

PROJECT:

BROCKHILL EAST, Phase 2

REDDITCH

DRAINAGE & FLOOD RISK STATEMENT

For

PERSIMMON HOMES SOUTH MIDLANDS AND GALLAGHER ESTATES

July 2013

Our Ref: AAC 4835

RPS Planning & Development

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1 INTRODUCTION

1.1 PURPOSE OF REPORT

This report considers the flood risk associated with the development of a parcel of greenfield land known as Brockhill East, Phase 2 on the northern outskirts of Redditch. The southern portion of the land falls within the Redditch Borough Council boundary with the northern portion being within Bromsgrove District Council's boundary.

This report also sets out the proposed foul and surface water drainage strategy for the proposed development.

1.2 SITE DETAILS

The site bounds the Birmingham to Redditch railway line to the east, Weights Lane to the north and an industrial development off Winsor Road to the south.

Development by Persimmon Homes of a parcel of land known as Brockhill East Phase 1, located immediately to the south of Brockhill East Phase 2 is currently underway.

An indicative masterplan for Brockhill East Phase 2 can be found in appendix A of this report. This also shows the phase 1 development.

The phase 2 development parcel occupies approx 83 hectares, and the development proposals include residential parcels, a mixed use local centre and employment parcels. There are also extensive areas of public open space/amenity space including tree and woodland planting, as well as a network of surface water features which will provide a sustainable means of surface water runoff control.

The approximate proposed impermeable area of the site is estimated to be 30% of the site area, this equates to 24.9 hectares (this includes highway infrastructure, roofs, hard standings, driveways and car parks etc).

The Red Ditch flows through the site in a south easterly direction before turning to follow a north easterly route alongside but outside of the south eastern boundary of the site. It then turns again to flow in a south easterly direction adjacent to the railway boundary before passing beneath Windsor Road.

The site is relatively steeply sloping and falls within the catchment of the Red Ditch.

2 FLOOD RISK

2.1 NATURE OF FLOOD RISK

The Environment Agency is responsible for the provision of information pertaining to flood risk from tidal and main watercourses throughout England and Wales. The EA provides an online information service through its Flood Map data an extract of which is provided in Figure 1.1 below. The site is wholly in flood zone 1 and therefore not prone to flooding from main watercourses.

The Red Ditch is not classified as a main watercourse therefore Clive Wilson, Redditch Borough Council's Operations Manager – Asset Maintenance has indicated that there may be a requirement to hydraulically model the Red Ditch in order to determine the extent of any flood zone associated with it. This modelling work would be undertaken and included within a Flood Risk Assessment for the site at the formal planning application stage. Suitable hydraulic modelling was undertaken and approved as part of the planning submission for phase 1, the hydraulic model used for this will be extended as required to fully assess any flood issues that may affect the phase 2 development. It is however thought that due to the steeply sloping nature of the phase 2 site any flooding would be contained within a very narrow corridor along the Red Ditch. Any proposed development would be kept well outside of any areas of potential flooding.

Surface Water run-off from the impermeable areas of the proposed development will discharge at existing greenfield run off rates to the Red Ditch. Appropriate surface water detention facilities such as ponds and swales will be provided throughout the development to sufficiently accommodate flows arising from storms up to a 1 in 100 year event plus a 30% allowance for future climate change. As a consequence of the development flows within the development and downstream would be better regulated reducing the risk of flooding to properties to the south and east.

The surface water drainage will fully comply with the requirements of the Land Drainage Act, the Flood Water Management Act, Severn Trent Water, Redditch Borough Council and Bromsgrove District Council.

- Flooding from rivers or sea without defences (1 in 100yr)
- Extent of extreme flood (1 in 1000yr)

Flood defences

Areas benefiting from flood defences

Based upon the Ordnance Survey map with the Permission of the Controller of Her Majesty's Stationery Office. @ Crown copyright Licence No. 100020449 RPS Design Group Ltd

3 SURFACE WATER DRAINAGE

3.1 SURFACE WATER DRAINAGE STRATEGY

Surface water drainage within the development site will be designed to accommodate flows arising from storms up to a 1 in 100 year event plus a 30% allowance for future climate change without any surface flooding or risk to lower lying properties.

Flows should be limited to existing greenfield run off rates and discharge to the Red Ditch which runs through and outside the site.

The greenfield run off rates have been calculated using Microdrainage software: ICP SUDS Mean Annual Flood, the results of which are as follows:

Impermeable area 24.9 hectares

Qbar run-off rate 109.4 litres/second

1 in 100 year run-off rate 281.1 litres/second

The results are contained in appendix B.

Surface Water detention volumes have been calculated again using Microdrainage software, the results of which are as-follows:

Impermeable Area 24.9 hectares

Detention Volume, for Qbar Outflow 16882.7m³

Detention Volume, for 1 in 100 year Outflow 13410.3m³

The results are contained in appendix C.

The proposed surface water detention ponds shown on the masterplan contained in appendix A are of sufficient size to accommodate the flows arising from a 1 in 100 year storm plus a 30% allowance for future climate change, with an outflow no greater than the Qbar run off rate.

The drainage proposals are subject to detailed design, following completion of a detailed development plan. At that time the actual impermeable areas will be utilised and the greenfield run-off rate re-calculated as necessary.

The use of infiltration methods as means of surface water disposal will also be investigated following the undertaking of ground investigation works, however from the results obtained for phase 1 it is unlikely that such methods will be viable.

•	The proposed detention ponds and other surface water features will be designed to provide sufficient treatment trains for surface water quality improvements, permanently wet ponds with reed beds and other network features will be provided in the pends which as well as improving water quality will also
	other natural features will be provided in the ponds which as well as improving water quality will also have amenity value and help to increase and enhance biodiversity etc.

4 FOUL WATER DRAINAGE

4.1 FOUL WATER DRAINAGE STRATEGY

Severn Trent Water were commissioned by Persimmon Homes South Midlands to carry out various hydraulic modelling assessments of the foul water sewer network in the vicinity of the site to establish whether available capacity is available to accommodate foul water flows from the development.

From the results of the modelling it was established that there was sufficient capacity to accommodate flows from phase 1 of the development within the foul water sewer infrastructure to the south of the site (Windsor Road), however it was identified that there would not be sufficient capacity within the immediate vicinity of the site to accommodate the foul flows arising from Phase 2 without the risk of flooding.

Severn Trent Water have therefore advised that foul water from the Phase 2 development site would need to gravitate to a single new foul water pumping station, flows would then be pumped over the River Arrow and gravitate via a new trunk sewer through the Arrow Valley or around the outskirts of Redditch before outfalling to the existing public sewer system downstream of Ipsley Church Lane (where sufficient capacity exists) before finally discharging to the Spernall Sewage Treatment Works.

This would provide a suitable and sustainable outfall.

This solution would not exacerbate any existing flooding problems, and the new trunk sewer could be utilised to convey flows from other adjacent areas where flooding may be occurring thus improving capacities and alleviating occurrences of flooding.

