MA

DEPARTMENT OF ENVIRONMENTAL MANAGEMENT

Indianapolis

OFFICE MEMORANDUM

DATE : June 21, 1988

TO : Joseph C. Krieger
Permits Section

THRU : A.B.Jumawan
T.P.Chang
J.C.Stallsmith
L.D.Brumfield

FROM : Mustafa Ak MA
Modeling and Engineering Services Section

SUBJECT : Updating the February 1987 Advance STP WLA Report (Continuous and Controlled Discharge Analysis)

Reference : Memo dated June 9, 1988 from William E. Bye

At the request of William E. Bye of Facility Plans Section, a wasteload allocation study has been updated for the above facility due to changes in the design flow from 0.042 mgd to 0.038 mgd and potential discharge location to Big Raccoon Creek for the proposed plant. These evaluations are based on the $Q_{7-10}$ flow reduction due to mixing zone policies / guidelines, and acute / chronic water quality standards Rule 327 IAC 2-1. Model parameters used in the former report are also applied in this anaysis.

The effluent limitations for a continuous discharge are controlled by the chronic ammonia toxicity as well as instream dissolved oxygen maintenance. For a waste stabilization pond system, controlled discharge is feasible when required holding volume/period (0.0778 MGAL/7.0 DAYS) is provided. This holding volume could be incorporated into the required multi-cell treatment pond(s) to have 25.0 mg/l $CBOD_5$ and 70.0 mg/l TSS effluent limits. The results of the analyses are summarized in the attached tables for both continuous and controlled discharge.

Results of this WLA analyses will be an addendum to the February 1987 Advance STP Wasteload Allocation report which is attached.

Attachments

cc: T. Keesling
W. E. Bye

**MEMORANDUM**
State Form 1352 (R / 12-87)

FROM:
Bill Bye, Facility Plans
Thru: Tom Keesling

TO:
Greg Thomason, Modeling Section
6/9/88
MA

SUBJECT:
Wasteload Assessment for
Town of Aquinas

MESSAGE:
Please provide a WLA for the Town of Aquinas on the two discharge points indicated in the A/E Letter of April 7, 1988 (Copy Attached)
F.P. #ai includes a HER Lagoon as selected treatment alternative
projected wastewater flow 38,000 gpd.

Signature
William E. Bye

Date
6/9/88

REPLY:
SEE ATTACHED TABLES

Signature
Mustafa

Date 6/21/88

Follow-up Date

**DISTRIBUTION:** White - Sender; Canary - Receiver; Pink - File Copy

DISCHARGE HERE

ALONG

DISCHARGE

Analyzed alternative STP site

TABLE : I RESULTS OF EFFLUENT LIMITATION ANALYSIS

FACILITY : PROPOSED ADVANCE STP,BOONE COUNTY

RECEIVING STREAM(s) : BIG RACOON CREEK
Stream Designation : GEN USE STREAM
Analysis Basis : Analysis Performed for WARMWATER SPECIES HABITAT

Case I : Existing STDs [ Rule 330 IAC 1-1 Recodified as 327 IAC 2-1 ]

| | | Summer ( May Thr. November ) | | Winter ( December Thr. April ) | |
|---|---|---|---|---|---|
| | FLOW | 0.0380 | mgd | 0.0380 | mgd |
| | cBOD5 | 25.0 | mg/l | 25.0 | mg/l |
| | D.O. | 5.0 | mg/l | 4.0 | mg/l |
| | AMMONIA-N | | | | |
| ( a ) | Acute ( Effluent Based ) | 15.52 | mg/l | 31.97 | mg/l |
| | ( Stream Based ) | 7.91 | mg/l | 16.16 | mg/l |
| ( b ) | Chronic ( Stream Based ) | 1.99 | mg/l | 4.49 | mg/l |

[ Based : Respective pH and Temperature data were used in the computations. ]
NH3-N and cBOD5 are on monthly average basis, whereas, D.O. is on Daily Ave.

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Case II : Proposed Standards Rule 327 IAC 2-1

| | | Summer ( May Thr. November ) | | Winter ( December Thr. April ) | |
|---|---|---|---|---|---|
| | FLOW | 0.0380 | mgd | 0.0380 | mgd |
| | cBOD5 | 25.0 | mg/l | 25.0 | mg/l |
| | D.O. | 5.0 | mg/l | 4.0 | mg/l |
| | AMMONIA-N | | | | |
| ( a ) | Acute ( Effluent Based ) | 11.91 | mg/l | 12.29 | mg/l |
| | ( Stream Based ) | 7.80 | mg/l | 7.97 | mg/l |
| ( b ) | Chronic ( Stream Based ) | 2.81 | mg/l | 4.24 | mg/l |

[ Based : Respective pH and Temperature data were used in the computations. ]
NH3-N and cBOD5 are on monthly average basis, whereas, D.O. is on Daily Ave.

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Case III : Waste Stabilization Pond Systems Option [ Controlled Discharge ]

| | Summer ( May Thr. November ) | | Winter ( December Thr. April ) | | |
|---|---|---|---|---|---|
| FLOW | 0.038 | mgd | 0.038 | mgd | |
| cBOD5 | 25.00 | mg/l | 25.00 | mg/l | [ Monthly ] |
| TSS | 70.00 | mg/l | 70.00 | mg/l | [ Monthly ] |

Controlled Pond(s) Volume Required 0.08 mgal
Holding Period 7.00 days

DEPARTMENT OF ENVIRONMENTAL MANAGEMENT
WATER MANAGEMENT
MODELING and ENGINEERING SERVICES

ANALYST : M.AK

TABLE : 2

## WASTE STABILIZATION LAGOON CONTROLLED DISCHARGE ANALYSIS

DATE : 06/13/88

Name of Facility : PROPOSED ADVANCED STP,BRUNE COUNTY
Flow Correction Factor for DO Analysis : 70.00 %
Receiving Stream : BIG BROWN CREEK
Gaging Station : BIG BROWN CK.near FINCASTLE,PUTNAM CO.

Facility Design Flow : 0.039 mgd 0.0609 cfs
Corrected FACILITY Flow used in the Analysis : 0.026 mgd 0.0412 cfs
Drainage area upstream of STP's Outfall location : 11.8 Sq.mi 7Q10 Flow : 0.24 cfs
Drainage area upstream of Referenced Gaging Station : 107.0 Sq.mi Corrected Flow Ratio : 5.82

| WR 1976 Month | Gaging Station cfs-day | Adjusted Flow cfs-day u/s STP [Qs] | Dilution Ratio [R] | Allowable Discharge cfs-day [QO=Qs/R] | STP Flow cfs-day [ Qi ] | Cumulative Flow cfs-day Qo-out | Qi-in | Deficiency cfs-day[Qi-QO] | Accumulation cfs-day Sum[Qi-QO] |
|---|---|---|---|---|---|---|---|---|---|
| OCT | 494.00 | 41.9366 | 10 | 4.1936 | 1.2781 | 4.1936 | 1.2781 | -2.9155 | 0.0000 |
| NOV | 904.00 | 76.7424 | 10 | 7.6742 | 1.2369 | 11.8679 | 2.5150 | -6.4373 | 0.0000 |
| DEC | 4400.00 | 373.5251 | 10 | 37.3525 | 1.2781 | 49.2204 | 3.7931 | -36.0743 | 0.0000 |
| JAN | 4041.00 | 373.0158 | 10 | 37.3015 | 1.2781 | 84.5220 | 5.0712 | -36.0234 | 0.0000 |
| FEB | 14451.00 | 1252.2431 | 10 | 125.2243 | 1.1544 | 211.7463 | 6.2257 | -124.0698 | 0.0000 |
| MAR | 7755.00 | 658.3381 | 10 | 65.8338 | 1.2781 | 277.5801 | 7.5038 | -64.5556 | 0.0000 |
| APR | 1095.00 | 110.7841 | 10 | 11.0784 | 1.2369 | 288.6585 | 8.7407 | -9.8415 | 0.0000 |
| MAY | 404.00 | 51.2748 | 10 | 5.1274 | 1.2781 | 293.7860 | 10.0188 | -3.8493 | 0.0000 |
| JUN | 3458.00 | 293.5568 | 10 | 29.3556 | 1.2369 | 323.1417 | 11.2557 | -28.1187 | 0.0000 |
| JUL | 3010.00 | 255.5251 | 10 | 25.5525 | 1.2781 | 348.6942 | 12.5339 | -24.2743 | 0.0000 |
| AUG | 2278.00 | 193.3041 | 10 | 19.3304 | 1.2781 | 368.0326 | 13.8120 | -19.0602 | 0.0000 |
| SEP | 208.50 | 17.7000 | 10 | 1.7700 | 1.2369 | 369.8026 | 15.0489 | -0.5331 | 0.0000 |

| WR 1977 Month | Gaging Station cfs-day | Adjusted Flow cfs-day u/s STP [Qs] | Dilution Ratio [R] | Allowable Discharge cfs-day [QO=Qs/R] | STP Flow cfs-day [ Qi ] | Cumulative Flow cfs-day Qo-out | Qi-in | Deficiency cfs-day[Qi-QO] | Accumulation cfs-day Sum[Qi-QO] |
|---|---|---|---|---|---|---|---|---|---|
| OCT | 247.80 | 21.0362 | 10 | 2.1036 | 1.2781 | 2.1036 | 1.2781 | -0.8254 | 0.0000 |
| NOV | 223.10 | 18.9394 | 10 | 1.8939 | 1.2369 | 3.9975 | 2.5150 | -0.6579 | 0.0000 |
| DEC | 170.40 | 14.4654 | 10 | 1.4465 | 1.2781 | 5.4441 | 3.7931 | -0.1484 | 0.0000 |
| JAN | 145.30 | 12.3348 | 10 | 1.2334 | 1.2781 | 6.6776 | 5.0712 | 0.0446 | 0.0446 |
| FEB | 1769.50 | 150.2165 | 10 | 15.0216 | 1.1544 | 21.6992 | 6.2257 | -13.8672 | 0.0000 |
| MAR | 5490.00 | 466.0575 | 10 | 46.6057 | 1.2781 | 68.3050 | 7.5038 | -45.3276 | 0.0000 |
| APR | 3403.00 | 288.8987 | 10 | 28.8898 | 1.2369 | 97.1937 | 8.7407 | -27.6018 | 0.0000 |
| MAY | 1849.00 | 156.9654 | 10 | 15.6965 | 1.2781 | 112.8703 | 10.0188 | -14.4184 | 0.0000 |
| JUN | 1190.70 | 101.0810 | 10 | 10.1081 | 1.2369 | 122.9984 | 11.2557 | -8.8712 | 0.0000 |
| JUL | 2101.30 | 178.3837 | 10 | 17.8383 | 1.2781 | 140.8360 | 12.5339 | -16.5602 | 0.0000 |
| AUG | 3237.00 | 274.8635 | 10 | 27.4863 | 1.2781 | 168.3221 | 13.8120 | -26.2082 | 0.0000 |
| SEP | 925.00 | 78.5251 | 10 | 7.8525 | 1.2369 | 176.1756 | 15.0489 | -6.6156 | 0.0000 |

