

Vine Farm, Deeping St. Nicholas

Drainage Strategy Report

Project No. 5994

November 2019

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Drainage Strategy Report

Vine Farm, Deeping St. Nicholas

Introduction

This report has been compiled by Steve Gilman Design Ltd to outline the sustainable surface water and foul drainage proposals for a proposed farm shop, tea room with associated parking and access at Vine Farm off A1175 Littleworth Drove, Deeping St. Nicholas.

This report has been produced to outline the sustainable urban drainage principles to be incorporated into the proposed development considering the hydrological and hydrogeological context of the development. The proposals have been developed in accordance with both national and local guidance including parts SG11 and SG13 of the South Holland Local Plan, 2006

This site is located in South Lincolnshire, approximately 7.5km south west of Spalding.

The site is a greenfield plot and is currently grassland with a small pond. The site is bound by existing residential plots to the west, Vine Farm to the east and agricultural land to the north. There is an existing watercourse which runs on the western boundary of the site.

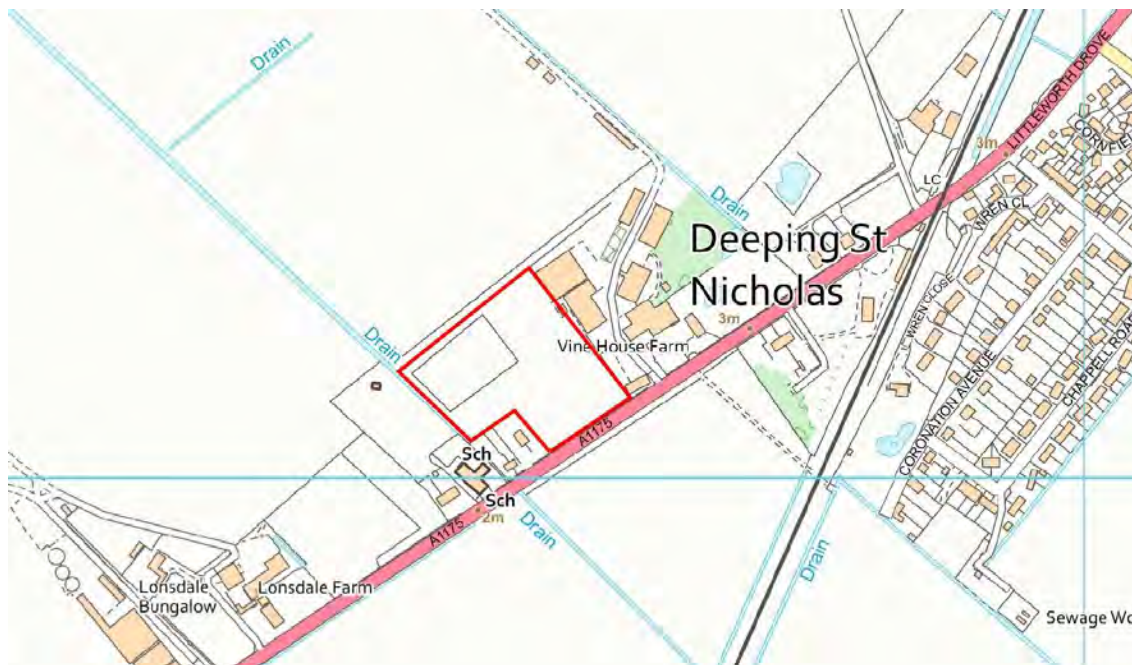


Figure 0-1 Site Location Plan

Sustainable Drainage Principles

The drainage strategy for the site has been devised in accordance with both national and local sustainable drainage guidance including the CIRIA SuDS Manual C753 and Policy 2 of the North East Lincolnshire Local Plan 2016 respectively.

Surface water will be managed in accordance with sustainable drainage principles by managing runoff at source, close to where it falls to mimic natural drainage. The surface water drainage system will be

designed aiming to provide multiple benefits in terms of water quantity, water quality, amenity and biodiversity.

Sustainable Drainage Proposals

In accordance with the guidance set out in the Building Regulations Part H and CIRIA's SuDS Manual, the hierarchy for surface water drainage discharge is as follows:

1. Via infiltration
2. To a watercourse
3. To a surface water sewer
4. To a combined sewer

An intrusive ground investigation was carried out on the site by Langdale Smith and Co Limited in March 2017, during which borehole samples were taken up to a depth of 11m BGL. The ground was found to comprise of peaty clay up to a depth of 3.6m BGL, with groundwater being struck at 2.5m BGL; as such the use of the infiltration features within the site will not be suitable.

The closest watercourse to the site is the Welland & Deepings IDB maintained drain that runs adjacent to the western boundary; as such the surface water discharge from the site will be via an outfall at a restricted rate at this location. In doing so, the most sustainable discharge point for surface water that is reasonably practicable to implement will be achieved for the site.

Preliminary discussions with Welland & Deepings IDB have confirmed that a discharge rate for the site at the accepted greenfield runoff rate of 1.4 l/s/ha is acceptable to the Board in principle. In accordance with this runoff rate, the surface water discharge rate for the 1.275ha site shall be restricted to 1.7 l/s through use of a flow control device.

Surface water from the site will be generated from two main areas; the farm shop/tea room roofs and ancillary car parking area. Surface water runoff from these areas will be managed as follows;

- **Car parking area**

The proposed car park will be constructed using permeable materials to mimic natural drainage processes. The permeable surface (gravel and block paving) will be laid on permeable sub-base which will be lined with an impermeable membrane to ensure the required attenuation volume for surface water is not compromised by surrounding groundwater, and to enable discharge into a filter drain and subsequent piped drainage network.

