Calculations

AECOM

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Introduction	These calculations have been undertaken to estimate the existing peak runoff rates from the development sites considered within the Level 2 Strategic Flood Risk Assessment. Target peak runoff rates have then been provided based on national and regional planning policy requirements and best practice guidance. The calculations presented herein have been undertaken in accordance with the methods and recommendations set out in Chapter 24 of the SuDS Manual (CIRIA C753, 2015).	

Selection of Runoff Estimation Method	There are several methods that can be used for estimating peak runoff rates, these can broadly be separated into the following two categories:
	
	    a) Methods for estimating runoff from greenfield sites; and,
	
	    b) Methods for estimating runoff from previously developed sites.
	
	Table 24.1 of the SuDS Manual provides a summary of the methods available and details of when they should be utilised. For these calculations, the Institute of Hydrology 124 (IH124) runoff estimation method (Marshall and Bayliss, 1994) has been used incorporating recommendations within Section 24.5 of the SuDS Manual for using this method for previously developed sites.	

IH124 Methodology	The flood frequency (flows for different return period events) estimation procedure consists of three stages:
	
	    1) Estimate the Q_{BAR} (mean annual flood);
	
	    2) Select an appropriate growth curve; and,
	
	    3) Evaluate the full flood frequency curve.	

1) Estimate the Q_{BAR} (mean annual flood):

The IH124 equation for Q_{BAR} is given in Equation 24.3 of the SuDS Manual (CIRIA C753, 2015).

EQ. 24.3   IH124: Catchment descriptor equation

$$Q_{BAR(rural)} = 0.00108\ AREA^{0.89} \times SAAR^{1.17} \times SOIL^{2.17}$$

where:

$Q_{BAR(rural)}$ = mean annual flood (a return period in the region of 2.3 years)

$AREA$ = area of the catchment in km²

$SAAR$ = Standard Average Annual Rainfall for the period 1941–1970 in mm

$SOIL$ = soil index, which is a value found from the FSR soil maps or the WRAP map of the Wallingford procedure, and represents an estimate of the proportion of runoff from the catchment surface*

Where the site is less than 50 ha, the formula should be applied for 50 ha and the result factored based on the ratio of the actual site area and the applied area (50 ha).

The input parameters for Equation 24.3 have been attained from the following sources / methods:

AREA - All of the sites assessed are less than 50 hectares in size therefore a value of 0.5km² (50ha) has been used for AREA and the Q_{BAR} value has been linearly factored for the site area.

Cont.

SAAR - Standard Average Annual Rainfall - This value for each of the development sites has been attained from the maps within the MicroDrainage Source Control software.

SOIL - In accordance with the recommendations in Section 24.5 of the SuDS Manual; for previously developed sites the SOIL value for Flood Studies Report (FSR) Soil Type 5 has been used. Soil Type 5 refers to soil with a very low permeability such as solid rock and is therefore an appropriate representation of previously developed land. The value used within these calculations from the FSR (NERC, 1975) is 0.53.

2) Select an appropriate growth curve

QBAR can be factored by the UK FSR growth curves (NERC, 1997) for return periods less than 2 years and NERC (1993) for all other return periods to obtain peak flow estimates for required return periods.

These regional growth curves are constant throughout a region and are given in Table 24.2 of the SuDS Manual.

TABLE 24.2   UK and Ireland growth curve factors (after NERC, 1993)

