Infrastructure Design Studio
CONSULTING ENGINEERS

Storm Drainage – LPA Planning Condition Submission.

Revision A (First Issue) - 02 May 2018.

Purpose of the report.

The following report is intended to clarify that the detailed design for storm drainage elements of the Lincolns Inn Development are compliant with the proposals submitted pre planning.

At planning stage a 'Non-Technical Summary' report dated 02/October 2015 was submitted which resulted in the wording of planning condition 13 & 14. This report is intended to confirm that the requirements of planning condition 13 have been achieved.

Planning Condition 13.

Prior to installation of the proposed sustainable drainage system as approved (Planning Drainage Statement, Jul 2015 submitted as part of the approved BIA and 'Storm drainage - non technical summary', Oct 2015), including rainwater harvesting and soakaway, the following details must be submitted to the local planning authority and approved in writing:
a) full infiltration testing and report confirming whether the ground is suitable to support the proposed soakaway together with detailed design of the proposed sustainable drainage system
b) a lifetime maintenance plan demonstrating how the sustainable drainage system will be maintained
The sustainable drainage system as approved in accordance with the above details and within the approved Planning Drainage Statement, Jul 2015 shall be installed as part of the development to achieve a site-wide 12% reduction in run off rate and a 69% reduction in run off rate associated with the new-build elements of the scheme as stated in the approved details and shall thereafter retained and maintained in accordance with the approved maintenance plan.

Infiltration Tests:

A full BRE365 infiltration test was undertaken by a specialist soil investigation company (ESG) at the site of the proposed soakaway on 25/Aug/2017.
The results are provided in Appendix A. The infiltration rate was into porous gravel material so generated a rate of 1.09x10-4 which is a significantly quicker infiltration rate than the conservative rate used for scheme design which was 4.0x10-6

This very good infiltration rate has enabled some additional storm drainage to be discharged to the soakaway and thereby provide a greater reduction of load to the local combined sewerage system.

The proposed soakway was schemed to accept drainage from the Eastern Terrace only. But given the good infiltration rate available a small area (370m2) of flow from the existing Great Hall roof has also been added to the soakaway. At planning the catchment to the soakaway was proposed at 680m2, the detailed calculations in Appendix B are design on the increased catchment of 1050m2.

