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CORMIX1 PREDICTION FILE:
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                        CORMIX MIXING ZONE EXPERT SYSTEM
              Subsystem CORMIX1:  Single Port Discharges
                          CORMIX Version 6.0GT
                       HYDRO1 Version 6.0.0.0 October 2009
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CASE DESCRIPTION
 Site name/label:   SIM
 Design case:       JD289(2)400GPMaStratFinal6.0
 FILE NAME:         P:\...00GPMFinalRiver\JD289(2)400GPMaStratFinal6.0R.prd
 Time stamp:        Fri Mar 26 14:40:15 2010

ENVIRONMENT PARAMETERS (metric units)
 Bounded section
 BS    =    158.50  AS    =   1099.33  QA    =    203.38  ICHREG= 1
 HA    =      6.94  HD    =      4.86
 Tidal Simulation at TIME =     -2.550 h
 PERIOD=    12.40 h UAmax =      0.300 dUa/dt=      0.073 (m/s)/h
 UA    =      0.185 F     =      0.026 USTAR =0.1049E-01
 UW    =      8.500 UWSTAR=0.1074E-01
 Density stratified environment
 STRCND=  B         RHOAM = 1017.9011
 RHOAS = 1012.0000  RHOAB = 1022.0000  RHOAH0= 1022.0000  E     =0.0000E+00
 DRHOJ =   10.0000  HINT  =      2.87  ES    =0.3349E-01

DISCHARGE PARAMETERS (metric units)
 Above Surface Discharge:
 Re-computed discharge conditions at entry point at water surface.
 BANK  =  RIGHT     DISTB =      1.00
 D0    =      0.125 A0    =      0.012 H0    =      4.86  SUB0  =      0.00
 THETA =      0.00  SIGMA =     90.00
 U0    =      4.408 Q0    =      0.054       =0.5394E-01
 RHO0  =  999.7019  DRHO0 =0.2230E+02  GP0   =0.2140E+00
 C0    =0.1230E+00  CUNITS=  mg/l
 IPOLL =  1         KS    =0.0000E+00  KD    =0.0000E+00

FLUX VARIABLES (metric units)
 Q0    =0.5394E-01  M0    =0.2377E+00  J0    =0.1154E-01  SIGNJ0=      1.0
 Associated length scales (meters)
 LQ    =      0.11  LM    =      3.17  Lm    =      2.64  Lb    =      1.82
                                       Lmp   =      1.63  Lbp   =      1.17
 Tidal:             Tu    =   0.2952 h Lu    =     22.763 Lmin  =      0.369

NON-DIMENSIONAL PARAMETERS
 FR0   =     26.97  R     =     23.83

FLOW CLASSIFICATION
 1111111111111111111111111111111111111111111
 1  Flow class (CORMIX1)      =    IV5    1
 1  Applicable layer depth HS =     1.99  1
 1111111111111111111111111111111111111111111

MIXING ZONE / TOXIC DILUTION / REGION OF INTEREST PARAMETERS
 C0    =0.1230E+00  CUNITS=  mg/l
 NTOX  =  1         CMC   =0.5800E-02  CCC   =  CSTD
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 NSTD  =  1         CSTD  =0.3730E-02
 REGMZ =  1
 REGSPC=  1         XREG  =     91.44  WREG  =      0.00  AREG  =      0.00
 XINT  =   3500.00  XMAX  =   3500.00

X-Y-Z COORDINATE SYSTEM:
    ORIGIN is located at the bottom and below the center of the port:
         1.00 m  from the RIGHT bank/shore.
    X-axis points downstream, Y-axis points to left, Z-axis points upward.
NSTEP =  30 display intervals per module
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BEGIN MOD101: DISCHARGE MODULE

       X        Y       Z        S       C       B        Uc        TT
      0.00     0.00    4.86     1.0 0.123E+00   0.06    4.408   .00000E+00

END OF MOD101: DISCHARGE MODULE
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BEGIN CORJET (MOD110): JET/PLUME NEAR-FIELD MIXING REGION

 Jet/plume transition motion in weak crossflow.

 Zone of flow establishment:            THETAE=    -87.40  SIGMAE=     67.48
  LE    =      0.54  XE    =      0.00  YE    =      0.02  ZE    =      4.32

 Profile definitions:
   B = Gaussian 1/e (37%) half-width, normal to trajectory
   S = hydrodynamic centerline dilution
   C = centerline concentration (includes reaction effects, if any)
  Uc = Local centerline excess velocity (above ambient)
  TT = Cumulative travel time

       X        Y       Z        S       C       B        Uc        TT
      0.00     0.00    4.86     1.0 0.123E+00   0.06    4.408   .00000E+00
      0.00     0.02    4.32     1.0 0.123E+00   0.06    4.408   .33078E-02
      0.01     0.03    4.18     1.1 0.115E+00   0.08    4.408   .29655E-01
      0.01     0.03    4.04     1.3 0.965E-01   0.10    4.036   .61645E-01
      0.02     0.04    3.90     1.5 0.830E-01   0.11    3.451   .99371E-01
      0.03     0.05    3.76     1.7 0.727E-01   0.13    3.003   .14295E+00
      0.05     0.05    3.62     1.9 0.646E-01   0.14    2.648   .19252E+00
      0.07     0.06    3.48     2.1 0.580E-01   0.16    2.359   .24826E+00
      0.09     0.06    3.35     2.3 0.526E-01   0.18    2.118   .31036E+00
      0.11     0.07    3.21     2.6 0.480E-01   0.19    1.912   .37905E+00
      0.14     0.08    3.07     2.8 0.441E-01   0.21    1.735   .45461E+00
      0.17     0.08    2.94     3.0 0.407E-01   0.23    1.579   .53734E+00
      0.20     0.09    2.80     3.3 0.377E-01   0.25    1.440   .62760E+00
      0.24     0.09    2.67     3.5 0.351E-01   0.27    1.317   .72579E+00
      0.28     0.10    2.53     3.8 0.327E-01   0.29    1.204   .83236E+00
      0.32     0.11    2.40     4.0 0.305E-01   0.31    1.102   .94782E+00
      0.37     0.11    2.27     4.3 0.286E-01   0.33    1.009   .10727E+01
      0.43     0.12    2.14     4.6 0.268E-01   0.35    0.922   .12077E+01
      0.49     0.13    2.02     4.9 0.251E-01   0.37    0.843   .13535E+01
      0.55     0.13    1.90     5.2 0.236E-01   0.39    0.769   .15108E+01
      0.62     0.14    1.77     5.5 0.222E-01   0.42    0.700   .16803E+01
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      0.69     0.14    1.66     5.9 0.210E-01   0.44    0.637   .18630E+01
      0.77     0.15    1.54     6.2 0.198E-01   0.46    0.578   .20596E+01
      0.86     0.16    1.43     6.6 0.187E-01   0.49    0.522   .22713E+01
      0.95     0.16    1.32     7.0 0.176E-01   0.52    0.469   .24994E+01
      1.04     0.17    1.22     7.4 0.165E-01   0.54    0.420   .27454E+01
      1.14     0.17    1.12     7.9 0.156E-01   0.57    0.374   .30103E+01
      1.24     0.18    1.03     8.4 0.147E-01   0.60    0.333   .32953E+01
      1.35     0.19    0.94     8.9 0.138E-01   0.63    0.295   .36009E+01
      1.46     0.19    0.86     9.4 0.131E-01   0.66    0.262   .39277E+01
      1.58     0.20    0.78     9.9 0.124E-01   0.68    0.233   .42757E+01
      1.70     0.20    0.71    10.4 0.119E-01   0.71    0.208   .46258E+01
 Cumulative travel time =           4.6258 sec

END OF CORJET (MOD110): JET/PLUME NEAR-FIELD MIXING REGION
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BEGIN MOD132: LAYER BOUNDARY IMPINGEMENT/UPSTREAM SPREADING

  Vertical angle of layer/boundary impingement    =     -29.38 deg
  Horizontal angle of layer/boundary impingement  =       2.51 deg

 UPSTREAM INTRUSION PROPERTIES:
        Upstream intrusion length               =       0.64 m
        X-position of upstream stagnation point =       1.06 m
        Thickness in intrusion region           =       1.17 m
        Half-width at downstream end            =       2.20 m
        Thickness at downstream end             =       1.17 m

  Control volume inflow:
       X        Y       Z        S       C       B        TT
      1.70     0.20    0.71    10.4 0.119E-01   0.71 .46258E+01

 Profile definitions:
   BV = top-hat thickness, measured vertically
   BH = top-hat half-width, measured horizontally in Y-direction
   ZU = upper plume boundary (Z-coordinate)
   ZL = lower plume boundary (Z-coordinate)
   S  = hydrodynamic average (bulk) dilution
   C  = average (bulk) concentration (includes reaction effects, if any)
   TT = Cumulative travel time

       X        Y       Z        S       C       BV       BH      ZU      ZL
TT
      1.06     0.20    0.00  9996.2 0.000E+00   0.00     0.00    0.00    0.00
.10583E+02
** CMC HAS BEEN FOUND **
 The pollutant concentration in the plume falls below CMC value of 0.580E-02
   in the current prediction interval.
 This is the extent of the TOXIC DILUTION ZONE.
**WATER QUALITY STANDARD OR CCC HAS BEEN FOUND**
 The pollutant concentration in the plume falls below water quality standard
   or CCC value of 0.373E-02 in the current prediction interval.
 This is the spatial extent of concentrations exceeding the water quality
   standard or CCC value.
      1.09     0.20    0.00    35.4 0.347E-02   0.34     0.31    0.34    0.00
.46258E+01
      1.27     0.20    0.00    14.9 0.825E-02   0.81     0.76    0.81    0.00
.46258E+01
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      1.44     0.20    0.00    11.6 0.106E-01   1.04     1.02    1.04    0.00
.46258E+01
      1.61     0.20    0.00    10.5 0.117E-01   1.15     1.24    1.15    0.00
.46258E+01
      1.78     0.20    0.00    10.5 0.117E-01   1.17     1.41    1.17    0.00
.50480E+01
      1.95     0.20    0.00    11.7 0.105E-01   1.17     1.57    1.17    0.00
.59705E+01
      2.12     0.20    0.00    13.5 0.908E-02   1.17     1.72    1.17    0.00
.68931E+01
      2.29     0.20    0.00    15.3 0.804E-02   1.17     1.85    1.17    0.00
.78157E+01
      2.46     0.20    0.00    16.5 0.744E-02   1.17     1.98    1.17    0.00
.87382E+01
      2.63     0.20    0.00    17.2 0.715E-02   1.17     2.09    1.17    0.00
.96608E+01
      2.80     0.20    0.00    17.6 0.699E-02   1.17     2.20    1.17    0.00
.10583E+02
 Cumulative travel time =          10.5833 sec

END OF MOD132: LAYER BOUNDARY IMPINGEMENT/UPSTREAM SPREADING
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** End of NEAR-FIELD REGION (NFR) **

 In this design case, the discharge is located CLOSE TO BANK/SHORE.
 Some boundary interaction occurs at end of near-field.
   This may be related to a design case with a very LOW AMBIENT VELOCITY.
   The dilution values in one or more of the preceding zones may be too high.
 Carefully evaluate results in near-field and check degree of interaction.

 Consider locating outfall further away from bank or shore.
 In the next prediction module, the plume centerline will be set
   to follow the bank/shore.
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BEGIN MOD141: BUOYANT AMBIENT SPREADING

 Plume is ATTACHED to RIGHT bank/shore.
   Plume width is now determined from RIGHT bank/shore.

 Profile definitions:
   BV = top-hat thickness, measured vertically
   BH = top-hat half-width, measured horizontally in Y-direction
   ZU = upper plume boundary (Z-coordinate)
   ZL = lower plume boundary (Z-coordinate)
   S  = hydrodynamic average (bulk) dilution
   C  = average (bulk) concentration (includes reaction effects, if any)
   TT = Cumulative travel time

 Plume Stage 2 (bank attached):
       X        Y       Z        S       C       BV       BH      ZU      ZL
TT
      2.80    -1.00    0.00    17.6 0.699E-02   1.51     3.40    1.51    0.00
.10583E+02
     29.10    -1.00    0.00    24.5 0.502E-02   0.58    12.42    0.58    0.00
.15271E+03
     55.40    -1.00    0.00    28.0 0.439E-02   0.44    18.73    0.44    0.00
.29484E+03
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     81.70    -1.00    0.00    31.6 0.389E-02   0.39    24.07    0.39    0.00
.43696E+03
 ** REGULATORY MIXING ZONE BOUNDARY **
 In this prediction interval the plume DOWNSTREAM  distance meets or exceeds
 the regulatory value =    91.44 m.
 This is the extent of the REGULATORY MIXING ZONE.
    108.00    -1.00    0.00    35.8 0.343E-02   0.37    28.84    0.37    0.00
.57909E+03
    134.30    -1.00    0.00    41.0 0.300E-02   0.37    33.23    0.37    0.00
.72121E+03
    160.60    -1.00    0.00    47.1 0.261E-02   0.39    37.33    0.39    0.00
.86334E+03
    186.90    -1.00    0.00    54.3 0.226E-02   0.41    41.21    0.41    0.00
.10055E+04
    213.20    -1.00    0.00    62.8 0.196E-02   0.43    44.91    0.43    0.00
.11476E+04
    239.50    -1.00    0.00    72.5 0.170E-02   0.47    48.46    0.47    0.00
.12897E+04
    265.80    -1.00    0.00    83.5 0.147E-02   0.51    51.89    0.51    0.00
.14318E+04
    292.10    -1.00    0.00    95.8 0.128E-02   0.55    55.21    0.55    0.00
.15740E+04
    318.40    -1.00    0.00   109.5 0.112E-02   0.60    58.43    0.60    0.00
.17161E+04
    344.70    -1.00    0.00   124.7 0.986E-03   0.65    61.57    0.65    0.00
.18582E+04
    371.01    -1.00    0.00   141.3 0.871E-03   0.70    64.64    0.70    0.00
.20003E+04
    397.31    -1.00    0.00   159.4 0.772E-03   0.76    67.64    0.76    0.00
.21425E+04
    423.61    -1.00    0.00   179.0 0.687E-03   0.82    70.57    0.82    0.00
.22846E+04
    449.91    -1.00    0.00   200.1 0.615E-03   0.89    73.45    0.89    0.00
.24267E+04
    476.21    -1.00    0.00   222.8 0.552E-03   0.96    76.27    0.96    0.00
.25689E+04
    502.51    -1.00    0.00   247.1 0.498E-03   1.03    79.05    1.03    0.00
.27110E+04
    528.81    -1.00    0.00   273.1 0.450E-03   1.10    81.78    1.10    0.00
.28531E+04
    555.11    -1.00    0.00   300.6 0.409E-03   1.18    84.47    1.18    0.00
.29952E+04
    581.41    -1.00    0.00   329.9 0.373E-03   1.26    87.12    1.26    0.00
.31374E+04
    607.71    -1.00    0.00   360.8 0.341E-03   1.34    89.73    1.34    0.00
.32795E+04
    634.01    -1.00    0.00   393.4 0.313E-03   1.42    92.30    1.42    0.00
.34216E+04
    660.31    -1.00    0.00   427.8 0.288E-03   1.51    94.85    1.51    0.00
.35637E+04
    686.61    -1.00    0.00   464.0 0.265E-03   1.60    97.36    1.60    0.00
.37059E+04
    712.91    -1.00    0.00   501.9 0.245E-03   1.70    99.83    1.70    0.00
.38480E+04
    739.21    -1.00    0.00   541.7 0.227E-03   1.79   102.28    1.79    0.00
.39901E+04
    765.51    -1.00    0.00   583.3 0.211E-03   1.89   104.71    1.89    0.00
.41322E+04
    783.81    -1.00    0.00   613.5 0.201E-03   1.96   106.37    1.96    0.00
 Cumulative travel time =        4231.1387 sec
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 CORMIX prediction has been TERMINATED at last prediction interval.
   Limiting distance due to TIDAL REVERSAL has been reached.

END OF MOD141: BUOYANT AMBIENT SPREADING
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CORMIX1: Single Port Discharges              End of Prediction File
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CORMIX SESSION REPORT:
XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
                      CORMIX MIXING ZONE EXPERT SYSTEM
                          CORMIX Version 6.0GT
                       HYDRO1:Version-6.0.0.0  October,2009
SITE NAME/LABEL:                SIM
  DESIGN CASE:                  JD289(2)400GPMaStratFinal6.0
  FILE NAME:
P:\Mixing\CriticalDischargeScenarios\V.6.0\400GPMFinalRiver\JD289(2)400GPMaStra
tFinal6.0R.prd
  Using subsystem CORMIX1:     Single Port Discharges
  Start of session:             03/26/2010--14:41:15
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SUMMARY OF INPUT DATA:
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AMBIENT PARAMETERS:
  Cross-section                          = bounded
  Width                           BS     = 158.50 m
  Channel regularity              ICHREG = 1
  Ambient flowrate                QA     = 203.38 m^3/s
  Average depth                   HA     = 6.94 m
  Depth at discharge              HD     = 4.86 m
  Darcy-Weisbach friction factor  F      = 0.0257
    Calculated from Manning's n          = 0.025
  Wind velocity                   UW     = 8.5 m/s
TIDAL SIMULATION at time          Tsim   = -2.55 hours
  Instantaneous ambient velocity  UA     = 0.185 m/s
  Maximum tidal velocity          UaMAX  = 0.3 m/s
Rate of tidal reversal          dUA/dt = 0.0725 (m/s)/hour
  Period of reversal              T      = 12.4 hours
  Stratification Type             STRCND = B
  Surface density                 RHOAS  = 1012 kg/m^3
  Bottom density                  RHOAB  = 1022 kg/m^3
  Stratification height           HINT   = 2.87 m (pycnocline level)
  Density below pycnocline        RHOAP  = 1022 kg/m^3
-----------------------------------------------------------------------------
DISCHARGE PARAMETERS:             Single Port Discharge
  Nearest bank                           = right
  Distance to bank                DISTB  = 1.00 m
  Port diameter                   D0     = 0.1248 m
  Port cross-sectional area       A0     = 0.0122 m^2
  Discharge velocity              U0     = 4.41 m/s
  Discharge flowrate              Q0     = 0.053935 m^3/s
  Discharge port height           H0     = 4.86 m
  Vertical discharge angle        THETA  = -87.60 deg
  Horizontal discharge angle      SIGMA  = 90 deg
  Discharge temperature (freshwater)     = 10 degC
  Corresponding density           RHO0   = 999.7019 kg/m^3
  Density difference              DRHO   = 22.2981 kg/m^3
  Buoyant acceleration            GP0    = 0.214 m/s^2
  Discharge concentration         C0     = 0.123 mg/l
  Surface heat exchange coeff.    KS     = 0 m/s
  Coefficient of decay            KD     = 0 /s
-----------------------------------------------------------------------------
DISCHARGE/ENVIRONMENT LENGTH SCALES:
  LQ  = 0.11 m         Lm  = 2.64 m         Lb  = 1.82 m
  LM  = 3.17 m         Lm' = 1.63 m         Lb' = 1.17 m
UNSTEADY TIDAL SCALES:
  Tu  = 0.2952 hours     Lu  = 22.76 m         Lmin= 0.37 m
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NON-DIMENSIONAL PARAMETERS:
  Port densimetric Froude number  FR0    = 26.97
  Velocity ratio                  R      = 23.83
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MIXING ZONE / TOXIC DILUTION ZONE / AREA OF INTEREST PARAMETERS:
  Toxic discharge                        = yes
  CMC concentration               CMC    = 0.0058 mg/l
  CCC concentration               CCC    = 0.00373 mg/l
  Water quality standard specified       = given by CCC value
  Regulatory mixing zone                 = yes
  Regulatory mixing zone specification   = distance
  Regulatory mixing zone value           = 91.44 m (m^2 if area)
  Region of interest                     = 3500 m
*****************************************************************************
HYDRODYNAMIC CLASSIFICATION:
  *------------------------*
  | FLOW CLASS   = IV5 |
  *------------------------*
  This flow configuration applies to a layer corresponding to lower stratified
  density layer at the discharge site.  The density jump at the pycnocline
  confines the flow to the lower layer.
  Applicable layer depth = lower layer depth = 1.99 m
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MIXING ZONE EVALUATION (hydrodynamic and regulatory summary):

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X-Y-Z Coordinate system:
  Origin is located at the bottom below the port center:
    1.00 m from the right bank/shore.
  Number of display steps NSTEP = 30 per module.
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NEAR-FIELD REGION (NFR) CONDITIONS :
Note: The NFR is the zone of strong initial mixing.  It has no regulatory
  implication.  However, this information may be useful for the discharge
  designer because the mixing in the NFR is usually sensitive to the
  discharge design conditions.
  Pollutant concentration at NFR edge  c = 0.007 mg/l
  Dilution at edge of NFR              s = 17.6
  NFR Location:                        x = 2.80 m
    (centerline coordinates)           y = 0.20 m
                                       z = 0 m
  NFR plume dimensions:  half-width (bh) = 2.20 m
                          thickness (bv) = 1.17 m
Cumulative travel time:       10.5833 sec.
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Buoyancy assessment:
  The effluent density is less than the surrounding ambient water
  density at the discharge level.
  Therefore, the effluent is POSITIVELY BUOYANT and will tend to rise towards
  the surface.
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Stratification assessment:
  The specified two layer ambient density stratification is dynamically
  important. The discharge near field flow will be confined to the lower
  layer by the ambient density stratification.
  Furthermore, it is trapped at the pycnocline by the ambient density
  jump.
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UPSTREAM INTRUSION SUMMARY:
Plume exhibits upstream intrusion due to low ambient velocity or strong
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  discharge buoyancy.
  Intrusion length                        =  0.64 m
  Intrusion stagnation point              =  1.06 m
  Intrusion thickness                     =  1.17 m
  Intrusion half width at impingement     =  2.20 m
  Intrusion half thickness at impingement =  1.17 m
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PLUME BANK CONTACT SUMMARY:
  Plume in bounded section contacts one bank only at 2.80 m downstream.
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UNSTEADY TIDAL ASSESSMENT:
 Because of the unsteadiness of the ambient current during the tidal
  reversal, CORMIX predictions have been TERMINATED at:
                                      x = 783.81 m
                                      y = -1.00 m
                                      z = 0 m.
  For this condition BEFORE TIDAL REVERSAL, extensive re-entrainment
  of previously discharged is unlikely.
  To determine the minimum dilution, perform additional simulations
  after slack tide.
************************ TOXIC DILUTION ZONE SUMMARY ************************
Recall: The TDZ corresponds to the three (3) criteria issued in the USEPA
  Technical Support Document (TSD) for Water Quality-based Toxics Control,
  1991 (EPA/505/2-90-001).
  Criterion maximum concentration (CMC)  = 0.0058  mg/l
Corresponding dilution                   = 21.206897
The CMC was encountered at the following plume position:
  Plume location:                     x = 1.57 m
    (centerline coordinates)          y = 0.20 m
                                      z = 0.20 m
  Plume dimension:       half-width (bh) = 0.70 m
                          thickness (bv) = 0.25 m

 Computed distance from port opening to CMC location = 4.92 m.
 CRITERION 1: This location is within 50 times the discharge length scale of
              Lq = 0.11 m.
 ++++++ The discharge length scale TEST for the TDZ has been SATISFIED. ++++++

 Computed horizontal distance from port opening to CMC location = 1.59 m.
 CRITERION 2: This location is within 5 times the ambient water depth of
              HD = 4.86 m.
 ++++++++++ The ambient depth TEST for the TDZ has been SATISFIED. ++++++++++

 Computed distance from port opening to CMC location = 4.92 m.
 CRITERION 3: This location is within one tenth the distance of the extent
              of the Regulatory Mixing Zone of 91.57 m in any
              spatial direction from the port opening.
 ++++++ The Regulatory Mixing Zone TEST for the TDZ has been SATISFIED. ++++++

 The diffuser discharge velocity is equal to 4.41 m/s.
 This exceeds the value of 3.0 m/s recommended in the TSD.

 *** All three CMC criteria for the TDZ are SATISFIED for this discharge. ***
********************** REGULATORY MIXING ZONE SUMMARY ***********************
The plume conditions at the boundary of the specified RMZ are as follows:
  Pollutant concentration             c = 0.003716  mg/l
  Corresponding dilution              s = 33.1
  Plume location:                     x = 91.44 m
    (centerline coordinates)          y = -1.00 m
                                      z = 0 m
```

```
  Plume dimensions:      half-width (bh) = 25.89 m
                          thickness (bv) = 0.38 m
Cumulative travel time:       489.5845 sec.
At this position, the plume is CONTACTING the RIGHT bank.
Furthermore, the CCC for the toxic pollutant has indeed been met
  within the RMZ. In particular:
The CCC was encountered at the following plume position:
The CCC for the toxic pollutant was encountered at the following
  plume position:
  CCC                                     = 0.00373  mg/l
Corresponding dilution                    = 33.0
  Plume location:                       x = 1.15 m
    (centerline coordinates)            y = 0.20 m
                                        z = 0.02 m
  Plume dimensions:      half-width (bh) = 0.35 m
                          thickness (bv) = 0.33 m
********************* FINAL DESIGN ADVICE AND COMMENTS *********************
REMINDER:  The user must take note that HYDRODYNAMIC MODELING by any known
  technique is NOT AN EXACT SCIENCE.
Extensive comparison with field and laboratory data has shown that the
  CORMIX predictions on dilutions and concentrations (with associated
  plume geometries) are reliable for the majority of cases and are accurate
  to within about +-50% (standard deviation).
As a further safeguard, CORMIX will not give predictions whenever it judges
  the design configuration as highly complex and uncertain for prediction.
```

```
CORMIX1 PREDICTION FILE:
1111111111111111111111111111111111111111111111111111111111111111111111111111111111
1111111111111111
                        CORMIX MIXING ZONE EXPERT SYSTEM
              Subsystem CORMIX1:  Single Port Discharges
                          CORMIX Version 6.0GT
                       HYDRO1 Version 6.0.0.0 October 2009
-------------------------------------------------------------------------------
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-------------------------------------------------------------------------------
---------------
CASE DESCRIPTION
 Site name/label:   SIM
 Design case:       JD289(2)400GPMbStratFinal6.0
 FILE NAME:         P:\...00GPMFinalRiver\JD289(2)400GPMbStratFinal6.0R.prd
 Time stamp:        Fri Mar 26 14:44:14 2010

ENVIRONMENT PARAMETERS (metric units)
 Bounded section
 BS    =    158.50  AS    =   1035.95  QA    =     90.13  ICHREG= 1
 HA    =      6.54  HD    =      4.58
 Tidal Simulation at TIME =     -1.300 h
 PERIOD=    12.40 h UAmax =      0.300 dUa/dt=      0.067 (m/s)/h
 UA    =      0.087 F     =      0.026 USTAR =0.4983E-02
 UW    =      8.500 UWSTAR=0.1074E-01
 Density stratified environment
 STRCND=  B         RHOAM = 1017.6293
 RHOAS = 1012.0000  RHOAB = 1022.0000  RHOAH0= 1022.0000  E     =0.0000E+00
 DRHOJ =   10.0000  HINT  =      2.58  ES    =0.3726E-01

DISCHARGE PARAMETERS (metric units)
 Above Surface Discharge:
 Re-computed discharge conditions at entry point at water surface.
 BANK  =  RIGHT     DISTB =      0.97
 D0    =      0.083 A0    =      0.005 H0    =      4.58  SUB0  =      0.00
 THETA =      0.00  SIGMA =     90.00
 U0    =      5.220 Q0    =      0.029       =0.2856E-01
 RHO0  =  999.7019  DRHO0 =0.2230E+02  GP0   =0.2140E+00
 C0    =0.1220E+00  CUNITS=  mg/l
 IPOLL =  1         KS    =0.0000E+00  KD    =0.0000E+00

FLUX VARIABLES (metric units)
 Q0    =0.2856E-01  M0    =0.1491E+00  J0    =0.6110E-02  SIGNJ0=      1.0
 Associated length scales (meters)
 LQ    =      0.07  LM    =      3.07  Lm    =      4.44  Lb    =      9.28
                                       Lmp   =      1.41  Lbp   =      0.96
 Tidal:             Tu    =   0.2882 h Lu    =     20.015 Lmin  =      0.247

NON-DIMENSIONAL PARAMETERS
 FR0   =     39.06  R     =     60.00

FLOW CLASSIFICATION
 1111111111111111111111111111111111111111111
 1  Flow class (CORMIX1)      =    IV5    1
 1  Applicable layer depth HS =     2.00  1
 1111111111111111111111111111111111111111111

MIXING ZONE / TOXIC DILUTION / REGION OF INTEREST PARAMETERS
 C0    =0.1220E+00  CUNITS=  mg/l
 NTOX  =  1         CMC   =0.5800E-02  CCC   =  CSTD
```

```
 NSTD  =  1         CSTD  =0.3730E-02
 REGMZ =  1
 REGSPC=  1         XREG  =     91.44  WREG  =      0.00  AREG  =      0.00
 XINT  =   3500.00  XMAX  =   3500.00

X-Y-Z COORDINATE SYSTEM:
    ORIGIN is located at the bottom and below the center of the port:
         0.97 m  from the RIGHT bank/shore.
    X-axis points downstream, Y-axis points to left, Z-axis points upward.
NSTEP =  30 display intervals per module
-------------------------------------------------------------------------------
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-------------------------------------------------------------------------------
---------------
BEGIN MOD101: DISCHARGE MODULE

       X        Y       Z        S       C       B        Uc        TT
      0.00     0.00    4.58     1.0 0.122E+00   0.04    5.220   .00000E+00

END OF MOD101: DISCHARGE MODULE
-------------------------------------------------------------------------------
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-------------------------------------------------------------------------------
---------------
BEGIN CORJET (MOD110): JET/PLUME NEAR-FIELD MIXING REGION

 Jet/plume transition motion in weak crossflow.

 Zone of flow establishment:            THETAE=    -88.86  SIGMAE=     69.78
  LE    =      0.39  XE    =      0.00  YE    =      0.01  ZE    =      4.18

 Profile definitions:
   B = Gaussian 1/e (37%) half-width, normal to trajectory
   S = hydrodynamic centerline dilution
   C = centerline concentration (includes reaction effects, if any)
  Uc = Local centerline excess velocity (above ambient)
  TT = Cumulative travel time

       X        Y       Z        S       C       B        Uc        TT
      0.00     0.00    4.58     1.0 0.122E+00   0.04    5.220   .00000E+00
      0.00     0.01    4.18     1.0 0.122E+00   0.04    5.220   .26682E-02
      0.00     0.01    4.07     1.1 0.109E+00   0.06    5.220   .21333E-01
      0.01     0.01    3.94     1.4 0.865E-01   0.07    4.343   .48884E-01
      0.01     0.01    3.81     1.7 0.719E-01   0.09    3.594   .82697E-01
      0.01     0.02    3.69     1.9 0.628E-01   0.10    3.128   .11670E+00
      0.02     0.02    3.56     2.2 0.547E-01   0.11    2.712   .16230E+00
      0.03     0.02    3.43     2.5 0.485E-01   0.13    2.390   .21434E+00
      0.03     0.02    3.32     2.8 0.442E-01   0.14    2.166   .26415E+00
      0.04     0.03    3.19     3.0 0.400E-01   0.15    1.949   .32842E+00
      0.05     0.03    3.08     3.3 0.370E-01   0.17    1.792   .38887E+00
      0.06     0.03    2.94     3.6 0.341E-01   0.18    1.635   .46577E+00
      0.08     0.03    2.81     3.9 0.316E-01   0.20    1.501   .54968E+00
      0.09     0.04    2.70     4.1 0.297E-01   0.21    1.399   .62730E+00
      0.11     0.04    2.57     4.4 0.278E-01   0.23    1.294   .72469E+00
      0.13     0.04    2.44     4.7 0.261E-01   0.24    1.201   .82962E+00
      0.14     0.04    2.33     4.9 0.248E-01   0.26    1.128   .92574E+00
      0.17     0.05    2.20     5.2 0.235E-01   0.27    1.052   .10453E+01
      0.19     0.05    2.07     5.5 0.223E-01   0.29    0.982   .11732E+01
      0.21     0.05    1.96     5.7 0.213E-01   0.30    0.927   .12897E+01
      0.24     0.05    1.83     6.0 0.203E-01   0.32    0.868   .14338E+01
```

```
      0.27     0.06    1.70     6.3 0.194E-01   0.34    0.813   .15873E+01
      0.29     0.06    1.60     6.5 0.187E-01   0.35    0.769   .17267E+01
      0.33     0.06    1.47     6.8 0.179E-01   0.37    0.721   .18987E+01
      0.36     0.07    1.34     7.1 0.172E-01   0.39    0.675   .20815E+01
      0.40     0.07    1.23     7.3 0.166E-01   0.40    0.638   .22473E+01
      0.44     0.07    1.11     7.6 0.160E-01   0.42    0.598   .24519E+01
      0.48     0.07    0.99     7.9 0.154E-01   0.44    0.559   .26693E+01
      0.52     0.08    0.88     8.1 0.150E-01   0.46    0.527   .28665E+01
      0.57     0.08    0.76     8.4 0.145E-01   0.48    0.491   .31102E+01
      0.62     0.08    0.64     8.7 0.139E-01   0.50    0.454   .33704E+01
      0.67     0.09    0.54     9.0 0.135E-01   0.52    0.423   .36082E+01
 Cumulative travel time =           3.6082 sec

END OF CORJET (MOD110): JET/PLUME NEAR-FIELD MIXING REGION
-------------------------------------------------------------------------------
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-------------------------------------------------------------------------------
---------------
BEGIN MOD132: LAYER BOUNDARY IMPINGEMENT/UPSTREAM SPREADING

  Vertical angle of layer/boundary impingement    =     -64.20 deg
  Horizontal angle of layer/boundary impingement  =       3.37 deg

 UPSTREAM INTRUSION PROPERTIES:
        Upstream intrusion length                =       3.34 m
        X-position of upstream stagnation point =      -2.68 m
        Thickness in intrusion region            =       0.44 m
        Half-width at downstream end             =       5.69 m
        Thickness at downstream end              =       0.44 m

  Control volume inflow:
       X        Y       Z        S       C       B        TT
      0.67     0.09    0.54     9.0 0.135E-01   0.52 .36082E+01

 Profile definitions:
   BV = top-hat thickness, measured vertically
   BH = top-hat half-width, measured horizontally in Y-direction
   ZU = upper plume boundary (Z-coordinate)
   ZL = lower plume boundary (Z-coordinate)
   S  = hydrodynamic average (bulk) dilution
   C  = average (bulk) concentration (includes reaction effects, if any)
   TT = Cumulative travel time

       X        Y       Z        S       C       BV       BH      ZU      ZL
TT
     -2.68     0.09    0.00  9996.0 0.000E+00   0.00     0.00    0.00    0.00
.36313E+02
** CMC HAS BEEN FOUND **
 The pollutant concentration in the plume falls below CMC value of 0.580E-02
   in the current prediction interval.
 This is the extent of the TOXIC DILUTION ZONE.
**WATER QUALITY STANDARD OR CCC HAS BEEN FOUND**
 The pollutant concentration in the plume falls below water quality standard
   or CCC value of 0.373E-02 in the current prediction interval.
 This is the spatial extent of concentrations exceeding the water quality
   standard or CCC value.
     -2.55     0.09    0.00    38.9 0.313E-02   0.10     0.80    0.10    0.00
.36082E+01
     -1.95     0.09    0.00    16.2 0.755E-02   0.25     1.95    0.25    0.00
.36082E+01
```

```
     -1.34     0.09    0.00    12.2 0.100E-01   0.33     2.64    0.33    0.00
.36082E+01
     -0.73     0.09    0.00    10.4 0.117E-01   0.38     3.19    0.38    0.00
.36082E+01
     -0.13     0.09    0.00     9.6 0.128E-01   0.42     3.65    0.42    0.00
.36082E+01
      0.48     0.09    0.00     9.1 0.134E-01   0.44     4.06    0.44    0.00
.36082E+01
      1.09     0.09    0.00     9.1 0.133E-01   0.44     4.44    0.44    0.00
.56383E+01
      1.69     0.09    0.00    10.9 0.112E-01   0.44     4.78    0.44    0.00
.13307E+02
      2.30     0.09    0.00    13.3 0.916E-02   0.44     5.10    0.44    0.00
.20975E+02
      2.91     0.09    0.00    14.8 0.826E-02   0.44     5.40    0.44    0.00
.28644E+02
      3.51     0.09    0.00    15.4 0.794E-02   0.44     5.69    0.44    0.00
.36313E+02
 Cumulative travel time =          36.3127 sec

END OF MOD132: LAYER BOUNDARY IMPINGEMENT/UPSTREAM SPREADING
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** End of NEAR-FIELD REGION (NFR) **

 In this design case, the discharge is located CLOSE TO BANK/SHORE.
 Some boundary interaction occurs at end of near-field.
   This may be related to a design case with a very LOW AMBIENT VELOCITY.
   The dilution values in one or more of the preceding zones may be too high.
 Carefully evaluate results in near-field and check degree of interaction.

 Consider locating outfall further away from bank or shore.
 In the next prediction module, the plume centerline will be set
   to follow the bank/shore.
-------------------------------------------------------------------------------
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BEGIN MOD141: BUOYANT AMBIENT SPREADING

 Plume is ATTACHED to RIGHT bank/shore.
   Plume width is now determined from RIGHT bank/shore.

 Profile definitions:
   BV = top-hat thickness, measured vertically
   BH = top-hat half-width, measured horizontally in Y-direction
   ZU = upper plume boundary (Z-coordinate)
   ZL = lower plume boundary (Z-coordinate)
   S  = hydrodynamic average (bulk) dilution
   C  = average (bulk) concentration (includes reaction effects, if any)
   TT = Cumulative travel time

 Plume Stage 2 (bank attached):
       X        Y       Z        S       C       BV       BH      ZU      ZL
TT
      3.51    -0.97    0.00    15.4 0.794E-02   0.75     6.74    0.75    0.00
.36313E+02
     22.01    -0.97    0.00    20.2 0.605E-02   0.37    18.05    0.37    0.00
.24882E+03
     40.50    -0.97    0.00    23.7 0.516E-02   0.30    26.33    0.30    0.00
.46133E+03
```

```
     59.00    -0.97    0.00    27.7 0.440E-02   0.27    33.38    0.27    0.00
.67383E+03
     77.49    -0.97    0.00    32.8 0.372E-02   0.27    39.69    0.27    0.00
.88634E+03
 ** REGULATORY MIXING ZONE BOUNDARY **
 In this prediction interval the plume DOWNSTREAM  distance meets or exceeds
 the regulatory value =    91.44 m.
 This is the extent of the REGULATORY MIXING ZONE.
     95.98    -0.97    0.00    39.2 0.311E-02   0.29    45.51    0.29    0.00
.10988E+04
    114.48    -0.97    0.00    47.0 0.260E-02   0.31    50.95    0.31    0.00
.13114E+04
    132.97    -0.97    0.00    56.3 0.217E-02   0.34    56.12    0.34    0.00
.15239E+04
    151.46    -0.97    0.00    67.3 0.181E-02   0.37    61.05    0.37    0.00
.17364E+04
    169.96    -0.97    0.00    80.0 0.153E-02   0.41    65.80    0.41    0.00
.19489E+04
    188.45    -0.97    0.00    94.4 0.129E-02   0.45    70.39    0.45    0.00
.21614E+04
    206.95    -0.97    0.00   110.7 0.110E-02   0.50    74.84    0.50    0.00
.23739E+04
    225.44    -0.97    0.00   128.9 0.947E-03   0.55    79.17    0.55    0.00
.25864E+04
    229.97    -0.97    0.00   133.8 0.915E-03   0.56    80.21    0.56    0.00
 Cumulative travel time =        2638.4316 sec

 CORMIX prediction has been TERMINATED at last prediction interval.
   Limiting distance due to TIDAL REVERSAL has been reached.

END OF MOD141: BUOYANT AMBIENT SPREADING
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CORMIX1: Single Port Discharges              End of Prediction File
1111111111111111111111111111111111111111111111111111111111111111111111111111111
1111111111111111
```

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CORMIX SESSION REPORT:
XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
                      CORMIX MIXING ZONE EXPERT SYSTEM
                          CORMIX Version 6.0GT
                       HYDRO1:Version-6.0.0.0  October,2009
SITE NAME/LABEL:                SIM
  DESIGN CASE:                  JD289(2)400GPMbStratFinal6.0
  FILE NAME:
P:\Mixing\CriticalDischargeScenarios\V.6.0\400GPMFinalRiver\JD289(2)400GPMbStra
tFinal6.0R.prd
  Using subsystem CORMIX1:     Single Port Discharges
  Start of session:             03/26/2010--14:44:14
*****************************************************************************
SUMMARY OF INPUT DATA:
-----------------------------------------------------------------------------
AMBIENT PARAMETERS:
  Cross-section                          = bounded
  Width                          BS      = 158.50 m
  Channel regularity             ICHREG = 1
  Ambient flowrate               QA      = 90.13 m^3/s
  Average depth                  HA      = 6.54 m
  Depth at discharge             HD      = 4.58 m
  Darcy-Weisbach friction factor F       = 0.0262
    Calculated from Manning's n          = 0.025
  Wind velocity                  UW      = 8.5 m/s
TIDAL SIMULATION at time         Tsim    = -1.3 hours
  Instantaneous ambient velocity UA      = 0.087 m/s
  Maximum tidal velocity         UaMAX   = 0.3 m/s
Rate of tidal reversal          dUA/dt = 0.0669 (m/s)/hour
  Period of reversal             T       = 12.4 hours
  Stratification Type            STRCND = B
  Surface density                RHOAS   = 1012 kg/m^3
  Bottom density                 RHOAB   = 1022 kg/m^3
  Stratification height          HINT    = 2.58 m (pycnocline level)
  Density below pycnocline       RHOAP   = 1022 kg/m^3
-----------------------------------------------------------------------------
DISCHARGE PARAMETERS:            Single Port Discharge
  Nearest bank                           = right
  Distance to bank               DISTB   = 0.97 m
  Port diameter                  D0      = 0.0835 m
  Port cross-sectional area      A0      = 0.0055 m^2
  Discharge velocity             U0      = 5.22 m/s
  Discharge flowrate             Q0      = 0.028558 m^3/s
  Discharge port height          H0      = 4.58 m
  Vertical discharge angle       THETA   = -88.93 deg
  Horizontal discharge angle     SIGMA   = 90 deg
  Discharge temperature (freshwater)     = 10 degC
  Corresponding density          RHO0    = 999.7019 kg/m^3
  Density difference             DRHO    = 22.2981 kg/m^3
  Buoyant acceleration           GP0     = 0.214 m/s^2
  Discharge concentration        C0      = 0.122 mg/l
  Surface heat exchange coeff.   KS      = 0 m/s
  Coefficient of decay           KD      = 0 /s
-----------------------------------------------------------------------------
DISCHARGE/ENVIRONMENT LENGTH SCALES:
  LQ  = 0.07 m         Lm  = 4.44 m         Lb  = 9.28 m
  LM  = 3.07 m         Lm' = 1.41 m         Lb' = 0.96 m
UNSTEADY TIDAL SCALES:
  Tu  = 0.2882 hours     Lu  = 20.01 m         Lmin= 0.25 m
-----------------------------------------------------------------------------
```

```
NON-DIMENSIONAL PARAMETERS:
  Port densimetric Froude number  FR0    = 39.06
  Velocity ratio                  R      = 60.00
-----------------------------------------------------------------------------
MIXING ZONE / TOXIC DILUTION ZONE / AREA OF INTEREST PARAMETERS:
  Toxic discharge                        = yes
  CMC concentration               CMC    = 0.0058 mg/l
  CCC concentration               CCC    = 0.00373 mg/l
  Water quality standard specified       = given by CCC value
  Regulatory mixing zone                 = yes
  Regulatory mixing zone specification   = distance
  Regulatory mixing zone value           = 91.44 m (m^2 if area)
  Region of interest                     = 3500 m
*****************************************************************************
HYDRODYNAMIC CLASSIFICATION:
  *------------------------*
  | FLOW CLASS   = IV5 |
  *------------------------*
  This flow configuration applies to a layer corresponding to lower stratified
  density layer at the discharge site.  The density jump at the pycnocline
  confines the flow to the lower layer.
  Applicable layer depth = lower layer depth = 2.00 m
*****************************************************************************
MIXING ZONE EVALUATION (hydrodynamic and regulatory summary):

-----------------------------------------------------------------------------
X-Y-Z Coordinate system:
  Origin is located at the bottom below the port center:
    0.97 m from the right bank/shore.
  Number of display steps NSTEP = 30 per module.
-----------------------------------------------------------------------------
NEAR-FIELD REGION (NFR) CONDITIONS :
Note: The NFR is the zone of strong initial mixing.  It has no regulatory
  implication.  However, this information may be useful for the discharge
  designer because the mixing in the NFR is usually sensitive to the
  discharge design conditions.
  Pollutant concentration at NFR edge  c = 0.0079 mg/l
  Dilution at edge of NFR              s = 15.4
  NFR Location:                        x = 3.51 m
    (centerline coordinates)           y = 0.09 m
                                       z = 0 m
  NFR plume dimensions:  half-width (bh) = 5.69 m
                          thickness (bv) = 0.44 m
Cumulative travel time:       36.3127 sec.
-----------------------------------------------------------------------------
Buoyancy assessment:
  The effluent density is less than the surrounding ambient water
  density at the discharge level.
  Therefore, the effluent is POSITIVELY BUOYANT and will tend to rise towards
  the surface.
-----------------------------------------------------------------------------
Stratification assessment:
  The specified two layer ambient density stratification is dynamically
  important. The discharge near field flow will be confined to the lower
  layer by the ambient density stratification.
  Furthermore, it is trapped at the pycnocline by the ambient density
  jump.
-----------------------------------------------------------------------------
UPSTREAM INTRUSION SUMMARY:
Plume exhibits upstream intrusion due to low ambient velocity or strong
```

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  discharge buoyancy.
  Intrusion length                        =  3.34 m
  Intrusion stagnation point              =  -2.68 m
  Intrusion thickness                     =  0.44 m
  Intrusion half width at impingement     =  5.69 m
  Intrusion half thickness at impingement =  0.44 m
-------------------------------------------------------------------------------
PLUME BANK CONTACT SUMMARY:
  Plume in bounded section contacts one bank only at 3.51 m downstream.
-------------------------------------------------------------------------------
UNSTEADY TIDAL ASSESSMENT:
 Because of the unsteadiness of the ambient current during the tidal
  reversal, CORMIX predictions have been TERMINATED at:
                                      x = 229.97 m
                                      y = -0.97 m
                                      z = 0 m.
  For this condition BEFORE TIDAL REVERSAL, extensive re-entrainment
  of previously discharged is unlikely.
  To determine the minimum dilution, perform additional simulations
  after slack tide.
************************ TOXIC DILUTION ZONE SUMMARY ************************
Recall: The TDZ corresponds to the three (3) criteria issued in the USEPA
  Technical Support Document (TSD) for Water Quality-based Toxics Control,
  1991 (EPA/505/2-90-001).
  Criterion maximum concentration (CMC)  = 0.0058  mg/l
Corresponding dilution                   = 21.034483
The CMC was encountered at the following plume position:
  Plume location:                     x = -0.65 m
    (centerline coordinates)          y = 0.09 m
                                      z = 0.14 m
  Plume dimension:       half-width (bh) = 1.89 m
                          thickness (bv) = 0.08 m

 Computed distance from port opening to CMC location = 4.48 m.
 CRITERION 1: This location is beyond 50 times the discharge length scale of
              Lq = 0.07 m.
 +++++ The discharge length scale TEST for the TDZ has FAILED. ++++++

 Computed horizontal distance from port opening to CMC location = 0.66 m.
 CRITERION 2: This location is within 5 times the ambient water depth of
              HD = 4.58 m.
 ++++++++++ The ambient depth TEST for the TDZ has been SATISFIED. ++++++++++

 Computed distance from port opening to CMC location = 4.48 m.
 CRITERION 3: This location is within one tenth the distance of the extent
              of the Regulatory Mixing Zone of 91.56 m in any
              spatial direction from the port opening.
 +++++ The Regulatory Mixing Zone TEST for the TDZ has been SATISFIED. ++++++

 The diffuser discharge velocity is equal to 5.22 m/s.
 This exceeds the value of 3.0 m/s recommended in the TSD.

 *** This discharge DOES NOT SATISFY all three CMC criteria for the TDZ. ****
********************** REGULATORY MIXING ZONE SUMMARY **********************
The plume conditions at the boundary of the specified RMZ are as follows:
  Pollutant concentration             c = 0.003255  mg/l
  Corresponding dilution              s = 37.6
  Plume location:                     x = 91.44 m
    (centerline coordinates)          y = -0.97 m
                                      z = 0 m
```

```
  Plume dimensions:      half-width (bh) = 44.10 m
                          thickness (bv) = 0.28 m
Cumulative travel time:       1046.6427 sec.
At this position, the plume is CONTACTING the RIGHT bank.
Furthermore, the CCC for the toxic pollutant has indeed been met
  within the RMZ. In particular:
The CCC was encountered at the following plume position:
The CCC for the toxic pollutant was encountered at the following
  plume position:
  CCC                                     = 0.00373  mg/l
Corresponding dilution                    = 32.7
  Plume location:                       x = -2.13 m
    (centerline coordinates)            y = 0.09 m
                                        z = 0.03 m
  Plume dimensions:      half-width (bh) = 1.05 m
                          thickness (bv) = 0.10 m
********************* FINAL DESIGN ADVICE AND COMMENTS **********************
REMINDER:  The user must take note that HYDRODYNAMIC MODELING by any known
  technique is NOT AN EXACT SCIENCE.
Extensive comparison with field and laboratory data has shown that the
  CORMIX predictions on dilutions and concentrations (with associated
  plume geometries) are reliable for the majority of cases and are accurate
  to within about +-50% (standard deviation).
As a further safeguard, CORMIX will not give predictions whenever it judges
  the design configuration as highly complex and uncertain for prediction.
```

```
CORMIX1 PREDICTION FILE:
1111111111111111111111111111111111111111111111111111111111111111111111111111111111
1111111111111111
                        CORMIX MIXING ZONE EXPERT SYSTEM
              Subsystem CORMIX1:  Single Port Discharges
                          CORMIX Version 6.0GT
                       HYDRO1 Version 6.0.0.0 October 2009
-------------------------------------------------------------------------------
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-------------------------------------------------------------------------------
---------------
CASE DESCRIPTION
 Site name/label:   SIM
 Design case:       JD289(2)400GPMcStrat2Final6.0
 FILE NAME:         P:\...00GPMFinalRiver\JD289(2)400GPMcStratFinal6.0R.prd
 Time stamp:        Fri Mar 26 14:48:14 2010

ENVIRONMENT PARAMETERS (metric units)
 Bounded section
 BS    =    158.50  AS    =   1035.95  QA    =     72.52  ICHREG= 1
 HA    =      6.54  HD    =      4.58
 Tidal Simulation at TIME =      0.700 h
 PERIOD=    12.40 h UAmax =      0.300 dUa/dt=      0.100 (m/s)/h
 UA    =      0.070 F     =      0.026 USTAR =0.4009E-02
 UW    =      8.500 UWSTAR=0.1074E-01
 Density stratified environment
 STRCND=  B         RHOAM = 1017.6293
 RHOAS = 1012.0000  RHOAB = 1022.0000  RHOAH0= 1022.0000  E     =0.0000E+00
 DRHOJ =   10.0000  HINT  =      2.58  ES    =0.3726E-01

DISCHARGE PARAMETERS (metric units)
 Above Surface Discharge:
 Re-computed discharge conditions at entry point at water surface.
 BANK  =  RIGHT     DISTB =      1.01
 D0    =      0.115 A0    =      0.010 H0    =      4.58  SUB0  =      0.00
 THETA =      0.00  SIGMA =     90.00
 U0    =      5.222 Q0    =      0.054       =0.5394E-01
 RHO0  =  999.7019  DRHO0 =0.2230E+02  GP0   =0.2140E+00
 C0    =0.3500E-01  CUNITS=  mg/l
 IPOLL =  1         KS    =0.0000E+00  KD    =0.0000E+00

FLUX VARIABLES (metric units)
 Q0    =0.5394E-01  M0    =0.2817E+00  J0    =0.1154E-01  SIGNJ0=      1.0
 Associated length scales (meters)
 LQ    =      0.10  LM    =      3.60  Lm    =      7.58  Lb    =     33.64
                                       Lmp   =      1.66  Lbp   =      1.13
 Tidal:             Tu    =   0.2452 h Lu    =     21.643 Lmin  =      0.339

NON-DIMENSIONAL PARAMETERS
 FR0   =     33.34  R     =     74.60

FLOW CLASSIFICATION
 1111111111111111111111111111111111111111111
 1  Flow class (CORMIX1)      =    IV5    1
 1  Applicable layer depth HS =     2.00  1
 1111111111111111111111111111111111111111111

MIXING ZONE / TOXIC DILUTION / REGION OF INTEREST PARAMETERS
 C0    =0.3500E-01  CUNITS=  mg/l
 NTOX  =  1         CMC   =0.5800E-02  CCC   =  CSTD
```

```
 NSTD  =  1         CSTD  =0.3730E-02
 REGMZ =  1
 REGSPC=  1         XREG  =     91.44  WREG  =      0.00  AREG  =      0.00
 XINT  =  35000.00  XMAX  =  35000.00

X-Y-Z COORDINATE SYSTEM:
    ORIGIN is located at the bottom and below the center of the port:
         1.01 m  from the RIGHT bank/shore.
    X-axis points downstream, Y-axis points to left, Z-axis points upward.
NSTEP =  30 display intervals per module
-------------------------------------------------------------------------------
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-------------------------------------------------------------------------------
---------------
BEGIN MOD101: DISCHARGE MODULE

       X        Y       Z        S       C       B        Uc        TT
      0.00     0.00    4.58     1.0 0.350E-01   0.06    5.222   .00000E+00

END OF MOD101: DISCHARGE MODULE
-------------------------------------------------------------------------------
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-------------------------------------------------------------------------------
---------------
BEGIN CORJET (MOD110): JET/PLUME NEAR-FIELD MIXING REGION

 Jet/plume transition motion in weak crossflow.