Hydrometric area	Return period								
	1^1	2	5	10	25	30^2	50	100	500
1	0.85	0.90	1.20	1.45	1.81	1.99	2.12	2.48	3.25
2	0.87	0.91	1.11	1.42	1.81	1.99	2.17	2.63	3.45
3	0.86	0.94	1.25	1.45	1.70	1.75	1.90	2.08	2.73
9	0.88	0.93	1.21	1.42	1.71	1.80	1.94	2.18	2.86
10	0.87	0.93	1.19	1.38	1.64	1.70	1.85	2.08	2.73
4	0.83	0.89	1.23	1.49	1.87	1.99	2.20	2.57	3.62
5	0.87	0.89	1.29	1.65	2.25	2.55	2.83	3.56	5.02
6/7	0.85	0.88	1.28	1.62	2.14	2.40	2.62	3.19	4.49
8	0.78	0.88	1.23	1.49	1.84	1.98	2.12	2.42	3.41
Ireland	0.83^2	0.95	1.20	1.37	1.60	1.65	1.77	1.96	2.40

3) Evaluate the full flood frequency curve

The peak flow rates for each return period can then be estimated as the product of Q_{BAR} and the relevant growth factor.

The SuDS Manual and the Non-Statutory Technical Standards for SuDS (Defra, 2015) recommend that the rate of runoff does not increase following development for the 1 in 1 year and 1 in 100 year events. The existing peak runoff rates from the development sites have been estimated for QBAR, Q(1), Q(30) and Q(100).

Target Post Development Runoff Rates

Greenfield Runoff Rates:

In accordance with the SuDS Manual, the peak greenfield runoff rate for each development site has been estimated as 2 litres per second per hectare.

London Plan :

The London Plan has a policy requirement that all development "aims to achieve greenfield run-off rates" to ensure that runoff from development sites is reduced as much as possible. In meeting this policy requirement, the Sustainable design and Construction Supporting Planning Guidance (2014) document provides further detail and guidance on managing runoff. It states that there is a minimum expectation to deliver 50% attenuation of a site's (prior to re-development) surface water runoff at peak times. It also states that "on previously developed sites, runoff rates should not be more than three times the calculated greenfield rate".

Minimum Realistic Design Discharge Rate

Where target post development runoff rates have been calculated to be less than 5 litres per second, a value of 5 litres per second has been specified as it is widely considered unrealistic to design drainage systems which discharge at rates lower than this without risk of frequent blockage.

