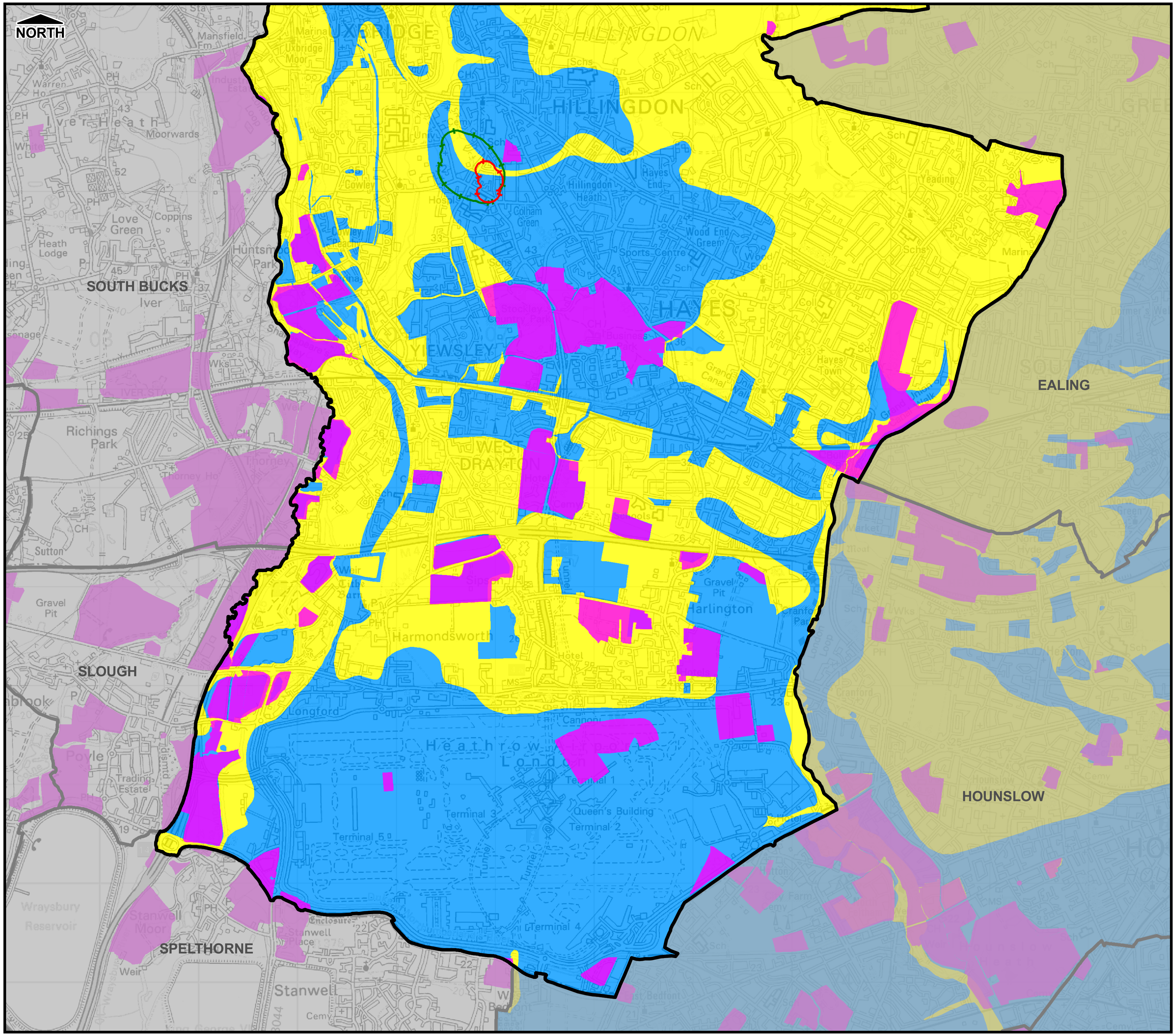

0 0.25 0.5 1 1.5 2 Kilometres

THIS DRAWING MAY BE USED ONLY FOR THE PURPOSE INTENDED

Legend

- Borough Administrative Boundary
- Infiltration SUDs Potentially Suitable
- Infiltration SUDs Potentially Unsuitable
- Infiltration SUDs Suitability Uncertain
- Historic Landfill Site

EA Groundwater Source Protection Zone

- Inner Zone
- Outer Zone

Notes

London Borough of Hillingdon

HILLINGDON
LONDON

Surface Water Management Plan

Scale at A3	Date	Drawn by	Approved by
1:40,000	06/04/2011	R.MOORE	P.HLINOVSKY

Infiltration SUDS Suitability Map

Consultants

CAPITA SYMONDS
Flood Risk Management
Scott Wilson

Capita Symonds
Level Seven,
52 Grosvenor Gardens,
Belgravia,
London
SW1W 0AU

Drain London Programme Board Members

Environment Agency
Thames Water
LONDON COUNCILS
GREATERLONDONAUTHORITY

FIGURE 11.2

Filepath: L:\Environment\zwet\CS046913_DrainLondon_Tier2\Group1\ARC\mxds\GP1_Hillingdon_Fig11.2_SUDS.mxd

Appendix F Drainage Strategy

GENERAL NOTES:

1. TOPOGRAPHICAL SURVEY WAS TAKEN FROM NGM SURVEYS DRAWING NUMBER 3167-01 DATED MARCH 2018, RECEIVED FROM SAVILLS ON 06.11.2018 AND FORMS THE BASE INFORMATION FOR THIS PLAN

LEGEND:

SITE BOUNDARY **(AREA = 3,889m²)**

EXISTING HARD LANDSCAPING **(AREA = 2,133m²)**

EXISTING SOFT LANDSCAPING **(AREA = 1,756m²)**

Mark	Revision	Date	Drawn	Chkd	Appd
1	PLANNING ISSUE	12.12.18	HM	PDS	PDS

SCALING NOTE: Do not scale from this drawing. If in doubt, ask.

UTILITIES NOTE: The position of any existing public or private sewers, utility services, plant or apparatus shown on this drawing is believed to be correct, but no warranty to this is expressed or implied. Other such plant or apparatus may also be present but not shown. The Contractor is therefore advised to undertake his own investigation where the presence of any existing sewers, services, plant or apparatus may affect his operations.

Drawing Issue Status

PLANNING

STATUS PARK, HEATHROW
EXISTING DRAINAGE CATCHMENTS

Client

MBH HEATHROW LTD

Date of 1st Issue	Designed	Drawn
12.12.2018	HM	HM
A1 Scale: 1:125 A1 / 1:250 A3	Checked: PDS	Approved: PDS

Project Number: 44303-PBA-XX-C-DR

Drawing Number: 500-S0

Revision: 1

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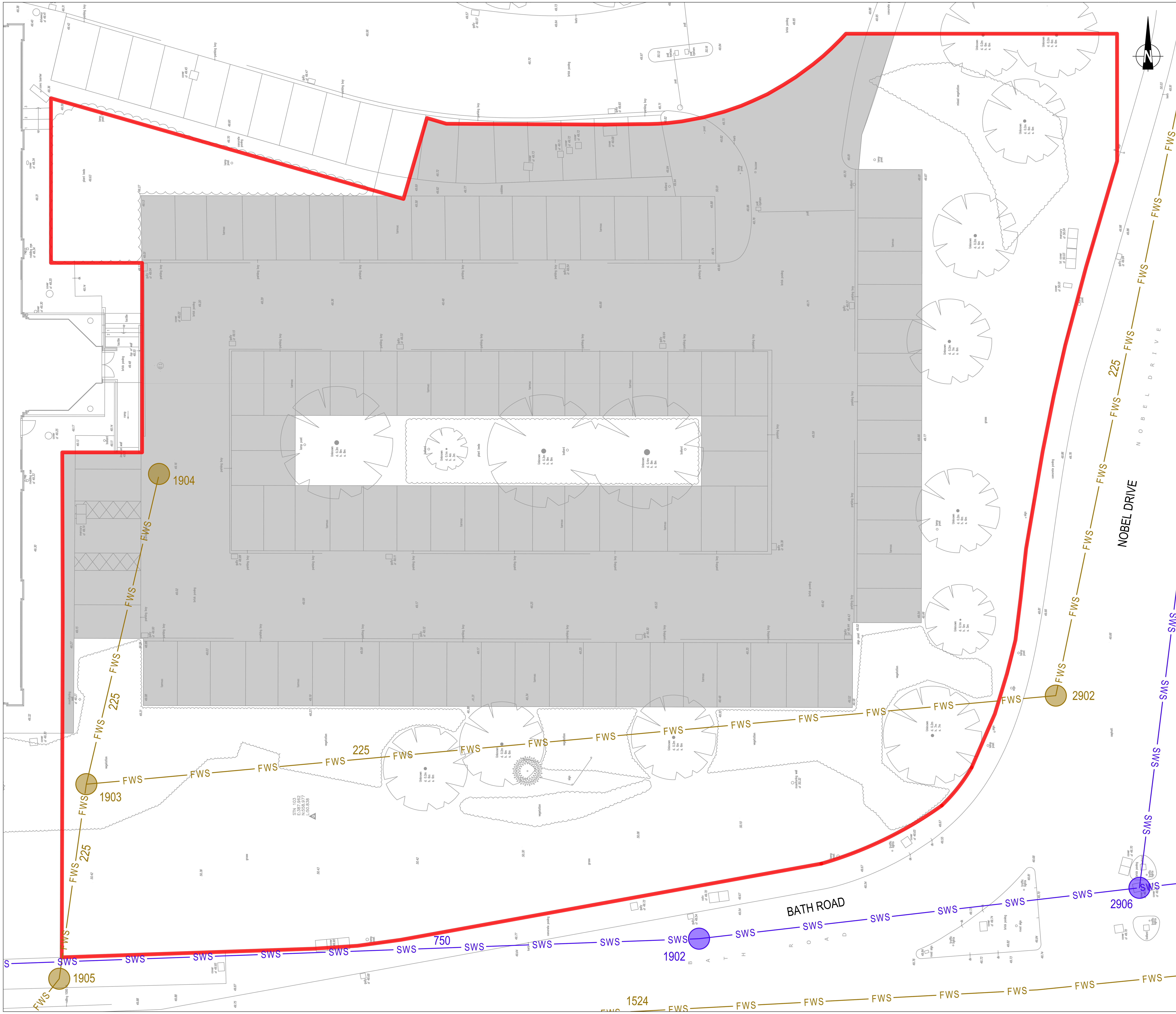
LONDON
Tel: 020 3824 6600

