

Appendix F



F Indicative surface water flood risk from proposed development

F.1 Introduction

Surface water runoff should be fully attenuated to the greenfield runoff rate for greenfield sites, and as such, ensure that there is no increase in surface water flood risk elsewhere. For brownfield sites, a betterment of at least 30% on the existing brownfield runoff rate should be considered though runoff should be as close as is reasonably practical to the greenfield runoff rate. This ensures a reduction in surface water flood risk elsewhere. An estimate of the required volumes of attenuation have been calculated for each site.

For the purposes of this assessment, the required volumes of surface water attenuation have been calculated below, based on an assumed 85% impermeable area and limiting runoff rate of Q_{bar} (l/s) for all sites. Q_{bar} is the mean annual maximum (peak) flow rate from a catchment. It acts similar to Q_{med} and is used to derive limits to permissible flow rates from developments. The limiting runoff rate of Q_{bar} (l/s) has been selected to follow the 'Surface Water Drainage, Flood Risk Management and Watercourses: Planning Advisory Note (PAN)' produced by Lancaster City Council in May 2015¹ in which it states:

"Discharge to a watercourse or surface water sewer must be restricted to the estimated mean Greenfield runoff rate (Q_{bar}) by means of a controlled outflow (or restricted to a betterment of existing runoff rates for brownfield sites)..."

...attenuation MUST be provided, and calculated for the restricted runoff, for flood events up to an including the 1 in 100 year (+30% allowance for climate change) critical storm. Considering only impermeable areas can mean that runoff from permeable areas when the ground is saturated can cause a system to have insufficient capacity".

Q_{bar} also provides an upper estimate of attenuation requirements for brownfield sites. As part of the calculation process, specific calculations have been included to provide an estimated land take if a pond with an assumed depth of 1.5 metres was included as part of the development. These areas provide an indication of required land take for SuDS measures prior to site allocation to ensure that an attenuation basin, or other surface SuDS can be incorporated into the future development layout. Application of the central (20%) and upper band (40%) potential change anticipated for climate change in the tables below shows the estimated attenuation volumes for the 1% AEP and 3.33% AEP rainfall events.

It is difficult to define sites where betterment in offsite flows could be achieved without knowing ground and flow conditions (e.g. brownfield, contamination) or aspirations for development. Whilst intercepting overland flow is possible, developers should seek to manage flows and ensure that impacts are not increase as a result of development. In certain circumstances the volume of offsite surface water flowing through part of the development site can be significant, expecting the developer to attenuate these volumes would be a disproportionate response. For previously developed sites, C753 The SuDS Manual suggests that a betterment of at least 30% should be considered as a minimum requirement (subject to LLFA confirmation).

¹ <https://silo.tips/download/surface-water-drainage-flood-risk-management-and-watercourses>

F.2 Attenuation tables

F.2.1 DOS1 – Land at Bulk Road and Lawson’s Quay, Central Lancaster

Proposed Development limiting runoff rate: Greenfield – FEH Statistical		Qbar: 6 l/s Q30: 11 l/s Q100: 13 l/s				
Design flood event (inc CC)	Critical storm duration (Hrs)	Inflow volume (m ³)	Outflow volume (m ³)	Attenuation required (m ³)	Time to empty assuming no infiltration (Hrs)	Total storage required: Area (ha) and % of site area
3.33% AEP Rainfall +20%	12	1086	194	892	55.1	0.059 ha 3.604 %
3.33% AEP Rainfall +40%	12	1267	194	1073	66.3	0.072 ha 4.335 %
1% AEP Rainfall +20%	12*	1427	194	1233 (341 exceedance storage)	76.1	0.082 ha 4.982 %
1% AEP Rainfall +40%	12*	1665	194	1471 (398 exceedance storage)	90.8	0.098 ha 5.943 %
*limited to a 12 hr critical storm						

Site DOS1 is a brownfield site hence the proposed discharge rate should provide a betterment on the existing brownfield runoff rate. Typically, a betterment of at least 30% should be considered as a minimum requirement though runoff should be as close as is reasonably practical to the greenfield runoff rate.

F.2.2 DOS2 – Lune Industrial Estate, Luneside

Proposed Development limiting runoff rate: Greenfield – FEH Statistical		Qbar: 68 l/s Q30: 115 l/s Q100: 141 l/s				
Design flood event (inc CC)	Critical storm duration (Hrs)	Inflow volume (m ³)	Outflow volume (m ³)	Attenuation required (m ³)	Time to empty assuming no infiltration (Hrs)	Total storage required: Area (ha) and % of site area
3.33% AEP Rainfall +20%	12	13419	2043	11376	66.6	0.758 ha 3.624 %
3.33% AEP Rainfall +40%	12	15656	2043	13613	79.7	0.908 ha 4.336 %
1% AEP Rainfall +20%	12*	17671	2043	15628 (4252 exceedance storage)	91.5	1.042 ha 4.978 %
1% AEP Rainfall +40%	12*	20616	2043	18573 (4960 exceedance storage)	108.8	1.238 ha 5.916 %
*limited to a 12 hr critical storm						

Site DOS2 is a brownfield site hence the proposed discharge rate should provide a betterment on the existing brownfield runoff rate. Typically, a betterment of at least 30% should be considered as a minimum requirement though runoff should be as close as is reasonably practical to the greenfield runoff rate.

F.2.3 DOS4 – Galgate Mill

Proposed Development limiting runoff rate: Greenfield – FEH Statistical		Qbar: 5 l/s Q30: 9 l/s Q100: 11 l/s				
Design flood event (inc CC)	Critical storm duration (Hrs)	Inflow volume (m ³)	Outflow volume (m ³)	Attenuation required (m ³)	Time to empty assuming no infiltration (Hrs)	Total storage required: Area (ha) and % of site area
3.33% AEP Rainfall +20%	7	379	91	288	22.2	0.019 ha 3.048 %
3.33% AEP Rainfall +40%	7.75	453	100	352	27.1	0.023 ha 3.725 %
1% AEP Rainfall +20%	7.75	510	100	409 (121 exceedance storage)	31.5	0.027 ha 4.328 %
1% AEP Rainfall +40%	8.75	608	113	495 (143 exceedance storage)	38.1	0.033 ha 5.238 %

Site DOS4 is a brownfield site hence the proposed discharge rate should provide a betterment on the existing brownfield runoff rate. Typically, a betterment of at least 30% should be considered as a minimum requirement though runoff should be as close as is reasonably practical to the greenfield runoff rate.

