APPENDIX I:

COMPLETED BREEAM SCORING SHEET & CALCULATORS

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BREEAM 2006 - Assessment Calculators

Assessment & Building Details

Assessor Name

Guy Mercer

Assessment Reference Number

ATK-BES-GM03-6

Building Name

HEFF

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Bespoke BREEAM 2006

HEFF Building
FINAL
07/05/07

Ref	Title	Whole Building / Site	Offices	Workshop	Supervisor Control Room	Meeting Rooms	Mess Room	Processing Cells	Control Corridor	Max credits available
		Enter the area (m^2) of each function into the cells below each function name								
		2716.51	69.92	34.45	24.43	33.53	50	1054.18	1450	
Management										
M1	Commissioning	2	2	2	2	2	2	2	2	2
M4	Considerate Constructors	2	2	2	2	2	2	2	2	2
M5	Construction Site Impacts	4	4	4	4	4	4	4	4	4
M8	Consultation	2	2	2	2	2	2	2	2	2
M12	Building User Guide	1	1	1	1	1	1	1	1	1
	Credits Available		11	11	11	11	11	11	11	
	Credits Achieved		11	11	11	11	11	11	11	
	% Function Score		100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	
	% Total Score		2.6%	1.3%	0.9%	1.2%	1.8%	38.8%	53.4%	
	Section Score		**100%**							

Ref	Title	Whole Building / Site	Offices	Workshop	Supervisor Control Room	Meeting Rooms	Mess Room	Processing Cells	Control Corridor	Max credits available
Health and Wellbeing										
HW1	Daylighting	N/A	0	0	0	0	0	N/A	N/A	1
HW2	View Out	N/A	1	1	N/A	N/A	N/A	N/A	N/A	1
HW3	Glare Control	N/A	1	1	1	1	1	N/A	N/A	1
HW4	High Frequency Lighting	1	1	1	1	1	1	1	1	1
HW5	Internal & External Lighting Levels	1	1	1	1	1	1	1	1	1
HW6	Lighting Zones	N/A	1	1	1	1	1	N/A	1	1
HW9	Internal Air Pollution	1	1	1	1	1	1	1	1	1
HW11	Ventilation Rates	1	1	1	1	1	1	1	1	1
HW14	Thermal Comfort	1	1	1	1	1	1	1	1	1
HW15	Thermal Zoning	1	1	1	1	1	1	1	1	1
HW16	Microbial Contamination	1	1	1	1	1	1	1	1	1
HW17	Acoustic Performance - Internal Noise Levels	N/A	0	0	0	0	0	0	0	1
	Credits Available		12	12	11	11	11	8	9	
	Credits Achieved		10	10	9	9	9	7	8	
	% Function Score		83.3%	83.3%	81.8%	81.8%	81.8%	87.5%	88.9%	
	% Total Score		2.1%	1.1%	0.7%	1.0%	1.5%	34.0%	47.4%	
	Section Score		**88%**							
Energy										
E1	Reduction of CO_2 Emissions	8	8	8	8	8	8	8	8	15
2	Sub Metering of Substantial Energy Uses	0	0	0	0	0	0	0	0	1

Ref	Title	Whole Building / Site	Offices	Workshop	Supervisor Control Room	Meeting Rooms	Mess Room	Processing Cells	Control Corridor	Max credits available
E3	Sub Metering of Areas / Tenancy	0	0	0	0	0	0	0	0	1
E4	External Lighting	1	1	1	1	1	1	1	1	1
	Credits Available		18	18	18	18	18	18	18	
	Credits Achieved		9	9	9	9	9	9	9	
	% Function Score		50.0%	50.0%	50.0%	50.0%	50.0%	50.0%	50.0%	
	% Total Score		1.3%	0.6%	0.4%	0.6%	0.9%	19.4%	26.7%	
	Section Score		**50%**							

Transport Credits

Ref	Title	Whole Building / Site	Offices	Workshop	Supervisor Control Room	Meeting Rooms	Mess Room	Processing Cells	Control Corridor	Max credits available
T1	Provision of Public Transport	2	2	2	2	2	2	2	2	2
T3	Proximity to Key Amenities	1	1	1	1	1	1	1	1	1
T4	Proximity to Other Amenities	1	1	1	1	1	1	1	1	1
T5	Cyclist Facilities	1	1	1	1	1	1	1	1	1
T6	Pedestrian & Cyclist Safety	1	1	1	1	1	1	1	1	1
T8	Travel Plan	1	1	1	1	1	1	1	1	1
T9	Maximum Car Parking Capacity	2	2	2	2	2	2	2	2	2
T10	Travel Information Space	1	1	1	1	1	1	1	1	1
T12	Deliveries & Manoeuvring	1	1	1	1	1	1	1	1	1

	Offices	Workshop	Supervisor Control Room	Meeting Rooms	Mess Room	Processing Cells	Control Corridor
Credits Available	11	11	11	11	11	11	11
Credits Achieved	11	11	11	11	11	11	11
% Function Score	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
% Total Score	2.6%	1.3%	0.9%	1.2%	1.8%	38.8%	53.4%

Section Score **100%**

Ref	Title	Whole Building / Site	Offices	Workshop	Supervisor Control Room	Meeting Rooms	Mess Room	Processing Cells	Control Corridor	Max credits available
			Combined Energy & Transport section scores							
		Credits Available	29	29	29	29	29	29	29	
		Credits Achieved	20	20	20	20	20	20	20	
		% Function Score	69.0%	69.0%	69.0%	69.0%	69.0%	69.0%	69.0%	
		% Total Score	1.8%	0.9%	0.6%	0.9%	1.3%	26.8%	36.8%	
		Section Score	**69%**							

Water Credits

W1	Water Consumption	3	3	3	3	3	3	3	3	3
W2	Water Meter	1	1	1	1	1	1	1	1	1
W3	Major Leak Detection	1	1	1	1	1	1	1	1	1
W4	Sanitary Supply Shut Off	0	0	0	0	0	0	0	0	1
W5	Water Recycling	0	0	0	0	0	0	0	0	1
W6	Irrigation Systems	1	1	1	1	1	1	1	1	1
		Credits Available	8	8	8	8	8	8	8	
		Credits Achieved	6	6	6	6	6	6	6	
		% Function Score	75.0%	75.0%	75.0%	75.0%	75.0%	75.0%	75.0%	
		% Total Score	1.9%	1.0%	0.7%	0.9%	1.4%	29.1%	40.0%	
		Section Score	**75%**							

Materials & Waste Credits

Ref	Title	Whole Building / Site	Offices	Workshop	Supervisor Control Room	Meeting Rooms	Mess Room	Processing Cells	Control Corridor	Max credits available
MW1	Materials Specification - Major Building Elements	2	2	2	2	2	2	N/A	N/A	3
MW2	Hard Landscaping & Boundary Protection	1	1	1	1	1	1	1	1	1
MW5	Reuse of Building Façade	0	0	0	0	0	0	0	0	1
MW6	Reuse of Building Structure	0	0	0	0	0	0	0	0	1
MW7	Recycled Aggregates	1	1	1	1	1	1	1	1	1
MW8	Responsible Sourcing of Materials	1	1	1	1	1	1	1	1	3
MW10	Designing for Robustness	1	1	1	1	1	1	1	1	1
MW12	Storage of Recyclable Waste	1	1	1	1	1	1	1	1	1

Credits Available	12	12	12	12	12	9	9
Credits Achieved	7	7	7	7	7	5	5
% Function Score	58.3%	58.3%	58.3%	58.3%	58.3%	55.6%	55.6%
% Total Score	1.5%	0.7%	0.5%	0.7%	1.1%	21.6%	29.7%

Section Score **56%**

Land Use and Ecology Credits

Ref	Title	Whole Building / Site	Offices	Workshop	Supervisor Control Room	Meeting Rooms	Mess Room	Processing Cells	Control Corridor	Max credits available
LE1	Reuse of Land	0	0	0	0	0	0	0	0	1
LE2	Contaminated Land	0	0	0	0	0	0	0	0	1
LE3	Ecological Value of Land & Protection of Ecological Features	0	0	0	0	0	0	0	0	1
LE4	Mitigating Ecological Impact	2	2	2	2	2	2	2	2	2
LE5	Enhancing Site Ecology	2	2	2	2	2	2	2	2	3
LE6	Long Term Impact on Biodiversity	2	2	2	2	2	2	2	2	2
	Credits Available		10	10	10	10	10	10	10	
	Credits Achieved		6	6	6	6	6	6	6	
	% Function Score		60.0%	60.0%	60.0%	60.0%	60.0%	60.0%	60.0%	
	% Total Score		1.5%	0.8%	0.5%	0.7%	1.1%	23.3%	32.0%	
	Section Score		**60%**							

Pollution Credits

Ref	Title	Whole Building / Site	Offices	Workshop	Supervisor Control Room	Meeting Rooms	Mess Room	Processing Cells	Control Corridor	Max credits available
P1	Refrigerant GWP - Building Services	0	0	0	0	0	0	0	0	1
P2	Preventing Refrigerant Leaks	1	1	1	1	1	1	1	1	2
P4	Insulant GWP	1	1	1	1	1	1	1	1	1
P6	NOx Emissions of Heating Source	2	2	2	2	2	2	2	2	3
P7	Flood Risk / Water Run Off	3	3	3	3	3	3	3	3	3
P8	Minimising Watercourse Pollution	1	1	1	1	1	1	1	1	1
P11	Renewable & Low Emission Energy	0	0	0	0	0	0	0	0	3
P12	Reduction of Night Time Light Pollution	1	1	1	1	1	1	1	1	1
P13	Noise Attenuation	0	0	0	0	0	0	0	0	1

Credits Available	16	16	16	16	16	16	16
Credits Achieved	9	9	9	9	9	9	9
% Function Score	56.3%	56.3%	56.3%	56.3%	56.3%	56.3%	56.3%
% Total Score	1.4%	0.7%	0.5%	0.7%	1.0%	21.8%	30.0%

Section Score **56%**

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M4: Construction Site Impacts

Where a firm commitment is made requiring the constructor to set up systems to set targets, monitor and report on the following impacts at site level:

1	CO_2 emissions / energy consumption resulting from energy use on site	Achieved
2	CO_2 emissions / energy consumption resulting from transport to and from site	Not Achieved
3	Construction waste resulting from site activities	Achieved
4	Recycling of construction waste resulting from site activities	Achieved
5	Water consumption resulting from site activities	Achieved

Where established best practice is specified to minimise the risks of:

6	Pollution to air arising from site operations	Achieved
7	Pollution to ground and watercourses / municipal systems.	Achieved

Points Achieved = 6

Sustainably sourced site timber

Where 75% of timber used for temporary site uses is certified by one of the schemes detailed in credit Mat 1-7	Achieved

Credits Achieved	**4**

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MW8: Responsible Sourcing of Materials

Elements Present	7
Credits	Points Required
1	5.00
2	10.00
3	15.00

ELEMENT	MATERIAL TYPES		Total Volume / Percentage	Percentage or Volume of Materials compliant with each Tier				% of assesed compliant with Tiers 1-4 (min. 80%)	Points scored
				Tier 1 (3 points)	Tier 2 (2 points)	Tier 3 (1.5 points)	Tier 4 (1 point)		
ROOF		Percentage							
Present	Mat 1	Kalzip Aluminium	100.00				100.00	100.00	1.00
	Mat 2								
	Mat 3								
	Mat 4								
	Total % of element (relevant materials) assessed		100.00						
FRAME		Percentage							
Present	Mat 1	Re-inforced Concrete & Steel Frame	100.00				100.00	100.00	1.00
	Mat 2								
	Mat 3								
	Mat 4								
	Total % of element (relevant materials) assessed		100.00						
EXTERNAL WALLS		Percentage							
Present	Mat 1	Kingspan Optimo	100.00				100.00	100.00	1.00
	Mat 2								
	Mat 3								
	Mat 4								
	Total % of element (relevant materials) assessed		100.00						
GROUND & UPPER FLOOR		Percentage							

Present	Mat 1	Concrete & Galvanised Steel (for Mezz)	100.00				100.00	100.00	1.00
	Mat 2								
	Mat 3								
	Mat 4								
	Total % of element (relevant materials) assessed		100.00						
FOUNDATIONS / SUBSTRUCTURE		Percentage							
Present	Mat 1	Concrete	100.00				100.00	100.00	1.00
	Mat 2								
	Mat 3								
	Mat 4								
	Total % of element (relevant materials) assessed		100.00						
DOORS		Percentage							
Present	Mat 1	Timber faced & Steel	100.00				100.00	100.00	1.00
	Mat 2								
	Mat 3								
	Mat 4								
	Total % of element (relevant materials) assessed		100.00						
WINDOWS		Percentage							
Present	Mat 1	Laminated & Toughened Glass	100.00				100.00	100.00	1.00
	Mat 2								
	Mat 3								
	Mat 4								
	Total % of element (relevant materials) assessed		100.00						

Total Points Achieved	7.00
Credits Achieved	1

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Ecological Calculator 2

Instruction: *This calculator is used to calculate LE4: Mitigating ecological impact and LE5: Enhancing site ecology, where a 'suitably qualified ecologist' has been appointed and is able to provide more site-specific ecological data with regard to plot types and number of floral species.*

Plot / Habitat Type	Area BEFORE development (m^2)	Total No. of Species	Area AFTER development (m^2)	Total No. of Species
Semi-improved grassland with occasional trees	67996.00	25.00	0.00	25.00
Amenity grassland (fertile, species poor)	18660.00	7.00	0.00	7.00
Scrub	1493.00	15.00	0.00	15.00
Developed land (buildings/concrete/gravel)	15767.00	0.00	43270.00	0.00
Semi-improved grassland (with trees) managed to incre	0.00	32.00	58016.00	32.00
SUDS pond vegetation and marginal planting	0.00	25.00	2630.00	25.00
TOTAL SITE AREA (M^2):	103916.00		103916.00	
TOTAL AVERAGE NUMBER OF SPECIES PER M^2:	0.00		0.00	

TOTAL CHANGE IN PLANT SPECIES DIVERSITY: **0.00**

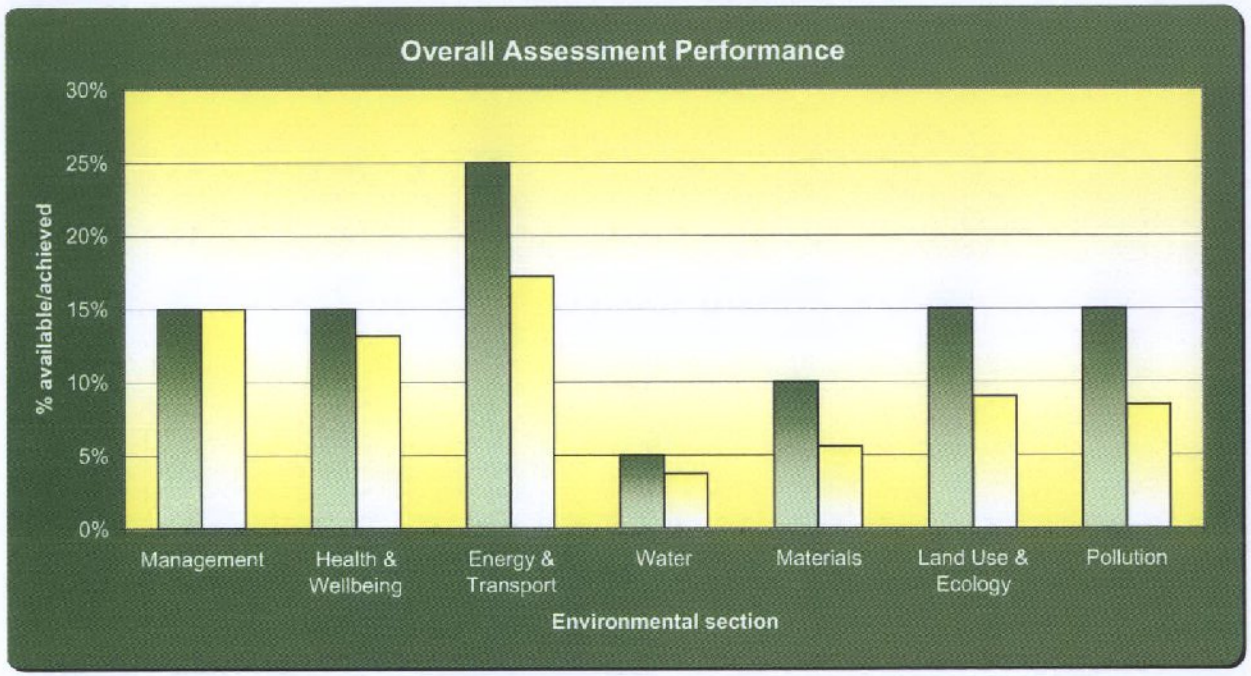
LE4 Credits Achieved **#DIV/0!**

LE5 Credits Achieved **0**

BREEAM Rating:	Excellent

Overall Credit Allocation	Env Weighting	Percentage section credits achieved	Overall Weighted Percentage
Management	15%	100.00%	**15.00%**
Health & Wellbeing	15%	87.86%	**13.18%**
Energy		50.00%	
Transport		100.00%	
Energy & Transport	25%	68.97%	**17.24%**
Water	5%	75.00%	**3.75%**
Materials	10%	55.77%	**5.58%**
Land Use & Ecology	15%	60.00%	**9.00%**
Pollution	15%	56.25%	**8.44%**
		Totals	**72.18%**

BREEAM Rating	
Unclassified	<25
Pass	≥25 - <40
Good	≥40 - <55
Very Good	≥55 - <70
Excellent	≥70



APPENDIX II:

SUGGESTED CONTENT OF BUILDING USER'S GUIDE

1. Building Services Information

a. **General User** - Information on heating, cooling and ventilation in the building and how these can be adjusted, e.g. thermostat location and use, implications of covering heating outlets with files, bags etc and use of lifts and security systems.

b. **FM** – As above plus, a non technical summary of the operation and maintenance of the building systems (including BMS if installed) and an overview of controls.

2. Emergency Information

a. **General User** - Include information on the location of fire exits, muster points, alarm systems and fire fighting systems.

b. **FM** – As above plus, details of location and nature of emergency and fire fighting systems, nearest emergency services, location of first aid equipment.

3. Energy & Environmental Strategy

This should give owners and occupiers information on energy efficient features and strategies relating to the building, and also provide an overview of the reasons for their use, e.g. economic and environmental savings. Information could include:

a. **General User** – Information on the operation of innovative features such as automatic blinds, lighting systems etc., and guidance on the impacts of strategies covering window opening and the use of blinds, lighting and heating controls

b. **FM** - As above plus, information on airtightness and solar gain (e.g. the impact of leaving windows/doors open in an air conditioned office, or use of blinds in winter with respect to solar gain); energy targets and benchmarks for the building type, information on monitoring such as the metering and sub-metering strategy, and how to read, record and present meter readings.

4. Water Use

a. **General User** – details of water saving features and their use and benefits, e.g. aerating taps, low flush toilets, leak detection, metering etc.

b. **FM** – As above plus, details of main components (including controls) and operation. Recommendations for system maintenance and its importance, e.g. risk of legionella.

5. Transport Facilities

a. **General User** – details of car-parking and cycling provision; local public transport information, maps and timetables; information on alternative methods of transport to the workplace, e.g. car sharing schemes; local 'green' transport facilities.

b. **FM** - As above plus, information on conditions of access, maintenance and appropriate use of car parking and cycling facilities, e.g. number of spaces provided.

6. Materials & Waste Policy

a. **General User** – Information on the location of recyclable materials storage areas and how to use them appropriately.

b. **FM** – As above plus, information on recycling, including recyclable building/office/fit out components, waste storage and disposal requirements; examples of Waste Management Strategies and any cleaning/maintenance requirements for particular materials and finishes.

7. Re-fit/Re-arrangement Considerations

a. **General User** – an explanation of the impact of re-positioning of furniture, i.e. may cover grilles/outlets, implications of layout change, e.g. installation of screens.

b. **FM** - As above plus, environmental recommendations for consideration in any refit. Relevant issues covered in BREEAM should be highlighted, e.g. the use of natural ventilation, use of Green Guide 'A' rated materials, re-use of other materials etc., the potential impact of increasing occupancy and any provision made in the original design to accommodate future changes.

8. Reporting Provision

a. **General User** – Contact details of FM/manager, maintenance team, and/or help desk facility; and details of any building user group if relevant.

b. **FM** – As above plus, contact details of suppliers/installers of equipment and services and their areas of responsibility for reporting any subsequent problems.

9. Training

Details of the proposed content and suggested suppliers of any training and/or demonstrations in the use of the building's services, features and facilities that will be needed. This could include:

a. **General User** - Training in the use of any innovative/energy saving features.

b. **FM** – As above plus, training in emergency procedures and setting up, adjusting, and fine tuning, the systems in the building.

10. Links & References

This should include links to other information including websites, publications and organisations. In particular, the 'Carbon Trust' programme should be referenced and links provided to its website and good practice guidance.

ATKINS

AWE High Explosives Fabrication Facility	Technical Report

Surface Water Drainage Report

Document No. : 5033650/07/0151

Revision	Date	Prepared	Checked	Approved
1P	11/10/2007	P Brown	G Wodjewodski	J. Dowding

DOCUMENT REVISION RECORD

Revision	Date	Reason for Revision
1P	11/10/2007	Planning Application

This document was previously issued under the document number of 5033650/07/0141 and a draft version of this document was issued under 5033650/07/0147. This document was issued 14/09/2007, this revision issued is purely an editorial change and does in no way alter the results or methodology.

Client:

Project: HEFF

Document Title:

Calculation for Surface Water Drainage

Job No: **5033650** Copy No:

Document Reference: 5033650/.07/00151

Issue	Purpose Description	Originated	Checked	Reviewed	Authorised	Date	Client
01	PLANNING APPLICATION	14/09/07	JAW Sept 07	24/07			
		ATKINS					

Distribution:
AWE

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1. Introduction

The HEFF (High Explosive Fabrication Facility) is to be located within the AWE Aldermaston Site at the location shown highlighted on the plan in Appendix A.

AWE, have specified that the surface water drainage design should follow the Environment Agencies requirements for a SUDS (Sustainable Drainage System) type system in full where possible, in preference to a conventional pipe/road gully system.

The system proposed incorporates the following devices: (wet) ponds, infiltration trenches, permeable block paving, swales and filter strips (including over the edge drainage, avoiding the need for gullies).

The main aspect of SUDS being to replicate as far as possible the existing greenfield surface run-off conditions prior to any development (by means of attenuation/infiltration). Greenfield run-off having been calculated using IH 124 method on Microdrainage Software.

2. Geology and Hydrogeology

The proposed site area is relatively level with a slight fall from West to North East (102.5 to 103.00 AOD approx.). There also appear to be no watercourses or natural ponds/lakes etc within the immediate vicinity that should be taken into consideration.
The ground at the proposed site comprises made ground just below the surface topsoil, and then Silchester Gravels containing sand/gravel with silt/clay, followed by Bagshot Beds and London Clay below.
Although containing sand and gravels, soakaway tests show the ground infiltration rate to be low, with a figure in the region of 10^{-3} m/hr. This does however fall within the lower end of the good infiltration values, shown in Table 4.7 of the SUDS manual.

Initial groundwater readings taken during July 2005 show the depth to vary between 1m and nearly 4m below ground level.
In addition, soakaway tests carried out at the start of 2007 encountered groundwater at only 2m down (North of proposed building) where previously it was 3.8m approx. In another location however (South of building) no groundwater was encountered at 1.5m depth (where previously it was 2m deep) apparently showing no change in level.

3. Drainage Philosophy

The overall strategy for the drainage system is that all devices (ponds, permeable pavement, infiltration trenches) will connect to a pipe system fitted with a hydrobrake that will prevent all flows to the existing AWE system from exceeding the Greenfield run-off flows calculated.

a. Ponds

Wet type ponds are proposed both North and South of the main buildings, draining the roof areas of the Process Building only. These ponds will retain a permanent level of water, while allowing temporary storage for storms up to 100yr return period without overtopping. They will predominantly provide attenuation, although some treatment (pollutant removal) by way of sedimentation will also occur. As the pond liner will stop at the permanent water level, there will also be some minor infiltration above this point.

The remaining roof areas (support and service buildings) will drain directly into the permeable paving sub-base (refer to permeable paving section), thereby avoiding the need to discharge into the ponds. The sub-base within the permeable paving acting as an underground attenuation/storage tank.