Severn Trent Water cannot refuse a sewer connection on capacity grounds, and as such they are obliged to upgrade the existing sewer system as necessary sufficient to accommodate new development flows (at their expense). They are required to carry out the improvement works within a reasonable time, which for major improvement works could be a number of years. Bearing this in mind the developer is continuing to discuss the development proposals with Severn Trent Water to ensure that the development will be deliverable and improvement works are completed at the necessary time.

5 CONCLUSIONS

5.1 FLOOD RISK

As demonstrated in section 2 of this report, the site is not at risk of flooding from main watercourses and is located in flood zone 1

Hydraulic modelling will be carried out to establish whether there is any potential flooding from the Red Ditch; no development would be carried out in any such areas.

Surface water outflow from the site will be limited to existing greenfield run off rates, and suitable on site surface water detention facilities provided. As a consequence there will be no increase risk of flooding to the site or lower lying land outside the development site.

In conclusion for the aforementioned reasons the proposed development would not increase flood risk.

5.2 SURFACE WATER DRAINAGE

As demonstrated in section 3 of this report, a suitable surface water drainage solution can be provided with outflows at greenfield run-off rates to the Red Ditch.

Sufficient space is provided on the current masterplan to accommodate the required surface water detention features.

In conclusion for the aforementioned reasons a suitable and sustainable surface water drainage solution for proposed development is deliverable.

5.3 FOUL WATER DRAINAGE

 As demonstrated in section 4 of this report, a suitable foul water drainage solution can be provided in accordance with the requirements of Severn Trent Water. Some off site improvement works are required, all of which are deliverable and may have benefits to areas downstream where capacity problems exist and flooding occurs.

In conclusion for the aforementioned reasons a suitable and sustainable foul water drainage solution for proposed development is deliverable.

5.4 ADDITIONAL REQUIREMENTS FOR FORMAL PLANNING APPLICATION IN RESPECT OD FLOOD RISK AND DRAINAGE

- Hydraulic Modelling of Red Ditch.
- Preparation of Flood Risk Assessment.
- Further dialogue and agreement with Redditch Borough Councils Land Drainage Officer.
- Further dialogue and agreement with Severn Trent Water with regard to the provision of foul water drainage outfall.
- Further preliminary but more detailed designs of surface water infrastructure and surface water detention facilities.
- Completion of detailed foul and surface water drainage strategy.

APPENDICES

A. APPENDIX A

Drawing No. AAH4936-121-A Phase 2 Masterplan



This drawing and the building works depicted are the copyright of RPS Planning & Development Ltd and may not be reproduced or amended except by written permission. No liability will be accepted for amendments made by other persons.

The Contractor is to check and verify all building and site dimensions, levels and sewer invert levels at connection points before work starts. The Contractor is to comply in all respects with current Building Legislation, British Standard Specifications, Building Regulations, Construction (Design & Management) Regulations, Party Wall Act, etc. whether or not specifically stated on this drawing. This drawing must be read with and checked against any structural, geotechnical or other specialist documentation provided.

This drawing is not intended to show details of foundations, ground conditions or ground contaminants. Each area of ground relied upon to support any structure depicted (including drainage) must be investigated by the Contractor: A suitable method of foundation should be provided allowing for existing ground conditions. Any suspect or fluid ground, contaminates on or within the ground, should be further investigated by a suitable expert. Any earthwork constructions shown indicate typical slopes for guidance only & should be further investigated by a suitable expert.

Where existing trees are to be retained they should be subject to a full Arboricultural inspection for safety. All trees are to be planted so as to ensure they are a minimum of 5 metres from buildings and 3 metres from drainage and services. A suitable method of foundation is to be provided to accommodate the proposed tree planting.

Sketch proposals are for illustrative purposes only & as such are subject to detailed site investigation including ground conditions/contaminants, drainage, design & planning/density negotiations. Sketch proposals may be based upon enlargements of OS sheets & visual estimations of existing site features, accuracy will therefore need to be verified by survey. Sketch proposals have not been considered in respect of CDM Regulations.





CHARLES CHURCH

Key

Proposed Residential Parcels

Existing Trees & Hedgerows

Proposed Woodland Planting

Proposed Tree Planting

Mixed Use Local Certre (with indicative gateway frontage)

Employment (with indicative gateway

Public Open Space / Amenity Space

Indicative Drainage Basin / Existing
Water Feature

Main Street / Main Internal Loop Road

Shared Surface Spaces / Local Streets

Lowan's Hill Farm (proposed conversion)

Vehicle Access Points

Phase I Site Boundary

AAH4936-121-Rev A.



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B. APPENDIX B

Greenfield run-off calculations

RPS Group Plc		Page I
Highfield House 5 Ridgeway Quinton Business Park Birmingham B32 I AF	Brockhill East, Phase 2 Redditch Greenfield Run-off Rate	Micro
Date 30.07.2013	Designed by A Granger	
File	Checked by	
Micro Drainage	Source Control 2013.1.1	

ICP SUDS Mean Annual Flood

Input

Return Period (years) 100 SAAR (mm) 700 Urban 0.000 Area (ha) 24.900 Soil 0.450 Region Number Region 4

Results 1/s

QBAR Rural 109.4 QBAR Urban 109.4

Q100 years 281.1

Q1 year 90.8 Q30 years 214.3 Q100 years 281.1



C. APPENDIX C

Surface Water Detention Volumes:

- 1. Qbar outflow rate
- 2. I in 100 year outflow rate

RPS Group Plc	0	Page I
Highfield House 5 Ridgeway Quinton Business Park Birmingham B32 IAF	Brockhill East, Phase 2 Surface Water Attenuation 109.4l/sec outflow Qbar	Micro
Date 30 July 2013 File East Qbar.srcx	Designed by A Granger Checked by	Dramage.
Micro Drainage	Source Control 2013.1.1	

Summary of Results for 100 year Return Period (+30%)