J:\44303 Land Adjacent to Building 2 - Heathrow\5. Drawings & Models\CAD\Civils\44303-PBA-XX-C-DR-500-S0 - EXISTING DRAINAGE CATCHMENTS.dwg, 11/12/2018 17:12:08, DWG To PDF.pc3



GENERAL NOTES:

1. PROPOSED ARCHITECTURAL LAYOUT AND SITE BOUNDARY RECEIVED FROM COLLARDO COLLINS ARCHITECTS (18032 P1-100 REV P6) ON 06.12.2018
2. PROPOSED LANDSCAPE LAYOUT (BD 0205 SD801 R02) RECEIVED FROM BD LANDSCAPE ARCHITECTS 28.11.2018
3. TOPOGRAPHICAL SURVEY WAS TAKEN FROM NGM SURVEYS DRAWING NUMBER 3167-01 DATED MARCH 2018, RECEIVED FROM SAVILLS ON 06.11.2018

EXISTING DRAINAGE NOTES:

1. FULL TOPOGRAPHICAL SURVEY IS SHOWN ON THIS PLAN
2. DRAINAGE SHOWN WAS TAKEN FROM THAMES WATER ASSET LOCATION SEARCH (PBA REF 44303) ALS/ALS Standard/2018_3835252, SEARCH DATE 13 JULY 2018

LEGEND:

SITE BOUNDARY
SWS EXISTING SURFACE WATER DRAINAGE FROM ASSET RECORDS
FWS EXISTING FOUL WATER DRAINAGE FROM ASSET RECORDS
EXISTING HARD LANDSCAPING

Mark	Revision	Date	Drawn	Chkd	Appd
1	PLANNING ISSUE	12.12.18	HM	PDS	PDS

SCALING NOTE: Do not scale from this drawing. If in doubt, ask.

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Drawing Issue Status
PLANNING

STATUS PARK, HEATHROW
EXISTING DRAINAGE LAYOUT

Client
MBH HEATHROW LTD

Date of 1st Issue	Designed	Drawn
12.12.2018	HM	HM
A1 Scale	Checked	Approved
1:125 A1 / 1:250 A3	PDS	PDS

Project Number 44303-PBA-XX-C-DR
Drawing Number 501-S0
Revision 1

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GENERAL NOTES:

1. PROPOSED ARCHITECTURAL LAYOUT AND SITE BOUNDARY RECEIVED FROM COLLARDO COLLINS ARCHITECTS (18032 P1-100 REV P6) ON 06.12.2018
2. PROPOSED LANDSCAPE LAYOUT (BD 0205 SD801 R02) RECEIVED FROM BD LANDSCAPE ARCHITECTS 28.11.2018
3. TOPOGRAPHICAL SURVEY WAS TAKEN FROM NGM SURVEYS DRAWING NUMBER 3167-01 DATED MARCH 2018, RECEIVED FROM SAVILLS ON 06.11.2018

PROPOSED DRAINAGE CATCHMENT NOTES:

1. TOPOGRAPHICAL SURVEY IS ONLY SHOWN OUTSIDE OF THE SITE BOUNDARY
2. ALL CATCHMENTS BASED ON PROPOSED ARCHITECTURAL LAYOUT RECEIVED FROM COLLARDO COLLINS ARCHITECTS (18032 P1-100 REV P3) ON 06.11.2018

LEGEND:

- SITE BOUNDARY **(AREA = 3,889m²)**
- PROPOSED BUILDINGS **(AREA = 875m²)**
- PROPOSED HARD LANDSCAPING **(AREA = 1,269m²)**
- PROPOSED SOFT LANDSCAPING **(AREA = 1,745m²)**

Mark	Revision	Date	Drawn	Chkd	Appd
1	PLANNING ISSUE	12.12.18	HM	PDS	PDS

SCALING NOTE: Do not scale from this drawing. If in doubt, ask.

UTILITIES NOTE: The position of any existing public or private sewers, utility services, plant or apparatus shown on this drawing is believed to be correct, but no warranty to this is expressed or implied. Other such plant or apparatus may also be present but not shown. The Contractor is therefore advised to undertake his own investigation where the presence of any existing sewers, services, plant or apparatus may affect his operations.

Drawing Issue Status

PLANNING

STATUS PARK, HEATHROW
PROPOSED DRAINAGE CATCHMENTS

Client

MBH HEATHROW LTD

Date of 1st Issue	Designed	Drawn
12.12.2018	HM	HM
A1 Scale: 1:125 A1 / 1:250 A3	Checked: PDS	Approved: PDS

Project Number: 44303-PBA-XX-C-DR

Drawing Number: 510-S0

Revision: 1

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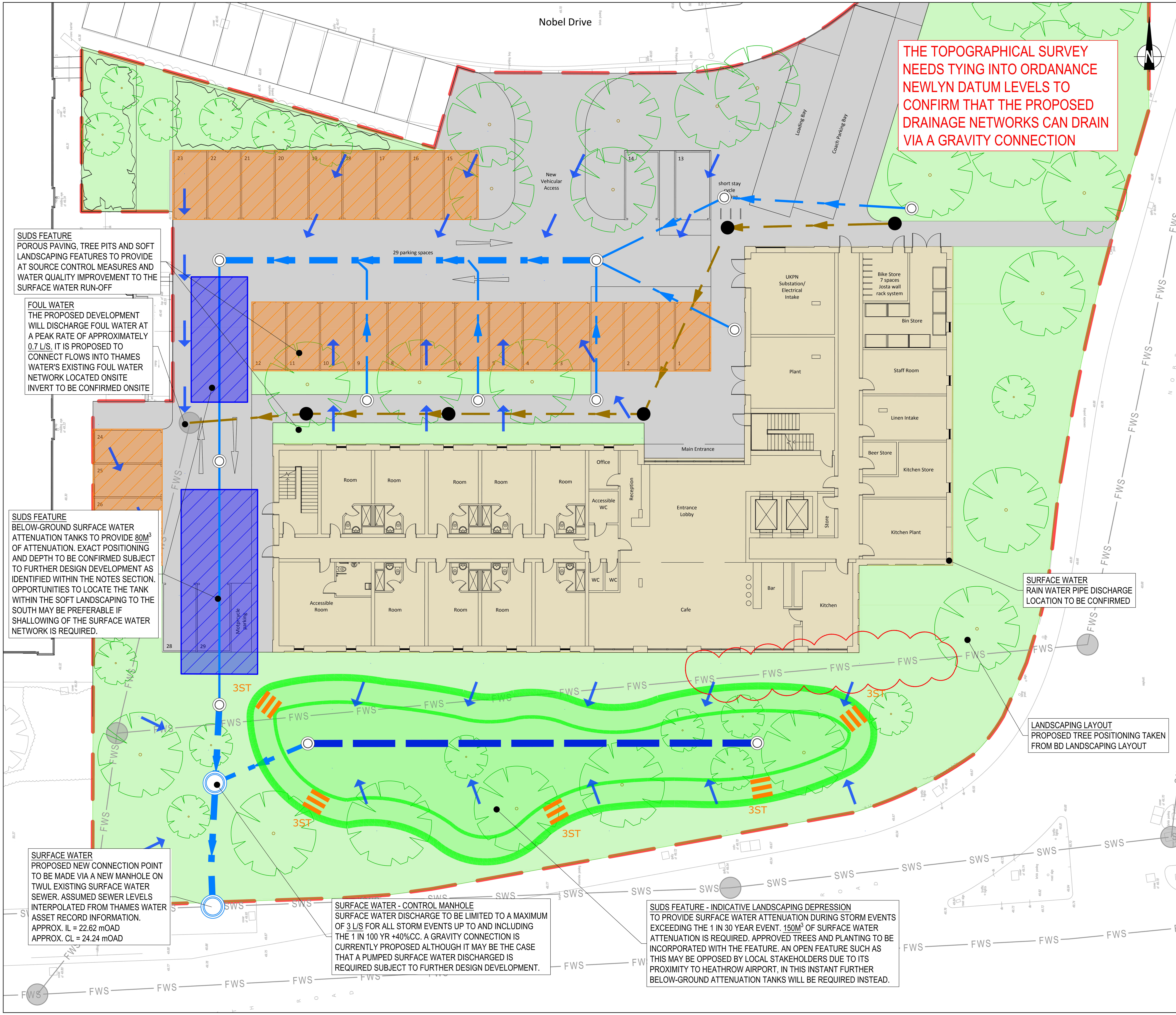
Tel: 020 3824 6600