A proposed underground pipe system will link these ponds (and permeable pavement outlets), back to a designated connection point on the existing AWE pipe system. A hydrobrake will be used prior to this existing outfall to ensure flows do not exceed the Greenfield run-off rate.

b. Over the Edge Drainage

The HGV access road will be constructed in standard impermeable flexible pavement (as agreed with AWE) due to the 30mph speed limit exceeding limit for using block paving (see Ciria C697 section 12.1). As part of the SUDS format, over the edge drainage will also be used, incorporating flush edge blocks instead of kerbs, allowing surface flow to run directly onto the filter strips adjacent to the road, and then into the infiltration trench. Outfalls from the infiltration trench will then connect to the underground pipe system.

c. Filter Strips

Adjacent to the impermeable pavement (HGV access road) there will be grassed filter strips approximately 5m wide that will pre-treat the sheet flow, prior to the infiltration trench, thereby reducing the amount of long term silt build up in these devices. This is a recommended form of pre-treatment that should help protect the trenches and downstream pipework from silt buildup, which is the main cause of failure.

d. Infiltration Trenches

The infiltration trenches (filled with granular material) will provide the main form of soakaway device for the site and will be used for the HGV access road surface water run-off, via over the edge drainage.

e. Concrete Pavement areas

For the HGV parking/loading areas into the Process Building, a separate impermeable concrete area is required by AWE utilising a positive drainage system and channel outlet, to allow the run-off to pass through a bypass separator in the event of a spillage. This will then outfall to the pipe system directly.

f. Permeable Block Pavements

Permeable block paving is now proposed in all traffic and pedestrian areas except the HGV access road itself. The HGV turning area is also included as updated literature from Interpave shows that higher traffic loadings can now be accommodated, (not the case until relatively recently).

With this type of pavement, the rainfall passes through the open joints and into a proprietary single size subbase material with large void characteristics. To maximise storage in the subbase, this type of pavement is laid without falls, using standard kerb details at the edges.

The proposed permeable pavement option chosen (refer SUDS manual Type C) does not allow infiltration of the surface run-off into the existing subgrade below. This is due to the proximity of the groundwater to the formation level, and also to avoid possible weakening of the subgrade that could lead to pavement failure.

This type of pavement will therefore act as attenuated underground storage, with an outfall directly to the pipe system.

AWE have designated the Support Building pavement area (from meetings and subsequent telephone discussions) for use by light duty (transit type – vehicle category 3 - GVW 7500 ku) site vehicles only.

It is now understood from AWE that mainly light duty vehicles will also service the Process Building as well, with occasional HGV's only (to be confirmed by AWE). Currently category 4 - GVW 21,000 ku has been used to design the subbase depth in this area .

Pedestrian areas will also use permeable block pavement. The same formation level will be used in both pedestrian and traffic areas, to maximise the storage volume in the subbase.

In addition to the paved areas themselves, other impermeable catchment areas (support and services building roofs) can also drain to this subbase layer by way of a diffusion chamber (acts as a baffle to avoid sudden inrush of flow). The additional catchment area may require additional storage in the pavement which can be achieved by increasing the depth of the subbase in the same way as increasing the volume of an underground storage tank. This procedure has been carried out therefore for both the Support and Service buildings. In view of the high permanent water level now in the

(wet) ponds, a conventional gravity pipe system from these building roofs would not have been possible due to the distance from the wet ponds.
The outfall from the paved areas is now direct to the pipe system instead of the ponds (or basins as in earlier design proposal).

g. Criteria Used

The surface water drainage system has been designed for the following return periods:

Drainage system and pond design – 1 in 100years + 30% increase in rainfall intensity due to climate change.
Based on the location of the AWE site within the country, values of 0.40, 18 and 750mm have been used for 'Ratio - R', M5-60(mm), and annual rainfall respectively (using the Wallingford Procedure Data).
Pond criteria as Ciria C697- section 17.
Greenfield run-off has been calculated from IH 124 (using Microdrainage Source Control).
General drainage design will follow Sewers for Adoption 6th Edition and BS EN 752.
Pipework will be vitrified clay(BS 65/BS EN 295) or concrete (BS 5911-1/BS EN 1916) or ductile iron (BS EN 598).
All infiltration tests and SUDS designs in accordance with BRE Digest 365 and Ciria C609 -- Sustainable Drainage Systems(2004), C697 - The SUDS manual (2007).
The design of the permeable pavement is based upon the current Interpave Permeable Block Pavement Guide –4 th Edition, and the SUDS Manual C697 (2007).

h. Climate Change

Planning Policy Statement PPS 25 Table B.2 recommends that rainfall intensity, when designing for 100yr life of the development, should be increased by 30%.

Refer also to Appendix A for a copy of PPS 25 Table B.2.

4. Detail Design

i. Greenfield run-off.

Referring to 'catchment area' spreadsheet in Appendix B., the overall area of the proposed works (including buildings, pavements and filter strips) is approximately 1.0 ha.
Using IH 124 (within Microdrainage/Source Control), the overall run-off flows are calculated for a range of storm events – 30yr -12.9 l/s and 100yr being 18.1 l/s. As well as at the pond outlets, hydrobrake will also be used on the main outfall from the site to restrict flows to within these values.

Variables used in IH 124 to determine flow include:

Catchment Area – 1.0 ha

SAAR(annual average rainfall) – 750mm (from Wallingford Procedure rainfall map).
Soil index – 0.4
Urban- 0. (currently no construction)

ii. Soakaway Test Data and Infiltration Rates

Refer to Appendix C for soakaway test data and calculations for infiltration rate for the infiltration trenches used for the HGV access.

Infiltration rate used – 6.0666×10^{-3} m/hr

iii. Surface Water Outfall pipe system

Refer to Microdrainage output in Appendix D

This shows the proposed gravity pipe system from the site, connecting to the existing system outfall point. This is a 200 mm diameter pipe laid at 1 in 200 average gradient.

iv. Ponds

a. North Pond.

The following areas will drain to this pond:

- North side of the Process Building Roof via above/below ground rainwater pipes and a swale inlet (Ref 1 on .Site drainage area drawing –Appendix B).

The existing ground levels in this area are approximately 102.55m AOD(subject to confirmation prior to construction).
Groundwater level 2m. down (from soakaway test report), therefore top of groundwater assumed at level 100.5m AOD.

The rainwater pipe system from the Process Building Roof will incorporate a baffle chamber at ground level prior to outfalling into the pond via a swale. These two devices will help reduce the velocity, in order to minimize the disturbance to the pond.

Both ponds will also have forebays to act as pre-treatment areas for coarse sediments, and to minimise any disturbance to the main settlement pond, from the inflows. Pond volume is approximate at this stage.

A Hydrobrake will be used on the outfall to pipe system.

Area draining to pond is 0.13ha
Refer to Appendix E for Microdrainage Data.

b. South Pond

The following areas will drain to it:

- South side of the Process Building Roof via above/below ground rainwater pipes and a swale inlet.(0.130ha) (Ref 2)

The existing ground levels in this area are approximately 102.6m AOD (subject to confirmation prior to construction).
Groundwater level at least 1.5m down (from soakaway test report- App. C), therefore top of groundwater at level 101.1m AOD approx.

Refer to North Pond also for rainwater pipe information. Pond volume is approximate at this stage.

A Hydrobrake will be used on the outfall to pipe system.

Area draining to pond is approximately 0.13 ha
Refer to Appendix E for Microdrainage Data.

v. Permeable Block Paving
(Note: Where roof areas indicated – these will drain into the porous subbase material via diffusion chambers - refer to detail). Where this has been done, subbase depths have been adjusted to take account of the increased catchment area.
A perforated pipe will also be incorporated into the base of the paved area, connected to the outfall pipe, details to be confirmed.
Orifice plates will also be incorporated into all of the permeable paving outfalls.

a. Area 1 – HGV turning area (Process Building)

Areas draining to the permeable pavement sub-base are:

- Pavement area only
- Canopy area.
- Emergency access south of Process Building and area West of Surface Utility Trough

Area draining to pipe system 0.10 ha
Refer to Appendix E for Microdrainage Data.

b. Area 2 – Support Building North and paved areas.

Areas draining to pipe system on NE corner of site:

- Support Building Roof –North side(0.038 ha)

- Permeable pavement north side of access road and emergency access north side of Process Building (0.9)
- Pedestrian pavements (0.03)

Area draining to pipe system 0.16ha

c. Area 3 – Support Building South and paved areas

Areas draining to pipe system on SE corner include:

- Support Building Roof and canopy– South Side (0.038 ha)
- Permeable pavement south side and access road and East of Utility Trough (0.1ha).
- Pedestrian pavements (0.03 ha)

Area draining to pipe system 0.17 ha

d. Area 4 – Service Building and paved areas

Areas draining to pipe system south of Service Building include:

- Service Building –entire roof area (0.05)
- Permeable pavement (0.15 ha).

Area draining to pipe system 0.19 ha

Refer to Appendix E

vii. Infiltration trenches
Orifice plate (50mm dia) used on outfall to pipe system

a. West infiltration trench

Areas draining to the West infiltration trench are:
- West side of HGV Access Road

Area draining to pipe system 0.06ha.

b. East infiltration trench

Areas draining to the East infiltration trench are:
- East side of HGV Access Road.

Area draining to pipe system 0.06ha.

ix. Pollution Control

AWE have specified that pollution control is required in the Process Building paved area where HGV vehicles will park to unload.
The actual parking area will be a bunded (by low kerbs) concrete area, which shall retain any oil spills. A longitudinal channel will intercept any spillages, which will then pass to a Class 1 bypass separator (Klargestor/ Conder or similar approved).
Outfall is to the South Pond above the top water level (flap valve on outfall).
Refer to Appendix H.

x. Overall pipe system analysis

Using the Cascade feature in Microdrainage/ Source Control, each of the separate devices have been connected together on-screen to check that the final outfall flow was within the expected limits. A schematic layout is enclosed in Appendix F to show the main SUDS devices connecting to the proposed pipe system, together with the results printout.

In Simulation the actual pipe system has been used to check the hydraulic operation of the system (although some dummy pipes have been used to input areas at specific locations), together with the inputs from each SUDS device.

Refer to Appendix F for Microdrainage Data

xi. Miscellaneous

Using these latest SUDS methods of drainage there are additional requirements/structures to be considered. These include flow diffusion chambers to be used where rainwater pipes outfall into the permeable block paving subbase (support and service buildings).

Two key materials are the subbase and geotextiles used in the permeable pavement.
Below the laying course will be a permeable membrane to allow the surface run-off to pass through to the subbase below, but prevent the laying course material from doing the same.
The second geotextile required is an impermeable membrane below the subbase preventing any infiltration (as already mentioned this is the type C non-infiltration option).
The wet pond will also require a impermeable geotextile lining.
Both Interpave and Ciria Technical Guides provide details of the geotextile/aggregate materials and method of construction, and these should be followed carefully (and inspected on site during laying) to avoid possible premature failure.

Another major issue with the type of drainage proposed is maintenance, especially of the permeable block paving and ponds. This involves regular vacuuming of the blocks to ensure the drainage pathways are kept clear, and for the ponds, with sediment and vegetation management.

xii. Conclusions

Using Source Control (Cascade) the results show the flows to be below the greenfield run-off for the worst case duration in the 30 and 100yr storms.
Using Windes Simulation, the results again show that for both 30 and 100yr events (for all winter and summer storm durations), the flows are substantially below the predicted greenfield run-off rates and therefore meet the overall design requirement, including no surface flooding for 100yr event.

Storm Event	Greenfield Flow (IH 124) (l/s)	Source Control Results (l/s)	Simulation Outfall Results l/s
100 year	18.1	12.8	11

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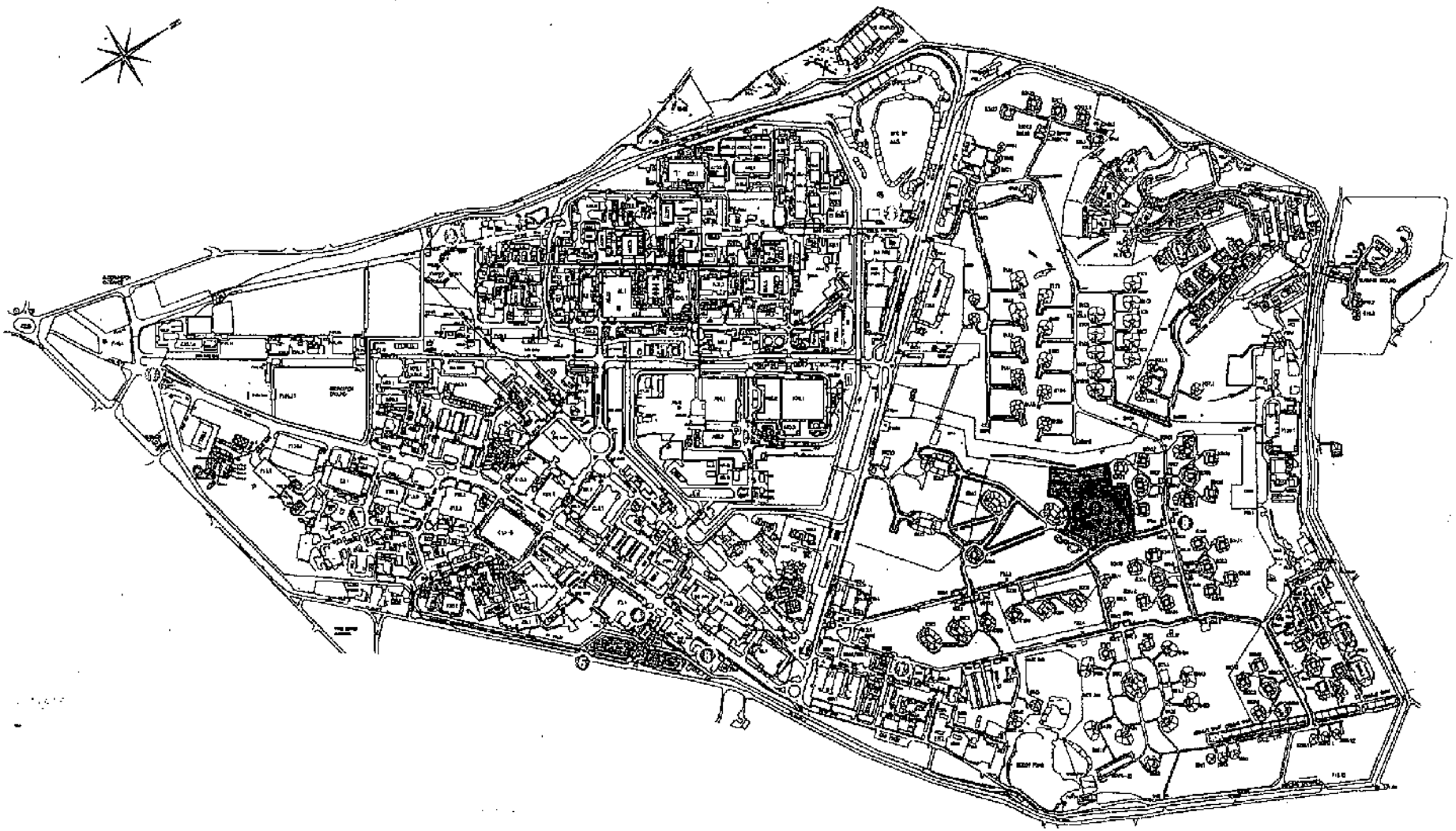
Woodcote Grove
Ashley Road Epsom
Surrey KT18 5BW

Telephone (01372) 726140
Telex 266701 (Atkins G)
Fax: (01372) 740055

Project	HEFF	Job ref	5033650
		Sheet no	1
Sub-section	SW DRAINAGE	Made by	PWB
		Date	04/07/2007
	Design information	Checked by	
		Date	

Client	WSA Engineer
Architect	
N/A	Building Regulation Authority or other & Date of submission
Ciria 697 - SUDS Design Manual Interpave Design Guide -Permeable Pavements 4th Edition Sewers for Adoption 6th Edition Planning Policy Statement 25 (PPS 25) BRE 365 - Soakaway Design C609 Sustainable Drainage Systems IH124 Rural Run-off	Relevant Building Regulations and Design Codes
Surface Water drainage design incorporating SUDS, with restricted (Greenfield run-off) flow to existing AWE system.	Intended use of structure including future extension or change of use allowed for in design
N/A	Fire resistance requirements
SUDS Drainage devices to be designed to contain runoff without flooding for a 100year storm event. Infiltration Basins to also drain down to half capacity in 24 hours for a 30 year event(soakaway design requirement).	General loading conditions
N/A	Wind loading conditions
N/A	Exposure conditions
N/A	Subsoil conditions
N/A	Foundation type
Concrete NA Reinforcement NA Steelwork N/A Other materials	Material data
Using Microdrainage Software	Other relevant information

Appendix A ①



Date	Title Site Location Plan	Figure
Project No.		
Created by		
File No.		

Appendix 2

PROTECTIVE MARKING
UNCLASSIFIED

DRAWING REFERENCE No.
SB/

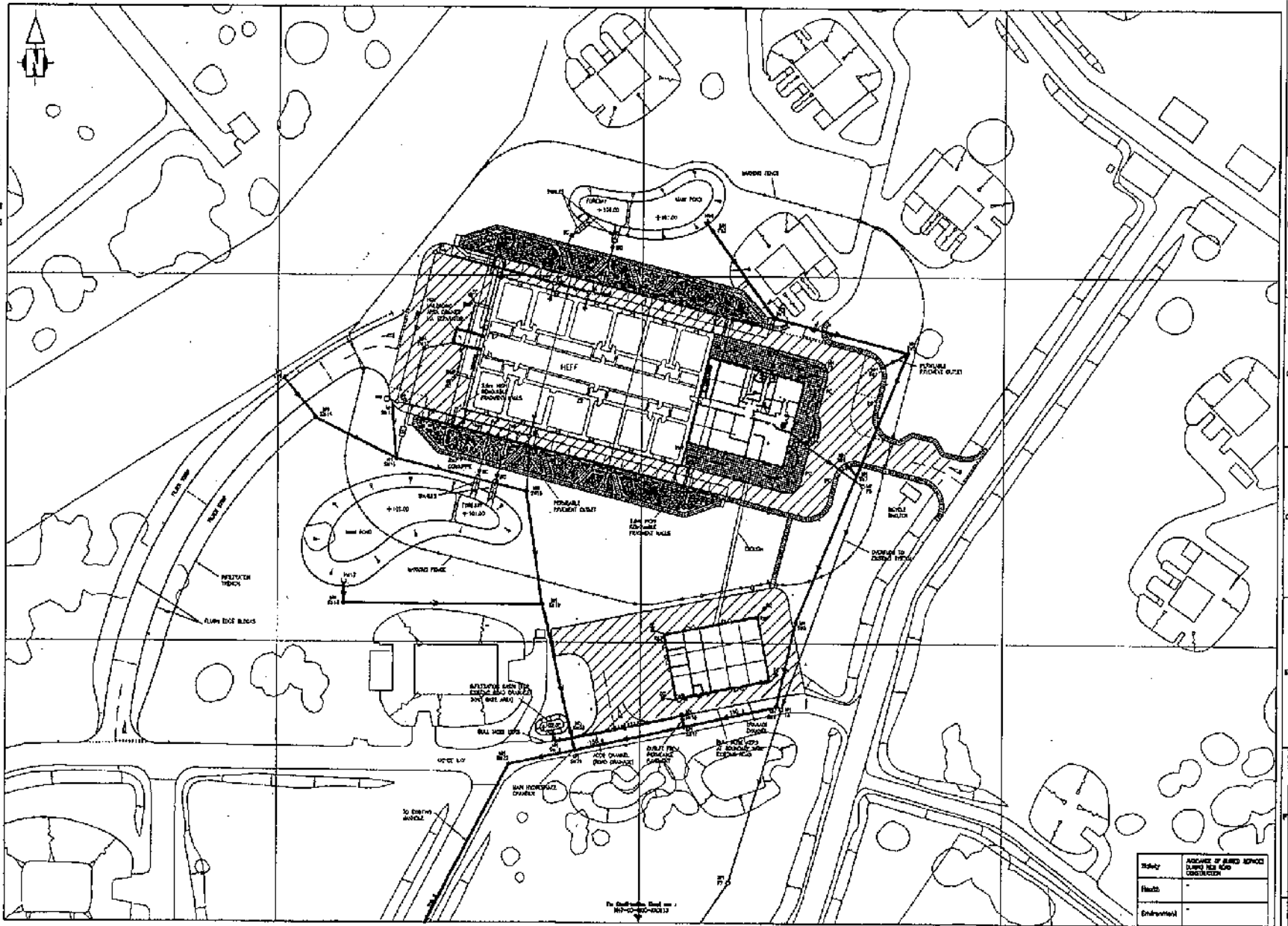
DRAWING No. N247-00-C100-XA0012-60 | SHT 1 OF 2

USED ON

NOTES

1. IMPERMEABLE FLEXIBLE SURFACING TO BE USED FOR ACCESS TURNING AREAS USED BY HGV's.
2. HGV LOADING/UNLOADING AREAS SURFACING AND DRAINAGE TO BE CONFIRMED.
3. NOTICE WAY ROAD TO DRAIN TO SEPARATE INFILTRATION BASIN (DESIGNED TO 5 YEAR EVENT).
4. THIS DRAWING IS TO READ IN CONJUNCTION WITH N247-00-C100-XA0015 (DRAINAGE LAYOUT SHEET 2) AND WITH THE RELEVANT STANDARD DRAINAGE DETAILS AND UTILITIES LAYOUT.
5. FOR AREAS OF PERMEABLE PAVEMENT DRAINING TO SURFACE WATER SYSTEM REFER TO DRAWING N247-00-C100-XA0014 AND N247-00-C100-YA0011 FOR DETAILS.
6. GROUND SURVEY TO BE CARRIED OUT PRIOR TO CONSTRUCTION TO CONFIRM SUITABILITY OF PROPOSED FINISHED LEVELS.
7. PROPOSED GROUND LEVELS AROUND BASINS ARE INDICATIVE LEVELS.
8. SUPPORT BUILDING EXCHANGE CANOPY TO DRAIN TO PERMEABLE PAVEMENT PERFORS SUB-BASE.
9. BYPASS SEPARATOR FOR HGV UNLOADING AREA TO BE CONSIDER DMS01.5/7 CLASS 1 OR SIMILAR APPROVED.
10. LOCATIONS OF ALL EXISTING SERVICES TO BE CONFIRMED PRIOR TO INFRASTRUCTURE WORKS.
11. THIS DRAWING TO BE READ IN CONJUNCTION WITH DRAWINGS N247-00-C100-XA0013, N247-00-C100-XA0014 AND N247-03-C100-YA0011 AND STANDARD DETAILS DRAWINGS N247-00-C100-YA0001 TO N247-00-C100-YA0023 INCLUSIVE. ALSO ALL RELEVANT DRAINAGE REPORTS AND HYDROGRAPHIC DATA.
12. ALL PERMEABLE BLOCK PAVING MATERIALS TO BE IN ACCORDANCE WITH CURRENT "INTERPAVE" GUIDELINES (MARSHALLS PROPA OR SIMILAR APPROVED).
13. OUTFALL PIPES FROM PERMEABLE PAVEMENTS AND INFILTRATION TRENCHES AND UNDERGROUND RAINWATER PIPES TO BE 150mm ø.

INFILTRATION TRENCH
INFILTRATION BASIN
PERMEABLE BLOCK PAVING (AREAS TO BE CONFIRMED)
CP CATCHPIT
DRAIN FROM PERMEABLE PAVEMENT
SURFACE WATER PIPE
BP BYPASS SEPARATOR
RC ROAD GULLY
PROPOSED KERB
DC DIFFUSION CHAMBER
BC BATTLE CHAMBER
HW HEADWALL



Safety	ANCHORAGE OF BURIED SERVICES DURING NEW ROAD CONSTRUCTION
Health	-
Environmental	-

CHANGE No / ACTION SHEET No	ISSUE	DATE
	60	-/-/-
BASIC DESIGN	5D	18/07/07
BASIC DESIGN FOR RGR	4P	19/04/07
ISSUED FOR COMMENT	3C	24/11/06
ISSUED FOR CONSTRUCTION	2C	20/10/06
DRAFT FOR INFORMATION	1P	01/06/06

MATERIAL | TOLERANCES | ORIGINAL SCALE 1:500 | TITLE HEFF - DRAINAGE LAYOUT (Sheet 1 of 2)

PROTECTIVE FINISH | SUB-CONTRACTOR | DIMS. IN m

SURFACE TEXTURE | CAD REF.

