Report No: 06/022.01

Dated: 14th December 2006

SR Gent Site
Dodworth Road, Barnsley, South Yorkshire

Flood Risk Assessment

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CONTENTS

1.0 INTRODUCTION AND BACKGROUND 4

2.0 PLANNING POLICY ON FLOOD RISK 4

3.0 LOCATION AND DESCRIPTION OF THE SITE 4

4.0 FLOOD RISK ASSESSMENT 5

4.1 Methodology 5

4.2 Information Acquired 5

4.3 Potential Sources of Flooding 6

4.4 History of Flooding 6

4.5 Assessment of fluvial flood risk 6

5.0 SURFACE WATER RUN-OFF 6

5.1 Existing conditions 6

5.2 Post-development conditions 7

5.3 Effect of re-development on surface water run-off volume 7

5.4 Disposal of surface water 8

6.0 GROUNDWATER FLOODING 8

7.0 CONCLUSIONS AND RECOMMENDATIONS 9

7.1 Conclusions 9

7.2 Recommendations 9

7.0 REFERENCES 10

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APPENDICES

APPENDIX A: Topographical survey plan by APS Surveying Services

APPENDIX B: Barnsley Metropolitan Borough Council letter dated 30th October 2006

APPENDIX C: Yorkshire Water sewer map

APPENDIX D: Surface water run-off calculations: Tables D1 to D3

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GLOSSARY

A.E.P:	Annual exceedence probability
AOD(N):	Above Ordnance Datum (Newlyn)
FARL:	Flood attenuation due to reservoirs and lakes
FEH:	Flood Estimation Handbook
Freeboard:	The margin between the predicted flood level and the flood defence level
NGR:	National Grid Reference
Swale:	A shallow grassed flow path for surface water disposal which allows infiltration en-route

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1.0 INTRODUCTION AND BACKGROUND

John O'Connor and Associates was instructed in October 2006 by Abatech International Ltd on behalf of Barratt Homes plc to undertake a flood risk assessment for a proposed residential development at the former S.R. Gent site in Dodworth Road, Barnsley, South Yorkshire. The site also includes the petrol station site on Dodworth Road, at the font of the factory site.

This report presents the findings of our investigation into potential flooding at the site together with our assessment of risk. The methodology used in the investigation and the flood risk assessment are discussed in section 4.

A topographical survey of the site has been undertaken by APS Surveying Services and a copy of the survey plan has been provided to us for the purposes of this assessment. A copy of the survey plan is reproduced in Appendix A.

References in this report to "the site" are references to the site which is the subject of the planning application. Specific references to sources of information are shown in square brackets and are listed in section 7.

Figures 1 and 2 are located at the end of the report, immediately following page 10 and Appendices A to D follow thereafter.

2.0 PLANNING POLICY ON FLOOD RISK

Planning Policy Guidance Statement (PPS) 25, published in December 2006, provides guidance to planning authorities on matters of flood risk and it supersedes the former guidance in Planning Policy Guidance Note 25.

PPS 25 emphasises that susceptibility to flooding is a material planning consideration and planning authorities are required to adopt a risk-based approach at all levels of planning. The requirements of a flood risk assessment are set out in Appendix E of PPS 25 which deals with all levels of assessment from regional to site-specific.

A flood risk assessment is required to be submitted with planning applications for all new developments in flood zone 2 and flood zones 3a and 3b, (medium and high probability and the functional floodplain). A flood risk assessment must also be submitted for all new development proposals of 1ha or greater in flood zone 1 (low probability).

The assessment must consider all forms of potential flooding that could affect the development itself and that could occur as a result of the development. Flood risk assessments should be *inter alia,* "proportionate to the risk and appropriate to the scale, nature and location of the development" and should take into account the effects of climate change.

3.0 LOCATION AND DESCRIPTION OF THE SITE

The site comprises the factory area of SR Gent Ltd and the petrol station immediately to the front of the factory in Dodworth Road, Barnsley. The gross site area amounts to 4.38ha and

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the site is bounded by the A628 Dodworth Road to the north-west, by a public footpath to the south-west and south east, and by a public footpath and residential development to the north-east.

The location of the site is shown in Figure 1 and the NGR coordinates at approximately the centre of the site are 429500E, 406100N. The site boundaries are outlined in red but this is for indicative purposes only and does not imply or suggest site ownership.

The site occupies a generally flat area that has been artificially formed by cutting into the sandstone and there is a significant difference in elevation between the site itself and the surrounding land to the south-west, south-east and north-east.

A "Pond" is noted within the site boundaries on the OS 1:1250 map and also on the topographical survey plan. This is an ornamental pond situated close to the former gatehouse and its maximum dimension is 13m. This pond has no bearing on flood risk and is unlikely to be retained in the re-development proposal.

4.0 FLOOD RISK ASSESSMENT

4.1 Methodology

PPS 25 Appendix E provides guidance on the matters that should be addressed by a flood risk assessment. The level of detail however must be appropriate to the scale of development and the extent of available information.

The methodology adopted for this assessment has therefore been as follows:

- site inspection on 1st December 2006;
- consultation with Barnsley District Council;
- review of large scale maps and the topographical survey plans for the site;
- review of flood zone data;
- interpretation of data acquired and assessment of fluvial flood risk in accordance with PPS 25;
- assessment of surface water run-off volumes in the pre-development and post development conditions of the site; and
- consideration of potential groundwater ingress to the site.