	Ston	m	Max	Max	Max	Max	Status
	Even		Level	Depth		Volume	
		_	(m)	(m)	(1/s)	(m³)	
			(/	,	,,	•	
15	min	Summer	98.344	0.344	50.7	5779.5	O K
30	min	Summer	98.450	0.450	65.7	7564.6	O K
60	min	Summer	98.560	0.560	79.0	9401.7	ОК
120	min	Summer	98.668	0.668	89.4	11220.7	O K
180	min	Summer	98.727	0.727	93.7	12217.5	O K
240	min	Summer	98.765	0.765	96.1	12855.8	O K
360	min	Summer	98.812	0.812	98.9	13648.1	ОК
480	min	Summer	98.842	0.842	100.6		ОК
600	min	Summer	98.861	0.861	101.7	14459.4	O K
720	min	Summer	98.872		102.3		ОК
960	min	Summer	98.880		102.8		ОК
1440	min	Summer	98.882	0.882		14816.7	O K
		Summer	98.875		102.5		O K
		Summer	98.861		101.7		O K
			98.821		99.4		O K
		Summer	98.776	0.776	96.7		ок
		Summer	98.732	0.732		12296.6	ОК
		Summer	98.691	0.691	91.2		ОК
		Summer	98.654	0.654	88.2		O K
		Winter		0.385		6473.0	O K
		Winter		0.504	72.6		ОК
		Winter		0.627		10537.2	ОК
		Winter	98.749	0.749	95.1		O K
		Winter				13721.2	OK
			98.860		101.7		0 K 0 K
		Winter		0.915		15369.1 15958.5	ОК
480	штп	Winter	98.950	0.330	T00.5	T3330.3	0 10
	CHAT	-	Dain	Floor	ded Disc	harde Ti	me-Peak
	Stor		Rain			harge Ti	
	Stor Even		Rain (mm/hr)	Volu	une Vol	.ume (me-Peak mins)
					une Vol	_	
15	Even		(mm/hr)	Volu (m³	une Vol	.ume (
	Even	.t	(mm/hr)	Volu (m³	me Vol) (m	ume (mins)
30	Even min min	t Summer	(mm/hr)	Volu (m³	volume Volume (no. 0. 0. 0. 3 0. 0. 3	ume (mins)
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30 60 120 180 240 360 480 600 720 960 1440 2160 2880 4320 5760 7200 8640 10080	min	Summer Summer Summer Summer Summer Summer Summer Summer Summer Summer Summer Summer Summer Summer Summer	(mm/hr) 124.774 81.962 51.304 31.032 22.830 18.253 10.562 8.853 7.653 6.083 4.403 3.170 2.513 1.433 1.190 1.023 0.900 124.777	Wolu (m³	me Vol) (n 0.0 3 0.0 3 0.0 7 0.0 8 0.0 9 0.0 10 0.0 11 0.0 11 0.0 12 0.0 12 0.0 12 0.0 12 0.0 12 0.0 12 0.0 12 0.0 12 0.0 12 0.0 12 0.0 12 0.0 12 0.0 12 0.0 12 0.0 12 0.0 13	.ume ((13)) 017.7 996.9 332.3 841.3 691.4 257.2 004.2 513.8 869.8 122.0 413.4 453.9 124.9 731.7 821.9 140.7 985.1 515.4 654.5 400.7	31 45 74 134 192 252 368 486 606 724 958 1166 1544 1956 2772 3576 4392 5112 5944 30
30 60 120 180 240 360 480 600 720 960 1440 2160 2880 4320 5760 7200 8640 10080	min	Summer Summer Summer Summer Summer Summer Summer Summer Summer Summer Summer Summer Summer Summer Summer Summer Summer	(mm/hr) 124.774 81.962 51.304 31.039 22.83(18.253 10.562 8.853 7.658 4.403 3.170 2.511 1.813 1.196 1.023 0.900 124.777 81.963	Volu (m³ / 4 / 2 / 4 / 9 / 9 / 9 / 9 / 9 / 9 / 9 / 9 / 9	me Vol) (n 0.0 3 0.0 3 0.0 7 0.0 8 0.0 9 0.0 10 0.0 11 0.0 11 0.0 12 0.	.ume ((13)) 017.7 996.9 332.3 841.3 691.4 257.2 004.2 513.8 869.8 122.0 413.4 453.9 124.9 731.7 821.9 140.7 985.1 515.4 654.5 400.7 481.4	31 45 74 134 192 252 368 486 606 724 958 1166 1544 1956 2772 3576 4392 5112 5944 30 45
30 60 120 180 240 360 480 600 720 960 1440 2160 2880 4320 5760 7200 8640 10080 15 30 60	min	Summer Summer Summer Summer Summer Summer Summer Summer Summer Summer Summer Summer Summer Summer Summer Summer Summer Summer	124.774 81.962 51.304 31.039 22.830 18.253 10.562 8.853 7.653 6.083 4.403 3.170 2.513 1.433 1.196 1.023 0.900 124.777 81.963 51.306	Wolu (m³ / 4 / 2 / 4 / 4 / 4 / 4 / 4 / 4 / 4 / 4	me Vol) (n 0.0 3 0.0 3 0.0 7 0.0 8 0.0 9 0.0 10 0.0 11 0.0 11 0.0 12 0.0 12 0.0 12 0.0 12 0.0 12 0.0 12 0.0 12 0.0 12 0.0 12 0.0 12 0.0 12 0.0 12 0.0 12 0.0 12 0.0 12 0.0 12 0.0 18	Outro (13) (17)	31 45 74 134 192 252 368 486 606 724 958 1166 1544 1956 2772 3576 4392 5112 5944 30 45 74
30 60 120 180 240 360 480 600 720 960 1440 2160 2880 4320 5760 7200 8640 10080 15	min	Summer Su	(mm/hr) 124.774 81.962 51.304 31.033 22.833 18.253 10.562 8.853 7.658 4.403 3.176 2.514 1.433 1.196 1.026 0.906 124.777 81.963 51.303	Wolu (m³ / 4 / 2 / 4 / 9 / 1 / 1 / 3 / 4 / 4 / 4 / 9 / 4 / 9 / 4 / 9 / 4 / 9 / 9	me Vol) (n 0.0 3 0.0 3 0.0 7 0.0 8 0.0 9 0.0 10 0.0 11 0.0 11 0.0 12 0.	.ume ((13)) 017.7 996.9 332.3 841.3 691.4 257.2 004.2 513.8 869.8 122.0 413.4 453.9 124.9 731.7 821.9 140.7 985.1 515.4 654.5 400.7 481.4 222.0 877.8	31 45 74 134 192 252 368 486 606 724 958 1166 1544 1956 2772 3576 4392 5112 5944 30 45 74 132
30 60 120 180 240 360 480 600 720 960 1440 2160 2880 4320 5760 7200 8640 10080 15	min	Summer Su	(mm/hr) 124.774 81.962 51.304 31.033 22.833 18.253 10.562 8.853 7.658 4.403 3.176 2.514 1.433 1.196 1.026 0.906 124.777 81.963 51.303	Wolu (m³ / 4 / 2 / 4 / 9 / 1 / 1 / 3 / 4 / 4 / 4 / 9 / 4 / 9 / 4 / 9 / 4 / 9 / 9	me Vol) (n 0.0 3 0.0 3 0.0 7 0.0 8 0.0 9 0.0 10 0.0 11 0.0 12 0.0 12 0.0 12 0.0 12 0.0 12 0.0 12 0.0 12 0.0 12 0.0 12 0.0 12 0.0 12 0.0 12 0.0 12 0.0 19 0.0 25 0.0 26 0.0 26 0.0 26 0.0 3 0.0 4 0.0 8 0.0 9 0.0 10	.ume ((13)) 017.7 996.9 332.3 841.3 691.4 257.2 004.2 513.8 869.8 122.0 413.4 453.9 124.9 731.7 821.9 140.7 985.1 515.4 654.5 400.7 481.4 222.0 877.8 798.6	31 45 74 134 192 252 368 486 606 724 958 1166 1544 1956 2772 3576 4392 5112 5944 30 45 74 132 188
30 60 120 180 240 360 480 600 720 960 1440 2160 2880 4320 5760 7200 8640 10080 15	min	Summer Su	(mm/hr) 124.774 81.962 51.304 31.033 22.833 18.253 10.562 8.853 7.658 4.403 3.176 2.514 1.433 1.196 1.026 0.906 124.777 81.963 51.303	Wolu (m³ / 4 / 2 / 4 / 9 / 1 / 1 / 3 / 4 / 4 / 4 / 9 / 4 / 9 / 4 / 9 / 4 / 9 / 9	me Vol) (n 0.0 3 0.0 3 0.0 7 0.0 8 0.0 9 0.0 10 0.0 11 0.0 11 0.0 12 0.0 12 0.0 12 0.0 12 0.0 12 0.0 12 0.0 12 0.0 12 0.0 12 0.0 12 0.0 12 0.0 12 0.0 12 0.0 19 0.0 25 0.0 26 0.0 26 0.0 3 0.0 4 0.0 8 0.0 9 0.0 10 0.0 11	.ume ((13)) (17 . 7) (1	31 45 74 134 192 252 368 486 606 724 958 1166 1544 1956 2772 3576 4392 5112 5944 30 45 74 132 188 246
30 60 120 180 240 360 480 600 720 960 1440 2160 2880 4320 5760 7200 8640 10080 15 30 60 120 180 240 360	min	Summer Su	(mm/hr) 124.774 81.962 51.304 31.032 22.836 18.255 10.562 8.855 7.658 4.400 3.176 2.511 1.433 1.196 1.026 0.906 124.777 81.965 51.306 31.03 22.83 18.255 13.25	Voluman (m³) 4 2 4 4 9 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	me Vol) (n 0.0 3 0.0 3 0.0 7 0.0 8 0.0 9 0.0 10 0.0 11 0.0 12 0.0 12 0.0 12 0.0 12 0.0 12 0.0 12 0.0 12 0.0 12 0.0 12 0.0 12 0.0 12 0.0 12 0.0 12 0.0 19 0.0 25 0.0 26 0.0 26 0.0 26 0.0 3 0.0 4 0.0 8 0.0 9 0.0 10 0.0 11	.ume ((13)) 017.7 996.9 332.3 841.3 691.4 257.2 004.2 513.8 869.8 122.0 413.4 453.9 124.9 731.7 821.9 140.7 985.1 515.4 654.5 400.7 481.4 222.0 877.8 798.6 406.0 197.9	31 45 74 134 192 252 368 486 606 724 958 1166 1544 1956 2772 3576 4392 5112 5944 30 45 74 132 188 246 362
30 60 120 180 240 360 480 600 720 960 1440 2160 2880 4320 5760 7200 8640 10080 15 30 60 120 180 240 360	min	Summer Su	(mm/hr) 124.774 81.962 51.304 31.033 22.833 18.253 10.562 8.853 7.658 4.403 3.176 2.514 1.433 1.196 1.026 0.906 124.777 81.963 51.303	Voluman (m³) 4 2 4 4 9 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	me Vol) (n 0.0 3 0.0 3 0.0 7 0.0 8 0.0 9 0.0 10 0.0 11 0.0 12 0.0 12 0.0 12 0.0 12 0.0 19 0.0 19 0.0 25 0.0 26 0.0 26 0.0 26 0.0 3 0.0 4 0.0 8 0.0 9 0.0 10 0.0 11 0.0 12	.ume ((13)) (17 . 7) (1	31 45 74 134 192 252 368 486 606 724 958 1166 1544 1956 2772 3576 4392 5112 5944 30 45 74 132 188 246

