

**Drainage Strategy Report for Proposed Car Park Extension to
Toyota Garage, Llay New Road, Wrexham, LL11 4BA**

Appendix 4

FLOOD ZONE MAP



a

Map Perygl Llifogydd / Flood Risk Map

Allwedd / Map Key

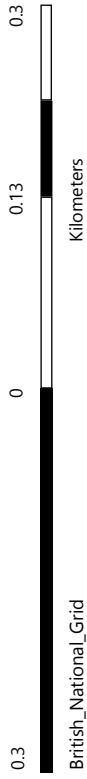
— Flood Defences

Risk of Flooding from Rivers & Sea

High
Medium
Low
Very Low

Graddfa / Scale 1: 5,001

Dyddiad / Date
06/12/2018



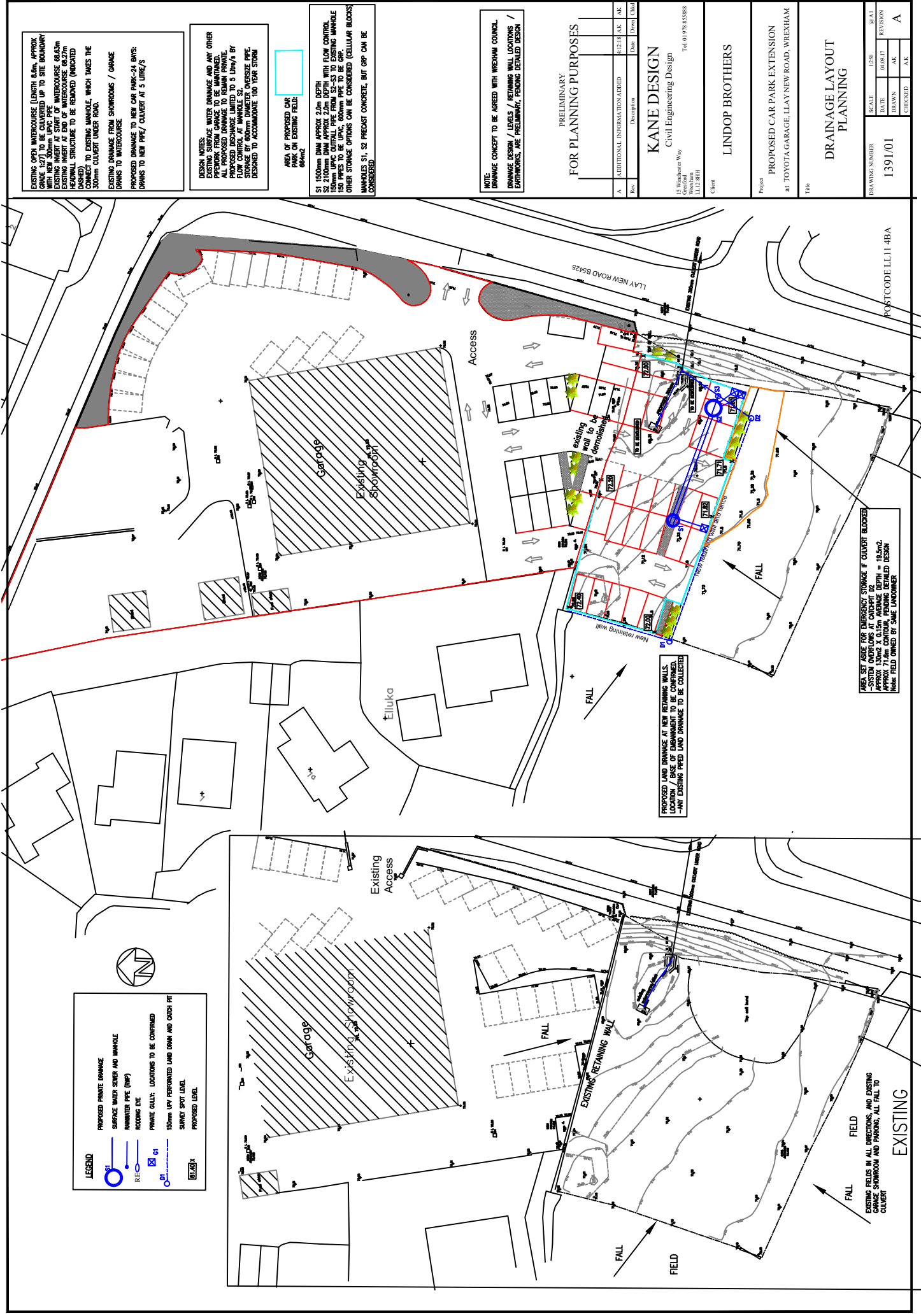
British_National_Grid

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Appendix 5

**DRAINAGE LAYOUT
PLANNING**





EXISTING OPEN WATERCOURSE (LENGTH 8.6m, APPROX GRADE 1:27) TO BE CULVERTED UP TO SITE BOUNDARY WITH NEW 300mm UPVC PIPE. WATERCOURSE 68.32m EXISTING INLET AT END OF WATERCOURSE 68.27m HEADWALL STRUCTURE TO BE REMOVED (INDICATED DASHED).
CONNECT TO EXISTING MANHOLE, WHICH TAKES THE 300mm CULVERT UNDER ROAD.
EXISTING DRAINAGE FROM SHOWROOMS / GARAGE DRAINS TO WATERCOURSE.
PROPOSED DRAINAGE TO NEW CAR PARK-24 BAYS, DRAINS TO NEW PIPE/ CULVERT AT 5 LITRE/S

DESIGN NOTES:
EXISTING SURFACE WATER DRAINAGE AND ANY OTHER DRAINAGE FROM GARAGE TO BE MAINTAINED.
ALL PROPOSED DRAINAGE TO REMAIN PRIVATE.
PROPOSED DISCHARGE LIMITED TO 5 LITRE/S BY 150mm UPVC OUTLET PIPE FROM S2-S3 TO EXISTING MANHOLE.
150mm UPVC OUTLET PIPE FROM S2-S3 TO EXISTING MANHOLE.
STORAGE BY 60mm DIAMETER CASESIE PIPE, DESIGNED TO ACCOMMODATE 100 YEAR STORM.

