

Central Coast Region Stormwater Control Measure Sizing Calculator

1. Project Information

Project name:	
Project location:	
Tier 2/Tier 3:	Tier 3 - Retention
Design rainfall depth (in):	
Total project area (ft2):	
Total DMA area (ft2):	0
Total new impervious area (ft2):	
Total replaced impervious within a USA (ft2):	
Total replaced impervious not in a USA (ft2):	
Total pervious/landscape area (ft2):	
Total SCM area (ft2):	

2. DMA Characterization

Name	DMA Type	Area (ft2)	Surface Type	New, Replaced?	Connection

DMA Summary Area CI	
Total assigned DMA area (ft2):	0
New impervious area (ft2):	0
Replaced impervious within a USA (ft2):	0
Replaced impervious not in a USA (ft2):	0
Total pervious/landscape area (ft2):	0

3. SCM Characterization

Name	SCM Type	Safety Factor	SCM Soil Type	Infilt. Rate (in/hr)	Area (ft2)

4. Run SBUH Model

5. SCM Minimum Sizing Requirements

SCM Name	Min. Required Storage Vol. (ft3)	Depth Below Underdrain (ft)	Drain Time (hours)	Orifice Diameter (in)

6. Self-Retaining Area Sizing Checks

Self-Retaining DMA Name	Self-Retaining DMA Area (ft2)	Tributary DMA Name(s)	Eff. Tributary DMA Area (ft2)	Effective Tributary / SRA Area Ratio

scm 1

SBUH Parameters:

Design rainfall depth (in) =	0.00		
Model time step (min) =	6		
DMA Summary	Area (ft2)	CN	S
New impervious area:	10000	98	0.20
Replaced impervious in USA:	0	98	0.20
Replaced impervious not USA:	0	98	0.20
Landscape area:	0	68	4.71
Solid unit pavers set in sand:	0	89	1.24
Non-runoff generating area:	0	N/A	N/A
Weighted impervious (ft2) =	#DIV/0!		
Travel path length (ft) =	141.4		
Time of concentration (min) =	#DIV/0!	(rain/runoff)	#DIV/0!

SBUH Runoff Calculations

Time (minutes)	Distribution (Type I)	Rainfall Depth (in)	Cumulative Rainfall (in)	Impervious	
				Cumulative Runoff Depth (in)	Instantaneous Runoff (in)
0	0.0000	0.0000	0.0000	0.0000	0.0000
6	0.0017	0.0000	0.0000	0.0000	0.0000
12	0.0017	0.0000	0.0000	0.0000	0.0000
18	0.0017	0.0000	0.0000	0.0000	0.0000
24	0.0017	0.0000	0.0000	0.0000	0.0000
30	0.0017	0.0000	0.0000	0.0000	0.0000
36	0.0017	0.0000	0.0000	0.0000	0.0000
42	0.0017	0.0000	0.0000	0.0000	0.0000
48	0.0017	0.0000	0.0000	0.0000	0.0000
54	0.0017	0.0000	0.0000	0.0000	0.0000
60	0.0018	0.0000	0.0000	0.0000	0.0000
66	0.0018	0.0000	0.0000	0.0000	0.0000
72	0.0018	0.0000	0.0000	0.0000	0.0000
78	0.0018	0.0000	0.0000	0.0000	0.0000
84	0.0018	0.0000	0.0000	0.0000	0.0000
90	0.0018	0.0000	0.0000	0.0000	0.0000
96	0.0018	0.0000	0.0000	0.0000	0.0000
102	0.0018	0.0000	0.0000	0.0000	0.0000
108	0.0018	0.0000	0.0000	0.0000	0.0000
114	0.0018	0.0000	0.0000	0.0000	0.0000
120	0.0018	0.0000	0.0000	0.0000	0.0000
126	0.0018	0.0000	0.0000	0.0000	0.0000
132	0.0018	0.0000	0.0000	0.0000	0.0000
138	0.0018	0.0000	0.0000	0.0000	0.0000
144	0.0019	0.0000	0.0000	0.0000	0.0000
150	0.0019	0.0000	0.0000	0.0000	0.0000

