STREAM2 for Aqueous Release Emergency Response

by

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ABSTRACT

This report documents the STREAM2 code and its input models developed for the WIND System. STREAM2 is a modification of the STREAM code, which is the transport and diffusion module of the WIND System aqueous emergency response program. STREAM predicts downstream pollutant concentrations for releases from the Savannah River Site to the Savannah River. The STREAM calculation module uses an algebraic equation to approximate the solution of the differential one-dimensional advective transport equation. The advantage of this simplified approach is that the time required to obtain a solution is shortened to a matter of minutes. However, this approach generates spurious oscillations in the concentration profile when modeling long duration releases. To improve the capability of the STREAM code to model long-term releases, its calculation module was replaced by the transport module of the WASP5 code. WASP5 is a US EPA water quality analysis program that simulates pollutant transport and fate through surface water. The revised STREAM code is named STREAM2.

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1 Introduction

The STREAM2 code is the aqueous transport and diffusion module of the WIND System emergency response program. STREAM2 predicts downstream pollutant concentrations for releases from the SRS area to the Savannah River. The code consists of pre-processor, calculation, and post-processor modules. The pre-processor module provides a user interface. To run STREAM2, the user inputs through the pre-processor the time and date of release, the type of release, the location of release, the amount and duration of release, and the calculation units. The pre-processor passes the user-specified data to the calculation module, which calculates the pollutant concentrations and transport times at downstream locations. The calculated downstream pollutant concentrations and travel times are passed to the post-processor, which displays the calculated results (pollutant concentrations and travel times) on the computer screen in graphical and tabular forms.

STREAM2 is a replacement for the STREAM code [1], which for many years was the aqueous emergency response module in WIND system. The STREAM calculation module uses an algebraic equation to approximate the solution of the one-dimensional advective transport equation. The advantage of this simplified approach is that the time required to obtain a solution is shortened to a matter of minutes. However, this approach generates spurious oscillations in the concentration profile when modeling long duration releases.

To improve the capability of the STREAM code to model long-term releases, its calculation module was replaced by the transport module of the WASP5 code [2]. WASP5 is a US EPA water quality analysis program that simulates pollutant transport and fate through surface water. The revised STREAM code is named STREAM2.

STREAM2 calculations for aqueous releases to surface waters require two types of input. One is the user-specified input to STREAM2, described previously. The other consists of input files that describe the geometry and flow conditions of the stream and river systems.

This report documents the STREAM2 code. It contains descriptions of the code structure, user input requirements, the advective transport model, geometric input for Savannah River Site streams and rivers, and the code output.

2 STREAM2 Code Structure

The STREAM2 code consists of pre-processor, calculation, and post-processor modules, as shown in Figure 1. The pre-processor module provides user interface. The user inputs through the pre-processor the time and date of release, type of release, location of release, amount and duration of release, and the calculation units. The pre-processor passes the user-specified data to the calculation module that calculates the pollutant concentrations and transport times at downstream locations. The calculated downstream pollutant concentrations and travel times are

passed to the post-processor, which displays the calculated results (pollutant concentrations and travel times) on the computer screen in graphical and tabular forms.

Additional input files that describe the geometry of the pollutant pathway from the release point to the coastal area and the stream/river flow conditions are required for STREAM2 simulation. Those additional input files are presented in Section 3.

2.1 Pre-processor Module

There are eight parameters that the user must input interactively. The eight input parameters are the time and date of release, the output units (in English or Metric units), the unit of released material (gallon, pound or curie), the location of the release, the amount released, and the duration of the release. Based on the release location, the subroutine Talk_virtual finds the input file names corresponding to the release location and passes these file names to the calculation module. The subroutine TRACE calculates release rates as a function of time based on user input values for the amount released and the release duration and passes a time series of release rates to the calculation module. If the release duration is equal to or less than three time steps, TRACE assumes the release is instantaneous. The time step is limited by numerical stability and varies from 5 to 10 minutes depending on the segment size. A discussion of the validity of this assumption follows.

For equal discharge amounts, the calculated downstream concentration increases as the discharge duration decreases. However, when the discharge duration becomes short relative to the transport time from the release point to downstream locations, the effect of discharge duration on downstream peak concentration is reduced by the dispersion process. Therefore, the discharge can be approximated as an instantaneous release when the release duration is short.

2.2 Calculation Module

The transport model of the WASP5 code is used by STREAM2 to perform pollutant transport calculations. WASP5 is a US EPA water quality analysis program that simulates pollutant transport and fate through surface water. The detailed descriptions of the WASP5 mathematical model, numerical approximation, program implementation and input manual are presented in Reference 2. A description of the transport model used by STREAM2 follows.

2.2.1 Pollutant Transport Equation

The pollutant transport equation is based on conservation of mass. In this equation, the rate change of the pollutant mass in a control volume equals the advective and dispersion transport; pollutant direct and diffusive loading; and rates of physical, chemical, and biological transformation. The advective transport equation is expressed as:

$$\begin{aligned}
\frac{\partial C}{\partial t} = & -\frac{\partial(U_x C)}{\partial x} - \frac{\partial(U_y C)}{\partial y} - \frac{\partial(U_z C)}{\partial z} \\
& + \frac{\partial}{\partial x} \left(E_x \frac{\partial C}{\partial x} \right) + \frac{\partial}{\partial y} \left(E_y \frac{\partial C}{\partial y} \right) + \frac{\partial}{\partial z} \left(E_z \frac{\partial C}{\partial z} \right) \\
& + S_L + S_B + S_k
\end{aligned} \tag{1}$$

where:

C	=	pollutant concentration (g/m^3)
U_x	=	longitudinal advective velocities (m/day)
U_y	=	lateral advective velocities (m/day)
U_z	=	vertical advective velocities (m/day)
E_x	=	longitudinal dispersion coefficients (m^2/day)
E_y	=	lateral dispersion coefficients (m^2/day)
E_z	=	vertical dispersion coefficients (m^2/day)
t	=	time (day)
S_L	=	direct and diffuse loading rate ($\text{g}/\text{m}^3\text{-day}$)
S_B	=	boundary loading rate ($\text{g}/\text{m}^3\text{-day}$)
S_k	=	total kinetic transformation rate; positive is source, negative is sink ($\text{g}/\text{m}^3\text{-day}$)

2.2.2 Finite Difference Approximation

For brevity and clarity, the derivation of the finite difference form of the transport equation will be for a one-dimensional reach. Assuming vertical and lateral homogeneity, Equation 1 can be integrated over the y and z directions to obtain

$$\frac{\partial}{\partial t} (AC) = -\frac{\partial}{\partial x} (U_x AC) + \frac{\partial}{\partial x} \left(E_x A \frac{\partial C}{\partial x} \right) + A(S_L + S_B) + AS_k \tag{2}$$

where:

A	=	cross-sectional area (m^2)
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Using a Taylor series expansion, the concentration at $x_o + \Delta x$ can be expressed respectively as:

$$C(x_o + \Delta x) = C(x_o) + \frac{\partial C}{\partial x} \bigg|_{x_o} \Delta x + \frac{1}{2!} \frac{\partial^2 C}{\partial x^2} \bigg|_{x_o} \Delta x^2 + \frac{1}{3!} \frac{\partial^3 C}{\partial x^3} \bigg|_{x_o} \Delta x^3 + \dots \tag{3}$$

and

$$C(x_0 - \Delta x) = C(x_0) - \left. \frac{\partial C}{\partial x} \right|_{x_0} \Delta x + \frac{1}{2!} \left. \frac{\partial^2 C}{\partial x^2} \right|_{x_0} \Delta x^2 - \frac{1}{3!} \left. \frac{\partial^3 C}{\partial x^3} \right|_{x_0} \Delta x^3 + \dots \quad (4)$$

