CE EN/Geography 513
Photogrammetry and Remote Sensing
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Section 1

Lab 11: Determining PMP

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Introduction

In this report, I analyzed the Clear Creek watershed. This drainage basin is located near Sevier, Utah. The Clear Creek watershed is small--only about 164 square miles. First, I obtained all the necessary information to make an outlet hydrograph. This information included the curve number, the drainage area of the watershed, the time of concentration, the percent of the watershed that is impervious, the percent of the impervious area that is directly drained, the routing coefficient, and the peaking factor.

Also, I estimated the probable maximum precipitation using hydrometerological report no. 49, located in appendix B. I ran the continuous time function convolution program to obtain the outlet hydrograph. Finally, I graphed the output hydrograph. This lab will discuss the results from my analysis of the Clear Creek watershed.

Objectives/Procedure

For the objectives and procedure, I have included the lab handout. You can find the lab handout in the appendix.

Results

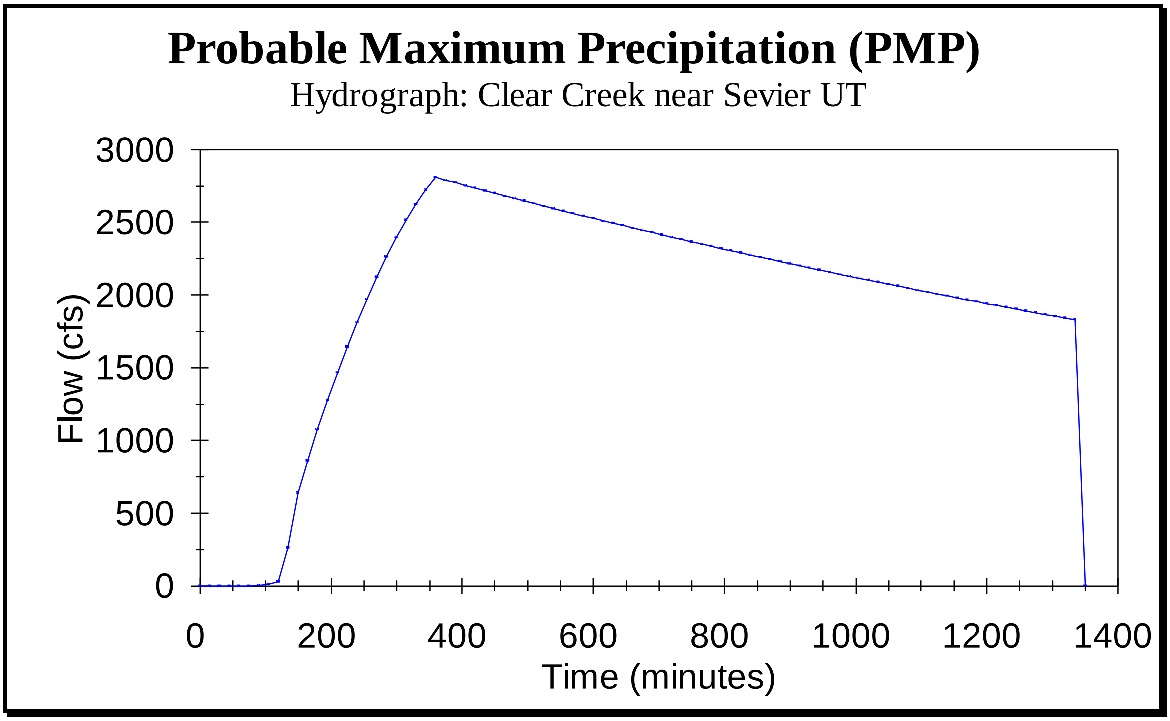

Figure 1: Probable maximum flood hydrograph for the Clear Creek drainage basin near Sevier, Utah. The values used in obtaining this hydrograph are outlined in table 1.

Table 1: Values used in the continuous time function convolution program to generate the output hydrograph in figure 1. The input and output from the program are located in appendix C.

