

## **Estimating the increase in water temperature caused by removal of riparian vegetation**

Brown, G.W. 1970. Predicting the Effect of Clearcutting on Stream Temperature. *J. Soil and Water Conservation* 25:11-13.

This model is probably best used for a “worst case” scenario, assuming:

- 100% exposure of the stream to the sun (no riparian vegetation on either side, no shading) from sunrise to sunset
- discharge is summer base flow
- the calculated temperature change is occurring at noon in mid-summer (July 15)

The formula is:

$$\Delta T = \frac{A \times H}{D} \times 0.000267$$

Where:

$\Delta T$  = change in temperature

A = surface area of stream exposed to direct sunlight (ft<sup>2</sup>)

H = rate of heat absorbed by exposed stream (BTUs/ft<sup>2</sup>/min)

D = discharge (cubic feet per second)

(Note: 0.000267 converts discharge in cfs to pounds of water per minute)

The term H for noon on July 15 in the center of the Rogue River is approximately 4.1 BTUs/ft<sup>2</sup>/min. The paper allows for the calculation of other values of H for other times or latitudes, though you need a solar ephemeris table to establish the maximum sun angle at solar noon for your date and latitude (available on the web).

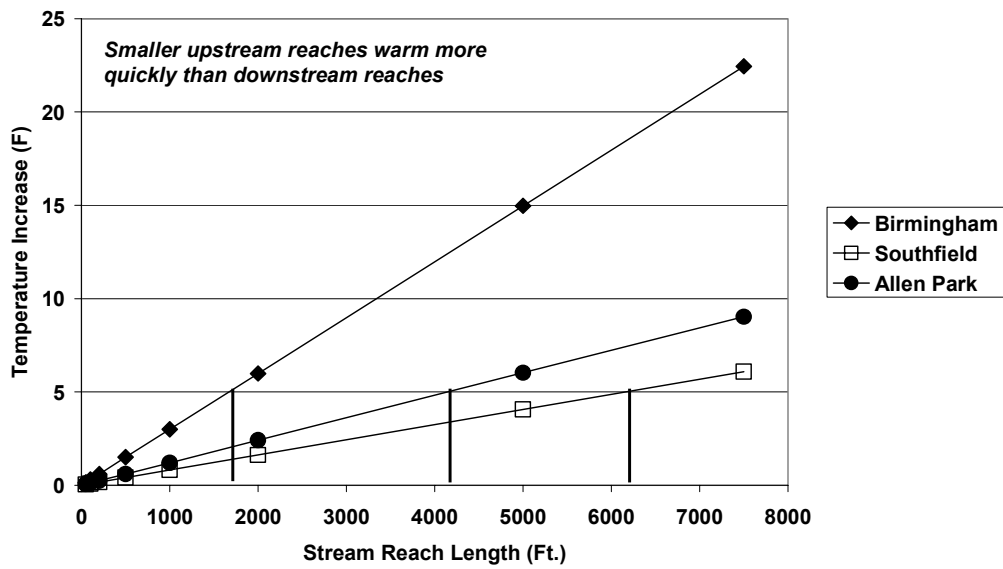
An alternative form of this equation, if you want to calculate the length of stream that has to be clearcut to produce a set temperature increase:

$$L = \frac{\Delta T \times D}{0.000267 \times W}$$

Where L is the stream length and W is the stream width, in feet.

This model was applied to three locations on the main branch of the Rogue River. A 5° F change was selected as being “significant.” Results (below) indicate that a substantial distance of open stream channel (1,700 to >6,000 ft.) is required to raise water temperature 5° F. These results were not verified with field data, though the author of the paper states his field data were within 1° to 3° F.

**Open Channel Length vs. Water Temperature Increase  
Main Branch USGS Gage Stations**



**Relevant Links**

- A US Forest Service report that calculates air temperature over a stream based on the width of a forested buffer strip:  
[http://www.watershed.org/news/sum\\_96/buffer.html](http://www.watershed.org/news/sum_96/buffer.html)