

PROPOSED DEVELOPMENT AT NORTH END ROAD, YAPTON

DRAINAGE STATEMENT
INCORPORATING DRAINAGE MAINTENANCE
MANAGEMENT PLAN

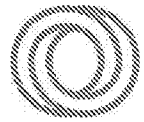
Report No. 18-343-06

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January 2020

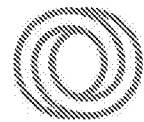


DOCUMENT CONTROL SHEET

Project Name North End Road, Yapton

Project No. 18-343

Rev	Issue Purpose	Author	Checked	Reviewed	Approved	Date
	Planning	SG	LH	SG	LH	17.01.2020
A	Updated Site Layout	SG	LH	SG	LH	18.06.2020



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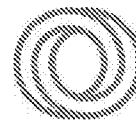
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1.0 INTRODUCTION

1.1 Odyssey has been commissioned by Redrow Homes to prepare this drainage report in support of their Reserved Matters (RM) application for the residential development at North End Road, Yapton. This follows the grant of outline planning permission on 15th February 2018 (Ref: Y/49/17/OUT). This report also sets out the background, existing drainage regime, proposed drainage regime, overland flow routes and maintenance of SuDS features.

1.2 The description of the development at the outline application was:

‘Outline application with some matters reserved for the demolition of all existing structures & redevelopment of the site with up to 45 dwellings (30% affordable (up to 14)) & 0.3 hectares of landscaped open space with vehicular access from Maypole Lane & pedestrian/cycle access only from North End Road. _

1.3 The aim of this report is to support the discharge of Conditions 12 and 13 which are set out below:

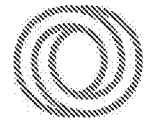
Condition 12

‘No development shall take place until details of the implementation, maintenance and management of a sustainable drainage scheme have been submitted to and approved in writing by the LPA. The scheme shall be implemented and thereafter managed and maintained in accordance with the approved details. Those details shall include:

- i) A timetable for the scheme’s implementation; and
- ii) A management and maintenance plan for the lifetime of the development which shall include the arrangements for the adoption by any public body or statutory undertaker, or any other arrangements to secure the operation of the sustainable drainage scheme throughout its lifetime.

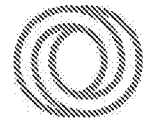
Condition 13

‘Construction of the development shall not commence until details of the proposed means of foul water sewerage have been submitted to and approved in writing by the LPA. No dwelling shall be occupied until works for the disposal of sewerage have been fully implemented in accordance with the approved details. _



2.0 EXISTING SITE

- 2.1 The proposed development site comprises of 1.8ha of greenfield land with outbuildings and is located off both Maypole Lane and North End Road to the north east of Yapton Village in West Sussex. The site is surrounded by arable land to the north, south and west, and a number of residential dwellings to the east.
- 2.2 The topographical survey shows the site to be relatively flat with a fall from north to south-west. Levels range from approximately 7.62m AOD in the north to 6.16m AOD in the south.
- 2.3 It is understood that there are no public surface water sewers in close proximity to the site and the existing drainage regime relies on surface water infiltrating through the underlying strata.
- 2.4 An intrusive ground investigation was conducted by LEAP Environmental in January 2019. A total of 17 No. trial pits were excavated throughout the development site to a maximum depth of 3.0m. The findings in their report indicate that the existing geology consists predominantly of river terrace sands and clays underlain by the chalk.
- 2.5 Infiltration testing carried out on 2 No. trial pits in accordance with BRE 365 showed the geology of the shallow soils to be unsuitable for conventional soakaways but it was indicated that deepened soakaways into more structured chalk at depth may be viable.
- 2.6 Further infiltration testing was undertaken in March 2019 on 1 No. borehole excavated to a depth of 9m. A falling head test was carried out and results identified a rate 9.60×10^{-6} m/s.
- 2.7 Throughout the first phase of testing, groundwater was not encountered in any of the trial pits. Groundwater was found at a depth of approximately 6.7m bgl during the excavation of the 1 No. borehole.
- 2.8 In accordance with the Arun DC requirements, winter groundwater monitoring (October to March inclusive) is currently being undertaken. Data will be provided upon completion.
- 2.9 It is also understood that there are no foul water sewers present within the site. The nearest public foul water sewer is located in North End Road and currently serves existing residential dwellings in the surrounding area.



3.0 PROPOSED DRAINAGE

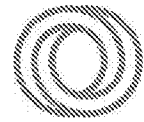
- 3.1 New foul and surface water drainage networks are proposed across the development site. The proposed foul and surface water drainage strategies are shown on Odyssey drawing 18-343/105 provided with this report in Appendix A.

Design Criteria

- 3.2 The design criteria applied for proposed drainage are as follows:
- ¿ Pipework beneath existing and proposed highways is to have a depth of at least 1.2m where possible
 - ¿ Private foul and surface water drainage is to be in accordance with Approved Document H of the Building Regulations
 - ¿ 10% urban creep has been allowed for the dwellings' hard standing areas (roofs and garages)

Surface Water Drainage

- 3.3 The proposed surface water strategy has been designed in accordance with the strategy set out in the Flood Risk Assessment (FRA) submitted as part of the outline planning application for the site. The FRA identifies the potential to discharge to ground through the use of infiltration structures such as soakaways and permeable paving as a means to drain the site.
- 3.4 Based on the testing undertaken by LEAP, the site lends itself to infiltration at depth and as a result the strategy is to infiltrate surface water run-off from roads, roofs, parking bays and parking courts into the chalk strata.
- 3.5 The proposed scheme splits the development into 3 No. catchments, as shown on drawing 18-343/108 in Appendix C. Two catchments drain to cellular soakaways located within areas of public open space (POS).
- 3.6 The remaining catchment covering the access road off Maypole Lane is to discharge via kerb drainage into an infiltration trench.
- 3.7 The surface water drainage system has been designed to accommodate all rainfall events up to 1 in 100 year event plus climate change (+40%). Supporting calculations can be found within Appendix D.



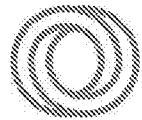
- 3.8 In some parking courts, the use of lined permeable paving system has been proposed in order to provide additional storage and treatment.
- 3.9 Surface water treatment will be provided by the permeable paving via both the grit layer and geotextile that the blocks are bedded on, as well as the underlying gravel media comprising of washed no fines material. These measures provide filtration and the breakdown of hydrocarbons as the water is conveyed through the system and into the piped network.
- 3.10 The proposed downstream defender will also provide treatment through hydrodynamic vortex separation that captures and retains sediment and pollutants from surface water runoff.

Urban Creep

- 3.11 The CIRIA SuDS Manual states that urban creep is defined as any increase in the impervious area that is drained to an existing drainage system without planning permission being required, and therefore without any consideration of whether the capacity of the receiving sewer system can accommodate the increased flow. An increase of 10% has been applied to areas which may be subject to urban creep; private drives and plot roof areas, to allow for future urban expansion on a local scale.

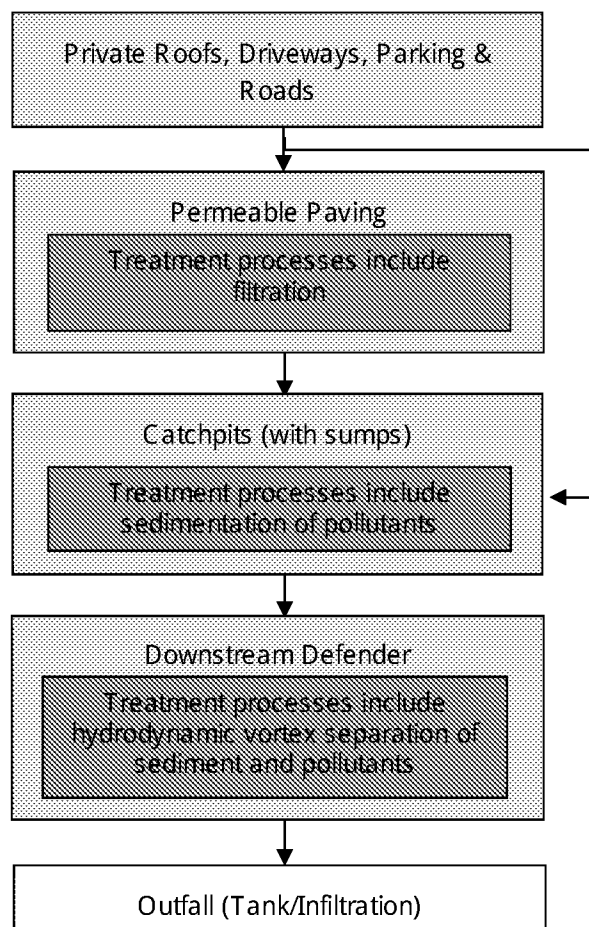
Foul Drainage

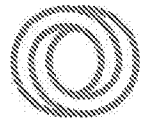
- 3.12 The proposed foul water strategy has been designed in accordance with the strategy set out in the FRA submitted as part of the outline planning application for the site.
- 3.13 It is proposed that all foul effluent created by the development will be conveyed by gravity to a pumping station located towards the south east corner east of the site. It will then be pumped via a rising main to the east before discharging into the existing Southern Water manhole 9901 in North End Road, subject to approval.
- 3.14 All drainage is to remain private and will be maintained by an appointed management company and subject to the maintenance schedules set out in Section 6 of this document.



