

February 2012

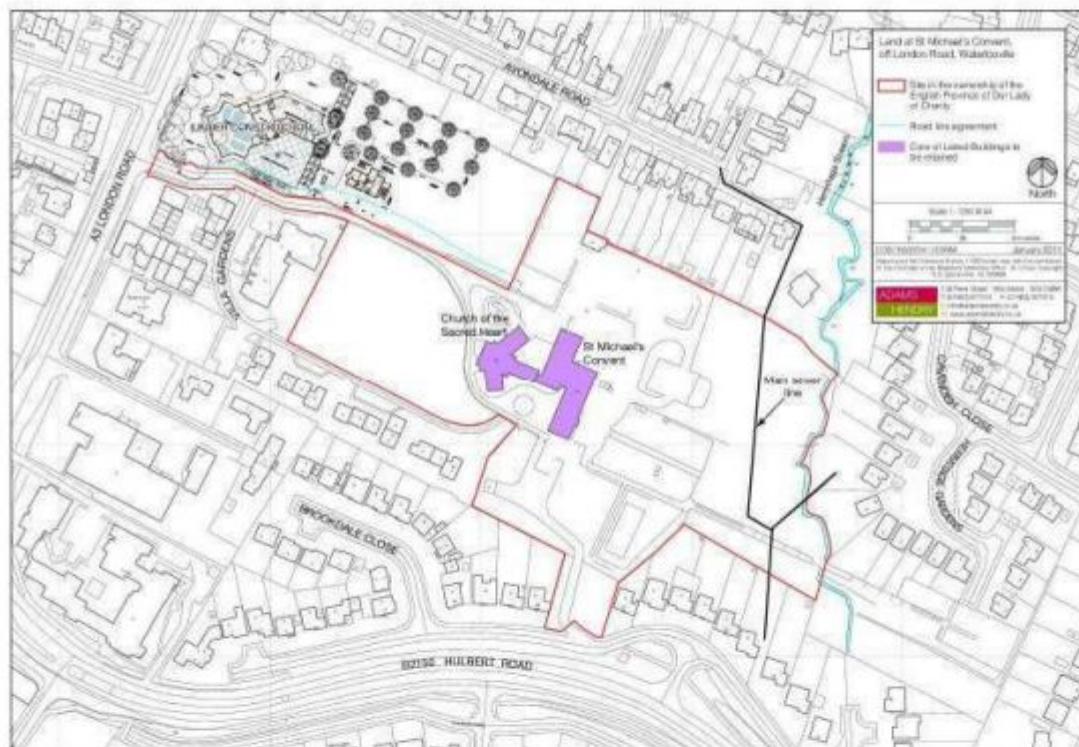
FLOOD RISK ASSESSMENT

PROPOSED DEVELOPMENT, ST.MICHAEL'S CONVENT, LONDON ROAD,
WATERLOOVILLE, HAMPSHIRE

1. INTRODUCTION

In February 2012, AMA Ltd were commissioned by Linden Homes Southern Ltd to undertake a Flood Risk Assessment to meet the requirements of Planning Policy Statement 25 (PPS 25): Development and Flood Risk (Reference 1) for the Proposed Development, St.Michael's Convent, London Road, Waterlooville, Hampshire (Figure 1).

Figure 1: Site Location Plan



1.1 Background

Planning permission will be sought for the development of the site for residential occupancy. The site is currently occupied by the existing convent building and church, with associated outbuildings, roads and areas of hard standing. As a statutory consultee the Environment Agency will comment on the proposals.

1.1.1 Ground Conditions

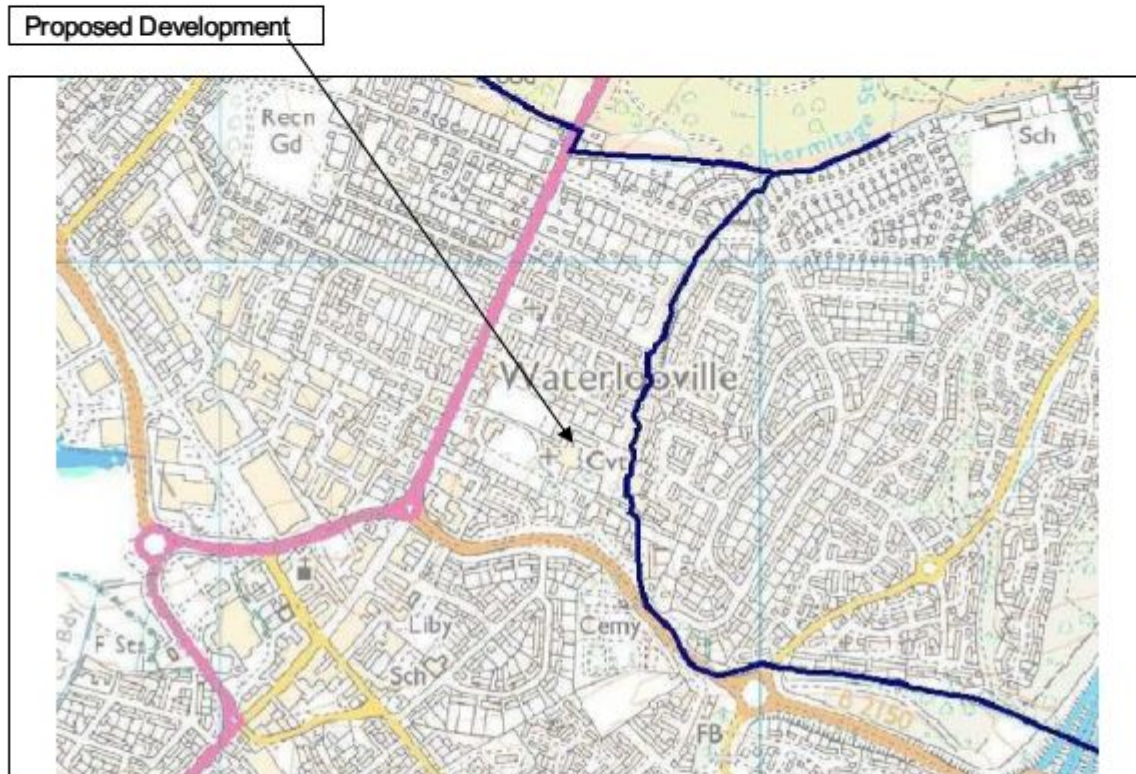
A Site Investigation has been carried out confirming that the site has a mantle of made ground, overlying soft to stiff clay and gravelly clay, logged as Head Deposits, overlying stiff to very stiff clay,

logged as London Clay. Silty sand, logged as Bognor Sand, was encountered beneath the London Clay in the lower ground in the north-eastern portion of the site, adjacent to the Hermitage Stream.

1.1.2 Flood History

The flood risk map indicates that the site is not located within an Environment Agency fluvial/tidal flood risk zone (Figure 2).

Figure 2: Environment Agency Flood Map



Map Courtesy of Environment Agency

The site is located 300m to the East of the Waterloo village town centre, and immediately west of the Hermitage Stream, which is classified as Main River by the Environment Agency.

Although the site is located immediately adjacent to the Hermitage Stream, there are no records of fluvial type flooding at the site location. This is because the stream passes through a steep sided valley, with bank heights more than 2.0m above normal water levels and with the adjacent land 50m either side, sloping steeply towards the stream at a gradient of more approximately 1in7. However, the likelihood of this has been investigated and is discussed in this report. In addition to this, issues of local site scale flooding and site runoff volumes have been addressed. This document is designed to fulfil these requirements in line with PPS25.

1.1.3 Correspondence and Discussions

During the preparation of this document the Environment Agency has been contacted in order to obtain information. The report has been based on the information provided by the Environment Agency, the client and observations from site visits.

1.1.4 Objectives

The principle aims of the FRA are:

1. To assess the risk associated with all potential flood sources;
2. To investigate the interaction between potential flood sources and the redevelopment proposals;
3. To discuss management of storm water runoff related to the potential development.

2. SITE DESCRIPTION

2.1 Location

The site is located 300m to the East of the Waterloo town centre, and immediately west of the Hermitage Stream (Figure 1). The A3(M) is located approximately 1km east of the site and the A3 London Road is located 100m west of the site. The main access road leading into the site is served from London Road.

