PINNACLE
CONSULTING ENGINEERS

Drainage Strategy Report

Peartree Lane Welwyn Garden City

One YMCA

3 December 2020

Prepared for:

Saunders Architects

STRUCTURAL • CIVIL • DUE DILIGENCE • ENGINEERING MASTERPLANNING
FLOOD MANAGEMENT • INFRASTRUCTURE DESIGN
PRE-DEVELOPMENT ENGINEERING • BIM • TRANSPORTATION

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APPROVALS

	Name	Position	Date
Prepared by	Shohely Sultana	Civil Engineer	09.10.19
Reviewed by	Jawsy Jabbar	Associate	09.10.19
Approved by	David Meigh	Director	09.10.19

VERSIONS

Number	By	Date	Context
1.0	Shohely Sultana	03.10.19	For comment
2.0	Shohely Sultana	09.10.19	Revised following comments
3.0	Sudeep Chongbang	27.05.20	Revised for HCC comments
3.1	Sudeep Chongbang	05.06.20	Revised for HCC comments
3.2	Sudeep Chongbang	18.11.20	Revised for HCC comments
3.3	Iran Limbu	03.12.20	Revised for LLFA comments

CONTENT

1 EXECUTIVE SUMMARY

The drainage strategy for the proposed development has incorporated the following:

- The proposed 0.671ha development is consist of hostel and maintenance/office units with adjacent car parks.
- The scheme proposed for this site comprised of 100 bed YMCA hostel and 43 residential dwellings with demolishment of existing buildings.
- The development site consists of a net increase of 15% in the proposed permeable area and 5% decrease of impermeable area.
- As a brownfield site, a well-defined surface and foul water sewer are identified in the Utility Survey. Both are discharging to the public sewer network of Thames Water authority in the vicinity of the development site.
- Upon referencing the records held by the British Geological Society map, the development site is found underlain with Lewes Nodular Chalk Formation and Seaford Chalk Formation.
- A Site-Specific infiltration test to BRE 365 is conducted by Delta-Simons in April 2020 to assess the viability of this proposed surface water strategy. Soil Infiltration rates of 4.5×10^{-5} m/s (good infiltration rate) and 7.0×10^{-6} m/s (poor infiltration rate) was found.
- A site-specific environmental report was produced by Delta-Simons in April 2020 to investigate for any potential risk of groundwater contamination. No significant source of contamination was found.
- Based on this infiltration rates and the location of the developments, the proposed surface water strategy involves the division of the entire site into two separate surface water networks.
- Two surface water drainage strategies have been prepared for this development.
- Primary Surface Water Drainage Strategy
    - Catchment A will have a cellular storage volume of 218m^3 (which includes the surface water runoff from Catchment C & the surface water drained from the identified pluvial flooding locations during the 100 year plus 40% climate change event) with infiltration into the ground with satisfying the half-drain time requirements.
    - Catchment B will have a cellular storage volume 183m^3 (which includes the surface water drained from the identified pluvial flooding locations during the 100 year plus 40% climate change event) that discharges via infiltration into the ground and into Thames Water public sewer at 5l/s with satisfying the half-drain time requirements. Thames Water approval has been obtained for 5 l/s discharge rate.
    - The surface water runoff from the existing carpark Catchment C with an impermeable area of 787m^2 will be collected using sponged gullies and infiltrated via soakaway located in Catchment A. Refer to Appendix G for proposed drainage plan.
- Should the geotechnical investigation find ground condition for potential sink holes, alternative surface water drainage strategy to be implemented.
- Alternative Surface Water Drainage Strategy

- The proposed alternative drainage strategy replaces the usages of cellular soakaways with cellular attenuation tanks and seeks to discharge the surface water runoff into the existing Thames Water surface water network.
- Total attenuation volume requirement of 175m^3 for the cellular attenuation tank 01.
- Total attenuation volume requirement of 262m^3 for the cellular attenuation tank 02.

- The proposal involves an average foul water discharge of 0.993l/s (peak flow 5.96l/s). This is proposed to connect into the existing Thames Water foul water sewer in the vicinity of the works. Thames Water has confirmed the capacity in their foul water sewer for this development run off.

2 INTRODUCTION

Pinnacle Consulting Engineers Ltd have been commissioned by Saunders Architects on behalf of YMCA to carry out a Drainage Strategy report for a proposed development of a site off Peartree Lane Welwyn Garden City AL7 3UL. A site location plan is enclosed in Appendix A.

The purpose of this report is to propose a viable and sustainable strategy for the management of foul water and surface water runoff (with climate change allowances). This will also require devising a feasible discharge location for both networks and ensuring the networks have the capacity to accommodate the proposed discharge rates.

2.1 Site description

The proposed 0.671ha development is centred on National Grid Reference (NGR) TL244125 (524409mE, 212593mN) at Peartree Lane, Welwyn Garden City, AL7 3UL within a predominantly residential/commercial area. The existing brownfield site comprises 1 and 2 storey buildings with car parking at the north of the site.

The site can be accessed from Peartree Lane. The site is bound to the North East by Peartree Farm, to North West by Carpark of another territory, to the South West by Landscaping and Peartree Lane runs along its southwestern boundary.

There are no fluvial features in the vicinity of the site. The nearest river Lea is approximately 2.1km to the South Western part of the site.

Figure 2.1 – Aerial View of the existing development site (approximate site boundary edged red)

2.2 Topography

The development site has a relatively shallow slope falling in the centre of the site. The highest level is 85.80m AOD and the lowest level is 82.20m AOD. No uniform sloping of the site is observed.

Details of existing development site levels are enclosed in Appendix B.

2.3 Geological ground conditions

The Geological conditions at the site detailed below in Table 2.1 are based on available records provided by the British Geological Survey (BGS) website.

Formation	Description
Artificial Ground (Made Ground)	No artificial deposits have been delineated on the BGS site maps.
Superficial Deposits (Drift Deposits)	Lowestoft Formation - Diamicton. Superficial Deposits formed up to 2 million years ago in the Quaternary Period. Local environment previously dominated by ice age conditions (U). ice age conditions (U). These sedimentary deposits are glacigenic in origin. They are detrital, created by the action of ice and meltwater, they can form a wide range of deposits and geomorphologies associated with glacial and inter-glacial periods during the Quaternary.
Bedrock	Lewes Nodular Chalk Formation and Seaford Chalk Formation (undifferentiated) - Chalk. Sedimentary Bedrock formed approximately 84 to 94 million years ago in the Cretaceous Period. Local environment previously dominated by warm chalk seas. These sedimentary rocks are shallow-marine in origin. They are biogenic and detrital, generally comprising carbonate material (coccoliths), forming distinctive beds of chalk.

Table 2.1 – Geological Ground Conditions

Figure 2.2 Extract of Groundwater Source Protection Zones Map of the Site from the Environmental Agency website.

An Environmental Site Investigation was carried out on the site in April 2020, where ground conditions were investigated for potential contaminants. During the investigation, Made ground was encountered across the site up to a maximum depth of 0.68m bgl (below ground level) and is generally comprised of a limited thickness of gravelly clayey sandy topsoil with brick and flint underlain by gravelly clay with brick fragments. Moreover, groundwater was found at 3.40m bgl. The Environmental Report is enclosed in Appendix J, respectively.

Figure 2.2 depicts that the development site lies within the Source Protection Zone 3 which is described as the total area needed to support the abstraction or discharge from the protected groundwater source.

2.4 Flood Zone

The Environmental Agency's Flood map for planning indicates that the site is in Flood Zone 1 - little or no risk, with an annual probability of flooding from rivers and the sea of less than 0.1% (1 in 1000-year rainfall event) (see Figure 2.3). The nearest river (River Lea) is approximately 2.1km to the south-west of the site.

Figure 2.3 – Environment Agency Online Flood Map Extract (Approximate Site Extents Edged Red)

2.5 Proposed Development

The scheme proposes 100 bed YMCA hostel and 43 residential dwellings with the demolishment of existing development. The proposed development plan is enclosed in Appendix C, respectively.

3 EXISTING DRAINAGE MANAGEMENT

3.1 Existing surface water management

A utility survey of the existing infrastructure within the site was conducted by Malcolm Hughes Charted Land Surveyors on the 9th of August 2019. Utility survey records are attached in Appendix E of this report; the records delineate all observed surface water networks within the site.

Surface water sewer operated/manages by Thames water runs along Peartree farm/ Peartree lane to the north-east. It appears this surface water sewer picks ups the run-off from the car parks, existing hostel buildings and form adjacent sites.

For the office units in the front of the site, the surface water runoff is infiltrated through Soakaway situated in the front of the site with existing Landscaping. Another surface water network is delineated for the north-western part of the building, but the outfall of this network is non-identified.

The existing finishing across the site was largely comprised of a large impermeable area with landscaping and vegetations roughly following its perimeter. The existing impermeable area which drained by the existing surface water sewers is approximately 5,083m^2.

3.2 Existing foul water management

The utility survey conducted by Malcolm Hughes Charted Land Surveyors also delineates the location of existing private foul water sewer. There are three separate foul water sewers identified discharging to the Thames water foul sewer network runs along the North-eastern part of the site. For the existing buildings and Carpark, the foul sewer is connected to the public sewer via Ø150mm pipe same goes for the existing hostel and office units to the other part of the site. For the existing development to the south-east of the site, the foul sewer is connected via Ø100mm pipe to the public sewer system runs along its south-eastern part.

4 PROPOSED SITE DRAINAGE

4.1 Surface Water Discharge

Traditional approaches to urban drainage have comprised of underground tanks and pipe networks. More recently, the benefits and opportunities to use Sustainable Drainage Systems (SuDS) have been realised and encouragement to use such systems is promoted throughout the Flood Risk Management policy at all levels. SuDS is a term which encompasses a variety of approaches to managing surface water in a way which is more sympathetic to the natural and human environment than conventional piped drainage systems. Management of surface water is an essential element for reducing flood risk and SuDS techniques are often designed to achieve this in a way that mimics the natural environment.

The Building Regulations (H3) states the priority for discharging surface water runoff from development is as follows:

1. Infiltration into the ground;

2. Discharge into a watercourse;

3. Discharge into a sewer.

Following the results of a site-specific infiltration test to BRE Digest 365, conducted in April 2020 by Delta-Simons, it can be confirmed (refer to Table 25.1 of the CIRIA "The *SuDS Manual*") that infiltration is a viable method of surface water discharge. Appendix J provides a plan and results of the soil infiltration soakaway tests. Infiltration values of 4.5x 10^{-5} m/s and 7.0x 10^{-6} m/s was recorded during the tests.

It should be noted that there is already a functioning soakaway within the site. However, given the historic use of the site, there may be a risk of groundwater contamination. Therefore, a Geo-Environmental investigation was conducted by Delta-Simons in April 2020 to investigate for any potential risk of groundwater contamination.

The Environmental report concluded that only marginal exceedances of PAHs, arsenic and lead were identified within shallow soils above stringent guidance values and are not considered significantly elevated. The overall risk to controlled water is considered low because the shallow Made Ground is likely to be excavated and removed from the site. Therefore, removing the identified source of contamination. Moreover, cohesive clay deposits have been identified above the mapped chalk, effectively limiting vertical migration of contamination. The use of interceptors is also recommended to mitigate any potential risk for groundwater contamination. The Environmental Site Investigation has confirmed that there are no Licensed Abstraction Records from groundwater for potable water supply within 250 m of the Site.

It can be seen from the enclosed drawing in Appendix D that the existing impermeable area for the site is 5,077m^2 and the proposed impermeable area is 4,824m^2, resulting in a net decrease of 253m^2 in the impermeable surface.

4.2 Local Constraints and Planning Policies

The information provided below is an extract from the Welwyn Hatfield Council was produced in 2005 found on the council website.

Policy R7 - Protection of Ground and Surface Water

Planning permission will not be granted for development which poses a threat to the quality of both surface and/or groundwater. Where proposals are acceptable the use of sustainable drainage systems will be encouraged, dependent on local site and underlying groundwater considerations.

<u>Development on Floodplains and Flood Prevention</u>

Floodplains act as storage and conveyancing areas for floodwater and may also have high environmental and amenity value. Floodplains therefore need safeguarding from inappropriate development. Any development, including raising the floor of the floodplain, may affect its storage capacity. This results in an increased risk of flooding and may affect other parts of the interconnected water system. The Environment Agency has identified the floodplains in the district, the majority of which are in the Green Belt. The Council will resist proposals after consultation with the Environment Agency for new development in these areas.

New development outside floodplains can result in increased problems of flooding downstream because of an increase in run-off from impermeable surfaces. There may be ways however of ameliorating the problem by the use of sustainable drainage systems including, for example, balancing ponds, swales and porous pavements. These techniques will require appropriate design and siting. The suitability of certain infiltration techniques will also depend on site specific groundwater considerations. There may also be opportunities for increasing biodiversity with sustainable drainage techniques. The Council will not allow development, after consultation with the Environment Agency, that would increase the risk of flooding downstream because of increased surface run-off.

