

Surface Water Pump Failure & Mitigation Strategies

Site: 147 – 149 College Lane, Hurstpierpoint
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Date: 5 August 2024

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1.0 Introduction

- 1.1 The surface water drainage strategy for the proposed development on the land behind 147 – 149 College Lane, Hurstpierpoint, proposed a pumped surface water system.
- 1.2 This was specified because of the prevailing geo-environmental constraints on the site, which determined that a pump was the only suitable option to discharge water from the topographically lowest parts of the site. The constraints, in brief, were:
 - „ Infiltration is not viable on the clay geology in this part of Hurstpierpoint.
 - „ There are no watercourses or open water bodies within the site (or on its boundaries) that can receive surface water.
 - „ There are no surface water sewers crossing the site that can be connected to.
 - „ The access to College Lane, where the site's proposed discharge point is located (the public sewer), is topographically above the developed area, thus draining by gravity is not an option.
- 1.3 Following a review of the drainage strategy by Mid-Sussex District Council (MSDC), they have stated that they do not normally accept pumped surface water drainage systems. This is because pumped surface water systems are less sustainable than gravity-drained SuDS systems and because there is a whole life energy consumption to consider, greater maintenance costs, and their failure can lead to flooding.
- 1.4 On this basis, MSDC requested that the drainage strategy was reviewed with a view to providing a more sustainable drainage system. However, as noted above and demonstrated in the discussion of the drainage hierarchy in the Drainage Strategy report, a more sustainable option is not available due to the absence of infiltration and there being no outfalls for surface water that can be connected to by gravity.
- 1.5 With this mind, this technical note has been produced to show how the proposed pumped surface water solution will minimise the risk of pump failure and what is required to achieve this so that the residual risk of pump failure is negligible. In addition, this technical note will record how, in the event of a pump failure, rainfall in the 'design' 1 in 100-year plus climate change will be attenuated and what flood flows will occur as a result. As with exceedance events and planning for them, this technical note will demonstrate how the development will not be affected by any residual flood risk and that there are also no downstream receptors to the flooding that could be impacted.

2.0 Risk of Surface Water Pump Failure and Mitigation

- 2.1 Aside from the whole life energy consumption and greater maintenance costs of pumped surface water solutions, the principal concern from Lead Local Flood Authority's (LLFA's) is that pump failure can lead to flooding.
- 2.2 Poorly designed and maintained surface water pumps can be problematic but, with correct design, specification, monitoring and maintenance of surface water pumping systems, they can be a viable solution to development sites that do not benefit from gravity outfalls or infiltration.
- 2.3 How this is achieved and how it will be put into action on the proposed development on the land behind 147 – 149 College Lane is detailed below.

Correct Pump Specification

- 2.4 Choosing a suitable pump for the application at hand and correctly specifying it (as well as all infrastructure around the pumping station and any associated control panels and switchgear) is vital to avoiding breakdowns. Failure to do so can lead to blockages or excessive wear on pump components.
- 2.5 Therefore, first and foremost, Motion and Earlswood Homes will work with a leading pump supplier (T-T Pumps) who will control the design, manufacture, supply and installation of the pump and any controls. By doing so, the correct pump for the application will be specified and it will be installed in accordance with the manufacturer's recommendations. This will optimise the efficiency and reliability of the installed pump system, which, in turn, will minimise the risk of wear and failure.

Duty/Standby Pump Arrangement

- 2.6 The system that will be specified for the site will have both a duty and standby pump, which will operate on the following basis:
 - „ Duty only, and;
 - „ Duty and standby basis (with the standby pump acting as a backup in the event of duty pump failing).
- 2.7 With a duty/standby pump set-up, it is only possible for one of the two pumps to be triggered at any one moment. If, for whatever reason, the duty pump fails, the standby pump will then be instructed by the control panel to take over. The pump station will then work as a single pump system until the damaged/blocked pump is fixed.
- 2.8 The chances of both the duty and standby pumps failing during the same event is minimal, and this ensures that the pump station will always remain operational. Furthermore, the chance of the duty and standby pump failing at the same time as a 1 in 100-year + 45\$ rainfall event is almost zero.

Control Panels and Alarms

- 2.9 The pump system specified for the development to the rear of 147 – 149 College Lane will be monitored by a fully telemetered remote alarm system.
- 2.10 It is proposed that T-T Pumps' products are used and that their 'Seer' remote monitoring system is connected to the surface water pump.
- 2.11 The Seer remote monitoring system uses cloud-based technology to continually communicate the operational status of the pump in real time with live status updates and alarm activation. Seer's historical data-logging, along with T-T monitoring services, means potential issues can be identified early, informing proactive maintenance and avoiding costly breakdowns (and flood risk, in the context of the development).
- 2.12 Seer remote monitoring and telemetry keeps track of the pump system 24-hours a day, 365-days a year and features live status and alarm activation along with an observation of the whole system, which means that the pump equipment's operational performance can be viewed constantly, and pro-active maintenance visits can be scheduled. Any issues that do arise can be identified early and dealt with accordingly.
- 2.13 Some actions can also be performed remotely, such as pump resets, when used with a compatible control panel removing the need for costly breakdown callouts, increasing the sustainability of the system and massively reducing the time that the pump is not operational.

Maintenance

- 2.14 Along with the remote monitoring, telemetry and alarm system, a Pump Maintenance Package (Service Agreement) will be signed up to and implemented to ensure that the surface water pump system is kept in optimal working condition.

