San Dimas Experimental Forest Watershed Modeling

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Background

Objectives

- Accurately exhibit watershed properties in an easy to understand manner
- Provide examples for educational support in the field of hydrology and environmental engineering
- Utilize the models for research and a better understanding of materials and their effects on hydrologic variables
- Use models to support outreach programs to improve knowledge of watersheds and hydrologic information

The San Dimas Experimental Forest

- One of 80 experimental forests in the US
- Isolated land mass that is not affected by outside factors (ideal for research)
- Two distinct watersheds: the San Dimas watershed and the **Big Dalton watershed**.
- Big Dalton: Volfe Canyon, **Bell Canyon**, and Monroe Canyon (Volfe is control)

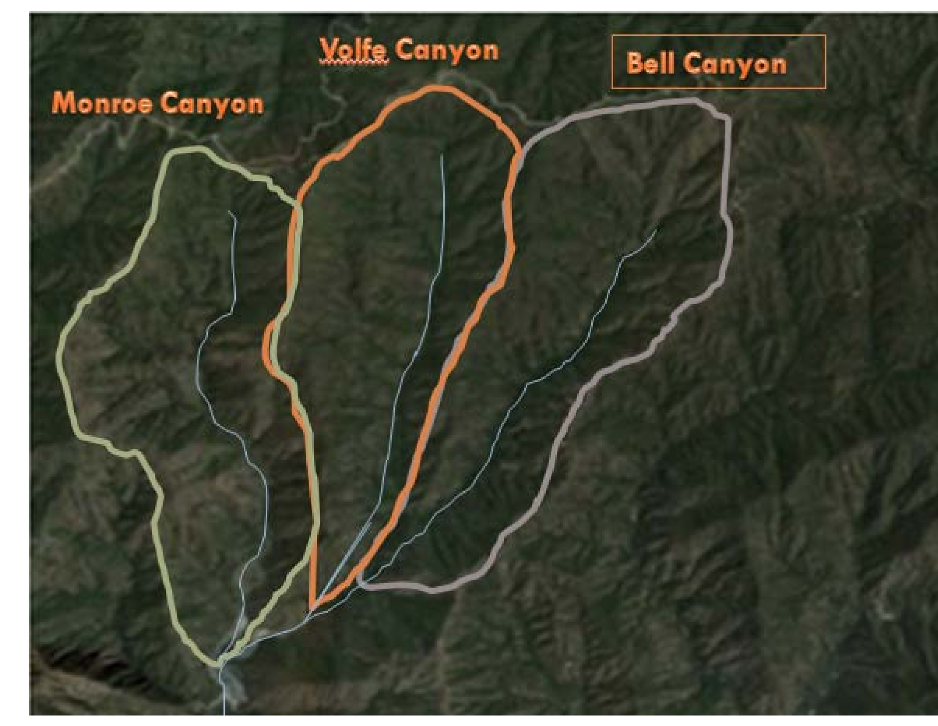

Figure 1: The San Dimas Experimental Forest: Big Dalton Watershed

Key Terms

- Watershed: area of land where all of the water entering the system drains to the same point
- Infiltration: the process in which surface water drains into the ground/soil
- Flow Rate: the amount of water traveling through an area at a given time
- Return Period: the recurrence interval of an event/ probability of accumulation
- SCS method: Soil conservation service's method of watershed modeling for forested areas
- Curve number: an empirical parameter used in the SCS method for predicting runoff and infiltration based on soil, land use, etc.
- Lag Time: the time from the center of mass of excess rainfall to the peak outflow

Digital Model

The digital model of Bell Canyon in the San Dimas Experimental Forest (SDEF) allows us to create an in depth hydrologic study of the watershed properties present in this location. We have determined the Outflow, Cumulative Precipitation, and Soil Infiltration for 5, 10, 25, and 50 year return periods using the SCS Method in HEC-HMS software. We have used this data to scale our physical model to accurately portray the watershed's properties. Below are the graphical and tabulated inputs and results:

Input Value into HEC-HMS		
Description	Value	Units
Watershed Area	1.38	mi²
Watershed Slope	11.9	%
Watershed Length	13,403	ft
Curve Number	55	unitless
% Impervious	0	%
Lag time	86.58	min
Precipitation Depth	varies	in

Table 1. *Input Values*. These values were entered into HEC-HMS software.

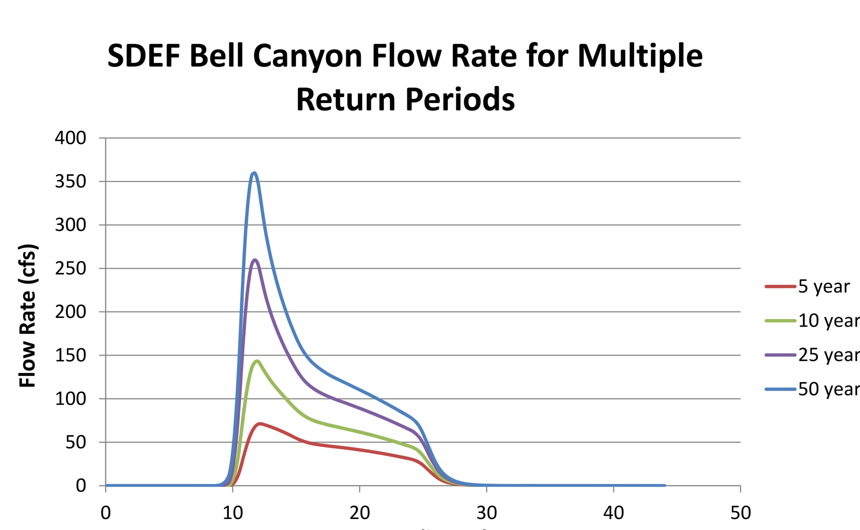

Figure 2. *SDEF Bell Canyon Flow Rate for Multiple Return Periods*. This is a graph showing the amount of water flow for 5, 10, 25, and 50 year storms.