Policy R8 - Floodplains and Flood Prevention

Within the floodplains identified on the Proposal Map, planning permission for development will not be granted where proposals would;

- *(i) Decrease the capacity of the floodplain to store flood water; or*
- *(ii) Impede the flow of water; or*
- *(iii) Increase the number of people and properties at risk from flooding. Planning permission for new development outside floodplains will not be granted where the proposals would result in an increase in flooding downstream because of increased run-off. The use of sustainable drainage systems will be encouraged, dependent on local site and underlying groundwater considerations.*

Proposals for development necessary to prevent an increase in flooding will be considered in terms of their impact on biodiversity, the landscape and recreation."

The proposed site falls into the Flood Zone 1 and therefore not affecting any floodplains.

Policy R10 – Water Conservation Measures

New development will be expected to incorporate water conservation measures wherever applicable, including sustainable drainage systems, water storage systems, soft landscaping and permeable surface to help reduce surface water run-off.

Sustainable drainage measures have been proposed such as permeable paving at the car parking bays, soft landscaping features and infiltration soakaways.

4.3 Proposed Development Surface Water Drainage Strategy

The proposed development plan necessitates demolishment of existing structures and construction of new development. The surface water runoff from the proposed impermeable areas in catchment A and B and C (total impermeable area of 4824m^2) will be collected into two separate networks. Refer to Appendix H for the catchment plan. It is also noteworthy to mention there is a significant increase in permeable areas from 1,633m² to 1,892m² (over 16%).

The Surface water runoff from the proposed surface finishing will be collected using an assortment of various devices including road gullies, rainwater downpipes, filter drain, permeable paving etc. The surface water runoff collected will be conveyed through a gravity piped network that will be filtered through petrol interceptors before allowing to infiltrate via cellular soakaways or discharge into the public sewer. Refer to Appendix G for the proposed drainage plan.

The attenuation volume required for the proposed development has been modelled in MicroDrainage using the 'Quick Storage Estimate' programme. The results of the calculations are designed to meet the storage demand for all events up to and including a 1 in 100 years + climate change event (40%). Variables and results of the calculations are shown below.

4.3.1 Catchment A

Proposed hostel building area catchment A surface water network with infiltration soakaway satisfies the half-drain time requirement based on the measured infiltration rate of 4.5x 10^{-5} m/s in the catchment area. Please see the figures below.

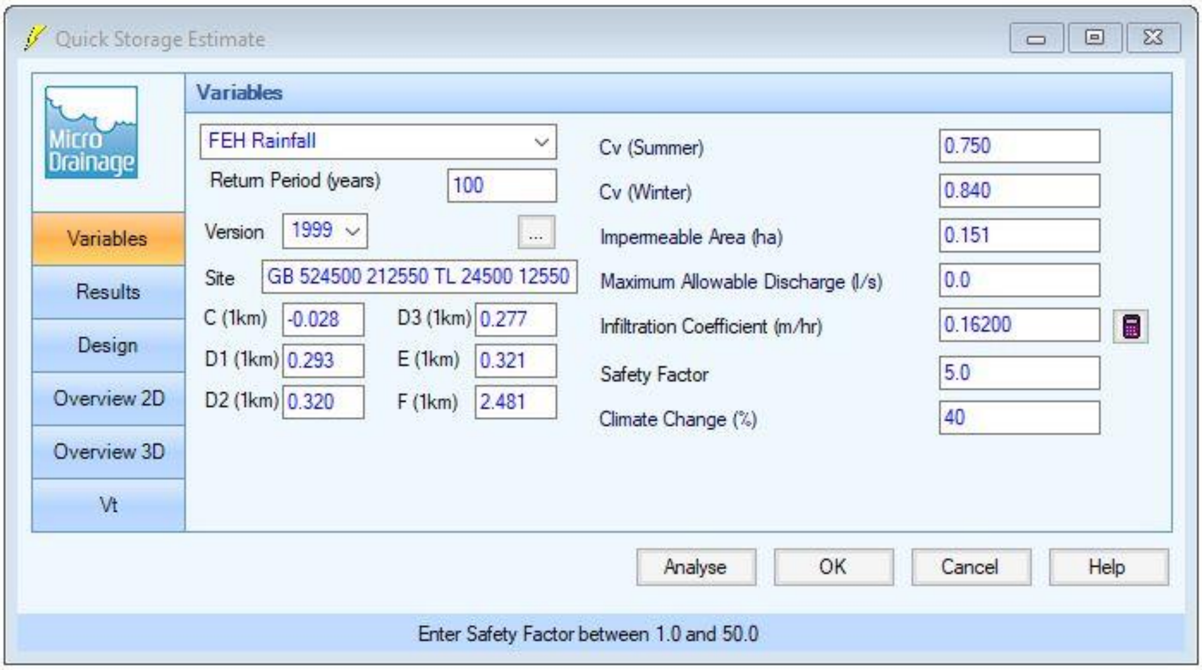


Figure 4.1 – Catchment A- Quick Storage Estimate Variables

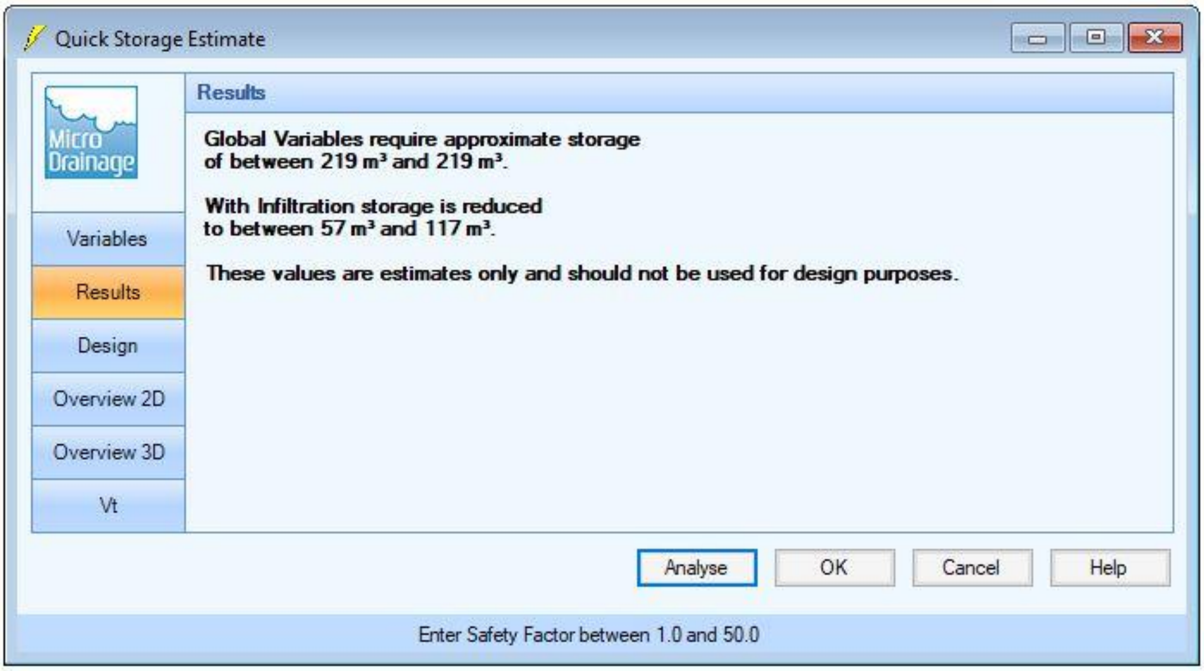


Figure 4.2 – Catchment A- Quick Storage Estimate Results

Based on the above estimate, Catchment A will require attenuation volume of 117m^3. However, additional storage volume is required to account for the surface water drained by the filter drain at the identified pluvial flooding locations during the 100 year plus 40% climate change event (refer to Figure 4.3) and the surface water runoff from the existing carpark Catchment C.

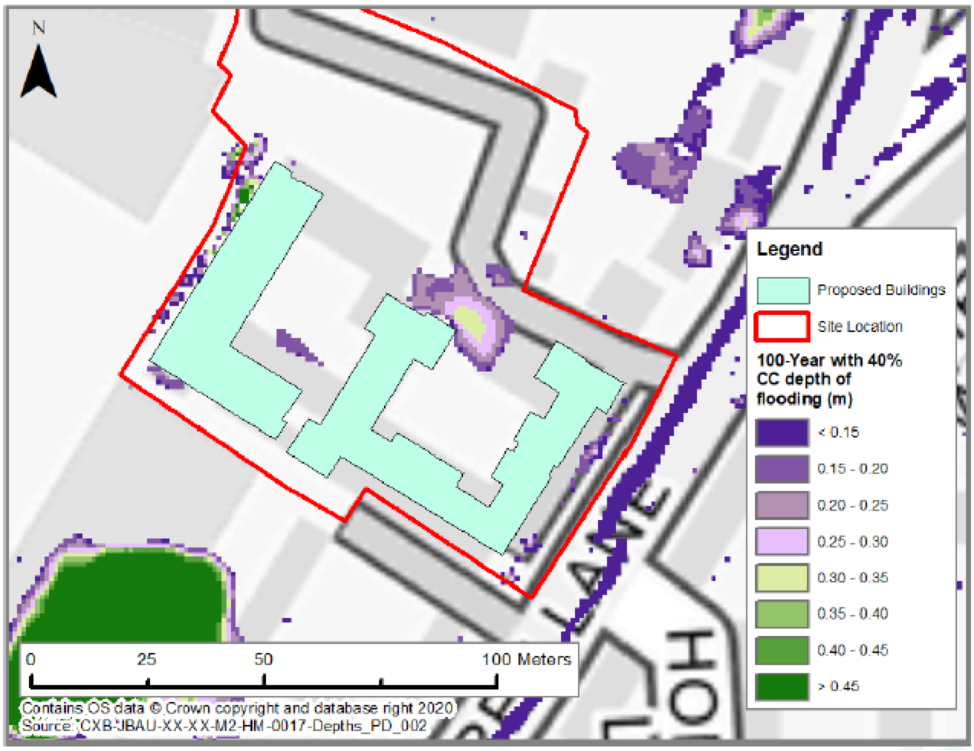


Figure 4.3 – Extract of Surface water flooding depth Map for 100 year plus 40% climate change from Surface Water Modelling Study produced by JBA

Based on the flood depths depicted in Figure 4.3, an upper bound average of 0.40m flood depth is estimated for Catchment A. The area at surface water flooding risk around Catchment A is approximately 98m^2 (refer to Figure 4.4). Therefore, additional storage volume of 40m^3 (98m^2 x 0.40m) has been provided within the soakaway to account for the surface water runoff drained by the filter drain. Whereas a storage volume requirement of 61m^3 has been estimated for Catchment C (refer to 4.3.3), resulting in a total attenuation volume requirement of 218m^3 for the soakaway located in Catchment A.

Figure 4.4 – Areas affected by pluvial flooding within Catchment A

Based on calculations provided below, Catchment A soakaway will have 389 minutes (<1440 minutes) half drain time at the 1.5 m deep soakaway.

Detailed drainage calculations for this catchment is appended in Appendix F.

