



Appendix D – Hydraulic Modelling Report

rappor



Land South of Bosworth Academy, Desford

Bellway Homes Limited

Flood Modelling Report
June 2026





Document Control

Job No.	250883	
Project Name	Land South of Bosworth Academy, Desford	
Document Title	Flood Modelling Report	
Status	Draft	
Client	Bellway Homes Limited	
	Name	Date
Prepared By	Seren Redmond	June 2026
Checked By	Sophie Reid	June 2026
Approved By	Richard Smith	June 2026

Record of Revisions

Revision	Date	Details	Made By
Draft	25/06/24	Draft Issue for Client Comment	SeR



Executive Summary

Current Environment Agency (EA) mapping indicates that there are four high risk surface water flow routes that flow through site and along the site boundaries to the northeast where they combine to form a large flow route, shortly before flowing into Rothley Brook. From analysis of the provided topographic survey (Submitted as part of the planning application) a series of ditches identified to be located on site. The flow routes are shown to be associated with these ditches that run through the site. Specifically, these are located along the northern boundary, through the south of site and north through the northeast of site before converging in the northeastern corner of site. An additional flow route is observed to form in the southwest of site and is shown to flow overland before it reaches the aforementioned ditch in the northwest.

The EA's mapping is strategic in nature and is not site specific and is therefore unlikely to have picked up the ditches in as much detail as the Topographic Survey provides. As such Rappor Consultants Ltd have undertaken a direct rainfall runoff model to confirm site specific risk.

Prior to the commencement of the hydraulic modelling exercise a meeting took place between Leicestershire County Council (LCC) and Rappor Consultants Ltd to ensure there was an agreed approach to the hydraulic modelling methodology. At the meeting (dated 19/09/25) the following points were agreed:

- The modelling would be undertaken as a surface water modelling exercise
- Post development modelling would be progressed to ensure the development scheme and access routes are safe throughout their design life without increasing risk elsewhere.
- The modelling exercise should represent the attenuation basin outfalls, with discharge rates taken from the flow restrictions set out in the drainage strategy.

The bullet points above were subsequently approved in writing by the LCC on 17/10/25 and the hydraulic modelling exercise was commenced.

Baseline scenarios, inclusive of climate change, as well as sensitivity analyses were run to assess the existing pluvial risk to Site at a higher, more detailed resolution than currently available from the Environment Agency's mapping. The modelling undertaken is more detailed due to the representation of the ditches identified within the topographic survey.

This modelling exercise has confirmed that pluvial risk will change because of the Proposed Development, and mitigation measures have been added to ensure areas of development, and access routes, remain outside the areas of risk whilst posing no increased risk to third party land.



Contents

Document Control.....	2
Executive Summary.....	3
1 Introduction	5
2 Existing Site & Hydrology Characteristics	6
3 Hydrological and Hydraulic Assessment.....	8
4 Results	21
5 Conclusions.....	29

List of Figures and Tables

Figure 2.1	Site Location.....	6
Figure 2.2	Ditches Located Across Site	7
Figure 3.1	Environment Agency Present Day Surface Water Flood Risk Extent	8
Figure 3.2	Pluvial Flood Depths – 1000 Year Event	9
Figure 3.3	Pluvial Flood Depths – 100 Year Event	10
Figure 3.4	Pluvial Flood Depths – 30 Year Event	10
Figure 3.5	Catchment Boundary.....	11
Table 3.1	Catchment Characteristics Summary	11
Figure 3.6	Graph Showing Depths Associated with the Critical Storms Tested.....	12
Figure 3.7	Urban/Rural Catchment De-lineation	14
Table 3.2	Runoff Parameterisation, PrIMP Reduction Factor	14
Figure 3.8	2D Elements Used to Adjust Baseline DTM.....	15
Table 3.3	Downstream Boundaries.....	16
Table 3.4	Mannings ‘n’ Roughness Values	17
Figure 3.9	Changes Made for Proposed Development Scenario	18
Table 3.5	Details of Structural Changes in Post Development Model.....	18
Figure 3.10	Annotated Culverts and Swale Dimensions	19
Table 3.6	Culvert Details.....	19
Figure 3.11	Applied Post Development Rainfall Boundary and Outfall Locations.....	20
Figure 4.1	Baseline 1 in 1000-Year Model Outputs	22
Figure 4.2	Baseline 1 in 100-Year Model Outputs	23
Figure 4.3	Baseline 1 in 100-Year Plus 40% Climate Change Allowance (Design Event) Model Outputs	24
Figure 4.4	Post Development 1 in 100-Year Plus 40% Climate Change Allowance (Design Event) Model Outputs	25
Figure 4.5	Post Development vs Baseline Difference Map for Design Event	26
Figure 4.6	Blockage Testing Results	27



1 Introduction

Background

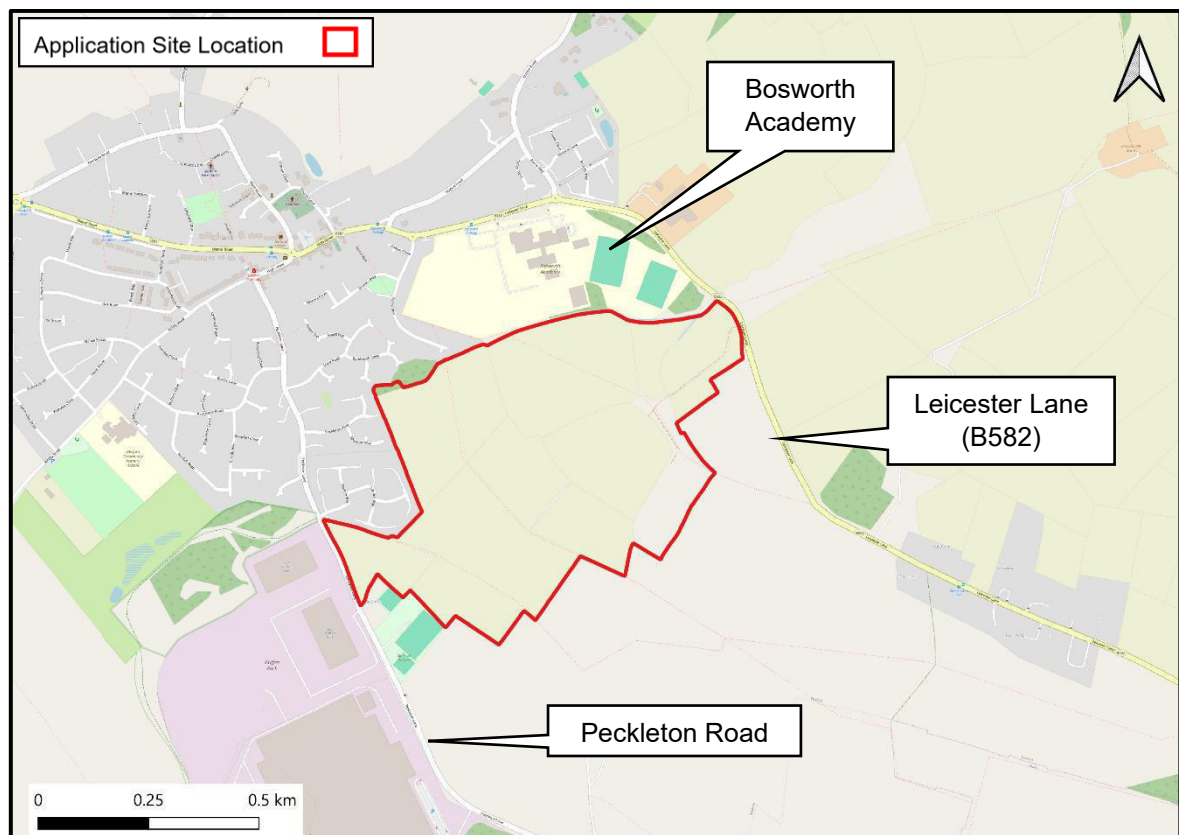
- 1.1 The purpose of this Flood Modelling Report is to both assess the current risk of surface water flooding on Site, before assessing the future risk of surface water flooding to the site as a result of both climate change and the development proposed on site.
- 1.2 This report has been produced in support of the outline planning application for residential development; provision of a new primary healthcare facility and district centre; sports pitches including car parking and changing facilities; children's play areas including a skatepark / BMX track; residential spine road between Peckleton Lane and Leicester Lane; public open space including allotments; sustainable drainage; and associated infrastructure. All matters reserved except for access.
- 1.3 An analysis of the topographic survey has shown an extensive network of ditches located across the site. It is expected that the detail of these ditches have not been included in the EA's currently available modelling, thus the current modelling is deemed coarse, not detailed nor Site specific.
- 1.4 As such, a more detailed direct rainfall runoff modelling exercise has been undertaken by Rappor to include these ditches to inform the baseline condition. Modelling of the proposed development has then been undertaken to portray how the proposed development would influence pluvial risk both on the Site and to the wider area. Where required, mitigation measures have been investigated and recommended within the model to ensure the development can come forward safely whilst ensuring there is not off-Site increase in pluvial risk.



2 Existing Site & Hydrology Characteristics

Site Location & Composition

- 2.1 The Site is southeast of the village of Desford, situated west of Leicester. The approximate co-ordinates for the centre of the site are E:448533; N:302881 with the nearest postcode of LE9 9JL. The approximate site location is shown in **Figure 2.1**.
- 2.2 The current site comprises of undeveloped land with no buildings on site. The site is bound to the north by Bosworth Academy and residential dwellings, to the east by Leicester Lane (B582) and undeveloped land, to the south by further undeveloped land and to the west by residential dwellings, a recreational centre and Peckleton Road **Figure 2.1**.



(Source: OpenStreetMaps)

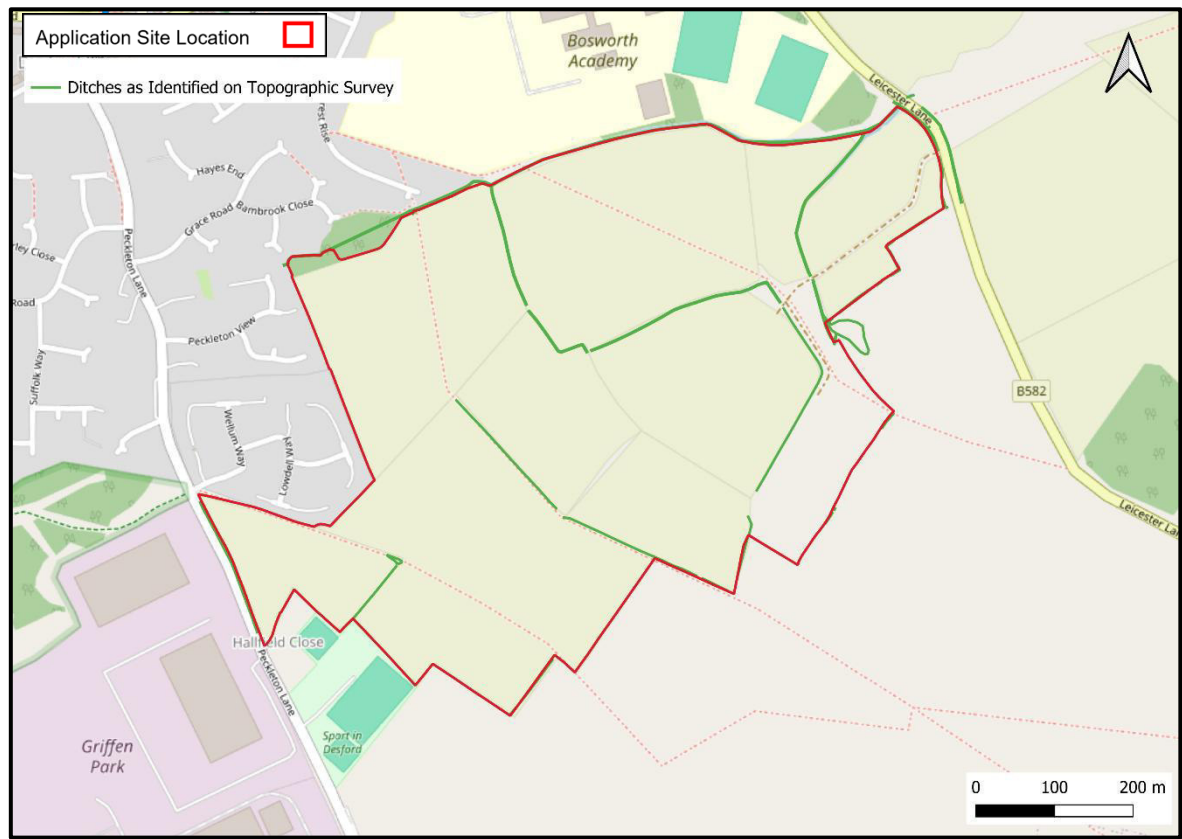
Figure 2.1 Site Location

Topography

- 2.3 A detailed topographic survey was carried out during May 2025. Ground levels on the site fall in a northerly direction from 129.50 meters Above Ordnance Datum (mAOD) located at the southern western boundary to 96.25 mAOD located in the northern corner of the site.
- 2.4 The topographic survey has identified several drainage ditches that flow through the site and along the site boundaries. There is a ditch that runs from west to east parallel to the northern boundary which is circa 1.3 m deep. Furthermore, there are a series of ditch networks that are located across site, and these are associated with various field margins. The deepest of these is located in the northeastern corner of site and runs from south to



north – this has depths of circa 1.5 m. All ditches identified within the topographic survey are shown in **Figure 2.2**.



(Source: OpenStreetMaps)

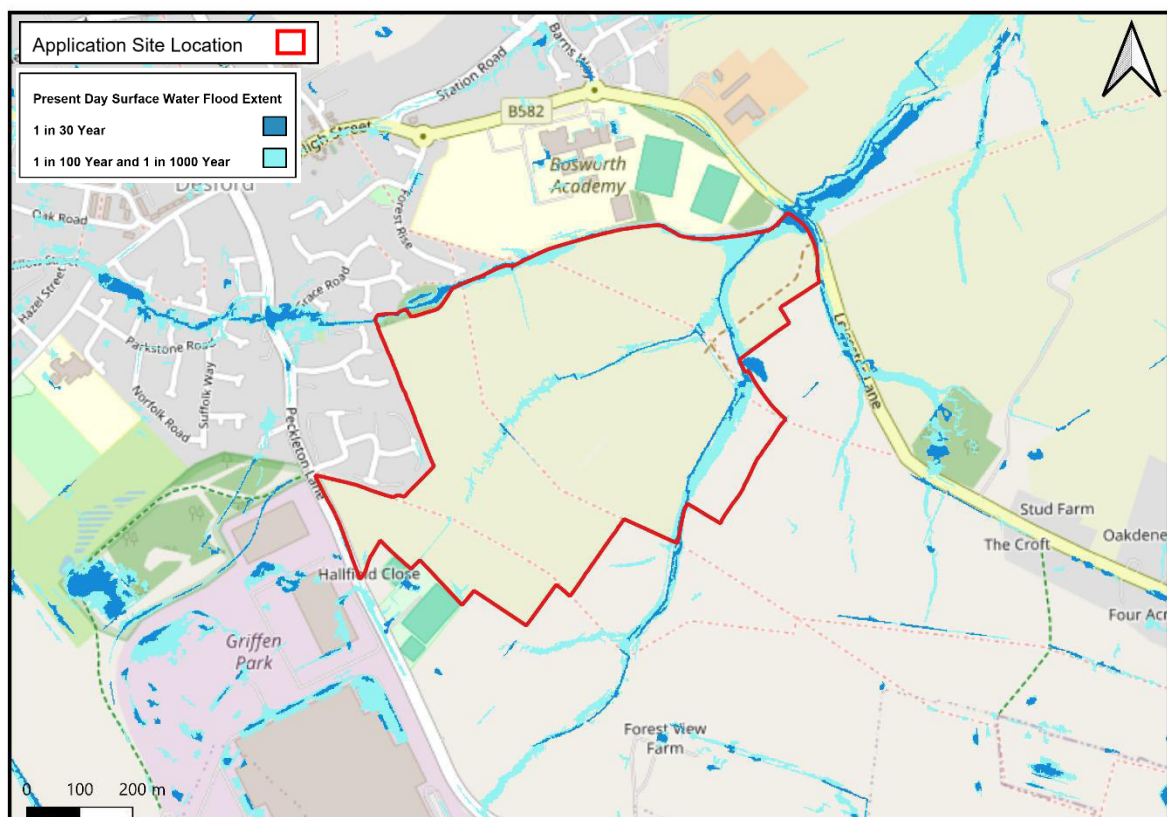
Figure 2.2 Ditches Located Across Site



3 Hydrological and Hydraulic Assessment

Background

- 3.1 Pluvial flooding can occur during prolonged or intense storm events when the infiltration potential of soils, or the capacity of drainage infrastructure, is overwhelmed leading to the accumulation of surface water and the generation of overland flow routes.
- 3.2 Risk of flooding from surface water mapping has been prepared¹, and is discussed below, this mapping shows the potential flooding which could occur when rainwater does not drain into drainage systems or infiltrate into the ground but lies on or flows over the ground instead.
- 3.3 The Present-Day Surface Water (Pluvial) Flood map provided by the Environment Agency (**Figure 3.1**) indicates that the majority of site is at low risk of pluvial flooding. However, mapping identifies four medium-high risk surface water flow routes that flow either through site or along site boundaries to the northeast where they converge to form a larger flow route before flowing towards the Rothley Brook. The flow routes are largely associated with existing ditches and topographical depressions that run through the site and along the boundaries. All flow paths that cross site are deemed to be generated by the wider catchment to the south and west.



