CEE 577 12 March 2013

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.

Important constants & conversions:

1 ha (hectare) = 10,000 m^2
1 ft = 0.3048 m

I. (50%) Husker Creek receives runoff from more than a dozen corn farms in a small area of central Nebraska. Each results in a certain dischage of organic nitrogen and contributes to the loading of Husker Creek. Assume that the drainage area for Husker Creek (10,000 ha) to its confluence with the Delmonte River is entirely made up of corn farms. Husker creek receives a baseflow from groundwater that is 1.7 m^3/s (at the confluence), and the nitrogen concentration in this baseflow is 0.25 mg/L. On July 7 the flow in Husker creek at the confluence was measured as 3.925 m^3/s.

a. Determine the basin-wide average runoff coefficient ("C") based on the single flow datum measured on Husker Creek near its confluence with the Delmonte River on July 7 of 3.925 m^3/s
b. Determine flows for each of the remaining 9 days using the rainfall data below and the rational formula
c. Calculate total organic nitrogen concentration for each day using the standard log-log model
d. Using this information, estimate the effective export coefficient for the corn farms during this 10-day period in units of kg-organic N/ha/yr.
e. Comment on the accuracy and usefulness of this organic nitrogen export coefficient for this watershed. Consider the average rainfall for this watershed is 3.2 inches in July and 27 inches for the entire year.

Date	Avg Rainfall (cm)	Organic Nitrogen Concentration (mg/L)
July 1	0	
July 2	0.5	0.52
July 3	0.7	
July 4	0	
July 5	1.1	
July 6	3.5	4.25
July 7	0.9	
July 8	0.2	
July 9	4.4	
July10	0.4	

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 as a total volume of $9x10^6$ m^3 and an outflow of 8000 m^3/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
2013	Data not yet available

A. Calculate the expected fluoxetine concentration at the beginning of the year 2015.
B. If a new WWTP capable of completely removing fluoxetine is placed on line at the beginning of 2015, when will the lake fluoxetine level finally drop below 2.0 µg/L?

III. (50%) On a separate sheet of paper, answer any five (5) of the following questions.

A. Calculate the % loss of CBOD as water moves 2 kilometers downstream in a river flowing at 0.01 m/s. Assume the CBOD deoxygenation rate is 0.12 d^{-1}, and the CBOD settling rate is 0.10 d^{-1}.
B. Describe the steps involved in a wasteload allocation process
C. What is the concentration of dioxane in a lake 1 year after Acme Chemical Company (ACC) initiates operation on its shore. The lake has an area of 100,000 m^2, an average depth of 1 m, and an outflow of 1000 m^3/day. Dioxane decays at a 1^{st} order rate of 0.5 yr^{-1}, and assume ACC discharged 11 kg/yr to the lake on the day it opened and this discharge increased linearly to 14.65 kg/yr by the end of year 1. Assume there was no dioxane in the lake before ACC started operation.
D. Describe what happens when a wastewater with ammonia is discharged into a flowing river. Be specific on the chemical changes and microbial ecology.
E. Is it common to add an inhibitor to the BOD test? Why or why not?
F. Explain the difference between CBOD and NBOD.