18th June 2020

Our Ref: JAG//43386/Lt004

Mr Adam Littler
Lead Local Flood Authority
Oxfordshire County Council
County Hall
New Road
Oxford,
OX1 1ND

Dear Sirs

Re: Proposed Development at Bicester Gateway: LLFA Response

Following our detailed discussions and e-mails regarding flood risk and drainage matters in relation to the planning application for Bicester Gateway, reference 20/00293, we summarise our response below.

Development and Flood Risk and Drainage Context
The planning application to Cherwell District Council is covered under application reference 20/00293. However, the site is also covered under an extant planning application, reference 16/02586, and Hamill Davies Limited provided a supporting 'Flood Risk Assessment' report and a 'Services, Foul and Surface Water Drainage Strategy' report.

In addition to the extant planning permission reference 16/02586, subsequent submittals have been made to discharge planning Conditions relevant to Phase 1A (the hotel). Pertinent to this report is application reference 18/00389/DISC, which included the WSP Drainage Technical Note and supporting drainage drawings and calculations.

Alan Wood & Partners produced the FRDA report to support this planning application based on the flood risk and drainage principles set by the extant permission and its supporting reports. However, through the consultation process Alan Wood & Partners and the Lead Local Flood Authority have worked closely together and additional information is provided within this letter report and its enclosures. The LLFA SuDS Pro-Forma is included in the submittal, as well as further information as set out below.

Soakage Tests
The soakaway tests were taken from the extant planning application submittals. The tests failed the BRE365 methodology, in that the water did not infiltrate. Furthermore, the site has shallow groundwater levels which also precludes the use of infiltration. The soakaway testing report is enclosed, which also includes details on groundwater levels and for these reasons, infiltration is ruled out.

Surface Water Drainage and SuDS
The updated Drainage Layout and supporting Calculations have been updated to allow for shallow, non-pumped connections to adjacent watercourses.

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Due to the size of the site, and the shallowness of the watercourses it is not feasible to drain to a single outfall via gravity. The site is therefore proposed to outfall to multiple outfalls to enable connection by gravity.

Discharge from each outfall will be restricted by use of flow control devices. The discharge from each outfall will be reduced to the lowest rate practicable, via vortex type flow control devices with 75mm opening. Any smaller opening size would mean a high risk of blockage, which could lead to a flood risk to the site.

Extensive use of shallow SuDS is proposed due to the shallow outfalls to the shallow watercourses. Surface water will be treated and excess flows will be stored via tree pits, swales, filter trenches, permeable paving and detention areas. Due to the site constraints, geo-cellular crates could provide the attenuation storage beneath permeable and paved surfaces, as these have a higher void ration than open graded sub-base material.

In terms of calculations for surface water storage; the LLFA recommended a Cv of 0.95 for roofs, and 0.9 for paved areas. As the calculation software used allows only one value for the whole system, the more conservative value of 0.95 has been applied to the calculations.

Climate Change
The calculations and drainage drawing allow for 40% climate change.

Urban Creep
Urban creep has not been applied, as firstly; this is a development of multi-storey, multi-occupancy buildings which cannot be reasonably extended without further planning permission, which would control flood risk and drainage matters in the usual manner, and secondly; almost all available green space not occupied by buildings is proposed to be occupied by SuDS features, which therefore limit space for future expansion.

Water Quality & Treatment Trains
By extensive use of SuDs components to intercept direct runoff, these utilise velocity control and retention time to reduce contaminants through settling, adsorption and other removal processes over the period of time that the runoff is in contact with the SuDS treatment media (e.g surface of a swale/basin, the filtration media within filter drains/permeable paving, or held within water storage volume in a basin).

Low risk run-off, in water quality terms, from roofs will achieve a minimum one level of treatment, generally via filter trenches or swales, whereas medium risk areas, such as car parks will achieve two levels of treatment, via permeable surfaces and either swales, filter trenches or basins, and normally via a combination of multiple SuDS features.

Land Drainage Consent
We note reference to requiring land drainage consent, which will be formally applied for at the right time. The drainage ditches are riparian owned, and site already discharges rainfall run-off to the surrounding ditches, so we are maintaining the status quo.

With the surface water discharge rate from each outfall limited to the lowest practicable rate, and in theory this being less than the unrestricted existing surface runoff equivalent rate for the 1 in 100 year return period, and with us allowing for climate change within the assessment, the flood risk to the existing ditches should be reduced.

Management of Water during Construction

As the site is at planning stage a contractor has not yet been appointed. The appointment of a contractor would go hand in hand with planning the phases of construction. A water management plan during phased construction would then be produced by the appointed contractor. We would therefore advise that a plan for water management during construction be suitably worded as a Planning Condition.

Factors of Safety

The updated drainage layout and supporting calculations are based on the worst case in relation to surface water. No allowance has been made of absorption of rain into landscaped areas, nor uptake by trees, plants and vegetation. There are covered decks between some buildings, which will be planted and have landscaping, and therefore will not be wholly impermeable, however, the calculations assume full impermeable run-off.

Summary

The flood risks and mitigation that was recommended in the Alan Wood & Partners FRDA report that accompanied the original planning application have not materially changed, and these were previously established and accepted for the extant permission and Condition discharge submittals.

However, following detailed discussions with the LLFA the updated drainage design and supporting calculations includes additional SuDS, more treatment and more attenuation and discha4rge to the watercourses via gravity.

We trust that the additional information and agreements are sufficient for the LLFA to be confident that Outline permission can be granted with suitably worded planning Conditions to control the proposed scheme as it is brought forward to the Reserved Matters stage.

Yours faithfully

James Gibson MEng (Hons), CEng, C.WEM, MCIWEM
Director
For and on behalf of Alan Wood and Partners

Enc.
Completed Oxfordshire County Council LLFA SuDS Pro-forma
Soakaway Testing by Soils Ltd.
Proposed Drainage Layout by Alan Wood & Partners Ltd.
Proposed Drainage MicroDrainage Calculations by Alan Wood & Partners Ltd.
Existing and Proposed Flood Routing Plans by Alan Wood & Partners Ltd.

SuDS Flows and Volumes - LLFA Technical Assessment Pro-forma

This form identifies the information required by Oxfordshire County Council LLFA to enable technical assessment of flows and volumes determined as part of drainage / SuDS calculations.

*Note : * means delete as appropriate; Numbers in brackets refer to accompanying notes.*

SITE DETAILS

1.1	Planning application reference	20/00293/OUT
1.2	Site name	Bicester Gateway Business Park
1.3	Total application site area (1)	3.3 ha
1.4	Is the site located in a CDA or LFRZ	~~Y~~/N
1.5	Is the site located in a SPZ	~~Y~~/N

VOLUME AND FLOW DESIGN INPUTS

2.1	Site area which is positively drained by SuDS (2)	19000 m^2
2.2	Impermeable area drained pre development (3)	0 m^2
2.3	Impermeable area drained post development (3)	16825 m^2
2.4	Additional impermeable area (2.3 minus 2.2)	16825 m^2
2.5	Predevelopment use (4)	Greenfield / ~~Brownfield / Mixed~~*
2.6	Method of discharge (5)	~~Infiltration~~ / waterbody / ~~storm sewer / combined sewer~~*
2.7	Infiltration rate (where applicable)	N/A
2.8	Influencing factors on infiltration	N/A
2.9	Depth to highest known ground watertable	0.8 mAOD
2.10	Coefficient of runoff (Cv) (6)	0.95
2.11	Justification for Cv used	Following discussion with LLFA, 0.95 agreed acceptable.
2.12	FEH rainfall data used (Note that FSR is no longer the preferred rainfall calculation method)	Y/~~N~~
2.13	Will storage be subject to surcharge by elevated water levels in watercourse / sewer	~~Y~~/N
2.14	Invert level at outlet (invert level of final flow control) – NOTE: Multiple outfalls–see drainage layout	
2.15	Design level used for surcharge water level at point of discharge (14)	N/A

SuDS Flows and Volumes - LLFA Technical Assessment Pro-forma

CALCULATION OUTPUTS

Sections 3 and 4 refer to site where storage is provided by attenuation and I or partial infiltration. Where all flows are infiltrated to ground omit Sections 3 -5 and complete Section 6.

3.0 Defining rate of runoff from the site

3.2	Max. discharge for 1in 1 year rainfall	2.7l/s/ha, 8.9l/s for the site
3.2	Max. discharge for Q_{med} rainfall	2.7l/s/ha, 8.8l/s for the site
3.3	Max. discharge for 1in 30 year rainfall	2.7l/s/ha, 9.0l/s for the site
3.4	Max. discharge for 1in 100 year rainfall	-NOT MEASURED – CLIMATE CHANGE APPLIED TO ALL 1IN100YEAR CALCS
3.5	Max. discharge for 1in 100 year plus 40%CC	2.8l/s/ha, 9.4l/s for the site

4.0 Attenuation storage to manage peak runoff rates from the site

4.1	Storage - 1in 1 year	427m^3, 0.025m^3/m^2 (of developed impermeable area)
4.2	Storage -1in 30 year (7	1116m^3, 0.066m^3/m^2
4.3	Storage - 1in 100 year (8)	NOT MEASURED – CLIMATE CHANGE APPLIED TO ALL 1IN100YEAR CALCS
4.4	Storage - 1in 100 year plus 40%CC (9)	2061m3, 0.122m3/m2

5.0 Controlling volume of runoff from the site

5.1	Pre development runoff volume (10)	0m^3 for the site
5.2	Post development runoff volume (unmitigated) (10)	1361m^3 for the site
5.3	Volume to be controlled/does not leave site (5.2-5.1)	1361m^3 for the site

5.4 Volume control provided by

Interception losses (11)	0m3
Rain harvesting (12)	0m3
Infiltration (even at very low rates)	0m3
Separate area designated as long term storage (13)	1361m3

5.5	Total volume control (sum of inputs for 5.4)	1361m3 (15)

6.0 Site storage volumes (full infiltration only)

6.1	Storage - 1in 30 year (7	N/A – not full infiltration
6.2	Storage - 1 in 100 year plus CC (9	N/A – not full infiltration

SuDS Flows and Volumes - LLFA Technical Assessment Pro-forma

Notes

1. All area with the proposed application site boundary to be included.
2. The site area which is positively drained includes all green areas which drain to the SuDS system and area of surface SuDS features. It excludes large open green spaces which do not drain to the SuDS system.
3. Impermeable area should be measured pre and post development. Impermeable surfaces include roofs, pavements, driveways and paths where runoff is conveyed to the drainage system.
4. Predevelopment use may impact on the allowable discharge rate. The LLFA will seek for reduction in flow rates to GF status in all instances. The design statement and drawings explain/ demonstrate how flows will be managed from the site.
5. Runoff may be discharge via one or a number of means.
6. Sewers for Adoption 6th Edition recommends a Cv of 100% when designing drainage for impermeable area (assumes no loss of runoff from impermeable surfaces) and 0% for permeable areas. Where lower Cv's are used the application should justify the selection of Cv.
7. Storage for the 1 in 30 year must be fully contained within the SuDS components. Note that standing water within SuDS components such as ponds, basins and swales is not classified as flooding. Storage should be calculated for the critical duration rainfall event.
8. Runoff generated from rainfall events up to the 1 in 100 year will not be allowed to leave the site in an uncontrolled way. Temporary flooding of specified areas to shallow depths (150-300mm) may be permitted in agreement with the LLFA.
9. Climate change is specified as 40% increase to rainfall intensity, unless otherwise agreed with the LLFA / EA.
10. To be determined using the 100 year return period 6 hour duration rainfall event.
11. Where Source Control is provided Interception losses will occur. An allowance of 5mm rainfall depth can be subtracted from the net inflow to the storage calculation where interception losses are demonstrated. The Applicant should demonstrate use of sub catchments and source control techniques.
12. Please refer to Rain harvesting BS for guidance on available storage.
13. Flow diverted to Long term storage areas should be infiltrated to the ground, or where this is not possible, discharged to the receiving water at slow flow rates (maximum 2 l/s/ha). LT storage would not be allowed to empty directly back into attenuation storage and would be expected to drain away over 5-10 days. Typically, LT storage may be provided on multi-functional open space or sacrificial car parking areas.
14. Careful consideration should be used for calculations where flow control / storage is likely to be influenced by surcharged sewer or peak levels within a watercourse. Storm sewers are designed for pipe full capacity for 1 in 1 to 1 in 5 year return period. Beyond this, the pipe network will usually be in conditions of surcharge. Where information cannot be gathered from Thames Water, engineering judgement should be used to evaluate potential impact (using sensitivity analysis for example).
15. In controlling the volume of runoff, the total volume from mitigation measures should be greater than or equal to the additional volume generated.

Design and Credit to: McCloy Consulting Ltd

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Bloom Bridge LLP
c/o
Hill Street Holdings

F.A.O. Lauren Bates

Our Ref: 15860/SA

16th November 2016

Dear Lauren

RE: Results of Soakaway Testing and Geotechnical Ground Investigation at Phase 1A & 1B Bicester Gate.

We are writing in regards to the ground investigation and soakaway testing undertaken at the above site

Brief
Soils Limited were commissioned following the acceptance of fee proposal Q18062 Rev3, dated 15th November 2015, to undertake a ground investigation on the site to collect information on the underlying ground conditions in the form of trial holes and the collection of geotechnical samples.
Soakaway testing was also undertaken to determine the level of natural drainage present under the site on the site. These works were undertaken to aid in the future development of the site.

Standards
The site works, soil descriptions and geotechnical testing was undertaken in accordance with the following standards:

- BS EN 1997-1:2004+A1:2013 Eurocode 7. Geotechnical design
- BS EN ISO 14688-1:2002+A1:2013 - Geotechnical investigation and testing - Identification and description
- BS EN ISO 14688-2:2004+A1:2013 - Geotechnical investigation and testing - Principles for a classification

The geotechnical laboratory testing was performed by GEO Site & Testing Services Ltd (GSTL) in accordance with the methods given in BS 1377:1990 Parts 1 to 8 and their UKAS accredited test methods.

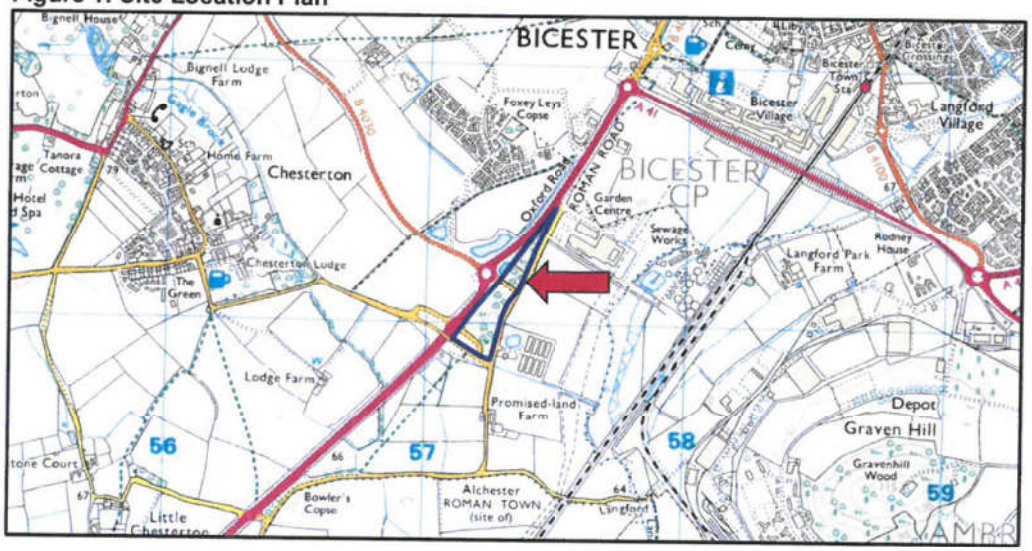
For the preparation of this report, the relevant BS code of practice was adopted for the geotechnical laboratory testing technical specifications, in the absence of the relevant Eurocode specifications (ref: ISO TS 17892).

