

Nolan Associates

consulting civil and structural engineers

54 Hagley Road, Birmingham B16 8PE
Tel: 0121- 454 3099 e-mail: enquiries@nolanassociates.co.uk

Bennet Court Reading Drainage Strategy

Project No.	2022-124	
Checked by:	JG	Pages:
Date:	November 2022	
Issued to:		
Issued by:		



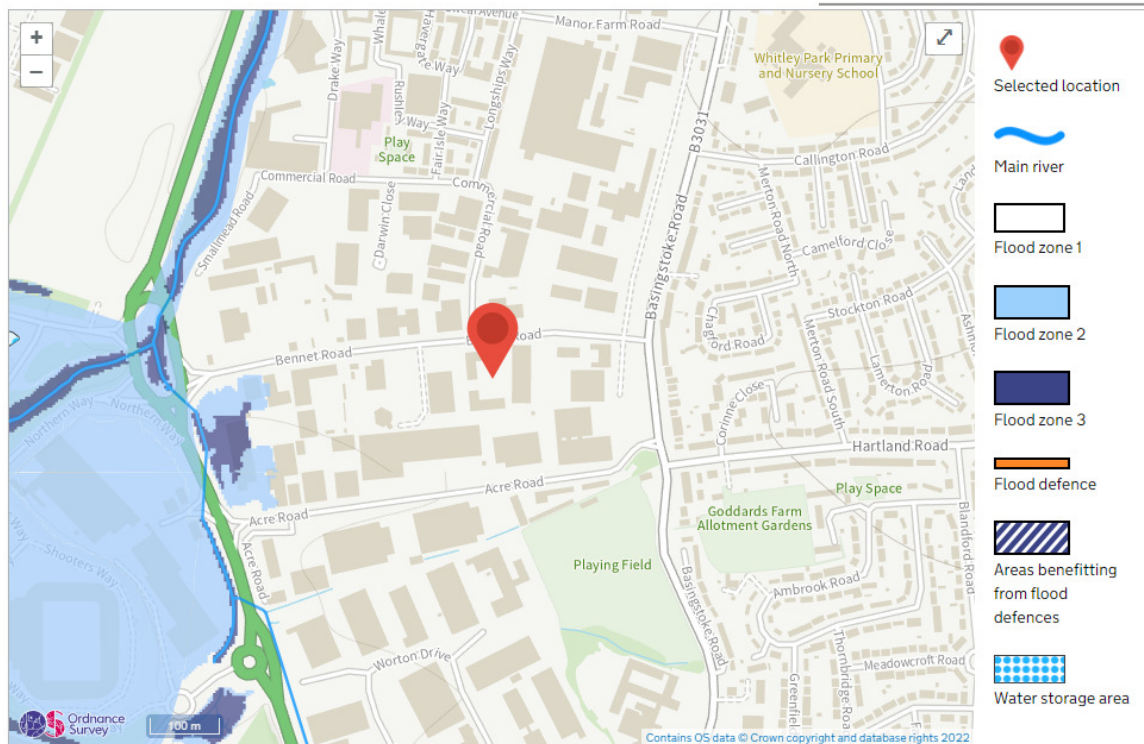
Directors: Prof. John Nolan BSc, MSc, DEng(Hon), C.Eng, F.I.Struct.E, F.I.C.E. Andrew Williams BSc(Hons) CEng MStructE
Valerie Nolan Cormac Kennedy BE (Civils)(Hons) CEng MStructE Nick Warwick BEng (Hons) CEng MStructE
Associates: James Lockley IEng AMStructE Chris Chrysostomou BEng(Hons) CEng MStructE
Karl Pritchard MEng(Hons) CEng MICE George Irwin MEng Msc DIC CEng MStructE MICE



Surface Water Drainage Strategy

The proposed development is to convert the existing brownfield at Bennet Court, Bennet Road, Reading, RG2 0QX into an industrial building with associated service yard and car park. The total site area is 7471m² with a total impermeable area of circa 7140m².