AREA OF PROPOSED CAR PARK ON EXISTING FIELD 664m²

S1 1500mm DIAM APPROX 2.0m DEPTH
S2 2100mm DIAM APPROX 2.0m DEPTH WITH FLOW CONTROL
150mm UPVC OUTLET PIPE FROM S2-S3 TO EXISTING MANHOLE
150mm UPVC OUTLET PIPE FROM S2-S3 TO EXISTING MANHOLE
OTHER STORMING OPTIONS CAN BE CONSIDERED (CELLULAR BLOCKS)
MANHOLES S1, S2, PRECAST CONCRETE, BUT ORP CAN BE CONSIDERED

NOTE:
DRAINAGE CONCEPT TO BE AGREED WITH WREXHAM COUNCIL.
DRAINAGE DESIGN / LEVELS / RETAINING WALL LOCATIONS / EARTHWORKS, ARE PRELIMINARY, PENDING DETAILED DESIGN

PRELIMINARY
FOR PLANNING PURPOSES

Rev	Description	Revised By	Revised Date
A	ADDITIONAL INFORMATION ADDED	AK	AK

KANE DESIGN
Civil Engineering Design
15 Winchester Way
Wrexham
LL12 8UH
Tel: 01978 555888

Client
LINDOP BROTHERS

Project
PROPOSED CAR PARK EXTENSION
at TOYOTA GARAGE, LLAY NEW ROAD, WREXHAM

Title
DRAINAGE LAYOUT PLANNING

DRAWING NUMBER	1391/01
SCALE	1:250 @ A1
DATE	06/09/17
DRAWN	AK
CHECKED	AK
REVISION	A

POSTCODE LL11 4BA

LEGEND

PROPOSED PRIVATE DRAINAGE

SURFACE WATER SINKER AND MANHOLE

MANHOLE PIPE (HMP)

PROPOSED EYE

PRIVATE GULLY: LOCATIONS TO BE CONFIRMED

150mm UPVC PERFORATED LAND DRAIN AND CATCH PIT

SURVEY SPOT LEVEL

PROPOSED LEVEL

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PROPOSED LAND DRAINAGE AT NEW RETAINING WALLS.
LOCATION OF EXISTING PAVED LAND DRAINAGE TO BE COLLECTED.
-ANY EXISTING PAVED LAND DRAINAGE TO BE COLLECTED

AREA SET ASIDE FOR EMERGENCY STORAGE & CULVERT BLOCKED
-SYSTEM OVERFLOWS AT CATCH PIT D2
APPROX 13m² X 0.15m AVERAGE DEPTH = 19.5m³
-AREA NOT TO BE USED FOR ANY OTHER PURPOSES
-AREA FIELD OWNED BY SILE LANDOWNER

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Appendix 6

**EXISTING GREENFIELD RUN-OFF
PROPOSED SITE**



		SURFACE WATER RUN-OFF: PRE AND POST DEVELOPMENT																																								
KANE DESIGN 15 Winchester Way, Gresford Wrexham LL12 8HH Tel: 01 9788 855888	Project	TOYOTA GARAGE LLAY NEW ROAD, WREXHAM LL11 4BA	Scheme number 1391 DATE 05-Sep-17 Engineer A Kane Sheet 1 of 7																																							
DESIGN BRIEF The Code of Practise for Sustainable Urban Development requires the following information: - Site pre-development surface water run-off rate - Site pre-development surface water run-off volume - Site post-development surface water run-off rate - Site post-development surface water run-off volume The above are to be computed for storms up to 100 year return, 6 hour duration, and are to include a factor for climate change. The difference between pre-development and post development is to be calculated,																																										
DOCUMENTS USED: Code for Sustainable Homes: Technical Guide: May 2009 Version A Institute of Hydrology Report 124 (IH 124): Flood Assessment for Small Catchments: (1994) Institute of Hydrology Report: Flood Studies Supplementary Report FSSR 16 (1985) Wallingford Procedure (1993) CIRIA Report 697: THE SUDS Manual (2007) HMSO: Planning Policy Statement 25 (PPS25)																																										
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		SURFACE WATER RUN-OFF: PRE AND POST DEVELOPMENT	
KANE DESIGN 15 Winchester Way, Gresford Wrexham LL12 8HH Tel: 01 9788 855888		Project TOYOTA GARAGE LLAY NEW ROAD, WREXHAM LL11 4BA Scheme number 1391 DATE 05-Sep-17 Engineer A Kane Sheet 2 of 7	
SITE SPECIFIC DETAILS		DRAWING REFERENCE: SITE PLAN SUPPLIED 4 February 2015 Construction of 16 residential property	
Location Postcode LL11 4BA			
Site	EXISTING DETAILS		
Site area (m2)	664 Calculated from drawing		
PIMP (%)	0.00 Greenfield		
Site Impermeable Area (m2)	0 Greenfield		
Site permeable area	664 m2		
PROPOSED:		664 m2	100.00% Impermeable (developed) area
Input data			
1.	Catchment Data	[proportion of each soil type estimated from Site Investigation Report]	
	<u>1a) Soil Data</u>	WRAP : = Soil Winter Rainfall potential (FSSR 16)	
	Prop S1	0	
	Prop S2	0	
	Prop S3	0.3	
	Prop S4	0.7	
	Prop S5	0	
Soil type = [sum of soil		= 0.15 S1 x 0.3 S2 x 0.4 S3 x 0.45 S4 x 0.5 S5	= 0.435
Soil Percentage Runoff (SPR) =		10 S1 x 30 S2 x 37 S3 x 47 S4 x 53 S5	= 44
<u>1 b) Remainder catchment of data</u>			
	Region number	9	From CIRIA 696
	SAAR	900	From FSSR rainfall maps
	CWI	125	From FSSR Figure A7.5
	UCWI	108	From CIRIA 697 Figure 4.6
<u>1 c) rainfall data</u>			
	M5-60 min rainfall	17	From FSSR rainfall maps
	Ratio "r"	0.35	From FSSR rainfall maps
	Climate Change % (C)	30	From PPS 25 Table B2
	Storm duration for	15	Selected [for post development]
peak run -off (min)			
	Z1	1.69	From BRE 365 Table 1 [r = .35 duration =360 mins]
	M5 - 60	28.73	,=Z1 x M5-60 Calculated = P1 year
	Z2	1.525	30 year Wallingford Vol 4 Table A1
	Therefore M30 year 360 min	43.81	mm/hr ,=Z1 x M5-60 Calculated = P30 year
	Z2	1.97	100 year Wallingford Vol 4 Table A1
	Therefore M100 year 360 min	56.60	mm/hr ,=Z1 x M5-60 Calculated = P100 year

