J ROBERTS DESIGN LTD
STRUCTURAL AND CIVIL ENGINEERING CONSULTANTS

Greenside Lane
Hoyland
Barnsley

DRAINAGE CALCULATIONS

Client – Fountain Developments and Construction Ltd

2640 / November 2020

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J ROBERTS DESIGN LTD STRUCTURAL AND CIVIL ENGINEERING CONSULTANTS	Project Greenside Lane, Hoyland			Job Ref. 2640	
	Section Drainage Design			Sheet no./rev. 1	
	Calc. by JR	Date 15/11/2020	Chk'd by	Date	App'd by	Date

Introduction

It is proposed to construct a 3 dwelling residential development and private access road.

The following calculations are in justification of the surface water drainage for the impermeable areas.

Percolation testing has been undertaken by the client for the purposes of sizing of the private soakaway structures. The results of these are summarised below.

These results have then be used to design the soakaway structures.

The design of the soakaways will be to a 1 in 100 year return period with 30% climate change allowance as any exceedance would flood onto the adjacent public highway.

The ground conditions from the BGS website is described as Bedrock of Pennine Middle Coal Measures Formation - Mudstone, Siltstone and Sandstone. There are no recorded Superficial deposits.

Building Regulations and Building Control Approval

It is the clients responsibility to ensure these calculations are submitted to Building Control for Building Regulations approval under a Building Notice or Full Application as required.
These calculations should be submitted to the local Authority Building Control for Building Regulations approval prior to the commencement of work on site.

Standards and References

BS EN 752:2008	Drain and sewer systems outside buildings
BS EN 12056-2:2000	Gravity Drainage systems inside buildings
Building Regulations - Pt H	Drainage and waster disposal
British Water – Flows and Loads	

Software

Tekla Tedds 2019
Microdrainage

Design information to be read in conjunction with

J Roberts Design Ltd General Structural and Foundation notes,
Construction (Design and Management) Regulations 2015,
CDM 2015 – Domestic Clients: Roles and responsibilities,
The Buildings Regulations 2010 - Part A

Construction, Design and Management (CDM)

J Roberts Design Ltd have undertaken the role of Designer for this project. It is assumed that an Architect has been appointed to the role of Principal Designer and has advised the Client of their responsibilities under the act.

If an Architect has not been appointed, the roles and responsibilities under the CDM regulations normally pass to the principal contactor.

Under CDM 2015 it is our duty as designers to provide adequate information about any significant risks associated with the design project.

Our scope of work on this project is:

- Surface and Foul Water Drainage.

The structural on concept and form of construction of the proposed work are conventional. In our opinion, the design solution reduces foreseeable risk to an acceptable level and no significant risks remain from the structural design in the construction or use that could reasonably have been avoided. We believe that the level of residual risk is normal for this type of project and would be obvious to a competent contractor.

Additional information regarding the responsibility of a client commissioning domestic building work under the CDM regulations 2015 can be found on the HSE website:
http://www.hse.gov.uk/construction/cdm/2015/responsibilities.htm

J Roberts Design Ltd Structural and Civil Engineering Consultants	Project Greenside Lane, Hoyland			Job Ref. 2640	
	Section Drainage Design			Sheet no./rev. 3	
	Calc. by JR	Date 15/11/2020	Chk'd by	Date	App'd by	Date

INFILTRATION RATE - TP1

3 Tests are normally undertaken in the same trial pit as required in BRE Digest 365, however a single test was adopted as it was not possible to fill the trial pit above a depth of 450mm due to the high infiltration rate.

A Trench was excavated 1.5m deep x 1.5 m long x 0.6m wide.
The ground was described as sandstone/ sand and the banks self-supported throughout the test .
900ltrs of fresh water was emptied into the trial pit starting at 8.30 am and it took 25 mins to discharge the 900L tank. By the end of discharge the trench only had 450mm deep water in it.

450mm depth of water equates to 405L of water at the start of the test. Hence 495L of water had already percolated into the ground at an average rate of 0.33×10^{-3}m/s.

The infitration rate based on the remaining 450mm of water is as follows: -

Soil infiltration rate (BRE digest 365)