2.2 Site Appearance

The site covers an area of approximately 3.13 hectares, although only 2.43 hectares is being developed for residential use, with the existing green and area adjacent to the Hermitage Stream being retained as Open Space.

Appendix 1 shows the existing site survey. The site can be accessed via existing access roads from London Road to the West and Hulbert Road to the South. It is currently occupied by the existing convent building and Sacred Heart Church, together with associated outbuildings, roads and areas of hardstanding. The existing impermeable area is 0.83 hectares.

The Hermitage Stream forms the eastern boundary of the site and flows from North to South. A tributary watercourse to the Hermitage Stream flows from west to east and joins the Hermitage Stream in the South Eastern corner of the site. This watercourse is open for approximately 60m upstream of where it meets the Hermitage Stream, a brick built headwall has been constructed at the head of the watercourse for the outfall of existing storm water drains.

The maximum site level is approximately 48.00m AOD at the Western end of the site adjacent to the existing Church Hall and gently falls south eastwards for approximately 200 metres at a gradient of 1in25. The site then steepens to an average gradient of 1in7 for approximately 50 metres down towards the Hermitage Stream at the eastern end of the site. The minimum site level is approximately 30.00m AOD in the south eastern corner of the site adjacent to the Hermitage Stream.

Most of the area surrounding the site has already been developed, mostly for residential use. To the west, a new church, church hall and car park have recently been constructed on the north side of the Access Road leading from London Road into the site.

2.2.1 Site Drainage

There are existing surface and foul water sewers/drains that run through the site serving the existing developments around the site and which will have to be retained. These have been indicated on the Drainage Strategy (Appendix 3) and are as follows:

- 1). An existing 225mm diameter public foul sewer running from North to South through the eastern part of the site near the Hermitage Stream.
- 2). An existing 150mm diameter public foul sewer running from West to East across the access road from Hulbert Road.
- 3). An existing 100mm diameter foul drain and 150mm diameter storm drain, running along the northern site boundary serving the new church and church hall. The foul drain connects to the sewer mentioned in Item 1, the storm drain connects to the Hermitage Stream via a concrete bag headwall.
- 4). An existing 150mm diameter foul drain and 300mm storm drain, running along the southern site boundary of the site serving the existing properties in Villa Gardens and the existing access road from London Road. The foul drain connects to the sewer mentioned in Item 2, the storm drain connects to the brick built headwall at the head of the tributary watercourse to the Hermitage Stream.

It should be noted that there are no soakaways on the site suggesting that ground conditions are such that infiltration methods for the disposal of surface water run-off are not viable. This has been confirmed by falling head permeability tests undertaken on the London Clay as part of the Site

Investigation. These tests did not return sufficient fall in water level for a permeability to be calculated. Typical permeability for clay such as encountered is 1.0×10^{-8} m/s or lower. Surface water run-off from the existing buildings, roads and areas of hardstanding, discharges to the Hermitage Stream via an existing 6inch diameter piped drainage system. However, this system has a limit capacity and has fallen into disrepair, so much of the surface water run-off now discharges to the Hermitage Stream via the overland route particularly in exceptional storm events.

From the net development area of 2.43ha (ie. Gross Area less Open Space areas) and taking into account the existing impermeable area and the site soil characteristics, the Mean Annual Flood Rate (Qbar) can be calculated using the IH124 method of calculation, together with the peak rate of discharge for varying storm events (Figure 3).

Figure 3: Existing Discharge Rates.

Andrew Malcolm Associates Ltd		Page 1
15 Wild Rose Crescent Southampton SO31 6TG	Qbar St.Michaels Convent Waterlooville	
Date 19-01-12	Designed By AJM	
File	Checked By	
Micro Drainage	Source Control W.11.2	

<u>IH 124 Mean Annual Flood</u>			
Input			
Return Period (years)	100	Soil	0.450
Area (Ha)	2.430	Urban	0.330
SAAR (mm)	800,000	Region Number	7
Results		l/s	
QBAR Rural		17.4	
QBAR Urban		27.9	
Q	100 years	70.4	
Q	1 year	23.7	
Q	2 years	26.3	
Q	5 years	36.5	
Q	10 years	44.2	
Q	20 years	51.6	
Q	25 years	54.0	
Q	30 years	55.6	
Q	50 years	60.6	
Q	100 years	70.4	
Q	200 years	79.5	
Q	250 years	82.4	
Q	1000 years	102.1	

2.2.2 Geology

GESL undertook an intrusive site investigation during December 2011. Table 1 shows the generalised ground profile encountered during this investigation.

Table 1. Generalised Ground Profile

Depth (mbgl)	Encountered Material
0 – 0.3	Top Soil/Made Ground.
0.3 – 2.00	HEAD DEPOSITS: Firm to stiff sandy silty CLAY with occasional fine to coarse flint gravel
2.00 – 4.00+	LONDON CLAY: Stiff to very stiff brown silty CLAY

2.3 Surrounding Area

The site is located 300m to the East of the Waterlooville town centre, and immediately west of the Hermitage Stream. The A3(M) is located approximately 1km east of the site and the A3 London Road is located 100m west of the site. The main access road leading into the site is served from London Road.

Most of the area surrounding the site has already been developed, mostly for residential use. To the west, a new church, church hall and car park have recently been constructed on the north side of the Access Road leading from London Road into the site.

The surrounding area is generally on sloping ground, falling from the London Road towards the Hermitage Stream. The areas surrounding the site have no specific conservation classification.

2.3.1 Local Drainage Network

The existing storm and foul sewers systems within the site have been indicated on the Drainage strategy (Appendix 3). The existing residential developments adjacent to the proposed site, have both storm and foul sewers systems as indicated on Southern Water's drainage records (Figure 4). It can be seen from these details that these storm sewers within the vicinity of the site and on the east side of the London Road, all eventually discharge to the Hermitage Stream. It should be noted that approximately 50 metres south of the site, the Hermitage Stream has been culverted with a 1.0 metre diameter pipe for a length of approximately 300m before it becomes an open stream again.

Figure 4: Southern Water Drainage Records



2.4 Description Of Redevelopment

The proposed residential development consists of 67 new houses/apartments, the refurbishment of the existing convent building for 17 apartments, the retention of the Sacred Heart Church, a further future development of approximately 13 units, together with associated roads and POS areas, as indicated on the proposed site layout (Appendix 2). The impermeable area will increase from 0.83ha to 1.24ha, an increase from 33% to 51%. Proposed ground levels will remain broadly in line with existing levels.

3. EXTERNAL FLOOD SOURCES

Current guidance recommends that a FRA must investigate all potential sources of flood risk that may affect each particular site. A number of site-specific mechanisms exist; however, many of these are not relevant to this site. Table 2 summarises the range of potential flood sources, pathways and the possibility of relevance to the site itself and immediately surrounding area.

Table 2: Summary of potential flood sources

Flood Type	Source	Pathway	Consider Further
Fluvial	Hermitage Stream	None	No - large level difference.
Tidal	None	None	No
Overland Flow	A3 London Road	Surface Water Run-off in exceptional storm events.	Yes
Drainage	Public Sewer	Blockage/overwhelmed capacity	Yes
Groundwater	Clay Sub-Strata	Rising Water Table	Yes

3.1 Overland Flow

The areas to the west of the site up to and including London Road are at a higher level than the site itself. Therefore in the event of an exceptional storm event, the natural overland flow route for surface water run-off is through the site. Therefore it will be necessary to maintain a flood route through the site to the Hermitage Stream.

3.2 Drainage

Southern Water maintains a database that records reported incidents of sewer flooding. There have been no recorded instances of flooding the site as a result of their sewers being overwhelmed.

3.3 Groundwater

As part of the intrusive investigation undertaken by GESL, groundwater data was available. This confirmed that no groundwater was encountered up to a depth of at least 4.0m. This is because of the impervious nature of the site's subgrade and as such groundwater is unlikely to represent a risk.

4. FLOOD MITIGATION AND MANAGEMENT

The assessment undertaken in Section 3 identified overland flow, off-site drainage and groundwater as a potential source of flood risk to the proposed development. However, it was demonstrated that only overland flow pathways are a potential source of flooding.

4.1 Overland Flow Pathways

As already mentioned, it has been identified that a flood route through the site to the Hermitage Stream needs to be maintained. This has been achieved by ensuring that the existing access road into the site is continued through the proposed development and leads to the Hermitage Stream, as indicate on the drainage strategy (Appendix 3).