SURFACE WATER RUN-OFF: PRE AND POST DEVELOPMENT

KANE DESIGN

15 Winchester Way, Gresford
Wrexham LL12 8HH
Tel: 01 9788 855888

Project

**TOYOTA GARAGE
LLAY NEW ROAD, WREXHAM
LL11 4BA**

Scheme number

1391

DATE

05-Sep-17

Engineer

A Kane

Sheet 3 of 7

NOTES

A: Calculation

**Existing (pre-development) Surface Water run-off rate:
GREENFIELD**

Use :

Annual peak flow = Q bar-rural = $0.00108 \text{Area [Km2]} ^{0.89} \times \text{SAAR} ^{1.17} \times \text{SOIL} ^{2.17}$

m3 / sec

Area (m2)= 664

Growth Factors: Table 4.3 CIRIA 696

Region number 9

Return Period

Growth

1

0.82

30

1.77

100

2.18

Calculated

100 +C/C

2.834

Q bar-rural: = 0.2738 m3/s [Based on equation default 50 Ha: Max area for equation]

Q bar-rural: (Actual) = 0.00036 m3/s Ratio, Q/Qbar as FSSR 16

ESTIMATED GREENFIELD RUN-OFF:

Storm Return period (yr)	1	30	100	100+CC
Growth (from above)	0.82	1.77	2.18	2.83
Peak run-off rate(m3	0.00030	0.00064	0.00079	0.00103
(Litres/s)	0.30	0.64	0.79	1.03

(Q bar actual x growth)

SURFACE WATER RUN-OFF: PRE AND POST DEVELOPMENT																																														
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B: Calculation Existing (pre-development) Surface Water run-off rate: BROWN PORTION OF SITE Use: Modified Ration Method: $Q = 2.78C \times \text{Rainfall} \times \text{Area}$ Where $C = C_v (\text{PR urban}/100) \times C_r$ PR (%) Impermeable area (PIMP) 0.00% from previous 0.00 Therefore $C_v =$ 0.750 Recommended Wallingford value for impermeable $C_r =$ 1.30 fixed equation value Rainfall intensity: Wallingford Procedure: 15 min Storm: Wallingford Vol 4 Table A1 <table> <tr> <th>Storm Return period (yr)</th> <th>15 min</th> <th>1</th> <th>30</th> <th>100</th> <th>100+CC</th> </tr> <tr> <td>Z1</td> <td>0.617</td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>M5-D</td> <td>10.489</td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>Z2</td> <td></td> <td>0.61</td> <td>1.535</td> <td>1.93</td> <td>2.51</td> </tr> <tr> <td>Rainfall intensity:</td> <td></td> <td>25.59</td> <td>64.40</td> <td>80.98</td> <td>105.27</td> </tr> </table> ESTIMATED BROWN POST-DEVELOPMENT RUN-OFF: <table> <tr> <th>Storm Return period (yr)</th> <th>1</th> <th>30</th> <th>100</th> <th>100+CC</th> </tr> <tr> <td>Rainfall intensity (15 mins)</td> <td>25.59</td> <td>64.40</td> <td>80.98</td> <td>105.27</td> </tr> <tr> <td>Run-off rate l/s</td> <td>0.00</td> <td>0.00</td> <td>0.00</td> <td>0.00</td> </tr> </table> (Peak Flow) $Q = 2.78 C_v \times C_r \times \text{Rainfall intensity} \times \text{Area}$		Storm Return period (yr)	15 min	1	30	100	100+CC	Z1	0.617					M5-D	10.489					Z2		0.61	1.535	1.93	2.51	Rainfall intensity:		25.59	64.40	80.98	105.27	Storm Return period (yr)	1	30	100	100+CC	Rainfall intensity (15 mins)	25.59	64.40	80.98	105.27	Run-off rate l/s	0.00	0.00	0.00	0.00
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SURFACE WATER RUN-OFF: PRE AND POST DEVELOPMENT	
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D: Calculation

Existing (pre-development) Surface Water run-off Volume:
SITE GREENFIELD :

Use:

FSSR16: Fixed Percentage Run-off Model

360 minute storm

100 year

Run-off Volume = PR X AREA [Km2] X Rainfall depth

wh PR = Percentage run-off = SPR + DPRcwi +DPR rain

Where D= Dynamic contribution

and

DPRcwi = 0.25 x (CWI-125)

DPR rain = 0.45 x (P-40)^0.7

Where P is greater than 40

SPR = 44

DPRcwi = 0

DPR rain = 3.216

Therefore PR = 47.216

Peak Run-off Volume (m3)17.74

With climate change23.07

SURFACE WATER RUN-OFF: PRE AND POST DEVELOPMENT																																														
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E: Calculation Post development Surface Water run-off RATE: Use: Modified Ration Method: $Q = 2.78C \times \text{Rainfall} \times \text{Area}$ Where $C = C_v (PR/100) \times C_r$ Where $PR_{urban} = (\%) \text{ percentage run-off area} = 0.829 PIMP + 25SOIL + 0.078 UCWI - 20.7$ [Fixed Wallingford Procedure] USES WHOLE CATCHMENT DATE (GREEN/BROWN) PR (%) Impermeable area (PIMP) 100.00% from previous (or use 'min PIMP 40%') PR urban = 81.50 Therefore $C_v =$ 0.750 $C_r =$ 1.30 fixed equation value Rainfall intensity: Wallingford Procedure: 15 min Storm: Wallingford Vol 4 Table A1 <table border="1"> <thead> <tr> <th>Storm Return period (years)</th> <th>15 min</th> <th>1</th> <th>30</th> <th>100</th> <th>100+CC</th> </tr> </thead> <tbody> <tr> <td>Z1</td> <td>0.617</td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>M5-D</td> <td>10.489</td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>Z2</td> <td></td> <td>0.61</td> <td>1.535</td> <td>1.93</td> <td>2.51</td> </tr> <tr> <td>Rainfall intensity:</td> <td></td> <td>25.59</td> <td>64.40</td> <td>80.98</td> <td>105.27</td> </tr> </tbody> </table> ESTIMATED POST-DEVELOPMENT RUN-OFF: <table border="1"> <thead> <tr> <th>Storm Return period (years)</th> <th>1</th> <th>30</th> <th>100</th> <th>100+CC</th> </tr> </thead> <tbody> <tr> <td>Rainfall intensity (15 mins)</td> <td>25.59</td> <td>64.40</td> <td>80.98</td> <td>105.27</td> </tr> <tr> <td>Run-off rate l/s (Peak Flow)</td> <td>4.61</td> <td>11.58</td> <td>14.56</td> <td>18.93</td> </tr> </tbody> </table> $Q = 2.78 C_v \times C_r \times \text{Rainfall intensity} \times \text{Area}$		Storm Return period (years)	15 min	1	30	100	100+CC	Z1	0.617					M5-D	10.489					Z2		0.61	1.535	1.93	2.51	Rainfall intensity:		25.59	64.40	80.98	105.27	Storm Return period (years)	1	30	100	100+CC	Rainfall intensity (15 mins)	25.59	64.40	80.98	105.27	Run-off rate l/s (Peak Flow)	4.61	11.58	14.56	18.93
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F: Calculation Post development Surface Water run-off VOLUME: 360min storm Use: Modified Ration Method: $Q = 2.78 C \times \text{Rainfall} \times \text{Area}$ Where $C = C_v (PR/100) \times C_r$ volume = $V = Q A$ Storm Return period (years) 1 30 100 100+CC Z1 360 mins M5-D Z2 1.97 Rainfall intensity: (mm/hr) 56.60 73.58 Run-off rate, Q (litres / s) 10.19 13.24 VOLUME V (m3)= Q/A: 360 mins 220.03 286.03 Post development run-off volume																																														

		SURFACE WATER RUN-OFF: PRE AND POST DEVELOPMENT			
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SUMMARY: SURFACE WATER					
RUN-OFF		PRE-DEVELOPMENT			
	Storm Return	1	30	100	100+CC
A	GREENFIELD	0.298	0.64	0.79	1.03
B	BROWN	0.00	0.00	0.00	0.00
	TOTAL	0.30	0.64	0.79	1.03
		LITRES /S			
VOLUME					
				100	100+CC 360 min
C	GREENFIELD			17.74	23.07
D	BROWN			0.00	0.00
	TOTAL			17.74	23.07
		m3			
RUN-OFF					
		POST DEVELOPMENT			
	Storm Return	1	30	100	100+CC
E		4.61	11.58	14.56	18.93
		LITRES /S			
VOLUME					
				100	100+CC 360 min
F				220.03	286.03
		m3			
		PRE-DEVELOPMENT		POST-DEVELOPMENT	
				ADDITIONAL	
SITE AREA		m3	664	664	
IMPERMEABLE		m3	0	664	664
PERMEABLE		m3	664	0	-664
100 year +climate change (litres/s)					
RUN-OFF			1.03	18.93	17.89
100 year +climate change (m3)					
VOLUME			23.07	286.03	262.97
ADDITIONAL FLOW DUE TO NEW DEVELOPMENT		17.89 Litres / s			
ADDITIONAL VOLUME DUE TO NEW DEVELOPMENT		262.97 m3			
EXISTING PEAK DISCHARGE RATES=				1.03	100 year +cc
				0.64	30 year
				0.30	1 year