Length of trial pit;	l_{trial} = 1500 mm
Width of trial pit;	b_{trial} = 600 mm
Water Depth in trial pit at start;	d_{trial} = 450 mm
Free volume (if fill used);	V_{trial} = 100 %;
75% depth of pit;	$d_{75} = (d_{trial} \times 0.75)$ = **337.50** mm
50% depth of pit;	$d_{50} = (d_{trial} \times 0.50)$ = **225.00** mm
25% depth of pit;	$d_{25} = (d_{trial} \times 0.25)$ = **112.50** mm
Test 1 - time to fall from 75% depth to 25% depth;	T1 = 100 min
Longest time to fall from 75% depth to 25% depth;	t_{lg} = T1 = **100** min
Storage volume from 75% to 25% depth;	$V_{p75_25} = (l_{trial} \times b_{trial} \times (d_{75} - d_{25})) \times V_{trial}$ = **0.20** m^3
Internal surface area to 50% depth;	$a_{p50} = ((l_{trial} \times b_{trial}) + (l_{trial} + b_{trial}) \times 2 \times d_{50})$ = **1.85** m^2
Surface area of soakaway to 50% storage depth;	$A_{s50} = 2 \times (l_{trial} + b_{trial}) \times d_{trial} / 2$ = **0.945** m^2
Soil infiltration rate;	$f9 = V_{p75_25} / (a_{p50} \times t_{lg})$ = **18.3×10^{-6}** m/s
;	f9a = f9 = **0.06585** m/hr

As the usual 1m depth of water at the start of the test was not achieved this calculation is based on what would be the second half of the graph which typically flattens off as the rate of infiltration slows down. Therefore, the calculated infiltration rate is considered to be conservative.

SURFACE WATER DRAINAGE DESIGN

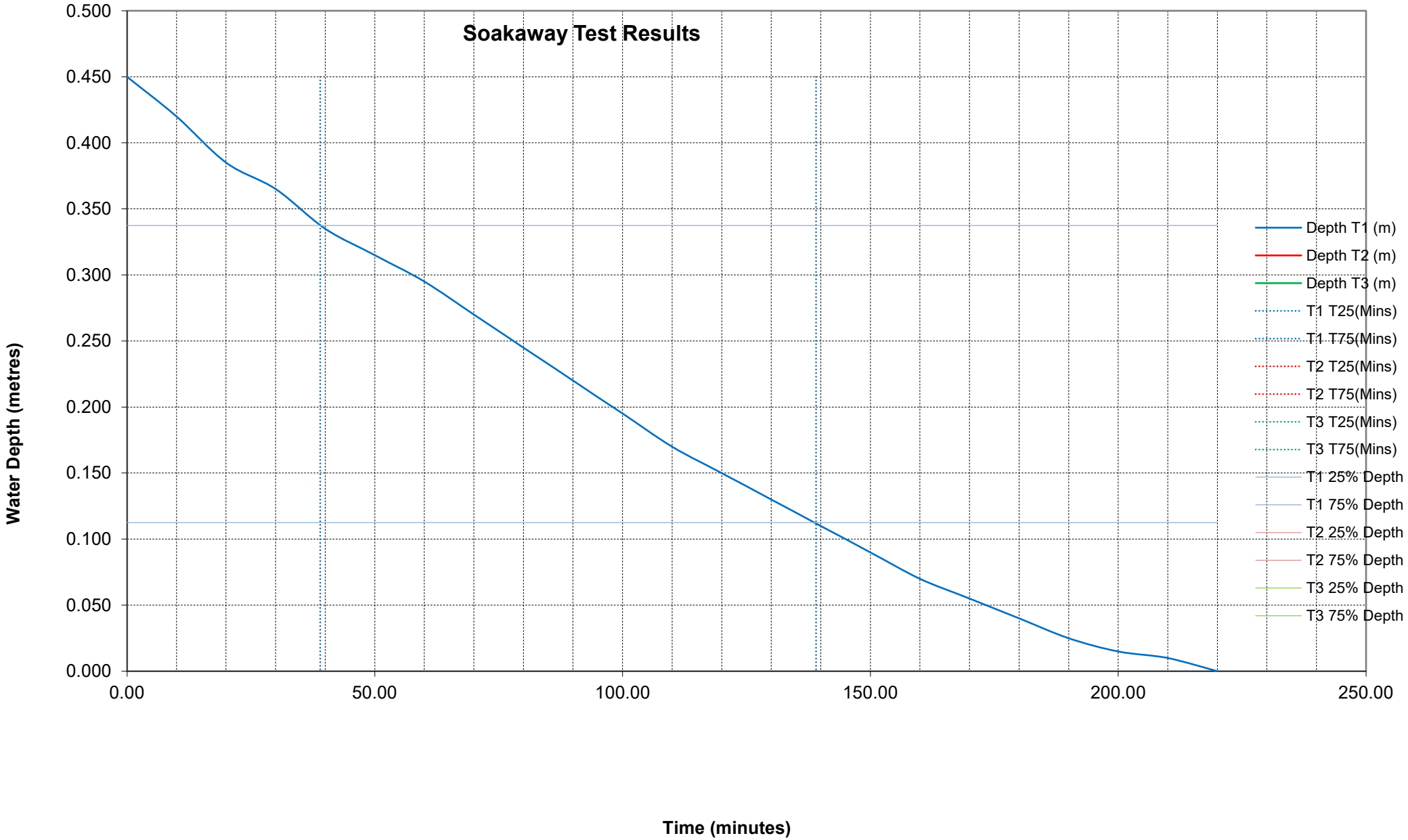
The total impermeable area for the dwelling and drive is 521m^2

Based on an infiltration rate of 0.06585 m/hr a soakaway a 7.5m x 2.5m x 2.0m deep cellular soakaway is required.