| WR 1978 Month | Gaging Station cfs-day | Adjusted Flow cfs-day u/s STP [Qs] | Dilution Ratio [R] | Allowable Discharge cfs-day [QO=Qs/R] | STP Flow cfs-day [ Qi ] | Cumulative Flow cfs-day Qo-out | Qi-in | Deficiency cfs-day[Qi-QO] | Accumulation cfs-day Sum[Qi-QO] |
|---|---|---|---|---|---|---|---|---|---|
| OCT | 9045.00 | 767.4809 | 10 | 76.7848 | 1.2781 | 76.7848 | 1.2781 | -75.5067 | 0.0000 |
| NOV | 8967.00 | 192.4503 | 10 | 19.2450 | 1.2369 | 96.0299 | 2.5150 | -18.0081 | 0.0000 |
| DEC | 14818.00 | 1257.9309 | 10 | 125.7930 | 1.2781 | 221.8230 | 3.7931 | -124.5149 | 0.0000 |
| JAN | 2669.00 | 226.4782 | 10 | 22.6492 | 1.2781 | 244.4722 | 5.0712 | -21.3710 | 0.0000 |
| FEB | 1017.00 | 86.3385 | 10 | 8.6335 | 1.1544 | 253.1057 | 6.2257 | -7.4790 | 0.0000 |
| MAR | 21171.00 | 1797.2503 | 10 | 179.7250 | 1.2781 | 432.8307 | 7.5038 | -172.4969 | 0.0000 |
| APR | 6092.00 | 560.2028 | 10 | 56.0202 | 1.2369 | 488.8510 | 8.7407 | -54.7833 | 0.0000 |
| MAY | 10961.00 | 930.5021 | 10 | 93.0502 | 1.2781 | 581.9012 | 10.0188 | -81.7720 | 0.0000 |
| JUN | 3179.00 | 184.9793 | 10 | 18.4979 | 1.2369 | 600.3992 | 11.2557 | -17.2610 | 0.0000 |
| JUL | 1779.00 | 151.0230 | 10 | 15.1023 | 1.2781 | 615.5015 | 12.5339 | -13.1241 | 0.0000 |
| AUG | 4931.00 | 418.6028 | 10 | 41.8602 | 1.2781 | 657.3619 | 13.8120 | -40.5821 | 0.0000 |
| SEP | 1706.00 | 146.5237 | 10 | 14.6523 | 1.2369 | 671.8142 | 15.0489 | -13.4154 | 0.0000 |

[ At 7Q10 Flow Conditions : CONTROLLED WASTEWATER VOLUME : 0.0778 Mgal HOLDING PERIOD : 7.00 Days ]]

Remark (s) :

DEPARTMENT OF ENVIRONMENTAL MANAGEMENT
WATER MANAGMENT

ALTERNATE TREATMENT PLANT - PROPOSED ADVANCED STP  SUMMER WASTE LOAD ALLOCATION ANALYSIS BASED ON USEPA SIMPLIFIED MODEL  DATE = 07/14/98

COUNTY - BOONE COUNTY  RECEIVING STREAM = BIG RACCOON CREEK  MAIN STREAM = WABASH RIVER  SIMULATED BY = M.AK

<u>THIS RESULTS HAS BEEN UPDATED DUE TO ANOTHER ALTERNATIVE PLANT SITE</u>

STREAM WATER QUALITY STANDARDS

<u>DISSOLVED OXYGEN = 5.0 MG/L
Ammonia-N Standard is based on the EXISTING RULE 327 IAC 2-1</u>

HEADWATER AND EFFLUENT WATER QUALITY INPUT DATA  REACH NUMBER 1

| | FLOW CFS | BOD (ULTIMATE) MG/L | NBOD MG/L | DISSOLVED OXYGEN MG/L | TEMPERATURE CG |
|---|---|---|---|---|---|
| HEADWATER WATER QUALITY | 0.240 | 5.000 | 0.300 | 7.360 | 25.00 |
| EFFLUENT WATER QUALITY | 0.059 | 58.000 | 9.100 | 5.000 | 25.00 |
| STREAM WATER QUALITY AT STP | 0.299 | 15.458 | 2.004 | 6.895 | 25.00 |

HYDRAULIC CHARACTERISTICS OF STREAM BELOW TREATMENT PLANT OR JUNCTION

VELOCITY IN FT/SEC = 0.060  HYDRAULIC DEPTH IN FT = 0.0800  STREAM BED SLOPE IN FT/MILE = 7.40  MANNING'S COEFF = 0.035

REACH  BIG RACCOON CRLE  MILES  FROM  6.000  TO  0.000  COMPUTATIONAL ELEMENT  0.25000  MILE

REAERATION AND DEOXYGENATION RATES

| | | AT 20 CG | AT INSTREAM TEMP 25.00 CG | REMARK |
|---|---|---|---|---|
| REAERATION RATE | (1/DAY) | 13.1572 | 14.81382 | CHANGLIEN-DURUM EQ. |
| BOD DECAY RATE | (1/DAY) | 0.40000 | 0.50328 | |
| NBOD DECAY RATE | (1/DAY) | 0.40000 | 0.58773 | |
| SEDIMENTATION RATE | (1/DAY) | 0.00000 | 0.00000 | "-"SUSPENSION "+" SEDIMENTATION |
| SEDIMENT OXIDATION OXYGEN DEMAND | | 0.00000 | 0.01102 | IN GM/SQ.M/DAY AT 20 CG |

STREETER-PHELPS DISSOLVED OXYGEN SAG CURVE FOR REACH OF A DISCHARGER OR BELOW JUNCTION

| TIME DAYS | DISTANCE BELOW DISCHARGER FROM MILE | DISTANCE BELOW DISCHARGER FROM OUTFALL | DISSOLVED OXYGEN MG/L | BOD (ULTIMATE) MG/L | BIOD MG/L |
|---|---|---|---|---|---|
| 0.00 | MILE = 6.00 | MILE = 0.00 | 6.895 | 15.450 | 2.036 |
| 0.25 | MILE = 5.75 | MILE = 0.25 | 6.502 | 13.598 | 1.793 |
| 0.50 | MILE = 5.50 | MILE = 0.50 | 6.559 | 11.963 | 1.609 |
| 0.76 | MILE = 5.25 | MILE = 0.75 | 6.613 | 10.524 | 1.299 |
| 1.01 | MILE = 5.00 | MILE = 1.00 | 6.670 | 9.258 | 1.119 |
| 1.27 | MILE = 4.75 | MILE = 1.25 | 6.716 | 8.145 | 0.971 |
| 1.52 | MILE = 4.50 | MILE = 1.50 | 6.756 | 7.165 | 0.829 |
| 1.78 | MILE = 4.25 | MILE = 1.75 | 6.791 | 6.303 | 0.714 |
| 2.03 | MILE = 4.00 | MILE = 2.00 | 6.821 | 5.545 | 0.615 |
| 2.29 | MILE = 3.75 | MILE = 2.25 | 6.848 | 4.878 | 0.529 |
| 2.54 | MILE = 3.50 | MILE = 2.50 | 6.872 | 4.291 | 0.455 |
| 2.80 | MILE = 3.25 | MILE = 2.75 | 6.892 | 3.775 | 0.392 |
| 3.05 | MILE = 3.00 | MILE = 3.00 | 6.911 | 3.321 | 0.338 |
| 3.31 | MILE = 2.75 | MILE = 3.25 | 6.927 | 2.921 | 0.291 |
| 3.56 | MILE = 2.50 | MILE = 3.50 | 6.941 | 2.570 | 0.250 |
| 3.81 | MILE = 2.25 | MILE = 3.75 | 6.953 | 2.261 | 0.215 |
| 4.07 | MILE = 2.00 | MILE = 4.00 | 6.964 | 1.989 | 0.185 |
| 4.32 | MILE = 1.75 | MILE = 4.25 | 6.974 | 1.750 | 0.159 |
| 4.58 | MILE = 1.50 | MILE = 4.50 | 6.982 | 1.539 | 0.137 |
| 4.83 | MILE = 1.25 | MILE = 4.75 | 6.989 | 1.354 | 0.118 |
| 5.07 | MILE = 1.00 | MILE = 5.00 | 6.996 | 1.191 | 0.103 |
| 5.34 | MILE = 0.75 | MILE = 5.25 | 7.001 | 1.048 | 0.087 |
| 5.60 | MILE = 0.50 | MILE = 5.50 | 7.006 | 0.922 | 0.075 |
| 5.85 | MILE = 0.25 | MILE = 5.75 | 7.011 | 0.811 | 0.065 |
| 6.11 | MILE = 0.00 | MILE = 6.00 | 7.014 | 0.713 | 0.056 |