Site ID	Site Name	Site Area	SOIL	SAAR	Institute of Hydrology 124 Method				Greenfield (2 l/s/ha)	Sustainable Design and Construction SPG target	
					QBAR (IH124)	Q(1)	Q(30)	Q(100)		50% Q(1)	50% Q(100)
(-)	(-)	(m2)	(-)	(mm)	(l/s)	(l/s)	(l/s)	(l/s)	(l/s)	(l/s)	(l/s)
16	Heath Clark, Stafford Road	35,613	0.53	693	22.1	18.7	52.9	70.4	7.1	9.4	35.2
25	Morrisons Supermarket, 500 Purley Way	37,455	0.53	693	23.2	19.7	55.7	74.0	7.5	9.9	37.0
30	Purley Leisure Centre, car park and former Sainsbury's Supermarket, High Street	6,555	0.53	742	4.4	3.7	10.6	14.0	5.0	5.0	7.0
31	Croydon College car park, College Road	1,383	0.53	682	0.8	0.7	2.0	2.7	5.0	5.0	5.0
35	Purley Baptist Church, 2-12 Banstead Road	4,279	0.53	740	2.9	2.4	6.9	9.1	5.0	5.0	5.0
48	294-330 Purley Way	26,275	0.53	681	15.9	13.6	38.3	50.9	5.3	6.8	25.4
54	BMW House, 375-401 Brighton Road	5,829	0.53	706	3.7	3.1	8.9	11.8	5.0	5.0	5.9
115	Cheriton House, 20 Chipstead Avenue	1,729	0.53	652	1.0	0.8	2.4	3.2	5.0	5.0	5.0
123	Prospect West and car park to the rear of, 81-85 Station Road	6,035	0.53	673	3.6	3.1	8.7	11.5	5.0	5.0	5.8
162	St George's House, Park Lane	2,960	0.53	681	1.8	1.5	4.3	5.7	5.0	5.0	5.0
174	30-38 Addiscombe Road	3,505	0.53	682	2.1	1.8	5.1	6.8	5.0	5.0	5.0
190	Car park to the rear of Leon House, 22-24 Edridge Road	3,994	0.53	684	2.4	2.1	5.8	7.8	5.0	5.0	5.0
194	St George's Walk, Katharine House and Park House, Park Street	18,269	0.53	681	11.1	9.4	26.6	35.4	5.0	5.0	17.7
195	Leon House, 233 High Street	5,573	0.53	684	3.4	2.9	8.2	10.8	5.0	5.0	5.4
201	Lidl, Easy Gym and car park, 99-101 London Road	11,554	0.53	671	6.9	5.9	16.5	22.0	5.0	5.0	11.0
203	West Croydon station and shops, 176 North End	18,605	0.53	674	11.2	9.5	26.8	35.6	5.0	5.0	17.8
236	Apollo House, Wellesley Road	5,713	0.53	677	3.4	2.9	8.3	11.0	5.0	5.0	5.5
294	Croydon College Annexe, Barclay Road	3,199	0.53	682	1.9	1.7	4.7	6.2	5.0	5.0	5.0
314	Valley Park (B&Q and Units A-G Daniell Way), Hesterman Way	141,781	0.53	666	83.8	71.3	201.2	267.4	28.4	35.6	133.7
320	S G Smith, 409-411 Beulah Hill	2,888	0.53	631	1.6	1.4	3.8	5.1	5.0	5.0	5.0
324	Additional Site - Gypsy traveller site	9,445	0.53	728	6.2	5.3	14.9	19.8	5.0	5.0	9.9
325	Telephone Exchange, 88-90 Brighton Road	3,346	0.53	745	2.3	1.9	5.4	7.2	5.0	5.0	5.0
326	Ambassador House, 3-17 Brigstock Road	3,664	0.53	654	2.1	1.8	5.1	6.8	5.0	5.0	5.0
332	Superstores, Drury Crescent	14,516	0.53	677	8.7	7.4	21.0	27.9	5.0	5.0	14.0
334	Valley Leisure Park, Hesterman Way	24,168	0.53	668	14.3	12.2	34.4	45.7	5.0	6.1	22.9
337	Zodiac Court, 161-183 London Road	6,836	0.53	669	4.1	3.5	9.7	13.0	5.0	5.0	6.5
347	Tesco, 2 Purley Road	37,977	0.53	745	25.6	21.8	61.4	81.6	7.6	10.9	40.8
350	Wing Yip, 544 Purley Way	15,528	0.53	699	9.7	8.2	23.3	31.0	5.0	5.0	15.5
351	Furniture Village, 222 Purley Way	6,848	0.53	672	4.1	3.5	9.8	13.1	5.0	5.0	6.5
355	Sainsbury Supermarket, 2 Trafaglar Way	12,930	0.53	672	7.7	6.6	18.5	24.6	5.0	5.0	12.3
