
Appendix C - Calculations

- C.1 Existing Run-off Rates (Zones 1-3)
- C.2 Estimated Attenuation Storage (Zones 1-3)
- C.3 Maximum Flow Rates of Existing Surface Water Sewers

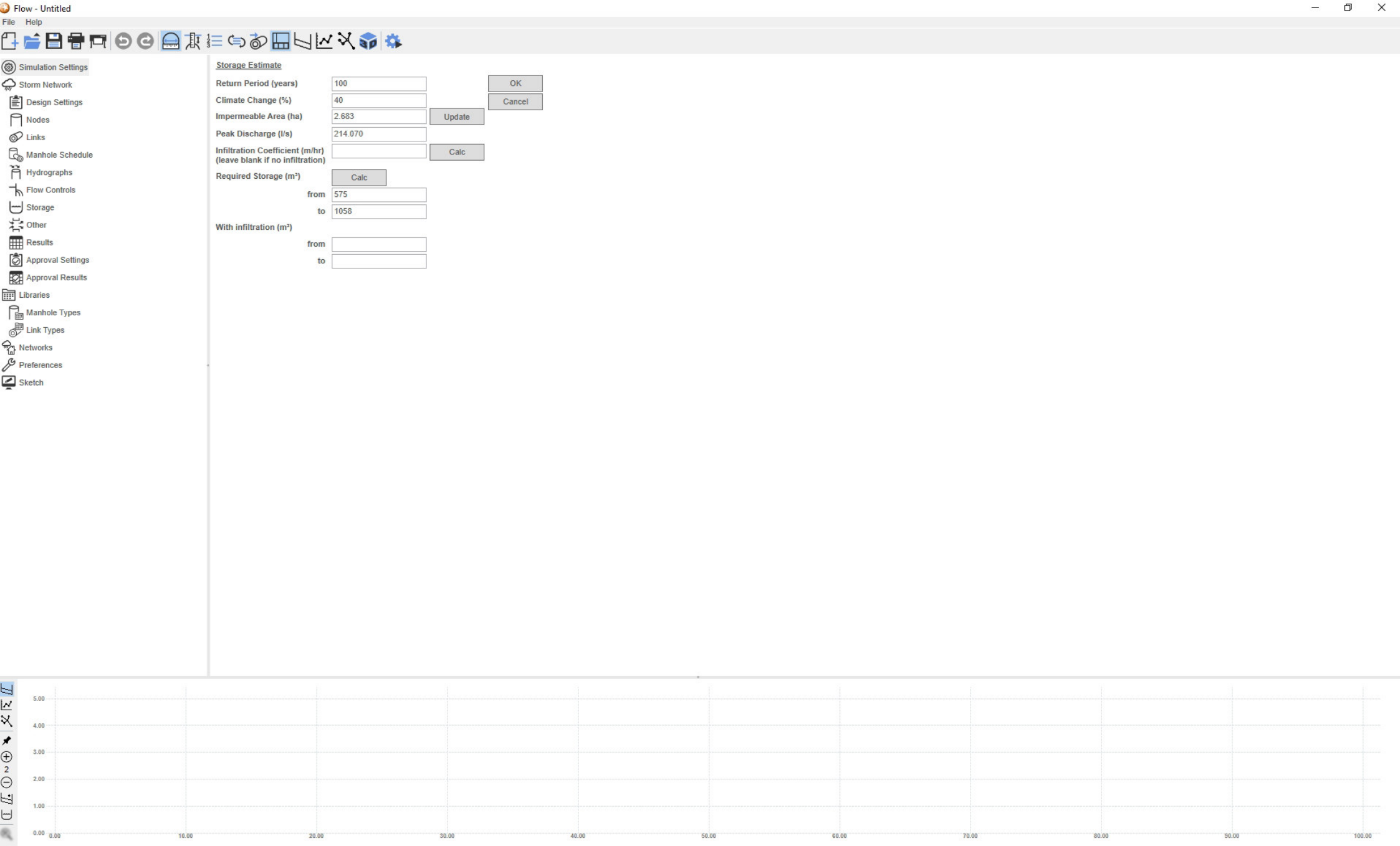
Baynham Meikle Consulting Structural & Civil Engineers 8 Meadow Road Edgbaston Birmingham B17 8BU tel: 0121 434 4100 fax: 0121 434 4073 email: admin@bm-p.co.uk	Contract Langstone Technology Park - Masterplan Surface water runoff calcs	Job No. 13023
	Part of Structure Rainfall intensity	Date. 13/05/21 Page No. 1/5
Member Ref.	Calculations	Output
	In accordance with Clancy flood risk assessment + SUDS Strategy and the Wallingford procedure: <u>Design Rainfall Intensity</u> 1yr: $i_{max} = 28.7 \text{ mm/hr}$ 30yr: $i_{max} = 70.4 \text{ mm/hr}$ 100yr: $i_{max} = 90.8 \text{ mm/hr}$	

