Chris Christou
CEng MIstructE
Director

Richard Russell
CEng MIstructE
Director

Drainage Strategy
Incorporating SuDS Design Statement

For

Proposed David Lloyd Leisure

At:

Catalyst Development
Wendlebury Road, Chesterton
Bicester, Oxfordshire

Local Authority	– Cherwell District Council
Planning Ref	–19/01740/HYBRID
Lead Local Flood Authority	– Oxfordshire County Council

David Lloyd Leisure Ltd
The Hanger, Mosquito Way,
Hatfield Business Park,
Hatfield, AL10 9AX

20110/nak
R01 30/11/2020

AMA Consulting Engineers
3 Marconi Place, New Southgate
London N11 1PE
T: +44(0)208 361 6827
www.amacl.co.uk

Revision	Prepared by	Checked by	Date	Status
00	NK	RR	26/11/20	Preliminary
01	NK	RR	30/11/20	Submission

Figure 1 Location of Leisure Centre within Development

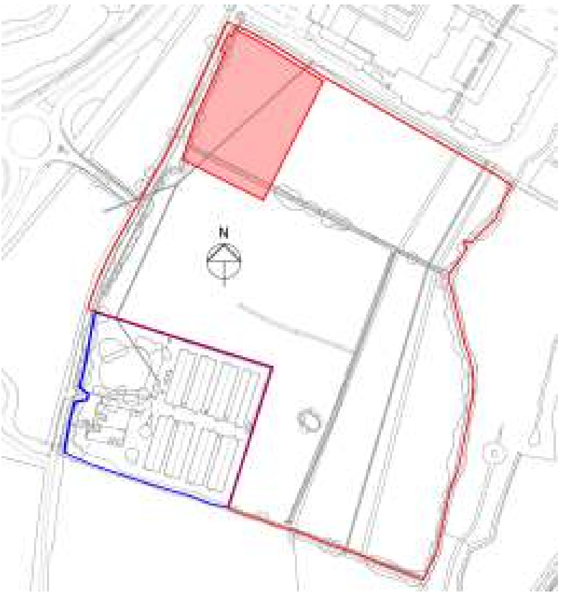
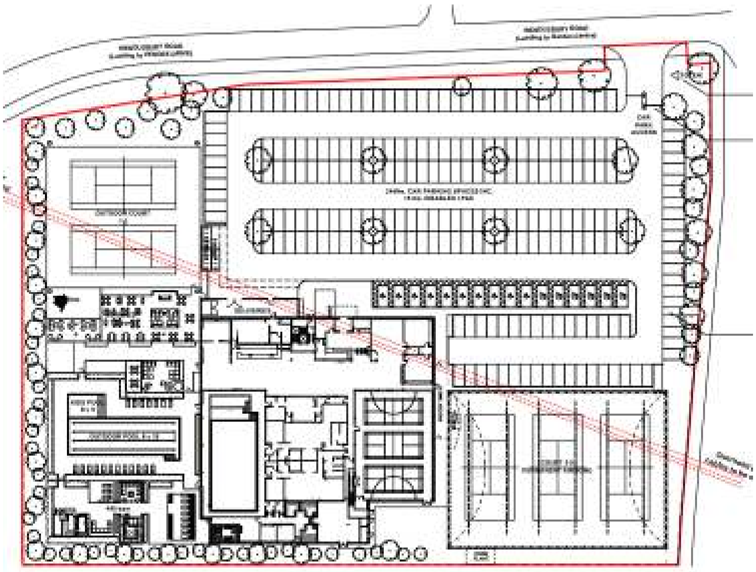


Figure 2 Site Plan of Leisure Club



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Contents

1 Introduction

1.1 AMA Consulting Engineers have been appointed by David Lloyd Leisure to prepare a drainage and Sustainable Drainage System (SuDS) for a proposed leisure centre to be located at in the Catalyst Development, Wendlebury Road, Chesterton, Oxfordshire.

1.2 A Hybrid Planning Application was made with an outline planning application for the Catalyst Development (18.4 ha) and a Full Plans Application for the leisure centre (1.67 ha). The application included a Flood Risk Assessment (FRA) for the Development as a whole which includes a Sustainable Drainage System (SuDS) strategy. This strategy did not detail the SuDS for the leisure centre site. The planning approval had a condition regarding Surface Water for the full plans application. (Below)

Full Plans Permission for Leisure Centre.
CONDITIONS REQUIRING APPROVAL OR COMPLIANCE BEFORE SPECIFIC CONSTRUCTION WORKS TAKE PLACE

18. No above ground development (other than site enabling works and those works required to provide a fully serviced development platform for construction of the development) shall take place until a detailed design and associated Management and Maintenance Plan for surface water drainage for the site, using sustainable drainage methods, has been submitted to and approved in writing by the Local Planning Authority. The development shall be implemented in accordance with the approved detailed design prior to the first occupation of the site and in accordance

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with the following, and the development shall be managed and maintained in accordance with the approved Management and Maintenance Plan.

- *S1358 - Ext - 34B - Tech Scheme Option 8 Drainage Layout*
- *FRA (Issue 3) - Main Body Text (PART 1 OF 11)*
- *Appendix A (PART 2 OF 11)*
- *Appendix B (PART 3 OF 11)*
- *Appendix C (PART 4 OF 11)*
- *Appendix D (PART 5 OF 11)*
- *Appendix E (PART 6 OF 11)*
- *Appendix F (PART 7 OF 11)*
- *Appendix G (PART 8 OF 11)*
- *Appendix H (PART 9 OF 11)*
- *Appendix J (PART 10 OF 11)*
- *Appendix K (PART 11 OF 11)*

Reason: To ensure that the principles of sustainable drainage are incorporated into this proposal in accordance with Policy ESD8 of the Cherwell Local Plan 2011-2031 Part 1 and Government guidance contained within the National Planning Policy Framework. This information is required prior to commencement of the development as it is fundamental to the acceptability of the scheme.

1.3 The Drawing, Flood Risk Assessment and its appendices quoted in planning condition 18 were prepared by Bailey Johnson Hayes Consulting Engineers Ltd. The SuDS for the wider development which includes downstream surface storage and flood mitigation is described, and allows for a discharge of 60l/sec from the leisure centre site for storm water.

1.4 This statement follows the guidance in the Oxfordshire County Council "*LOCAL STANDARDS AND GUIDANCE FOR SURFACE WATER DRAINAGE ON MAJOR DEVELOPMENT IN OXFORDSHIRE* as well as CIRIA Document "*The SuDS Manual*". As this is supplementary to the FRA already submitted to planning this document does not repeat discussion found in the FRA.

1.5 The surface water drainage shall comply with *Building Regulations Approved Document H*.

1.6 This document is not a Flood Risk Assessment nor is Foul Water management addressed in this document. The Foul water will be a gravity system from the club.

2 Description of the Site & Constraints

2.1 The site is located to the east side of the Wendlebury Road, between Wendlebury and Bicester. The O.S. Grid reference is SP 57475 21274.

2.2 The parcel of land proposed for the development is enclosed by the Wendlesbury Road on the Western Boundary with a Garden centre on the Northern Boundary. The

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Leisure centre is in the North East corner of the Catalyst development. Historical maps show the site has remained undeveloped. The Site is approximately level sloping very gently east from the road to the Langford Brook.

2.3 The Road is higher than the site along the boundary with the verge falling from the road approximately half a metre. The rest of the site is almost flat falling slightly from West to East.

2.4 The site is located outside and higher than the existing flood plain and the proposed building *Finished Floor Level* and *External Ground Levels* are higher than the minimum levels recommended in the FRA.

2.5 The Catalyst SuDS drawing locates a manhole MH 55 on the East Boundary of the site. It is shallow at 1.35 m deep which constrains the SuDS designs to avoid pumping.

2.6 Soils information indicate that the site is underlain by clays over sands and gravels over clays.

2.7 The site is highly developed with very limited areas of landscaping to accommodate any surface SuDS features.

3 SuDS Planning Basis & Definition

3.1 The UK Government sets out a National Planning Policy Framework for England and to support decision making provides guidance in a document "*Guidance-Flood risk and coastal change this includes requirements for Sustainable Drainage Systems (SuDS)*"

3.2 Paragraph 001 sates amongst other items.

"Local planning authorities and developers should seek flood risk management opportunities (eg safeguarding land), and to reduce the causes and impacts of flooding (eg through the use of sustainable drainage systems in developments)."

3.3 This is repeated in Paragraph 050, Paragraph 51 explains the importance of SuDS as follows:-

Why are sustainable drainage systems important?
Sustainable drainage systems are designed to control surface water run off close to where it falls and mimic natural drainage as closely as possible. They provide opportunities to:

reduce the causes and impacts of flooding;
remove pollutants from urban run-off at source;
combine water management with green space with benefits for amenity, recreation and wildlife.

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Guidance on the hierarchy of SuDS is provided in paragraph 80 generally, the aim should be to discharge surface run off as high up the following hierarchy of drainage options as reasonably practicable:

into the ground (infiltration)

to a surface water body;

to a surface water sewer, highway drain, or another drainage system to a combined sewer.

3.4 The Department for Environment, Food and Rural Affairs (DEFRA) provide non-statutory technical standards for SuDS.

3.5 Oxfordshire County Council is the Lead Local Flood Authority for the area and are a statutory consultee for planning applications

4 Climate Change

4.1 As a consequence of global warming an increase in the intensity of rainfall events is anticipated, therefore calculations based on historic hydrographs must be adjusted. Guidance is provided in the Environment Agency Document Flood risk assessments: climate change allowances, dated 12 April 2016 Table 2

4.2 Values for rainfall in the 2080's 2070 to 2115 require increases as follows :-

Upper End Value	40%
Central Value	20%.

4.3 For consistency with the FRA .the upper end value of 40% will be used

4.4 For a 1 in 100 Year storm (A storm with the probability of being exceeded in any one year of $^{1}/_{100}$) the design rainfall intensity will be increased by 40%.

5 Urban Creep

5.1 It is recognised that residential houses will be extended and a percentage for Urban Creep should be added to the drained areas for houses. No increase is applied to this develop[pment.

6 Outline of Development Proposal

6.1 The proposed development would involve

i. Constructing a new leisure centre building.

ii. Constructing External Terraces.

iii. Constructing external tennis courts.

iv. Constructing tennis courts that will have an air supported dome roof.

v. Constructing a Spa Garden with a Sauna/plant building.

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vi. Constructing an external swimming pool.

vii. Constructing a new car park with access road.

7 Suds Outline.

7.1 This section describes the SuDS proposals in outline.

7.2 The Hierarchy of SuDS Discharge was applied as follows

i. The ground is impervious and infiltration is not an option

ii. There is a watercourse to the East of the site into which the undeveloped site drains.

iii. It is proposed to discharge to the watercourse through the Catalyst Surface Water network and use its SuDS features to attenuate surface water to green field flows as set out in the FRA.

iv. The Catalyst drainage designers have limited flows from this site to 60 litres per second as shown on Drawing "*S1358 - Ext - 34B - Tech Scheme Option 8 Drainage Layout* referenced in the condition.

v. Storage of surface water on the surface in ponds swales and lagoons is not possible because of the intensity of development.

7.3 The approach has been to use source control by way of permeable paving for the car parking bays and having a drainage blanket under the parking bays and access roads. Gap graded Type 3 granular material will be used to act as both sub-base and drainage blanket. (Zone A)

7.4 Tennis courts and terraces will drain to filter drains.

7.5 It will not be practical to discharge the roof runoff to the stone tanks under the car park because of the associated levels, and the large area of roofs, therefore geocell units will be provided to store water run-off from the roofs. (Zone B).

7.6 The run off from the domed tennis courts will be split between the two systems. Permeable surfaces and drainage blankets under air dome roofs are deprecated as they may cause condensation.

7.7 The permitted flow will be proportioned by area of catchment and the flows limited by vortex control units. Three flow controls are proposed one for the car park and open tennis courts, one for roofs flowing to the south and one for roofs flowing to the north.

7.8 The storm sewers should be designed for a 1 in 2 year return period design storm without surcharging the pipe and 1 in 30 year return period without surcharging the ground level. In view of the small number of manholes this means the pipes are designed for the 1 in 30 year flows.

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7.9 Attenuation shall accommodate a storm of 1 in 100 years return period plus climate change and lasting 6 hours. As stated above the climate change allowance will be 40%.

8 Treatment

8.1 The surface water discharge from car park areas will pass through a stone drainage blanket to provide interception storage and treatment.

8.2 Roof runoff will not be treated.

8.3 To reduce the risks of silt, the tennis courts, and main terrace will drain to filter drains.

9 Design for Exceedance

9.1 Exceedance will flow as existing surface water flows across the site following the existing ground levels to the Langford Brook.

10 Hydraulic Calculations

10.1 The calculations are attached, parameters are based on the Oxford CC Guide.

10.2 Qbar rural is calculated in accordance with the "Flood estimation for small catchments Marshall DCW and Bayliss AC. IOH Report No.124. Institute of hydrology, Wallingford, 1994 ," see spread sheet.

10.3 The proposed limited flow is 60 l/sec as specified by the Catalyst in the consented drawing. Limits are divided proportional to area. For simplicity area B2 which is smaller will have the same flow limit as B1 conservative.

10.4 Cv is taken as 0.9 for roofs Cr as 1.2 giving CvCr=1.1.

10.5 The volume to be stored is considered by balancing storm inflows and limited outflows with a hydrograph based on the Wallingford Modified Rational Method. Outflows vary with the depth of stored water in accordance with the vortex unit's suppliers data.

10.6 No allowance for storage in manholes and pipes is made (M_{ADD}=0).

10.7 No increase for Urban Creep has been made.

10.8 Summary of outputs.

Ref		Units	Zone A	Zone B	Total
(i.)	Catchment	ha	8450	4136	12586
(ii.)	%age		67%	33%	100%
(iii.)	Discharge Limit	l/s	40	20	60
	Storage Required				
(iv.)	30 Year Storm	cu m	149.31	73.23	216
(v.)	100 Year +CC 6hr	cu m	347.65	168.7	517

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Ref		Units	Zone A	Zone B	Total
(vi.)	*Storage Provided*	cu m	415	88.9	971

11 SuDS Management and Maintenance Plan

11.1 Sustainable drainage systems require maintenance and the elements used in the proposed system are simple and robust.

11.2 The system will be in a single ownership who are responsible for its management and maintenance.

11.3 A management and maintenance document is attached and will be updated to reflect any development during construction..

11.4 As far as possible the system is a simple one designed so that maintenance and management should be within the competence of the landscape maintenance.

11.5 If costly procedures were required they would likely not be carried out.

11.6 Gullies and catch pits can be cleaned out on an annual basis.

11.7 The permeable paving shall require periodic vacuum cleaning and may require lifting and relaying after 15 – 20 years.

12 Foul Drainage

12.1 Foul drainage shall be a gravity system draining to manholes offsite provided by the Catalyst and then to a pump station up to a public sewer. The drainage

12.2 The foul water drainage system shall deal with

i. ‘Domestic’ effluent from sanitary appliances (WC, wash hand basins, showers. the kitchen sinks and appliances).

ii. The filter backwash flow from cleaning the swimming pool filters. This will require a trade effluent discharge licence.

