PINNACLE
CONSULTING ENGINEERS

DB11.1, Profile Park,
Clondalkin,
Dublin 22

Engineering Planning Report

Response to Request for Additional Information
Planning Ref: SD21A/0241

December 2021

P210501

VANTAGE™
DATA CENTERS

Document No.: DUB11.1-RP-00-C001-V0-WS4-PIN

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

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APPROVALS

	Name	Signature	Position	Date
Prepared by	S. O'Reilly		Associate	10/07/2021
Reviewed by	J. Mayer		Director	11/07/2021
Approved by	J. Mayer		Director	12/07/2021

REVISIONS

Revision By	Date	Context
JKM	03/12/2021	Revision to Storm Water Drainage & Additional SUDs Measures

VERSIONS

Number	By	Date	Context
0	S. O'Reilly	15/07/2021	WS3 Submission
1	S. O'Reilly	03/12/2021	Additonal Information Submission

SOURCES OF DATA

Burns McDonnell	Land Survey Services Ltd.
Google	Marston Planning

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REPORT CONTENTS

Executive Summary

This is a revised report for South Dublin County Council, based on the Additional Information request pertaining to Planning Reg. Ref: SD21A/0241, in connection with the planning application for a data centre development and addresses the existing and proposed civil infrastructure, for the proposed development, located in Profile Park, Clondalkin, Dublin 22.

Planning permission is sought by Vantage Data Centers Dub 11 Ltd. under Planning Register Reference no. SD21A/0241 at this site that includes an abandoned single storey residential property on the New Nangor Road (R134), Dublin 22; and on land within the townlands of Ballybane and Kilbride within Profile Park, Clondalkin, Dublin 22 on an overall site of 8.7 hectares.

The development applied for consists of the demolition of the abandoned single storey dwelling and associated outbuilding (206sqm); and the construction of 2 no. two storey data centers with plant at roof level of each facility and associated ancillary development that will have a gross floor area of 40,589sqm that will consist of the following:

- 1 no. two storey data center (Building 11) that will be located to the south of the site and will have a gross floor area of 24,667sqm. It will include 22 no. emergency generators located at ground floor level within a compound to the western side of the data center with associated flues that will be 22.3m in height;
- 1 no. two storey data center (Building 12) that will be located to the north of the site, and to the immediate north of Building 11 and will have a gross floor area of 12,915sqm. It will include 11 no. emergency generators located at ground floor level within a compound to the western side of the data center with associated flues that will be 22.3m in height;
- Each of the two data centers will includes data storage rooms, associated electrical and mechanical plant rooms, loading bays, maintenance and storage spaces, office administration areas, and plant including PV panels at roof level as well as a separate house generator for each facility that will provide emergency power to the admin and ancillary spaces. Each generator will include a diesel tank and there will be a refuelling area to serve the proposed emergency generators;
- The overall height of each data center apart from the flues and plant at roof level is c. 14.23m above the finished floor level;
- Construction of internal road network and circulation areas, with main entrance off Falcon Avenue to the south, as well as a secondary vehicular access off Legacy Drive to the south-west, both from within Profile Park; footpaths, provision of 144 no. car parking spaces, and 66 no. cycle parking spaces;
- single storey step-up substation (38sqm) as well as 2 no. single storey switch substations (121sqm);
- AGI Gas Regulator compound that include 3 no. single storey buildings (134sqm);
- construction of a gas powered generation plant in the form of a 13m high single storey building with a gross floor area of 2,714sqm that will contain 10 gas generators with associated flues that will be 25m in height, and grouped in pairs and threes. The Gas Plant will be located to the west of Building 11;

- Ancillary site development works, that will include reorientation of the Baldonnel Stream, biodiversity management initiatives, attenuation ponds and the installation and connection to the underground foul and storm water drainage network, and installation of utility ducts and cables, that will include the drilling and laying of ducts and cables under the internal road network within Profile Park. Other ancillary site development works will include hard and soft landscaping, lighting, fencing, signage, services road, entrance gates, sprinkler tanks and pump room; and
- A temporary gas powered generation plant within a fenced yard containing 21 no. generator units in containers, each with associated flues (each 25m high), 12 transformers and 10 containers of controls to be located to the west of, and associated with the first phase of Building 11, and will be required for a period of up to 2 years if connection to the national grid is delayed. This temporary plant will not be built if the connection to the national grid is in place prior to the operation of Building 11.

The development will be accessed from Falcon Avenue and Legacy Drive from within the Profile Park Business Park that contains an access from the New Nangor Road (R134). An Environmental Impact Assessment Report (EIAR) has been submitted with this application.

The Significant Further Information / Revised Plans includes a revised site plan that has modified the location of Buildings 11 and 12 within the site that enables the stream to remain in its current alignment within an enhanced riparian strip; amendment to the gross floor area of the entire development to 41,105sqm; revised EIAR that includes new photomontages; revised car parking layout; additional SUDS measures, attenuation and green infrastructure; as well as revised landscaping. It also includes a modification to the nature and use of the Gas Plant to a Multi-Fuel Generation Plant, which includes breaking it into two components and increasing its 11 no. flues to being 30m in height; and that its primary purpose is now to reinforce the national grid.

The site is bounded to the south by an estate road known as Falcon Avenue, to the north by Nangor Road (R134), to the east by existing greenfield and to the west by existing commercial units and greenfield.

The report should be read in conjunction with our engineering planning drawings, and deals with existing foul, surface water and water mains present within the surrounding area, and the proposals for the site with regards to these services.

The report also discusses the ground conditions present on the site, the current proposals for achieving the development plateau and sustainability measures incorporated with the development.

1 Introduction

The applicant proposes to construct 2No. two-storey data centres and associated office areas, which will be accessed off Falcon Avenue to the south. The purpose of this revised report is based on the Additional Information request pertaining to Planning Reg. Ref: SD21A/0241 and addresses the civil infrastructural aspects of the proposed data centre development, located in Profile Park, Clondalkin, Dublin 22.

The total subject site area extends to circa 21.49 acres (8.7 ha) and is currently a greenfield site. The site is bounded to the north by the New Nangor Road, to the south by Falcon Avenue and to the east by existing greenfield and to the west by existing commercial units and greenfield.

There are no known public sewer drainage pipes or watermains, presently located on the subject site.

This report has been prepared to outline the existing and proposed drainage, pollution control measures and water main infrastructure, in order to support the proposed development application.

The location of the site is indicated on the map extract below - Figure 1.

FIGURE 1 - Site Location (Source Google Maps)

2 Existing Drainage & Watermain Services

2.1 Existing Foul Drainage Networks

South Dublin County Council record drawings have identified 3 No. 150mm / 225mm Ø spur connections, located adjacent to the southern boundary of the property & Profile Park. These spur connections were left out to facilitate development of these lands. These spur connections are joined into the reticulation network for Profile Park.

The existing foul sewer reticulation network has adequate capacity to cater for the proposed effluent discharge from the subject site and there are no known issues noted with the sewer reticulation network.

2.2 Existing Surface Water Drainage Networks

The topographical survey as carried out has identified a stream which runs along a portion of the eastern boundary, up to the north, prior to discharging to the west into a culverted system beneath Grange Castle Motor Company. This stream network then runs in a westerly direction via a tributary into the Camac River.

The aforementioned open stream has been identified as having capacity to accommodate the proposed discharge from the subject site.

2.3 Existing Water Main Network

South Dublin County Council record drawings have identified an existing 6" (160mm) Ø main located along the southern boundary of the property, within Falcon Avenue adjacent to the subject site. 2No. 160mm Ø capped connections with sluice valves, have been left off the aforementioned water main, in order to facilitate development of these lands.

There is also an existing 700mm Ø trunk water main running parallel to the New Nangor Road adjacent to the northern boundary of the subject site.

From discussions with the South Dublin County Council, it is understood that there is adequate capacity within the existing watermain network to supply the proposed development.

3 Proposed Site Drainage & Water Supply

3.1 Proposed Foul Water Drainage

It is proposed to discharge foul water from the proposed development, via a 225mm Ø gravity foul sewer outfall, laid from MH FWMH 1.1 and discharge into the existing 225mm Ø spur connection laid across Falcon Avenue, which is connected to the existing foul sewer network laid along the western edge of Falcon Avenue.

The office building contains 6 No. WC's, with a predicted maximum number of daily staff being in the region of circa 144 people, over a 24hr period. Based on Irish Water's Code of Practice of 150ltr/hd/day, the peak wastewater flow will not be in excess of circa 0.25l/s (@1DWF) & a peak discharge of 1.5l/s (@6DWF).

The proposed network connects into the existing foul water MH FWMH CON, with an invert level of 70.405m, prior to the ultimate outfall discharging into the Profile Park reticulation network, - refer Drawing No.'s DB11.1-DR-SP-C127-V0-WS4-PIN and DB11.1-DR-SP-C128-V0-WS4-PIN.

All on-site foul sewers have been designed to be a minimum 225mm Ø diameter pipes, with gradients designed to achieve self-cleansing velocities.

3.2 Proposed Surface Water Drainage

Storm water from the proposed development has been designed in accordance with the GDSDS and ensures that Best Management Practice has been incorporated into the design.

It should be noted that the subject site currently comprises a greenfield site and the proposed surface water measures are aimed at improving the general surface water management of the site, by introducing interceptors, attenuation measures and by restricting the ultimate discharge, etc.

Storm water from the rear roof areas of the proposed building units, will be directed via rain water pipes into an on-site reticulation system. The outflow from this system will be connected into the surface water drainage network collecting run-off from the road areas and will be ultimately discharged into stormwater storage ponds and swales - refer Drawing No.'s DB11.1-DR-SP-C127-V0-WS4-PIN and DB11.1-DR-SP-C128-V0-WS4-PIN.

The front roof areas of the buildings drain into the permeable paving sub-base, prior to draining into storage ponds and then ultimate discharge into the ditch / stream to the east. Oil inceptors will be installed on all drainages systems that collects surface water from roads, loading docks and parking areas before it gets dischargeds into storage ponds for attenuation.

Based on the contributing area for this current application, i.e. circa 50,005m^2 (5.00Ha), the total attenuation volume required has been calculated as being circa 2,391m^3, which will be provided for as mentioned above, in a combination of storage ponds, swales and permeable paving - Refer Appendix B for Surface Water Calculations.

The following volumes have been provided for within the storage elements:-

- Attenuation Pond 1 provides a storage volume of 428m^3
- Attenuation Pond 2 provides a storage volume of 361m^3
- Attenuation Pond 3 provides a storage volume of 680m^3
- Attenuation Pond 4 provides a storage volume of 296m^3
- Attenuation Pond 5 provides a storage volume of 70m^3
- Permeable paving sub-base provides a combined storage volume of 556m^3

Storm water from all car park areas and access roads / delivery areas will be drained as follows:-

- A series of on-site gullies and channels draining into a separate system of below ground gravity storm water.
- Permeable Paving

Prior to discharging into the proposed ponds, the storm water from the car park and access roads, which is drained via the methods as described above, will be directed through appropriately sized Conder Separators (or similar approved) petrol interceptors - refer Appendix A for Interceptor Details.

Site investigations have been carried out and the results have shown that the existing sub-soil would provide inadequate soil infiltration rates and thus it is not practical to install a soakaway system. The storm water drainage within the entire development has been designed to accommodate a 1:2 year storm frequency. The attenuation ponds and permeable paving sub-base areas have been designed to accommodate a 1:100 year storm event + 20% climate change.

The outflow from the proposed development, will be restricted by way of several Hydrobrake facilities, which will limit the total site discharge to the greenfield QBAR run-off rate for the site to 10.0l/s - refer Appendix B for Surface Water Calculations.

The surface water discharge for this application will incorporate the road areas, parking, service yard area and the roof water from the proposed data halls, which then ultimately feeds into the existing network as previously mentioned. Refer Dwg. No. DB11.1-DR-SP-C130-V0-WS4-PIN (External Works Plan), for a drawing indicating the various surface areas of this application; all areas are hardstanding of various types, with the respective coefficients detailed below:-

- Permeable Paving & Parking Areas (5,517m^2) / c = 0.70
- Data Hall Roof Areas (21,703m^2) / c = 1.00
- Permeable Asphalt / Grass Crete (2,866m^2) / c = 0.7
- Yard Slab Areas, Concrete Roads etc. – Concrete (8,333m^2) / c = 0.80

- Asphalt Road – Tarmac (3,550m^2) / c = 0.80
- Gravel Areas – Gravel (3,317m^2) / c = 0.70
- Existing Road (To Remain - 6,114m^2) / c = 0.00
- Open Space / Landscaping (28,997m^2) / c = 0.00
- Concrete Footpath (4,183m^2) / c = 0.8

3.3 Proposed Water Mains

It is intended to serve the proposed development via connection off the 150mm Ø network, as located in Falcon Avenue - Refer Drawing No.'s DB11.1-DR-SP-C124-V0-WS4-PIN & DB11.1-DR-SP-C125-V0-WS4-PIN.

Hydrants will be installed in accordance with the Requirements of the Building Regulations and in accordance with the recommendations contained in the Technical Guidance Documents, Section B – Fire Safety, dated 2006, and these are detailed on our engineering drawings.

Water demand for the development has been based on Irish Water's criteria, i.e. 150 litres/hd/day = 21,600 litres/hd/day (based on 144 PE) = 0.250 litres/second.

Avg. Demand = 0.250 l/s x 1.25 = 0.312 litres/second

Peak Demand = 0.312 l/s x 5 = 1.560 litres/second

Water meters, sluice valves and hydrants, in line with Irish Water requirements and specifications, will be installed at the connections onto the aforementioned existing water mains, as required. A Pre-Connection Enquiry application was submitted to Irish Water in respect of the water supply and a Confirmation of Feasibility in respect has been received – Ref: CDS 21005426 dated (1st November 2021). This correspondence has been incorporated into the AI response to Items 6 & 8, as prepared by Pinnacle under seaparate cover.

3.4 Standard Drainage Details

All standard drainage details including manhole details, pipe bedding, channels, hydrants etc. have been included within the planning pack. Details of the types and construction methods will be agreed with the local authority prior to construction.

Drains generally will consist of PVC (to IS 123) or concrete spigot and socket pipes to (IS 6).

Drains shall be laid to comply with the Requirements of the Building Regulations 1997 and in accordance with the recommendations contained in the Technical Guidance Documents, Section H.

Strict separation of surface water and foul sewerage will be imposed on the development. Drains will be laid out to minimise the risk of inadvertent connections of sinks, dishwashers etc. to the surface water system.

In order to minimise the risk of floating contamination of the surface water system, road gullies will be precast trapped gullies to BS5911:Part2:1982.

Concrete bed and surround to the pipe runs will be used where the cover to the pipes is less than 900mm, where the pipes are sufficiently close to the building, or where the pipe runs are below the ground floor slab.

All works are to be carried out in accordance with Irish Water's Code of Practice for Water Infrastructure, dated July 2020 : Document IW-CDS-5020-03 and any subsequent revisions thereof.

4 Surface & Groundwater Impacts

4.1 Construction Phase

Water pollution will be minimised by the implementation of good construction practices. Such practices will include adequate bunding for oil containers, wheel washers and dust suppression on site roads, and regular plant maintenance. The Construction Industry Research and Information Association provides guidance on the control and management of water pollution from construction sites in their publication Control of Water Pollution from Construction Sites, Guidance for Consultants and Contractors – C532 CIRIA Report (Masters-Williams *et al*, 2001), which provides information on these issues.

Pollutants can commonly include suspended solids, oil, chemicals, cement, cleaning materials and paints. These can enter controlled waters in various ways:

- directly into a watercourse
- via drains or public sewers
- via otherwise dry ditches
- in old field drains
- by seepage into groundwater systems
- through excavations into underlying aquifers
- by disturbance of an already contaminated site

The proximity of the site to streams, aquifers and water abstractions; potential sources, pathways and impacts of pollution; and the historical uses of the site and nearby areas should be examined early in project planning and design, to ensure that suitable redesign and mitigation measures are undertaken as necessary.

During construction, careful management and planning will help minimise water pollution. This may include adequate bunding of all oil tanks, wheel washers and dust suppression on haul roads, particular care to be taken near watercourses, and regular plant maintenance.

A contingency plan for pollution emergencies should also be developed and regularly updated, which would identify the actions to be taken in the event of a pollution incident.

The CIRIA document (2001), recommends that a contingency plan for pollution emergencies should address the following:

- containment measures
- emergency discharge routes
- list of appropriate equipment and clean-up materials
- maintenance schedule for equipment
- details of trained staff, location, and provision for 24-hour cover
- details of staff responsibilities
- notification procedures to inform the relevant environmental protection authority
- audit and review schedule

- telephone numbers of statutory water undertakers and local water company
- list of specialist pollution clean-up companies and their telephone numbers

4.2 Operational Phase

The sources of pollution that could potentially have an effect on surface or groundwater during the operational phase of the development will be oil and fuel leaks from parked cars, service vehicles, HGV delivery's etc. Hydrocarbon interceptors will be provided on storm water drainage sewers from car parking areas as required.

Storm water attenuation measures will be incorporated into the scheme as mentioned previously.

It is not anticipated that flooding of the site will occur, due to the fact that there is no historical data, which refers to any past flooding on this site.

4.3 Mitigation Measures

The construction management of the building project will incorporate protection measures to minimise as far as possible the risk of spillage that could lead to surface and groundwater contamination.

All appropriate methods will be utilised to ensure that surface water arising during the course of construction activities will contain minimum sediment, prior to the ultimate discharge to the proposed attenuation pond / tanks and the existing stream.

Storm water attenuation measures will be incorporated into the scheme as mentioned previously. Hydrocarbon interceptors will be provided on storm water drainage sewers from service yard areas as necessary. Grease traps will be installed on foul sewers where necessary.

Best practice in design and construction will be employed for the installation of surface water and sanitary drainage.

5 Sustainability

5.1 Site Development

In order to minimize material export and import to the site and the impact of this on the surrounding road network, we are proposing to maintain existing on-site levels as far as is practical. Where this is not feasible, a terrain model has been produced, which will indicate the volumes of cut/fill material, based on the proposed levels and a levels balance will be struck across the site, thereby mitigating any import/export of material for site development - refer Drawing No. DB11.1-DR-SP-C126-V0-WS4-PIN.

5.2 Site Drainage

Storm water drainage proposals for the site have been designed in accordance with the GDSDS and incorporate on site storm water attenuation in order to limit discharge of storm water from the developed site to the equivalent Q-bar run-off rates.

The attenuation system proposed is in keeping with other developments within Grange Castle Business Park. The pond area not only provides flood storage, but also provides ecological benefits as well, which are described in detail by the ecological consultants / landscape architect and submitted under separate cover as part of this application.

6 Conclusion

In conclusion, the proposed development of the site by the applicant, for use as a Data Centre development, is considered a suitable use of the site. Local infrastructure has the capacity to serve the proposed development.

The site will be developed in a sustainable manner, in order to minimise the impact of the development during construction and throughout the lifespan of the proposed development.

Accordingly, there are no reasons in relation to the drainage elements as to why this scheme should not be granted planning permission, and with this in mind, the Planning Authority is respectfully requested to recommend a grant of planning permission.

Appendix A

Conder Petrol Interceptor Details

Conder® OIL/WATER SEPARATORS

40 years OF PASSION

CONDER
AQUA SOLUTIONS
A PREMIER TECH AND EPS JOINT COMPANY

THE PARTNER OF CHOICE

The Conder Range of Oil Separators are for installation on surface water drainage systems and are designed to prevent hydrocarbons (e.g. diesel, petrol, engine oil) from mixing with surface water and entering our drainage systems.

Pollution prevention is a critical part of sustainable drainage systems and statutory regulations are in force to control the discharge of hydrocarbons, with severe penalties imposed for non-compliance.

Compliance

The Conder Range of Oil Separators fully conform to both the Environment Agency's latest PPG guidelines and European standard BSEN-858-1-2 and are proven to effectively separate oil and water. Under test, the Conder Bypass performed to less than 1 mg/l and in doing so guarantees minimal environmental impact and ensures public safety.

Classes of Separator

There are two classes of separator which are defined by performance.

Class 1

Class 1 Separators are designed to achieve a concentration of less than 5mg/l of oil under standard test conditions. These conditions are required for discharges to surface water drains and the water environment.

Class 2*

Class 2 Separators are designed to achieve a concentration of less than 100mg/l oil under standard test conditions and are suitable for dealing with discharges where a lower quality requirement applies such as discharges to the foul sewer.

*Class 2 available in forecourt separators only.

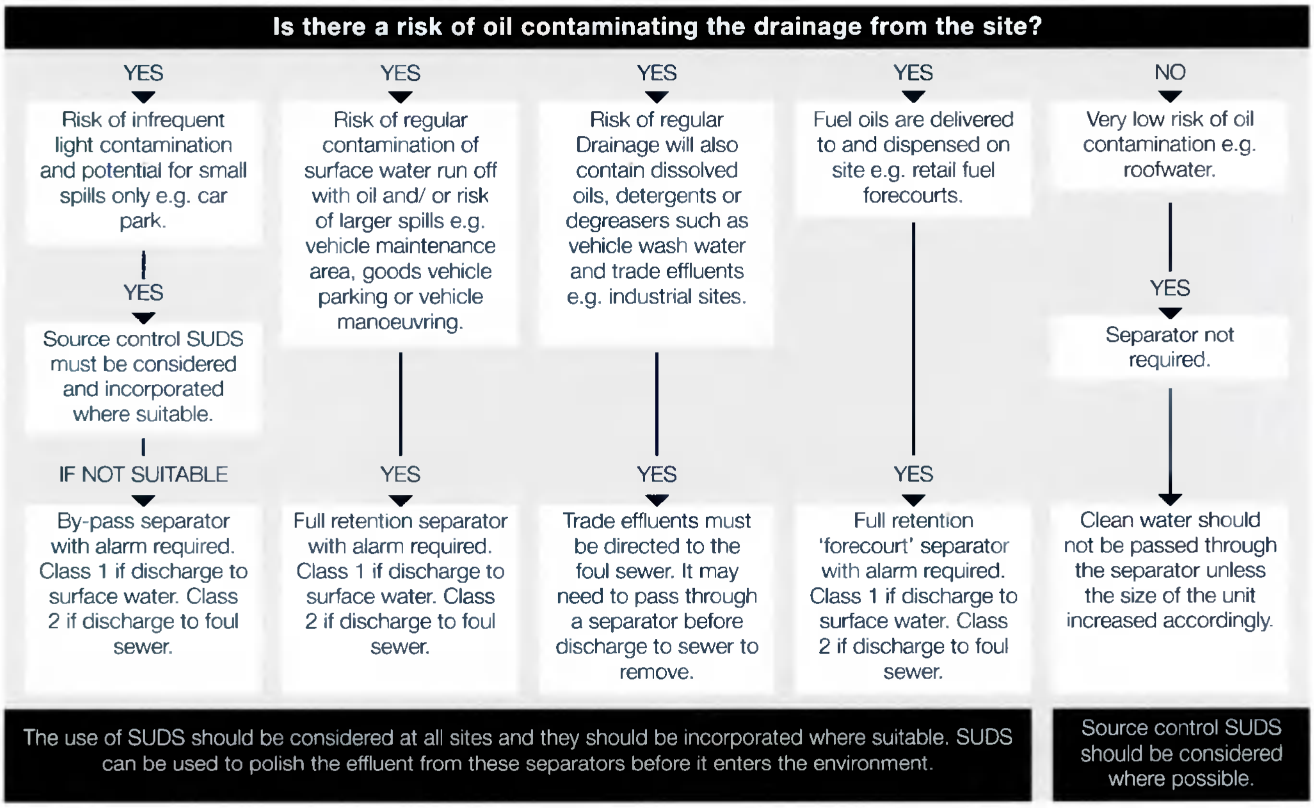
Selecting the Right Separator

Conder offers a full range of Separators for varying use and application:

- Bypass Separator
- Full Retention Separator
- Forecourt Separator
- Wash Down and Silt Separators

If you're unsure of what type of Conder Oil Separator you require please use the below chart to help you identify the most suitable product for your project.