4.2 Information Acquired

The following information has been acquired for this assessment:

1. The topographical survey plan undertaken by APS Surveying Services (see Appendix A);

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2. Ordnance Survey Landplan at scale 1:5,000, centred on coordinates 424935E, 402630N (see Figure 1);

3. Yorkshire Water sewer map of the area (Appendix C); and

4. Rainfall data from the FEH CD-ROM DDF model.

4.3 Potential Sources of Flooding

Fluvial flooding

The Environment Agency Flood Map indicates that the site lies within Flood Zone 1: "Low risk", where the annual risk of fluvial flooding is less than 0.1% (1 in 1000 years). Comparison of the topographical survey with Figure 1 reveals that the site is at an elevation of approximately 90m above the River Dearne. The River Dearne does not therefore represent a realistic risk of fluvial flooding to the site.

Surface water flooding

There is the potential for quick response surface water run-off to enter the site from the surrounding high ground. Any such ingress would flow overland towards Dodworth Road or would enter the existing drainage system.

Groundwater flooding

There is the potential for groundwater to emerge from the adjacent thinly-bedded sandstone face at the north-east boundary at times of high phreatic surface in the sandstone.

4.4 History of Flooding

We have been unable to discover any documentary information on historic flood events at the site. It is understood from our consultations with Barnsley District Council that the Council is not aware of any flooding affecting the site.

4.5 Assessment of fluvial flood risk

In accordance with Table D.1 of PPS 25 the site is assessed to be in Flood Zone 1: "Low risk". All uses of land are appropriate in this flood zone.

5.0 SURFACE WATER RUN-OFF

5.1 Existing conditions

It is apparent from the topographical survey plan that much of the site area is impervious, due either to rooftops or tarmac hard-standing. It is estimated from the plan that the pervious areas around the periphery of the site amount to approximately 2,700m^2. This represents

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approximately 6% of the gross site area. The impervious area therefore amounts to approximately 3.79ha.

5.2 Post-development conditions

The proposed residential development is for houses with gardens. A reasonable estimate, of the pervious surface area, based on previous experience, would be approximately 25% of the gross area.

5.3 Effect of re-development on surface water run-off volume

The reduction in the impervious area due to the introduction of gardens on the site will reduce the overall run-off volume. There will be quick response run-off from the pervious areas but the volume of run-off from these areas will depend on the infiltration characteristics of the soil and antecedent conditions. These will vary according to season. In the summer months, the infiltration rate can be expected to be high due to the desiccation of the soil in dry weather but in winter, the soil may be close to saturation for much of the time, resulting in higher volumes of quick response run-off. The US Soil Conservation Service has published data on coefficients of run-off according to the "infiltrability" of the soil and the soil slope [7]. This data is reproduced in Table 5.1 below.

Table 5.1: Guideline coefficients of run-off

		Infiltrability of the soil		
	Slope	High	Medium	Low
Arable land	<5%	0.30	0.50	0.60
	5 - 10%	0.40	0.60	0.70
	10 - 30%	0.50	0.70	0.80
Pasture land	<5%	0.10	0.30	0.40
	5 - 10%	0.15	0.35	0.55
	10 - 30%	0.20	0.40	0.60
Forest	<5%	0.10	0.30	0.40
	5 - 10%	0.25	0.35	0.50
	10 - 30%	0.30	0.50	0.60

The slope of the site is less than 5%, the type of land most closely resembling garden land at the site would be pasture and the most onerous case would be a "low" infiltration rate, which could be expected to occur in the winter months. With reference to Table 5.1, a coefficient of run-off of 0.40 would therefore be appropriate. Of the total rain falling on the pervious ground, 40% would appear as quick response run-off in the drainage system.

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For the impervious areas, the quick response run-off is always less than 100% due to surface tension effects and ponding in depressions in the ground surface. A coefficient of run-off of 0.95 has therefore been assumed for these areas.

The volumes of quick response run-off generated by a 3.3% A.E.P rainfall event having durations up to 8 days have been calculated for the site in its pre-development and post-development conditions and the results are tabulated in Appendix D, Tables D1 and D2 respectively. The run-off volume has also been calculated for the post-development condition in 50 years time, allowing for an increase in rainfall of 20% due to climate change effects and the results of this calculation are presented in Appendix D, Table D3.

The run-off volumes from Tables D1 to D3 are plotted in Figure 2 which illustrates the effect of the proposed development. Following development, there is an immediate reduction in run-off volume, amounting to approximately 11%. This reduction is eroded over time due to expected climate change effects and after 50 years the run-off volume is estimated to be approximately 6% greater than the present day pre-development run-off. This increase, it must be understood, is not due to the development; if the site were to remain in its existing condition, an increase in run-off of approximately 20% is currently predicted due to climate change effects. The proposed development therefore reduces the effect of climate change on run-off volume that would otherwise occur.

5.4 Disposal of surface water

It is likely that much of the existing run-off is discharged to the 525mm diameter surface water sewer situated parallel to the south-west boundary of the site and, in the absence of a suitable watercourse, it would be appropriate for this sewer to be the destination of quick response run-off from the proposed development.