**Drainage Strategy Report for Proposed Car Park Extension to
Toyota Garage, Llay New Road, Wrexham, LL11 4BA**

Appendix 7

PROPOSED STORAGE

PROPOSED SITE



		DRAINAGE CALCULATION							
KANE DESIGN		30 year and 100 year STORAGE							
Civil Engineering Design Services 15 Winchester Way, Gresford Wrexham LL12 8HH Tel: 01 9788 855888		Project TOYOTA GARAGE LLAY NEW ROAD, WREXHAM LL11 4BA		Scheme number 1391 DATE 05-Sep-17 BY AK Sheet 1 of 2 checked					
NOTES									
Calculation Description		Proposed (post-development) PROPOSED STORAGE							
SURFACE WATER DESIGN:		MODIFIED RATIONAL METHOD							
		Refer to volume 4 The Wallingford Procedure (Vol 4)							
Site									
a	Site area (m2)	664	Calculated from drawing						
b	PIMP (%)	100.00%							
A	Site Impermeable Area (m2)	664							
M5-60 min rainfall		17	Figure A1		Vol4				
Ratio "r"		0.35	Figure A2		Vol4				
YEAR	Climate Change %	30	Table B2		PPS 25				
100 Permissible run-off		5.00 litres / s							
30 Permissible run-off		5.00 litres / s							
Rational Method		Q= Peak flow (=run-off) $Q = 2.78 \times C_v \times C_r \times A / 10000 \times i$ Equation 4 Vol 4 Where i = rainfall intensity Cr= 1.30 Cv= 0.75 From SUR calcuations Formula: $M5-D = Z1 \times M5-60$ $Rainfall\ intensity\ (i) = (M5-60) \times Z2 / Duration\ per\ hour$ $Storge = (run-off-permissible\ discharge) / duration$							
		100-YEAR STORM							
30 % Include climate change		BRE 365 table A1 =Z1	(M5-D) mins	Vol 4 inrerpolated table A1 =Z2	Storm Duration (mins)	Rainfall intensity (i) (mm/hr)	100 year Rainfall x 30%	Q Run-off (litres/s)	Storage Volume required (m3)
		0.617	10.489	1.93	15	80.98	105.27	18.93	12.53
		0.787	13.379	1.98	30	52.98	68.88	12.38	13.29
		0.894	15.198	2.00	45	40.53	52.69	9.47	12.07
		1.000	17.000	2.01	60	34.17	44.42	7.99	10.75
		1.111	18.887	2.03	90	25.56	33.23	5.97	5.26
		1.223	20.791	2.02	120	21.00	27.30	4.91	-0.66
100 year		1.360	23.120	2.01	180	15.49	20.14	3.62	-14.90
WORST CASE		1.497	25.449	2.00	240	12.72	16.54	2.97	-29.18
30.00 min storage value =		1.690	28.730	1.97	360	9.43	12.26	2.20	-60.38
13.29 m3		1.819	30.923	1.95	480	7.54	9.80	1.76	-93.26
		1.947	33.099	1.93	600	6.39	8.30	1.49	-126.25
		2.020	34.340	1.92	720	5.49	7.14	1.28	-160.53

KANE DESIGN

Civil Engineering Design Services

15 Winchester Way, Gresford

Wrexham LL12 8HH

Tel: 01 9788 855888

DRAINAGE CALCULATION**30 year and 100 year STORAGE**

Project

**TOYOTA GARAGE
LLAY NEW ROAD, WREXHAM
LL11 4BA**

Scheme number

1391

DATE 05-Sep-17

B'Y AK

Sheet 2 of 2

checked

Z2 = M30 (30 year)**30-YEAR STORM**

BRE 365 table A1 =Z1	(M5-D) mins	Vol 4 interpolated table A1 =Z2	Storm Duration (mins)	Rainfall intensity (i) (mm/hr)	Q Run-off (litres/s)	Storage Volume required (m3)
0.617	10.489	1.535	15	64.40	11.58	5.92
0.787	13.379	1.56	30	41.74	7.50	4.51
0.894	15.198	1.57	45	31.81	5.72	1.94
1.000	17.000	1.58	60	26.86	4.83	-0.62
1.111	18.887	1.575	90	19.83	3.57	-7.75
1.223	20.791	1.57	120	16.32	2.93	-14.87
1.360	23.120	1.56	180	12.02	2.16	-30.66
1.497	25.449	1.55	240	9.86	1.77	-46.47
1.690	28.730	1.525	360	7.30	1.31	-79.64
1.819	30.923	1.513	480	5.85	1.05	-113.72
1.947	33.099	1.50	600	4.96	0.89	-147.87
2.020	34.340	1.49	720	4.26	0.77	-182.88

30 year

WORST CASE15.00 Min storage value =
5.92 m3**STORAGE REQUIRED;**

30 year: 5.92 m3

To be contained in storage system

100 year: 13.29 m3

To be contained on site

Storage System: 100 year storm

Use Oversize pipes:

Totals

0.60 mm diameter

0.283 m3

18.00 m length

5.09 m3

Manhole Number	Diam(m)	Depth (m)	C.S.A.(m2)	Volume (m3)
S1	1.50	2.00	1.77	2.74
S2	2.10	2.05	3.47	5.54

TOTAL

13.38

Manhole Depths are [ground level less 450mm = underside of cover slab]