4.0 TREATMENT OF SURFACE WATER RUN-OFF

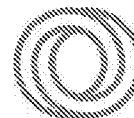
4.1 Surface water will be subject to the following treatment train prior to infiltration. The levels of proposed treatment are shown below.





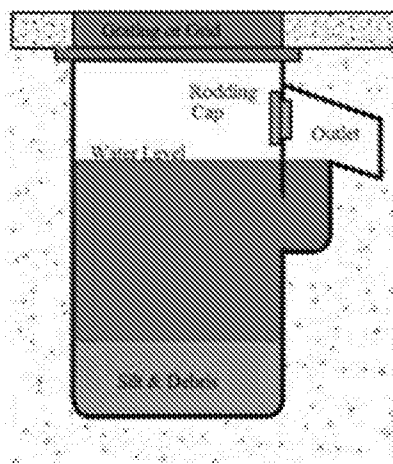
5.0 OVERLAND FLOW ROUTES AND EXCEEDANCE ROUTES

- 5.1 The calculations provided in Appendix D show there is no flooding for storm events up to and including the 1 in 100 year plus 40% climate change. If an event greater than the design storm, or a drainage system failure occurs levels have been designed such that overland flow will predominantly run away from buildings and be conveyed within the main highways and ultimately to the open spaces on site.
- 5.2 Overland flow routes have been shown on Odyssey drawing 18-343/107, which is supplied in Appendix B.



6.0 MAINTENANCE OF PIPE SYSTEMS, GULLIES AND MANHOLES

Description



- 6.1 Drainage systems comprising of pipe runs, manholes and gullies are a more conventional method of draining surface water run-off from highway areas.
- 6.2 Surface water falling on impermeable areas, such as roads and footways, drain at surface level to gullies which convey the water below ground to the main drainage network. Manholes are also provided on the main drainage system at regular intervals, changes in sewer direction, gradient or pipe diameter. This type of drainage system can be accessed from the gullies or manholes for routine inspection and maintenance.
- 6.3 Gullies are to be 'trapped' such that on collecting and conveying surface water they trap sediment and prevent any unpleasant odors returning from the sewers.

Table 6.1: Pipe Systems, Gullies and Manholes Maintenance Activities & Frequency

Maintenance Category	Maintenance Activity	Comments	Frequency
Routine Maintenance	Inspect and identify any areas that are not operating correctly.	Gullies and manholes.	Monthly (for the first 3 months) then annually.
	Remove debris from gratings, sumps / silt traps.		Annually
Infrequent Maintenance	Clear blockages.	Piped system.	As required.

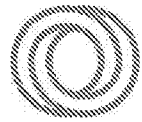
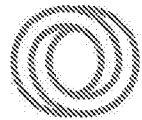
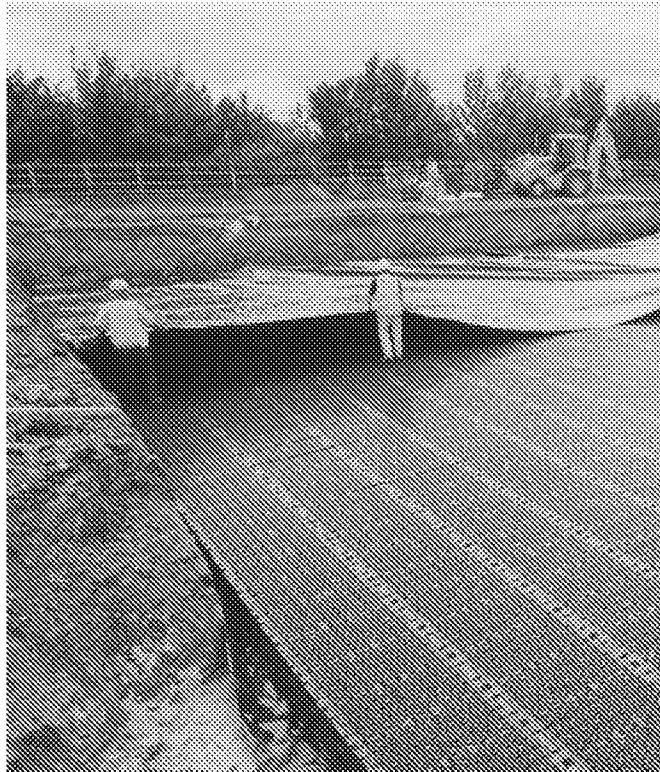


Table 6.2: Pipe Systems, Gullies and Manholes Inspection & Frequency

Inspection Activity	Comments	Frequency
Clearing of gullies / sumps	Gullies found to be non-functioning/blocked on annual inspection will be noted and cleared at 6 monthly intervals. Recurring blockages should be investigated.	Annually (or 6 monthly if blocked annually).
Cleaning / jetting	Pipes and manholes.	When required.



7.0 MAINTENANCE OF CELLULAR SYSTEMS



Description

- 7.1 Cellular (or Modular) systems provide storage within a void space. They are usually built out of plastic, or other man-made materials, and can store and infiltrate (where conditions permit) run-off. Cellular systems are sub-surface components that can cater for vehicle loading, given appropriate specification and installation depth.
- 7.2 As cellular systems only offer a limited improvement in water quality, it is preferable that they form one part of a treatment train. It is important to pre-treat upstream as this will curtail sediment influx and increase the system's longevity.
- 7.3 Surface water flow to the cellular system will be via trapped gullies prior to connecting to the piped network. All manholes immediately upstream of the cellular storage structure will incorporate a silt trap / sump. The above system will offer treatment of surface water prior to entering the cellular system.

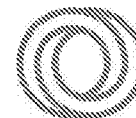


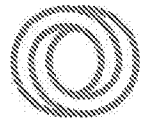
Table 7.1: Cellular System Maintenance Activities & Frequency

Maintenance Category	Maintenance Activity	Comments	Frequency
Routine Maintenance	Inspect and identify any areas that are not operating correctly.		Monthly (for the first 3 months) then six monthly.
	Remove sediment from upstream silt trap (sump).	Remove sediment from sump when 50% volume lost. N.B. Sumps must be maintained to limit sediment entry into the underground cells.	Six monthly, or as required.
Infrequent Maintenance	Clear blockage of X perforated underflow pipes (Stormcell only) by rodding / jetting.	Stormcell system (if used) should be designed with underflow pipes laid at self-cleansing velocity; reducing likelihood of blockage.	As required.
Corrective Maintenance	Excavate, uncover & jet cells to remove sediment (Wavin Aquacell or similar).		As required.

Table 7.2: Cellular System Inspection & Frequency

Inspection Activity	Comments	Frequency
Inspect all inlets / outlets, vents and overflows to check they are in good condition and operating as designed.		Annually.
Check mechanical devices within associated chambers.		Half yearly.

- 7.4 The above maintenance and inspection regime is recommended however reference should also be made to the appropriate manufacturers guidance and recommendations and the more frequent maintenance and inspection regime implemented.



8.0 MAINTENANCE OF PERMEABLE PAVING



Description

- 8.1 Permeable Block Paving allows water to pass through the gaps between the blocks into underlying sand and gravel layers allowing for the attenuation, conveyance and where possible infiltration, of surface water runoff.
- 8.2 Permeable paving will cleanse surface water run-off. The initial cleansing occurs within the sand bedding layer where hydrocarbons are collected. The layer of geotextile below the sand acts as a secondary filter before infiltration through to the sub-base further filters the discharge before connecting into the downstream pipe network.
- 8.3 A cellular diffuser unit will be utilised at the outlet of each area of permeable paving to filter outflow and mitigate any 'wash-out' of the granular material.

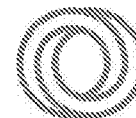


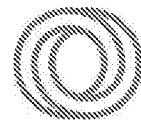
Table 8.1: Permeable Paving Maintenance Activities & Frequency

Maintenance Category	Maintenance Activity	Comments	Frequency
Routine Maintenance	Visual inspection of paving.	Ensure joints are kept fully filled.	Monthly (depending on local environment)
	Paving should be agitated (e.g. brushed, vacuumed, etc.)	To ensure no vegetation of any sort is allowed to grow and develop in the joints.	Six monthly or as required (Spring and Autumn seasons).
	Paving should be inspected after any heavy precipitations.	Ensure no displacement of any organic matter into the surface of the pavement.	As required.
Corrective Maintenance	Inspection of outfall should be undertaken.	Non-infiltration systems to have outfall checked for debris and blockages.	Six monthly or as required.
	Removal of weeds.	To ensure weeds are killed effectively they should be actively growing so that the glyphosate will go down to the roots. Glyphosate based weed killers include Roundup and Tumbleweed.	As required.
	Laying material may require cleaning and /or replacing.	Depending on the environment the permeable pavement has received and been exposed to.	25 to 30 year period.

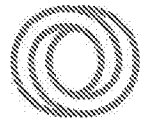
Table 8.2: Permeable Paving Inspection & Frequency

Inspection Activity	Comments	Frequency
Visual inspection of permeable surface for poor operation.	Includes visual inspection of blocks, water ponding, weeds and to make sure joints are kept full.	Monthly.
Visual inspection of outfall.	Includes visual inspection of control structures and outfall to check for damage and blockages.	Monthly.