156	0.0019	0.0000	0.0000	0.0000	0.0000
162	0.0019	0.0000	0.0000	0.0000	0.0000
168	0.0020	0.0000	0.0000	0.0000	0.0000
174	0.0020	0.0000	0.0000	0.0000	0.0000
180	0.0020	0.0000	0.0000	0.0000	0.0000
186	0.0021	0.0000	0.0000	0.0000	0.0000
192	0.0021	0.0000	0.0000	0.0000	0.0000
198	0.0021	0.0000	0.0000	0.0000	0.0000
204	0.0022	0.0000	0.0000	0.0000	0.0000
210	0.0022	0.0000	0.0000	0.0000	0.0000
216	0.0022	0.0000	0.0000	0.0000	0.0000
222	0.0022	0.0000	0.0000	0.0000	0.0000
228	0.0023	0.0000	0.0000	0.0000	0.0000
234	0.0023	0.0000	0.0000	0.0000	0.0000
240	0.0023	0.0000	0.0000	0.0000	0.0000
246	0.0023	0.0000	0.0000	0.0000	0.0000
252	0.0024	0.0000	0.0000	0.0000	0.0000
258	0.0024	0.0000	0.0000	0.0000	0.0000
264	0.0024	0.0000	0.0000	0.0000	0.0000
270	0.0024	0.0000	0.0000	0.0000	0.0000
276	0.0024	0.0000	0.0000	0.0000	0.0000
282	0.0024	0.0000	0.0000	0.0000	0.0000
288	0.0024	0.0000	0.0000	0.0000	0.0000
294	0.0024	0.0000	0.0000	0.0000	0.0000
300	0.0024	0.0000	0.0000	0.0000	0.0000
306	0.0025	0.0000	0.0000	0.0000	0.0000
312	0.0025	0.0000	0.0000	0.0000	0.0000
318	0.0025	0.0000	0.0000	0.0000	0.0000
324	0.0025	0.0000	0.0000	0.0000	0.0000
330	0.0025	0.0000	0.0000	0.0000	0.0000
336	0.0025	0.0000	0.0000	0.0000	0.0000
342	0.0025	0.0000	0.0000	0.0000	0.0000
348	0.0025	0.0000	0.0000	0.0000	0.0000
354	0.0025	0.0000	0.0000	0.0000	0.0000
360	0.0026	0.0000	0.0000	0.0000	0.0000
366	0.0026	0.0000	0.0000	0.0000	0.0000
372	0.0027	0.0000	0.0000	0.0000	0.0000
378	0.0028	0.0000	0.0000	0.0000	0.0000
384	0.0029	0.0000	0.0000	0.0000	0.0000
390	0.0030	0.0000	0.0000	0.0000	0.0000
396	0.0032	0.0000	0.0000	0.0000	0.0000
402	0.0033	0.0000	0.0000	0.0000	0.0000
408	0.0034	0.0000	0.0000	0.0000	0.0000
414	0.0035	0.0000	0.0000	0.0000	0.0000
420	0.0036	0.0000	0.0000	0.0000	0.0000
426	0.0037	0.0000	0.0000	0.0000	0.0000
432	0.0037	0.0000	0.0000	0.0000	0.0000
438	0.0037	0.0000	0.0000	0.0000	0.0000