The access road at the site entrance will be constructed with flexible construction (bituminous bound materials). Proposed levels will ensure that all surface water runoff generated by this area will fall back into the site to mitigate the risk of surface water entering the public highway.

- **Roof areas** – Traditional gutters will collect rainwater and discharge surface water to a below ground gravity drainage system. Some sections of roof will first drain to water butts for re-use, which will then overflow into the same below ground gravity drainage system.

The surface water drainage from both the roof and car parking areas will then be routed via the below ground gravity drainage system towards a 'wet' pond that will be adequately sized to attenuate the anticipated volume of water generated by a 1 in 100 year (plus 40% climate change) return period storm event. All outfalls into the pond will be fit with non-return valves to mitigate the risk of surface water within the attenuation feature surcharging the upstream drainage network.

Due to the inherently low lying and flat land associated with the area in which the site is located, a pump will then be utilised in a chamber immediately upstream of the outfall from the 'wet' pond to convey surface water a restricted discharge rate of 1.7l/s directly towards an outfall into the Welland & Deepings IDB maintained watercourse. This outfall will also include a non-return valve to mitigate the risk of the upstream drainage network surcharging if the IDB drain water levels rise to sufficient levels.

Filter drains will be constructed so as to drain the proposed concrete access road to the northeast of the site, as well as to provide sub-surface drainage to protect the sub-base layer of this access road. These drains will also be routed through a below ground gravity drainage system towards an outfall into the 'wet' pond.

In line with recommendations made within CIRIA's SuDS Manual, the proposed surface water drainage system will provide multiple benefits addressing quantity, quality, amenity and biodiversity:

- The restricted discharge rate of 1.7 l/s (to greenfield runoff rate) and associated attenuation features (wet pond and permeable sub-base) ensure that the quantity of surface water generated by the site is as sustainable as is practicable.
- Filtration of surface water generated by the car parking area through the aggregate that comprises the permeable pavement construction will provide treatment of silt and pollutants in this area. Similarly, the proposed filter drains will offer treatment of surface water generated by the access road in the northeast of the site. All of this surface water, as well as the roof-water will then pass through the 'wet' pond to provide further treatment through the processes of settling and biological uptake. As such, the quality of surface water discharging from the site will be as sustainable as is practicable.
- The proposed 'wet' pond will provide amenity value for users of the commercial property, most notably through positive visual aesthetics.
- Biodiversity benefits can also be realised by the proposed 'wet' pond as the constant water level can act as a habitat for numerous species. The specific ecological conditions required to support specific species should be assessed at a detailed design stage in order to achieve the desired biodiversity benefits within this feature.

The sustainable drainage system described above is displayed in the Proposed Surface Water Drainage Layout drawing included as Appendix A.

Surface Water Design

The surface water drainage system has been designed and modelled using Causeway Flow software to ensure compliance to design guidance and sustainable drainage best practice.

Outputs from the Causeway Flow software have been provided as Appendix B. These outputs demonstrate the surface water system to be capable of managing surface water flows for storms up to and including the 1 in 100 year event including a 40% allowance for climate change. No increased surface water flood risk is therefore present from the site to the proposed development or the surrounding properties.

Drainage Maintenance

Maintenance of the proposed surface and foul water drainage systems shall remain the responsibility of the property owner.

The piped network has been designed to ensure self-cleansing velocities therefore regular specialist maintenance is not envisaged.

The SuDS features within the proposed surface water drainage network are likely to require maintenance as follows:

- 'Wet' Pond

Maintenance schedule	Required action	Typical frequency
Regular maintenance	Remove litter and debris	Monthly (or as required)
	Cut the grass – public areas	Monthly (during growing season)
	Cut the meadow grass	Half yearly (spring, before nesting season, and autumn)
	Inspect marginal and bankside vegetation and remove nuisance plants (for first 3 years)	Monthly (at start, then as required)
	Inspect inlets, outlets, banksides, structures, pipework etc for evidence of blockage and/or physical damage	Monthly
	Inspect water body for signs of poor water quality	Monthly (May – October)
	Inspect silt accumulation rates in any forebay and in main body of the pond and establish appropriate removal frequencies: undertake contamination testing once some build-up has occurred, to inform management and disposal options.	Half yearly
	Check any mechanical devices, eg penstocks	Half yearly
	Hand cut submerged and emergent aquatic plants (at minimum of 0.1 m above pond base: include max 25% of pond surface)	Annually
	Remove 25% of bank vegetation from water's edge to a minimum of 1 m above water level	Annually
	Tidy all dead growth (scrub clearance) before start of growing season (Note: tree maintenance is usually part of overall landscape management contract)	Annually
	Remove sediment from any forebay	Every 1–5 years, or as required
	Remove sediment and planting from one quadrant of the main body of ponds without sediment forebays.	Every 5 years, or as required
Occasional maintenance	Remove sediment from the main body of big ponds when pool volume is reduced by 20%	With effective pre-treatment, this will only be required rarely, eg every 25–50 years
Remedial actions	Repair erosion or other damage	As required
	Replant, where necessary	As required
	Aerate pond when signs of eutrophication are detected	As required
	Realign rip-rap or repair other damage	As required
	Repair / rehabilitate inlets, outlets and overflows.	As required

Table 1 – Typical maintenance requirements for ponds, as outlined within CIRIA's SuDS Manual