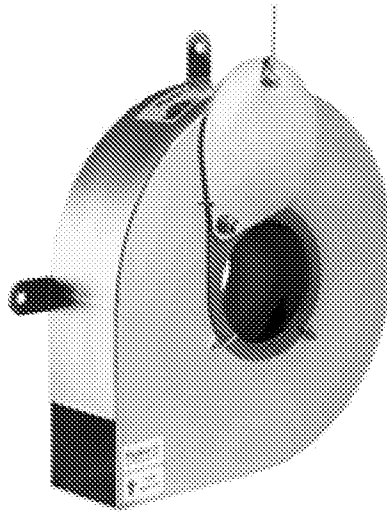
- 8.4 It is recommended that the surfaces should be regularly inspected and cleaned accordingly. Based on the results of full-scale trials carried out by Aggregate Industries, the most effective method is to use a cleaner with suction only. Even if the surface has become completely clogged, trials have shown that this method of cleaning can rehabilitate the surface to an acceptable level.



- 8.5 The maintenance and inspection regime is recommended however reference should also be made to the appropriate manufacturers guidance and recommendations and the more frequent maintenance and inspection regime implemented.



9.0 MAINTENANCE OF FLOW CONTROL DEVICES



Description

- 9.1 A flow control device usually comprises of a fixed orifice or an alternative form of throttle such as a vortex flow control unit. Its principle function is to throttle the discharge passed down stream and thereby retain water upstream within associated storage facilities.
- 9.2 The vortex flow controls provide a non-linear flow curve and as such, can respond to both high and low intensity rainfall events.
- 9.3 Normally, little maintenance is required as there are no moving parts within the Flow Control device and generally if blockages occur, they do so at the intake and can be due to poor installation or upstream treatment of water entering the system.

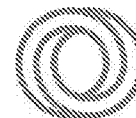


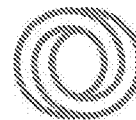
Table 9.1: Flow Control Devices Maintenance Activities & Frequency

Maintenance Category	Maintenance Activity	Comments	Frequency
Routine Maintenance	Inspect and identify any areas that are not operating correctly.		Monthly (for the first 3 months) then six monthly.
	Remove sediment from upstream silt trap (sump).		Six monthly, or as required.
	Hose down unit / chamber		Six monthly, or as required.
Infrequent Maintenance	Clear blockages	Pivoting bypass door to ensure manhole can be drained in the event of a blockage.	As required.

Table 9.2: Flow Control Inspection & Frequency

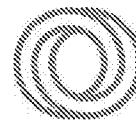
Inspection Activity	Comments	Frequency
Inspect all inlets / outlets, to check they are in good condition and operating as designed.		Annually.
Check mechanical devices within associated chambers		Half yearly.

- 9.4 The above maintenance and inspection regime is recommended however reference should also be made to the appropriate manufacturer's guidance and recommendations and the more frequent maintenance and inspection regime implemented.

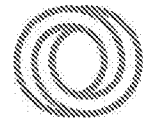


10.0 GLOSSARY

Amenity grass	Close mown grass, cut 16 times per annum to a length of 50-65mm.
Attenuation	Storage of runoff; used with a flow control to control discharge.
Baseflow	Sustained (or constant) flow required for wetlands.
Barrier vegetation	Vegetation to deter access.
Berm	A mound of earth used to control flow (similar to a submerged dam or weir).
Check dam	Small dam used to control flow, common (for swales) where site slope exceeds 4%.
Conveyance	Movement of runoff from one point to another.
Diaphragm trench	Small trench (normally containing pea gravel) acting as a silt trap prior to sheet flow onto a filter strip.
Design level (or flood level)	Level of water storage within SUDS.
Emergent vegetation	Vegetation which grows in water but which pierces the surface, e.g. Phragmites.
Energy dissipation technique	A method to reduce energy of water flow to prevent damage / erosion to the structure.
Filter bed	A gravel filled base designed to ensure the base of a structure remains dry during small storm events. Similar in nature and construction to a filter trench.
Flow control	A device used to control the discharge from a structure, e.g. weir, orifice.
Flow spreading technique	A method to reduce intensity of flow, scattering across a wider area, reducing erosion and scour.
Forebay	Small basin designed to capture and retain sediment.
Gabion	Wire baskets filled with large boulders, offering reinforcement whilst allowing water to drain through.
Geocellular system	Plastic storage system used to attenuate runoff.
Geotextile	Synthetic permeable fabric commonly used in SUDS construction, e.g. filter trenches, helping to retain sediment.
Groundwater recharge	Where surface water moves downward to groundwater.
Half drain down	Time taken for the attenuated volume (in SUDS) to reduce to half of the storage volume by infiltration or use of flow control.



Hydro-Brake	Control device to regulate flow. Uses a vortex system to achieve design flow.
Infiltration	Process by which water on the ground surface enters the soil.
Inspection chamber	Open chamber used to assess level of sediment in the structure and assess half drain down time.
Long grass	Similar to meadow grass but without wildflower mix.
Meadow (or long) grass	Long grass with wildflower mix (sown or natural) cut 1-2 times per annum.
Modular system	See geocellular system.
Overflow weir	Type of weir (hard or soft engineered) to control flow when design level is exceeded.
Penstock	An adjustable vertical sliding plate to control flow.
Permeable paving	Paving designed to allow infiltration of runoff between blocks; can be designed to attenuate or allow infiltration into the ground.
Permanent water level	Static level of water within a pond. Storage capacity is the volume above this.
Point flow	Inflow from a specific source, i.e. a pipe.
Regional control	Management of runoff from a site or several sites, typically a pond or wetland.
Reno mattress	Type of gabion, typically wider and shallower (in depth) than normal gabions.
Rip-rap	Rock or other material used to prevent erosion, reduce velocity and dissipate flow.
Runoff	Surface runoff is water from rain, snow melt or other sources that flows over the land surface.
Safety bench	Shallow sloped margin areas normally used around pond edges to reduce risk of falling in and allows ease of exit from the water following an emergency.
Scarify	Method to break up silt deposits, remove dead grass and other organic deposits and relieves compaction of the soil surface.
Scour	Localised erosion usually as a result of high flows (or velocities of flow).
Sediment forebay	See forebay.
Sheet flow	Runoff that moves as overland flow in very shallow depths.
Site control	Management of runoff from a local area or site, typically detention basins or infiltration basins.



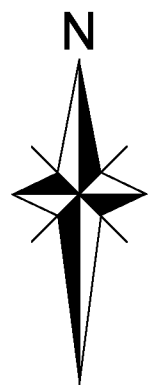
Slotted (or perforated) pipe	Pipe usually (UPVC) with holes or slots at regular intervals allowing water to drain out or in as required.
Source control	Control of runoff at or near its source, e.g. soakaway.
Spike	Method (usually mechanical) to open up soil, improving infiltration.
Spillway	Structure allowing the controlled release of water when design levels are exceeded. Can be soft or hard engineered.
Storage	See attenuation.
Stormwater	An interchangeable term for surface water runoff. See runoff.
Surface blinding	Blockage of the soil (normally by sediment) preventing infiltration.
Treatment	Improving water quality by physical, chemical and/or biological means.
Treatment train	Series of SUDS component used to provide incremental water quality improvement and storage.
Void space	The storage volume between gravel particles (usually for filter/infiltration trenches).
Weir	Horizontal structure designed to control flow.

Abbreviations

Ha	Hectare (1ha = 10,000 square metres)
SUDS	Sustainable Urban Drainage Systems

APPENDIX A

Odyssey Drawing 18-343/105

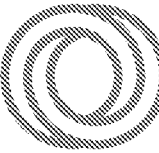


- NOTES**
- DO NOT SCALE FROM THIS DRAWING. WORK FROM FIGURED DIMENSIONS ONLY.
 - ALL DIMENSIONS SHOWN ON THIS DRAWING ARE IN METRES.
 - THIS DRAWING IS A PRELIMINARY REVIEW ONLY AND SUBJECT TO DETAILED DESIGN.
 - TOPOGRAPHICAL SURVEY TAKEN FROM MK SURVEYS DRAWING 28436.
 - ODYSSEY ACCEPT NO LIABILITY FOR THE ACCURACY OF SURVEY INFORMATION AND LAYOUTS SUPPLIED BY OTHERS.
 - THIS DRAWING IS BASED ON THE PLANNING LAYOUT PROVIDED BY GEOFF PERRY ASSOCIATES. DRAWING REFERENCE A855-047.
 - FOR OVERLAND FLOW ROUTES REFER TO ODYSSEY DRAWING 18-343/107.
 - FFL'S ARE +/- 300mm AND ARE SUBJECT TO ADJUSTMENT AT DETAILED DESIGN.

