

CHAPTER 6

STORAGE FACILITIES

6.7 Routing Calculations

The following procedure is used to perform routing through a reservoir or storage facility (Puls Method of storage routing).

Step 1 - Develop an inflow hydrograph, stage-discharge curve, and stage-storage curve for the proposed storage facility. Example stage-storage and stage-discharge curves are shown below.

Figure 6.7-1
Example Stage-Storage Curve

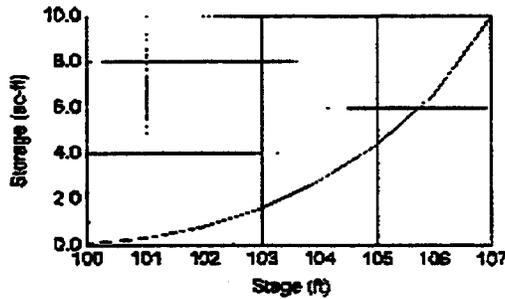
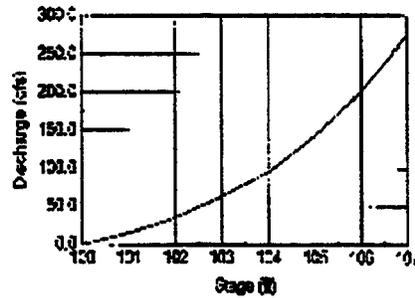


Figure 6.7-2
Example Stage-Discharge Curve



Select a routing time period, Δt , to provide at least five points on the rising limb of the inflow hydrograph.

Step 2 - Use the storage-discharge data from Step 1 to develop storage characteristics curves that provide values of $S \pm (O/2) \Delta t$ versus stage. An example tabulation of storage characteristics curve data is shown in Table 6.7-1.

Table 6.7-1 Storage Characteristics

(1)	(2)	(3)	(4)	(5)	(6)
Stage (ft)	Storage ¹ (ac-ft)	Discharge ² (cfs)	(ac-ft/hr)	S-(O/2) Δt (ac-ft)	S+(O/2) Δt (ac-ft)
100	0.05	0	0.00	0.05	0.05
101	0.3	15	1.24	0.20	0.40
102	0.8	35	2.89	0.56	1.04
103	1.6	63	5.21	1.17	2.03
104	2.8	95	7.85	2.15	3.45
105	4.4	143	11.82	3.41	5.39
106	6.6	200	16.53	5.22	7.98
107	10.0	275	22.73	8.11	11.89

¹Obtained from the Stage-Storage Curve.

²Obtained from the Stage-Discharge Curve.

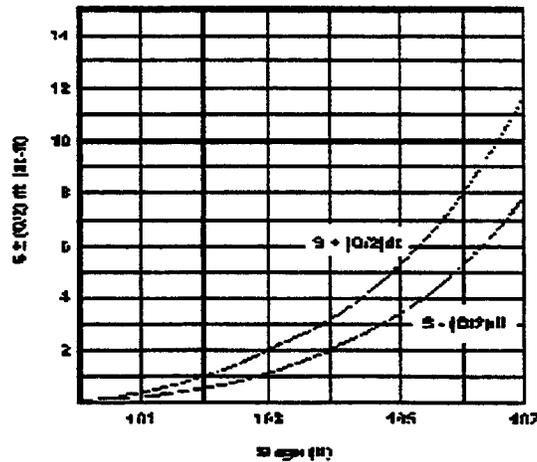
Note: t=10 minutes = 0.167 hours and 1 cfs = 0.0826 ac-ft/hr.

(If the detention facility contains a permanent pool of water, this can be accounted for by considering the water surface as the stage, with zero flood storage volume.)

Step 3 –

For a given time interval, I_1 and I_2 are known. Given the depth of storage or stage, H_1 , at the beginning of that time interval, $S_1-(O_1/2)t$ can be determined from the appropriate storage characteristics curve (example given below).

Figure 6.7-3
Storage Characteristic Curve



Step 4 – Determine the value of $S_2 + (O_2/2) \Delta t$ from the following equation:

$$S_2 + (O_2 / 2) \Delta t = [S_1 - (O_1 / 2) \Delta t] + [(I_1 + I_2) / 2 \Delta t] \quad \text{(EQ-6.7-1)}$$

Where: S_2 = storage volume at time 2, ft^3
 O_2 = outflow rate at time 2, cfs
 Δt = routing time period, sec
 S_1 = storage volume at time 1, ft^3
 O_1 = outflow rate at time 1, cfs
 I_1 = inflow rate at time 1, cfs
 I_2 = inflow rate at time 2, cfs

Other consistent units are equally appropriate.

Step 5– Enter the storage characteristics curve at the calculated value of $S_2 + (O_2/2)t$ determined in Step 4 and read off a new depth of water, H_2 .

Step 6- Determine the value of O_2 , which corresponds to a stage of H_2 , determined in Step 5, using the stage-discharge curve.

Step 7- Repeat Steps 3 through 6 by setting new values of I_1 , O_1 , S_1 , and H_1 equal to the previous I_2 , O_2 , S_2 , and H_2 , and using a new I_2 value. This process is continued until the entire inflow hydrograph has been routed through the storage basin.

END OF SECTION 6.7