It can be seen from the flood map below that the site lies within Flood Zone 1.



Therefore, as the site is under 1 Ha and lies within flood zone 1 a Flood Risk Assessment is not required.

It is understood from the Site Investigation that due to the presence of shallow cohesive soils soakaways are not a viable solution.

The nearest watercourse is circa 500m away therefore it is proposed that the site will discharge to the public sewer at a greenfield runoff rate of 5l/s in accordance with the UK Suds website and will be attenuated for all events up to and including 1 in 100 year + 40% climate change. It is assumed that both a foul and surface water sewer lie within Bennet Road due to the surrounding buildings and road drainage. Both connections will require a S106 for a direct connection to the public sewer.

The overall performance of the drainage network has been analysed using the MicroDrainage Simulation computer programme and this can be seen in Appendix A.

Due to the development being largely impermeable and the amount of delivery vehicles using the site there is minimal amount of space and options for above ground SuDs to be located within the site. Therefore, it is proposed to utilize the car parking bays as permeable paving, the rest of the attenuation required will be provided by an underground attenuation tank. Please see proposed drainage layout in Appendix B.

Sustainable Urban Drainage Systems – SUDS

With reference to the SFRA level 2 it recommends that suitable surface water mitigation measures are incorporated into any development plans in order to reduce and manage surface water flood risk to and posed, by the development. This should be achieved by incorporating SUDs techniques.

Suitability of SUDS techniques to this site

The suitability of each of the following SUDs measures to this project are discussed below.

Infiltration Techniques

Infiltration techniques are unfeasible within this site due to the ground strata being cohesive soils.

Porous Paving

The nature of the proposed site layout lends itself to a porous paving solution lined with an impermeable membrane this will provide some attenuation for the site together with a pollutant treatment medium prior to discharge.

Swales/ponds/detention basins

The shape and function of the external areas do not lend themselves to the use of swales which are linear drainage features that would be in conflict with pedestrian and vehicle routes. There is insufficient space to provide a useful volume of storage in either Ponds or Detention Basins in areas with a practical requirement for a high proportion of hard paving.

Balancing structures including tanks

The amount of attenuation required for the site to achieve the required reduction in peak discharge rate is more than what can be provided by porous paving and rain garden solutions alone. As a result, underground attenuation tanks seem the most practical way to provide the full storage required.

Foul Water Drainage

It is proposed that all foul drainage will discharge by gravity to the public sewer within Bennet Road. The formal Section 106 approval will be required to all drainage connections to the Public Sewer network.

Jamie Glynn

B.Eng. M.Sc.

For Nolan Associates

Appendix A

MicroDrainage Calculations

Nolan Associates Ltd		Page 1
54 Hagley Road Birmingham West Midlands B16 8PE		
Date 21/11/2022 11:23 File SWD.MDX	Designed by j.glynn Checked by	
Causeway Network 2020.1.3		

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Storm

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - England and Wales

Return Period (years)	100	PIMP (%)	100
M5-60 (mm)	18.700	Add Flow / Climate Change (%)	0
Ratio R	0.400	Minimum Backdrop Height (m)	0.200
Maximum Rainfall (mm/hr)	50	Maximum Backdrop Height (m)	1.500
Maximum Time of Concentration (mins)	30	Min Design Depth for Optimisation (m)	1.200
Foul Sewage (l/s/ha)	0.000	Min Vel for Auto Design only (m/s)	1.00
Volumetric Runoff Coeff.	0.750	Min Slope for Optimisation (1:X)	500

Designed with Level Soffits

Time Area Diagram for Storm

Time (mins)	Area (ha)	Time (mins)	Area (ha)
0-4	0.354	4-8	0.350

Total Area Contributing (ha) = 0.704

Total Pipe Volume (m³) = 20.953

©1982-2020 Innovyze

Nolan Associates Ltd		Page 2
54 Hagley Road Birmingham West Midlands B16 8PE		
Date 21/11/2022 11:23 File SWD.MDX	Designed by j.glynn Checked by	