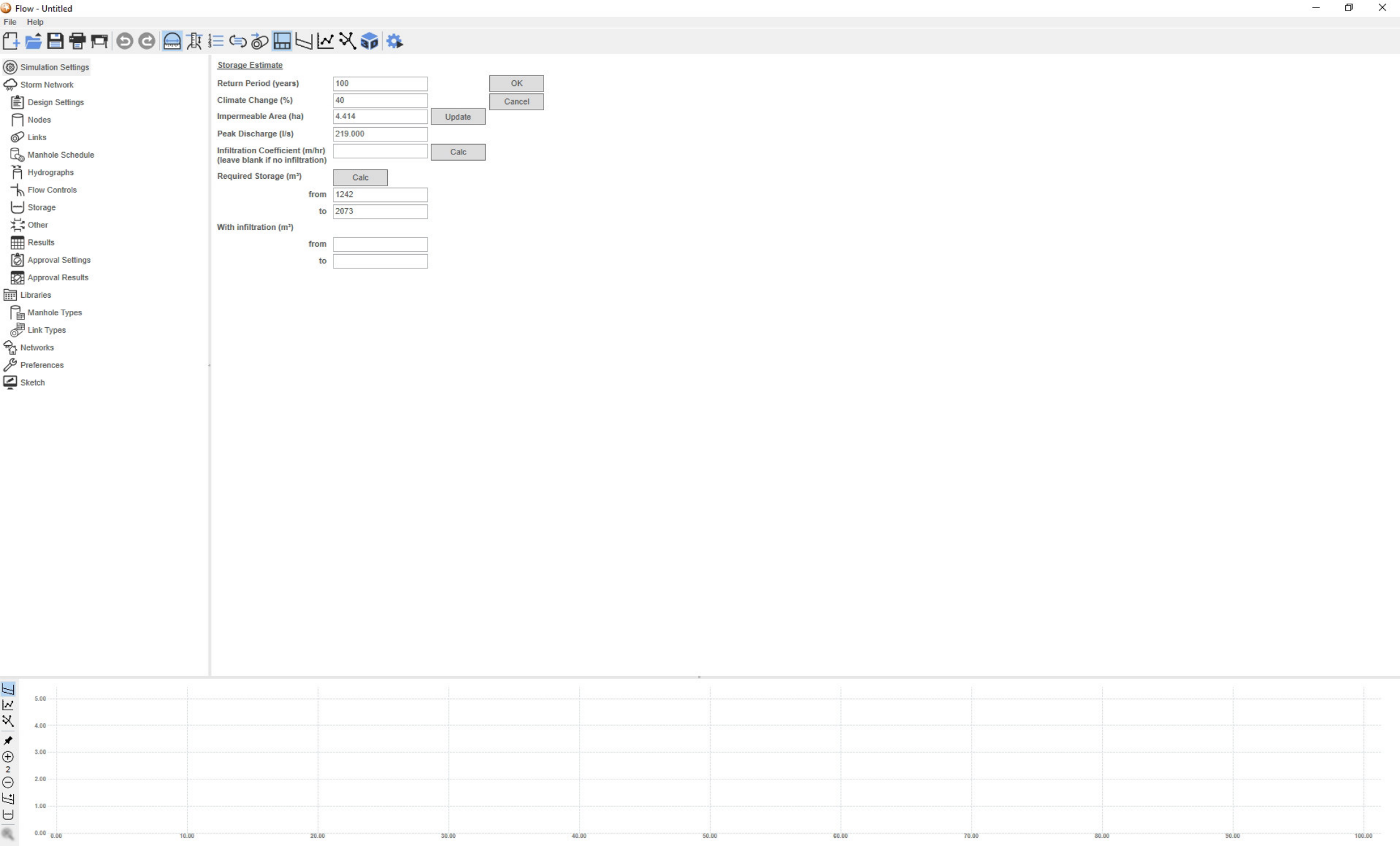
Baynham Meikle Consulting Structural & Civil Engineers 8 Meadow Road Edgbaston Birmingham B17 8BU tel: 0121 434 4100 fax: 0121 434 4073 email: admin@bm-p.co.uk	Contract Langstone Technology Park - Masterplan Surface water runoff caks	Job No. 13023
	Part of Structure Zone 1	Date. 13/05/21
		Page No. 2/5
Member Ref.	Calculations	Output
	<u>Zone 1</u> : Development located in north west area (building units 8+9). <u>Max. Surface water runoff</u> <u>1 year</u> ($I_{max} = 28.7 \text{ mm/hr}$) Ex. Imp area : 2.683 ha $\therefore$ Max surface water runoff (Q_{max}) = C_{it}. $\therefore Q_{max} = 2.78 \times 28.7 \times 2.683$ $= \underline{214.07 \text{ l/s.}}$ <u>30 year</u> ($I_{max} = 70.4 \text{ mm/hr}$) Ex. Imp area = 2.683 $\therefore Q_{max} = 2.78 \times 70.4 \times 2.683$ $= \underline{525.60 \text{ l/s.}}$ <u>100 year</u> ($I_{max} = 90.8 \text{ mm/hr}$) Ex. Imp area = 2.683 $\therefore Q_{max} = 2.78 \times 90.8 \times 2.683$ $= \underline{677.25 \text{ l/s.}}$	