- 2.15 Because it is proposed to use T-T Pumps' Seer monitoring system, this can be linked to a higher level of bespoke support that goes beyond standard services (at least two per year) and covers all major equipment and mechanical and electrical components so that the pump system will continue to work reliably and efficiently with maximum longevity.
- 2.16 Typical activities carried out in a maintenance service include:
- „ Cleaning and emptying the chamber
 - „ Checking that there are no blockages and if there are any removing them
 - „ Inspecting that there are no defects in the sewage pump system e.g. broken pipes, pump seals, problems with the float switch or impeller
 - „ Testing water alarms, battery backup systems and telemetry systems
 - „ Testing and checking all operating control panels
 - „ Performing electrical insulation resistance tests for longevity

Summary

- 2.17 When the above processes are considered together, they show that the risk of surface water pump failure can be minimised to the point that they become negligible. In unison with this, flood risks on- and off-site from surface water pump failure can also be minimised.
- 2.18 Notwithstanding this, flood risks stemming from possible pump failure can be further minimised through the design of the drainage system and this is discussed further, below.

3.0 Increasing Surface Water Attenuation

- 3.1 The proposed drainage strategy included a geocellular attenuation tank in the topographically lowest part of the site to attenuate surface water prior to it being lifted by the surface water pump at a rate of 5.0 l/s to another geocellular attenuation tank, prior to a gravity discharge to the public sewer in College Lane.
- 3.2 This means that if the surface water pump was to fail that the geocellular attenuation tank in the lower part of the site is a critical item of infrastructure. This size of this tank has been optimised to provide further attenuation than would be required. This surfeit of attenuation, which is far beyond that required in the 1 in 100-year + 40% rainfall event, allows surface water accumulating during the design rainfall event to be captured and stored without causing flooding, even when the pump is not working.
- 3.3 The geocellular attenuation tank previously measure 8m x 7m x 2.0m (L x W x D) and provided an attenuation volume of 106.4m³.
- 3.4 The size of the attenuation tank has been increased by 50% so that it measures 7m x 12m x 2.0m and provides 159.6m³ of surface water storage. The revised drainage strategy layout has been included in [Appendix A](#) of this Technical Note.
- 3.5 To understand the effect of this additional attenuation, pump failure modelling has been carried out and the consequences reviewed. This is discussed below.

Surface Water Pump Failure Modelling and Consequence

- 3.6 To understand the impact of pump failure during a design rainfall event, a MicroDrainage Network Hydraulic model was constructed to model the performance of the drainage system with no flow through the pump station. This was carried out for the 360-minute (6-hour) 1 in 100-year + 45% rainfall event.

- 3.7 The MicroDrainage Network hydraulic model shows that during the 360-minute (6-hour) 1 in 100-year + 45% rainfall event only 1.794m³ of flooding would occur on site. The outputs of revised MicroDrainage Hydraulic model can be seen in [Appendix B](#).
- 3.8 This is a minimal amount of flooding when the overall area of the development is considered. Over the 182m² area of the turning head, which is where flooding would occur, this volume of flooding would create approximately 10mm of above-ground flooding. The turning head will be bounded by 125mm HB2 kerbs, thus flooding will predominantly be stored on site.
- 3.9 It is noted that this is a high level view of the flooding, but serves to demonstrate that the resultant flooding from pump failure during the design rainfall event would not be sufficient to cause disruptive flooding, on- or off-site. Flooding would be largely retained within the lower road area.
- 3.10 To investigate whether there are any further consequences, a review of flood routing and downstream receptors has been carried out.

4.0 Review of Downstream Receptors

- 4.1 With regards to flood flows, in the very unlikely event that the 1.794m³ of flooding was able to leave the site, the route it would take is captured by the exceedance plan that was presented in Appendix P of the Drainage Strategy Report and is included in [Appendix C](#).
- 4.2 Although the turning head would be bounded by HB2 kerbs, the lowered kerb that allow access to shared driveway of the two northern-most units may let surface water flow to the north and to the back gardens of these two units.
- 4.3 It is unlikely that the small volume of flooding discussed above would ingress to the dwellings in the development. Once 1.794m³ of flooding begins to pass over the surface and through the shared driveway with it would sheet and be relatively shallow. As such, mitigation in terms of resistance and resilience would not be needed beyond raising thresholds approximately 150mm above ground level. We believe that this requirement can be secured through condition and provided accordingly at the detailed design and condition discharge stage.
- 4.4 In terms of downstream receptors, there is nothing but open fields and farmland between the site and the watercourse to north, which is 290m away and at the bottom of the shallow valley. This is marked up in the plan included in [Appendix D](#) of this Technical Note. Therefore, there are no receptors to flooding or surface water beyond the site boundary and the volume of flooding described above would not cause issues elsewhere in the catchment.