MINIMUM DISSOLVED OXYGEN 6.500 MG/L OCCURS AT 0.216 DAY AND 0.2125 MILES
BELOW DISCHARGER OR JUNCTION

[illegible] TREATMENT PLANT - PROPOSED ADVANCE STP  WINTER WASTELOAD ALLOCATION ANALYSIS BASED ON USEPA SIMPLIFIED MODEL  DATE = 06/14/90

COUNTY = BOONE COUNTY  RECEIVING STREAM = BIG RACCOON CREEK  MAIN STREAM = NODAWAY RIVER  CIRCULATED BY = M.DR

[illegible] BIG RACCOON CREEK TO ANOTHER ALTERNATIVE PLANT SITE

STREAM WATER QUALITY STANDARDS

INSTREAM DISSOLVED OXYGEN = 5.0 MG/L.
Ammonia-N Standards is based on the EXISTING RULE 10/ TAC 2-1

DOWNSTREAM TREATMENT WATER QUALITY INPUT DATA  REACH NUMBER 1

| | FLOW CFS | BOD (ULTIMATE) MG/L | NBOD MG/L | DISSOLVED OXYGEN MG/L | TEMPERATURE CG |
|---|---|---|---|---|---|
| UPSTREAM WATER QUALITY | 0.240 | 5.000 | 0.300 | 7.360 | 15.00 |
| EFFLUENT WATER QUALITY | 0.059 | 58.000 | 20.500 | 4.000 | 15.00 |
| STREAM WQ D/S OF STP | 0.299 | 15.438 | 4.286 | 6.698 | 15.00 |

HYDRAULIC CHARACTERISTICS OF STREAM BELOW TREATMENT PLANT OR JUNCTION

VELOCITY IN FT/SEC = 0.060  HYDRAULIC DEPTH IN FT = 0.0300  STREAM BED SLOPE IN FT/MILE = 7.60  MANNING'S COEFF = 0.035

REACH  BIG RACCOON CREE  MILES  FROM  6.000  TO  0.000  COMPUTATIONAL ELEMENT  0.25000  MILE

REACTION AND REDUCTION RATES

| | | AT 20 CG | AT INSTREAM TEMP 15.00 CG | REMARK |
|---|---|---|---|---|
| REAERATION RATE | [1/DAY] | 13.15738 | 11.60604 | LANGBIEN-DURUM ER. |
| BOD DECAY RATE | [1/DAY] | 0.40000 | 0.31792 | |
| NBOD DECAY RATE | [1/DAY] | 0.40000 | 0.27793 | |
| SEDIMENTATION RATE | [1/DAY] | 0.00000 | 0.00000 | "-"SUSPENSION "+" SEDIMENTATION |
| SEDIMENT (BENTHIC) OXYGEN DEMAND | | 0.30000 | 0.21896 | IN GM/SQ.M/DAY AT 20 CG |

STREETER-PHELPS MODEL WASTE LOAD ALLOCATION DOWNSTREAM OF A DISCHARGE OR BELOW JUNCTION

| TIME (DAYS) | DISTANCE BELOW POINT (MILES) | DISTANCE FROM JUNCTION | DISSOLVED OXYGEN MG/L | BOD (ULTIMATE) MG/L | NBOD MG/L |
|---|---|---|---|---|---|
| 0.00 | MILE = 6.00 | MILE = 0.00 | 6.698 | 15.400 | 4.285 |
| 0.25 | MILE = 5.75 | MILE = 0.25 | 8.471 | 14.256 | 3.998 |
| 0.50 | MILE = 5.50 | MILE = 0.50 | 8.807 | 13.147 | 3.701 |
| 0.75 | MILE = 5.25 | MILE = 0.75 | 8.947 | 12.125 | 3.411 |
| 1.00 | MILE = 5.00 | MILE = 1.00 | 8.829 | 11.182 | 3.148 |
| 1.27 | MILE = 4.75 | MILE = 1.25 | 8.909 | 10.312 | 3.030 |
| 1.52 | MILE = 4.50 | MILE = 1.50 | 8.936 | 9.510 | 2.827 |
| 1.78 | MILE = 4.25 | MILE = 1.75 | 8.961 | 8.771 | 2.638 |
| 2.00 | MILE = 4.00 | MILE = 2.00 | 8.984 | 8.089 | 2.461 |
| 2.27 | MILE = 3.75 | MILE = 2.25 | 9.006 | 7.460 | 2.296 |
| 2.54 | MILE = 3.50 | MILE = 2.50 | 9.026 | 6.879 | 2.142 |
| 2.80 | MILE = 3.25 | MILE = 2.75 | 9.044 | 6.341 | 1.999 |
| 3.05 | MILE = 3.00 | MILE = 3.00 | 9.061 | 5.851 | 1.865 |
| 3.31 | MILE = 2.75 | MILE = 3.25 | 9.077 | 5.396 | 1.740 |
| 3.56 | MILE = 2.50 | MILE = 3.50 | 9.091 | 4.976 | 1.623 |
| 3.81 | MILE = 2.25 | MILE = 3.75 | 9.105 | 4.589 | 1.515 |
| 4.07 | MILE = 2.00 | MILE = 4.00 | 9.117 | 4.232 | 1.413 |
| 4.32 | MILE = 1.75 | MILE = 4.25 | 9.129 | 3.903 | 1.319 |
| 4.58 | MILE = 1.50 | MILE = 4.50 | 9.139 | 3.600 | 1.230 |
| 4.83 | MILE = 1.25 | MILE = 4.75 | 9.149 | 3.320 | 1.148 |
| 5.07 | MILE = 1.00 | MILE = 5.00 | 9.158 | 3.062 | 1.071 |
| 5.34 | MILE = 0.75 | MILE = 5.25 | 9.167 | 2.823 | 0.999 |
| 5.60 | MILE = 0.50 | MILE = 5.50 | 9.174 | 2.604 | 0.932 |
| 5.85 | MILE = 0.25 | MILE = 5.75 | 9.181 | 2.401 | 0.870 |
| 6.11 | MILE = 0.00 | MILE = 6.00 | 9.186 | 2.215 | 0.811 |

MINIMUM DISSOLVED OXYGEN 6.698 MG/L OCCURS AT 0.000 DAY AND 0.0000 MILES
BELOW DISCHARGE OR JUNCTION

DETERMINATION OF EFFLUENT AND STREAM LIMITATIONS
WATER MANAGEMENT

PROPOSED TREATMENT PLANT PROPOSED ADVANCE STP SUMMER WASTELOAD ALLOCATION ANALYSIS BASED ON USEPA SIMPLIFIED MODEL DATE = 06/14/89

COUNTY = DOUGLAS COUNTY RECEIVING STREAM = BIG RACCOON CREEK MAIN STREAM = WABASH RIVER SIMULATED BY = M.DK

* * * THIS IS SCENARIO NO. 10 * * * TO ANOTHER DISCHARGING PLANT SITE

STREAM WATER QUALITY STANDARDS

DOWNSTREAM DISSOLVED OXYGEN = 5.0 MG/L
Ammonia-N Standards is based on the PROPOSED RULE 327 IAC 2-1

ALL WATER AND EFFLUENT WATER QUALITY INPUT DATA ARE BASED ON 1 SAMPLE

| | FLOW CFS | BOD (ULTIMATE) MG/L | NH3-N MG/L | DISSOLVED OXYGEN MG/L | TEMPERATURE CG |
|---|---|---|---|---|---|
| HEADWATER WATER QUALITY | 0.190 | 5.000 | 0.300 | 7.362 | 25.00 |
| EFFLUENT WATER QUALITY | 0.059 | 53.000 | 12.800 | 5.000 | 25.00 |
| STREAM WQ AFTER MIX | 0.299 | 16.408 | 2.766 | 6.875 | 25.00 |

HYDRAULIC CHARACTERISTICS AT STREAM BELOW TREATMENT PLANT OR JUNCTION

VELOCITY IN FT/SEC = 0.060 HYDRAULIC DEPTH IN FT = 0.0800 STREAM BED SLOPE IN FT/MILE = 7.60 MANNING'S COEFF = 0.035

REACH NO RACCOON CREEK MILES FROM 6.000 TO 0.000 COMPUTATIONAL ELEMENT 0.25000 MILE

DEOXYGENATION AND REAERATION RATES

| | | AT 20.00 | AT INSTREAM TEMP 25.00 CG | REMARK |
|---|---|---|---|---|
| REAERATION RATE | [1/DAY] | 13.15732 | 14.81382 | LANGBIEN-NUROM EQ. |
| BOD DECAY RATE | [1/DAY] | 0.40000 | 0.50926 | |
| NBOD DECAY RATE | [1/DAY] | 0.40000 | 0.50926 | |
| SEDIMENTATION RATE | [1/DAY] | 0.00000 | 0.00000 | + "SUSPENSION "+" SEDIMENTATION |
| SEDIMENT DEMAND OXYGEN DEMAND | | 0.30000 | 0.41102 | IN GM/SQ.M/DAY AT 20 CG |