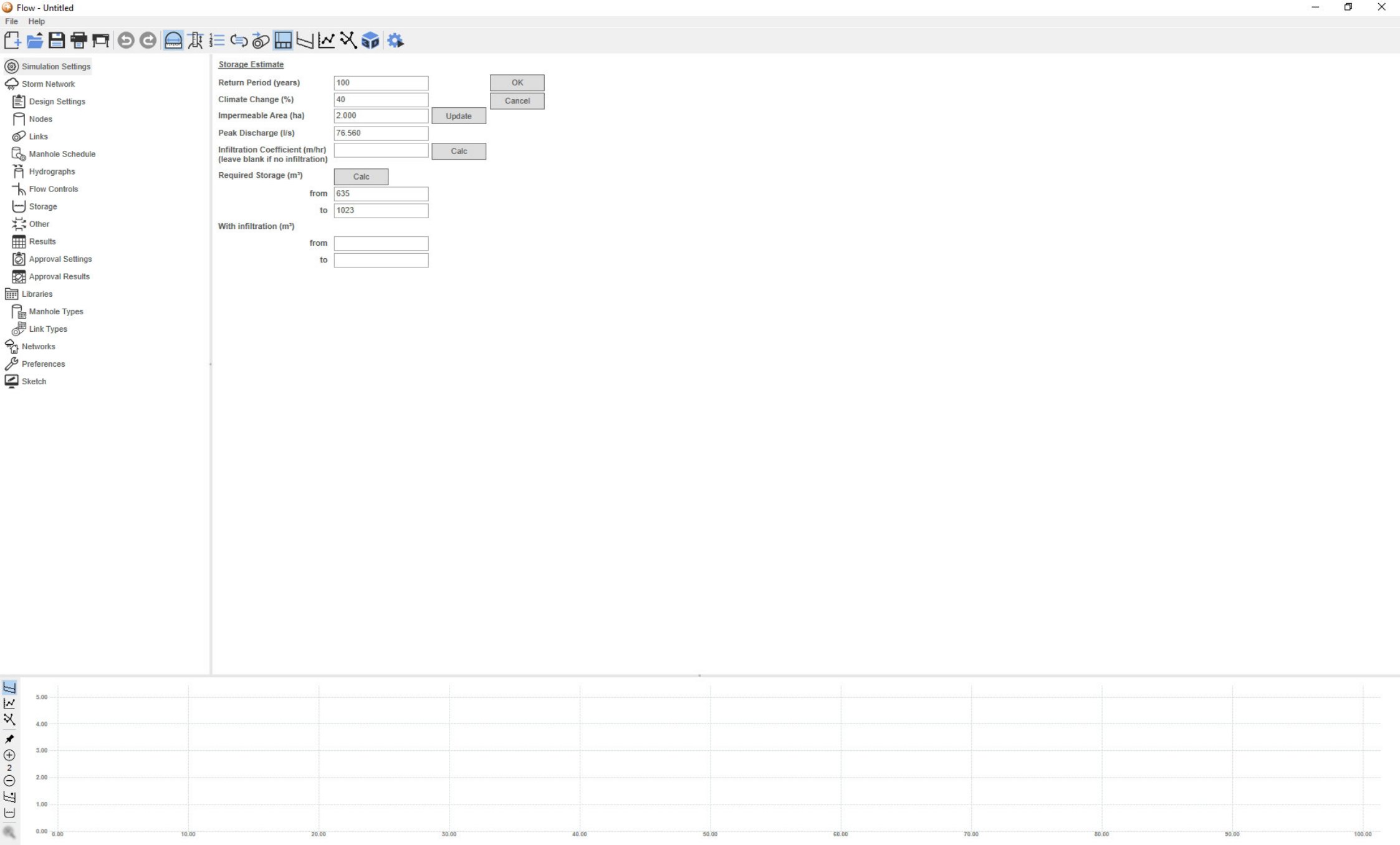
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	Part of Structure Zone 2	Date. 12/05/21
		Page No. 3/5
Member Ref.	Calculations	Output
	<u>Zone 2: Development located in north east area</u> <u>(building units 6, 7, 10, 11, 12, 13, 14, 15 + 16)</u> <u>Max. Surface water runoff:</u> <u>1 year ($f_{max} = 28.7 \text{ mm/hr}$)</u> Ex. Imp area : 4.414 ha. $\therefore Q_{max} = 2.78 \times 28.7 \times 4.414$ <u>$= 352.18 \text{ l/s.}$</u> <u>30 year ($f_{max} = 70.4 \text{ mm/hr}$)</u> Ex. Imp area : 4.414 $\therefore Q_{max} = 2.78 \times 70.4 \times 4.414$ <u>$= 863.87 \text{ l/s.}$</u> <u>100 year ($f_{max} = 90.8 \text{ mm/hr}$)</u> Ex. Imp area : 4.414 $\therefore Q_{max} = 2.78 \times 90.8 \times 4.414$ <u>$= 1114.20 \text{ l/s.}$</u>	