5.0 Summary and Conclusion

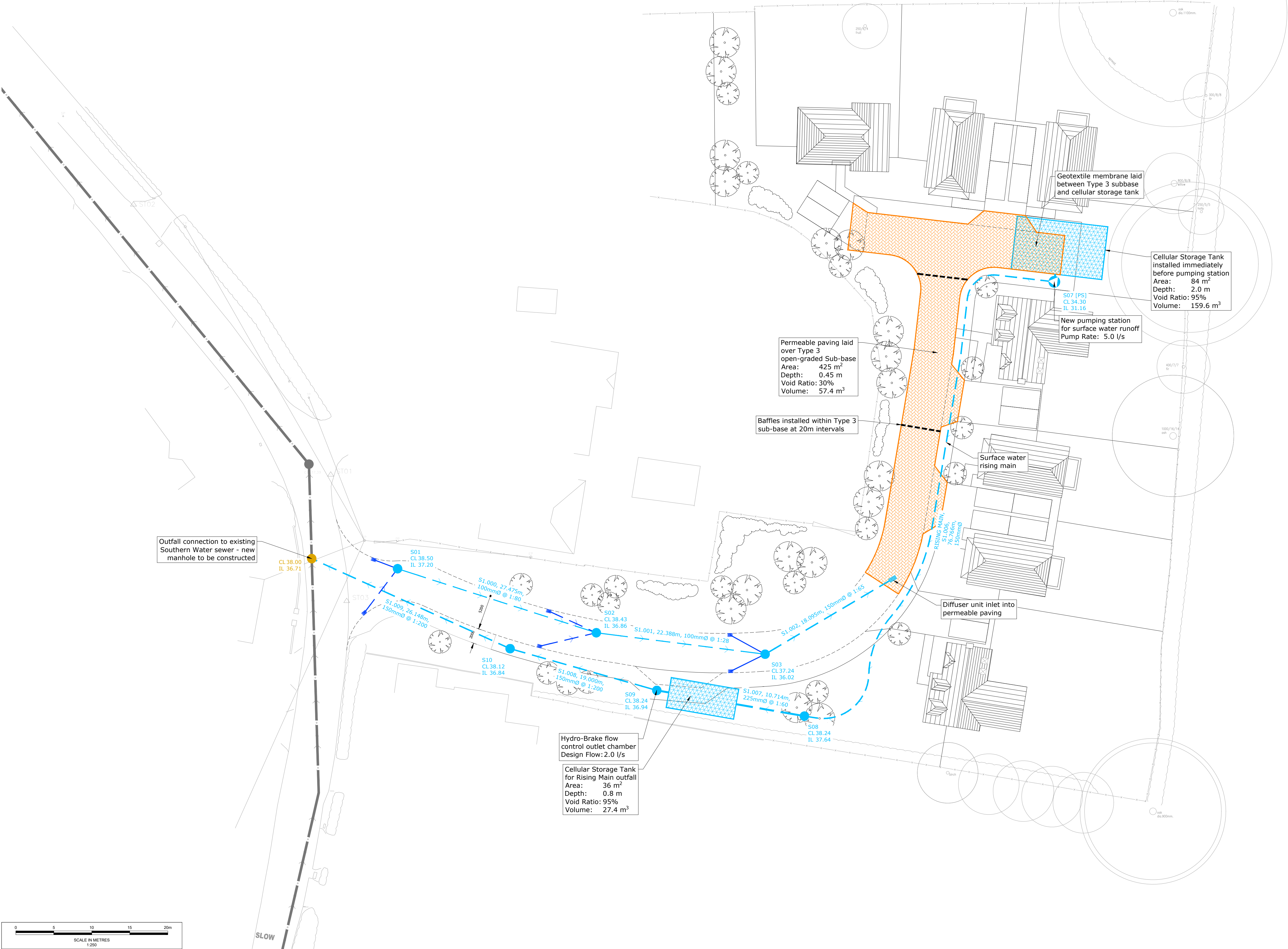
- 5.1 MSDC's position that a pumped surface water solution is not the most sustainable is acknowledged. However, through the Drainage Strategy report and this Technical Note, it has been established that it is the only viable option for the development due to the prevailing topographical and geo-environmental constraints faced by the site and the proposed development.
- 5.2 With this in mind, this Technical Note has presented the mechanisms through which pump failure will be minimised to the point of being negligible. This is achieved through the specification and installation of the optimum pump for the application, which will be supplied by T-T Pumps, who are a leading designer, manufacturer and supplier of pumped systems in the UK. A dual and standby pump arrangement will also be used, to ensure that the site's surface water system is served by a backup pump should the duty pump fail. It should be noted that the chances of two pumps failing at the same time as the 1 in 100-year + 45% rainfall event are extremely small.
- 5.3 It has also been presented that the pumped system will be served by a frequent and rigorous maintenance and inspection programme. This will be provided by one of T-T Pumps' bespoke service packages, which will be supported by the 'Seer' telemetered monitoring system, which provides real-time feedback of a pump's

performance so that potential issues can be identified early and even fixed remotely. This informs proactive maintenance and avoiding costly breakdowns, but also gives immediate notification of any problems 24-hours a day, 365 days a year.

- 5.4 This Technical Note has looked beyond the pump specification and maintenance requirements to minimise flood risk and enhance the sustainability of the pumped surface water system. The overall drainage design has been modified to provide increased surface water attenuation. It has been shown that in the 360-minute (6-hour) 1 in 100-year + 45% rainfall event only 1.794m³ of flooding would occur in the event of a pump failure. This is not a sufficient volume of flooding to create disruptive issues on- or off-site and the likely exceedance pathways mean that it would not ingress to property, which would have raised finished floor levels.
- 5.5 Offsite receptors have been explored and none exist between the site and the watercourse 290m to the north at the bottom of the shallow valley. Therefore, there would not be any offsite impact of the surface water pump failure.
- 5.6 When the contents of this Technical Note are considered, as summarised above, the residual risk of surface water pump failure is negligible and any impacts of such an event are zero. As such, and as the only option available to the proposed development, pumping surface water at 147 – 149 College Lane stands as the most economically and environmentally sustainable solution to surface water drainage.