General

The site was located on the A41 at OS Land Ranger Grid Reference of SP 573 211. At the time of reporting the site was open fields that sloped down towards to the east.

A site location plan is presented in Figure 1.

Figure 1: Site Location Plan



Proposed Development

It is understood that the site is to be developed into a 150 bed hotel and office buildings.

Ground Conditions

On the 27th October 2016 a total of 10 trial holes TP101 – TP107 (including soakaway test locations TP102A, TP103A and TP106A) were excavated on the site by a back acting excavator to depths ranging between 0.60m and 2.90m bgl. The maximum depths of trial holes have been included in Table 1.

All trial holes were scanned with a Cable Avoidance Tool (C.A.T.) and GENNY prior to excavation to ensure the health and safety of the operatives.

Table 1 Final Depth of Trial Holes

Trial Hole	Depth (m bgl)	Trial Hole	Depth (m bgl)
TP101	2.10	TP104	2.50
TP102	0.80	TP105	2.70
TP102A	0.60	TP106	2.70
TP103	2.90	TP106A	1.50
TP103A	1.20	TP107	2.50

Note: Trial holes with 'A' signifies that they are soakaways

The approximate trial hole locations are shown on Figure 2.

The soil conditions encountered were recorded and soil sampling commensurate with the purposes of the investigation was carried out. The depths given on the trial hole logs and quoted in this report were measured from ground level.

The soils encountered from immediately below ground surface have been described in the following manner. Where the soil incorporated an organic content such as either decomposing leaf litter or roots, or has been identified as part of the in-situ weathering profile, it has been described as Topsoil both on the logs and within this report. Where man has clearly either placed the soil, or the composition altered, with say greater than an estimated 5% of a non-natural constituent, it has been referred to as Made Ground both on the log and within this report.

For more complete information about the soils encountered within the general area of the site reference should be made to the detailed records given within Appendix A, but for the purposes of discussion, the succession of conditions encountered in the trial holes in descending order can be summarised:

Topsoil
River Terrace Deposits
Kellaways Clay Member
Kellaways Sand Member

The ground conditions encountered are summarised in Table 2 below.

Table 2 – Summary of Ground Conditions Encountered

Strata	Depth Encountered (m bgl)		Typical Description
	Top	Base	
Topsoil	0.00	0.25 – 0.65	Dark brown slightly gravelly sandy SILT
River Terrace Deposits	0.25 – 0.65	0.80 – 2.10	Light yellow orange very sandy slightly GRAVEL Light yellow orange very sandy gravelly CLAY
Kellaways Clay Member	1.10 – 2.90	2.00 – 2.90[1]	Dark grey blue black silty CLAY
Kellaways Sand Member	2.00 – 2.80	2.30 – 2.90[1]	Dark blue grey SILTSTONE

Notes: [1] encountered to base of trial hole

With the exception of soakaway trial pit TP102A, which encountered a ceramic field drain pipe at 0.60m bgl, no Made Ground was encountered.

Groundwater

Groundwater was encountered within all the trial holes at depths between 0.80m bgl to 2.90m bgl. When encountered, groundwater in TP103, TP104, TP105 and TP107 was observed to quickly fill the trial pits and rise to between 2.40m and 1.10m bgl. The details of the groundwater strikes are presented in Table 3 below.

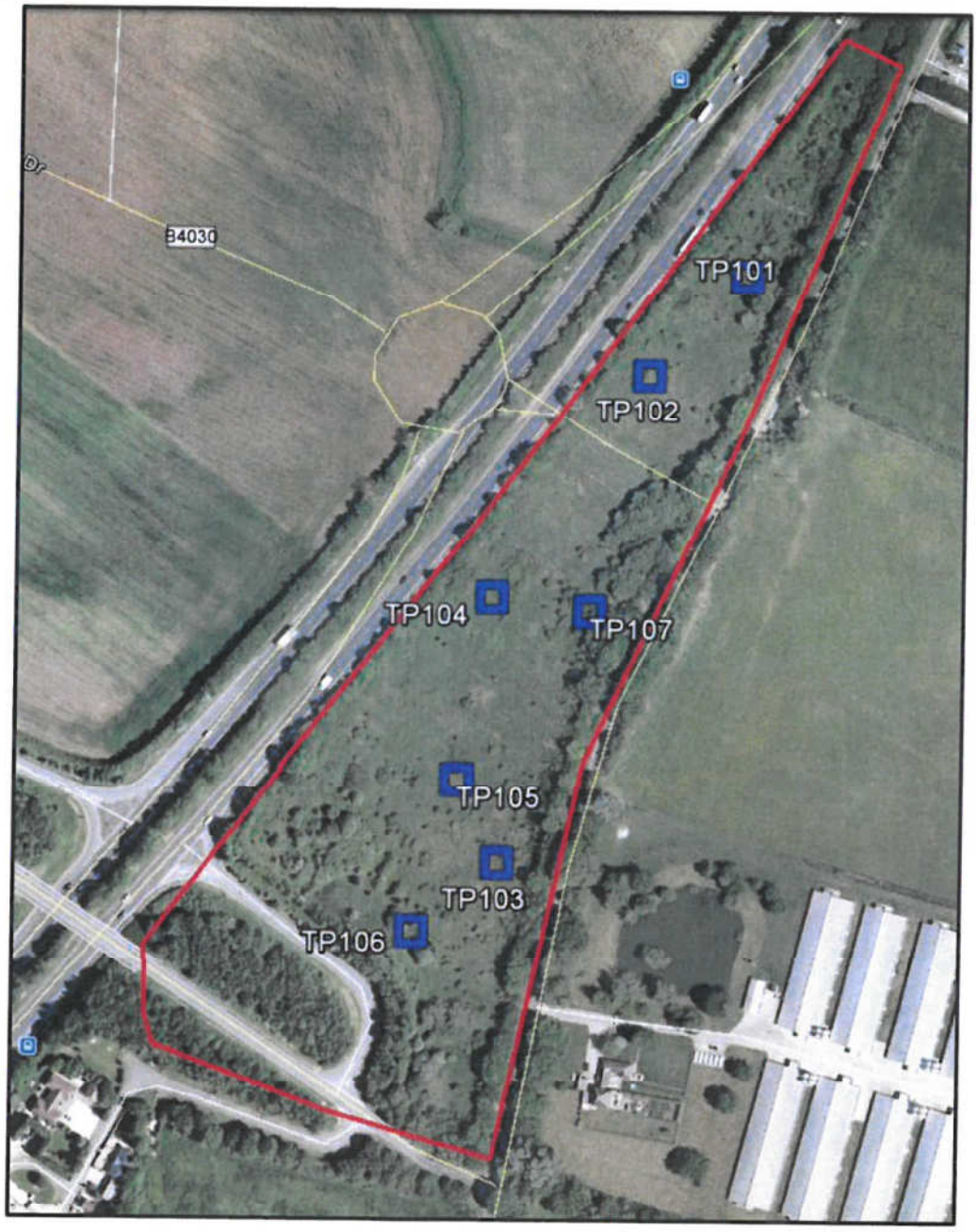
Table 3 – Groundwater Levels

Trial Hole	Groundwater Strike Depth (m bgl)	Groundwater standing level after recorded time (m bgl)
TP101	2.10	Standing water at 2.10m
TP102	0.80	Standing water at 0.80
TP103	2.90	1.10m (after 2 hours)
TP104	2.30	2.20m (after 10 minutes)
TP105	2.70	2.40m (after 10 minutes)

Trial Hole	Groundwater Strike Depth (m bgl)	Groundwater standing level after recorded time (m bgl)
TP106	1.60	Standing water at 1.60m
TP107	2.50	2.40m (after 10 minutes)

The groundwater, with the exception of TP102 originated from the Kellaways Sand Member.

Figure 2: Trial Hole Layout Plan



Geotechnical Testing

A total of 4 samples from the cohesive soils of the Kellaways Clay Formation were submitted to the laboratories of GSTL for 4 Point liquid & Plastic Limit testing. The results of the analysis are presented in Appendix B of this letter and summarised in Table 4 below.

Table 4 – Results of Geotechnical Testing

Stratum	Moisture Content (%)	Plasticity Index (%)	Passing 425µm Sieve (%)	Modified Plasticity Index (%)	Soil Classification	Volume Change Potential BRE
Kellaways Clay Formation	28 - 38	25 - 31	92 - 100	23.75 - 31	CI - CH	Medium

Notes: BRE Volume Change Potential refers to BRE Digest 240 (based on Atterberg results)
Soils Classification based on British Soil Classification System
The most common use of the term clay is to describe a soil that contains enough clay-sized material or clay minerals to exhibit cohesive properties. The fraction of clay-sized material required varies, but can be as low as 15%. Unless stated otherwise, this is the sense used in Digest 240. The term can be used to denote the clay minerals. These are specific, naturally occurring chemical compounds, predominately silicates. The term is often used as a particle size descriptor. Soil particles that have a nominal diameter of less than 2 µm are normally considered to be of clay size, but they are not necessarily clay minerals. Some clay minerals are larger than 2 µm and some particles, 'rock flour' for example, can be finer than 2 µm but are not clay minerals.
(The Atterberg Limit Tests were undertaken in accordance with BS 1377:Part 2:1990 Clauses 3.2, 4.3 and 5)

Soakaway Testing

Soakaway tests were undertaken within TP102A, TP103A and TP106A. The tests comprised piping water via a water tanker into the open trial hole, the drop in water level over time was then recorded to give an indication of soakage potential.

BRE DG365:2016 states that for an accurate infiltration rate to be obtained a soakage pit needs to be filled three times in quick succession. Each test is completed once 75% of the water present has drained away, in order to determine whether or not the underlying ground conditions may be suitable for surface water drainage.

To avoid encountering groundwater, the depth of these soakaway trial pits were advanced to depths above where groundwater had been observed in neighbouring trial pits - in this case TP102, TP103 and TP106. Due to the infiltration rates observed only one test was undertaken in each trial hole. The test in TP102 was voided as water in the trial pit was escaping into a field drain pipe that had been exposed as the water was emptied into the pit. Table 5 below details the depths of the soakaways and the corresponding strata. The results of the soakaway testing is presented in Appendix C of this letter report.

Table 5 – Summary of Soakaway Test Locations

Trial Hole	Depth of Soakaways (m bgl)	Strata	Infiltration Rate
TP102A	0.60	Gravel field drain	
TP103A	1.20	Sandy GRAVEL (River Terrace Deposits)	**1.382 x10^{-5} m/sec**[1]
TP106A	1.50	Sandy GRAVEL (River Terrace Deposits)	**4.499 x10^{-6} m/sec**[2]
Notes:	[1] One test undertaken [2] Results of an extrapolated test		

Of the three soakaway trial holes undertaken, only one soakaway test (TP103A) drained sufficiently to calculated an infiltration rate. TP106 did not finish however it was possible to extrapolate and infiltration rate from the data collected. The test completed in TP103A produced a calculated infiltration rate of **1.382 x10^{-5} m/sec** for the unsaturated sandy GRAVELS of the River Terrace Deposits at a depth of 1.20m. Extrapolation of the test in TP106A produced an infiltration rate of **4.499 x10^{-6} m/sec.** As the tests were not conducted a further two times it has not been possible to provide an infiltration rate in full compliance accordance with the BRE standard.

Conclusions

The ground investigation encountered Topsoil over superficial River Terrace Deposits. The River Terrace Deposits overlie the Kellaways Clay and Sand Member. Groundwater was encountered at depths of between 0.80m and 2.90m bgl.

Geotechnical sampling undertaken recorded the cohesive soils of the Kellaways Clay Formation to have medium volume change potential.

Three trial pit soakaways TP102A, TP103A and TP106A were undertaken on site. The results of the single soakaway test completed in TP103A and the extrapolated test in TP106A indicated an infiltration rates of between **1.382 x10^{-5} m/sec** and **4.499 x10^{-6} m/sec** in the shallow sandy GRAVEL of the River Terrace Deposits in the south of the site. Providing that the gravel band encountered in TP103A is laterally continuous across the site and at a suitably shallow depth then it is possible that this stratum will provide suitable infiltration for a SUDS system. It is however, recommended that further testing is undertaken to identify the extent and depth of the gravel band across the site. The infiltration rates provided in this letter report should be used with caution until further testing is undertaken. If no further testing is undertaken, then the more conservative value of **4.499 x10^{-6} m/sec** should be adopted.

The following attachments make up the remainder of this letter report.

Appendix A – Trial Hole Logs
Appendix B – Geotechnical Analysis
Appendix C - Soakaway Results

Should you have any further questions please do not hesitate to contact the undersigned.

Yours Sincerely

J. Hucklesby BEng (Hons)
Geo environmental Engineer
JSH@soilslimited.co.uk

Appendix A – Trial Hole Logs

Soils Limited
Newton House, Cross Road, Tadworth KT20 5SR
Tel: 01737 814221 Email: admin@soilslimited.co.uk

Trial Pit Log

Trial Pit No.
TP101
Sheet 1 of 1

Project Name: Phase 1a & 1B	Project No.: 15860	Method:	Hole Type: TP
Location: Bicester Gateway		Plant:	Scale: 1:25
Client: Hill Street Holdings Ltd	Trial Pit Length: m	Trial Pit Width: m	Logged By: CF
Dates: 27/10/2016	Level:	Co-ords:	

Water Strike	Samples & In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
	0.20	D					Dark brown slightly gravelly sandy SILT. Sand is fine to coarse, gravel is fine to medium, made up of flint. Frequent rootlets
				0.45			
	0.60	D					Light yellow orange very sandy slightly clayey fine to medium flint GRAVEL. Sand is fine to coarse.
				0.80			
	0.90	D					Dark blue grey silty CLAY. Frequent shell fragments
	1.50	D					
▼	2.00	D		2.00			Dark blue grey SILTSTONE.
▼	2.10	D		2.10			End of Pit at 2.10m

General Remarks:
Roots observed to 0.50m bgl. Groundwater encountered at 2.10m bgl and rising.

Groundwater Remarks:

Sample Type
D: Disturbed
B: Bulk
J: Jar
W: Water

Soils Limited
Newton House, Cross Road, Tadworth KT20 5SR
Tel: 01737 814221 Email: admin@soilslimited.co.uk

Trial Pit Log

Trial Pit No.
TP102
Sheet 1 of 1

Project Name: Phase 1a & 1B	Project No.: 15860	Method:	Hole Type: TP
Location: Bicester Gateway		Plant:	Scale: 1:25
Client: Hill Street Holdings Ltd	Trial Pit Length: m	Trial Pit Width: m	Logged By: CF
Dates: 27/10/2016	Level:	Co-ords:	

Water Strike	Samples & In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
	0.20	D		0.25			Dark brown slightly gravelly sandy SILT. Sand is fine to coarse, gravel is fine to medium, made up of flint. Frequent rootlets
	0.50	D					Light yellow orange very sandy slightly clayey fine to medium flint GRAVEL. Sand is fine to coarse.
▼				0.80			End of Pit at 0.80m

General Remarks:
Roots observed to 0.50m bgl. First hole had ground water at 0.80 so back filled and dug a shallower pit next to it.

