Exercise 4
Nitrogen Balance in a Nitrifying and Denitrifying Plant

Use the attached worksheet to calculate the amount of denitrification at an 8 day MCRT:

Primary Effluent Flow = 40 MGD

Primary Effluent TKN = 25 mg/L

Primary Effluent NOx-N = 0 mg/L

Secondary Effluent NH_4^+-N = 1 mg/L

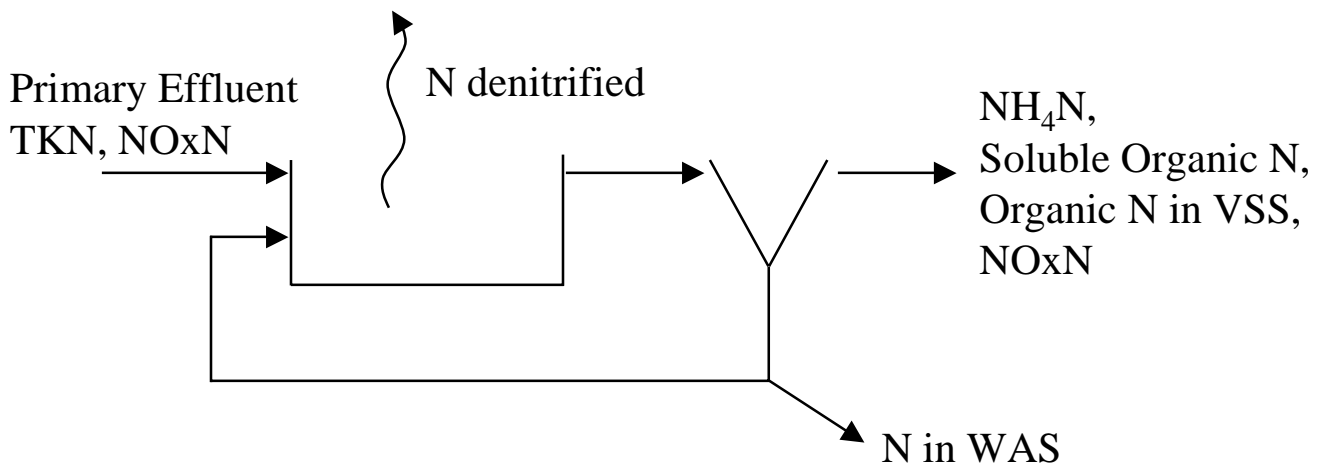Secondary Effluent Soluble Organic N = 1 mg/L

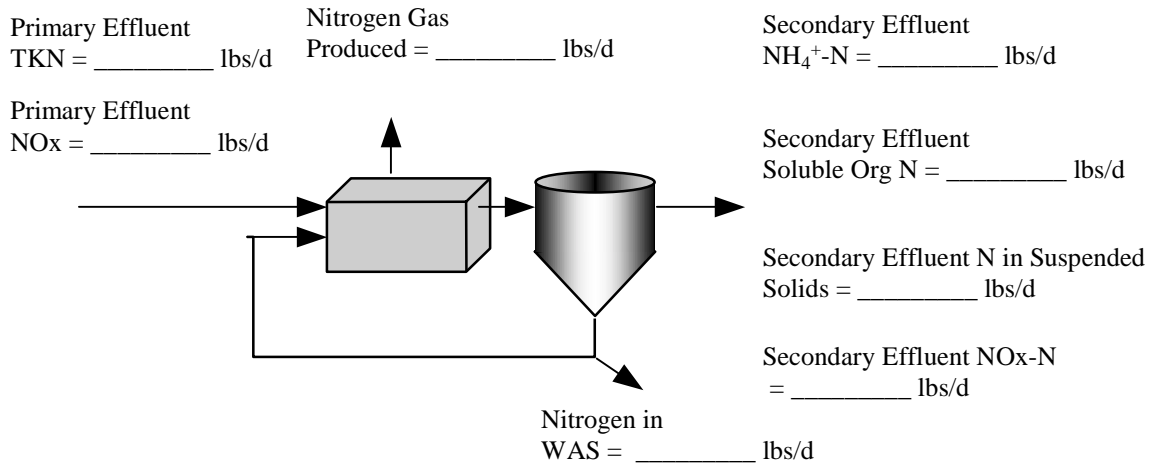Secondary Effluent NOx-N = 6 mg/L

Volatile solids wasted in WAS = 18,680 lbs/d

Volatile solids in secondary effluent = 10 mg/L

Percentage of MLVSS that is nitrogen = 12%

Primary Effluent
TKN, NOxN

N denitrified

NH_4N,
Soluble Organic N,
Organic N in VSS,
NOxN

N in WAS

Primary Effluent
TKN = _____ lbs/d

Nitrogen Gas
Produced = _____ lbs/d

Secondary Effluent
NH_4^+-N = _____ lbs/d

Primary Effluent
NOx = _____ lbs/d

Secondary Effluent
Soluble Org N = _____ lbs/d

Secondary Effluent N in Suspended
Solids = _____ lbs/d

Secondary Effluent NOx-N
= _____ lbs/d

Nitrogen in
WAS = _____ lbs/d

Nitrogen Balance in a Nitrifying and Denitrifying Plant

Condition: 8-day MCRT, nitrification and denitrification

Required Input Data

(1) Secondary effluent flow   MGD
      (assume equal to primary effluent flow)