444	0.0038	0.0000	0.0000	0.0000	0.0000
450	0.0038	0.0000	0.0000	0.0000	0.0000
456	0.0038	0.0000	0.0000	0.0000	0.0000
462	0.0038	0.0000	0.0000	0.0000	0.0000
468	0.0039	0.0000	0.0000	0.0000	0.0000
474	0.0039	0.0000	0.0000	0.0000	0.0000
480	0.0039	0.0000	0.0000	0.0000	0.0000
486	0.0042	0.0000	0.0000	0.0000	0.0000
492	0.0046	0.0000	0.0000	0.0000	0.0000
498	0.0050	0.0000	0.0000	0.0000	0.0000
504	0.0054	0.0000	0.0000	0.0000	0.0000
510	0.0058	0.0000	0.0000	0.0000	0.0000
516	0.0062	0.0000	0.0000	0.0000	0.0000
522	0.0066	0.0000	0.0000	0.0000	0.0000
528	0.0070	0.0000	0.0000	0.0000	0.0000
534	0.0074	0.0000	0.0000	0.0000	0.0000
540	0.0078	0.0000	0.0000	0.0000	0.0000
546	0.0083	0.0000	0.0000	0.0000	0.0000
552	0.0091	0.0000	0.0000	0.0000	0.0000
558	0.0098	0.0000	0.0000	0.0000	0.0000
564	0.0105	0.0000	0.0000	0.0000	0.0000
570	0.0113	0.0000	0.0000	0.0000	0.0000
576	0.0164	0.0000	0.0000	0.0000	0.0000
582	0.0260	0.0000	0.0000	0.0000	0.0000
588	0.0424	0.0000	0.0000	0.0000	0.0000
594	0.0753	0.0000	0.0000	0.0000	0.0000
600	0.0518	0.0000	0.0000	0.0000	0.0000
606	0.0172	0.0000	0.0000	0.0000	0.0000
612	0.0154	0.0000	0.0000	0.0000	0.0000
618	0.0136	0.0000	0.0000	0.0000	0.0000
624	0.0118	0.0000	0.0000	0.0000	0.0000
630	0.0100	0.0000	0.0000	0.0000	0.0000
636	0.0089	0.0000	0.0000	0.0000	0.0000
642	0.0084	0.0000	0.0000	0.0000	0.0000
648	0.0080	0.0000	0.0000	0.0000	0.0000
654	0.0076	0.0000	0.0000	0.0000	0.0000
660	0.0071	0.0000	0.0000	0.0000	0.0000
666	0.0068	0.0000	0.0000	0.0000	0.0000
672	0.0067	0.0000	0.0000	0.0000	0.0000
678	0.0065	0.0000	0.0000	0.0000	0.0000
684	0.0063	0.0000	0.0000	0.0000	0.0000
690	0.0062	0.0000	0.0000	0.0000	0.0000
696	0.0060	0.0000	0.0000	0.0000	0.0000
702	0.0059	0.0000	0.0000	0.0000	0.0000
708	0.0057	0.0000	0.0000	0.0000	0.0000
714	0.0055	0.0000	0.0000	0.0000	0.0000
720	0.0054	0.0000	0.0000	0.0000	0.0000
726	0.0052	0.0000	0.0000	0.0000	0.0000

732	0.0051	0.0000	0.0000	0.0000	0.0000
738	0.0051	0.0000	0.0000	0.0000	0.0000
744	0.0050	0.0000	0.0000	0.0000	0.0000
750	0.0049	0.0000	0.0000	0.0000	0.0000
756	0.0047	0.0000	0.0000	0.0000	0.0000
762	0.0047	0.0000	0.0000	0.0000	0.0000
768	0.0045	0.0000	0.0000	0.0000	0.0000
774	0.0045	0.0000	0.0000	0.0000	0.0000
780	0.0043	0.0000	0.0000	0.0000	0.0000
786	0.0042	0.0000	0.0000	0.0000	0.0000
792	0.0041	0.0000	0.0000	0.0000	0.0000
798	0.0041	0.0000	0.0000	0.0000	0.0000
804	0.0040	0.0000	0.0000	0.0000	0.0000
810	0.0039	0.0000	0.0000	0.0000	0.0000
816	0.0038	0.0000	0.0000	0.0000	0.0000
822	0.0037	0.0000	0.0000	0.0000	0.0000
828	0.0035	0.0000	0.0000	0.0000	0.0000
834	0.0035	0.0000	0.0000	0.0000	0.0000
840	0.0033	0.0000	0.0000	0.0000	0.0000
846	0.0033	0.0000	0.0000	0.0000	0.0000
852	0.0033	0.0000	0.0000	0.0000	0.0000
858	0.0032	0.0000	0.0000	0.0000	0.0000
864	0.0032	0.0000	0.0000	0.0000	0.0000
870	0.0032	0.0000	0.0000	0.0000	0.0000
876	0.0032	0.0000	0.0000	0.0000	0.0000
882	0.0032	0.0000	0.0000	0.0000	0.0000
888	0.0031	0.0000	0.0000	0.0000	0.0000
894	0.0031	0.0000	0.0000	0.0000	0.0000
900	0.0031	0.0000	0.0000	0.0000	0.0000
906	0.0031	0.0000	0.0000	0.0000	0.0000
912	0.0031	0.0000	0.0000	0.0000	0.0000
918	0.0031	0.0000	0.0000	0.0000	0.0000
924	0.0030	0.0000	0.0000	0.0000	0.0000
930	0.0030	0.0000	0.0000	0.0000	0.0000
936	0.0030	0.0000	0.0000	0.0000	0.0000
942	0.0030	0.0000	0.0000	0.0000	0.0000
948	0.0030	0.0000	0.0000	0.0000	0.0000
954	0.0029	0.0000	0.0000	0.0000	0.0000
960	0.0029	0.0000	0.0000	0.0000	0.0000
966	0.0029	0.0000	0.0000	0.0000	0.0000
972	0.0029	0.0000	0.0000	0.0000	0.0000
978	0.0029	0.0000	0.0000	0.0000	0.0000
984	0.0028	0.0000	0.0000	0.0000	0.0000
990	0.0028	0.0000	0.0000	0.0000	0.0000
996	0.0028	0.0000	0.0000	0.0000	0.0000
1002	0.0028	0.0000	0.0000	0.0000	0.0000
1008	0.0028	0.0000	0.0000	0.0000	0.0000
1014	0.0027	0.0000	0.0000	0.0000	0.0000

