WARD ASSOCIATES (CE)

WARD

Project: Spalding

Job No. 2642

Sheet No.

Date. Dec 2018

Engineer GB | Check

DRAINAGE STRATEGY

EXISTING SITE IS A PUBLIC HOUSE - THE BIRDS

FROM EXISTING DRAINAGE SURVEY EXISTING DRAIN.

IS A COMBINED SYSTEM CONNECTING INTO FOUL

DRAIN CROSSING SITE BETWEEN MH 7805 AND 8802

INFILTRATION TESTING ON SITE FAILED AS PER ATTACHED

REPORT.

EXISTING SITE IMPERMEABLE AREA

BUILDING - 433m²

CAR PARK - 1656 m²

TOTAL = 2089m²

PROPOSE TO LIMIT OUTFLOW TO 7 GREENFIELD RUNOFF

RATE AND CONNECT INTO DITCH/DRAIN TO EAST OF SITE

FROM HR WALLINGFORD ON UKSUDS WEBSITE GREENFIELD

RUNOFF RATE = 0.5 l/s FOR 1:1 YR EVENT = 2.0 l/s FOR 1:100YR

PROPOSE TO USE DISCHARGE LIMITED TO 1 l/s TO AVOID

BLOCKAGES.

PROPOSED DEVELOPMENT

BUILDING = 1640

CAR PARK = 900

HARDSTANDING = 303

TOTAL = 2843 m²

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DRAINAGE STRATEGY

FROM TEDDS + ECCEL ATTENUATION STORAGE REQ'D

= 158.4m3

APPLY CLIMATE CHANGE @ 40%

= 221.8 m3 STORAGE REQ'D.

↳ GIVEN SITE RESTRICTIONS AND PROPOSED END USER

- PERMEABLE TYPE C INFILTRATION PAVING SUITABLE
- RAINWATER HARVESTING TO GARDEN USE ONLY
- ABOVE GROUND ATTENUATION NOT FEASIBLE. DUE TO END USER ↳ USE BELOW GROUND.

FOR PERMEABLE PAVING USE MIN SUBBASE 300mm @ 30%

STORAGE PROVIDED = 1656 x 0.3 x 0.3 = 149m3

ADDITIONAL STORAGE PROVIDED BY CRATES BELOW CAR PARK.

REQ'D = 2218 - 149 = 728 m3

2642 - Spalding Attenuation Design

Impermeable Area of proposed site 1435.7m2

r=0.44

Period		Storm Duration (mins)	post development Max Runoff (l/s)	Total Volume (l)		Outflow (l/s) - Predevelopment run off	Total volume (l)	Storage Required m3
5yrs	5 mins	5	73.0	21900		1	300	21.6
5yrs	10 mins	10	51.0	30600		1	600	30.0
5yrs	15mins	15	41.0	36900		1	900	36.0
5yrs	30mins	30	26.0	46800		1	1800	45.0
5yrs	1hr	60	16.0	57600		1	3600	54.0
5yrs	2hr	120	10.0	72000		1	7200	64.8
5yrs	4hr	240	6.0	86400		1	14400	72.0
5yrs	6hr	360	4.0	86400		1	21600	64.8
5yrs	10hr	600	3.0	108000		1	36000	72.0
5yrs	24hr	1440	1.0	86400		1	86400	0.0

Period		Storm Duration (mins)	post development Max Runoff (l/s)	Total Volume (l)		Outflow (l/s) - Predevelopment run off	Total volume (l)	Storage Required m3
30yrs	5 mins	5	104.0	31200		1	300	30.9
30yrs	10 mins	10	74.0	44400		1	600	43.8
30yrs	15mins	15	61.0	54900		1	900	54.0
30yrs	30mins	30	39.0	70200		1	1800	68.4
30yrs	1hr	60	24.0	86400		1	3600	82.8
30yrs	2hr	120	15.0	108000		1	7200	100.8
30yrs	4hr	240	9.0	129600		1	14400	115.2
30yrs	6hr	360	6.0	129600		1	21600	108.0
30yrs	10hr	600	4.0	144000		1	36000	108.0
30yrs	24hr	1440	2.0	172800		1	86400	86.4

Period		Storm Duration (mins)	post development Max Runoff (l/s)	Total Volume (l)		Outflow (l/s) - Predevelopment run off	Total volume (l)	Storage Required m3
100yrs	5 mins	5	131.7	39510		1	300	39.2
100yrs	10 mins	10	95.5	57300		1	600	56.7
100yrs	15mins	15	78.3	70470		1	900	69.6
100yrs	30mins	30	50.8	91440		1	1800	89.6
100yrs	1hr	60	32.0	115200		1	3600	111.6
100yrs	2hr	120	19.1	137520		1	7200	130.3
100yrs	4hr	240	11.2	161280		1	14400	146.9
100yrs	6hr	360	8.1	174960		1	21600	153.4
100yrs	10hr	600	5.4	194400		1	36000	158.4
100yrs	24hr	1440	2.7	233280		1	86400	146.9