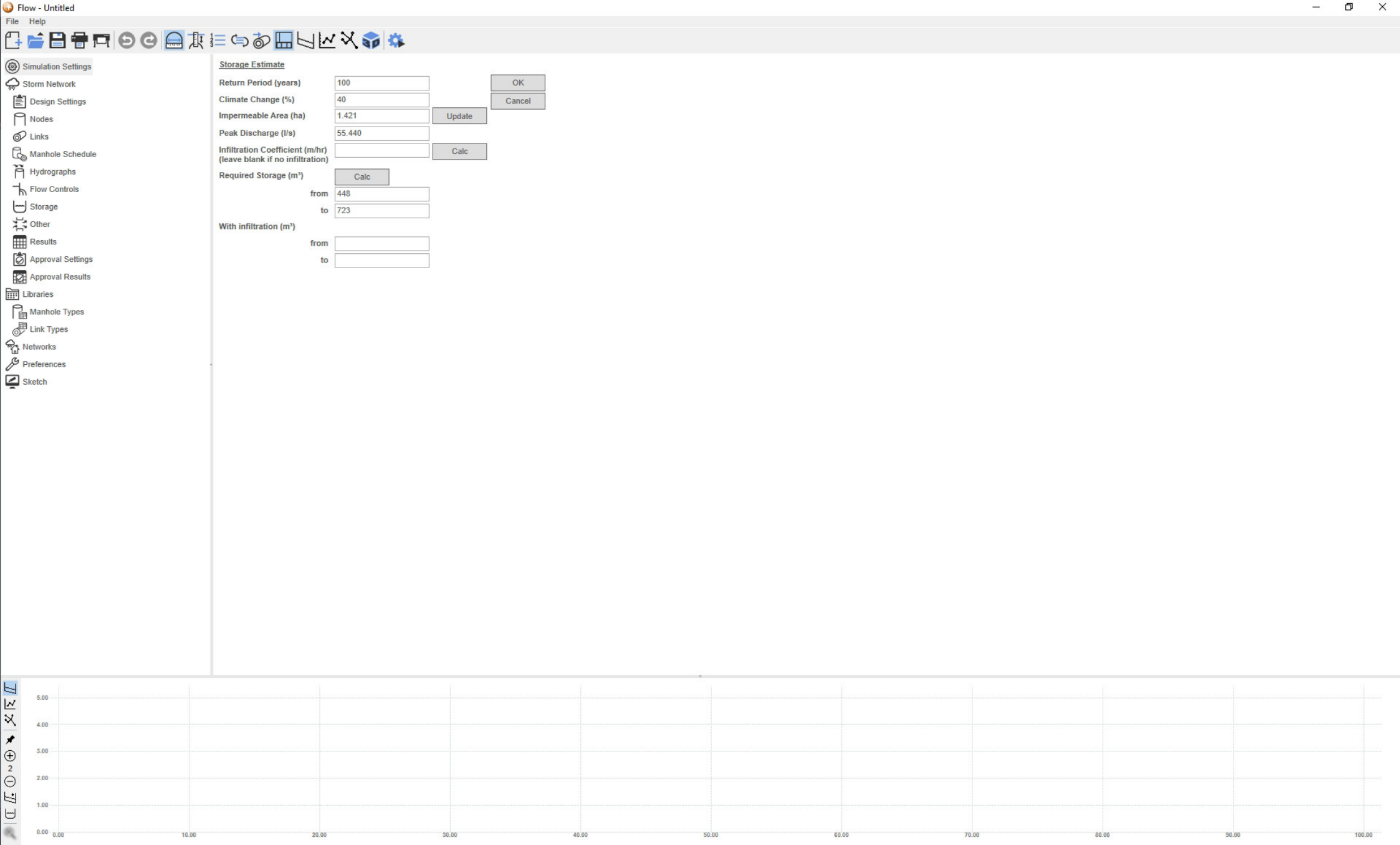
Baynham Meikle Consulting Structural & Civil Engineers 8 Meadow Road Edgbaston Birmingham B17 8BU tel: 0121 434 4100 fax: 0121 434 4073 email: admin@bm-p.co.uk	Contract Langstone Technology Park - Masterplan Surface water runoff calcs Part of Structure Zone 3	Job No. 13023 Date. 13/05/21 Page No. 4/5
Member Ref.	Calculations	Output
	<u>Zone 3: Development located in Southern area (building units 4-5)</u> <u>Max. surface water runoff</u> <u>1 year</u> ($i_{max} = 28.7 \text{ mm/hr}$) Total Ex. Imp area ($\Sigma 3A + 3B$) = 3.421 ha. $\therefore Q_{max} = 2.78 \times 28.7 \times 3.421$ $= \underline{272.95 \text{ l/s}}$ <u>30 year</u> ($i_{max} = 70.4 \text{ mm/hr}$) Total Ex. Imp area ($\Sigma 3A + 3B$) = 3.421 ha $\therefore Q_{max} = 2.78 \times 70.4 \times 3.421$ $= \underline{669.51 \text{ l/s}}$ <u>100 year</u> ($i_{max} = 90.8 \text{ mm/hr}$) Total Ex. Imp area ($\Sigma 3A + 3B$) = 3.421 ha $\therefore Q_{max} = 2.78 \times 90.8 \times 3.421$ $= \underline{863.54 \text{ l/s}}$ In accordance with Clancy FKA + SUGS Strategy (02/07/2019, rep. 8/1982), Maximum flow through 375mm discharge pipe = 132 l/s. Total Imp. area in Zone 3 = 3.421 ha Imp. area in Zone 3A = 2.000 ha (58%) Imp. area in Zone 3B = 1.421 ha (42%) Impermeable area in Zone 3A accounts for 58% of the total Zone 3 impermeable area and Zone 3B accounts for 42%.	