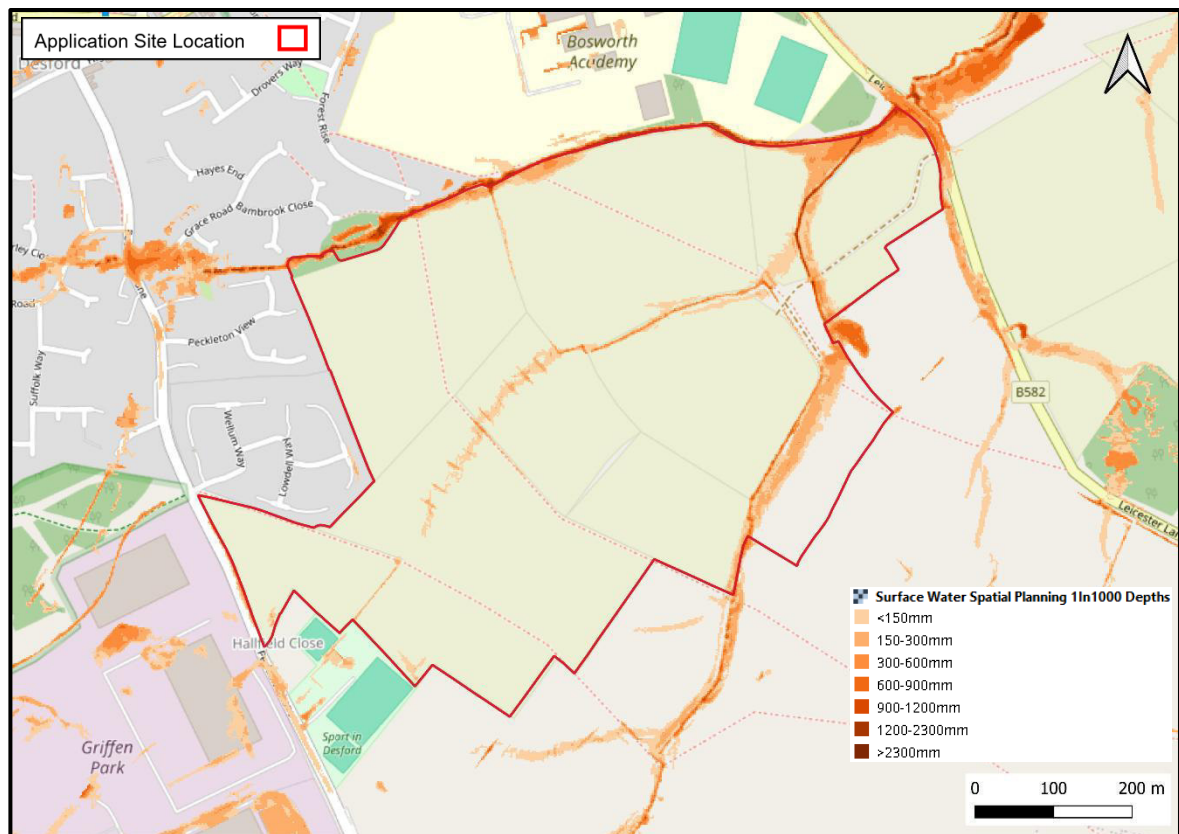
(Source: OpenStreetMap/Environment Agency)

Figure 3.1 Environment Agency Present Day Surface Water Flood Risk Extent

¹ <https://flood-warning-information.service.gov.uk/long-term-flood-risk/map>



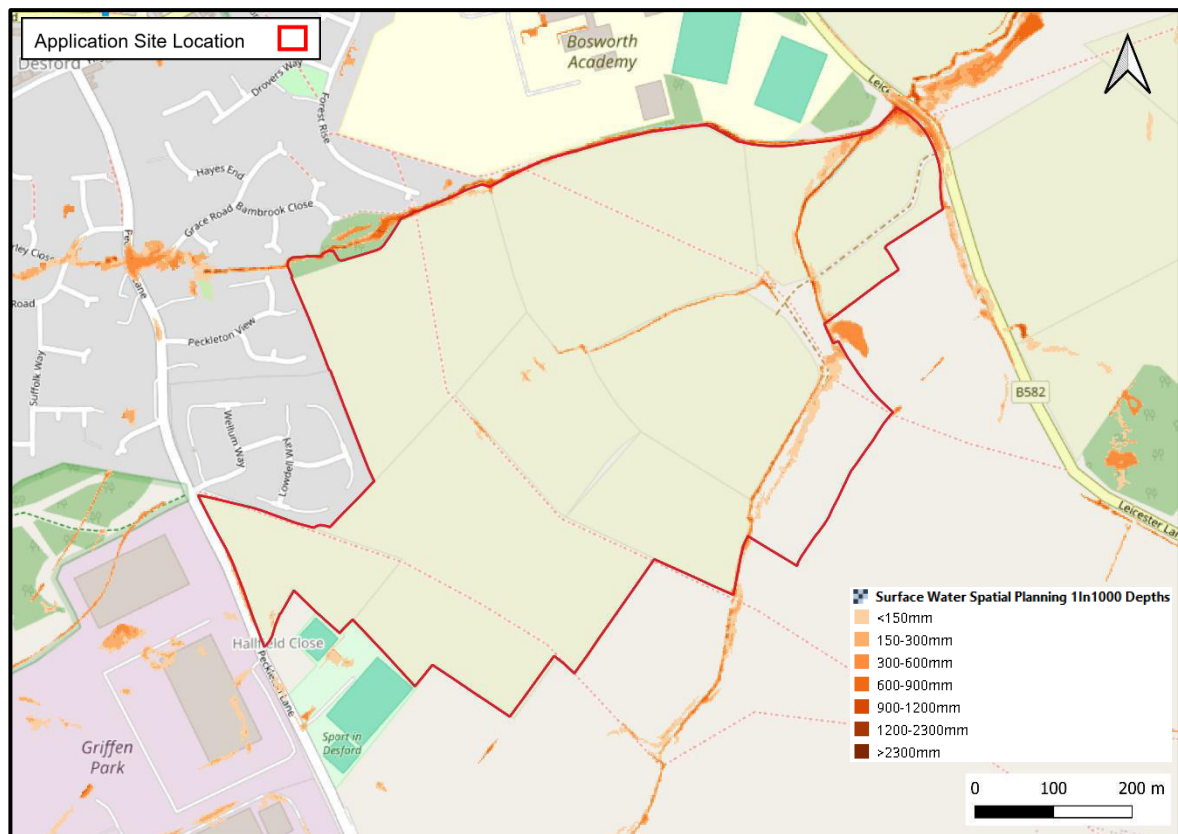
- 3.4 In the 1000-year event the majority of the surface water flooding is shown to be confined to where the ditch channels are known as per the topographic survey. Where the risk is deemed to be outside of the ditch channel located to flow across the centre of site depths are shown to reach a maximum of 300 mm which is deemed shallow and not a risk as such. Furthermore, where flows are expected to exceed the ditch network in the east of site they are shown to reach in the main up to 300 mm, however, some pockets are shown to exceed this and reach up to circa 600 mm. This can be seen in **Figure 3.2**.
- 3.5 Furthermore, the four flow paths discussed, converge in the northern corner of site and in this location depths of up to 600 mm can be seen outside of bank along the northern boundary before breaching onto Leicester Lane.
- 3.6 The deepest depths are shown to be associated with the ditch that runs across the northern boundary – here depths are shown to reach up to 1200 mm. On observation of the topographical survey, it is expected that these flows will be contained within the ditch located here, however the site specific modelling exercise will confirm this.



(Source: OpenStreetMap/Environment Agency)

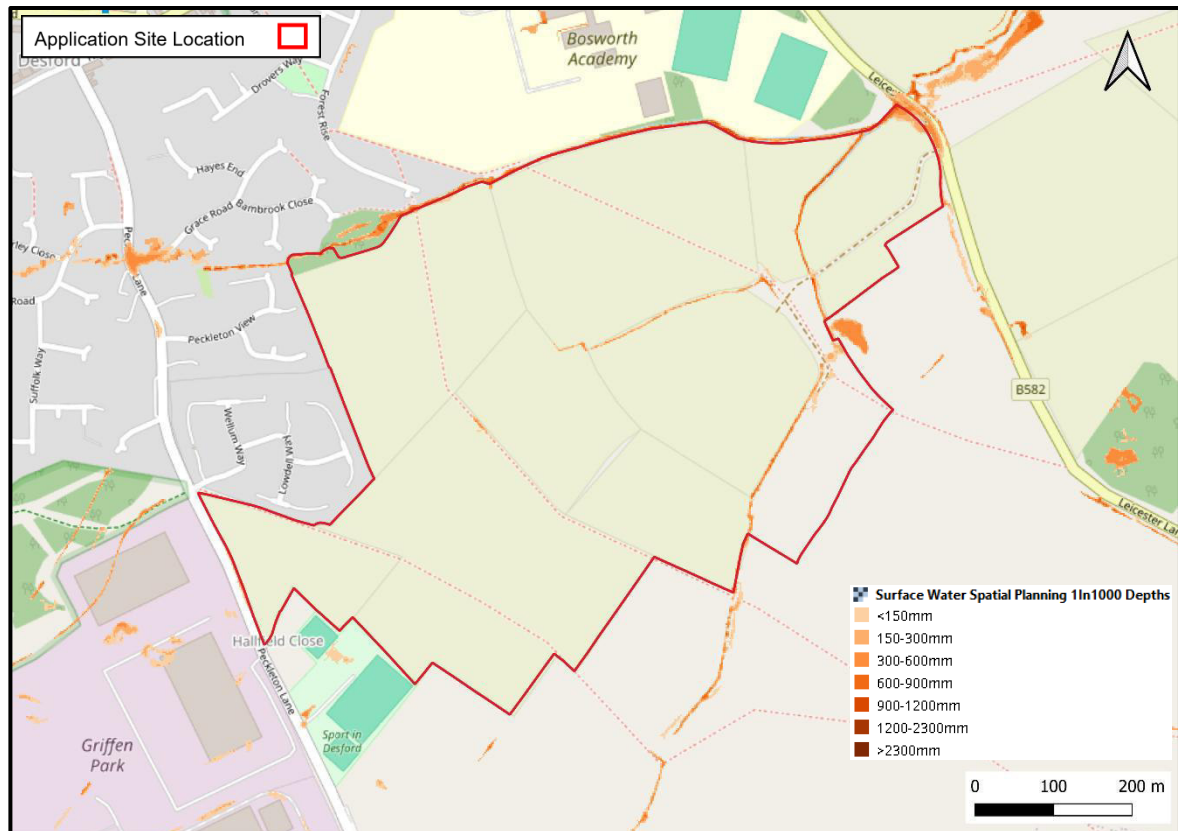
Figure 3.2 Pluvial Flood Depths – 1000 Year Event

- 3.7 It should be noted that the depths are shown to be relatively similar to both the 100-year and 30-year events, however, the extents of these regions decrease as the return period increases (i.e., the 30-year extents are lesser than that of the 100 year). Depths associated with the 100-year event are shown in **Figure 3.3** and associated with the 30 year event are shown in **Figure 3.4**. Depths are shown to be completely confined to the identified ditches in the 30 year event (**Figure 3.4**).



(Source: OpenStreetMap/Environment Agency)

Figure 3.3 Pluvial Flood Depths – 100 Year Event



(Source: OpenStreetMap/Environment Agency)

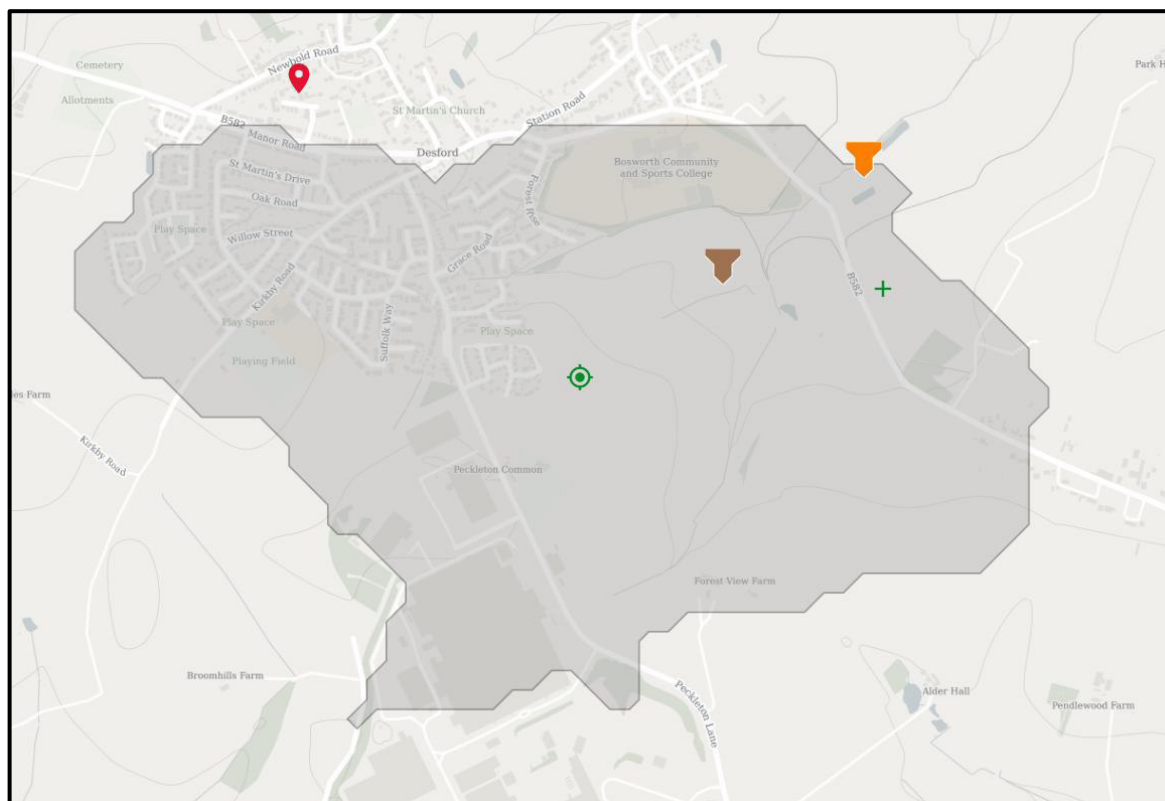
Figure 3.4 Pluvial Flood Depths – 30 Year Event



- 3.8 Whilst the pluvial maps give a good indication of flood risk, they do not contain any Site-specific information owing to the strategic nature of the mapping and supporting models. This results in the EA's mapping being coarse as well excluding details picked up in the topographic survey (i.e., the ditch networks across site). As a consequence, more detailed modelling has been undertaken by Rappor that is deemed to be a lot more representative of reality and the flooding experienced on Site.

Flood Catchment Boundary

- 3.9 The catchment for which the Site lies within is illustrated in **Figure 3.5**. A brief summary of the catchment characteristics is highlighted in **Table 3.1**.



(Source: OpenStreetMap, FEH Web Service, Rappor)

Figure 3.5 Catchment Boundary

Catchment Descriptor	Value
Catchment Area	2.52 km ²
Saar9120	740 mm
BFIHOST	0.394
URBEXT2015	0.1822

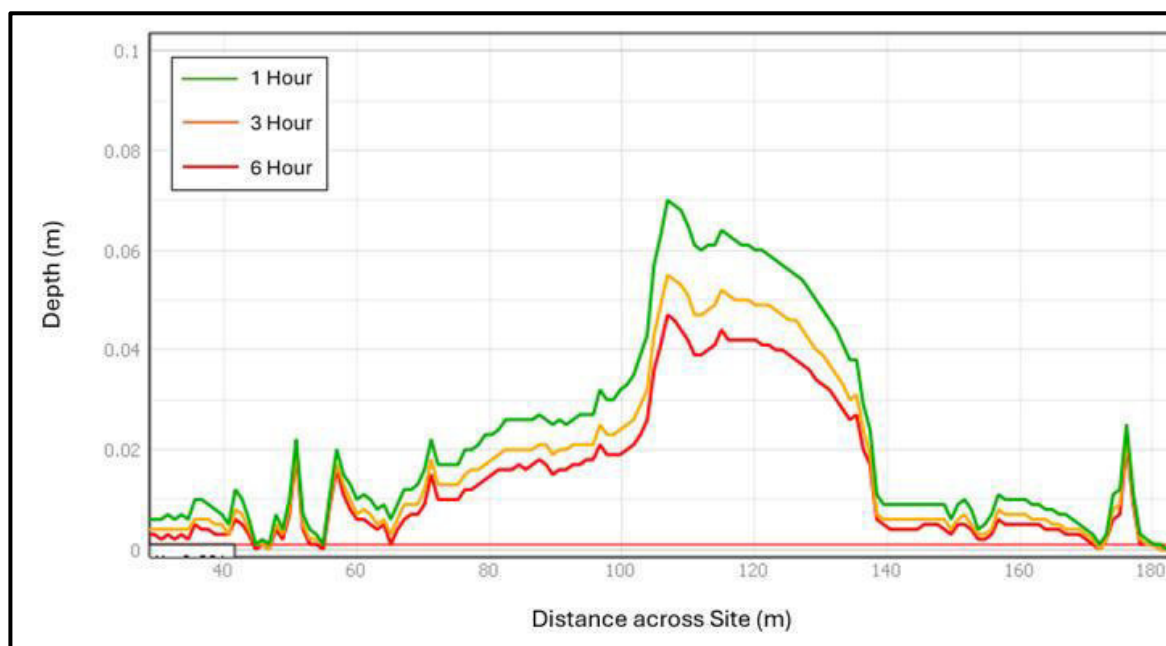
Table 3.1 Catchment Characteristics Summary



Rainfall Modelling

Rainfall

- 3.10 Rainfall depths are generated within FEH and are derived from the catchment parameters taken from the FEH Web Service from an outlet catchment, grid reference 410150, 192900.
- 3.11 The 1 in 30-year, 1 in 30-year plus 35% climate change, 1 in 100-year and 1 in 100-year plus 40% climate change, and 1 in 1,000-year storm events have been modelled to gain an understanding of the range of events and impacts these have on the Site, access routes and surrounding areas.
- 3.12 Multiple storm durations were run and assessed for the design event (100 year plus 40% climate change) and the critical storm duration was identified. This analysis concluded out of the storm durations tested (1-hour, 3-hour and 6-hour) the 1-hour storm was found to cause greatest flood depths and extents on Site – this storm duration was then taken forward as the critical storm duration and used for running the remaining return periods. **Figure 3.6** shows the depth associated with each of the critical storms tested and illustrates that depths for the 1-hour storm is most significant hence the 1-hour storm being deemed critical.
- 3.13 The storm intervals were set at 0.1, equivalent to 6-minute intervals. This resolution was used to ensure the rise and fall of the storm (hydrograph) was effectively captured.



(Source: Rappor)

Figure 3.6 Graph Showing Depths Associated with the Critical Storms Tested

- 3.14 The 1 in 100-year plus climate change event, for which a 40% allowance is required in this catchment, is the design event which new developments should be designed to withstand, whereby flooding may occur, but the scheme must be designed to ensure buildings or key access/egress routes remain safe. This is the 'design event' in accordance with national



guidance² and residential developments are assumed to have a design life of up to 100 years and therefore adopts an appropriate approach in assessing Site specific risk. The additional events are to gain an understanding of the more extreme events.

- 3.15 All the modelling undertaken follows standard (and national) modelling guidance³ as issued by the EA for rainfall runoff models. This includes measures such as inclusion of 'stubby' buildings to reflect the impact of buildings on flow routes and the assumption that all sewerage in the catchment is 'full' and therefore all rainfall generates overland flow to ensure a conservative approach is adopted. The stubby buildings approach involves setting all building footprints within the model to 0.3 m to simulate the impact buildings would have on overland flows; this is in line with preferred EA methodology.

Run-off Calculation

- 3.16 Factors which can affect runoff calculations are as follows:

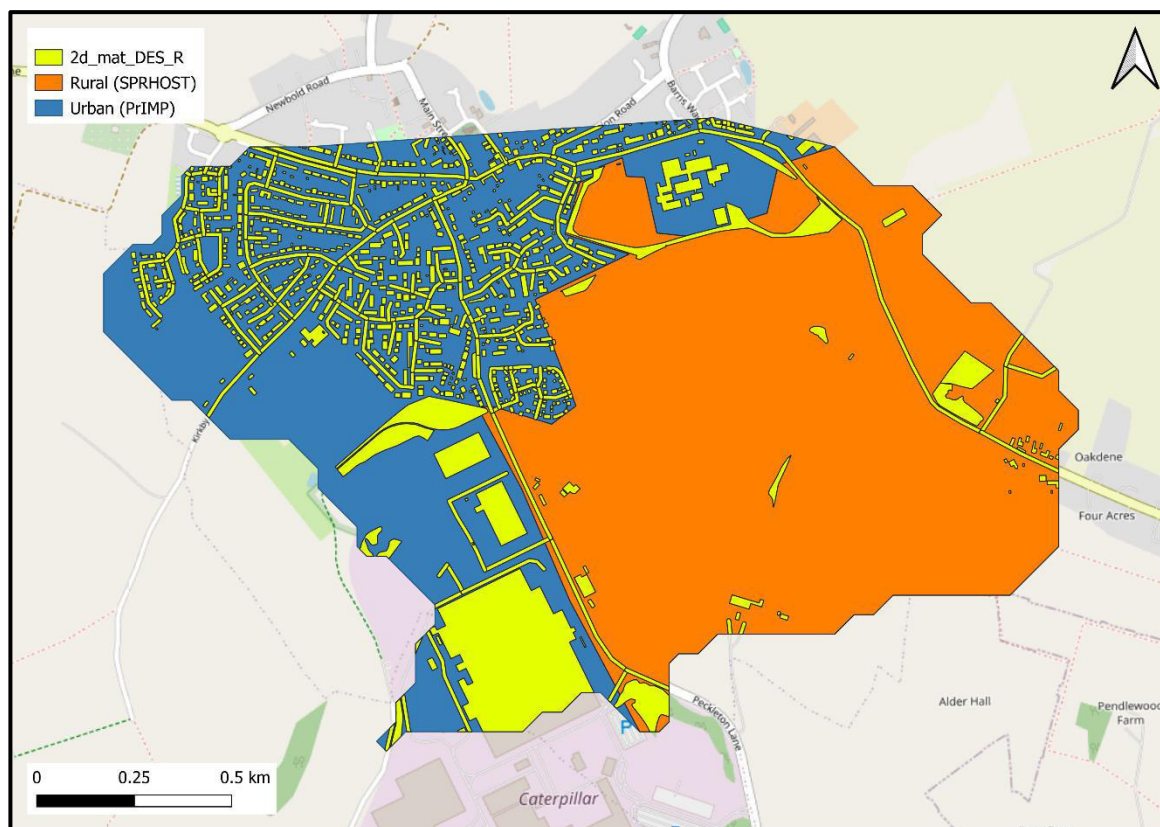
- a) Permeability of soils, with runoff less accurately predicted in highly permeable soils. The soils at the Site within the catchment were described on Soilscales as "Slowly permeable seasonally wet slightly acid but base-rich loamy and clayey soils". The entire catchment has an SPRHOST value of 41.22%, indicating average permeability in comparison to the UK as a whole.
- b) Small drainage catchments (<5km²) can result in small rainfall depths (it should be noted the catchment used in this modelling exercise was 2.52 km²). Runoff calculated by models with an initial storage component may therefore be very sensitive to storage parameters and initial conditions. Total runoff estimates may therefore be uncertain.
- c) Urbanisation resulting in different surface characteristics and runoff coefficients to the natural catchment.

