

The Lillies, Yapton Road, Barnham

Flood Risk Assessment and Drainage Strategy Compliance Report (Discharge of Planning Conditions 6, 9, 10 and 15)

February 2018
Revision B

Civil Engineering Consultants

Partners

Alan L. Brown MSc
Tom Francis ACIAT IEng BA(Hons)
John G. Freeman MEng CEng NICE
Jason Lambert BA(Hons)
Carmel Wilson

Associate Directors

George Brown-Rold BA(Hons) MCHT
Matthew Ford
Eric McCormick BSc MICE MCHT
Juliette Withney MAAT (Practice Manager)

Associate

Peter Kemmerley BSc(Hons)

Woods Hardwick Infrastructure LLP

Registered in England & Wales No. 0325811
Registered Address
Equinox House
Iscon Place
Bedford MK40 3LE

CONTENTS

1.0	INTRODUCTION	2
2.0	PROPOSED DEVELOPMENT	4
3.0	OVERVIEW OF APPROVED FRA AND DRAINAGE STRATEGY	5
4.0	PROPOSED DRAINAGE STRATEGY	6
5.0	MAINTENANCE	7
6.0	COMPLIANCE	9

APPENDICES

Appendix A	Approved Flood Risk and Water Management Assessment (ref: IT1543FRA08.07.15_issue)
Appendix B	Site Location Plan
Appendix C	Planning Layout
Appendix D	Drainage Strategy Drawing
Appendix E	Microdrainage Modelling Output
Appendix F	Landscape Proposals and SUDS Depression Section

REPORT REFERENCE 17748/FRA-C

REVISION HISTORY

Revision	Amendments	Prepared By	Reviewed By	Date
First Issue	N/A	KEC	J GF	04/05/2017
A	Updated to suit revised Drainage Strategy Drawing	KEC	J GF	27/11/2017
B	Masterplan and calculations updated	J GF	J GF	22/02/2018

1.0 INTRODUCTION

1.1 This Flood Risk Assessment (FRA) and Drainage Strategy Compliance Report has been prepared on behalf of Matthew Homes Ltd in support of their Reserved Matters application for the proposed development known as The Lillies, Yapton Road, Barnham.

1.2 The purpose of this report is to demonstrate that the proposed drainage design complies with the approved Flood Risk and Water Management Assessment (ref: IT1543FRA08.07.15_issue) carried out by Intermodal Transportation Limited, dated July 2015 and to allow discharge of Planning Conditions 6, 9,10 and 15 of the outline consent (ref BN/32/15/OUT). A copy of the approved Flood Risk and Water Management Assessment can be found in Appendix A.

1.3 Planning condition 6 is related to the surface water drainage principles and states:

[illegible][illegible]

° QH↑EIXTBZLH↑IIXIXQIE IXTITLHGDpDdF↑LIIIW/EIXTB ZLH↑BTH LTB ixixLXHX
↑IH IE IX. w9 按EXIGICL LixIX↑O=ZGzT↑←HTO IXLixX↑FD OTGEIIX%LIE=GHJPLIX
OTKLLET

bIX G6UE DdVzT IXd Xto QPQD dIXixt ↑↑ Qnd z↑t↑ oLkUfET ↓↑t I t↑↑tUE Dd iXIXx↑= Dd GTT II Gix It Pto GPddXoUtt zGp Dd Lf↑tto otPLG UDb Dd otPLG IXLf↑tto DdVzT I kPLKto QeIXX zIXAtE IXot↑IXIxix↑t↑

1.4 Planning condition 9 is related to the future access and maintenance of the watercourse and states:

[illegible]

bIXdIX↑↑dIXIXix↑I↑to↑<DdD>=Cz↑↑G↑d↑↑I↑C↑B↑<↑↑>↑B↑IX↑I↑↑<↑IXI↑>↑↑C↑A↑E↑<D↑>
 ↑<X↑>↑I↑C↑↑I↑↑↑↑↑↑↑↑↑IXIXIXC↑G↑↑IXI↑<↑>↑<↑>↑IX↑↑IXIXI↑<↑>↑I↑IXIXIXI↑<↑>

1.5 Planning condition 10 is related to the surface water drainage principles and states:

[illegible]

5↑↑L0IXDIX>↑D↑↑D↑↑IT↑↑D↑↑IT IUGNUGTO IUT IUTLEETO IUT↑↑DIXIX↑↑DIXIX

1.6 Planning condition 15 is related to the foul water drainage principles and states:

[illegible]

2.0 PROPOSED DEVELOPMENT

- 2.1 Barnham is located within West Sussex, approximately 5.6km north east of Bognor Regis and 10.4km east of Chichester. The site itself covers some 1.1ha and is located to the south east of Barnham, to the south of Yapton Road. A Site Location Plan is included within Appendix B.
- 2.2 The site has previously been used as a holiday park which included static caravans, touring caravans, fixed chalets and areas for tents. The site is currently abutted: by open agricultural land to the south, residential dwellings to the west and to the east by a site containing glass houses and poly tunnels.
- 2.3 The proposal is for the construction of 38 residential dwellings, vehicular access will be provided via Yapton Road. A Planning Layout for the site can be found in Appendix C.

3.0 OVERVIEW OF APPROVED FRA AND DRAINAGE STRATEGY

3.1 The aforementioned Flood Risk and Water Management Assessment (ref: IT1543FRA08.07.15_issue) stated that according to the Environment Agency (EA) Indicative Online mapping the site is located within Flood Zone 1, outside the area of risk and is therefore classified as having a less than 1 in 1,000 risk of flooding and is deemed acceptable for residential development under the NPPF guidance.

3.2 The site was also found not to be at risk from pluvial, groundwater and artificial sources of flooding.

Surface Water Drainage Strategy

3.3 A Ground Investigation was undertaken by Leap Environmental Ltd in November 2012 for the outline consent (ref BN/32/15/OUT).

3.4 During the investigation, three soakage tests were undertaken, all three tests failed to reach 25% effective depth and therefore the infiltration rates were found to be very poor. Further to this a high groundwater was encountered which would restrict soakaway storage capacity. Therefore soakaways were not included in the drainage design of the site.

3.5 The strategy proposed within the approved Flood Risk and Water Management Assessment (ref: IT1543FRA08.07.15_issue) was therefore to discharge surface water into a drainage ditch located to the south of the site. Communication was undertaken with the LLFA and they confirmed that the rate of discharge would be restricted to the 1 in 1 year greenfield runoff rate, this equated to a figure of 2.9l/s.

3.6 The design of the system proposed to restrict the discharge to 5l/s, this being the minimum acceptable discharge rate that many authorities were willing to adopt. As the 1 in 100 year discharge rate at greenfield was found to be 8l/s, the figure of 5l/s was found to be robust. Therefore, the proposed drainage strategy would create betterment on the existing conditions.

3.7 Attenuation would be provided on site through the use of an attenuation basin and underground storage crates. The drainage system would drain via gravity and be designed to accommodate the 1 in 100 year storm event with 30% allowance for climatic change.

Foul Water Drainage Strategy

3.8 The approved Flood Risk and Water Management Assessment stated that the foul water system would be laid within the new road infrastructure serving the site.

3.9 The low lying area of the site to the southern boundary would take foul water discharge to an onsite pumping station located in the south west corner of the site.

3.10 The flows would then be pumped back to connect to the gravity system within the north of the site. This gravity system would then connect into the existing foul water system which crosses the northern part of the site and lies parallel with Yapton Road.

3.11 The approved document identified that Southern Water accepted that the existing holiday park site represented a broadly similar foul sewerage output to the proposed 38 dwellings.

4.0 PROPOSED SURFACE WATER DRAINAGE STRATEGY

- 4.1 The proposed strategy follows the same principles as the approved Flood Risk and Water Management Assessment. A copy of the proposed drainage strategy drawing can be found in Appendix D.

Surface Water Drainage Strategy

- 4.2 As the use of soakaways were found to be unsuitable for the site, the proposed strategy is to discharge into the watercourse located to the south of the site, thereby complying with the approved document.
- 4.3 The discharge from the site will flow via gravity and will be restricted through a flow control device to the approved 5l/s rate.
- 4.4 The area of hardstanding for the proposed residential dwellings and associated infrastructure has been digitally measured from the Planning Layout and found to be 0.53ha. It is necessary to ensure that sufficient attenuation is provided to accommodate the runoff from the hardstanding areas during a 1 in 100 year (+30% climate change) storm event.
- 4.5 A three dimensional model has been created in WinDes that incorporates the pipe network, flow controls and attenuation features. This model has been used to simulate various storm return periods and durations to determine the critical storm events and ensure compliance with the FRA.
- 4.6 It is proposed to provide the necessary surface water attenuation in a number of features across the site.
- 4.7 In keeping with the approved FRA part of the attenuation will be provided within a depression in the public open space. Additional attenuation will be provided in a number of area of lined permeable paving. Not only will this provide the necessary level of attenuation but also water quality benefits.
- 4.8 A summary of the attenuation features can be found below:

	Storage (m³)
SUDS Depression	184
Permeable Paving	161
Total	345

- 4.9 Due to the layout of the site and the positioning of the depression within the PoS two flow control chambers will be required. These will likely take the form of hydrobrakes.

Performance & Compliance

- 4.10 The results of the WinDes simulations can be found in Appendix E and are summarised below.
- 4.11 The model uses the latest FEH rainfall catchment data and includes for 30% climate change.

Return Period (1 in X year)	Discharge Rate (l/s)	Depth of Water in Depression (m)
1	4.8	0.142
5	4.9	0.257
10	4.9	0.333
20	4.9	0.414
30	4.9	0.467
50	4.9	0.545
75	4.9	0.623
100 + CC	4.9	0.908

4.12 It can be seen from the above that the proposed discharge rates are below the allowable 5 l/s for all storms.

4.13 The WinDes model also notes that the system can accommodate a 1 in 100 year event, including a 30% allowance for climate change, without flooding.

Depression

4.14 In the approved FRA the depression can be seen to occupy over 430m² of the PoS. The addition of permeable paving within the design has allowed the footprint to be reduced to circa 284m² ^{*1}.

4.15 The proposed depression will be circa 1m deep ensuring the base is above the level of the ground water table as noted in the SI. The depression will have 1 in 4 side slopes as it fronts the area of PoS and will be landscaped accordingly (sections and layouts of the depression can be found in Appendix F).

4.16 It is proposed to place free draining material beneath the base of the depression to ensure that the bottom does not become boggy or retain stagnant water.

4.17 Due to the low permeability of the underlying soils no infiltration has been factored into the calculations.

Permeable Paving

4.18 Due to the low permeability of the underlying soils no infiltration has been factored into the calculations. The permeable paving will be lined (otherwise known as System C). The calculations assume a 600mm deep stone of 30% voids.

Sustainability

4.19 The proposed system comprises of a series of cascading SUDs features. Permeable paving within private parking courts will help significantly with water quality filtering suspended solids.

4.20 Surface water flows will then pass to a depression further assisting with the removal of suspended solids and contaminants.

4.21 Finally flows will be attenuated within permeable paving, again, providing further removal of suspended solids and contaminants.

Foul Water Drainage Strategy

4.22 The proposed foul water drainage strategy will follow the approved strategy whereby foul water flows in the south of the site will flow via gravity to a pumping station. Flows from here will be pumped to a rising main to the gravity network in the north of the site. Flows will then discharge via gravity to the existing public foul water sewer located on site.

^{*1} based on 1 in 3 side slopes and at 1m depth measure from the IL

5.0 MAINTENANCE AND MANAGEMENT

- 5.1 It is proposed to offer both surface water and foul water sewers for adoption under S 104 of the Water Industry Act.
- 5.2 These systems will be subject to the maintenance regime of Southern Water which is subject to regulatory approval.
- 5.3 The SuDS depression will be managed by a developer funded Management Company and will require routine inspections to assess the need for maintenance. The inspections required are:

Item	Routine Inspections for Maintenance	Min. Frequency
Flow Control Device	Inspect flow control devices & grill for blockages, damage and general condition. To be visually inspected after heavy rainfall events to ensure they are free of debris and litter.	6 monthly As required
Depression	Inspect depression for level of silt build-up, general litter/debris build-up and erosion or damaged areas To be visually inspected after heavy rainfall events to ensure they are free of debris and litter.	6 monthly As required
Headwalls	Inspect headwalls & flap valves for signs of deterioration (scouring), blockage or damage. To be visually inspected after heavy rainfall events to ensure they are free of debris and litter.	6 monthly As required

- 5.4 As a result of the routine inspections, a schedule of maintenance activities shall be drawn up to address those issues identified during the inspection. Examples of possible maintenance activities may comprise, but not be limited to those listed in the table below:

Item	Routine Inspections for Maintenance	Min. Frequency
Pipes / Flow Control Device	Clear accumulated sediment and debris	6 monthly
Depression	Clear accumulated sedimentation Clear accumulated debris Grass cutting and vegetation management Repair areas of erosion, other damage or re-seeding/re-turfing	6 monthly Monthly Monthly to start then as required As required
Headwalls	Repair/replace damaged flap valves Clear vegetation/debris from outlet pipe/flap valve	As required 6 monthly

- 5.5 The areas of permeable paving will be conveyed to the households that are accessed from it. The Interpave 'Guide to the Design, Construction and Maintenance of Concrete Block Permeable Pavements' demonstrates that long term maintenance need comprise no more than simple sweeping.
- 5.6 Maintenance responsibility of the ditch which runs along the southern boundary of the site will largely fall to a Developer funded Management Company. The section of ditch which runs adjacent to no. 18 will fall to the land owner, making the household owner a riparian landowner. Details of the responsibility will be written into the house holders welcome pack and deeds.
- 5.7 Access to the land to the south of the site will not be impeded, therefore the current landowners will be able to undertake their riparian maintenance.

6.0 FRA COMPLIANCE

6.1 Presented below is a summary of how the proposed strategy complies with the requirements of the conditions and where the relevant information can be found.

6.2 Condition 6

Requirement	Compliance
Detailed Surface Water drainage scheme to be submitted.	The surface water drainage scheme can be found within Section 4.0, the drawing within Appendix D and the associated calculations within Appendix E.
Design should follow hierarchy of preference for different types of surface water drainage disposal systems as set out in the Approved Document H of the Building Regulations, the recommendations of the SuDS Manual produced by CIRIA.	Drainage via soakaways were found to be unsuitable, with soakage tests revealing poor infiltration rates. Surface water will therefore discharge into the watercourse located to the south of the site.
Winter groundwater monitoring to establish highest annual ground water levels and percolation testing to BRE 365, or similar approved, will be required to support the design of any infiltration drainage.	Infiltration Drainage has not been utilised within the drainage strategy.

6.3 Condition 9

Requirement	Compliance
The development layout shall not be agreed until such time that arrangements for the future access and maintenance of any watercourse or culvert (piped watercourse) crossing or abutting the site has been submitted and approved in writing by the local planning authority.	Provided in Section 5.0.
No construction is permitted, which will restrict current and future land owners from undertaking their riparian maintenance responsibilities of any watercourse on or adjacent to the site.	Construction will not be undertaken that will restrict current landowners from undertaking their riparian responsibility.

6.4 Condition 10

Requirement	Compliance
Development shall not begin until a surface water drainage scheme for the site, based on sustainable drainage principles and an assessment of the hydrological and hydro geological context of the development, has been submitted to and approved in writing by the local planning authority.	Provided in Section 4.0 and Appendix D.
The drainage designs should demonstrate that the surface water runoff generated up to and including the 100 year, plus 30% for climate change, critical storm will not exceed the greenfield runoff from the current site following the corresponding rainfall event.	Provided in Appendix D and Appendix E.

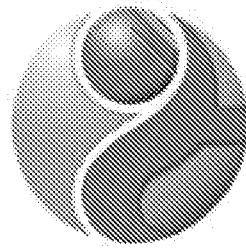
Details of how the scheme shall be maintained and managed after completion.	Provided in Section 5.0.
---	--------------------------

6.5 Condition 15

Requirement	Compliance
Prior to the commencement of construction works details of a proposed foul drainage system shall be submitted to and approved in writing by the Local Planning Authority (including details of the siting, design and subsequent management/maintenance) and no dwelling shall be occupied until works for the disposal of sewerage have been fully implemented in accordance with the approved details.	Provided in Section 4.0 and Appendix D.

6.6 It can therefore be concluded that the proposed surface water Drainage Strategy complies with the approved FRA and Drainage Strategy and conditions 6, 9, 10 and 15 of the planning consent can be discharged.

APPENDIX A



**Proposed Residential
Development, The Lillies
Caravan Site, Yapton Road,
Barnham**

**Flood Risk And Water
Management Assessment**

on behalf of

One Property Group Ltd.

July 2015

INTERMODAL TRANSPORTATION

Hunters Court, Beltham Road, Saffron Walden, Essex, CB11 4AA

IT1543



CONTENTS

1	INTRODUCTION	1
2	SITE LOCATION AND EXISTING CONDITIONS	3
3	POLICY AND GUIDANCE	6
4	THE PROPOSED DEVELOPEMNT	8
5	FLOOD RISK & DRAINAGE STRATEGY	10
6	RISK APPRAISAL	13
7	CONCLUSIONS	14

DRAWINGS

IT1543/FRA/01	SITE LOCATION PLAN
IT1543/FRA/02	PROPOSED DRAINAGE SCHEME
15708cv-01 & 02	TOPOGRAPHICAL SURVEY
Dapa_409_200	ARCHITECTS LAYOUT PLAN

APPENDICES

APPENDIX A	SITE INVESTIGATION REPORT
APPENDIX B	SOUTHERN WATER SW AND FW ASSET INFORMATION
APPENDIX C	CORRESPONDENCE WITH SOUTHERN WATER (SW)
APPENDIX D	MICRO DRAINAGE ATTENUATION CALCULATIONS



1 INTRODUCTION

- 1.1 Intermodal Transportation Ltd (ITL) has been commissioned by One Property Group Ltd to prepare a Flood Risk Assessment (FRA) in support of a planning application for the proposed residential development on the site situated to the south of Yapton Road in Barnham, West Sussex. The site falls within the Arun District Council (ADC) administration area.
- 1.2 This FRA considers whether the site is susceptible to flooding from watercourses and defines the zone upon which redevelopment would take place. Being an inland site flooding influences from sea levels are not relevant. This report also considers the outline design philosophy for the management of surface water and disposal of foul effluent from the site.
- 1.3 Under the Flood and Water Management Act 2010, the Lead Local Flood Authority (LLFA) is West Sussex County Council (WSCC) who have also been contacted.
- 1.4 The Environment Agency (EA) has not been approached as the site is within a low flood risk area, although they would be a statutory consultee as part of any planning application. Where possible, SuDs mechanisms are the preferred methods to minimise the run off to existing public sewers or watercourses.
- 1.5 ITL have also consulted with Southern Water (SW) to understand how they would review redevelopment of the site although there is an existing public foul water sewer crossing the northern part of the site with an existing connection from the site. Given the relatively flat levels across the site it is proposed that the foul drainage system would be split into two parts; one draining under gravity directly to the public sewer and one draining by gravity to an on-site pumping station and being pumped to the head of the proposed gravity system.
- 1.6 The proposed development is for 38 residential units on the site, served by cul-de-sac road system which would be offered for adoption by the local highway authority. The new development would replace all existing buildings and hard paved areas. For the purposes of this assessment the site is to be regarded as partly 'greenfield' and partly 'brownfield' in composition. The site has previously been subject to a planning application for residential development which was refused at a planning appeal although the Planning Inspector concluded that a revised planning application addressing his concerns could succeed and that drainage issues could be dealt with by applying appropriate conditions. Hence this FRA report has been prepared to accompany the planning application now submitted.