AWE ALDERMASTON, READING, BERKS, ENGLAND RG7 4PR

SAFETY SYSTEM LEVEL: CRITICAL / RELATED / UNRELATED

PRINT CONTROL No. N

PROTECTIVE MARKING UNCLASSIFIED

DRAWING REFERENCE No. SB/

DRAWING No. N247-00-C100-XA0012-60 | SHT 1 OF 2

A1

DRAWING OFFICE REFERENCE 1

DO. -

AWE(-)

CERTIFIED KNC | CHECKED EW | DRAWN JPM

CDO FORM 991 Issue 4.2

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Append. 3

PROTECTIVE MARKING
UNCLASSIFIED

DRAWING REFERENCE No.
SB/

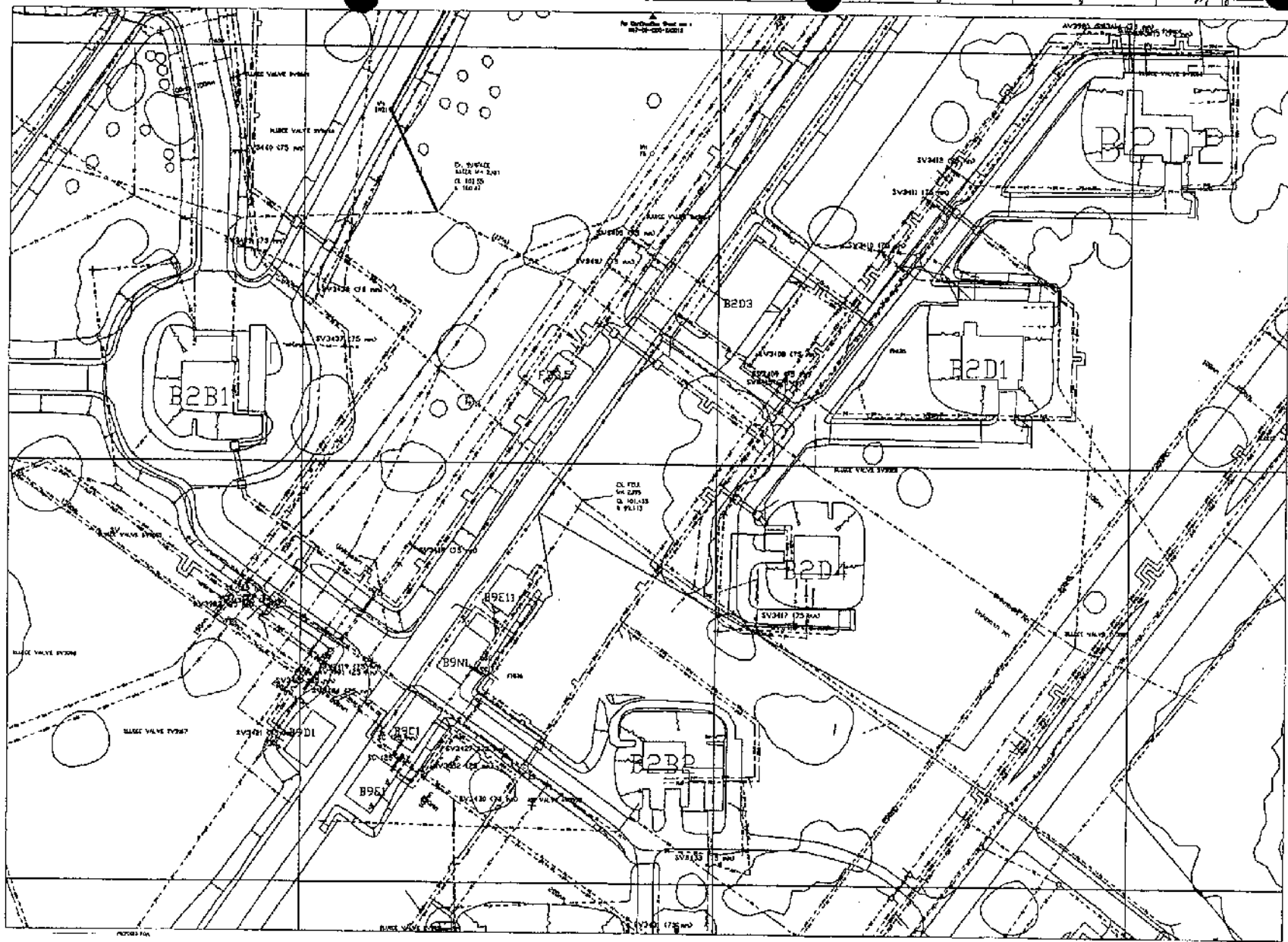
DRAWING No.
H247-00-C100-XA0013-40

SHT 2 OF 2

USED ON

NOTES

1. THIS DRAWING IS TO READ IN CONJUNCTION WITH H247-00-C100-XA0012 (DRAINAGE LAYOUT SHEET 1) AND THE RELEVANT STANDARD DRAINAGE DETAILS, PAVEMENT DRAINAGE AND UTILITIES LAYOUT.



BASIC DESIGN	4D	19/07/07
BASIC DESIGN FOR RCR	3P	19/04/07
ISSUED FOR CONSTRUCTION	2C	20/10/06
DRAFT FOR INFORMATION	1P	01/06/06
CHANGE No / ACTION SHEET No	ISSUE	DATE

MATERIAL

PROTECTIVE FINISH

SURFACE TEXTURE

TOLERANCES

SUB-CONTRACTOR

CAD REF.

ORIGINAL SCALE 1:500

DIMS. IN m

TITLE
HEFF - DRAINAGE LAYOUT
(Sheet 2 of 2)

ALDERMASTON, READING, BERKS, ENGLAND, RG7 4PR

SAFETY SYSTEM LEVEL: CRITICAL / RELATED / UNRELATED

PRINT CONTROL No. N

PROTECTIVE MARKING UNCLASSIFIED

DRAWING REFERENCE No. SB/

DRAWING No. H247-00-C100-XA0013-40

SHT 2 OF 2

A 1

DRAWING OFFICE REFERENCE

DO. –

AWE(–)

CERTIFIED JMC

CHECKED DW

DRAWN JPM

CDC FORM 991 Issue 4.2

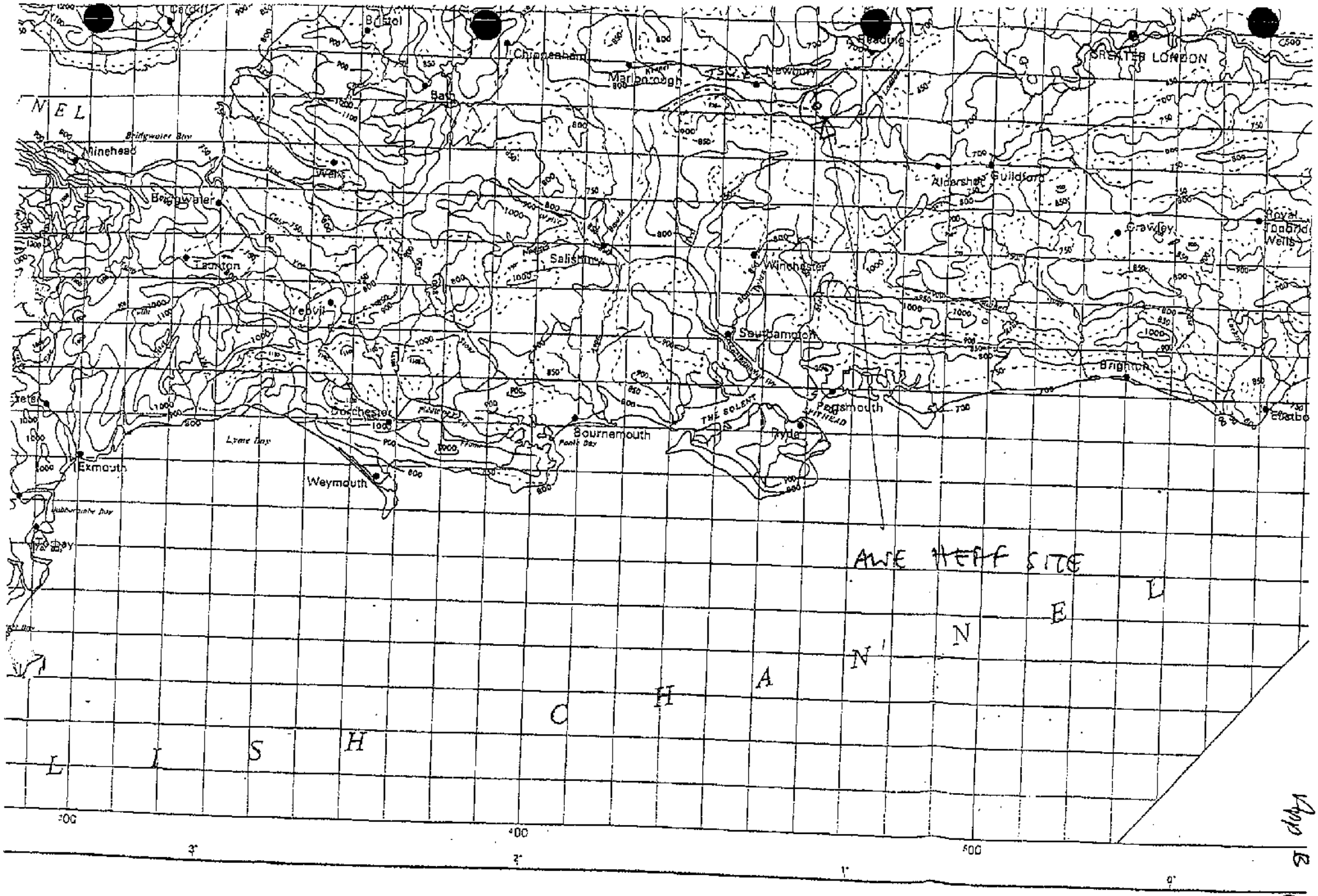
IH 124 Mean Annual Flood

Input

Return Period (years)	100	Soil	0.400
Area (Ha)	1.000	Urban	0.000
SAAR (mm)	750.000	Region Number	6

Results	**l/s**
QBAR Rural	5.7
QBAR Urban	5.7
Q 100 years	18.1
Q 1 year	4.8
Q 2 years	5.0
Q 5 years	7.3
Q 10 years	9.2
Q 20 years	11.4
Q 25 years	12.2
Q 30 years	12.9
Q 50 years	14.9
Q 100 years	18.1
Q 200 years	21.3
Q 250 years	22.3
Q 1000 years	29.3

(c)1982-2006 Micro Drainage


Bristol
Chippenham
Marlborough
Newbury
Reading
GREATER LONDON
Bath
Minehead
Bridgwater Bay
Wells
Bridgwater
Taunton
Yeovil
Salisbury
Winchester
Aldershot
Guildford
Crawley
Royal Tunbridge Wells
Southampton
Brighton
Portsmouth
Fareham
Ryde
THE SOLENT
Bournemouth
Poole Bay
Dorchester
Lyme Bay
Weymouth
Exmouth
Torbay
Newquay
AWE HEAF SITE
L E N N A H C H I S L
500
400
500

Map 18

(2)

Appendix B – (3)

Table 5/1 Runoff potential and soil classes

General soil description	Runoff potential	Soil class
Well drained sandy, loamy or earthy peat soils Less permeable loamy soils over clayey soils on plateaux adjacent to very permeable soils in valleys	Very low	S_1
Very permeable soils (e.g. gravel, sand) with shallow groundwater Permeable soils over rocks Moderately permeable soils some with slowly permeable subsoils	Low	S_2
Very fine sands, silts and sedimentary clays Permeable soils (e.g. gravel, sand) with shallow groundwater in low lying areas Mixed areas of permeable and impermeable soils in similar proportions	Moderate	S_3
Clayey or loamy soils	High	S_4
Soils of the wet uplands: Bare rocks or cliffs Shallow, permeable rocky soils on steep slopes Peats with impermeable layers at shallow depth	Very high	S_5

Note: Chalky soils can have a wide range of permeabilities, and runoff potentials that vary between those of clay loams and those of coarse sands.

The parameter SAAR for the site under consideration can be obtained from a map of the annual average rainfall in the UK (see Figure 4 in Appendix A).

The mean annual flow can be scaled to the required return period of 75 years, by applying a scaling factor, F, based on the regional growth curves suggested by the Flood Studies Report (Ref. 5) for the area under consideration (see Figure 5 in Appendix A):

$$Q = F\,Q_a \qquad (3)$$

where

Q is the design flow (in m³/s)
F is the scaling factor, dependent on the region
Q_a is the mean annual flow.

5.5 The Agricultural Development and Advisory Service, ADAS (Ref. 4) developed a method primarily for the sizing of field drainage pipes, which was based on the Transport and Road Research Laboratory, TRRL, method (Ref. 6). The ADAS method is applicable to very small catchments, having been developed for catchment areas up to 0.3km² (or 30ha). This method takes into account the design storm rainfall and time of concentration for the required return period by using the Bilham formula. For the required 75 year return period the design flow, Q (in m³/s) can be determined from:

$$Q = AREA\,(0.0443\,SAAR - 11.19)\,SOIL^{2.0} * \left[\frac{18.79T^{0.28} - 1}{10T}\right]^{-} \qquad (4)$$

where

AREA (in km²) is the catchment plan area
SAAR (in mm) is the standard average annual rainfall for the particular location (see Figure 4 in Appendix A)
SOIL is the soil index, defined as:

$$SOIL = \frac{(0.15S_1 + 0.30S_2 + 0.40S_3 + 0.45S_4 + 0.5S_5)}{(1 - S_u)} \qquad (5)$$

$S_{1,2...}$ denote the proportions of catchment covered by each of the soil classes 1 to 5 and S_u is the unclassified area of the catchment covered by water or pavement. Soil class 1 has a low runoff potential and soil class 5 has a high runoff potential. The parameter SOIL for a natural catchment can vary between 0.15 (very low runoff) to 0.5 (very high runoff). This parameter can be estimated from soil maps reproduced in HA 71/95 (DMRB, Ref. 1) or, for a simplified approach, through consultation of Table 5/1 (adapted from the Agricultural Development and Advisory Service, ADAS, Ref. 4):

T is the time of concentration (in hrs) and is given by:

$$T = 0.1677\,\frac{W^{0.78}}{Z^{0.39}} \qquad (6)$$

where

W is the maximum catchment width in metres (see definition of width in 3.3)
Z is the average height of the catchment divide in metres (see Figure 2 in Appendix A) above the discharge level (ditch level).

APPENDIX C

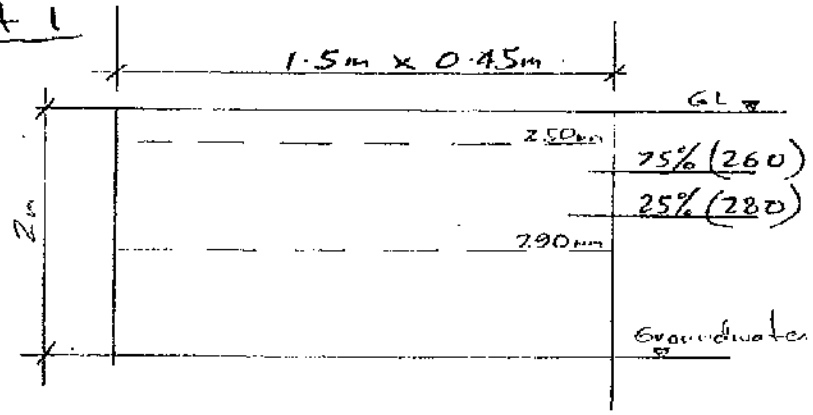
ATKINS

Project	Job ref
HEFF	503365
Part of structure: DRAINAGE INFILTRATION RATE	Calc sheet no / rev: 1 / 1
Drawing ref. / Calc by: PuB. / Date: 12/2/07	Check by: G.W. / Date: 12/02/07

Ref	Calculations	Output

Soakaway test carried out by Golden Associates. (17/1/07)

(Ref Fig 2) Test 1



102.50
10 min
90 min
100.50

Note
As BRE 365 – if full depth test cannot be carried out infil. rate should be based on time for fall of water level from 75% → 25% of actual max depth achieved.

Vol outflowing between 75% & 25%

$= 1.5 \times 0.45 \times (0.28 - 0.26)$
$= 0.0135 m^3$

Surface area thru' which outflow occurs (50% effective depth).

$(1.5 \times 1.73 \times 2) + (0.45 \times 1.73 \times 2) + (1.45 \times 0.45)$

$= 5.19 + 1.557 + 0.6525$
$= 7.3995 \ m^2$

Time of outflow between 75% & 25% = 80 min.

Soil Infil Rate

$$= \frac{0.0135}{5.19 \times (80 \times 60)} = 3.674 \times 10^{-7} \ m/s$$

$$= 1.3227 \times 10^{-3} \ m/hr$$

(North Pond)

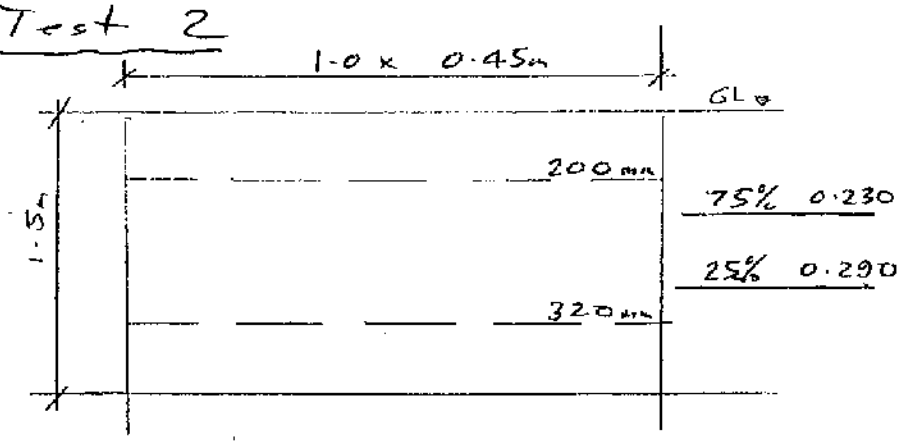
Appendix C (2)

ATKINS

Project	Job ref
HEFF	5033650
Part of structure: DRAINAGE INFILTRATION RATE	Calc sheet no / rev: 2 / 1
Drawing ref.	Calc by: PuB; Date: 12/2/07; Check by: G.W.; Date: 12/2/07

Ref	Calculations	Output

Test 2



101.70

30 mm

96 min

101.20 m groundwater

Vol outflowing between 75% & 25%

$= 1 \times 0.45 \times (0.29 - 0.23)$

$= 0.027\ m^3$

Surface area

$= (1.0 \times 1.24 \times 2) + (0.45 \times 1.24 \times 2) + (1 \times 0.45)$

$2.48 + 1.116 + 0.45$

$= 4.046\ m^2$

Time of inflow = 66 min. (96-30)

Soil Infiltration Rate $= \dfrac{0.027}{4.046 \times 66 \times 60}$

$= 1.685 \times 10^{-6}\ m/s$

$= 6.0666 \times 10^{-3}\ m/hr$

(South Pond)

TECHNICAL MEMORANDUM

Golder Associates (UK) Limited.
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Browns Lane Business Park
Stanton-on-the-Wolds
Nottinghamshire, NG12 5BL, England

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Facsimile: [44] (0)115 9371100
Email: nottingham@golder.com
http://www.golder.com

TO:	Derek Smith	DATE:	17 January 2007
CC:		JOB NO:	
FROM:	DAN TAYLOR 07971 492963		
EMAIL:	dtaylor@golder.com		
RE:	HEFF SOAKAWAY TESTS		

Three soakaway tests were performed in the HEFF area of Aldermaston as per the plan supplied by AWE.

The geology encountered in each the excavations of the soakaway tests was 0.3m damp soft dark brown clay topsoil followed by the Silchester Gravels comprising of 0.9m of damp gravely clay followed by clayey gravel of flint. The first excavation had a slightly increased gravel content.

Test location 1 was excavated to a depth of 2.0 m with a width of 0.45 m and a length of 1.5 m. The target depth was 2.5 m, however, groundwater was evident in the base of the excavation at 2.0 m. Further excavation at this location was terminated and the test was performed at this depth.

The details of the test are enclosed in the table below;

Elapsed time (minutes)	Depth of water surface below ground level (cm)
0	25
2	25
4	25
6	25.5
8	25.5
10	26
15	26
20	26.5
25	26.5
30	27
45	27.5
60	27.5
75	28
90	28
105	28.5

Elapsed time (minutes)	Depth of water surface below ground level (cm)
120	29
135	29
150	29
165	29
180	29

Test location 2 was excavated to a depth of 1.5 m with a width of 0.45 m and a length of 1.0 m. The details of the test are enclosed in the table below;

Elapsed time (minutes)	Depth of water surface below ground level (cm)
0	20
2	20
4	20
6	20
8	20.5
10	21
15	21.5
20	22
25	22
30	23
45	24
60	25.5
75	27
90	28
105	30.5
120	32
135	32
150	32
165	32
180	32

Test location 3 was excavated to a depth of 1.0 m with a width of 0.45 m and a length of 1.0 m. The details of the test are enclosed in the table below;

Elapsed time (minutes)	Depth of water surface below ground level (cm)
0	15
2	15
4	15
6	15
8	15
10	15

Elapsed time (minutes)	Depth of water surface below ground level (cm)
15	15
20	15.5
25	15.5
30	16
45	17.5
60	19
75	19.5
90	19.5
105	19.5
120	19.5
135	20
150	20
165	20
180	20

Should you require any further information then please do not hesitate to contact us.