A detailed drainage scheme for the proposed development will be required and this should adopt sustainable drainage principles. It will be necessary to agree discharge rates to the surface water sewer with Yorkshire Water and some detention storage may be required to offset the effects of climate change. This will need to be investigated at the detailed design stage.

6.0 GROUNDWATER FLOODING

The presence of a thinly-bedded exposed sandstone face at the north-east boundary of the site raises the possibility of groundwater ingress into the site. The height of the rock face above the site elevation is approximately two to three metres. It is foreseeable that there could be occasions when the elevated ground adjacent to the site becomes temporarily saturated, resulting in a hydrostatic pressure on the exposed face and on the site floor. This could result in water-logging of the site and possible ponding.

The risk of groundwater flooding can be mitigated by the provision of a drain at the toe of the elevated land surrounding the site, thereby reducing the phreatic surface beneath the site itself.

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7.0 CONCLUSIONS AND RECOMMENDATIONS

7.1 Conclusions

1. The annual risk of fluvial flooding at the site is less than 0.1%, which places the site in Flood Zone 1: “Low risk”, in accordance with PPS 25.

2. The effect of the development will reduce surface water run-off volumes by approximately 11% due to a reduction in the impervious surface of the site.

3. By the year 2056, rainfall is predicted to increase by 20% due to climate change effects. A similar increase in surface water run-off could be expected if the site remains in its existing condition. The proposed development however will reduce this increase to approximately 6% of present day run-off volume.

4. It is likely that detention storage of quick response run-off volume will be necessary to offset the future increase in run-off volume due to climate change.

5. There is the possibility of groundwater ingress to the site from the elevated surrounding thinly-bedded sandstone. This may result in water-logging of the site and ponding.

6. The proposed development will not increase the risk of flooding elsewhere.

7. It is concluded that the risks of flooding at the site are not such as to make the site unsuitable for the proposed development.

7.2 Recommendations

1. It is recommended that a detailed drainage scheme be prepared for the site. The scheme should ensure that flow rates to the surface water sewer do not exceed present day discharge rates in order to ensure that the flood risk downstream is not increased. It is therefore likely that detention storage will be required to offset the effects of climate change.

2. It is recommended that the drainage scheme for the development includes provision to drain the toe of the surrounding high ground in order to minimise the risk of groundwater ingress to the site.

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7.0 REFERENCES

1. Landplan for plot centre coordinates: 346100, 388200, scale 1:5,000, Ordnance Survey, 2006.

2. Planning Policy Statement 25: Development and Flood Risk. Department of Communities and Local Government. December 2006.

3. The Building Regulations 2000. Approved Document H: Drainage and waste disposal. The Stationery Office, 2001.

4. FEH-CDROM, NERC, 1999.

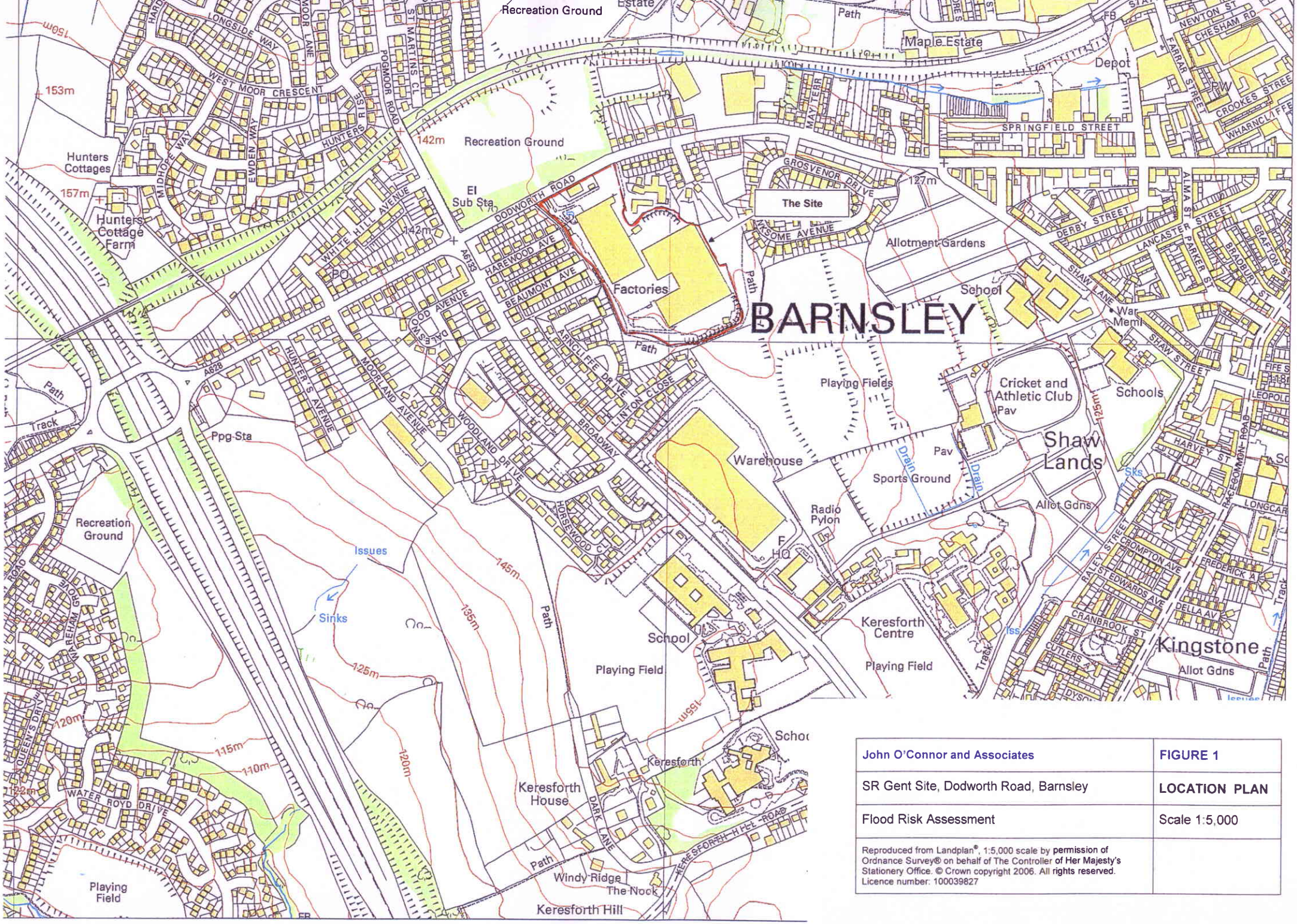
5. Climate Change Scenarios For The United Kingdom: The UKCIP 02 Scientific Report. Tyndall Centre For Climate Change Research, School of Environmental Sciences, University of East Anglia. 2002.