1020	0.0027	0.0000	0.0000	0.0000	0.0000
1026	0.0027	0.0000	0.0000	0.0000	0.0000
1032	0.0027	0.0000	0.0000	0.0000	0.0000
1038	0.0026	0.0000	0.0000	0.0000	0.0000
1044	0.0026	0.0000	0.0000	0.0000	0.0000
1050	0.0026	0.0000	0.0000	0.0000	0.0000
1056	0.0026	0.0000	0.0000	0.0000	0.0000
1062	0.0026	0.0000	0.0000	0.0000	0.0000
1068	0.0025	0.0000	0.0000	0.0000	0.0000
1074	0.0025	0.0000	0.0000	0.0000	0.0000
1080	0.0025	0.0000	0.0000	0.0000	0.0000
1086	0.0025	0.0000	0.0000	0.0000	0.0000
1092	0.0025	0.0000	0.0000	0.0000	0.0000
1098	0.0025	0.0000	0.0000	0.0000	0.0000
1104	0.0024	0.0000	0.0000	0.0000	0.0000
1110	0.0024	0.0000	0.0000	0.0000	0.0000
1116	0.0024	0.0000	0.0000	0.0000	0.0000
1122	0.0024	0.0000	0.0000	0.0000	0.0000
1128	0.0024	0.0000	0.0000	0.0000	0.0000
1134	0.0023	0.0000	0.0000	0.0000	0.0000
1140	0.0023	0.0000	0.0000	0.0000	0.0000
1146	0.0023	0.0000	0.0000	0.0000	0.0000
1152	0.0023	0.0000	0.0000	0.0000	0.0000
1158	0.0022	0.0000	0.0000	0.0000	0.0000
1164	0.0022	0.0000	0.0000	0.0000	0.0000
1170	0.0022	0.0000	0.0000	0.0000	0.0000
1176	0.0022	0.0000	0.0000	0.0000	0.0000
1182	0.0022	0.0000	0.0000	0.0000	0.0000
1188	0.0021	0.0000	0.0000	0.0000	0.0000
1194	0.0021	0.0000	0.0000	0.0000	0.0000
1200	0.0021	0.0000	0.0000	0.0000	0.0000
1206	0.0021	0.0000	0.0000	0.0000	0.0000
1212	0.0021	0.0000	0.0000	0.0000	0.0000
1218	0.0021	0.0000	0.0000	0.0000	0.0000
1224	0.0020	0.0000	0.0000	0.0000	0.0000
1230	0.0020	0.0000	0.0000	0.0000	0.0000
1236	0.0020	0.0000	0.0000	0.0000	0.0000
1242	0.0020	0.0000	0.0000	0.0000	0.0000
1248	0.0020	0.0000	0.0000	0.0000	0.0000
1254	0.0019	0.0000	0.0000	0.0000	0.0000
1260	0.0019	0.0000	0.0000	0.0000	0.0000
1266	0.0019	0.0000	0.0000	0.0000	0.0000
1272	0.0019	0.0000	0.0000	0.0000	0.0000
1278	0.0018	0.0000	0.0000	0.0000	0.0000
1284	0.0018	0.0000	0.0000	0.0000	0.0000
1290	0.0018	0.0000	0.0000	0.0000	0.0000
1296	0.0018	0.0000	0.0000	0.0000	0.0000
1302	0.0018	0.0000	0.0000	0.0000	0.0000