13 Standards for Drainage.

13.1 Drainage has been designed to the following:-

i. BS EN 12056-3:2000 Gravity drainage systems inside buildings. Roof drainage, layout and calculation.

ii. BS EN 752:2008 Drain and sewer systems outside buildings

iii. BS EN 1610:1998 Construction and testing of drains and sewers

iv. Building regulations Part H - Drainage

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v. Sewers for Adoption 7th Edition

vi. The SuDS Manual 2015 - CIRIA

14 Attached documents

14.1 Plans and drawings

Drainage & SuDS Proposal Drawings

i.	Plan	20110--D100
ii.	Details	18031- D200

14.2 SuDS Calculations

14.3 SuDS Management and Maintenance Document.

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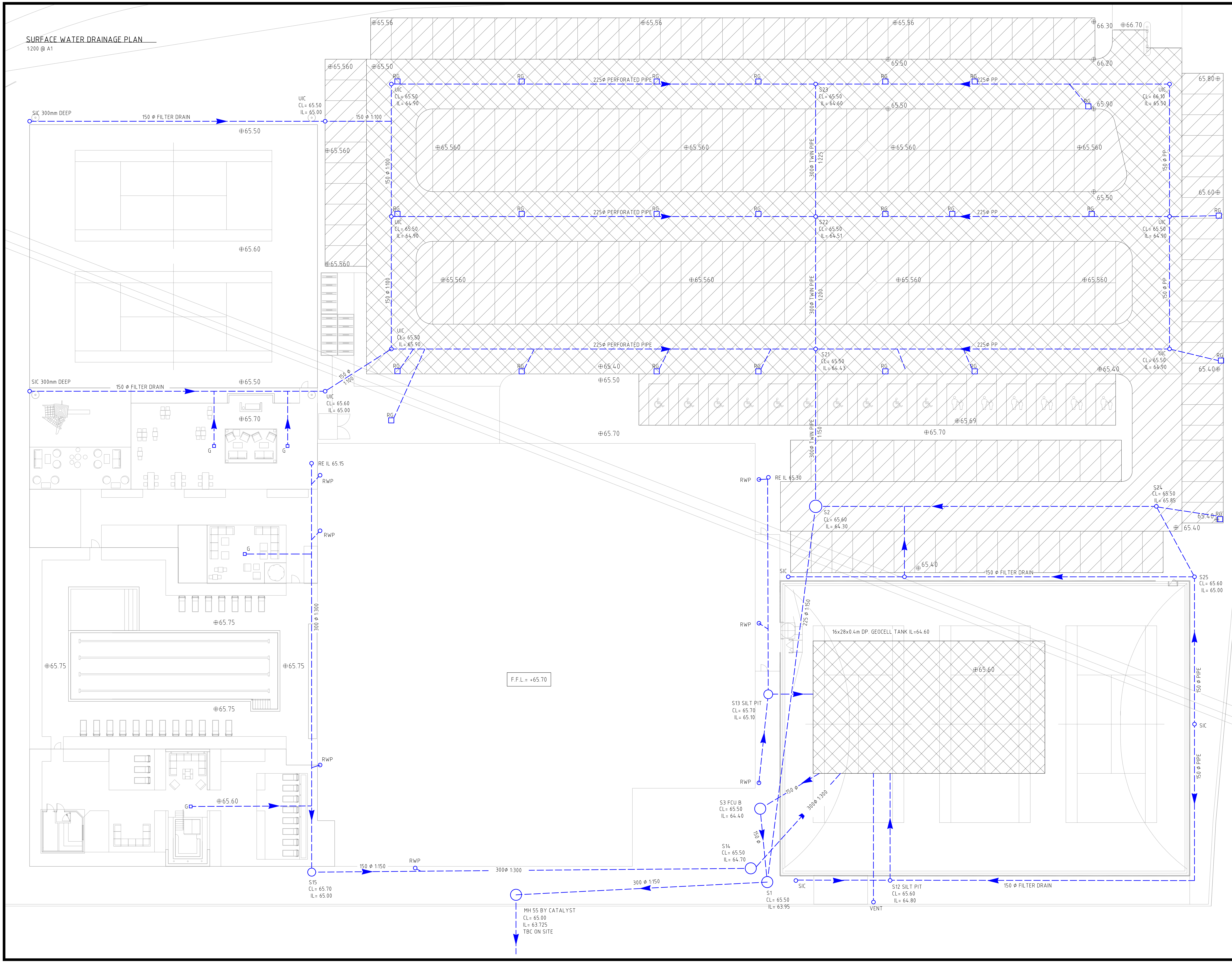

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DRAINAGE NOTES

NOTATION KEY

RWP:	RAIN WATER PIPE
CD:	CHANNEL DRAIN
RE:	RODDING EYE
RG	TRAPPED ROAD GULLEY
G:	TRAPPED YARD GULLY (EXTERNAL)
SVP:	NEW FOUL WATER MANHOLE
NS:	NEW SURFACE WATER MANHOLE
	FOUL WATER PIPE RUN
	FOUL WATER MANHOLE OR INSPECTION CHAMBER
	SURFACE WATER PIPE RUN
	SURFACE WATER MANHOLE OR INSPECTION CHAMBER
	ASPHALT CONCRETE SURFACE OVER 250mm DEEP DRAINAGE BLANKET
	ASPHALT CONCRETE SURFACE OVER 400mm DEEP DRAINAGE BLANKET

SPECIFICATION

1. FOUL DRAINS ARE TO BE 100mm NOMINAL DIAMETER LAID AT A GRADIENT NOT FLATTER THAN 1:70 U.N.O.
2. DRAINS ARE TO BE CONSTRUCTED USING VITRIFIED CLAY PIPES TO BS 65 OR FLEXIBLE UPVC PIPES TO BS4660 WITH FLEXIBLE JOINTS BEDDED AND BACKFILLED IN ACCORDANCE WITH THE MANUFACTURERS RECOMMENDATIONS AND BS 8301.
3. 100mm RIGID PIPES WITH LESS THAN 300mm COVER OR PIPES OF 150mm OR GREATER DIAMETER WITH LESS THAN 600mm COVER ARE TO BE SURROUNDED BY 150mm OF CONCRETE WITH MOVEMENT JOINTS PROVIDED AT EVERY PIPE JOINT.
4. FLEXIBLE PIPES WITH LESS THAN 600mm COVER ARE TO BE SURROUNDED WITH CONCRETE OR TO HAVE CONCRETE PAVING SLABS LAID AS BRIDGING ABOVE THE PIPE. PIPES UNDER BUILDINGS ARE TO BE SURROUNDED WITH 100mm MIN. OF GRANULAR MATERIAL.
5. ACCESS TO DRAINS MAY PROVIDED BY VITRIFIED CLAY, GRP OR POLYPROPYLENE INSPECTION CHAMBERS TO BS 7158, OR MANHOLES CONSTRUCTED USING CLASS B ENGINEERING BRICKS TO BS 3921, OR PRECAST CONCRETE SECTIONS TO BS 5911, SURROUNDED WITH 150mm OF CONCRETE MINIMUM DIMENSIONS TO CONFORM TO TABLE 8 OF BS 8301. COVERS AND FRAMES FOR MANHOLES/INSPECTION CHAMBERS MUST COMPLY WITH THE APPROPRIATE LOADING GRADE OF BS 497 OR BS 5911.
6. PROVIDE GULLIES AND RWP'S WITH RODDABLE ACCESS.
7. ALL PIPES THAT CONNECT TO MAIN RUN DRAINAGE MANHOLES TO BE FIXED 'CROWNS ADJACENT'.
8. CONCRETE BEDDING & SURROUND TO BE MIX TYPE GEN 1 TO TABLE 6 OF BS 5328-PART 2 U.N.O. IF A DIFFERENT 'GEN' MIX IS SPECIFIED IT WILL BE TO THE ABOVE TABLE.
9. ALL RWP'S TO CONNECT INTO RODDABLE GULLIES.

NOT FOR CONSTRUCTION

REV	DETAIL	Dr	DATE
P2	Submission	NK	30/11/20
P1	Preliminary	TS	26/11/20

Status: PRELIMINARY

Client: DAVID LLOYD CLUBS

Project: Catalyst Bicester
Wendlebury Road, Bicester

Title: Drainage GA's ,
Surface Water Drainage

Project N°:	Drawing N°:	Rev:
20110	D100	P2

Date: Nov 2020

Scale @A1: 1:200

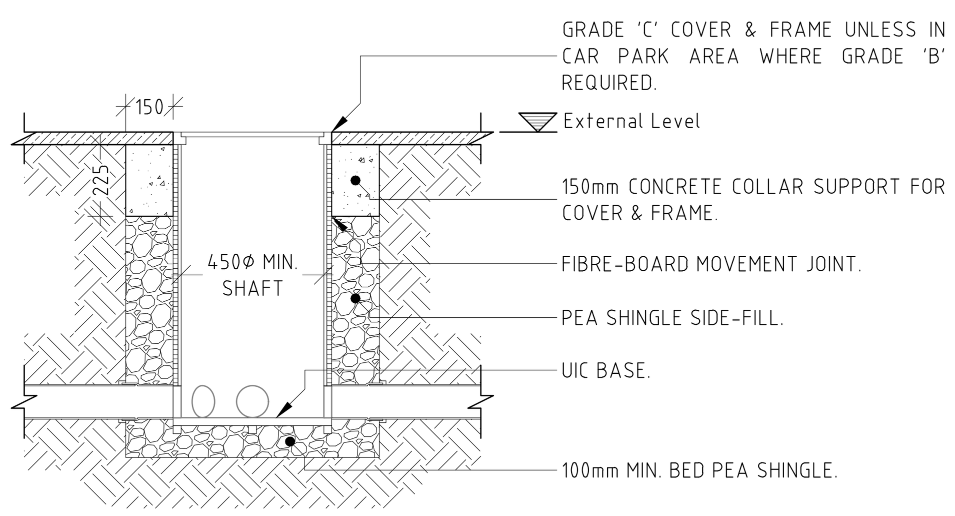
X:\4.0 AutoCad\4.6 Settings\Logo Image\AMA logo_BW_small.jpg

Drawn: TS

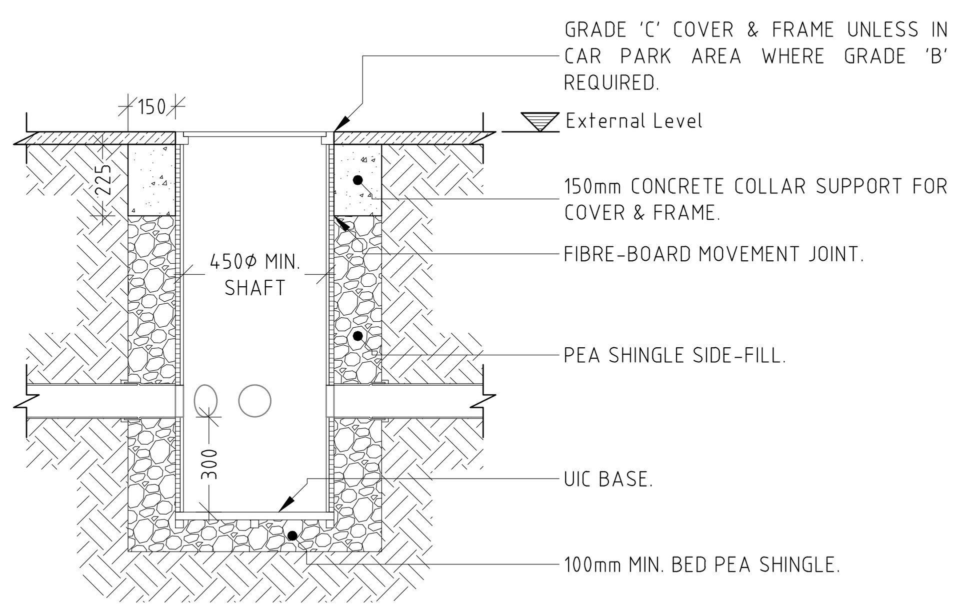
Engineer: NK

3 Marconi Place, London, N11 1PE
+44(0)20 8361 6827
www.amacl.co.uk

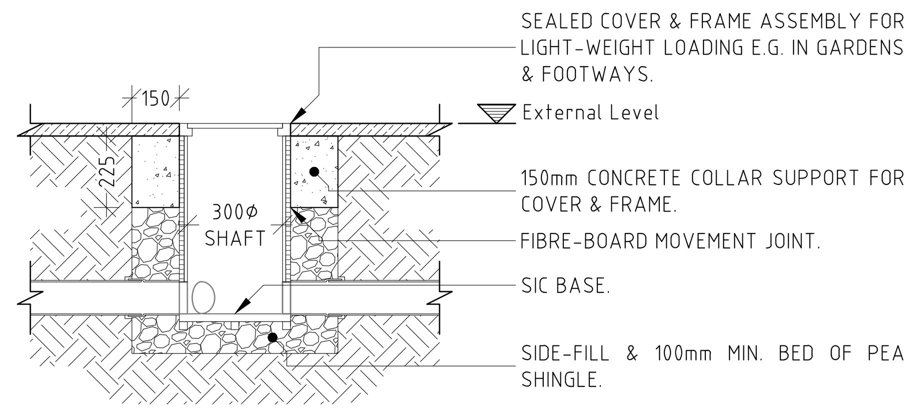
UNIVERSAL INSPECTION CHAMBER (UIC) 0.6 - 1.2m DEEP
NOT TO SCALE



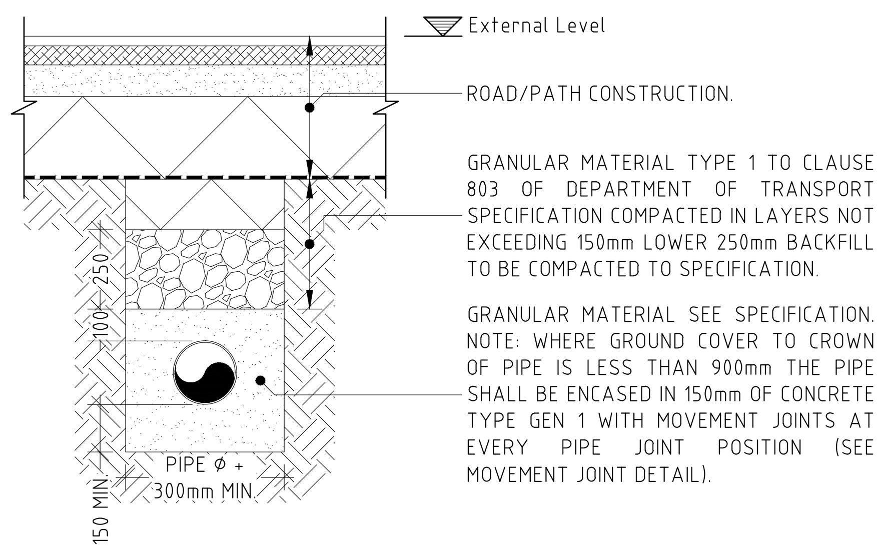
UNIVERSAL INSPECTION CHAMBER (UIC) CATCH-PIT 0.6 - 1.2m DEEP
NOT TO SCALE



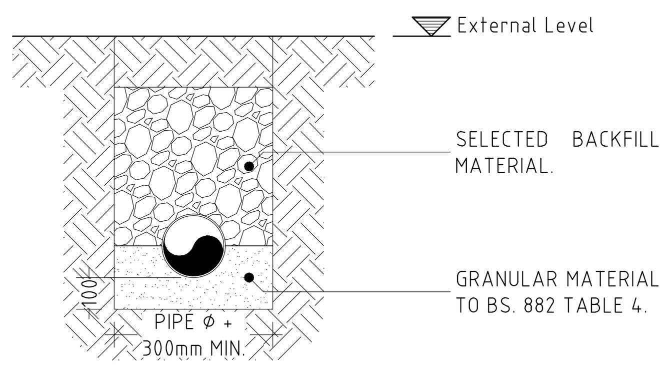
SHALLOW INSPECTION CHAMBER (SIC) <0.6m DEEP
NOT TO SCALE