6. Tables for the hydraulic design of pipes and sewers, 4th Edition. Hydraulics Research Wallingford, 1983.

7. Land Drainage: planning and design of agricultural systems p.185. Smedema, L.K. and Ryecroft, D.W. Cornell University Press. 1983.

8. Development and flood risk. Guidance for the construction industry. CIRIA Report No. C624. 2004

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John O'Connor and Associates	**FIGURE 1**
SR Gent Site, Dodworth Road, Barnsley	**LOCATION PLAN**
Flood Risk Assessment	Scale 1:5,000
Reproduced from Landplan®, 1:5,000 scale by permission of Ordnance Survey® on behalf of The Controller of Her Majesty's Stationery Office. © Crown copyright 2006. All rights reserved. Licence number: 100039827	

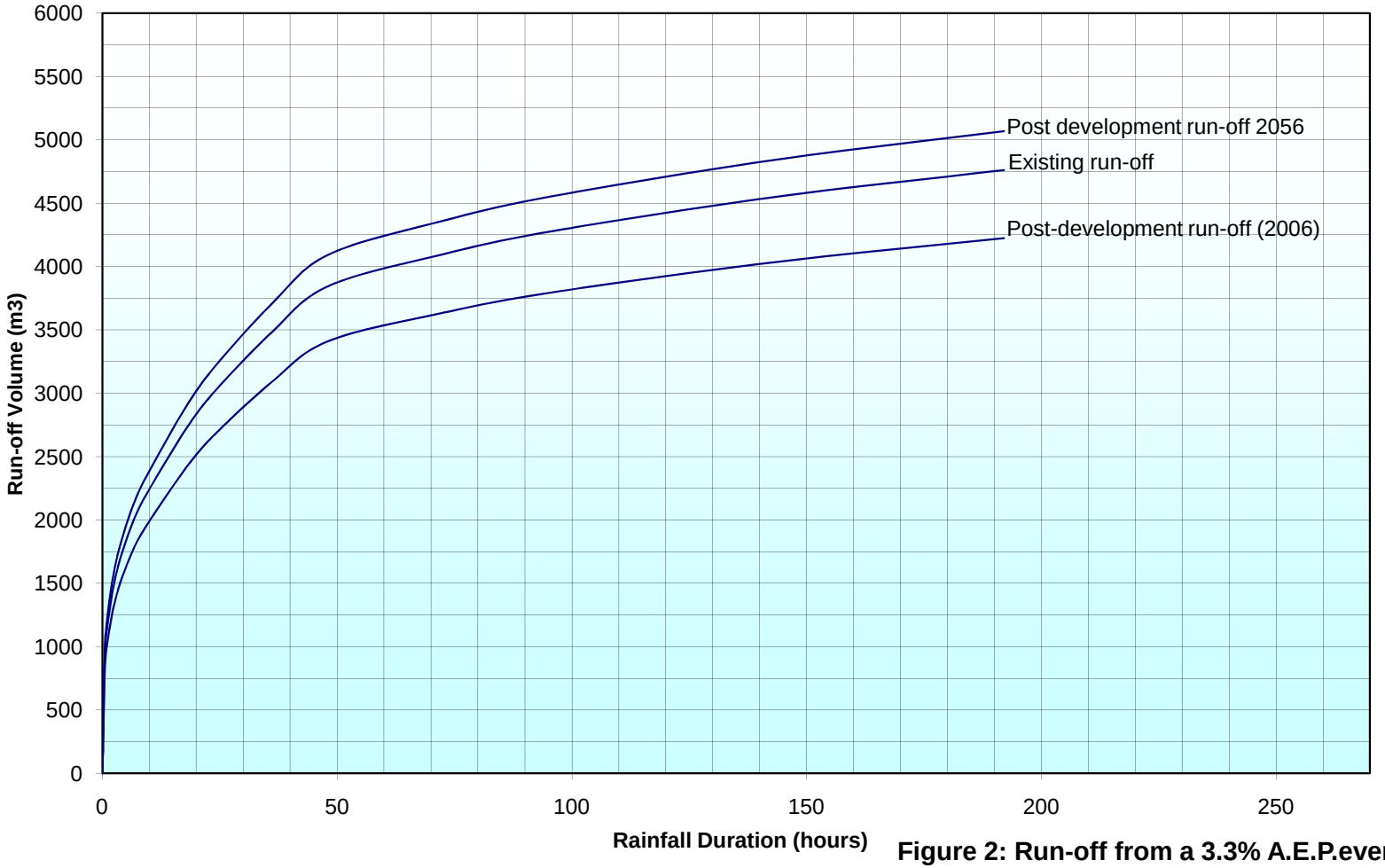
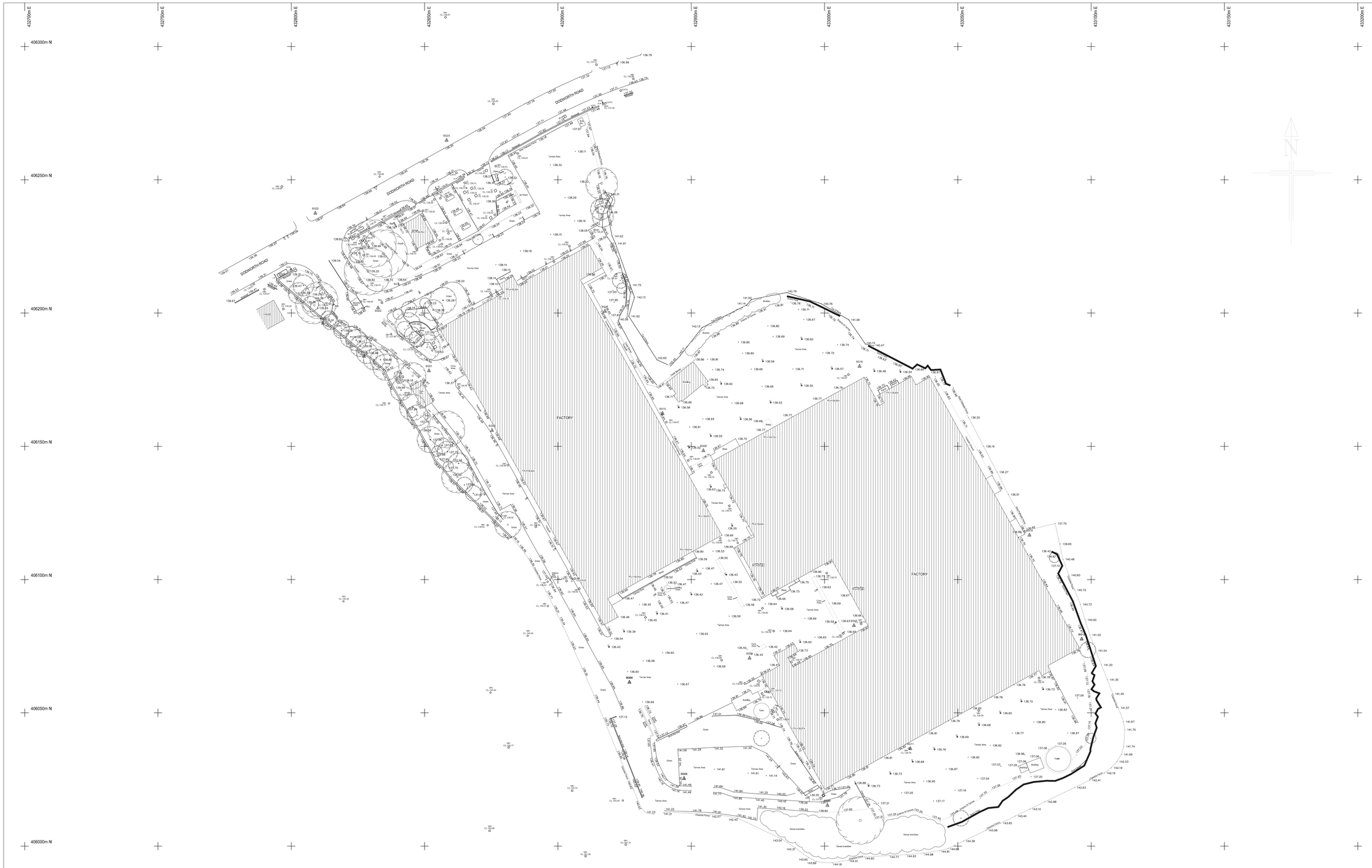


