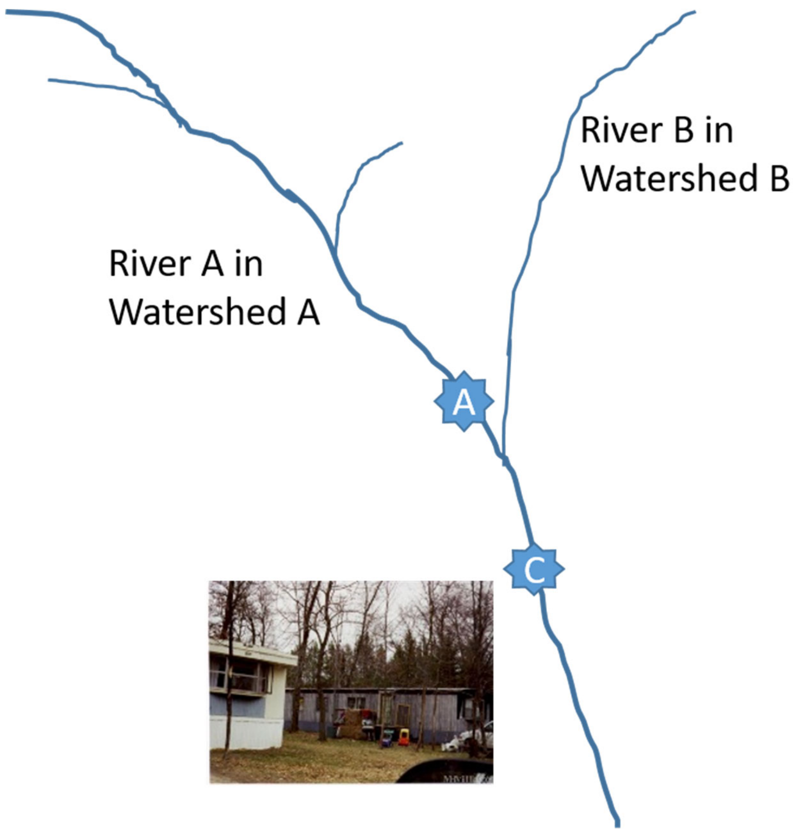
ENVE 4810 Engineering Hydrology

Term Project, Fall 2022 (Due Friday December 9 11:59pm)



River A drains from watershed A and another smaller river (River B) drains from a nearby watershed B. River A and River B join to form River C. There is a stream gage station (Station A) near the outlet of river A and another gage station on river C (Station C) as shown in the above digram. The dominant soil type in the region is silt loam. There is a mobile home park near station C and outside the flood plain of the river. The community was told that the flood plain along the river channel should protect them against 1-in-50-year flood events.

Problem Statement:

Last September, a hurricane downgraded to a tropical storm and was forecast to pass this region. There was already a rain event not long ago, so the initial effective saturation is high across the region, at approximately 80%. The weather forecast indicates 5.6 cm of rain over four hours. At the time of this forecast, streamflow at station C was at 60 m^3/s.

While watching the weather forecast for this severe storm, some residents in the mobile park community grew concerned and wondered if they should prepare their homes for flooding, but they were not sure where to find guidance. As the town engineer who also frequently visited this area for white water rafting, you took it upon yourself and jumped to help. What would be your advice to the community?

1) Do you think the flood peak from the forecast storm would be able to pass the river C segment near station C safely? Support your statement with quantitative evidence.
2) As the climate warms, do you think they are still protected against 1-in-50-year flood events? State your rationale based on what you learned in Engineering Hydrology.

Materials given:

There are abundant historical observational data of rainfall and river flow for stream A (at station A), but very little data about stream B. There are also 40 years of daily discharge data at station C.

a) Based on topography and river network maps, one can extract the following approximately information:
   Watershed A: area = 290 km^2 , Lc =12 km,   L= 32km
   Watershed B: area = 120 km^2, Lc =8 km, L=20 km
   (L: channel length;
   Lc: distance from the outlet to the point on the stream near the watershed centroid)

b) Precipitation forecast for the tropical storm

Time	1st Hour	2nd Hour	3rd Hour	4th Hour
Incremental rainfall (cm/hr)	1.2	1.5	2.0	0.9

c) You searched through the online streamflow data from the USGS website and found data for a storm event in watershed A three years ago that you consider representative. For that event, you conducted baseflow separation, calculated the direct runoff, and derived the excess rainfall using constant Φ method. Here are the results you produced:

Time(hrs)	1	2	3	4	5	6	7
Direct Runoff (m3/s) at Station A	94	245	280	210	120	30	0

Excess rainfall over watershed A for this event three years ago:
P1=0.8 cm (1st hour), P2 = 0.4 cm (2nd hour)

d) Analysis of streamflow data at Point C in the past 40 years led to the following annual maximum flow rate (in m^3/s):

1981	246	1991	306	2001	310	2011	421
1982	241	1992	194	2002	208	2012	380
1983	87	1993	110	2003	455	2013	90
1984	250	1994	265	2004	284	2014	358
1985	220	1995	140	2005	280	2015	370
1986	160	1996	216	2006	230	2016	290
1987	145	1997	175	2007	219	2017	330
1988	183	1998	344	2008	201	2018	544
1989	220	1999	401	2009	310	2019	277
1990	309	2000	140	2010	270	2020	230