By subtracting Equation 4 from Equation 3 and neglecting the higher order of Δx , the central difference approximation of the concentration derivative is obtained as:

$$\left. \frac{\partial C}{\partial x} \right|_{x_0} = \frac{C(x_0 + \Delta x) - C(x_0 - \Delta x)}{2\Delta x} = \frac{C|_{x_0 + \Delta x} - C|_{x_0 - \Delta x}}{2\Delta x} \quad (5)$$

The finite difference approximation of the dispersion term is expressed as:

$$\frac{\partial}{\partial x} \left(E_x A \frac{\partial C}{\partial x} \right) = \frac{\left(E_x A \frac{\partial C}{\partial x} \right)_{(x_0 + \Delta x)} - \left(E_x A \frac{\partial C}{\partial x} \right)_{(x_0 - \Delta x)}}{2\Delta x} \quad (6)$$

Substituting Equation 5 into Equation 6 gives:

$$\frac{\partial}{\partial x} \left(E_x A \frac{\partial C}{\partial x} \right) = \frac{(E_x A)_{(x_0 + \Delta x)} \frac{C(x_0 + 2\Delta x) - C(x_0)}{2\Delta x} - (E_x A)_{(x_0 - \Delta x)} \frac{C(x_0) - C(x_0 - 2\Delta x)}{2\Delta x}}{2\Delta x} \quad (7)$$

When applying the difference approximation to segment "j" in a network as in Figure 2, x_0 corresponds to the center of element j, $x_0 + \Delta x$ to the interface between elements j and j+1, $x_0 - \Delta x$ to the interface between elements j-1 and j, $x_0 - 2\Delta x$ to the center of element j-1, and $x_0 + 2\Delta x$ to the center of element j+1. The pollutant transport equation for element j can be written:

$$\begin{aligned} \frac{\partial}{\partial t} (AC)_j = & -\frac{(QC)_{j,j+1}}{L_j} + \frac{(QC)_{j-1,j}}{L_j} \\ & + \frac{(E_x A)_{j,j+1}}{L_{j,j+1} L_j} (C_{j+1} - C_j) - \frac{(E_x A)_{j-1,j}}{L_{j-1,j} L_j} (C_j - C_{j-1}) \\ & + A_j S_j^T \end{aligned} \quad (8)$$

where

- Q = AU, volumetric flow rate (m^3/day)
- S^T = $S_L + S_b + S_k$, total source and sink rates ($g/m^3\text{-day}$)
- L = characteristic length shown in Figure 2 (m)

Multiplying both side of Equation 8 with L_j gives:

$$\begin{aligned} \frac{\partial}{\partial t}(VC)_j = & -(QC)_{j,j+1} + (QC)_{j-1,j} \\ & + R_{j,j+1}(C_{j+1} - C_j) - R_{j-1,j}(C_j - C_{j-1}) \\ & + V_j S_j^T \end{aligned} \quad (9)$$

where

$$\begin{aligned} V &= \text{segment volume (m}^3\text{)} \\ R &= EA/L, \text{ dispersive flow (m}^3\text{/day)} \end{aligned}$$

The concentrations at the interface of two segments are defined by WASP5 in terms of the segment concentrations as:

$$C_{j,j+1} = \alpha C_{j+1} + (1 - \alpha) C_j \quad (10)$$

$$C_{j-1,j} = \alpha C_j + (1 - \alpha) C_{j-1} \quad (11)$$

where

$$\alpha = \text{numerical weighting factor (advection factor) between 0 and 1}$$

When α is zero, a backward difference approximation for the advective term results. When α is 0.5, a central difference approximation for the advective term is obtained.

WASP5 extends Equation 9 to the multi-dimensional form by including all segments (i 's) adjoining segment j . Interfaces are denoted as " i,j ". The general equation used by WASP5 is expressed as:

$$\frac{\partial}{\partial t}(VC)_j = -\sum_i (QC)_{i,j} + \sum_i R_{i,j}(C_i - C_j) + V_j S_j^T \quad (12)$$

where Q is volumetric flow. Q is positive when flow leaves segment j and is negative when flow enters segment j . The pollutant mass of the segment j is:

$$M_j = (VC)_j \quad (13)$$

Substituting Equation 13 into Equation 12, the general equation becomes:

$$\frac{\partial}{\partial t}(M)_j = -\sum_i (QC)_{i,j} + \sum_i R_{i,j}(C_i - C_j) + V_j S_j^T \quad (14)$$

WASP5 uses Equation 14 to evaluate the mass derivatives for every segment (j) during each time step between initial time t_0 and final t_F . Given concentrations and volumes at time t , WASP5 calculates new masses at $t+\Delta t$ using the one-step Euler scheme:

$$(M_j)_{t+\Delta t} = (M_j)_t + \frac{\partial}{\partial t}(M_j)_t \Delta t \quad (15)$$

where Δt is the time step.

Given new mass at time $t+\Delta t$, WASP5 calculates the new concentrations by dividing the masses with the volumes:

$$(C_j)_{t+\Delta t} = \frac{(M_j)_{t+\Delta t}}{(V_j)_{t+\Delta t}} \quad (16)$$

The segment volumes are input values in STREAM2.

Figure 3 shows that the calculation module, WASP5V, attaches the proper input files and reads input data from the input files. WASP5V calls subroutine EULER to perform transport simulations. EULER is the heart of the simulation, stepping through time performing a first-order Euler integration. At the start of a transport simulation, counters and time functions are initialized using subroutine TINIT. Initial mass derivatives are computed with a call to subroutine DERIV. For each time step, EULER loops through each segment, computing the new mass as shown in Equation 15. Each new concentration is obtained by dividing the new mass with a new volume (Equation 16). Next, EULER increments the time and adjusts the new day counter if necessary. If it is the proper time, EULER calls WASPB to store the intermediate results in the file with a file extension of ".SMP". New mass derivatives are obtained with a call to DERIV. The final task for each time step is to check for a new time step and for the end of the simulation. New time steps are periodically set by subroutine WAS14. When the final time for the simulation is detected, EULER triggers a final call to WASPB to store the results and returns the control to the main program, STREAM2. Reference 2 contains a detailed description of WASP5.

2.3 Post-Processor Module

Calculated concentrations as functions of time for downstream locations are stored in an ASCII file with a file extension of ".SMP". This ASCII file is passed to the subroutine SORT. Subroutine

SORT finds the peak concentrations at downstream locations and the peak concentration travel times from the discharge point to the downstream locations. Subroutine SORT passes this information to the subroutines WINDOW_VIRTUAL and PLOTCON_VIRTUAL, which display the results in tabular and graphical forms, as shown in Figure 1.

3 Input Files for Surface Stream Characterization

Significant efforts were devoted to develop input files for each discharge location. There are fifteen pre-determined potential release points (listed in Table 1) in SRS. Figure 4 shows the onsite streams, facilities, and the USGS gauge stations. Table 2 shows the input file name conventions. The input files should be in the subdirectory INP and the subdirectory INP should be in the same directory of the STREAM2 executable file. The input manual modified from Reference 2 is presented in Appendix 1.

