

MID-TERM EXAM

Closed book, 1 sheet of notes allowed.

Answer 2 of the following 3 questions. Please state any additional assumptions you made, and show all work.

- I. (50%) Hubbard Creek receives runoff from more than a dozen wheat farms in a small area of central Nebraska. Each results in a certain discharge of organic nitrogen and contributes to the loading of Hubbard Creek. The effective drainage area of the wheat farms that impacts Hubbard Creek is 20,000 ha. Assume that prior to creation of the farms, when the drainage basin was 100% pristine prairie, the organic nitrogen level in Hubbard Creek was constant at 0.25 mg/L. Now the level is substantially higher as shown in the table below.
- Determine the total organic nitrogen concentration for each day using the standard log-log model
 - Using this information, estimate the effective export coefficient for the wheat farms during this 10-day period in units of kg-organic N/ha/yr.
 - Comment on the relationship between the organic nitrogen export coefficient for this watershed and the amount of rainfall in a given year.

Day	Flow (m ³ /s)	Organic Nitrogen Concentration (mg/L)
1	1.7	
2	1.8	1.9
3	2.9	
4	4.4	
5	7.6	
6	12.1	4.25
7	11.1	
8	8.3	
9	5.4	
10	3.3	

- II. (50%) Pleasantville is a rapidly growing community in an exclusive area of California. Starting on January 1, 1988, half of the population of Pleasantville began taking 20 mg/day of the newly released drug, fluoxetine (trade name: Prozac). Studies have shown that 80% of ingested fluoxetine is excreted. Furthermore the removal efficiency of the Pleasantville wastewater treatment plant (serving the entire population of Pleasantville) for fluoxetine is only 60% prior to discharge into nearby Tranquil Lake. This lake has a total volume of 9×10^6 m³ and an outflow of 8000 m³/d. Fluoxetine decays in the lake at a rate of 0.10 yr^{-1} due to direct photolysis. No other losses are known.

Pleasantville, CA

Year	Population on Jan 1
1988	300,000
1993	350,000
1998	400,000
2003	450,000
2008	500,000

- A. Calculate the expected fluoxetine concentration at the beginning of the year 2008.
- B. If a new WWTP capable of completely removing fluoxetine is placed on line at the beginning of 2008, when will the lake fluoxetine level finally drop below 2.0 $\mu\text{g/L}$?
- III. (50%) On a separate sheet of paper, answer any five (5) of the following questions.
- A. Calculate the % loss of CBOD as the water moves 1 km downstream in a river flowing at 0.01 m/s. Assume the CBOD deoxygenation rate is 0.15 d^{-1} , and the CBOD settling rate is 0.11 d^{-1} .
- B. Explain how you determined ultimate BOD from a wastewater sample.
- C. Describe how the algal metabolism parameters, P and R, can be determined experimentally in a lake
- D. Explain the relationship between the critical concentration and wastewater loading in a river with only a single point load
- E. Is it common to add an inhibitor to the BOD test? Why or why not?
- F. Describe the relationship between drainage basin area and flow
- G. Does SOD cause an increase, a decrease or no change in CBOD? Explain.