Groundwater Remarks:

Sample Type
D: Disturbed
B: Bulk
J: Jar
W: Water

Soils Limited
Newton House, Cross Road, Tadworth KT20 5SR
Tel: 01737 814221 Email: admin@soilslimited.co.uk

Trial Pit Log

Trial Pit No.
TP102A
Sheet 1 of 1

Project Name: Phase 1a & 1B	Project No.: 15860	Method:	Hole Type: TP
Location: Bicester Gateway		Plant:	
		Support:	Scale: 1:25
Client: Hill Street Holdings Ltd	Trial Pit Length: m	Trial Pit Width: m	
Dates: 27/10/2016	Level:	Co-ords:	Logged By

Water Strike	Samples & In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
							Dark brown slightly gravelly sandy SILT. Sand is fine to coarse, gravel is fine to medium, made up of flint. Frequent rootlets
				0.25			Light yellow orange very sandy slightly clayey fine to medium flint GRAVEL. Sand is fine to coarse.
				0.60			End of Pit at 0.60m

1
2
3
4
5

General Remarks:
Roots observed to 0.50m bgl. Field drain encountered during soakaway testing

Groundwater Remarks:

Sample Type
D: Disturbed
B: Bulk
J: Jar
W: Water

Soils Limited
Newton House, Cross Road, Tadworth KT20 5SR
Tel: 01737 814221 Email: admin@soilslimited.co.uk

Trial Pit Log

Trial Pit No. **TP103**
Sheet 1 of 1

Project Name: Phase 1a & 1B	Project No.: 15860	Method:	Hole Type: TP
Location: Bicester Gateway		Plant:	
		Support:	Scale: 1:25
Client: Hill Street Holdings Ltd	Trial Pit Length: m	Trial Pit Width: m	
Dates: 27/10/2016	Level:	Co-ords:	Logged By: CF

Water Strike	Samples & In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
	0.30	D		0.40			Dark brown slightly gravelly sandy SILT. Sand is fine to coarse, gravel is fine to medium, made up of flint. Frequent rootlets
	0.60	D					Light yellow orange very sandy slightly clayey fine to medium flint GRAVEL. Sand is fine to coarse.
▼	0.90	D					
	1.50	D		1.40			Dark blue grey silty CLAY. Frequent shell fragments
	2.00	D					
	2.50	D					
▽	2.90	D		2.80			Dark blue grey SILTSTONE.
				2.90			End of Pit at 2.90m

General Remarks:
Roots observed to 0.50m bgl. Groundwater encountered at 2.9m bgl, standing at 1.10m bgl after 2 hours.

Groundwater Remarks:

Sample Type
D: Disturbed
B: Bulk
J: Jar
W: Water

soils LIMITED
Geotechnical & Environmental Consultants

Soils Limited
Newton House, Cross Road, Tadworth KT20 5SR
Tel: 01737 814221 Email: admin@soilslimited.co.uk

Trial Pit Log

Trial Pit No.
TP103A
Sheet 1 of 1

Project Name: Phase 1a & 1B	Project No.: 15860	Method:	Hole Type: TP
Location: Bicester Gateway		Plant:	
		Support:	Scale: 1:25
Client: Hill Street Holdings Ltd	Trial Pit Length: m	Trial Pit Width: m	
Dates: 27/10/2016	Level:	Co-ords:	Logged By

Water Strike	Samples & In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
							Dark brown slightly gravelly sandy SILT. Sand is fine to coarse, gravel is fine to medium, made up of flint. Frequent rootlets
				0.40			Light yellow orange very sandy slightly clayey fine to medium flint GRAVEL. Sand is fine to coarse.
				1.40			End of Pit at 1.40m

General Remarks:
Roots observed to 0.50m bgl. Groundwater encountered at 2.9m bgl, standing at 1.10m bgl after 2 hours.

Groundwater Remarks:

Sample Type
D: Disturbed
B: Bulk
J: Jar
W: Water

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Trial Pit Log

Trial Pit No. **TP104** Sheet 1 of 1

Project Name: Phase 1a & 1B	Project No.: 15860	Method:	Hole Type: TP
Location: Bicester Gateway		Plant:	
		Support:	Scale: 1:25
Client: Hill Street Holdings Ltd	Trial Pit Length: m	Trial Pit Width: m	
Dates: 27/10/2016	Level:	Co-ords:	Logged By: CF

Water Strike	Samples & In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
	0.30	D		0.40			Dark brown slightly gravelly sandy SILT. Sand is fine to coarse, gravel is fine to medium, made up of flint. Frequent rootlets
	0.60	D					Light yellow orange very sandy gravelly CLAY. Sand is fine to coarse. Gravel is fine to medium made up of flint. Frequent rootlets, becoming less gravelly and less sandy with depth
	0.90	D		1.20			
	1.50	D					Dark blue grey silty CLAY. Frequent shell fragments
	2.00	D					
▼				2.20			Dark blue grey SILTSTONE.
	2.50	D		2.50			End of Pit at 2.50m

1 2 3 4 5

General Remarks:
Roots observed to 1.20m bgl. Groundwater encountered at 2.30m bgl, standing at 2.20m bgl after 10 minutes.

Groundwater Remarks:

Sample Type
D: Disturbed
B: Bulk
J: Jar
W: Water

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Tel: 01737 814221 Email: admin@soilslimited.co.uk

Trial Pit Log

Trial Pit No. **TP105** Sheet 1 of 1

Project Name: Phase 1a & 1B	Project No.: 15860	Method:	Hole Type TP
Location: Bicester Gateway		Plant:	
		Support:	Scale 1:25
Client: Hill Street Holdings Ltd	Trial Pit Length: m	Trial Pit Width: m	
Dates: 27/10/2016	Level:	Co-ords:	Logged By CF

Water Strike	Samples & In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
	0.30	D		0.40			Dark brown slightly gravelly sandy SILT. Sand is fine to coarse, gravel is fine to medium, made up of flint. Frequent rootlets
	0.60	D					Light yellow orange very sandy gravelly CLAY. Sand is fine to coarse. Gravel is fine to medium made up of flint. Frequent rootlets... becoming less gravelly and less sandy with depth
	0.90	D					
	1.50	D					
	2.00	D		2.10			Dark blue grey silty CLAY Frequent shell fragments
▼	2.50	D					
▽				2.60			Dark blue grey SILTSTONE.
				2.70			End of Pit at 2.70m

1 2 3 4 5

General Remarks:
Roots observed to 2.10m bgl. Groundwater encountered at 2.70m bgl, standing at 2.40m bgl after 10 minutes.

Groundwater Remarks:

Sample Type
D: Disturbed
B: Bulk
J: Jar
W: Water

Soils Limited	Trial Pit Log	Trial Pit No.
Newton House, Cross Road, Tadworth KT20 5SR Tel: 01737 814221 Email: admin@soilslimited.co.uk		TP106 Sheet 1 of 1

Project Name: Phase 1a & 1B	Project No.: 15860	Method:	Hole Type: TP
Location: Bicester Gateway		Plant:	
		Support:	Scale: 1:25
Client: Hill Street Holdings Ltd	Trial Pit Length: m	Trial Pit Width: m	
Dates: 27/10/2016	Level:	Co-ords:	Logged By: CF

Water Strike	Samples & In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
	0.20	D					Dark brown slightly gravelly sandy SILT. Sand is fine to coarse, gravel is fine to medium, made up of flint. Frequent rootlets
	0.60	D		0.65			
	0.90	D					Light yellow orange very sandy slightly clayey fine to medium flint GRAVEL. Sand is fine to coarse.
▼	1.50	D		1.60			Dark blue grey CLAYEY SILT. Frequent shell fragments
	2.00	D					
	2.50	D		2.70			End of Pit at 2.70m

General Remarks:
Roots observed to 0.50m bgl. Groundwater encountered at 1.60m bgl.

Groundwater Remarks:

Sample Type
D: Disturbed
B: Bulk
J: Jar
W: Water

Soils Limited
Newton House, Cross Road, Tadworth KT20 5SR
Tel: 01737 814221 Email: admin@soilslimited.co.uk

Trial Pit Log

Trial Pit No.
TP106A
Sheet 1 of 1

Project Name: Phase 1a & 1B	Project No.: 15860	Method:	Hole Type: TP
Location: Bicester Gateway		Plant:	
Client: Hill Street Holdings Ltd	Trial Pit Length: m	Trial Pit Width: m	Scale: 1:25
Dates: 27/10/2016	Level:	Co-ords:	Logged By

Water Strike	Samples & In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
							Dark brown slightly gravelly sandy SILT. Sand is fine to coarse, gravel is fine to medium, made up of flint. Frequent rootlets
				0.65			Light yellow orange very sandy slightly clayey fine to medium flint GRAVEL. Sand is fine to coarse.
				1.60			End of Pit at 1.60m

1
2
3
4
5

General Remarks:
Roots observed to 0.50m bgl. Groundwater encountered at 1.60m bgl.

Groundwater Remarks:

Sample Type
D: Disturbed
B: Bulk
J: Jar
W: Water

soils LIMITED Geotechnical & Environmental Consultants

Soils Limited
Newton House, Cross Road, Tadworth KT20 5SR
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Trial Pit Log

Trial Pit No. **TP107** Sheet 1 of 1

Project Name: Phase 1a & 1B	Project No.: 15860	Method:	Hole Type: TP
Location: Bicester Gateway		Plant:	
		Support:	Scale: 1:25
Client: Hill Street Holdings Ltd	Trial Pit Length: m	Trial Pit Width: m	
Dates: 27/10/2016	Level:	Co-ords:	Logged By: CF

Water Strike	Samples & In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
	0.30	D		0.40			Dark brown slightly gravelly sandy SILT. Sand is fine to coarse, gravel is fine to medium, made up of flint. Frequent rootlets
	0.60	D					Light yellow orange very sandy gravelly CLAY. Sand is fine to coarse. Gravel is fine to medium made up of flint. Frequent rootlets becoming less gravelly and less sandy with depth
	0.90	D		1.00			Dark blue grey silty CLAY. Frequent shell fragments
	1.50	D					
	2.00	D					
▼				2.40			Dark blue grey silty CLAY.
▽	2.50	D		2.50			End of Pit at 2.50m

General Remarks:
Roots observed to 1.00m bgl. Groundwater encountered at 2.50m bgl, standing at 2.40m bgl after 10 minutes.

Groundwater Remarks:

Sample Type
D: Disturbed
B: Bulk
J: Jar
W: Water

Appendix B – Geotechnical Analysis

Laboratory Report

2788

GSTL
GEO Site & Testing Services Ltd

Contract Number: 32973

Client's Reference: **15860**

Report Date: **08-11-2016**

Client **Soils Limited**
Newton House
Cross Road
Tadworth
Surrey
KT20 5SR

Contract Title: **1a and 1b Gateway Bicester**
For the attention of: **James Hucklesby**

Date Received: **02-11-2016**
Date Commenced: **02-11-2016**
Date Completed: **08-11-2016**

Test Description	Qty
4 Point Liquid & Plastic Limit (LL/PL) 1377 : 1990 Part 2 : 4.3 & 5.3 - * UKAS	4
Moisture Content 1377 : 1990 Part 2 : 3.2 - * UKAS	4
Disposal of Samples on Project	1

Notes: **Observations and Interpretations are outside the UKAS Accreditation**
*** - denotes test included in laboratory scope of accreditation**
 # - denotes test carried out by approved contractor
@ - denotes non accredited tests

Approved Signatories:
Alex Wynn (Associate Director) - Benjamin Sharp (Contracts Manager) - Emma Sharp (Office Manager)
Paul Evans (Quality/Technical Manager) - Vaughan Edwards (Managing Director)

GEO Site & Testing Services Ltd
Unit 3-4, Heol Aur, Dafen Ind Estate, Dafen, Llanelli, Carmarthenshire SA14 8QN
Tel: 01554 784040 Fax: 01554 784041 info@gstl.co.uk gstl.co.uk

Client ref: 15860

Location: 1a & 1b Gateway Bicester

Contract Number: 32973

Hole Number	Sample Number	Type	Depth (m)	Description of Sample*
TP101		S/B	2.00	Grey silty CLAY
TP103		S/B	1.50	Brown fine to medium gravelly SAND
TP105		S/B	2.50	Grey silty CLAY. Contains shell fragments
TP107		S/B	2.50	Grey silty CLAY. Contains shell fragments

Note: Results on this table are in summary format and may not meet the requirements of the relevant standards, additional information is held by the laboratory

GSTL
GEO SITE & TESTING SERVICES LTD

For and behalf of GEO Site & Testing Services Ltd

Authorised By:
Emma Sharp (Office Manager)
Date: 8.11.16

UKAS TESTING
2788

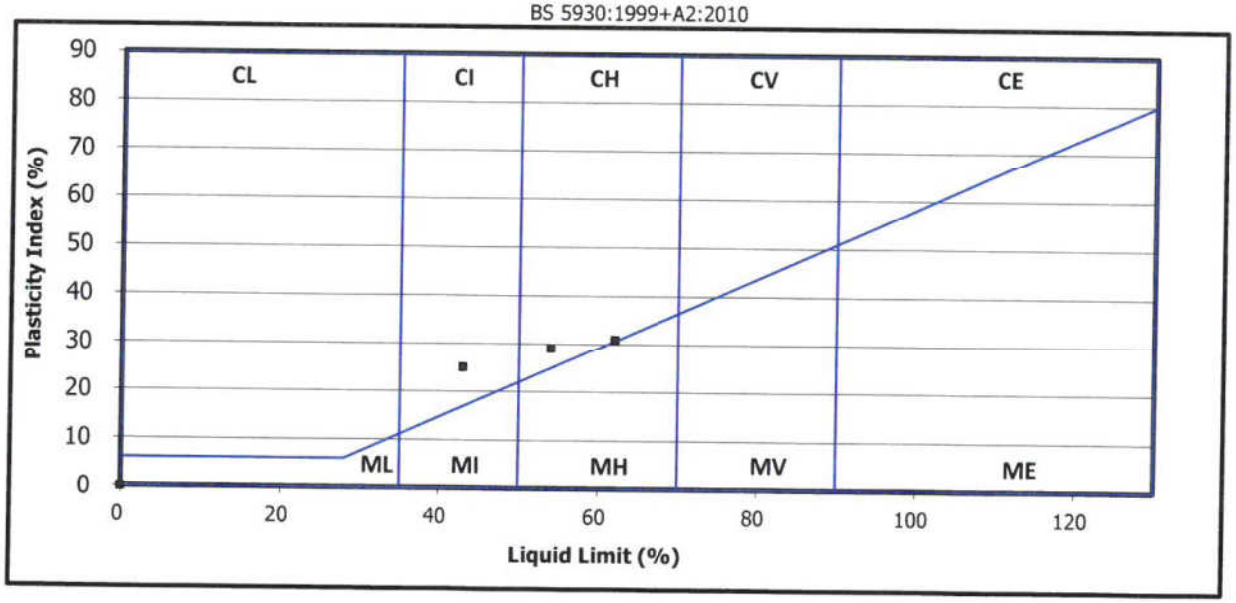
Test Report: **Method of the Determination of the plastic limit and plasticity index**
BS 1377 : Part 2 : 1990 Method 5

Client ref: 15860
Location: 1a & 1b Gateway Bicester
Contract Number: 32973

Hole/ Sample Number	Sample Type	Depth m	Moisture Content % Cl. 3.2	Liquid Limit % Cl. 4.3/4.4	Plastic Limit % Cl. 5.	Plasticity Index % Cl. 6.	% Passing .425mm	Remarks
TP101	S/B	2.00	38	62	31	31	100	CH High Plasticity
TP103	S/B	1.50	8.2		NP		50	
TP105	S/B	2.50	25	43	18	25	95	CI Intermediate Plasticity
TP107	S/B	2.50	28	54	25	29	92	CH High Plasticity

Symbols: NP : Non Plastic # : Liquid Limit and Plastic Limit Wet Sieved

PLASTICITY CHART FOR CASAGRANDE CLASSIFICATION.
BS 5930:1999+A2:2010



GSTL
GEO SITE & TESTING SERVICES LTD

For and behalf of GEO Site & Testing Services Ltd

Authorised By:
Emma Sharp (Office Manager)
Date: 8.11.16

UKAS TESTING 2788

Appendix C - Soakaway Results

Soakaway Calculations

Soakaway Test No.	TP103
Contract:	Phase 1a & 1b Bicester Gateway
Contract No.	15860

Field Test

Trial Pit Log (include details of groundwater):
See trial Pit record

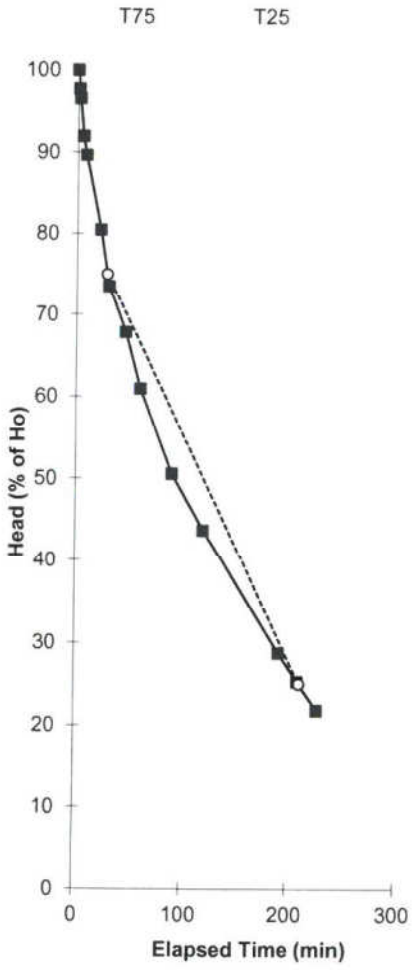
Depth of Pit	1.20 m
Width of Pit	0.60 m
Length of Pit	2.10 m
Depth of Pit Soaked	0.87 m

ap50	3.609 m2
Vp75-25	0.5481 m3
t75-25	183.2 min
water used	1.0962 m3
f	1.382E-05 m/sec.