Causeway

Network 2020.1.3

Manhole Schedules for Storm

MH Name	MH CL (m)	MH Depth (m)	MH Connection	MH Diam., L*W (mm)	PN	Pipe Out Invert Level (m)	Diameter (mm)	PN	Pipes In Invert Level (m)	Diameter (mm)	Backdrop (mm)
S1	41.183	1.300	Open Manhole	1200	1.000	39.883	300				
S2	41.200	1.447	Open Manhole	1200	1.001	39.753	300	1.000	39.753	300	
S3	41.350	1.200	Open Manhole	1200	2.000	40.150	225				
S4	41.380	1.444	Open Manhole	1200	2.001	39.936	225	2.000	39.936	225	
S5	41.450	1.879	Open Manhole	1350	1.002	39.571	375	1.001	39.646	300	
								2.001	39.917	225	196
S6	41.560	1.300	Open Manhole	1200	3.000	40.260	300				
S7	41.560	1.354	Open Manhole	1200	3.001	40.206	300	3.000	40.206	300	
S8	41.450	2.076	Open Manhole	1350	1.003	39.374	450	1.002	39.449	375	
								3.001	40.193	300	669
S9	41.500	1.240	Open Manhole	1350	4.000	40.260	375				
S10	41.400	2.146	Open Manhole	1350	1.004	39.254	375	1.003	39.254	450	
								4.000	40.237	375	983
0	41.400	2.228	Open Manhole	0		OUTFALL		1.004	39.172	375	

No coordinates have been specified, layout information cannot be produced.

Simulation Criteria for Storm

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 1 Number of Time/Area Diagrams 0
 Number of Offline Controls 0 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FSR Profile Type Summer
 Return Period (years) 100 Cv (Summer) 0.750
 Region England and Wales Cv (Winter) 0.840
 M5-60 (mm) 18.700 Storm Duration (mins) 30
 Ratio R 0.400

Nolan Associates Ltd		Page 3																																																																																													
54 Hagley Road Birmingham West Midlands B16 8PE																																																																																															
Date 21/11/2022 11:23	Designed by j.glynn																																																																																														
File SWD.MDX	Checked by																																																																																														
Causeway	Network 2020.1.3																																																																																														
Online Controls for Storm Hydro-Brake® Optimum Manhole: S10, DS/PN: 1.004, Volume (m³): 13.0 Unit Reference MD-SHE-0105-5000-1000-5000 Design Head (m)1.000 Design Flow (l/s)5.0 Flush-Flo™Calculated ObjectiveMinimise upstream storage ApplicationSurface Sump AvailableYes Diameter (mm)105 Invert Level (m)39.254 Minimum Outlet Pipe Diameter (mm)150 Suggested Manhole Diameter (mm)1200 <table><tr><th>Control Points</th><th>Head (m)</th><th>Flow (l/s)</th><th>Control Points</th><th>Head (m)</th><th>Flow (l/s)</th></tr><tr><td>Design Point (Calculated)</td><td>1.000</td><td>5.0</td><td>Kick-Flo®</td><td>0.637</td><td>4.1</td></tr><tr><td>Flush-Flo™</td><td>0.296</td><td>5.0</td><td>Mean Flow over Head Range</td><td>-</td><td>4.3</td></tr></table> The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated <table><tr><th>Depth (m)</th><th>Flow (l/s)</th><th>Depth (m)</th><th>Flow (l/s)</th><th>Depth (m)</th><th>Flow (l/s)</th><th>Depth (m)</th><th>Flow (l/s)</th></tr><tr><td>0.100</td><td>3.6</td><td>1.200</td><td>5.4</td><td>3.000</td><td>8.4</td><td>7.000</td><td>12.5</td></tr><tr><td>0.200</td><td>4.8</td><td>1.400</td><td>5.8</td><td>3.500</td><td>9.0</td><td>7.500</td><td>12.9</td></tr><tr><td>0.300</td><td>5.0</td><td>1.600</td><td>6.2</td><td>4.000</td><td>9.6</td><td>8.000</td><td>13.3</td></tr><tr><td>0.400</td><td>4.9</td><td>1.800</td><td>6.6</td><td>4.500</td><td>10.1</td><td>8.500</td><td>13.7</td></tr><tr><td>0.500</td><td>4.7</td><td>2.000</td><td>6.9</td><td>5.000</td><td>10.6</td><td>9.000</td><td>14.1</td></tr><tr><td>0.600</td><td>4.3</td><td>2.200</td><td>7.2</td><td>5.500</td><td>11.1</td><td>9.500</td><td>14.5</td></tr><tr><td>0.800</td><td>4.5</td><td>2.400</td><td>7.5</td><td>6.000</td><td>11.6</td><td></td><td></td></tr><tr><td>1.000</td><td>5.0</td><td>2.600</td><td>7.8</td><td>6.500</td><td>12.1</td><td></td><td></td></tr></table> <tr><td colspan="3">©1982-2020 Innovyze</td></tr>			Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)	Design Point (Calculated)	1.000	5.0	Kick-Flo®	0.637	4.1	Flush-Flo™	0.296	5.0	Mean Flow over Head Range	-	4.3	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	0.100	3.6	1.200	5.4	3.000	8.4	7.000	12.5	0.200	4.8	1.400	5.8	3.500	9.0	7.500	12.9	0.300	5.0	1.600	6.2	4.000	9.6	8.000	13.3	0.400	4.9	1.800	6.6	4.500	10.1	8.500	13.7	0.500	4.7	2.000	6.9	5.000	10.6	9.000	14.1	0.600	4.3	2.200	7.2	5.500	11.1	9.500	14.5	0.800	4.5	2.400	7.5	6.000	11.6			1.000	5.0	2.600	7.8	6.500	12.1			©1982-2020 Innovyze		
Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)																																																																																										
Design Point (Calculated)	1.000	5.0	Kick-Flo®	0.637	4.1																																																																																										
Flush-Flo™	0.296	5.0	Mean Flow over Head Range	-	4.3																																																																																										
Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)																																																																																								
0.100	3.6	1.200	5.4	3.000	8.4	7.000	12.5																																																																																								
0.200	4.8	1.400	5.8	3.500	9.0	7.500	12.9																																																																																								
0.300	5.0	1.600	6.2	4.000	9.6	8.000	13.3																																																																																								
0.400	4.9	1.800	6.6	4.500	10.1	8.500	13.7																																																																																								
0.500	4.7	2.000	6.9	5.000	10.6	9.000	14.1																																																																																								
0.600	4.3	2.200	7.2	5.500	11.1	9.500	14.5																																																																																								
0.800	4.5	2.400	7.5	6.000	11.6																																																																																										
1.000	5.0	2.600	7.8	6.500	12.1																																																																																										
©1982-2020 Innovyze																																																																																															

Nolan Associates Ltd		Page 4												
54 Hagley Road Birmingham West Midlands B16 8PE														
Date 21/11/2022 11:23 File SWD.MDX	Designed by j.glynn Checked by													
Causeway Network 2020.1.3														
<u>Storage Structures for Storm</u> <u>Tank or Pond Manhole: S10, DS/PN: 1.004</u> Invert Level (m) 39.254 <table border="1"> <thead> <tr> <th>Depth (m)</th> <th>Area (m²)</th> <th>Depth (m)</th> <th>Area (m²)</th> <th>Depth (m)</th> <th>Area (m²)</th> </tr> </thead> <tbody> <tr> <td>0.000</td> <td>421.0</td> <td>1.000</td> <td>421.0</td> <td>1.001</td> <td>0.0</td> </tr> </tbody> </table>			Depth (m)	Area (m ²)	Depth (m)	Area (m ²)	Depth (m)	Area (m ²)	0.000	421.0	1.000	421.0	1.001	0.0
Depth (m)	Area (m ²)	Depth (m)	Area (m ²)	Depth (m)	Area (m ²)									
0.000	421.0	1.000	421.0	1.001	0.0									
©1982-2020 Innovyze														

Nolan Associates Ltd

54 Hagley Road
Birmingham
West Midlands B16 8PE

Date 21/11/2022 11:23
File SWD.MDX

Causeway

Designed by j.glynn
Checked by

Network 2020.1.3

Page 5



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

Simulation Criteria

Areal Reduction Factor 1.000

Hot Start (mins) 0

Hot Start Level (mm) 0

Manhole Headloss Coeff (Global) 0.500

Foul Sewage per hectare (l/s) 0.000

Additional Flow - % of Total Flow 0.000

MADD Factor * 10m³/ha Storage 2.000

Inlet Coefficient 0.800

Flow per Person per Day (l/per/day) 0.000

Number of Input Hydrographs 0

Number of Storage Structures 1

Number of Online Controls 1

Number of Time/Area Diagrams 0

Number of Offline Controls 0

Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model

Region England and Wales

M5-60 (mm)

FSR

Cv (Summer) 0.750

Cv (Winter) 0.840

Ratio R 0.400

Margin for Flood Risk Warning (mm) 300.0

Analysis Timestep

DTS Status OFF

DVD Status ON

Fine Inertia Status ON

Profile(s)

Duration(s) (mins)

Return Period(s) (years)

Climate Change (%)

Summer and Winter

15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080

1, 30, 100

0, 0, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
1.000	S1	15 Winter	100	+40%	100/15 Summer				40.740
1.001	S2	15 Winter	100	+40%	100/15 Summer				40.420
2.000	S3	15 Winter	100	+40%	100/15 Summer				40.666
2.001	S4	15 Winter	100	+40%	100/15 Summer				40.284
1.002	S5	480 Winter	100	+40%	100/15 Summer				40.188
3.000	S6	15 Winter	100	+40%	30/15 Summer				40.933
3.001	S7	15 Winter	100	+40%	30/15 Summer				40.685
1.003	S8	480 Winter	100	+40%	100/15 Summer				40.187
4.000	S9	15 Winter	100	+40%	100/15 Summer				40.724
1.004	S10	480 Winter	100	+40%	30/120 Winter				40.185

PN	US/MH Name	Depth (m)	Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	S1	0.557	0.000	1.49			88.1	SURCHARGED	
1.001	S2	0.367	0.000	1.48			86.3	SURCHARGED	
2.000	S3	0.291	0.000	1.34			44.2	SURCHARGED	

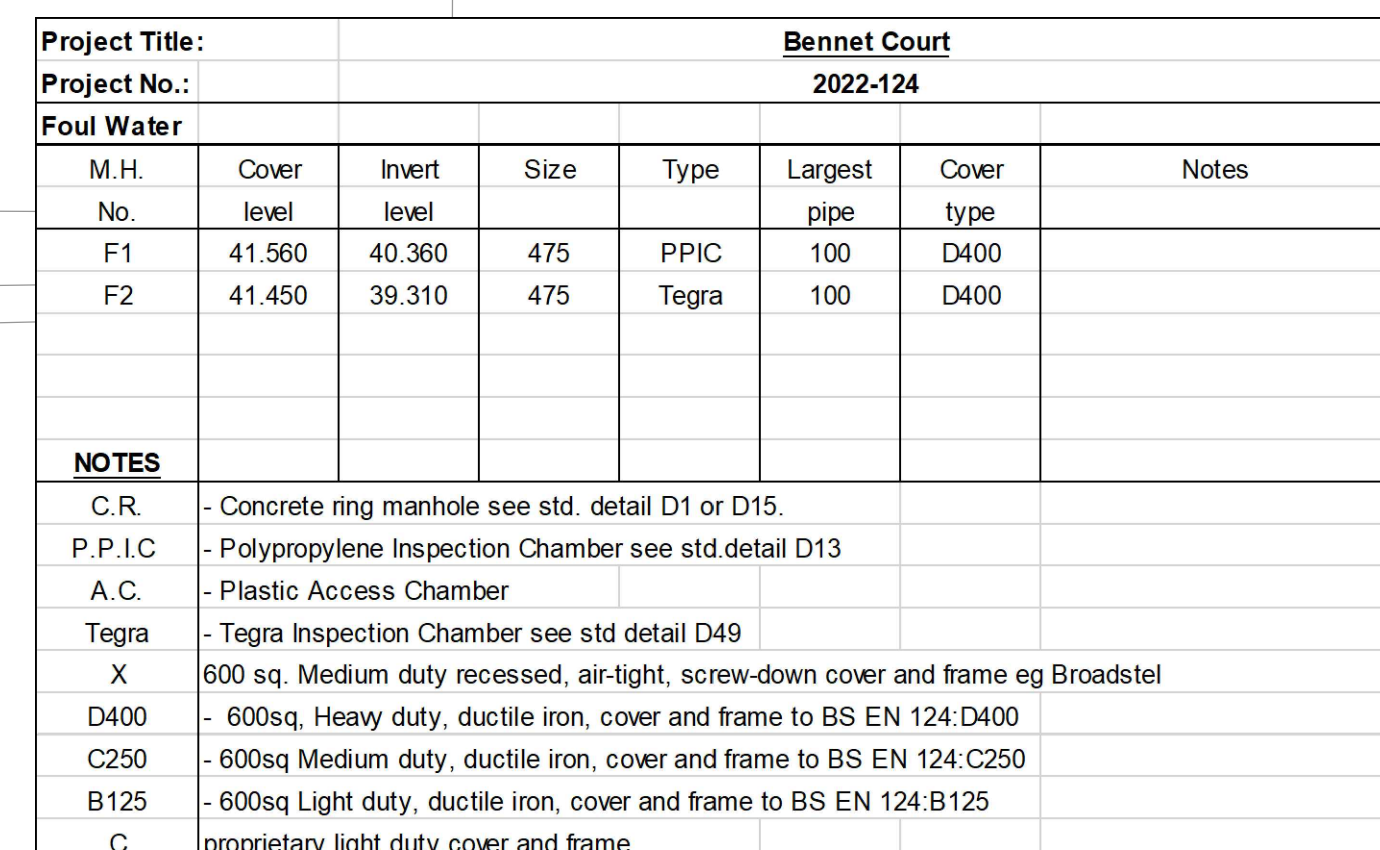
©1982-2020

Innovyze

Nolan Associates Ltd							Page 6		
54 Hagley Road Birmingham West Midlands B16 8PE									
Date 21/11/2022 11:23				Designed by j.glynn					
File SWD.MDX				Checked by					
Causeway				Network 2020.1.3					
<u>Summary of Critical Results by Maximum Level (Rank 1) for Storm</u>									
		Surcharged	Flooded			Half Drain	Pipe		
	US/MH	Depth	Volume	Flow /	Overflow	Time	Flow		Level
PN	Name	(m)	(m³)	Cap.	(l/s)	(mins)	(l/s)	Status	Exceeded
2.001	S4	0.123	0.000	1.81			45.1	SURCHARGED	
1.002	S5	0.242	0.000	0.12			16.7	SURCHARGED	
3.000	S6	0.373	0.000	2.09			113.3	SURCHARGED	
3.001	S7	0.180	0.000	2.31			113.4	SURCHARGED	
1.003	S8	0.363	0.000	0.22			29.4	SURCHARGED	
4.000	S9	0.089	0.000	1.85			138.6	SURCHARGED	
1.004	S10	0.556	0.000	0.04			5.0	SURCHARGED	
©1982-2020 Innovyze									

Appendix B

2022-124-100 Drainage Layout



11. For Manhole covers see schedule.
12. The Contractor is to enter into all necessary legal agreements with the drainage authority for all connections to the Public Sewer Network.
13. The Contractor is to survey all drainage outfalls and determine the levels of any Utility Apparatus that might affect the levels of drainage connections, prior to commencing any drainage works on site.
14. The Contractor is to obtain the consent of the Highway Authority to any works within the highway and enter into any necessary legal agreements.
15. Rising main to be BS EN 13244-2, all joints electrofusion welded to provide continuous main.

P3	Revised layout added	LC	JJG	09.01.23
P2	Revised layout added	MH	JJG	07.12.22
P1	Preliminary issue	MH	JJG	21.11.22
REV	DESCRIPTION	BY	CHKD	DATE

Bennet Court

Drainage Layout

NOLAN ASSOCIATES
CONSULTING CIVIL & STRUCTURAL ENGINEERS

54 HAGLEY ROAD, EDGBASTON, BIRMINGHAM B16 8PE
TEL: 0121-454 3099 FAX: 0121-454 3059
E-MAIL: enquiries@nolanassociates.co.uk

Drawn by MH	Date 21.11.22	Plot Date 09.01.23	Scale 1: 2500 A1
Checked by JJC	Project No 2022-124		Dwg No 100 P3

Appendix C

Suds Maintenance

Bennet Court
SuDS / Drainage Maintenance

Project No.	2022-124	
Checked by:	JJG	Pages:
Date:	November 2022	
Issued to:		
Issued by:	JJG	

All maintenance to be the responsibility of the landowner.

Component	Regular Maintenance	Occasional (Infrequent) Maintenance	Remedial Maintenance	Monitoring
Attenuation storage tank (1)	Inspect and identify any areas that are not operating correctly. Will be seen from inspection of (2) showing large sediment and water. If required, take remedial action. Remove debris from the catchment surface MONTHLY . Remove sediment from pre-treatment structures ANNUALLY . Manholes to be lifted using manhole keys.		Repair/rehabilitate inlets, outlets, overflows and vents. As this is remedial maintenance this is only required if the attenuation tank is not function as required. This would be evident from inspections of the upstream and downstream catchpits overfilling.	Inspect/check all inlets (2) , outlets (2), vents and overflows to ensure that they are in good condition and operating as designed annually. Survey inside of tank for sediment build-up and remove if necessary EVERY FIVE YEARS .
Catchpits (3)	Visual Inspection ANNUALLY to determine silt build up. Manholes to be lifted using manhole keys.	Use gully sucker to remove silt if any present.		Visual Inspection ANNUALLY to determine silt build up
Hydrobrake (4)	Remove sediment and debris from flow control chambers and upstream manholes MONTHLY FOR FIRST 6 MONTHS THEN ANNUALLY . Manholes to be lifted using manhole keys.		Replace or clean hydrobrake if performance deteriorates or failure occurs.	Check flow control to ensure emptying is occurring ANNUALLY and POST HIGH INTENSITY STORM EVENT
Linear Drainage Channels (5)	Visual Inspection ANNUALLY to determine silt build up. Channel to be lifted with crowbar.	Use gully sucker to remove silt from outlet sump and Jetting to remove silt build up in channel if silt has built up. Channels are more likely to fill within the autumn with leaves so more regular inspections should take place in this season.		Visual Inspection ANNUALLY to determine silt build up
Pervious Pavements (6)	Brushing and vacuuming (standard cosmetic sweep over whole surface) ONCE A YEAR	Stabilise and mow contributing and adjacent areas AS REQUIRED . Removal of weeds or management using glyphosphate applied directly into the weeds by an applicator rather than spraying AS REQUIRED .	Remediate any landscaping which, through vegetation maintenance or soil slip, has been raised to within 50mm of the level of the paving as required. Remedial work to any depressions, rutting and cracked or broken blocks considered detrimental to the structural performance or a	Initial inspection MONTHLY . Inspect for evidence of poor operation and/or weed growth – if required, take remedial action three monthly. Inspect silt accumulation rates and establish appropriate brushing frequencies ANNUALLY .

			hazard to users, and replace lost jointing material AS REQUIRED.	Monitor inspection chambers ANNUALLY.
--	--	--	---	---