- 3.17 Given the complex nature of the issues outlined above, the following method has been used to address the limitations identified above and provide a robust runoff parameterisation for modelling:

- a) Runoff calculated from 'rural' areas calculated by taking the SPRHOST value from the FEH Catchment Descriptors as a representative percentage run-off value for the Site of interest.
- b) Runoff calculated from 'urban' areas using a hybrid approach which takes the weighted average of the rural runoff (as described above) and a 90% run-off from impermeable areas. The weighting factor is the Percentage Impermeable (PrIMP) value as used in the Wallingford procedure. The revised catchment is indicated to have a PrIMP value of 0.353, the overall Percentage Runoff was calculated as 57.6% (0.576) across the RF boundary. The Site itself is a split of rural and urban.
- c) It has been assumed that for the purpose of the direct rainfall modelling that no water enters any sewer system. This is a conservative approach as this system will help to alleviate ponding in low-lying areas. This approach is not considered to impact the predicted flow routes as all flows will be routed via the topography.
- d) The results of applying these methods are summarised in **Table 3.2** and can be viewed in **Figure 3.7**.

² <https://www.gov.uk/guidance/flood-risk-and-coastal-change> (Paragraph: 002 Reference ID: 7-002-20220825)

³ <https://www.gov.uk/guidance/using-modelling-for-flood-risk-assessments>



(Source: OpenStreetMap, FEH Web Service, Rappor)

Figure 3.7 Urban/Rural Catchment De-lineation

Method	Percentage Run-off Values
SPRHOST (from FEH Data)	41.22%
PrIMP weighted rural/urban – Total	57.6%

Table 3.2 Runoff Parameterisation, PrIMP Reduction Factor

Baseline Hydraulic Assessment

Model Type

- 3.18 Based on the identified requirement to consider overland flow routes, a linked 2D model has been developed using TUFLOW HPC 2025.0.3. This was run in double precision to follow standard guidance for direct run-off modelling.

Model Grid

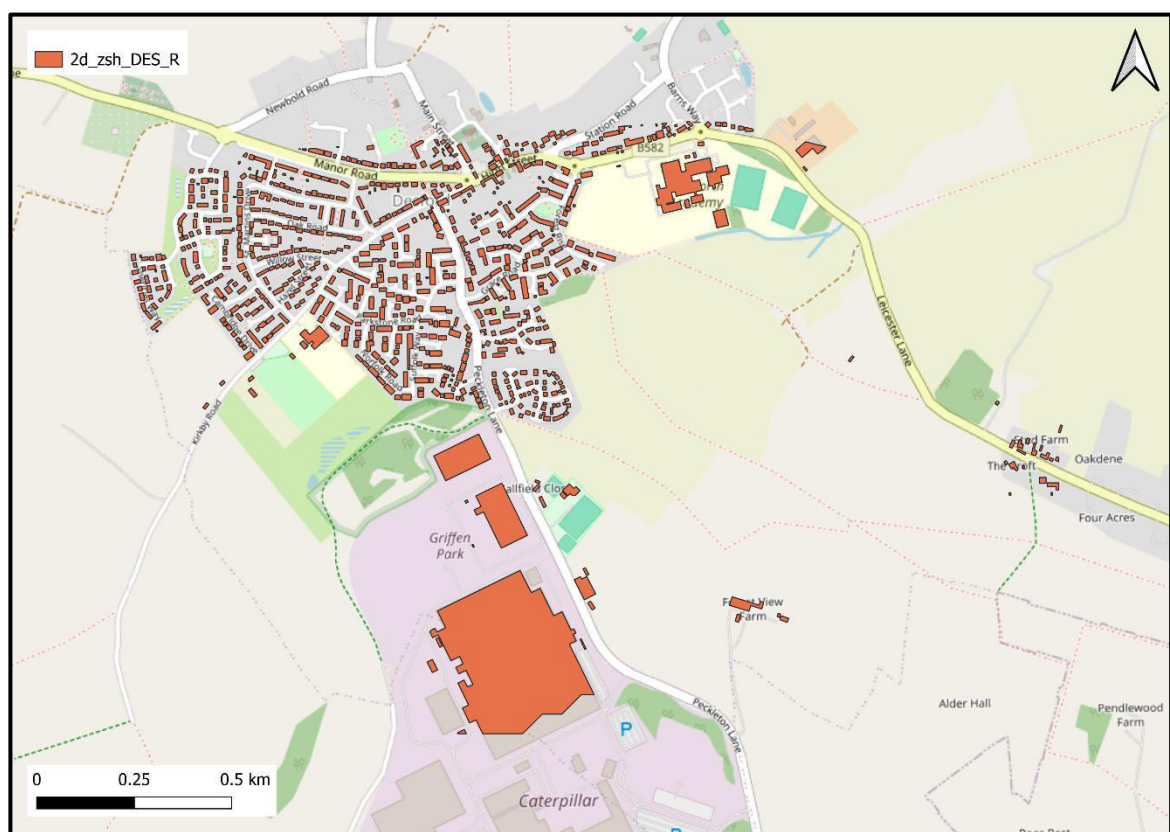
- 3.19 The 2D model is based on LiDAR data (1m resolution flown in 2022 and downloaded for use in December 2025) to represent ground levels for the rest of the wider catchment. The topographical survey (surveyed in August 2025) picks up more detail than the LiDAR and so was used to represent ground on the site itself. The final grid files referenced by the model are 'x-topo_update.asc' and 'Lidar.asc'.
- 3.20 A high-level comparison was done between the topographic survey and the LiDAR data to assess whether the survey was appropriate for use in modelling. Six individual points across the topographic surface were compared to the LiDAR data and on average the topographic survey was shown to be very similar to that of the LiDAR. As expected, the representation



of the ditches was more explicit within the topographical survey surface compared to the LiDAR data. This comparison showed whilst differences were present, the two surfaces were deemed suitable for use.

DTM Adjustments

- 3.21 The surface created from the topographic survey was deemed detailed enough to not require any further adjustments to be made. A sense check of the topographic survey and surface showed the ditches at the northern and eastern boundaries has been picked up effectively and thus were representative of ground levels on site.
- 3.22 It should be noted that buildings (identified based on the OS Local Mapping) were added as 'stubby' (file reference: '2d_zsh_DES_R') this involved raising the areas in which buildings were located by 0.3m to meet standard approaches.
- 3.23 The 2D elements added, and used to adjust the DTM, for the Baseline Scenario are shown in **Figure 3.8**.



(Source: OpenStreetMap, FEH Web Service, Rappor)

Figure 3.8 2D Elements Used to Adjust Baseline DTM

2D Shapefiles

- 3.24 **Figure 3.7** shows the model schematic and GIS layers which comprise the 2D model. The watershed area (the model domain '2d_code_DES_R') was determined as per the method outlined in point 3.14 above. The extent of the domain has ensured that all areas draining to the Site are accounted for, as well as areas which the Site drains to. This was achieved by extending the FEH catchment to ensure both the Site and key areas surrounding Site were included in the model domain. Specifically, the model domain was extended north of



the FEH catchment by circa 170 m. This meant the model utilised the B582 as a natural high point ensuing the flows reaching site were representative of reality.

- 3.25 The file '2d_rf_DES_R' follows the domain boundary and references the percentage runoff values for the urban/rural areas as shown in **Table 3.2**. The domain boundary when the URBEXT2015 value is used is categorised as very heavily urbanised as per the categories denoted in the Flood Estimation Handbook⁴.

Boundary Conditions

- 3.26 A downstream boundary condition was represented using '2d_bc_DES_L'. This boundary line was generated where surface water was indicated to be ponding along the 2D code on the Environment Agency's Surface Water Flooding map. The boundary used a unique calculated gradient, denoted in **Table 3.3**, to allow water to drain freely at each location. For this model, the downstream boundary was added at the northeastern extent of the model domain as this was deemed to be the lowest part of the catchment. The gradient of the slope towards the northeastern extent of the code was calculated based upon LiDAR data downloaded from the EA. This was applied as a consistent value across the southern extent.

Downstream Boundaries	Gradient
1	0.0211

Table 3.3 Downstream Boundaries

Roughness Coefficient

- 3.27 The 2D roughness values are represented within the 'Materials.csv' file referenced in the tcf which links to the model shapefile '2d_mat_DES_R'. This is based on Manning's 'n' roughness values specified by Chow (1959) which is the industry standard approach. Within the 2D code, observed land uses included woodland, roads and buildings. All other space was assumed as 'pasture' with a Manning's 'n' value of 0.06, following the standard modelling approach. **Table 3.4** outlines the Manning's 'n' value for each material. It should be noted that an element of professional judgement is used in determining the roughness value.
- 3.28 The materials file is largely based on the OS Open Map Local Vector Files which provides a good basis for existing land uses.
- 3.29 The roads have been modelled as a single centre line with a buffer distance of 10m applied to them to represent their width. This was checked against aerial photography and found to be suitable.

Features	Manning's 'n'
Pastures	0.06
Roads	0.022
Buildings	0.3

⁴ https://www.ceh.ac.uk/sites/default/files/2021-11/Flood-Estimation%20Handbook-5-Catchment-Descriptors_Adrian-Bayliss.pdf



Woodland	0.07
----------	------

Table 3.4 Mannings 'n' Roughness Values

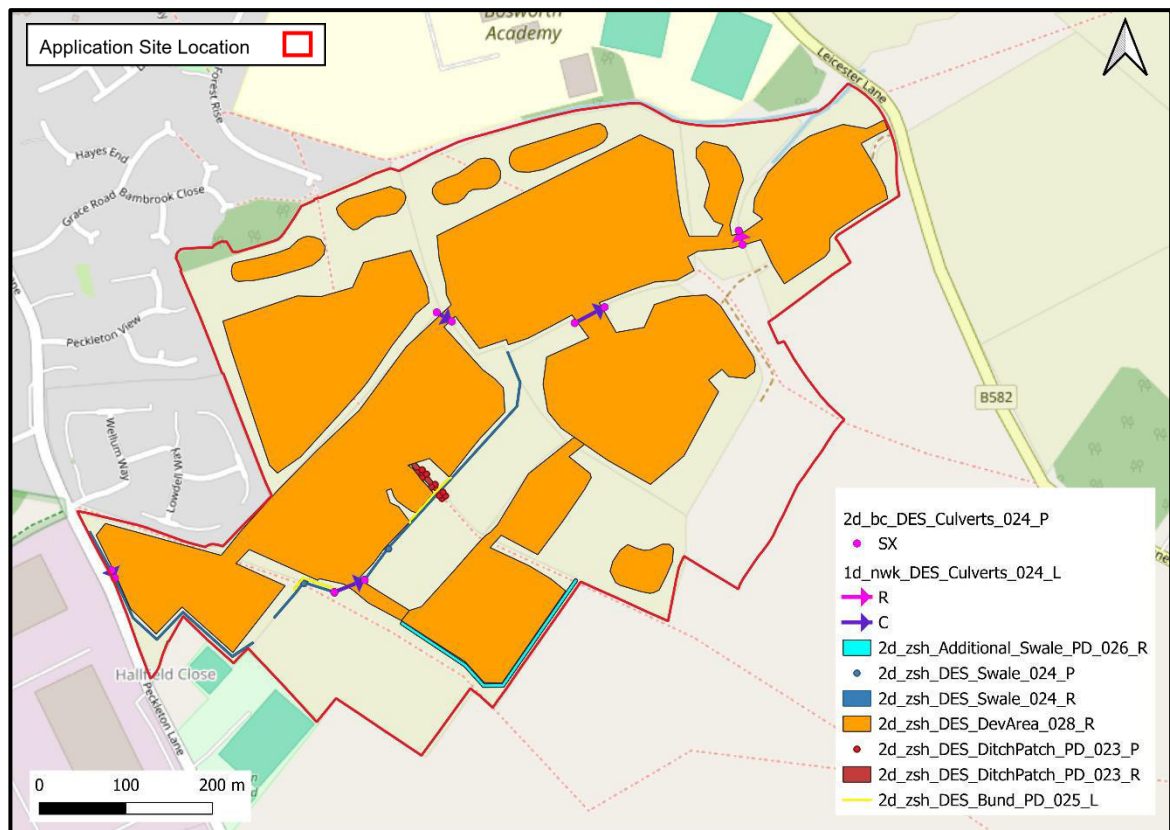
Model Run Parameters

- 3.30 The model was run at a 2m grid resolution with a 1 second timestep for all events which was considered to provide an appropriate balance between model run times and resolution of results. An 8-hour run time was specified for the 1-hour rainfall events which was sufficient time to observe the runoff affecting the Site. For the 1D elements of the model, included in the post development modelling, a 0.5 second timestep was applied for all events.

Proposed Development Hydraulic Assessment

- 3.31 Further modelling was undertaken to observe how the Proposed Development will influence both on and off-Site pluvial risk. The modelling below sets out to confirm any change in risk.
- 3.32 The baseline model parameters identified and used in the baseline modelling set out above were maintained for the Post Development scenario, with changes made to reflect the nature of the proposed development and any necessary mitigation options.
- 3.33 The following layers were amended in the model to reflect the changes:
- *2d_zsh_DES_Swale_024_R and 2d_zsh_DES_Swale_024_P* - applied to represent a series of swales proposed to collect and convey water around the development parcel.
 - *2d_bc_DES_Culvert_024_P and 1d_nwk_DES_Culvert_024_L* – several culverts have been proposed to both ensure safe access and egress as well as to allow continuous flow between the proposed swales and between the existing ditch networks.
 - *2d_zsh_Additional_Swale_PD_026_R* – Swale modelled to collect and convey flows in the southeast of site before discharging them as per the existing drainage regime.
 - *2d_zsh_DES_DevArea_028_R* – 1m raise to represent the proposed development area. It should be noted that it is recognised this is not representative of final ground levels, however, the raising by 1 m demonstrates the impact of all parcels being above (with freeboard) all flood depths. Finalised FFLs based on flood level modelled will be set out within the FRA submitted as part of the planning application.
 - *2d_zsh_DES_Bund_PD_025_L* – Two bunds, 0.5 m high and 1 m high respectively to encourage flows into the proposed swales and prevent overtopping.
 - *2d_zsh_DES_DitchPatch_PD_023_P and 2d_zsh_DES_DitchPatch_PD_023_R* – Region and points applied to represent the filling in of an existing ditch. This prevents water entering this existing ditch and overtopping onto the proposed development. It also encourages flows to enter the proposed swale aforementioned.

- 3.34 The changes outlined above are shown in **Figure 3.9** and the dimensions of all these changes are shown in **Table 3.5**.

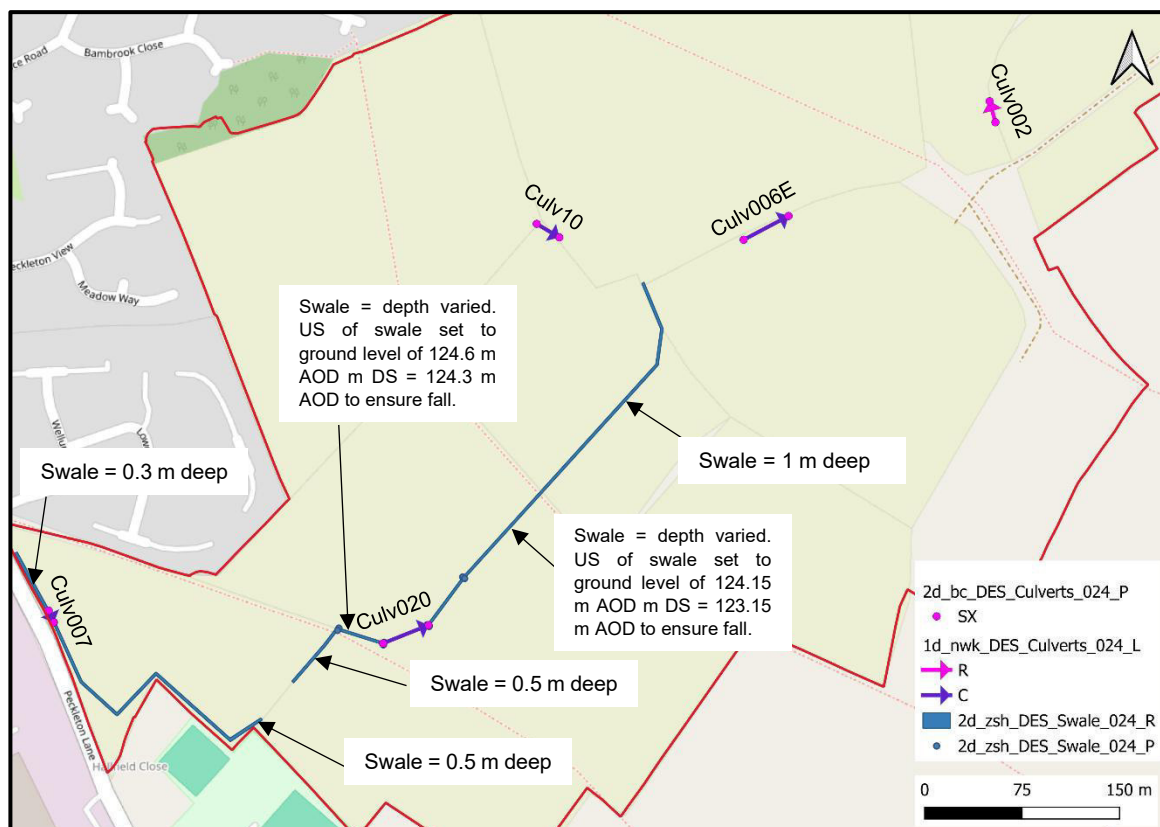


(Source: OpenStreetMap, Rappor)

Figure 3.9 Changes Made for Proposed Development Scenario

Structure Number/ Label	Details of the Change in Dimensions
2d_zsh_DES_Swale_024_R and 2d_zsh_DES_Swale_024_P	All 2 m but depths vary and are annotated in Figure 3.10
2d_bc_DES_Culvert_024_P and 1d_nwk_DES_Culvert_024_L	Varied details of this are shown in Table 3.6
2d_zsh_Additional_Swale_PD_026_R	0.5 m deep, 3 m wide
2d_zsh_DES_DevArea_028_R	Arbitrary 0.75m Raised Above Existing Ground Level
2d_zsh_DES_Bund_PD_025_L	Southern most bund = 0.5 m and bund in centre of the site = 1 m
2d_zsh_DES_DitchPatch_PD_023_P and 2d_zsh_DES_DitchPatch_PD_023_R	Applied to 'fill in the ditches' and sets ground levels to respective top of bank levels.

