Avie Consulting Ltd
6 Killingbeck Court
Killingbeck Office Village
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Newsome Bowling Club

Kirklees Housing

July 2023



Soakaway Testing

P3932-RP02

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Registered in England and Wales No 8325892

Revision History		
Initial Issue	25 July 2023	
Prepared By		
	Shane Plunkett Engineering Technician	Steve Bowles Senior Engineer

Rev No	Date	Description	By	Checked
P00	25/07/2023	Initial issue	STP	SAB

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1.0 Introduction

1.0.1 It is understood that the site is to comprise a 10-plot residential development at the former Newsome Bowling Club. Avie were appointed to monitor infiltration testing undertaken on site and prepare a report in support of proving the viability of draining the surface water runoff from site by infiltration means in accordance with the hierarchy of surface water discharge.

1.1 Fieldworks

1.1.1 The fieldworks were undertaken on the 14th July 2023 and included the following:

- Three machine excavated trial pits with soakaway tests.

1.2 Trial Pits

1.2.1 A total of three trial pits were excavated to undertake the soakaway testing. The method of excavation was using a JCB 3CX.

1.2.2 Once excavations were completed, and soakaway testing had been undertaken the trial pits were carefully reinstated with the excavated arisings. During the backfilling process the compaction of the infill material occurred at regular intervals with the back-acting arm of the excavator.

1.3 Soakaway Tests

1.3.1 Soakaway tests were conducted within all three of the trial pits. Refer to appendix A of the report for the location of the soakaway testing.

1.3.2 The pits were trimmed and squared as much as practicable at the elected test depths. Water was then emptied into the soakaway pit from the bowser and the water depth level was monitored at timed intervals relative to the datum and steel tape measure at ground level. The monitoring was conducted and calculated in general accordance with the method given in BRE Digest 365. Refer to Appendix B in the report for results.

1.3.3 The following table presents the results of the testing:

Trial Pit	1	2	3
Depth	1.1m	1.5m	1.48m
Test 1 (m/s)	75% Effective Depth not reached.	75% Effective Depth not reached.	3.9001×10^{-5}
Test 2 (m/s)	-	-	2.6919×10^{-5}
Test 3 (m/s)	-	-	2.9437×10^{-5}

1.4 Suitability

1.4.1 It should be appreciated the soakaway test undertaken in Trial Pit 03 indicated a positive infiltration rate that would allow for part of the site to drain to ground via infiltration.

1.4.2 Following the confirmation of the soakaway tests and calculation of the infiltration rates, it is proposed the surface water runoff from Plots 8-10 (roofs, and associated hardstanding areas) will be served by an infiltration trench located to the rear of the properties. Refer to drawing P3932-01 Rev A for location and soakaway characteristics. The maintenance of the SUDS feature should be carried out in accordance with the SUDS operation and maintenance manual report number P3932-RP01.

The infiltration trench has been designed in accordance with CIRIA C697 and BS EN 752-4. Calculations can be found in Appendix D.

1.4.3 Due to the poor infiltration results obtained from Trial Pits 1 & 2, the remainder of the site is required to be pumped to MH S01 at a rate of 3 L/s. The flows will then outfall via gravity to the existing combined sewer located within St. Johns Avenue.

1.4.4 The porous carriageway subbase is to be utilised as attenuation for the surface water system. The required attenuation for the development has been sized at 182 cubic metres. As a result of this, the subbase of the carriageway at the lower levels on site will be 700mm deep, covering a surface area of approximately 260 square metres. A low flow channel will be installed to direct flows towards the surface water pump chamber located within the carriageway. Calculations can be found in Appendix E.

APPENDIX A

OS GRID REFERENCE
414316,414662

SOAKAWAY TESTING LOCATIONS 1 & 2 PROVIDED INSUFFICIENT RESULTS TO DISCHARGE TO GROUND.

UNABLE TO PERFORM SOAKAWAY TESTING IN DESIRED LOCATION DUE TO EXISTING TARMAC AND OVERGROWN VEGETATION IN AREA.

UNABLE TO PERFORM SOAKAWAY TESTING IN DESIRED LOCATION DUE TO EXISTING TARMAC AND OVERGROWN VEGETATION IN AREA.

TP01

TP02

TP03

Clarence Hotel (PH)

PLOT 1

PLOT 2

PLOT 3

PLOT 4

PLOT 5

PLOT 6

PLOT 7

PLOT 8

PLOT 9

PLOT 10

PARKING FOR APARTMENTS

BIN STORE FOR FLATS 12 NO 240L WHEELIE BINS

GATE

FORMER NEWSOME WMC BOWLING CLUB

ST JOHNS AVENUE

ST JOHNS AVENUE

To 48

34

40

27

31

33

1

3

7

2

8

15

193

175

414700N

414680N

414660N

414640N

414620N

414600N

414280E

414300E

414320E

414340E

414360E

Notes-

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3. The drawings shall be read in accordance with all other contract documents relevant at that time of issue and during the period of the contract.
4. The contractor must ensure the overall stability of the works is adequate at all stages of the construction.