Refer to the attached Microdrainage calculations for the soakaway design

INFILTRATION TEST 1

Soakaway Field Data						
Time	Hrs: Minutes: Seconds From Start of Test	Seconds From Start of Test	Minutes From Start of Test	WL m below OGL	Depth of Water	Depth of soakaway pit. m
08:55	00:00:00	0	0	1.050	0.450	1.5
09:05	00:10:00	600	10	1.080	0.420	
09:15	00:20:00	1200	20	1.115	0.385	
09:25	00:30:00	1800	30	1.135	0.365	
09:35	00:40:00	2400	40	1.165	0.335	
09:45	00:50:00	3000	50	1.185	0.315	
09:55	01:00:00	3600	60	1.205	0.295	
10:05	01:10:00	4200	70	1.230	0.270	
10:15	01:20:00	4800	80	1.255	0.245	
10:25	01:30:00	5400	90	1.280	0.220	
10:35	01:40:00	6000	100	1.305	0.195	
10:45	01:50:00	6600	110	1.330	0.170	
10:55	02:00:00	7200	120	1.350	0.150	
11:05	02:10:00	7800	130	1.370	0.130	
11:15	02:20:00	8400	140	1.390	0.110	
11:25	02:30:00	9000	150	1.410	0.090	
11:35	02:40:00	9600	160	1.430	0.070	
11:45	02:50:00	10200	170	1.445	0.055	
11:55	03:00:00	10800	180	1.460	0.040	
12:05	03:10:00	11400	190	1.475	0.025	
12:15	03:20:00	12000	200	1.485	0.015	
12:25	03:30:00	12600	210	1.490	0.010	
12:35	03:40:00	13200	220	1.500	0.000	


Soakaway Test Results
Water Depth (metres)
0.500
0.450
0.400
0.350
0.300
0.250
0.200
0.150
0.100
0.050
0.000
0.00
50.00
100.00
150.00
200.00
250.00
Time (minutes)
Depth T1 (m)
Depth T2 (m)
Depth T3 (m)
T1 T25(Mins)
T1 T75(Mins)
T2 T25(Mins)
T2 T75(Mins)
T3 T25(Mins)
T3 T75(Mins)
T1 25% Depth
T1 75% Depth
T2 25% Depth
T2 75% Depth
T3 25% Depth
T3 75% Depth

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

Half Drain Time : 1084 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
15 min Summer	99.633	0.633	0.1	11.3	O K
30 min Summer	99.844	0.844	0.2	15.0	O K
60 min Summer	100.070	1.070	0.2	19.1	O K
120 min Summer	100.298	1.298	0.2	23.1	O K
180 min Summer	100.423	1.423	0.3	25.3	O K
240 min Summer	100.500	1.500	0.3	26.7	O K
360 min Summer	100.592	1.592	0.3	28.4	O K
480 min Summer	100.645	1.645	0.3	29.3	O K
600 min Summer	100.672	1.672	0.3	29.8	O K
720 min Summer	100.685	1.685	0.3	30.0	O K
960 min Summer	100.704	1.704	0.3	30.3	O K
1440 min Summer	100.719	1.719	0.3	30.6	O K
2160 min Summer	100.707	1.707	0.3	30.4	O K
2880 min Summer	100.673	1.673	0.3	29.8	O K
4320 min Summer	100.584	1.584	0.3	28.2	O K
5760 min Summer	100.492	1.492	0.3	26.6	O K
7200 min Summer	100.406	1.406	0.3	25.0	O K
8640 min Summer	100.329	1.329	0.2	23.7	O K
10080 min Summer	100.261	1.261	0.2	22.5	O K
15 min Winter	99.708	0.708	0.1	12.6	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
15 min Summer	116.536	0.0	27
30 min Summer	78.082	0.0	41
60 min Summer	49.937	0.0	70
120 min Summer	30.853	0.0	130
180 min Summer	22.945	0.0	188
240 min Summer	18.469	0.0	246
360 min Summer	13.550	0.0	364
480 min Summer	10.876	0.0	482
600 min Summer	9.164	0.0	600
720 min Summer	7.962	0.0	672
960 min Summer	6.373	0.0	778
1440 min Summer	4.648	0.0	1028
2160 min Summer	3.383	0.0	1436
2880 min Summer	2.697	0.0	1848
4320 min Summer	1.956	0.0	2648
5760 min Summer	1.555	0.0	3464
7200 min Summer	1.301	0.0	4248
8640 min Summer	1.125	0.0	5016
10080 min Summer	0.995	0.0	5752
15 min Winter	116.536	0.0	27

