Solution Homework 2 Problem 1
Hydraulic Engineering Design
Spring 2014
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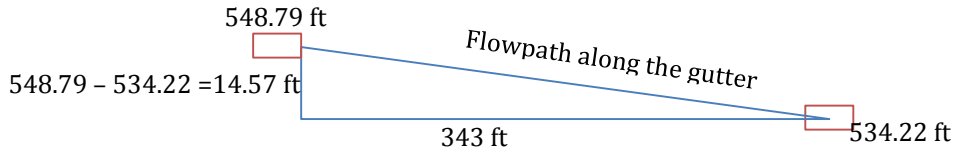
(a) Determine the area of the Catchment in acres

$$Area = \ 0.3\ acres$$

(b) Determine the length of flow path from the centerline of the street to the gutter (ft)

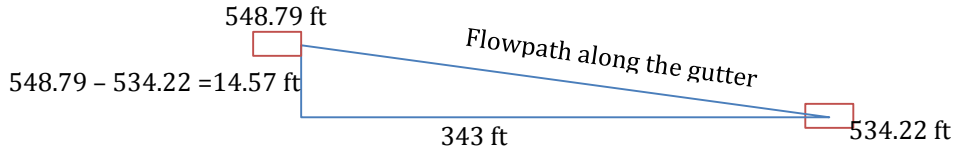
Range between $32.2ft\ and\ 40.9ft$

(c) Determine the length of the flow path along the gutter to the inlet (ft)



$$Length = \sqrt{14.57^2 + 343^2} = 343.309\ ft$$

(d) Determine the slope of the gutter (ft/ft). The elevations shown in the diagram above were taken from a digital elevation model of the area.



$$Slope = \frac{14.57}{343} = 0.0424\ \frac{ft}{ft}$$

(e) Determine the time of concentration of this catchment (min).

Applying equation 2-5 (Drainage Criteria Manual of the City of Austin) for shallow concentrated flow for paved areas with greater length than 100 ft.

$$T_c = \frac{L}{60(20.3282)(s)^{0.5}} = \frac{343.309\ ft}{60(20.3282)(0.0424)^{0.5}} = 1.36695\ min$$

Since the minimum time of concentration for any drainage area has to be 5 minutes, the time of concentration for design purposes of this catchment is $T_c = 5\ mins$

(f) Determine the runoff coefficient, C, and the rainfall intensity i, (in/hr) for a 25 year return period storm in Austin.

From Table 2-1 of the Drainage Criteria Manual of the City of Austin:

$$C = 0.86$$

The rainfall intensity varies depending on the duration of the storm. For a 25 year return period, the intensities are:

25 year Return Period Storm	
Duration minutes	Intensity in/hr
5	10.1
15	7.04
30	4.72
60	3.28
120	2.1
180	1.52
360	0.857
720	0.492
1440	0.318

Since the time of concentration of the catchment is 5 minutes, the intensity is 10.1 in/hr.

(g) Calculate the design runoff (cfs) at the stormwater inlet at 534.22 ft above datum using the Rational Method

25 Return Period Storm					
Duration minutes	Intensity in/hr	C	Area (acres)	Q = CiA acre-in-hr	Q = CiA cfs
5	10.1	0.86	0.3	2.606	2.627
15	7.04	0.86	0.3	1.816	1.831
30	4.72	0.86	0.3	1.218	1.228
60	3.28	0.86	0.3	0.846	0.853
120	2.1	0.86	0.3	0.542	0.546
180	1.52	0.86	0.3	0.392	0.395
360	0.857	0.86	0.3	0.221	0.223
720	0.492	0.86	0.3	0.127	0.128
1440	0.318	0.86	0.3	0.082	0.083

Since the time of concentration of the catchment is 5 minutes, the design runoff is 2.627 cfs.