Appendix A

Revised Drainage Strategy Layout



- Notes**
- All levels and dimensions to be checked on site before any work commences. All dimensions in metres unless stated otherwise.
 - This drawing is based on survey information supplied by [add], and Motion cannot guarantee the accuracy of the data provided.
 - This drawing is based on OS mapping and Motion cannot guarantee the accuracy of the data.
 - Highway boundary information obtained from [add] and based on OS mapping, Motion cannot guarantee the accuracy of the data provided.
 - Motion accepts no liability for any vehicle specification errors or inaccuracies within the vehicle tracking software used / or it's vehicle libraries. The vehicles speeds used for the analysis are as follows: forward **mph / reversing **mph.
- Legend**
- Existing Southern Water Foul Sewer
 - Proposed Surface Water Drain
 - Proposed Surface Water Gully and Pipe Connection
 - Proposed Surface Water Rising Main
 - Proposed Surface Water Manhole
 - Proposed Surface Water Pumping Station
 - Proposed Diffuser Unit
 - Proposed Permeable Paving
 - Proposed Permeable Paving Baffle
 - Proposed Cellular Storage Tank
 - Proposed Foul Manhole - Outfall Connection to existing sewer network

P2	Revised with increased tank size	PA	PA	PA	05/08/2024
P1	Revised Issue following client review	MH	MH	PA	19/04/2024
P0	First Issue	MH	MH	PA	12/04/2024
Rev.	Description	Drm	Chk	App	Date

Drawing Status: **FOR PLANNING**
NOT FOR CONSTRUCTION



Client: **Earlswood Homes Ltd**

Project: **Land off College Land
Hurstpierpoint**

Title: **Proposed Drainage Strategy
Surface Water Drainage**

Scale: **1:250 (@ A1)**

Drawing: **2403069-0501**

Revision: **P2**

Appendix B

Pump Failure Modelling MicroDrainage Results

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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)	20.000	Add Flow / Climate Change (%)	0
Ratio R	0.350	Minimum Backdrop Height (m)	0.200
Maximum Rainfall (mm/hr)	150	Maximum Backdrop Height (m)	1.500
Maximum Time of Concentration (mins)	30	Min Design Depth for Optimisation (m)	0.400
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)	Time (mins)	Area (ha)	Time (mins)	Area (ha)	Time (mins)	Area (ha)
0-4	0.000	4-8	0.000	8-12	0.000	12-16	0.153	16-20	0.067

Total Area Contributing (ha) = 0.220

Total Pipe Volume (m³) = 4.549

Network Design Table for Storm

- Indicates pipe length does not match coordinates
« - Indicates pipe capacity < flow

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
S1.000	27.475	0.343	80.1	0.007	5.00	0.0	0.600	o	100	Pipe/Conduit	
S1.001	22.388	0.790	28.3	0.020	0.00	0.0	0.600	o	100	Pipe/Conduit	
S1.002	18.095	0.280	64.6	0.019	0.00	0.0	0.600	o	150	Pipe/Conduit	
S1.003	2.000#	1.840	1.1	0.033	0.00	0.0	0.600	o	100	Pipe/Conduit	
S1.004	16.276	0.814	20.0	0.106	0.00	0.0	0.600	o	300	Pipe/Conduit	
S1.005	3.985	0.199	20.0	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
S1.006	65.962	-6.483	-10.2	0.036	0.00	0.0	0.600	o	150	Pipe/Conduit	
S1.007	10.714	0.179	60.0	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
S1.008	19.000#	0.095	200.0	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	E I.Area (ha)	E Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S1.000	146.63	5.53	37.200	0.007	0.0	0.0	0.0	0.86	6.8	2.6
S1.001	144.22	5.79	36.857	0.026	0.0	0.0	0.0	1.46	11.4	10.3
S1.002	142.05	6.03	36.017	0.045	0.0	0.0	0.0	1.25	22.1	17.3
S1.003	142.02	6.03	35.660	0.078	0.0	0.0	0.0	7.48	58.8	30.0
S1.004	141.34	6.11	33.820	0.184	0.0	0.0	0.0	3.53	249.7	70.4
S1.005	141.18	6.13	33.006	0.184	0.0	0.0	0.0	3.53	249.6	70.4
S1.006	85.32	17.99	31.157	0.220	0.0	0.0	0.0	0.09	1.6«	70.4
S1.007	85.04	18.10	37.640	0.220	0.0	0.0	0.0	1.69	67.3«	70.4
S1.008	83.89	18.54	36.936	0.220	0.0	0.0	0.0	0.71	12.5«	70.4

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Area Summary for Storm

Pipe Number	PIMP Type	PIMP Name	PIMP (%)	Gross Area (ha)	Imp. Area (ha)	Pipe Total (ha)
1.000	User	-	100	0.005	0.005	0.005
	User	-	100	0.001	0.001	0.007
1.001	User	-	100	0.020	0.020	0.020
1.002	User	-	100	0.019	0.019	0.019
1.003	-	-	100	0.033	0.033	0.033
1.004	-	-	100	0.106	0.106	0.106
1.005	-	-	100	0.000	0.000	0.000
1.006	-	-	100	0.036	0.036	0.036
1.007	-	-	100	0.000	0.000	0.000
1.008	-	-	100	0.000	0.000	0.000
1.009	-	-	100	0.000	0.000	0.000
				Total	Total	Total
				0.220	0.220	0.220

Free Flowing Outfall Details for Storm

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
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S1.009	S	38.000	36.710	0.000	0	0
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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 Offline Controls	1
Number of Online Controls	1	Number of Time/Area Diagrams	0
		Number of Storage Structures	3
		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)	20.000	Storm Duration (mins)	30
Ratio R	0.350		