The pathway of the material released from the SRS facilities to the surface water includes onsite streams and the Savannah River. Therefore, the input model includes onsite streams and the Savannah River.

3.1 Savannah River

The development of the Savannah River model is described in Reference 3. Reference 3 also presents the benchmark of the model results with the dye tracer study results conducted by the US Environmental Protection Agency (EPA) in 1990 and 1991.

3.2 Upper Three Runs Creek

To model releases to Upper Three Runs Creek, the river system model includes both Upper Three Runs and the Savannah River. Figure 5 depicts this system. The reach from Point 1 to Point 2 in Figure 5 was divided into 19 segments, each with a cross-sectional area of 11.04 m^2 . The reach from Point 2 to Point 3 was divided into 42 segments, each with a cross-sectional area of 30.00 m^2 . The Savannah River from 30.5 km downstream from the New Savannah Bluff Lock and Dam to 14.5 km upstream from Fort Pulaski was divided into 489 segments, each with a cross-sectional area of 278 m^2 . All model segments are 500 m in length. The cross-sectional areas of Upper Three Runs Creek were estimated from USGS measurements. The cross-sectional area for the Savannah River was obtained from previous 1990 and 1991 EPA dye studies [3]. Figure 6 depicts the schematic for the finite difference model. Reference 4 presents Upper Three Runs Creek model development and the benchmarking of the model results with data obtained by the dye tracer studies conducted in 1995 and 1996.

3.3 Beaver Dam Creek

To model the release to the Beaver Dam Creek, the river system modeled includes both Beaver Dam Creek and the Savannah River. Beaver Dam Creek, shown in Figure 7, was modeled for a distance of 5.54 km, starting above the D-Area outfall and extending to the Savannah River. Beaver Dam Creek was divided into 11 segments with a segment length of 500 m. An average cross section of 5.94 m^2 was used. The Savannah River model was obtained from Reference 3. Figure 8 presents the finite difference scheme for the Beaver Dam Creek. There are no dye tracer study data available for Beaver Dam Creek. However, the Beaver Dam Creek model was benchmarked indirectly with the measured tritium concentrations in the Savannah River at the Highway 301 bridge, as described in Reference 5.

3.4 Fourmile Branch

To model the release to the Fourmile Branch, the river system modeled includes both Fourmile Branch and Savannah River. The original Fourmile Branch model was developed based on the 1995 dye tracer study, as presented in Reference 6. However, the computation time on an IBM 300 MHz Pentium II personal computer is about forty minutes that is too long for emergency response application. Therefore, the segment size of the Fourmile Branch and the time step in Reference 6 were optimized to reduce the computation time. The computation time for the new model to simulate the pollutant transport from H-Area outfall to the city of Savannah, Georgia is less than fifteen minutes. As Figure 9 shows, Fourmile Branch was divided into 158 segments, each of which is 150 m long. The reach from Point 1 to Point 2 was divided into 137 segments, each with a cross-sectional area of 4.5 m^2 . The reach in the swamp area, from Point 2 to the mouth, was divided into 21 segments, each with a cross-sectional area of 5.0 m^2 . The Savannah River from the New Savannah Bluff Lock and Dam to 14.5 km upstream from Fort Pulaski was divided into 550 segments, each with a segment length of 500 m [3]. The cross-sectional areas of Fourmile Branch were adjusted so that the predicted dye plume traveling times matched the measured times from 1995 dye tracer study. The cross-sectional area of 278 m^2 for the Savannah River was obtained from previous 1990 and 1991 EPA dye studies [3]. The segment length for the Fourmile Branch was shortened from 500 m to 150 m. The reason for shortening the segment length follows.

The inherent numerical diffusion coefficient, $\left(\frac{U_s \Delta x}{2} \left(1 - \frac{U_s \Delta t}{\Delta x} \right) \right)$, for the backward finite difference method, is proportional to the segment size. Numerical diffusion became too large when a segment length of 500 m was used for Fourmile Branch, and the predicted dye plume became too wide relative to the 1995 dye tracer measurements. Therefore, the segment length was shortened to 150 m. The drawback to using this shorter segment length is that the number of segments increased and time step decreased due to numerical stability, causing the computing time to go up significantly. Figure 10 presents the finite difference scheme for the Fourmile Branch.

3.5 Pen Branch

The development of Pen Branch model is presented in Reference 7. The river system model includes Indian Grave Branch, part of Pen Branch, part of Steel Creek, and the Savannah River, as shown in Figure 11. The K-Area outfalls discharge to Indian Grave Branch, which flows into Pen Branch about five miles upstream from the swamp. Pen Branch enters the swamp about three miles from the Savannah River, flows directly toward the Savannah River for about 1.5 miles, and then turns and runs parallel to the Savannah River for about five miles before discharging into Steel Creek about 0.5 miles from where Steel Creek empties into the Savannah River. The reach from Point 1 to Point 2 in Figure 11 was divided into 38 segments, each with a segment length of 500 m and a cross section area of 11.33 m^2 . The reach from Point 2 to Point 3 is in the swamp area and was divided into 22 segments, each with a segment length of 500 m and a cross section area of 197.14 m^2 . The Savannah River from the point 30.5 km downstream from the New Savannah Bluff Lock and Dam to the point 14.5 km upstream from Fort Pulaski was divided into 489 segments, each with a segment length of 500 m and a cross section area of 278 m^2 [3]. Figure 12 presents the finite difference scheme for the Pen Branch. Reference 7 shows the comparison of the model results with the measured tritium concentrations from the 1991 K-Reactor tritiated aqueous release incident.

3.6 Steel Creek

The river system model includes both Steel Creek and the Savannah River. The reach from L lake Dam to the Steel Creek mouth was divided into 16 segments, each with a cross-sectional area of 10.498 m^2 . The Savannah River from 30.5 km downstream from the New Savannah Bluff Lock and Dam to 14.5 km upstream from Fort Pulaski was divided into 489 segments, each with a cross-sectional area of 278 m^2 . All model segments are 500 m in length. The cross-sectional areas for Steel Creek were estimated from USGS discharge measurements at Road A [8]. The cross-sectional area for the Savannah River was obtained from previous 1990 and 1991 EPA dye studies [3]. Figure 13 depicts the schematic for the finite difference model. No dye study data are available to benchmark the model. Therefore, it is suggested that a dye study be conducted for Steel Creek.

3.7 Lower Three Runs Creek

The river system model includes both Lower Three Runs Creek and the Savannah River. The reach from PAR Pond Dam to the Lower Three Runs Creek mouth in was divided into 32 segments, each with a cross-sectional area of 17.28 m^2 . The Savannah River from 30.5 km downstream from the New Savannah Bluff Lock and Dam to 14.5 km upstream from Fort Pulaski was divided into 489 segments, each with a cross-sectional area of 278 m^2 . All model segments are 500 m in length. The cross-sectional areas for Lower Three Runs were estimated from USGS discharge measurements at Station 02197400 [9]. The cross-sectional area for the Savannah River was obtained from previous 1990 and 1991 EPA dye studies [3]. Figure 14 depicts the schematic

for the finite difference model. No dye study data are available to benchmark this model. Consequently, it is suggested that a dye study be conducted for Lower Three Runs Creek.