Figure 2: Run-off from a 3.3% A.E.P.event

APPENDIX A

Topographical survey plan by APS Surveying Services

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NOTES

ALL LEVELS ARE RELATED TO OSBM VALUE OF:-

SITUATED:-

LEVELS ARE RELATED TO OSGM02
VALUE n/a

CO-ORDINATES ARE RELATED TO NATIONAL GRID
USING GPS AND WGS84

Name	Eastings	Northings	Level
SG02	432632.589	406201.920	136.29
SG05	432947.346	406025.360	141.43
SG04	432926.853	406061.435	136.66
SG12	433096.467	406077.669	136.65
SG14	433076.893	406116.644	136.70
SG15	432939.307	406162.333	136.62
SG16	433013.149	406180.002	136.64
SG17	432917.633	406200.627	136.66
SG20	432811.965	406196.197	139.09
SG21	432627.330	406183.767	139.01
SG22	432609.035	406237.463	139.09
SG23	432658.275	406264.802	136.32
SG01	432851.874	406178.328	136.85
SG03	432875.315	406155.956	136.61
SG06	432971.908	406070.495	136.46
SG07	433011.066	406082.744	136.69
SG08	433001.110	406015.299	136.33
SG09	432954.592	406148.368	136.62
SG10	433094.832	406055.601	

KEY

LEVELS
OBM Ordnance Bench Mark
CL Cover Level
FFL Finished Floor Level
FRL Flat Roof Level
IL Invert Level
SSL Structural Slab Level
WL Water Level

BUILDINGS - HEIGHTS ABOVE FLOOR
C Ceiling
DH Door Head
FL Floor Level
WC Window Cill
WH Window Head

INSPECTION CHAMBERS
AC Access Cover
CB Cable Access
CATV CATV Access
EIC Electric Inspection Chamber
HYD Fire Hydrant
FWI Foul Water Inspection Chamber
IC Inspection Cover
SWC Storm Water Chamber
GV Gas Valve
G Gully
IC Inspection Chamber
JB Junction Box
MH Manhole
RE Rodding Eye
SV Stop Valve
SWCP Surface Water Catch Pit
SWMH Surface Water Inspection Chamber
BT Telephone Inspection Chamber
U Unidentified
UTL Unknown
WIC Water Inspection Chamber
WM Water Meter
WSV Water Stop Valve

PIPES
GP Gas Pipe
RWP Rain Water Pipe
SVP Sewer Vent Pipe
VP Vent Pipe
pvp Petrol Vent Pipes

POSTS
CPO Concrete Post
HYD Fire Hydrant Marker
FPO Fence Post
GM Gas Marker Post
GV Gas Valve
LPO Lockable Post
MK Marker Post
MPO Metal Post
RP Reflector Post
TPO Timber Post

STREET FURNITURE
BB Bollsha Beacon
BO Bollard
BS Bus Stop
CB Cabinet
EC Electric Cupboard
EP Electric Pole
FB Flower Border
FL Flood Light
FP Flag Pole
LB Light Bollard
LL Lamp Bollard
LP Lamp Post
NP Name Plate
PM Parking Meter
RS Road Sign
S Seat
STN Survey Station
TL Traffic Light
TCB Traffic Light Control Box
TP Telephone Pole

FENCES
B/W Barbed Wire
C/B Close Board
C/L Chain Link
C/P Chestnut Paling
C/W Conc. Post & Wire
S/P Steel palisade
P/R Post and Rail
P/W Post and Wall
R/W Retaining Wall

LEGEND

SPOT LEVEL
SURVEY STATION
WATER FEATURE..DITCH ETC
SAPLING
BUSHES/SHRUB
HEDGE/AREA OF UNDERGROWTH
TREE (SPREAD TO SCALE)
BUILDING
CONTOUR
BOREHOLE/TEST HOLE
TRIAL PIT
RETAINING WALL
BUILDING/WALLS
GATE
STILE
KERB LINE
BANKING
ROCKFACE
ORDNANCE SURVEY BENCH MARK
TEMPORARY BENCH MARK/SITE DATUM

REVISIONS

CLIENT

BEN BAILEY HOMES LTD

SITE

SR GENTS,
DODWORTH ROAD,
BARNSLEY

DRAWING

TOPOGRAPHICAL SURVEY

DRAWING NUMBER BBH06-15	SURVEYED BY CP	DATE MAY 2006
SHEET REVISION No.	DRAWN BY CP	SCALE 1:500

APS Surveying Services
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APPENDIX B

Barnsley Metropolitan Borough Council letter dated 30th October 2006

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BARNSLEY
Metropolitan Borough Council

Highways and Engineering
Assistant Director: A. J. Carnall, BSc, M.Eng, M.I.C.E., M.I.H.T.
Central Offices, Kendray Street, Barnsley, S70 2TN

My Ref. EMDRD/SK/55/302 Your Ref. 06/022/JO'C

Enquiries to Mr. S. Kilner Dial Direct (01226)772116 Fax (01226)772196

Date 30th October, 2006

Dear Sir

S.R. Gent site at Dodworth Road, Barnsley – Flood risk Assessment

I refer to your letter dated 26th October, 2006.

My Council have no records of any culverted or open watercourses crossing this site. The only watercourse I am aware of in this area is located 200 metres north east of your site adjacent to the Barnsley to Huddersfield railway line.

I note that there is a pond shown on the Ordnance Survey map of this site, which may have a bearing on the flood risk assessment. I would recommend that this be investigated to establish if it has an outlet, and the potential impact it may have on any proposed development.

