

MERIDIAN

CIVIL ENGINEERING CONSULTANCY

IVY FARM,
GIDDEAHALL,
CHIPPENHAM,
SN14 7EW

SURFACE WATER DRAINAGE STRATEGY

OCTOBER 2025

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Client : Stonewood Builders

Rev	Date	Prepared by	Checked by	Approved by
P01	07/10/2025	DF	MN	MN
P02	27/11/2025	DF	MN	MN

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1.0 INTRODUCTION

- 1.1 Meridian Civil Engineering Consultancy LTD (MCEC) has been instructed by Stonewood Builders to prepare a Surface Water Drainage Strategy for the development at Ivy Farm, Giddeahall, Chippenham, SN14 7EW.
- 1.2 It is understood the proposed development is for the construction of a 4237m² horse riding area.
- 1.3 The Environment Agency (EA) mapping for Flood Risk (Figure 3), shows the site to be located largely within Flood Zone 1 (Low risk of fluvial or tidal flooding indicating a less than 0.1% annual probability of flooding).
- 1.4 The Environment Agency (EA) mapping for surface water shows the site to be at very low risk of surface water flooding.
- 1.5 According to the British Geological Survey (BGS) Geology Viewer, bedrock geology on site is comprised of limestone and mudstone. This is an area with high groundwater vulnerability so runoff must be treated properly before being infiltrated.
- 1.6 Current local Sustainable drainage guidance is to reduce the peak runoff rate to the QBAR greenfield rate, or as close as practical in line with Wiltshire County Council. This has been achieved by attenuating and infiltrating all runoff on site.
- 1.7 An infiltration test was conducted in riding area on September 19th 2025; the slowest of the tests yielded an infiltration rate of 1.47x10⁻⁵m/s. This has been used in the infiltration calculations in line with best practice. A safety factor of 2 has been used in the calculation in line with guidance set out in the national standards for sustainable drainage systems (SuDS)
- 1.8 Due to the possibility of contamination, runoff from the riding area is proposed be treated and attenuated in the gravel subbase beneath the Wax track. This subbase provides 190m³ of attenuation.
- 1.9 This report has been produced broadly in accordance with the National Planning Policy Framework (NPPF), the Ciria SuDS manual, Wiltshire County Council LLFA guidance.

2.0 POLICY COMPLIANCE

- 2.1 The purpose of this assessment is to demonstrate that the development proposal outlined above can be satisfactorily accommodated without worsening flood risk for the area and without placing the development itself at risk of flooding, as per the:
 - National Planning Policy Framework
 - Ciria SuDS Manual
 - Wiltshire County Council LLFA guidance
 - National standards for sustainable drainage systems (SuDS)

3.0 SITE LOCATION

- 3.1 The proposed development location is at Ivy Farm, Giddeahall, Chippenham, SN14 7EW. The site location is outlined within Figure 1 below.



Figure 1 - Site location within red line boundary

- 3.2 It is understood the proposed development is for the construction of a 4237m² horse riding area. Architect's plans showing the proposed works are included in appendix I

4.0 GEOLOGY AND INFILTRATION POTENTIAL

- 4.1 According to the British Geological Survey (BGS) Geology Viewer, bedrock geology on site is comprised of limestone and mudstone. The site is shown within an area with high groundwater vulnerability so runoff must be treated properly before being infiltrated.
- 4.2 Infiltration testing was conducted by Earthstone construction on 19th September 2025 to determine the infiltration rate in the riding area. The slowest of the test results ($1.47 \times 10^{-5} \text{m/s}$) was used in the model in this area.
- 4.3 The Infiltration test result document is included in appendix IV.

5.0 SOURCES OF FLOODING

5.1 Tidal and Fluvial

- 5.1.1 The Environment Agency (EA) mapping for Flood Risk (Figure 3), shows the site to be located largely within Flood Zone 1 (Low risk of fluvial or tidal flooding indicating a less than 0.1% annual probability of flooding).

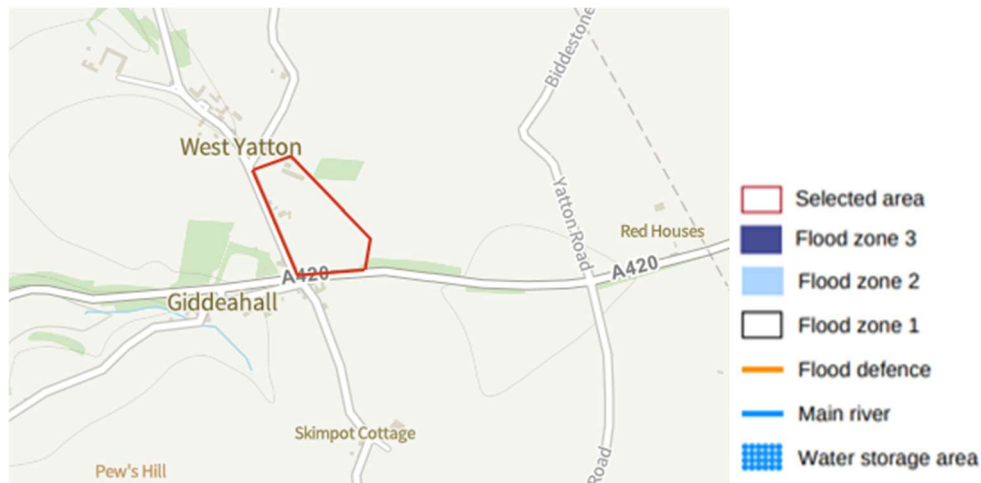


Figure 3 - EA Flood Map for planning Extract

6.0 CLIMATE CHANGE ALLOWANCES

- 6.1 Making an allowance for climate change in the design of surface water drainage systems will help to minimise vulnerability and provide resilience to flooding and coastal change in the future. Climate Change allowances vary across the UK subject to catchment conditions and are based on climate change projections and different scenarios of carbon dioxide (CO₂) emissions to the atmosphere.
- 6.2 Climate change allowances were recently updated by the EA and the climate change allowances are now defined by River Catchment peak rainfall allowances and peak river flow allowances.
- 6.3 The data published on the DEFRA database shows the site located within the Colne Management Catchment and for this residential development (lifespan 100yrs) an upper end allowance of 45% should be applied to rainfall events as the climate change allowance within this region.

7.0 SUSTAINABLE URBAN DRAINAGE (SUDS) ASSESSMENT

7.1 In accordance with the SuDS management train approach, the use of various SuDS measures to reduce and control surface water flows have been considered in detail for the development.

7.2 The management of surface water has been considered in respect to the SuDS hierarchy below as detailed in the CIRIA 753 'The SUDS Manual', Section 3.2.3:

SUDS DRAINAGE HIERARCHY				
			Suitability	Comment
	1.	Store rainwater for later use	✓	Rainwater harvesting should be considered by the developer.
	2.	Use infiltration techniques, such as porous surfaces in non-clay areas	✓	Infiltration proposed through the riding area subbase
	3.	Attenuate rainwater in ponds or open water features for gradual release	x	Unnecessary due to management further up hierarchy
	4.	Attenuate rainwater by storing in tanks or sealed water features for gradual release	x	Unnecessary due to management further up hierarchy
	5.	Discharge rainwater direct to a watercourse	x	Unnecessary due to management further up hierarchy
	6.	Discharge rainwater to a surface water sewer/drain	x	Unnecessary due to management further up hierarchy
	7.	Discharge rainwater to Combined Sewer	x	Unnecessary due to management further up hierarchy

Table 1: SuDS Drainage Hierarchy

7.3 The total impermeable area remains unchanged as the riding area is constructed from permeable materials. 150mm of clean crushed stone under the riding area provide treatment and attenuation.

7.4 The suitability of SuDS components has been assessed in order to provide a sustainable means of providing the required attenuation volumes. The following components have been assessed as follows in Table 2, below.