F.2.4 DOS5 – Middleton Towers, Carr Lane

Proposed Development limiting runoff rate: Greenfield – FEH Statistical		Qbar: 39 l/s Q30: 66 l/s Q100: 81 l/s				
Design flood event (inc CC)	Critical storm duration (Hrs)	Inflow volume (m ³)	Outflow volume (m ³)	Attenuation required (m ³)	Time to empty assuming no infiltration (Hrs)	Total storage required: Area (ha) and % of site area
3.33% AEP Rainfall +20%	12	12399	1171	11227	114.7	0.748 ha 3.827 %
3.33% AEP Rainfall +40%	12	14465	1171	13294	135.8	0.886 ha 4.531 %
1% AEP Rainfall +20%	12*	16295	1171	15124 (3897 exceedance storage)	154.5	1.008 ha 5.155 %
1% AEP Rainfall +40%	12*	19011	1171	17839 (4545 exceedance storage)	182.2	1.189 ha 6.080 %
*limited to a 12 hr critical storm						

Site DOS5 contains greenfield and brownfield areas. For greenfield areas, greenfield discharge rates apply and post-development runoff should be comparable to that of the undeveloped area. For brownfield areas, a betterment of at least 30% on the existing brownfield runoff rate should be considered as a minimum requirement though runoff should be as close as is reasonably practical to the greenfield runoff rate.

F.2.5 DOS6 – Morecambe Festival Market and Surrounding Area

Proposed Development limiting runoff rate: Greenfield – FEH Statistical		Qbar: 11 l/s Q30: 19 l/s Q100: 23 l/s				
Design flood event (inc CC)	Critical storm duration (Hrs)	Inflow volume (m ³)	Outflow volume (m ³)	Attenuation required (m ³)	Time to empty assuming no infiltration (Hrs)	Total storage required: Area (ha) and % of site area
3.33% AEP Rainfall +20%	12	3864	339	3525	124.4	0.235 ha 3.796 %
3.33% AEP Rainfall +40%	12	4508	339	4169	147.2	0.278 ha 4.490 %
1% AEP Rainfall +20%	12*	5122	339	4783 (1258 exceedance storage)	168.8	0.319 ha 5.151 %
1% AEP Rainfall +40%	12*	5976	339	5637 (1468 exceedance storage)	199	0.376 ha 6.071 %
*limited to a 12 hr critical storm						

Site DOS6 is a brownfield site hence the proposed discharge rate should provide a betterment on the existing brownfield runoff rate. Typically, a betterment of at least 30% should be considered as a minimum requirement though runoff should be as close as is reasonably practical to the greenfield runoff rate.

F.2.6 DOS7 – Land at Former TDG Depot, Warton Road

Proposed Development limiting runoff rate: Greenfield – FEH Statistical		Qbar: 35 l/s Q30: 60 l/s Q100: 73 l/s				
Design flood event (inc CC)	Critical storm duration (Hrs)	Inflow volume (m ³)	Outflow volume (m ³)	Attenuation required (m ³)	Time to empty assuming no infiltration (Hrs)	Total storage required: Area (ha) and % of site area
3.33% AEP Rainfall +20%	12	4178	1067	3111	34.9	0.207 ha 3.226 %
3.33% AEP Rainfall +40%	12	4875	1067	3808	42.7	0.254 ha 3.948 %
1% AEP Rainfall +20%	12*	5483	1067	4416 (1305 exceedance storage)	49.5	0.294 ha 4.579 %
1% AEP Rainfall +40%	12*	6396	1067	5329 (1521 exceedance storage)	59.8	0.355 ha 5.525 %
*limited to a 12 hr critical storm						

Site DOS7 is a brownfield site hence the proposed discharge rate should provide a betterment on the existing brownfield runoff rate. Typically, a betterment of at least 30% should be considered as a minimum requirement though runoff should be as close as is reasonably practical to the greenfield runoff rate.

F.2.7 DOS8 – Former Thomas Graveson Site, Warton Road, Carnforth

Proposed Development limiting runoff rate: Greenfield – FEH Statistical		Qbar: 13 l/s Q30: 23 l/s Q100: 28 l/s				
Design flood event (inc CC)	Critical storm duration (Hrs)	Inflow volume (m ³)	Outflow volume (m ³)	Attenuation required (m ³)	Time to empty assuming no infiltration (Hrs)	Total storage required: Area (ha) and % of site area
3.33% AEP Rainfall +20%	12	1584	403	1181	35.1	0.079 ha 3.240 %
3.33% AEP Rainfall +40%	12	1848	403	1445	42.9	0.096 ha 3.964 %
1% AEP Rainfall +20%	12*	2079	403	1675 (494 exceedance storage)	49.7	0.112 ha 4.595 %
1% AEP Rainfall +40%	12*	2425	403	2022 (577 exceedance storage)	60	0.135 ha 5.547 %
*limited to a 12 hr critical storm						

Site DOS8 contains greenfield areas and developed areas. For greenfield areas, greenfield discharge rates apply and post-development runoff should be comparable to that of the undeveloped area. For brownfield areas, a betterment of at least 30% on the existing brownfield runoff rate should be considered as a minimum requirement though runoff should be as close as is reasonably practical to the greenfield runoff rate.