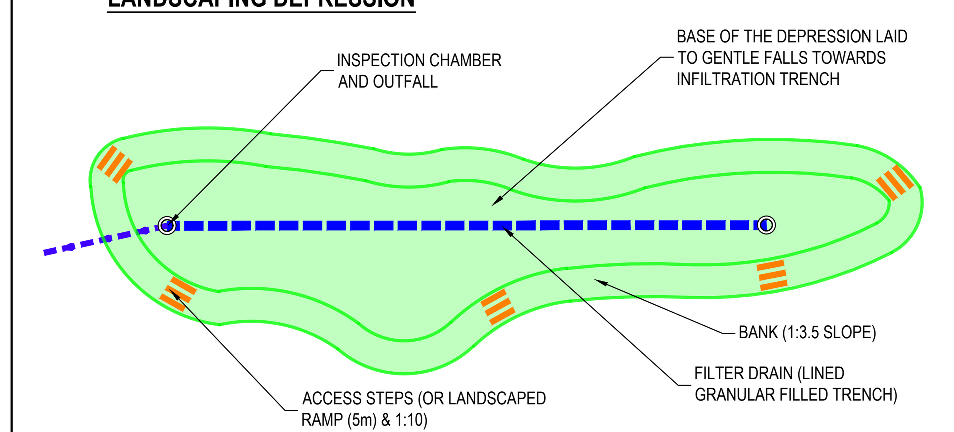
NOTES

1. PROPOSED ARCHITECTURAL LAYOUT AND SITE BOUNDARY RECEIVED FROM COLLARDOCOLLINS ARCHITECTS (P1-100 REV P6) ON 06.12.2018
2. PROPOSED LANDSCAPE LAYOUT (BD 0205 SD801 R02) RECEIVED FROM BD LANDSCAPE ARCHITECTS 28.11.18
3. TOPOGRAPHICAL SURVEY WAS TAKEN FROM NGM SURVEYS DRAWING NUMBER 3167-01 DATED MARCH 2018, RECEIVED FROM SAVILLS ON 06.11.2018
4. THE TOPOGRAPHICAL SURVEY AND PROPOSED LAYOUTS HAVE NOT BEEN PROVIDED TO A GLOBAL COORDINATE SYSTEM, THEREFORE PBA HAVE LOCATED THEM BASED ON COMMON POINTS THE ACCURACY OF WHICH NEED VERIFICATION
5. THE LOCATION AND SIZE OF THE SURFACE WATER ATTENUATION FEATURES, SUDS AND THE SURFACE WATER DRAINAGE NETWORK ARE INDICATIVE ONLY AND SUBJECT TO FURTHER DESIGN DEVELOPMENT AND COORDINATION WITH THE DESIGN TEAM
6. EXISTING AND PROPOSED UTILITIES AND DRAINAGE WILL REQUIRE COORDINATION AT THE NEXT STAGE. DIVERSIONS OF EXISTING SERVICES MAY BE REQUIRED
7. IT IS PROPOSED TO DISCHARGE SURFACE WATER (AT A PROPORTION OF THE SITE'S GREENFIELD RUN-OFF RATE) TO A NEW THAMES WATER (TWUL) SURFACE WATER MANHOLE CONSTRUCTION WITHIN BATH ROAD'S NORTHERN FOOTWAY
8. THE DEVELOPMENT'S SURFACE WATER ATTENUATION REQUIREMENT IS $240M^3$ BASED ON A THREE TIMES GREENFIELD DISCHARGE RATE OF 3.0 L/S FOR THE 1 IN 100 ANNUAL PROBABILITY STORM EVENT + 40% CC. CALCULATIONS ARE BASED ON A INNOVYZE MICRODRAINAGE MODEL, USING AN IMPERMEABLE AREA OF 0.223 HA
9. SURFACE WATER RUN-OFF IS PROPOSED TO BE ATTENUATED WITHIN THE PIPE NETWORK, BELOW-GROUND ATTENUATION CRATES AND LANDSCAPING DEPRESSION, THE SURFACE WATER STRATEGY LOOKS TO CONVEY AND ATTENUATE SURFACE WATER RUN-OFF DURING THE 1 IN 30 YEAR STORM WITHIN THE BELOW GROUND NETWORK
10. NEXT STEPS WORKING TOWARDS STAGE 3 DESIGN:
    - 10.1. CCTV DRAINAGE SURVEY TO CONFIRM EXISTING DRAINAGE EXTENTS AND CONNECTION LOCATIONS. EXACT LOCATION OF TWUL'S ADOPTABLE DRAINAGE NETWORK ONSITE TO BE CONFIRMED
    - 10.2. DEVELOPMENT OF SITE'S PROPOSED EXTERNAL TO ASSESS IF A GRAVITY SURFACE WATER OUTFALL CAN BE IMPLEMENTED
    - 10.3. SOAKAWAY TESTING TO BE CARRIED OUT (BRE 365)

LEGEND

SITE BOUNDARY
SWS — EXISTING SURFACE WATER SEWER
FWS — EXISTING FOUL WATER SEWER
PROP. PRIVATE SURFACE WATER DRAIN
PROP. PRIVATE FOUL WATER DRAIN
PROP. FILTER DRAIN
OVERLAND SURFACE WATER FLOW DIRECTION
BELOW-GROUND SURFACE WATER ATTENUATION CRATES
POROUS PARKING AREAS
3ST — STEPS
POSSIBLE BUILD-OVER AGREEMENT TO BE DISCUSSED WITH THAMES WATER. LATERAL DRAINAGE / ADOPTABLE SEWERS TO BE LOCATED 1.5M FROM PILE FOUNDATION (OUTSIDE FACE TO OUTSIDE FACE)

LANDSCAPING DEPRESSION



Mark	Revision	Date	Drawn	Chkd	Appd
2	PLANNING	12.12.18	HM	KG	PDS
1	DRAFT FOR COMMENTS	28.11.18	HM	PDS	-

SCALING NOTE: Do not scale from this drawing. If in doubt, ask.

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Drawing Issue Status
PLANNING

STATUS PARK, HEATHROW
PROPOSED DRAINAGE STRATEGY

Client
MBH HEATHROW LTD

Date of 1st Issue	Designed	Drawn
28.11.18	HM	HM
A1 Scale 1:125	Checked PDS	Approved PDS

Project Number 44303-PBA-XX-C-DR
Drawing Number 511-S0
Revision 2

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Tel: 020 3824 6600

Appendix G Drainage Calculations

FEH Greenfield Runoff

Per Hectare

Using 2008 QMED Equation

Project Title	Status Park, Nobel Drive, Harlington, UB3 5EY
Project No	44303

Methodology as set out in SuDS Manual 24.3.2 — [SUDS Manual Chapter 24]

1 Retrieve FEH Catchment Information

Export point data from FEH Webs Service as .XML file and save in project folder

Catchment Descriptors	**BFIHOST**	0.722		*see note 1*
	SAAR	610.0		*see note 1*
	FARL	1.0		*see note 2*

2 Derive QBAR (mean annual flood)

Define area	**Site Area**	0.3	ha	
	Applied Area	50.0	ha	*see note 3*
FEH Index Flood (SuDS Manual Equation 24.2)	**QMED (Q_2)**	0.3	l/s	*see note 4*
Calculate QBAR by dividing QMED by 2yr growth factor	**QBAR**	0.3	l/s	*see note 5*

3 Select appropriate growth factors

FSR Hydrological Region		6	*(refer to FSR Hydrological Region tab)*
100yr Growth Curve Factor	**GQ_{100}**	3.19	
30yr Growth Curve Factor	**GQ_{30}**	2.40	
10yr Growth Curve Factor	**GQ_{10}**	1.62	
2yr Growth Curve Factor	**GQ_2**	0.88	
1yr Growth Curve Factor	**GQ_1**	0.85	

Figure 24.1 Hydrological areas

4 Derive Flood Frequency

Greenfield Runoff per 1ha

100yr Peak Runoff Rate	**Q_{100}**	1.0	l/s	**Q_{100}**	3.1	l/s/ha
30yr Peak Runoff Rate	**Q_{30}**	0.8	l/s	**Q_{30}**	2.3	l/s/ha
10yr Growth Curve Factor	**Q_{10}**	0.5	l/s	**Q_{10}**	1.6	l/s/ha
QBAR Peak Runoff Rate	**QBAR**	0.3	l/s	**Q_{BAR}**	1.0	l/s/ha
2yr Peak Runoff Rate	**Q_2**	0.3	l/s	**Q_2**	0.9	l/s/ha
1yr Peak Runoff Rate	**Q_1**	0.3	l/s	**Q_1**	0.8	l/s/ha

Location of FEH Point Data (as Hyperlink) — J:\44303 Land Adjacent to Building 2 - Heathrow\6.

DOCUMENT ISSUE RECORD

Rev	Comments	Prepared	Date	Checked	Date
1	FEH Calculations	HM	23.11.18	CW	11.12.18

Sheet created by Alex Bearne

Last updated 30.01.18 Recommended Review 30.07.18

Notes This spreadsheet has been created to allow derivation of greenfield runoff rates using the FEH statistical method applied in a manner consistent with the recommendations of the SuDS Manual. If you have recommendations to improve this spreadsheet please contact the owner.

Note 1 FEH Web version 3 allows extraction of BFIHOST and SAAR values for each square kilometre grid If you do not think the BFIHOST value is representative of your site then it is possible to derive it manually. This should only very occasionally be necessary. BFI can be derived manually using the the methodology set out in the Flood Estimation Handbook (see *Manual Derivation of BFIHOST tab).*

Note 2 FARL value is a measure of attenuation from reservoirs and lakes for the majority of studies this should be set to 1 (representing no attenuation). If your site includes a large water body with an attenuating affect on runoff please consult a hydrologist.
FARL is a measurement of studies water bodies in the catchment so that their attenuation effects so this term becomes 1.0 and therefore drops out. (see page 23 of the Preliminary rainfall runoff management for developments EA/Defra 2013)
Rainfall runoff management for developments.pdf

Note 3 If the site area is less than 50 hectare the spreadsheet will calculate QMED for 50ha and scale the results automatically to the defined Site Area

Note 4 QMED is calculated using the statistical equation as revised by Kjeldsen in 2008

$$Q_{MED} = 8.3062 AREA^{0.8510} . 0.1536^{(1000/SAAR)} . FARL^{3.4451} . 0.0460^{BFIHOST^2}$$

Rainfall runoff management for developments.pdf
It is reproduced as Equation 24.2 in the SUDS Manual (pg 512)

Note 5 QBAR is calculated by dividing QMED by the growth factor for the 2 year event, as per the methodology set out in paragraph 6.2.2 of 'Rainfall runoff management for developments' . QBAR is then used as the index flood for the basis of applying the growth factors.