FIGURE_D_DISTRIBUTIONS_QUALITY_DOWNSTREAM_OF_A_DISCHARGER_OR_BELOW_JUNCTION

| TIME DAYS | DISTANCE BELOW DISCHARGER FROM MILE | DISCHARGER FROM OUTFALL | DISSOLVED OXYGEN MG/L | BOD (ULTIMATE) MG/L | BOD MG/L |
|---|---|---|---|---|---|
| 0.000 | MILE = 6.00 | MILE = 0.00 | 6.895 | 15.450 | 2.766 |
| 0.013 | MILE = 5.75 | MILE = 0.25 | 6.477 | 13.593 | 2.434 |
| 0.026 | MILE = 5.50 | MILE = 0.50 | 6.537 | 11.963 | 2.050 |
| 0.039 | MILE = 5.25 | MILE = 0.75 | 6.699 | 10.529 | 1.765 |
| 0.051 | MILE = 5.00 | MILE = 1.00 | 6.659 | 9.268 | 1.520 |
| 0.064 | MILE = 4.75 | MILE = 1.25 | 6.701 | 8.159 | 1.309 |
| 0.077 | MILE = 4.50 | MILE = 1.50 | 6.743 | 7.185 | 1.147 |
| 0.090 | MILE = 4.25 | MILE = 1.75 | 6.780 | 6.323 | 0.970 |
| 0.103 | MILE = 4.00 | MILE = 2.00 | 6.817 | 5.565 | 0.835 |
| 0.129 | MILE = 3.75 | MILE = 2.25 | 6.911 | 4.879 | 0.719 |
| 0.154 | MILE = 3.50 | MILE = 2.50 | 6.876 | 4.291 | 0.619 |
| 0.180 | MILE = 3.25 | MILE = 2.75 | 6.887 | 3.775 | 0.533 |
| 0.205 | MILE = 3.00 | MILE = 3.00 | 6.906 | 3.321 | 0.459 |
| 0.231 | MILE = 2.75 | MILE = 3.25 | 6.923 | 2.921 | 0.394 |
| 0.256 | MILE = 2.50 | MILE = 3.50 | 6.937 | 2.570 | 0.340 |
| 0.281 | MILE = 2.25 | MILE = 3.75 | 6.950 | 2.261 | 0.293 |
| 0.307 | MILE = 2.00 | MILE = 4.00 | 6.961 | 1.989 | 0.252 |
| 0.332 | MILE = 1.75 | MILE = 4.25 | 6.971 | 1.750 | 0.217 |
| 0.358 | MILE = 1.50 | MILE = 4.50 | 6.980 | 1.539 | 0.187 |
| 0.383 | MILE = 1.25 | MILE = 4.75 | 6.988 | 1.354 | 0.161 |
| 0.409 | MILE = 1.00 | MILE = 5.00 | 6.994 | 1.191 | 0.138 |
| 0.434 | MILE = 0.75 | MILE = 5.25 | 7.000 | 1.048 | 0.119 |
| 0.460 | MILE = 0.50 | MILE = 5.50 | 7.005 | 0.922 | 0.102 |
| 0.485 | MILE = 0.25 | MILE = 5.75 | 7.010 | 0.811 | 0.089 |
| 0.511 | MILE = 0.00 | MILE = 6.00 | 7.014 | 0.713 | 0.076 |

MINIMUM DISSOLVED OXYGEN 6.474 MG/L OCCURS AT 0.237 DAY AND 0.2130 MILES
BELOW DISCHARGER OR JUNCTION

CITY OF TERRE HAUTE = PROPOSED ADVANCED STP  WINTER WASTELOAD ALLOCATION ANALYSIS BASED ON USEPA SIMPLIFIED MODEL  DATE = 06/14/88

COUNTY = VIGO COUNTY  RECEIVING STREAM = BIG SUGAR CREEK  MAIN STREAM = WABASH RIVER  SIMULATED BY = M.AP

DESIGN FLOW FOR THE PROPOSED 20 MGD TERRE HAUTE ADVANCED WASTEWATER TREATMENT PLANT SITE

STEADY-STATE WATER QUALITY STANDARDS

CRITERION DISSOLVED OXYGEN = 5.0 MG/L
Ammonia-N Standards is based on the PROPOSED RULE 327 IAC 2-1

UPSTREAM AND EFFLUENT WATER QUALITY INPUT DATA ..... REACH NUMBER ..... 1

| | FLOW CFS | BOD (ULTIMATE) MG/L | NBOD MG/L | DISSOLVED OXYGEN MG/L | TEMPERATURE CG |
|---|---|---|---|---|---|
| HEADWATER WATER QUALITY | 0.240 | 5.000 | 0.300 | 7.362 | 15.00 |
| EFFLUENT WATER QUALITY | 0.059 | 58.000 | 19.400 | 4.000 | 15.00 |
| STREAM WQ D/S OF STP | 0.299 | 15.458 | 4.068 | 6.698 | 15.00 |

HYDRAULIC CHARACTERISTICS OF STREAM BELOW EFFLUENT PLANT DISCHARGE

VELOCITY IN FT/SEC = 0.500  HYDRAULIC DEPTH IN FT = 0.0800  STREAM BED SLOPE IN FT/MILE = 7.40  MANNING'S COEFF. = 0.035

REACH  BIG RACCOON CREEK  AREA  FROM  6.000  TO  0.000  COMPUTATIONAL ELEMENT  0.25000  MILE

REACTION AND SOLUBILITY RATES

| | | AT 20 CG | AT INSTREAM TEMP 15.00 CG | REMARK |
|---|---|---|---|---|
| DEOXYGENATION RATE | (1/DAY) | 13.15738* | 11.68604 | LANGDIEN-DIAMOND EQ. |
| BOD DECAY RATE | (1/DAY) | 0.40000 | 0.31792 | |
| NBOD DECAY RATE | (1/DAY) | 0.40000 | 0.27823 | |
| SEDIMENTATION RATE | (1/DAY) | 0.00000 | 0.00000 | "-"SUSPENSION "+" SEDIMENTATION |
| BENTHAL (CONSTANT) OXYGEN DEMAND | | 0.00000 | 0.21896 | IN GM/SQ.M/DAY AT 20 CG |

FISHOOKED LOCATION RATIO: MODELED/OBSERVED DO DISCHARGER DB BELOW INJECTION

| TIME (DAY) | DISTANCE BELOW DISCHARGE POINT (MILE) | DISTANCE BELOW DISCHARGE POINT (MILE) | DISSOLVED OXYGEN MG/L | BOD, ULTIMATE MG/L | BOD MG/L |
|---|---|---|---|---|---|
| 0.00 | MILE = 0.00 | MILE = 0.00 | 5.698 | 15.458 | 4.068 |
| 0.25 | MILE = 0.25 | MILE = 0.25 | 8.675 | 14.256 | 3.796 |
| 0.50 | MILE = 0.50 | MILE = 0.50 | 8.830 | 13.147 | 3.562 |
| 0.75 | MILE = 0.75 | MILE = 0.75 | 8.851 | 12.125 | 3.304 |
| 1.00 | MILE = 1.00 | MILE = 1.00 | 8.861 | 11.183 | 3.061 |
| 1.25 | MILE = 1.25 | MILE = 1.25 | 8.912 | 10.312 | 2.877 |
| 1.50 | MILE = 1.50 | MILE = 1.50 | 8.939 | 9.510 | 2.684 |
| 1.78 | MILE = 1.75 | MILE = 1.75 | 8.964 | 8.771 | 2.504 |
| 2.00 | MILE = 2.00 | MILE = 2.00 | 8.987 | 8.089 | 2.336 |
| 2.29 | MILE = 2.25 | MILE = 2.25 | 9.009 | 7.460 | 2.180 |
| 2.50 | MILE = 2.50 | MILE = 2.50 | 9.028 | 6.879 | 2.034 |
| 2.80 | MILE = 2.75 | MILE = 2.75 | 9.047 | 6.344 | 1.898 |
| 3.00 | MILE = 3.00 | MILE = 3.00 | 9.063 | 5.851 | 1.771 |
| 3.31 | MILE = 2.75 | MILE = 3.25 | 9.079 | 5.396 | 1.652 |
| 3.50 | MILE = 3.50 | MILE = 3.50 | 9.093 | 4.976 | 1.541 |
| 3.81 | MILE = 3.25 | MILE = 3.75 | 9.107 | 4.589 | 1.438 |
| 4.07 | MILE = 4.00 | MILE = 4.00 | 9.119 | 4.232 | 1.342 |
| 4.32 | MILE = 1.75 | MILE = 4.25 | 9.130 | 3.903 | 1.252 |
| 4.58 | MILE = 4.50 | MILE = 4.50 | 9.141 | 3.600 | 1.168 |
| 4.81 | MILE = 4.25 | MILE = 4.75 | 9.151 | 3.320 | 1.090 |
| 5.09 | MILE = 1.00 | MILE = 5.00 | 9.159 | 3.062 | 1.017 |
| 5.31 | MILE = 0.75 | MILE = 5.25 | 9.168 | 2.823 | 0.949 |
| 5.60 | MILE = 0.50 | MILE = 5.50 | 9.176 | 2.604 | 0.885 |
| 5.86 | MILE = 0.25 | MILE = 5.75 | 9.183 | 2.401 | 0.826 |
| 6.11 | MILE = 0.00 | MILE = 6.00 | 9.189 | 2.215 | 0.770 |

MINIMUM DISSOLVED OXYGEN 5.698 MG/L OCCURS AT 0.000 DAY AND 0.0000 MILES
FISH DISCHARGER DB FUNCTION

INDIANA DEPARTMENT OF ENVIRONMENTAL MANAGEMENT
OFFICE OF WATER MANAGEMENT

# ADVANCE STP
# BOONE COUNTY

# WASTELOAD ALLOCATION ANALYSIS

## SIMPLIFIED STEADY STATE MODEL

February 1987

## Summary

A wasteload allocation analysis has been performed for the proposed sewage treatment plant of the Town of Advance, Boone County. The purpose of the analysis is to determine the National Pollutant Discharge Elimination System (NPDES) effluent permit limits in conjunction with the U.S. EPA construction grant funding requirements. The summer and winter effluent limits, to meet water quality standards, were determined by using the U.S. EPA steady state simplified mathematical water quality model. Presently, the Town of Advance does not have a wastewater treatment facility. The proposed sewage treatment plant (STP) will have a design flow of 0.042 mgd and will be discharging its effluent into Brinegar Ditch, then to the Walnut Fork Sugar Creek/Sugar Creek. The drainage area of the primary receiving stream above the proposed site is estimated to be 1.0 square-mile, and 7-day, 10-year low-flow ($Q_{7,10}$) is about zero.

Also, a controlled discharge analysis has been performed as an option to the continuous discharge analysis.

