



GRAINGER PLC
BLUE STAR LAND
WATERLOOVILLE

SUDS DESIGN DOCUMENT

MAY 2023



the journey is the reward

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List of Contents

Sections

1	Introduction	1
2	Existing Condition	2
3	Design Parameters and Methodology	4
4	Proposals	6
5	Conclusion	9

Tables

Table 3.1: Assumed Run-off Factors and Discharge Rate	5
Table 4.1: SuDs Basin Operation Parameters	7

Appendices

APPENDIX A: Extracts from Tree Survey Report Ref. JFA9514	
APPENDIX B: Drawings	
APPENDIX C: Model Data Output	
APPENDIX D: Maintenance Schedule	

1 Introduction

- 1.1 This document sets out the design principles for the drainage associated with the proposed Blue Star Land development (BSL).
- 1.2 The BSL site covers an area of 1.96Ha and is located between the Berewood development site and the A3/Maurepas Way (OS Grid Ref. SU678093). A location plan of the site is shown on Dwg. GTWVILLE_BSL_GA_01 in Appendix B.
- 1.3 The site historically contained public allotments which have since been relocated. Since then, it has mainly been vacant apart from the construction of a footway network providing access from Laxton Leaze and the Forest End estate to London Road.
- 1.4 The BSL development will comprise of up to 90 residential units with a primary highway access off Laxton Leaze to the west and an emergency/pedestrian access off Peasgood Lane in the north-west corner of the site.

2 Existing Condition

Topography

- 2.1 Topographical survey of the existing land was undertaken by Encompass Surveys LTD in March 2023. The site slopes predominantly from the south to the northeast. Ground levels range from approximately from 38.00mAOD 44.50mAOD. The site is predominantly overgrown grassed areas intersected by two 3m wide pedestrian paths running from Laxton Leaze (west side) and Forest End (south side) to London Rd (east side). A number of mature trees are situated along the northern and eastern boundaries with smaller trees dispersed within the site.
- 2.2 A tree survey has been carried out by James Fuller in March 2023. Relevant extracts from the subsequent report (Ref. JFA9514) are contained in Appendix A.
- 2.3 There is a hard surfaced area in the southeast corner of the site which used to serve as the allotment parking. It is not clear at the moment what the make up or extent of the parking area is due to the existing overgrowth.

Geology and Hydrogeology

- 2.4 The original land use was agricultural, before being utilised as public allotments approximately 80 years ago.
- 2.5 A geological survey is to be undertaken in the immediate future once ecological constraints have been addressed. However, there is extensive geological information from the adjacent Berewood sites to suggest the ground make up is topsoil overlying silty/clay subsoil overlying Oxford Clay head deposits, overlying chalk.
- 2.6 The Oxford clay and overlying sub-soil will be the main materials affecting the drainage strategy. Results from the adjacent Berewood ground investigations for Phases 1 and 3B indicate that the ground will be unsuitable for infiltration.
- 2.7 A ground investigation is due to be undertaken in late April 2023. The investigation will inform on the current groundwater levels. However, further seasonal monitoring may be necessary to determine the level of risk.

Hydrology

- 2.8 The main recipient watercourse for site run-off will be the River Wallington, which flows east to west and is located approximately 250m to the north of the site.

- 2.9 The site is bordered on the south west and north side by field ditches typical of those on the adjacent Berewood site prior to development. An additional ditch also crosses the site from the southern boundary to the north east corner of the site. Dwg. GTWVILLE/DR/01 in Appendix B shows the general surface water flow routes for the site and the overland flood flow paths. Generally overland flows are collected and drain northwards via the ditches on the east and west sides of the site.

Arboricultural Assets

- 2.10 Appendix A contains an extract from the tree survey which was undertaken in March 2023 by James Fuller. The plan in Appendix A indicates that all of the trees within the proposed SuDs footprint are Category C (Trees of Low Quality). There are two Category B trees (Trees of Moderate Quality) on the northern boundary of the site. The pond has been located to ensure its sits outside the potential root zone of these trees.

3 Design Parameters and Methodology

- 3.1 For the purposes of the design, it is assumed there are no impermeable areas within the existing site.

Rainfall and Run-off Parameters

- 3.2 The discharge rate for the adjacent Berewood development has been agreed at the outline planning stage and is written into the Berewood S.106 Agreement. A QBAR greenfield run-off rate of 5.06l/s/ha has been assumed for the purposes of the BSL drainage design. This rate is considered to be representative for the BSL site.
- 3.3 The design has been tested for storm events 1 in 5yr, 1 in 30yr and 1 in 100yr+40% (climate change allowance). The design has also been tested for exceedance using a 1 in 200yr event. The Exceedance event assumes the flow control is blocked so that resulting head water would then be drained via an overflow.
- 3.4 Storm durations have been tested from 15 minutes up to 10080 minutes to ensure worst case scenario is considered.
- 3.5 Both FEH and FSR rainfall parameters have been used to ensure the worst case for short and long duration rainfall events is considered.
- 3.6 The FEH parameters relevant to the BSL site are:

C(1km) = -0.027	D1(1km) = 0.461	D2(1km) = 0.293
D3(1km) = 0.380	E(1km) = 0.306	F(1km) = 2.247

Catchment Areas

- 3.7 A permeability factor of 0.65 has been assumed for the whole of the development area. This is considered conservative but will be verified during the detailed design of the residential development plots.
- 3.8 Urban Creep can be described as future urban expansion within a development such as extensions to buildings and paving of gardens. These activities increase the impermeable area of a site and often sit outside of the development control process. Therefore, an allowance for a 10% increase in the impermeable area on the development site has been made to allow for urban creep.
- 3.9 The SuDs basin will also be considered impermeable due to assumption that ground infiltration will be insignificant. The SuDs basin has a permeability factor of 1.0.

- 3.10 The catchment details for the BSL site based on the permeability factors referred above, are summarised in Table 3.1 below.

Description	
Total Development Area (TDA)	1.96Ha
Total 'Built up' Area	1.48Ha
Development Drained Area (design impermeable area) (TDA x 0.65 x 1.10)	1.06Ha
SuDs basin Footprint	0.10Ha
Total Drained Area (1.06+0.1)	1.16Ha
Design Discharge Rate (5.06 x 1.16)	5.9l/s

Table 3.1: Assumed Run-off Factors and Discharge Rate

Design Methodology

- 3.11 The design has been modelled using Microdrainage Network software to determine the size of the required SuDs basin. A preliminary network has been developed to ensure general falls across the site align with the general topography and to ensure the design water levels within the basin do not adversely affect the upstream network.
- 3.12 Current pipe sizing has been selected to ensure flooding does not occur for storm events of 1 in 30yrs and less. There is likely to be local flooding within the network for storm events over 1 in 30yrs. It is expected that the safe overland flow paths will be developed into the residential layout during design development. Overland flow paths will need to ensure surface water is directed towards the northern boundary of the site.
- 3.13 The outfall from the pond will be restricted to a maximum 5.9l/s using a vortex flow control unit.

4 Proposals

Proposed Drainage Network and SuDS Provision

- 4.1 Dwg GTWVILLE_BSL/DR/03 in Appendix B shows the proposed SuDS provision in context with the site and an outline drainage network.
- 4.2 The drainage network indicated on Dwg. GTWVILLE_BSL/DR/03, is a preliminary layout used to test the available falls across the site. The proposed network will need to be developed once a more detailed layout of the development is available.
- 4.3 Dwg GTWVILLE_BSL-DR-04 in Appendix B shows the proposed SuDS provision in more detail and provides a cross-section of the basin to inform how it would sit within the existing topography. The basin will have a rim level of 39.50m AoD and a base level of 38.01m AoD.
- 4.4 The main drainage including the SuDs basin discharge control and the main upstream drainage will be adopted by LEEP under a S104 agreement. Any drainage solely draining public highway will be adopted Hampshire County Council (HCC) under a S38 agreement.
- 4.5 The SuDs basin has been located to avoid tree root protection zones within the vicinity whilst optimising the remaining amenity space. The pond has been positioned a minimum 5m from the existing medium pressure gas main which runs along the eastern boundary of the site. This is more than the required 3m clearance. The SuDs basin will be maintained by Havant Borough Council as part of a wider open space maintenance agreement.
- 4.6 A vortex silt separator will be provided upstream of the basin inlet to intercept as much solid matter as possible. This measure also intercepts a significant amount of potential pollutants thereby maintaining water quality within the basin and downstream.
- 4.7 The outfall from the basin will be fitted with a Pollution Control Valve (PCV) and a vortex flow restrictor. The PCV will enable routine maintenance of the hydrobrake and allow immediate detention of flow in the event of contamination spillages upstream.
- 4.8 The basin will be fitted with an overflow to ensure the pond sides are not breached and to allow resulting exceedance flows to be discharged in a controlled manner.

- 4.9 The outfall from the basin will discharge to the existing ditch network to the north. The existing ditch network in the vicinity of the outfall will be cleaned out beforehand to ensure the necessary outfall IL can be achieved.
- 4.10 The basin is to be designed to be dry during dry weather periods. Planting/landscaping of the basin will be in co-ordination with the wider open space. The planting/landscaping proposals are being developed by Allen Pyke Associates (APA).
- 4.11 Erosion control at the inlet to the basin will be provided as a combination of hessian erosion control matting and filtration stone.
- 4.12 The overflow will be a series of highway gullies set into the northern slope of the pond. With an outfall pipe connected to the outfall headwall.

Summary of Results

- 4.13 The model data output is contained in Appendix C. Details of the required storage and storm event water levels is contained in Table 4.1 below. The maximum required storage will be 1,070cu.m. This is based on a basin covering 1215sq.m with 1 in 3 side slopes to it's base.

Event	Water Level (mAoD)	Stored Volume (cu.m)	Depth (m)	Discharge Rate (l/s)	Remaining Freeboard to Overflow (mm)
1 in 5yr	38.343	330	0.429	5.9	764
1 in 30yr+40%	38.848	712	0.840	5.9	458
1 in 100yr+40%	39.168	1,090	1.161	5.9	79
1 in 200yr (Exceedance Event)*	38.931	1,145	1.235	5.9	-43

Table 4.1: SuDs Basin Operation Parameters

- 4.14 The basin capacity ensures the discharge flow rate for all storm events up to and including a 1in 100yr (plus climate change allowance) is less than the greenfield run-off rate.
- 4.15 The overflow operates only during the 1 in 200yr exceedance event. The overflow begins to operate after 72hours. The greenfield discharge rate would be exceeded after

96hours. The pond would not be breached until after 7 days. It is expected a maintenance response would take place within the 96 hours.

Maintenance

- 4.16 A maintenance schedule can be found in Appendix D.
- 4.17 The outlet controls will be accessed via a 2m cinder surfaced path connected to the nearest adoptable highway. If necessary, a maintenance bay will be provided for visiting maintenance crew.

5 Conclusion

- 5.1 The total discharge rate for the worst-case scenario (1 in 100 year return period +40% for climate change) from the BSL development can be limited to the greenfield run-off rate.
- 5.2 The maximum depth within the pond during the worst case event (storm duration) will be 1.16m.
- 5.3 The greenfield design discharge rate will be exceeded during an exceedance event after 96hrs when water levels within the pond reach the overflow level. In comparison, the greenfield run-off rate for a 1 in 200yr event would be 18.6l/s when applying a growth factor of 3.61 (Ref. Fig A1.2 FSSR 14). This value would not be exceeded until after 6 days . It is expected that any necessary repairs would have been undertaken within the 6 day period.

APPENDIX A: Extracts from Tree Survey Report Ref. JFA9514

Tree Survey Report



Grainger



Berewood



Blue Star



Ref:

March 2023
JFA9514



TREE SURVEY NOTES

This Tree Survey has been undertaken in accordance with the recommendations set out in British Standard 5837:2012 and current arboricultural best practice.

- Each tree has been numbered sequentially and recorded on the Tree Survey Plan.
- Due to variations of existing ground levels through the site, height dimensions are estimated and are given in metres. Accurate heights, measured with the aid of optical instruments can be provided where instructed.
- Trunk/stem diameters are measured in millimetres (mm) at 1.5 metres above ground level, using a diameter measuring tape, unless otherwise stated.
- Estimated branch spread is taken in metres from the centre of the trunk, at the four cardinal points of a compass, to achieve an accurate representation of the crown shape which is recorded on the tree survey plan.
- An assessment of a tree's age classification is made in terms of its maturity within the site's landscape and defined as:

Y	=	young trees
SM	=	semi-mature trees
EM	=	early mature trees
M	=	mature trees
OM	=	over-mature trees

- An assessment of a tree's physiological condition is defined as:

Good	=	fully functioning biological system showing average vitality i.e. normal bud growth, leaf size, crown density and wound closure
Fair	=	fully functioning biological system showing below average vitality i.e. reduced bud growth, smaller leaf size, lower crown density and reduced wound closure

Poor = a biological system with limited functionality showing significantly below average vitality i.e. limited bud growth, small and chlorotic leaves, low crown density and limited wound closure

Dead = dead

➤ An assessment of a tree's structural condition is defined as:

Good = no significant structural defects

Fair = structural defects which could be alleviated through remedial tree surgery or management practices

Poor = structural defects which cannot be alleviated through tree surgery or management practices

Dead = dead

➤ An assessment of a tree's future life expectancy is defined as: **<10, 10+, 20+ or 40+ years.**

Categorisation of Trees

The category for each tree is assessed in accordance with the recommendations of BS5837:2012. The assessment has not considered any site-specific development proposals, but will have considered any changes on or off-site which may have an effect on the conditions surrounding the surveyed trees.

The trees have been classified into one of the following categories (and one or more sub-categories [this will not increase the value of the tree]) and are indicated on the associated drawings by colours as indicated.

Category U		Identification colour on plan		
Trees in such a condition that they cannot realistically be retained as living trees in the context of the current land use for longer than 10 years		- Trees that have a serious, irremediable, structural defect, such that their early loss is expected due to collapse, including those that will become unviable after removal of other category U trees (e.g. where, for whatever reason, the loss of companion shelter cannot be mitigated by pruning) - Trees that are dead or are showing signs of significant, immediate, and irreversible overall decline - Trees infected with pathogens of significance to the health and/or safety of other trees nearby, or very low quality trees suppressing adjacent trees of better quality		
Category A		1 – Mainly arboricultural values	2 – Mainly landscape values	3 – Mainly cultural values
Trees of high quality with an estimated remaining life expectancy of at least 40 years		Trees that are particularly good examples of their species, especially if rare or unusual; or those that are essential components of groups or formal or semi-formal arboricultural features (e.g. the dominant and/or principal trees within an avenue	Trees, groups of woodlands of particular visual importance as arboricultural and/or landscape features	Trees, groups or woodlands, of significant conservation, historical, commemorative or other value (e.g. veteran trees or wood-pasture)
		Identification colour on plan		
		LIGHT GREEN		

Category B	1 – Mainly arboricultural values	2 – Mainly landscape values	3 – Mainly cultural values	Identification colour on plan
Trees of moderate quality with an estimated remaining life expectancy of at least 20 years	Trees that might be included in category A, but are down-graded because of impaired condition (e.g. presence of significant through remediable defects, including unsympathetic past management and storm damage), such that they are unlikely to be suitable for retention for beyond 40 years; or trees lacking the special quality necessary to merit the category A designation	Trees present in numbers, usually growing as groups or woodlands, such that they attract a higher collective rating than they might as individuals; or trees occurring as collectives but situated so as to make little visual contribution to the wider locality	Trees with material conservation value or other cultural value	MID BLUE
Category C	1 – Mainly arboricultural values	2 – Mainly landscape values	3 – Mainly cultural values	Identification colour on plan
Trees of low quality with an estimated remaining life expectancy of at least 10 years, or young trees with a stem diameter below 150mm	Unremarkable trees of very limited merit or such impaired condition that they do not qualify in higher categories	Trees present in groups or woodlands, but without this conferring on them significantly greater collective landscape value; and/or trees offering low or only temporary/transient landscape benefits	Trees with no material conservation or other cultural value	GREY

Clients are advised that Tree Surveys are a basic data collection exercise and record of tree condition at the time of survey. It will identify any visible signs of ill-health or major defects, advising a further detailed investigation where appropriate. This will most often take the form of a request for either “*full ground level inspection*” or “*climbing inspection required*”. There may also be a further reference to the need for “*decay detection equipment*” to aid diagnosis. A tree survey does not include a comprehensive schedule or specification of remedial tree works, but may contain a guide to the work which might be undertaken by a prudent tree owner, purely for reasons of health and safety.

A Tree Survey should not be confused with a Tree Inspection or Arboricultural Implication Assessment, which are totally separate exercises.

	BS5837 – Tree Survey			
	Client:	Grainger	Site:	Blue Star
	Date:	March 2023	Consultant:	James Fuller FdSc Arb, BTEC Nat.Dip Forestry & Arb
	Tagged:	No	Weather:	Raining

Notes:-

1. It may be advised that some trees should have the ivy removed to enable a re-survey to be carried out. This would also alleviate the tree from becoming suppressed; carrying additional weight that increases the chance of windthrow due to a larger dense crown area; and only receiving restricted light. Unless otherwise stated, in order to prevent regrowth, it is only necessary to remove a 300mm section of ivy and clear around the base.
2. It may be advised that it was only possible to estimate the diameter of some trees because of ivy smothering, dense vegetation, or trees located off-site with no access.
3. The estimated remaining contribution in years, and the tree grading category have been calculated for the current situation and may alter where further investigation works are advised.
4. Some trees or groups may have been given an interim grade. The reason for the interim grading is addressed in the timescales given as this may have a bearing on health and safety and/or any development proposals.
5. Tree Groups have been assessed with estimated and representative data.
6. This is not a Tree Works Schedule. Any preliminary management recommendations are listed in the interests of health and safety and should be carried out by a prudent tree owner.
7. Any management recommendations are suggested for reasons of health and safety only, regardless of development proposals at this stage. However, the defects requiring remedial tree surgery are by their very nature potential wildlife habitats, including protected species, which needs consideration prior to any tree surgery works commencing.
8. Any tree numbers that are followed by a * are indicatively plotted and their locations should be verified on site by a land surveyor.
9. Tree data colours: -
 - U Grade Trees Highlighted in RED
 - A Grade Trees Highlighted in Green
 - B Grade Trees Highlighted in Blue
 - C Grade Trees Highlighted in Grey

James Fuller Arboriculture has checked Winchester City Councils and Havant Borough Councils website and has been informed that the site is not located within a Conservation Area.

James Fuller Arboriculture has checked Winchester City Councils and Havant Borough Councils website and has confirmed that Trees 2 M3 and 3 M3 are protected by a Tree Preservation Order, enforced by Havant Borough Council.

Tree No	Species	H't (m)	Single/ Multi-Stemmed (S or MS)	Stem Diam (mm)	Root Protection Area (m²)	Root Protection Distance (m)	Branch Spread (m)	H't of Crown AGL (m)	Life Stage	Physiological Condition	Structural Condition and General Observations	Preliminary Management Recommendations	Est. Rem. Contrib. (Yrs)	Cat
1	Pedunculate Oak <i>Quercus robur</i>	17	S	660	197	7.9	N 8 E 7 S 3 W 8	N 1.5 E 2 S 4 W 3	Early Mature	Good	Structural Condition - Fair Growing on bank, Crown shape distorted due to group pressure, Minor deadwood in crown Burrowing at base,	None required at time of survey	20+	B1+2
2	Common Ash <i>Fraxinus excelsior</i>	14	S	400	72	4.8	N 6 E 6 S 6 W 6	N 3 E 3 S 3 W 3	Semi-mature	Good	Structural Condition - Good Offsite tree, Unable to verify health and safety due to no access, Estimated data	Gain access and resurvey within 1 month	20+	B1+2 Interim
Grp 1	Willow, Hazel, Hawthorn, Ash, Bramble	9	S	150	10	1.8	N - E - S - W -	N - E - S - W -	Semi-mature	Fair	Structural Condition - Fair Scrubby group, Dense Bramble understorey, Self set trees within, Poor quality group	None required at time of survey	20+	C2
Grp 2	Oak x 3	22	S	750	254	9.0	N - E - S - W -	N - E - S - W -	Early Mature	Good	Structural Condition - Good Unable to verify health and safety due to no access, Crown shape distorted due to group pressure, Major deadwood in crown Off site group,	Gain access and resurvey within 1 month	40+	A2 Interim
Grp 3	Willow, Birch, Ash, Hazel, Bramble	10	S	150	10	1.8	N - E - S - W -	N - E - S - W -	Semi-mature	Fair	Structural Condition - Fair Scrubby group, Mixed species, Mainly dense Bramble, Self set trees within, Poor quality group	None required at time of survey	10+	C2

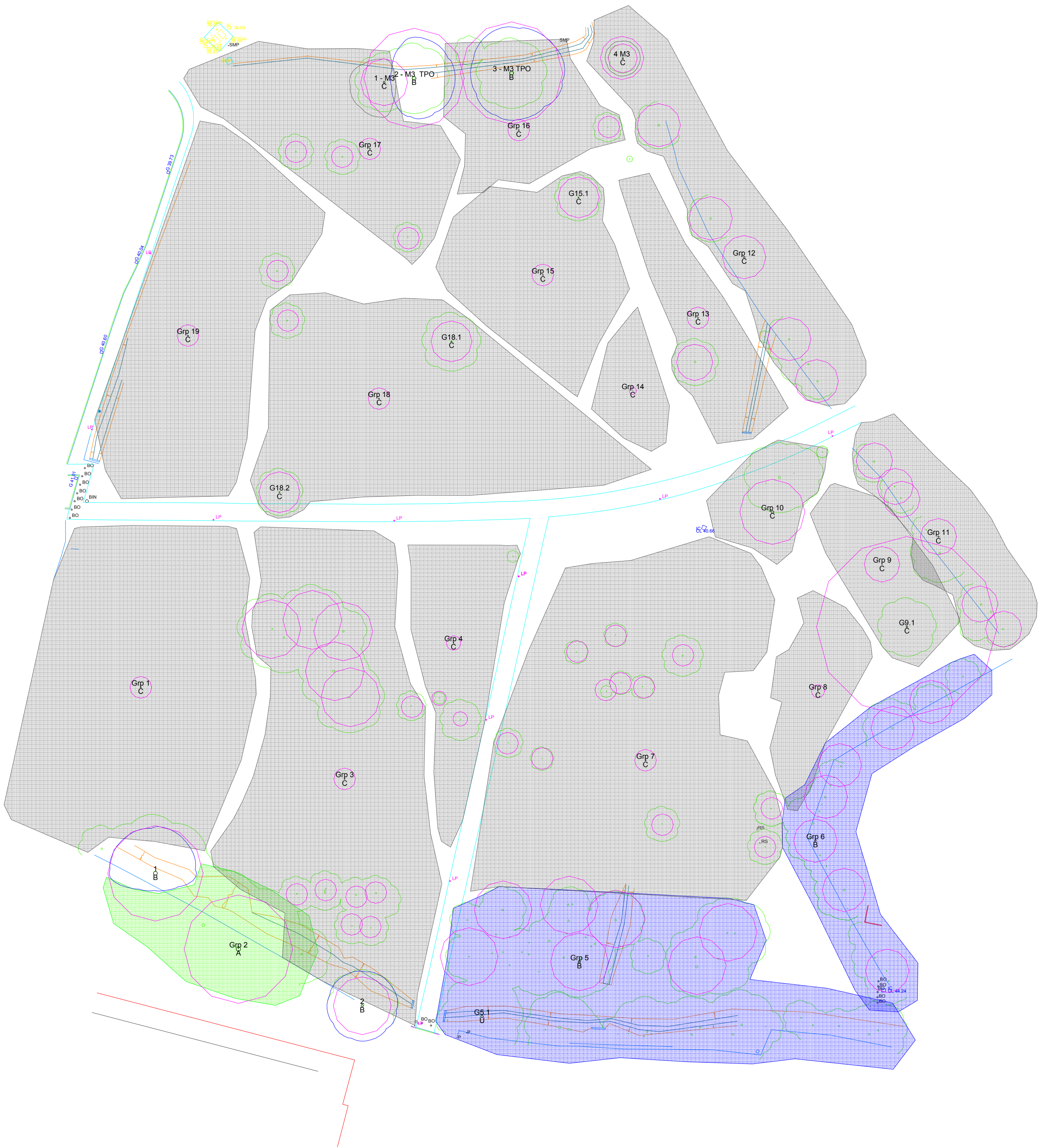
Tree No	Species	H't (m)	Single/ Multi-Stemmed (S or MS)	Stem Diam (mm)	Root Protection Area (m²)	Root Protection Distance (m)	Branch Spread (m)	H't of Crown AGL (m)	Life Stage	Physiological Condition	Structural Condition and General Observations	Preliminary Management Recommendations	Est. Rem. Contrib. (Yrs)	Cat
Grp 4	Oak, Ash, Willow, Bramble	7	S	100	5	1.2	N - E - S - W -	N - E - S - W -	Young	Fair	Structural Condition - Fair Scrubby group, Mainly Bramble, Self set trees within, Poor quality group	None required at time of survey	10+	C2
Grp 5	Alder, Ash, Field Maple, Bramble	19	S	400	72	4.8	N - E - S - W -	N - E - S - W -	Early Mature	Good	Structural Condition - Fair Mixed species group, Dense Bramble understorey, Creates screening into and out of site, Would benefit from being managed (thinning and new planting)	See below	20+	B2
G5.1	Common Ash		MS	6 @ 400	-	-	-	-	Early Mature	Poor	Fair In decline, Ash Dieback, Major deadwood	Advise Removal and replant bank	<10	U
Grp 6	Beech, Oak, Cherry, Ash	14	S	300	41	3.6	N - E - S - W -	N - E - S - W -	Semi-mature	Good	Structural Condition - Fair Estimated data, Unable to verify health and safety due to no access Off site group, Mixed species, Creates screening into and out of site,	None required at time of survey	20+	B2
Grp 7	Ash, Willow, Oak, Cypress, Bramble	8	S	150	10	1.8	N - E - S - W -	N - E - S - W -	Young	Fair	Structural Condition - Fair Scrubby group, Mixed species, Mainly Bramble, Self set trees within, Poor quality group	None required at time of survey	10+	C2
Grp 8	Bramble, Oak, Ash	5	S	90	4	1.1	N - E - S - W -	N - E - S - W -	Young	Fair	Structural Condition - Fair Scrubby group, Mainly Bramble, Self set trees within, Poor quality group	None required at time of survey	10+	C2