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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	99.945	0.945	0.2	16.8	O K
60 min Winter	100.199	1.199	0.2	21.4	O K
120 min Winter	100.456	1.456	0.3	25.9	O K
180 min Winter	100.596	1.596	0.3	28.4	O K
240 min Winter	100.684	1.684	0.3	30.0	O K
360 min Winter	100.790	1.790	0.3	31.9	O K
480 min Winter	100.852	1.852	0.3	33.0	O K
600 min Winter	100.886	1.886	0.3	33.6	O K
720 min Winter	100.903	1.903	0.3	33.9	O K
960 min Winter	100.911	1.911	0.3	34.0	O K
1440 min Winter	100.917	1.917	0.4	34.1	O K
2160 min Winter	100.874	1.874	0.3	33.4	O K
2880 min Winter	100.808	1.808	0.3	32.2	O K
4320 min Winter	100.664	1.664	0.3	29.6	O K
5760 min Winter	100.530	1.530	0.3	27.2	O K
7200 min Winter	100.412	1.412	0.3	25.1	O K
8640 min Winter	100.309	1.309	0.2	23.3	O K
10080 min Winter	100.222	1.222	0.2	21.8	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
30 min Winter	78.082	0.0	41
60 min Winter	49.937	0.0	70
120 min Winter	30.853	0.0	126
180 min Winter	22.945	0.0	184
240 min Winter	18.469	0.0	242
360 min Winter	13.550	0.0	356
480 min Winter	10.876	0.0	470
600 min Winter	9.164	0.0	580
720 min Winter	7.962	0.0	686
960 min Winter	6.373	0.0	798
1440 min Winter	4.648	0.0	1088
2160 min Winter	3.383	0.0	1540
2880 min Winter	2.697	0.0	1992
4320 min Winter	1.956	0.0	2852
5760 min Winter	1.555	0.0	3648
7200 min Winter	1.301	0.0	4472
8640 min Winter	1.125	0.0	5272
10080 min Winter	0.995	0.0	6048

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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)	19.000	Shortest Storm (mins)	15
Ratio R	0.357	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+30

Time Area Diagram

Total Area (ha) 0.052

Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)
0	4	0.018	4	8	0.017	8	12	0.017

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Model Details

Storage is Online Cover Level (m) 102.000

Cellular Storage Structure

Invert Level (m) 99.000 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.06585

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	18.8	18.8	2.001	0.0	58.8
2.000	18.8	58.8			

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MAINTENANCE

As the surface water drainage system is proposed to remain in private ownership the dwelling owners will have responsibility for the maintenance of the drainage systems for the life of the development.

Below Ground Drainage and drainage channels

1. No work shall be carried out on the drainage system without permission from a nominated person, who has access to information/a working knowledge of the system.
2. Maintenance/inspection work shall be carried out in a safe/planned manner.
3. All work is to be carried out by competent persons suitably trained and equipped in accordance with current statutory safe working policies.
4. Entry into confined spaces shall be kept to a minimum and be restricted to suitably qualified/equipped persons working in accordance with current statutory safe working policies.
5. High levels of hygiene shall be maintained at all times, with adequate welfare facilities being provided for the personnel.
6. Drainage systems shall be inspected on a regular basis or should any problems be suspected. Any debris/ defects discovered shall be recorded and a programme of cleaning/ repair initiated. Urgent repairs/ cleaning shall be actioned as soon as practicable.
7. The following operations should be carried out annually.
    a) Covers of inspection chambers and manholes shall be removed and the sides, benchings and channels cleared.
    b) Accumulated deposits of silt in soakaways, catchpit manholes, drainage channels, gullies etc. shall be removed. Any traps shall then be plunged and thoroughly flushed out with clean water.
    c) Main and branch drains shall be cleared as required and afterwards be flushed with clean water. Any obstructions found shall be removed and not flushed down the system.
    d) Covers of inspection chambers, manholes, gullies etc. shall be replaced, bedded in suitable grease or other sealing material as required and bolted/locked down as appropriate. Missing bolts and broken items shall be replaced in accordance with the manufacturer's details.
8. Trapped gullies shall be checked and replenished as necessary in order to maintain the seal, preventing the escape of odours.
9. Clearing of the drainage system can be achieved by a number of methods depending on the nature of the work
    a) Rodding – Manual/Mechanical with flexible rods.
    b) Jetting – High pressure water jetting.
    c) Plunging.