 Zone of flow establishment:            THETAE=    -87.95  SIGMAE=     81.08
  LE    =      0.55  XE    =      0.00  YE    =      0.02  ZE    =      4.03

 Profile definitions:
   B = Gaussian 1/e (37%) half-width, normal to trajectory
   S = hydrodynamic centerline dilution
   C = centerline concentration (includes reaction effects, if any)
  Uc = Local centerline excess velocity (above ambient)
  TT = Cumulative travel time

       X        Y       Z        S       C       B        Uc        TT
      0.00     0.00    4.58     1.0 0.350E-01   0.06    5.222   .00000E+00
      0.00     0.02    4.03     1.0 0.350E-01   0.06    5.222   .25057E-02
      0.00     0.02    3.92     1.0 0.339E-01   0.07    5.222   .19297E-01
      0.00     0.03    3.79     1.2 0.285E-01   0.08    4.973   .42702E-01
      0.01     0.03    3.69     1.4 0.250E-01   0.10    4.359   .66050E-01
      0.01     0.04    3.56     1.6 0.219E-01   0.11    3.807   .97142E-01
      0.01     0.04    3.44     1.8 0.195E-01   0.12    3.376   .13241E+00
      0.01     0.04    3.33     2.0 0.178E-01   0.14    3.075   .16599E+00
      0.02     0.05    3.20     2.2 0.162E-01   0.15    2.784   .20909E+00
      0.02     0.05    3.08     2.4 0.149E-01   0.16    2.540   .25648E+00
      0.03     0.06    2.97     2.5 0.139E-01   0.18    2.361   .30053E+00
      0.04     0.06    2.85     2.7 0.129E-01   0.19    2.180   .35598E+00
      0.04     0.07    2.72     2.9 0.120E-01   0.20    2.023   .41584E+00
      0.05     0.07    2.62     3.1 0.114E-01   0.22    1.903   .47070E+00
      0.06     0.08    2.49     3.3 0.107E-01   0.23    1.779   .53893E+00
      0.07     0.08    2.37     3.5 0.101E-01   0.24    1.668   .61174E+00
      0.08     0.08    2.26     3.6 0.968E-02   0.26    1.582   .67788E+00
      0.09     0.09    2.13     3.8 0.920E-02   0.27    1.491   .75945E+00
      0.10     0.09    2.01     4.0 0.877E-02   0.29    1.408   .84586E+00
      0.11     0.10    1.90     4.1 0.844E-02   0.30    1.343   .92385E+00
      0.12     0.10    1.78     4.3 0.808E-02   0.31    1.272   .10195E+01
```

```
      0.14     0.11    1.65     4.5 0.776E-02   0.33    1.207   .11203E+01
      0.15     0.11    1.55     4.7 0.750E-02   0.34    1.155   .12109E+01
      0.16     0.12    1.42     4.8 0.723E-02   0.35    1.098   .13216E+01
      0.18     0.12    1.30     5.0 0.697E-02   0.37    1.046   .14379E+01
      0.20     0.13    1.19     5.2 0.677E-02   0.38    1.003   .15421E+01
      0.21     0.13    1.07     5.3 0.656E-02   0.40    0.956   .16690E+01
      0.23     0.14    0.95     5.5 0.635E-02   0.41    0.911   .18021E+01
      0.25     0.14    0.84     5.7 0.619E-02   0.43    0.875   .19211E+01
      0.27     0.15    0.72     5.8 0.602E-02   0.44    0.835   .20660E+01
      0.30     0.15    0.59     6.0 0.586E-02   0.46    0.797   .22176E+01
** CMC HAS BEEN FOUND **
 The pollutant concentration in the plume falls below CMC value of 0.580E-02
   in the current prediction interval.
 This is the extent of the TOXIC DILUTION ZONE.
      0.32     0.16    0.49     6.1 0.573E-02   0.47    0.766   .23531E+01
 Cumulative travel time =           2.3531 sec

END OF CORJET (MOD110): JET/PLUME NEAR-FIELD MIXING REGION
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---------------
BEGIN MOD132: LAYER BOUNDARY IMPINGEMENT/UPSTREAM SPREADING

  Vertical angle of layer/boundary impingement    =     -78.50 deg
  Horizontal angle of layer/boundary impingement  =      13.04 deg

 UPSTREAM INTRUSION PROPERTIES:
        Upstream intrusion length               =      10.46 m
        X-position of upstream stagnation point =     -10.15 m
        Thickness in intrusion region           =       0.24 m
        Half-width at downstream end            =      16.11 m
        Thickness at downstream end             =       0.25 m

  Control volume inflow:
       X        Y       Z        S       C       B        TT
      0.32     0.16    0.49     6.1 0.573E-02   0.47 .23531E+01

 Profile definitions:
   BV = top-hat thickness, measured vertically
   BH = top-hat half-width, measured horizontally in Y-direction
   ZU = upper plume boundary (Z-coordinate)
   ZL = lower plume boundary (Z-coordinate)
   S  = hydrodynamic average (bulk) dilution
   C  = average (bulk) concentration (includes reaction effects, if any)
   TT = Cumulative travel time

       X        Y       Z        S       C       BV       BH      ZU      ZL
TT
    -10.15     0.16    0.00  9915.9 0.000E+00   0.00     0.00    0.00    0.00
.11740E+03
**WATER QUALITY STANDARD OR CCC HAS BEEN FOUND**
 The pollutant concentration in the plume falls below water quality standard
   or CCC value of 0.373E-02 in the current prediction interval.
 This is the spatial extent of concentrations exceeding the water quality
   standard or CCC value.
     -9.78     0.16    0.00    25.8 0.135E-02   0.06     2.28    0.06    0.00
.23531E+01
     -7.96     0.16    0.00    10.7 0.326E-02   0.13     5.53    0.13    0.00
.23531E+01
```

```
     -6.15     0.16    0.00     8.1 0.431E-02   0.18     7.49    0.18    0.00
.23531E+01
     -4.33     0.16    0.00     7.0 0.501E-02   0.21     9.03    0.21    0.00
.23531E+01
     -2.52     0.16    0.00     6.4 0.546E-02   0.23    10.34    0.23    0.00
.23531E+01
     -0.70     0.16    0.00     6.2 0.569E-02   0.24    11.50    0.24    0.00
.23531E+01
      1.11     0.16    0.00     6.2 0.561E-02   0.24    12.56    0.24    0.00
.12443E+02
      2.93     0.16    0.00     7.5 0.467E-02   0.24    13.53    0.24    0.00
.38682E+02
      4.74     0.16    0.00     9.0 0.387E-02   0.25    14.44    0.25    0.00
.64921E+02
      6.55     0.16    0.00     9.9 0.352E-02   0.25    15.30    0.25    0.00
.91160E+02
      8.37     0.16    0.00    10.3 0.339E-02   0.25    16.11    0.25    0.00
.11740E+03
 Cumulative travel time =         117.3987 sec

END OF MOD132: LAYER BOUNDARY IMPINGEMENT/UPSTREAM SPREADING
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** End of NEAR-FIELD REGION (NFR) **

 In this design case, the discharge is located CLOSE TO BANK/SHORE.
 Some boundary interaction occurs at end of near-field.
   This may be related to a design case with a very LOW AMBIENT VELOCITY.
   The dilution values in one or more of the preceding zones may be too high.
 Carefully evaluate results in near-field and check degree of interaction.

 Consider locating outfall further away from bank or shore.
 In the next prediction module, the plume centerline will be set
   to follow the bank/shore.
-------------------------------------------------------------------------------
---------------
BEGIN MOD141: BUOYANT AMBIENT SPREADING

 Plume is ATTACHED to RIGHT bank/shore.
   Plume width is now determined from RIGHT bank/shore.

 Profile definitions:
   BV = top-hat thickness, measured vertically
   BH = top-hat half-width, measured horizontally in Y-direction
   ZU = upper plume boundary (Z-coordinate)
   ZL = lower plume boundary (Z-coordinate)
   S  = hydrodynamic average (bulk) dilution
   C  = average (bulk) concentration (includes reaction effects, if any)
   TT = Cumulative travel time

 Plume Stage 2 (bank attached):
       X        Y       Z        S       C       BV       BH      ZU      ZL
TT
      8.37    -1.01    0.00    10.3 0.339E-02   0.46    17.28    0.46    0.00
.11740E+03
     19.61    -1.01    0.00    11.6 0.301E-02   0.34    26.91    0.34    0.00
.27785E+03
     30.85    -1.01    0.00    12.7 0.276E-02   0.29    34.94    0.29    0.00
.43831E+03
```

```
     42.09    -1.01    0.00    13.8 0.254E-02   0.26    42.04    0.26    0.00
.59877E+03
     53.33    -1.01    0.00    14.9 0.235E-02   0.25    48.51    0.25    0.00
.75922E+03
     64.57    -1.01    0.00    16.2 0.216E-02   0.24    54.52    0.24    0.00
.91968E+03
     75.81    -1.01    0.00    17.7 0.198E-02   0.24    60.17    0.24    0.00
.10801E+04
     87.05    -1.01    0.00    19.4 0.181E-02   0.24    65.54    0.24    0.00
.12406E+04
 ** REGULATORY MIXING ZONE BOUNDARY **
 In this prediction interval the plume DOWNSTREAM  distance meets or exceeds
 the regulatory value =    91.44 m.
 This is the extent of the REGULATORY MIXING ZONE.
     88.20    -1.01    0.00    19.6 0.179E-02   0.24    66.06    0.24    0.00
 Cumulative travel time =        1256.9954 sec

 CORMIX prediction has been TERMINATED at last prediction interval.
   Limiting time due to TIDAL REVERSAL has been reached.

END OF MOD141: BUOYANT AMBIENT SPREADING
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CORMIX1: Single Port Discharges              End of Prediction File
1111111111111111111111111111111111111111111111111111111111111111111111111111111
1111111111111111
```

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CORMIX SESSION REPORT:
XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
                      CORMIX MIXING ZONE EXPERT SYSTEM
                          CORMIX Version 6.0GT
                       HYDRO1:Version-6.0.0.0  October,2009
SITE NAME/LABEL:                SIM
  DESIGN CASE:                  JD289(2)400GPMcStrat2Final6.0
  FILE NAME:
P:\Mixing\CriticalDischargeScenarios\V.6.0\400GPMFinalRiver\JD289(2)400GPMcStra
tFinal6.0R.prd
  Using subsystem CORMIX1:     Single Port Discharges
  Start of session:             03/26/2010--14:48:14
*****************************************************************************
SUMMARY OF INPUT DATA:
-----------------------------------------------------------------------------
AMBIENT PARAMETERS:
  Cross-section                          = bounded
  Width                          BS      = 158.50 m
  Channel regularity             ICHREG = 1
  Ambient flowrate               QA      = 72.52 m^3/s
  Average depth                  HA      = 6.54 m
  Depth at discharge             HD      = 4.58 m
  Darcy-Weisbach friction factor F       = 0.0262
    Calculated from Manning's n          = 0.025
  Wind velocity                  UW      = 8.5 m/s
TIDAL SIMULATION at time         Tsim    = 0.7 hours
  Instantaneous ambient velocity UA      = 0.07 m/s
  Maximum tidal velocity         UaMAX   = 0.3 m/s
Rate of tidal reversal          dUA/dt = 0.1 (m/s)/hour
  Period of reversal             T       = 12.4 hours
  Stratification Type            STRCND = B
  Surface density                RHOAS   = 1012 kg/m^3
  Bottom density                 RHOAB   = 1022 kg/m^3
  Stratification height          HINT    = 2.58 m (pycnocline level)
  Density below pycnocline       RHOAP   = 1022 kg/m^3
-----------------------------------------------------------------------------
DISCHARGE PARAMETERS:            Single Port Discharge
  Nearest bank                           = right
  Distance to bank               DISTB   = 1.01 m
  Port diameter                  D0      = 0.1147 m
  Port cross-sectional area      A0      = 0.0103 m^2
  Discharge velocity             U0      = 5.22 m/s
  Discharge flowrate             Q0      = 0.053935 m^3/s
  Discharge port height          H0      = 4.58 m
  Vertical discharge angle       THETA   = -87.97 deg
  Horizontal discharge angle     SIGMA   = 90 deg
  Discharge temperature (freshwater)     = 10 degC
  Corresponding density          RHO0    = 999.7019 kg/m^3
  Density difference             DRHO    = 22.2981 kg/m^3
  Buoyant acceleration           GP0     = 0.214 m/s^2
  Discharge concentration        C0      = 0.035 mg/l
  Surface heat exchange coeff.   KS      = 0 m/s
  Coefficient of decay           KD      = 0 /s
-----------------------------------------------------------------------------
DISCHARGE/ENVIRONMENT LENGTH SCALES:
  LQ  = 0.10 m         Lm  = 7.58 m         Lb  = 33.64 m
  LM  = 3.60 m         Lm' = 1.66 m         Lb' = 1.13 m
UNSTEADY TIDAL SCALES:
  Tu  = 0.2452 hours     Lu  = 21.64 m         Lmin= 0.34 m
-----------------------------------------------------------------------------
```

```
NON-DIMENSIONAL PARAMETERS:
  Port densimetric Froude number  FR0    = 33.34
  Velocity ratio                  R      = 74.60
-----------------------------------------------------------------------------
MIXING ZONE / TOXIC DILUTION ZONE / AREA OF INTEREST PARAMETERS:
  Toxic discharge                        = yes
  CMC concentration               CMC    = 0.0058 mg/l
  CCC concentration               CCC    = 0.00373 mg/l
  Water quality standard specified       = given by CCC value
  Regulatory mixing zone                 = yes
  Regulatory mixing zone specification   = distance
  Regulatory mixing zone value           = 91.44 m (m^2 if area)
  Region of interest                     = 35000 m
*****************************************************************************
HYDRODYNAMIC CLASSIFICATION:
  *------------------------*
  | FLOW CLASS   = IV5 |
  *------------------------*
  This flow configuration applies to a layer corresponding to lower stratified
  density layer at the discharge site.  The density jump at the pycnocline
  confines the flow to the lower layer.
  Applicable layer depth = lower layer depth = 2.00 m
*****************************************************************************
MIXING ZONE EVALUATION (hydrodynamic and regulatory summary):

-----------------------------------------------------------------------------
X-Y-Z Coordinate system:
  Origin is located at the bottom below the port center:
    1.01 m from the right bank/shore.
  Number of display steps NSTEP = 30 per module.
-----------------------------------------------------------------------------
NEAR-FIELD REGION (NFR) CONDITIONS :
Note: The NFR is the zone of strong initial mixing.  It has no regulatory
  implication.  However, this information may be useful for the discharge
  designer because the mixing in the NFR is usually sensitive to the
  discharge design conditions.
  Pollutant concentration at NFR edge  c = 0.0034 mg/l
  Dilution at edge of NFR              s = 10.3
  NFR Location:                        x = 8.37 m
    (centerline coordinates)           y = 0.16 m
                                       z = 0 m
  NFR plume dimensions:  half-width (bh) = 16.11 m
                          thickness (bv) = 0.25 m
Cumulative travel time:       117.3987 sec.
-----------------------------------------------------------------------------
Buoyancy assessment:
  The effluent density is less than the surrounding ambient water
  density at the discharge level.
  Therefore, the effluent is POSITIVELY BUOYANT and will tend to rise towards
  the surface.
-----------------------------------------------------------------------------
Stratification assessment:
  The specified two layer ambient density stratification is dynamically
  important. The discharge near field flow will be confined to the lower
  layer by the ambient density stratification.
  Furthermore, it is trapped at the pycnocline by the ambient density
  jump.
-----------------------------------------------------------------------------
UPSTREAM INTRUSION SUMMARY:
Plume exhibits upstream intrusion due to low ambient velocity or strong
```

```
  discharge buoyancy.
  Intrusion length                        =  10.46 m
  Intrusion stagnation point              =  -10.15 m
  Intrusion thickness                     =  0.24 m
  Intrusion half width at impingement     =  16.11 m
  Intrusion half thickness at impingement =  0.25 m
-------------------------------------------------------------------------
PLUME BANK CONTACT SUMMARY:
  Plume in bounded section contacts nearest bank at 8.37 m downstream.
  Plume contacts second bank at 345.58 m downstream.
-------------------------------------------------------------------------
UNSTEADY TIDAL ASSESSMENT:
 Because of the unsteadiness of the ambient current during the tidal
  reversal, CORMIX predictions have been TERMINATED at:
                                        x = 88.20 m
                                        y = -1.01 m
                                        z = 0 m.
  For this condition AFTER TIDAL REVERSAL, mixed water from the previous
  half-cycle becomes re-entrained into the near field of the discharge,
  increasing pollutant concentrations compared to steady-state predictions.
  A pool of mixed water formed at slack tide will be advected downstream
  in this phase.
************************ TOXIC DILUTION ZONE SUMMARY ************************
Recall: The TDZ corresponds to the three (3) criteria issued in the USEPA
  Technical Support Document (TSD) for Water Quality-based Toxics Control,
  1991 (EPA/505/2-90-001).
  Criterion maximum concentration (CMC)  = 0.0058  mg/l
Corresponding dilution                   = 6.034483
The CMC was encountered at the following plume position:
  Plume location:                       x = 0.30 m
    (centerline coordinates)            y = 0.15 m
                                        z = 0.55 m
  Plume dimension:       half-width (bh) = 0.04 m
                          thickness (bv) = 0.04 m

 Computed distance from port opening to CMC location = 4.04 m.
 CRITERION 1: This location is within 50 times the discharge length scale of
              Lq = 0.10 m.
 +++++ The discharge length scale TEST for the TDZ has been SATISFIED. ++++++

 Computed horizontal distance from port opening to CMC location = 0.34 m.
 CRITERION 2: This location is within 5 times the ambient water depth of
              HD = 4.58 m.
 ++++++++++ The ambient depth TEST for the TDZ has been SATISFIED. ++++++++++

 Computed distance from port opening to CMC location = 4.04 m.
 CRITERION 3: This location is within one tenth the distance of the extent
              of the Regulatory Mixing Zone of 91.56 m in any
              spatial direction from the port opening.
 +++++ The Regulatory Mixing Zone TEST for the TDZ has been SATISFIED. ++++++

 The diffuser discharge velocity is equal to 5.22 m/s.
 This exceeds the value of 3.0 m/s recommended in the TSD.

 *** All three CMC criteria for the TDZ are SATISFIED for this discharge. ***
********************** REGULATORY MIXING ZONE SUMMARY ***********************
The plume conditions at the boundary of the specified RMZ are as follows:
  Pollutant concentration               c = 0.001743  mg/l
  Corresponding dilution                s = 20.1
  Plume location:                       x = 91.44 m
```

```
    (centerline coordinates)          y = -1.01 m
                                      z = 0 m
  Plume dimensions:      half-width (bh) = 67.56 m
                          thickness (bv) = 0.25 m
Cumulative travel time:       1303.2467 sec.
At this position, the plume is CONTACTING the RIGHT bank.
Furthermore, the CCC for the toxic pollutant has indeed been met
  within the RMZ. In particular:
The CCC was encountered at the following plume position:
The CCC for the toxic pollutant was encountered at the following
  plume position:
  CCC                                   = 0.00373  mg/l
Corresponding dilution                  = 9.4
  Plume location:                     x = 2.73 m
    (centerline coordinates)          y = 0.16 m
                                      z = 0.27 m
  Plume dimensions:      half-width (bh) = 9.35 m
                          thickness (bv) = 0.03 m
********************* FINAL DESIGN ADVICE AND COMMENTS *********************
REMINDER:  The user must take note that HYDRODYNAMIC MODELING by any known
  technique is NOT AN EXACT SCIENCE.
Extensive comparison with field and laboratory data has shown that the
  CORMIX predictions on dilutions and concentrations (with associated
  plume geometries) are reliable for the majority of cases and are accurate
  to within about +-50% (standard deviation).
As a further safeguard, CORMIX will not give predictions whenever it judges
  the design configuration as highly complex and uncertain for prediction.
```

```
CORMIX3 PREDICTION FILE:
3333333333333333333333333333333333333333333333333333333333333333333333333333
3
                        CORMIX MIXING ZONE EXPERT SYSTEM
                 Subsystem CORMIX3:   Buoyant Surface Discharges
                          CORMIX Version 6.0GT
                       HYDRO3 Version 6.0.0.0 October 2009
-------------------------------------------------------------------------------
--
-------------------------------------------------------------------------------
--
CASE DESCRIPTION
 Site name/label:   SIM
 Design case:       JD289(2)400GPMdStratFinal6.0
 FILE NAME:         P:\...00GPMFinalRiver\JD289(2)400GPMdStratFinal6.0R.prd
 Time stamp:        Fri Mar 26 14:49:59 2010

ENVIRONMENT PARAMETERS (metric units)
 Bounded section
 BS    =    158.50  AS    =   1257.79  QA    =    109.43  ICHREG= 1
 HA    =      7.94  HD    =      5.56
 Tidal Simulation at TIME =      1.250 h
 PERIOD=    12.40 h UAmax =      0.300 dUa/dt=      0.070 (m/s)/h
 UA    =      0.087 F     =      0.025 USTAR =0.4824E-02
 UW    =      8.500 UWSTAR=0.1074E-01
 Density stratified environment
 STRCND=  B         RHOAM = 1018.3648
 RHOAS = 1012.0000  RHOAB = 1022.0000  RHOAEF= 1012.0000  E     =0.0000E+00
 DRHOJ =   10.0000  HINT  =      3.54  ES    =0.2714E-01

DISCHARGE PARAMETERS (metric units)
 BANK  =  RIGHT     DISTB =      0.91  Configuration: protruding_discharge
 SIGMA =     90.00  HDO   =      5.56  SLOPE =    0.00 deg.
 Circular discharge pipe:
 D0    =      0.610 A0    =      0.149
 Dimensions of equivalent rectangular discharge:
 B0    =      0.479 H0    =      0.610 A0    =0.2919E+00  AR    =      1.273
 Reduced channel geometry due to intrusion:
 B0    =      0.479 H0    =      0.311 A0    =0.1488E+00  AR    =      0.649
 (All relevant parameters further below are based on this geometry.)
 U0    =      0.192 Q0    =      0.029       =0.2856E-01
 RHO0  =  999.7019  DRHO0 =0.1230E+02  GP0   =0.1192E+00
 C0    =0.1800E-01  CUNITS=  mg/l
 IPOLL =  1         KS    =0.0000E+00  KD    =0.0000E+00

FLUX VARIABLES (metric units)
 Q0    =0.2856E-01  M0    =0.5480E-02  J0    =0.3403E-02
 Associated length scales (meters)
 LQ    =      0.39  LM    =      0.35  Lm    =      0.85  Lb    =      5.14
 Tidal:             Tu    =   0.1619 h Lu    =      6.569 Lmin  =      0.247

NON-DIMENSIONAL PARAMETERS
 FR0   =      0.90  FRCH  =      1.00  R     =      2.21

FLOW CLASSIFICATION
 3333333333333333333333333333333333333333333
 3  Flow class (CORMIX3)      =    PL1    3
 3  Applicable layer depth HS =     2.02  3
 3333333333333333333333333333333333333333333
```

```
MIXING ZONE / TOXIC DILUTION / REGION OF INTEREST PARAMETERS
 C0    =0.1800E-01  CUNITS=  mg/l
 NTOX  =  1         CMC   =0.5800E-02  CCC   =  CSTD
 NSTD  =  1         CSTD  =0.3730E-02
 REGMZ =  1
 REGSPC=  1         XREG  =     91.44  WREG  =      0.00  AREG  =      0.00
 XINT  =   3500.00  XMAX  =   3500.00

X-Y-Z COORDINATE SYSTEM:
    ORIGIN is located at the WATER SURFACE and at center of discharge
      channel/outlet:      0.91 m  from the RIGHT bank/shore.
    X-axis points downstream
    Y-axis points to left as seen by an observer looking downstream
    Z-axis points vertically upward (in CORMIX3, all values Z = 0.00)
NSTEP =  30 display intervals per module
-------------------------------------------------------------------------------
--
-------------------------------------------------------------------------------
--
BEGIN MOD301: DISCHARGE MODULE

 Efflux conditions:
       X        Y       Z        S       C       BV       BH        TT
      0.00     0.00    0.00     1.0 0.180E-01   0.31     0.24 .00000E+00

END OF MOD301: DISCHARGE MODULE
-------------------------------------------------------------------------------
--
-------------------------------------------------------------------------------
--
BEGIN MOD302: ZONE OF FLOW ESTABLISHMENT

  Control volume inflow:
       X        Y       Z        S       C       BV       BH        TT
      0.00     0.00    0.00     1.0 0.180E-01   0.31     0.24 .00000E+00

 Profile definitions:
   BV = Gaussian 1/e (37%) vertical thickness
   BH = Gaussian 1/e (37%) horizontal half-width, normal to trajectory
   S  = hydrodynamic centerline dilution
   C  = centerline concentration (includes reaction efects, if any)
   TT = Cumulative travel time

  Control volume outflow:                                SIGMAE=     86.55
       X        Y       Z        S       C       BV       BH        TT
      0.02     0.36    0.00     1.0 0.180E-01   0.18     0.43 .18946E+01
 Cumulative travel time =           1.8946 sec

END OF MOD302: ZONE OF FLOW ESTABLISHMENT
-------------------------------------------------------------------------------
--
-------------------------------------------------------------------------------
--
BEGIN MOD331: UPSTREAM INTRUDING PLUME

  Control volume inflow:
       X        Y       Z        S       C       BV       BH        TT
      0.02     0.36    0.00     1.0 0.180E-01   0.18     0.43 .18946E+01

 UPSTREAM INTRUSION PROPERTIES:
```

```
        Upstream intrusion length                =       2.81 m
        X-position of upstream stagnation point =      -2.81 m
        Thickness in intrusion region            =       0.07 m
        Half-width at downstream end             =       6.28 m
        Thickness at downstream end              =       0.07 m

 Profile definitions:
   BV = top-hat thickness,measured vertically
   BH = top-hat half-width, measured horizontally from bank/shoreline
   S  = hydrodynamic average (bulk) dilution
   C  = average (bulk) concentration (includes reaction effects, if any)
   TT = Cumulative travel time

       X        Y       Z        S       C       BV       BH        TT
     -2.81     0.00    0.00  9614.2 0.000E+00   0.00     0.00 .18946E+01
** CMC HAS BEEN FOUND **
 The pollutant concentration in the plume falls below CMC value of 0.580E-02
   in the current prediction interval.
 This is the extent of the TOXIC DILUTION ZONE.
     -2.64     0.00    0.00     3.2 0.571E-02   0.02     0.89 .18946E+01
     -1.81     0.00    0.00     1.3 0.134E-01   0.05     2.16 .18946E+01
     -0.99     0.00    0.00     1.1 0.168E-01   0.07     2.92 .18946E+01
     -0.16     0.00    0.00     1.0 0.180E-01   0.07     3.52 .18946E+01
      0.66     0.00    0.00     1.0 0.178E-01   0.07     4.03 .92617E+01
      1.49     0.00    0.00     1.1 0.168E-01   0.07     4.48 .18753E+02
      2.31     0.00    0.00     1.2 0.155E-01   0.07     4.89 .28244E+02
      3.14     0.00    0.00     1.2 0.146E-01   0.07     5.27 .37735E+02
      3.97     0.00    0.00     1.3 0.141E-01   0.07     5.63 .47226E+02
      4.79     0.00    0.00     1.3 0.139E-01   0.07     5.96 .56717E+02
      5.62     0.00    0.00     1.3 0.139E-01   0.07     6.28 .66208E+02
 Cumulative travel time =          66.2075 sec

END OF MOD331: UPSTREAM INTRUDING PLUME
-------------------------------------------------------------------------------
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-------------------------------------------------------------------------------
--
** End of NEAR-FIELD REGION (NFR) **
-------------------------------------------------------------------------------
--
-------------------------------------------------------------------------------
--
BEGIN MOD341: BUOYANT AMBIENT SPREADING

  Because of the WEAK VERTICAL MIXING, the surface plume in the far-field
    will be vertically limited WITHIN THE UPPER LAYER of the ambient
    stratification.
 Profile definitions:
   BV = top-hat thickness,measured vertically
   BH = top-hat half-width, measured horizontally from bank/shoreline
   S  = hydrodynamic average (bulk) dilution
   C  = average (bulk) concentration (includes reaction effects, if any)
   TT = Cumulative travel time

 Plume Stage 2 (bank attached):
       X        Y       Z        S       C       BV       BH        TT
      5.62    -0.91    0.00     1.3 0.139E-01   0.07     6.28 .66208E+02
     33.76    -0.91    0.00     2.4 0.756E-02   0.06    18.40 .38959E+03
** WATER QUALITY STANDARD OR CCC HAS BEEN FOUND **
 The pollutant concentration in the plume falls below water quality standard
```

```
   or CCC value of 0.373E-02 in the current prediction interval.
 This is the spatial extent of concentrations exceeding the water quality
   standard or CCC value.
     61.90    -0.91    0.00     4.9 0.368E-02   0.10    27.07 .71297E+03
     90.04    -0.91    0.00     9.0 0.199E-02   0.15    34.61 .10364E+04
 ** REGULATORY MIXING ZONE BOUNDARY **
 In this prediction interval the plume DOWNSTREAM distance meets or exceeds
 the regulatory value =    91.44 m.
 This is the extent of the REGULATORY MIXING ZONE.
    118.18    -0.91    0.00    15.1 0.120E-02   0.23    41.50 .13597E+04
    146.32    -0.91    0.00    23.3 0.773E-03   0.31    47.91 .16831E+04
    154.52    -0.91    0.00    26.4 0.701E-03   0.34    49.68
 Cumulative travel time =        1777.3157 sec

 CORMIX prediction has been TERMINATED at last prediction interval.
   Limiting distance due to TIDAL REVERSAL has been reached.

END OF MOD341: BUOYANT AMBIENT SPREADING
-------------------------------------------------------------------------------
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-------------------------------------------------------------------------------
--
CORMIX3: Buoyant Surface Discharges                    End of Prediction File
3333333333333333333333333333333333333333333333333333333333333333333333333333333
3
```

```
CORMIX SESSION REPORT:
XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
                      CORMIX MIXING ZONE EXPERT SYSTEM
                          CORMIX Version 6.0GT
                       HYDRO3:Version-6.0.0.0  October,2009
SITE NAME/LABEL:                SIM
  DESIGN CASE:                  JD289(2)400GPMdStratFinal6.0
  FILE NAME:
P:\Mixing\CriticalDischargeScenarios\V.6.0\400GPMFinalRiver\JD289(2)400GPMdStra
tFinal6.0R.prd
  Using subsystem CORMIX3:     Buoyant Surface Discharges
  Start of session:             03/26/2010--14:49:59
*****************************************************************************
SUMMARY OF INPUT DATA:
-----------------------------------------------------------------------------
AMBIENT PARAMETERS:
  Cross-section                          = bounded
  Width                           BS     = 158.50 m
  Channel regularity              ICHREG = 1
  Ambient flowrate                QA     = 109.43 m^3/s
  Average depth                   HA     = 7.94 m
  Depth at discharge              HD     = 5.56 m
  Darcy-Weisbach friction factor  F      = 0.0246
    Calculated from Manning's n          = 0.025
  Wind velocity                   UW     = 8.5 m/s
TIDAL SIMULATION at time          Tsim   = 1.25 hours
  Instantaneous ambient velocity  UA     = 0.087 m/s
  Maximum tidal velocity          UaMAX  = 0.3 m/s
Rate of tidal reversal          dUA/dt = 0.0696 (m/s)/hour
  Period of reversal              T      = 12.4 hours
  Stratification Type             STRCND = B
  Surface density                 RHOAS  = 1012 kg/m^3
  Bottom density                  RHOAB  = 1022 kg/m^3
  Stratification height           HINT   = 3.54 m (pycnocline level)
  Density below pycnocline        RHOAP  = 1022 kg/m^3
-----------------------------------------------------------------------------
DISCHARGE PARAMETERS:             Surface Discharge
  Discharge located on                   = right bank/shoreline
  Discharge configuration                = protruding discharge
  Distance from bank to outlet    DISTB  = 0.91 m
  Discharge angle                 SIGMA  = 90 deg
  Depth near discharge outlet     HD0    = 5.56 m
  Bottom slope at discharge       SLOPE  = 0 deg
  Circular pipe diameter                 = 0.6096 m
    Equivalent rectangular discharge:
    Discharge cross-section area  A0     = 0.291864 m^2
    Discharge channel width       B0     = 0.478779 m
    Discharge channel depth       H0     = 0.6096 m
    Discharge aspect ratio        AR     = 1.273240
  Reduced discharge channel due to intrusion:
    Cross-section area            A0     = 0.1488 m^2
    Channel width                 B0     = 0.4788 m
    Channel depth                 H0     = 0.31 m
    Aspect ratio                  AR     = 0.65
  Discharge flowrate              Q0     = 0.028558 m^3/s
  Discharge velocity              U0     = 0.19 m/s
  Discharge temperature (freshwater)     = 10 degC
  Corresponding density           RHO0   = 999.7019 kg/m^3
  Density difference              DRHO   = 12.2981 kg/m^3
  Buoyant acceleration            GP0    = 0.1192 m/s^2
```

```
  Discharge concentration         C0     = 0.018 mg/l
  Surface heat exchange coeff.    KS     = 0 m/s
  Coefficient of decay            KD     = 0 /s
-----------------------------------------------------------------------------
DISCHARGE/ENVIRONMENT LENGTH SCALES:
  LQ  = 0.39 m         Lm  = 0.85 m         Lbb = 5.14 m
  LM  = 0.35 m
UNSTEADY TIDAL SCALES:
  Tu  = 0.1619 hours     Lu  = 6.57 m         Lmin= 0.25 m
-----------------------------------------------------------------------------
NON-DIMENSIONAL PARAMETERS:
  Densimetric Froude number       FR0    = 0.90 (based on LQ)
  Channel densimetric Froude no.  FRCH   = 1 (based on H0)
  Velocity ratio                  R      = 2.21
-----------------------------------------------------------------------------
MIXING ZONE / TOXIC DILUTION ZONE / AREA OF INTEREST PARAMETERS:
  Toxic discharge                        = yes
  CMC concentration               CMC    = 0.0058 mg/l
  CCC concentration               CCC    = 0.00373 mg/l
  Water quality standard specified       = given by CCC value
  Regulatory mixing zone                 = yes
  Regulatory mixing zone specification   = distance
  Regulatory mixing zone value           = 91.44 m (m^2 if area)
  Region of interest                     = 3500 m
*****************************************************************************
HYDRODYNAMIC CLASSIFICATION:
  *------------------------*
  | FLOW CLASS   = PL1 |
  *------------------------*
*****************************************************************************
MIXING ZONE EVALUATION (hydrodynamic and regulatory summary):

-----------------------------------------------------------------------------
X-Y-Z Coordinate system:
Origin is located at water surface and at centerline of discharge channel:
    0.91 m from the right bank/shore.
  Number of display steps NSTEP = 30 per module.
-----------------------------------------------------------------------------
NEAR-FIELD REGION (NFR) CONDITIONS :
Note: The NFR is the zone of strong initial mixing.  It has no regulatory
  implication.  However, this information may be useful for the discharge
  designer because the mixing in the NFR is usually sensitive to the
  discharge design conditions.
  Pollutant concentration at NFR edge  c = 0.0128 mg/l
  Dilution at edge of NFR              s = 1.4
  NFR Location:                        x = 5.62 m
    (centerline coordinates)           y = 0 m
                                       z = 0 m
  NFR plume dimensions:  half-width (bh) = 6.28 m
                          thickness (bv) = 0.07 m
Cumulative travel time:       66.2075 sec.
-----------------------------------------------------------------------------
Buoyancy assessment:
  The effluent density is less than the surrounding ambient water
  density at the discharge level.
  Therefore, the effluent is POSITIVELY BUOYANT and will tend to rise towards
  the surface.
-----------------------------------------------------------------------------
Stratification assessment:
  Due to WEAK VERTICAL MIXING the surface plume will be confined to
```

```
  the upper layer above the pycnocline!
-----------------------------------------------------------------------------
PLUME BANK CONTACT SUMMARY:
  Plume in bounded section contacts nearest bank at -2.81 m downstream.
  Plume contacts second bank at 849.86 m downstream.
-----------------------------------------------------------------------------
UNSTEADY TIDAL ASSESSMENT:
 Because of the unsteadiness of the ambient current during the tidal
  reversal, CORMIX predictions have been TERMINATED at:
                                        x = 154.52 m
                                        y = -0.91 m
                                        z = 0 m.
  For this condition AFTER TIDAL REVERSAL, mixed water from the previous
  half-cycle becomes re-entrained into the near field of the discharge,
  increasing pollutant concentrations compared to steady-state predictions.
  A pool of mixed water formed at slack tide will be advected downstream
  in this phase.
************************ TOXIC DILUTION ZONE SUMMARY ************************
Recall: The TDZ corresponds to the three (3) criteria issued in the USEPA
  Technical Support Document (TSD) for Water Quality-based Toxics Control,
  1991 (EPA/505/2-90-001).
  Criterion maximum concentration (CMC)  = 0.0058  mg/l
Corresponding dilution                   = 3.103448
The CMC was encountered at the following plume position:
  Plume location:                       x = -2.58 m
    (centerline coordinates)            y = 0.00 m
                                        z = 0 m
  Plume dimension:       half-width (bh) = 0.92 m
                          thickness (bv) = 0.02 m

 Computed distance from port opening to CMC location = 2.58 m.
 CRITERION 1: This location is within 50 times the discharge length scale of
              Lq = 0.39 m.
 +++++ The discharge length scale TEST for the TDZ has been SATISFIED. ++++++

 Computed horizontal distance from port opening to CMC location = 2.58 m.
 CRITERION 2: This location is within 5 times the ambient water depth of
              HD = 5.56 m.
 ++++++++++ The ambient depth TEST for the TDZ has been SATISFIED. ++++++++++

 Computed distance from port opening to CMC location = 2.58 m.
 CRITERION 3: This location is within one tenth the distance of the extent
              of the Regulatory Mixing Zone of 91.44 m in any
              spatial direction from the port opening.
 +++++ The Regulatory Mixing Zone TEST for the TDZ has been SATISFIED. ++++++

 The diffuser discharge velocity is equal to 0.19 m/s.
 This is below the value of 3.0 m/s recommended in the TSD.

 *** All three CMC criteria for the TDZ are SATISFIED for this discharge. ***
********************** REGULATORY MIXING ZONE SUMMARY **********************
The plume conditions at the boundary of the specified RMZ are as follows:
  Pollutant concentration               c = 0.001941  mg/l
  Corresponding dilution                s = 9.3
  Plume location:                       x = 91.44 m
    (centerline coordinates)            y = -0.91 m
                                        z = 0 m
  Plume dimensions:      half-width (bh) = 34.97 m
                          thickness (bv) = 0.16 m
Cumulative travel time:       1052.4203 sec.
```

```
At this position, the plume is CONTACTING the RIGHT bank.
Furthermore, the CCC for the toxic pollutant has indeed been met
  within the RMZ. In particular:
The CCC was encountered at the following plume position:
The CCC for the toxic pollutant was encountered at the following
  plume position:
  CCC                                   = 0.00373  mg/l
Corresponding dilution                  = 4.8
  Plume location:                     x = 61.40 m
    (centerline coordinates)          y = -0.91 m
                                      z = 0 m
  Plume dimensions:      half-width (bh) = 26.93 m
                          thickness (bv) = 0.10 m
********************* FINAL DESIGN ADVICE AND COMMENTS *********************

INTRUSION OF AMBIENT WATER into the discharge opening will occur!

For the present discharge/environment conditions the discharge densimetric
Froude number is well below unity. This is an UNDESIRABLE operating condition.

To prevent intrusion, change the discharge parameters (e.g. decrease the
discharge opening area) in order to increase the discharge Froude number.

In a future iteration, change the discharge parameters (e.g. decrease port
diameter) in order to increase the Froude number.
-----------------------------------------------------------------------------
REMINDER:  The user must take note that HYDRODYNAMIC MODELING by any known
  technique is NOT AN EXACT SCIENCE.
Extensive comparison with field and laboratory data has shown that the
  CORMIX predictions on dilutions and concentrations (with associated
  plume geometries) are reliable for the majority of cases and are accurate
  to within about +-50% (standard deviation).
As a further safeguard, CORMIX will not give predictions whenever it judges
  the design configuration as highly complex and uncertain for prediction.
```

```
CORMIX1 PREDICTION FILE:
1111111111111111111111111111111111111111111111111111111111111111111111111111111111
1111111111111111
                        CORMIX MIXING ZONE EXPERT SYSTEM
              Subsystem CORMIX1:  Single Port Discharges
                          CORMIX Version 6.0GT
                       HYDRO1 Version 6.0.0.0 October 2009
-------------------------------------------------------------------------------
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-------------------------------------------------------------------------------
---------------
CASE DESCRIPTION
 Site name/label:   SIM
 Design case:       JD300400GPMa6.0
 FILE NAME:         P:\...\V.6.0\400GPMFinalRiver\JD300400GPMaFinal6.0R.prd
 Time stamp:        Fri Mar 26 14:51:52 2010

ENVIRONMENT PARAMETERS (metric units)
 Bounded section
 BS    =    158.50  AS    =    829.96  QA    =     95.45  ICHREG= 1
 HA    =      5.24  HD    =      3.67
 Tidal Simulation at TIME =     -1.500 h
 PERIOD=    12.40 h UAmax =      0.359 dUa/dt=      0.077 (m/s)/h
 UA    =      0.115 F     =      0.028 USTAR =0.6834E-02
 UW    =      8.500 UWSTAR=0.1074E-01
 Density stratified environment
 STRCND=  B         RHOAM = 1008.2144
 RHOAS = 1001.0000  RHOAB = 1019.0000  RHOAH0= 1019.0000  E     =0.0000E+00
 DRHOJ =   18.0000  HINT  =      1.47  ES    =0.1179E+00

DISCHARGE PARAMETERS (metric units)
 Above Surface Discharge:
 Re-computed discharge conditions at entry point at water surface.
 BANK  =  RIGHT     DISTB =      0.99
 D0    =      0.071 A0    =      0.004 H0    =      3.67  SUB0  =      0.00
 THETA =      0.00  SIGMA =     90.00
 U0    =      7.262 Q0    =      0.029       =0.2856E-01
 RHO0  =  999.7019  DRHO0 =0.1930E+02  GP0   =0.1857E+00
 C0    =0.1370E+00  CUNITS=  mg/l
 IPOLL =  1         KS    =0.0000E+00  KD    =0.0000E+00

FLUX VARIABLES (metric units)
 Q0    =0.2856E-01  M0    =0.2074E+00  J0    =0.5304E-02  SIGNJ0=      1.0
 Associated length scales (meters)
 LQ    =      0.06  LM    =      4.22  Lm    =      3.96  Lb    =      3.49
                                       Lmp   =      1.15  Lbp   =      0.60
 Tidal:             Tu    =   0.2782 h Lu    =     21.354 Lmin  =      0.175

NON-DIMENSIONAL PARAMETERS
 FR0   =     63.35  R     =     63.15

FLOW CLASSIFICATION
 1111111111111111111111111111111111111111111
 1  Flow class (CORMIX1)      =    IV5    1
 1  Applicable layer depth HS =     2.20  1
 1111111111111111111111111111111111111111111

MIXING ZONE / TOXIC DILUTION / REGION OF INTEREST PARAMETERS
 C0    =0.1370E+00  CUNITS=  mg/l
 NTOX  =  1         CMC   =0.5800E-02  CCC   =  CSTD
```

```
 NSTD  =  1         CSTD  =0.3730E-02
 REGMZ =  1
 REGSPC=  1         XREG  =     91.44  WREG  =      0.00  AREG  =      0.00
 XINT  =   3500.00  XMAX  =   3500.00

X-Y-Z COORDINATE SYSTEM:
    ORIGIN is located at the bottom and below the center of the port:
         0.99 m  from the RIGHT bank/shore.
    X-axis points downstream, Y-axis points to left, Z-axis points upward.
NSTEP =  30 display intervals per module
-------------------------------------------------------------------------------
---------------
-------------------------------------------------------------------------------
---------------
BEGIN MOD101: DISCHARGE MODULE

       X        Y       Z        S       C       B        Uc        TT
      0.00     0.00    3.67     1.0 0.137E+00   0.04    7.262   .00000E+00

END OF MOD101: DISCHARGE MODULE
-------------------------------------------------------------------------------
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-------------------------------------------------------------------------------
---------------
BEGIN CORJET (MOD110): JET/PLUME NEAR-FIELD MIXING REGION

 Jet/plume transition motion in weak crossflow.

 Zone of flow establishment:            THETAE=    -89.14  SIGMAE=     64.04
  LE    =      0.34  XE    =      0.00  YE    =      0.00  ZE    =      3.33

 Profile definitions:
   B = Gaussian 1/e (37%) half-width, normal to trajectory
   S = hydrodynamic centerline dilution
   C = centerline concentration (includes reaction effects, if any)
  Uc = Local centerline excess velocity (above ambient)
  TT = Cumulative travel time

       X        Y       Z        S       C       B        Uc        TT
      0.00     0.00    3.67     1.0 0.137E+00   0.04    7.262   .00000E+00
      0.00     0.00    3.33     1.0 0.137E+00   0.04    7.262   .15186E-02
      0.00     0.01    3.24     1.1 0.124E+00   0.05    7.262   .12047E-01
      0.00     0.01    3.14     1.4 0.996E-01   0.06    6.215   .27404E-01
      0.01     0.01    3.05     1.6 0.852E-01   0.07    5.311   .43210E-01
      0.01     0.01    2.94     1.9 0.729E-01   0.08    4.537   .64748E-01
      0.01     0.01    2.84     2.2 0.637E-01   0.09    3.957   .89636E-01
      0.02     0.01    2.75     2.4 0.575E-01   0.10    3.563   .11365E+00
      0.02     0.01    2.64     2.7 0.516E-01   0.11    3.190   .14482E+00
      0.03     0.02    2.54     2.9 0.467E-01   0.12    2.885   .17940E+00
      0.04     0.02    2.45     3.2 0.433E-01   0.13    2.664   .21179E+00
      0.05     0.02    2.35     3.4 0.398E-01   0.15    2.444   .25280E+00
      0.06     0.02    2.24     3.7 0.369E-01   0.16    2.255   .29733E+00
      0.07     0.02    2.14     4.0 0.343E-01   0.17    2.090   .34541E+00
      0.08     0.02    2.05     4.2 0.324E-01   0.18    1.966   .38948E+00
      0.09     0.02    1.95     4.5 0.304E-01   0.19    1.836   .44428E+00
      0.10     0.02    1.84     4.8 0.286E-01   0.20    1.720   .50277E+00
      0.11     0.03    1.76     5.0 0.272E-01   0.22    1.631   .55589E+00
      0.13     0.03    1.65     5.3 0.257E-01   0.23    1.535   .62140E+00
      0.15     0.03    1.55     5.6 0.244E-01   0.24    1.449   .69077E+00
      0.16     0.03    1.46     5.9 0.234E-01   0.25    1.381   .75338E+00
```

```
      0.18     0.03    1.36     6.2 0.223E-01   0.26    1.307   .83014E+00
      0.20     0.03    1.27     6.4 0.214E-01   0.27    1.249   .89920E+00
      0.22     0.03    1.17     6.7 0.204E-01   0.29    1.185   .98364E+00
      0.24     0.04    1.07     7.0 0.196E-01   0.30    1.126   .10723E+01
      0.26     0.04    0.98     7.3 0.189E-01   0.31    1.079   .11519E+01
      0.29     0.04    0.88     7.6 0.181E-01   0.33    1.027   .12488E+01
      0.31     0.04    0.78     7.9 0.174E-01   0.34    0.978   .13503E+01
      0.34     0.04    0.69     8.1 0.168E-01   0.35    0.938   .14410E+01
      0.37     0.04    0.59     8.5 0.162E-01   0.37    0.895   .15514E+01
      0.40     0.04    0.49     8.8 0.156E-01   0.38    0.853   .16667E+01
      0.42     0.05    0.41     9.1 0.151E-01   0.39    0.820   .17696E+01
 Cumulative travel time =           1.7696 sec

END OF CORJET (MOD110): JET/PLUME NEAR-FIELD MIXING REGION
-------------------------------------------------------------------------------
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-------------------------------------------------------------------------------
---------------
BEGIN MOD132: LAYER BOUNDARY IMPINGEMENT/UPSTREAM SPREADING

  Vertical angle of layer/boundary impingement    =     -71.87 deg
  Horizontal angle of layer/boundary impingement  =       2.64 deg

 UPSTREAM INTRUSION PROPERTIES:
        Upstream intrusion length                =       2.39 m
        X-position of upstream stagnation point =      -1.96 m
        Thickness in intrusion region            =       0.49 m
        Half-width at downstream end             =       3.90 m
        Thickness at downstream end              =       0.49 m

  Control volume inflow:
       X        Y       Z        S       C       B        TT
      0.42     0.05    0.41     9.1 0.151E-01   0.39 .17696E+01

 Profile definitions:
   BV = top-hat thickness, measured vertically
   BH = top-hat half-width, measured horizontally in Y-direction
   ZU = upper plume boundary (Z-coordinate)
   ZL = lower plume boundary (Z-coordinate)
   S  = hydrodynamic average (bulk) dilution
   C  = average (bulk) concentration (includes reaction effects, if any)
   TT = Cumulative travel time

       X        Y       Z        S       C       BV       BH      ZU      ZL
TT
     -1.96     0.05    0.00  9997.9 0.000E+00   0.00     0.00    0.00    0.00
.18715E+02
** CMC HAS BEEN FOUND **
 The pollutant concentration in the plume falls below CMC value of 0.580E-02
   in the current prediction interval.
 This is the extent of the TOXIC DILUTION ZONE.
**WATER QUALITY STANDARD OR CCC HAS BEEN FOUND**
 The pollutant concentration in the plume falls below water quality standard
   or CCC value of 0.373E-02 in the current prediction interval.
 This is the spatial extent of concentrations exceeding the water quality
   standard or CCC value.
     -1.88     0.05    0.00    39.0 0.351E-02   0.11     0.55    0.11    0.00
.17696E+01
     -1.45     0.05    0.00    16.2 0.846E-02   0.28     1.34    0.28    0.00
.17696E+01
```

```
     -1.03     0.05    0.00    12.2 0.112E-01   0.36     1.81    0.36    0.00
.17696E+01
     -0.60     0.05    0.00    10.5 0.131E-01   0.43     2.18    0.43    0.00
.17696E+01
     -0.18     0.05    0.00     9.6 0.143E-01   0.47     2.50    0.47    0.00
.17696E+01
      0.25     0.05    0.00     9.2 0.150E-01   0.49     2.78    0.49    0.00
.17696E+01
      0.67     0.05    0.00     9.2 0.149E-01   0.49     3.04    0.49    0.00
.28521E+01
      1.10     0.05    0.00    11.0 0.125E-01   0.49     3.27    0.49    0.00
.68177E+01
      1.52     0.05    0.00    13.4 0.102E-01   0.49     3.49    0.49    0.00
.10783E+02
      1.95     0.05    0.00    14.8 0.925E-02   0.49     3.70    0.49    0.00
.14749E+02
      2.37     0.05    0.00    15.4 0.889E-02   0.49     3.90    0.49    0.00
.18715E+02
 Cumulative travel time =          18.7147 sec

END OF MOD132: LAYER BOUNDARY IMPINGEMENT/UPSTREAM SPREADING
-------------------------------------------------------------------------------
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** End of NEAR-FIELD REGION (NFR) **

 In this design case, the discharge is located CLOSE TO BANK/SHORE.
 Some boundary interaction occurs at end of near-field.
   This may be related to a design case with a very LOW AMBIENT VELOCITY.
   The dilution values in one or more of the preceding zones may be too high.
 Carefully evaluate results in near-field and check degree of interaction.

 Consider locating outfall further away from bank or shore.
 In the next prediction module, the plume centerline will be set
   to follow the bank/shore.
-------------------------------------------------------------------------------
---------------
BEGIN MOD141: BUOYANT AMBIENT SPREADING

 Plume is ATTACHED to RIGHT bank/shore.
   Plume width is now determined from RIGHT bank/shore.

 Profile definitions:
   BV = top-hat thickness, measured vertically
   BH = top-hat half-width, measured horizontally in Y-direction
   ZU = upper plume boundary (Z-coordinate)
   ZL = lower plume boundary (Z-coordinate)
   S  = hydrodynamic average (bulk) dilution
   C  = average (bulk) concentration (includes reaction effects, if any)
   TT = Cumulative travel time

 Plume Stage 2 (bank attached):
       X        Y       Z        S       C       BV       BH      ZU      ZL
TT
      2.37    -0.99    0.00    15.4 0.889E-02   0.78     4.93    0.78    0.00
.18715E+02
     22.52    -0.99    0.00    20.5 0.670E-02   0.37    13.67    0.37    0.00
.19385E+03
     42.66    -0.99    0.00    24.1 0.567E-02   0.30    20.05    0.30    0.00
.36898E+03
```

```
     62.81    -0.99    0.00    28.5 0.480E-02   0.28    25.48    0.28    0.00
.54411E+03
     82.96    -0.99    0.00    34.2 0.401E-02   0.28    30.36    0.28    0.00
.71925E+03
 ** REGULATORY MIXING ZONE BOUNDARY **
 In this prediction interval the plume DOWNSTREAM  distance meets or exceeds
 the regulatory value =    91.44 m.
 This is the extent of the REGULATORY MIXING ZONE.
    103.10    -0.99    0.00    41.2 0.332E-02   0.30    34.85    0.30    0.00
.89438E+03
    123.25    -0.99    0.00    49.9 0.275E-02   0.32    39.06    0.32    0.00
.10695E+04
    143.40    -0.99    0.00    60.3 0.227E-02   0.35    43.05    0.35    0.00
.12446E+04
    163.54    -0.99    0.00    72.6 0.189E-02   0.39    46.87    0.39    0.00
.14198E+04
    183.69    -0.99    0.00    86.8 0.158E-02   0.43    50.54    0.43    0.00
.15949E+04
    203.84    -0.99    0.00   103.0 0.133E-02   0.48    54.08    0.48    0.00
.17700E+04
    223.98    -0.99    0.00   121.4 0.113E-02   0.54    57.52    0.54    0.00
.19452E+04
    244.13    -0.99    0.00   141.9 0.966E-03   0.59    60.86    0.59    0.00
.21203E+04
    264.27    -0.99    0.00   164.6 0.832E-03   0.65    64.12    0.65    0.00
.22954E+04
    284.42    -0.99    0.00   189.6 0.723E-03   0.72    67.30    0.72    0.00
.24706E+04
    304.57    -0.99    0.00   217.0 0.631E-03   0.79    70.41    0.79    0.00
.26457E+04
    324.71    -0.99    0.00   246.7 0.555E-03   0.86    73.46    0.86    0.00
.28208E+04
    325.65    -0.99    0.00   248.2 0.552E-03   0.86    73.60    0.86    0.00
 Cumulative travel time =        2828.9495 sec

 CORMIX prediction has been TERMINATED at last prediction interval.
   Limiting distance due to TIDAL REVERSAL has been reached.

END OF MOD141: BUOYANT AMBIENT SPREADING
-------------------------------------------------------------------------------
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-------------------------------------------------------------------------------
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CORMIX1: Single Port Discharges              End of Prediction File
1111111111111111111111111111111111111111111111111111111111111111111111111111111
1111111111111111
```