Tree No	Species	H't (m)	Single/ Multi-Stemmed (S or MS)	Stem Diam (mm)	Root Protection Area (m²)	Root Protection Distance (m)	Branch Spread (m)	H't of Crown AGL (m)	Life Stage	Physio-logical Condition	Structural Condition and General Observations	Preliminary Management Recommendations	Est. Rem. Contrib. (Yrs)	Cat
Grp 9	Willow, Alder, Bramble	11	MS	100	27	2.9	N - E - S - W -	N - E - S - W -	Semi-mature	Fair	Structural Condition - Fair Scrubby group, Poor quality group, Provides screening, Self set trees,	None required at time of survey	10+	C2
Grp 10	Willow, Bramble	15	S	450	92	5.4	N - E - S - W -	N - E - S - W -	Semi-mature	Fair	Structural Condition - Fair Bramble understorey, Self set trees, Multi-stemmed at ground level, One main tree, Poor quality group	None required at time of survey	10+	C2
Grp 11	Ash, Willow, Oak	14	S	250	28	3.0	N - E - S - W -	N - E - S - W -	Semi-mature	Fair	Structural Condition - Fair Off site group, Boundary edge group, Mixed species, Dead trees within, Provides screening into and out of site,	Inform owner of duty of care	10+	C2
Grp 12	Oak, Ash, Willow, Alder	12	S	300	41	3.6	N - E - S - W -	N - E - S - W -	Semi-mature	Good	Structural Condition - Good Off site group, Mixed species, Boundary edge group, Provides screening, Some better quality trees within, Dead trees within	Inform owner of duty of care	20+	C2
Grp 13	Willow, Alder, Bramble, Oak, Ash	8	MS	100	27	2.9	N - E - S - W -	N - E - S - W -	Semi-mature	Fair	Structural Condition - Fair Scrubby group, Poor quality group, Self set trees,	None required at time of survey	10+	C2
Grp 14	Bramble	5	S	90	4	1.1	N - E - S - W -	N - E - S - W -	Young	Fair	Structural Condition - Fair Scrubby group, Mainly Bramble, Self set trees within, Poor quality group	None required at time of survey	10+	C2

Tree No	Species	H't (m)	Single/ Multi-Stemmed (S or MS)	Stem Diam (mm)	Root Protection Area (m²)	Root Protection Distance (m)	Branch Spread (m)	H't of Crown AGL (m)	Life Stage	Physiological Condition	Structural Condition and General Observations	Preliminary Management Recommendations	Est. Rem. Contrib. (Yrs)	Cat
Grp 15	Willow, Alder, Bramble, Oak, Ash	8	MS	100	27	2.9	N - E - S - W -	N - E - S - W -	Semi-mature	Fair	Structural Condition - Fair Scrubby group, Poor quality group, Self set trees,	None required at time of survey	10+	C2
Grp 15.1	Willow		MS	8 @ 100	36.17	3.5	-	-	Semi Mature	Good	Fair Multi-stemmed at ground level	None required at time of survey	10+	C1+2
Grp 16	Willow, Alder, Bramble, Oak, Ash	8	MS	100	27	2.9	N - E - S - W -	N - E - S - W -	Semi-mature	Fair	Structural Condition - Fair Scrubby group, Poor quality group, Self set trees,	None required at time of survey	10+	C2
Gro 17	Willow, Alder, Bramble, Oak, Ash	8	MS	100	27	2.9	N - E - S - W -	N - E - S - W -	Semi-mature	Fair	Structural Condition - Fair Scrubby group, Poor quality group, Self set trees,	None required at time of survey	10+	C2
Grp 18	Willow, Alder, Bramble, Oak, Ash	8	MS	100	27	2.9	N - E - S - W -	N - E - S - W -	Semi-mature	Fair	Structural Condition - Fair Scrubby group, Poor quality group, Self set trees,	None required at time of survey	10+	C2
G 18.1	Willow		MS	8 @ 100	36.17	3.5	-	-	Semi Mature	Good	Fair Multi-stemmed at ground level	None required at time of survey	10+	C1+2
G 18.2	Willow		MS	8 @ 100	36.17	3.5	-	-	Semi Mature	Good	Fair Multi-stemmed at ground level	None required at time of survey	10+	C1+2

Tree No	Species	H't (m)	Single/ Multi-Stemmed (S or MS)	Stem Diam (mm)	Root Protection Area (m²)	Root Protection Distance (m)	Branch Spread (m)	H't of Crown AGL (m)	Life Stage	Physiological Condition	Structural Condition and General Observations	Preliminary Management Recommendations	Est. Rem. Contrib. (Yrs)	Cat
Grp 19	Willow, Alder, Bramble, Oak, Ash, Blackthorn	8	MS	100	27	2.9	N - E - S - W -	N - E - S - W -	Semi-mature	Fair	Structural Condition - Fair Scrubby group, Poor quality group, Provides screening, Self set trees,	None required at time of survey	10+	C2
1 M3	Common Ash <i>Fraxinus excelsior</i>	12	MS	230 230	48	3.9	N 4 E 2 S 6 W 6	N 3 E 4 S 3 W 3	Semi-mature	Fair	Structural Condition - Fair Bifurcated at ground level; Crown shape distorted due to group pressure; Minor deadwood in crown	None required at time of survey	20+	C1+2
2 M3 TPO	Pedunculate Oak <i>Quercus robur</i>	12	MS	500 480	217	8.3	N 7 E 7 S 7 W 4	N 2 E 2 S 2 W 4	Early Mature	Good	Structural Condition - Fair Bifurcated at ground level; Minor deadwood in crown Stem to northeast has decay,	Full ground level inspection using decay detection equipment	20+	B1+2 Interim
3 M3 TPO	Pedunculate Oak <i>Quercus robur</i>	12	MS	500 500	226	8.5	N 8 E 9 S 8 W 7	N 1.5 E 1.5 S 1 W 1	Early Mature	Good	Structural Condition - Fair Bifurcated at ground level; Minor deadwood in crown No access to base due to dense vegetation	Clear around base and resurvey within 1 month	20+	B1+2 Interim
4 M3	Field Maple <i>Acer campestre</i>	8	S	200	18	2.4	N 3 E 3 S 3 W 3	N 2 E 2 S 2 W 2	Semi-mature	Good	Structural Condition - Fair Trunk and crown shape distorted No access due to dense understorey,	Clear around base and resurvey within 1 month	20+	C1+2 Interim





NOTES:
1. The site is not located within a Conservation Area.
2. Trees 2 M3 and 3 M3 are protected by a TPO, enforced by Havant Borough Council.



Tree Survey Plan

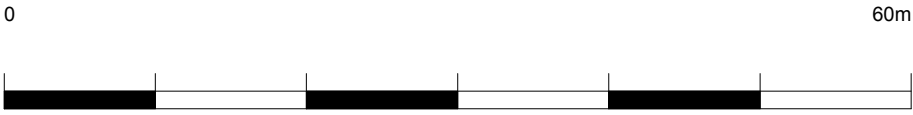
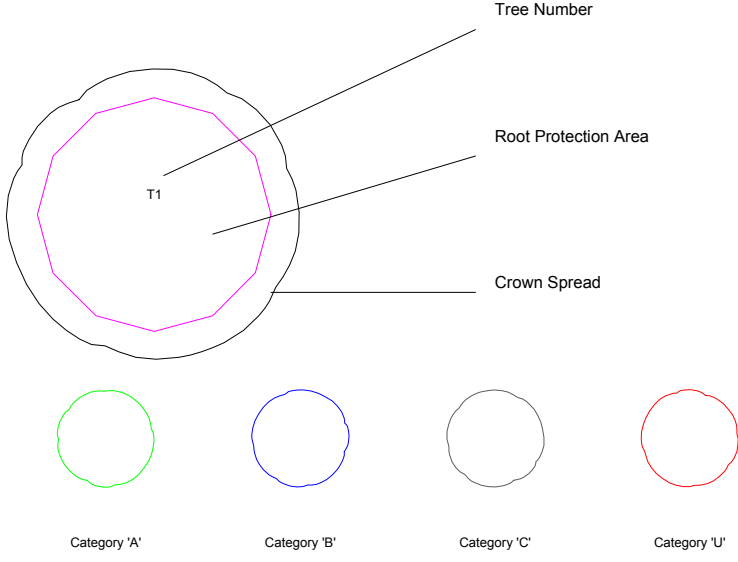
SITE: Blue Star

SCALE : 1 : 500 @ A2 DATE : 20/03/2023

MAP FILENAME : JFA9514.01 TSP



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Qualifications of James Fuller

James Fuller, has over 17 years experience within the field of Arboriculture and has attained a Foundation Degree in Arboriculture (FDSc Arb.) and a BTEC National Diploma in Forestry & Arboriculture (BTEC Nat.Dip. Forestry & Arb.).

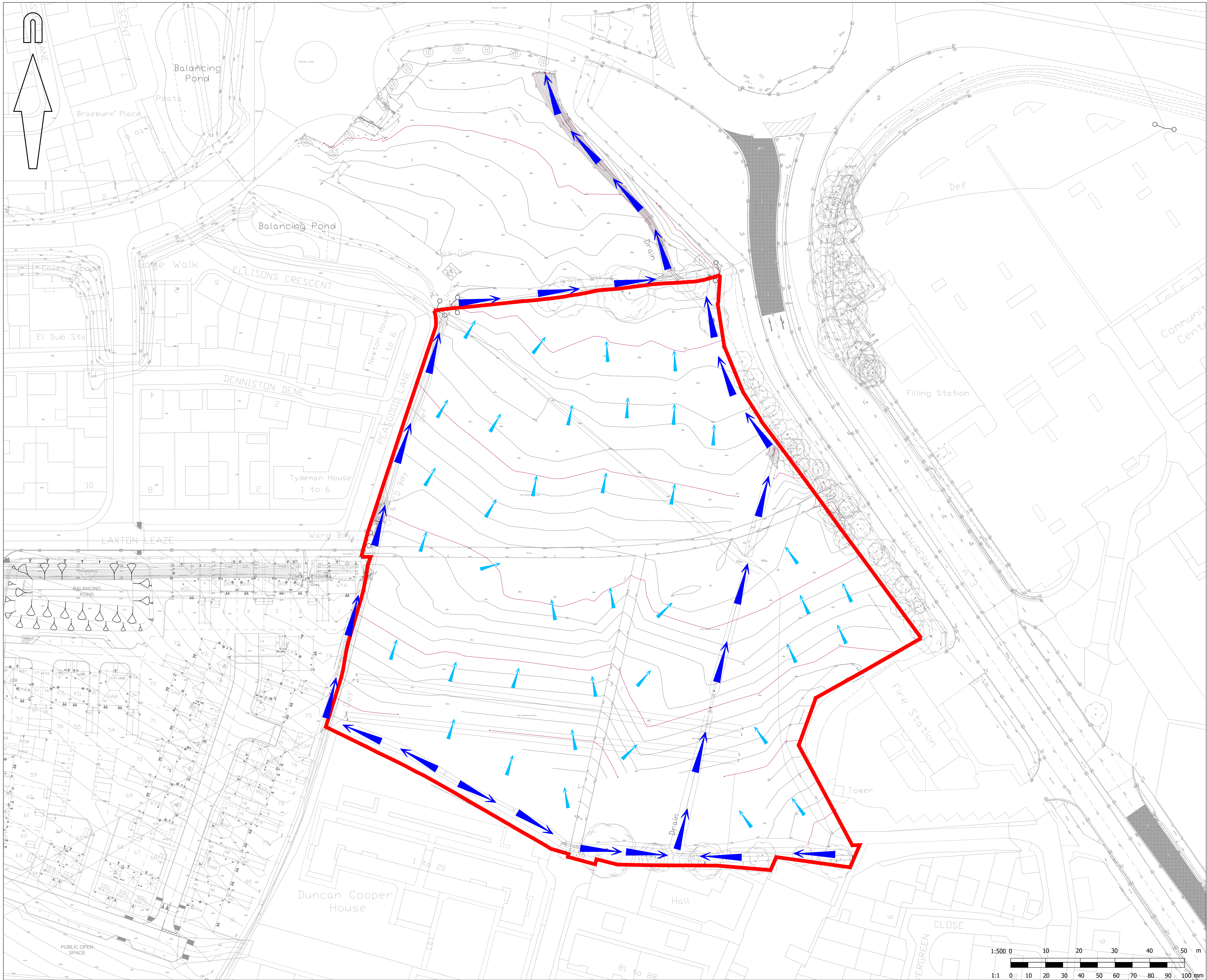
James is also a Professional Member of the Arboricultural Association (MArborA) and has successfully completed the Professional Tree Inspector's, Capital Asset Value for Amenity Trees (CAVAT), Quantified Tree Risk Assessment (QTRA) and Visual Tree Assessment (VTA) Courses.

James previously worked as an Arboricultural Consultant, providing professional advice in relation to trees for one of the leading arboricultural consultancy practices in the country. As part of this role James was instrumental in providing clients with advice from the initial Tree Survey through to site completion and sign off.

James has experience of working on a variety of sites throughout the UK, from individual Visual Tree Assessments (VTA) to large development sites (BS5837: 2012) with 1'000s of trees.

James is now building an ever-growing portfolio of private clients whilst providing consultancy advice to local arboricultural companies and their clients.

APPENDIX B: Drawings



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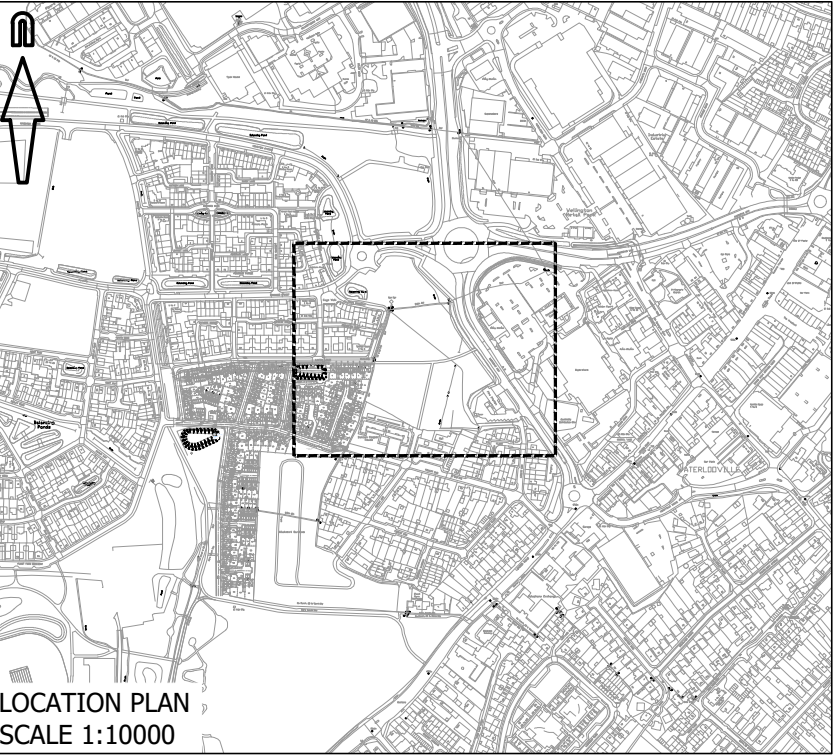
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KEY

EXTENT OF DEVELOPMENT BOUNDARY

DIRECTION OF WATERCOURSE

DIRECTION OF OVERLAND WATER



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rev.	amendment	checked	date
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client **grainger plc**

project **BLUE STAR LAND, WATERLOOVILLE**

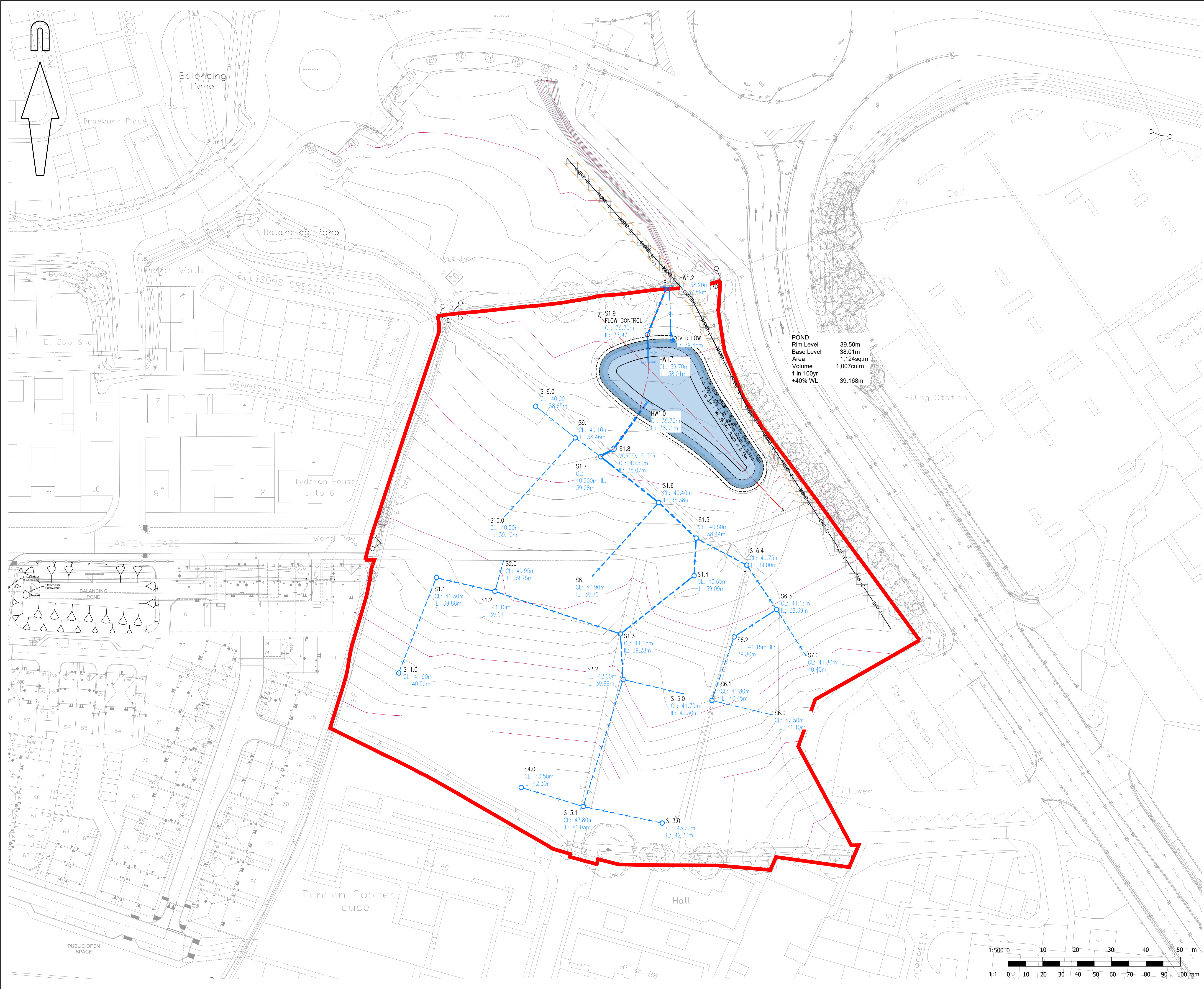
scale 1:500 drawn by KD checked by WD

date JANUARY 2023 cad file DR_01.DWG

title **EXISTING OVERLAND FLOOD FLOW PATH**

drawing number **GTWVILLE_BSL/DR/01**

rev.