Proposed Impermeable Area

Site boundary

Soakaway testing locations

Rev	Details	By	Chk	Date
Ø	Initial issue	S.T.P.	T.C.	25.07.2023

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Tel: 0113 249 7416
www.avie-consulting.co.uk

Client: Acumen

Project: Newsome Bowling Club

Title: Soakaway Testing Locations

Drawn:	Checked:	Date:	Scale:	Original dwg size
S.T.P.	T.C.	July 2023	1:200	A1

Drawing Number: P3932-04 Rev: Ø

APPENDIX B

AVIE CONSULTING LTD
6 Killingbeck Court
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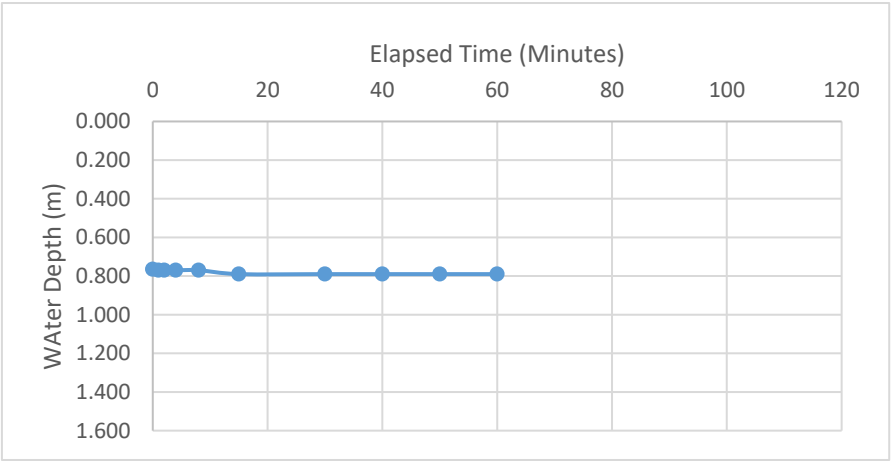
Project	Proj No
Newsome Bowling Club, Huddersfield	P3932

Soakaway Test	Date	By
	July 2023	STP

Trial Pit No:	1		Length (m):	2.3m	
Test No:	1		Width (m):	0.35m	
			Depth (m):	1.1m	
			Datum height:	0.0m agl	

Elapsed time (minutes)	Water depth (m below datum)
0	0.765
1	0.770
2	0.770
4	0.770
8	0.790
15	0.790
30	0.790
40	0.790
50	0.790
60	0.790

Elapsed time (minutes)	Water depth (m below datum)
70	TEST ABANDONED
80	
90	
100	
110	
120	
150	
180	



Start of water depth	0.765
75% effective depth	0.8490
50% effective depth	0.933
25% effective depth	1.0163
Base of soakage zone	1.100

Soil infiltration rate (m/s):	**Test incomplete as 25% effective depth not achieved. Unable to reliably determine soil infiltration rate.**

Remarks:

- Results processed following BRE 365 (2007).
- Unable to obtain infiltration rate due to practically impervious drainage characteristics.
- Test abandoned at 70 minutes due to poor results.

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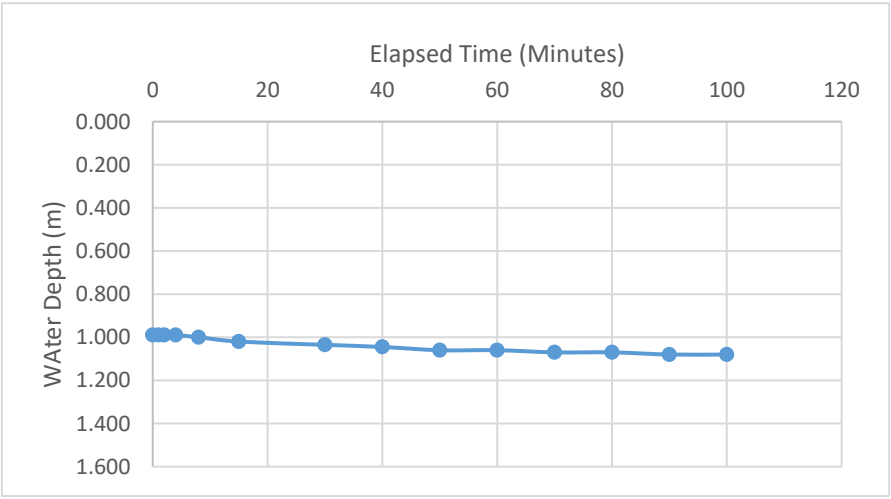
Project	Proj No
Newsome Bowling Club, Huddersfield	P3932
Soakaway Test	Date: July 2023 / By: STP

Trial Pit No:	2		Length (m):	3.0m	
Test No:	1		Width (m):	0.41m	
			Depth (m):	1.5m	
			Datum height:	0.0m agl	

Elapsed time (minutes)	Water depth (m below datum)
0	0.990
1	0.990
2	0.990
4	0.990
8	1.000
15	1.020
30	1.035
40	1.045
50	1.060
60	1.060

Elapsed time (minutes)	Water depth (m below datum)
70	1.070
80	1.070
90	1.080
100	1.080
110	1.090
120	1.100
150	1.120
180	1.140



Start of water depth	0.990
75% effective depth	1.1175
50% effective depth	1.245
25% effective depth	1.3725
Base of soakage zone	1.500

Soil infiltration rate (m/s):	**Test incomplete as 25% effective depth not achieved. Unable to reliably determine soil infiltration rate.**

Remarks:

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- Unable to obtain infiltration rate due to practically impervious drainage characteristics.

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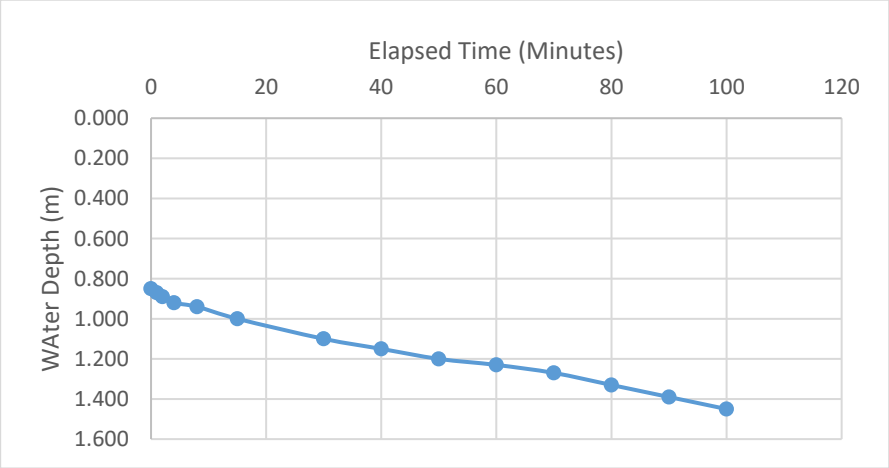
Project	Proj No
Newsome Bowling Club, Huddersfield	P3932
Soakaway Test	Date: July 2023 / By: STP