Table 3.5 Details of Structural Changes in Post Development Model



(Source: OpenStreetMap, Rappor)

Figure 3.10 Annotated Culverts and Swale Dimensions

ID	Dimension (m)	US Invert (m AOD)	DS Invert (m AOD)
Culv007	0.6	129.1	128.95
Culv020	0.45	124.3	124.15
Culv10	0.6	114.1	113.4
Culv006E	0.6	107.4	106.1
Culv002	2 by 1 box	99.5	99.2

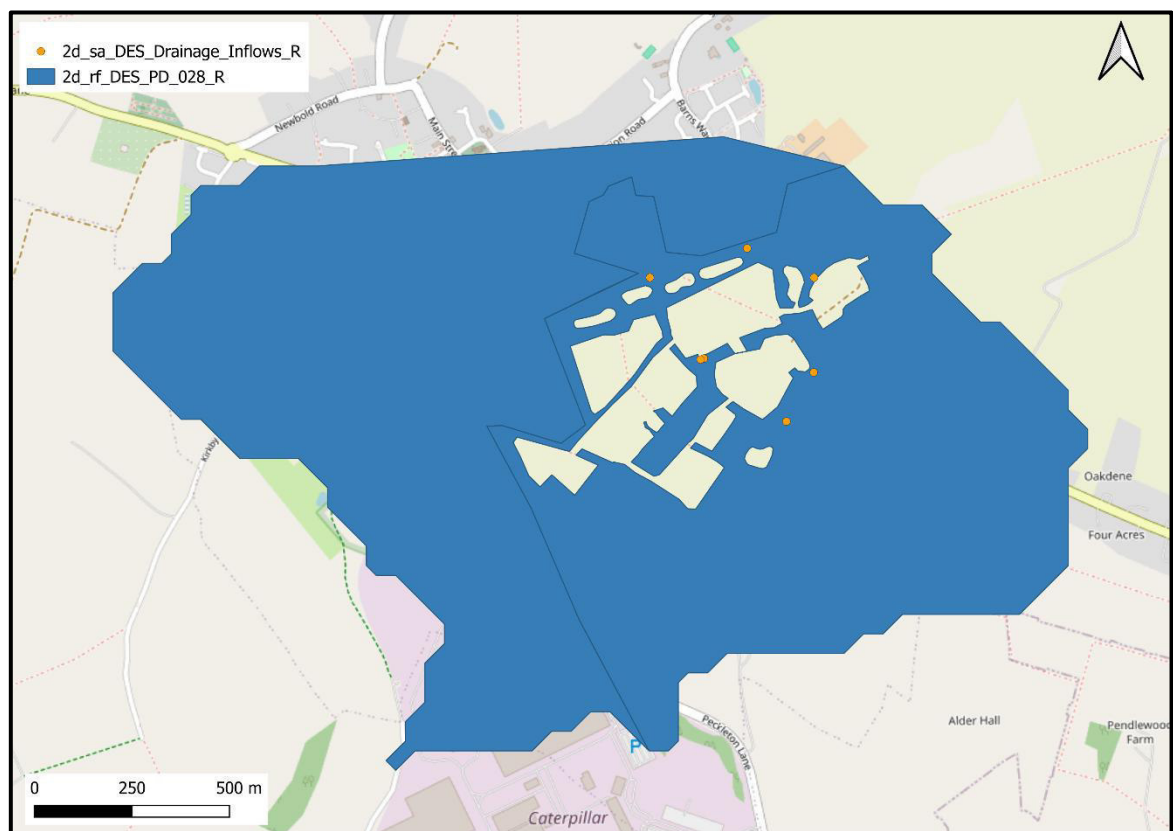
Table 3.6 Culvert Details

- 3.35 The rainfall applied to the proposed developable area was removed to represent the application of a surface water drainage strategy which will attenuate surface water flows which originate from the impermeable areas of Site itself. The applied rainfall boundary used to create this condition is shown in **Figure 3.10** and is common practise for greenfield sites that are being developed.
- 3.36 Outflows from the seven proposed attenuation basins have been incorporated into the TUFLOW hydraulic model as time-varying inflow boundaries to address the LLFAs request for them to be included in the exercise. Source control models run in Microdrainage were used to derive an outflow hydrograph for each basin for the 1 in 100-year return period with a 40% allowance for climate change. The resulting hydrographs were exported at 2-minute



intervals in l/s and were converted to 6-minute (0.1 hour) intervals and units of m³/s for compatibility with TUFLOW boundary condition inputs.

- 3.37 Each basin outflow has been applied to the 2D domain using a source area (2d_sa) polygon boundary condition, positioned at the respective outfall location within the active model domain. Flow is distributed uniformly across the 2D cells within each polygon. Boundary conditions are defined as QT (flowtime) type, with each hydrograph referenced via a central boundary condition database (bc_dbase.csv).
- 3.38 The model run duration has been set to cover the full drainage period of the slowest-draining basin (1,994 minutes/ 33 hours), ensuring the complete outflow volume from all basins is represented within the simulation. Basins with shorter drain times return to zero flow prior to the end of the simulation.
- 3.39 The location of each applied outfall is shown in **Figure 3.11**.



(Source: OpenStreetMap, Rappor)

Figure 3.11 Applied Post Development Rainfall Boundary and Outfall Locations



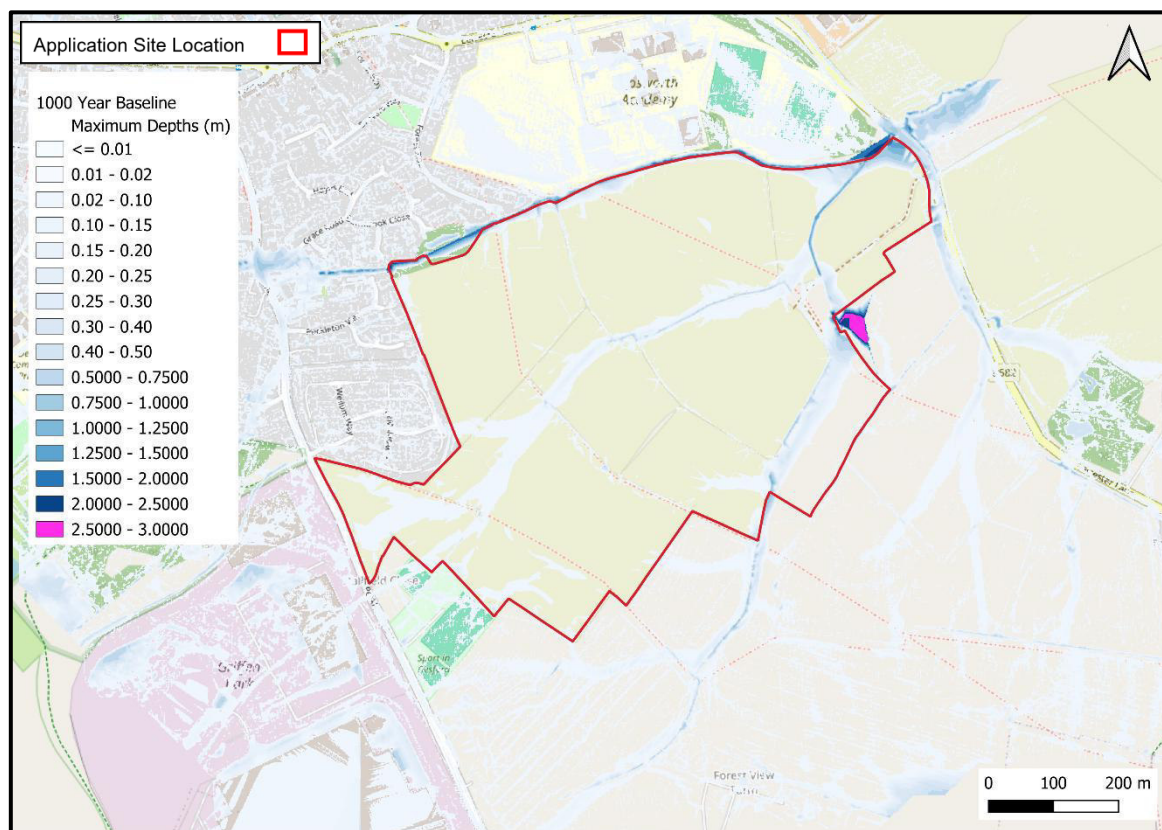
4 Results

- 4.1 The baseline scenario provides an indication of flood extents before any proposed development at the Site has been undertaken. This supersedes the extents and depths depicted in the catchment in the Environment Agency's Surface Water Flood Map as the rainfall runoff modelling is of higher resolution and is Site specific. This baseline scenario was also run for climate change events to understand the effects climate change has on pluvial risk to the Site of interest.
- 4.2 Several model runs took place, each accounting for different return periods. These return periods included the 1 in 30-year, 1 in 30-year + 35% climate change allowance, 1 in 100-year 1 in 100-year + 40% climate change allowance and the 1 in 1000-year event.
- 4.3 The results below first outline the 1 in 1000-year event to allow comparison to the EA's largest extent results (the low-risk event). Following this, the 100-year event results are discussed to compare to the EA's surface water mapping.
- 4.4 The extent and depths of flooding for the design event (in accordance with paragraph 002 of the PPG) inclusive of climate change (1 in 100-year event plus 40% climate change) flood event is then outlined with the associated mapping provided.
- 4.5 The Proposed Development results are then provided for the design event to allow for analysis of the impact of the Proposed Development on pluvial risk for both the Site itself and the area surrounding Site. A difference map has also been produced to allow the change in pluvial risk, as a result of the Proposed Development to be identified.



Baseline Results

- 4.6 Surface water flooding depths and extents for the 1 in 1000-year flood event in the baseline scenario is illustrated in **Figure 4.1**.



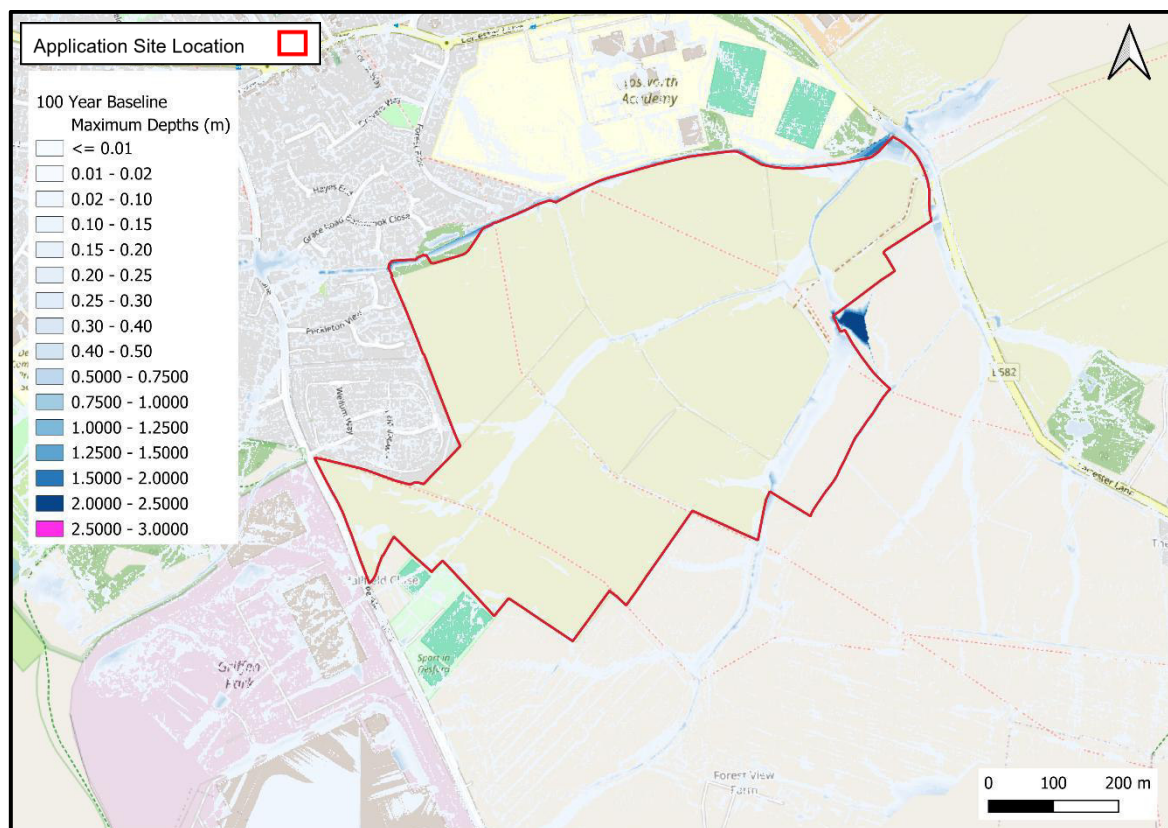
(Source: OpenStreetMap, Rappor)

Figure 4.1 Baseline 1 in 1000-Year Model Outputs

- 4.7 The outputs from the baseline modelling have provided outlines that are largely like those shown on the EA's surface water mapping. Whilst the patterns of risk are generally the same, the modelling undertaken by Rappor show, in the main, there is a slight increase in extents and depths.
- 4.8 The site-specific modelling undertaken by Rappor has shown the flow route in the southwestern corner of site originates from overland flows generated on the site itself. These overland flows are shown to be shallow reaching maximum depths of 0.2 m in the southwestern corner (**Figure 4.1**).
- 4.9 The flow route becomes more defined where the flow route in the EA's mapping begins. Modelling undertaken by Rappor shows these flows, that flow from west to east across the centre of the site, are associated with a valley and as the flow route progresses northwest, they become more confined to a ditch. The topographic survey confirms this ditch has depths of circa 0.8 m, given depths associated with this flow route reach a maximum of 0.6 m thus all flows are suggested to be contained within the ditch. Whilst mapping shows some pluvial extents to be beyond this primary flow path, any flows outside of the ditch network are shown to be shallow (less than 0.05 m) (**Figure 4.1**).



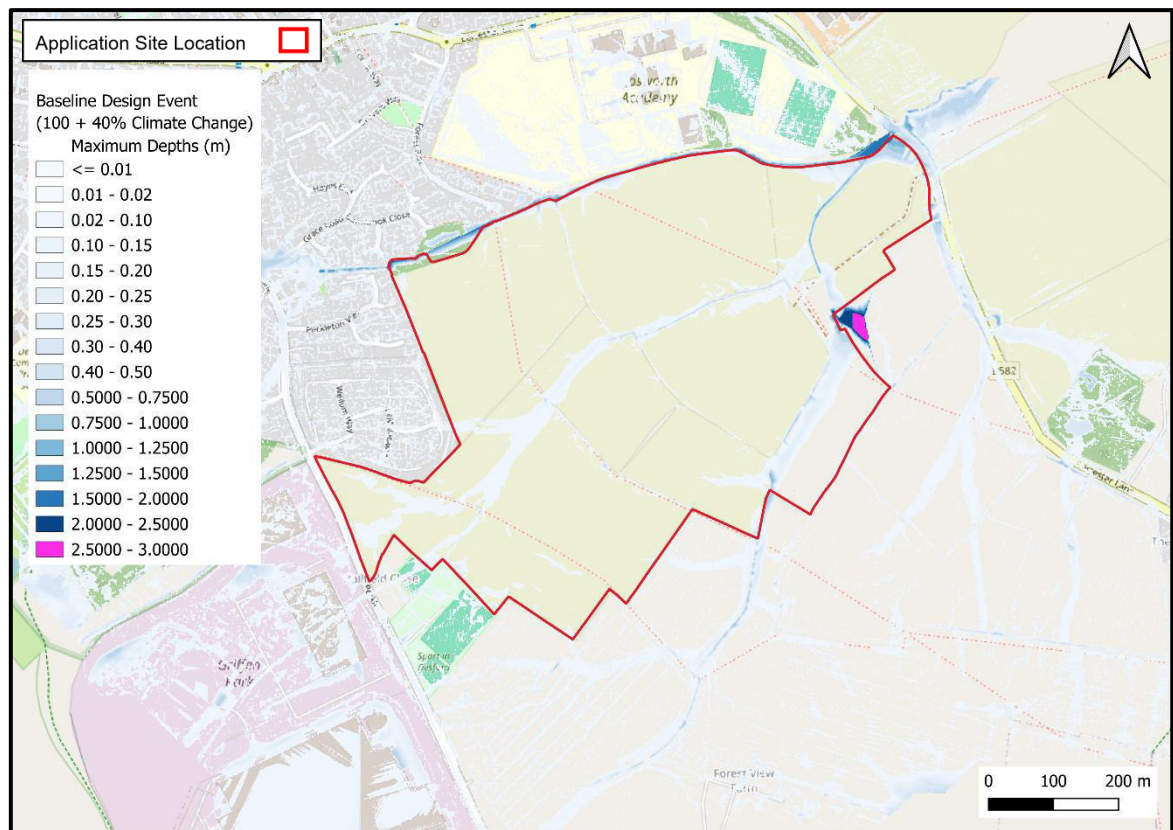
- 4.10 The flow route originating from the centre of the southern boundary, that flows in a northeasterly direction through site is shown to have the same extents and similar depths compared to the EA's mapping. However, the modelling undertaken by Rappor illustrates that the flow route becomes more confined as it reaches the ditch in the northeastern corner of site. In the 1 in 1000-year (**Figure 4.1**) event, contrary to the EA's mapping, modelling undertaken by Rappor suggests this flow route remains, in places completely contained within the ditch. Depths of the pluvial risk reach up to 1.3 m, however, the ditch is shown to reach depths of up to 1.75 m.
- 4.11 The modelling undertaken by Rappor also showed the flow route at the northern boundary as per the EA's mapping. The modelling demonstrated that in the 1000-year event (**Figure 4.1**) some flows were not contained entirely within the ditch and extended out south of the northern boundary.
- 4.12 The 1 in 100-year event (**Figure 4.2**) is shown to have generally the same patterns of pluvial risk, however, extents are reduced compared to the 1 in 1000-year event. Specifically, the extents surrounding the ditch networks located across site are shown to decrease and the flow routes across site are shown to be more confined to the ditch networks.



(Source: OpenStreetMap, Rappor)

Figure 4.2 Baseline 1 in 100-Year Model Outputs

- 4.13 When climate change was allowed for (40% increase in rainfall), **Figure 4.3** shows that again the patterns of pluvial risk stay the same, however, the depths and extents increase compared to the 100-Year Event.

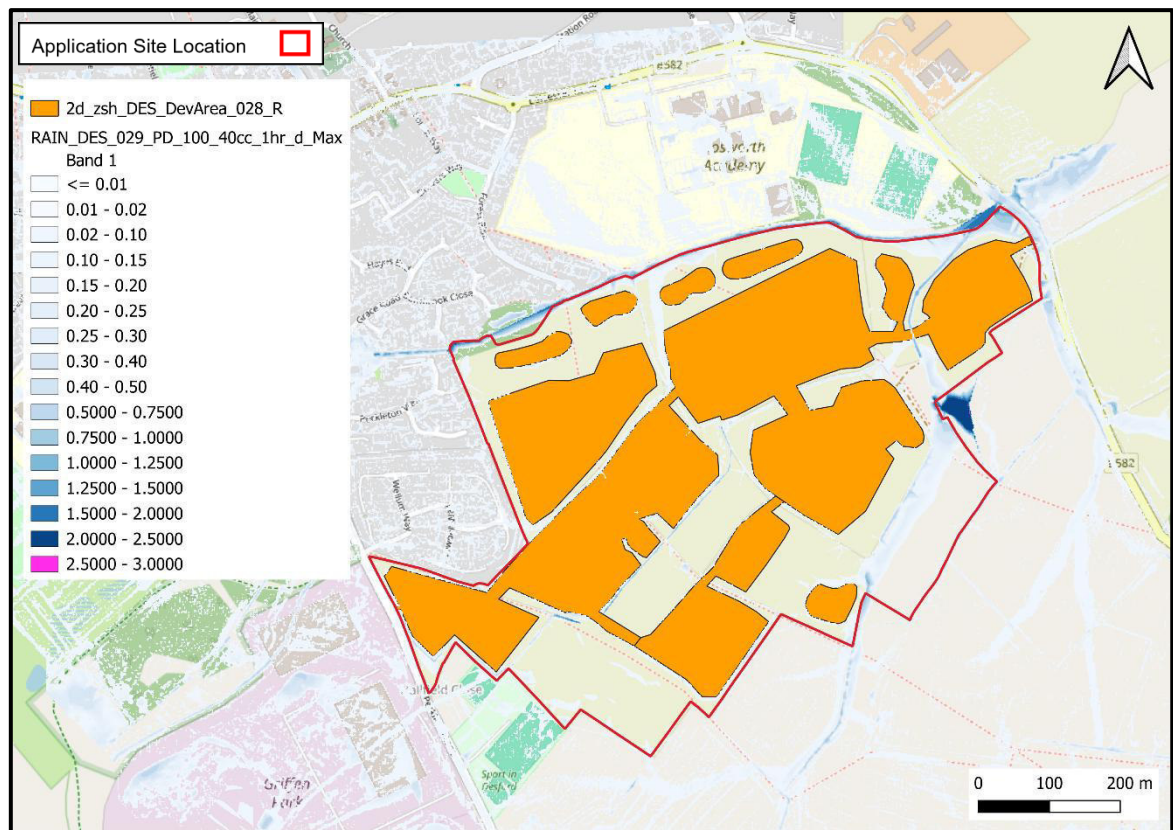


(Source: OpenStreetMap, Rappor)

Figure 4.3 Baseline 1 in 100-Year Plus 40% Climate Change Allowance (Design Event) Model Outputs

Post Development Results

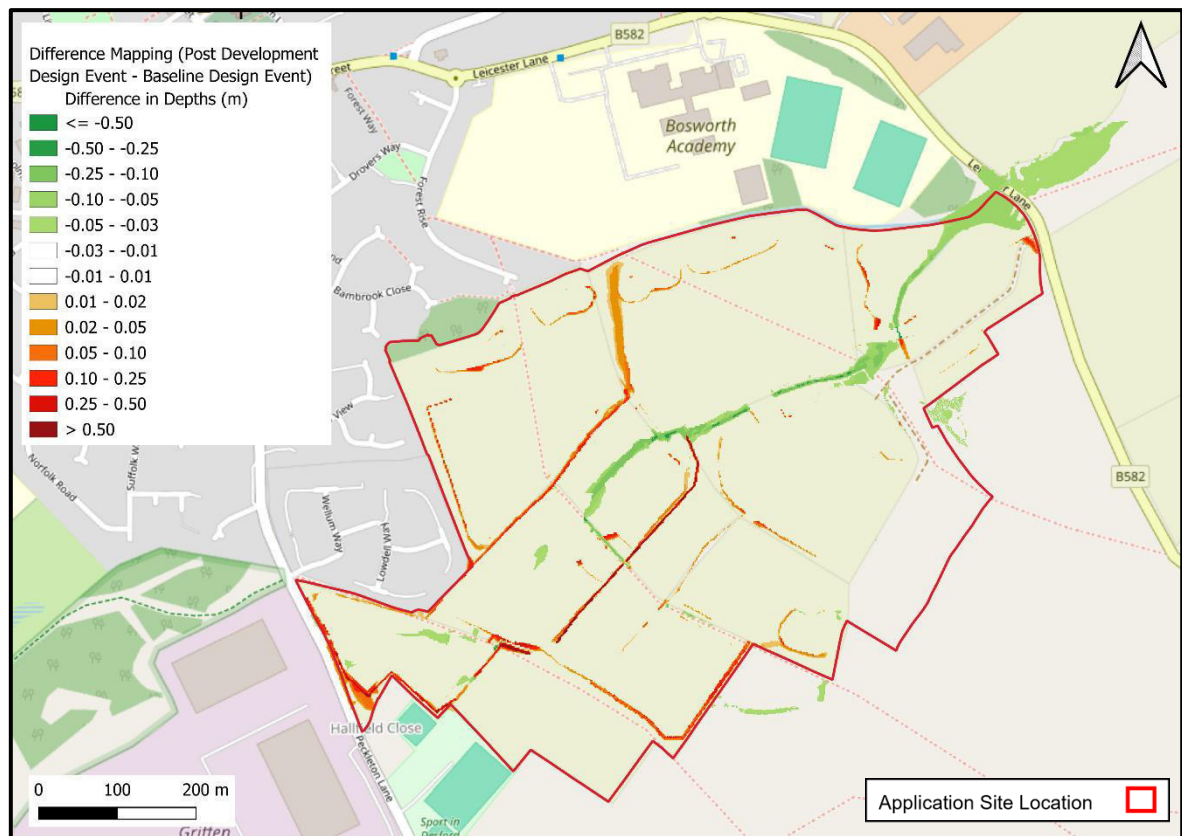
- 4.14 The Post Development modelling, representative of the Proposed Development and mitigation ensures the Proposed Developable area is free from pluvial flooding (**Figure 4.4**). The aforementioned swale features and culverts allow the diversion and maintenance of flow routes, where necessary, to ensure these are directed away from the proposed development.
- 4.15 The most prevalent change to the pattern of pluvial risk is shown to be located in the southwestern corner where the proposed swale here is shown to reroute the flow route before letting it continue in its natural flow regime towards the northeastern corner of site (**Figure 4.4**).