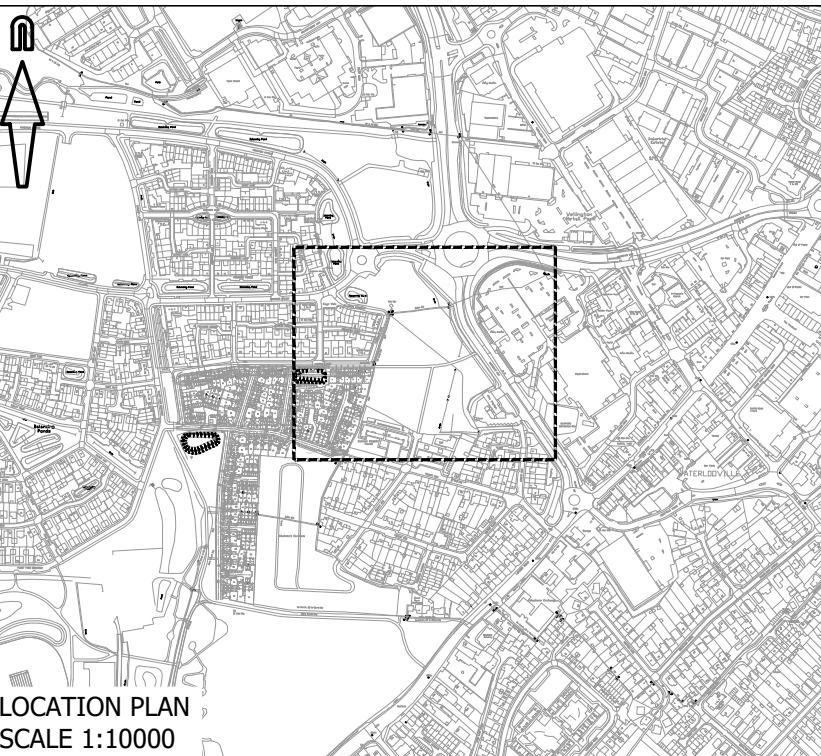
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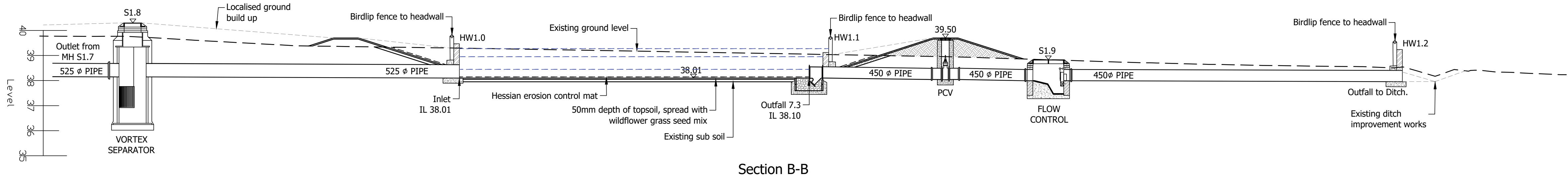
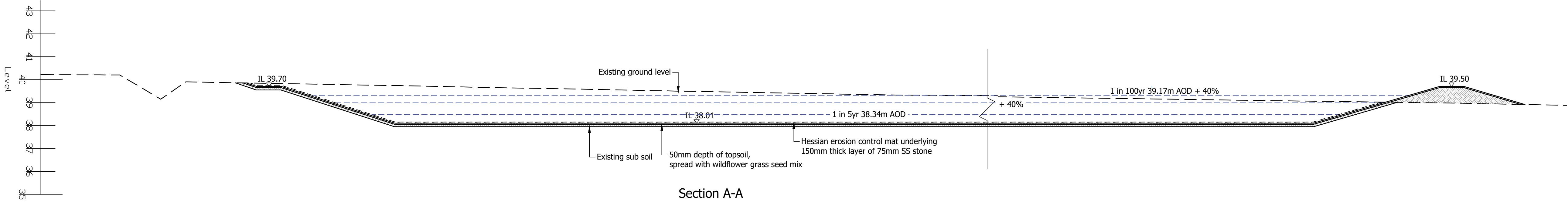
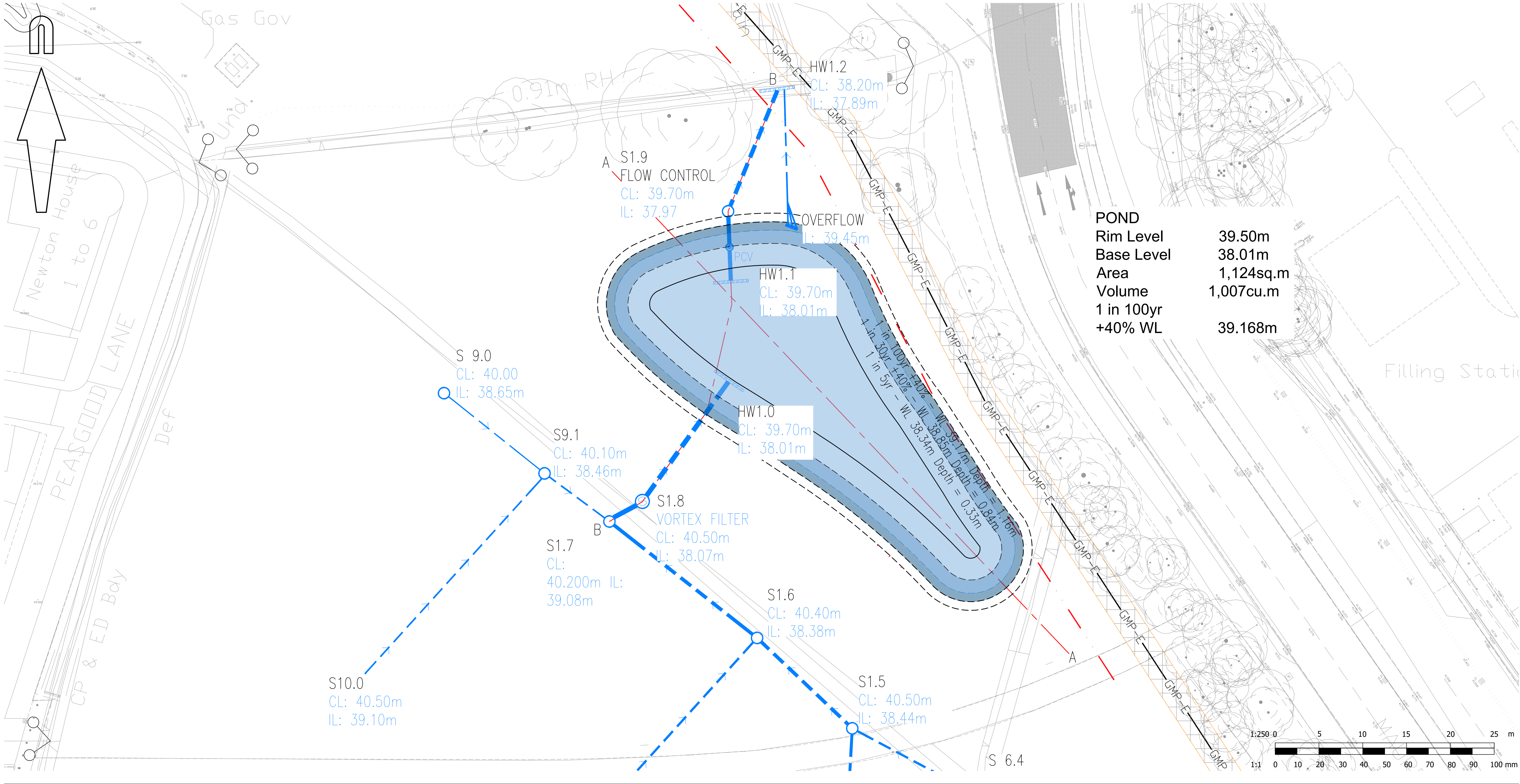
project **BLUE STAR LAND, WATERLOOVILLE**

scale	1:500	drawn by	KD	checked by	RHA
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date	JANUARY 2023	cad file	DR_03.DWG
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title
PRELIMINARY DRAINAGE NETWORK

drawing number	GTWVILLE_BSL/DR/03	rev.
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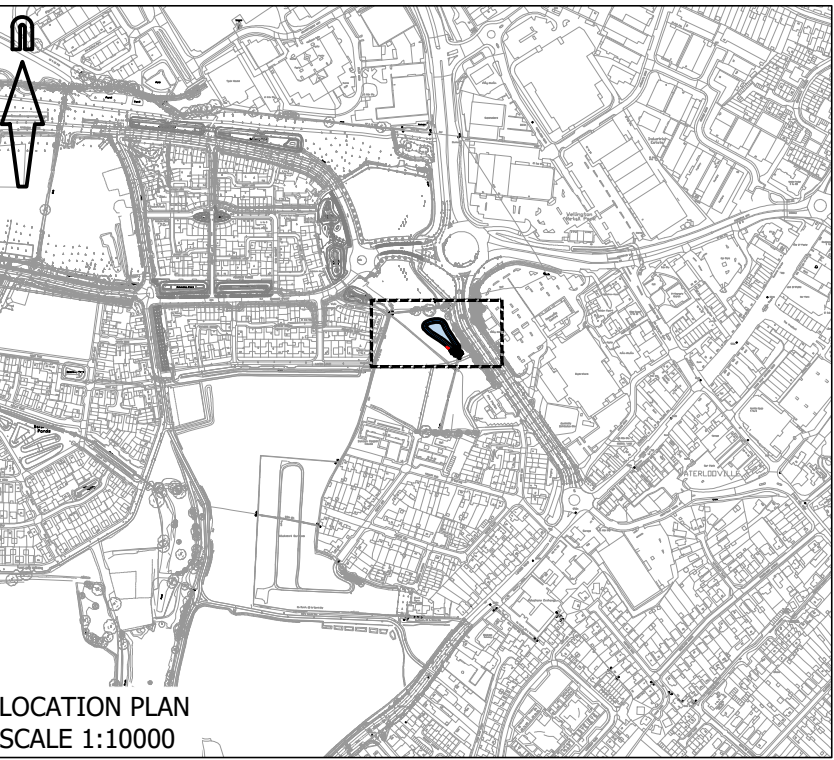
NOTES:

1. DRAINAGE NETWORK BASED ON CONCEPT LAYOUT. ANY SUBSEQUENT ALTERNATIVE LAYOUT WILL REQUIRE RE-ROUTING OF NETWORK BRANCHES WHERE NECESSARY.

KEY

EXISTING GAS MAIN EASEMENT

GAS MAIN 5m CLEARANCE (INDICATIVE)



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rev.	amendment	checked	date
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client
Investing in homes since 1912
grainger plc

project
BLUE STAR LAND, WATERLOOVILLE

scale 1:250/1:100 drawn by NT checked by RHA

date MARCH 2023 cad file DR_04.DWG

title
SUDS POND DETAILS

drawing number
GTWVILLE_BSL/DR/04

rev.

APPENDIX C: Model Data Output

Mayer Brown Limited		Page 1
Lion House Oriental Road Woking GU22 8AP	Blue Star Land Residential Development SuDs Basin (FEH)	
Date 24/03/2023 File 200324 BSL FEH.MDX	Designed by IC Checked by RHA	
Micro Drainage		Network 2020.1.3

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Storm

Pipe Sizes STANDARD Manhole Sizes STANDARD

FEH Rainfall Model			
Return Period (years)	100	Maximum Time of Concentration (mins)	20
		Foul Sewage (l/s/ha)	0.000
FEH Rainfall Version	1999	Volumetric Runoff Coeff.	0.750
Site Location		PIMP (%)	100
C (1km)	-0.027	Add Flow / Climate Change (%)	0
D1 (1km)	0.461	Minimum Backdrop Height (m)	0.000
D2 (1km)	0.289	Maximum Backdrop Height (m)	0.000
D3 (1km)	0.376	Min Design Depth for Optimisation (m)	1.200
E (1km)	0.304	Min Vel for Auto Design only (m/s)	1.00
F (1km)	2.245	Min Slope for Optimisation (1:X)	200
Maximum Rainfall (mm/hr)	75		

Designed with Level Soffits

Time Area Diagram for Storm

Time (mins)	Area (ha)	Time (mins)	Area (ha)
0-4	0.627	4-8	0.529

Total Area Contributing (ha) = 1.155

Total Pipe Volume (m³) = 36.055

Network Design Table for Storm

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	29.797	0.550	54.2	0.021	4.00	0.0	0.600	o	150	Pipe/Conduit	
S1.001	17.484	0.200	87.4	0.050	0.00	0.0	0.600	o	225	Pipe/Conduit	
S2.000	9.320	0.143	65.2	0.044	4.00	0.0	0.600	o	225	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S1.000	75.00	4.36	40.500	0.021	0.0	0.0	0.0	1.37	24.2	4.2
S1.001	75.00	4.57	39.875	0.070	0.0	0.0	0.0	1.40	55.6	14.3
S2.000	75.00	4.10	39.750	0.044	0.0	0.0	0.0	1.62	64.5	8.9

Mayer Brown Limited											Page 2	
Lion House Oriental Road Woking GU22 8AP					Blue Star Land Residential Development SuDs Basin (FEH)							
Date 24/03/2023 File 200324 BSL FEH.MDX					Designed by IC Checked by RHA							
Micro Drainage					Network 2020.1.3							
Network Design Table for Storm												
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	
S1.002	38.482	0.257	150.0	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit		
S3.000	23.457	0.293	80.0	0.041	4.00	0.0	0.600	o	150	Pipe/Conduit		
S4.000	18.829	0.188	100.0	0.027	4.00	0.0	0.600	o	150	Pipe/Conduit		
S3.001	38.633	0.483	80.0	0.038	0.00	0.0	0.600	o	225	Pipe/Conduit		
S5.000	18.100	0.226	80.1	0.000	4.00	0.0	0.600	o	150	Pipe/Conduit		
S3.002	13.244	0.110	120.4	0.061	0.00	0.0	0.600	o	225	Pipe/Conduit		
S1.003	27.269	0.182	150.0	0.120	0.00	0.0	0.600	o	300	Pipe/Conduit		
S1.004	10.892	0.084	130.0	0.044	0.00	0.0	0.600	o	300	Pipe/Conduit		
S6.000	18.109	0.650	27.9	0.031	4.00	0.0	0.600	o	150	Pipe/Conduit		
S6.001	19.578	0.650	30.1	0.025	0.00	0.0	0.600	o	150	Pipe/Conduit		
S6.002	14.664	0.326	45.0	0.033	0.00	0.0	0.600	o	150	Pipe/Conduit		
S7.000	16.052	0.600	26.8	0.018	4.00	0.0	0.600	o	150	Pipe/Conduit		
S6.003	15.499	0.310	50.0	0.080	0.00	0.0	0.600	o	225	Pipe/Conduit		
Network Results Table												
PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)		
S1.002	75.00	5.17	39.607	0.114	0.0	0.0	0.0	1.07	42.4	23.2		
S3.000	75.00	4.35	42.000	0.041	0.0	0.0	0.0	1.12	19.9	8.2		
S4.000	75.00	4.31	42.300	0.027	0.0	0.0	0.0	1.00	17.8	5.5		
S3.001	75.00	4.79	41.032	0.106	0.0	0.0	0.0	1.46	58.2	21.5		
S5.000	75.00	4.27	40.300	0.000	0.0	0.0	0.0	1.12	19.9	0.0		
S3.002	75.00	4.97	39.999	0.167	0.0	0.0	0.0	1.19	47.3	34.0		
S1.003	75.00	5.53	39.275	0.402	0.0	0.0	0.0	1.28	90.6	81.6		
S1.004	75.00	5.66	39.094	0.446	0.0	0.0	0.0	1.38	97.4	90.5		
S6.000	75.00	4.16	41.100	0.031	0.0	0.0	0.0	1.91	33.8	6.4		
S6.001	75.00	4.33	40.450	0.056	0.0	0.0	0.0	1.84	32.5	11.4		
S6.002	75.00	4.50	39.800	0.089	0.0	0.0	0.0	1.50	26.6	18.0		
S7.000	75.00	4.14	40.400	0.018	0.0	0.0	0.0	1.95	34.5	3.6		
S6.003	75.00	4.64	39.399	0.186	0.0	0.0	0.0	1.85	73.7	37.8		
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Mayer Brown Limited			Page 3
Lion House Oriental Road Woking GU22 8AP	Blue Star Land Residential Development SuDs Basin (FEH)		
Date 24/03/2023 File 200324 BSL FEH.MDX	Designed by IC Checked by RHA		
Micro Drainage		Network 2020.1.3	

Network Design Table for Storm

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
S6.004	16.645	0.333	50.0	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
S1.005	14.988	0.060	250.0	0.028	0.00	0.0	0.600	o	450	Pipe/Conduit	
S8.000	28.791	0.492	58.5	0.026	4.00	0.0	0.600	o	150	Pipe/Conduit	
S1.006	21.473	0.086	250.0	0.040	0.00	0.0	0.600	o	450	Pipe/Conduit	
S9.000	14.971	0.187	80.1	0.033	4.00	0.0	0.600	o	150	Pipe/Conduit	
S10.000	31.008	0.388	80.0	0.044	4.00	0.0	0.600	o	150	Pipe/Conduit	
S9.001	8.928	0.089	100.0	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
S1.007	16.611	0.066	250.0	0.149	0.00	0.0	0.600	o	450	Pipe/Conduit	
S1.008	15.248	0.002	7624.0	0.098	0.00	0.0	0.600	o	900	Pipe/Conduit	
S1.009	8.081	0.040	202.0	0.105	0.00	0.0	0.600	o	525	Pipe/Conduit	
S1.010	15.010	0.075	200.0	0.000	0.00	0.0	0.600	o	525	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S6.004	75.00	4.79	39.000	0.186	0.0	0.0	0.0	1.85	73.7	37.8
S1.005	75.00	5.85	38.442	0.660	0.0	0.0	0.0	1.28	203.8	134.1
S8.000	75.00	4.36	39.700	0.026	0.0	0.0	0.0	1.32	23.3	5.3
S1.006	75.00	6.13	38.382	0.726	0.0	0.0	0.0	1.28	203.8	147.5
S9.000	75.00	4.22	38.650	0.033	0.0	0.0	0.0	1.12	19.9	6.7
S10.000	75.00	4.46	39.100	0.044	0.0	0.0	0.0	1.12	19.9	8.9
S9.001	75.00	4.61	38.463	0.077	0.0	0.0	0.0	1.00	17.8	15.6
S1.007	75.00	6.35	38.074	0.952	0.0	0.0	0.0	1.28	203.8	193.4
S1.008	75.00	7.08	38.007	1.050	0.0	0.0	0.0	0.35	221.9	213.3
S1.009	75.00	7.16	38.005	1.155	0.0	0.0	0.0	1.57	340.3	234.7
S1.010	75.00	7.32	37.965	1.155	0.0	0.0	0.0	1.58	342.1	234.7

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Lion House Oriental Road Woking GU22 8AP	Blue Star Land Residential Development SuDs Basin (FEH)	
Date 24/03/2023 File 200324 BSL FEH.MDX	Designed by IC Checked by RHA	
Micro Drainage		Network 2020.1.3

PIPELINE SCHEDULES for Storm

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
S1.000	o	150	S1.0	41.900	40.500	1.250	Open Manhole	1200
S1.001	o	225	S1.1	41.300	39.875	1.200	Open Manhole	1200
S2.000	o	225	S2.0	40.950	39.750	0.975	Open Manhole	1200
S1.002	o	225	S1.2	41.100	39.607	1.268	Open Manhole	1200
S3.000	o	150	S3.0	43.200	42.000	1.050	Open Manhole	1200
S4.000	o	150	S4.0	43.500	42.300	1.050	Open Manhole	1200
S3.001	o	225	S3.1	43.800	41.032	2.543	Open Manhole	1200
S5.000	o	150	S5.0	41.700	40.300	1.250	Open Manhole	1200
S3.002	o	225	S3.2	42.000	39.999	1.776	Open Manhole	1200
S1.003	o	300	S1.3	41.650	39.275	2.075	Open Manhole	1200
S1.004	o	300	S1.4	40.650	39.094	1.256	Open Manhole	1200
S6.000	o	150	S6.0	42.500	41.100	1.250	Open Manhole	1200

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
S1.000	29.797	54.2	S1.1	41.300	39.950	1.200	Open Manhole	1200
S1.001	17.484	87.4	S1.2	41.100	39.675	1.200	Open Manhole	1200
S2.000	9.320	65.2	S1.2	41.100	39.607	1.268	Open Manhole	1200
S1.002	38.482	150.0	S1.3	41.650	39.350	2.075	Open Manhole	1200
S3.000	23.457	80.0	S3.1	43.800	41.707	1.943	Open Manhole	1200
S4.000	18.829	100.0	S3.1	43.800	42.112	1.538	Open Manhole	1200
S3.001	38.633	80.0	S3.2	42.000	40.549	1.226	Open Manhole	1200
S5.000	18.100	80.1	S3.2	42.000	40.074	1.776	Open Manhole	1200
S3.002	13.244	120.4	S1.3	41.650	39.889	1.536	Open Manhole	1200
S1.003	27.269	150.0	S1.4	40.650	39.094	1.256	Open Manhole	1200
S1.004	10.892	130.0	S1.5	40.500	39.010	1.190	Open Manhole	1350
S6.000	18.109	27.9	S6.1	41.800	40.450	1.200	Open Manhole	1200

Mayer Brown Limited		Page 5
Lion House Oriental Road Woking GU22 8AP	Blue Star Land Residential Development SuDs Basin (FEH)	
Date 24/03/2023 File 200324 BSL FEH.MDX	Designed by IC Checked by RHA	
Micro Drainage		Network 2020.1.3

PIPELINE SCHEDULES for Storm

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
S6.001	o	150	S6.1	41.800	40.450	1.200	Open Manhole	1200
S6.002	o	150	S6.2	41.150	39.800	1.200	Open Manhole	1200
S7.000	o	150	S7.0	41.800	40.400	1.250	Open Manhole	1200
S6.003	o	225	S6.3	41.150	39.399	1.526	Open Manhole	1200
S6.004	o	225	S6.4	40.750	39.000	1.525	Open Manhole	1200
S1.005	o	450	S1.5	40.500	38.442	1.608	Open Manhole	1350
S8.000	o	150	S8.0	40.900	39.700	1.050	Open Manhole	1200
S1.006	o	450	S1.6	40.400	38.382	1.568	Open Manhole	1350
S9.000	o	150	S9.0	40.000	38.650	1.200	Open Manhole	1200
S10.000	o	150	S10.0	40.500	39.100	1.250	Open Manhole	1200
S9.001	o	150	S9.1	40.100	38.463	1.487	Open Manhole	1200
S1.007	o	450	S1.7	40.500	38.074	1.976	Open Manhole	1350

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
S6.001	19.578	30.1	S6.2	41.150	39.800	1.200	Open Manhole	1200
S6.002	14.664	45.0	S6.3	41.150	39.474	1.526	Open Manhole	1200
S7.000	16.052	26.8	S6.3	41.150	39.800	1.200	Open Manhole	1200
S6.003	15.499	50.0	S6.4	40.750	39.089	1.436	Open Manhole	1200
S6.004	16.645	50.0	S1.5	40.500	38.667	1.608	Open Manhole	1350
S1.005	14.988	250.0	S1.6	40.400	38.382	1.568	Open Manhole	1350
S8.000	28.791	58.5	S1.6	40.400	39.208	1.042	Open Manhole	1350
S1.006	21.473	250.0	S1.7	40.500	38.296	1.754	Open Manhole	1350
S9.000	14.971	80.1	S9.1	40.100	38.463	1.487	Open Manhole	1200
S10.000	31.008	80.0	S9.1	40.100	38.712	1.238	Open Manhole	1200
S9.001	8.928	100.0	S1.7	40.500	38.374	1.976	Open Manhole	1350
S1.007	16.611	250.0	SHW1.0 (Pond)	39.500	38.007	1.043	Open Manhole	1800

Mayer Brown Limited		Page 6
Lion House Oriental Road Woking GU22 8AP	Blue Star Land Residential Development SuDs Basin (FEH)	
Date 24/03/2023 File 200324 BSL FEH.MDX	Designed by IC Checked by RHA	
Micro Drainage		Network 2020.1.3

PIPELINE SCHEDULES for Storm

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
S1.008	o	900	SHW1.0 (Pond)	39.500	38.007	0.593	Open Manhole	1800
S1.009	o	525	SHW1.1	39.700	38.005	1.170	Open Manhole	1800
S1.010	o	525	SS1.9 Flow Control	39.700	37.965	1.210	Open Manhole	1500

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
S1.008	15.248	7624.0	SHW1.1	39.700	38.005	0.795	Open Manhole	1800
S1.009	8.081	202.0	SS1.9 Flow Control	39.700	37.965	1.210	Open Manhole	1500
S1.010	15.010	200.0	SHW1.2	39.700	37.890	1.285	Open Manhole	0

Mayer Brown Limited		Page 7
Lion House Oriental Road Woking GU22 8AP	Blue Star Land Residential Development SuDs Basin (FEH)	
Date 24/03/2023 File 200324 BSL FEH.MDX	Designed by IC Checked by RHA	
Micro Drainage		Network 2020.1.3

Area Summary for Storm

Pipe Number	PIMP Type	PIMP Name	PIMP (%)	Gross Area (ha)	Imp. Area (ha)	Pipe Total (ha)
1.000	User	-	100	0.021	0.021	0.021
1.001	User	-	100	0.050	0.050	0.050
2.000	-	-	100	0.044	0.044	0.044
1.002	-	-	100	0.000	0.000	0.000
3.000	User	-	100	0.041	0.041	0.041
4.000	User	-	100	0.027	0.027	0.027
3.001	User	-	100	0.017	0.017	0.017
	User	-	100	0.021	0.021	0.038
5.000	-	-	100	0.000	0.000	0.000
3.002	User	-	100	0.041	0.041	0.041
	User	-	100	0.020	0.020	0.061
1.003	User	-	100	0.019	0.019	0.019
	User	-	100	0.064	0.064	0.083
	User	-	100	0.037	0.037	0.120
1.004	User	-	100	0.039	0.039	0.039
	User	-	100	0.005	0.005	0.044
6.000	User	-	100	0.031	0.031	0.031
6.001	User	-	100	0.025	0.025	0.025
6.002	User	-	100	0.033	0.033	0.033
7.000	User	-	100	0.018	0.018	0.018
6.003	User	-	100	0.045	0.045	0.045
	User	-	100	0.035	0.035	0.080
6.004	-	-	100	0.000	0.000	0.000
1.005	User	-	100	0.017	0.017	0.017
	User	-	100	0.011	0.011	0.028
8.000	-	-	100	0.026	0.026	0.026
1.006	-	-	100	0.040	0.040	0.040
9.000	User	-	100	0.033	0.033	0.033
10.000	-	-	100	0.044	0.044	0.044
9.001	-	-	100	0.000	0.000	0.000
1.007	-	-	100	0.149	0.149	0.149
1.008	-	-	100	0.098	0.098	0.098
1.009	User	-	100	0.105	0.105	0.105
1.010	-	-	100	0.000	0.000	0.000
				Total	Total	Total
				1.155	1.155	1.155

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)
S1.010	SHW1.2	39.700	37.890	37.600	0	0

Mayer Brown Limited		Page 8
Lion House Oriental Road Woking GU22 8AP	Blue Star Land Residential Development SuDs Basin (FEH)	
Date 24/03/2023 File 200324 BSL FEH.MDX	Designed by IC Checked by RHA	
Micro Drainage Network 2020.1.3		
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 Coeffiecient 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 1 Number of Real Time Controls 0 Synthetic Rainfall Details Rainfall Model FEH D1 (1km) 0.461 Summer Storms Yes Return Period (years) 100 D2 (1km) 0.289 Winter Storms No FEH Rainfall Version 1999 D3 (1km) 0.376 Cv (Summer) 0.750 Site Location E (1km) 0.304 Cv (Winter) 0.840 C (1km) -0.027 F (1km) 2.245 Storm Duration (mins) 30		
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Mayer Brown Limited		Page 9
Lion House Oriental Road Woking GU22 8AP	Blue Star Land Residential Development SuDs Basin (FEH)	
Date 24/03/2023 File 200324 BSL FEH.MDX	Designed by IC Checked by RHA	
Micro Drainage	Network 2020.1.3	