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Online Controls for Storm

Hydro-Brake® Optimum Manhole: S9, DS/PN: S1.008, Volume (m³): 1.9

Unit Reference	MD-SHE-0070-2000-0800-2000
Design Head (m)	0.800
Design Flow (l/s)	2.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	70
Invert Level (m)	36.936
Minimum Outlet Pipe Diameter (mm)	100
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.800	2.0	Kick-Flo®	0.504	1.6
Flush-Flo™	0.240	2.0	Mean Flow over Head Range	-	1.7

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	1.8	0.800	2.0	2.000	3.0	4.000	4.2	7.000	5.5
0.200	2.0	1.000	2.2	2.200	3.2	4.500	4.4	7.500	5.6
0.300	2.0	1.200	2.4	2.400	3.3	5.000	4.7	8.000	5.8
0.400	1.9	1.400	2.6	2.600	3.4	5.500	4.9	8.500	6.0
0.500	1.6	1.600	2.7	3.000	3.7	6.000	5.1	9.000	6.2
0.600	1.8	1.800	2.9	3.500	3.9	6.500	5.3	9.500	6.3

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Offline Controls for Storm Pump Manhole: S7, DS/PN: S1.006, Loop to PN: S1.007 Invert Level (m) 31.157 <table><thead><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><th>Depth (m)</th><th>Flow (l/s)</th></tr></thead><tbody><tr><td>0.200</td><td>0.0000</td><td>1.400</td><td>0.0000</td><td>2.600</td><td>0.0000</td><td>3.800</td><td>0.0000</td><td>5.000</td><td>0.0000</td></tr><tr><td>0.400</td><td>0.0000</td><td>1.600</td><td>0.0000</td><td>2.800</td><td>0.0000</td><td>4.000</td><td>0.0000</td><td>5.200</td><td>0.0000</td></tr><tr><td>0.600</td><td>0.0000</td><td>1.800</td><td>0.0000</td><td>3.000</td><td>0.0000</td><td>4.200</td><td>0.0000</td><td>5.400</td><td>0.0000</td></tr><tr><td>0.800</td><td>0.0000</td><td>2.000</td><td>0.0000</td><td>3.200</td><td>0.0000</td><td>4.400</td><td>0.0000</td><td>5.600</td><td>0.0000</td></tr><tr><td>1.000</td><td>0.0000</td><td>2.200</td><td>0.0000</td><td>3.400</td><td>0.0000</td><td>4.600</td><td>0.0000</td><td>5.800</td><td>0.0000</td></tr><tr><td>1.200</td><td>0.0000</td><td>2.400</td><td>0.0000</td><td>3.600</td><td>0.0000</td><td>4.800</td><td>0.0000</td><td>6.000</td><td>0.0000</td></tr></tbody></table>			Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	0.200	0.0000	1.400	0.0000	2.600	0.0000	3.800	0.0000	5.000	0.0000	0.400	0.0000	1.600	0.0000	2.800	0.0000	4.000	0.0000	5.200	0.0000	0.600	0.0000	1.800	0.0000	3.000	0.0000	4.200	0.0000	5.400	0.0000	0.800	0.0000	2.000	0.0000	3.200	0.0000	4.400	0.0000	5.600	0.0000	1.000	0.0000	2.200	0.0000	3.400	0.0000	4.600	0.0000	5.800	0.0000	1.200	0.0000	2.400	0.0000	3.600	0.0000	4.800	0.0000	6.000	0.0000
Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)																																																															
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0.400	0.0000	1.600	0.0000	2.800	0.0000	4.000	0.0000	5.200	0.0000																																																															
0.600	0.0000	1.800	0.0000	3.000	0.0000	4.200	0.0000	5.400	0.0000																																																															
0.800	0.0000	2.000	0.0000	3.200	0.0000	4.400	0.0000	5.600	0.0000																																																															
1.000	0.0000	2.200	0.0000	3.400	0.0000	4.600	0.0000	5.800	0.0000																																																															
1.200	0.0000	2.400	0.0000	3.600	0.0000	4.800	0.0000	6.000	0.0000																																																															
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Storage Structures for Storm

Porous Car Park Manhole: S5, DS/PN: S1.004

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	10.0
Membrane Percolation (mm/hr)	1000	Length (m)	41.0
Max Percolation (l/s)	113.9	Slope (1:X)	40.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	33.820	Cap Volume Depth (m)	0.450

Cellular Storage Manhole: S7, DS/PN: S1.006

Invert Level (m)	31.157	Safety Factor	2.0
Infiltration Coefficient Base (m/hr)	0.00000	Porosity	0.95
Infiltration Coefficient Side (m/hr)	0.00000		

Depth (m)	Area (m ²)	Inf. Area (m ²)	Depth (m)	Area (m ²)	Inf. Area (m ²)	Depth (m)	Area (m ²)	Inf. Area (m ²)
0.000	84.0	84.0	2.000	84.0	160.0	2.001	0.0	160.0

Cellular Storage Manhole: S9, DS/PN: S1.008

Invert Level (m)	36.936	Safety Factor	2.0
Infiltration Coefficient Base (m/hr)	0.00000	Porosity	0.95
Infiltration Coefficient Side (m/hr)	0.00000		

Depth (m)	Area (m ²)	Inf. Area (m ²)	Depth (m)	Area (m ²)	Inf. Area (m ²)	Depth (m)	Area (m ²)	Inf. Area (m ²)
0.000	36.0	36.0	0.800	36.0	56.8	0.801	0.0	56.8

Volume Summary (Static)