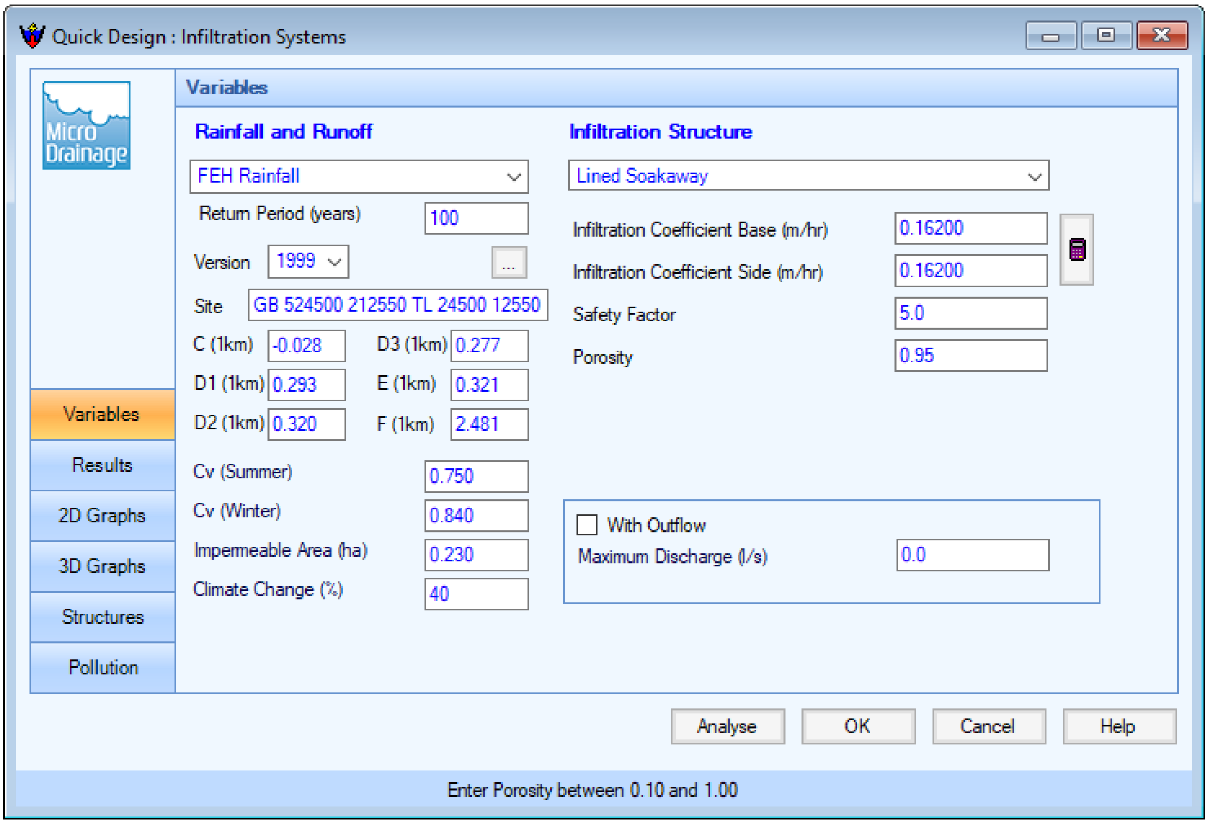
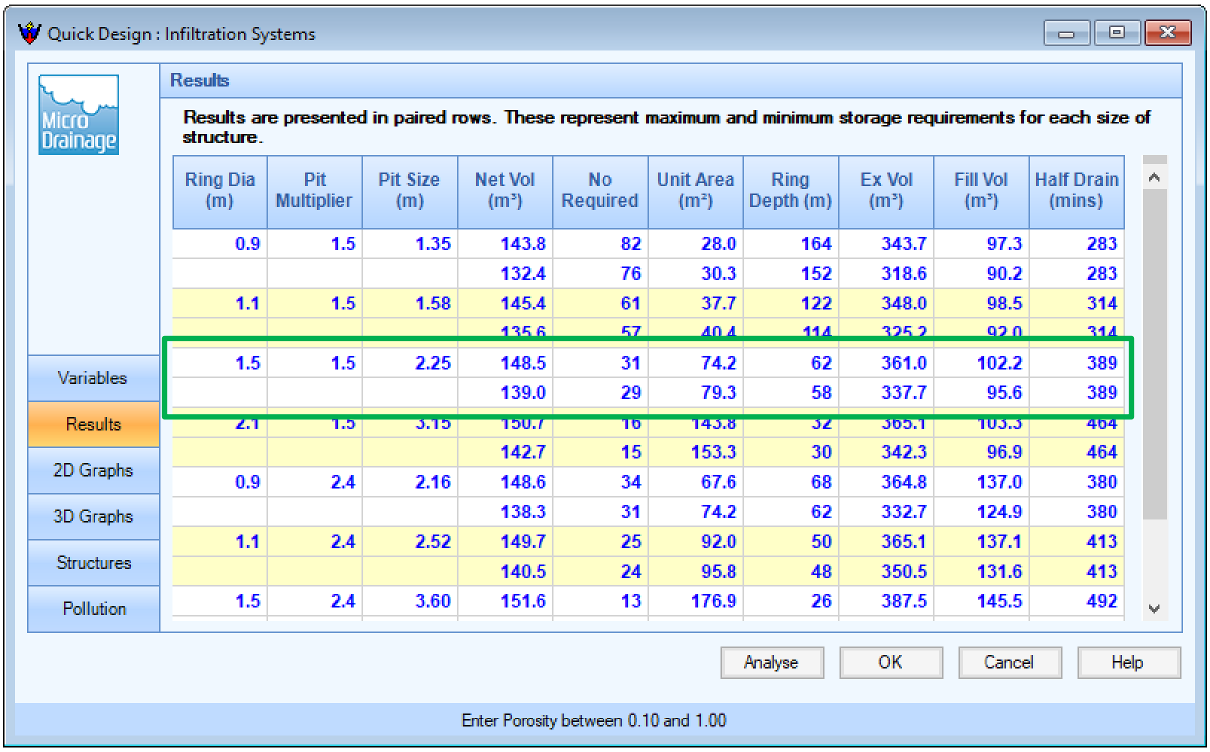


Figure 4.5 – Catchment A- Half Drain Time Calculation Variables



Ring Dia (m)	Pit Multiplier	Pit Size (m)	Net Vol (m³)	No Required	Unit Area (m²)	Ring Depth (m)	Ex Vol (m³)	Fill Vol (m³)	Half Drain (mins)
0.9	1.5	1.35	143.8	82	28.0	164	343.7	97.3	283
			132.4	76	30.3	152	318.6	90.2	283
1.1	1.5	1.58	145.4	61	37.7	122	348.0	98.5	314
			135.6	57	40.4	114	325.2	92.0	314
1.5	1.5	2.25	148.5	31	74.2	62	361.0	102.2	389
			139.0	29	79.3	58	337.7	95.6	389
2.1	1.5	3.15	150.7	16	143.8	32	365.1	103.3	464
			142.7	15	153.3	30	342.3	96.9	464
0.9	2.4	2.16	148.6	34	67.6	68	364.8	137.0	380
			138.3	31	74.2	62	332.7	124.9	380
1.1	2.4	2.52	149.7	25	92.0	50	365.1	137.1	413
			140.5	24	95.8	48	350.5	131.6	413
1.5	2.4	3.60	151.6	13	176.9	26	387.5	145.5	492

Figure 4.6 – Catchment A- Half Drain Time Calculation Results

4.3.2 Catchment B

Proposed residential building area Catchment B (2523 m^2) surface water network with infiltration soakaway does not satisfy the half-drain time requirement based on the measured infiltration rate of 7.0x 10^{-6} m/s in the catchment area. Therefore, it is proposed to discharge some of the surface water runoff from this catchment into the public sewer at the greenfield rate.

