Appendix C – Water Quality Flow (WQF) and Flow Diversion Guidance

Water Quality Flow Calculation

The water quality flow (WQF) is the peak flow rate associated with the water quality design storm. This section describes the recommended procedures for calculating the water quality flow for the design of:

- Pre-manufactured stormwater treatment devices (e.g. hydrodynamic separators, catch basin inserts, and media filters)
- Flow diversion structures for off-line stormwater treatment practices

The WQF should be calculated using the water quality volume (WQV) described in Chapter 10. This WQV, converted to watershed inches, should be substituted for the runoff depth (Q) in the Natural Resources Conservation Service (NRCS) (formerly Soil Conservation Service), TR-55 Graphical Peak Discharge Method. The procedures are based on the approach described in Claytor and Schueler, 1996.

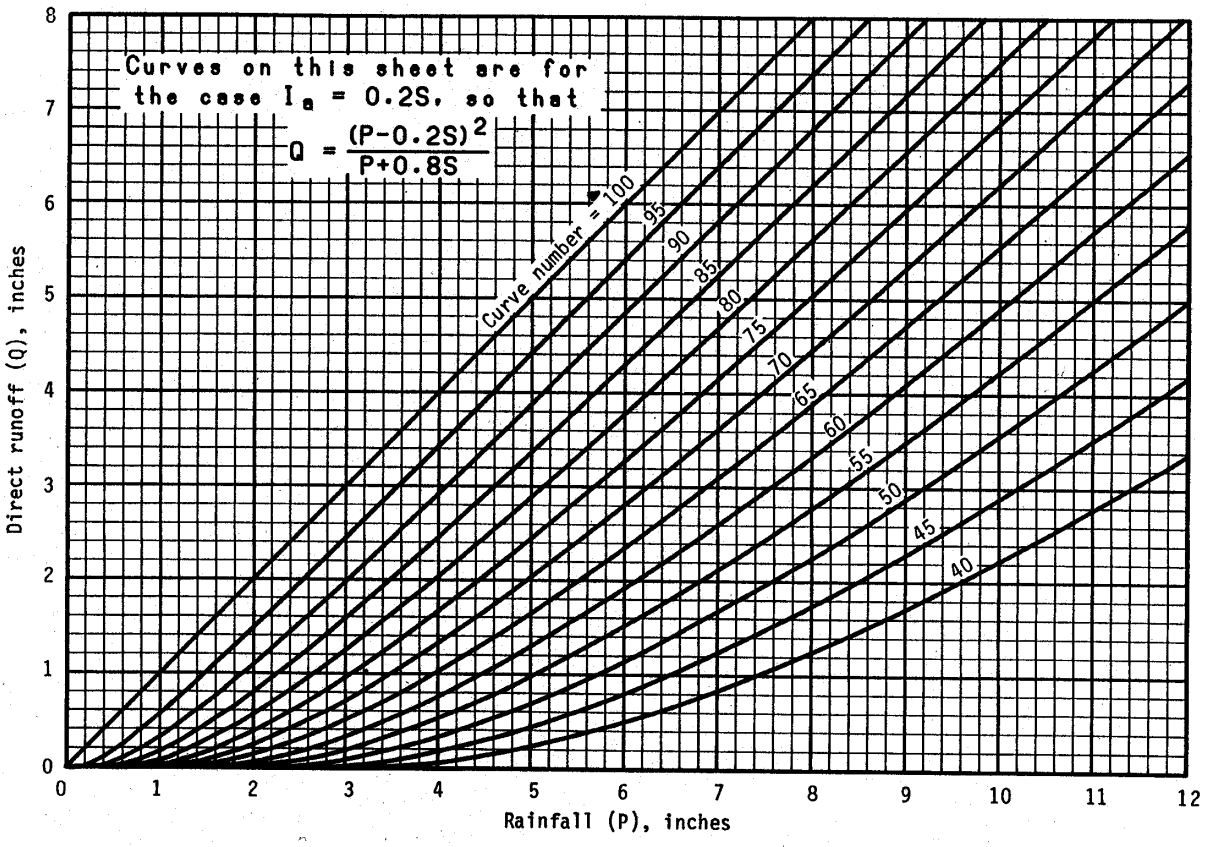
1. Compute the NRCS Runoff Curve Number (CN) using the following equation, or graphically using Figure 2-1 from TR-55 (USDA, 1986) (reproduced below):

$$CN = \frac{1000}{\left[10 + 5P + 10Q - 10(Q^2 + 1.25QP)^{1/2}\right]}$$ (English Units Only)

where: CN = Runoff Curve Number
P = design precipitation, inches (1" for water quality storm)
Q = runoff depth (in watershed inches)

$$Q = \frac{\left[\text{WQV}(acrefeet)\right] X \left[12(inches/foot)\right]}{DrainageArea(acres)}$$

Solution of runoff equation (Figure 2-1 TR55)



2. Compute the time of concentration (t_c) based on the methods described in Chapter 3 of TR-55. A minimum value of 0.167 hours (10 minutes) should be used. For sheet flow, the flow path should not be longer than 300 feet.

3. Using the computed CN, t_c, and drainage area (A) in acres, compute the peak discharge for the water quality storm (i.e., the water quality flow), based on the procedures described in Chapter 4 of TR-55.

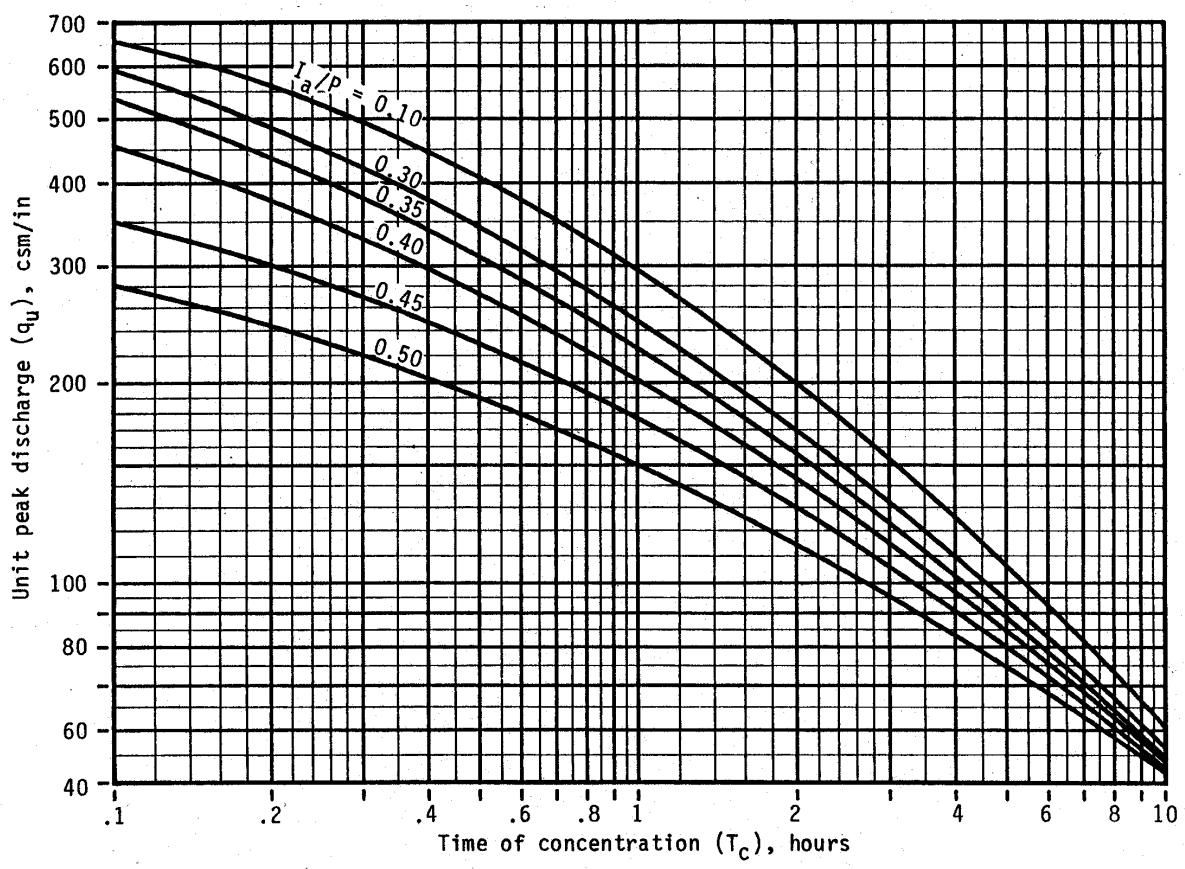
- Read initial abstraction (I_a) from Table 4-1 in Chapter 4 of TR-55 (reproduced below); compute I_a/P