- Permeable Pavement Construction

Maintenance schedule	Required action	Typical frequency
Regular maintenance	Brushing and vacuuming (standard cosmetic sweep over whole surface)	Once a year, after autumn leaf fall, or reduced frequency as required, based on site-specific observations of clogging or manufacturer's recommendations – pay particular attention to areas where water runs onto pervious surface from adjacent impermeable areas as this area is most likely to collect the most sediment
Occasional maintenance	Stabilise and mow contributing and adjacent areas	As required
	Removal of weeds or management using glyphosate applied directly into the weeds by an applicator rather than spraying	As required – once per year on less frequently used pavements
Remedial Actions	Remediate any landscaping which, through vegetation maintenance or soil slip, has been raised to within 50 mm of the level of the paving	As required
	Remedial work to any depressions, rutting and cracked or broken blocks considered detrimental to the structural performance or a hazard to users, and replace lost jointing material	As required
	Rehabilitation of surface and upper substructure by remedial sweeping	Every 10 to 15 years or as required (if infiltration performance is reduced due to significant clogging)
Monitoring	Initial inspection	Monthly for three months after installation
	Inspect for evidence of poor operation and/or weed growth – if required, take remedial action	Three-monthly, 48 h after large storms in first six months
	Inspect silt accumulation rates and establish appropriate brushing frequencies	Annually
	Monitor inspection chambers	Annually

Table 2 – Typical maintenance requirements for permeable paving, as outlined within CIRIA's SuDS Manual

- Filter Drains

Maintenance schedule	Required action	Typical frequency
Regular maintenance	Remove litter (including leaf litter) and debris from filter drain surface, access chambers and pre-treatment devices	Monthly (or as required)
	Inspect filter drain surface, inlet/outlet pipework and control systems for blockages, clogging, standing water and structural damage	Monthly
	Inspect pre-treatment systems, inlets and perforated pipework for silt accumulation, and establish appropriate silt removal frequencies	Six monthly
	Remove sediment from pre-treatment devices	Six monthly, or as required
Occasional maintenance	Remove or control tree roots where they are encroaching the sides of the filter drain, using recommended methods (eg NJUG, 2007 or BS 3998:2010)	As required
	At locations with high pollution loads, remove surface geotextile and replace, and wash or replace overlying filter medium	Five yearly, or as required
	Clear perforated pipework of blockages	As required

Table 3 – Typical maintenance requirements for filter drains, as outlined within CIRIA's SuDS Manual

Foul Drainage

As there are no public sewers within a suitable distance from the site to discharge into, domestic foul flows generated by the farm shop/tea room will be directed via a below ground gravity drainage system towards an on-site treatment plant. The treated effluent will then be directed into the 'wet' pond that forms a part of the surface water drainage system, before ultimately discharging into the Welland & Deepings IDB maintained drain.

The piped network itself has been designed to ensure self-cleansing velocities are achieved, therefore regular specialist maintenance is not envisaged.

An Environmental Permit shall be sought from the Environment Agency to grant approval for the proposed foul drainage network described above, including use of an on-site foul drainage treatment plant.

Foul drainage will be designed in accordance with Building Regulations and discharge units contained within BS EN 12056-2:2000.