Regards

Dan Taylor

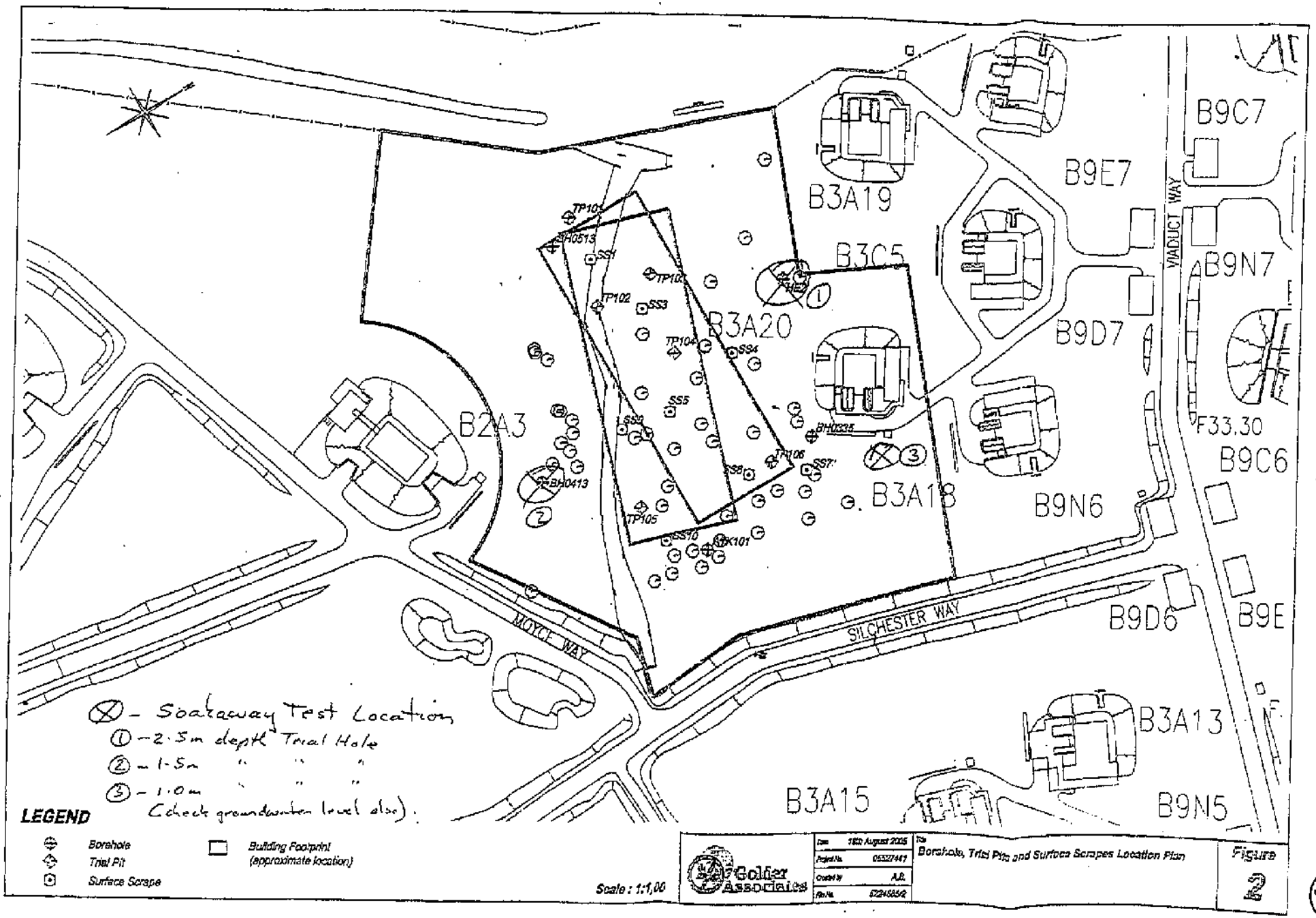
Golder Associates

Table 2: Groundwater Levels Monitored During the Site Works

Date*		Borehole				
		BH0413	BH0513	HE2	ATK101	BH0335
28/06/2005	Dip (m bGL)	2.04	2.05	3.71	-	1.01
29/06/2005	Dip (m bGL)	2.19	1.97	3.74	1.55	0.98
06/07/2005	Dip (m bGL)	1.91	2.05	3.74	1.65	1.05
07/07/2007	Dip (m bGL)	1.92	2.06	3.76	1.65	1.04
08/07/2007	Dip (m bGL)	1.94	2.08	3.77	1.68	1.05
12/07/2005	Dip (m bGL)	1.98	2.10	3.78	1.72	1.11
13/07/2005	Dip (m bGL)	1.98	2.10	3.78	1.72	1.07
14/07/2005	Dip (m bGL)	1.98	2.10	3.77	1.72	1.07
15/07/2005	Dip (m bGL)	1.98	2.11	3.78	1.72	1.07
18/07/2005	Dip (m bGL)	2.00	2.13	3.80	1.71	1.09
19/07/2005	Dip (m bGL)	1.99	2.13	3.80	1.72	1.08

* *Boreholes were dipped daily during Site works. Gaps between dates are when no work was being conducted on the project.*

\- *Borehole ATK101 had not been installed on this date.*


B9C7
B9E7
B3A19
B3C5
B9N7
VIADUCT WAY
B9D7
B3A20
B2A3
F33.30
B9C6
B3A18
B9N6
B9D6
B9E
MOYCE WAY
SILCHESTER WAY
B3A13
B3A15
B9N5
TP101
BH0513
SS1
TP102
SS3
TP104
SS4
SS5
SS6
BH0413
TP105
SS10
BK101
TP106
SS7
BH0335
HE2
1
2
3
⊗ - Soakaway Test Location
① - 2.5m depth Trial Hole
② - 1.5m " " "
③ - 1.0m " " "
(Check groundwater level also).
LEGEND
Borehole
Trial Pit
Surface Scrape
Building Footprint (approximate location)
Scale : 1:1,00
Golder Associates
Date 18th August 2005
Project No. 05527441
Drawn by A.B.
File No. 5224585/2
Borehole, Trial Pits and Surface Scrapes Location Plan
Figure 2

2

STORM SEWER DESIGN by the Modified Rational Method

Global Variables

Pipe Size File C:\Apps\WinDes104\STANDARD.PIP
Manhole Size File C:\Apps\WinDes104\STANDARD.MHS

Location - England & Wales

Return Period (years)	1	Depth from Soffit to G.L. (m)	1.200
M5-60 (mm)	18.000	Min Vel. (m/s - Auto Design Only)	1.00
Ratio R	0.400	Min Slope (1:X - Optimisation)	500
Maximum Rainfall (mm/hr)	0	Minimum Outfall Invert (m)	0.000
Foul Sewage (l/s/ha)	0.00	Ground Level at Outfall (m)	101.700
O'flow Setting (*Foul only)	0	Outfall Manhole Name	23
Volumetric Runoff Coeff.	0.75	Outfall Manhole Dia/Length (mm)	0
Infiltration %	0	Outfall Manhole Width (mm)	0
Minimum Backdrop Height (m)	0.100		

Designed with Level Inverts

Network Design Table

PN	Length (m)	Fall (m)	Slope (1:X)	Area (ha)	T.E. (mins)	DWF (l/s)	k (mm)	HYD SECT	DIA (mm)
1.000	30.00	0.150	200.0	0.130	3.00	0.0	0.600	o	200
1.001	36.00	0.180	200.0	0.000	0.00	0.0	0.600	o	200
2.000	5.00	0.050	100.0	0.160	3.00	0.0	0.600	o	150
1.002	35.00	0.175	200.0	0.000	0.00	0.0	0.600	o	200
3.000	5.00	0.050	100.0	0.170	3.00	0.0	0.600	o	150
1.003	47.00	0.235	200.0	0.000	0.00	0.0	0.600	o	200
1.004	24.00	0.120	200.0	0.000	0.00	0.0	0.600	o	200
1.005	27.00	0.135	200.0	0.000	0.00	0.0	0.600	o	200
4.000	5.00	0.050	100.0	0.190	3.00	0.0	0.600	o	150
1.006	30.00	0.150	200.0	0.000	0.00	0.0	0.600	o	200

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	E.Area (ha)	E.DWF (l/s)	Foul (l/s)	Infil. (l/s)	Vel (m/s)	CAP (l/s)	Flow (l/s)
1.000	0.0	3.6	102.250	0.130	0	0	0	0.85	27	0
1.001	0.0	4.3	102.100	0.130	0	0	0	0.85	27	0
2.000	0.0	3.1	102.100	0.160	0	0	0	1.00	18	0
1.002	0.0	5.0	101.920	0.290	0	0	0	0.85	27	0
3.000	0.0	3.1	102.100	0.170	0	0	0	1.00	18	0
1.003	0.0	5.9	101.745	0.460	0	0	0	0.85	27	0
1.004	0.0	6.4	101.510	0.460	0	0	0	0.85	27	0
1.005	0.0	6.9	101.390	0.460	0	0	0	0.85	27	0
4.000	0.0	3.1	101.500	0.190	0	0	0	1.00	18	0
1.006	0.0	7.5	101.255	0.650	0	0	0	0.85	27	0

(c)1982-2006 Micro Drainage

Network Design Table

PN	Length (m)	Fall (m)	Slope (1:X)	Area (ha)	T.E. (mins)	DWF (l/s)	k (mm)	HYD SECT	DIA (mm)
5.000	30.00	0.200	150.0	0.000	3.00	0.0	0.600	o	150
6.000	10.00	0.100	100.0	0.120	3.00	0.0	0.600	o	150
7.000	10.00	0.100	100.0	0.100	3.00	0.0	0.600	o	150
5.001	30.00	0.200	150.0	0.000	0.00	0.0	0.600	o	150
5.002	30.00	0.280	107.1	0.000	0.00	0.0	0.600	o	150
8.000	5.00	0.025	200.0	0.130	3.00	0.0	0.600	o	200
8.001	56.00	0.280	200.0	0.000	0.00	0.0	0.600	o	200
5.003	38.00	0.190	200.0	0.000	0.00	0.0	0.600	o	200
5.004	5.00	0.025	200.0	0.000	0.00	0.0	0.600	o	200
1.007	17.00	0.081	209.9	0.000	0.00	0.0	0.600	o	200
1.008	86.00	0.411	209.2	0.000	0.00	0.0	0.600	o	200
1.009	30.00	0.143	209.8	0.000	0.00	0.0	0.600	o	200

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	E.Area (ha)	E.DWF (l/s)	Foul (l/s)	Infil. (l/s)	Vel (m/s)	CAP (l/s)	Flow (l/s)
5.000	0.0	3.6	102.000	0.000	0	0	0	0.82	14	0
6.000	0.0	3.2	102.000	0.120	0	0	0	1.00	18	0
7.000	0.0	3.2	102.000	0.100	0	0	0	1.00	18	0
5.001	0.0	4.2	101.800	0.220	0	0	0	0.82	14	0
5.002	0.0	4.7	101.600	0.220	0	0	0	0.97	17	0
8.000	0.0	3.1	101.625	0.130	0	0	0	0.85	27	0
8.001	0.0	4.2	101.600	0.130	0	0	0	0.85	27	0
5.003	0.0	5.5	101.320	0.350	0	0	0	0.85	27	0
5.004	0.0	5.6	101.130	0.350	0	0	0	0.85	27	0
1.007	0.0	7.8	101.105	1.000	0	0	0	0.83	26	0
1.008	0.0	9.5	101.024	1.000	0	0	0	0.83	26	0
1.009	0.0	10.1	100.613	1.000	0	0	0	0.83	26	0

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PIPELINE SCHEDULES

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH No.	C.Level (m)	I.Level (m)	Depth (m)	MH DIAM., L*W (mm)
1.000	o	200	1	102.600	102.250	0.150	1050
1.001	o	200	2	102.600	102.100	0.300	1050
2.000	o	150	3	102.600	102.100	0.350	1050
1.002	o	200	4	102.600	101.920	0.480	1050
3.000	o	150	5	102.600	102.100	0.350	1050
1.003	o	200	6	102.600	101.745	0.655	1050
1.004	o	200	7	102.600	101.510	0.890	1050
1.005	o	200	8	102.300	101.390	0.710	1050
4.000	o	150	9	102.300	101.500	0.650	1050
1.006	o	200	10	102.300	101.255	0.845	1050
5.000	o	150	11	102.800	102.000	0.650	1050
6.000	o	150	12	102.800	102.000	0.650	1050
7.000	o	150	13	102.800	102.000	0.650	1050
5.001	o	150	14	102.600	101.800	0.650	1050
5.002	o	150	15	102.600	101.600	0.850	1050

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH No.	C.Level (m)	I.Level (m)	Depth (m)	MH DIAM., L*W (mm)
1.000	30.00	200.0	2	102.600	102.100	0.300	1050
1.001	36.00	200.0	4	102.600	101.920	0.480	1050
2.000	5.00	100.0	4	102.600	102.050	0.400	1050
1.002	35.00	200.0	6	102.600	101.745	0.655	1050
3.000	5.00	100.0	6	102.600	102.050	0.400	1050
1.003	47.00	200.0	7	102.600	101.510	0.890	1050
1.004	24.00	200.0	8	102.300	101.390	0.710	1050
1.005	27.00	200.0	10	102.300	101.255	0.845	1050
4.000	5.00	100.0	10	102.300	101.450	0.700	1050
1.006	30.00	200.0	20	102.300	101.105	0.995	1050
5.000	30.00	150.0	14	102.600	101.800	0.650	1050
6.000	10.00	100.0	14	102.600	101.900	0.550	1050
7.000	10.00	100.0	14	102.600	101.900	0.550	1050
5.001	30.00	150.0	15	102.600	101.600	0.850	1050
5.002	30.00	107.1	18	102.400	101.320	0.930	1050

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PIPELINE SCHEDULES

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH No.	C.Level (m)	I.Level (m)	Depth (m)	MH DIAM., L*W (mm)
8.000	o	200	16	102.600	101.625	0.775	1050
8.001	o	200	17	102.600	101.600	0.800	1050
5.003	o	200	18	102.400	101.320	0.880	1050
5.004	o	200	19	102.400	101.130	1.070	1050
1.007	o	200	20	102.300	101.105	0.995	1050
1.008	o	200	21	102.300	101.024	1.076	1050
1.009	o	200	22	102.000	100.613	1.187	1050

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH No.	C.Level (m)	I.Level (m)	Depth (m)	MH DIAM., L*W (mm)
8.000	5.00	200.0	17	102.600	101.600	0.800	1050
8.001	56.00	200.0	18	102.400	101.320	0.880	1050
5.003	38.00	200.0	19	102.400	101.130	1.070	1050
5.004	5.00	200.0	20	102.300	101.105	0.995	1050
1.007	17.00	209.9	21	102.300	101.024	1.076	1050
1.008	86.00	209.2	22	102.000	100.613	1.187	1050
1.009	30.00	209.8	23	101.700	100.470	1.030	0

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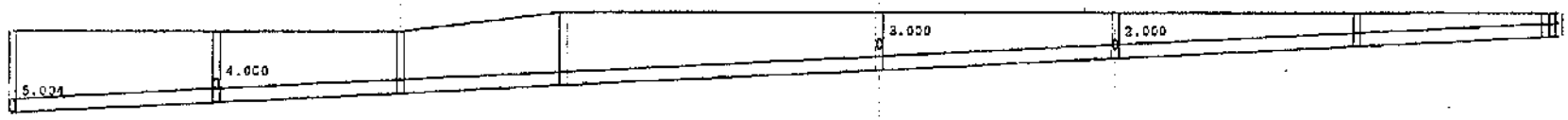
W S Atkins (Services) Ltd Ashley Road Epsom Surrey KT18 5BW	HEFF Project Proposed Surface Water drain to ex. system
Date 12 September 2007 11:38 File HEFF ALT SW 3.SWS	Designed By brow5402 Checked By
Micro Drainage	System1 W.10.4

MH Name	21	12	9	8	7	6	3	2 1



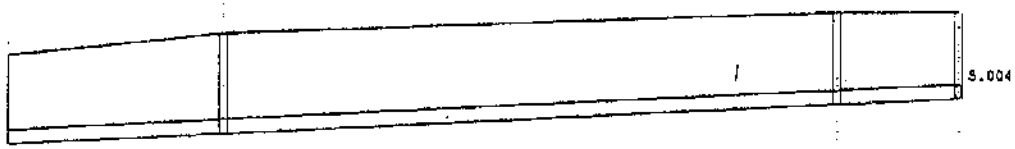
Hor Scale 1000

Ver Scale 100

Datum (m) 99.000

PN	1.007	1.006	1.005	1.004	1.003	1.002	1.001	1.000
Dia (mm)	200	200	200	200	200	200	200	200
Slope (1:X)	200.0	200.0	200.0	200.0	200.0	200.0	200.0	200.0
Cover Level (m)	102.300	102.300	102.300	102.600	102.600	102.600	102.600	102.600 102.500
Invert Level (m)	101.105	101.255 101.255	101.380 101.380	101.510 101.510	101.745 101.745	101.920 101.920	102.100 102.100	102.240 102.240
Length (m)	30.00	27.00	24.00	47.00	35.00	36.00	26.00	2.00

MH Name	Ex. 2301	23	22	21



Hor Scale 1000

Ver Scale 100

Datum (m) 99.000

PN	1.010	1.009	1.008	
Dia (mm)	200	200	200	
Slope (1:X)	209.8	209.2	209.9	
Cover Level (m)	101.700	102.000	102.300	102.300
Invert Level (m)	100.470	100.613 100.613	101.024 101.024	101.105
Length (m)	30.00	86.00	17.00	

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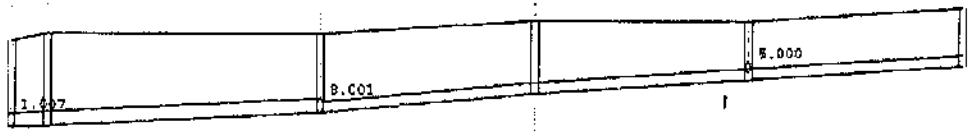
MH Name	5 4
Hor Scale 1000 Ver Scale 100 Datum (m) 100.000	
PN	2.000
Dia (mm)	150
Slope (1:X)	100.0
Cover Level (m)	102.600 102.600
Invert Level (m)	102.050 102.100
Length (m)	5.00

MH Name	7 6
Hor Scale 1000 Ver Scale 100 Datum (m) 99.000	
PN	3.000
Dia (mm)	150
Slope (1:X)	100.0
Cover Level (m)	102.600 102.600
Invert Level (m)	102.050 102.100
Length (m)	5.00

W S Atkins (Services) Ltd Ashley Road Epsom Surrey KT18 5BW	HEFF Project Proposed Surface Water drain to ex. system
Date 12 September 2007 11:50 File HEFF ALT SW 3.SWS	Designed By brown402 Checked By
Micro Drainage	System1 W.10.4

MH Name	11 10
Hor Scale 1000 Ver Scale 100 Datum (m) 99.000	
PN	4.000
Dia (mm)	150
Slope (1:X)	100.0
Cover Level (m)	102.300 102.300
Invert Level (m)	101.450 101.500
Length (m)	5.00

MH Name	21	20	19	16	15	12
Hor Scale 1000 Ver Scale 100 Datum (m) 99.000						
PN	5.004	5.003	5.002	5.001	5.000	
Dia (mm)	200	200	150	150	150	
Slope (1:X)	200.0	200.0	107.1	150.0	150.0	
Cover Level (m)	102.300 102.400		102.400	102.600	102.600	102.800
Invert Level (m)	101.105 101.130 101.130		101.320 101.320	101.600 101.600	101.800 101.800	102.000
Length (m)	5.00	38.00	30.00	30.00	30.00	

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MH Name	15	13
Hor Scale 1000 Ver Scale 100 Datum (m) 100.000		
PN	6.000	
Dia (mm)	150	
Slope (1:X)	100.0	
Cover Level (m)	102.600	102.800
Invert Level (m)	101.900	102.000
Length (m)	10.00	

MH Name	15	14
Hor Scale 1000 Ver Scale 100 Datum (m) 100.000		
PN	7.000	
Dia (mm)	150	
Slope (1:X)	100.0	
Cover Level (m)	102.600	102.800
Invert Level (m)	101.900	102.000
Length (m)	10.00	

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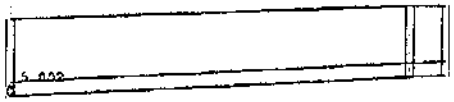
MH Name	19	18	17
Hor Scale 1000 Ver Scale 100 Datum (m) 99.000			
PN		8.001	8.000
Dia (mm)		200	200
Slope (1:X)		200.0	200.0
Cover Level (m)	102.400	102.600	102.600
Invert Level (m)	101.320	101.600 101.600	101.625
Length (m)		56.00	5.00

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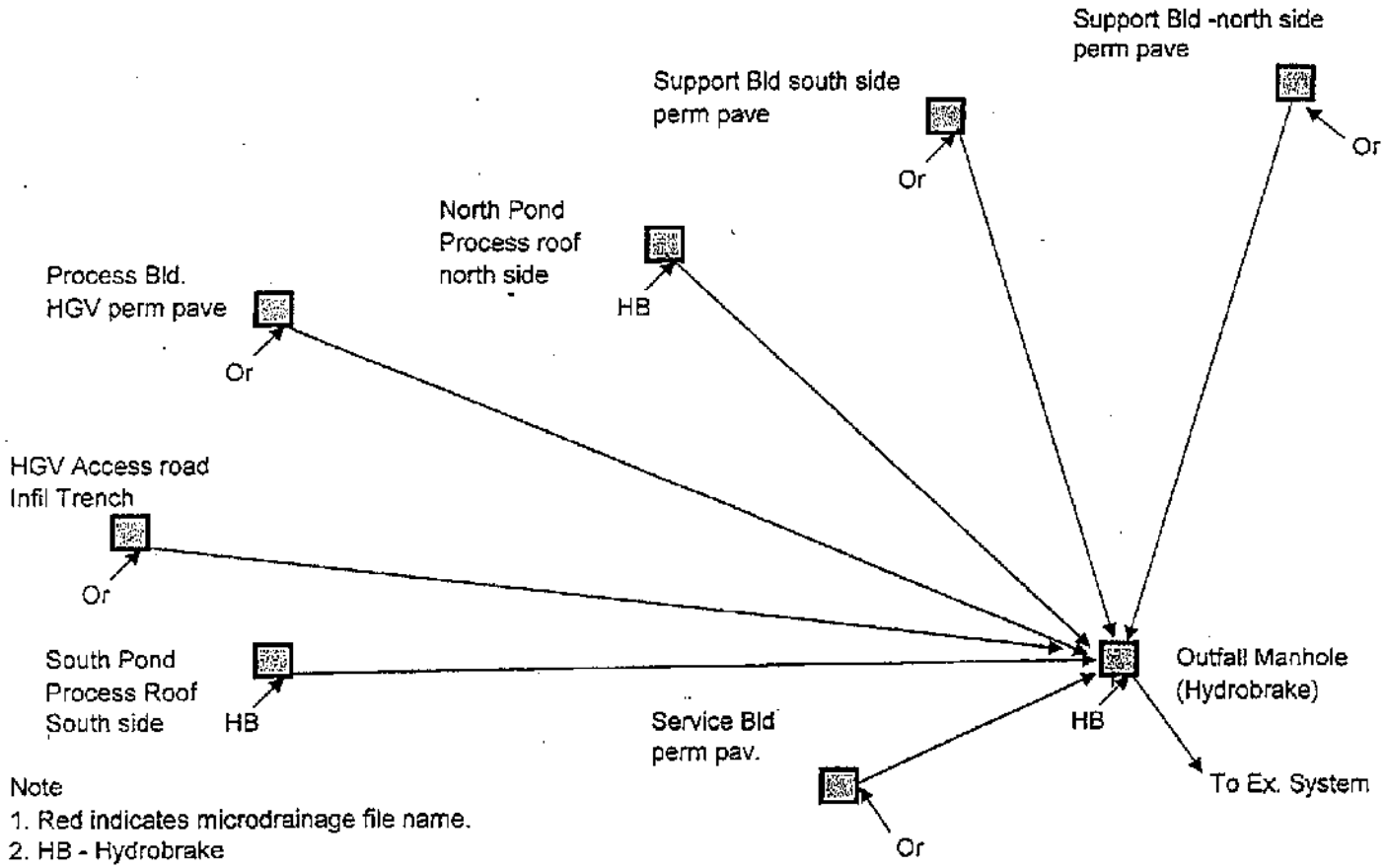
HEFF Project
SW Drainage - Microdranage/Source Control/Cascade Layout
Rev 1



Note
1. Red indicates microdrainage file name.
2. HB - Hydrobrake
3. Or - orifice

PROTECTIVE MARKING
UNCLASSIFIED

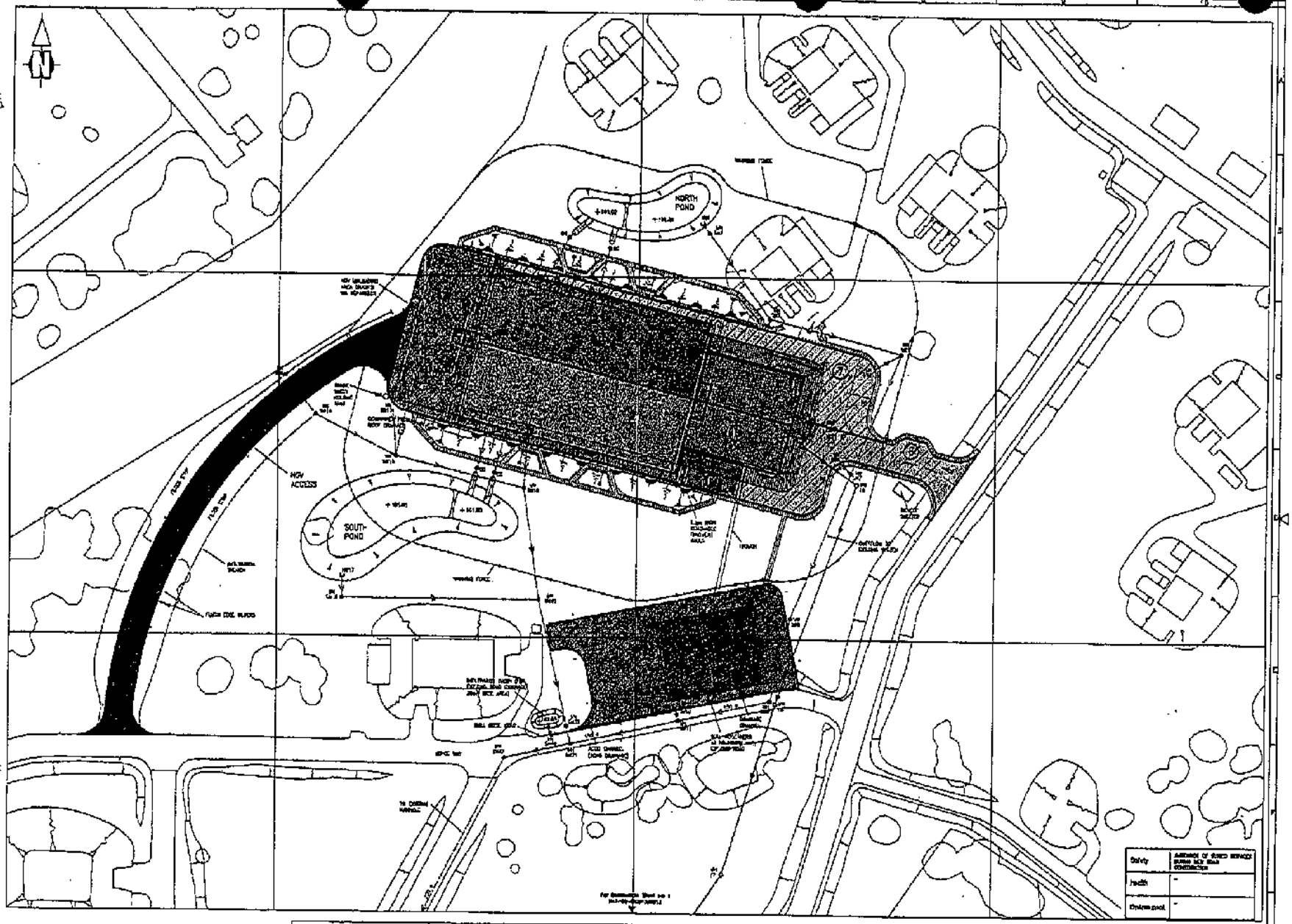
DRAWING REFERENCE No.
SB/

DRAWING No. N247-00-C100-XA0047-1P | SHT OF

USED ON

NOTES

1. TO BE READ IN CONJUNCTION WITH THE DRAINAGE AREA SPREADSHEET (RM).
2. THE COLOURS SHOWN INDICATE THE DRAINAGE AREAS INCORPORATED WITHIN THE DRAINAGE DESIGN.
3. THE NUMBERS INDICATED REFER TO COLUMN 1 OF THE SPREADSHEET.