3.8 Input Flows

For the current version of STREAM2 code, the USGS measured historical flows are used in the calculation. When the USGS instantaneous measured flows become available, the user will have the option to chose the instantaneous measured stream flows for input. The current version of STREAM2 input flows are derived from USGS measured flow records. The input flow for the Savannah River is derived by averaging the measured daily mean flow by month from January 1, 1975 to December 31, 1995. The same method is used to derive input flows for the onsite streams except that the averaging period for the onsite streams are shorter to exclude the influence of reactor discharge flows. The averaging period for onsite streams is from January 1, 1990 to December 31, 1995.

Appendix 2 lists the input files for releases from H-Area to Fourmile Branch.

4 Output Files

STREAM2 simulations produce several files that may be examined by the user. Those files are in the Subdirectory OUT. Subdirectory OUT is in the subdirectory in which the executable file STREAM2 resides. These files use the file name of the input data set with a unique extension. Files created by a STREAM2 simulation include XX.OUT, XX.DMP, XX.MSS, XX.DAT, and XX.SMP (where 'XX' is the name of the input data set), as shown in Table 2. The .OUT file contains a record of the input data plus any simulation error messages that may have been generated.

The .DMP file contains calculated results for each segment at each print interval throughout the simulation.

The .MSS file contains a mass balance record for one designated system in the model network as a whole (in kg). For each print interval, this file records the accumulated mass in from advection, dispersion, and loading; the accumulated mass out through advection, dispersion, burial (or volatilization), and kinetic transformation; the total resident mass; and the residual (unaccounted for) mass.

The .SMP file contains calculated results for selected segments at each print interval throughout the simulation. The selected segments correspond to the downstream locations of interest for displaying the results on the computer monitor in tabular and graphical forms.

The .DAT file contains a table that lists the peak concentration at selected downstream locations and the traveling time from the release point to the selected downstream locations.

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Table 1 Potential Release Locations

Release Location	File Name Prefix
D-Area Outfall to Beaver Dam	DD
Highway 278 to Upper Three Runs	H8
Road C to Upper Three Runs	FS
Road A to Upper Three Runs	UA
H-Area to Fourmile Branch	HH
F-Area to Fourmile Branch	FF
K-Area Outfall to Pen Branch Creek	KK
Road A to Fourmile Branch	A4
Road A to Steel Creek	AS
Par Pond Dam to Lower Three Runs	PD
Mouth of Lower Three Runs	ML
Mouth of Steel-Pen Branch	MS
Mouth of Fourmile Branch	M4
Mouth of Beaver Dam	MB
Mouth of Upper Three Runs	MR

Table 2 File Name Conventions

File Name	Description
Input Files:	
XX.INP	Input file
XX.NPS	Input file
Output Files:	
XX.OUT	This file contains input data and error messages.
XX.DMP	This file contains all the WASP5 simulation calculations.
XX.MSS	This file contains mass balance table.
XX.SMP	This file contains calculated concentrations as a function of time at sampling locations and is passed to the post-processor subroutines for displaying on the computer monitor.
XX.DAT	This file contains the peak concentrations at sampling locations and the peak concentration transport time from the release point to the sampling location.

XX: Corresponding to the release location, as described in Table 1.

Figure 1 STREAM2 Flow Chart

Figure 2 Finite Difference Scheme

Figure 3 WASP5V Flow Chart

Figure 4 SRS Onsite streams, facilities, and the USGS gauge stations

Figure 5 Upper Three Runs Creek

Figure 6 Model Schematics for Upper Three Runs Creek (not to scale)

Figure 7 Beaver Dam Creek

Figure 8 Model Schematics for Beaver Dam Creek (not to scale)

Figure 9 Fourmile Branch

Figure 10 Model Schematics for Fourmile Branch (not to scale)

Figure 11 Pen Branch

Figure 12 Model Schematics for Pen Branch (not to scale)

Figure 13 Model Schematics for Steel Creek (not to scale)

Figure 14 Model Schematics for Lower Three Runs Creek (not to scale)

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Appendix 1 STREAM2 Input Manual

Input Manual for Model Development

The WASP5 input manual is modified for the STREAM2 model. WASP5 is a versatile water quality analysis simulation program, while the STREAM2 code is a pollutant transport model for SRS emergency response purpose. Therefore, specific values are assigned to some of the input variables, and the input flow (Data Group D) and the input source loading (Data Group F) sections are completely modified.

DATA GROUP A: MODEL IDENTIFICATION AND SIMULATION CONTROL

Basic simulation information is provided in Data Group A, beginning with titles and descriptions in Records 1 and 2. The number of systems (state variables) and segments are specified in Record 4. Calculation time steps are provided in Records 6 and 7, and print intervals in Records 8 and 9. System bypass options are set in Record 10.

2.1 RECORD FORMATS

Record 1--Title of Simulation (A80)

TITLE1 = descriptive title of simulation. (A80)

Record 2--Description of Simulation (A80)

TITLE2 = description of simulation. (A80)

Record 3--Record 4 Names (A80)

HEADER = names of Record 4 variables, positioned properly; for user convenience only. (A80)

Record 4--Simulation Control Parameters (7I5, 2F5.0, F3.0, F2.0)

NOSEG = number of segments in model network. (I5)

NOSYS* = 2 (I5)

ICFL* = flag controlling use of restart file; 0 = neither read from nor write to restart file (initial conditions located in input file)

MFLAG = flag controlling messages printed in XX.dmp file; 0 = yes

		messages printed; 1 = no. (I5)
JMASS	=	0 = no mass balance table generated; or 2 = generate mass balance table. (I5)
NEGSLN	=	negative solution option; 0 = prevents negative solutions; 1 = allows negative solutions. (I5)
INTYP	=	time step option; 0 = user inputs time step history; 1=model calculates time step. (I5)
ADFAC	=	advection factor; 0 = backward difference; 0.5 = central difference; 0-0.4 recommended. (F5.0)
ZDAY	=	day at beginning of simulation; 1 is first day. (F5.0)
ZHR	=	hour at the beginning of simulation. (F3.0)
ZMIN	=	minute at the beginning of simulation. (F2.0)
TFLG	=	switch controlling generation of transport file; 0 = generate file; 1 = do not generate file. (I5)

Record 5-- Print Segments (6I5)

ISEGOUT = six segment numbers for which the calculated peak concentration
will be displayed on the screen. (I5)

Record 6--Number of Time Intervals (I5)

NOBRK = number of intervals into which the total simulation time is divided.
time step size used in calculation over each time interval is defined
in Record 7. (I5)

Record 7--Time Steps (4(F10.0, F10.0))

DTS(I) = maximum time step to be used until time T(I), days. (F10.0)

T(I) = time up to when time step DTS(I) will be used, days. (F10.0)

Record 8--Number of Print Intervals (I5)

NPRINT = number of print intervals. (I5)

Record 9--Print Intervals (4(F10.0, F10.0))

PRINT(I) = print interval to be used until time TPRINT(I), days. (F10.0)

TPRINT(I) = time up to when print interval PRINT(I) will be used, days. (F10.0)

Record 10--System Bypass Options (16I5)

SYSBY(K)* = SYSBY(1) is 1 and SYSBY(2) is 0. (I5)

* A specific value is assigned to the variable.

DATA GROUP B: EXCHANGE COEFFICIENTS

Exchange coefficients for surface water are computed from input dispersion coefficients, cross-sectional areas, and characteristic lengths. Dispersion coefficients may vary in time according to piecewise-linear time functions, with groups of segment pairs having the same dispersion time function.