-
- 1.7 A walk over survey was undertaken on 19th June 2015 to gain a better understanding of how the site naturally drains at present and some spot levels were taken along the ditch which runs along the southern boundary. This was essential to help formulate the drainage strategy for the site development.
- 1.8 Revised National Planning Policy Framework (NPPF) was published in March 2012. This framework document supersedes many planning policy guidance documents including PPS25. The NPPF sets out the Government's planning policies and, like its predecessor documents, provides guidance for local planning authorities when considering suitable sites for appropriate development in preparing development plans. The NPPF places a greater presumption in favour of sustainable development. The Technical Guidance for the NPPF document provides specific guidance in terms of the methodology and/or parameters for undertaking the actual FRA.
- 1.9 The technical guidance to NPPF, Flood Risk Section, classifies residential property as 'More Vulnerable' in terms of Flood Risk Vulnerability Classification (Table 2). NPPF also defines that developments classified as 'More Vulnerable' are appropriate in Flood Zone 1 (Table 3 Flood Risk Vulnerability and Flood Zone Compatibility).
- 1.10 Within Table 1 of the technical guidance the requirements for an FRA are set out for development in Flood Zone 1 areas where it states:
- 'For development proposals on sites comprising one hectare or above the vulnerability to flooding from other sources as well as from river and sea flooding, and the potential to increase flood risk elsewhere through the addition of hard surfaces and the effect of the new development on surface water run-off, should be incorporated in a flood risk assessment. This need only be brief unless the factors above or other local considerations require particular attention.'*
- 1.11 The planning application for development of this site for residential development was submitted in 2015 following a request for pre-application advice in January 2015. The pre-application response from ADC includes comments received from the council's drainage engineer in respect to the site drainage matters.
- 1.12 This report therefore addresses the pertinent flood risk and drainage matters to ensure that a surface water and foul drainage management scheme can be delivered to eliminate risk of flooding arising from the development, and addressing where appropriate the preliminary comments received in respect to the pre-application enquiry.
-



2 SITE LOCATION AND EXISTING CONDITIONS

Site Location

- 2.1 The site is located to the south-east of Barnham village centre, but is within the defined settlement area of the village. The site is situated to the south of Yapton Road and is currently served by a tarmacked access with forecourt parking served from a verge crossing. The southern boundary of the site interfaces with open agricultural land beyond a drainage ditch, which itself is located within the site boundary. To the west the site boundary is shared with a site which has planning consent for the development of up to 90 residential dwellings. The eastern boundary of the site interfaces with a site containing a number of glass houses and poly tunnels, although at least some of these appeared to be out of use at the time of the site inspection by ITL.
- 2.2 The site location in the local and wider context is shown on drawing IT1543/FRA/01 appended.

Existing Conditions

- 2.3 The overall area of the residential development site is approximately 1.1 hectares. The site has been in use as a holiday park with fixed chalets, static caravans and touring caravan and tents accommodated. The chalets have been removed and the site no longer provides camping pitches for touring caravans or tents. However, there are currently a small number of static caravans remaining in use on the site together with some stored touring caravans. The development site does not include the existing residential property, N^o 47 Yapton Road, which is part of the same land holding at present and shares the vehicular access to the site. Within the site there is a mix of asphalt, concrete and block paved access roadways, as well as a toilet block with showers and laundry facilities; all as shown on the topographical survey drawings 15708cv-01 & 02 appended.
- 2.4 Hence, a significant proportion of the site, where existing development and infrastructure exists can be regarded as brown field and the remainder of the site is greenfield by definition. Hence, a proportion of the site is currently impermeable.
- 2.5 The road passing the northern part of the site has a reasonably flat profile with ground levels of approximately 8.9m AOD (Above Ordnance Datum) and the site falls gently towards the south-east corner, where the existing ground level is approximately 7.6m AOD. The south-west corner of the site is at approximately 8.3m AOD and therefore the site levels fall more gently along the western boundary than the eastern boundary, which in turn allows the ditch located at the southern edge of the site to fall from the western side of the site to the eastern side. Hence, there is a gentle fall of circa 1 in 100 along the southern boundary of the site and a gentle fall from the north-west corner to south-east corner of 1 in 135 across the site.



-
- 2.6 There is an existing public foul sewer which crosses the northern edge of the site approximately 6.0m from the boundary along Yapton Road and there is an existing cess pit located towards the southern end of the site. There is also a public foul rising main crossing the site from west to east at a location approximately 110m south of Yapton Road. The position of this has been respected in the masterplan layout.
- 2.7 The ditch located along the southern boundary of the site connects downstream to the existing ditch system running along Hill Lane in a north to south direction. The head of the ditch system starts to the west of the site and runs on a straight route following the property boundaries eastwards before joining the ditch along Hill Lane, which flows north to south to the corner adjacent to Tile Barn Farm. This drainage ditch was not surveyed as part of the site topographical survey however ITL have carried out a spot level survey to establish the existing fall of the ditch and can confirm the directions noted above. From the corner in Hill Lane ITL believed that the ditch is piped under the road to join the watercourse located to the south of Tile Barn Farm. This ditch system appears to serve the local greenfield catchment area, including the proposal site and the development site to the west, and it is noted that the ditch along Hill Lane was cleaned out recently, prior to the site visit by ITL. ITL understand that the system eventually drains to Lidsey Rife located to the south-west of Barnham.
- 2.8 There are no other ditches or watercourses adjacent to the site. We have been advised by the current owner that there has never been a flooding problem on the site, even during exceptionally wet periods.
- 2.9 No detailed ground investigation work has been carried out to date on this specific site, except for some trial hole excavations for soakaway tests (see section 5). The soakage report is attached at Appendix A.
- 2.10 The underlying ground is made up of silty clays with fine sands and some gravel. Groundwater was encountered as seepage at a depth of approximately 1.2m below the surface and the infiltration rates were very low, indicating that soakaway drains would be unlikely to be a viable option to drain this site although this would be the preferred SuDs mechanism.
- 2.11 Following discussions with WSCC, we have been advised that there are no records of the highway drainage assets along Yapton Road and therefore it has not been possible to establish if there is a contiguous connected highway drain in Yapton Road. Based upon our inspections along the road, surface gullies and catch pits are present along with pipework connections. However, it was not possible to establish whether there is a separate highway drainage system, although it is likely that the road drains to an outfall into a watercourse at some point.
-



- 2.12 There is no history of flooding on the site and, as far as we have been able to establish, there has been no reported incidents of surface water flooding of adjacent properties situated downstream of the site, i.e. the natural water path for any overland flow during extreme storm events.



3 POLICY AND GUIDANCE

National Planning Policy Framework (March 2012)

- 3.1 The National Planning Policy Framework (NPPF) was published in March 2012.
- 3.2 The framework sets out the Government's planning policies for England and how the framework objectives are expected to be applied. The NPPF provides guidance for local planning authorities in preparing development plans and clarifies that there should be a presumption in favour of sustainable development. The NPPF does not propose anything dramatically new in terms of its responsibilities from the preceding PPS 25 guidance where the key principles to be applied by Authorities should:
- include Strategic Flood Risk Assessments as part of the LDF process and include policies to manage flood risk from all sources with wide consultation with all relevant bodies. LPA's should apply a sequential approach to the location of development.
 - take climatic change into account and avoid increased vulnerability to ensure that risks can be managed where necessary;
 - inappropriate development should be avoided in areas at risk of flooding by directing development away from areas at highest risk; where development is necessary it should be made safe without increasing flood risk elsewhere;
- 3.3 The NPPF requires site-specific FRAs, application of the Sequential Test where this has not been undertaken and, for sites that are vulnerable, possible application of the Exception Test.

Planning Policy Statement 25 'Development and Flood Risk' (March 2010)

- 3.4 The last issue of PPS 25 (March 2010) has now been superseded by the NPPF. However many of the requirements of PPS 25 have been carried forward within the Technical Guidance to the NPPF, but with an emphasis for LPA's to ensure, as far as they are able, that appropriate SuDs mechanisms are required as part of development and, in many cases, for the LPA's to maintain adoptable SuDs systems.
- 3.5 The Development and Flood Risk Practice Guide (December 2009) provided advice on the practical implementation of PPS 25, and provides additional guidance on what is required at regional and local level. The document is still very relevant given that the NPPF is a more holistic document. The guidance is more helpful in considering regional spatial strategies, sustainability appraisals and local development documents and the roles and responsibilities for those managing individual planning applications. It also gives additional guidance on the importance of regional and strategic FRAs; The application of the sequential approach and Sequential and Exception Tests; surface
-



water management and implementing sustainable drainage and measures to reduce flood risk.

- 3.6 Whilst the Environment Agency has the lead role in providing advice on flood issues, at a strategic level and in relation to planning applications, the LPA's have a duty to ensure that 'precautionary principles' in relation to flood risk and the location of vulnerable development are adopted, first using a risk based site search sequential review to avoid any risk of fluvial or sea flooding where possible and managing residual (perhaps pluvial) risks elsewhere.

Flood and Water Management Act, 2010

- 3.7 The FWMA now places significantly greater responsibility on Local Authorities to manage and lead on local flooding issues. The Act, and supporting Regulations, together bestow more responsibility onto LPA's by requiring Authorities to:

- Develop Local Flood Risk Management Strategies (LFRMS);
- Implementing requirements of Flood and Water Management legislation;
- Preparation of preliminary flood risk assessments and flood risk management plans;
- Development and implementation of drainage and flooding management strategies; and
- Taking responsibility for approving, adopting, managing and maintaining Sustainable Urban Drainage System (SuDs) where they serve more than one property.

- 3.8 The FWMA makes provision for a national standard to be prepared on SuDs, and developers will be required to obtain local authority approval for SuDs in accordance with the standards; this may be covered by appropriate conditions which would need to be discharged. Supporting this, the Act requires local authorities to adopt and maintain SuDs, removing any on-going responsibility for developers to maintain SuDs. West Sussex County Council is the Lead Local Flood Authority (LLFA). We are unclear whether WSCC have become a SAB (SuDs Approval Body) but, we are aware many Authorities have not yet taken on the responsibility to maintain SuDs systems.

Sewers for Adoption 6th or 7th Edition (August 2012)

- 3.9 Detailed design of proposed adopted sewers should be in accordance with the above documents which are the definitive guides for those planning and designing sewers (both surface water and foul water) for subsequent adoption by the relevant water authority. This guidance provides best practice on planning, design, construction and operation of sewers, and their maintenance.



4.0 THE PROPOSED DEVELOPMENT

The Lillies Caravan Site

- 4.1 The development proposal is to build 38 new residential properties on the site. The materplan of the development is shown on the illustrative plan DAPA.409.200 appended. Pockets of soft landscape areas are proposed to provide open space areas. No substantial ground remodelling works are proposed to facilitate the access or the new dwellings and road infrastructure, although minor level changes may be required locally within the site.
- 4.2 The principal vehicular access to the development would approximately follow the line of the existing access to the main body of the site, leading directly southwards from the access along Yapton Road. Within the site the access road would link to a cross connection to both the western and eastern boundaries while a mews would continue south from this junction. The cross link would approximately follow the line of the existing rising main foul sewer that crosses the site to respect easement requirements.
- 4.3 In terms of the total development area (being 1.1 Ha within the red line boundary), the existing ratios of permeable to impermeable areas are given below:
- 9,100 m² of permeable grass, gardens or unbound access road areas
 - 2,090 m² of impermeable area, comprising roof areas, private driveways and hard standing areas (caravans are considered to be part of the permeable areas)

The development of the site would result in the following ratios:

- 5,468 m² of permeable soft landscaped areas
 - 5,722 m² of impermeable area, comprising roof areas, adoptable roads, private driveways and hard standing areas
- 4.4 Ground conditions are such that it not considered viable to discharge surface water run-off from roofs and hard standing areas to soakaways as discussed in section 5 of this assessment, although following further winter soakage tests it may be possible to incorporate some permeable paved and high level storage/soakaway features within the overall system.
- 4.5 A storm water attenuation pond is proposed to be sited within the middle part of the site, within the proposed public open space area, to temporarily hold storm water run-off from roof and roadway areas up to the most extreme 1 in 100 year event. Given the location of this feature and the general site levels, the south-eastern corner of the site would not be able to be drained into this feature and it is therefore proposed that this part of the site would drain to a shallow underground storage area constructed from storm cells



(modular crates) situated under the turning area and part of the parking area at the south end of the mews. The attenuation pond would effectively be dry most of the time but would fill to varying depths on occasions to cater for more severe storm events. This facility would provide a pleasant open landscaped area within the site and it would be a relatively shallow feature of no more than 1.0m in depth. Outflow from this pond would be restricted to 4 l/s and this regulated flow would be additional to the surface water flows generated downstream of the first control device. The underground storage area beneath the turning head at the bottom of the site would also act as a retention feature, but would additionally provide some soakage function as well as having a controlled discharge overflow to the ditch of 5 l/s.

- 4.6 Foul drainage will be connected to the existing adopted foul system, located at the northern end of the site, by a combination of gravity and pumped systems. A new adopted pumping station is to be located in the south-western corner of the site. See drawing IT1543/FRA/02 Rev B for the general principles of the system which is discussed later in this report.
- 4.7 The existing driveway which serves the existing site is to be essentially retained but widened and the drainage of this link into the site will be to the proposed attenuation pond.



5 FLOOD RISK & DRAINAGE STRATEGY

Flood Plain

- 5.1 The site is approximately 260m north of the nearest notable main watercourse (Lidsey Rife), is outside the flood plain and thereby situated in a flood zone 1 area. The extent of the flood contour is shown on the Environment Agency's published web site plan. Therefore, there is no risk to the development, or the future occupants, arising from fluvial flooding for any storm up to and including a 1 in 1000 year event.

Surface Water Drainage

- 5.2 The NPPF emphasises that development should be located in the least vulnerable places and that Local Plans should look to the Strategic Flood Risk Assessments (SFRA) to inform the process and help with the sequential test. The SFRA mapping maintained by the Environment Agency has been reviewed and the site is located within a zone 1 area, which is not subject to fluvial or coastal flooding. Clearly, the site would be immune from fluvial flooding even for a 1 in 1000 year event. In planning policy terms it can be asserted that the site would be compliant with national policy and local policies in terms of its location from a flood risk perspective.
- 5.3 As the proposed development is not at risk from fluvial or pluvial flooding, the main purpose of this FRA is to consider the management of surface water run-off and to ensure that the impact of the development does not affect downstream interests and/or properties.
- 5.4 Given the low gradients on the site it is expected that much of the surface water soaks to ground finding subterranean water paths to the ditch system at the southern end of the site, or eventually by slow percolation to aquifers deep below ground level.
- 5.5 In October 2012 six trial holes were dug, ostensibly for undertaking BRE 365 soakage tests, but the excavations were also useful in understanding the make-up of the soil sub strata down to proving depths of 2.4m below ground level. The make-up of the ground was: Topsoil to a depth of 200mm to 400mm being brown silty clay with occasional flint gravel; to a depth of 1.0m to 1.6m was a soft to firm orange brown silty clay with occasional fine flint gravel and below 1.6m depth was orange brown silty fine sand. Groundwater was encountered as seepage within the fine sands at a depth of 1.2m to 2.0m.
- 5.6 A copy of the factual report undertaken by Leap Environmental Ltd and dated 5th November 2012 is attached at Appendix A, shows the make-up of the ground for the six trial pits and also shows that the soakage test readings which suggest that the soil was impermeable within the upper layers but that existing groundwater is likely to prevent reasonable soakaway rates at a usual formation level depths. Clearly these results affirm
-



that this site is unlikely to be suitable for conventional soakaway mechanisms for the development and hence, the need to consider on-site storage, which is itself a sustainable mechanism. Therefore the drainage philosophy is to adopt a combination of open pond storage system, where feasible within the confines of the submitted planning application masterplan, and sub-surface storage at the southern end to be located under the vehicle turning area. Within the surface pond there would be an element of evaporation, during warmer climatic conditions, to assist with the dispersal of stored water - a recognised dissipation mechanism, allied to a controlled discharge from the site. Within the sub-surface system there would opportunity for some soakage to occur by adopting a shallow soakaway type design for the storage volume above the water table. Controlled discharge of surface water from the system would be taken to the ditch to the south of the site at a rate almost comparable to the 1 in 1 year greenfield runoff.

5.7 Correspondence from SW contained in Appendix C confirms that SW would accept the greenfield run off (Q_{bar}) into the existing ditch system, the Q_{bar} figure for this geographical location has been calculated to indicate what the discharge rate would be for this rural location. This equates to a greenfield run off rate of 2.9 l/s which is close to the allowable discharge rate for a 1 in 1 year return period. The design of the system would restrict the outfall flow from the developed site to the 5 l/s volume and this would represent a cautious approach to the water management because for a 1 in 100 year return storm (upon which the maximum attenuation is calculated) a higher theoretical Q_{100} discharge rate of circa 8 l/s could be adopted. The 5 l/s level of discharge from the site is the minimum acceptable discharge rate that many Authorities are happy to adopt, given that control devices tend to be more trouble free at, or above, this minimum restricted outflow. Therefore the existing downstream system, to the south-east of the site, would essentially perform with little detriment as a result of the flow from the site. Although there is only limited fall between the site and the aforementioned ditch, it is possible to provide a combination of drainage features that would allow the surface water run-off to drain by gravity from the site. This, taken with the potential for evaporation, a limited amount of soakage through the bottom of the unsealed pond and also soakage from the storm cell system, provides a good default SuDs system.

5.8 A preliminary skeletal design has been worked up for the proposed development which is shown on drawing 1543/FRA/02 appended. The drawing shows the basic spine system and the various contributing areas to the system as it is loaded incrementally when migrating from north to south. This design would need to ensure that for storms up to the 1 in 100 event (including a 30% uplift in rainfall intensity) the surface water should be managed on the site to ensure either no surface flooding occurs or, where surface flooding is allowed that the water is managed, so as not to pose any risk of flooding to buildings or creating safety hazards. Essentially all hard paved areas, whether adopted or not (and including roofs) would drain to the system shown on the drawing. The different coloured areas on the drawing indicate the sub-catchment areas that would incrementally feed into the system for calculation purposes. The piped system then feeds to two control manholes (M/H's S4 and S9 identified on the drawing) which allows controlled discharge within the site and from the site via two hydrobrake control devices



eventually leading to the existing ditch system. For demands greater than 5 l/s the surface water would then surcharge back into the underground crates and partially through the piped system upstream towards the pond. The northern part of the site would flow to the pond and water from this attenuation feature would dissipate at a controlled rate of 4 l/s from MH S4 into the lower system.

- 5.9 Micro Drainage runs for this conceptual design have been undertaken and the results are attached in Appendix D. The assessment indicates that the adopted system would surcharge (but not flood within the site) for the worst case storm event including the 1 in 100 probability plus 30% climatic change rainfall intensity. The analysis of the attenuation requirement indicates that under the worst case event that some 227 cubic metres of water would be stored in the attenuation pond reaching a level of 8.105 m AOD (about 0.65m deep). This would mean that there would be a freeboard of approximately 0.3m before the pond would overtop and therefore the risk of overtopping would be improbable.