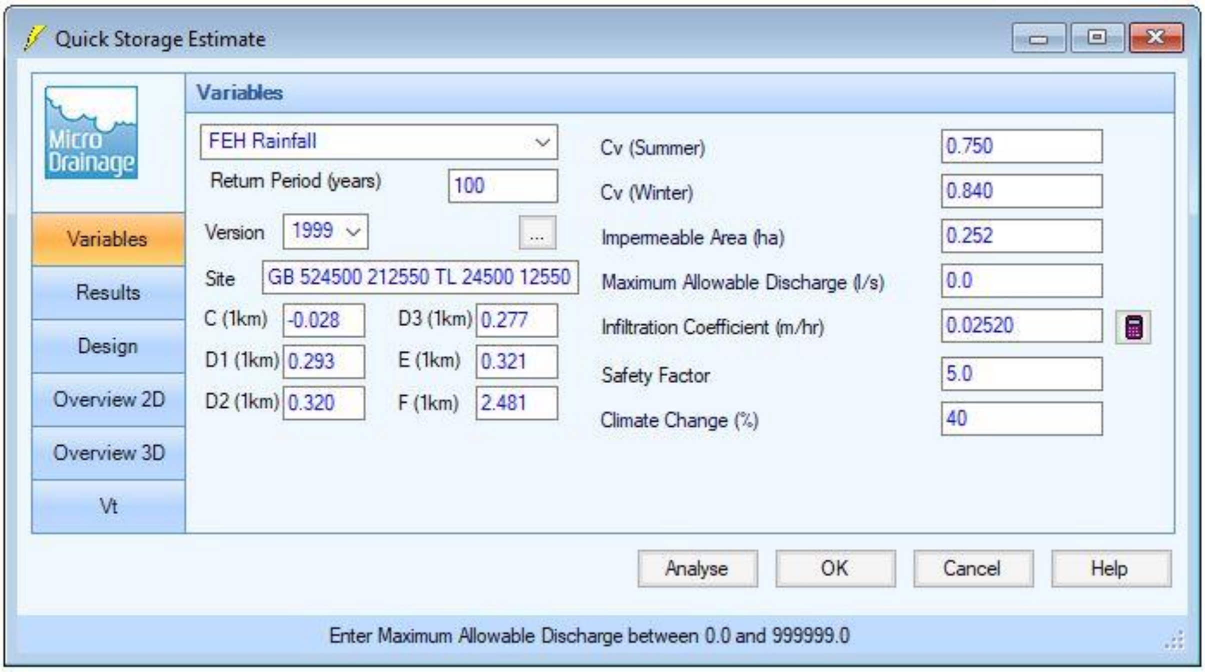


Figure 4.7 – Catchment B- Quick Storage Estimate Variables

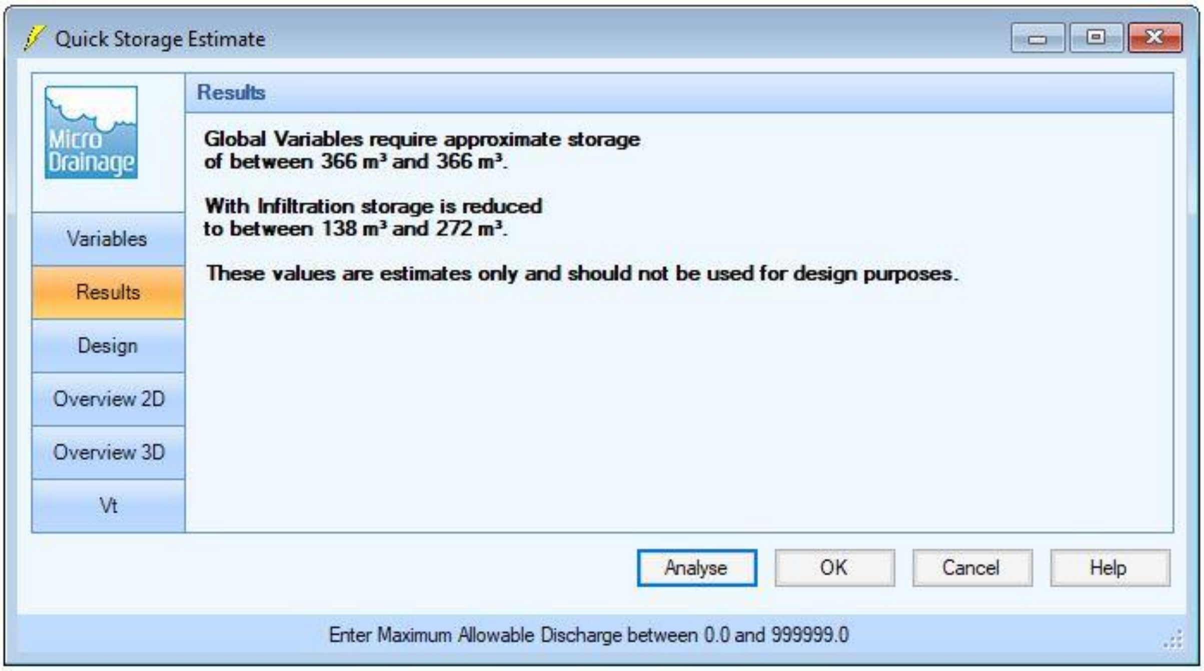


Figure 4.8 – Catchment B- Quick Storage Estimate Results

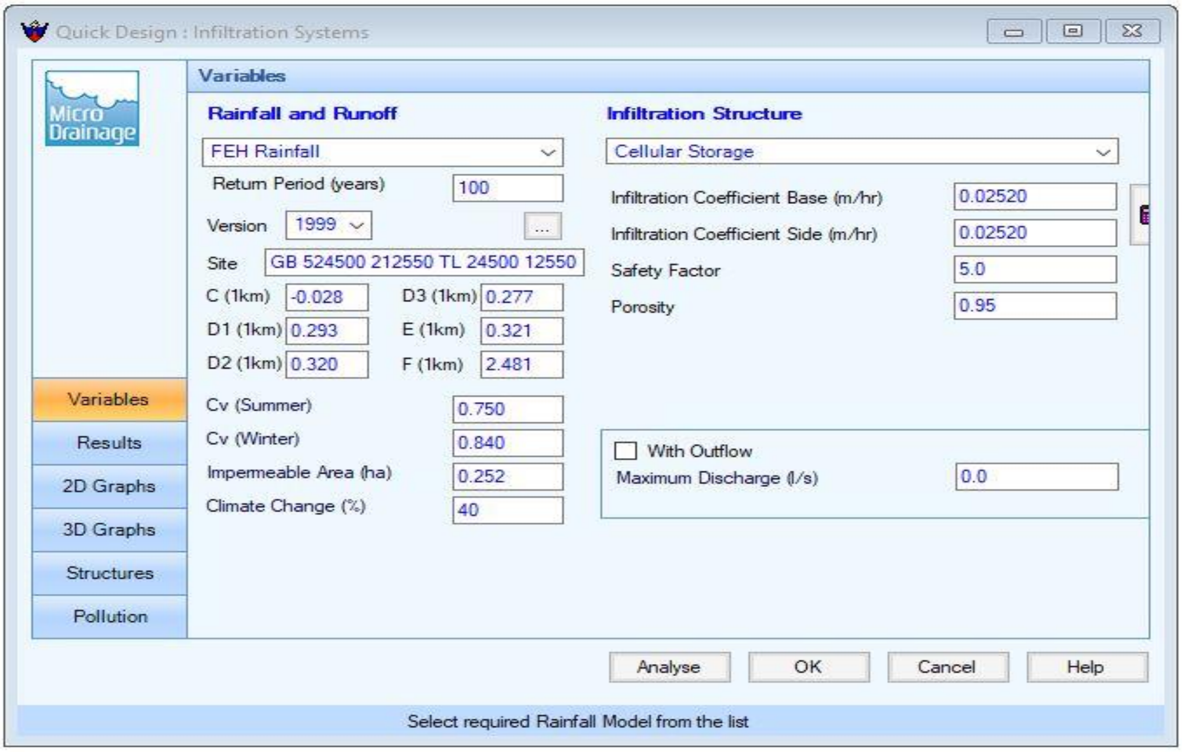
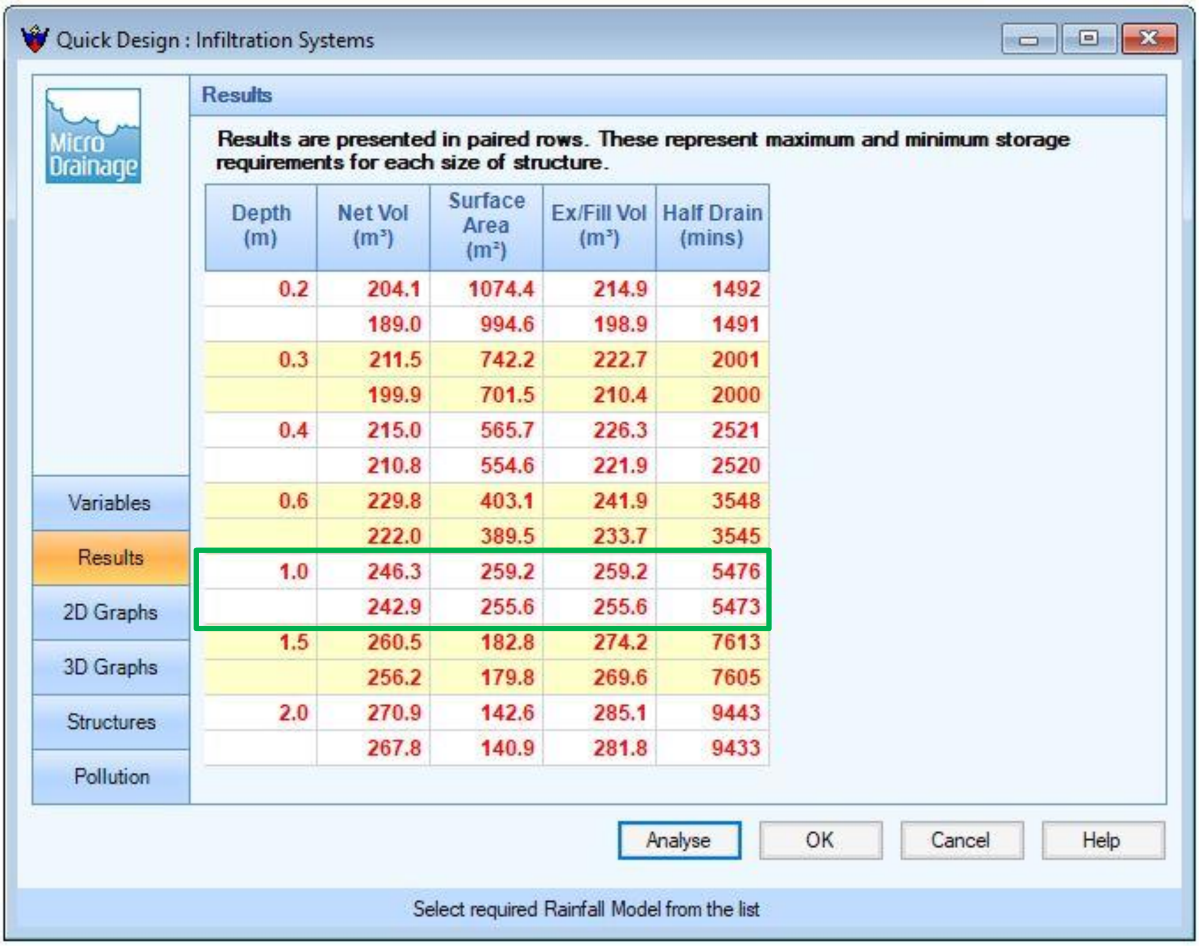


Figure 4.9 – Catchment B- Half Drain Time Calculation Variables



Depth (m)	Net Vol (m³)	Surface Area (m²)	Ex/Fill Vol (m³)	Half Drain (mins)
0.2	204.1	1074.4	214.9	1492
	189.0	994.6	198.9	1491
0.3	211.5	742.2	222.7	2001
	199.9	701.5	210.4	2000
0.4	215.0	565.7	226.3	2521
	210.8	554.6	221.9	2520
0.6	229.8	403.1	241.9	3548
	222.0	389.5	233.7	3545
1.0	246.3	259.2	259.2	5476
	242.9	255.6	255.6	5473
1.5	260.5	182.8	274.2	7613
	256.2	179.8	269.6	7605
2.0	270.9	142.6	285.1	9443
	267.8	140.9	281.8	9433

Figure 4.10 – Catchment B- Half Drain Time Calculation Results

Based on the above half drain calculation, the Catchment B soakaway will have 5476 minutes (>1440 minutes) half drain time at the 1 m deep soakaway. Therefore, the proposed soakaway arrangement will not satisfy the BRE365 requirements.

Alternatively, a combined option of infiltration soakaway and discharge into the public sewer has been explored. Greenfield discharge rate for Catchment B is calculated below.

HR Wallingford
Working with water

Greenfield runoff rate estimation for sites

www.uksuds.com | Greenfield runoff tool

Calculated by:	Sudeep Chongbang
Site name:	YMCA
Site location:	YMCA

This is an estimation of the greenfield runoff rates that are used to meet normal best practice criteria in line with Environment Agency guidance "Rainfall runoff management for developments", SC030219 (2013) , the SuDS Manual C753 (Ciria, 2015) and the non-statutory standards for SuDS (Defra, 2015). This information on greenfield runoff rates may be the basis for setting consents for the drainage of surface water runoff from sites.

Site Details

Latitude:	51.79810° N
Longitude:	0.19699° W
Reference:	2915941919
Date:	May 26 2020 16:13

Runoff estimation approach IH124

Site characteristics

Total site area (ha): 0.2523

Methodology

Q_{BAR} estimation method:	Calculate from SPR and SAAR
SPR estimation method:	Calculate from SOIL type

Soil characteristics

	Default	Edited
SOIL type:	2	2
HOST class:	N/A	N/A
SPR/SPRHOST:	0.3	0.3

Hydrological characteristics

	Default	Edited
SAAR (mm):	655	655
Hydrological region:	6	6
Growth curve factor 1 year:	0.85	0.85
Growth curve factor 30 years:	2.3	2.3
Growth curve factor 100 years:	3.19	3.19
Growth curve factor 200 years:	3.74	3.74

Notes

(1) Is Q_{BAR} < 2.0 l/s/ha?

When Q_{BAR} is < 2.0 l/s/ha then limiting discharge rates are set at 2.0 l/s/ha.

(2) Are flow rates < 5.0 l/s?

Where flow rates are less than 5.0 l/s consent for discharge is usually set at 5.0 l/s if blockage from vegetation and other materials is possible. Lower consent flow rates may be set where the blockage risk is addressed by using appropriate drainage elements.

(3) Is SPR/SPRHOST ≤ 0.3?

Where groundwater levels are low enough the use of soakaways to avoid discharge offsite would normally be preferred for disposal of surface water runoff.

Greenfield runoff rates

	Default	Edited
Q_{BAR} (l/s):	0.43	0.43
1 in 1 year (l/s):	0.36	0.36
1 in 30 years (l/s):	0.98	0.98
1 in 100 year (l/s):	1.36	1.36
1 in 200 years (l/s):	1.59	1.59

This report was produced using the greenfield runoff tool developed by HR Wallingford and available at www.uksuds.com. The use of this tool is subject to the UK SuDS terms and conditions and licence agreement , which can both be found at www.uksuds.com/terms-and-conditions.htm. The outputs from this tool are estimates of greenfield runoff rates. The use of these results is the responsibility of the users of this tool. No liability will be accepted by HR Wallingford, the Environment Agency, CEH, Hydrosolutions or any other organisation for the use of this data in the design or operational characteristics of any drainage scheme.

Figure 4.11 – Catchment B- Greenfield rate calculation

Based on the above calculation, the greenfield discharge rate for Catchment B is 0.43 l/s. Storage and Half drain time requirement were calculated using the 0.43 l/s discharge rate and found that the Half drain calculation is still not satisfied. Refer to below calculations.

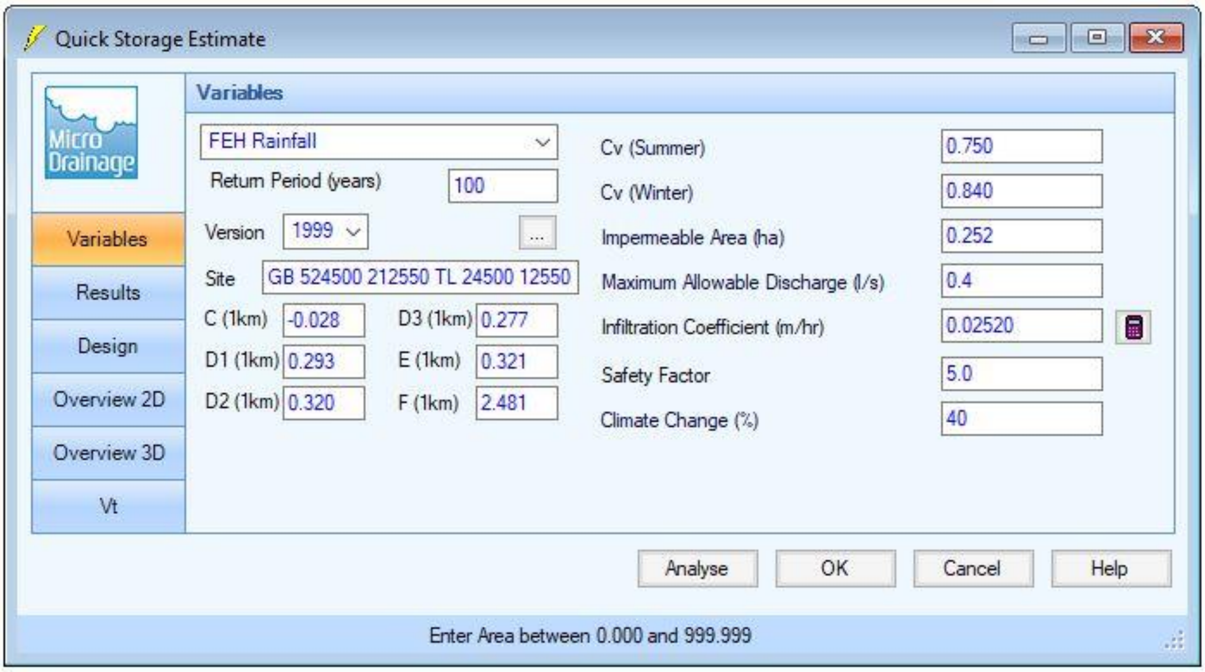


Figure 4.12 – Catchment B- Quick Storage Estimate with Greenfield Rate Discharge Variables