SUITABILITY OF SUDS		
SuDS Component	Comment	Suitability
Infiltrating SuDS	Runoff to be infiltrated through riding area subbase.	✓
Permeable Pavement	The subbase of the riding area is to be constructed from permeable materials.	✓
Green / Blue Roofs	There are no proposed buildings on site.	x
Rainwater Harvesting	Water butts are impractical in this location	x
Swales	Insufficient space to implement such conveyancing SuDS techniques	x
Rills and Channels	A 600mm drainage channel is to be installed around the perimeter of the riding area, this has been excluded from calculations.	✓
Bioretention Systems	These could be provided in landscaping areas for amenity but would overall provide little benefit to the required storage volumes.	✓
Retention Ponds and Wetlands	Unnecessary due to management further up the hierarchy	X
Detention Basins	Unnecessary due to management further up the hierarchy	x
Geocellular Systems	Unnecessary due to management further up the hierarchy	x
Proprietary Treatment Systems	Unnecessary due to management further up the hierarchy	x
Filter Drains and Filter Strips	Unnecessary due to management further up the hierarchy	x

Table 2: Suitability of SuDS Components

7.5 Rainwater harvesting

7.5.1 The standard position taken by regulators, is that the storage provided within water butts or rainfall harvesting measures does not normally count towards the attenuation storage requirements as there is no guarantee that these devices would be empty at the time that a rainfall event occurs. The principle which allows rainwater systems to be designed to provide surface water control (prevent runoff) is based on demand being greater (on average over a period of time) than the supply to it. As such, rainwater harvesting can be considered around the site in the form of water butts, but has been excluded from any storage calculations.

8.0 SURFACE WATER DRAINAGE STRATEGY

- 8.1 The surface of the large riding area will be of permeable construction. Infiltration testing was conducted in this area on September 19th 2025; the slowest of the tests yielded an infiltration rate of $1.47 \times 10^{-5} \text{m/s}$.
- 8.2 Runoff from the riding area is conveyed through filter drains in the subsurface layer at 5m centres. The riding area subbase has 150mm depth of 6-20mm clean crushed stone providing 191m^2 of attenuation. This area is proposed to be underlain with a permeable membrane.
- 8.3 Supporting calculations in Appendix III show the predicted 100 year + 45% climate change storm event can be attenuated and infiltrated on site.

9.0 WATER QUALITY

- 9.1 The primary risk to water quality is from the riding area. The plans included in Appendix II and III shows permeable sub base proposed to be provided to treat surface water runoff.
- 9.2 To avoid any traces of faecal matter being infiltrated, it is directed through the permeable subbase to be treated.
- 9.3 The Pollution Hazard Indices are summarised in Table 4 – Summary of Pollution Hazard Indices for different Land Use below (based on Table 26.2 of The SuDS Manual). As the riding area isn't included in the SuDS manual we have assumed a medium risk of suspended solids and a lower risk of metals and hydrocarbons.

POLLUTION HAZARD INDICES FOR DIFFERENT LAND USE CLASSIFICATIONS				
LAND USE	Pollution Hazard Level	Total Suspended Solids	Metals	Hydrocarbons
Riding Area	Low	0.7	0.1	0.1
TOTAL POLLUTION HAZARD INDEX		0.5	0.4	0.4

Table 4: Summary of Pollution hazard Indices for different Land Use

- 9.4 When designing suitable treatment trains to deliver adequate treatment prior to discharging to sewers, watercourse or groundwater, consideration of the treatment properties of each SuDS component specified should be reviewed. With the total mitigation potential of a SuDS treatment train determined by:

$$SuDS_1 + 0.5 * SuDS_2 + 0.5 * SuDS_3 \dots = Total\ SuDS\ Mitigation\ Index$$

- 9.5 The Mitigation Indices of the proposed SuDS techniques are summarised in Table 6 below.

INDICATIVE SuDS MITIGATION INDICES FOR DISCHARGES TO SURFACE WATER			
SuDS Component	Total Suspended Solids	Metals	Hydrocarbons
Permeable Paving	0.7	0.6	0.7
TOTAL SUDS MITIGATION INDEX	0.7	0.6	0.7

Table 5: Indicative SuDS Mitigation Indices.

- 9.6 It can be seen that the Total SuDS Mitigation Index $\geq$ Pollution Hazard Index therefore the water treatment provided by this SuDS train is enough to remove the potential pollutants.

10.0 SCHEDULE OF MAINTENANCE

- 10.1 All onsite SuDS and drainage systems will be privately maintained. The property owner will be responsible for the management and maintenance of SuDS devices. A long-term maintenance regime should be agreed with the site owners before adoption.
- 10.2 In addition to a long-term maintenance regime, it is recommended that all drainage elements implemented on site should be inspected following the first rainfall event post-construction and monthly for the first quarter following construction. Typical key suds components operation and maintenance activities are provided below.

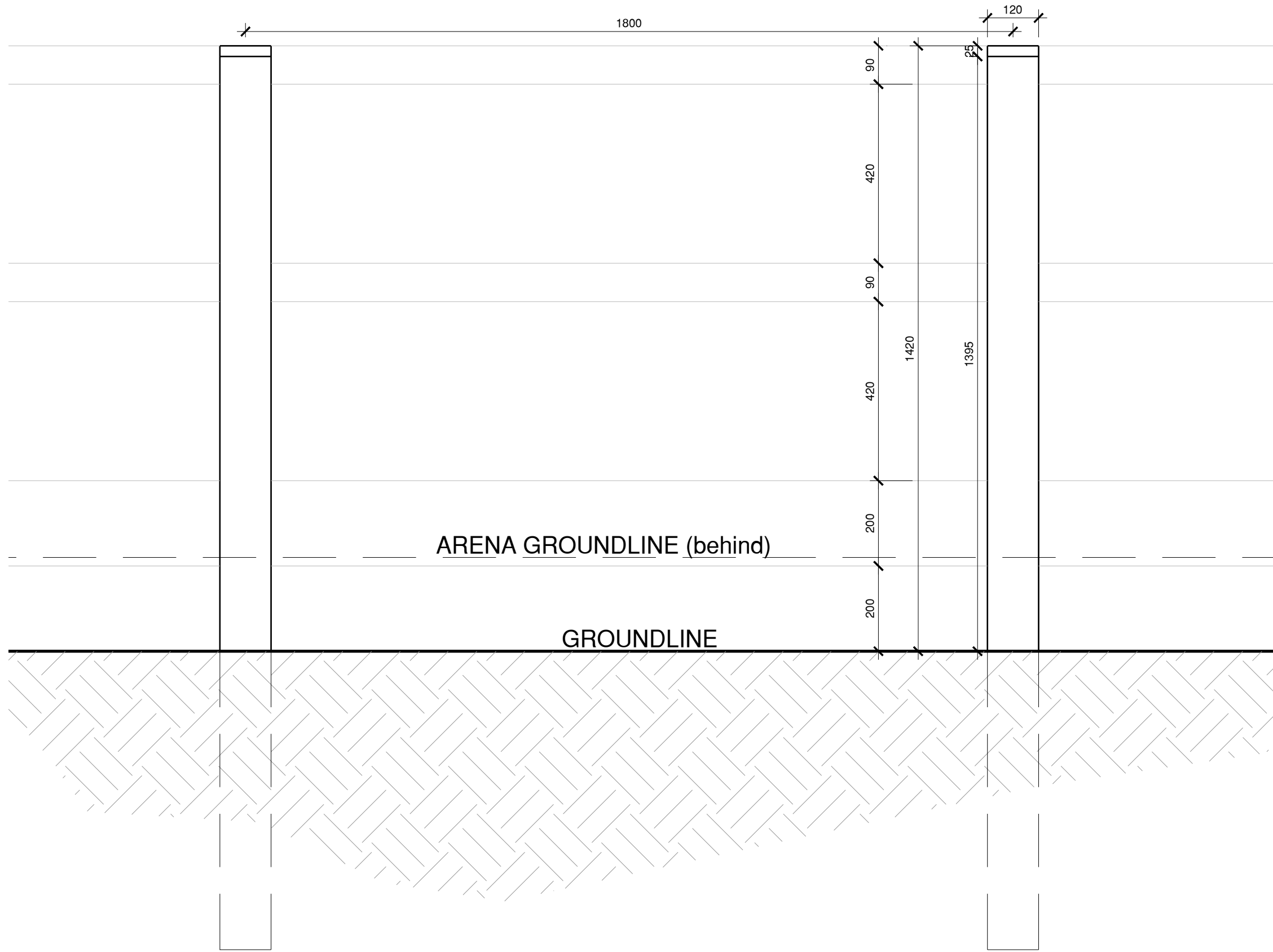
PROPOSED SCHEDULE OF MAINTENANCE FOR BELOW GROUND DRAINAGE				
Item	Visual Inspection	Cleanse / De-sludge	CCTV Survey	Comments
Surface Water Drainage System (pipework, chambers etc.)	5 years	10 years	10 years	Cleansing to be carried as necessary
Gullies/Channels	1 year	1 year	N/A	Cleansing to be carried as necessary
Permeable Paving	1 year	'Swept' clean of debris every 2 years.	N/A	Lift surfacing and remove sand bedding and replace and re-bed surfacing – refer to individual manufacturers recommendations.