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	Part of Structure <i>Zone 3</i>	Page No. 5/5.
Member Ref.	Calculations	Output
	∴ Zone 3A is to discharge at existing rate of 76.56 l/s (132 x 0.58) and zone 3B is to discharge at existing rate of 55.44 l/s (132 x 0.42). ∴ Entire development within Zone 3 is limited to 132 l/s as per Clancy FRA + SUDS Strategy, Appendix D.	









MASTERPLAN

MAX DISCHARGE RATE
OF EX. SW SEWER
ZONE 1.

ks = 0.600mm
i = 0.00015 to 0.004

ie hydraulic gradient =
1 in 6667 to 1 in 250

Water (or sewage) at 15°C
full bore conditions.

18

continued

velocities in m/s
discharges in m³/s

Gradient	Pipe diameters in mm:											
	350	375	400	450	500	525	600	675	700	750	800	825
0.00075 1/ 1333	0.465 0.045	0.486 0.054	0.507 0.064	0.547 0.087	0.585 0.115	0.603 0.131	0.657 0.186	0.707 0.253	0.724 0.279	0.756 0.334	0.787 0.396	0.803 0.429
0.00080 1/ 1250	0.480 0.046	0.502 0.055	0.524 0.066	0.565 0.090	0.604 0.119	0.623 0.135	0.678 0.192	0.731 0.262	0.748 0.288	0.781 0.345	0.813 0.409	0.829 0.443
0.00085 1/ 1176	0.496 0.048	0.518 0.057	0.540 0.068	0.583 0.093	0.623 0.122	0.643 0.139	0.700 0.198	0.754 0.270	0.771 0.297	0.806 0.356	0.839 0.422	0.855 0.457
0.00090 1/ 1111	0.510 0.049	0.534 0.059	0.556 0.070	0.600 0.095	0.642 0.126	0.662 0.143	0.720 0.204	0.776 0.278	0.794 0.306	0.829 0.366	0.864 0.434	0.880 0.471
0.00095 1/ 1053	0.525 0.050	0.549 0.061	0.572 0.072	0.617 0.098	0.660 0.130	0.680 0.147	0.741 0.209	0.798 0.285	0.816 0.314	0.852 0.377	0.888 0.446	0.905 0.484
0.00100 1/ 1000	0.539 0.052	0.563 0.062	0.587 0.074	0.633 0.101	0.677 0.133	0.698 0.151	0.760 0.215	0.819 0.293	0.838 0.322	0.875 0.387	0.911 0.458	0.929 0.496
0.00110 1/ 909	0.566 0.054	0.591 0.065	0.616 0.077	0.665 0.106	0.711 0.140	0.733 0.159	0.798 0.226	0.859 0.308	0.879 0.338	0.918 0.406	0.956 0.481	0.975 0.521
0.00120 1/ 833	0.591 0.057	0.618 0.068	0.644 0.081	0.695 0.110	0.743 0.146	0.766 0.166	0.834 0.236	0.898 0.321	0.919 0.354	0.960 0.424	0.999 0.502	1.019 0.545
0.00130 1/ 769	0.616 0.059	0.644 0.071	0.671 0.084	0.724 0.115	0.774 0.152	0.798 0.173	0.869 0.246	0.935 0.335	0.957 0.368	0.999 0.442	1.041 0.523	1.061 0.567
0.00140 1/ 714	0.640 0.062	0.669 0.074	0.697 0.088	0.751 0.120	0.803 0.158	0.829 0.179	0.902 0.255	0.971 0.348	0.994 0.382	1.038 0.458	1.080 0.543	1.101 0.589