The recommended effluent limits for continuous discharge analysis are as follows:

| | Summer | Winter |
|---|---|---|
| $CBOD_5$ | = 25.0 mg/l | 25.0 mg/l |
| TSS | = 30.0 mg/l | 30.0 mg/l |
| DO | = 6.0 mg/l | 5.0 mg/l |
| $NH_3$-N | = 1.6 mg/l | 3.1 mg/l |


## A. General Description

The Town of Advance is located in southwest Boone County in central Indiana. Currently, Advance does not have a municipally owned sewage treatment facility. The proposed plant will be discharging its effluent first to Brinegar Ditch, then to the Walnut Fork Sugar Creek and Sugar Creek. The Town's projected population for the year 2010 would be 600 people (1). The plant design flow for this population is determined to be 0.042 million gallon day (MGD).

## B. Applicable Water Quality Standards

The receiving stream of the Advance STP is covered under Indiana's Rule 330 IAC 1-1 and is designated for general use including the protection of fish and aquatic life. The general use designation of streams requires a daily average instream dissolved oxygen (DO) concentration of 5.0 mg/l and a limitation on toxic substances to 1/10 of the 96-hour lethal concentration ($LC_{50}$) for indigenous life. This would include a weekly average instream ammonia concentration of not more than 0.05 mg/l un-ionized ammonia (0.033 mg/l monthly).

## C. Wasteload Allocation Parameters and Their Determination

The effluent quality required to meet water quality standards was determined by the U.S. EPA simplified modeling techniques. The water quality input variables for this modeling analysis were extrapolated from field measurements conducted by the Indiana Department of Environmental Management (IDEM) Survey Section in March and May 1986 (2). During the survey, stream channel characteristics and time of travel were measured. These values are presented in Table 1. The velocity and depth were determined by extrapolating the March-June 1986 survey data at $Q_{7,10}$ conditions. The Langbien-Durum reaeration equation was selected for the reaeration reaction rate ($K_2$), because it resulted with a reasonable and typical value for the given characteristics of the receiving stream (3). BOD rate coefficiently ($K_1$) NBOD rate coefficient ($K_3$), and SOD rate coefficient ($K_5$) were determined by using the U.S. EPA simplified modeling guidelines (4).

## D. Sensitivity Analysis

The sensitivity analysis of each input variable for the proposed outfall location are presented in Figures 1 and 2. Three sets of calculations were made for each input variable by using model variables that represent the worst and the best ends of their sensitivity ranges and the value actually used in the wasteload allocation. Figure 1 illustrates the high sensitivity of total ammonia-N to changes in pH rather than temperature. As they are shown in Figure 2, the variables that require the most precision in the projected WLAs are the determination of $K_2$ and $K_1$ rates. The remaining input variables in the model require somewhat less precision.

## E. Recommended Effluent Limitations

The computer printouts for the summer and winter wasteload allocations are presented in Table 2 and Table 3 from which the instream water quality is associated with the recommended effluent limitations.

The recommended effluent limitations for both summer and winter months are presented in Table 4. The upstream flow was not changed for the winter analysis because streams in the area often experience flows near the summer $Q_{7,10}$=0.0 cfs during the winter months. For both the summer and winter wasteload allocations, the ammonia-N requirements were set at the toxicity limit and the effluent $BOD_u$ concentration was varied until an instream dissolved oxygen concentration of 5.0 mg/l was achieved.

Table 5 demonstrates the relationship between the various treatment levels and the resulting ammonia-N and dissolved oxygen concentrations.

## F. Controlled Discharge Analysis

As an option to the continuous discharge the feasibility of a controlled discharge operation which is essentially based on the availability of receiving stream flow for dilution is examined. The analysis is in accordance with the September 1985 controlled discharge guidelines(5) and the Indiana

Department of Environmental Management's, Water Management's, Controlled Discharge Committee memo of February 1987.(6) The IDEM existing guidelines impose a stream to plant discharge flow ratio of 5 from May through September and 3 from October through April. Presently, the guidelines are under review the reflect the impacts of mixing zones in instream water quality. Therefore, an additional analysis was performed by utilizing dilution ratios of 6:1 and 10:1 for winter and summer; respectively.

Since there is no USGS flow recording station on the upstream of the proposed Advance STP, it is necessary to select the nearest USGS gaging station in order to project the upstream flow of the STP. A review/evaluation of Indiana Water Resources Data indicates that the nearest USGS flow record station is on Sugar Creek at Crawfordsville, Montgomery County. A review of the past ten years shows that water year 1977 has the lowest annual flow at the reference station, and its flow data was used as a base water year together with the flow data of water years 1976 and 1978. Then, flow data of the reference gaging station was adjusted to the receiving stream by drainage area ratio method to determine the required storage ponds.

G. Results of the Analysis

Part I of the attached Table 6 represents the information, data and parameters of the controlled discharge analysis according to the above mentioned guidelines. Part II represents the computation of required storage pond size. Columns 2 and 3 of the tabulated data represent the transfer of flow data from the reference gaging station to the receiving stream. Using the conservation of mass (volume in this case) principle for a pond storage system, the maximum volume of wastewater held due to insufficient flow of the receiving stream to meet the dilution requirement is shown on the 10th column which is 5.83 mgal. and 8.20 mgal. for the dilution ratios of 3:1/5:1 and 6:1/10:1, respectively.

Based on 70.0 gpcd water consumption and 600 people population of or the year 2010, the Town's controlled discharge treatment system should consist of a treatment pond and a controlled discharge storage pond for a holding period of 195 days. The treatment pond should be sized to provide sufficient surface to meet the recommended organic loading (25.0 lb. $BOD_5$/acre-day) and should be at least two cells in order to meet effluent quality of 25.0 mg/l $CBOD_5$ and 70.0 mg/l TSS on a maximum monthly average basis.

## References


1. Stevens, Jill; IDEM Facility Plan Section

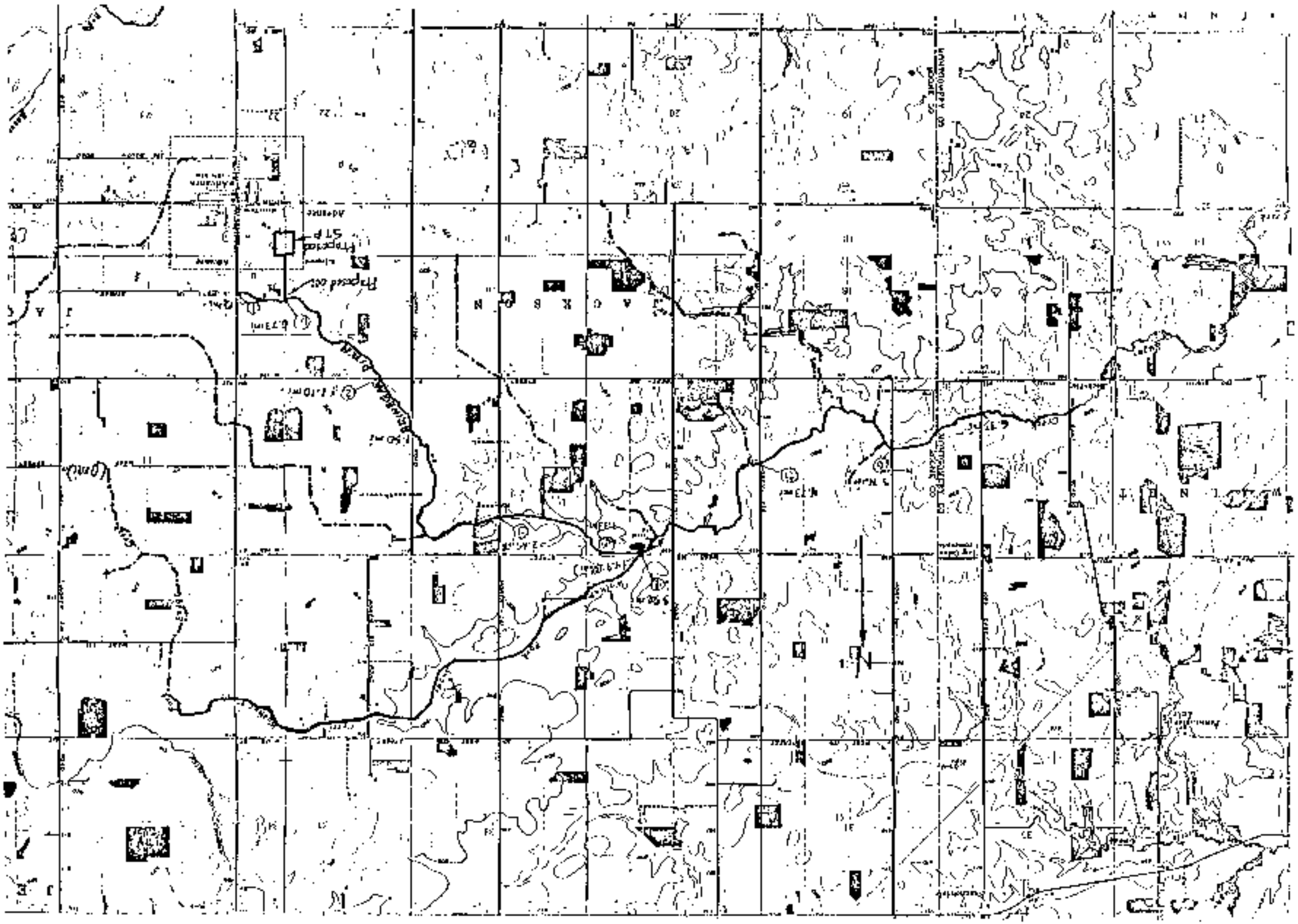
2. IDEM Survey Data, March-May 1986.

3. Determining the Reaeration Coefficients of Ohio Streams, Ohio Environmental Protection Agency.

4. U.S. Environmental Protection Agency (EPA Simplified Modeling Technology for National Use, 1980 w/Addendum June 1982).