1308	0.0018	0.0000	0.0000	0.0000	0.0000
1314	0.0017	0.0000	0.0000	0.0000	0.0000
1320	0.0017	0.0000	0.0000	0.0000	0.0000
1326	0.0017	0.0000	0.0000	0.0000	0.0000
1332	0.0017	0.0000	0.0000	0.0000	0.0000
1338	0.0017	0.0000	0.0000	0.0000	0.0000
1344	0.0016	0.0000	0.0000	0.0000	0.0000
1350	0.0016	0.0000	0.0000	0.0000	0.0000
1356	0.0016	0.0000	0.0000	0.0000	0.0000
1362	0.0016	0.0000	0.0000	0.0000	0.0000
1368	0.0015	0.0000	0.0000	0.0000	0.0000
1374	0.0015	0.0000	0.0000	0.0000	0.0000
1380	0.0015	0.0000	0.0000	0.0000	0.0000
1386	0.0015	0.0000	0.0000	0.0000	0.0000
1392	0.0015	0.0000	0.0000	0.0000	0.0000
1398	0.0015	0.0000	0.0000	0.0000	0.0000
1404	0.0014	0.0000	0.0000	0.0000	0.0000
1410	0.0014	0.0000	0.0000	0.0000	0.0000
1416	0.0014	0.0000	0.0000	0.0000	0.0000
1422	0.0014	0.0000	0.0000	0.0000	0.0000
1428	0.0014	0.0000	0.0000	0.0000	0.0000
1434	0.0013	0.0000	0.0000	0.0000	0.0000
1440	0.0013	0.0000	0.0000	0.0000	0.0000
1446	0.0000	0.0000	0.0000	0.0000	0.0000
1452	0.0000	0.0000	0.0000	0.0000	0.0000
1458	0.0000	0.0000	0.0000	0.0000	0.0000
1464	0.0000	0.0000	0.0000	0.0000	0.0000
1470	0.0000	0.0000	0.0000	0.0000	0.0000
1476	0.0000	0.0000	0.0000	0.0000	0.0000
1482	0.0000	0.0000	0.0000	0.0000	0.0000
1488	0.0000	0.0000	0.0000	0.0000	0.0000
1494	0.0000	0.0000	0.0000	0.0000	0.0000
1500	0.0000	0.0000	0.0000	0.0000	0.0000
1506	0.0000	0.0000	0.0000	0.0000	0.0000
1512	0.0000	0.0000	0.0000	0.0000	0.0000
1518	0.0000	0.0000	0.0000	0.0000	0.0000
1524	0.0000	0.0000	0.0000	0.0000	0.0000
1530	0.0000	0.0000	0.0000	0.0000	0.0000
1536	0.0000	0.0000	0.0000	0.0000	0.0000
1542	0.0000	0.0000	0.0000	0.0000	0.0000
1548	0.0000	0.0000	0.0000	0.0000	0.0000
1554	0.0000	0.0000	0.0000	0.0000	0.0000
1560	0.0000	0.0000	0.0000	0.0000	0.0000
1566	0.0000	0.0000	0.0000	0.0000	0.0000
1572	0.0000	0.0000	0.0000	0.0000	0.0000
1578	0.0000	0.0000	0.0000	0.0000	0.0000
1584	0.0000	0.0000	0.0000	0.0000	0.0000
1590	0.0000	0.0000	0.0000	0.0000	0.0000

7068	0.0000	0.0000	0.0000	0.0000	0.0000
7074	0.0000	0.0000	0.0000	0.0000	0.0000
7080	0.0000	0.0000	0.0000	0.0000	0.0000
7086	0.0000	0.0000	0.0000	0.0000	0.0000
7092	0.0000	0.0000	0.0000	0.0000	0.0000
7098	0.0000	0.0000	0.0000	0.0000	0.0000
7104	0.0000	0.0000	0.0000	0.0000	0.0000
7110	0.0000	0.0000	0.0000	0.0000	0.0000
7116	0.0000	0.0000	0.0000	0.0000	0.0000
7122	0.0000	0.0000	0.0000	0.0000	0.0000
7128	0.0000	0.0000	0.0000	0.0000	0.0000
7134	0.0000	0.0000	0.0000	0.0000	0.0000
7140	0.0000	0.0000	0.0000	0.0000	0.0000
7146	0.0000	0.0000	0.0000	0.0000	0.0000
7152	0.0000	0.0000	0.0000	0.0000	0.0000
7158	0.0000	0.0000	0.0000	0.0000	0.0000
7164	0.0000	0.0000	0.0000	0.0000	0.0000
7170	0.0000	0.0000	0.0000	0.0000	0.0000
7176	0.0000	0.0000	0.0000	0.0000	0.0000
7182	0.0000	0.0000	0.0000	0.0000	0.0000
7188	0.0000	0.0000	0.0000	0.0000	0.0000
7194	0.0000	0.0000	0.0000	0.0000	0.0000
7200	0.0000	0.0000	0.0000	0.0000	0.0000

SCS Type I Distribution (6-min)