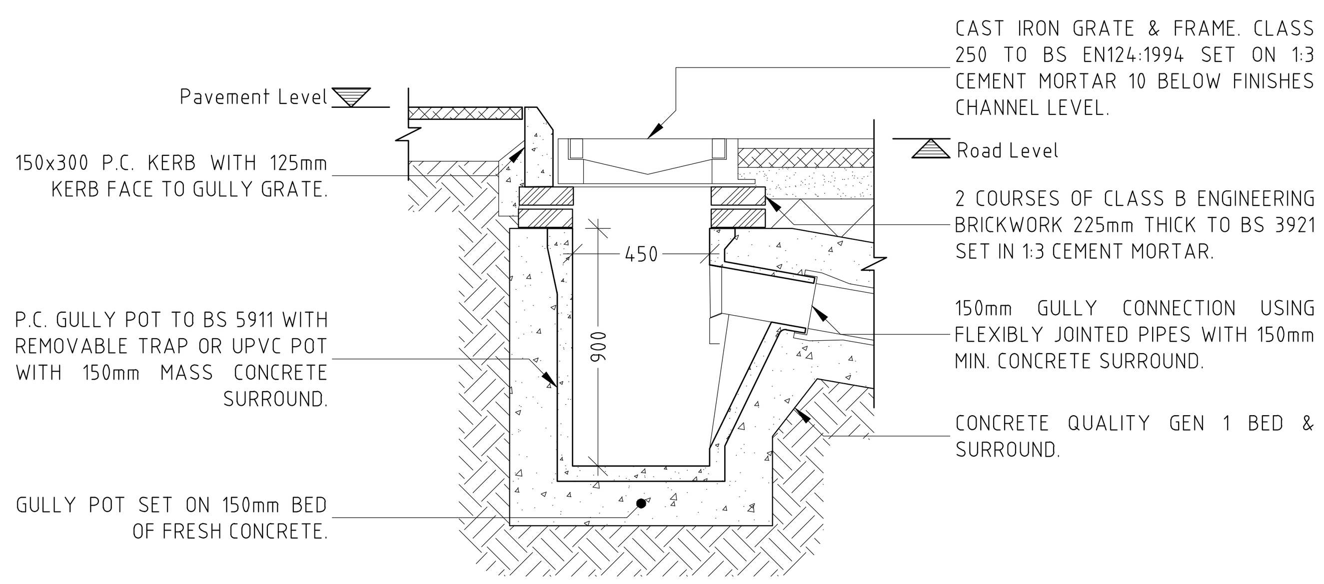
BEDDING CONSTRUCTION FOR DRAINAGE UNDER ROADS, CARPARKS & PUBLIC FOOTWAYS
NOT TO SCALE



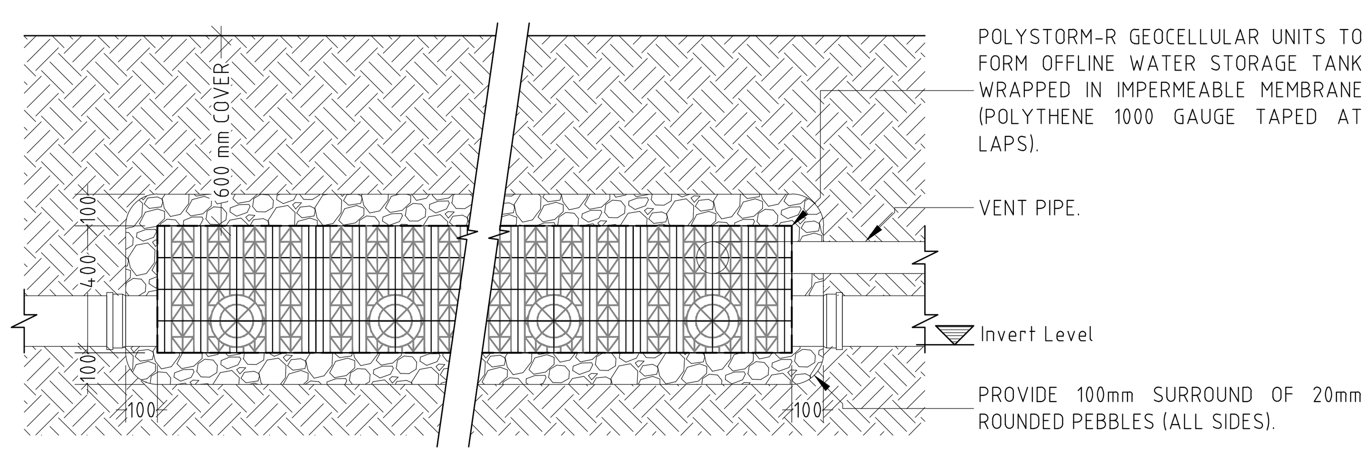
BEDDING CONSTRUCTION FOR DRAINAGE UNDER LANDSCAPING
NOT TO SCALE



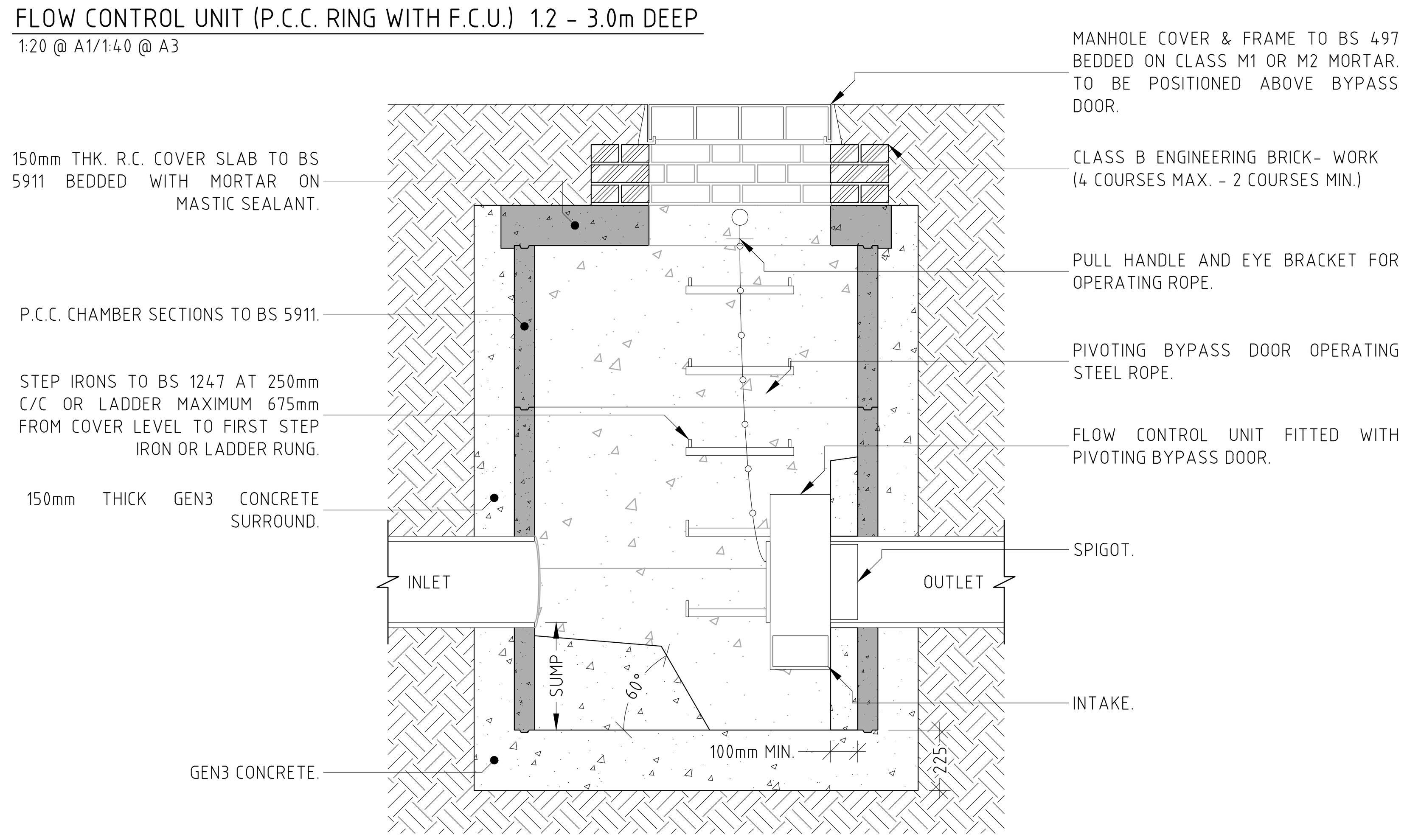
TRAPPED ROAD GULLY - HEAVY DUTY GRATE
NOT TO SCALE



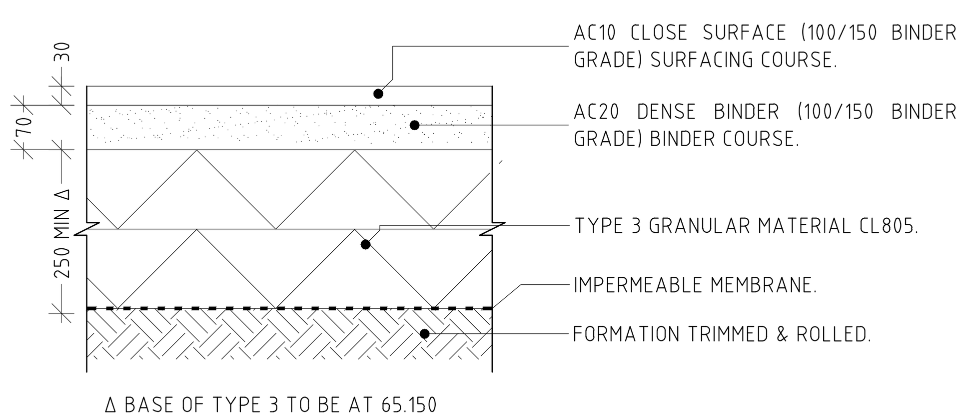
TYPICAL GEOCELLULAR STORAGE TANK (SECTION)
NOT TO SCALE



DETAIL 1: PRECAST CONCRETE MANHOLE WITH FLOW CONTROL UNIT (P.C.C. RING WITH F.C.U.) 1.2 - 3.0m DEEP
1:20 @ A1/1:40 @ A3

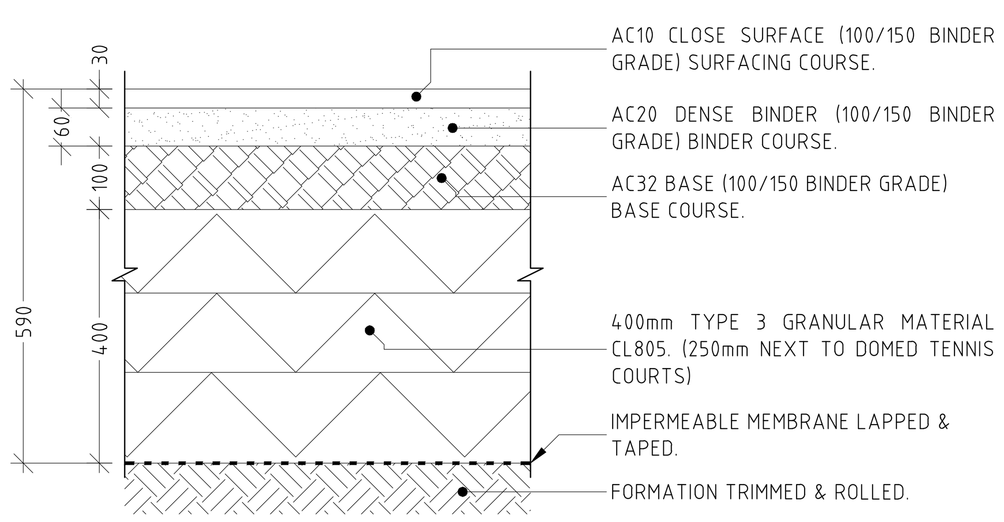


SURFACE 1: OVER TANK PARKING BAY
1:10 @ A1/1:20 @ A3

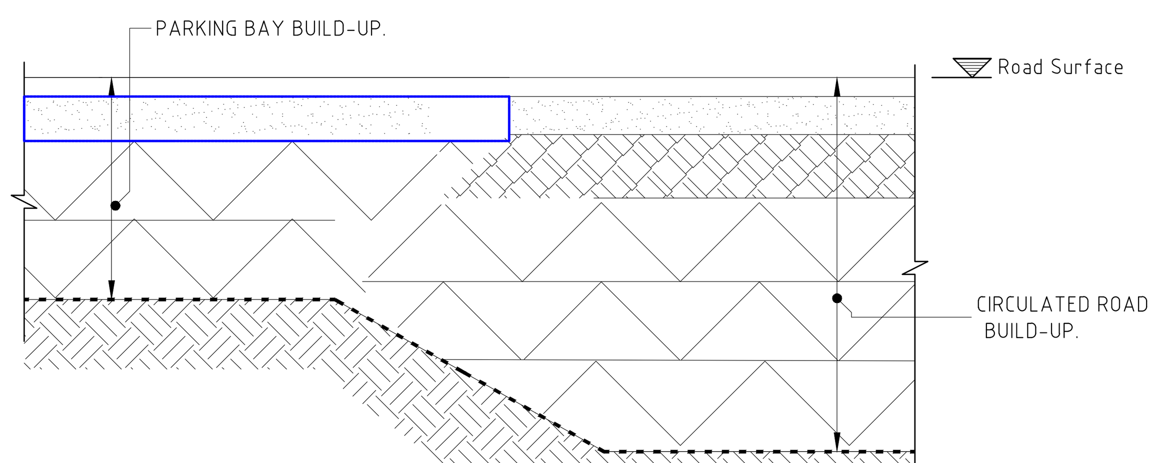


Δ BASE OF TYPE 3 TO BE AT 65.150

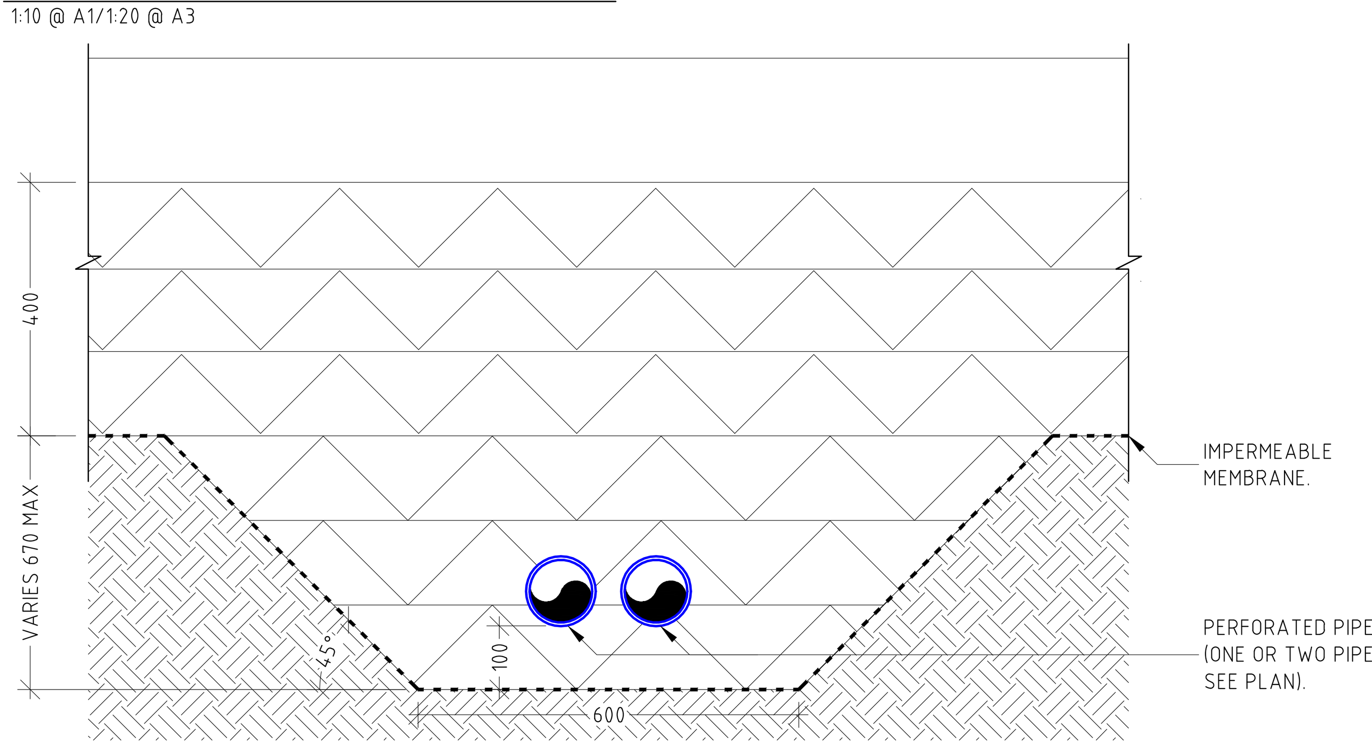
SURFACE 2: ACCESS/CIRCULATION ROAD BUILD-UP
1:10 @ A1/1:20 @ A3