Safety	ALLOWANCE OF SUNDRY DRAINAGE BURIED BELOW GROUND CONSTRUCTION
Health	-
Environment	-

			MATERIAL	TOLERANCES	ORIGINAL SCALE 1:500	TITLE HEFF – SITE DRAINAGE AREAS	PRINT CONTROL No. N
			PROTECTIVE FINISH	SUB-CONTRACTOR	DRWG. IN m	ALDERMASTON, READING, BERKS, ENGLAND. RG7 4PR	PROTECTIVE MARKING UNCLASSIFIED
DRAFT FOR INFORMATION	1P	-/-/-	SURFACE TEXTURE	CAD REF.		SAFETY SYSTEM LEVEL: CRITICAL / RELATED / UNRELATED	DRAWING REFERENCE No. SB/
CHANGE No. / ACTION SHEET No.	ISSUE	DATE					DRAWING No. N247-00-C100-XA0047-1P — SHT OF — A1

DERIVED FROM | CHECKED | DRAWN

DRAWING OFFICE REFERENCE

DO. –

AWE(–)

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C100 FORM 1991 Issue 4.2

Cascade Summary of Results for final mh hyd 1.src

Upstream Structures	Outflow To	Overflow To
hgv access 1.src north pond 1.src pave process 1.src pave service 1.src pave supp 1.src pave supp 2.src south pond 1.src	(None)	(None)

Storm Duration (mins)	Maximum Control (l/s)	Maximum Outflow (l/s)	Maximum Water Level (m OD)	Maximum Depth (m)	Maximum Volume (m³)	Status
15 Summer	7.0	7.0	101.3000	0.0000	0.0	O K
30 Summer	9.6	9.6	101.3000	0.0000	0.0	O K
60 Summer	11.0	11.0	101.3000	0.0000	0.0	O K
120 Summer	11.6	11.6	101.3000	0.0000	0.0	O K
180 Summer	11.7	11.7	101.3000	0.0000	0.0	O K
240 Summer	11.7	11.7	101.3000	0.0000	0.0	O K
360 Summer	11.5	11.5	101.3000	0.0000	0.0	O K
480 Summer	10.9	10.9	101.3000	0.0000	0.0	O K
600 Summer	10.5	10.5	101.3000	0.0000	0.0	O K
720 Summer	10.4	10.4	101.3000	0.0000	0.0	O K
960 Summer	10.3	10.3	101.3000	0.0000	0.0	O K
1440 Summer	9.9	9.9	101.3000	0.0000	0.0	O K
2160 Summer	9.3	9.3	101.3000	0.0000	0.0	O K
2880 Summer	8.7	8.7	101.3000	0.0000	0.0	O K
4320 Summer	7.8	7.8	101.3000	0.0000	0.0	O K
5760 Summer	7.0	7.0	101.3000	0.0000	0.0	O K
7200 Summer	6.3	6.3	101.3000	0.0000	0.0	O K
8640 Summer	5.8	5.8	101.3000	0.0000	0.0	O K
10080 Summer	5.2	5.2	101.3000	0.0000	0.0	O K
15 Winter	8.3	8.3	101.3000	0.0000	0.0	O K
30 Winter	10.6	10.6	101.3000	0.0000	0.0	O K

Storm Duration (mins)	Rain (mm/hr)	Time-Peak (mins)
15 Summer	87.91	0
30 Summer	57.81	0
60 Summer	36.29	0
120 Summer	22.07	0
180 Summer	16.31	0
240 Summer	13.09	0
360 Summer	9.53	0
480 Summer	7.59	0
600 Summer	6.36	0
720 Summer	5.51	0
960 Summer	4.38	0
1440 Summer	3.17	0
2160 Summer	2.29	0
2880 Summer	1.82	0
4320 Summer	1.31	0
5760 Summer	1.04	0
7200 Summer	0.86	0
8640 Summer	0.74	0
10080 Summer	0.66	0
15 Winter	87.91	0
30 Winter	57.81	0

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Cascade Summary of Results for final mh hyd 1.src

Storm Duration (mins)	Maximum Control (l/s)	Maximum Outflow (l/s)	Maximum Water Level (m OD)	Maximum Depth (m)	Maximum Volume (m³)	Status
60 Winter	12.0	12.0	101.3018	0.0018	0.0	O K
120 Winter	12.6	12.6	101.3203	0.0202	0.0	O K
180 Winter	12.8	12.8	101.3238	0.0237	0.0	O K
240 Winter	12.7	12.7	101.3218	0.0217	0.0	O K
360 Winter	12.3	12.3	101.3102	0.0103	0.0	O K
480 Winter	11.6	11.6	101.3000	0.0000	0.0	O K
600 Winter	11.1	11.1	101.3000	0.0000	0.0	O K
720 Winter	10.9	10.9	101.3000	0.0000	0.0	O K
960 Winter	10.7	10.7	101.3000	0.0000	0.0	O K
1440 Winter	10.0	10.0	101.3000	0.0000	0.0	O K
2160 Winter	9.1	9.1	101.3000	0.0000	0.0	O K
2880 Winter	8.4	8.4	101.3000	0.0000	0.0	O K
4320 Winter	7.2	7.2	101.3000	0.0000	0.0	O K
5760 Winter	6.1	6.1	101.3000	0.0000	0.0	O K
7200 Winter	5.3	5.3	101.3000	0.0000	0.0	O K
8640 Winter	4.6	4.6	101.3000	0.0000	0.0	O K
10080 Winter	4.1	4.1	101.3000	0.0000	0.0	O K

Storm Duration (mins)	Rain (mm/hr)	Time-Peak (mins)
60 Winter	36.29	62
120 Winter	22.07	104
180 Winter	16.31	142
240 Winter	13.09	182
360 Winter	9.53	254
480 Winter	7.59	0
600 Winter	6.36	0
720 Winter	5.51	0
960 Winter	4.38	0
1440 Winter	3.17	0
2160 Winter	2.29	0
2880 Winter	1.82	0
4320 Winter	1.31	0
5760 Winter	1.04	0
7200 Winter	0.86	0
8640 Winter	0.74	0
10080 Winter	0.66	0

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Cascade Storage Controls for final mh hyd 1.src

Tank/Pond Details

Invert Level (m) 101.300 Ground Level (m) 102.600

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.00	1.0	1.00	1.0	2.00	1.0	3.00	1.0	4.00	1.0	5.00	1.0
0.20	1.0	1.20	1.0	2.20	1.0	3.20	1.0	4.20	1.0		
0.40	1.0	1.40	1.0	2.40	1.0	3.40	1.0	4.40	1.0		
0.60	1.0	1.60	1.0	2.60	1.0	3.60	1.0	4.60	1.0		
0.80	1.0	1.80	1.0	2.80	1.0	3.80	1.0	4.80	1.0		

Hydro-Brake Outflow Control

Design Head (m) 1.300 Hydro-Brake Type MD4 Invert Level (m) 101.100
Design Flow (l/s) 18.1 Diameter (mm) 143

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.10	3.8	0.80	14.2	2.00	22.4	4.00	31.7	7.00	42.0
0.20	11.9	1.00	15.9	2.20	23.5	4.50	33.6	7.50	43.4
0.30	15.3	1.20	17.4	2.40	24.6	5.00	35.5	8.00	44.9
0.40	13.9	1.40	18.8	2.60	25.6	5.50	37.2	8.50	46.2
0.50	12.7	1.60	20.1	3.00	27.5	6.00	38.9	9.00	47.6
0.60	12.8	1.80	21.3	3.50	29.7	6.50	40.4	9.50	48.9

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Cascade Rainfall Details for final mh hyd 1.src

Region	ENG+WAL	Shortest Storm (mins)	15
Return Period (years)	100	Longest Storm (mins)	10080
M5-60 (mm)	18.000	Summer Storms	Yes
Ratio-R	0.400	Winter Storms	Yes
Cv (Summer)	0.750	Climate Change %	+30
Cv (Winter)	0.840		

Time / Area Diagram

Total Area (ha) = 0.000

Time (mins) from:	to:	Area (ha)
0	4	0.000

Cascade Summary of Results for hgv access 1.src

Upstream Structures	Outflow To	Overflow To
(None)	final mh hyd 1.src	(None)

Half Drain Time : 70 minutes

Storm Duration (mins)	Maximum Control (l/s)	Maximum Filtration (l/s)	Maximum Outflow (l/s)	Maximum Water Level (m OD)	Maximum Depth (m)	Maximum Volume (m³)	Status
15 Summer	0.1	3.3	3.4	102.3187	0.3187	22.9	O K
30 Summer	1.3	3.6	4.9	102.3902	0.3902	28.1	O K
60 Summer	1.7	3.8	5.4	102.4287	0.4287	30.9	O K
120 Summer	1.8	3.8	5.6	102.4387	0.4387	31.6	O K
180 Summer	1.7	3.8	5.4	102.4262	0.4262	30.7	O K
240 Summer	1.5	3.7	5.2	102.4092	0.4092	29.4	O K
360 Summer	1.2	3.5	4.7	102.3752	0.3752	27.0	O K
480 Summer	0.6	3.4	4.1	102.3482	0.3482	25.1	O K
600 Summer	0.2	3.3	3.5	102.3227	0.3227	23.3	O K
720 Summer	0.0	3.2	3.2	102.2947	0.2947	21.2	O K
960 Summer	0.0	3.0	3.0	102.2417	0.2417	17.4	O K
1440 Summer	0.0	2.7	2.7	102.1622	0.1623	11.7	O K
2160 Summer	0.0	2.4	2.4	102.0872	0.0873	6.3	O K
2880 Summer	0.0	2.2	2.2	102.0518	0.0517	3.7	O K
4320 Summer	0.0	1.7	1.7	102.0372	0.0372	2.7	O K
5760 Summer	0.0	1.3	1.3	102.0297	0.0297	2.1	O K
7200 Summer	0.0	1.1	1.1	102.0247	0.0247	1.8	O K
8640 Summer	0.0	0.9	0.9	102.0212	0.0212	1.5	O K
10080 Summer	0.0	0.8	0.8	102.0188	0.0188	1.3	O K
15 Winter	0.8	3.5	4.3	102.3577	0.3577	25.7	O K
30 Winter	1.8	3.8	5.6	102.4397	0.4397	31.6	O K
60 Winter	2.1	4.0	6.1	102.4852	0.4852	34.9	O K
120 Winter	2.1	4.0	6.1	102.4912	0.4912	35.4	O K

Storm Duration (mins)	Rain (mm/hr)	Time-Peak (mins)
15 Summer	87.91	20
30 Summer	57.81	32
60 Summer	36.29	52
120 Summer	22.07	86
180 Summer	16.31	120
240 Summer	13.09	154
360 Summer	9.53	222
480 Summer	7.59	292
600 Summer	6.36	362
720 Summer	5.51	428
960 Summer	4.38	554
1440 Summer	3.17	796
2160 Summer	2.29	1148
2880 Summer	1.82	1472
4320 Summer	1.31	2204
5760 Summer	1.04	2928
7200 Summer	0.86	3592
8640 Summer	0.74	4400
10080 Summer	0.66	5136
15 Winter	87.91	20
30 Winter	57.81	32
60 Winter	36.29	54
120 Winter	22.07	92

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Cascade Summary of Results for hgv access 1.src

Storm Duration (mins)	Maximum Control (l/s)	Maximum Filtration (l/s)	Maximum Outflow (l/s)	Maximum Water Level (m OD)	Maximum Depth (m)	Maximum Volume (m³)	Status
180 Winter	2.0	3.9	5.9	102.4697	0.4697	33.8	O K
240 Winter	1.8	3.8	5.6	102.4427	0.4427	31.9	O K
360 Winter	1.4	3.6	5.0	102.3927	0.3927	28.3	O K
480 Winter	0.8	3.5	4.3	102.3562	0.3562	25.6	O K
600 Winter	0.2	3.3	3.5	102.3242	0.3242	23.4	O K
720 Winter	0.0	3.2	3.2	102.2852	0.2852	20.5	O K
960 Winter	0.0	2.9	2.9	102.2132	0.2132	15.4	O K
1440 Winter	0.0	2.5	2.5	102.1117	0.1118	8.0	O K
2160 Winter	0.0	2.1	2.1	102.0472	0.0473	3.4	O K
2880 Winter	0.0	1.7	1.7	102.0378	0.0377	2.7	O K
4320 Winter	0.0	1.2	1.2	102.0273	0.0272	1.9	O K
5760 Winter	0.0	1.0	1.0	102.0218	0.0217	1.5	O K
7200 Winter	0.0	0.8	0.8	102.0182	0.0183	1.3	O K
8640 Winter	0.0	0.7	0.7	102.0157	0.0158	1.1	O K
10080 Winter	0.0	0.6	0.6	102.0137	0.0138	1.0	O K

Storm Duration (mins)	Rain (mm/hr)	Time-Peak (mins)
180 Winter	16.31	128
240 Winter	13.09	164
360 Winter	9.53	234
480 Winter	7.59	306
600 Winter	6.36	382
720 Winter	5.51	454
960 Winter	4.38	582
1440 Winter	3.17	822
2160 Winter	2.29	1104
2880 Winter	1.82	1468
4320 Winter	1.31	2164
5760 Winter	1.04	2928
7200 Winter	0.86	3632
8640 Winter	0.74	4368
10080 Winter	0.66	5032

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Cascade Rainfall Details for hgv access 1.src

Region	ENG+WAL	Shortest Storm (mins)	15
Return Period (years)	100	Longest Storm (mins)	10080
M5-60 (mm)	18.000	Summer Storms	Yes
Ratio-R	0.400	Winter Storms	Yes
Cv (Summer)	0.750	Climate Change %	+30
Cv (Winter)	0.840		

Time / Area Diagram

Total Area (ha) = 0.120

Time from:	(mins) to:	Area (ha)	Time from:	(mins) to:	Area (ha)
0	4	0.060	4	8	0.060

Cascade Storage Controls for hgv access 1.src

Infiltration Trench Details

Infil Coef - Base (m/hr)	0.060660	Length (m)	240.0
Infil Coef - Sides (m/hr)	0.060660	Invert Level (m)	102.000
Safety Factor	2.0	Cover Level (m)	102.600
Porosity	0.30	Slope (1:x)	0.0
Width (m)	1.0		

Orifice Outflow Control

Diameter (m)	0.050	Invert Level (m)	102.300
Discharge Coefficient	0.600		

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Cascade Summary of Results for north pond 1.src

Upstream Structures	Outflow To	Overflow To
(None)	final mh hyd 1.src	(None)

Storm Duration (mins)	Maximum Control (l/s)	Maximum Outflow (l/s)	Maximum Water Level (m OD)	Maximum Depth (m)	Maximum Volume (m³)	Status
15 Summer	1.2	1.2	102.3562	0.1063	27.1	O K
30 Summer	1.2	1.2	102.3818	0.1318	35.2	O K
60 Summer	1.2	1.2	102.4047	0.1547	43.1	O K
120 Summer	1.2	1.2	102.4242	0.1742	50.1	O K
180 Summer	1.2	1.2	102.4327	0.1827	53.2	O K
240 Summer	1.2	1.2	102.4358	0.1857	54.5	O K
360 Summer	1.2	1.2	102.4368	0.1867	54.7	O K
480 Summer	1.2	1.2	102.4352	0.1852	54.2	O K
600 Summer	1.2	1.2	102.4337	0.1837	53.6	O K
720 Summer	1.2	1.2	102.4317	0.1817	52.9	O K
960 Summer	1.2	1.2	102.4268	0.1767	51.1	O K
1440 Summer	1.2	1.2	102.4153	0.1653	46.8	O K
2160 Summer	1.2	1.2	102.3972	0.1473	40.6	O K
2880 Summer	1.2	1.2	102.3808	0.1308	35.0	O K
4320 Summer	1.2	1.2	102.3552	0.1053	26.8	O K
5760 Summer	1.1	1.1	102.3408	0.0908	22.5	O K
7200 Summer	0.9	0.9	102.3303	0.0803	19.6	O K
8640 Summer	0.9	0.9	102.3223	0.0723	17.3	O K
10080 Summer	0.8	0.8	102.3158	0.0658	15.6	O K
15 Winter	1.2	1.2	102.3668	0.1168	30.4	O K
30 Winter	1.2	1.2	102.3948	0.1448	39.6	O K
60 Winter	1.2	1.2	102.4202	0.1702	48.6	O K
120 Winter	1.2	1.2	102.4417	0.1917	56.7	O K
180 Winter	1.3	1.3	102.4512	0.2012	60.4	O K

Storm Duration (mins)	Rain (mm/hr)	Time-Peak (mins)
15 Summer	87.91	19
30 Summer	57.81	33
60 Summer	36.29	62
120 Summer	22.07	122
180 Summer	16.31	182
240 Summer	13.09	240
360 Summer	9.53	326
480 Summer	7.59	382
600 Summer	6.36	446
720 Summer	5.51	510
960 Summer	4.38	646
1440 Summer	3.17	920
2160 Summer	2.29	1316
2880 Summer	1.82	1676
4320 Summer	1.31	2380
5760 Summer	1.04	3112
7200 Summer	0.86	3824
8640 Summer	0.74	4576
10080 Summer	0.66	5248
15 Winter	87.91	18
30 Winter	57.81	33
60 Winter	36.29	62
120 Winter	22.07	120
180 Winter	16.31	178

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Cascade Summary of Results for north pond 1.src

Storm Duration (mins)	Maximum Control (l/s)	Maximum Outflow (l/s)	Maximum Water Level (m OD)	Maximum Depth (m)	Maximum Volume (m³)	Status
240 Winter	1.3	1.3	102.4557	0.2057	62.1	O K
360 Winter	1.3	1.3	102.4573	0.2072	62.8	O K
480 Winter	1.3	1.3	102.4552	0.2052	61.9	O K
600 Winter	1.3	1.3	102.4528	0.2027	60.9	O K
720 Winter	1.2	1.2	102.4498	0.1997	59.8	O K
960 Winter	1.2	1.2	102.4427	0.1927	57.1	O K
1440 Winter	1.2	1.2	102.4258	0.1758	50.6	O K
2160 Winter	1.2	1.2	102.3993	0.1493	41.2	O K
2880 Winter	1.2	1.2	102.3753	0.1253	33.1	O K
4320 Winter	1.1	1.1	102.3443	0.0943	23.6	O K
5760 Winter	0.9	0.9	102.3288	0.0788	19.1	O K
7200 Winter	0.8	0.8	102.3177	0.0678	16.1	O K
8640 Winter	0.7	0.7	102.3092	0.0593	13.9	O K
10080 Winter	0.6	0.6	102.3033	0.0533	12.3	O K

Storm Duration (mins)	Rain (mm/hr)	Time-Peak (mins)
240 Winter	13.09	234
360 Winter	9.53	344
480 Winter	7.59	444
600 Winter	6.36	476
720 Winter	5.51	550
960 Winter	4.38	704
1440 Winter	3.17	996
2160 Winter	2.29	1404
2880 Winter	1.82	1784
4320 Winter	1.31	2424
5760 Winter	1.04	3176
7200 Winter	0.86	3896
8640 Winter	0.74	4664
10080 Winter	0.66	5344

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Cascade Rainfall Details for north pond 1.src

Region	ENG+WAL	Shortest Storm (mins)	15
Return Period (years)	100	Longest Storm (mins)	10080
M5-60 (mm)	18.000	Summer Storms	Yes
Ratio-R	0.400	Winter Storms	Yes
Cv (Summer)	0.750	Climate Change %	+30
Cv (Winter)	0.840		

Time / Area Diagram

Total Area (ha) = 0.130

Time (mins) from:	to:	Area (ha)
0	4	0.130

Cascade Storage Controls for north pond 1.src

Tank/Pond Details

Invert Level (m) 102.250 Ground Level (m) 102.550

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.00	206.5	0.60	671.0	1.20	671.0	1.80	671.0	2.40	671.0
0.10	299.4	0.70	671.0	1.30	671.0	1.90	671.0	2.50	671.0
0.20	392.1	0.80	671.0	1.40	671.0	2.00	671.0		
0.30	485.2	0.90	671.0	1.50	671.0	2.10	671.0		
0.40	578.2	1.00	671.0	1.60	671.0	2.20	671.0		
0.50	671.0	1.10	671.0	1.70	671.0	2.30	671.0		

Hydro-Brake Outflow Control

Design Head (m) 0.300 Hydro-Brake Type MD3 Invert Level (m) 102.250
Design Flow (l/s) 1.5 Diameter (mm) 54

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.10	1.2	0.80	2.5	2.00	3.9	4.00	5.6	7.00	7.4
0.20	1.2	1.00	2.8	2.20	4.1	4.50	5.9	7.50	7.6
0.30	1.5	1.20	3.1	2.40	4.3	5.00	6.2	8.00	7.9
0.40	1.8	1.40	3.3	2.60	4.5	5.50	6.5	8.50	8.1
0.50	2.0	1.60	3.5	3.00	4.8	6.00	6.8	9.00	8.4
0.60	2.2	1.80	3.7	3.50	5.2	6.50	7.1	9.50	8.6

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Cascade Summary of Results for pave process 1.src

Upstream Structures	Outflow To	Overflow To
(None)	final mh hyd 1.src	(None)

Half Drain Time : 252 minutes

Storm Duration (mins)	Maximum Control (l/s)	Maximum Filtration (l/s)	Maximum Outflow (l/s)	Maximum Water Level (m OD)	Maximum Depth (m)	Maximum Volume (m³)	Status
15 Summer	0.7	0.0	0.7	102.3012	0.0513	15.9	O K
30 Summer	1.1	0.0	1.1	102.3213	0.0713	22.0	O K
60 Summer	1.3	0.0	1.3	102.3398	0.0898	27.8	O K
120 Summer	1.5	0.0	1.5	102.3548	0.1048	32.4	O K
180 Summer	1.5	0.0	1.5	102.3597	0.1098	34.0	O K
240 Summer	1.5	0.0	1.5	102.3617	0.1118	34.7	O K
360 Summer	1.6	0.0	1.6	102.3637	0.1138	35.4	O K
480 Summer	1.6	0.0	1.6	102.3643	0.1143	35.4	O K
600 Summer	1.6	0.0	1.6	102.3638	0.1138	35.2	O K
720 Summer	1.5	0.0	1.5	102.3623	0.1123	34.9	O K
960 Summer	1.5	0.0	1.5	102.3587	0.1088	33.8	O K
1440 Summer	1.4	0.0	1.4	102.3508	0.1008	31.2	O K
2160 Summer	1.3	0.0	1.3	102.3388	0.0888	27.6	O K
2880 Summer	1.2	0.0	1.2	102.3292	0.0793	24.7	O K
4320 Summer	1.0	0.0	1.0	102.3173	0.0673	20.8	O K
5760 Summer	0.9	0.0	0.9	102.3090	0.0597	18.5	O K
7200 Summer	0.8	0.0	0.8	102.3043	0.0542	16.8	O K
8640 Summer	0.7	0.0	0.7	102.2998	0.0497	15.5	O K
10080 Summer	0.6	0.0	0.6	102.2962	0.0462	14.4	O K
15 Winter	0.9	0.0	0.9	102.3092	0.0593	18.4	O K
30 Winter	1.2	0.0	1.2	102.3317	0.0818	25.3	O K
60 Winter	1.5	0.0	1.5	102.3528	0.1028	31.9	O K
120 Winter	1.6	0.0	1.6	102.3702	0.1203	37.2	O K

Storm Duration (mins)	Rain (mm/hr)	Time-Peak (mins)
15 Summer	87.91	19
30 Summer	57.81	33
60 Summer	36.29	62
120 Summer	22.07	120
180 Summer	16.31	170
240 Summer	13.09	196
360 Summer	9.53	258
480 Summer	7.59	326
600 Summer	6.36	394
720 Summer	5.51	462
960 Summer	4.38	596
1440 Summer	3.17	854
2160 Summer	2.29	1232
2880 Summer	1.82	1588
4320 Summer	1.31	2296
5760 Summer	1.04	3048
7200 Summer	0.86	3752
8640 Summer	0.74	4496
10080 Summer	0.66	5240
15 Winter	87.91	18
30 Winter	57.81	33
60 Winter	36.29	62
120 Winter	22.07	118