Step	Minute	Cummulative Distribution	Incremental Distribution
0	0	0.0000	0.0000
1	6	0.0017	0.0017
2	12	0.0035	0.0017
3	18	0.0052	0.0017
4	24	0.0070	0.0017
5	30	0.0087	0.0017
6	36	0.0105	0.0017
7	42	0.0122	0.0017
8	48	0.0140	0.0017
9	54	0.0157	0.0017
10	60	0.0175	0.0018
11	66	0.0192	0.0018
12	72	0.0210	0.0018
13	78	0.0227	0.0018
14	84	0.0245	0.0018
15	90	0.0262	0.0018
16	96	0.0280	0.0018
17	102	0.0297	0.0018
18	108	0.0315	0.0018
19	114	0.0332	0.0018
20	120	0.0350	0.0018
21	126	0.0368	0.0018
22	132	0.0386	0.0018
23	138	0.0404	0.0018
24	144	0.0423	0.0019
25	150	0.0442	0.0019
26	156	0.0461	0.0019
27	162	0.0480	0.0019
28	168	0.0500	0.0020
29	174	0.0520	0.0020
30	180	0.0541	0.0020
31	186	0.0561	0.0021
32	192	0.0582	0.0021
33	198	0.0603	0.0021
34	204	0.0625	0.0022
35	210	0.0647	0.0022
36	216	0.0669	0.0022
37	222	0.0691	0.0022
38	228	0.0714	0.0023
39	234	0.0737	0.0023
40	240	0.0760	0.0023
41	246	0.0783	0.0023
42	252	0.0807	0.0024
43	258	0.0831	0.0024

Stormwater Runoff

Computing Runoff (SCS)

$$R = \frac{(P - I_a)^2}{P - I_a + S}$$

$$I_a = 0.2S$$

$$R = \frac{(P - 0.2S)^2}{P - 0.8S}$$

$$S = \frac{1000}{CN} - 10$$

SBUH Runoff Routing:

$$I_t = \frac{R_t \times A}{dt} \times \frac{1}{12 \times 60}$$

$$Q_{t+1} = Q_t + w[I_t +$$

$$w = \frac{dt}{(2T_c + dt)}$$

$$T_c = \frac{0.007(nL)^{0.8}}{(P_2)^{0.5} \times S^{0.4}}$$

from TR-55 user manual

Chapter 3

Sheet flow

Sheet flow is flow over pla
occurs in the headwater of
the friction value (Manning;
ness coefficient that inclu
impact; drag over the plan
litter, crop ridges, and roc

44	264	0.0854	0.0024
45	270	0.0878	0.0024
46	276	0.0902	0.0024
47	282	0.0926	0.0024
48	288	0.0951	0.0024
49	294	0.0975	0.0024
50	300	0.1000	0.0024
51	306	0.1024	0.0025
52	312	0.1049	0.0025
53	318	0.1074	0.0025
54	324	0.1098	0.0025
55	330	0.1123	0.0025
56	336	0.1148	0.0025
57	342	0.1174	0.0025
58	348	0.1199	0.0025
59	354	0.1224	0.0025
60	360	0.1250	0.0026
61	366	0.1276	0.0026
62	372	0.1303	0.0027
63	378	0.1332	0.0028
64	384	0.1361	0.0029
65	390	0.1392	0.0030
66	396	0.1423	0.0032
67	402	0.1456	0.0033
68	408	0.1489	0.0034
69	414	0.1524	0.0035
70	420	0.1560	0.0036
71	426	0.1597	0.0037
72	432	0.1633	0.0037
73	438	0.1671	0.0037
74	444	0.1708	0.0038
75	450	0.1746	0.0038
76	456	0.1784	0.0038
77	462	0.1823	0.0038
78	468	0.1861	0.0039
79	474	0.1901	0.0039
80	480	0.1940	0.0039
81	486	0.1982	0.0042
82	492	0.2028	0.0046
83	498	0.2078	0.0050
84	504	0.2132	0.0054
85	510	0.2190	0.0058
86	516	0.2252	0.0062
87	522	0.2318	0.0066
88	528	0.2388	0.0070
89	534	0.2462	0.0074
90	540	0.2540	0.0078
91	546	0.2623	0.0083

portation of sediment. The shallow flow depths of abc gives Manning's n values f surface conditions.

Table 3-1 Roughness co sheet flow

Surface description
Smooth surfaces (concrete, a gravel, or bare soil)
Fallow (no residue)
Cultivated soils:
Residue cover ≤20%
Residue cover >20%
Grass:
Short grass prairie
Dense grasses ²
Bermudagrass
Range (natural)
Woods: ³
Light underbrush
Dense underbrush

¹ The n values are a composite of (1986).