RPS Group Pic		Page 2
Highfield House 5 Ridgeway Quinton Business Park Birmingham B32 IAF	Brockhill East, Phase 2 Surface Water Attenuation 109.4l/sec outflow Qbar	Micro
Date 30 July 2013 File East Qbar.srcx	Designed by A Granger Checked by	Dramae
Micro Drainage	Source Control 2013.1.1	

Summary of Results for 100 year Return Period (+30%)

	Stor	m.	Max	Max	M	lax	Max	2	Stati	18
	Even	t	Leve1	Depth	Con	trol	Volu	me		
			(m)	(m)	(1	/s)	(m³)		
									_	
			98.973				16339		_	K
720	min	Winter	98.987				16585			K
960	min	Winter		1.001			16822		_	K
1440	min	Winter	98.998	0.998			16759		-	K
2160	min	Winter	98.981	0.981			16489			K
2880	min	Winter	98.955	0.955	1	06.8	16047	7.4	0	K
4320	min	Winter	98.889	0.889	1	.03.2	14928	3.9	0	K
5760	min	Winter	98.820	0.820		99.3	13767	7.7	0	K
7200	min	Winter	98.755	0.755		95.4	12683	3.7	0	K
8640	min	Winter	98.697	0.697		91.6	11716	5.2	0	K
10080	min	Winter	98.647	0.647		87.6	10872	2.3	0	K
	Stor	m.	Rain	Floo	ded	Disc	harge	Tin	ne-Pea	ak
	Stor Even		Rain (mm/hr)				harge ume		ne-Pea mins)	
					me	Vol	-			
				Volu (m³	me)	Vol	ume		mins)	
	Even		(mm/hr)	Volu (m³	me	Vol. (m	ume 13)		mins) 59	92
600	Even	t	(mm/hr)	Volu (m³	me)	Vol. (m	ume		mins) 59	92 06
600 720	Even min min	t Winter	(mm/hr)	Volu (m³	me) 0.0	Vol. (m. 130	ume 13)		mins) 59 70	92 06 26
600 720 960	min min min	t Winter Winter	8.853 7.658 6.089	Volu (m³	me) 0.0	Vol (m 130 131	ume (3) (3) (3) (3) (3) (4) (3) (4) (4) (4) (4) (4) (4) (4) (4) (4) (4		mins) 59	92 06 26
600 720 <mark>960</mark> 1440	min min min min	winter Winter Winter	8.853 7.658 6.089	Volu (m³	o.0	Vol. (m. 130 133 130 131 131 131 131 131 131 131	ume (3) (3) (3) (3) (4) (5) (4) (5)		mins) 59 70	92 06 26 28
600 720 <mark>960</mark> 1440 2160	min min min min min	Winter Winter Winter Winter	8.853 7.658 6.083 4.403 3.176	Volu (m³	0.0 0.0 0.0	Vol (m 130 130 131 131 211	090.4 339.0 504.5 554.3		55 70 93 132	92 06 26 28
600 720 960 1440 2160 2880	min min min min min min	Winter Winter Winter Winter Winter	8.853 7.658 6.083 4.403 3.176	Volu (m³	0.0 0.0 0.0 0.0	Vol. (m. 136 133 136 131 211 211	090.4 339.0 504.5 554.3		59 70 93 133	92 06 26 28 48
600 720 960 1440 2160 2880 4320	min min min min min min	Winter Winter Winter Winter Winter Winter	8.855 7.658 6.089 4.400 3.176 2.511	Volu (m³	0.0 0.0 0.0 0.0 0.0	Vol (m 130 130 130 130 130 210 210 210	090.4 339.0 604.5 554.3 323.7		55 70 93 133 164 210	92 06 26 28 48 08
600 720 960 1440 2160 2880 4320 5760	min min min min min min min	Winter Winter Winter Winter Winter Winter Winter	8.855 7.658 6.089 4.400 3.176 2.511	Wolu (m³	0.0 0.0 0.0 0.0 0.0 0.0	Vol (m 130 131 130 131 211 211 28	090.4 339.0 604.5 554.3 323.7 955.1		55 70 93 133 164 210 295	92 06 26 28 48 08 92
600 720 960 1440 2160 2880 4320 5760 7200	min min min min min min min min	Winter Winter Winter Winter Winter Winter Winter Winter	8.853 7.658 6.089 4.403 3.176 2.51 1.813	Volu (m³	0.0 0.0 0.0 0.0 0.0 0.0 0.0	Vol (m 130 131 131 211 211 281 291	ume (3) 090.4 339.0 504.5 554.3 323.7 955.1 941.6 162.6		59 70 92 132 164 21(299 388	92 06 26 28 48 08 92 56