Foul Drainage

- 5.10 The foul water system would be laid within the new road infrastructure serving the site. For the southern end of the site (lower part of site) a gravity system would take discharges to an on-site pumping station to be located in the south-western corner of the site. The discharge would then be pumped back up the site to connect to a gravity system that would cater for the northern part of the site which would connect by gravity to the existing SW system which runs across the northern part of the site and parallel with Yapton Road. This existing sewer has historically taken the previous chalets and static caravans located on the site drained directly to this system or, from a private pumped sump to the southern end of the site taking the demands of touring caravan and camping pitch patrons who were provided with a toilet block incorporating showers, a laundry and washing up facilities.
- 5.11 In correspondence relating to the previous planning application (heard at appeal ref APP/C3810/A/13/2201753) Southern Water (SW) accepted that the existing site, comprising 11 log cabins, 19 Static caravans and 15 touring pitches represented a broadly similar foul sewage output to the proposed 38 dwellings on the basis that a log cabin and a static caravan would generally be let to an average of 3-4 persons while 2 touring caravans would be approximately equal to one house. In connection with this planning application SW has advised that either a system capacity check is required or proof that the proposal does not represent an increase in foul drainage flow is required (see scoping correspondence at Appendix C).
- 5.12 For the purposes of drainage calculation it is assumed that an average house has three occupants and produces 4,000 litres of foul water per day. The foul discharge consists of toilet flushes, bath and shower use, discharge from washing machines and dishwashers and other household activity. The existing site contained 11 log built chalets, 19 static caravans (mobile homes) and pitches for 15 touring caravans /



campers. It was advised for the previous planning application that the chalets and static caravans were occupied by 3-4 people on average and the site has planning permission for all units (and camping pitches) to be occupied all year. A caravan or log cabin with 3 or more occupants would be expected to produce similar foul water flows to a normal dwelling house and therefore the 30 such units would be broadly comparable to 30 houses. The touring pitches would probably be likely to be occupied by two adults and perhaps one or two children and, given that the washing and other such facilities would be the shared toilet block it is likely that the foul water produced by each unit would be less than for a typical dwelling house. Each units occupied by two adults would be roughly equivalent to 2/3 of typical house but given the use of shared toilet block facilities this could realistically be reduced to one half. Therefore one house would be comparable to two touring caravan pitches. On this basis the existing site would comparable to 37.5 houses. It was also noted that two surface water gullies were previously connected to the foul water drainage system (confirmed by SW correspondence contained at Appendix C) and this would have contributed further flows to the public foul sewer connection from the site. The existing drainage system consists of the northern part of the site draining directly by gravity to the public manhole located in the north-western corner of the site while the southern part is drained to a private on-site pumping station which then discharges to the public sewer via the on-site gravity sewer. This arrangement was implemented due to the lower ground levels along the southern side and particularly at the south-eastern corner which could not be drained to the north by gravity.

- 5.13 While ITL consider that the previous agreement with SW is reasonable it is possible that the accommodation on the site would not be 'let' for at least part of the year and therefore it would be reasonable to assume that for some proportion of time the log cabins and static caravans would not be operating at full capacity. Conversely, there would be periods during the middle of summer when all of the accommodation would be in use to a higher level of occupancy than the average rate of 3-4 persons per unit noted above because occupants would be on vacation. Taking this into consideration it would be reasonable to assume that the average rate of occupancy would be 3 persons per unit over 9 months of the year (24,638 person days) for the caravans and log cabins and 2 persons per unit over 6 months of the year (5,475 person days) for the touring pitches. This would equate to the foul outflow of 27.5 permanent dwelling houses (365 days x 3 persons x 27.5 = 30,112 person days) when averaged across the year. It is therefore concluded that the existing site should be considered to generate foul sewer flows at least equivalent to 27.5 dwelling houses over the course of one year, plus the addition of the surface water flow from two gullies.
- 5.14 As it is proposed to provide a new gravity sewer for the northern part of the site and a separate system with pumping station for the southern part, due to existing ground levels, it would be possible to arrange a system whereby the pumped drainage does not pass into the public sewer during times of daily peak flow, i.e. the pump would not be run during the am peak (say from 07:00 to 9:00) or the evening peak (say from 17:00 to 20:00) when flows from existing connections are at their highest. Additional storage



would be provided at the pump station to allow for extra storage at peak times. For 11 new houses (proposed 38 minus 27.5 to the gravity system) this would require an additional storage volume of 5.28m^3 (equivalent to 160 litres per hour per dwelling for 3 hours) within the wet well. For the current proposal only 16 properties can be drained directly by gravity, due to the site ground levels and the connection manhole invert level, and the remaining 22 would therefore drain to the pumping station. This would require a wet well volume of at least 10.56m^3 to accommodate 3 hours of flow.

- 5.15 The connection manhole is located on the development site and hence, an adoptable foul water sewer connection can be facilitated.



6 RISK APPRAISAL

6.1 The following 'flood risk' checklist reveals:

- The development site is within a flood risk zone 1 area, above any fluvial flood influence areas;
- The development site is not within a groundwater protection zone;
- The development site is not near any groundwater or surface level abstraction point;
- There has been no history of flooding arising from run off from this site;
- Soakaway mechanisms have been dismissed because of poor ground porosity and existing groundwater levels; although some underground storage within a soakaway type retention system may allow some discharge to ground;
- An attenuation strategy has been adopted, which would restrict run off rates from the site to essentially to mimic the greenfield 1 in 1 year rate for all events up to the 1 in 100 year probability, which is a conservative design; and
- A detailed drainage design would be prepared following collection of winter ground conditions and peak ground water level data, as requested by Arun Council, although the drainage strategy contained in this report demonstrates that the site can be satisfactorily drained, as stated by the Planning Inspector in relation to the previous proposal.

6.2 Based upon the review and conceptual drainage strategy the risk of flooding either on the site or downstream of the site would be negligible.



7 CONCLUSIONS

- 7.1 This report considers the flood risk issues arising from the proposals for residential development on the Lillies Caravan site located south of Yapton Road in Barnham village, West Sussex. In this report the requirements of the guidance embodied within the NPPF Framework have been considered. Moreover, initial discussions have been held with Arun District Council (ADC), West Sussex County Council and Southern Water (SW) to deliver an acceptable strategy.
- 7.2 The site is located within a Flood Zone 1 area, with a low probability of fluvial, pluvial or tidal flooding, where residential development, designated as 'More Vulnerable', would be considered to be appropriate.
- 7.3 The site is a brownfield development site and there are no historical records of any flooding on the site or to areas immediately downstream arising from extreme rainfall events. There are currently no off site connections to either surface water or foul drainage systems in the area.
- 7.4 The soil sub strata and presence of groundwater seepage on the site would suggest that it would not be suitable for infiltration type SuDs systems, as confirmed by the results of three soakaway tests carried out on the site.
- 7.5 It is therefore evident that the new development would need to be drained positively into a new separate surface water sewer system which has been designed to attenuate flows and store surface water at two locations on the site. The northern half of the site would direct excess demands greater than 4 l/s to a shallow pond area within the proposed public open space area. A separate sub-surface storage facility would be provide under the turning head and parking areas close to the southern boundary of the site to essentially store run off from the lower part of the site before discharging at a controlled 5 l/s to the ditch existing ditch system.
- 7.6 The foul water sewer system for the development site would drain under gravity to a new pumping station located in the south-west corner of the site, from where it would be pumped back up the site to the existing public foul sewer crossing the site. The existing adopted foul water manhole located in the north-east of the site adjacent to Yapton Road would be the point of connection to the public sewer system. The pumped system can be controlled to operate outside peak waste water demand periods, which means that the site would place much less demand on the adopted system by managing and spreading the load from the site.
- 7.7 The planning application is an outline submission with all matters reserved, but a considerable amount of drainage assessment has been carried out to demonstrate that the site would be suitable for residential development and that based upon reasonable assumptions and some further detailed modelling work, it can be confidently stated that
-

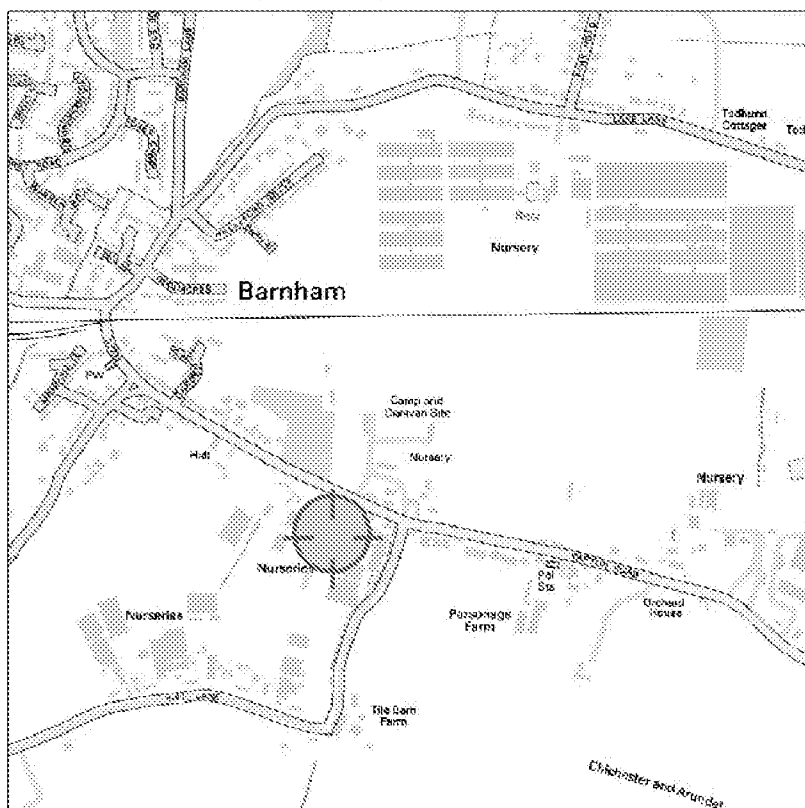


-
- a drainage scheme could be developed that would not create any surface flooding for the worst case 1 in 100 year probability event and is sustainable. A detailed design will need to be developed as part of any reserved matters application and it is acknowledged that winter monitoring of ground water levels would need to be undertaken to ascertain if further SuDs systems can be considered, such as permeable paving.
- 7.8 It should be noted that the Inspector's Decision notice for the 2014 planning inquiry for a similar number of units on the site, stated at paragraph 4 that drainage schemes could be secured by condition. Therefore, the Inspector was satisfied that there was a technical solution to drainage, which has been proven.
- 7.9 Hence, it is concluded that there would be no flood risk affecting property or the welfare of residents and the public arising from the development of the site and that surface water discharge from the development can be adequately managed to ensure no additional risk of flooding both on site and off site, under extreme conditions. Sufficient details have been provided to satisfy the requirements of the policy guidance and with the imposition of a suitable planning condition the Local Lead Flood Authority and Water Authority's interests can be protected pending final detailed design.
- 7.10 It is concluded that there should not be any drainage reasons why this development proposal should not be granted planning consent.

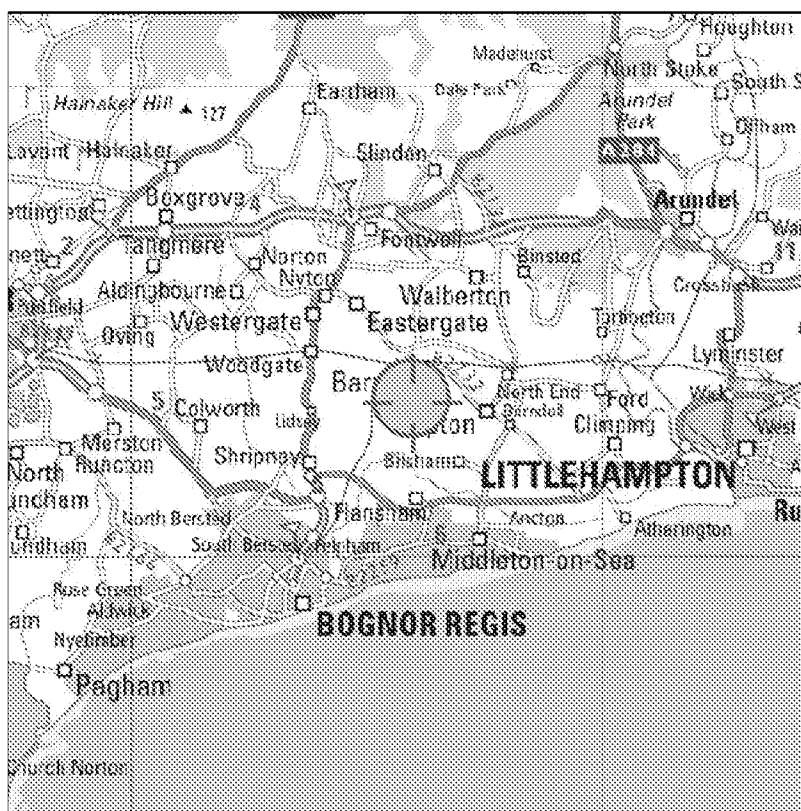
Drawings



LOCAL CONTEXT



WIDER CONTEXT



SITE LOCATION

Rev	Description	Date
01	ONE PROPERTY GROUP UK LTD	
A4	ARUN DISTRICT COUNCIL BN/02/05/09	

IT Project
**THE LILLIES CARAVAN PARK,
BARNHAM**

Drawn By:
BK

Approved By:
SW

Notes:
Consultations should not be undertaken.
The current status of the development
should be verified by the responsible
person prior to any further development.
Date: 01/06/2015

Supervision of the construction of the development
should be undertaken by the responsible
person prior to any further development.
Date: 01/06/2015

Drawing Title
**SITE LOCATION
IN THE LOCAL AND
WIDER CONTEXT**

Drawing No
IT1543/FRA/01

Date
JUN 2015

CAD File
IT1543_FRA_01.dwg

Scale
NTS

Sheet 1 of 1



**Intermodal
TRANSPORTATION**

**Tel: +44 (0)1799 25629
Fax: +44 (0)1799 25630
e: enquiries@inter-modal.co.uk**



Topographical Surveys

Trees are drawn to scale showing the average canopy spread. Descriptions and heights should be used as a guide only.

All building names, descriptions, number of storeys, construction type including roof line details are indicative only and taken externally from ground level.

All below ground details including drainage, voids and services have been identified from above ground and therefore all details relating to these features including: sizes, depth, description etc will be approximate only. All critical dimensions and connections should be checked and verified prior to starting work.

Detail, services and features may not have been surveyed if obstructed or not reasonably visible at the time of the survey.

General

The contractor must check and verify all site and building dimensions, levels, utilities and drainage details and connections prior to commencing work. Any errors or discrepancies must be notified to Survey Solutions immediately.

The survey control listed is only to be used for topographical surveys at the stated scale. All control must be checked and verified prior to use.

© Land Survey Solutions Limited holds the copyright to all the information contained within this document and their written consent must be obtained before copying or using the data other than for the purpose it was originally supplied.

DO NOT SCARE FROM THE GLASSING.

CONTROL CO-ORDINATES

STATIONS	EASTINGS	NORTHINGS	LEVEL	DESCRIPTION
5201	496359.993	103990.953	8.60	peg
5401	496395.498	104228.281	8.87	HIS Nail
5402	496415.549	104556.277	8.93	HIS Nail
5701	496385.976	103843.739	8.16	HIS Nail

ST02	496390.152	104032.097	0.40	HIS Nai
ST03	496391.501	104035.453	0.71	HIS Nai
ST04	496405.933	104028.170	0.89	HIS Nai
ST05	496374.704	104026.834	0.88	HIS Nai
ST06	496389.929	104070.431	0.58	HIS Nai
ST07	496423.540	104079.888	0.82	HIS Nai

ST09	696365.902	104119.894	8.97	HIS Nal
------	------------	------------	------	---------

Ordinance Survey (OS) national grid coordinates have been established for survey control point ST04 using GPS and related to OSTN02(GB) and OSGM02(GB). The survey grid is orientated to [Grid or True] North with a scale

All levels relate to the Ordnance Survey (OS) level datum at survey control point ST04 established by GPS using OSGM02(OS).

REV	DESCRIPTION	DRAWN	APPR	DATE
-----	-------------	-------	------	------

 SURVEY
**SURVELL
SOLUTIONS**

Ipswich Coventry Yeovil Norwich Perth Nottingham Brentwood

Tel No: 0845 0405 989 Fax No: 0845 0405 970
www.survey-solutions.co.uk enquiries@survey-solutions.co.uk

PROJECT TITLE
MARTON ROAD, BARNHAM, BONGERBEG, BONGERBEG

DRAWING DETAIL
TOPOGRAPHICAL SURVEY
Sheet 1 of 2

CLIENT DAP ARCHITECTURE LTD				SCALE 1:200
SURVEYOR	SURVEY DATE	CHECKED BY	APPROVED BY	DWG STATUS

DATE	27/04/2015	DES	DES	FINISH
DRAWING NUMBER			REVISION	ISSUE DATE
15708cv-01				24/04/2015

YAPTON ROAD, BARNHAM.

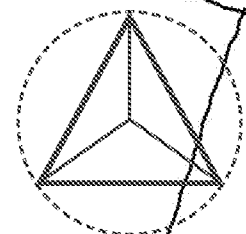
RESIDENTIAL SCHEME: 38NO. RESIDENTIAL DWELLINGS.

SCALE BAR 1:500



GENERAL NOTES
THE COPYRIGHT IN ALL DESIGNS, DRAWINGS, SPECIFICATIONS AND ANY OTHER DOCUMENTATION PREPARED BY DAVID PLANT ARCHITECTURE LTD IN RELATION TO THIS PROJECT SHALL REMAIN THE PROPERTY OF DAVID PLANT ARCHITECTURE LTD AND MUST NOT BE ISSUED, LOANED OR COPIED WITHOUT PRIOR WRITTEN CONSENT.

THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL ARCHITECT'S DRAWINGS, SPECIFICATIONS, AND ALL RELEVANT CONSULTANTS AND/OR SPECIALISTS INFORMATION RELATING TO THE PROJECT. REFER ALL DISCREPANCIES TO DAVID PLANT ARCHITECTURE LTD.



DAVID PLANT
ARCHITECTURE LTD

PROJECT
RESIDENTIAL DEVELOPMENT

DRAWING
AS PROPOSED
SITE LAYOUT PLAN

CLIENT
ONE PROPERTY GROUP

ADDRESS
YAPTON ROAD
BARNHAM
BOGNOR REGIS
PO22 0AY

DATE
07.05.2015

SCALE
1:200 @ A0

DRAWN
RW

CHECK
-

PROJECT NO.
409.200.00

DWG NO.
-

REVISION
-

ISSUE STATUS
PLANNING

studio@daparchitectures.co.uk t: (0844) 854 9007
w: w.daparchitecture.co.uk
LONDON BIRMINGHAM ESSAY

AS PROPOSED: SITE LAYOUT PLAN

Appendix A

SITE INVESTIGATION REPORT

Gary Biggs

Banner Homes Ltd
Tilford House,
Farnham Business Park,
Weydon Lane
Farnham,
Surrey,
GU9 8QT



5 November 2012

Our ref. GAD/LP00451

Dear Gary,

Re: The Lillies, Yapton Road, Barnham

LEAP attended the above site on 31 October 2012 to undertake 3 No. BRE365 soakage tests. The trial hole logs and location plan are attached.

The site comprises a caravan park situated on the south side of Yapton Road, near Barnham, West Sussex. The majority of the site comprises grassed enclosures with caravans or log cabins. Overall the site slopes very gently to the south. The British Geological Survey map indicates the site is underlain by River Terrace Deposits (silts, sands and clays) over the London Clay.

Ground conditions encountered are detailed on the attached logs and summarised below:

GL -0.2/0.4m	Dark brown silty clay TOPSOIL with occasional flint gravel.
- 1.0/1.6m	Soft to firm orange brown silty CLAY, with occasional fine flint gravel with depth.
- 1.6/2.06m	Orange brown silty fine SAND.

Groundwater was encountered as a seepage within the fine sands, at about 1.2-2.0m.

Due to time constraints, trial pits TP2, TP3 and TP6 were tested once. The results of the soakage tests are attached.

In summary, the tests achieved soakage rates of about 1.6×10^{-6} m/sec or 0.1 l/m²/min. None of the pits emptied over the test duration, with the water levels in TP2 and TP3 falling 37cm and 44 cm over 298mins and 270mins respectively. Soakage in TP6 was particularly poor, with the water level falling 6cm over 154mins.

Leap Environmental Ltd
The Atrium, Curtis Road
Dorking, Surrey, RH4 1XA



None of the test completed were compliant with the BRE365 methodology, as water levels did not fall to 25% of the effective depth.

On the basis of the above, achievable soakage rates on the site are very poor, with a maximum design soakage rate of 0.1l/m²/min recommended. In addition, a high groundwater table at about 1.2-1.5m should be anticipated on site and this will severely restrict the storage capacity of soakaways. Furthermore, running sands are encountered below about 1.2m with excavations becoming unstable and collapsing below this depth.

Given the above, conventional soakaways will not work well on site and will be difficult to construct to ensure they penetrate into the more permeable fine sands at depth. Allowance should therefore be made for surface water drainage to be piped off site.

Please contact the undersigned if you have any queries.

Yours faithfully,



Georgina Donbroski





Leap Environmental Ltd
The Atrium, Curtis Road, Dorking,
Surrey

Trialpit No

TP1

Sheet 1 of 1

Project Name
Barnham

Project No.
LP00451

Co-ords: -
Level: -

Date
31/10/2012

Location: The Lillies Caravan Park, Yapton Road, Barnham

Dimensions: -

Depth
2.00m

0.45m



Scale
1:15

Client: Banner Homes Southern

Logged By
GAD

Samples & In Situ Testing			Depth (m)	Level (m AOD)	Legend	Stratum Description
Depth (m)	Type	Results				
0.10	D		0.20			Dark brown silty clay TOPSOIL with occasional flint gravel.
						Soft to firm orange brown silty CLAY with occasional black speckling
1.00	D		1.20			
						Orange brown silty fine SAND becoming patched grey with depth.
1.80	D		2.00			
						Trialpit Complete at 2.00 m

Remarks: Pit collapsing below 1.7m

Groundwater: Seepage at 1.8m





Leap Environmental Ltd
The Atrium, Curtis Road, Dorking,
Surrey

Trialpit No

TP2

Sheet 1 of 1

Project Name
Barnham

Project No.
LP00451

Co-ords: -
Level: -

Date
31/10/2012

Location: The Lillies Caravan Park, Yapton Road, Barnham

Dimensions: 1.40m

Depth
1.80m

0.45m



Scale
1:15

Client: Banner Homes Southern

Logged By
GAD

Samples & In Situ Testing			Depth (m)	Level (m AOD)	Legend	Stratum Description	
Depth (m)	Type	Results					
			0.20			Dark brown silty clay TOPSOIL with occasional flint gravel.	
						Soft to firm orange brown silty CLAY with occasional black speckling	
			1.30			Orange brown silty CLAY with some fine flint gravel.	1
			1.60			Orange brown and buff brown silty fine SAND	
			1.70			Trialpit Complete at 1.80 m	2

Remarks: Pit collapsing at 1.7m. BRE365 soakage test.

Groundwater: Seepage at 1.7m. Rose to 1.5m



FieldBASE 3.1 (B14 426.48) Standard Trialpit Log v2 dated 27th Nov 03



Leap Environmental Ltd
The Atrium, Curtis Road, Dorking,
Surrey

Trialpit No

TP3

Sheet 1 of 1

Project Name
Barnham

Project No.
LP00451

Co-ords: -
Level: -

Date
31/10/2012

Location: The Lillies Caravan Park, Yapton Road, Barnham

Dimensions: 1.35m

Depth
2.00m

0.45m



Scale
1:15

Client: Banner Homes Southern

Logged By
GAD

Samples & In Situ Testing			Depth (m)	Level (m AOD)	Legend	Stratum Description	
Depth (m)	Type	Results					
0.10	D					Dark brown silty clay TOPSOIL with occasional flint gravel.	
			0.40			Soft to firm buff brown mottled orange brown silty CLAY. Becoming slightly gravelly with depth.	
1.00	D						1
			1.50			Orange brown patched buff silty fine SAND.	
1.70	D						
			2.00				
						Trialpit Complete at 2.00 m	2

Remarks: Pit collapsing below 1.5m. BRE365 soakage test.

Groundwater: Seepage at 2.0m. Rose to 1.7m



FileBASE 3.1 (B14 426.48) Standard Trialpit Log v2 dated 27th Nov 03



Leap Environmental Ltd
The Atrium, Curtis Road, Dorking,
Surrey

Trialpit No

TP5

Sheet 1 of 1

Project Name
Barnham

Project No.
LP00451

Co-ords: -
Level: -

Date
31/10/2012

Location: The Lillies Caravan Park, Yapton Road, Barnham

Dimensions: -

Depth
1.60m

0.45m



Scale
1:15

Client: Banner Homes Southern

Logged By
GAD

Samples & In Situ Testing			Depth (m)	Level (m AOD)	Legend	Stratum Description	
Depth (m)	Type	Results					
0.70	D		0.20			Dark brown silty clay TOPSOIL with occasional flint gravel.	
						Soft to firm buff brown silty CLAY	
1.10	D		1.00			Orange brown silty fine SAND	1
			1.60			Trialpit Complete at 1.60 m	2

Remarks: Pit collapsing below 1.0m.

Groundwater: Seepage at 1.6m.



FileBASE 3.1 (B14 426.48) Standard Trialpit Log v2 dated 27th Nov 03



Leap Environmental Ltd
The Atrium, Curtis Road, Dorking,
Surrey

Trialpit No

TP6

Sheet 1 of 1

Project Name
Barnham

Project No.
LP00451

Co-ords: -
Level: -

Date
31/10/2012

Location: The Lillies Caravan Park, Yapton Road, Barnham

Dimensions: 1.50m

Depth
1.20m

0.45m



Scale
1:15

Client: Banner Homes Southern

Logged By
GAD

Samples & In Situ Testing			Depth (m)	Level (m AOD)	Legend	Stratum Description	
Depth (m)	Type	Results					
			0.30			Dark brown silty clay TOPSOIL with occasional flint gravel.	
			1.00			Firm buff brown silty CLAY becoming sandy clay with depth.	
			1.60			Orange brown silty fine SAND	1
						Trialpit Complete at 1.20 m	2

Remarks: Pit collapsing below 1.0m. BRE365 soakage test.

Groundwater: Seepage at 1.2m.



FieldBASE 3.1 (B14 426.48) Standard Trialpit Log v2 dated 27th Nov 03



Results of BRE Digest 365 Soakage Tests

Site : Barnham
 Client : Banner Homes Southern
 O S Reference :
 Tested By : Oakland SI
 Test Date : 31/10/2012

Hole Number	Test Number	Hole Depth m	Test Soakage Rate litre/m2/min	Design Soakage Rate litre/m2/min	m/sec	End Water Level	Remarks
TP2	No 1	1.65	0.08	0.08	1.39588E-06	Pit was not emptied	
TP3	No 1	1.65	0.12	0.12	2.0464E-06	Pit was not emptied	
TP6	No 1	1.2	0.10	0.10	1.60128E-06	Pit was not emptied	
Mean Value of All Calculated Soakage Rates :				0.10 litre/m2/min	1.6812E-06 m/sec		

Appendix B

SOUTHERN WATER SW AND FW ASSET INFORMATION



Atkins Limited
Anglo St James House
39A Southgate Street
Winchester
Hampshire SO23 9EH

Planning and Development Services
Arun Civic Centre
Maltravers Road
Littlehampton
West Sussex
BN17 5LF

Your Ref: BN/3/13

Our Ref: PLAN-003263

05/06/2013

Proposal: Demolition of 6 no holiday lodges, toilet block. Removal of circa 30 touring caravans/motorhomes/camping pitches & replace with erection of 38no.residential dwellings, associated garages/car parking..

Site: The Lillies Caravan Park, Yapton Road, Barnham PO22 OAY.

BN/3/13

Dear Sir,

Thank you for your letter of 23/05/2013.

Please find attached a plan of the sewer records showing the approximate position of a foul rising main sewer and foul sewer crossing the site. The exact position of the public sewers must be determined on site by the applicant before the layout of the proposed development is finalised.

It might be possible to divert the foul rising main sewer and foul sewer, so long as this would result in no unacceptable loss of hydraulic capacity, and the work was carried out at the developer's expense to the satisfaction of Southern Water under the relevant statutory provisions.

Should the applicant wish to divert apparatus:

- 1.The 300 mm diameter foul rising main sewer requires a clearance of 3 metres either side of the sewer
- 2.The 225 mm diameter foul sewer requires a clearance of 3 metres either side of the sewer to protect it from construction works and allow for future access for maintenance.

- 3.No development or new tree planting should be located within 3 metres either side of the centreline of the public sewer
- 4.No new soakaways should be located within 5 metres of a public sewer.
- 5.All other existing infrastructure should be protected during the course of construction works.

Alternatively, the applicant may wish to amend the site layout, or combine a diversion with amendment of the site layout. If the applicant would prefer to advance these options, items (1) – (4) above also apply.

In order to protect/divert drainage apparatus, Southern Water requests that if consent is granted, a condition is attached to the planning permission. For example "The developer must advise the local authority (in consultation with Southern Water) of the measures which will be undertaken to protect/divert the public sewers, prior to the commencement of the development."

Following initial investigations, there is currently inadequate capacity in the local network to provide foul sewage disposal to service the proposed development. The proposed development would increase flows to the public sewerage system, and existing properties and land may be subject to a greater risk of flooding as a result. Additional off-site sewers, or improvements to existing sewers, will be required to provide sufficient capacity to service the development. Section 98 of the Water Industry Act 1991 provides a legal mechanism through which the appropriate infrastructure can be requested (by the developer) and provided to drain to a specific location.

Should this application receive planning approval, please include, as an informative to the permission, the following requirement:

"The applicant/developer should enter into a formal agreement with Southern Water to provide the necessary sewerage infrastructure required to service this development. Please contact Atkins Ltd, Anglo St James House, 39A Southgate Street, Winchester, SO23 9EH (Tel 01962 858688), or www.southernwater.co.uk"

Our initial investigations indicate that there are no public surface water sewers in the area to serve this development. Alternative means of draining surface water from this development are required. This should not involve disposal to a public foul sewer.

The planning application form makes reference to drainage using Sustainable Urban Drainage Systems (SUDS).

Under current legislation and guidance SUDS rely upon facilities which are not adoptable by sewerage undertakers. Therefore, the applicant will need to ensure that arrangements exist for the long term maintenance of the SUDS facilities. It is critical that the effectiveness of these systems is maintained in perpetuity. Good management will avoid flooding from the proposed surface water system, which may result in the inundation of the foul sewerage system.

Thus, where a SUDS scheme is to be implemented, the drainage details submitted to the Local Planning Authority should:

- Specify the responsibilities of each party for the implementation of the SUDS scheme
- Specify a timetable for implementation
- Provide a management and maintenance plan for the lifetime of the development.

This should include the arrangements for adoption by any public authority or statutory undertaker and any other arrangements to secure the operation of the scheme throughout its lifetime.

The application details for this development indicate that the proposed means of surface water drainage for the site is via a watercourse. The Council's technical staff and the relevant authority for land drainage consent should comment on the adequacy of the proposals to discharge surface water to the local watercourse.

If it is proposed to discharge surface water to a highway drain, this would not be adoptable by Southern Water and the planning authority would need to be satisfied that the highway authority are content with the proposal.

We request that should this application receive planning approval, the following condition is attached to the consent: "Construction of the development shall not commence until details of the proposed means of foul and surface water sewerage disposal have been submitted to, and approved in writing by, the Local Planning Authority in consultation with Southern Water."

You

Dev

SOUTHERN WATER



The positions of pipes shown on this plan are believed to be correct, but Southern Water Services Ltd accept no responsibility in the event of inaccuracy. The actual positions should be determined on site.

Based upon Ordnance Survey Digital Data with the permission of the controller of H.M.S.O. Crown Copyright Reserved Licence No. WU 298530

O.S. REF: SU9604SW

Scale: 1:2500

Screen Print

WARNING: BAC pipes are constructed of Bonded Asbestos Cement

WARNING: Unknown (UNK) materials may include Bonded Asbestos Cement

 **Southern Water**



Printed By: Ponnarv

Date: 4-3-2013

Southern Water MapGuide Browser

Requested By:

Appendix C

CORRESPONDENCE WITH SOUTHERN WATER

Steve Williamson

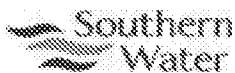
From: [REDACTED]
Sent: 01 July 2015 06:49
To: 'Chris Glegg'
Cc: 'Steve Williamson'
Subject: RE: Lillies Caravan Park, Yapton Road, Barnham

Chris

I would suggest that a capacity assessment is undertaken to confirm that there is sufficient capacity to service the proposed 38 units or you provide evidence of the existing discharge to the public sewerage network and provide calculations confirming that there will be no increase in net flows discharging to the public sewerage system. The capacity application forms can be downloaded from the following link <https://www.southernwater.co.uk/capacity-check-sewer> also you must state if the flow is to be pumped or gravity connection. If you require any additional information please do not hesitate to contact this office on the numbers below.

Regards

Stuart Ward
Technical Manager



Southern Water, Southern House, Sparrowgrove, Otterbourne, SO21 2SW

From: Chris Glegg [REDACTED]
Sent: 22 June 2015 13:25
To: Ward, Stuart
Cc: 'Steve Williamson'
Subject: FW: Lillies Caravan Park, Yapton Road, Barnham

Stuart,

On the back of the e-mail below, we met with the owner of the Lillie's Caravan site on Friday and he thought that the adjacent site which has been approved for circa 80 house (application BN/29/13) is draining directly to your FW sewer and that a pumping station was not required. As the lie of the land is very similar on our Clients site and we have access to the same foul sewer (assuming invert levels are very similar) then we would be very interested to understand the basic philosophy of their design and what agreement was reached with the adjacent promoter of the site to dispose of foul water sewerage.

We look forward to hearing from you in relation to these matters.

Regards

Chris

From: Chris Glegg [REDACTED]
Sent: 18 June 2015 07:35
To: 'Ward, Stuart'

Cc: 'Steve Williamson'

Subject: RE: Lillies Caravan Park, Yapton Road, Barnham

Dear Stuart,

Thank you for sending over your contact details, following our telcon on Monday.

You should find an e-mail chain between David and Alastair Aitken of Fortridge which, culminated in David saying that in principle he accepts the proposed redevelopment that the Lillies Caravan Park Site, off Yapton Road in Barnham, would not likely increase flows to the foul system. This was based on the preceding information that Fortridge had given David in that e-mail chain. If you can't find it I can scan over a copy.

Would you need any further information than that given in 2012 to be able to condition a new planning application? It is certain that foul drainage can be delivered, even if the Developer had to resort to using requisition powers, and so we consider that a suitably worded condition could be applied to require the submission of an acceptable detailed design to secure the necessary discharge of the condition, of which one option (most likely) is to adopt a similar system to what exists on site at present (to adoptable standards) but which would be capable of taking out some surface water that currently drains into your foul system, as David clearly acknowledged is currently the case.

Your early thoughts on this would be appreciated to enable us to progress the foul drain consideration and drainage strategy aspects of serving the site for a resubmitted scheme for a similar number of housing units (38) on the site.

I look forward to hearing from you.

Regards

Chris Glegg
Director

Intermodal
TRANSPORTATION
Hunters Court
Debden Road
Saffron Walden
Essex CB11 4AA



The information in this e-mail and any files transmitted with it are confidential and intended to be solely for the use of the addressee(s). The contents of the e-mail may contain copyright and or legally privileged information.

If you should receive this e-mail in error or are not the addressee please e-mail us at enquiries@inter-modal.co.uk and delete the message and its content from your computer. Copying, distribution, use or disclosure of its contents is strictly prohibited without the express permission of Intermodal Transportation Ltd.

Data is susceptible to corruption through Internet communications, as such no responsibility is accepted for changes made to this message after it was sent. No liability or responsibility is accepted for viruses and it is the recipients responsibility to scan attachments (if any).

From: Ward, Stuart [REDACTED]
Sent: 15 June 2015 16:46
To: [REDACTED]
Subject: FW: Barnham

Stuart Ward

Technical Manager

outbind://105-
000000001E084814AC9979469235ADB3D77D9CC00700E044679DCE68974B9A4CE7D0B84A
4B200000002BA3F80000332BD67941EF2F489CAEC6F4CC753091000E9EE46AE70000/cid:9
40393721@12052015-28F0

Southern Water, Southern House, Sparrowgrove, Otterbourne, SO21 2SW

Mail Delivery System [REDACTED]
June 2015 16:44
Ward, Stuart
Undeliverable: Barnham

Delivery has failed to these recipients or distribution lists:

[REDACTED]
A problem occurred during the delivery of this message. Microsoft Exchange will not try to redeliver this message for you. Please try resending this message later, or provide the following diagnostic text to your system administrator.

Diagnostic information for administrators:

Generating server: braisdmrff0.southernwater.co.uk

[REDACTED]
* * * * * X-Postfix: Host or domain name not found. Name service error for name=inter-moedal.co.uk type=A:
Host not found> #SMTP#

Original message headers:

Return-Path: [REDACTED]
X-M-MSG:
X-WSS-ID: 0NPZT1T-04-5ED-03
Received: from explorer.sws.int.southernwater.co.uk (unknown [10.131.29.23])
(using TLSv1 with cipher RC4-MD5 (128/128 bits)) (No client certificate
requested) by braisdmrff0.southernwater.co.uk (Postfix) with ESMTPS id
28B5B996ABD for <[REDACTED]>; Mon, 15 Jun 2015 16:44:17
+0100 (BST)
Received: from VECTRA.sws.int.southernwater.co.uk ([10.131.29.18]) by
explorer.sws.int.southernwater.co.uk ([10.131.29.23]) with mapi; Mon, 15 Jun 2015 16:44:18 +0100

From: "Ward, Stuart" [REDACTED]
To: "'chris.glegg@inter-moedal.co.uk'" [REDACTED]
Date: Mon, 15 Jun 2015 16:44:18 +0100
Subject: Barnham
Thread-Topic: Barnham
Thread-Index: AdCngiQUmdqUa6HGSRuNb06o9WjuTg==
Message-ID: <332BD67941EF2F489CAEC6F4CC7530910E9EE45CE3@VECTRA.sws.int.southernwater.co.uk>
Accept-Language: en-US
Content-Language: en-US
X-MS-Has-Attach: yes
X-MS-TNEF-Correlator:
acceptlanguage: en-US
Content-Type: multipart/related;
 boundary="._004_332BD67941EF2F489CAEC6F4CC7530910E9EE45CE3VECTRAswsints_";
 type="multipart/alternative"
MIME-Version: 1.0

This e-mail is intended solely for the person or organisation to which it is addressed. It may contain privileged and confidential information. If you are not the intended recipient, you are prohibited from copying, disclosing or distributing this e-mail or its contents (as it may be unlawful for you to do so) or taking any action in reliance on it.

If you receive this e-mail by mistake, please delete it then advise the sender immediately by reply e-mail to "Ward, Stuart" [REDACTED]

Without prejudice to the above prohibition on unauthorised copying and disclosure of this e-mail or its contents, it is your responsibility to ensure that any onward transmission, opening or use of this message and any attachments will not adversely affect your or the onward recipients' systems or data. Please carry out such virus and other such checks as you consider appropriate.

An e-mail reply to this address may be subject to monitoring for operational reasons or lawful business practices.

This e-mail is issued by Southern Water Services Limited, company number 2366670, registered in England and having its registered office at Southern House, Yeoman Road, Worthing, BN13 3NX, England.

In sending this e-mail the sender cannot be deemed to have specified authority and the contents of the e-mail will have no contractual effect unless (in either case) it is otherwise agreed between Southern Water Services Limited and the recipient.

This e-mail is intended solely for the person or organisation to which it is addressed. It may contain privileged and confidential information. If you are not the intended recipient, you are prohibited from copying, disclosing or distributing this e-mail or its contents (as it may be unlawful for you to do so) or taking any action in reliance on it.

If you receive this e-mail by mistake, please delete it then advise the sender immediately by reply e-mail to "Ward, Stuart" [REDACTED]

Without prejudice to the above prohibition on unauthorised copying and disclosure of this e-mail or its contents, it is your responsibility to ensure that any onward transmission, opening or use of this message and any attachments will not adversely affect your or the onward recipients' systems or data. Please carry out such virus and other such checks as you consider appropriate.

An e-mail reply to this address may be subject to monitoring for operational reasons or lawful business practices

**WEST SUSSEX COUNTY COUNCIL
FLOOD RISK MANAGEMENT CONSULTATION**

DATE: 29 June 2015

FROM: Kevin Macknay **TO: Intermodal Transportation**
FAO: Chris Glegg

SUBJECT: Lillies Caravan Park, Yapton Road, Barnham.

West Sussex County Council (WSCC), in its capacity as the Lead Local Flood Authority (LLFA), has been consulted on the above proposed development in respect of surface water drainage.

The following is the detailed comments of the LLFA relating to surface water drainage and flood risk for the proposed development and any associated observations, advice and conditions.

Note: Unfortunately, we do not hold any modelled or historic river or associated watercourse level data relevant to the study area.

Current surface water flood risk based on uFMfSW for 30year and 100year events:	Low risk.
Comments: Current uFMfSW mapping shows the proposed site to be at 'Low' risk from surface water flooding, for both a 1 in 30 and 1 in 100 storm events. It should be noted that the current uFMfSW mapping does show the road adjacent to the site, Guildford Road, and both the southern and western boundaries to be moderate risk from surface water flooding. Any existing surface water flow paths across the site must be maintained. Reason: NPPF paragraph 103 states – 'When determining planning applications, local planning authorities should ensure flood risk is not increased elsewhere..' Therefore, a wholesale site level rise via the spreading of excavated material should be avoided. Any excavated material kept on site should be located in areas designed and designated for that purpose.	

Current ground water flood risk based on ESI Ground Water mapping:	Moderate to Low risk / High susceptibility.
Comments: The southern end of the proposed development site is shown to be at 'Moderate to Low risk' from ground water flooding on the current ESI maps. Based on the same mapping the current geology is shown as 'High susceptibility' to ground water flooding. This means the general geology in the area may be suitable for infiltration / soakaways. Where the intention is to dispose of surface water via infiltration / soakaway, these should be shown to work through an appropriate assessment carried out under BRE Digest 365. Ground water contamination and Source Protection Zones. The potential for ground water contamination within a source protection zone has not been considered by the LLFA. The LPA should consult with the EA if this is considered as risk.	

Is the proposed development within or close to (within 150m) an existing Flood Zone, as defined by the National Planning Policy Framework (NPPF):	No
Comments: None.	

Records of any ordinary watercourses or culverted watercourses within or in close vicinity to the site:	Yes.
Comments: Current Ordnance Survey mapping does show an ordinary watercourse running along the western side of Hill lane. Other local or field boundary ditches, not shown on Ordnance Survey mapping, may exist around the site. If present these should be maintained and highlighted on future development plans. No development should take place within 5m of any watercourse or culvert.	

Records of any historic ordinary watercourses shown to have once crossed or been in close vicinity to the site:	None.
Comments: See comments above.	

Records of any historic flooding within the confines of the proposed site:	None.
Comments: We do not have any records of historic flooding within the confines of the proposed site. This should not be taken that this site has never suffered from flooding, only that it has never been reported to the LLFA.	

Existing highway drainage in the vicinity to the site:	Yes.
Comments: The adjacent road, Yapton Road, has a positive highway drainage system. This is likely to discharge into the local watercourse on the western side of Hill Lane.	

Records of any historic flooding in close vicinity to the site and/or on the adjacent public highway:	None.
Comments: We do not have any records of historic flooding within the confines of the proposed site. This should not be taken that this site has never suffered from flooding, only that it has never been reported to the LLFA.	

Future development - Sustainable Drainage Systems (SuDs)

SuDs seek to mimic natural drainage systems and retain water on or near to the site, when rain falls, in contrast to traditional drainage approaches, which tend to pipe water off site as quickly as possible.

SuDs offer significant advantages over conventional piped drainage systems in reducing flood risk by reducing the quantity of surface water run-off from a site and the speed at which it reaches water courses, promoting groundwater recharge, and improving water quality and amenity. The range of SuDs techniques available means that a SuDs approach in some form will be applicable to almost any development.

Government policy set out in paragraph 103 of the NPPF expects LPAs to give priority to the use of SuDs in determining planning applications. Further support for SuDs is set out in chapter 5 of the flood risk Practice Guide.

Approved Document Part H of the Building Regulations 2000 establishes a hierarchy for surface water disposal, which encourages a SuDs approach beginning with infiltration where possible e.g. soakaways or infiltration trenches.

Where SuDs are used, it must be established that these options are feasible, can be adopted and properly maintained and would not lead to any other environmental problems. For example, using soakaways or other infiltration methods on contaminated land carries groundwater pollution risks and may not work in areas with a high water table. Where the intention is to dispose to soakaway, these should be shown to work through an appropriate assessment carried out under BRE Digest 365.

Provision for long-term maintenance should be provided as part of any SuDs scheme submitted to the LPA.

Kevin Macknay
Flood Risk Management Team

Appendix D

MICRO DRAINAGE ATTENUATION CALCULATION

Donald Hall Associates		Page 1
44 Vicarage Lane Acton Sudbury CO10 0UQ	The Lillies, Yapton Rd, Barnham, W. Sussex.	
Date 08/07/2015 File	Designed by DMAH Checked by	
Micro Drainage Source Control 2013.1.1		

ICP SUDS Mean Annual Flood

Input

Return Period (years)	100	SAAR (mm)	700	Urban	0.187
Area (ha)	1.119	Soil	0.300	Region Number	Region 7

Results 1/s

QBAR Rural	2.0
QBAR Urban	2.9
Q100 years	8.0
Q1 year	2.5
Q30 years	6.1
Q100 years	8.0

©1982-2013 Micro Drainage Ltd

Donald Hall Associates		Page 1
44 Vicarage Lane Acton Sudbury CO10 0UQ	The Lillies, Yapton Road, Barnham, West Sussex.	
Date 08/07/2015 File 1239MD.mdx	Designed by DMAH Checked by	
Micro Drainage Network 2013.1.1		

Existing Network Details for 1239WD.SWS

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	k (mm)	HYD SECT	DIA (mm)
1.000	77.957	0.195	399.8	0.185	4.00	0.600	o	450
1.001	18.498	0.046	402.1	0.088	0.00	0.600	o	450
2.000	19.871	0.050	397.4	0.097	4.00	0.600	o	450
2.001	15.644	0.039	401.1	0.000	0.00	0.600	o	450
2.002	23.209	0.058	400.2	0.025	0.00	0.600	o	450
3.000	21.131	0.053	398.7	0.066	4.00	0.600	o	450
1.002	41.429	0.104	398.4	0.000	4.00	0.600	o	450
1.003	17.832	0.045	396.3	0.113	0.00	0.600	o	450
1.004	6.130	0.026	235.8	0.000	4.00	0.600	o	300

PN	US/MH Name	US/CL (m)	US/IL (m)	US C.Depth (m)	DS/CL (m)	DS/IL (m)	DS C.Depth (m)	Ctrl	US/MH (mm)
1.000	S7	8.700	7.416	0.834	8.530	7.221	0.859		900 x 900
1.001	S6	8.530	7.221	0.859	8.230	7.175	0.605		900 x 900
2.000	S1	8.490	7.322	0.718	8.520	7.272	0.798		900 x 900
2.001	S2	8.520	7.272	0.798	8.500	7.233	0.817		900 x 900
2.002	S3	8.500	7.233	0.817	8.230	7.175	0.605		900 x 900
3.000	S5	8.410	7.228	0.732	8.230	7.175	0.605		900 x 900
1.002	S4	8.230	7.175	0.605	7.880	7.071	0.359	Hydro-Brake®	900 x 900
1.003	S8	7.880	7.071	0.359	7.780	7.026	0.304		900 x 900
1.004	S9	7.780	7.026	0.454	7.780	7.000	0.480	Hydro-Brake®	900 x 900

Free Flowing Outfall Details for 1239WD.SWS

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
1.004	O/F	7.780	7.000	0.000	1	0

Simulation Criteria for 1239WD.SWS

Volumetric Runoff Coeff	0.750	Additional Flow - % of Total Flow	0.000
Areal Reduction Factor	1.000	MADD Factor * 10m³/ha Storage	2.000
Hot Start (mins)	0	Inlet Coefficient	0.800
Hot Start Level (mm)	0	Flow per Person per Day (l/per/day)	0.000
Manhole Headloss Coeff (Global)	0.500	Run Time (mins)	60
Foul Sewage per hectare (l/s)	0.000	Output Interval (mins)	1
Number of Input Hydrographs	0	Number of Offline Controls	0
Number of Online Controls	2	Number of Storage Structures	2
		Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Profile Type	Summer
Return Period (years)	1	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	19.300	Storm Duration (mins)	30
Ratio R	0.350		

©1982-2013 Micro Drainage Ltd

Donald Hall Associates		Page 2
44 Vicarage Lane Acton Sudbury CO10 0UQ	The Lillies, Yapton Road, Barnham, West Sussex.	
Date 08/07/2015 File 1239MD.mdx	Designed by DMAH Checked by	
Micro Drainage	Network 2013.1.1	

Online Controls for 1239WD.SWS

Hydro-Brake® Manhole: S4, DS/PN: 1.002, Volume (m³): 10.4

Design Head (m) 0.900 Hydro-Brake® Type Md5 SW Only Invert Level (m) 7.175
Design Flow (l/s) 4.0 Diameter (mm) 83

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)
0.100	2.1	0.800	3.7	2.000	5.9	4.000	8.3	7.000	11.0
0.200	2.5	1.000	4.1	2.200	6.1	4.500	8.8	7.500	11.4
0.300	2.5	1.200	4.5	2.400	6.4	5.000	9.3	8.000	11.7
0.400	2.7	1.400	4.9	2.600	6.7	5.500	9.7	8.500	12.1
0.500	2.9	1.600	5.2	3.000	7.2	6.000	10.2	9.000	12.4
0.600	3.2	1.800	5.6	3.500	7.8	6.500	10.6	9.500	12.8

Hydro-Brake® Manhole: S9, DS/PN: 1.004, Volume (m³): 3.3

Design Head (m) 0.475 Hydro-Brake® Type Md5 SW Only Invert Level (m) 7.026
Design Flow (l/s) 5.0 Diameter (mm) 107

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)
0.100	3.2	0.800	6.2	2.000	9.7	4.000	13.8	7.000	18.2
0.200	4.7	1.000	6.9	2.200	10.2	4.500	14.6	7.500	18.9
0.300	4.6	1.200	7.5	2.400	10.7	5.000	15.4	8.000	19.5
0.400	4.7	1.400	8.2	2.600	11.1	5.500	16.2	8.500	20.1
0.500	5.0	1.600	8.7	3.000	11.9	6.000	16.9	9.000	20.7
0.600	5.4	1.800	9.2	3.500	12.9	6.500	17.6	9.500	21.2

©1982-2013 Micro Drainage Ltd

Donald Hall Associates		Page 4
44 Vicarage Lane Acton Sudbury CO10 0UQ	The Lillies, Yapton Road, Barnham, West Sussex.	
Date 08/07/2015 File 1239MD.mdx	Designed by DMAH Checked by	
Micro Drainage Network 2013.1.1		

1 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for 1239WD.SWS

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coefficient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 2 Number of Storage Structures 2 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model	FSR M5-60 (mm)	19.300	Cv (Summer)	0.750	
Region	England and Wales	Ratio R	0.350	Cv (Winter)	0.840

Margin for Flood Risk Warning (mm) 450.0
Analysis Timestep 2.5 Second Increment (Extended)
DTS Status ON
DVD Status OFF
Inertia Status OFF

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years) 1, 30, 100
Climate Change (%) 0, 0, 30

PN	Storm	Return Period	Climate Change	First X Surchage	First Y Flood	First Z Overflow	O/F Act.	Lvl Exc.
1.000	240 Winter	1	0%	100/60 Winter				
1.001	240 Winter	1	0%	30/60 Summer				
2.000	240 Winter	1	0%	30/240 Winter				
2.001	240 Winter	1	0%	30/120 Winter				
2.002	240 Winter	1	0%	30/60 Winter				
3.000	240 Winter	1	0%	30/60 Winter				
1.002	240 Winter	1	0%	30/30 Summer				
1.003	240 Winter	1	0%	100/240 Winter				
1.004	240 Winter	1	0%	100/30 Winter				

PN	US/MH Name	Water		Flooded		Pipe		Status
		Level (m)	Surch'd Depth (m)	Volume (m³)	Flow / Cap. (l/s)	Flow (l/s)		
1.000	S7	7.555	-0.311	0.000	0.04	0.0	5.3	OK
1.001	S6	7.555	-0.116	0.000	0.06	0.0	6.9	OK
2.000	S1	7.554	-0.218	0.000	0.02	0.0	2.7	OK
2.001	S2	7.555	-0.167	0.000	0.02	0.0	2.5	OK
2.002	S3	7.555	-0.128	0.000	0.02	0.0	3.0	OK
3.000	S5	7.555	-0.123	0.000	0.01	0.0	1.9	OK
1.002	S4	7.555	-0.070	0.000	0.02	0.0	2.6	OK
1.003	S8	7.190	-0.331	0.000	0.05	0.0	5.7	OK
1.004	S9	7.188	-0.138	0.000	0.08	0.0	3.9	OK

©1982-2013 Micro Drainage Ltd

Donald Hall Associates		Page 5
44 Vicarage Lane Acton Sudbury CO10 0UQ	The Lillies, Yapton Road, Barnham, West Sussex.	
Date 08/07/2015 File 1239MD.mdx	Designed by DMAH Checked by	
Micro Drainage Network 2013.1.1		

30 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for 1239WD.SWS

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coefficient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 2 Number of Storage Structures 2 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model	FSR M5-60 (mm)	19.300	Cv (Summer)	0.750	
Region	England and Wales	Ratio R	0.350	Cv (Winter)	0.840

Margin for Flood Risk Warning (mm) 450.0
Analysis Timestep 2.5 Second Increment (Extended)
DTS Status ON
DVD Status OFF
Inertia Status OFF

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years) 1, 30, 100
Climate Change (%) 0, 0, 30

PN	Storm	Return Period	Climate Change	First X Surcharge	First Y Flood	First Z Overflow	O/F Act.	Lvl Exc.
1.000	360 Winter	30	0%	100/60 Winter				
1.001	360 Winter	30	0%	30/60 Summer				
2.000	360 Winter	30	0%	30/240 Winter				
2.001	360 Winter	30	0%	30/120 Winter				
2.002	360 Winter	30	0%	30/60 Winter				
3.000	360 Winter	30	0%	30/60 Winter				
1.002	360 Winter	30	0%	30/30 Summer				
1.003	240 Winter	30	0%	100/240 Winter				
1.004	240 Winter	30	0%	100/30 Winter				

PN	US/MH Name	Water		Flooded Volume (m³)	Pipe		Status
		Level (m)	Surch'd Depth (m)		Flow / Cap. (l/s)	O'flow (l/s)	
1.000	S7	7.788	-0.078	0.000	0.06	0.0	8.8 OK
1.001	S6	7.788	0.117	0.000	0.09	0.0	11.6 SURCHARGED
2.000	S1	7.787	0.015	0.000	0.04	0.0	4.6 SURCHARGED
2.001	S2	7.787	0.065	0.000	0.04	0.0	4.1 SURCHARGED
2.002	S3	7.787	0.104	0.000	0.04	0.0	5.0 SURCHARGED
3.000	S5	7.787	0.109	0.000	0.02	0.0	3.1 SURCHARGED
1.002	S4	7.787	0.162	0.000	0.02	0.0	3.1 FLOOD RISK
1.003	S8	7.317	-0.204	0.000	0.08	0.0	9.2 OK
1.004	S9	7.315	-0.011	0.000	0.09	0.0	4.7 OK

©1982-2013 Micro Drainage Ltd

Donald Hall Associates		Page 6
44 Vicarage Lane Acton Sudbury CO10 0UQ	The Lillies, Yapton Road, Barnham, West Sussex.	
Date 08/07/2015 File 1239MD.mdx	Designed by DMAH Checked by	
Micro Drainage	Network 2013.1.1	

100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for 1239WD.SWS

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coefficient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 2 Number of Storage Structures 2 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model	FSR M5-60 (mm)	19.300	Cv (Summer)	0.750	
Region	England and Wales	Ratio R	0.350	Cv (Winter)	0.840

Margin for Flood Risk Warning (mm) 450.0
Analysis Timestep 2.5 Second Increment (Extended)
DTS Status ON
DVD Status OFF
Inertia Status OFF

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years) 1, 30, 100
Climate Change (%) 0, 0, 30

PN	Storm	Return Period	Climate Change	First X Surchage	First Y Flood	First Z Overflow	O/F Act.	Lvl Exc.
1.000	480 Winter	100	+30%	100/60 Winter				
1.001	480 Winter	100	+30%	30/60 Summer				
2.000	480 Winter	100	+30%	30/240 Winter				
2.001	480 Winter	100	+30%	30/120 Winter				
2.002	480 Winter	100	+30%	30/60 Winter				
3.000	480 Winter	100	+30%	30/60 Winter				
1.002	480 Winter	100	+30%	30/30 Summer				
1.003	240 Winter	100	+30%	100/240 Winter				
1.004	240 Winter	100	+30%	100/30 Winter				

PN	US/MH Name	Water		Flooded		Pipe		Status
		Level (m)	Surch'd Depth (m)	Volume (m³)	Flow / Cap.	O'flow (l/s)	Flow (l/s)	
1.000	S7	8.106	0.240	0.000	0.08	0.0	11.8	SURCHARGED
1.001	S6	8.106	0.435	0.000	0.14	0.0	17.0	FLOOD RISK
2.000	S1	8.105	0.333	0.000	0.05	0.0	6.2	FLOOD RISK
2.001	S2	8.105	0.383	0.000	0.06	0.0	6.1	FLOOD RISK
2.002	S3	8.105	0.422	0.000	0.06	0.0	7.6	FLOOD RISK
3.000	S5	8.105	0.427	0.000	0.03	0.0	4.2	FLOOD RISK
1.002	S4	8.105	0.480	0.000	0.02	0.0	3.4	FLOOD RISK
1.003	S8	7.526	0.005	0.000	0.11	0.0	13.3	FLOOD RISK
1.004	S9	7.524	0.198	0.000	0.10	0.0	5.0	FLOOD RISK

©1982-2013 Micro Drainage Ltd

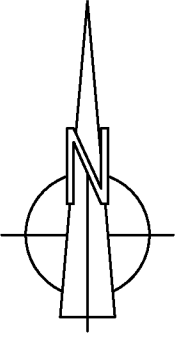
APPENDIX B



NOTES

This drawing is the copyright of Thrive Ltd ©. All rights reserved.
Ordnance Survey Data © Crown Copyright. All rights reserved.
Licence No. 100007359. DO NOT scale from this drawing.
Contractors, Sub Contractors and Suppliers are to check all relevant dimensions and levels of the site and building before commencing any shop drawings or building work. Any discrepancies should be recorded to the Architect.
Where applicable this drawing is to be read in conjunction with the Consultants' drawings.

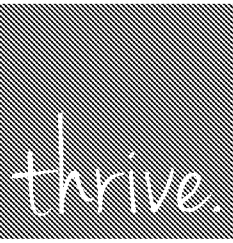
REV	DESCRIPTION	DATE	AUTH	CHK'D
P1	Description	00/00/00	abc	abc



scale 1:1250



PLANNING



Romsey Office

Building 300, The Grange, Romsey Road, Michelmersh, SO51 0AE
t: 01794 367703 f: 01794 367276 www.thrivearchitects.co.uk

PROJECT

Lillies, Yapton Road

Barnham

For: Matthew Homes

DRAWING

Location Plan

SCALE	DATE	AUTHOR	CHK'D
1:1250 @ A3	April 17	FK	
JOB NO.	DRAWING NO.	REV	
MATT151202	LP.01	A	

CLIENT REF.

APPENDIX C



NOTES

This drawing is the copyright of Thrive Architects Ltd ©. All rights reserved.
Ordnance Survey Data © Crown Copyright. All rights reserved.
Licence No. 100007359. DO NOT scale from this drawing.
Contractors, Sub-contractors and suppliers are to check all relevant dimensions and levels of the site and building before commencing any shop drawings or building work. Any discrepancies should be recorded to the Architect.
Where applicable this drawing is to be read in conjunction with the Consultants' drawings.

REV	DESCRIPTION	DATE	AUTHOR	CHK'D
A	Planning Issue	26/02/18	PR	MD

KEY

Site Boundary

Foul Water

Rising Main

23

Plot Number

1102

House Type

Affordable Housing

Built Form

Back Garden

Front Garden

Public Open Space

Road

Pavement

Shared Surface Mews

↔

Link to adjacent development

thrive.

architects

Romsey Office

Building 300, The Grange, Romsey Road, Michelmersh, SO51 0AE

t: 01794 367703 f: 01794 367276 www.thrivearchitects.co.uk

PROJECT

Lillies, Yapton Rd

Barnham

For: Matthew Homes

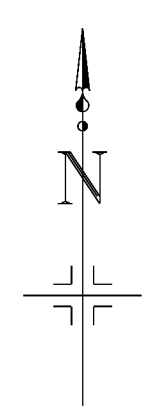
DRAWING

Sketch Layout - 01

SCALE	DATE	AUTHOR	CHK'D
1:500 @ A1	07/12/16	MD/al	BA

JOB NO.	DRAWING NO.	REV
MATT151202	SKL-01	A

APPENDIX D



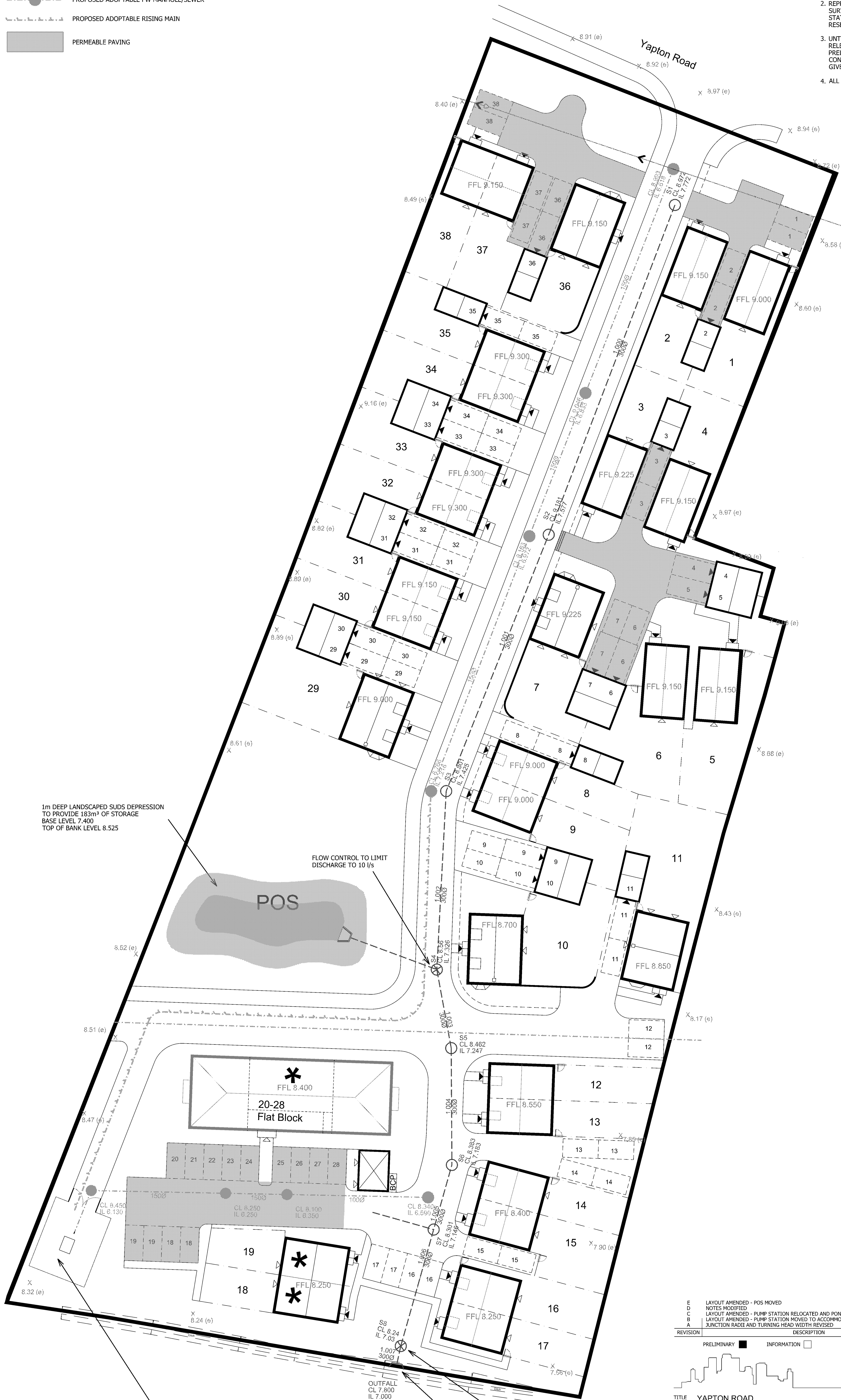
KEY

- PROPOSED ADOPTABLE SW MANHOLE/SEWER
- PROPOSED ADOPTABLE FW MANHOLE/SEWER
- PROPOSED ADOPTABLE RISING MAIN
- PERMEABLE PAVING

SAFETY HEALTH AND ENVIRONMENTAL

THERE ARE NO EXCEPTIONAL RISKS ASSOCIATED WITH THESE WORKS. REFER TO THE DESIGNERS RISK ASSESSMENT FOR THE FULL ASSESSMENT OF RISKS.

- NOTES**
- CONTRACTORS MUST CHECK ALL DIMENSIONS ON SITE. ONLY FIGURED DIMENSIONS ARE TO BE WORKED FROM. DISCREPANCIES MUST BE REPORTED TO THE ARCHITECT OR ENGINEER BEFORE PROCEEDING. © THIS DRAWING IS COPYRIGHT.
 - REPRODUCED FROM OS SITEMAP © BY PERMISSION OF ORDNANCE SURVEY® ON BEHALF OF THE CONTROLLER OF HER MAJESTY'S STATIONERY OFFICE. © CROWN COPYRIGHT 2008. ALL RIGHTS RESERVED. LICENCE NUMBER 100007126.
 - UNTIL TECHNICAL APPROVAL HAS BEEN OBTAINED FROM THE RELEVANT AUTHORITIES, ALL DRAWINGS ARE ISSUED AS PRELIMINARY AND NOT FOR CONSTRUCTION. SHOULD THE CONTRACTOR COMMENCE SITE WORK PRIOR TO APPROVAL BEING GIVEN IT IS ENTIRELY AT HIS OWN RISK.
 - ALL FLOOR LEVELS ARE NOTED AS +/-450mm



E	LAYOUT AMENDED - POS MOVED	JGF	JGF	13.02.18	
D	NOTES MODIFIED	KEC	JGF	01.12.17	
C	LAYOUT AMENDED - PUMP STATION RELOCATED AND POND ADJUSTED	JGF	JGF	22.11.17	
B	LAYOUT AMENDED - PUMP STATION MOVED TO ACCOMMODATE DITCH OFFSET	GLG	JGF	12.10.17	
A	JUNCTION RADII AND TURNING HEAD WIDTH REVISED	GLG	JGF	04.07.17	
REVISION	DESCRIPTION	DRAWN	CHECKED	DATE	
	PRELIMINARY ☒	INFORMATION ☐	TENDER ☐	CONSTRUCTION ☐	AS BUILT ☐

WOODS HARDWICK
ARCHITECTS, ENGINEERS AND DEVELOPMENT CONSULTANTS

15-17 GOLDINGTON ROAD
BEDFORD, MK40 3NH
T: +44 (0)1234 26862
FORT DUNLOP, FORT PARKWAY
BIRMINGHAM, B24 9FE
UNITED KINGDOM
T: +44 (0)121 6297700
MAIL@WOODSHARDWICK.COM
WWW.WOODSHARDWICK.COM

TITLE: YAPTON ROAD BARNHAM

DETAILS: DRAINAGE STRATEGY

SCALE: 1:250 @ A1 DATE: NOVEMBER 2016 DRAWN: LCC CHK: JGF

Please consider the environment before printing this drawing
Filepath: F:\Engineer

APPENDIX E

Woods Hardwick		Page 1																																																																																																																																																																																
15- 17 Goldington Road Bedford MK40 3NH																																																																																																																																																																																		
Date 22/02/2018 13:57 File sw alternative layout.MDX	Designed by J.Freeman Checked by																																																																																																																																																																																	
Micro Drainage Network 2014.1.1																																																																																																																																																																																		
<u>STORM SEWER DESIGN by the Modified Rational Method</u> <u>Design Criteria for Storm</u> Pipe Sizes NETWORK Manhole Sizes STANDARD FEH Rainfall Model <table><tr><td>Return Period (years)</td><td>2</td></tr><tr><td>Site Location GB 495800 104050 SU 95800 04050</td><td></td></tr><tr><td>C (1km)</td><td>-0.025</td></tr><tr><td>D1 (1km)</td><td>0.403</td></tr><tr><td>D2 (1km)</td><td>0.246</td></tr><tr><td>D3 (1km)</td><td>0.396</td></tr><tr><td>E (1km)</td><td>0.308</td></tr><tr><td>F (1km)</td><td>2.327</td></tr><tr><td>Maximum Rainfall (mm/hr)</td><td>0</td></tr><tr><td>Maximum Time of Concentration (mins)</td><td>30</td></tr><tr><td>Foul Sewage (l/s/ha)</td><td>0.000</td></tr><tr><td>Volumetric Runoff Coeff.</td><td>0.750</td></tr><tr><td>Add Flow / Climate Change (%)</td><td>0</td></tr><tr><td>Minimum Backdrop Height (m)</td><td>0.000</td></tr><tr><td>Maximum Backdrop Height (m)</td><td>0.000</td></tr><tr><td>Mn Design Depth for Optimisation (m)</td><td>1.200</td></tr><tr><td>Mn Vel for Auto Design only (m/s)</td><td>1.00</td></tr><tr><td>Mn Slope for Optimisation (1:X)</td><td>500</td></tr></table> Designed with Level Soffits			Return Period (years)	2	Site Location GB 495800 104050 SU 95800 04050		C (1km)	-0.025	D1 (1km)	0.403	D2 (1km)	0.246	D3 (1km)	0.396	E (1km)	0.308	F (1km)	2.327	Maximum Rainfall (mm/hr)	0	Maximum Time of Concentration (mins)	30	Foul Sewage (l/s/ha)	0.000	Volumetric Runoff Coeff.	0.750	Add Flow / Climate Change (%)	0	Minimum Backdrop Height (m)	0.000	Maximum Backdrop Height (m)	0.000	Mn Design Depth for Optimisation (m)	1.200	Mn Vel for Auto Design only (m/s)	1.00	Mn Slope for Optimisation (1:X)	500																																																																																																																																												
Return Period (years)	2																																																																																																																																																																																	
Site Location GB 495800 104050 SU 95800 04050																																																																																																																																																																																		
C (1km)	-0.025																																																																																																																																																																																	
D1 (1km)	0.403																																																																																																																																																																																	
D2 (1km)	0.246																																																																																																																																																																																	
D3 (1km)	0.396																																																																																																																																																																																	
E (1km)	0.308																																																																																																																																																																																	
F (1km)	2.327																																																																																																																																																																																	
Maximum Rainfall (mm/hr)	0																																																																																																																																																																																	
Maximum Time of Concentration (mins)	30																																																																																																																																																																																	
Foul Sewage (l/s/ha)	0.000																																																																																																																																																																																	
Volumetric Runoff Coeff.	0.750																																																																																																																																																																																	
Add Flow / Climate Change (%)	0																																																																																																																																																																																	
Minimum Backdrop Height (m)	0.000																																																																																																																																																																																	
Maximum Backdrop Height (m)	0.000																																																																																																																																																																																	
Mn Design Depth for Optimisation (m)	1.200																																																																																																																																																																																	
Mn Vel for Auto Design only (m/s)	1.00																																																																																																																																																																																	
Mn Slope for Optimisation (1:X)	500																																																																																																																																																																																	
<u>Network Design Table for Storm</u> <table><tr><th>PN</th><th>Length (m)</th><th>Fall (m)</th><th>Slope (1:X)</th><th>I. Area (ha)</th><th>T. E. (mins)</th><th>Base Flow (l/s)</th><th>k (mm)</th><th>HYD SECT</th><th>DIA (mm)</th><th>Auto Design</th></tr><tr><td>1.000</td><td>47.729</td><td>0.195</td><td>245.0</td><td>0.118</td><td>6.00</td><td>0.0</td><td>0.600</td><td>o</td><td>300</td><td></td></tr><tr><td>1.001</td><td>37.325</td><td>0.152</td><td>245.0</td><td>0.129</td><td>0.00</td><td>0.0</td><td>0.600</td><td>o</td><td>300</td><td></td></tr><tr><td>1.002</td><td>24.155</td><td>0.099</td><td>244.0</td><td>0.071</td><td>0.00</td><td>0.0</td><td>0.600</td><td>o</td><td>300</td><td></td></tr><tr><td>1.003</td><td>10.799</td><td>0.079</td><td>136.7</td><td>0.069</td><td>0.00</td><td>0.0</td><td>0.600</td><td>o</td><td>300</td><td></td></tr><tr><td>1.004</td><td>15.792</td><td>0.064</td><td>246.8</td><td>0.000</td><td>0.00</td><td>0.0</td><td>0.600</td><td>o</td><td>300</td><td></td></tr><tr><td>1.005</td><td>9.074</td><td>0.037</td><td>245.2</td><td>0.028</td><td>0.00</td><td>0.0</td><td>0.600</td><td>o</td><td>300</td><td></td></tr><tr><td>1.006</td><td>16.359</td><td>0.067</td><td>244.2</td><td>0.115</td><td>0.00</td><td>0.0</td><td>0.600</td><td>o</td><td>300</td><td></td></tr></table> <u>Network Results Table</u> <table><tr><th>PN</th><th>Rain (mm/hr)</th><th>T. C. (mins)</th><th>US/IL (m)</th><th>√ I. Area (ha)</th><th>√ Base Flow (l/s)</th><th>Foul (l/s)</th><th>Add Flow (l/s)</th><th>Vel (m/s)</th><th>Cap (l/s)</th><th>Flow (l/s)</th></tr><tr><td>1.000</td><td>0.00</td><td>6.80</td><td>7.772</td><td>0.118</td><td>0.0</td><td>0.0</td><td>0.0</td><td>1.00</td><td>70.7</td><td>0.0</td></tr><tr><td>1.001</td><td>0.00</td><td>7.42</td><td>7.577</td><td>0.247</td><td>0.0</td><td>0.0</td><td>0.0</td><td>1.00</td><td>70.7</td><td>0.0</td></tr><tr><td>1.002</td><td>0.00</td><td>7.82</td><td>7.425</td><td>0.318</td><td>0.0</td><td>0.0</td><td>0.0</td><td>1.00</td><td>70.8</td><td>0.0</td></tr><tr><td>1.003</td><td>0.00</td><td>7.95</td><td>7.326</td><td>0.387</td><td>0.0</td><td>0.0</td><td>0.0</td><td>1.34</td><td>94.9</td><td>0.0</td></tr><tr><td>1.004</td><td>0.00</td><td>8.22</td><td>7.247</td><td>0.387</td><td>0.0</td><td>0.0</td><td>0.0</td><td>1.00</td><td>70.4</td><td>0.0</td></tr><tr><td>1.005</td><td>0.00</td><td>8.37</td><td>7.183</td><td>0.415</td><td>0.0</td><td>0.0</td><td>0.0</td><td>1.00</td><td>70.7</td><td>0.0</td></tr><tr><td>1.006</td><td>0.00</td><td>8.64</td><td>7.146</td><td>0.530</td><td>0.0</td><td>0.0</td><td>0.0</td><td>1.00</td><td>70.8</td><td>0.0</td></tr></table> ø1982- 2014 XP Solutions			PN	Length (m)	Fall (m)	Slope (1:X)	I. Area (ha)	T. E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Auto Design	1.000	47.729	0.195	245.0	0.118	6.00	0.0	0.600	o	300		1.001	37.325	0.152	245.0	0.129	0.00	0.0	0.600	o	300		1.002	24.155	0.099	244.0	0.071	0.00	0.0	0.600	o	300		1.003	10.799	0.079	136.7	0.069	0.00	0.0	0.600	o	300		1.004	15.792	0.064	246.8	0.000	0.00	0.0	0.600	o	300		1.005	9.074	0.037	245.2	0.028	0.00	0.0	0.600	o	300		1.006	16.359	0.067	244.2	0.115	0.00	0.0	0.600	o	300		PN	Rain (mm/hr)	T. C. (mins)	US/IL (m)	√ I. Area (ha)	√ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)	1.000	0.00	6.80	7.772	0.118	0.0	0.0	0.0	1.00	70.7	0.0	1.001	0.00	7.42	7.577	0.247	0.0	0.0	0.0	1.00	70.7	0.0	1.002	0.00	7.82	7.425	0.318	0.0	0.0	0.0	1.00	70.8	0.0	1.003	0.00	7.95	7.326	0.387	0.0	0.0	0.0	1.34	94.9	0.0	1.004	0.00	8.22	7.247	0.387	0.0	0.0	0.0	1.00	70.4	0.0	1.005	0.00	8.37	7.183	0.415	0.0	0.0	0.0	1.00	70.7	0.0	1.006	0.00	8.64	7.146	0.530	0.0	0.0	0.0	1.00	70.8	0.0
PN	Length (m)	Fall (m)	Slope (1:X)	I. Area (ha)	T. E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Auto Design																																																																																																																																																																								
1.000	47.729	0.195	245.0	0.118	6.00	0.0	0.600	o	300																																																																																																																																																																									
1.001	37.325	0.152	245.0	0.129	0.00	0.0	0.600	o	300																																																																																																																																																																									
1.002	24.155	0.099	244.0	0.071	0.00	0.0	0.600	o	300																																																																																																																																																																									
1.003	10.799	0.079	136.7	0.069	0.00	0.0	0.600	o	300																																																																																																																																																																									
1.004	15.792	0.064	246.8	0.000	0.00	0.0	0.600	o	300																																																																																																																																																																									
1.005	9.074	0.037	245.2	0.028	0.00	0.0	0.600	o	300																																																																																																																																																																									
1.006	16.359	0.067	244.2	0.115	0.00	0.0	0.600	o	300																																																																																																																																																																									
PN	Rain (mm/hr)	T. C. (mins)	US/IL (m)	√ I. Area (ha)	√ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)																																																																																																																																																																								
1.000	0.00	6.80	7.772	0.118	0.0	0.0	0.0	1.00	70.7	0.0																																																																																																																																																																								
1.001	0.00	7.42	7.577	0.247	0.0	0.0	0.0	1.00	70.7	0.0																																																																																																																																																																								
1.002	0.00	7.82	7.425	0.318	0.0	0.0	0.0	1.00	70.8	0.0																																																																																																																																																																								
1.003	0.00	7.95	7.326	0.387	0.0	0.0	0.0	1.34	94.9	0.0																																																																																																																																																																								
1.004	0.00	8.22	7.247	0.387	0.0	0.0	0.0	1.00	70.4	0.0																																																																																																																																																																								
1.005	0.00	8.37	7.183	0.415	0.0	0.0	0.0	1.00	70.7	0.0																																																																																																																																																																								
1.006	0.00	8.64	7.146	0.530	0.0	0.0	0.0	1.00	70.8	0.0																																																																																																																																																																								

Woods Hardwick		Page 2
15-17 Goldington Road Bedford MK40 3NH		
Date 22/02/2018 13:57 File sw alternative layout.MDX		
Designed by J.Freeman Checked by		
Micro Drainage		Network 2014.1.1

Network Design Table for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I. Area (ha)	T. E. (mins)	Base Flow (l/s)	k	HYD SECT	DIA (mm)	Auto Design
1.007	3.164	0.013	245.0	0.000	0.00	0.0	0.600	o	300	

Network Results Table

PN	Rain (mm/hr)	T. C. (mins)	US/IL (m)	√ I. Area (ha)	√ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
1.007	0.00	8.69	7.079	0.530	0.0	0.0	0.0	1.00	70.7	0.0

Free Flowing Outfall Details for Storm

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Mn I. Level (m)	D, L (mm)	W (mm)
1.007	9	7.800	7.066	0.000	0	0

Simulation Criteria for Storm

Volumetric Runoff Coeff	0.840	Additional Flow - % of Total Flow	0.000
Areal Reduction Factor	1.000	MADD Factor * 10mE/ha Storage	1.000
Hot Start (mins)	0	Inlet Coefficient	0.800
Hot Start Level (mm)	0	Flow per Person per Day (l/per/day)	0.000
Manhole Headloss Coeff (Global)	0.500	Run Time (mins)	60
Foul Sewage per hectare (l/s)	0.000	Output Interval (mins)	1

Number of Input Hydrographs	0	Number of Storage Structures	4
Number of Online Controls	2	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FEH
Return Period (years)	100
Site Location	GB 495800 104050 SU 95800 04050
C (1km)	-0.025
D1 (1km)	0.403
D2 (1km)	0.246
D3 (1km)	0.396
E (1km)	0.308
F (1km)	2.327
Summer Storms	No
Winter Storms	Yes
Cv (Summer)	0.750
Cv (Winter)	0.840
Storm Duration (mins)	15

©1982- 2014 XP Solutions

Woods Hardwick		Page 3
15-17 Goldington Road Bedford MK40 3NH		
Date 22/02/2018 13:57 File sw alternative layout.MDX	Designed by J. Freeman Checked by	
Micro Drainage Network 2014.1.1		

Online Controls for Storm

Hydro-Brake Optimum# Manhole: 4, DS/PN: 1.003, Volume (mE): 3.0

Unit Reference	MD-SHE-0142-1000-1200-1000
Design Head (m)	1.200
Design Flow (l/s)	10.0
Flush-Flow	Calculated
Objective	Minimise upstream storage
Diameter (mm)	142
Invert Level (m)	7.326
Minimum Outlet Pipe Diameter (mm)	225
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.200	9.9
Flush-Flow	0.354	9.9
Kick-Flow	0.775	8.1
Mean Flow over Head Range	-	8.6

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake Optimum# as specified. Should another type of control device other than a Hydro-Brake Optimum# be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	5.1	1.200	9.9	3.000	15.3	7.000	23.0
0.200	9.4	1.400	10.7	3.500	16.5	7.500	23.8
0.300	9.9	1.600	11.4	4.000	17.6	8.000	24.6
0.400	9.9	1.800	12.0	4.500	18.6	8.500	25.3
0.500	9.7	2.000	12.7	5.000	19.6	9.000	26.0
0.600	9.5	2.200	13.2	5.500	20.5	9.500	26.7
0.800	8.2	2.400	13.8	6.000	21.4		
1.000	9.1	2.600	14.3	6.500	22.2		

Hydro-Brake Optimum# Manhole: 8, DS/PN: 1.007, Volume (mE): 2.4

Unit Reference	MD-SHE-0102-5000-1200-5000
Design Head (m)	1.200
Design Flow (l/s)	5.0
Flush-Flow	Calculated
Objective	Minimise upstream storage
Diameter (mm)	102
Invert Level (m)	7.079
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.200	5.0
Flush-Flow	0.353	4.9

ø1982-2014 XP Solutions

Woods Hardwick		Page 4
15-17 Goldington Road Bedford MK40 3NH		
Date 22/02/2018 13:57 File sw alternative layout.MDX	Designed by J.Freeman Checked by	
Micro Drainage Network 2014.1.1		

Hydro-Brake Optimum# Manhole: 8, DS/PN: 1.007, Volume (mE): 2.4

Control Points	Head (m)	Flow (l/s)
Kick-Flow	0.740	4.0
Mean Flow over Head Range	-	4.3

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake Optimum# as specified. Should another type of control device other than a Hydro-Brake Optimum# be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	3.4	1.200	5.0	3.000	7.6	7.000	11.4
0.200	4.7	1.400	5.3	3.500	8.2	7.500	11.8
0.300	4.9	1.600	5.7	4.000	8.7	8.000	12.1
0.400	4.9	1.800	6.0	4.500	9.2	8.500	12.5
0.500	4.8	2.000	6.3	5.000	9.7	9.000	12.8
0.600	4.6	2.200	6.6	5.500	10.2	9.500	13.2
0.800	4.1	2.400	6.9	6.000	10.6		
1.000	4.6	2.600	7.1	6.500	11.0		

©1982-2014 XP Solutions

Woods Hardwick		Page 5
15-17 Goldington Road Bedford MK40 3NH		
Date 22/02/2018 13:57 File sw alternative layout.MDX	Designed by J.Freeman Checked by	
Micro Drainage Network 2014.1.1		

Storage Structures for Storm

Porous Car Park Manhole: 1, DS/PN: 1.000

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	6.0
Membrane Percolation (mm/hr)	1000	Length (m)	57.5
Max Percolation (l/s)	95.8	Slope (1:X)	0.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	7.772	Cap Volume Depth (m)	0.600

Porous Car Park Manhole: 2, DS/PN: 1.001

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	6.0
Membrane Percolation (mm/hr)	1000	Length (m)	36.5
Max Percolation (l/s)	60.8	Slope (1:X)	0.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	7.577	Cap Volume Depth (m)	0.600

Tank or Pond Manhole: 4, DS/PN: 1.003

Invert Level (m) 7.326

Depth (m)	Area (m ²)	Depth (m)	Area (m ²)	Depth (m)	Area (m ²)
0.000	98.9	1.000	284.0	1.001	0.0

Porous Car Park Manhole: 7, DS/PN: 1.006

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	11.0
Membrane Percolation (mm/hr)	1000	Length (m)	30.0
Max Percolation (l/s)	91.7	Slope (1:X)	0.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	7.146	Cap Volume Depth (m)	0.600

©1982-2014 XP Solutions

Woods Hardwick		Page 6
15-17 Goldington Road Bedford MK40 3NH		
Date 22/02/2018 13:57 File sw alternative layout.MDX	Designed by J.Freeman Checked by	
Micro Drainage Network 2014.1.1		

1 year Return Period Summary of Critical Results by Maximum Level (Rank 1)
for Storm

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10mE/ha Storage	1.000
Hot Start Level (mm)	0	Inlet Coefficient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs	0	Number of Storage Structures	4
Number of Online Controls	2	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FEH
Site Location	GB 495800 104050 SU 95800 04050
C (1km)	-0.025
D1 (1km)	0.403
D2 (1km)	0.246
D3 (1km)	0.396
E (1km)	0.308
F (1km)	2.327
Cv (Summer)	0.750
Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	300.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	ON
DVD Status	ON
Inertia Status	ON

Profile(s)

Duration(s) (mins)	15, 30, 60, 120, 240, 360, 480, 960, 1440	Summer and Winter
Return Period(s) (years)	1, 5, 10, 20, 30, 50, 75, 100	
Climate Change (%)	0, 0, 0, 0, 0, 0, 0, 0, 30	

PN	Storm	Return Climate Period Change	First X Surcharge	First Y Flood	First Z Overflow	O/F Act.	Lvl Exc.
1.000	60 W nter	1	0%	100/120 W nter			
1.001	60 W nter	1	0%	50/360 W nter			
1.002	60 W nter	1	0%	20/240 W nter			
1.003	240 W nter	1	0%	10/120 W nter			
1.004	360 W nter	1	0%	10/240 W nter			
1.005	360 W nter	1	0%	5/240 W nter			
1.006	360 W nter	1	0%	5/240 W nter			
1.007	360 W nter	1	0%	5/60 W nter			

PN	Water US/ MH Name	Level (m)	Flooded Surched Depth (m)	Volume (mE)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status
1.000	1	7.816	-0.256	0.000	0.05	0.0	3.5	OK

ø1982- 2014 XP Sol ut i o n s

Woods Hardwick		Page 7						
15- 17 Goldington Road Bedford MK40 3NH								
Date 22/02/2018 13: 57 File sw alternative layout.MDX								
Designed by J. Freeman Checked by		Micro Drainage Network 2014. 1. 1						
<u>1 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm</u>								
	Water	Flooded	Pipe					
PN	US/ MH Name	Level (m) Surch' ed Depth (m)	Vol ume (mE) Flow / Cap. Flow / (l/ s) Flow (l/ s) Status					
1. 001	2	7. 645	- 0. 232	0. 000	0. 12	0. 0	7. 7	OK
1. 002	3	7. 505	- 0. 219	0. 000	0. 16	0. 0	10. 2	OK
1. 003	4	7. 468	- 0. 158	0. 000	0. 09	0. 0	6. 3	OK
1. 004	5	7. 370	- 0. 177	0. 000	0. 10	0. 0	5. 8	OK
1. 005	6	7. 366	- 0. 116	0. 000	0. 11	0. 0	6. 2	OK
1. 006	7	7. 364	- 0. 082	0. 000	0. 09	0. 0	5. 3	OK
1. 007	8	7. 365	- 0. 013	0. 000	0. 09	0. 0	4. 8	OK
ø1982- 2014 XP Sol ut i ons								

Woods Hardwick		Page 8
15-17 Goldington Road Bedford MK40 3NH		
Date 22/02/2018 13:57 File sw alternative layout.MDX		
Designed by J.Freeman Checked by		
Micro Drainage		Network 2014.1.1

5 year Return Period Summary of Critical Results by Maximum Level (Rank 1)
for Storm

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10mE/ha Storage	1.000
Hot Start Level (mm)	0	Inlet Coefficient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs	0	Number of Storage Structures	4
Number of Online Controls	2	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FEH
Site Location	GB 495800 104050 SU 95800 04050
C (1km)	-0.025
D1 (1km)	0.403
D2 (1km)	0.246
D3 (1km)	0.396
E (1km)	0.308
F (1km)	2.327
Cv (Summer)	0.750
Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	300.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	ON
DVD Status	ON
Inertia Status	ON

Profile(s)

Duration(s) (mins)	15, 30, 60, 120, 240, 360, 480, 960, 1440	Summer and Winter
Return Period(s) (years)	1, 5, 10, 20, 30, 50, 75, 100	
Climate Change (%)	0, 0, 0, 0, 0, 0, 0, 0, 30	

PN	Storm	Return Climate Period Change	First X Surcharge	First Y Flood	First Z Overflow	O/F Act.	Lvl Exc.
1.000	60 W nter	5 0%	100/120 W nter				
1.001	30 W nter	5 0%	50/360 W nter				
1.002	360 W nter	5 0%	20/240 W nter				
1.003	360 W nter	5 0%	10/120 W nter				
1.004	360 W nter	5 0%	10/240 W nter				
1.005	360 W nter	5 0%	5/240 W nter				
1.006	360 W nter	5 0%	5/240 W nter				
1.007	360 W nter	5 0%	5/60 W nter				

Water		Flooded		Pipe			
PN	US/MH Name	Level (m)	Surch'ed Depth (m)	Volume (mE)	Flow / Cap. (l/s)	Overflow Flow (l/s)	Status
1.000	1	7.836	-0.236	0.000	0.10	0.0 6.9	OK

ø1982- 2014 XP Sol ut i o n s

Woods Hardwick								Page 9
15- 17 Goldington Road Bedford MK40 3NH								
Date 22/02/2018 13:57 File sw alternative layout.MDX				Designed by J. Freeman Checked by				
Micro Drainage				Network 2014.1.1				
<u>5 year Return Period Summary of Critical Results by Maximum Level (Rank 1)</u> <u>for Storm</u>								
PN	US/MH Name	Water Level (m)	Surch'd Depth (m)	Flooded Volume (m ³)	Flow / Cap.	O'flow (l/s)	Pipe Flow (l/s)	Status
1.001	2	7.674	-0.204	0.000	0.23	0.0	14.8	OK
1.002	3	7.587	-0.138	0.000	0.15	0.0	9.4	OK
1.003	4	7.583	-0.043	0.000	0.09	0.0	6.4	OK
1.004	5	7.494	-0.053	0.000	0.11	0.0	6.3	OK
1.005	6	7.490	0.007	0.000	0.13	0.0	6.9	SURCHARGED
1.006	7	7.488	0.042	0.000	0.10	0.0	5.9	SURCHARGED
1.007	8	7.559	0.180	0.000	0.10	0.0	4.9	SURCHARGED
ø1982- 2014 XP Solutions								