Trial Pit No:	3		Length (m):	2.3m	
Test No:	1		Width (m):	0.4m	
			Depth (m):	1.48m	
			Datum height:	0.0m agl	

Elapsed time (minutes)	Water depth (m below datum)
0	0.850
1	0.870
2	0.890
4	0.920
8	0.940
15	1.000
30	1.100
40	1.150
50	1.200
60	1.230

Elapsed time (minutes)	Water depth (m below datum)
70	1.270
80	1.330
90	1.390
100	1.450
110	1.480
120	
150	
180	



Start of water depth	0.850
75% effective depth	1.0075
50% effective depth	1.165
25% effective depth	1.3225
Base of soakage zone	1.480

Soil infiltration rate (m/s):	**3.9001×10^{-5}**

Remarks:

- Results processed following BRE 365 (2007).

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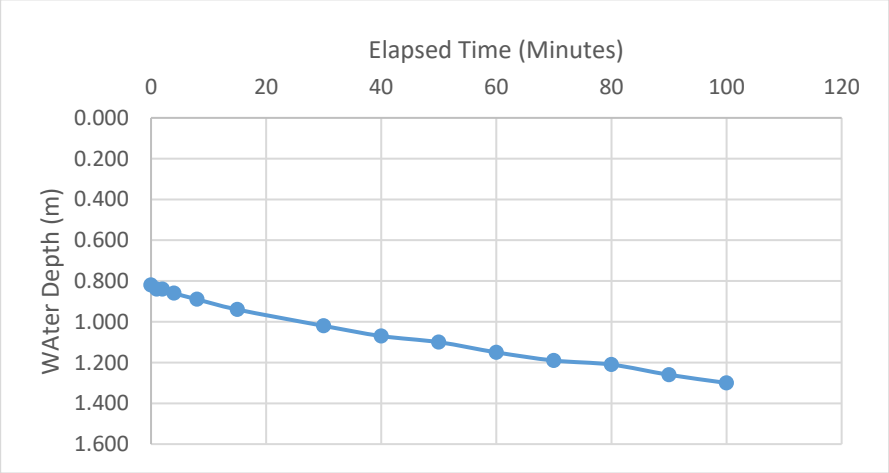
Project	Proj No
Newsome Bowling Club, Huddersfield	P3932
Soakaway Test	Date: July 2023 / By: STP

Trial Pit No:	3		Length (m):	2.3m	
Test No:	2		Width (m):	0.4m	
			Depth (m):	1.48m	
			Datum height:	0.0m agl	

Elapsed time (minutes)	Water depth (m below datum)
0	0.820
1	0.840
2	0.840
4	0.860
8	0.890
15	0.940
30	1.020
40	1.070
50	1.100
60	1.150

Elapsed time (minutes)	Water depth (m below datum)
70	1.190
80	1.210
90	1.260
100	1.300
110	1.340
120	1.400
150	1.480
180	



Start of water depth	0.820
75% effective depth	0.9850
50% effective depth	1.150
25% effective depth	1.3150
Base of soakage zone	1.480

Soil infiltration rate (m/s):	**2.6919×10^{-5}**

Remarks:

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Project	Proj No
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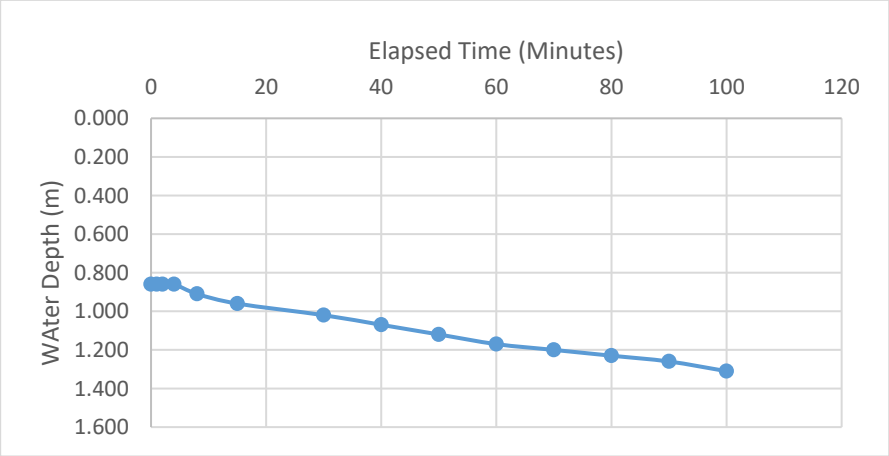
Soakaway Test	Date: July 2023 / By: STP

Trial Pit No:	3		Length (m):	2.3m	
Test No:	3		Width (m):	0.4m	
			Depth (m):	1.48m	
			Datum height:	0.0m agl	

Elapsed time (minutes)	Water depth (m below datum)
0	0.860
1	0.860
2	0.860
4	0.860
8	0.910
15	0.960
30	1.020
40	1.070
50	1.120
60	1.170

Elapsed time (minutes)	Water depth (m below datum)
70	1.200
80	1.230
90	1.260
100	1.310
110	1.360
120	1.400
150	1.480
180	



Start of water depth	0.860
75% effective depth	1.0150
50% effective depth	1.170
25% effective depth	1.3250
Base of soakage zone	1.480