(Source: OpenStreetMap, Rappor)

Figure 4.4 Post Development 1 in 100-Year Plus 40% Climate Change Allowance (Design Event) Model Outputs

- 4.16 Furthermore, the mitigation measures (specifically using culverts) also ensure the proposed access road to Site is free from surface water risk and safe for both access and egress.
- 4.17 The Proposed Development, and associated proposed mitigation, is shown to manage the pluvial risk on Site by ensuring all development is outside the areas of risk (**Figure 4.4**).
- 4.18 No off-Site increases are shown because of the proposed development, with the proposed development only shown to result in betterment (**Figure 4.5**). This betterment is specifically observed in northeast of the proposed development (shown below in green).



(Source: OpenStreetMap, Rappor)

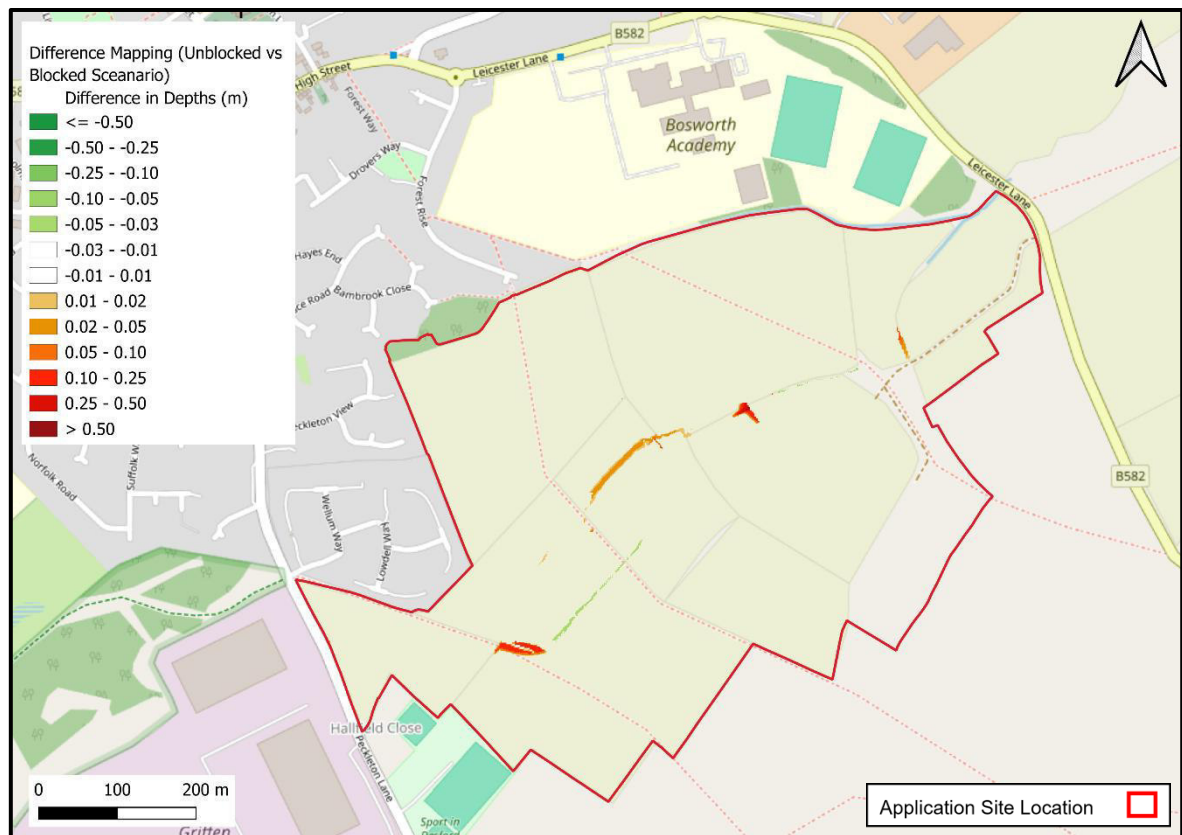
Figure 4.5 Post Development vs Baseline Difference Map for Design Event

Sensitivity Analysis

- 4.19 Typically, sensitivity analyses include tests to flow, roughness and downstream boundary conditions. Further testing is done to understand the risk of culverts being blocked, given culverts were only applied in the Post Development scenario the blockage testing was carried out for this scenario only.
- 4.20 Sensitivity testing for flow in accordance with CIRIA SuDS Manual guidance involved two storm profiles being tested. These scenarios included the 75% winter rainfall profile, representative of a more evenly distributed and prolonged event which often gives a higher runoff volume and flood peak as well as a 50% summer profile, which captures a flashier and more intense event but often gives a lower total runoff volume. Results of the sensitivity test showed the two storms produced very similar baseline conditions giving a water level change ranging between -0.061 m and 0.028 m. Therefore, the 75% winter storm, and storm yielding the greatest water depths on site, was used and carried forward for the completion of this assessment.
- 4.21 Sensitivity analysis was undertaken for the design event (1 in 100 year plus 40% climate change) to understand the impact of roughness parameter selection on modelled results at the Site of interest. Manning's 'n' roughness was altered in the 2D domain for a 20% increase and 20% decrease in roughness values. The water level change at the Site of interest ranges from -0.073 m to 0.236 m. Whilst there is some change noted in sensitivity testing, values selected during the model build process use industry standard values and Chow, 1959 guidance.



- 4.22 As stated in the methodology, the downstream boundary of the hydraulic model was defined using a normal depth boundary with the slope applied being calculated from the surrounding topography. To access the sensitivity of the model to this assumption, the slope applied was varied by +/- 20% from the baseline value and run for the baseline design event. The results of the sensitivity runs were compared against the baseline simulation and demonstrate that modelled flood extents, depths, and velocities within the study area are not materially sensitive to the assumed downstream boundary slope, providing confidence that this assumption does not significantly influence the conclusions of the assessment.
- 4.23 Blockage sensitivity analysis was undertaken on the post development scenario to understand the importance of maintenance to existing culverts and the impact on flood risk to the Site. This was carried out using the British Standards 2017 guidance (BS8533), with 90% blockage represented on all pipes with an area of culverts less than 1m² and a 50% blockage was applied to the pipe which has a culvert area of greater than 1m². Given all culverts implemented have diameters less than 1m² all culverts were blocked by 90% in this test. Results from blockage testing showed that water level changes ranged from -0.73 m to 0.236 m and these changes are shown to be associated with areas immediately upstream and downstream of the culvert under the proposed access. It is noted that in the blocked scenario whilst water backs up behind the culverts, now blocked, there are no off-site impacts because of the blockages and the development, including its access routes, remain safe. (**Figure 4.6**). Despite there being no off-site increase, it is the responsibility of the landowner to ensure all structures are kept clear and fit for purpose this is to ensure effective conveyance at all times.



(Source: OpenStreetMap, Rappor)

Figure 4.6 Blockage Testing Results



Limitations and Assumptions

- 4.24 The results of hydraulic models are largely dependent on the accuracy of the hydrological and topographical/geometry data included in the model. While the most appropriate available information has been used to construct the model there are associated uncertainties and limitations with it. Effort has been made to limit the level of uncertainty to meet the objectives of this study and sensitivity analysis has been undertaken where appropriate.
- 4.25 There are uncertainties associated with the hydrological methods of small drainage catchments (<5km²), and runoff calculated by models with an initial storage component (such as the PDM model used in ReFH) may be very sensitive to storage parameters and initial conditions. Total runoff estimates may therefore be uncertain, however appropriate effort was made in order to reduce uncertainty surrounding this including applying a Percentage Impermeable (PIMP) value as used in the Wallingford procedure. In addition, surface water drainage networks have not been represented in the model and infiltration has not been represented in the surface water model; this is considered a conservative approach.
- 4.26 Hydraulic roughness estimates are based on land-use according to aerial imagery, Site specific survey photographs, Site visit observations and modeller experience and is a simplification of the real-world situation. It is not possible to achieve the level of detail to capture the full range of complex hydraulics that would be likely to occur on the ground and as such, this approach is considered appropriate and applicable. The roughness values are based on available guidance (Chow, 1959). The roughness value may vary over the year and as such sensitivity analysis (as set out above) was undertaken to quantify the impact.
- 4.27 The downstream boundary for the 2D model domain is located a sufficient distance from the Site of interest and therefore this should not impact results at the Site of interest.



5 Conclusions

- 5.1 This Technical Note has provided details of the 2D Direct-Rainfall model which has been undertaken by Rappor Consultants Ltd on behalf of Bellway Homes Ltd.
- 5.2 The Baseline scenario provides an indication of flood extents before any proposed development at the Site has been undertaken. This provides more detailed modelling of the extents and depths in the Environment Agency's Surface Water Flood Map as it has a higher resolution and contains Site-Specific information.
- 5.3 The Post Development scenario is representative of the proposed development on Site along with suggested mitigation options designed to manage pluvial risk on and off Site. The Post Development scenario, as per the LLFAs requests, also represents the outfalls from the proposed attenuation basins.
- 5.4 Results show, compared to EA mapping, patterns of pluvial risk are extremely similar with only slight changes in depth and extent. The similarities in the baseline modelling and the EA's modelling provides good evidence that the modelling undertaken is representative of the Post Development Scenario.
- 5.5 Post Development modelling shows a change in pluvial risk both on and off Site. The difference map has illustrated that there is a change in pluvial risk both on and off Site as a result of the Proposed Development. The areas of development are shown to be outside of the areas of risk as a result of the mitigation measures outlined above. Pluvial risk is shown to decrease off-Site as a result of the proposed development with a significant betterment shown northeast of Site.
- 5.6 Subject to inclusion of the mitigation measures proposed the modelling has demonstrated that areas of development, and access routes, will remain outside the areas of risk whilst posing no increased risk to third party land throughout the lifetime of the development.

rappor



Rappor Consultants Ltd

www.rappor.co.uk

Cheltenham
Bristol
London
Bedford
Exeter
Manchester
Hereford





Appendix E – Drainage Calculations

Cotswold Transport Planning		Page 1																
CTP House, Knapp Road Cheltenham Gloucestershire, GL50 3QQ	Desford Greenfield Runoff																	
Date 17/06/2026 16:58 File STORAGE.SRCX	Designed by SR Checked by CG																	
Innovyze Source Control 2020.1.3																		
<u>FEH Mean Annual Flood</u> Input <table> <tr> <td>QMED Method</td> <td>2008</td> </tr> <tr> <td>Site Location GB 448589 303025 SK 48589 03025</td> <td></td> </tr> <tr> <td>Area (ha)</td> <td>1.000</td> </tr> <tr> <td>SAAR (mm)</td> <td>657</td> </tr> <tr> <td>URBEXT (1990)</td> <td>0.0000</td> </tr> <tr> <td>SPRHOST</td> <td>0.000</td> </tr> <tr> <td>BFIHOST</td> <td>0.376</td> </tr> <tr> <td>FARL</td> <td>1.000</td> </tr> </table> Results QMED Rural (l/s) 6.2 QMED Urban (l/s) n/a			QMED Method	2008	Site Location GB 448589 303025 SK 48589 03025		Area (ha)	1.000	SAAR (mm)	657	URBEXT (1990)	0.0000	SPRHOST	0.000	BFIHOST	0.376	FARL	1.000
QMED Method	2008																	
Site Location GB 448589 303025 SK 48589 03025																		
Area (ha)	1.000																	
SAAR (mm)	657																	
URBEXT (1990)	0.0000																	
SPRHOST	0.000																	
BFIHOST	0.376																	
FARL	1.000																	
©1982-2020 Innovyze																		

Cotswold Transport Planning					Page 1
CTP House, Knapp Road Cheltenham Gloucestershire, GL50 3QQ		Desford South West Catchment			
Date 17/06/2026 16:57 File STORAGE.SRCX		Designed by SR Checked by CG			
Innovyze		Source Control 2020.1.3			
<u>Summary of Results for 100 year Return Period (+40%)</u>					
Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	0.600	0.550	24.7	774.9	O K
30 min Summer	0.754	0.704	24.7	1013.1	O K
60 min Summer	0.898	0.848	24.7	1245.5	O K
120 min Summer	1.048	0.998	24.7	1498.1	O K
180 min Summer	1.128	1.078	24.7	1635.2	O K
240 min Summer	1.172	1.122	24.7	1713.2	O K
360 min Summer	1.205	1.155	24.8	1771.1	O K
480 min Summer	1.199	1.149	24.8	1760.9	O K
600 min Summer	1.177	1.127	24.7	1721.4	O K
720 min Summer	1.152	1.102	24.7	1678.3	O K
960 min Summer	1.100	1.050	24.7	1588.0	O K
1440 min Summer	1.002	0.952	24.7	1419.1	O K
2160 min Summer	0.867	0.817	24.7	1195.7	O K
2880 min Summer	0.736	0.686	24.7	985.5	O K
4320 min Summer	0.543	0.493	24.7	688.9	O K
5760 min Summer	0.409	0.359	24.7	491.6	O K
7200 min Summer	0.323	0.273	24.5	369.5	O K
8640 min Summer	0.268	0.218	24.1	292.5	O K
10080 min Summer	0.234	0.184	23.6	246.2	O K
15 min Winter	0.600	0.550	24.7	775.0	O K
30 min Winter	0.754	0.704	24.7	1013.4	O K
Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)	
15 min Summer	137.129	0.0	801.5	26	
30 min Summer	90.204	0.0	1054.7	41	
60 min Summer	56.345	0.0	1317.9	70	
120 min Summer	35.073	0.0	1640.8	128	
180 min Summer	26.383	0.0	1851.4	186	
240 min Summer	21.413	0.0	2004.2	246	
360 min Summer	15.735	0.0	2208.5	364	
480 min Summer	12.511	0.0	2341.4	480	
600 min Summer	10.417	0.0	2436.8	554	
720 min Summer	8.942	0.0	2510.9	608	
960 min Summer	6.991	0.0	2617.6	730	
1440 min Summer	4.907	0.0	2755.2	996	
2160 min Summer	3.435	0.0	2893.2	1408	
2880 min Summer	2.677	0.0	3005.8	1788	
4320 min Summer	1.909	0.0	3215.9	2512	
5760 min Summer	1.521	0.0	3415.5	3224	
7200 min Summer	1.290	0.0	3621.9	3888	
8640 min Summer	1.138	0.0	3832.9	4576	
10080 min Summer	1.030	0.0	4050.1	5240	
15 min Winter	137.129	0.0	801.5	26	
30 min Winter	90.204	0.0	1054.8	40	
©1982-2020 Innovyze					

Cotswold Transport Planning					Page 2
CTP House, Knapp Road Cheltenham Gloucestershire, GL50 3QQ		Desford South West Catchment			
Date 17/06/2026 16:57 File STORAGE.SRCX		Designed by SR Checked by CG			
Innovyze		Source Control 2020.1.3			
<u>Summary of Results for 100 year Return Period (+40%)</u>					
Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
60 min Winter	0.898	0.848	24.7	1245.8	O K
120 min Winter	1.050	1.000	24.7	1500.4	O K
180 min Winter	1.130	1.080	24.7	1639.7	O K
240 min Winter	1.176	1.126	24.7	1719.8	O K
360 min Winter	1.211	1.161	24.9	1781.7	O K
480 min Winter	1.207	1.157	24.9	1775.6	O K
600 min Winter	1.186	1.136	24.7	1737.7	O K
720 min Winter	1.156	1.106	24.7	1684.2	O K
960 min Winter	1.094	1.044	24.7	1577.7	O K
1440 min Winter	0.970	0.920	24.7	1366.4	O K
2160 min Winter	0.770	0.720	24.7	1039.2	O K
2880 min Winter	0.593	0.543	24.7	763.3	O K
4320 min Winter	0.347	0.297	24.6	403.8	O K
5760 min Winter	0.229	0.179	23.5	238.7	O K
7200 min Winter	0.197	0.147	20.7	195.0	O K
8640 min Winter	0.178	0.128	18.4	170.1	O K
10080 min Winter	0.166	0.116	16.7	154.0	O K
Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)	
60 min Winter	56.345	0.0	1317.8	68	
120 min Winter	35.073	0.0	1640.8	126	
180 min Winter	26.383	0.0	1851.4	184	
240 min Winter	21.413	0.0	2004.2	240	
360 min Winter	15.735	0.0	2209.1	354	
480 min Winter	12.511	0.0	2341.5	466	
600 min Winter	10.417	0.0	2436.9	572	
720 min Winter	8.942	0.0	2510.4	670	
960 min Winter	6.991	0.0	2617.6	754	
1440 min Winter	4.907	0.0	2755.1	1062	
2160 min Winter	3.435	0.0	2893.1	1496	
2880 min Winter	2.677	0.0	3005.9	1872	
4320 min Winter	1.909	0.0	3216.2	2516	
5760 min Winter	1.521	0.0	3415.0	3112	
7200 min Winter	1.290	0.0	3621.4	3752	
8640 min Winter	1.138	0.0	3832.6	4496	
10080 min Winter	1.030	0.0	4050.4	5152	
©1982-2020 Innovyze					

Cotswold Transport Planning		Page 3
CTP House, Knapp Road Cheltenham Gloucestershire, GL50 3QQ	Desford South West Catchment	
Date 17/06/2026 16:57 File STORAGE.SRCX	Designed by SR Checked by CG	
Innovyze Source Control 2020.1.3		

Rainfall Details

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	2013
Site Location	GB 448589 303025 SK 48589 03025
Data Type	Point
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	1.000
Cv (Winter)	1.000
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Climate Change %	+40

Time Area Diagram

Total Area (ha) 2.340

Time (mins)	Area	Time (mins)	Area	Time (mins)	Area
From: To:	(ha)	From: To:	(ha)	From: To:	(ha)
0 4	0.780	4 8	0.780	8 12	0.780