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CORMIX SESSION REPORT:
XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
                      CORMIX MIXING ZONE EXPERT SYSTEM
                          CORMIX Version 6.0GT
                       HYDRO1:Version-6.0.0.0  October,2009
SITE NAME/LABEL:                SIM
  DESIGN CASE:                  JD300400GPMa6.0
  FILE NAME:
P:\Mixing\CriticalDischargeScenarios\V.6.0\400GPMFinalRiver\JD300400GPMaFinal6.
0R.prd
  Using subsystem CORMIX1:     Single Port Discharges
  Start of session:             03/26/2010--14:51:52
*****************************************************************************
SUMMARY OF INPUT DATA:
-----------------------------------------------------------------------------
AMBIENT PARAMETERS:
  Cross-section                          = bounded
  Width                           BS     = 158.50 m
  Channel regularity              ICHREG = 1
  Ambient flowrate                QA     = 95.45 m^3/s
  Average depth                   HA     = 5.24 m
  Depth at discharge              HD     = 3.67 m
  Darcy-Weisbach friction factor  F      = 0.0283
    Calculated from Manning's n          = 0.025
  Wind velocity                   UW     = 8.5 m/s
TIDAL SIMULATION at time          Tsim   = -1.5 hours
  Instantaneous ambient velocity  UA     = 0.115 m/s
  Maximum tidal velocity          UaMAX  = 0.359 m/s
Rate of tidal reversal          dUA/dt = 0.0767 (m/s)/hour
  Period of reversal              T      = 12.4 hours
  Stratification Type             STRCND = B
  Surface density                 RHOAS  = 1001.0000 kg/m^3
  Bottom density                  RHOAB  = 1019.0000 kg/m^3
  Stratification height           HINT   = 1.47 m (pycnocline level)
  Density below pycnocline        RHOAP  = 1019.0000 kg/m^3
-----------------------------------------------------------------------------
DISCHARGE PARAMETERS:             Single Port Discharge
  Nearest bank                           = right
  Distance to bank                DISTB  = 0.99 m
  Port diameter                   D0     = 0.0708 m
  Port cross-sectional area       A0     = 0.0039 m^2
  Discharge velocity              U0     = 7.26 m/s
  Discharge flowrate              Q0     = 0.028558 m^3/s
  Discharge port height           H0     = 3.67 m
  Vertical discharge angle        THETA  = -89.23 deg
  Horizontal discharge angle      SIGMA  = 90 deg
  Discharge temperature (freshwater)     = 10 degC
  Corresponding density           RHO0   = 999.7019 kg/m^3
  Density difference              DRHO   = 19.2981 kg/m^3
  Buoyant acceleration            GP0    = 0.1857 m/s^2
  Discharge concentration         C0     = 0.137 mg/l
  Surface heat exchange coeff.    KS     = 0 m/s
  Coefficient of decay            KD     = 0 /s
-----------------------------------------------------------------------------
DISCHARGE/ENVIRONMENT LENGTH SCALES:
  LQ  = 0.06 m         Lm  = 3.96 m         Lb  = 3.49 m
  LM  = 4.22 m         Lm' = 1.15 m         Lb' = 0.60 m
UNSTEADY TIDAL SCALES:
  Tu  = 0.2782 hours     Lu  = 21.35 m         Lmin= 0.17 m
-----------------------------------------------------------------------------
```

```
NON-DIMENSIONAL PARAMETERS:
  Port densimetric Froude number  FR0    = 63.35
  Velocity ratio                  R      = 63.15
-----------------------------------------------------------------------------
MIXING ZONE / TOXIC DILUTION ZONE / AREA OF INTEREST PARAMETERS:
  Toxic discharge                        = yes
  CMC concentration               CMC    = 0.0058 mg/l
  CCC concentration               CCC    = 0.00373 mg/l
  Water quality standard specified       = given by CCC value
  Regulatory mixing zone                 = yes
  Regulatory mixing zone specification   = distance
  Regulatory mixing zone value           = 91.44 m (m^2 if area)
  Region of interest                     = 3500 m
*****************************************************************************
HYDRODYNAMIC CLASSIFICATION:
  *------------------------*
  | FLOW CLASS   = IV5 |
  *------------------------*
  This flow configuration applies to a layer corresponding to lower stratified
  density layer at the discharge site.  The density jump at the pycnocline
  confines the flow to the lower layer.
  Applicable layer depth = lower layer depth = 2.20 m
*****************************************************************************
MIXING ZONE EVALUATION (hydrodynamic and regulatory summary):

-----------------------------------------------------------------------------
X-Y-Z Coordinate system:
  Origin is located at the bottom below the port center:
    0.99 m from the right bank/shore.
  Number of display steps NSTEP = 30 per module.
-----------------------------------------------------------------------------
NEAR-FIELD REGION (NFR) CONDITIONS :
Note: The NFR is the zone of strong initial mixing.  It has no regulatory
  implication.  However, this information may be useful for the discharge
  designer because the mixing in the NFR is usually sensitive to the
  discharge design conditions.
  Pollutant concentration at NFR edge  c = 0.0089 mg/l
  Dilution at edge of NFR              s = 15.4
  NFR Location:                        x = 2.37 m
    (centerline coordinates)           y = 0.05 m
                                       z = 0 m
  NFR plume dimensions:  half-width (bh) = 3.90 m
                          thickness (bv) = 0.49 m
Cumulative travel time:       18.7147 sec.
-----------------------------------------------------------------------------
Buoyancy assessment:
  The effluent density is less than the surrounding ambient water
  density at the discharge level.
  Therefore, the effluent is POSITIVELY BUOYANT and will tend to rise towards
  the surface.
-----------------------------------------------------------------------------
Stratification assessment:
  The specified two layer ambient density stratification is dynamically
  important. The discharge near field flow will be confined to the lower
  layer by the ambient density stratification.
  Furthermore, it is trapped at the pycnocline by the ambient density
  jump.
-----------------------------------------------------------------------------
UPSTREAM INTRUSION SUMMARY:
Plume exhibits upstream intrusion due to low ambient velocity or strong
```

```
  discharge buoyancy.
  Intrusion length                        =  2.39 m
  Intrusion stagnation point              =  -1.96 m
  Intrusion thickness                     =  0.49 m
  Intrusion half width at impingement     =  3.90 m
  Intrusion half thickness at impingement =  0.49 m
-------------------------------------------------------------------------------
PLUME BANK CONTACT SUMMARY:
  Plume in bounded section contacts one bank only at 2.37 m downstream.
-------------------------------------------------------------------------------
UNSTEADY TIDAL ASSESSMENT:
 Because of the unsteadiness of the ambient current during the tidal
  reversal, CORMIX predictions have been TERMINATED at:
                                      x = 325.65 m
                                      y = -0.99 m
                                      z = 0 m.
  For this condition BEFORE TIDAL REVERSAL, extensive re-entrainment
  of previously discharged is unlikely.
  To determine the minimum dilution, perform additional simulations
  after slack tide.
************************ TOXIC DILUTION ZONE SUMMARY ************************
Recall: The TDZ corresponds to the three (3) criteria issued in the USEPA
  Technical Support Document (TSD) for Water Quality-based Toxics Control,
  1991 (EPA/505/2-90-001).
  Criterion maximum concentration (CMC)  = 0.0058  mg/l
Corresponding dilution                   = 23.620690
The CMC was encountered at the following plume position:
  Plume location:                     x = -0.90 m
    (centerline coordinates)          y = 0.05 m
                                      z = 0.08 m
  Plume dimension:       half-width (bh) = 1.05 m
                          thickness (bv) = 0.09 m

 Computed distance from port opening to CMC location = 3.69 m.
 CRITERION 1: This location is beyond 50 times the discharge length scale of
              Lq = 0.06 m.
 +++++ The discharge length scale TEST for the TDZ has FAILED. ++++++

 Computed horizontal distance from port opening to CMC location = 0.90 m.
 CRITERION 2: This location is within 5 times the ambient water depth of
              HD = 3.67 m.
 ++++++++++ The ambient depth TEST for the TDZ has been SATISFIED. ++++++++++

 Computed distance from port opening to CMC location = 3.69 m.
 CRITERION 3: This location is within one tenth the distance of the extent
              of the Regulatory Mixing Zone of 91.52 m in any
              spatial direction from the port opening.
 +++++ The Regulatory Mixing Zone TEST for the TDZ has been SATISFIED. ++++++

 The diffuser discharge velocity is equal to 7.26 m/s.
 This exceeds the value of 3.0 m/s recommended in the TSD.

 *** This discharge DOES NOT SATISFY all three CMC criteria for the TDZ. ****
********************** REGULATORY MIXING ZONE SUMMARY **********************
The plume conditions at the boundary of the specified RMZ are as follows:
  Pollutant concentration             c = 0.003711  mg/l
  Corresponding dilution              s = 37.0
  Plume location:                     x = 91.44 m
    (centerline coordinates)          y = -0.99 m
                                      z = 0 m
```

```
  Plume dimensions:      half-width (bh) = 32.28 m
                          thickness (bv) = 0.29 m
Cumulative travel time:       792.9850 sec.
At this position, the plume is CONTACTING the RIGHT bank.
Furthermore, the CCC for the toxic pollutant has indeed been met
  within the RMZ. In particular:
The CCC was encountered at the following plume position:
The CCC for the toxic pollutant was encountered at the following
  plume position:
  CCC                                     = 0.00373  mg/l
Corresponding dilution                    = 36.7
  Plume location:                       x = -1.78 m
    (centerline coordinates)            y = 0.05 m
                                        z = 0.01 m
  Plume dimensions:      half-width (bh) = 0.60 m
                          thickness (bv) = 0.11 m
********************* FINAL DESIGN ADVICE AND COMMENTS **********************
REMINDER:  The user must take note that HYDRODYNAMIC MODELING by any known
  technique is NOT AN EXACT SCIENCE.
Extensive comparison with field and laboratory data has shown that the
  CORMIX predictions on dilutions and concentrations (with associated
  plume geometries) are reliable for the majority of cases and are accurate
  to within about +-50% (standard deviation).
As a further safeguard, CORMIX will not give predictions whenever it judges
  the design configuration as highly complex and uncertain for prediction.
```

```
CORMIX3 PREDICTION FILE:
3333333333333333333333333333333333333333333333333333333333333333333333333333
3
                        CORMIX MIXING ZONE EXPERT SYSTEM
                 Subsystem CORMIX3:   Buoyant Surface Discharges
                          CORMIX Version 6.0GT
                       HYDRO3 Version 6.0.0.0 October 2009
-------------------------------------------------------------------------------
--
-------------------------------------------------------------------------------
--
CASE DESCRIPTION
 Site name/label:   SIM
 Design case:       JD300400GPMb6.0
 FILE NAME:         P:\...ios\V.6.0\400GPMFinalRiver\JD300400GPMbFinalR.prd
 Time stamp:        Fri Mar 26 14:53:30 2010

ENVIRONMENT PARAMETERS (metric units)
 Bounded section
 BS    =    158.50  AS    =   1321.17  QA    =     27.74  ICHREG= 1
 HA    =      8.34  HD    =      5.83
 Tidal Simulation at TIME =      2.500 h
 PERIOD=    12.40 h UAmax =      0.359 dUa/dt=      0.008 (m/s)/h
 UA    =      0.021 F     =      0.024 USTAR =0.1155E-02
 UW    =      8.500 UWSTAR=0.1074E-01
 Density stratified environment
 STRCND=  B         RHOAM = 1008.2024
 RHOAS = 1001.0000  RHOAB = 1019.0000  RHOAEF= 1001.0000  E     =0.0000E+00
 DRHOJ =   18.0000  HINT  =      2.33  ES    =0.7420E-01

DISCHARGE PARAMETERS (metric units)
 BANK  =  RIGHT     DISTB =      0.91  Configuration: protruding_discharge
 SIGMA =     90.00  HDO   =      5.83  SLOPE =    0.00 deg.
 Circular discharge pipe:
 D0    =      0.610 A0    =      0.292
 Dimensions of equivalent rectangular discharge:
 B0    =      0.479 H0    =      0.610 A0    =0.2919E+00  AR    =      1.273
 U0    =      0.185 Q0    =      0.054       =0.5394E-01
 RHO0  =  999.7019  DRHO0 =0.1298E+01  GP0   =0.1272E-01
 C0    =0.1500E-01  CUNITS=  mg/l
 IPOLL =  1         KS    =0.0000E+00  KD    =0.0000E+00

FLUX VARIABLES (metric units)
 Q0    =0.5394E-01  M0    =0.9967E-02  J0    =0.6859E-03
 Associated length scales (meters)
 LQ    =      0.54  LM    =      1.21  Lm    =      4.75  Lb    =     73.53
 Tidal:             Tu    =   0.7325 h Lu    =     16.225 Lmin  =      0.278

NON-DIMENSIONAL PARAMETERS
 FR0   =      2.24  FRCH  =      2.11  R     =      8.80

FLOW CLASSIFICATION
 3333333333333333333333333333333333333333
 3  Flow class (CORMIX3)      =    FJ1    3
 3  Applicable layer depth HS =     3.50  3
 3333333333333333333333333333333333333333

MIXING ZONE / TOXIC DILUTION / REGION OF INTEREST PARAMETERS
 C0    =0.1500E-01  CUNITS=  mg/l
 NTOX  =  1         CMC   =0.5800E-02  CCC   =  CSTD
```

```
 NSTD  =  1         CSTD  =0.3730E-02
 REGMZ =  1
 REGSPC=  1         XREG  =     91.44  WREG  =      0.00  AREG  =      0.00
 XINT  =   3500.00  XMAX  =   3500.00

X-Y-Z COORDINATE SYSTEM:
    ORIGIN is located at the WATER SURFACE and at center of discharge
      channel/outlet:      0.91 m  from the RIGHT bank/shore.
    X-axis points downstream
    Y-axis points to left as seen by an observer looking downstream
    Z-axis points vertically upward (in CORMIX3, all values Z = 0.00)
NSTEP =  30 display intervals per module
-------------------------------------------------------------------------------
--
-------------------------------------------------------------------------------
--
BEGIN MOD301: DISCHARGE MODULE

 Efflux conditions:
       X        Y       Z        S       C       BV       BH        TT
      0.00     0.00    0.00     1.0 0.150E-01   0.61     0.24 .00000E+00

END OF MOD301: DISCHARGE MODULE
-------------------------------------------------------------------------------
--
-------------------------------------------------------------------------------
--
BEGIN MOD302: ZONE OF FLOW ESTABLISHMENT

  Control volume inflow:
       X        Y       Z        S       C       BV       BH        TT
      0.00     0.00    0.00     1.0 0.150E-01   0.61     0.24 .00000E+00

 Profile definitions:
   BV = Gaussian 1/e (37%) vertical thickness
   BH = Gaussian 1/e (37%) horizontal half-width, normal to trajectory
   S  = hydrodynamic centerline dilution
   C  = centerline concentration (includes reaction efects, if any)
   TT = Cumulative travel time

  Control volume outflow:                                  SIGMAE=     89.15
       X        Y       Z        S       C       BV       BH        TT
      0.02     1.51    0.00     1.0 0.150E-01   0.29     0.65 .81813E+01
 Cumulative travel time =           8.1813 sec

END OF MOD302: ZONE OF FLOW ESTABLISHMENT
-------------------------------------------------------------------------------
--
-------------------------------------------------------------------------------
--
BEGIN CORSURF (MOD310): BUOYANT SURFACE JET - NEAR-FIELD REGION

 Surface jet in deep crossflow with strong buoyancy effects.

 Profile definitions:
   BV = Gaussian 1/e (37%) vertical thickness
   BH = Gaussian 1/e (37%) horizontal half-width, normal to trajectory
   S  = hydrodynamic centerline dilution
   C  = centerline concentration (includes reaction efects, if any)
   TT = Cumulative travel time
```

```
       X         Y        Z         S        C        BV        BH         TT
      0.02      1.51     0.00      1.0 0.150E-01   0.29      0.65 .81813E+01
      0.04      2.07     0.00      1.7 0.909E-02   0.39      1.26 .13421E+02
      0.06      2.61     0.00      1.7 0.882E-02   0.35      1.48 .18563E+02
      0.09      3.15     0.00      1.8 0.850E-02   0.33      1.70 .23843E+02
      0.13      3.68     0.00      1.8 0.817E-02   0.32      1.91 .29207E+02
      0.18      4.23     0.00      1.9 0.784E-02   0.31      2.13 .34943E+02
      0.23      4.77     0.00      2.0 0.753E-02   0.31      2.35 .40954E+02
      0.30      5.31     0.00      2.1 0.724E-02   0.30      2.59 .47250E+02
      0.37      5.83     0.00      2.2 0.697E-02   0.30      2.82 .53693E+02
      0.45      6.37     0.00      2.2 0.670E-02   0.30      3.07 .60600E+02
      0.54      6.91     0.00      2.3 0.645E-02   0.30      3.32 .67842E+02
      0.63      7.44     0.00      2.4 0.622E-02   0.29      3.58 .75422E+02
      0.74      7.97     0.00      2.5 0.602E-02   0.29      3.84 .83163E+02
      0.85      8.50     0.00      2.6 0.582E-02   0.29      4.10 .91418E+02
** CMC HAS BEEN FOUND **
 The pollutant concentration in the plume falls below CMC value of 0.580E-02
   in the current prediction interval.
 This is the extent of the TOXIC DILUTION ZONE.
      0.97      9.03     0.00      2.7 0.563E-02   0.29      4.37 .10002E+03
      1.09      9.56     0.00      2.7 0.546E-02   0.29      4.65 .10897E+03
      1.22     10.07     0.00      2.8 0.530E-02   0.30      4.93 .11806E+03
      1.36     10.60     0.00      2.9 0.515E-02   0.30      5.21 .12771E+03
      1.51     11.12     0.00      3.0 0.501E-02   0.30      5.51 .13773E+03
      1.66     11.63     0.00      3.1 0.487E-02   0.30      5.80 .14788E+03
      1.82     12.15     0.00      3.2 0.474E-02   0.30      6.10 .15864E+03
      1.99     12.67     0.00      3.2 0.462E-02   0.30      6.41 .16979E+03
      2.17     13.19     0.00      3.3 0.450E-02   0.31      6.72 .18135E+03
      2.35     13.69     0.00      3.4 0.438E-02   0.31      7.03 .19305E+03
      2.54     14.20     0.00      3.5 0.427E-02   0.32      7.36 .20546E+03
      2.73     14.70     0.00      3.6 0.417E-02   0.32      7.70 .21833E+03
      2.94     15.21     0.00      3.7 0.407E-02   0.33      8.04 .23171E+03
      3.14     15.70     0.00      3.8 0.397E-02   0.33      8.39 .24533E+03
      3.36     16.20     0.00      3.9 0.387E-02   0.34      8.76 .25991E+03
      3.59     16.69     0.00      4.0 0.378E-02   0.36      9.18 .27539E+03
** WATER QUALITY STANDARD OR CCC HAS BEEN FOUND **
 The pollutant concentration in the plume falls below water quality standard
   or CCC value of 0.373E-02 in the current prediction interval.
 This is the spatial extent of concentrations exceeding the water quality
   standard or CCC value.
      3.81     17.17     0.00      4.1 0.370E-02   0.24      9.68 .28971E+03
 Buoyant jet regime ends with local CRITICAL CONDITIONS.
 Cumulative travel time =         289.7109 sec

END OF CORSURF (MOD310): BUOYANT SURFACE JET - NEAR-FIELD REGION
-------------------------------------------------------------------------------
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** End of NEAR-FIELD REGION (NFR) **
-------------------------------------------------------------------------------
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 The initial plume WIDTH/THICKNESS VALUE in the next far-field module will be
  CORRECTED by a factor  1.53 to conserve the mass flux in the far-field!
 The correction factor is quite large because of the small ambient velocity
   relative to the strong mixing characteristics of the discharge!
   This indicates localized RECIRCULATION REGIONS and internal hydraulic JUMPS.
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BEGIN MOD341: BUOYANT AMBIENT SPREADING

  Because of the WEAK VERTICAL MIXING, the surface plume in the far-field
    will be vertically limited WITHIN THE UPPER LAYER of the ambient
    stratification.
 Profile definitions:
   BV = top-hat thickness,measured vertically
   BH = top-hat half-width, measured horizontally from bank/shoreline
   S  = hydrodynamic average (bulk) dilution
   C  = average (bulk) concentration (includes reaction effects, if any)
   TT = Cumulative travel time

 Plume Stage 1 (not bank attached):
       X        Y       Z        S       C       BV       BH        TT
      3.81    17.17    0.00     4.1 0.370E-02   0.37    14.77 .28971E+03
      3.86    17.17    0.00     4.1 0.369E-02   0.37    14.89 .29217E+03
      3.92    17.17    0.00     4.1 0.368E-02   0.36    15.01 .29463E+03
      3.97    17.17    0.00     4.1 0.367E-02   0.36    15.12 .29708E+03
      4.02    17.17    0.00     4.1 0.366E-02   0.36    15.24 .29954E+03
      4.07    17.17    0.00     4.1 0.365E-02   0.36    15.35 .30200E+03
      4.12    17.17    0.00     4.1 0.365E-02   0.36    15.47 .30445E+03
      4.17    17.17    0.00     4.1 0.364E-02   0.35    15.58 .30691E+03
      4.23    17.17    0.00     4.1 0.363E-02   0.35    15.69 .30937E+03
      4.28    17.17    0.00     4.1 0.362E-02   0.35    15.81 .31183E+03
      4.33    17.17    0.00     4.2 0.361E-02   0.35    15.92 .31428E+03
      4.38    17.17    0.00     4.2 0.360E-02   0.35    16.03 .31674E+03
      4.43    17.17    0.00     4.2 0.360E-02   0.35    16.14 .31920E+03
      4.48    17.17    0.00     4.2 0.359E-02   0.34    16.26 .32166E+03
      4.54    17.17    0.00     4.2 0.358E-02   0.34    16.37 .32411E+03
      4.59    17.17    0.00     4.2 0.357E-02   0.34    16.48 .32657E+03
      4.64    17.17    0.00     4.2 0.357E-02   0.34    16.59 .32903E+03
      4.69    17.17    0.00     4.2 0.356E-02   0.34    16.70 .33148E+03
      4.74    17.17    0.00     4.2 0.355E-02   0.34    16.81 .33394E+03
      4.79    17.17    0.00     4.2 0.354E-02   0.33    16.92 .33640E+03
      4.85    17.17    0.00     4.2 0.354E-02   0.33    17.03 .33886E+03
      4.90    17.17    0.00     4.3 0.353E-02   0.33    17.14 .34131E+03
      4.95    17.17    0.00     4.3 0.352E-02   0.33    17.24 .34377E+03
      5.00    17.17    0.00     4.3 0.351E-02   0.33    17.35 .34623E+03
      5.05    17.17    0.00     4.3 0.351E-02   0.33    17.46 .34869E+03
      5.11    17.17    0.00     4.3 0.350E-02   0.33    17.57 .35114E+03
      5.16    17.17    0.00     4.3 0.349E-02   0.33    17.67 .35360E+03
      5.21    17.17    0.00     4.3 0.348E-02   0.32    17.78 .35606E+03
      5.26    17.17    0.00     4.3 0.348E-02   0.32    17.89 .35851E+03
      5.31    17.17    0.00     4.3 0.347E-02   0.32    17.99 .36097E+03
      5.36    17.17    0.00     4.3 0.346E-02   0.32    18.10 .36343E+03
 Cumulative travel time =         363.4290 sec

-------------------------------------------------------------------------------
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 Plume is ATTACHED to RIGHT bank/shore.
   Plume width is now determined from RIGHT bank/shore.

 Plume Stage 2 (bank attached):
       X        Y       Z        S       C       BV       BH        TT
      5.36    -0.91    0.00     4.5 0.336E-02   0.32    36.17 .36343E+03
      8.75    -0.91    0.00     4.8 0.311E-02   0.30    42.63 .52432E+03
     12.13    -0.91    0.00     5.2 0.288E-02   0.28    48.58 .68521E+03
     15.52    -0.91    0.00     5.7 0.265E-02   0.28    54.15 .84610E+03
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     18.90    -0.91    0.00     6.2 0.244E-02   0.28    59.41 .10070E+04
     22.29    -0.91    0.00     6.7 0.223E-02   0.28    64.42 .11679E+04
     25.68    -0.91    0.00     7.3 0.204E-02   0.29    69.22 .13288E+04
     29.06    -0.91    0.00     8.0 0.186E-02   0.30    73.86 .14897E+04
     32.45    -0.91    0.00     8.8 0.170E-02   0.31    78.34 .16506E+04
     35.83    -0.91    0.00     9.7 0.155E-02   0.32    82.69 .18115E+04
     39.22    -0.91    0.00    10.6 0.142E-02   0.34    86.94 .19723E+04
     42.60    -0.91    0.00    11.6 0.130E-02   0.36    91.08 .21332E+04
     45.99    -0.91    0.00    12.6 0.119E-02   0.38    95.13 .22941E+04
     49.37    -0.91    0.00    13.8 0.109E-02   0.40    99.09 .24550E+04
     52.76    -0.91    0.00    15.0 0.998E-03   0.42   102.99 .26159E+04
     56.14    -0.91    0.00    16.4 0.917E-03   0.44   106.81 .27768E+04
     59.53    -0.91    0.00    17.7 0.845E-03   0.47   110.58 .29377E+04
     62.91    -0.91    0.00    19.2 0.780E-03   0.49   114.28 .30986E+04
     66.30    -0.91    0.00    20.8 0.722E-03   0.52   117.94 .32595E+04
     69.68    -0.91    0.00    22.4 0.669E-03   0.55   121.54 .34204E+04
     73.07    -0.91    0.00    24.2 0.621E-03   0.58   125.09 .35813E+04
     76.45    -0.91    0.00    26.0 0.578E-03   0.61   128.60 .37422E+04
     79.84    -0.91    0.00    27.9 0.538E-03   0.64   132.07 .39031E+04
     83.23    -0.91    0.00    29.8 0.503E-03   0.67   135.49 .40639E+04
     86.61    -0.91    0.00    31.9 0.470E-03   0.71   138.88 .42248E+04
     90.00    -0.91    0.00    34.1 0.440E-03   0.74   142.24 .43857E+04
 ** REGULATORY MIXING ZONE BOUNDARY **
 In this prediction interval the plume DOWNSTREAM distance meets or exceeds
 the regulatory value =    91.44 m.
 This is the extent of the REGULATORY MIXING ZONE.
     91.43    -0.91    0.00    35.0 0.429E-03   0.75   143.64
 Cumulative travel time =        4453.9761 sec

 CORMIX prediction has been TERMINATED at last prediction interval.
   Limiting distance due to TIDAL REVERSAL has been reached.

END OF MOD341: BUOYANT AMBIENT SPREADING
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CORMIX3: Buoyant Surface Discharges                    End of Prediction File
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3
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CORMIX SESSION REPORT:
XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
                      CORMIX MIXING ZONE EXPERT SYSTEM
                          CORMIX Version 6.0GT
                       HYDRO3:Version-6.0.0.0  October,2009
SITE NAME/LABEL:                SIM
  DESIGN CASE:                  JD300400GPMb6.0
  FILE NAME:
P:\Mixing\CriticalDischargeScenarios\V.6.0\400GPMFinalRiver\JD300400GPMbFinalR.
prd
  Using subsystem CORMIX3:     Buoyant Surface Discharges
  Start of session:             03/26/2010--14:53:30
*****************************************************************************
SUMMARY OF INPUT DATA:
-----------------------------------------------------------------------------
AMBIENT PARAMETERS:
  Cross-section                          = bounded
  Width                           BS     = 158.50 m
  Channel regularity              ICHREG = 1
  Ambient flowrate                QA     = 27.74 m^3/s
  Average depth                   HA     = 8.34 m
  Depth at discharge              HD     = 5.83 m
  Darcy-Weisbach friction factor  F      = 0.0242
    Calculated from Manning's n          = 0.025
  Wind velocity                   UW     = 8.5 m/s
TIDAL SIMULATION at time          Tsim   = 2.5 hours
  Instantaneous ambient velocity  UA     = 0.021 m/s
  Maximum tidal velocity          UaMAX  = 0.359 m/s
Rate of tidal reversal          dUA/dt = 0.0084 (m/s)/hour
  Period of reversal              T      = 12.4 hours
  Stratification Type             STRCND = B
  Surface density                 RHOAS  = 1001.0000 kg/m^3
  Bottom density                  RHOAB  = 1019.0000 kg/m^3
  Stratification height           HINT   = 2.33 m (pycnocline level)
  Density below pycnocline        RHOAP  = 1019.0000 kg/m^3
-----------------------------------------------------------------------------
DISCHARGE PARAMETERS:             Surface Discharge
  Discharge located on                   = right bank/shoreline
  Discharge configuration                = protruding discharge
  Distance from bank to outlet    DISTB  = 0.91 m
  Discharge angle                 SIGMA  = 90 deg
  Depth near discharge outlet     HD0    = 5.83 m
  Bottom slope at discharge       SLOPE  = 0 deg
  Circular pipe diameter                 = 0.6096 m
    Equivalent rectangular discharge:
    Discharge cross-section area  A0     = 0.291864 m^2
    Discharge channel width       B0     = 0.478779 m
    Discharge channel depth       H0     = 0.6096 m
    Discharge aspect ratio        AR     = 1.273240
  Discharge flowrate              Q0     = 0.053935 m^3/s
  Discharge velocity              U0     = 0.18 m/s
  Discharge temperature (freshwater)     = 10 degC
  Corresponding density           RHO0   = 999.7019 kg/m^3
  Density difference              DRHO   = 1.2981 kg/m^3
  Buoyant acceleration            GP0    = 0.0127 m/s^2
  Discharge concentration         C0     = 0.015 mg/l
  Surface heat exchange coeff.    KS     = 0 m/s
  Coefficient of decay            KD     = 0 /s
-----------------------------------------------------------------------------
DISCHARGE/ENVIRONMENT LENGTH SCALES:
```

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  LQ  = 0.54 m         Lm  = 4.75 m         Lbb = 73.53 m
  LM  = 1.21 m
UNSTEADY TIDAL SCALES:
  Tu  = 0.7325 hours     Lu  = 16.22 m         Lmin= 0.28 m
-------------------------------------------------------------------------------
NON-DIMENSIONAL PARAMETERS:
  Densimetric Froude number       FR0    = 2.24 (based on LQ)
  Channel densimetric Froude no.  FRCH   = 2.11 (based on H0)
  Velocity ratio                  R      = 8.80
-------------------------------------------------------------------------------
MIXING ZONE / TOXIC DILUTION ZONE / AREA OF INTEREST PARAMETERS:
  Toxic discharge                        = yes
  CMC concentration               CMC    = 0.0058 mg/l
  CCC concentration               CCC    = 0.00373 mg/l
  Water quality standard specified       = given by CCC value
  Regulatory mixing zone                 = yes
  Regulatory mixing zone specification   = distance
  Regulatory mixing zone value           = 91.44 m (m^2 if area)
  Region of interest                     = 3500 m
*******************************************************************************
HYDRODYNAMIC CLASSIFICATION:
  *------------------------*
  | FLOW CLASS   = FJ1 |
  *------------------------*
*******************************************************************************
MIXING ZONE EVALUATION (hydrodynamic and regulatory summary):

-------------------------------------------------------------------------------
X-Y-Z Coordinate system:
Origin is located at water surface and at centerline of discharge channel:
    0.91 m from the right bank/shore.
  Number of display steps NSTEP = 30 per module.
-------------------------------------------------------------------------------
NEAR-FIELD REGION (NFR) CONDITIONS :
Note: The NFR is the zone of strong initial mixing.  It has no regulatory
  implication.  However, this information may be useful for the discharge
  designer because the mixing in the NFR is usually sensitive to the
  discharge design conditions.
  Pollutant concentration at NFR edge  c = 0.0035 mg/l
  Dilution at edge of NFR              s = 4.2
  NFR Location:                        x = 3.81 m
    (centerline coordinates)           y = 17.17 m
                                       z = 0 m
  NFR plume dimensions:  half-width (bh) = 9.68 m
                          thickness (bv) = 0.24 m
Cumulative travel time:       289.7109 sec.
-------------------------------------------------------------------------------
Buoyancy assessment:
  The effluent density is less than the surrounding ambient water
  density at the discharge level.
  Therefore, the effluent is POSITIVELY BUOYANT and will tend to rise towards
  the surface.
-------------------------------------------------------------------------------
Stratification assessment:
  Due to WEAK VERTICAL MIXING the surface plume will be confined to
  the upper layer above the pycnocline!
-------------------------------------------------------------------------------
PLUME BANK CONTACT SUMMARY:
  Plume in bounded section contacts nearest bank at 5.36 m downstream.
  Plume contacts second bank at 106.92 m downstream.
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UNSTEADY TIDAL ASSESSMENT:
 Because of the unsteadiness of the ambient current during the tidal
  reversal, CORMIX predictions have been TERMINATED at:
                                        x = 91.43 m
                                        y = -0.91 m
                                        z = 0 m.
  For this condition AFTER TIDAL REVERSAL, mixed water from the previous
  half-cycle becomes re-entrained into the near field of the discharge,
  increasing pollutant concentrations compared to steady-state predictions.
  A pool of mixed water formed at slack tide will be advected downstream
  in this phase.
************************ TOXIC DILUTION ZONE SUMMARY ************************
Recall: The TDZ corresponds to the three (3) criteria issued in the USEPA
  Technical Support Document (TSD) for Water Quality-based Toxics Control,
  1991 (EPA/505/2-90-001).
  Criterion maximum concentration (CMC)  = 0.0058  mg/l
Corresponding dilution                   = 2.586207
The CMC was encountered at the following plume position:
  Plume location:                       x = 0.86 m
    (centerline coordinates)            y = 8.55 m
                                        z = 0 m
  Plume dimension:       half-width (bh) = 4.13 m
                          thickness (bv) = 0.29 m

 Computed distance from port opening to CMC location = 8.59 m.
 CRITERION 1: This location is within 50 times the discharge length scale of
              Lq = 0.54 m.
 +++++ The discharge length scale TEST for the TDZ has been SATISFIED. ++++++

 Computed horizontal distance from port opening to CMC location = 8.59 m.
 CRITERION 2: This location is within 5 times the ambient water depth of
              HD = 5.83 m.
 ++++++++++ The ambient depth TEST for the TDZ has been SATISFIED. ++++++++++

 Computed distance from port opening to CMC location = 8.59 m.
 CRITERION 3: This location is within one tenth the distance of the extent
              of the Regulatory Mixing Zone of 91.44 m in any
              spatial direction from the port opening.
 +++++ The Regulatory Mixing Zone TEST for the TDZ has been SATISFIED. ++++++

 The diffuser discharge velocity is equal to 0.18 m/s.
 This is below the value of 3.0 m/s recommended in the TSD.

 *** All three CMC criteria for the TDZ are SATISFIED for this discharge. ***
********************** REGULATORY MIXING ZONE SUMMARY **********************
The plume conditions at the boundary of the specified RMZ are as follows:
  Pollutant concentration               c = 0.000429  mg/l
  Corresponding dilution                s = 35.0
  Plume location:                       x = 91.44 m
    (centerline coordinates)            y = -0.91 m
                                        z = 0 m
  Plume dimensions:      half-width (bh) = 143.65 m
                          thickness (bv) = 0.75 m
Cumulative travel time:       4454.3540 sec.
At this position, the plume is CONTACTING the RIGHT bank.
Furthermore, the CCC for the toxic pollutant has indeed been met
  within the RMZ. In particular:
The CCC was encountered at the following plume position:
The CCC for the toxic pollutant was encountered at the following
```

```
  plume position:
  CCC                                    = 0.00373  mg/l
Corresponding dilution                   = 4.0
  Plume location:                      x = 3.81 m
    (centerline coordinates)           y = 17.17 m
                                       z = 0 m
  Plume dimensions:      half-width (bh) = 9.68 m
                          thickness (bv) = 0.25 m
********************* FINAL DESIGN ADVICE AND COMMENTS **********************
REMINDER:  The user must take note that HYDRODYNAMIC MODELING by any known
  technique is NOT AN EXACT SCIENCE.
Extensive comparison with field and laboratory data has shown that the
  CORMIX predictions on dilutions and concentrations (with associated
  plume geometries) are reliable for the majority of cases and are accurate
  to within about +-50% (standard deviation).
As a further safeguard, CORMIX will not give predictions whenever it judges
  the design configuration as highly complex and uncertain for prediction.
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CORMIX3 PREDICTION FILE:
3333333333333333333333333333333333333333333333333333333333333333333333333333333
3
                        CORMIX MIXING ZONE EXPERT SYSTEM
                 Subsystem CORMIX3:   Buoyant Surface Discharges
                          CORMIX Version 6.0GT
                       HYDRO3 Version 6.0.0.0 October 2009
-------------------------------------------------------------------------------
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-------------------------------------------------------------------------------
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CASE DESCRIPTION
 Site name/label:   SIM
 Design case:       JD300400GPMcFinal6.0
 FILE NAME:         P:\...\V.6.0\400GPMFinalRiver\JD300400GPMcFinal6.0R.prd
 Time stamp:        Fri Mar 26 14:57:13 2010

ENVIRONMENT PARAMETERS (metric units)
 Bounded section
 BS    =    158.50  AS    =   1329.09  QA    =    293.73  ICHREG= 1
 HA    =      8.39  HD    =      5.87
 Tidal Simulation at TIME =      3.000 h
 PERIOD=    12.40 h UAmax =      0.359 dUa/dt=      0.074 (m/s)/h
 UA    =      0.221 F     =      0.024 USTAR =0.1214E-01
 UW    =      8.500 UWSTAR=0.1074E-01
 Density stratified environment
 STRCND=  B         RHOAM = 1008.2062
 RHOAS = 1001.0000  RHOAB = 1019.0000  RHOAEF= 1001.0000  E     =0.0000E+00
 DRHOJ =   18.0000  HINT  =      2.35  ES    =0.7371E-01

DISCHARGE PARAMETERS (metric units)
 BANK  =  RIGHT     DISTB =      0.91  Configuration: protruding_discharge
 SIGMA =     90.00  HDO   =      5.87  SLOPE =    0.00 deg.
 Circular discharge pipe:
 D0    =      0.610 A0    =      0.292
 Dimensions of equivalent rectangular discharge:
 B0    =      0.479 H0    =      0.610 A0    =0.2919E+00  AR    =      1.273
 U0    =      0.185 Q0    =      0.054       =0.5394E-01
 RHO0  =  999.7019  DRHO0 =0.1298E+01  GP0   =0.1272E-01
 C0    =0.8000E-02  CUNITS=  mg/l
 IPOLL =  1         KS    =0.0000E+00  KD    =0.0000E+00

FLUX VARIABLES (metric units)
 Q0    =0.5394E-01  M0    =0.9967E-02  J0    =0.6859E-03
 Associated length scales (meters)
 LQ    =      0.54  LM    =      1.21  Lm    =      0.45  Lb    =      0.06
 Tidal:             Tu    =   0.1722 h Lu    =      7.868 Lmin  =      0.278

NON-DIMENSIONAL PARAMETERS
 FR0   =      2.24  FRCH  =      2.11  R     =      0.84

FLOW CLASSIFICATION
 3333333333333333333333333333333333333333
 3  Flow class (CORMIX3)      =    FJ2    3
 3  Applicable layer depth HS =     3.52  3
 3333333333333333333333333333333333333333

MIXING ZONE / TOXIC DILUTION / REGION OF INTEREST PARAMETERS
 C0    =0.8000E-02  CUNITS=  mg/l
 NTOX  =  1         CMC   =0.5800E-02  CCC   =  CSTD
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```
 NSTD  =  1         CSTD  =0.3730E-02
 REGMZ =  1
 REGSPC=  1         XREG  =     91.44  WREG  =      0.00  AREG  =      0.00
 XINT  =   3500.00  XMAX  =   3500.00

X-Y-Z COORDINATE SYSTEM:
    ORIGIN is located at the WATER SURFACE and at center of discharge
      channel/outlet:      0.91 m  from the RIGHT bank/shore.
    X-axis points downstream
    Y-axis points to left as seen by an observer looking downstream
    Z-axis points vertically upward (in CORMIX3, all values Z = 0.00)
NSTEP =  30 display intervals per module
-------------------------------------------------------------------------------
--
-------------------------------------------------------------------------------
--
BEGIN MOD301: DISCHARGE MODULE

 Efflux conditions:
       X        Y       Z        S       C       BV       BH        TT
      0.00     0.00    0.00     1.0 0.800E-02   0.61     0.24 .00000E+00

END OF MOD301: DISCHARGE MODULE
-------------------------------------------------------------------------------
--
-------------------------------------------------------------------------------
--
BEGIN MOD302: ZONE OF FLOW ESTABLISHMENT

  Control volume inflow:
       X        Y       Z        S       C       BV       BH        TT
      0.00     0.00    0.00     1.0 0.800E-02   0.61     0.24 .00000E+00

 Profile definitions:
   BV = Gaussian 1/e (37%) vertical thickness
   BH = Gaussian 1/e (37%) horizontal half-width, normal to trajectory
   S  = hydrodynamic centerline dilution
   C  = centerline concentration (includes reaction efects, if any)
   TT = Cumulative travel time

  Control volume outflow:                                  SIGMAE=     81.11
       X        Y       Z        S       C       BV       BH        TT
      0.07     0.43    0.00     1.0 0.800E-02   0.48     0.40 .23353E+01
 Cumulative travel time =           2.3353 sec

END OF MOD302: ZONE OF FLOW ESTABLISHMENT
-------------------------------------------------------------------------------
--
-------------------------------------------------------------------------------
--
BEGIN CORSURF (MOD310): BUOYANT SURFACE JET - NEAR-FIELD REGION

 Surface jet in deep crossflow with weak buoyancy effects.

 Profile definitions:
   BV = Gaussian 1/e (37%) vertical thickness
   BH = Gaussian 1/e (37%) horizontal half-width, normal to trajectory
   S  = hydrodynamic centerline dilution
   C  = centerline concentration (includes reaction efects, if any)
   TT = Cumulative travel time
```

```
       X        Y       Z        S       C       BV       BH        TT
      0.07     0.43    0.00     1.0 0.800E-02   0.48     0.40 .23353E+01
 JET REGION is INSIGNIFICANT in its spatial extent!
      0.07     0.43    0.00     1.0 0.800E-02   0.67     0.56 .23353E+01
 Buoyant jet regime ends with local CRITICAL CONDITIONS.
 Cumulative travel time =           2.3353 sec

END OF CORSURF (MOD310): BUOYANT SURFACE JET - NEAR-FIELD REGION
--------------------------------------------------------------------------------
--
--------------------------------------------------------------------------------
--
** End of NEAR-FIELD REGION (NFR) **
--------------------------------------------------------------------------------
--

 The initial plume WIDTH/THICKNESS VALUE in the next far-field module will be
  CORRECTED by a factor  0.57 to conserve the mass flux in the far-field!
--------------------------------------------------------------------------------
--
BEGIN MOD341: BUOYANT AMBIENT SPREADING

  Because of the WEAK VERTICAL MIXING, the surface plume in the far-field
    will be vertically limited WITHIN THE UPPER LAYER of the ambient
    stratification.
 Profile definitions:
   BV = top-hat thickness,measured vertically
   BH = top-hat half-width, measured horizontally from bank/shoreline
   S  = hydrodynamic average (bulk) dilution
   C  = average (bulk) concentration (includes reaction effects, if any)
   TT = Cumulative travel time

 Plume Stage 1 (not bank attached):
       X        Y       Z        S       C       BV       BH        TT
      0.07     0.43    0.00     1.0 0.800E-02   0.38     0.32 .23353E+01
      0.31     0.43    0.00     1.0 0.775E-02   0.34     0.37 .34324E+01
      0.55     0.43    0.00     1.1 0.752E-02   0.31     0.42 .45294E+01
      0.79     0.43    0.00     1.1 0.734E-02   0.29     0.47 .56265E+01
      1.04     0.43    0.00     1.1 0.719E-02   0.27     0.51 .67235E+01
      1.28     0.43    0.00     1.1 0.706E-02   0.25     0.55 .78205E+01
      1.52     0.43    0.00     1.2 0.694E-02   0.24     0.59 .89176E+01
      1.76     0.43    0.00     1.2 0.684E-02   0.23     0.63 .10015E+02
      2.01     0.43    0.00     1.2 0.675E-02   0.22     0.67 .11112E+02
      2.25     0.43    0.00     1.2 0.667E-02   0.21     0.71 .12209E+02
      2.49     0.43    0.00     1.2 0.659E-02   0.21     0.74 .13306E+02
      2.73     0.43    0.00     1.2 0.652E-02   0.20     0.78 .14403E+02
      2.98     0.43    0.00     1.2 0.645E-02   0.19     0.81 .15500E+02
      3.22     0.43    0.00     1.3 0.639E-02   0.19     0.84 .16597E+02
      3.46     0.43    0.00     1.3 0.633E-02   0.18     0.88 .17694E+02
      3.70     0.43    0.00     1.3 0.627E-02   0.18     0.91 .18791E+02
      3.95     0.43    0.00     1.3 0.622E-02   0.17     0.94 .19888E+02
      4.19     0.43    0.00     1.3 0.617E-02   0.17     0.97 .20985E+02
      4.43     0.43    0.00     1.3 0.612E-02   0.17     1.00 .22082E+02
      4.67     0.43    0.00     1.3 0.607E-02   0.16     1.03 .23179E+02
      4.92     0.43    0.00     1.3 0.602E-02   0.16     1.06 .24276E+02
      5.16     0.43    0.00     1.3 0.598E-02   0.16     1.09 .25373E+02
      5.40     0.43    0.00     1.3 0.593E-02   0.16     1.12 .26470E+02
      5.64     0.43    0.00     1.4 0.589E-02   0.15     1.15 .27567E+02
      5.89     0.43    0.00     1.4 0.584E-02   0.15     1.18 .28664E+02
```

```
      6.13     0.43    0.00     1.4 0.580E-02   0.15     1.21 .29761E+02
** CMC HAS BEEN FOUND **
 The pollutant concentration in the plume falls below CMC value of 0.580E-02
   in the current prediction interval.
 This is the extent of the TOXIC DILUTION ZONE.
      6.37     0.43    0.00     1.4 0.576E-02   0.15     1.23 .30858E+02
      6.61     0.43    0.00     1.4 0.572E-02   0.15     1.26 .31956E+02
      6.86     0.43    0.00     1.4 0.568E-02   0.14     1.29 .33053E+02
      7.10     0.43    0.00     1.4 0.563E-02   0.14     1.31 .34150E+02
      7.34     0.43    0.00     1.4 0.559E-02   0.14     1.34 .35247E+02
 Cumulative travel time =          35.2467 sec

--------------------------------------------------------------------------------
--
 Plume is ATTACHED to RIGHT bank/shore.
   Plume width is now determined from RIGHT bank/shore.

 Plume Stage 2 (bank attached):
       X        Y       Z        S       C       BV       BH        TT
      7.34    -0.91    0.00     1.4 0.560E-02   0.14     2.68 .35247E+02
     14.50    -0.91    0.00     1.7 0.479E-02   0.14     3.41 .67649E+02
     21.67    -0.91    0.00     2.0 0.401E-02   0.15     4.06 .10005E+03
** WATER QUALITY STANDARD OR CCC HAS BEEN FOUND **
 The pollutant concentration in the plume falls below water quality standard
   or CCC value of 0.373E-02 in the current prediction interval.
 This is the spatial extent of concentrations exceeding the water quality
   standard or CCC value.
     28.83    -0.91    0.00     2.4 0.332E-02   0.16     4.67 .13245E+03
     35.99    -0.91    0.00     2.9 0.274E-02   0.18     5.24 .16486E+03
     43.15    -0.91    0.00     3.5 0.227E-02   0.21     5.78 .19726E+03
     50.31    -0.91    0.00     4.2 0.190E-02   0.24     6.29 .22966E+03
     57.48    -0.91    0.00     5.0 0.160E-02   0.27     6.79 .26206E+03
     64.64    -0.91    0.00     5.9 0.136E-02   0.31     7.26 .29447E+03
     71.80    -0.91    0.00     6.9 0.116E-02   0.35     7.73 .32687E+03
     78.96    -0.91    0.00     8.0 0.100E-02   0.39     8.18 .35927E+03
     86.13    -0.91    0.00     9.2 0.874E-03   0.44     8.61 .39167E+03
 ** REGULATORY MIXING ZONE BOUNDARY **
 In this prediction interval the plume DOWNSTREAM distance meets or exceeds
 the regulatory value =    91.44 m.
 This is the extent of the REGULATORY MIXING ZONE.
     93.29    -0.91    0.00    10.4 0.766E-03   0.48     9.04 .42407E+03
    100.45    -0.91    0.00    11.8 0.676E-03   0.53     9.46 .45648E+03
    107.61    -0.91    0.00    13.3 0.600E-03   0.59     9.87 .48888E+03
    114.77    -0.91    0.00    15.0 0.535E-03   0.64    10.27 .52128E+03
    121.94    -0.91    0.00    16.7 0.479E-03   0.70    10.66 .55368E+03
    129.10    -0.91    0.00    18.5 0.432E-03   0.76    11.04 .58609E+03
    136.26    -0.91    0.00    20.5 0.390E-03   0.82    11.42 .61849E+03
    143.42    -0.91    0.00    22.6 0.354E-03   0.88    11.80 .65089E+03
    150.59    -0.91    0.00    24.8 0.322E-03   0.95    12.16 .68329E+03
    157.75    -0.91    0.00    27.2 0.294E-03   1.02    12.52 .71570E+03
    164.91    -0.91    0.00    29.7 0.269E-03   1.09    12.88 .74810E+03
    172.07    -0.91    0.00    32.3 0.247E-03   1.16    13.23 .78050E+03
    179.23    -0.91    0.00    35.1 0.228E-03   1.24    13.58 .81290E+03
    186.40    -0.91    0.00    38.1 0.210E-03   1.31    13.92 .84531E+03
    193.56    -0.91    0.00    41.2 0.194E-03   1.39    14.26 .87771E+03
    200.72    -0.91    0.00    44.4 0.180E-03   1.47    14.60 .91011E+03
    207.88    -0.91    0.00    47.8 0.167E-03   1.55    14.93 .94251E+03
    215.05    -0.91    0.00    51.4 0.156E-03   1.64    15.26 .97491E+03
    222.21    -0.91    0.00    55.2 0.145E-03   1.72    15.58 .10073E+04
 Cumulative travel time =        1007.3170 sec
```

```
END OF MOD341: BUOYANT AMBIENT SPREADING
-------------------------------------------------------------------------------
--
-------------------------------------------------------------------------------
--
BEGIN MOD361: PASSIVE AMBIENT MIXING IN UNIFORM AMBIENT

  Vertical diffusivity (initial value)   = 0.940E-08 m^2/s
  Horizontal diffusivity (initial value) = 0.304E-01 m^2/s

 Profile definitions:
   BV = Gaussian s.d.*sqrt(pi/2) (46%) thickness, measured vertically
      = or equal to water depth, if fully mixed
   BH = Gaussian s.d.*sqrt(pi/2) (46%) half-width,
        measured horizontally in Y-direction
   S  = hydrodynamic centerline dilution
   C  = centerline concentration (includes reaction efects, if any)
   TT = Cumulative travel time

 Plume Stage 2 (bank attached):
       X        Y       Z        S       C       BV       BH        TT
    222.21    -0.91    0.00    55.2 0.145E-03   1.72    15.58 .10073E+04
    331.47    -0.91    0.00    62.0 0.129E-03   1.72    17.03 .15016E+04
    440.73    -0.91    0.00    72.4 0.110E-03   1.72    18.36 .19959E+04
    549.99    -0.91    0.00    85.2 0.939E-04   1.72    19.60 .24902E+04
    659.25    -0.91    0.00    99.5 0.804E-04   1.72    20.77 .29845E+04
    768.51    -0.91    0.00   114.4 0.699E-04   1.72    21.87 .34788E+04
    877.77    -0.91    0.00   129.2 0.619E-04   1.72    22.92 .39731E+04
    929.35    -0.91    0.00   135.8 0.591E-04   1.72    23.40
 Cumulative travel time =        4206.4517 sec

 CORMIX prediction has been TERMINATED at last prediction interval.
   Limiting distance due to TIDAL REVERSAL has been reached.

END OF MOD361: PASSIVE AMBIENT MIXING IN UNIFORM AMBIENT
-------------------------------------------------------------------------------
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-------------------------------------------------------------------------------
--
CORMIX3: Buoyant Surface Discharges                    End of Prediction File
3333333333333333333333333333333333333333333333333333333333333333333333333333333
3
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```
CORMIX SESSION REPORT:
XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
                      CORMIX MIXING ZONE EXPERT SYSTEM
                          CORMIX Version 6.0GT
                       HYDRO3:Version-6.0.0.0  October,2009
SITE NAME/LABEL:                SIM
  DESIGN CASE:                  JD300400GPMcFinal6.0
  FILE NAME:
P:\Mixing\CriticalDischargeScenarios\V.6.0\400GPMFinalRiver\JD300400GPMcFinal6.
0R.prd
  Using subsystem CORMIX3:     Buoyant Surface Discharges
  Start of session:             03/26/2010--14:57:13
*****************************************************************************
SUMMARY OF INPUT DATA:
-----------------------------------------------------------------------------
AMBIENT PARAMETERS:
  Cross-section                          = bounded
  Width                           BS     = 158.50 m
  Channel regularity              ICHREG = 1
  Ambient flowrate                QA     = 293.73 m^3/s
  Average depth                   HA     = 8.39 m
  Depth at discharge              HD     = 5.87 m
  Darcy-Weisbach friction factor  F      = 0.0242
    Calculated from Manning's n          = 0.025
  Wind velocity                   UW     = 8.5 m/s
TIDAL SIMULATION at time          Tsim   = 3 hours
  Instantaneous ambient velocity  UA     = 0.221 m/s
  Maximum tidal velocity          UaMAX  = 0.359 m/s
Rate of tidal reversal          dUA/dt = 0.0737 (m/s)/hour
  Period of reversal              T      = 12.4 hours
  Stratification Type             STRCND = B
  Surface density                 RHOAS  = 1001.0000 kg/m^3
  Bottom density                  RHOAB  = 1019.0000 kg/m^3
  Stratification height           HINT   = 2.35 m (pycnocline level)
  Density below pycnocline        RHOAP  = 1019.0000 kg/m^3
-----------------------------------------------------------------------------
DISCHARGE PARAMETERS:             Surface Discharge
  Discharge located on                   = right bank/shoreline
  Discharge configuration                = protruding discharge
  Distance from bank to outlet    DISTB  = 0.91 m
  Discharge angle                 SIGMA  = 90 deg
  Depth near discharge outlet     HD0    = 5.87 m
  Bottom slope at discharge       SLOPE  = 0 deg
  Circular pipe diameter                 = 0.6096 m
    Equivalent rectangular discharge:
    Discharge cross-section area  A0     = 0.291864 m^2
    Discharge channel width       B0     = 0.478779 m
    Discharge channel depth       H0     = 0.6096 m
    Discharge aspect ratio        AR     = 1.273240
  Discharge flowrate              Q0     = 0.053935 m^3/s
  Discharge velocity              U0     = 0.18 m/s
  Discharge temperature (freshwater)     = 10 degC
  Corresponding density           RHO0   = 999.7019 kg/m^3
  Density difference              DRHO   = 1.2981 kg/m^3
  Buoyant acceleration            GP0    = 0.0127 m/s^2
  Discharge concentration         C0     = 0.008 mg/l
  Surface heat exchange coeff.    KS     = 0 m/s
  Coefficient of decay            KD     = 0 /s
-----------------------------------------------------------------------------
DISCHARGE/ENVIRONMENT LENGTH SCALES:
```

```
  LQ  = 0.54 m         Lm  = 0.45 m         Lbb = 0.06 m
  LM  = 1.21 m
UNSTEADY TIDAL SCALES:
  Tu  = 0.1722 hours     Lu  = 7.87 m         Lmin= 0.28 m
-------------------------------------------------------------------------------
NON-DIMENSIONAL PARAMETERS:
  Densimetric Froude number       FR0    = 2.24 (based on LQ)
  Channel densimetric Froude no.  FRCH   = 2.11 (based on H0)
  Velocity ratio                  R      = 0.84
-------------------------------------------------------------------------------
MIXING ZONE / TOXIC DILUTION ZONE / AREA OF INTEREST PARAMETERS:
  Toxic discharge                        = yes
  CMC concentration               CMC    = 0.0058 mg/l
  CCC concentration               CCC    = 0.00373 mg/l
  Water quality standard specified       = given by CCC value
  Regulatory mixing zone                 = yes
  Regulatory mixing zone specification   = distance
  Regulatory mixing zone value           = 91.44 m (m^2 if area)
  Region of interest                     = 3500 m
*******************************************************************************
HYDRODYNAMIC CLASSIFICATION:
  *------------------------*
  | FLOW CLASS   = FJ2 |
  *------------------------*
*******************************************************************************
MIXING ZONE EVALUATION (hydrodynamic and regulatory summary):

-------------------------------------------------------------------------------
X-Y-Z Coordinate system:
Origin is located at water surface and at centerline of discharge channel:
    0.91 m from the right bank/shore.
  Number of display steps NSTEP = 30 per module.
-------------------------------------------------------------------------------
NEAR-FIELD REGION (NFR) CONDITIONS :
Note: The NFR is the zone of strong initial mixing.  It has no regulatory
  implication.  However, this information may be useful for the discharge
  designer because the mixing in the NFR is usually sensitive to the
  discharge design conditions.
  Pollutant concentration at NFR edge  c = 0.008 mg/l
  Dilution at edge of NFR              s = 1
  NFR Location:                        x = 0.07 m
    (centerline coordinates)           y = 0.43 m
                                       z = 0 m
  NFR plume dimensions:  half-width (bh) = 0.56 m
                          thickness (bv) = 0.67 m
Cumulative travel time:       2.3353 sec.
-------------------------------------------------------------------------------
Buoyancy assessment:
  The effluent density is less than the surrounding ambient water
  density at the discharge level.
  Therefore, the effluent is POSITIVELY BUOYANT and will tend to rise towards
  the surface.
-------------------------------------------------------------------------------
Stratification assessment:
  Due to WEAK VERTICAL MIXING the surface plume will be confined to
  the upper layer above the pycnocline!
-------------------------------------------------------------------------------
PLUME BANK CONTACT SUMMARY:
  Plume in bounded section contacts one bank only at 7.34 m downstream.
-------------------------------------------------------------------------------
```

```
UNSTEADY TIDAL ASSESSMENT:
 Because of the unsteadiness of the ambient current during the tidal
  reversal, CORMIX predictions have been TERMINATED at:
                                        x = 929.35 m
                                        y = -0.91 m
                                        z = 0 m.
  For this condition AFTER TIDAL REVERSAL, mixed water from the previous
  half-cycle becomes re-entrained into the near field of the discharge,
  increasing pollutant concentrations compared to steady-state predictions.
  A pool of mixed water formed at slack tide will be advected downstream
  in this phase.
************************ TOXIC DILUTION ZONE SUMMARY ************************
Recall: The TDZ corresponds to the three (3) criteria issued in the USEPA
  Technical Support Document (TSD) for Water Quality-based Toxics Control,
  1991 (EPA/505/2-90-001).
  Criterion maximum concentration (CMC)  = 0.0058  mg/l
Corresponding dilution                   = 1.379310
The CMC was encountered at the following plume position:
  Plume location:                       x = 6.14 m
    (centerline coordinates)            y = 0.43 m
                                        z = 0 m
  Plume dimension:       half-width (bh) = 1.21 m
                          thickness (bv) = 0.15 m

 Computed distance from port opening to CMC location = 6.15 m.
 CRITERION 1: This location is within 50 times the discharge length scale of
              Lq = 0.54 m.
 +++++ The discharge length scale TEST for the TDZ has been SATISFIED. ++++++

 Computed horizontal distance from port opening to CMC location = 6.15 m.
 CRITERION 2: This location is within 5 times the ambient water depth of
              HD = 5.87 m.
 ++++++++++ The ambient depth TEST for the TDZ has been SATISFIED. ++++++++++

 Computed distance from port opening to CMC location = 6.15 m.
 CRITERION 3: This location is within one tenth the distance of the extent
              of the Regulatory Mixing Zone of 91.44 m in any
              spatial direction from the port opening.
 +++++ The Regulatory Mixing Zone TEST for the TDZ has been SATISFIED. ++++++

 The diffuser discharge velocity is equal to 0.18 m/s.
 This is below the value of 3.0 m/s recommended in the TSD.

 *** All three CMC criteria for the TDZ are SATISFIED for this discharge. ***
********************** REGULATORY MIXING ZONE SUMMARY ***********************
The plume conditions at the boundary of the specified RMZ are as follows:
  Pollutant concentration               c = 0.000793  mg/l
  Corresponding dilution                s = 10.1
  Plume location:                       x = 91.44 m
    (centerline coordinates)            y = -0.91 m
                                        z = 0 m
  Plume dimensions:      half-width (bh) = 8.93 m
                          thickness (bv) = 0.47 m
Cumulative travel time:       415.7134 sec.
At this position, the plume is CONTACTING the RIGHT bank.
Furthermore, the CCC for the toxic pollutant has indeed been met
  within the RMZ. In particular:
The CCC was encountered at the following plume position:
The CCC for the toxic pollutant was encountered at the following
  plume position:
```

```
  CCC                                    = 0.00373  mg/l
Corresponding dilution                   = 2.1
  Plume location:                      x = 24.43 m
    (centerline coordinates)           y = -0.91 m
                                       z = 0 m
  Plume dimensions:      half-width (bh) = 4.30 m
                          thickness (bv) = 0.15 m
********************* FINAL DESIGN ADVICE AND COMMENTS *********************
REMINDER:  The user must take note that HYDRODYNAMIC MODELING by any known
  technique is NOT AN EXACT SCIENCE.
Extensive comparison with field and laboratory data has shown that the
  CORMIX predictions on dilutions and concentrations (with associated
  plume geometries) are reliable for the majority of cases and are accurate
  to within about +-50% (standard deviation).
As a further safeguard, CORMIX will not give predictions whenever it judges
  the design configuration as highly complex and uncertain for prediction.
```

```
CORMIX1 PREDICTION FILE:
1111111111111111111111111111111111111111111111111111111111111111111111111111111111
1111111111111111
                        CORMIX MIXING ZONE EXPERT SYSTEM
              Subsystem CORMIX1:  Single Port Discharges
                          CORMIX Version 6.0GT
                       HYDRO1 Version 6.0.0.0 October 2009
-------------------------------------------------------------------------------
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-------------------------------------------------------------------------------
---------------
CASE DESCRIPTION
 Site name/label:   SIM
 Design case:       JD300400GPMeFinal6.0
 FILE NAME:         P:\...\V.6.0\400GPMFinalRiver\JD300400GPMeFinal6.0R.prd
 Time stamp:        Fri Mar 26 14:59:19 2010

ENVIRONMENT PARAMETERS (metric units)
 Bounded section
 BS    =    158.50  AS    =   1004.26  QA    =    115.49  ICHREG= 1
 HA    =      6.34  HD    =      4.44
 Tidal Simulation at TIME =     -1.130 h
 PERIOD=    12.40 h UAmax =      0.359 dUa/dt=      0.102 (m/s)/h
 UA    =      0.115 F     =      0.027 USTAR =0.6621E-02
 UW    =      8.500 UWSTAR=0.1074E-01
 Density stratified environment
 STRCND=  B         RHOAM = 1008.2115
 RHOAS = 1001.0000  RHOAB = 1019.0000  RHOAH0= 1019.0000  E     =0.0000E+00
 DRHOJ =   18.0000  HINT  =      1.78  ES    =0.9748E-01

DISCHARGE PARAMETERS (metric units)
 Above Surface Discharge:
 Re-computed discharge conditions at entry point at water surface.
 BANK  =  RIGHT     DISTB =      0.97
 D0    =      0.081 A0    =      0.005 H0    =      4.44  SUB0  =      0.00
 THETA =      0.00  SIGMA =     90.00
 U0    =      5.583 Q0    =      0.029       =0.2856E-01
 RHO0  =  999.7019  DRHO0 =0.1930E+02  GP0   =0.1857E+00
 C0    =0.1500E+00  CUNITS=  mg/l
 IPOLL =  1         KS    =0.0000E+00  KD    =0.0000E+00

FLUX VARIABLES (metric units)
 Q0    =0.2856E-01  M0    =0.1594E+00  J0    =0.5304E-02  SIGNJ0=      1.0
 Associated length scales (meters)
 LQ    =      0.07  LM    =      3.46  Lm    =      3.47  Lb    =      3.49
                                       Lmp   =      1.13  Lbp   =      0.65
 Tidal:             Tu    =   0.2204 h Lu    =     17.799 Lmin  =      0.199

NON-DIMENSIONAL PARAMETERS
 FR0   =     45.60  R     =     48.55

FLOW CLASSIFICATION
 1111111111111111111111111111111111111111111
 1  Flow class (CORMIX1)      =    IV5    1
 1  Applicable layer depth HS =     2.66  1
 1111111111111111111111111111111111111111111

MIXING ZONE / TOXIC DILUTION / REGION OF INTEREST PARAMETERS
 C0    =0.1500E+00  CUNITS=  mg/l
 NTOX  =  1         CMC   =0.5800E-02  CCC   =  CSTD
```

```
 NSTD  =  1         CSTD  =0.3730E-02
 REGMZ =  1
 REGSPC=  1         XREG  =     91.44  WREG  =      0.00  AREG  =      0.00
 XINT  =   3500.00  XMAX  =   3500.00

X-Y-Z COORDINATE SYSTEM:
    ORIGIN is located at the bottom and below the center of the port:
         0.97 m  from the RIGHT bank/shore.
    X-axis points downstream, Y-axis points to left, Z-axis points upward.
NSTEP =  30 display intervals per module
-------------------------------------------------------------------------------
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-------------------------------------------------------------------------------
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BEGIN MOD101: DISCHARGE MODULE

       X        Y       Z        S       C       B        Uc        TT
      0.00     0.00    4.44     1.0 0.150E+00   0.04    5.583   .00000E+00

END OF MOD101: DISCHARGE MODULE
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-------------------------------------------------------------------------------
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BEGIN CORJET (MOD110): JET/PLUME NEAR-FIELD MIXING REGION

 Jet/plume transition motion in weak crossflow.

 Zone of flow establishment:            THETAE=    -88.88  SIGMAE=     64.04
  LE    =      0.38  XE    =      0.00  YE    =      0.01  ZE    =      4.06

 Profile definitions:
   B = Gaussian 1/e (37%) half-width, normal to trajectory
   S = hydrodynamic centerline dilution
   C = centerline concentration (includes reaction effects, if any)
  Uc = Local centerline excess velocity (above ambient)
  TT = Cumulative travel time

       X        Y       Z        S       C       B        Uc        TT
      0.00     0.00    4.44     1.0 0.150E+00   0.04    5.583   .00000E+00
      0.00     0.01    4.06     1.0 0.150E+00   0.04    5.583   .24491E-02
      0.00     0.01    3.95     1.1 0.133E+00   0.05    5.583   .19615E-01
      0.01     0.01    3.82     1.4 0.106E+00   0.07    4.616   .45015E-01
      0.01     0.01    3.69     1.7 0.875E-01   0.08    3.814   .76243E-01
      0.02     0.02    3.58     2.0 0.763E-01   0.10    3.315   .10769E+00
      0.02     0.02    3.45     2.3 0.663E-01   0.11    2.871   .14988E+00
      0.03     0.02    3.32     2.6 0.587E-01   0.12    2.527   .19809E+00
      0.04     0.02    3.21     2.8 0.533E-01   0.14    2.288   .24425E+00
      0.05     0.02    3.08     3.1 0.482E-01   0.15    2.057   .30386E+00
      0.07     0.03    2.96     3.4 0.440E-01   0.17    1.863   .36977E+00
      0.08     0.03    2.85     3.7 0.409E-01   0.18    1.721   .43138E+00
      0.10     0.03    2.72     4.0 0.377E-01   0.19    1.577   .50936E+00
      0.12     0.03    2.59     4.3 0.350E-01   0.21    1.452   .59407E+00
      0.14     0.03    2.48     4.5 0.330E-01   0.22    1.356   .67217E+00
      0.16     0.04    2.36     4.9 0.309E-01   0.24    1.256   .76988E+00
      0.19     0.04    2.23     5.2 0.290E-01   0.26    1.166   .87491E+00
      0.21     0.04    2.12     5.5 0.275E-01   0.27    1.096   .97096E+00
      0.24     0.04    2.00     5.8 0.260E-01   0.29    1.022   .10903E+01
      0.27     0.05    1.89     6.1 0.247E-01   0.30    0.962   .11990E+01
      0.30     0.05    1.77     6.4 0.234E-01   0.32    0.899   .13337E+01
```