TOTAL STORAGE AVAILABLE=

13.38 m3

100 YEAR REQUIRED =

13.29 m3

**Drainage Strategy Report for Proposed Car Park Extension to
Toyota Garage, Llay New Road, Wrexham, LL11 4BA**

Appendix 8

**EXISTING GREENFIELD RUN-OFF
EXISTING SHOWROOMS**



		SURFACE WATER RUN-OFF: PRE AND POST DEVELOPMENT	
KANE DESIGN 15 Winchester Way, Gresford Wrexham LL12 8HH Tel: 01 9788 855888	Project	TOYOTA GARAGE -SHOWROOMS LLAY NEW ROAD, WREXHAM LL11 4BA	Scheme number 1391 DATE 05-Dec-18 Engineer A Kane Sheet 1 of 7
	EXISTING SHOWROOMS		
	DESIGN BRIEF The Code of Practise for Sustainable Urban Development requires the following information: Site pre-development surface water run-off rate Site pre-development surface water run-off volume Site post-development surface water run-off rate Site post-development surface water run-off volume The above are to be computed for storms up to 100 year return, 6 hour duration, and are to include a factor for climate change. The difference between pre-development and post development is to be calculated, DOCUMENTS USED: Code for Sustainable Homes: Technical Guide: May 2009 Version A Institute of Hydrology Report 124 (IH 124): Flood Assessment for Small Catchments: (1994) Institute of Hydrology Report: Flood Studies Supplementary Report FSSR 16 (1985) Wallingford Procedure (1993) CIRIA Report 697: THE SUDS Manual (2007) HMSO: Planning Policy Statement 25 (PPS25) FORMULA USED: Existing (Pre): Greenfield run-off rate Greenfield run-off volume: Brown Wallingford Procedure Post: Development run-off rate: (Green portion) Development run-off volume: Climate change: Page 2 Site specific details 3 A: Existing Surface Water run-off rate: Greenfield 4 B: Existing Surface Water run-off : Brown 4 C: Existing Surface Water run-off Volume : Brown 5 D: Existing Surface Water run-off Volume : Green 6 E: Post-development run-off rate 6 F: Post-development run-off Volume 7 Summary source IH124 FSSR16 FSSR 16 Run-off model: Fixed percentage run-off= PR rural Modified Rational Method W.P. W.P. UK run-off = PR urban Q = area v rate PPS25 Table B2 NOTES PIMP SOIL SAAR UCWI CWI Percentage Impermeable Area Soil type taken from Wallingford maps and FSR Report Standard Average Annual Rainfall from F.E.H CD for the catchment Urban Catchment Wetness Index (evaluated form Fig 9.7, Wallington Procedure) Catchment Wetness Index		

		SURFACE WATER RUN-OFF: PRE AND POST DEVELOPMENT	
KANE DESIGN 15 Winchester Way, Gresford Wrexham LL12 8HH Tel: 01 9788 855888		Scheme number 1391 Project TOYOTA GARAGE -SHOWROOMS LLAY NEW ROAD, WREXHAM LL11 4BA DATE 05-Dec-18 Engineer A Kane Sheet 2 of 7	
EXISTING SHOWROOMS			
SITE SPECIFIC DETAILS Location Postcode LL11 4BA		DRAWING REFERENCE: SITE PLAN SUPPLIED 4 February 2015 Construction of 16 residential property	
Site	EXISTING DETAILS Site area (m2) 4037 Calculated from drawing SHOWROOMS PIMP (%) 100.00 Greenfield Site Impermeable Area (m2) 4037 Greenfield Site permeable area 0 m2 PROPOSED: 4037 m2 100.00% Impermeable (developed) area		
Input data			
1.	Catchment Data [proportion of each soil type estimated from Site Investigation Report] <u>1a) Soil Data</u> WRAP : = Soil Winter Rainfall potential (FSSR 16) Prop S1 0 Prop S2 0 Prop S3 0.3 Prop S4 0.7 Prop S5 0 Soil type = [sum of soil = 0.15 S1 x 0.3 S2 x 0.4 S3 x 0.45 S4 x 0.5 S5 = 0.435 Soil Percentage Runoff (SPR) = 10 S1 x 30 S2 x 37 S3 x 47 S4 x 53 S5 = 44 <u>1 b) Remainder catchment of data</u> Region number 9 From CIRIA 696 SAAR 900 From FSSR rainfall maps CWI 125 From FSSR Figure A7.5 UCWI 108 From CIRIA 697 Figure 4.6 <u>1 c) rainfall data</u> M5-60 min rainfall 17 From FSSR rainfall maps Ratio "r" 0.35 From FSSR rainfall maps Climate Change % (C) 30 From PPS 25 Table B2 Storm duration for 15 Selected [for post development] peak run -off (min) Z1 1.69 From BRE 365 Table 1 [r = .35 duration =360 mins] M5 - 60 28.73 ,=Z1 x M5-60 Calculated = P1 year Z2 1.525 30 year Wallingford Vol 4 Table A1 Therefore M30 year 360 min 43.81 mm/hr ,=Z1 x M5-60 Calculated = P30 year Z2 1.97 100 year Wallingford Vol 4 Table A1 Therefore M100 year 360 min 56.60 mm/hr ,=Z1 x M5-60 Calculated = P100 year		