Field Data

Depth to Water (m)	Elapsed Time (min)	Head of Water (% of Ho)	Head of Water (m)
0.33	0	100	0.87
0.35	1.0	98	0.85
0.36	2.0	97	0.84
0.40	5.0	92	0.80
0.42	8.0	90	0.78
0.50	22.0	80	0.70
0.56	30.0	74	0.64
0.61	46.0	68	0.59
0.67	60.0	61	0.53
0.76	90.0	51	0.44
0.82	120.0	44	0.38
0.95	192.0	29	0.25
0.98	210.0	25	0.22
1.01	228.0	22	0.19

T75	28.333	75
T25	211.500	25
T75-25	183.167	Derived from Best Fit



Comments

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Newton House, Cross Road, Tadworth
Surrey, KT20 5SR

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Facsimile: 01737 812 557

Soakaway Calculations

Soakaway Test No.	TP106
Contract:	Phase 1a & 1b Bicester Gateway
Contract No.	15860

Field Test

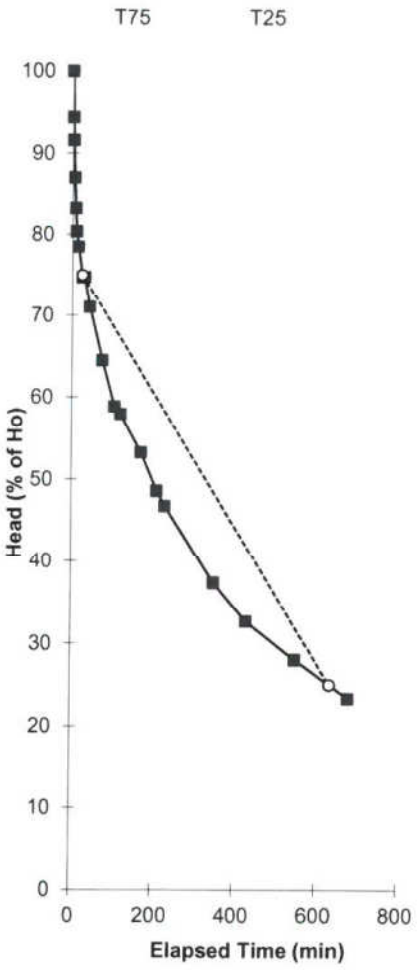
Trial Pit Log (include details of groundwater):
See trial Pit record

Depth of Pit	1.50 m
Width of Pit	0.60 m
Length of Pit	2.30 m
Depth of Pit Soaked	1.07 m

ap50	4.483 m2
Vp75-25	0.7383 m3
t75-25	610.1 min
water used	1.4766 m3
f	4.499E-06 m/sec.

Field Data

Depth to Water (m)	Elapsed Time (min)	Head of Water (% of Ho)	Head of Water (m)
0.43	0	100	1.07
0.49	1.0	94	1.01
0.52	2.0	92	0.98
0.57	5.0	87	0.93
0.61	8.0	83	0.89
0.64	10.0	80	0.86
0.66	15.0	79	0.84
0.70	25.0	75	0.80
0.7	30.0	75	0.80
0.74	43.0	71	0.76
0.81	75.0	64	0.69
0.87	105.0	59	0.63
0.88	120.0	58	0.62
0.93	171.0	53	0.57
0.98	210.0	49	0.52
1.00	230.0	47	0.50
1.10	350.0	37	0.40
1.15	430.0	33	0.35
1.20	550.0	28	0.30
1.25	680.0	23	0.25



T75	24.375	75
T25	634.500	25
T75-25	610.125	Derived from Best Fit

Comments

Extrapolated from 230 mins in order to calculate an indicative infiltration rate

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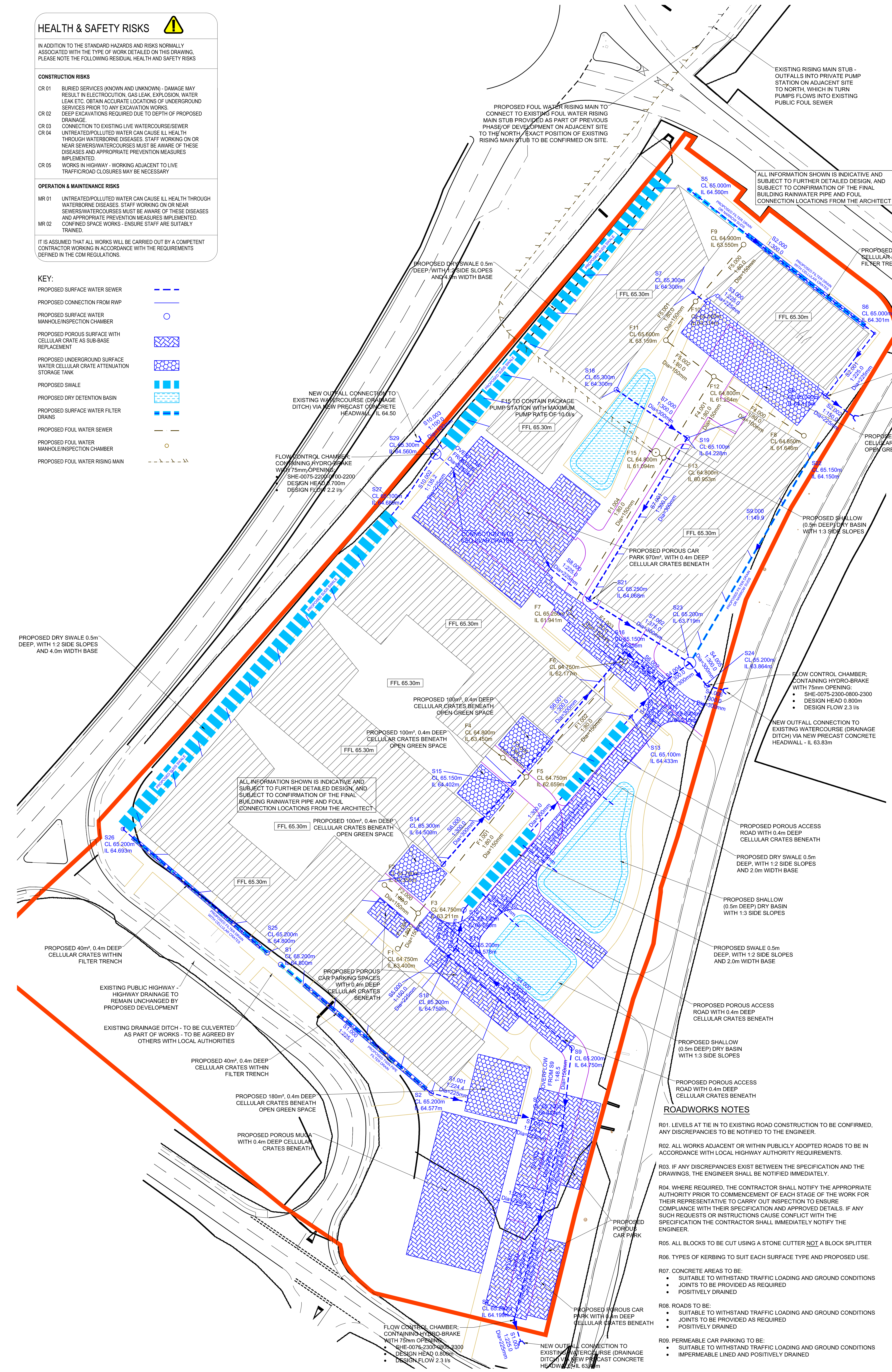

HEALTH & SAFETY RISKS

IN ADDITION TO THE STANDARD HAZARDS AND RISKS NORMALLY ASSOCIATED WITH THE TYPE OF WORK DETAILED ON THIS DRAWING, PLEASE NOTE THE FOLLOWING RESIDUAL HEALTH AND SAFETY RISKS

CONSTRUCTION RISKS

- CR 01 BURIED SERVICES (KNOWN AND UNKNOWN) - DAMAGE MAY RESULT IN ELECTROCUTION, GAS LEAK, EXPLOSION, WATER LEAK ETC. OBTAIN ACCURATE LOCATIONS OF UNDERGROUND SERVICES PRIOR TO ANY EXCAVATION WORKS.
- CR 02 DEEP EXCAVATIONS REQUIRED DUE TO DEPTH OF PROPOSED DRAINAGE.
- CR 03 CONNECTION TO EXISTING LIVE WATERCOURSE/SEWER
- CR 04 UNTREATED/POLLUTED WATER CAN CAUSE ILL HEALTH THROUGH WATERBORNE DISEASES. STAFF WORKING ON OR NEAR SEWERS/WATERCOURSES MUST BE AWARE OF THESE DISEASES AND APPROPRIATE PREVENTION MEASURES IMPLEMENTED.
- CR 05 WORKS IN HIGHWAY - WORKING ADJACENT TO LIVE TRAFFIC/ROAD CLOSURES MAY BE NECESSARY

OPERATION & MAINTENANCE RISKS

- MR 01 UNTREATED/POLLUTED WATER CAN CAUSE ILL HEALTH THROUGH WATERBORNE DISEASES. STAFF WORKING ON OR NEAR SEWERS/WATERCOURSES MUST BE AWARE OF THESE DISEASES AND APPROPRIATE PREVENTION MEASURES IMPLEMENTED.
- MR 02 CONFINED SPACE WORKS - ENSURE STAFF ARE SUITABLY TRAINED.

IT IS ASSUMED THAT ALL WORKS WILL BE CARRIED OUT BY A COMPETENT CONTRACTOR WORKING IN ACCORDANCE WITH THE REQUIREMENTS DEFINED IN THE CDM REGULATIONS.

KEY:

- PROPOSED SURFACE WATER SEWER
- PROPOSED CONNECTION FROM RWP
- PROPOSED SURFACE WATER MANHOLE/INSPECTION CHAMBER
- PROPOSED POROUS SURFACE WITH CELLULAR CRATE AS SUB-BASE REPLACEMENT
- PROPOSED UNDERGROUND SURFACE WATER CELLULAR CRATE ATTENUATION STORAGE TANK
- PROPOSED SWALE
- PROPOSED DRY DETENTION BASIN
- PROPOSED SURFACE WATER FILTER DRAINS
- PROPOSED FOUL WATER SEWER
- PROPOSED FOUL WATER MANHOLE/INSPECTION CHAMBER
- PROPOSED FOUL WATER RISING MAIN

PRIVATE DRAINAGE NOTES:

1. DRAINAGE SYSTEMS TO COMPLY WITH THE FOLLOWING STANDARDS:
   - BS EN 752:2008
   - BUILDING REGULATIONS APPROVED DOCUMENT PART H, 2015 EDITION
2. ALL COMPONENTS USED IN DRAINAGE SYSTEMS TO COMPLY WITH THE FOLLOWING: BS EN 476:2011
3. ALL DRAINAGE SYSTEMS AND COMPONENTS TO BE CONSTRUCTED AND TESTED TO THE FULL SATISFACTION OF THE BUILDING REGULATIONS INSPECTOR
4. ALL DRAINAGE TO BE CONSTRUCTED AND TESTED IN ACCORDANCE WITH BS EN 1610:2015.
5. PIPES UPTO 225Ø TO BE VITRIFIED CLAY, VITRIFIED CLAY PIPES AND FITTINGS TO COMPLY WITH THE RELEVANT PROVISIONS OF BS EN295-1:2013,-2:2013,-3:2012 AND BS 65 RESPECTIVELY AND BE KITEMARKED. ALL PIPES SHALL BE EXTRA STRENGTH TO BS 65 OR EQUIVALENT BS EN295 PIPE CRUSHING STRENGTH.
6. PIPES > 225Ø TO BE CONCRETE. CONCRETE PIPES TO BE CLASS 120 TO BS EN1916:2002 & BS5911-1:2002.
7. PRECAST CONCRETE MANHOLES TO BE IN ACCORDANCE WITH BS EN 1917:2002 AND BS 5911-3:2010,-4:2002 AND TO BE KITEMARKED. PRECAST CONCRETE RINGS AND COVER SLABS TO CONCRETE PIPES TO BE JOINTED WITH CEMENT MORTAR UNLESS NOTED OTHERWISE.
8. INSITU AND PRECAST CONCRETE UNITS SHALL HAVE SULPHATE RESISTING PORTLAND CEMENT TO BS EN 197-1:2011.
9. POLYPROPYLENE INSPECTION CHAMBERS TO COMPLY WITH BS EN 13598-1:2010,-2:2016 AND BS 7158:2001 AND TO BE KITEMARKED.
10. MANHOLE COVERS AND FRAMES SHALL COMPLY WITH THE RELEVANT PROVISIONS OF BS EN 124-1 TO 6:2015. MANHOLE COVERS AND FRAMES TO BE OF A NON-ROCKING DESIGN WITH CUSHION INSERTS AND KITEMARKED. LOAD CLASS D400 COVERS TO BE USED IN ALL LOCATIONS. ALL COVERS TO BE BADGED "FW" OR "SW" AS APPROPRIATE. MANHOLE COVER SLABS AND ACCESS TO BE IN ACCORDANCE WITH CONCRETE PIPE ASSOCIATION TECHNICAL BULLETIN ISSUED SEPTEMBER 2001.
11. POLYPROPYLENE INSPECTION CHAMBER COVERS AND FRAMES SHALL COMPLY WITH THE RELEVANT PROVISIONS OF BS EN 124-1 TO 6:2015. COVERS AND FRAMES TO BE OF A NON-ROCKING DESIGN WITH CUSHION INSERTS AND KITEMARKED. LOAD CLASS A15 COVERS TO BE USED IN AREAS INACCESSIBLE TO VEHICLES; LOAD CLASS D400 COVERS TO BE USED ELSEWHERE.
12. ROAD GULLY GRATES AND FRAMES SHALL COMPLY WITH THE RELEVANT PROVISIONS OF BS EN 124-1 TO 6:2015 AND BE OF A NON-ROCKING DESIGN WITH LEFT HANDED CAPTIVE HINGE ACCESS AND BE KITEMARKED. LOAD CLASS D400 GRATES TO BE USED THROUGHOUT WITH 450mm SQ. GRATE AND FRAME. MINIMUM AREA OF WATERWAY TO BE 1010cm².
13. YARD GULLY GRATES AND FRAMES SHALL COMPLY WITH THE RELEVANT PROVISIONS OF BS EN 124-1 TO 6:2015 AND BE OF A NON-ROCKING DESIGN AND BE KITEMARKED. LOAD CLASS A15 GRATES TO BE USED IN AREAS INACCESSIBLE TO VEHICLES. GRATES TO BE 300mm SQ. MINIMUM AREA OF WATERWAY TO BE 900cm².
14. DRAINAGE CHANNELS TO BE ACO MULTIDRAIN MD100 0.0 OR EQUAL & APPROVED, UNLESS NOTED OTHERWISE ON DRAWING. CHANNELS TO BE FITTED WITH SLOTTED DUCTILE IRON GRATING. GRATES SHALL COMPLY WITH THE RELEVANT PROVISIONS OF BS EN 124-1 TO 6:2015 AND BE KITEMARKED. LOAD CLASS B125 GRATES TO BE USED IN AREAS INACCESSIBLE TO VEHICLES; LOAD CLASS D400 GRATES TO BE USED ELSEWHERE. SUMP UNIT AND SILT BUCKET UNITS TO BE USED ON ALL OUTLETS.
15. CLASS Z BEDDING DETAIL SHALL BE PROVIDED:
   - WHERE COVER TO PIPE BARREL IS;
     i) <1.2m IN VEHICULAR TRAFFICKED AREAS
     ii) <0.9m IN AREAS INACCESSIBLE TO VEHICLES.
   - AT ALL ROAD GULLY, YARD GULLY, RWP, SVP AND DRAINAGE CHANNEL BRANCHES.
   - AREAS OF DEEP ROOTING VEGETATION.
   - PIPE RUNS NEAR BUILDINGS IN ACCORDANCE WITH TYPICAL SECTIONS ON AWP DRAWINGS.
   - WHERE TWO PIPES CROSS WITH A CLEAR GAP OF <300mm. CLASS Z SURROUND TO EXTEND A MINIMUM OF 1.0m FROM THE CENTRE OF THE CROSSING POINT & EXTENDED TO WITHIN 150mm OF THE NEAREST FLEXIBLE JOINT, WHERE REQUIRED.