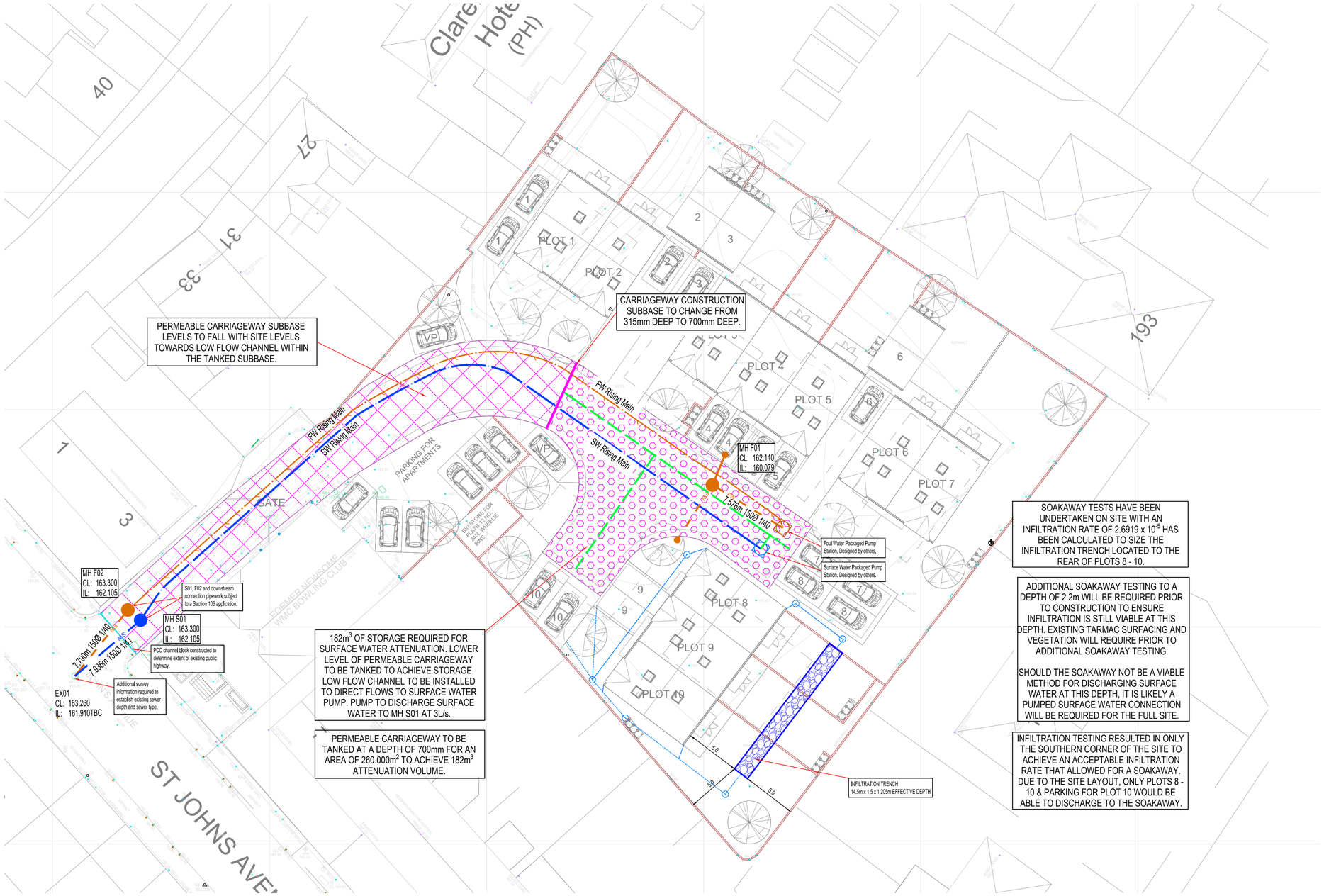
Soil infiltration rate (m/s):	**2.9437×10^{-5}**

Remarks:

- Results processed following BRE 365 (2007).

APPENDIX C

OS GRID REFERENCE
414316,414662



SOAKAWAY TESTS HAVE BEEN UNDERTAKEN ON SITE WITH AN INFILTRATION RATE OF 2.6919×10^{-5} HAS BEEN CALCULATED TO SIZE THE INFILTRATION TRENCH LOCATED TO THE REAR OF PLOTS 8 - 10.

ADDITIONAL SOAKAWAY TESTING TO A DEPTH OF 2.2m WILL BE REQUIRED PRIOR TO CONSTRUCTION TO ENSURE INFILTRATION IS STILL VIABLE AT THIS DEPTH. EXISTING TARMAC SURFACING AND VEGETATION WILL REQUIRE PRIOR TO ADDITIONAL SOAKAWAY TESTING.

SHOULD THE SOAKAWAY NOT BE A VIABLE METHOD FOR DISCHARGING SURFACE WATER AT THIS DEPTH, IT IS LIKELY A PUMPED SURFACE WATER CONNECTION WILL BE REQUIRED FOR THE FULL SITE.

INFILTRATION TESTING RESULTED IN ONLY THE SOUTHERN CORNER OF THE SITE TO ACHIEVE AN ACCEPTABLE INFILTRATION RATE THAT ALLOWED FOR A SOAKAWAY. DUE TO THE SITE LAYOUT, ONLY PLOTS 8 - 10 & PARKING FOR PLOT 10 WOULD BE ABLE TO DISCHARGE TO THE SOAKAWAY.

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4. The contractor must ensure the overall stability of the works is adequate at all stages of the construction.

DRAINAGE KEY:

- PROPOSED LOW FLOW CHANNEL (PERFORATED PIPE)
- PROPOSED FOUL WATER SEWER/MANHOLE
- PROPOSED SURFACE WATER SEWER/MANHOLE
- GRANULAR INFILTRATION TRENCH
- POROUS PAVING
- POROUS TANKED PAVING (253.075m²)
- PROPOSED PCC CHANNEL BLOCK
- PROPOSED FOUL WATER RISING MAIN
- PROPOSED SURFACE WATER RISING MAIN

Any existing live services will require diverting to accommodate future development if any present.

Drainage proposals subject to additional infiltration testing and sewerage undertakers pre development enquiry.