RPS Group Plc		Page 3
Highfield House 5 Ridgeway Quinton Business Park Birmingham B32 I AF	Brockhill East, Phase 2 Surface Water Attenuation 109.4l/sec outflow Qbar	Micho
Date 30 July 2013 File East Qbar.srcx	Designed by A Granger Checked by	Dremeeg
Micro Drainage	Source Control 2013.1.1	

Rainfall Details

 Rainfall Model
 FSR
 Winter Storms
 Yes

 Return
 Period (years)
 100
 Cv (Summer)
 0.750

 Region
 England and Wales
 Cv (Winter)
 0.840

 M5-60 (mm)
 19.500
 Shortest Storm (mins)
 15

 Ratio R
 0.400
 Longest Storm (mins)
 10080

 Summer Storms
 Yes
 Climate Change %
 +30

Time Area Diagram

Total Area (ha) 24.900

Time	(mins)	Area									
From:	To:	(ha)									
0	4	6.225	4	8	6.225	8	12	6.225	12	16	6.225

RPS Group Plc		Page 4
Highfield House 5 Ridgeway Quinton Business Park Birmingham B32 IAF	Brockhill East, Phase 2 Surface Water Attenuation 109.4l/sec outflow Qbar	Micro
Date 30 July 2013 File East Qbar.srcx	Designed by A Granger Checked by	Dramace
Micro Drainage	Source Control 2013.1.1	

Model Details

Storage is Online Cover Level (m) 100.000

Tank or Pond Structure

Invert Level (m) 98.000

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000 0.100 0.200	16800.0 16800.0 16800.0	0.600 0.700 0.800	16800.0 16800.0 16800.0	1.300	16800.0 16800.0 16800.0	1.800 1.900 2.000	16800.0 16800.0 16800.0	2.500	16800.0 16800.0
0.300 0.400 0.500	16800.0 16800.0 16800.0	0.900 1.000 1.100	16800.0 16800.0 16800.0	1.600	16800.0 16800.0 16800.0	2.200	16800.0 16800.0 16800.0		

Hydro-Brake® Outflow Control

Design Head (m) 1.000 Hydro-Brake® Type Md8 Invert Level (m) 98.000 Design Flow (l/s) 109.4 Diameter (mm) 412

	Depth (m)	Flow (1/s)								
1	0.100	12.6	0.800	98.2	2.000	148.5	4.000	207.9	7.000	275.0
	0.200	28.2		109.0	2.200	155.3	4.500	220.5	7.500	284.6
	0.300	44.0	1.200	118.2	2.400	161.9	5.000	232.4	8.000	294.0
	0.400	58.8	1.400	126.5	2.600	168.2	5.500	243.7	8.500	303.0
	0.500	72.1	1.600	134.2	3.000	180.4	6.000	254.6	9.000	311.8
	0.600	83.2	1.800	141.5	3.500	194.6	6.500	265.0	9.500	320.3

Storm

Event



Status

Max

Summary of Results for 100 year Return Period (+30%)