PARKING BAY TO CIRCULATED ROAD DETAIL
1:10 @ A1/1:20 @ A3



PERFORATED PIPE THROUGH TANKING DETAIL
1:10 @ A1/1:20 @ A3



MANHOLE SCHEDULE

MANHOLE No.	APPROX. COVER LEVEL	INVERT LEVEL IN	INVERT LEVEL OUT	DEPTH (m)	PIPE SIZE OUT (mm)	GRADIENT OUT	TYPE/COMMENT		COVER
							SIZE/∅	TYPE	
S1	65.50	64.03	63.95	1.55	300Ø	1:150	600	NEIC	350x350 Class B
S2	65.60	54.30	64.30	1.3	225Ø	1:150	1200	FCU PC	600Ø Class B
S3	65.50	64.50	64.50	1.0	150Ø	1:150	1200	FCU PC	600Ø Class B
S11	NOT	USED							
S12	65.60	64.80	64.80	1.0	150Ø	1:150	450	UIC Silt Pit	450Ø Class B
S13	65.70	65.10	64.10	0.80	225Ø	1:150	450	UIC Silt Pit	450Ø Class B
S14	65.70	65.00	65.00	0.90	300	1:300	600	UIC SILTPIT	600Ø Class B
S15	65.70	65.25	65.25	0.45	300	1:300	600	UIC	600Ø Class B
S21	65.50	64.43	64.43	1.07	300Øx2	150	1050	PC Ring	600Ø Class C
S22	65.50	64.53	64.51	0.99	300Øx2	150	1050	PC Ring	600Ø Class C
S23	65.50	64.68	64.6	0.9	300Ø	275	600	UIC PC	600Ø Class C
S24	65.50	64.85	65.85	0.75	150Ø	100	450	UIC	450Ø Class B
S25	65.60	65.00	65.00	0.6	150Ø	100	300	SIC	300Ø Class B

ANNOTATIONS		MANHOLE COVERS TO BS EN 124		
BD	DENOTES IF BACKDROP CONNECTION IS REQUIRED	CLASS A	LIGHT DUTY	PEDESTRIAN ONLY
SIC	SHALLOW INSPECTION CHAMBER	CLASS B	MEDIUM DUTY	LIGHT VEHICLES
UIC	UNIVERSAL INSPECTION CHAMBER	CLASS C	HEAVY DUTY	CARRIAGEWAY <0.5m FROM KERB
TRAD./ P.C. RING	TRADITIONAL BRICK OR PRECAST CONCRETE CHAMBER CONSTRUCTION	CLASS D	HEAVY DUTY	CARRIAGEWAY & HARD SHOULDERS

NOTES	
	DENOTES COVER RECESSED FOR FINISHES
	ALL SVP/AAV LOCATIONS BY OTHERS
	CONNECTIONS TO EXISTING RUNS TO USE PRE-FORMED CONNECTIONS

VORTEX FLOW CONTROL UNITS

MANHOLE	MAX. FLOW	HEAD	HYDRO INTERNATIONAL REFERENCE
S2	40 l/s	0.80 m	SHE-0270-4000-0800-4000
S11	10 l/s	0.65 m	SHE-0150-1000-0650-1000
S3	10 l/s	0.65 m	SHE-0150-1000-0650-1000

VORTEX FLOW CONTROL UNITS ARE TO BY HYDRO® BRAKE BY HYDRO INTERNATIONAL LTD. WITH INTEGRAL BY-PASS AND FITTED TO A VERTICAL FACE IN CHAMBER WITH SUMP TO DETAIL. NO SUBSTITUTION WITHOUT RECALCULATION OF STORAGE VOLUMES TO SHOW COMPLIANCE WITH DESIGN.

DRAWING NOTES

2. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH THE SPECIFICATION AND ALL OTHER RELEVANT DRAWINGS.
3. DO NOT SCALE FROM THIS DRAWING USE FIGURED DIMENSIONS ONLY. DO NOT TAKE DIMENSIONS FROM ELECTRONIC COPIES WITHOUT REFERENCE TO AMA CONSULTING ENGINEERS IN EVERY INSTANCE.
4. ALL MATERIALS AND WORKMANSHIP ARE TO COMPLY WITH THE RELEVANT CURRENT BRITISH STANDARDS' AND, WHERE REQUIRED BY THE EMPLOYER, TO NHBC STANDARDS.

NOT FOR CONSTRUCTION

P3	Submission	NK	30/11/20
P1	Preliminary	TS	26/11/20
REV	DETAIL	Dr	DATE

Status: PRELIMINARY

Client: DAVID LLOYD CLUBS

Project: Catalyst Bicester
Wendlebury Road, Bicester

Title: Drainage Details
Surface Build-ups & Details

Project N°:	Drawing N°:	Rev:
20110	D200	P1

Date: Nov 2020

Scale @A1: As Noted

Drawn: TS

Engineer: NK

3 Marconi Place, London, N11 1PE
+44(0)20 8361 6827
www.amacl.co.uk

AMA Consulting Engineers
e: ama@amacl.co.uk
w: www.amacl.co.uk
t: +44(0)20 8361 6827

ref

1 Background

a) This is a cover sheet for the Surface Water calculations for SuDS at David Lloyd Leisure Centre, Bicester.
b) The Planning Authority is Cherwell District Council.
c) The Lead Local Flood Authority is Oxfordshire County Council
d) The calculations have been made in accordance with the SuDS manual 2015, generally.
e) Calculations should be read with the SuDS Statement.

2 Organisation of Calculations

a) Introduction with Parameters.
b) Catchment Area Sketch
c) Summaries of catchment areas, stage volumes and and calculation of storage volumes.
d) Design spreadsheets for storage requirements for each catchment and associated Vortex data sheets.
e) Note that the storage empties before the end of a 100 Yr + CC 6 hour storm event so the 50% empty check is not required.
f) Spreadsheet for drainage network capacity

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3 Marconi Place
London EN4 8RE
Tel 020 8361 6827

Job No	**20110**
Page No	c-sw 1
Rev	
	27/11/2020

SURF1 - SURFACE WATER; HYDRAULIC CALCULATIONS

i

Project Name **DLL Bicester**

Location **Bicester**

1. Schedule of Areas

1.1	Area of Site	A_{site}	**16647**	*m²*
1.2	Impermeable Area Before Developı	A_{dbd}	**0**	*m²*
	Zone A		**8450**	*m²*
	Zone B		**4136**	*m²*
1.3	Impermeable Area After Developme	A_{dad}	12586	*m²*

2. Location Specific Hydological Data

2.1	*Wallingford Coefficients*	M5-60	**20**	*mm*
		r	**0.4**	

2.2 *Flood Esimate for small catchment areas*

	SAAR	**617**	*mm*
WRAP Soil type **1** →	SOIL	**0.15**	

Increase for Climate Change

2.3

NPPF Guidance Table 2	50-95 Yr Life
Central	20%
High (Upper)	40%
None	0%

%age increase on i **High (Upper)** **40%**

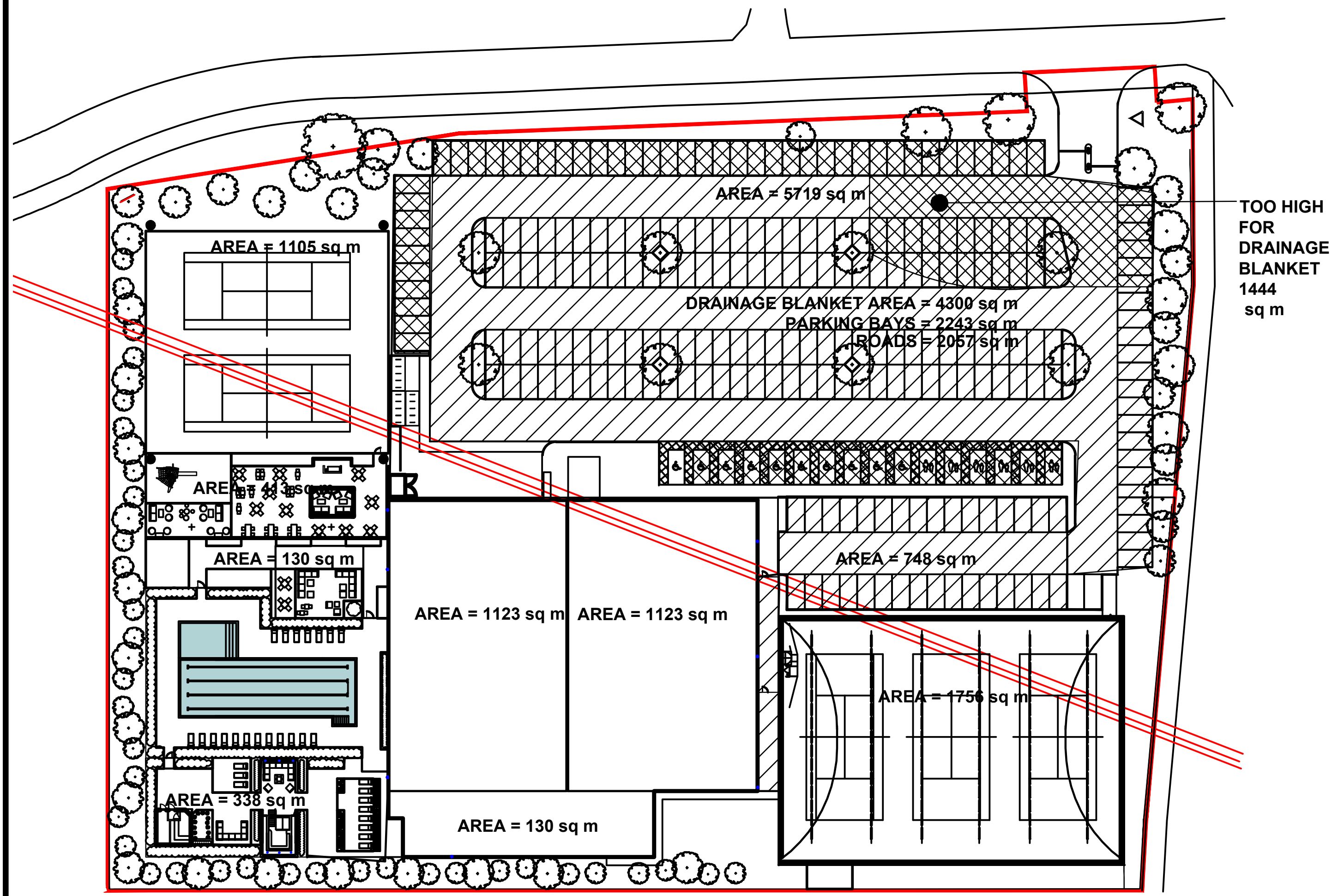
Urban Drift

2.4 Uplift on storage **N/A**

Applies to developments with houses only.

WRAP - *Winter Rain Acceptance Potential*

AMA Consulting Engineers	Client: David Lloyd Leisure	Title: SuDS Drained Areas	Drawing N°:	Rev: P1
3 Marconi Place, London, N11 1PE +44(0)20 8361 6827 www.amacl.co.uk	Project: DLL Bicester Catalyst	Project N°: 20110	Date: Nov 20 Scale: 1:1000	Drawn: XX Engineer: nk



DRAINED AREAS

ITEM	AREA sq m
OUTDOOR COURT	1,105
TERRACE 1	413
TERRACE 2	130
OUTDOOR SPA	338
ROOF L	1,123
ROOF R	1,123
ROOF REAR	130
DOMED TENNIS COURTS	1,756
SMALL PARKING	748
LARGE PARKING	5,719
TOTAL	**12,585**

AMA Consulting Engineers
3 Marconi Place
London EN4 8RE
Tel 020 8361 6827

Job No	**20110**
Page No	C-SW-
Rev	
	27/11/2020

Areas & Storage — Storage Summary

Project Name DLL Bicester

Location Bicester

Permitted Discharge **60 l/s**

Area Drained Total **12586** sq m See Plan

Catchment		sq m	%Age Area		Flow Limit		**Storage**	**Required**	
Zone A	Outdoor Court	1105							
	Large Car Park	5719					30 Year	100 Yr +CC	
	Small Car Park	748							
	Half Domed Courts	878							
		8450	67%		40	l/s	*149.31*	*347.65*	*cu m*
Zone B	Roofs	2376							
	Terraces	543							
	Outdoor Spa	338							
	Half Domed Courts	879							
		4136	33%		20	l/s	73.23	168.78	*cu m*
	Check Total	12586							

STORAGE

Attenuation Storage Zone A

Stone Drainage Blanket

		A	V 30% VOIDS	
250	Under Parking Bays	2243	168	
400	Under Roads	2057	247	
			415	cu m

> Required, no Surcharge

Attenuation Storage Zone B

Geocell Tanks

		cu m	Voids Ratio	Height m	A sq m		W	L	V cu m
	44%	168.8	95%	0.4	444.2		16	28	170.2

Volume Required 168.7804 **Volume** Provided 170.24 OK

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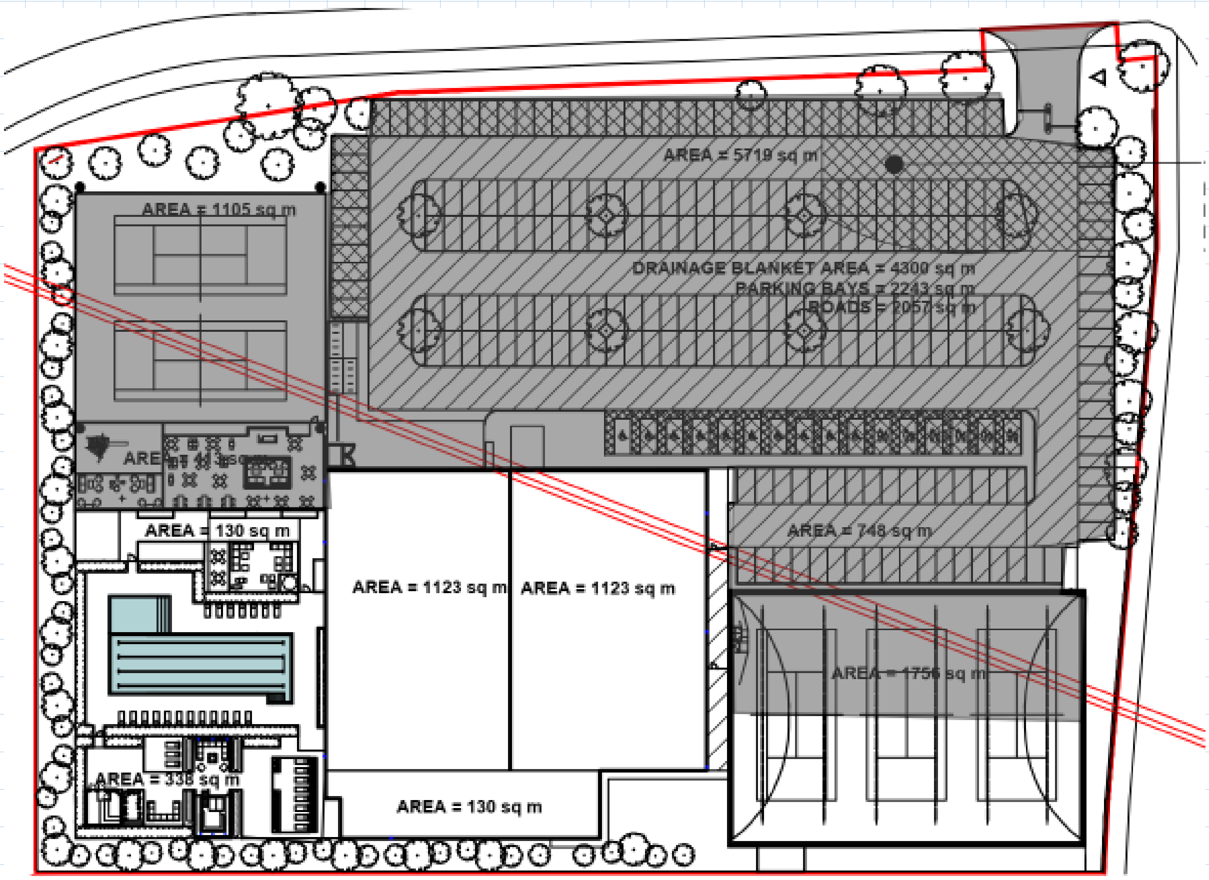
e: ama@amacl.co.uk
w: www.amacl.co.uk
t: +44(0)20 8361 6827

ref

Catchment Area A

Car parks, open tennis court and adjacent terrace one half of air dome roof.