Table 6: Schedule of Maintenance for Below Ground Drainage

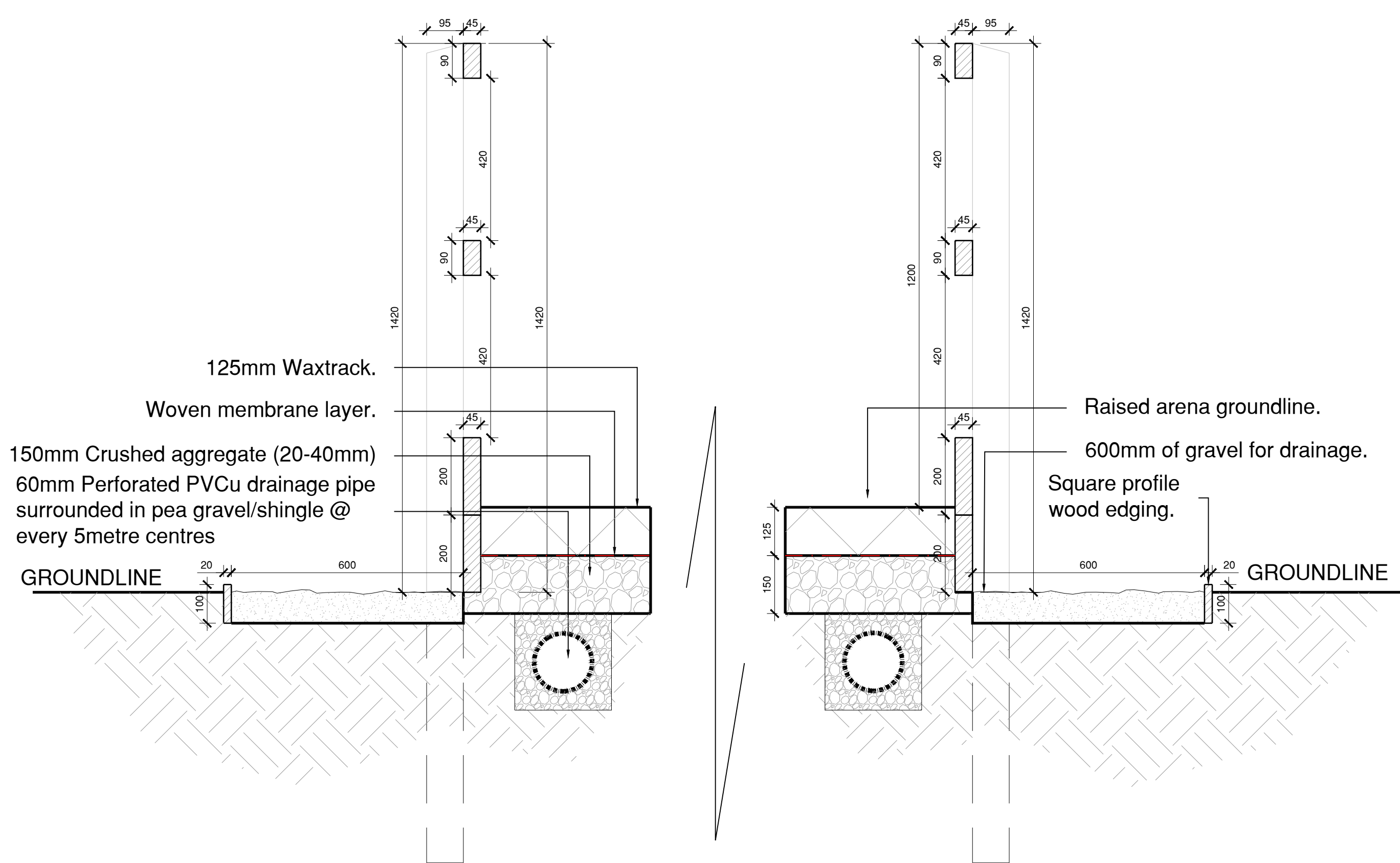
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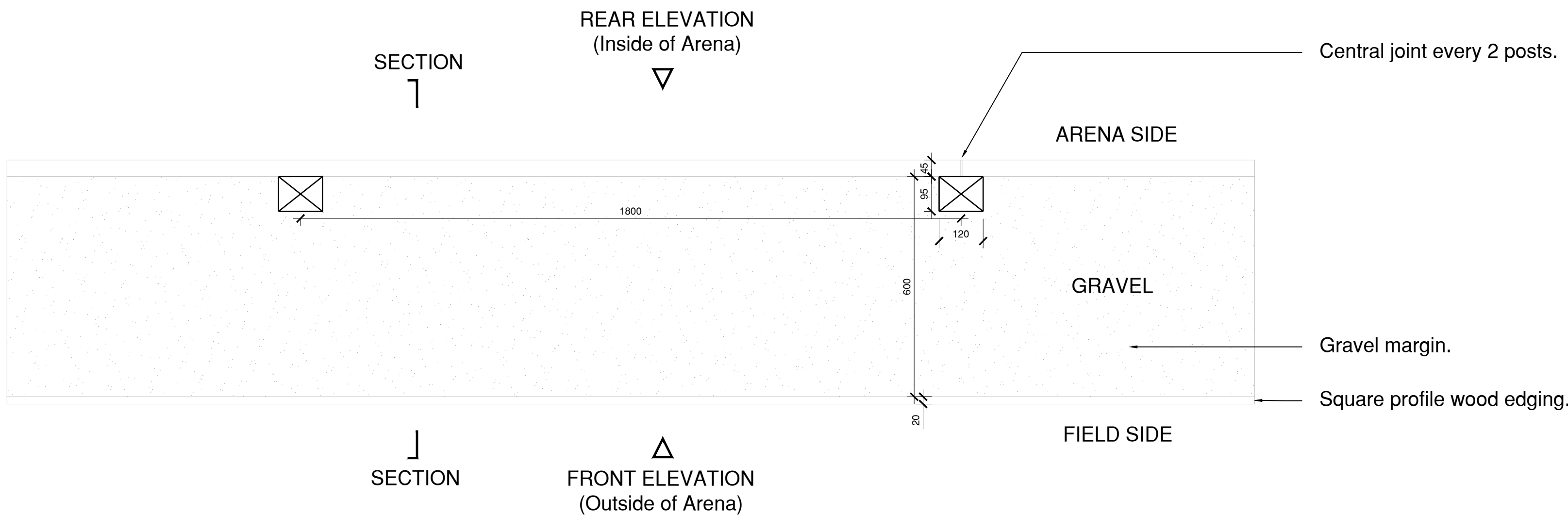
APPENDIX I Architects plans



ELEVATION OF FENCING FROM OUTSIDE ARENA (SCALE 1:10)



DETAIL SECTION THROUGH FENCING (SCALE 1:10)



DETAIL PLAN OF FENCING (SCALE 1:10)

0m 0.2m 0.4m 0.6m 0.8m 1m
Scale: 1:10

DO NOT SCALE
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THIS DRAWING IS THE PROPERTY OF HAPTICITY
ARCHITECTS AND SHALL NOT BE REPRODUCED BY
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AND LEVELS ON SITE AND REPORT ANY ERRORS/
DISCREPANCIES TO THE ARCHITECT

NOTES:

revision:	date:



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ARCHITECTS

Countess of Huntingdon's Chapel
Vineyards, Bath BA1 5NA

info@hapticity.co.uk / tel: 01225 443 679

drawing title:

**Proposed Riding Arena
Fencing & floor build up details**

status:

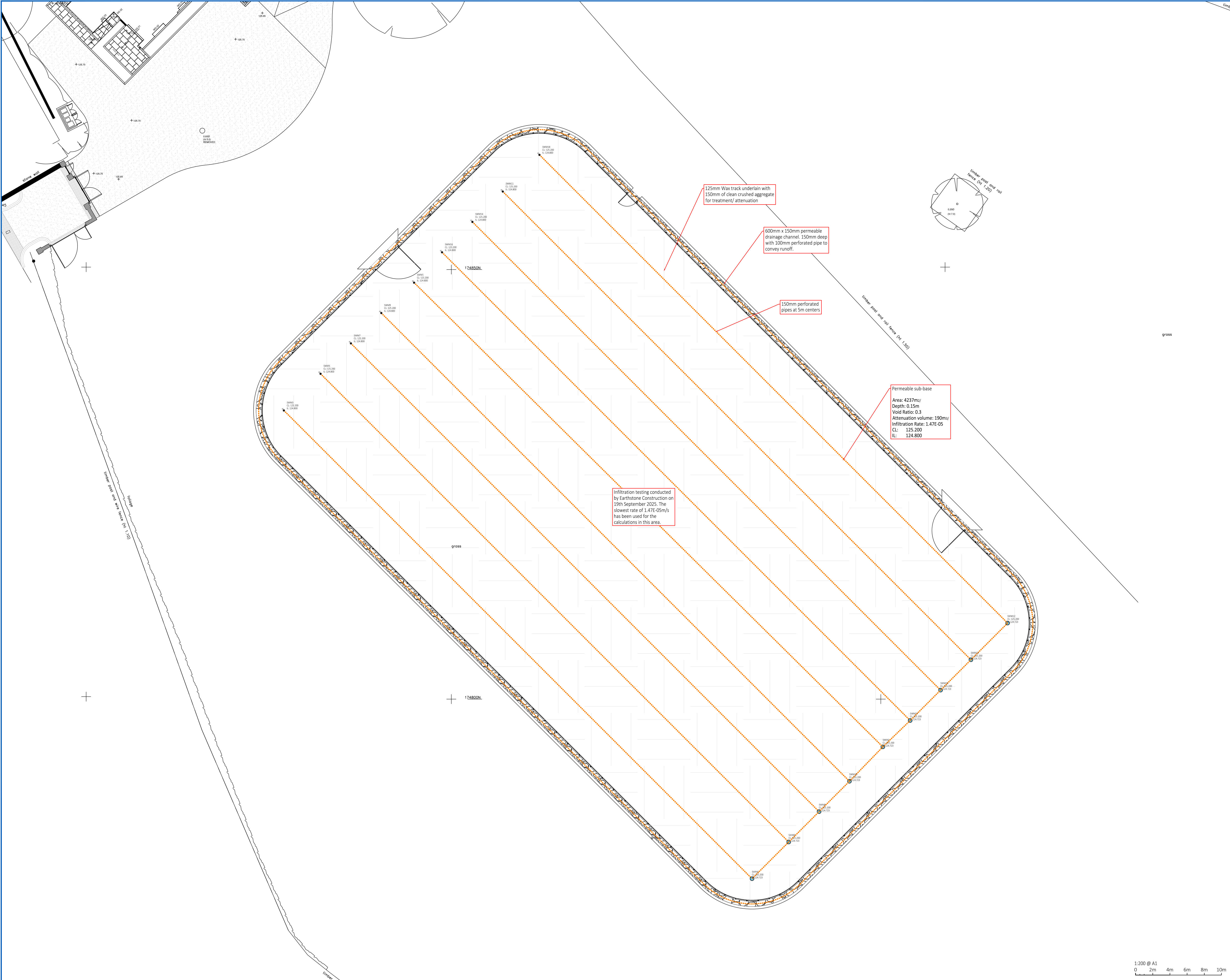
PLANNING

project:

Oak Lodge
West Yatton, Yatton Keynell
Chippenham, SN11 7EW

date:	JUNE 2025	dwn/ichkd:	JW/NC
reference:	218-PL23	revision:	-
		scale @ A1:	1:10

APPENDIX II Proposed Drainage Layout



- GENERAL

a. THIS DRAWING IS NOT TO BE SCALED, WORK TO FIGURED DIMENSIONS ONLY, CONFIRMED ON SITE.

b. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL RELEVANT ARCHITECTURAL DRAWINGS, DETAILED SPECIFICATIONS WHERE APPLICABLE AND ALL ASSOCIATED DRAWINGS IN THIS SERIES.

c. ANY DISCREPANCY ON THIS DRAWING IS TO BE REPORTED IMMEDIATELY TO THE PARTNERSHIP FOR CLARIFICATION.

d. THE CONTRACTOR IS RESPONSIBLE FOR ALL TEMPORARY WORKS AND FOR THE STABILITY OF THE WORKS IN PROGRESS.

e. CDM REGULATIONS 2015: ALL CURRENT DRAWINGS AND SPECIFICATIONS MUST BE READ IN CONJUNCTION WITH THE DESIGNER'S HAZARD RISK AND ENVIRONMENT ASSESSMENT RECORD. DESIGN HAS BEEN PRODUCED BASED ON INFORMATION PROVIDED BY THE CLIENT/PRINCIPLE DESIGNER AVAILABLE AT TIME OF ISSUE. CONTRACTOR TO REVIEW DRAWING AND SPECIFICATION IN CONTEXT WITH THE WIDER SITE AND SPECIFIC SITE INVESTIGATION, CONTAMINATION ASSESSMENT, ASBESTOS SURVEY, ENVIRONMENTAL SURVEY, UXO SURVEY AND ANY OTHER RELEVANT INFORMATION AND MANAGE RISKS RELATING TO THE WORKS OUTLINED IN THE DRAWINGS AND SPECIFICATION. PRINCIPLE CONTRACTOR TO MAKE DESIGNER AND CLIENT AWARE OF SITE SPECIFIC RISKS THAT MAY AFFECT THE DRAWING AND SPECIFICATION.

f. CDM REGULATIONS 2015: FOR GENERIC MAINTENANCE AND MANAGEMENT RISKS REFER TO CHAPTER 36 OF CRIA 752 SUDS MANUAL. FOR PROPRIETARY SYSTEMS SEE MANUFACTURER'S MANAGEMENT AND MAINTENANCE DETAILS AND RISK ASSESSMENT WITH REGARDS TO MAINTENANCE OF PROPRIETARY SYSTEMS.
- CONSTRUCTION NOTE

a. THE MAIN CONTRACTOR IS RESPONSIBLE FOR THE DESIGN OF ALL TEMPORARY WORKS, AND IS ALSO RESPONSIBLE FOR THE SAFE MAINTENANCE AND STABILITY OF EXISTING BUILDINGS AT ALL TIMES.

b. THE MAIN CONTRACTOR IS RESPONSIBLE FOR ALL OCCURRENCES OF GROUND WATER DURING THE CONSTRUCTION PERIOD.

c. ANY INFORMATION GIVEN REGARDING EXISTING UNDERGROUND SERVICES IS GIVEN IN GOOD FAITH AFTER CONSULTATION WITH THE RELEVANT AUTHORITY, HOWEVER ACCURACY IS NOT CERTAIN. THE MAIN CONTRACTOR IS RESPONSIBLE FOR CHECKING ALL INFORMATION ON SITE PRIOR TO WORK COMMENCING AND TAKING DUE CARE AND ATTENTION WHILST UNDERTAKING THE WORKS.

d. THE CONTRACTOR MUST COMPLY WITH ALL CURRENT LEGISLATION RELATING TO HEALTH & SAFETY.

e. ALL PRODUCTS SPECIFIED SHALL BE INSTALLED IN STRICT ACCORDANCE WITH THE MANUFACTURERS RECOMMENDATIONS AND INSTRUCTIONS. IF THERE ARE DISCREPANCIES BETWEEN THAT INFORMATION AND THE DETAILS ON ANY MERIDIAN DRAWINGS, THE MANUFACTURERS INSTRUCTIONS MUST BE USED.
- BELOW GROUND DRAINAGE

a. UPVC-U PIPES TO BS 4660: 2000 AND PLASTIC INSPECTION CHAMBERS AND FITTINGS TO BS EN 13598-1:2020. CLAY PIPES TO BS EN 295-1:2013. CONCRETE MANHOLE AND INSPECTION CHAMBERS TO BS EN 1917:2002.

b. ALL ADAPTABLE DRAINAGE TO BE CONSTRUCTED IN ACCORDANCE WITH SEWERAGE SECTOR GUIDANCE App C - DESIGN AND CONSTRUCTION GUIDANCE AND THE RELEVANT COUNCIL DESIGN GUIDE.

c. ALL PRIVATE FOUL WATER SEWERS TO BE LAID AT 1 IN 40 AT THE HEAD OF PIPE RUNS AND 1 IN 80 ELSEWHERE UNLESS OTHERWISE STATED.

d. ALL PRIVATE FOUL SEWER PIPES TO BE 100mm DIAMETER FROM SOIL STACKS UNLESS OTHERWISE STATED ON THE DRAWING AND 150mm WHERE SERVING MORE THAN 9 PROPERTIES.

e. ALL PRIVATE SURFACE WATER SEWERS TO BE LAID AT 1 IN 100 UNLESS OTHERWISE STATED ON THE DRAWING.

f. ALL PRIVATE SURFACE WATER SEWER PIPES TO BE 100mm DIAMETER FROM DOWNPIPES AND 150mm DIAMETER ELSEWHERE UNLESS OTHERWISE STATED ON THE DRAWING.

g. ALLOW FOR RODDING ACCESS ABOVE GROUND WHERE RAINWATER DOWNPIPES OR SOIL STACKS DO NOT HAVE A DIRECT CONNECTION TO AN INSPECTION CHAMBER.

h. EXISTING SEWER PIPE TO BE RE-USED TO BE SURVEYED AND LEVELED PRIOR TO COMMENCEMENT OF THE DRAINAGE WORKS AND REFRUBISHED IF NECESSARY.

i. CONNECTIONS TO AN ADOPTED SEWER ONLY TO BE MADE FOLLOWING APPROVAL FROM THE RELEVANT ADOPTING AUTHORITY.