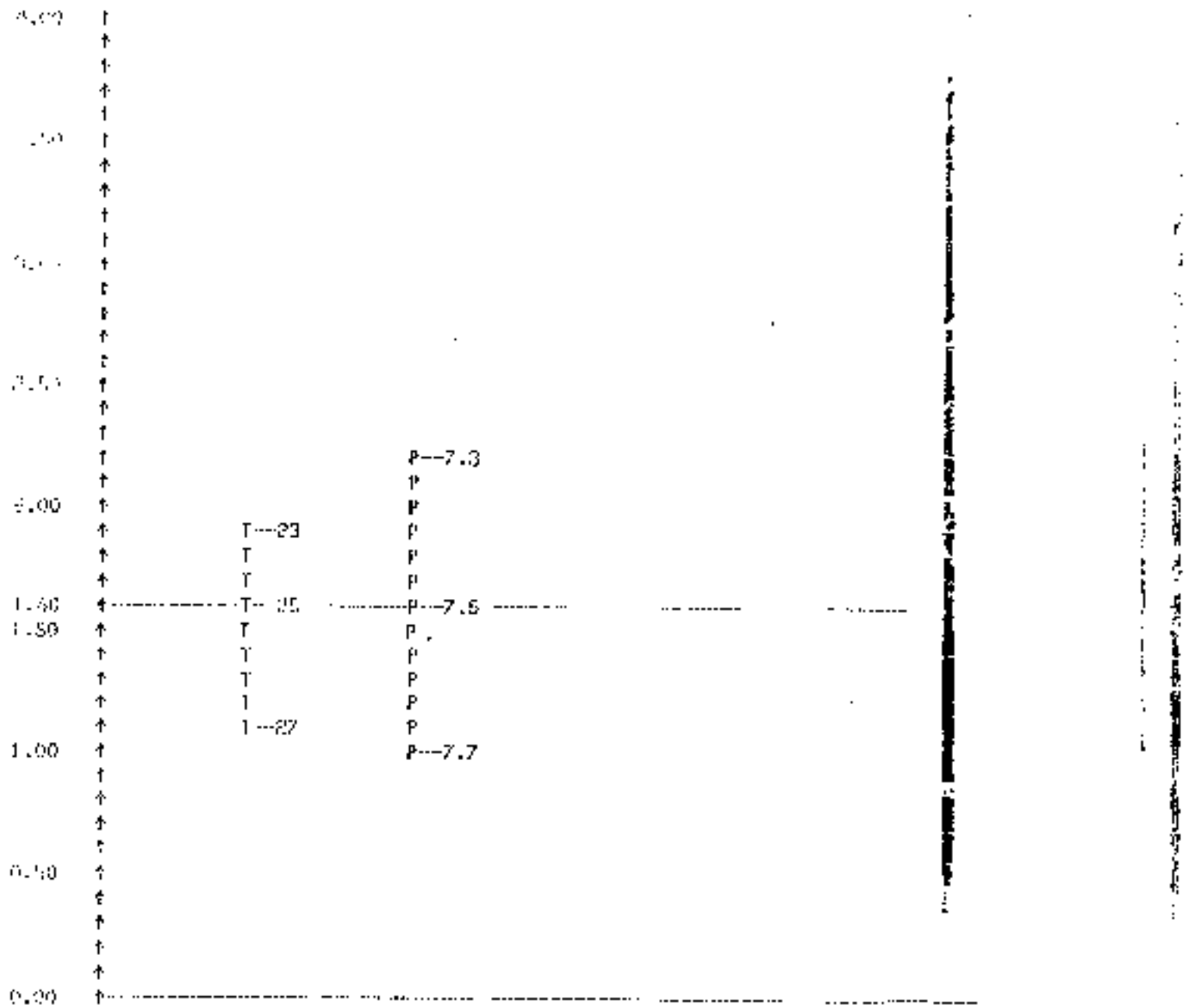
5. Revised Controlled Discharge Guidelines for Wastewater Stabilization Lagoon, September 1985.

6. Memo from IDEM Water Management Controlled Discharge Committee, February 1987.



SENSITIVITY OF RECEIVING WATER TO WASTEWATER TREATMENT PLANT = OXFORD STP.  COUNTY = DODGE CO.  FIGURE 1

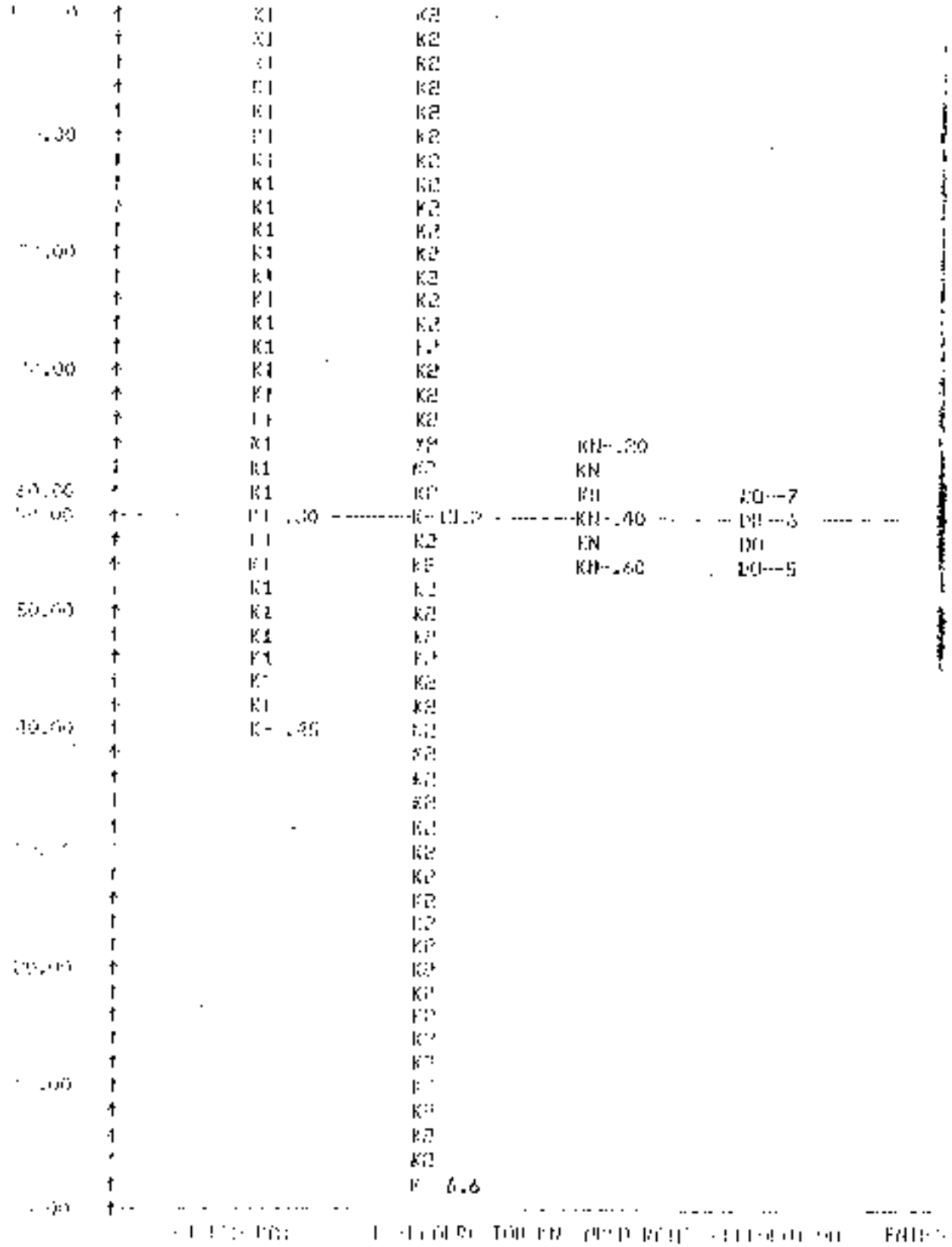
Y - AXIS REPRESENTS  INSTREAM AMMONIA N  VARIATION MG/L  WRT TO TEMPERATURE AND pH




DISCHARGE LOCATION  0  TOXIC LIMIT = 1.6 MG/L MONTHLY  CORRESPONDING EFFLUENT AMMONIA-N  LIMITATION = 1.6 MG/L MONTHLY

| | | |
|---|---|---|
| [illegible] | SELECTED INPUT VARIABLES | SUMMER EFFLUENT LIMITS |
| [illegible] 0.40 0.20 | K1= 0.40 [1/DAY] | DESIGN FLOW 0.042 MGD |
| [illegible] 0.40 0.20 | K2= 0.40 [1/DAY] | CBOD5 20.00 MG/L [REMOVAL] |
| [illegible] | KP= 10.70 [1/DAY] | AMMONIA N 1.40 MG/L [NONE] |
| [illegible] 0.50 0.15 | BENTHIC 0.30 [GM/SQ/DAY] | EFFLUENT DO 6.00 MG/L |

[illegible] MONTHLY REGULATORY - BOD5 REQUIRED TO MEET UPSTREAM DO OF 5.00 MG/L




[illegible]

DEPARTMENT OF ENVIRONMENTAL MANAGEMENT
WATER MANAGMENT

SEWAGE TREATMENT PLANT = ADVANCE STP. SUMMER WASTELOAD ALLOCATION ANALYSIS BASED ON USEPA SIMPLIFIED MODEL DATE = 02/18/87

COUNTY = BOONE COUNTY RECEIVING STREAM = ARNEGAR DITCH MAIN STREAM SUGAR CREEK SIMULATED BY = H.AK

GENERAL CITY STREAM

STREAM WATER QUALITY STANDARDS

DISSOLVED OXYGEN = 5.00 MG/L. UN-IONIZED AMMONIA IN MG/L = 0.050 (WEEKLY) 0.093 (MONTHLY)

HEADWATER AND EFFLUENT WATER QUALITY INPUT DATA ..... REACH NUMBER 1

| | FLOW CFS | BOD (ULTIMATE) MG/L | NBOD MG/L | DISSOLVED OXYGEN MG/L | TEMPERATURE CG |
|---|---|---|---|---|---|
| HEADWATER WATER QUALITY | 0.000 | 0.000 | 0.000 | 0.000 | 0.00 |
| EFFLUENT WATER QUALITY | 0.060 | 57.500 | 7.100 | 6.000 | 25.00 |
| STREAM WQ C/S AT STP | 0.060 | 57.500 | 7.100 | 6.000 | 25.00 |