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      0.34     0.05    1.64     6.7 0.223E-01   0.34    0.840   .14772E+01
      0.37     0.05    1.54     7.0 0.213E-01   0.35    0.792   .16075E+01
      0.41     0.06    1.42     7.4 0.203E-01   0.37    0.741   .17685E+01
      0.46     0.06    1.30     7.8 0.193E-01   0.39    0.692   .19395E+01
      0.50     0.06    1.19     8.1 0.186E-01   0.40    0.653   .20945E+01
      0.55     0.06    1.07     8.5 0.177E-01   0.42    0.610   .22857E+01
      0.61     0.07    0.96     8.8 0.170E-01   0.44    0.569   .24886E+01
      0.65     0.07    0.86     9.2 0.163E-01   0.46    0.536   .26724E+01
      0.71     0.07    0.74     9.6 0.156E-01   0.48    0.499   .28989E+01
      0.78     0.07    0.63    10.0 0.150E-01   0.50    0.464   .31392E+01
      0.84     0.07    0.54    10.4 0.145E-01   0.52    0.435   .33568E+01
 Cumulative travel time =           3.3568 sec

END OF CORJET (MOD110): JET/PLUME NEAR-FIELD MIXING REGION
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BEGIN MOD132: LAYER BOUNDARY IMPINGEMENT/UPSTREAM SPREADING

  Vertical angle of layer/boundary impingement    =     -58.09 deg
  Horizontal angle of layer/boundary impingement  =       2.16 deg

 UPSTREAM INTRUSION PROPERTIES:
        Upstream intrusion length                =       2.28 m
        X-position of upstream stagnation point =      -1.45 m
        Thickness in intrusion region            =       0.60 m
        Half-width at downstream end             =       3.62 m
        Thickness at downstream end              =       0.60 m

  Control volume inflow:
       X        Y       Z        S       C       B        TT
      0.84     0.07    0.54    10.4 0.145E-01   0.52 .33568E+01

 Profile definitions:
   BV = top-hat thickness, measured vertically
   BH = top-hat half-width, measured horizontally in Y-direction
   ZU = upper plume boundary (Z-coordinate)
   ZL = lower plume boundary (Z-coordinate)
   S  = hydrodynamic average (bulk) dilution
   C  = average (bulk) concentration (includes reaction effects, if any)
   TT = Cumulative travel time

       X        Y       Z        S       C       BV       BH      ZU      ZL
TT
     -1.45     0.07    0.00  9998.0 0.000E+00   0.00     0.00    0.00    0.00
.19103E+02
** CMC HAS BEEN FOUND **
 The pollutant concentration in the plume falls below CMC value of 0.580E-02
   in the current prediction interval.
 This is the extent of the TOXIC DILUTION ZONE.
**WATER QUALITY STANDARD OR CCC HAS BEEN FOUND**
 The pollutant concentration in the plume falls below water quality standard
   or CCC value of 0.373E-02 in the current prediction interval.
 This is the spatial extent of concentrations exceeding the water quality
   standard or CCC value.
     -1.36     0.07    0.00    46.8 0.320E-02   0.13     0.51    0.13    0.00
.33568E+01
     -0.96     0.07    0.00    19.4 0.773E-02   0.32     1.24    0.32    0.00
.33568E+01
```

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     -0.56     0.07    0.00    14.6 0.103E-01   0.43     1.68    0.43    0.00
.33568E+01
     -0.16     0.07    0.00    12.4 0.121E-01   0.50     2.03    0.50    0.00
.33568E+01
      0.24     0.07    0.00    11.3 0.133E-01   0.56     2.32    0.56    0.00
.33568E+01
      0.64     0.07    0.00    10.6 0.141E-01   0.59     2.59    0.59    0.00
.33568E+01
      1.04     0.07    0.00    10.4 0.144E-01   0.60     2.82    0.60    0.00
.33568E+01
      1.44     0.07    0.00    11.3 0.133E-01   0.60     3.04    0.60    0.00
.62690E+01
      1.84     0.07    0.00    14.5 0.104E-01   0.60     3.25    0.60    0.00
.10547E+02
      2.25     0.07    0.00    16.8 0.895E-02   0.60     3.44    0.60    0.00
.14825E+02
      2.65     0.07    0.00    17.6 0.851E-02   0.60     3.62    0.60    0.00
.19103E+02
 Cumulative travel time =          19.1029 sec

END OF MOD132: LAYER BOUNDARY IMPINGEMENT/UPSTREAM SPREADING
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** End of NEAR-FIELD REGION (NFR) **

 In this design case, the discharge is located CLOSE TO BANK/SHORE.
 Some boundary interaction occurs at end of near-field.
   This may be related to a design case with a very LOW AMBIENT VELOCITY.
   The dilution values in one or more of the preceding zones may be too high.
 Carefully evaluate results in near-field and check degree of interaction.

 Consider locating outfall further away from bank or shore.
 In the next prediction module, the plume centerline will be set
   to follow the bank/shore.
-------------------------------------------------------------------------------
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BEGIN MOD141: BUOYANT AMBIENT SPREADING

 Plume is ATTACHED to RIGHT bank/shore.
   Plume width is now determined from RIGHT bank/shore.

 Profile definitions:
   BV = top-hat thickness, measured vertically
   BH = top-hat half-width, measured horizontally in Y-direction
   ZU = upper plume boundary (Z-coordinate)
   ZL = lower plume boundary (Z-coordinate)
   S  = hydrodynamic average (bulk) dilution
   C  = average (bulk) concentration (includes reaction effects, if any)
   TT = Cumulative travel time

 Plume Stage 2 (bank attached):
       X        Y       Z        S       C       BV       BH      ZU      ZL
TT
      2.65    -0.97    0.00    17.6 0.851E-02   0.94     4.67    0.94    0.00
.19103E+02
     25.57    -0.97    0.00    24.1 0.623E-02   0.41    14.49    0.41    0.00
.21837E+03
     48.49    -0.97    0.00    28.6 0.524E-02   0.33    21.52    0.33    0.00
.41763E+03
```

```
     71.41    -0.97    0.00    34.2 0.439E-02   0.31    27.48    0.31    0.00
.61690E+03
 ** REGULATORY MIXING ZONE BOUNDARY **
 In this prediction interval the plume DOWNSTREAM  distance meets or exceeds
 the regulatory value =    91.44 m.
 This is the extent of the REGULATORY MIXING ZONE.
     94.33    -0.97    0.00    41.3 0.363E-02   0.32    32.83    0.32    0.00
.81617E+03
    117.25    -0.97    0.00    50.4 0.298E-02   0.34    37.75    0.34    0.00
.10154E+04
    140.17    -0.97    0.00    61.6 0.243E-02   0.37    42.36    0.37    0.00
.12147E+04
    163.09    -0.97    0.00    75.1 0.200E-02   0.41    46.73    0.41    0.00
.14140E+04
    186.02    -0.97    0.00    91.1 0.165E-02   0.45    50.90    0.45    0.00
.16132E+04
    208.94    -0.97    0.00   109.6 0.137E-02   0.51    54.92    0.51    0.00
.18125E+04
    231.86    -0.97    0.00   130.7 0.115E-02   0.57    58.80    0.57    0.00
.20118E+04
    250.10    -0.97    0.00   149.8 0.101E-02   0.62    61.79    0.62    0.00
 Cumulative travel time =        2170.3081 sec

 CORMIX prediction has been TERMINATED at last prediction interval.
   Limiting distance due to TIDAL REVERSAL has been reached.

END OF MOD141: BUOYANT AMBIENT SPREADING
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CORMIX1: Single Port Discharges              End of Prediction File
1111111111111111111111111111111111111111111111111111111111111111111111111111111
1111111111111111
```

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CORMIX SESSION REPORT:
XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
                      CORMIX MIXING ZONE EXPERT SYSTEM
                          CORMIX Version 6.0GT
                       HYDRO1:Version-6.0.0.0  October,2009
SITE NAME/LABEL:                SIM
  DESIGN CASE:                  JD300400GPMeFinal6.0
  FILE NAME:
P:\Mixing\CriticalDischargeScenarios\V.6.0\400GPMFinalRiver\JD300400GPMeFinal6.
0R.prd
  Using subsystem CORMIX1:     Single Port Discharges
  Start of session:             03/26/2010--14:59:19
*****************************************************************************
SUMMARY OF INPUT DATA:
-----------------------------------------------------------------------------
AMBIENT PARAMETERS:
  Cross-section                          = bounded
  Width                           BS     = 158.50 m
  Channel regularity              ICHREG = 1
  Ambient flowrate                QA     = 115.49 m^3/s
  Average depth                   HA     = 6.34 m
  Depth at discharge              HD     = 4.44 m
  Darcy-Weisbach friction factor  F      = 0.0265
    Calculated from Manning's n          = 0.025
  Wind velocity                   UW     = 8.5 m/s
TIDAL SIMULATION at time          Tsim   = -1.13 hours
  Instantaneous ambient velocity  UA     = 0.115 m/s
  Maximum tidal velocity          UaMAX  = 0.359 m/s
Rate of tidal reversal          dUA/dt = 0.1018 (m/s)/hour
  Period of reversal              T      = 12.4 hours
  Stratification Type             STRCND = B
  Surface density                 RHOAS  = 1001.0000 kg/m^3
  Bottom density                  RHOAB  = 1019.0000 kg/m^3
  Stratification height           HINT   = 1.78 m (pycnocline level)
  Density below pycnocline        RHOAP  = 1019.0000 kg/m^3
-----------------------------------------------------------------------------
DISCHARGE PARAMETERS:             Single Port Discharge
  Nearest bank                           = right
  Distance to bank                DISTB  = 0.97 m
  Port diameter                   D0     = 0.0807 m
  Port cross-sectional area       A0     = 0.0051 m^2
  Discharge velocity              U0     = 5.58 m/s
  Discharge flowrate              Q0     = 0.028558 m^3/s
  Discharge port height           H0     = 4.44 m
  Vertical discharge angle        THETA  = -89.00 deg
  Horizontal discharge angle      SIGMA  = 90 deg
  Discharge temperature (freshwater)     = 10 degC
  Corresponding density           RHO0   = 999.7019 kg/m^3
  Density difference              DRHO   = 19.2981 kg/m^3
  Buoyant acceleration            GP0    = 0.1857 m/s^2
  Discharge concentration         C0     = 0.15 mg/l
  Surface heat exchange coeff.    KS     = 0 m/s
  Coefficient of decay            KD     = 0 /s
-----------------------------------------------------------------------------
DISCHARGE/ENVIRONMENT LENGTH SCALES:
  LQ  = 0.07 m         Lm  = 3.47 m         Lb  = 3.49 m
  LM  = 3.46 m         Lm' = 1.13 m         Lb' = 0.65 m
UNSTEADY TIDAL SCALES:
  Tu  = 0.2204 hours     Lu  = 17.80 m         Lmin= 0.20 m
-----------------------------------------------------------------------------
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NON-DIMENSIONAL PARAMETERS:
  Port densimetric Froude number  FR0    = 45.60
  Velocity ratio                  R      = 48.55
-----------------------------------------------------------------------------
MIXING ZONE / TOXIC DILUTION ZONE / AREA OF INTEREST PARAMETERS:
  Toxic discharge                        = yes
  CMC concentration               CMC    = 0.0058 mg/l
  CCC concentration               CCC    = 0.00373 mg/l
  Water quality standard specified       = given by CCC value
  Regulatory mixing zone                 = yes
  Regulatory mixing zone specification   = distance
  Regulatory mixing zone value           = 91.44 m (m^2 if area)
  Region of interest                     = 3500 m
*****************************************************************************
HYDRODYNAMIC CLASSIFICATION:
  *------------------------*
  | FLOW CLASS   = IV5 |
  *------------------------*
  This flow configuration applies to a layer corresponding to lower stratified
  density layer at the discharge site.  The density jump at the pycnocline
  confines the flow to the lower layer.
  Applicable layer depth = lower layer depth = 2.66 m
*****************************************************************************
MIXING ZONE EVALUATION (hydrodynamic and regulatory summary):

-----------------------------------------------------------------------------
X-Y-Z Coordinate system:
  Origin is located at the bottom below the port center:
    0.97 m from the right bank/shore.
  Number of display steps NSTEP = 30 per module.
-----------------------------------------------------------------------------
NEAR-FIELD REGION (NFR) CONDITIONS :
Note: The NFR is the zone of strong initial mixing.  It has no regulatory
  implication.  However, this information may be useful for the discharge
  designer because the mixing in the NFR is usually sensitive to the
  discharge design conditions.
  Pollutant concentration at NFR edge  c = 0.0085 mg/l
  Dilution at edge of NFR              s = 17.6
  NFR Location:                        x = 2.65 m
    (centerline coordinates)           y = 0.07 m
                                       z = 0 m
  NFR plume dimensions:  half-width (bh) = 3.62 m
                          thickness (bv) = 0.60 m
Cumulative travel time:       19.1029 sec.
-----------------------------------------------------------------------------
Buoyancy assessment:
  The effluent density is less than the surrounding ambient water
  density at the discharge level.
  Therefore, the effluent is POSITIVELY BUOYANT and will tend to rise towards
  the surface.
-----------------------------------------------------------------------------
Stratification assessment:
  The specified two layer ambient density stratification is dynamically
  important. The discharge near field flow will be confined to the lower
  layer by the ambient density stratification.
  Furthermore, it is trapped at the pycnocline by the ambient density
  jump.
-----------------------------------------------------------------------------
UPSTREAM INTRUSION SUMMARY:
Plume exhibits upstream intrusion due to low ambient velocity or strong
```

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  discharge buoyancy.
  Intrusion length                        =  2.28 m
  Intrusion stagnation point              =  -1.45 m
  Intrusion thickness                     =  0.60 m
  Intrusion half width at impingement     =  3.62 m
  Intrusion half thickness at impingement =  0.60 m
-------------------------------------------------------------------------------
PLUME BANK CONTACT SUMMARY:
  Plume in bounded section contacts one bank only at 2.65 m downstream.
-------------------------------------------------------------------------------
UNSTEADY TIDAL ASSESSMENT:
 Because of the unsteadiness of the ambient current during the tidal
  reversal, CORMIX predictions have been TERMINATED at:
                                      x = 250.10 m
                                      y = -0.97 m
                                      z = 0 m.
  For this condition BEFORE TIDAL REVERSAL, extensive re-entrainment
  of previously discharged is unlikely.
  To determine the minimum dilution, perform additional simulations
  after slack tide.
************************ TOXIC DILUTION ZONE SUMMARY ************************
Recall: The TDZ corresponds to the three (3) criteria issued in the USEPA
  Technical Support Document (TSD) for Water Quality-based Toxics Control,
  1991 (EPA/505/2-90-001).
  Criterion maximum concentration (CMC)  = 0.0058  mg/l
Corresponding dilution                   = 25.862069
The CMC was encountered at the following plume position:
  Plume location:                     x = -0.26 m
    (centerline coordinates)          y = 0.07 m
                                      z = 0.13 m
  Plume dimension:       half-width (bh) = 1.07 m
                          thickness (bv) = 0.10 m

 Computed distance from port opening to CMC location = 4.32 m.
 CRITERION 1: This location is beyond 50 times the discharge length scale of
              Lq = 0.07 m.
 +++++ The discharge length scale TEST for the TDZ has FAILED. ++++++

 Computed horizontal distance from port opening to CMC location = 0.27 m.
 CRITERION 2: This location is within 5 times the ambient water depth of
              HD = 4.44 m.
 ++++++++++ The ambient depth TEST for the TDZ has been SATISFIED. ++++++++++

 Computed distance from port opening to CMC location = 4.32 m.
 CRITERION 3: This location is within one tenth the distance of the extent
              of the Regulatory Mixing Zone of 91.55 m in any
              spatial direction from the port opening.
 +++++ The Regulatory Mixing Zone TEST for the TDZ has been SATISFIED. ++++++

 The diffuser discharge velocity is equal to 5.58 m/s.
 This exceeds the value of 3.0 m/s recommended in the TSD.

 *** This discharge DOES NOT SATISFY all three CMC criteria for the TDZ. ****
********************** REGULATORY MIXING ZONE SUMMARY ***********************
The plume conditions at the boundary of the specified RMZ are as follows:
  Pollutant concentration             c = 0.003721  mg/l
  Corresponding dilution              s = 40.3
  Plume location:                     x = 91.44 m
    (centerline coordinates)          y = -0.97 m
                                      z = 0 m
```

```
  Plume dimensions:      half-width (bh) = 32.18 m
                          thickness (bv) = 0.31 m
Cumulative travel time:       791.0333 sec.
At this position, the plume is CONTACTING the RIGHT bank.
Furthermore, the CCC for the toxic pollutant has indeed been met
  within the RMZ. In particular:
The CCC was encountered at the following plume position:
The CCC for the toxic pollutant was encountered at the following
  plume position:
  CCC                                     = 0.00373  mg/l
Corresponding dilution                    = 40.2
  Plume location:                       x = -1.14 m
    (centerline coordinates)            y = 0.07 m
                                        z = 0.03 m
  Plume dimensions:      half-width (bh) = 0.63 m
                          thickness (bv) = 0.13 m
********************* FINAL DESIGN ADVICE AND COMMENTS **********************
REMINDER:  The user must take note that HYDRODYNAMIC MODELING by any known
  technique is NOT AN EXACT SCIENCE.
Extensive comparison with field and laboratory data has shown that the
  CORMIX predictions on dilutions and concentrations (with associated
  plume geometries) are reliable for the majority of cases and are accurate
  to within about +-50% (standard deviation).
As a further safeguard, CORMIX will not give predictions whenever it judges
  the design configuration as highly complex and uncertain for prediction.
```

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CORMIX1 PREDICTION FILE:
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1111111111111111
                        CORMIX MIXING ZONE EXPERT SYSTEM
              Subsystem CORMIX1:  Single Port Discharges
                          CORMIX Version 6.0GT
                       HYDRO1 Version 6.0.0.0 October 2009
-------------------------------------------------------------------------------
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-------------------------------------------------------------------------------
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CASE DESCRIPTION
 Site name/label:   SIM
 Design case:       JD300400GPMfFinal6.0
 FILE NAME:         P:\...\V.6.0\400GPMFinalRiver\JD300400GPMfFinal6.0R.prd
 Time stamp:        Fri Mar 26 15:00:43 2010

ENVIRONMENT PARAMETERS (metric units)
 Bounded section
 BS    =    158.50  AS    =    790.34  QA    =     90.89  ICHREG= 1
 HA    =      4.99  HD    =      3.49
 Tidal Simulation at TIME =      0.620 h
 PERIOD=    12.40 h UAmax =      0.359 dUa/dt=      0.185 (m/s)/h
 UA    =      0.115 F     =      0.029 USTAR =0.6890E-02
 UW    =      8.500 UWSTAR=0.1074E-01
 Density stratified environment
 STRCND=  B         RHOAM = 1008.2003
 RHOAS = 1001.0000  RHOAB = 1019.0000  RHOAH0= 1019.0000  E     =0.0000E+00
 DRHOJ =   18.0000  HINT  =      1.40  ES    =0.1241E+00

DISCHARGE PARAMETERS (metric units)
 Above Surface Discharge:
 Re-computed discharge conditions at entry point at water surface.
 BANK  =  RIGHT     DISTB =      0.99
 D0    =      0.069 A0    =      0.004 H0    =      3.49  SUB0  =      0.00
 THETA =      0.00  SIGMA =     90.00
 U0    =      7.592 Q0    =      0.029       =0.2856E-01
 RHO0  =  999.7019  DRHO0 =0.1930E+02  GP0   =0.1857E+00
 C0    =0.1270E+00  CUNITS=  mg/l
 IPOLL =  1         KS    =0.0000E+00  KD    =0.0000E+00

FLUX VARIABLES (metric units)
 Q0    =0.2856E-01  M0    =0.2168E+00  J0    =0.5304E-02  SIGNJ0=      1.0
 Associated length scales (meters)
 LQ    =      0.06  LM    =      4.36  Lm    =      4.05  Lb    =      3.49
                                       Lmp   =      1.15  Lbp   =      0.59
 Tidal:             Tu    =   0.1555 h Lu    =     16.144 Lmin  =      0.171

NON-DIMENSIONAL PARAMETERS
 FR0   =     66.97  R     =     66.02

FLOW CLASSIFICATION
 1111111111111111111111111111111111111111111
 1  Flow class (CORMIX1)      =    IV5    1
 1  Applicable layer depth HS =     2.09  1
 1111111111111111111111111111111111111111111

MIXING ZONE / TOXIC DILUTION / REGION OF INTEREST PARAMETERS
 C0    =0.1270E+00  CUNITS=  mg/l
 NTOX  =  1         CMC   =0.5800E-02  CCC   =  CSTD
```

```
 NSTD  =  1         CSTD  =0.3730E-02
 REGMZ =  1
 REGSPC=  1         XREG  =     91.44  WREG  =      0.00  AREG  =      0.00
 XINT  =  35000.00  XMAX  =  35000.00

X-Y-Z COORDINATE SYSTEM:
    ORIGIN is located at the bottom and below the center of the port:
         0.99 m  from the RIGHT bank/shore.
    X-axis points downstream, Y-axis points to left, Z-axis points upward.
NSTEP =  30 display intervals per module
-------------------------------------------------------------------------------
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-------------------------------------------------------------------------------
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BEGIN MOD101: DISCHARGE MODULE

       X        Y       Z        S       C       B        Uc        TT
      0.00     0.00    3.49     1.0 0.127E+00   0.03    7.592   .00000E+00

END OF MOD101: DISCHARGE MODULE
-------------------------------------------------------------------------------
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-------------------------------------------------------------------------------
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BEGIN CORJET (MOD110): JET/PLUME NEAR-FIELD MIXING REGION

 Jet/plume transition motion in weak crossflow.

 Zone of flow establishment:            THETAE=    -89.18  SIGMAE=     64.04
  LE    =      0.33  XE    =      0.00  YE    =      0.00  ZE    =      3.16

 Profile definitions:
   B = Gaussian 1/e (37%) half-width, normal to trajectory
   S = hydrodynamic centerline dilution
   C = centerline concentration (includes reaction effects, if any)
  Uc = Local centerline excess velocity (above ambient)
  TT = Cumulative travel time

       X        Y       Z        S       C       B        Uc        TT
      0.00     0.00    3.49     1.0 0.127E+00   0.03    7.592   .00000E+00
      0.00     0.00    3.16     1.0 0.127E+00   0.04    7.592   .13754E-02
      0.00     0.01    3.08     1.1 0.116E+00   0.05    7.592   .10873E-01
      0.00     0.01    2.98     1.4 0.936E-01   0.06    6.578   .24655E-01
      0.01     0.01    2.89     1.6 0.803E-01   0.07    5.638   .38791E-01
      0.01     0.01    2.79     1.8 0.689E-01   0.08    4.829   .58001E-01
      0.01     0.01    2.70     2.1 0.603E-01   0.09    4.220   .80151E-01
      0.02     0.01    2.61     2.3 0.544E-01   0.10    3.806   .10149E+00
      0.02     0.01    2.51     2.6 0.489E-01   0.11    3.413   .12914E+00
      0.03     0.01    2.41     2.9 0.444E-01   0.12    3.090   .15978E+00
      0.03     0.02    2.33     3.1 0.411E-01   0.13    2.857   .18844E+00
      0.04     0.02    2.23     3.4 0.379E-01   0.14    2.624   .22470E+00
      0.05     0.02    2.13     3.6 0.351E-01   0.15    2.424   .26401E+00
      0.06     0.02    2.03     3.9 0.326E-01   0.16    2.250   .30642E+00
      0.07     0.02    1.95     4.1 0.308E-01   0.17    2.118   .34525E+00
      0.08     0.02    1.85     4.4 0.289E-01   0.18    1.981   .39349E+00
      0.09     0.02    1.75     4.7 0.272E-01   0.19    1.859   .44492E+00
      0.10     0.02    1.67     4.9 0.259E-01   0.20    1.764   .49157E+00
      0.11     0.03    1.57     5.2 0.246E-01   0.22    1.663   .54904E+00
      0.13     0.03    1.47     5.4 0.233E-01   0.23    1.572   .60984E+00
      0.14     0.03    1.39     5.7 0.223E-01   0.24    1.500   .66464E+00
```

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      0.16     0.03    1.29     6.0 0.213E-01   0.25    1.422   .73175E+00
      0.17     0.03    1.19     6.2 0.203E-01   0.26    1.351   .80235E+00
      0.19     0.03    1.11     6.5 0.196E-01   0.27    1.294   .86569E+00
      0.21     0.03    1.01     6.8 0.187E-01   0.28    1.232   .94293E+00
      0.23     0.03    0.92     7.1 0.180E-01   0.30    1.174   .10239E+01
      0.25     0.04    0.83     7.3 0.174E-01   0.31    1.127   .10962E+01
      0.27     0.04    0.74     7.6 0.167E-01   0.32    1.076   .11842E+01
      0.29     0.04    0.64     7.9 0.161E-01   0.33    1.028   .12761E+01
      0.32     0.04    0.56     8.2 0.155E-01   0.34    0.989   .13581E+01
      0.34     0.04    0.46     8.5 0.150E-01   0.36    0.946   .14575E+01
      0.37     0.04    0.37     8.7 0.145E-01   0.37    0.911   .15461E+01
 Cumulative travel time =          1.5461 sec

END OF CORJET (MOD110): JET/PLUME NEAR-FIELD MIXING REGION
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BEGIN MOD132: LAYER BOUNDARY IMPINGEMENT/UPSTREAM SPREADING

  Vertical angle of layer/boundary impingement    =     -73.63 deg
  Horizontal angle of layer/boundary impingement  =       2.76 deg

 UPSTREAM INTRUSION PROPERTIES:
        Upstream intrusion length               =       2.36 m
        X-position of upstream stagnation point =      -1.99 m
        Thickness in intrusion region           =       0.47 m
        Half-width at downstream end            =       3.91 m
        Thickness at downstream end             =       0.47 m

  Control volume inflow:
       X        Y       Z        S       C       B        TT
      0.37     0.04    0.37     8.7 0.145E-01   0.37 .15461E+01

 Profile definitions:
   BV = top-hat thickness, measured vertically
   BH = top-hat half-width, measured horizontally in Y-direction
   ZU = upper plume boundary (Z-coordinate)
   ZL = lower plume boundary (Z-coordinate)
   S  = hydrodynamic average (bulk) dilution
   C  = average (bulk) concentration (includes reaction effects, if any)
   TT = Cumulative travel time

       X        Y       Z        S       C       BV       BH      ZU      ZL
TT
     -1.99     0.04    0.00  9985.4 0.000E+00   0.00     0.00    0.00    0.00
.18568E+02
** CMC HAS BEEN FOUND **
 The pollutant concentration in the plume falls below CMC value of 0.580E-02
   in the current prediction interval.
 This is the extent of the TOXIC DILUTION ZONE.
**WATER QUALITY STANDARD OR CCC HAS BEEN FOUND**
 The pollutant concentration in the plume falls below water quality standard
   or CCC value of 0.373E-02 in the current prediction interval.
 This is the spatial extent of concentrations exceeding the water quality
   standard or CCC value.
     -1.90     0.04    0.00    37.3 0.341E-02   0.11     0.55    0.11    0.00
.15461E+01
     -1.48     0.04    0.00    15.5 0.821E-02   0.27     1.34    0.27    0.00
.15461E+01
```

```
     -1.06     0.04    0.00    11.7 0.109E-01   0.35     1.82    0.35    0.00
.15461E+01
     -0.63     0.04    0.00    10.0 0.127E-01   0.41     2.19    0.41    0.00
.15461E+01
     -0.21     0.04    0.00     9.2 0.138E-01   0.45     2.51    0.45    0.00
.15461E+01
      0.21     0.04    0.00     8.8 0.144E-01   0.47     2.80    0.47    0.00
.15461E+01
      0.63     0.04    0.00     8.9 0.142E-01   0.47     3.05    0.47    0.00
.29914E+01
      1.06     0.04    0.00    10.7 0.118E-01   0.47     3.29    0.47    0.00
.68855E+01
      1.48     0.04    0.00    13.0 0.980E-02   0.47     3.51    0.47    0.00
.10780E+02
      1.90     0.04    0.00    14.3 0.890E-02   0.47     3.72    0.47    0.00
.14674E+02
      2.33     0.04    0.00    14.8 0.856E-02   0.47     3.91    0.47    0.00
.18568E+02
 Cumulative travel time =          18.5677 sec

END OF MOD132: LAYER BOUNDARY IMPINGEMENT/UPSTREAM SPREADING
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** End of NEAR-FIELD REGION (NFR) **

 In this design case, the discharge is located CLOSE TO BANK/SHORE.
 Some boundary interaction occurs at end of near-field.
   This may be related to a design case with a very LOW AMBIENT VELOCITY.
   The dilution values in one or more of the preceding zones may be too high.
 Carefully evaluate results in near-field and check degree of interaction.

 Consider locating outfall further away from bank or shore.
 In the next prediction module, the plume centerline will be set
   to follow the bank/shore.
-------------------------------------------------------------------------------
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BEGIN MOD141: BUOYANT AMBIENT SPREADING

 Plume is ATTACHED to RIGHT bank/shore.
   Plume width is now determined from RIGHT bank/shore.

 Profile definitions:
   BV = top-hat thickness, measured vertically
   BH = top-hat half-width, measured horizontally in Y-direction
   ZU = upper plume boundary (Z-coordinate)
   ZL = lower plume boundary (Z-coordinate)
   S  = hydrodynamic average (bulk) dilution
   C  = average (bulk) concentration (includes reaction effects, if any)
   TT = Cumulative travel time

 Plume Stage 2 (bank attached):
       X        Y       Z        S       C       BV       BH      ZU      ZL
TT
      2.33    -0.99    0.00    14.8 0.856E-02   0.75     4.95    0.75    0.00
.18568E+02
     21.83    -0.99    0.00    19.4 0.656E-02   0.36    13.45    0.36    0.00
.18811E+03
     41.33    -0.99    0.00    22.5 0.563E-02   0.29    19.68    0.29    0.00
.35765E+03
```

```
     60.84    -0.99    0.00    26.3 0.483E-02   0.27    24.99    0.27    0.00
.52720E+03
     80.34    -0.99    0.00    31.0 0.409E-02   0.27    29.76    0.27    0.00
.69674E+03
 ** REGULATORY MIXING ZONE BOUNDARY **
 In this prediction interval the plume DOWNSTREAM  distance meets or exceeds
 the regulatory value =    91.44 m.
 This is the extent of the REGULATORY MIXING ZONE.
     99.84    -0.99    0.00    37.0 0.344E-02   0.29    34.15    0.29    0.00
.86628E+03
    115.64    -0.99    0.00    42.8 0.298E-02   0.31    37.48    0.31    0.00
 Cumulative travel time =        1003.5983 sec

 CORMIX prediction has been TERMINATED at last prediction interval.
   Limiting distance due to TIDAL REVERSAL has been reached.

END OF MOD141: BUOYANT AMBIENT SPREADING
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CORMIX1: Single Port Discharges              End of Prediction File
1111111111111111111111111111111111111111111111111111111111111111111111111111111
1111111111111111
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CORMIX SESSION REPORT:
XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
                      CORMIX MIXING ZONE EXPERT SYSTEM
                          CORMIX Version 6.0GT
                       HYDRO1:Version-6.0.0.0  October,2009
SITE NAME/LABEL:                SIM
  DESIGN CASE:                  JD300400GPMfFinal6.0
  FILE NAME:
P:\Mixing\CriticalDischargeScenarios\V.6.0\400GPMFinalRiver\JD300400GPMfFinal6.
0R.prd
  Using subsystem CORMIX1:     Single Port Discharges
  Start of session:             03/26/2010--15:00:43
*****************************************************************************
SUMMARY OF INPUT DATA:
-----------------------------------------------------------------------------
AMBIENT PARAMETERS:
  Cross-section                          = bounded
  Width                           BS     = 158.50 m
  Channel regularity              ICHREG = 1
  Ambient flowrate                QA     = 90.89 m^3/s
  Average depth                   HA     = 4.99 m
  Depth at discharge              HD     = 3.49 m
  Darcy-Weisbach friction factor  F      = 0.0287
    Calculated from Manning's n          = 0.025
  Wind velocity                   UW     = 8.5 m/s
TIDAL SIMULATION at time          Tsim   = 0.62 hours
  Instantaneous ambient velocity  UA     = 0.115 m/s
  Maximum tidal velocity          UaMAX  = 0.359 m/s
Rate of tidal reversal          dUA/dt = 0.1855 (m/s)/hour
  Period of reversal              T      = 12.4 hours
  Stratification Type             STRCND = B
  Surface density                 RHOAS  = 1001.0000 kg/m^3
  Bottom density                  RHOAB  = 1019.0000 kg/m^3
  Stratification height           HINT   = 1.40 m (pycnocline level)
  Density below pycnocline        RHOAP  = 1019.0000 kg/m^3
-----------------------------------------------------------------------------
DISCHARGE PARAMETERS:             Single Port Discharge
  Nearest bank                           = right
  Distance to bank                DISTB  = 0.99 m
  Port diameter                   D0     = 0.0692 m
  Port cross-sectional area       A0     = 0.0038 m^2
  Discharge velocity              U0     = 7.59 m/s
  Discharge flowrate              Q0     = 0.028558 m^3/s
  Discharge port height           H0     = 3.49 m
  Vertical discharge angle        THETA  = -89.26 deg
  Horizontal discharge angle      SIGMA  = 90 deg
  Discharge temperature (freshwater)     = 10 degC
  Corresponding density           RHO0   = 999.7019 kg/m^3
  Density difference              DRHO   = 19.2981 kg/m^3
  Buoyant acceleration            GP0    = 0.1857 m/s^2
  Discharge concentration         C0     = 0.127 mg/l
  Surface heat exchange coeff.    KS     = 0 m/s
  Coefficient of decay            KD     = 0 /s
-----------------------------------------------------------------------------
DISCHARGE/ENVIRONMENT LENGTH SCALES:
  LQ  = 0.06 m         Lm  = 4.05 m         Lb  = 3.49 m
  LM  = 4.36 m         Lm' = 1.15 m         Lb' = 0.59 m
UNSTEADY TIDAL SCALES:
  Tu  = 0.1555 hours     Lu  = 16.14 m         Lmin= 0.17 m
-----------------------------------------------------------------------------
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NON-DIMENSIONAL PARAMETERS:
  Port densimetric Froude number  FR0    = 66.97
  Velocity ratio                  R      = 66.02
-----------------------------------------------------------------------------
MIXING ZONE / TOXIC DILUTION ZONE / AREA OF INTEREST PARAMETERS:
  Toxic discharge                        = yes
  CMC concentration               CMC    = 0.0058 mg/l
  CCC concentration               CCC    = 0.00373 mg/l
  Water quality standard specified       = given by CCC value
  Regulatory mixing zone                 = yes
  Regulatory mixing zone specification   = distance
  Regulatory mixing zone value           = 91.44 m (m^2 if area)
  Region of interest                     = 35000 m
*****************************************************************************
HYDRODYNAMIC CLASSIFICATION:
  *------------------------*
  | FLOW CLASS   = IV5 |
  *------------------------*
  This flow configuration applies to a layer corresponding to lower stratified
  density layer at the discharge site.  The density jump at the pycnocline
  confines the flow to the lower layer.
  Applicable layer depth = lower layer depth = 2.09 m
*****************************************************************************
MIXING ZONE EVALUATION (hydrodynamic and regulatory summary):

-----------------------------------------------------------------------------
X-Y-Z Coordinate system:
  Origin is located at the bottom below the port center:
    0.99 m from the right bank/shore.
  Number of display steps NSTEP = 30 per module.
-----------------------------------------------------------------------------
NEAR-FIELD REGION (NFR) CONDITIONS :
Note: The NFR is the zone of strong initial mixing.  It has no regulatory
  implication.  However, this information may be useful for the discharge
  designer because the mixing in the NFR is usually sensitive to the
  discharge design conditions.
  Pollutant concentration at NFR edge  c = 0.0086 mg/l
  Dilution at edge of NFR              s = 14.8
  NFR Location:                        x = 2.33 m
    (centerline coordinates)           y = 0.04 m
                                       z = 0 m
  NFR plume dimensions:  half-width (bh) = 3.92 m
                          thickness (bv) = 0.47 m
Cumulative travel time:       18.5677 sec.
-----------------------------------------------------------------------------
Buoyancy assessment:
  The effluent density is less than the surrounding ambient water
  density at the discharge level.
  Therefore, the effluent is POSITIVELY BUOYANT and will tend to rise towards
  the surface.
-----------------------------------------------------------------------------
Stratification assessment:
  The specified two layer ambient density stratification is dynamically
  important. The discharge near field flow will be confined to the lower
  layer by the ambient density stratification.
  Furthermore, it is trapped at the pycnocline by the ambient density
  jump.
-----------------------------------------------------------------------------
UPSTREAM INTRUSION SUMMARY:
Plume exhibits upstream intrusion due to low ambient velocity or strong
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  discharge buoyancy.
  Intrusion length                        =  2.36 m
  Intrusion stagnation point              =  -1.99 m
  Intrusion thickness                     =  0.47 m
  Intrusion half width at impingement     =  3.92 m
  Intrusion half thickness at impingement =  0.47 m
-------------------------------------------------------------------------------
PLUME BANK CONTACT SUMMARY:
  Plume in bounded section contacts one bank only at 2.33 m downstream.
-------------------------------------------------------------------------------
UNSTEADY TIDAL ASSESSMENT:
 Because of the unsteadiness of the ambient current during the tidal
  reversal, CORMIX predictions have been TERMINATED at:
                                       x = 115.64 m
                                       y = -0.99 m
                                       z = 0 m.
  For this condition AFTER TIDAL REVERSAL, mixed water from the previous
  half-cycle becomes re-entrained into the near field of the discharge,
  increasing pollutant concentrations compared to steady-state predictions.
  A pool of mixed water formed at slack tide will be advected downstream
  in this phase.
************************ TOXIC DILUTION ZONE SUMMARY ************************
Recall: The TDZ corresponds to the three (3) criteria issued in the USEPA
  Technical Support Document (TSD) for Water Quality-based Toxics Control,
  1991 (EPA/505/2-90-001).
  Criterion maximum concentration (CMC)  = 0.0058  mg/l
Corresponding dilution                   = 21.896552
The CMC was encountered at the following plume position:
  Plume location:                      x = -0.80 m
    (centerline coordinates)           y = 0.04 m
                                       z = 0.08 m
  Plume dimension:       half-width (bh) = 1.13 m
                          thickness (bv) = 0.09 m

 Computed distance from port opening to CMC location = 3.50 m.
 CRITERION 1: This location is beyond 50 times the discharge length scale of
              Lq = 0.06 m.
 +++++ The discharge length scale TEST for the TDZ has FAILED. ++++++

 Computed horizontal distance from port opening to CMC location = 0.80 m.
 CRITERION 2: This location is within 5 times the ambient water depth of
              HD = 3.49 m.
 ++++++++++ The ambient depth TEST for the TDZ has been SATISFIED. ++++++++++

 Computed distance from port opening to CMC location = 3.50 m.
 CRITERION 3: This location is within one tenth the distance of the extent
              of the Regulatory Mixing Zone of 91.51 m in any
              spatial direction from the port opening.
 +++++ The Regulatory Mixing Zone TEST for the TDZ has been SATISFIED. ++++++

 The diffuser discharge velocity is equal to 7.59 m/s.
 This exceeds the value of 3.0 m/s recommended in the TSD.

 *** This discharge DOES NOT SATISFY all three CMC criteria for the TDZ. ****
********************** REGULATORY MIXING ZONE SUMMARY **********************
The plume conditions at the boundary of the specified RMZ are as follows:
  Pollutant concentration              c = 0.003709  mg/l
  Corresponding dilution               s = 34.3
  Plume location:                      x = 91.44 m
    (centerline coordinates)           y = -0.99 m
```