©1982-2020 Innovyze

Cotswold Transport Planning		Page 4																																																																																															
CTP House, Knapp Road Cheltenham Gloucestershire, GL50 3QQ	Desford South West Catchment																																																																																																
Date 17/06/2026 16:57 File STORAGE.SRCX	Designed by SR Checked by CG																																																																																																
Innovyze	Source Control 2020.1.3																																																																																																
Model Details Storage is Online Cover Level (m) 1.550 Tank or Pond Structure Invert Level (m) 0.050 <table><thead><tr><th>Depth (m)</th><th>Area (m²)</th><th>Depth (m)</th><th>Area (m²)</th></tr></thead><tbody><tr><td>0.000</td><td>1300.0</td><td>1.500</td><td>1938.8</td></tr></tbody></table> Hydro-Brake® Optimum Outflow Control Unit Reference MD-SHE-0215-2480-1200-2480 Design Head (m)1.200 Design Flow (l/s)24.8 Flush-Flo™Calculated ObjectiveMinimise upstream storage ApplicationSurface Sump AvailableYes Diameter (mm)215 Invert Level (m)0.000 Minimum Outlet Pipe Diameter (mm)300 Suggested Manhole Diameter (mm)1500 <table><thead><tr><th>Control Points</th><th>Head (m)</th><th>Flow (l/s)</th></tr></thead><tbody><tr><td>Design Point (Calculated)</td><td>1.200</td><td>24.8</td></tr><tr><td>Flush-Flo™</td><td>0.390</td><td>24.7</td></tr><tr><td>Kick-Flo®</td><td>0.841</td><td>20.9</td></tr><tr><td>Mean Flow over Head Range</td><td>-</td><td>21.0</td></tr></tbody></table> 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 <table><thead><tr><th>Depth (m)</th><th>Flow (l/s)</th><th>Depth (m)</th><th>Flow (l/s)</th><th>Depth (m)</th><th>Flow (l/s)</th><th>Depth (m)</th><th>Flow (l/s)</th></tr></thead><tbody><tr><td>0.100</td><td>7.3</td><td>1.200</td><td>24.8</td><td>3.000</td><td>38.5</td><td>7.000</td><td>58.0</td></tr><tr><td>0.200</td><td>21.1</td><td>1.400</td><td>26.7</td><td>3.500</td><td>41.5</td><td>7.500</td><td>60.0</td></tr><tr><td>0.300</td><td>24.4</td><td>1.600</td><td>28.5</td><td>4.000</td><td>44.2</td><td>8.000</td><td>61.9</td></tr><tr><td>0.400</td><td>24.7</td><td>1.800</td><td>30.1</td><td>4.500</td><td>46.8</td><td>8.500</td><td>63.7</td></tr><tr><td>0.500</td><td>24.4</td><td>2.000</td><td>31.7</td><td>5.000</td><td>49.3</td><td>9.000</td><td>65.5</td></tr><tr><td>0.600</td><td>24.0</td><td>2.200</td><td>33.1</td><td>5.500</td><td>51.6</td><td>9.500</td><td>67.3</td></tr><tr><td>0.800</td><td>21.9</td><td>2.400</td><td>34.6</td><td>6.000</td><td>53.8</td><td></td><td></td></tr><tr><td>1.000</td><td>22.7</td><td>2.600</td><td>35.9</td><td>6.500</td><td>55.9</td><td></td><td></td></tr></tbody></table>			Depth (m)	Area (m²)	Depth (m)	Area (m²)	0.000	1300.0	1.500	1938.8	Control Points	Head (m)	Flow (l/s)	Design Point (Calculated)	1.200	24.8	Flush-Flo™	0.390	24.7	Kick-Flo®	0.841	20.9	Mean Flow over Head Range	-	21.0	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	24.8	3.000	38.5	7.000	58.0	0.200	21.1	1.400	26.7	3.500	41.5	7.500	60.0	0.300	24.4	1.600	28.5	4.000	44.2	8.000	61.9	0.400	24.7	1.800	30.1	4.500	46.8	8.500	63.7	0.500	24.4	2.000	31.7	5.000	49.3	9.000	65.5	0.600	24.0	2.200	33.1	5.500	51.6	9.500	67.3	0.800	21.9	2.400	34.6	6.000	53.8			1.000	22.7	2.600	35.9	6.500	55.9		
Depth (m)	Area (m²)	Depth (m)	Area (m²)																																																																																														
0.000	1300.0	1.500	1938.8																																																																																														
Control Points	Head (m)	Flow (l/s)																																																																																															
Design Point (Calculated)	1.200	24.8																																																																																															
Flush-Flo™	0.390	24.7																																																																																															
Kick-Flo®	0.841	20.9																																																																																															
Mean Flow over Head Range	-	21.0																																																																																															
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	24.8	3.000	38.5	7.000	58.0																																																																																										
0.200	21.1	1.400	26.7	3.500	41.5	7.500	60.0																																																																																										
0.300	24.4	1.600	28.5	4.000	44.2	8.000	61.9																																																																																										
0.400	24.7	1.800	30.1	4.500	46.8	8.500	63.7																																																																																										
0.500	24.4	2.000	31.7	5.000	49.3	9.000	65.5																																																																																										
0.600	24.0	2.200	33.1	5.500	51.6	9.500	67.3																																																																																										
0.800	21.9	2.400	34.6	6.000	53.8																																																																																												
1.000	22.7	2.600	35.9	6.500	55.9																																																																																												
©1982-2020 Innovyze																																																																																																	

Cotswold Transport Planning					Page 1	
CTP House, Knapp Road Cheltenham Gloucestershire, GL50 3QQ			Desford South East Catchment			
Date 17/06/2026 17:15 File South East Catchment.SRCX			Designed by SR Checked by CG			
Innovyze			Source Control 2020.1.3			
<u>Summary of Results for 100 year Return Period (+40%)</u>						
	Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
	15 min Summer	0.521	0.471	16.2	509.6	O K
	30 min Summer	0.653	0.603	16.2	666.0	O K
	60 min Summer	0.776	0.726	16.2	818.5	O K
	120 min Summer	0.907	0.857	16.2	986.5	O K
	180 min Summer	0.976	0.926	16.2	1077.8	O K
	240 min Summer	1.015	0.965	16.2	1130.3	O K
	360 min Summer	1.045	0.995	16.2	1170.6	O K
	480 min Summer	1.041	0.991	16.2	1165.9	O K
	600 min Summer	1.023	0.973	16.2	1140.3	O K
	720 min Summer	1.000	0.950	16.2	1110.4	O K
	960 min Summer	0.955	0.905	16.2	1049.2	O K
	1440 min Summer	0.867	0.817	16.2	934.6	O K
	2160 min Summer	0.740	0.690	16.2	773.7	O K
	2880 min Summer	0.632	0.582	16.2	640.5	O K
	4320 min Summer	0.469	0.419	16.2	449.1	O K
	5760 min Summer	0.355	0.305	16.2	321.1	O K
	7200 min Summer	0.282	0.232	16.0	241.4	O K
	8640 min Summer	0.235	0.185	15.7	190.5	O K
	10080 min Summer	0.205	0.155	15.4	159.1	O K
	15 min Winter	0.521	0.471	16.2	509.7	O K
	30 min Winter	0.653	0.603	16.2	666.3	O K
	Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)	
	15 min Summer	137.129	0.0	527.4	26	
	30 min Summer	90.204	0.0	694.1	41	
	60 min Summer	56.345	0.0	867.2	70	
	120 min Summer	35.073	0.0	1079.8	128	
	180 min Summer	26.383	0.0	1218.4	188	
	240 min Summer	21.413	0.0	1318.6	246	
	360 min Summer	15.735	0.0	1453.3	364	
	480 min Summer	12.511	0.0	1540.8	482	
	600 min Summer	10.417	0.0	1603.7	578	
	720 min Summer	8.942	0.0	1652.0	624	
	960 min Summer	6.991	0.0	1722.1	748	
	1440 min Summer	4.907	0.0	1813.2	1010	
	2160 min Summer	3.435	0.0	1904.0	1404	
	2880 min Summer	2.677	0.0	1978.2	1788	
	4320 min Summer	1.909	0.0	2116.4	2512	
	5760 min Summer	1.521	0.0	2247.7	3224	
	7200 min Summer	1.290	0.0	2383.6	3896	
	8640 min Summer	1.138	0.0	2522.2	4576	
	10080 min Summer	1.030	0.0	2665.5	5248	
	15 min Winter	137.129	0.0	527.4	26	
	30 min Winter	90.204	0.0	694.1	40	
©1982-2020 Innovyze						

Cotswold Transport Planning					Page 2	
CTP House, Knapp Road Cheltenham Gloucestershire, GL50 3QQ			Desford South East Catchment			
Date 17/06/2026 17:15 File South East Catchment.SRCX			Designed by SR Checked by CG			
Innovyze			Source Control 2020.1.3			
<u>Summary of Results for 100 year Return Period (+40%)</u>						
	Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
	60 min Winter	0.776	0.726	16.2	818.8	O K
	120 min Winter	0.908	0.858	16.2	987.8	O K
	180 min Winter	0.978	0.928	16.2	1080.5	O K
	240 min Winter	1.018	0.968	16.2	1134.1	O K
	360 min Winter	1.049	0.999	16.2	1176.7	O K
	480 min Winter	1.048	0.998	16.2	1174.3	O K
	600 min Winter	1.030	0.980	16.2	1150.6	O K
	720 min Winter	1.005	0.955	16.2	1116.2	O K
	960 min Winter	0.949	0.899	16.2	1041.7	O K
	1440 min Winter	0.839	0.789	16.2	898.5	O K
	2160 min Winter	0.660	0.610	16.2	674.4	O K
	2880 min Winter	0.511	0.461	16.2	497.8	O K
	4320 min Winter	0.304	0.254	16.1	264.9	O K
	5760 min Winter	0.201	0.151	15.3	154.7	O K
	7200 min Winter	0.170	0.120	13.6	122.9	O K
	8640 min Winter	0.154	0.104	12.1	105.7	O K
	10080 min Winter	0.143	0.093	11.0	94.5	O K
	Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)	
	60 min Winter	56.345	0.0	867.3	68	
	120 min Winter	35.073	0.0	1079.6	126	
	180 min Winter	26.383	0.0	1218.4	184	
	240 min Winter	21.413	0.0	1318.6	240	
	360 min Winter	15.735	0.0	1453.4	356	
	480 min Winter	12.511	0.0	1540.9	468	
	600 min Winter	10.417	0.0	1603.8	576	
	720 min Winter	8.942	0.0	1652.0	678	
	960 min Winter	6.991	0.0	1722.1	766	
	1440 min Winter	4.907	0.0	1813.2	1074	
	2160 min Winter	3.435	0.0	1904.2	1480	
	2880 min Winter	2.677	0.0	1978.3	1856	
	4320 min Winter	1.909	0.0	2117.0	2548	
	5760 min Winter	1.521	0.0	2247.3	3120	
	7200 min Winter	1.290	0.0	2383.3	3752	
	8640 min Winter	1.138	0.0	2522.3	4496	
	10080 min Winter	1.030	0.0	2665.5	5208	
©1982-2020 Innovyze						

Cotswold Transport Planning		Page 3
CTP House, Knapp Road Cheltenham Gloucestershire, GL50 3QQ	Desford South East Catchment	
Date 17/06/2026 17:15 File South East Catchment.SRCX	Designed by SR Checked by CG	
Innovyze Source Control 2020.1.3		

Rainfall Details

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	2013
Site Location	GB 448589 303025 SK 48589 03025
Data Type	Point
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	1.000
Cv (Winter)	1.000
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Climate Change %	+40

Time Area Diagram

Total Area (ha) 1.540

Time (mins)	Area	Time (mins)	Area	Time (mins)	Area
From: To:	(ha)	From: To:	(ha)	From: To:	(ha)
0 4	0.513	4 8	0.513	8 12	0.513

©1982-2020 Innovyze

Cotswold Transport Planning		Page 4																																																																																															
CTP House, Knapp Road Cheltenham Gloucestershire, GL50 3QQ	Desford South East Catchment																																																																																																
Date 17/06/2026 17:15 File South East Catchment.SRCX	Designed by SR Checked by CG																																																																																																
Innovyze Source Control 2020.1.3																																																																																																	
Model Details Storage is Online Cover Level (m) 1.450 Tank or Pond Structure Invert Level (m) 0.050 <table><tr><th>Depth (m)</th><th>Area (m²)</th><th>Depth (m)</th><th>Area (m²)</th></tr><tr><td>0.000</td><td>1000.0</td><td>1.400</td><td>1526.2</td></tr></table> Hydro-Brake® Optimum Outflow Control Unit Reference MD-SHE-0179-1620-1150-1620 Design Head (m) 1.150 Design Flow (l/s) 16.2 Flush-Flo™ Calculated Objective Minimise upstream storage Application Surface Sump Available Yes Diameter (mm) 179 Invert Level (m) 0.000 Minimum Outlet Pipe Diameter (mm) 225 Suggested Manhole Diameter (mm) 1500 <table><tr><th>Control Points</th><th>Head (m)</th><th>Flow (l/s)</th></tr><tr><td>Design Point (Calculated)</td><td>1.150</td><td>16.2</td></tr><tr><td>Flush-Flo™</td><td>0.358</td><td>16.2</td></tr><tr><td>Kick-Flo®</td><td>0.788</td><td>13.5</td></tr><tr><td>Mean Flow over Head Range</td><td>-</td><td>13.9</td></tr></table> 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 <table><tr><th>Depth (m)</th><th>Flow (l/s)</th><th>Depth (m)</th><th>Flow (l/s)</th><th>Depth (m)</th><th>Flow (l/s)</th><th>Depth (m)</th><th>Flow (l/s)</th></tr><tr><td>0.100</td><td>6.3</td><td>1.200</td><td>16.5</td><td>3.000</td><td>25.6</td><td>7.000</td><td>38.5</td></tr><tr><td>0.200</td><td>15.3</td><td>1.400</td><td>17.8</td><td>3.500</td><td>27.6</td><td>7.500</td><td>39.8</td></tr><tr><td>0.300</td><td>16.1</td><td>1.600</td><td>18.9</td><td>4.000</td><td>29.4</td><td>8.000</td><td>41.1</td></tr><tr><td>0.400</td><td>16.2</td><td>1.800</td><td>20.0</td><td>4.500</td><td>31.1</td><td>8.500</td><td>42.3</td></tr><tr><td>0.500</td><td>15.9</td><td>2.000</td><td>21.1</td><td>5.000</td><td>32.7</td><td>9.000</td><td>43.5</td></tr><tr><td>0.600</td><td>15.6</td><td>2.200</td><td>22.1</td><td>5.500</td><td>34.3</td><td>9.500</td><td>44.6</td></tr><tr><td>0.800</td><td>13.6</td><td>2.400</td><td>23.0</td><td>6.000</td><td>35.7</td><td></td><td></td></tr><tr><td>1.000</td><td>15.2</td><td>2.600</td><td>23.9</td><td>6.500</td><td>37.1</td><td></td><td></td></tr></table>			Depth (m)	Area (m²)	Depth (m)	Area (m²)	0.000	1000.0	1.400	1526.2	Control Points	Head (m)	Flow (l/s)	Design Point (Calculated)	1.150	16.2	Flush-Flo™	0.358	16.2	Kick-Flo®	0.788	13.5	Mean Flow over Head Range	-	13.9	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	0.100	6.3	1.200	16.5	3.000	25.6	7.000	38.5	0.200	15.3	1.400	17.8	3.500	27.6	7.500	39.8	0.300	16.1	1.600	18.9	4.000	29.4	8.000	41.1	0.400	16.2	1.800	20.0	4.500	31.1	8.500	42.3	0.500	15.9	2.000	21.1	5.000	32.7	9.000	43.5	0.600	15.6	2.200	22.1	5.500	34.3	9.500	44.6	0.800	13.6	2.400	23.0	6.000	35.7			1.000	15.2	2.600	23.9	6.500	37.1		
Depth (m)	Area (m²)	Depth (m)	Area (m²)																																																																																														
0.000	1000.0	1.400	1526.2																																																																																														
Control Points	Head (m)	Flow (l/s)																																																																																															
Design Point (Calculated)	1.150	16.2																																																																																															
Flush-Flo™	0.358	16.2																																																																																															
Kick-Flo®	0.788	13.5																																																																																															
Mean Flow over Head Range	-	13.9																																																																																															
Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)																																																																																										
0.100	6.3	1.200	16.5	3.000	25.6	7.000	38.5																																																																																										
0.200	15.3	1.400	17.8	3.500	27.6	7.500	39.8																																																																																										
0.300	16.1	1.600	18.9	4.000	29.4	8.000	41.1																																																																																										
0.400	16.2	1.800	20.0	4.500	31.1	8.500	42.3																																																																																										
0.500	15.9	2.000	21.1	5.000	32.7	9.000	43.5																																																																																										
0.600	15.6	2.200	22.1	5.500	34.3	9.500	44.6																																																																																										
0.800	13.6	2.400	23.0	6.000	35.7																																																																																												
1.000	15.2	2.600	23.9	6.500	37.1																																																																																												
©1982-2020 Innovyze																																																																																																	

Cotswold Transport Planning					Page 1
CTP House, Knapp Road Cheltenham Gloucestershire, GL50 3QQ		Desford North East Catchment			
Date 17/06/2026 17:22 File North Catchment.SRCX		Designed by SR Checked by CG			
Innovyze		Source Control 2020.1.3			
<u>Summary of Results for 100 year Return Period (+40%)</u>					
Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	0.552	0.502	17.5	545.9	O K
30 min Summer	0.692	0.642	17.5	713.5	O K
60 min Summer	0.822	0.772	17.5	877.0	O K
120 min Summer	0.959	0.909	17.5	1055.1	O K
180 min Summer	1.031	0.981	17.5	1151.6	O K
240 min Summer	1.071	1.021	17.5	1206.5	O K
360 min Summer	1.101	1.051	17.5	1247.3	O K
480 min Summer	1.095	1.045	17.5	1240.0	O K
600 min Summer	1.075	1.025	17.5	1211.5	O K
720 min Summer	1.052	1.002	17.5	1179.8	O K
960 min Summer	1.003	0.953	17.5	1114.4	O K
1440 min Summer	0.912	0.862	17.5	992.9	O K
2160 min Summer	0.784	0.734	17.5	828.4	O K
2880 min Summer	0.665	0.615	17.5	680.5	O K
4320 min Summer	0.489	0.439	17.5	472.7	O K
5760 min Summer	0.367	0.317	17.5	334.5	O K
7200 min Summer	0.289	0.239	17.3	249.2	O K
8640 min Summer	0.239	0.189	17.0	195.5	O K
10080 min Summer	0.209	0.159	16.6	163.0	O K
15 min Winter	0.552	0.502	17.5	546.0	O K
30 min Winter	0.692	0.642	17.5	713.8	O K
Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)	
15 min Summer	137.129	0.0	565.1	26	
30 min Summer	90.204	0.0	743.7	41	
60 min Summer	56.345	0.0	929.2	70	
120 min Summer	35.073	0.0	1157.0	128	
180 min Summer	26.383	0.0	1305.4	186	
240 min Summer	21.413	0.0	1412.7	246	
360 min Summer	15.735	0.0	1557.3	364	
480 min Summer	12.511	0.0	1651.0	482	
600 min Summer	10.417	0.0	1718.2	564	
720 min Summer	8.942	0.0	1770.0	614	
960 min Summer	6.991	0.0	1845.2	738	
1440 min Summer	4.907	0.0	1942.6	1000	
2160 min Summer	3.435	0.0	2039.9	1412	
2880 min Summer	2.677	0.0	2119.5	1788	
4320 min Summer	1.909	0.0	2267.8	2512	
5760 min Summer	1.521	0.0	2408.2	3184	
7200 min Summer	1.290	0.0	2553.6	3888	
8640 min Summer	1.138	0.0	2702.4	4576	
10080 min Summer	1.030	0.0	2855.9	5240	
15 min Winter	137.129	0.0	565.2	26	
30 min Winter	90.204	0.0	743.6	40	
©1982-2020 Innovyze					

