the site at manhole 4309 located in grass verge near Brascote Lane. I can confirm the flows from the proposed development of 250 houses, will generate approximate peak flow of 3.9 l/s (2xDWF). Given the overall development size, it will be necessary to undertake a hydraulic assessment of the site to understand the impact on the receiving Sewerage Treatment Works (Newbold Verdon STW). As you may be aware, we no longer charge developers for the hydraulic modelling service. All sites now go forward for prioritization against our risk matrix that takes into account such things as planning status and potential impact on the environment or our existing customers.

We may contact you in due course for further information and will liaise with you over time with regard to the outcome of our investigations and any impact that may have on the Planning status, occupation, or phasing of the site. However, while we can provide a brief summary of our findings if you need us to, we will no longer provide the full external SCA report. In the meantime, as you progress matters for your site, we

would appreciate any updates you have regarding the development progression, as we will be reviewing the modelling requirements on a weekly basis. I would therefore be grateful if you would forward as soon as possible the following details:

- **Please advise us of your preferred connection point, at the earliest opportunity.**
- Proposed submission of your Planning Application
- Proposed planned start and completion date.
- Any phasing details of the proposed development
- Planned occupation dates

Surface Water Drainage

Under the terms of Section H of the Building Regulations 2010, the disposal of surface water by means of soakaways should be considered as the primary method. If this is not practical, you can liaise directly with the Lead Local Flood Authority (Local Council Authority) and Canal and River Trust for a discharge into the local brook/ditch or the pound south of the site

Connections

For any new connections including the use, reuse and indirect to the public sewerage system, the developer will need to submit Section 106 application. Our Developer Services department are responsible for handling all such enquiries and applications. To contact them for an application form and associated guidance notes please call 0800 7076600 or download from www.stwater.co.uk

Please quote 1019696 in any future correspondence (including e-mails) with STW Limited. Please note that Developer Enquiry responses are only valid for 6 months from the date of this letter.

Yours Sincerely,

[redacted]

Sadeq Hadi
Senior Evaluation Technician
Network Solutions
Developer Services

BWB

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www.bwbconsulting.com