		SURFACE WATER RUN-OFF: PRE AND POST DEVELOPMENT																					
KANE DESIGN 15 Winchester Way, Gresford Wrexham LL12 8HH Tel: 01 9788 855888		Scheme number 1391 Project TOYOTA GARAGE -SHOWROOMS LLAY NEW ROAD, WREXHAM LL11 4BA DATE 05-Dec-18 Engineer A Kane Sheet 3 of 7																					
EXISTING SHOWROOMS																							
A: Calculation		NOTES Existing (pre-development) Surface Water run-off rate: GREENFIELD																					
Use :		Annual peak flow = $Q_{bar-rural} = 0.00108 Area [Km^2] ^{0.89} \times SAAR ^{1.17} \times SOIL ^{2.17}$																					
		m3 / sec																					
Area (m2)=		0																					
Growth Factors: Table 4.3 CIRIA 696 Region number 9		<table border="1"> <thead> <tr> <th>Return Period</th> <th>Growth</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>0.82</td> </tr> <tr> <td>30</td> <td>1.77</td> </tr> <tr> <td>100</td> <td>2.18</td> </tr> <tr> <td>Calculated</td> <td>2.834</td> </tr> </tbody> </table>	Return Period	Growth	1	0.82	30	1.77	100	2.18	Calculated	2.834											
Return Period	Growth																						
1	0.82																						
30	1.77																						
100	2.18																						
Calculated	2.834																						
Q bar-rural: =		0.2738 m3/s [Based on equation default 50 Ha: Max area for equation]																					
Q bar-rural: (Actual) =		0.00000 m3/s Ratio, Q/Qbar as FSSR 16																					
ESTIMATED GREENFIELD RUN-OFF:																							
<table border="1"> <thead> <tr> <th>Storm Return period (yr)</th> <th>1</th> <th>30</th> <th>100</th> <th>100+CC</th> </tr> </thead> <tbody> <tr> <td>Growth (from above)</td> <td>0.82</td> <td>1.77</td> <td>2.18</td> <td>2.83</td> </tr> <tr> <td>Peak run-off rate(m3</td> <td>0.00000</td> <td>0.00000</td> <td>0.00000</td> <td>0.00000</td> </tr> <tr> <td>(Litres/s)</td> <td>0.00</td> <td>0.00</td> <td>0.00</td> <td>0.00</td> </tr> </tbody> </table>				Storm Return period (yr)	1	30	100	100+CC	Growth (from above)	0.82	1.77	2.18	2.83	Peak run-off rate(m3	0.00000	0.00000	0.00000	0.00000	(Litres/s)	0.00	0.00	0.00	0.00
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(Litres/s)	0.00	0.00	0.00	0.00																			
(Q bar actual x growth)																							

		SURFACE WATER RUN-OFF: PRE AND POST DEVELOPMENT				
KANE DESIGN 15 Winchester Way, Gresford Wrexham LL12 8HH Tel: 01 9788 855888		Scheme number 1391 Project TOYOTA GARAGE -SHOWROOMS DATE 05-Dec-18 LLAY NEW ROAD, WREXHAM Engineer A Kane LL11 4BA Sheet 4 of 7				
EXISTING SHOWROOMS						
B: Calculation		Existing (pre-development) Surface Water run-off rate: BROWN PORTION OF SITE				
Use:		Modified Ration Method: $Q = 2.78C \times \text{Rainfall} \times \text{Area}$ Where $C = C_v (\text{PR urban}/100) \times C_r$				
PR (%) Impermeable area (PIMP)		100.00% from previous				
		4037.00				
Therefore $C_v =$		0.750 Recommended Wallingford value for impermeable				
$C_r =$		1.30 fixed equation value				
Rainfall intensity:		Wallingford Procedure: 15 min Storm: Wallingford Vol 4 Table A1				
Storm Return period (yr)		15 min	1	30	100	100+CC
Z1		0.617				
M5-D		10.489				
Z2			0.61	1.535	1.93	2.51
Rainfall intensity:			25.59	64.40	80.98	105.27
ESTIMATED BROWN POST-DEVELOPMENT RUN-OFF:						
Storm Return period (yr)		1	30	100	100+CC	
Rainfall intensity (15 mins)		25.59	64.40	80.98	105.27	
Run-off rate l/s		28.00	70.47	88.61	115.06	
(Peak Flow)		$Q = 2.78 C_v \times C_r \times \text{Rainfall intensity} \times \text{Area}$				
C: Calculation		Existing (pre-development) Surface Water run-off Volume: BROWN PORTION OF SITE				
Use:		Modified Ration Method: $Q = 2.78 C \times \text{Rainfall} \times \text{Area}$ Where $C = C_v (\text{PR}/100) \times C_r$ volume = $V = Q A$				
Storm Return period (years)		100	100+CC			
Z1				360 mins		
M5-D						
Z2			1.97			
Rainfall intensity: (mm/hr)			56.60	73.58		
Run-off rate, Q (litres / s)			61.93	80.51		
VOLUME V (m3)= Q/A: 360 mins		1337.72	1739.03			

SURFACE WATER RUN-OFF: PRE AND POST DEVELOPMENT	
KANE DESIGN 15 Winchester Way, Gresford Wrexham LL12 8HH Tel: 01 9788 855888	Scheme number 1391 Project TOYOTA GARAGE -SHOWROOMS DATE 05-Dec-18 LLAY NEW ROAD, WREXHAM LL11 4BA Engineer A Kane Sheet 5 of 7

EXISTING SHOWROOMS			
D: Calculation	Existing (pre-development) Surface Water run-off Volume: SITE GREENFIELD :		
Use:	FSSR16: Fixed Percentage Run-off Model	360 minute storm	100 year
Run-off Volume = PR X AREA [Km2] X Rainfall depth wh PR = Percentage run-off = SPR + DPRcwi +DPR rain Where D= Dynamic contribution and DPRcwi = 0.25 x (CWI-125) DPR rain = 0.45 x (P-40)^0.7 Where P is greater than 40 SPR = 0 DPRcwi = 0 DPR rain = 0.000 Therefore PR = 0.00000000000000			
Peak Run-off Volume (m3)		0.00	
With climate change		0.00	