F.2.8 EC2.1 – Middleton Road Employment Area

Proposed Development limiting runoff rate: Greenfield – FEH Statistical		Qbar: 30 l/s Q30: 51 l/s Q100: 63 l/s				
Design flood event (inc CC)	Critical storm duration (Hrs)	Inflow volume (m ³)	Outflow volume (m ³)	Attenuation required (m ³)	Time to empty assuming no infiltration (Hrs)	Total storage required: Area (ha) and % of site area
3.33% AEP Rainfall +20%	12	6116	913	5202	68.2	0.347 ha 3.575 %
3.33% AEP Rainfall +40%	12	7135	913	6222	81.5	0.415 ha 4.276 %
1% AEP Rainfall +20%	12*	8070	913	7157 (1955 exceedance storage)	93.8	0.477 ha 4.919 %
1% AEP Rainfall +40%	12*	9415	913	8502 (2280 exceedance storage)	111.4	0.567 ha 5.843 %
*limited to a 12 hr critical storm						

Site EC2.1 is a greenfield site hence greenfield discharge rates apply. In theory, post-development runoff should be comparable to that of the undeveloped site.

F.2.9 EC3 – Junction 33 Auction Market

Proposed Development limiting runoff rate: Greenfield – FEH Statistical		Qbar: 77 l/s Q30: 132 l/s Q100: 161 l/s				
Design flood event (inc CC)	Critical storm duration (Hrs)	Inflow volume (m ³)	Outflow volume (m ³)	Attenuation required (m ³)	Time to empty assuming no infiltration (Hrs)	Total storage required: Area (ha) and % of site area
3.33% AEP Rainfall +20%	10.25	10220	2000	8220	42	0.548 ha 3.558 %
3.33% AEP Rainfall +40%	12	12297	2341	9957	50.9	0.664 ha 4.310 %
1% AEP Rainfall +20%	11.25	13484	2195	11289 (3069 exceedance storage)	57.7	0.753 ha 4.887 %
1% AEP Rainfall +40%	12*	15896	2341	13555 (3598 exceedance storage)	69.3	0.904 ha 5.868 %
*limited to a 12 hr critical storm						

Site EC3 is a greenfield site hence greenfield discharge rates apply. In theory, post-development runoff should be comparable to that of the undeveloped site.

F.2.10EC4 – White Lund Employment Area

Proposed Development limiting runoff rate: Greenfield – FEH Statistical		Qbar: 320 l/s Q30: 544 l/s Q100: 665 l/s				
Design flood event (inc CC)	Critical storm duration (Hrs)	Inflow volume (m ³)	Outflow volume (m ³)	Attenuation required (m ³)	Time to empty assuming no infiltration (Hrs)	Total storage required: Area (ha) and % of site area
3.33% AEP Rainfall +20%	12	63217	9670	53547	66.3	3.570 ha 3.562 %
3.33% AEP Rainfall +40%	12	73753	9670	64083	79.3	4.272 ha 4.262 %
1% AEP Rainfall +20%	12*	83444	9670	73773 (20226 exceedance storage)	91.3	4.918 ha 4.907 %
1% AEP Rainfall +40%	12*	97351	9670	87681 (23598 exceedance storage)	108.5	5.845 ha 5.832 %
*limited to a 12 hr critical storm						

Site EC4 is a brownfield site hence the proposed discharge rate should provide a betterment on the existing brownfield runoff rate. Typically, a betterment of at least 30% should be considered as a minimum requirement though runoff should be as close as is reasonably practical to the greenfield runoff rate.

F.2.11 EC5.3 – Caton Road Gateway

Proposed Development limiting runoff rate: Greenfield – FEH Statistical		Qbar: 462 l/s Q30: 785 l/s Q100: 961 l/s				
Design flood event (inc CC)	Critical storm duration (Hrs)	Inflow volume (m ³)	Outflow volume (m ³)	Attenuation required (m ³)	Time to empty assuming no infiltration (Hrs)	Total storage required: Area (ha) and % of site area
3.33% AEP Rainfall +20%	6.25	26760	7276	19484	16.7	1.299 ha 2.689 %
3.33% AEP Rainfall +40%	7.25	32485	8440	24045	20.6	1.603 ha 3.319 %
1% AEP Rainfall +20%	7.25	37359	8440	28919 (9435 exceedance storage)	24.8	1.928 ha 3.992 %
1% AEP Rainfall +40%	8.25	44845	9604	35241 (11196 exceedance storage)	30.2	2.349 ha 4.864 %

Site EC5.3 is a brownfield site hence the proposed discharge rate should provide a betterment on the existing brownfield runoff rate. Typically, a betterment of at least 30% should be considered as a minimum requirement though runoff should be as close as is reasonably practical to the greenfield runoff rate.

F.2.12EC6 – University of Cumbria Campus, Lancaster

Proposed Development limiting runoff rate: Greenfield – FEH Statistical		Qbar: 42 l/s Q30: 72 l/s Q100: 88 l/s				
Design flood event (inc CC)	Critical storm duration (Hrs)	Inflow volume (m ³)	Outflow volume (m ³)	Attenuation required (m ³)	Time to empty assuming no infiltration (Hrs)	Total storage required: Area (ha) and % of site area
3.33% AEP Rainfall +20%	8	3433	856	2577	24	0.172 ha 3.030 %
3.33% AEP Rainfall +40%	9.25	4149	990	3159	29.4	0.211 ha 3.714 %
1% AEP Rainfall +20%	9	4663	963	3701 (1124 exceedance storage)	34.5	0.247 ha 4.352 %
1% AEP Rainfall +40%	10.25	5584	1096	4487 (1328 exceedance storage)	41.8	0.299 ha 5.276 %

Site EC6 is a brownfield site hence the proposed discharge rate should provide a betterment on the existing brownfield runoff rate. Typically, a betterment of at least 30% should be considered as a minimum requirement though runoff should be as close as is reasonably practical to the greenfield runoff rate.