Checked by Natasha Vaughan, Clare Waller, David Collis

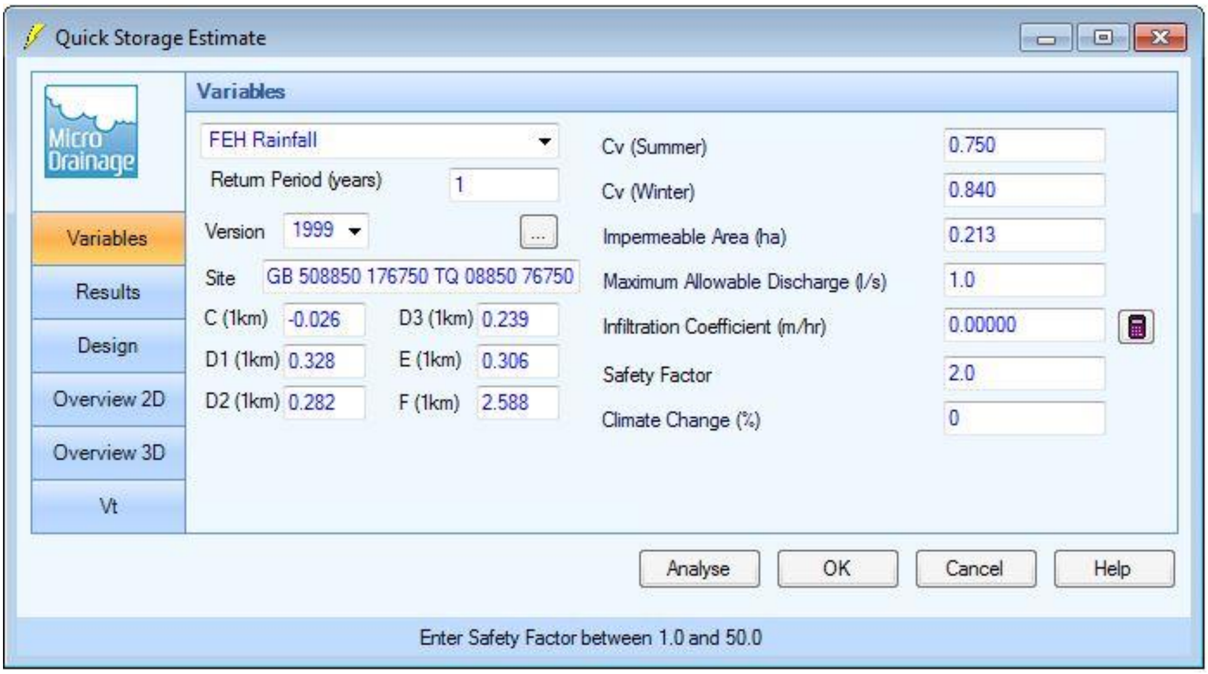
Quick Storage Attenuation Estimates

Status Park Heathrow

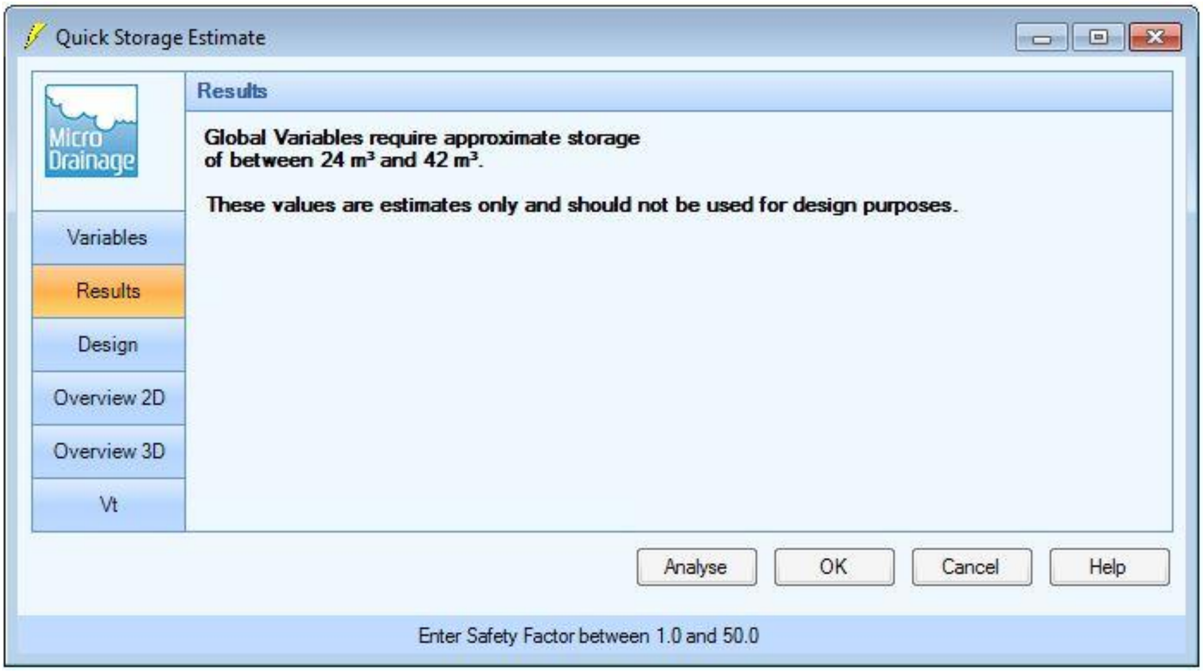
H. Millar

23.11.18

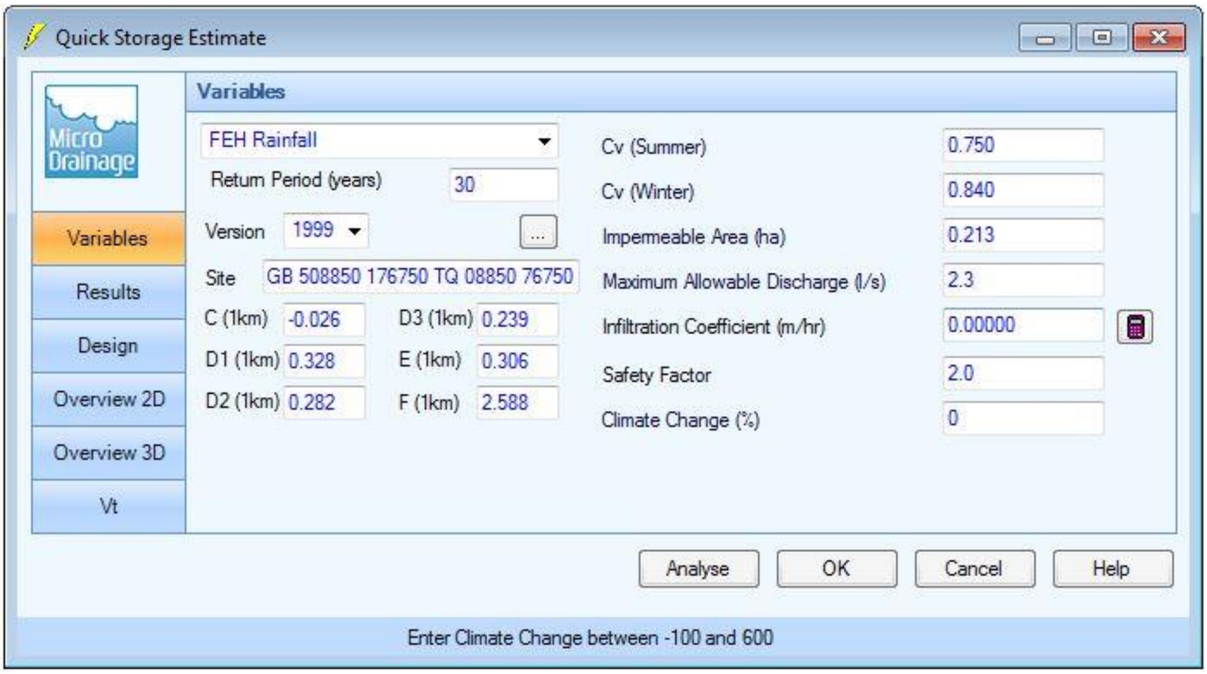
1 in 1 Calc



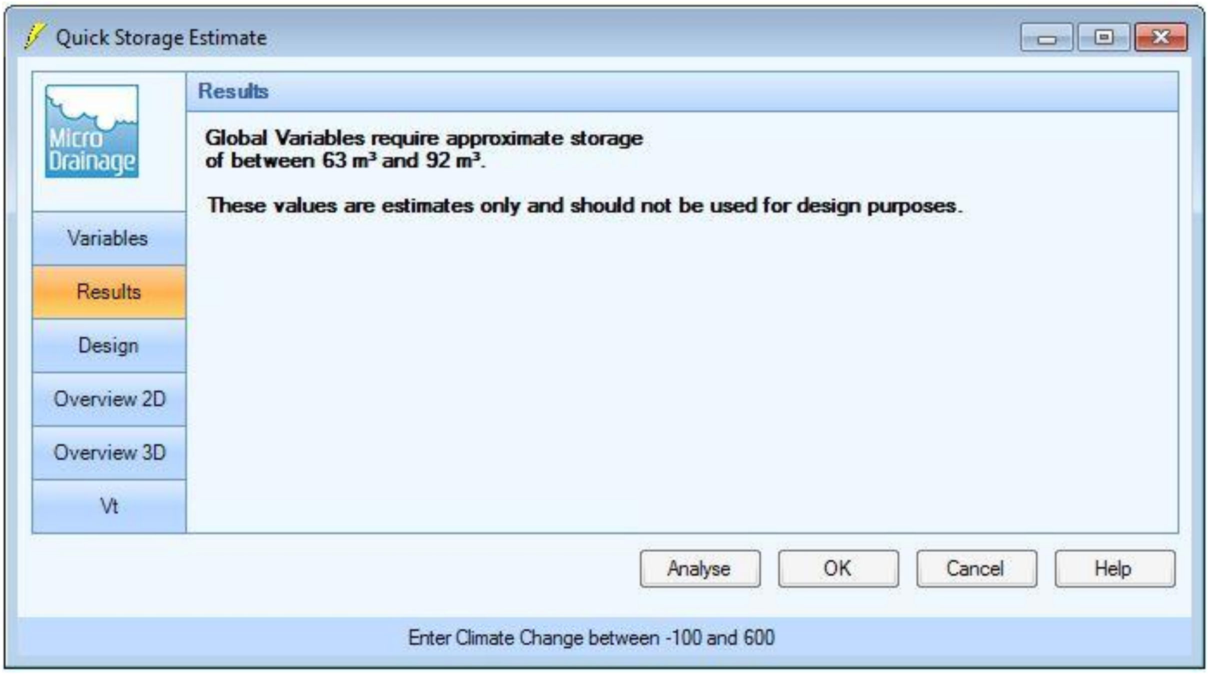
1 in 1 Result



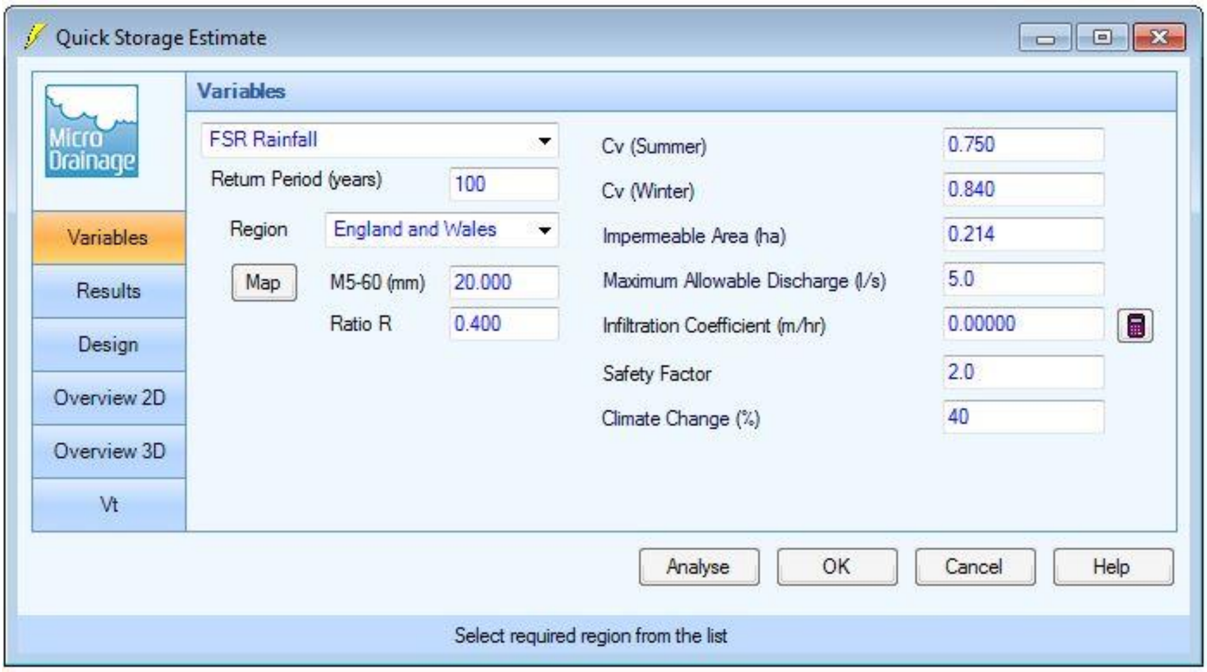
1 in 30 Calc



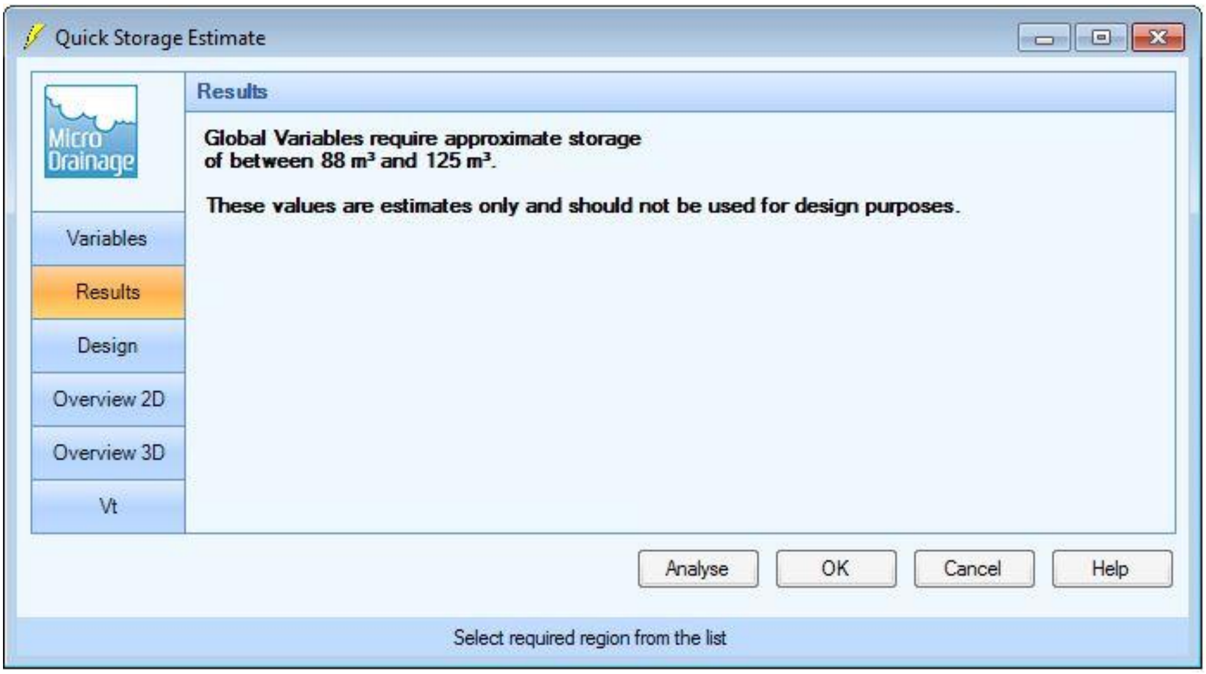
1 in 30 Result



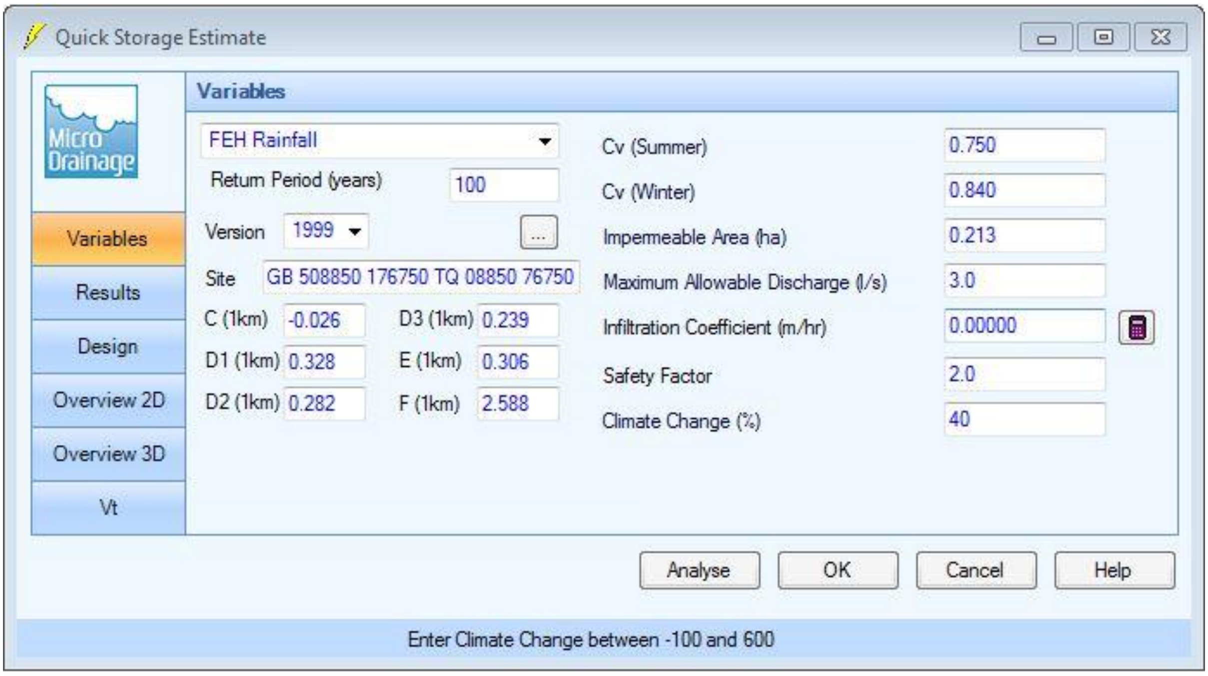
1 in 100 Calc



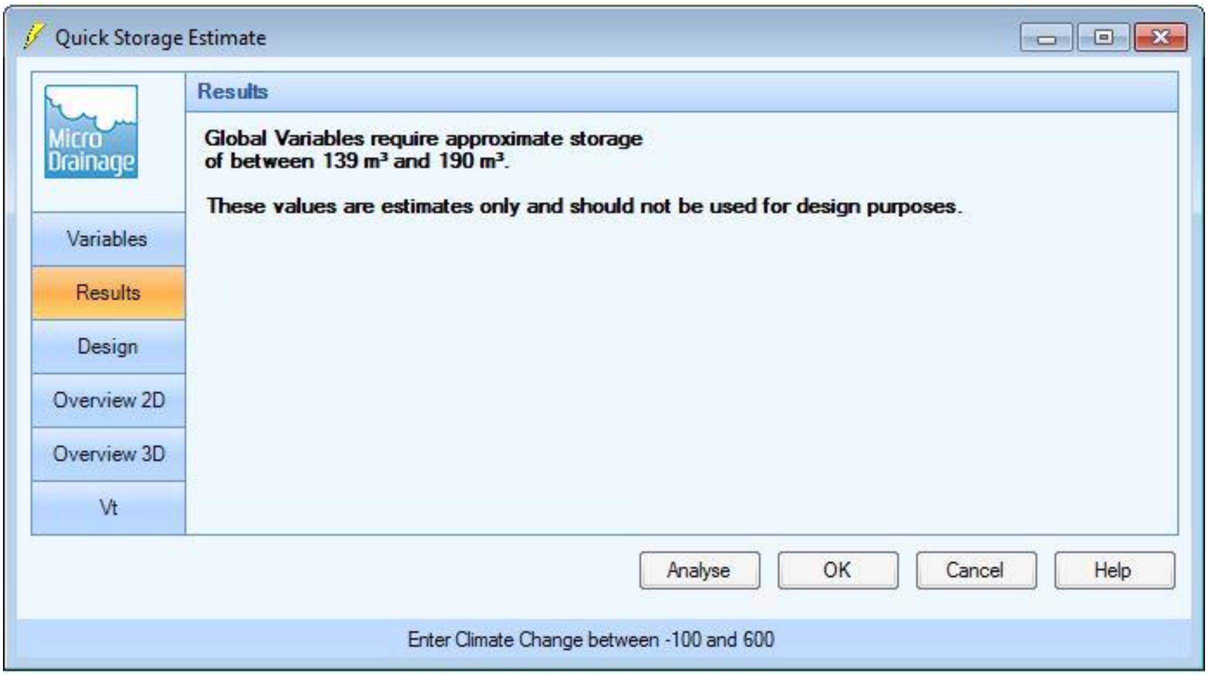
1 in 100 Result



1 in 100 + 40% Calc



1 in 100 + 40% Result



SUDS MAINTENANCE SCHEDULES

1.1 SUDS Maintenance Regime

Geo-cellular Attenuation Tank

1.1.1 Tanks are proposed to store the surface water runoff from several sub catchments as shown on PBA Proposed Drainage drawing 44303-PBA-XX-C-DR-511-S0-2.

1.1.2 The outfall from the tanks will be controlled by a hydro-brake, or other similar flow control device.

1.1.3 Table 1 details the proposed maintenance regime for the geo-cellular attenuation tanks. Further details on the maintenance of these will be provided during the later stages of the project.

1.1.4 Geo-cellular attenuation cells are proposed to provide the majority of the attenuation volume requirements for buildings and private landscape areas, and are expected to be maintained by a private management company.

Table.1 - Maintenance Schedule for Geo-Cellular Tanks

Maintenance Schedule	Required Action	Recommended Frequency
Regular Maintenance	Inspect and identify any areas that are not operating correctly. If required take remedial action	Monthly for 3 months and then 3 monthly intervals
	Debris removal from catchment surface (where may cause risks to performance)	Monthly
	Remove sediment from pre-treatment structures (i.e. catchpits proposed immediately upstream of the geo-cellular tanks)	3 monthly intervals, as required
Remedial actions	Repair/rehabilitation of inlets, outlets, overflows and vents	As required
Monitoring	Inspect/check all inlets, outlets, vents and overflows to ensure that they are in good condition and operating as designed	Annually and after major storms

Porous Paving Systems

1.1.5 Porous paving systems are proposed in several private parking areas as identified in drawing 44303-PBA-XX-C-DR-511-S0-2.

1.1.6 Due to the low infiltration rates expected on site, any areas of porous paving area proposed to be designed to paving system type C (no infiltration) as per BS 7533-13. This would mean the sub-base would be bound by an impermeable geo-membrane.

1.1.7 There is the opportunity to construct the parking bays across site in permeable block paving. In these instances, the system will fulfil the role normally performed by road gullies, whereby rainwater landing on surrounding hard impermeable surfaces will runoff towards the permeable block paving by cross falls and long falls designed in the road and footway. The system acts as a source control for the runoff, providing some degree of water treatment, and offering potential to attenuate within the open-graded crushed rock subbase.

1.1.8 The storage capacity of the permeable paving is not included in attenuation calculations to take a conservative approach at this early design stage.

SUDS MAINTENANCE SCHEDULES

1.1.9 Table 2 details the proposed maintenance regime for the porous paving systems. Further details on the maintenance of the porous paving systems will be provided at the later stages of the project.

Table.2 - Maintenance Schedule for Porous Paving

Maintenance Schedule	Required Action	Recommended Frequency
Regular Maintenance	Brushing and vacuuming (standard cosmetic sweep over whole surface)	Once a year, after autumn leaf fall, or reduced frequency as required, based on site-specific observations of clogging or manufacturer's recommendations – pay particular attention to areas where water runs onto pervious surface from adjacent impermeable areas as this area is most likely to collect the most sediment
Occasional Maintenance	Stabilise and mow contributing and adjacent areas	As required.
	Removal of weeds or management using glyphospate applied directly into the weeds by an applicator rather than spraying	As required – once per year on less frequently used pavements
Remedial Actions	Remediate any landscaping which, through vegetation maintenance or soil slip, has been raised to within 50 mm of the level of the paving	As required
	Remedial work to any depressions, rutting and cracked or broken blocks considered detrimental to the structural performance or a hazard to users, and replace lost jointing material	As required
	Rehabilitation of surface and upper substructure by remedial sweeping	Every 10 to 15 years or as required (if infiltration performance is reduced due to significant clogging)
Monitoring	Initial inspection	Monthly for three months after installation
	Inspect for evidence of poor operation and/or weed growth – if required, take remedial action	Three-monthly, 48 h after large storms in first six months
	Inspect silt accumulation rates and establish appropriate brushing frequencies	Annually
	Monitor inspection chambers	Annually

Rain Gardens and Bio-retention Areas

1.1.10 Where feasible, hardstanding areas will be designed to drain into adjacent soft landscaping areas. Sometimes this can avoid the use of a built drainage system; but where required, a land-drain or overflow pipe will be provided. Draining surface water runoff to landscaping areas can also have the added benefits of nourishing planting areas and by reducing the overall volume of surface water runoff entering the below ground drainage system by infiltration, absorption and evapotranspiration.

1.1.11 As referenced above due to the assumed limited infiltration rates expected on site, it may be the case that the landspacing depression as proposed on PBA drawing 44303-PBA-XX-C-DR-511-S0-2 could be bound by an impermeable geo-membrane.

1.1.12 Table 3 details the proposed maintenance regime for rain gardens and bio-retention areas. Further details on the maintenance of these will be provided at the later stages of the project.

Table 3 - Maintenance Schedule for Rain Gardens and Bio-Retention Areas

Maintenance Schedule	Required Action	Recommended Frequency
Regular Maintenance	Remove litter and debris	Monthly (or as required)
	Manage other vegetation and remove nuisance plant	Monthly (at start, then as required)
	Inspect inlets and outlets	Inspect Monthly
Occasional Maintenance	Check tree health and manage tree appropriately	Annually
	Remove silt build-up from inlets and surface and replace mulch as necessary	Annually, or as required
Monitoring	Inspect silt accumulation rates and establish appropriate removal frequencies	Half yearly

Filter Drains

1.1.13 Filter drains are gravelled strips which allow rain water to infiltrate into the sub-base below. As with ‘soft’ drainage features, such as rain gardens, discussed above, filter drains will be under drained with a perforated pipe and connected to the below ground drainage network. These provide water quality benefits as the filtration provides some level of treatment to the percolating runoff. There is also opportunity to use the sub base to attenuate runoff.

1.1.14 Table 4 Detailed the proposed maintenance regime for the filter drains. Further details on the maintenance of the filter drains will be provided at the later stages of the project.

Table 4 - Maintenance Schedule for Filter Drains

Maintenance Schedule	Required Action	Recommended Frequency
Regular Maintenance	Remove litter (including leaf litter) and debris from filter drain surface, access chambers and pre-treatment devices	Monthly (or as required)
	Inspect filter drain surface, inlet/outlet pipework and control systems for blockages, clogging, standing water and structural damage	Monthly
	Inspect pre-treatment systems, inlets and perforated pipework for silt accumulation, and establish appropriate silt removal frequencies	Six-monthly
	Remove sediment from pre-treatment devices	Six-monthly, or as required
Occasional Maintenance	Remove or control tree roots where they are encroaching the sides of the filter drain, using recommended methods (eg NJUG, 2007 or BS 3998:2010)	As required
	At locations with high pollution loads, remove surface geotextile and replace, and wash or replace overlying filter medium	Five yearly, or as required
	Clear perforated pipework of blockages	As required

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
FEH Rainfall Version	1999
Site Location	GB 508850 176750 TQ 08850 76750
C (1km)	-0.026
D1 (1km)	0.328
D2 (1km)	0.282
D3 (1km)	0.239
E (1km)	0.306
F (1km)	2.588
Maximum Rainfall (mm/hr)	50
Maximum Time of Concentration (mins)	30
Foul Sewage (l/s/ha)	0.000
Volumetric Runoff Coeff.	0.750
PIMP (%)	100
Add Flow / Climate Change (%)	40
Minimum Backdrop Height (m)	0.200
Maximum Backdrop Height (m)	1.500
Min Design Depth for Optimisation (m)	1.200
Min Vel for Auto Design only (m/s)	1.00
Min Slope for Optimisation (1:X)	500

Designed with Level Soffits

Time Area Diagram for Storm

Time (mins)	Area (ha)	Time (mins)	Area (ha)
0-4	0.175	4-8	0.051

Total Area Contributing (ha) = 0.226

Total Pipe Volume (m³) = 21.559

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

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)

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	43.807	0.292	150.0	0.182	4.00	0.0	0.600	o	450	Pipe/Conduit	
S1.001	22.581	0.151	150.0	0.003	0.00	0.0	0.600	o	450	Pipe/Conduit	
S2.000	41.366	0.276	149.9	0.041	4.00	0.0	0.600	o	450	Pipe/Conduit	
S1.002	24.134	0.161	150.0	0.000	0.00	0.0	0.600	o	450	Pipe/Conduit	
S1.003	3.666	0.024	150.0	0.000	0.00	0.0	0.600	o	450	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	50.00	4.44	48.700	0.182	0.0	0.0	9.9	1.66	263.6	34.5
S1.001	50.00	4.67	48.408	0.185	0.0	0.0	10.0	1.66	263.6	35.1
S2.000	50.00	4.42	48.257	0.041	0.0	0.0	2.2	1.66	263.8	7.7
S1.002	50.00	4.91	47.981	0.226	0.0	0.0	12.2	1.66	263.6	42.8
S1.003	50.00	4.95	47.820	0.226	0.0	0.0	12.2	1.66	263.7	42.8

Area Summary for Storm

Pipe Number	PIMP Type	PIMP Name	PIMP (%)	Gross Area (ha)	Imp. Area (ha)	Pipe Total (ha)
1.000	Classification	Roads	80	0.228	0.182	0.182
1.001	Classification	Landscaping	25	0.011	0.003	0.003
2.000	Classification	Landscaping	25	0.149	0.037	0.037
	Classification	Landscaping	25	0.014	0.004	0.041
1.002	-	-	100	0.000	0.000	0.000
1.003	-	-	100	0.000	0.000	0.000
				Total	Total	Total
				0.402	0.226	0.226

Network Classifications for Storm

PN	USMH Name	Pipe Dia (mm)	Min Cover Depth (m)	Max Cover Depth (m)	Pipe Type	MH Dia (mm)	MH Width (mm)	MH Ring Depth (m)	MH Type
S1.000	S1	450	0.850	0.942	Unclassified	1350	0	0.850	Unclassified
S1.001	S2	450	0.793	0.942	Unclassified	1350	0	0.942	Unclassified
S2.000	S3	450	0.793	1.069	Unclassified	1350	0	0.793	Unclassified
S1.002	S3	450	0.930	1.069	Unclassified	1350	0	1.069	Unclassified
S1.003	S4	450	0.930	0.954	Unclassified	1350	0	0.930	Unclassified

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)
S1.003	S	49.200	47.796	0.000	0	0

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

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	40.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coeffiecient	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	0
Number of Online Controls	0	Number of Time/Area Diagrams	3
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FEH
FEH Rainfall Version	1999
Site Location	GB 508850 176750 TQ 08850 76750
C (1km)	-0.026
D1 (1km)	0.328
D2 (1km)	0.282
D3 (1km)	0.239
E (1km)	0.306
F (1km)	2.588
Cv (Summer)	0.750
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)	30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440
Return Period(s) (years)	1, 30, 100
Climate Change (%)	0, 0, 0

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
S1.000	S1	30 Summer	1	+0%					48.810
S1.001	S2	30 Summer	1	+0%					48.523
S2.000	S3	180 Winter	1	+0%					48.265
S1.002	S3	30 Summer	1	+0%					48.095
S1.003	S4	30 Summer	1	+0%					47.970

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

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
S1.000	S1	-0.340	0.000	0.13		31.6	OK	
S1.001	S2	-0.335	0.000	0.15		32.1	OK	
S2.000	S3	-0.442	0.000	0.00		0.9	OK	
S1.002	S3	-0.336	0.000	0.15		32.0	OK	
S1.003	S4	-0.300	0.000	0.24		32.2	OK	

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

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	40.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coeffiecient	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	0
Number of Online Controls	0	Number of Time/Area Diagrams	3
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FEH
FEH Rainfall Version	1999
Site Location	GB 508850 176750 TQ 08850 76750
C (1km)	-0.026
D1 (1km)	0.328
D2 (1km)	0.282
D3 (1km)	0.239
E (1km)	0.306
F (1km)	2.588
Cv (Summer)	0.750
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)	30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440
Return Period(s) (years)	1, 30, 100
Climate Change (%)	0, 0, 0

PN	**US/MH Name**	**Storm**	**Return Period**	**Climate Change**	**First (X) Surcharge**	**First (Y) Flood**	**First (Z) Overflow**	**Overflow Act.**	**Water Level (m)**
S1.000	S1	30 Summer	30	+0%					48.901
S1.001	S2	30 Summer	30	+0%					48.618
S2.000	S3	180 Winter	30	+0%					48.278
S1.002	S3	30 Summer	30	+0%					48.190
S1.003	S4	30 Summer	30	+0%					48.106

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

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
S1.000	S1	-0.249	0.000	0.40		94.4	OK	
S1.001	S2	-0.240	0.000	0.44		96.3	OK	
S2.000	S3	-0.429	0.000	0.01		2.4	OK	
S1.002	S3	-0.241	0.000	0.44		95.6	OK	
S1.003	S4	-0.165	0.000	0.72		96.4	OK	

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

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	40.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coeffiecient	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	0
Number of Online Controls	0	Number of Time/Area Diagrams	3
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FEH
FEH Rainfall Version	1999
Site Location	GB 508850 176750 TQ 08850 76750
C (1km)	-0.026
D1 (1km)	0.328
D2 (1km)	0.282
D3 (1km)	0.239
E (1km)	0.306
F (1km)	2.588
Cv (Summer)	0.750
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)	30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440
Return Period(s) (years)	1, 30, 100
Climate Change (%)	0, 0, 0

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
S1.000	S1	30 Summer	100	+0%					48.954
S1.001	S2	30 Summer	100	+0%					48.675
S2.000	S3	30 Summer	100	+0%					48.291
S1.002	S3	30 Summer	100	+0%					48.273
S1.003	S4	30 Summer	100	+0%					48.217

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

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
S1.000	S1	-0.196	0.000	0.59		140.0	OK	
S1.001	S2	-0.183	0.000	0.66		142.7	OK	
S2.000	S3	-0.416	0.000	0.01		2.1	OK	
S1.002	S3	-0.158	0.000	0.62		137.3	OK	
S1.003	S4	-0.053	0.000	1.00		133.1	OK	

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
FEH Rainfall Version	1999
Site Location	GB 508850 176750 TQ 08850 76750
C (1km)	-0.026
D1 (1km)	0.328
D2 (1km)	0.282
D3 (1km)	0.239
E (1km)	0.306
F (1km)	2.588
Maximum Rainfall (mm/hr)	50
Maximum Time of Concentration (mins)	30
Foul Sewage (l/s/ha)	0.000
Volumetric Runoff Coeff.	0.750
PIMP (%)	100
Add Flow / Climate Change (%)	40
Minimum Backdrop Height (m)	0.200
Maximum Backdrop Height (m)	1.500
Min Design Depth for Optimisation (m)	1.200
Min Vel for Auto Design only (m/s)	1.00
Min Slope for Optimisation (1:X)	500

Designed with Level Soffits

Time Area Diagram for Storm

Time (mins)	Area (ha)	Time (mins)	Area (ha)
0-4	0.199	4-8	0.024

Total Area Contributing (ha) = 0.223

Total Pipe Volume (m^3) = 8.556

Area Summary for Storm

Pipe Number	PIMP Type	PIMP Name	PIMP (%)	Gross Area (ha)	Imp. Area (ha)	Pipe Total (ha)
1.000	Classification	Landscaping	25	0.032	0.008	0.008
1.001	-	-	100	0.000	0.000	0.000
1.002	-	-	100	0.000	0.000	0.000
1.003	Classification	Landscaping	25	0.012	0.003	0.003
	Classification	Roads	80	0.125	0.100	0.103
	Classification	Landscaping	25	0.007	0.002	0.105
	Classification	Roof	90	0.088	0.080	0.184
1.004	-	-	100	0.000	0.000	0.000
1.005	-	-	100	0.000	0.000	0.000
1.006	Classification	Landscaping	25	0.123	0.031	0.031
1.007	-	-	100	0.000	0.000	0.000
1.008	-	-	100	0.000	0.000	0.000
				Total	Total	Total
				0.388	0.223	0.223

Network Classifications for Storm

PN	USMH Name	Pipe Dia (mm)	Min Cover Depth (m)	Max Cover Depth (m)	Pipe Type	MH Dia (mm)	MH Width (mm)	MH Ring Depth (m)	MH Type
S1.000	S1	150	1.313	1.350	Unclassified	1200	0	1.350	Unclassified
S1.001	S2	150	1.308	1.313	Unclassified	1200	0	1.313	Unclassified
S1.002	S3	375	1.308	1.466	Unclassified	1350	0	1.308	Unclassified
S1.003	S4	375	1.466	1.516	Unclassified	1350	0	1.466	Unclassified
S1.004	S5	375	1.495	1.516	Unclassified	1350	0	1.516	Unclassified
S1.005	S6	375	1.444	1.495	Unclassified	1350	0	1.495	Unclassified
S1.006	S7	375	1.436	1.444	Unclassified	1350	0	1.444	Unclassified
S1.007	S8	375	1.396	1.436	Unclassified	1350	0	1.436	Unclassified
S1.008	S9	375	1.396	1.451	Unclassified	1350	0	1.396	Unclassified

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)
S1.008	S	49.200	47.374	0.000	225	0

Online Controls for Storm

Hydro-Brake® Optimum Manhole: S9, DS/PN: S1.008, Volume (m^3): 3.0

Unit Reference	MD-SHE-0073-3000-1700-3000
Design Head (m)	1.700
Design Flow (l/s)	3.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	73
Invert Level (m)	47.429
Minimum Outlet Pipe Diameter (mm)	100
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.700	3.0
Flush-Flo™	0.322	2.4
Kick-Flo®	0.653	1.9
Mean Flow over Head Range	-	2.3

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	1.9	1.200	2.6	3.000	3.9	7.000	5.8
0.200	2.3	1.400	2.7	3.500	4.2	7.500	6.0
0.300	2.4	1.600	2.9	4.000	4.5	8.000	6.2
0.400	2.4	1.800	3.1	4.500	4.7	8.500	6.4
0.500	2.3	2.000	3.2	5.000	5.0	9.000	6.5
0.600	2.1	2.200	3.4	5.500	5.2	9.500	6.7
0.800	2.1	2.400	3.5	6.000	5.4		
1.000	2.4	2.600	3.6	6.500	5.6		

Storage Structures for Storm

Tank or Pond Manhole: S8, DS/PN: S1.007

Invert Level (m) 47.638

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	65.0	1.200	65.0	1.201	0.0

Tank or Pond Manhole: S9, DS/PN: S1.008

Invert Level (m) 48.700

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	216.0	0.500	381.0

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

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	40.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coeffiecient	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	2
Number of Online Controls	1	Number of Time/Area Diagrams	2
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FEH
FEH Rainfall Version	1999
Site Location	GB 508850 176750 TQ 08850 76750
C (1km)	-0.026
D1 (1km)	0.328
D2 (1km)	0.282
D3 (1km)	0.239
E (1km)	0.306
F (1km)	2.588
Cv (Summer)	0.750
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)	30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440
Return Period(s) (years)	1, 30, 100
Climate Change (%)	0, 0, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
S1.000	S1	60 Winter	1	+0%	30/120 Winter				48.520
S1.001	S2	60 Winter	1	+0%	30/60 Winter				48.455
S1.002	S3	60 Winter	1	+0%	30/60 Winter				48.123
S1.003	S4	30 Summer	1	+0%	30/30 Summer				47.969
S1.004	S5	180 Winter	1	+0%	30/30 Summer				47.949
S1.005	S6	180 Winter	1	+0%	30/30 Summer				47.949
S1.006	S7	180 Winter	1	+0%	30/30 Summer				47.950
S1.007	S8	180 Winter	1	+0%	1/30 Winter				47.949
S1.008	S9	120 Winter	1	+0%	1/30 Summer				48.042

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

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
S1.000	S1	-0.130	0.000	0.04		0.5	OK	
S1.001	S2	-0.132	0.000	0.03		0.5	OK	
S1.002	S3	-0.370	0.000	0.00		0.5	OK	
S1.003	S4	-0.265	0.000	0.19		28.6	OK	
S1.004	S5	-0.135	0.000	0.09		9.8	OK	
S1.005	S6	-0.055	0.000	0.09		9.4	OK	
S1.006	S7	-0.006	0.000	0.08		9.6	OK	
S1.007	S8	0.085	0.000	0.06		6.7	SURCHARGED	
S1.008	S9	0.238	0.000	0.02		2.4	SURCHARGED	

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

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	40.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coeffiecient	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	2
Number of Online Controls	1	Number of Time/Area Diagrams	2
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FEH
FEH Rainfall Version	1999
Site Location	GB 508850 176750 TQ 08850 76750
C (1km)	-0.026
D1 (1km)	0.328
D2 (1km)	0.282
D3 (1km)	0.239
E (1km)	0.306
F (1km)	2.588
Cv (Summer)	0.750
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)	30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440
Return Period(s) (years)	1, 30, 100
Climate Change (%)	0, 0, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
S1.000	S1	240 Winter	30	+0%	30/120 Winter				48.743
S1.001	S2	240 Winter	30	+0%	30/60 Winter				48.743
S1.002	S3	240 Winter	30	+0%	30/60 Winter				48.743
S1.003	S4	240 Winter	30	+0%	30/30 Summer				48.743
S1.004	S5	240 Winter	30	+0%	30/30 Summer				48.741
S1.005	S6	240 Winter	30	+0%	30/30 Summer				48.741
S1.006	S7	240 Winter	30	+0%	30/30 Summer				48.740
S1.007	S8	240 Winter	30	+0%	1/30 Winter				48.739
S1.008	S9	240 Winter	30	+0%	1/30 Summer				48.738

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

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
S1.000	S1	0.093	0.000	0.06		0.8	SURCHARGED	
S1.001	S2	0.156	0.000	0.05		0.8	SURCHARGED	
S1.002	S3	0.250	0.000	0.00		0.6	SURCHARGED	
S1.003	S4	0.508	0.000	0.12		17.8	SURCHARGED	
S1.004	S5	0.657	0.000	0.16		17.1	SURCHARGED	
S1.005	S6	0.736	0.000	0.16		16.9	SURCHARGED	
S1.006	S7	0.785	0.000	0.15		18.0	SURCHARGED	
S1.007	S8	0.875	0.000	0.08		8.1	SURCHARGED	
S1.008	S9	0.934	0.000	0.02		2.7	SURCHARGED	

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

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	40.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coeffiecient	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	2
Number of Online Controls	1	Number of Time/Area Diagrams	2
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FEH
FEH Rainfall Version	1999
Site Location	GB 508850 176750 TQ 08850 76750
C (1km)	-0.026
D1 (1km)	0.328
D2 (1km)	0.282
D3 (1km)	0.239
E (1km)	0.306
F (1km)	2.588
Cv (Summer)	0.750
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)	30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440
Return Period(s) (years)	1, 30, 100
Climate Change (%)	0, 0, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
S1.000	S1	30 Winter	100	+40%	30/120 Winter				49.290
S1.001	S2	30 Winter	100	+40%	30/60 Winter				49.284
S1.002	S3	30 Winter	100	+40%	30/60 Winter				49.279
S1.003	S4	30 Winter	100	+40%	30/30 Summer				49.278
S1.004	S5	480 Winter	100	+40%	30/30 Summer				49.151
S1.005	S6	480 Winter	100	+40%	30/30 Summer				49.150
S1.006	S7	480 Winter	100	+40%	30/30 Summer				49.150
S1.007	S8	480 Winter	100	+40%	1/30 Winter				49.149
S1.008	S9	480 Winter	100	+40%	1/30 Summer				49.148

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

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
S1.000	S1	0.640	0.000	0.43		5.5	SURCHARGED	
S1.001	S2	0.697	0.000	0.49		7.7	SURCHARGED	
S1.002	S3	0.786	0.000	0.06		10.6	SURCHARGED	
S1.003	S4	1.044	0.000	1.09		164.9	SURCHARGED	
S1.004	S5	1.067	0.000	0.20		22.6	SURCHARGED	
S1.005	S6	1.146	0.000	0.21		22.5	SURCHARGED	
S1.006	S7	1.194	0.000	0.21		24.8	FLOOD RISK	
S1.007	S8	1.285	0.000	0.22		23.6	FLOOD RISK	
S1.008	S9	1.343	0.000	0.03		3.0	FLOOD RISK	

SuDS Flows and Volumes –
Hillingdon LLFA Technical Assessment Proforma

This form identifies the information required by the LLFA to enable technical assessment of flows and volumes determined as part of drainage / SuDS calculations. *Note : * means delete as appropriate; Numbers in brackets refer to accompanying notes.*

SITE BACKGROUND INFORMATION

1.0 SITE DETAILS AND RELEVANT CLASSIFICIATIONS

1.1 Planning application reference ....TBC....

1.2 Site name ....STATUS PARK, HEATHROW....

1.3 Total application site area (1) ....3,889....m² ....0.3889....ha

1.4 Is the site in an area at SW flood risk, a CDA or LFRZ (see L.B. Hillingdon website SWMP) Y / N

1.5 Is the site located in a SPZ (refer to Environment Agency website Groundwater) Y / N

2.0 VOLUME AND FLOW DESIGN INPUTS

2.1 Site area which is positively drained by SuDS (2) ....m²

2.2 Impermeable area drained pre development (3) ....3,889....m²

2.3 Impermeable area drained post development (3) ....2,133....m²

2.4 Additional impermeable area (2.3 minus 2.2) ....2,144....m²

POROUS PAVING IS PROPOSED WHICH HAS BEEN TREATED AS AN IMPERMEABLE SURFACE AT THIS STAGE OF DESIGN

2.5 Predevelopment use (4) Greenfield / Brownfield / Mixed*

2.6 Coefficient of runoff (Cv) (6) ....

The LLFA would typically anticipate a Cv of 0.95 from roofed areas and a Cv of 0.9 from other hard standing areas.
These values should be applied for both summer and winter scenarios if using hydraulic design software

2.7 Justification for Cv used if less THE FOLLOWING Cv VALUES HAVE BEEN USED AS ADVISED WITHIN MICRODRAINAGE'S GUIDANCE DOCUMENT ROOFS - 0.9, ROADS - 0.8 LANDSCAPING -0.25

2.8 FEH rainfall data used (for Hillingdon typical value 4l/s/ha (Note that FSR not to be used)) Y / N

3.0 DISCHARGE(5)

3.1 Infiltration
Rate (evidence to be supplied to BRE365 as minimum) .m/s
Influencing factors on infiltration ....
Depth to highest known ground water table ....mAOD

GROUND CONDITIONS NOT LIKELY TO ACCEPT INFILTRATION, BRE SOAKAWAY TESTING PROPOSED POST PLANNING TO CONFIRM THIS

Appropriate site investigations should be undertaken at the likely highest ground water level time in the year, as this fluctuates.

3.2 Waterbody
Invert level at outlet (invert level of final flow control) .... N/A ....mAOD
1in 100 year plus CC Waterbody Flood Level ....mAOD
Surcharged outfall Y / N

3.3 Adopted surface water storm sewer (Note no combined sewer in LBH)
Provide confirmation of invert levels at discharge point Y / N

NEW MANHOLE PROPOSED ON TW SEWER.

3.4 Private Sewer
Provide condition and levels of private system and any remediation works Y / N
Provide legal easement agreement, where not within same ownership Y / N

CALCULATION OUTPUTS REQUIRED

Note: Sections 3 and 4 refer to site where storage is provided by attenuation and / or partial infiltration.
Where all flows are infiltrated to ground omit Sections 3 -5 and complete Section 6.

4.0 Defining rate of runoff from the site and betterment. These values must be calculated for each return period and should vary.

	Max Discharge	Greenfield		Existing		Proposed		Reduction
		l/s/ha	l/s for the site	l/s/ha	l/s for the site	l/s/ha	l/s for the site	%
4.1	1 in 1 year rainfall	0.8	0.3		28.4		3.0	90%
4.2	Q_{med} rainfall	1.0	0.3				3.0	96%
4.3	1 in 30 year rainfall	2.3	0.8		85.1		3.0	
4.4	1 in 100 year rainfall	3.1	1.0		124.5		3.0	98%
4.5	1 in 100 year plus 40%CC						3.0	

5.0 Attenuation storage to manage peak runoff rates from the site. These values must be calculated for each

		m^3	m^3/m^2 (of developed impermeable area)
5.1	Storage - 1 in 1 year	8	
5.2	Storage - 1in 30 year (7)	80	0.04
5.3	Storage - 1in 100 year (8)	135	0.06
5.4	**Storage - 1 in 100 year plus 40%CC (10)**	240	0.11

6.0 Controlling volume of runoff from the site

6.1 Pre development runoff volume …………… m^3 for the site

6.2 Post development runoff volume (unmitigated) …………… m^3 for the site

6.3 Volume to be controlled/ does not leave site (5.2 - 5.1) …………… m^3 for the site

6.4 Volume control provided by:
1. Interception losses(12) ………m^3
2. Rain harvesting(13) ………m^3
3. Infiltration (even at very low rates) ………m^3
4. Separate area designated as long term storage(14) ………m^3

6.5 Total volume control (sum of inputs for 5.4 (1-4) ………m^3 (15)

7.0 Site storage volumes (full infiltration only)

7.1 Storage - 1in 30 year (7) ………m^3 ………m^3/m^2 (of developed impermeable area)
7.2 Storage - 1 in 100 year plus CC (8) ………m^3 ………m^3/m^2

SuDS Flows and Volumes – Hillingdon LLFA Technical Assessment Proforma

Notes

1. All area with the proposed application site boundary to be included.
2. The site area which is positively drained, includes all green areas which drain to the SuDS system and area of surface SuDS features. It excludes large open green spaces which do not drain to the SuDS system. http://www.uksuds.com/
3. Impermeable area should be measured pre and post development. Impermeable surfaces includes, roofs, pavements, driveways and paths where runoff is conveyed to the drainage system.
4. Predevelopment use may impact on the allowable discharge rate. The LLFA will seek for reduction in flow rates to GF status in all instances. The design statement and drawings explain / demonstrate how flows will be managed from the site.
5. Runoff may be discharge via one or a number of means.
6. Sewers for Adoption 6th Edition recommends a Cv of 100% when designing drainage for impermeable area (assumes no loss of runoff from impermeable surfaces) and 0% for permeable areas. Where lower Cv's are used the application should justify the selection of Cv.
7. Storage for the 1 in 30 year must be fully contained within the SuDS components. Note that standing water within SuDS components such as ponds, basins and swales is not classified as flooding. Storage should be calculated for the critical duration rainfall event.
8. Runoff generated from rainfall events up to the 1 in 100 year (plus Climate Change) will not be allowed to leave the site in an uncontrolled way.
9. Temporary flooding of specified areas to shallow depths (150-300mm) may be permitted in agreement with the LLFA.
10. Climate change is specified as 40% increase to rainfall intensity, unless otherwise agreed with the LLFA / EA.
11. To be determined using the 100 year return period 6 hour duration rainfall event.
12. Where Source Control is provided Interception losses will occur. An allowance of 5mm rainfall depth can be subtracted from the net inflow to the storage calculation where interception losses are demonstrated. The Applicant should demonstrate use of subcatchments and source control techniques.
13. Please refer to Rainwater harvesting systems BS 8515:2009+A1:2013 for guidance on available storage.
14. Flow diverted to Long term storage areas should be infiltrated to the ground, or where this is not possible, discharged to the receiving water at slow flow rates (maximum 2 l/s/ha). LT storage would not be allowed to empty directly back into attenuation storage and would be expected to drain away over 5-10 days. Typically LT storage may be provided on multi-functional open space or sacrificial car parking areas.
15. Careful consideration should be used for calculations where flow control / storage is likely to be influenced by surcharged sewer or peak levels within a watercourse. Storm sewers are designed for pipe full capacity for 1 in 1 - 1 in 5year return period. Beyond this, the pipe network will usually be in conditions of surcharge. Where information cannot be gathered from Thames Water, engineering judgement should be used to evaluate potential impact (using sensitivity analysis for example).
16. In controlling the volume of runoff the total volume from mitigation measures should be greater than or equal to the additional volume generated.