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                                        z = 0 m
  Plume dimensions:      half-width (bh) = 32.29 m
                          thickness (bv) = 0.28 m
Cumulative travel time:       793.2192 sec.
At this position, the plume is CONTACTING the RIGHT bank.
Furthermore, the CCC for the toxic pollutant has indeed been met
  within the RMZ. In particular:
The CCC was encountered at the following plume position:
The CCC for the toxic pollutant was encountered at the following
  plume position:
  CCC                                     = 0.00373  mg/l
Corresponding dilution                    = 34.0
  Plume location:                       x = -1.76 m
    (centerline coordinates)            y = 0.04 m
                                        z = 0.01 m
  Plume dimensions:      half-width (bh) = 0.63 m
                          thickness (bv) = 0.11 m
********************* FINAL DESIGN ADVICE AND COMMENTS **********************
REMINDER:  The user must take note that HYDRODYNAMIC MODELING by any known
  technique is NOT AN EXACT SCIENCE.
Extensive comparison with field and laboratory data has shown that the
  CORMIX predictions on dilutions and concentrations (with associated
  plume geometries) are reliable for the majority of cases and are accurate
  to within about +-50% (standard deviation).
As a further safeguard, CORMIX will not give predictions whenever it judges
  the design configuration as highly complex and uncertain for prediction.
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CORMIX1 PREDICTION FILE:
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1111111111111111
                        CORMIX MIXING ZONE EXPERT SYSTEM
              Subsystem CORMIX1:  Single Port Discharges
                          CORMIX Version 6.0GT
                       HYDRO1 Version 6.0.0.0 October 2009
-------------------------------------------------------------------------------
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-------------------------------------------------------------------------------
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CASE DESCRIPTION
 Site name/label:   SIM
 Design case:       JD300400GPMg2Final6.0
 FILE NAME:         P:\...\V.6.0\400GPMFinalRiver\JD300400GPMgFinal6.0R.prd
 Time stamp:        Fri Mar 26 15:02:28 2010

ENVIRONMENT PARAMETERS (metric units)
 Bounded section
 BS    =    158.50  AS    =    770.54  QA    =     33.90  ICHREG= 1
 HA    =      4.86  HD    =      3.40
 Tidal Simulation at TIME =      1.120 h
 PERIOD=    12.40 h UAmax =      0.359 dUa/dt=      0.039 (m/s)/h
 UA    =      0.044 F     =      0.029 USTAR =0.2647E-02
 UW    =      8.500 UWSTAR=0.1074E-01
 Density stratified environment
 STRCND=  B         RHOAM = 1008.2064
 RHOAS = 1001.0000  RHOAB = 1019.0000  RHOAH0= 1008.2064  E     =0.0000E+00
 DRHOJ =   18.0000  HINT  =      1.36  ES    =0.1271E+00

DISCHARGE PARAMETERS (metric units)
 Above Surface Discharge:
 Re-computed discharge conditions at entry point at water surface.
 BANK  =  RIGHT     DISTB =      1.06
 D0    =      0.094 A0    =      0.007 H0    =      3.40  SUB0  =      0.00
 THETA =      0.00  SIGMA =     90.00
 U0    =      7.753 Q0    =      0.054       =0.5394E-01
 RHO0  =  999.7019  DRHO0 =0.8505E+01  GP0   =0.8272E-01
 C0    =0.1000E+00  CUNITS=  mg/l
 IPOLL =  1         KS    =0.0000E+00  KD    =0.0000E+00

FLUX VARIABLES (metric units)
 Q0    =0.5394E-01  M0    =0.4182E+00  J0    =0.4462E-02  SIGNJ0=      1.0
 Associated length scales (meters)
 LQ    =      0.08  LM    =      7.79  Lm    =     14.70  Lb    =     52.38
                                       Lmp   =  99999.00  Lbp   =  99999.00
 Tidal:             Tu    =   0.4882 h Lu    =     33.713 Lmin  =      0.232

NON-DIMENSIONAL PARAMETERS
 FR0   =     87.87  R     =    176.21

FLOW CLASSIFICATION
 1111111111111111111111111111111111111111111
 1  Flow class (CORMIX1)      =    IPV5   1
 1  Applicable layer depth HS =     3.40  1
 1111111111111111111111111111111111111111111

MIXING ZONE / TOXIC DILUTION / REGION OF INTEREST PARAMETERS
 C0    =0.1000E+00  CUNITS=  mg/l
 NTOX  =  1         CMC   =0.5800E-02  CCC   =  CSTD
```

```
 NSTD  =  1         CSTD  =0.3730E-02
 REGMZ =  1
 REGSPC=  1         XREG  =     91.44  WREG  =      0.00  AREG  =      0.00
 XINT  =   3500.00  XMAX  =   3500.00

X-Y-Z COORDINATE SYSTEM:
    ORIGIN is located at the bottom and below the center of the port:
         1.06 m  from the RIGHT bank/shore.
    X-axis points downstream, Y-axis points to left, Z-axis points upward.
NSTEP =  30 display intervals per module
-------------------------------------------------------------------------------
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-------------------------------------------------------------------------------
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BEGIN MOD101: DISCHARGE MODULE

       X        Y       Z        S       C       B        Uc        TT
      0.00     0.00    3.40     1.0 0.100E+00   0.05    7.753   .00000E+00

END OF MOD101: DISCHARGE MODULE
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BEGIN MOD134: UNSTABLE RECIRCULATION REGION OVER LAYER DEPTH

 INITIAL LOCAL VERTICAL INSTABILITY REGION:
   Bulk dilution (S =  17.93) occurs in a limited region (horizontal extent
   =    23.36 m) surrounding the discharge location.

  Control volume inflow:
       X        Y       Z        S       C       B        TT
      0.00     0.00    3.40     1.0 0.100E+00   0.05 .00000E+00

** CMC HAS BEEN FOUND **
 The pollutant concentration in the plume falls below CMC value of 0.580E-02
   due to mixing in this control volume.
 The actual extent of the TOXIC DILUTION ZONE will be smaller than control
   volume outflow values predicted below.

  Control volume outflow:
       X        Y       Z        S       C       BV       BH      ZU      ZL
TT
      0.00     0.00    3.40     1.0 0.100E+00   8.51     0.00    0.00    0.00
.00000E+00

END OF MOD134: UNSTABLE RECIRCULATION REGION OVER LAYER DEPTH
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-------------------------------------------------------------------------------
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BEGIN MOD134a: UPSTREAM SPREADING AFTER NEAR-FIELD INSTABILITY

 UPSTREAM INTRUSION PROPERTIES:
        Upstream intrusion length               =       5.19 m
        X-position of upstream stagnation point =      -5.19 m
        Thickness in intrusion region           =       1.76 m
        Half-width at downstream end            =     117.52 m
        Thickness at downstream end             =       0.20 m
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```
  Control volume inflow:
       X        Y       Z        S       C       B        TT
      0.00     0.00    1.70    17.9 0.558E-02   0.05 .00000E+00

 Profile definitions:
   BV = top-hat thickness, measured vertically
   BH = top-hat half-width, measured horizontally in Y-direction
   ZU = upper plume boundary (Z-coordinate)
   ZL = lower plume boundary (Z-coordinate)
   S  = hydrodynamic average (bulk) dilution
   C  = average (bulk) concentration (includes reaction effects, if any)
   TT = Cumulative travel time

       X        Y       Z        S       C       BV       BH      ZU      ZL
TT
     -5.19     0.00    3.40  9986.4 0.000E+00   0.00     0.00    3.40    3.40
.13354E+04
**WATER QUALITY STANDARD OR CCC HAS BEEN FOUND**
 The pollutant concentration in the plume falls below water quality standard
   or CCC value of 0.373E-02 in the current prediction interval.
 This is the spatial extent of concentrations exceeding the water quality
   standard or CCC value.
     -3.91     0.00    3.40    29.2 0.343E-02   1.08    16.62    3.40    2.32
.00000E+00
      2.35     0.00    3.40    18.0 0.554E-02   1.75    40.37    3.40    1.65
.53522E+02
      8.62     0.00    3.40    19.5 0.512E-02   1.63    54.62    3.40    1.77
.19596E+03
     14.89     0.00    3.40    22.3 0.448E-02   1.41    65.85    3.40    2.00
.33839E+03
     21.16     0.00    3.40    25.8 0.388E-02   1.13    75.43    3.40    2.28
.48082E+03
     27.42     0.00    3.40    29.2 0.342E-02   0.85    83.92    3.40    2.55
.62326E+03
     33.69     0.00    3.40    32.1 0.312E-02   0.62    91.63    3.40    2.79
.76569E+03
     39.96     0.00    3.40    34.2 0.292E-02   0.44    98.74    3.40    2.96
.90812E+03
     46.22     0.00    3.40    35.6 0.281E-02   0.33   105.37    3.40    3.08
.10506E+04
     52.49     0.00    3.40    36.4 0.275E-02   0.26   111.61    3.40    3.14
.11930E+04
     58.76     0.00    3.40    37.1 0.269E-02   0.20   117.52    3.40    3.21
.13354E+04
 Cumulative travel time =        1335.4260 sec

END OF MOD134a: UPSTREAM SPREADING AFTER NEAR-FIELD INSTABILITY
-------------------------------------------------------------------------------
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** End of NEAR-FIELD REGION (NFR) **

 In this design case, the discharge is located CLOSE TO BANK/SHORE.
 Some boundary interaction occurs at end of near-field.
   This may be related to a design case with a very LOW AMBIENT VELOCITY.
   The dilution values in one or more of the preceding zones may be too high.
 Carefully evaluate results in near-field and check degree of interaction.

 Consider locating outfall further away from bank or shore.
 In the next prediction module, the plume centerline will be set
   to follow the bank/shore.
```

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-------------------------------------------------------------------------------
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BEGIN MOD141: BUOYANT AMBIENT SPREADING

 Plume is ATTACHED to RIGHT bank/shore.
   Plume width is now determined from RIGHT bank/shore.

 Profile definitions:
   BV = top-hat thickness, measured vertically
   BH = top-hat half-width, measured horizontally in Y-direction
   ZU = upper plume boundary (Z-coordinate)
   ZL = lower plume boundary (Z-coordinate)
   S  = hydrodynamic average (bulk) dilution
   C  = average (bulk) concentration (includes reaction effects, if any)
   TT = Cumulative travel time

 Plume Stage 2 (bank attached):
       X        Y       Z        S       C       BV       BH      ZU      ZL
TT
     58.76    -1.06    3.40    37.1 0.269E-02   0.39   118.58    3.40    3.01
.13354E+04
     64.72    -1.06    3.40    41.6 0.240E-02   0.43   119.65    3.40    2.97
.14707E+04
     70.68    -1.06    3.40    46.1 0.217E-02   0.48   120.76    3.40    2.93
.16059E+04
     76.64    -1.06    3.40    50.7 0.197E-02   0.52   121.90    3.40    2.88
.17411E+04
     82.60    -1.06    3.40    55.5 0.180E-02   0.56   123.07    3.40    2.84
.18764E+04
     88.56    -1.06    3.40    60.3 0.166E-02   0.61   124.26    3.40    2.80
.20116E+04
 ** REGULATORY MIXING ZONE BOUNDARY **
 In this prediction interval the plume DOWNSTREAM  distance meets or exceeds
 the regulatory value =    91.44 m.
 This is the extent of the REGULATORY MIXING ZONE.
     88.70    -1.06    3.40    60.4 0.166E-02   0.61   124.29    3.40    2.80
 Cumulative travel time =        2014.9191 sec

 CORMIX prediction has been TERMINATED at last prediction interval.
   Limiting time due to TIDAL REVERSAL has been reached.

END OF MOD141: BUOYANT AMBIENT SPREADING
-------------------------------------------------------------------------------
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-------------------------------------------------------------------------------
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CORMIX1: Single Port Discharges              End of Prediction File
1111111111111111111111111111111111111111111111111111111111111111111111111111111
1111111111111111
```

```
CORMIX SESSION REPORT:
XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
                      CORMIX MIXING ZONE EXPERT SYSTEM
                          CORMIX Version 6.0GT
                       HYDRO1:Version-6.0.0.0  October,2009
SITE NAME/LABEL:                SIM
  DESIGN CASE:                  JD300400GPMg2Final6.0
  FILE NAME:
P:\Mixing\CriticalDischargeScenarios\V.6.0\400GPMFinalRiver\JD300400GPMgFinal6.
0R.prd
  Using subsystem CORMIX1:     Single Port Discharges
  Start of session:             03/26/2010--15:02:28
*****************************************************************************
SUMMARY OF INPUT DATA:
-----------------------------------------------------------------------------
AMBIENT PARAMETERS:
  Cross-section                          = bounded
  Width                           BS     = 158.50 m
  Channel regularity              ICHREG = 1
  Ambient flowrate                QA     = 33.90 m^3/s
  Average depth                   HA     = 4.86 m
  Depth at discharge              HD     = 3.40 m
  Darcy-Weisbach friction factor  F      = 0.0290
    Calculated from Manning's n          = 0.025
  Wind velocity                   UW     = 8.5 m/s
TIDAL SIMULATION at time          Tsim   = 1.12 hours
  Instantaneous ambient velocity  UA     = 0.044 m/s
  Maximum tidal velocity          UaMAX  = 0.359 m/s
Rate of tidal reversal          dUA/dt = 0.0393 (m/s)/hour
  Period of reversal              T      = 12.4 hours
  Stratification Type             STRCND = B
  Surface density                 RHOAS  = 1001.0000 kg/m^3
  Bottom density                  RHOAB  = 1019.0000 kg/m^3
  Stratification height           HINT   = 1.36 m (pycnocline level)
  Density below pycnocline        RHOAP  = 1019.0000 kg/m^3
-----------------------------------------------------------------------------
DISCHARGE PARAMETERS:             Single Port Discharge
  Nearest bank                           = right
  Distance to bank                DISTB  = 1.06 m
  Port diameter                   D0     = 0.0941 m
  Port cross-sectional area       A0     = 0.0070 m^2
  Discharge velocity              U0     = 7.75 m/s
  Discharge flowrate              Q0     = 0.053935 m^3/s
  Discharge port height           H0     = 3.40 m
  Vertical discharge angle        THETA  = -88.63 deg
  Horizontal discharge angle      SIGMA  = 90 deg
  Discharge temperature (freshwater)     = 10 degC
  Corresponding density           RHO0   = 999.7019 kg/m^3
  Density difference              DRHO   = 8.5045 kg/m^3
  Buoyant acceleration            GP0    = 0.0827 m/s^2
  Discharge concentration         C0     = 0.1 mg/l
  Surface heat exchange coeff.    KS     = 0 m/s
  Coefficient of decay            KD     = 0 /s
-----------------------------------------------------------------------------
DISCHARGE/ENVIRONMENT LENGTH SCALES:
  LQ  = 0.08 m         Lm  = 14.70 m         Lb  = 52.38 m
  LM  = 7.79 m         Lm' = 99999 m         Lb' = 99999 m
UNSTEADY TIDAL SCALES:
  Tu  = 0.4882 hours     Lu  = 33.71 m         Lmin= 0.23 m
-----------------------------------------------------------------------------
```

```
NON-DIMENSIONAL PARAMETERS:
  Port densimetric Froude number  FR0    = 87.87
  Velocity ratio                  R      = 176.21
-----------------------------------------------------------------------------
MIXING ZONE / TOXIC DILUTION ZONE / AREA OF INTEREST PARAMETERS:
  Toxic discharge                        = yes
  CMC concentration               CMC    = 0.0058 mg/l
  CCC concentration               CCC    = 0.00373 mg/l
  Water quality standard specified       = given by CCC value
  Regulatory mixing zone                 = yes
  Regulatory mixing zone specification   = distance
  Regulatory mixing zone value           = 91.44 m (m^2 if area)
  Region of interest                     = 3500 m
*****************************************************************************
HYDRODYNAMIC CLASSIFICATION:
  *------------------------*
  | FLOW CLASS   = IPV5 |
  *------------------------*
  This flow configuration applies to a layer corresponding to the full water
  depth at the discharge site.  The ambient density stratification at the
  discharge site is relatively weak and unimportant so the discharge flow
  penetrates to the surface and/or breaks down the existing stratification
  through vigorous mixing.
  Applicable layer depth = water depth = 3.40 m
*****************************************************************************
MIXING ZONE EVALUATION (hydrodynamic and regulatory summary):

-----------------------------------------------------------------------------
X-Y-Z Coordinate system:
  Origin is located at the bottom below the port center:
    1.06 m from the right bank/shore.
  Number of display steps NSTEP = 30 per module.
-----------------------------------------------------------------------------
NEAR-FIELD REGION (NFR) CONDITIONS :
Note: The NFR is the zone of strong initial mixing.  It has no regulatory
  implication.  However, this information may be useful for the discharge
  designer because the mixing in the NFR is usually sensitive to the
  discharge design conditions.
  Pollutant concentration at NFR edge  c = 0.0027 mg/l
  Dilution at edge of NFR              s = 37.1
  NFR Location:                        x = 58.76 m
    (centerline coordinates)           y = 0 m
                                       z = 3.40 m
  NFR plume dimensions:  half-width (bh) = 117.52 m
                          thickness (bv) = 0.20 m
Cumulative travel time:       1335.4261 sec.
-----------------------------------------------------------------------------
Buoyancy assessment:
  The effluent density is less than the surrounding ambient water
  density at the discharge level.
  Therefore, the effluent is POSITIVELY BUOYANT and will tend to rise towards
  the surface.
-----------------------------------------------------------------------------
Stratification assessment:
  The specified ambient density stratification is weak relative to the
  discharge conditions and is dynamically unimportant. The discharge will
  behave as if the ambient were unstratified.
-----------------------------------------------------------------------------
UPSTREAM INTRUSION SUMMARY:
Plume exhibits upstream intrusion due to low ambient velocity or strong
```

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  discharge buoyancy.
  Intrusion length                        =  5.19 m
  Intrusion stagnation point              =  -5.19 m
  Intrusion thickness                     =  1.76 m
  Intrusion half width at impingement     =  117.52 m
  Intrusion half thickness at impingement =  0.20 m
-------------------------------------------------------------------------------
FAR-FIELD MIXING SUMMARY:
  Plume becomes vertically fully mixed WITHIN NEAR-FIELD at 0 m
  downstream, but RE-STRATIFIES LATER and is not mixed in the far-field.
-------------------------------------------------------------------------------
PLUME BANK CONTACT SUMMARY:
  Plume in bounded section contacts nearest bank at 58.76 m downstream.
  Plume contacts second bank at 237.55 m downstream.
-------------------------------------------------------------------------------
UNSTEADY TIDAL ASSESSMENT:
 Because of the unsteadiness of the ambient current during the tidal
  reversal, CORMIX predictions have been TERMINATED at:
                                       x = 88.70 m
                                       y = -1.06 m
                                       z = 3.40 m.
  For this condition AFTER TIDAL REVERSAL, mixed water from the previous
  half-cycle becomes re-entrained into the near field of the discharge,
  increasing pollutant concentrations compared to steady-state predictions.
  A pool of mixed water formed at slack tide will be advected downstream
  in this phase.
************************ TOXIC DILUTION ZONE SUMMARY ************************
Recall: The TDZ corresponds to the three (3) criteria issued in the USEPA
  Technical Support Document (TSD) for Water Quality-based Toxics Control,
  1991 (EPA/505/2-90-001).
  Criterion maximum concentration (CMC)  = 0.0058  mg/l
Corresponding dilution                   = 17.241379
The CMC was encountered within a control volume describing a portion
  of the discharge plume.
Therefore, the following plume conditions are a conservative estimate (with
  lower concentrations or with larger dimensions) for the region at whose
  boundary the CMC is met:
  Local boundary concentration           = 0.005579  mg/l
Corresponding dilution                   = 17.925700
  Plume location:                      x = 0 m
    (centerline coordinates)           y = 0 m
                                       z = 1.70 m
  Plume dimension:       half-width (bh) = 8.51 m
                          thickness (bv) = 0 m

 Computed distance from port opening to CMC location = 1.70 m.
 CRITERION 1: This location is within 50 times the discharge length scale of
              Lq = 0.08 m.
 +++++ The discharge length scale TEST for the TDZ has been SATISFIED. ++++++

 Computed horizontal distance from port opening to CMC location = 0 m.
 CRITERION 2: This location is within 5 times the ambient water depth of
              HD = 3.40 m.
 ++++++++++ The ambient depth TEST for the TDZ has been SATISFIED. ++++++++++

 Computed distance from port opening to CMC location = 1.70 m.
 CRITERION 3: This location is within one tenth the distance of the extent
              of the Regulatory Mixing Zone of 91.45 m in any
              spatial direction from the port opening.
 +++++ The Regulatory Mixing Zone TEST for the TDZ has been SATISFIED. ++++++
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```
 The diffuser discharge velocity is equal to 7.75 m/s.
 This exceeds the value of 3.0 m/s recommended in the TSD.

 *** All three CMC criteria for the TDZ are SATISFIED for this discharge. ***
********************** REGULATORY MIXING ZONE SUMMARY **********************
The plume conditions at the boundary of the specified RMZ are as follows:
  Pollutant concentration              c = 0.001597  mg/l
  Corresponding dilution               s = 62.6
  Plume location:                      x = 91.44 m
    (centerline coordinates)           y = -1.06 m
                                       z = 3.40 m
  Plume dimensions:      half-width (bh) = 124.85 m
                          thickness (bv) = 0.63 m
Cumulative travel time:       2077.0022 sec.
At this position, the plume is CONTACTING the RIGHT bank.
Furthermore, the CCC for the toxic pollutant has indeed been met
  within the RMZ. In particular:
The CCC was encountered at the following plume position:
The CCC for the toxic pollutant was encountered at the following
  plume position:
  CCC                                    = 0.00373  mg/l
Corresponding dilution                   = 26.8
  Plume location:                      x = -3.88 m
    (centerline coordinates)           y = 0 m
                                       z = 3.40 m
  Plume dimensions:      half-width (bh) = 16.93 m
                          thickness (bv) = 1.08 m
********************* FINAL DESIGN ADVICE AND COMMENTS *********************
REMINDER:  The user must take note that HYDRODYNAMIC MODELING by any known
  technique is NOT AN EXACT SCIENCE.
Extensive comparison with field and laboratory data has shown that the
  CORMIX predictions on dilutions and concentrations (with associated
  plume geometries) are reliable for the majority of cases and are accurate
  to within about +-50% (standard deviation).
As a further safeguard, CORMIX will not give predictions whenever it judges
  the design configuration as highly complex and uncertain for prediction.
```

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CORMIX1 PREDICTION FILE:
1111111111111111111111111111111111111111111111111111111111111111111111111111111111
1111111111111111
                        CORMIX MIXING ZONE EXPERT SYSTEM
              Subsystem CORMIX1:  Single Port Discharges
                          CORMIX Version 6.0GT
                       HYDRO1 Version 6.0.0.0 October 2009
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-------------------------------------------------------------------------------
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CASE DESCRIPTION
 Site name/label:
 Design case:       JD309(2)400GPMaSteadyFinal
 FILE NAME:         P:\...0GPMFinalRiver\JD309(2)400GPMaSteadyFinal6.0R.prd
 Time stamp:        Fri Mar 26 14:21:47 2010

ENVIRONMENT PARAMETERS (metric units)
 Bounded section
 BS    =    158.50  AS    =    972.57  QA    =    109.90  ICHREG= 1
 HA    =      6.14  HD    =      4.30
 UA    =      0.113 F     =      0.027 USTAR =0.6540E-02
 UW    =      9.300 UWSTAR=0.1193E-01
 Uniform density environment
 STRCND=  U         RHOAM = 1001.0000

DISCHARGE PARAMETERS (metric units)
 Above Surface Discharge:
 Re-computed discharge conditions at entry point at water surface.
 BANK  =  RIGHT     DISTB =      0.97
 D0    =      0.078 A0    =      0.005 H0    =      4.30  SUB0  =      0.00
 THETA =      0.00  SIGMA =     90.00
 U0    =      5.924 Q0    =      0.029       =0.2856E-01
 RHO0  =  999.7019  DRHO0 =0.1298E+01  GP0   =0.1272E-01
 C0    =0.1150E+00  CUNITS=  mg/l
 IPOLL =  1         KS    =0.0000E+00  KD    =0.0000E+00

FLUX VARIABLES (metric units)
 Q0    =0.2856E-01  M0    =0.1692E+00  J0    =0.3632E-03  SIGNJ0=      1.0
 Associated length scales (meters)
 LQ    =      0.07  LM    =     13.84  Lm    =      3.64  Lb    =      0.25
                                       Lmp   =  99999.00  Lbp   =  99999.00

NON-DIMENSIONAL PARAMETERS
 FR0   =    187.66  R     =     52.42

FLOW CLASSIFICATION
 111111111111111111111111111111111111111111
 1  Flow class (CORMIX1)      =    IPV4   1
 1  Applicable layer depth HS =     4.30  1
 111111111111111111111111111111111111111111

MIXING ZONE / TOXIC DILUTION / REGION OF INTEREST PARAMETERS
 C0    =0.1150E+00  CUNITS=  mg/l
 NTOX  =  1         CMC   =0.5800E-02  CCC   =  CSTD
 NSTD  =  1         CSTD  =0.3730E-02
 REGMZ =  1
 REGSPC=  1         XREG  =     91.44  WREG  =      0.00  AREG  =      0.00
 XINT  =   3500.00  XMAX  =   3500.00
```

```
X-Y-Z COORDINATE SYSTEM:
    ORIGIN is located at the bottom and below the center of the port:
         0.97 m  from the RIGHT bank/shore.
    X-axis points downstream, Y-axis points to left, Z-axis points upward.
NSTEP =  30 display intervals per module
-------------------------------------------------------------------------------
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-------------------------------------------------------------------------------
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BEGIN MOD101: DISCHARGE MODULE

       X        Y       Z        S       C       B        Uc        TT
      0.00     0.00    4.30     1.0 0.115E+00   0.04    5.924   .00000E+00

END OF MOD101: DISCHARGE MODULE
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-------------------------------------------------------------------------------
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BEGIN CORJET (MOD110): JET/PLUME NEAR-FIELD MIXING REGION

 Jet-like motion in weak crossflow.
   UNSTABLE NEAR-FIELD: Jet/plume will mix over full layer depth.
   Following MOD133 will include recirculation into jet region.

 Zone of flow establishment:            THETAE=    -88.95  SIGMAE=     64.44
  LE    =      0.37  XE    =      0.00  YE    =      0.01  ZE    =      3.93

 Profile definitions:
   B = Gaussian 1/e (37%) half-width, normal to trajectory
   S = hydrodynamic centerline dilution
   C = centerline concentration (includes reaction effects, if any)
  Uc = Local centerline excess velocity (above ambient)
  TT = Cumulative travel time

       X        Y       Z        S       C       B        Uc        TT
      0.00     0.00    4.30     1.0 0.115E+00   0.04    5.924   .00000E+00
      0.00     0.01    3.93     1.0 0.115E+00   0.04    5.924   .22170E-02
      0.00     0.01    3.82     1.1 0.102E+00   0.05    5.924   .17727E-01
      0.01     0.01    3.70     1.4 0.812E-01   0.07    4.930   .40613E-01
      0.01     0.01    3.57     1.7 0.673E-01   0.08    4.084   .68676E-01
      0.01     0.01    3.47     2.0 0.586E-01   0.09    3.558   .96867E-01
      0.02     0.02    3.34     2.3 0.510E-01   0.11    3.090   .13460E+00
      0.03     0.02    3.24     2.5 0.458E-01   0.12    2.775   .17113E+00
      0.04     0.02    3.12     2.8 0.409E-01   0.13    2.478   .21865E+00
      0.05     0.02    2.99     3.1 0.370E-01   0.15    2.235   .27150E+00
      0.06     0.02    2.89     3.4 0.341E-01   0.16    2.060   .32107E+00
      0.07     0.03    2.76     3.7 0.312E-01   0.17    1.886   .38393E+00
      0.09     0.03    2.64     4.0 0.288E-01   0.19    1.737   .45228E+00
      0.10     0.03    2.53     4.3 0.270E-01   0.20    1.625   .51527E+00
      0.12     0.03    2.41     4.6 0.251E-01   0.21    1.509   .59397E+00
      0.14     0.03    2.29     4.9 0.234E-01   0.23    1.407   .67836E+00
      0.16     0.04    2.19     5.2 0.222E-01   0.24    1.328   .75528E+00
      0.18     0.04    2.06     5.5 0.208E-01   0.26    1.245   .85046E+00
      0.20     0.04    1.94     5.9 0.196E-01   0.27    1.171   .95159E+00
      0.23     0.04    1.84     6.2 0.187E-01   0.28    1.112   .10431E+01
      0.25     0.04    1.72     6.5 0.177E-01   0.30    1.049   .11556E+01
      0.28     0.04    1.60     6.9 0.167E-01   0.32    0.991   .12743E+01
      0.31     0.05    1.48     7.2 0.159E-01   0.33    0.938   .13995E+01
      0.34     0.05    1.38     7.6 0.152E-01   0.35    0.895   .15120E+01
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      0.38     0.05    1.26     8.0 0.145E-01   0.36    0.849   .16495E+01
      0.42     0.05    1.14     8.3 0.138E-01   0.38    0.806   .17938E+01
      0.45     0.05    1.04     8.7 0.132E-01   0.39    0.771   .19230E+01
      0.49     0.06    0.92     9.1 0.126E-01   0.41    0.733   .20804E+01
      0.53     0.06    0.81     9.5 0.121E-01   0.43    0.697   .22451E+01
      0.57     0.06    0.71     9.9 0.116E-01   0.45    0.668   .23923E+01
      0.62     0.06    0.59    10.4 0.111E-01   0.46    0.636   .25710E+01
      0.67     0.06    0.48    10.8 0.107E-01   0.48    0.610   .27305E+01
 Cumulative travel time =           2.7305 sec

END OF CORJET (MOD110): JET/PLUME NEAR-FIELD MIXING REGION
-------------------------------------------------------------------------------
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-------------------------------------------------------------------------------
---------------
BEGIN MOD133: LAYER BOUNDARY IMPINGEMENT/FULL VERTICAL MIXING

  Control volume inflow:
       X        Y       Z        S       C       B        TT
      0.67     0.06    0.48    10.8 0.107E-01   0.48 .27305E+01

 Profile definitions:
   BV = layer depth (vertically mixed)
   BH = top-hat half-width, in horizontal plane normal to trajectory
   ZU = upper plume boundary (Z-coordinate)
   ZL = lower plume boundary (Z-coordinate)
   S  = hydrodynamic average (bulk) dilution
   C  = average (bulk) concentration (includes reaction effects, if any)
   TT = Cumulative travel time

       X        Y       Z        S       C       BV       BH      ZU      ZL
TT
      0.19     0.14    4.30    10.8 0.107E-01   0.00     0.00    4.30    4.30
.27305E+01
      0.67     0.14    4.30    10.8 0.107E-01   4.30     0.14    4.30    0.00
.27305E+01
      1.15     0.14    4.30    11.0 0.105E-01   4.30     0.20    4.30    0.00
.69398E+01
      1.62     0.14    4.30    11.5 0.997E-02   4.30     0.24    4.30    0.00
.11165E+02
      2.10     0.14    4.30    12.3 0.934E-02   4.30     0.28    4.30    0.00
.15390E+02
      2.58     0.14    4.30    13.1 0.877E-02   4.30     0.31    4.30    0.00
.19616E+02
      3.06     0.14    4.30    13.8 0.832E-02   4.30     0.34    4.30    0.00
.23841E+02
      3.53     0.14    4.30    14.3 0.802E-02   4.30     0.37    4.30    0.00
.28067E+02
      4.01     0.14    4.30    14.7 0.783E-02   4.30     0.40    4.30    0.00
.32292E+02
      4.49     0.14    4.30    14.9 0.772E-02   4.30     0.42    4.30    0.00
.36517E+02
      4.97     0.14    4.30    15.1 0.763E-02   4.30     0.44    4.30    0.00
.40743E+02
 Cumulative travel time =          40.7426 sec

END OF MOD133: LAYER BOUNDARY IMPINGEMENT/FULL VERTICAL MIXING
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** End of NEAR-FIELD REGION (NFR) **
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BEGIN MOD141: BUOYANT AMBIENT SPREADING

 Profile definitions:
   BV = top-hat thickness, measured vertically
   BH = top-hat half-width, measured horizontally in Y-direction
   ZU = upper plume boundary (Z-coordinate)
   ZL = lower plume boundary (Z-coordinate)
   S  = hydrodynamic average (bulk) dilution
   C  = average (bulk) concentration (includes reaction effects, if any)
   TT = Cumulative travel time

 Plume Stage 1 (not bank attached):
       X        Y       Z        S       C       BV       BH      ZU      ZL
TT
      4.97     0.14    4.30    15.1 0.763E-02   4.30     0.44    4.30    0.00
.40743E+02
      5.04     0.14    4.30    15.3 0.751E-02   4.09     0.47    4.30    0.20
.41439E+02
      5.12     0.14    4.30    15.5 0.740E-02   3.92     0.50    4.30    0.38
.42136E+02
      5.20     0.14    4.30    15.7 0.730E-02   3.77     0.53    4.30    0.53
.42833E+02
      5.28     0.14    4.30    15.9 0.721E-02   3.63     0.56    4.30    0.67
.43530E+02
      5.36     0.14    4.30    16.1 0.713E-02   3.51     0.58    4.30    0.79
.44227E+02
      5.44     0.14    4.30    16.3 0.705E-02   3.39     0.61    4.30    0.90
.44924E+02
      5.52     0.14    4.30    16.5 0.698E-02   3.29     0.63    4.30    1.00
.45620E+02
      5.60     0.14    4.30    16.6 0.691E-02   3.20     0.66    4.30    1.09
.46317E+02
      5.67     0.14    4.30    16.8 0.685E-02   3.12     0.68    4.30    1.18
.47014E+02
      5.75     0.14    4.30    16.9 0.679E-02   3.04     0.70    4.30    1.26
.47711E+02
      5.83     0.14    4.30    17.1 0.674E-02   2.96     0.73    4.30    1.33
.48408E+02
      5.91     0.14    4.30    17.2 0.669E-02   2.90     0.75    4.30    1.40
.49105E+02
      5.99     0.14    4.30    17.3 0.664E-02   2.83     0.77    4.30    1.46
.49801E+02
      6.07     0.14    4.30    17.5 0.659E-02   2.77     0.80    4.30    1.52
.50498E+02
      6.15     0.14    4.30    17.6 0.654E-02   2.72     0.82    4.30    1.58
.51195E+02
      6.23     0.14    4.30    17.7 0.650E-02   2.66     0.84    4.30    1.63
.51892E+02
      6.30     0.14    4.30    17.8 0.646E-02   2.61     0.86    4.30    1.68
.52589E+02
      6.38     0.14    4.30    17.9 0.642E-02   2.57     0.88    4.30    1.73
.53286E+02
      6.46     0.14    4.30    18.0 0.638E-02   2.52     0.90    4.30    1.77
.53983E+02
      6.54     0.14    4.30    18.1 0.635E-02   2.48     0.92    4.30    1.82
.54679E+02
      6.62     0.14    4.30    18.2 0.631E-02   2.44     0.94    4.30    1.86
.55376E+02
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      6.70     0.14    4.30    18.3 0.628E-02   2.40     0.96    4.30    1.89
.56073E+02
      6.78     0.14    4.30    18.4 0.624E-02   2.37     0.98    4.30    1.93
.56770E+02
      6.86     0.14    4.30    18.5 0.621E-02   2.33     1.00    4.30    1.96
.57467E+02
      6.93     0.14    4.30    18.6 0.618E-02   2.30     1.02    4.30    2.00
.58164E+02
      7.01     0.14    4.30    18.7 0.615E-02   2.27     1.04    4.30    2.03
.58860E+02
      7.09     0.14    4.30    18.8 0.612E-02   2.23     1.06    4.30    2.06
.59557E+02
      7.17     0.14    4.30    18.9 0.610E-02   2.21     1.08    4.30    2.09
.60254E+02
      7.25     0.14    4.30    18.9 0.607E-02   2.18     1.10    4.30    2.12
.60951E+02
      7.33     0.14    4.30    19.0 0.604E-02   2.15     1.12    4.30    2.15
.61648E+02
 Cumulative travel time =          61.6478 sec

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 Plume is ATTACHED to RIGHT bank/shore.
   Plume width is now determined from RIGHT bank/shore.

 Plume Stage 2 (bank attached):
       X        Y       Z        S       C       BV       BH      ZU      ZL
TT
      7.33    -0.97    4.30    19.0 0.604E-02   2.15     2.24    4.30    2.15
.61648E+02
** CMC HAS BEEN FOUND **
 The pollutant concentration in the plume falls below CMC value of 0.580E-02
   in the current prediction interval.
 This is the extent of the TOXIC DILUTION ZONE.
     13.57    -0.97    4.30    21.6 0.532E-02   1.55     3.52    4.30    2.75
.11685E+03
     19.81    -0.97    4.30    23.6 0.487E-02   1.30     4.59    4.30    3.00
.17206E+03
     26.05    -0.97    4.30    25.6 0.450E-02   1.17     5.54    4.30    3.13
.22727E+03
     32.29    -0.97    4.30    27.6 0.416E-02   1.09     6.41    4.30    3.21
.28247E+03
     38.53    -0.97    4.30    29.9 0.384E-02   1.05     7.21    4.30    3.25
.33768E+03
**WATER QUALITY STANDARD OR CCC HAS BEEN FOUND**
 The pollutant concentration in the plume falls below water quality standard
   or CCC value of 0.373E-02 in the current prediction interval.
 This is the spatial extent of concentrations exceeding the water quality
   standard or CCC value.
     44.77    -0.97    4.30    32.5 0.354E-02   1.03     7.96    4.30    3.26
.39289E+03
     51.01    -0.97    4.30    35.4 0.325E-02   1.03     8.68    4.30    3.27
.44809E+03
     57.25    -0.97    4.30    38.6 0.298E-02   1.04     9.36    4.30    3.25
.50330E+03
     63.49    -0.97    4.30    42.2 0.273E-02   1.06    10.02    4.30    3.23
.55851E+03
     69.73    -0.97    4.30    46.2 0.249E-02   1.09    10.65    4.30    3.20
.61371E+03
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     75.97    -0.97    4.30    50.6 0.227E-02   1.13    11.27    4.30    3.16
.66892E+03
     82.21    -0.97    4.30    55.4 0.208E-02   1.18    11.87    4.30    3.12
.72412E+03
     88.45    -0.97    4.30    60.7 0.190E-02   1.23    12.45    4.30    3.06
.77933E+03
 ** REGULATORY MIXING ZONE BOUNDARY **
 In this prediction interval the plume DOWNSTREAM  distance meets or exceeds
 the regulatory value =    91.44 m.
 This is the extent of the REGULATORY MIXING ZONE.
     94.69    -0.97    4.30    66.4 0.173E-02   1.29    13.02    4.30    3.01
.83454E+03
    100.93    -0.97    4.30    72.6 0.158E-02   1.35    13.57    4.30    2.94
.88974E+03
    107.17    -0.97    4.30    79.3 0.145E-02   1.42    14.12    4.30    2.88
.94495E+03
    113.41    -0.97    4.30    86.5 0.133E-02   1.49    14.66    4.30    2.80
.10002E+04
    119.65    -0.97    4.30    94.2 0.122E-02   1.57    15.18    4.30    2.73
.10554E+04
    125.89    -0.97    4.30   102.4 0.112E-02   1.65    15.70    4.30    2.65
.11106E+04
    132.13    -0.97    4.30   111.1 0.104E-02   1.73    16.21    4.30    2.56
.11658E+04
    138.37    -0.97    4.30   120.4 0.955E-03   1.82    16.72    4.30    2.48
.12210E+04
    144.61    -0.97    4.30   130.2 0.883E-03   1.91    17.22    4.30    2.38
.12762E+04
    150.85    -0.97    4.30   140.6 0.818E-03   2.01    17.71    4.30    2.29
.13314E+04
    157.09    -0.97    4.30   151.6 0.759E-03   2.11    18.19    4.30    2.19
.13866E+04
    163.33    -0.97    4.30   163.1 0.705E-03   2.21    18.67    4.30    2.09
.14418E+04
    169.57    -0.97    4.30   175.2 0.656E-03   2.31    19.14    4.30    1.98
.14970E+04
    175.81    -0.97    4.30   188.0 0.612E-03   2.42    19.61    4.30    1.87
.15522E+04
    182.05    -0.97    4.30   201.3 0.571E-03   2.53    20.08    4.30    1.76
.16074E+04
    188.29    -0.97    4.30   215.2 0.534E-03   2.65    20.53    4.30    1.65
.16626E+04
    194.53    -0.97    4.30   229.8 0.500E-03   2.77    20.99    4.30    1.53
.17178E+04
 Cumulative travel time =        1717.8406 sec

END OF MOD141: BUOYANT AMBIENT SPREADING
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 Bottom coordinate for FAR-FIELD is determined by average depth, ZFB = -1.84m
-------------------------------------------------------------------------------
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BEGIN MOD161: PASSIVE AMBIENT MIXING IN UNIFORM AMBIENT

  Vertical diffusivity (initial value)   = 0.108E-01 m^2/s
  Horizontal diffusivity (initial value) = 0.135E-01 m^2/s

 Profile definitions:
   BV = Gaussian s.d.*sqrt(pi/2) (46%) thickness, measured vertically
      = or equal to layer depth, if fully mixed
```

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   BH = Gaussian s.d.*sqrt(pi/2) (46%) half-width,
        measured horizontally in Y-direction
   ZU = upper plume boundary (Z-coordinate)
   ZL = lower plume boundary (Z-coordinate)
   S  = hydrodynamic centerline dilution
   C  = centerline concentration (includes reaction effects, if any)
   TT = Cumulative travel time

 Plume Stage 2 (bank attached):
      X        Y       Z        S       C       BV       BH      ZU      ZL
TT
    194.53    -0.97    4.30   229.8 0.500E-03   2.77    20.99    4.30    1.53
.17178E+04
    304.71    -0.97    4.30   334.5 0.344E-03   3.85    21.95    4.30    0.44
.26927E+04
    414.89    -0.97    4.30   474.8 0.242E-03   5.25    22.87    4.30   -0.95
.36675E+04
 Plume interacts with BOTTOM.
 The passive diffusion plume becomes VERTICALLY FULLY MIXED within this
   prediction interval.
    525.07    -0.97    4.30   576.8 0.199E-03   6.14    23.76    4.30   -1.84
.46423E+04
    635.26    -0.97    4.30   597.6 0.192E-03   6.14    24.61    4.30   -1.84
.56171E+04
    745.44    -0.97    4.30   617.6 0.186E-03   6.14    25.44    4.30   -1.84
.65919E+04
    855.62    -0.97    4.30   637.0 0.181E-03   6.14    26.24    4.30   -1.84
.75667E+04
    965.80    -0.97    4.30   655.8 0.175E-03   6.14    27.01    4.30   -1.84
.85415E+04
   1075.99    -0.97    4.30   674.1 0.171E-03   6.14    27.76    4.30   -1.84
.95163E+04
   1186.17    -0.97    4.30   692.0 0.166E-03   6.14    28.50    4.30   -1.84
.10491E+05
   1296.35    -0.97    4.30   709.3 0.162E-03   6.14    29.21    4.30   -1.84
.11466E+05
   1406.53    -0.97    4.30   726.3 0.158E-03   6.14    29.91    4.30   -1.84
.12441E+05
   1516.72    -0.97    4.30   742.9 0.155E-03   6.14    30.60    4.30   -1.84
.13416E+05
   1626.90    -0.97    4.30   759.1 0.151E-03   6.14    31.26    4.30   -1.84
.14390E+05
   1737.08    -0.97    4.30   774.9 0.148E-03   6.14    31.92    4.30   -1.84
.15365E+05
   1847.26    -0.97    4.30   790.5 0.145E-03   6.14    32.56    4.30   -1.84
.16340E+05
   1957.45    -0.97    4.30   805.8 0.143E-03   6.14    33.19    4.30   -1.84
.17315E+05
   2067.63    -0.97    4.30   820.7 0.140E-03   6.14    33.80    4.30   -1.84
.18290E+05
   2177.81    -0.97    4.30   835.4 0.138E-03   6.14    34.41    4.30   -1.84
.19264E+05
   2287.99    -0.97    4.30   849.9 0.135E-03   6.14    35.00    4.30   -1.84
.20239E+05
   2398.18    -0.97    4.30   864.1 0.133E-03   6.14    35.59    4.30   -1.84
.21214E+05
   2508.36    -0.97    4.30   878.0 0.131E-03   6.14    36.16    4.30   -1.84
.22189E+05
   2618.54    -0.97    4.30   891.8 0.129E-03   6.14    36.73    4.30   -1.84
.23164E+05
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   2728.72    -0.97    4.30   905.3 0.127E-03   6.14    37.29    4.30   -1.84
.24139E+05
   2838.91    -0.97    4.30   918.7 0.125E-03   6.14    37.84    4.30   -1.84
.25113E+05
   2949.09    -0.97    4.30   931.9 0.123E-03   6.14    38.38    4.30   -1.84
.26088E+05
   3059.27    -0.97    4.30   944.8 0.122E-03   6.14    38.91    4.30   -1.84
.27063E+05
   3169.45    -0.97    4.30   957.6 0.120E-03   6.14    39.44    4.30   -1.84
.28038E+05
   3279.63    -0.97    4.30   970.3 0.119E-03   6.14    39.96    4.30   -1.84
.29013E+05
   3389.82    -0.97    4.30   982.7 0.117E-03   6.14    40.47    4.30   -1.84
.29987E+05
   3500.00    -0.97    4.30   995.0 0.116E-03   6.14    40.98    4.30   -1.84
.30962E+05
 Cumulative travel time =       30962.2207 sec

 Simulation limit based on maximum specified distance =   3500.00 m.
   This is the REGION OF INTEREST limitation.