0.00150 1/ 667	0.663 0.064	0.693 0.077	0.722 0.091	0.778 0.124	0.832 0.163	0.858 0.186	0.934 0.264	1.006 0.360	1.029 0.396	1.075 0.475	1.119 0.562	1.141 0.610
0.00160 1/ 625	0.685 0.066	0.716 0.079	0.746 0.094	0.804 0.128	0.860 0.169	0.887 0.192	0.965 0.273	1.039 0.372	1.063 0.409	1.110 0.490	1.156 0.581	1.178 0.630
0.00170 1/ 588	0.706 0.068	0.738 0.082	0.769 0.097	0.829 0.132	0.887 0.174	0.915 0.198	0.995 0.281	1.072 0.383	1.096 0.422	1.145 0.506	1.192 0.599	1.215 0.650
0.00180 1/ 556	0.727 0.070	0.760 0.084	0.792 0.100	0.854 0.136	0.913 0.179	0.942 0.204	1.024 0.290	1.103 0.395	1.129 0.434	1.178 0.521	1.227 0.617	1.251 0.669
0.00190 1/ 526	0.747 0.072	0.781 0.086	0.814 0.102	0.878 0.140	0.938 0.184	0.968 0.209	1.053 0.298	1.134 0.406	1.160 0.446	1.211 0.535	1.261 0.634	1.285 0.687
0.00200 1/ 500	0.767 0.074	0.802 0.089	0.836 0.105	0.901 0.143	0.963 0.189	0.993 0.215	1.081 0.306	1.164 0.416	1.190 0.458	1.243 0.549	1.294 0.650	1.319 0.705
0.00220 1/ 455	0.805 0.077	0.842 0.093	0.877 0.110	0.945 0.150	1.011 0.198	1.042 0.226	1.134 0.321	1.221 0.437	1.249 0.481	1.304 0.576	1.358 0.683	1.384 0.740
0.00240 1/ 417	0.842 0.081	0.880 0.097	0.917 0.115	0.988 0.157	1.056 0.207	1.089 0.236	1.185 0.335	1.276 0.457	1.305 0.502	1.363 0.602	1.419 0.713	1.446 0.773
0.00260 1/ 385	0.877 0.084	0.916 0.101	0.955 0.120	1.029 0.164	1.100 0.216	1.134 0.246	1.234 0.349	1.329 0.475	1.359 0.523	1.419 0.627	1.477 0.743	1.506 0.805
0.00280 1/ 357	0.910 0.088	0.951 0.105	0.991 0.125	1.068 0.170	1.142 0.224	1.178 0.255	1.281 0.362	1.379 0.494	1.411 0.543	1.473 0.651	1.534 0.771	1.563 0.836
0.00300 1/ 333	0.943 0.091	0.985 0.109	1.026 0.129	1.106 0.176	1.183 0.232	1.220 0.264	1.326 0.375	1.428 0.511	1.461 0.562	1.525 0.674	1.588 0.798	1.619 0.865
0.00320 1/ 313	0.974 0.094	1.018 0.112	1.061 0.133	1.143 0.182	1.222 0.240	1.260 0.273	1.370 0.387	1.475 0.528	1.509 0.581	1.576 0.696	1.641 0.825	1.672 0.894
0.00340 1/ 294	1.004 0.097	1.050 0.116	1.094 0.137	1.179 0.187	1.260 0.247	1.299 0.281	1.413 0.400	1.521 0.544	1.556 0.599	1.625 0.718	1.692 0.850	1.724 0.922
0.00360 1/ 278	1.034 0.099	1.080 0.119	1.126 0.141	1.213 0.193	1.297 0.255	1.337 0.289	1.454 0.411	1.566 0.560	1.602 0.616	1.672 0.739	1.741 0.875	1.775 0.949
0.00380 1/ 263	1.063 0.102	1.110 0.123	1.157 0.145	1.247 0.198	1.333 0.262	1.374 0.297	1.495 0.423	1.609 0.576	1.646 0.634	1.719 0.759	1.789 0.899	1.824 0.975