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Cascade Summary of Results for pave process 1.src

Storm Duration (mins)	Maximum Control (l/s)	Maximum Filtration (l/s)	Maximum Outflow (l/s)	Maximum Water Level (m OD)	Maximum Depth (m)	Maximum Volume (m³)	Status
180 Winter	1.7	0.0	1.7	102.3763	0.1263	39.1	O K
240 Winter	1.7	0.0	1.7	102.3777	0.1278	39.6	O K
360 Winter	1.7	0.0	1.7	102.3788	0.1288	39.9	O K
480 Winter	1.7	0.0	1.7	102.3773	0.1273	39.5	O K
600 Winter	1.6	0.0	1.6	102.3747	0.1248	38.8	O K
720 Winter	1.6	0.0	1.6	102.3717	0.1218	37.8	O K
960 Winter	1.6	0.0	1.6	102.3652	0.1153	35.7	O K
1440 Winter	1.4	0.0	1.4	102.3512	0.1013	31.4	O K
2160 Winter	1.3	0.0	1.3	102.3347	0.0848	26.2	O K
2880 Winter	1.1	0.0	1.1	102.3228	0.0728	22.6	O K
4320 Winter	0.9	0.0	0.9	102.3102	0.0602	18.6	O K
5760 Winter	0.7	0.0	0.7	102.3023	0.0522	16.2	O K
7200 Winter	0.6	0.0	0.6	102.2968	0.0467	14.5	O K
8640 Winter	0.5	0.0	0.5	102.2927	0.0427	13.3	O K
10080 Winter	0.4	0.0	0.4	102.2897	0.0397	12.3	O K

Storm Duration (mins)	Rain (mm/hr)	Time-Peak (mins)
180 Winter	16.31	172
240 Winter	13.09	220
360 Winter	9.53	274
480 Winter	7.59	352
600 Winter	6.36	426
720 Winter	5.51	498
960 Winter	4.38	638
1440 Winter	3.17	910
2160 Winter	2.29	1280
2880 Winter	1.82	1640
4320 Winter	1.31	2376
5760 Winter	1.04	3112
7200 Winter	0.86	3824
8640 Winter	0.74	4584
10080 Winter	0.66	5344

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Cascade Rainfall Details for pave process 1.src

Region	ENG+WAL	Shortest Storm (mins)	15
Return Period (years)	100	Longest Storm (mins)	10080
M5-60 (mm)	18.000	Summer Storms	Yes
Ratio-R	0.400	Winter Storms	Yes
Cv (Summer)	0.750	Climate Change %	+30
Cv (Winter)	0.840		

Time / Area Diagram

Total Area (ha) = 0.100

Time (mins) from:	to:	Area (ha)
0	4	0.100

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Cascade Storage Controls for pave process 1.src

Porous Car Park Details

Infil Coef - Base (m/hr)	0.000000	Invert Level (m)	102.250
Membrane Percolation (mm/hr)	1000	Cover Level (m)	102.850
Safety Factor	2.0	Slope (1:x)	0.0
Porosity	0.30	Max Percolation (l/s)	287.2
Length (m)	47.0	Depression Storage (mm)	5
Width (m)	22.0	Evaporation (mm/day)	3

Orifice Outflow Control

Diameter (m)	0.050	Invert Level (m)	102.250
Discharge Coefficient	0.600		

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Cascade Summary of Results for pave service 1.src

Upstream Structures	Outflow To	Overflow To
(None)	final mh hyd 1.src	(None)

Half Drain Time : 251 minutes

Storm Duration (mins)	Maximum Control (l/s)	Maximum Filtration (l/s)	Maximum Outflow (l/s)	Maximum Water Level (m OD)	Maximum Depth (m)	Maximum Volume (m³)	Status
15 Summer	1.9	0.0	1.9	101.8418	0.0918	33.7	O K
30 Summer	2.3	0.0	2.3	101.8733	0.1233	45.3	O K
60 Summer	2.6	0.0	2.6	101.9037	0.1537	56.4	O K
120 Summer	2.9	0.0	2.9	101.9277	0.1777	65.3	O K
180 Summer	3.0	0.0	3.0	101.9358	0.1857	68.2	O K
240 Summer	3.0	0.0	3.0	101.9392	0.1892	69.4	O K
360 Summer	3.0	0.0	3.0	101.9412	0.1912	70.2	O K
480 Summer	3.0	0.0	3.0	101.9402	0.1902	70.0	O K
600 Summer	3.0	0.0	3.0	101.9388	0.1887	69.2	O K
720 Summer	3.0	0.0	3.0	101.9358	0.1857	68.2	O K
960 Summer	2.9	0.0	2.9	101.9283	0.1782	65.5	O K
1440 Summer	2.7	0.0	2.7	101.9122	0.1623	59.6	O K
2160 Summer	2.5	0.0	2.5	101.8903	0.1403	51.6	O K
2880 Summer	2.3	0.0	2.3	101.8733	0.1233	45.2	O K
4320 Summer	2.0	0.0	2.0	101.8493	0.0993	36.4	O K
5760 Summer	1.7	0.0	1.7	101.8347	0.0848	31.1	O K
7200 Summer	1.5	0.0	1.5	101.8262	0.0763	28.0	O K
8640 Summer	1.3	0.0	1.3	101.8197	0.0698	25.7	O K
10080 Summer	1.2	0.0	1.2	101.8148	0.0647	23.8	O K
15 Winter	2.1	0.0	2.1	101.8548	0.1048	38.5	O K
30 Winter	2.5	0.0	2.5	101.8907	0.1408	51.6	O K
60 Winter	2.9	0.0	2.9	101.9248	0.1747	64.2	O K
120 Winter	3.1	0.0	3.1	101.9528	0.2027	74.4	O K

Storm Duration (mins)	Rain (mm/hr)	Time-Peak (mins)
15 Summer	87.91	26
30 Summer	57.81	39
60 Summer	36.29	68
120 Summer	22.07	122
180 Summer	16.31	174
240 Summer	13.09	200
360 Summer	9.53	262
480 Summer	7.59	330
600 Summer	6.36	398
720 Summer	5.51	466
960 Summer	4.38	602
1440 Summer	3.17	866
2160 Summer	2.29	1240
2880 Summer	1.82	1612
4320 Summer	1.31	2332
5760 Summer	1.04	3008
7200 Summer	0.86	3752
8640 Summer	0.74	4496
10080 Summer	0.66	5240
15 Winter	87.91	25
30 Winter	57.81	39
60 Winter	36.29	66
120 Winter	22.07	122

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Cascade Summary of Results for pave service 1.src

Storm Duration (mins)	Maximum Control (l/s)	Maximum Filtration (l/s)	Maximum Outflow (l/s)	Maximum Water Level (m OD)	Maximum Depth (m)	Maximum Volume (m³)	Status
180 Winter	3.2	0.0	3.2	101.9622	0.2122	78.0	O K
240 Winter	3.2	0.0	3.2	101.9648	0.2147	78.8	O K
360 Winter	3.2	0.0	3.2	101.9648	0.2147	78.9	O K
480 Winter	3.2	0.0	3.2	101.9617	0.2117	77.7	O K
600 Winter	3.2	0.0	3.2	101.9567	0.2067	75.9	O K
720 Winter	3.1	0.0	3.1	101.9508	0.2007	73.7	O K
960 Winter	3.0	0.0	3.0	101.9382	0.1882	69.0	O K
1440 Winter	2.7	0.0	2.7	101.9133	0.1633	59.9	O K
2160 Winter	2.4	0.0	2.4	101.8828	0.1328	48.8	O K
2880 Winter	2.1	0.0	2.1	101.8607	0.1108	40.7	O K
4320 Winter	1.7	0.0	1.7	101.8347	0.0848	31.1	O K
5760 Winter	1.4	0.0	1.4	101.8228	0.0728	26.8	O K
7200 Winter	1.2	0.0	1.2	101.8152	0.0653	23.9	O K
8640 Winter	1.0	0.0	1.0	101.8092	0.0592	21.8	O K
10080 Winter	0.9	0.0	0.9	101.8047	0.0547	20.1	O K

Storm Duration (mins)	Rain (mm/hr)	Time-Peak (mins)
180 Winter	16.31	176
240 Winter	13.09	224
360 Winter	9.53	280
480 Winter	7.59	356
600 Winter	6.36	430
720 Winter	5.51	504
960 Winter	4.38	646
1440 Winter	3.17	916
2160 Winter	2.29	1300
2880 Winter	1.82	1672
4320 Winter	1.31	2340
5760 Winter	1.04	3064
7200 Winter	0.86	3792
8640 Winter	0.74	4504
10080 Winter	0.66	5248

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Cascade Rainfall Details for pave service 1.src

Region	ENG+WAL	Shortest Storm (mins)	15
Return Period (years)	100	Longest Storm (mins)	10080
M5-60 (mm)	18.000	Summer Storms	Yes
Ratio-R	0.400	Winter Storms	Yes
Cv (Summer)	0.750	Climate Change %	+30
Cv (Winter)	0.840		

Time / Area Diagram

Total Area (ha) = 0.192

Time (mins) from:	to:	Area (ha)	Time (mins) from:	to:	Area (ha)	Time (mins) from:	to:	Area (ha)
0	4	0.064	4	8	0.064	8	12	0.064

Cascade Storage Controls for pave service 1.src

Porous Car Park Details

Infil Coef - Base (m/hr)	0.000000	Invert Level (m)	101.750
Membrane Percolation (mm/hr)	1000	Cover Level (m)	102.350
Safety Factor	10.0	Slope (1:x)	0.0
Porosity	0.30	Max Percolation (l/s)	340.0
Length (m)	68.0	Depression Storage (mm)	5
Width (m)	18.0	Evaporation (mm/day)	3

Orifice Outflow Control

Diameter (m)	0.060	Invert Level (m)	101.750
Discharge Coefficient	0.600		

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Cascade Summary of Results for pave supp 1.src

Upstream Structures	Outflow To	Overflow To
(None)	final mh hyd 1.src	(None)

Half Drain Time : 337 minutes

Storm Duration (mins)	Maximum Control (l/s)	Maximum Filtration (l/s)	Maximum Outflow (l/s)	Maximum Water Level (m OD)	Maximum Depth (m)	Maximum Volume (m³)	Status
15 Summer	1.2	0.0	1.2	102.3268	0.0768	27.6	O K
30 Summer	1.5	0.0	1.5	102.3542	0.1043	37.5	O K
60 Summer	1.7	0.0	1.7	102.3812	0.1313	47.2	O K
120 Summer	1.9	0.0	1.9	102.4043	0.1542	55.6	O K
180 Summer	1.9	0.0	1.9	102.4137	0.1637	58.9	O K
240 Summer	2.0	0.0	2.0	102.4173	0.1672	60.2	O K
360 Summer	2.0	0.0	2.0	102.4197	0.1697	61.1	O K
480 Summer	2.0	0.0	2.0	102.4202	0.1702	61.4	O K
600 Summer	2.0	0.0	2.0	102.4202	0.1702	61.2	O K
720 Summer	2.0	0.0	2.0	102.4187	0.1687	60.8	O K
960 Summer	2.0	0.0	2.0	102.4153	0.1652	59.4	O K
1440 Summer	1.9	0.0	1.9	102.4043	0.1543	55.6	O K
2160 Summer	1.8	0.0	1.8	102.3877	0.1378	49.7	O K
2880 Summer	1.6	0.0	1.6	102.3733	0.1233	44.4	O K
4320 Summer	1.4	0.0	1.4	102.3512	0.1013	36.4	O K
5760 Summer	1.3	0.0	1.3	102.3357	0.0858	30.9	O K
7200 Summer	1.2	0.0	1.2	102.3252	0.0753	27.1	O K
8640 Summer	1.1	0.0	1.1	102.3183	0.0683	24.6	O K
10080 Summer	0.9	0.0	0.9	102.3132	0.0632	22.8	O K
15 Winter	1.3	0.0	1.3	102.3378	0.0878	31.6	O K
30 Winter	1.6	0.0	1.6	102.3688	0.1188	42.8	O K
60 Winter	1.8	0.0	1.8	102.3992	0.1492	53.8	O K
120 Winter	2.0	0.0	2.0	102.4258	0.1757	63.3	O K

Storm Duration (mins)	Rain (mm/hr)	Time-Peak (mins)
15 Summer	87.91	22
30 Summer	57.81	37
60 Summer	36.29	66
120 Summer	22.07	124
180 Summer	16.31	182
240 Summer	13.09	228
360 Summer	9.53	284
480 Summer	7.59	346
600 Summer	6.36	414
720 Summer	5.51	482
960 Summer	4.38	618
1440 Summer	3.17	884
2160 Summer	2.29	1276
2880 Summer	1.82	1648
4320 Summer	1.31	2380
5760 Summer	1.04	3112
7200 Summer	0.86	3816
8640 Summer	0.74	4496
10080 Summer	0.66	5240
15 Winter	87.91	22
30 Winter	57.81	36
60 Winter	36.29	64
120 Winter	22.07	120

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Cascade Summary of Results for pave supp 1.src

Storm Duration (mins)	Maximum Control (l/s)	Maximum Filtration (l/s)	Maximum Outflow (l/s)	Maximum Water Level (m OD)	Maximum Depth (m)	Maximum Volume (m³)	Status
180 Winter	2.1	0.0	2.1	102.4368	0.1867	67.3	O K
240 Winter	2.1	0.0	2.1	102.4417	0.1917	69.0	O K
360 Winter	2.1	0.0	2.1	102.4423	0.1922	69.3	O K
480 Winter	2.1	0.0	2.1	102.4417	0.1917	69.1	O K
600 Winter	2.1	0.0	2.1	102.4398	0.1897	68.3	O K
720 Winter	2.1	0.0	2.1	102.4368	0.1867	67.2	O K
960 Winter	2.0	0.0	2.0	102.4287	0.1787	64.3	O K
1440 Winter	1.9	0.0	1.9	102.4108	0.1608	57.9	O K
2160 Winter	1.7	0.0	1.7	102.3863	0.1363	49.1	O K
2880 Winter	1.6	0.0	1.6	102.3668	0.1168	42.0	O K
4320 Winter	1.3	0.0	1.3	102.3388	0.0888	32.0	O K
5760 Winter	1.1	0.0	1.1	102.3223	0.0723	26.1	O K
7200 Winter	1.0	0.0	1.0	102.3142	0.0643	23.1	O K
8640 Winter	0.8	0.0	0.8	102.3083	0.0582	20.9	O K
10080 Winter	0.7	0.0	0.7	102.3037	0.0537	19.3	O K

Storm Duration (mins)	Rain (mm/hr)	Time-Peak (mins)
180 Winter	16.31	178
240 Winter	13.09	232
360 Winter	9.53	294
480 Winter	7.59	368
600 Winter	6.36	444
720 Winter	5.51	520
960 Winter	4.38	668
1440 Winter	3.17	952
2160 Winter	2.29	1344
2880 Winter	1.82	1732
4320 Winter	1.31	2464
5760 Winter	1.04	3120
7200 Winter	0.86	3824
8640 Winter	0.74	4576
10080 Winter	0.66	5248

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Cascade Rainfall Details for pave supp 1.src

Region	ENG+WAL	Shortest Storm (mins)	15
Return Period (years)	100	Longest Storm (mins)	10080
M5-60 (mm)	18.000	Summer Storms	Yes
Ratio-R	0.400	Winter Storms	Yes
Cv (Summer)	0.750	Climate Change %	+30
Cv (Winter)	0.840		

Time / Area Diagram

Total Area (ha) = 0.160

Time (mins) from:	to:	Area (ha)	Time (mins) from:	to:	Area (ha)
0	4	0.080	4	8	0.080

Cascade Storage Controls for pave supp 1.src

Porous Car Park Details

Infil Coef - Base (m/hr)	0.000000	Invert Level (m)	102.250
Membrane Percolation (mm/hr)	1000	Cover Level (m)	102.850
Safety Factor	10.0	Slope (1:x)	0.0
Porosity	0.30	Max Percolation (l/s)	333.3
Length (m)	50.0	Depression Storage (mm)	5
Width (m)	24.0	Evaporation (mm/day)	3

Orifice Outflow Control

Diameter (m)	0.050	Invert Level (m)	102.250
Discharge Coefficient	0.600		

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Cascade Summary of Results for pave supp 2.src

Upstream Structures	Outflow To	Overflow To
(None)	final mh hyd 1.src	(None)

Half Drain Time : 346 minutes

Storm Duration (mins)	Maximum Control (l/s)	Maximum Filtration (l/s)	Maximum Outflow (l/s)	Maximum Water Level (m OD)	Maximum Depth (m)	Maximum Volume (m³)	Status
15 Summer	1.2	0.0	1.2	102.3323	0.0823	29.6	O K
30 Summer	1.5	0.0	1.5	102.3617	0.1118	40.2	O K
60 Summer	1.8	0.0	1.8	102.3907	0.1408	50.6	O K
120 Summer	2.0	0.0	2.0	102.4153	0.1652	59.5	O K
180 Summer	2.0	0.0	2.0	102.4252	0.1752	63.1	O K
240 Summer	2.0	0.0	2.0	102.4293	0.1792	64.5	O K
360 Summer	2.1	0.0	2.1	102.4317	0.1817	65.5	O K
480 Summer	2.1	0.0	2.1	102.4327	0.1827	65.7	O K
600 Summer	2.1	0.0	2.1	102.4323	0.1822	65.6	O K
720 Summer	2.1	0.0	2.1	102.4307	0.1807	65.1	O K
960 Summer	2.0	0.0	2.0	102.4268	0.1767	63.6	O K
1440 Summer	2.0	0.0	2.0	102.4157	0.1658	59.6	O K
2160 Summer	1.8	0.0	1.8	102.3978	0.1478	53.3	O K
2880 Summer	1.7	0.0	1.7	102.3822	0.1323	47.6	O K
4320 Summer	1.5	0.0	1.5	102.3583	0.1083	39.0	O K
5760 Summer	1.3	0.0	1.3	102.3418	0.0918	33.0	O K
7200 Summer	1.2	0.0	1.2	102.3298	0.0798	28.7	O K
8640 Summer	1.1	0.0	1.1	102.3217	0.0718	25.8	O K
10080 Summer	1.0	0.0	1.0	102.3163	0.0663	23.9	O K
15 Winter	1.4	0.0	1.4	102.3443	0.0943	33.9	O K
30 Winter	1.7	0.0	1.7	102.3773	0.1273	45.9	O K
60 Winter	1.9	0.0	1.9	102.4098	0.1597	57.6	O K
120 Winter	2.1	0.0	2.1	102.4382	0.1882	67.8	O K

Storm Duration (mins)	Rain (mm/hr)	Time-Peak (mins)
15 Summer	87.91	22
30 Summer	57.81	37
60 Summer	36.29	66
120 Summer	22.07	124
180 Summer	16.31	182
240 Summer	13.09	230
360 Summer	9.53	286
480 Summer	7.59	348
600 Summer	6.36	416
720 Summer	5.51	484
960 Summer	4.38	620
1440 Summer	3.17	886
2160 Summer	2.29	1280
2880 Summer	1.82	1652
4320 Summer	1.31	2380
5760 Summer	1.04	3112
7200 Summer	0.86	3816
8640 Summer	0.74	4496
10080 Summer	0.66	5240
15 Winter	87.91	22
30 Winter	57.81	36
60 Winter	36.29	64
120 Winter	22.07	122

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Cascade Summary of Results for pave supp 2.src

Storm Duration (mins)	Maximum Control (l/s)	Maximum Filtration (l/s)	Maximum Outflow (l/s)	Maximum Water Level (m OD)	Maximum Depth (m)	Maximum Volume (m³)	Status
180 Winter	2.2	0.0	2.2	102.4502	0.2002	72.1	O K
240 Winter	2.2	0.0	2.2	102.4552	0.2052	73.9	O K
360 Winter	2.2	0.0	2.2	102.4562	0.2062	74.2	O K
480 Winter	2.2	0.0	2.2	102.4557	0.2057	74.0	O K
600 Winter	2.2	0.0	2.2	102.4532	0.2032	73.3	O K
720 Winter	2.2	0.0	2.2	102.4502	0.2002	72.1	O K
960 Winter	2.1	0.0	2.1	102.4417	0.1917	69.1	O K
1440 Winter	2.0	0.0	2.0	102.4232	0.1733	62.3	O K
2160 Winter	1.8	0.0	1.8	102.3968	0.1468	52.9	O K
2880 Winter	1.7	0.0	1.7	102.3757	0.1258	45.2	O K
4320 Winter	1.4	0.0	1.4	102.3453	0.0953	34.4	O K
5760 Winter	1.2	0.0	1.2	102.3268	0.0768	27.7	O K
7200 Winter	1.0	0.0	1.0	102.3173	0.0673	24.1	O K
8640 Winter	0.9	0.0	0.9	102.3108	0.0607	21.9	O K
10080 Winter	0.8	0.0	0.8	102.3057	0.0557	20.1	O K

Storm Duration (mins)	Rain (mm/hr)	Time-Peak (mins)
180 Winter	16.31	178
240 Winter	13.09	232
360 Winter	9.53	298
480 Winter	7.59	370
600 Winter	6.36	446
720 Winter	5.51	522
960 Winter	4.38	670
1440 Winter	3.17	954
2160 Winter	2.29	1360
2880 Winter	1.82	1732
4320 Winter	1.31	2468
5760 Winter	1.04	3168
7200 Winter	0.86	3824
8640 Winter	0.74	4576
10080 Winter	0.66	5336

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Cascade Rainfall Details for pave supp 2.src

Region	ENG+WAL	Shortest Storm (mins)	15
Return Period (years)	100	Longest Storm (mins)	10080
M5-60 (mm)	18.000	Summer Storms	Yes
Ratio-R	0.400	Winter Storms	Yes
Cv (Summer)	0.750	Climate Change %	+30
Cv (Winter)	0.840		

Time / Area Diagram

Total Area (ha) = 0.170

Time (mins) from:	to:	Area (ha)	Time (mins) from:	to:	Area (ha)
0	4	0.085	4	8	0.085

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Cascade Storage Controls for pave supp 2.src

Porous Car Park Details

Infil Coef - Base (m/hr)	0.000000	Invert Level (m)	102.250
Membrane Percolation (mm/hr)	1000	Cover Level (m)	102.850
Safety Factor	2.0	Slope (1:x)	0.0
Porosity	0.30	Max Percolation (l/s)	333.3
Length (m)	50.0	Depression Storage (mm)	5
Width (m)	24.0	Evaporation (mm/day)	3

Orifice Outflow Control

Diameter (m)	0.050	Invert Level (m)	102.250
Discharge Coefficient	0.600		

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Cascade Summary of Results for south pond 1.src

Upstream Structures	Outflow To	Overflow To
(None)	final mh hyd 1.src	(None)

Storm Duration (mins)	Maximum Control (l/s)	Maximum Outflow (l/s)	Maximum Water Level (m OD)	Maximum Depth (m)	Maximum Volume (m³)	Status
15 Summer	0.8	0.8	102.2097	0.1098	27.4	O K
30 Summer	0.8	0.8	102.2367	0.1368	35.7	O K
60 Summer	0.8	0.8	102.2622	0.1622	44.2	O K
120 Summer	0.8	0.8	102.2852	0.1852	52.5	O K
180 Summer	0.8	0.8	102.2967	0.1967	56.8	O K
240 Summer	0.8	0.8	102.3037	0.2037	59.4	O K
360 Summer	0.8	0.8	102.3102	0.2102	62.0	O K
480 Summer	0.8	0.8	102.3127	0.2127	62.9	O K
600 Summer	0.8	0.8	102.3127	0.2127	63.0	O K
720 Summer	0.8	0.8	102.3122	0.2122	62.6	O K
960 Summer	0.8	0.8	102.3097	0.2097	61.7	O K
1440 Summer	0.8	0.8	102.3037	0.2037	59.4	O K
2160 Summer	0.8	0.8	102.2923	0.1922	55.1	O K
2880 Summer	0.8	0.8	102.2797	0.1797	50.5	O K
4320 Summer	0.8	0.8	102.2552	0.1553	41.8	O K
5760 Summer	0.8	0.8	102.2327	0.1328	34.5	O K
7200 Summer	0.8	0.8	102.2142	0.1143	28.7	O K
8640 Summer	0.8	0.8	102.2008	0.1008	24.7	O K
10080 Summer	0.7	0.7	102.1927	0.0928	22.4	O K
15 Winter	0.8	0.8	102.2207	0.1208	30.7	O K
30 Winter	0.8	0.8	102.2503	0.1502	40.1	O K
60 Winter	0.8	0.8	102.2777	0.1777	49.7	O K
120 Winter	0.8	0.8	102.3027	0.2027	59.1	O K
180 Winter	0.8	0.8	102.3158	0.2157	64.1	O K