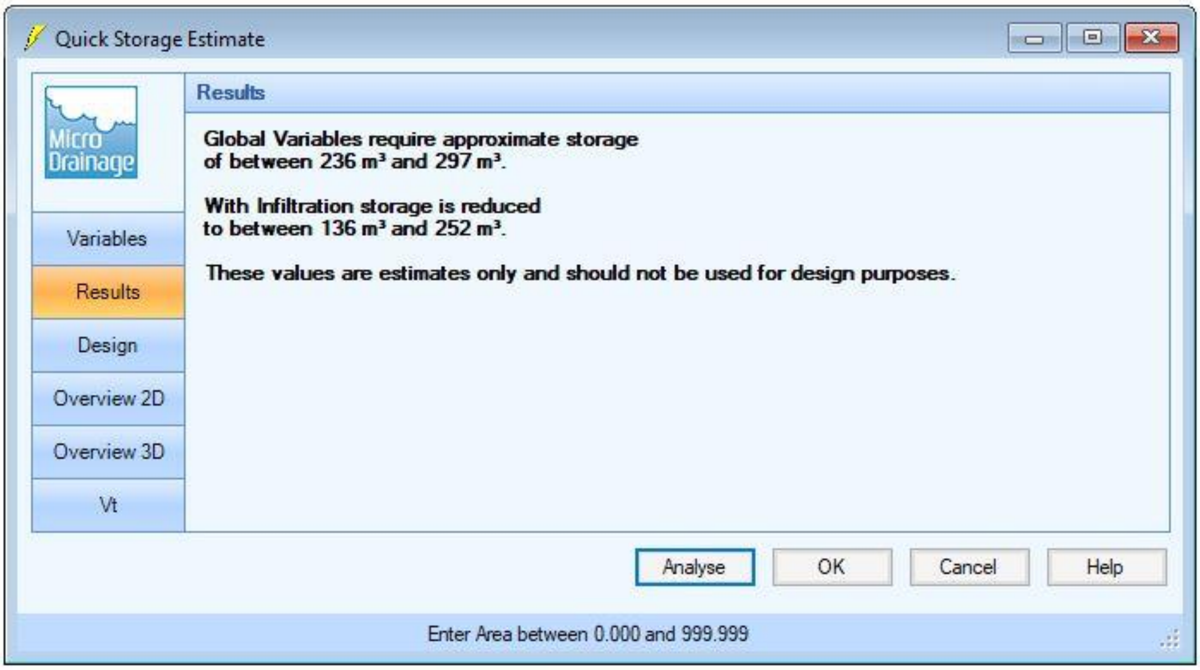


Figure 4.13 – Catchment B- Quick Storage Estimate with Greenfield Rate Discharge Results

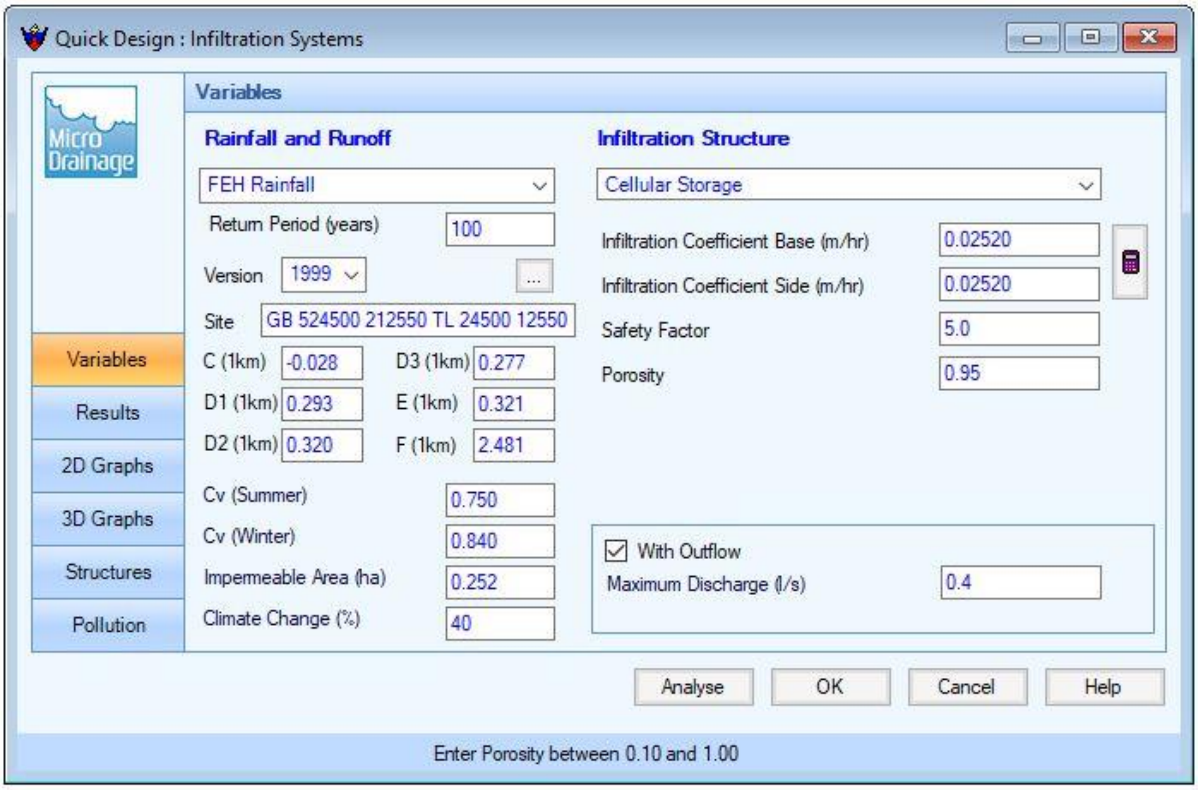
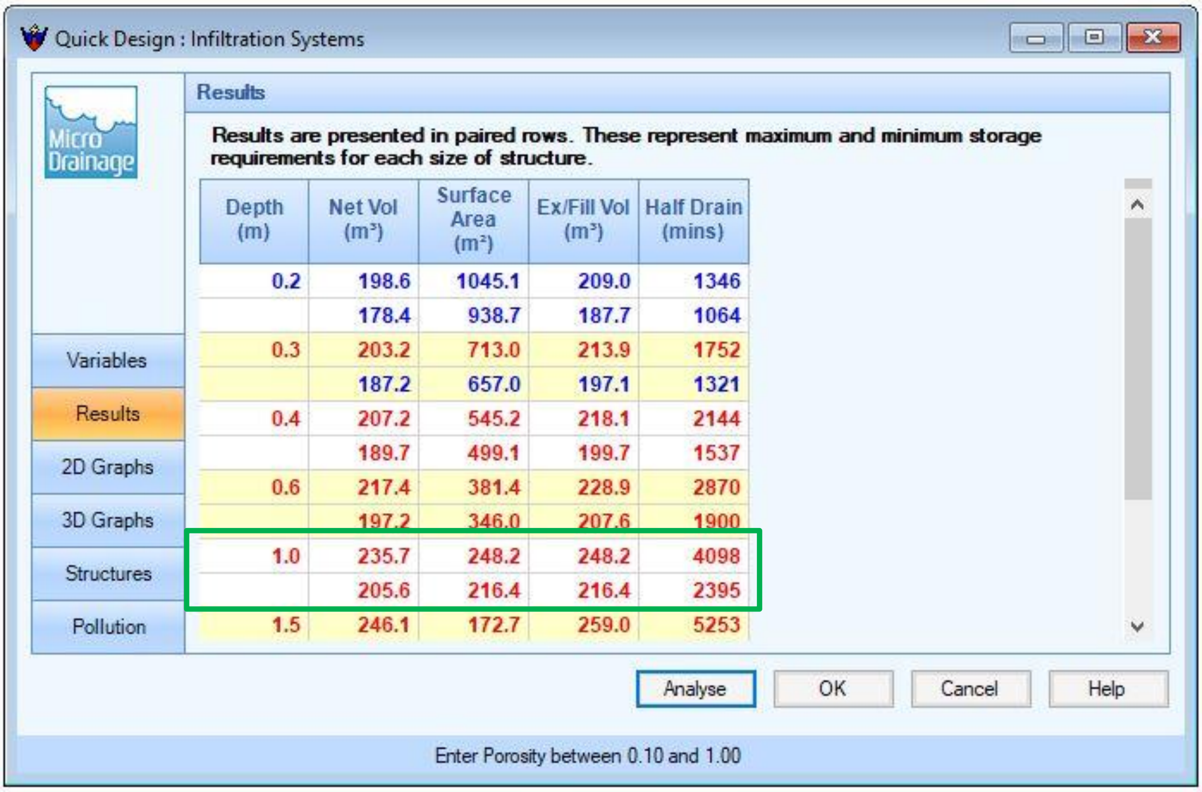


Figure 4.14 – Catchment B-Half Drain Time Calculation with Greenfield Rate Discharge Variables



Depth (m)	Net Vol (m³)	Surface Area (m²)	Ex/Fill Vol (m³)	Half Drain (mins)
0.2	198.6	1045.1	209.0	1346
	178.4	938.7	187.7	1064
0.3	203.2	713.0	213.9	1752
	187.2	657.0	197.1	1321
0.4	207.2	545.2	218.1	2144
	189.7	499.1	199.7	1537
0.6	217.4	381.4	228.9	2870
	197.2	346.0	207.6	1900
1.0	235.7	248.2	248.2	4098
	205.6	216.4	216.4	2395
1.5	246.1	172.7	259.0	5253

Figure 4.15 – Catchment B- Half Drain Time Calculation with Greenfield Rate Discharge Results

As the half drain time calculation is not satisfied with 0.43l/s discharge rate and there will be a risk of blockage, it is proposed to increase the discharge rate into the public sewer to 5 l/s. Calculations below shows this scenario.