Online Controls for Storm

Hydro-Brake® Optimum Manhole: SS1.9 Flow Control, DS/PN: S1.010, Volume (m³): 4.5

Unit Reference	MD-SHE-0125-7500-1200-7500
Design Head (m)	1.200
Design Flow (l/s)	7.5
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	125
Invert Level (m)	37.965
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

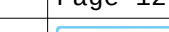
Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.200	7.5
Flush-Flo™	0.356	7.5
Kick-Flo®	0.763	6.1
Mean Flow over Head Range	-	6.5

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)
0.100	4.5	1.200	7.5	3.000	11.5	7.000	17.3
0.200	7.1	1.400	8.1	3.500	12.4	7.500	17.9
0.300	7.5	1.600	8.6	4.000	13.2	8.000	18.4
0.400	7.5	1.800	9.1	4.500	14.0	8.500	19.0
0.500	7.4	2.000	9.5	5.000	14.7	9.000	19.5
0.600	7.1	2.200	10.0	5.500	15.4	9.500	20.0
0.800	6.2	2.400	10.4	6.000	16.1		
1.000	6.9	2.600	10.8	6.500	16.7		

Mayer Brown Limited		Page 10																
Lion House Oriental Road Woking GU22 8AP	Blue Star Land Residential Development SuDs Basin (FEH)																	
Date 24/03/2023 File 200324 BSL FEH.MDX	Designed by IC Checked by RHA																	
Micro Drainage Network 2020.1.3																		
Offline Controls for Storm Pipe Manhole: SHW1.0 (Pond), DS/PN: S1.008, Loop to PN: S1.010 <table><tr><td>Diameter (m)</td><td>0.225</td><td>Roughness k (mm)</td><td>0.600</td></tr><tr><td>Section Type</td><td>Pipe/Conduit</td><td>Entry Loss Coefficient</td><td>0.500</td></tr><tr><td>Slope (1:X)</td><td>100.0</td><td>Coefficient of Contraction</td><td>0.600</td></tr><tr><td>Length (m)</td><td>16.000</td><td>Upstream Invert Level (m)</td><td>39.200</td></tr></table>			Diameter (m)	0.225	Roughness k (mm)	0.600	Section Type	Pipe/Conduit	Entry Loss Coefficient	0.500	Slope (1:X)	100.0	Coefficient of Contraction	0.600	Length (m)	16.000	Upstream Invert Level (m)	39.200
Diameter (m)	0.225	Roughness k (mm)	0.600															
Section Type	Pipe/Conduit	Entry Loss Coefficient	0.500															
Slope (1:X)	100.0	Coefficient of Contraction	0.600															
Length (m)	16.000	Upstream Invert Level (m)	39.200															
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Mayer Brown Limited		Page 11								
Lion House Oriental Road Woking GU22 8AP	Blue Star Land Residential Development SuDs Basin (FEH)									
Date 24/03/2023 File 200324 BSL FEH.MDX	Designed by IC Checked by RHA									
Micro Drainage Network 2020.1.3										
Storage Structures for Storm Tank or Pond Manhole: SHW1.0 (Pond), DS/PN: S1.008 Invert Level (m) 38.007 <table><thead><tr><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>679.0</td><td>1.493</td><td>1124.0</td></tr></tbody></table>			Depth (m)	Area (m²)	Depth (m)	Area (m²)	0.000	679.0	1.493	1124.0
Depth (m)	Area (m²)	Depth (m)	Area (m²)							
0.000	679.0	1.493	1124.0							
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Mayer Brown Limited		Page 12
Lion House Oriental Road Woking GU22 8AP	Blue Star Land Residential Development SuDs Basin (FEH)	
Date 24/03/2023 File 200324 BSL FEH.MDX	Designed by IC Checked by RHA	
Micro Drainage	Network 2020.1.3	

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

Simulation Criteria

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	1	Number of Real Time Controls	0

Synthetic Rainfall Details

Margin for Flood Risk Warning (mm)	300.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	ON
DVD Status	OFF
Inertia Status	OFF

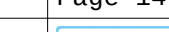
Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320
Return Period(s) (years)	5
Climate Change (%)	0

									Water
PN	US/MH		Return	Climate	First (X)	First (Y)	First (Z)	Overflow	Level
	Name	Storm	Period	Change	Surcharge	Flood	Overflow	Act.	(m)
S1.000	S1.0	15 Winter	5	+0%					40.537
S1.001	S1.1	15 Winter	5	+0%					39.942
S2.000	S2.0	15 Summer	5	+0%					39.804
S1.002	S1.2	15 Winter	5	+0%					39.708
S3.000	S3.0	15 Winter	5	+0%					42.061
S4.000	S4.0	15 Winter	5	+0%					42.352
S3.001	S3.1	15 Winter	5	+0%					41.114
S5.000	S5.0	15 Summer	5	+0%					40.300
S3.002	S3.2	15 Winter	5	+0%					40.122
S1.003	S1.3	15 Winter	5	+0%					39.456
S1.004	S1.4	15 Winter	5	+0%					39.303
S6.000	S6.0	15 Winter	5	+0%					41.140
S6.001	S6.1	15 Winter	5	+0%					40.503
S6.002	S6.2	15 Winter	5	+0%					39.876
S7.000	S7.0	15 Winter	5	+0%					40.430
S6.003	S6.3	15 Winter	5	+0%					39.497
S6.004	S6.4	15 Winter	5	+0%					39.097
S1.005	S1.5	15 Winter	5	+0%					38.684

Mayer Brown Limited		Page 13
Lion House Oriental Road Woking GU22 8AP	Blue Star Land Residential Development SuDs Basin (FEH)	
Date 24/03/2023 File 200324 BSL FEH.MDX	Designed by IC Checked by RHA	
Micro Drainage		Network 2020.1.3

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

PN	US/MH Name	Surcharged		Flooded		Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
		Depth (m)	Volume (m³)	Flow / Cap.	Overflow (l/s)				
S1.000	S1.0	-0.113	0.000	0.14			3.3	OK	
S1.001	S1.1	-0.158	0.000	0.19			9.6	OK	
S2.000	S2.0	-0.171	0.000	0.13			7.0	OK	
S1.002	S1.2	-0.124	0.000	0.41			16.3	OK	
S3.000	S3.0	-0.089	0.000	0.34			6.5	OK	
S4.000	S4.0	-0.098	0.000	0.26			4.3	OK	
S3.001	S3.1	-0.143	0.000	0.28			15.6	OK	
S5.000	S5.0	-0.150	0.000	0.00			0.0	OK	
S3.002	S3.2	-0.102	0.000	0.57			23.4	OK	
S1.003	S1.3	-0.119	0.000	0.67			54.6	OK	
S1.004	S1.4	-0.091	0.000	0.82			59.2	OK	
S6.000	S6.0	-0.110	0.000	0.16			5.0	OK	
S6.001	S6.1	-0.097	0.000	0.27			8.2	OK	
S6.002	S6.2	-0.074	0.000	0.50			12.2	OK	
S7.000	S7.0	-0.120	0.000	0.09			2.8	OK	
S6.003	S6.3	-0.127	0.000	0.39			25.1	OK	
S6.004	S6.4	-0.128	0.000	0.38			25.1	OK	
S1.005	S1.5	-0.208	0.000	0.56			87.1	OK	

Mayer Brown Limited		Page 14
Lion House Oriental Road Woking GU22 8AP	Blue Star Land Residential Development SuDs Basin (FEH)	
Date 24/03/2023 File 200324 BSL FEH.MDX	Designed by IC Checked by RHA	
Micro Drainage	Network 2020.1.3	

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

US/MH			Return	Climate	First (X)	First (Y)	First (Z)
PN	Name	Storm	Period	Change	Surcharge	Flood	Overflow
S8.000	S8.0	15	Winter	5	+0%		
S1.006	S1.6	15	Winter	5	+0%		
S9.000	S9.0	15	Summer	5	+0%		
S10.000	S10.0	15	Winter	5	+0%		
S9.001	S9.1	15	Summer	5	+0%		
S1.007	S1.7	15	Winter	5	+0%		
S1.008	SHW1.0 (Pond)	720	Winter	5	+0%		
S1.009	SHW1.1	720	Winter	5	+0%		
S1.010	SS1.9 Flow Control	720	Winter	5	+0%		
			Water	Surcharged	Flooded		Half Drain
PN	US/MH Name	Overflow Act.	Level (m)	Depth (m)	Volume (m³)	Flow / Cap.	Overflow (l/s)
S8.000	S8.0		39.744	-0.106	0.000	0.19	
S1.006	S1.6		38.628	-0.204	0.000	0.57	
S9.000	S9.0		38.705	-0.095	0.000	0.29	
S10.000	S10.0		39.163	-0.087	0.000	0.37	
S9.001	S9.1		38.564	-0.049	0.000	0.79	
S1.007	S1.7		38.376	-0.148	0.000	0.78	
S1.008	SHW1.0 (Pond)	0	38.313	-0.594	0.000	0.04	0.0
S1.009	SHW1.1		38.316	-0.214	0.000	0.04	
S1.010	SS1.9 Flow Control		38.316	-0.174	0.000	0.03	
			US/MH	Pipe			
	PN		Name	Flow (l/s)	Status	Level Exceeded	
	S8.000			S8.0	4.2	OK	
	S1.006			S1.6	95.6	OK	
	S9.000			S9.0	5.3	OK	
	S10.000			S10.0	7.0	OK	
	S9.001			S9.1	12.3	OK	
	S1.007			S1.7	123.6	OK	
	S1.008		SHW1.0 (Pond)	11.6	OK		
	S1.009		SHW1.1	9.3	OK		
	S1.010		SS1.9 Flow Control	7.5	OK		

Mayer Brown Limited		Page 1
Lion House Oriental Road Woking GU22 8AP	Blue Star Land Residential Development SuDs Basin (FSR)	
Date 24/03/2023 File 200324 BSL FSR.MDX	Designed by IC Checked by RHA	
Micro Drainage		Network 2020.1.3

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Storm

Pipe Sizes STANDARD Manhole Sizes STANDARD

FEH Rainfall Model			
Return Period (years)	100	Maximum Time of Concentration (mins)	20
		Foul Sewage (l/s/ha)	0.000
FEH Rainfall Version	1999	Volumetric Runoff Coeff.	0.750
Site Location		PIMP (%)	100
C (1km)	-0.027	Add Flow / Climate Change (%)	0
D1 (1km)	0.461	Minimum Backdrop Height (m)	0.000
D2 (1km)	0.289	Maximum Backdrop Height (m)	0.000
D3 (1km)	0.376	Min Design Depth for Optimisation (m)	1.200
E (1km)	0.304	Min Vel for Auto Design only (m/s)	1.00
F (1km)	2.245	Min Slope for Optimisation (1:X)	200
Maximum Rainfall (mm/hr)	75		

Designed with Level Soffits

Network Design Table for Storm

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	29.797	0.550	54.2	0.021	4.00	0.0	0.600	o	150	Pipe/Conduit	
S1.001	17.484	0.200	87.4	0.050	0.00	0.0	0.600	o	225	Pipe/Conduit	
S2.000	9.320	0.143	65.2	0.044	4.00	0.0	0.600	o	225	Pipe/Conduit	
S1.002	38.482	0.257	150.0	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
S3.000	23.457	0.293	80.0	0.041	4.00	0.0	0.600	o	150	Pipe/Conduit	
S4.000	18.829	0.188	100.0	0.027	4.00	0.0	0.600	o	150	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S1.000	75.00	4.36	40.500	0.021	0.0	0.0	0.0	1.37	24.2	4.2
S1.001	75.00	4.57	39.875	0.070	0.0	0.0	0.0	1.40	55.6	14.3
S2.000	75.00	4.10	39.750	0.044	0.0	0.0	0.0	1.62	64.5	8.9
S1.002	75.00	5.17	39.607	0.114	0.0	0.0	0.0	1.07	42.4	23.2
S3.000	75.00	4.35	42.000	0.041	0.0	0.0	0.0	1.12	19.9	8.2
S4.000	75.00	4.31	42.300	0.027	0.0	0.0	0.0	1.00	17.8	5.5

Mayer Brown Limited											Page 2		
Lion House Oriental Road Woking GU22 8AP						Blue Star Land Residential Development SuDs Basin (FSR)							
Date 24/03/2023 File 200324 BSL FSR.MDX						Designed by IC Checked by RHA							
Micro Drainage						Network 2020.1.3							
Network Design Table for Storm													
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		
S3.001	38.633	0.483	80.0	0.038	0.00	0.0	0.600	o	225	Pipe/Conduit			
S5.000	18.100	0.226	80.1	0.000	4.00	0.0	0.600	o	150	Pipe/Conduit			
S3.002	13.244	0.110	120.4	0.061	0.00	0.0	0.600	o	225	Pipe/Conduit			
S1.003	27.269	0.182	150.0	0.120	0.00	0.0	0.600	o	300	Pipe/Conduit			
S1.004	10.892	0.084	130.0	0.044	0.00	0.0	0.600	o	300	Pipe/Conduit			
S6.000	18.109	0.650	27.9	0.031	4.00	0.0	0.600	o	150	Pipe/Conduit			
S6.001	19.578	0.650	30.1	0.025	0.00	0.0	0.600	o	150	Pipe/Conduit			
S6.002	14.664	0.326	45.0	0.033	0.00	0.0	0.600	o	150	Pipe/Conduit			
S7.000	16.052	0.600	26.8	0.018	4.00	0.0	0.600	o	150	Pipe/Conduit			
S6.003	15.499	0.310	50.0	0.080	0.00	0.0	0.600	o	225	Pipe/Conduit			
S6.004	16.645	0.333	50.0	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit			
S1.005	14.988	0.060	250.0	0.028	0.00	0.0	0.600	o	450	Pipe/Conduit			
S8.000	28.791	0.492	58.5	0.026	4.00	0.0	0.600	o	150	Pipe/Conduit			
Network Results Table													
PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)			
S3.001	75.00	4.79	41.032	0.106	0.0	0.0	0.0	1.46	58.2	21.5			
S5.000	75.00	4.27	40.300	0.000	0.0	0.0	0.0	1.12	19.9	0.0			
S3.002	75.00	4.97	39.999	0.167	0.0	0.0	0.0	1.19	47.3	34.0			
S1.003	75.00	5.53	39.275	0.402	0.0	0.0	0.0	1.28	90.6	81.6			
S1.004	75.00	5.66	39.094	0.446	0.0	0.0	0.0	1.38	97.4	90.5			
S6.000	75.00	4.16	41.100	0.031	0.0	0.0	0.0	1.91	33.8	6.4			
S6.001	75.00	4.33	40.450	0.056	0.0	0.0	0.0	1.84	32.5	11.4			
S6.002	75.00	4.50	39.800	0.089	0.0	0.0	0.0	1.50	26.6	18.0			
S7.000	75.00	4.14	40.400	0.018	0.0	0.0	0.0	1.95	34.5	3.6			
S6.003	75.00	4.64	39.399	0.186	0.0	0.0	0.0	1.85	73.7	37.8			
S6.004	75.00	4.79	39.000	0.186	0.0	0.0	0.0	1.85	73.7	37.8			
S1.005	75.00	5.85	38.442	0.660	0.0	0.0	0.0	1.28	203.8	134.1			
S8.000	75.00	4.36	39.700	0.026	0.0	0.0	0.0	1.32	23.3	5.3			
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Mayer Brown Limited		Page 4
Lion House Oriental Road Woking GU22 8AP	Blue Star Land Residential Development SuDs Basin (FSR)	
Date 24/03/2023 File 200324 BSL FSR.MDX	Designed by IC Checked by RHA	
Micro Drainage		Network 2020.1.3

Area Summary for Storm

Pipe Number	PIMP Type	PIMP Name	PIMP (%)	Gross Area (ha)	Imp. Area (ha)	Pipe Total (ha)
1.000	User	-	100	0.021	0.021	0.021
1.001	User	-	100	0.050	0.050	0.050
2.000	-	-	100	0.044	0.044	0.044
1.002	-	-	100	0.000	0.000	0.000
3.000	User	-	100	0.041	0.041	0.041
4.000	User	-	100	0.027	0.027	0.027
3.001	User	-	100	0.017	0.017	0.017
	User	-	100	0.021	0.021	0.038
5.000	-	-	100	0.000	0.000	0.000
3.002	User	-	100	0.041	0.041	0.041
	User	-	100	0.020	0.020	0.061
1.003	User	-	100	0.019	0.019	0.019
	User	-	100	0.064	0.064	0.083
	User	-	100	0.037	0.037	0.120
1.004	User	-	100	0.039	0.039	0.039
	User	-	100	0.005	0.005	0.044
6.000	User	-	100	0.031	0.031	0.031
6.001	User	-	100	0.025	0.025	0.025
6.002	User	-	100	0.033	0.033	0.033
7.000	User	-	100	0.018	0.018	0.018
6.003	User	-	100	0.045	0.045	0.045
	User	-	100	0.035	0.035	0.080
6.004	-	-	100	0.000	0.000	0.000
1.005	User	-	100	0.017	0.017	0.017
	User	-	100	0.011	0.011	0.028
8.000	-	-	100	0.026	0.026	0.026
1.006	-	-	100	0.040	0.040	0.040
9.000	User	-	100	0.033	0.033	0.033
10.000	-	-	100	0.044	0.044	0.044
9.001	-	-	100	0.000	0.000	0.000
1.007	-	-	100	0.149	0.149	0.149
1.008	-	-	100	0.098	0.098	0.098
1.009	User	-	100	0.105	0.105	0.105
1.010	-	-	100	0.000	0.000	0.000
				Total	Total	Total
				1.155	1.155	1.155

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)
S1.010	SHW1.2	39.700	37.890	37.600	0	0

Mayer Brown Limited		Page 5
Lion House Oriental Road Woking GU22 8AP	Blue Star Land Residential Development SuDs Basin (FSR)	
Date 24/03/2023 File 200324 BSL FSR.MDX	Designed by IC Checked by RHA	
Micro Drainage Network 2020.1.3		

Simulation Criteria for Storm

Volumetric Runoff Coeff	0.750	Additional Flow - % of Total Flow	0.000
Areal Reduction Factor	1.000	MADD Factor * 10m ³ /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	1	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FEH D1 (1km)	0.461	Summer Storms	Yes	
Return Period (years)	100 D2 (1km)	0.289	Winter Storms	No	
FEH Rainfall Version	1999 D3 (1km)	0.376	Cv (Summer)	0.750	
Site Location	E (1km)	0.304	Cv (Winter)	0.840	
C (1km)	-0.027	F (1km)	2.245	Storm Duration (mins)	30

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Mayer Brown Limited		Page 6
Lion House Oriental Road Woking GU22 8AP	Blue Star Land Residential Development SuDs Basin (FSR)	
Date 24/03/2023 File 200324 BSL FSR.MDX	Designed by IC Checked by RHA	
Micro Drainage	Network 2020.1.3	

Online Controls for Storm

Hydro-Brake® Optimum Manhole: SS1.9 Flow Control, DS/PN: S1.010, Volume (m³): 4.5

Unit Reference	MD-SHE-0111-5900-1200-5900
Design Head (m)	1.200
Design Flow (l/s)	5.9
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	111
Invert Level (m)	37.965
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.200	5.9
Flush-Flo™	0.352	5.9
Kick-Flo®	0.750	4.7
Mean Flow over Head Range	-	5.1

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)
0.100	3.8	1.200	5.9	3.000	9.1	7.000	13.6
0.200	5.6	1.400	6.3	3.500	9.8	7.500	14.0
0.300	5.9	1.600	6.7	4.000	10.4	8.000	14.5
0.400	5.9	1.800	7.1	4.500	11.0	8.500	14.9
0.500	5.8	2.000	7.5	5.000	11.6	9.000	15.3
0.600	5.6	2.200	7.8	5.500	12.1	9.500	15.7
0.800	4.9	2.400	8.2	6.000	12.6		
1.000	5.4	2.600	8.5	6.500	13.1		

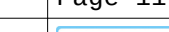
Mayer Brown Limited		Page 7																
Lion House Oriental Road Woking GU22 8AP	Blue Star Land Residential Development SuDs Basin (FSR)																	
Date 24/03/2023	Designed by IC																	
File 200324 BSL FSR.MDX	Checked by RHA																	
Micro Drainage	Network 2020.1.3																	
<u>Offline Controls for Storm</u> <u>Pipe Manhole: SHW1.0 (Pond), DS/PN: S1.008, Loop to PN: S1.010</u> <table><tr><td>Diameter (m)</td><td>0.225</td><td>Roughness k (mm)</td><td>0.600</td></tr><tr><td>Section Type</td><td>Pipe/Conduit</td><td>Entry Loss Coefficient</td><td>0.500</td></tr><tr><td>Slope (1:X)</td><td>100.0</td><td>Coefficient of Contraction</td><td>0.600</td></tr><tr><td>Length (m)</td><td>16.000</td><td>Upstream Invert Level (m)</td><td>39.200</td></tr></table>			Diameter (m)	0.225	Roughness k (mm)	0.600	Section Type	Pipe/Conduit	Entry Loss Coefficient	0.500	Slope (1:X)	100.0	Coefficient of Contraction	0.600	Length (m)	16.000	Upstream Invert Level (m)	39.200
Diameter (m)	0.225	Roughness k (mm)	0.600															
Section Type	Pipe/Conduit	Entry Loss Coefficient	0.500															
Slope (1:X)	100.0	Coefficient of Contraction	0.600															
Length (m)	16.000	Upstream Invert Level (m)	39.200															
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Mayer Brown Limited		Page 8								
Lion House Oriental Road Woking GU22 8AP	Blue Star Land Residential Development SuDs Basin (FSR)									
Date 24/03/2023 File 200324 BSL FSR.MDX	Designed by IC Checked by RHA									
Micro Drainage Network 2020.1.3										
<u>Storage Structures for Storm</u> <u>Tank or Pond Manhole: SHW1.1, DS/PN: S1.009</u> Invert Level (m) 38.007 <table><tr><th>Depth (m)</th><th>Area (m²)</th><th>Depth (m)</th><th>Area (m²)</th></tr><tr><td>0.000</td><td>679.0</td><td>1.693</td><td>1259.0</td></tr></table>			Depth (m)	Area (m²)	Depth (m)	Area (m²)	0.000	679.0	1.693	1259.0
Depth (m)	Area (m²)	Depth (m)	Area (m²)							
0.000	679.0	1.693	1259.0							
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Mayer Brown Limited		Page 10
Lion House Oriental Road Woking GU22 8AP	Blue Star Land Residential Development SuDs Basin (FSR)	
Date 24/03/2023 File 200324 BSL FSR.MDX	Designed by IC Checked by RHA	
Micro Drainage		Network 2020.1.3

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

PN	US/MH Name	Surcharged		Flooded		Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
		Depth (m)	Volume (m³)	Flow / Cap.	Overflow (l/s)				
S1.000	S1.0	-0.104	0.000	0.20			4.7	OK	
S1.001	S1.1	-0.144	0.000	0.28			13.8	OK	
S2.000	S2.0	-0.159	0.000	0.19			10.2	OK	
S1.002	S1.2	-0.099	0.000	0.59			23.5	OK	
S3.000	S3.0	-0.075	0.000	0.50			9.4	OK	
S4.000	S4.0	-0.087	0.000	0.37			6.2	OK	
S3.001	S3.1	-0.125	0.000	0.41			22.4	OK	
S5.000	S5.0	-0.150	0.000	0.00			0.0	OK	
S3.002	S3.2	-0.068	0.000	0.82			33.7	OK	
S1.003	S1.3	-0.012	0.000	0.92			75.2	OK	
S1.004	S1.4	0.010	0.000	1.14			82.5	SURCHARGED	
S6.000	S6.0	-0.102	0.000	0.23			7.2	OK	
S6.001	S6.1	-0.085	0.000	0.39			11.8	OK	
S6.002	S6.2	-0.055	0.000	0.72			17.7	OK	
S7.000	S7.0	-0.115	0.000	0.13			4.1	OK	
S6.003	S6.3	-0.104	0.000	0.56			36.2	OK	
S6.004	S6.4	-0.104	0.000	0.55			36.2	OK	
S1.005	S1.5	-0.149	0.000	0.78			120.9	OK	
S8.000	S8.0	-0.097	0.000	0.27			6.0	OK	

Mayer Brown Limited		Page 11
Lion House Oriental Road Woking GU22 8AP	Blue Star Land Residential Development SuDs Basin (FSR)	
Date 24/03/2023 File 200324 BSL FSR.MDX	Designed by IC Checked by RHA	
Micro Drainage	Network 2020.1.3	