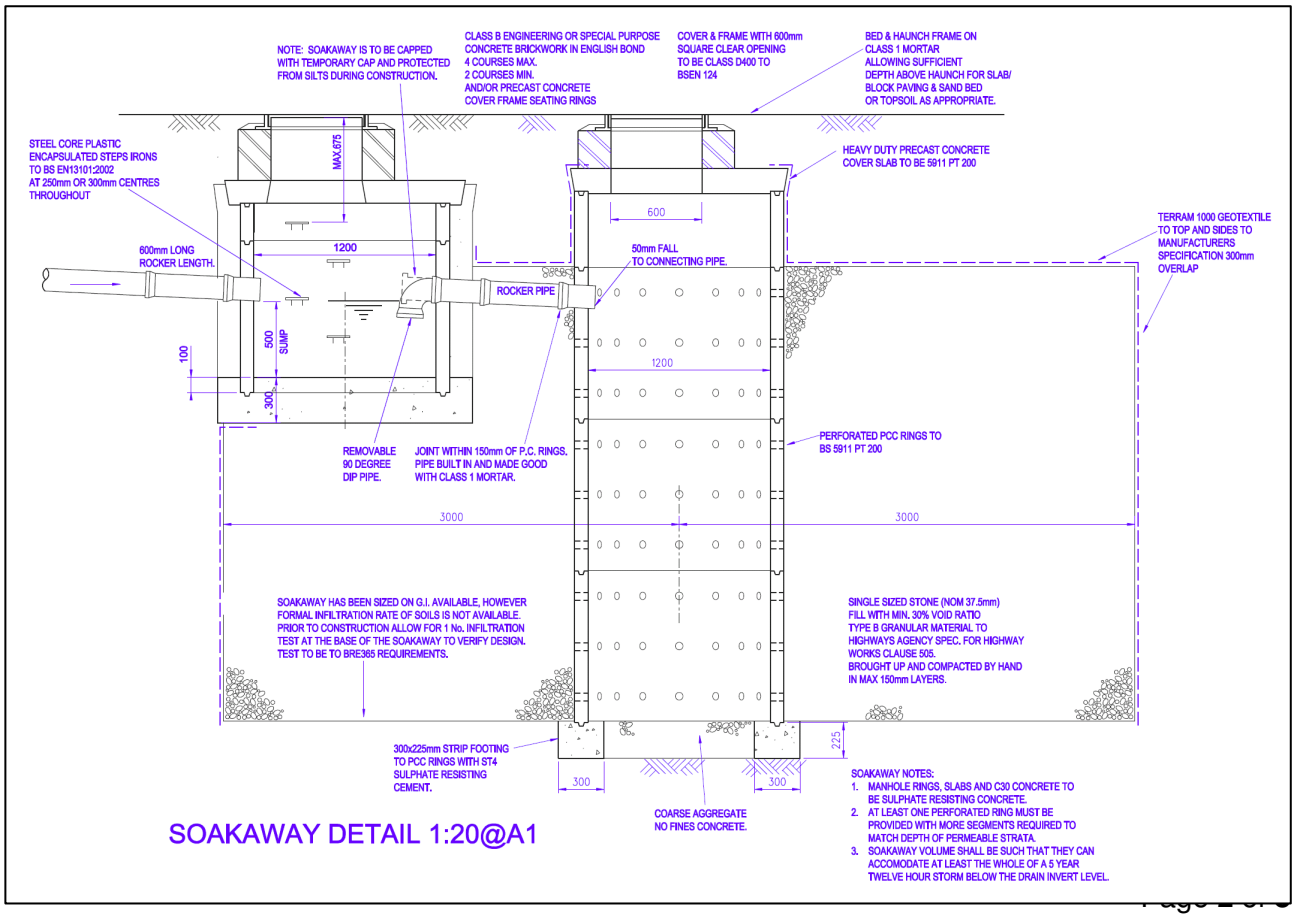
This has the benefit of reducing the off-site discharges to a lower rate than those approved at planning. Calculations for the soakaway are shown in Appendix B, as can be seen the soakaway size provided has sufficient capacity and if necessary could accept a little more future catchment should any future building or paving alterations be proposed.

Given the detailed design (post planning) has reduced the drained area which now goes off site, this has changed the previously mentioned discharge rates as follows:

- The developed parts of the site have not changed their run off regime since the design submitted at planning. The Eastern Terrace still entirely drains to soakaway. Therefore the reduction in run off from the developed areas remains reduced from 26.67l/s (100yr) to 8.24 l/s (100+30%CC) **a 69% reduction in run off rate**. This is as approved at planning.

- For the entire site, since planning submission a small area (370m2) of the existing Great hall has been added to the soakaway, this has had the benefit of reducing the site-wide run off, the previous drained area reduction was from 3734m2 to 3274m2 so a 12% reduction confirmed at planning. The reduction in catchment area going off site has now been reduced from 3734m2 to 2904m2 so the overall discharge from site for both the developed and existing storm catchment is **now reduced by 22%.** This is an improvement over the 12% reduction approved at planning.

The soakaway has been detailed as per the 'Non-Technical Summary' report and utilizes a pre-treatment silt trap. An extract form the design drawing 14132-C06 is shown below.



Maintenance.

A maintenance schedule for maintenance of both the storm and foul drainage features has been prepared. This is provided under separate cover.

Mark Simmonds
Infrastructure design Studio.

Appendix A. Infiltration Rates.

ESG
River Laboratory Farmhouse
East Stoke
Wareham
Dorset
BH20 6BB
United Kingdom

TEST REPORT

Determination of Soil Infiltration Rate
BRE Digest 365 (2007)

Client: Euro City Group

Report No: RS172680
Our Ref: 51027307/M5

Site: **Lincoln's Inn, London WC2A 3TL**

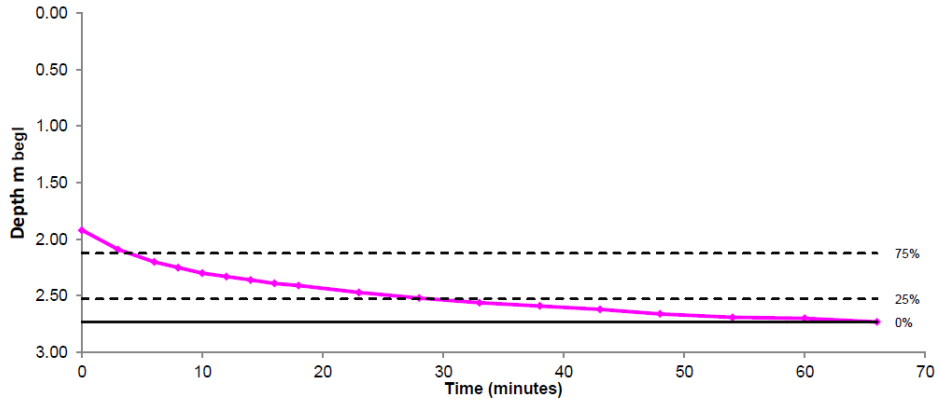
Excavation Details

Trial Pit No:	1	Filling No.	2	
Location:	1	Date Started:	25 August 2017	
Length (m):	2.77	Granular infill:	None	
Width (m):	0.69	Porosity:	1.00	assumed
Depth (m):	2.73	Datum height:	0.00	m agl

Test Data

Elapsed Time (minutes)	Water Depth (m below ground level)	Elapsed Time (minutes)	Water Depth (m below ground level)
0	1.92	33	2.56
3	2.09	38	2.59
6	2.20	43	2.62
8	2.25	48	2.66
10	2.30	54	2.69
12	2.33	60	2.7
14	2.36	66	2.73
16	2.39		
18	2.41		
23	2.47		
28	2.52		

Plot



Results

Start water depth for analysis (mbgl):	1.92	Mean surface area of outflow (m^2):	4.7139
75% effective depth (mbgl):	2.12	Elapsed time to 75% (mins):	4
50% effective depth (mbgl):	2.33	Elapsed time to 25% (mins):	29
25% effective depth (mbgl):	2.53	Volume outflow 75% to 25%(m^3):	0.774
Base of soakage zone (mbgl):	2.73	Time for outflow 75% to 25% (min)	25

Soil infiltration rate (m/s): 1.093E-04

Remarks: Results processed following BRE 365 (2007).

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Date Reported: 29/08/2017

Signed: _____ ☑ T. Green - Technical Manager
For and on behalf of **ESG.**

Appendix B. Soakaway Calculations.

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31 Dyer Street Cirencester Glos GL7 2PP	HSLI -Great Hall Terrace Soakaway	
Date 02/05/2018 11:52 File SOAKAWAY-3-1-09X10-4.SRCX	Designed by MDS Checked by MJ	
Causeway	Source Control 2017.1.2	

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

Half Drain Time : 65 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
15 min Summer	17.436	1.236	5.0	22.1	O K
30 min Summer	17.645	1.445	5.0	25.8	O K
60 min Summer	17.745	1.545	5.0	27.6	O K
120 min Summer	17.670	1.470	5.0	26.3	O K
180 min Summer	17.532	1.332	5.0	23.8	O K
240 min Summer	17.397	1.197	5.0	21.4	O K
360 min Summer	17.167	0.967	4.9	17.2	O K
480 min Summer	16.988	0.788	4.6	14.0	O K
600 min Summer	16.837	0.637	4.3	11.3	O K
720 min Summer	16.710	0.510	4.1	9.0	O K
960 min Summer	16.513	0.313	3.8	5.5	O K
1440 min Summer	16.289	0.089	3.4	1.4	O K
2160 min Summer	16.240	0.040	2.7	0.5	O K
2880 min Summer	16.232	0.032	2.1	0.4	O K
4320 min Summer	16.223	0.023	1.5	0.2	O K
5760 min Summer	16.219	0.019	1.2	0.2	O K
7200 min Summer	16.218	0.018	1.0	0.1	O K
8640 min Summer	16.216	0.016	0.9	0.1	O K
10080 min Summer	16.215	0.015	0.8	0.1	O K
15 min Winter	17.390	1.190	5.0	21.2	O K
30 min Winter	17.921	1.721	5.0	30.8	O K
60 min Winter	18.057	1.857	5.0	33.2	O K
120 min Winter	17.911	1.711	5.0	30.6	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
15 min Summer	138.439	0.0	20
30 min Summer	89.338	0.0	33
60 min Summer	54.817	0.0	56
120 min Summer	32.487	0.0	88
180 min Summer	23.617	0.0	122
240 min Summer	18.732	0.0	154
360 min Summer	13.493	0.0	220
480 min Summer	10.688	0.0	284
600 min Summer	8.914	0.0	346
720 min Summer	7.683	0.0	406
960 min Summer	6.072	0.0	524
1440 min Summer	4.353	0.0	748
2160 min Summer	3.116	0.0	1096
2880 min Summer	2.456	0.0	1444
4320 min Summer	1.755	0.0	2200
5760 min Summer	1.381	0.0	2920
7200 min Summer	1.146	0.0	3664
8640 min Summer	0.984	0.0	4384
10080 min Summer	0.865	0.0	5064
15 min Winter	138.439	0.0	17
30 min Winter	89.338	0.0	33
60 min Winter	54.817	0.0	60
120 min Winter	32.487	0.0	96

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

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
180 min Winter	17.708	1.508	5.0	27.0	O K
240 min Winter	17.503	1.303	5.0	23.3	O K
360 min Winter	17.163	0.963	4.9	17.2	O K
480 min Winter	16.915	0.715	4.5	12.7	O K
600 min Winter	16.716	0.516	4.1	9.1	O K
720 min Winter	16.554	0.354	3.8	6.2	O K
960 min Winter	16.324	0.124	3.4	2.1	O K
1440 min Winter	16.241	0.041	2.7	0.6	O K
2160 min Winter	16.229	0.029	1.9	0.3	O K
2880 min Winter	16.223	0.023	1.5	0.2	O K
4320 min Winter	16.218	0.018	1.1	0.2	O K
5760 min Winter	16.216	0.016	0.9	0.1	O K
7200 min Winter	16.215	0.015	0.8	0.1	O K
8640 min Winter	16.214	0.014	0.6	0.1	O K
10080 min Winter	16.213	0.013	0.6	0.1	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
180 min Winter	23.617	0.0	132
240 min Winter	18.732	0.0	168
360 min Winter	13.493	0.0	234
480 min Winter	10.688	0.0	298
600 min Winter	8.914	0.0	360
720 min Winter	7.683	0.0	422
960 min Winter	6.072	0.0	528
1440 min Winter	4.353	0.0	724
2160 min Winter	3.116	0.0	1080
2880 min Winter	2.456	0.0	1432
4320 min Winter	1.755	0.0	2156
5760 min Winter	1.381	0.0	2880
7200 min Winter	1.146	0.0	3576
8640 min Winter	0.984	0.0	4176
10080 min Winter	0.865	0.0	5136

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Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.800	Shortest Storm (mins)	15
Ratio R	0.440	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+30

Pipe Network

Volume in Pipe Network (m³)	5	Dia of Outfall Pipe (m)	0.2
Slope of Outfall Pipe (1:X)	150	Roughness of Outfall Pipe (mm)	0.600

Time Area Diagram

Total Area (ha) 0.105

Time (mins) From:	To:	Area (ha)
0	4	0.105

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Model Details

Storage is Online Cover Level (m) 20.200

Trench Soakaway Structure

Infiltration Coefficient Base (m/hr)	0.39000	Trench Width (m)	6.0
Infiltration Coefficient Side (m/hr)	0.39200	Trench Length (m)	10.0
Safety Factor	2.0	Slope (1:X)	500.0
Porosity	0.30	Cap Volume Depth (m)	3.000
Invert Level (m)	16.200	Cap Infiltration Depth (m)	1.000