Coefficient for part-full pipes:

120	130	140	150	150	200	200	250	250	250	300	300
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ks = 0.600mm i < 0.004

Max discharge rate ex. 675mm ϕ
SW sewer can take is 528 l/s.

18

ks = 0.600mm

I = 0.004 to 0.1

continued

ie hydraulic gradient =
1 in 250 to 1 in 10Water (or sewage) at 15°C
full bore conditions.velocities in m/s
discharges in m³/s13023 - LANGTONE TECH PARK
MASTER PLAN.MAX DISCHARGE RATE OF
EX. SW SEWER.

ZONE 2

Gradient	Pipe diameters in mm:											
	350	375	400	450	500	525	600	675	700	750	800	825
0.00400 1/ 250	1.091 0.105	1.140 0.126	1.187 0.149	1.280 0.203	1.368 0.269	1.410 0.305	1.534 0.434	1.651 0.591	1.689 0.650	1.764 0.779	1.836 0.923	1.871 1.000
0.00420 1/ 238	1.118 0.108	1.168 0.129	1.217 0.153	1.311 0.209	1.402 0.275	1.446 0.313	1.572 0.444	1.692 0.606	1.731 0.666	1.808 0.799	1.882 0.946	1.918 1.025
0.00440 1/ 227	1.145 0.110	1.196 0.132	1.246 0.157	1.343 0.214	1.435 0.282	1.480 0.320	1.609 0.455	1.733 0.620	1.772 0.682	1.850 0.817	1.926 0.968	1.963 1.050
0.00460 1/ 217	1.171 0.113	1.223 0.135	1.274 0.160	1.373 0.218	1.468 0.288	1.513 0.328	1.646 0.465	1.772 0.634	1.813 0.698	1.892 0.836	1.970 0.990	2.008 1.073
0.00480 1/ 208	1.196 0.115	1.250 0.138	1.302 0.164	1.403 0.223	1.499 0.294	1.546 0.335	1.682 0.475	1.810 0.648	1.852 0.713	1.933 0.854	2.013 1.012	2.051 1.097
0.00500 1/ 200	1.221 0.117	1.276 0.141	1.329 0.167	1.432 0.228	1.531 0.301	1.578 0.342	1.717 0.485	1.848 0.661	1.890 0.727	1.973 0.872	2.054 1.033	2.094 1.119
0.00550 1/ 182	1.281 0.123	1.339 0.148	1.395 0.175	1.503 0.239	1.606 0.315	1.656 0.359	1.801 0.509	1.939 0.694	1.983 0.763	2.070 0.915	2.155 1.083	2.197 1.174
0.00600 1/ 167	1.339 0.129	1.399 0.155	1.457 0.183	1.570 0.250	1.678 0.330	1.730 0.375	1.882 0.532	2.026 0.725	2.072 0.797	2.163 0.856	2.252 1.132	2.295 1.227
0.00650 1/ 154	1.394 0.134	1.457 0.161	1.518 0.191	1.635 0.260	1.747 0.343	1.802 0.390	1.959 0.554	2.109 0.755	2.157 0.830	2.252 0.995	2.344 1.178	2.390 1.277
0.00700 1/ 143	1.447 0.139	1.512 0.167	1.575 0.198	1.697 0.270	1.814 0.356	1.870 0.405	2.034 0.575	2.189 0.783	2.239 0.862	2.338 1.033	2.433 1.223	2.480 1.326
0.00750 1/ 133	1.499 0.144	1.566 0.173	1.631 0.205	1.757 0.279	1.878 0.369	1.936 0.419	2.106 0.595	2.266 0.811	2.318 0.892	2.420 1.069	2.519 1.266	2.568 1.373