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

US/MH			Return	Climate	First (X)	First (Y)	First (Z)
PN	Name	Storm	Period	Change	Surcharge	Flood	Overflow
S1.006	S1.6	15	Winter	5	+0%		
S9.000	S9.0	15	Summer	5	+0%		
S10.000	S10.0	15	Winter	5	+0%		
S9.001	S9.1	15	Winter	5	+0%	5/15	Summer
S1.007	S1.7	15	Winter	5	+0%	5/15	Summer
S1.008	SHW1.0 (Pond)	15	Winter	5	+0%		
S1.009	SHW1.1	480	Winter	5	+0%		
S1.010	SS1.9 Flow Control	240	Winter	5	+0%		

US/MH		Water	Surcharged	Flooded	Half Drain		
PN	Name	Overflow	Level	Depth	Volume	Flow /	Overflow
		Act.	(m)	(m)	(m³)	Cap.	(l/s)
S1.006	S1.6		38.686	-0.146	0.000	0.79	
S9.000	S9.0		38.717	-0.083	0.000	0.42	
S10.000	S10.0		39.178	-0.072	0.000	0.53	
S9.001	S9.1		38.662	0.049	0.000	1.04	
S1.007	S1.7		38.587	0.063	0.000	1.06	
S1.008	SHW1.0 (Pond)	0	38.507	-0.400	0.000	0.66	0.0
S1.009	SHW1.1		38.326	-0.204	0.000	0.05	
S1.010	SS1.9 Flow Control		38.418	-0.072	0.000	0.02	

PN	US/MH Name	Pipe Flow (l/s)	Status	Level Exceeded
S1.006		S1.6 131.7		OK
S9.000		S9.0 7.6		OK
S10.000		S10.0 10.1		OK
S9.001		S9.1 16.2	SURCHARGED	
S1.007		S1.7 168.6	SURCHARGED	
S1.008	SHW1.0 (Pond)	183.5		OK
S1.009	SHW1.1	10.2		OK
S1.010	SS1.9 Flow Control	5.9		OK

Mayer Brown Limited		Page 1
Lion House Oriental Road Woking GU22 8AP	Blue Star Land Residential Development SuDs Basin (FEH)	
Date 24/03/2023 File 200324 BSL FEH.MDX	Designed by IC Checked by RHA	
Micro Drainage Network 2020.1.3		

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Storm

Pipe Sizes STANDARD Manhole Sizes STANDARD

FEH Rainfall Model			
Return Period (years)	100	Maximum Time of Concentration (mins)	20
		Foul Sewage (l/s/ha)	0.000
FEH Rainfall Version	1999	Volumetric Runoff Coeff.	0.750
Site Location		PIMP (%)	100
C (1km)	-0.027	Add Flow / Climate Change (%)	0
D1 (1km)	0.461	Minimum Backdrop Height (m)	0.000
D2 (1km)	0.289	Maximum Backdrop Height (m)	0.000
D3 (1km)	0.376	Min Design Depth for Optimisation (m)	1.200
E (1km)	0.304	Min Vel for Auto Design only (m/s)	1.00
F (1km)	2.245	Min Slope for Optimisation (1:X)	200
Maximum Rainfall (mm/hr)	75		

Designed with Level Soffits

Network Design Table for Storm

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	29.797	0.550	54.2	0.021	4.00	0.0	0.600	o	150	Pipe/Conduit	
S1.001	17.484	0.200	87.4	0.050	0.00	0.0	0.600	o	225	Pipe/Conduit	
S2.000	9.320	0.143	65.2	0.044	4.00	0.0	0.600	o	225	Pipe/Conduit	
S1.002	38.482	0.257	150.0	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
S3.000	23.457	0.293	80.0	0.041	4.00	0.0	0.600	o	150	Pipe/Conduit	
S4.000	18.829	0.188	100.0	0.027	4.00	0.0	0.600	o	150	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S1.000	75.00	4.36	40.500	0.021	0.0	0.0	0.0	1.37	24.2	4.2
S1.001	75.00	4.57	39.875	0.070	0.0	0.0	0.0	1.40	55.6	14.3
S2.000	75.00	4.10	39.750	0.044	0.0	0.0	0.0	1.62	64.5	8.9
S1.002	75.00	5.17	39.607	0.114	0.0	0.0	0.0	1.07	42.4	23.2
S3.000	75.00	4.35	42.000	0.041	0.0	0.0	0.0	1.12	19.9	8.2
S4.000	75.00	4.31	42.300	0.027	0.0	0.0	0.0	1.00	17.8	5.5

Mayer Brown Limited		Page 4
Lion House Oriental Road Woking GU22 8AP	Blue Star Land Residential Development SuDs Basin (FEH)	
Date 24/03/2023 File 200324 BSL FEH.MDX	Designed by IC Checked by RHA	
Micro Drainage		Network 2020.1.3

Area Summary for Storm

Pipe Number	PIMP Type	PIMP Name	PIMP (%)	Gross Area (ha)	Imp. Area (ha)	Pipe Total (ha)
1.000	User	-	100	0.021	0.021	0.021
1.001	User	-	100	0.050	0.050	0.050
2.000	-	-	100	0.044	0.044	0.044
1.002	-	-	100	0.000	0.000	0.000
3.000	User	-	100	0.041	0.041	0.041
4.000	User	-	100	0.027	0.027	0.027
3.001	User	-	100	0.017	0.017	0.017
	User	-	100	0.021	0.021	0.038
5.000	-	-	100	0.000	0.000	0.000
3.002	User	-	100	0.041	0.041	0.041
	User	-	100	0.020	0.020	0.061
1.003	User	-	100	0.019	0.019	0.019
	User	-	100	0.064	0.064	0.083
	User	-	100	0.037	0.037	0.120
1.004	User	-	100	0.039	0.039	0.039
	User	-	100	0.005	0.005	0.044
6.000	User	-	100	0.031	0.031	0.031
6.001	User	-	100	0.025	0.025	0.025
6.002	User	-	100	0.033	0.033	0.033
7.000	User	-	100	0.018	0.018	0.018
6.003	User	-	100	0.045	0.045	0.045
	User	-	100	0.035	0.035	0.080
6.004	-	-	100	0.000	0.000	0.000
1.005	User	-	100	0.017	0.017	0.017
	User	-	100	0.011	0.011	0.028
8.000	-	-	100	0.026	0.026	0.026
1.006	-	-	100	0.040	0.040	0.040
9.000	User	-	100	0.033	0.033	0.033
10.000	-	-	100	0.044	0.044	0.044
9.001	-	-	100	0.000	0.000	0.000
1.007	-	-	100	0.149	0.149	0.149
1.008	-	-	100	0.098	0.098	0.098
1.009	User	-	100	0.105	0.105	0.105
1.010	-	-	100	0.000	0.000	0.000
				Total	Total	Total
				1.155	1.155	1.155

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)
S1.010	SHW1.2	39.700	37.890	37.600	0	0

Mayer Brown Limited		Page 5
Lion House Oriental Road Woking GU22 8AP	Blue Star Land Residential Development SuDs Basin (FEH)	
Date 24/03/2023 File 200324 BSL FEH.MDX	Designed by IC Checked by RHA	
Micro Drainage		Network 2020.1.3
<u>Simulation Criteria for Storm</u> 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 1 Number of Real Time Controls 0 <u>Synthetic Rainfall Details</u> Rainfall Model FEH D1 (1km) 0.461 Summer Storms Yes Return Period (years) 100 D2 (1km) 0.289 Winter Storms No FEH Rainfall Version 1999 D3 (1km) 0.376 Cv (Summer) 0.750 Site Location E (1km) 0.304 Cv (Winter) 0.840 C (1km) -0.027 F (1km) 2.245 Storm Duration (mins) 30		
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Mayer Brown Limited		Page 6
Lion House Oriental Road Woking GU22 8AP	Blue Star Land Residential Development SuDs Basin (FEH)	
Date 24/03/2023 File 200324 BSL FEH.MDX	Designed by IC Checked by RHA	
Micro Drainage	Network 2020.1.3	

Online Controls for Storm

Hydro-Brake® Optimum Manhole: SS1.9 Flow Control, DS/PN: S1.010, Volume (m³): 4.5

Unit Reference	MD-SHE-0111-5900-1200-5900
Design Head (m)	1.200
Design Flow (l/s)	5.9
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	111
Invert Level (m)	37.965
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.200	5.9
Flush-Flo™	0.352	5.9
Kick-Flo®	0.750	4.7
Mean Flow over Head Range	-	5.1

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)
0.100	3.8	1.200	5.9	3.000	9.1	7.000	13.6
0.200	5.6	1.400	6.3	3.500	9.8	7.500	14.0
0.300	5.9	1.600	6.7	4.000	10.4	8.000	14.5
0.400	5.9	1.800	7.1	4.500	11.0	8.500	14.9
0.500	5.8	2.000	7.5	5.000	11.6	9.000	15.3
0.600	5.6	2.200	7.8	5.500	12.1	9.500	15.7
0.800	4.9	2.400	8.2	6.000	12.6		
1.000	5.4	2.600	8.5	6.500	13.1		

Mayer Brown Limited		Page 7																
Lion House Oriental Road Woking GU22 8AP	Blue Star Land Residential Development SuDs Basin (FEH)																	
Date 24/03/2023	Designed by IC																	
File 200324 BSL FEH.MDX	Checked by RHA																	
Micro Drainage	Network 2020.1.3																	
Offline Controls for Storm Pipe Manhole: SHW1.0 (Pond), DS/PN: S1.008, Loop to PN: S1.010 <table><tr><td>Diameter (m)</td><td>0.225</td><td>Roughness k (mm)</td><td>0.600</td></tr><tr><td>Section Type</td><td>Pipe/Conduit</td><td>Entry Loss Coefficient</td><td>0.500</td></tr><tr><td>Slope (1:X)</td><td>100.0</td><td>Coefficient of Contraction</td><td>0.600</td></tr><tr><td>Length (m)</td><td>16.000</td><td>Upstream Invert Level (m)</td><td>39.200</td></tr></table>			Diameter (m)	0.225	Roughness k (mm)	0.600	Section Type	Pipe/Conduit	Entry Loss Coefficient	0.500	Slope (1:X)	100.0	Coefficient of Contraction	0.600	Length (m)	16.000	Upstream Invert Level (m)	39.200
Diameter (m)	0.225	Roughness k (mm)	0.600															
Section Type	Pipe/Conduit	Entry Loss Coefficient	0.500															
Slope (1:X)	100.0	Coefficient of Contraction	0.600															
Length (m)	16.000	Upstream Invert Level (m)	39.200															
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Mayer Brown Limited		Page 8								
Lion House Oriental Road Woking GU22 8AP	Blue Star Land Residential Development SuDs Basin (FEH)									
Date 24/03/2023 File 200324 BSL FEH.MDX	Designed by IC Checked by RHA									
Micro Drainage Network 2020.1.3										
Storage Structures for Storm Tank or Pond Manhole: SHW1.0 (Pond), DS/PN: S1.008 Invert Level (m) 38.007 <table><thead><tr><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>679.0</td><td>1.493</td><td>1124.0</td></tr></tbody></table>			Depth (m)	Area (m²)	Depth (m)	Area (m²)	0.000	679.0	1.493	1124.0
Depth (m)	Area (m²)	Depth (m)	Area (m²)							
0.000	679.0	1.493	1124.0							
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Lion House

Oriental Road

Woking GU22 8AP

Date 24/03/2023

File 200324 BSL FEH.MDX

Micro Drainage

Blue Star Land

Residential Development

SuDs Basin (FEH)

Designed by IC

Checked by RHA

Network 2020.1.3

Page 9



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 Storage Structures	1
Number of Online Controls	1	Number of Time/Area Diagrams	0
Number of Offline Controls	1	Number of Real Time Controls	0
Synthetic Rainfall Details			
Rainfall Model	FEH D1 (1km) 0.461	F (1km)	2.245
FEH Rainfall Version	1999 D2 (1km) 0.289	Cv (Summer)	0.750
Site Location	D3 (1km) 0.376	Cv (Winter)	0.840
C (1km)	-0.027	E (1km)	0.304
Margin for Flood Risk Warning (mm)			300.0
Analysis Timestep	2.5 Second	Increment (Extended)	
DTS Status			ON
DVD Status			OFF
Inertia Status			OFF
Profile(s)		Summer and Winter	
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320		
Return Period(s) (years)			30
Climate Change (%)			40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
S1.000	S1.0	15 Winter	30	+40%					40.564
S1.001	S1.1	15 Winter	30	+40%	30/15 Summer				40.451
S2.000	S2.0	15 Winter	30	+40%	30/15 Summer				40.424
S1.002	S1.2	15 Winter	30	+40%	30/15 Summer				40.406
S3.000	S3.0	15 Winter	30	+40%					42.112
S4.000	S4.0	15 Winter	30	+40%					42.392
S3.001	S3.1	15 Winter	30	+40%					41.188
S5.000	S5.0	15 Winter	30	+40%	30/15 Winter				40.464
S3.002	S3.2	15 Winter	30	+40%	30/15 Summer				40.465
S1.003	S1.3	15 Winter	30	+40%	30/15 Summer				40.205
S1.004	S1.4	15 Winter	30	+40%	30/15 Summer				39.674
S6.000	S6.0	15 Winter	30	+40%					41.168
S6.001	S6.1	15 Winter	30	+40%	30/15 Summer				40.631
S6.002	S6.2	15 Winter	30	+40%	30/15 Summer				40.341
S7.000	S7.0	15 Winter	30	+40%					40.449
S6.003	S6.3	15 Winter	30	+40%	30/15 Summer				39.784
S6.004	S6.4	15 Winter	30	+40%	30/15 Summer				39.462
S1.005	S1.5	15 Winter	30	+40%	30/15 Summer				39.131

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Mayer Brown Limited		Page 10
Lion House Oriental Road Woking GU22 8AP	Blue Star Land Residential Development SuDs Basin (FEH)	
Date 24/03/2023 File 200324 BSL FEH.MDX	Designed by IC Checked by RHA	
Micro Drainage		Network 2020.1.3

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

PN	US/MH Name	Surcharged		Flooded		Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
		Depth (m)	Volume (m³)	Flow / Cap.	Overflow (l/s)				
S1.000	S1.0	-0.086	0.000	0.38			8.7	OK	
S1.001	S1.1	0.351	0.000	0.46			22.9	SURCHARGED	
S2.000	S2.0	0.449	0.000	0.26			13.9	SURCHARGED	
S1.002	S1.2	0.574	0.000	1.01			40.7	SURCHARGED	
S3.000	S3.0	-0.038	0.000	0.92			17.3	OK	
S4.000	S4.0	-0.058	0.000	0.69			11.5	OK	
S3.001	S3.1	-0.069	0.000	0.82			45.0	OK	
S5.000	S5.0	0.014	0.000	0.10			1.8	SURCHARGED	
S3.002	S3.2	0.241	0.000	1.63			67.0	SURCHARGED	
S1.003	S1.3	0.629	0.000	1.68			136.8	SURCHARGED	
S1.004	S1.4	0.280	0.000	2.10			151.9	SURCHARGED	
S6.000	S6.0	-0.082	0.000	0.42			13.4	OK	
S6.001	S6.1	0.031	0.000	0.73			22.5	SURCHARGED	
S6.002	S6.2	0.391	0.000	1.31			32.2	SURCHARGED	
S7.000	S7.0	-0.101	0.000	0.24			7.6	OK	
S6.003	S6.3	0.160	0.000	1.06			68.8	SURCHARGED	
S6.004	S6.4	0.237	0.000	1.01			66.0	SURCHARGED	
S1.005	S1.5	0.239	0.000	1.46			227.9	SURCHARGED	

Mayer Brown Limited		Page 1
Lion House Oriental Road Woking GU22 8AP	Blue Star Land Residential Development SuDs Basin (FSR)	
Date 24/03/2023 File 200324 BSL FSR.MDX	Designed by IC Checked by RHA	
Micro Drainage		Network 2020.1.3

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Storm

Pipe Sizes STANDARD Manhole Sizes STANDARD

FEH Rainfall Model			
Return Period (years)	100	Maximum Time of Concentration (mins)	20
		Foul Sewage (l/s/ha)	0.000
FEH Rainfall Version	1999	Volumetric Runoff Coeff.	0.750
Site Location		PIMP (%)	100
C (1km)	-0.027	Add Flow / Climate Change (%)	0
D1 (1km)	0.461	Minimum Backdrop Height (m)	0.000
D2 (1km)	0.289	Maximum Backdrop Height (m)	0.000
D3 (1km)	0.376	Min Design Depth for Optimisation (m)	1.200
E (1km)	0.304	Min Vel for Auto Design only (m/s)	1.00
F (1km)	2.245	Min Slope for Optimisation (1:X)	200
Maximum Rainfall (mm/hr)	75		

Designed with Level Soffits

Network Design Table for Storm

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	29.797	0.550	54.2	0.021	4.00	0.0	0.600	o	150	Pipe/Conduit	
S1.001	17.484	0.200	87.4	0.050	0.00	0.0	0.600	o	225	Pipe/Conduit	
S2.000	9.320	0.143	65.2	0.044	4.00	0.0	0.600	o	225	Pipe/Conduit	
S1.002	38.482	0.257	150.0	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
S3.000	23.457	0.293	80.0	0.041	4.00	0.0	0.600	o	150	Pipe/Conduit	
S4.000	18.829	0.188	100.0	0.027	4.00	0.0	0.600	o	150	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S1.000	75.00	4.36	40.500	0.021	0.0	0.0	0.0	1.37	24.2	4.2
S1.001	75.00	4.57	39.875	0.070	0.0	0.0	0.0	1.40	55.6	14.3
S2.000	75.00	4.10	39.750	0.044	0.0	0.0	0.0	1.62	64.5	8.9
S1.002	75.00	5.17	39.607	0.114	0.0	0.0	0.0	1.07	42.4	23.2
S3.000	75.00	4.35	42.000	0.041	0.0	0.0	0.0	1.12	19.9	8.2
S4.000	75.00	4.31	42.300	0.027	0.0	0.0	0.0	1.00	17.8	5.5

Mayer Brown Limited											Page 2		
Lion House Oriental Road Woking GU22 8AP						Blue Star Land Residential Development SuDs Basin (FSR)							
Date 24/03/2023 File 200324 BSL FSR.MDX						Designed by IC Checked by RHA							
Micro Drainage						Network 2020.1.3							
Network Design Table for Storm													
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		
S3.001	38.633	0.483	80.0	0.038	0.00	0.0	0.600	o	225	Pipe/Conduit			
S5.000	18.100	0.226	80.1	0.000	4.00	0.0	0.600	o	150	Pipe/Conduit			
S3.002	13.244	0.110	120.4	0.061	0.00	0.0	0.600	o	225	Pipe/Conduit			
S1.003	27.269	0.182	150.0	0.120	0.00	0.0	0.600	o	300	Pipe/Conduit			
S1.004	10.892	0.084	130.0	0.044	0.00	0.0	0.600	o	300	Pipe/Conduit			
S6.000	18.109	0.650	27.9	0.031	4.00	0.0	0.600	o	150	Pipe/Conduit			
S6.001	19.578	0.650	30.1	0.025	0.00	0.0	0.600	o	150	Pipe/Conduit			
S6.002	14.664	0.326	45.0	0.033	0.00	0.0	0.600	o	150	Pipe/Conduit			
S7.000	16.052	0.600	26.8	0.018	4.00	0.0	0.600	o	150	Pipe/Conduit			
S6.003	15.499	0.310	50.0	0.080	0.00	0.0	0.600	o	225	Pipe/Conduit			
S6.004	16.645	0.333	50.0	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit			
S1.005	14.988	0.060	250.0	0.028	0.00	0.0	0.600	o	450	Pipe/Conduit			
S8.000	28.791	0.492	58.5	0.026	4.00	0.0	0.600	o	150	Pipe/Conduit			
Network Results Table													
PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)			
S3.001	75.00	4.79	41.032	0.106		0.0	0.0	0.0	1.46	58.2	21.5		
S5.000	75.00	4.27	40.300	0.000		0.0	0.0	0.0	1.12	19.9	0.0		
S3.002	75.00	4.97	39.999	0.167		0.0	0.0	0.0	1.19	47.3	34.0		
S1.003	75.00	5.53	39.275	0.402		0.0	0.0	0.0	1.28	90.6	81.6		
S1.004	75.00	5.66	39.094	0.446		0.0	0.0	0.0	1.38	97.4	90.5		
S6.000	75.00	4.16	41.100	0.031		0.0	0.0	0.0	1.91	33.8	6.4		
S6.001	75.00	4.33	40.450	0.056		0.0	0.0	0.0	1.84	32.5	11.4		
S6.002	75.00	4.50	39.800	0.089		0.0	0.0	0.0	1.50	26.6	18.0		
S7.000	75.00	4.14	40.400	0.018		0.0	0.0	0.0	1.95	34.5	3.6		
S6.003	75.00	4.64	39.399	0.186		0.0	0.0	0.0	1.85	73.7	37.8		
S6.004	75.00	4.79	39.000	0.186		0.0	0.0	0.0	1.85	73.7	37.8		
S1.005	75.00	5.85	38.442	0.660		0.0	0.0	0.0	1.28	203.8	134.1		
S8.000	75.00	4.36	39.700	0.026		0.0	0.0	0.0	1.32	23.3	5.3		
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Mayer Brown Limited		Page 4
Lion House Oriental Road Woking GU22 8AP	Blue Star Land Residential Development SuDs Basin (FSR)	
Date 24/03/2023 File 200324 BSL FSR.MDX	Designed by IC Checked by RHA	
Micro Drainage		Network 2020.1.3

Area Summary for Storm

Pipe Number	PIMP Type	PIMP Name	PIMP (%)	Gross Area (ha)	Imp. Area (ha)	Pipe Total (ha)
1.000	User	-	100	0.021	0.021	0.021
1.001	User	-	100	0.050	0.050	0.050
2.000	-	-	100	0.044	0.044	0.044
1.002	-	-	100	0.000	0.000	0.000
3.000	User	-	100	0.041	0.041	0.041
4.000	User	-	100	0.027	0.027	0.027
3.001	User	-	100	0.017	0.017	0.017
	User	-	100	0.021	0.021	0.038
5.000	-	-	100	0.000	0.000	0.000
3.002	User	-	100	0.041	0.041	0.041
	User	-	100	0.020	0.020	0.061
1.003	User	-	100	0.019	0.019	0.019
	User	-	100	0.064	0.064	0.083
	User	-	100	0.037	0.037	0.120
1.004	User	-	100	0.039	0.039	0.039
	User	-	100	0.005	0.005	0.044
6.000	User	-	100	0.031	0.031	0.031
6.001	User	-	100	0.025	0.025	0.025
6.002	User	-	100	0.033	0.033	0.033
7.000	User	-	100	0.018	0.018	0.018
6.003	User	-	100	0.045	0.045	0.045
	User	-	100	0.035	0.035	0.080
6.004	-	-	100	0.000	0.000	0.000
1.005	User	-	100	0.017	0.017	0.017
	User	-	100	0.011	0.011	0.028
8.000	-	-	100	0.026	0.026	0.026
1.006	-	-	100	0.040	0.040	0.040
9.000	User	-	100	0.033	0.033	0.033
10.000	-	-	100	0.044	0.044	0.044
9.001	-	-	100	0.000	0.000	0.000
1.007	-	-	100	0.149	0.149	0.149
1.008	-	-	100	0.098	0.098	0.098
1.009	User	-	100	0.105	0.105	0.105
1.010	-	-	100	0.000	0.000	0.000
				Total	Total	Total
				1.155	1.155	1.155

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)
S1.010	SHW1.2	39.700	37.890	37.600	0	0

Mayer Brown Limited		Page 5
Lion House Oriental Road Woking GU22 8AP	Blue Star Land Residential Development SuDs Basin (FSR)	
Date 24/03/2023 File 200324 BSL FSR.MDX	Designed by IC Checked by RHA	
Micro Drainage Network 2020.1.3		

Simulation Criteria for Storm

Volumetric Runoff Coeff	0.750	Additional Flow - % of Total Flow	0.000
Areal Reduction Factor	1.000	MADD Factor * 10m ³ /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	1	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FEH D1 (1km)	0.461	Summer Storms	Yes	
Return Period (years)	100 D2 (1km)	0.289	Winter Storms	No	
FEH Rainfall Version	1999 D3 (1km)	0.376	Cv (Summer)	0.750	
Site Location	E (1km)	0.304	Cv (Winter)	0.840	
C (1km)	-0.027	F (1km)	2.245	Storm Duration (mins)	30