END OF MOD161: PASSIVE AMBIENT MIXING IN UNIFORM AMBIENT
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CORMIX1: Single Port Discharges              End of Prediction File
1111111111111111111111111111111111111111111111111111111111111111111111111111111
1111111111111111
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CORMIX SESSION REPORT:
XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
                      CORMIX MIXING ZONE EXPERT SYSTEM
                          CORMIX Version 6.0GT
                       HYDRO1:Version-6.0.0.0  October,2009
SITE NAME/LABEL:
  DESIGN CASE:                  JD309(2)400GPMaSteadyFinal
  FILE NAME:
P:\Mixing\CriticalDischargeScenarios\V.6.0\400GPMFinalRiver\JD309(2)400GPMaStea
dyFinal6.0R.prd
  Using subsystem CORMIX1:     Single Port Discharges
  Start of session:             03/26/2010--14:21:47
*****************************************************************************
SUMMARY OF INPUT DATA:
-----------------------------------------------------------------------------
AMBIENT PARAMETERS:
  Cross-section                           = bounded
  Width                           BS      = 158.50 m
  Channel regularity              ICHREG = 1
  Ambient flowrate                QA      = 109.90 m^3/s
  Average depth                   HA      = 6.14 m
  Depth at discharge              HD      = 4.30 m
  Ambient velocity                UA      = 0.113 m/s
  Darcy-Weisbach friction factor  F       = 0.0268
    Calculated from Manning's n           = 0.025
  Wind velocity                   UW      = 9.30 m/s
  Stratification Type             STRCND = U
  Surface density                 RHOAS   = 1001.0000 kg/m^3
  Bottom density                  RHOAB   = 1001.0000 kg/m^3
-----------------------------------------------------------------------------
DISCHARGE PARAMETERS:             Single Port Discharge
  Nearest bank                            = right
  Distance to bank                DISTB   = 0.97 m
  Port diameter                   D0      = 0.0783 m
  Port cross-sectional area       A0      = 0.0048 m^2
  Discharge velocity              U0      = 5.92 m/s
  Discharge flowrate              Q0      = 0.028558 m^3/s
  Discharge port height           H0      = 4.30 m
  Vertical discharge angle        THETA   = -89.05 deg
  Horizontal discharge angle      SIGMA   = 90 deg
  Discharge temperature (freshwater)      = 10 degC
  Corresponding density           RHO0    = 999.7019 kg/m^3
  Density difference              DRHO    = 1.2981 kg/m^3
  Buoyant acceleration            GP0     = 0.0127 m/s^2
  Discharge concentration         C0      = 0.115 mg/l
  Surface heat exchange coeff.    KS      = 0 m/s
  Coefficient of decay            KD      = 0 /s
-----------------------------------------------------------------------------
DISCHARGE/ENVIRONMENT LENGTH SCALES:
  LQ  = 0.07 m         Lm  = 3.64 m         Lb  = 0.25 m
  LM  = 13.84 m         Lm' = 99999 m         Lb' = 99999 m
-----------------------------------------------------------------------------
NON-DIMENSIONAL PARAMETERS:
  Port densimetric Froude number  FR0     = 187.66
  Velocity ratio                  R       = 52.42
-----------------------------------------------------------------------------
MIXING ZONE / TOXIC DILUTION ZONE / AREA OF INTEREST PARAMETERS:
  Toxic discharge                         = yes
  CMC concentration               CMC     = 0.0058 mg/l
  CCC concentration               CCC     = 0.00373 mg/l
```

```
  Water quality standard specified       = given by CCC value
  Regulatory mixing zone                 = yes
  Regulatory mixing zone specification   = distance
  Regulatory mixing zone value           = 91.44 m (m^2 if area)
  Region of interest                     = 3500 m
*****************************************************************************
HYDRODYNAMIC CLASSIFICATION:
  *------------------------*
  | FLOW CLASS   = IPV4 |
  *------------------------*
  This flow configuration applies to a layer corresponding to the full water
  depth at the discharge site.
  Applicable layer depth = water depth = 4.30 m
*****************************************************************************
MIXING ZONE EVALUATION (hydrodynamic and regulatory summary):

-----------------------------------------------------------------------------
X-Y-Z Coordinate system:
  Origin is located at the bottom below the port center:
    0.97 m from the right bank/shore.
  Number of display steps NSTEP = 30 per module.
-----------------------------------------------------------------------------
NEAR-FIELD REGION (NFR) CONDITIONS :
Note: The NFR is the zone of strong initial mixing.  It has no regulatory
  implication.  However, this information may be useful for the discharge
  designer because the mixing in the NFR is usually sensitive to the
  discharge design conditions.
  Pollutant concentration at NFR edge  c = 0.0076 mg/l
  Dilution at edge of NFR              s = 15.1
  NFR Location:                        x = 4.97 m
    (centerline coordinates)           y = 0.14 m
                                       z = 4.30 m
  NFR plume dimensions:  half-width (bh) = 0.44 m
                          thickness (bv) = 4.30 m
Cumulative travel time:       40.7426 sec.
-----------------------------------------------------------------------------
Buoyancy assessment:
  The effluent density is less than the surrounding ambient water
  density at the discharge level.
  Therefore, the effluent is POSITIVELY BUOYANT and will tend to rise towards
  the surface.
-----------------------------------------------------------------------------
Near-field instability behavior:
  The discharge flow will experience instabilities with full vertical mixing
  in the near-field.
  There may be benthic impact of high pollutant concentrations.
-----------------------------------------------------------------------------
FAR-FIELD MIXING SUMMARY:
  Plume is vertically fully mixed WITHIN NEAR-FIELD (or a fraction thereof),
  but RE-STRATIFIES LATER.
  Plume becomes vertically fully mixed again at 525.07 m downstream.
-----------------------------------------------------------------------------
PLUME BANK CONTACT SUMMARY:
  Plume in bounded section contacts one bank only at 7.33 m downstream.
************************ TOXIC DILUTION ZONE SUMMARY ************************
Recall: The TDZ corresponds to the three (3) criteria issued in the USEPA
  Technical Support Document (TSD) for Water Quality-based Toxics Control,
  1991 (EPA/505/2-90-001).
  Criterion maximum concentration (CMC)  = 0.0058  mg/l
Corresponding dilution                   = 19.827586
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The CMC was encountered at the following plume position:
  Plume location:                      x = 9.00 m
    (centerline coordinates)           y = -0.97 m
                                       z = 4.30 m
  Plume dimension:       half-width (bh) = 2.61 m
                          thickness (bv) = 1.92 m

 Computed distance from port opening to CMC location = 9.05 m.
 CRITERION 1: This location is beyond 50 times the discharge length scale of
              Lq = 0.07 m.
 +++++ The discharge length scale TEST for the TDZ has FAILED. ++++++

 Computed horizontal distance from port opening to CMC location = 9.05 m.
 CRITERION 2: This location is within 5 times the ambient water depth of
              HD = 4.30 m.
 ++++++++++ The ambient depth TEST for the TDZ has been SATISFIED. ++++++++++

 Computed distance from port opening to CMC location = 9.05 m.
 CRITERION 3: This location is within one tenth the distance of the extent
              of the Regulatory Mixing Zone of 91.45 m in any
              spatial direction from the port opening.
 +++++ The Regulatory Mixing Zone TEST for the TDZ has been SATISFIED. ++++++

 The diffuser discharge velocity is equal to 5.92 m/s.
 This exceeds the value of 3.0 m/s recommended in the TSD.

 *** This discharge DOES NOT SATISFY all three CMC criteria for the TDZ. ****
********************** REGULATORY MIXING ZONE SUMMARY **********************
The plume conditions at the boundary of the specified RMZ are as follows:
  Pollutant concentration              c = 0.001815  mg/l
  Corresponding dilution               s = 63.4
  Plume location:                      x = 91.44 m
    (centerline coordinates)           y = -0.97 m
                                       z = 4.30 m
  Plume dimensions:      half-width (bh) = 12.72 m
                          thickness (bv) = 1.26 m
Cumulative travel time:       805.8083 sec.
At this position, the plume is CONTACTING the RIGHT bank.
Furthermore, the CCC for the toxic pollutant has indeed been met
  within the RMZ. In particular:
The CCC was encountered at the following plume position:
The CCC for the toxic pollutant was encountered at the following
  plume position:
  CCC                                    = 0.00373  mg/l
Corresponding dilution                   = 30.8
  Plume location:                      x = 40.84 m
    (centerline coordinates)           y = -0.97 m
                                       z = 4.30 m
  Plume dimensions:      half-width (bh) = 7.49 m
                          thickness (bv) = 1.04 m
********************* FINAL DESIGN ADVICE AND COMMENTS *********************
REMINDER:  The user must take note that HYDRODYNAMIC MODELING by any known
  technique is NOT AN EXACT SCIENCE.
Extensive comparison with field and laboratory data has shown that the
  CORMIX predictions on dilutions and concentrations (with associated
  plume geometries) are reliable for the majority of cases and are accurate
  to within about +-50% (standard deviation).
As a further safeguard, CORMIX will not give predictions whenever it judges
  the design configuration as highly complex and uncertain for prediction.
```

```
CORMIX1 PREDICTION FILE:
1111111111111111111111111111111111111111111111111111111111111111111111111111111111
1111111111111111
                        CORMIX MIXING ZONE EXPERT SYSTEM
              Subsystem CORMIX1:  Single Port Discharges
                          CORMIX Version 6.0GT
                       HYDRO1 Version 6.0.0.0 October 2009
-------------------------------------------------------------------------------
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-------------------------------------------------------------------------------
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CASE DESCRIPTION
 Site name/label:
 Design case:       JD309(2)400GPMbSteadyFinal6.0
 FILE NAME:         P:\...\400GPMFinalRiver\JD309(2)400GPMbSteadyFinalR.prd
 Time stamp:        Fri Mar 26 14:24:42 2010

ENVIRONMENT PARAMETERS (metric units)
 Bounded section
 BS    =    158.50  AS    =    964.65  QA    =    171.71  ICHREG= 1
 HA    =      6.09  HD    =      4.26
 UA    =      0.178 F     =      0.027 USTAR =0.1032E-01
 UW    =      9.300 UWSTAR=0.1193E-01
 Uniform density environment
 STRCND=  U         RHOAM = 1001.0000

DISCHARGE PARAMETERS (metric units)
 Above Surface Discharge:
 Re-computed discharge conditions at entry point at water surface.
 BANK  =  RIGHT     DISTB =      1.03
 D0    =      0.107 A0    =      0.009 H0    =      4.26  SUB0  =      0.00
 THETA =      0.00  SIGMA =     90.00
 U0    =      6.008 Q0    =      0.054       =0.5394E-01
 RHO0  =  999.7019  DRHO0 =0.1298E+01  GP0   =0.1272E-01
 C0    =0.8800E-01  CUNITS=  mg/l
 IPOLL =  1         KS    =0.0000E+00  KD    =0.0000E+00

FLUX VARIABLES (metric units)
 Q0    =0.5394E-01  M0    =0.3240E+00  J0    =0.6859E-03  SIGNJ0=      1.0
 Associated length scales (meters)
 LQ    =      0.09  LM    =     16.40  Lm    =      3.20  Lb    =      0.12
                                       Lmp   =  99999.00  Lbp   =  99999.00

NON-DIMENSIONAL PARAMETERS
 FR0   =    162.93  R     =     33.75

FLOW CLASSIFICATION
 1111111111111111111111111111111111111111111
 1  Flow class (CORMIX1)      =    IPV4   1
 1  Applicable layer depth HS =     4.26  1
 1111111111111111111111111111111111111111111

MIXING ZONE / TOXIC DILUTION / REGION OF INTEREST PARAMETERS
 C0    =0.8800E-01  CUNITS=  mg/l
 NTOX  =  1         CMC   =0.5800E-02  CCC   =  CSTD
 NSTD  =  1         CSTD  =0.3730E-02
 REGMZ =  1
 REGSPC=  1         XREG  =     91.44  WREG  =      0.00  AREG  =      0.00
 XINT  =  35000.00  XMAX  =  35000.00
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X-Y-Z COORDINATE SYSTEM:
    ORIGIN is located at the bottom and below the center of the port:
         1.03 m  from the RIGHT bank/shore.
    X-axis points downstream, Y-axis points to left, Z-axis points upward.
NSTEP =  30 display intervals per module
-------------------------------------------------------------------------------
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-------------------------------------------------------------------------------
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BEGIN MOD101: DISCHARGE MODULE

       X        Y       Z        S       C       B        Uc        TT
      0.00     0.00    4.26     1.0 0.880E-01   0.05    6.008   .00000E+00

END OF MOD101: DISCHARGE MODULE
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BEGIN CORJET (MOD110): JET/PLUME NEAR-FIELD MIXING REGION

 Jet-like motion in weak crossflow.
   UNSTABLE NEAR-FIELD: Jet/plume will mix over full layer depth.
   Following MOD133 will include recirculation into jet region.

 Zone of flow establishment:            THETAE=    -88.10  SIGMAE=     68.25
  LE    =      0.48  XE    =      0.00  YE    =      0.02  ZE    =      3.78

 Profile definitions:
   B = Gaussian 1/e (37%) half-width, normal to trajectory
   S = hydrodynamic centerline dilution
   C = centerline concentration (includes reaction effects, if any)
  Uc = Local centerline excess velocity (above ambient)
  TT = Cumulative travel time

       X        Y       Z        S       C       B        Uc        TT
      0.00     0.00    4.26     1.0 0.880E-01   0.05    6.008   .00000E+00
      0.00     0.02    3.78     1.0 0.880E-01   0.06    6.008   .20742E-02
      0.00     0.02    3.67     1.0 0.846E-01   0.07    6.008   .15999E-01
      0.01     0.02    3.56     1.2 0.706E-01   0.08    5.681   .35461E-01
      0.01     0.03    3.45     1.4 0.618E-01   0.09    4.969   .54912E-01
      0.02     0.03    3.34     1.6 0.539E-01   0.10    4.331   .80851E-01
      0.03     0.03    3.22     1.8 0.477E-01   0.12    3.833   .11031E+00
      0.03     0.04    3.10     2.1 0.428E-01   0.13    3.434   .14332E+00
      0.04     0.04    3.00     2.2 0.393E-01   0.14    3.149   .17447E+00
      0.06     0.04    2.88     2.5 0.358E-01   0.16    2.868   .21417E+00
      0.07     0.05    2.76     2.7 0.329E-01   0.17    2.629   .25752E+00
      0.08     0.05    2.66     2.9 0.307E-01   0.18    2.451   .29764E+00
      0.10     0.05    2.54     3.1 0.285E-01   0.20    2.268   .34792E+00
      0.12     0.06    2.42     3.3 0.265E-01   0.21    2.107   .40202E+00
      0.14     0.06    2.32     3.5 0.250E-01   0.22    1.984   .45148E+00
      0.16     0.06    2.20     3.8 0.234E-01   0.24    1.854   .51283E+00
      0.18     0.07    2.09     4.0 0.220E-01   0.25    1.738   .57820E+00
      0.20     0.07    1.99     4.2 0.209E-01   0.27    1.646   .63749E+00
      0.23     0.07    1.87     4.5 0.197E-01   0.28    1.548   .71053E+00
      0.26     0.08    1.76     4.7 0.186E-01   0.30    1.459   .78783E+00
      0.29     0.08    1.66     5.0 0.177E-01   0.31    1.388   .85756E+00
      0.32     0.08    1.54     5.2 0.168E-01   0.33    1.311   .94305E+00
      0.36     0.09    1.43     5.5 0.160E-01   0.34    1.239   .10331E+01
      0.39     0.09    1.33     5.8 0.153E-01   0.36    1.182   .11140E+01
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      0.43     0.09    1.22     6.1 0.145E-01   0.37    1.119   .12129E+01
      0.47     0.10    1.11     6.4 0.138E-01   0.39    1.060   .13166E+01
      0.51     0.10    1.02     6.6 0.133E-01   0.40    1.013   .14096E+01
      0.55     0.10    0.91     7.0 0.126E-01   0.42    0.961   .15228E+01
      0.60     0.11    0.80     7.3 0.121E-01   0.44    0.912   .16413E+01
      0.65     0.11    0.70     7.6 0.116E-01   0.46    0.872   .17473E+01
      0.70     0.11    0.60     8.0 0.111E-01   0.48    0.828   .18760E+01
      0.75     0.12    0.49     8.3 0.106E-01   0.49    0.792   .19909E+01
 Cumulative travel time =           1.9909 sec

END OF CORJET (MOD110): JET/PLUME NEAR-FIELD MIXING REGION
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BEGIN MOD133: LAYER BOUNDARY IMPINGEMENT/FULL VERTICAL MIXING

  Control volume inflow:
       X        Y       Z        S       C       B        TT
      0.75     0.12    0.49     8.3 0.106E-01   0.49 .19909E+01

 Profile definitions:
   BV = layer depth (vertically mixed)
   BH = top-hat half-width, in horizontal plane normal to trajectory
   ZU = upper plume boundary (Z-coordinate)
   ZL = lower plume boundary (Z-coordinate)
   S  = hydrodynamic average (bulk) dilution
   C  = average (bulk) concentration (includes reaction effects, if any)
   TT = Cumulative travel time

       X        Y       Z        S       C       BV       BH      ZU      ZL
TT
      0.26     0.24    4.26     8.3 0.106E-01   0.00     0.00    4.26    4.26
.19909E+01
      0.74     0.24    4.26     8.3 0.106E-01   4.26     0.13    4.26    0.00
.19909E+01
      1.21     0.24    4.26     8.4 0.105E-01   4.26     0.18    4.26    0.00
.45687E+01
      1.69     0.24    4.26     8.8 0.994E-02   4.26     0.23    4.26    0.00
.72383E+01
      2.16     0.24    4.26     9.4 0.932E-02   4.26     0.26    4.26    0.00
.99079E+01
      2.64     0.24    4.26    10.1 0.874E-02   4.26     0.29    4.26    0.00
.12578E+02
      3.11     0.24    4.26    10.6 0.830E-02   4.26     0.32    4.26    0.00
.15247E+02
      3.59     0.24    4.26    11.0 0.799E-02   4.26     0.34    4.26    0.00
.17917E+02
      4.06     0.24    4.26    11.3 0.780E-02   4.26     0.37    4.26    0.00
.20586E+02
      4.54     0.24    4.26    11.4 0.769E-02   4.26     0.39    4.26    0.00
.23256E+02
      5.01     0.24    4.26    11.6 0.760E-02   4.26     0.41    4.26    0.00
.25926E+02
 Cumulative travel time =          25.9256 sec

END OF MOD133: LAYER BOUNDARY IMPINGEMENT/FULL VERTICAL MIXING
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** End of NEAR-FIELD REGION (NFR) **
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BEGIN MOD141: BUOYANT AMBIENT SPREADING

 Profile definitions:
   BV = top-hat thickness, measured vertically
   BH = top-hat half-width, measured horizontally in Y-direction
   ZU = upper plume boundary (Z-coordinate)
   ZL = lower plume boundary (Z-coordinate)
   S  = hydrodynamic average (bulk) dilution
   C  = average (bulk) concentration (includes reaction effects, if any)
   TT = Cumulative travel time

 Plume Stage 1 (not bank attached):
       X        Y       Z        S       C       BV       BH      ZU      ZL
TT
      5.01     0.24    4.26    11.6 0.760E-02   4.26     0.41    4.26    0.00
.25926E+02
      5.16     0.24    4.26    11.8 0.743E-02   3.98     0.45    4.26    0.28
.26762E+02
      5.31     0.24    4.26    12.1 0.728E-02   3.74     0.49    4.26    0.52
.27598E+02
      5.46     0.24    4.26    12.3 0.715E-02   3.55     0.53    4.26    0.71
.28434E+02
      5.61     0.24    4.26    12.5 0.703E-02   3.38     0.56    4.26    0.88
.29270E+02
      5.76     0.24    4.26    12.7 0.693E-02   3.23     0.59    4.26    1.03
.30106E+02
      5.91     0.24    4.26    12.9 0.684E-02   3.11     0.63    4.26    1.16
.30942E+02
      6.06     0.24    4.26    13.0 0.675E-02   2.99     0.66    4.26    1.27
.31779E+02
      6.20     0.24    4.26    13.2 0.667E-02   2.89     0.69    4.26    1.37
.32615E+02
      6.35     0.24    4.26    13.3 0.660E-02   2.80     0.72    4.26    1.47
.33451E+02
      6.50     0.24    4.26    13.5 0.653E-02   2.71     0.75    4.26    1.55
.34287E+02
      6.65     0.24    4.26    13.6 0.647E-02   2.63     0.78    4.26    1.63
.35123E+02
      6.80     0.24    4.26    13.7 0.641E-02   2.56     0.81    4.26    1.70
.35959E+02
      6.95     0.24    4.26    13.8 0.635E-02   2.50     0.84    4.26    1.76
.36795E+02
      7.10     0.24    4.26    14.0 0.630E-02   2.44     0.87    4.26    1.82
.37632E+02
      7.25     0.24    4.26    14.1 0.625E-02   2.38     0.90    4.26    1.88
.38468E+02
      7.40     0.24    4.26    14.2 0.621E-02   2.33     0.92    4.26    1.93
.39304E+02
      7.54     0.24    4.26    14.3 0.616E-02   2.28     0.95    4.26    1.98
.40140E+02
      7.69     0.24    4.26    14.4 0.612E-02   2.23     0.98    4.26    2.03
.40976E+02
      7.84     0.24    4.26    14.5 0.608E-02   2.19     1.00    4.26    2.07
.41812E+02
      7.99     0.24    4.26    14.6 0.604E-02   2.15     1.03    4.26    2.11
.42648E+02
      8.14     0.24    4.26    14.7 0.600E-02   2.11     1.05    4.26    2.15
.43485E+02
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      8.29     0.24    4.26    14.8 0.596E-02   2.07     1.08    4.26    2.19
.44321E+02
      8.44     0.24    4.26    14.8 0.593E-02   2.04     1.10    4.26    2.22
.45157E+02
      8.59     0.24    4.26    14.9 0.590E-02   2.01     1.13    4.26    2.25
.45993E+02
      8.74     0.24    4.26    15.0 0.586E-02   1.97     1.15    4.26    2.29
.46829E+02
      8.88     0.24    4.26    15.1 0.583E-02   1.94     1.18    4.26    2.32
.47665E+02
      9.03     0.24    4.26    15.2 0.580E-02   1.92     1.20    4.26    2.34
.48501E+02
** CMC HAS BEEN FOUND **
 The pollutant concentration in the plume falls below CMC value of 0.580E-02
   in the current prediction interval.
 This is the extent of the TOXIC DILUTION ZONE.
      9.18     0.24    4.26    15.2 0.577E-02   1.89     1.22    4.26    2.37
.49338E+02
      9.33     0.24    4.26    15.3 0.574E-02   1.86     1.25    4.26    2.40
.50174E+02
      9.48     0.24    4.26    15.4 0.572E-02   1.84     1.27    4.26    2.42
.51010E+02
 Cumulative travel time =          51.0098 sec

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 Plume is ATTACHED to RIGHT bank/shore.
   Plume width is now determined from RIGHT bank/shore.

 Plume Stage 2 (bank attached):
       X        Y       Z        S       C       BV       BH      ZU      ZL
TT
      9.48    -1.03    4.26    15.4 0.572E-02   1.84     2.54    4.26    2.42
.51010E+02
     17.88    -1.03    4.26    17.2 0.512E-02   1.41     3.69    4.26    2.85
.98213E+02
     26.29    -1.03    4.26    18.7 0.471E-02   1.21     4.68    4.26    3.05
.14542E+03
     34.69    -1.03    4.26    20.2 0.435E-02   1.10     5.56    4.26    3.16
.19262E+03
     43.10    -1.03    4.26    21.9 0.403E-02   1.04     6.37    4.26    3.22
.23982E+03
**WATER QUALITY STANDARD OR CCC HAS BEEN FOUND**
 The pollutant concentration in the plume falls below water quality standard
   or CCC value of 0.373E-02 in the current prediction interval.
 This is the spatial extent of concentrations exceeding the water quality
   standard or CCC value.
     51.50    -1.03    4.26    23.7 0.372E-02   1.01     7.12    4.26    3.25
.28702E+03
     59.91    -1.03    4.26    25.7 0.342E-02   1.00     7.83    4.26    3.26
.33423E+03
     68.31    -1.03    4.26    28.0 0.314E-02   1.00     8.50    4.26    3.26
.38143E+03
     76.72    -1.03    4.26    30.6 0.288E-02   1.01     9.15    4.26    3.25
.42863E+03
     85.12    -1.03    4.26    33.4 0.263E-02   1.04     9.77    4.26    3.22
.47584E+03
 ** REGULATORY MIXING ZONE BOUNDARY **
 In this prediction interval the plume DOWNSTREAM  distance meets or exceeds
 the regulatory value =    91.44 m.
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 This is the extent of the REGULATORY MIXING ZONE.
     93.53    -1.03    4.26    36.6 0.240E-02   1.07    10.37    4.26    3.19
.52304E+03
    101.93    -1.03    4.26    40.1 0.219E-02   1.11    10.96    4.26    3.15
.57024E+03
    110.34    -1.03    4.26    43.9 0.200E-02   1.15    11.53    4.26    3.11
.61744E+03
    118.74    -1.03    4.26    48.1 0.183E-02   1.21    12.08    4.26    3.05
.66465E+03
    127.15    -1.03    4.26    52.6 0.167E-02   1.26    12.62    4.26    3.00
.71185E+03
    135.55    -1.03    4.26    57.5 0.153E-02   1.32    13.15    4.26    2.94
.75905E+03
    143.96    -1.03    4.26    62.8 0.140E-02   1.39    13.67    4.26    2.87
.80626E+03
    152.36    -1.03    4.26    68.4 0.129E-02   1.46    14.18    4.26    2.80
.85346E+03
    160.77    -1.03    4.26    74.5 0.118E-02   1.54    14.68    4.26    2.72
.90066E+03
    169.17    -1.03    4.26    80.9 0.109E-02   1.62    15.18    4.26    2.65
.94786E+03
    177.58    -1.03    4.26    87.8 0.100E-02   1.70    15.67    4.26    2.56
.99507E+03
    185.98    -1.03    4.26    95.0 0.926E-03   1.78    16.15    4.26    2.48
.10423E+04
    194.38    -1.03    4.26   102.7 0.856E-03   1.87    16.62    4.26    2.39
.10895E+04
    202.79    -1.03    4.26   110.9 0.794E-03   1.97    17.09    4.26    2.29
.11367E+04
    211.19    -1.03    4.26   119.5 0.737E-03   2.06    17.55    4.26    2.20
.11839E+04
    219.60    -1.03    4.26   128.5 0.685E-03   2.16    18.01    4.26    2.10
.12311E+04
    228.00    -1.03    4.26   138.0 0.638E-03   2.26    18.46    4.26    2.00
.12783E+04
    236.41    -1.03    4.26   147.9 0.595E-03   2.37    18.91    4.26    1.89
.13255E+04
    244.81    -1.03    4.26   158.3 0.556E-03   2.48    19.35    4.26    1.78
.13727E+04
    253.22    -1.03    4.26   169.2 0.520E-03   2.59    19.79    4.26    1.67
.14199E+04
    261.62    -1.03    4.26   180.6 0.487E-03   2.71    20.22    4.26    1.55
.14671E+04
 Cumulative travel time =        1467.0963 sec

END OF MOD141: BUOYANT AMBIENT SPREADING
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 Bottom coordinate for FAR-FIELD is determined by average depth, ZFB = -1.83m
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BEGIN MOD161: PASSIVE AMBIENT MIXING IN UNIFORM AMBIENT

  Vertical diffusivity (initial value)   = 0.120E-01 m^2/s
  Horizontal diffusivity (initial value) = 0.150E-01 m^2/s

 Profile definitions:
   BV = Gaussian s.d.*sqrt(pi/2) (46%) thickness, measured vertically
      = or equal to layer depth, if fully mixed
   BH = Gaussian s.d.*sqrt(pi/2) (46%) half-width,
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        measured horizontally in Y-direction
   ZU = upper plume boundary (Z-coordinate)
   ZL = lower plume boundary (Z-coordinate)
   S  = hydrodynamic centerline dilution
   C  = centerline concentration (includes reaction effects, if any)
   TT = Cumulative travel time

 Plume Stage 2 (bank attached):
       X        Y       Z        S       C       BV       BH      ZU      ZL
TT
    261.62    -1.03    4.26   180.6 0.487E-03   2.71    20.22    4.26    1.55
.14671E+04
 Plume interacts with BOTTOM.
 The passive diffusion plume becomes VERTICALLY FULLY MIXED within this
   prediction interval.
   1419.57    -1.03    4.26   537.3 0.164E-03   6.09    26.75    4.26   -1.83
.79704E+04
   2577.51    -1.03    4.26   642.2 0.137E-03   6.09    31.97    4.26   -1.83
.14474E+05
   3735.46    -1.03    4.26   732.2 0.120E-03   6.09    36.45    4.26   -1.83
.20977E+05
   4893.41    -1.03    4.26   812.3 0.108E-03   6.09    40.44    4.26   -1.83
.27480E+05
   6051.35    -1.03    4.26   885.2 0.994E-04   6.09    44.07    4.26   -1.83
.33983E+05
   7209.30    -1.03    4.26   952.6 0.924E-04   6.09    47.42    4.26   -1.83
.40487E+05
   8367.24    -1.03    4.26  1015.4 0.867E-04   6.09    50.55    4.26   -1.83
.46990E+05
   9525.19    -1.03    4.26  1074.6 0.819E-04   6.09    53.50    4.26   -1.83
.53493E+05
  10683.14    -1.03    4.26  1130.7 0.778E-04   6.09    56.29    4.26   -1.83
.59997E+05
  11841.08    -1.03    4.26  1184.2 0.743E-04   6.09    58.96    4.26   -1.83
.66500E+05
  12999.03    -1.03    4.26  1235.3 0.712E-04   6.09    61.50    4.26   -1.83
.73003E+05
  14156.98    -1.03    4.26  1284.4 0.685E-04   6.09    63.95    4.26   -1.83
.79506E+05
  15314.92    -1.03    4.26  1331.7 0.661E-04   6.09    66.30    4.26   -1.83
.86010E+05
  16472.87    -1.03    4.26  1377.4 0.639E-04   6.09    68.57    4.26   -1.83
.92513E+05
  17630.81    -1.03    4.26  1421.6 0.619E-04   6.09    70.78    4.26   -1.83
.99016E+05
  18788.76    -1.03    4.26  1464.5 0.601E-04   6.09    72.91    4.26   -1.83
.10552E+06
  19946.70    -1.03    4.26  1506.1 0.584E-04   6.09    74.98    4.26   -1.83
.11202E+06
  21104.65    -1.03    4.26  1546.7 0.569E-04   6.09    77.00    4.26   -1.83
.11853E+06
  22262.59    -1.03    4.26  1586.2 0.555E-04   6.09    78.97    4.26   -1.83
.12503E+06
  23420.54    -1.03    4.26  1624.7 0.542E-04   6.09    80.89    4.26   -1.83
.13153E+06
  24578.48    -1.03    4.26  1662.3 0.529E-04   6.09    82.76    4.26   -1.83
.13804E+06
  25736.43    -1.03    4.26  1699.1 0.518E-04   6.09    84.59    4.26   -1.83
.14454E+06
```

```
  26894.38    -1.03    4.26  1735.2 0.507E-04   6.09    86.39    4.26   -1.83
.15104E+06
  28052.32    -1.03    4.26  1770.5 0.497E-04   6.09    88.14    4.26   -1.83
.15755E+06
  29210.27    -1.03    4.26  1805.1 0.488E-04   6.09    89.87    4.26   -1.83
.16405E+06
  30368.21    -1.03    4.26  1839.0 0.479E-04   6.09    91.56    4.26   -1.83
.17055E+06
  31526.16    -1.03    4.26  1872.4 0.470E-04   6.09    93.22    4.26   -1.83
.17706E+06
  32684.10    -1.03    4.26  1905.1 0.462E-04   6.09    94.85    4.26   -1.83
.18356E+06
  33842.05    -1.03    4.26  1937.3 0.454E-04   6.09    96.45    4.26   -1.83
.19006E+06
  34999.99    -1.03    4.26  1969.0 0.447E-04   6.09    98.03    4.26   -1.83
.19657E+06
 Cumulative travel time =      196565.2344 sec

 Simulation limit based on maximum specified distance =  35000.00 m.
   This is the REGION OF INTEREST limitation.

END OF MOD161: PASSIVE AMBIENT MIXING IN UNIFORM AMBIENT
-------------------------------------------------------------------------------
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-------------------------------------------------------------------------------
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CORMIX1: Single Port Discharges              End of Prediction File
1111111111111111111111111111111111111111111111111111111111111111111111111111111
1111111111111111
```

```
CORMIX SESSION REPORT:
XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
                      CORMIX MIXING ZONE EXPERT SYSTEM
                          CORMIX Version 6.0GT
                       HYDRO1:Version-6.0.0.0  October,2009
SITE NAME/LABEL:
  DESIGN CASE:                  JD309(2)400GPMbSteadyFinal6.0
  FILE NAME:
P:\Mixing\CriticalDischargeScenarios\V.6.0\400GPMFinalRiver\JD309(2)400GPMbStea
dyFinalR.prd
  Using subsystem CORMIX1:     Single Port Discharges
  Start of session:             03/26/2010--14:24:42
*****************************************************************************
SUMMARY OF INPUT DATA:
-----------------------------------------------------------------------------
AMBIENT PARAMETERS:
  Cross-section                           = bounded
  Width                           BS      = 158.50 m
  Channel regularity              ICHREG = 1
  Ambient flowrate                QA      = 171.71 m^3/s
  Average depth                   HA      = 6.09 m
  Depth at discharge              HD      = 4.26 m
  Ambient velocity                UA      = 0.178 m/s
  Darcy-Weisbach friction factor  F       = 0.0269
    Calculated from Manning's n           = 0.025
  Wind velocity                   UW      = 9.30 m/s
  Stratification Type             STRCND = U
  Surface density                 RHOAS   = 1001.0000 kg/m^3
  Bottom density                  RHOAB   = 1001.0000 kg/m^3
-----------------------------------------------------------------------------
DISCHARGE PARAMETERS:             Single Port Discharge
  Nearest bank                            = right
  Distance to bank                DISTB   = 1.03 m
  Port diameter                   D0      = 0.1069 m
  Port cross-sectional area       A0      = 0.0090 m^2
  Discharge velocity              U0      = 6.01 m/s
  Discharge flowrate              Q0      = 0.053935 m^3/s
  Discharge port height           H0      = 4.26 m
  Vertical discharge angle        THETA   = -88.24 deg
  Horizontal discharge angle      SIGMA   = 90 deg
  Discharge temperature (freshwater)      = 10 degC
  Corresponding density           RHO0    = 999.7019 kg/m^3
  Density difference              DRHO    = 1.2981 kg/m^3
  Buoyant acceleration            GP0     = 0.0127 m/s^2
  Discharge concentration         C0      = 0.088 mg/l
  Surface heat exchange coeff.    KS      = 0 m/s
  Coefficient of decay            KD      = 0 /s
-----------------------------------------------------------------------------
DISCHARGE/ENVIRONMENT LENGTH SCALES:
  LQ  = 0.09 m         Lm  = 3.20 m         Lb  = 0.12 m
  LM  = 16.40 m         Lm' = 99999 m         Lb' = 99999 m
-----------------------------------------------------------------------------
NON-DIMENSIONAL PARAMETERS:
  Port densimetric Froude number  FR0     = 162.93
  Velocity ratio                  R       = 33.75
-----------------------------------------------------------------------------
MIXING ZONE / TOXIC DILUTION ZONE / AREA OF INTEREST PARAMETERS:
  Toxic discharge                         = yes
  CMC concentration               CMC     = 0.0058 mg/l
  CCC concentration               CCC     = 0.00373 mg/l
```

```
  Water quality standard specified       = given by CCC value
  Regulatory mixing zone                 = yes
  Regulatory mixing zone specification   = distance
  Regulatory mixing zone value           = 91.44 m (m^2 if area)
  Region of interest                     = 35000 m
*****************************************************************************
HYDRODYNAMIC CLASSIFICATION:
  *------------------------*
  | FLOW CLASS   = IPV4 |
  *------------------------*
  This flow configuration applies to a layer corresponding to the full water
  depth at the discharge site.
  Applicable layer depth = water depth = 4.26 m
*****************************************************************************
MIXING ZONE EVALUATION (hydrodynamic and regulatory summary):

-----------------------------------------------------------------------------
X-Y-Z Coordinate system:
  Origin is located at the bottom below the port center:
    1.03 m from the right bank/shore.
  Number of display steps NSTEP = 30 per module.
-----------------------------------------------------------------------------
NEAR-FIELD REGION (NFR) CONDITIONS :
Note: The NFR is the zone of strong initial mixing.  It has no regulatory
  implication.  However, this information may be useful for the discharge
  designer because the mixing in the NFR is usually sensitive to the
  discharge design conditions.
  Pollutant concentration at NFR edge  c = 0.0076 mg/l
  Dilution at edge of NFR              s = 11.6
  NFR Location:                        x = 5.01 m
    (centerline coordinates)           y = 0.24 m
                                       z = 4.26 m
  NFR plume dimensions:  half-width (bh) = 0.41 m
                          thickness (bv) = 4.26 m
Cumulative travel time:       25.9256 sec.
-----------------------------------------------------------------------------
Buoyancy assessment:
  The effluent density is less than the surrounding ambient water
  density at the discharge level.
  Therefore, the effluent is POSITIVELY BUOYANT and will tend to rise towards
  the surface.
-----------------------------------------------------------------------------
Near-field instability behavior:
  The discharge flow will experience instabilities with full vertical mixing
  in the near-field.
  There may be benthic impact of high pollutant concentrations.
-----------------------------------------------------------------------------
FAR-FIELD MIXING SUMMARY:
  Plume is vertically fully mixed WITHIN NEAR-FIELD (or a fraction thereof),
  but RE-STRATIFIES LATER.
  Plume becomes vertically fully mixed again at 1419.57 m downstream.
-----------------------------------------------------------------------------
PLUME BANK CONTACT SUMMARY:
  Plume in bounded section contacts one bank only at 9.48 m downstream.
************************ TOXIC DILUTION ZONE SUMMARY ************************
Recall: The TDZ corresponds to the three (3) criteria issued in the USEPA
  Technical Support Document (TSD) for Water Quality-based Toxics Control,
  1991 (EPA/505/2-90-001).
  Criterion maximum concentration (CMC)  = 0.0058  mg/l
Corresponding dilution                   = 15.172414
```

```
The CMC was encountered at the following plume position:
  Plume location:                      x = 9.05 m
    (centerline coordinates)           y = 0.24 m
                                       z = 4.26 m
  Plume dimension:       half-width (bh) = 1.20 m
                          thickness (bv) = 1.91 m

 Computed distance from port opening to CMC location = 9.05 m.
 CRITERION 1: This location is beyond 50 times the discharge length scale of
              Lq = 0.09 m.
 +++++ The discharge length scale TEST for the TDZ has FAILED. ++++++

 Computed horizontal distance from port opening to CMC location = 9.05 m.
 CRITERION 2: This location is within 5 times the ambient water depth of
              HD = 4.26 m.
 ++++++++++ The ambient depth TEST for the TDZ has been SATISFIED. ++++++++++

 Computed distance from port opening to CMC location = 9.05 m.
 CRITERION 3: This location is within one tenth the distance of the extent
              of the Regulatory Mixing Zone of 91.45 m in any
              spatial direction from the port opening.
 +++++ The Regulatory Mixing Zone TEST for the TDZ has been SATISFIED. ++++++

 The diffuser discharge velocity is equal to 6.01 m/s.
 This exceeds the value of 3.0 m/s recommended in the TSD.

 *** This discharge DOES NOT SATISFY all three CMC criteria for the TDZ. ****
********************** REGULATORY MIXING ZONE SUMMARY **********************
The plume conditions at the boundary of the specified RMZ are as follows:
  Pollutant concentration              c = 0.002459  mg/l
  Corresponding dilution               s = 35.8
  Plume location:                      x = 91.44 m
    (centerline coordinates)           y = -1.03 m
                                       z = 4.26 m
  Plume dimensions:      half-width (bh) = 10.23 m
                          thickness (bv) = 1.06 m
Cumulative travel time:       511.3139 sec.
At this position, the plume is CONTACTING the RIGHT bank.
Furthermore, the CCC for the toxic pollutant has indeed been met
  within the RMZ. In particular:
The CCC was encountered at the following plume position:
The CCC for the toxic pollutant was encountered at the following
  plume position:
  CCC                                    = 0.00373  mg/l
Corresponding dilution                   = 23.6
  Plume location:                      x = 51.14 m
    (centerline coordinates)           y = -1.03 m
                                       z = 4.26 m
  Plume dimensions:      half-width (bh) = 7.09 m
                          thickness (bv) = 1.01 m
********************* FINAL DESIGN ADVICE AND COMMENTS *********************
REMINDER:  The user must take note that HYDRODYNAMIC MODELING by any known
  technique is NOT AN EXACT SCIENCE.
Extensive comparison with field and laboratory data has shown that the
  CORMIX predictions on dilutions and concentrations (with associated
  plume geometries) are reliable for the majority of cases and are accurate
  to within about +-50% (standard deviation).
As a further safeguard, CORMIX will not give predictions whenever it judges
  the design configuration as highly complex and uncertain for prediction.
```

```
CORMIX1 PREDICTION FILE:
1111111111111111111111111111111111111111111111111111111111111111111111111111111111
1111111111111111
                        CORMIX MIXING ZONE EXPERT SYSTEM
             Subsystem CORMIX1:  Single Port Discharges
                          CORMIX Version 6.0GT
                       HYDRO1 Version 6.0.0.0 October 2009
-------------------------------------------------------------------------------
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-------------------------------------------------------------------------------
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CASE DESCRIPTION
 Site name/label:   SIM
 Design case:       JD309400GPMcSteadyFinal6.0
 FILE NAME:         P:\...\400GPMFinalRiver\JD309400GPMcSteadyFinal6.0R.prd
 Time stamp:        Fri Mar 26 14:30:40 2010

ENVIRONMENT PARAMETERS (metric units)
 Bounded section
 BS    =    158.50  AS    =   1226.10  QA    =    138.55  ICHREG= 1
 HA    =      7.74  HD    =      5.42
 UA    =      0.113 F     =      0.025 USTAR =0.6293E-02
 UW    =      9.300 UWSTAR=0.1193E-01
 Uniform density environment
 STRCND=  U         RHOAM = 1001.0000

DISCHARGE PARAMETERS (metric units)
 Above Surface Discharge:
 Re-computed discharge conditions at entry point at water surface.
 BANK  =  RIGHT     DISTB =      0.93
 D0    =      0.137 A0    =      0.015 H0    =      5.42  SUB0  =      0.00
 THETA =      0.00  SIGMA =     90.00
 U0    =      1.928 Q0    =      0.029       =0.2856E-01
 RHO0  =  999.7019  DRHO0 =0.1298E+01  GP0   =0.1272E-01
 C0    =0.1720E+00  CUNITS=  mg/l
 IPOLL =  1         KS    =0.0000E+00  KD    =0.0000E+00

FLUX VARIABLES (metric units)
 Q0    =0.2856E-01  M0    =0.5505E-01  J0    =0.3632E-03  SIGNJ0=      1.0
 Associated length scales (meters)
 LQ    =      0.12  LM    =      5.96  Lm    =      2.08  Lb    =      0.25
                                       Lmp   =  99999.00  Lbp   =  99999.00

NON-DIMENSIONAL PARAMETERS
 FR0   =     46.13  R     =     17.06

FLOW CLASSIFICATION
 111111111111111111111111111111111111111111
 1  Flow class (CORMIX1)      =    IPV3   1
 1  Applicable layer depth HS =     5.42  1
 111111111111111111111111111111111111111111

MIXING ZONE / TOXIC DILUTION / REGION OF INTEREST PARAMETERS
 C0    =0.1720E+00  CUNITS=  mg/l
 NTOX  =  1         CMC   =0.5800E-02  CCC   =  CSTD
 NSTD  =  1         CSTD  =0.3730E-02
 REGMZ =  1
 REGSPC=  1         XREG  =     91.44  WREG  =      0.00  AREG  =      0.00
 XINT  =   3500.00  XMAX  =   3500.00
```

```
X-Y-Z COORDINATE SYSTEM:
    ORIGIN is located at the bottom and below the center of the port:
         0.93 m  from the RIGHT bank/shore.
    X-axis points downstream, Y-axis points to left, Z-axis points upward.
NSTEP =  30 display intervals per module
-------------------------------------------------------------------------------
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-------------------------------------------------------------------------------
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BEGIN MOD101: DISCHARGE MODULE

       X        Y       Z        S       C       B        Uc        TT
      0.00     0.00    5.42     1.0 0.172E+00   0.07    1.928   .00000E+00

END OF MOD101: DISCHARGE MODULE
-------------------------------------------------------------------------------
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-------------------------------------------------------------------------------
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BEGIN CORJET (MOD110): JET/PLUME NEAR-FIELD MIXING REGION


 Zone of flow establishment:            THETAE=    -86.78  SIGMAE=     64.44
  LE    =      0.56  XE    =      0.01  YE    =      0.03  ZE    =      4.86

 Profile definitions:
   B = Gaussian 1/e (37%) half-width, normal to trajectory
   S = hydrodynamic centerline dilution
   C = centerline concentration (includes reaction effects, if any)
  Uc = Local centerline excess velocity (above ambient)
  TT = Cumulative travel time
```

X	Y	Z	S	C	B	Uc	TT
0.00	0.00	5.42	1.0	0.172E+00	0.07	1.928	.00000E+00
0.01	0.03	4.86	1.0	0.172E+00	0.07	1.928	.10737E-01
0.01	0.04	4.69	1.1	0.156E+00	0.09	1.928	.85044E-01
0.03	0.05	4.50	1.4	0.125E+00	0.11	1.639	.19351E+00
0.05	0.06	4.30	1.7	0.104E+00	0.14	1.352	.32614E+00
0.07	0.07	4.14	1.9	0.902E-01	0.16	1.167	.45981E+00
0.11	0.08	3.94	2.2	0.777E-01	0.18	0.996	.64018E+00
0.15	0.09	3.75	2.5	0.677E-01	0.21	0.859	.84833E+00
0.19	0.09	3.59	2.8	0.606E-01	0.23	0.761	.10502E+01
0.25	0.10	3.41	3.2	0.536E-01	0.26	0.663	.13151E+01
0.31	0.11	3.25	3.6	0.484E-01	0.28	0.591	.15690E+01
0.39	0.12	3.07	4.0	0.431E-01	0.31	0.517	.18988E+01
0.48	0.13	2.90	4.5	0.386E-01	0.34	0.452	.22675E+01
0.57	0.14	2.75	4.9	0.351E-01	0.37	0.403	.26167E+01
0.67	0.15	2.59	5.4	0.316E-01	0.40	0.353	.30649E+01
0.79	0.15	2.43	6.0	0.285E-01	0.44	0.309	.35595E+01
0.90	0.16	2.30	6.6	0.262E-01	0.47	0.277	.40215E+01
1.03	0.17	2.16	7.2	0.239E-01	0.50	0.243	.46062E+01
1.17	0.18	2.02	7.9	0.218E-01	0.54	0.215	.52403E+01
1.30	0.18	1.91	8.5	0.203E-01	0.57	0.194	.58228E+01
1.45	0.19	1.79	9.2	0.187E-01	0.60	0.172	.65470E+01
1.61	0.20	1.68	9.9	0.174E-01	0.63	0.154	.73177E+01
1.75	0.20	1.58	10.5	0.164E-01	0.66	0.141	.80136E+01
1.92	0.21	1.48	11.2	0.153E-01	0.69	0.128	.88646E+01
2.09	0.21	1.39	11.9	0.144E-01	0.71	0.116	.97555E+01
2.24	0.22	1.31	12.5	0.137E-01	0.74	0.107	.10549E+02
2.41	0.22	1.22	13.2	0.130E-01	0.76	0.099	.11508E+02

```
      2.59     0.23    1.14    13.9 0.124E-01   0.79    0.091   .12500E+02
      2.75     0.23    1.08    14.5 0.119E-01   0.81    0.085   .13375E+02
      2.93     0.24    1.01    15.2 0.113E-01   0.83    0.079   .14422E+02
      3.11     0.24    0.94    15.8 0.109E-01   0.85    0.074   .15497E+02
      3.30     0.24    0.87    16.4 0.105E-01   0.87    0.070   .16437E+02
 Cumulative travel time =          16.4371 sec

END OF CORJET (MOD110): JET/PLUME NEAR-FIELD MIXING REGION
-------------------------------------------------------------------------------
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-------------------------------------------------------------------------------
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BEGIN MOD131: LAYER BOUNDARY/TERMINAL LAYER APPROACH

  Control volume inflow:
       X        Y       Z        S       C       B        TT
      3.30     0.24    0.87    16.4 0.105E-01   0.87 .16437E+02

 Profile definitions:
   BV = top-hat thickness, measured vertically
   BH = top-hat half-width, measured horizontally in Y-direction
   ZU = upper plume boundary (Z-coordinate)
   ZL = lower plume boundary (Z-coordinate)
   S  = hydrodynamic average (bulk) dilution
   C  = average (bulk) concentration (includes reaction effects, if any)
   TT = Cumulative travel time

       X        Y       Z        S       C       BV       BH      ZU      ZL
TT
      2.42     0.23    5.42    16.4 0.105E-01   0.00     0.00    5.42    5.42
.16437E+02
      2.69     0.24    5.42    16.4 0.105E-01   1.18     0.59    5.42    4.24
.16437E+02
      2.95     0.24    5.42    16.4 0.105E-01   1.40     0.84    5.42    4.02
.16437E+02
      3.21     0.24    5.42    16.4 0.105E-01   1.54     1.03    5.42    3.88
.16437E+02
      3.47     0.25    5.42    16.8 0.102E-01   1.64     1.19    5.42    3.77
.17983E+02
      3.73     0.25    5.42    18.9 0.909E-02   1.72     1.33    5.42    3.69
.20300E+02
      3.99     0.25    5.42    21.8 0.789E-02   1.78     1.45    5.42    3.64
.22617E+02
      4.26     0.25    5.42    24.4 0.704E-02   1.82     1.57    5.42    3.59
.24934E+02
      4.52     0.26    5.42    26.2 0.656E-02   1.85     1.68    5.42    3.56
.27251E+02
      4.78     0.26    5.42    27.2 0.632E-02   1.87     1.78    5.42    3.54
.29569E+02
      5.04     0.26    5.42    27.9 0.618E-02   1.88     1.88    5.42    3.54
.31886E+02
 Cumulative travel time =          31.8857 sec

END OF MOD131: LAYER BOUNDARY/TERMINAL LAYER APPROACH
-------------------------------------------------------------------------------
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** End of NEAR-FIELD REGION (NFR) **

 In this design case, the discharge is located CLOSE TO BANK/SHORE.
 Some boundary interaction occurs at end of near-field.
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   This may be related to a design case with a very LOW AMBIENT VELOCITY.
   The dilution values in one or more of the preceding zones may be too high.
 Carefully evaluate results in near-field and check degree of interaction.

 Consider locating outfall further away from bank or shore.
 In the next prediction module, the plume centerline will be set
   to follow the bank/shore.
-------------------------------------------------------------------------------
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BEGIN MOD141: BUOYANT AMBIENT SPREADING

 Plume is ATTACHED to RIGHT bank/shore.
   Plume width is now determined from RIGHT bank/shore.