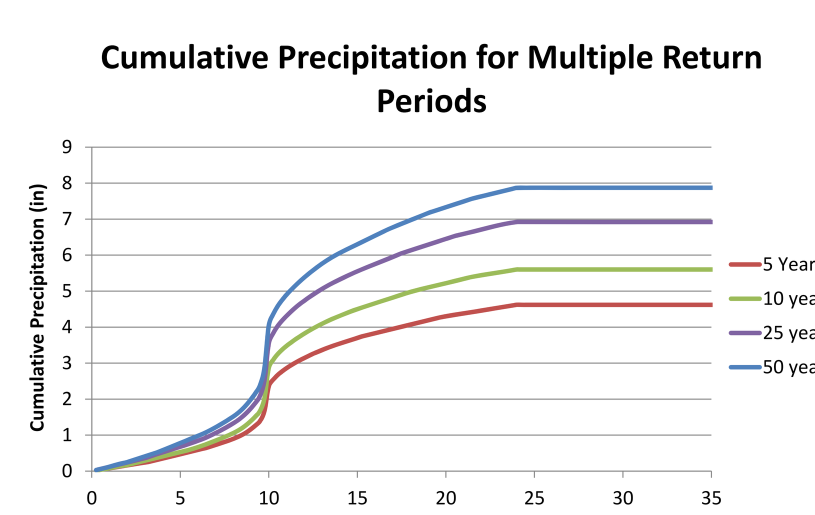

Figure 3. *Cumulative Precipitation Multiple Return Periods*. This is a graph showing the amount of rain (in inches) each storm will produce over a 24 hour period.

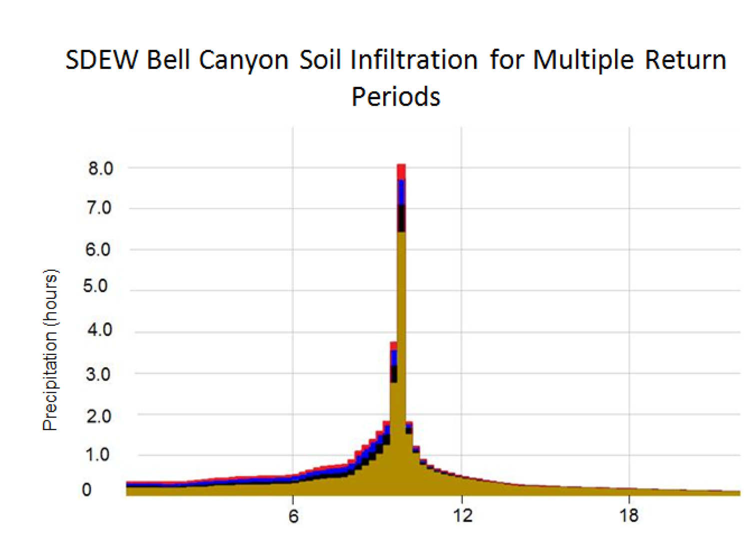

Figure 4. *SDEF Bell Canyon Soil Infiltration for Multiple Return Periods*. This is a graph showing the amount of water infiltrating the soil (in inches) for multiple storms.

Results and Outflow Scaling Factors					
Return Period (years)	Soil Infiltration (in)	Cumulative Rainfall Depth (in)	SDEF Peak Discharge (cfs)	SDEF Peak Discharge (gpm)	Model Peak Discharge (gpm)
5	0.64	4.60	71.1	32,000	0.20
10	0.71	5.63	143.0	64,200	0.40
25	0.77	6.92	259.7	116,500	0.72
50	0.81	7.88	359.6	161,400	1.00

Table 2. *Results and Outflow Scaling Factors*. These results represent the soil infiltration, rainfall depth, and flow rate found form the hydrologic model. They were linearly scaled to match the size of our box.

Scaling Methods

- **Flow Rate-** Using the peak values represented in Figure 4 above, we have scaled the flow rates to accommodate the physical model.
- **Precipitation and Infiltration -** Using values represented in Figures 5 and 6, we have determined how much rainfall our model will emit and how much will infiltrate the soil.

Figure 5. Physical Model Testing and Calibration Phase.

Results and Outflow Scaling Factors					
Trial	Time (min)	Initial depth (inches)	Final Depth (inches)	Depth (inches)	Out flow rate (gpm)
1	1.00	0	0.625	0.625	1.17
2	2.00	0.625	1.125	0.5	0.94
3	3.00	1.125	1.625	0.5	0.94
4	4.00	1.625	2.125	0.5	0.94
				Average	1.00

Table 3. *Model Testing Results*. This table shows the flow rates we obtained through physical model simulations of a 50 year flow.

References

- Mike Oxford, USFS San Dimas Experimental Forest Manager
- Dr. Kenneth Lamb, Cal Poly Pomona Civil Engineering Professor
- LA County Hydrology Manual, LA County Department of Public Works 2006
- Reynolds Advanced Materials, North Hollywood, CA
- U.S. Army Corps of Engineering, Hydrologic Engineering Center
- Enquire for additional references.