Length Calculations based on Centre-Centre

Pipe Number	USMH Name	Manhole Volume (m ³)	Pipe Volume (m ³)	Storage Structure Volume (m ³)	Total Volume (m ³)
S1.000	S1	1.470	0.216	0.000	1.686
S1.001	S2	1.779	0.176	0.000	1.955
S1.002	S3	1.383	0.320	0.000	1.703
S1.003	S4	1.470	0.016	0.000	1.486
S1.004	S5	0.656	1.150	19.170	20.976
S1.005	S6	1.463	0.282	0.000	1.745
S1.006	S7	3.555	1.166	159.627	164.347
S1.007	S8	0.679	0.426	0.000	1.105
S1.008	S9	1.475	0.336	27.371	29.182
S1.009	S10	1.447	0.462	0.000	1.909
Total		15.377	4.549	206.168	226.093

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

Simulation Criteria

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

Number of Input Hydrographs 0 Number of Offline Controls 1 Number of Time/Area Diagrams 0
Number of Online Controls 1 Number of Storage Structures 3 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FSR M5-60 (mm) 20.000 Cv (Summer) 0.750
Region England and Wales Ratio R 0.350 Cv (Winter) 0.840

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

Profile(s) Summer and Winter
Duration(s) (mins) 360
Return Period(s) (years) 1, 2, 30, 100
Climate Change (%) 0, 0, 40, 45

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)
S1.000	S1	360 Summer	1	+0%					37.211	-0.089
S1.001	S2	360 Summer	1	+0%					36.875	-0.082
S1.002	S3	360 Summer	1	+0%					36.042	-0.125
S1.003	S4	360 Summer	1	+0%					35.676	-0.084
S1.004	S5	360 Summer	1	+0%	100/360 Winter				33.852	-0.268
S1.005	S6	360 Summer	1	+0%	100/360 Winter	100/360 Winter			33.049	-0.257
S1.006	S7	360 Winter	1	+0%	1/360 Summer	100/360 Winter		0	31.663	0.356
S1.007	S8	360 Summer	1	+0%					37.640	-0.225
S1.008	S9	360 Summer	1	+0%					36.936	-0.150
S1.009	S10	360 Summer	1	+0%					36.841	-0.150

PN	US/MH Name	Flooded Volume (m³)	Flow / Cap. (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
S1.000	S1	0.000	0.03		0.2	OK	
S1.001	S2	0.000	0.07		0.8	OK	
S1.002	S3	0.000	0.07		1.4	OK	
S1.003	S4	0.000	0.06		2.4	OK	
S1.004	S5	0.000	0.03		5.6	OK	
S1.005	S6	0.000	0.05		5.6	OK	1
S1.006	S7	0.000	0.00	0.0	0.0	SURCHARGED	1
S1.007	S8	0.000	0.00		0.0	OK	
S1.008	S9	0.000	0.00		0.0	OK	
S1.009	S10	0.000	0.00		0.0	OK	

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2 year Return Period 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 Coeffiecient 0.800
Flow per Person per Day (l/per/day) 0.000

Number of Input Hydrographs 0
Number of Online Controls 1

Number of Offline Controls 1
Number of Storage Structures 3

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

Synthetic Rainfall Details

Rainfall Model FSR M5-60 (mm)
Region England and Wales

20.000 Cv (Summer) 0.750
Ratio R 0.350 Cv (Winter) 0.840

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

DVD Status ON
Inertia Status ON

Profile(s) Summer and Winter
Duration(s) (mins) 360
Return Period(s) (years) 1, 2, 30, 100
Climate Change (%) 0, 0, 40, 45

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)
S1.000	S1	360 Summer	2	+0%					37.212	-0.088
S1.001	S2	360 Summer	2	+0%					36.877	-0.080
S1.002	S3	360 Summer	2	+0%					36.045	-0.122
S1.003	S4	360 Summer	2	+0%					35.678	-0.082
S1.004	S5	360 Summer	2	+0%	100/360 Winter				33.855	-0.265
S1.005	S6	360 Summer	2	+0%	100/360 Winter	100/360 Winter			33.054	-0.252
S1.006	S7	360 Winter	2	+0%	1/360 Summer	100/360 Winter		0	31.775	0.468
S1.007	S8	360 Summer	2	+0%					37.640	-0.225
S1.008	S9	360 Summer	2	+0%					36.936	-0.150
S1.009	S10	360 Summer	2	+0%					36.841	-0.150

Flooded

Half Drain

Pipe

PN	US/MH Name	Volume (m³)	Flow / Cap. (l/s)	Time (mins)	Flow (l/s)	Status	Level Exceeded
S1.000	S1	0.000	0.04		0.2	OK	
S1.001	S2	0.000	0.09		1.0	OK	
S1.002	S3	0.000	0.08		1.7	OK	
S1.003	S4	0.000	0.08		2.9	OK	
S1.004	S5	0.000	0.03		36 6.8	OK	
S1.005	S6	0.000	0.06		6.8	OK	1
S1.006	S7	0.000	0.00	0.0	0.0	SURCHARGED	1
S1.007	S8	0.000	0.00		0.0	OK	
S1.008	S9	0.000	0.00		0.0	OK	
S1.009	S10	0.000	0.00		0.0	OK	

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30 year Return Period 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 Coeffiecient 0.800
Flow per Person per Day (l/per/day) 0.000

Number of Input Hydrographs 0
Number of Online Controls 1

Number of Offline Controls 1
Number of Storage Structures 3

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

Synthetic Rainfall Details

Rainfall Model FSR M5-60 (mm)
Region England and Wales

20.000 Cv (Summer) 0.750
Ratio R 0.350 Cv (Winter) 0.840

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

DVD Status ON
Inertia Status ON

Profile(s) Summer and Winter
Duration(s) (mins) 360
Return Period(s) (years) 1, 2, 30, 100
Climate Change (%) 0, 0, 40, 45