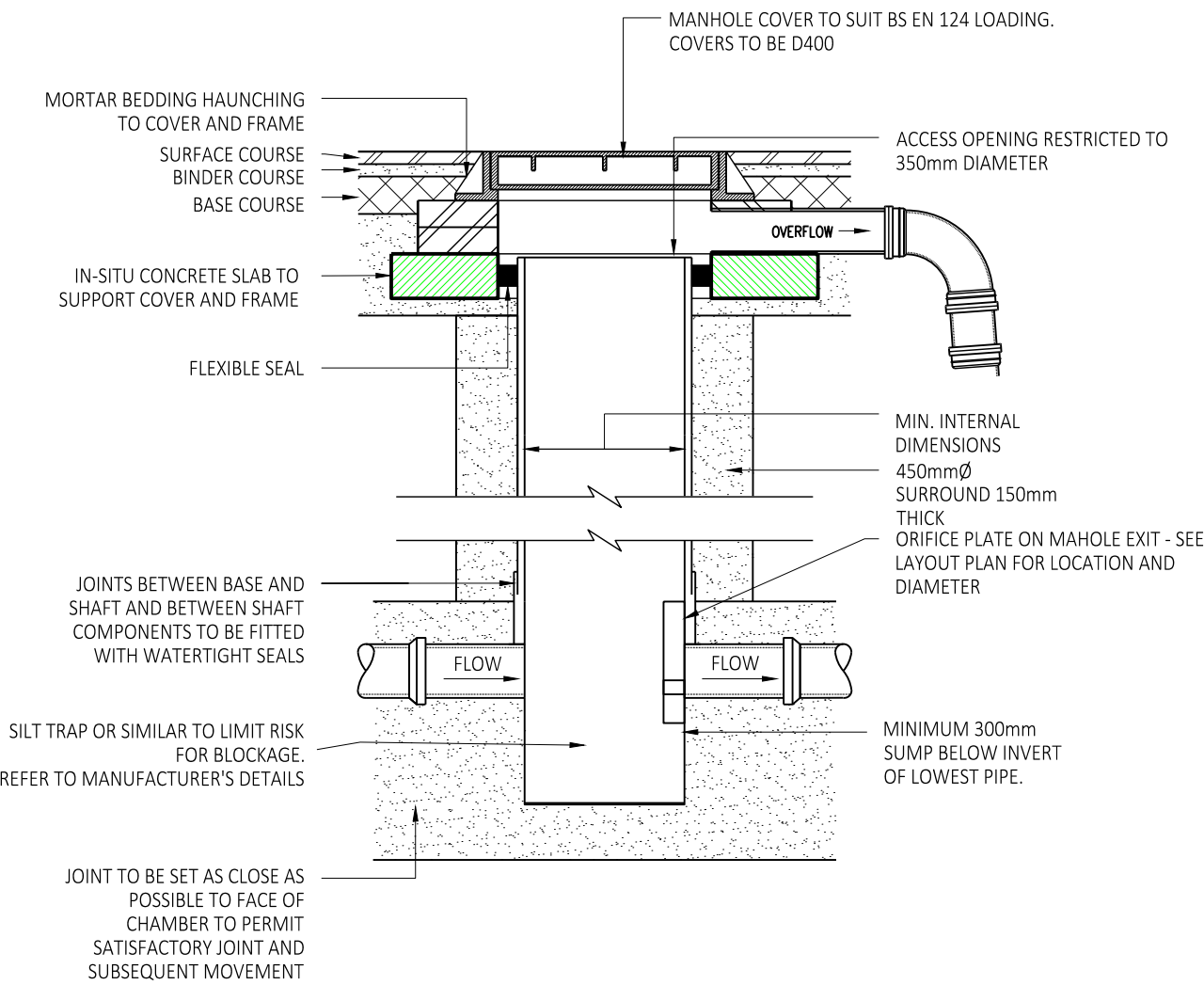
j. ALL DRAINS, SEWER PIPES AND MANHOLES TO BE CLEANED AND TESTED FOR WATER TIGHTNESS ON COMPLETION OF CONSTRUCTION.
- MANHOLE COVERS AND FRAMES

a. MANHOLE COVERS TO BE CLASS D400 IN HIGHWAYS, CLASS B125 IN FOOTWAYS AND VERGES, CLASS A15 IN NON-TRAFFICKED AREAS.

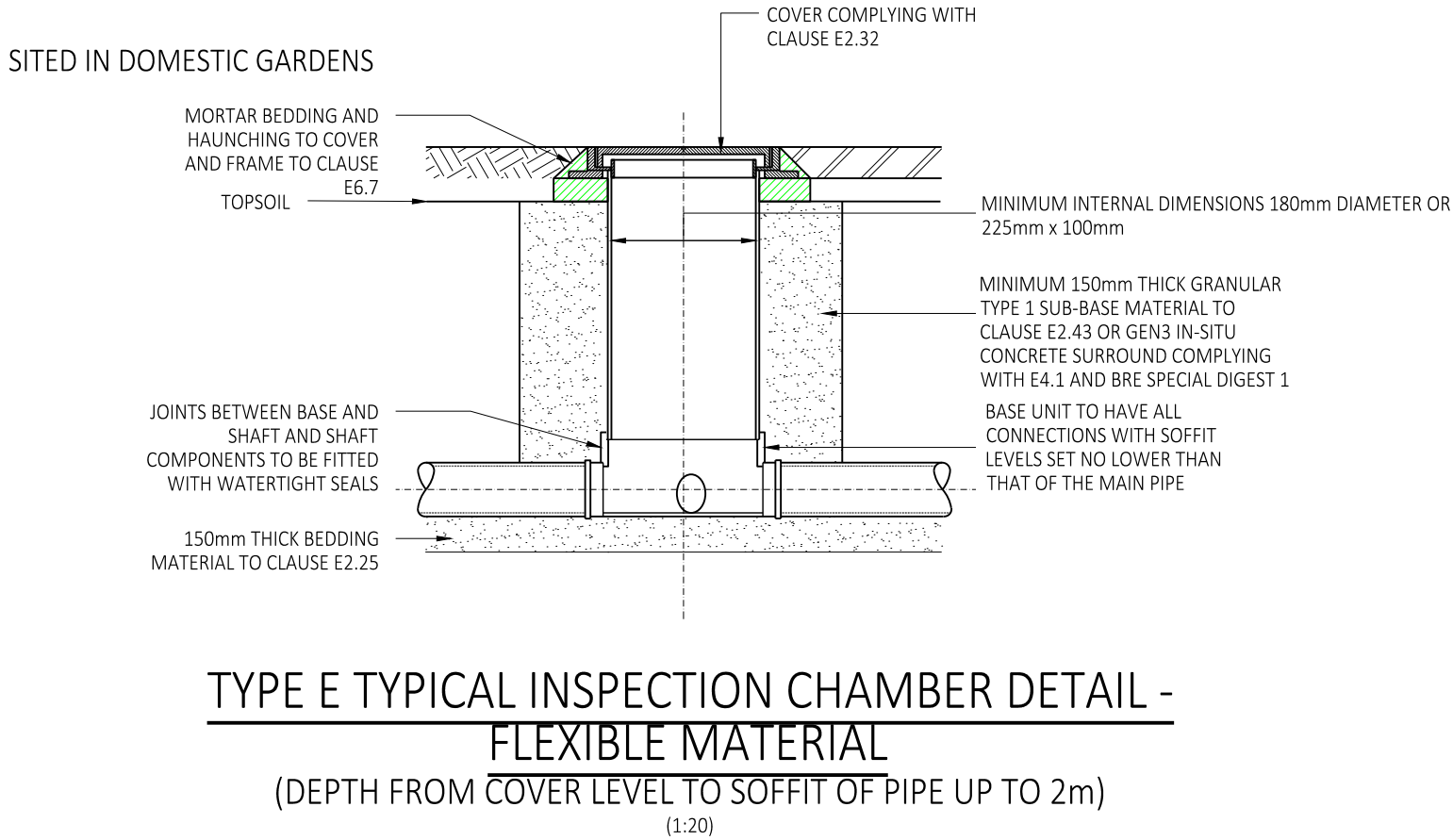
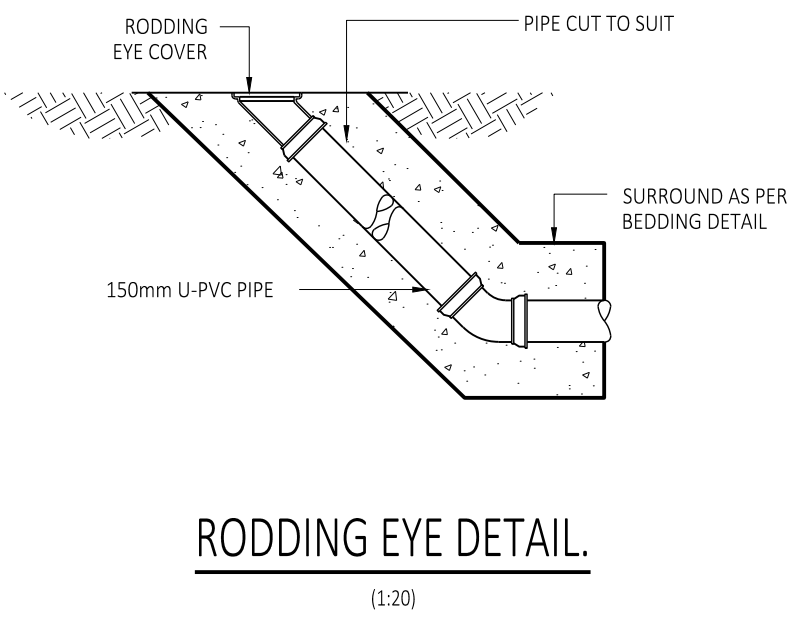
b. MANHOLE COVER AND FRAME TO BE BEDDED AND SURROUNDED IN 1:3 MORTAR.