 Profile definitions:
   BV = top-hat thickness, measured vertically
   BH = top-hat half-width, measured horizontally in Y-direction
   ZU = upper plume boundary (Z-coordinate)
   ZL = lower plume boundary (Z-coordinate)
   S  = hydrodynamic average (bulk) dilution
   C  = average (bulk) concentration (includes reaction effects, if any)
   TT = Cumulative travel time

 Plume Stage 2 (bank attached):
       X        Y       Z        S       C       BV       BH      ZU      ZL
TT
      5.04    -0.93    5.42    27.9 0.618E-02   2.29     3.07    5.42    3.12
.31886E+02
** CMC HAS BEEN FOUND **
 The pollutant concentration in the plume falls below CMC value of 0.580E-02
   in the current prediction interval.
 This is the extent of the TOXIC DILUTION ZONE.
     11.19    -0.93    5.42    30.5 0.563E-02   1.83     4.21    5.42    3.58
.86245E+02
     17.33    -0.93    5.42    32.9 0.523E-02   1.60     5.20    5.42    3.82
.14060E+03
     23.47    -0.93    5.42    35.2 0.488E-02   1.46     6.10    5.42    3.96
.19496E+03
     29.62    -0.93    5.42    37.7 0.457E-02   1.37     6.94    5.42    4.04
.24932E+03
     35.76    -0.93    5.42    40.3 0.427E-02   1.32     7.72    5.42    4.10
.30368E+03
     41.90    -0.93    5.42    43.3 0.398E-02   1.29     8.47    5.42    4.12
.35804E+03
**WATER QUALITY STANDARD OR CCC HAS BEEN FOUND**
 The pollutant concentration in the plume falls below water quality standard
   or CCC value of 0.373E-02 in the current prediction interval.
 This is the spatial extent of concentrations exceeding the water quality
   standard or CCC value.
     48.05    -0.93    5.42    46.5 0.370E-02   1.28     9.18    5.42    4.14
.41240E+03
     54.19    -0.93    5.42    50.1 0.343E-02   1.28     9.87    5.42    4.13
.46676E+03
     60.34    -0.93    5.42    54.1 0.318E-02   1.30    10.53    5.42    4.12
.52112E+03
     66.48    -0.93    5.42    58.4 0.294E-02   1.32    11.16    5.42    4.09
.57548E+03
     72.62    -0.93    5.42    63.2 0.272E-02   1.36    11.78    5.42    4.06
.62984E+03
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     78.77    -0.93    5.42    68.4 0.251E-02   1.40    12.39    5.42    4.02
.68420E+03
     84.91    -0.93    5.42    74.1 0.232E-02   1.44    12.98    5.42    3.97
.73856E+03
     91.06    -0.93    5.42    80.2 0.215E-02   1.50    13.55    5.42    3.92
.79292E+03
 ** REGULATORY MIXING ZONE BOUNDARY **
 In this prediction interval the plume DOWNSTREAM  distance meets or exceeds
 the regulatory value =    91.44 m.
 This is the extent of the REGULATORY MIXING ZONE.
     97.20    -0.93    5.42    86.8 0.198E-02   1.55    14.12    5.42    3.86
.84728E+03
    103.34    -0.93    5.42    93.9 0.183E-02   1.62    14.67    5.42    3.80
.90164E+03
    109.49    -0.93    5.42   101.4 0.170E-02   1.69    15.21    5.42    3.73
.95599E+03
    115.63    -0.93    5.42   109.5 0.157E-02   1.76    15.74    5.42    3.66
.10104E+04
    121.78    -0.93    5.42   118.2 0.146E-02   1.84    16.27    5.42    3.58
.10647E+04
    127.92    -0.93    5.42   127.3 0.135E-02   1.92    16.78    5.42    3.50
.11191E+04
    134.06    -0.93    5.42   137.0 0.126E-02   2.00    17.29    5.42    3.41
.11734E+04
    140.21    -0.93    5.42   147.3 0.117E-02   2.09    17.79    5.42    3.32
.12278E+04
    146.35    -0.93    5.42   158.1 0.109E-02   2.18    18.29    5.42    3.23
.12822E+04
    152.49    -0.93    5.42   169.5 0.101E-02   2.28    18.78    5.42    3.13
.13365E+04
    158.64    -0.93    5.42   181.5 0.948E-03   2.38    19.26    5.42    3.03
.13909E+04
    164.78    -0.93    5.42   194.0 0.887E-03   2.48    19.74    5.42    2.93
.14452E+04
    170.93    -0.93    5.42   207.2 0.830E-03   2.59    20.21    5.42    2.82
.14996E+04
    177.07    -0.93    5.42   220.9 0.779E-03   2.70    20.67    5.42    2.71
.15539E+04
    183.21    -0.93    5.42   235.3 0.731E-03   2.81    21.13    5.42    2.60
.16083E+04
    189.36    -0.93    5.42   250.3 0.687E-03   2.93    21.59    5.42    2.49
.16627E+04
 Cumulative travel time =        1662.6667 sec

END OF MOD141: BUOYANT AMBIENT SPREADING
-------------------------------------------------------------------------------
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 Bottom coordinate for FAR-FIELD is determined by average depth, ZFB = -2.32m
-------------------------------------------------------------------------------
---------------
BEGIN MOD161: PASSIVE AMBIENT MIXING IN UNIFORM AMBIENT

  Vertical diffusivity (initial value)   = 0.135E-01 m^2/s
  Horizontal diffusivity (initial value) = 0.169E-01 m^2/s

 Profile definitions:
   BV = Gaussian s.d.*sqrt(pi/2) (46%) thickness, measured vertically
      = or equal to layer depth, if fully mixed
   BH = Gaussian s.d.*sqrt(pi/2) (46%) half-width,
        measured horizontally in Y-direction
```

```
   ZU = upper plume boundary (Z-coordinate)
   ZL = lower plume boundary (Z-coordinate)
   S  = hydrodynamic centerline dilution
   C  = centerline concentration (includes reaction effects, if any)
   TT = Cumulative travel time

 Plume Stage 2 (bank attached):
       X        Y       Z        S       C       BV       BH      ZU      ZL
TT
    189.36    -0.93    5.42   250.3 0.687E-03   2.93    21.59    5.42    2.49
.16627E+04
    299.71    -0.93    5.42   344.0 0.500E-03   3.82    22.76    5.42    1.60
.26391E+04
    410.07    -0.93    5.42   476.1 0.361E-03   5.04    23.87    5.42    0.37
.36154E+04
    520.42    -0.93    5.42   642.5 0.268E-03   6.51    24.94    5.42   -1.10
.45918E+04
 Plume interacts with BOTTOM.
 The passive diffusion plume becomes VERTICALLY FULLY MIXED within this
   prediction interval.
    630.78    -0.93    5.42   794.5 0.216E-03   7.74    25.96    5.42   -2.32
.55682E+04
    741.13    -0.93    5.42   824.5 0.209E-03   7.74    26.94    5.42   -2.32
.65446E+04
    851.49    -0.93    5.42   853.5 0.202E-03   7.74    27.88    5.42   -2.32
.75210E+04
    961.84    -0.93    5.42   881.5 0.195E-03   7.74    28.80    5.42   -2.32
.84974E+04
   1072.20    -0.93    5.42   908.6 0.189E-03   7.74    29.68    5.42   -2.32
.94738E+04
   1182.55    -0.93    5.42   935.0 0.184E-03   7.74    30.55    5.42   -2.32
.10450E+05
   1292.91    -0.93    5.42   960.6 0.179E-03   7.74    31.38    5.42   -2.32
.11427E+05
   1403.26    -0.93    5.42   985.6 0.175E-03   7.74    32.20    5.42   -2.32
.12403E+05
   1513.61    -0.93    5.42  1010.0 0.170E-03   7.74    33.00    5.42   -2.32
.13379E+05
   1623.97    -0.93    5.42  1033.8 0.166E-03   7.74    33.77    5.42   -2.32
.14356E+05
   1734.32    -0.93    5.42  1057.0 0.163E-03   7.74    34.53    5.42   -2.32
.15332E+05
   1844.68    -0.93    5.42  1079.8 0.159E-03   7.74    35.27    5.42   -2.32
.16309E+05
   1955.03    -0.93    5.42  1102.0 0.156E-03   7.74    36.00    5.42   -2.32
.17285E+05
   2065.39    -0.93    5.42  1123.9 0.153E-03   7.74    36.72    5.42   -2.32
.18261E+05
   2175.74    -0.93    5.42  1145.3 0.150E-03   7.74    37.42    5.42   -2.32
.19238E+05
   2286.10    -0.93    5.42  1166.3 0.147E-03   7.74    38.10    5.42   -2.32
.20214E+05
   2396.45    -0.93    5.42  1187.0 0.145E-03   7.74    38.78    5.42   -2.32
.21190E+05
   2506.81    -0.93    5.42  1207.3 0.142E-03   7.74    39.44    5.42   -2.32
.22167E+05
   2617.16    -0.93    5.42  1227.2 0.140E-03   7.74    40.09    5.42   -2.32
.23143E+05
   2727.52    -0.93    5.42  1246.9 0.138E-03   7.74    40.73    5.42   -2.32
.24120E+05
```

```
   2837.87    -0.93    5.42  1266.2 0.136E-03   7.74    41.37    5.42   -2.32
.25096E+05
   2948.23    -0.93    5.42  1285.3 0.134E-03   7.74    41.99    5.42   -2.32
.26072E+05
   3058.58    -0.93    5.42  1304.0 0.132E-03   7.74    42.60    5.42   -2.32
.27049E+05
   3168.94    -0.93    5.42  1322.5 0.130E-03   7.74    43.21    5.42   -2.32
.28025E+05
   3279.29    -0.93    5.42  1340.8 0.128E-03   7.74    43.80    5.42   -2.32
.29002E+05
   3389.65    -0.93    5.42  1358.8 0.127E-03   7.74    44.39    5.42   -2.32
.29978E+05
   3500.00    -0.93    5.42  1376.6 0.125E-03   7.74    44.97    5.42   -2.32
.30954E+05
 Cumulative travel time =       30954.3477 sec

 Simulation limit based on maximum specified distance =   3500.00 m.
   This is the REGION OF INTEREST limitation.

END OF MOD161: PASSIVE AMBIENT MIXING IN UNIFORM AMBIENT
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CORMIX1: Single Port Discharges              End of Prediction File
1111111111111111111111111111111111111111111111111111111111111111111111111111111
1111111111111111
```

```
CORMIX SESSION REPORT:
XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
                      CORMIX MIXING ZONE EXPERT SYSTEM
                          CORMIX Version 6.0GT
                       HYDRO1:Version-6.0.0.0  October,2009
SITE NAME/LABEL:                SIM
  DESIGN CASE:                  JD309400GPMcSteadyFinal6.0
  FILE NAME:
P:\Mixing\CriticalDischargeScenarios\V.6.0\400GPMFinalRiver\JD309400GPMcSteadyF
inal6.0R.prd
  Using subsystem CORMIX1:     Single Port Discharges
  Start of session:             03/26/2010--14:30:40
*****************************************************************************
SUMMARY OF INPUT DATA:
-----------------------------------------------------------------------------
AMBIENT PARAMETERS:
  Cross-section                           = bounded
  Width                           BS      = 158.50 m
  Channel regularity              ICHREG = 1
  Ambient flowrate                QA      = 138.55 m^3/s
  Average depth                   HA      = 7.74 m
  Depth at discharge              HD      = 5.42 m
  Ambient velocity                UA      = 0.113 m/s
  Darcy-Weisbach friction factor  F       = 0.0248
    Calculated from Manning's n           = 0.025
  Wind velocity                   UW      = 9.30 m/s
  Stratification Type             STRCND = U
  Surface density                 RHOAS   = 1001.0000 kg/m^3
  Bottom density                  RHOAB   = 1001.0000 kg/m^3
-----------------------------------------------------------------------------
DISCHARGE PARAMETERS:             Single Port Discharge
  Nearest bank                            = right
  Distance to bank                DISTB   = 0.93 m
  Port diameter                   D0      = 0.1373 m
  Port cross-sectional area       A0      = 0.0148 m^2
  Discharge velocity              U0      = 1.93 m/s
  Discharge flowrate              Q0      = 0.028558 m^3/s
  Discharge port height           H0      = 5.42 m
  Vertical discharge angle        THETA   = -87.09 deg
  Horizontal discharge angle      SIGMA   = 90 deg
  Discharge temperature (freshwater)      = 10 degC
  Corresponding density           RHO0    = 999.7019 kg/m^3
  Density difference              DRHO    = 1.2981 kg/m^3
  Buoyant acceleration            GP0     = 0.0127 m/s^2
  Discharge concentration         C0      = 0.172 mg/l
  Surface heat exchange coeff.    KS      = 0 m/s
  Coefficient of decay            KD      = 0 /s
-----------------------------------------------------------------------------
DISCHARGE/ENVIRONMENT LENGTH SCALES:
  LQ  = 0.12 m         Lm  = 2.08 m         Lb  = 0.25 m
  LM  = 5.96 m         Lm' = 99999 m         Lb' = 99999 m
-----------------------------------------------------------------------------
NON-DIMENSIONAL PARAMETERS:
  Port densimetric Froude number  FR0     = 46.13
  Velocity ratio                  R       = 17.06
-----------------------------------------------------------------------------
MIXING ZONE / TOXIC DILUTION ZONE / AREA OF INTEREST PARAMETERS:
  Toxic discharge                         = yes
  CMC concentration               CMC     = 0.0058 mg/l
  CCC concentration               CCC     = 0.00373 mg/l
```

```
  Water quality standard specified       = given by CCC value
  Regulatory mixing zone                 = yes
  Regulatory mixing zone specification   = distance
  Regulatory mixing zone value           = 91.44 m (m^2 if area)
  Region of interest                     = 3500 m
*****************************************************************************
HYDRODYNAMIC CLASSIFICATION:
  *------------------------*
  | FLOW CLASS   = IPV3 |
  *------------------------*
  This flow configuration applies to a layer corresponding to the full water
  depth at the discharge site.
  Applicable layer depth = water depth = 5.42 m
*****************************************************************************
MIXING ZONE EVALUATION (hydrodynamic and regulatory summary):

-----------------------------------------------------------------------------
X-Y-Z Coordinate system:
  Origin is located at the bottom below the port center:
    0.93 m from the right bank/shore.
  Number of display steps NSTEP = 30 per module.
-----------------------------------------------------------------------------
NEAR-FIELD REGION (NFR) CONDITIONS :
Note: The NFR is the zone of strong initial mixing.  It has no regulatory
  implication.  However, this information may be useful for the discharge
  designer because the mixing in the NFR is usually sensitive to the
  discharge design conditions.
  Pollutant concentration at NFR edge  c = 0.0062 mg/l
  Dilution at edge of NFR              s = 27.9
  NFR Location:                        x = 5.04 m
    (centerline coordinates)           y = 0.26 m
                                       z = 5.42 m
  NFR plume dimensions:  half-width (bh) = 1.88 m
                          thickness (bv) = 1.88 m
Cumulative travel time:       31.8857 sec.
-----------------------------------------------------------------------------
Buoyancy assessment:
  The effluent density is less than the surrounding ambient water
  density at the discharge level.
  Therefore, the effluent is POSITIVELY BUOYANT and will tend to rise towards
  the surface.
-----------------------------------------------------------------------------
FAR-FIELD MIXING SUMMARY:
  Plume becomes vertically fully mixed at 630.78 m downstream.
-----------------------------------------------------------------------------
PLUME BANK CONTACT SUMMARY:
  Plume in bounded section contacts one bank only at 5.04 m downstream.
************************ TOXIC DILUTION ZONE SUMMARY ************************
Recall: The TDZ corresponds to the three (3) criteria issued in the USEPA
  Technical Support Document (TSD) for Water Quality-based Toxics Control,
  1991 (EPA/505/2-90-001).
  Criterion maximum concentration (CMC)  = 0.0058  mg/l
Corresponding dilution                   = 29.655172
The CMC was encountered at the following plume position:
  Plume location:                      x = 9.03 m
    (centerline coordinates)           y = -0.93 m
                                       z = 5.42 m
  Plume dimension:       half-width (bh) = 3.83 m
                          thickness (bv) = 1.96 m
```

```
 Computed distance from port opening to CMC location = 9.08 m.
 CRITERION 1: This location is beyond 50 times the discharge length scale of
              Lq = 0.12 m.
 +++++ The discharge length scale TEST for the TDZ has FAILED. ++++++

 Computed horizontal distance from port opening to CMC location = 9.08 m.
 CRITERION 2: This location is within 5 times the ambient water depth of
              HD = 5.42 m.
 ++++++++++ The ambient depth TEST for the TDZ has been SATISFIED. ++++++++++

 Computed distance from port opening to CMC location = 9.08 m.
 CRITERION 3: This location is within one tenth the distance of the extent
              of the Regulatory Mixing Zone of 91.44 m in any
              spatial direction from the port opening.
 +++++ The Regulatory Mixing Zone TEST for the TDZ has been SATISFIED. ++++++

 The diffuser discharge velocity is equal to 1.93 m/s.
 This is below the value of 3.0 m/s recommended in the TSD.

 *** This discharge DOES NOT SATISFY all three CMC criteria for the TDZ. ****
 **** This MAY be caused by the low discharge velocity for this design. *****
********************** REGULATORY MIXING ZONE SUMMARY **********************
The plume conditions at the boundary of the specified RMZ are as follows:
  Pollutant concentration              c = 0.002135  mg/l
  Corresponding dilution               s = 80.6
  Plume location:                      x = 91.44 m
    (centerline coordinates)           y = -0.93 m
                                       z = 5.42 m
  Plume dimensions:      half-width (bh) = 13.59 m
                          thickness (bv) = 1.50 m
Cumulative travel time:       796.3146 sec.
At this position, the plume is CONTACTING the RIGHT bank.
Furthermore, the CCC for the toxic pollutant has indeed been met
  within the RMZ. In particular:
The CCC was encountered at the following plume position:
The CCC for the toxic pollutant was encountered at the following
  plume position:
  CCC                                    = 0.00373  mg/l
Corresponding dilution                   = 46.1
  Plume location:                      x = 47.34 m
    (centerline coordinates)           y = -0.93 m
                                       z = 5.42 m
  Plume dimensions:      half-width (bh) = 9.10 m
                          thickness (bv) = 1.28 m
********************* FINAL DESIGN ADVICE AND COMMENTS **********************
REMINDER:  The user must take note that HYDRODYNAMIC MODELING by any known
  technique is NOT AN EXACT SCIENCE.
Extensive comparison with field and laboratory data has shown that the
  CORMIX predictions on dilutions and concentrations (with associated
  plume geometries) are reliable for the majority of cases and are accurate
  to within about +-50% (standard deviation).
As a further safeguard, CORMIX will not give predictions whenever it judges
  the design configuration as highly complex and uncertain for prediction.
```

```
CORMIX1 PREDICTION FILE:
1111111111111111111111111111111111111111111111111111111111111111111111111111111111
1111111111111111
                        CORMIX MIXING ZONE EXPERT SYSTEM
              Subsystem CORMIX1:  Single Port Discharges
                          CORMIX Version 6.0GT
                       HYDRO1 Version 6.0.0.0 October 2009
-------------------------------------------------------------------------------
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-------------------------------------------------------------------------------
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CASE DESCRIPTION
 Site name/label:
 Design case:       JD309400GPMdSteadyFinal6.0
 FILE NAME:         P:\...\400GPMFinalRiver\JD309400GPMdSteadyFinal6.0R.prd
 Time stamp:        Fri Mar 26 14:35:09 2010

ENVIRONMENT PARAMETERS (metric units)
 Bounded section
 BS    =    158.50  AS    =   1210.25  QA    =    215.42  ICHREG= 1
 HA    =      7.64  HD    =      5.35
 UA    =      0.178 F     =      0.025 USTAR =0.9934E-02
 UW    =      9.300 UWSTAR=0.1193E-01
 Uniform density environment
 STRCND=  U         RHOAM = 1001.0000

DISCHARGE PARAMETERS (metric units)
 Above Surface Discharge:
 Re-computed discharge conditions at entry point at water surface.
 BANK  =  RIGHT     DISTB =      0.96
 D0    =      0.170 A0    =      0.023 H0    =      5.35  SUB0  =      0.00
 THETA =      0.00  SIGMA =     90.00
 U0    =      2.388 Q0    =      0.054       =0.5394E-01
 RHO0  =  999.7019  DRHO0 =0.1298E+01  GP0   =0.1272E-01
 C0    =0.1390E+00  CUNITS=  mg/l
 IPOLL =  1         KS    =0.0000E+00  KD    =0.0000E+00

FLUX VARIABLES (metric units)
 Q0    =0.5394E-01  M0    =0.1288E+00  J0    =0.6859E-03  SIGNJ0=      1.0
 Associated length scales (meters)
 LQ    =      0.15  LM    =      8.21  Lm    =      2.02  Lb    =      0.12
                                        Lmp   =  99999.00  Lbp   =  99999.00

NON-DIMENSIONAL PARAMETERS
 FR0   =     51.42  R     =     13.41

FLOW CLASSIFICATION
 111111111111111111111111111111111111111111
 1  Flow class (CORMIX1)      =    IPV3   1
 1  Applicable layer depth HS =     5.35  1
 111111111111111111111111111111111111111111

MIXING ZONE / TOXIC DILUTION / REGION OF INTEREST PARAMETERS
 C0    =0.1390E+00  CUNITS=  mg/l
 NTOX  =  1         CMC   =0.5800E-02  CCC   =  CSTD
 NSTD  =  1         CSTD  =0.3730E-02
 REGMZ =  1
 REGSPC=  1         XREG  =     91.44  WREG  =      0.00  AREG  =      0.00
 XINT  =  35000.00  XMAX  =  35000.00
```

```
X-Y-Z COORDINATE SYSTEM:
    ORIGIN is located at the bottom and below the center of the port:
         0.96 m  from the RIGHT bank/shore.
    X-axis points downstream, Y-axis points to left, Z-axis points upward.
NSTEP =  30 display intervals per module
-------------------------------------------------------------------------------
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-------------------------------------------------------------------------------
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BEGIN MOD101: DISCHARGE MODULE

       X        Y       Z        S       C       B        Uc        TT
      0.00     0.00    5.35     1.0 0.139E+00   0.08    2.388   .00000E+00

END OF MOD101: DISCHARGE MODULE
-------------------------------------------------------------------------------
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-------------------------------------------------------------------------------
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BEGIN CORJET (MOD110): JET/PLUME NEAR-FIELD MIXING REGION


 Zone of flow establishment:            THETAE=    -85.22  SIGMAE=     68.25
  LE    =      0.64  XE    =      0.01  YE    =      0.05  ZE    =      4.70

 Profile definitions:
   B = Gaussian 1/e (37%) half-width, normal to trajectory
   S = hydrodynamic centerline dilution
   C = centerline concentration (includes reaction effects, if any)
  Uc = Local centerline excess velocity (above ambient)
  TT = Cumulative travel time
```

X	Y	Z	S	C	B	Uc	TT
0.00	0.00	5.35	1.0	0.139E+00	0.08	2.388	.00000E+00
0.01	0.05	4.70	1.0	0.139E+00	0.09	2.388	.82641E-02
0.02	0.06	4.54	1.0	0.133E+00	0.11	2.388	.63881E-01
0.03	0.08	4.35	1.3	0.110E+00	0.13	2.211	.14209E+00
0.05	0.09	4.19	1.5	0.957E-01	0.15	1.909	.22093E+00
0.08	0.10	4.01	1.7	0.824E-01	0.17	1.633	.32724E+00
0.11	0.12	3.83	1.9	0.719E-01	0.19	1.412	.44979E+00
0.16	0.13	3.64	2.2	0.632E-01	0.22	1.230	.58954E+00
0.20	0.15	3.49	2.4	0.569E-01	0.24	1.097	.72392E+00
0.26	0.16	3.31	2.7	0.506E-01	0.27	0.962	.89887E+00
0.34	0.17	3.14	3.1	0.452E-01	0.30	0.845	.10948E+01
0.40	0.18	2.99	3.4	0.411E-01	0.32	0.756	.12806E+01
0.49	0.20	2.82	3.8	0.369E-01	0.35	0.665	.15197E+01
0.57	0.21	2.69	4.1	0.337E-01	0.38	0.595	.17449E+01
0.68	0.22	2.53	4.6	0.304E-01	0.41	0.524	.20324E+01
0.79	0.23	2.38	5.1	0.275E-01	0.45	0.461	.23478E+01
0.90	0.24	2.26	5.5	0.253E-01	0.48	0.415	.26410E+01
1.03	0.25	2.12	6.0	0.231E-01	0.51	0.367	.30100E+01
1.17	0.26	1.99	6.6	0.212E-01	0.54	0.326	.34080E+01
1.29	0.27	1.89	7.0	0.197E-01	0.57	0.295	.37721E+01
1.43	0.28	1.77	7.6	0.182E-01	0.60	0.265	.42227E+01
1.59	0.29	1.66	8.2	0.169E-01	0.63	0.238	.47002E+01
1.72	0.30	1.57	8.7	0.160E-01	0.66	0.219	.51300E+01
1.88	0.31	1.47	9.3	0.150E-01	0.69	0.199	.56540E+01
2.04	0.31	1.38	9.9	0.141E-01	0.71	0.182	.62009E+01
2.21	0.32	1.29	10.4	0.133E-01	0.74	0.168	.67692E+01
2.36	0.33	1.22	10.9	0.127E-01	0.76	0.157	.72723E+01

```
      2.53     0.33    1.14    11.5 0.121E-01   0.79    0.146   .78765E+01
      2.70     0.34    1.06    12.0 0.116E-01   0.81    0.136   .84981E+01
      2.85     0.35    1.00    12.5 0.111E-01   0.83    0.128   .90437E+01
      3.02     0.35    0.93    13.0 0.107E-01   0.85    0.120   .96943E+01
      3.20     0.36    0.87    13.5 0.103E-01   0.87    0.114   .10263E+02
 Cumulative travel time =          10.2633 sec

END OF CORJET (MOD110): JET/PLUME NEAR-FIELD MIXING REGION
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-------------------------------------------------------------------------------
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BEGIN MOD131: LAYER BOUNDARY/TERMINAL LAYER APPROACH

  Control volume inflow:
       X        Y       Z        S       C       B        TT
      3.20     0.36    0.87    13.5 0.103E-01   0.87 .10263E+02

 Profile definitions:
   BV = top-hat thickness, measured vertically
   BH = top-hat half-width, measured horizontally in Y-direction
   ZU = upper plume boundary (Z-coordinate)
   ZL = lower plume boundary (Z-coordinate)
   S  = hydrodynamic average (bulk) dilution
   C  = average (bulk) concentration (includes reaction effects, if any)
   TT = Cumulative travel time

       X        Y       Z        S       C       BV       BH      ZU      ZL
TT
      2.33     0.34    5.35    13.5 0.103E-01   0.00     0.00    5.35    5.35
.10263E+02
      2.59     0.35    5.35    13.5 0.103E-01   1.17     0.59    5.35    4.17
.10263E+02
      2.85     0.35    5.35    13.5 0.103E-01   1.39     0.83    5.35    3.96
.10263E+02
      3.11     0.36    5.35    13.5 0.103E-01   1.53     1.02    5.35    3.82
.10263E+02
      3.37     0.36    5.35    13.9 0.100E-01   1.63     1.18    5.35    3.71
.11239E+02
      3.63     0.36    5.35    15.6 0.892E-02   1.71     1.32    5.35    3.64
.12699E+02
      3.89     0.37    5.35    17.9 0.774E-02   1.77     1.44    5.35    3.58
.14159E+02
      4.15     0.37    5.35    20.1 0.691E-02   1.81     1.56    5.35    3.53
.15620E+02
      4.41     0.38    5.35    21.6 0.644E-02   1.84     1.67    5.35    3.50
.17080E+02
      4.67     0.38    5.35    22.4 0.621E-02   1.86     1.77    5.35    3.49
.18540E+02
      4.93     0.39    5.35    22.9 0.606E-02   1.86     1.86    5.35    3.48
.20001E+02
 Cumulative travel time =          20.0007 sec

END OF MOD131: LAYER BOUNDARY/TERMINAL LAYER APPROACH
-------------------------------------------------------------------------------
---------------
** End of NEAR-FIELD REGION (NFR) **

 In this design case, the discharge is located CLOSE TO BANK/SHORE.
 Some boundary interaction occurs at end of near-field.
```

```
   This may be related to a design case with a very LOW AMBIENT VELOCITY.
   The dilution values in one or more of the preceding zones may be too high.
 Carefully evaluate results in near-field and check degree of interaction.

 Consider locating outfall further away from bank or shore.
 In the next prediction module, the plume centerline will be set
   to follow the bank/shore.
-------------------------------------------------------------------------------
---------------
BEGIN MOD141: BUOYANT AMBIENT SPREADING

 Plume is ATTACHED to RIGHT bank/shore.
   Plume width is now determined from RIGHT bank/shore.

 Profile definitions:
   BV = top-hat thickness, measured vertically
   BH = top-hat half-width, measured horizontally in Y-direction
   ZU = upper plume boundary (Z-coordinate)
   ZL = lower plume boundary (Z-coordinate)
   S  = hydrodynamic average (bulk) dilution
   C  = average (bulk) concentration (includes reaction effects, if any)
   TT = Cumulative travel time

 Plume Stage 2 (bank attached):
       X        Y       Z        S       C       BV       BH      ZU      ZL
TT
      4.93    -0.96    5.35    22.9 0.606E-02   2.17     3.21    5.35    3.18
.20001E+02
** CMC HAS BEEN FOUND **
 The pollutant concentration in the plume falls below CMC value of 0.580E-02
   in the current prediction interval.
 This is the extent of the TOXIC DILUTION ZONE.
     13.38    -0.96    5.35    25.0 0.556E-02   1.77     4.28    5.35    3.57
.67472E+02
     21.83    -0.96    5.35    26.9 0.517E-02   1.56     5.22    5.35    3.79
.11494E+03
     30.29    -0.96    5.35    28.7 0.484E-02   1.43     6.08    5.35    3.91
.16241E+03
     38.74    -0.96    5.35    30.7 0.453E-02   1.35     6.89    5.35    3.99
.20989E+03
     47.19    -0.96    5.35    32.9 0.423E-02   1.30     7.64    5.35    4.04
.25736E+03
     55.64    -0.96    5.35    35.2 0.395E-02   1.28     8.36    5.35    4.07
.30483E+03
**WATER QUALITY STANDARD OR CCC HAS BEEN FOUND**
 The pollutant concentration in the plume falls below water quality standard
   or CCC value of 0.373E-02 in the current prediction interval.
 This is the spatial extent of concentrations exceeding the water quality
   standard or CCC value.
     64.09    -0.96    5.35    37.8 0.367E-02   1.27     9.04    5.35    4.08
.35230E+03
     72.55    -0.96    5.35    40.7 0.341E-02   1.27     9.70    5.35    4.07
.39977E+03
     81.00    -0.96    5.35    43.9 0.316E-02   1.29    10.34    5.35    4.06
.44724E+03
     89.45    -0.96    5.35    47.4 0.293E-02   1.31    10.95    5.35    4.03
.49471E+03
 ** REGULATORY MIXING ZONE BOUNDARY **
 In this prediction interval the plume DOWNSTREAM  distance meets or exceeds
 the regulatory value =    91.44 m.
```

```
 This is the extent of the REGULATORY MIXING ZONE.
     97.90    -0.96    5.35    51.3 0.271E-02   1.34    11.55    5.35    4.00
.54219E+03
    106.36    -0.96    5.35    55.5 0.251E-02   1.38    12.14    5.35    3.96
.58966E+03
    114.81    -0.96    5.35    60.0 0.232E-02   1.43    12.71    5.35    3.91
.63713E+03
    123.26    -0.96    5.35    64.9 0.214E-02   1.48    13.26    5.35    3.86
.68460E+03
    131.71    -0.96    5.35    70.2 0.198E-02   1.54    13.81    5.35    3.81
.73207E+03
    140.16    -0.96    5.35    75.8 0.183E-02   1.60    14.34    5.35    3.74
.77954E+03
    148.62    -0.96    5.35    81.9 0.170E-02   1.67    14.87    5.35    3.68
.82701E+03
    157.07    -0.96    5.35    88.3 0.157E-02   1.74    15.38    5.35    3.60
.87449E+03
    165.52    -0.96    5.35    95.2 0.146E-02   1.82    15.89    5.35    3.53
.92196E+03
    173.97    -0.96    5.35   102.5 0.136E-02   1.90    16.39    5.35    3.45
.96943E+03
    182.42    -0.96    5.35   110.2 0.126E-02   1.98    16.88    5.35    3.37
.10169E+04
    190.88    -0.96    5.35   118.4 0.117E-02   2.07    17.37    5.35    3.28
.10644E+04
    199.33    -0.96    5.35   127.0 0.109E-02   2.16    17.85    5.35    3.19
.11118E+04
    207.78    -0.96    5.35   136.1 0.102E-02   2.25    18.32    5.35    3.09
.11593E+04
    216.23    -0.96    5.35   145.6 0.955E-03   2.35    18.79    5.35    3.00
.12068E+04
    224.68    -0.96    5.35   155.6 0.893E-03   2.45    19.25    5.35    2.90
.12543E+04
    233.14    -0.96    5.35   166.0 0.837E-03   2.55    19.70    5.35    2.79
.13017E+04
    241.59    -0.96    5.35   177.0 0.785E-03   2.66    20.16    5.35    2.68
.13492E+04
    250.04    -0.96    5.35   188.4 0.738E-03   2.77    20.60    5.35    2.57
.13967E+04
    258.49    -0.96    5.35   200.3 0.694E-03   2.88    21.04    5.35    2.46
.14441E+04
 Cumulative travel time =        1444.1418 sec

END OF MOD141: BUOYANT AMBIENT SPREADING
--------------------------------------------------------------------------------
---------------
 Bottom coordinate for FAR-FIELD is determined by average depth, ZFB = -2.29m
--------------------------------------------------------------------------------
---------------
BEGIN MOD161: PASSIVE AMBIENT MIXING IN UNIFORM AMBIENT

  Vertical diffusivity (initial value)   = 0.149E-01 m^2/s
  Horizontal diffusivity (initial value) = 0.186E-01 m^2/s

 Profile definitions:
   BV = Gaussian s.d.*sqrt(pi/2) (46%) thickness, measured vertically
      = or equal to layer depth, if fully mixed
   BH = Gaussian s.d.*sqrt(pi/2) (46%) half-width,
        measured horizontally in Y-direction
   ZU = upper plume boundary (Z-coordinate)
```

```
   ZL = lower plume boundary (Z-coordinate)
   S  = hydrodynamic centerline dilution
   C  = centerline concentration (includes reaction effects, if any)
   TT = Cumulative travel time

 Plume Stage 2 (bank attached):
       X        Y       Z        S       C       BV       BH      ZU      ZL
TT
    258.49    -0.96    5.35   200.3 0.694E-03   2.88    21.04    5.35    2.46
.14441E+04
 Plume interacts with BOTTOM.
 The passive diffusion plume becomes VERTICALLY FULLY MIXED within this
   prediction interval.
   1416.54    -0.96    5.35   722.6 0.192E-03   7.64    28.67    5.35   -2.29
.79484E+04
   2574.59    -0.96    5.35   873.5 0.159E-03   7.64    34.66    5.35   -2.29
.14453E+05
   3732.64    -0.96    5.35  1002.0 0.139E-03   7.64    39.76    5.35   -2.29
.20957E+05
   4890.69    -0.96    5.35  1115.7 0.125E-03   7.64    44.28    5.35   -2.29
.27461E+05
   6048.74    -0.96    5.35  1218.9 0.114E-03   7.64    48.37    5.35   -2.29
.33966E+05
   7206.79    -0.96    5.35  1314.0 0.106E-03   7.64    52.14    5.35   -2.29
.40470E+05
   8364.84    -0.96    5.35  1402.7 0.991E-04   7.64    55.66    5.35   -2.29
.46974E+05
   9522.89    -0.96    5.35  1486.1 0.935E-04   7.64    58.97    5.35   -2.29
.53478E+05
  10680.95    -0.96    5.35  1565.1 0.888E-04   7.64    62.11    5.35   -2.29
.59983E+05
  11839.00    -0.96    5.35  1640.2 0.847E-04   7.64    65.09    5.35   -2.29
.66487E+05
  12997.05    -0.96    5.35  1712.1 0.812E-04   7.64    67.94    5.35   -2.29
.72991E+05
  14155.10    -0.96    5.35  1781.1 0.780E-04   7.64    70.68    5.35   -2.29
.79495E+05
  15313.15    -0.96    5.35  1847.4 0.752E-04   7.64    73.31    5.35   -2.29
.86000E+05
  16471.20    -0.96    5.35  1911.5 0.727E-04   7.64    75.85    5.35   -2.29
.92504E+05
  17629.25    -0.96    5.35  1973.5 0.704E-04   7.64    78.31    5.35   -2.29
.99008E+05
  18787.30    -0.96    5.35  2033.7 0.683E-04   7.64    80.70    5.35   -2.29
.10551E+06
  19945.35    -0.96    5.35  2092.1 0.664E-04   7.64    83.02    5.35   -2.29
.11202E+06
  21103.40    -0.96    5.35  2148.9 0.647E-04   7.64    85.27    5.35   -2.29
.11852E+06
  22261.45    -0.96    5.35  2204.2 0.631E-04   7.64    87.47    5.35   -2.29
.12503E+06
  23419.50    -0.96    5.35  2258.2 0.616E-04   7.64    89.61    5.35   -2.29
.13153E+06
  24577.55    -0.96    5.35  2310.9 0.601E-04   7.64    91.70    5.35   -2.29
.13803E+06
  25735.61    -0.96    5.35  2362.5 0.588E-04   7.64    93.75    5.35   -2.29
.14454E+06
  26893.66    -0.96    5.35  2412.9 0.576E-04   7.64    95.75    5.35   -2.29
.15104E+06
```

```
  28051.71    -0.96    5.35  2462.3 0.565E-04   7.64    97.71    5.35   -2.29
.15755E+06
  29209.76    -0.96    5.35  2510.8 0.554E-04   7.64    99.63    5.35   -2.29
.16405E+06
  30367.81    -0.96    5.35  2558.3 0.543E-04   7.64   101.52    5.35   -2.29
.17056E+06
  31525.86    -0.96    5.35  2605.0 0.534E-04   7.64   103.37    5.35   -2.29
.17706E+06
  32683.91    -0.96    5.35  2650.8 0.524E-04   7.64   105.19    5.35   -2.29
.18356E+06
  33841.96    -0.96    5.35  2695.9 0.516E-04   7.64   106.98    5.35   -2.29
.19007E+06
  35000.01    -0.96    5.35  2740.2 0.507E-04   7.64   108.74    5.35   -2.29
.19657E+06
 Cumulative travel time =      196572.2969 sec

 Simulation limit based on maximum specified distance =  35000.00 m.
   This is the REGION OF INTEREST limitation.

END OF MOD161: PASSIVE AMBIENT MIXING IN UNIFORM AMBIENT
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-------------------------------------------------------------------------------
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CORMIX1: Single Port Discharges              End of Prediction File
1111111111111111111111111111111111111111111111111111111111111111111111111111111
1111111111111111
```

```
CORMIX SESSION REPORT:
XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
                      CORMIX MIXING ZONE EXPERT SYSTEM
                          CORMIX Version 6.0GT
                       HYDRO1:Version-6.0.0.0  October,2009
SITE NAME/LABEL:
  DESIGN CASE:                  JD309400GPMdSteadyFinal6.0
  FILE NAME:
P:\Mixing\CriticalDischargeScenarios\V.6.0\400GPMFinalRiver\JD309400GPMdSteadyF
inal6.0R.prd
  Using subsystem CORMIX1:     Single Port Discharges
  Start of session:             03/26/2010--14:35:09
*****************************************************************************
SUMMARY OF INPUT DATA:
-----------------------------------------------------------------------------
AMBIENT PARAMETERS:
  Cross-section                           = bounded
  Width                           BS      = 158.50 m
  Channel regularity              ICHREG = 1
  Ambient flowrate                QA      = 215.42 m^3/s
  Average depth                   HA      = 7.64 m
  Depth at discharge              HD      = 5.35 m
  Ambient velocity                UA      = 0.178 m/s
  Darcy-Weisbach friction factor  F       = 0.0249
    Calculated from Manning's n           = 0.025
  Wind velocity                   UW      = 9.30 m/s
  Stratification Type             STRCND = U
  Surface density                 RHOAS   = 1001.0000 kg/m^3
  Bottom density                  RHOAB   = 1001.0000 kg/m^3
-----------------------------------------------------------------------------
DISCHARGE PARAMETERS:             Single Port Discharge
  Nearest bank                            = right
  Distance to bank                DISTB   = 0.96 m
  Port diameter                   D0      = 0.1696 m
  Port cross-sectional area       A0      = 0.0226 m^2
  Discharge velocity              U0      = 2.39 m/s
  Discharge flowrate              Q0      = 0.053935 m^3/s
  Discharge port height           H0      = 5.35 m
  Vertical discharge angle        THETA   = -85.56 deg
  Horizontal discharge angle      SIGMA   = 90 deg
  Discharge temperature (freshwater)      = 10 degC
  Corresponding density           RHO0    = 999.7019 kg/m^3
  Density difference              DRHO    = 1.2981 kg/m^3
  Buoyant acceleration            GP0     = 0.0127 m/s^2
  Discharge concentration         C0      = 0.139 mg/l
  Surface heat exchange coeff.    KS      = 0 m/s
  Coefficient of decay            KD      = 0 /s
-----------------------------------------------------------------------------
DISCHARGE/ENVIRONMENT LENGTH SCALES:
  LQ  = 0.15 m         Lm  = 2.02 m         Lb  = 0.12 m
  LM  = 8.21 m         Lm' = 99999 m         Lb' = 99999 m
-----------------------------------------------------------------------------
NON-DIMENSIONAL PARAMETERS:
  Port densimetric Froude number  FR0     = 51.42
  Velocity ratio                  R       = 13.41
-----------------------------------------------------------------------------
MIXING ZONE / TOXIC DILUTION ZONE / AREA OF INTEREST PARAMETERS:
  Toxic discharge                         = yes
  CMC concentration               CMC     = 0.0058 mg/l
  CCC concentration               CCC     = 0.00373 mg/l
```

```
  Water quality standard specified       = given by CCC value
  Regulatory mixing zone                 = yes
  Regulatory mixing zone specification   = distance
  Regulatory mixing zone value           = 91.44 m (m^2 if area)
  Region of interest                     = 35000 m
*****************************************************************************
HYDRODYNAMIC CLASSIFICATION:
  *------------------------*
  | FLOW CLASS   = IPV3 |
  *------------------------*
  This flow configuration applies to a layer corresponding to the full water
  depth at the discharge site.
  Applicable layer depth = water depth = 5.35 m
*****************************************************************************
MIXING ZONE EVALUATION (hydrodynamic and regulatory summary):

-----------------------------------------------------------------------------
X-Y-Z Coordinate system:
  Origin is located at the bottom below the port center:
    0.96 m from the right bank/shore.
  Number of display steps NSTEP = 30 per module.
-----------------------------------------------------------------------------
NEAR-FIELD REGION (NFR) CONDITIONS :
Note: The NFR is the zone of strong initial mixing.  It has no regulatory
  implication.  However, this information may be useful for the discharge
  designer because the mixing in the NFR is usually sensitive to the
  discharge design conditions.
  Pollutant concentration at NFR edge  c = 0.0061 mg/l
  Dilution at edge of NFR              s = 22.9
  NFR Location:                        x = 4.93 m
    (centerline coordinates)           y = 0.39 m
                                       z = 5.35 m
  NFR plume dimensions:  half-width (bh) = 1.86 m
                          thickness (bv) = 1.86 m
Cumulative travel time:       20.0007 sec.
-----------------------------------------------------------------------------
Buoyancy assessment:
  The effluent density is less than the surrounding ambient water
  density at the discharge level.
  Therefore, the effluent is POSITIVELY BUOYANT and will tend to rise towards
  the surface.
-----------------------------------------------------------------------------
FAR-FIELD MIXING SUMMARY:
  Plume becomes vertically fully mixed at 1416.54 m downstream.
-----------------------------------------------------------------------------
PLUME BANK CONTACT SUMMARY:
  Plume in bounded section contacts one bank only at 4.93 m downstream.
************************ TOXIC DILUTION ZONE SUMMARY ************************
Recall: The TDZ corresponds to the three (3) criteria issued in the USEPA
  Technical Support Document (TSD) for Water Quality-based Toxics Control,
  1991 (EPA/505/2-90-001).
  Criterion maximum concentration (CMC)  = 0.0058  mg/l
Corresponding dilution                   = 23.965517
The CMC was encountered at the following plume position:
  Plume location:                      x = 8.99 m
    (centerline coordinates)           y = -0.96 m
                                       z = 5.35 m
  Plume dimension:       half-width (bh) = 3.74 m
                          thickness (bv) = 1.94 m
```

```
 Computed distance from port opening to CMC location = 9.04 m.
 CRITERION 1: This location is beyond 50 times the discharge length scale of
              Lq = 0.15 m.
 +++++ The discharge length scale TEST for the TDZ has FAILED. ++++++

 Computed horizontal distance from port opening to CMC location = 9.04 m.
 CRITERION 2: This location is within 5 times the ambient water depth of
              HD = 5.35 m.
 ++++++++++ The ambient depth TEST for the TDZ has been SATISFIED. ++++++++++

 Computed distance from port opening to CMC location = 9.04 m.
 CRITERION 3: This location is within one tenth the distance of the extent
              of the Regulatory Mixing Zone of 91.45 m in any
              spatial direction from the port opening.
 +++++ The Regulatory Mixing Zone TEST for the TDZ has been SATISFIED. ++++++

 The diffuser discharge velocity is equal to 2.39 m/s.
 This is below the value of 3.0 m/s recommended in the TSD.

 *** This discharge DOES NOT SATISFY all three CMC criteria for the TDZ. ****
 **** This MAY be caused by the low discharge velocity for this design. *****
********************** REGULATORY MIXING ZONE SUMMARY **********************
The plume conditions at the boundary of the specified RMZ are as follows:
  Pollutant concentration              c = 0.002878  mg/l
  Corresponding dilution               s = 48.3
  Plume location:                      x = 91.44 m
    (centerline coordinates)           y = -0.96 m
                                       z = 5.35 m
  Plume dimensions:      half-width (bh) = 11.10 m
                          thickness (bv) = 1.32 m
Cumulative travel time:       505.8855 sec.
At this position, the plume is CONTACTING the RIGHT bank.
Furthermore, the CCC for the toxic pollutant has indeed been met
  within the RMZ. In particular:
The CCC was encountered at the following plume position:
The CCC for the toxic pollutant was encountered at the following
  plume position:
  CCC                                    = 0.00373  mg/l
Corresponding dilution                   = 37.3
  Plume location:                      x = 62.30 m
    (centerline coordinates)           y = -0.96 m
                                       z = 5.35 m
  Plume dimensions:      half-width (bh) = 8.90 m
                          thickness (bv) = 1.27 m
********************* FINAL DESIGN ADVICE AND COMMENTS **********************
REMINDER:  The user must take note that HYDRODYNAMIC MODELING by any known
  technique is NOT AN EXACT SCIENCE.
Extensive comparison with field and laboratory data has shown that the
  CORMIX predictions on dilutions and concentrations (with associated
  plume geometries) are reliable for the majority of cases and are accurate
  to within about +-50% (standard deviation).
As a further safeguard, CORMIX will not give predictions whenever it judges
  the design configuration as highly complex and uncertain for prediction.
```

```
CORMIX1 PREDICTION FILE:
1111111111111111111111111111111111111111111111111111111111111111111111111111111111
1111111111111111
                        CORMIX MIXING ZONE EXPERT SYSTEM
              Subsystem CORMIX1:  Single Port Discharges
                          CORMIX Version 6.0GT
                       HYDRO1 Version 6.0.0.0 October 2009
-------------------------------------------------------------------------------
---------------
-------------------------------------------------------------------------------
---------------
CASE DESCRIPTION
 Site name/label:
 Design case:       JD309(4)400GPMeSteadyFinal6.0
 FILE NAME:         P:\...0GPMFinalRiver\JD309(4)400GPMeSteadyFinal6.0R.prd
 Time stamp:        Fri Mar 26 14:37:00 2010

ENVIRONMENT PARAMETERS (metric units)
 Bounded section
 BS    =    158.50  AS    =    996.34  QA    =     49.82  ICHREG= 1
 HA    =      6.29  HD    =      4.40
 UA    =      0.050 F     =      0.027 USTAR =0.2882E-02
 UW    =      9.300 UWSTAR=0.1193E-01
 Uniform density environment
 STRCND=  U         RHOAM = 1001.0000

DISCHARGE PARAMETERS (metric units)
 Above Surface Discharge:
 Re-computed discharge conditions at entry point at water surface.
 BANK  =  RIGHT     DISTB =      1.02
 D0    =      0.110 A0    =      0.010 H0    =      4.40  SUB0  =      0.00
 THETA =      0.00  SIGMA =     90.00
 U0    =      5.672 Q0    =      0.054       =0.5394E-01
 RHO0  =  999.7019  DRHO0 =0.1298E+01  GP0   =0.1272E-01
 C0    =0.5900E-01  CUNITS=  mg/l
 IPOLL =  1         KS    =0.0000E+00  KD    =0.0000E+00

FLUX VARIABLES (metric units)
 Q0    =0.5394E-01  M0    =0.3059E+00  J0    =0.6859E-03  SIGNJ0=      1.0
 Associated length scales (meters)
 LQ    =      0.10  LM    =     15.71  Lm    =     11.06  Lb    =      5.49
                                       Lmp   =  99999.00  Lbp   =  99999.00

NON-DIMENSIONAL PARAMETERS
 FR0   =    151.63  R     =    113.44

FLOW CLASSIFICATION
 111111111111111111111111111111111111111111
 1  Flow class (CORMIX1)      =    IPV5   1
 1  Applicable layer depth HS =     4.40  1
 111111111111111111111111111111111111111111

MIXING ZONE / TOXIC DILUTION / REGION OF INTEREST PARAMETERS
 C0    =0.5900E-01  CUNITS=  mg/l
 NTOX  =  1         CMC   =0.5800E-02  CCC   =  CSTD
 NSTD  =  1         CSTD  =0.3730E-02
 REGMZ =  1
 REGSPC=  1         XREG  =     91.44  WREG  =      0.00  AREG  =      0.00
 XINT  =   3500.00  XMAX  =   3500.00
```

```
X-Y-Z COORDINATE SYSTEM:
    ORIGIN is located at the bottom and below the center of the port:
         1.02 m  from the RIGHT bank/shore.
    X-axis points downstream, Y-axis points to left, Z-axis points upward.
NSTEP =  30 display intervals per module
-------------------------------------------------------------------------------
---------------
-------------------------------------------------------------------------------
---------------
BEGIN MOD101: DISCHARGE MODULE

       X        Y       Z        S       C       B        Uc        TT
      0.00     0.00    4.40     1.0 0.590E-01   0.06    5.672   .00000E+00

END OF MOD101: DISCHARGE MODULE
-------------------------------------------------------------------------------
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-------------------------------------------------------------------------------
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BEGIN MOD134: UNSTABLE RECIRCULATION REGION OVER LAYER DEPTH

 INITIAL LOCAL VERTICAL INSTABILITY REGION:
   Bulk dilution (S =  14.76) occurs in a limited region (horizontal extent
   =    47.12 m) surrounding the discharge location.

  Control volume inflow:
       X        Y       Z        S       C       B        TT
      0.00     0.00    4.40     1.0 0.590E-01   0.06 .00000E+00

** CMC HAS BEEN FOUND **
 The pollutant concentration in the plume falls below CMC value of 0.580E-02
   due to mixing in this control volume.
 The actual extent of the TOXIC DILUTION ZONE will be smaller than control
   volume outflow values predicted below.

  Control volume outflow:
       X        Y       Z        S       C       BV       BH      ZU      ZL
TT
      0.00     0.00    4.40     1.0 0.590E-01  11.00     0.00    0.00    0.00
.00000E+00

END OF MOD134: UNSTABLE RECIRCULATION REGION OVER LAYER DEPTH
-------------------------------------------------------------------------------
---------------
-------------------------------------------------------------------------------
---------------
BEGIN MOD134a: UPSTREAM SPREADING AFTER NEAR-FIELD INSTABILITY

 UPSTREAM INTRUSION PROPERTIES:
        Upstream intrusion length               =       0.55 m
        X-position of upstream stagnation point =      -0.55 m
        Thickness in intrusion region           =       4.40 m
        Half-width at downstream end            =      72.65 m
        Thickness at downstream end             =       0.48 m

  Control volume inflow:
       X        Y       Z        S       C       B        TT
      0.00     0.00    2.20    14.8 0.400E-02   0.06 .00000E+00

 Profile definitions:
```

```
   BV = top-hat thickness, measured vertically
   BH = top-hat half-width, measured horizontally in Y-direction
   ZU = upper plume boundary (Z-coordinate)
   ZL = lower plume boundary (Z-coordinate)
   S  = hydrodynamic average (bulk) dilution
   C  = average (bulk) concentration (includes reaction effects, if any)
   TT = Cumulative travel time

       X        Y       Z        S       C       BV       BH      ZU      ZL
TT
     -0.55     0.00    4.40  9999.9 0.000E+00   0.00     0.00    4.40    4.40
.72647E+03
      0.19     0.00    4.40    14.8 0.400E-02   4.40    10.27    4.40    0.00
.38154E+01
**WATER QUALITY STANDARD OR CCC HAS BEEN FOUND**
 The pollutant concentration in the plume falls below water quality standard
   or CCC value of 0.373E-02 in the current prediction interval.
 This is the spatial extent of concentrations exceeding the water quality
   standard or CCC value.
      3.80     0.00    4.40    16.9 0.350E-02   4.40    24.96    4.40    0.00
.76081E+02
      7.42     0.00    4.40    22.3 0.264E-02   4.40    33.76    4.40    0.00
.14835E+03
     11.03     0.00    4.40    30.0 0.197E-02   4.40    40.71    4.40    0.00
.22061E+03
     14.64     0.00    4.40    38.4 0.154E-02   4.40    46.63    4.40    0.00
.29288E+03
     18.26     0.00    4.40    46.2 0.128E-02   4.40    51.88    4.40    0.00
.36515E+03
     21.87     0.00    4.40    52.6 0.112E-02   4.40    56.65    4.40    0.00
.43741E+03
     25.48     0.00    4.40    57.3 0.103E-02   3.93    61.04    4.40    0.47
.50968E+03
     29.10     0.00    4.40    60.4 0.977E-03   2.38    65.14    4.40    2.02
.58194E+03
     32.71     0.00    4.40    62.2 0.948E-03   1.44    69.00    4.40    2.96
.65421E+03
     36.32     0.00    4.40    64.2 0.920E-03   0.48    72.65    4.40    3.92
.72647E+03
 Cumulative travel time =         726.4749 sec

END OF MOD134a: UPSTREAM SPREADING AFTER NEAR-FIELD INSTABILITY
-------------------------------------------------------------------------------
---------------
** End of NEAR-FIELD REGION (NFR) **

 In this design case, the discharge is located CLOSE TO BANK/SHORE.
 Some boundary interaction occurs at end of near-field.
   This may be related to a design case with a very LOW AMBIENT VELOCITY.
   The dilution values in one or more of the preceding zones may be too high.
 Carefully evaluate results in near-field and check degree of interaction.