17. CLASS Y BEDDING DETAIL TO BE PROVIDED WHERE COVER TO PIPE CROWN FROM THE UNDERSIDE OF THE SUB STRUCTURE IS LESS THAN 300mm.
18. PIPE BEDDING MATERIALS TO COMPLY GENERALLY WITH SHW - SERIES 500 - CLAUSE 503. GRANULAR BEDDING MATERIALS TO ALSO COMPLY WITH BS EN 13242 & THE GRANULAR BEDDING MATERIAL TABLE ON THIS DRAWING.
19. SELECTED BACKFILL MATERIAL TO BE PROVIDED ABOVE THE PIPE SURROUND TO A HEIGHT OF 300mm MINIMUM ABOVE THE TOP OF THE PIPE. SELECTED BACKFILL MATERIAL TO BE CLASS 8 - LOWER TRENCH FILL MATERIAL IN ACCORDANCE WITH SHW - SERIES 600 TABLE 6/1 & TO COMPRISE OF UNIFORM SOIL, FREE FROM STONES LARGER THAN 40mm, LUMPS OF CLAY OVER 100mm, TIMBER, FROZEN MATERIAL & VEGETABLE MATTER. SELECTED BACKFILL MATERIAL TO BE PLACED & COMPACTED IN LAYERS NOT EXCEEDING 150mm IN THICKNESS. SHOULD THE MATERIAL BE UNSUITABLE OR WEATHER CONDITIONS AFFECT THE MATERIALS STABILITY, THEN A SUITABLE HARD GRANULAR MATERIAL SHALL BE USED.
20. GENERAL BACKFILL TO DRAINAGE TRENCHES [OTHER THAN FILTER DRAINS] IN VEHICULAR TRAFFICKED AREAS ABOVE THE PIPE BEDDING & SELECTED BACKFILL SHALL BE CLASS 1, 2 OR 3 GENERAL FILL MATERIAL IN ACCORDANCE WITH SHW - SERIES 600.
21. GENERAL BACKFILL UNDER NON-VEHICULAR TRAFFICED AREAS TO BE SUITABLE AS-DUG MATERIAL COMPACTED IN ACCORDANCE WITH SHW - SERIES 600 IN LAYERS NOT EXCEEDING 225mm, EACH LAYER COMPACTED TO FORM A STABLE TRENCH BACKFILL, SHOULD THE MATERIAL BE UNSUITABLE OR WEATHER CONDITIONS AFFECT THE MATERIALS STABILITY, THEN A HARD GRANULAR MATERIAL SHALL BE USED UP TO FORMATION LEVEL.
22. ALL CONCRETE TO BE DESIGNATED CONCRETE TO CONFORM TO BS 8500-2.
23. NO MECHANICAL COMPACTION OF FILL MATERIAL WITHIN 300mm OF THE CROWN OF ANY PIPE.

THE VERSIONS OF BRITISH STANDARDS AND OTHER PUBLICATIONS LISTED ABOVE ARE CURRENT AT THE TIME OF THE DRAWING ISSUE. HOWEVER IF THESE HAVE BEEN REVISED OR UPDATED THEN THE NEWER VERSIONS SHOULD BE USED. ANY DISCREPANCIES SHOULD BE NOTIFIED TO AWP IMMEDIATELY.

ROADWORKS NOTES

R01. LEVELS AT TIE IN TO EXISTING ROAD CONSTRUCTION TO BE CONFIRMED, ANY DISCREPANCIES TO BE NOTIFIED TO THE ENGINEER.

R02. ALL WORKS ADJACENT OR WITHIN PUBLICLY ADOPTED ROADS TO BE IN ACCORDANCE WITH LOCAL HIGHWAY AUTHORITY REQUIREMENTS.

R03. IF ANY DISCREPANCIES EXIST BETWEEN THE SPECIFICATION AND THE DRAWINGS, THE ENGINEER SHALL BE NOTIFIED IMMEDIATELY.

R04. WHERE REQUIRED, THE CONTRACTOR SHALL NOTIFY THE APPROPRIATE AUTHORITY PRIOR TO COMMENCEMENT OF EACH STAGE OF THE WORK FOR THEIR REPRESENTATIVE TO CARRY OUT INSPECTION TO ENSURE COMPLIANCE WITH THEIR SPECIFICATION AND APPROVED DETAILS. IF ANY SUCH REQUESTS OR INSTRUCTIONS CAUSE CONFLICT WITH THE SPECIFICATION THE CONTRACTOR SHALL IMMEDIATELY NOTIFY THE ENGINEER.

R05. ALL BLOCKS TO BE CUT USING A STONE CUTTER NOT A BLOCK SPLITTER

R06. TYPES OF KERBING TO SUIT EACH SURFACE TYPE AND PROPOSED USE.

R07. CONCRETE AREAS TO BE:
- SUITABLE TO WITHSTAND TRAFFIC LOADING AND GROUND CONDITIONS
- JOINTS TO BE PROVIDED AS REQUIRED
- POSITIVELY DRAINED

R08. ROADS TO BE:
- SUITABLE TO WITHSTAND TRAFFIC LOADING AND GROUND CONDITIONS
- JOINTS TO BE PROVIDED AS REQUIRED
- POSITIVELY DRAINED

R09. PERMEABLE CAR PARKING TO BE:
- SUITABLE TO WITHSTAND TRAFFIC LOADING AND GROUND CONDITIONS
- IMPERMEABLE LINED AND POSITIVELY DRAINED

PUMP STATION NOTES

1. PUMPING STATIONS TO BE DESIGNED BY SPECIALISTS TO MEET THE RELEVANT STANDARDS.
2. PACKAGE PUMPING STATIONS PREFERRED.
3. PUMPING STATION TO BE SUPPLIED WITH DUTY/STANDBY PUMPS, ISOLATION VALVES AND NON-RETURN VALVES.
4. PUMPING STATION TO BE PROVIDED WITH AN ALARM, POWER AND TELEMETRY LINKED TO A LOCATION TO BE AGREED.
5. PUMPING STATION TO RESIST GROUNDWATER AND BE STRUCTURALLY APPROPRIATE FOR ITS' LOCATION RELATIVE TO TRAFFIC LOADING (TEMPORARY AND PERMANENT STATES).
6. PUMP RATE TO BE SUITABLE FOR PEAK FLOWS FROM THE DEVELOPMENT.
7. FOUL PUMPING STATIONS TO BE PROVIDED WITH EMERGENCY STORAGE AS REQUIRED.

NOTES:

1. THESE NOTES ARE INTENDED TO AUGMENT DRAWINGS AND SPECIFICATIONS. WHERE CONFLICT OF REQUIREMENTS EXIST THE ORDER OF PRECEDENCE SHALL BE AS SHOWN IN THE SPECIFICATION. OTHERWISE THE STRICTEST PROVISION SHALL GOVERN.
2. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL OTHER RELEVANT ENGINEERS AND ARCHITECTS DRAWINGS.
3. DRAWINGS NOT TO BE SCALED. ALL DIMENSIONS TO BE CHECKED ON SITE BY THE CONTRACTOR. ANY DISCREPANCIES TO BE NOTIFIED TO THE ENGINEER AND FURTHER INSTRUCTIONS OBTAINED BEFORE WORK IS COMMENCED.
4. THE STRUCTURE IS DESIGNED TO BE SELF-SUPPORTING AND STABLE AFTER THE BUILDING IS FULLY COMPLETED. IT IS THE CONTRACTORS SOLE RESPONSIBILITY TO DETERMINE THE ERECTION PROCEDURE AND SEQUENCE AND ENSURE THAT THE BUILDING AND ITS COMPONENTS ARE SAFE DURING ERECTION. THIS INCLUDES THE ADDITION OF WHATEVER TEMPORARY BRACING, GUYS OR TIE-DOWNS WHICH MAY BE NECESSARY, SUCH MATERIAL REMAINING THE THE PROPERTY OF THE CONTRACTOR ON COMPLETION, AND FOR ENSURING THAT THE WORKS AND ANY ADJACENT PROPERTIES ARE SAFE IN THE TEMPORARY CONDITION.

100mm at A1

GENERAL NOTES:

G01. ALL WORKS SUBJECT TO ANY SECTION 38, SECTION 62/278 AND SECTION 104 AGREEMENTS THAT MAY NEED TO BE APPROVED BY THE RELEVANT AUTHORITIES PRIOR TO COMMENCEMENT OF WORKS.

G02. ALL LEVELS ARE IN METRES AOD (ABOVE ORDNANCE DATUM) UNLESS NOTED OTHERWISE.

G03. ALL WORKS TO BE UNDERTAKEN IN COMPLIANCE WITH BS 8000 FOR WORKMANSHIP ON BUILDING SITES.

G04. ABBREVIATIONS:
- MH = MANHOLE
- CL = COVER LEVEL
- IL = INVERT LEVEL
- S / SW = SURFACE WATER
- F / FW = FOUL WATER
- SD = DEMARCATION CHAMBER
- FD = FLOW CONTROL CHAMBER
- CONC = CONCRETE
- VC = VITRIFIED CLAY
- FFL = FINISHED FLOOR LEVEL
- DWG = DRAWING

G05. PROPOSED SURFACE WATER DRAINAGE AND ATTENUATION DESIGNED TO ACCOMMODATE STORM EVENTS UP TO 1 IN 100 YEAR RETURN PERIOD PLUS 40% CLIMATE CHANGE ALLOWANCE.

Rev	Description	Date	By	Chk	App
P5	DRAINAGE DESIGN REVISED TO OMIT PUMP AND INCLUDE MORE SUDS	18.06.20	JP	JAG	JAG
P4	DRAINAGE AMENDED TO ACCOMMODATE A +40% CLIMATE CHANGE ALLOWANCE, PROPOSED FFLS AMENDED	30.04.20	JP	JAG	JAG
P3	DRAINAGE ADJUSTED TO SUIT TREE SURVEY AND 'PRESERVATION' ZONE REQUIREMENTS	28.01.20	JP	JAG	JAG
P2	INDICATIVE FFLs ADDED	15.01.20	JP	JAG	JAG
P1	FIRST ISSUE	06.01.20	JP	AD	JAG

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Project: Development Site at Bicester Gateway, A41 / Oxford Road, Bicester

Client: Bicester Gateway Ltd

Drawing: Proposed Drainage Layout

Role: Civil Engineer

Drawing Status: For Approval

Job. no. 43386 | Scale@ A1: 1:500 | Rev. P5

Project	Originator	Volume	Level	Type	Role	Number
BCG	AWP	ZZ	XX	DR	C	3100

STORM SEWER DESIGN by the Modified Rational Method

Network Design Table for Storm

« - Indicates pipe capacity < flow

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	n	HYD SECT	DIA (mm)	Section Type	Auto Design
S1.000	50.207	0.223	225.0	0.047	1.00	0.0		0.075	→|o|→		Filter Drain	
S1.001	34.335	0.153	225.0	0.000	0.00	0.0		0.075	oo	225	Double Pipe	
S1.002	50.617	0.225	225.0	0.183	0.00	0.0	0.600		o	225	Pipe/Conduit	
S1.003	5.700	0.025	225.0	0.035	0.00	0.0	0.600		o	225	Pipe/Conduit	
S2.000	59.823	0.199	300.0	0.044	1.00	0.0		0.075	→|o|→		Filter Drain	
S2.001	20.193	0.090	225.0	0.032	0.00	0.0	0.600		o	225	Pipe/Conduit	
S3.000	42.652	0.190	225.0	0.078	1.00	0.0	0.600		o	225	Pipe/Conduit	
S2.002	9.972	0.066	150.0	0.023	0.00	0.0	0.600		o	225	Pipe/Conduit	
S4.000	38.752	0.172	225.0	0.068	1.00	0.0		0.075	o	300	Pipe/Conduit	
S5.000	2.841	0.019	150.0	0.046	1.00	0.0		0.075	o	225	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S1.000	50.00	7.79	64.800	0.047	0.0	0.0	0.0	0.12	15.3	6.4
S1.001	45.36	12.18	64.577	0.047	0.0	0.0	0.0	0.13	10.4	6.4
S1.002	43.42	13.15	64.424	0.230	0.0	0.0	0.0	0.87	34.5	27.0
S1.003	43.22	13.26	64.199	0.265	0.0	0.0	0.0	0.87	34.5	31.0
S2.000	50.00	9.52	64.500	0.044	0.0	0.0	0.0	0.12	20.8	5.9
S2.001	50.00	9.91	64.301	0.076	0.0	0.0	0.0	0.87	34.5	10.2
S3.000	50.00	1.82	64.300	0.078	0.0	0.0	0.0	0.87	34.5	10.6
S2.002	50.00	10.06	64.110	0.177	0.0	0.0	0.0	1.07	42.4	24.0
S4.000	50.00	5.09	64.750	0.068	0.0	0.0	0.0	0.16	11.2	9.2
S5.000	50.00	1.30	64.750	0.046	0.0	0.0	0.0	0.16	6.4	6.2