- LEGEND**
- SITE BOUNDARY
 - PROPOSED FINISHED FLOOR LEVEL(mAOD)
 - PROPOSED FINISHED GARAGE LEVEL (mAOD)
 - PROPOSED LEVEL
 - PROPOSED GRADIENT
 - STEPPED ACCESS
 - PROPOSED HIGHWAY CONTOURS.
 - INDICATIVE RETAINING WALL
 - INDICATIVE CONCRETE GRAVEL BOARD
 - FOUL SEWER AND MANHOLE (GRADIENT/PIPE SIZE)
 - SURFACE WATER SEWER AND MANHOLE (GRADIENT/PIPE SIZE)
 - EXISTING FOUL SEWER AND MANHOLE
 - DOWNSTREAM DEFENDER
 - PROPOSED CELLULAR SOAKAWAY
 - FOUL RISING MAIN
 - PROPOSED PUMPING STATION
 - PERMEABLE PAVING
 - INDICATIVE SERVICE CORRIDOR
 - TREE ROOT PROTECTION ZONE
 - GRANULAR INFILTRATION TRENCH

FOR PLANNING
PURPOSES ONLY

B	SERVICE MARGIN UPDATED	LP	LH	LH	17.06.20
A	UPDATED TO SUIT REVISED SITE LAYOUT	LP	SG	LH	12.06.20
Rev	Amendments	Dm	Chk	App	Date

**ODYSSEY**

Tuscany House
White Hart Lane
Basingstoke
Hampshire RG21 4AF

Telephone: 01256 331144
Fax: 01256 331134
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W: www.odysseyconsult.co.uk

Job Title
**NORTH END ROAD,
YAPTON**

Drawing Title
**PRELIMINARY ENGINEERING
LAYOUT**

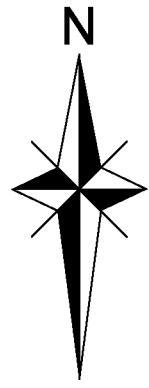
Client
 **REDROW**

Scale 1:500 @A1	Date JAN 2020	Designed SG
Drawn JA	Checked SG	Approved LH
Job No 18-343	Drawing No 18-393/105	Rev B

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APPENDIX B

Odyssey Drawing 18-343/107



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 - ALL DIMENSIONS SHOWN ON THIS DRAWING ARE IN METRES.
 - ODYSSEY ACCEPT NO LIABILITY FOR THE ACCURACY OF SURVEY INFORMATION AND LAYOUTS SUPPLIED BY OTHERS.
 - FOR PROPOSED SURFACE WATER DRAINAGE LAYOUT, REFER TO ODYSSEY DRAWING 18-343-105.

- LEGEND**
- SITE BOUNDARY
 - PROPOSED FINISHED FLOOR LEVEL (m.AOD)
 - PROPOSED GARAGE LEVEL (m.AOD)
 - PROPOSED HIGHWAY CONTOURS (20mm INTERVAL)
 - INDICATIVE DIRECTION OF OVERLAND FLOW
 - H.P. HIGH POINT
 - L.P. LOW POINT

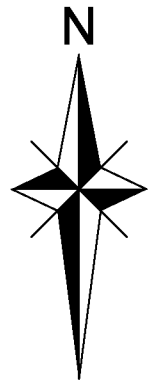
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PURPOSES ONLY

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APPENDIX C

Odyssey Drawing 18-343/108



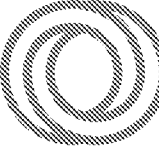
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LEGEND

	TANK 1 CATCHMENT
	TANK 2 CATCHMENT
	INFILTRATION TRENCH CATCHMENT

FOR PLANNING
PURPOSES ONLY

A		UPDATED TO SUIT REVISED SITE LAYOUT	SOM	SG	LH	12.06.20
Rev	Amendments		Dm	Chk	App	Date



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Job Title NORTH END ROAD, YAPTON		
Drawing Title SURFACE WATER CATCHMENT PLAN		
Client  REDROW		
Scale 1:500 @A1	Date JAN 2020	Designed SG
Drawn JA	Checked SG	Approved LH
Job No 18-343	Drawing No 18-393/108	Rev A

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APPENDIX D

Windes Calculations

Odyssey Markides		Page 1
Tuscany House	18-343	
White Hart Lane	North End Road, Yapton	
Basingstoke RG21 4AF	SW Network	
Date 17/01/2020 17:31	Designed by SG	
File 18-343 SW DRAINAGE +UC.MDX	Checked by	
XP Solutions	Network 2018.1	

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Storm

Pipe Sizes STANDARD Manhole Sizes STANDARD

FEH Rainfall Model	
Return Period (years)	2
FEH Rainfall Version	1999
Site Location	GB 498650 101750 SU 98650 01750
C (1km)	-0.025
D1 (1km)	0.390
D2 (1km)	0.245
D3 (1km)	0.403
E (1km)	0.310
F (1km)	2.321
Maximum Rainfall (mm/hr)	50
Maximum Time of Concentration (mins)	30
Foul Sewage (l/s/ha)	0.000
Volumetric Runoff Coeff.	0.750
PIMP (%)	100
Add Flow / Climate Change (%)	0
Minimum Backdrop Height (m)	0.200
Maximum Backdrop Height (m)	1.500
Min Design Depth for Optimisation (m)	1.200
Min Vel for Auto Design only (m/s)	1.00
Min Slope for Optimisation (1:X)	500

Designed with Level Soffits

Network Design Table for Storm

« - Indicates pipe capacity < flow

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
S1.000	9.613	0.058	167.0	0.070	4.00	0.0	0.600	o	225	Pipe/Conduit	
S1.001	40.430	0.170	238.0	0.078	0.00	0.0	0.600	o	300	Pipe/Conduit	
S1.002	9.357	0.030	313.0	0.085	0.00	0.0	0.600	o	375	Pipe/Conduit	
S1.003	24.238	0.063	385.0	0.075	0.00	0.0	0.600	o	450	Pipe/Conduit	
S1.004	29.498	0.077	385.0	0.054	0.00	0.0	0.600	o	450	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL Σ (m)	I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S1.000	50.00	4.16	4.889	0.070	0.0	0.0	0.0	1.01	40.1	9.5
S1.001	50.00	4.82	4.756	0.148	0.0	0.0	0.0	1.01	71.7	20.0
S1.002	50.00	4.98	4.512	0.233	0.0	0.0	0.0	1.02	112.5	31.6
S1.003	50.00	5.37	4.407	0.308	0.0	0.0	0.0	1.03	163.8	41.7
S1.004	50.00	5.85	4.344	0.362	0.0	0.0	0.0	1.03	163.8	49.0

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Odyssey Markides		Page 2
Tuscany House White Hart Lane Basingstoke RG21 4AF	18-343 North End Road, Yapton SW Network	
Date 17/01/2020 17:31 File 18-343 SW DRAINAGE +UC.MDX	Designed by SG Checked by	
XP Solutions	Network 2018.1	

Network Design Table for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
S2.000	21.183	1.138	18.6	0.108	4.00	0.0	0.600	o	225	Pipe/Conduit	
S1.005	32.668	0.131	250.0	0.099	0.00	0.0	0.600	o	450	Pipe/Conduit	
S1.006	29.928	0.120	250.0	0.090	0.00	0.0	0.600	o	525	Pipe/Conduit	
S3.000	28.906	1.394	20.7	0.103	4.00	0.0	0.600	o	225	Pipe/Conduit	
S4.000	10.098	1.184	8.5	0.049	4.00	0.0	0.600	o	150	Pipe/Conduit	
S1.007	4.996	0.143	34.9	0.029	0.00	0.0	0.600	o	525	Pipe/Conduit	
S1.008	2.954	0.084	35.2	0.000	0.00	0.0	0.600	o	525	Pipe/Conduit	
S1.009	6.522	0.014	465.9	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S2.000	50.00	4.12	5.630	0.108	0.0	0.0	0.0	3.05	121.2	14.6
S1.005	50.00	6.27	4.267	0.569	0.0	0.0	0.0	1.28	203.8	77.0
S1.006	50.00	6.62	4.061	0.659	0.0	0.0	0.0	1.41	305.7	89.2
S3.000	50.00	4.17	5.636	0.103	0.0	0.0	0.0	2.89	114.8	13.9
S4.000	50.00	4.05	5.501	0.049	0.0	0.0	0.0	3.47	61.3	6.6
S1.007	50.00	6.65	3.942	0.840	0.0	0.0	0.0	3.80	822.3	113.7
S1.008	50.00	6.66	3.799	0.840	0.0	0.0	0.0	3.79	819.6	113.7
S1.009	49.06	6.90	6.800	0.840	0.0	0.0	0.0	0.46	8.1	113.7