² Includes species such as weep grass, blue grama grass, and n

³ When selecting n , consider co is the only part of the plant co

92	552	0.2714	0.0091
93	558	0.2812	0.0098
94	564	0.2917	0.0105
95	570	0.3030	0.0113
96	576	0.3194	0.0164
97	582	0.3454	0.0260
98	588	0.3878	0.0424
99	594	0.4632	0.0753
100	600	0.5150	0.0518
101	606	0.5322	0.0172
102	612	0.5476	0.0154
103	618	0.5612	0.0136
104	624	0.5730	0.0118
105	630	0.5830	0.0100
106	636	0.5919	0.0089
107	642	0.6003	0.0084
108	648	0.6083	0.0080
109	654	0.6159	0.0076
110	660	0.6230	0.0071
111	666	0.6298	0.0068
112	672	0.6365	0.0067
113	678	0.6430	0.0065
114	684	0.6493	0.0063
115	690	0.6555	0.0062
116	696	0.6615	0.0060
117	702	0.6674	0.0059
118	708	0.6731	0.0057
119	714	0.6786	0.0055
120	720	0.6840	0.0054
121	726	0.6893	0.0052
122	732	0.6944	0.0051
123	738	0.6995	0.0051
124	744	0.7044	0.0050
125	750	0.7093	0.0049
126	756	0.7140	0.0047
127	762	0.7187	0.0047
128	768	0.7232	0.0045
129	774	0.7277	0.0045
130	780	0.7320	0.0043
131	786	0.7363	0.0042
132	792	0.7404	0.0041
133	798	0.7445	0.0041
134	804	0.7484	0.0040
135	810	0.7523	0.0039
136	816	0.7560	0.0038
137	822	0.7597	0.0037
138	828	0.7632	0.0035
139	834	0.7667	0.0035

140	840	0.7700	0.0033
141	846	0.7733	0.0033
142	852	0.7766	0.0033
143	858	0.7798	0.0032
144	864	0.7830	0.0032
145	870	0.7863	0.0032
146	876	0.7894	0.0032
147	882	0.7926	0.0032
148	888	0.7958	0.0031
149	894	0.7989	0.0031
150	900	0.8020	0.0031
151	906	0.8051	0.0031
152	912	0.8082	0.0031
153	918	0.8112	0.0031
154	924	0.8142	0.0030
155	930	0.8173	0.0030
156	936	0.8202	0.0030
157	942	0.8232	0.0030
158	948	0.8262	0.0030
159	954	0.8291	0.0029
160	960	0.8320	0.0029
161	966	0.8349	0.0029
162	972	0.8378	0.0029
163	978	0.8406	0.0029
164	984	0.8434	0.0028
165	990	0.8463	0.0028
166	996	0.8490	0.0028
167	1002	0.8518	0.0028
168	1008	0.8546	0.0028
169	1014	0.8573	0.0027
170	1020	0.8600	0.0027
171	1026	0.8627	0.0027
172	1032	0.8654	0.0027
173	1038	0.8680	0.0026
174	1044	0.8706	0.0026
175	1050	0.8733	0.0026
176	1056	0.8758	0.0026
177	1062	0.8784	0.0026
178	1068	0.8810	0.0025
179	1074	0.8835	0.0025
180	1080	0.8860	0.0025
181	1086	0.8885	0.0025
182	1092	0.8910	0.0025
183	1098	0.8934	0.0025
184	1104	0.8958	0.0024
185	1110	0.8983	0.0024
186	1116	0.9006	0.0024
187	1122	0.9030	0.0024