(2) Primary effluent TKN   mg/L   lbs/day

(3) Primary effluent NOxN   mg/L   lbs/day

(4) Nitrogen in waste activated sludge   mg/L   lbs/day

(5) Secondary effluent NH_4^+-N   mg/L   lbs/day

(6) Secondary effluent soluble org-N   mg/L   lbs/day

(7) Nitrogen in secondary effluent SS   mg/L   lbs/day

(8) Secondary Effluent NOxN   mg/L   lbs/day

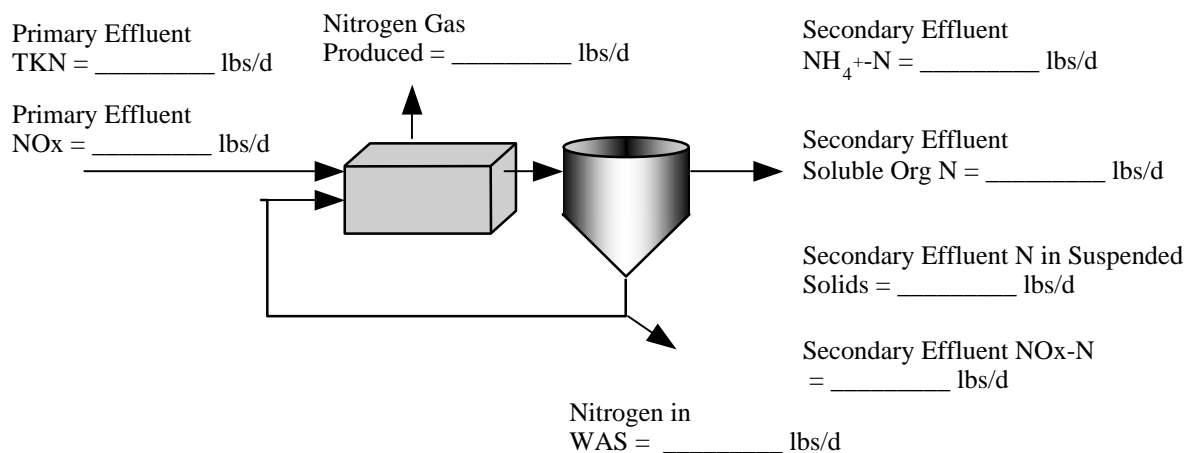# Mass Balance Calculations (do in lbs/day first because it is easier)

(9)   Nitrogen Entering activated sludge system = Nitrogen leaving activated sludge system

(10) Nitrogen entering activated sludge system = Primary Effluent (TKN + NOxN)

(11) Nitrogen leaving activated sludge system = N in secondary effluent + N in WAS + N denitrified

Combining equations (10) and (11):

(12) Primary Eff (TKN+NOxN) = Sec Eff (NH_4N + Sol org N + N in SS + NOxN) + N in WAS + N denitrified

Primary Effluent
TKN = _____ lbs/d

Nitrogen Gas
Produced = _____ lbs/d

Secondary Effluent
NH_4^+-N = _____ lbs/d

Primary Effluent
NOx = _____ lbs/d

Secondary Effluent
Soluble Org N = _____ lbs/d

Secondary Effluent N in Suspended
Solids = _____ lbs/d

Secondary Effluent NOx-N
 = _____ lbs/d

Nitrogen in
WAS = _____ lbs/d

Nitrification is the difference between the <u>unoxidized-N</u> forms entering and leaving the activated sludge tank

(12) Nitrification = Primary Effluent TKN - Secondary Effluent(NH_4^+-N + sol org N + N in TSS) - WAS org N

(13) Nitrification = (_____) - (_____ + _____ + _____) - (_____) = _____ lbs/day

        From line 2   From line 5   From line 7   From line 4

                              From line 6

Denitrification is the difference in <u>unoxidized and oxidized N</u> forms entering and leaving the activated sludge process.

(14) Denitrification = Primary Effluent (TKN + NOxN)
                - Secondary Effluent (NH_4N + sol org N + N in TSS + NOxN) - N in WAS

(15) Denitrification = (___ + _____) - (_____ + _____ + _____ + _____) - (_____) = _____ lbs/day

    From line 2   From line 5   From line 7   From line 4

          From line 3   From line 6   From line 8

Effluent NH_4^+-N   _____ mg/L
(16) Effluent SKN   _____ mg/L
Effluent TKN   _____ mg/L
Effluent NOxN   _____ mg/L
Effluent TN   _____ mg/L