Max

Max

Level Depth Control Volume

	Even	t	Level	_	Contr		Aorm	e	
			(m)	(w)	(l/s)	(m³)		
15		Carmon	98.426	0.426	126	7	5714.	Д	ОК
		Summer Summer	98.555	0.555	167		7435.		ОК
		Summer	98.682	0.682	204		9136.		ОК
		Summer	98.795	0.795	234		10657.		ок
		Summer	98.846	0.846	247		11342.		ОК
		Summer	98.870	0.870	253		11664.		ОК
		Summer	98.884	0.884	256		11848.		ОК
		Summer	98.891	0.891	258		11936		ОК
		Summer	98.893	0.893	258	.5	11970.	. 8	ОК
		Summer	98.893	0.893	258	.4	11965.	. 6	ОК
960	min	Summer	98.885	0.885	256	.7	11863	. 4	ОК
1440	min	Summer	98.856	0.856	249	.8	11471	. 8	O K
2160	min	Summer	98.802	0.802	236	.6	10744	. 5	ОК
2880	min	Summer	98.749	0.749	222	.8	10033.	. 0	O K
4320	min	Summer	98.659	0.659	197	.9	8829	. 4	ОК
5760	min	Summer	98.590	0.590	177	.7	7902	. 7	ОК
7200	min	Summer	98.535	0.535	161	.1	7176	. 2	O K
8640	min	Summer	98.491	0.491	147	.4	6586	. 9	O K
10080	min	Summer	98.456	0.456	136	. 2	6110	. 5	O K
15	min	Winter	98.478	0.478	143	.1	6400	.5	O K
30	min	Winter	98.622	0.622	187	. 2	8331	. 7	O K
60	\min	Winter	98.765	0.765	227	.0	10246	. 4	ОК
120	min	Winter	98.894	0.894	258	.6	11977	. 9	ОК
180	min	Winter	98.953	0.953	271	.6	12773	. 8	O K
240	min	Winter	98.982	0.982	277	.5	13164	. 9	O K
360	min	Winter	99.001	1.001	281	.1	13414	.8	O K
480	min	Winter	99.001	1.001	281	.1	13410	.3	ОК
	Stor	m.	Rain	Floo	ded Di	.sch	arge '	Time-	Peak
	Even		(mm/hr)			Volu	me	(mir	
	Even		(mm/hr)		me '				
		it		Volu (m³	me '	Volu (m³)		ıs)
	min	summer	124.774	Volu (m³	o.0	Volu (m³) 28.7		3 0
30	min min	Summer Summer	124.774 81.962	Volu (m³	o.0	Volu (m³ 47 62	28.7 92.3		30 44
30 60	min min min	Summer Summer Summer	124.774 81.962 51.304	Volu (m³	0.0 0.0 0.0	Volu (m³ 47 62 91	28.7 92.3 52.8		30 44 72
30 60 120	min min min	Summer Summer Summer Summer	124.774 81.962 51.304 31.039	Volu (m³	0.0 0.0 0.0 0.0	(m³ 47 62 91 110	28.7 92.3 52.8 99.2		30 44 72 130
30 60 120 180	min min min min	Summer Summer Summer Summer Summer	124.774 81.962 51.304 31.039 22.830	Volu (m³	0.0 0.0 0.0 0.0 0.0	(m ³ 47 62 91 110 122	28.7 92.3 52.8 99.2 50.9		30 44 72 130 186
30 60 120 180 240	min min min min min	Summer Summer Summer Summer Summer	124.774 81.962 51.304 31.033 22.830 18.253	Volu (m³	0.0 0.0 0.0 0.0 0.0	47 62 91 110 122	28.7 92.3 52.8 99.2 50.9 56.9		30 44 72 130 186 244
30 60 120 180 240 360	min min min min min min	Summer Summer Summer Summer Summer Summer	124.774 81.962 51.304 31.039 22.830 18.253 13.253	Volu (m³	0.0 0.0 0.0 0.0 0.0 0.0	47 62 91 110 122 130	28.7 92.3 52.8 99.2 50.9 56.9 01.3		30 44 72 130 186 244 330
30 60 120 180 240 360 480	min min min min min min min	Summer Summer Summer Summer Summer Summer Summer	124.774 81.962 51.304 31.039 22.830 18.250 13.250	Volu (m³ 4 2 4 9 0 3 3 1	0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0	47 62 91 110 122 130 142	28.7 92.3 52.8 99.2 50.9 56.9 01.3 66.1		30 44 72 130 186 244 330 386
30 60 120 180 240 360 480 600	min min min min min min min	Summer Summer Summer Summer Summer Summer Summer Summer	124.774 81.962 51.304 31.039 22.830 18.253 13.253 10.562 8.853	Volu (m³	0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0	47 62 91 110 122 130 142 150	28.7 92.3 52.8 99.2 50.9 01.3 66.1 48.8		30 44 72 130 186 244 330 386 448
30 60 120 180 240 360 480 600 720	min min min min min min min min	Summer Summer Summer Summer Summer Summer Summer Summer Summer	124.774 81.962 51.304 31.039 22.830 18.253 10.562 8.853 7.656	Volu (m³	0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0	Volu (m³ 47 62 91 110 122 130 142 150 157 163	28.7 92.3 52.8 99.2 50.9 01.3 66.1 48.8 10.1		30 44 72 130 186 244 330 386 448 514
30 60 120 180 240 360 480 600 720 960	min min min min min min min min	Summer Summer Summer Summer Summer Summer Summer Summer Summer	124.774 81.962 51.304 31.033 22.830 18.253 10.562 8.853 7.656	Voluma (m ³ 4 2 2 4 4 9 9 9 9 1 1 1 1 1 1 1 1 1 1 1 1 1 1	0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0	Volu (m³ 47 62 91 110 122 130 142 150 157 163	28.7 92.3 52.8 99.2 50.9 01.3 66.1 48.8 10.1 88.0		30 44 72 130 186 244 330 386 448 514 650
30 60 120 180 240 360 480 600 720 960 1440	min min min min min min min min min	Summer Summer Summer Summer Summer Summer Summer Summer Summer Summer	124.774 81.962 51.304 31.039 22.830 18.253 10.562 8.853 7.656 6.089 4.403	Voluma (m ³ 4 2 2 4 4 9 9 9 1 1 8 9 9 1	0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0	477 622 91 110 122 130 142 157 163 171 183	28.7 92.3 52.8 99.2 50.9 01.3 66.1 48.8 10.1 88.0 23.5		30 44 72 130 186 244 330 386 448 514 650 924
30 600 120 180 240 360 480 600 720 960 1440 2160	min min min min min min min min min	Summer Summer Summer Summer Summer Summer Summer Summer Summer Summer	124.774 81.962 51.304 31.039 22.830 18.253 10.562 8.853 7.656 6.089 4.400 3.176	Voluman (m ³) 4 2 4 9 1 1 1 1 1 1 1 1 1 1 1 1	0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0	47 62 91 110 122 130 142 150 157 163 171 183 211) 28.7 92.3 52.8 99.2 50.9 56.9 01.3 66.1 48.8 10.1 88.0 23.5 62.7		30 44 72 130 186 244 330 386 448 514 650 924 1328
30 600 120 180 240 360 480 600 720 960 1440 2160 2880	min	Summer Summer Summer Summer Summer Summer Summer Summer Summer Summer Summer	124.774 81.962 51.304 31.039 22.830 18.253 10.562 8.853 7.656 6.089 4.400 3.176 2.510	Wolu (m³ (m³)	0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0	47 62 91 110 122 130 142 150 157 163 171 183 211 222) 28.7 92.3 52.8 99.2 50.9 56.9 01.3 66.1 48.8 10.1 88.0 23.5 62.7 97.2		30 44 72 130 186 244 330 386 448 514 650 924 1328 1716
30 60 120 180 240 360 480 600 720 960 1440 2160 2880 4320	min	Summer Summer Summer Summer Summer Summer Summer Summer Summer Summer Summer Summer	124.774 81.962 51.304 31.039 22.830 18.253 10.562 8.853 7.656 6.089 4.400 3.176 2.514	Woluman (m3 4 2 4 9 0 3 1 2 1 8 9 1 6 7 1	0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0	47 62 91 110 122 130 142 150 157 163 171 231 211 222) 28.7 92.3 52.8 99.2 50.9 56.9 01.3 66.1 48.8 10.1 88.0 23.5 62.7 97.2 40.0		30 44 72 130 186 244 330 386 448 514 650 924 1328 1716 2476
30 60 120 180 240 360 480 600 720 960 1440 2160 2880 4320 5760	min min min min min min min min min min	Summer Summer Summer Summer Summer Summer Summer Summer Summer Summer Summer Summer	124.774 81.962 51.304 31.039 22.830 18.253 10.562 8.853 7.656 6.089 4.400 3.176 2.511 1.813	Woluman (m3 4 2 4 9 0 3 1 2 1 8 9 1 6 7 1 3	0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0	47 62 91 110 122 130 142 150 157 163 171 222 237 256) 28.7 92.3 52.8 99.2 50.9 56.9 01.3 66.1 48.8 10.1 88.0 23.5 62.7 97.2 40.0 51.2		30 44 72 130 186 244 330 386 448 514 650 924 1328 1716 2476 3232
30 60 120 180 240 360 480 600 720 960 1440 2160 2880 4320 5760 7200	min	Summer Summer Summer Summer Summer Summer Summer Summer Summer Summer Summer Summer Summer	124.774 81.962 51.304 31.039 22.830 18.253 10.562 8.853 7.656 6.089 4.400 3.176 2.511 1.813 1.19	Wolum (m ³) 4 2 4 9 0 3 1 2 1 8 9 1 3 4	0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0	(m³ 47 62 91 110 122 130 157 163 171 1222 237 256 266) 28.7 92.3 52.8 99.2 50.9 56.9 01.3 66.1 48.8 10.1 88.0 23.5 62.7 97.2 40.0 51.2 91.1		30 44 72 130 186 244 330 386 448 514 650 924 1328 1716 2476 3232 3968