F.2.13H1.1 – Land at New Quay Road, Lancaster

Proposed Development limiting runoff rate: Greenfield – FEH Statistical		Qbar: 1 l/s (assumed minimum discharge 5 l/s) Q30: 2 l/s (assumed minimum discharge 5 l/s) Q100: 2 l/s (assumed minimum discharge 5 l/s)				
Design flood event (inc CC)	Critical storm duration (Hrs)	Inflow volume (m ³)	Outflow volume (m ³)	Attenuation required (m ³)	Time to empty assuming no infiltration (Hrs)	Total storage required: Area (ha) and % of site area
3.33% AEP Rainfall +20%	4.25	187	54	133	10.6	0.009 ha 2.396 %
3.33% AEP Rainfall +40%	5	229	63	166	13.1	0.011 ha 2.991 %
1% AEP Rainfall +20%	5.25	269	66	203 (70 exceedance storage)	16.1	0.014 ha 3.658 %
1% AEP Rainfall +40%	6	324	76	248 (82 exceedance storage)	19.7	0.017 ha 4.468 %

Site H1.1 is a brownfield site hence the proposed discharge rate should provide a betterment on the existing brownfield runoff rate. Typically, a betterment of at least 30% should be considered as a minimum requirement though runoff should be as close as is reasonably practical to the greenfield runoff rate.

F.2.14H1.3 – Former Police Station, Heysham Road

Proposed Development limiting runoff rate: Greenfield – FEH Statistical		Qbar: 0.1 l/s (assumed minimum discharge 5 l/s) Q30: 0.2 l/s (assumed minimum discharge 5 l/s) Q100: 0.3 l/s (assumed minimum discharge 5 l/s)				
Design flood event (inc CC)	Critical storm duration (Hrs)	Inflow volume (m ³)	Outflow volume (m ³)	Attenuation required (m ³)	Time to empty assuming no infiltration (Hrs)	Total storage required: Area (ha) and % of site area
3.33% AEP Rainfall +20%	0.5	14	6	7	0.6	0.000 ha 0.778 %
3.33% AEP Rainfall +40%	0.5	16	6	10	0.8	0.001 ha 1.111 %
1% AEP Rainfall +20%	0.75	23	9	13 (6 exceedance storage)	1	0.001 ha 1.444 %
1% AEP Rainfall +40%	0.75	26	9	17 (7 exceedance storage)	1.3	0.001 ha 1.889 %

Site H1.3 is a brownfield site hence the proposed discharge rate should provide a betterment on the existing brownfield runoff rate. Typically, a betterment of at least 30% should be considered as a minimum requirement though runoff should be as close as is reasonably practical to the greenfield runoff rate.

F.2.15H1.4 – Land West of Middleton Road, Heysham

Proposed Development limiting runoff rate: Greenfield – FEH Statistical		Qbar: 7 l/s Q30: 12 l/s Q100: 14 l/s				
Design flood event (inc CC)	Critical storm duration (Hrs)	Inflow volume (m ³)	Outflow volume (m ³)	Attenuation required (m ³)	Time to empty assuming no infiltration (Hrs)	Total storage required: Area (ha) and % of site area
3.33% AEP Rainfall +20%	12	1370	206	1164	67.7	0.078 ha 3.560 %
3.33% AEP Rainfall +40%	12	1599	206	1393	80.9	0.093 ha 4.260 %
1% AEP Rainfall +20%	12*	1810	206	1604 (440 exceedance storage)	93.2	0.107 ha 4.905 %
1% AEP Rainfall +40%	12*	2111	206	1905 (512 exceedance storage)	110.7	0.127 ha 5.826 %
*limited to a 12 hr critical storm						

Site H1.4 is a greenfield site hence greenfield discharge rates apply. In theory, post-development runoff should be comparable to that of the undeveloped site.

F.2.16H2.1 – Royal Oak Meadow, Hornby

Proposed Development limiting runoff rate: Greenfield – FEH Statistical		Qbar: 10 l/s Q30: 16 l/s Q100: 20 l/s				
Design flood event (inc CC)	Critical storm duration (Hrs)	Inflow volume (m ³)	Outflow volume (m ³)	Attenuation required (m ³)	Time to empty assuming no infiltration (Hrs)	Total storage required: Area (ha) and % of site area
3.33% AEP Rainfall +20%	8.25	686	198	488	20.3	0.033 ha 2.879 %
3.33% AEP Rainfall +40%	10	846	240	606	25.2	0.040 ha 3.575 %
1% AEP Rainfall +20%	9.75	949	234	715 (227 exceedance storage)	29.7	0.048 ha 4.218 %
1% AEP Rainfall +40%	11.5	1152	276	876 (270 exceedance storage)	36.4	0.058 ha 5.168 %

Site H2.1 is a greenfield site hence greenfield discharge rates apply. In theory, post-development runoff should be comparable to that of the undeveloped site.

F.2.17H2.2 – Lancaster Road, Overton

Proposed Development limiting runoff rate: Greenfield – FEH Statistical		Qbar: 4 l/s (assumed minimum discharge 5 l/s) Q30: 7 l/s Q100: 8 l/s				
Design flood event (inc CC)	Critical storm duration (Hrs)	Inflow volume (m ³)	Outflow volume (m ³)	Attenuation required (m ³)	Time to empty assuming no infiltration (Hrs)	Total storage required: Area (ha) and % of site area
3.33% AEP Rainfall +20%	12	1055	151	904	71.5	0.060 ha 3.675 %
3.33% AEP Rainfall +40%	12	1231	151	1080	85.5	0.072 ha 4.390 %
1% AEP Rainfall +20%	12*	1383	151	1232 (328 exceedance storage)	97.5	0.082 ha 5.008 %
1% AEP Rainfall +40%	12*	1614	151	1462 (382 exceedance storage)	115.7	0.097 ha 5.943 %
*limited to a 12 hr critical storm						

Site H2.2 is a greenfield site hence greenfield discharge rates apply. In theory, post-development runoff should be comparable to that of the undeveloped site.

