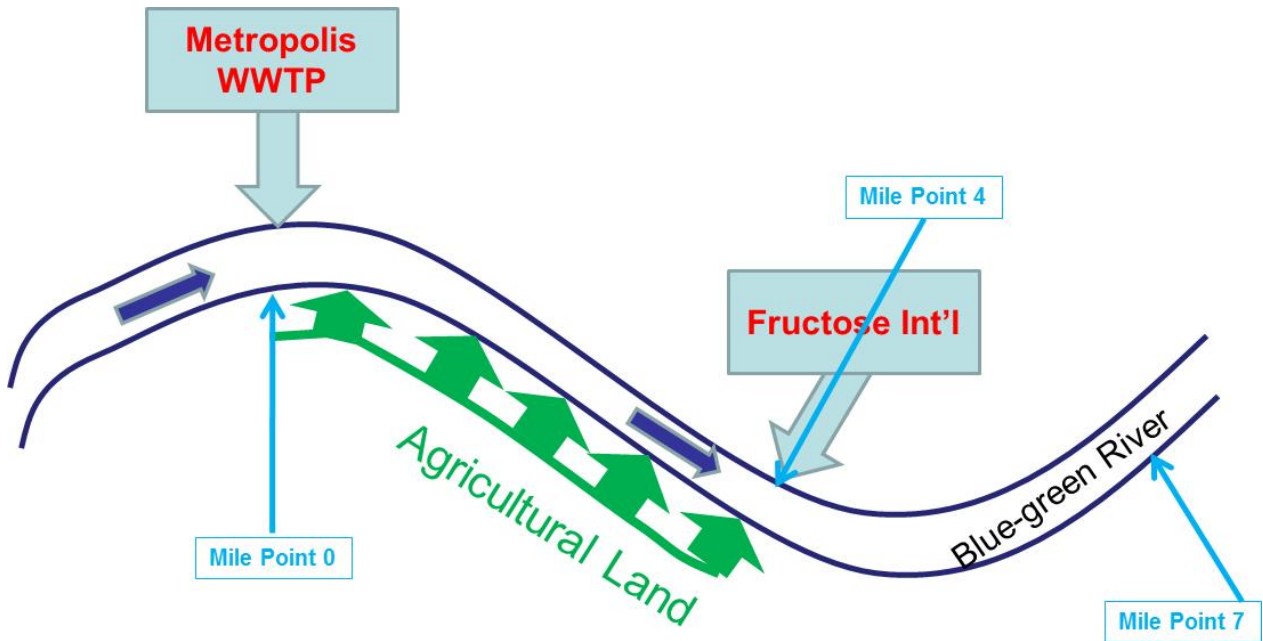


Homework #6

The Blue-green River emerges from pristine headwaters and runs by a city (Metropolis with its WWTP) and then through an agricultural region that stretches for 4 miles. At milepoint 4, there is an industrial wastewater discharge (from Fructose International Corporation, FIC). The CBOD_u of the headwaters is 2.8 mg/L, and the dissolved oxygen is 7.2 mg/L (saturation is 9.1 mg/L for 20°C). At mile point 0 is the Metropolis wastewater outfall. Here a fully nitrified WW flow of 10 cfs is discharged with a CBOD_u of 20 mg/L and a DO of 4 mg/L. Also starting at mile point zero, there is a significant non-point agricultural runoff of CBOD_u amounting to 45 kg/mile/day. At milepoint 4 is the FIC outfall with its 200 mg/L of CBOD_u in the form of high fructose corn syrup. This flow is 2 cfs and the DO is zero. Immediately past this outfall is 3 more miles of undeveloped land.

- A) Calculate the dissolved oxygen concentration immediately above the FIC wastewater outfall (i.e. at MP 3.9999)**
- B) Calculate the dissolved oxygen concentration immediately below the FIC outfall (i.e. at MP 4.0001)**
- C) Calculate the dissolved oxygen concentration at the end of the undeveloped land (i.e. at MP 7)**

Assume complete mixing across the stream in cross section. Assume also a temperature of 20°C, a flow of 40 cfs from the headwaters and no incremental flow downstream except for flow from the city and FIC industrial outfall. Many years of discharge has resulted in a very high SOD immediately downstream of the municipal WWTP outfall of 2.2 g/m²/d for the first four miles (i.e., up to MP 4). After this, you can assume that it decreases to a fixed value of 0.5 g/m²/d. Assume the undeveloped land does not introduce any additional flow or BOD loading.



Additional Information:

$U = 0.200 \text{ ft/sec} = 3.27 \text{ miles/day}$	$T = 20^\circ\text{C}$
$DO_{\text{sat}} \text{ or } C_s = 9.1 \text{ mg/L (at } 20^\circ\text{C)}$	$H = 4 \text{ ft} = 1.22 \text{ m}$
BOD deoxygenation rate ($k_N = k_d$) = 0.8 day^{-1} (at 20°C)	for k_N and k_d , $\theta=1.047$
CBOD settling rate (k_S) = 0.080 day^{-1} (at 20°C)	for reaeration, $\theta=1.024$

Assigned: 30 Oct 2017
Due: 6 Nov 2017