5. SITE GENERATED FLOOD RISK

5.1 Storm Water Strategy

5.1.1 Background

As the site prior to development discharged to the Hermitage Stream via the local drainage system, and overland in exceptional storm events, the discharge from the proposed development should

not exceed the Mean Annual Maximum Flood Rate (Qbar) for the existing site. This has been calculated as 27.9 litres/sec (Figure 3).

5.1.2 Run-off Calculations

The maximum rate of discharge for the development post development should not exceed Qbar. For the purposes of comparison however, the maximum run-off for design storms of 1in1 year, 1in30 year, 1in100 year and 1in100year+30% allowance for climate change, have been calculated prior to and after the site is developed, in accordance with PPS25 (Table 3).

Table 3: Outline run-off calculations based on relevant design storm

Development Status	1in1year Design Storm	Qbar – Mean Annual Max. Flood Rate	1in30year Design Storm	1in100year Design Storm	1in100year+30% Design Storm
Existing	23.7 l/sec	27.9 l/sec	55.6 l/sec	70.4 l/sec	91.5 l/sec
Proposed	23.7 l/sec	27.9 l/sec	27.9 l/sec	27.9 l/sec	27.9 l/sec

5.2 Options for Disposal

5.2.1 Unattenuated Discharge

The existing site drains to the Hermitage Stream on the eastern boundary of the site. Given the increase in impermeable area of the development and the decrease in time of concentration associated with a new piped drainage system, an unattenuated discharge may overwhelm the culverted section of the Hermitage Stream downstream of the site with an increase in the risk of fluvial flooding. Therefore this method of discharge is not an option.

In accordance with PPS25, the volume of run-off from the impermeable areas prior to and after development have been calculated for a 1in100 yr storm +30%CC of 6 hours duration in Table 4. It should be noted that for this site these figures are irrelevant, because of the issues with overland flows from the existing site.

Table 4: Volume of run-off from Impermeable Areas (1in100 yr storm +30%CC of 6 hours duration).

Conditions	Impermeable Area	Volume
Existing	0.83 hectares	566m ³
Proposed	1.24 hectares	846m ³

2.2.2 Attenuated Discharge

Attenuation of storm water will be required if the permitted maximum rate of discharge is limited to 27.9 litres/sec (ie the mean annual maximum flood rate). The storage requirements will have to accord with the requirements of PPS25 and cater for a 1in100year storm with a 30% allowance in rainfall intensities for climate change.

In accordance with current guidelines, the storage of storm water should be provided where possible in ponds, swales, porous paving and similar Suds features. A drainage strategy using swales and porous paving, with some underground storage has been prepared to meet the aforementioned requirements of PPS25.

This strategy indicates two outfalls to the Hermitage Stream, one direct connection where the discharge has been limited to 22.9 litres/sec and one connection to the tributary of the Hermitage Stream where the discharge has been limited to 5.0 litres/sec. It should be noted that this strategy has been submitted to the Environment Agency who have approved the scheme subject to the provision of detailed calculations (Appendix 4).

In support of this strategy Drainage Calculations have been prepared (Appendix 5).

2.2.3 Infiltration

As already discussed, it has been shown that the Clay sub-grade (Head Deposits overlying London Clay) will provide a suitable drainage medium. Infiltration devices will therefore not be an option for the disposal of storm water.

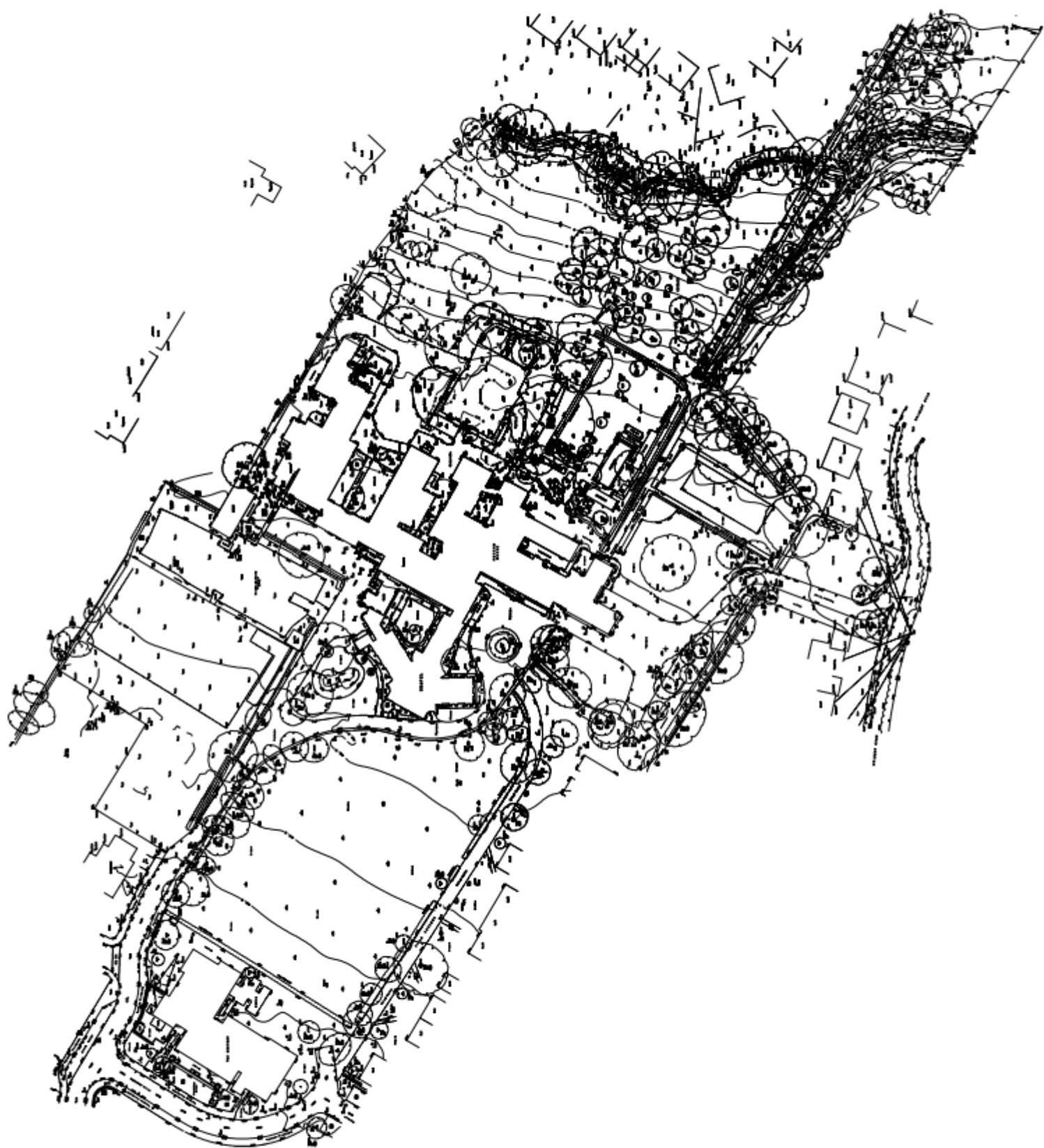
6. CONCLUSIONS AND RECOMMENDATIONS.

The following conclusions and recommendations can be made:

- The site is not located within an area considered to be at risk from fluvial flooding.
- Overland flow from London Road through the site was identified as a flood risk to the proposed development. As such a flood route through the site should be maintained.
- Because of the non-porous nature of the clay sub-grade, groundwater will not be a potential flood risk.
- It is proposed that storm water generated on-site will be discharged to the Hermitage Stream at a maximum rate of 27.9 litres/sec (Q_{bar}).
- Detailed calculations of storage requirements should be undertaken.