3.1 RECORD FORMATS

Record 1--Number of Exchange Fields (I5, 75X)

NRFLD* = number of exchange fields. NRFLD =1. (I5)

TITLE = name of data group. (75X)

Record 2--Exchange Time Functions for Surface Water Field (I5, 2F10.0)

NTEX(1) = number of exchange time functions for field 1. (I5)

SCALR = scale factor for exchange coefficients. All exchange coefficients for field 1 will be multiplied by this factor. (F10.0)

CONVR = conversion factor for exchanges in field 1. (F10.0)

Records 3-6 are input as a group NTEX(1) times:

Record 3--Exchange Data (I5)

NORS(1,NT) = number of exchanges for field 1, time function NT. (I5)

Record 4--Areas, Characteristic Lengths (2F10.0, 2I5)

A(K) = area in square meters for exchange pair K. (F10.0)

EL(K) = characteristic length in meters for exchange pair K. (F10.0)

IR(K),JR(K) = segments between which exchange occurs. The order of the

segments is unimportant. (2I5)

Record 4 is repeated NORS(1,NT) times.

Record 5--Number of Breaks in Time Function (I5)

NBRKR(1,NT) = number of values and times used to describe dispersion coefficient piecewise-linear time function. (I5)

Record 6--Piecewise Linear Dispersion Time Function (4(F10.0, F10.0))

RT(K) = value of dispersion coefficient in m^2/sec at time TR(K). (F10.0)

TR(K) = time in days. (F10.0)

Record 6 is repeated NBRKR(1,NT)/4 times.

Record 7--Exchange Bypass Options (16I5)

RBK(K)* = RBK(1)=1 and RBK(2)=0. (I5)

Record 1 is entered once for Data Group B. Records 2 through 6 are input for the surface water exchange field, with Records 3, 4, 5, and 6 being repeated for each time function in this exchange field. Record 4 uses as many lines as necessary to input NORS sets of A(K), EL(K), IR(K), and JR(K), with 1 set on each line. Record 6 uses as many lines as needed to input NBRKR pairs of RT(K) and TR(K), with 4 pairs occupying each line.

After data for all exchange fields are entered, Record 7 is input on the following line with NOSYS entries. For STREAM2, NOSYS is 2.

DATA GROUP C: VOLUMES

Initial segment volumes are provided in Data Group C. In addition, segment type and underlying segment numbers are specified.

4.1 RECORD FORMATS

Record 1--Preliminary Data (2I5, F10.0, 60X)

IVOPT	=	water column volume option -- 1 = constant water column volumes; 2, 3 = volumes adjusted to maintain flow continuity. (I5)
IBEDV*	=	benthic volume option -- 0 = constant bed volumes. (I5)
TDINTS	=	benthic time step in days for recomputing porosity (if IBEDV = 0) or for sediment bed compaction (if IBEDV = 1). (F10.0)
TITLE	=	name of data group. (60X)

Record 2--Scale Factors (2F10.0)

SCALV	=	scale factor for volumes. All volumes will be multiplied by this factor. (F10.0)
CONVV	=	conversion factor for volumes. (F10.0)

Record 3 is repeated NOSEG times:

Record 3--Segment Types and Volumes (3I10, 5F10.0)

ISEG	=	segment number.
IBOTSG	=	segment immediately below ISEG. (I10)
ITYPE(ISEG)*	=	segment types: 1 = surface water segment. (I10)
BVOL(ISEG)	=	volume of segment ISEG in cubic meters. (F10.0)

VMULT(ISEG) = hydraulic coefficient "a" for velocity in ISEG as a function of flow:

$$v = a Q^b$$

If $b = 0$, VMULT is a constant velocity in m/sec. (F10.0)

VEXP(ISEG) = hydraulic exponent "b" for velocity in ISEG as a function of flow (0-1). A value of 0.4 represents rectangular channels. (F10.0)

DMULT(ISEG) = hydraulic coefficient "c" for depth of ISEG as a function of flow:

$$d = c Q^d$$

If $d = 0$, DMULT is a constant depth in m. (F10.0)

DXP(ISEG) = hydraulic exponent "d" for depth of ISEG as a function of flow (0-1). A value of 0.6 represents rectangular channels. (F10.0)

Note that the four hydraulic geometry parameters are used to calculate segment velocity and depth, which are not used by WASP5 in transport calculations. These are used to calculate reaeration or volatilization from segments.

Records 1 and 2 are entered once for Data Group C. Record 3 is repeated NOSEG times.

DATA GROUP D: FLOWS

5.1 RECORD FORMATS

Data Group D provides for the advective transport flows that are used in the model. The input format for Data Group D is rewritten for the STREAM2 code. A constant flow as a function of the month in which the release is taking place is used for the transport calculation in STREAM2.

Record 1--Data Input Options: Number of Flow Fields (2I5, A12)

IQOPT*	=	1
NFIELD*	=	1 (I5)
HYDFIL	=	name of hydrodynamic file to be read by WASP5 during the simulation (for example, RIVER1.HYD). (A12)

DATA BLOCK D1: Direct Input of Field One Flows

Record 2--Number of Flow Time Functions (I5, 2F10.0)

NINQ(1)	=	number of time functions. (I5)
SCALQ	=	scaling factor. All flows in Field one are multiplied by SCALQ. (F10.0)
CONVQ	=	units conversion factor. (F10.0)

Records 3 - 6 are input as a group NINQ(1) times:

Record 3--Number of Flows (I5)

NOQS(1,NI)	=	number of unit flow responses in field one, time function NI; each
------------	---	--

unit flow is defined for a single segment pair. (I5)

Record 4--Flow Routing for Field One (4(F10.0, 2I15))

BQ(1,NI,K) = portion of flow for field one, time function NI that flows between segment pair K. (F10.0)

JQ(1,NI,K) = upstream segment. (I5)

IQ(1,NI,K) = downstream segment. (I5)

Record 4 is repeated NOQS(1,NI)/4 times.

Record 5--Flows from January to December (4F10.0))

QFLW(I) = advective flow in m³/s. (F10.0)

Record 5, I = 1 to 12, four entries per line.

Record 2 is input once for Data Block D1. Records 3, 4, and 5 are input once for each flow time function. Record 4 uses as many lines as needed to input NOQS sets of BQ, JQ, and IQ, with four sets per line. Record 5 uses three lines with four entries on each line.

END OF DATA BLOCKS FOR D

Record 6--Flow Bypass Options (16I5)

QBY(ISYS) = flow bypass option -- 0 = flow transport occurs in system ISYS;
1 = flow transport is bypassed for system ISYS. (I5)

ISYS = 1, NOSYS. For STREAM2, NOSYS is 2.

The flow bypass option allows flow transport to be set to zero in one or more systems. The bypass option applies to all transport fields. The input values for STREAM2 are 1 and 0.

DATA GROUP E: BOUNDARY CONCENTRATIONS

Data Group E supplies concentrations for each system at the model network boundaries. Model boundaries consist of those segments that import, export, or exchange water with locations outside the network, as specified in Data Groups B and D. All system concentrations from 1 to NOSEG must be supplied for each boundary. Boundary concentrations vary with time following a piecewise linear time function specified by the user in Records 3 and 4.

6.1 RECORD FORMATS

Data Group E is repeated, in its entirety, NOSYS times.

Record 1--Data Input Option--Number of Boundary Conditions (I10, 70X)

NOBC(K) = number of boundary conditions used for system K. (I10)

TITLE = name of data group. (70X)

If no boundary conditions are to be input for system K, set NOBC(K) equal to zero and either continue with the next system or go to Data Group F if K is the last system.