Appendix A

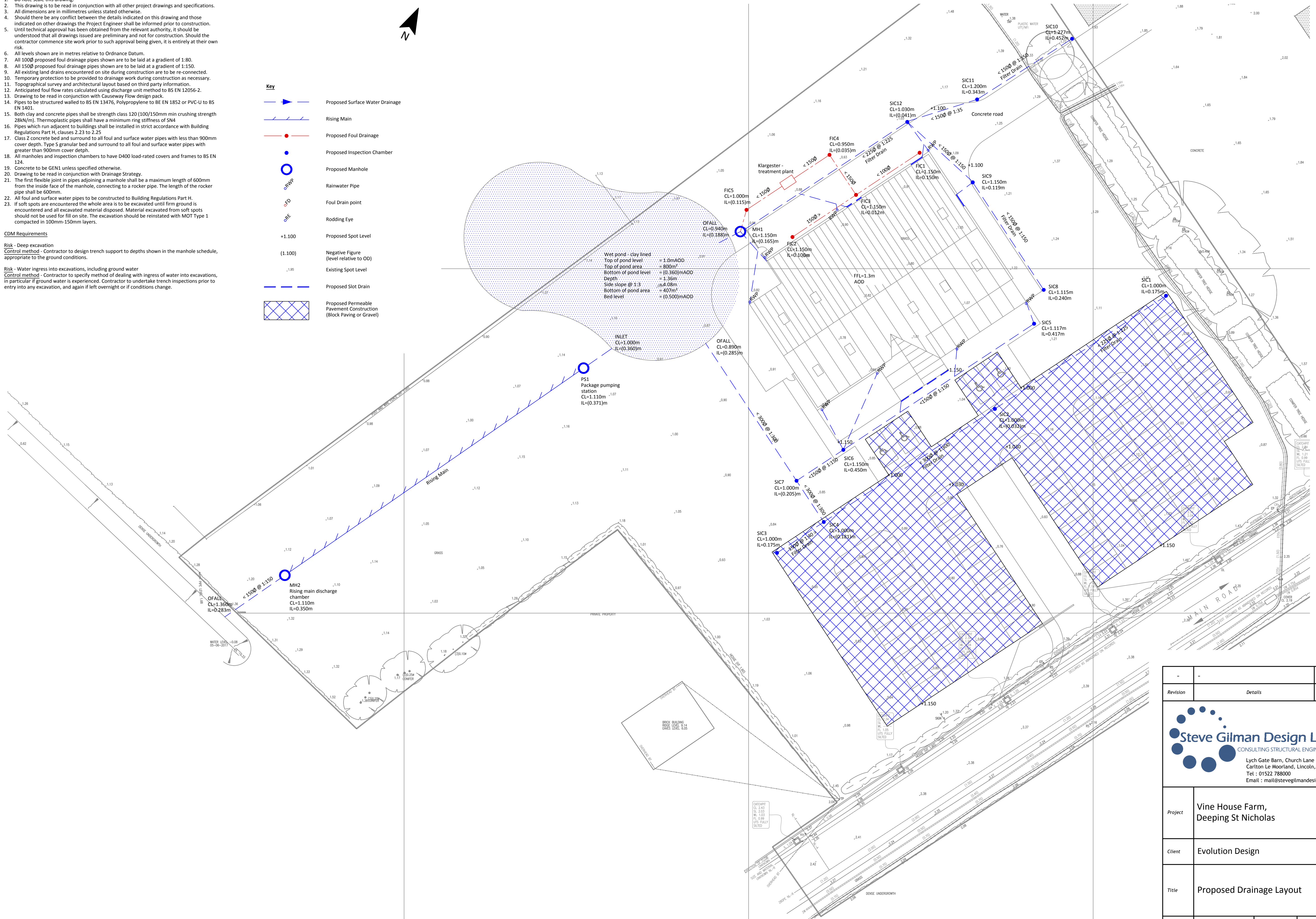
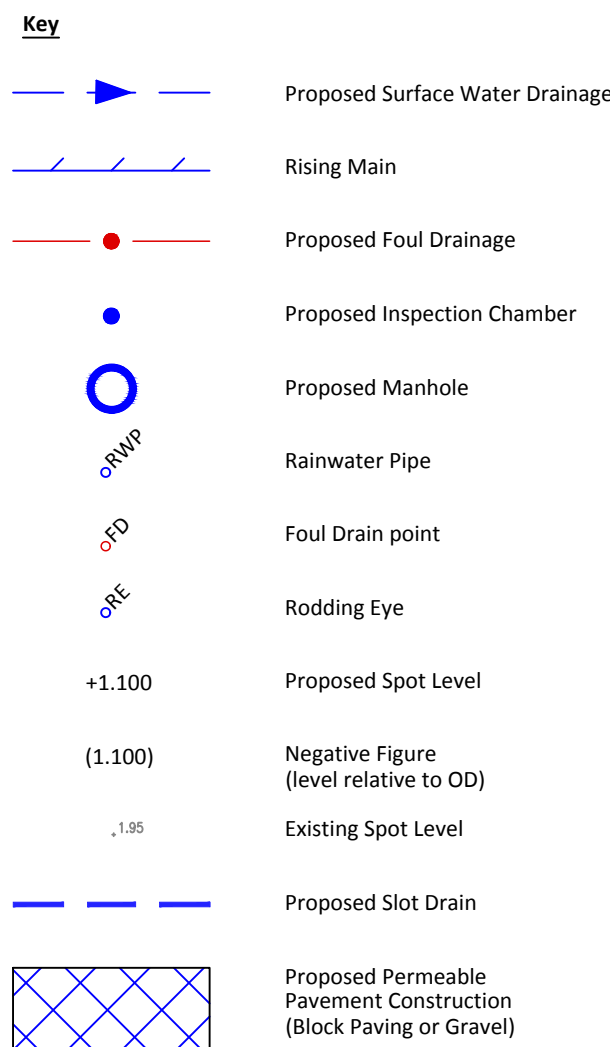
Surface water drainage layout drawing

1. Do not scale this drawing.
2. This drawing is to be read in conjunction with all other project drawings and specifications.
3. All dimensions are in millimetres unless stated otherwise.
4. Should there be any conflict between the details indicated on this drawing and those indicated on other drawings the Project Engineer shall be informed prior to construction.
5. If approval has been given by the relevant authority, it should be understood that all drawings issued are preliminary and not for construction. Should the contractor commence site work prior to such approval being given, it is entirely at their own risk.
6. All levels shown are in metres relative to Ordnance Datum.
7. All 1100p proposed foul drainage pipes shown are to be laid at a gradient of 1:80.
8. All 1500p proposed foul drainage pipes shown are to be laid at a gradient of 1:150.
9. All existing land drains encountered on site during construction are to be re-connected.
10. Temporary protection to be provided to drainage work during construction as necessary.
11. Temporary accessways and laydown areas to be based on third party information.
12. Anticipated flow rates calculated using discharge unit method BS EN 12056-2.
13. Drawing to be read in conjunction with Causeway Flow design pack.
14. Pipes to be structured welded to BS EN 13476, Polypropylene to BE EN 1852 or PVC-U to BS EN 12201.
15. Both clay and concrete pipes shall be strength class 120 (1000/150mm min crushing stress 28kN/m²). Thermoplastic pipes shall have a minimum ring stiffness of S₄
16. Pipes which run adjacent to buildings shall be installed in strict accordance with Building Regulations Part H, clauses 2.23 to 2.25.
17. Concrete and clay pipes shall be laid on 100mm sand and surface water pipes with less than 900mm cover depth. Type 5 granular bed and surround to all foul and surface water pipes with greater than 900mm cover depth.
18. All manholes and inspection chambers to have D400 load-rated covers and frames to BS EN 124.
19. Concrete to be G611 unless specified otherwise.
20. Drawing to be read in conjunction with Drainage Strategy.
21. The first flexible joint in pipes adjoining a manhole shall be a maximum length of 600mm from the concrete face of the manhole, connecting to a rocker pipe. The length of the rocker pipe shall be 600mm.
22. All foul and surface water pipes to be constructed to Building Regulations Part H.
23. If soil spots are encountered the whole area is to be excavated until firm ground is encountered and all excavated material disposed. Material excavated from soil spots should not be used for fill or site cover. The excavation should be reinstated with MOT Type 1 compacted in 100mm-150mm layers.

Risk - Deep excavation
Control method - Contractor to design trench support to depths shown in the manhole schedule, appropriate to the ground conditions.

Risk - Water ingress into excavations, including ground water
Control method - Contractor to specify method of dealing with ingress of water into excavations, in particular if ground water is experienced. Contractor to undertake trench inspections prior to entry into any excavation, and again if left overnight or if conditions change.

Risk - Water ingress into excavations, including ground water
Control method - Contractor to specify method of dealing with ingress of water into excavations, in particular if ground water is experienced. Contractor to undertake trench inspections prior to entry into any excavation, and again if left overnight or if conditions change.



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Revision	Details	Date
 Steve Gilman Design Ltd CONSULTING STRUCTURAL ENGINEERS Lych Gate Barn, Church Lane Carlton Le Moorland, Lincoln, LN5 9HS Tel : 01522 788000 Email : mail@stevegilmandesign.co.uk		
Project	Vine House Farm, Deeping St Nicholas	
Client	Evolution Design	
Title	Proposed Drainage Layout	
Date	October 2019	Scale 1:250
Number	5994/010	Status Preliminary

Appendix B

Modelled Outputs

Design Settings

Rainfall Methodology	FSR	Maximum Time of Concentration (mins)	30.00
Return Period (years)	2	Maximum Rainfall (mm/hr)	50.0
Additional Flow (%)	0	Minimum Velocity (m/s)	1.00
FSR Region	England and Wales	Connection Type	Level Soffits
M5-60 (mm)	20.000	Minimum Backdrop Height (m)	0.200
Ratio-R	0.400	Preferred Cover Depth (m)	0.600
CV	0.750	Include Intermediate Ground	x
Time of Entry (mins)	4.00	Enforce best practice design rules	✓

Nodes

Name	Area (ha)	T of E (mins)	Add Inflow (l/s)	Cover Level (m)	Diameter (mm)	Depth (m)
SIC1	0.116	4.00		1.000	1200	0.825
SIC2	0.149	4.00		1.000	1200	1.032
SIC3	0.032	4.00		1.000	1200	0.825
SIC4	0.000	4.00		1.000	1200	1.181
SIC5	0.030	4.00		1.000	1200	0.750
SIC6	0.019	4.00		1.000	1200	0.971
SIC7	0.000	4.00		1.000	1200	1.205
SIC8	0.010	4.00		1.000	1200	0.760
SIC9	0.000	4.00		1.000	1200	0.881
SIC10	0.015	4.00		1.000	1200	0.548
SIC11	0.000	4.00		1.000	1200	0.657
SIC12	0.043	4.00		1.000	1200	1.041
MH1	0.027	4.00	1.0	1.000	1200	1.165
Pond	0.096	4.00		1.000	1350	1.360
PS1	0.000	4.00		1.000	1350	1.371
MH2	0.000	4.00		1.000	1350	1.530

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)
1.000	SIC1	SIC2	29.765	0.600	0.175	0.043	0.132	225.0	225	4.57	50.0
1.001	SIC2	SIC4	29.765	0.600	-0.032	-0.131	0.099	300.0	300	5.12	50.0
2.000	SIC3	SIC4	8.132	0.600	0.175	-0.031	0.206	39.5	150	4.08	50.0
1.002	SIC4	SIC7	7.175	0.600	-0.181	-0.205	0.024	300.0	300	5.25	50.0
3.000	SIC5	SIC6	33.190	0.600	0.250	0.029	0.221	150.0	150	4.68	50.0
3.001	SIC6	SIC7	8.141	0.600	0.029	-0.025	0.054	150.0	150	4.84	50.0
1.003	SIC7	Pond	23.895	0.600	-0.205	-0.285	0.080	300.0	300	5.70	50.0
4.000	SIC8	SIC9	18.198	0.600	0.240	0.119	0.121	150.0	150	4.37	50.0

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)
1.000	0.867	34.5	15.7	0.600	0.732	0.116	0.0	107	0.848
1.001	0.902	63.8	35.9	0.732	0.831	0.265	0.0	161	0.929
2.000	1.606	28.4	4.3	0.675	0.881	0.032	0.0	40	1.165
1.002	0.902	63.8	40.3	0.881	0.905	0.297	0.0	173	0.953
3.000	0.818	14.5	4.1	0.600	0.821	0.030	0.0	54	0.702
3.001	0.818	14.5	6.6	0.821	0.875	0.049	0.0	71	0.800
1.003	0.902	63.8	46.9	0.905	0.985	0.346	0.0	192	0.984
4.000	0.818	14.5	1.4	0.610	0.731	0.010	0.0	31	0.511

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)
4.001	SIC9	SIC12	12.687	0.600	0.119	0.034	0.085	150.0	150	4.63	50.0
5.000	SIC10	SIC11	16.360	0.600	0.452	0.343	0.109	150.0	150	4.33	50.0
5.001	SIC11	SIC12	10.405	0.600	0.343	0.034	0.309	33.7	150	4.43	50.0
4.002	SIC12	MH1	27.933	0.600	-0.041	-0.165	0.124	225.0	225	5.17	50.0
4.003	MH1	Pond	3.500	0.600	-0.165	-0.188	0.023	150.0	225	5.22	50.0
1.004	Pond	PS1	3.500	0.600	-0.360	-0.371	0.011	318.2	375	5.75	50.0
1.005	PS1	MH2	51.561	0.600	-0.371	-0.530	0.159	324.3	375	6.61	50.0

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)
4.001	0.818	14.5	1.4	0.731	0.816	0.010	0.0	31	0.511
5.000	0.818	14.5	2.0	0.398	0.507	0.015	0.0	38	0.577
5.001	1.740	30.8	2.0	0.507	0.816	0.015	0.0	26	0.987
4.002	0.867	34.5	9.2	0.816	0.940	0.068	0.0	80	0.738
4.003	1.065	42.3	13.9	0.940	0.963	0.095	1.0	88	0.955
1.004	1.010	111.6	73.8	0.985	0.996	0.537	1.0	223	1.077
1.005	1.000	110.5	73.8	0.996	1.155	0.537	1.0	224	1.069

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)
1.000	29.765	225.0	225	Circular	1.000	0.175	0.600	1.000	0.043	0.732
1.001	29.765	300.0	300	Circular	1.000	-0.032	0.732	1.000	-0.131	0.831
2.000	8.132	39.5	150	Circular	1.000	0.175	0.675	1.000	-0.031	0.881
1.002	7.175	300.0	300	Circular	1.000	-0.181	0.881	1.000	-0.205	0.905
3.000	33.190	150.0	150	Circular	1.000	0.250	0.600	1.000	0.029	0.821
3.001	8.141	150.0	150	Circular	1.000	0.029	0.821	1.000	-0.025	0.875
1.003	23.895	300.0	300	Circular	1.000	-0.205	0.905	1.000	-0.285	0.985
4.000	18.198	150.0	150	Circular	1.000	0.240	0.610	1.000	0.119	0.731
4.001	12.687	150.0	150	Circular	1.000	0.119	0.731	1.000	0.034	0.816
5.000	16.360	150.0	150	Circular	1.000	0.452	0.398	1.000	0.343	0.507
5.001	10.405	33.7	150	Circular	1.000	0.343	0.507	1.000	0.034	0.816
4.002	27.933	225.0	225	Circular	1.000	-0.041	0.816	1.000	-0.165	0.940
4.003	3.500	150.0	225	Circular	1.000	-0.165	0.940	1.000	-0.188	0.963

Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
1.000	SIC1	1200	Manhole	Private	SIC2	1200	Manhole	Private
1.001	SIC2	1200	Manhole	Private	SIC4	1200	Manhole	Private
2.000	SIC3	1200	Manhole	Private	SIC4	1200	Manhole	Private
1.002	SIC4	1200	Manhole	Private	SIC7	1200	Manhole	Private
3.000	SIC5	1200	Manhole	Private	SIC6	1200	Manhole	Private
3.001	SIC6	1200	Manhole	Private	SIC7	1200	Manhole	Private
1.003	SIC7	1200	Manhole	Private	Pond	1350	Manhole	Private
4.000	SIC8	1200	Manhole	Private	SIC9	1200	Manhole	Private
4.001	SIC9	1200	Manhole	Private	SIC12	1200	Manhole	Private
5.000	SIC10	1200	Manhole	Private	SIC11	1200	Manhole	Private
5.001	SIC11	1200	Manhole	Private	SIC12	1200	Manhole	Private
4.002	SIC12	1200	Manhole	Private	MH1	1200	Manhole	Private
4.003	MH1	1200	Manhole	Private	Pond	1350	Manhole	Private

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)
1.004	3.500	318.2	375	Circular	1.000	-0.360	0.985	1.000	-0.371	0.996
1.005	51.561	324.3	375	Circular	1.000	-0.371	0.996	1.000	-0.530	1.155

Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
1.004	Pond	1350	Manhole	Private	PS1	1350	Manhole	Private
1.005	PS1	1350	Manhole	Private	MH2	1350	Manhole	Private

Manhole Schedule

Node	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
SIC1	1.000	0.825	1200				
				0	1.000	0.175	225
SIC2	1.000	1.032	1200				
				0	1.001	-0.032	300
SIC3	1.000	0.825	1200				
				0	2.000	0.175	150
SIC4	1.000	1.181	1200				
				1	2.000	-0.031	150
				2	1.001	-0.131	300
				0	1.002	-0.181	300
SIC5	1.000	0.750	1200				
				0	3.000	0.250	150
SIC6	1.000	0.971	1200				
				1	3.000	0.029	150
				0	3.001	0.029	150
SIC7	1.000	1.205	1200				
				1	3.001	-0.025	150
				2	1.002	-0.205	300
				0	1.003	-0.205	300
SIC8	1.000	0.760	1200				
				0	4.000	0.240	150
SIC9	1.000	0.881	1200				
				1	4.000	0.119	150
				0	4.001	0.119	150
SIC10	1.000	0.548	1200				
				0	5.000	0.452	150

Manhole Schedule

Node	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
SIC11	1.000	0.657	1200	1	5.000	0.343	150
				0	5.001	0.343	150
SIC12	1.000	1.041	1200	1	5.001	0.034	150
				2	4.001	0.034	150
				0	4.002	-0.041	225
MH1	1.000	1.165	1200	1	4.002	-0.165	225
				0	4.003	-0.165	225
Pond	1.000	1.360	1350	1	4.003	-0.188	225
				2	1.003	-0.285	300
				0	1.004	-0.360	375
PS1	1.000	1.371	1350	1	1.004	-0.371	375
				0	1.005	-0.371	375
MH2	1.000	1.530	1350	1	1.005	-0.530	375

Simulation Settings

Rainfall Methodology	FSR	Analysis Speed	Normal
FSR Region	England and Wales	Skip Steady State	x
M5-60 (mm)	20.000	Drain Down Time (mins)	240
Ratio-R	0.400	Additional Storage (m ³ /ha)	20.0
Summer CV	0.750	Check Discharge Rate(s)	x
Winter CV	0.840	Check Discharge Volume	x

Storm Durations

15 | 30 | 60 | 120 | 180 | 240 | 360 | 480 | 600 | 720 | 960 | 1440

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

Node PS1 Online Pump Control

Flap Valve	x	Design Depth (m)	1.500	Switch off depth (m)	0.050
Replaces Downstream Link	✓	Design Flow (l/s)	1.7		
Invert Level (m)	-0.371	Switch on depth (m)	0.100		

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	1.700	1.500	1.700

Node SIC2 Carpark Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Invert Level (m)	0.570	Slope (1:X)	202.0
Side Inf Coefficient (m/hr)	0.00000	Time to half empty (mins)	3	Depth (m)	0.300
Safety Factor	2.0	Width (m)	30.100	Inf Depth (m)	
Porosity	0.30	Length (m)	30.300		

Node SIC3 Carpark Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Invert Level (m)	0.570	Slope (1:X)	202.0
Side Inf Coefficient (m/hr)	0.00000	Time to half empty (mins)	0	Depth (m)	0.300
Safety Factor	2.0	Width (m)	38.400	Inf Depth (m)	
Porosity	0.30	Length (m)	30.300		

Node Pond Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	-0.360
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	407.0	0.0	1.360	800.0	0.0

Results for 2 year Critical Storm Duration. Lowest mass balance: 99.85%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	SIC1	10	0.312	0.137	22.4	0.5416	0.0000	OK
15 minute winter	SIC2	10	0.180	0.212	51.0	0.8533	0.0000	OK
15 minute summer	SIC3	9	0.224	0.049	6.2	0.0932	0.0000	OK
15 minute winter	SIC4	11	0.080	0.261	55.7	0.2953	0.0000	OK
15 minute winter	SIC5	10	0.315	0.065	5.8	0.1265	0.0000	OK
15 minute winter	SIC6	10	0.123	0.094	9.4	0.1430	0.0000	OK
15 minute winter	SIC7	11	0.043	0.248	63.2	0.2807	0.0000	OK
15 minute summer	SIC8	10	0.277	0.037	1.9	0.0522	0.0000	OK
15 minute winter	SIC9	11	0.156	0.037	1.9	0.0415	0.0000	OK
15 minute summer	SIC10	10	0.500	0.048	2.9	0.0808	0.0000	OK
15 minute winter	SIC11	10	0.375	0.032	2.9	0.0361	0.0000	OK
15 minute winter	SIC12	10	0.053	0.094	13.0	0.1844	0.0000	OK
1440 minute winter	MH1	1350	-0.046	0.119	1.8	0.1896	0.0000	OK
1440 minute winter	Pond	1350	-0.046	0.314	6.0	142.8858	0.0000	OK
1440 minute winter	PS1	1350	-0.046	0.325	1.7	0.4649	0.0000	OK
15 minute summer	MH2	1	-0.530	0.000	1.7	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute winter	SIC1	1.000	SIC2	22.3	0.880	0.648	0.7553	
15 minute winter	SIC2	1.001	SIC4	49.5	0.959	0.776	1.5608	
15 minute summer	SIC3	2.000	SIC4	6.2	1.136	0.218	0.0730	
15 minute winter	SIC4	1.002	SIC7	54.3	0.873	0.851	0.4571	
15 minute winter	SIC5	3.000	SIC6	5.7	0.609	0.398	0.3152	
15 minute winter	SIC6	3.001	SIC7	9.1	0.828	0.632	0.0899	
15 minute winter	SIC7	1.003	Pond	63.8	1.138	1.000	1.3305	
15 minute summer	SIC8	4.000	SIC9	1.9	0.577	0.132	0.0612	
15 minute winter	SIC9	4.001	SIC12	1.8	0.557	0.126	0.0416	
15 minute summer	SIC10	5.000	SIC11	2.9	0.770	0.200	0.0622	
15 minute winter	SIC11	5.001	SIC12	2.9	1.073	0.093	0.0278	
15 minute winter	SIC12	4.002	MH1	12.8	0.694	0.372	0.5167	
1440 minute winter	MH1	4.003	Pond	1.8	0.510	0.043	0.0834	
1440 minute winter	Pond	1.004	PS1	1.7	0.077	0.015	0.3500	
1440 minute winter	PS1	Pump	MH2	1.7				133.1

Results for 30 year Critical Storm Duration. Lowest mass balance: 99.85%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	SIC1	11	0.731	0.556	42.4	2.1910	0.0000	FLOOD RISK
15 minute winter	SIC2	11	0.555	0.587	88.4	2.3585	0.0000	SURCHARGED
15 minute winter	SIC3	11	0.380	0.205	11.7	0.3905	0.0000	SURCHARGED
15 minute winter	SIC4	11	0.345	0.526	93.4	0.5943	0.0000	SURCHARGED
15 minute winter	SIC5	11	0.391	0.141	11.0	0.2725	0.0000	OK
15 minute winter	SIC6	11	0.317	0.288	17.3	0.4383	0.0000	SURCHARGED
15 minute winter	SIC7	11	0.247	0.452	107.4	0.5110	0.0000	SURCHARGED
15 minute summer	SIC8	10	0.293	0.053	3.7	0.0740	0.0000	OK
15 minute winter	SIC9	10	0.170	0.051	3.7	0.0579	0.0000	OK
15 minute summer	SIC10	10	0.520	0.068	5.5	0.1138	0.0000	OK
15 minute winter	SIC11	10	0.386	0.043	5.5	0.0486	0.0000	OK
1440 minute winter	SIC12	1410	0.165	0.206	1.1	0.4040	0.0000	OK
1440 minute winter	MH1	1410	0.165	0.330	2.5	0.5267	0.0000	SURCHARGED
1440 minute winter	Pond	1410	0.165	0.525	9.3	255.2325	0.0000	SURCHARGED
1440 minute winter	PS1	1410	0.165	0.536	1.7	0.7670	0.0000	SURCHARGED
15 minute summer	MH2	1	-0.530	0.000	1.7	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute winter	SIC1	1.000	SIC2	36.4	0.916	1.056	1.1838	
15 minute winter	SIC2	1.001	SIC4	83.5	1.186	1.310	2.0960	
15 minute winter	SIC3	2.000	SIC4	10.0	1.133	0.353	0.1432	
15 minute winter	SIC4	1.002	SIC7	93.4	1.326	1.464	0.5053	
15 minute winter	SIC5	3.000	SIC6	10.3	0.679	0.713	0.5774	
15 minute winter	SIC6	3.001	SIC7	14.7	0.867	1.018	0.1433	
15 minute winter	SIC7	1.003	Pond	107.2	1.535	1.681	1.5981	
15 minute summer	SIC8	4.000	SIC9	3.7	0.681	0.256	0.0989	
15 minute winter	SIC9	4.001	SIC12	3.7	0.635	0.253	0.0852	
15 minute summer	SIC10	5.000	SIC11	5.5	0.932	0.381	0.0972	
15 minute winter	SIC11	5.001	SIC12	5.5	1.097	0.179	0.0639	
1440 minute winter	SIC12	4.002	MH1	1.1	0.260	0.032	1.0887	
1440 minute winter	MH1	4.003	Pond	2.4	0.533	0.057	0.1392	
1440 minute winter	Pond	1.004	PS1	1.7	0.077	0.016	0.3860	
1440 minute winter	PS1	Pump	MH2	1.7				142.3

Results for 100 year +40% CC Critical Storm Duration. Lowest mass balance: 99.85%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	SIC1	9	1.000	0.825	77.1	3.2530	4.0154	FLOOD
15 minute winter	SIC2	13	0.696	0.728	152.0	17.4640	0.0000	SURCHARGED
15 minute winter	SIC3	11	0.584	0.409	21.3	1.0219	0.0000	SURCHARGED
1440 minute winter	SIC4	1410	0.511	0.692	8.1	0.7828	0.0000	SURCHARGED
15 minute winter	SIC5	11	0.961	0.711	19.9	1.3728	0.0000	FLOOD RISK
15 minute winter	SIC6	11	0.632	0.603	27.8	0.9178	0.0000	SURCHARGED
1440 minute winter	SIC7	1440	0.509	0.714	9.3	0.8076	0.0000	SURCHARGED
1440 minute winter	SIC8	1440	0.510	0.270	0.3	0.3769	0.0000	SURCHARGED
1440 minute winter	SIC9	1440	0.510	0.391	0.3	0.4424	0.0000	SURCHARGED
15 minute summer	SIC10	10	0.548	0.096	10.0	0.1616	0.0000	OK
1440 minute winter	SIC11	1440	0.510	0.167	0.4	0.1889	0.0000	SURCHARGED
1440 minute winter	SIC12	1440	0.510	0.551	1.9	1.0783	0.0000	SURCHARGED
1440 minute winter	MH1	1440	0.510	0.675	3.6	1.0756	0.0000	SURCHARGED
1440 minute winter	Pond	1440	0.510	0.870	15.4	465.7688	0.0000	SURCHARGED
1440 minute winter	PS1	1440	0.509	0.880	3.3	1.2596	0.0000	SURCHARGED
15 minute summer	MH2	1	-0.530	0.000	1.7	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute winter	SIC1	1.000	SIC2	52.9	1.331	1.535	1.1838	
15 minute winter	SIC2	1.001	SIC4	96.1	1.365	1.506	2.0960	
15 minute winter	SIC3	2.000	SIC4	18.3	1.173	0.643	0.1432	
1440 minute winter	SIC4	1.002	SIC7	8.1	0.451	0.126	0.5053	
15 minute winter	SIC5	3.000	SIC6	16.4	0.933	1.136	0.5843	
15 minute winter	SIC6	3.001	SIC7	27.1	1.541	1.877	0.1433	
1440 minute winter	SIC7	1.003	Pond	9.2	0.432	0.145	1.6827	
1440 minute winter	SIC8	4.000	SIC9	0.3	0.328	0.021	0.3204	
1440 minute winter	SIC9	4.001	SIC12	0.3	0.326	0.021	0.2234	
15 minute summer	SIC10	5.000	SIC11	10.0	1.089	0.692	0.1501	
1440 minute winter	SIC11	5.001	SIC12	0.4	0.602	0.013	0.1832	
1440 minute winter	SIC12	4.002	MH1	1.8	0.260	0.051	1.1109	
1440 minute winter	MH1	4.003	Pond	3.5	0.533	0.082	0.1392	
1440 minute winter	Pond	1.004	PS1	3.3	0.077	0.030	0.3860	
1440 minute winter	PS1	Pump	MH2	1.7				148.4