										Water	Surcharged
PN	US/MH		Return	Climate	First (X)	First (Y)	First (Z)	Overflow		Level	Depth
	Name	Storm	Period	Change	Surcharge	Flood	Overflow	Act.		(m)	(m)
S1.000	S1	360 Summer	30	+40%						37.220	-0.080
S1.001	S2	360 Summer	30	+40%						36.889	-0.068
S1.002	S3	360 Summer	30	+40%						36.063	-0.104
S1.003	S4	360 Summer	30	+40%						35.690	-0.070
S1.004	S5	360 Summer	30	+40%	100/360 Winter					33.877	-0.243
S1.005	S6	360 Summer	30	+40%	100/360 Winter	100/360 Winter				33.084	-0.222
S1.006	S7	360 Winter	30	+40%	1/360 Summer	100/360 Winter		0		32.751	1.444
S1.007	S8	360 Summer	30	+40%						37.640	-0.225
S1.008	S9	360 Summer	30	+40%						36.936	-0.150
S1.009	S10	360 Summer	30	+40%						36.841	-0.150

Flooded

Half Drain

Pipe

US/MH

Volume

Flow /

Overflow

Time

Flow

Status

Level

PN	Name	(m³)	Cap.	(l/s)	(mins)	(l/s)		Exceeded
S1.000	S1	0.000	0.09			0.6	OK	
S1.001	S2	0.000	0.22			2.5	OK	
S1.002	S3	0.000	0.20			4.2	OK	
S1.003	S4	0.000	0.19			7.3	OK	
S1.004	S5	0.000	0.08		36	17.2	OK	
S1.005	S6	0.000	0.15			17.2	OK	1
S1.006	S7	0.000	0.00	0.0		0.0	SURCHARGED	1
S1.007	S8	0.000	0.00			0.0	OK	
S1.008	S9	0.000	0.00			0.0	OK	
S1.009	S10	0.000	0.00			0.0	OK	

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100 year Return Period 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 Coeffiecient 0.800

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

Number of Input Hydrographs 0

Number of Offline Controls 1

Number of Time/Area Diagrams 0

Number of Online Controls 1

Number of Storage Structures 3

Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FSR M5-60 (mm) 20.000 Cv (Summer) 0.750

Region England and Wales Ratio R 0.350 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0

Analysis Timestep Fine

DTS Status OFF

DVD Status ON

Inertia Status ON

Profile(s) Summer and Winter

Duration(s) (mins) 360

Return Period(s) (years) 1, 2, 30, 100

Climate Change (%) 0, 0, 40, 45

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Surcharged	
									Level (m)	Depth (m)
S1.000	S1	360 Summer	100	+45%					37.223	-0.077
S1.001	S2	360 Summer	100	+45%					36.894	-0.063
S1.002	S3	360 Summer	100	+45%					36.070	-0.097
S1.003	S4	360 Summer	100	+45%					35.694	-0.066
S1.004	S5	360 Winter	100	+45%	100/360 Winter				34.212	0.092
S1.005	S6	360 Winter	100	+45%	100/360 Winter	100/360 Winter			34.300	0.994
S1.006	S7	360 Winter	100	+45%	1/360 Summer	100/360 Winter		0	34.300	2.993
S1.007	S8	360 Summer	100	+45%					37.640	-0.225
S1.008	S9	360 Summer	100	+45%					36.936	-0.150
S1.009	S10	360 Summer	100	+45%					36.841	-0.150

Flooded

Half Drain

Pipe

PN	US/MH Name	Volume (m³)	Flow / Cap. (l/s)	Overflow (l/s)	Time (mins)	Flow (l/s)	Status	Level Exceeded
S1.000	S1	0.000	0.12			0.8	OK	
S1.001	S2	0.000	0.30			3.3	OK	
S1.002	S3	0.000	0.27			5.6	OK	
S1.003	S4	0.000	0.26			9.8	OK	
S1.004	S5	0.000	0.08			17.2	FLOOD RISK	
S1.005	S6	0.305	0.15			17.2	FLOOD	1
S1.006	S7	1.433	0.00	0.0		0.0	FLOOD	1
S1.007	S8	0.000	0.00			0.0	OK	
S1.008	S9	0.000	0.00			0.0	OK	
S1.009	S10	0.000	0.00			0.0	OK	

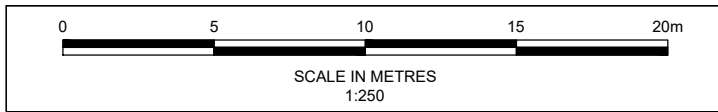
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Appendix C

Exceedance Plan



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Outfall connection to existing Southern Water foul sewer - new manhole to be constructed

SLOW

Potential for some ponding here

Permeable paving laid over Type 3 open-graded Sub-base
Area: 425 m²
Depth: 0.45 m
Void Ratio: 30%
Volume: 57.4 m³

Baffles installed within Type 3 sub-base at 20m intervals

Geotextile membrane laid between Type 3 subbase and cellular storage tank

Cellular Storage Tank installed immediately before pumping station
Area: 56 m²
Depth: 2.0 m
Void Ratio: 95%
Volume: 106.4 m³

New pumping station for surface water runoff
Pump Rate: 5.0 l/s

Surface water rising main

Diffuser unit inlet into permeable paving

Hydro-Brake flow control outlet chamber
Design Flow: 2.0 l/s

Cellular Storage Tank for Rising Main outfall
Area: 36 m²
Depth: 0.8 m
Void Ratio: 95%
Volume: 27.4 m³

Notes

- All levels and dimensions to be checked on site before any work commences. All dimensions in metres unless stated otherwise.
- This drawing is based on survey information supplied by [add], and Motion cannot guarantee the accuracy of the data provided.
- This drawing is based on OS mapping and Motion cannot guarantee the accuracy of the data.
- Highway boundary information obtained from [add] and based on OS mapping, Motion cannot guarantee the accuracy of the data provided.
- Motion accepts no liability for any vehicle specification errors or inaccuracies within the vehicle tracking software used / or it's vehicle libraries. The vehicles speeds used for the analysis are as follows: forward **mph / reversing **mph.