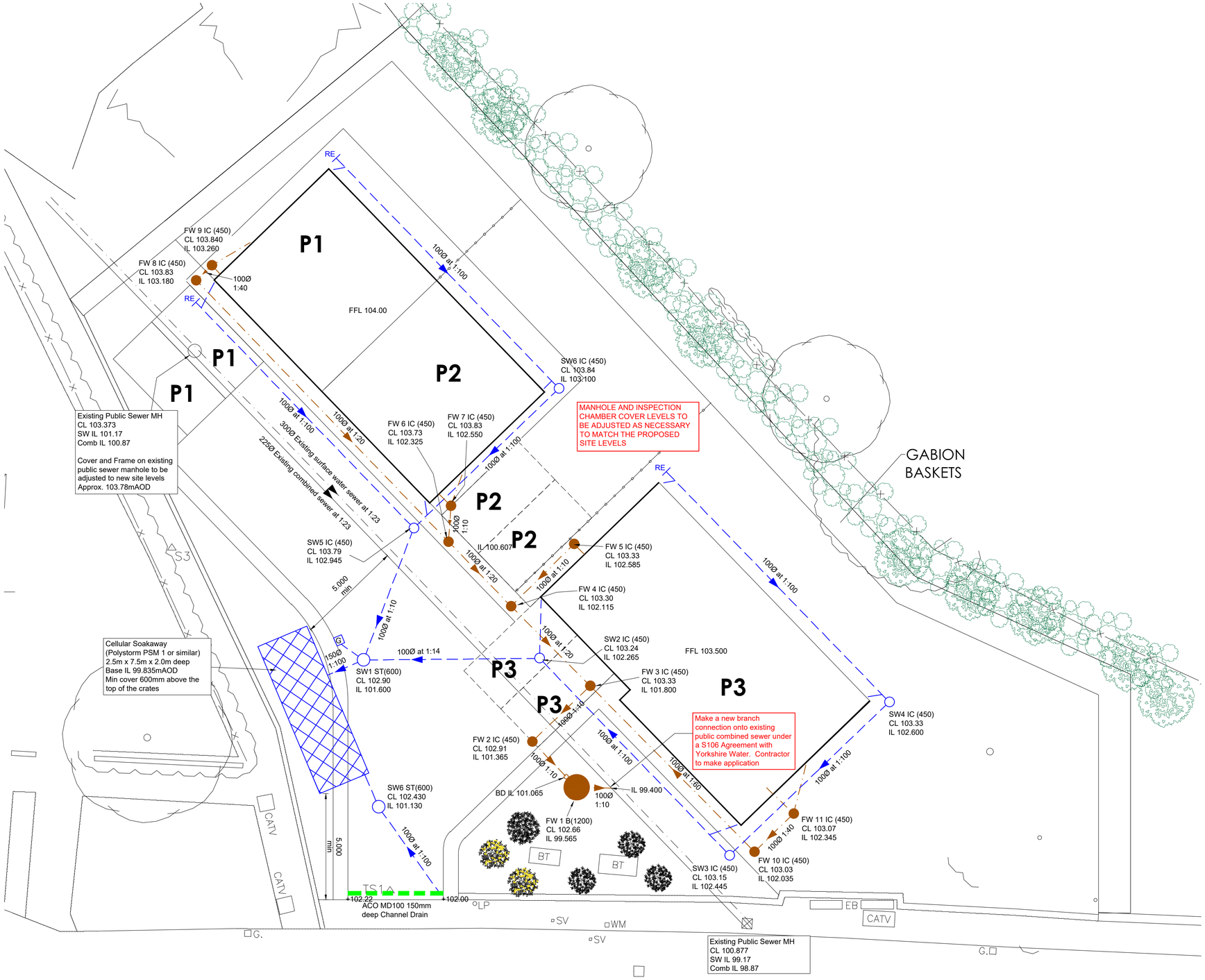
Maintenance Schedule for Cellular Crate Tanks

Regular Maintenance		
Element	**Maintenance / Action Required**	**Frequency**
Crate Structures	CCTV / jetting through central channel to assess and clear any build-up of silt	Annually – Autumn after leaf fall
Regular Monitoring		
Inlets / outles / vents	Inspect all inlets / outlets and vents to ensure in a good working condition and operating as designed	Annually and after large storms
Remedial Actions		
Inlets / outles / vents	Repair as necessary	As required.
Crates	Inspect and replace crates where necessary	As required.

NOTES

1. DO NOT SCALE - Use figured dimensions only.
2. All dimensions shown are in millimetres unless otherwise stated.
3. The Contractor is to verify all dimension on site before commencing work or preparing shop drawings.
4. This drawing is to be read in conjunction with all Engineers and Architects drawings and specifications.
5. 100 & 150 dia. pipes to be vitrified clay (FH40kN/m) & 225 dia. pipes to be vitrified clay (FH45kN/m) to B.S EN295-1, Hepworth or similar.
   300, 375 & 450 dia. pipes to be Class 120 concrete to B.S. 5911 Part 1:2002.