I am not aware of any flooding issues associated with the site, and would confirm that to my knowledge it is not affected by any flood plains from major watercourses in the area.

Should you wish to discuss this matter further, please do not hesitate to contact my assistant Mr. Steven Kilner on the above telephone number.

Yours Faithfully

Mr S. Kilner
Principal Engineer.

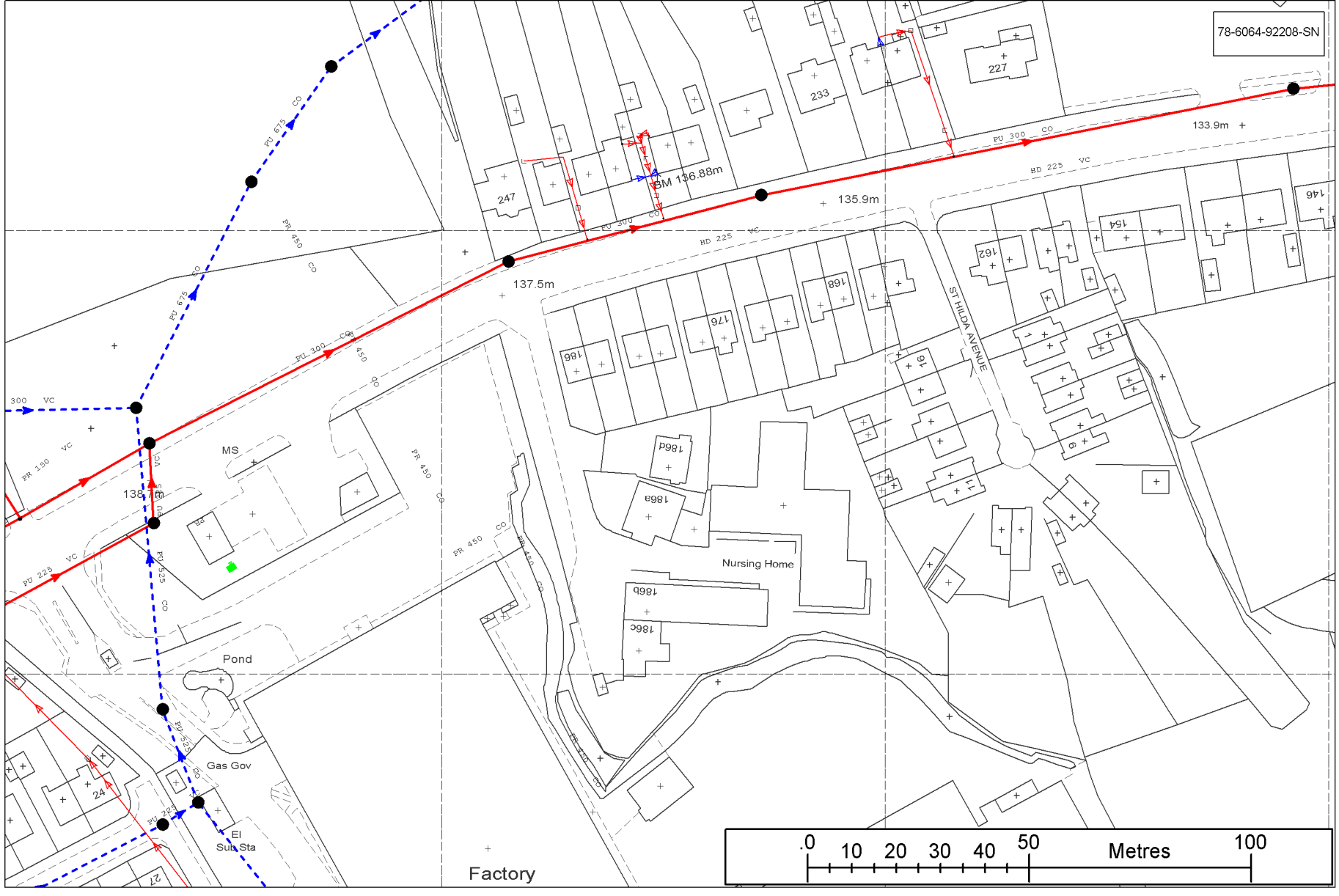
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3/11/06
06/022

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APPENDIX C

Yorkshire Water sewer map

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YorMap
a part of YorkshireWater

Map Name: SE329062	YorMap has centred this plan at OS Centre Grid Co-ordinates: 432951 : 406251		
Map Scale: 1:1250	06/022: SR Gent Site		
	13 Dec 2006	13:06	Originator: YorMap

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Mapping sourced from Ordnance Survey

APPENDIX D

Surface run-off calculations: Tables D1 to D3

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Table D1: Quick response run-off: existing condition (1 in 30 years rainfall event)

