

		SURFACE WATER RUN-OFF: PRE AND POST DEVELOPMENT																																													
KANE DESIGN 15 Winchester Way, Gresford Wrexham LL12 8HH Tel: 01 9788 855888	Project	PLAS POWER ESTATE COEDPOETH	Scheme number 1292 DATE 17-Feb-16 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)																																														
FORMULA USED:	<table border="0"> <tr> <td>Existing (Pre):</td> <td>Greenfield run-off rate</td> <td><u>source</u></td> <td></td> </tr> <tr> <td></td> <td></td> <td>IH124</td> <td>Annual peak flow=Qbar-rural</td> </tr> <tr> <td></td> <td></td> <td>FSSR16</td> <td>Ratio Q/Qbar-rural</td> </tr> <tr> <td></td> <td>Greenfield run-off volume:</td> <td>FSSR 16 Run-off model:</td> <td></td> </tr> <tr> <td></td> <td></td> <td>Fixed percentage run-off= PR rural</td> <td></td> </tr> <tr> <td></td> <td>Brown Wallingford Procedure</td> <td>Modified Rational Method</td> <td></td> </tr> <tr> <td>Post:</td> <td>Development run-off rate:</td> <td>W.P.</td> <td>Modified Rational Method</td> </tr> <tr> <td></td> <td>(Green portion)</td> <td>W.P.</td> <td>Fixed Wallingford Procedure</td> </tr> <tr> <td></td> <td></td> <td></td> <td>UK run-off = PR urban</td> </tr> <tr> <td></td> <td>Development run-off volume:</td> <td></td> <td>Q = area v rate</td> </tr> <tr> <td>Climate change:</td> <td></td> <td>PPS25</td> <td>Table B2</td> </tr> </table>			Existing (Pre):	Greenfield run-off rate	<u>source</u>				IH124	Annual peak flow=Qbar-rural			FSSR16	Ratio Q/Qbar-rural		Greenfield run-off volume:	FSSR 16 Run-off model:				Fixed percentage run-off= PR rural			Brown Wallingford Procedure	Modified Rational Method		Post:	Development run-off rate:	W.P.	Modified Rational Method		(Green portion)	W.P.	Fixed Wallingford Procedure				UK run-off = PR urban		Development run-off volume:		Q = area v rate	Climate change:		PPS25	Table B2
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CALCULATION INDEX:	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																																													
NOTES																																															
PIMP	Percentage Impermeable Area																																														
SOIL	Soil type taken from Wallingford maps and FSR Report																																														
SAAR	Standard Average Annual Rainfall from F.E.H CD for the catchment																																														
UCWI	Urban Catchment Wetness Index (evaluated form Fig 9.7, Wallington Procedure)																																														
CWI	Catchment Wetness Index																																														

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SITE SPECIFIC DETAILS		DRAWING REFERENCE: SITE PLAN SUPPLIED 4 February 2015 Construction of 16 residential property	
Location Postcode CH7 3PJ			
Site	EXISTING DETAILS		
Site area (m2)	22432 Calculated from drawing		
PIMP (%)	28.65 Greenfield		
Site Impermeable Area (m2)	6426 Greenfield		
Site permeable area	16006 m2		
PROPOSED:		2586.5 m2	11.53% 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 peak run -off (min)	15	Selected [for post development]
	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

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A: Calculation		NOTES 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)= 16006																							
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											
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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) = 0.00877 m3/s		Ratio, Q/Qbar as FSSR 16																					
ESTIMATED GREENFIELD RUN-OFF:																							
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NOTES						
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)	28.65% from previous 6426.00				
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	1.52	1.93	2.51
Rainfall intensity:			25.59	63.77	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	63.77	80.98	105.27	
Run-off rate l/s		44.58	111.08	141.04	183.35	
(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 = $V = Q \times A$				
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)		98.58 128.15				
VOLUME V (m3)= Q/A: 360 mins		2129.34 2768.15				

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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 $DPRcwi = 0.25 \times (CWI-125)$ $DPR\ rain = 0.45 \times (P-40)^{0.7}$ Where P is greater than 40							
	SPR =	44					
	DPRcwi =	0					
	DPR rain =	3.216					
	Therefore PR =	47.216					
<table border="1"> <tr> <td>Peak Run-off Volume (m3)</td> <td>599.45</td> </tr> <tr> <td>With climate change</td> <td>779.29</td> </tr> </table>				Peak Run-off Volume (m3)	599.45	With climate change	779.29
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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 $C = C_v (\text{PR}/100) \times C_r$ 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) PR (%) Impermeable area (PIMP) 11.53% from previous (or use 'min PIMP 40%') PR urban = 8.16 Therefore $C_v =$ 0.082 $C_r =$ 1.30 fixed equation value Rainfall intensity: Wallingford Procedure: 15 min Storm: Wallingford Vol 4 Table A1 <table> <tr> <th>Storm Return period (y)</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 POST-DEVELOPMENT RUN-OFF: <table> <tr> <th>Storm Return period (years)</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>16.93</td> <td>42.59</td> <td>53.55</td> <td>69.62</td> </tr> </table> (Peak Flow) $Q = 2.78 C_v \times C_r \times \text{Rainfall intensity} \times \text{Area}$		Storm Return period (y)	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	16.93	42.59	53.55	69.62
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SUMMARY: SURFACE WATER						
RUN-OFF		PRE-DEVELOPMENT				
		Storm Return	1	30	100	100+CC
A	GREENFIELD		7.188	15.52	19.11	24.84
B	BROWN		44.58	111.08	141.04	183.35
		TOTAL	51.77	126.59	160.15	208.19
						LITRES /S
VOLUME					100	100+CC
						360 min
C	GREENFIELD				599.45	779.29
D	BROWN				2129.34	2768.15
		TOTAL			2728.80	3547.43
						m3
RUN-OFF		POST DEVELOPMENT				
		Storm Return	1	30	100	100+CC
E			16.93	42.59	53.55	69.62
						LITRES /S
VOLUME					100	100+CC
						360 min
F					808.50	1051.05
						m3
			PRE-DEVELOPMENT	POST-DEVELOPMENT		ADDITIONAL
SITE AREA	m3		22432	22432		
IMPERMEABLE	m3		6426	2586.5		-3839.5
PERMEABLE	m3		16006	19845.5		3839.5
100 year +climate change (litres/s)						
RUN-OFF			208.19	69.62		-138.58
100 year +climate change (m3)						
VOLUME			3547.43	1051.05		-2496.39
ADDITIONAL FLOW DUE TO NEW DEVELOPMENT				-138.58 Litres / s		
ADDITIONAL VOLUME DUE TO NEW DEVELOPMENT				-2496.39 m3		
EXISTING PEAK DISCHARGE RATES=				208.19 100 year +cc		
				126.59 30 year		
				51.77 1 year		