   Plastic structural wall sewer pipes to be Wavin Plastic Drainage to BS. EN13476-1/2 and WIS-4-35-01. Kitemarked.
   - Plastic pipes less than 500mm. dia. shall be a nominal short term ring stiffness not less than 8kN/m². (SN8).
   - Plastic pipes greater than 500mm. dia. shall have a nominal short term ring stiffness not less than 2kN/m². (SN2), unless supported by design calculations.
   - Plastic chambers & rings to BS. EN13598-1and 2. Kitemarked.
   - Drainage pipes to be laid in maximum 3m lengths.
6. All pipe connections at manholes to be soffit to soffit.
7. Sulphate resistant cement (C20-DC2) and precast concrete products must be used or a laboratory report provided proving that such precautions are not necessary.
8. All sewer works and materials to be in accordance with "Sewer For Adoption 6th Edition", The Relevant British /European and Yorkshire Water's Standards / Requirements / Addendum and KITEMARKED.
9. Manhole Covers shall/must have a clear opening of 600mm and shall be Class D400 to BS EN 124 with 150mm deep frames in Highways. Refer to manhole schedule for all other Class of manhole covers. Where a B125 cover and frame are specified these must be coated in plastic and and must have lifting eyes suitably sized to accommodate standard lifting keys.
10. Cover slabs must carry the BSI Kitemark. Where the clear opening of the Kitemarked product is different to that of the cover and frame, a load bearing slab should be fitted above the cover slab to bring the size down to 600x600mm. Refer to Concrete Pipe Systems Association (CPSA), 'Technical Bulletin' issued Autumn 2004 for Kitemarked cover slab opening sizes.
11. Sewers to be laid in Class 'S' bedding (150mm granular bed and surround). Where depth of cover to top of the sewer is less than 1.2m in highways and verges (or less than 900mm in none vehicular access areas) then a concrete slab should be provided above granular bed and surround. Refer to drainage details.
12. Bedding and backfill material to conform to the requirement of Water Industry Specification 4-08-02 (Table A2).
13. The chamber size of manholes with more than one connection in them may need to be increased an increment to accommodate the connections and bends.
14. Plastic Channel Sections in manholes are not acceptable and clayware is required.
15. All gully connections to be 150 dia. at 1 : 150 fall.
16. Gully connections to be encased in concrete (GEN3) 150th. where depth of cover is less than 1.2m. 18mm. Flexcell board to be provided at each pipe joint.



P1	PRELIMINARY ISSUE	RKG	JR	15.11.2020
Rev	Description	Dr	Ch	Date

Client: FOUNTAIN DEVELOPMENTS

Project: GREENSIDE LANE, HOYLAND BARNSLEY

Title: DRAINAGE PLAN

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Sheet Size	A1	Scale	1:100
Drawn	RKG	Drawing Number	Rev
Checked	JR	2640/01	P1
Approved	JR		

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A1 BS1192 : Part 1 1984

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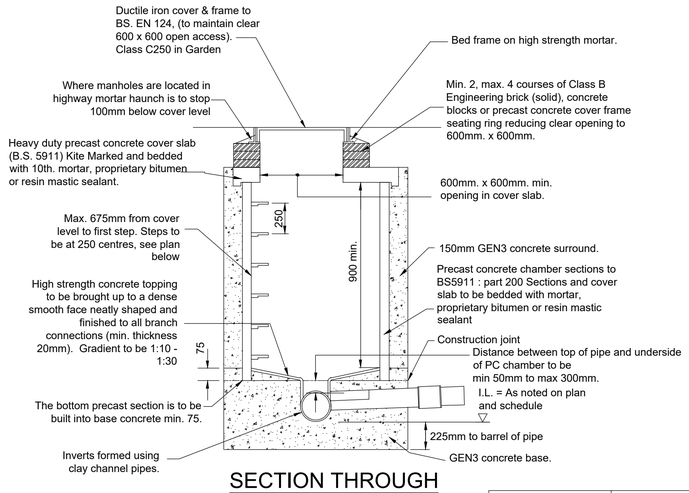
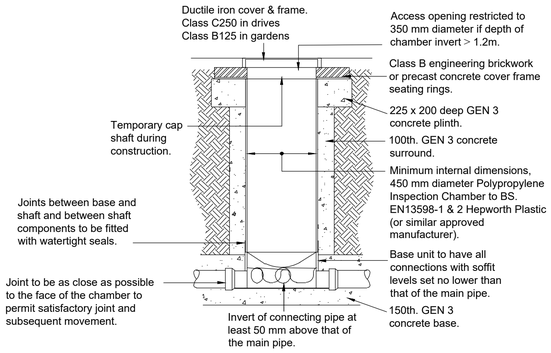