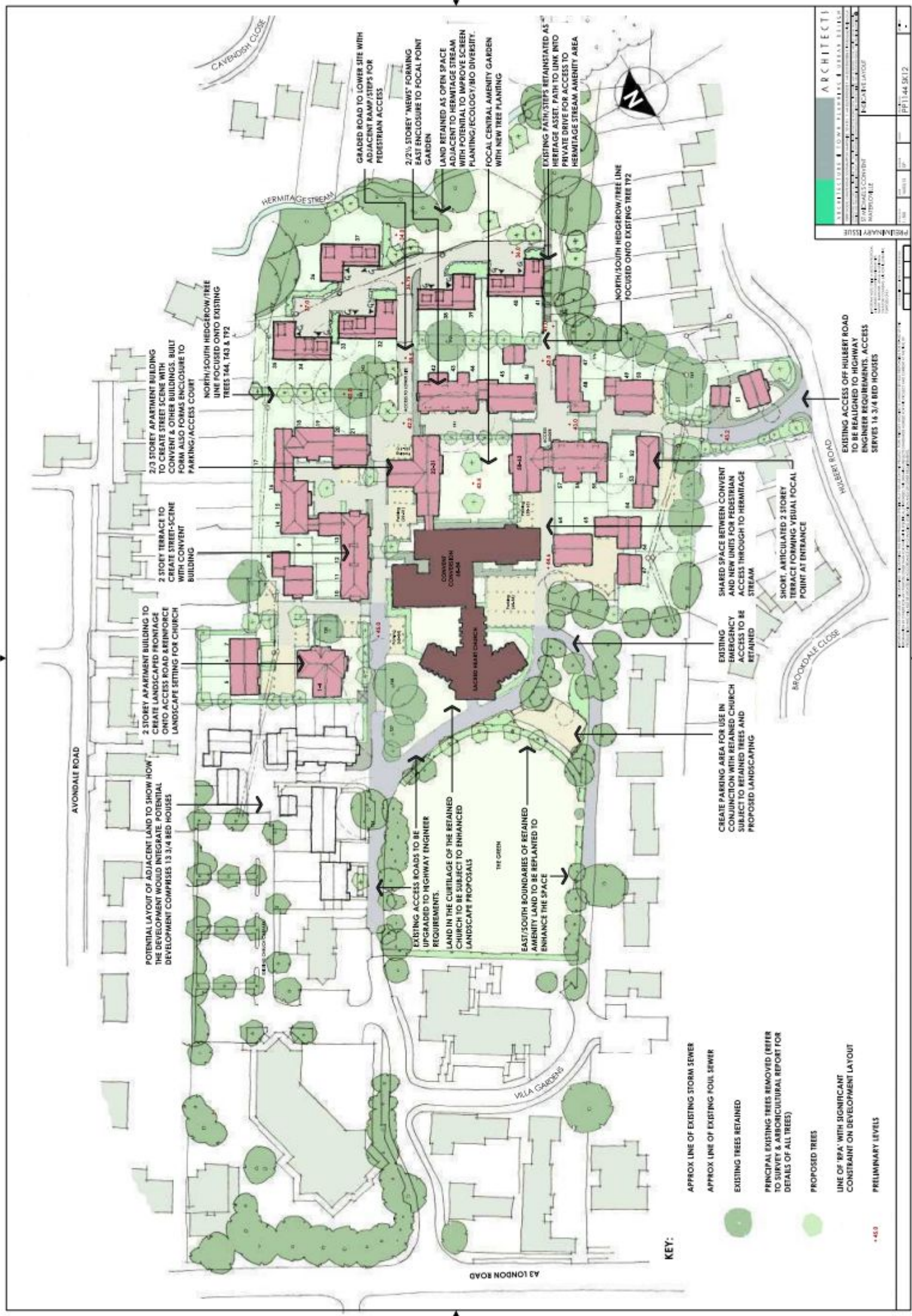
Appendix 1

SITE SURVEY



Appendix 2

SITE LAYOUT



KEY:

- APPROX LINE OF EXISTING STORM SEWER
- APPROX LINE OF EXISTING FOUL SEWER
- EXISTING TREES RETAINED
- PRINCIPAL EXISTING TREES REMOVED (REFER TO SURVEY & ARBOCULTURAL REPORT FOR DETAILS OF ALL TREES)
- PROPOSED TREES
- LINE OF '10' A' WITH SIGNIFICANT CONSTRAINT ON DEVELOPMENT LAYOUT
- PRELIMINARY LEVELS

ARCHITECTS

PRELIMINARY ISSUE

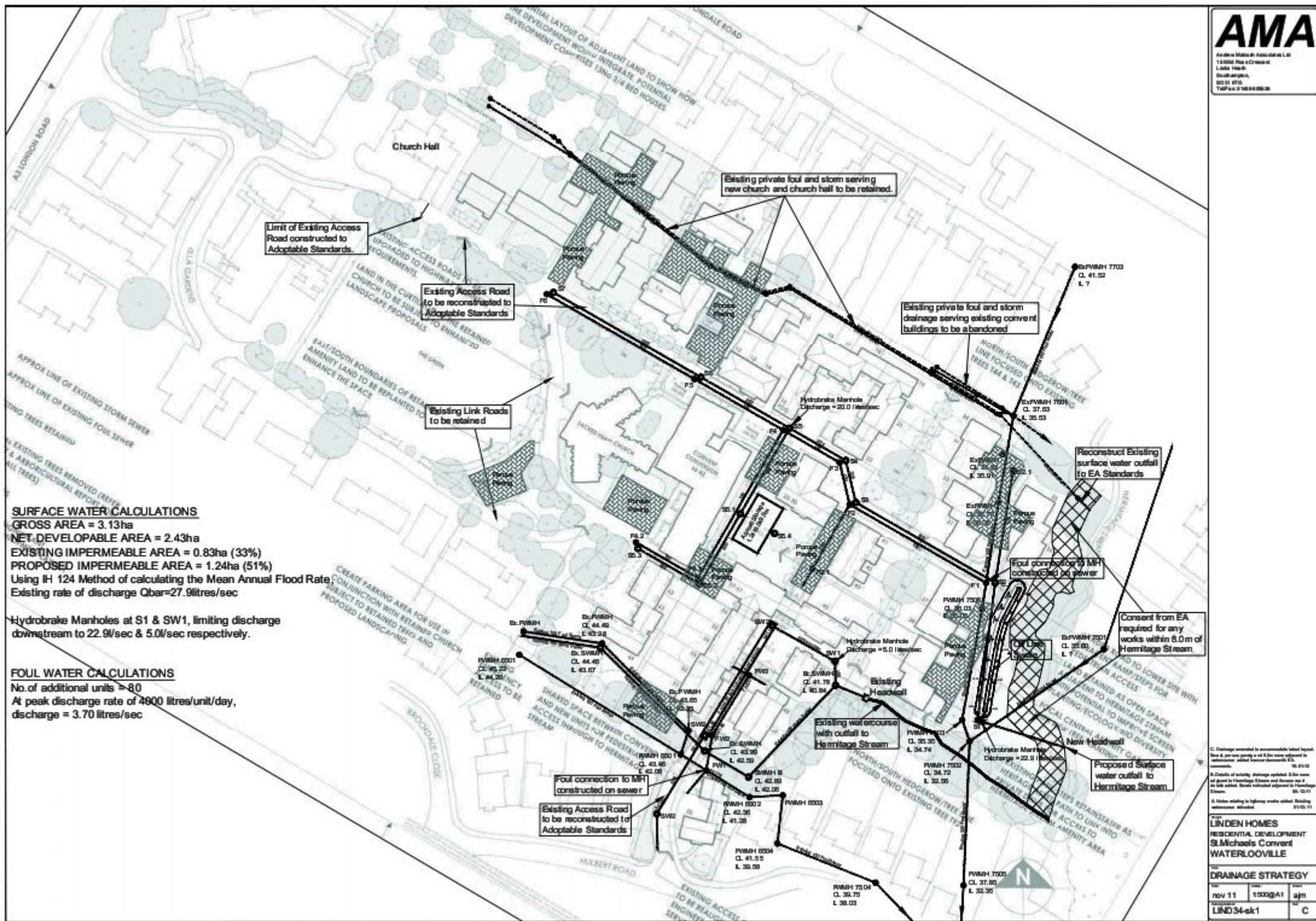
DATE: 10/10/2023

PROJECT: 10/10/2023

PP1144 SK12

Appendix 3

DRAINAGE STRATEGY



Appendix 4

ENVIRONMENT AGENCY CORRESPONDENCE

Andrew Malcolm

From: "Waite, Rob" <robert.waite@environment-agency.gov.uk>
Date: 20 February 2012 10:20
To: "Andrew Malcolm" <amassoc@ntlworld.com>
Subject: RE: Environment Agency Response ref.HA/2011/112395/02-L01, St.Michaels Convent, Waterloooville

Dear Mr Malcolm,

Thank you for confirming the drainage arrangement at MH SW1. I can confirm that in principle the drainage scheme proposed is acceptable subject to the provision of detailed calculations.

Regards

Rob Waite

Development and Flood Risk Officer

Environment Agency
Solent and South Downs Area
Colvedene Court
Wessex Way
Colden Common
Winchester
Hampshire
SO21 1WP

Tel: 01962 764897

e-mail: robert.waite@environment-agency.gov.uk

We would be really grateful if you could spare five minutes to help us improve our service. Please click on the link below and fill in our survey - we use every piece of feedback we receive.

<http://goo.gl/mHxkR>

-----Original Message-----

From: Andrew Malcolm [mailto:amassoc@ntlworld.com]

Sent: 13 February 2012 08:56

To: Waite, Rob

Cc: Michael.O'Brien@lindenhomes.co.uk

Subject: Environment Agency Response ref.HA/2011/112395/02-L01, St.Michaels Convent, Waterloooville

Dear Mr.Waite,

Thank you for your attached letter dated the 10th February.

I note that you have no objections to the drainage proposals for the above site, but require confirmation regarding the connection upstream of MH SW1.

The 300dia. storm sewer shown on the drawing is an existing sewer serving the properties in Villa Gardens. No connections are made to this sewer from the proposed development, other than via MH SW1. All the surface water run-off from the proposed development will therefore be stored/attenuated before discharging to the existing sewer.

I trust this clarifies the proposed arrangement for you, so that you are able to confirm your approval. If you should have any further queries however, please do not hesitate to contact me.

Regards
Andrew Malcolm
AMA Ltd
tel.01489 605526

From: <planning.southdowns@environment-agency.gov.uk>

Sent: Friday, February 10, 2012 4:58 PM

To: <amassoc@ntlworld.com>

Subject: Environment Agency Response to:

- > The proposal has been reviewed and I enclose the Environment Agency's
- > comments on:
- > St. Michael's Convent
- > London Road
- > Waterlooville
- > Hampshire
- >
- > LPA ref:
- >
- >
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- > the sender immediately, delete it and do not copy it to anyone else.
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- > We have checked this email and its attachments for viruses. But you should
- > still check any attachment before opening it.
- > We may have to make this message and any reply to it public if asked to
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- >
- > If we have sent you information and you wish to use it please read our
- > terms and conditions which you can get by calling us on 08708 506 506.

Mr Andrew Malcolm
Andrew Malcolm Associates Ltd.
15 Wild Rose Crescent
Locks Heath
Southampton
SO31 6TG

Our ref: HA/2011/112395/02-L01

Your ref:

Date: 10 February 2012

Dear Mr Malcolm,

**PROPOSED RESIDENTIAL DEVELOPMENT AT ST MICHAEL'S CONVENT,
LONDON ROAD, WATERLOOVILLE - REVISED DRAINAGE STRATEGY TO
INCLUDE EXTRA BUILDINGS AND THE INCLUSION OF PERMEABLE PAVING
AND SWALE.**

ST. MICHAEL'S CONVENT, LONDON ROAD, WATERLOOVILLE, HAMPSHIRE

Thank you for submitting the revised drainage information for the St Michaels Convent development site.

The inclusion of a swale and porous paving within the drainage system is welcomed and in principle the proposed drainage strategy is acceptable. My previous comments with regards to the provision of drainage calculations to confirm the rate and long term storage requirements still apply.

One further issue that requires confirmation is the discharge arrangement at the SW1 hydrobrake. This feature in the drainage drawing appears to be sited upstream of another drainage route (300 storm sewer) and therefore potentially this source would be unattenuated before entering the existing headwall and being discharged to the Hermitage Stream. Can you please confirm the final arrangement for this discharge point please.

Please note that the view expressed in this letter by the Environment Agency is a response to a pre application enquiry only and does not represent our final view in relation to any future planning application made in relation to this site. We reserve the right to change our position in relation to any such application.

Should you require any further assistance please do not hesitate to contact me on the number shown below.

Environment Agency
Wessex Business Park (Colvedene Court) Wessex Way, Colden Common, Winchester, SO21 1WP.
Customer services line: 03708 506 506
www.environment-agency.gov.uk

Cont/d..

Yours sincerely

Rob Waite
Development & Flood Risk Officer

Direct dial: 01962 764897

Direct e-mail: robert.waite@environment-agency.gov.uk

On behalf of Planning Liaison

Appendix 5

DRAINAGE CALCULATIONS

Andrew Malcolm Associates Ltd		Page 1
15 Wild Rose Crescent	lin100+30% 30min	
Southampton	OUTFALL 1	
SO31 6TG	St.Michaels Convent	
Date 19-01-12	Designed By AJM	
File OUTFALL 1 lin100+30% 3...	Checked By	
Micro Drainage	Simulation W.11.2	

Summary of Results

Return Period (years)	100
Storm Duration (mins)	30
Profile Type	Winter
Margin for Flood Risk warning (mm)	300
Analysis Time Step	2.5 second increment (extended)
DTS Status	ON
DVD Status	ON
Inertia Status	ON

PN	Water Lev. (m)	Surcharged Depth (m)	Flooded Vol (m³)	Flow/ Capacity	Overflow (l/s)	Pipe Flow (l/s)	Status
1.000	45.015	-0.110	0.000	0.51	0.0	41.9	O K
1.001	44.117	0.392	0.000	1.17	0.0	103.1	SURCH'ED
2.000	43.430	0.105	0.000	1.14	0.0	68.2	SURCH'ED
2.001	43.165	0.189	0.000	0.15	0.0	143.0	SURCH'ED
3.000	43.165	-0.045	0.000	0.00	0.0	0.2	O K
2.002	43.165	0.315	0.000	0.02	0.0	23.4	SURCH'ED
1.002	43.207	1.185	0.000	0.36	0.0	20.8	SURCH'ED
1.003	41.583	-0.142	0.000	0.29	0.0	35.6	O K
1.004	39.072	-0.153	0.000	0.22	0.0	35.6	O K
4.000	35.082	-0.143	0.000	0.28	0.0	23.6	O K
1.005	33.737	0.427	0.000	0.08	0.0	86.2	SURCH'ED
5.000	33.735	-0.269	0.000	0.00	0.0	0.1	FLD RISK
1.006	33.735	1.310	0.000	0.19	0.0	21.1	SURCH'ED

Andrew Malcolm Associates Ltd		Page 1
15 Wild Rose Crescent	lin100+30% 60min	
Southampton	OUTFALL 1	
SO31 6TG	St.Michaels Convent	
Date 19-01-12	Designed By AJM	
File OUTFALL 1 lin100+30% 6...	Checked By	
Micro Drainage	Simulation W.11.2	

Summary of Results

Return Period (years)	100
Storm Duration (mins)	60
Profile Type	Winter
Margin for Flood Risk warning (mm)	300
Analysis Time Step	2.5 second increment (extended)
DTS Status	ON
DVD Status	ON
Inertia Status	ON

PN	Water Lev. (m)	Surcharged Depth (m)	Flooded Vol (m³)	Flow/ Capacity	Overflow (l/s)	Pipe Flow (l/s)	Status
1.000	44.990	-0.135	0.000	0.34	0.0	27.6	O K
1.001	43.788	0.063	0.000	0.78	0.0	68.9	SURCH'ED
2.000	43.779	0.454	0.000	0.75	0.0	44.7	SURCH'ED
2.001	43.765	0.789	0.000	0.10	0.0	93.9	FLD RISK
3.000	43.763	0.553	0.000	0.00	0.0	1.8	FLD RISK
2.002	43.764	0.914	0.000	0.02	0.0	23.5	FLD RISK
1.002	43.762	1.740	0.000	0.45	0.0	25.5	FLD RISK
1.003	41.576	-0.149	0.000	0.24	0.0	30.1	O K
1.004	39.067	-0.158	0.000	0.19	0.0	30.2	O K
4.000	35.065	-0.160	0.000	0.19	0.0	15.5	O K
1.005	33.895	0.585	0.000	0.06	0.0	65.8	SURCH'ED
5.000	33.893	-0.111	0.000	0.00	0.0	0.1	FLD RISK
1.006	33.893	1.468	0.000	0.20	0.0	22.2	SURCH'ED