Record 2--Scale Factor for Boundary Conditions (2F10.0)

SCALB = scale factor for boundary conditions. All boundary conditions will be multiplied by this factor. (F10.0)

CONVB = unit conversion factor for boundary conditions. Boundary conditions are expected to be in mg/L (i.e. - g/m³), in which case CONVB will be 1.0. (F10.0)

Records 3-4 are input as a unit NOBC(K) times:

Record 3--Boundary Location (2I5)

IBC(K) = boundary segment number. (I5)

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NOBRK(K) = number of values and times used to describe the broken line approximation. The number of breaks must be equal for all boundary conditions within a system. (I5)

Record 4--Boundary Concentrations (4(2F10.0))

BCT(K) = value of the boundary concentration at time T(K) in mg/L. (F10.0)

T(K) = time in days. If the length of the simulation exceeds T(NOBRK), the broken line approximation is repeated, starting at T(1), i.e., the approximation is assumed to be periodic, with period equation to T(NOBRK). All break times must agree for all segments, i.e., T(1) must be the same for all boundaries, T(2) must be the same for all boundaries, etc. (F10.0)

Record 4 is repeated NOBRK(K)/4 times.

Records 1 and 2 are entered once. Records 3 and 4 are a set and are repeated NOBC times. Within each NOBC set, Record 3 is entered once and Record 4 is repeated until NOBRK entries are input. Four entries (four BCT(K)-T(K) pairs) will fit on each 80-space line. The whole group (Records 1 - 4) is repeated NOSYS times, once for each model system. For STREAM2, NOSYS is 2.

DATA GROUP F: WASTE LOADS

The pollutant loading for STREAM2 is defined by the user at the pre-processor module and the loading is passed to WASP5 from sub-routine TRACE

7.1 RECORD FORMATS

Data Block F1 (records 1) is repeated in its entirety NOSYS times:

Record 1--Number of Point Sources (I5)

IWK = segment number that has point source loading BWK. (I5)

Record 1 is repeated NOSYS times, once for each system. For STREAM2, NOSYS is 2.

Data Block F2, record 2, is input once:

Record 2—Instantaneous Release (I10)

NPSFIL = To conform with the WASP5 logic, NPSFIL is an external file used by WASP5 to input instantaneous release. This file name should include the directory name in which the NPSFIL resides. This file and its contents are described below. (A12)

7.2 THE EXTERNAL NONPOINT SOURCE FILE

This file contains information on which WASP5 systems and segments receive instantaneous releases.

Six records comprise the instantaneous release file.

Record 1--Data Options (A15, 3I5)

NPSMOD = Name or description of loading source model or method of generation; this is echoed to the output file for the record. (A15)

NUMSEG = Number of segments receiving loads. (I5)

INTOPT = Interpolation option; 1 = step function (only one in code now). (I5)

NUMSYS = Number of WASP systems receiving loads. (I5)

Record 2--Loading Segments (I5)

LSEG(I) = segment number receiving loads. (I5)

Record 2 is repeated NUMSEG times.

Record 3--Loading Systems (20I5)

LSYS(I) = WASP system numbers receiving loads. (I5)

Record 4--System Descriptors (A15)

NAMESY(I) = Name or description of WASP systems receiving loads. (A15)

Record 4 is repeated NUMSYS times.

Records 5 and 6 are repeated as a unit for the number of days that nonzero loads occur:

Record 5--Loading Days (F10.0)

LDAY = Time in days for the following nonzero load. (F10.0)

Record 6--Nonpoint Source Loads (A15, 20F10.0)

NAMESY(I) = System name or description (not read in by WASP). (A15)

NPSWK(I,J)* = 0.0; this is the loading that will be assigned by user at the pre-processor module and passed to WASP5 by subroutine TRACE (20F10.0)

Record 6 is repeated NUMSYS times.

Record 1 is input once. Record 2 is repeated NUMSEG times. Record 3 is then input once. Record 4 is repeated NUMSYS times. Records 5 and 6 are a set and are repeated (as a set) NUMSYS times. Within each set, Record 5 is entered once and Record 6 is repeated NUMSYS times.

DATA GROUP G: PARAMETERS

Parameters are not used by STREAM2.

8.1 RECORD FORMATS

Record 1--Number of Parameters (I10, 70X)

NOPAM* = 0 number of parameters required by the model. If no parameters are to be input, set NOPAM to zero and go to Data Group H. (I10)

TITLE = name of data group. (70X)

DATA GROUP H: CONSTANTS

STREAM2 does not use this data group.

9.1 RECORD FORMATS

Record 1--Header (80X)

TITLE = name of data group. (80X)

Records 2-4 are input as a group NOSYS+1 times:

Record 2--Data Fields in Group ISYS (A10, I10)

CHNAME(ISYS) = a ten-character descriptive name for System (ISYS). (A10)

NFLD* = 0 number of fields of constants for this group; 0 = no constants for this group; the user may subdivide the constants into any number of arbitrary fields. (I10)

Record 1 is entered once in Data Group H. Record 2 is entered as NOSYS + 1 groups. For STREAM2, NOSYS is 2.

DATA GROUP I: KINETIC TIME FUNCTIONS

Note: STREAM2 does not use kinetic time functions.

10.1 RECORD FORMATS

Record 1--Number of Time Functions (I10, 70X)

NFUNC = 0 number of time functions required by the model. If no time functions are to be input, set NFUNC equal to zero and go to Data Group J. (I10)

TITLE = name of data group. (70X)

DATA GROUP J: INITIAL CONDITIONS

11.1 RECORD FORMATS

The initial conditions are the segment concentrations and densities for the state variables at time zero (the start of the simulation).

Records 1-2 are input as a group NOSYS times:

Record 1--System Information (A40, I5, F5.0, F10.0, 20X)

CHEML	=	chemical or system name (A40).
IFIELD	=	solids field (3, 4, or 5) that transports this system in its pure or sorbed form (I5).
DSED	=	density of system; 0.0 for chemical, 0.5-2.5 for solids, kg/L. (F5.0).
CMAX	=	maximum concentration allowed, mg/L. (F10.0)
TITLE	=	name of data group. (20X)

Record 2--Initial Conditions (3(A5, 2F10.0))

ANAME(K)	=	an optional one to five alphanumeric character descriptive name or number identifying segment K. (A5)
C(ISYS,K)	=	initial concentration in segment K of system ISYS in the appropriate units, mg/L. (F10.0)
DISSF	=	dissolved fraction of chemical in segment K. (F10.0)

Record 2 is repeated NOSEG/3 times.

Records 1 and 2 are a set and will be repeated NOSYS times. Within each NOSYS set, Record 2 will use as many 80-space lines as needed to input NOSEG entries. Three entries (ANAME-C-DISSF) will fit on one line. After NOSEG entries have been entered in a NOSYS set, begin the next NOSYS set on the following line. For STREAM2, NOSYS is 2.