Parameter	Value
Drainage area of watershed	104,960 acres
Time of Concentration	400 minutes
Percent of watershed that is impervious	2 %
Percent of watershed that is directly drained impervious	0.5 %
SCS curve number for the watershed soil	74
k, the routing coefficient	0.000439 / minute
a, the peaking factor	17,639 cfs

Discussion

You can see the results in figure 1 and table 1.

Probable maximum flood (PMF). The results from my determining the probable maximum flood are located in appendix B. Also, they are located in the computer program output in appendix C. This flood supposedly represents a worst-case scenario. A larger flood than the PMF may occur in the future, but it is unlikely. This flood included a time in which 1.86 inches of rain fell over the watershed in a period of only 15 minutes.

Clear Creek outlet hydrograph. The Creek Outlet hydrograph is located in figure 1. This hydrograph included flows of up to 2800 cfs. This is a large flow for little Clear Creek, and approaches the flow of the Provo River. But this represents the flow from the probable maximum flood. From the output hydrograph in figure 1, you can see that the hydrograph starts out with a sharp rise. The time to peak is about 260 minutes, or about 4.3 hours. Then, the hydrograph recedes at almost a constant slope.

The hydrograph turns out to approximate an exponential at the beginning and a trapezoid after the peak flow has occurred.

Calculations

The calculations were fairly straightforward and involved finding the drainage area of the watershed, the time of concentration, the percent of watershed that is impervious, the percent of the impervious area that is directly drained, the SCS curve number, the routing coefficient (k), and the peaking factor (a) for the watershed. *My calculations and output from the computer program are located in Appendices B and C.*

To find the CN, I used tables 4.5 and 4.6 in the hydrology book. These tables are located on pages 82-83. I used the first table to find the CN for antecedent moisture condition 2. Then, I converted this to antecedent moisture condition 3 using table 4.6.

I found the PMF using the steps outlined in ***Hydrometerological Report no. 49: Probable Maximum Precipitation Estimates, Colorado River and Great Basin Drainages***. I found the peaking factor, ***a***, using the following equation:

$$a = \frac{R}{3600 \times D}$$

where ***a*** is the peaking factor (cfs), ***R*** is the runoff (ft^3), and ***D*** is the duration of the storm, in hours.

I calculated R and I was given D. From these values, I found a. Then, I determined ***k*** by plugging the following equation into my HP calculator and solving for ***k***:

$$Q_t = a\left(1 - e^{-kt}\right)$$

Q_t is the flowrate (cfs) at a certain time during the storm ($t < D$), ***a*** is the peaking factor above, ***k*** is the routing coefficient in units of 1/time, and ***t*** is the time that the particular flowrate occurred, from the beginning of the storm.

I then made the output hydrograph by running the continuous time function convolution program. The output and input parameters are located in appendix C.

Conclusions/Applications

The probable maximum flood (PMF) is highly useful. Using this flood along with other watershed parameters, you can generate the outlet hydrograph for a drainage basin using the continuous time function convolution. The continuous time function convolution hydrograph was generated using the program at the end of the book.

This lab was highly excellent and very practical. The probable maximum flood hydrograph can be used to locate where to put houses in a watershed area. It can also be used when designing bridges and culverts which the creek can flow through. All kinds of hydraulic structures require a maximum flow when you design them. In conclusion, I must say that this lab was most excellent.

<u>Appendix</u>

Appendix A: References

- Wanielista, Martin. **Hydrology and Water Quantity Control**. John Wiley and Sons, Inc. 1990.
- United States Department of Interior, Geological Survey. **Water Supply Papers- Basin 13, 1940-1970 data (3 volumes)**.
- Hansen, E. Marshall and others. **Hydrometerological Report no. 49: Probable Maximum Precipitation Estimates, Colorado River and Great Basin Drainages**. US Army Corps of Engineers, Silver Spring, Md., 1977.

The lab handout and my calculations are located on the following pages.

Appendix B: Lab Handout

Appendix C: Calculations and Data