374	Reeves Corner former buildings, 104-112 Church Street	767	0.53	677	0.5	0.4	1.1	1.5	5.0	5.0	5.0
375	7 Cairo New Road	2,357	0.53	676	1.4	1.2	3.4	4.5	5.0	5.0	5.0
393	Whitgift Centre, North End	69,773	0.53	679	42.2	35.9	101.3	134.6	14.0	17.9	67.3
396	Praise House, 145-149 London Road	2,468	0.53	670	1.5	1.2	3.5	4.7	5.0	5.0	5.0
398	Coombe Cross, 2-4 South End	2,568	0.53	685	1.6	1.3	3.8	5.0	5.0	5.0	5.0
403	Roman House, 13-27 Grant Road	5,572	0.53	680	3.4	2.9	8.1	10.8	5.0	5.0	5.4
405	Capella Court & Royal Oak Centre, 725 Brighton Road	7,329	0.53	729	4.8	4.1	11.6	15.4	5.0	5.0	7.7
409	Beech House, 840 Brighton Road	1,323	0.53	739	0.9	0.8	2.1	2.8	5.0	5.0	5.0
411	Palmerston House, 814 Brighton Road	711	0.53	739	0.5	0.4	1.1	1.5	5.0	5.0	5.0
416	Challenge House, 618 Mitcham Road	8,055	0.53	651	4.6	3.9	11.1	14.8	5.0	5.0	7.4
420	87-91 Biggin Hill	2,970	0.53	635	1.7	1.4	4.0	5.3	5.0	5.0	5.0
430	Grafton Quarter, Grafton Road	6,112	0.53	672	3.7	3.1	8.8	11.6	5.0	5.0	5.8
490	95-111 Brighton Road	8,236	0.53	749	5.6	4.7	13.4	17.8	5.0	5.0	8.9
495	Dairy Crest dairy, 823-825 Brighton Road	3,374	0.53	732	2.2	1.9	5.3	7.1	5.0	5.0	5.0
499	Croydon University Hospital Site, London Road	81,935	0.53	660	47.9	40.7	115.0	152.9	16.4	20.4	76.5
504	Stroud Green Pumping Station, 140 Primrose Lane	7,212	0.53	693	4.5	3.8	10.7	14.2	5.0	5.0	7.1
517	Milton House, 2-36 Milton Avenue	7,900	0.53	673	4.7	4.0	11.4	15.1	5.0	5.0	7.5
522	Surface car park, Wandle Road	6,512	0.53	682	4.0	3.4	9.5	12.6	5.0	5.0	6.3
636	Land west of Timebridge Community Centre, Lodge Lane	74,256	0.53	736	49.3	41.9	118.4	157.3	14.9	21.0	78.7
662	Coombe Road Playing Fields, Coombe Road	107,722	0.53	700	67.5	57.4	162.0	215.3	21.5	28.7	107.7
683	Purley Back Lanes, 16-28 Pampisford Road	6,228	0.53	739	4.2	3.5	10.0	13.3	5.0	5.0	6.6
764	Land to the east of Portnalls Road, Portnalls Road	67,955	0.53	774	47.9	40.7	114.9	152.7	13.6	20.3	76.3
945	Waitrose, 110-112 Brighton Road	2,696	0.53	761	1.9	1.6	4.5	5.9	5.0	5.0	5.0
946	Stubbs Mead Depot, Factory Lane	27,080	0.53	674	16.2	13.8	38.9	51.8	5.4	6.9	25.9
DM31.4_1	Setting of the Sanderstead Local Centre	49,521	0.53	773	34.9	29.6	83.7	111.2	9.9	14.8	55.6
DM31.4_2	Setting of the Sanderstead Local Centre	68,438	0.53	762	47.4	40.3	113.7	151.1	13.7	20.1	75.5
DM31.4_3	Setting of the Sanderstead Local Centre	31,172	0.53	759	21.5	18.3	51.6	68.5	6.2	9.1	34.3
DM31.4_4	Around Forestdale Neighbourhood Centre	136,995	0.53	740	91.6	77.9	219.9	292.2	27.4	38.9	146.1
DM31.4_5	Settings of Shirley Local Centre and Shirley Road Neighbourhood Centre	201,742	0.53	701	126.6	107.6	303.8	403.8	40.3	53.8	201.9
DM31.4_6	Brighton Road (Sanderstead Road) Local Centre with its setting	220,688	0.53	720	142.9	121.4	342.9	455.7	44.1	60.7	227.9
DM31.4_7	Area around Kenley station	169,071	0.53	783	120.7	102.6	289.8	385.2	33.8	51.3	192.6
DM31.4_8	Settings of Shirley Local Centre and Shirley Road Neighbourhood Centre	86,004	0.53	703	54.2	46.0	130.0	172.8	17.2	23.0	86.4