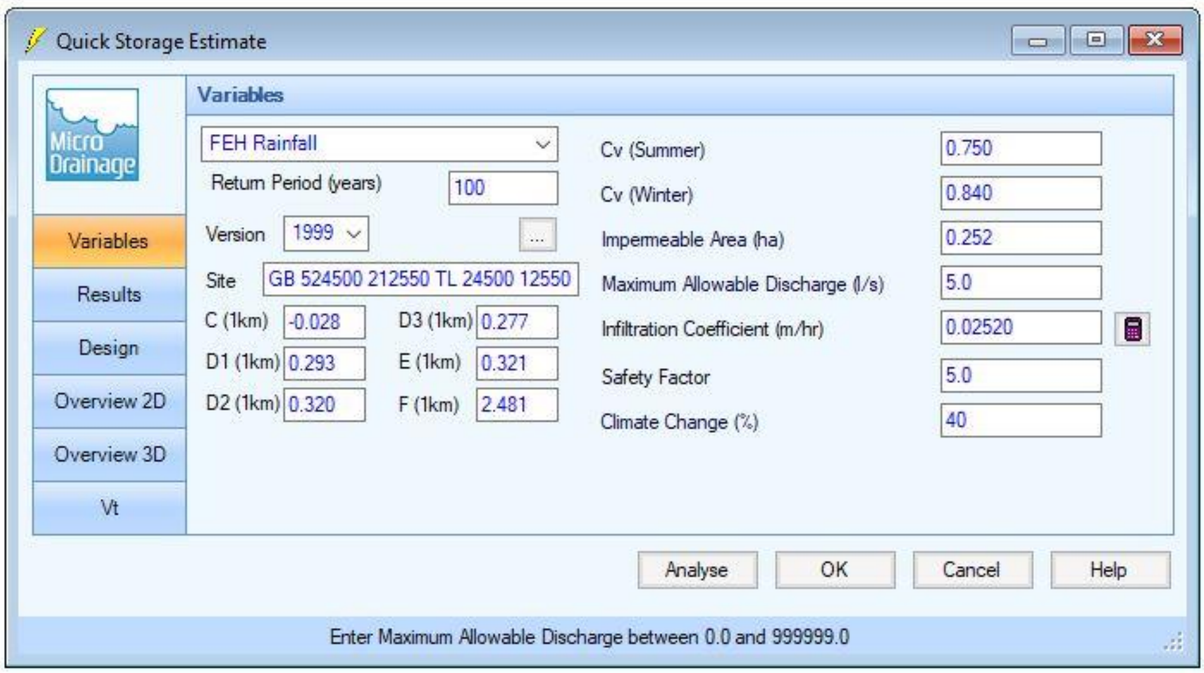


Figure 4.16 – Catchment B- Quick Storage Estimate with 5 l/s Discharge Variables

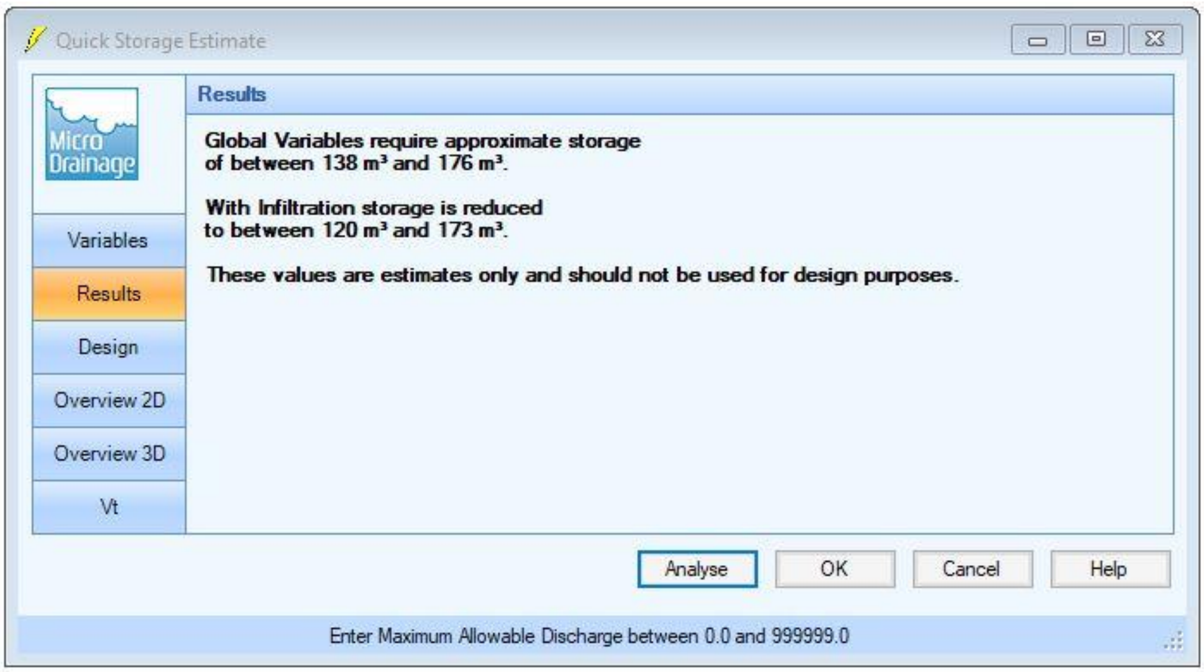


Figure 4.17 – Catchment B- Quick Storage Estimate with 5 l/s Discharge Results

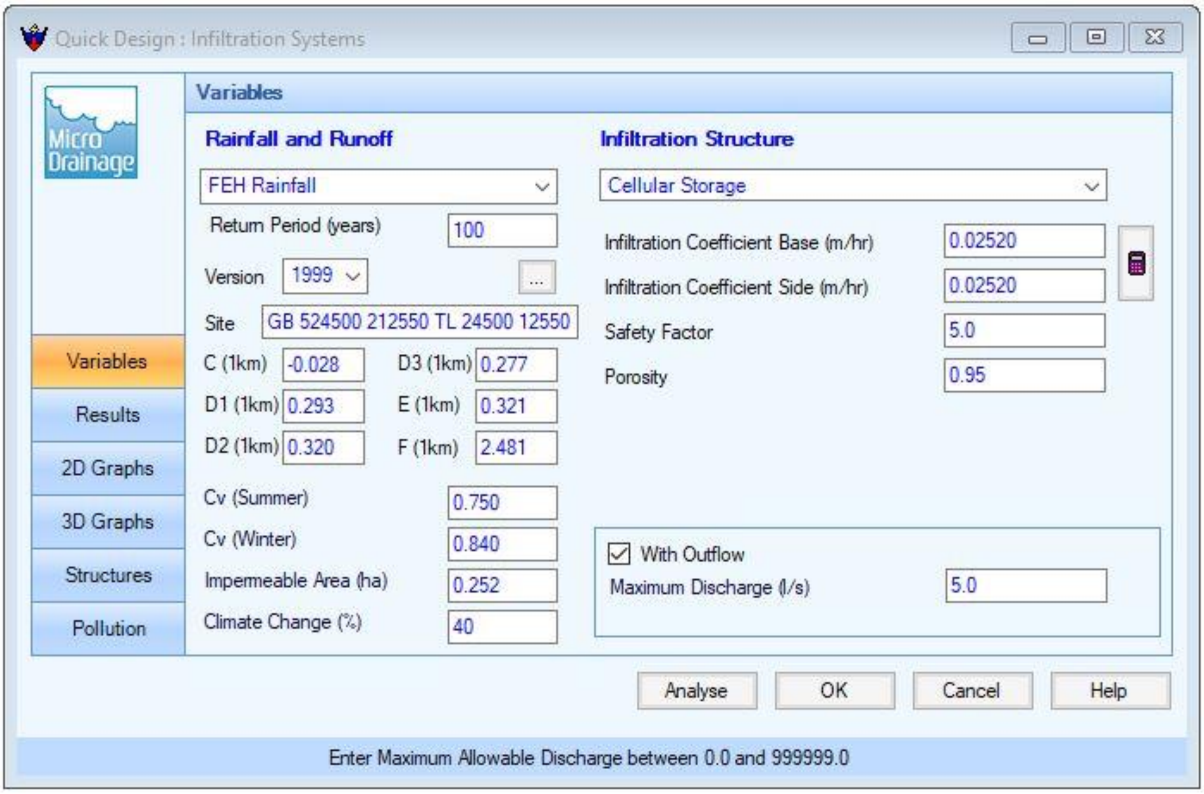


Figure 4.18 – Catchment B- Half Drain Time Calculation with 5 l/s Discharge Variables

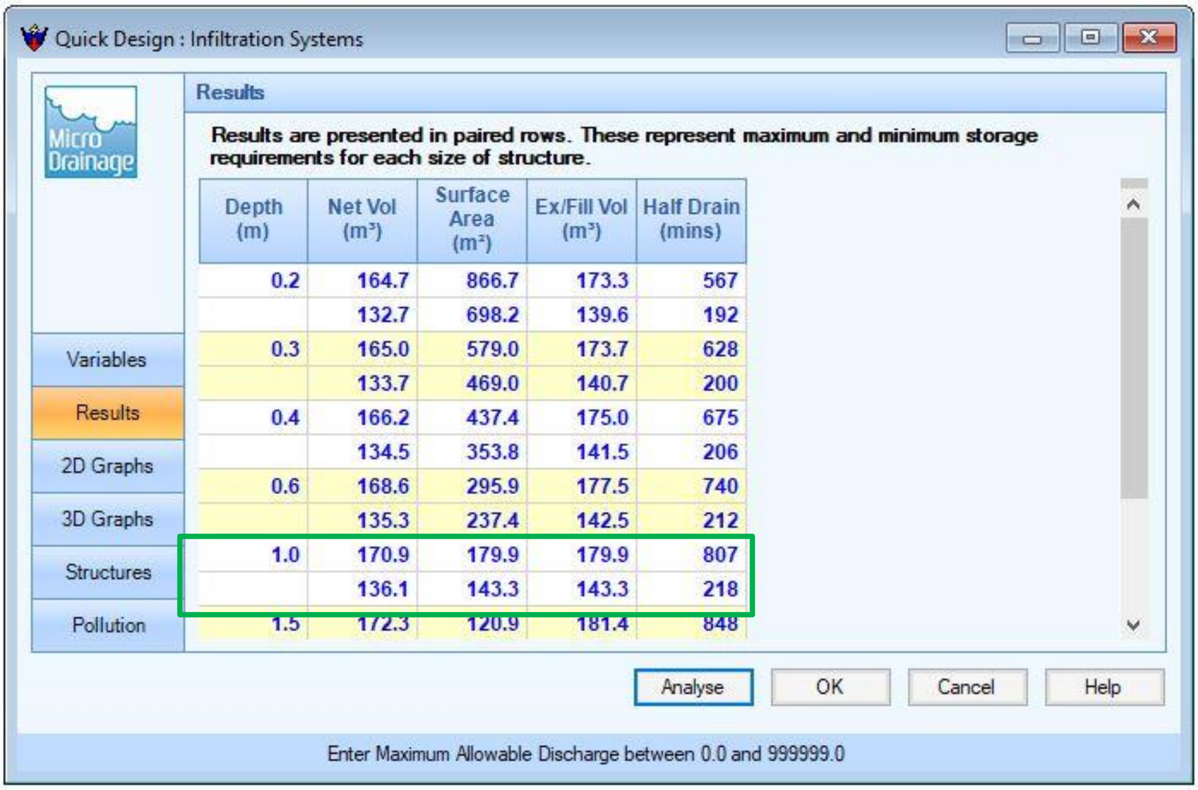


Figure 4.19 – Catchment B- Half Drain Time Calculation with 5 l/s Discharge Results

Based on the above storage estimate, Catchment B soakaway will have a storage volume of 173m^3. However, additional storage volume is required to account for the surface water drained by the filter drains at the southern boundary for the pluvial flooding identified during the 100 year plus 40% climate change event (refer to Figure 4.3).

The area at surface water flooding risk around the southern boundary is approximately 50m^2 (refer to Figure 4.20). Based on the flood depths depicted in Figure 4.3, an average of 0.20m flood depth is estimated. Therefore, additional storage volume of 10m^3 (50m^2 x 0.20m) has been provided within the soakaway to account for the surface water runoff drained by the filter drain.

Figure 4.20 also identifies surface water flooding risk at the middle of the site during the 100 year plus 40% climate change event. The flood risk area is 130m^2 with an average flood depth of 0.225m, resulting in 30m^3 of excess flood volume. This excess flood volume will be mitigated by the permeable paving allocated at the parking bays connected at the subbase level.

Furthermore, the soakaway will discharge via infiltration into the ground and into the public sewer at 5l/s and achieve the half drain time of 807 minutes (<1440 minutes).

A pre-development enquiry has been submitted and Thames Water has confirmed capacity in their surface water sewer for the 5 l/s discharge rate. Refer to Appendix K for Thames Water confirmation letter.

Detailed drainage calculations for this catchment is appended in Appendix F.

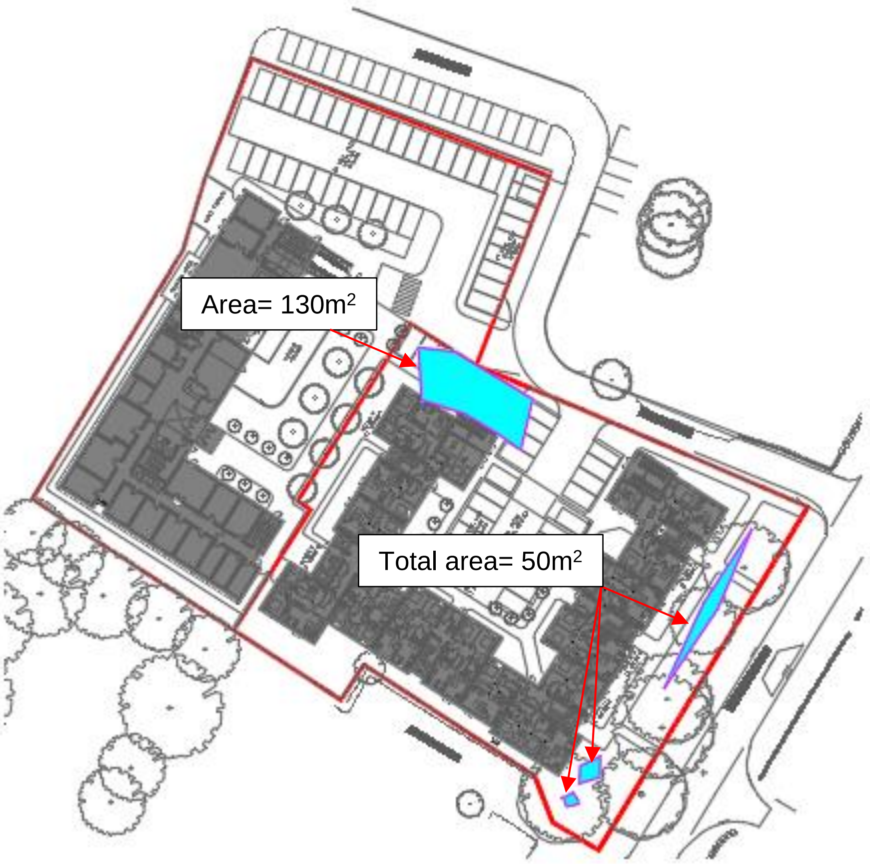


Figure 4.20 – Areas affected by pluvial flooding within Catchment B

4.3.3 Catchment C

The existing carpark area Catchment C (787 m^2) is proposed to drain via infiltration soakaway located within the proposed hotel building/ Catchment A area. The storage estimate calculations provided below suggests that Catchment C will require a storage volume of $61m^3$.