Andrew Malcolm Associates Ltd		Page 1
15 Wild Rose Crescent	lin100+30% 120min	
Southampton	OUTFALL 1	
SO31 6TG	St.Michaels Convent	
Date 19-01-12	Designed By AJM	
File OUTFALL 1 lin100+30% 1...	Checked By	
Micro Drainage	Simulation W.11.2	

Summary of Results

Return Period (years)	100
Storm Duration (mins)	120
Profile Type	Winter
Margin for Flood Risk warning (mm)	300
Analysis Time Step	2.5 second increment (extended)
DTS Status	ON
DVD Status	ON
Inertia Status	ON

PN	Water Lev. (m)	Surcharged Depth (m)	Flooded Vol (m³)	Flow/ Capacity	Overflow (l/s)	Pipe Flow (l/s)	Status
1.000	44.969	-0.156	0.000	0.21	0.0	17.0	O K
1.001	43.722	-0.003	0.000	0.48	0.0	42.3	O K
2.000	43.713	0.388	0.000	0.46	0.0	27.4	SURCH'ED
2.001	43.700	0.724	0.000	0.06	0.0	57.7	FLD RISK
3.000	43.699	0.489	0.000	0.00	0.0	0.4	FLD RISK
2.002	43.699	0.849	0.000	0.02	0.0	23.8	SURCH'ED
1.002	43.698	1.676	0.000	0.44	0.0	25.1	SURCH'ED
1.003	41.571	-0.154	0.000	0.22	0.0	26.8	O K
1.004	39.062	-0.163	0.000	0.17	0.0	26.8	O K
4.000	35.050	-0.175	0.000	0.11	0.0	9.5	O K
1.005	34.004	0.694	0.000	0.05	0.0	47.7	SURCH'ED
5.000	33.996	-0.008	0.000	0.00	0.0	1.6	FLD RISK
1.006	34.002	1.577	0.000	0.20	0.0	22.9	SURCH'ED

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15 Wild Rose Crescent	lin100+30% 180min	
Southampton	OUTFALL 1	
SO31 6TG	St.Michaels Convent	
Date 19-01-12	Designed By AJM	
File OUTFALL 1 lin100+30% 1...	Checked By	
Micro Drainage	Simulation W.11.2	

Summary of Results

Return Period (years)	100
Storm Duration (mins)	180
Profile Type	Winter
Margin for Flood Risk warning (mm)	300
Analysis Time Step	2.5 second increment (extended)
DTS Status	ON
DVD Status	ON
Inertia Status	ON

PN	Water Lev. (m)	Surcharged Depth (m)	Flooded Vol (m³)	Flow/ Capacity	Overflow (l/s)	Pipe Flow (l/s)	Status
1.000	44.958	-0.167	0.000	0.15	0.0	12.5	O K
1.001	43.592	-0.133	0.000	0.35	0.0	31.2	O K
2.000	43.318	-0.007	0.000	0.34	0.0	20.2	O K
2.001	43.307	0.331	0.000	0.04	0.0	42.7	SURCH'ED
3.000	43.306	0.096	0.000	0.00	0.0	0.2	SURCH'ED
2.002	43.306	0.456	0.000	0.02	0.0	23.3	SURCH'ED
1.002	43.244	1.222	0.000	0.38	0.0	22.0	SURCH'ED
1.003	41.568	-0.157	0.000	0.19	0.0	24.0	O K
1.004	39.059	-0.166	0.000	0.15	0.0	24.0	O K
4.000	35.044	-0.181	0.000	0.08	0.0	7.0	O K
1.005	33.989	0.679	0.000	0.04	0.0	39.6	SURCH'ED
5.000	33.987	-0.017	0.000	0.00	0.0	0.2	FLD RISK
1.006	33.987	1.562	0.000	0.20	0.0	22.8	SURCH'ED

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15 Wild Rose Crescent	lin100+30% 240min	
Southampton	OUTFALL 1	
SO31 6TG	St.Michaels Convent	
Date 19-01-12	Designed By AJM	
File OUTFALL 1 lin100+30% 2...	Checked By	
Micro Drainage	Simulation W.11.2	

Summary of Results

Return Period (years)	100
Storm Duration (mins)	240
Profile Type	Winter
Margin for Flood Risk warning (mm)	300
Analysis Time Step	2.5 second increment (extended)
DTS Status	ON
DVD Status	ON
Inertia Status	ON

PN	Water Lev. (m)	Surcharged Depth (m)	Flooded Vol (m³)	Flow/ Capacity	Overflow (l/s)	Pipe Flow (l/s)	Status
1.000	44.952	-0.173	0.000	0.12	0.0	10.0	O K
1.001	43.581	-0.144	0.000	0.28	0.0	25.0	O K
2.000	43.186	-0.139	0.000	0.27	0.0	16.2	O K
2.001	43.172	0.196	0.000	0.04	0.0	34.2	SURCH'ED
3.000	43.170	-0.040	0.000	0.00	0.0	0.2	O K
2.002	43.170	0.320	0.000	0.02	0.0	21.4	SURCH'ED
1.002	43.193	1.171	0.000	0.36	0.0	20.9	SURCH'ED
1.003	41.566	-0.159	0.000	0.18	0.0	22.8	O K
1.004	39.057	-0.168	0.000	0.14	0.0	22.8	O K
4.000	35.038	-0.187	0.000	0.07	0.0	5.6	O K
1.005	33.948	0.638	0.000	0.03	0.0	34.8	SURCH'ED
5.000	33.945	-0.059	0.000	0.00	0.0	1.0	FLD RISK
1.006	33.945	1.520	0.000	0.20	0.0	22.5	SURCH'ED

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15 Wild Rose Crescent	lin100+30% 360min	
Southampton	OUTFALL 1	
SO31 6TG	St.Michaels Convent	
Date 19-01-12	Designed By AJM	
File OUTFALL 1 lin100+30% 3...	Checked By	
Micro Drainage	Simulation W.11.2	

Summary of Results

Return Period (years)	100
Storm Duration (mins)	360
Profile Type	Winter
Margin for Flood Risk warning (mm)	300
Analysis Time Step	2.5 second increment (extended)
DTS Status	ON
DVD Status	ON
Inertia Status	ON

PN	Water Lev. (m)	Surcharged Depth (m)	Flooded Vol (m³)	Flow/ Capacity	Overflow (l/s)	Pipe Flow (l/s)	Status
1.000	44.945	-0.180	0.000	0.09	0.0	7.3	O K
1.001	43.569	-0.156	0.000	0.21	0.0	18.1	O K
2.000	43.167	-0.158	0.000	0.20	0.0	11.7	O K
2.001	42.986	0.010	0.000	0.03	0.0	24.9	SURCH'ED
3.000	42.984	-0.226	0.000	0.00	0.0	0.2	O K
2.002	42.984	0.134	0.000	0.02	0.0	18.3	SURCH'ED
1.002	43.020	0.998	0.000	0.34	0.0	19.4	SURCH'ED
1.003	41.563	-0.162	0.000	0.17	0.0	21.2	O K
1.004	39.055	-0.170	0.000	0.13	0.0	21.2	O K
4.000	35.032	-0.193	0.000	0.05	0.0	4.1	O K
1.005	33.873	0.563	0.000	0.03	0.0	29.5	SURCH'ED
5.000	33.871	-0.133	0.000	0.00	0.0	0.7	FLD RISK
1.006	33.871	1.446	0.000	0.20	0.0	22.0	SURCH'ED

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15 Wild Rose Crescent	lin100+30% 480min	
Southampton	OUTFALL 1	
SO31 6TG	St.Michaels Convent	
Date 19-01-12	Designed By AJM	
File OUTFALL 1 lin100+30% 4...	Checked By	
Micro Drainage	Simulation W.11.2	

Summary of Results

Return Period (years)	100
Storm Duration (mins)	480
Profile Type	Winter
Margin for Flood Risk warning (mm)	300
Analysis Time Step	2.5 second increment (extended)
DTS Status	ON
DVD Status	ON
Inertia Status	ON

PN	Water Lev. (m)	Surcharged Depth (m)	Flooded Vol (m³)	Flow/ Capacity	Overflow (l/s)	Pipe Flow (l/s)	Status
1.000	44.939	-0.186	0.000	0.07	0.0	5.8	O K
1.001	43.561	-0.164	0.000	0.16	0.0	14.5	O K
2.000	43.159	-0.166	0.000	0.16	0.0	9.4	O K
2.001	42.831	-0.145	0.000	0.02	0.0	19.9	O K
3.000	42.826	-0.384	0.000	0.00	0.0	0.3	O K
2.002	42.826	-0.024	0.000	0.01	0.0	14.0	O K
1.002	42.807	0.785	0.000	0.32	0.0	18.3	SURCH'ED
1.003	41.560	-0.165	0.000	0.16	0.0	19.9	O K
1.004	39.053	-0.172	0.000	0.13	0.0	19.9	O K
4.000	35.029	-0.196	0.000	0.04	0.0	3.2	O K
1.005	33.813	0.503	0.000	0.03	0.0	26.3	SURCH'ED
5.000	33.810	-0.194	0.000	0.00	0.0	0.4	FLD RISK
1.006	33.811	1.386	0.000	0.19	0.0	21.6	SURCH'ED

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15 Wild Rose Crescent	lin100+30% 480min	
Southampton	OUTFALL 1	
SO31 6TG	St.Michaels Convent	
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File OUTFALL 1 lin100+30% 4...	Checked By	
Micro Drainage	Simulation W.11.2	

Global Variables

Region	FSR - England & Wales
Return Period (yrs)	100
M5-60 (mm)	20.000
Ratio R	0.400
Volumetric Runoff Coef	0.840
Profile Type	Winter
PIMP (%)	100
Areal Reduction Factor	1.000
Storm Duration (mins)	480
Hot Start (mins)	0
Hot Start Level (mm)	0
Manhole Headloss Coefficient	0.500
MADD Factor * 10m ³ /ha Storage	2.000
Foul Sewage/Hectare (l/s)	0.00
Additional Flow - % of Total Flow	30
Number of Input Hydrographs	0
Number of Time/Area Diagrams	8
Number of Bifurcations	0
Number of Overflows	0
Number of Off-Line Controls	0
Number of On-Line Controls	4

Starting Storm file name

\\HP2\Users\Public\Documents\PROJECTS\LINDEN\WATERLOOVILLE\WINDES\STORM1.SWS

Time/Area Diagram at Pipe Number 1.000

Time	(mins)	Area
From:	To:	(ha)

0	4	0.091
---	---	-------

Total Area (ha) 0.091

Time/Area Diagram at Pipe Number 1.001

Time	(mins)	Area
From:	To:	(ha)

0	4	0.136
---	---	-------

Total Area (ha) 0.136

Time/Area Diagram at Pipe Number 2.000

Time	(mins)	Area
From:	To:	(ha)

0	4	0.147
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Total Area (ha) 0.147

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15 Wild Rose Crescent	lin100+30% 480min	
Southampton	OUTFALL 1	
SO31 6TG	St.Michaels Convent	
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File OUTFALL 1 lin100+30% 4...	Checked By	
Micro Drainage	Simulation W.11.2	

Time/Area Diagram at Pipe Number 2.001

Time	(mins)	Area
From:	To:	(ha)
0	4	0.171
Total Area (ha)		0.171

Time/Area Diagram at Pipe Number 1.002

Time	(mins)	Area
From:	To:	(ha)
0	4	0.068
Total Area (ha)		0.068

Time/Area Diagram at Pipe Number 1.003

Time	(mins)	Area
From:	To:	(ha)
0	4	0.041
Total Area (ha)		0.041

Time/Area Diagram at Pipe Number 4.000

Time	(mins)	Area
From:	To:	(ha)
0	4	0.051
Total Area (ha)		0.051

Time/Area Diagram at Pipe Number 1.005

Time	(mins)	Area
From:	To:	(ha)
0	4	0.075
Total Area (ha)		0.075

Freely Discharging Outfalls

Outfall Pipe Number	Outfall MH/No	C.Level (m)	I.Level (m)	D,L (mm)	B (mm)
1.006	HW	31.500	30.700	1200	0

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15 Wild Rose Crescent	lin100+30% 480min	
Southampton	OUTFALL 1	
SO31 6TG	St.Michaels Convent	
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File OUTFALL 1 lin100+30% 4...	Checked By	
Micro Drainage	Simulation W.11.2	

On-Line Controls (Hydro-Brake®)

US/PN	Volume (m³)	Ctrl MH Name	Invert (m)	Type	Dia (m)	D.Head (m)	D.Flow (l/s)	Headloss (m)	Flow (l/s)
1.001	1.206	S5	41.797	Md4	0.153	1.200	20.0	0.2	13.0
								0.4	17.1
								0.6	15.1
								0.8	16.4
								1.0	18.2
								1.4	21.6
								1.8	24.5
								2.2	27.0
								2.6	29.4
2.002	18.347	S5	41.797	Md4	0.153	1.200	20.0	0.2	13.0
								0.4	17.1
								0.6	15.1
								0.8	16.4
								1.0	18.2
								1.4	21.6
								1.8	24.5
								2.2	27.0
								2.6	29.4
1.005	26.280	S1	32.200	Md4	0.148	1.800	22.9	0.2	12.5
								0.4	15.5
								0.6	13.9
								0.8	15.3
								1.0	17.1
								1.4	20.2
								1.8	22.9
								2.2	25.3
								2.6	27.5
5.000	22.619	S1	32.200	Md4	0.148	1.800	22.9	3.0	29.5
								3.4	31.4
								3.8	33.2
								0.2	12.5
								0.4	15.5
								0.6	13.9
								0.8	15.3
								1.0	17.1
								1.4	20.2
								1.8	22.9
								2.2	25.3
								2.6	27.5
								3.0	29.5
								3.4	31.4
								3.8	33.2

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15 Wild Rose Crescent	lin100+30% 480min	
Southampton	OUTFALL 1	
SO31 6TG	St.Michaels Convent	
Date 19-01-12	Designed By AJM	
File OUTFALL 1 lin100+30% 4...	Checked By	
Micro Drainage	Simulation W.11.2	

Network Details

PN	Length (m)	Fall (m)	Slope (1:x)	Area (ha)	T.E. (mins)	Rain Pro	k (mm)	Hyd Sect	Dia (mm)
1.000	52.80	1.400	37.7	0.000	5.00	1	0.600	o	225
1.001	31.75	1.028	30.9	0.000	0.00	1	0.600	o	225
2.000	22.16	0.349	63.5	0.000	5.00	1	0.600	o	225
2.001	25.21	0.126	200.1	0.000	0.00	1	0.600	o	900
3.000	9.00	0.060	150.0	0.000	5.00	1	0.600	_	-2
2.002	30.64	0.153	200.3	0.000	0.00	1	0.600	o	900
1.002	20.09	0.297	67.6	0.000	0.00	1	0.600	o	225
1.003	13.43	1.000	13.4	0.000	0.00	1	0.600	o	225
1.004	50.00	5.000	10.0	0.000	0.00	1	0.600	o	225
4.000	35.11	1.000	35.1	0.000	5.00	1	0.600	o	225
1.005	43.11	0.210	205.3	0.000	0.00	1	0.600	o	900
5.000	42.00	0.004	9900.0	0.000	5.00	1	0.600	\/	-1
1.006	28.30	1.500	18.9	0.000	0.00	1	0.600	o	225
PN	USMH No.	US/CL (m)	US/IL (m)	US C.Depth (m)	DS/CL (m)	DS/IL (m)	DS C.Depth (m)	Ctrl No.	US/MH (mm)
1.000	S7	46.400	44.900	1.275	45.000	43.500	1.275		1050
1.001	S6	45.000	43.500	1.275	44.000	42.472	1.303		1050
2.000	S5.3	44.640	43.100	1.315	44.000	42.751	1.024		1050
2.001	S5.2	44.000	42.076	1.024	44.000	41.950	1.150		1800
3.000	S5.4	43.800	42.010	0.590	44.000	41.950	0.850		
2.002	S5.1	44.000	41.950	1.150	44.000	41.797	1.303		1800
1.002	S5	44.000	41.797	1.978	43.000	41.500	1.275	9	1800
1.003	S4	43.000	41.500	1.275	42.200	40.500	1.475		1050
1.004	S3	42.200	39.000	2.975	35.500	34.000	1.275		1200
4.000	S2.1	37.000	35.000	1.775	35.500	34.000	1.275		1200
1.005	S2	35.500	32.410	2.190	34.500	32.200	1.400		1800
5.000	SWALE	34.000	33.304	-0.004	34.500	33.300	0.500		
1.006	S1	34.500	32.200	2.075	31.500	30.700	0.575	9	1800

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15 Wild Rose Crescent	lin100+30% 480min	
Southampton	OUTFALL 1	
SO31 6TG	St.Michaels Convent	
Date 19-01-12	Designed By AJM	
File OUTFALL 1 lin100+30% 4...	Checked By	
Micro Drainage	Simulation W.11.2	

The following hydraulic sections have been used in this network

NOTE: Diameters less than 66 refer to section numbers of hydraulic conduits. These conduits are marked by the symbols:- [] box culvert, \ / open channel, oo dual pipe, ooo triple pipe, O egg.