SURFACE WATER RUN-OFF: PRE AND POST DEVELOPMENT																																										
KANE DESIGN 15 Winchester Way, Gresford Wrexham LL12 8HH Tel: 01 9788 855888	Scheme number 1391 Project TOYOTA GARAGE -SHOWROOMS LLAY NEW ROAD, WREXHAM LL11 4BA DATE 05-Dec-18 Engineer A Kane Sheet 6 of 7																																									
EXISTING SHOWROOMS																																										
E: Calculation Use: Modified Ration Method: $Q = 2.78C \times \text{Rainfall} \times \text{Area}$ Where $C = C_v (\text{PR}/100) \times C_r$ Where PR urban = (%) percentage run-off area = $=0.829 \text{ PIMP} + 25\text{SOIL} + 0.078 \text{ UCWI} - 20.7$ [Fixed Wallingford Procedure] USES WHOLE CATCHMENT DATE (GREEN/BROWN)	Post development Surface Water run-off RATE: PR (%) Impermeable area (PIMP) 100.00% from previous (or use 'min PIMP 40%') PR urban = Therefore $C_v =$ 0.750 $C_r =$ 1.30 fixed equation value Rainfall intensity: Wallingford Procedure: 15 min Storm: Wallingford Vol 4 Table A1 Storm Return period (yr) <table border="1"> <thead> <tr> <th>15 min</th> <th>1</th> <th>30</th> <th>100</th> <th>100+CC</th> </tr> </thead> <tbody> <tr> <td>Z1</td> <td>0.617</td> <td></td> <td></td> <td></td> </tr> <tr> <td>M5-D</td> <td>10.489</td> <td></td> <td></td> <td></td> </tr> <tr> <td>Z2</td> <td></td> <td>0.61</td> <td>1.535</td> <td>1.93</td> <td>2.51</td> </tr> <tr> <td>Rainfall intensity:</td> <td>25.59</td> <td>64.40</td> <td>80.98</td> <td>105.27</td> <td></td> </tr> </tbody> </table> ESTIMATED POST-DEVELOPMENT RUN-OFF: Storm Return period (years) <table border="1"> <thead> <tr> <th>1</th> <th>30</th> <th>100</th> <th>100+CC</th> </tr> </thead> <tbody> <tr> <td>Rainfall intensity (15 mins)</td> <td>25.59</td> <td>64.40</td> <td>80.98</td> <td>105.27</td> </tr> <tr> <td>Run-off rate l/s</td> <td>27.97</td> <td>70.39</td> <td>88.51</td> <td>115.06</td> </tr> </tbody> </table> (Peak Flow) $Q = 2.78 C_v \times C_r \times \text{Rainfall intensity} \times \text{Area}$	15 min	1	30	100	100+CC	Z1	0.617				M5-D	10.489				Z2		0.61	1.535	1.93	2.51	Rainfall intensity:	25.59	64.40	80.98	105.27		1	30	100	100+CC	Rainfall intensity (15 mins)	25.59	64.40	80.98	105.27	Run-off rate l/s	27.97	70.39	88.51	115.06
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F: Calculation Use: Modified Ration Method: $Q = 2.78 C \times \text{Rainfall} \times \text{Area}$ Where $C = C_v (\text{PR}/100) \times C_r$ volume = $V = Q A$	Post development Surface Water run-off VOLUME: 360min storm Storm Return period (years) <table border="1"> <thead> <tr> <th>1</th> <th>30</th> <th>100</th> <th>100+CC</th> </tr> </thead> <tbody> <tr> <td>Z1</td> <td></td> <td></td> <td>360 mins</td> </tr> <tr> <td>M5-D</td> <td></td> <td></td> <td></td> </tr> <tr> <td>Z2</td> <td></td> <td>1.97</td> <td></td> </tr> <tr> <td>Rainfall intensity: (mm/hr)</td> <td></td> <td>56.60</td> <td>73.58</td> </tr> <tr> <td>Run-off rate, Q (litres / s)</td> <td></td> <td>61.93</td> <td>80.51</td> </tr> </tbody> </table> VOLUME V (m3)= $Q/A: 360 \text{ mins}$ 1337.72 1739.03 Post development run-off volume	1	30	100	100+CC	Z1			360 mins	M5-D				Z2		1.97		Rainfall intensity: (mm/hr)		56.60	73.58	Run-off rate, Q (litres / s)		61.93	80.51																	
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		SURFACE WATER RUN-OFF: PRE AND POST DEVELOPMENT					
KANE DESIGN 15 Winchester Way, Gresford Wrexham LL12 8HH Tel: 01 9788 855888		Project		TOYOTA GARAGE -SHOWROOMS LLAY NEW ROAD, WREXHAM LL11 4BA		Scheme number 1391 DATE 05-Dec-18 Engineer A Kane Sheet 7 of 7	
EXISTING SHOWROOMS							
SUMMARY: SURFACE WATER							
RUN-OFF		PRE-DEVELOPMENT					
		Storm Return	1	30	100 100+CC		
A	GREENFIELD		0.000	0.00	0.00	0.00	
B	BROWN		28.00	70.47	88.61	115.06	
TOTAL			28.00	70.47	88.61	115.06 LITRES /S	
VOLUME							
				100 100+CC	360 min		
C	GREENFIELD			0.00	0.00		
D	BROWN			1337.72	1739.03		
TOTAL				1337.72	1739.03	m3	
RUN-OFF		POST DEVELOPMENT					
		Storm Return	1	30	100 100+CC		
E			27.97	70.39	88.51	115.06 LITRES /S	
VOLUME							
				100 100+CC	360 min		
F				1337.72	1739.03	m3	
		PRE-DEVELOPMENT		POST-DEVELOPMENT		ADDITIONAL	
SITE AREA	m3	4037		4037			
IMPERMEABLE	m3	4037		4037		0	
PERMEABLE	m3	0		0		0	
100 year +climate change (litres/s)							
RUN-OFF		115.06		115.06		0.00	
100 year +climate change (m3)							
VOLUME		1739.03		1739.03		0.00	
ADDITIONAL FLOW DUE TO NEW DEVELOPMENT				0.00 Litres / s			
ADDITIONAL VOLUME DUE TO NEW DEVELOPMENT				0.00 m3			
EXISTING PEAK DISCHARGE RATES=				115.06 100 year +cc			
				70.47 30 year			
				28.00 1 year			