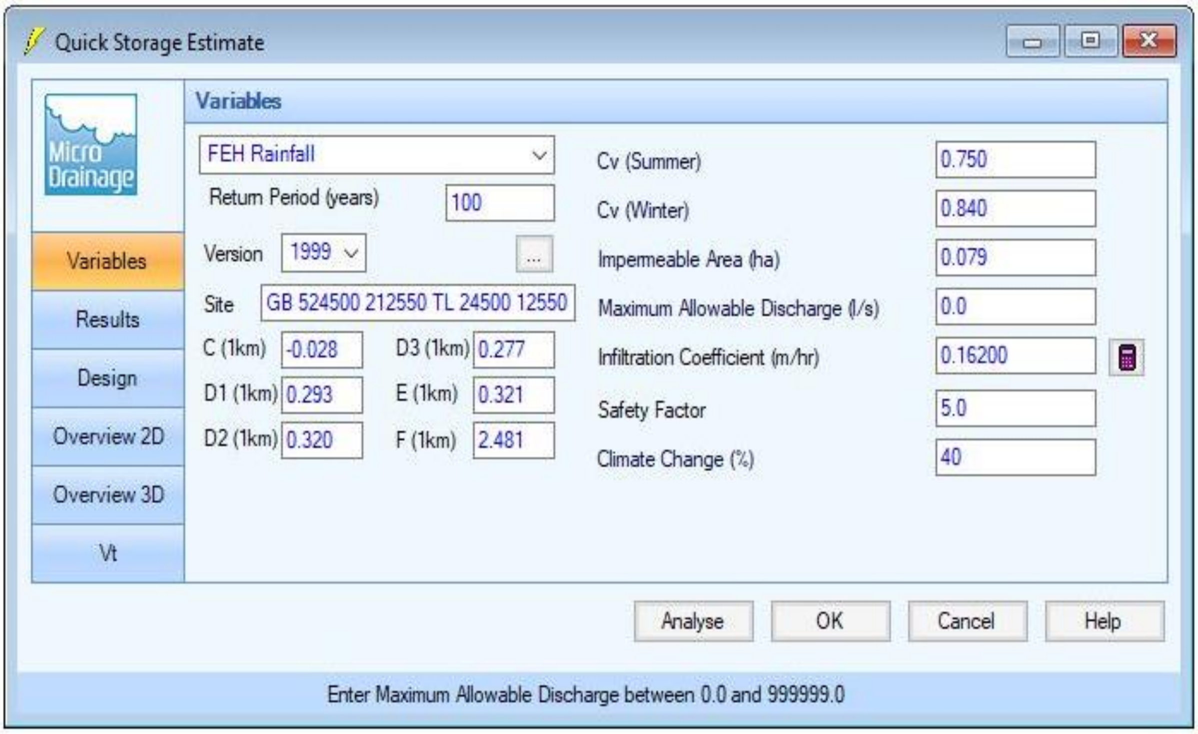


Figure 4.21 – Catchment C- Quick Storage Estimate Variables

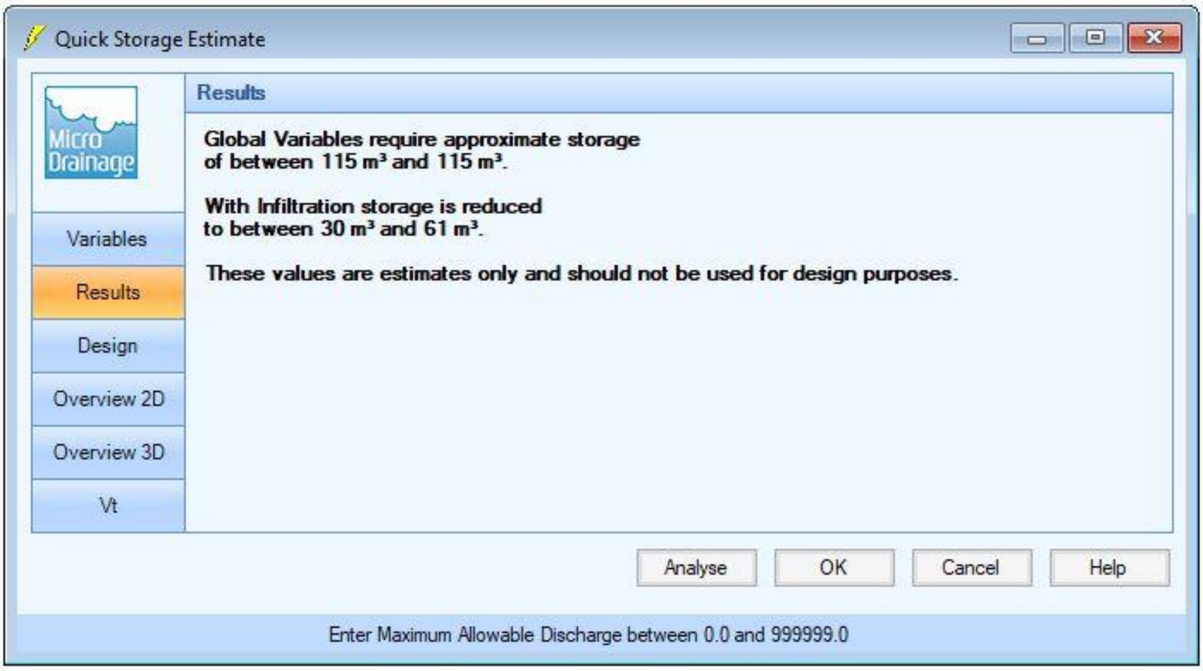


Figure 4.22 – Catchment C- Quick Storage Estimate Results

4.4 Proposed Development Alternative Surface Water Drainage Strategy

Should the geotechnical investigation find ground condition for potential sink holes, alternative surface water drainage strategy to be implemented. The proposed alternative surface water drainage strategy replaces the usages of cellular soakaways with cellular attenuation tanks and seeks to discharge the surface water runoff into the existing Thames Water surface water network. Refer to Appendix L for the proposed alternative drainage plan.

The volumes of each proposed cellular attenuation tanks have been derived from total site impermeable area (4824m^2) in MicroDrainage using the 'Quick Storage Estimate' programme. The outcomes of the calculations are designed to meet the storage demand for all events up to and including 1 in 100+ climate change event (40%).

4.4.1 Catchment A, B & C

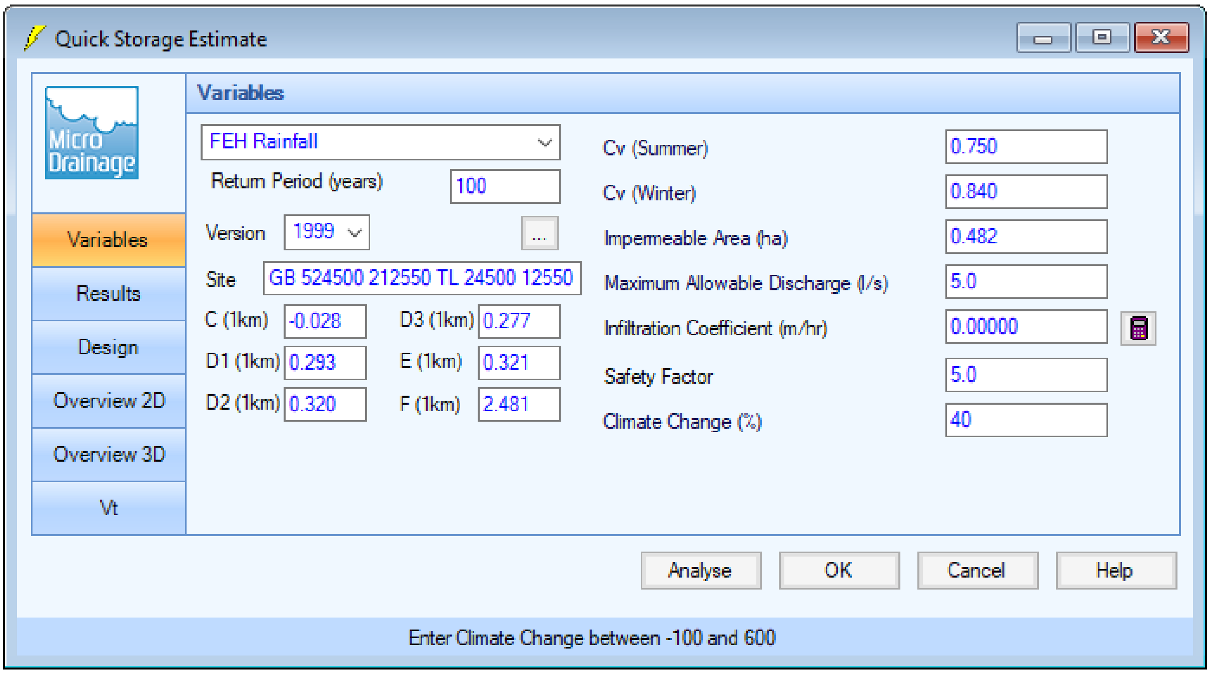


Figure 4.23 – Catchment A, B & C - Quick Storage Estimate Variables

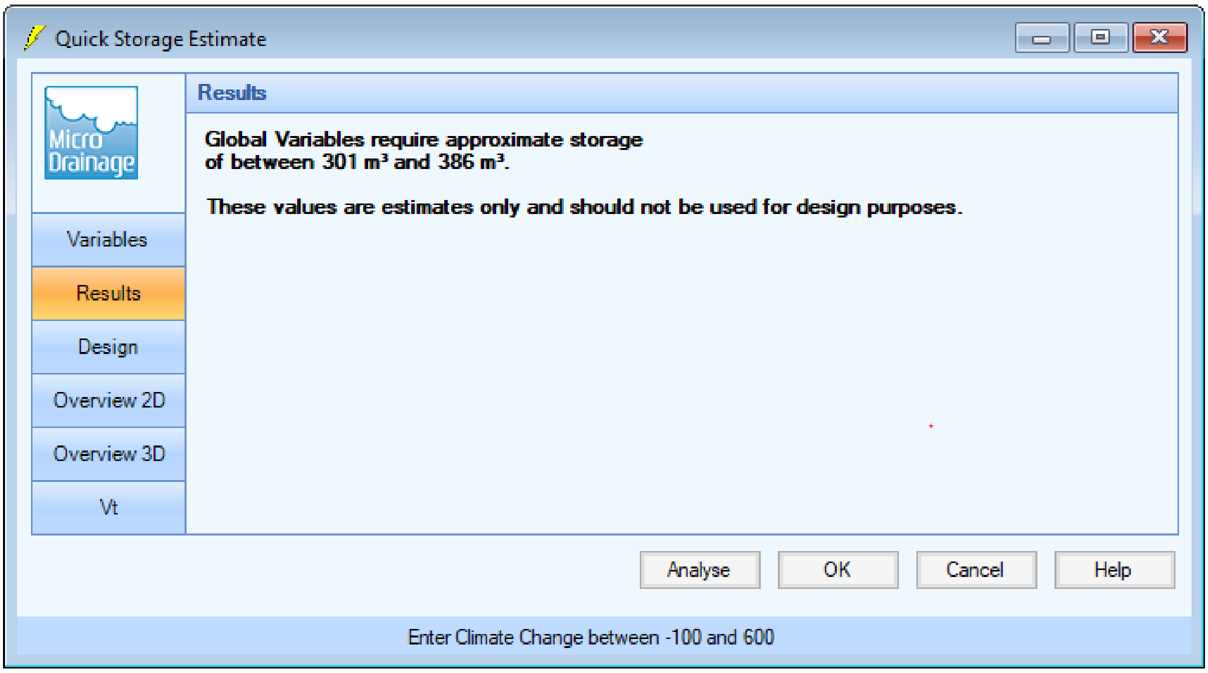


Figure 4.24 – Catchment A, B & C- Quick Storage Estimate Results

Above estimate shows Catchment A, B & C will require total attenuation volume of 386m^3. However, additional storage volume is required to account for the surface water drained by the filter drains at the identified pluvial flooding locations during the 100 year plus 40% climate change event (refer to Figure 4.3, Figure 4.4 and Figure 4.20), resulting in a total attenuation volume requirement of 436m^3 (386m^3 + 40m^3+ 10m^3). Based on this figure, for cellular attenuation tank 01 and cellular attenuation tank 02, attenuation volumes of 175m^3 and 262m^3 are allocated respectively.

Detailed drainage calculations for this catchment is appended in Appendix M.

4.5 Proposed Development Foul Water Drainage Strategy

As presented in Appendix F- Foul water discharge calculation, the proposed development consists of 100 unit of hostel units and 43 of residential schemes. The peak and average flow for hostel units are 4.167l/s and 0.6945l/s. The residential units were estimated as 1.792l/s and 0.2987l/s respectively. The total peak flow discharge from the development site is 5.958l/s.

Thames Water has confirmed capacity in their foul water sewer for this site development foul water runoff. Refer to Appendix K for Thames Water confirmation letter.

4.6 Maintenance Requirements

It is anticipated that a private management company will be employed to maintain the completed drainage network for the development incorporating the following activities and frequency for each SuDS component.

4.6.1 Gullies/Channels/Pipes/Manholes

All components are to be periodically cleaned of foreign particles and silt accumulation, on a quarterly basis. Components located in unadopted areas will be maintained by the landowner. Those located in adopted areas will be maintained by the adopting authority.

4.6.2 Oil Separators/ Petrol Interceptors

Units are to be inspected at least every six months in accordance with the manufacturer's recommendations. A log should be kept detailing the depth of oil found, any oil volume and silt removed, or cleaning carried out. Alarm probes should be removed and cleaned at each inspection.

4.6.3 Proprietary Systems

Proprietary systems will require routine maintenance by the owner to ensure continuing operation to design performance standards. A typical maintenance schedule is detailed below in table 14.2 from the CIRIA SuDS manual.