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Mayer Brown Limited		Page 6
Lion House Oriental Road Woking GU22 8AP	Blue Star Land Residential Development SuDs Basin (FSR)	
Date 24/03/2023 File 200324 BSL FSR.MDX	Designed by IC Checked by RHA	
Micro Drainage	Network 2020.1.3	

Online Controls for Storm

Hydro-Brake® Optimum Manhole: SS1.9 Flow Control, DS/PN: S1.010, Volume (m³): 4.5

Unit Reference	MD-SHE-0111-5900-1200-5900
Design Head (m)	1.200
Design Flow (l/s)	5.9
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	111
Invert Level (m)	37.965
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.200	5.9
Flush-Flo™	0.352	5.9
Kick-Flo®	0.750	4.7
Mean Flow over Head Range	-	5.1

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)
0.100	3.8	1.200	5.9	3.000	9.1	7.000	13.6
0.200	5.6	1.400	6.3	3.500	9.8	7.500	14.0
0.300	5.9	1.600	6.7	4.000	10.4	8.000	14.5
0.400	5.9	1.800	7.1	4.500	11.0	8.500	14.9
0.500	5.8	2.000	7.5	5.000	11.6	9.000	15.3
0.600	5.6	2.200	7.8	5.500	12.1	9.500	15.7
0.800	4.9	2.400	8.2	6.000	12.6		
1.000	5.4	2.600	8.5	6.500	13.1		

Mayer Brown Limited		Page 7																
Lion House Oriental Road Woking GU22 8AP	Blue Star Land Residential Development SuDs Basin (FSR)																	
Date 24/03/2023 File 200324 BSL FSR.MDX	Designed by IC Checked by RHA																	
Micro Drainage Network 2020.1.3																		
<u>Offline Controls for Storm</u> <u>Pipe Manhole: SHW1.0 (Pond), DS/PN: S1.008, Loop to PN: S1.010</u> <table><tr><td>Diameter (m)</td><td>0.225</td><td>Roughness k (mm)</td><td>0.600</td></tr><tr><td>Section Type</td><td>Pipe/Conduit</td><td>Entry Loss Coefficient</td><td>0.500</td></tr><tr><td>Slope (1:X)</td><td>100.0</td><td>Coefficient of Contraction</td><td>0.600</td></tr><tr><td>Length (m)</td><td>16.000</td><td>Upstream Invert Level (m)</td><td>39.200</td></tr></table>			Diameter (m)	0.225	Roughness k (mm)	0.600	Section Type	Pipe/Conduit	Entry Loss Coefficient	0.500	Slope (1:X)	100.0	Coefficient of Contraction	0.600	Length (m)	16.000	Upstream Invert Level (m)	39.200
Diameter (m)	0.225	Roughness k (mm)	0.600															
Section Type	Pipe/Conduit	Entry Loss Coefficient	0.500															
Slope (1:X)	100.0	Coefficient of Contraction	0.600															
Length (m)	16.000	Upstream Invert Level (m)	39.200															
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Mayer Brown Limited		Page 8
Lion House Oriental Road Woking GU22 8AP	Blue Star Land Residential Development SuDs Basin (FSR)	
Date 24/03/2023 File 200324 BSL FSR.MDX	Designed by IC Checked by RHA	
Micro Drainage	Network 2020.1.3	
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Lion House

Oriental Road

Woking GU22 8AP

Date 24/03/2023

File 200324 BSL FSR.MDX

Blue Star Land

Residential Development

SuDs Basin (FSR)

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Micro Drainage

Network 2020.1.3

Page 9



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 Storage Structures 1

Number of Online Controls 1

Number of Time/Area Diagrams 0

Number of Offline Controls 1

Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FSR

Ratio R 0.350

Region England and Wales Cv (Summer) 0.750

M5-60 (mm) 19.400 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0

Analysis Timestep 2.5 Second Increment (Extended)

DTS Status ON

DVD Status OFF

Inertia Status OFF

Profile(s) Summer and Winter

Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320

Return Period(s) (years) 30

Climate Change (%) 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
S1.000	S1.0	15 Winter	30	+40%	30/15 Winter				40.709
S1.001	S1.1	15 Winter	30	+40%	30/15 Summer				40.675
S2.000	S2.0	15 Winter	30	+40%	30/15 Summer				40.650
S1.002	S1.2	15 Winter	30	+40%	30/15 Summer				40.632
S3.000	S3.0	15 Winter	30	+40%					42.139
S4.000	S4.0	15 Winter	30	+40%					42.399
S3.001	S3.1	15 Winter	30	+40%					41.199
S5.000	S5.0	15 Winter	30	+40%	30/15 Summer				40.710
S3.002	S3.2	15 Winter	30	+40%	30/15 Summer				40.720
S1.003	S1.3	15 Winter	30	+40%	30/15 Summer				40.443
S1.004	S1.4	15 Winter	30	+40%	30/15 Summer				39.878
S6.000	S6.0	15 Winter	30	+40%					41.172
S6.001	S6.1	15 Winter	30	+40%	30/15 Summer				40.887
S6.002	S6.2	15 Winter	30	+40%	30/15 Summer				40.621
S7.000	S7.0	15 Winter	30	+40%					40.452
S6.003	S6.3	15 Winter	30	+40%	30/15 Summer				40.123
S6.004	S6.4	15 Winter	30	+40%	30/15 Summer				39.802
S1.005	S1.5	15 Winter	30	+40%	30/15 Summer				39.476
S8.000	S8.0	15 Winter	30	+40%					39.780

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Mayer Brown Limited		Page 10
Lion House Oriental Road Woking GU22 8AP	Blue Star Land Residential Development SuDs Basin (FSR)	
Date 24/03/2023 File 200324 BSL FSR.MDX	Designed by IC Checked by RHA	
Micro Drainage		Network 2020.1.3

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

PN	US/MH Name	Surcharged	Flooded	Flow / Cap.	Overflow (l/s)	Half Drain	Pipe	Status	Level Exceeded
		Depth (m)	Volume (m³)			Time (mins)	Flow (l/s)		
S1.000	S1.0	0.059	0.000	0.41			9.6	SURCHARGED	
S1.001	S1.1	0.575	0.000	0.51			25.4	SURCHARGED	
S2.000	S2.0	0.675	0.000	0.28			14.8	SURCHARGED	
S1.002	S1.2	0.800	0.000	1.10			44.3	SURCHARGED	
S3.000	S3.0	-0.011	0.000	1.00			18.9	OK	
S4.000	S4.0	-0.051	0.000	0.77			12.8	OK	
S3.001	S3.1	-0.058	0.000	0.90			49.7	OK	
S5.000	S5.0	0.260	0.000	0.26			4.9	SURCHARGED	
S3.002	S3.2	0.496	0.000	1.67			68.5	SURCHARGED	
S1.003	S1.3	0.868	0.000	1.74			142.1	SURCHARGED	
S1.004	S1.4	0.485	0.000	2.18			157.9	SURCHARGED	
S6.000	S6.0	-0.078	0.000	0.47			14.9	OK	
S6.001	S6.1	0.287	0.000	0.75			22.9	SURCHARGED	
S6.002	S6.2	0.671	0.000	1.30			31.7	SURCHARGED	
S7.000	S7.0	-0.098	0.000	0.26			8.4	OK	
S6.003	S6.3	0.499	0.000	1.04			67.6	SURCHARGED	
S6.004	S6.4	0.577	0.000	1.00			65.8	SURCHARGED	
S1.005	S1.5	0.584	0.000	1.50			234.1	SURCHARGED	
S8.000	S8.0	-0.070	0.000	0.55			12.3	OK	

Mayer Brown Limited		Page 1
Lion House Oriental Road Woking GU22 8AP	Blue Star Land Residential Development SuDs Basin (FEH)	
Date 24/03/2023 File 200324 BSL FEH.MDX	Designed by IC Checked by RHA	
Micro Drainage		Network 2020.1.3

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Storm

Pipe Sizes STANDARD Manhole Sizes STANDARD

FEH Rainfall Model			
Return Period (years)	100	Maximum Time of Concentration (mins)	20
		Foul Sewage (l/s/ha)	0.000
FEH Rainfall Version	1999	Volumetric Runoff Coeff.	0.750
Site Location		PIMP (%)	100
C (1km)	-0.027	Add Flow / Climate Change (%)	0
D1 (1km)	0.461	Minimum Backdrop Height (m)	0.000
D2 (1km)	0.289	Maximum Backdrop Height (m)	0.000
D3 (1km)	0.376	Min Design Depth for Optimisation (m)	1.200
E (1km)	0.304	Min Vel for Auto Design only (m/s)	1.00
F (1km)	2.245	Min Slope for Optimisation (1:X)	200
Maximum Rainfall (mm/hr)	75		

Designed with Level Soffits

Time Area Diagram for Storm

Time (mins)	Area (ha)	Time (mins)	Area (ha)
0-4	0.627	4-8	0.529

Total Area Contributing (ha) = 1.155

Total Pipe Volume (m³) = 36.055

Network Design Table for Storm

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	29.797	0.550	54.2	0.021	4.00	0.0	0.600	o	150	Pipe/Conduit	
S1.001	17.484	0.200	87.4	0.050	0.00	0.0	0.600	o	225	Pipe/Conduit	
S2.000	9.320	0.143	65.2	0.044	4.00	0.0	0.600	o	225	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S1.000	75.00	4.36	40.500	0.021	0.0	0.0	0.0	1.37	24.2	4.2
S1.001	75.00	4.57	39.875	0.070	0.0	0.0	0.0	1.40	55.6	14.3
S2.000	75.00	4.10	39.750	0.044	0.0	0.0	0.0	1.62	64.5	8.9

Mayer Brown Limited										Page 2		
Lion House Oriental Road Woking GU22 8AP					Blue Star Land Residential Development SuDs Basin (FEH)							
Date 24/03/2023 File 200324 BSL FEH.MDX					Designed by IC Checked by RHA							
Micro Drainage					Network 2020.1.3							
Network Design Table for Storm												
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
S1.002	38.482	0.257	150.0	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit		
S3.000	23.457	0.293	80.0	0.041	4.00	0.0	0.600	o	150	Pipe/Conduit		
S4.000	18.829	0.188	100.0	0.027	4.00	0.0	0.600	o	150	Pipe/Conduit		
S3.001	38.633	0.483	80.0	0.038	0.00	0.0	0.600	o	225	Pipe/Conduit		
S5.000	18.100	0.226	80.1	0.000	4.00	0.0	0.600	o	150	Pipe/Conduit		
S3.002	13.244	0.110	120.4	0.061	0.00	0.0	0.600	o	225	Pipe/Conduit		
S1.003	27.269	0.182	150.0	0.120	0.00	0.0	0.600	o	300	Pipe/Conduit		
S1.004	10.892	0.084	130.0	0.044	0.00	0.0	0.600	o	300	Pipe/Conduit		
S6.000	18.109	0.650	27.9	0.031	4.00	0.0	0.600	o	150	Pipe/Conduit		
S6.001	19.578	0.650	30.1	0.025	0.00	0.0	0.600	o	150	Pipe/Conduit		
S6.002	14.664	0.326	45.0	0.033	0.00	0.0	0.600	o	150	Pipe/Conduit		
S7.000	16.052	0.600	26.8	0.018	4.00	0.0	0.600	o	150	Pipe/Conduit		
S6.003	15.499	0.310	50.0	0.080	0.00	0.0	0.600	o	225	Pipe/Conduit		
Network Results Table												
PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)		
S1.002	75.00	5.17	39.607	0.114		0.0	0.0		0.0	1.07	42.4	23.2
S3.000	75.00	4.35	42.000	0.041		0.0	0.0		0.0	1.12	19.9	8.2
S4.000	75.00	4.31	42.300	0.027		0.0	0.0		0.0	1.00	17.8	5.5
S3.001	75.00	4.79	41.032	0.106		0.0	0.0		0.0	1.46	58.2	21.5
S5.000	75.00	4.27	40.300	0.000		0.0	0.0		0.0	1.12	19.9	0.0
S3.002	75.00	4.97	39.999	0.167		0.0	0.0		0.0	1.19	47.3	34.0
S1.003	75.00	5.53	39.275	0.402		0.0	0.0		0.0	1.28	90.6	81.6
S1.004	75.00	5.66	39.094	0.446		0.0	0.0		0.0	1.38	97.4	90.5
S6.000	75.00	4.16	41.100	0.031		0.0	0.0		0.0	1.91	33.8	6.4
S6.001	75.00	4.33	40.450	0.056		0.0	0.0		0.0	1.84	32.5	11.4
S6.002	75.00	4.50	39.800	0.089		0.0	0.0		0.0	1.50	26.6	18.0
S7.000	75.00	4.14	40.400	0.018		0.0	0.0		0.0	1.95	34.5	3.6
S6.003	75.00	4.64	39.399	0.186		0.0	0.0		0.0	1.85	73.7	37.8
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Mayer Brown Limited		Page 3
Lion House Oriental Road Woking GU22 8AP	Blue Star Land Residential Development SuDs Basin (FEH)	
Date 24/03/2023 File 200324 BSL FEH.MDX	Designed by IC Checked by RHA	
Micro Drainage	Network 2020.1.3	

Network Design Table for Storm

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
S6.004	16.645	0.333	50.0	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
S1.005	14.988	0.060	250.0	0.028	0.00	0.0	0.600	o	450	Pipe/Conduit	
S8.000	28.791	0.492	58.5	0.026	4.00	0.0	0.600	o	150	Pipe/Conduit	
S1.006	21.473	0.086	250.0	0.040	0.00	0.0	0.600	o	450	Pipe/Conduit	
S9.000	14.971	0.187	80.1	0.033	4.00	0.0	0.600	o	150	Pipe/Conduit	
S10.000	31.008	0.388	80.0	0.044	4.00	0.0	0.600	o	150	Pipe/Conduit	
S9.001	8.928	0.089	100.0	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
S1.007	16.611	0.066	250.0	0.149	0.00	0.0	0.600	o	450	Pipe/Conduit	
S1.008	15.248	0.002	7624.0	0.098	0.00	0.0	0.600	o	900	Pipe/Conduit	
S1.009	8.081	0.040	202.0	0.105	0.00	0.0	0.600	o	525	Pipe/Conduit	
S1.010	15.010	0.075	200.0	0.000	0.00	0.0	0.600	o	525	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S6.004	75.00	4.79	39.000	0.186	0.0	0.0	0.0	1.85	73.7	37.8
S1.005	75.00	5.85	38.442	0.660	0.0	0.0	0.0	1.28	203.8	134.1
S8.000	75.00	4.36	39.700	0.026	0.0	0.0	0.0	1.32	23.3	5.3
S1.006	75.00	6.13	38.382	0.726	0.0	0.0	0.0	1.28	203.8	147.5
S9.000	75.00	4.22	38.650	0.033	0.0	0.0	0.0	1.12	19.9	6.7
S10.000	75.00	4.46	39.100	0.044	0.0	0.0	0.0	1.12	19.9	8.9
S9.001	75.00	4.61	38.463	0.077	0.0	0.0	0.0	1.00	17.8	15.6
S1.007	75.00	6.35	38.074	0.952	0.0	0.0	0.0	1.28	203.8	193.4
S1.008	75.00	7.08	38.007	1.050	0.0	0.0	0.0	0.35	221.9	213.3
S1.009	75.00	7.16	38.005	1.155	0.0	0.0	0.0	1.57	340.3	234.7
S1.010	75.00	7.32	37.965	1.155	0.0	0.0	0.0	1.58	342.1	234.7

Mayer Brown Limited		Page 4
Lion House Oriental Road Woking GU22 8AP	Blue Star Land Residential Development SuDs Basin (FEH)	
Date 24/03/2023 File 200324 BSL FEH.MDX	Designed by IC Checked by RHA	
Micro Drainage		Network 2020.1.3

Area Summary for Storm

Pipe Number	PIMP Type	PIMP Name	PIMP (%)	Gross Area (ha)	Imp. Area (ha)	Pipe Total (ha)
1.000	User	-	100	0.021	0.021	0.021
1.001	User	-	100	0.050	0.050	0.050
2.000	-	-	100	0.044	0.044	0.044
1.002	-	-	100	0.000	0.000	0.000
3.000	User	-	100	0.041	0.041	0.041
4.000	User	-	100	0.027	0.027	0.027
3.001	User	-	100	0.017	0.017	0.017
	User	-	100	0.021	0.021	0.038
5.000	-	-	100	0.000	0.000	0.000
3.002	User	-	100	0.041	0.041	0.041
	User	-	100	0.020	0.020	0.061
1.003	User	-	100	0.019	0.019	0.019
	User	-	100	0.064	0.064	0.083
	User	-	100	0.037	0.037	0.120
1.004	User	-	100	0.039	0.039	0.039
	User	-	100	0.005	0.005	0.044
6.000	User	-	100	0.031	0.031	0.031
6.001	User	-	100	0.025	0.025	0.025
6.002	User	-	100	0.033	0.033	0.033
7.000	User	-	100	0.018	0.018	0.018
6.003	User	-	100	0.045	0.045	0.045
	User	-	100	0.035	0.035	0.080
6.004	-	-	100	0.000	0.000	0.000
1.005	User	-	100	0.017	0.017	0.017
	User	-	100	0.011	0.011	0.028
8.000	-	-	100	0.026	0.026	0.026
1.006	-	-	100	0.040	0.040	0.040
9.000	User	-	100	0.033	0.033	0.033
10.000	-	-	100	0.044	0.044	0.044
9.001	-	-	100	0.000	0.000	0.000
1.007	-	-	100	0.149	0.149	0.149
1.008	-	-	100	0.098	0.098	0.098
1.009	User	-	100	0.105	0.105	0.105
1.010	-	-	100	0.000	0.000	0.000
				Total	Total	Total
				1.155	1.155	1.155

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)
S1.010	SHW1.2	39.700	37.890	37.600	0	0

Mayer Brown Limited		Page 5
Lion House Oriental Road Woking GU22 8AP	Blue Star Land Residential Development SuDs Basin (FEH)	
Date 24/03/2023 File 200324 BSL FEH.MDX	Designed by IC Checked by RHA	
Micro Drainage		Network 2020.1.3
<u>Simulation Criteria for Storm</u> 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 1 Number of Real Time Controls 0 <u>Synthetic Rainfall Details</u> Rainfall Model FEH D1 (1km) 0.461 Summer Storms Yes Return Period (years) 100 D2 (1km) 0.289 Winter Storms No FEH Rainfall Version 1999 D3 (1km) 0.376 Cv (Summer) 0.750 Site Location E (1km) 0.304 Cv (Winter) 0.840 C (1km) -0.027 F (1km) 2.245 Storm Duration (mins) 30		
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Mayer Brown Limited		Page 6
Lion House Oriental Road Woking GU22 8AP	Blue Star Land Residential Development SuDs Basin (FEH)	
Date 24/03/2023 File 200324 BSL FEH.MDX	Designed by IC Checked by RHA	
Micro Drainage		Network 2020.1.3

Online Controls for Storm

Hydro-Brake® Optimum Manhole: SS1.9 Flow Control, DS/PN: S1.010, Volume (m³): 4.5

Unit Reference	MD-SHE-0111-5900-1200-5900
Design Head (m)	1.200
Design Flow (l/s)	5.9
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	111
Invert Level (m)	37.965
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

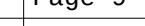
Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.200	5.9
Flush-Flo™	0.352	5.9
Kick-Flo®	0.750	4.7
Mean Flow over Head Range	-	5.1

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)
0.100	3.8	1.200	5.9	3.000	9.1	7.000	13.6
0.200	5.6	1.400	6.3	3.500	9.8	7.500	14.0
0.300	5.9	1.600	6.7	4.000	10.4	8.000	14.5
0.400	5.9	1.800	7.1	4.500	11.0	8.500	14.9
0.500	5.8	2.000	7.5	5.000	11.6	9.000	15.3
0.600	5.6	2.200	7.8	5.500	12.1	9.500	15.7
0.800	4.9	2.400	8.2	6.000	12.6		
1.000	5.4	2.600	8.5	6.500	13.1		

Mayer Brown Limited		Page 7																
Lion House Oriental Road Woking GU22 8AP	Blue Star Land Residential Development SuDs Basin (FEH)																	
Date 24/03/2023	Designed by IC																	
File 200324 BSL FEH.MDX	Checked by RHA																	
Micro Drainage	Network 2020.1.3																	
<u>Offline Controls for Storm</u> <u>Pipe Manhole: SHW1.0 (Pond), DS/PN: S1.008, Loop to PN: S1.010</u> <table><tr><td>Diameter (m)</td><td>0.225</td><td>Roughness k (mm)</td><td>0.600</td></tr><tr><td>Section Type</td><td>Pipe/Conduit</td><td>Entry Loss Coefficient</td><td>0.500</td></tr><tr><td>Slope (1:X)</td><td>100.0</td><td>Coefficient of Contraction</td><td>0.600</td></tr><tr><td>Length (m)</td><td>16.000</td><td>Upstream Invert Level (m)</td><td>39.200</td></tr></table>			Diameter (m)	0.225	Roughness k (mm)	0.600	Section Type	Pipe/Conduit	Entry Loss Coefficient	0.500	Slope (1:X)	100.0	Coefficient of Contraction	0.600	Length (m)	16.000	Upstream Invert Level (m)	39.200
Diameter (m)	0.225	Roughness k (mm)	0.600															
Section Type	Pipe/Conduit	Entry Loss Coefficient	0.500															
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Length (m)	16.000	Upstream Invert Level (m)	39.200															
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Mayer Brown Limited		Page 8								
Lion House Oriental Road Woking GU22 8AP	Blue Star Land Residential Development SuDs Basin (FEH)									
Date 24/03/2023 File 200324 BSL FEH.MDX	Designed by IC Checked by RHA									
Micro Drainage Network 2020.1.3										
Storage Structures for Storm Tank or Pond Manhole: SHW1.0 (Pond), DS/PN: S1.008 Invert Level (m) 38.007 <table><thead><tr><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>679.0</td><td>1.493</td><td>1124.0</td></tr></tbody></table>			Depth (m)	Area (m²)	Depth (m)	Area (m²)	0.000	679.0	1.493	1124.0
Depth (m)	Area (m²)	Depth (m)	Area (m²)							
0.000	679.0	1.493	1124.0							
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Mayer Brown Limited		Page 9
Lion House Oriental Road Woking GU22 8AP	Blue Star Land Residential Development SuDs Basin (FEH)	
Date 24/03/2023 File 200324 BSL FEH.MDX	Designed by IC Checked by RHA	
Micro Drainage	Network 2020.1.3	

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

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	1	Number of Real Time Controls	0

Margin for Flood Risk Warning (mm)	300.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	ON
DVD Status	OFF
Inertia Status	OFF

US/MH			Return	Climate	First (X)	First (Y)	First (Z)	Overflow
PN	Name	Storm	Period	Change	Surcharge	Flood	Overflow	Act.
S1.000	S1.0	15 Winter	100	+40%	100/15 Summer			
S1.001	S1.1	15 Winter	100	+40%	100/15 Summer			
S2.000	S2.0	15 Winter	100	+40%	100/15 Summer	100/15 Summer		
S1.002	S1.2	15 Winter	100	+40%	100/15 Summer			
S3.000	S3.0	15 Winter	100	+40%	100/15 Summer			
S4.000	S4.0	15 Winter	100	+40%	100/15 Summer			
S3.001	S3.1	15 Winter	100	+40%	100/15 Summer			
S5.000	S5.0	15 Winter	100	+40%	100/15 Summer			
S3.002	S3.2	15 Winter	100	+40%	100/15 Summer			
S1.003	S1.3	15 Winter	100	+40%	100/15 Summer			
S1.004	S1.4	15 Winter	100	+40%	100/15 Summer			
S6.000	S6.0	15 Winter	100	+40%	100/15 Summer			
S6.001	S6.1	15 Winter	100	+40%	100/15 Summer			
S6.002	S6.2	15 Winter	100	+40%	100/15 Summer	100/15 Summer		
S7.000	S7.0	15 Winter	100	+40%	100/15 Summer			
S6.003	S6.3	15 Winter	100	+40%	100/15 Summer			
S6.004	S6.4	15 Winter	100	+40%	100/15 Summer			
S1.005	S1.5	15 Winter	100	+40%	100/15 Summer			

Mayer Brown Limited		Page 10
Lion House Oriental Road Woking GU22 8AP	Blue Star Land Residential Development SuDs Basin (FEH)	
Date 24/03/2023 File 200324 BSL FEH.MDX	Designed by IC Checked by RHA	
Micro Drainage		Network 2020.1.3