F.2.18H2.3 – Yenham Lane, Overton

Proposed Development limiting runoff rate: Greenfield – FEH Statistical		Qbar: 2 l/s (assumed minimum discharge 5 l/s) Q30: 3 l/s (assumed minimum discharge 5 l/s) Q100: 4 l/s (assumed minimum discharge 5 l/s)				
Design flood event (inc CC)	Critical storm duration (Hrs)	Inflow volume (m ³)	Outflow volume (m ³)	Attenuation required (m ³)	Time to empty assuming no infiltration (Hrs)	Total storage required: Area (ha) and % of site area
3.33% AEP Rainfall +20%	7	406	88	317	25.1	0.021 ha 3.019 %
3.33% AEP Rainfall +40%	8.25	490	104	386	30.6	0.026 ha 3.676 %
1% AEP Rainfall +20%	8	555	101	454 (137 exceedance storage)	35.9	0.030 ha 4.324 %
1% AEP Rainfall +40%	9	661	113	547 (161 exceedance storage)	43.3	0.036 ha 5.210 %

Site H2.3 is a greenfield site hence greenfield discharge rates apply. In theory, post-development runoff should be comparable to that of the undeveloped site.

F.2.19H2.5 – Land North of Old Hall Farm, Over Kellet

Proposed Development limiting runoff rate: Greenfield – FEH Statistical		Qbar: 25 l/s Q30: 42 l/s Q100: 51 l/s				
Design flood event (inc CC)	Critical storm duration (Hrs)	Inflow volume (m ³)	Outflow volume (m ³)	Attenuation required (m ³)	Time to empty assuming no infiltration (Hrs)	Total storage required: Area (ha) and % of site area
3.33% AEP Rainfall +20%	10	2231	623	1608	25.7	0.107 ha 3.054 %
3.33% AEP Rainfall +40%	11.75	2721	732	1989	31.8	0.133 ha 3.778 %
1% AEP Rainfall +20%	11.5	3048	716	2332 (724 exceedance storage)	37.3	0.155 ha 4.429 %
1% AEP Rainfall +40%	12*	3592	748	2844 (855 exceedance storage)	45.5	0.190 ha 5.402 %
*limited to a 12 hr critical storm						

Site H2.5 is a greenfield site hence greenfield discharge rates apply. In theory, post-development runoff should be comparable to that of the undeveloped site.

F.2.20H2.6 – Halton Mills, Halton

Proposed Development limiting runoff rate: Greenfield – FEH Statistical		Qbar: 30 l/s Q30: 52 l/s Q100: 63 l/s				
Design flood event (inc CC)	Critical storm duration (Hrs)	Inflow volume (m ³)	Outflow volume (m ³)	Attenuation required (m ³)	Time to empty assuming no infiltration (Hrs)	Total storage required: Area (ha) and % of site area
3.33% AEP Rainfall +20%	6	1579	460	1119	14.6	0.075 ha 2.608 %
3.33% AEP Rainfall +40%	7	1926	537	1389	18.1	0.093 ha 3.238 %
1% AEP Rainfall +20%	7.25	2234	556	1678 (559 exceedance storage)	21.8	0.112 ha 3.911 %
1% AEP Rainfall +40%	8.25	2689	632	2057 (668 exceedance storage)	26.8	0.137 ha 4.795 %

Site H2.6 is a greenfield site hence greenfield discharge rates apply. In theory, post-development runoff should be comparable to that of the undeveloped site.

F.2.21 H2.8 – Land between Low Road and Forge Lane, Halton

Proposed Development limiting runoff rate: Greenfield – FEH Statistical		Qbar: 56 l/s Q30: 95 l/s Q100: 116 l/s				
Design flood event (inc CC)	Critical storm duration (Hrs)	Inflow volume (m ³)	Outflow volume (m ³)	Attenuation required (m ³)	Time to empty assuming no infiltration (Hrs)	Total storage required: Area (ha) and % of site area
3.33% AEP Rainfall +20%	6	2898	843	2055	14.6	0.137 ha 2.615 %
3.33% AEP Rainfall +40%	7	3535	983	2552	18.1	0.170 ha 3.247 %
1% AEP Rainfall +20%	7.25	4100	1018	3082 (1027 exceedance storage)	21.9	0.205 ha 3.921 %
1% AEP Rainfall +40%	8.25	4935	1159	3777 (1225 exceedance storage)	26.8	0.252 ha 4.805 %

Site H2.8 is a greenfield site hence greenfield discharge rates apply. In theory, post-development runoff should be comparable to that of the undeveloped site.

F.2.22H2.9 – Land to the rear of Pointer Grove and adjacent to High Road, Halton

Proposed Development limiting runoff rate: Greenfield – FEH Statistical		Qbar: 49 l/s Q30: 83 l/s Q100: 102 l/s				
Design flood event (inc CC)	Critical storm duration (Hrs)	Inflow volume (m ³)	Outflow volume (m ³)	Attenuation required (m ³)	Time to empty assuming no infiltration (Hrs)	Total storage required: Area (ha) and % of site area
3.33% AEP Rainfall +20%	5.75	2359	710	1649	13.3	0.110 ha 2.533 %
3.33% AEP Rainfall +40%	6.75	2886	833	2053	16.6	0.137 ha 3.154 %
1% AEP Rainfall +20%	7	3352	864	2488 (839 exceedance storage)	20.1	0.166 ha 3.822 %
1% AEP Rainfall +40%	8	4044	987	3056 (1003 exceedance storage)	24.7	0.204 ha 4.694 %

Site H2.9 is a greenfield site hence greenfield discharge rates apply. In theory, post-development runoff should be comparable to that of the undeveloped site.