DESIGN RAINFALL

In accordance with the Wallingford Procedure

Tedds calculation version 2.0.00

Design rainfall intensity

Location of catchment area	Norwich
Storm duration	D = **10** hr
Return period	Period = **100** yr
Ratio 60 min to 2 day rainfall of 5 yr return period	r = **0.410**
5-year return period rainfall of 60 minutes duration	M5_60min = **20.0** mm
Increase of rainfall intensity due to global warming	$p_{climate}$ = **0** %
Factor Z1 (Wallingford procedure)	Z1 = **1.77**
Rainfall for 10hr storm with 5 year return period	$M5_10hr_1 = Z1 \times M5_60min$ = **35.3** mm
Factor Z2 (Wallingford procedure)	Z2 = **1.93**
Rainfall for 10hr storm with 100 year return period	$M100_10hr = Z2 \times M5_10hr_1$ = **68.1** mm
Design rainfall intensity	I_{max} = M100_10hr / D = **6.8** mm/hr

Maximum surface water runoff

Catchment area	A_{catch} = **2834** m^2
Percentage of area that is impermeable	p = **100** %
Maximum surface water runoff	$Q_{max} = A_{catch} \times p \times I_{max}$ = **5.4** l/s

DESIGN RAINFALL

In accordance with the Wallingford Procedure

Tedds calculation version 2.0.00

Design rainfall intensity

Location of catchment area	Norwich
Storm duration	D = **15** min
Return period	Period = **100** yr
Ratio 60 min to 2 day rainfall of 5 yr return period	r = **0.410**
5-year return period rainfall of 60 minutes duration	M5_60min = **20.0** mm
Increase of rainfall intensity due to global warming	$p_{climate}$ = **0** %
Factor Z1 (Wallingford procedure)	Z1 = **0.64**
Rainfall for 15min storm with 5 year return period	$M5_15min_I$ = Z1 × M5_60min = **12.7** mm
Factor Z2 (Wallingford procedure)	Z2 = **1.95**
Rainfall for 15min storm with 100 year return period	M100_15min = Z2 × $M5_15min_I$ = **24.9** mm
Design rainfall intensity	I_{max} = M100_15min / D = **99.5** mm/hr

Maximum surface water runoff

Catchment area	A_{catch} = **2834** m^2
Percentage of area that is impermeable	p = **100** %
Maximum surface water runoff	Q_{max} = A_{catch} × p × I_{max} = **78.3** l/s

DESIGN RAINFALL

In accordance with the Wallingford Procedure

Tedds calculation version 2.0.00

Design rainfall intensity

Location of catchment area	Norwich
Storm duration	D = **30** min
Return period	Period = **100** yr
Ratio 60 min to 2 day rainfall of 5 yr return period	r = **0.410**
5-year return period rainfall of 60 minutes duration	M5_60min = **20.0** mm
Increase of rainfall intensity due to global warming	$p_{climate}$ = **0** %
Factor Z1 (Wallingford procedure)	Z1 = **0.81**
Rainfall for 30min storm with 5 year return period	$M5_30min_I$ = Z1 × M5_60min = **16.1** mm
Factor Z2 (Wallingford procedure)	Z2 = **2.00**
Rainfall for 30min storm with 100 year return period	M100_30min = Z2 × $M5_30min_I$ = **32.3** mm
Design rainfall intensity	I_{max} = M100_30min / D = **64.5** mm/hr

Maximum surface water runoff

Catchment area	A_{catch} = **2834** m^2
Percentage of area that is impermeable	p = **100** %
Maximum surface water runoff	Q_{max} = A_{catch} × p × I_{max} = **50.8** l/s

Tekla Tedds	Project: Spalding				Job no.: 2642	
	Calcs for: Attenuation				Start page no./Revision: 1	
	Calcs by: GB	Calcs date: 21/12/2018	Checked by:	Checked date:	Approved by:	Approved date:

DESIGN RAINFALL

In accordance with the Wallingford Procedure

Tedds calculation version 2.0.00

Design rainfall intensity

Location of catchment area	Norwich
Storm duration	D = **1** hr
Return period	Period = **100** yr
Ratio 60 min to 2 day rainfall of 5 yr return period	r = **0.410**
5-year return period rainfall of 60 minutes duration	M5_60min = **20.0** mm
Increase of rainfall intensity due to global warming	$p_{climate}$ = **0** %
Factor Z1 (Wallingford procedure)	Z1 = **1.00**
Rainfall for 1hr storm with 5 year return period	M5_1hr = Z1 × M5_60min = **20.0** mm
Factor Z2 (Wallingford procedure)	Z2 = **2.03**
Rainfall for 1hr storm with 100 year return period	M100_1hr = Z2 × M5_1hr = **40.6** mm
Design rainfall intensity	I_{max} = M100_1hr / D = **40.6** mm/hr

Maximum surface water runoff

Catchment area	A_{catch} = **2834** m^2
Percentage of area that is impermeable	p = **100** %
Maximum surface water runoff	Q_{max} = A_{catch} × p × I_{max} = **32.0** l/s