TABLE 14.2 An example of operation and maintenance requirements for a proprietary treatment system

Maintenance schedule	Required action	Typical frequency
Routine maintenance	Remove litter and debris and inspect for sediment, oil and grease accumulation	Six monthly
	Change the filter media	As recommended by manufacturer
	Remove sediment, oil, grease and floatables	As necessary – indicated by system inspections or immediately following significant spill
Remedial actions	Replace malfunctioning parts or structures	As required
Monitoring	Inspect for evidence of poor operation	Six monthly
	Inspect filter media and establish appropriate replacement frequencies	Six monthly
	Inspect sediment accumulation rates and establish appropriate removal frequencies	Monthly during first half year of operation, then every six months

4.6.4 Cellular Soakaway/Attenuation Storage Unit

The proposed Geolight (or equivalent) soakaway/attenuation unit includes a perforated/ slotted distribution pipe surrounded by granular material providing filtration and treatment for surface water flows. This will be installed with an associated filtration device (petrol interceptor, sponge gulley or other) to prevent the intake of debris and the treatment of hydrocarbon mixed in the surface water runoff. Size of the soakaway/attenuation unit must be appropriate for the scale and nature of the development. A typical maintenance schedule is detailed below in table 13.1 and 21.3 respectively from the CIRIA SuDS manual.

TABLE 13.1 Operation and maintenance requirements for soakaways

Maintenance schedule	Required action	Typical frequency
Regular maintenance	Inspect for sediment and debris in pre-treatment components and floor of inspection tube or chamber and inside of concrete manhole rings	Annually
	Cleaning of gutters and any filters on downpipes	Annually (or as required based on inspections)
	Trimming any roots that may be causing blockages	Annually (or as required)
Occasional maintenance	Remove sediment and debris from pre-treatment components and floor of inspection tube or chamber and inside of concrete manhole rings	As required, based on inspections
Remedial actions	Reconstruct soakaway and/or replace or clean void fill, if performance deteriorates or failure occurs	As required
	Replacement of clogged geotextile (will require reconstruction of soakaway)	As required
Monitoring	Inspect silt traps and note rate of sediment accumulation	Monthly in the first year and then annually
	Check soakaway to ensure emptying is occurring	Annually

TABLE 21.3 Operation and maintenance requirements for attenuation storage tanks		
Maintenance schedule	**Required action**	**Typical frequency**
Regular maintenance	Inspect and identify any areas that are not operating correctly. If required, take remedial action	Monthly for 3 months, then annually
	Remove debris from the catchment surface (where it may cause risks to performance)	Monthly
	For systems where rainfall infiltrates into the tank from above, check surface of filter for blockage by sediment, algae or other matter; remove and replace surface infiltration medium as necessary.	Annually
	Remove sediment from pre-treatment structures and/ or internal forebays	Annually, or as required
Remedial actions	Repair/rehabilitate inlets, outlet, overflows and vents	As required
Monitoring	Inspect/check all inlets, outlets, vents and overflows to ensure that they are in good condition and operating as designed	Annually
	Survey inside of tank for sediment build-up and remove if necessary	Every 5 years or as required

4.7 Consultation with Hertfordshire County Council LLFA

4.7.1 Response received on 10th December 2019

Following comments were received from LLFA based on our previous issue of the Drainage Strategy report. Our responses are included below under each item.

1. Full assessment of all existing sources of flooding on the development site.

A separate Flood Risk Assessment report has been prepared for the site assessing all the existing sources of flooding.

2. Clarification of the existing ground condition and contamination risk on the site.

Refer to Appendix J for the Environment Assessment report which provides the clarification on the existing ground conditions and the contaminations risks.

3. Clarification on the existing surface water drainage on the site.

Refer to Appendix G for the proposed drainage plan which identifies the existing drainage networks.

4. Details of the proposed drainage for the indicated road and car parking.

The presence of underground electrical lines with potential high voltage in the vicinity of the car park and its associated easements makes it disadvantageous to extend development/surface water drainage features within this boundary. The drainage strategy was developed keeping the car park and its existing drainage features as it is. The car park, therefore, forms part of the impermeable catchment for the overall site drainage strategy.

5. Clarification of the provided SuDS management stages.

Section 4.3 of the submitted Drainage strategy highlights the maintenance requirements of the proposed SUDs features. The revised drainage strategy report will further highlight the proximity of some region of the site to the Source Protection Zone. Further management stages included in the revised drainage strategy report.

6. Limiting the proposed discharge of surface water runoff from the site to Greenfield runoff rates.

Refer to the proposed development surface water drainage strategy on section 4.3 for further information.

7. Post-development calculations/modelling in relation to surface water for all rainfall events up to and including the 1 in 100 year return period, this must also include a +40% allowance for climate change.

Refer to Appendix F for the surface water post development drainage detailed calculations and simulation results.

8. Clarification of the provided drainage layout.

A revised drawing of the existing drainage pattern included in the revised drainage strategy. Clear separation zones of Soakaway from adjacent buildings highlighted. Refer to Appendix G for the proposed drainage plan which identifies the existing drainage networks.

9. If the drainage proposals are to infiltrate to ground then evidence of permeability should be provided, and test must be conducted in accordance with BRE Digest 365.

Refer to Appendix I for the infiltration test results report.

10. Evidence that if the applicant is proposing to discharge to the local sewer network that they have confirmation from the relevant water company or sewer network operator that they have the capacity to take the proposed volumes and runoff rates.

A pre-development enquiry has been submitted to Thames Water and the confirmation received for both the surface water and foul water discharge rates and their arrangements. Refer to Appendix K for Thames Water confirmation letter.

4.7.2 Response received on 11th September 2020

The following sets of comments were received after a re-consultation with the LLFA. Our responses are included below under each item.

1. We acknowledge that the applicant has submitted an updated drainage strategy. An FRA was also submitted to assess all existing flood risks on the development site. The applicant has undertaken BRE 365 infiltration tests, which proved that infiltration is viable on the site. Having the knowledge of the area, as the LLFA, we are concern about possible ground solutions and creation of potential sink holes. Therefore, further ground investigation will have to be undertaken to assess this potential. This will have to be provided at later design stage.

Detailed geotechnical investigation exercise to be carried out at the detailed design stage to overcome the above concern.

2. We understand that risk of contamination has been assessed and there is not significant risk on site. However, our understanding is that the topsoil will be stripped from the site, as a remediation technique. Moreover, we note that shallow groundwater levels are present on the site. Therefore, groundwater monitoring will have to be undertaken following all required remediation on the site and the removal of the topsoil. Further infiltration testing may be also required. This will have to be provided at later design stage and fully incorporated within the drainage strategy. We would like to remind the applicant that a minimum of 1 meter buffer zone needs to be provided between a bottom of any infiltration feature and the existing groundwater levels on the proposed development site.

Detailed geotechnical investigation exercise including the further groundwater monitoring to be carried out at the detailed design stage to overcome the above concern.

3. We note Thames Water agreement has been provided. We understand that 5 l/s of discharge has been agreed from catchment B. We would advise that a flow control should be identified on a plan, as unrestricted connection will not be approved.

We have updated the Drainage Strategy drawing to show the Hydro-brake manhole and the discharge rate.

4. We have also assessed the submitted Surface Water Modelling Study produced by JBA. It shows post-development site at high surface water flood risk. Therefore, we would strongly advise these flooding areas have to be incorporated within the proposed drainage scheme. Additional storage volumes may be required. We would like to remind the applicant that no flooding should occur on the site for up to and including the 1 in 30 year event. Any informal flooding for up to the 1 in 100 year plus 40% for climate change should be identified on a map.

We have proposed filter drain at the identified pluvial flooding locations to drain the floodwater on the Drainage Strategy drawing with notes. We have added a drainage connection for these filter drains into the proposed drainage system and provide additional storage volume to account for.

5. Moreover, we note that applicant has clarified that the car park will drain via an existing network, which includes two gullies and direct discharge into Thames Water sewer. We understand that the car park may be constrained, however the current proposal is not acceptable. The car park has to be included in the drainage strategy and needs to be appropriately drained. If there is no possibility of a storage structure being proposed within the car park, this area should be connected into the private drainage network proposed for the development. We would like to remind that based on the current standards surface water runoff from a development site needs to be managed on site for up to and including the 1 in 100 year plus 40% for climate change. Moreover, based on the modelled high surface water flood risk on the site, as the LLFA we will seek for all impermeable area within the development site to be positively drained.

Noted. We have updated our strategy for the existing car park on the Drainage Strategy report. The surface water runoff from the car park will be collected using sponged gullies and connected into the proposed surface water network for Catchment A. Refer to Appendix G for the updated drainage strategy.

6. Based on the above the applicant needs to provide an updated drainage strategy with a drainage layout including any further updates, indicating the proposed discharge rate and all flow control structures.

The proposed development site lies within the Source Protection Zone 3 and the applicant intends to infiltrate into the ground. Therefore, an appropriate treatment train needs to be provided.

As the LLFA, we recommend a minimum of two SuDS management stages should be provided to manage any potential contaminants arising from surface water runoff from the car parking areas, internal and access roads. This is because the LPA needs to be satisfied that the proposed development will not have a detrimental impact to the water quality of any receiving surface water body with regards to the Water Framework Directive.

Based on the provided drainage layout, we note that both catchments include road gullies connected directly into the private network, with petrol interceptors prior to a discharge into tanks. We would not consider this as an appropriate treatment train and the applicant should consider further treatment allowance.

Moreover, as further drainage details are required for the car park area, the applicant should strongly consider treatment train for this area, if a discharge into the ground will be considered.

Due to the space restriction in the proposed site layout, we propose to include the following to provide the necessary treatment trains for the surface water runoff.

- Asphalt road gullies and existing car park gullies connected to the private drainage will have the smart sponge component (Smart Gully Adaptor) to capture any hydro-carbon content present in the surface water runoff. This will provide one level of treatment.
- Proposed car parks and internal roads will be paved with permeable block paving which will provide two levels of treatment trains for the surface water runoff.
- The proposed cellular infiltration tank will have a porous distribution pipe surrounded by a granular media before the surface water released into the crates. This will provide one level of treatment.

5 CONCLUSION

The proposed 0.671ha development is centred on National Grid Reference (NGR) TL244125 (524409mE, 212593mN) at Peartree Lane, Welwyn Garden City, AL7 3UL within a predominantly residential/commercial area. The existing brownfield site comprises 1 and 2 storey buildings with car parking at the north of the site.

There are no fluvial features in the vicinity of the site. The nearest river Lea is approximately 2.1km to the South Western part of the site.

The development site has a relatively shallow slope falling in the centre of the site. The highest level is 85.80m AOD and the lowest level is 82.20m AOD. No uniform sloping of the site is observed.

The Environmental Agency's Flood map for planning indicates that the site is in Flood Zone 1 - little or no risk, with an annual probability of flooding from rivers and the sea of less than 0.1% (1 in 1000-year rainfall event).

Based on the British Geological Society map, the development site is found underlain with Lewes Nodular Chalk Formation and Seaford Chalk Formation.

The development proposal consists of 100 bed YMCA hostel and 43 residential dwellings with the demolishment of existing development.

The proposed development contributes to a significant increase (16%) in permeable areas 1,633m^2 to 1,892m^2.

In accordance with the Welwyn Hatfield Council Planning policy and the dictates of Building Regulation H3; the proposed Surface Water Strategy consists of Sustainable Urban Drainage System by focusing on the infiltration of resulting run-off into the ground.

A site-specific infiltration test to BRE Digest 365, conducted in April 2020 by Delta-Simons confirmed (refer to Table 25.1 of the CIRIA "The *SuDS Manual*") that infiltration is a viable method of surface water discharge. Appendix I provides a plan and results of the soil infiltration soakaway tests. A value of 4.5x 10^{-5} m/s and 7.0x 10^{-6} m/s was recorded during the tests.

A Site-Specific Environmental Report was produced by Delta-Simons in April 2020 to investigate for any potential risk of groundwater contamination and no significant source of contamination was identified. Only marginally elevated levels of PAHs, arsenic and lead were identified within shallow soils.

Two surface water drainage strategies have been prepared for this development.

The surface water runoff from the proposed impermeable areas in catchment A and B and C (total impermeable area of 4824m^2) will be collected into two separate networks. The surface water runoff from the existing carpark Catchment C with an impermeable area of 787m^2 will be collected using sponged gullies and infiltrated via soakaway located in Catchment A.

Catchment A will have a cellular storage volume of 218m^3 with infiltration into the ground with satisfying the half-drain time requirements. Catchment B will have a cellular storage volume 183m^3 with combined infiltration into the ground and a 5 l/s discharge rate into the Thames Water public sewer with satisfying the half-drain time requirements. Thames Water approval has been obtained for 5 l/s discharge rate.

Should the geotechnical investigation find ground condition for potential sink holes, alternative surface water drainage strategy to be implemented. Alternative surface water drainage strategy has been prepared and it replaces the usages of cellular soakaways with cellular attenuation tanks and seeks to discharge the surface water runoff into the existing Thames Water surface water network. Total attenuation volume requirement for the cellular attenuation tank 01 is 175m^3. Total attenuation volume requirement for the cellular attenuation tank 02 is 262m^3.

The proposal involves an average foul water discharge of 0.993l/s (peak flow 5.96l/s). This is proposed to connect into the existing Thames Water foul water sewer in the vicinity of the works. Thames Water has confirmed the capacity in their foul water sewer for this development run off.

The proposed drainage system and the SuDS features to be maintained by a private management company based on the maintenance requirement set out on this report.