Odyssey Markides							Page 3				
Tuscany House White Hart Lane Basingstoke RG21 4AF				18-343 North End Road, Yapton SW Network							
Date 17/01/2020 17:31				Designed by SG							
File 18-343 SW DRAINAGE +UC.MDX				Checked by							
XP Solutions				Network 2018.1							
<u>Manhole Schedules for Storm</u>											
MH Name	MH CL (m)	MH Depth (m)	MH Connection	MH Diam., L*W (mm)	PN	Pipe Out Invert Level (m)	Pipe Out Diameter (mm)	PN	Pipes In Invert Level (m)	Pipes In Diameter (mm)	Backdrop (mm)
S1	6.614	1.725	Open Manhole	1200	S1.000	4.889	225				
S2	6.731	1.975	Open Manhole	1200	S1.001	4.756	300	S1.000	4.831	225	
S3	6.687	2.175	Open Manhole	1350	S1.002	4.512	375	S1.001	4.587	300	
S4	6.778	2.371	Open Manhole	1350	S1.003	4.407	450	S1.002	4.482	375	
S5	7.042	2.698	Open Manhole	1350	S1.004	4.344	450	S1.003	4.344	450	
S6	7.055	1.425	Open Manhole	1200	S2.000	5.630	225				
S7	6.770	2.503	Open Manhole	1350	S1.005	4.267	450	S1.004	4.267	450	
								S2.000	4.492	225	
S8	6.912	2.851	Open Manhole	1500	S1.006	4.061	525	S1.005	4.136	450	
S9	7.061	1.425	Open Manhole	1200	S3.000	5.636	225				
S10	6.851	1.350	Open Manhole	1200	S4.000	5.501	150				
S11	6.760	2.818	Open Manhole	1500	S1.007	3.942	525	S1.006	3.942	525	
								S3.000	4.242	225	
								S4.000	4.317	150	
S12	7.100	3.301	Open Manhole	1500	S1.008	3.799	525	S1.007	3.799	525	
S13	7.100	3.385	Open Manhole	1500	S1.009	6.800	150	S1.008	3.715	525	
S	7.000	0.214	Open Manhole	0		OUTFALL		S1.009	6.786	150	
<u>Simulation Criteria for Storm</u>											
Volumetric Runoff Coeff 0.750 Additional Flow - % of Total Flow 0.000 Areal Reduction Factor 1.000 MADD Factor * 10m³/ha Storage 2.000 Hot Start (mins) 0 Inlet Coefficient 0.800 Hot Start Level (mm) 0 Flow per Person per Day (l/per/day) 0.000 Manhole Headloss Coeff (Global) 0.500 Run Time (mins) 60 Foul Sewage per hectare (l/s) 0.000 Output Interval (mins) 1 Number of Input Hydrographs 0 Number of Storage Structures 1 Number of Online Controls 0 Number of Time/Area Diagrams 0 Number of Offline Controls 0 Number of Real Time Controls 0											
<u>Synthetic Rainfall Details</u>											
Rainfall Model FEH Return Period (years) 2 FEH Rainfall Version 1999 Site Location GB 498650 101750 SU 98650 01750 C (1km) -0.025 D1 (1km) 0.390 D2 (1km) 0.245 D3 (1km) 0.403 E (1km) 0.310											
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Odyssey Markides		Page 4
Tuscany House White Hart Lane Basingstoke RG21 4AF	18-343 North End Road, Yapton SW Network	
Date 17/01/2020 17:31	Designed by SG	
File 18-343 SW DRAINAGE +UC.MDX	Checked by	
XP Solutions	Network 2018.1	
<u>Synthetic Rainfall Details</u> F (1km) 2.321 Summer Storms Yes Winter Storms Yes Cv (Summer) 0.750 Cv (Winter) 0.840 Storm Duration (mins) 30		
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Odyssey Markides		Page 5
Tuscany House White Hart Lane Basingstoke RG21 4AF	18-343 North End Road, Yapton SW Network	
Date 17/01/2020 17:31	Designed by SG	
File 18-343 SW DRAINAGE +UC.MDX	Checked by	
XP Solutions	Network 2018.1	

Storage Structures for Storm

Cellular Storage Manhole: S13, DS/PN: S1.009

Invert Level (m) 2.800 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.06876 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m ²)	Inf. Area (m ²)	Depth (m)	Area (m ²)	Inf. Area (m ²)
0.000	429.0	408.0	1.601	0.0	539.2
1.600	429.0	539.2			

Odyssey Markides		Page 6
Tuscany House	18-343	
White Hart Lane	North End Road, Yapton	
Basingstoke RG21 4AF	SW Network	
Date 17/01/2020 17:31	Designed by SG	
File 18-343 SW DRAINAGE +UC.MDX	Checked by	
XP Solutions	Network 2018.1	

1 year Return Period Summary of Critical Results by Maximum Level (Rank 1)
for Storm

Simulation Criteria

Areal Reduction Factor 1.000 Additional Flow - % of Total Flow 0.000
Hot Start (mins) 0 MADD Factor * 10m³/ha Storage 2.000
Hot Start Level (mm) 0 Inlet Coefficient 0.800
Manhole Headloss Coeff (Global) 0.500 Flow per Person per Day (l/per/day) 0.000
Foul Sewage per hectare (l/s) 0.000

Number of Input Hydrographs 0 Number of Storage Structures 1
Number of Online Controls 0 Number of Time/Area Diagrams 0
Number of Offline Controls 0 Number of Real Time Controls 0

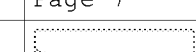
Synthetic Rainfall Details

Rainfall Model FEH
FEH Rainfall Version 1999
Site Location GB 498650 101750 SU 98650 01750
C (1km) -0.025
D1 (1km) 0.390
D2 (1km) 0.245
D3 (1km) 0.403
E (1km) 0.310
F (1km) 2.321
Cv (Summer) 0.750
Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0 DVD Status OFF
Analysis Timestep Fine Inertia Status OFF
DTS Status ON

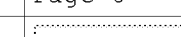
Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years) 1, 30, 100
Climate Change (%) 0, 0, 40

US/MH		Return Climate		First (X)	First (Y)	First (Z)	Overflow	Water
PN	Name	Storm	Period	Change	Surcharge	Flood	Overflow	Level
							Act.	(m)
S1.000	S1	15 Summer	1	+0%	100/15 Summer			4.964
S1.001	S2	15 Winter	1	+0%	100/15 Summer			4.853
S1.002	S3	15 Winter	1	+0%	100/15 Summer			4.646
S1.003	S4	15 Winter	1	+0%	100/15 Summer			4.559
S1.004	S5	15 Winter	1	+0%	100/15 Summer			4.502
S2.000	S6	15 Winter	1	+0%	100/15 Summer			5.680
S1.005	S7	15 Winter	1	+0%	100/15 Summer			4.429
S1.006	S8	15 Winter	1	+0%	100/15 Summer			4.228
S3.000	S9	15 Winter	1	+0%				5.685
S4.000	S10	15 Winter	1	+0%				5.533
S1.007	S11	15 Winter	1	+0%	100/15 Summer			4.116
S1.008	S12	15 Winter	1	+0%	100/15 Summer			3.987
S1.009	S13	480 Winter	1	+0%				3.011

Odyssey Markides		Page 7
Tuscany House	18-343	
White Hart Lane	North End Road, Yapton	
Basingstoke RG21 4AF	SW Network	
Date 17/01/2020 17:31	Designed by SG	
File 18-343 SW DRAINAGE +UC.MDX	Checked by	
XP Solutions	Network 2018.1	

1 year Return Period Summary of Critical Results by Maximum Level (Rank 1)
for Storm

PN	US/MH Name	Surcharged Flooded		Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
		Depth (m)	Volume (m³)					
S1.000	S1	-0.150	0.000	0.24		8.0	OK	
S1.001	S2	-0.204	0.000	0.22		14.7	OK	
S1.002	S3	-0.240	0.000	0.28		22.3	OK	
S1.003	S4	-0.298	0.000	0.21		28.3	OK	
S1.004	S5	-0.292	0.000	0.23		32.5	OK	
S2.000	S6	-0.175	0.000	0.11		12.3	OK	
S1.005	S7	-0.288	0.000	0.28		49.4	OK	
S1.006	S8	-0.358	0.000	0.22		55.7	OK	
S3.000	S9	-0.176	0.000	0.11		11.8	OK	
S4.000	S10	-0.118	0.000	0.10		5.6	OK	
S1.007	S11	-0.350	0.000	0.24		70.3	OK	
S1.008	S12	-0.337	0.000	0.28		70.0	OK	
S1.009	S13	-3.939	0.000	0.00		0.0	OK	

Odyssey Markides		Page 8
Tuscany House	18-343	
White Hart Lane	North End Road, Yapton	
Basingstoke RG21 4AF	SW Network	
Date 17/01/2020 17:31	Designed by SG	
File 18-343 SW DRAINAGE +UC.MDX	Checked by	
XP Solutions	Network 2018.1	

30 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

Number of Input Hydrographs	0	Number of Storage Structures	1
Number of Online Controls	0	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

```
Margin for Flood Risk Warning (mm) 300.0      DVD Status OFF
      Analysis Timestep   Fine Inertia Status OFF
      DTS Status         ON
```

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years)	1, 30, 100
Climate Change (%)	0, 0, 40

									Water
	US/MH		Return	Climate	First (X)	First (Y)	First (Z)	Overflow	Level
PN	Name	Storm	Period	Change	Surcharge	Flood	Overflow	Act.	(m)
S1.000	S1	15 Summer	30	+0%	100/15 Summer				5.038
S1.001	S2	15 Summer	30	+0%	100/15 Summer				4.963
S1.002	S3	15 Winter	30	+0%	100/15 Summer				4.825
S1.003	S4	15 Winter	30	+0%	100/15 Summer				4.758
S1.004	S5	15 Winter	30	+0%	100/15 Summer				4.710
S2.000	S6	15 Winter	30	+0%	100/15 Summer				5.723
S1.005	S7	15 Winter	30	+0%	100/15 Summer				4.645
S1.006	S8	15 Winter	30	+0%	100/15 Summer				4.419
S3.000	S9	15 Winter	30	+0%					5.728
S4.000	S10	15 Winter	30	+0%					5.560
S1.007	S11	15 Winter	30	+0%	100/15 Summer				4.324
S1.008	S12	15 Winter	30	+0%	100/15 Summer				4.219
S1.009	S13	480 Winter	30	+0%					3.505

Odyssey Markides		Page 9
Tuscany House White Hart Lane Basingstoke RG21 4AF	18-343 North End Road, Yapton SW Network	
Date 17/01/2020 17:31	Designed by SG	
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XP Solutions	Network 2018.1	

30 year Return Period Summary of Critical Results by Maximum Level (Rank 1)
for Storm