Woods Hardwick		Page 10																																																																																	
15-17 Goldington Road Bedford MK40 3NH																																																																																			
Date 22/02/2018 13:57 File sw alternative layout.MDX																																																																																			
Designed by J.Freeman Checked by																																																																																			
Micro Drainage		Network 2014.1.1																																																																																	
<u>10 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm</u>																																																																																			
<u>Simulation Criteria</u>																																																																																			
Areal Reduction Factor 1.000 Additional Flow - % of Total Flow 0.000 Hot Start (mins) 0 MADD Factor * 10mE/ha Storage 1.000 Hot Start Level (mm) 0 Inlet Coefficient 0.800 Manhole Headloss Coeff (Global) 0.500 Flow per Person per Day (l/per/day) 0.000 Foul Sewage per hectare (l/s) 0.000																																																																																			
Number of Input Hydrographs 0 Number of Storage Structures 4 Number of Online Controls 2 Number of Time/Area Diagrams 0 Number of Offline Controls 0 Number of Real Time Controls 0																																																																																			
<u>Synthetic Rainfall Details</u>																																																																																			
Rainfall Model FEH Site Location GB 495800 104050 SU 95800 04050 C (1km) -0.025 D1 (1km) 0.403 D2 (1km) 0.246 D3 (1km) 0.396 E (1km) 0.308 F (1km) 2.327 Cv (Summer) 0.750 Cv (Winter) 0.840																																																																																			
Margin for Flood Risk Warning (mm) 300.0 Analysis Timestep 2.5 Second Increment (Extended) DTS Status ON DVD Status ON Inertia Status ON																																																																																			
<u>Profile(s)</u>																																																																																			
Duration(s) (mins) 15, 30, 60, 120, 240, 360, 480, 960, 1440 Return Period(s) (years) 1, 5, 10, 20, 30, 50, 75, 100 Climate Change (%) 0, 0, 0, 0, 0, 0, 0, 0, 30																																																																																			
<table border="1"> <thead> <tr> <th>PN</th> <th>Storm</th> <th>Return Climate Period</th> <th>Climate Change</th> <th>First X Surge</th> <th>First Y Flood</th> <th>First Z Overflow</th> <th>O/F Act.</th> <th>Lvl Exc.</th> </tr> </thead> <tbody> <tr><td>1.000</td><td>30</td><td>Winter</td><td>10</td><td>0%</td><td>100/120</td><td>Winter</td><td></td><td></td></tr> <tr><td>1.001</td><td>30</td><td>Winter</td><td>10</td><td>0%</td><td>50/360</td><td>Winter</td><td></td><td></td></tr> <tr><td>1.002</td><td>360</td><td>Winter</td><td>10</td><td>0%</td><td>20/240</td><td>Winter</td><td></td><td></td></tr> <tr><td>1.003</td><td>360</td><td>Winter</td><td>10</td><td>0%</td><td>10/120</td><td>Winter</td><td></td><td></td></tr> <tr><td>1.004</td><td>480</td><td>Winter</td><td>10</td><td>0%</td><td>10/240</td><td>Winter</td><td></td><td></td></tr> <tr><td>1.005</td><td>480</td><td>Winter</td><td>10</td><td>0%</td><td>5/240</td><td>Winter</td><td></td><td></td></tr> <tr><td>1.006</td><td>480</td><td>Winter</td><td>10</td><td>0%</td><td>5/240</td><td>Winter</td><td></td><td></td></tr> <tr><td>1.007</td><td>360</td><td>Winter</td><td>10</td><td>0%</td><td>5/60</td><td>Winter</td><td></td><td></td></tr> </tbody> </table>			PN	Storm	Return Climate Period	Climate Change	First X Surge	First Y Flood	First Z Overflow	O/F Act.	Lvl Exc.	1.000	30	Winter	10	0%	100/120	Winter			1.001	30	Winter	10	0%	50/360	Winter			1.002	360	Winter	10	0%	20/240	Winter			1.003	360	Winter	10	0%	10/120	Winter			1.004	480	Winter	10	0%	10/240	Winter			1.005	480	Winter	10	0%	5/240	Winter			1.006	480	Winter	10	0%	5/240	Winter			1.007	360	Winter	10	0%	5/60	Winter		
PN	Storm	Return Climate Period	Climate Change	First X Surge	First Y Flood	First Z Overflow	O/F Act.	Lvl Exc.																																																																											
1.000	30	Winter	10	0%	100/120	Winter																																																																													
1.001	30	Winter	10	0%	50/360	Winter																																																																													
1.002	360	Winter	10	0%	20/240	Winter																																																																													
1.003	360	Winter	10	0%	10/120	Winter																																																																													
1.004	480	Winter	10	0%	10/240	Winter																																																																													
1.005	480	Winter	10	0%	5/240	Winter																																																																													
1.006	480	Winter	10	0%	5/240	Winter																																																																													
1.007	360	Winter	10	0%	5/60	Winter																																																																													
<table border="1"> <thead> <tr> <th colspan="3">Water</th> <th colspan="2">Flooded</th> <th colspan="3">Pipe</th> <th></th> </tr> <tr> <th>PN</th> <th>US/MH Name</th> <th>Level (m)</th> <th>Surch'd Depth (m)</th> <th>Volume (mE)</th> <th>Flow / Cap.</th> <th>O'flow (l/s)</th> <th>Pipe Flow (l/s)</th> <th>Status</th> </tr> </thead> <tbody> <tr> <td>1.000</td> <td>1</td> <td>7.850</td> <td>-0.222</td> <td>0.000</td> <td>0.15</td> <td>0.0</td> <td>9.9</td> <td>OK</td> </tr> </tbody> </table>			Water			Flooded		Pipe				PN	US/MH Name	Level (m)	Surch'd Depth (m)	Volume (mE)	Flow / Cap.	O'flow (l/s)	Pipe Flow (l/s)	Status	1.000	1	7.850	-0.222	0.000	0.15	0.0	9.9	OK																																																						
Water			Flooded		Pipe																																																																														
PN	US/MH Name	Level (m)	Surch'd Depth (m)	Volume (mE)	Flow / Cap.	O'flow (l/s)	Pipe Flow (l/s)	Status																																																																											
1.000	1	7.850	-0.222	0.000	0.15	0.0	9.9	OK																																																																											
ø1982-2014 XP Solutions																																																																																			

Woods Hardwick							Page 11	
15- 17 Goldington Road Bedford MK40 3NH								
Date 22/02/2018 13:57 File sw alternative layout.MDX								
Designed by J. Freeman Checked by				Micro Drainage				
Network 2014.1.1								
<u>10 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm</u>								
		Water		Flooded		Pipe		
PN	US/MH Name	Level (m)	Surch'ed Depth (m)	Volume (mE)	Flow / Cap.	O'flow (l/s)	Flow (l/s)	Status
1.001	2	7.692	-0.185	0.000	0.31	0.0	20.4	OK
1.002	3	7.663	-0.062	0.000	0.18	0.0	11.1	OK
1.003	4	7.659	0.033	0.000	0.09	0.0	6.5	SURCHARGED
1.004	5	7.577	0.030	0.000	0.10	0.0	5.8	SURCHARGED
1.005	6	7.573	0.090	0.000	0.12	0.0	6.4	SURCHARGED
1.006	7	7.571	0.125	0.000	0.10	0.0	6.2	SURCHARGED
1.007	8	7.669	0.290	0.000	0.10	0.0	4.9	SURCHARGED
ø1982- 2014 XP Solutions								

Woods Hardwick		Page 12
15-17 Goldington Road Bedford MK40 3NH		
Date 22/02/2018 13:57 File sw alternative layout.MDX	Designed by J.Freeman Checked by	
Micro Drainage Network 2014.1.1		

20 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10mE/ha Storage	1.000
Hot Start Level (mm)	0	Inlet Coefficient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs	0	Number of Storage Structures	4
Number of Online Controls	2	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FEH
Site Location	GB 495800 104050 SU 95800 04050
C (1km)	-0.025
D1 (1km)	0.403
D2 (1km)	0.246
D3 (1km)	0.396
E (1km)	0.308
F (1km)	2.327
Cv (Summer)	0.750
Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	300.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	ON
DVD Status	ON
Inertia Status	ON

Profile(s)

Duration(s) (mins)	15, 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years)	1, 5, 10, 20, 30, 50, 75, 100
Climate Change (%)	0, 0, 0, 0, 0, 0, 0, 0, 30

PN	Storm	Return Climate Period	Climate Change	First X Surge	First Y Flood	First Z Overflow	O/F Act.	Lvl Exc.
1.000	30 W nter	20	0%	100/120 W nter				
1.001	360 W nter	20	0%	50/360 W nter				
1.002	360 W nter	20	0%	20/240 W nter				
1.003	360 W nter	20	0%	10/120 W nter				
1.004	480 W nter	20	0%	10/240 W nter				
1.005	480 W nter	20	0%	5/240 W nter				
1.006	480 W nter	20	0%	5/240 W nter				
1.007	480 W nter	20	0%	5/60 W nter				

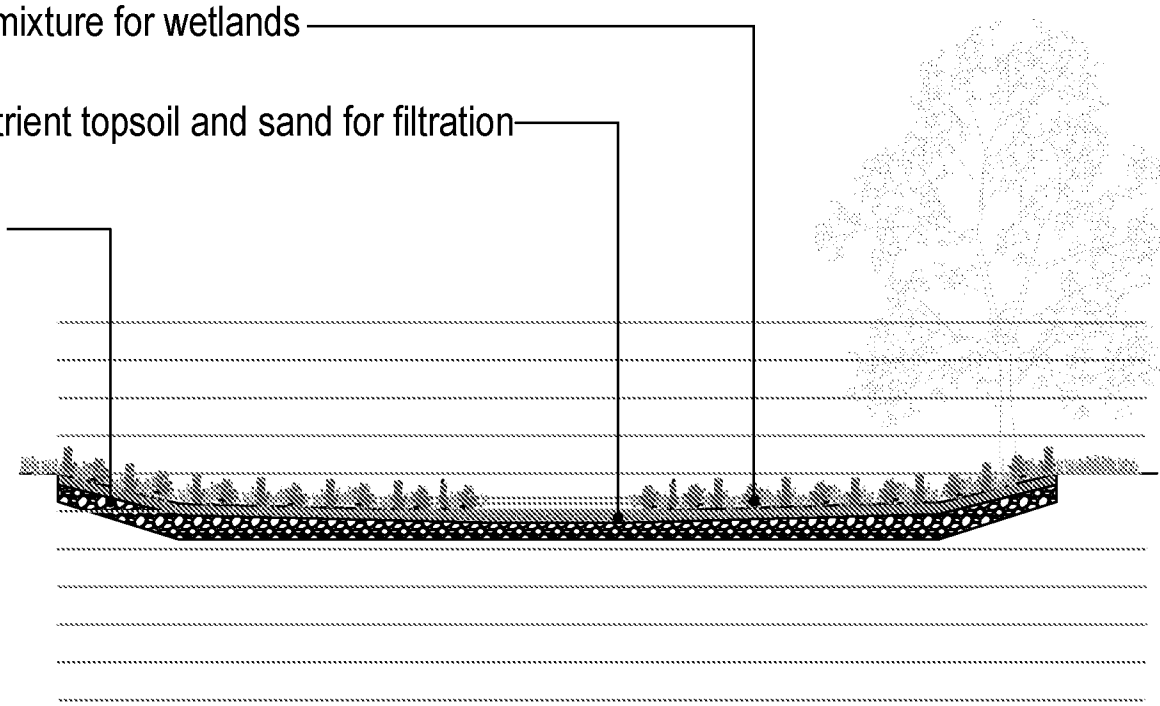
Water		Flooded		Pipe			
PN	US/MH Name	Level (m)	Surch'ed Depth (m)	Volume (mE)	Flow / Cap. (l/s)	Overflow Flow (l/s)	Status
1.000	1	7.866	-0.206	0.000	0.21	0.0 14.0	OK

ø1982- 2014 XP Sol ut i o n s

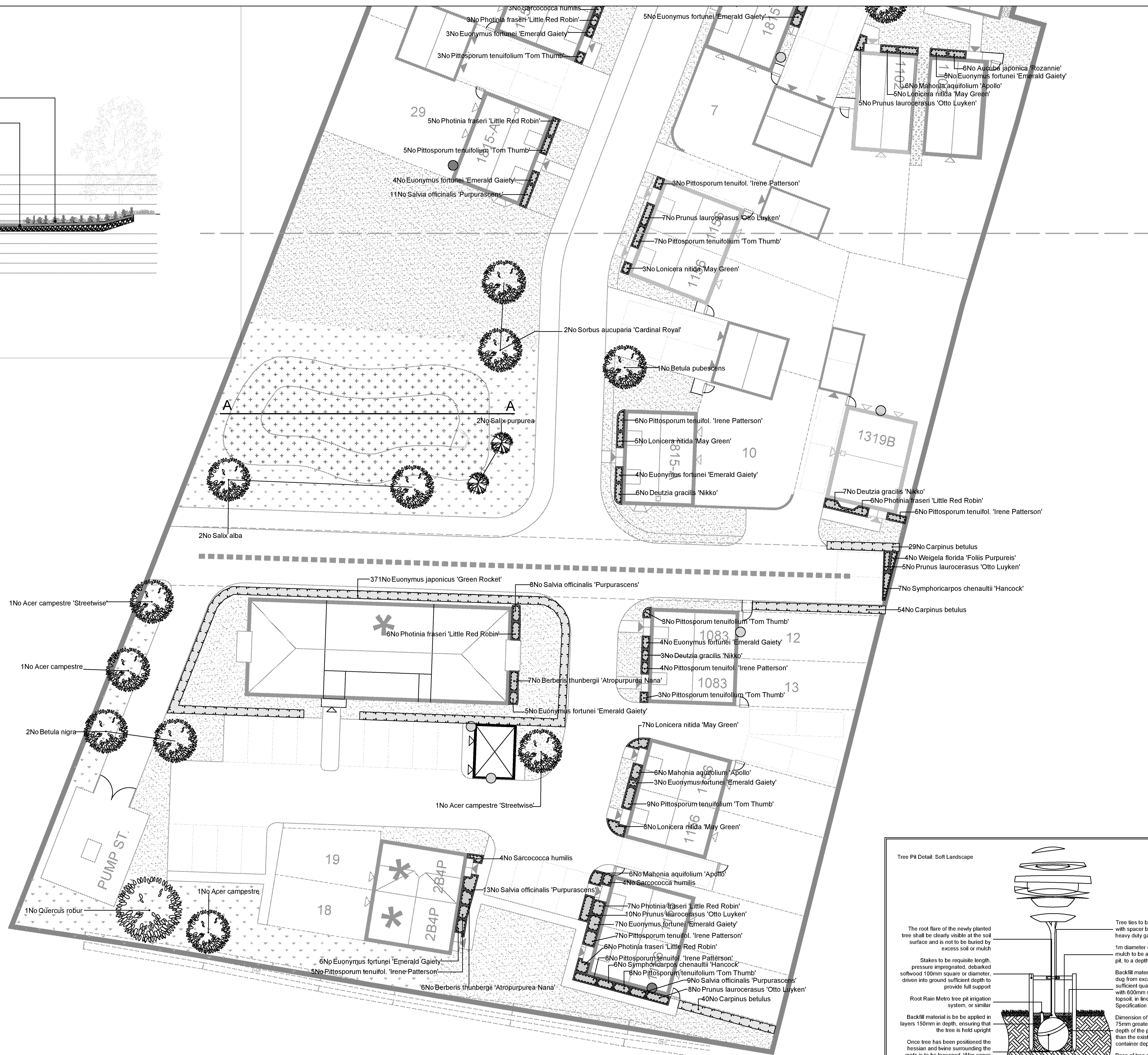
Woods Hardwick		Page 13						
15- 17 Goldington Road Bedford MK40 3NH								
Date 22/02/2018 13: 57 File sw alternative layout.MDX								
Designed by J. Freeman Checked by		Micro Drainage Network 2014. 1. 1						
<u>20 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm</u>								
PN	US/MH Name	Water Level (m)	Surch'ed Depth (m)	Flooded Volume (m ³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status
1. 001	2	7. 747	- 0. 130	0. 000	0. 16	0. 0	10. 5	OK
1. 002	3	7. 743	0. 019	0. 000	0. 21	0. 0	13. 0	SURCHARGED
1. 003	4	7. 740	0. 114	0. 000	0. 09	0. 0	6. 6	SURCHARGED
1. 004	5	7. 664	0. 118	0. 000	0. 10	0. 0	5. 9	SURCHARGED
1. 005	6	7. 660	0. 178	0. 000	0. 12	0. 0	6. 5	SURCHARGED
1. 006	7	7. 658	0. 213	0. 000	0. 10	0. 0	6. 3	SURCHARGED
1. 007	8	7. 775	0. 396	0. 000	0. 10	0. 0	4. 9	SURCHARGED
ø1982- 2014 XP Solutions								

APPENDIX F

450mm gravel



Section A-A 1:200



SPECIFICATION
All works generally, to comply with the written Soft Landscape Specification.

NOTE: DO NOT SCALE FROM DRAWING

Legend



Existing trees to be retained and protected during construction



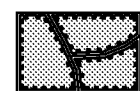
Proposed tree planting within soft landscape. See detail on sheet



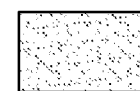
Proposed *Carpinus* (hornbeam) hedge planting to be planted in a double staggered row 300mm apart and at 500mm centres in each row. To be maintained at 1m height



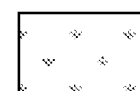
Proposed mixed native hedge
planting to be planted in a double
staggered row 300mm apart and
at 500mm centres in each row.
To be maintained at 1.8m height.



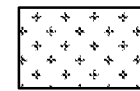
Proposed shrub planting to receive 75mm bark mulch after planting operations



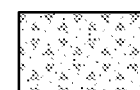
Proposed grass areas to receive good quality amenity grass turves laid in line with good horticultural practices



Proposed grassland areas, to be seeded with EL1 (Flowering Lawn Mixture) from Emorsgate Seeds or similar and approved. Seeded at 4g/m²



Proposed grassland areas, to be seeded with EM8 wetland meadow mix as supplied by Germinal Seeds, or similar and approved



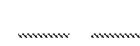
Proposed areas of angular chippings laid on weedproof membrane



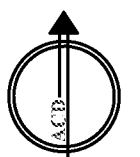
Bat Box (See Ecological Mitigation Report)



Bird box (See Ecological Mitigation Report)



Cut lines



G	22.02.18	Section added	LS
F	16.02.18	Layout change	LS
E	12.12.17	Play space added	LS
D	07.12.17	Hedge added to apartment block	JM
C	06.12.17	Layout change	JM
B	12.10.17	Layout change	LS
A	04.07.17	Layout change	LS
Rev	Date	Details	Drawn



HEAD OFFICE
Rodbourne Rail Business Centre, Grange Lane,
Malmesbury, SN16 0ES
Tel: 01666 825646

Courtyard House, Mill Lane, Godalming, GU7 1EY
Tel: 01483 425714

Suite 6, Crescent House, Yonge Close, Eastleigh, SO50 9SX
Tel: 02382 026300

9 Brownlow Road, Cambridge, CB4 3NG
Tel: 07825 868654

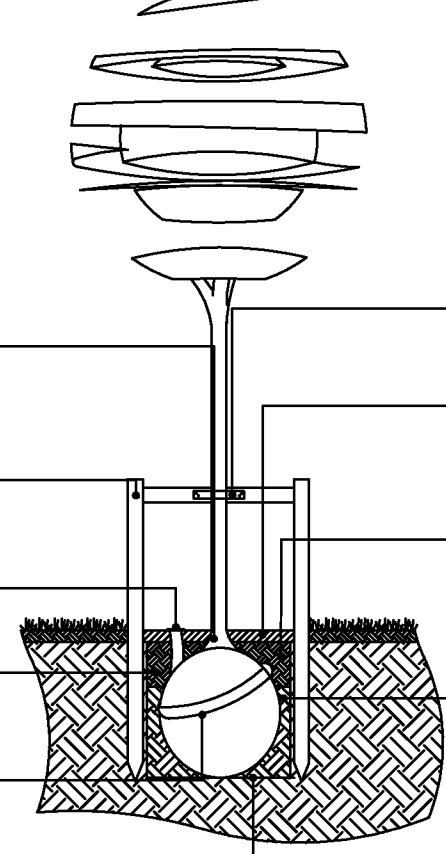
email: mail@accenv.co.uk
www.accenvironmental.co.uk



scheme: The Lillies, Yapton Rd
Barnham
client: Matthew Homes
drawing: Landscape Proposals
date: April 2017
scale: 1:200@A1
drawing no: MAT21212 11G sheet 2
drawn: AE checked: DKM

Copyright of ACD Environmental Ltd. All rights described in Chapter IV of the Copyright, Designs and Patents Act 1988 have been generally asserted: 2011. Copyright of this plan remains with ACD until all fees have been paid in full.

Tree Pit Detail: Soft Landscape



The diagram illustrates the installation of a tree pit with various components and their specifications:

- Tree ties:** Tree ties to be expandable rubber with spacer block, fixed to stake with heavy duty galvanised nails.
- Soil surface:** The root flare of the newly planted tree shall be clearly visible at the soil surface and is not to be buried by excess soil or mulch.
- Stakes:** Stakes to be requisite length, pressure impregnated, debarked softwood 100mm square or diameter, driven into ground sufficient depth to provide full support.
- Root Rain Metro:** Root Rain Metro tree pit irrigation system, or similar.
- Backfill material:** Backfill material to be applied in layers 150mm in depth, ensuring that the tree is held upright.
- 1m diameter of decorative bark mulch:** 1m diameter of decorative bark mulch to be applied to surface of tree pit, to a depth of 75mm.
- Backfill material to comprise of soil dug from excavated pits (if of sufficient quality) or to be backfilled with 600mm subsoil and 300mm of topsoil, in line with BS3882:2015 Specification for topsoil.**
- Dimension of free pit to be at least 75mm greater than the rootball.** The depth of the pit shall be no deeper than the existing rootball and container depth.
- Base of free pit to remain undisturbed unless there is evidence**

Components as supplied from GreenBlue Urban or similar