Cotswold Transport Planning					Page 2
CTP House, Knapp Road Cheltenham Gloucestershire, GL50 3QQ		Desford North East Catchment			
Date 17/06/2026 17:22 File North Catchment.SRCX		Designed by SR Checked by CG			
Innovyze		Source Control 2020.1.3			
<u>Summary of Results for 100 year Return Period (+40%)</u>					
Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
60 min Winter	0.823	0.773	17.5	877.3	O K
120 min Winter	0.960	0.910	17.5	1056.7	O K
180 min Winter	1.033	0.983	17.5	1154.8	O K
240 min Winter	1.075	1.025	17.5	1211.1	O K
360 min Winter	1.106	1.056	17.5	1254.6	O K
480 min Winter	1.103	1.053	17.5	1250.2	O K
600 min Winter	1.083	1.033	17.5	1223.3	O K
720 min Winter	1.056	1.006	17.5	1185.2	O K
960 min Winter	0.998	0.948	17.5	1107.1	O K
1440 min Winter	0.883	0.833	17.5	955.0	O K
2160 min Winter	0.695	0.645	17.5	716.9	O K
2880 min Winter	0.534	0.484	17.5	524.3	O K
4320 min Winter	0.311	0.261	17.4	273.1	O K
5760 min Winter	0.204	0.154	16.6	157.7	O K
7200 min Winter	0.174	0.124	14.6	126.5	O K
8640 min Winter	0.157	0.107	13.0	109.0	O K
10080 min Winter	0.146	0.096	11.8	97.8	O K
Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)	
60 min Winter	56.345	0.0	929.2	68	
120 min Winter	35.073	0.0	1156.9	126	
180 min Winter	26.383	0.0	1305.3	184	
240 min Winter	21.413	0.0	1412.8	240	
360 min Winter	15.735	0.0	1557.2	354	
480 min Winter	12.511	0.0	1651.0	466	
600 min Winter	10.417	0.0	1718.3	574	
720 min Winter	8.942	0.0	1770.0	672	
960 min Winter	6.991	0.0	1845.2	760	
1440 min Winter	4.907	0.0	1942.7	1068	
2160 min Winter	3.435	0.0	2039.9	1488	
2880 min Winter	2.677	0.0	2119.6	1856	
4320 min Winter	1.909	0.0	2267.7	2516	
5760 min Winter	1.521	0.0	2408.5	3112	
7200 min Winter	1.290	0.0	2553.5	3752	
8640 min Winter	1.138	0.0	2702.5	4488	
10080 min Winter	1.030	0.0	2855.9	5152	
©1982-2020 Innovyze					

Cotswold Transport Planning		Page 3
CTP House, Knapp Road Cheltenham Gloucestershire, GL50 3QQ	Desford North East Catchment	
Date 17/06/2026 17:22 File North Catchment.SRCX	Designed by SR Checked by CG	
Innovyze Source Control 2020.1.3		

Rainfall Details

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	2013
Site Location	GB 448589 303025 SK 48589 03025
Data Type	Point
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	1.000
Cv (Winter)	1.000
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Climate Change %	+40

Time Area Diagram

Total Area (ha) 1.650

Time (mins)	Area	Time (mins)	Area	Time (mins)	Area
From: To:	(ha)	From: To:	(ha)	From: To:	(ha)
0 4	0.550	4 8	0.550	8 12	0.550

©1982-2020 Innovyze

Cotswold Transport Planning		Page 4
CTP House, Knapp Road Cheltenham Gloucestershire, GL50 3QQ	Desford North East Catchment	
Date 17/06/2026 17:22 File North Catchment.SRCX	Designed by SR Checked by CG	
Innovyze Source Control 2020.1.3		

Model Details

Storage is Online Cover Level (m) 1.450

Tank or Pond Structure

Invert Level (m) 0.050

Depth (m)	Area (m ²)	Depth (m)	Area (m ²)
0.000	1000.0	1.400	1526.2

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0185-1750-1150-1750
Design Head (m)	1.150
Design Flow (l/s)	17.5
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	185
Invert Level (m)	0.000
Minimum Outlet Pipe Diameter (mm)	225
Suggested Manhole Diameter (mm)	1500

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.150	17.5
Flush-Flo™	0.361	17.5
Kick-Flo®	0.792	14.7
Mean Flow over Head Range	-	14.9

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	6.5	1.200	17.9	3.000	27.7	7.000	41.6
0.200	16.5	1.400	19.2	3.500	29.8	7.500	43.0
0.300	17.4	1.600	20.5	4.000	31.8	8.000	44.4
0.400	17.5	1.800	21.7	4.500	33.6	8.500	45.7
0.500	17.2	2.000	22.8	5.000	35.4	9.000	47.0
0.600	16.8	2.200	23.8	5.500	37.0	9.500	48.3
0.800	14.7	2.400	24.9	6.000	38.6		
1.000	16.4	2.600	25.8	6.500	40.2		

©1982-2020 Innovyze

Cotswold Transport Planning					Page 1
CTP House, Knapp Road Cheltenham Gloucestershire, GL50 3QQ		Desford North Catchment			
Date 17/06/2026 17:26 File North Catchment.SRCX		Designed by SR Checked by CG			
Innovyze		Source Control 2020.1.3			
<u>Summary of Results for 100 year Return Period (+40%)</u>					
Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	0.498	0.448	15.4	483.1	O K
30 min Summer	0.624	0.574	15.4	631.3	O K
60 min Summer	0.742	0.692	15.4	775.5	O K
120 min Summer	0.868	0.818	15.4	935.8	O K
180 min Summer	0.935	0.885	15.4	1023.0	O K
240 min Summer	0.973	0.923	15.4	1073.3	O K
360 min Summer	1.002	0.952	15.4	1112.4	O K
480 min Summer	0.999	0.949	15.4	1108.8	O K
600 min Summer	0.982	0.932	15.4	1085.1	O K
720 min Summer	0.960	0.910	15.4	1056.5	O K
960 min Summer	0.916	0.866	15.4	998.1	O K
1440 min Summer	0.831	0.781	15.4	888.0	O K
2160 min Summer	0.707	0.657	15.4	731.7	O K
2880 min Summer	0.604	0.554	15.4	607.2	O K
4320 min Summer	0.449	0.399	15.4	426.8	O K
5760 min Summer	0.342	0.292	15.4	306.3	O K
7200 min Summer	0.273	0.223	15.2	231.3	O K
8640 min Summer	0.228	0.178	14.9	183.4	O K
10080 min Summer	0.200	0.150	14.6	153.7	O K
15 min Winter	0.499	0.449	15.4	483.2	O K
30 min Winter	0.624	0.574	15.4	631.6	O K
Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)	
15 min Summer	137.129	0.0	500.0	26	
30 min Summer	90.204	0.0	658.0	41	
60 min Summer	56.345	0.0	822.1	70	
120 min Summer	35.073	0.0	1023.6	128	
180 min Summer	26.383	0.0	1155.1	188	
240 min Summer	21.413	0.0	1249.9	246	
360 min Summer	15.735	0.0	1377.7	364	
480 min Summer	12.511	0.0	1460.8	482	
600 min Summer	10.417	0.0	1520.3	584	
720 min Summer	8.942	0.0	1566.1	628	
960 min Summer	6.991	0.0	1632.6	752	
1440 min Summer	4.907	0.0	1718.8	1012	
2160 min Summer	3.435	0.0	1805.0	1396	
2880 min Summer	2.677	0.0	1875.1	1784	
4320 min Summer	1.909	0.0	2006.5	2512	
5760 min Summer	1.521	0.0	2130.9	3224	
7200 min Summer	1.290	0.0	2259.5	3896	
8640 min Summer	1.138	0.0	2391.2	4576	
10080 min Summer	1.030	0.0	2527.0	5248	
15 min Winter	137.129	0.0	500.0	26	
30 min Winter	90.204	0.0	657.9	40	
©1982-2020 Innovyze					

Cotswold Transport Planning					Page 2
CTP House, Knapp Road Cheltenham Gloucestershire, GL50 3QQ		Desford North Catchment			
Date 17/06/2026 17:26 File North Catchment.SRCX		Designed by SR Checked by CG			
Innovyze		Source Control 2020.1.3			
<u>Summary of Results for 100 year Return Period (+40%)</u>					
Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
60 min Winter	0.742	0.692	15.4	775.8	O K
120 min Winter	0.869	0.819	15.4	936.9	O K
180 min Winter	0.937	0.887	15.4	1025.2	O K
240 min Winter	0.975	0.925	15.4	1076.5	O K
360 min Winter	1.006	0.956	15.4	1117.7	O K
480 min Winter	1.005	0.955	15.4	1116.1	O K
600 min Winter	0.988	0.938	15.4	1094.2	O K
720 min Winter	0.964	0.914	15.4	1061.9	O K
960 min Winter	0.910	0.860	15.4	990.2	O K
1440 min Winter	0.803	0.753	15.4	852.0	O K
2160 min Winter	0.630	0.580	15.4	638.7	O K
2880 min Winter	0.489	0.439	15.4	472.5	O K
4320 min Winter	0.293	0.243	15.3	253.4	O K
5760 min Winter	0.196	0.146	14.5	149.7	O K
7200 min Winter	0.167	0.117	12.9	119.4	O K
8640 min Winter	0.151	0.101	11.4	102.6	O K
10080 min Winter	0.140	0.090	10.4	91.5	O K
Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)	
60 min Winter	56.345	0.0	822.2	68	
120 min Winter	35.073	0.0	1023.7	126	
180 min Winter	26.383	0.0	1155.2	184	
240 min Winter	21.413	0.0	1250.0	242	
360 min Winter	15.735	0.0	1377.8	356	
480 min Winter	12.511	0.0	1460.9	468	
600 min Winter	10.417	0.0	1520.5	576	
720 min Winter	8.942	0.0	1566.3	680	
960 min Winter	6.991	0.0	1632.7	770	
1440 min Winter	4.907	0.0	1718.8	1076	
2160 min Winter	3.435	0.0	1805.0	1480	
2880 min Winter	2.677	0.0	1875.5	1856	
4320 min Winter	1.909	0.0	2006.3	2520	
5760 min Winter	1.521	0.0	2130.8	3112	
7200 min Winter	1.290	0.0	2259.6	3752	
8640 min Winter	1.138	0.0	2391.1	4496	
10080 min Winter	1.030	0.0	2527.0	5152	
©1982-2020 Innovyze					

Cotswold Transport Planning		Page 3
CTP House, Knapp Road Cheltenham Gloucestershire, GL50 3QQ	Desford North Catchment	
Date 17/06/2026 17:26 File North Catchment.SRCX	Designed by SR Checked by CG	
Innovyze Source Control 2020.1.3		

Rainfall Details

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	2013
Site Location	GB 448589 303025 SK 48589 03025
Data Type	Point
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	1.000
Cv (Winter)	1.000
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Climate Change %	+40

Time Area Diagram

Total Area (ha) 1.460

Time (mins)	Area	Time (mins)	Area	Time (mins)	Area
From: To:	(ha)	From: To:	(ha)	From: To:	(ha)
0 4	0.487	4 8	0.487	8 12	0.487

©1982-2020 Innovyze

Cotswold Transport Planning		Page 4																																																																																															
CTP House, Knapp Road Cheltenham Gloucestershire, GL50 3QQ	Desford North Catchment																																																																																																
Date 17/06/2026 17:26 File North Catchment.SRCX	Designed by SR Checked by CG																																																																																																
Innovyze Source Control 2020.1.3																																																																																																	
Model Details Storage is Online Cover Level (m) 1.450 Tank or Pond Structure Invert Level (m) 0.050 <table><thead><tr><th>Depth (m)</th><th>Area (m²)</th><th>Depth (m)</th><th>Area (m²)</th></tr></thead><tbody><tr><td>0.000</td><td>1000.0</td><td>1.400</td><td>1526.2</td></tr></tbody></table> Hydro-Brake® Optimum Outflow Control Unit Reference MD-SHE-0175-1540-1150-1540 Design Head (m) 1.150 Design Flow (l/s) 15.4 Flush-Flo™ Calculated Objective Minimise upstream storage Application Surface Sump Available Yes Diameter (mm) 175 Invert Level (m) 0.000 Minimum Outlet Pipe Diameter (mm) 225 Suggested Manhole Diameter (mm) 1500 <table><thead><tr><th>Control Points</th><th>Head (m)</th><th>Flow (l/s)</th></tr></thead><tbody><tr><td>Design Point (Calculated)</td><td>1.150</td><td>15.4</td></tr><tr><td>Flush-Flo™</td><td>0.352</td><td>15.4</td></tr><tr><td>Kick-Flo®</td><td>0.780</td><td>12.8</td></tr><tr><td>Mean Flow over Head Range</td><td>-</td><td>13.2</td></tr></tbody></table> 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 <table><thead><tr><th>Depth (m)</th><th>Flow (l/s)</th><th>Depth (m)</th><th>Flow (l/s)</th><th>Depth (m)</th><th>Flow (l/s)</th><th>Depth (m)</th><th>Flow (l/s)</th></tr></thead><tbody><tr><td>0.100</td><td>6.2</td><td>1.200</td><td>15.7</td><td>3.000</td><td>24.3</td><td>7.000</td><td>36.6</td></tr><tr><td>0.200</td><td>14.6</td><td>1.400</td><td>16.9</td><td>3.500</td><td>26.2</td><td>7.500</td><td>37.8</td></tr><tr><td>0.300</td><td>15.3</td><td>1.600</td><td>18.0</td><td>4.000</td><td>27.9</td><td>8.000</td><td>39.0</td></tr><tr><td>0.400</td><td>15.3</td><td>1.800</td><td>19.0</td><td>4.500</td><td>29.5</td><td>8.500</td><td>40.2</td></tr><tr><td>0.500</td><td>15.1</td><td>2.000</td><td>20.0</td><td>5.000</td><td>31.1</td><td>9.000</td><td>41.3</td></tr><tr><td>0.600</td><td>14.7</td><td>2.200</td><td>21.0</td><td>5.500</td><td>32.5</td><td>9.500</td><td>42.4</td></tr><tr><td>0.800</td><td>13.0</td><td>2.400</td><td>21.9</td><td>6.000</td><td>33.9</td><td></td><td></td></tr><tr><td>1.000</td><td>14.4</td><td>2.600</td><td>22.7</td><td>6.500</td><td>35.3</td><td></td><td></td></tr></tbody></table>			Depth (m)	Area (m²)	Depth (m)	Area (m²)	0.000	1000.0	1.400	1526.2	Control Points	Head (m)	Flow (l/s)	Design Point (Calculated)	1.150	15.4	Flush-Flo™	0.352	15.4	Kick-Flo®	0.780	12.8	Mean Flow over Head Range	-	13.2	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	15.7	3.000	24.3	7.000	36.6	0.200	14.6	1.400	16.9	3.500	26.2	7.500	37.8	0.300	15.3	1.600	18.0	4.000	27.9	8.000	39.0	0.400	15.3	1.800	19.0	4.500	29.5	8.500	40.2	0.500	15.1	2.000	20.0	5.000	31.1	9.000	41.3	0.600	14.7	2.200	21.0	5.500	32.5	9.500	42.4	0.800	13.0	2.400	21.9	6.000	33.9			1.000	14.4	2.600	22.7	6.500	35.3		
Depth (m)	Area (m²)	Depth (m)	Area (m²)																																																																																														
0.000	1000.0	1.400	1526.2																																																																																														
Control Points	Head (m)	Flow (l/s)																																																																																															
Design Point (Calculated)	1.150	15.4																																																																																															
Flush-Flo™	0.352	15.4																																																																																															
Kick-Flo®	0.780	12.8																																																																																															
Mean Flow over Head Range	-	13.2																																																																																															
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	15.7	3.000	24.3	7.000	36.6																																																																																										
0.200	14.6	1.400	16.9	3.500	26.2	7.500	37.8																																																																																										
0.300	15.3	1.600	18.0	4.000	27.9	8.000	39.0																																																																																										
0.400	15.3	1.800	19.0	4.500	29.5	8.500	40.2																																																																																										
0.500	15.1	2.000	20.0	5.000	31.1	9.000	41.3																																																																																										
0.600	14.7	2.200	21.0	5.500	32.5	9.500	42.4																																																																																										
0.800	13.0	2.400	21.9	6.000	33.9																																																																																												
1.000	14.4	2.600	22.7	6.500	35.3																																																																																												
©1982-2020 Innovyze																																																																																																	

Cotswold Transport Planning					Page 1	
CTP House, Knapp Road Cheltenham Gloucestershire, GL50 3QQ			Desford Central East Catchment			
Date 17/06/2026 17:18 File Central East Catchment....			Designed by SR Checked by CG			
Innovyze			Source Control 2020.1.3			
<u>Summary of Results for 100 year Return Period (+40%)</u>						
	Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
	15 min Summer	0.538	0.488	16.9	529.4	O K
	30 min Summer	0.674	0.624	16.9	691.9	O K
	60 min Summer	0.802	0.752	16.9	850.5	O K
	120 min Summer	0.936	0.886	16.9	1024.0	O K
	180 min Summer	1.006	0.956	16.9	1118.1	O K
	240 min Summer	1.046	0.996	16.9	1172.0	O K
	360 min Summer	1.076	1.026	16.9	1212.6	O K
	480 min Summer	1.071	1.021	16.9	1206.5	O K
	600 min Summer	1.051	1.001	16.9	1179.3	O K
	720 min Summer	1.029	0.979	16.9	1148.5	O K
	960 min Summer	0.981	0.931	16.9	1084.9	O K
	1440 min Summer	0.892	0.842	16.9	966.6	O K
	2160 min Summer	0.764	0.714	16.9	802.8	O K
	2880 min Summer	0.650	0.600	16.9	662.2	O K
	4320 min Summer	0.480	0.430	16.9	462.1	O K
	5760 min Summer	0.362	0.312	16.9	328.6	O K
	7200 min Summer	0.286	0.236	16.7	246.0	O K
	8640 min Summer	0.238	0.188	16.4	193.5	O K
	10080 min Summer	0.207	0.157	16.1	161.4	O K
	15 min Winter	0.538	0.488	16.9	529.5	O K
	30 min Winter	0.674	0.624	16.9	692.2	O K
	Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)	
	15 min Summer	137.129	0.0	548.0	26	
	30 min Summer	90.204	0.0	721.1	41	
	60 min Summer	56.345	0.0	901.0	70	
	120 min Summer	35.073	0.0	1121.7	128	
	180 min Summer	26.383	0.0	1265.8	188	
	240 min Summer	21.413	0.0	1369.9	246	
	360 min Summer	15.735	0.0	1510.0	364	
	480 min Summer	12.511	0.0	1600.9	482	
	600 min Summer	10.417	0.0	1666.3	570	
	720 min Summer	8.942	0.0	1716.5	620	
	960 min Summer	6.991	0.0	1789.2	742	
	1440 min Summer	4.907	0.0	1883.8	1004	
	2160 min Summer	3.435	0.0	1978.2	1408	
	2880 min Summer	2.677	0.0	2055.3	1788	
	4320 min Summer	1.909	0.0	2198.9	2512	
	5760 min Summer	1.521	0.0	2334.7	3224	
	7200 min Summer	1.290	0.0	2475.8	3888	
	8640 min Summer	1.138	0.0	2620.5	4576	
	10080 min Summer	1.030	0.0	2769.3	5240	
	15 min Winter	137.129	0.0	548.0	26	
	30 min Winter	90.204	0.0	721.2	40	
©1982-2020 Innovyze						

Cotswold Transport Planning					Page 2	
CTP House, Knapp Road Cheltenham Gloucestershire, GL50 3QQ			Desford Central East Catchment			
Date 17/06/2026 17:18 File Central East Catchment....			Designed by SR Checked by CG			
Innovyze			Source Control 2020.1.3			
<u>Summary of Results for 100 year Return Period (+40%)</u>						
	Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
	60 min Winter	0.802	0.752	16.9	850.8	O K
	120 min Winter	0.937	0.887	16.9	1025.4	O K
	180 min Winter	1.008	0.958	16.9	1121.1	O K
	240 min Winter	1.049	0.999	16.9	1176.2	O K
	360 min Winter	1.080	1.030	16.9	1219.3	O K
	480 min Winter	1.078	1.028	16.9	1215.8	O K
	600 min Winter	1.059	1.009	16.9	1190.5	O K
	720 min Winter	1.033	0.983	16.9	1154.1	O K
	960 min Winter	0.976	0.926	16.9	1077.5	O K
	1440 min Winter	0.863	0.813	16.9	929.5	O K
	2160 min Winter	0.679	0.629	16.9	697.4	O K
	2880 min Winter	0.524	0.474	16.9	512.4	O K
	4320 min Winter	0.308	0.258	16.8	269.7	O K
	5760 min Winter	0.203	0.153	16.0	156.6	O K
	7200 min Winter	0.172	0.122	14.1	124.9	O K
	8640 min Winter	0.156	0.106	12.6	107.5	O K
	10080 min Winter	0.145	0.095	11.5	96.3	O K
	Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)	
	60 min Winter	56.345	0.0	901.1	68	
	120 min Winter	35.073	0.0	1121.8	126	
	180 min Winter	26.383	0.0	1265.8	184	
	240 min Winter	21.413	0.0	1369.9	240	
	360 min Winter	15.735	0.0	1510.1	356	
	480 min Winter	12.511	0.0	1600.9	466	
	600 min Winter	10.417	0.0	1666.4	574	
	720 min Winter	8.942	0.0	1716.5	676	
	960 min Winter	6.991	0.0	1789.3	762	
	1440 min Winter	4.907	0.0	1883.8	1070	
	2160 min Winter	3.435	0.0	1978.2	1484	
	2880 min Winter	2.677	0.0	2055.4	1856	
	4320 min Winter	1.909	0.0	2198.8	2516	
	5760 min Winter	1.521	0.0	2335.1	3112	
	7200 min Winter	1.290	0.0	2476.3	3752	
	8640 min Winter	1.138	0.0	2620.4	4488	
	10080 min Winter	1.030	0.0	2769.3	5152	
©1982-2020 Innovyze						