PN	US/MH Name	Surcharged Flooded		Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
		Depth (m)	Volume (m³)					
S1.000	S1	-0.076	0.000	0.77		25.7	OK	
S1.001	S2	-0.094	0.000	0.77		51.6	OK	
S1.002	S3	-0.062	0.000	1.00		79.9	OK	
S1.003	S4	-0.098	0.000	0.75		103.0	OK	
S1.004	S5	-0.084	0.000	0.83		117.3	OK	
S2.000	S6	-0.132	0.000	0.36		39.6	OK	
S1.005	S7	-0.072	0.000	0.99		176.1	OK	
S1.006	S8	-0.167	0.000	0.78		199.3	OK	
S3.000	S9	-0.133	0.000	0.35		37.8	OK	
S4.000	S10	-0.091	0.000	0.33		18.0	OK	
S1.007	S11	-0.142	0.000	0.86		248.2	OK	
S1.008	S12	-0.104	0.000	1.00		248.4	OK	
S1.009	S13	-3.445	0.000	0.00		0.0	OK	

Odyssey Markides		Page 10
Tuscany House	18-343	
White Hart Lane	North End Road, Yapton	
Basingstoke RG21 4AF	SW Network	
Date 17/01/2020 17:31	Designed by SG	
File 18-343 SW DRAINAGE +UC.MDX	Checked by	
XP Solutions	Network 2018.1	

100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

Areal Reduction Factor 1.000 Additional Flow - % of Total Flow 0.000
Hot Start (mins) 0 MADD Factor * 10m³/ha Storage 2.000
Hot Start Level (mm) 0 Inlet Coefficient 0.800
Manhole Headloss Coeff (Global) 0.500 Flow per Person per Day (l/per/day) 0.000
Foul Sewage per hectare (l/s) 0.000

Number of Input Hydrographs 0 Number of Storage Structures 1
Number of Online Controls 0 Number of Time/Area Diagrams 0
Number of Offline Controls 0 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FEH
FEH Rainfall Version 1999
Site Location GB 498650 101750 SU 98650 01750
C (1km) -0.025
D1 (1km) 0.390
D2 (1km) 0.245
D3 (1km) 0.403
E (1km) 0.310
F (1km) 2.321
Cv (Summer) 0.750
Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0 DVD Status OFF
Analysis Timestep Fine Inertia Status OFF
DTS Status ON

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years) 1, 30, 100
Climate Change (%) 0, 0, 40

US/MH		Return Climate		First (X)	First (Y)	First (Z)	Overflow	Water
PN	Name	Storm	Period	Change	Surcharge	Flood	Overflow	Level
							Act.	(m)
S1.000	S1	15 Winter	100	+40%	100/15 Summer			6.613
S1.001	S2	15 Winter	100	+40%	100/15 Summer			6.520
S1.002	S3	15 Winter	100	+40%	100/15 Summer			6.214
S1.003	S4	15 Winter	100	+40%	100/15 Summer			6.088
S1.004	S5	15 Winter	100	+40%	100/15 Summer			5.975
S2.000	S6	15 Winter	100	+40%	100/15 Summer			6.231
S1.005	S7	15 Winter	100	+40%	100/15 Summer			5.799
S1.006	S8	15 Winter	100	+40%	100/15 Summer			5.326
S3.000	S9	15 Winter	100	+40%				5.785
S4.000	S10	15 Winter	100	+40%				5.594
S1.007	S11	15 Winter	100	+40%	100/15 Summer			5.052
S1.008	S12	15 Winter	100	+40%	100/15 Summer			4.629
S1.009	S13	960 Winter	100	+40%				4.371

Odyssey Markides		Page 11
Tuscany House White Hart Lane Basingstoke RG21 4AF	18-343 North End Road, Yapton SW Network	
Date 17/01/2020 17:31	Designed by SG	
File 18-343 SW DRAINAGE +UC.MDX	Checked by	
XP Solutions	Network 2018.1	

100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Surcharged Flooded		Flow / Overflow		Pipe Flow	Status	Level Exceeded
		Depth (m)	Volume (m³)	Cap.	(l/s)	(l/s)		
S1.000	S1	1.499	0.000	1.26		42.0	FLOOD RISK	
S1.001	S2	1.464	0.000	1.31		87.4	FLOOD RISK	
S1.002	S3	1.327	0.000	1.71		136.5	SURCHARGED	
S1.003	S4	1.231	0.000	1.32		180.4	SURCHARGED	
S1.004	S5	1.181	0.000	1.50		210.5	SURCHARGED	
S2.000	S6	0.376	0.000	0.72		79.2	SURCHARGED	
S1.005	S7	1.082	0.000	1.87		331.7	SURCHARGED	
S1.006	S8	0.740	0.000	1.49		381.1	SURCHARGED	
S3.000	S9	-0.076	0.000	0.75		80.3	OK	
S4.000	S10	-0.057	0.000	0.70		38.2	OK	
S1.007	S11	0.586	0.000	1.69		490.2	SURCHARGED	
S1.008	S12	0.306	0.000	1.96		487.6	SURCHARGED	
S1.009	S13	-2.579	0.000	0.00		0.0	OK	

