



# **Analysis of the Harpeth River Dissolved Oxygen Demands Downstream from the Franklin POTW**

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## FRANKLIN POTW PERMITTED LOADS

- **MASS (lbs/day) = CONCENTRATION (mg/L) \* FLOW (mgd) \* 8.34**
- **OXYGEN (O<sub>2</sub>) DEMAND = CBOD<sub>U</sub> (mg/L) + TKN (mg/L)**
- **TKN = TOTAL KJELDAHL NITROGEN = ORGANIC NITROGEN + AMMONIA**
- **O<sub>2</sub> DEMAND FROM CBOD<sub>U</sub> = BOD<sub>5</sub> \* 5.4**
- **O<sub>2</sub> DEMAND FROM TKN = TKN \* 4.57**
- **POTW PERMITTED BOD<sub>5</sub> = 5 mg/L**
- **POTW PERMITTED TKN = 1 mg/L**
- **POTW EFFLUENT BOD<sub>5</sub> O<sub>2</sub> DEMAND = 5 mg/L \* 5.4 \* 12 mgd \* 8.34 = 2,702 lbs/day**
- **POTW EFFLUENT TKN O<sub>2</sub> DEMAND = 1 mg/L \* 4.57 \* 12 mgd \* 8.34 = 457 lbs/day**
- **FRANKLIN POTW TOTAL O<sub>2</sub> DEMAND = 3,159 lbs/day**

## HARPETH RIVER O<sub>2</sub> DEMAND

- **BACKGROUND CBOD<sub>U</sub> = 1 mg/L (USEPA)**
- **BACKGROUND TKN = 0.42 mg/L (USEPA)**
- **TOTAL FLOW IN RIVER AT 7-DAY 10-YEAR LOW FLOW (7Q10) = 0.3 cfs or 0.19 mgd**
- **TOTAL CBOD<sub>U</sub> O<sub>2</sub> DEMAND IN RIVER = 1 mg/L \* 0.19 mgd \* 8.34 = 1.62 lbs/day**
- **TOTAL TKN O<sub>2</sub> DEMAND IN RIVER = 0.42 mg/L \* 4.57 \* 0.19 mgd \* 8.34 = 3.10 lbs/day**
- **TOTAL BACKGROUND O<sub>2</sub> DEMAND IN RIVER = 1.62 lbs/day + 3.10 lbs/day = 4.72 lbs/day**

## **TOTAL O<sub>2</sub> DEMAND IN HARPETH RIVER AT FRANKLIN POTW**

- **TOTAL O<sub>2</sub> DEMAND IN RIVER AFTER FRANKLIN POTW = 3,159 lbs/day + 4.7 lbs/day**
- **TOTAL O<sub>2</sub> DEMAND IN RIVER = 3,164 lbs/day**

# **OXYGEN AVAILABLE IN RIVER AT FRANKLIN POTW**

- **O<sub>2</sub> IN HARPETH RIVER ASSUMED = 6 mg/L**
- **O<sub>2</sub> IN FRANKLIN POTW EFFLUENT ASSUMED = 6 mg/L**
- **FLOW IN HARPETH RIVER = 0.19 mgd (TDEC 7-DAY 10-YEAR LOW FLOW)**
- **FLOW FROM POTW = 12 mgd**
- **O<sub>2</sub> MASS IN RIVER = 6 mg/L \* 0.19 mgd \* 8.34 = 9.51 lbs/day**
- **O<sub>2</sub> MASS IN EFFLUENT = 6 mg/L \* 12 mgd \* 8.34 = 600.5 lbs/day**
- **TOTAL O<sub>2</sub> MASS IN RIVER = 9.51 lbs/day + 600.5 lbs/day = 610 lbs/day**

## **O<sub>2</sub> DEMAND VERSUS INITIAL AVAILABLE O<sub>2</sub>**

- **TOTAL O<sub>2</sub> DEMAND IN RIVER AFTER FRANKLIN POTW = - 3,164 lbs/day**
- **TOTAL O<sub>2</sub> AVAILABLE IN RIVER AFTER FRANKLIN POTW = + 610 lbs/day**
- **O<sub>2</sub> DEFICIT AT FRANKLIN = - 2,554 lbs/day**

## **BACKGROUND FLOW TO MEET DEFICIT**

- **TOTAL O<sub>2</sub> DEFICIT = - 3,164 lbs/day**
- **TOTAL O<sub>2</sub> IN EFFLUENT = + 600.5 lbs/day**
- **TOTAL O<sub>2</sub> MASS TO BALANCE O<sub>2</sub> IN RIVER AT 5 mg/L =**  
 **$Q_{\text{RIVER}} = (+ 600.5 \text{ lbs/day} - 3,164 \text{ lbs/day}) / (5 \text{ mg/L} * 8.34)$**   
 **$Q_{\text{RIVER}} = 2,564 \text{ lbs/day} / 41.7 \text{ lbs/day/mgd} = 61.5 \text{ mgd}$**   
 **$Q_{\text{RIVER}} = 61.5 \text{ mgd} * 1.547 \text{ cfs/mgd} = 95.1 \text{ cfs}$**

### **NOTES:**

1. **ASSUMES NO LOW-FLOW NON-POINT SOURCE OXYGEN DEMANDS FROM SEDIMENT OXYGEN DEMAND OR ALGAL RESPIRATION AND NO OXYGEN ADDITION FROM EITHER REAERATION OR ALGAL PRODUCTION**
2. **AT THE 7Q10 LOW FLOW, NO OTHER NON-POINT SOURCES ARE AVAILABLE**

# **FRANKLIN POTW REQUIRED EFFLUENT LIMITS**

- **USEPA HAS SET A TOTAL MAXIMUM DAILY LOAD (TMDL) LIMIT FOR THE FRANKLIN POTW OF 2 mg/L BOD<sub>5</sub> WHEN FLOW IN THE RIVER UPSTREAM FROM THE POTW WAS 17 cfs.**
- **BECAUSE OF THE ANTI-DEGRADATION REGULATION AND THE REQUIREMENT IN THE HARPETH RIVER NPDES PERMITS (3 PERMITS) THAT THE DISCHARGERS MEET THE WATER QUALITY STANDARDS, THE DISCHARGERS CANNOT FURTHER DEGRADE THE RIVER DISSOLVED OXYGEN DOWNSTREAM FROM EACH OF THE DISCHARGERS.**
- **THE FACT THAT THE RIVER DOES NOT MEET THE DO STANDARD OF 5 mg/L UPSTREAM FROM THE FRANKLIN POTW, THE LYNWOOD UTILITY OR THE CARTWRIGHT CREEK UTILITY MEANS THAT THESE DISCHARGERS ARE IN VIOLATION OF THEIR PERMITS IF THEY REDUCE THE DISSOLVED OXYGEN IN THE RIVER.**
- **USEPA HAS PREDICTED THAT THE FRANKLIN POTW REDUCES OXYGEN IN THE RIVER BY MORE THAN 2 mg/L, THAT THE LYNWOOD UTILITY REDUCES THE DO BY 1 mg/L AND THAT THE CARTWRIGHT CREEK UTILITY REDUCES THE DO BY ABOUT 0.6 mg/L (ESTIMATED FROM LYNWOOD DEFICIT).**
- **THESE DISCHARGERS WOULD BE REQUIRED TO MEET BACKGROUND CONCENTRATIONS OF BOD<sub>5</sub> AND TKN OF 1 mg/L AND 0.42 mg/L, RESPECTIVELY TO BE ABLE TO DISCHARGE TO THE HARPETH RIVER.**