It has been considered the new access road serving the 10 properties is to remain private and maintained by a management company.

It has been considered the new drainage proposals are to remain private, with the exception of MHF02 and its connection being offered for adoption under a Section 106.

Existing sewer information to be provided to allow assessment of levels and determine the requirement of pumping features. A gravity connection may be viable.

Rev	Details	By	Chk	Date
A	Updated following infiltration testing	S.T.P.	T.C.	25.07.2023
Ø	Initial issue	J.C.	T.C.	19.04.2023

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Tel: 0113 249 7416
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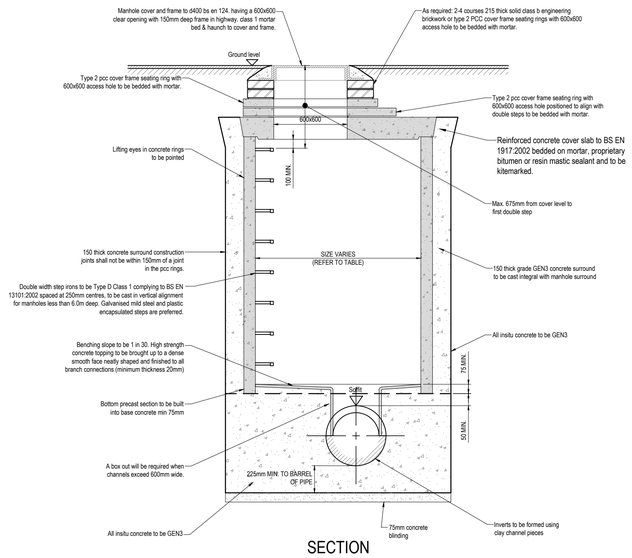
Client: Acumen

Project: Newsome Bowling Club

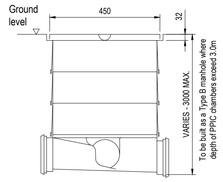
Title: Proposed Foul and Surface Water Drainage Strategy

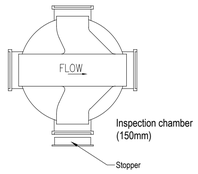
Drawn:	Checked:	Date:	Scale:	Original dwg size
J.C.	T.C.	April 2023	1:200	A1

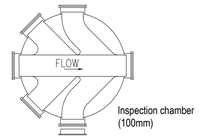
Drawing Number: P3932-01 Rev: Ø



SECTION



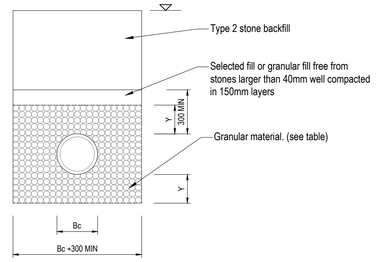




NOTES 1.

1. Cast iron cover and plastic frame are suitable for use where wheel loads do not exceed 1.5 tonnes.
2. For vehicle loading installations, chamber to be surrounded with 250mm thick concrete and cover replaced with appropriate loading classification cover.
3. Where side branches are not to be used stopper to be inserted to blank off connection
4. Access to chamber restricted to 350mm for chamber depths greater than 1.2m

PRIVATE POLYPROPYLENE INSPECTION CHAMBER (PPIC) TYPE NON ENTRY INSPECTION BY WAVIN OSA TO BS 7158:2001 KITEMARKED



CLASS S DETAIL

NOMINAL PIPE DIA (mm)	SINGLE SIZED (mm)	GRADED (mm)
150 200 to 300 375 to 525 Greater than 525	10 or 14 10,14 or 20 14 or 20 14,20 or 40	14 to 5 14 to 5 or 20 to 5 14 to 5 or 20 to 5 14 to 5,20 to 5 or 40 to 5

GRANULAR BEDDING MATERIAL
(ALL AGGREGATES TO TABLE 4 OF BS 882:1983)

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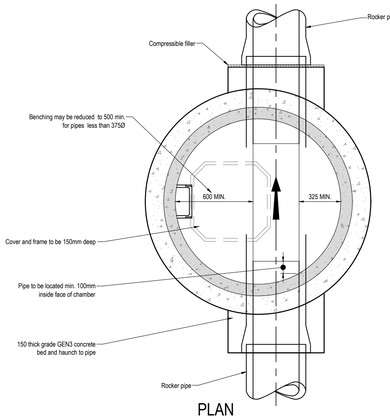
PIPE DIA	EQUIVALENT ROCKER PIPE LENGTH
≤ 525	0.60
600-750	1.00
≥ 825	1.25

ROCKER PIPES USED UNTIL THE PIPE O.D. EXCEEDS THE EFFECTIVE LENGTH OF THE ROCKER PIPE

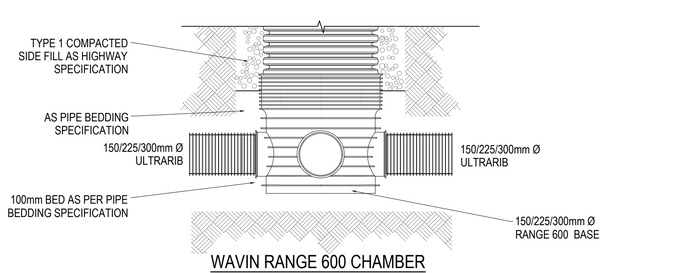
MIN. CHANNEL LENGTH	
CHAMBER DIA.	MIN. LENGTH 'X'
1200	950
1500	1050
1800	1150
2100	1300
2400	1450
2700	1550
3000	1700



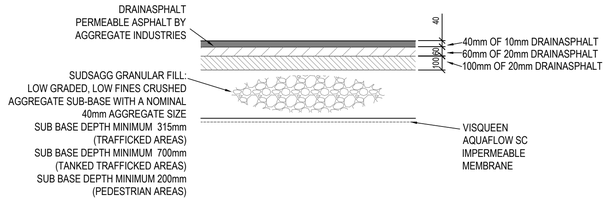
PLAN

TYPICAL MANHOLE DETAIL TYPE B DEPTH TO SOFFIT OF PIPE 1500 TO 3000
SCALE 1:20

SCHEDULE OF CHAMBER DIAMETERS	
DIA. OF LARGEST PIPE IN MANHOLE	INTERNAL DIA. OF MANHOLE
LESS THAN 375Ø	1200
375-700 (incl)	1500
750-900 (incl)	1800
>900	N/A



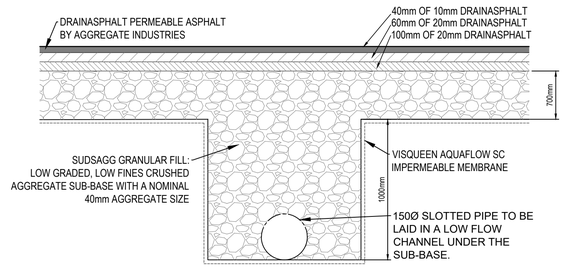
WAVIN RANGE 600 CHAMBER B125 / D400 LOADING
NOT TO SCALE



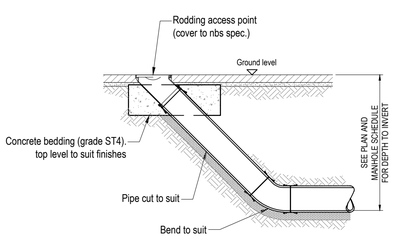
TYPICAL SECTION THROUGH POROUS TARMAC
NOT TO SCALE

CONSTRUCTION DEPTHS ARE BASED ON AN ASSUMED 5% CBR VALUE. CBR TESTING SHOULD BE UNDERTAKEN PRIOR TO CONSTRUCTION TO DETERMINE DEPTHS.

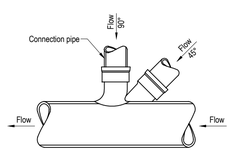
POROUS PAVING SHOULD BE LAID IN ACCORDANCE WITH AGGREGATE INDUSTRIES LATEST DETAILS



TYPICAL SECTION THROUGH LOW FLOW
NOT TO SCALE

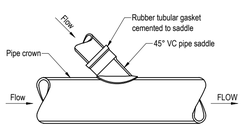


PRIVATE TYPICAL RODDING EYE DETAIL



TYPICAL JUNCTION CONNECTION DETAIL

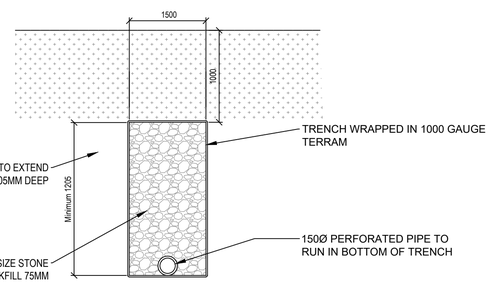
OBLIQUE OR SQUARE CURVED JUNCTION CONNECTION TO BE USED WHEN PUBLIC SEWER IS NOT 3 PIPE SIZES LARGER THAN THE LATERAL (CONNECTION) TO BE CONNECTED



TYPICAL SADDLE CONNECTION DETAIL

SADDLE CONNECTION INTO PUBLIC SEWER IS ACCEPTABLE WHEN SEWER DIAMETER IS THREE INCREMENTS LARGER THAN CONNECTION DIAMETER. SADDLE CONNECTIONS MUST BE POSITIONED AT 10 O'CLOCK OR 2 O'CLOCK AND AT AN ANGLE OF 45°. SADDLES SHALL BE THE SAME MATERIAL AS EXISTING SEWER.

THE TABLE BELOW SHOWS IF A JUNCTION OR SADDLE MAY BE USED FOR VARIOUS PUBLIC SEWER AND LATERAL COMBINTIONS



TYPICAL INFILTRATION TRENCH
NOT TO SCALE

Rev	Details	By	Chk	Date
A	Updated to latest drainage design	S.T.P.	T.C.	25.07.2023
Ø	Initial issue	J.C.	T.C.	19.04.2023

AVIE CONSULTING LTD
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www.avie-consulting.co.uk

Client: Acumen

Project: Newsome Bowling Club

Title: Standard Drainage Details

Drawn:	Checked:	Date:	Scale:	Original dwg size
J.C.	T.C.	April 2023	AS STATED	A1

Drawing Number: P3932-02 Rev: A



Notes-

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All dimensions are in millimetres unless noted otherwise.

DO NOT SCALE THIS DRAWING - IF IN DOUBT ASK

1. All dimensions & levels to be checked by the contractor prior to commencement of work, any discrepancy shall be reported immediately to Avie Consulting Ltd.
2. All work shall be carried out in accordance with Local Authority, statutory authority, health & safety requirements and regulations.
3. The drawings shall be read in accordance with all other contract documents relevant at that time of issue and during the period of the contract.
4. The contractor must ensure the overall stability of the works is adequate at all stages of the construction.