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Appendix 2 Input File for Release from H-Outfall to Fourmile Branch (HH.inp)

Release From H-outfall to 4MB

USING ACE MILES AND FLOW AT AUGUSTA (SOLID), detailed 4m flw, 4mb seg=150m

NSEG NSYS ICRD DMPF JMAS NSLN INTY ADPC DD HHMM TRAN A:MODEL OPTIONS

711	2	0	1	2	0	1	0.0	0	0000	1
624	115	222	406	478	511					
2										
0.0035		5.0		0.0064			12.0			
3										
0.02		0.00		0.02			10.0	0.5	365.0	
1	0	1	1	1	1					
1					*					
8		1.00		1.000						

+B:EXCHANGES

551										
277.966		250.0		0	1					
277.966		500.0		1	2					
277.966		500.0		2	3					
277.966		500.0		3	4					
277.966		500.0		4	5					
277.966		500.0		5	6					
277.966		500.0		6	7					
277.966		500.0		7	8					
277.966		500.0		8	9					
277.966		500.0		9	10					
277.966		500.0		10	11					
277.966		500.0		11	12					
277.966		500.0		12	13					
277.966		500.0		13	14					
277.966		500.0		14	15					
277.966		500.0		15	16					
277.966		500.0		16	17					
277.966		500.0		17	18					
277.966		500.0		18	19					
277.966		500.0		19	20					
277.966		500.0		20	21					
277.966		500.0		21	22					
277.966		500.0		22	23					
277.966		500.0		23	24					
277.966		500.0		24	25					
277.966		500.0		25	26					
277.966		500.0		26	27					
277.966		500.0		27	28					
277.966		500.0		28	29					
277.966		500.0		29	30					
277.966		500.0		30	31					
277.966		500.0		31	32					
277.966		500.0		32	33					
277.966		500.0		33	34					
277.966		500.0		34	35					
277.966		500.0		35	36					
277.966		500.0		36	37					
277.966		500.0		37	38					
277.966		500.0		38	39					
277.966		500.0		39	40					
277.966		500.0		40	41					
277.966		500.0		41	42					
277.966		500.0		42	43					
277.966		500.0		43	44					
277.966		500.0		44	45					
277.966		500.0		45	46					
277.966		500.0		46	47					
277.966		500.0		47	48					
277.966		500.0		48	49					
277.966		500.0		49	50					
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277.966		500.0		51	52					
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277.966		500.0		55	56					
277.966		500.0		56	57					
277.966		500.0		57	58					
277.966		500.0		58	59					
277.966		500.0		59	60					
277.966		500.0		60	61					
277.966		500.0		61	62					
277.966		500.0		62	63					

277.966	500.0	63	64
277.966	500.0	64	65
277.966	500.0	65	66
277.966	500.0	66	67
277.966	500.0	67	68
277.966	500.0	68	69
277.966	500.0	69	70
277.966	500.0	70	71
277.966	500.0	71	72
277.966	500.0	72	73
277.966	500.0	73	74
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277.966	500.0	103	104
277.966	500.0	104	105
277.966	500.0	105	106
277.966	500.0	106	107
277.966	500.0	107	108
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277.966	500.0	127	128
277.966	500.0	128	129
277.966	500.0	129	130
277.966	500.0	130	131
277.966	500.0	131	132
277.966	500.0	132	133
277.966	500.0	133	134
277.966	500.0	134	135
277.966	500.0	135	136
277.966	500.0	136	137
277.966	500.0	137	138
277.966	500.0	138	139
277.966	500.0	139	140
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4.50000	150.0	593	594

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5.00000	150.0	700	701
5.00000	150.0	701	702
5.00000	150.0	702	703
5.00000	150.0	703	704
5.00000	150.0	704	705
5.00000	150.0	705	706
5.00000	150.0	706	707
5.00000	150.0	707	708
5.00000	150.0	708	115
2			
20.0	0.	20.0	365.0
6			
4.50000	75.0	0	709
4.50000	150.0	709	561
4.50000	75.0	0	710
4.50000	150.0	710	580
4.50000	75.0	0	711
4.50000	150.0	711	614

2	0.0	0.	0.0	365.0
---	-----	----	-----	-------

1	0			
2	0	1.20	*	+
1.000	1.00			

* C: VOLUMES

1	0	1	138983.00	0.054	0.43	0.4497	0.45
2	0	1	138983.00	0.054	0.43	0.4497	0.45
3	0	1	138983.00	0.054	0.43	0.4497	0.45
4	0	1	138983.00	0.054	0.43	0.4497	0.45
5	0	1	138983.00	0.054	0.43	0.4497	0.45
6	0	1	138983.00	0.054	0.43	0.4497	0.45
7	0	1	138983.00	0.054	0.43	0.4497	0.45
8	0	1	138983.00	0.054	0.43	0.4497	0.45
9	0	1	138983.00	0.054	0.43	0.4497	0.45
10	0	1	138983.00	0.054	0.43	0.4497	0.45
11	0	1	138983.00	0.054	0.43	0.4497	0.45
12	0	1	138983.00	0.054	0.43	0.4497	0.45
13	0	1	138983.00	0.054	0.43	0.4497	0.45
14	0	1	138983.00	0.054	0.43	0.4497	0.45
15	0	1	138983.00	0.054	0.43	0.4497	0.45
16	0	1	138983.00	0.054	0.43	0.4497	0.45
17	0	1	138983.00	0.054	0.43	0.4497	0.45
18	0	1	138983.00	0.054	0.43	0.4497	0.45
19	0	1	138983.00	0.054	0.43	0.4497	0.45
20	0	1	138983.00	0.054	0.43	0.4497	0.45
21	0	1	138983.00	0.054	0.43	0.4497	0.45
22	0	1	138983.00	0.054	0.43	0.4497	0.45
23	0	1	138983.00	0.054	0.43	0.4497	0.45
24	0	1	138983.00	0.054	0.43	0.4497	0.45
25	0	1	138983.00	0.054	0.43	0.4497	0.45
26	0	1	138983.00	0.054	0.43	0.4497	0.45
27	0	1	138983.00	0.054	0.43	0.4497	0.45
28	0	1	138983.00	0.054	0.43	0.4497	0.45
29	0	1	138983.00	0.054	0.43	0.4497	0.45
30	0	1	138983.00	0.054	0.43	0.4497	0.45
31	0	1	138983.00	0.054	0.43	0.4497	0.45
32	0	1	138983.00	0.054	0.43	0.4497	0.45
33	0	1	138983.00	0.054	0.43	0.4497	0.45
34	0	1	138983.00	0.054	0.43	0.4497	0.45
35	0	1	138983.00	0.054	0.43	0.4497	0.45
36	0	1	138983.00	0.054	0.43	0.4497	0.45
37	0	1	138983.00	0.054	0.43	0.4497	0.45
38	0	1	138983.00	0.054	0.43	0.4497	0.45
39	0	1	138983.00	0.054	0.43	0.4497	0.45
40	0	1	138983.00	0.054	0.43	0.4497	0.45
41	0	1	138983.00	0.054	0.43	0.4497	0.45