I_a values for runoff curve numbers (Table 4-1 TR55)

Curve number	I_a (in)	Curve number	I_a (in)
40	3.000	70	0.857
41	2.878	71	0.817
42	2.762	72	0.778
43	2.651	73	0.740
44	2.545	74	0.703
45	2.444	75	0.667
46	2.348	76	0.632
47	2.255	77	0.597
48	2.167	78	0.564
49	2.082	79	0.532
50	2.000	80	0.500
51	1.922	81	0.469
52	1.846	82	0.439
53	1.774	83	0.410
54	1.704	84	0.381
55	1.636	85	0.353
56	1.571	86	0.326
57	1.509	87	0.299
58	1.448	88	0.273
59	1.390	89	0.247
60	1.333	90	0.222
61	1.279	91	0.198
62	1.226	92	0.174
63	1.175	93	0.151
64	1.125	94	0.128
65	1.077	95	0.105
66	1.030	96	0.083
67	0.985	97	0.062
68	0.941	98	0.041
69	0.899		

- Read the unit peak discharge (q_u) from Exhibit 4-III in Chapter 4 of TR-55 (reproduced below) for appropriate t_c

Unit peak discharge (q_u) for SCS type III rainfall distribution (Exhibit 4-III TR55)



- Substituting the water quality volume (WQV), converted to watershed inches, for runoff depth (Q), compute the water quality flow (WQF) from the following equation:

$$WQF = (q_u)(A)(Q)$$

where: WQF = water quality flow (cfs) (English units only)
qu = unit peak discharge (cfs/mi^2/inch)
A = drainage area (mi^2)
Q = runoff depth (in watershed inches)

$$Q = \frac{[\mathrm{WQV}(acrefeet]X[12(inches/\ foot]}{DrainageArea(acres)}$$

Flow Diversion Structures

Flow diversion structures, also called flow splitters, are designed to deliver flows up to the design water quality flow or water quality volume to off-line stormwater treatment practices. Flow in excess of the WQF or WQV are diverted around the treatment facility with minimal increase in head at the flow diversion structure to avoid surcharging the treatment facility under higher flow conditions. Flow diversion structures are typically manholes or vaults equipped with weirs, orifices, or pipes to bypass excess runoff.

The following general procedures are recommended for design of flow diversion structures:

- Locate the top of the weir or overflow structure at the maximum water surface elevation associated with the WQF, or the water surface elevation in the treatment practice when the entire WQV is being held, whichever is higher.

- Determine the diversion structure dimensions required to divert flows in excess of the WQF using standard equations for a rectangular sharp-crested weir, uniform flow in pipes or channels, or orifice depending on the type of diversion structure.

- Provide sufficient freeboard in the stormwater treatment practice and flow splitter to accommodate flow over the diversion structure.

- Limit the maximum head over the flow diversion structure to avoid surcharging the stormwater treatment practice under high flow conditions.

- Design diversion structures to withstand the effects of freezing, frost in foundations, erosion, and flotation due to high water conditions. These structures should be designed to minimize clogging potential and to allow for ease of inspection and maintenance.