30 60 120 180 240 360 480 600 720 960 1440 2160 2880 4320 5760 7200 8640	min	Summer Summer Summer Summer Summer Summer Summer Summer Summer Summer Summer Summer Summer Summer	124.774 81.962 51.304 31.033 22.830 18.253 10.562 8.853 7.656 6.083 4.403 3.170 2.511 1.433 1.19 1.02	Wolum (m ³) 4 2 4 9 1 1 1 1 1 1 1 1 1 1 1 1	0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0	(m³ 47 62 91 110 122 130 142 150 157 163 171 122 237 256 275) 28.7 92.3 52.8 99.2 50.9 56.9 01.3 66.1 48.8 10.1 88.0 23.5 62.7 97.2 40.0 51.2 91.1 21.0		30 44 72 130 186 244 330 386 448 514 650 924 1328 1716 2476 3232 3968 4680
30 60 120 180 240 360 480 600 720 960 1440 2160 2880 4320 5760 7200 8640 10080	min	Summer Summer Summer Summer Summer Summer Summer Summer Summer Summer Summer Summer Summer Summer	124.774 81.962 51.304 31.033 22.836 18.253 10.562 8.853 7.656 6.083 4.403 3.176 2.511 1.433 1.194 1.02	Woluman (m ³) 4 2 4 9 1 1 1 1 1 1 1 1 1 1 1 1	0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0	Volu (m³ 47 62 91 110 122 130 142 150 157 163 171 222 237 256 275 281) 28.7 92.3 52.8 99.2 50.9 56.9 01.3 66.1 48.8 10.1 88.0 23.5 62.7 97.2 40.0 51.2 91.1 21.0 13.3		30 44 72 130 186 244 330 386 448 514 650 924 1328 1716 2476 3232 3968 4680 5448
30 60 120 180 240 360 480 600 720 960 1440 2160 2880 4320 5760 7200 8640 10080	min	Summer Summer Summer Summer Summer Summer Summer Summer Summer Summer Summer Summer Summer Summer Summer	124.774 81.962 51.304 31.033 22.830 18.253 10.562 8.853 7.653 6.083 4.403 3.170 2.511 1.433 1.19 1.02 0.900 124.775	Wolum (m ³) 4 2 4 9 1 1 1 1 1 1 1 1 1 1 1 1	0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0	Volu (m³ 47 62 91 110 122 130 142 157 163 171 183 211 222 237 256 266 275 281 53) 28.7 92.3 52.8 99.2 50.9 56.9 01.3 66.1 48.8 10.1 88.0 23.5 62.7 97.2 40.0 51.2 91.1 21.0 13.3 29.9		30 44 72 130 186 244 330 386 448 514 650 924 1328 1716 2476 3232 3968 4680
30 60 120 180 240 360 480 600 720 960 1440 2160 2880 4320 5760 7200 8640 10080	min	Summer Summer Summer Summer Summer Summer Summer Summer Summer Summer Summer Summer Summer Summer Summer Summer	124.774 81.962 51.304 31.033 22.836 18.253 10.562 8.853 7.656 6.083 4.403 3.176 2.511 1.433 1.196 1.02 0.900 124.777 81.96	Wolum (m ³ 4 2 4 9 1 1 1 1 1 1 1 1 1 1 1 1	0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0	Voluma 47 62 91 110 122 130 142 150 157 163 171 222 237 256 266 275 281 53 70) 28.7 92.3 52.8 99.2 50.9 56.9 01.3 66.1 48.8 10.1 88.0 23.5 62.7 97.2 40.0 51.2 91.1 21.0 13.3 29.9 84.2		30 44 72 130 186 244 330 386 448 514 650 924 1328 1716 2476 3232 3968 4680 5448 30 44
30 60 120 180 240 360 480 600 720 960 1440 2160 2880 7200 8640 10080 15 30	min	Summer Summer Summer Summer Summer Summer Summer Summer Summer Summer Summer Summer Summer Summer Summer Summer Summer Summer	124.774 81.962 51.304 31.033 22.836 18.253 10.562 8.853 7.653 6.083 4.403 3.176 2.511 1.433 1.19 1.02 0.90 124.777 81.96 51.30	Wolum (m ³) 4 2 4 9 1 1 1 1 1 1 1 1 1 1 1 1	0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0	Volum (m³ 47 62 91 1100 122 1300 142 1507 163 171 183 211 222 237 2566 275 281 53 70 102) 28.7 92.3 52.8 99.2 50.9 56.9 01.3 66.1 48.8 10.1 88.0 23.5 62.7 97.2 40.0 51.2 91.1 21.0 13.3 29.9 84.2 71.9		30 44 72 130 186 244 330 386 448 514 650 924 1328 1716 2476 3232 3968 4680 5448 30
30 60 120 180 240 360 480 600 720 960 1440 2160 2880 7200 8640 10080 15 30 60 120	min	Summer Summer	124.774 81.962 51.304 31.033 22.836 18.253 10.562 8.853 7.656 6.083 4.403 3.176 2.511 1.433 1.19 1.02 0.90 124.777 81.96 51.30 31.03	Volum (m) 1 2 1 2 1 3 1 2 1 8 9 1 6 7 1 3 4 8 6 4 2 4 9	0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0	Volum (m³ 47 62 91 1100 122 1300 142 1500 157 163 171 122 237 2566 275 281 53 70 102 124) 28.7 92.3 52.8 99.2 50.9 56.9 01.3 66.1 48.8 10.1 88.0 23.5 62.7 97.2 40.0 51.2 91.1 21.0 13.3 29.9 84.2 71.9 52.9		30 44 72 130 186 244 330 386 448 514 650 924 1328 1716 2476 3232 3968 4680 5448 30 44 72 128
30 60 120 180 240 360 480 600 720 960 1440 2160 2880 4320 5760 7200 8640 10080 15 30 60 120 180	min	Summer	124.774 81.962 51.304 31.033 22.836 18.253 10.562 8.853 7.658 4.403 3.176 2.511 1.433 1.196 1.02 0.906 124.777 81.965 51.30 31.03 22.83	Voluma (ma) 4 2 4 9 0 1 6 7 7 1 3 3 4 8 6 4 4 2 4 9 0 0	0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0	Volum (m³ 47 62 91 1100 122 1300 142 1507 163 171 183 211 222 237 2566 275 281 53 70 102 124 137) 28.7 92.3 52.8 99.2 50.9 56.9 01.3 66.1 48.8 10.1 88.0 23.5 62.7 97.2 40.0 51.2 91.1 21.0 13.3 29.9 84.2 71.9 52.9 43.0		30 44 72 130 186 244 330 386 448 514 650 924 1328 1716 2476 3232 3968 4680 5448 30 44 72 128 182
30 60 120 180 240 360 480 600 720 960 1440 2160 2880 7200 8640 10080 15 30 60 120 180 240	min	Summer	124.774 81.962 51.304 31.033 22.836 18.253 10.562 8.853 7.656 6.083 4.403 3.176 2.511 1.433 1.196 1.02 0.90 124.777 81.96 51.30 31.03 22.83 18.25	Volum (m) 1 2 1 2 1 3 1 2 1 8 9 1 6 7 1 3 4 8 6 4 9 0 3	0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0	Voluma 47 62 91 110 122 130 142 150 157 163 171 222 237 2566 275 281 53 70 102 124 137 146) 28.7 92.3 52.8 99.2 50.9 56.9 01.3 66.1 48.8 10.1 88.0 23.5 62.7 97.2 40.0 51.2 91.1 21.0 13.3 29.9 84.2 71.9 52.9 43.0 45.9		30 44 72 130 186 244 330 386 448 514 650 924 1328 1716 2476 3232 3968 4680 5448 30 44 72 128 182 238
30 60 120 180 240 360 480 600 720 960 1440 2160 2880 7200 8640 10080 15 30 60 120 180 240 360	min	Summer	124.774 81.962 51.304 31.033 22.836 18.253 10.562 8.853 7.656 6.083 4.403 3.176 2.511 1.433 1.196 1.02 0.90 124.777 81.96 51.30 31.03 22.83 18.25 13.25	Volum (m) 1 2 1 2 1 3 1 2 1 3 4 8 6 4 2 4 9 0 3 1	0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0	Volum (m³ 47 62 91 1100 122 1300 1422 1507 1633 1711 2222 237 700 1024 137 1466 159) 28.7 92.3 52.8 99.2 50.9 56.9 01.3 66.1 48.8 10.1 88.0 23.5 62.7 97.2 40.0 51.2 91.1 21.0 13.3 29.9 84.2 71.9 52.9 43.0 45.9 27.8		30 44 72 130 186 244 330 386 448 514 650 924 1328 1716 2476 3232 3968 4680 5448 30 44 72 128 182
30 60 120 180 240 360 480 600 720 960 1440 2160 2880 7200 8640 10080 15 30 60 120 180 240 360	min	Summer	124.774 81.962 51.304 31.033 22.836 18.253 10.562 8.853 7.656 6.083 4.403 3.176 2.511 1.433 1.196 1.02 0.90 124.777 81.96 51.30 31.03 22.83 18.25 13.25	Volum (m) 1 2 1 2 1 3 1 2 1 3 4 8 6 4 2 4 9 0 3 1	0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0	Volum (m³ 47 62 91 1100 122 1300 1422 1507 1633 1711 2222 237 700 1024 137 1466 159) 28.7 92.3 52.8 99.2 50.9 56.9 01.3 66.1 48.8 10.1 88.0 23.5 62.7 97.2 40.0 51.2 91.1 21.0 13.3 29.9 84.2 71.9 52.9 43.0 45.9		30 44 72 130 186 244 330 386 448 514 650 924 1328 1716 2476 3232 3968 4680 5448 30 44 72 128 182 238 348

RPS Group Plc		Page 2
Highfield House 5 Ridgeway Quinton Business Park Birmingham B32 AF	Brockhill East, Phase 2 Surface Water Attenuation 281.11/sec outflow	Micro
Date 30 July 2013	Designed by A Granger	Drainage
File East 1 in 100.srcx Micro Drainage	Checked by Source Control 2013.1.1	

Summary of Results for 100 year Return Period (+30%)

Storm Event		Max Level	Max Depth	Max Control		Max Volume		Status	
		_	(m)	(m)		/s)	(m³)	
600	min	Winter	99.000	1.000	2	81.0	13408	3.3	ок
720	min	Winter	98.995	0.995	2	80.0	13340	1.3	O K
960	min	Winter	98.976	0.976	2	76.2	13078	3.3	ОК
1440	min	Winter	98.921	0.921	2	64.8	12347	1.9	O K
2160	min	Winter	98.835	0.835	2	44.9	11197	7.3	O K
2880	min	Winter	98.759	0.759	2:	25.6	10175	5.5	ОК
4320	min	Winter	98.640	0.640	1	92.6	8577	7.4	O K
5760	min	Winter	98.554	0.554	1	66.9	7426	5.2	O K
7200	min	Winter	98.490	0.490	1	47.1	6571	1.1	O K
8640	min	Winter	98.441	0.441	1	31.5	5911	1.1	ок
10080	min	Winter	98.402	0.402	1	18.8	5385	5.8	ОК
Storm		Rain	Floo	ded	Discl	narge	Tir	ne-Peak	
	Even	t	(mm/hr)	Volu	me	Vol	ume	(mins)
			(m³)	(m	3)			
				_					472
		Winter	8.85		0.0		561.3		
		Winter	7.658		0.0		290.3		548
		Winter	6.089		0.0		274.2		700
		Winter	4.40		0.0		546.7		994
	min	Winter	3.17	5	0.0	23'	713.5		1412
				-					
	min	Winter	2.51	7	0.0	24	987.9		1820
4320	min min	Winter	2.51 1.81	7 1	0.0	24: 26:	987.9 619.5		2600
4320 5760	min min min	Winter Winter	2.51 1.81 1.43	7 1 3	0.0	24: 26: 28:	987.9 619.5 732.7		2600 3352
4320 5760	min min min	Winter	2.51 1.81 1.43 1.19	7 1 3	0.0	24: 26: 28: 29:	987.9 619.5 732.7 900.6		2600 3352 4112
4320 5760 7200 8640	min min min min min	Winter Winter	2.51 1.81 1.43	7 1 3 4 8	0.0	249 260 281 291 301	987.9 619.5 732.7		2600 3352

RPS Group Plc		Page 3		
Highfield House 5 Ridgeway Quinton Business Park Birmingham B32 I AF	Brockhill East, Phase 2 Surface Water Attenuation 281.1/sec outflow	Micro		
Date 30 July 2013 File East 1 in 100.srcx	Designed by A Granger Checked by	Dramag		
Micro Drainage	Source Control 2013.1.1			

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	19.500	Shortest Storm (mins)	15
Ratio R	0.400	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+30

Time Area Diagram

Total Area (ha) 24.900

Time	(mins)	Area									
From:	To:	(ha)									
0	4	6.225	4	8	6.225	8	12	6.225	12	16	6.225

RPS Group Plc		Page 4
Highfield House 5 Ridgeway Quinton Business Park	Brockhill East, Phase 2 Surface Water Attenuation	Micro
Birmingham B32 IAF	281.11/sec outflow	
Date 30 July 2013	Designed by A Granger	
File East I in 100.srcx	Checked by	
Micro Drainage	Source Control 2013.1.1	

Model Details

Storage is Online Cover Level (m) 100.000

Tank or Pond Structure

Invert Level (m) 98.000

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	13402.0	0.600	13402.0	1.200	13402.0		13402.0		13402.0 13402.0
0.100 0.200	13402.0 13402.0		13402.0 13402.0	1.300 1.400	13402.0 13402.0	2.000	13402.0		13402.0
0.300	13402.0 13402.0		13402.0 13402.0	1.500 1.600	13402.0 13402.0		13402.0 13402.0		
0.500	13402.0	1.100	13402.0	1.700	13402.0	2.300	13402.0		

Hydro-Brake® Outflow Control

Design Head (m) 1.000 Hydro-Brake® Type Md8 Invert Level (m) 98.000 Design Flow (1/s) 281.1 Diameter (mm) 664

Depth	(m)	Flow (1/s)	Depth (m)	Flow (1/s)						
0.:	100	23.4	0.800	236.1	2.000	395.6	4.000	542.4	7,000	714.4
0.:	200	53.6	1.000	281.0	2.200	412.4	4.500	574.2	7.500	739.4
0.	300	85.8	1,200	312.5	2.400	428.5	5.000	604.6	8.000	763.6
0.4	400	118.3	1.400	336.8	2.600	444.0	5.500	633.7	8.500	787.1
0.	500	150.1	1.600	358.3	3.000	473.7	6.000	661.6	9.000	809.9
0.	600	180.7	1.800	377.7	3.500	509.0	6.500	688.5	9.500	832.1