SECTION THROUGH TYPICAL MANHOLE UP TO 3000 DEEP

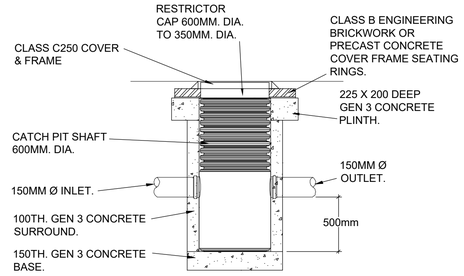
SCALE 1 : 25

Dia of largest pipe	Internal Dia of Manhole
150 - 375	1200
375 - 700	1500
750 - 900	1800
1000 -1200	2100



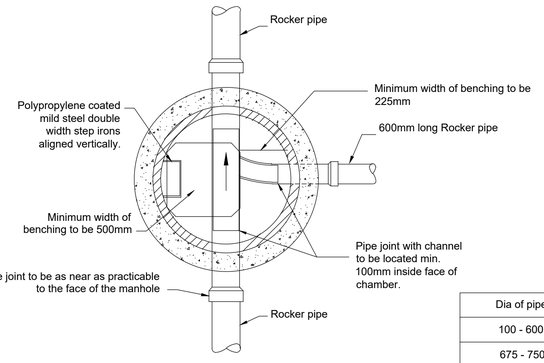
450mm. DIA. INSPECTION CHAMBER DETAIL 100 & 150 DIA.

SCALE 1 : 20



CATCH PIT DETAIL

SCALE 1:25



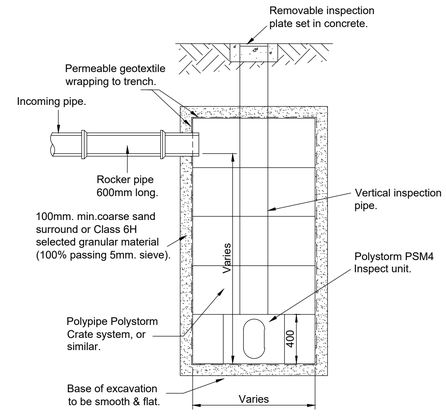
Dia of pipe	Length of rocker pipe
100 - 600	600
675 - 750	1000
over 750	1250

PLAN OF TYPICAL MANHOLE UP TO 3000 DEEP

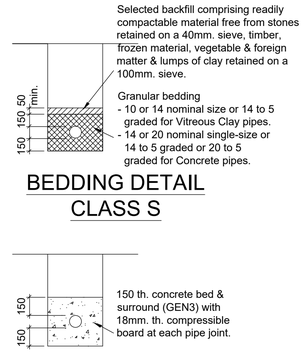
Maximum depth from ground level to soffit of pipe 3000

MANHOLE DETAIL TYPE 'B'

SCALE 1 : 25

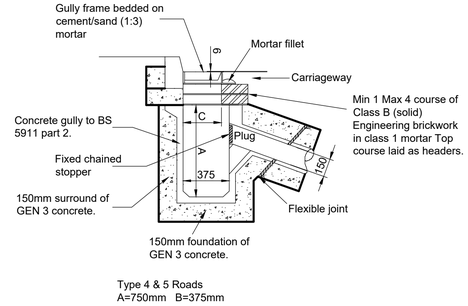


CRATE SOAKAWAY DETAIL



BEDDING DETAIL CLASS S

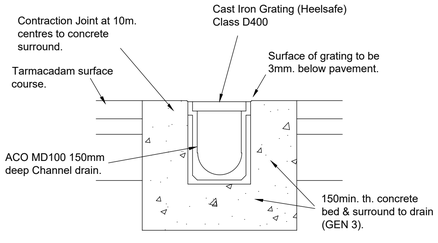
PIPE BEDDING DETAIL DEPTH OF COVER LESS THAN 1.2m. CLASS A



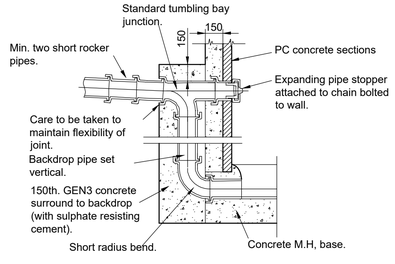
Type 4 & 5 Roads
A=750mm B=375mm

Minimum clear opening between gully pot and gully frame to be (C=300min) in any concrete or clayware

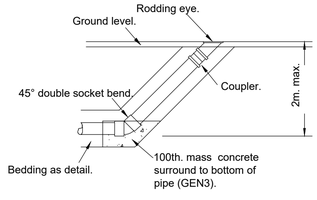
GULLY DETAIL



CHANNEL DRAIN DETAIL



VERTICAL BACKDROP DETAIL



RODDING EYE DETAIL

Rev	Description	Dr	Ch	Date
P1	PRELIMINARY ISSUE	RKG	JR	15.11.2020

Client: FOUNTAIN DEVELOPMENTS

Project: GREENSIDE LANE, HOYLAND BARNSLEY

Title: DRAINAGE DETAILS

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Approved	JR
Drawing Number	2640/02
Rev	P1