LEGEND	
	PROPOSED PERFORATED SW DRAIN
	PROPOSED TYPE E SW INSPECTION CHAMBER
	PROPOSED SW RODDING EYE

REV:	DESCRIPTION:	BY:	DATE:
STATUS:		Preliminary	
MERIDIAN			
CIVIL ENGINEERING CONSULTANCY			
CLIENT: Stonewood Builders Ltd			
SITE: Oak Lodge			
TITLE: Surface Water Drainage Strategy			
SCALE AT A1:	DATE:	DRAWN:	CHECKED:
1:200	27/11/25	DF	MN
PROJECT NO:	DRAWING NO:	REVISION:	
MC0690	CIV01	P01	



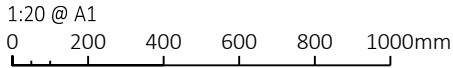
ORIFICE PLATE CHAMBER.
(PREFORMED POLYPIPE RIDGISTORM 450-1500Ø CATCHPIT MANHOLE OR SIMILAR),
MAX. DEPTH 3m, NON-ENTRY)
(1:20)



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	PROPOSED PERFORATED SW DRAIN
	PROPOSED TYPE E SW INSPECTION CHAMBER
	PROPOSED SW RODDING EYE

REV:	DESCRIPTION:	BY:	DATE:
STATUS: Preliminary			
MERIDIAN CIVIL ENGINEERING CONSULTANCY			
CLIENT: Stonewood Builders Ltd			
SITE: Oak Lodge			
TITLE: Surface Water Drainage Strategy			
SCALE AT A1: 1:20	DATE: 27/11/25	DRAWN: DF	CHECKED: BB
PROJECT NO: MC0690	DRAWING NO: CIV02	REVISION: P01	



APPENDIX III Calculations

Design Settings

Rainfall Methodology	FEH-22	Maximum Time of Concentration (mins)	30.00	Preferred Cover Depth (m)	0.100
Return Period (years)	100	Maximum Rainfall (mm/hr)	50.0	Include Intermediate Ground	✓
Additional Flow (%)	45	Minimum Velocity (m/s)	1.00	Enforce best practice design rules	x
CV	0.750	Connection Type	Level Soffits		
Time of Entry (mins)	4.00	Minimum Backdrop Height (m)	0.200		

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Diameter (mm)	Easting (m)	Northing (m)	Depth (m)
1	0.022	4.00	125.200	450	177.249	12.360	0.400
2	0.022	4.00	125.200	1350	231.820	-41.672	0.702
19			125.200	1350	233.518	-43.652	0.711
3	0.035	4.00	125.200	600	162.086	-2.515	0.400
4	0.035	4.00	125.200	600	216.590	-57.019	0.477
5	0.022	4.00	125.200	450	166.357	1.756	0.400
6	0.022	4.00	125.200	1200	220.861	-52.748	0.477
7	0.022	4.00	125.200	450	169.893	5.291	0.400
8	0.022	4.00	125.200	1200	224.397	-49.213	0.477
9	0.022	4.00	125.200	450	173.429	8.826	0.400
10	0.022	4.00	125.200	1350	227.933	-45.677	0.477
11	0.022	4.00	125.200	450	187.571	22.969	0.400
12	0.034	4.00	125.200	600	246.345	-27.264	0.477
13	0.022	4.00	125.200	1200	242.074	-31.535	0.477
14	0.043	4.00	125.200	600	184.035	19.433	0.400
15	0.043	4.00	125.200	1350	238.539	-35.070	0.477
16	0.022	4.00	125.200	450	180.500	15.898	0.400
17	0.022	4.00	125.200	1350	235.003	-38.606	0.477
18	0.034	4.00	125.200	600	191.842	27.240	0.400

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	3	4	77.080	0.600	124.800	124.723	0.077	999.0	225	7.17	50.0
1.001	4	6	6.040	0.600	124.800	124.794	0.006	999.0	225	7.42	50.0
2.000	5	6	77.080	0.600	124.800	124.723	0.077	999.0	150	8.14	50.0
1.002	6	8	5.000	0.600	124.800	124.795	0.005	999.0	300	8.31	50.0
3.000	7	8	77.080	0.600	124.800	124.723	0.077	999.0	150	8.14	50.0
1.003	8	10	5.001	0.600	124.800	124.795	0.005	999.0	300	8.48	50.0
4.000	9	10	77.080	0.600	124.800	124.723	0.077	999.0	150	8.14	50.0
1.004	10	2	5.581	0.600	124.800	124.794	0.006	999.0	375	8.65	50.0
5.000	18	12	77.080	0.600	124.800	124.723	0.077	999.0	225	7.17	50.0
5.001	12	13	6.040	0.600	124.800	124.794	0.006	999.0	225	7.42	50.0
6.000	11	13	77.080	0.600	124.800	124.723	0.077	999.0	150	8.14	50.0
5.002	13	15	4.999	0.600	124.800	124.795	0.005	999.0	300	8.31	50.0
7.000	14	15	77.080	0.600	124.800	124.723	0.077	999.0	225	7.17	50.0
5.003	15	17	5.001	0.600	124.800	124.795	0.005	999.0	375	8.46	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	0.406	16.1	6.8	0.175	0.252	0.035	0.0	102	0.389
1.001	0.406	16.1	13.6	0.175	0.181	0.069	0.0	159	0.454
2.000	0.310	5.5	4.2	0.250	0.327	0.022	0.0	99	0.343
1.002	0.489	34.6	22.1	0.100	0.105	0.113	0.0	174	0.518
3.000	0.310	5.5	4.2	0.250	0.327	0.022	0.0	99	0.343
1.003	0.489	34.6	30.6	0.100	0.105	0.156	0.0	220	0.550
4.000	0.310	5.5	4.2	0.250	0.327	0.022	0.0	99	0.343
1.004	0.565	62.4	39.1	0.025	0.031	0.199	0.0	216	0.596
5.000	0.406	16.1	6.6	0.175	0.252	0.034	0.0	101	0.386
5.001	0.406	16.1	13.3	0.175	0.181	0.068	0.0	156	0.452
6.000	0.310	5.5	4.2	0.250	0.327	0.022	0.0	99	0.343
5.002	0.489	34.6	21.8	0.100	0.105	0.111	0.0	173	0.517
7.000	0.406	16.1	8.5	0.175	0.252	0.043	0.0	116	0.411
5.003	0.565	62.4	38.8	0.025	0.030	0.198	0.0	214	0.594