188	1128	0.9054	0.0024
189	1134	0.9077	0.0023
190	1140	0.9100	0.0023
191	1146	0.9123	0.0023
192	1152	0.9146	0.0023
193	1158	0.9168	0.0022
194	1164	0.9190	0.0022
195	1170	0.9213	0.0022
196	1176	0.9234	0.0022
197	1182	0.9256	0.0022
198	1188	0.9278	0.0021
199	1194	0.9299	0.0021
200	1200	0.9320	0.0021
201	1206	0.9341	0.0021
202	1212	0.9362	0.0021
203	1218	0.9382	0.0021
204	1224	0.9402	0.0020
205	1230	0.9423	0.0020
206	1236	0.9442	0.0020
207	1242	0.9462	0.0020
208	1248	0.9482	0.0020
209	1254	0.9501	0.0019
210	1260	0.9520	0.0019
211	1266	0.9539	0.0019
212	1272	0.9558	0.0019
213	1278	0.9576	0.0018
214	1284	0.9594	0.0018
215	1290	0.9613	0.0018
216	1296	0.9630	0.0018
217	1302	0.9648	0.0018
218	1308	0.9666	0.0018
219	1314	0.9683	0.0017
220	1320	0.9700	0.0017
221	1326	0.9717	0.0017
222	1332	0.9734	0.0017
223	1338	0.9750	0.0017
224	1344	0.9766	0.0016
225	1350	0.9783	0.0016
226	1356	0.9798	0.0016
227	1362	0.9814	0.0016
228	1368	0.9830	0.0015
229	1374	0.9845	0.0015
230	1380	0.9860	0.0015
231	1386	0.9875	0.0015
232	1392	0.9890	0.0015
233	1398	0.9904	0.0015
234	1404	0.9918	0.0014
235	1410	0.9933	0.0014

236	1416	0.9946	0.0014
237	1422	0.9960	0.0014
238	1428	0.9974	0.0014
239	1434	0.9987	0.0013
240	1440	1.0000	0.0013

and Routing Equations:

and SBUH are the same):

where:

R = runoff (in)

P = rainfall (in)

Ia = initial abstraction (in)

S = potential maximum soil moisture retention after runoff begins (in)

CN = runoff curve number

50

$$I_{t+1} - 2Q_t]$$

where:

I_t = instantaneous hydrograph (cfs)

R_t = runoff for current time step (in)

A = contributing area (ft)

dt = calculation time step (min)

Q_t = routed stormwater flow

w = routing function

T_c = time of concentration

n = Manning's roughness (0.011 for pavement)

L = flow length (ft; computed from tributary area)

P₂ = 2-year, 24-hour rainfall (in)

s = 0.005 (ft/ft; assumed value)

Note: set minimum T_c = 5 minutes (Portland BES recommendation)

...

Time of Concentration and Travel Time	Technical Release 55 Urban Hydrology for Small Watersheds
<p>me surfaces. It usually f streams. With sheet flow, g's n) is an effective rough- des the effect of raindrop e surface; obstacles such as ks; and erosion and trans-</p>	<p>For sheet flow of less than 300 feet, use Manning's kinematic solution (Overtop and Meadows 1976) to compute T_t:</p> $T_t = \frac{0.007(nL)^{0.8}}{(P_2)^{0.5} s^{0.4}} \quad [\text{eq. 3-3}]$ <p>where:</p>

These n values are for very
shallow flow, about 0.1 foot or so. Table 3-1
gives n values for sheet flow for various

Coefficients (Manning's n) for	
	n
Asphalt,	
.....	0.011
.....	0.05
.....	0.06
.....	0.17
.....	0.15
.....	0.24
.....	0.41
.....	0.13
.....	0.40
.....	0.80

of information compiled by Engman

including lovegrass, bluegrass, buffalo
grasses, and other grass mixtures.
Cover to a height of about 0.1 ft. This
cover that will obstruct sheet flow.

- T_t = travel time (hr),
- n = Manning's roughness coefficient (table 3-1)
- L = flow length (ft)
- P_2 = 2-year, 24-hour rainfall (in)
- s = slope of hydraulic grade line
(land slope, ft/ft)

This simplified form of the Manning's kinematic solution is based on the following: (1) shallow steady uniform flow, (2) constant intensity of rainfall excess (that part of a rain available for runoff), (3) rainfall duration of 24 hours, and (4) minor effect of infiltration on travel time. Rainfall depth can be obtained from appendix B.

Shallow concentrated flow

After a maximum of 300 feet, sheet flow usually becomes shallow concentrated flow. The average velocity for this flow can be determined from figure 3-1, in which average velocity is a function of watercourse slope and type of channel. For slopes less than 0.005 ft/ft, use equations given in appendix F for figure 3-1. Tillage can affect the direction of shallow concentrated flow. Flow may not always be directly down the watershed slope if tillage runs across the slope.

After determining average velocity in figure 3-1, use equation 3-1 to estimate travel time for the shallow concentrated flow segment.

Open channels

Open channels are assumed to begin where surveyed cross section information has been obtained, where channels are visible on aerial photographs, or where blue lines (indicating streams) appear on United States Geological Survey (USGS) quadrangle sheets. Manning's equation or water surface profile information can be used to estimate average flow velocity. Average flow velocity is usually determined for bank-full elevation.