Odyssey Markides				Page 1																																																																																																																																																																																																									
Tuscany House		18-343																																																																																																																																																																																																											
White Hart Lane		North End Road, Yapton																																																																																																																																																																																																											
Basingstoke RG21 4AF		Infiltration Trench																																																																																																																																																																																																											
Date 17/01/2020 10:08		Designed by JH																																																																																																																																																																																																											
File 18-343 INFILTRATION TRE...		Checked by																																																																																																																																																																																																											
XP Solutions		Source Control 2018.1																																																																																																																																																																																																											
<u>Summary of Results for 100 year Return Period (+40%)</u> Half Drain Time exceeds 7 days. Outflow is too low. Design is unsatisfactory. <table><tr><th>Storm Event</th><th>Max Level (m)</th><th>Max Depth (m)</th><th>Max Infiltration (l/s)</th><th>Max Volume (m³)</th><th>Status</th></tr><tr><td>15 min Summer</td><td>4.000</td><td>0.580</td><td>0.0</td><td>7.6</td><td>O K</td></tr><tr><td>30 min Summer</td><td>4.076</td><td>0.656</td><td>0.0</td><td>9.2</td><td>O K</td></tr><tr><td>60 min Summer</td><td>4.167</td><td>0.747</td><td>0.0</td><td>11.1</td><td>O K</td></tr><tr><td>120 min Summer</td><td>4.276</td><td>0.856</td><td>0.0</td><td>13.4</td><td>O K</td></tr><tr><td>180 min Summer</td><td>4.350</td><td>0.930</td><td>0.0</td><td>14.9</td><td>O K</td></tr><tr><td>240 min Summer</td><td>4.407</td><td>0.987</td><td>0.0</td><td>16.1</td><td>O K</td></tr><tr><td>360 min Summer</td><td>4.495</td><td>1.075</td><td>0.0</td><td>18.0</td><td>O K</td></tr><tr><td>480 min Summer</td><td>4.562</td><td>1.142</td><td>0.0</td><td>19.4</td><td>O K</td></tr><tr><td>600 min Summer</td><td>4.618</td><td>1.198</td><td>0.0</td><td>20.6</td><td>O K</td></tr><tr><td>720 min Summer</td><td>4.665</td><td>1.245</td><td>0.0</td><td>21.6</td><td>O K</td></tr><tr><td>960 min Summer</td><td>4.697</td><td>1.277</td><td>0.0</td><td>22.2</td><td>O K</td></tr><tr><td>1440 min Summer</td><td>4.741</td><td>1.321</td><td>0.0</td><td>23.1</td><td>O K</td></tr><tr><td>2160 min Summer</td><td>4.779</td><td>1.359</td><td>0.0</td><td>24.0</td><td>O K</td></tr><tr><td>2880 min Summer</td><td>4.802</td><td>1.382</td><td>0.0</td><td>24.4</td><td>O K</td></tr><tr><td>4320 min Summer</td><td>4.910</td><td>1.490</td><td>0.0</td><td>26.7</td><td>O K</td></tr><tr><td>5760 min Summer</td><td>4.983</td><td>1.563</td><td>0.0</td><td>28.2</td><td>O K</td></tr><tr><td>7200 min Summer</td><td>5.037</td><td>1.617</td><td>0.0</td><td>29.4</td><td>O K</td></tr><tr><td>8640 min Summer</td><td>5.077</td><td>1.657</td><td>0.0</td><td>30.2</td><td>O K</td></tr><tr><td>10080 min Summer</td><td>5.107</td><td>1.687</td><td>0.0</td><td>30.8</td><td>O K</td></tr></table> <table><tr><th>Storm Event</th><th>Rain (mm/hr)</th><th>Flooded Volume (m³)</th><th>Time-Peak (mins)</th></tr><tr><td>15 min Summer</td><td>162.161</td><td>0.0</td><td>19</td></tr><tr><td>30 min Summer</td><td>98.106</td><td>0.0</td><td>34</td></tr><tr><td>60 min Summer</td><td>59.354</td><td>0.0</td><td>64</td></tr><tr><td>120 min Summer</td><td>35.909</td><td>0.0</td><td>124</td></tr><tr><td>180 min Summer</td><td>26.763</td><td>0.0</td><td>184</td></tr><tr><td>240 min Summer</td><td>21.725</td><td>0.0</td><td>244</td></tr><tr><td>360 min Summer</td><td>16.191</td><td>0.0</td><td>364</td></tr><tr><td>480 min Summer</td><td>13.143</td><td>0.0</td><td>484</td></tr><tr><td>600 min Summer</td><td>11.180</td><td>0.0</td><td>604</td></tr><tr><td>720 min Summer</td><td>9.796</td><td>0.0</td><td>724</td></tr><tr><td>960 min Summer</td><td>7.627</td><td>0.0</td><td>964</td></tr><tr><td>1440 min Summer</td><td>5.360</td><td>0.0</td><td>1444</td></tr><tr><td>2160 min Summer</td><td>3.767</td><td>0.0</td><td>2164</td></tr><tr><td>2880 min Summer</td><td>2.933</td><td>0.0</td><td>2884</td></tr><tr><td>4320 min Summer</td><td>2.197</td><td>0.0</td><td>4324</td></tr><tr><td>5760 min Summer</td><td>1.790</td><td>0.0</td><td>5768</td></tr><tr><td>7200 min Summer</td><td>1.527</td><td>0.0</td><td>7200</td></tr><tr><td>8640 min Summer</td><td>1.341</td><td>0.0</td><td>8640</td></tr><tr><td>10080 min Summer</td><td>1.202</td><td>0.0</td><td>10080</td></tr></table>						Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status	15 min Summer	4.000	0.580	0.0	7.6	O K	30 min Summer	4.076	0.656	0.0	9.2	O K	60 min Summer	4.167	0.747	0.0	11.1	O K	120 min Summer	4.276	0.856	0.0	13.4	O K	180 min Summer	4.350	0.930	0.0	14.9	O K	240 min Summer	4.407	0.987	0.0	16.1	O K	360 min Summer	4.495	1.075	0.0	18.0	O K	480 min Summer	4.562	1.142	0.0	19.4	O K	600 min Summer	4.618	1.198	0.0	20.6	O K	720 min Summer	4.665	1.245	0.0	21.6	O K	960 min Summer	4.697	1.277	0.0	22.2	O K	1440 min Summer	4.741	1.321	0.0	23.1	O K	2160 min Summer	4.779	1.359	0.0	24.0	O K	2880 min Summer	4.802	1.382	0.0	24.4	O K	4320 min Summer	4.910	1.490	0.0	26.7	O K	5760 min Summer	4.983	1.563	0.0	28.2	O K	7200 min Summer	5.037	1.617	0.0	29.4	O K	8640 min Summer	5.077	1.657	0.0	30.2	O K	10080 min Summer	5.107	1.687	0.0	30.8	O K	Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)	15 min Summer	162.161	0.0	19	30 min Summer	98.106	0.0	34	60 min Summer	59.354	0.0	64	120 min Summer	35.909	0.0	124	180 min Summer	26.763	0.0	184	240 min Summer	21.725	0.0	244	360 min Summer	16.191	0.0	364	480 min Summer	13.143	0.0	484	600 min Summer	11.180	0.0	604	720 min Summer	9.796	0.0	724	960 min Summer	7.627	0.0	964	1440 min Summer	5.360	0.0	1444	2160 min Summer	3.767	0.0	2164	2880 min Summer	2.933	0.0	2884	4320 min Summer	2.197	0.0	4324	5760 min Summer	1.790	0.0	5768	7200 min Summer	1.527	0.0	7200	8640 min Summer	1.341	0.0	8640	10080 min Summer	1.202	0.0	10080
Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status																																																																																																																																																																																																								
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8640 min Summer	5.077	1.657	0.0	30.2	O K																																																																																																																																																																																																								
10080 min Summer	5.107	1.687	0.0	30.8	O K																																																																																																																																																																																																								
Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)																																																																																																																																																																																																										
15 min Summer	162.161	0.0	19																																																																																																																																																																																																										
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240 min Summer	21.725	0.0	244																																																																																																																																																																																																										
360 min Summer	16.191	0.0	364																																																																																																																																																																																																										
480 min Summer	13.143	0.0	484																																																																																																																																																																																																										
600 min Summer	11.180	0.0	604																																																																																																																																																																																																										
720 min Summer	9.796	0.0	724																																																																																																																																																																																																										
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1440 min Summer	5.360	0.0	1444																																																																																																																																																																																																										
2160 min Summer	3.767	0.0	2164																																																																																																																																																																																																										
2880 min Summer	2.933	0.0	2884																																																																																																																																																																																																										
4320 min Summer	2.197	0.0	4324																																																																																																																																																																																																										
5760 min Summer	1.790	0.0	5768																																																																																																																																																																																																										
7200 min Summer	1.527	0.0	7200																																																																																																																																																																																																										
8640 min Summer	1.341	0.0	8640																																																																																																																																																																																																										
10080 min Summer	1.202	0.0	10080																																																																																																																																																																																																										
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Odyssey Markides				Page 2	
Tuscany House		18-343			
White Hart Lane		North End Road, Yapton			
Basingstoke RG21 4AF		Infiltration Trench			
Date 17/01/2020 10:08		Designed by JH			
File 18-343 INFILTRATION TRE...		Checked by			
XP Solutions		Source Control 2018.1			
<u>Summary of Results for 100 year Return Period (+40%)</u>					
Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
15 min Winter	4.044	0.624	0.0	8.5	O K
30 min Winter	4.128	0.708	0.0	10.3	O K
60 min Winter	4.230	0.810	0.0	12.4	O K
120 min Winter	4.353	0.933	0.0	15.0	O K
180 min Winter	4.436	1.016	0.0	16.7	O K
240 min Winter	4.500	1.080	0.0	18.1	O K
360 min Winter	4.599	1.179	0.0	20.2	O K
480 min Winter	4.675	1.255	0.0	21.8	O K
600 min Winter	4.737	1.317	0.0	23.1	O K
720 min Winter	4.791	1.371	0.0	24.2	O K
960 min Winter	4.828	1.408	0.0	25.0	O K
1440 min Winter	4.878	1.458	0.0	26.0	O K
2160 min Winter	4.924	1.504	0.0	27.0	O K
2880 min Winter	4.953	1.533	0.0	27.6	O K
4320 min Winter	5.079	1.659	0.0	30.2	O K
5760 min Winter	5.168	1.748	0.0	32.1	O K
7200 min Winter	5.234	1.814	0.0	33.5	O K
8640 min Winter	5.285	1.865	0.0	34.6	O K
10080 min Winter	5.325	1.905	0.0	35.4	O K
Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)		
15 min Winter	162.161	0.0	19		
30 min Winter	98.106	0.0	34		
60 min Winter	59.354	0.0	64		
120 min Winter	35.909	0.0	124		
180 min Winter	26.763	0.0	184		
240 min Winter	21.725	0.0	242		
360 min Winter	16.191	0.0	362		
480 min Winter	13.143	0.0	482		
600 min Winter	11.180	0.0	602		
720 min Winter	9.796	0.0	722		
960 min Winter	7.627	0.0	960		
1440 min Winter	5.360	0.0	1430		
2160 min Winter	3.767	0.0	2144		
2880 min Winter	2.933	0.0	2852		
4320 min Winter	2.197	0.0	4276		
5760 min Winter	1.790	0.0	5656		
7200 min Winter	1.527	0.0	7064		
8640 min Winter	1.341	0.0	8472		
10080 min Winter	1.202	0.0	9880		
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Odyssey Markides		Page 4
Tuscany House White Hart Lane Basingstoke RG21 4AF	18-343 North End Road, Yapton Infiltration Trench	
Date 17/01/2020 10:08 File 18-343 INFILTRATION TRE...	Designed by JH Checked by	
XP Solutions Source Control 2018.1		

Model Details

Storage is Online Cover Level (m) 6.000

Infiltration Trench Structure

Infiltration Coefficient Base (m/hr)	0.00138	Trench Width (m)	2.0
Infiltration Coefficient Side (m/hr)	0.00000	Trench Length (m)	35.0
Safety Factor	2.0	Slope (1:X)	80.0
Porosity	0.30	Cap Volume Depth (m)	2.000
Invert Level (m)	3.420	Cap Infiltration Depth (m)	0.000