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

PN	US/MH Name	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status
S1.000	S1.0	41.221	0.571	0.000	0.45			10.5	SURCHARGED
S1.001	S1.1	41.113	1.013	0.000	0.70			34.8	FLOOD RISK
S2.000	S2.0	40.955	0.980	4.704	0.85			45.2	FLOOD
S1.002	S1.2	41.007	1.175	0.000	1.54			61.9	FLOOD RISK
S3.000	S3.0	42.366	0.216	0.000	1.30			24.5	SURCHARGED
S4.000	S4.0	42.457	0.007	0.000	1.01			16.8	SURCHARGED
S3.001	S3.1	41.903	0.646	0.000	1.04			57.5	SURCHARGED
S5.000	S5.0	41.384	0.934	0.000	0.45			8.3	SURCHARGED
S3.002	S3.2	41.408	1.184	0.000	2.13			87.4	SURCHARGED
S1.003	S1.3	40.955	1.380	0.000	2.04			166.2	SURCHARGED
S1.004	S1.4	40.180	0.787	0.000	2.60			188.2	SURCHARGED
S6.000	S6.0	41.666	0.416	0.000	0.60			18.9	SURCHARGED
S6.001	S6.1	41.549	0.949	0.000	0.81			24.8	FLOOD RISK
S6.002	S6.2	41.151	1.201	0.519	1.65			40.4	FLOOD
S7.000	S7.0	40.640	0.090	0.000	0.35			11.1	SURCHARGED
S6.003	S6.3	40.600	0.976	0.000	1.25			81.1	SURCHARGED
S6.004	S6.4	40.109	0.884	0.000	1.25			81.7	SURCHARGED
S1.005	S1.5	39.604	0.712	0.000	1.83			284.6	SURCHARGED

PN	US/MH Name	Level Exceeded
S1.000	S1.0	
S1.001	S1.1	
S2.000	S2.0	2
S1.002	S1.2	
S3.000	S3.0	
S4.000	S4.0	
S3.001	S3.1	
S5.000	S5.0	
S3.002	S3.2	
S1.003	S1.3	
S1.004	S1.4	
S6.000	S6.0	
S6.001	S6.1	
S6.002	S6.2	2
S7.000	S7.0	
S6.003	S6.3	
S6.004	S6.4	
S1.005	S1.5	

Mayer Brown Limited		Page 1
Lion House Oriental Road Woking GU22 8AP	Blue Star Land Residential Development SuDs Basin (FSR)	
Date 24/03/2023 File 200324 BSL FSR.MDX	Designed by IC Checked by RHA	
Micro Drainage		Network 2020.1.3

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Storm

Pipe Sizes STANDARD Manhole Sizes STANDARD

FEH Rainfall Model			
Return Period (years)	100	Maximum Time of Concentration (mins)	20
		Foul Sewage (l/s/ha)	0.000
FEH Rainfall Version	1999	Volumetric Runoff Coeff.	0.750
Site Location		PIMP (%)	100
C (1km)	-0.027	Add Flow / Climate Change (%)	0
D1 (1km)	0.461	Minimum Backdrop Height (m)	0.000
D2 (1km)	0.289	Maximum Backdrop Height (m)	0.000
D3 (1km)	0.376	Min Design Depth for Optimisation (m)	1.200
E (1km)	0.304	Min Vel for Auto Design only (m/s)	1.00
F (1km)	2.245	Min Slope for Optimisation (1:X)	200
Maximum Rainfall (mm/hr)	75		

Designed with Level Soffits

Network Design Table for Storm

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	29.797	0.550	54.2	0.021	4.00	0.0	0.600	o	150	Pipe/Conduit	
S1.001	17.484	0.200	87.4	0.050	0.00	0.0	0.600	o	225	Pipe/Conduit	
S2.000	9.320	0.143	65.2	0.044	4.00	0.0	0.600	o	225	Pipe/Conduit	
S1.002	38.482	0.257	150.0	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
S3.000	23.457	0.293	80.0	0.041	4.00	0.0	0.600	o	150	Pipe/Conduit	
S4.000	18.829	0.188	100.0	0.027	4.00	0.0	0.600	o	150	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S1.000	75.00	4.36	40.500	0.021	0.0	0.0	0.0	1.37	24.2	4.2
S1.001	75.00	4.57	39.875	0.070	0.0	0.0	0.0	1.40	55.6	14.3
S2.000	75.00	4.10	39.750	0.044	0.0	0.0	0.0	1.62	64.5	8.9
S1.002	75.00	5.17	39.607	0.114	0.0	0.0	0.0	1.07	42.4	23.2
S3.000	75.00	4.35	42.000	0.041	0.0	0.0	0.0	1.12	19.9	8.2
S4.000	75.00	4.31	42.300	0.027	0.0	0.0	0.0	1.00	17.8	5.5

Mayer Brown Limited											Page 2	
Lion House Oriental Road Woking GU22 8AP					Blue Star Land Residential Development SuDs Basin (FSR)							
Date 24/03/2023 File 200324 BSL FSR.MDX					Designed by IC Checked by RHA							
Micro Drainage					Network 2020.1.3							
Network Design Table for Storm												
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
S3.001	38.633	0.483	80.0	0.038	0.00	0.0	0.600	o	225	Pipe/Conduit		
S5.000	18.100	0.226	80.1	0.000	4.00	0.0	0.600	o	150	Pipe/Conduit		
S3.002	13.244	0.110	120.4	0.061	0.00	0.0	0.600	o	225	Pipe/Conduit		
S1.003	27.269	0.182	150.0	0.120	0.00	0.0	0.600	o	300	Pipe/Conduit		
S1.004	10.892	0.084	130.0	0.044	0.00	0.0	0.600	o	300	Pipe/Conduit		
S6.000	18.109	0.650	27.9	0.031	4.00	0.0	0.600	o	150	Pipe/Conduit		
S6.001	19.578	0.650	30.1	0.025	0.00	0.0	0.600	o	150	Pipe/Conduit		
S6.002	14.664	0.326	45.0	0.033	0.00	0.0	0.600	o	150	Pipe/Conduit		
S7.000	16.052	0.600	26.8	0.018	4.00	0.0	0.600	o	150	Pipe/Conduit		
S6.003	15.499	0.310	50.0	0.080	0.00	0.0	0.600	o	225	Pipe/Conduit		
S6.004	16.645	0.333	50.0	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit		
S1.005	14.988	0.060	250.0	0.028	0.00	0.0	0.600	o	450	Pipe/Conduit		
S8.000	28.791	0.492	58.5	0.026	4.00	0.0	0.600	o	150	Pipe/Conduit		
Network Results Table												
PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)		
S3.001	75.00	4.79	41.032	0.106		0.0	0.0	0.0	1.46	58.2	21.5	
S5.000	75.00	4.27	40.300	0.000		0.0	0.0	0.0	1.12	19.9	0.0	
S3.002	75.00	4.97	39.999	0.167		0.0	0.0	0.0	1.19	47.3	34.0	
S1.003	75.00	5.53	39.275	0.402		0.0	0.0	0.0	1.28	90.6	81.6	
S1.004	75.00	5.66	39.094	0.446		0.0	0.0	0.0	1.38	97.4	90.5	
S6.000	75.00	4.16	41.100	0.031		0.0	0.0	0.0	1.91	33.8	6.4	
S6.001	75.00	4.33	40.450	0.056		0.0	0.0	0.0	1.84	32.5	11.4	
S6.002	75.00	4.50	39.800	0.089		0.0	0.0	0.0	1.50	26.6	18.0	
S7.000	75.00	4.14	40.400	0.018		0.0	0.0	0.0	1.95	34.5	3.6	
S6.003	75.00	4.64	39.399	0.186		0.0	0.0	0.0	1.85	73.7	37.8	
S6.004	75.00	4.79	39.000	0.186		0.0	0.0	0.0	1.85	73.7	37.8	
S1.005	75.00	5.85	38.442	0.660		0.0	0.0	0.0	1.28	203.8	134.1	
S8.000	75.00	4.36	39.700	0.026		0.0	0.0	0.0	1.32	23.3	5.3	
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Mayer Brown Limited		Page 4
Lion House Oriental Road Woking GU22 8AP	Blue Star Land Residential Development SuDs Basin (FSR)	
Date 24/03/2023 File 200324 BSL FSR.MDX	Designed by IC Checked by RHA	
Micro Drainage		Network 2020.1.3

Area Summary for Storm

Pipe Number	PIMP Type	PIMP Name	PIMP (%)	Gross Area (ha)	Imp. Area (ha)	Pipe Total (ha)
1.000	User	-	100	0.021	0.021	0.021
1.001	User	-	100	0.050	0.050	0.050
2.000	-	-	100	0.044	0.044	0.044
1.002	-	-	100	0.000	0.000	0.000
3.000	User	-	100	0.041	0.041	0.041
4.000	User	-	100	0.027	0.027	0.027
3.001	User	-	100	0.017	0.017	0.017
	User	-	100	0.021	0.021	0.038
5.000	-	-	100	0.000	0.000	0.000
3.002	User	-	100	0.041	0.041	0.041
	User	-	100	0.020	0.020	0.061
1.003	User	-	100	0.019	0.019	0.019
	User	-	100	0.064	0.064	0.083
	User	-	100	0.037	0.037	0.120
1.004	User	-	100	0.039	0.039	0.039
	User	-	100	0.005	0.005	0.044
6.000	User	-	100	0.031	0.031	0.031
6.001	User	-	100	0.025	0.025	0.025
6.002	User	-	100	0.033	0.033	0.033
7.000	User	-	100	0.018	0.018	0.018
6.003	User	-	100	0.045	0.045	0.045
	User	-	100	0.035	0.035	0.080
6.004	-	-	100	0.000	0.000	0.000
1.005	User	-	100	0.017	0.017	0.017
	User	-	100	0.011	0.011	0.028
8.000	-	-	100	0.026	0.026	0.026
1.006	-	-	100	0.040	0.040	0.040
9.000	User	-	100	0.033	0.033	0.033
10.000	-	-	100	0.044	0.044	0.044
9.001	-	-	100	0.000	0.000	0.000
1.007	-	-	100	0.149	0.149	0.149
1.008	-	-	100	0.098	0.098	0.098
1.009	User	-	100	0.105	0.105	0.105
1.010	-	-	100	0.000	0.000	0.000
				Total	Total	Total
				1.155	1.155	1.155

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)
S1.010	SHW1.2	39.700	37.890	37.600	0	0

Mayer Brown Limited		Page 5
Lion House Oriental Road Woking GU22 8AP	Blue Star Land Residential Development SuDs Basin (FSR)	
Date 24/03/2023 File 200324 BSL FSR.MDX	Designed by IC Checked by RHA	
Micro Drainage Network 2020.1.3		

Simulation Criteria for Storm

Volumetric Runoff Coeff	0.750	Additional Flow - % of Total Flow	0.000
Areal Reduction Factor	1.000	MADD Factor * 10m ³ /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	1	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FEH D1 (1km)	0.461	Summer Storms	Yes	
Return Period (years)	100 D2 (1km)	0.289	Winter Storms	No	
FEH Rainfall Version	1999 D3 (1km)	0.376	Cv (Summer)	0.750	
Site Location	E (1km)	0.304	Cv (Winter)	0.840	
C (1km)	-0.027	F (1km)	2.245	Storm Duration (mins)	30

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Mayer Brown Limited		Page 6
Lion House Oriental Road Woking GU22 8AP	Blue Star Land Residential Development SuDs Basin (FSR)	
Date 24/03/2023 File 200324 BSL FSR.MDX	Designed by IC Checked by RHA	
Micro Drainage	Network 2020.1.3	

Online Controls for Storm

Hydro-Brake® Optimum Manhole: SS1.9 Flow Control, DS/PN: S1.010, Volume (m³): 4.5

Unit Reference	MD-SHE-0111-5900-1200-5900
Design Head (m)	1.200
Design Flow (l/s)	5.9
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	111
Invert Level (m)	37.965
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.200	5.9
Flush-Flo™	0.352	5.9
Kick-Flo®	0.750	4.7
Mean Flow over Head Range	-	5.1

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)
0.100	3.8	1.200	5.9	3.000	9.1	7.000	13.6
0.200	5.6	1.400	6.3	3.500	9.8	7.500	14.0
0.300	5.9	1.600	6.7	4.000	10.4	8.000	14.5
0.400	5.9	1.800	7.1	4.500	11.0	8.500	14.9
0.500	5.8	2.000	7.5	5.000	11.6	9.000	15.3
0.600	5.6	2.200	7.8	5.500	12.1	9.500	15.7
0.800	4.9	2.400	8.2	6.000	12.6		
1.000	5.4	2.600	8.5	6.500	13.1		

Mayer Brown Limited		Page 7																
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Diameter (m)	0.225	Roughness k (mm)	0.600															
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Length (m)	16.000	Upstream Invert Level (m)	39.200															
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Mayer Brown Limited		Page 8								
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Depth (m)	Area (m²)	Depth (m)	Area (m²)							
0.000	679.0	1.693	1259.0							
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Oriental Road

Woking GU22 8AP

Date 24/03/2023

File 200324 BSL FSR.MDX

Blue Star Land

Residential Development

SuDs Basin (FSR)

Designed by IC

Checked by RHA

Micro Drainage

Network 2020.1.3

Page 9



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 Storage Structures 1

Number of Online Controls 1

Number of Time/Area Diagrams 0

Number of Offline Controls 1

Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FSR

Ratio R 0.350

Region England and Wales Cv (Summer) 0.750

M5-60 (mm) 19.400 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0

Analysis Timestep 2.5 Second Increment (Extended)

DTS Status ON

DVD Status OFF

Inertia Status OFF

Profile(s) Summer and Winter

Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320

Return Period(s) (years) 100

Climate Change (%) 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surge	First (Y) Flood	First (Z) Overflow	Overflow Act.
S1.000	S1.0	15 Winter	100	+40%	100/15 Summer			
S1.001	S1.1	15 Winter	100	+40%	100/15 Summer			
S2.000	S2.0	15 Winter	100	+40%	100/15 Summer	100/15 Summer		
S1.002	S1.2	15 Winter	100	+40%	100/15 Summer			
S3.000	S3.0	15 Winter	100	+40%	100/15 Summer			
S4.000	S4.0	15 Winter	100	+40%				
S3.001	S3.1	15 Winter	100	+40%	100/15 Summer			
S5.000	S5.0	15 Winter	100	+40%	100/15 Summer			
S3.002	S3.2	15 Winter	100	+40%	100/15 Summer			
S1.003	S1.3	15 Winter	100	+40%	100/15 Summer			
S1.004	S1.4	15 Winter	100	+40%	100/15 Summer			
S6.000	S6.0	15 Winter	100	+40%	100/15 Summer			
S6.001	S6.1	15 Winter	100	+40%	100/15 Summer			
S6.002	S6.2	15 Winter	100	+40%	100/15 Summer	100/15 Summer		
S7.000	S7.0	15 Winter	100	+40%	100/15 Summer			
S6.003	S6.3	15 Winter	100	+40%	100/15 Summer			
S6.004	S6.4	15 Winter	100	+40%	100/15 Summer			
S1.005	S1.5	15 Winter	100	+40%	100/15 Summer			
S8.000	S8.0	15 Winter	100	+40%				

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Mayer Brown Limited		Page 10
Lion House Oriental Road Woking GU22 8AP	Blue Star Land Residential Development SuDs Basin (FSR)	
Date 24/03/2023 File 200324 BSL FSR.MDX	Designed by IC Checked by RHA	
Micro Drainage		Network 2020.1.3

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

PN	US/MH Name	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status
S1.000	S1.0	41.200	0.550	0.000	0.42			9.8	SURCHARGED
S1.001	S1.1	41.116	1.016	0.000	0.64			32.0	FLOOD RISK
S2.000	S2.0	40.955	0.980	4.771	0.83			44.1	FLOOD
S1.002	S1.2	41.027	1.195	0.000	1.55			62.0	FLOOD RISK
S3.000	S3.0	42.321	0.171	0.000	1.24			23.5	SURCHARGED
S4.000	S4.0	42.419	-0.031	0.000	0.99			16.5	OK
S3.001	S3.1	41.835	0.578	0.000	1.02			56.0	SURCHARGED
S5.000	S5.0	41.371	0.921	0.000	0.45			8.4	SURCHARGED
S3.002	S3.2	41.397	1.173	0.000	1.98			81.3	SURCHARGED
S1.003	S1.3	41.002	1.427	0.000	1.85			151.3	SURCHARGED
S1.004	S1.4	40.357	0.963	0.000	2.37			171.6	FLOOD RISK
S6.000	S6.0	41.589	0.339	0.000	0.59			18.6	SURCHARGED
S6.001	S6.1	41.490	0.890	0.000	0.76			23.2	SURCHARGED
S6.002	S6.2	41.151	1.201	0.504	1.52			37.2	FLOOD
S7.000	S7.0	40.729	0.179	0.000	0.33			10.6	SURCHARGED
S6.003	S6.3	40.698	1.074	0.000	1.13			73.2	SURCHARGED
S6.004	S6.4	40.289	1.064	0.000	1.14			74.5	SURCHARGED
S1.005	S1.5	39.875	0.983	0.000	1.66			258.9	SURCHARGED
S8.000	S8.0	39.823	-0.027	0.000	0.71			15.8	OK

PN	US/MH Name	Level Exceeded
S1.000	S1.0	
S1.001	S1.1	
S2.000	S2.0	3
S1.002	S1.2	
S3.000	S3.0	
S4.000	S4.0	
S3.001	S3.1	
S5.000	S5.0	
S3.002	S3.2	
S1.003	S1.3	
S1.004	S1.4	
S6.000	S6.0	
S6.001	S6.1	
S6.002	S6.2	2
S7.000	S7.0	
S6.003	S6.3	
S6.004	S6.4	
S1.005	S1.5	
S8.000	S8.0	

Mayer Brown Limited		Page 11
Lion House Oriental Road Woking GU22 8AP	Blue Star Land Residential Development SuDs Basin (FSR)	
Date 24/03/2023 File 200324 BSL FSR.MDX	Designed by IC Checked by RHA	
Micro Drainage		Network 2020.1.3

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

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surchage	First (Y) Flood	First (Z) Overflow
S1.006	S1.6	15 Winter	100	+40%	100/15 Summer		
S9.000	S9.0	15 Winter	100	+40%	100/15 Summer		
S10.000	S10.0	15 Winter	100	+40%	100/15 Summer		
S9.001	S9.1	15 Winter	100	+40%	100/15 Summer		
S1.007	S1.7	15 Winter	100	+40%	100/15 Summer		
S1.008	SHW1.0 (Pond)	960 Winter	100	+40%	100/360 Winter		
S1.009	SHW1.1	960 Winter	100	+40%	100/60 Summer		
S1.010	SS1.9 Flow Control	360 Winter	100	+40%	100/30 Summer		

PN	US/MH Name	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)
S1.006	S1.6		39.664	0.832	0.000	1.74		
S9.000	S9.0		39.861	1.061	0.000	0.74		
S10.000	S10.0		40.125	0.875	0.000	0.96		
S9.001	S9.1		39.748	1.135	0.000	2.14		
S1.007	S1.7		39.399	0.876	0.000	2.41		
S1.008	SHW1.0 (Pond)	0	38.969	0.062	0.000	0.15	0.0	
S1.009	SHW1.1		38.969	0.439	0.000	0.17		
S1.010	SS1.9 Flow Control		39.166	0.676	0.000	0.02		

PN	US/MH Name	Pipe Flow (l/s)	Status	Level Exceeded
S1.006	S1.6	289.7	SURCHARGED	
S9.000	S9.0	13.6	FLOOD RISK	
S10.000	S10.0	18.4	SURCHARGED	
S9.001	S9.1	33.4	SURCHARGED	
S1.007	S1.7	384.2	SURCHARGED	
S1.008	SHW1.0 (Pond)	42.6	SURCHARGED	
S1.009	SHW1.1	35.6	SURCHARGED	
S1.010	SS1.9 Flow Control	5.9	SURCHARGED	

Mayer Brown Limited		Page 1
Lion House Oriental Road Woking GU22 8AP	Blue Star Land Residential Development SuDs Basin (FEH)	
Date 24/03/2023	Designed by IC	
File 200324 BSL FEH Exceedan...	Checked by RHA	
Micro Drainage		Network 2020.1.3

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Storm

Pipe Sizes STANDARD Manhole Sizes STANDARD

FEH Rainfall Model			
Return Period (years)	100	Maximum Time of Concentration (mins)	20
		Foul Sewage (l/s/ha)	0.000
FEH Rainfall Version	1999	Volumetric Runoff Coeff.	0.750
Site Location		PIMP (%)	100
C (1km)	-0.027	Add Flow / Climate Change (%)	0
D1 (1km)	0.461	Minimum Backdrop Height (m)	0.000
D2 (1km)	0.289	Maximum Backdrop Height (m)	0.000
D3 (1km)	0.376	Min Design Depth for Optimisation (m)	1.200
E (1km)	0.304	Min Vel for Auto Design only (m/s)	1.00
F (1km)	2.245	Min Slope for Optimisation (1:X)	200
Maximum Rainfall (mm/hr)	75		

Designed with Level Soffits

Simulation Criteria for Storm

Volumetric Runoff Coeff	0.750	Additional Flow - % of Total Flow	0.000
Areal Reduction Factor	1.000	MADD Factor * 10m ³ /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 1 Number of Real Time Controls 0			

Synthetic Rainfall Details

Rainfall Model	FEH D1 (1km)	0.461	Summer Storms	Yes
Return Period (years)	100 D2 (1km)	0.289	Winter Storms	No
FEH Rainfall Version	1999 D3 (1km)	0.376	Cv (Summer)	0.750
Site Location	E (1km)	0.304	Cv (Winter)	0.840
C (1km)	-0.027 F (1km)	2.245	Storm Duration (mins)	30

Mayer Brown Limited		Page 2
Lion House Oriental Road Woking GU22 8AP	Blue Star Land Residential Development SuDs Basin (FEH)	
Date 24/03/2023	Designed by IC	
File 200324 BSL FEH Exceedan...	Checked by RHA	
Micro Drainage		Network 2020.1.3

Summary Wizard of 5760 minute 200 year Summer I+0% 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 Storage Structures 1
 Number of Online Controls 1 Number of Time/Area Diagrams 0
 Number of Offline Controls 1 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FEH D1 (1km) 0.461 F (1km) 2.245
 FEH Rainfall Version 1999 D2 (1km) 0.289 Cv (Summer) 0.750
 Site Location D3 (1km) 0.376 Cv (Winter) 0.840
 C (1km) -0.027 E (1km) 0.304

Margin for Flood Risk Warning (mm) 300.0
 Analysis Timestep 2.5 Second Increment (Extended)
 DTS Status OFF
 DVD Status ON
 Inertia Status ON

Profile(s) Summer and Winter
 Duration(s) (mins) 480, 600, 720, 960, 1440, 2160, 2880, 4320,
 5760, 7200, 8640, 10080
 Return Period(s) (years) 200
 Climate Change (%) 0

PN	US/MH Name	Storm Rank	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m ³)	Flow / Overflow Cap. (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status
S1.000	S1.0	16	40.508	-0.142	0.000	0.01		0.3	OK
S1.001	S1.1	16	39.894	-0.206	0.000	0.02		0.9	OK
S2.000	S2.0	16	39.761	-0.214	0.000	0.01		0.6	OK
S1.002	S1.2	17	39.635	-0.197	0.000	0.04		1.5	OK
S3.000	S3.0	16	42.016	-0.134	0.000	0.03		0.5	OK
S4.000	S4.0	16	42.315	-0.135	0.000	0.02		0.3	OK
S3.001	S3.1	16	41.056	-0.201	0.000	0.02		1.4	OK
S5.000	S5.0	15	40.300	-0.150	0.000	0.00		0.0	OK
S3.002	S3.2	16	40.032	-0.192	0.000	0.05		2.1	OK
S1.003	S1.3	16	39.374	-0.201	0.000	0.06		5.1	OK
S1.004	S1.4	9	39.374	-0.019	0.000	0.08		5.7	OK
S6.000	S6.0	16	41.109	-0.141	0.000	0.01		0.4	OK
S6.001	S6.1	16	40.466	-0.134	0.000	0.02		0.7	OK
S6.002	S6.2	16	39.821	-0.129	0.000	0.05		1.1	OK
S7.000	S7.0	16	40.405	-0.145	0.000	0.01		0.2	OK
S6.003	S6.3	24	39.427	-0.197	0.000	0.04		2.4	OK
S6.004	S6.4	9	39.374	0.149	0.000	0.04		2.4	SURCHARGED
S1.005	S1.5	9	39.374	0.482	0.000	0.05		8.4	SURCHARGED

Mayer Brown Limited		Page 3
Lion House Oriental Road Woking GU22 8AP	Blue Star Land Residential Development SuDs Basin (FEH)	
Date 24/03/2023 File 200324 BSL FEH Exceedan...	Designed by IC Checked by RHA	
Micro Drainage		Network 2020.1.3

