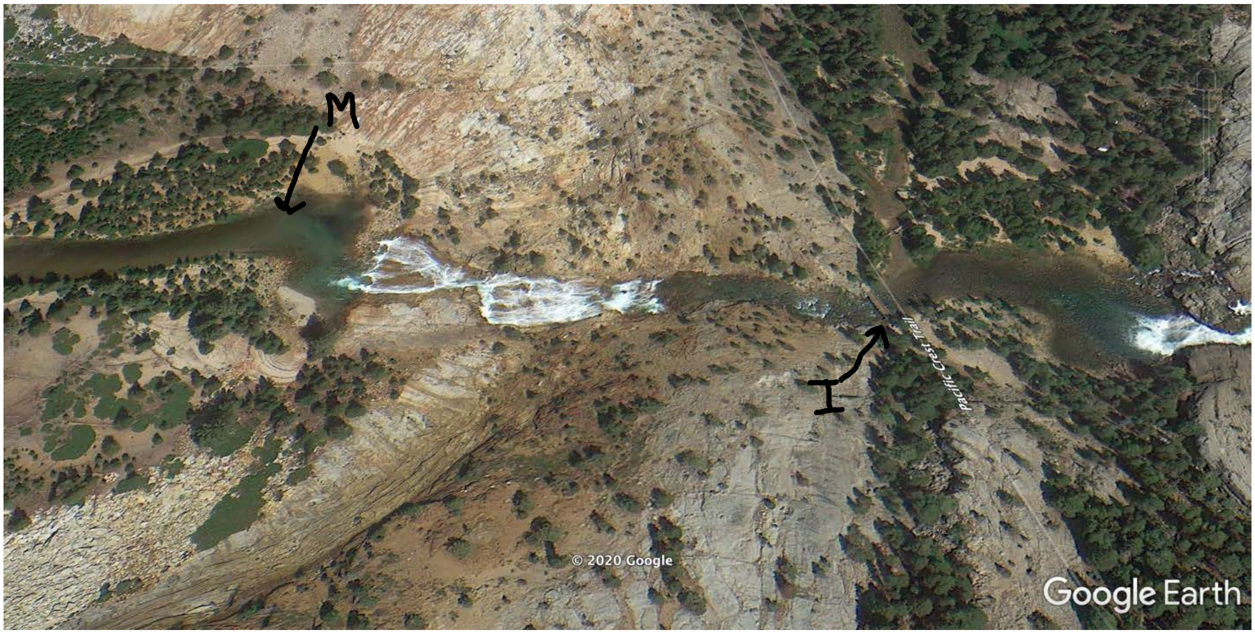
CEE 348 Spring 2022 Week 9 Lab/Workshop

Mixing and Dilution in Stream Gauging on the Tuolumne River, Yosemite, California



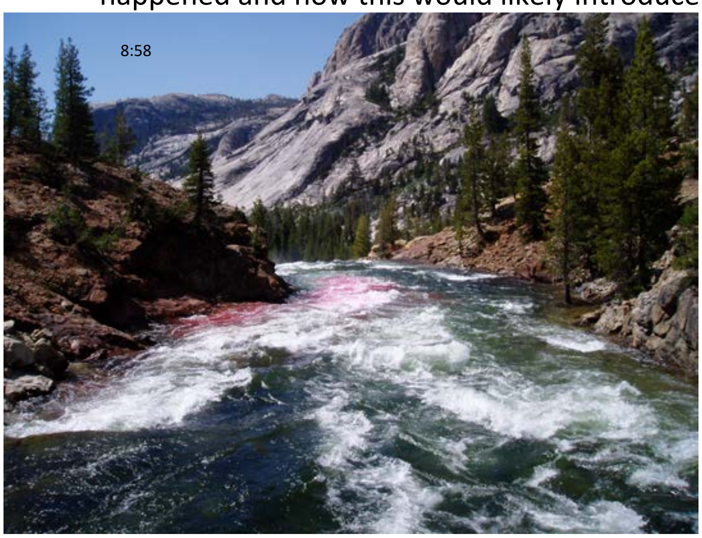
We injected dye at the bridge (marked with I and an arrow above the waterfall) and measured it from the side of the pool downstream of the waterfall (marked with M). From Google Earth, I estimate that we measured the Rhodamine Dye 250 m downstream from the injection point. The width of the river is about 20 m at the upstream injection point and about 40 m at the downstream measurement point. The river depth is about 2.5 m at the upstream location, where it can be approximated as a rectangular channel. The river depth over the waterfall is much shallower, probably only about 0.2 m elevation. The elevation at the upstream location is 7873 ft, and the elevation at the downstream location is 7800 ft, so 73 ft or 22 m of elevation loss. If we presume the water surface elevation change is roughly equal to these elevation changes, the slope is 0.09 over this reach. Four attempts were made to estimate discharge through slug injection. The data can be found in the excel file: CEE348_dye_data_Lab10.xlsx. Note that rhodamine concentration was measured towards river right. [River right or left is defined by your right or left hand when facing downstream on a river.]

1. The injection time is rounded to the nearest minute and so is not precise. If we presume that the average channel velocity can be represented as the time from the very first detection of rhodamine dye to the time of the peak concentration of rhodamine dye, what is the average velocity in the channel for each of the 4 injection experiments? How do these change if we presume 10 seconds pass before the very first detection?
2. If we presume this average velocity is also the average velocity at the bridge injection site, what would be the discharge of the river (using area x velocity)? How does this estimate compare with the values computed using the rhodamine dye? What discharge

values do you get if you presume the average velocity corresponds more to the waterfall depth (0.2 m) than the under the bridge depth?

3. Recall that the first try (a), was to throw the dye into the stream at river right (see photo below). Explain what happened and how this would likely introduce bias into the discharge calculation:

4. The second try (b), was to throw the dye into river left (photo below). Explain what happened and how this would likely introduce bias into the discharge calculation:



5. Between (a) and (b), which do you think is closer to accurate and why?
6. How do your answers to 4 and 5 above relate to the different average velocities you calculated in 2?
7. In the third and fourth tries (c and d on the excel tabs), we tossed the dye closer to the center of the stream. How do you think these results compare to a and b?
8. Can you apply Manning's Equation to calculate discharge over this reach? If yes, what value do you get? If no, why not?
9. Determine an approximate value of sigma (the spread around the peak, approximated by a Gaussian, at a width where +- 1 sigma incorporates 68% of the rhodamine dye) in units of seconds. Which of the different coefficients (vertical, transverse, or longitudinal) do you think the dominant influence on this spread? Why?

10. The rhodamine concentration measured is not a Gaussian. How does it differ from a Gaussian, and what physical processes do you think are causing this difference?

(above) Google Earth image from May 2014, with the bridge and the pool.