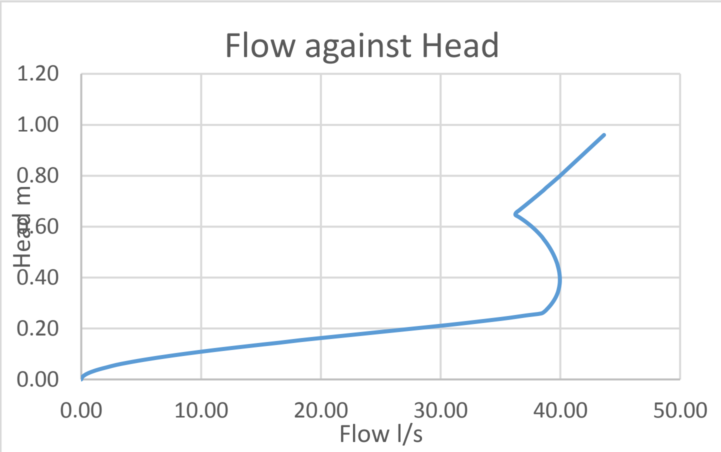


Hydraulic Data for Hydro International for Hydro-Brake Optimum®

Ref *SHE-0270-4000-0800-4000*

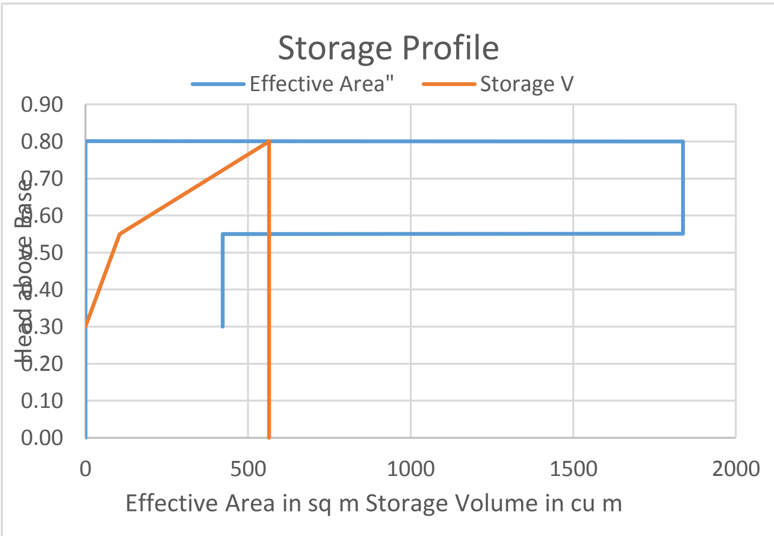
Head (m)	Flow (l/s)	Head (m)	Flow (l/s)
0.00	0.00	0.44	39.80
0.01	0.06	0.45	39.75
0.02	0.25	0.46	39.69
0.02	0.56	0.47	39.63
0.03	0.98	0.48	39.56
0.04	1.52	0.49	39.48
0.05	2.17	0.49	39.40
0.06	2.92	0.50	39.31
0.07	3.77	0.51	39.22
0.07	4.72	0.52	39.11
0.08	5.76	0.53	39.01
0.09	6.88	0.53	38.89
0.10	8.08	0.54	38.77
0.11	9.36	0.55	38.64
0.11	10.71	0.56	38.50
0.12	12.12	0.57	38.35
0.13	13.59	0.57	38.20
0.14	15.11	0.58	38.03
0.15	16.67	0.59	37.85
0.15	18.27	0.60	37.67
0.16	19.90	0.61	37.47
0.17	21.55	0.61	37.25
0.18	23.21	0.62	37.03
0.19	24.88	0.63	36.79
0.19	26.53	0.64	36.53
0.20	28.19	0.65	36.26
0.21	29.85	0.66	36.32
0.22	31.43	0.66	36.53
0.23	32.94	0.67	36.74
0.23	34.37	0.68	36.96
0.24	35.76	0.69	37.17
0.25	37.09	0.70	37.38
0.26	38.39	0.70	37.58
0.27	38.69	0.71	37.79
0.28	38.87	0.72	38.00
0.28	39.03	0.73	38.20
0.29	39.17	0.74	38.40
0.30	39.30	0.74	38.60
0.31	39.42	0.75	38.80
0.32	39.53	0.76	39.00
0.32	39.62	0.77	39.20
0.33	39.70	0.78	39.40
0.34	39.77	0.78	39.60
0.35	39.83	0.79	39.79
0.36	39.87	0.80	39.99
0.36	39.91	0.82	40.35
0.37	39.94	0.83	40.72
0.38	39.95	0.85	41.09
0.39	39.96	0.86	41.45
0.40	39.96	0.88	41.82
0.40	39.95	0.90	42.18
0.41	39.94	0.91	42.55
0.42	39.91	0.93	42.92
0.43	39.88	0.94	43.28
0.44	39.84	0.96	43.65

TECHNICAL SPECIFICATION	Head (m)	Flow (l/s)	2 No Thus
Design	0.8	40	
Flush-Flo	0.392	39.962	
Kick-Flo®	0.649	36.16	
Mean Flow over head		31.304	
Minimum Clearance (m²)		0	



Storage Profile

Head m	Area sq m	Voids Ratio	Aeff=A.VR	Storage V	Type
0.3	1405	0.3	421.5	0	Stone
0.55	1405	0.3	421.5	105.375	Stone
0.551	6127	0.3	1838.1	107.2131	Stone
0.8	6127	0.3	1838.1	564.9	Stone
0.801	0	0.3	0	564.9	Stone
0	0	0	0	564.9	-
0	0	0	0	564.9	-
0	0	0	0	564.9	-
0	0	0	0	564.9	-
0	0	0	0	564.9	-
0	0	0	0	564.9	-



Project	DLL Bicester	Job ref.	19153
Date	27-Nov-20	Page No.	
		Calc by	

1 in 1 Year Storm 15 Mins Duration
Outflow based on Hydraulic Curves

i=50 mm/hr, as the Wallingford Rational Method coefficients are not applicable for T < 5 Years

Area **0.845** ha

Storage profile described on adjoining sheet
Volume = 564.90 cu m

Out Flow fron supplier data based on Head
Head based on Stored Volume of previous line.

D	i	Q_{peak}	Run Off	Head	Out Flow	Disch.	Stored Volume
mins	*mm/hr*	*l/sec*	*cu m*		*l/s*	*cu m*	*cu m*
1	50.00	117.46	7.05	0.00	0.00	0.01	**7.04**
2	50.00	117.46	14.09	0.37	39.91	2.40	**11.69**
3	50.00	117.46	21.14	0.41	39.95	4.80	**16.34**
4	50.00	117.46	28.19	0.46	39.75	7.19	**21.00**
5	50.00	117.46	35.24	0.50	39.40	9.55	**25.69**
6	50.00	117.46	42.28	0.54	38.77	11.88	**30.41**
7	50.00	117.46	49.33	0.59	38.03	14.16	**35.17**
8	50.00	117.46	56.38	0.63	36.79	16.37	**40.01**
9	50.00	117.46	63.43	0.68	36.96	18.58	**44.84**
10	50.00	117.46	70.47	0.73	38.00	20.86	**49.61**
11	50.00	117.46	77.52	0.77	39.20	23.21	**54.31**
12	50.00	117.46	84.57	0.82	39.99	25.61	**58.95**
13	50.00	117.46	91.61	0.86	39.99	28.01	**63.60**
14	50.00	117.46	98.66	0.90	39.99	30.41	**68.25**
15	50.00	117.46	105.71	0.95	39.99	32.81	**72.90**
20	50.00	117.46	140.95	0.99	39.99	44.81	**96.14**
25	50.00	117.46	176.18	1.21	39.99	56.80	**119.38**
30	50.00	117.46	211.42	1.43	39.99	68.80	**142.62**
35	50.00	117.46	246.66	1.65	39.99	80.79	**165.86**
40	50.00	117.46	281.89	1.87	39.99	92.79	**189.10**
45	50.00	117.46	317.13	2.09	39.99	104.79	**212.34**
					Max Volume to be Stored		**72.90** *cu m*

Mean Outflow **36.457** *l/sec*

Calculation ignores *Interception Storage* of 1st 5 mm rainfall -42.25 *cu m*
Nett storage requirement 30.65 *cu m*

D Duration in minutes Q_{peak} Peak Flow l/s =2.78 Cv.Cr.i.A
T Return Period in Years CvCr=1
I Rainfall Intensity in mm/hour A Area in hectares
(10,000sq m = 1ha)

Project	DLL Bicester	Job ref	19153
Date	27-Nov-20	Page No	
		Calc by	

4 Hour Event

Outflow based on Hydraulic Curves

Return Period T	30	*Years*
M5-60	20	*mm*
r	0.4	
Area	0.845	*ha*

Out Flow fron supplier data based on Head
Head based on Storage Volume of previous line.

D	Z1	M5-D	Z2	M30-D	i	Q_{peak}	Run Off	Head	Out Flow	Allow. Disch.	Stor. Vol.
mins		*mm*		*mm*	*mm/hr*	*l/sec*	*cu m*		*l/s*	*cu m*	*cu m*
5	0.37	7.41	1.45	10.78	129.32	303.78	91.13	0.00	0.00	0.01	**91.12**
10	0.53	10.59	1.49	15.82	94.93	223.00	133.80	1.16	39.99	12.01	**121.79**
15	0.63	12.59	1.51	19.01	76.03	178.61	160.75	1.46	39.99	24.00	**136.75**
20	0.70	14.06	1.52	21.35	64.06	150.47	180.57	1.60	39.99	36.00	**144.57**
25	0.76	15.22	1.53	23.21	55.70	130.85	196.27	1.67	39.99	47.99	**148.28**
30	0.81	16.18	1.53	24.75	49.50	116.28	209.30	1.71	39.99	59.99	**149.31**
35	0.85	17.01	1.53	26.07	44.69	104.98	220.46	1.72	39.99	71.98	**148.47**
40	0.89	17.73	1.54	27.22	40.84	95.93	230.23	1.71	39.99	83.98	**146.25**
45	0.92	18.38	1.54	28.25	37.67	88.50	238.94	1.69	39.99	95.98	**142.96**
50	0.95	18.97	1.54	29.18	35.02	82.27	246.80	1.66	39.99	107.97	**138.83**
55	0.98	19.50	1.54	30.03	32.76	76.96	253.97	1.62	39.99	119.97	**134.00**
60	1.00	20.00	1.54	30.81	30.81	72.38	260.56	1.57	39.99	131.96	**128.60**
90	1.12	22.39	1.54	34.52	23.01	54.06	291.93	1.52	39.99	203.94	**87.99**
120	1.21	24.19	1.54	37.23	18.61	43.73	314.84	1.14	39.99	275.91	**38.93**
180	1.34	26.87	1.53	41.15	13.72	32.22	347.96	0.67	36.53	407.43	**0.00**
240	1.45	28.91	1.52	43.98	10.99	25.83	371.92	0.30	39.30	548.92	**0.00**
										Max Volume to be Stored	**149.31** *cu m*

Storage profile described on adjoining sheet

Volume : 564.90 cu m Storage **OK < Provided**

1] T= Return Period of Storm (Years)
2] D= Duration of Storm (Mins)
3] i =[MT-D]*60/D
4] Q = 2.78 * Area * i
5] Run Off = Q *D *60/1000
6] Allowable Discharge = Va * D / 1000
Valid Range for T is 5 to 100 Years

7] M5-D=Z1 * M5-60
8] MT-D=Z2 * M5-D
9]Z1 & Z2 Wallingford Procedure Vols 1 and 4

This calculation uses a hydrograph described in the Wallingford Modified Rational Method. Whilst more advanced methods exist based on the Flood Estimation Handbook (1999), the Revitalised Flood Hydrograph (ReFH)(2007) and the Revitalised Flood Hydrograph rainfall-runoff method version 2 (ReFH 2)(2015). As at May 2020 ReFH 2.3 which incorporates urban modelling is currant.
It should be noted that ReFH was rural only and only for catchments > 0.5 sq km or 50 hectares which is a much larger than any project for which these calculations apply.
A calibration study of ReFH2 considered a 40 sq km catchment (4,000 hectares) small, the FEH method has only been calibrated for catchments of over 200 ha, whilst the typical catchment for which these calculations are made is less than 5 ha and frequently less than 1.
Bearing in mind the small catchments and that ReFH and FEH are proprietary, the Wallingford Modified Rational method does not appear inappropriate.

Project	DLL Bicester	Job ref	19153
Date	27-Nov-20	Page No	
		Calc by	

6 Hour Event

Outflow based on Hydraulic Curves

Allowance for Climate Change

High (Upper)	40%	Refer NPPF Table 2

Return Period T	100	Years
M5-60	20	mm
r	0.4	
Area	0.845	ha

Out Flow fron supplier data based on Head
Head based on Storage Volume of previous line.

D	Z1	M5-D	Z2	M100-D	i	i + %age	Q_{peak}	Run Off	Head	Out Flow	Allow. Disch.	Stor. Vol.
mins		mm		mm	mm/hr	mm/hr	l/sec	cu m			cu m	cu m
5	0.37	7.41	1.84	13.66	163.91	229.48	539.07	161.72	0.00	0.00	0.01	**161.71**
10	0.53	10.59	1.93	20.40	122.40	171.36	402.54	241.52	1.83	39.99	12.01	**229.52**
15	0.63	12.59	1.96	24.67	98.68	138.15	324.54	292.08	2.48	39.99	24.00	**268.08**
20	0.70	14.06	1.98	27.82	83.46	116.85	274.49	329.39	2.84	39.99	36.00	**293.40**
25	0.76	15.22	1.99	30.32	72.77	101.88	239.32	358.98	3.08	39.99	47.99	**310.99**
30	0.81	16.18	2.00	32.39	64.79	90.70	213.07	383.53	3.25	39.99	59.99	**323.55**
35	0.85	17.01	2.01	34.17	58.57	82.00	192.64	404.54	3.37	39.99	71.98	**332.55**
40	0.89	17.73	2.01	35.72	53.58	75.01	176.21	422.90	3.46	39.99	83.98	**338.92**
45	0.92	18.38	2.02	37.10	49.47	69.25	162.68	439.23	3.52	39.99	95.98	**343.26**
50	0.95	18.97	2.02	38.34	46.01	64.41	151.31	453.94	3.56	39.99	107.97	**345.97**
55	0.98	19.50	2.02	39.47	43.06	60.28	141.61	467.33	3.58	39.99	119.97	**347.36**
60	1.00	20.00	2.03	40.51	40.51	56.71	133.23	479.61	3.60	39.99	131.96	**347.65**
90	1.12	22.39	2.03	45.40	30.27	42.38	99.55	537.57	3.60	39.99	203.94	**333.63**
120	1.21	24.19	2.02	48.92	24.46	34.25	80.45	579.22	3.47	39.99	275.91	**303.31**
180	1.34	26.87	2.01	53.89	17.96	25.15	59.08	638.04	3.18	39.99	419.86	**218.17**
240	1.45	28.91	1.98	57.37	14.34	20.08	47.17	679.19	2.37	39.99	563.81	**115.38**
270	1.49	29.77	1.97	58.76	13.06	18.28	42.95	695.73	1.39	39.99	635.79	**59.94**
300	1.53	30.57	1.97	60.11	12.02	16.83	39.54	711.71	0.87	39.99	707.76	**3.95**
330	1.57	31.30	1.96	61.36	11.16	15.62	36.69	726.43	0.34	39.70	779.22	**0.00**
360	1.60	31.98	1.95	62.51	10.42	14.58	34.26	740.05	0.30	39.30	849.97	**0.00**
								Max Volume to be Stored				**347.65**

Storage profile described on adjoining sheet   Volume : 564.90 cu m   Storage **OK < Provided**

1] T= Return Period of Storm (Years)	7] M5-D=Z1 * M5-60
2] D= Duration of Storm (Mins)	8] MT-D=Z2 * M5-D
3] i =[MT-D]*60/D	9]Z1 & Z2 Wallingford Procedure Vols 1 and 4
4] Q = 2.78 * Area * i	
5] Run Off = Q *D *60/1000	
6] Allowable Discharge = Va * D / 1000	
Valid Range for T is 5 to 100 Years	

NPPF/EA UPLIFT FOR CC

Central	0.2
High (Upper)	0.4
None	0

This calculation uses a hydrograph described in the Wallingford Modified Rational Method. Whilst more advanced methods exist based on the Flood Estimation Handbook (1999), the Revitalised Flood Hydrograph (ReFH)(2007) and the Revitalised Flood Hydrograph rainfall-runoff method version 2 (ReFH 2)(2015). As at May 2020 ReFH 2.3 which incorporates urban modelling is currant.
It should be noted that ReFH was rural only and only for catchments > 0.5 sq km or 50 hectares which is a much larger than any project for which these calculations apply.
A calibration study of ReFH2 considered a 40 sq km catchment (4,000 hectares) small, the FEH method has only been calibrated for catchments of over 200 ha, whilst the typical catchment for which these calculations are made is less than 5 ha and frequently less than 1.
Bearing in mind the small catchments and that ReFH and FEH are proprietary, the Wallingford Modified Rational method does not appear inappropriate.

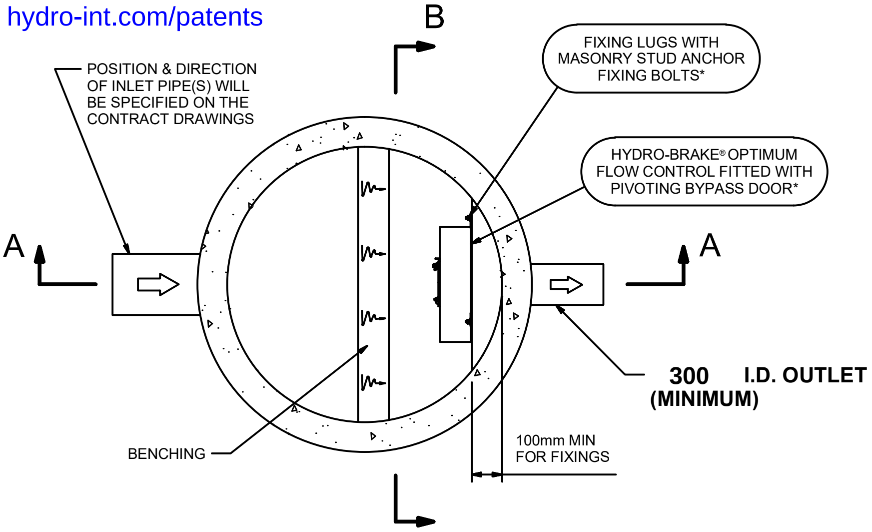
Technical Specification

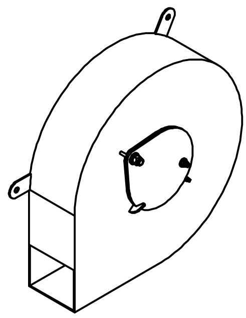
Control Point	Head (m)	Flow (l/s)
Primary Design	0.800	40.000
Flush-Flo™	0.392	39.962
Kick-Flo®	0.649	36.160
Mean Flow		31.304

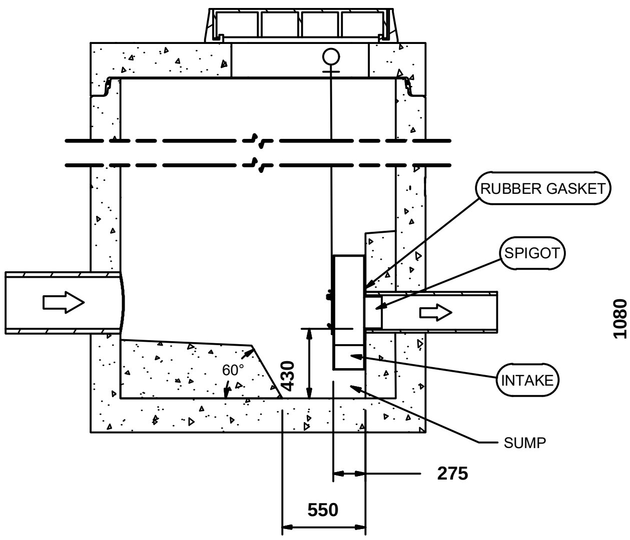
Hydro-Brake® Optimum Flow Control including:

- 3 mm grade 304L stainless steel
- Integral stainless steel pivoting by-pass door allowing clear line of sight through to outlet, c/w stainless steel operating rope
- Beed blasted finish to maximise corrosion resistance
- Stainless steel fixings
- Rubber gasket to seal outlet

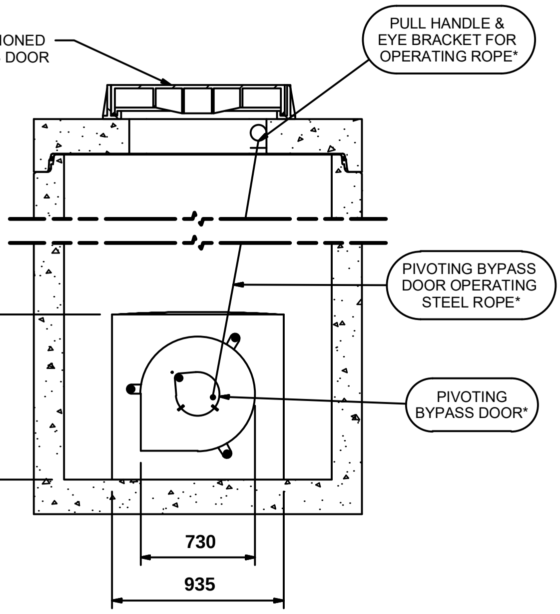
hydro-int.com/patents







SECTION A-A



SECTION B-B

IMPORTANT: ⬭ LIMIT OF HYDRO INTERNATIONAL SUPPLY
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FOR SITE SPECIFIC DETAILS AND MINIMUM CHAMBER SIZE REFER TO HYDRO INTERNATIONAL
ALL CIVIL AND INSTALLATION WORK BY OTHERS
* WHERE SUPPLIED
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DESIGN ADVICE !

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The use of any other flow control will invalidate any design based on this data and could constitute a flood risk.

Hydro International

DATE	11/19/2020 3:25 PM
SITE	DLL Bicester
DESIGNER	Nick Kramer
REF	20110 3 go a / 20_21_5883

SHE-0270-4000-0800-4000

Hydro-Brake® Optimum

nick.kramer@amacl.co.uk

Technical Specification

Control Point	Head (m)	Flow (l/s)
Primary Design	0.800	40.000
Flush-Flo	0.392	39.962
Kick-Flo®	0.649	36.160
Mean Flow		31.304

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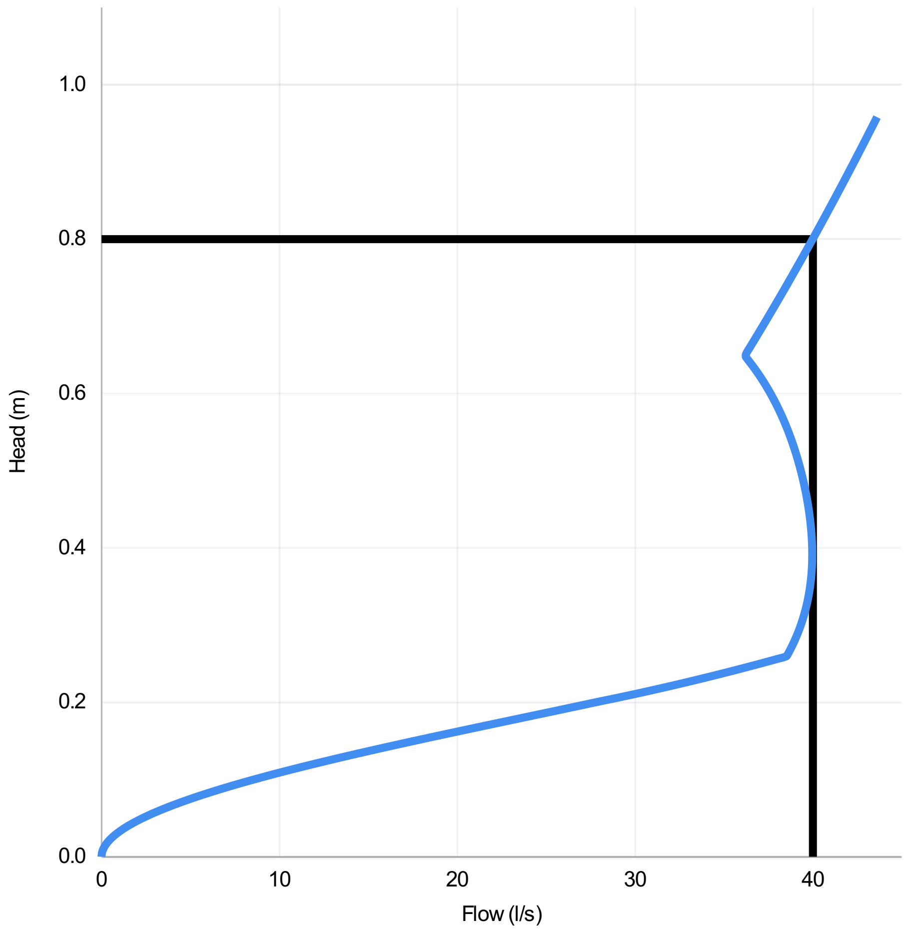
CERTIFICATE No 08/4596

PT/329/0412



Head (m)	Flow (l/s)
0.000	0.000
0.028	0.721
0.055	2.785
0.083	6.021
0.110	10.237
0.138	15.213
0.166	20.693
0.193	26.363
0.221	31.906
0.248	36.725
0.276	38.888
0.303	39.370
0.331	39.696
0.359	39.887
0.386	39.960
0.414	39.932
0.441	39.817
0.469	39.624
0.497	39.359
0.524	39.020
0.552	38.600
0.579	38.083
0.607	37.445
0.634	36.655
0.662	36.517
0.690	37.238
0.717	37.945
0.745	38.638
0.772	39.319
0.800	39.986

DESIGN ADVICE

!

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DATE	19/11/2020 15:25
Site	DLL Bicester
DESIGNER	Nick Kramer
Ref	20110 3 go a / 20_21_5883

SHE-0270-4000-0800-4000

Hydro-Brake Optimum®

project	job no
DLL Bicester –Catalyst Site	20110
title	drg/page no: C-SuDS-A1
SuDS & SW Calcs	scale:
	date: 26/11/20
	drawn: NK
	checked:

AMA Consulting Engineers
e: ama@amacl.co.uk
w: www.amacl.co.uk
t: +44(0)20 8361 6827

ref

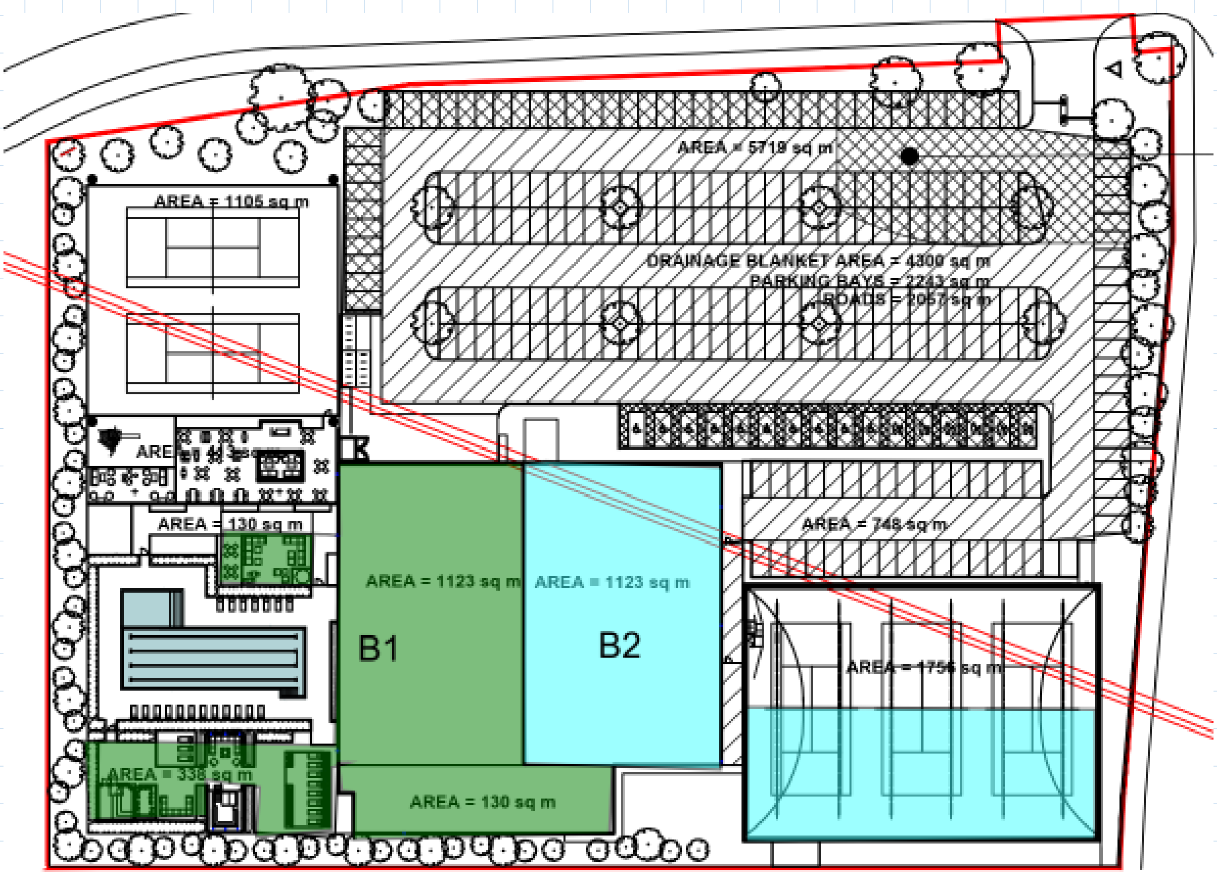
<u>Catchment Area B1 & B2</u>

<u>B1</u>

Half main roof, rear low level roof, Small Terrace, Spa Garden

<u>B2</u>

Half main roof, half air dome roof

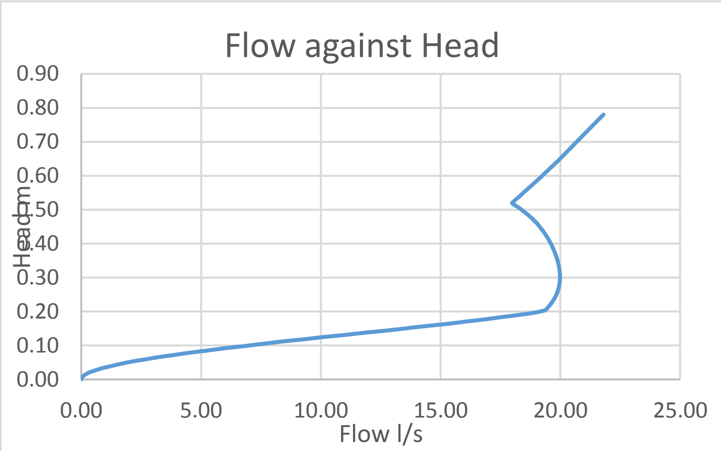


Hydraulic Data for Hydro International for Hydro-Brake Optimum®

Ref *SHE-0203-2000-0650-2000*

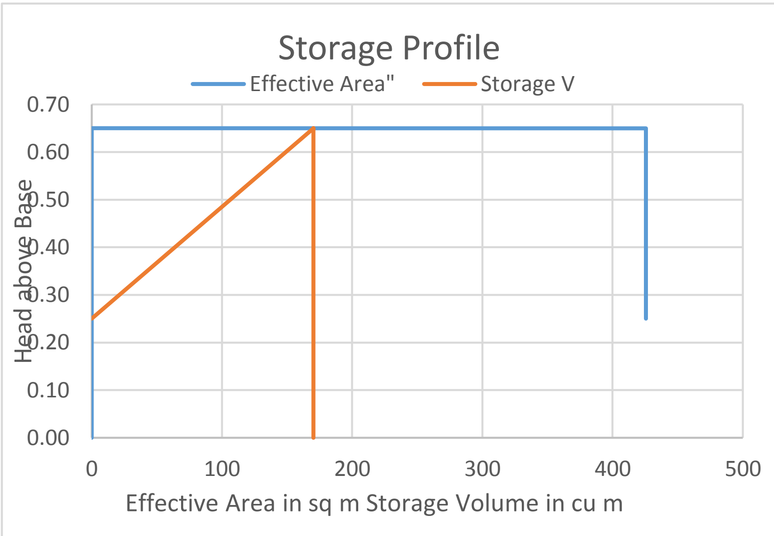
Head (m)	Flow (l/s)	Head (m)	Flow (l/s)
0.00	0.00	0.36	19.83
0.01	0.04	0.37	19.80
0.01	0.14	0.37	19.77
0.02	0.32	0.38	19.73
0.03	0.56	0.39	19.69
0.03	0.86	0.39	19.64
0.04	1.23	0.40	19.60
0.05	1.65	0.41	19.55
0.05	2.13	0.41	19.50
0.06	2.66	0.42	19.44
0.07	3.25	0.43	19.38
0.07	3.87	0.43	19.32
0.08	4.54	0.44	19.25
0.09	5.25	0.45	19.18
0.09	6.00	0.45	19.10
0.10	6.78	0.46	19.02
0.11	7.59	0.47	18.93
0.11	8.42	0.47	18.84
0.12	9.26	0.48	18.74
0.13	10.13	0.49	18.63
0.13	11.00	0.49	18.52
0.14	11.88	0.50	18.40
0.14	12.75	0.51	18.27
0.15	13.62	0.51	18.12
0.16	14.50	0.52	17.99
0.16	15.33	0.53	18.07
0.17	16.12	0.53	18.17
0.18	16.87	0.54	18.28
0.18	17.59	0.55	18.39
0.19	18.28	0.55	18.49
0.20	18.95	0.56	18.59
0.20	19.37	0.57	18.70
0.21	19.46	0.57	18.80
0.22	19.54	0.58	18.90
0.22	19.61	0.58	19.00
0.23	19.68	0.59	19.11
0.24	19.74	0.60	19.21
0.24	19.79	0.60	19.31
0.25	19.83	0.61	19.40
0.26	19.87	0.62	19.50
0.26	19.90	0.62	19.60
0.27	19.93	0.63	19.70
0.28	19.95	0.64	19.80
0.28	19.97	0.64	19.89
0.29	19.98	0.65	19.99
0.30	19.98	0.66	20.17
0.30	19.99	0.68	20.35
0.31	19.98	0.69	20.53
0.32	19.98	0.70	20.71
0.32	19.97	0.72	20.90
0.33	19.95	0.73	21.08
0.34	19.94	0.74	21.26
0.34	19.91	0.75	21.44
0.35	19.89	0.77	21.62
0.36	19.86	0.78	21.80

TECHNICAL SPECIFICATION	Head (m)	Flow (l/s)	2 No Thus
Design	0.65	20	
Flush-Flo	0.302	19.985	
Kick-Flo®	0.519	17.96	
Mean Flow over head		15.846	
Minimum Clearance (m²)		0	



Storage Profile

Head m	Area sq m	Voids Rati	Aeff=A.VR	Storage V	Type
0.25	448	0.95	425.6	0	Geocell
0.65	448	0.95	425.6	170.24	Geocell
0.6501	0	0.95	0	170.24	Geocell
0	0	0	0	170.24	-
0	0	0	0	170.24	-
0	0	0	0	170.24	-
0	0	0	0	170.24	-
0	0	0	0	170.24	-
0	0	0	0	170.24	-
0	0	0	0	170.24	-
0	0	0	0	170.24	-



Project	DLL Bicester Area B	Job ref.	19153
Date	27-Nov-20	Page No.	
		Calc by	

1 in 1 Year Storm 15 Mins Duration
Outflow based on Hydraulic Curves

i=50 mm/hr, as the Wallingford Rational Method coefficients are not applicable for T < 5 Years

Area **0.4136** ha

Storage profile described on adjoining sheet
Volume = 170.24 cu m

Out Flow fron supplier data based on Head
Head based on Stored Volume of previous line.

D	i	Q_{peak}	Run Off	Head	Out Flow	Disch.	Stored Volume
mins	*mm/hr*	*l/sec*	*cu m*		*l/s*	*cu m*	*cu m*
1	50.00	57.49	3.45	0.00	0.00	0.01	**3.44**
2	50.00	57.49	6.90	0.27	19.93	1.21	**5.69**
3	50.00	57.49	10.35	0.28	19.97	2.40	**7.94**
4	50.00	57.49	13.80	0.30	19.98	3.60	**10.19**
5	50.00	57.49	17.25	0.31	19.98	4.80	**12.45**
6	50.00	57.49	20.70	0.32	19.97	6.00	**14.70**
7	50.00	57.49	24.15	0.34	19.94	7.20	**16.95**
8	50.00	57.49	27.60	0.35	19.89	8.39	**19.21**
9	50.00	57.49	31.04	0.36	19.83	9.58	**21.47**
10	50.00	57.49	34.49	0.38	19.77	10.77	**23.73**
11	50.00	57.49	37.94	0.39	19.69	11.95	**26.00**
12	50.00	57.49	41.39	0.40	19.60	13.12	**28.27**
13	50.00	57.49	44.84	0.42	19.50	14.29	**30.55**
14	50.00	57.49	48.29	0.43	19.38	15.45	**32.84**
15	50.00	57.49	51.74	0.44	19.25	16.61	**35.13**
20	50.00	57.49	68.99	0.46	19.10	22.34	**46.65**
25	50.00	57.49	86.24	0.52	17.99	27.74	**58.50**
30	50.00	57.49	103.48	0.59	19.11	33.47	**70.01**
35	50.00	57.49	120.73	0.66	19.99	39.47	**81.26**
40	50.00	57.49	137.98	0.73	19.99	45.46	**92.52**
45	50.00	57.49	155.22	0.79	19.99	51.46	**103.77**
Max Volume to be Stored							**35.13** *cu m*

Mean Outflow 18.455 *l/sec*

D Duration in minutes
T Return Period in Years
I Rainfall Intensity in mm/hour

Q_{peak} Peak Flow l/s =2.78 Cv.Cr.i.A
CvCr=1
A Area in hectares
(10,000sq m = 1ha)

Project	DLL Bicester Area B	Job ref	191
Date	27-Nov-20	Page No	
		Calc by	

4 Hour Event

Outflow based on Hydraulic Curves

Return Period T	**30**	*Years*
M5-60	**20**	*mm*
r	**0.4**	
Area	**0.4136**	*ha*

Out Flow fron supplier data based on Head
Head based on Storage Volume of previous line.

D	Z1	M5-D	Z2	M30-D	i	Q_{peak}	Run Off	Head	Out Flow	Allow. Disch.	Stor. Vol.
mins		*mm*		*mm*	*mm/hr*	*l/sec*	*cu m*		*l/s*	*cu m*	*cu m*
5	0.37	7.41	1.45	10.78	129.32	148.69	44.61	0.00	0.00	0.01	**44.60**
10	0.53	10.59	1.49	15.82	94.93	109.15	65.49	0.51	18.27	5.49	**60.00**
15	0.63	12.59	1.51	19.01	76.03	87.43	78.68	0.60	19.21	11.25	**67.43**
20	0.70	14.06	1.52	21.35	64.06	73.65	88.38	0.65	19.89	17.22	**71.16**
25	0.76	15.22	1.53	23.21	55.70	64.04	96.07	0.67	19.99	23.22	**72.85**
30	0.81	16.18	1.53	24.75	49.50	56.91	102.45	0.68	19.99	29.21	**73.23**
35	0.85	17.01	1.53	26.07	44.69	51.38	107.91	0.68	19.99	35.21	**72.70**
40	0.89	17.73	1.54	27.22	40.84	46.95	112.69	0.68	19.99	41.21	**71.49**
45	0.92	18.38	1.54	28.25	37.67	43.32	116.95	0.67	19.99	47.20	**69.75**
50	0.95	18.97	1.54	29.18	35.02	40.27	120.80	0.66	19.99	53.20	**67.60**
55	0.98	19.50	1.54	30.03	32.76	37.67	124.31	0.65	19.89	59.17	**65.14**
60	1.00	20.00	1.54	30.81	30.81	35.43	127.54	0.63	19.70	65.08	**62.46**
90	1.12	22.39	1.54	34.52	23.01	26.46	142.89	0.62	19.40	100.00	**42.89**
120	1.21	24.19	1.54	37.23	18.61	21.40	154.10	0.50	18.40	133.12	**20.99**
180	1.34	26.87	1.53	41.15	13.72	15.77	170.32	0.37	19.80	204.40	**0.00**
240	1.45	28.91	1.52	43.98	10.99	12.64	182.04	0.25	19.83	275.80	**0.00**
										Max Volume to be Stored	**73.23**

Storage profile described on adjoining sheet Volume : 170.24 cu m Storage **OK < Provided**

1] T= Return Period of Storm (Years)
2] D= Duration of Storm (Mins)
3] i =[MT-D]*60/D
4] Q = 2.78 * Area * i
5] Run Off = Q *D *60/1000
6] Allowable Discharge = Va * D / 1000
Valid Range for T is 5 to 100 Years

7] M5-D=Z1 * M5-60
8] MT-D=Z2 * M5-D
9]Z1 & Z2 Wallingford Procedure Vols 1 and 4

This calculation uses a hydrograph described in the Wallingford Modified Rational Method. Whilst more advanced met exist based on the Flood Estimation Handbook (1999), the Revitalised Flood Hydrograph (ReFH)(2007) and the Revitalis Flood Hydrograph rainfall-runoff method version 2 (ReFH 2)(2015). As at May 2020 ReFH 2.3 which incorporates urban modelling is currant.
It should be noted that ReFH was rural only and only for catchments > 0.5 sq km or 50 hectares which is a much larger any project for which these calculations apply.
A calibration study of ReFH2 considered a 40 sq km catchment (4,000 hectares) small, the FEH method has only been calibrated for catchments of over 200 ha, whilst the typical catchment for which these calculations are made is less th ha and frequently less than 1.
Bearing in mind the small catchments and that ReFH and FEH are proprietary, the Wallingford Modified Rational metho does not appear inappropriate.

Technical Specification

Control Point	Head (m)	Flow (l/s)
Primary Design	0.650	20.000
Flush-Flo™	0.302	19.985
Kick-Flo®	0.519	17.960
Mean Flow		15.846

Hydro-Brake® Optimum Flow Control including:

- 3 mm grade 304L stainless steel
- Integral stainless steel pivoting by-pass door allowing clear line of sight through to outlet, c/w stainless steel operating rope
- Beed blasted finish to maximise corrosion resistance
- Stainless steel fixings
- Rubber gasket to seal outlet

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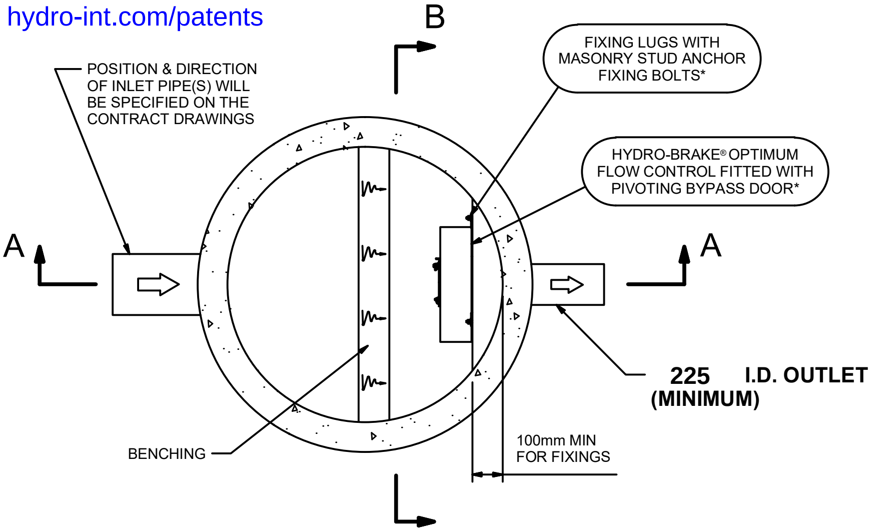
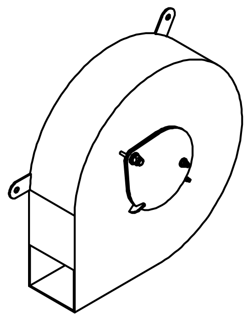
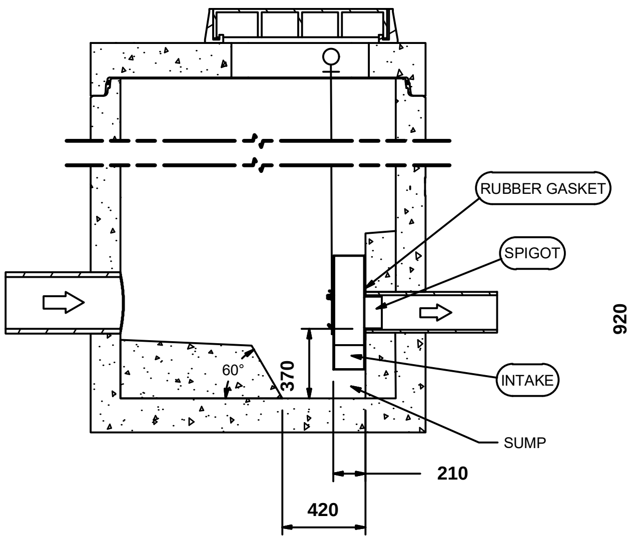
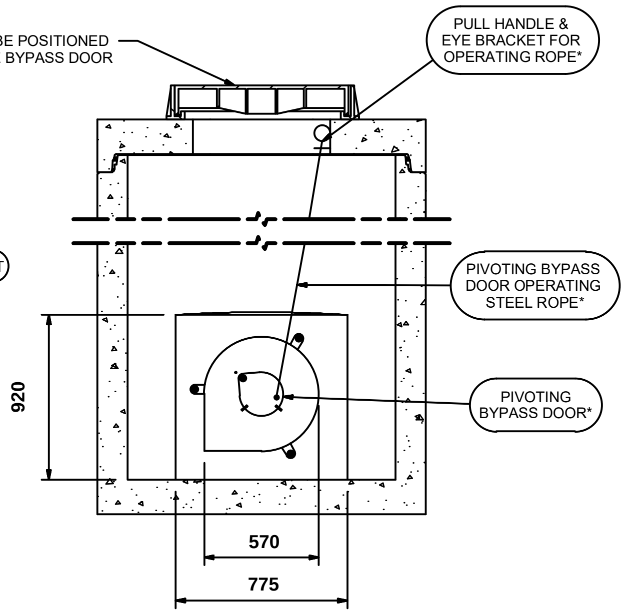






SECTION A-A



SECTION B-B

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Hydro International

DATE	11/19/2020 4:25 PM
SITE	DLL Bicester
DESIGNER	Nick Kramer
REF	20110 4 B / 20_21_5883

SHE-0203-2000-0650-2000
Hydro-Brake® Optimum

nick.kramer@amacl.co.uk

Technical Specification

Control Point	Head (m)	Flow (l/s)
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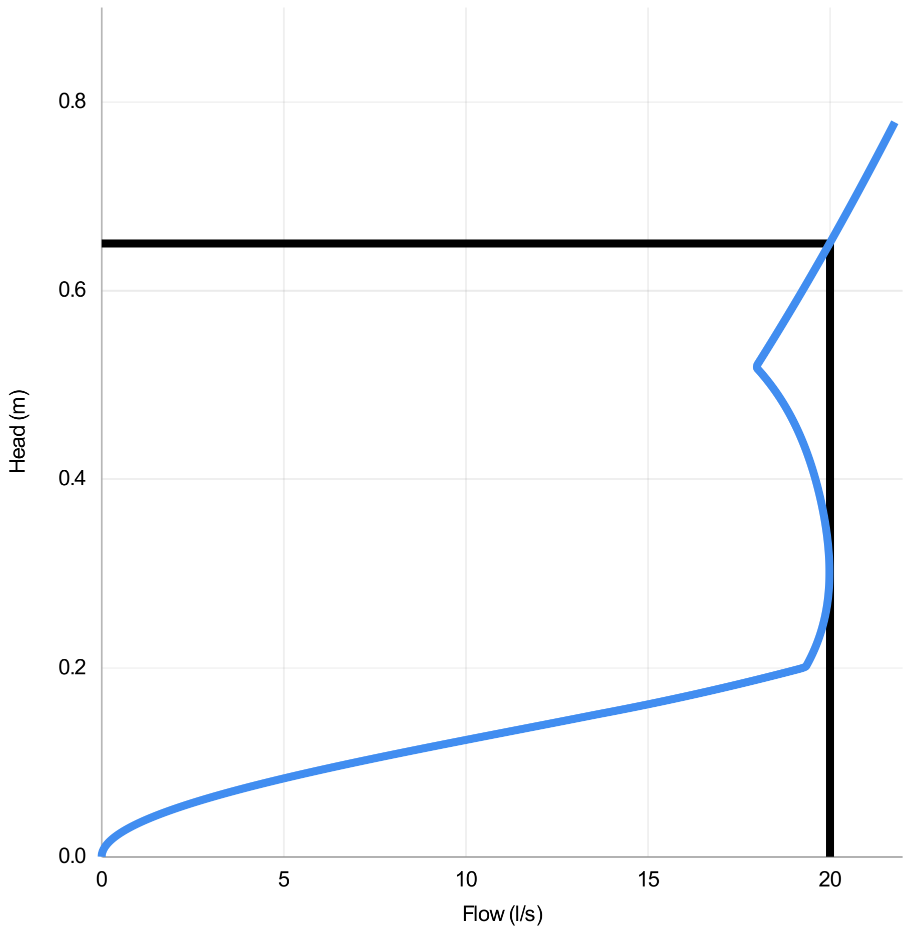
Mean Flow		15.846

hydro-int.com/patents

BBA APPROVAL INSPECTION TESTING CERTIFICATION CERTIFICATE No 08/4596

WRc APPROVED PT/329/0412



Head (m)	Flow (l/s)
0.000	0.000
0.022	0.409
0.045	1.576
0.067	3.393
0.090	5.739
0.112	8.473
0.134	11.424
0.157	14.408
0.179	17.095
0.202	19.342
0.224	19.621
0.247	19.812
0.269	19.929
0.291	19.980
0.314	19.978
0.336	19.931
0.359	19.846
0.381	19.727
0.403	19.576
0.426	19.388
0.448	19.157
0.471	18.869
0.493	18.506
0.516	18.047
0.538	18.272
0.560	18.629
0.583	18.979
0.605	19.322
0.628	19.659
0.650	19.989

DESIGN ADVICE

!

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Hydro International®

DATE	19/11/2020 16:25
Site	DLL Bicester
DESIGNER	Nick Kramer
Ref	20110 4 B / 20_21_5883

SHE-0203-2000-0650-2000

Hydro-Brake Optimum®

AMA Consulting Engineers

AMA Pipeline System Calc

Surface Water

Colebrook White Formula Full Bore Flow

Velocity $= -2\sqrt{(2gDS)}\log\left(\frac{k}{3.7D} + \frac{2.51\nu}{D\sqrt{2gDS}}\right)$ [Eqn. 1]

Project	**Runnymede ELC**	Job ref.	**16193**
Date	**27-Nov-20**	Page No.	
		Calc by	**NK**

Wallingford Rational Method

Return Period T (years)=	**30**	**Tc**	**4** min	Tc Time of Concentration
M5-60 (mm)=	**20**	**k_s**	**0.6** mm	Te Time of Entry
r =	**0.4**			k_s Surface Roughness Coefficient in mm

Reasons for Adjusting MH Invert

NA	*No Adjustment*
BD	*Back Drop*
CA	*Crowns Adjoining/Change in Dia*
MinD	*Min Depth / Ground Level*

Run

Ref	**U/S MH**	**D/S MH**	**L**	**Tc +∑Te**	**M30-D**	**i**	**Area**	**Q_{peak}**	**Pipe Dia**	**Pipe Gradient**	**Velocity.** Full Bore	**Time Te**	**Discharge Capacity**	**U/S Invert**	**D/S Invert**	**MH Adjustment**	**And Reason**	**D/S MH Invert**	**D/S MH GL**	**Depth**
No	*No*	*No*	*m*	*mins*	*mm*	*mm/hr*	*Ha*	*l/sec*	*mm*	*1 in G*	*m/sec*	*Mins*	*l/sec*	*m*	*m*	*m*	*--*	*m*		*m*
RWP A-	rwpa	s13	37	4.00	9.36	140.35	0.0778	30.36	225	1 : 200	0.919	0.67	36.551	65.300	65.115			**65.115**	**65.700**	**0.585**
s11-s1	s11	S1	30	4.00	9.36	140.35	-	20.00	150	1 : 100	1.003	0.50	17.728	64.500	64.200			**64.200**	**65.500**	**1.300**
uic	uic	s23	50	4.00	9.36	140.35	0.0880	34.34	225	1 : 150	1.064	0.78	42.290	64.900	64.567			**64.567**	**65.500**	**0.933**
	s23	s22	16	4.78	10.49	131.52	0.1760	64.35	300	1 : 275	0.942	0.28	66.557	64.567	64.508			**64.508**	**65.500**	**0.992**
Double	s22	s21	16	5.07	10.86	128.65	0.3530	126.25	300	1 : 200	1.106	0.24	78.212	64.508	64.428			**64.428**	**65.500**	**1.072**
Double	s21	s2	19	5.31	11.18	126.33	0.5400	189.65	300	1 : 150	1.280	0.25	90.464	64.428	64.302			**64.302**	**65.500**	**1.198**
FCU	s2	S1	47	4.00	9.36	140.35	-	40.00	225	1 : 150	1.064	0.74	42.290	64.500	64.187			**64.187**	**65.500**	**1.313**
S1-MHS5	S1	MH	34	4.00	9.36	140.35	-	50.00	300	1 : 150	1.280	0.44	90.464	64.187	63.960			**63.960**	**65.500**	**1.540**
RE-S15	RE	15	45	4.44	10.01	135.19	0.1253	47.09	300	1 : 300	0.901	0.83	63.682	65.400	65.250			**65.250**	**65.700**	**0.450**
x	S15	S14	50	5.28	11.13	126.64	0.1383	48.69	300	1 : 300	0.901	0.92	63.682	65.250	65.083			**65.083**	**65.700**	**0.617**
x	S14	tank	16	6.20	12.25	118.54	0.1383	45.58	300	1 : 300	0.901	0.30	63.682	65.083	65.030			**65.030**	**65.500**	**0.470**

Intensity i is a function of Tc+ΣTe for D≥5

Note Pipes from MH S22 to S21 and S21 to S22 are doubled up 300 Diameter pipes in order to accommodate flows withot the need for larger diameter pipes.

Self Cleansing Criteria
Sewers For Adoption 6th edition 2.13 4 Full Bore velocity ≥ 1.0 m/sec
B Regs H3 3.15

Dia	Minimum Gradient
75 & 100	1:100
150	1:150
225	1:225

AMA Consulting Engineers

Chris Christou
CEng MIstructE
Director
Richard Russell
CEng MIstructE
Director

SuDS Management and Maintenance Plan

For

David Lloyd Bicester

At:

Catalyst Development
Wendlebury Road, Chesterton
Bicester, Oxfordshire

20110/NK
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AMA Consulting Engineers
3 Marconi Place, New Southgate
London N11 1PE
T: +44(0)208 361 6827
www.amaci.co.uk

The Institution of Structural Engineers
Constructionline

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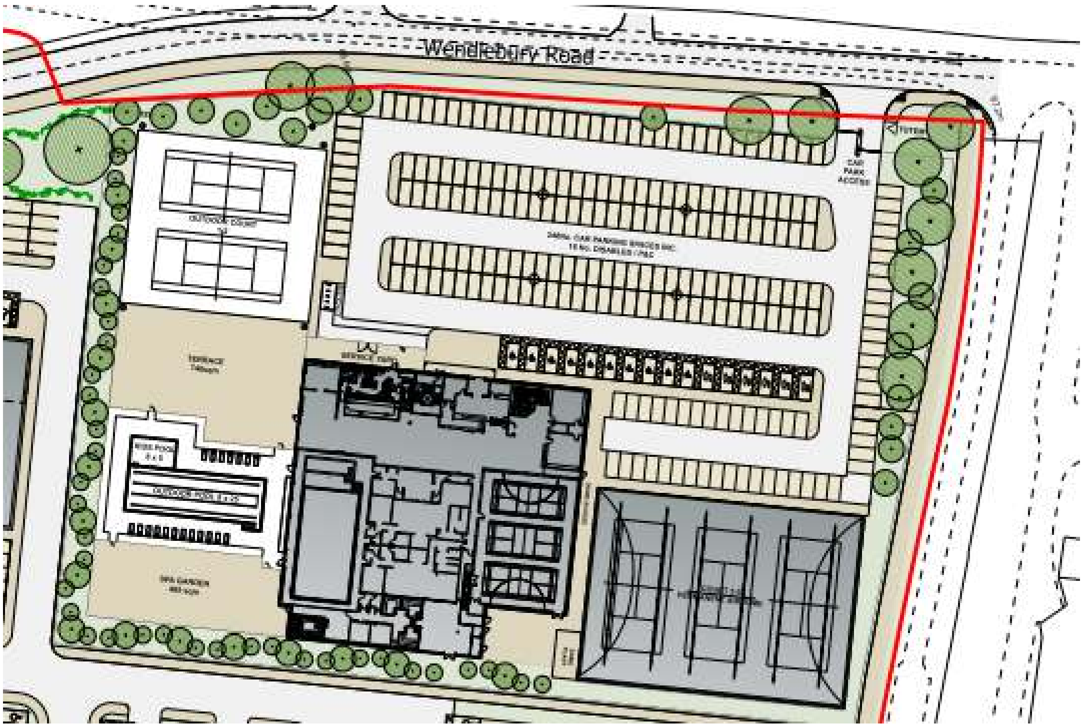

Contents

1 Introduction

1.1 The new leisure club has been designed with a Sustainable Drainage System (SuDS) this document explains why a SuDS was installed and why it is important that it is maintained, how it must be managed and a schedule if maintenance.

1.2 The SuDS selected are intended to require a low level of maintenance within the capacity of a general landscape maintenance organisation.

1.3 With the increase in urban development it was realised that the traditional collection of ever larger volumes of surface water into public sewers was not sustainable and that measures were required to control the amount of water discharged off-site and to improve the quality of the water discharged.

1.4 The UK Government sets out a National Planning Policy Framework for England and to support decision making provides guidance in a document “Guidance-Flood risk and coastal change this includes requirements for Sustainable Drainage Systems (SuDS)” Paragraph 51 states.

“*Why are sustainable drainage systems important?*

> *Sustainable drainage systems are designed to control surface water run off close to where it falls and mimic natural drainage as closely as possible. They provide opportunities to:*
> *reduce the causes and impacts of flooding;*
> *remove pollutants from urban run-off at source;*
> *combine water management with green space with benefits for amenity, recreation and wildlife*.”

1.5 A management system may be required where the SuDS serves more than one property or has complex features. This does not apply in the case of this development.

1.6 For the continued efficiency and effectiveness of the SuDS system maintenance is required. A schedule of anticipated maintenance is included.

2 Description of the Sustainable Drainage System.

2.1 The drainage system is shown on the drainage drawings 20110 D100 and D200.

2.2 The SuDS Elements are

a) A drainage blanket of granular material under the car park surfaces..
b) Perforated pipes to collect the water in the stone drainage blanket.
c) Catchpit (or *siltpit)* manholes to allow solids to settle.
d) Filter Drains to collect water from the tennis courts and terraces.
e) Underground tanks formed from plastic geocell units for attenuation storage.
f) A Vortex Flow control device in the final manhole.
g) A precast concrete headwall and spillway in the bank of the stream.

3 Management of the SuDS

3.1 The SuDS is intended to be simple and robust.

3.2 Management of the SuDS will be a responsibility of the centre management assisted by regional and head office technical managers for any capital works.

3.3 If the facilities are to be extended or altered then the implications for SuDS should be considered.

3.4 Further guidance can be found in the SuDS Manual published by CIRIA as Report C735. It is available as a free download from http://www.ciria.org/Resources/Free_publications/SuDS_manual_C753.aspx

4 Maintenance of the SuDS

4.1 A SuDS maintenance table is attached at Annex A

4.2 SuDS maintenance may be considered to be

a) Regular maintenance, including inspections,
b) Occasional Maintenance, and
c) Remedial Maintenance.

4.3 Items described as regular or occasional can be included in the landscape maintenance. Items described as remedial may require design and result in a capital expenditure.

4.4 The frequency of maintenance may require to be ascertained after the system has been in use.

4.5 Where SuDS elements need to be replaced then the design drawings should be used to specify replacement material.

4.6 All the work described as routine or occasional should be within the capability of a competent landscape maintenance contractor.

5 Maintenance Schedule

Ref	SuDS Element	Activity	Frequency	Type & Notes
1.	Catchpit Manhole	Inspect to check for sediment and empty if full.	Annually	Routine/Occasional Material removed should be disposed of as contaminated.
2.	Road Gullies Yard Gullies	Inspect to check for sediment and empty if full.	Annually	Routine/Occasional Material removed should be disposed of as contaminated.
3.	Filter Drains	Inspection and Silt Removal Inspection chambers are provided at ends and changes of direction.	As required	Occasional Maintenance The drain should be checked to see that it empties after a storm and if it appears to be silted the pipes should be jetted and the silt removed. Material removed should be disposed of as contaminated.
4.	Perforated Collector Drains	Inspection and Silt removal if required A manhole is provided at each end of the perforated pipes.	As required	Occasional Maintenance The Tank should be checked to see that it empties after a storm and if it appears to be silted the pipes should be jetted and the silt removed. Material removed should be disposed of as contaminated.
5.	Flow control Manhole	Inspect	Annually	Routine Maintenance

Ref	SuDS Element	Activity	Frequency	Type & Notes
6.	Flow control Manhole	If the manhole is blocked, open By Pass doors, let system drain, unblock and close doors. See Safety Note.	As required	Occasional Maintenance The by-pass doors can be opened by chains fixed to the manhole below the cover.

<u>Safety Notes</u> Personnel should never enter manholes without taking *Confined Spaces* precautions. Guidance is available from the HSE.
Any Personnel working on or with the drainage must be warned of the risks of *Leptospirosis*, also called Weil's disease. If flu like symptoms occur then a GP must be consulted to avoid serious complications.