Proposed Impermeable Area

Site boundary

Road/Drives - 1121.670m² - 0.112 ha

Plots - 591.873m² - 0.059 ha
(651.060m² - 0.065ha considering 10% urban creep)

TOTAL - 1772.730m² - 0.177 ha

Area to drain to ground - 215.566m² - 0.021 ha
(230.883m² - 0.023ha considering 10% urban creep)

Rev	Details	By	Chk	Date
Ø	Initial issue	S.T.P.	T.C.	25.07.2023

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Client: Acumen

Project: Newsome Bowling Club

Title: Proposed Impermeable Areas

Drawn:	Checked:	Date:	Scale:	Original dwg size
S.T.P.	T.C.	July 2023	1:200	A1

Drawing Number: P3932-03 Rev: Ø

APPENDIX D

Summary of Results for 100 year Return Period (+30%)

Half Drain Time : 92 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
15 min Summer	0.633	0.633	0.6	4.2	O K
30 min Summer	0.828	0.828	0.7	5.5	O K
60 min Summer	0.983	0.983	0.8	6.5	O K
120 min Summer	1.055	1.055	0.8	7.0	O K
180 min Summer	1.053	1.053	0.8	7.0	O K
240 min Summer	1.024	1.024	0.8	6.8	O K
360 min Summer	0.964	0.964	0.8	6.4	O K
480 min Summer	0.903	0.903	0.8	6.0	O K
600 min Summer	0.845	0.845	0.7	5.6	O K
720 min Summer	0.790	0.790	0.7	5.2	O K
960 min Summer	0.692	0.692	0.7	4.6	O K
1440 min Summer	0.532	0.532	0.6	3.5	O K
2160 min Summer	0.361	0.361	0.5	2.3	O K
2880 min Summer	0.242	0.242	0.4	1.5	O K
4320 min Summer	0.096	0.096	0.4	0.5	O K
5760 min Summer	0.047	0.047	0.3	0.2	O K
7200 min Summer	0.040	0.040	0.3	0.2	O K
8640 min Summer	0.035	0.035	0.2	0.1	O K
10080 min Summer	0.031	0.031	0.2	0.1	O K
15 min Winter	0.714	0.714	0.7	4.7	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
15 min Summer	111.290	0.0	23
30 min Summer	76.254	0.0	36
60 min Summer	49.937	0.0	62
120 min Summer	31.538	0.0	96
180 min Summer	23.698	0.0	130
240 min Summer	19.179	0.0	164
360 min Summer	14.264	0.0	234
480 min Summer	11.538	0.0	300
600 min Summer	9.777	0.0	368
720 min Summer	8.535	0.0	434
960 min Summer	6.880	0.0	562
1440 min Summer	5.066	0.0	812
2160 min Summer	3.720	0.0	1176
2880 min Summer	2.983	0.0	1536
4320 min Summer	2.181	0.0	2248
5760 min Summer	1.747	0.0	2896
7200 min Summer	1.472	0.0	3616
8640 min Summer	1.280	0.0	4360
10080 min Summer	1.137	0.0	5016
15 min Winter	111.290	0.0	24

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Summary of Results for 100 year Return Period (+30%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
30 min Winter	0.937	0.937	0.8	6.2	O K
60 min Winter	1.122	1.122	0.9	7.5	O K
120 min Winter	1.205	1.205	0.9	8.0	O K
180 min Winter	1.197	1.197	0.9	8.0	O K
240 min Winter	1.153	1.153	0.9	7.7	O K
360 min Winter	1.054	1.054	0.8	7.0	O K
480 min Winter	0.960	0.960	0.8	6.4	O K
600 min Winter	0.873	0.873	0.7	5.8	O K
720 min Winter	0.794	0.794	0.7	5.3	O K
960 min Winter	0.657	0.657	0.6	4.3	O K
1440 min Winter	0.449	0.449	0.5	2.9	O K
2160 min Winter	0.243	0.243	0.4	1.5	O K
2880 min Winter	0.112	0.112	0.4	0.7	O K
4320 min Winter	0.043	0.043	0.3	0.2	O K
5760 min Winter	0.035	0.035	0.2	0.1	O K
7200 min Winter	0.030	0.030	0.2	0.1	O K
8640 min Winter	0.028	0.028	0.2	0.1	O K
10080 min Winter	0.026	0.026	0.2	0.1	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
30 min Winter	76.254	0.0	36
60 min Winter	49.937	0.0	62
120 min Winter	31.538	0.0	100
180 min Winter	23.698	0.0	138
240 min Winter	19.179	0.0	176
360 min Winter	14.264	0.0	250
480 min Winter	11.538	0.0	322
600 min Winter	9.777	0.0	390
720 min Winter	8.535	0.0	458
960 min Winter	6.880	0.0	590
1440 min Winter	5.066	0.0	844
2160 min Winter	3.720	0.0	1212
2880 min Winter	2.983	0.0	1560
4320 min Winter	2.181	0.0	2192
5760 min Winter	1.747	0.0	2904
7200 min Winter	1.472	0.0	3560
8640 min Winter	1.280	0.0	4264
10080 min Winter	1.137	0.0	5120

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Model Details

Storage is Online Cover Level (m) 2.500

Infiltration Trench Structure

Infiltration Coefficient Base (m/hr)	0.10597	Trench Width (m)	1.5
Infiltration Coefficient Side (m/hr)	0.10597	Trench Length (m)	15.0
Safety Factor	2.0	Slope (1:X)	500.0
Porosity	0.30	Cap Volume Depth (m)	0.000
Invert Level (m)	0.000	Cap Infiltration Depth (m)	0.000

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APPENDIX E

Summary of Results for 100 year Return Period (+30%)