0.00800 1/ 125	1.548 0.149	1.618 0.179	1.685 0.212	1.815 0.289	1.940 0.381	2.000 0.433	2.175 0.615	2.341 0.838	2.395 0.922	2.500 1.105	2.602 1.308	2.653 1.418
0.00850 1/ 118	1.596 0.154	1.668 0.184	1.737 0.218	1.872 0.298	2.000 0.393	2.062 0.446	2.243 0.634	2.414 0.864	2.469 0.950	2.577 1.139	2.683 1.349	2.735 1.462
0.00900 1/ 111	1.643 0.158	1.717 0.190	1.788 0.225	1.926 0.306	2.059 0.404	2.123 0.459	2.308 0.653	2.484 0.889	2.541 0.978	2.653 1.172	2.761 1.388	2.814 1.504
0.00950 1/ 105	1.688 0.162	1.764 0.195	1.838 0.231	1.980 0.315	2.115 0.415	2.181 0.472	2.372 0.671	2.553 0.913	2.611 1.005	2.726 1.204	2.837 1.426	2.892 1.546
0.01000 1/ 100	1.733 0.167	1.810 0.200	1.886 0.237	2.031 0.323	2.171 0.426	2.238 0.485	2.434 0.688	2.619 0.937	2.679 1.031	2.797 1.236	2.911 1.463	2.967 1.586
0.01100 1/ 91	1.818 0.175	1.899 0.210	1.978 0.249	2.131 0.339	2.277 0.447	2.348 0.508	2.553 0.722	2.748 0.983	2.811 1.082	2.934 1.296	3.054 1.535	3.113 1.664
0.01200 1/ 83	1.899 0.183	1.984 0.219	2.067 0.260	2.227 0.354	2.379 0.467	2.453 0.531	2.667 0.754	2.871 1.027	2.936 1.130	3.065 1.354	3.191 1.604	3.252 1.738
0.01300 1/ 77	1.977 0.190	2.066 0.228	2.152 0.270	2.318 0.369	2.477 0.486	2.554 0.553	2.777 0.785	2.989 1.069	3.057 1.176	3.191 1.410	3.321 1.670	3.385 1.810
0.01400 1/ 71	2.053 0.197	2.144 0.237	2.234 0.281	2.406 0.383	2.571 0.505	2.651 0.574	2.882 0.815	3.102 1.110	3.173 1.221	3.312 1.463	3.447 1.733	3.514 1.878
0.01500 1/ 67	2.125 0.204	2.220 0.245	2.313 0.291	2.491 0.396	2.662 0.523	2.745 0.594	2.984 0.844	3.211 1.149	3.285 1.264	3.429 1.515	3.569 1.794	3.638 1.945
0.01600 1/ 62	2.195 0.211	2.294 0.253	2.389 0.300	2.573 0.409	2.750 0.540	2.835 0.614	3.082 0.871	3.317 1.187	3.393 1.306	3.542 1.565	3.686 1.853	3.757 2.009
0.01700 1/ 59	2.263 0.218	2.365 0.261	2.463 0.310	2.653 0.422	2.835 0.557	2.923 0.633	3.177 0.898	3.420 1.224	3.498 1.346	3.651 1.613	3.800 1.910	3.874 2.071
0.01800 1/ 56	2.329 0.224	2.434 0.269	2.535 0.319	2.730 0.434	2.917 0.573	3.008 0.651	3.270 0.925	3.519 1.259	3.600 1.385	3.757 1.660	3.911 1.966	3.986 2.131
0.01900 1/ 53	2.394 0.230	2.501 0.276	2.605 0.327	2.806 0.446	2.998 0.589	3.091 0.669	3.360 0.950	3.616 1.294	3.699 1.423	3.861 1.706	4.019 2.020	4.096 2.190
Coefficient for part-full pipes:												
	200	200	200	250	250	250	300	350	350	400	400	450

ks = 0.600mm

I = 0.1

Max discharge rate ex. 375mm ϕ
80
SW Sewer can take 15 219 l/s.