F.2.23H2.10 – Land South of Marsh Lane, Cockerham

Proposed Development limiting runoff rate: Greenfield – FEH Statistical		Qbar: 11 l/s Q30: 18 l/s Q100: 22 l/s				
Design flood event (inc CC)	Critical storm duration (Hrs)	Inflow volume (m ³)	Outflow volume (m ³)	Attenuation required (m ³)	Time to empty assuming no infiltration (Hrs)	Total storage required: Area (ha) and % of site area
3.33% AEP Rainfall +20%	9.5	1298	257	1040	38.3	0.069 ha 3.502 %
3.33% AEP Rainfall +40%	10.75	1550	291	1259	46.3	0.084 ha 4.239 %
1% AEP Rainfall +20%	10.25	1710	278	1432 (392 exceedance storage)	52.7	0.095 ha 4.822 %
1% AEP Rainfall +40%	11.5	2031	312	1720 (461 exceedance storage)	63.3	0.115 ha 5.791 %

Site H2.10 is a greenfield site hence greenfield discharge rates apply. In theory, post-development runoff should be comparable to that of the undeveloped site.

F.2.24H3.1 – Former Ridge Lea Hospital, Lancaster

Proposed Development limiting runoff rate: Greenfield – FEH Statistical		Qbar: 30 l/s Q30: 52 l/s Q100: 63 l/s				
Design flood event (inc CC)	Critical storm duration (Hrs)	Inflow volume (m ³)	Outflow volume (m ³)	Attenuation required (m ³)	Time to empty assuming no infiltration (Hrs)	Total storage required: Area (ha) and % of site area
3.33% AEP Rainfall +20%	6.5	1844	497	1347	17.5	0.090 ha 2.772 %
3.33% AEP Rainfall +40%	7.5	2235	574	1661	21.6	0.111 ha 3.418 %
1% AEP Rainfall +20%	7.5	2555	574	1981 (634 exceedance storage)	25.8	0.132 ha 4.076 %
1% AEP Rainfall +40%	8.75	3083	670	2413 (752 exceedance storage)	31.4	0.161 ha 4.965 %

Site H3.1 is a brownfield site hence the proposed discharge rate should provide a betterment on the existing brownfield runoff rate. Typically, a betterment of at least 30% should be considered as a minimum requirement though runoff should be as close as is reasonably practical to the greenfield runoff rate.

F.2.25H3.2 – Land at Stone Row Head Farm, East Lancaster

Proposed Development limiting runoff rate: Greenfield – FEH Statistical		Qbar: 15 l/s Q30: 26 l/s Q100: 32 l/s				
Design flood event (inc CC)	Critical storm duration (Hrs)	Inflow volume (m ³)	Outflow volume (m ³)	Attenuation required (m ³)	Time to empty assuming no infiltration (Hrs)	Total storage required: Area (ha) and % of site area
3.33% AEP Rainfall +20%	6.5	925	249	677	17.6	0.045 ha 2.786 %
3.33% AEP Rainfall +40%	7.5	1122	287	835	21.8	0.056 ha 3.436 %
1% AEP Rainfall +20%	7.5	1282	287	995 (318 exceedance storage)	25.9	0.066 ha 4.095 %
1% AEP Rainfall +40%	8.75	1547	335	1212 (377 exceedance storage)	31.6	0.081 ha 4.988 %

Site H3.2 is a brownfield site hence the proposed discharge rate should provide a betterment on the existing brownfield runoff rate. Typically, a betterment of at least 30% should be considered as a minimum requirement though runoff should be as close as is reasonably practical to the greenfield runoff rate.

F.2.26H3.3 – Land at University of Cumbria Campus, East Lancaster

Proposed Development limiting runoff rate: Greenfield – FEH Statistical		Qbar: 12 l/s Q30: 20 l/s Q100: 24 l/s				
Design flood event (inc CC)	Critical storm duration (Hrs)	Inflow volume (m ³)	Outflow volume (m ³)	Attenuation required (m ³)	Time to empty assuming no infiltration (Hrs)	Total storage required: Area (ha) and % of site area
3.33% AEP Rainfall +20%	8	933	232	701	24	0.047 ha 3.035 %
3.33% AEP Rainfall +40%	9.25	1128	269	859	29.5	0.057 ha 3.719 %
1% AEP Rainfall +20%	9	1267	262	1006 (305 exceedance storage)	34.5	0.067 ha 4.355 %
1% AEP Rainfall +40%	10.25	1518	298	1220 (361 exceedance storage)	41.9	0.081 ha 5.281 %

Site H3.3 is a brownfield site hence the proposed discharge rate should provide a betterment on the existing brownfield runoff rate. Typically, a betterment of at least 30% should be considered as a minimum requirement though runoff should be as close as is reasonably practical to the greenfield runoff rate.

F.2.27H4 – Land at Grab Lane, East Lancaster

Proposed Development limiting runoff rate: Greenfield – FEH Statistical		Qbar: 81 l/s Q30: 139 l/s Q100: 169 l/s				
Design flood event (inc CC)	Critical storm duration (Hrs)	Inflow volume (m ³)	Outflow volume (m ³)	Attenuation required (m ³)	Time to empty assuming no infiltration (Hrs)	Total storage required: Area (ha) and % of site area
3.33% AEP Rainfall +20%	6.5	5069	1334	3735	18.1	0.249 ha 2.836 %
3.33% AEP Rainfall +40%	7.75	6194	1591	4603	22.4	0.307 ha 3.495 %
1% AEP Rainfall +20%	7.5	6984	1540	5444 (1709 exceedance storage)	26.4	0.363 ha 4.134 %
1% AEP Rainfall +40%	8.75	8428	1796	6631 (2028 exceedance storage)	32.2	0.442 ha 5.035 %

Site H4 is a greenfield site hence greenfield discharge rates apply. In theory, post-development runoff should be comparable to that of the undeveloped site.

F.2.28H5 – Land at Leisure Park/Auction Mart, Wyresdale Road

Proposed Development limiting runoff rate: Greenfield – FEH Statistical		Qbar: 129 l/s Q30: 220 l/s Q100: 269 l/s				
Design flood event (inc CC)	Critical storm duration (Hrs)	Inflow volume (m ³)	Outflow volume (m ³)	Attenuation required (m ³)	Time to empty assuming no infiltration (Hrs)	Total storage required: Area (ha) and % of site area
3.33% AEP Rainfall +20%	6.5	8052	2119	5933	18.2	0.396 ha 2.837 %
3.33% AEP Rainfall +40%	7.75	9839	2526	7313	22.4	0.488 ha 3.497 %
1% AEP Rainfall +20%	7.5	11093	2445	8649 (2716 exceedance storage)	26.5	0.577 ha 4.136 %
1% AEP Rainfall +40%	8.75	13387	2852	10535 (3222 exceedance storage)	32.2	0.702 ha 5.038 %

Site H5 contains greenfield areas and developed areas. For greenfield areas, greenfield discharge rates apply and post-development runoff should be comparable to that of the undeveloped area. For brownfield areas, a betterment of at least 30% on the existing brownfield runoff rate should be considered as a minimum requirement though runoff should be as close as is reasonably practical to the greenfield runoff rate.

F.2.29H6 – Royal Albert Fields, Ashton Road

Proposed Development limiting runoff rate: Greenfield – FEH Statistical		Qbar: 11 l/s Q30: 18 l/s Q100: 22 l/s				
Design flood event (inc CC)	Critical storm duration (Hrs)	Inflow volume (m ³)	Outflow volume (m ³)	Attenuation required (m ³)	Time to empty assuming no infiltration (Hrs)	Total storage required: Area (ha) and % of site area
3.33% AEP Rainfall +20%	12	3831	320	3511	131.2	0.234 ha 4.029 %
3.33% AEP Rainfall +40%	12	4469	320	4149	155	0.277 ha 4.761 %
1% AEP Rainfall +20%	12*	5005	320	4685 (1174 exceedance storage)	175	0.312 ha 5.376 %
1% AEP Rainfall +40%	12*	5839	320	5519 (1370 exceedance storage)	206.2	0.368 ha 6.333 %
*limited to a 12 hr critical storm						

Site H6 is a greenfield site hence greenfield discharge rates apply. In theory, post-development runoff should be comparable to that of the undeveloped site.

F.2.30SG2 – Lancaster University Health Innovation Campus

Proposed Development limiting runoff rate: Greenfield – FEH Statistical		Qbar: 61 l/s Q30: 104 l/s Q100: 127 l/s				
Design flood event (inc CC)	Critical storm duration (Hrs)	Inflow volume (m ³)	Outflow volume (m ³)	Attenuation required (m ³)	Time to empty assuming no infiltration (Hrs)	Total storage required: Area (ha) and % of site area
3.33% AEP Rainfall +20%	10	7125	1536	5589	36.3	0.373 ha 3.397 %
3.33% AEP Rainfall +40%	11.5	8565	1767	6798	44.1	0.453 ha 4.131 %
1% AEP Rainfall +20%	11.25	9502	1728	7773 (2184 exceedance storage)	50.5	0.518 ha 4.724 %
1% AEP Rainfall +40%	12*	11212	1844	9369 (2571 exceedance storage)	60.8	0.625 ha 5.694 %
*limited to a 12 hr critical storm						

Site SG2 is a greenfield site hence greenfield discharge rates apply. In theory, post-development runoff should be comparable to that of the undeveloped site.

F.2.31 SG5 – Canal Quarter

Proposed Development limiting runoff rate: Greenfield – FEH Statistical		Qbar: 25 l/s Q30: 42 l/s Q100: 52 l/s				
Design flood event (inc CC)	Critical storm duration (Hrs)	Inflow volume (m ³)	Outflow volume (m ³)	Attenuation required (m ³)	Time to empty assuming no infiltration (Hrs)	Total storage required: Area (ha) and % of site area
3.33% AEP Rainfall +20%	12	4401	752	3650	58.1	0.243 ha 3.637 %
3.33% AEP Rainfall +40%	12	5135	752	4383	69.8	0.292 ha 4.368 %
1% AEP Rainfall +20%	12*	5774	752	5022 (1372 exceedance storage)	79.9	0.335 ha 5.004 %
1% AEP Rainfall +40%	12*	6736	752	5984 (1601 exceedance storage)	95.3	0.399 ha 5.963 %
*limited to a 12 hr critical storm						

Site SG5 is a brownfield site hence the proposed discharge rate should provide a betterment on the existing brownfield runoff rate. Typically, a betterment of at least 30% should be considered as a minimum requirement though runoff should be as close as is reasonably practical to the greenfield runoff rate.

F.2.32SG7 – East Lancaster Strategic Site

Proposed Development limiting runoff rate: Greenfield – FEH Statistical		Qbar: 692 l/s Q30: 1177 l/s Q100: 1440 l/s				
Design flood event (inc CC)	Critical storm duration (Hrs)	Inflow volume (m ³)	Outflow volume (m ³)	Attenuation required (m ³)	Time to empty assuming no infiltration (Hrs)	Total storage required: Area (ha) and % of site area
3.33% AEP Rainfall +20%	7.5	50323	13086	37237	21.3	2.482 ha 2.898 %
3.33% AEP Rainfall +40%	8.75	61087	15267	45820	26.2	3.055 ha 3.566 %
1% AEP Rainfall +20%	8.75	69630	15267	54363 (17126 exceedance storage)	31.1	3.624 ha 4.231 %
1% AEP Rainfall +40%	10	83551	17447	66103 (20283 exceedance storage)	37.8	4.407 ha 5.145 %

Site SG7 is predominantly greenfield with some developed areas. For greenfield areas, greenfield discharge rates apply and post-development runoff should be comparable to that of the undeveloped area. For brownfield areas, a betterment of at least 30% on the existing brownfield runoff rate should be considered as a minimum requirement though runoff should be as close as is reasonably practical to the greenfield runoff rate.