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	Calcs for: Attenuation				Start page no./Revision: 1	
	Calcs by: GB	Calcs date: 21/12/2018	Checked by:	Checked date:	Approved by:	Approved date:

DESIGN RAINFALL

In accordance with the Wallingford Procedure

Tedds calculation version 2.0.00

Design rainfall intensity

Location of catchment area	Norwich
Storm duration	D = **2** hr
Return period	Period = **100** yr
Ratio 60 min to 2 day rainfall of 5 yr return period	r = **0.410**
5-year return period rainfall of 60 minutes duration	M5_60min = **20.0** mm
Increase of rainfall intensity due to global warming	$p_{climate}$ = **0** %
Factor Z1 (Wallingford procedure)	Z1 = **1.20**
Rainfall for 2hr storm with 5 year return period	$M5_2hr = Z1 \times M5_60min$ = **24.1** mm
Factor Z2 (Wallingford procedure)	Z2 = **2.01**
Rainfall for 2hr storm with 100 year return period	$M100_2hr = Z2 \times M5_2hr$ = **48.5** mm
Design rainfall intensity	$I_{max} = M100_2hr / D$ = **24.2** mm/hr

Maximum surface water runoff

Catchment area	A_{catch} = **2834** m^2
Percentage of area that is impermeable	p = **100** %
Maximum surface water runoff	$Q_{max} = A_{catch} \times p \times I_{max}$ = **19.1** l/s

DESIGN RAINFALL

In accordance with the Wallingford Procedure

Tedds calculation version 2.0.00

Design rainfall intensity

Location of catchment area	Norwich
Storm duration	D = **4** hr
Return period	Period = **100** yr
Ratio 60 min to 2 day rainfall of 5 yr return period	r = **0.410**
5-year return period rainfall of 60 minutes duration	M5_60min = **20.0** mm
Increase of rainfall intensity due to global warming	$p_{climate}$ = **0** %
Factor Z1 (Wallingford procedure)	Z1 = **1.43**
Rainfall for 4hr storm with 5 year return period	$M5_4hr_1$ = Z1 × M5_60min = **28.7** mm
Factor Z2 (Wallingford procedure)	Z2 = **1.98**
Rainfall for 4hr storm with 100 year return period	M100_4hr = Z2 × $M5_4hr_1$ = **56.8** mm
Design rainfall intensity	I_{max} = M100_4hr / D = **14.2** mm/hr

Maximum surface water runoff

Catchment area	A_{catch} = **2834** m^2
Percentage of area that is impermeable	p = **100** %
Maximum surface water runoff	Q_{max} = A_{catch} × p × I_{max} = **11.2** l/s

DESIGN RAINFALL

In accordance with the Wallingford Procedure

Tedds calculation version 2.0.00

Design rainfall intensity

Location of catchment area	Norwich
Storm duration	D = **6** hr
Return period	Period = **100** yr
Ratio 60 min to 2 day rainfall of 5 yr return period	r = **0.410**
5-year return period rainfall of 60 minutes duration	M5_60min = **20.0** mm
Increase of rainfall intensity due to global warming	$p_{climate}$ = **0** %
Factor Z1 (Wallingford procedure)	Z1 = **1.59**
Rainfall for 6hr storm with 5 year return period	M5_6hr = Z1 × M5_60min = **31.7** mm
Factor Z2 (Wallingford procedure)	Z2 = **1.96**
Rainfall for 6hr storm with 100 year return period	M100_6hr = Z2 × M5_6hr = **62.1** mm
Design rainfall intensity	I_{max} = M100_6hr / D = **10.3** mm/hr

Maximum surface water runoff

Catchment area	A_{catch} = **2834** m^2
Percentage of area that is impermeable	p = **100** %
Maximum surface water runoff	Q_{max} = A_{catch} × p × I_{max} = **8.1** l/s

DESIGN RAINFALL

In accordance with the Wallingford Procedure

Tedds calculation version 2.0.00

Design rainfall intensity

Location of catchment area	Norwich
Storm duration	D = **24** hr
Return period	Period = **100** yr
Ratio 60 min to 2 day rainfall of 5 yr return period	r = **0.410**
5-year return period rainfall of 60 minutes duration	M5_60min = **20.0** mm
Increase of rainfall intensity due to global warming	$p_{climate}$ = **0** %
Factor Z1 (Wallingford procedure)	Z1 = **2.20**
Rainfall for 24hr storm with 5 year return period	$M5_24hr_1$ = Z1 × M5_60min = **44.0** mm
Factor Z2 (Wallingford procedure)	Z2 = **1.86**
Rainfall for 24hr storm with 100 year return period	M100_24hr = Z2 × $M5_24hr_1$ = **81.8** mm
Design rainfall intensity	I_{max} = M100_24hr / D = **3.4** mm/hr

Maximum surface water runoff

Catchment area	A_{catch} = **2834** m^2
Percentage of area that is impermeable	p = **100** %
Maximum surface water runoff	Q_{max} = A_{catch} × p × I_{max} = **2.7** l/s