 Consider locating outfall further away from bank or shore.
 In the next prediction module, the plume centerline will be set
   to follow the bank/shore.
-------------------------------------------------------------------------------
---------------
BEGIN MOD141: BUOYANT AMBIENT SPREADING

 Plume is ATTACHED to RIGHT bank/shore.
```

Plume width is now determined from RIGHT bank/shore.

Profile definitions:
BV = top-hat thickness, measured vertically
BH = top-hat half-width, measured horizontally in Y-direction
ZU = upper plume boundary (Z-coordinate)
ZL = lower plume boundary (Z-coordinate)
S = hydrodynamic average (bulk) dilution
C = average (bulk) concentration (includes reaction effects, if any)
TT = Cumulative travel time

Plume Stage 2 (bank attached):

X	Y	Z	S	C	BV	BH	ZU	ZL	TT
36.32	-1.02	4.40	64.2	0.920E-03	0.94	73.67	4.40	3.46	.72647E+03
39.05	-1.02	4.40	72.2	0.817E-03	1.05	74.01	4.40	3.35	.78104E+03
41.79	-1.02	4.40	80.3	0.734E-03	1.17	74.36	4.40	3.23	.83560E+03
44.52	-1.02	4.40	88.6	0.666E-03	1.28	74.72	4.40	3.12	.89016E+03
47.25	-1.02	4.40	96.9	0.609E-03	1.39	75.09	4.40	3.01	.94472E+03
49.98	-1.02	4.40	105.3	0.560E-03	1.51	75.46	4.40	2.90	.99928E+03
52.71	-1.02	4.40	113.8	0.518E-03	1.62	75.84	4.40	2.78	.10538E+04
55.44	-1.02	4.40	122.4	0.482E-03	1.73	76.22	4.40	2.67	.11084E+04
58.17	-1.02	4.40	131.1	0.450E-03	1.85	76.61	4.40	2.55	.11630E+04
60.90	-1.02	4.40	139.9	0.422E-03	1.96	77.00	4.40	2.44	.12175E+04
63.63	-1.02	4.40	148.8	0.397E-03	2.07	77.39	4.40	2.33	.12721E+04
66.36	-1.02	4.40	157.8	0.374E-03	2.19	77.79	4.40	2.21	.13266E+04
69.10	-1.02	4.40	166.9	0.354E-03	2.30	78.19	4.40	2.10	.13812E+04
71.83	-1.02	4.40	176.1	0.335E-03	2.42	78.59	4.40	1.98	.14358E+04
74.56	-1.02	4.40	185.4	0.318E-03	2.53	78.99	4.40	1.87	.14903E+04
77.29	-1.02	4.40	194.8	0.303E-03	2.65	79.40	4.40	1.75	.15449E+04
80.02	-1.02	4.40	204.4	0.289E-03	2.76	79.81	4.40	1.64	.15995E+04
82.75	-1.02	4.40	214.0	0.276E-03	2.88	80.22	4.40	1.52	.16540E+04
85.48	-1.02	4.40	223.7	0.264E-03	2.99	80.63	4.40	1.41	.17086E+04
88.21	-1.02	4.40	233.6	0.253E-03	3.11	81.04	4.40	1.29	.17631E+04
90.94	-1.02	4.40	243.5	0.242E-03	3.22	81.45	4.40	1.18	.18177E+04

** REGULATORY MIXING ZONE BOUNDARY **
In this prediction interval the plume DOWNSTREAM distance meets or exceeds the regulatory value = 91.44 m.
This is the extent of the REGULATORY MIXING ZONE.

```
     93.68    -1.02    4.40   253.6 0.233E-03   3.34    81.87    4.40    1.06
.18723E+04
     96.41    -1.02    4.40   263.8 0.224E-03   3.46    82.28    4.40    0.94
.19268E+04
     99.14    -1.02    4.40   274.1 0.215E-03   3.57    82.70    4.40    0.83
.19814E+04
    101.87    -1.02    4.40   284.5 0.207E-03   3.69    83.12    4.40    0.71
.20359E+04
    104.60    -1.02    4.40   295.0 0.200E-03   3.81    83.53    4.40    0.59
.20905E+04
    107.33    -1.02    4.40   305.6 0.193E-03   3.93    83.95    4.40    0.47
.21451E+04
    110.06    -1.02    4.40   316.3 0.187E-03   4.04    84.37    4.40    0.36
.21996E+04
    112.79    -1.02    4.40   327.2 0.180E-03   4.16    84.79    4.40    0.24
.22542E+04
    115.52    -1.02    4.40   338.2 0.174E-03   4.28    85.21    4.40    0.12
.23088E+04
    118.25    -1.02    4.40   349.3 0.169E-03   4.40    85.63    4.40    0.00
.23633E+04
 Cumulative travel time =        2363.3167 sec

END OF MOD141: BUOYANT AMBIENT SPREADING
-------------------------------------------------------------------------------
---------------
 Bottom coordinate for FAR-FIELD is determined by average depth, ZFB = -1.89m
-------------------------------------------------------------------------------
---------------
BEGIN MOD161: PASSIVE AMBIENT MIXING IN UNIFORM AMBIENT

  Vertical diffusivity (initial value)   = 0.106E-01 m^2/s
  Horizontal diffusivity (initial value) = 0.132E-01 m^2/s

 Profile definitions:
   BV = Gaussian s.d.*sqrt(pi/2) (46%) thickness, measured vertically
      = or equal to layer depth, if fully mixed
   BH = Gaussian s.d.*sqrt(pi/2) (46%) half-width,
        measured horizontally in Y-direction
   ZU = upper plume boundary (Z-coordinate)
   ZL = lower plume boundary (Z-coordinate)
   S  = hydrodynamic centerline dilution
   C  = centerline concentration (includes reaction effects, if any)
   TT = Cumulative travel time

 Plume Stage 2 (bank attached):
       X        Y       Z        S       C       BV       BH      ZU      ZL
TT
    118.25    -1.02    4.40   349.3 0.169E-03   4.40    85.63    4.40    0.00
.23633E+04
 Plume interacts with BOTTOM.
 The passive diffusion plume becomes VERTICALLY FULLY MIXED within this
   prediction interval.
    230.98    -1.02    4.40   502.2 0.117E-03   6.29    86.17    4.40   -1.89
.46154E+04
    343.70    -1.02    4.40   505.3 0.117E-03   6.29    86.71    4.40   -1.89
.68674E+04
    456.43    -1.02    4.40   508.4 0.116E-03   6.29    87.24    4.40   -1.89
.91195E+04
    569.15    -1.02    4.40   511.5 0.115E-03   6.29    87.78    4.40   -1.89
.11372E+05
```

```
    681.88    -1.02    4.40   514.6 0.115E-03   6.29    88.31    4.40   -1.89
.13624E+05
    794.60    -1.02    4.40   517.7 0.114E-03   6.29    88.83    4.40   -1.89
.15876E+05
    907.33    -1.02    4.40   520.7 0.113E-03   6.29    89.36    4.40   -1.89
.18128E+05
   1020.05    -1.02    4.40   523.8 0.113E-03   6.29    89.88    4.40   -1.89
.20380E+05
   1132.78    -1.02    4.40   526.8 0.112E-03   6.29    90.40    4.40   -1.89
.22632E+05
   1245.50    -1.02    4.40   529.8 0.111E-03   6.29    90.91    4.40   -1.89
.24884E+05
   1358.23    -1.02    4.40   532.8 0.111E-03   6.29    91.42    4.40   -1.89
.27136E+05
   1470.95    -1.02    4.40   535.7 0.110E-03   6.29    91.93    4.40   -1.89
.29388E+05
   1583.68    -1.02    4.40   538.7 0.110E-03   6.29    92.44    4.40   -1.89
.31640E+05
   1696.40    -1.02    4.40   541.6 0.109E-03   6.29    92.94    4.40   -1.89
.33892E+05
   1809.13    -1.02    4.40   544.5 0.108E-03   6.29    93.44    4.40   -1.89
.36144E+05
   1921.85    -1.02    4.40   547.4 0.108E-03   6.29    93.94    4.40   -1.89
.38396E+05
   2034.58    -1.02    4.40   550.3 0.107E-03   6.29    94.44    4.40   -1.89
.40648E+05
   2147.30    -1.02    4.40   553.2 0.107E-03   6.29    94.93    4.40   -1.89
.42900E+05
   2260.03    -1.02    4.40   556.1 0.106E-03   6.29    95.42    4.40   -1.89
.45152E+05
   2372.75    -1.02    4.40   558.9 0.106E-03   6.29    95.91    4.40   -1.89
.47404E+05
   2485.48    -1.02    4.40   561.7 0.105E-03   6.29    96.39    4.40   -1.89
.49657E+05
   2598.20    -1.02    4.40   564.5 0.105E-03   6.29    96.88    4.40   -1.89
.51909E+05
   2710.93    -1.02    4.40   567.3 0.104E-03   6.29    97.36    4.40   -1.89
.54161E+05
   2823.65    -1.02    4.40   570.1 0.103E-03   6.29    97.83    4.40   -1.89
.56413E+05
   2936.38    -1.02    4.40   572.9 0.103E-03   6.29    98.31    4.40   -1.89
.58665E+05
   3049.10    -1.02    4.40   575.7 0.102E-03   6.29    98.78    4.40   -1.89
.60917E+05
   3161.83    -1.02    4.40   578.4 0.102E-03   6.29    99.25    4.40   -1.89
.63169E+05
   3274.55    -1.02    4.40   581.1 0.102E-03   6.29    99.72    4.40   -1.89
.65421E+05
   3387.28    -1.02    4.40   583.9 0.101E-03   6.29   100.19    4.40   -1.89
.67673E+05
   3500.00    -1.02    4.40   586.6 0.101E-03   6.29   100.66    4.40   -1.89
.69925E+05
 Cumulative travel time =       69925.0781 sec

 Simulation limit based on maximum specified distance =   3500.00 m.
   This is the REGION OF INTEREST limitation.

END OF MOD161: PASSIVE AMBIENT MIXING IN UNIFORM AMBIENT
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CORMIX1: Single Port Discharges              End of Prediction File
11111111111111111111111111111111111111111111111111111111111111111111111111111111
1111111111111111
```

```
CORMIX SESSION REPORT:
XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
                      CORMIX MIXING ZONE EXPERT SYSTEM
                          CORMIX Version 6.0GT
                       HYDRO1:Version-6.0.0.0  October,2009
SITE NAME/LABEL:
  DESIGN CASE:                  JD309(4)400GPMeSteadyFinal6.0
  FILE NAME:
P:\Mixing\CriticalDischargeScenarios\V.6.0\400GPMFinalRiver\JD309(4)400GPMeStea
dyFinal6.0R.prd
  Using subsystem CORMIX1:     Single Port Discharges
  Start of session:             03/26/2010--14:37:00
*****************************************************************************
SUMMARY OF INPUT DATA:
-----------------------------------------------------------------------------
AMBIENT PARAMETERS:
  Cross-section                           = bounded
  Width                           BS      = 158.50 m
  Channel regularity              ICHREG = 1
  Ambient flowrate                QA      = 49.82 m^3/s
  Average depth                   HA      = 6.29 m
  Depth at discharge              HD      = 4.40 m
  Ambient velocity                UA      = 0.05 m/s
  Darcy-Weisbach friction factor  F       = 0.0266
    Calculated from Manning's n           = 0.025
  Wind velocity                   UW      = 9.30 m/s
  Stratification Type             STRCND = U
  Surface density                 RHOAS   = 1001.0000 kg/m^3
  Bottom density                  RHOAB   = 1001.0000 kg/m^3
-----------------------------------------------------------------------------
DISCHARGE PARAMETERS:             Single Port Discharge
  Nearest bank                            = right
  Distance to bank                DISTB   = 1.02 m
  Port diameter                   D0      = 0.1100 m
  Port cross-sectional area       A0      = 0.0095 m^2
  Discharge velocity              U0      = 5.67 m/s
  Discharge flowrate              Q0      = 0.053935 m^3/s
  Discharge port height           H0      = 4.40 m
  Vertical discharge angle        THETA   = -88.13 deg
  Horizontal discharge angle      SIGMA   = 90 deg
  Discharge temperature (freshwater)      = 10 degC
  Corresponding density           RHO0    = 999.7019 kg/m^3
  Density difference              DRHO    = 1.2981 kg/m^3
  Buoyant acceleration            GP0     = 0.0127 m/s^2
  Discharge concentration         C0      = 0.059 mg/l
  Surface heat exchange coeff.    KS      = 0 m/s
  Coefficient of decay            KD      = 0 /s
-----------------------------------------------------------------------------
DISCHARGE/ENVIRONMENT LENGTH SCALES:
  LQ  = 0.10 m         Lm  = 11.06 m         Lb  = 5.49 m
  LM  = 15.71 m         Lm' = 99999 m         Lb' = 99999 m
-----------------------------------------------------------------------------
NON-DIMENSIONAL PARAMETERS:
  Port densimetric Froude number  FR0     = 151.63
  Velocity ratio                  R       = 113.44
-----------------------------------------------------------------------------
MIXING ZONE / TOXIC DILUTION ZONE / AREA OF INTEREST PARAMETERS:
  Toxic discharge                         = yes
  CMC concentration               CMC     = 0.0058 mg/l
  CCC concentration               CCC     = 0.00373 mg/l
```

```
  Water quality standard specified       = given by CCC value
  Regulatory mixing zone                 = yes
  Regulatory mixing zone specification   = distance
  Regulatory mixing zone value           = 91.44 m (m^2 if area)
  Region of interest                     = 3500 m
*****************************************************************************
HYDRODYNAMIC CLASSIFICATION:
  *------------------------*
  | FLOW CLASS   = IPV5 |
  *------------------------*
  This flow configuration applies to a layer corresponding to the full water
  depth at the discharge site.
  Applicable layer depth = water depth = 4.40 m
*****************************************************************************
MIXING ZONE EVALUATION (hydrodynamic and regulatory summary):

-----------------------------------------------------------------------------
X-Y-Z Coordinate system:
  Origin is located at the bottom below the port center:
    1.02 m from the right bank/shore.
  Number of display steps NSTEP = 30 per module.
-----------------------------------------------------------------------------
NEAR-FIELD REGION (NFR) CONDITIONS :
Note: The NFR is the zone of strong initial mixing.  It has no regulatory
  implication.  However, this information may be useful for the discharge
  designer because the mixing in the NFR is usually sensitive to the
  discharge design conditions.
  Pollutant concentration at NFR edge  c = 0.0009 mg/l
  Dilution at edge of NFR              s = 64.2
  NFR Location:                        x = 36.32 m
    (centerline coordinates)           y = 0 m
                                       z = 4.40 m
  NFR plume dimensions:  half-width (bh) = 72.65 m
                          thickness (bv) = 0.48 m
Cumulative travel time:       726.4748 sec.
-----------------------------------------------------------------------------
Buoyancy assessment:
  The effluent density is less than the surrounding ambient water
  density at the discharge level.
  Therefore, the effluent is POSITIVELY BUOYANT and will tend to rise towards
  the surface.
-----------------------------------------------------------------------------
UPSTREAM INTRUSION SUMMARY:
Plume exhibits upstream intrusion due to low ambient velocity or strong
  discharge buoyancy.
  Intrusion length                       =  0.55 m
  Intrusion stagnation point             =  -0.55 m
  Intrusion thickness                    =  25.23 m
  Intrusion half width at impingement    =  72.65 m
  Intrusion half thickness at impingement =  0.48 m
-----------------------------------------------------------------------------
FAR-FIELD MIXING SUMMARY:
  Plume is vertically fully mixed WITHIN NEAR-FIELD (or a fraction thereof),
  but RE-STRATIFIES LATER.
  Plume becomes vertically fully mixed again at 230.98 m downstream.
-----------------------------------------------------------------------------
PLUME BANK CONTACT SUMMARY:
  Plume in bounded section contacts one bank only at 36.32 m downstream.
************************ TOXIC DILUTION ZONE SUMMARY ************************
Recall: The TDZ corresponds to the three (3) criteria issued in the USEPA
```

```
  Technical Support Document (TSD) for Water Quality-based Toxics Control,
  1991 (EPA/505/2-90-001).
  Criterion maximum concentration (CMC)  = 0.0058  mg/l
Corresponding dilution                   = 10.172414
The CMC was encountered within a control volume describing a portion
  of the discharge plume.
Therefore, the following plume conditions are a conservative estimate (with
  lower concentrations or with larger dimensions) for the region at whose
  boundary the CMC is met:
  Local boundary concentration           = 0.003999  mg/l
Corresponding dilution                   = 14.755100
  Plume location:                      x = 0 m
    (centerline coordinates)           y = 0 m
                                       z = 2.20 m
  Plume dimension:       half-width (bh) = 11.00 m
                          thickness (bv) = 0 m

 Computed distance from port opening to CMC location = 2.20 m.
 CRITERION 1: This location is within 50 times the discharge length scale of
              Lq = 0.10 m.
 +++++ The discharge length scale TEST for the TDZ has been SATISFIED. ++++++

 Computed horizontal distance from port opening to CMC location = 0 m.
 CRITERION 2: This location is within 5 times the ambient water depth of
              HD = 4.40 m.
 ++++++++++ The ambient depth TEST for the TDZ has been SATISFIED. ++++++++++

 Computed distance from port opening to CMC location = 2.20 m.
 CRITERION 3: This location is within one tenth the distance of the extent
              of the Regulatory Mixing Zone of 91.45 m in any
              spatial direction from the port opening.
 +++++ The Regulatory Mixing Zone TEST for the TDZ has been SATISFIED. ++++++

 The diffuser discharge velocity is equal to 5.67 m/s.
 This exceeds the value of 3.0 m/s recommended in the TSD.

 *** All three CMC criteria for the TDZ are SATISFIED for this discharge. ***
********************** REGULATORY MIXING ZONE SUMMARY **********************
The plume conditions at the boundary of the specified RMZ are as follows:
  Pollutant concentration              c = 0.000241  mg/l
  Corresponding dilution               s = 245.3
  Plume location:                      x = 91.44 m
    (centerline coordinates)           y = -1.02 m
                                       z = 4.40 m
  Plume dimensions:      half-width (bh) = 81.53 m
                          thickness (bv) = 3.25 m
Cumulative travel time:       1827.6079 sec.
At this position, the plume is CONTACTING the RIGHT bank.
Furthermore, the CCC for the toxic pollutant has indeed been met
  within the RMZ. In particular:
The CCC was encountered at the following plume position:
The CCC for the toxic pollutant was encountered at the following
  plume position:
  CCC                                    = 0.00373  mg/l
Corresponding dilution                   = 15.8
  Plume location:                      x = 2.12 m
    (centerline coordinates)           y = 0 m
                                       z = 4.40 m
  Plume dimensions:      half-width (bh) = 18.10 m
                          thickness (bv) = 24.66 m
```

********** FINAL DESIGN ADVICE AND COMMENTS **********

REMINDER: The user must take note that HYDRODYNAMIC MODELING by any known technique is NOT AN EXACT SCIENCE.

Extensive comparison with field and laboratory data has shown that the CORMIX predictions on dilutions and concentrations (with associated plume geometries) are reliable for the majority of cases and are accurate to within about +-50% (standard deviation).

As a further safeguard, CORMIX will not give predictions whenever it judges the design configuration as highly complex and uncertain for prediction.

```
CORMIX1 PREDICTION FILE:
1111111111111111111111111111111111111111111111111111111111111111111111111111111111
1111111111111111
                        CORMIX MIXING ZONE EXPERT SYSTEM
              Subsystem CORMIX1:  Single Port Discharges
                          CORMIX Version 6.0GT
                       HYDRO1 Version 6.0.0.0 October 2009
-------------------------------------------------------------------------------
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-------------------------------------------------------------------------------
---------------
CASE DESCRIPTION
 Site name/label:
 Design case:       JD309400GPMfSteadyFinal6.0
 FILE NAME:         P:\...\400GPMFinalRiver\JD309400GPMfSteadyFinal6.0R.prd
 Time stamp:        Fri Mar 26 14:38:43 2010

ENVIRONMENT PARAMETERS (metric units)
 Bounded section
 BS    =    158.50  AS    =   1087.45  QA    =    122.88  ICHREG= 1
 HA    =      6.86  HD    =      4.80
 UA    =      0.113 F     =      0.026 USTAR =0.6420E-02
 UW    =      9.300 UWSTAR=0.1193E-01
 Uniform density environment
 STRCND=  U         RHOAM = 1001.0000

DISCHARGE PARAMETERS (metric units)
 Above Surface Discharge:
 Re-computed discharge conditions at entry point at water surface.
 BANK  =  RIGHT     DISTB =      0.96
 D0    =      0.089 A0    =      0.006 H0    =      4.80  SUB0  =      0.00
 THETA =      0.00  SIGMA =     90.00
 U0    =      4.569 Q0    =      0.029       =0.2856E-01
 RHO0  =  999.7019  DRHO0 =0.1298E+01  GP0   =0.1272E-01
 C0    =0.1260E+00  CUNITS=  mg/l
 IPOLL =  1         KS    =0.0000E+00  KD    =0.0000E+00

FLUX VARIABLES (metric units)
 Q0    =0.2856E-01  M0    =0.1305E+00  J0    =0.3632E-03  SIGNJ0=      1.0
 Associated length scales (meters)
 LQ    =      0.08  LM    =     11.39  Lm    =      3.20  Lb    =      0.25
                                       Lmp   =  99999.00  Lbp   =  99999.00

NON-DIMENSIONAL PARAMETERS
 FR0   =    135.64  R     =     40.43

FLOW CLASSIFICATION
 111111111111111111111111111111111111111111
 1  Flow class (CORMIX1)      =    IPV4   1
 1  Applicable layer depth HS =     4.80  1
 111111111111111111111111111111111111111111

MIXING ZONE / TOXIC DILUTION / REGION OF INTEREST PARAMETERS
 C0    =0.1260E+00  CUNITS=  mg/l
 NTOX  =  1         CMC   =0.5800E-02  CCC   =  CSTD
 NSTD  =  1         CSTD  =0.3730E-02
 REGMZ =  1
 REGSPC=  1         XREG  =     91.44  WREG  =      0.00  AREG  =      0.00
 XINT  =   3500.00  XMAX  =   3500.00
```

```
X-Y-Z COORDINATE SYSTEM:
    ORIGIN is located at the bottom and below the center of the port:
         0.96 m  from the RIGHT bank/shore.
    X-axis points downstream, Y-axis points to left, Z-axis points upward.
NSTEP =  30 display intervals per module
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BEGIN MOD101: DISCHARGE MODULE

       X        Y       Z        S       C       B        Uc        TT
      0.00     0.00    4.80     1.0 0.126E+00   0.04    4.569   .00000E+00

END OF MOD101: DISCHARGE MODULE
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BEGIN CORJET (MOD110): JET/PLUME NEAR-FIELD MIXING REGION

 Jet-like motion in weak crossflow.
   UNSTABLE NEAR-FIELD: Jet/plume will mix over full layer depth.
   Following MOD133 will include recirculation into jet region.

 Zone of flow establishment:            THETAE=    -88.64  SIGMAE=     64.44
  LE    =      0.41  XE    =      0.00  YE    =      0.01  ZE    =      4.39

 Profile definitions:
   B = Gaussian 1/e (37%) half-width, normal to trajectory
   S = hydrodynamic centerline dilution
   C = centerline concentration (includes reaction effects, if any)
  Uc = Local centerline excess velocity (above ambient)
  TT = Cumulative travel time

       X        Y       Z        S       C       B        Uc        TT
      0.00     0.00    4.80     1.0 0.126E+00   0.04    4.569   .00000E+00
      0.00     0.01    4.39     1.0 0.126E+00   0.05    4.569   .32597E-02
      0.00     0.01    4.27     1.1 0.112E+00   0.06    4.569   .26057E-01
      0.01     0.01    4.13     1.4 0.890E-01   0.08    3.802   .59691E-01
      0.01     0.02    3.99     1.7 0.737E-01   0.09    3.148   .10095E+00
      0.02     0.02    3.87     2.0 0.642E-01   0.10    2.739   .14241E+00
      0.03     0.02    3.73     2.3 0.558E-01   0.12    2.375   .19797E+00
      0.04     0.03    3.61     2.5 0.500E-01   0.13    2.130   .25181E+00
      0.05     0.03    3.47     2.8 0.446E-01   0.15    1.897   .32196E+00
      0.07     0.03    3.33     3.1 0.402E-01   0.17    1.706   .40012E+00
      0.09     0.03    3.21     3.4 0.371E-01   0.18    1.569   .47357E+00
      0.11     0.04    3.07     3.7 0.339E-01   0.20    1.431   .56694E+00
      0.13     0.04    2.94     4.0 0.311E-01   0.21    1.312   .66871E+00
      0.15     0.04    2.82     4.3 0.291E-01   0.23    1.223   .76277E+00
      0.18     0.05    2.68     4.7 0.270E-01   0.25    1.130   .88065E+00
      0.21     0.05    2.54     5.0 0.251E-01   0.26    1.048   .10075E+01
      0.24     0.05    2.43     5.3 0.237E-01   0.28    0.985   .11235E+01
      0.27     0.05    2.29     5.7 0.221E-01   0.30    0.917   .12676E+01
      0.31     0.06    2.15     6.1 0.207E-01   0.32    0.856   .14214E+01
      0.35     0.06    2.04     6.4 0.197E-01   0.33    0.808   .15612E+01
      0.39     0.06    1.91     6.8 0.185E-01   0.35    0.756   .17337E+01
      0.44     0.07    1.77     7.2 0.174E-01   0.37    0.709   .19168E+01
      0.49     0.07    1.64     7.7 0.164E-01   0.39    0.665   .21108E+01
      0.54     0.07    1.53     8.1 0.157E-01   0.41    0.629   .22860E+01
```

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      0.59     0.07    1.40     8.5 0.148E-01   0.43    0.591   .25012E+01
      0.65     0.08    1.28     9.0 0.140E-01   0.45    0.555   .27283E+01
      0.70     0.08    1.17     9.4 0.134E-01   0.47    0.526   .29327E+01
      0.77     0.08    1.04     9.9 0.127E-01   0.49    0.495   .31830E+01
      0.84     0.08    0.92    10.5 0.120E-01   0.52    0.465   .34464E+01
      0.90     0.09    0.82    11.0 0.115E-01   0.54    0.442   .36827E+01
      0.97     0.09    0.70    11.5 0.109E-01   0.56    0.415   .39713E+01
      1.05     0.09    0.58    12.0 0.105E-01   0.58    0.394   .42298E+01
 Cumulative travel time =           4.2298 sec

END OF CORJET (MOD110): JET/PLUME NEAR-FIELD MIXING REGION
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BEGIN MOD133: LAYER BOUNDARY IMPINGEMENT/FULL VERTICAL MIXING

  Control volume inflow:
       X        Y       Z        S       C       B        TT
      1.05     0.09    0.58    12.0 0.105E-01   0.58 .42298E+01

 Profile definitions:
   BV = layer depth (vertically mixed)
   BH = top-hat half-width, in horizontal plane normal to trajectory
   ZU = upper plume boundary (Z-coordinate)
   ZL = lower plume boundary (Z-coordinate)
   S  = hydrodynamic average (bulk) dilution
   C  = average (bulk) concentration (includes reaction effects, if any)
   TT = Cumulative travel time

       X        Y       Z        S       C       BV       BH      ZU      ZL
TT
      0.47     0.17    4.80    12.0 0.105E-01   0.00     0.00    4.80    4.80
.42298E+01
      1.01     0.17    4.80    12.0 0.105E-01   4.80     0.14    4.80    0.00
.42298E+01
      1.55     0.17    4.80    12.2 0.103E-01   4.80     0.20    4.80    0.00
.86169E+01
      2.08     0.17    4.80    12.9 0.980E-02   4.80     0.24    4.80    0.00
.13382E+02
      2.62     0.17    4.80    13.7 0.918E-02   4.80     0.28    4.80    0.00
.18146E+02
      3.16     0.17    4.80    14.6 0.861E-02   4.80     0.31    4.80    0.00
.22911E+02
      3.70     0.17    4.80    15.4 0.816E-02   4.80     0.34    4.80    0.00
.27676E+02
      4.24     0.17    4.80    16.0 0.786E-02   4.80     0.37    4.80    0.00
.32440E+02
      4.78     0.17    4.80    16.4 0.767E-02   4.80     0.40    4.80    0.00
.37205E+02
      5.32     0.17    4.80    16.7 0.756E-02   4.80     0.42    4.80    0.00
.41970E+02
      5.85     0.17    4.80    16.9 0.747E-02   4.80     0.44    4.80    0.00
.46735E+02
 Cumulative travel time =          46.7345 sec

END OF MOD133: LAYER BOUNDARY IMPINGEMENT/FULL VERTICAL MIXING
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** End of NEAR-FIELD REGION (NFR) **
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BEGIN MOD141: BUOYANT AMBIENT SPREADING

 Profile definitions:
   BV = top-hat thickness, measured vertically
   BH = top-hat half-width, measured horizontally in Y-direction
   ZU = upper plume boundary (Z-coordinate)
   ZL = lower plume boundary (Z-coordinate)
   S  = hydrodynamic average (bulk) dilution
   C  = average (bulk) concentration (includes reaction effects, if any)
   TT = Cumulative travel time

 Plume Stage 1 (not bank attached):
       X        Y       Z        S       C       BV       BH      ZU      ZL
TT
      5.85     0.17    4.80    16.9 0.747E-02   4.80     0.44    4.80    0.00
.46735E+02
      5.93     0.17    4.80    17.1 0.735E-02   4.58     0.47    4.80    0.23
.47445E+02
      6.01     0.17    4.80    17.4 0.724E-02   4.38     0.50    4.80    0.43
.48156E+02
      6.09     0.17    4.80    17.6 0.715E-02   4.20     0.53    4.80    0.60
.48867E+02
      6.17     0.17    4.80    17.9 0.706E-02   4.05     0.56    4.80    0.76
.49577E+02
      6.26     0.17    4.80    18.1 0.697E-02   3.91     0.58    4.80    0.90
.50288E+02
      6.34     0.17    4.80    18.3 0.690E-02   3.78     0.61    4.80    1.02
.50999E+02
      6.42     0.17    4.80    18.5 0.683E-02   3.67     0.64    4.80    1.14
.51710E+02
      6.50     0.17    4.80    18.6 0.676E-02   3.56     0.66    4.80    1.24
.52420E+02
      6.58     0.17    4.80    18.8 0.670E-02   3.47     0.69    4.80    1.34
.53131E+02
      6.66     0.17    4.80    19.0 0.664E-02   3.38     0.71    4.80    1.42
.53842E+02
      6.74     0.17    4.80    19.1 0.659E-02   3.30     0.73    4.80    1.51
.54552E+02
      6.82     0.17    4.80    19.3 0.654E-02   3.22     0.76    4.80    1.58
.55263E+02
      6.90     0.17    4.80    19.4 0.649E-02   3.15     0.78    4.80    1.65
.55974E+02
      6.98     0.17    4.80    19.6 0.644E-02   3.08     0.80    4.80    1.72
.56685E+02
      7.06     0.17    4.80    19.7 0.640E-02   3.02     0.82    4.80    1.78
.57395E+02
      7.14     0.17    4.80    19.8 0.635E-02   2.96     0.85    4.80    1.84
.58106E+02
      7.22     0.17    4.80    20.0 0.631E-02   2.91     0.87    4.80    1.90
.58817E+02
      7.30     0.17    4.80    20.1 0.627E-02   2.85     0.89    4.80    1.95
.59527E+02
      7.38     0.17    4.80    20.2 0.624E-02   2.80     0.91    4.80    2.00
.60238E+02
      7.46     0.17    4.80    20.3 0.620E-02   2.76     0.93    4.80    2.05
.60949E+02
      7.54     0.17    4.80    20.4 0.617E-02   2.71     0.95    4.80    2.09
.61660E+02
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      7.62     0.17    4.80    20.5 0.613E-02   2.67     0.97    4.80    2.14
.62370E+02
      7.70     0.17    4.80    20.6 0.610E-02   2.63     0.99    4.80    2.18
.63081E+02
      7.78     0.17    4.80    20.8 0.607E-02   2.59     1.01    4.80    2.21
.63792E+02
      7.86     0.17    4.80    20.9 0.604E-02   2.55     1.03    4.80    2.25
.64502E+02
      7.94     0.17    4.80    21.0 0.601E-02   2.52     1.05    4.80    2.29
.65213E+02
      8.02     0.17    4.80    21.1 0.598E-02   2.48     1.07    4.80    2.32
.65924E+02
      8.10     0.17    4.80    21.2 0.596E-02   2.45     1.09    4.80    2.35
.66635E+02
      8.18     0.17    4.80    21.2 0.593E-02   2.42     1.11    4.80    2.39
.67345E+02
      8.26     0.17    4.80    21.3 0.590E-02   2.39     1.13    4.80    2.42
.68056E+02
 Cumulative travel time =          68.0561 sec

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 Plume is ATTACHED to RIGHT bank/shore.
   Plume width is now determined from RIGHT bank/shore.

 Plume Stage 2 (bank attached):
       X        Y       Z        S       C       BV       BH      ZU      ZL
TT
      8.26    -0.96    4.80    21.3 0.590E-02   2.39     2.26    4.80    2.42
.68056E+02
** CMC HAS BEEN FOUND **
 The pollutant concentration in the plume falls below CMC value of 0.580E-02
   in the current prediction interval.
 This is the extent of the TOXIC DILUTION ZONE.
     14.83    -0.96    4.80    24.3 0.519E-02   1.70     3.61    4.80    3.10
.12617E+03
     21.40    -0.96    4.80    26.6 0.474E-02   1.42     4.72    4.80    3.38
.18429E+03
     27.97    -0.96    4.80    28.8 0.438E-02   1.27     5.71    4.80    3.53
.24241E+03
     34.54    -0.96    4.80    31.1 0.405E-02   1.19     6.61    4.80    3.61
.30053E+03
     41.11    -0.96    4.80    33.6 0.375E-02   1.14     7.44    4.80    3.66
.35865E+03
**WATER QUALITY STANDARD OR CCC HAS BEEN FOUND**
 The pollutant concentration in the plume falls below water quality standard
   or CCC value of 0.373E-02 in the current prediction interval.
 This is the spatial extent of concentrations exceeding the water quality
   standard or CCC value.
     47.68    -0.96    4.80    36.5 0.345E-02   1.12     8.23    4.80    3.68
.41677E+03
     54.25    -0.96    4.80    39.7 0.317E-02   1.12     8.97    4.80    3.68
.47489E+03
     60.82    -0.96    4.80    43.3 0.291E-02   1.13     9.68    4.80    3.67
.53301E+03
     67.38    -0.96    4.80    47.4 0.266E-02   1.15    10.37    4.80    3.65
.59113E+03
     73.95    -0.96    4.80    51.8 0.243E-02   1.19    11.03    4.80    3.62
.64924E+03
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     80.52    -0.96    4.80    56.8 0.222E-02   1.23    11.67    4.80    3.57
.70736E+03
     87.09    -0.96    4.80    62.2 0.203E-02   1.28    12.29    4.80    3.52
.76548E+03
 ** REGULATORY MIXING ZONE BOUNDARY **
 In this prediction interval the plume DOWNSTREAM  distance meets or exceeds
 the regulatory value =    91.44 m.
 This is the extent of the REGULATORY MIXING ZONE.
     93.66    -0.96    4.80    68.1 0.185E-02   1.33    12.90    4.80    3.47
.82360E+03
    100.23    -0.96    4.80    74.5 0.169E-02   1.40    13.49    4.80    3.41
.88172E+03
    106.80    -0.96    4.80    81.5 0.155E-02   1.46    14.07    4.80    3.34
.93984E+03
    113.37    -0.96    4.80    89.0 0.142E-02   1.54    14.64    4.80    3.27
.99796E+03
    119.94    -0.96    4.80    97.1 0.130E-02   1.61    15.20    4.80    3.19
.10561E+04
    126.50    -0.96    4.80   105.7 0.119E-02   1.70    15.74    4.80    3.11
.11142E+04
    133.07    -0.96    4.80   114.9 0.110E-02   1.78    16.28    4.80    3.02
.11723E+04
    139.64    -0.96    4.80   124.8 0.101E-02   1.88    16.81    4.80    2.93
.12304E+04
    146.21    -0.96    4.80   135.2 0.932E-03   1.97    17.34    4.80    2.83
.12886E+04
    152.78    -0.96    4.80   146.2 0.862E-03   2.07    17.85    4.80    2.73
.13467E+04
    159.35    -0.96    4.80   157.9 0.798E-03   2.17    18.36    4.80    2.63
.14048E+04
    165.92    -0.96    4.80   170.2 0.740E-03   2.28    18.87    4.80    2.52
.14629E+04
    172.49    -0.96    4.80   183.2 0.688E-03   2.39    19.37    4.80    2.41
.15210E+04
    179.06    -0.96    4.80   196.8 0.640E-03   2.51    19.86    4.80    2.30
.15791E+04
    185.63    -0.96    4.80   211.1 0.597E-03   2.62    20.34    4.80    2.18
.16373E+04
    192.19    -0.96    4.80   226.1 0.557E-03   2.74    20.83    4.80    2.06
.16954E+04
    198.76    -0.96    4.80   241.8 0.521E-03   2.87    21.30    4.80    1.93
.17535E+04
    205.33    -0.96    4.80   258.2 0.488E-03   3.00    21.77    4.80    1.81
.18116E+04
 Cumulative travel time =        1811.6215 sec

END OF MOD141: BUOYANT AMBIENT SPREADING
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 Bottom coordinate for FAR-FIELD is determined by average depth, ZFB = -2.06m
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BEGIN MOD161: PASSIVE AMBIENT MIXING IN UNIFORM AMBIENT

  Vertical diffusivity (initial value)   = 0.120E-01 m^2/s
  Horizontal diffusivity (initial value) = 0.150E-01 m^2/s

 Profile definitions:
   BV = Gaussian s.d.*sqrt(pi/2) (46%) thickness, measured vertically
      = or equal to layer depth, if fully mixed
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```
   BH = Gaussian s.d.*sqrt(pi/2) (46%) half-width,
        measured horizontally in Y-direction
   ZU = upper plume boundary (Z-coordinate)
   ZL = lower plume boundary (Z-coordinate)
   S  = hydrodynamic centerline dilution
   C  = centerline concentration (includes reaction effects, if any)
   TT = Cumulative travel time

 Plume Stage 2 (bank attached):
      X        Y       Z        S       C       BV       BH      ZU      ZL
TT
    205.33    -0.96    4.80   258.2 0.488E-03   3.00    21.77    4.80    1.81
.18116E+04
    315.15    -0.96    4.80   366.7 0.344E-03   4.06    22.80    4.80    0.74
.27833E+04
    424.98    -0.96    4.80   512.3 0.246E-03   5.44    23.79    4.80   -0.64
.37549E+04
 Plume interacts with BOTTOM.
 The passive diffusion plume becomes VERTICALLY FULLY MIXED within this
   prediction interval.
    534.80    -0.96    4.80   671.5 0.188E-03   6.86    24.74    4.80   -2.06
.47266E+04
    644.62    -0.96    4.80   696.3 0.181E-03   6.86    25.65    4.80   -2.06
.56982E+04
    754.44    -0.96    4.80   720.2 0.175E-03   6.86    26.53    4.80   -2.06
.66699E+04
    864.27    -0.96    4.80   743.3 0.170E-03   6.86    27.38    4.80   -2.06
.76415E+04
    974.09    -0.96    4.80   765.7 0.165E-03   6.86    28.20    4.80   -2.06
.86132E+04
   1083.91    -0.96    4.80   787.5 0.160E-03   6.86    29.01    4.80   -2.06
.95848E+04
   1193.73    -0.96    4.80   808.7 0.156E-03   6.86    29.79    4.80   -2.06
.10556E+05
   1303.55    -0.96    4.80   829.4 0.152E-03   6.86    30.55    4.80   -2.06
.11528E+05
   1413.38    -0.96    4.80   849.5 0.148E-03   6.86    31.29    4.80   -2.06
.12500E+05
   1523.20    -0.96    4.80   869.2 0.145E-03   6.86    32.02    4.80   -2.06
.13471E+05
   1633.02    -0.96    4.80   888.5 0.142E-03   6.86    32.73    4.80   -2.06
.14443E+05
   1742.84    -0.96    4.80   907.3 0.139E-03   6.86    33.42    4.80   -2.06
.15415E+05
   1852.67    -0.96    4.80   925.8 0.136E-03   6.86    34.10    4.80   -2.06
.16386E+05
   1962.49    -0.96    4.80   943.9 0.133E-03   6.86    34.77    4.80   -2.06
.17358E+05
   2072.31    -0.96    4.80   961.6 0.131E-03   6.86    35.42    4.80   -2.06
.18330E+05
   2182.13    -0.96    4.80   979.0 0.129E-03   6.86    36.06    4.80   -2.06
.19301E+05
   2291.96    -0.96    4.80   996.2 0.126E-03   6.86    36.69    4.80   -2.06
.20273E+05
   2401.78    -0.96    4.80  1013.0 0.124E-03   6.86    37.31    4.80   -2.06
.21245E+05
   2511.60    -0.96    4.80  1029.6 0.122E-03   6.86    37.92    4.80   -2.06
.22216E+05
   2621.42    -0.96    4.80  1045.9 0.120E-03   6.86    38.52    4.80   -2.06
.23188E+05
```

```
   2731.24    -0.96    4.80  1061.9 0.119E-03   6.86    39.12    4.80   -2.06
.24160E+05
   2841.07    -0.96    4.80  1077.8 0.117E-03   6.86    39.70    4.80   -2.06
.25131E+05
   2950.89    -0.96    4.80  1093.3 0.115E-03   6.86    40.27    4.80   -2.06
.26103E+05
   3060.71    -0.96    4.80  1108.7 0.114E-03   6.86    40.84    4.80   -2.06
.27075E+05
   3170.53    -0.96    4.80  1123.9 0.112E-03   6.86    41.40    4.80   -2.06
.28046E+05
   3280.36    -0.96    4.80  1138.8 0.111E-03   6.86    41.95    4.80   -2.06
.29018E+05
   3390.18    -0.96    4.80  1153.6 0.109E-03   6.86    42.49    4.80   -2.06
.29990E+05
   3500.00    -0.96    4.80  1168.2 0.108E-03   6.86    43.03    4.80   -2.06
.30961E+05
 Cumulative travel time =       30961.1992 sec

 Simulation limit based on maximum specified distance =   3500.00 m.
   This is the REGION OF INTEREST limitation.

END OF MOD161: PASSIVE AMBIENT MIXING IN UNIFORM AMBIENT
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-------------------------------------------------------------------------------
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CORMIX1: Single Port Discharges              End of Prediction File
1111111111111111111111111111111111111111111111111111111111111111111111111111111
1111111111111111
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CORMIX SESSION REPORT:
XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
                      CORMIX MIXING ZONE EXPERT SYSTEM
                          CORMIX Version 6.0GT
                       HYDRO1:Version-6.0.0.0  October,2009
SITE NAME/LABEL:
  DESIGN CASE:                  JD309400GPMfSteadyFinal6.0
  FILE NAME:
P:\Mixing\CriticalDischargeScenarios\V.6.0\400GPMFinalRiver\JD309400GPMfSteadyF
inal6.0R.prd
  Using subsystem CORMIX1:     Single Port Discharges
  Start of session:             03/26/2010--14:38:43
*****************************************************************************
SUMMARY OF INPUT DATA:
-----------------------------------------------------------------------------
AMBIENT PARAMETERS:
  Cross-section                           = bounded
  Width                           BS      = 158.50 m
  Channel regularity              ICHREG = 1
  Ambient flowrate                QA      = 122.88 m^3/s
  Average depth                   HA      = 6.86 m
  Depth at discharge              HD      = 4.80 m
  Ambient velocity                UA      = 0.113 m/s
  Darcy-Weisbach friction factor  F       = 0.0258
    Calculated from Manning's n           = 0.025
  Wind velocity                   UW      = 9.30 m/s
  Stratification Type             STRCND = U
  Surface density                 RHOAS   = 1001.0000 kg/m^3
  Bottom density                  RHOAB   = 1001.0000 kg/m^3
-----------------------------------------------------------------------------
DISCHARGE PARAMETERS:             Single Port Discharge
  Nearest bank                            = right
  Distance to bank                DISTB   = 0.96 m
  Port diameter                   D0      = 0.0892 m
  Port cross-sectional area       A0      = 0.0063 m^2
  Discharge velocity              U0      = 4.57 m/s
  Discharge flowrate              Q0      = 0.028558 m^3/s
  Discharge port height           H0      = 4.80 m
  Vertical discharge angle        THETA   = -88.77 deg
  Horizontal discharge angle      SIGMA   = 90 deg
  Discharge temperature (freshwater)      = 10 degC
  Corresponding density           RHO0    = 999.7019 kg/m^3
  Density difference              DRHO    = 1.2981 kg/m^3
  Buoyant acceleration            GP0     = 0.0127 m/s^2
  Discharge concentration         C0      = 0.126 mg/l
  Surface heat exchange coeff.    KS      = 0 m/s
  Coefficient of decay            KD      = 0 /s
-----------------------------------------------------------------------------
DISCHARGE/ENVIRONMENT LENGTH SCALES:
  LQ  = 0.08 m         Lm  = 3.20 m         Lb  = 0.25 m
  LM  = 11.39 m         Lm' = 99999 m         Lb' = 99999 m
-----------------------------------------------------------------------------
NON-DIMENSIONAL PARAMETERS:
  Port densimetric Froude number  FR0     = 135.64
  Velocity ratio                  R       = 40.43
-----------------------------------------------------------------------------
MIXING ZONE / TOXIC DILUTION ZONE / AREA OF INTEREST PARAMETERS:
  Toxic discharge                         = yes
  CMC concentration               CMC     = 0.0058 mg/l
  CCC concentration               CCC     = 0.00373 mg/l
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  Water quality standard specified       = given by CCC value
  Regulatory mixing zone                 = yes
  Regulatory mixing zone specification   = distance
  Regulatory mixing zone value           = 91.44 m (m^2 if area)
  Region of interest                     = 3500 m
*****************************************************************************
HYDRODYNAMIC CLASSIFICATION:
  *------------------------*
  | FLOW CLASS   = IPV4 |
  *------------------------*
  This flow configuration applies to a layer corresponding to the full water
  depth at the discharge site.
  Applicable layer depth = water depth = 4.80 m
*****************************************************************************
MIXING ZONE EVALUATION (hydrodynamic and regulatory summary):

-----------------------------------------------------------------------------
X-Y-Z Coordinate system:
  Origin is located at the bottom below the port center:
    0.96 m from the right bank/shore.
  Number of display steps NSTEP = 30 per module.
-----------------------------------------------------------------------------
NEAR-FIELD REGION (NFR) CONDITIONS :
Note: The NFR is the zone of strong initial mixing.  It has no regulatory
  implication.  However, this information may be useful for the discharge
  designer because the mixing in the NFR is usually sensitive to the
  discharge design conditions.
  Pollutant concentration at NFR edge  c = 0.0075 mg/l
  Dilution at edge of NFR              s = 16.9
  NFR Location:                        x = 5.85 m
    (centerline coordinates)           y = 0.17 m
                                       z = 4.80 m
  NFR plume dimensions:  half-width (bh) = 0.44 m
                          thickness (bv) = 4.80 m
Cumulative travel time:       46.7345 sec.
-----------------------------------------------------------------------------
Buoyancy assessment:
  The effluent density is less than the surrounding ambient water
  density at the discharge level.
  Therefore, the effluent is POSITIVELY BUOYANT and will tend to rise towards
  the surface.
-----------------------------------------------------------------------------
Near-field instability behavior:
  The discharge flow will experience instabilities with full vertical mixing
  in the near-field.
  There may be benthic impact of high pollutant concentrations.
-----------------------------------------------------------------------------
FAR-FIELD MIXING SUMMARY:
  Plume is vertically fully mixed WITHIN NEAR-FIELD (or a fraction thereof),
  but RE-STRATIFIES LATER.
  Plume becomes vertically fully mixed again at 534.80 m downstream.
-----------------------------------------------------------------------------
PLUME BANK CONTACT SUMMARY:
  Plume in bounded section contacts one bank only at 8.26 m downstream.
************************ TOXIC DILUTION ZONE SUMMARY ************************
Recall: The TDZ corresponds to the three (3) criteria issued in the USEPA
  Technical Support Document (TSD) for Water Quality-based Toxics Control,
  1991 (EPA/505/2-90-001).
  Criterion maximum concentration (CMC)  = 0.0058  mg/l
Corresponding dilution                   = 21.724138
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The CMC was encountered at the following plume position:
  Plume location:                      x = 8.97 m
    (centerline coordinates)           y = -0.96 m
                                       z = 4.80 m
  Plume dimension:       half-width (bh) = 2.42 m
                          thickness (bv) = 2.27 m

 Computed distance from port opening to CMC location = 9.02 m.
 CRITERION 1: This location is beyond 50 times the discharge length scale of
              Lq = 0.08 m.
 +++++ The discharge length scale TEST for the TDZ has FAILED. ++++++

 Computed horizontal distance from port opening to CMC location = 9.02 m.
 CRITERION 2: This location is within 5 times the ambient water depth of
              HD = 4.80 m.
 ++++++++++ The ambient depth TEST for the TDZ has been SATISFIED. ++++++++++

 Computed distance from port opening to CMC location = 9.02 m.
 CRITERION 3: This location is within one tenth the distance of the extent
              of the Regulatory Mixing Zone of 91.45 m in any
              spatial direction from the port opening.
 +++++ The Regulatory Mixing Zone TEST for the TDZ has been SATISFIED. ++++++

 The diffuser discharge velocity is equal to 4.57 m/s.
 This exceeds the value of 3.0 m/s recommended in the TSD.

 *** This discharge DOES NOT SATISFY all three CMC criteria for the TDZ. ****
********************** REGULATORY MIXING ZONE SUMMARY **********************
The plume conditions at the boundary of the specified RMZ are as follows:
  Pollutant concentration              c = 0.001908  mg/l
  Corresponding dilution               s = 66.1
  Plume location:                      x = 91.44 m
    (centerline coordinates)           y = -0.96 m
                                       z = 4.80 m
  Plume dimensions:      half-width (bh) = 12.69 m
                          thickness (bv) = 1.32 m
Cumulative travel time:       803.9597 sec.
At this position, the plume is CONTACTING the RIGHT bank.
Furthermore, the CCC for the toxic pollutant has indeed been met
  within the RMZ. In particular:
The CCC was encountered at the following plume position:
The CCC for the toxic pollutant was encountered at the following
  plume position:
  CCC                                    = 0.00373  mg/l
Corresponding dilution                   = 33.8
  Plume location:                      x = 41.44 m
    (centerline coordinates)           y = -0.96 m
                                       z = 4.80 m
  Plume dimensions:      half-width (bh) = 7.48 m
                          thickness (bv) = 1.14 m
********************* FINAL DESIGN ADVICE AND COMMENTS *********************
REMINDER:  The user must take note that HYDRODYNAMIC MODELING by any known
  technique is NOT AN EXACT SCIENCE.
Extensive comparison with field and laboratory data has shown that the
  CORMIX predictions on dilutions and concentrations (with associated
  plume geometries) are reliable for the majority of cases and are accurate
  to within about +-50% (standard deviation).
As a further safeguard, CORMIX will not give predictions whenever it judges
  the design configuration as highly complex and uncertain for prediction.
```