HYDRAULIC CHARACTERISTICS OF STREAM BELOW TREATMENT PLANT OR JUNCTION

VELOCITY IN FT/SEC = 0.060 HYDRAULIC DEPTH IN FT = 0.0800 STREAM BED SLOPE IN FT/MILE = 7.60 MANNING'S COEFF = 0.035

REACH SPINNEGAR DITCH MILES FROM 6.000 TO 0.000 COMPUTATIONAL ELEMENT 0.25000 MILE

REACTION AND REAERATION RATES

| | | AT 20 CG | AT INSTREAM TEMP 25.00 CG | REMARK |
|---|---|---|---|---|
| REAERATION RATE | [1/DAY] | 13.15702 | 14.81382 | LANGBIEN-NURUM EQ. |
| BOD DECAY RATE | [1/DAY] | 0.40000 | 0.50326 | |
| NBOD DECAY RATE | [1/DAY] | 0.40000 | 0.58773 | |
| SEDIMENTATION RATE | [1/DAY] | 0.00000 | 0.00000 | "-"SUSPENSION "+" SEDIMENTATION |
| SEDIMENT OXYGEN DEMAND | | 0.30000 | 0.41102 | IN GM/SQ.M/DAY AT 20 CG |

SIMULATED DISSOLVED WATER QUALITY RESPONSE TO DISCHARGE OF 0.0 CFS

| TIME DAYS | DISTANCE FROM HEAD | DISTANCE FROM OUTFALL | DISSOLVED OXYGEN MG/L | BOD (ULTIMATE) MG/L | NBOD MG/L |
|---|---|---|---|---|---|
| 0.00 | MILE = 6.00 | MILE = 0.00 | 6.000 | 57.500 | 7.100 |
| 0.25 | MILE = 5.75 | MILE = 0.25 | 5.040 | 50.594 | 6.113 |
| 0.50 | MILE = 5.50 | MILE = 0.50 | 5.250 | 44.500 | 5.263 |
| 0.75 | MILE = 5.25 | MILE = 0.75 | 5.478 | 39.148 | 4.531 |
| 1.01 | MILE = 5.00 | MILE = 1.00 | 5.669 | 34.439 | 3.901 |
| 1.27 | MILE = 4.75 | MILE = 1.25 | 5.838 | 30.297 | 3.359 |
| 1.52 | MILE = 4.50 | MILE = 1.50 | 5.995 | 26.653 | 2.892 |
| 1.78 | MILE = 4.25 | MILE = 1.75 | 6.114 | 23.447 | 2.490 |
| 2.03 | MILE = 4.00 | MILE = 2.00 | 6.228 | 20.627 | 2.144 |
| 2.29 | MILE = 3.75 | MILE = 2.25 | 6.327 | 18.146 | 1.846 |
| 2.54 | MILE = 3.50 | MILE = 2.50 | 6.415 | 15.963 | 1.587 |
| 2.80 | MILE = 3.25 | MILE = 2.75 | 6.471 | 14.043 | 1.368 |
| 3.05 | MILE = 3.00 | MILE = 3.00 | 6.539 | 12.354 | 1.178 |
| 3.31 | MILE = 2.75 | MILE = 3.25 | 6.618 | 10.868 | 1.014 |
| 3.56 | MILE = 2.50 | MILE = 3.50 | 6.669 | 9.561 | 0.873 |
| 3.81 | MILE = 2.25 | MILE = 3.75 | 6.715 | 8.411 | 0.752 |
| 4.07 | MILE = 2.00 | MILE = 4.00 | 6.755 | 7.399 | 0.647 |
| 4.32 | MILE = 1.75 | MILE = 4.25 | 6.790 | 6.509 | 0.557 |
| 4.58 | MILE = 1.50 | MILE = 4.50 | 6.821 | 5.726 | 0.480 |
| 4.83 | MILE = 1.25 | MILE = 4.75 | 6.848 | 5.038 | 0.413 |
| 5.09 | MILE = 1.00 | MILE = 5.00 | 6.871 | 4.432 | 0.355 |
| 5.34 | MILE = 0.75 | MILE = 5.25 | 6.892 | 3.899 | 0.306 |
| 5.60 | MILE = 0.50 | MILE = 5.50 | 6.910 | 3.430 | 0.263 |
| 5.85 | MILE = 0.25 | MILE = 5.75 | 6.926 | 3.017 | 0.227 |
| 6.11 | MILE = 0.00 | MILE = 6.00 | 6.940 | 2.654 | 0.195 |

MINIMUM DISSOLVED OXYGEN 5.01 MG/L OCCURS AT 0.260 DAY AND 0.1963 MILES
BELOW DISCHARGE OR JUNCTION

SEWAGE TREATMENT PLANT = ADVANCE STP. WINTER WASTELOAD ALLOCATION ANALYSIS BASED ON USEPA SIMPLIFIED MODEL DATE = 02/18/87

COUNTY = [illegible] COUNTY RECEIVING STREAM = DRINEGAR DITCH MAIN STREAM = SUGAR CREEK SIMULATED DY = M.AK

[illegible] STREAM

STREAM WATER QUALITY STANDARDS

DISSOLVED OXYGEN = 5.00 MG/L UN-IONIZED AMMONIA IN MG/L = 0.050 [WEEKLY] 0.033 [MONTHLY]

HEADWATER AND EFFLUENT WATER QUALITY INPUT DATA . . . . REACH NUMBER . . . . . 1

| | FLOW CFS | BOD (ULTIMATE) MG/L | NBOD MG/L | DISSOLVED OXYGEN MG/L | TEMPERATURE CG |
|---|---|---|---|---|---|
| HEADWATER WATER QUALITY | 0.000 | 0.000 | 0.000 | 0.000 | 0.00 |
| EFFLUENT WATER QUALITY | 0.060 | 57.500 | 14.100 | 5.000 | 15.50 |
| STREAM WQ D/S OF STP | 0.060 | 57.500 | 14.100 | 5.000 | 15.50 |

[illegible] CHARACTERISTICS OF STREAM BELOW TREATMENT PLANT DISCHARGE JUNCTION

VELOCITY IN FT/SEC = 0.040 HYDRAULIC DEPTH IN FT = 0.0800 STREAM BED SLOPE IN FT/MILE = 7.60 MANNING'S COEFF = 0.035

REACH DATA/REACH DIVIDE MILES FROM 6.000 TO 0.000 COMPUTATIONAL ELEMENT 0.25000 MILE

REOXIDATION AND REGENERATION RATES

| | | AT 20 CG | AT INSTREAM TEMP 15.50 CG | REMARK |
|---|---|---|---|---|
| REAERATION RATE | (1/DAY) | COMPUTED | 11.69545 | CHURCHILL-BUCKINGHAM EQ. |
| BOD DECAY RATE | (1/DAY) | 0.40000 | 0.32531 | |
| NBOD DECAY RATE | (1/DAY) | 0.40000 | 0.32531 | |
| SEDIMENTATION RATE | (1/DAY) | 0.00000 | 0.00000 | "-"SUSPENSION "+" SEDIMENTATION |
| BENTHAL [illegible] OXYGEN DEMAND | | 0.20000 | 0.22596 | IN GM/SQ.M/DAY AT 20 CG |

SIMULATED WATER QUALITY RESPONSES OF D.DISCHARGE OR BELOW JUNCTION

| TIME DAY | DISTANCE BELOW FROM MILE | DISTANCE BELOW FROM MILE | DISSOLVED OXYGEN MG/L | BOD (ULTIMATE) MG/L | NBOD MG/L |
|---|---|---|---|---|---|
| 0.00 | MILE = 6.00 | MILE = 0.00 | 5.000 | 57.500 | 14.100 |
| 0.05 | MILE = 5.75 | MILE = 0.25 | 7.211 | 52.928 | 13.119 |
| 0.10 | MILE = 5.50 | MILE = 0.50 | 7.461 | 48.721 | 12.208 |
| 0.16 | MILE = 5.25 | MILE = 0.75 | 7.596 | 44.848 | 11.359 |
| 0.21 | MILE = 5.00 | MILE = 1.00 | 7.717 | 41.282 | 10.570 |
| 0.27 | MILE = 4.75 | MILE = 1.25 | 7.868 | 38.001 | 9.835 |
| 0.32 | MILE = 4.50 | MILE = 1.50 | 7.930 | 34.988 | 9.151 |
| 0.38 | MILE = 4.25 | MILE = 1.75 | 8.024 | 32.197 | 8.515 |
| 0.43 | MILE = 4.00 | MILE = 2.00 | 8.111 | 29.639 | 7.923 |
| 0.49 | MILE = 3.75 | MILE = 2.25 | 8.191 | 27.293 | 7.373 |
| 0.54 | MILE = 3.50 | MILE = 2.50 | 8.265 | 25.144 | 6.860 |
| 0.60 | MILE = 3.25 | MILE = 2.75 | 8.333 | 23.177 | 6.383 |
| 0.65 | MILE = 3.00 | MILE = 3.00 | 8.396 | 21.380 | 5.940 |
| 0.71 | MILE = 2.75 | MILE = 3.25 | 8.454 | 19.738 | 5.527 |
| 0.76 | MILE = 2.50 | MILE = 3.50 | 8.508 | 18.231 | 5.143 |
| 0.81 | MILE = 2.25 | MILE = 3.75 | 8.557 | 16.857 | 4.785 |
| 0.87 | MILE = 2.00 | MILE = 4.00 | 8.602 | 15.579 | 4.452 |
| 0.92 | MILE = 1.75 | MILE = 4.25 | 8.644 | 14.043 | 4.143 |
| 0.98 | MILE = 1.50 | MILE = 4.50 | 8.683 | 12.945 | 3.855 |
| 1.03 | MILE = 1.25 | MILE = 4.75 | 8.719 | 11.916 | 3.587 |
| 1.09 | MILE = 1.00 | MILE = 5.00 | 8.752 | 10.969 | 3.338 |
| 1.14 | MILE = 0.75 | MILE = 5.25 | 8.782 | 10.097 | 3.106 |
| 1.20 | MILE = 0.50 | MILE = 5.50 | 8.810 | 9.294 | 2.890 |
| 1.25 | MILE = 0.25 | MILE = 5.75 | 8.836 | 8.555 | 2.689 |
| 1.31 | MILE = 0.00 | MILE = 6.00 | 8.860 | 7.875 | 2.502 |