Cotswold Transport Planning		Page 4																																																																																															
CTP House, Knapp Road Cheltenham Gloucestershire, GL50 3QQ	Desford Central East Catchment																																																																																																
Date 17/06/2026 17:18 File Central East Catchment....	Designed by SR Checked by CG																																																																																																
Innovyze Source Control 2020.1.3																																																																																																	
Model Details Storage is Online Cover Level (m) 1.450 Tank or Pond Structure Invert Level (m) 0.050 <table><tr><th>Depth (m)</th><th>Area (m²)</th><th>Depth (m)</th><th>Area (m²)</th></tr><tr><td>0.000</td><td>1000.0</td><td>1.400</td><td>1526.2</td></tr></table> Hydro-Brake® Optimum Outflow Control Unit Reference MD-SHE-0182-1690-1150-1690 Design Head (m) 1.150 Design Flow (l/s) 16.9 Flush-Flo™ Calculated Objective Minimise upstream storage Application Surface Sump Available Yes Diameter (mm) 182 Invert Level (m) 0.000 Minimum Outlet Pipe Diameter (mm) 225 Suggested Manhole Diameter (mm) 1500 <table><tr><th>Control Points</th><th>Head (m)</th><th>Flow (l/s)</th></tr><tr><td>Design Point (Calculated)</td><td>1.150</td><td>16.9</td></tr><tr><td>Flush-Flo™</td><td>0.361</td><td>16.9</td></tr><tr><td>Kick-Flo®</td><td>0.792</td><td>14.2</td></tr><tr><td>Mean Flow over Head Range</td><td>-</td><td>14.5</td></tr></table> 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 <table><tr><th>Depth (m)</th><th>Flow (l/s)</th><th>Depth (m)</th><th>Flow (l/s)</th><th>Depth (m)</th><th>Flow (l/s)</th><th>Depth (m)</th><th>Flow (l/s)</th></tr><tr><td>0.100</td><td>6.4</td><td>1.200</td><td>17.2</td><td>3.000</td><td>26.7</td><td>7.000</td><td>40.2</td></tr><tr><td>0.200</td><td>16.0</td><td>1.400</td><td>18.6</td><td>3.500</td><td>28.8</td><td>7.500</td><td>41.5</td></tr><tr><td>0.300</td><td>16.8</td><td>1.600</td><td>19.8</td><td>4.000</td><td>30.7</td><td>8.000</td><td>42.9</td></tr><tr><td>0.400</td><td>16.9</td><td>1.800</td><td>20.9</td><td>4.500</td><td>32.5</td><td>8.500</td><td>44.1</td></tr><tr><td>0.500</td><td>16.6</td><td>2.000</td><td>22.0</td><td>5.000</td><td>34.1</td><td>9.000</td><td>45.4</td></tr><tr><td>0.600</td><td>16.3</td><td>2.200</td><td>23.0</td><td>5.500</td><td>35.8</td><td>9.500</td><td>46.6</td></tr><tr><td>0.800</td><td>14.2</td><td>2.400</td><td>24.0</td><td>6.000</td><td>37.3</td><td></td><td></td></tr><tr><td>1.000</td><td>15.8</td><td>2.600</td><td>24.9</td><td>6.500</td><td>38.8</td><td></td><td></td></tr></table>			Depth (m)	Area (m²)	Depth (m)	Area (m²)	0.000	1000.0	1.400	1526.2	Control Points	Head (m)	Flow (l/s)	Design Point (Calculated)	1.150	16.9	Flush-Flo™	0.361	16.9	Kick-Flo®	0.792	14.2	Mean Flow over Head Range	-	14.5	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	0.100	6.4	1.200	17.2	3.000	26.7	7.000	40.2	0.200	16.0	1.400	18.6	3.500	28.8	7.500	41.5	0.300	16.8	1.600	19.8	4.000	30.7	8.000	42.9	0.400	16.9	1.800	20.9	4.500	32.5	8.500	44.1	0.500	16.6	2.000	22.0	5.000	34.1	9.000	45.4	0.600	16.3	2.200	23.0	5.500	35.8	9.500	46.6	0.800	14.2	2.400	24.0	6.000	37.3			1.000	15.8	2.600	24.9	6.500	38.8		
Depth (m)	Area (m²)	Depth (m)	Area (m²)																																																																																														
0.000	1000.0	1.400	1526.2																																																																																														
Control Points	Head (m)	Flow (l/s)																																																																																															
Design Point (Calculated)	1.150	16.9																																																																																															
Flush-Flo™	0.361	16.9																																																																																															
Kick-Flo®	0.792	14.2																																																																																															
Mean Flow over Head Range	-	14.5																																																																																															
Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)																																																																																										
0.100	6.4	1.200	17.2	3.000	26.7	7.000	40.2																																																																																										
0.200	16.0	1.400	18.6	3.500	28.8	7.500	41.5																																																																																										
0.300	16.8	1.600	19.8	4.000	30.7	8.000	42.9																																																																																										
0.400	16.9	1.800	20.9	4.500	32.5	8.500	44.1																																																																																										
0.500	16.6	2.000	22.0	5.000	34.1	9.000	45.4																																																																																										
0.600	16.3	2.200	23.0	5.500	35.8	9.500	46.6																																																																																										
0.800	14.2	2.400	24.0	6.000	37.3																																																																																												
1.000	15.8	2.600	24.9	6.500	38.8																																																																																												
©1982-2020 Innovyze																																																																																																	

Cotswold Transport Planning					Page 1	
CTP House, Knapp Road Cheltenham Gloucestershire, GL50 3QQ			Desford Central Catchment			
Date 17/06/2026 17:08 File Central Catchment.SRCX			Designed by SR Checked by CG			
Innovyze			Source Control 2020.1.3			
<u>Summary of Results for 100 year Return Period (+40%)</u>						
	Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
	15 min Summer	0.394	0.344	11.6	364.0	O K
	30 min Summer	0.492	0.442	11.6	475.4	O K
	60 min Summer	0.584	0.534	11.6	583.3	O K
	120 min Summer	0.683	0.633	11.6	702.9	O K
	180 min Summer	0.738	0.688	11.6	770.2	O K
	240 min Summer	0.770	0.720	11.6	810.7	O K
	360 min Summer	0.798	0.748	11.6	845.5	O K
	480 min Summer	0.798	0.748	11.6	846.4	O K
	600 min Summer	0.785	0.735	11.6	830.2	O K
	720 min Summer	0.765	0.715	11.6	803.8	O K
	960 min Summer	0.723	0.673	11.6	752.5	O K
	1440 min Summer	0.650	0.600	11.6	662.7	O K
	2160 min Summer	0.557	0.507	11.6	551.6	O K
	2880 min Summer	0.481	0.431	11.6	462.6	O K
	4320 min Summer	0.366	0.316	11.6	332.8	O K
	5760 min Summer	0.287	0.237	11.5	246.6	O K
	7200 min Summer	0.236	0.186	11.3	191.8	O K
	8640 min Summer	0.202	0.152	11.0	155.6	O K
	10080 min Summer	0.179	0.129	10.8	132.1	O K
	15 min Winter	0.394	0.344	11.6	364.1	O K
	30 min Winter	0.492	0.442	11.6	475.6	O K
	Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)	
	15 min Summer	137.129	0.0	376.6	26	
	30 min Summer	90.204	0.0	495.6	41	
	60 min Summer	56.345	0.0	619.2	70	
	120 min Summer	35.073	0.0	771.1	128	
	180 min Summer	26.383	0.0	870.1	188	
	240 min Summer	21.413	0.0	941.7	246	
	360 min Summer	15.735	0.0	1037.9	364	
	480 min Summer	12.511	0.0	1100.5	482	
	600 min Summer	10.417	0.0	1145.4	600	
	720 min Summer	8.942	0.0	1180.0	666	
	960 min Summer	6.991	0.0	1230.0	756	
	1440 min Summer	4.907	0.0	1294.9	990	
	2160 min Summer	3.435	0.0	1359.9	1384	
	2880 min Summer	2.677	0.0	1412.9	1764	
	4320 min Summer	1.909	0.0	1511.7	2512	
	5760 min Summer	1.521	0.0	1605.2	3224	
	7200 min Summer	1.290	0.0	1702.3	3896	
	8640 min Summer	1.138	0.0	1801.4	4584	
	10080 min Summer	1.030	0.0	1903.8	5248	
	15 min Winter	137.129	0.0	376.6	26	
	30 min Winter	90.204	0.0	495.6	40	
©1982-2020 Innovyze						

Cotswold Transport Planning					Page 2
CTP House, Knapp Road Cheltenham Gloucestershire, GL50 3QQ		Desford Central Catchment			
Date 17/06/2026 17:08 File Central Catchment.SRCX		Designed by SR Checked by CG			
Innovyze		Source Control 2020.1.3			
<u>Summary of Results for 100 year Return Period (+40%)</u>					
Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
60 min Winter	0.584	0.534	11.6	583.7	O K
120 min Winter	0.684	0.634	11.6	703.9	O K
180 min Winter	0.739	0.689	11.6	771.6	O K
240 min Winter	0.771	0.721	11.6	812.4	O K
360 min Winter	0.799	0.749	11.6	847.6	O K
480 min Winter	0.800	0.750	11.6	848.8	Flood Risk
600 min Winter	0.788	0.738	11.6	833.1	O K
720 min Winter	0.767	0.717	11.6	806.3	O K
960 min Winter	0.716	0.666	11.6	743.2	O K
1440 min Winter	0.625	0.575	11.6	632.7	O K
2160 min Winter	0.500	0.450	11.6	484.9	O K
2880 min Winter	0.396	0.346	11.6	366.2	O K
4320 min Winter	0.253	0.203	11.4	210.0	O K
5760 min Winter	0.178	0.128	10.7	130.6	O K
7200 min Winter	0.152	0.102	9.6	103.3	O K
8640 min Winter	0.137	0.087	8.6	87.9	O K
10080 min Winter	0.127	0.077	7.8	77.8	O K
Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)	
60 min Winter	56.345	0.0	619.3	68	
120 min Winter	35.073	0.0	771.2	126	
180 min Winter	26.383	0.0	870.1	184	
240 min Winter	21.413	0.0	941.6	242	
360 min Winter	15.735	0.0	1038.0	356	
480 min Winter	12.511	0.0	1100.5	470	
600 min Winter	10.417	0.0	1145.4	582	
720 min Winter	8.942	0.0	1179.9	686	
960 min Winter	6.991	0.0	1229.9	770	
1440 min Winter	4.907	0.0	1295.0	1056	
2160 min Winter	3.435	0.0	1359.7	1472	
2880 min Winter	2.677	0.0	1412.8	1852	
4320 min Winter	1.909	0.0	1511.6	2552	
5760 min Winter	1.521	0.0	1605.1	3168	
7200 min Winter	1.290	0.0	1702.3	3816	
8640 min Winter	1.138	0.0	1801.5	4504	
10080 min Winter	1.030	0.0	1903.8	5240	
©1982-2020 Innovyze					

Cotswold Transport Planning		Page 3
CTP House, Knapp Road Cheltenham Gloucestershire, GL50 3QQ	Desford Central Catchment	
Date 17/06/2026 17:08 File Central Catchment.SRCX	Designed by SR Checked by CG	
Innovyze Source Control 2020.1.3		

Rainfall Details

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	2013
Site Location	GB 448589 303025 SK 48589 03025
Data Type	Point
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	1.000
Cv (Winter)	1.000
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Climate Change %	+40

Time Area Diagram

Total Area (ha) 1.100

Time (mins)	Area	Time (mins)	Area	Time (mins)	Area
From: To:	(ha)	From: To:	(ha)	From: To:	(ha)
0 4	0.367	4 8	0.367	8 12	0.367

©1982-2020 Innovyze

Cotswold Transport Planning		Page 4																																																																																															
CTP House, Knapp Road Cheltenham Gloucestershire, GL50 3QQ	Desford Central Catchment																																																																																																
Date 17/06/2026 17:08 File Central Catchment.SRCX	Designed by SR Checked by CG																																																																																																
Innovyze Source Control 2020.1.3																																																																																																	
Model Details Storage is Online Cover Level (m) 1.100 Tank or Pond Structure Invert Level (m) 0.050 <table><thead><tr><th>Depth (m)</th><th>Area (m²)</th><th>Depth (m)</th><th>Area (m²)</th></tr></thead><tbody><tr><td>0.000</td><td>1000.0</td><td>1.050</td><td>1384.3</td></tr></tbody></table> Hydro-Brake® Optimum Outflow Control Unit Reference MD-SHE-0153-1170-1200-1170 Design Head (m) 1.200 Design Flow (l/s) 11.7 Flush-Flo™ Calculated Objective Minimise upstream storage Application Surface Sump Available Yes Diameter (mm) 153 Invert Level (m) 0.000 Minimum Outlet Pipe Diameter (mm) 225 Suggested Manhole Diameter (mm) 1200 <table><thead><tr><th>Control Points</th><th>Head (m)</th><th>Flow (l/s)</th></tr></thead><tbody><tr><td>Design Point (Calculated)</td><td>1.200</td><td>11.7</td></tr><tr><td>Flush-Flo™</td><td>0.358</td><td>11.6</td></tr><tr><td>Kick-Flo®</td><td>0.783</td><td>9.6</td></tr><tr><td>Mean Flow over Head Range</td><td>-</td><td>10.1</td></tr></tbody></table> 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 <table><thead><tr><th>Depth (m)</th><th>Flow (l/s)</th><th>Depth (m)</th><th>Flow (l/s)</th><th>Depth (m)</th><th>Flow (l/s)</th><th>Depth (m)</th><th>Flow (l/s)</th></tr></thead><tbody><tr><td>0.100</td><td>5.5</td><td>1.200</td><td>11.7</td><td>3.000</td><td>18.1</td><td>7.000</td><td>27.1</td></tr><tr><td>0.200</td><td>11.0</td><td>1.400</td><td>12.6</td><td>3.500</td><td>19.5</td><td>7.500</td><td>28.0</td></tr><tr><td>0.300</td><td>11.6</td><td>1.600</td><td>13.4</td><td>4.000</td><td>20.7</td><td>8.000</td><td>28.9</td></tr><tr><td>0.400</td><td>11.6</td><td>1.800</td><td>14.2</td><td>4.500</td><td>21.9</td><td>8.500</td><td>29.8</td></tr><tr><td>0.500</td><td>11.4</td><td>2.000</td><td>14.9</td><td>5.000</td><td>23.1</td><td>9.000</td><td>30.6</td></tr><tr><td>0.600</td><td>11.1</td><td>2.200</td><td>15.6</td><td>5.500</td><td>24.2</td><td>9.500</td><td>31.4</td></tr><tr><td>0.800</td><td>9.7</td><td>2.400</td><td>16.2</td><td>6.000</td><td>25.2</td><td></td><td></td></tr><tr><td>1.000</td><td>10.7</td><td>2.600</td><td>16.9</td><td>6.500</td><td>26.2</td><td></td><td></td></tr></tbody></table>			Depth (m)	Area (m²)	Depth (m)	Area (m²)	0.000	1000.0	1.050	1384.3	Control Points	Head (m)	Flow (l/s)	Design Point (Calculated)	1.200	11.7	Flush-Flo™	0.358	11.6	Kick-Flo®	0.783	9.6	Mean Flow over Head Range	-	10.1	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	0.100	5.5	1.200	11.7	3.000	18.1	7.000	27.1	0.200	11.0	1.400	12.6	3.500	19.5	7.500	28.0	0.300	11.6	1.600	13.4	4.000	20.7	8.000	28.9	0.400	11.6	1.800	14.2	4.500	21.9	8.500	29.8	0.500	11.4	2.000	14.9	5.000	23.1	9.000	30.6	0.600	11.1	2.200	15.6	5.500	24.2	9.500	31.4	0.800	9.7	2.400	16.2	6.000	25.2			1.000	10.7	2.600	16.9	6.500	26.2		
Depth (m)	Area (m²)	Depth (m)	Area (m²)																																																																																														
0.000	1000.0	1.050	1384.3																																																																																														
Control Points	Head (m)	Flow (l/s)																																																																																															
Design Point (Calculated)	1.200	11.7																																																																																															
Flush-Flo™	0.358	11.6																																																																																															
Kick-Flo®	0.783	9.6																																																																																															
Mean Flow over Head Range	-	10.1																																																																																															
Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)																																																																																										
0.100	5.5	1.200	11.7	3.000	18.1	7.000	27.1																																																																																										
0.200	11.0	1.400	12.6	3.500	19.5	7.500	28.0																																																																																										
0.300	11.6	1.600	13.4	4.000	20.7	8.000	28.9																																																																																										
0.400	11.6	1.800	14.2	4.500	21.9	8.500	29.8																																																																																										
0.500	11.4	2.000	14.9	5.000	23.1	9.000	30.6																																																																																										
0.600	11.1	2.200	15.6	5.500	24.2	9.500	31.4																																																																																										
0.800	9.7	2.400	16.2	6.000	25.2																																																																																												
1.000	10.7	2.600	16.9	6.500	26.2																																																																																												
©1982-2020 Innovyze																																																																																																	



Appendix F – Drainage Strategy



- Notes:**
1. Scale for planning purposes only.
 2. All adoptable drainage shall be in accordance with Sewer Sector Guidance Appendix C: The Design and Construction Guidance and statutory undertakers requirements
 3. The proposed drainage aims to provide a SuDS management train through incorporating, where practical, swales, detention basins, bioretention features, tree pits and permeable paving across the site.
 4. At this stage of the masterplan is indicative of establishing land use as per the requirements of an outline planning application. As such, it is not possible to provide further detail of SuDS features however, as the plan progresses the proposals will be refined and incorporate treatment train measures.
 5. This drawing is for information purposes only

Calculations

Discharge rates and surface water storage calculations have been based on 65% of the developable area. This 65% accounts for an estimated 55% to become impermeable + 10% allowance for urban creep.

Total Developable Area: 17.86ha
Total Estimated Impermeable Area = 11.62ha
Total Discharge rate (QBAR): 123l/s
Storage Required: 8,877m³
Storage Provided: 10,564m³

- Key:**
- Existing Watercourse/Ditch
 - Proposed Surface Water Attenuation
 - Proposed 3m Maintenance Easement (Attenuation)
 - Proposed Surface Water Sewer
 - Proposed Foul Sewer
 - Potential Foul Rising Main Route
 - Existing STW Foul Sewer
 - Indicative Swale/Rain Garden (SuDS)
 - Proposed Swale (Surface Water Mitigation)
 - Proposed Culvert (Surface Water Mitigation)

P6	10.07.26	Updated Following Client Comment	SR	CG
P5	25.06.26	Updated Masterplan	SR	CG
P4	17.06.26	Updated For Planning	SR	CG
P3	22.05.26	Updated Masterplan	SR	CG
P2	13.02.26	Revised Masterplan	SR	CG
P1	14.10.25	First Issue	SR	SM
Rev	Date	Details	By	Chkd



CLIENT: Bellway Homes Limited

PROJECT: Land Sout of Bosworth Academy, Desford

TITLE: Preliminary Drainage Strategy

SCALE @ A1:	DATE:	DRAWN:	CHECKED:	APPROVED:
1:1250	14/10/25	SR	CG	SM

STATUS: PRELIMINARY

DRAWING NO:	REVISION:
250883-RAP-XX-XX-DR-D-3100	P6

rappor



Rappor Consultants Ltd

www.rappor.co.uk

Cheltenham
Bristol
London
Bedford
Exeter
Manchester
Hereford