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)
8.000	16	17	77.080	0.600	124.800	124.723	0.077	999.0	150	8.14	50.0
5.004	17	2	4.419	0.600	124.800	124.796	0.004	999.0	375	8.59	50.0
9.000	1	2	76.795	0.600	124.800	124.723	0.077	999.0	150	8.13	50.0
1.005	2	19	2.608	0.600	124.498	124.489	0.009	289.8	375	8.69	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)
8.000	0.310	5.5	4.2	0.250	0.327	0.022	0.0	99	0.343
5.004	0.565	62.4	47.3	0.025	0.029	0.241	0.0	245	0.620
9.000	0.310	5.5	4.2	0.250	0.327	0.022	0.0	99	0.343
1.005	1.059	117.0	94.9	0.327	0.336	0.483	0.0	257	1.174

Simulation Settings

Rainfall Methodology	FEH-22	Winter CV	0.840	Drain Down Time (mins)	5000	Check Discharge Rate(s)	x
Rainfall Events	Singular	Analysis Speed	Normal	Additional Storage (m³/ha)	0.0	Check Discharge Volume	x
Summer CV	0.750	Skip Steady State	x	Starting Level (m)			

Storm Durations

15 | 30 | 60 | 120 | 180 | 240 | 360 | 720 | 1440

Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)
100	45	0	0

Node 2 Online Depth/Flow Control

Flap Valve x | Replaces Downstream Link ✓ | Invert Level (m) 124.498

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.001	0.000	1.000	0.000

Node 1 Carpark Storage Structure

Base Inf Coefficient (m/hr)	0.05294	Porosity	0.30	Width (m)	5.000	Depth (m)	0.150
Side Inf Coefficient (m/hr)	0.00000	Invert Level (m)	124.950	Length (m)	43.240	Inf Depth (m)	
Safety Factor	2.0	Time to half empty (mins)		Slope (1:X)	999.0		

Node 2 Carpark Storage Structure

Base Inf Coefficient (m/hr)	0.05294	Porosity	0.30	Width (m)	5.000	Depth (m)	0.150
Side Inf Coefficient (m/hr)	0.00000	Invert Level (m)	124.950	Length (m)	42.000	Inf Depth (m)	
Safety Factor	2.0	Time to half empty (mins)		Slope (1:X)	999.0		

Node 4 Carpark Storage Structure

Base Inf Coefficient (m/hr)	0.05294	Porosity	0.30	Width (m)	5.000	Depth (m)	0.150
Side Inf Coefficient (m/hr)	0.00000	Invert Level (m)	124.950	Length (m)	43.240	Inf Depth (m)	
Safety Factor	2.0	Time to half empty (mins)		Slope (1:X)	999.0		

Node 6 Carpark Storage Structure

Base Inf Coefficient (m/hr)	0.05294	Porosity	0.30	Width (m)	5.000	Depth (m)	0.150
Side Inf Coefficient (m/hr)	0.00000	Invert Level (m)	124.950	Length (m)	43.240	Inf Depth (m)	
Safety Factor	2.0	Time to half empty (mins)		Slope (1:X)	999.0		

Node 8 Carpark Storage Structure

Base Inf Coefficient (m/hr)	0.05294	Porosity	0.30	Width (m)	5.000	Depth (m)	0.150
Side Inf Coefficient (m/hr)	0.00000	Invert Level (m)	124.950	Length (m)	43.240	Inf Depth (m)	
Safety Factor	2.0	Time to half empty (mins)		Slope (1:X)	999.0		

Node 10 Carpark Storage Structure

Base Inf Coefficient (m/hr)	0.05294	Porosity	0.30	Width (m)	5.000	Depth (m)	0.150
Side Inf Coefficient (m/hr)	0.00000	Invert Level (m)	124.950	Length (m)	43.240	Inf Depth (m)	
Safety Factor	2.0	Time to half empty (mins)		Slope (1:X)	999.0		

Node 12 Carpark Storage Structure

Base Inf Coefficient (m/hr)	0.05294	Porosity	0.30	Width (m)	0.800	Depth (m)	0.150
Side Inf Coefficient (m/hr)	0.00000	Invert Level (m)	124.950	Length (m)	43.240	Inf Depth (m)	
Safety Factor	2.0	Time to half empty (mins)		Slope (1:X)	999.0		

Node 13 Carpark Storage Structure

Base Inf Coefficient (m/hr)	0.05294	Porosity	0.30	Width (m)	5.000	Depth (m)	0.150
Side Inf Coefficient (m/hr)	0.00000	Invert Level (m)	124.950	Length (m)	43.240	Inf Depth (m)	
Safety Factor	2.0	Time to half empty (mins)		Slope (1:X)	999.0		

Node 15 Carpark Storage Structure

Base Inf Coefficient (m/hr)	0.05294	Porosity	0.30	Width (m)	5.000	Depth (m)	0.150
Side Inf Coefficient (m/hr)	0.00000	Invert Level (m)	124.950	Length (m)	43.240	Inf Depth (m)	
Safety Factor	2.0	Time to half empty (mins)		Slope (1:X)	999.0		

Node 17 Carpark Storage Structure

Base Inf Coefficient (m/hr)	0.05294	Porosity	0.30	Width (m)	5.000	Depth (m)	0.150
Side Inf Coefficient (m/hr)	0.00000	Invert Level (m)	124.950	Length (m)	43.240	Inf Depth (m)	
Safety Factor	2.0	Time to half empty (mins)		Slope (1:X)	999.0		

Node 18 Carpark Storage Structure

Base Inf Coefficient (m/hr)	0.05294	Porosity	0.30	Width (m)	5.000	Depth (m)	0.150
Side Inf Coefficient (m/hr)	0.00000	Invert Level (m)	124.950	Length (m)	43.240	Inf Depth (m)	
Safety Factor	2.0	Time to half empty (mins)		Slope (1:X)	999.0		

Node 11 Carpark Storage Structure

Base Inf Coefficient (m/hr)	0.05294	Porosity	0.30	Width (m)	5.000	Depth (m)	0.150
Side Inf Coefficient (m/hr)	0.00000	Invert Level (m)	124.950	Length (m)	43.240	Inf Depth (m)	
Safety Factor	2.0	Time to half empty (mins)		Slope (1:X)	999.0		

Node 14 Carpark Storage Structure

Base Inf Coefficient (m/hr)	0.05294	Porosity	0.30	Width (m)	5.000	Depth (m)	0.150
Side Inf Coefficient (m/hr)	0.00000	Invert Level (m)	124.950	Length (m)	43.240	Inf Depth (m)	
Safety Factor	2.0	Time to half empty (mins)		Slope (1:X)	999.0		

Node 16 Carpark Storage Structure

Base Inf Coefficient (m/hr)	0.05294	Porosity	0.30	Width (m)	5.000	Depth (m)	0.150
Side Inf Coefficient (m/hr)	0.00000	Invert Level (m)	124.950	Length (m)	43.240	Inf Depth (m)	
Safety Factor	2.0	Time to half empty (mins)		Slope (1:X)	999.0		

Node 9 Carpark Storage Structure

Base Inf Coefficient (m/hr)	0.05294	Porosity	0.30	Width (m)	5.000	Depth (m)	0.150
Side Inf Coefficient (m/hr)	0.00000	Invert Level (m)	124.950	Length (m)	43.240	Inf Depth (m)	
Safety Factor	2.0	Time to half empty (mins)		Slope (1:X)	999.0		

Node 7 Carpark Storage Structure

Base Inf Coefficient (m/hr)	0.05294	Porosity	0.30	Width (m)	5.000	Depth (m)	0.150
Side Inf Coefficient (m/hr)	0.00000	Invert Level (m)	124.950	Length (m)	43.240	Inf Depth (m)	
Safety Factor	2.0	Time to half empty (mins)		Slope (1:X)	999.0		

Node 5 Carpark Storage Structure

Base Inf Coefficient (m/hr)	0.05294	Porosity	0.30	Width (m)	5.000	Depth (m)	0.150
Side Inf Coefficient (m/hr)	0.00000	Invert Level (m)	124.950	Length (m)	43.240	Inf Depth (m)	
Safety Factor	2.0	Time to half empty (mins)		Slope (1:X)	999.0		