Legend

- Existing Southern Water Foul Sewer
- Proposed Surface Water Drain
- Proposed Surface Water Gully and Pipe Connection
- Proposed Surface Water Rising Main
- Proposed Surface Water Manhole
- Proposed Surface Water Pumping Station
- Proposed Diffuser Unit
- Proposed Permeable Paving
- Proposed Permeable Paving Baffle
- Proposed Cellular Storage Tank
- Proposed Foul Manhole - Outfall Connection to existing sewer network

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Client:
Earlswood Homes Ltd

Project:
Land off College Land
Hurstpierpoint

Title:
Proposed Drainage Strategy
Surface Water Drainage

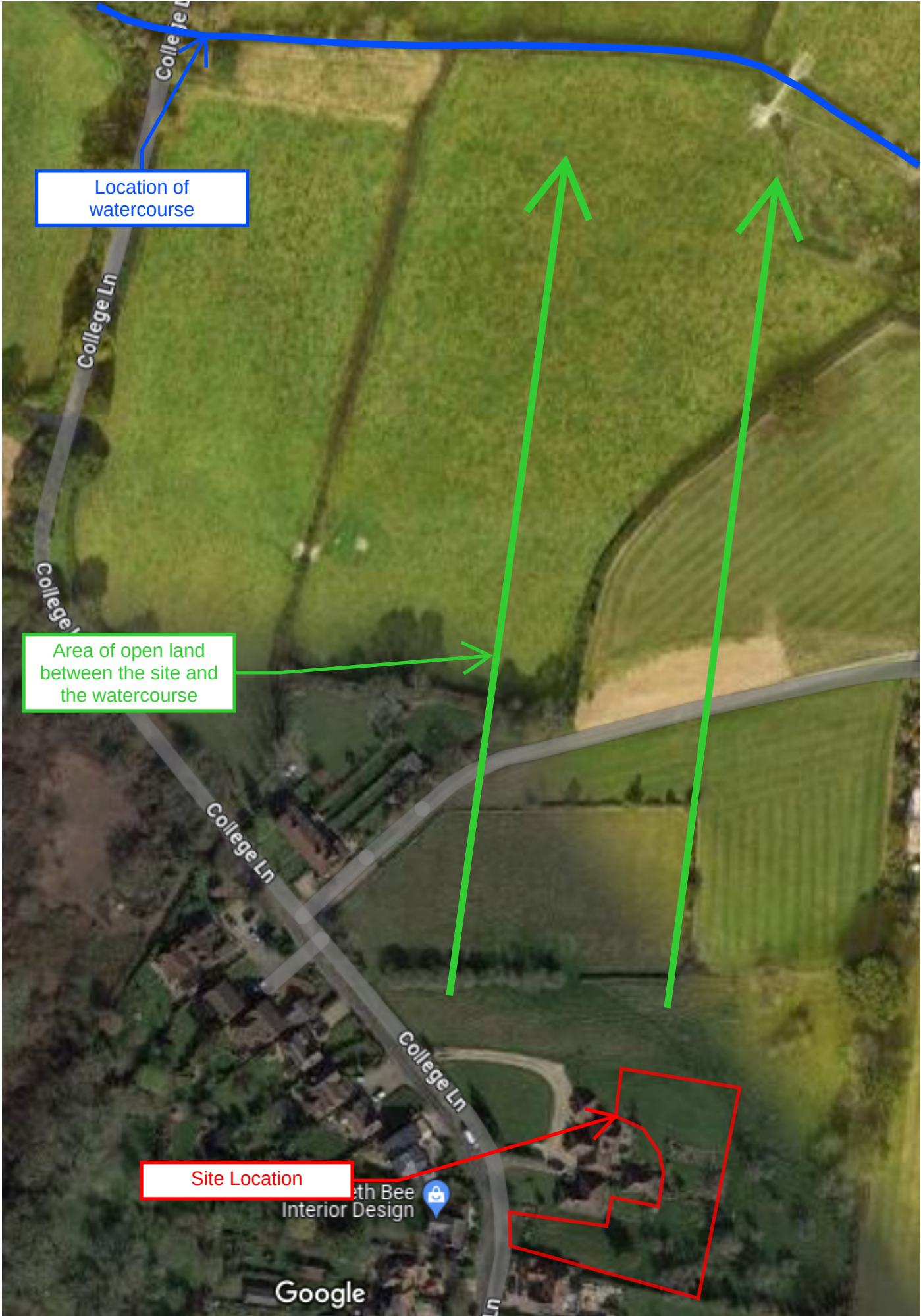
Scale: 1:250 (@ A1)

Drawing:
2403069-0501

Revision:
P0

Appendix D

Receptors Plan



Location of
watercourse

Area of open land
between the site and
the watercourse

Site Location

th Bee
Interior Design

Google