Section numbers < 0 are taken from the file CONDUITS.SEC

Section Number	Conduit Type	Major Dimn. (mm)	Minor Dimn. (mm)	Side Slope (Deg)	Corner Splay (mm)	4*Hyd Radius (m)	XSect Area (m ²)
-1	\ /	1000	700	30		1.631	1.549
-2	_	16000	1200			4.174	19.200

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15 Wild Rose Crescent	OUTFALL 2	
Southampton	St.Michaels Convent	
SO31 6TG	Waterlooville	
Date 19-01-12	Designed By ajm	
File OUTFALL 2.src	Checked By	
Micro Drainage	Source Control W.11.2	

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

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	3.9	3.9	41.7453	0.5852	46.2	O K
30 Summer	4.2	4.2	41.8948	0.7348	58.9	O K
60 Summer	4.5	4.5	42.0138	0.8538	69.0	O K
120 Summer	4.6	4.6	42.0653	0.9053	73.4	O K
180 Summer	4.6	4.6	42.0543	0.8943	72.5	O K
240 Summer	4.5	4.5	42.0318	0.8718	70.6	O K
360 Summer	4.4	4.4	41.9828	0.8228	66.4	O K
480 Summer	4.3	4.3	41.9353	0.7753	62.4	O K
600 Summer	4.2	4.2	41.8903	0.7303	58.5	O K
720 Summer	4.0	4.0	41.8468	0.6868	54.9	O K
960 Summer	3.9	3.9	41.7663	0.6063	48.0	O K
1440 Summer	3.9	3.9	41.6202	0.4602	35.6	O K
2160 Summer	3.9	3.9	41.4378	0.2777	20.1	O K
2880 Summer	3.7	3.7	41.3473	0.1872	12.4	O K
4320 Summer	2.9	2.9	41.2783	0.1183	6.5	O K
5760 Summer	2.4	2.4	41.2503	0.0903	4.2	O K
7200 Summer	2.1	2.1	41.2363	0.0763	3.0	O K
8640 Summer	1.8	1.8	41.2258	0.0658	2.2	O K
10080 Summer	1.6	1.6	41.2183	0.0582	1.7	O K
15 Winter	4.0	4.0	41.8148	0.6548	52.1	O K
30 Winter	4.4	4.4	41.9858	0.8258	66.7	O K
60 Winter	4.7	4.7	42.1268	0.9668	78.6	O K
120 Winter	5.0	5.0	42.2203	1.0603	84.8	O K
180 Winter	4.9	4.9	42.1923	1.0323	83.7	O K
240 Winter	4.8	4.8	42.1593	0.9993	81.4	O K
360 Winter	4.7	4.7	42.0943	0.9343	75.9	O K
480 Winter	4.5	4.5	42.0263	0.8663	70.1	O K

Storm Duration (mins)	Rain (mm/hr)	Time-Peak (mins)
15 Summer	128.29	21
30 Summer	84.23	35
60 Summer	52.66	64
120 Summer	31.80	120
180 Summer	23.35	150
240 Summer	18.64	180
360 Summer	13.54	250
480 Summer	10.79	318
600 Summer	9.04	386
720 Summer	7.82	456
960 Summer	6.22	590
1440 Summer	4.49	852
2160 Summer	3.24	1192
2880 Summer	2.57	1504
4320 Summer	1.85	2212
5760 Summer	1.46	2936
7200 Summer	1.22	3672
8640 Summer	1.05	4400
10080 Summer	0.92	5136
15 Winter	128.29	21
30 Winter	84.23	35
60 Winter	52.66	62
120 Winter	31.80	118
180 Winter	23.35	168
240 Winter	18.64	190
360 Winter	13.54	268
480 Winter	10.79	344

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15 Wild Rose Crescent	OUTFALL 2	
Southampton	St.Michaels Convent	
SO31 6TG	Waterlooville	
Date 19-01-12	Designed By ajm	
File OUTFALL 2.src	Checked By	
Micro Drainage	Source Control W.11.2	

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

Storm Duration (mins)	Maximum Control (l/s)	Maximum Outflow (l/s)	Maximum Water Level (m OD)	Maximum Depth (m)	Maximum Volume (m³)	Status
600 Winter	4.3	4.3	41.9598	0.7998	64.5	O K
720 Winter	4.2	4.2	41.8963	0.7363	59.1	O K
960 Winter	3.9	3.9	41.7778	0.6178	49.0	O K
1440 Winter	3.9	3.9	41.5552	0.3952	30.1	O K
2160 Winter	3.7	3.7	41.3453	0.1852	12.2	O K
2880 Winter	3.0	3.0	41.2873	0.1273	7.3	O K
4320 Winter	2.3	2.3	41.2433	0.0833	3.6	O K
5760 Winter	1.8	1.8	41.2263	0.0663	2.2	O K
7200 Winter	1.5	1.5	41.2153	0.0552	1.6	O K
8640 Winter	1.3	1.3	41.2078	0.0477	1.2	O K
10080 Winter	1.1	1.1	41.2023	0.0422	0.9	O K

Storm Duration (mins)	Rain (mm/hr)	Time-Peak (mins)
600 Winter	9.04	418
720 Winter	7.82	492
960 Winter	6.22	634
1440 Winter	4.49	896
2160 Winter	3.24	1172
2880 Winter	2.57	1528
4320 Winter	1.85	2208
5760 Winter	1.46	2936
7200 Winter	1.22	3632
8640 Winter	1.05	4360
10080 Winter	0.92	5120

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15 Wild Rose Crescent	OUTFALL 2	
Southampton	St.Michaels Convent	
SO31 6TG	Waterlooville	
Date 19-01-12	Designed By ajm	
File OUTFALL 2.src	Checked By	
Micro Drainage	Source Control W.11.2	

Rainfall Details

Region	ENG+WAL	Shortest Storm (mins)	15
Return Period (years)	100	Longest Storm (mins)	10080
M5-60 (mm)	20.000	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) = 0.208

Time from:	(mins) to:	Area (ha)	Time from:	(mins) to:	Area (ha)
0	4	0.104	4	8	0.104

Andrew Malcolm Associates Ltd		Page 4
15 Wild Rose Crescent	OUTFALL 2	
Southampton	St.Michaels Convent	
SO31 6TG	Waterlooville	
Date 19-01-12	Designed By ajm	
File OUTFALL 2.src	Checked By	
Micro Drainage	Source Control W.11.2	

Box Culvert Details

Height (m) 1.000 Width (m) 2.000 Invert Level (m) 41.160
 Length (m) 42.000 Slope (1:x) 500.0 Cover Level (m) 43.000

Hydro-Brake Outflow Control

Design Head (m) 1.100 Hydro-Brake Type MD6 Invert Level (m) 41.160
 Design Flow (l/s) 5.0 Diameter (mm) 92

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	2.7	0.80	4.3	2.00	6.8	4.00	9.6	7.00	12.8
0.20	3.9	1.00	4.8	2.20	7.1	4.50	10.2	7.50	13.2
0.30	3.7	1.20	5.3	2.40	7.5	5.00	10.8	8.00	13.6
0.40	3.5	1.40	5.7	2.60	7.8	5.50	11.3	8.50	14.1
0.50	3.6	1.60	6.1	3.00	8.3	6.00	11.8	9.00	14.5
0.60	3.8	1.80	6.5	3.50	9.0	6.50	12.3	9.50	14.9