Duration	Rainfall (2006) at Site	Area (m^2)			Volume (m^3)		
		Impervious	Pervious	Total	Impervious	Pervious	Run-off
hours	mm	Area (m^2)	Area (m^2)	Area (m^2)	Area (m^2)	Area	Volume
		C_v 0.95	C_v 0.40				
0	0.0	41055.00	2700.00	43755.00	0.00	0.00	0.00
0.5	23.2	41055.00	2700.00	43755.00	904.85	25.06	929.91
1	28.5	41055.00	2700.00	43755.00	1111.56	30.78	1142.34
2	35.0	41055.00	2700.00	43755.00	1365.08	37.80	1402.88
3	39.5	41055.00	2700.00	43755.00	1540.59	42.66	1583.25
4	42.9	41055.00	2700.00	43755.00	1673.20	46.33	1719.53
6	48.3	41055.00	2700.00	43755.00	1883.81	52.16	1935.97
8	52.6	41055.00	2700.00	43755.00	2051.52	56.81	2108.33
12	59.1	41055.00	2700.00	43755.00	2305.03	63.83	2368.86
18	68.1	41055.00	2700.00	43755.00	2656.05	73.55	2729.60
24	75.3	41055.00	2700.00	43755.00	2936.87	81.32	3018.19
36	86.8	41055.00	2700.00	43755.00	3385.40	93.74	3479.14
48	95.9	41055.00	2700.00	43755.00	3740.32	103.57	3843.89
72	102.1	41055.00	2700.00	43755.00	3982.13	110.27	4092.40
96	106.8	41055.00	2700.00	43755.00	4165.44	115.34	4280.78
144	113.6	41055.00	2700.00	43755.00	4430.66	122.69	4553.34
192	118.8	41055.00	2700.00	43755.00	4633.47	128.30	4761.77

Table D2: Quick response run-off: post development condition (1 in 30 years rainfall event)

Duration	Rainfall (2006) at Site	Area (m^2)			Volume (m^3)		
		Impervious	Pervious	Total	Impervious	Pervious	Run-off
hours	mm	Area (m^2)	Area (m^2)	Area (m^2)	Area (m^2)	Area	Volume
		C_v 0.95	C_v 0.40				
0	0.0	32816.25	10938.75	43755.00	0.00	0.00	0.00
0.5	23.2	32816.25	10938.75	43755.00	723.27	101.51	824.78
1	28.5	32816.25	10938.75	43755.00	888.50	124.70	1013.20
2	35.0	32816.25	10938.75	43755.00	1091.14	153.14	1244.28
3	39.5	32816.25	10938.75	43755.00	1231.43	172.83	1404.26
4	42.9	32816.25	10938.75	43755.00	1337.43	187.71	1525.14
6	48.3	32816.25	10938.75	43755.00	1505.77	211.34	1717.11
8	52.6	32816.25	10938.75	43755.00	1639.83	230.15	1869.98
12	59.1	32816.25	10938.75	43755.00	1842.47	258.59	2101.06
18	68.1	32816.25	10938.75	43755.00	2123.05	297.97	2421.02
24	75.3	32816.25	10938.75	43755.00	2347.51	329.48	2676.99
36	86.8	32816.25	10938.75	43755.00	2706.03	379.79	3085.82
48	95.9	32816.25	10938.75	43755.00	2989.72	419.61	3409.33
72	102.1	32816.25	10938.75	43755.00	3183.01	446.74	3629.75
96	106.8	32816.25	10938.75	43755.00	3329.54	467.30	3796.84
144	113.6	32816.25	10938.75	43755.00	3541.53	497.06	4038.59
192	118.8	32816.25	10938.75	43755.00	3703.64	519.81	4223.45

Table D3: Quick response run-off: post development condition (1 in 30 years rainfall event including climate change allowance)

Duration	Rainfall (2056) at Site	Area (m^2)			Volume (m^3)		
		Impervious	Pervious	Total	Impervious	Pervious	Run-off
hours	mm	Area (m^2)	Area (m^2)	Area (m^2)	Area (m^2)	Area	Volume
		C_v 0.95	C_v 0.40				
0	0.0	32816.25	10938.75	43755.00	0.00	0.00	0.00
0.5	27.8	32816.25	10938.75	43755.00	867.92	121.81	989.74
1	34.2	32816.25	10938.75	43755.00	1066.20	149.64	1215.84
2	42.0	32816.25	10938.75	43755.00	1309.37	183.77	1493.14
3	47.4	32816.25	10938.75	43755.00	1477.72	207.40	1685.11
4	51.5	32816.25	10938.75	43755.00	1604.91	225.25	1830.16
6	58.0	32816.25	10938.75	43755.00	1806.93	253.60	2060.53
8	63.1	32816.25	10938.75	43755.00	1967.79	276.18	2243.98
12	70.9	32816.25	10938.75	43755.00	2210.96	310.31	2521.27
18	81.7	32816.25	10938.75	43755.00	2547.66	357.57	2905.22
24	90.4	32816.25	10938.75	43755.00	2817.01	395.37	3212.38
36	104.2	32816.25	10938.75	43755.00	3247.23	455.75	3702.99
48	115.1	32816.25	10938.75	43755.00	3587.67	503.53	4091.20
72	122.5	32816.25	10938.75	43755.00	3819.61	536.09	4355.70
96	128.2	32816.25	10938.75	43755.00	3995.44	560.76	4556.21
144	136.3	32816.25	10938.75	43755.00	4249.84	596.47	4846.30
192	142.6	32816.25	10938.75	43755.00	4444.37	623.77	5068.14