The guidance given is for the use of separators in surface water drainage systems that discharge to rivers and soakways.



Is there a risk of oil contaminating the drainage from the site?

YES

Risk of infrequent light contamination and potential for small spills only e.g. car park.

YES

Source control SUDS must be considered and incorporated where suitable.

IF NOT SUITABLE

By-pass separator with alarm required. Class 1 if discharge to surface water. Class 2 if discharge to foul sewer.

YES

Risk of regular contamination of surface water run off with oil and/ or risk of larger spills e.g. vehicle maintenance area, goods vehicle parking or vehicle manoeuvring.

YES

Full retention separator with alarm required. Class 1 if discharge to surface water. Class 2 if discharge to foul sewer.

YES

Risk of regular Drainage will also contain dissolved oils, detergents or degreasers such as vehicle wash water and trade effluents e.g. industrial sites.

YES

Trade effluents must be directed to the foul sewer. It may need to pass through a separator before discharge to sewer to remove.

YES

Fuel oils are delivered to and dispensed on site e.g. retail fuel forecourts.

YES

Full retention 'forecourt' separator with alarm required. Class 1 if discharge to surface water. Class 2 if discharge to foul sewer.

NO

Very low risk of oil contamination e.g. roofwater.

YES

Separator not required.

Clean water should not be passed through the separator unless the size of the unit increased accordingly.

The use of SUDS should be considered at all sites and they should be incorporated where suitable. SUDS can be used to polish the effluent from these separators before it enters the environment.

Source control SUDS should be considered where possible.

Separator Alarms

All oil separators are required by legislation to be fitted with an oil level alarm system with recommendations that the alarm is installed, tested, commissioned and regularly serviced by a qualified technician.

The alarm indicates when the separator is in need of immediate maintenance in order for it to continue to work effectively. Conder Aqua Solutions can offer a full technical and service package for a variety of alarm options.

The Conder Range of Bypass Separators

The Conder Range of Bypass Separators are used to fully treat all flows generated by rainfall rates of up to 6.5mm/hr. Bypass Separators are used when it is considered an acceptable risk not to provide full treatment for high flows, for example where only small spillages occur and the risk of spillage is small.

Typical Application

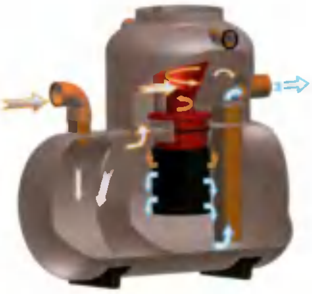
- Car parks
- Roadways and major trunk roads
- Light industrial and goods yards

Features and Benefits

- Innovative design
- Compact and easy to handle/install
- Fully compliant to the Environment Agency's PPG3 guidelines
- Low product and install costs
- Full BSI certification
- Exceeds industry standards
- Easy to service
- Fully tested and verified with a range from CNSB 3 to CNSB 1000 (Class 1)

Performance

Conder Bypass Separators have been designed to treat all flow up to the designed nominal size. Any flow in excess of the nominal size is allowed to bypass the separation chamber thereby keeping the separated and trapped oil safe.



How it Works

Step 1

During the early part of a rain storm, which is a time of high oil contamination, all of the contaminated water flow passes through the sediment collection chamber and enters the separation chamber through a patented oil skimming and filter device.

Step 2

All of the oil then proceeds to the separation chamber where it is separated to the Class 1 standard of 5 mg/l and safely trapped.

Step 3

As the rainstorm builds up to its maximum and the level of oil contamination reduces significantly, the nominal size flow continues to pass through the separation chamber and any excess flow of virtually clean water is allowed to bypass directly to the outlet.

Specification

Larger models up to CNSB 1000 are available.

Area Drained (m²)	Tank Code including Silt	Length including Silt (mm)	Silt Capacity (L)	Oil Storage Capacity (L)	Diameter (mm)	Height (mm)	Base to inlet Invert (mm)	Base to outlet Invert (mm)	Access (mm)
1667	CNSB3s/21	1400	300	45	1026	2200	1730	1680	750
2500	CNSB4.5s/21	1785	450	67.5	1026	1875	1270	1220	600
3333	CNSB6s/21	1975	600	90	1026	1875	1270	1220	600
4444	CNSB8s/21	2165	800	120	1026	1875	1270	1220	600
5555	CNSB10s/21	2485	1000	150	1026	1875	1270	1220	600
8333	CNSB15s/21	2670	1500	225	1210	2150	1450	1400	600
11111	CNSB20s/21	3115	2000	300	1210	2150	1450	1400	600
13889	CNSB25s/21	3555	2500	375	1210	2150	1450	1400	600
16667	CNSB30s/21	3470	3000	450	1510	2690	1770	1720	750
22222	CNSB40s/21	4040	4000	600	1510	2690	1770	1720	750
27778	CNSB50s/21	4655	5000	750	1510	2690	1770	1720	750
33333	CNSB60s/21	4415	6000	900	1880	3300	2025	1975	2 x 600
44444	CNSB80s/21	5225	8000	1200	1880	3300	2025	1975	2 x 600
55556	CNSB100s/21	6010	10,000	1500	1880	3300	2025	1975	2 x 600

Note: It is a requirement of PPG3 that you have a silt capacity either in your tank or in an upstream catch pit.

The Conder Range of Full Retention Separators

The Conder Range of Full Retention Separators are designed to treat the full flow that can be delivered by a drainage system, which is normally equivalent to the flow generated by a rainfall intensity of 65mm/hr. Full Retention Separators are used where there is a risk of regular contamination with oil and a foreseeable risk of significant spillages.

Typical Application

- Sites with hi-risk of oil contamination
- Fuel storage depots
- Refuelling facilities
- Petrol forecourts
- Vehicle maintenance areas/workshops
- Where discharge is to a sensitive environment

Features and Benefits

- All surface water is treated
- Automatic closure device (ACD) fitted as standard

Performance

All Conder Full Retention Separators have an automatic closure device (ACD) fitted as standard. This is compulsory for all PPG3 compliant Full Retention Separators and prevents accumulated pollutants flowing through the unit when maximum storage level is reached.

How it Works

▶ Step 1

Contaminated water enters the separator where the liquid is retained for a sufficient period to ensure that the lighter than water pollutants (such as oil, petrol) separate and rise to the surface of the water.

▶ Step 2

The decontaminated water then passes through the coalescing filter before it is safely discharged from the separator, with the remaining pollutants being retained in the separator.

▶ Step 3

Retained pollutants must be emptied from the separator once the level of oil is reached, or the oil level alarm is activated. This waste should be removed from the separator under the terms of The Waste Management Code of Practice.

Specification

Larger models available upon request.

Area Drained (m^2)	Tank code Incl. Silt	Length including Silt (mm)	Slit Capacity (L)	Oil Storage Capacity	Diameter (mm)	Height (mm)	Base to inlet Invert (mm)	Base to outlet Invert (mm)
222	CNS4s/11	2319	400	40	1026	1655	1295	1245
333	CNS6s/11	3414	600	60	1026	1655	1295	1245
444	CNS8s/11	3197	800	80	1210	1855	1480	1430
556	CNS10s/11	3957	1000	100	1210	1855	1480	1430
833	CNS15s/11	3870	1500	150	1510	2180	1780	1730
1111	CNS20s/11	5060	2000	200	1510	2180	1780	1730
1667	CNS30s/11	5369	3000	300	1880	2560	2030	1980
2222	CNS40s/11	7059	4000	400	1880	2560	2030	1980
2778	CNS50s/11	4080	5000	500	2600	3315	2730	2680
3333	CNS60s/11	4805	6000	600	2600	3315	2730	2680
3889	CNS70s/11	5529	7000	700	2600	3315	2730	2680
4444	CNS80s/11	6254	8000	800	2600	3315	2730	2680
5556	CNS100s/11	6751	10,000	1,000	2600	3315	2730	2680

Note: It is a requirement of PPG3 that you have a silt capacity either in your tank or in an upstream catch pit.

Conder Range of Forecourt Separators

Conder Forecourt Separators have been designed for specific use in petrol filling stations and other similar applications. The size of this separator has been specifically increased in order to retain the possible loss of the contents from one compartment of a road tanker, which could be up to 7,600 litres.

Forecourt separators are an essential infrastructure requirement for all forecourts so as to ensure compliance with both health and safety and environmental legislation.

Application Areas

- Petrol forecourts
- Refuelling facilities
- Fuel storage depot

Features and Benefits

- All surface water is treated
- Available in Class 1 and Class 2
- Automatic Closure Device (ACD) fitted as standard
- Includes 2000L silt capacity

Performance

All Conder Forecourt Separators have an automatic closure device (ACD) fitted as standard. This is compulsory for all PPG3 compliant Full Retention Separators and prevents accumulated pollutants flowing through the unit when maximum storage level is reached.

How it Works

Step 1

Contaminated water enters the separator where the liquid is retained for a sufficient period to ensure that the lighter than water pollutants (such as oil, petrol) separate and rise to the surface of the water.

Step 2

The decontaminated water then passes through the coalescing filter before it is safely discharged from the separator, with the remaining pollutants being retained in the separator.

Step 3

Retained pollutants must be emptied from the separator once the level of oil is reached, or the oil level alarm is activated. This waste should be removed from the separator under the terms of The Waste Management Code of Practice.

Specification

Tank Code	Volume (L)	Length (mm)	Diameter (mm)	Height (mm)	Base to inlet (mm)	Base to outlet (mm)	Access (mm)
ANO/11*	10000	4250	1800	2100	1600	1550	750
ANT/12**	10000	4250	1800	2100	1600	1550	750
LNO/11***	10000	4250	1800	2100	1600	1550	750

*Class 1 Forecourt Separator suitable for discharging to surface water drains

**Class 2 Forecourt Separator suitable for discharging to foul drains only

*** Class 1 Forecourt Separator suitable for installation in granular materials

Conder Range of Washdown and Silt Separators

Conder Washdown and Silt Separators are for use in areas such as car washes, pressure wash facilities or other cleaning facilities and must be discharged to the foul water drainage system in accordance with PPG13.

Application Areas

- Car wash facilities
- Tool hire depots
- Pressure washer facilities

Features and Benefits

- Available in 1,2 and 3 stage options
- Efficient silt and hydrocarbon removal

Performance

The Environment Agency's PPG13 requires that discharge from pressure washers must discharge to a foul drainage system. Where there is no foul drainage available, the effluent must be contained within a sealed drainage system or catchpit for disposal by a licenced waste contractor.

Silt build-up is the primary concern with washdown facilities and so the Conder range of washdown and silt separators are used to remove the silt and will allow some separation of hydrocarbons.

Detergents that are used in wash down areas will break down and disperse hydrocarbons (hindering the separation process). Therefore it is important to remember the main function of wash down separators is to remove silt.

How it Works

Step 1

Contaminated wash down water enters the unit where the heavier solids, silts, settle to the bottom of the tank.

Step 2

The lighter liquids, hydrocarbons, will rise to the surface and be retained within the tank.

Step 3

Treated water will exit the separator via the dipped outlet.

Specification

Although it is recognised that single stage separators give the most efficient separation, 2 and 3 chamber Conder Washdown and Silt Separators are available on request.

Tank Code	Capacity (L)	Silt Storage	Diameter (mm)	Length (mm)	Access Diameter (mm)	Base to Inlet Invert (mm)	Base to Outlet Invert (mm)
CWS2/12	2000	1000	1000	2713	600	1290	1240
CWS3/12	3000	1500	1200	2853	600	1475	1425
CWS4/12	4000	2000	1200	3737	600	1475	1425
CWS6/12	6000	3000	1500	3636	600	1775	1725
CWS8/12	8000	4000	1800	3443	600	2030	1980
CWS10/12	10000	5000	1800	4250	600	2030	1980

FST Silt Trap

Large quantities of silt can be associated with washdown areas. The Conder FST silt trap is ideal for easy removal of silt either manually or by a waste disposal contractor.

The FST range of silt traps are available with varying grades of covers from B125 up to E600 to allow installation in all types of vehicle or plant washdown facilities.

Conder Range of Alarm Systems

All separators must be fitted with an alarm in order to provide visual and audible warning when the level of oil reaches 90% of its storage volume, as required by The Environment Agency's PPG3.

The alarm system will then be triggered to indicate that the separator is in need of immediate emptying, in order to continue effective operation.

Features and Benefits

- Option for installation at a remote supervisory point
- Audible and visual
- Eliminates unnecessary waste management visits
- Easy installation
- Audible, visual and text message alert alarm systems available

Mains Powered System

Mains powered alarm systems are best suited to new build situations or sites where installation of the necessary cabling and ducting is straight forward and economical. The probe located in the separator will, when surrounded by floating hydrocarbons, activate an alarm condition on the remote panel to advise that the unit requires emptying.

Solar Powered System (Flashing Beacon)

This option requires no mains power supply or any significant cabling and ducting, making it extremely economical for large sites and retro fitting alarms to existing oil separators. A High Intensity Beacon will flash when a problem is detected.

Solar GSM Alarm

The Solar GSM alarm sends a status report on your separator to a mobile phone number of your choice. The status of the GSM alarm can also be tested at any time by simply sending a pre-recorded text message, via your directed mobile phone, for added peace of mind.

Peripherals

Coalescing Filters

The Conder Coalescing Filter is designed to separate residual oil in already separated oil/water and ensures a discharge quality of less than 5mg/litre of oil in water.

Features and Benefits

- Handle for easy removal and cleaning
- Flashing beacons (with option of siren kit)
- Kiosks
- Probe brackets
- Bas 1000 intrinsically safe junction box
- High level probe
- Silt level probe
- Oil level probe

Servicing

The Environmental Agency's PPG3 guidelines stipulate that every 6 months, and in accordance with manufacturer's instructions, experienced personnel should carry out maintenance to both the separator and alarm.

Conder and our service partners can offer a full technical and service package including separator and alarm installation, commissioning, oil and silt removal and route service contracts.

Appendix B

Surface Water Calculations

Met Eireann
Return Period Rainfall Depths for sliding Durations
Irish Grid: Easting: 304087, Northing: 230773,

	Interval		Years													
DURATION	6months,	1year,	2,	3,	4,	5,	10,	20,	30,	50,	75,	100,	150,	200,	250,	500,
5 mins	2.3,	3.4,	4.1,	5.0,	5.7,	6.2,	8.0,	10.0,	11.4,	13.4,	15.2,	16.6,	18.8,	20.6,	22.1,	N/A ,
10 mins	3.2,	4.8,	5.7,	7.0,	7.9,	8.7,	11.1,	14.0,	15.9,	18.7,	21.2,	23.2,	26.3,	28.7,	30.7,	N/A ,
15 mins	3.8,	5.7,	6.7,	8.3,	9.3,	10.2,	13.1,	16.4,	18.7,	22.0,	24.9,	27.3,	30.9,	33.8,	36.2,	N/A ,
30 mins	5.0,	7.4,	8.7,	10.7,	12.0,	13.1,	16.7,	20.9,	23.7,	27.7,	31.4,	34.2,	38.7,	42.2,	45.1,	N/A ,
1 hours	6.6,	9.6,	11.2,	13.7,	15.5,	16.8,	21.3,	26.5,	30.0,	35.0,	39.4,	42.9,	48.4,	52.6,	56.2,	N/A ,
2 hours	8.6,	12.5,	14.6,	17.7,	19.9,	21.6,	27.2,	33.7,	38.0,	44.1,	49.6,	53.9,	60.5,	65.7,	70.0,	N/A ,
3 hours	10.1,	14.6,	17.0,	20.6,	23.1,	25.0,	31.4,	38.7,	43.6,	50.5,	56.7,	61.5,	69.0,	74.8,	79.7,	N/A ,
4 hours	11.4,	16.2,	18.9,	22.9,	25.6,	27.7,	34.7,	42.7,	48.1,	55.6,	62.3,	67.6,	75.7,	82.0,	87.3,	N/A ,
6 hours	13.3,	18.9,	22.0,	26.6,	29.7,	32.1,	40.1,	49.2,	55.2,	63.7,	71.3,	77.2,	86.3,	93.4,	99.3,	N/A ,
9 hours	15.6,	22.1,	25.6,	30.8,	34.4,	37.2,	46.2,	56.5,	63.3,	72.9,	81.5,	88.1,	98.4,	106.4,	113.0,	N/A ,
12 hours	17.5,	24.7,	28.5,	34.3,	38.2,	41.2,	51.2,	62.4,	69.8,	80.3,	89.6,	96.8,	108.0,	116.6,	123.8,	N/A ,
18 hours	20.5,	28.8,	33.2,	39.8,	44.3,	47.7,	59.0,	71.8,	80.2,	92.0,	102.5,	110.6,	123.1,	132.8,	140.8,	N/A ,
24 hours	23.0,	32.1,	37.0,	44.2,	49.1,	52.9,	65.3,	79.3,	88.4,	101.3,	112.7,	121.5,	135.1,	145.6,	154.3,	184.7,
2 days	28.9,	39.2,	44.6,	52.5,	57.8,	61.9,	75.1,	89.6,	99.1,	112.2,	123.7,	132.5,	146.0,	156.4,	164.9,	194.5,
3 days	33.6,	44.9,	50.7,	59.2,	64.9,	69.2,	83.0,	98.2,	108.0,	121.4,	133.2,	142.2,	155.9,	166.3,	174.9,	204.4,
4 days	37.8,	49.9,	56.1,	65.1,	71.0,	75.6,	90.0,	105.7,	115.8,	129.6,	141.6,	150.8,	164.7,	175.3,	183.9,	213.6,
6 days	45.1,	58.5,	65.4,	75.2,	81.7,	86.6,	102.0,	118.7,	129.3,	143.8,	156.3,	165.8,	180.1,	191.0,	199.9,	230.1,
8 days	51.6,	66.2,	73.5,	84.1,	91.0,	96.2,	112.5,	130.0,	141.1,	156.2,	169.1,	178.9,	193.7,	204.8,	213.9,	244.7,
10 days	57.5,	73.2,	81.0,	92.1,	99.4,	104.9,	122.0,	140.2,	151.7,	167.3,	180.7,	190.8,	205.9,	217.3,	226.6,	257.9,
12 days	63.1,	79.6,	87.9,	99.6,	107.2,	112.9,	130.7,	149.6,	161.5,	177.6,	191.3,	201.7,	217.1,	228.8,	238.3,	270.2,
16 days	73.5,	91.6,	100.6,	113.3,	121.5,	127.7,	146.7,	166.8,	179.4,	196.3,	210.7,	221.5,	237.6,	249.7,	259.5,	292.4,
20 days	83.0,	102.7,	112.3,	125.9,	134.6,	141.1,	161.3,	182.4,	195.5,	213.2,	228.1,	239.3,	256.0,	268.5,	278.6,	312.4,
25 days	94.3,	115.5,	125.9,	140.4,	149.7,	156.6,	178.0,	200.3,	214.1,	232.5,	248.1,	259.8,	277.1,	290.0,	300.4,	335.2,

NOTES:
N/A Data not available
These values are derived from a Depth Duration Frequency (DDF) Model
For details refer to:
'Fitzgerald D. L. (2007), Estimates of Point Rainfall Frequencies, Technical Note No. 61, Met Eireann, Dublin',
Available for download at www.met.ie/climate/dataproducts/Estimation-of-Point-Rainfall-Frequencies_TN61.pdf

Design Settings

Rainfall Methodology	FSR	Maximum Time of Concentration (mins)	30.00
Return Period (years)	100	Maximum Rainfall (mm/hr)	40.0
Additional Flow (%)	20	Minimum Velocity (m/s)	0.70
FSR Region	Scotland and Ireland	Connection Type	Level Inverts
M5-60 (mm)	16.000	Minimum Backdrop Height (m)	0.200
Ratio-R	0.300	Preferred Cover Depth (m)	0.800
CV	0.750	Include Intermediate Ground	✓
Time of Entry (mins)	15.00	Enforce best practice design rules	x

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Diameter (mm)	Easting (m)	Northing (m)	Depth (m)
SWMH Con			73.750	1200	303817.958	230626.095	1.930
SWMH 1.1			73.750	1200	303815.504	230625.668	1.920
SWMH 1.2			74.110	1200	303799.696	230598.832	2.155
SWMH 1.3			74.950	1200	303782.426	230580.233	2.894
SWMH 1.4			74.000	1200	303758.271	230566.848	1.834
SWMH 1.5			73.400	1200	303757.069	230569.573	1.200
SWMH 2.1			73.400	1200	303711.904	230562.661	1.200
SWMH 2.2			74.070	1200	303687.569	230556.650	1.589
SWMH 2.3			74.470	1200	303670.643	230547.154	1.773
SWMH 2.4			74.750	1200	303642.697	230541.928	1.740
SWMH 2.5			74.400	1200	303635.113	230535.287	1.100
SWMH 3.1			73.400	1200	303713.345	230563.983	1.200
SWMH 3.2			73.440	1200	303712.194	230567.644	1.224
SWMH 3.3			73.350	1200	303708.217	230566.882	1.118
SWMH 3.4			73.350	1200	303704.599	230566.252	1.118
SWMH 3.5			73.950	1200	303686.012	230558.931	1.377
SWMH 3.6	0.100	15.00	73.980	1200	303661.138	230552.006	1.000
SWMH 4.1			74.400	1200	303631.352	230537.088	1.100
SWMH 4.2			74.430	1200	303631.148	230539.756	1.100
SWMH 4.3			74.420	1200	303634.232	230540.511	1.055
SWMH 4.4	0.095	15.00	74.410	1200	303637.844	230541.476	1.010
SWMH 5.1			73.580	1200	303685.833	230580.559	1.238
SWMH 5.2	0.304	15.00	73.590	1200	303672.259	230648.324	0.990
SWMH 6.1			73.200	1200	303847.702	230663.364	1.340
SWMH 6.2			73.210	1200	303844.808	230663.133	1.270
SWMH 6.3			73.230	1200	303842.379	230664.158	1.210
SWMH 6.4			73.260	1200	303839.319	230665.554	1.160
SWMH 6.5	0.919	15.00	73.200	1200	303833.673	230655.847	0.990
SWMH 7.1			74.090	1200	303773.734	230579.515	1.940
SWMH 7.2	0.176	15.00	73.330	1200	303768.761	230579.061	1.130
SWMH 8.1	0.578	15.00	73.240	1200	303839.708	230679.632	0.990
SWMH 9.1			73.200	1200	303847.525	230671.902	1.500
SWMH 9.2			73.780	1200	303792.728	230685.834	1.852

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Diameter (mm)	Easting (m)	Northing (m)	Depth (m)
SWMH 9.3			73.850	1200	303704.302	230668.965	1.562
SWMH 9.4			73.630	1200	303671.938	230669.031	1.214
SWMH 9.5	0.147	15.00	73.830	1200	303667.664	230668.294	1.330
SWMH 10.1	0.107	15.00	73.840	1200	303667.035	230606.315	1.140
SWMH 11.1			73.400	1200	303649.445	230812.584	1.400
SWMH 11.2			73.480	1200	303650.077	230810.421	1.470
SWMH 11.3			73.510	1200	303646.938	230809.503	1.484
SWMH 11.4			73.450	1200	303640.412	230807.832	1.400
SWMH 11.5			73.650	1200	303642.244	230781.958	1.496
SWMH 11.6			73.600	1200	303656.748	230746.601	1.294
SWMH 11.7			73.580	1200	303671.252	230711.244	1.122
SWMH 11.8	0.620	15.00	73.580	1200	303676.967	230683.964	1.000
SWMH 12.1			73.400	1200	303738.067	230855.865	1.400
SWMH 12.2			73.480	1200	303734.936	230849.613	1.440
SWMH 12.3			73.590	1200	303702.648	230834.615	1.360
SWMH 12.4			73.710	1200	303669.274	230819.112	1.250
SWMH 12.5	0.545	15.00	73.810	1200	303667.251	230811.410	1.310
SWMH 13.1			73.400	1200	303711.263	230852.399	1.250
SWMH 13.2			73.380	1200	303712.947	230849.060	1.170
SWMH 13.3			73.390	1200	303717.240	230850.696	1.110
SWMH 13.4			73.390	1200	303721.614	230852.503	1.040
SWMH 13.5	0.228	15.00	73.390	1200	303722.638	230850.369	1.000
SWMH 14.1			72.500	1200	303694.193	230852.700	0.550
SWMH 14.2			73.180	1200	303696.055	230852.502	1.205
SWMH 14.3			73.400	1200	303698.321	230852.272	1.400
SWMH 15.1			72.500	1200	303817.102	230737.720	1.200
SWMH 15.2			72.710	1200	303816.412	230732.304	1.370
SWMH 15.3			73.200	1200	303850.692	230702.747	1.606
SWMH 15.4			73.200	1200	303857.797	230686.534	1.500
SWMH 16.1			73.400	1200	303800.963	230758.451	1.170
SWMH 16.2			73.380	1200	303799.149	230762.228	1.100
SWMH 16.3			73.400	1200	303797.672	230765.466	1.070
SWMH 16.4	0.537	15.00	73.380	1200	303795.212	230764.430	1.000
SWMH 17.1			72.500	1200	303793.390	230792.952	0.550
SWMH 17.2			73.300	1200	303793.004	230791.640	1.325
SWMH 17.3			73.400	1200	303792.566	230790.278	1.400
SWMH 18.1	0.622	15.00	73.940	1200	303621.405	230776.978	1.586

Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
1.1	SWMH 1.1	SWMH Con	2.491	0.600	71.830	71.820	0.010	249.1	300	16.49	40.0
1.2	SWMH 1.2	SWMH 1.1	31.146	0.600	71.955	71.830	0.125	249.2	300	16.45	40.0
1.3	SWMH 1.3	SWMH 1.2	25.381	0.600	72.056	71.955	0.101	251.3	300	15.92	40.0
1.4	SWMH 1.4	SWMH 1.3	27.616	0.600	72.166	72.056	0.110	251.1	300	15.50	40.0
1.5	SWMH 1.5	SWMH 1.4	2.978	0.600	72.200	72.166	0.034	87.6	300	15.03	40.0
2.2	SWMH 2.2	SWMH 2.1	25.066	0.600	72.481	72.200	0.281	89.2	150	16.24	40.0
2.3	SWMH 2.3	SWMH 2.2	19.408	0.600	72.697	72.481	0.216	89.9	150	15.85	40.0
2.4	SWMH 2.4	SWMH 2.3	28.430	0.600	73.010	72.697	0.313	90.8	150	15.55	40.0
2.5	SWMH 2.5	SWMH 2.4	10.081	0.600	73.300	73.010	0.290	34.8	150	15.10	40.0
3.2	SWMH 3.2	SWMH 3.1	3.838	0.600	72.216	72.200	0.016	239.9	300	16.76	40.0
3.3	SWMH 3.3	SWMH 3.2	4.049	0.600	72.232	72.216	0.016	253.1	300	16.70	40.0
3.4	SWMH 3.4	SWMH 3.3	3.672	0.600	72.248	72.232	0.016	229.5	300	16.63	40.0
3.5	SWMH 3.5	SWMH 3.4	19.977	0.600	72.573	72.248	0.325	61.5	225	15.46	40.0
3.6	SWMH 3.6	SWMH 3.5	25.820	0.600	72.980	72.573	0.407	63.4	225	15.26	40.0
4.2	SWMH 4.2	SWMH 4.1	2.676	0.600	73.330	73.300	0.030	89.2	225	15.12	40.0
4.3	SWMH 4.3	SWMH 4.2	3.175	0.600	73.365	73.330	0.035	90.7	225	15.09	40.0
4.4	SWMH 4.4	SWMH 4.3	3.739	0.600	73.400	73.365	0.035	106.8	225	15.05	40.0
5.1	SWMH 5.1	SWMH 3.4	23.598	0.600	72.342	72.232	0.110	214.5	300	16.57	40.0
5.2	SWMH 5.2	SWMH 5.1	69.111	0.600	72.600	72.342	0.258	267.9	300	16.21	40.0

Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)	Pro Depth (mm)	Pro Velocity (m/s)
1.1	0.991	70.1	101.7	1.620	1.630	0.782	0.0	300	1.004
1.2	0.991	70.1	101.7	1.855	1.620	0.782	0.0	300	1.004
1.3	0.987	69.8	101.7	2.594	1.855	0.782	0.0	300	1.000
1.4	0.987	69.8	78.8	1.534	2.594	0.606	0.0	300	1.000
1.5	1.681	118.8	78.8	0.900	1.534	0.606	0.0	179	1.793
2.2	1.064	18.8	12.4	1.439	1.050	0.095	0.0	89	1.135
2.3	1.060	18.7	12.4	1.623	1.439	0.095	0.0	89	1.130
2.4	1.055	18.6	12.4	1.590	1.623	0.095	0.0	89	1.127
2.5	1.713	30.3	12.4	0.950	1.590	0.095	0.0	67	1.625
3.2	1.011	71.4	66.5	0.924	0.900	0.511	0.0	230	1.142
3.3	0.984	69.5	66.5	0.818	0.924	0.511	0.0	236	1.114
3.4	1.033	73.0	66.5	0.802	0.818	0.511	0.0	226	1.166
3.5	1.671	66.4	13.0	1.152	0.877	0.100	0.0	67	1.303
3.6	1.644	65.4	13.0	0.775	1.152	0.100	0.0	68	1.292
4.2	1.385	55.1	12.4	0.875	0.875	0.095	0.0	73	1.124
4.3	1.373	54.6	12.4	0.830	0.875	0.095	0.0	73	1.115
4.4	1.264	50.3	12.4	0.785	0.830	0.095	0.0	76	1.052
5.1	1.069	75.6	53.5	0.938	0.818	0.411	0.0	187	1.156
5.2	0.956	67.5	39.6	0.690	0.938	0.304	0.0	165	0.992

Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
6.2	SWMH 6.2	SWMH 6.1	2.903	0.600	71.940	71.860	0.080	36.3	225	15.24	40.0
6.3	SWMH 6.3	SWMH 6.2	2.636	0.600	72.020	71.940	0.080	33.0	225	15.22	40.0
6.4	SWMH 6.4	SWMH 6.3	3.363	0.600	72.100	72.020	0.080	42.0	225	15.20	40.0
6.5	SWMH 6.5	SWMH 6.4	11.230	0.600	72.210	72.100	0.110	102.1	225	15.14	40.0
7.1	SWMH 7.1	SWMH 1.3	8.722	0.600	72.150	72.056	0.094	92.8	150	15.22	40.0
7.2	SWMH 7.2	SWMH 7.1	4.994	0.600	72.200	72.150	0.050	99.9	150	15.08	40.0
8.1	SWMH 8.1	SWMH 6.4	14.083	0.600	72.250	72.100	0.150	93.9	225	15.17	40.0
9.2	SWMH 9.2	SWMH 9.1	56.540	0.600	71.928	71.700	0.228	248.0	300	19.03	40.0
9.3	SWMH 9.3	SWMH 9.2	90.021	0.600	72.288	71.928	0.360	250.1	300	18.08	40.0
9.4	SWMH 9.4	SWMH 9.3	32.364	0.600	72.416	72.288	0.128	252.8	300	16.57	40.0
9.5	SWMH 9.5	SWMH 9.4	4.337	0.600	72.500	72.416	0.084	51.6	300	15.03	40.0
10.1	SWMH 10.1	SWMH 5.1	26.113	0.600	72.700	72.342	0.358	72.9	225	15.38	40.0
11.2	SWMH 11.2	SWMH 11.1	2.253	0.600	72.010	72.000	0.010	225.3	300	17.38	40.0
11.3	SWMH 11.3	SWMH 11.2	3.270	0.600	72.026	72.010	0.016	204.4	300	17.35	40.0
11.4	SWMH 11.4	SWMH 11.3	6.737	0.600	72.050	72.026	0.024	280.7	300	17.30	40.0
11.5	SWMH 11.5	SWMH 11.4	25.939	0.600	72.154	72.050	0.104	249.4	300	17.18	40.0
11.6	SWMH 11.6	SWMH 11.5	38.216	0.600	72.306	72.154	0.152	251.4	300	16.74	40.0
11.7	SWMH 11.7	SWMH 11.6	38.216	0.600	72.458	72.306	0.152	251.4	300	16.09	40.0
11.8	SWMH 11.8	SWMH 11.7	27.872	0.600	72.580	72.458	0.122	228.5	300	15.45	40.0

Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)	Pro Depth (mm)	Pro Velocity (m/s)
6.2	2.178	86.6	194.8	1.045	1.115	1.497	0.0	225	2.218
6.3	2.287	90.9	194.8	0.985	1.045	1.497	0.0	225	2.329
6.4	2.023	80.4	194.8	0.935	0.985	1.497	0.0	225	2.060
6.5	1.294	51.4	119.6	0.765	0.935	0.919	0.0	225	1.317
7.1	1.043	18.4	22.9	1.790	2.744	0.176	0.0	150	1.063
7.2	1.005	17.8	22.9	0.980	1.790	0.176	0.0	150	1.024
8.1	1.349	53.7	75.2	0.765	0.935	0.578	0.0	225	1.374
9.2	0.994	70.2	19.1	1.552	1.200	0.147	0.0	107	0.850
9.3	0.989	69.9	19.1	1.262	1.552	0.147	0.0	107	0.847
9.4	0.984	69.6	19.1	0.914	1.262	0.147	0.0	107	0.842
9.5	2.193	155.0	19.1	1.030	0.914	0.147	0.0	71	1.505
10.1	1.533	60.9	13.9	0.915	1.013	0.107	0.0	73	1.244
11.2	1.043	73.7	161.6	1.170	1.100	1.242	0.0	300	1.057
11.3	1.096	77.5	161.6	1.184	1.170	1.242	0.0	300	1.110
11.4	0.933	66.0	161.6	1.100	1.184	1.242	0.0	300	0.945
11.5	0.991	70.0	161.6	1.196	1.100	1.242	0.0	300	1.004
11.6	0.987	69.8	80.7	0.994	1.196	0.620	0.0	300	1.000
11.7	0.987	69.8	80.7	0.822	0.994	0.620	0.0	300	1.000
11.8	1.036	73.2	80.7	0.700	0.822	0.620	0.0	300	1.049

Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
12.2	SWMH 12.2	SWMH 12.1	6.992	0.600	72.040	72.000	0.040	174.8	300	16.23	40.0
12.3	SWMH 12.3	SWMH 12.2	35.601	0.600	72.230	72.040	0.190	187.4	300	16.13	40.0
12.4	SWMH 12.4	SWMH 12.3	36.799	0.600	72.460	72.230	0.230	160.0	300	15.61	40.0
12.5	SWMH 12.5	SWMH 12.4	7.963	0.600	72.500	72.460	0.040	199.1	300	15.12	40.0
13.2	SWMH 13.2	SWMH 13.1	3.740	0.600	72.210	72.150	0.060	62.3	225	15.16	40.0
13.3	SWMH 13.3	SWMH 13.2	4.594	0.600	72.280	72.210	0.070	65.6	225	15.12	40.0
13.4	SWMH 13.4	SWMH 13.3	4.733	0.600	72.350	72.280	0.070	67.6	225	15.07	40.0
13.5	SWMH 13.5	SWMH 13.4	2.367	0.600	72.390	72.350	0.040	59.2	225	15.02	40.0
14.2	SWMH 14.2	SWMH 14.1	1.872	0.600	71.975	71.950	0.025	74.9	225	15.05	40.0
14.3	SWMH 14.3	SWMH 14.2	2.278	0.600	72.000	71.975	0.025	91.1	225	15.03	40.0
15.2	SWMH 15.2	SWMH 15.1	5.460	0.600	71.340	71.300	0.040	136.5	225	16.15	40.0
15.3	SWMH 15.3	SWMH 15.2	45.263	0.600	71.594	71.340	0.254	178.2	225	16.07	40.0
15.4	SWMH 15.4	SWMH 15.3	17.701	0.600	71.700	71.597	0.103	171.9	225	15.30	40.0
16.2	SWMH 16.2	SWMH 16.1	4.190	0.600	72.280	72.230	0.050	83.8	225	15.11	40.0
16.3	SWMH 16.3	SWMH 16.2	3.559	0.600	72.330	72.280	0.050	71.2	225	15.06	40.0
16.4	SWMH 16.4	SWMH 16.3	2.669	0.600	72.380	72.330	0.050	53.4	225	15.02	40.0
17.2	SWMH 17.2	SWMH 17.1	1.368	0.600	71.975	71.950	0.025	54.7	225	15.03	40.0
17.3	SWMH 17.3	SWMH 17.2	1.431	0.600	72.000	71.975	0.025	57.2	225	15.01	40.0

Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)	Pro Depth (mm)	Pro Velocity (m/s)
12.2	1.186	83.8	70.9	1.140	1.100	0.545	0.0	212	1.324
12.3	1.145	80.9	70.9	1.060	1.140	0.545	0.0	218	1.285
12.4	1.240	87.7	70.9	0.950	1.060	0.545	0.0	205	1.375
12.5	1.110	78.5	70.9	1.010	0.950	0.545	0.0	224	1.251
13.2	1.659	66.0	29.7	0.945	1.025	0.228	0.0	106	1.617
13.3	1.617	64.3	29.7	0.885	0.945	0.228	0.0	108	1.587
13.4	1.592	63.3	29.7	0.815	0.885	0.228	0.0	109	1.569
13.5	1.703	67.7	29.7	0.775	0.815	0.228	0.0	104	1.648
14.2	1.513	60.1	191.3	0.980	0.325	1.470	0.0	225	1.540
14.3	1.370	54.5	191.3	1.175	0.980	1.470	0.0	225	1.395
15.2	1.117	44.4	213.9	1.145	0.975	1.644	0.0	225	1.138
15.3	0.976	38.8	213.9	1.381	1.145	1.644	0.0	225	0.994
15.4	0.994	39.5	213.9	1.275	1.378	1.644	0.0	225	1.013
16.2	1.429	56.8	69.9	0.875	0.945	0.537	0.0	225	1.455
16.3	1.552	61.7	69.9	0.845	0.875	0.537	0.0	225	1.580
16.4	1.794	71.3	69.9	0.775	0.845	0.537	0.0	181	2.034
17.2	1.772	70.4	140.8	1.100	0.325	1.082	0.0	225	1.804
17.3	1.732	68.9	140.8	1.175	1.100	1.082	0.0	225	1.764

Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
Pond 1.1	SWMH 11.1	SWMH 14.3	62.960	0.600	72.000	72.000	0.000	0.0	300	18.88	40.0
Pond 1.2	SWMH 13.1	SWMH 14.3	12.943	0.600	72.150	72.000	0.150	86.3	225	15.31	40.0
Pond 2.1	SWMH 12.1	SWMH 17.3	85.275	0.600	72.000	72.000	0.000	0.0	300	18.26	40.0
Pond 2.2	SWMH 16.1	SWMH 17.3	32.916	0.600	72.230	72.000	0.230	143.1	225	15.61	40.0
Pond 3.1	SWMH 9.1	SWMH 15.4	17.878	0.600	71.700	71.700	0.000	0.0	300	19.46	40.0
Pond 3.2	SWMH 6.1	SWMH 15.4	25.274	0.600	71.860	71.700	0.160	158.0	300	15.58	40.0
Pond 4.1	SWMH 3.1	SWMH 1.5	44.080	0.600	72.200	72.200	0.000	0.0	300	17.81	40.0
Pond 4.2	SWMH 2.1	SWMH 1.5	45.691	0.600	72.200	72.200	0.000	0.0	150	17.33	40.0
Pond 5	SWMH 4.1	SWMH 2.5	4.170	0.600	73.300	73.300	0.000	0.0	225	15.22	40.0
18.1	SWMH 18.1	SWMH 11.5	21.426	0.600	72.354	72.154	0.200	107.1	300	15.24	40.0

Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)	Pro Depth (mm)	Pro Velocity (m/s)
Pond 1.1	0.700	49.5	161.6	1.100	1.100	1.242	0.0	0	∞
Pond 1.2	1.408	56.0	29.7	1.025	1.175	0.228	0.0	116	1.428
Pond 2.1	0.700	49.5	70.9	1.100	1.100	0.545	0.0	0	∞
Pond 2.2	1.091	43.4	69.9	0.945	1.175	0.537	0.0	225	1.111
Pond 3.1	0.700	49.5	19.1	1.200	1.200	0.147	0.0	0	∞
Pond 3.2	1.248	88.2	194.8	1.040	1.200	1.497	0.0	300	1.264
Pond 4.1	0.700	49.5	66.5	0.900	0.900	0.511	0.0	0	∞
Pond 4.2	0.700	12.4	12.4	1.050	1.050	0.095	0.0	0	∞
Pond 5	0.700	27.8	12.4	0.875	0.875	0.095	0.0	0	∞
18.1	1.518	107.3	80.9	1.286	1.196	0.622	0.0	195	1.663

Pipeline Schedule

Link	Length (m)	Slope (1:X)	Dia (mm)	Link Type	US CL (m)	US IL (m)	US Depth (m)	DS CL (m)	DS IL (m)	DS Depth (m)
1.1	2.491	249.1	300	Circular	73.750	71.830	1.620	73.750	71.820	1.630
1.2	31.146	249.2	300	Circular	74.110	71.955	1.855	73.750	71.830	1.620
1.3	25.381	251.3	300	Circular	74.950	72.056	2.594	74.110	71.955	1.855
1.4	27.616	251.1	300	Circular	74.000	72.166	1.534	74.950	72.056	2.594
1.5	2.978	87.6	300	Circular	73.400	72.200	0.900	74.000	72.166	1.534
2.2	25.066	89.2	150	Circular	74.070	72.481	1.439	73.400	72.200	1.050
2.3	19.408	89.9	150	Circular	74.470	72.697	1.623	74.070	72.481	1.439
2.4	28.430	90.8	150	Circular	74.750	73.010	1.590	74.470	72.697	1.623

Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
1.1	SWMH 1.1	1200	Manhole	Adoptable	SWMH Con	1200	Manhole	Adoptable
1.2	SWMH 1.2	1200	Manhole	Adoptable	SWMH 1.1	1200	Manhole	Adoptable
1.3	SWMH 1.3	1200	Manhole	Adoptable	SWMH 1.2	1200	Manhole	Adoptable
1.4	SWMH 1.4	1200	Manhole	Adoptable	SWMH 1.3	1200	Manhole	Adoptable
1.5	SWMH 1.5	1200	Manhole	Adoptable	SWMH 1.4	1200	Manhole	Adoptable
2.2	SWMH 2.2	1200	Manhole	Adoptable	SWMH 2.1	1200	Manhole	Adoptable
2.3	SWMH 2.3	1200	Manhole	Adoptable	SWMH 2.2	1200	Manhole	Adoptable
2.4	SWMH 2.4	1200	Manhole	Adoptable	SWMH 2.3	1200	Manhole	Adoptable

Pipeline Schedule

Link	Length (m)	Slope (1:X)	Dia (mm)	Link Type	US CL (m)	US IL (m)	US Depth (m)	DS CL (m)	DS IL (m)	DS Depth (m)
2.5	10.081	34.8	150	Circular	74.400	73.300	0.950	74.750	73.010	1.590
3.2	3.838	239.9	300	Circular	73.440	72.216	0.924	73.400	72.200	0.900
3.3	4.049	253.1	300	Circular	73.350	72.232	0.818	73.440	72.216	0.924
3.4	3.672	229.5	300	Circular	73.350	72.248	0.802	73.350	72.232	0.818
3.5	19.977	61.5	225	Circular	73.950	72.573	1.152	73.350	72.248	0.877
3.6	25.820	63.4	225	Circular	73.980	72.980	0.775	73.950	72.573	1.152
4.2	2.676	89.2	225	Circular	74.430	73.330	0.875	74.400	73.300	0.875
4.3	3.175	90.7	225	Circular	74.420	73.365	0.830	74.430	73.330	0.875
4.4	3.739	106.8	225	Circular	74.410	73.400	0.785	74.420	73.365	0.830
5.1	23.598	214.5	300	Circular	73.580	72.342	0.938	73.350	72.232	0.818
5.2	69.111	267.9	300	Circular	73.590	72.600	0.690	73.580	72.342	0.938
6.2	2.903	36.3	225	Circular	73.210	71.940	1.045	73.200	71.860	1.115
6.3	2.636	33.0	225	Circular	73.230	72.020	0.985	73.210	71.940	1.045
6.4	3.363	42.0	225	Circular	73.260	72.100	0.935	73.230	72.020	0.985
6.5	11.230	102.1	225	Circular	73.200	72.210	0.765	73.260	72.100	0.935
7.1	8.722	92.8	150	Circular	74.090	72.150	1.790	74.950	72.056	2.744
7.2	4.994	99.9	150	Circular	73.330	72.200	0.980	74.090	72.150	1.790
8.1	14.083	93.9	225	Circular	73.240	72.250	0.765	73.260	72.100	0.935

Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
2.5	SWMH 2.5	1200	Manhole	Adoptable	SWMH 2.4	1200	Manhole	Adoptable
3.2	SWMH 3.2	1200	Manhole	Adoptable	SWMH 3.1	1200	Manhole	Adoptable
3.3	SWMH 3.3	1200	Manhole	Adoptable	SWMH 3.2	1200	Manhole	Adoptable
3.4	SWMH 3.4	1200	Manhole	Adoptable	SWMH 3.3	1200	Manhole	Adoptable
3.5	SWMH 3.5	1200	Manhole	Adoptable	SWMH 3.4	1200	Manhole	Adoptable
3.6	SWMH 3.6	1200	Manhole	Adoptable	SWMH 3.5	1200	Manhole	Adoptable
4.2	SWMH 4.2	1200	Manhole	Adoptable	SWMH 4.1	1200	Manhole	Adoptable
4.3	SWMH 4.3	1200	Manhole	Adoptable	SWMH 4.2	1200	Manhole	Adoptable
4.4	SWMH 4.4	1200	Manhole	Adoptable	SWMH 4.3	1200	Manhole	Adoptable
5.1	SWMH 5.1	1200	Manhole	Adoptable	SWMH 3.4	1200	Manhole	Adoptable
5.2	SWMH 5.2	1200	Manhole	Adoptable	SWMH 5.1	1200	Manhole	Adoptable
6.2	SWMH 6.2	1200	Manhole	Adoptable	SWMH 6.1	1200	Manhole	Adoptable
6.3	SWMH 6.3	1200	Manhole	Adoptable	SWMH 6.2	1200	Manhole	Adoptable
6.4	SWMH 6.4	1200	Manhole	Adoptable	SWMH 6.3	1200	Manhole	Adoptable
6.5	SWMH 6.5	1200	Manhole	Adoptable	SWMH 6.4	1200	Manhole	Adoptable
7.1	SWMH 7.1	1200	Manhole	Adoptable	SWMH 1.3	1200	Manhole	Adoptable
7.2	SWMH 7.2	1200	Manhole	Adoptable	SWMH 7.1	1200	Manhole	Adoptable
8.1	SWMH 8.1	1200	Manhole	Adoptable	SWMH 6.4	1200	Manhole	Adoptable

Pipeline Schedule

Link	Length (m)	Slope (1:X)	Dia (mm)	Link Type	US CL (m)	US IL (m)	US Depth (m)	DS CL (m)	DS IL (m)	DS Depth (m)
9.2	56.540	248.0	300	Circular	73.780	71.928	1.552	73.200	71.700	1.200
9.3	90.021	250.1	300	Circular	73.850	72.288	1.262	73.780	71.928	1.552
9.4	32.364	252.8	300	Circular	73.630	72.416	0.914	73.850	72.288	1.262
9.5	4.337	51.6	300	Circular	73.830	72.500	1.030	73.630	72.416	0.914
10.1	26.113	72.9	225	Circular	73.840	72.700	0.915	73.580	72.342	1.013
11.2	2.253	225.3	300	Circular	73.480	72.010	1.170	73.400	72.000	1.100
11.3	3.270	204.4	300	Circular	73.510	72.026	1.184	73.480	72.010	1.170
11.4	6.737	280.7	300	Circular	73.450	72.050	1.100	73.510	72.026	1.184
11.5	25.939	249.4	300	Circular	73.650	72.154	1.196	73.450	72.050	1.100
11.6	38.216	251.4	300	Circular	73.600	72.306	0.994	73.650	72.154	1.196
11.7	38.216	251.4	300	Circular	73.580	72.458	0.822	73.600	72.306	0.994
11.8	27.872	228.5	300	Circular	73.580	72.580	0.700	73.580	72.458	0.822
12.2	6.992	174.8	300	Circular	73.480	72.040	1.140	73.400	72.000	1.100
12.3	35.601	187.4	300	Circular	73.590	72.230	1.060	73.480	72.040	1.140
12.4	36.799	160.0	300	Circular	73.710	72.460	0.950	73.590	72.230	1.060
12.5	7.963	199.1	300	Circular	73.810	72.500	1.010	73.710	72.460	0.950
13.2	3.740	62.3	225	Circular	73.380	72.210	0.945	73.400	72.150	1.025
13.3	4.594	65.6	225	Circular	73.390	72.280	0.885	73.380	72.210	0.945
13.4	4.733	67.6	225	Circular	73.390	72.350	0.815	73.390	72.280	0.885
13.5	2.367	59.2	225	Circular	73.390	72.390	0.775	73.390	72.350	0.815

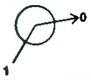
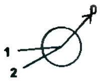
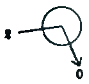
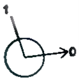
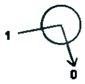
Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
9.2	SWMH 9.2	1200	Manhole	Adoptable	SWMH 9.1	1200	Manhole	Adoptable
9.3	SWMH 9.3	1200	Manhole	Adoptable	SWMH 9.2	1200	Manhole	Adoptable
9.4	SWMH 9.4	1200	Manhole	Adoptable	SWMH 9.3	1200	Manhole	Adoptable
9.5	SWMH 9.5	1200	Manhole	Adoptable	SWMH 9.4	1200	Manhole	Adoptable
10.1	SWMH 10.1	1200	Manhole	Adoptable	SWMH 5.1	1200	Manhole	Adoptable
11.2	SWMH 11.2	1200	Manhole	Adoptable	SWMH 11.1	1200	Manhole	Adoptable
11.3	SWMH 11.3	1200	Manhole	Adoptable	SWMH 11.2	1200	Manhole	Adoptable
11.4	SWMH 11.4	1200	Manhole	Adoptable	SWMH 11.3	1200	Manhole	Adoptable
11.5	SWMH 11.5	1200	Manhole	Adoptable	SWMH 11.4	1200	Manhole	Adoptable
11.6	SWMH 11.6	1200	Manhole	Adoptable	SWMH 11.5	1200	Manhole	Adoptable
11.7	SWMH 11.7	1200	Manhole	Adoptable	SWMH 11.6	1200	Manhole	Adoptable
11.8	SWMH 11.8	1200	Manhole	Adoptable	SWMH 11.7	1200	Manhole	Adoptable
12.2	SWMH 12.2	1200	Manhole	Adoptable	SWMH 12.1	1200	Manhole	Adoptable
12.3	SWMH 12.3	1200	Manhole	Adoptable	SWMH 12.2	1200	Manhole	Adoptable
12.4	SWMH 12.4	1200	Manhole	Adoptable	SWMH 12.3	1200	Manhole	Adoptable
12.5	SWMH 12.5	1200	Manhole	Adoptable	SWMH 12.4	1200	Manhole	Adoptable
13.2	SWMH 13.2	1200	Manhole	Adoptable	SWMH 13.1	1200	Manhole	Adoptable
13.3	SWMH 13.3	1200	Manhole	Adoptable	SWMH 13.2	1200	Manhole	Adoptable
13.4	SWMH 13.4	1200	Manhole	Adoptable	SWMH 13.3	1200	Manhole	Adoptable
13.5	SWMH 13.5	1200	Manhole	Adoptable	SWMH 13.4	1200	Manhole	Adoptable

Pipeline Schedule

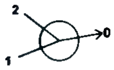
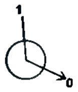
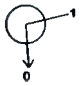
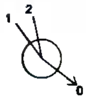
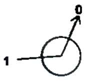
Link	Length (m)	Slope (1:X)	Dia (mm)	Link Type	US CL (m)	US IL (m)	US Depth (m)	DS CL (m)	DS IL (m)	DS Depth (m)
14.2	1.872	74.9	225	Circular	73.180	71.975	0.980	72.500	71.950	0.325
14.3	2.278	91.1	225	Circular	73.400	72.000	1.175	73.180	71.975	0.980
15.2	5.460	136.5	225	Circular	72.710	71.340	1.145	72.500	71.300	0.975
15.3	45.263	178.2	225	Circular	73.200	71.594	1.381	72.710	71.340	1.145
15.4	17.701	171.9	225	Circular	73.200	71.700	1.275	73.200	71.597	1.378
16.2	4.190	83.8	225	Circular	73.380	72.280	0.875	73.400	72.230	0.945
16.3	3.559	71.2	225	Circular	73.400	72.330	0.845	73.380	72.280	0.875
16.4	2.669	53.4	225	Circular	73.380	72.380	0.775	73.400	72.330	0.845
17.2	1.368	54.7	225	Circular	73.300	71.975	1.100	72.500	71.950	0.325
17.3	1.431	57.2	225	Circular	73.400	72.000	1.175	73.300	71.975	1.100
Pond 1.1	62.960	0.0	300	Circular	73.400	72.000	1.100	73.400	72.000	1.100
Pond 1.2	12.943	86.3	225	Circular	73.400	72.150	1.025	73.400	72.000	1.175
Pond 2.1	85.275	0.0	300	Circular	73.400	72.000	1.100	73.400	72.000	1.100
Pond 2.2	32.916	143.1	225	Circular	73.400	72.230	0.945	73.400	72.000	1.175
Pond 3.1	17.878	0.0	300	Circular	73.200	71.700	1.200	73.200	71.700	1.200
Pond 3.2	25.274	158.0	300	Circular	73.200	71.860	1.040	73.200	71.700	1.200
Pond 4.1	44.080	0.0	300	Circular	73.400	72.200	0.900	73.400	72.200	0.900
Pond 4.2	45.691	0.0	150	Circular	73.400	72.200	1.050	73.400	72.200	1.050
Pond 5	4.170	0.0	225	Circular	74.400	73.300	0.875	74.400	73.300	0.875
18.1	21.426	107.1	300	Circular	73.940	72.354	1.286	73.650	72.154	1.196

Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
14.2	SWMH 14.2	1200	Manhole	Adoptable	SWMH 14.1	1200	Manhole	Adoptable
14.3	SWMH 14.3	1200	Manhole	Adoptable	SWMH 14.2	1200	Manhole	Adoptable
15.2	SWMH 15.2	1200	Manhole	Adoptable	SWMH 15.1	1200	Manhole	Adoptable
15.3	SWMH 15.3	1200	Manhole	Adoptable	SWMH 15.2	1200	Manhole	Adoptable
15.4	SWMH 15.4	1200	Manhole	Adoptable	SWMH 15.3	1200	Manhole	Adoptable
16.2	SWMH 16.2	1200	Manhole	Adoptable	SWMH 16.1	1200	Manhole	Adoptable
16.3	SWMH 16.3	1200	Manhole	Adoptable	SWMH 16.2	1200	Manhole	Adoptable
16.4	SWMH 16.4	1200	Manhole	Adoptable	SWMH 16.3	1200	Manhole	Adoptable
17.2	SWMH 17.2	1200	Manhole	Adoptable	SWMH 17.1	1200	Manhole	Adoptable
17.3	SWMH 17.3	1200	Manhole	Adoptable	SWMH 17.2	1200	Manhole	Adoptable
Pond 1.1	SWMH 11.1	1200	Manhole	Adoptable	SWMH 14.3	1200	Manhole	Adoptable
Pond 1.2	SWMH 13.1	1200	Manhole	Adoptable	SWMH 14.3	1200	Manhole	Adoptable
Pond 2.1	SWMH 12.1	1200	Manhole	Adoptable	SWMH 17.3	1200	Manhole	Adoptable
Pond 2.2	SWMH 16.1	1200	Manhole	Adoptable	SWMH 17.3	1200	Manhole	Adoptable
Pond 3.1	SWMH 9.1	1200	Manhole	Adoptable	SWMH 15.4	1200	Manhole	Adoptable
Pond 3.2	SWMH 6.1	1200	Manhole	Adoptable	SWMH 15.4	1200	Manhole	Adoptable
Pond 4.1	SWMH 3.1	1200	Manhole	Adoptable	SWMH 1.5	1200	Manhole	Adoptable
Pond 4.2	SWMH 2.1	1200	Manhole	Adoptable	SWMH 1.5	1200	Manhole	Adoptable
Pond 5	SWMH 4.1	1200	Manhole	Adoptable	SWMH 2.5	1200	Manhole	Adoptable
18.1	SWMH 18.1	1200	Manhole	Adoptable	SWMH 11.5	1200	Manhole	Adoptable

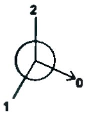
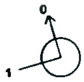
Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections		Link	IL (m)	Dia (mm)
SWMH Con	303817.958	230626.095	73.750	1.930	1200		1	1.1	71.820	300
SWMH 1.1	303815.504	230625.668	73.750	1.920	1200		1	1.2	71.830	300
							0	1.1	71.830	300
SWMH 1.2	303799.696	230598.832	74.110	2.155	1200		1	1.3	71.955	300
							0	1.2	71.955	300
SWMH 1.3	303782.426	230580.233	74.950	2.894	1200		1	7.1	72.056	150
							2	1.4	72.056	300
							0	1.3	72.056	300
SWMH 1.4	303758.271	230566.848	74.000	1.834	1200		1	1.5	72.166	300
							0	1.4	72.166	300
SWMH 1.5	303757.069	230569.573	73.400	1.200	1200		1	Pond 4.2	72.200	150
							2	Pond 4.1	72.200	300
							0	1.5	72.200	300
SWMH 2.1	303711.904	230562.661	73.400	1.200	1200		1	2.2	72.200	150
							0	Pond 4.2	72.200	150
SWMH 2.2	303687.569	230556.650	74.070	1.589	1200		1	2.3	72.481	150
							0	2.2	72.481	150
SWMH 2.3	303670.643	230547.154	74.470	1.773	1200		1	2.4	72.697	150
							0	2.3	72.697	150
SWMH 2.4	303642.697	230541.928	74.750	1.740	1200		1	2.5	73.010	150
							0	2.4	73.010	150
SWMH 2.5	303635.113	230535.287	74.400	1.100	1200		1	Pond 5	73.300	225
							0	2.5	73.300	150
SWMH 3.1	303713.345	230563.983	73.400	1.200	1200		1	3.2	72.200	300
							0	Pond 4.1	72.200	300
SWMH 3.2	303712.194	230567.644	73.440	1.224	1200		1	3.3	72.216	300
							0	3.2	72.216	300

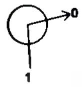
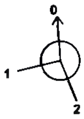
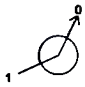
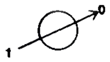
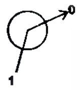
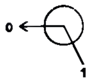
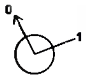
Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections		Link	IL (m)	Dia (mm)
SWMH 3.3	303708.217	230566.882	73.350	1.118	1200		1	3.4	72.232	300
							0	3.3	72.232	300
SWMH 3.4	303704.599	230566.252	73.350	1.118	1200		1	3.5	72.248	225
							2	5.1	72.232	300
							0	3.4	72.248	300
SWMH 3.5	303686.012	230558.931	73.950	1.377	1200		1	3.6	72.573	225
							0	3.5	72.573	225
SWMH 3.6	303661.138	230552.006	73.980	1.000	1200					
							0	3.6	72.980	225
SWMH 4.1	303631.352	230537.088	74.400	1.100	1200		1	4.2	73.300	225
							0	Pond 5	73.300	225
SWMH 4.2	303631.148	230539.756	74.430	1.100	1200		1	4.3	73.330	225
							0	4.2	73.330	225
SWMH 4.3	303634.232	230540.511	74.420	1.055	1200		1	4.4	73.365	225
							0	4.3	73.365	225
SWMH 4.4	303637.844	230541.476	74.410	1.010	1200					
							0	4.4	73.400	225
SWMH 5.1	303685.833	230580.559	73.580	1.238	1200		1	10.1	72.342	225
							2	5.2	72.342	300
							0	5.1	72.342	300
SWMH 5.2	303672.259	230648.324	73.590	0.990	1200					
							0	5.2	72.600	300
SWMH 6.1	303847.702	230663.364	73.200	1.340	1200		1	6.2	71.860	225
							0	Pond 3.2	71.860	300
SWMH 6.2	303844.808	230663.133	73.210	1.270	1200		1	6.3	71.940	225
							0	6.2	71.940	225
SWMH 6.3	303842.379	230664.158	73.230	1.210	1200		1	6.4	72.020	225
							0	6.3	72.020	225

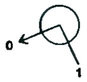
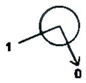
Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections		Link	IL (m)	Dia (mm)
SWMH 6.4	303839.319	230665.554	73.260	1.160	1200		1	6.5	72.100	225
							2	8.1	72.100	225
							0	6.4	72.100	225
SWMH 6.5	303833.673	230655.847	73.200	0.990	1200		0	6.5	72.210	225
SWMH 7.1	303773.734	230579.515	74.090	1.940	1200		1	7.2	72.150	150
							0	7.1	72.150	150
SWMH 7.2	303768.761	230579.061	73.330	1.130	1200		0	7.2	72.200	150
SWMH 8.1	303839.708	230679.632	73.240	0.990	1200		0	8.1	72.250	225
SWMH 9.1	303847.525	230671.902	73.200	1.500	1200		1	9.2	71.700	300
							0	Pond 3.1	71.700	300
SWMH 9.2	303792.728	230685.834	73.780	1.852	1200		1	9.3	71.928	300
							0	9.2	71.928	300
SWMH 9.3	303704.302	230668.965	73.850	1.562	1200		1	9.4	72.288	300
							0	9.3	72.288	300
SWMH 9.4	303671.938	230669.031	73.630	1.214	1200		1	9.5	72.416	300
							0	9.4	72.416	300
SWMH 9.5	303667.664	230668.294	73.830	1.330	1200		0	9.5	72.500	300
SWMH 10.1	303667.035	230606.315	73.840	1.140	1200		0	10.1	72.700	225
SWMH 11.1	303649.445	230812.584	73.400	1.400	1200		1	11.2	72.000	300
							0	Pond 1.1	72.000	300
SWMH 11.2	303650.077	230810.421	73.480	1.470	1200		1	11.3	72.010	300
							0	11.2	72.010	300

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections		Link	IL (m)	Dia (mm)
SWMH 11.3	303646.938	230809.503	73.510	1.484	1200		1	11.4	72.026	300
							0	11.3	72.026	300
SWMH 11.4	303640.412	230807.832	73.450	1.400	1200		1	11.5	72.050	300
							0	11.4	72.050	300
SWMH 11.5	303642.244	230781.958	73.650	1.496	1200		1	18.1	72.154	300
							2	11.6	72.154	300
							0	11.5	72.154	300
SWMH 11.6	303656.748	230746.601	73.600	1.294	1200		1	11.7	72.306	300
							0	11.6	72.306	300
SWMH 11.7	303671.252	230711.244	73.580	1.122	1200		1	11.8	72.458	300
							0	11.7	72.458	300
SWMH 11.8	303676.967	230683.964	73.580	1.000	1200					
							0	11.8	72.580	300
SWMH 12.1	303738.067	230855.865	73.400	1.400	1200		1	12.2	72.000	300
							0	Pond 2.1	72.000	300
SWMH 12.2	303734.936	230849.613	73.480	1.440	1200		1	12.3	72.040	300
							0	12.2	72.040	300
SWMH 12.3	303702.648	230834.615	73.590	1.360	1200		1	12.4	72.230	300
							0	12.3	72.230	300
SWMH 12.4	303669.274	230819.112	73.710	1.250	1200		1	12.5	72.460	300
							0	12.4	72.460	300
SWMH 12.5	303667.251	230811.410	73.810	1.310	1200					
							0	12.5	72.500	300
SWMH 13.1	303711.263	230852.399	73.400	1.250	1200		1	13.2	72.150	225
							0	Pond 1.2	72.150	225
SWMH 13.2	303712.947	230849.060	73.380	1.170	1200		1	13.3	72.210	225
							0	13.2	72.210	225

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections		Link	IL (m)	Dia (mm)
SWMH 13.3	303717.240	230850.696	73.390	1.110	1200		1	13.4	72.280	225
							0	13.3	72.280	225
SWMH 13.4	303721.614	230852.503	73.390	1.040	1200		1	13.5	72.350	225
							0	13.4	72.350	225
SWMH 13.5	303722.638	230850.369	73.390	1.000	1200					
							0	13.5	72.390	225
SWMH 14.1	303694.193	230852.700	72.500	0.550	1200		1	14.2	71.950	225
SWMH 14.2	303696.055	230852.502	73.180	1.205	1200		1	14.3	71.975	225
							0	14.2	71.975	225
SWMH 14.3	303698.321	230852.272	73.400	1.400	1200		1	Pond 1.2	72.000	225
							2	Pond 1.1	72.000	300
							0	14.3	72.000	225
SWMH 15.1	303817.102	230737.720	72.500	1.200	1200		1	15.2	71.300	225
SWMH 15.2	303816.412	230732.304	72.710	1.370	1200		1	15.3	71.340	225
							0	15.2	71.340	225
SWMH 15.3	303850.692	230702.747	73.200	1.606	1200		1	15.4	71.597	225
							0	15.3	71.594	225
SWMH 15.4	303857.797	230686.534	73.200	1.500	1200		1	Pond 3.2	71.700	300
							2	Pond 3.1	71.700	300
							0	15.4	71.700	225
SWMH 16.1	303800.963	230758.451	73.400	1.170	1200		1	16.2	72.230	225
							0	Pond 2.2	72.230	225
SWMH 16.2	303799.149	230762.228	73.380	1.100	1200		1	16.3	72.280	225
							0	16.2	72.280	225
SWMH 16.3	303797.672	230765.466	73.400	1.070	1200		1	16.4	72.330	225
							0	16.3	72.330	225

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections		Link	IL (m)	Dia (mm)
SWMH 16.4	303795.212	230764.430	73.380	1.000	1200		0	16.4	72.380	225
SWMH 17.1	303793.390	230792.952	72.500	0.550	1200		1	17.2	71.950	225
SWMH 17.2	303793.004	230791.640	73.300	1.325	1200		1	17.3	71.975	225
							0	17.2	71.975	225
SWMH 17.3	303792.566	230790.278	73.400	1.400	1200		1	Pond 2.2	72.000	225
							2	Pond 2.1	72.000	300
							0	17.3	72.000	225
SWMH 18.1	303621.405	230776.978	73.940	1.586	1200		0	18.1	72.354	300

Simulation Settings

Rainfall Methodology	FSR	Drain Down Time (mins)	1440
FSR Region	Scotland and Ireland	Additional Storage (m³/ha)	20.0
M5-60 (mm)	16.800	Check Discharge Rate(s)	✓
Ratio-R	0.300	1 year (l/s)	8.5
Summer CV	0.750	30 year (l/s)	19.4
Winter CV	0.840	100 year (l/s)	24.7
Analysis Speed	Normal	Check Discharge Volume	✓
Skip Steady State	x	100 year +20% 1440 minute (m³)	1876

Storm Durations
1440

Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)
100	20	0	0

Pre-development Discharge Rate

Site Makeup	Greenfield	Growth Factor 30 year	1.95
Greenfield Method	IH124	Growth Factor 100 year	2.48
Positively Drained Area (ha)	5.005	Betterment (%)	0
SAAR (mm)	755	QBar	10.0
Soil Index	3	Q 1 year (l/s)	8.5
SPR	0.30	Q 30 year (l/s)	19.4
Region	11	Q 100 year (l/s)	24.7
Growth Factor 1 year	0.85		

Pre-development Discharge Volume

Site Makeup	Greenfield	Return Period (years)	100
Greenfield Method	FSR/FEH	Climate Change (%)	20
Positively Drained Area (ha)	5.005	Storm Duration (mins)	1440
Soil Index	3	Betterment (%)	0
SPR	0.30	PR	0.378
CWI	124.865	Runoff Volume (m³)	1876

Node SWMH 1.4 Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Replaces Downstream Link	x	Sump Available	✓
Invert Level (m)	72.166	Product Number	CTL-SHE-0079-3000-1200-3000
Design Depth (m)	1.200	Min Outlet Diameter (m)	0.100
Design Flow (l/s)	3.0	Min Node Diameter (mm)	1200

Node SWMH 2.4 Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Replaces Downstream Link	x	Sump Available	✓
Invert Level (m)	73.010	Product Number	CTL-SHE-0013-1000-1000-1000
Design Depth (m)	1.000	Min Outlet Diameter (m)	0.075
Design Flow (l/s)	0.1	Min Node Diameter (mm)	1200

Node SWMH 7.2 Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Replaces Downstream Link	x	Sump Available	✓
Invert Level (m)	72.200	Product Number	CTL-SHE-0023-2000-0500-2000
Design Depth (m)	0.500	Min Outlet Diameter (m)	0.075
Design Flow (l/s)	0.2	Min Node Diameter (mm)	1200

Node SWMH 8.1 Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Replaces Downstream Link	x	Sump Available	✓
Invert Level (m)	72.250	Product Number	CTL-SHE-0023-2000-0500-2000
Design Depth (m)	0.500	Min Outlet Diameter (m)	0.075
Design Flow (l/s)	0.2	Min Node Diameter (mm)	1200

Node SWMH 13.5 Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Replaces Downstream Link	x	Sump Available	✓
Invert Level (m)	72.390	Product Number	CTL-SHE-0023-2000-0500-2000
Design Depth (m)	0.500	Min Outlet Diameter (m)	0.075
Design Flow (l/s)	0.2	Min Node Diameter (mm)	1200

Node SWMH 14.2 Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Replaces Downstream Link	x	Sump Available	✓
Invert Level (m)	71.975	Product Number	CTL-SHE-0064-1800-1000-1800
Design Depth (m)	1.000	Min Outlet Diameter (m)	0.100
Design Flow (l/s)	1.8	Min Node Diameter (mm)	1200

Node SWMH 15.3 Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Replaces Downstream Link	x	Sump Available	✓
Invert Level (m)	71.594	Product Number	CTL-SHE-0071-2500-1300-2500
Design Depth (m)	1.300	Min Outlet Diameter (m)	0.100
Design Flow (l/s)	2.5	Min Node Diameter (mm)	1200

Node SWMH 16.4 Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Replaces Downstream Link	x	Sump Available	✓
Invert Level (m)	72.380	Product Number	CTL-SHE-0045-7000-0500-7000
Design Depth (m)	0.500	Min Outlet Diameter (m)	0.075
Design Flow (l/s)	0.7	Min Node Diameter (mm)	1200

Node SWMH 17.2 Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Replaces Downstream Link	x	Sump Available	✓
Invert Level (m)	71.975	Product Number	CTL-SHE-0064-1800-1000-1800
Design Depth (m)	1.000	Min Outlet Diameter (m)	0.100
Design Flow (l/s)	1.8	Min Node Diameter (mm)	1200

Node SWMH 18.1 Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Replaces Downstream Link	x	Sump Available	✓
Invert Level (m)	72.354	Product Number	CTL-SHE-0029-3000-0500-3000
Design Depth (m)	0.500	Min Outlet Diameter (m)	0.075
Design Flow (l/s)	0.3	Min Node Diameter (mm)	1200

Node SWMH 13.5 Carpark Storage Structure

Base Inf Coefficient (m/hr)	0.02500	Invert Level (m)	72.390	Slope (1:X)	100.0
Side Inf Coefficient (m/hr)	0.02500	Time to half empty (mins)	360	Depth (m)	0.350
Safety Factor	2.0	Width (m)	43.000	Inf Depth (m)	0.350
Porosity	0.33	Length (m)	17.000		

Node SWMH 16.4 Carpark Storage Structure

Base Inf Coefficient (m/hr)	0.05000	Invert Level (m)	72.380	Slope (1:X)	100.0
Side Inf Coefficient (m/hr)	0.05000	Time to half empty (mins)	330	Depth (m)	0.350
Safety Factor	2.0	Width (m)	57.000	Inf Depth (m)	0.350
Porosity	0.36	Length (m)	17.000		

Node SWMH 8.1 Carpark Storage Structure

Base Inf Coefficient (m/hr)	0.02000	Invert Level (m)	72.250	Slope (1:X)	100.0
Side Inf Coefficient (m/hr)	0.02000	Time to half empty (mins)	420	Depth (m)	0.350
Safety Factor	2.0	Width (m)	46.000	Inf Depth (m)	0.350
Porosity	0.33	Length (m)	44.000		

Node SWMH 7.2 Carpark Storage Structure

Base Inf Coefficient (m/hr)	0.01000	Invert Level (m)	72.200	Slope (1:X)	100.0
Side Inf Coefficient (m/hr)	0.01000	Time to half empty (mins)	450	Depth (m)	0.350
Safety Factor	2.0	Width (m)	58.000	Inf Depth (m)	0.350
Porosity	0.33	Length (m)	17.000		

Node SWMH 1.5 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	72.200
Side Inf Coefficient (m/hr)	0.00000	Porosity	1.00	Time to half empty (mins)	900

Depth (m)	Area (m^2)	Inf Area (m^2)	Depth (m)	Area (m^2)	Inf Area (m^2)
0.000	211.0	0.0	1.100	422.0	0.0

Node SWMH 2.5 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	73.300
Side Inf Coefficient (m/hr)	0.00000	Porosity	1.00	Time to half empty (mins)	

Depth (m)	Area (m^2)	Inf Area (m^2)	Depth (m)	Area (m^2)	Inf Area (m^2)
0.000	138.0	0.0	1.100	60.0	0.0

Node SWMH 15.4 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	71.700
Side Inf Coefficient (m/hr)	0.00000	Porosity	1.00	Time to half empty (mins)	

Depth (m)	Area (m^2)	Inf Area (m^2)	Depth (m)	Area (m^2)	Inf Area (m^2)
0.000	500.0	0.0	1.500	800.0	0.0

Node SWMH 17.3 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	72.000
Side Inf Coefficient (m/hr)	0.00000	Porosity	1.00	Time to half empty (mins)	600

Depth (m)	Area (m^2)	Inf Area (m^2)	Depth (m)	Area (m^2)	Inf Area (m^2)
0.000	300.0	0.0	1.300	750.0	0.0

Node SWMH 14.3 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	72.000
Side Inf Coefficient (m/hr)	0.00000	Porosity	1.00	Time to half empty (mins)	750

Depth (m)	Area (m^2)	Inf Area (m^2)	Depth (m)	Area (m^2)	Inf Area (m^2)
0.000	300.0	0.0	1.300	850.0	0.0

Node SWMH 18.1 Carpark Storage Structure

Base Inf Coefficient (m/hr)	0.02000	Invert Level (m)	72.354	Slope (1:X)	1000.0
Side Inf Coefficient (m/hr)	0.02000	Time to half empty (mins)	0	Depth (m)	0.350
Safety Factor	2.0	Width (m)	20.000	Inf Depth (m)	0.350
Porosity	0.33	Length (m)	160.000		

Rainfall

Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)	Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)
100 year +20% CC 1440 minute summer	15.421	4.133	100 year +20% CC 1440 minute winter	10.364	4.133

Results for 100 year +20% CC 1440 minute summer. 2880 minute analysis at 30 minute timestep. Mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
1440 minute summer	SWMH Con	720	71.861	0.041	3.1	0.0000	0.0000	OK
1440 minute summer	SWMH 1.1	720	71.876	0.046	3.1	0.0518	0.0000	OK
1440 minute summer	SWMH 1.2	720	71.997	0.042	3.1	0.0480	0.0000	OK
1440 minute summer	SWMH 1.3	720	72.099	0.043	3.1	0.0490	0.0000	OK
1440 minute summer	SWMH 1.4	1080	72.889	0.723	3.6	0.8176	0.0000	SURCHARGED
1440 minute summer	SWMH 1.5	1080	72.889	0.689	15.6	191.6685	0.0000	SURCHARGED
1440 minute summer	SWMH 2.1	1080	72.889	0.689	0.3	0.7791	0.0000	SURCHARGED
1440 minute summer	SWMH 2.2	1080	72.889	0.408	0.3	0.4612	0.0000	SURCHARGED
1440 minute summer	SWMH 2.3	1080	72.889	0.192	0.1	0.2169	0.0000	SURCHARGED
1440 minute summer	SWMH 2.4	1470	73.788	0.778	0.2	0.8803	0.0000	SURCHARGED
1440 minute summer	SWMH 2.5	1470	73.788	0.488	2.9	59.4913	0.0000	SURCHARGED
1440 minute summer	SWMH 3.1	1110	72.890	0.690	15.6	0.7805	0.0000	SURCHARGED
1440 minute summer	SWMH 3.2	1500	72.934	0.718	15.7	0.8125	0.0000	SURCHARGED
1440 minute summer	SWMH 3.3	1110	72.892	0.660	15.7	0.7467	0.0000	SURCHARGED
1440 minute summer	SWMH 3.4	1230	72.900	0.668	15.8	0.7551	0.0000	SURCHARGED
1440 minute summer	SWMH 3.5	1230	72.895	0.322	3.2	0.3636	0.0000	SURCHARGED
1440 minute summer	SWMH 3.6	720	73.014	0.034	3.2	0.1071	0.0000	OK
1440 minute summer	SWMH 4.1	1470	73.790	0.490	3.0	0.5538	0.0000	SURCHARGED
1440 minute summer	SWMH 4.2	1440	73.790	0.460	3.0	0.5203	0.0000	SURCHARGED
1440 minute summer	SWMH 4.3	1470	73.790	0.425	3.0	0.4804	0.0000	SURCHARGED
1440 minute summer	SWMH 4.4	1440	73.790	0.390	3.1	1.1742	0.0000	SURCHARGED

Link Event	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
1440 minute summer	SWMH 1.1	1.1	SWMH Con	3.1	0.490	0.044	0.0157	406.0
1440 minute summer	SWMH 1.2	1.2	SWMH 1.1	3.1	0.480	0.044	0.1999	
1440 minute summer	SWMH 1.3	1.3	SWMH 1.2	3.1	0.500	0.044	0.1564	
1440 minute summer	SWMH 1.4	1.4	SWMH 1.3	2.9	0.487	0.042	0.1683	
1440 minute summer	SWMH 1.5	1.5	SWMH 1.4	3.6	0.262	0.030	0.2097	
1440 minute summer	SWMH 2.1	Pond 4.2	SWMH 1.5	0.3	0.062	0.027	0.8044	
1440 minute summer	SWMH 2.2	2.2	SWMH 2.1	0.3	0.089	0.016	0.4413	
1440 minute summer	SWMH 2.3	2.3	SWMH 2.2	0.3	0.271	0.013	0.3417	
1440 minute summer	SWMH 2.4	2.4	SWMH 2.3	0.1	0.271	0.005	0.2550	
1440 minute summer	SWMH 2.5	2.5	SWMH 2.4	0.2	0.165	0.006	0.1775	
1440 minute summer	SWMH 3.1	Pond 4.1	SWMH 1.5	15.6	0.256	0.315	3.1041	
1440 minute summer	SWMH 3.2	3.2	SWMH 3.1	15.6	0.222	0.219	0.2703	
1440 minute summer	SWMH 3.3	3.3	SWMH 3.2	15.7	0.268	0.226	0.2851	
1440 minute summer	SWMH 3.4	3.4	SWMH 3.3	15.7	0.363	0.216	0.2586	
1440 minute summer	SWMH 3.5	3.5	SWMH 3.4	3.2	0.174	0.048	0.7945	
1440 minute summer	SWMH 3.6	3.6	SWMH 3.5	3.2	0.857	0.049	0.5457	
1440 minute summer	SWMH 4.1	Pond 5	SWMH 2.5	2.9	0.383	0.105	0.1658	
1440 minute summer	SWMH 4.2	4.2	SWMH 4.1	3.0	0.247	0.054	0.1064	
1440 minute summer	SWMH 4.3	4.3	SWMH 4.2	3.0	0.421	0.055	0.1263	
1440 minute summer	SWMH 4.4	4.4	SWMH 4.3	3.0	0.515	0.060	0.1487	

Results for 100 year +20% CC 1440 minute summer. 2880 minute analysis at 30 minute timestep. Mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
1440 minute summer	SWMH 5.1	1110	72.895	0.553	13.2	0.6254	0.0000	SURCHARGED
1440 minute summer	SWMH 5.2	1110	72.895	0.295	9.8	2.1438	0.0000	OK
1440 minute summer	SWMH 6.1	1440	72.684	0.824	28.8	0.9321	0.0000	SURCHARGED
1440 minute summer	SWMH 6.2	1440	72.687	0.747	28.8	0.8453	0.0000	SURCHARGED
1440 minute summer	SWMH 6.3	1440	72.683	0.663	28.9	0.7502	0.0000	SURCHARGED
1440 minute summer	SWMH 6.4	1440	72.687	0.587	29.3	0.6635	0.0000	SURCHARGED
1440 minute summer	SWMH 6.5	1440	72.686	0.476	29.5	9.3722	0.0000	SURCHARGED
1440 minute summer	SWMH 7.1	600	72.160	0.010	0.2	0.0113	0.0000	OK
1440 minute summer	SWMH 7.2	930	72.460	0.260	5.7	58.1699	0.0000	SURCHARGED
1440 minute summer	SWMH 8.1	930	72.800	0.550	18.6	182.5781	0.0000	SURCHARGED
1440 minute summer	SWMH 9.1	1440	72.685	0.985	4.3	1.1139	0.0000	SURCHARGED
1440 minute summer	SWMH 9.2	1440	72.685	0.757	4.7	0.8561	0.0000	SURCHARGED
1440 minute summer	SWMH 9.3	1440	72.685	0.397	4.7	0.4489	0.0000	SURCHARGED
1440 minute summer	SWMH 9.4	1440	72.685	0.269	4.7	0.3042	0.0000	OK
1440 minute summer	SWMH 9.5	1440	72.685	0.185	4.7	0.6179	0.0000	OK
1440 minute summer	SWMH 10.1	1230	72.895	0.195	3.4	0.5876	0.0000	OK
1440 minute summer	SWMH 11.1	1290	72.707	0.707	266.9	0.7999	0.0000	SURCHARGED

Link Event	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
1440 minute summer	SWMH 5.1	5.1	SWMH 3.4	12.9	0.303	0.170	1.6618	
1440 minute summer	SWMH 5.2	5.2	SWMH 5.1	9.8	0.516	0.145	4.8571	
1440 minute summer	SWMH 6.1	Pond 3.2	SWMH 15.4	28.7	0.963	0.325	1.7798	
1440 minute summer	SWMH 6.2	6.2	SWMH 6.1	28.8	1.136	0.332	0.1155	
1440 minute summer	SWMH 6.3	6.3	SWMH 6.2	28.8	1.253	0.317	0.1048	
1440 minute summer	SWMH 6.4	6.4	SWMH 6.3	28.9	1.289	0.359	0.1338	
1440 minute summer	SWMH 6.5	6.5	SWMH 6.4	29.3	1.196	0.569	0.4466	
1440 minute summer	SWMH 7.1	7.1	SWMH 1.3	0.2	0.209	0.009	0.0205	
1440 minute summer	SWMH 7.2	7.2	SWMH 7.1	0.2	0.313	0.009	0.0025	
1440 minute summer	SWMH 7.2	Infiltration		1.4				
1440 minute summer	SWMH 8.1	8.1	SWMH 6.4	-0.4	0.088	-0.007	0.5601	
1440 minute summer	SWMH 8.1	Infiltration		5.7				
1440 minute summer	SWMH 9.1	Pond 3.1	SWMH 15.4	4.3	0.171	0.086	1.2590	
1440 minute summer	SWMH 9.2	9.2	SWMH 9.1	4.3	0.162	0.062	3.9815	
1440 minute summer	SWMH 9.3	9.3	SWMH 9.2	4.7	0.456	0.067	6.3392	
1440 minute summer	SWMH 9.4	9.4	SWMH 9.3	4.7	0.567	0.068	2.2171	
1440 minute summer	SWMH 9.5	9.5	SWMH 9.4	4.7	0.701	0.030	0.2432	
1440 minute summer	SWMH 10.1	10.1	SWMH 5.1	3.4	0.325	0.056	0.9974	
1440 minute summer	SWMH 11.1	Pond 1.1	SWMH 14.3	25.4	0.361	0.513	4.4336	

Results for 100 year +20% CC 1440 minute summer. 2880 minute analysis at 30 minute timestep. Mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
1440 minute summer	SWMH 11.2	2070	72.962	0.952	338.5	1.0763	0.0000	SURCHARGED
1440 minute summer	SWMH 11.3	930	72.728	0.702	194.6	0.7938	0.0000	SURCHARGED
1440 minute summer	SWMH 11.4	1380	72.711	0.661	35.7	0.7475	0.0000	SURCHARGED
1440 minute summer	SWMH 11.5	1380	72.708	0.554	19.5	0.6266	0.0000	SURCHARGED
1440 minute summer	SWMH 11.6	1380	72.709	0.403	19.9	0.4557	0.0000	SURCHARGED
1440 minute summer	SWMH 11.7	1380	72.710	0.252	19.9	0.2849	0.0000	OK
1440 minute summer	SWMH 11.8	1230	72.710	0.130	19.9	1.7569	0.0000	OK
1440 minute summer	SWMH 12.1	1140	72.687	0.687	17.1	0.7767	0.0000	SURCHARGED
1440 minute summer	SWMH 12.2	1140	72.687	0.647	17.2	0.7315	0.0000	SURCHARGED
1440 minute summer	SWMH 12.3	1140	72.687	0.457	17.5	0.5168	0.0000	SURCHARGED
1440 minute summer	SWMH 12.4	1140	72.687	0.227	17.5	0.2569	0.0000	OK
1440 minute summer	SWMH 12.5	1140	72.687	0.187	17.5	1.7692	0.0000	OK
1440 minute summer	SWMH 13.1	1440	72.706	0.556	0.9	0.6289	0.0000	SURCHARGED
1440 minute summer	SWMH 13.2	1350	72.706	0.496	1.0	0.5614	0.0000	SURCHARGED
1440 minute summer	SWMH 13.3	1260	72.706	0.426	0.8	0.4812	0.0000	SURCHARGED
1440 minute summer	SWMH 13.4	1410	72.708	0.358	3.5	0.4046	0.0000	SURCHARGED
1440 minute summer	SWMH 13.5	900	72.697	0.307	7.3	55.3402	0.0000	SURCHARGED
1440 minute summer	SWMH 14.1	660	71.976	0.026	1.7	0.0000	0.0000	OK
1440 minute summer	SWMH 14.2	1350	72.706	0.731	1.8	0.8269	0.0000	SURCHARGED
1440 minute summer	SWMH 14.3	1350	72.706	0.706	25.4	318.1295	0.0000	SURCHARGED

Link Event	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
1440 minute summer	SWMH 11.2	11.2	SWMH 11.1	259.2	3.727	3.515	0.1587	
1440 minute summer	SWMH 11.3	11.3	SWMH 11.2	-166.1	-2.360	-2.144	0.2303	
1440 minute summer	SWMH 11.4	11.4	SWMH 11.3	-30.4	-0.432	-0.461	0.4744	
1440 minute summer	SWMH 11.5	11.5	SWMH 11.4	19.3	0.442	0.276	1.8266	
1440 minute summer	SWMH 11.6	11.6	SWMH 11.5	19.5	0.680	0.280	2.6911	
1440 minute summer	SWMH 11.7	11.7	SWMH 11.6	19.9	0.808	0.285	2.5525	
1440 minute summer	SWMH 11.8	11.8	SWMH 11.7	19.9	0.859	0.272	1.2855	
1440 minute summer	SWMH 12.1	Pond 2.1	SWMH 17.3	17.1	0.242	0.345	6.0050	
1440 minute summer	SWMH 12.2	12.2	SWMH 12.1	17.1	0.243	0.204	0.4924	
1440 minute summer	SWMH 12.3	12.3	SWMH 12.2	17.2	0.425	0.212	2.5070	
1440 minute summer	SWMH 12.4	12.4	SWMH 12.3	17.5	0.850	0.200	2.3486	
1440 minute summer	SWMH 12.5	12.5	SWMH 12.4	17.5	0.901	0.223	0.4119	
1440 minute summer	SWMH 13.1	Pond 1.2	SWMH 14.3	1.1	0.323	0.020	0.5148	
1440 minute summer	SWMH 13.2	13.2	SWMH 13.1	-1.0	0.327	-0.015	0.1487	
1440 minute summer	SWMH 13.3	13.3	SWMH 13.2	-0.8	0.343	-0.013	0.1827	
1440 minute summer	SWMH 13.4	13.4	SWMH 13.3	-1.6	0.338	-0.026	0.1882	
1440 minute summer	SWMH 13.5	13.5	SWMH 13.4	0.9	0.342	0.013	0.0941	
1440 minute summer	SWMH 13.5	Infiltration		2.6				
1440 minute summer	SWMH 14.2	14.2	SWMH 14.1	1.7	0.627	0.028	0.0051	245.1
1440 minute summer	SWMH 14.3	14.3	SWMH 14.2	1.8	0.172	0.034	0.0906	

Results for 100 year +20% CC 1440 minute summer. 2880 minute analysis at 30 minute timestep. Mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
1440 minute summer	SWMH 15.1	1440	71.334	0.034	2.3	0.0000	0.0000	OK
1440 minute summer	SWMH 15.2	1440	71.376	0.036	2.3	0.0410	0.0000	OK
1440 minute summer	SWMH 15.3	1440	72.684	1.090	2.3	1.2333	0.0000	SURCHARGED
1440 minute summer	SWMH 15.4	1440	72.685	0.985	32.5	590.5580	0.0000	SURCHARGED
1440 minute summer	SWMH 16.1	1170	72.688	0.458	1.3	0.5181	0.0000	SURCHARGED
1440 minute summer	SWMH 16.2	1170	72.689	0.409	3.6	0.4623	0.0000	SURCHARGED
1440 minute summer	SWMH 16.3	1200	72.687	0.357	2.3	0.4035	0.0000	SURCHARGED
1440 minute summer	SWMH 16.4	870	73.250	0.870	17.3	102.9511	0.0000	FLOOD RISK
1440 minute summer	SWMH 17.1	660	71.974	0.024	1.7	0.0000	0.0000	OK
1440 minute summer	SWMH 17.2	1170	72.686	0.711	3.2	0.8045	0.0000	SURCHARGED
1440 minute summer	SWMH 17.3	1170	72.686	0.686	17.8	288.2270	0.0000	SURCHARGED
1440 minute summer	SWMH 18.1	870	72.560	0.206	20.0	135.4268	0.0000	OK

Link Event	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
1440 minute summer	SWMH 15.2	15.2	SWMH 15.1	2.3	0.573	0.051	0.0217	354.7
1440 minute summer	SWMH 15.3	15.3	SWMH 15.2	2.3	0.542	0.059	0.1900	
1440 minute summer	SWMH 15.4	15.4	SWMH 15.3	2.3	0.170	0.058	0.7040	
1440 minute summer	SWMH 16.1	Pond 2.2	SWMH 17.3	-1.2	0.363	-0.027	1.3091	
1440 minute summer	SWMH 16.2	16.2	SWMH 16.1	-1.6	0.441	-0.029	0.1666	
1440 minute summer	SWMH 16.3	16.3	SWMH 16.2	2.4	0.495	0.039	0.1415	
1440 minute summer	SWMH 16.4	16.4	SWMH 16.3	2.3	0.533	0.033	0.1061	
1440 minute summer	SWMH 16.4	Infiltration		7.0				
1440 minute summer	SWMH 17.2	17.2	SWMH 17.1	1.7	0.688	0.024	0.0034	248.4
1440 minute summer	SWMH 17.3	17.3	SWMH 17.2	3.2	0.287	0.046	0.0569	
1440 minute summer	SWMH 18.1	18.1	SWMH 11.5	-13.6	-0.238	-0.127	1.5088	
1440 minute summer	SWMH 18.1	Infiltration		9.0				

Results for 100 year +20% CC 1440 minute winter. 2880 minute analysis at 30 minute timestep. Mass balance: 99.16%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
1440 minute winter	SWMH Con	690	71.861	0.041	3.1	0.0000	0.0000	OK
1440 minute winter	SWMH 1.1	690	71.876	0.046	3.1	0.0518	0.0000	OK
1440 minute winter	SWMH 1.2	690	71.997	0.042	3.1	0.0480	0.0000	OK
1440 minute winter	SWMH 1.3	660	72.099	0.043	3.1	0.0490	0.0000	OK
1440 minute winter	SWMH 1.4	1170	72.981	0.815	3.0	0.9219	0.0000	SURCHARGED
1440 minute winter	SWMH 1.5	1170	72.981	0.781	11.8	224.2416	0.0000	SURCHARGED
1440 minute winter	SWMH 2.1	1170	72.981	0.781	0.2	0.8838	0.0000	SURCHARGED
1440 minute winter	SWMH 2.2	1170	72.982	0.501	0.2	0.5661	0.0000	SURCHARGED
1440 minute winter	SWMH 2.3	1170	72.982	0.285	0.1	0.3219	0.0000	SURCHARGED
1440 minute winter	SWMH 2.4	1440	73.866	0.856	0.3	0.9676	0.0000	SURCHARGED
1440 minute winter	SWMH 2.5	1440	73.865	0.565	2.8	67.3372	0.0000	SURCHARGED
1440 minute winter	SWMH 3.1	1230	72.985	0.785	11.8	0.8877	0.0000	SURCHARGED
1440 minute winter	SWMH 3.2	1230	72.988	0.772	12.2	0.8730	0.0000	SURCHARGED
1440 minute winter	SWMH 3.3	1230	72.987	0.755	11.8	0.8540	0.0000	SURCHARGED
1440 minute winter	SWMH 3.4	1230	72.990	0.758	11.8	0.8572	0.0000	SURCHARGED
1440 minute winter	SWMH 3.5	1230	72.995	0.422	2.4	0.4768	0.0000	SURCHARGED
1440 minute winter	SWMH 3.6	750	73.009	0.029	2.4	0.0921	0.0000	OK
1440 minute winter	SWMH 4.1	1410	73.866	0.566	2.3	0.6397	0.0000	SURCHARGED
1440 minute winter	SWMH 4.2	1440	73.869	0.539	3.3	0.6093	0.0000	SURCHARGED
1440 minute winter	SWMH 4.3	1440	73.866	0.501	2.2	0.5666	0.0000	SURCHARGED
1440 minute winter	SWMH 4.4	1440	73.867	0.467	2.3	1.4060	0.0000	SURCHARGED

Link Event	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
1440 minute winter	SWMH 1.1	1.1	SWMH Con	3.1	0.490	0.044	0.0157	436.0
1440 minute winter	SWMH 1.2	1.2	SWMH 1.1	3.1	0.480	0.044	0.1998	
1440 minute winter	SWMH 1.3	1.3	SWMH 1.2	3.1	0.500	0.044	0.1563	
1440 minute winter	SWMH 1.4	1.4	SWMH 1.3	2.9	0.487	0.042	0.1682	
1440 minute winter	SWMH 1.5	1.5	SWMH 1.4	3.0	0.225	0.025	0.2097	
1440 minute winter	SWMH 2.1	Pond 4.2	SWMH 1.5	0.2	-0.034	0.019	0.8044	
1440 minute winter	SWMH 2.2	2.2	SWMH 2.1	0.2	0.056	0.012	0.4413	
1440 minute winter	SWMH 2.3	2.3	SWMH 2.2	0.2	0.273	0.011	0.3417	
1440 minute winter	SWMH 2.4	2.4	SWMH 2.3	0.1	0.274	0.005	0.2551	
1440 minute winter	SWMH 2.5	2.5	SWMH 2.4	0.3	0.091	0.009	0.1775	
1440 minute winter	SWMH 3.1	Pond 4.1	SWMH 1.5	11.8	0.262	0.238	3.1041	
1440 minute winter	SWMH 3.2	3.2	SWMH 3.1	11.8	0.193	0.166	0.2703	
1440 minute winter	SWMH 3.3	3.3	SWMH 3.2	12.2	0.272	0.175	0.2851	
1440 minute winter	SWMH 3.4	3.4	SWMH 3.3	11.8	0.366	0.162	0.2586	
1440 minute winter	SWMH 3.5	3.5	SWMH 3.4	2.3	0.174	0.035	0.7945	
1440 minute winter	SWMH 3.6	3.6	SWMH 3.5	2.4	0.777	0.037	0.5481	
1440 minute winter	SWMH 4.1	Pond 5	SWMH 2.5	2.8	0.363	0.100	0.1658	
1440 minute winter	SWMH 4.2	4.2	SWMH 4.1	2.3	0.273	0.042	0.1064	
1440 minute winter	SWMH 4.3	4.3	SWMH 4.2	3.3	0.431	0.061	0.1263	
1440 minute winter	SWMH 4.4	4.4	SWMH 4.3	2.2	0.529	0.044	0.1487	

Results for 100 year +20% CC 1440 minute winter. 2880 minute analysis at 30 minute timestep. Mass balance: 99.16%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m^3)	Flood (m^3)	Status
1440 minute winter	SWMH 5.1	1230	72.993	0.651	10.0	0.7359	0.0000	SURCHARGED
1440 minute winter	SWMH 5.2	1230	72.992	0.392	7.4	2.8527	0.0000	SURCHARGED
1440 minute winter	SWMH 6.1	1410	72.811	0.951	21.3	1.0755	0.0000	SURCHARGED
1440 minute winter	SWMH 6.2	1380	72.813	0.873	21.4	0.9876	0.0000	SURCHARGED
1440 minute winter	SWMH 6.3	1410	72.811	0.791	21.4	0.8941	0.0000	SURCHARGED
1440 minute winter	SWMH 6.4	1410	72.813	0.713	21.6	0.8062	0.0000	SURCHARGED
1440 minute winter	SWMH 6.5	1410	72.812	0.602	22.2	11.8597	0.0000	SURCHARGED
1440 minute winter	SWMH 7.1	510	72.160	0.010	0.2	0.0113	0.0000	OK
1440 minute winter	SWMH 7.2	1020	72.479	0.279	4.3	64.3698	0.0000	SURCHARGED
1440 minute winter	SWMH 8.1	990	72.827	0.577	14.0	197.0560	0.0000	SURCHARGED
1440 minute winter	SWMH 9.1	1410	72.812	1.112	3.3	1.2573	0.0000	SURCHARGED
1440 minute winter	SWMH 9.2	1410	72.812	0.884	3.6	0.9995	0.0000	SURCHARGED
1440 minute winter	SWMH 9.3	1410	72.812	0.524	3.6	0.5923	0.0000	SURCHARGED
1440 minute winter	SWMH 9.4	1410	72.812	0.396	8.0	0.4475	0.0000	SURCHARGED
1440 minute winter	SWMH 9.5	1410	72.812	0.312	3.6	1.0414	0.0000	SURCHARGED
1440 minute winter	SWMH 10.1	1230	72.995	0.295	2.6	0.8861	0.0000	SURCHARGED
1440 minute winter	SWMH 11.1	2640	72.951	0.951	335.3	1.0761	0.0000	SURCHARGED

Link Event	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m^3)	Discharge Vol (m^3)
1440 minute winter	SWMH 5.1	5.1	SWMH 3.4	9.7	0.301	0.128	1.6618	
1440 minute winter	SWMH 5.2	5.2	SWMH 5.1	7.4	0.511	0.109	4.8667	
1440 minute winter	SWMH 6.1	Pond 3.2	SWMH 15.4	21.3	0.908	0.242	1.7798	
1440 minute winter	SWMH 6.2	6.2	SWMH 6.1	21.3	1.119	0.246	0.1155	
1440 minute winter	SWMH 6.3	6.3	SWMH 6.2	21.4	1.225	0.235	0.1048	
1440 minute winter	SWMH 6.4	6.4	SWMH 6.3	21.4	1.260	0.266	0.1338	
1440 minute winter	SWMH 6.5	6.5	SWMH 6.4	21.5	1.157	0.417	0.4466	
1440 minute winter	SWMH 7.1	7.1	SWMH 1.3	0.2	0.160	0.009	0.0205	
1440 minute winter	SWMH 7.2	7.2	SWMH 7.1	0.2	0.313	0.009	0.0025	
1440 minute winter	SWMH 7.2	Infiltration		1.4				
1440 minute winter	SWMH 8.1	8.1	SWMH 6.4	-0.4	0.081	-0.008	0.5601	
1440 minute winter	SWMH 8.1	Infiltration		5.7				
1440 minute winter	SWMH 9.1	Pond 3.1	SWMH 15.4	3.3	0.173	0.066	1.2590	
1440 minute winter	SWMH 9.2	9.2	SWMH 9.1	3.3	0.176	0.047	3.9815	
1440 minute winter	SWMH 9.3	9.3	SWMH 9.2	3.6	0.450	0.051	6.3392	
1440 minute winter	SWMH 9.4	9.4	SWMH 9.3	3.6	0.525	0.052	2.2791	
1440 minute winter	SWMH 9.5	9.5	SWMH 9.4	8.0	0.665	0.051	0.3054	
1440 minute winter	SWMH 10.1	10.1	SWMH 5.1	2.6	0.316	0.043	1.0385	
1440 minute winter	SWMH 11.1	Pond 1.1	SWMH 14.3	18.0	0.272	0.365	4.4336	

Results for 100 year +20% CC 1440 minute winter. 2880 minute analysis at 30 minute timestep. Mass balance: 99.16%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m^3)	Flood (m^3)	Status
1440 minute winter	SWMH 11.2	2820	73.069	1.059	187.5	1.1981	0.0000	SURCHARGED
1440 minute winter	SWMH 11.3	1320	72.792	0.766	251.8	0.8659	0.0000	SURCHARGED
1440 minute winter	SWMH 11.4	1410	72.793	0.743	38.8	0.8405	0.0000	SURCHARGED
1440 minute winter	SWMH 11.5	1410	72.794	0.640	18.2	0.7240	0.0000	SURCHARGED
1440 minute winter	SWMH 11.6	1410	72.793	0.487	18.1	0.5504	0.0000	SURCHARGED
1440 minute winter	SWMH 11.7	1410	72.793	0.335	15.0	0.3790	0.0000	SURCHARGED
1440 minute winter	SWMH 11.8	1410	72.794	0.214	15.0	2.8933	0.0000	OK
1440 minute winter	SWMH 12.1	1320	72.763	0.763	13.0	0.8631	0.0000	SURCHARGED
1440 minute winter	SWMH 12.2	1320	72.763	0.723	13.0	0.8180	0.0000	SURCHARGED
1440 minute winter	SWMH 12.3	1320	72.763	0.533	13.2	0.6033	0.0000	SURCHARGED
1440 minute winter	SWMH 12.4	1320	72.764	0.304	13.2	0.3434	0.0000	SURCHARGED
1440 minute winter	SWMH 12.5	1320	72.764	0.264	13.2	2.4919	0.0000	OK
1440 minute winter	SWMH 13.1	1380	72.791	0.641	1.2	0.7247	0.0000	SURCHARGED
1440 minute winter	SWMH 13.2	1380	72.791	0.581	1.2	0.6566	0.0000	SURCHARGED
1440 minute winter	SWMH 13.3	1380	72.790	0.510	0.5	0.5773	0.0000	SURCHARGED
1440 minute winter	SWMH 13.4	1350	72.790	0.440	1.3	0.4980	0.0000	SURCHARGED
1440 minute winter	SWMH 13.5	990	72.707	0.317	5.5	57.8103	0.0000	SURCHARGED
1440 minute winter	SWMH 14.1	600	71.976	0.026	1.7	0.0000	0.0000	OK
1440 minute winter	SWMH 14.2	1380	72.790	0.815	1.7	0.9218	0.0000	SURCHARGED
1440 minute winter	SWMH 14.3	1380	72.790	0.790	18.0	369.9526	0.0000	SURCHARGED

Link Event	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m^3)	Discharge Vol (m^3)
1440 minute winter	SWMH 11.2	11.2	SWMH 11.1	293.8	4.172	3.984	0.1587	
1440 minute winter	SWMH 11.3	11.3	SWMH 11.2	-176.7	-2.510	-2.282	0.2303	
1440 minute winter	SWMH 11.4	11.4	SWMH 11.3	-34.0	-0.483	-0.515	0.4744	
1440 minute winter	SWMH 11.5	11.5	SWMH 11.4	14.9	0.456	0.213	1.8266	
1440 minute winter	SWMH 11.6	11.6	SWMH 11.5	18.2	0.646	0.261	2.6911	
1440 minute winter	SWMH 11.7	11.7	SWMH 11.6	18.1	0.748	0.259	2.6911	
1440 minute winter	SWMH 11.8	11.8	SWMH 11.7	15.0	0.797	0.205	1.7300	
1440 minute winter	SWMH 12.1	Pond 2.1	SWMH 17.3	13.0	0.240	0.262	6.0050	
1440 minute winter	SWMH 12.2	12.2	SWMH 12.1	13.0	0.211	0.155	0.4924	
1440 minute winter	SWMH 12.3	12.3	SWMH 12.2	13.0	0.425	0.161	2.5070	
1440 minute winter	SWMH 12.4	12.4	SWMH 12.3	13.2	0.804	0.151	2.5914	
1440 minute winter	SWMH 12.5	12.5	SWMH 12.4	13.2	0.834	0.168	0.5415	
1440 minute winter	SWMH 13.1	Pond 1.2	SWMH 14.3	-1.2	0.173	-0.022	0.5148	
1440 minute winter	SWMH 13.2	13.2	SWMH 13.1	-1.2	0.328	-0.018	0.1487	
1440 minute winter	SWMH 13.3	13.3	SWMH 13.2	-0.5	0.343	-0.009	0.1827	
1440 minute winter	SWMH 13.4	13.4	SWMH 13.3	-0.9	0.338	-0.014	0.1882	
1440 minute winter	SWMH 13.5	13.5	SWMH 13.4	-0.8	0.343	-0.012	0.0941	
1440 minute winter	SWMH 13.5	Infiltration		2.6				
1440 minute winter	SWMH 14.2	14.2	SWMH 14.1	1.7	0.627	0.028	0.0051	248.4
1440 minute winter	SWMH 14.3	14.3	SWMH 14.2	1.7	0.227	0.032	0.0906	

Results for 100 year +20% CC 1440 minute winter. 2880 minute analysis at 30 minute timestep. Mass balance: 99.16%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
1440 minute winter	SWMH 15.1	1410	71.335	0.035	2.4	0.0000	0.0000	OK
1440 minute winter	SWMH 15.2	1410	71.377	0.037	2.4	0.0421	0.0000	OK
1440 minute winter	SWMH 15.3	1410	72.811	1.217	2.4	1.3767	0.0000	SURCHARGED
1440 minute winter	SWMH 15.4	1410	72.812	1.112	24.3	680.6896	0.0000	SURCHARGED
1440 minute winter	SWMH 16.1	1380	72.764	0.534	1.7	0.6038	0.0000	SURCHARGED
1440 minute winter	SWMH 16.2	1320	72.763	0.483	1.2	0.5458	0.0000	SURCHARGED
1440 minute winter	SWMH 16.3	1350	72.763	0.433	1.8	0.4896	0.0000	SURCHARGED
1440 minute winter	SWMH 16.4	930	72.795	0.415	13.0	97.5464	0.0000	SURCHARGED
1440 minute winter	SWMH 17.1	600	71.974	0.024	1.7	0.0000	0.0000	OK
1440 minute winter	SWMH 17.2	1320	72.763	0.788	4.9	0.8909	0.0000	SURCHARGED
1440 minute winter	SWMH 17.3	1320	72.763	0.763	13.6	330.3813	0.0000	SURCHARGED
1440 minute winter	SWMH 18.1	930	72.558	0.204	15.1	132.9076	0.0000	OK

Link Event	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
1440 minute winter	SWMH 15.2	15.2	SWMH 15.1	2.4	0.581	0.054	0.0225	368.5
1440 minute winter	SWMH 15.3	15.3	SWMH 15.2	2.4	0.550	0.062	0.1972	
1440 minute winter	SWMH 15.4	15.4	SWMH 15.3	2.4	0.162	0.061	0.7040	
1440 minute winter	SWMH 16.1	Pond 2.2	SWMH 17.3	-1.0	0.339	-0.023	1.3091	
1440 minute winter	SWMH 16.2	16.2	SWMH 16.1	1.7	0.441	0.030	0.1666	
1440 minute winter	SWMH 16.3	16.3	SWMH 16.2	-1.7	0.495	-0.027	0.1415	
1440 minute winter	SWMH 16.4	16.4	SWMH 16.3	-1.4	0.533	-0.020	0.1061	
1440 minute winter	SWMH 16.4	Infiltration		7.0				
1440 minute winter	SWMH 17.2	17.2	SWMH 17.1	1.7	0.688	0.024	0.0034	250.0
1440 minute winter	SWMH 17.3	17.3	SWMH 17.2	4.9	0.302	0.071	0.0569	
1440 minute winter	SWMH 18.1	18.1	SWMH 11.5	6.6	0.099	0.061	1.5088	
1440 minute winter	SWMH 18.1	Infiltration		9.0				

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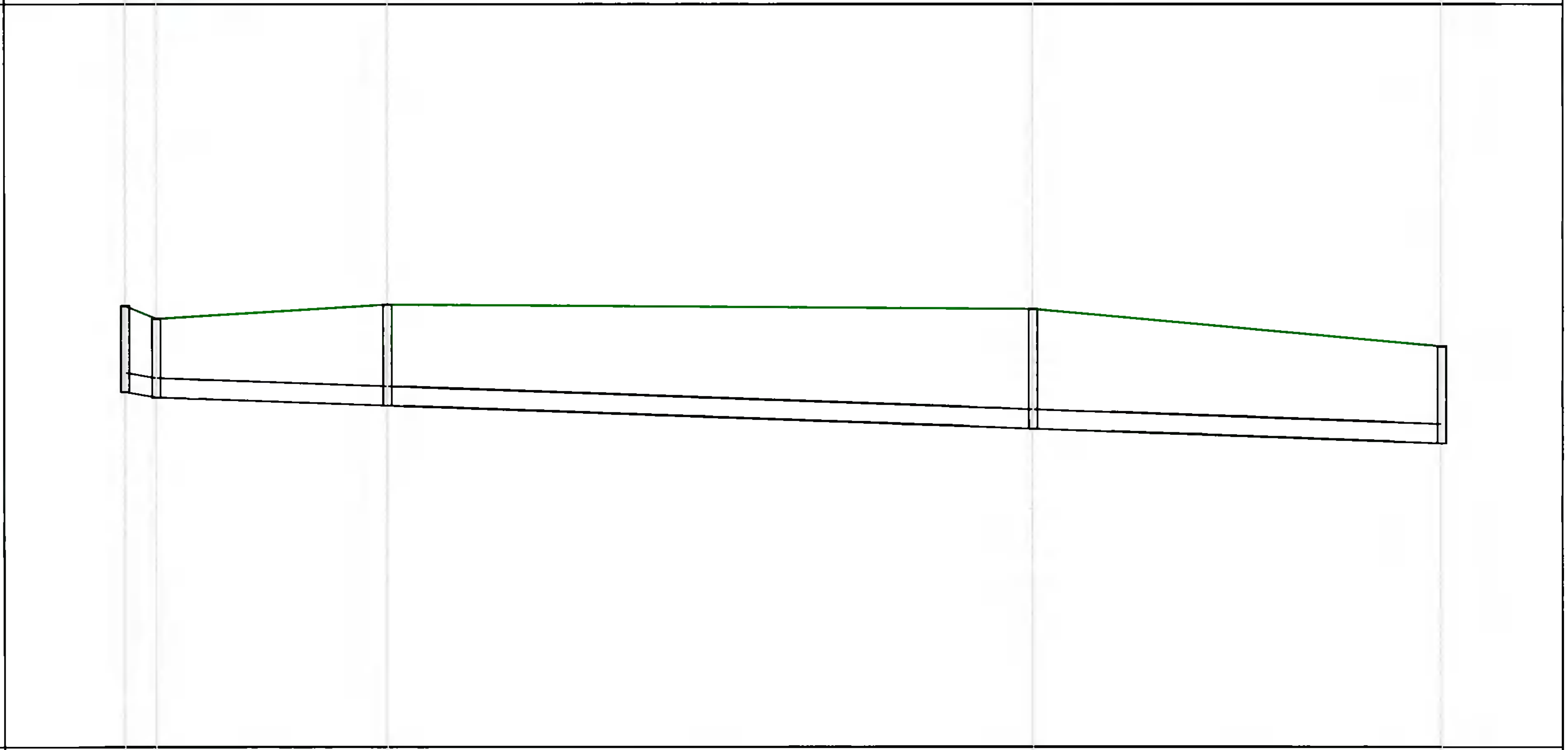

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Datum (m) 67.000

Node Name	SWMH 9.5		SWMH 9.4		SWMH 9.3		SWMH 9.2		SWMH 9.1
Link Name		9.5		9.4		9.3		9.2	
Section Type		30		300mm		300mm		300mm	
Slope (1:X)		51.		252.8		250.1		248.0	
Cover Level (m)	73.830		73.630		73.850		73.780		73.200
Invert Level (m)	72.500 [illegible]		72.416		72.288 72.288		71.928 71.928		71.700
Length (m)		4.3		32.364		90.021		56.540	

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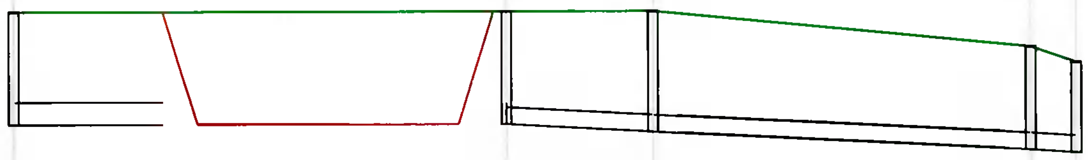

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Datum (m) 66.000

Node Name	SWMH 9.1			SWMH 15.4			SWMH 15.3			SWMH 15.2	SWMH 15.1
Link Name		Pond 3.1			15.4			15.3		15.2	
Section Type		300mm			225mm			225mm		225ı	
Slope (1:X)		0.0			171.9			178.2		136.	
Cover Level (m)	73.200			73.200			73.200			72.710	72.500
Invert Level (m)	71.700		71.700	71.700		71.597	71.594		71.340	71.340 71.300	
Length (m)		17.878			17.701			45.263		5.46	

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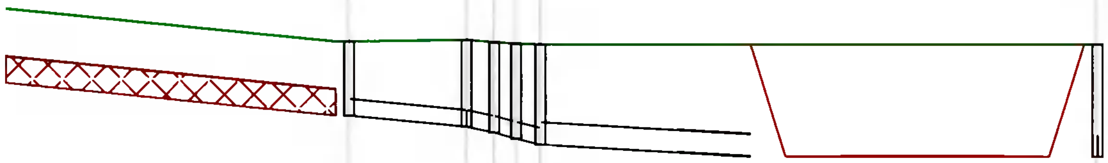

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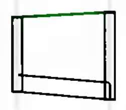
Datum (m) 67.000

Node Name	SWMH 8.1			SW[illegible]6.1				SWMH 15.4
Link Name		8.1		6.46.6.[illegible]		Pond 3.2		
Section Type		225mm		222222		300mm		
Slope (1:X)		93.9		423336		158.0		
Cover Level (m)	73.240			73.260 73.230 73.210	73.200			73.200
Invert Level (m)	72.250		72.100	72.000 [illegible]	71.860		71.700	
Length (m)		14.083		3.32.2.[illegible]		25.274		



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Node Name	SWMH 6.5		SWMH 6.4
Link Name		6.5	
Section Type		225mm	
Slope (1:X)		102.1	
Cover Level (m)	73.200		73.260
Invert Level (m)	72.210		72.100
Length (m)		11.230	

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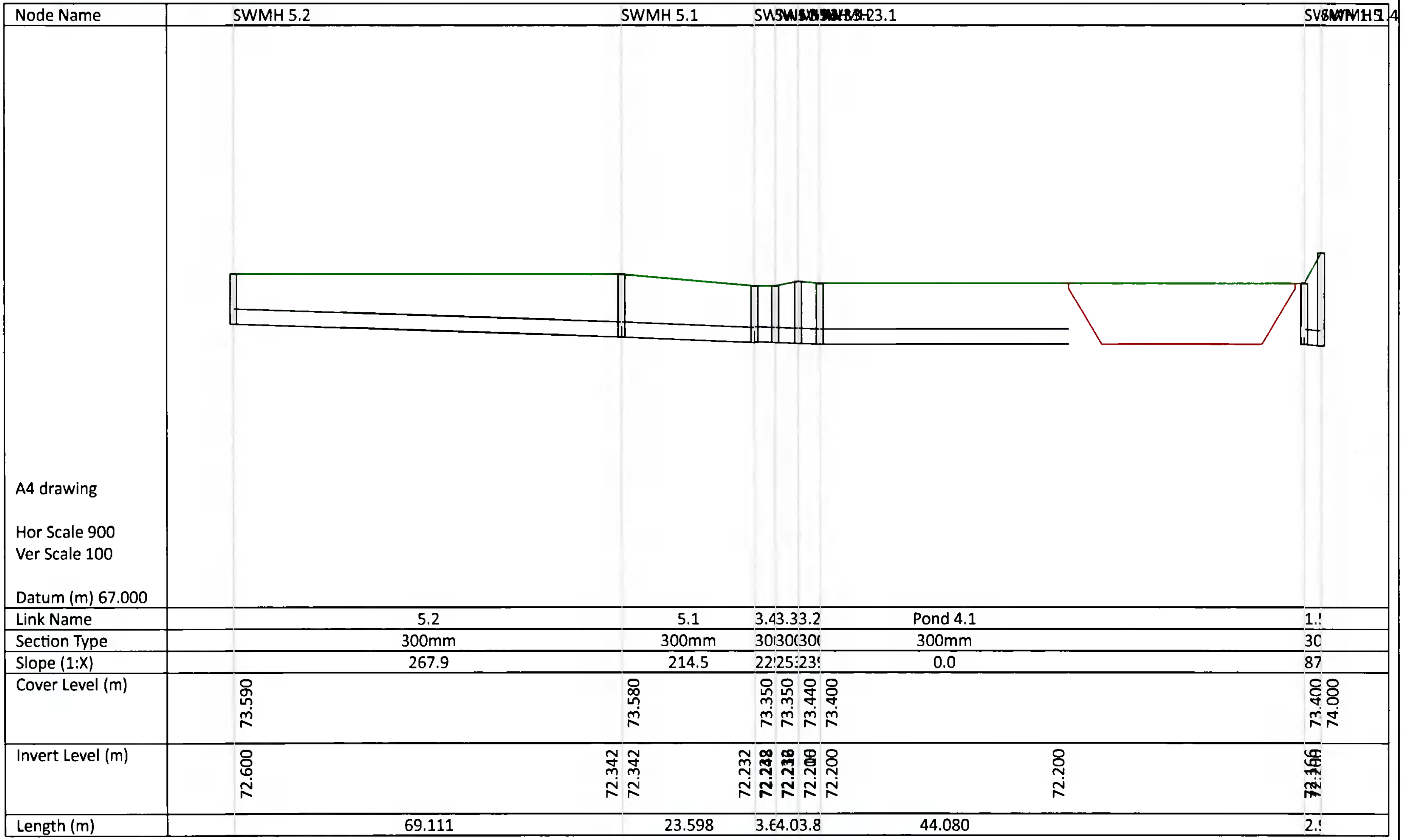

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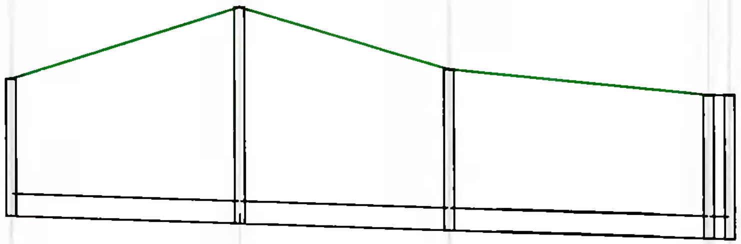

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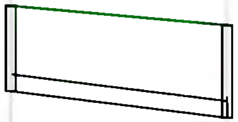
Node Name	SWMH 1.4		SWMH 1.3		SWMH 1.2		S\SWMH 1.Con	
Link Name		1.4		1.3		1.2		1.
Section Type		300mm		300mm		300mm		3(
Slope (1:X)		251.1		251.3		249.2		24
Cover Level (m)	74.000		74.950		74.110		73.750 73.750	
Invert Level (m)	72.166		72.056 72.056		71.955 71.955		71.830 71.820 71.830	
Length (m)		27.616		25.381		31.146		2.



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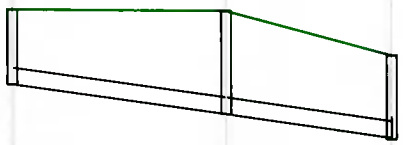
Node Name	SWMH 10.1	SWMH 5.1
Link Name	10.1	
Section Type	225mm	
Slope (1:X)	72.9	
Cover Level (m)	73.840	73.580
Invert Level (m)	72.700	72.342
Length (m)	26.113	

Node Name	SWMH 3.6		SWMH 3.5		SWMH 3.4



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Link Name		3.6		3.5	
Section Type		225mm		225mm	
Slope (1:X)		63.4		61.5	
Cover Level (m)	73.980		73.950		73.350
Invert Level (m)	72.980	72.573	72.573		72.248
Length (m)		25.820		19.977	

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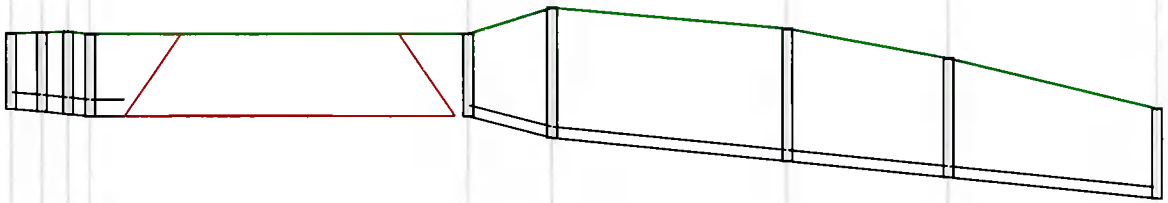

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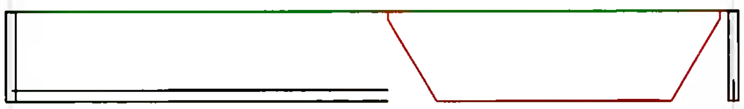
Node Name	SWSWSMMH4.2.1	SWMH 2.5	SWMH 2.4	SWMH 2.3	SWMH 2.2	SWMH 2.1
Link Name	4.44.:4.Por	2.5	2.4	2.3	2.2	
Section Type	22!222222225	150mm	150mm	150mm	150mm	
Slope (1:X)	10(90890.0	34.8	90.8	89.9	89.2	
Cover Level (m)	74.410 74.420 74.430 74.400	74.400	74.750	74.470	74.070	73.400
Invert Level (m)	[illegible] [illegible] [illegible] 73.300	73.300	73.010 73.010	72.697 72.697	72.481 72.481	72.200
Length (m)	3.73.:2.4.1	10.081	28.430	19.408	25.066	

Node Name	SWMH 2.1		SWMH 1.5



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Link Name		Pond 4.2	
Section Type		150mm	
Slope (1:X)		0.0	
Cover Level (m)	73.400		73.400
Invert Level (m)	72.200		72.200
Length (m)		45.691	

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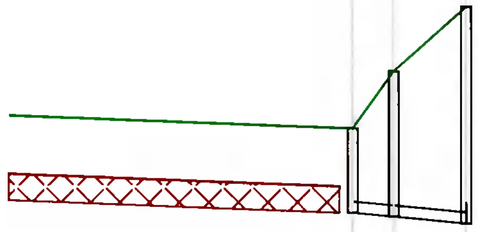

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Node Name	SWISWMPSTMMH 1.3		
Link Name	7.2	7.1	
Section Type	150	150mn	
Slope (1:X)	99.9	92.8	
Cover Level (m)	73.330	74.090	74.950
Invert Level (m)	72.200 72.150	72.150	72.056
Length (m)	4.9	8.722	

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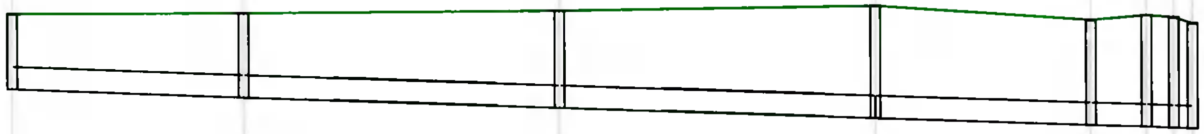
Node Name: SWMH 11.8 | SWMH 11.7 | SWMH 11.6 | SWMH 11.5 | SWMSWSSWMHBH1.2.1



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Link Name	11.8	11.7	11.6	11.5	11.4	111:
Section Type	300mm	300mm	300mm	300mm	300m	303(
Slope (1:X)	228.5	251.4	251.4	249.4	280.7	202:
Length (m)	27.872	38.216	38.216	25.939	6.737	3.:2.

Node Name	Cover Level (m)	Invert Level (m)
SWMH 11.8	73.580	72.580
SWMH 11.7	73.580	72.458 72.458
SWMH 11.6	73.600	72.306 72.306
SWMH 11.5	73.650	72.154 72.154
SWM	73.450	72.050 72.050 72.026
SW	73.510	72.010
SW	73.480	72.000
SWMH 12.1	73.400	72.010

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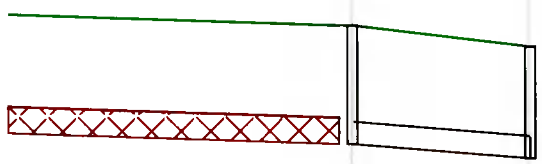
Datum (m) 67.000

Node Name	SWMH 11.1		SWSWMH14.4.2.1
Link Name	Pond 1.1		1.1
Section Type	300mm		2.2
Slope (1:X)	0.0		9.7
Cover Level (m)	73.400		73.400 73.180 72.500
Invert Level (m)	72.000	72.000	71.975 72.000 71.975
Length (m)	62.960		2.1



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Node Name	SWMH 18.1		SWMH 11.5
Link Name		18.1	
Section Type		300mm	
Slope (1:X)		107.1	
Cover Level (m)	73.940		73.650
Invert Level (m)	72.354		72.154
Length (m)		21.426	

Node Name	S\SWMH 13.1 ... SWMH 13.3 SWMH 14.3

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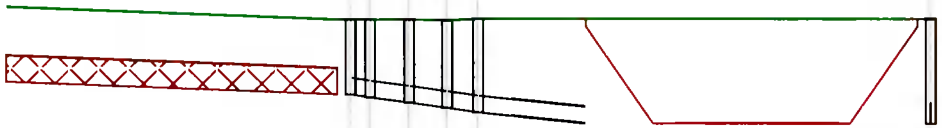
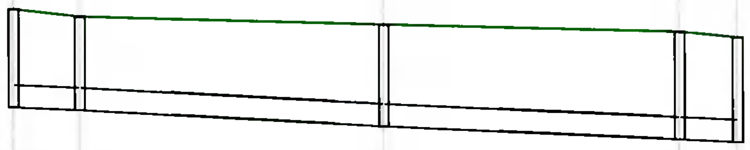


Link Name	1:13.13.13. Pond 1.2
Section Type	2:22522522! 225mm
Slope (1:X)	5!67.65.62. 86.3
Cover Level (m)	73.390 73.390 73.390 73.380 73.400 73.400
Invert Level (m)	72.350 72.350 72.280 72.280 72.250 72.150 72.000
Length (m)	2.4.7:4.5:3.7 12.943



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Node Name	SWMH 12.5		SWMH 12.4		SWMH 12.3		SWMH 12.2		SWMH 12.1
Link Name		12.5		12.4		12.3		12.2	
Section Type		300m		300mm		300mm		300m	
Slope (1:X)		199.1		160.0		187.4		174.8	
Cover Level (m)	73.810		73.710		73.590		73.480		73.400
Invert Level (m)	72.500		72.460 72.460		72.230 72.230		72.040 72.040		72.000
Length (m)		7.963		36.799		35.601		6.992	

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Ver Scale 100

Datum (m) 67.000

Node Name	SWMH 12.1			[illegible]
Link Name		Pond 2.1		11
Section Type		300mm		22
Slope (1:X)		0.0		55
Cover Level (m)	73.400			73.400 72.500
Invert Level (m)	72.000		72.000	71.975 [illegible] 71.975
Length (m)		85.275		11

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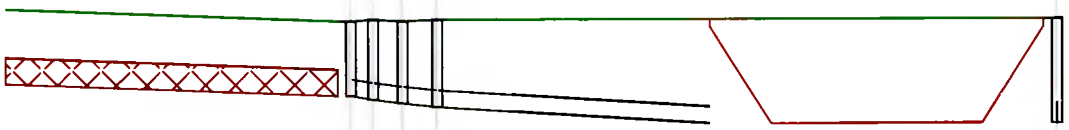

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Node Name	SVSWMH16.16.1		SWMH 17.3
Link Name	1616 16.	Pond 2.2	
Section Type	222 225	225mm	
Slope (1:X)	5:71 83.	143.1	
Cover Level (m)	73.380 73.400 73.380 73.400		73.400
Invert Level (m)	72.330 72.380 72.280 72.280 72.230		72.000
Length (m)	2.3.54.1	32.916	

Appendix C

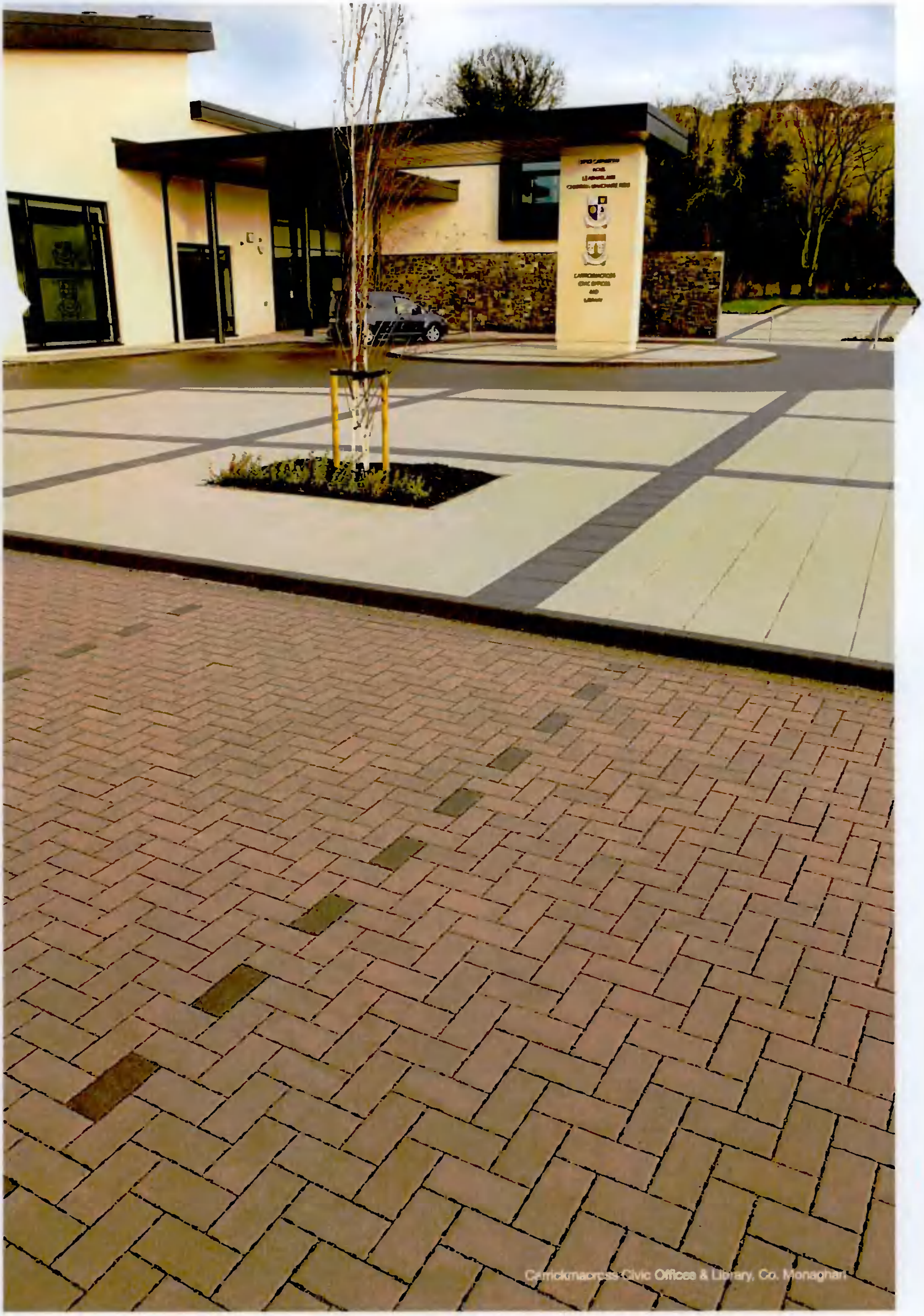
Permeable Paving

Clima-Pave™

Permeable Paving Solutions

Kilsaran

ideas taking shape



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The rapid development of previously green-field sites and the associated creation of impermeable areas such as roofs, car parks and footpaths will mean that at project conception stage there will be potentially large volumes of surface water to be dealt with. Traditionally this has been done by piping the surface water into storage tanks or discharging it into nearby streams or surface water drainage. This method of drainage is not currently favoured by planners and designers, as it simply moves the surface water downstream where it still has to be dealt with. This is especially important where large volumes of water need to be dealt with during heavy rainfall events. Piping large volumes of water into streams and rivers increases the risk of flooding and also allows for the potential pollution of local water courses and drinking water supplies.

Sustainable Urban Drainage Systems (SUDS) and Water Source Control

Planners are encouraging the use of Sustainable Urban Drainage Systems (SUDS) in all new developments, in particular the use of appropriate source control techniques is important as this allows for the containment of the surface water collected on the site and for this surface water to be dealt with on-site as opposed to traditionally draining it off-site. SUDS, as a sustainable development approach to Surface Water Design Techniques, has the aim of balancing the following:

1. **To manage water run-off from developed areas to similar quantities prior to development (Source Control)**
2. **Reduce and avoid incidences of downstream flooding**
3. **To protect or enhance water quality of the run-off**
4. **To improve or enhance the amenity where possible**

Advantages of Permeable Paving

- Permeable Paving is a ‘source control’ method. Water is managed and dealt with on-site without piping off to storage tanks or surface water treatment systems
- The Water Framework Directive (Directive 2000/60/EC) requires that surface water discharges are managed to ensure that risk of contamination or pollution are mitigated. Permeable paving systems filter contaminants by microbial action. There is no requirement for additional filtering/polishing with Permeable Paving in normal use
- Separate attenuation tank systems are not required
- No need for gullies or channels or conventional drainage
- Recharges ground water
- Roofs, roads and other non-permeable areas can be discharged into permeable paving (No gullies required)
- No ponding or surface water
- Collected water can potentially be re-used for non-potable purposes
- Improves water quality

Clima-Pave™

Permeable Paving Solutions

Clima-Pave™, the permeable paving solution from Kilsaran, offers an advantage over traditional SUDS techniques, such as storm water attenuation tanks. This is because the stone based sub-base, which needs to be installed for any type of surfacing material, is adapted to an open graded material in permeable paving systems. This allows the water collected from the site to be stored in the pavement and either infiltrated back into the ground or discharged at a controlled rate into the surface water drainage system.

The Clima-Pave™ system is constructed using our specially engineered permeable paving block, which has enlarged joints on all sides, typically 4-8mm in width. When the blocks have been laid, a corresponding slot is formed between the paving blocks which are then filled with a clean 3mm aggregate. This allows water to rapidly drain from the surface down into the pavement.

Traditional block paving is laid on a sand bedding layer and a Type 1/CL. 804 sub-base. To allow for storage and infiltration of the surface water percolating through the block, permeable block paving is laid on a grit laying course instead of sand and an open-graded stone sub-base instead of Type 1/CL. 804.

Advantages of Clima-Pave™ for your project

Clima-Pave™ from Kilsaran offers the widest range of permeable paving products for use in commercial, retail and civic projects.

Kilsaran can also offer a full site-specific permeable paving design for your project, taking into account the site ground conditions, drainage requirements and structural and traffic loading requirements for the site. This is a chargeable service and Kilsaran will provide an indemnified design provided by our nominated Consulting Engineer who will visit the site if required to appraise the installation.

Clima-Pave™
Technical Information

- Design Guidance
- Permeable Paving Aggregates
- Materials for HGV Trafficked Pavements
- Typical Design Diagrams
- Construction & Maintenance Guidelines

Design Guidance

Clima-Pave™ permeable paving provides a structural pavement suitable for both pedestrian and vehicular traffic depending on design. The water management and permeable functionality of the pavement is largely dependent on the correct specification and design of the pavement to meet the unique requirements of the individual site. The correct specification, testing and installation of aggregates is of paramount importance with any permeable paving system to ensure the finished pavement meets both initial and long term design requirements.

We advise that all permeable pavements require a site-specific design which should be carried out in accordance with BS 7533-13:2009 'Pavements constructed with clay, natural stone of concrete pavers. Part 13 Guide for the design of permeable pavements constructed with concrete paving blocks and flags, natural stone slabs and setts and clay pavers'.

We can provide a design service to customers who require a site specific design to be carried out for their project. In order to carry out this, we require a completed Clima-Pave™ Permeable Paving Design form available to download from our website, from our Sales team or can be requested by emailing technical@kilsaran.ie. This form should be returned via email with the supporting information about the site to enable a design to be carried out.

The information required includes:

- **Drawings of proposed site layout in AutoCad**
- **Full existing and proposed site levels for the pavement**
- **Full site investigation report to establish ground conditions and soaked CBR values of the sub-grade at formation level**
- **Infiltration values from soak-pit testing to BRE 365**
- **Overall drainage design strategy for the site**
- **Planning requirements or conditions for the site relating to paving and drainage (e.g. discharge limits)**
- **Any other pertinent site specific information or client / contractor requirements**

Design Guidance Basics

The below information is provided for guidance purposes only at project conception stage to allow appraisal of a permeable pavement system. Full independent advice should be sought from both the Consulting Engineer and the Contractor prior to the commencement of works. A full site-specific design will always be required in accordance with the above guidelines and BS 7533-13:2009.

The design information below is based on BS 7533-13:2009 which should also be consulted at project appraisal stage.

Types of Permeable Pavement

There are three main types of permeable pavement commonly used on sites:

System A – Full Infiltration: All water from the pavement is infiltrated to the ground

Suitable for sites with good ground conditions, higher CBR values and soils which will readily allow water to dissipate through the ground. These favourable conditions are rarely encountered on larger sites.

System B – Partial Infiltration: Most water infiltrated to ground with excess water piped off

Suitable for sites with medium ground conditions. The soil will infiltrate some of the water in the system. When storm events occur and water builds up in the system due to the soil being at capacity for drainage, perforated pipes are laid in the bottom of the sub-base to deal with the excess, taking it to the surface water drainage system. This is the most commonly used type of permeable pavement.

System C – Fully Tanked System: No water is allowed to infiltrate to ground

This type of system is used where poor sub-grade drainage conditions exist (heavy clays), where the stability of the sub-grade would diminish if extra surface water was introduced, or where ground water levels are within 1 metre of the formation level (system could gain water). In this system the sub-base acts essentially as an attenuation tank, wrapped in an impermeable polythene membrane and all water is piped out.

Selection of Pavement Type

The type of permeable pavement system to be adapted is based primarily on site ground conditions, site suitability and the permeability values of the sub-grade encountered on site from infiltration soak-pit testing. Table 1 gives guidance on the suitability of the three types of permeable pavement system.

Table 1: Guidance on selection of a pavement system

		System A - total infiltration	System B - partial infiltration	System C - no infiltration
Permeability of subgrade defined by coefficient of permeability, *k* (m/s)	10^{-6} to 10^{-3}	✓	✓	✓
	10^{-8} to 10^{-6}	✗	✓	✓
	10^{-10} to 10^{-8}	✗	✗	✓
Highest recorded water table within 1000mm of formation level		✗	✗	✓
Pollutants present in subgrade		✗	✗	✓

Selection of Pavement Sub-Base Thickness

The design of the sub-base for the permeable pavement should take into account the traffic loadings likely to use the pavement. It is essential to take into account any future increase in traffic volume and any HGV traffic which may use the pavement irrespective of how frequent. The correct loading category should be then selected from Table 2 taking into account the above considerations. It should be noted that no layers of the permeable pavement are designed for site traffic to use them and when finished the permeable pavement surface should not be trafficked by site traffic vehicles which are heavier than that for which the pavement was designed. It is advisable to complete paving works after all other work in the vicinity has been completed.

Typical build up details for each traffic category are illustrated on page 20 and 21 for guidance purposes.

Table 2: Loading Categories

1 DOMESTIC PARKING	2 CAR	3 PEDESTRIAN	4 SHOPPING	5 COMMERCIAL	6 HEAVY TRAFFIC
No Large Goods Vehicles	Emergency Large Goods Vehicles only	One Large Goods Vehicles per week	Ten Large Goods Vehicles per week	100 Large Goods Vehicles per week	1000 Large Goods Vehicles per week
Zero standard axles	**100 standard axles**	**0.015msa**	**0.15msa**	**1.5msa**	**15msa**
Patio	Car Parking Bays and Aisles	Town/city Pedestrian Street	Retail development delivery access route	Industrial Premises	Main road
Private Drive	Railway Station platform	Nursery Access	School/college access road	Lightly Trafficked Public Road	Distribution Centre
Decorative feature	External Car Showroom	Parking area to residential development	Office block delivery route	Light Industrial development	Bus Station (bus every 5 minutes)
Enclosed Playground	Sports Stadium Pedestrian route	Garden centre external display area	Deliveries to small residential development	Mixed retail/ industrial development	Motorway Truck Stop
Footway with zero vehicle overrun	Footway with occasional overrun	Cemetery Crematorium	Garden centre delivery route	Town Square	Bus Stop
	Private drive/ footway crossover	Hotel Parking	Fire Station Yard	Footway with regular overrun	Roundabout
		Airport Car Park with no bus pickup	Airport Car Park with bus to terminal	Airport landside roads	Bus Lane
		Sports Centre	Sports Stadium access route/ forecourt		

msa = millions of standard 8,000 kg axles

Sub-Base Thickness For Water Storage

The sub base depth must also take into consideration the water storage requirements for the site. The depth of sub-base may have to be adjusted to allow for increased site specific water storage. Further guidance on hydraulic factors can be found in BS 7533-13:2009 section 5.4.

Adjustment To Pavement Design For Low CBR Sub-Grade

In the case of CBR values below 5%, either ground improvement work will be required for the site, or the thickness of the coarse graded aggregate sub-base will have to be adjusted in accordance with 5.6.3 and table 9 of BS 7533-13:2009

Permeable Paving Aggregates

All materials used as permeable paving aggregate must comply to the grading and physical requirements below, as well at the general requirements of BS EN 12620 and BS EN 13242. Sub-base laying course materials should be clean, sound, non-friable and sound crushed rock material. Rounded gravel materials are not recommended for sub-base layers. The jointing material may be either clean crushed material or clean gravel material. The materials should be tested to confirm that it meets the requirements below.

The contractor shall also ensure that on-going deliveries to site are checked frequently for grading, shape and inspected to ensure cleanliness.

During installation on site, great care and attention must be paid to ensure that the aggregates are kept free of contamination and deleterious matter. Construction traffic cannot be allowed to traverse the layers of permeable paving aggregates during installation.

4/40mm Coarse Graded Permeable Paving Aggregate

Sieve Size (mm)	Percentage Passing
80	100
63	98-100
40	90-99
31,5	-
20	25-70
10	-
4	0-15
2	0-5

4/20mm Coarse Graded Permeable Paving Aggregate

Sieve Size (mm)	Percentage Passing
40	100
31,5	98-100
20	90-99
10	25-70
4	0-15
2	0-5

2/6.3mm Laying Course Paving Aggregate

Sieve Size (mm)	Percentage Passing
14	100
10	98-100
6.3	80-99
2	0-20
1	0-5

3mm Jointing Grit

Sieve Size (mm)	Percentage Passing
40	100
8	100
6.3	95-100
4	85-99
2	15-35
1	0-10
0.063	0.0-1.5

Property	Category to BS EN 13242 or BS EN 12620
Grading	4/20 (preferred) or 4/40 as per table above
Fines Content	F4
Shape	FI20
Resistance to Fragmentation	LA30
Water Absorption to BS EN 1097-6:2000	WA2
For water absorption > 2% Magnesium Sulfate Soundness	MS18
Resistance to Wear	MDE20
Acid Soluble Sulfate Content	AS0.2
Total Sulfur	≤1% by mass
Recycled Aggregates	Seek guidance from Kilsaran Technical Department

Materials for HGV Trafficked Areas

For loading category 3 and above as detailed in Table 2 page 17, these pavement types are designed to accommodate HGV traffic either on an occasional or more frequent basis. The pavement structure therefore requires a 'stiffening layer' to accommodate the HGV traffic which exerts significantly increased loading on the pavement. This stiffening layer can be either a hydraulically-bound coarse graded aggregate (porous no fines concrete) as detailed below and shown on the section details on pages 20 and 21 or alternatively a 80mm thick layer of DBM macadam as detailed below.

DBM Macadam Material

The DBM material should be an AC 32 Dense Base complying with the requirements of BS EN 13108-1 and should be supplied and installed to meet the requirements of BS 594987:2010. The DBM should be punctured after installation at 750mm centres with 100mm diameter holes. The holes should be fully filled and compacted with the appropriate coarse graded permeable paving aggregate as used in the layer underneath.

Hydraulically-Bound Coarse Graded Aggregate (Porous No Fines Concrete)

Porous concrete provides a stiffening transfer layer in concrete block permeable pavements which are to receive heavier traffic loads. The lack of sand (fines) in the mixture allows the material to act as a transfer drainage layer, whereby the open-graded matrix of the material allows for 20%-30% voids within the compacted volume of the material. Special measures are to be taken in the production, installation and curing of this material. Kilsaran can provide information and guidance on this upon request.

Product Standard	BS EN 14227-1
Material Compositon	Hydraulically Bound Coarse Graded Aggregate is a mixture of a coarse aggregate (usually 20mm nominal size), cement and water.
Typical Compressive Strength	Class C5/6 in accordance with IS EN 14227-1.Table 2 Line 4. Other strength classes available upon request from supplier.

Typical Design Diagrams

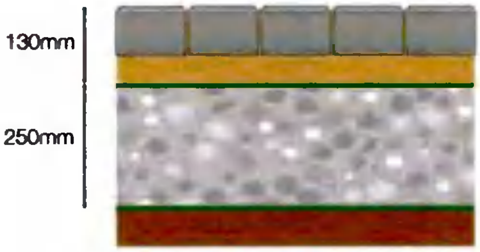
Below are typical build-up details for permeable pavement systems based on BS 7533-13:2009. These diagrams are based on ideal site conditions for drainage and CBR values of 5% or greater. The diagrams are for project appraisal purposes only and in all cases a site specific design in accordance with BS 7533-13:2009 will be required.

Key:

🟧 2 / 6.3mm Laying Course
▨ Hydraulically-Bound Coarse Graded Aggregate or 80mm of DBM Macadam
▨ 4 / 20mm Coarse Graded Aggregate and /or 4/40mm Coarse Graded Aggregate
🟫 Capping Material
━ Approved Geotextile
━ Approved Impermeable Membrane

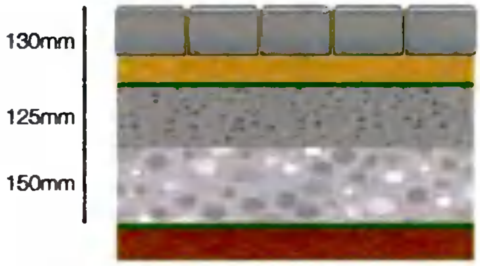
System A & B (Infiltrating & Partial Infiltration Systems)

LOAD CATEGORY 1



LOAD CATEGORY 2

LOAD CATEGORY 3



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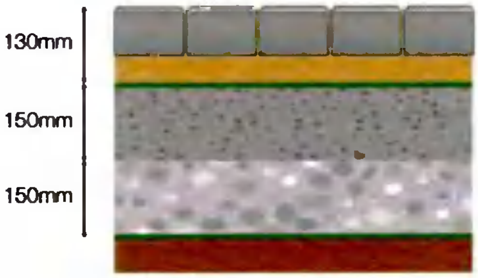
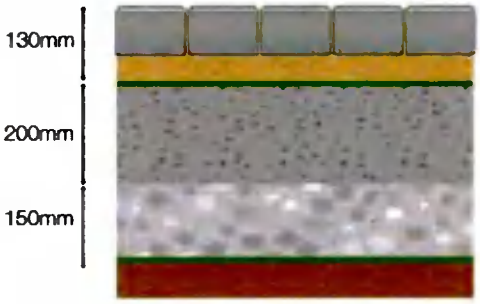
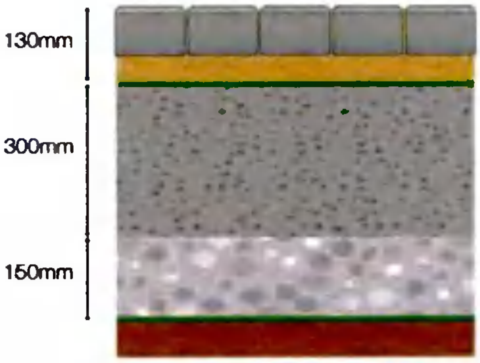


LOAD CATEGORY 5



LOAD CATEGORY 6



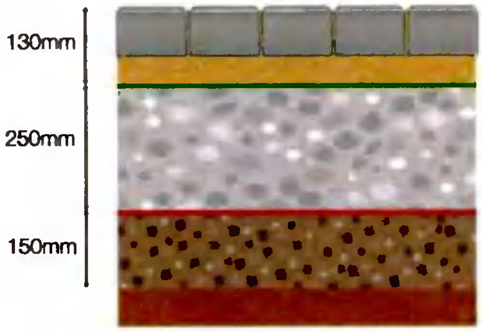
Alternative build up / materials may be used depending on project specific details.

For load categories 3-6 the hydraulically-bound coarse graded aggregate (porous no fines concrete) layer may be replaced with 80mm depth of DBM Macadam to act as a stiffening layer. The macadam layer should be punctured at 750mm centres on grid. Further details on the DBM macadam layer are given on page 19.

Where the depth of aggregate sub-base is in excess of 350mm for the given loading category, it may be possible to reduce the depth of aggregate required and provide a more cost effective design with the use of an appropriate and approved geo-grid. This can be appraised at design stage.

System C (Fully Tanked/Bunded)

LOAD CATEGORY 1



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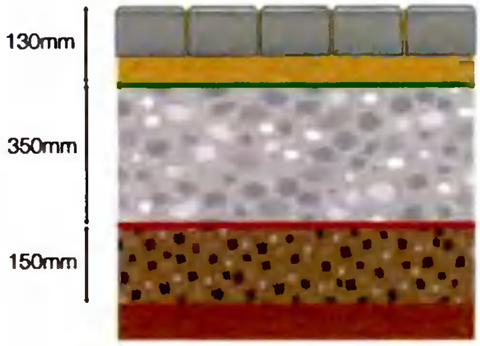

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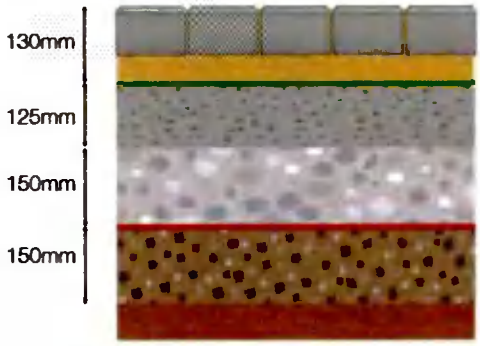

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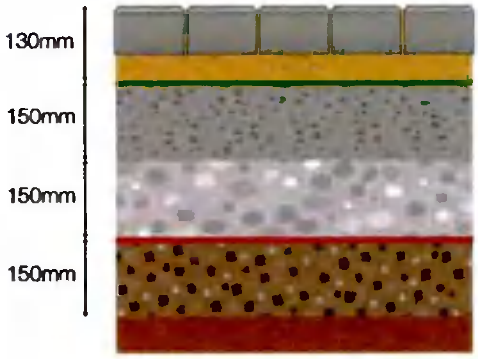

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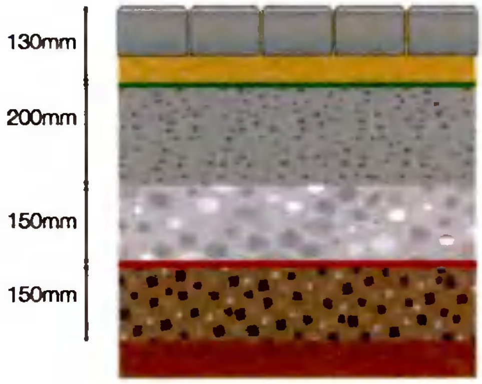

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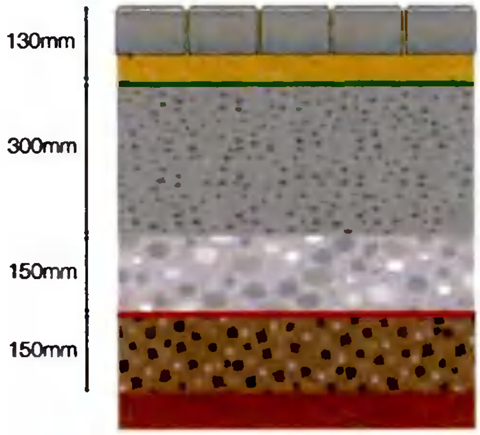
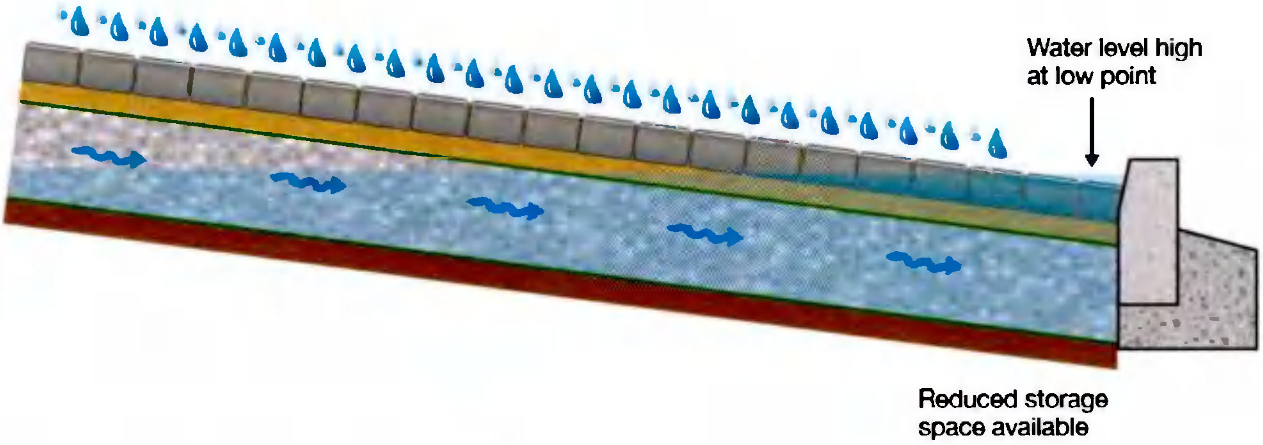


In the case of System C (fully tanked permeable pavements) there is always a requirement for 150mm depth of capping to be used beneath the impermeable membrane as shown above. The capping material should be approved by the Engineer and should comply with either the NRA Specification for Roadworks Series 600 or the Specification for Highway Works Series 600. The material should be tested before and during supply for full compliance, and should be compacted in accordance with the series 600 requirements. The capping layer should be blinded immediately before laying the impermeable membrane to prevent puncturing the membrane.

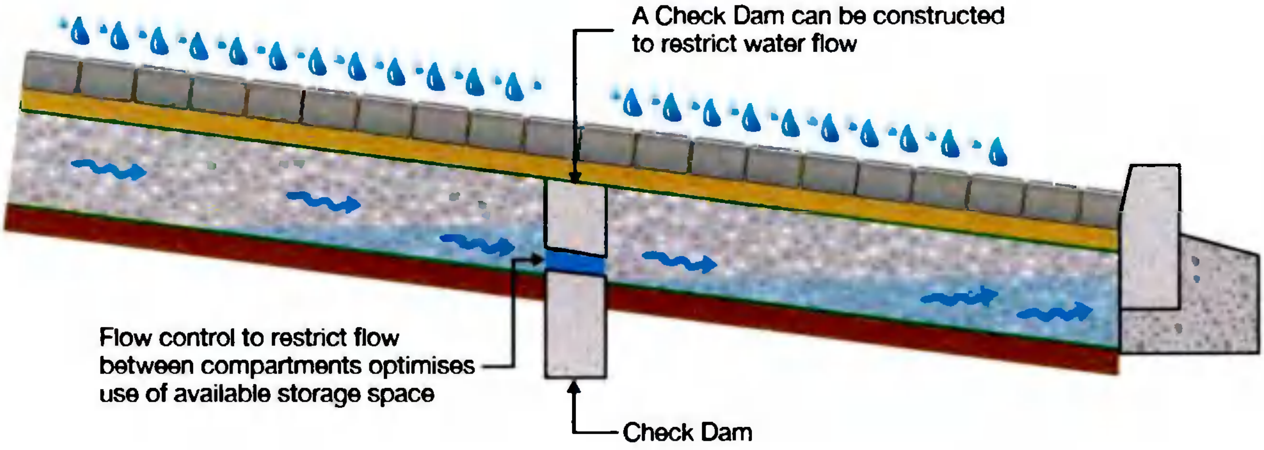
The requirement for using capping material may be eliminated by carrying out a design using an appropriate geo-grid which would negate the requirement for both the capping material and may also reduce the total depth of sub-base stone required.

Sloping Sites

On sloping sites water will naturally collect at the lowest point of the pavement. If sharp falls are allowed on site this will reduce the effective water storage capacity of the sub-base aggregate. In order to minimise this effect, gradients should be at a maximum 1 in 20 and preferably 1 in 30 or better.



Where sloping sites are unavoidable due to site layout, it will be necessary to reduce any sharp falls to maintain the water attenuation capacity of the system. This can be achieved by creating 'dams' in the sub-base of the pavement which will 'step' the pavement sub-base and reduce the overall falls. On extreme slopes, the pavement can be terraced with a step down and a dam between the two levels to restrict water flow.



Construction & Maintenance Guidelines

Construction

To ensure correct performance and durability of a permeable pavement, a fully detailed design should be carried out in accordance with BS 7533-13:2009 taking into account all site specific requirements for the project. Construction should be carried out strictly in accordance with BS 7533-13:2009 and BS 7533-3. All materials to be used shall be tested for full compliance to the above standard both before supply and during construction. It is also advised not to use any of the layers of permeable pavement construction for site traffic unless the build-up has been specifically designed to accommodate this. Additionally site equipment such as tele-handlers and forklifts should not be used on the paving surface after construction has been completed unless the pavement has been designed to accommodate this.

Maintenance

Permeable pavements should not be contaminated with soft landscaping materials, soil, detritus or general dirt as this may wash into the pavement. Also the pavement should not be trafficked by construction traffic or unsuitably heavy vehicles above that for which the pavement was designed.

To keep any growths or weeds to a minimum it is advised that the installed permeable paving be sealed with an appropriate sealer. Where the paved area is beneath overhanging trees or in a very damp area, an annual treatment of an environmentally friendly weed killer can be applied. Note the weed killer should be applied as directed by the supplier and only in very dry weather where rain is not expected, active weed killer could be washed into the sub-system otherwise. The manufacturer's instructions for all treatment products should be followed in detail.

The pavement should be inspected on a routine basis and carefully swept as required using a mechanical sweeper or by hand for smaller areas. The sweeping action may remove some of the jointing grit from the surface, the joints must be topped up after sweeping if required.

Should silting or blocking of the joints occur after a period of years, the use of a suitable jet wash and suction sweeper should be used to remove the defective material. It is likely that the jetting of the pavement will remove some grit. This grit should be replaced as required.

As with conventional block pavements, depressions, rutting and cracked or broken blocks which may be a structural concern or a hazard to users should be remedied as soon as possible. All joints must be maintained full at all times.

Permeable pavements will drain relatively quickly compared with other types of surfacing, and are not as liable to freezing over of standing water, hoar frosts may occur which can cause surface slip on any material. The use of de-icing salts on permeable pavements, as with any other concrete surface, should be kept to a minimum as the chlorides in the salt will penetrate the concrete and excessive use will damage the surface. Any de-icing material applied should not cause blockage or clogging of the permeable pavement joints (if blockage occurs in localised areas this will need to be removed by suction sweeper and joints topped up with appropriate jointing grit). It should also be considered that any de-icing material used will drain into either the sub-grade or the drainage system through the permeable pavement. Care should be taken to ensure no contamination of water courses or drainage systems. De-icing materials should be applied to the paving surface before ice or snow covers the surface to prevent damage.