Node 3 Carpark Storage Structure

Base Inf Coefficient (m/hr)	0.05294	Porosity	0.30	Width (m)	5.000	Depth (m)	0.150
Side Inf Coefficient (m/hr)	0.00000	Invert Level (m)	124.950	Length (m)	43.240	Inf Depth (m)	
Safety Factor	2.0	Time to half empty (mins)		Slope (1:X)	999.0		

Approval Settings

Node Size	✓	Maximum Cover Depth (m)	3.000	Surcharged Depth	✓
Node Losses	✓	Backdrops	✓	Return Period (years)	
Link Size	✓	Minimum Backdrop Height (m)		Maximum Surcharged Depth (m)	0.100
Minimum Diameter (mm)	150	Maximum Backdrop Height (m)	1.500	Flooding	✓
Link Length	✓	Full Bore Velocity	✓	Return Period (years)	30
Maximum Length (m)	100.000	Minimum Full Bore Velocity (m/s)		Time to Half Empty	x
Coordinates	✓	Maximum Full Bore Velocity (m/s)	3.000	Discharge Rates	✓
Accuracy (m)	1.000	Proportional Velocity	✓	Discharge Volume	✓
Crossings	✓	Return Period (years)		100 year 360 minute (m ³)	
Cover Depth	✓	Minimum Proportional Velocity (m/s)	0.750		
Minimum Cover Depth (m)		Maximum Proportional Velocity (m/s)	3.000		

Results for 100 year +45% CC Critical Storm Duration. Lowest mass balance: 97.75%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
60 minute winter	1	53	125.084	0.284	8.0	7.3340	0.0000	FLOOD RISK
60 minute winter	2	50	125.084	0.586	17.7	7.9744	0.0000	FLOOD RISK
15 minute summer	19	1	124.489	0.000	0.0	0.0000	0.0000	OK
60 minute winter	3	48	125.084	0.284	10.6	7.3695	0.0000	FLOOD RISK
60 minute winter	4	49	125.084	0.361	12.6	7.3933	0.0000	FLOOD RISK
60 minute winter	5	53	125.084	0.284	8.0	7.3324	0.0000	FLOOD RISK
60 minute winter	6	49	125.084	0.361	10.5	7.6973	0.0000	OK
60 minute winter	7	53	125.084	0.284	8.0	7.3324	0.0000	FLOOD RISK
Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
60 minute winter	1	9.000	2	-1.7	0.215	-0.307	1.3520	
60 minute winter	1	Infiltration		1.6				
60 minute winter	2	Depth/Flow	19	0.0				0.0
60 minute winter	2	Infiltration		1.5				
60 minute winter	3	1.000	4	2.0	0.150	0.126	3.0656	
60 minute winter	3	Infiltration		1.6				
60 minute winter	4	1.001	6	3.9	0.269	0.242	0.2402	
60 minute winter	4	Infiltration		1.6				
60 minute winter	5	2.000	6	-1.7	0.143	-0.309	1.3570	
60 minute winter	5	Infiltration		1.6				
60 minute winter	6	1.002	8	-2.4	0.223	-0.069	0.3468	
60 minute winter	6	Infiltration		1.6				
60 minute winter	7	3.000	8	-1.7	0.143	-0.309	1.3570	

Results for 100 year +45% CC Critical Storm Duration. Lowest mass balance: 97.75%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
60 minute winter	8	49	125.084	0.361	10.3	7.6972	0.0000	OK
60 minute winter	9	53	125.084	0.284	8.0	7.3326	0.0000	FLOOD RISK
60 minute winter	10	50	125.084	0.361	14.0	7.8047	0.0000	OK
60 minute winter	11	51	125.085	0.285	8.1	7.3474	0.0000	FLOOD RISK
60 minute winter	12	49	125.085	0.361	11.7	1.2721	0.0000	FLOOD RISK
60 minute winter	13	49	125.084	0.361	16.8	7.6974	0.0000	OK
60 minute winter	14	55	125.084	0.284	13.2	7.3760	0.0000	FLOOD RISK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
60 minute winter	7	Infiltration		1.6				
60 minute winter	8	1.003	10	-3.9	0.275	-0.112	0.3468	
60 minute winter	8	Infiltration		1.6				
60 minute winter	9	4.000	10	-1.7	0.150	-0.309	1.3570	
60 minute winter	9	Infiltration		1.6				
60 minute winter	10	1.004	2	-7.8	0.239	-0.124	0.5057	
60 minute winter	10	Infiltration		1.6				
60 minute winter	11	6.000	13	-1.7	0.143	-0.307	1.3570	
60 minute winter	11	Infiltration		1.6				
60 minute winter	12	5.001	13	10.3	0.260	0.640	0.2402	
60 minute winter	12	Infiltration		0.3				
60 minute winter	13	5.002	15	6.7	-0.253	0.193	0.3467	
60 minute winter	13	Infiltration		1.6				
60 minute winter	14	7.000	15	4.5	0.165	0.277	3.0656	
60 minute winter	14	Infiltration		1.6				

Results for 100 year +45% CC Critical Storm Duration. Lowest mass balance: 97.75%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
60 minute winter	15	49	125.084	0.361	23.9	7.8053	0.0000	OK
60 minute winter	16	52	125.084	0.284	8.0	7.3367	0.0000	FLOOD RISK
60 minute winter	17	50	125.084	0.361	21.6	7.8046	0.0000	OK
60 minute winter	18	55	125.084	0.284	10.3	7.3707	0.0000	FLOOD RISK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
60 minute winter	15	5.003	17	15.3	0.336	0.245	0.4524	
60 minute winter	15	Infiltration		1.6				
60 minute winter	16	8.000	17	-1.7	0.150	-0.306	1.3570	
60 minute winter	16	Infiltration		1.6				
60 minute winter	17	5.004	2	11.4	0.388	0.183	0.3990	
60 minute winter	17	Infiltration		1.6				
60 minute winter	18	5.000	12	2.2	0.146	0.135	3.0656	
60 minute winter	18	Infiltration		1.6				

APPENDIX IV Infiltration test results

ES QA 32		PERCOLATION TEST		
In accordance with BS 6297:2007				
Client	Stonewood Builders	Contract	Oak Lodge	
Location	Proposed new arena	Operative	S. Crocker	

Extract of drawing showing location of percolation test.

Grid Reference	ST 85842 74847	What 3 Words	///sweetened.range.lengthen
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Hole No.	Test Date	Test No.	Start Time	Finish Time	Elapsed time			Vp (s/mm)
					Hours / minutes	Minutes	Seconds	Seconds divided by 150mm
1	19/9/25	1	10:35	10:47	0 Hrs 12 Mins	12	720	4.8
	19/9/25	2	11:10	11:29	0 Hrs 19 Mins	19	1140	7.6
	19/9/25	3	12:15	12:40	0 Hrs 25 Mins	25	1500	10
Average VP for Hole 1								7.46
2		1			0 Hrs 42 Mins			
		2			1 Hrs 4 Mins			
		3			1 Hrs 8 Mins			
Average VP for Hole 2								
3		1			Hrs Mins			
		2			Hrs Mins			
		3			Hrs Mins			
Average VP for Hole 3								

Test method

The percolation test should be carried out as follows.

- Excavate at least two holes 300 mm square to a depth at least 300 mm below the proposed invert level (bottom of pipe) of the infiltration pipe, spacing them along the proposed line of the subsurface irrigation system. While digging the hole, note and record changes in soil characteristics at measured depths and the position of the water table if reached.
- Saturate the local soil by filling each hole with water to a depth of at least 300 mm and allow this to seep away completely.
- If the water drains rapidly (within 10 minutes) the hole should be refilled up to a maximum of 10 times. If the water continues to drain away rapidly the ground is unsuitable.
- If the water has not soaked away within 6 hours the area is not suitable.
- Determine the percolation rate by refilling each hole with water to a depth of at least 300 mm and observe the time in seconds for the water to seep away from 75% full to 25% full (i.e. a depth of 150 mm).
- Divide this time in seconds by 150. This gives the average time in seconds required for the water to drop 1mm.
- Repeat the test at least three times in each hole in the location of the proposed trench(es).
- Take the average figure from the tests to produce the percolation value V_p (in seconds).
- Obtain the average figure for the percolation value (V_p) by summing all the values and dividing by the number of values used.
- The results from the percolation test should be tabulated as set out in Figure 3. It is advisable to retain this information for the future property owner.

Cross-section of typical percolation test hole and trial hole