Half Drain Time : 150 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	1.607	0.307	0.0	3.0	3.0	23.2	O K
30 min Summer	1.720	0.420	0.0	3.0	3.0	32.0	Flood Risk
60 min Summer	1.816	0.516	0.0	3.0	3.0	39.5	Flood Risk
120 min Summer	1.881	0.581	0.0	3.0	3.0	44.5	Flood Risk
180 min Summer	1.882	0.582	0.0	3.0	3.0	44.6	Flood Risk
240 min Summer	1.869	0.569	0.0	3.0	3.0	43.6	Flood Risk
360 min Summer	1.833	0.533	0.0	3.0	3.0	40.8	Flood Risk
480 min Summer	1.796	0.496	0.0	3.0	3.0	37.9	Flood Risk
600 min Summer	1.752	0.452	0.0	3.0	3.0	34.4	Flood Risk
720 min Summer	1.723	0.423	0.0	3.0	3.0	32.2	Flood Risk
960 min Summer	1.653	0.353	0.0	3.0	3.0	26.7	O K
1440 min Summer	1.530	0.230	0.0	3.0	3.0	17.1	O K
2160 min Summer	1.397	0.097	0.0	3.0	3.0	6.8	O K
2880 min Summer	1.327	0.027	0.0	3.0	3.0	1.3	O K
4320 min Summer	1.305	0.005	0.0	3.0	3.0	0.1	O K
5760 min Summer	1.301	0.001	0.0	2.3	2.3	0.2	O K
7200 min Summer	1.303	0.003	0.0	3.0	3.0	0.2	O K
8640 min Summer	1.301	0.001	0.0	2.3	2.3	0.2	O K
10080 min Summer	1.300	0.000	0.0	1.2	1.2	0.2	O K
15 min Winter	1.627	0.327	0.0	3.0	3.0	24.7	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	108.511	0.0	30.0	27
30 min Summer	73.176	0.0	40.8	41
60 min Summer	47.182	0.0	52.7	70
120 min Summer	29.435	0.0	66.5	126
180 min Summer	22.030	0.0	74.6	170
240 min Summer	17.818	0.0	80.9	202
360 min Summer	13.109	0.0	89.3	268
480 min Summer	10.549	0.0	95.4	336
600 min Summer	8.905	0.0	100.6	418
720 min Summer	7.750	0.0	104.5	470
960 min Summer	6.219	0.0	112.0	604
1440 min Summer	4.551	0.0	123.2	848
2160 min Summer	3.323	0.0	133.9	1188
2880 min Summer	2.655	0.0	142.5	1504
4320 min Summer	1.932	0.0	154.8	2160
5760 min Summer	1.540	0.0	162.3	3440
7200 min Summer	1.290	0.0	168.7	3696
8640 min Summer	1.116	0.0	174.3	3792
10080 min Summer	0.989	0.0	175.3	5560
15 min Winter	108.511	0.0	27.1	18

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Summary of Results for 100 year Return Period (+30%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
30 min Winter	1.780	0.480	0.0	3.0	3.0	36.6	Flood Risk
60 min Winter	1.891	0.591	0.0	3.0	3.0	45.3	Flood Risk
120 min Winter	1.979	0.679	0.0	3.0	3.0	52.2	Flood Risk
180 min Winter	1.992	0.692	0.0	3.0	3.0	53.2	Flood Risk
240 min Winter	1.973	0.673	0.0	3.0	3.0	51.7	Flood Risk
360 min Winter	1.922	0.622	0.0	3.0	3.0	47.7	Flood Risk
480 min Winter	1.868	0.568	0.0	3.0	3.0	43.5	Flood Risk
600 min Winter	1.812	0.512	0.0	3.0	3.0	39.2	Flood Risk
720 min Winter	1.754	0.454	0.0	3.0	3.0	34.6	Flood Risk
960 min Winter	1.619	0.319	0.0	3.0	3.0	24.1	O K
1440 min Winter	1.457	0.157	0.0	3.0	3.0	11.5	O K
2160 min Winter	1.309	0.009	0.0	3.0	3.0	0.2	O K
2880 min Winter	1.304	0.004	0.0	3.0	3.0	0.1	O K
4320 min Winter	1.302	0.002	0.0	3.0	3.0	0.1	O K
5760 min Winter	1.301	0.001	0.0	2.3	2.3	0.2	O K
7200 min Winter	1.300	0.000	0.0	1.2	1.2	0.2	O K
8640 min Winter	1.300	0.000	0.0	1.0	1.0	0.2	O K
10080 min Winter	1.300	0.000	0.0	0.9	0.9	0.2	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
30 min Winter	73.176	0.0	45.6	41
60 min Winter	47.182	0.0	58.6	70
120 min Winter	29.435	0.0	74.6	126
180 min Winter	22.030	0.0	83.8	180
240 min Winter	17.818	0.0	90.5	222
360 min Winter	13.109	0.0	100.1	290
480 min Winter	10.549	0.0	107.7	364
600 min Winter	8.905	0.0	113.4	438
720 min Winter	7.750	0.0	117.8	508
960 min Winter	6.219	0.0	125.5	626
1440 min Winter	4.551	0.0	137.9	878
2160 min Winter	3.323	0.0	150.8	1148
2880 min Winter	2.655	0.0	160.0	884
4320 min Winter	1.932	0.0	171.8	1940
5760 min Winter	1.540	0.0	178.2	3720
7200 min Winter	1.290	0.0	181.1	4104
8640 min Winter	1.116	0.0	192.1	3696
10080 min Winter	0.989	0.0	202.7	5624

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Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	18.000	Shortest Storm (mins)	15
Ratio R	0.345	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+30

Pipe Network

Volume in Pipe Network (m^3)	5	Dia of Outfall Pipe (m)	0.1
Slope of Outfall Pipe (1:X)	150	Roughness of Outfall Pipe (mm)	0.600

Time Area Diagram

Total Area (ha) 0.154

Time (mins) From:	To:	Area (ha)
0	4	0.154

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Model Details

Storage is Online Cover Level (m) 2.000

Porous Car Park Structure

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	26.0
Membrane Percolation (mm/hr)	1000	Length (m)	10.0
Max Percolation (l/s)	72.2	Slope (1:X)	500.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	1.300	Membrane Depth (m)	0

Pump Outflow Control

Invert Level (m) 0.300

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	0.0000	0.900	0.0000	1.700	3.0000	2.500	3.0000
0.200	0.0000	1.000	0.0000	1.800	3.0000	2.600	3.0000
0.300	0.0000	1.001	3.0000	1.900	3.0000	2.700	3.0000
0.400	0.0000	1.200	3.0000	2.000	3.0000	2.800	3.0000
0.500	0.0000	1.300	3.0000	2.100	3.0000	2.900	3.0000
0.600	0.0000	1.400	3.0000	2.200	3.0000	3.000	3.0000
0.700	0.0000	1.500	3.0000	2.300	3.0000		
0.800	0.0000	1.600	3.0000	2.400	3.0000		

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