MINIMUM DISSOLVED OXYGEN 5.00 MG/L OCCURS AT 0.000 DAY AND 0.0000 MILES
BELOW DISCHARGE OR JUNCTION

| | | | |
|---|---|---|---|
| [illegible] | FLORENCE, CITY OF | COUNTY | FLORENCE CO. |
| [illegible] | LAGOON FOR OUTFALL | PROJ. | SEWAGE SYSTEM |

PROPOSED EFFLUENT LIMITATIONS

| OUTFALL NUMBER | [illegible] | [illegible] |
|---|---|---|
| EFFLUENT CHARACTERISTICS | [illegible] | [illegible] |
| [illegible] | 0.048 | 0.048 |
| | 37,500 KG/D | 25,000 KG/D |
| | 50,000 KG/D | 30,000 KG/D |
| | 1,500 KG/D | 1,000 KG/D |
| | 5,000 KG/D | DAILY |

| OUTFALL NUMBER | [illegible] | [illegible] |
|---|---|---|
| EFFLUENT CHARACTERISTICS | [illegible] | [illegible] |
| [illegible] | 0.048 | 0.048 |
| | 37,500 MG/L | 25,000 MG/L |
| | 50,000 MG/L | 30,000 MG/L |
| | 1,500 MG/L | 1,000 MG/L |
| | 5,000 PH | DAILY |

[illegible]
[illegible] SERVICES

6

WASTE STABILIZATION LAGOON CONTROLLED DISCHARGE [illegible]

[illegible] : [illegible]

[illegible] Flow : 100.0 [illegible]

[illegible]

Population Served : [illegible] [illegible] Flow : [illegible] mgd 0.0451 cfs
[illegible] Flow : [illegible] cfs 0.0451 [illegible]
Drainage Area [illegible] of 5.0% [illegible]
[illegible] Design BOD5 Loading : 25.0 (lbs BOD5 per acre)

| [illegible] | [illegible] | Adjusted Flow [illegible] | Dilution Ratio [illegible] | Allowable Discharge cfs-day [illegible] | [illegible] Flow [illegible] | Cumulative Flow cfs-day Qo out | Qi in | Deficiency [illegible] cfs-day | Accumulation Sum(Qi-Qo) |
|---|---|---|---|---|---|---|---|---|---|
| [illegible] | [illegible] | [illegible] | 3 | 1.59[illegible] | [illegible] | [illegible] | 2.0181 | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | 3 | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | 3 | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | 3 | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | 3 | [illegible] | [illegible] | 57.3364 | 9.8301 | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | 3 | [illegible] | 2.0181 | 71.1051 | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | 3 | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | 5 | [illegible] | 2.0181 | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | 13.7406 | 5 | [illegible] | [illegible] | [illegible] | 17.7763 | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | 5 | [illegible] | 2.0181 | 88.5934 | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | 5 | 0.6081 | [illegible] | [illegible] | [illegible] | 1.4129 | [illegible] |
| [illegible] | [illegible] | [illegible] | 5 | [illegible] | [illegible] | [illegible] | 23.7615 | [illegible] | [illegible] |

| [illegible] | [illegible] | Adjusted Flow [illegible] | Dilution Ratio [illegible] | Allowable Discharge cfs-day [illegible] | [illegible] Flow cfs-day [illegible] | Cumulative Flow cfs-day Qo out | Qi in | Deficiency cfs-day(Qi-Qo) | Accumulation cfs-day Sum(Qi-Qo) |
|---|---|---|---|---|---|---|---|---|---|
| [illegible] | [illegible] | [illegible] | 3 | 0.5703 | 2.0181 | [illegible] | 2.0181 | 1.4477 | [illegible] |
| [illegible] | [illegible] | [illegible] | 3 | [illegible] | [illegible] | [illegible] | [illegible] | 1.2681 | 5.8915 |
| [illegible] | [illegible] | [illegible] | 3 | [illegible] | [illegible] | [illegible] | [illegible] | 1.4859 | 7.3804 |
| [illegible] | [illegible] | [illegible] | 3 | 0.3470 | [illegible] | [illegible] | [illegible] | 1.6710 | 9.0514 |
| [illegible] | [illegible] | [illegible] | 3 | 1.5664 | 1.8270 | [illegible] | [illegible] | -0.1419 | 8.9074 |
| [illegible] | [illegible] | [illegible] | 3 | [illegible] | [illegible] | [illegible] | 11.8499 | 6.3473 | 2.1603 |
| [illegible] | [illegible] | [illegible] | 3 | 7.1453 | [illegible] | [illegible] | [illegible] | [illegible] | 0.0000 |
| [illegible] | [illegible] | 5.2108 | 5 | 1.9232 | 2.0181 | [illegible] | 15.8193 | 0.0947 | 0.0947 |
| [illegible] | [illegible] | [illegible] | 5 | 0.5938 | 1.9530 | 22.3803 | [illegible] | 1.4449 | 1.5397 |
| [illegible] | [illegible] | [illegible] | 5 | 1.9823 | 2.0181 | [illegible] | [illegible] | 0.0357 | 1.9754 |
| [illegible] | [illegible] | [illegible] | 5 | [illegible] | [illegible] | [illegible] | [illegible] | 0.9115 | [illegible] |
| [illegible] | [illegible] | [illegible] | 5 | 1.8[illegible] | [illegible] | [illegible] | [illegible] | 0.3712 | [illegible] |

| [illegible] | [illegible] | Adjusted Flow [illegible] | Dilution Ratio [illegible] | Allowable Discharge cfs-day [illegible] | [illegible] Flow [illegible] | Cumulative Flow cfs-day Qo out | Qi in | Deficiency cfs-day(Qi-Qo) | Accumulation cfs-day Sum(Qi-Qo) |
|---|---|---|---|---|---|---|---|---|---|
| [illegible] | [illegible] | [illegible] | 3 | 22.2929 | [illegible] | 22.2929 | 2.0181 | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | 3 | [illegible] | 1.9530 | [illegible] | [illegible] | -2.6304 | 0.0000 |
| [illegible] | [illegible] | [illegible] | 3 | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | 3 | [illegible] | [illegible] | [illegible] | [illegible] | -2.6594 | [illegible] |
| [illegible] | [illegible] | [illegible] | 3 | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | 3 | 10.5114 | [illegible] | [illegible] | [illegible] | 16.4933 | [illegible] |
| [illegible] | [illegible] | [illegible] | 3 | [illegible] | [illegible] | [illegible] | 13.8012 | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | 5 | [illegible] | [illegible] | [illegible] | 15.8191 | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | 5 | [illegible] | [illegible] | [illegible] | 17.7221 | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | 5 | [illegible] | [illegible] | [illegible] | 19.7904 | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | 5 | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | 5 | 1.3351 | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |

[illegible] cfs-day CONTROLLED DISCHARGE VOLUME : [illegible] Mgal HOLDING [illegible] : [illegible] Days [illegible]

Design Flow : [illegible] and [illegible] cfs

Design BOD5 loading : [illegible]

| Adjusted Discharge | Dilution Ratio | Allowable Discharge | WWTP Flow | Cumulative Flow (cfs-day) Out | In | Deficiency | Accumulation |
|---|---|---|---|---|---|---|---|
| [illegible] | 6 | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | 6 | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | 6 | [illegible] | [illegible] | [illegible] | [illegible] | -1.8585 | 0.0000 |
| [illegible] | 6 | [illegible] | [illegible] | [illegible] | 6.0079 | -5.7075 | 0.0000 |
| [illegible] | 6 | [illegible] | [illegible] | [illegible] | [illegible] | -15.1143 | 0.0000 |
| [illegible] | 6 | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | 0.0000 |
| [illegible] | 6 | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | 10 | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | 1.9041 |
| [illegible] | 10 | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | 10 | [illegible] | [illegible] | [illegible] | [illegible] | 0.0189 | [illegible] |
| [illegible] | 10 | [illegible] | [illegible] | 44.?992 | [illegible] | 1.7155 | [illegible] |
| 1.4519 | 10 | [illegible] | [illegible] | [illegible] | 22.7213 | [illegible] | [illegible] |

| Adjusted Discharge | Dilution Ratio | Allowable Discharge | WWTP Flow | Cumulative Flow (cfs-day) Out | In | Deficiency | Accumulation |
|---|---|---|---|---|---|---|---|
| [illegible] | 6 | [illegible] | [illegible] | [illegible] | 2.0191 | [illegible] | [illegible] |
| [illegible] | 6 | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | 6 | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | 6 | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | 6 | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | 6 | [illegible] | 2.0191 | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | 6 | [illegible] | [illegible] | [illegible] | 17.8012 | [illegible] | [illegible] |
| [illegible] | 10 | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | 10 | [illegible] | 1.9530 | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | 10 | [illegible] | [illegible] | 22.1210 | [illegible] | [illegible] | 11.1454 |
| [illegible] | 10 | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | 10 | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |

| Adjusted Discharge | Dilution Ratio | Allowable Discharge | WWTP Flow | Cumulative Flow (cfs-day) Out | In | Deficiency | Accumulation |
|---|---|---|---|---|---|---|---|
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | 0.0000 |
| [illegible] | 6 | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | 0.0000 |
| [illegible] | 6 | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | 10 | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | 10 | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | 10 | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | 10 | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | 10 | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |