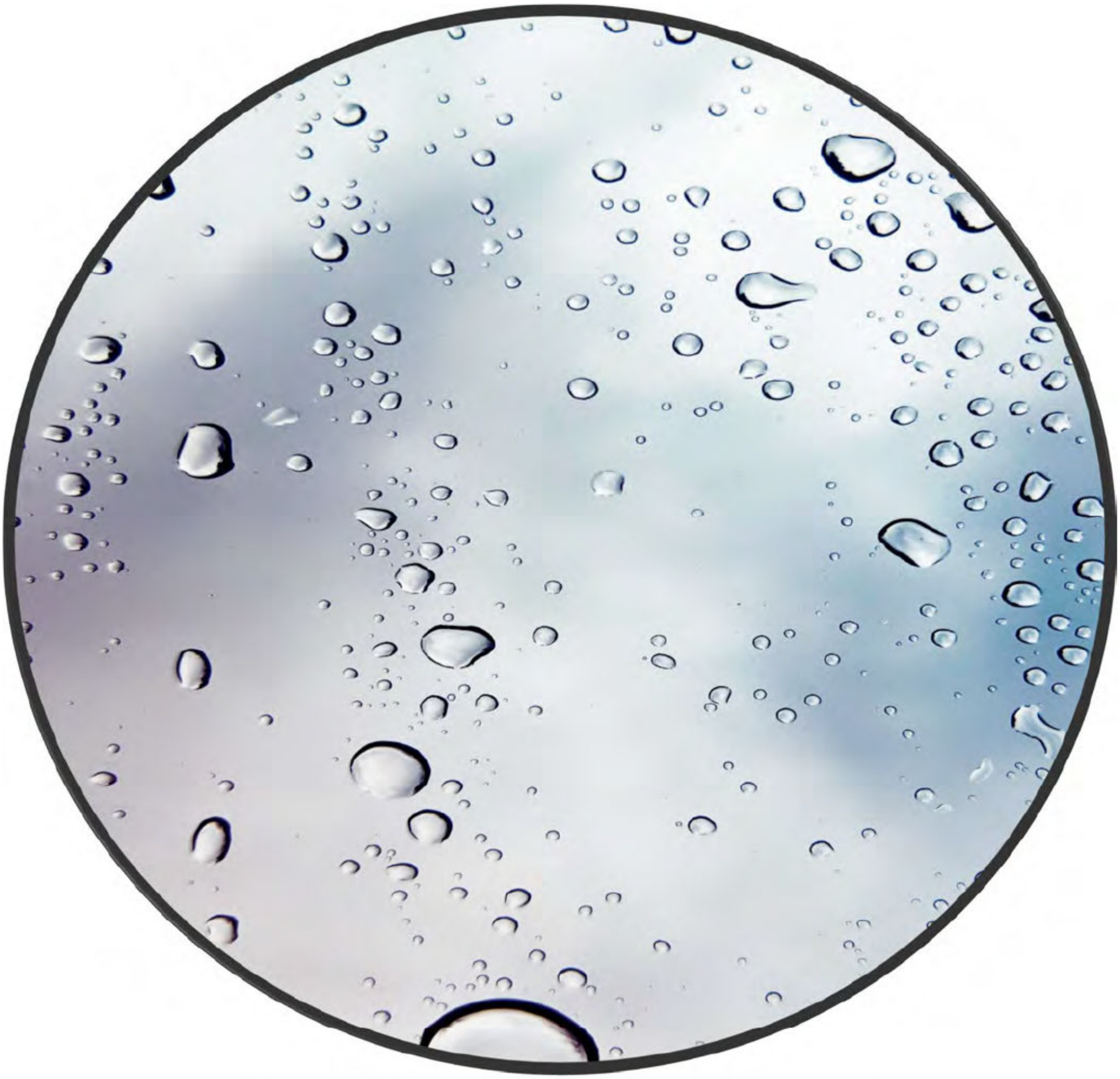
DRAINAGE STRATEGY REPORT

Former Friends School Fields, Mount Pleasant Road, Saffron Walden, Essex

On Behalf Of Chase New Homes Limited

June 2024

IDL/1162/DS/001



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DRAINAGE STRATEGY REPORT

IDL/1162/DS/001

REPORT ISSUE

Revision	Date	Notes
P01	19/06/2024	Preliminary Issue
P02	19/09/2024	Drainage strategy report revised
P03	11/10/2024	LLFA comments dated 9th October reviewed & Drainage strategy report revised

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CONTENTS

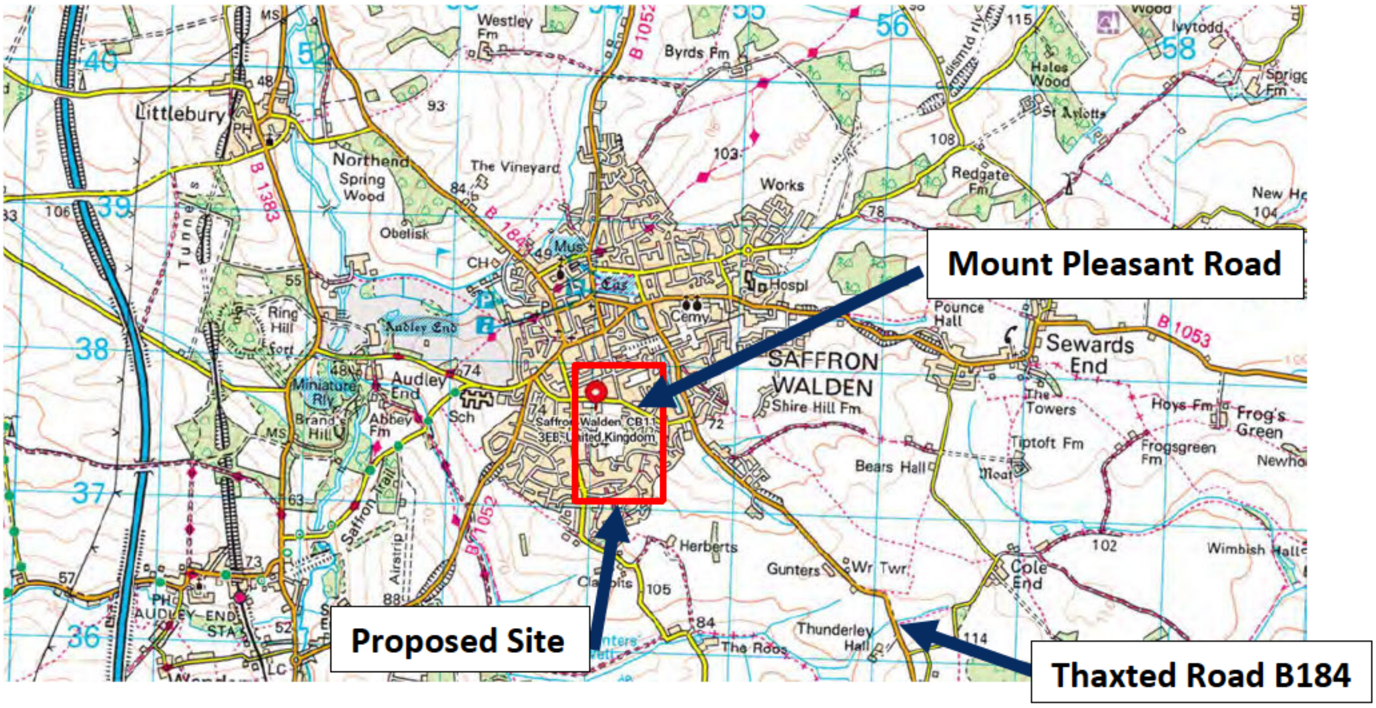
1 INTRODUCTION

1.1 Chase New Homes Limited has appointed Infrastructure Design Ltd (IDL) to prepare this Drainage Strategy Summary Report to support their planning application for their proposed residential development site.

1.2 This report has been prepared in accordance with both national and local planning policy and takes guidance from CIRIA 753, The SuDS Manual and The Building Regulations, Approved Document Part H.

1.3 The site is situated off Mount Pleasant Road, Saffron Walden, in the Uttlesford District. The National Grid Reference for the site is TL 54136 37688.

***Figure 1** – Site Location Plan*



1.4 Reference Documents:-

- Card Geotechnics Limited Soakaway Test results.
- Anglian Water Utilities Report
- Proposed site layout Plan from Coles Architects.
- Datum Surveys Services Ltd Topographical Survey (Sheets 1 and 2)
- Amazi Flood Risk Assessment report dated 24th June 2024.

1.5 The site is an open playing field classified as greenfield open space, covering approximately 6.96 ha. The levels range from approximately 92.59m AOD at the site's eastern boundary to 85m AOD at the northwestern boundary lowest point near Mount Pleasant Road. On the west of the playing field is a former school site, which is currently under development to provide 96 residential units.

1.6 The proposed development of the playing field site will comprise 91 new dwellings (houses and apartments), a new sports facility (comprising marked out football and cricket pitches and a new clubhouse), access roads, shared and private drives, POS and communal landscaping.

The proposed main access to the development site will be from the former Walden School Access Road to the west and will remain private (constructed to standards acceptable to Essex Highways).

1.7 There are no foul or surface water sewers located within the playing field site, however, adopted foul water sewers do exist to the north in Mount Pleasant Road, and to the southwest in The Avenue.

The former school site (located west of the playing field site) discharged to a number of soakaways, and infiltration techniques are being implemented as part of the redevelopment of this site.

Furthermore, the former school site discharges foul water drainage to both the adopted in Mount Pleasant Road and, in part, to a foul sewer in Avenue Road to the south.

Refer to Appendix B for the Anglian Water sewer record map and the Datum topographical survey plans.

1.8 BGS data shows the site is underlain with Seaford Chalk Formation and Newhaven Chalk Formation (undifferentiated), which suggests potential for soakaway drainage.

1.9 Card Geotechnics Limited carried out soakage testing in April 2024, fully in accordance with BRE Digest 365.

1.10 The test results indicated infiltration rates between 7.4 x 10-5 m/s and 4.5 x 10-6 m/s.

1.11 No groundwater was observed during the infiltration testing and is expected to exist at considerable depth within the chalk strata.

Figure 2*–Summary of Soakaway test results*

Trial Pit No:	Infiltration rate	Infiltration m/s	m/hr	Lowest results
SA01-1	8.2X10-5	8.20E-05	0.2952	
SA01-2	7.4X10-5	7.40E-05	0.2664	0.252
SA01-3	7.0X10-5	7.00E-05	0.252	
SA02-1	3.6X10-5	3.60E-05	0.1296	
SA02-2	7.0X10-5	3.10E-05	0.1116	
SA02-3	7.0X10-9	1.80E-05	0.0648	0.0648
SA03-1	7.6X10-6	7.60E-06	0.02736	
SA03-2	4.5X10-6	4.50E-06	0.0162	0.0162
SA03-3	5.7X10-6	5.70E-06	0.02052	

SA04-1	1.9X10-5	1.90E-05	0.0684	
SA04-2	6.5X10-6	6.50E-06	0.0234	0.0234
SA04-3	1.9X10-5	1.90E-05	0.0684	
SA05-1	4.3X10-5	4.30E-05	0.1548	
SA05-2	2.9X10-5	2.90E-05	0.1044	0.1044
SA05-3	1.3X10-4	1.30E-04	0.468	

1.12 The north part of the site is within groundwater source protection zone 3 (SPZ3), and the south part of the site is located within groundwater source protection zone 2 (SPZ2).

1.13 The site is located within flood zone 1 and is not considered to be at risk of surface water or groundwater flooding. Refer to the Amazi Flood Risk Assessment report dated 24th June 2024.

2 FOUL WATER DRAINAGE

2.1 The proposed residential development's north and central parts of the development will discharge foul drainage via gravity to the existing Anglian Water foul sewer manhole located on Mount Pleasant Road manhole reference 2701. The southern part of the development will discharge via gravity to the Anglian Water foul sewer manhole located in The Avenue manhole reference 9504 via a newly formed lateral provided within the former school site and terminating at the western boundary of the playing fields site. Foul water drainage from the new clubhouse will discharge via a private package pump station to join the western outfall.

2.2 Prior to commencing any onsite drainage works, the exact location and levels of the existing sewer manhole will be recorded, and consent pursuant to Section 106 of The Water Industry Act will be obtained from Anglian Water.

2.3 The drainage strategy layout is included in Appendix C.

3 SURFACE WATER DRAINAGE & SUDS

3.1 The total site area extends to approximately 6.96 hectares.

3.2 The total proposed impermeable area for the site is 17196m2(1.72 Ha) with a roof of 0.732Ha, including 10% of urban creep allowances on the roof area added to the overall site area and a porous pavement area of 0.988 Ha. The impermeable area layout is included in Appendix C.

3.3 A hierarchal approach has been taken to selecting SuDS for the surface water drainage system outfalls. In order of priority, the methods of surface water discharge considered are:

i) via infiltration techniques

ii) to the nearest watercourse

iii) and to the nearest sewer.

3.4 As noted in sections 1.8-1.12, and with reference to Appendix A1, infiltration techniques are feasible options for discharging the proposed surface water runoff from the site.

3.5 Given the underlying chalk strata, the cellular soakaway systems are positioned at least 10m from the foundations of any existing or proposed structures.

3.6 Surface water from plot driveways, parking areas and access roads will discharge via porous paving into the ground (System A-full infiltration).

3.7 Any excess surface water runoff from the sports pitches generated during periods of heavy or prolonged rainfall, will be diverted via a land drain located alongside the western boundary of the sports pitches and discharging into the cellular soakaway.

3.8 To summarise, the following SuDs devices will be applied to the scheme;

Permeable paving - To access roads, car parking aisles and parking bays.

Cellular Soakaway (Crate Storage) - To accommodate the runoff from all storm events, including the peak 1 in 100 years, plus climate change storm events.

3.10 The permeable paving system incorporating a geotextile-lined subbase will be used to form the new parking areas, communal parking/access roads, and drives. This will serve to improve water quality prior to discharge to the ground. A minimum permeable stone layer of 350mm is required where the sub-base is laid level.

3.11 In all instances, there will be an absolute minimum of 1m of freeboard between the base of any infiltration device and the seasonally high groundwater level. (Note: Historically, groundwater levels in the chalk strata locally have been circa 45m+ BGL.)

3.12 Given the low risk of pollution that surface water runoff from residential roofs and trafficked areas (via permeable paving) poses to the underlying geology, the groundwater resource within the SPZ's (2 & 3) will remain protected from harm.

3.13 Appendix D provides the *Flow* software results summary for the 1 in 1, 1 in 30 (3.3%) (plus a 35% allowance for 'upper end' climate change) and 1 in 100 (1%) years (plus a 40% allowance for 'upper end' climate change) return period events for the cellular soakaway system.

4 ENCLOSURES

4.1 Appendix A1 includes the SuDS Hierarchy and Appendix A2 includes Simple Index Tools.

4.2 Appendix B includes a copy of the Topographical Site Survey and Infiltration test results.

4.3 Appendix C includes a copy of the Drainage Strategy Layouts.

4.4 Appendix D includes the Surface Water / SuDS calculations and simulation results.

4.5 Appendix E Management & Maintenance Regime.

APPENDIX A1 – SUDS HIERARCHY

Most Sustainable	SUDS technique	Flood Reduction	Pollution Reduction	Landscape & Wildlife Benefit	Included in the scheme?	Comments
↑	**Living roofs**	√	√	√	√	The clubhouse roof has a proposal of green roof. This will promote biodiversity and help retain and purify surface water runoff in the system.
	Basins and ponds	√	√	√		Given the site layout, topography, and requirement for sports facilities, this type of above-ground feature is not practicable for use on this development.
	Filter strips and swales	√	√	√	√	Filter strips will deal with excess runoff from the sports fields, however swales are not suited on this scheme.
	Infiltration devices	√	√	√	√	Cellular Soakaway systems are proposed for the scheme.
	Permeable surfaces and infiltration blanket	√	√		√	Permeable paving is proposed to be used extensively across the site. This will assist in pollution reduction
↓ Least Sustainable	**Tanked systems-Over size Pipes**	√	√			Not required.

APPENDIX A2– SIMPLE INDEX TOOLS

SIMPLE INDEX APPROACH: TOOL

1. The steps set out in the tool should be applied for each inflow or 'runoff area' (ie each impermeable surface area separately discharging to a SuDS component).

2. The supporting 'Design Conditions' stated by the tool must be fully considered and implemented in all cases.

3. Relevant design examples are included in the SuDS Manual Appendix C.

4. Each of the steps below are part of the process set out in the flowchart on Sheet 3.

5. Sheet 4 summarises the selections made below and indicates the acceptability of the proposed SuDS components.

(blue box)	DROP DOWN LIST	RELEVANT INPUTS NEED TO BE SELECTED FROM THESE LISTS, FOR EACH STEP
(green box)	USER ENTRY	USER ENTRY CELLS ARE ONLY REQUIRED WHERE INDICATED BY THE TOOL

STEP 1 Determine the Pollution Hazard Index for the runoff area discharging to the proposed SuDS scheme

This step requires the user to select the appropriate land use type for the area from which the runoff is occurring

If the land use varies across the 'runoff area', either:

- use the land use type with the highest Pollution Hazard Index
- apply the approach for each of the land use types to determine whether the proposed SuDS design is sufficient for all. If it is not, consider collecting more hazardous runoff separately and providing additional treatment.

If the generic land use types suggested are not applicable, select 'Other' and enter a description of the land use of the runoff area and agreed user defined indices in the row below the drop down lists.

	Runoff Area Land Use Description	Hazard Level	Pollution Hazard Indices: Total Suspended Solids	Metals	Hydrocarbons
Select land use type from the drop down list (or 'Other' if none applicable): →	Individual driveway	Low	0.5	0.4	0.4
If the generic land use types in the drop down list above are not applicable, select 'Other' and enter a description of the land use of the runoff area and agreed user defined indices in this row:					
	Landuse Pollution Hazard Index	Low	0.5	0.4	0.4

DESIGN CONDITIONS

1	2

STEP 2A Determine the Pollution Mitigation Index for the proposed SuDS components

This step requires the user to select the proposed SuDS components that will be used to treat runoff - before it is discharged to a receiving surface waterbody or downstream infiltration component

If the runoff is discharged directly to an infiltration component, without upstream treatment, select 'None' for each of the 3 SuDS components and move to Step 2B

This step should be applied to evaluate the water quality protection provided by proposed SuDS components for discharges to receiving surface waters or downstream infiltration components (note: in England and Wales this will include components that allow any amount of infiltration, however small, even where infiltration is not specifically accounted for in the design).

If you have fewer than 3 components, select 'None' for the components that are not required

If the proposed component is bespoke and/or a proprietary treatment product and not generically described by the suggested components, then 'Proprietary treatment system' or 'User defined indices' should be selected and a description of the component and agreed user defined indices should be entered in the rows below the drop down lists

	SuDS Component Description	Pollution Mitigation Indices: Total Suspended Solids	Metals	Hydrocarbons
Select SuDS Component 1 (i.e. the upstream SuDS component) from the drop down list: →	None			
Select SuDS Component 2 (i.e. the second SuDS component in a series) from the drop down list: →	None			
Select SuDS Component 3 (i.e. the third SuDS component in a series) from the drop down list: →	None			
If the proposed SuDS components are bespoke/proprietary and/or the generic indices above are not considered appropriate, select 'Proprietary treatment system' or 'User defined indices' and enter component descriptions and agreed user defined indices in these rows:				
	Aggregated Surface Water Pollution Mitigation Index	0	0	0

DESIGN CONDITIONS

1	2	3

Note: If the total aggregated mitigation index is > 1 (which is not a realistic outcome), then the outcome is fixed at ">0.95". In this scenario, the proposed components are likely to have a very high mitigation potential for reducing pollutant levels in the runoff and should be sufficient for any proposed land use (note: where risk assessment is required, this outcome would need more detailed verification).

Is the runoff now discharged to an infiltration component?

Yes ? Go to Step 2B
No ? Go to Step 2C

STEP 2B Determine the Pollution Mitigation Index for the proposed Groundwater Protection

This step requires the user to select the type of groundwater protection that is either part of the SuDS component or that lies between the component and the groundwater

This step should be applied where a SuDS component is specifically designed to infiltrate runoff (note: in England and Wales this will include components that allow any amount of infiltration, however small, even where infiltration is not specifically accounted for in the design).

'Groundwater protection' describes the proposed depth of soil or other material through which runoff will flow between the runoff surface and the underlying groundwater.

Where the discharge is to surface waters and risks to groundwater need not be considered, select 'None'

If the proposed groundwater protection is bespoke and/or a proprietary product and not generically described by the suggested measures, then a description of the protection and agreed user defined indices should be entered in the row below the drop down list

		Pollution Mitigation Indices: Total Suspended Solids	Metals	Hydrocarbons
Select type of groundwater protection from the drop down list: →	Pervious pavement underlain by 300 mm minimum depth of soils with good contamination attenuation potential	0.7	0.6	0.7
If the proposed groundwater protection is bespoke/proprietary and/or the generic indices above are not considered appropriate, select 'Proprietary product' or 'User defined indices' and enter a description of the protection and agreed user defined indices in this row:				
	Groundwater Protection Pollution Mitigation Index	0.7	0.6	0.7

DESIGN CONDITIONS

1	2	3	4
All designs must include a minimum of 1 m unsaturated depth of subsoil or aquifer material between the infiltration surface and the maximum likely groundwater level. Infiltration components should always be preceded by upstream component(s) that trap(s) silt, or designed specifically to retain sediment in a separate lined zone, easily accessible for maintenance, such that the sediment will not be re-suspended in subsequent events	The permeable pavement must include a suitable filtration layer provides treatment and must include a geotextile at the base separating the foundation from the sub-grade. The underlying soils must provide good contaminant attenuation potential (eg as recommended in Sniffer 2008 (a) and (b) / Scott Wilson (2010) or other appropriate guidance). Alternative depth and soil combinations must provide equivalent protection to the underlying groundwater		

STEP 2C Determine the Combined Pollution Mitigation Indices for the Runoff Area

This is an automatic step which combines the proposed SuDS Pollution Mitigation Indices with any Groundwater Protection Pollution Mitigation Indices

	Combined Pollution Mitigation Indices: Total Suspended Solids	Metals	Hydrocarbons
Combined Pollution Mitigation Indices for the Runoff Area	0.7	0.6	0.7

Note: If the total aggregated mitigation index is > 1 (which is not a realistic outcome), then the outcome is fixed at ">0.95". In this scenario, the proposed components are likely to have a very high mitigation potential for reducing pollutant levels in the runoff and should be sufficient for any proposed land use (note: where risk assessment is required, this outcome would need more detailed verification).

STEP 2D Determine Sufficiency of Pollution Mitigation Indices for Selected SuDS Components

This is an automatic step which compares the Combined Pollution Mitigation Indices with the Land Use Hazard Indices, to determine whether the proposed components are sufficient to manage each pollutant category type

When the combined mitigation index exceeds the land use pollution hazard index, then the proposed components are considered sufficient in providing pollution risk mitigation.

In England and Wales, where the discharge is to protected surface waters or groundwater, an additional treatment component (ie over and above that required for standard discharges), or other equivalent protection, is required that provides environmental protection in the event of an unexpected pollution event or poor system performance. Protected surface waters are those designated for drinking water abstraction. In England and Wales, protected groundwater resources are defined as Source Protection Zone 1. In Northern Ireland, a more precautionary approach may be required and this should be checked with the environmental regulator on a site by site basis.

Sufficiency of Pollution Mitigation Indices: Total Suspended Solids	Metals	Hydrocarbons
Sufficient	Sufficient	Sufficient

DESIGN CONDITIONS

1
Reference to local planning documents should also be made to identify any additional protection required for sites due to habitat conservation (see *Chapter 7 The SuDS design process*). The implications of developments on or within close proximity to an area with an environmental designation, such as a Site of Special Scientific Interest (SSSI), should be considered via consultation with relevant conservation bodies such as Natural England

SIMPLE INDEX APPROACH: TOOL

1. The steps set out in the tool should be applied for each inflow or 'runoff area' (ie each impermeable surface area separately discharging to a SuDS component).

2. The supporting 'Design Conditions' stated by the tool must be fully considered and implemented in all cases.

3. Relevant design examples are included in the SuDS Manual Appendix C.

4. Each of the steps below are part of the process set out in the flowchart on Sheet 3.

5. Sheet 4 summarises the selections made below and indicates the acceptability of the proposed SuDS components.

(blue box)	DROP DOWN LIST	RELEVANT INPUTS NEED TO BE SELECTED FROM THESE LISTS, FOR EACH STEP
(green box)	USER ENTRY	USER ENTRY CELLS ARE ONLY REQUIRED WHERE INDICATED BY THE TOOL

STEP 1 **Determine the Pollution Hazard Index for the runoff area discharging to the proposed SuDS scheme**

This step requires the user to select the appropriate land use type for the area from which the runoff is occurring

If the land use varies across the 'runoff area', either:

- use the land use type with the highest Pollution Hazard Index
- apply the approach for each of the land use types to determine whether the proposed SuDS design is sufficient for all. If it is not, consider collecting more hazardous runoff separately and providing additional treatment.

If the generic land use types suggested are not applicable, select 'Other' and enter a description of the land use of the runoff area and agreed user defined indices in the row below the drop down lists.

	Runoff Area Land Use Description	*Hazard Level*	Total Suspended Solids (*Pollution Hazard Indices*)	Metals	Hydrocarbons
Select land use type from the drop down list (or 'Other' if none applicable): →	Roads (excluding low traffic roads, highly frequented lorry approaches to industrial estates, trunk roads/motorways)	Medium	0.7	0.6	0.7
If the generic land use types in the drop down list above are not applicable, select 'Other' and enter a description of the land use of the runoff area and agreed user defined indices in this row:					
	Landuse Pollution Hazard Index	**Medium**	**0.7**	**0.6**	**0.7**

DESIGN CONDITIONS

1	2

STEP 2A **Determine the Pollution Mitigation Index for the proposed SuDS components**

This step requires the user to select the proposed SuDS components that will be used to treat runoff - before it is discharged to a receiving surface waterbody or downstream infiltration component

If the runoff is discharged directly to an infiltration component, without upstream treatment, select 'None' for each of the 3 SuDS components and move to Step 2B

This step should be applied to evaluate the water quality protection provided by proposed SuDS components for discharges to receiving surface waters or downstream infiltration components (note: in England and Wales this will include components that allow any amount of infiltration, however small, even where infiltration is not specifically accounted for in the design).

If you have fewer than 3 components, select 'None' for the components that are not required

If the proposed component is bespoke and/or a proprietary treatment product and not generically described by the suggested components, then 'Proprietary treatment system' or 'User defined indices' should be selected and a description of the component and agreed user defined indices should be entered in the rows below the drop down lists

	SuDS Component Description	Total Suspended Solids (*Pollution Mitigation Indices*)	Metals	Hydrocarbons
Select SuDS Component 1 (i.e. the upstream SuDS component) from the drop down list: →	None			
Select SuDS Component 2 (i.e. the second SuDS component in a series) from the drop down list: →	None			
Select SuDS Component 3 (i.e. the third SuDS component in a series) from the drop down list: →	None			
If the proposed SuDS components are bespoke/proprietary and/or the generic indices above are not considered appropriate, select 'Proprietary treatment system' or 'User defined indices' and enter component descriptions and agreed user defined indices in these rows:				
	Aggregated Surface Water Pollution Mitigation Index	**0**	**0**	**0**

DESIGN CONDITIONS

1	2	3

Note: If the total aggregated mitigation index is > 1 (which is not a realistic outcome), then the outcome is fixed at ">0.95". In this scenario, the proposed components are likely to have a very high mitigation potential for reducing pollutant levels in the runoff and should be sufficient for any proposed land use (note: where risk assessment is required, this outcome would need more detailed verification).

Is the runoff now discharged to an infiltration component?

Yes ? Go to Step 2B
No ? Go to Step 2C

STEP 2B **Determine the Pollution Mitigation Index for the proposed Groundwater Protection**

This step requires the user to select the type of groundwater protection that is either part of the SuDS component or that lies between the component and the groundwater

This step should be applied where a SuDS component is specifically designed to infiltrate runoff (note: in England and Wales this will include components that allow any amount of infiltration, however small, even where infiltration is not specifically accounted for in the design).

'Groundwater protection' describes the proposed depth of soil or other material through which runoff will flow between the runoff surface and the underlying groundwater.

Where the discharge is to surface waters and risks to groundwater need not be considered, select 'None'

If the proposed groundwater protection is bespoke and/or a proprietary product and not generically described by the suggested measures, then a description of the protection and agreed user defined indices should be entered in the row below the drop down list

		Total Suspended Solids (*Pollution Mitigation Indices*)	Metals	Hydrocarbons
Select type of groundwater protection from the drop down list: →	Pervious pavement underlain by 300 mm minimum depth of soils with good contamination attenuation potential	0.7	0.6	0.7
If the proposed groundwater protection is bespoke/proprietary and/or the generic indices above are not considered appropriate, select 'Proprietary product' or 'User defined indices' and enter a description of the protection and agreed user defined indices in this row:				
	Groundwater Protection Pollution Mitigation Index	**0.7**	**0.6**	**0.7**

DESIGN CONDITIONS

1	2	3	4
All designs must include a minimum of 1 m unsaturated depth of subsoil or aquifer material between the infiltration surface and the maximum likely groundwater level. Infiltration components should always be preceded by upstream component(s) that trap(s) silt, or designed specifically to retain sediment in a separate lined zone, easily accessible for maintenance, such that the sediment will not be re-suspended in subsequent events.	The permeable pavement must include a suitable filtration layer provides treatment and must include a geotextile at the base separating the foundation from the sub-grade. The underlying soils must provide good contaminant attenuation potential (eg as recommended in Sniffer 2008 (a) and (b) / Scott Wilson (2010) or other appropriate guidance). Alternative depth and soil combinations must provide equivalent protection to the underlying groundwater		

STEP 2C **Determine the Combined Pollution Mitigation Indices for the Runoff Area**

This is an automatic step which combines the proposed SuDS Pollution Mitigation Indices with any Groundwater Protection Pollution Mitigation Indices

	Total Suspended Solids (*Combined Pollution Mitigation Indices*)	Metals	Hydrocarbons
Combined Pollution Mitigation Indices for the Runoff Area	**0.7**	**0.6**	**0.7**

Note: If the total aggregated mitigation index is > 1 (which is not a realistic outcome), then the outcome is fixed at ">0.95". In this scenario, the proposed components are likely to have a very high mitigation potential for reducing pollutant levels in the runoff and should be sufficient for any proposed land use (note: where risk assessment is required, this outcome would need more detailed verification).

STEP 2D **Determine Sufficiency of Pollution Mitigation Indices for Selected SuDS Components**

This is an automatic step which compares the Combined Pollution Mitigation Indices with the Land Use Hazard Indices, to determine whether the proposed components are sufficient to manage each pollutant category type

When the combined mitigation index exceeds the land use pollution hazard index, then the proposed components are considered sufficient in providing pollution risk mitigation.

In England and Wales, where the discharge is to protected surface waters or groundwater, an additional treatment component (ie over and above that required for standard discharges), or other equivalent protection, is required that provides environmental protection in the event of an unexpected pollution event or poor system performance. Protected surface waters are those designated for drinking water abstraction. In England and Wales, protected groundwater resources are defined as Source Protection Zone 1. In Northern Ireland, a more precautionary approach may be required and this should be checked with the environmental regulator on a site by site basis.

Total Suspended Solids (*Sufficiency of Pollution Mitigation Indices*)	Metals	Hydrocarbons
Sufficient	**Sufficient**	**Sufficient**

DESIGN CONDITIONS

1
Reference to local planning documents should also be made to identify any additional protection required for sites due to habitat conservation (see *Chapter 7 The SuDS design process*). The implications of developments on or within close proximity to an area with an environmental designation, such as a Site of Special Scientific Interest (SSSI), should be considered via consultation with relevant conservation bodies such as Natural England

SIMPLE INDEX APPROACH: TOOL

1. The steps set out in the tool should be applied for each inflow or 'runoff area' (ie each impermeable surface area separately discharging to a SuDS component).

2. The supporting 'Design Conditions' stated by the tool must be fully considered and implemented in all cases.

3. Relevant design examples are included in the SuDS Manual Appendix C.

4. Each of the steps below are part of the process set out in the flowchart on Sheet 3.

5. Sheet 4 summarises the selections made below and indicates the acceptability of the proposed SuDS components.

(blue box)	DROP DOWN LIST	RELEVANT INPUTS NEED TO BE SELECTED FROM THESE LISTS, FOR EACH STEP
(green box)	USER ENTRY	USER ENTRY CELLS ARE ONLY REQUIRED WHERE INDICATED BY THE TOOL

STEP 1 **Determine the Pollution Hazard Index for the runoff area discharging to the proposed SuDS scheme**

This step requires the user to select the appropriate land use type for the area from which the runoff is occurring

If the land use varies across the 'runoff area', either:

- use the land use type with the highest Pollution Hazard Index
- apply the approach for each of the land use types to determine whether the proposed SuDS design is sufficient for all. If it is not, consider collecting more hazardous runoff separately and providing additional treatment.

If the generic land use types suggested are not applicable, select 'Other' and enter a description of the land use of the runoff area and agreed user defined indices in the row below the drop down lists.

	Runoff Area Land Use Description	*Hazard Level*	Total Suspended Solids	Metals	Hydrocarbons
			Pollution Hazard Indices		
Select land use type from the drop down list (or 'Other' if none applicable): →	Residential parking	Low	0.5	0.4	0.4
If the generic land use types in the drop down list above are not applicable, select 'Other' and enter a description of the land use of the runoff area and agreed user defined indices in this row:					
	Landuse Pollution Hazard Index	**Low**	**0.5**	**0.4**	**0.4**

DESIGN CONDITIONS

1	2

STEP 2A **Determine the Pollution Mitigation Index for the proposed SuDS components**

This step requires the user to select the proposed SuDS components that will be used to treat runoff - before it is discharged to a receiving surface waterbody or downstream infiltration component

If the runoff is discharged directly to an infiltration component, without upstream treatment, select 'None' for each of the 3 SuDS components and move to Step 2B

This step should be applied to evaluate the water quality protection provided by proposed SuDS components for discharges to receiving surface waters or downstream infiltration components (note: in England and Wales this will include components that allow any amount of infiltration, however small, even where infiltration is not specifically accounted for in the design).

If you have fewer than 3 components, select 'None' for the components that are not required

If the proposed component is bespoke and/or a proprietary treatment product and not generically described by the suggested components, then 'Proprietary treatment system' or 'User defined indices' should be selected and a description of the component and agreed user defined indices should be entered in the rows below the drop down lists

	SuDS Component Description	Total Suspended Solids	Metals	Hydrocarbons
		Pollution Mitigation Indices		
Select SuDS Component 1 (i.e. the upstream SuDS component) from the drop down list: →	None			
Select SuDS Component 2 (i.e. the second SuDS component in a series) from the drop down list: →	None			
Select SuDS Component 3 (i.e. the third SuDS component in a series) from the drop down list: →	None			
If the proposed SuDS components are bespoke/proprietary and/or the generic indices above are not considered appropriate, select 'Proprietary treatment system' or 'User defined indices' and enter component descriptions and agreed user defined indices in these rows:				
	Aggregated Surface Water Pollution Mitigation Index	**0**	**0**	**0**

DESIGN CONDITIONS

1	2	3

Note: If the total aggregated mitigation index is > 1 (which is not a realistic outcome), then the outcome is fixed at ">0.95". In this scenario, the proposed components are likely to have a very high mitigation potential for reducing pollutant levels in the runoff and should be sufficient for any proposed land use (note: where risk assessment is required, this outcome would need more detailed verification).

Is the runoff now discharged to an infiltration component?

Yes ? Go to Step 2B
No ? Go to Step 2C

STEP 2B **Determine the Pollution Mitigation Index for the proposed Groundwater Protection**

This step requires the user to select the type of groundwater protection that is either part of the SuDS component or that lies between the component and the groundwater

This step should be applied where a SuDS component is specifically designed to infiltrate runoff (note: in England and Wales this will include components that allow any amount of infiltration, however small, even where infiltration is not specifically accounted for in the design).

'Groundwater protection' describes the proposed depth of soil or other material through which runoff will flow between the runoff surface and the underlying groundwater.

Where the discharge is to surface waters and risks to groundwater need not be considered, select 'None'

If the proposed groundwater protection is bespoke and/or a proprietary product and not generically described by the suggested measures, then a description of the protection and agreed user defined indices should be entered in the row below the drop down list

		Total Suspended Solids	Metals	Hydrocarbons
		Pollution Mitigation Indices		
Select type of groundwater protection from the drop down list: →	Pervious pavement underlain by 300 mm minimum depth of soils with good contamination attenuation potential	0.7	0.6	0.7
If the proposed groundwater protection is bespoke/proprietary and/or the generic indices above are not considered appropriate, select 'Proprietary product' or 'User defined indices' and enter a description of the protection and agreed user defined indices in this row:				
	Groundwater Protection Pollution Mitigation Index	**0.7**	**0.6**	**0.7**

DESIGN CONDITIONS

1	2	3	4
All designs must include a minimum of 1 m unsaturated depth of subsoil or aquifer material between the infiltration surface and the maximum likely groundwater level. Infiltration components should always be preceded by upstream component(s) that trap(s) silt, or designed specifically to retain sediment in a separate lined zone, easily accessible for maintenance, such that the sediment will not be re-suspended in subsequent events.	The permeable pavement must include a suitable filtration layer provides treatment and must include a geotextile at the base separating the foundation from the sub-grade. The underlying soils must provide good contaminant attenuation potential (eg as recommended in Sniffer 2008 (a) and (b) / Scott Wilson (2010) or other appropriate guidance). Alternative depth and soil combinations must provide equivalent protection to the underlying groundwater		

STEP 2C **Determine the Combined Pollution Mitigation Indices for the Runoff Area**

This is an automatic step which combines the proposed SuDS Pollution Mitigation Indices with any Groundwater Protection Pollution Mitigation Indices

	Total Suspended Solids	Metals	Hydrocarbons
	Combined Pollution Mitigation Indices		
Combined Pollution Mitigation Indices for the Runoff Area	**0.7**	**0.6**	**0.7**

Note: If the total aggregated mitigation index is > 1 (which is not a realistic outcome), then the outcome is fixed at ">0.95". In this scenario, the proposed components are likely to have a very high mitigation potential for reducing pollutant levels in the runoff and should be sufficient for any proposed land use (note: where risk assessment is required, this outcome would need more detailed verification).

STEP 2D **Determine Sufficiency of Pollution Mitigation Indices for Selected SuDS Components**

This is an automatic step which compares the Combined Pollution Mitigation Indices with the Land Use Hazard Indices, to determine whether the proposed components are sufficient to manage each pollutant category type

When the combined mitigation index exceeds the land use pollution hazard index, then the proposed components are considered sufficient in providing pollution risk mitigation.

In England and Wales, where the discharge is to protected surface waters or groundwater, an additional treatment component (ie over and above that required for standard discharges), or other equivalent protection, is required that provides environmental protection in the event of an unexpected pollution event or poor system performance. Protected surface waters are those designated for drinking water abstraction. In England and Wales, protected groundwater resources are defined as Source Protection Zone 1. In Northern Ireland, a more precautionary approach may be required and this should be checked with the environmental regulator on a site by site basis.

Total Suspended Solids	Metals	Hydrocarbons
Sufficiency of Pollution Mitigation Indices		
Sufficient	Sufficient	Sufficient

DESIGN CONDITIONS

1
Reference to local planning documents should also be made to identify any additional protection required for sites due to habitat conservation (see *Chapter 7 The SuDS design process*). The implications of developments on or within close proximity to an area with an environmental designation, such as a Site of Special Scientific Interest (SSSI), should be considered via consultation with relevant conservation bodies such as Natural England

SIMPLE INDEX APPROACH: TOOL

1. The steps set out in the tool should be applied for each inflow or 'runoff area' (ie each impermeable surface area separately discharging to a SuDS component).

2. The supporting 'Design Conditions' stated by the tool must be fully considered and implemented in all cases.

3. Relevant design examples are included in the SuDS Manual Appendix C.

4. Each of the steps below are part of the process set out in the flowchart on Sheet 3.

5. Sheet 4 summarises the selections made below and indicates the acceptability of the proposed SuDS components.

(blue box)	DROP DOWN LIST	RELEVANT INPUTS NEED TO BE SELECTED FROM THESE LISTS, FOR EACH STEP
(green box)	USER ENTRY	USER ENTRY CELLS ARE ONLY REQUIRED WHERE INDICATED BY THE TOOL

STEP 1 **Determine the Pollution Hazard Index for the runoff area discharging to the proposed SuDS scheme**

This step requires the user to select the appropriate land use type for the area from which the runoff is occurring

If the land use varies across the 'runoff area', either:

- use the land use type with the highest Pollution Hazard Index
- apply the approach for each of the land use types to determine whether the proposed SuDS design is sufficient for all. If it is not, consider collecting more hazardous runoff separately and providing additional treatment.

If the generic land use types suggested are not applicable, select 'Other' and enter a description of the land use of the runoff area and agreed user defined indices in the row below the drop down lists.

	Runoff Area Land Use Description	*Hazard Level*	Total Suspended Solids (*Pollution Hazard Indices*)	Metals	Hydrocarbons
Select land use type from the drop down list (or 'Other' if none applicable): →	Residential roofing	Very low	0.2	0.2	0.05
If the generic land use types in the drop down list above are not applicable, select 'Other' and enter a description of the land use of the runoff area and agreed user defined indices in this row:					
	Landuse Pollution Hazard Index	**Very low**	**0.2**	**0.2**	**0.05**

DESIGN CONDITIONS

1	2

STEP 2A **Determine the Pollution Mitigation Index for the proposed SuDS components**

This step requires the user to select the proposed SuDS components that will be used to treat runoff - before it is discharged to a receiving surface waterbody or downstream infiltration component
If the runoff is discharged directly to an infiltration component, without upstream treatment, select 'None' for each of the 3 SuDS components and move to Step 2B

This step should be applied to evaluate the water quality protection provided by proposed SuDS components for discharges to receiving surface waters or downstream infiltration components (note: in England and Wales this will include components that allow any amount of infiltration, however small, even where infiltration is not specifically accounted for in the design).

If you have fewer than 3 components, select 'None' for the components that are not required

If the proposed component is bespoke and/or a proprietary treatment product and not generally described by the suggested components, then 'Proprietary treatment system' or 'User defined indices' should be selected and a description of the component and agreed user defined indices should be entered in the rows below the drop down lists

	SuDS Component Description	Total Suspended Solids (*Pollution Mitigation Indices*)	Metals	Hydrocarbons
Select SuDS Component 1 (i.e. the upstream SuDS component) from the drop down list: →	None			
Select SuDS Component 2 (i.e. the second SuDS component in a series) from the drop down list: →	None			
Select SuDS Component 3 (i.e. the third SuDS component in a series) from the drop down list: →	None			
If the proposed SuDS components are bespoke/proprietary and/or the generic indices above are not considered appropriate, select 'Proprietary treatment system' or 'User defined indices' and enter component descriptions and agreed user defined indices in these rows:				
	Aggregated Surface Water Pollution Mitigation Index	**0**	**0**	**0**

DESIGN CONDITIONS

1	2	3

Note: If the total aggregated mitigation index is > 1 (which is not a realistic outcome), then the outcome is fixed at ">0.95". In this scenario, the proposed components are likely to have a very high mitigation potential for reducing pollutant levels in the runoff and should be sufficient for any proposed land use (note: where risk assessment is required, this outcome would need more detailed verification).

Is the runoff now discharged to an infiltration component?

Yes ? Go to Step 2B
No ? Go to Step 2C

STEP 2B **Determine the Pollution Mitigation Index for the proposed Groundwater Protection**

This step requires the user to select the type of groundwater protection that is either part of the SuDS component or that lies between the component and the groundwater

This step should be applied where a SuDS component is specifically designed to infiltrate runoff (note: in England and Wales this will include components that allow any amount of infiltration, however small, even where infiltration is not specifically accounted for in the design).

'Groundwater protection' describes the proposed depth of soil or other material through which runoff will flow between the runoff surface and the underlying groundwater.

Where the discharge is to surface waters and risks to groundwater need not be considered, select 'None'

If the proposed groundwater protection is bespoke and/or a proprietary product and not generically described by the suggested measures, then a description of the protection and agreed user defined indices should be entered in the row below the drop down list

		Total Suspended Solids (*Pollution Mitigation Indices*)	Metals	Hydrocarbons
Select type of groundwater protection from the drop down list: →	300 mm minimum depth of soils with good contamination attenuation potential	0.4	0.3	0.3
If the proposed groundwater protection is bespoke/proprietary and/or the generic indices above are not considered appropriate, select 'Proprietary product' or 'User defined indices' and enter a description of the protection and agreed user defined indices in this row:				
	Groundwater Protection Pollution Mitigation Index	**0.4**	**0.3**	**0.3**

DESIGN CONDITIONS

1	2	3	4
All designs must include a minimum of 1 m unsaturated depth of subsoil or aquifer material between the infiltration surface and the maximum likely groundwater level. Infiltration components should always be preceded by upstream component(s) that trap(s) silt, or designed specifically to retain sediment in a separate lined zone, easily accessible for maintenance, such that the sediment will not be re-suspended in subsequent events.	The underlying soils must provide good contaminant attenuation potential (eg as recommended in Sniffer 2008 (a) and (b) / Scott Wilson (2010) or other appropriate guidance). Alternative depth and soil combinations must provide equivalent protection to the underlying groundwater		

STEP 2C **Determine the Combined Pollution Mitigation Indices for the Runoff Area**

This is an automatic step which combines the proposed SuDS Pollution Mitigation Indices with any Groundwater Protection Pollution Mitigation Indices

	Total Suspended Solids (*Combined Pollution Mitigation Indices*)	Metals	Hydrocarbons
Combined Pollution Mitigation Indices for the Runoff Area	**0.4**	**0.3**	**0.3**

Note: If the total aggregated mitigation index is > 1 (which is not a realistic outcome), then the outcome is fixed at ">0.95". In this scenario, the proposed components are likely to have a very high mitigation potential for reducing pollutant levels in the runoff and should be sufficient for any proposed land use (note: where risk assessment is required, this outcome would need more detailed verification).

STEP 2D **Determine Sufficiency of Pollution Mitigation Indices for Selected SuDS Components**

This is an automatic step which compares the Combined Pollution Mitigation Indices with the Land Use Hazard Indices, to determine whether the proposed components are sufficient to manage each pollutant category type

When the combined mitigation index exceeds the land use pollution hazard index, then the proposed components are considered sufficient in providing pollution risk mitigation.

In England and Wales, where the discharge is to protected surface waters or groundwater, an additional treatment component (ie over and above that required for standard discharges), or other equivalent protection, is required that provides environmental protection in the event of an unexpected pollution event or poor system performance. Protected surface waters are those designated for drinking water abstraction. In England and Wales, protected groundwater resources are defined as Source Protection Zone 1. In Northern Ireland, a more precautionary approach may be required and this should be checked with the environmental regulator on a site by site basis.

Total Suspended Solids (*Sufficiency of Pollution Mitigation Indices*)	Metals	Hydrocarbons
Sufficient	**Sufficient**	**Sufficient**

DESIGN CONDITIONS

1
Reference to local planning documents should also be made to identify any additional protection required for sites due to habitat conservation (see *Chapter 7 The SuDS design process*). The implications of developments on or within close proximity to an area with an environmental designation, such as a Site of Special Scientific Interest (SSSI), should be considered via consultation with relevant conservation bodies such as Natural England

SIMPLE INDEX APPROACH: TOOL

1. The steps set out in the tool should be applied for each inflow or 'runoff area' (ie each impermeable surface area separately discharging to a SuDS component).

2. The supporting 'Design Conditions' stated by the tool must be fully considered and implemented in all cases.

3. Relevant design examples are included in the SuDS Manual Appendix C.

4. Each of the steps below are part of the process set out in the flowchart on Sheet 3.

5. Sheet 4 summarises the selections made below and indicates the acceptability of the proposed SuDS components.

(blue box)	DROP DOWN LIST	RELEVANT INPUTS NEED TO BE SELECTED FROM THESE LISTS, FOR EACH STEP
(green box)	USER ENTRY	USER ENTRY CELLS ARE ONLY REQUIRED WHERE INDICATED BY THE TOOL

STEP 1 Determine the Pollution Hazard Index for the runoff area discharging to the proposed SuDS scheme

This step requires the user to select the appropriate land use type for the area from which the runoff is occurring

If the land use varies across the 'runoff area', either:

- use the land use type with the highest Pollution Hazard Index
- apply the approach for each of the land use types to determine whether the proposed SuDS design is sufficient for all. If it is not, consider collecting more hazardous runoff separately and providing additional treatment.

If the generic land use types suggested are not applicable, select 'Other' and enter a description of the land use of the runoff area and agreed user defined indices in the row below the drop down lists.

	Runoff Area Land Use Description	*Hazard Level*	*Pollution Hazard Indices* Total Suspended Solids	Metals	Hydrocarbons
Select land use type from the drop down list (or 'Other' if none applicable): →	Low traffic roads (e.g. residential roads and general access roads, < 300 traffic movements/day)	Low	0.5	0.4	0.4
If the generic land use types in the drop down list above are not applicable, select 'Other' and enter a description of the land use of the runoff area and agreed user defined indices in this row:					
	Landuse Pollution Hazard Index	**Low**	**0.5**	**0.4**	**0.4**

DESIGN CONDITIONS

1	2

STEP 2A Determine the Pollution Mitigation Index for the proposed SuDS components

This step requires the user to select the proposed SuDS components that will be used to treat runoff - before it is discharged to a receiving surface waterbody or downstream infiltration component

If the runoff is discharged directly to an infiltration component, without upstream treatment, select 'None' for each of the 3 SuDS components and move to Step 2B

This step should be applied to evaluate the water quality protection provided by proposed SuDS components for discharges to receiving surface waters or downstream infiltration components (note: in England and Wales this will include components that allow any amount of infiltration, however small, even where infiltration is not specifically accounted for in the design).

If you have fewer than 3 components, select 'None' for the components that are not required

If the proposed component is bespoke and/or a proprietary treatment product and not generically described by the suggested components, then 'Proprietary treatment system' or 'User defined indices' should be selected and a description of the component and agreed user defined indices should be entered in the rows below the drop down lists

	SuDS Component Description	*Pollution Mitigation Indices* Total Suspended Solids	Metals	Hydrocarbons
Select SuDS Component 1 (i.e. the upstream SuDS component) from the drop down list: →	None			
Select SuDS Component 2 (i.e. the second SuDS component in a series) from the drop down list: →	None			
Select SuDS Component 3 (i.e. the third SuDS component in a series) from the drop down list: →	None			
If the proposed SuDS components are bespoke/proprietary and/or the generic indices above are not considered appropriate, select 'Proprietary treatment system' or 'User defined indices' and enter component descriptions and agreed user defined indices in these rows:				
	Aggregated Surface Water Pollution Mitigation Index	**0**	**0**	**0**

DESIGN CONDITIONS

1	2	3

Note: If the total aggregated mitigation index is > 1 (which is not a realistic outcome), then the outcome is fixed at ">0.95". In this scenario, the proposed components are likely to have a very high mitigation potential for reducing pollutant levels in the runoff and should be sufficient for any proposed land use (note: where risk assessment is required, this outcome would need more detailed verification).

Is the runoff now discharged to an infiltration component?

Yes ? Go to Step 2B
No ? Go to Step 2C

STEP 2B Determine the Pollution Mitigation Index for the proposed Groundwater Protection

This step requires the user to select the type of groundwater protection that is either part of the SuDS component or that lies between the component and the groundwater

This step should be applied where a SuDS component is specifically designed to infiltrate runoff (note: in England and Wales this will include components that allow any amount of infiltration, however small, even where infiltration is not specifically accounted for in the design).

'Groundwater protection' describes the proposed depth of soil or other material through which runoff will flow between the runoff surface and the underlying groundwater.

Where the discharge is to surface waters and risks to groundwater need not be considered, select 'None'

If the proposed groundwater protection is bespoke and/or a proprietary product and not generically described by the suggested measures, then a description of the protection and agreed user defined indices should be entered in the row below the drop down list

		Pollution Mitigation Indices Total Suspended Solids	Metals	Hydrocarbons
Select type of groundwater protection from the drop down list: →	Pervious pavement underlain by 300 mm minimum depth of soils with good contamination attenuation potential	0.7	0.6	0.7
If the proposed groundwater protection is bespoke/proprietary and/or the generic indices above are not considered appropriate, select 'Proprietary product' or 'User defined indices' and enter a description of the protection and agreed user defined indices in this row:				
	Groundwater Protection Pollution Mitigation Index	**0.7**	**0.6**	**0.7**

DESIGN CONDITIONS

1	2	3	4
All designs must include a minimum of 1 m unsaturated depth of subsoil or aquifer material between the infiltration surface and the maximum likely groundwater level. Infiltration components should always be preceded by upstream component(s) that trap(s) silt, or designed specifically to retain sediment in a separate lined zone, easily accessible for maintenance, such that the sediment will not be re-suspended in subsequent events	The permeable pavement must include a suitable filtration layer provides treatment and must include a geotextile at the base separating the foundation from the sub-grade. The underlying soils must provide good contaminant attenuation potential (eg as recommended in Sniffer 2008 (a) and (b) / Scott Wilson (2010) or other appropriate guidance). Alternative depth and soil combinations must provide equivalent protection to the underlying groundwater		

STEP 2C Determine the Combined Pollution Mitigation Indices for the Runoff Area

This is an automatic step which combines the proposed SuDS Pollution Mitigation Indices with any Groundwater Protection Pollution Mitigation Indices

	Combined Pollution Mitigation Indices Total Suspended Solids	Metals	Hydrocarbons
Combined Pollution Mitigation Indices for the Runoff Area	**0.7**	**0.6**	**0.7**

Note: If the total aggregated mitigation index is > 1 (which is not a realistic outcome), then the outcome is fixed at ">0.95". In this scenario, the proposed components are likely to have a very high mitigation potential for reducing pollutant levels in the runoff and should be sufficient for any proposed land use (note: where risk assessment is required, this outcome would need more detailed verification).

STEP 2D Determine Sufficiency of Pollution Mitigation Indices for Selected SuDS Components

This is an automatic step which compares the Combined Pollution Mitigation Indices with the Land Use Hazard Indices, to determine whether the proposed components are sufficient to manage each pollutant category type

When the combined mitigation index exceeds the land use pollution hazard index, then the proposed components are considered sufficient in providing pollution risk mitigation.

In England and Wales, where the discharge is to protected surface waters or groundwater, an additional treatment component (ie over and above that required for standard discharges), or other equivalent protection, is required that provides environmental protection in the event of an unexpected pollution event or poor system performance. Protected surface waters are those designated for drinking water abstraction. In England and Wales, protected groundwater resources are defined as Source Protection Zone 1. In Northern Ireland, a more precautionary approach may be required and this should be checked with the environmental regulator on a site by site basis.

Sufficiency of Pollution Mitigation Indices Total Suspended Solids	Metals	Hydrocarbons
Sufficient	**Sufficient**	**Sufficient**

DESIGN CONDITIONS

1
Reference to local planning documents should also be made to identify any additional protection required for sites due to habitat conservation (see *Chapter 7 The SuDS design process*). The implications of developments on or within close proximity to an area with an environmental designation, such as a Site of Special Scientific Interest (SSSI), should be considered via consultation with relevant conservation bodies such as Natural England

SIMPLE INDEX APPROACH: TOOL

1. The steps set out in the tool should be applied for each inflow or 'runoff area' (ie each impermeable surface area separately discharging to a SuDS component).

2. The supporting 'Design Conditions' stated by the tool must be fully considered and implemented in all cases.

3. Relevant design examples are included in the SuDS Manual Appendix C.

4. Each of the steps below are part of the process set out in the flowchart on Sheet 3.

5. Sheet 4 summarises the selections made below and indicates the acceptability of the proposed SuDS components.

(blue box)	DROP DOWN LIST	RELEVANT INPUTS NEED TO BE SELECTED FROM THESE LISTS, FOR EACH STEP
(green box)	USER ENTRY	USER ENTRY CELLS ARE ONLY REQUIRED WHERE INDICATED BY THE TOOL

STEP 1 **Determine the Pollution Hazard Index for the runoff area discharging to the proposed SuDS scheme**

This step requires the user to select the appropriate land use type for the area from which the runoff is occurring

If the land use varies across the 'runoff area', either:

- use the land use type with the highest Pollution Hazard Index
- apply the approach for each of the land use types to determine whether the proposed SuDS design is sufficient for all. If it is not, consider collecting more hazardous runoff separately and providing additional treatment.

If the generic land use types suggested are not applicable, select 'Other' and enter a description of the land use of the runoff area and agreed user defined indices in the row below the drop down lists.

	Runoff Area Land Use Description	Hazard Level	Pollution Hazard Indices: Total Suspended Solids	Metals	Hydrocarbons
Select land use type from the drop down list (or 'Other' if none applicable): →	Non-residential parking with infrequent change (e.g. schools, offices, < 300 traffic movements a day)	Low	0.5	0.4	0.4
If the generic land use types in the drop down list above are not applicable, select 'Other' and enter a description of the land use of the runoff area and agreed user defined indices in this row:					
	Landuse Pollution Hazard Index	**Low**	**0.5**	**0.4**	**0.4**

DESIGN CONDITIONS

1	2

STEP 2A **Determine the Pollution Mitigation Index for the proposed SuDS components**

This step requires the user to select the proposed SuDS components that will be used to treat runoff - before it is discharged to a receiving surface waterbody or downstream infiltration component

If the runoff is discharged directly to an infiltration component, without upstream treatment, select 'None' for each of the 3 SuDS components and move to Step 2B

This step should be applied to evaluate the water quality protection provided by proposed SuDS components for discharges to receiving surface waters or downstream infiltration components (note: in England and Wales this will include components that allow any amount of infiltration, however small, even where infiltration is not specifically accounted for in the design).

If you have fewer than 3 components, select 'None' for the components that are not required

If the proposed component is bespoke and/or a proprietary treatment product and not generically described by the suggested components, then 'Proprietary treatment system' or 'User defined indices' should be selected and a description of the component and agreed user defined indices should be entered in the rows below the drop down lists

	SuDS Component Description	Pollution Mitigation Indices: Total Suspended Solids	Metals	Hydrocarbons
Select SuDS Component 1 (i.e. the upstream SuDS component) from the drop down list: →	None			
Select SuDS Component 2 (i.e. the second SuDS component in a series) from the drop down list: →	None			
Select SuDS Component 3 (i.e. the third SuDS component in a series) from the drop down list: →	None			
If the proposed SuDS components are bespoke/proprietary and/or the generic indices above are not considered appropriate, select 'Proprietary treatment system' or 'User defined indices' and enter component descriptions and agreed user defined indices in these rows:				
	Aggregated Surface Water Pollution Mitigation Index	0	0	0

DESIGN CONDITIONS

1	2	3

Note: If the total aggregated mitigation index is > 1 (which is not a realistic outcome), then the outcome is fixed at ">0.95". In this scenario, the proposed components are likely to have a very high mitigation potential for reducing pollutant levels in the runoff and should be sufficient for any proposed land use (note: where risk assessment is required, this outcome would need more detailed verification).

Is the runoff now discharged to an infiltration component?

Yes ? Go to Step 2B
No ? Go to Step 2C

STEP 2B **Determine the Pollution Mitigation Index for the proposed Groundwater Protection**

This step requires the user to select the type of groundwater protection that is either part of the SuDS component or that lies between the component and the groundwater

This step should be applied where a SuDS component is specifically designed to infiltrate runoff (note: in England and Wales this will include components that allow any amount of infiltration, however small, even where infiltration is not specifically accounted for in the design).

'Groundwater protection' describes the proposed depth of soil or other material through which runoff will flow between the runoff surface and the underlying groundwater.

Where the discharge is to surface waters and risks to groundwater need not be considered, select 'None'

If the proposed groundwater protection is bespoke and/or a proprietary product and not generically described by the suggested measures, then a description of the protection and agreed user defined indices should be entered in the row below the drop down list

		Pollution Mitigation Indices: Total Suspended Solids	Metals	Hydrocarbons
Select type of groundwater protection from the drop down list: →	Pervious pavement underlain by 300 mm minimum depth of soils with good contamination attenuation potential	0.7	0.6	0.7
If the proposed groundwater protection is bespoke/proprietary and/or the generic indices above are not considered appropriate, select 'Proprietary product' or 'User defined indices' and enter a description of the protection and agreed user defined indices in this row:				
	Groundwater Protection Pollution Mitigation Index	**0.7**	**0.6**	**0.7**

DESIGN CONDITIONS

1	2	3	4
All designs must include a minimum of 1 m unsaturated depth of subsoil or aquifer material between the infiltration surface and the maximum likely groundwater level. Infiltration components should always be preceded by upstream component(s) that trap(s) silt, or designed specifically to retain sediment in a separate lined zone, easily accessible for maintenance, such that the sediment will not be re-suspended in subsequent events	The permeable pavement must include a suitable filtration layer provides treatment and must include a geotextile at the base separating the foundation from the sub-grade. The underlying soils must provide good contaminant attenuation potential (eg as recommended in Sniffer 2008 (a) and (b) / Scott Wilson (2010) or other appropriate guidance). Alternative depth and soil combinations must provide equivalent protection to the underlying groundwater		

STEP 2C **Determine the Combined Pollution Mitigation Indices for the Runoff Area**

This is an automatic step which combines the proposed SuDS Pollution Mitigation Indices with any Groundwater Protection Pollution Mitigation Indices

	Combined Pollution Mitigation Indices: Total Suspended Solids	Metals	Hydrocarbons
Combined Pollution Mitigation Indices for the Runoff Area	0.7	0.6	0.7

Note: If the total aggregated mitigation index is > 1 (which is not a realistic outcome), then the outcome is fixed at ">0.95". In this scenario, the proposed components are likely to have a very high mitigation potential for reducing pollutant levels in the runoff and should be sufficient for any proposed land use (note: where risk assessment is required, this outcome would need more detailed verification).

STEP 2D **Determine Sufficiency of Pollution Mitigation Indices for Selected SuDS Components**

This is an automatic step which compares the Combined Pollution Mitigation Indices with the Land Use Hazard Indices, to determine whether the proposed components are sufficient to manage each pollutant category type

When the combined mitigation index exceeds the land use pollution hazard index, then the proposed components are considered sufficient in providing pollution risk mitigation.

In England and Wales, where the discharge is to protected surface waters or groundwater, an additional treatment component (ie over and above that required for standard discharges), or other equivalent protection, is required that provides environmental protection in the event of an unexpected pollution event or poor system performance. Protected surface waters are those designated for drinking water abstraction. In England and Wales, protected groundwater resources are defined as Source Protection Zone 1. In Northern Ireland, a more precautionary approach may be required and this should be checked with the environmental regulator on a site by site basis.

Sufficiency of Pollution Mitigation Indices: Total Suspended Solids	Metals	Hydrocarbons
Sufficient	Sufficient	Sufficient

DESIGN CONDITIONS

1
Reference to local planning documents should also be made to identify any additional protection required for sites due to habitat conservation (see *Chapter 7 The SuDS design process*). The implications of developments on or within close proximity to an area with an environmental designation, such as a Site of Special Scientific Interest (SSSI), should be considered via consultation with relevant conservation bodies such as Natural England

APPENDIX C – PROPOSED DRAINAGE STRATEGY LAYOUTS & DRAINAGE AREA PLANS

CONTRACT DOCUMENT

Notes

Refers to Keen Consultant's tree protection plan for the location of TPO and existing tree removal.

Rev	Description	Date
1	Preliminary Issue	20 06.24

Status: Preliminary Issue

Scale : 1:250@A0
Date : Jan 2024
Drawn : IDL
Checked: BM
Approved: PT

Title : Levels Layout Sheet 1 of 2

Project : Playing Fields Site, Saffron Walden

Drg. No: IDL/1229/05/101
Rev: 1
File Ref: 1229-05.dwg
Plot Ref: 1229-05-101 pdf

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Welwyn Garden City
Hertfordshire, AL8 6HG

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CONTRACT DOCUMENT

Notes

Key

+ 90.00	Proposed finished levels
+ (90.00)	Interpolated existing spot levels
FFL 90.700	Proposed finished floor level
+ 90.34	Existing (pre-demolition) levels
	Denotes Retaining Walls
	Exceedance flow route
90.700	Primary Contours
90.725	Secondary Contours
	Tree to be removed (Refers to Keen Consultant's tree protection plan for the location of TPO and existing tree removal)

Rev	Description	Date
1	Preliminary Issue	20.06.24

Status: Preliminary Issue

Scale : 1:250@A0

Date : Jan 2024 | Checked: RM | Approved: PT

Drawn : IDL

Title : Levels Layout Sheet 2 of 2

Project : Playing Fields Site, Saffron Walden

Drg. No: IDL/1229/05/102 | Rev: 1 | File Ref: 1229-05 dwg | Plot Ref: 1229-05-102.pdf

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working for

CHASE NEW HOMES

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CONTRACT DOCUMENT

Notes

Drainage Area Key

- Approximately 2805m2 + 280.5m2 **(10%UC)** = 3086m2 area discharging to SA-01 Cellular Soakaway
  0.309 Ha area calculated in drainage calculation
- Approximately (857m2 flat area + 1066m2 Houses + 192 3m2 **(10% UC)** = 2115 3m2 area discharging to SA-02 Cellular Soakaway
  0 211 Ha area calculated in drainage calculation
- Approximately 1371m2 + 137.1 **(10%UC)** = 1508m2 area discharging to SA-03 Cellular Soakaway
  0.151 Ha area calculated in drainage calculation
- Approximately 552m2 + 55 2m2 **(10%UC)** = 607m2 area discharging to SA-04 Cellular Soakaway
  0 061 Ha area calculated in drainage calculation

Total Catchment area discharging to SA-01 TO SA-04 is 7316.3m3
0.732 Ha (**inc 10%UC**)

Note:-Approximately 60% of 1040m2 area (Playing Field) discharging to SA-05 Cellular Soakaway which is 624m2 + 62.4m2 (**10%UC**)=686.4m2
0 07 Ha area calculated in drainage calculation

- Private access roads in Permeable Block Paving (System A full infiltration) Infiltration into ground
  Approximate Area 3638m2
  0.364 Ha area calculated in drainage calculation
- Parking spaces and drives in Permeable Block Paving (System A full infiltration) infiltration into ground
  Approximate Area 6241m2
  0 624 Ha area calculated in drainage calculation

Total Catchment area for Porous paving is 0.988 Ha
0.988 Ha area calculated in drainage calculation

Total Catchment area for 0.988 Ha + 0.732 Ha = 1.72 Ha (inc 10%UC)

Rev	Description	Date
3	Urban Creep Area clarified and urban creep area clearly shown with catchment areas	10.10 24
2	Impermeable Area revised	19 09 24
1	Preliminary Issue	20 06 24

Status:

Preliminary Issue

Scale : 1:250@A0
Date : Jun 2024
Drawn : IDL
Checked: BM
Approved: PT

Title :

Drainage Area Layout

Project :

Playing Fields Site, Saffron Walden

Drg. No:	Rev:	File Ref:	1229-07-DAP.dwg
IDL/1229/07/105	3	Plot Ref:	1229-07-105 pdf

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Notes

Rev	Description	Date
2	Drainage plan revised to LLFA comments SA-2 & SA-5 soakaway corrected	10.10 24
1	Preliminary Issue	20 06 24

Status:

Preliminary Issue

Scale : 1:250@A0		
Date : Jan 2024	Checked: RM	Approved: PT
Drawn : IDL		

Title :

Drainage Layout Sheet 1 of 2

Project :

Playing Fields Site, Saffron Walden

Drg. No:	Rev:	File Ref:	1229-07.dwg
IDL/1229/07/101	1	Plot Ref:	1229-07-101 pdf

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Notes

Rev	Description	Date
2	Drainage plan revised to LLFA comments SA-2 & SA-5 soakaway corrected	10.10.24
1	Preliminary Issue	20.06.24

Status:

Preliminary Issue

Scale :	1:250@A0		
Date :	June 2024	Checked:	Approved:
Drawn :	IDL	BM	PT

Title :

Drainage Layout Sheet 2 of 2

Project :

Playing Fields Site, Saffron Walden

Drg. No:	Rev:	File Ref:	1229-07 dwg
IDL/1229/07/104	2	Plot Ref:	1229-07-104.pdf

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Drainage Key

- Foul Water Drainage
- Surface Water Drainage
- Foul rising Main
- FWPS — Private foul water package pump station
- Foul PCC manhole
- Polypropylene universal inspection chambers 1200 deep max, 450 dia, 100 inlet / outlet connections (6 no. max) or 150 inlet/outlet connections (4 no max) as detailed on private drainage construction details.
- R500 / R600 — Denotes 500/600 dia ppic, 3000mm deep max with 4 no. max inlets / outlets up to 150mm dia, as detailed on private drainage construction details. Where >1200mm deep, use reduced size access cover. Wavin Range 500/600 or similar.
- st — Denotes 500/600 dia ppic silt trap with 300mm nominal sump, as messrs Polypipe Basic Silt Trap or similar.
- re — Rodding eye same dia. as downstream drain
- Private access roads in Permeable Block Paving (System A full infiltration) Infiltration into ground
- Parking spaces and drives in Permeable Block Paving (System A full infiltration) infiltration into ground
- Cellular soakaway system (SDS Geolight or similar approved)

APPENDIX D – SURFACE WATER DRAINAGE CALCULATION

Design Settings

Rainfall Methodology	FEH-22	Minimum Velocity (m/s)	1.00
Return Period (years)	100	Connection Type	Level Soffits
Additional Flow (%)	0	Minimum Backdrop Height (m)	0.200
CV	1.000	Preferred Cover Depth (m)	1.200
Time of Entry (mins)	5.00	Include Intermediate Ground	✓
Maximum Time of Concentration (mins)	30.00	Enforce best practice design rules	✓
Maximum Rainfall (mm/hr)	50.0		

Nodes

Name	Area (ha)	Cover Level (m)	Easting (m)	Northing (m)	Depth (m)
SA1	0.309	88.350	554102.536	237747.849	2.700

Simulation Settings

Rainfall Methodology	FEH-22	Analysis Speed	Normal	Starting Level (m)		100 year (l/s)	5.8
Rainfall Events	Singular	Skip Steady State	✓	Check Discharge Rate(s)	✓	Check Discharge Volume	x
Summer CV	0.950	Drain Down Time (mins)	10080	1 year (l/s)	1.5		
Winter CV	0.950	Additional Storage (m³/ha)	0.0	30 year (l/s)	4.3		

Storm Durations

15	60	180	360	600	960	2160	4320	7200	10080
30	120	240	480	720	1440	2880	5760	8640	

Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)	Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)
2	0	0	0	100	0	0	0
30	0	0	0	100	40	0	0
30	35	0	0				

Pre-development Discharge Rate

Site Makeup	Greenfield	SPR	0.53	Betterment (%)	0
Greenfield Method	IH124	Region	6	QBar	1.8
Positively Drained Area (ha)	0.353	Growth Factor 1 year	0.85	Q 1 year (l/s)	1.5
SAAR (mm)	590	Growth Factor 30 year	2.40	Q 30 year (l/s)	4.3
Soil Index	5	Growth Factor 100 year	3.19	Q 100 year (l/s)	5.8

Node SA1 Online Depth/Flow Control

Flap Valve	x	Invert Level (m)	85.650	Design Flow (l/s)	0.1
Replaces Downstream Link	✓	Design Depth (m)	2.500		

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.001	0.000	2.500	0.000

Node SA1 Carpark Storage Structure

Base Inf Coefficient (m/hr)	0.25200	Porosity	0.95	Width (m)	3.000	Depth (m)	1.500
Side Inf Coefficient (m/hr)	0.25200	Invert Level (m)	85.650	Length (m)	39.000	Inf Depth (m)	
Safety Factor	2.0	Time to half empty (mins)	196	Slope (1:X)	1000.0		

Other (defaults)

Entry Loss (manhole)	0.250	Entry Loss (junction)	0.000	Apply Recommended Losses	x
Exit Loss (manhole)	0.250	Exit Loss (junction)	0.000	Flood Risk (m)	0.300

Rainfall

Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)	Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)
2 year 15 minute summer	100.123	28.331	2 year 1440 minute summer	5.100	1.367
2 year 15 minute winter	70.261	28.331	2 year 1440 minute winter	3.428	1.367
2 year 30 minute summer	62.784	17.766	2 year 2160 minute summer	3.557	0.983
2 year 30 minute winter	44.059	17.766	2 year 2160 minute winter	2.451	0.983
2 year 60 minute summer	40.921	10.814	2 year 2880 minute summer	2.924	0.784
2 year 60 minute winter	27.187	10.814	2 year 2880 minute winter	1.965	0.784
2 year 120 minute summer	30.840	8.150	2 year 4320 minute summer	2.229	0.583
2 year 120 minute winter	20.489	8.150	2 year 4320 minute winter	1.468	0.583
2 year 180 minute summer	25.361	6.526	2 year 5760 minute summer	1.877	0.480
2 year 180 minute winter	16.485	6.526	2 year 5760 minute winter	1.215	0.480
2 year 240 minute summer	20.644	5.456	2 year 7200 minute summer	1.641	0.419
2 year 240 minute winter	13.715	5.456	2 year 7200 minute winter	1.059	0.419
2 year 360 minute summer	16.001	4.118	2 year 8640 minute summer	1.479	0.377
2 year 360 minute winter	10.401	4.118	2 year 8640 minute winter	0.955	0.377
2 year 480 minute summer	12.559	3.319	2 year 10080 minute summer	1.363	0.348
2 year 480 minute winter	8.344	3.319	2 year 10080 minute winter	0.880	0.348
2 year 600 minute summer	10.200	2.790	30 year 15 minute summer	283.716	80.282
2 year 600 minute winter	6.969	2.790	30 year 15 minute winter	199.099	80.282
2 year 720 minute summer	9.002	2.413	30 year 30 minute summer	181.802	51.444
2 year 720 minute winter	6.050	2.413	30 year 30 minute winter	127.580	51.444
2 year 960 minute summer	7.247	1.908	30 year 60 minute summer	118.283	31.259
2 year 960 minute winter	4.800	1.908	30 year 60 minute winter	78.585	31.259

Rainfall

Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)	Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)
30 year 120 minute summer	75.603	19.980	30 year 7200 minute winter	1.831	0.724
30 year 120 minute winter	50.229	19.980	30 year 8640 minute summer	2.507	0.640
30 year 180 minute summer	58.236	14.986	30 year 8640 minute winter	1.618	0.640
30 year 180 minute winter	37.855	14.986	30 year 10080 minute summer	2.271	0.579
30 year 240 minute summer	45.711	12.080	30 year 10080 minute winter	1.466	0.579
30 year 240 minute winter	30.370	12.080	30 year +35% CC 15 minute summer	383.017	108.381
30 year 360 minute summer	34.072	8.768	30 year +35% CC 15 minute winter	268.784	108.381
30 year 360 minute winter	22.147	8.768	30 year +35% CC 30 minute summer	245.432	69.449
30 year 480 minute summer	26.166	6.915	30 year +35% CC 30 minute winter	172.233	69.449
30 year 480 minute winter	17.384	6.915	30 year +35% CC 60 minute summer	159.682	42.199
30 year 600 minute summer	20.941	5.728	30 year +35% CC 60 minute winter	106.089	42.199
30 year 600 minute winter	14.308	5.728	30 year +35% CC 120 minute summer	102.064	26.973
30 year 720 minute summer	18.282	4.900	30 year +35% CC 120 minute winter	67.809	26.973
30 year 720 minute winter	12.287	4.900	30 year +35% CC 180 minute summer	78.618	20.231
30 year 960 minute summer	14.496	3.817	30 year +35% CC 180 minute winter	51.104	20.231
30 year 960 minute winter	9.602	3.817	30 year +35% CC 240 minute summer	61.710	16.308
30 year 1440 minute summer	9.972	2.673	30 year +35% CC 240 minute winter	40.999	16.308
30 year 1440 minute winter	6.702	2.673	30 year +35% CC 360 minute summer	45.997	11.836
30 year 2160 minute summer	6.797	1.878	30 year +35% CC 360 minute winter	29.899	11.836
30 year 2160 minute winter	4.683	1.878	30 year +35% CC 480 minute summer	35.324	9.335
30 year 2880 minute summer	5.490	1.471	30 year +35% CC 480 minute winter	23.468	9.335
30 year 2880 minute winter	3.689	1.471	30 year +35% CC 600 minute summer	28.270	7.733
30 year 4320 minute summer	4.050	1.059	30 year +35% CC 600 minute winter	19.316	7.733
30 year 4320 minute winter	2.667	1.059	30 year +35% CC 720 minute summer	24.681	6.615
30 year 5760 minute summer	3.318	0.849	30 year +35% CC 720 minute winter	16.587	6.615
30 year 5760 minute winter	2.148	0.849	30 year +35% CC 960 minute summer	19.569	5.153
30 year 7200 minute summer	2.837	0.724	30 year +35% CC 960 minute winter	12.963	5.153

Rainfall

Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)
30 year +35% CC 1440 minute summer	13.462	3.608
30 year +35% CC 1440 minute winter	9.047	3.608
30 year +35% CC 2160 minute summer	9.176	2.536
30 year +35% CC 2160 minute winter	6.322	2.536
30 year +35% CC 2880 minute summer	7.411	1.986
30 year +35% CC 2880 minute winter	4.981	1.986
30 year +35% CC 4320 minute summer	5.468	1.430
30 year +35% CC 4320 minute winter	3.601	1.430
30 year +35% CC 5760 minute summer	4.479	1.147
30 year +35% CC 5760 minute winter	2.899	1.147
30 year +35% CC 7200 minute summer	3.830	0.977
30 year +35% CC 7200 minute winter	2.472	0.977
30 year +35% CC 8640 minute summer	3.384	0.863
30 year +35% CC 8640 minute winter	2.184	0.863
30 year +35% CC 10080 minute summer	3.065	0.782
30 year +35% CC 10080 minute winter	1.978	0.782
100 year 15 minute summer	359.906	101.841
100 year 15 minute winter	252.566	101.841
100 year 30 minute summer	231.671	65.555
100 year 30 minute winter	162.576	65.555
100 year 60 minute summer	151.892	40.141
100 year 60 minute winter	100.913	40.141
100 year 120 minute summer	94.622	25.006
100 year 120 minute winter	62.865	25.006
100 year 180 minute summer	72.259	18.595
100 year 180 minute winter	46.970	18.595
100 year 240 minute summer	56.501	14.932

Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)
100 year 240 minute winter	37.538	14.932
100 year 360 minute summer	42.000	10.808
100 year 360 minute winter	27.301	10.808
100 year 480 minute summer	32.234	8.519
100 year 480 minute winter	21.416	8.519
100 year 600 minute summer	25.786	7.053
100 year 600 minute winter	17.619	7.053
100 year 720 minute summer	22.503	6.031
100 year 720 minute winter	15.123	6.031
100 year 960 minute summer	17.821	4.693
100 year 960 minute winter	11.805	4.693
100 year 1440 minute summer	12.225	3.276
100 year 1440 minute winter	8.216	3.276
100 year 2160 minute summer	8.279	2.288
100 year 2160 minute winter	5.704	2.288
100 year 2880 minute summer	6.644	1.781
100 year 2880 minute winter	4.465	1.781
100 year 4320 minute summer	4.845	1.267
100 year 4320 minute winter	3.190	1.267
100 year 5760 minute summer	3.928	1.006
100 year 5760 minute winter	2.542	1.006
100 year 7200 minute summer	3.329	0.849
100 year 7200 minute winter	2.149	0.849
100 year 8640 minute summer	2.919	0.745
100 year 8640 minute winter	1.884	0.745
100 year 10080 minute summer	2.626	0.670
100 year 10080 minute winter	1.695	0.670

Rainfall

Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)	Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)
100 year +40% CC 15 minute summer	503.868	142.577	100 year +40% CC 720 minute winter	21.172	8.443
100 year +40% CC 15 minute winter	353.592	142.577	100 year +40% CC 960 minute summer	24.949	6.570
100 year +40% CC 30 minute summer	324.339	91.777	100 year +40% CC 960 minute winter	16.527	6.570
100 year +40% CC 30 minute winter	227.607	91.777	100 year +40% CC 1440 minute summer	17.114	4.587
100 year +40% CC 60 minute summer	212.648	56.197	100 year +40% CC 1440 minute winter	11.502	4.587
100 year +40% CC 60 minute winter	141.279	56.197	100 year +40% CC 2160 minute summer	11.590	3.203
100 year +40% CC 120 minute summer	132.471	35.008	100 year +40% CC 2160 minute winter	7.986	3.203
100 year +40% CC 120 minute winter	88.011	35.008	100 year +40% CC 2880 minute summer	9.301	2.493
100 year +40% CC 180 minute summer	101.162	26.032	100 year +40% CC 2880 minute winter	6.251	2.493
100 year +40% CC 180 minute winter	65.758	26.032	100 year +40% CC 4320 minute summer	6.782	1.773
100 year +40% CC 240 minute summer	79.101	20.904	100 year +40% CC 4320 minute winter	4.467	1.773
100 year +40% CC 240 minute winter	52.553	20.904	100 year +40% CC 5760 minute summer	5.499	1.408
100 year +40% CC 360 minute summer	58.801	15.131	100 year +40% CC 5760 minute winter	3.559	1.408
100 year +40% CC 360 minute winter	38.222	15.131	100 year +40% CC 7200 minute summer	4.661	1.189
100 year +40% CC 480 minute summer	45.128	11.926	100 year +40% CC 7200 minute winter	3.008	1.189
100 year +40% CC 480 minute winter	29.982	11.926	100 year +40% CC 8640 minute summer	4.087	1.043
100 year +40% CC 600 minute summer	36.101	9.874	100 year +40% CC 8640 minute winter	2.638	1.043
100 year +40% CC 600 minute winter	24.666	9.874	100 year +40% CC 10080 minute summer	3.676	0.938
100 year +40% CC 720 minute summer	31.504	8.443	100 year +40% CC 10080 minute winter	2.372	0.938

Results for 2 year Critical Storm Duration. Lowest mass balance: 98.87%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
180 minute summer	SA1	124	85.903	0.253	19.3	25.9001	0.0000	OK

Link Event (Velocity)	US Node	Link	Outflow (l/s)	Discharge Vol (m³)
180 minute summer	SA1	Depth/Flow	0.0	0.0
180 minute summer	SA1	Infiltration	4.8	

Results for 30 year Critical Storm Duration. Lowest mass balance: 98.87%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
120 minute winter	SA1	114	86.411	0.761	40.6	82.4014	0.0000	OK

Link Event (Velocity)	US Node	Link	Outflow (l/s)	Discharge Vol (m³)
120 minute winter	SA1	Depth/Flow	0.0	0.0
120 minute winter	SA1	Infiltration	6.3	

Results for 30 year +35% CC Critical Storm Duration. Lowest mass balance: 98.87%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
180 minute winter	SA1	152	86.750	1.100	41.1	120.1381	0.0000	OK

Link Event (Velocity)	US Node	Link	Outflow (l/s)	Discharge Vol (m³)
180 minute winter	SA1	Depth/Flow	0.0	0.0
180 minute winter	SA1	Infiltration	7.3	

Results for 100 year Critical Storm Duration. Lowest mass balance: 98.87%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
120 minute winter	SA1	116	86.650	1.000	50.8	108.9422	0.0000	OK

Link Event (Velocity)	US Node	Link	Outflow (l/s)	Discharge Vol (m³)
120 minute winter	SA1	Depth/Flow	0.0	0.0
120 minute winter	SA1	Infiltration	7.0	

Results for 100 year +40% CC Critical Storm Duration. Lowest mass balance: 98.87%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
180 minute winter	SA1	172	87.147	1.497	52.9	164.2112	0.0000	OK

Link Event (Velocity)	US Node	Link	Outflow (l/s)	Discharge Vol (m³)
180 minute winter	SA1	Depth/Flow	0.0	0.0
180 minute winter	SA1	Infiltration	8.4	

Design Settings

Rainfall Methodology	FEH-22	Minimum Velocity (m/s)	1.00
Return Period (years)	100	Connection Type	Level Soffits
Additional Flow (%)	0	Minimum Backdrop Height (m)	0.200
CV	1.000	Preferred Cover Depth (m)	1.200
Time of Entry (mins)	5.00	Include Intermediate Ground	✓
Maximum Time of Concentration (mins)	30.00	Enforce best practice design rules	✓
Maximum Rainfall (mm/hr)	50.0		

Nodes

Name	Area (ha)	Cover Level (m)	Easting (m)	Northing (m)	Depth (m)
SA2	0.211	90.850	554102.536	237747.849	2.000

Simulation Settings

Rainfall Methodology	FEH-22	Analysis Speed	Normal	Starting Level (m)		100 year (l/s)	5.8
Rainfall Events	Singular	Skip Steady State	✓	Check Discharge Rate(s)	✓	Check Discharge Volume	x
Summer CV	0.950	Drain Down Time (mins)	10080	1 year (l/s)	1.5		
Winter CV	0.950	Additional Storage (m³/ha)	0.0	30 year (l/s)	4.3		

Storm Durations

15	60	180	360	600	960	2160	4320	7200	10080
30	120	240	480	720	1440	2880	5760	8640	

Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)	Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)
2	0	0	0	100	0	0	0
30	0	0	0	100	40	0	0
30	35	0	0				

Pre-development Discharge Rate

Site Makeup	Greenfield	SPR	0.53	Betterment (%)	0
Greenfield Method	IH124	Region	6	QBar	1.8
Positively Drained Area (ha)	0.353	Growth Factor 1 year	0.85	Q 1 year (l/s)	1.5
SAAR (mm)	590	Growth Factor 30 year	2.40	Q 30 year (l/s)	4.3
Soil Index	5	Growth Factor 100 year	3.19	Q 100 year (l/s)	5.8

Node SA2 Online Depth/Flow Control

Flap Valve	x	Invert Level (m)	88.850	Design Flow (l/s)	0.1
Replaces Downstream Link	✓	Design Depth (m)	2.500		

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.001	0.000	2.500	0.000

Node SA2 Carpark Storage Structure

Base Inf Coefficient (m/hr)	0.06480	Porosity	0.95	Width (m)	3.000	Depth (m)	1.500
Side Inf Coefficient (m/hr)	0.06480	Invert Level (m)	88.850	Length (m)	37.000	Inf Depth (m)	
Safety Factor	2.0	Time to half empty (mins)	728	Slope (1:X)	1000.0		

Other (defaults)

Entry Loss (manhole)	0.250	Entry Loss (junction)	0.000	Apply Recommended Losses	x
Exit Loss (manhole)	0.250	Exit Loss (junction)	0.000	Flood Risk (m)	0.300

Rainfall

Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)	Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)
2 year 15 minute summer	100.123	28.331	2 year 1440 minute summer	5.100	1.367
2 year 15 minute winter	70.261	28.331	2 year 1440 minute winter	3.428	1.367
2 year 30 minute summer	62.784	17.766	2 year 2160 minute summer	3.557	0.983
2 year 30 minute winter	44.059	17.766	2 year 2160 minute winter	2.451	0.983
2 year 60 minute summer	40.921	10.814	2 year 2880 minute summer	2.924	0.784
2 year 60 minute winter	27.187	10.814	2 year 2880 minute winter	1.965	0.784
2 year 120 minute summer	30.840	8.150	2 year 4320 minute summer	2.229	0.583
2 year 120 minute winter	20.489	8.150	2 year 4320 minute winter	1.468	0.583
2 year 180 minute summer	25.361	6.526	2 year 5760 minute summer	1.877	0.480
2 year 180 minute winter	16.485	6.526	2 year 5760 minute winter	1.215	0.480
2 year 240 minute summer	20.644	5.456	2 year 7200 minute summer	1.641	0.419
2 year 240 minute winter	13.715	5.456	2 year 7200 minute winter	1.059	0.419
2 year 360 minute summer	16.001	4.118	2 year 8640 minute summer	1.479	0.377
2 year 360 minute winter	10.401	4.118	2 year 8640 minute winter	0.955	0.377
2 year 480 minute summer	12.559	3.319	2 year 10080 minute summer	1.363	0.348
2 year 480 minute winter	8.344	3.319	2 year 10080 minute winter	0.880	0.348
2 year 600 minute summer	10.200	2.790	30 year 15 minute summer	283.716	80.282
2 year 600 minute winter	6.969	2.790	30 year 15 minute winter	199.099	80.282
2 year 720 minute summer	9.002	2.413	30 year 30 minute summer	181.802	51.444
2 year 720 minute winter	6.050	2.413	30 year 30 minute winter	127.580	51.444
2 year 960 minute summer	7.247	1.908	30 year 60 minute summer	118.283	31.259
2 year 960 minute winter	4.800	1.908	30 year 60 minute winter	78.585	31.259

Rainfall

Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)	Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)
30 year 120 minute summer	75.603	19.980	30 year 7200 minute winter	1.831	0.724
30 year 120 minute winter	50.229	19.980	30 year 8640 minute summer	2.507	0.640
30 year 180 minute summer	58.236	14.986	30 year 8640 minute winter	1.618	0.640
30 year 180 minute winter	37.855	14.986	30 year 10080 minute summer	2.271	0.579
30 year 240 minute summer	45.711	12.080	30 year 10080 minute winter	1.466	0.579
30 year 240 minute winter	30.370	12.080	30 year +35% CC 15 minute summer	383.017	108.381
30 year 360 minute summer	34.072	8.768	30 year +35% CC 15 minute winter	268.784	108.381
30 year 360 minute winter	22.147	8.768	30 year +35% CC 30 minute summer	245.432	69.449
30 year 480 minute summer	26.166	6.915	30 year +35% CC 30 minute winter	172.233	69.449
30 year 480 minute winter	17.384	6.915	30 year +35% CC 60 minute summer	159.682	42.199
30 year 600 minute summer	20.941	5.728	30 year +35% CC 60 minute winter	106.089	42.199
30 year 600 minute winter	14.308	5.728	30 year +35% CC 120 minute summer	102.064	26.973
30 year 720 minute summer	18.282	4.900	30 year +35% CC 120 minute winter	67.809	26.973
30 year 720 minute winter	12.287	4.900	30 year +35% CC 180 minute summer	78.618	20.231
30 year 960 minute summer	14.496	3.817	30 year +35% CC 180 minute winter	51.104	20.231
30 year 960 minute winter	9.602	3.817	30 year +35% CC 240 minute summer	61.710	16.308
30 year 1440 minute summer	9.972	2.673	30 year +35% CC 240 minute winter	40.999	16.308
30 year 1440 minute winter	6.702	2.673	30 year +35% CC 360 minute summer	45.997	11.836
30 year 2160 minute summer	6.797	1.878	30 year +35% CC 360 minute winter	29.899	11.836
30 year 2160 minute winter	4.683	1.878	30 year +35% CC 480 minute summer	35.324	9.335
30 year 2880 minute summer	5.490	1.471	30 year +35% CC 480 minute winter	23.468	9.335
30 year 2880 minute winter	3.689	1.471	30 year +35% CC 600 minute summer	28.270	7.733
30 year 4320 minute summer	4.050	1.059	30 year +35% CC 600 minute winter	19.316	7.733
30 year 4320 minute winter	2.667	1.059	30 year +35% CC 720 minute summer	24.681	6.615
30 year 5760 minute summer	3.318	0.849	30 year +35% CC 720 minute winter	16.587	6.615
30 year 5760 minute winter	2.148	0.849	30 year +35% CC 960 minute summer	19.569	5.153
30 year 7200 minute summer	2.837	0.724	30 year +35% CC 960 minute winter	12.963	5.153

Rainfall

Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)	Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)
30 year +35% CC 1440 minute summer	13.462	3.608	100 year 240 minute winter	37.538	14.932
30 year +35% CC 1440 minute winter	9.047	3.608	100 year 360 minute summer	42.000	10.808
30 year +35% CC 2160 minute summer	9.176	2.536	100 year 360 minute winter	27.301	10.808
30 year +35% CC 2160 minute winter	6.322	2.536	100 year 480 minute summer	32.234	8.519
30 year +35% CC 2880 minute summer	7.411	1.986	100 year 480 minute winter	21.416	8.519
30 year +35% CC 2880 minute winter	4.981	1.986	100 year 600 minute summer	25.786	7.053
30 year +35% CC 4320 minute summer	5.468	1.430	100 year 600 minute winter	17.619	7.053
30 year +35% CC 4320 minute winter	3.601	1.430	100 year 720 minute summer	22.503	6.031
30 year +35% CC 5760 minute summer	4.479	1.147	100 year 720 minute winter	15.123	6.031
30 year +35% CC 5760 minute winter	2.899	1.147	100 year 960 minute summer	17.821	4.693
30 year +35% CC 7200 minute summer	3.830	0.977	100 year 960 minute winter	11.805	4.693
30 year +35% CC 7200 minute winter	2.472	0.977	100 year 1440 minute summer	12.225	3.276
30 year +35% CC 8640 minute summer	3.384	0.863	100 year 1440 minute winter	8.216	3.276
30 year +35% CC 8640 minute winter	2.184	0.863	100 year 2160 minute summer	8.279	2.288
30 year +35% CC 10080 minute summer	3.065	0.782	100 year 2160 minute winter	5.704	2.288
30 year +35% CC 10080 minute winter	1.978	0.782	100 year 2880 minute summer	6.644	1.781
100 year 15 minute summer	359.906	101.841	100 year 2880 minute winter	4.465	1.781
100 year 15 minute winter	252.566	101.841	100 year 4320 minute summer	4.845	1.267
100 year 30 minute summer	231.671	65.555	100 year 4320 minute winter	3.190	1.267
100 year 30 minute winter	162.576	65.555	100 year 5760 minute summer	3.928	1.006
100 year 60 minute summer	151.892	40.141	100 year 5760 minute winter	2.542	1.006
100 year 60 minute winter	100.913	40.141	100 year 7200 minute summer	3.329	0.849
100 year 120 minute summer	94.622	25.006	100 year 7200 minute winter	2.149	0.849
100 year 120 minute winter	62.865	25.006	100 year 8640 minute summer	2.919	0.745
100 year 180 minute summer	72.259	18.595	100 year 8640 minute winter	1.884	0.745
100 year 180 minute winter	46.970	18.595	100 year 10080 minute summer	2.626	0.670
100 year 240 minute summer	56.501	14.932	100 year 10080 minute winter	1.695	0.670

Rainfall

Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)	Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)
100 year +40% CC 15 minute summer	503.868	142.577	100 year +40% CC 720 minute winter	21.172	8.443
100 year +40% CC 15 minute winter	353.592	142.577	100 year +40% CC 960 minute summer	24.949	6.570
100 year +40% CC 30 minute summer	324.339	91.777	100 year +40% CC 960 minute winter	16.527	6.570
100 year +40% CC 30 minute winter	227.607	91.777	100 year +40% CC 1440 minute summer	17.114	4.587
100 year +40% CC 60 minute summer	212.648	56.197	100 year +40% CC 1440 minute winter	11.502	4.587
100 year +40% CC 60 minute winter	141.279	56.197	100 year +40% CC 2160 minute summer	11.590	3.203
100 year +40% CC 120 minute summer	132.471	35.008	100 year +40% CC 2160 minute winter	7.986	3.203
100 year +40% CC 120 minute winter	88.011	35.008	100 year +40% CC 2880 minute summer	9.301	2.493
100 year +40% CC 180 minute summer	101.162	26.032	100 year +40% CC 2880 minute winter	6.251	2.493
100 year +40% CC 180 minute winter	65.758	26.032	100 year +40% CC 4320 minute summer	6.782	1.773
100 year +40% CC 240 minute summer	79.101	20.904	100 year +40% CC 4320 minute winter	4.467	1.773
100 year +40% CC 240 minute winter	52.553	20.904	100 year +40% CC 5760 minute summer	5.499	1.408
100 year +40% CC 360 minute summer	58.801	15.131	100 year +40% CC 5760 minute winter	3.559	1.408
100 year +40% CC 360 minute winter	38.222	15.131	100 year +40% CC 7200 minute summer	4.661	1.189
100 year +40% CC 480 minute summer	45.128	11.926	100 year +40% CC 7200 minute winter	3.008	1.189
100 year +40% CC 480 minute winter	29.982	11.926	100 year +40% CC 8640 minute summer	4.087	1.043
100 year +40% CC 600 minute summer	36.101	9.874	100 year +40% CC 8640 minute winter	2.638	1.043
100 year +40% CC 600 minute winter	24.666	9.874	100 year +40% CC 10080 minute summer	3.676	0.938
100 year +40% CC 720 minute summer	31.504	8.443	100 year +40% CC 10080 minute winter	2.372	0.938

Results for 2 year Critical Storm Duration. Lowest mass balance: 98.47%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m^3)	Flood (m^3)	Status
360 minute summer	SA2	272	89.154	0.304	8.9	30.1000	0.0000	OK

Link Event (Velocity)	US Node	Link	Outflow (l/s)	Discharge Vol (m^3)
360 minute summer	SA2	Depth/Flow	0.0	0.0
360 minute summer	SA2	Infiltration	1.2	

Results for 30 year Critical Storm Duration. Lowest mass balance: 98.47%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
360 minute winter	SA2	352	89.625	0.775	12.3	79.7838	0.0000	OK

Link Event (Velocity)	US Node	Link	Outflow (l/s)	Discharge Vol (m³)
360 minute winter	SA2	Depth/Flow	0.0	0.0
360 minute winter	SA2	Infiltration	1.5	

Results for 30 year +35% CC Critical Storm Duration. Lowest mass balance: 98.47%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
360 minute winter	SA2	352	89.945	1.095	16.6	113.5514	0.0000	OK

Link Event (Velocity)	US Node	Link	Outflow (l/s)	Discharge Vol (m³)
360 minute winter	SA2	Depth/Flow	0.0	0.0
360 minute winter	SA2	Infiltration	1.8	

Results for 100 year Critical Storm Duration. Lowest mass balance: 98.47%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
360 minute winter	SA2	352	89.838	0.988	15.2	102.2401	0.0000	OK

Link Event (Velocity)	US Node	Link	Outflow (l/s)	Discharge Vol (m³)
360 minute winter	SA2	Depth/Flow	0.0	0.0
360 minute winter	SA2	Infiltration	1.7	

Results for 100 year +40% CC Critical Storm Duration. Lowest mass balance: 98.47%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
360 minute winter	SA2	352	90.294	1.444	21.3	150.3089	0.0000	OK

Link Event (Velocity)	US Node	Link	Outflow (l/s)	Discharge Vol (m³)
360 minute winter	SA2	Depth/Flow	0.0	0.0
360 minute winter	SA2	Infiltration	2.0	

Design Settings

Rainfall Methodology	FEH-22	Minimum Velocity (m/s)	1.00
Return Period (years)	100	Connection Type	Level Soffits
Additional Flow (%)	0	Minimum Backdrop Height (m)	0.200
CV	1.000	Preferred Cover Depth (m)	1.200
Time of Entry (mins)	5.00	Include Intermediate Ground	✓
Maximum Time of Concentration (mins)	30.00	Enforce best practice design rules	✓
Maximum Rainfall (mm/hr)	50.0		

Nodes

Name	Area (ha)	Cover Level (m)	Easting (m)	Northing (m)	Depth (m)
SA3	0.151	90.850	554102.536	237747.849	2.850

Simulation Settings

Rainfall Methodology	FEH-22	Analysis Speed	Normal	Starting Level (m)		100 year (l/s)	5.8
Rainfall Events	Singular	Skip Steady State	✓	Check Discharge Rate(s)	✓	Check Discharge Volume	x
Summer CV	0.950	Drain Down Time (mins)	10080	1 year (l/s)	1.5		
Winter CV	0.950	Additional Storage (m³/ha)	0.0	30 year (l/s)	4.3		

Storm Durations

15	60	180	360	600	960	2160	4320	7200	10080
30	120	240	480	720	1440	2880	5760	8640	

Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)
2	0	0	0
30	0	0	0
30	35	0	0
100	0	0	0
100	40	0	0

Pre-development Discharge Rate

Site Makeup	Greenfield	SPR	0.53	Betterment (%)	0
Greenfield Method	IH124	Region	6	QBar	1.8
Positively Drained Area (ha)	0.353	Growth Factor 1 year	0.85	Q 1 year (l/s)	1.5
SAAR (mm)	590	Growth Factor 30 year	2.40	Q 30 year (l/s)	4.3
Soil Index	5	Growth Factor 100 year	3.19	Q 100 year (l/s)	5.8

Node SA3 Online Depth/Flow Control

Flap Valve	x	Invert Level (m)	88.000	Design Flow (l/s)	0.1
Replaces Downstream Link	✓	Design Depth (m)	2.500		

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.001	0.000	2.500	0.000

Node SA3 Carpark Storage Structure

Base Inf Coefficient (m/hr)	0.02340	Porosity	0.95	Width (m)	5.500	Depth (m)	0.750
Side Inf Coefficient (m/hr)	0.02340	Invert Level (m)	88.000	Length (m)	31.000	Inf Depth (m)	
Safety Factor	2.0	Time to half empty (mins)	1515	Slope (1:X)	1000.0		

Other (defaults)

Entry Loss (manhole)	0.250	Entry Loss (junction)	0.000	Apply Recommended Losses	x
Exit Loss (manhole)	0.250	Exit Loss (junction)	0.000	Flood Risk (m)	0.300

Rainfall

Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)	Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)
2 year 15 minute summer	100.123	28.331	2 year 1440 minute summer	5.100	1.367
2 year 15 minute winter	70.261	28.331	2 year 1440 minute winter	3.428	1.367
2 year 30 minute summer	62.784	17.766	2 year 2160 minute summer	3.557	0.983
2 year 30 minute winter	44.059	17.766	2 year 2160 minute winter	2.451	0.983
2 year 60 minute summer	40.921	10.814	2 year 2880 minute summer	2.924	0.784
2 year 60 minute winter	27.187	10.814	2 year 2880 minute winter	1.965	0.784
2 year 120 minute summer	30.840	8.150	2 year 4320 minute summer	2.229	0.583
2 year 120 minute winter	20.489	8.150	2 year 4320 minute winter	1.468	0.583
2 year 180 minute summer	25.361	6.526	2 year 5760 minute summer	1.877	0.480
2 year 180 minute winter	16.485	6.526	2 year 5760 minute winter	1.215	0.480
2 year 240 minute summer	20.644	5.456	2 year 7200 minute summer	1.641	0.419
2 year 240 minute winter	13.715	5.456	2 year 7200 minute winter	1.059	0.419
2 year 360 minute summer	16.001	4.118	2 year 8640 minute summer	1.479	0.377
2 year 360 minute winter	10.401	4.118	2 year 8640 minute winter	0.955	0.377
2 year 480 minute summer	12.559	3.319	2 year 10080 minute summer	1.363	0.348
2 year 480 minute winter	8.344	3.319	2 year 10080 minute winter	0.880	0.348
2 year 600 minute summer	10.200	2.790	30 year 15 minute summer	283.716	80.282
2 year 600 minute winter	6.969	2.790	30 year 15 minute winter	199.099	80.282
2 year 720 minute summer	9.002	2.413	30 year 30 minute summer	181.802	51.444
2 year 720 minute winter	6.050	2.413	30 year 30 minute winter	127.580	51.444
2 year 960 minute summer	7.247	1.908	30 year 60 minute summer	118.283	31.259
2 year 960 minute winter	4.800	1.908	30 year 60 minute winter	78.585	31.259

Rainfall

Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)	Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)
30 year 120 minute summer	75.603	19.980	30 year 7200 minute winter	1.831	0.724
30 year 120 minute winter	50.229	19.980	30 year 8640 minute summer	2.507	0.640
30 year 180 minute summer	58.236	14.986	30 year 8640 minute winter	1.618	0.640
30 year 180 minute winter	37.855	14.986	30 year 10080 minute summer	2.271	0.579
30 year 240 minute summer	45.711	12.080	30 year 10080 minute winter	1.466	0.579
30 year 240 minute winter	30.370	12.080	30 year +35% CC 15 minute summer	383.017	108.381
30 year 360 minute summer	34.072	8.768	30 year +35% CC 15 minute winter	268.784	108.381
30 year 360 minute winter	22.147	8.768	30 year +35% CC 30 minute summer	245.432	69.449
30 year 480 minute summer	26.166	6.915	30 year +35% CC 30 minute winter	172.233	69.449
30 year 480 minute winter	17.384	6.915	30 year +35% CC 60 minute summer	159.682	42.199
30 year 600 minute summer	20.941	5.728	30 year +35% CC 60 minute winter	106.089	42.199
30 year 600 minute winter	14.308	5.728	30 year +35% CC 120 minute summer	102.064	26.973
30 year 720 minute summer	18.282	4.900	30 year +35% CC 120 minute winter	67.809	26.973
30 year 720 minute winter	12.287	4.900	30 year +35% CC 180 minute summer	78.618	20.231
30 year 960 minute summer	14.496	3.817	30 year +35% CC 180 minute winter	51.104	20.231
30 year 960 minute winter	9.602	3.817	30 year +35% CC 240 minute summer	61.710	16.308
30 year 1440 minute summer	9.972	2.673	30 year +35% CC 240 minute winter	40.999	16.308
30 year 1440 minute winter	6.702	2.673	30 year +35% CC 360 minute summer	45.997	11.836
30 year 2160 minute summer	6.797	1.878	30 year +35% CC 360 minute winter	29.899	11.836
30 year 2160 minute winter	4.683	1.878	30 year +35% CC 480 minute summer	35.324	9.335
30 year 2880 minute summer	5.490	1.471	30 year +35% CC 480 minute winter	23.468	9.335
30 year 2880 minute winter	3.689	1.471	30 year +35% CC 600 minute summer	28.270	7.733
30 year 4320 minute summer	4.050	1.059	30 year +35% CC 600 minute winter	19.316	7.733
30 year 4320 minute winter	2.667	1.059	30 year +35% CC 720 minute summer	24.681	6.615
30 year 5760 minute summer	3.318	0.849	30 year +35% CC 720 minute winter	16.587	6.615
30 year 5760 minute winter	2.148	0.849	30 year +35% CC 960 minute summer	19.569	5.153
30 year 7200 minute summer	2.837	0.724	30 year +35% CC 960 minute winter	12.963	5.153

Rainfall

Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)	Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)
30 year +35% CC 1440 minute summer	13.462	3.608	100 year 240 minute winter	37.538	14.932
30 year +35% CC 1440 minute winter	9.047	3.608	100 year 360 minute summer	42.000	10.808
30 year +35% CC 2160 minute summer	9.176	2.536	100 year 360 minute winter	27.301	10.808
30 year +35% CC 2160 minute winter	6.322	2.536	100 year 480 minute summer	32.234	8.519
30 year +35% CC 2880 minute summer	7.411	1.986	100 year 480 minute winter	21.416	8.519
30 year +35% CC 2880 minute winter	4.981	1.986	100 year 600 minute summer	25.786	7.053
30 year +35% CC 4320 minute summer	5.468	1.430	100 year 600 minute winter	17.619	7.053
30 year +35% CC 4320 minute winter	3.601	1.430	100 year 720 minute summer	22.503	6.031
30 year +35% CC 5760 minute summer	4.479	1.147	100 year 720 minute winter	15.123	6.031
30 year +35% CC 5760 minute winter	2.899	1.147	100 year 960 minute summer	17.821	4.693
30 year +35% CC 7200 minute summer	3.830	0.977	100 year 960 minute winter	11.805	4.693
30 year +35% CC 7200 minute winter	2.472	0.977	100 year 1440 minute summer	12.225	3.276
30 year +35% CC 8640 minute summer	3.384	0.863	100 year 1440 minute winter	8.216	3.276
30 year +35% CC 8640 minute winter	2.184	0.863	100 year 2160 minute summer	8.279	2.288
30 year +35% CC 10080 minute summer	3.065	0.782	100 year 2160 minute winter	5.704	2.288
30 year +35% CC 10080 minute winter	1.978	0.782	100 year 2880 minute summer	6.644	1.781
100 year 15 minute summer	359.906	101.841	100 year 2880 minute winter	4.465	1.781
100 year 15 minute winter	252.566	101.841	100 year 4320 minute summer	4.845	1.267
100 year 30 minute summer	231.671	65.555	100 year 4320 minute winter	3.190	1.267
100 year 30 minute winter	162.576	65.555	100 year 5760 minute summer	3.928	1.006
100 year 60 minute summer	151.892	40.141	100 year 5760 minute winter	2.542	1.006
100 year 60 minute winter	100.913	40.141	100 year 7200 minute summer	3.329	0.849
100 year 120 minute summer	94.622	25.006	100 year 7200 minute winter	2.149	0.849
100 year 120 minute winter	62.865	25.006	100 year 8640 minute summer	2.919	0.745
100 year 180 minute summer	72.259	18.595	100 year 8640 minute winter	1.884	0.745
100 year 180 minute winter	46.970	18.595	100 year 10080 minute summer	2.626	0.670
100 year 240 minute summer	56.501	14.932	100 year 10080 minute winter	1.695	0.670

Rainfall

Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)	Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)
100 year +40% CC 15 minute summer	503.868	142.577	100 year +40% CC 720 minute winter	21.172	8.443
100 year +40% CC 15 minute winter	353.592	142.577	100 year +40% CC 960 minute summer	24.949	6.570
100 year +40% CC 30 minute summer	324.339	91.777	100 year +40% CC 960 minute winter	16.527	6.570
100 year +40% CC 30 minute winter	227.607	91.777	100 year +40% CC 1440 minute summer	17.114	4.587
100 year +40% CC 60 minute summer	212.648	56.197	100 year +40% CC 1440 minute winter	11.502	4.587
100 year +40% CC 60 minute winter	141.279	56.197	100 year +40% CC 2160 minute summer	11.590	3.203
100 year +40% CC 120 minute summer	132.471	35.008	100 year +40% CC 2160 minute winter	7.986	3.203
100 year +40% CC 120 minute winter	88.011	35.008	100 year +40% CC 2880 minute summer	9.301	2.493
100 year +40% CC 180 minute summer	101.162	26.032	100 year +40% CC 2880 minute winter	6.251	2.493
100 year +40% CC 180 minute winter	65.758	26.032	100 year +40% CC 4320 minute summer	6.782	1.773
100 year +40% CC 240 minute summer	79.101	20.904	100 year +40% CC 4320 minute winter	4.467	1.773
100 year +40% CC 240 minute winter	52.553	20.904	100 year +40% CC 5760 minute summer	5.499	1.408
100 year +40% CC 360 minute summer	58.801	15.131	100 year +40% CC 5760 minute winter	3.559	1.408
100 year +40% CC 360 minute winter	38.222	15.131	100 year +40% CC 7200 minute summer	4.661	1.189
100 year +40% CC 480 minute summer	45.128	11.926	100 year +40% CC 7200 minute winter	3.008	1.189
100 year +40% CC 480 minute winter	29.982	11.926	100 year +40% CC 8640 minute summer	4.087	1.043
100 year +40% CC 600 minute summer	36.101	9.874	100 year +40% CC 8640 minute winter	2.638	1.043
100 year +40% CC 600 minute winter	24.666	9.874	100 year +40% CC 10080 minute summer	3.676	0.938
100 year +40% CC 720 minute summer	31.504	8.443	100 year +40% CC 10080 minute winter	2.372	0.938

Results for 2 year Critical Storm Duration. Lowest mass balance: 98.74%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
360 minute winter	SA3	344	88.172	0.172	4.1	25.4250	0.0000	OK

Link Event (Velocity)	US Node	Link	Outflow (l/s)	Discharge Vol (m³)
360 minute winter	SA3	Depth/Flow	0.0	0.0
360 minute winter	SA3	Infiltration	0.6	

Results for 30 year Critical Storm Duration. Lowest mass balance: 98.74%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
360 minute winter	SA3	352	88.410	0.410	8.8	63.8527	0.0000	OK

Link Event (Velocity)	US Node	Link	Outflow (l/s)	Discharge Vol (m³)
360 minute winter	SA3	Depth/Flow	0.0	0.0
360 minute winter	SA3	Infiltration	0.6	

Results for 30 year +35% CC Critical Storm Duration. Lowest mass balance: 98.74%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
480 minute winter	SA3	472	88.577	0.577	9.4	90.9450	0.0000	OK

Link Event (Velocity)	US Node	Link	Outflow (l/s)	Discharge Vol (m³)
480 minute winter	SA3	Depth/Flow	0.0	0.0
480 minute winter	SA3	Infiltration	0.7	

Results for 100 year Critical Storm Duration. Lowest mass balance: 98.74%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
480 minute winter	SA3	472	88.519	0.519	8.5	81.6028	0.0000	OK

Link Event (Velocity)	US Node	Link	Outflow (l/s)	Discharge Vol (m³)
480 minute winter	SA3	Depth/Flow	0.0	0.0
480 minute winter	SA3	Infiltration	0.7	

Results for 100 year +40% CC Critical Storm Duration. Lowest mass balance: 98.74%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
600 minute winter	SA3	600	89.566	1.566	9.8	119.0532	0.0000	OK

Link Event (Velocity)	US Node	Link	Outflow (l/s)	Discharge Vol (m³)
600 minute winter	SA3	Depth/Flow	0.0	0.0
600 minute winter	SA3	Infiltration	0.7	

Design Settings

Rainfall Methodology	FEH-22	Minimum Velocity (m/s)	1.00
Return Period (years)	100	Connection Type	Level Soffits
Additional Flow (%)	0	Minimum Backdrop Height (m)	0.200
CV	1.000	Preferred Cover Depth (m)	1.200
Time of Entry (mins)	5.00	Include Intermediate Ground	✓
Maximum Time of Concentration (mins)	30.00	Enforce best practice design rules	✓
Maximum Rainfall (mm/hr)	50.0		

Nodes

Name	Area (ha)	Cover Level (m)	Easting (m)	Northing (m)	Depth (m)
SA4	0.061	90.850	554102.536	237747.849	4.450

Simulation Settings

Rainfall Methodology	FEH-22	Analysis Speed	Normal	Starting Level (m)		100 year (l/s)	5.8
Rainfall Events	Singular	Skip Steady State	✓	Check Discharge Rate(s)	✓	Check Discharge Volume	x
Summer CV	0.950	Drain Down Time (mins)	10080	1 year (l/s)	1.5		
Winter CV	0.950	Additional Storage (m³/ha)	0.0	30 year (l/s)	4.3		

Storm Durations

15	60	180	360	600	960	2160	4320	7200	10080
30	120	240	480	720	1440	2880	5760	8640	

Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)
2	0	0	0
30	0	0	0
30	35	0	0
100	0	0	0
100	40	0	0

Pre-development Discharge Rate

Site Makeup	Greenfield	SPR	0.53	Betterment (%)	0
Greenfield Method	IH124	Region	6	QBar	1.8
Positively Drained Area (ha)	0.353	Growth Factor 1 year	0.85	Q 1 year (l/s)	1.5
SAAR (mm)	590	Growth Factor 30 year	2.40	Q 30 year (l/s)	4.3
Soil Index	5	Growth Factor 100 year	3.19	Q 100 year (l/s)	5.8

Node SA4 Online Depth/Flow Control

Flap Valve	x	Invert Level (m)	86.400	Design Flow (l/s)	0.1
Replaces Downstream Link	✓	Design Depth (m)	2.500		

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.001	0.000	2.500	0.000

Node SA4 Carpark Storage Structure

Base Inf Coefficient (m/hr)	0.10440	Porosity	0.95	Width (m)	4.000	Depth (m)	0.750
Side Inf Coefficient (m/hr)	0.10440	Invert Level (m)	86.400	Length (m)	15.000	Inf Depth (m)	
Safety Factor	2.0	Time to half empty (mins)	268	Slope (1:X)	1000.0		

Other (defaults)

Entry Loss (manhole)	0.250	Entry Loss (junction)	0.000	Apply Recommended Losses	x
Exit Loss (manhole)	0.250	Exit Loss (junction)	0.000	Flood Risk (m)	0.300

Rainfall

Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)	Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)
2 year 15 minute summer	100.123	28.331	2 year 1440 minute summer	5.100	1.367
2 year 15 minute winter	70.261	28.331	2 year 1440 minute winter	3.428	1.367
2 year 30 minute summer	62.784	17.766	2 year 2160 minute summer	3.557	0.983
2 year 30 minute winter	44.059	17.766	2 year 2160 minute winter	2.451	0.983
2 year 60 minute summer	40.921	10.814	2 year 2880 minute summer	2.924	0.784
2 year 60 minute winter	27.187	10.814	2 year 2880 minute winter	1.965	0.784
2 year 120 minute summer	30.840	8.150	2 year 4320 minute summer	2.229	0.583
2 year 120 minute winter	20.489	8.150	2 year 4320 minute winter	1.468	0.583
2 year 180 minute summer	25.361	6.526	2 year 5760 minute summer	1.877	0.480
2 year 180 minute winter	16.485	6.526	2 year 5760 minute winter	1.215	0.480
2 year 240 minute summer	20.644	5.456	2 year 7200 minute summer	1.641	0.419
2 year 240 minute winter	13.715	5.456	2 year 7200 minute winter	1.059	0.419
2 year 360 minute summer	16.001	4.118	2 year 8640 minute summer	1.479	0.377
2 year 360 minute winter	10.401	4.118	2 year 8640 minute winter	0.955	0.377
2 year 480 minute summer	12.559	3.319	2 year 10080 minute summer	1.363	0.348
2 year 480 minute winter	8.344	3.319	2 year 10080 minute winter	0.880	0.348
2 year 600 minute summer	10.200	2.790	30 year 15 minute summer	283.716	80.282
2 year 600 minute winter	6.969	2.790	30 year 15 minute winter	199.099	80.282
2 year 720 minute summer	9.002	2.413	30 year 30 minute summer	181.802	51.444
2 year 720 minute winter	6.050	2.413	30 year 30 minute winter	127.580	51.444
2 year 960 minute summer	7.247	1.908	30 year 60 minute summer	118.283	31.259
2 year 960 minute winter	4.800	1.908	30 year 60 minute winter	78.585	31.259

Rainfall

Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)	Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)
30 year 120 minute summer	75.603	19.980	30 year 7200 minute winter	1.831	0.724
30 year 120 minute winter	50.229	19.980	30 year 8640 minute summer	2.507	0.640
30 year 180 minute summer	58.236	14.986	30 year 8640 minute winter	1.618	0.640
30 year 180 minute winter	37.855	14.986	30 year 10080 minute summer	2.271	0.579
30 year 240 minute summer	45.711	12.080	30 year 10080 minute winter	1.466	0.579
30 year 240 minute winter	30.370	12.080	30 year +35% CC 15 minute summer	383.017	108.381
30 year 360 minute summer	34.072	8.768	30 year +35% CC 15 minute winter	268.784	108.381
30 year 360 minute winter	22.147	8.768	30 year +35% CC 30 minute summer	245.432	69.449
30 year 480 minute summer	26.166	6.915	30 year +35% CC 30 minute winter	172.233	69.449
30 year 480 minute winter	17.384	6.915	30 year +35% CC 60 minute summer	159.682	42.199
30 year 600 minute summer	20.941	5.728	30 year +35% CC 60 minute winter	106.089	42.199
30 year 600 minute winter	14.308	5.728	30 year +35% CC 120 minute summer	102.064	26.973
30 year 720 minute summer	18.282	4.900	30 year +35% CC 120 minute winter	67.809	26.973
30 year 720 minute winter	12.287	4.900	30 year +35% CC 180 minute summer	78.618	20.231
30 year 960 minute summer	14.496	3.817	30 year +35% CC 180 minute winter	51.104	20.231
30 year 960 minute winter	9.602	3.817	30 year +35% CC 240 minute summer	61.710	16.308
30 year 1440 minute summer	9.972	2.673	30 year +35% CC 240 minute winter	40.999	16.308
30 year 1440 minute winter	6.702	2.673	30 year +35% CC 360 minute summer	45.997	11.836
30 year 2160 minute summer	6.797	1.878	30 year +35% CC 360 minute winter	29.899	11.836
30 year 2160 minute winter	4.683	1.878	30 year +35% CC 480 minute summer	35.324	9.335
30 year 2880 minute summer	5.490	1.471	30 year +35% CC 480 minute winter	23.468	9.335
30 year 2880 minute winter	3.689	1.471	30 year +35% CC 600 minute summer	28.270	7.733
30 year 4320 minute summer	4.050	1.059	30 year +35% CC 600 minute winter	19.316	7.733
30 year 4320 minute winter	2.667	1.059	30 year +35% CC 720 minute summer	24.681	6.615
30 year 5760 minute summer	3.318	0.849	30 year +35% CC 720 minute winter	16.587	6.615
30 year 5760 minute winter	2.148	0.849	30 year +35% CC 960 minute summer	19.569	5.153
30 year 7200 minute summer	2.837	0.724	30 year +35% CC 960 minute winter	12.963	5.153

Rainfall

Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)	Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)
30 year +35% CC 1440 minute summer	13.462	3.608	100 year 240 minute winter	37.538	14.932
30 year +35% CC 1440 minute winter	9.047	3.608	100 year 360 minute summer	42.000	10.808
30 year +35% CC 2160 minute summer	9.176	2.536	100 year 360 minute winter	27.301	10.808
30 year +35% CC 2160 minute winter	6.322	2.536	100 year 480 minute summer	32.234	8.519
30 year +35% CC 2880 minute summer	7.411	1.986	100 year 480 minute winter	21.416	8.519
30 year +35% CC 2880 minute winter	4.981	1.986	100 year 600 minute summer	25.786	7.053
30 year +35% CC 4320 minute summer	5.468	1.430	100 year 600 minute winter	17.619	7.053
30 year +35% CC 4320 minute winter	3.601	1.430	100 year 720 minute summer	22.503	6.031
30 year +35% CC 5760 minute summer	4.479	1.147	100 year 720 minute winter	15.123	6.031
30 year +35% CC 5760 minute winter	2.899	1.147	100 year 960 minute summer	17.821	4.693
30 year +35% CC 7200 minute summer	3.830	0.977	100 year 960 minute winter	11.805	4.693
30 year +35% CC 7200 minute winter	2.472	0.977	100 year 1440 minute summer	12.225	3.276
30 year +35% CC 8640 minute summer	3.384	0.863	100 year 1440 minute winter	8.216	3.276
30 year +35% CC 8640 minute winter	2.184	0.863	100 year 2160 minute summer	8.279	2.288
30 year +35% CC 10080 minute summer	3.065	0.782	100 year 2160 minute winter	5.704	2.288
30 year +35% CC 10080 minute winter	1.978	0.782	100 year 2880 minute summer	6.644	1.781
100 year 15 minute summer	359.906	101.841	100 year 2880 minute winter	4.465	1.781
100 year 15 minute winter	252.566	101.841	100 year 4320 minute summer	4.845	1.267
100 year 30 minute summer	231.671	65.555	100 year 4320 minute winter	3.190	1.267
100 year 30 minute winter	162.576	65.555	100 year 5760 minute summer	3.928	1.006
100 year 60 minute summer	151.892	40.141	100 year 5760 minute winter	2.542	1.006
100 year 60 minute winter	100.913	40.141	100 year 7200 minute summer	3.329	0.849
100 year 120 minute summer	94.622	25.006	100 year 7200 minute winter	2.149	0.849
100 year 120 minute winter	62.865	25.006	100 year 8640 minute summer	2.919	0.745
100 year 180 minute summer	72.259	18.595	100 year 8640 minute winter	1.884	0.745
100 year 180 minute winter	46.970	18.595	100 year 10080 minute summer	2.626	0.670
100 year 240 minute summer	56.501	14.932	100 year 10080 minute winter	1.695	0.670

Rainfall

Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)	Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)
100 year +40% CC 15 minute summer	503.868	142.577	100 year +40% CC 720 minute winter	21.172	8.443
100 year +40% CC 15 minute winter	353.592	142.577	100 year +40% CC 960 minute summer	24.949	6.570
100 year +40% CC 30 minute summer	324.339	91.777	100 year +40% CC 960 minute winter	16.527	6.570
100 year +40% CC 30 minute winter	227.607	91.777	100 year +40% CC 1440 minute summer	17.114	4.587
100 year +40% CC 60 minute summer	212.648	56.197	100 year +40% CC 1440 minute winter	11.502	4.587
100 year +40% CC 60 minute winter	141.279	56.197	100 year +40% CC 2160 minute summer	11.590	3.203
100 year +40% CC 120 minute summer	132.471	35.008	100 year +40% CC 2160 minute winter	7.986	3.203
100 year +40% CC 120 minute winter	88.011	35.008	100 year +40% CC 2880 minute summer	9.301	2.493
100 year +40% CC 180 minute summer	101.162	26.032	100 year +40% CC 2880 minute winter	6.251	2.493
100 year +40% CC 180 minute winter	65.758	26.032	100 year +40% CC 4320 minute summer	6.782	1.773
100 year +40% CC 240 minute summer	79.101	20.904	100 year +40% CC 4320 minute winter	4.467	1.773
100 year +40% CC 240 minute winter	52.553	20.904	100 year +40% CC 5760 minute summer	5.499	1.408
100 year +40% CC 360 minute summer	58.801	15.131	100 year +40% CC 5760 minute winter	3.559	1.408
100 year +40% CC 360 minute winter	38.222	15.131	100 year +40% CC 7200 minute summer	4.661	1.189
100 year +40% CC 480 minute summer	45.128	11.926	100 year +40% CC 7200 minute winter	3.008	1.189
100 year +40% CC 480 minute winter	29.982	11.926	100 year +40% CC 8640 minute summer	4.087	1.043
100 year +40% CC 600 minute summer	36.101	9.874	100 year +40% CC 8640 minute winter	2.638	1.043
100 year +40% CC 600 minute winter	24.666	9.874	100 year +40% CC 10080 minute summer	3.676	0.938
100 year +40% CC 720 minute summer	31.504	8.443	100 year +40% CC 10080 minute winter	2.372	0.938

Results for 2 year Critical Storm Duration. Lowest mass balance: 95.12%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
180 minute summer	SA4	124	86.510	0.110	3.8	5.8151	0.0000	OK

Link Event (Velocity)	US Node	Link	Outflow (l/s)	Discharge Vol (m³)
180 minute summer	SA4	Depth/Flow	0.0	0.0
180 minute summer	SA4	Infiltration	0.9	

Results for 30 year Critical Storm Duration. Lowest mass balance: 95.12%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
180 minute winter	SA4	168	86.715	0.315	6.0	17.5450	0.0000	OK

Link Event (Velocity)	US Node	Link	Outflow (l/s)	Discharge Vol (m³)
180 minute winter	SA4	Depth/Flow	0.0	0.0
180 minute winter	SA4	Infiltration	1.0	

Results for 30 year +35% CC Critical Storm Duration. Lowest mass balance: 95.12%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
180 minute winter	SA4	176	86.860	0.460	8.1	25.7992	0.0000	OK

Link Event (Velocity)	US Node	Link	Outflow (l/s)	Discharge Vol (m³)
180 minute winter	SA4	Depth/Flow	0.0	0.0
180 minute winter	SA4	Infiltration	1.1	

Results for 100 year Critical Storm Duration. Lowest mass balance: 95.12%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
180 minute winter	SA4	172	86.814	0.414	7.5	23.1501	0.0000	OK

Link Event (Velocity)	US Node	Link	Outflow (l/s)	Discharge Vol (m³)
180 minute winter	SA4	Depth/Flow	0.0	0.0
180 minute winter	SA4	Infiltration	1.1	

Results for 100 year +40% CC Critical Storm Duration. Lowest mass balance: 95.12%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
180 minute winter	SA4	176	87.022	0.622	10.4	35.0124	0.0000	OK

Link Event (Velocity)	US Node	Link	Outflow (l/s)	Discharge Vol (m³)
180 minute winter	SA4	Depth/Flow	0.0	0.0
180 minute winter	SA4	Infiltration	1.2	

Design Settings

Rainfall Methodology	FEH-22	Minimum Velocity (m/s)	1.00
Return Period (years)	100	Connection Type	Level Soffits
Additional Flow (%)	0	Minimum Backdrop Height (m)	0.200
CV	1.000	Preferred Cover Depth (m)	1.200
Time of Entry (mins)	5.00	Include Intermediate Ground	✓
Maximum Time of Concentration (mins)	30.00	Enforce best practice design rules	✓
Maximum Rainfall (mm/hr)	50.0		

Nodes

Name	Area (ha)	Cover Level (m)	Easting (m)	Northing (m)	Depth (m)
PP	0.988	84.000	554102.536	237747.849	0.350

Simulation Settings

Rainfall Methodology	FEH-22	Analysis Speed	Normal	Starting Level (m)		100 year (l/s)	5.8
Rainfall Events	Singular	Skip Steady State	✓	Check Discharge Rate(s)	✓	Check Discharge Volume	x
Summer CV	0.950	Drain Down Time (mins)	10080	1 year (l/s)	1.5		
Winter CV	0.950	Additional Storage (m^3/ha)	0.0	30 year (l/s)	4.3		

Storm Durations

15	60	180	360	600	960	2160	4320	7200	10080
30	120	240	480	720	1440	2880	5760	8640	

Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)	Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)
2	0	0	0	100	0	0	0
30	0	0	0	100	40	0	0
30	35	0	0				

Pre-development Discharge Rate

Site Makeup	Greenfield	SPR	0.53	Betterment (%)	0
Greenfield Method	IH124	Region	6	QBar	1.8
Positively Drained Area (ha)	0.353	Growth Factor 1 year	0.85	Q 1 year (l/s)	1.5
SAAR (mm)	590	Growth Factor 30 year	2.40	Q 30 year (l/s)	4.3
Soil Index	5	Growth Factor 100 year	3.19	Q 100 year (l/s)	5.8

Node PP Online Depth/Flow Control

Flap Valve	x	Invert Level (m)	83.650	Design Flow (l/s)	0.1
Replaces Downstream Link	✓	Design Depth (m)	2.500		

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.001	0.000	2.500	0.000

Node PP Carpark Storage Structure

Base Inf Coefficient (m/hr)	0.03600	Porosity	0.33	Width (m)	98.800	Depth (m)	0.350
Side Inf Coefficient (m/hr)	0.03600	Invert Level (m)	83.650	Length (m)	100.000	Inf Depth (m)	
Safety Factor	2.0	Time to half empty (mins)	92	Slope (1:X)	1000.0		

Other (defaults)

Entry Loss (manhole)	0.250	Entry Loss (junction)	0.000	Apply Recommended Losses	x
Exit Loss (manhole)	0.250	Exit Loss (junction)	0.000	Flood Risk (m)	0.300

Rainfall

Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)	Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)
2 year 15 minute summer	100.123	28.331	2 year 1440 minute summer	5.100	1.367
2 year 15 minute winter	70.261	28.331	2 year 1440 minute winter	3.428	1.367
2 year 30 minute summer	62.784	17.766	2 year 2160 minute summer	3.557	0.983
2 year 30 minute winter	44.059	17.766	2 year 2160 minute winter	2.451	0.983
2 year 60 minute summer	40.921	10.814	2 year 2880 minute summer	2.924	0.784
2 year 60 minute winter	27.187	10.814	2 year 2880 minute winter	1.965	0.784
2 year 120 minute summer	30.840	8.150	2 year 4320 minute summer	2.229	0.583
2 year 120 minute winter	20.489	8.150	2 year 4320 minute winter	1.468	0.583
2 year 180 minute summer	25.361	6.526	2 year 5760 minute summer	1.877	0.480
2 year 180 minute winter	16.485	6.526	2 year 5760 minute winter	1.215	0.480
2 year 240 minute summer	20.644	5.456	2 year 7200 minute summer	1.641	0.419
2 year 240 minute winter	13.715	5.456	2 year 7200 minute winter	1.059	0.419
2 year 360 minute summer	16.001	4.118	2 year 8640 minute summer	1.479	0.377
2 year 360 minute winter	10.401	4.118	2 year 8640 minute winter	0.955	0.377
2 year 480 minute summer	12.559	3.319	2 year 10080 minute summer	1.363	0.348
2 year 480 minute winter	8.344	3.319	2 year 10080 minute winter	0.880	0.348
2 year 600 minute summer	10.200	2.790	30 year 15 minute summer	283.716	80.282
2 year 600 minute winter	6.969	2.790	30 year 15 minute winter	199.099	80.282
2 year 720 minute summer	9.002	2.413	30 year 30 minute summer	181.802	51.444
2 year 720 minute winter	6.050	2.413	30 year 30 minute winter	127.580	51.444
2 year 960 minute summer	7.247	1.908	30 year 60 minute summer	118.283	31.259
2 year 960 minute winter	4.800	1.908	30 year 60 minute winter	78.585	31.259

Rainfall

Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)	Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)
30 year 120 minute summer	75.603	19.980	30 year 7200 minute winter	1.831	0.724
30 year 120 minute winter	50.229	19.980	30 year 8640 minute summer	2.507	0.640
30 year 180 minute summer	58.236	14.986	30 year 8640 minute winter	1.618	0.640
30 year 180 minute winter	37.855	14.986	30 year 10080 minute summer	2.271	0.579
30 year 240 minute summer	45.711	12.080	30 year 10080 minute winter	1.466	0.579
30 year 240 minute winter	30.370	12.080	30 year +35% CC 15 minute summer	383.017	108.381
30 year 360 minute summer	34.072	8.768	30 year +35% CC 15 minute winter	268.784	108.381
30 year 360 minute winter	22.147	8.768	30 year +35% CC 30 minute summer	245.432	69.449
30 year 480 minute summer	26.166	6.915	30 year +35% CC 30 minute winter	172.233	69.449
30 year 480 minute winter	17.384	6.915	30 year +35% CC 60 minute summer	159.682	42.199
30 year 600 minute summer	20.941	5.728	30 year +35% CC 60 minute winter	106.089	42.199
30 year 600 minute winter	14.308	5.728	30 year +35% CC 120 minute summer	102.064	26.973
30 year 720 minute summer	18.282	4.900	30 year +35% CC 120 minute winter	67.809	26.973
30 year 720 minute winter	12.287	4.900	30 year +35% CC 180 minute summer	78.618	20.231
30 year 960 minute summer	14.496	3.817	30 year +35% CC 180 minute winter	51.104	20.231
30 year 960 minute winter	9.602	3.817	30 year +35% CC 240 minute summer	61.710	16.308
30 year 1440 minute summer	9.972	2.673	30 year +35% CC 240 minute winter	40.999	16.308
30 year 1440 minute winter	6.702	2.673	30 year +35% CC 360 minute summer	45.997	11.836
30 year 2160 minute summer	6.797	1.878	30 year +35% CC 360 minute winter	29.899	11.836
30 year 2160 minute winter	4.683	1.878	30 year +35% CC 480 minute summer	35.324	9.335
30 year 2880 minute summer	5.490	1.471	30 year +35% CC 480 minute winter	23.468	9.335
30 year 2880 minute winter	3.689	1.471	30 year +35% CC 600 minute summer	28.270	7.733
30 year 4320 minute summer	4.050	1.059	30 year +35% CC 600 minute winter	19.316	7.733
30 year 4320 minute winter	2.667	1.059	30 year +35% CC 720 minute summer	24.681	6.615
30 year 5760 minute summer	3.318	0.849	30 year +35% CC 720 minute winter	16.587	6.615
30 year 5760 minute winter	2.148	0.849	30 year +35% CC 960 minute summer	19.569	5.153
30 year 7200 minute summer	2.837	0.724	30 year +35% CC 960 minute winter	12.963	5.153

Rainfall

Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)	Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)
30 year +35% CC 1440 minute summer	13.462	3.608	100 year 240 minute winter	37.538	14.932
30 year +35% CC 1440 minute winter	9.047	3.608	100 year 360 minute summer	42.000	10.808
30 year +35% CC 2160 minute summer	9.176	2.536	100 year 360 minute winter	27.301	10.808
30 year +35% CC 2160 minute winter	6.322	2.536	100 year 480 minute summer	32.234	8.519
30 year +35% CC 2880 minute summer	7.411	1.986	100 year 480 minute winter	21.416	8.519
30 year +35% CC 2880 minute winter	4.981	1.986	100 year 600 minute summer	25.786	7.053
30 year +35% CC 4320 minute summer	5.468	1.430	100 year 600 minute winter	17.619	7.053
30 year +35% CC 4320 minute winter	3.601	1.430	100 year 720 minute summer	22.503	6.031
30 year +35% CC 5760 minute summer	4.479	1.147	100 year 720 minute winter	15.123	6.031
30 year +35% CC 5760 minute winter	2.899	1.147	100 year 960 minute summer	17.821	4.693
30 year +35% CC 7200 minute summer	3.830	0.977	100 year 960 minute winter	11.805	4.693
30 year +35% CC 7200 minute winter	2.472	0.977	100 year 1440 minute summer	12.225	3.276
30 year +35% CC 8640 minute summer	3.384	0.863	100 year 1440 minute winter	8.216	3.276
30 year +35% CC 8640 minute winter	2.184	0.863	100 year 2160 minute summer	8.279	2.288
30 year +35% CC 10080 minute summer	3.065	0.782	100 year 2160 minute winter	5.704	2.288
30 year +35% CC 10080 minute winter	1.978	0.782	100 year 2880 minute summer	6.644	1.781
100 year 15 minute summer	359.906	101.841	100 year 2880 minute winter	4.465	1.781
100 year 15 minute winter	252.566	101.841	100 year 4320 minute summer	4.845	1.267
100 year 30 minute summer	231.671	65.555	100 year 4320 minute winter	3.190	1.267
100 year 30 minute winter	162.576	65.555	100 year 5760 minute summer	3.928	1.006
100 year 60 minute summer	151.892	40.141	100 year 5760 minute winter	2.542	1.006
100 year 60 minute winter	100.913	40.141	100 year 7200 minute summer	3.329	0.849
100 year 120 minute summer	94.622	25.006	100 year 7200 minute winter	2.149	0.849
100 year 120 minute winter	62.865	25.006	100 year 8640 minute summer	2.919	0.745
100 year 180 minute summer	72.259	18.595	100 year 8640 minute winter	1.884	0.745
100 year 180 minute winter	46.970	18.595	100 year 10080 minute summer	2.626	0.670
100 year 240 minute summer	56.501	14.932	100 year 10080 minute winter	1.695	0.670

Rainfall

Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)	Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)
100 year +40% CC 15 minute summer	503.868	142.577	100 year +40% CC 720 minute winter	21.172	8.443
100 year +40% CC 15 minute winter	353.592	142.577	100 year +40% CC 960 minute summer	24.949	6.570
100 year +40% CC 30 minute summer	324.339	91.777	100 year +40% CC 960 minute winter	16.527	6.570
100 year +40% CC 30 minute winter	227.607	91.777	100 year +40% CC 1440 minute summer	17.114	4.587
100 year +40% CC 60 minute summer	212.648	56.197	100 year +40% CC 1440 minute winter	11.502	4.587
100 year +40% CC 60 minute winter	141.279	56.197	100 year +40% CC 2160 minute summer	11.590	3.203
100 year +40% CC 120 minute summer	132.471	35.008	100 year +40% CC 2160 minute winter	7.986	3.203
100 year +40% CC 120 minute winter	88.011	35.008	100 year +40% CC 2880 minute summer	9.301	2.493
100 year +40% CC 180 minute summer	101.162	26.032	100 year +40% CC 2880 minute winter	6.251	2.493
100 year +40% CC 180 minute winter	65.758	26.032	100 year +40% CC 4320 minute summer	6.782	1.773
100 year +40% CC 240 minute summer	79.101	20.904	100 year +40% CC 4320 minute winter	4.467	1.773
100 year +40% CC 240 minute winter	52.553	20.904	100 year +40% CC 5760 minute summer	5.499	1.408
100 year +40% CC 360 minute summer	58.801	15.131	100 year +40% CC 5760 minute winter	3.559	1.408
100 year +40% CC 360 minute winter	38.222	15.131	100 year +40% CC 7200 minute summer	4.661	1.189
100 year +40% CC 480 minute summer	45.128	11.926	100 year +40% CC 7200 minute winter	3.008	1.189
100 year +40% CC 480 minute winter	29.982	11.926	100 year +40% CC 8640 minute summer	4.087	1.043
100 year +40% CC 600 minute summer	36.101	9.874	100 year +40% CC 8640 minute winter	2.638	1.043
100 year +40% CC 600 minute winter	24.666	9.874	100 year +40% CC 10080 minute summer	3.676	0.938
100 year +40% CC 720 minute summer	31.504	8.443	100 year +40% CC 10080 minute winter	2.372	0.938

Results for 2 year Critical Storm Duration. Lowest mass balance: 99.13%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
120 minute summer	PP	76	83.711	0.061	76.9	61.2735	0.0000	OK

Link Event (Velocity)	US Node	Link	Outflow (l/s)	Discharge Vol (m³)
120 minute summer	PP	Depth/Flow	0.0	0.0
120 minute summer	PP	Infiltration	30.3	

Results for 30 year Critical Storm Duration. Lowest mass balance: 99.13%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
120 minute summer	PP	82	83.759	0.109	188.3	192.8586	0.0000	OK

Link Event (Velocity)	US Node	Link	Outflow (l/s)	Discharge Vol (m³)
120 minute summer	PP	Depth/Flow	0.0	0.0
120 minute summer	PP	Infiltration	49.5	

Results for 30 year +35% CC Critical Storm Duration. Lowest mass balance: 99.13%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
120 minute summer	PP	86	83.789	0.139	254.3	289.1855	0.0000	OK

Link Event (Velocity)	US Node	Link	Outflow (l/s)	Discharge Vol (m³)
120 minute summer	PP	Depth/Flow	0.0	0.0
120 minute summer	PP	Infiltration	49.6	

Results for 100 year Critical Storm Duration. Lowest mass balance: 99.13%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
120 minute summer	PP	84	83.780	0.130	235.7	261.1829	0.0000	OK

Link Event (Velocity)	US Node	Link	Outflow (l/s)	Discharge Vol (m³)
120 minute summer	PP	Depth/Flow	0.0	0.0
120 minute summer	PP	Infiltration	49.6	

Results for 100 year +40% CC Critical Storm Duration. Lowest mass balance: 99.13%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
120 minute summer	PP	92	83.825	0.175	330.1	408.9187	0.0000	OK

Link Event (Velocity)	US Node	Link	Outflow (l/s)	Discharge Vol (m³)
120 minute summer	PP	Depth/Flow	0.0	0.0
120 minute summer	PP	Infiltration	49.6	

APPENDIX E – MANAGEMENT & MAINTENANCE REGIME

The Management Company

The responsibility for maintenance of all elements of the development remain with Chase New Homes until handed over to the Management Company.

Handover of external works to the Management Company coincides with completion of the final residential unit.

The Management Company employs a specialist Managing Agent to manage the development which includes all aspects of maintenance.

The Management Company BI registered No. ***'tbc'*** *was incorporated in* ***'tbc'*** *and its directors are currently made up of Chase New Homes representatives plus an appointment from the Managing Agent.*

The Managing Agents are ***'tbc'*** *who have over '****tbc'*** *years' experience in the industry.*

At handover the Management Company and Managing Agent receive as built information together with operating and maintenance manuals which detail all maintenance protocols.

Approximately 1 year following completion of the final unit the residents will be invited to elect members to become directors of the Management Company, the Chase New Homes appointed directors at that time resign from the Management Company to be replaced by the elected representatives of the residents.

To ensure continuity and a full understanding of the development and the operation and maintenance of its various components the representative of the Managing Agent remains as a director of the Management Company and the appointment of the Managing Agents is fixed for a minimum period of two years following the date of resignation of the last Chase New Homes director.

After that two year period the Management Company have the right to re-tender the Managing Agent services but it is very rare that a change is made as our original appointments provide an excellent service.

Within the first two years from the final unit completion on the development the residents have two ways in which they can report any defects and problems which would include flooding and that is either to our Aftersales department or to the Managing Agents, the residents are issued with telephone numbers for both which include out of hours emergency response.

After two years our Aftersales contacts are normally replaced by members of the Management Company. The residents therefore have the ability to contact them or the Managing Agents which then remains through the life of the development.

Onsite Surface Water Drainage System (generally)

The Management Company will ensure that the following measures are undertaken to ensure the longevity of the surface water drainage system;

Every 6 months: Remove silt build up from ***all*** catchpits and road gullies.

Annually: elect approx. 20% of the development's surface water inspection chambers (situated in accessible non-private areas) and inspect for blockages / silt build up. Remove silt and debris. Rotate on a 5 yearly cycle to cover all such chambers over this period.

Every 2-5 years (depending on outcome of aforementioned inspections)

Commission a CCTV survey and report on condition of the surface water piped drainage system upstream of the soakaways to check for structural integrity and hydraulic fluidity. Carry out promptly any remedial work as advised by CCTV company.

Permeable Paving

External parking areas and access roads are to be constructed in permeable block paving in order to;

a) Delay the surface water runoff from these areas, and
b) Enhance the quality of the rainwater prior to discharge into the ground.

The Management Company will ensure that the following measures are undertaken to ensure the longevity of the pervious pavement;

Quarterly

i) Inspect the pervious pavement for signs of ponding and ensure there is no migration of soils from adjacent landscaped areas or other deleterious material that may prematurely clog up the jointing stone situated in the gaps between the blocks. Ideally this type of inspection should be undertaken immediately following a heavy rainfall event.

ii) Commission vacuum sweeping and brushing of the pervious pavement to ensure joints are kept free of silt. Minimum 3 sweeping per year, thus;

a) End of Winter (April) – to collect winter debris
b) Mid-Summer (July/August) – to collect dust, flower and grass-type deposits.
c) After Autumn leaf fall (November)

The company commissioned to carry out this work should ensure that their vacuum equipment is adjusted accordingly to avoid the removal of jointing material.

Any lost material should be replaced promptly to avoid the blocks from being dislodged.

Last Resort Remedial Action

i) Should a portion of the pervious pavement become substantially impervious due to excessive siltation, the following procedure should be followed;

a) Lift block paving and laying course
b) Break out underlying bitmac base layer and replace with similar compacted depth of course aggregate subbase material to BS EN 13242:2002 Type 4/20, wrapped in geotextile as Terram 1000 or similar.
c) Renew laying course, replace blocks and renew jointing material

NB. Material removed from the voids or the layers below the surface may contain heavy metals and hydrocarbons and as such may need to be disposed of as 'controlled waste'. Sediment testing should be carried out before disposal to confirm its classification and appropriate disposal methods.

Renew laying course, replace blocks and renew jointing material.NB. Material removed from the voids or the layers below the surface may contain heavy metals and hydrocarbons and as such may need to be disposed of as 'controlled waste'. Sediment testing should be carried out before disposal to confirm its classification and appropriate disposal methods.

Cellular Soakaway Storage

The principle means of surface water attenuation/disposal from the development is by way of cellular soakaways storage.

The Management Company will ensure that the following measures are undertaken to ensure the longevity of the surface water drainage system;

Inspections to identify any areas not operating correctly, pollution, blocked inlets or outlets, standing water etc.

Collect and remove from site all extraneous rubbish that is detrimental to the operation or detracts from the appearance of the site, including paper, bottles, cans and similar debris.