STORM SEWER DESIGN by the Modified Rational Method

Network Design Table for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	n	HYD SECT	DIA (mm)	Section Type	Auto Design
S4.001	11.580	0.051	225.0	0.059	0.00	0.0		0.075	o	225	Pipe/Conduit	
S4.002	60.525	0.067	900.0	0.043	0.00	0.0		0.075	→_/→		Swale	
S4.003	13.934	0.062	225.0	0.051	0.00	0.0		0.075	o	225	Pipe/Conduit	
S6.000	29.458	0.098	300.0	0.117	1.00	0.0	0.600		o	300	Pipe/Conduit	
S6.001	43.621	0.145	300.0	0.065	0.00	0.0	0.600		o	300	Pipe/Conduit	
S6.002	12.398	0.041	300.0	0.000	0.00	0.0	0.600		o	300	Pipe/Conduit	
S4.004	8.820	0.029	300.0	0.026	0.00	0.0	0.600		o	300	Pipe/Conduit	
S7.000	21.723	0.072	300.0	0.028	1.00	0.0	0.600		o	300	Pipe/Conduit	
S7.001	47.937	0.160	300.0	0.141	0.00	0.0	0.600		o	300	Pipe/Conduit	
S8.000	14.163	0.063	225.0	0.112	1.00	0.0	0.600		o	225	Pipe/Conduit	
S7.002	30.351	0.081	375.0	0.000	0.00	0.0	0.600		o	300	Pipe/Conduit	
S9.000	64.619	0.431	150.0	0.068	1.00	0.0		0.075	→|o|→		Filter Drain	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S4.001	50.00	6.56	64.653	0.173	0.0	0.0	0.0	0.13	5.2«	23.5
S4.002	47.76	11.10	64.500	0.216	0.0	0.0	0.0	0.22	333.7	28.0
S4.003	43.94	12.88	64.433	0.267	0.0	0.0	0.0	0.13	5.2«	31.8
S6.000	50.00	1.54	64.500	0.117	0.0	0.0	0.0	0.90	63.8	15.8
S6.001	50.00	2.35	64.402	0.182	0.0	0.0	0.0	0.90	63.8	24.7
S6.002	50.00	2.58	64.256	0.182	0.0	0.0	0.0	0.90	63.8	24.7
S4.004	43.63	13.04	64.215	0.475	0.0	0.0	0.0	0.90	63.8	56.2
S7.000	50.00	1.40	64.300	0.028	0.0	0.0	0.0	0.90	63.8	3.8
S7.001	50.00	2.29	64.228	0.169	0.0	0.0	0.0	0.90	63.8	22.8
S8.000	50.00	1.27	64.500	0.112	0.0	0.0	0.0	0.87	34.5	15.2
S7.002	50.00	2.91	64.068	0.281	0.0	0.0	0.0	0.81	57.0	38.1
S9.000	50.00	6.24	64.150	0.068	0.0	0.0	0.0	0.21	67.3	9.1

STORM SEWER DESIGN by the Modified Rational Method

Network Design Table for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	n	HYD SECT	DIA (mm)	Section Type	Auto Design
S4.005	7.089	0.024	300.0	0.000	0.00	0.0	0.600		o	300	Pipe/Conduit	
S4.006	5.498	0.018	300.0	0.000	0.00	0.0	0.600		o	300	Pipe/Conduit	
S10.000	46.829	0.107	437.8	0.044	1.00	0.0		0.075	→|o|→		Filter Drain	
S10.001	107.171	0.011	10000.0	0.000	0.00	0.0		0.030	→_/→		Swale	
S10.002	16.901	0.125	135.2	0.455	0.00	0.0		0.030	o	225	Pipe/Conduit	
S11.000	91.779	0.102	900.0	0.135	1.00	0.0		0.030	→_/→		Swale	
S10.003	6.207	0.062	100.0	0.000	0.00	0.0	0.600		o	100	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S4.005	43.38	13.17	63.888	0.824	0.0	0.0	0.0	0.90	63.8«	96.8
S4.006	43.19	13.27	63.864	0.824	0.0	0.0	0.0	0.90	63.8«	96.8
S10.000	50.00	9.70	64.800	0.044	0.0	0.0	0.0	0.09	13.3	6.0
S10.001	33.04	20.71	64.700	0.044	0.0	0.0	0.0	0.16	321.5	6.0
S10.002	32.38	21.38	64.700	0.499	0.0	0.0	0.0	0.42	16.7«	43.8
S11.000	50.00	3.73	64.662	0.135	0.0	0.0	0.0	0.56	1197.3	18.3
S10.003	32.26	21.52	64.560	0.634	0.0	0.0	0.0	0.77	6.0«	55.4

Online Controls for Storm

Hydro-Brake® Optimum Manhole: S4, DS/PN: S1.003, Volume (m³): 2.2

Unit Reference	MD-SHE-0075-2300-0800-2300
Design Head (m)	0.800
Design Flow (l/s)	2.3
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	75
Invert Level (m)	64.199
Minimum Outlet Pipe Diameter (mm)	100
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.800	2.3	Kick-Flo®	0.508	1.9
Flush-Flo™	0.238	2.3	Mean Flow over Head Range	-	2.0

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	2.0	1.200	2.8	3.000	4.2	7.000	6.3
0.200	2.3	1.400	3.0	3.500	4.5	7.500	6.5
0.300	2.3	1.600	3.2	4.000	4.8	8.000	6.7
0.400	2.2	1.800	3.3	4.500	5.1	8.500	6.9
0.500	1.9	2.000	3.5	5.000	5.4	9.000	7.1
0.600	2.0	2.200	3.7	5.500	5.6	9.500	7.3
0.800	2.3	2.400	3.8	6.000	5.9		
1.000	2.5	2.600	4.0	6.500	6.1		

Hydro-Brake® Optimum Manhole: S8, DS/PN: S2.002, Volume (m³): 3.4

Unit Reference	MD-SHE-0075-2200-0700-2200
Design Head (m)	0.700
Design Flow (l/s)	2.2
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	75
Invert Level (m)	64.110

Hydro-Brake® Optimum Manhole: S8, DS/PN: S2.002, Volume (m³): 3.4

Minimum Outlet Pipe Diameter (mm) 100
Suggested Manhole Diameter (mm) 1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.700	2.2	Kick-Flo®	0.453	1.8
Flush-Flo™	0.208	2.2	Mean Flow over Head Range	-	1.9

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	2.0	1.200	2.8	3.000	4.3	7.000	6.4
0.200	2.2	1.400	3.0	3.500	4.6	7.500	6.6
0.300	2.2	1.600	3.2	4.000	4.9	8.000	6.8
0.400	2.0	1.800	3.4	4.500	5.2	8.500	7.0
0.500	1.9	2.000	3.6	5.000	5.5	9.000	7.2
0.600	2.1	2.200	3.7	5.500	5.7	9.500	7.4
0.800	2.3	2.400	3.9	6.000	6.0		
1.000	2.6	2.600	4.0	6.500	6.2		

Hydro-Brake® Optimum Manhole: S24, DS/PN: S4.006, Volume (m³): 1.9

Unit Reference	MD-SHE-0075-2300-0800-2300
Design Head (m)	0.800
Design Flow (l/s)	2.3
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	75
Invert Level (m)	63.864
Minimum Outlet Pipe Diameter (mm)	100
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.800	2.3	Kick-Flo®	0.508	1.9
Flush-Flo™	0.238	2.3	Mean Flow over Head Range	-	2.0

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

Hydro-Brake® Optimum Manhole: S24, DS/PN: S4.006, Volume (m³): 1.9

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	2.0	1.200	2.8	3.000	4.2	7.000	6.3
0.200	2.3	1.400	3.0	3.500	4.5	7.500	6.5
0.300	2.3	1.600	3.2	4.000	4.8	8.000	6.7
0.400	2.2	1.800	3.3	4.500	5.1	8.500	6.9
0.500	1.9	2.000	3.5	5.000	5.4	9.000	7.1
0.600	2.0	2.200	3.7	5.500	5.6	9.500	7.3
0.800	2.3	2.400	3.8	6.000	5.9		
1.000	2.5	2.600	4.0	6.500	6.1		

Hydro-Brake® Optimum Manhole: S29, DS/PN: S10.003, Volume (m³): 230.2

Unit Reference	MD-SHE-0075-2200-0700-2200
Design Head (m)	0.700
Design Flow (l/s)	2.2
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	75
Invert Level (m)	64.560
Minimum Outlet Pipe Diameter (mm)	100
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.700	2.2	Kick-Flo®	0.453	1.8
Flush-Flo™	0.208	2.2	Mean Flow over Head Range	-	1.9

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	2.0	1.200	2.8	3.000	4.3	7.000	6.4
0.200	2.2	1.400	3.0	3.500	4.6	7.500	6.6
0.300	2.2	1.600	3.2	4.000	4.9	8.000	6.8
0.400	2.0	1.800	3.4	4.500	5.2	8.500	7.0
0.500	1.9	2.000	3.6	5.000	5.5	9.000	7.2
0.600	2.1	2.200	3.7	5.500	5.7	9.500	7.4
0.800	2.3	2.400	3.9	6.000	6.0		
1.000	2.6	2.600	4.0	6.500	6.2		

Offline Controls for Storm

Pipe Manhole: S9, DS/PN: S4.000, Loop to PN: S1.002

Diameter (m)	0.150	Roughness k (mm)	0.600
Section Type	Pipe/Conduit	Entry Loss Coefficient	0.500
Slope (1:X)	48.5	Coefficient of Contraction	0.600
Length (m)	20.000	Upstream Invert Level (m)	64.750

Pipe Manhole: S27, DS/PN: S10.002, Loop to PN: S8.000

Diameter (m)	0.225	Roughness k (mm)	0.600
Section Type	Pipe/Conduit	Entry Loss Coefficient	0.500
Slope (1:X)	15.0	Coefficient of Contraction	0.600
Length (m)	3.000	Upstream Invert Level (m)	64.700

Storage Structures for Storm

Cellular Storage Manhole: S1, DS/PN: S1.000

Invert Level (m)	64.800	Safety Factor	2.0
Infiltration Coefficient Base (m/hr)	0.00000	Porosity	0.95
Infiltration Coefficient Side (m/hr)	0.00000		

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	40.0	0.0	0.401	0.0	0.0
0.400	40.0	0.0			

Filter Drain Pipe: S1.000

Manning's N	0.075	Trench Length (m)	50.2
Infiltration Coefficient Base (m/hr)	0.00000	Pipe Diameter (m)	0.225
Infiltration Coefficient Side (m/hr)	0.00000	Pipe Depth above Invert (m)	0.000
Safety Factor	2.0	Number of Pipes	1
Porosity	0.30	Slope (1:X)	225.0
Invert Level (m)	64.800	Cap Volume Depth (m)	0.000
Trench Width (m)	0.8	Cap Infiltration Depth (m)	0.000

Cellular Storage Manhole: S2, DS/PN: S1.001

Invert Level (m)	64.577	Safety Factor	2.0
Infiltration Coefficient Base (m/hr)	0.00000	Porosity	0.95
Infiltration Coefficient Side (m/hr)	0.00000		

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	200.0	0.0	0.401	0.0	0.0
0.400	200.0	0.0			

Complex Manhole: S3, DS/PN: S1.002

Porous Car Park

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	25.0
Membrane Percolation (mm/hr)	1000	Length (m)	16.0
Max Percolation (l/s)	111.1	Slope (1:X)	0.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.95	Evaporation (mm/day)	3
Invert Level (m)	64.850	Cap Volume Depth (m)	0.400

Porous Car Park

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	37.5
Membrane Percolation (mm/hr)	1000	Length (m)	19.5
Max Percolation (l/s)	203.1	Slope (1:X)	400.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.95	Evaporation (mm/day)	3
Invert Level (m)	64.850	Cap Volume Depth (m)	0.400

Porous Car Park Manhole: S4, DS/PN: S1.003

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	20.0
Membrane Percolation (mm/hr)	1000	Length (m)	16.0
Max Percolation (l/s)	88.9	Slope (1:X)	400.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.95	Evaporation (mm/day)	3
Invert Level (m)	64.850	Cap Volume Depth (m)	0.320

Cellular Storage Manhole: S5, DS/PN: S2.000

Invert Level (m)	64.500	Safety Factor	2.0
Infiltration Coefficient Base (m/hr)	0.00000	Porosity	0.95
Infiltration Coefficient Side (m/hr)	0.00000		

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	40.0	0.0	0.401	0.0	0.0
0.400	40.0	0.0			

Filter Drain Pipe: S2.000

Manning's N	0.075	Trench Length (m)	59.8
Infiltration Coefficient Base (m/hr)	0.00000	Pipe Diameter (m)	0.225
Infiltration Coefficient Side (m/hr)	0.00000	Pipe Depth above Invert (m)	0.000
Safety Factor	2.0	Number of Pipes	1
Porosity	0.30	Slope (1:X)	300.0
Invert Level (m)	64.500	Cap Volume Depth (m)	0.000
Trench Width (m)	1.0	Cap Infiltration Depth (m)	0.000

Cellular Storage Manhole: S7, DS/PN: S3.000

Invert Level (m)	64.300	Safety Factor	2.0
Infiltration Coefficient Base (m/hr)	0.00000	Porosity	0.95
Infiltration Coefficient Side (m/hr)	0.00000		

Cellular Storage Manhole: S7, DS/PN: S3.000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	400.0	0.0	0.801	0.0	0.0
0.800	400.0	0.0			

Porous Car Park Manhole: S9, DS/PN: S4.000

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	5.5
Membrane Percolation (mm/hr)	1000	Length (m)	50.0
Max Percolation (l/s)	76.4	Slope (1:X)	900.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.95	Evaporation (mm/day)	3
Invert Level (m)	64.750	Cap Volume Depth (m)	0.400

Porous Car Park Manhole: S10, DS/PN: S5.000

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	37.5
Membrane Percolation (mm/hr)	1000	Length (m)	5.0
Max Percolation (l/s)	52.1	Slope (1:X)	400.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.95	Evaporation (mm/day)	3
Invert Level (m)	64.750	Cap Volume Depth (m)	0.400

Complex Manhole: S11, DS/PN: S4.001

Porous Car Park

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	5.5
Membrane Percolation (mm/hr)	1000	Length (m)	27.0
Max Percolation (l/s)	41.3	Slope (1:X)	900.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.95	Evaporation (mm/day)	3
Invert Level (m)	64.650	Cap Volume Depth (m)	0.400

Swale

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

Infiltration Coefficient Base (m/hr)	0.00000	Invert Level (m)	64.650
Infiltration Coefficient Side (m/hr)	0.00000	Base Width (m)	4.0
Safety Factor	2.0	Length (m)	49.0
Porosity	1.00	Side Slope (1:X)	2.0

Swale

Slope (1:X)	900.0	Cap Infiltration Depth (m)	0.000
Cap Volume Depth (m)	0.500	Include Swale Volume	Yes

Porous Car Park

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	5.5
Membrane Percolation (mm/hr)	1000	Length (m)	78.0
Max Percolation (l/s)	119.2	Slope (1:X)	0.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.95	Evaporation (mm/day)	3
Invert Level (m)	65.100	Cap Volume Depth (m)	0.400

Tank or Pond

Invert Level (m) 64.700

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	197.0	0.500	287.0

Swale Pipe: S4.002

Manning's N	0.075	Base Width (m)	2.0
Infiltration Coefficient Base (m/hr)	0.00000	Length (m)	60.5
Infiltration Coefficient Side (m/hr)	0.00000	Side Slope (1:X)	2.0
Safety Factor	2.0	Slope (1:X)	900.0
Porosity	1.00	Cap Volume Depth (m)	0.500
Invert Level (m)	64.500	Cap Infiltration Depth (m)	0.000

Tank or Pond Manhole: S13, DS/PN: S4.003

Invert Level (m) 64.500

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	367.0	0.500	506.0

Cellular Storage Manhole: S14, DS/PN: S6.000

Invert Level (m)	64.500	Safety Factor	2.0
Infiltration Coefficient Base (m/hr)	0.00000	Porosity	0.95
Infiltration Coefficient Side (m/hr)	0.00000		

Cellular Storage Manhole: S14, DS/PN: S6.000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	100.0	0.0	0.401	0.0	0.0
0.400	100.0	0.0			

Cellular Storage Manhole: S15, DS/PN: S6.001

Invert Level (m) 64.402 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	200.0	0.0	0.401	0.0	0.0
0.400	200.0	0.0			

Complex Manhole: S16, DS/PN: S6.002

Porous Car Park

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	2.5
Membrane Percolation (mm/hr)	1000	Length (m)	24.0
Max Percolation (l/s)	16.7	Slope (1:X)	0.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.95	Evaporation (mm/day)	3
Invert Level (m)	64.700	Cap Volume Depth (m)	0.400

Porous Car Park

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	5.5
Membrane Percolation (mm/hr)	1000	Length (m)	52.5
Max Percolation (l/s)	80.2	Slope (1:X)	0.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.95	Evaporation (mm/day)	3
Invert Level (m)	64.700	Cap Volume Depth (m)	0.400

Tank or Pond Manhole: S18, DS/PN: S7.000

Invert Level (m) 64.800

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	166.0	0.500	276.0

Porous Car Park Manhole: S20, DS/PN: S8.000

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	28.6
Membrane Percolation (mm/hr)	1000	Length (m)	36.0
Max Percolation (l/s)	286.0	Slope (1:X)	400.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.95	Evaporation (mm/day)	3
Invert Level (m)	64.300	Cap Volume Depth (m)	0.400

Filter Drain Pipe: S9.000

Manning's N	0.075	Trench Length (m)	64.6
Infiltration Coefficient Base (m/hr)	0.00000	Pipe Diameter (m)	0.225
Infiltration Coefficient Side (m/hr)	0.00000	Pipe Depth above Invert (m)	0.000
Safety Factor	2.0	Number of Pipes	1
Porosity	0.30	Slope (1:X)	150.0
Invert Level (m)	64.150	Cap Volume Depth (m)	0.000
Trench Width (m)	1.0	Cap Infiltration Depth (m)	0.000

Cellular Storage Manhole: S25, DS/PN: S10.000

Invert Level (m)	64.800	Safety Factor	2.0
Infiltration Coefficient Base (m/hr)	0.00000	Porosity	0.95
Infiltration Coefficient Side (m/hr)	0.00000		

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	40.0	0.0	0.400	40.0	0.0

Filter Drain Pipe: S10.000

Manning's N	0.075	Trench Length (m)	46.8
Infiltration Coefficient Base (m/hr)	0.00000	Pipe Diameter (m)	0.225
Infiltration Coefficient Side (m/hr)	0.00000	Pipe Depth above Invert (m)	0.000
Safety Factor	2.0	Number of Pipes	1
Porosity	0.30	Slope (1:X)	437.8
Invert Level (m)	64.800	Cap Volume Depth (m)	0.000
Trench Width (m)	1.0	Cap Infiltration Depth (m)	0.000

Swale Pipe: S10.001

Manning's N	0.030	Base Width (m)	4.0
Infiltration Coefficient Base (m/hr)	0.00000	Length (m)	107.2
Infiltration Coefficient Side (m/hr)	0.00000	Side Slope (1:X)	2.0
Safety Factor	2.0	Slope (1:X)	10000.0
Porosity	1.00	Cap Volume Depth (m)	0.500
Invert Level (m)	64.700	Cap Infiltration Depth (m)	0.000

Swale Pipe: S11.000

Manning's N	0.030	Base Width (m)	4.0
Infiltration Coefficient Base (m/hr)	0.00000	Length (m)	91.8
Infiltration Coefficient Side (m/hr)	0.00000	Side Slope (1:X)	2.0
Safety Factor	2.0	Slope (1:X)	900.0
Porosity	1.00	Cap Volume Depth (m)	0.500
Invert Level (m)	64.662	Cap Infiltration Depth (m)	0.000

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 * 10m³/ha Storage	0.000
Hot Start Level (mm)	0	Inlet Coeffiecient	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 2 Number of Time/Area Diagrams 0
Number of Online Controls 4 Number of Storage Structures 23 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model	FEH	D3 (1km)	0.226
FEH Rainfall Version	1999	E (1km)	0.292
Site Location	Bicester Gateway	F (1km)	2.561
C (1km)	-0.023	Cv (Summer)	0.750
D1 (1km)	0.345	Cv (Winter)	0.950
D2 (1km)	0.312		

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

Profile(s)	Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years)	1, 2, 30, 100
Climate Change (%)	0, 0, 0, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
S1.000	S1	60 Winter	1	+0%					64.873
S1.001	S2	480 Winter	1	+0%	30/60 Winter				64.731
S1.002	S3	30 Winter	1	+0%	1/15 Winter				64.855
S1.003	S4	15 Winter	1	+0%	1/15 Winter				64.858
S2.000	S5	60 Winter	1	+0%					64.569
S2.001	S6	15 Winter	1	+0%	30/15 Winter				64.370
S3.000	S7	240 Winter	1	+0%	100/60 Winter				64.334
S2.002	S8	15 Winter	1	+0%	1/15 Winter				64.366
S4.000	S9	120 Winter	1	+0%			1/15 Winter	76	64.811

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

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
S1.000	S1	-0.327	0.000	0.13		36	2.0	OK	
S1.001	S2	-0.071	0.000	0.21		208	2.1	OK	
S1.002	S3	0.206	0.000	0.53		17	17.7	SURCHARGED	
S1.003	S4	0.434	0.000	0.09			2.3	SURCHARGED	
S2.000	S5	-0.431	0.000	0.08		39	1.7	OK	
S2.001	S6	-0.156	0.000	0.13			4.0	OK	
S3.000	S7	-0.191	0.000	0.04		156	1.3	OK	
S2.002	S8	0.030	0.000	0.06			2.2	SURCHARGED	
S4.000	S9	-0.239	0.000	0.09	4.2	25	1.0	OK	

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

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
S5.000	S10	480 Winter	1	+0%	100/2160 Winter				64.790
S4.001	S11	960 Winter	1	+0%	100/360 Winter				64.707
S4.002	S12	15 Winter	1	+0%	100/2160 Winter				64.554
S4.003	S13	720 Winter	1	+0%	30/240 Winter				64.538
S6.000	S14	30 Winter	1	+0%	100/15 Winter				64.570
S6.001	S15	600 Winter	1	+0%	30/120 Winter				64.544
S6.002	S16	600 Winter	1	+0%	2/180 Winter				64.543
S4.004	S17	600 Winter	1	+0%	1/180 Winter				64.542
S7.000	S18	600 Winter	1	+0%	30/15 Winter				64.544
S7.001	S19	600 Winter	1	+0%	1/180 Winter				64.544
S8.000	S20	2880 Winter	1	+0%	30/720 Winter				64.531
S7.002	S21	600 Winter	1	+0%	1/30 Winter				64.542
S9.000	S22	600 Winter	1	+0%					64.543
S4.005	S23	600 Winter	1	+0%	1/15 Winter				64.541
S4.006	S24	600 Winter	1	+0%	1/15 Winter				64.540
S10.000	S25	60 Winter	1	+0%					64.880
S10.001	S26	120 Winter	1	+0%					64.766
S10.002	S27	15 Winter	1	+0%	100/15 Winter		1/15 Winter	76	64.780
S11.000	S28	15 Winter	1	+0%					64.715
S10.003	S29	360 Winter	1	+0%	1/120 Winter				64.683

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
S5.000	S10	-0.185	0.000	0.07		266	0.5	OK	
S4.001	S11	-0.171	0.000	0.13		459	0.7	OK	
S4.002	S12	-0.546	0.000	0.01		9	2.7	OK	
S4.003	S13	-0.120	0.000	0.25			1.3	OK	
S6.000	S14	-0.230	0.000	0.12		22	7.2	OK	
S6.001	S15	-0.158	0.000	0.04		480	2.6	OK	
S6.002	S16	-0.014	0.000	0.04		611	2.2	OK	
S4.004	S17	0.027	0.000	0.06			3.0	SURCHARGED	
S7.000	S18	-0.056	0.000	0.01			0.5	OK	
S7.001	S19	0.016	0.000	0.05			2.8	SURCHARGED	
S8.000	S20	-0.194	0.000	0.03			0.9	OK	
S7.002	S21	0.174	0.000	0.05			2.7	SURCHARGED	
S9.000	S22	-0.607	0.000	0.01		760	0.8	OK	
S4.005	S23	0.353	0.000	0.05			2.4	SURCHARGED	
S4.006	S24	0.376	0.000	0.05			2.3	SURCHARGED	
S10.000	S25	-0.320	0.000	0.12		44	1.6	OK	

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

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
S10.001	S26	-0.434	0.000	0.00		59	4.6	OK	
S10.002	S27	-0.145	0.000	0.27	17.0		4.4	OK	
S11.000	S28	-0.385	0.000	0.01		5	15.5	OK	
S10.003	S29	0.023	0.000	0.39			2.1	SURCHARGED	

2 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 * 10m³/ha Storage	0.000
Hot Start Level (mm)	0	Inlet Coeffiecient	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 2 Number of Time/Area Diagrams 0
Number of Online Controls 4 Number of Storage Structures 23 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model	FEH	D3 (1km)	0.226
FEH Rainfall Version	1999	E (1km)	0.292
Site Location	Bicester Gateway	F (1km)	2.561
C (1km)	-0.023	Cv (Summer)	0.750
D1 (1km)	0.345	Cv (Winter)	0.950
D2 (1km)	0.312		

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

Profile(s)	Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years)	1, 2, 30, 100
Climate Change (%)	0, 0, 0, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
S1.000	S1	60 Winter	2	+0%					64.885
S1.001	S2	600 Winter	2	+0%	30/60 Winter				64.774
S1.002	S3	30 Winter	2	+0%	1/15 Winter				64.861
S1.003	S4	15 Winter	2	+0%	1/15 Winter				64.866
S2.000	S5	60 Winter	2	+0%					64.581
S2.001	S6	15 Winter	2	+0%	30/15 Winter				64.395
S3.000	S7	240 Winter	2	+0%	100/60 Winter				64.346
S2.002	S8	15 Winter	2	+0%	1/15 Winter				64.389
S4.000	S9	120 Winter	2	+0%			1/15 Winter	76	64.824

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

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
S1.000	S1	-0.315	0.000	0.17		34	2.6	OK	
S1.001	S2	-0.028	0.000	0.21		279	2.2	OK	
S1.002	S3	0.211	0.000	0.58		12	19.4	SURCHARGED	
S1.003	S4	0.441	0.000	0.08			2.2	SURCHARGED	
S2.000	S5	-0.419	0.000	0.11		37	2.3	OK	
S2.001	S6	-0.131	0.000	0.15			4.6	OK	
S3.000	S7	-0.179	0.000	0.05		141	1.6	OK	
S2.002	S8	0.054	0.000	0.06			2.2	SURCHARGED	
S4.000	S9	-0.226	0.000	0.14	5.4	32	1.5	OK	

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

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
S5.000	S10	360 Winter	2	+0%	100/2160 Winter				64.795
S4.001	S11	720 Winter	2	+0%	100/360 Winter				64.712
S4.002	S12	15 Winter	2	+0%	100/2160 Winter				64.561
S4.003	S13	960 Winter	2	+0%	30/240 Winter				64.557
S6.000	S14	30 Winter	2	+0%	100/15 Winter				64.583
S6.001	S15	480 Winter	2	+0%	30/120 Winter				64.574
S6.002	S16	480 Winter	2	+0%	2/180 Winter				64.572
S4.004	S17	480 Winter	2	+0%	1/180 Winter				64.571
S7.000	S18	180 Winter	2	+0%	30/15 Winter				64.576
S7.001	S19	180 Winter	2	+0%	1/180 Winter				64.575
S8.000	S20	2880 Winter	2	+0%	30/720 Winter				64.554
S7.002	S21	480 Winter	2	+0%	1/30 Winter				64.571
S9.000	S22	480 Winter	2	+0%					64.573
S4.005	S23	480 Winter	2	+0%	1/15 Winter				64.571
S4.006	S24	480 Winter	2	+0%	1/15 Winter				64.570
S10.000	S25	60 Winter	2	+0%					64.894
S10.001	S26	120 Winter	2	+0%					64.776
S10.002	S27	15 Winter	2	+0%	100/15 Winter		1/15 Winter	76	64.792
S11.000	S28	15 Winter	2	+0%					64.722
S10.003	S29	360 Winter	2	+0%	1/120 Winter				64.704

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
S5.000	S10	-0.180	0.000	0.09		226	0.6	OK	
S4.001	S11	-0.166	0.000	0.16		410	0.8	OK	
S4.002	S12	-0.539	0.000	0.01		8	3.6	OK	
S4.003	S13	-0.101	0.000	0.27			1.4	OK	
S6.000	S14	-0.217	0.000	0.17		20	9.8	OK	
S6.001	S15	-0.127	0.000	0.05		536	2.9	OK	
S6.002	S16	0.016	0.000	0.05			2.4	SURCHARGED	
S4.004	S17	0.056	0.000	0.07			3.2	SURCHARGED	
S7.000	S18	-0.024	0.000	0.02			1.3	OK	
S7.001	S19	0.047	0.000	0.12			7.2	SURCHARGED	
S8.000	S20	-0.171	0.000	0.03			1.0	OK	
S7.002	S21	0.204	0.000	0.08			4.1	SURCHARGED	
S9.000	S22	-0.577	0.000	0.02			1.2	OK	
S4.005	S23	0.383	0.000	0.05			2.5	SURCHARGED	
S4.006	S24	0.406	0.000	0.05			2.3	SURCHARGED	
S10.000	S25	-0.306	0.000	0.16		41	2.1	OK	

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

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
S10.001	S26	-0.424	0.000	0.01		58	5.7	OK	
S10.002	S27	-0.133	0.000	0.35	22.2		5.7	OK	
S11.000	S28	-0.378	0.000	0.01		5	20.8	OK	
S10.003	S29	0.044	0.000	0.40			2.1	SURCHARGED	

30 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 * 10m³/ha Storage	0.000
Hot Start Level (mm)	0	Inlet Coeffiecient	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 2 Number of Time/Area Diagrams 0
Number of Online Controls 4 Number of Storage Structures 23 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model	FEH	D3 (1km)	0.226
FEH Rainfall Version	1999	E (1km)	0.292
Site Location	Bicester Gateway	F (1km)	2.561
C (1km)	-0.023	Cv (Summer)	0.750
D1 (1km)	0.345	Cv (Winter)	0.950
D2 (1km)	0.312		

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

Profile(s)	Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years)	1, 2, 30, 100
Climate Change (%)	0, 0, 0, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
S1.000	S1	15 Winter	30	+0%					64.970
S1.001	S2	480 Winter	30	+0%	30/60 Winter				64.875
S1.002	S3	60 Winter	30	+0%	1/15 Winter				64.891
S1.003	S4	30 Winter	30	+0%	1/15 Winter				64.889
S2.000	S5	15 Winter	30	+0%					64.661
S2.001	S6	15 Winter	30	+0%	30/15 Winter				64.592
S3.000	S7	240 Winter	30	+0%	100/60 Winter				64.438
S2.002	S8	15 Winter	30	+0%	1/15 Winter				64.603
S4.000	S9	180 Winter	30	+0%			1/15 Winter	76	64.865

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

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
S1.000	S1	-0.230	0.000	0.49		18	7.5	FLOOD RISK	
S1.001	S2	0.073	0.000	0.26		439	2.7	SURCHARGED	
S1.002	S3	0.241	0.000	0.40		39	13.3	SURCHARGED	
S1.003	S4	0.465	0.000	0.08		31	2.2	SURCHARGED	
S2.000	S5	-0.339	0.000	0.29		21	6.1	OK	
S2.001	S6	0.066	0.000	0.32			9.9	SURCHARGED	
S3.000	S7	-0.087	0.000	0.06		245	2.0	OK	
S2.002	S8	0.267	0.000	0.06			2.2	SURCHARGED	
S4.000	S9	-0.185	0.000	0.31	1.6	162	3.5	OK	

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

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
S5.000	S10	180 Winter	30	+0%	100/2160 Winter				64.828
S4.001	S11	480 Winter	30	+0%	100/360 Winter				64.778
S4.002	S12	1440 Winter	30	+0%	100/2160 Winter				64.750
S4.003	S13	1440 Winter	30	+0%	30/240 Winter				64.750
S6.000	S14	1440 Winter	30	+0%	100/15 Winter				64.742
S6.001	S15	1440 Winter	30	+0%	30/120 Winter				64.742
S6.002	S16	1440 Winter	30	+0%	2/180 Winter				64.742
S4.004	S17	1440 Winter	30	+0%	1/180 Winter				64.741
S7.000	S18	30 Winter	30	+0%	30/15 Winter				64.820
S7.001	S19	15 Winter	30	+0%	1/180 Winter				64.849
S8.000	S20	1440 Winter	30	+0%	30/720 Winter				64.742
S7.002	S21	15 Winter	30	+0%	1/30 Winter				64.780
S9.000	S22	30 Winter	30	+0%					64.782
S4.005	S23	15 Winter	30	+0%	1/15 Winter				64.772
S4.006	S24	15 Winter	30	+0%	1/15 Winter				64.772
S10.000	S25	15 Winter	30	+0%					64.987
S10.001	S26	15 Winter	30	+0%					64.853
S10.002	S27	15 Winter	30	+0%	100/15 Winter		1/15 Winter	76	64.888
S11.000	S28	240 Winter	30	+0%					64.793
S10.003	S29	240 Winter	30	+0%	1/120 Winter				64.792

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
S5.000	S10	-0.147	0.000	0.26		147	1.7	OK	
S4.001	S11	-0.100	0.000	0.60		378	3.1	OK	
S4.002	S12	-0.350	0.000	0.01		1158	2.4	OK	
S4.003	S13	0.092	0.000	0.24			1.2	SURCHARGED	
S6.000	S14	-0.058	0.000	0.03			1.8	OK	
S6.001	S15	0.040	0.000	0.04			2.3	SURCHARGED	
S6.002	S16	0.185	0.000	0.04		472	2.3	SURCHARGED	
S4.004	S17	0.226	0.000	0.05			2.5	SURCHARGED	
S7.000	S18	0.220	0.000	0.21			11.9	SURCHARGED	
S7.001	S19	0.322	0.000	1.29			77.1	FLOOD RISK	
S8.000	S20	0.017	0.000	0.08			2.5	SURCHARGED	
S7.002	S21	0.413	0.000	1.15			59.8	SURCHARGED	
S9.000	S22	-0.368	0.000	0.13			8.6	OK	
S4.005	S23	0.584	0.000	0.15			7.2	SURCHARGED	
S4.006	S24	0.608	0.000	0.05			2.4	SURCHARGED	
S10.000	S25	-0.213	0.000	0.42		24	5.6	FLOOD RISK	

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

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
S10.001	S26	-0.347	0.000	0.03		25	27.3	OK	
S10.002	S27	-0.037	0.000	1.00	63.0		16.4	FLOOD RISK	
S11.000	S28	-0.307	0.000	0.00		217	5.0	OK	
S10.003	S29	0.132	0.000	0.41			2.2	SURCHARGED	

100 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 * 10m³/ha Storage	0.000
Hot Start Level (mm)	0	Inlet Coeffiecient	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 2 Number of Time/Area Diagrams 0
Number of Online Controls 4 Number of Storage Structures 23 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model	FEH	D3 (1km)	0.226
FEH Rainfall Version	1999	E (1km)	0.292
Site Location	Bicester Gateway	F (1km)	2.561
C (1km)	-0.023	Cv (Summer)	0.750
D1 (1km)	0.345	Cv (Winter)	0.950
D2 (1km)	0.312		

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

Profile(s)	Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years)	1, 2, 30, 100
Climate Change (%)	0, 0, 0, 40

WARNING: Half Drain Time has not been calculated as the structure is too full.

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
S1.000	S1	15 Winter	100	+40%					65.139
S1.001	S2	480 Winter	100	+40%	30/60 Winter				64.951
S1.002	S3	360 Winter	100	+40%	1/15 Winter				64.943
S1.003	S4	360 Winter	100	+40%	1/15 Winter				64.938
S2.000	S5	15 Winter	100	+40%					64.816
S2.001	S6	15 Winter	100	+40%	30/15 Winter				64.826

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

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
S1.000	S1	-0.061	0.000	0.99		16	15.2	FLOOD RISK	
S1.001	S2	0.149	0.000	0.10			1.1	FLOOD RISK	
S1.002	S3	0.293	0.000	0.14		327	4.7	FLOOD RISK	
S1.003	S4	0.513	0.000	0.09		291	2.3	FLOOD RISK	
S2.000	S5	-0.184	0.000	0.68		19	14.2	FLOOD RISK	
S2.001	S6	0.300	0.000	0.73			23.0	FLOOD RISK	

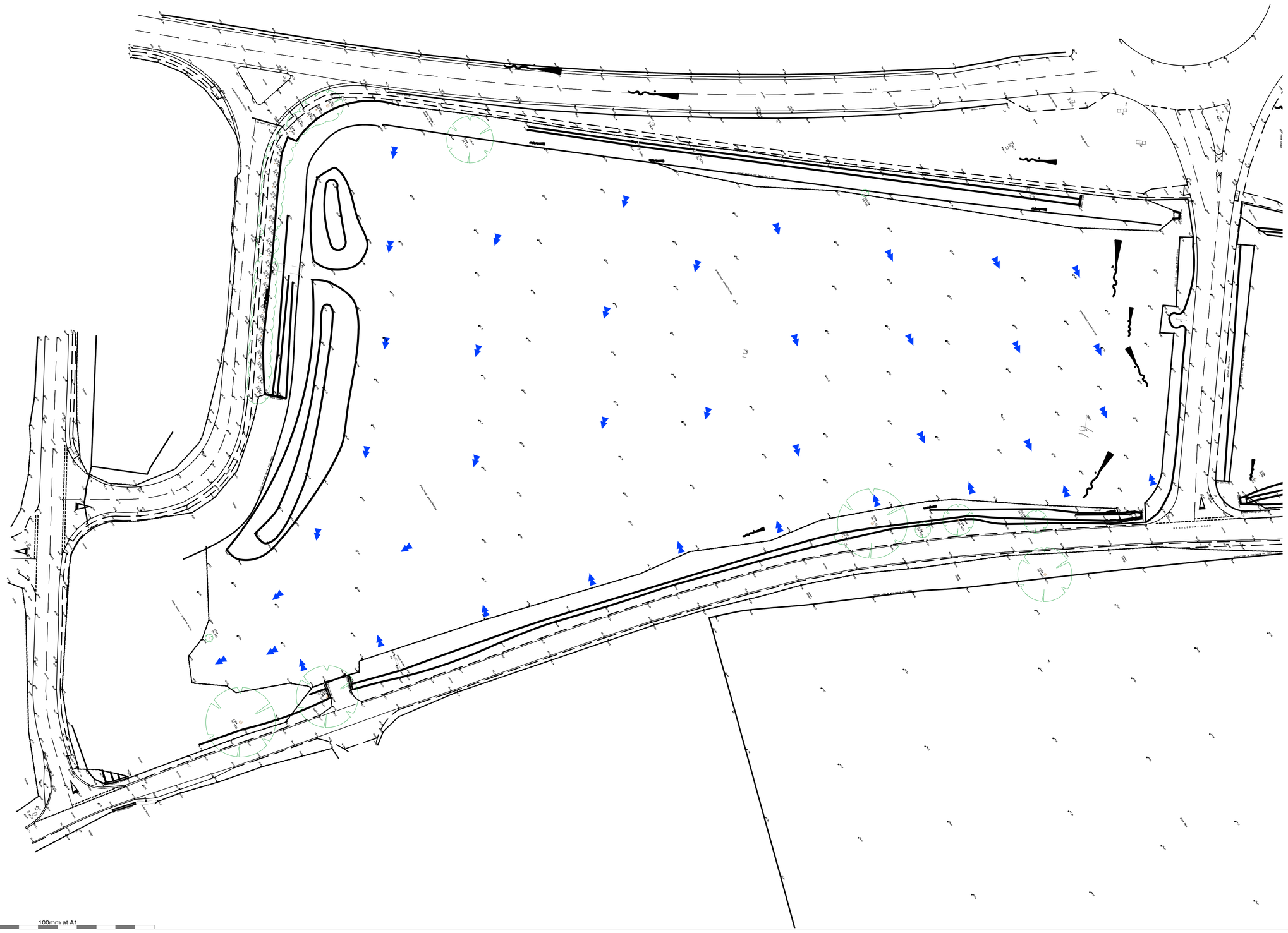
100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
S3.000	S7	480 Winter	100	+40%	100/60 Winter				64.627
S2.002	S8	15 Winter	100	+40%	1/15 Winter				64.806
S4.000	S9	1440 Winter	100	+40%			1/15 Winter	76	64.935
S5.000	S10	2160 Winter	100	+40%	100/2160 Winter				64.975
S4.001	S11	2160 Winter	100	+40%	100/360 Winter				64.975
S4.002	S12	2160 Winter	100	+40%	100/2160 Winter				65.000
S4.003	S13	2160 Winter	100	+40%	30/240 Winter				65.001
S6.000	S14	1440 Winter	100	+40%	100/15 Winter				65.045
S6.001	S15	1440 Winter	100	+40%	30/120 Winter				65.044
S6.002	S16	1440 Winter	100	+40%	2/180 Winter				65.042
S4.004	S17	1440 Winter	100	+40%	1/180 Winter				65.042
S7.000	S18	960 Winter	100	+40%	30/15 Winter				65.052
S7.001	S19	15 Winter	100	+40%	1/180 Winter				65.082
S8.000	S20	960 Winter	100	+40%	30/720 Winter				65.149
S7.002	S21	960 Winter	100	+40%	1/30 Winter				65.058
S9.000	S22	15 Winter	100	+40%					65.113
S4.005	S23	1440 Winter	100	+40%	1/15 Winter				65.045
S4.006	S24	1440 Winter	100	+40%	1/15 Winter				65.044
S10.000	S25	15 Winter	100	+40%					65.159
S10.001	S26	960 Winter	100	+40%					65.046
S10.002	S27	960 Winter	100	+40%	100/15 Winter		1/15 Winter	76	65.046
S11.000	S28	960 Winter	100	+40%					65.039
S10.003	S29	960 Winter	100	+40%	1/120 Winter				65.039

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
S3.000	S7	0.102	0.000	0.06			1.8	SURCHARGED	
S2.002	S8	0.471	0.000	0.06			2.2	FLOOD RISK	
S4.000	S9	-0.115	0.000	0.34	1.3		3.8	FLOOD RISK	
S5.000	S10	0.000	0.000	0.20		1501	1.3	FLOOD RISK	
S4.001	S11	0.097	0.000	0.74		1817	3.8	FLOOD RISK	
S4.002	S12	-0.100	0.000	0.01			3.6	FLOOD RISK	
S4.003	S13	0.343	0.000	0.39			2.0	FLOOD RISK	
S6.000	S14	0.245	0.000	0.07			4.0	FLOOD RISK	
S6.001	S15	0.342	0.000	0.10			5.9	FLOOD RISK	
S6.002	S16	0.486	0.000	0.07		1381	3.5	FLOOD RISK	
S4.004	S17	0.527	0.000	0.05			2.6	FLOOD RISK	
S7.000	S18	0.452	0.000	0.05			2.9	FLOOD RISK	
S7.001	S19	0.555	0.000	1.52			91.2	FLOOD RISK	

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

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
S8.000	S20	0.424	0.000	0.35			10.5	FLOOD RISK	
S7.002	S21	0.690	0.000	0.25			13.0	FLOOD RISK	
S9.000	S22	-0.037	0.000	0.65			43.7	FLOOD RISK	
S4.005	S23	0.857	0.000	0.06			2.8	FLOOD RISK	
S4.006	S24	0.880	0.000	0.06			2.7	FLOOD RISK	
S10.000	S25	-0.041	0.000	1.13		20	15.0	FLOOD RISK	
S10.001	S26	-0.154	0.000	0.00			3.3	FLOOD RISK	
S10.002	S27	0.121	0.000	0.38	27.5		6.3	FLOOD RISK	
S11.000	S28	-0.061	0.000	0.00			5.2	FLOOD RISK	
S10.003	S29	0.379	0.000	0.41			2.2	FLOOD RISK	



NOTES:

1. THESE NOTES ARE INTENDED TO AUGMENT DRAWINGS AND SPECIFICATIONS. WHERE CONFLICT OF REQUIREMENTS EXIST THE ORDER OF PRECEDENCE SHALL BE AS SHOWN IN THE SPECIFICATION. OTHERWISE THE STRICTEST PROVISION SHALL GOVERN.
2. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL OTHER RELEVANT ENGINEERS AND ARCHITECTS DRAWINGS.
3. DRAWINGS NOT TO BE SCALED. ALL DIMENSIONS TO BE CHECKED ON SITE BY THE CONTRACTOR. ANY DISCREPANCIES TO BE NOTIFIED TO THE ENGINEER AND FURTHER INSTRUCTIONS OBTAINED BEFORE WORK IS COMMENCED.

KEY

= EXISTING SURFACE WATER EXCEEDANCE FLOW PATH ROUTE

Rev	Description	Date	By	Chk	App
P1	FIRST ISSUE	06.01.20	MJC	AD	--

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Sheffield	T. 01142 440077
York	T. 01904 611594

Project: Development Site at Bicester Gateway, A41/Oxford Road, Bicester

Client: Bicester Gateway Ltd

Drawing: Existing Surface Water Exceedance Flow Paths

Role: Civil Engineer

Drawing Status: Preliminary

Job. no. 43386 | Scale@ A1: 1:500 | Rev. P1

Project	Originator	Volume	Level	Type	Role	Number
BCG	AWP	ZZ	XX	DR	C	3001

100mm at A1

100mm at A1

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KEY

= PROPOSED SURFACE WATER EXCEEDANCE FLOW PATH ROUTE

Rev	Description	Date	By	Chk	App
P1	FIRST ISSUE	06.01.20	MJC	AD	--

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Sheffield	T. 01142 440077
York	T. 01904 611594

Project:	Development Site at Bicester Gateway, A41/Oxford Road, Bicester
Client:	Bicester Gateway Ltd
Drawing:	Proposed Surface Water Exceedance Flow Paths
Role:	Civil Engineer
Drawing Status:	Preliminary
Job. no.	43386
Scale@ A1:	1:500
Rev.	P1

Project Originator Volume Level Type Role Number

BCG - AWP - ZZ - XX - DR - C - 3002