Storm Duration (mins)	Rain (mm/hr)	Time-Peak (mins)
15 Summer	87.91	19
30 Summer	57.81	34
60 Summer	36.29	64
120 Summer	22.07	122
180 Summer	16.31	182
240 Summer	13.09	242
360 Summer	9.53	362
480 Summer	7.59	480
600 Summer	6.36	600
720 Summer	5.51	684
960 Summer	4.38	788
1440 Summer	3.17	1038
2160 Summer	2.29	1448
2880 Summer	1.82	1844
4320 Summer	1.31	2596
5760 Summer	1.04	3344
7200 Summer	0.86	4032
8640 Summer	0.74	4672
10080 Summer	0.66	5352
15 Winter	87.91	19
30 Winter	57.81	33
60 Winter	36.29	62
120 Winter	22.07	122
180 Winter	16.31	180

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Cascade Summary of Results for south pond 1.src

Storm Duration (mins)	Maximum Control (l/s)	Maximum Outflow (l/s)	Maximum Water Level (m OD)	Maximum Depth (m)	Maximum Volume (m³)	Status
240 Winter	0.8	0.8	102.3232	0.2232	67.1	O K
360 Winter	0.8	0.8	102.3312	0.2312	70.3	O K
480 Winter	0.8	0.8	102.3342	0.2342	71.6	O K
600 Winter	0.8	0.8	102.3353	0.2352	72.0	O K
720 Winter	0.8	0.8	102.3353	0.2352	71.9	O K
960 Winter	0.8	0.8	102.3317	0.2317	70.6	O K
1440 Winter	0.8	0.8	102.3237	0.2237	67.3	O K
2160 Winter	0.8	0.8	102.3092	0.2092	61.5	O K
2880 Winter	0.8	0.8	102.2912	0.1912	54.7	O K
4320 Winter	0.8	0.8	102.2537	0.1538	41.3	O K
5760 Winter	0.8	0.8	102.2203	0.1203	30.5	O K
7200 Winter	0.7	0.7	102.1982	0.0983	24.1	O K
8640 Winter	0.7	0.7	102.1878	0.0878	21.0	O K
10080 Winter	0.6	0.6	102.1793	0.0793	18.6	O K

Storm Duration (mins)	Rain (mm/hr)	Time-Peak (mins)
240 Winter	13.09	238
360 Winter	9.53	354
480 Winter	7.59	468
600 Winter	6.36	580
720 Winter	5.51	688
960 Winter	4.38	894
1440 Winter	3.17	1110
2160 Winter	2.29	1576
2880 Winter	1.82	2016
4320 Winter	1.31	2808
5760 Winter	1.04	3464
7200 Winter	0.86	4040
8640 Winter	0.74	4760
10080 Winter	0.66	5456

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Cascade Rainfall Details for south pond 1.src

Region	ENG+WAL	Shortest Storm (mins)	15
Return Period (years)	100	Longest Storm (mins)	10080
M5-60 (mm)	18.000	Summer Storms	Yes
Ratio-R	0.400	Winter Storms	Yes
Cv (Summer)	0.750	Climate Change %	+30
Cv (Winter)	0.840		

Time / Area Diagram

Total Area (ha) = 0.130

Time (mins) from:	to:	Area (ha)
0	4	0.130

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Cascade Storage Controls for south pond 1.src

Tank/Pond Details

Invert Level (m) 102.100 Ground Level (m) 102.600

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.00	200.0	0.60	650.0	1.20	650.0	1.80	650.0	2.40	650.0
0.10	290.0	0.70	650.0	1.30	650.0	1.90	650.0	2.50	650.0
0.20	380.0	0.80	650.0	1.40	650.0	2.00	650.0		
0.30	470.0	0.90	650.0	1.50	650.0	2.10	650.0		
0.40	560.0	1.00	650.0	1.60	650.0	2.20	650.0		
0.50	650.0	1.10	650.0	1.70	650.0	2.30	650.0		

Hydro-Brake Outflow Control

Design Head (m) 0.500 Hydro-Brake Type MD4 Invert Level (m) 102.100
Design Flow (l/s) 1.0 Diameter (mm) 43

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.10	0.8	0.80	1.3	2.00	2.0	4.00	2.9	7.00	3.8
0.20	0.7	1.00	1.4	2.20	2.1	4.50	3.1	7.50	4.0
0.30	0.8	1.20	1.6	2.40	2.2	5.00	3.2	8.00	4.1
0.40	0.9	1.40	1.7	2.60	2.3	5.50	3.4	8.50	4.2
0.50	1.0	1.60	1.8	3.00	2.5	6.00	3.5	9.00	4.3
0.60	1.1	1.80	1.9	3.50	2.7	6.50	3.7	9.50	4.5

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Global Variables

Region	FSR - England & Wales
Return Period (yrs)	100
M5-60 (mm)	24.000
Ratio R	0.400
Volumetric Runoff Coef	0.750
Profile Type	Summer
PIMP (%)	100
Areal Reduction Factor	1.000
Storm Duration (mins)	240
Hot Start (mins)	0
Manhole Headloss Coefficient	0.500
MADD Factor * 10m³/ha Storage	2.000
Foul Sewage/Hectare (l/s)	0.00
Additional Flow - % of Total Flow	0
Number of Input Hydrographs	0
Number of Time/Area Diagrams	0
Number of Bifurcations	0
Number of Overflows	0
Number of Off-Line Controls	5
Number of On-Line Controls	13

(18 x 1.3 - 30% for increase in rainfall intensity)

Freely Discharging Outfalls

Outfall Pipe Number	Outfall MH/No	C.Level (m)	I.Level (m)	D,L (mm)	B (mm)
1.010	24	101.700	100.470	1200	0

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On-Line Controls (Orifice)

US/PN	Volume (m^3)	Ctrl MH Name	Invert (m)	Dia (m)	Discharge Coefficient
1.002	1.098	5	101.920	0.050	0.600
2.000	0.070	5	101.920	0.050	0.600
1.003	1.067	7	101.745	0.050	0.600
3.000	0.070	7	101.745	0.050	0.600
1.006	0.815	11	101.255	0.060	0.600
4.000	0.070	11	101.255	0.060	0.600
5.000	0.512	15	101.800	0.050	0.600
6.000	0.158	15	101.800	0.050	0.600
7.000	0.158	15	101.800	0.050	0.600

On-Line Controls (Hydro-Brake®)

US/PN	Volume (m^3)	Ctrl MH Name	Invert (m)	Type	Dia (m)	D.Head (m)	D.Flow (l/s)	Headloss (m)	Flow (l/s)
1.000	0.030	2	102.240	Md3	0.062	0.300	2	0.1	1.6
								0.2	1.7
								0.3	2.0
								0.4	2.3
								0.5	2.6
								0.6	2.9
1.007	0.909	21	101.105	Md4	0.142	1.300	18	0.1	3.8
								0.2	11.9
								0.3	15.2
								0.4	13.8
								0.5	12.6
								0.6	12.7
								0.7	13.4
								0.8	14.2
								0.9	15.0
								1.0	15.8
								1.2	17.3
								1.4	18.7
8.000	0.124	18	101.600	Md4	0.043	0.500	1	0.1	0.8
								0.2	0.7
								0.3	0.8
								0.4	0.9
								0.5	1.0
								0.6	1.1
								0.7	1.2
								0.8	1.3
								0.9	1.4
								1.0	1.4
								1.2	1.6
								1.4	1.7
5.004	0.124	21	101.105	Md4	0.142	1.300	18	0.1	3.8
								0.2	11.9
								0.3	15.2
								0.4	13.8
								0.5	12.6
								0.6	12.7
								0.7	13.4
								0.8	14.2
								0.9	15.0
								1.0	15.8
								1.2	17.3
								1.4	18.7

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Infiltration Systems

Warning:- Volume should always be included unless the upstream pipe is being used for storage and/or as a carrier.

DS/PN	MH Loss	Height above outgoing PN (m)	Filename	Type	Include Volume
2.000	0.500	-0.100	PAVE supp 1.SRC	Porous Car Park	Yes
3.000	0.500	-0.100	PAVE SUPP 2.SRC	Porous Car Park	Yes
4.000	0.500	0.200	PAVE service 1.SRC	Porous Car Park	Yes
6.000	0.500	0.200	PAVE process 1.SRC	Porous Car Park	Yes
7.000	0.500	0.200	HGV ACCESS 1.SRC	Infiltration Trench	Yes

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Storage Pond at pipe 1.000 USMH 1

Storage Pond Invert Level (m) 102.250

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.0	206.5	0.6	671.0	1.2	671.0	1.8	671.0	2.4	671.0
0.1	299.4	0.7	671.0	1.3	671.0	1.9	671.0	2.5	671.0
0.2	392.1	0.8	671.0	1.4	671.0	2.0	671.0		
0.3	485.2	0.9	671.0	1.5	671.0	2.1	671.0		
0.4	578.2	1.0	671.0	1.6	671.0	2.2	671.0		
0.5	671.0	1.1	671.0	1.7	671.0	2.3	671.0		

Storage Pond at pipe 8.000 USMH 17

Storage Pond Invert Level (m) 102.100

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.0	200.0	0.6	650.0	1.2	650.0	1.8	650.0	2.4	650.0
0.1	290.0	0.7	650.0	1.3	650.0	1.9	650.0	2.5	650.0
0.2	380.0	0.8	650.0	1.4	650.0	2.0	650.0		
0.3	470.0	0.9	650.0	1.5	650.0	2.1	650.0		
0.4	560.0	1.0	650.0	1.6	650.0	2.2	650.0		
0.5	650.0	1.1	650.0	1.7	650.0	2.3	650.0		

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Summary of Results

Return Period (years)	100
Storm Duration (mins)	240
Profile Type	Summer
Margin for Flood Risk warning (mm)	10
Analysis Time Step	2.5 second increment (extended)
DVD Status	OFF
Inertia Status	OFF

PN	Water Lev. (m)	Surcharged Depth (m)	Flooded Vol (m³)	Flow/ Capacity	Overflow (l/s)	Pipe Flow (l/s)	Status
1.000	102.416	-0.034	0.000	0.16	0	4	O K
1.001	102.492	0.052	0.000	0.07	0	2	SURCH'ED
1.002	102.238	-0.062	0.000	0.07	0	2	O K
2.000	102.222	-0.028	0.000	0.11	0	1	O K
1.003	102.232	0.112	0.000	0.08	0	2	SURCH'ED
3.000	102.174	-0.076	0.000	0.22	0	3	O K
1.004	102.171	0.226	0.000	0.12	0	3	SURCH'ED
1.005	101.855	0.145	0.000	0.12	0	3	SURCH'ED
1.006	101.853	0.263	0.000	0.12	0	3	SURCH'ED
4.000	101.835	0.185	0.000	0.42	0	6	SURCH'ED
1.007	101.845	0.390	0.000	0.21	0	5	SURCH'ED
5.000	102.363	0.213	0.000	0.02	0	0	SURCH'ED
6.000	102.333	0.183	0.000	0.32	0	5	SURCH'ED
7.000	102.347	0.197	0.000	0.38	3	6	SURCH'ED
5.001	102.408	0.458	0.000	0.27	0	4	SURCH'ED
5.002	101.648	-0.102	0.000	0.23	0	4	O K
8.000	102.269	0.444	0.000	0.19	0	4	SURCH'ED
8.001	102.356	0.556	0.000	0.05	0	1	SURCH'ED
5.003	101.379	-0.141	0.000	0.19	0	5	O K
5.004	101.304	-0.026	0.000	0.24	0	5	O K
1.008	101.299	-0.006	0.000	0.43	0	10	O K
1.009	101.111	-0.113	0.000	0.40	0	10	O K
1.010	100.702	-0.111	0.000	0.41	0	10	O K

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Rainfall Hyetograph

Region	FSR - England & Wales
Return Period (yrs)	100
M5-60 (mm)	24.000
Ratio R	0.400
Profile Type	Summer
Storm Duration (mins)	240

Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)
1	5.36	49	7.70	97	28.47	145	25.46	193	7.54
2	5.36	50	7.70	98	28.47	146	25.46	194	7.54
3	5.46	51	7.90	99	30.28	147	23.85	195	7.44
4	5.53	52	8.04	100	31.49	148	22.78	196	7.37
5	5.53	53	8.07	101	32.16	149	22.34	197	7.34
6	5.53	54	8.21	102	34.83	150	20.60	198	7.20
7	5.53	55	8.21	103	34.83	151	20.60	199	7.20
8	5.66	56	8.47	104	37.51	152	18.86	200	7.07
9	5.69	57	8.54	105	38.18	153	18.42	201	7.03
10	5.69	58	8.61	106	39.66	154	17.69	202	6.97
11	5.69	59	8.71	107	41.87	155	16.58	203	6.87
12	5.69	60	8.71	108	41.87	156	16.58	204	6.87
13	5.86	61	9.04	109	45.89	157	15.24	205	6.70
14	5.86	62	9.04	110	45.89	158	15.24	206	6.70
15	5.86	63	9.24	111	48.50	159	14.54	207	6.60
16	5.86	64	9.38	112	50.24	160	14.07	208	6.53
17	5.90	65	9.45	113	51.18	161	13.87	209	6.50
18	6.03	66	9.71	114	54.93	162	13.06	210	6.36
19	6.03	67	9.71	115	54.93	163	13.06	211	6.36
20	6.03	68	10.12	116	58.95	164	12.26	212	6.36
21	6.03	69	10.22	117	59.96	165	12.06	213	6.36
22	6.10	70	10.42	118	62.23	166	11.79	214	6.30
23	6.20	71	10.72	119	65.65	167	11.39	215	6.20
24	6.20	72	10.72	120	65.65	168	11.39	216	6.20
25	6.20	73	11.39	121	65.65	169	10.72	217	6.20
26	6.20	74	11.39	122	65.65	170	10.72	218	6.20
27	6.30	75	11.79	123	62.23	171	10.42	219	6.10
28	6.36	76	12.06	124	59.96	172	10.22	220	6.03
29	6.36	77	12.26	125	58.95	173	10.12	221	6.03
30	6.36	78	13.06	126	54.93	174	9.71	222	6.03
31	6.36	79	13.06	127	54.93	175	9.71	223	6.03
32	6.50	80	13.87	128	51.18	176	9.45	224	5.90
33	6.53	81	14.07	129	50.24	177	9.38	225	5.86
34	6.60	82	14.54	130	48.50	178	9.24	226	5.86
35	6.70	83	15.24	131	45.89	179	9.04	227	5.86
36	6.70	84	15.24	132	45.89	180	9.04	228	5.86
37	6.87	85	16.58	133	41.87	181	8.71	229	5.69
38	6.87	86	16.58	134	41.87	182	8.71	230	5.69
39	6.97	87	17.69	135	39.66	183	8.61	231	5.69
40	7.03	88	18.42	136	38.18	184	8.54	232	5.69
41	7.07	89	18.86	137	37.51	185	8.47	233	5.66
42	7.20	90	20.60	138	34.83	186	8.21	234	5.53
43	7.20	91	20.60	139	34.83	187	8.21	235	5.53
44	7.34	92	22.34	140	32.16	188	8.07	236	5.53
45	7.37	93	22.78	141	31.49	189	8.04	237	5.53
46	7.44	94	23.85	142	30.28	190	7.91	238	5.46
47	7.54	95	25.46	143	28.47	191	7.70	239	5.36
48	7.54	96	25.46	144	28.47	192	7.70	240	5.36

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Appendix G (1)

ATKINS	Project HEFF			Job ref 5033650	
	Part of structure PERMEABLE BLOCK PAVING CATEGORY 3 AXLE LOAD.			Calc sheet no 1 /	rev 1
	Drawing ref.	Calc by P.W.B.	Date 31/05/07	Check by	Date 14/9/07

Ref	Calculations	Output
Interpave LS34:L217 4th Edn 2006	Refer to Section VIII on Page 9 for introduction to Permeable Block Pavement Design.	
	Note Pavement for axle loads up to 7500 kn to suit use by light vehicles & site buses etc. (As agreed with AWE). (Ref Interpave Table 5 & Table B1).	
	Criteria 1) CBR = 5 (based on Silchester Gravels being formation 2) Design for 100yr no flooding. 3) Sub base - open graded crushed rock. 4). No infiltration to subgrade - system C. 5) Category 3 axle load. 6) 4000mm/hr (C697) & 10 f of s.	
	Design 1) Sub-base thickness (Interpave. Table 3 & Fig D1). r value = 0·40 approx Table 4 gives 220mm thick sub base for 100yr storm with 6hr retention.	
on	2) Sub base thickness for vehicle loading. Cat. 3. (AWE Agreed). Table 5 5 000 x partial safety factor (Table 6) 5 000 x 1·0 = 5000 Table 7 gives 350 mm open graded crushed rock As 5% CBR this figure correct. Table 9 - partial safety factor of 1·0. ie to BS EN 13242 (4/20).	

Appendix G. (2)

ATKINS

Project	Job ref
HEFF	5033650
Part of structure: PERMEABLE BLOCK PAVING	Calc sheet no / rev: 21 / 1
Drawing ref. / Calc by: Pw B / Date: 31/05/07	Check by: JW / Date: 4/9/07

Ref	Calculations	Output

Overall depth therefore (Light vehicles).

80mm BLOCKS (BS EN 1338: 2003)
50mm LAYING COURSE
- - - - PERMEABLE MEMBRANE (OPTIONAL)
350mm SUB-BASE. (Table 12.11)
- - - - IMPERMEABLE MEMBRANE (Ref (c) 697 P12-7
480mm

for footways (where not combined).

150mm SUB-BASE

Overall depth 80mm Blocks (BS EN 1338 : 2003)
50mm laying course
- - - - Permeable membrane (optional)
150 Sub base
- - - - Impermeable membrane (Ref (c) c 697) P.12-7.
250mm

Where footways adjacent to trafficked area, use same formation level.

Appendix G

(3)

ATKINS

Project	Job ref
HEFF	5033650
Part of structure: PERMEABLE BLOCK PAVING HEAVY DUTY – CAT 5 LOADING	Calc sheet no / rev: 3 / 1
Drawing ref.	Calc by: PWK Date: 31/5/07 Check by: [illegible] Date: 11/9/07

Ref	Calculations	Output
	Note 1) HGV turning area adjacent to Process Building Assumed Cat 5 (Table 5) P18. Interpave. 2) Refer to Drainage Report for area details. Area 1 – HGV Area. Sub-base thickness for vehicle loading Cat 5 (table 5) 11,000 ku × 1.0 (safety factor). = 11000 ku Table 7 gives 300 mm cement stabilised open graded crushed rock 150 mm open graded crushed rock 450 mm overall subbase depth. Pavement construction 80 mm Block 50 laying course 450 Subbase 580 mm.	

ATKINS	Project: HEFF	Job ref: 5033650
	Part of structure: PERMEABLE BLOCK PAVING	Calc sheet no: 41 rev: 1
	Drawing ref. / Calc by: [illegible] / Date: 31/05/07	Check by: GW / Date: 11/9/07

Ref	Calculations	Output
	Refer to Drainage Report for details of areas to be paved.	
	1) Area 2 (Support Building roof to drain to pavement subbase).	
	∴ (½) Roof area = 28 x 24/2 = 336 m²	
	Paved area = (48 x 22) + (5 x 60) =	
	= 1056 m²	
	Thickness of 'hydraulic design' subbase =	
	$\frac{1056 + 336}{1056} = \underline{\underline{1.3}}$	
	∴ 220mm subbase x 1.3	
	= 286 mm < vehicle loading figures (350/450)	
	∴ Subbase depth already sufficient.	
	2). Area 4 (Service Building).	
	Roof area = 26 x 18 = 468 m²	
	Paved area = 66 x 29 = 1914 m²	
	Subbase factor = $\frac{1914 + 468}{1914}$	
	= 1.24	
	Subbase 'hydraulic thickness = 220 x 1.24 = 273 mm.	
	∴ < 350mm (traffic loading depth)	
	∴ 350 mm is correct still	

Appendix G (5)

ANNEXE B EXAMPLES OF VEHICLES OF CATEGORY 2 AND 3 DESIGNATIONS.

Table B1: Vehicle categories

category	vehicle description	GVW ku
2	Renault Master Panel Van SL33TD	3,300
	Mercedes Benz Sprinter Van	2,800
	Renault Master DCLL35TD	3,500
3	Mercedes Benz Sprinter	4,600
	Mercedes Benz Vario	7,490

ANNEXE C TYPICAL SPECIFICATION FOR A GEOTEXTILE

The geotextile should function as a filter and must be installed according to the manufacturer's requirements, and should be submitted for approval by the engineer. The geotextile can be either a monofilament woven or needle punched non-woven fabric corresponding to the relevant specification shown below.

The geotextile should be manufactured from a suitable polyethylene or polypropylene filament able to withstand naturally occurring chemical and microbial effects.

Quality The tensile properties of the material should be verified in accordance with EN ISO 10319 by both internal quality assurance and external quality control and assurance by an independent authorised laboratory.

The production of the geotextile shall be EN ISO 9001 certified.

Each roll shall have at least one identification label with roll number and product type in accordance with EN ISO 10320, and carry a CE mark.

Table C1: Geotextile specification

Characteristics	Standard	Woven Filter	Non Woven Filter
Weight	EN 965	≥ 200g/m²	≥400g/m²
Ultimate Tensile Strength		EN ISO 10319	
Longitudinal		≥ 30kN/m	≥16kN/m
Transverse		≥ 30kN/m	≥15kN/m
Strain at Nom. Ten. Strength		EN ISO 10319	
Longitudinal		≥ 25%	≥ 70%
Transverse		≤ 25%	≤ 70%
CBR Puncture	EN ISO 12236	≥ 2000N	≥ 3000N
Opening Size	EN ISO 12956	≤ 0.2 mm	≤ 0.1mm
Water Permeability	EN ISO 11058	≥ 200 x 10^{-3} m/s	≥ 6 x 10^{-3} m/s

Installation Procedure

Adjacent rolls of the geotextile should be overlapped by at least 300mm.

All vehicles should be prevented from trafficking directly over the material.

The material should be protected from ultra-violet light.

The quotation for the material should incorporate all overlaps.

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Appendix G (6)

Table 12.11 *Sub-base aggregate specification requirements*

Properties	Category to BS EN 13242 (BSI, 2003) or BS 12620 (BSI, 2002b)
Grading	Grading 4/40, Gc 85-15, GTc 20/17.5.
Fines content	f_4
Shape	FI_{20}
Resistance to fragmentation	LA_{30}
Durability:Water absorption to BS EN 1097-6:2000, Clause 7 For WA,2%, magnesium sulphate soundness	WA_{242} MS_{18}
Resistance to wear	$M_{DE}20$
Acid-soluble sulphate content: aggregates other than air-cooled blast-furnace slag air-cooled blast-furnace slag	$AS_{0.2}$ $AS_{1.0}$
Total sulphur:aggregates other than air-cooled blast-furnace slag air-cooled blast-furnace slag	</ = 1% by mass. </ = 2% by mass.
Volume stability of blast-furnace and steel slags:air-cooled blast-furnace slag steel slag	Free from dicalcium silicate and iron disintegration (BS EN 13242, (BSI, 2003), 6.4.2.2). V_5
Leaching of contaminants	Blast furnace slag and other recycled materials should meet the requirements of the Environment Agency Waste Acceptance Criteria for inert waste when leachate tested in accordance with BS EN 12457,3 (BSI, 2002a).

(c) Impermeable membrane characteristics

These should typically be manufactured from HDPE, polypropylene or EPDM and should be:

- durable, robust and able to withstand construction and operational loads
- resistant to puncture, multi-axial stresses and strains associated with movement and environmental stress cracking
- unaffected by potential pollutants
- installed with fully watertight joints and discharge outlets; welded joints should be tested to ensure the integrity of the system and provide a more robust jointing method. The membrane must be able to resist the punching stresses caused by sharp points of contact from the aggregate sub-base. It must also have sufficient strength to resist the imposed tensile forces from traffic or other loading. Consideration can be given to protecting membranes with geotextile fleeces where the risks associated with puncture are particularly high.

Additional guidance on specifications is given in Appendix C.