Summary Wizard of 5760 minute 200 year Summer I+0% for Storm

PN	US/MH Name	Storm Rank	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)
S8.000		S8.0 16	39.711	-0.139	0.000	0.01		
S1.006		S1.6 9	39.374	0.542	0.000	0.06		
S9.000		S9.0 9	39.374	0.574	0.000	0.02		
S10.000		S10.0 9	39.374	0.124	0.000	0.03		
S9.001		S9.1 9	39.374	0.761	0.000	0.06		
S1.007		S1.7 9	39.374	0.850	0.000	0.08		
S1.008	SHW1.0 (Pond)	9	39.374	0.467	0.000	0.05	0.0	
S1.009	SHW1.1	9	39.374	0.844	0.000	0.00		
S1.010	SS1.9 Flow Control	9	39.404	0.914	0.000	0.00		

PN	US/MH Name	Pipe Flow (l/s)	Status
S8.000		S8.0 0.3	OK
S1.006		S1.6 9.3	SURCHARGED
S9.000		S9.0 0.4	SURCHARGED
S10.000		S10.0 0.6	SURCHARGED
S9.001		S9.1 0.9	SURCHARGED
S1.007		S1.7 12.0	SURCHARGED
S1.008	SHW1.0 (Pond)	13.2	SURCHARGED
S1.009	SHW1.1	0.8	SURCHARGED
S1.010	SS1.9 Flow Control	0.1	FLOOD RISK

Mayer Brown Limited		Page 5
Lion House Oriental Road Woking GU22 8AP	Blue Star Land Residential Development SuDs Basin (FEH)	
Date 24/03/2023 File 200324 BSL FEH Exceedan...	Designed by IC Checked by RHA	
Micro Drainage Network 2020.1.3		

Summary Wizard of 5760 minute 200 year Winter I+0% for Storm

PN	US/MH Name	Storm Rank	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)
S8.000		S8.0	20 39.708	-0.142	0.000	0.01		
S1.006		S1.6	4 39.513	0.681	0.000	0.04		
S9.000		S9.0	5 39.512	0.712	0.000	0.02		
S10.000		S10.0	5 39.512	0.262	0.000	0.02		
S9.001		S9.1	5 39.513	0.900	0.000	0.05		
S1.007		S1.7	4 39.514	0.990	0.000	0.05		
S1.008	SHW1.0 (Pond)	4	39.516	0.609	0.000	0.05	4.0	
S1.009	SHW1.1	4	39.513	0.983	0.000	0.01		
S1.010	SS1.9 Flow Control	4	39.579	1.089	0.000	0.00		

PN	US/MH Name	Pipe Flow (l/s)	Status
S8.000		S8.0 0.2	OK
S1.006		S1.6 6.7	SURCHARGED
S9.000		S9.0 0.3	SURCHARGED
S10.000		S10.0 0.4	SURCHARGED
S9.001		S9.1 0.7	SURCHARGED
S1.007		S1.7 8.7	SURCHARGED
S1.008	SHW1.0 (Pond)	13.3	FLOOD RISK
S1.009	SHW1.1	2.9	FLOOD RISK
S1.010	SS1.9 Flow Control	0.1	FLOOD RISK

Mayer Brown Limited		Page 1
Lion House Oriental Road Woking GU22 8AP	Blue Star Land Residential Development SuDs Basin (FEH)	
Date 24/03/2023	Designed by IC	
File 200324 BSL FEH Exceedan...	Checked by RHA	
Micro Drainage		Network 2020.1.3

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Storm

Pipe Sizes STANDARD Manhole Sizes STANDARD

FEH Rainfall Model			
Return Period (years)	100	Maximum Time of Concentration (mins)	20
		Foul Sewage (l/s/ha)	0.000
FEH Rainfall Version	1999	Volumetric Runoff Coeff.	0.750
Site Location		PIMP (%)	100
C (1km)	-0.027	Add Flow / Climate Change (%)	0
D1 (1km)	0.461	Minimum Backdrop Height (m)	0.000
D2 (1km)	0.289	Maximum Backdrop Height (m)	0.000
D3 (1km)	0.376	Min Design Depth for Optimisation (m)	1.200
E (1km)	0.304	Min Vel for Auto Design only (m/s)	1.00
F (1km)	2.245	Min Slope for Optimisation (1:X)	200
Maximum Rainfall (mm/hr)	75		

Designed with Level Soffits

Time Area Diagram for Storm

Time (mins)	Area (ha)	Time (mins)	Area (ha)
0-4	0.627	4-8	0.529

Total Area Contributing (ha) = 1.155

Total Pipe Volume (m³) = 36.055

Network Design Table for Storm

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	29.797	0.550	54.2	0.021	4.00	0.0	0.600	o	150	Pipe/Conduit	
S1.001	17.484	0.200	87.4	0.050	0.00	0.0	0.600	o	225	Pipe/Conduit	
S2.000	9.320	0.143	65.2	0.044	4.00	0.0	0.600	o	225	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S1.000	75.00	4.36	40.500	0.021	0.0	0.0	0.0	1.37	24.2	4.2
S1.001	75.00	4.57	39.875	0.070	0.0	0.0	0.0	1.40	55.6	14.3
S2.000	75.00	4.10	39.750	0.044	0.0	0.0	0.0	1.62	64.5	8.9

Mayer Brown Limited											Page 2	
Lion House Oriental Road Woking GU22 8AP					Blue Star Land Residential Development SuDs Basin (FEH)							
Date 24/03/2023 File 200324 BSL FEH Exceedan...					Designed by IC Checked by RHA							
Micro Drainage					Network 2020.1.3							
Network Design Table for Storm												
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	
S1.002	38.482	0.257	150.0	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit		
S3.000	23.457	0.293	80.0	0.041	4.00	0.0	0.600	o	150	Pipe/Conduit		
S4.000	18.829	0.188	100.0	0.027	4.00	0.0	0.600	o	150	Pipe/Conduit		
S3.001	38.633	0.483	80.0	0.038	0.00	0.0	0.600	o	225	Pipe/Conduit		
S5.000	18.100	0.226	80.1	0.000	4.00	0.0	0.600	o	150	Pipe/Conduit		
S3.002	13.244	0.110	120.4	0.061	0.00	0.0	0.600	o	225	Pipe/Conduit		
S1.003	27.269	0.182	150.0	0.120	0.00	0.0	0.600	o	300	Pipe/Conduit		
S1.004	10.892	0.084	130.0	0.044	0.00	0.0	0.600	o	300	Pipe/Conduit		
S6.000	18.109	0.650	27.9	0.031	4.00	0.0	0.600	o	150	Pipe/Conduit		
S6.001	19.578	0.650	30.1	0.025	0.00	0.0	0.600	o	150	Pipe/Conduit		
S6.002	14.664	0.326	45.0	0.033	0.00	0.0	0.600	o	150	Pipe/Conduit		
S7.000	16.052	0.600	26.8	0.018	4.00	0.0	0.600	o	150	Pipe/Conduit		
S6.003	15.499	0.310	50.0	0.080	0.00	0.0	0.600	o	225	Pipe/Conduit		
Network Results Table												
PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)		
S1.002	75.00	5.17	39.607	0.114	0.0	0.0	0.0	1.07	42.4	23.2		
S3.000	75.00	4.35	42.000	0.041	0.0	0.0	0.0	1.12	19.9	8.2		
S4.000	75.00	4.31	42.300	0.027	0.0	0.0	0.0	1.00	17.8	5.5		
S3.001	75.00	4.79	41.032	0.106	0.0	0.0	0.0	1.46	58.2	21.5		
S5.000	75.00	4.27	40.300	0.000	0.0	0.0	0.0	1.12	19.9	0.0		
S3.002	75.00	4.97	39.999	0.167	0.0	0.0	0.0	1.19	47.3	34.0		
S1.003	75.00	5.53	39.275	0.402	0.0	0.0	0.0	1.28	90.6	81.6		
S1.004	75.00	5.66	39.094	0.446	0.0	0.0	0.0	1.38	97.4	90.5		
S6.000	75.00	4.16	41.100	0.031	0.0	0.0	0.0	1.91	33.8	6.4		
S6.001	75.00	4.33	40.450	0.056	0.0	0.0	0.0	1.84	32.5	11.4		
S6.002	75.00	4.50	39.800	0.089	0.0	0.0	0.0	1.50	26.6	18.0		
S7.000	75.00	4.14	40.400	0.018	0.0	0.0	0.0	1.95	34.5	3.6		
S6.003	75.00	4.64	39.399	0.186	0.0	0.0	0.0	1.85	73.7	37.8		
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Mayer Brown Limited			Page 3
Lion House Oriental Road Woking GU22 8AP	Blue Star Land Residential Development SuDs Basin (FEH)		
Date 24/03/2023 File 200324 BSL FEH Exceedan...	Designed by IC Checked by RHA		
Micro Drainage		Network 2020.1.3	

Network Design Table for Storm

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
S6.004	16.645	0.333	50.0	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
S1.005	14.988	0.060	250.0	0.028	0.00	0.0	0.600	o	450	Pipe/Conduit	
S8.000	28.791	0.492	58.5	0.026	4.00	0.0	0.600	o	150	Pipe/Conduit	
S1.006	21.473	0.086	250.0	0.040	0.00	0.0	0.600	o	450	Pipe/Conduit	
S9.000	14.971	0.187	80.1	0.033	4.00	0.0	0.600	o	150	Pipe/Conduit	
S10.000	31.008	0.388	80.0	0.044	4.00	0.0	0.600	o	150	Pipe/Conduit	
S9.001	8.928	0.089	100.0	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
S1.007	16.611	0.066	250.0	0.149	0.00	0.0	0.600	o	450	Pipe/Conduit	
S1.008	15.248	0.002	7624.0	0.098	0.00	0.0	0.600	o	900	Pipe/Conduit	
S1.009	8.081	0.040	202.0	0.105	0.00	0.0	0.600	o	525	Pipe/Conduit	
S1.010	15.010	0.075	200.0	0.000	0.00	0.0	0.600	o	525	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S6.004	75.00	4.79	39.000	0.186	0.0	0.0	0.0	1.85	73.7	37.8
S1.005	75.00	5.85	38.442	0.660	0.0	0.0	0.0	1.28	203.8	134.1
S8.000	75.00	4.36	39.700	0.026	0.0	0.0	0.0	1.32	23.3	5.3
S1.006	75.00	6.13	38.382	0.726	0.0	0.0	0.0	1.28	203.8	147.5
S9.000	75.00	4.22	38.650	0.033	0.0	0.0	0.0	1.12	19.9	6.7
S10.000	75.00	4.46	39.100	0.044	0.0	0.0	0.0	1.12	19.9	8.9
S9.001	75.00	4.61	38.463	0.077	0.0	0.0	0.0	1.00	17.8	15.6
S1.007	75.00	6.35	38.074	0.952	0.0	0.0	0.0	1.28	203.8	193.4
S1.008	75.00	7.08	38.007	1.050	0.0	0.0	0.0	0.35	221.9	213.3
S1.009	75.00	7.16	38.005	1.155	0.0	0.0	0.0	1.57	340.3	234.7
S1.010	75.00	7.32	37.965	1.155	0.0	0.0	0.0	1.58	342.1	234.7

Mayer Brown Limited		Page 4
Lion House Oriental Road Woking GU22 8AP	Blue Star Land Residential Development SuDs Basin (FEH)	
Date 24/03/2023 File 200324 BSL FEH Exceedan...	Designed by IC Checked by RHA	
Micro Drainage		Network 2020.1.3

Area Summary for Storm

Pipe Number	PIMP Type	PIMP Name	PIMP (%)	Gross Area (ha)	Imp. Area (ha)	Pipe Total (ha)
1.000	User	-	100	0.021	0.021	0.021
1.001	User	-	100	0.050	0.050	0.050
2.000	-	-	100	0.044	0.044	0.044
1.002	-	-	100	0.000	0.000	0.000
3.000	User	-	100	0.041	0.041	0.041
4.000	User	-	100	0.027	0.027	0.027
3.001	User	-	100	0.017	0.017	0.017
	User	-	100	0.021	0.021	0.038
5.000	-	-	100	0.000	0.000	0.000
3.002	User	-	100	0.041	0.041	0.041
	User	-	100	0.020	0.020	0.061
1.003	User	-	100	0.019	0.019	0.019
	User	-	100	0.064	0.064	0.083
	User	-	100	0.037	0.037	0.120
1.004	User	-	100	0.039	0.039	0.039
	User	-	100	0.005	0.005	0.044
6.000	User	-	100	0.031	0.031	0.031
6.001	User	-	100	0.025	0.025	0.025
6.002	User	-	100	0.033	0.033	0.033
7.000	User	-	100	0.018	0.018	0.018
6.003	User	-	100	0.045	0.045	0.045
	User	-	100	0.035	0.035	0.080
6.004	-	-	100	0.000	0.000	0.000
1.005	User	-	100	0.017	0.017	0.017
	User	-	100	0.011	0.011	0.028
8.000	-	-	100	0.026	0.026	0.026
1.006	-	-	100	0.040	0.040	0.040
9.000	User	-	100	0.033	0.033	0.033
10.000	-	-	100	0.044	0.044	0.044
9.001	-	-	100	0.000	0.000	0.000
1.007	-	-	100	0.149	0.149	0.149
1.008	-	-	100	0.098	0.098	0.098
1.009	User	-	100	0.105	0.105	0.105
1.010	-	-	100	0.000	0.000	0.000
				Total	Total	Total
				1.155	1.155	1.155

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)
S1.010	SHW1.2	39.700	37.890	37.600	0	0

Mayer Brown Limited		Page 5
Lion House Oriental Road Woking GU22 8AP	Blue Star Land Residential Development SuDs Basin (FEH)	
Date 24/03/2023	Designed by IC	
File 200324 BSL FEH Exceedan...	Checked by RHA	
Micro Drainage		Network 2020.1.3

Simulation Criteria for Storm

Volumetric Runoff Coeff	0.750	Additional Flow - % of Total Flow	0.000
Areal Reduction Factor	1.000	MADD Factor * 10m ³ /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	1	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FEH D1 (1km)	0.461	Summer Storms	Yes
Return Period (years)	100 D2 (1km)	0.289	Winter Storms	No
FEH Rainfall Version	1999 D3 (1km)	0.376	Cv (Summer)	0.750
Site Location	E (1km)	0.304	Cv (Winter)	0.840
C (1km)	-0.027	F (1km)	2.245	Storm Duration (mins)
				30

Mayer Brown Limited		Page 6
Lion House Oriental Road Woking GU22 8AP	Blue Star Land Residential Development SuDs Basin (FEH)	
Date 24/03/2023	Designed by IC	
File 200324 BSL FEH Exceedan...	Checked by RHA	
Micro Drainage		Network 2020.1.3

Online Controls for Storm

Hydro-Brake® Optimum Manhole: SS1.9 Flow Control, DS/PN: S1.010, Volume (m³): 4.5

Unit Reference	MD-SHE-0013-1000-1200-1000
Design Head (m)	1.200
Design Flow (l/s)	0.1
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	13
Invert Level (m)	37.965
Minimum Outlet Pipe Diameter (mm)	75
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.200	0.1
Flush-Flo™	0.050	0.0
Kick-Flo®	0.115	0.0
Mean Flow over Head Range	-	0.1

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)
0.100	0.0	1.200	0.1	3.000	0.1	7.000	0.2
0.200	0.0	1.400	0.1	3.500	0.2	7.500	0.2
0.300	0.1	1.600	0.1	4.000	0.2	8.000	0.2
0.400	0.1	1.800	0.1	4.500	0.2	8.500	0.2
0.500	0.1	2.000	0.1	5.000	0.2	9.000	0.2
0.600	0.1	2.200	0.1	5.500	0.2	9.500	0.2
0.800	0.1	2.400	0.1	6.000	0.2		
1.000	0.1	2.600	0.1	6.500	0.2		

Mayer Brown Limited		Page 7																
Lion House Oriental Road Woking GU22 8AP	Blue Star Land Residential Development SuDs Basin (FEH)																	
Date 24/03/2023	Designed by IC																	
File 200324 BSL FEH Exceedan...	Checked by RHA																	
Micro Drainage	Network 2020.1.3																	
<u>Offline Controls for Storm</u> <u>Pipe Manhole: SHW1.0 (Pond), DS/PN: S1.008, Loop to PN: S1.010</u> <table><tr><td>Diameter (m)</td><td>0.225</td><td>Roughness k (mm)</td><td>0.600</td></tr><tr><td>Section Type</td><td>Pipe/Conduit</td><td>Entry Loss Coefficient</td><td>0.500</td></tr><tr><td>Slope (1:X)</td><td>100.0</td><td>Coefficient of Contraction</td><td>0.600</td></tr><tr><td>Length (m)</td><td>16.000</td><td>Upstream Invert Level (m)</td><td>39.450</td></tr></table>			Diameter (m)	0.225	Roughness k (mm)	0.600	Section Type	Pipe/Conduit	Entry Loss Coefficient	0.500	Slope (1:X)	100.0	Coefficient of Contraction	0.600	Length (m)	16.000	Upstream Invert Level (m)	39.450
Diameter (m)	0.225	Roughness k (mm)	0.600															
Section Type	Pipe/Conduit	Entry Loss Coefficient	0.500															
Slope (1:X)	100.0	Coefficient of Contraction	0.600															
Length (m)	16.000	Upstream Invert Level (m)	39.450															
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Mayer Brown Limited		Page 8
Lion House Oriental Road Woking GU22 8AP	Blue Star Land Residential Development SuDs Basin (FEH)	
Date 24/03/2023	Designed by IC	
File 200324 BSL FEH Exceedan...	Checked by RHA	
Micro Drainage	Network 2020.1.3	
</		

Mayer Brown Limited		Page 10
Lion House Oriental Road Woking GU22 8AP	Blue Star Land Residential Development SuDs Basin (FEH)	
Date 24/03/2023 File 200324 BSL FEH Exceedan...	Designed by IC Checked by RHA	
Micro Drainage		Network 2020.1.3

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

PN	US/MH Name	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status
S1.000	S1.0	40.529	-0.121	0.000	0.08			1.9	OK
S1.001	S1.1	39.929	-0.171	0.000	0.13			6.6	OK
S2.000	S2.0	39.791	-0.184	0.000	0.08			4.1	OK
S1.002	S1.2	39.686	-0.146	0.000	0.27			10.7	OK
S3.000	S3.0	42.045	-0.105	0.000	0.20			3.8	OK
S4.000	S4.0	42.339	-0.111	0.000	0.15			2.5	OK
S3.001	S3.1	41.096	-0.161	0.000	0.18			9.9	OK
S5.000	S5.0	40.300	-0.150	0.000	0.00			0.0	OK
S3.002	S3.2	40.095	-0.129	0.000	0.38			15.6	OK
S1.003	S1.3	39.654	0.078	0.000	0.03			2.4	SURCHARGED
S1.004	S1.4	39.657	0.263	0.000	0.04			2.7	SURCHARGED
S6.000	S6.0	41.131	-0.119	0.000	0.09			2.9	OK
S6.001	S6.1	40.491	-0.109	0.000	0.17			5.2	OK
S6.002	S6.2	39.860	-0.090	0.000	0.34			8.3	OK
S7.000	S7.0	40.422	-0.128	0.000	0.05			1.7	OK
S6.003	S6.3	39.653	0.029	0.000	0.02			1.1	SURCHARGED
S6.004	S6.4	39.655	0.430	0.000	0.02			1.1	SURCHARGED
S1.005	S1.5	39.656	0.764	0.000	0.03			3.9	SURCHARGED

PN	US/MH Name	Level Exceeded
S1.000	S1.0	
S1.001	S1.1	
S2.000	S2.0	
S1.002	S1.2	
S3.000	S3.0	
S4.000	S4.0	
S3.001	S3.1	
S5.000	S5.0	
S3.002	S3.2	
S1.003	S1.3	
S1.004	S1.4	
S6.000	S6.0	
S6.001	S6.1	
S6.002	S6.2	
S7.000	S7.0	
S6.003	S6.3	
S6.004	S6.4	
S1.005	S1.5	

APPENDIX D: Maintenance Schedule

Blue Star Land, Waterloooville
Drainage Maintenance Plan

Introduction

This document sets out the planned maintenance requirements for the (non-highways) Sustainable Drainage System (SuDS), which are associated with the Blue Star Land development, Waterloooville. This plan should be reviewed and updated periodically by the adopting authority as additional experience is gained. The SuDS consist of open space features, distribution pipework and a SuDs basin.

Schedule of Open Space SuDS Maintenance Requirements

Activity Breakdown

Flow Controls (HydroBrakes)

Frequency – 6 Monthly Inspections

Tasks

- Remove covers to chambers and enter where safe to do to. Staff to be appropriately trained and equipped for confined entry.
- Inspect visually for damage or corrosion.
- Check for and clear any obstructions. Wash down if required.
- Check correct operation of Bypass door and handle on HydroBrakes, grease lightly if required
- File Record of Visit and Actions Taken, report any defects for repair.

Shut-Off Valves

Frequency – 6 Monthly Inspections

Tasks

- Remove covers & attach operating tool
- Confirm valve was previously left in the open position
- Operate Valve to fully closed and reopen
- Repeat operation 3 times and leave in fully open position
- File Record of Visit and report any defect or stiff operation for repair.

Weirs (Kerb Gully Type)

Frequency – 6 monthly or where defects reported

Tasks

- Remove covers, remove any debris and rod through to junction
- File Record of Visit and report any defects for repair or blockage for jetting.

Rock Outlets

Frequency – 6 Monthly or where defects reported

Tasks

- Ensure that pipe and basket are covered by rocks as intended.
- Reposition or replace any rocks that have been removed.
- Check for and clear any debris or self sown vegetation caught between the rocks.
- File Record of Visit and report any defects for repair.

Landscape Maintenance

Frequency – As Specified in the Landscape Management Plan

- The Contractor shall regularly inspect and maintain SuDS features to ensure their effective operation as designed. Regular mowing in and around detention basins is required only along maintenance access routes, amenity areas (e.g. footpaths), across embankments and main storage area. The remaining areas can be managed as damp meadow grass, unless additional management is required for landscaping purposes.
- Management of vegetation and removal of nuisance plants.
- Remove sediment from inlets, outlet and fore bay. Tidy all dead growth before start of growing season.
- Repair erosion or other damage by re-seeding or re-turfing. Realignment of rip-rap, repair and rehabilitation of inlets, outlets and overflows, re-level uneven surfaces and reinstate design levels as required.

Silt Monitoring & Removal

Frequency – Monitor Annually, Remove as required (Assumed 5 yearly)

Tasks

Sustainable Drainage Maintenance Plan

- Take measurements and record depths of silt annually in pool areas of SuDS
- Arrange Removal of Silts in deep pools, where average depth is approximately 100mm, and a maximum not exceeding 300mm. Before de-silting a particular pond it should be trapped and netted out for amphibians and macro-invertebrates which should be transferred to a nearby pond assuming no fish are present. Not all ponds are to be de-silted in the
- Remove silts in dry basins where it threatens to restrict the capacity of inlets or outlets or is unsightly.
- NOTE - Sediments excavated from detention basins that receive runoff from residential or standard road and roof areas are generally not toxic or hazardous material and can therefore be safely disposed of by either land application or land filling. However, consultation should take place with the environmental regulator to confirm appropriate protocols. Sediment testing may be required before sediment excavation to determine its classification and appropriate disposal methods. In the majority of cases it will be acceptable to distribute the sediment on site if there is an appropriate safe and acceptable location to do so.

SuDS Ancillaries

In addition to the open space SuDS and associated maintenance activities as listed above, there are a number of other items requiring periodic inspection and maintenance as follows:

Pipes

Frequency –Annual visit initially, then adjust as necessary

Tasks

- CCTV survey and jetting of areas of sediment build-up, repeat after 1 year.
- Re-jet Jet identified sedimentation areas on a cycle as determined
- CCTV survey on a 10 year cycle to identify blockages and structural defects.
-

Chambers

Frequency –Annual Surface Inspection, below ground inspection as above

Tasks

- Visual inspection of covers and frames to identify defects on an annual basis

Sustainable Drainage Maintenance Plan

- View internal chamber structure when CCTV surveys of pipework are carried out to identify structural defects or maintenance issues.

Signage

Frequency – 6 monthly

Tasks

- Check that pollution shut-off signage is intact.
- Clean sign face with soapy water
- Report any defects for repair

Fencing

Frequency – 6 monthly

Tasks

- Check that fencing is intact and secure, check for signs of corrosion / rot.
- Report any defects for repair or replacement