F.2.33 SG7 Wider Site – East Lancaster Strategic Site

Proposed Development limiting runoff rate: Greenfield – FEH Statistical		Qbar: 25 l/s Q30: 42 l/s Q100: 52 l/s				
Design flood event (inc CC)	Critical storm duration (Hrs)	Inflow volume (m ³)	Outflow volume (m ³)	Attenuation required (m ³)	Time to empty assuming no infiltration (Hrs)	Total storage required: Area (ha) and % of site area
3.33% AEP Rainfall +20%	8	68270	17840	50430	22.6	3.362 ha 2.942 %
3.33% AEP Rainfall +40%	9.25	82643	20627	62015	27.7	4.134 ha 3.617 %
1% AEP Rainfall +20%	9	93457	20070	73387 (22957 exceedance storage)	32.8	4.892 ha 4.281 %
1% AEP Rainfall +40%	10.25	112028	22857	89170 (27155 exceedance storage)	39.9	5.945 ha 5.201 %

Site SG7 Wider Site is predominantly greenfield with some developed areas. For greenfield areas, greenfield discharge rates apply and post-development runoff should be comparable to that of the undeveloped area. For brownfield areas, a betterment of at least 30% on the existing brownfield runoff rate should be considered as a minimum requirement though runoff should be as close as is reasonably practical to the greenfield runoff rate.

F.2.34SG9 Wider Site – North Lancaster Strategic Site

Proposed Development limiting runoff rate: Greenfield – FEH Statistical		Qbar: 153 l/s Q30: 260 l/s Q100: 318 l/s				
Design flood event (inc CC)	Critical storm duration (Hrs)	Inflow volume (m ³)	Outflow volume (m ³)	Attenuation required (m ³)	Time to empty assuming no infiltration (Hrs)	Total storage required: Area (ha) and % of site area
3.33% AEP Rainfall +20%	12	48658	4623	44035	114	2.936 ha 3.882 %
3.33% AEP Rainfall +40%	12	56767	4623	52144	135	3.476 ha 4.596 %
1% AEP Rainfall +20%	12*	64238	4623	59616 (15581 exceedance storage)	154.3	3.974 ha 5.255 %
1% AEP Rainfall +40%	12*	74945	4623	70322 (18178 exceedance storage)	182	4.688 ha 6.199 %
*limited to a 12 hr critical storm						

Site SG9 is predominantly greenfield with some developed areas. For greenfield areas, greenfield discharge rates apply and post-development runoff should be comparable to that of the undeveloped area. For brownfield areas, a betterment of at least 30% on the existing brownfield runoff rate should be considered as a minimum requirement though runoff should be as close as is reasonably practical to the greenfield runoff rate.

F.2.35SG11 – Lundsfield Quarry, South Carnforth

Proposed Development limiting runoff rate: Greenfield – FEH Statistical		Qbar: 81 l/s Q30: 138 l/s Q100: 169 l/s				
Design flood event (inc CC)	Critical storm duration (Hrs)	Inflow volume (m ³)	Outflow volume (m ³)	Attenuation required (m ³)	Time to empty assuming no infiltration (Hrs)	Total storage required: Area (ha) and % of site area
3.33% AEP Rainfall +20%	11	8736	2255	6481	31.5	0.432 ha 3.156 %
3.33% AEP Rainfall +40%	12	10420	2460	7960	38.7	0.531 ha 3.876 %
1% AEP Rainfall +20%	12	11783	2460	9323 (2842 exceedance storage)	45.4	0.622 ha 4.540 %
1% AEP Rainfall +40%	12*	13747	2460	11287 (3327 exceedance storage)	54.9	0.752 ha 5.496 %
*limited to a 12 hr critical storm						

Site SG11 is a brownfield site hence the proposed discharge rate should provide a betterment on the existing brownfield runoff rate. Typically, a betterment of at least 30% should be considered as a minimum requirement though runoff should be as close as is reasonably practical to the greenfield runoff rate.

F.2.36SG12 – Port of Heysham Industrial Estate

Proposed Development limiting runoff rate: Greenfield – FEH Statistical		Qbar: 54 l/s Q30: 92 l/s Q100: 112 l/s				
Design flood event (inc CC)	Critical storm duration (Hrs)	Inflow volume (m ³)	Outflow volume (m ³)	Attenuation required (m ³)	Time to empty assuming no infiltration (Hrs)	Total storage required: Area (ha) and % of site area
3.33% AEP Rainfall +20%	12	20394	1628	18766	138	1.251 ha 3.861 %
3.33% AEP Rainfall +40%	12	23793	1628	22165	163	1.478 ha 4.561 %
1% AEP Rainfall +20%	12*	26946	1628	25318 (6552 exceedance storage)	186.2	1.688 ha 5.209 %
1% AEP Rainfall +40%	12*	31437	1628	29809 (7644 exceedance storage)	219.2	1.987 ha 6.134 %
*limited to a 12 hr critical storm						

Site SG12 is a greenfield site hence greenfield discharge rates apply. In theory, post-development runoff should be comparable to that of the undeveloped site.

F.2.37SG12 – Expansion of Facilities for Port of Heysham (Land off Imperial Road)

Proposed Development limiting runoff rate: Greenfield – FEH Statistical		Qbar: 24 l/s Q30: 40 l/s Q100: 56 l/s				
Design flood event (inc CC)	Critical storm duration (Hrs)	Inflow volume (m ³)	Outflow volume (m ³)	Attenuation required (m ³)	Time to empty assuming no infiltration (Hrs)	Total storage required: Area (ha) and % of site area
3.33% AEP Rainfall +20%	12	4772	713	4060	68.2	0.271 ha 3.576 %
3.33% AEP Rainfall +40%	12	5568	713	4855	81.5	0.324 ha 4.276 %
1% AEP Rainfall +20%	12*	6297	713	5585 (1525 exceedance storage)	93.8	0.372 ha 4.919 %
1% AEP Rainfall +40%	12*	7347	713	6634 (1779 exceedance storage)	111.4	0.442 ha 5.842 %
*limited to a 12 hr critical storm						

Site SG12 is a greenfield site hence greenfield discharge rates apply. In theory, post-development runoff should be comparable to that of the undeveloped site