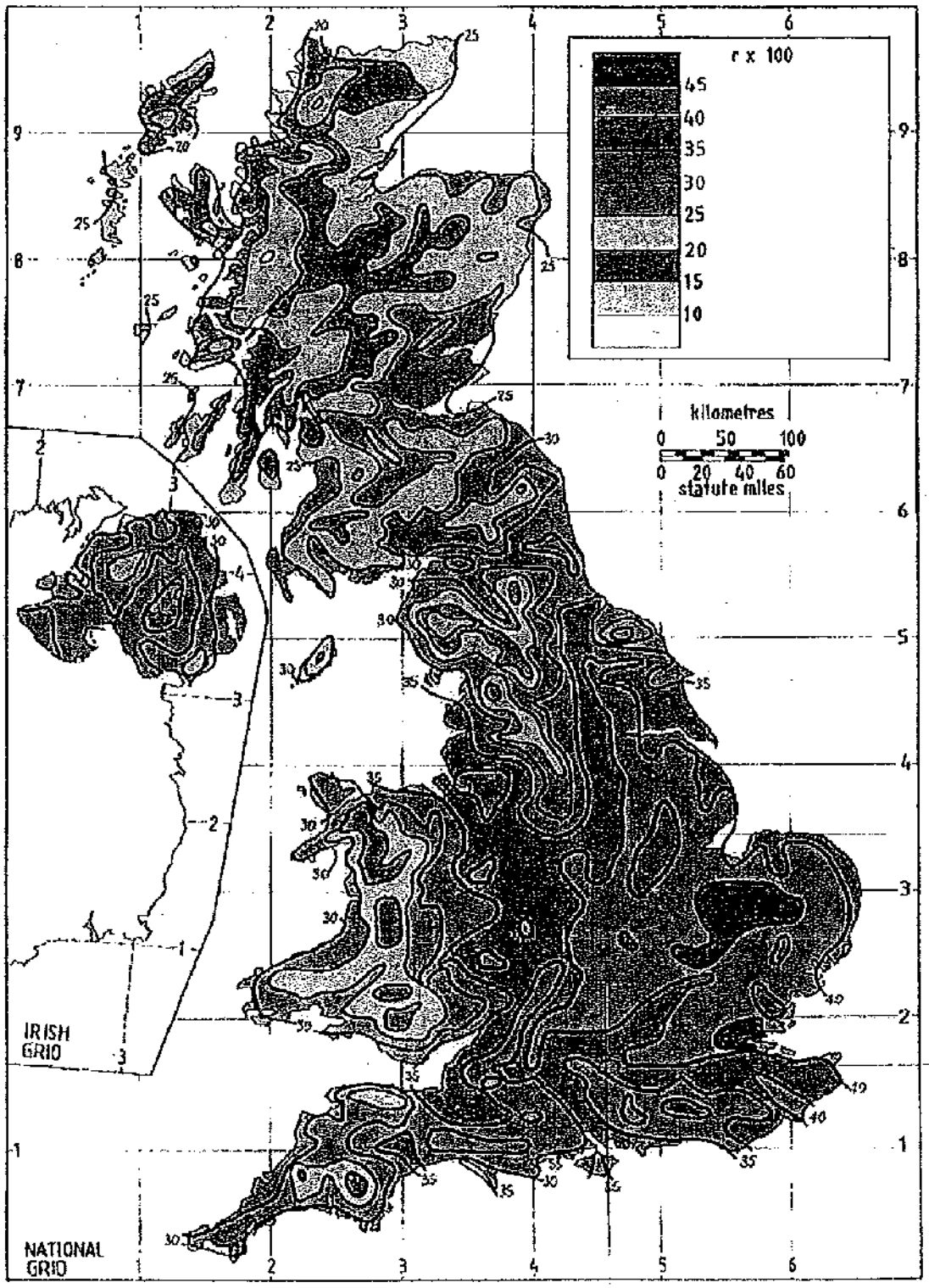
Material sustainability principles are presented in Section 3.6.

12.4 PRE-TREATMENT/INLETS

Where runoff from adjacent areas is accepted into the facility it is advisable to release any additional waters either onto the surface of the pervious construction, or accept it via a silt/debris trap. This should be done to prevent clogging of the pavement.

Appendix G

7



164 Aldermaston

460

Annexe D, Figure D1: UK contour map of r values

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Appendix G (8)

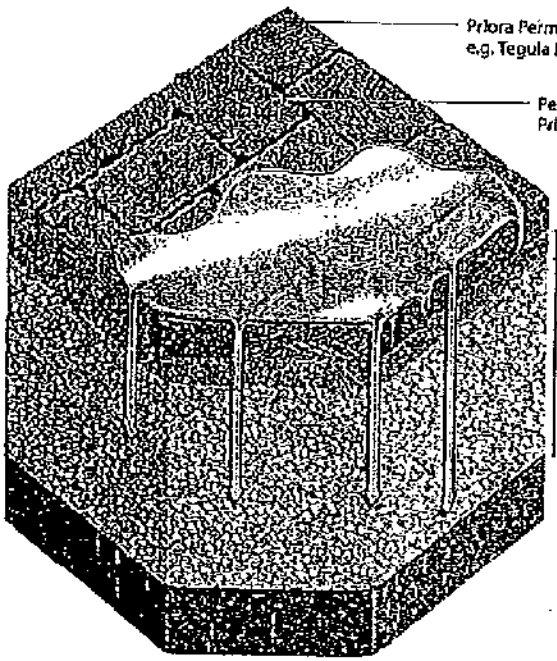
Traffic up to 7.5 tonne

Application: Areas subject to light commercial vehicular traffic to a gross vehicle weight of 7.5 tonne

Standard Design based upon Structural Requirements only.	
Priora block thickness:	80mm
Laying course depth:	50mm
Sub-base depth:	350mm
Capping layer depth:	0mm
System Storage Capacity:	166 litres per m² Based on the sub-base depth using 20mm Priora Aggregate with a characteristic void ratio of 33%

For a free no obligation bespoke hydrologic design please contact the Water Management Design Team 0845 30 20 606

The depth of this design is unique to the use of Priora Permeable block paving as the surfacing material. The structural interlocking properties of the Priora block, together with the associated design methodology, allows for a reduction in sub-base thickness.



*Alternative materials may be suitable on the condition that they meet the required performance specification

This example uses Tegula Priora Herringbone, Traditional. All Priora products which can be laid in the Herringbone laying pattern are suitable for this application. For advice on laying patterns by application, please contact the Water Management Design Team: 0845 30 20 606

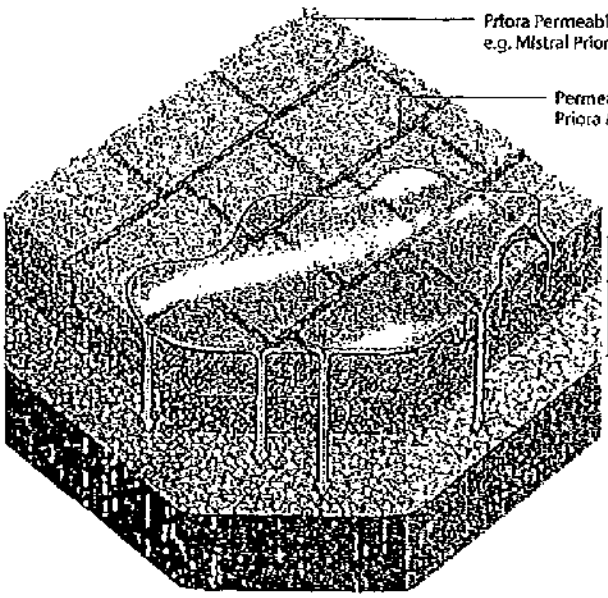
Marshalls
water management

Pedestrian and Driveways

Application: Pedestrian Areas and Domestic Driveways

Standard Design based upon Structural Requirements only.	
Priora block thickness:	80mm
Laying course depth:	50mm
Sub-base depth:	150mm
Capping layer depth:	0mm
System Storage Capacity:	50 litres per m² Based on the sub-base depth using 20mm Priora Aggregate with a characteristic void ratio of 33%

The depth of this design is unique to the use of Priora Permeable block paving as the surfacing material. The structural interlocking properties of the Priora block, together with the associated design methodology, allows for a reduction in sub-base thickness.



*Alternative materials may be suitable on the condition that they meet the required performance specification

This example uses Mistral Priora Random Course, Silver Grey, however the full Priora Range is suitable for this application. For advice on laying patterns by application, please contact the Water Management Design Team: 0845 30 20 606

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water management

7.1.2 Loading design factors

The following design factors should be considered:

- The subgrade soaked CBR value (see Table 2)
- Maximum axle load (see Table 5)
- Load partial safety factors (see Table 6)
- Material partial safety factors (see Table 9)

7.2 Sub-base thickness for water storage

The thickness of the sub-base necessary for water storage depends upon the factor r which is the ratio of the 60-minute storm rainfall depth to the 2-day maximum rainfall depth. This factor varies across the UK and implies a 5-year storm return period. For greater return periods a correction factor, Z2, given in Table A3 should be applied to the five year return period rainfall value and the sub-base thickness calculated in accordance with Annex A. Results for commonly used return periods are given in Table 4.

Figure D1 at the back of this Guide is a contour map of the UK indicating values of r but, for convenience, Table 3 gives r values for some UK cities.

Table 3: r values for various UK cities

city	r value	city	r value	city	r value
Cambridge	0.45	London	0.45	Norwich	0.42
Birmingham	0.39	Bristol	0.39	Liverpool	0.39
Nottingham	0.39	Sheffield	0.39	Southampton	0.39
Belfast	0.33	Cardiff	0.33	Leeds	0.33
Manchester	0.33	Newcastle	0.33	Plymouth	0.33
Edinburgh	0.27	Aberdeen	0.24	Glasgow	0.24

Table 4: Thickness of permeable pavement sub-base required for water storage

ratio 60 minutes rainfall to 2-day rainfall, r	base thickness to accommodate 6 hour rainfall (mm)			
	5 year return period	10 year return period	30 year return period	100 year return period
0.12	185	220	260	330
0.15	165	200	240	300
0.18	150	180	220	280
0.21	140	170	210	270
0.24	135	160	200	260
0.27	125	160	190	240
0.30	120	150	180	240
0.33	115	140	180	230
0.36	110	140	170	220
0.39	110	140	170	220
0.42	105	130	160	210
0.45	100	130	160	200

Note: For different return periods a correction factor, Z2 given in Table A3 should be applied to the 5 year return period rainfall value and the sub-base thickness calculated as shown in Annex A. Thicknesses shown in the table assume no outflow during storm event. Outflow can be allowed for by following the hydraulic design method in CIRIA Report C582. While this table is applicable to the whole of the UK it may be conservative for large parts of Scotland and Northern Ireland.

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The thickness of the sub-base required to provide sufficient water storage capacity can be obtained by calculation as described in Annexe A or, for 6-hour rainfall and 24-hour rainfall periods, values are given in Table 4 for the range of values of r found in the UK.

If permeable paving is required to handle runoff from impermeable areas including roofs, the thickness of the permeable paving sub-base should be increased in the ratio of:

$$\frac{\textbf{total of impermeable and permeable areas}}{\textbf{area of permeable paving}}$$

The pavement thickness calculated using this procedure assumes that there is no outflow of water through the subgrade or any other drainage during the period of the storm (the worst case scenario). Therefore, the design capacity given in Table 4 will generally exceed the required capacity.

7.3 Sub-base thickness for loading

7.3.1 Vehicle loading factors

Traffic loading needs to be assessed so that the pavement can be placed into one of the three load categories shown in Table 5, from which the axle load can be determined. Examples of vehicle types relative to these load categories are given in Table B1 of Annexe B.

Table 5 Axle loads

load category	maximum axle load (ku)
Category 1 – domestic (GVW = 2,000ku)	1,000
Category 2 – light (GVW = 3,500ku) supermarket car park	2,000
Category 3 – commercial (GVW = 7,500ku)	5,000
Category 4 – one/two delivery vehicle(s) per day (GVW = 21,000ku)	8,000
Category 5 – heavy (GVW = 44,000ku)	11,000

The "ultimate limit" state design approach is used in this Guide, where values are multiplied by various partial safety factors. The first is a load partial safety factor, reflecting the degree of accuracy of predicting loads. Values of load partial safety factors are given in Table 6.

Table 6: Load partial safety factors

level of certainty of load	load partial safety factor
certain	1.0
well-informed value	1.2*
anecdotal information	1.5*

* For category 4 vehicles, maximum partial load safety factor = 1.1

7.3.2 Sub-base thickness factors

The sub-base thickness of open-graded crushed rock required to meet the loading criteria can then be read from Table 7.

Table 7: Drainage/storage thickness of open-graded crushed rock for loadings for sub-grade of CBR 5%

factored load (ku)	course thickness (mm)	
	cement Stabilised open graded crushed rock	open graded crushed rock
1,400	-	150
1,600	-	150
2,000	-	175
2,800	-	200
3,200	-	250
4,000	-	300
6,000		350
8,000		450
10,000 supermarket delivery route	200	150
15,400	300	150

The pavement layer thickness of open-graded crushed rock is applicable to a subgrade with a CBR of 5% (when saturated for System A or B pavements). For subgrade CBR values lower than 5% either the thickness can be adjusted using the values given in Table 8 or the subgrade can be improved to give a higher CBR value.

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PROTECTIVE MARKING
UNCLASSIFIED

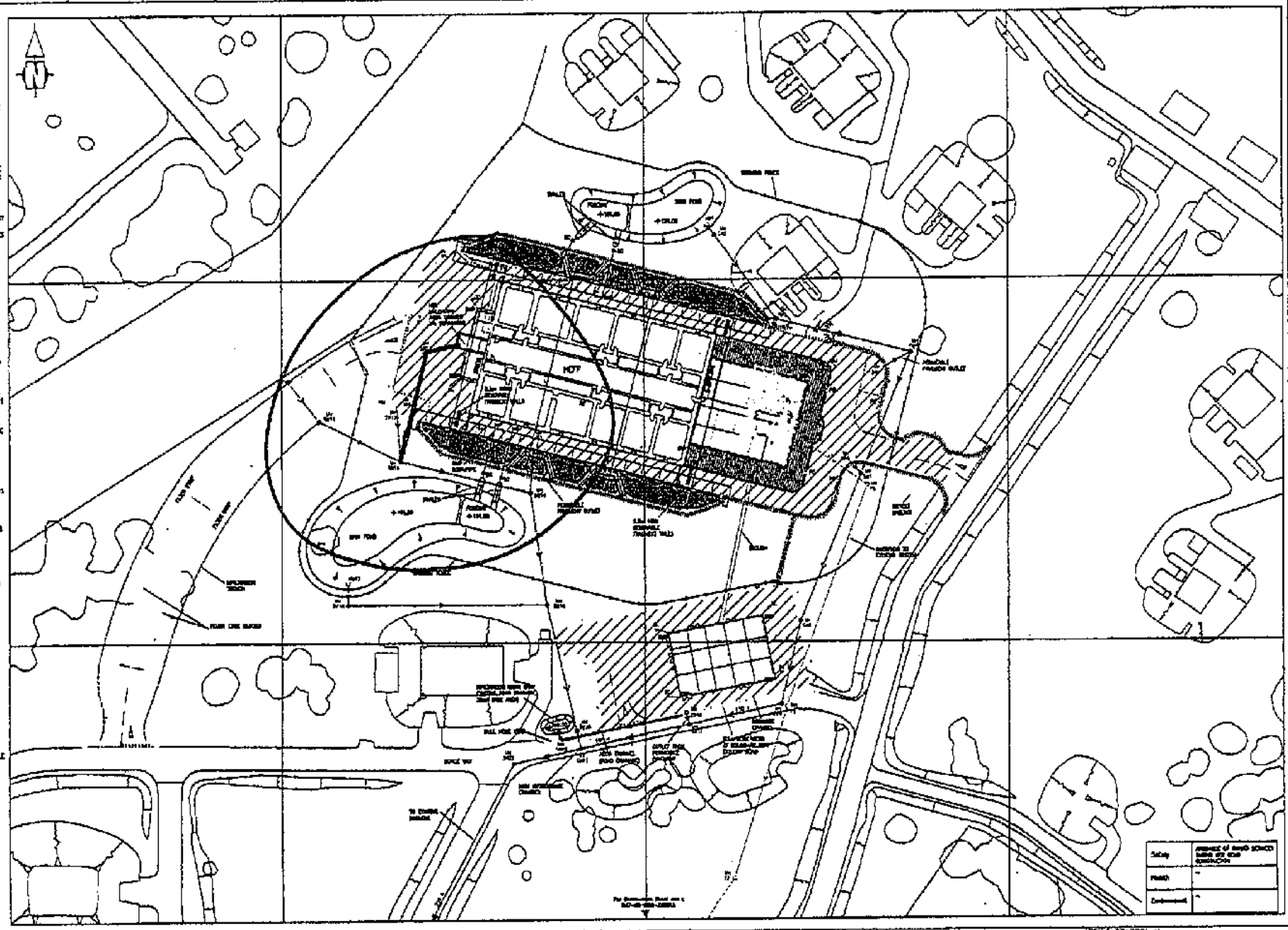
DRAWING REFERENCE No.
SB/

DRAWING No. K247-00-C000-XA0012-SD | SHT 1 OF 2

USED ON

NOTES

1. IMPERMEABLE FLEXIBLE SURFACING TO BE USED FOR ACCESS TURNING AREAS USED BY HGV'S.
2. NON LANDMARK/HOME AREAS SURFACING AND DRAINAGE TO BE CONFIRMED.
3. NOVICE MAT ROAD TO DRAIN TO SOFTWATER INFILTRATION BASIN (DESIGNED TO 5 YEAR EVENT).
4. THIS DRAWING IS TO READ IN CONJUNCTION WITH K247-00-C000-XA0013 (DRAINAGE LAYOUT SHEET 2) AND WITH THE RELEVANT STANDARD DRAINAGE DETAILS AND UTILITIES LAYOUT.
5. FOR AREAS OF PERMEABLE PAVIOUR DRAINAGE TO SURFACE WATER SYSTEM REFER TO DRAWING K247-00-C000-XA0014 AND K247-00-C000-TA0011 FOR DETAILS.
6. GROUND SURVEY TO BE CARRIED OUT PRIOR TO CONSTRUCTION TO CONFIRM SUFFICIENCY OF PROPOSED TRENCH LEVELS.
7. PROPOSED GROUND LEVELS AROUND BUILDING ARE MINIMUM LEVELS.
8. SUPPORT BUILDING ENTRANCE CANOPY TO DRAIN TO PERMEABLE PAVIOUR POROUS SUB-BASE.
9. BYPASS SEPARATOR FOR HGV UNLOADING AREA TO BE CONSIDER CHORLEY CLASS 1 OR SIMILAR APPROVED.
10. LOCATIONS OF ALL EXISTING SERVICES TO BE CONFIRMED PRIOR TO INFRASTRUCTURE WORKS.
11. THIS DRAWING TO BE READ IN CONJUNCTION WITH DRAWINGS K247-00-C000-XA0013, K247-00-C000-XA0014 AND K247-00-C000-TA0011 AND STANDARD DETAILS DRAWINGS K247-00-C000-YA0003 TO K247-00-C000-YA0005 INCLUDING ALSO ALL RELEVANT DRAINAGE REPORTS AND MICRODRAINAGE DATA.
12. ALL PERMEABLE BLOCK PAVING MATERIALS TO BE IN ACCORDANCE WITH CURRENT INTERPRETIVE GUIDELINES (MATERIALS FROM OR SIMILAR APPROVED).
13. OUTFALL PIPES FROM PERMEABLE PAVIOURS AND INFILTRATION TRENCHES AND UNDERGROUND RAINWATER PIPES TO BE 100mm Ø.



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BASIC DESIGN FOR R&R	AP	19/04/07	
ISSUED FOR COMMENT	JC	24/11/06	
ISSUED FOR CONSTRUCTION	PC	20/10/06	
DRAFT FOR INFORMATION	IP	01/06/06	
CHANGE No / ACTION SHEET No	ISSUE	DATE	

MATERIAL | TOLERANCES | ORIGINAL SCALE 1:500

TITLE
HEFF – DRAINAGE LAYOUT
(Sheet 1 of 2)

PROTECTIVE FINISH | SUB-CONTRACTOR | DIMS. IN m

SURFACE TEXTURE | CAD REF.

ALDERMASTON, READING, BERKS., ENGLAND, RG7 4PR

SAFETY SYSTEM LEVEL: CRITICAL / RELATED / UNRELATED

PRINT CONTROL No. N

PROTECTIVE MARKING
UNCLASSIFIED

DRAWING REFERENCE No. SB/

DRAWING No. K247-00-C000-XA0012-SD | SHT 1 OF 2

A1

DRAWING OFFICE REFERENCE

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Appendix H

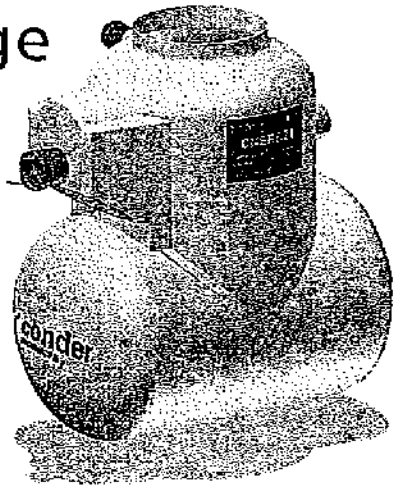
1

conder
PRODUCTS

Product Update

Conder Products Ltd, the leading UK manufacturer of oil/water separators, has launched its new:

CNSB Bypass Separator range



Pollution prevention is a critical part of sustainable drainage systems and verified oil separators are designed to prevent watercourse pollution by containing oil and other hydrocarbons that have entered a drainage system.

Conder's new range of CNSB Bypass Separators are designed and tested in accordance with BS EN858-1-2 and are proven to effectively separate oil and water under test to less than 1 parts per million and, therefore, protect the environment and public safety. The new CNSB range fulfils all current regulatory requirements for oil separators in the UK.

Features & benefits

- Innovative design
- Competitively priced
- Small & easy to handle
- Major installed cost savings
- Easy to service & maintain
- Fully compliant to the Environment Agency's new PPG3 guidelines
- An Environment Agency verified manufacturer
- Fully tested & verified with a range from CNSB 1.5 to CNSB 1000 (class 1 & class 2)
- Exceeds industry standards
- Full BSI certification
- Silt & non-silt options
- Prevents pollution & reduces risk

Application areas

- Car parks
- Roadways & major trunk roads
- Light industrial & goods yards
- Discharge to a sensitive environment

Alarm systems

Under the new PPG3 guidelines all separators must be provided with an alarm system. This automatic warning device indicates that the separator is in need of immediate maintenance for it to continue to work effectively.

A full technical and service package is available which can include product specification, separator & alarm installation, commissioning, oil & silt removal, service and maintenance.

For further technical information please contact our sales office: 08702 640004 or email: sales@conderproducts.com

Unit Reference	Nominal Size	Area Drained sq. m	Length excl. Silt	Diameter	Length inc. Silt	Silt Capacity Litres	Overall Height	Inlet to Base	Outlet to Base
CNSB1.5/2*	1.5	833	1400	1000	1400	150	2150	1680	1630
CNSB3/2*	3	1667	1400	1000	1400	300	2150	1680	1630
CNSB4.5/2*	4.5	2500	1700	1000	1785	450	1825	1220	1170
CNSB6/2*	6	3333	1700	1000	1975	600	1825	1220	1170
CNSB7.5/2*	7.5	4167	1700	1000	2165	750	1825	1220	1170
CNSB10/2*	10	5556	1700	1000	2485	1000	1825	1220	1170
CNSB15/2*	15	8333	1800	1200	2670	1500	2100	1400	1350
CNSB20/2*	20	11111	1800	1200	3115	2000	2100	1400	1350
CNSB25/2*	25	13889	1800	1200	3555	2500	2100	1400	1350
CNSB30/2*	30	16667	2200	1500	3520	3000	2640	1720	1670
CNSB40/2*	40	22222	2200	1500	4090	4000	2640	1720	1670
CNSB50/2*	50	27778	2200	1500	4655	5000	2640	1720	1670
CNSB60/2*	60	33333	2600	1800	4415	6000	3300	2025	1975
CNSB70/2*	70	38889	2600	1800	4835	7000	3300	2025	1975
CNSB80/2*	80	44444	2600	1800	5225	8000	3300	2025	1975
CNSB90/2*	90	50000	2600	1800	5620	9000	3300	2025	1975
CNSB100/2*	100	55556	2600	1800	6010	10000	3300	2025	1975
CNSB135/2*	135	75000	4100	2500	6781	13500	3000	**	**
CNSB1000/2*	1000	555556	Details on application for all sizes between CNSB135 and CNSB1000						

We reserve the right to alter specification without prior notice.

*ADD Class of Separator required ie Class 1 or Class 2 **Dependent on pipework sizes