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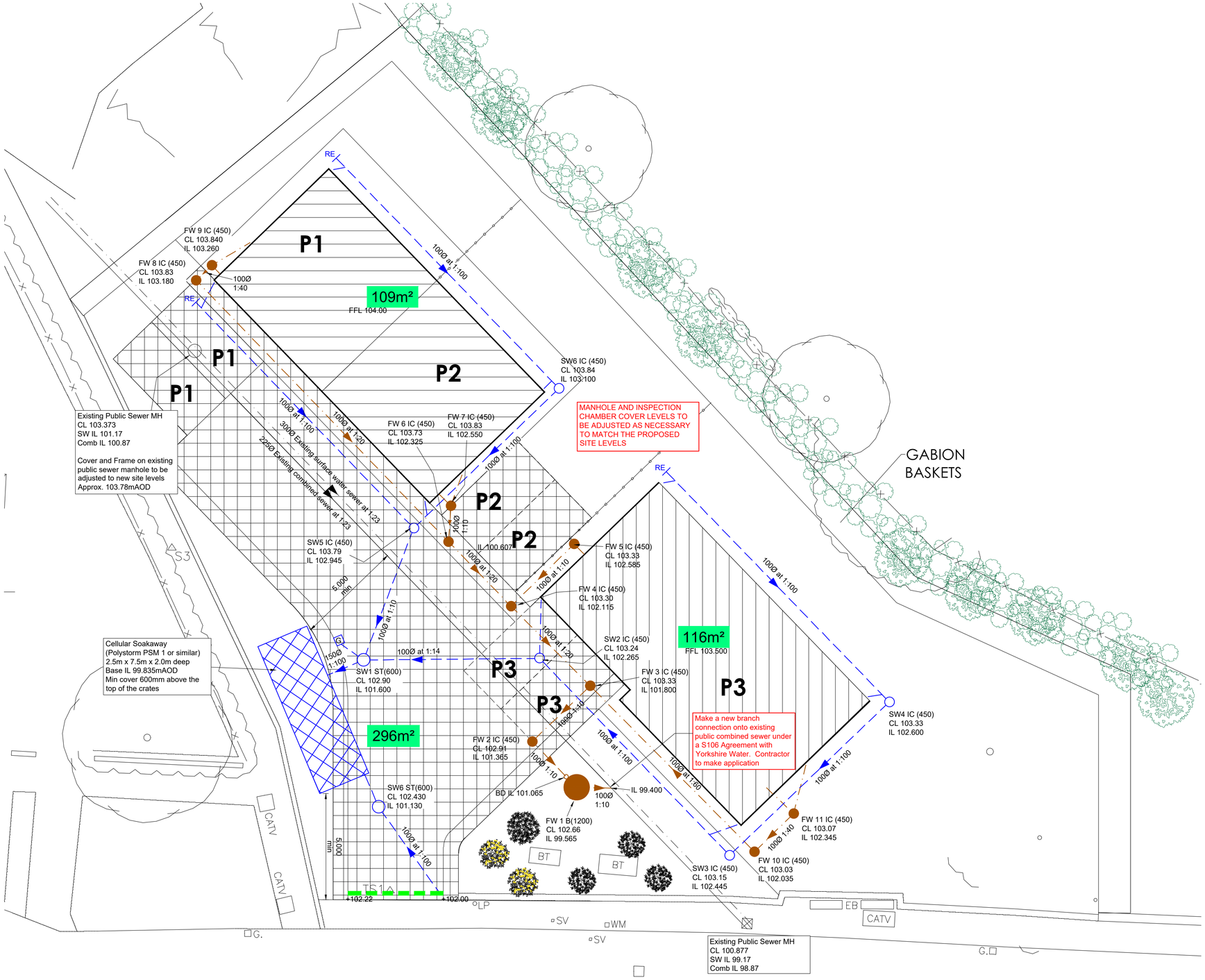
NOTES

1. DO NOT SCALE - Use figured dimensions only.
2. All dimensions shown are in millimetres unless otherwise stated.
3. The Contractor is to verify all dimension on site before commencing work or preparing shop drawings.
4. This drawing is to be read in conjunction with all Engineers and Architects drawings and specifications.



P1	PRELIMINARY ISSUE	RKG	JR	15.11.2020
Rev	Description	Dr	Ch	Date

Client: FOUNTAIN DEVELOPMENTS

Project: GREENSIDE LANE, HOYLAND BARNSLEY

Title: DRAINAGE AREA PLAN

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