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Odyssey Markides				Page 1																																																																																																																																																																																																									
Tuscany House		18-343																																																																																																																																																																																																											
White Hart Lane		North End Road, Yapton																																																																																																																																																																																																											
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Date 17/01/2020 16:01		Designed by JH																																																																																																																																																																																																											
File 18-343 TANK 2.SRCX		Checked by																																																																																																																																																																																																											
XP Solutions		Source Control 2018.1																																																																																																																																																																																																											
<u>Summary of Results for 100 year Return Period (+40%)</u> Half Drain Time exceeds 7 days. Outflow is too low. Design is unsatisfactory. <table><tr><th>Storm Event</th><th>Max Level (m)</th><th>Max Depth (m)</th><th>Max Infiltration (l/s)</th><th>Max Volume (m³)</th><th>Status</th></tr><tr><td>15 min Summer</td><td>2.907</td><td>0.107</td><td>0.0</td><td>4.6</td><td>O K</td></tr><tr><td>30 min Summer</td><td>2.929</td><td>0.129</td><td>0.0</td><td>5.5</td><td>O K</td></tr><tr><td>60 min Summer</td><td>2.956</td><td>0.156</td><td>0.0</td><td>6.7</td><td>O K</td></tr><tr><td>120 min Summer</td><td>2.988</td><td>0.188</td><td>0.0</td><td>8.0</td><td>O K</td></tr><tr><td>180 min Summer</td><td>3.010</td><td>0.210</td><td>0.0</td><td>9.0</td><td>O K</td></tr><tr><td>240 min Summer</td><td>3.026</td><td>0.226</td><td>0.0</td><td>9.7</td><td>O K</td></tr><tr><td>360 min Summer</td><td>3.052</td><td>0.252</td><td>0.0</td><td>10.8</td><td>O K</td></tr><tr><td>480 min Summer</td><td>3.072</td><td>0.272</td><td>0.0</td><td>11.6</td><td>O K</td></tr><tr><td>600 min Summer</td><td>3.088</td><td>0.288</td><td>0.0</td><td>12.3</td><td>O K</td></tr><tr><td>720 min Summer</td><td>3.102</td><td>0.302</td><td>0.0</td><td>12.9</td><td>O K</td></tr><tr><td>960 min Summer</td><td>3.112</td><td>0.312</td><td>0.0</td><td>13.3</td><td>O K</td></tr><tr><td>1440 min Summer</td><td>3.124</td><td>0.324</td><td>0.0</td><td>13.9</td><td>O K</td></tr><tr><td>2160 min Summer</td><td>3.136</td><td>0.336</td><td>0.0</td><td>14.3</td><td>O K</td></tr><tr><td>2880 min Summer</td><td>3.142</td><td>0.342</td><td>0.0</td><td>14.6</td><td>O K</td></tr><tr><td>4320 min Summer</td><td>3.173</td><td>0.373</td><td>0.0</td><td>15.9</td><td>O K</td></tr><tr><td>5760 min Summer</td><td>3.194</td><td>0.394</td><td>0.0</td><td>16.8</td><td>O K</td></tr><tr><td>7200 min Summer</td><td>3.209</td><td>0.409</td><td>0.0</td><td>17.5</td><td>O K</td></tr><tr><td>8640 min Summer</td><td>3.220</td><td>0.420</td><td>0.0</td><td>18.0</td><td>O K</td></tr><tr><td>10080 min Summer</td><td>3.228</td><td>0.428</td><td>0.0</td><td>18.3</td><td>O K</td></tr></table> <table><tr><th>Storm Event</th><th>Rain (mm/hr)</th><th>Flooded Volume (m³)</th><th>Time-Peak (mins)</th></tr><tr><td>15 min Summer</td><td>162.161</td><td>0.0</td><td>19</td></tr><tr><td>30 min Summer</td><td>98.106</td><td>0.0</td><td>34</td></tr><tr><td>60 min Summer</td><td>59.354</td><td>0.0</td><td>64</td></tr><tr><td>120 min Summer</td><td>35.909</td><td>0.0</td><td>124</td></tr><tr><td>180 min Summer</td><td>26.763</td><td>0.0</td><td>184</td></tr><tr><td>240 min Summer</td><td>21.725</td><td>0.0</td><td>244</td></tr><tr><td>360 min Summer</td><td>16.191</td><td>0.0</td><td>364</td></tr><tr><td>480 min Summer</td><td>13.143</td><td>0.0</td><td>484</td></tr><tr><td>600 min Summer</td><td>11.180</td><td>0.0</td><td>604</td></tr><tr><td>720 min Summer</td><td>9.796</td><td>0.0</td><td>724</td></tr><tr><td>960 min Summer</td><td>7.627</td><td>0.0</td><td>964</td></tr><tr><td>1440 min Summer</td><td>5.360</td><td>0.0</td><td>1444</td></tr><tr><td>2160 min Summer</td><td>3.767</td><td>0.0</td><td>2164</td></tr><tr><td>2880 min Summer</td><td>2.933</td><td>0.0</td><td>2884</td></tr><tr><td>4320 min Summer</td><td>2.197</td><td>0.0</td><td>4324</td></tr><tr><td>5760 min Summer</td><td>1.790</td><td>0.0</td><td>5768</td></tr><tr><td>7200 min Summer</td><td>1.527</td><td>0.0</td><td>7200</td></tr><tr><td>8640 min Summer</td><td>1.341</td><td>0.0</td><td>8640</td></tr><tr><td>10080 min Summer</td><td>1.202</td><td>0.0</td><td>10080</td></tr></table>						Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status	15 min Summer	2.907	0.107	0.0	4.6	O K	30 min Summer	2.929	0.129	0.0	5.5	O K	60 min Summer	2.956	0.156	0.0	6.7	O K	120 min Summer	2.988	0.188	0.0	8.0	O K	180 min Summer	3.010	0.210	0.0	9.0	O K	240 min Summer	3.026	0.226	0.0	9.7	O K	360 min Summer	3.052	0.252	0.0	10.8	O K	480 min Summer	3.072	0.272	0.0	11.6	O K	600 min Summer	3.088	0.288	0.0	12.3	O K	720 min Summer	3.102	0.302	0.0	12.9	O K	960 min Summer	3.112	0.312	0.0	13.3	O K	1440 min Summer	3.124	0.324	0.0	13.9	O K	2160 min Summer	3.136	0.336	0.0	14.3	O K	2880 min Summer	3.142	0.342	0.0	14.6	O K	4320 min Summer	3.173	0.373	0.0	15.9	O K	5760 min Summer	3.194	0.394	0.0	16.8	O K	7200 min Summer	3.209	0.409	0.0	17.5	O K	8640 min Summer	3.220	0.420	0.0	18.0	O K	10080 min Summer	3.228	0.428	0.0	18.3	O K	Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)	15 min Summer	162.161	0.0	19	30 min Summer	98.106	0.0	34	60 min Summer	59.354	0.0	64	120 min Summer	35.909	0.0	124	180 min Summer	26.763	0.0	184	240 min Summer	21.725	0.0	244	360 min Summer	16.191	0.0	364	480 min Summer	13.143	0.0	484	600 min Summer	11.180	0.0	604	720 min Summer	9.796	0.0	724	960 min Summer	7.627	0.0	964	1440 min Summer	5.360	0.0	1444	2160 min Summer	3.767	0.0	2164	2880 min Summer	2.933	0.0	2884	4320 min Summer	2.197	0.0	4324	5760 min Summer	1.790	0.0	5768	7200 min Summer	1.527	0.0	7200	8640 min Summer	1.341	0.0	8640	10080 min Summer	1.202	0.0	10080
Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status																																																																																																																																																																																																								
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Odyssey Markides				Page 2	
Tuscany House		18-343			
White Hart Lane		North End Road, Yapton			
Basingstoke RG21 4AF		Tank 2			
Date 17/01/2020 16:01		Designed by JH			
File 18-343 TANK 2.SRCX		Checked by			
XP Solutions		Source Control 2018.1			
<u>Summary of Results for 100 year Return Period (+40%)</u>					
Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
15 min Winter	2.919	0.119	0.0	5.1	O K
30 min Winter	2.944	0.144	0.0	6.2	O K
60 min Winter	2.974	0.174	0.0	7.5	O K
120 min Winter	3.011	0.211	0.0	9.0	O K
180 min Winter	3.035	0.235	0.0	10.0	O K
240 min Winter	3.054	0.254	0.0	10.9	O K
360 min Winter	3.083	0.283	0.0	12.1	O K
480 min Winter	3.105	0.305	0.0	13.0	O K
600 min Winter	3.124	0.324	0.0	13.8	O K
720 min Winter	3.139	0.339	0.0	14.5	O K
960 min Winter	3.150	0.350	0.0	15.0	O K
1440 min Winter	3.165	0.365	0.0	15.6	O K
2160 min Winter	3.178	0.378	0.0	16.2	O K
2880 min Winter	3.186	0.386	0.0	16.5	O K
4320 min Winter	3.223	0.423	0.0	18.1	O K
5760 min Winter	3.248	0.448	0.0	19.2	O K
7200 min Winter	3.267	0.467	0.0	20.0	O K
8640 min Winter	3.281	0.481	0.0	20.6	O K
10080 min Winter	3.292	0.492	0.0	21.0	O K
Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)		
15 min Winter	162.161	0.0	19		
30 min Winter	98.106	0.0	34		
60 min Winter	59.354	0.0	64		
120 min Winter	35.909	0.0	124		
180 min Winter	26.763	0.0	184		
240 min Winter	21.725	0.0	242		
360 min Winter	16.191	0.0	362		
480 min Winter	13.143	0.0	482		
600 min Winter	11.180	0.0	602		
720 min Winter	9.796	0.0	720		
960 min Winter	7.627	0.0	960		
1440 min Winter	5.360	0.0	1430		
2160 min Winter	3.767	0.0	2140		
2880 min Winter	2.933	0.0	2852		
4320 min Winter	2.197	0.0	4276		
5760 min Winter	1.790	0.0	5656		
7200 min Winter	1.527	0.0	7064		
8640 min Winter	1.341	0.0	8464		
10080 min Winter	1.202	0.0	9872		
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Tuscany House	18-343	
White Hart Lane	North End Road, Yapton	
Basingstoke RG21 4AF	Tank 2	
Date 17/01/2020 16:01	Designed by JH	
File 18-343 TANK 2.SRCX	Checked by	
XP Solutions		Source Control 2018.1

Model Details

Storage is Online Cover Level (m) 6.900

Cellular Storage Structure

Invert Level (m) 2.800 Safety Factor 2.0

Infiltration Coefficient Base (m/hr) 0.00138 Porosity 0.95

Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	45.0	45.0	0.501	0.0	59.0
0.500	45.0	59.0			

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