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

682	0	1	675.00000	0.054	0.43	0.4497	0.45
683	0	1	675.00000	0.054	0.43	0.4497	0.45
684	0	1	675.00000	0.054	0.43	0.4497	0.45
685	0	1	675.00000	0.054	0.43	0.4497	0.45
686	0	1	675.00000	0.054	0.43	0.4497	0.45
687	0	1	675.00000	0.054	0.43	0.4497	0.45
688	0	1	750.00000	0.054	0.43	0.4497	0.45
689	0	1	750.00000	0.054	0.43	0.4497	0.45
690	0	1	750.00000	0.054	0.43	0.4497	0.45
691	0	1	750.00000	0.054	0.43	0.4497	0.45
692	0	1	750.00000	0.054	0.43	0.4497	0.45
693	0	1	750.00000	0.054	0.43	0.4497	0.45
694	0	1	750.00000	0.054	0.43	0.4497	0.45
695	0	1	750.00000	0.054	0.43	0.4497	0.45
696	0	1	750.00000	0.054	0.43	0.4497	0.45
697	0	1	750.00000	0.054	0.43	0.4497	0.45
698	0	1	750.00000	0.054	0.43	0.4497	0.45
699	0	1	750.00000	0.054	0.43	0.4497	0.45
700	0	1	750.00000	0.054	0.43	0.4497	0.45
701	0	1	750.00000	0.054	0.43	0.4497	0.45
702	0	1	750.00000	0.054	0.43	0.4497	0.45
703	0	1	750.00000	0.054	0.43	0.4497	0.45
704	0	1	750.00000	0.054	0.43	0.4497	0.45
705	0	1	750.00000	0.054	0.43	0.4497	0.45
706	0	1	750.00000	0.054	0.43	0.4497	0.45
707	0	1	750.00000	0.054	0.43	0.4497	0.45
708	0	1	750.00000	0.054	0.43	0.4497	0.45
709	0	1	675.00000	0.054	0.43	0.4497	0.45
710	0	1	675.00000	0.054	0.43	0.4497	0.45
711	0	1	675.00000	0.054	0.43	0.4497	0.45

1 1 * + * + D: FLOWS S. RIVER

5 1.0 1.00

551

1.00	0	1	1.00	1	2	1.00	2	3	1.00	3	4
1.00	4	5	1.00	5	6	1.00	6	7	1.00	7	8
1.00	8	9	1.00	9	10	1.00	10	11	1.00	11	12
1.00	12	13	1.00	13	14	1.00	14	15	1.00	15	16
1.00	16	17	1.00	17	18	1.00	18	19	1.00	19	20
1.00	20	21	1.00	21	22	1.00	22	23	1.00	23	24
1.00	24	25	1.00	25	26	1.00	26	27	1.00	27	28
1.00	28	29	1.00	29	30	1.00	30	31	1.00	31	32
1.00	32	33	1.00	33	34	1.00	34	35	1.00	35	36
1.00	36	37	1.00	37	38	1.00	38	39	1.00	39	40
1.00	40	41	1.00	41	42	1.00	42	43	1.00	43	44
1.00	44	45	1.00	45	46	1.00	46	47	1.00	47	48
1.00	48	49	1.00	49	50	1.00	50	51	1.00	51	52
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1.00	56	57	1.00	57	58	1.00	58	59	1.00	59	60
1.00	60	61	1.00	61	62	1.00	62	63	1.00	63	64
1.00	64	65	1.00	65	66	1.00	66	67	1.00	67	68
1.00	68	69	1.00	69	70	1.00	70	71	1.00	71	72
1.00	72	73	1.00	73	74	1.00	74	75	1.00	75	76
1.00	76	77	1.00	77	78	1.00	78	79	1.00	79	80
1.00	80	81	1.00	81	82	1.00	82	83	1.00	83	84
1.00	84	85	1.00	85	86	1.00	86	87	1.00	87	88
1.00	88	89	1.00	89	90	1.00	90	91	1.00	91	92
1.00	92	93	1.00	93	94	1.00	94	95	1.00	95	96
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1.00	100	101	1.00	101	102	1.00	102	103	1.00	103	104
1.00	104	105	1.00	105	106	1.00	106	107	1.00	107	108
1.00	108	109	1.00	109	110	1.00	110	111	1.00	111	112
1.00	112	113	1.00	113	114	1.00	114	115	1.00	115	116
1.00	116	117	1.00	117	118	1.00	118	119	1.00	119	120
1.00	120	121	1.00	121	122	1.00	122	123	1.00	123	124
1.00	124	125	1.00	125	126	1.00	126	127	1.00	127	128
1.00	128	129	1.00	129	130	1.00	130	131	1.00	131	132
1.00	132	133	1.00	133	134	1.00	134	135	1.00	135	136
1.00	136	137	1.00	137	138	1.00	138	139	1.00	139	140
1.00	140	141	1.00	141	142	1.00	142	143	1.00	143	144
1.00	144	145	1.00	145	146	1.00	146	147	1.00	147	148
1.00	148	149	1.00	149	150	1.00	150	151	1.00	151	152
1.00	152	153	1.00	153	154	1.00	154	155	1.00	155	156
1.00	156	157	1.00	157	158	1.00	158	159	1.00	159	160
1.00	160	161	1.00	161	162	1.00	162	163	1.00	163	164
1.00	164	165	1.00	165	166	1.00	166	167	1.00	167	168
1.00	168	169	1.00	169	170	1.00	170	171	1.00	171	172
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1.00	176	177	1.00	177	178	1.00	178	179	1.00	179	180
1.00	180	181	1.00	181	182	1.00	182	183	1.00	183	184
1.00	184	185	1.00	185	186	1.00	186	187	1.00	187	188

1.00	188	189	1.00	189	190	1.00	190	191	1.00	191	192
1.00	192	193	1.00	193	194	1.00	194	195	1.00	195	196
1.00	196	197	1.00	197	198	1.00	198	199	1.00	199	200
1.00	200	201	1.00	201	202	1.00	202	203	1.00	203	204
1.00	204	205	1.00	205	206	1.00	206	207	1.00	207	208
1.00	208	209	1.00	209	210	1.00	210	211	1.00	211	212
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1.00	216	217	1.00	217	218	1.00	218	219	1.00	219	220
1.00	220	221	1.00	221	222	1.00	222	223	1.00	223	224
1.00	224	225	1.00	225	226	1.00	226	227	1.00	227	228
1.00	228	229	1.00	229	230	1.00	230	231	1.00	231	232
1.00	232	233	1.00	233	234	1.00	234	235	1.00	235	236
1.00	236	237	1.00	237	238	1.00	238	239	1.00	239	240
1.00	240	241	1.00	241	242	1.00	242	243	1.00	243	244
1.00	244	245	1.00	245	246	1.00	246	247	1.00	247	248
1.00	248	249	1.00	249	250	1.00	250	251	1.00	251	252
1.00	252	253	1.00	253	254	1.00	254	255	1.00	255	256
1.00	256	257	1.00	257	258	1.00	258	259	1.00	259	260
1.00	260	261	1.00	261	262	1.00	262	263	1.00	263	264
1.00	264	265	1.00	265	266	1.00	266	267	1.00	267	268
1.00	268	269	1.00	269	270	1.00	270	271	1.00	271	272
1.00	272	273	1.00	273	274	1.00	274	275	1.00	275	276
1.00	276	277	1.00	277	278	1.00	278	279	1.00	279	280
1.00	280	281	1.00	281	282	1.00	282	283	1.00	283	284
1.00	284	285	1.00	285	286	1.00	286	287	1.00	287	288
1.00	288	289	1.00	289	290	1.00	290	291	1.00	291	292
1.00	292	293	1.00	293	294	1.00	294	295	1.00	295	296
1.00	296	297	1.00	297	298	1.00	298	299	1.00	299	300
1.00	300	301	1.00	301	302	1.00	302	303	1.00	303	304
1.00	304	305	1.00	305	306	1.00	306	307	1.00	307	308
1.00	308	309	1.00	309	310	1.00	310	311	1.00	311	312
1.00	312	313	1.00	313	314	1.00	314	315	1.00	315	316
1.00	316	317	1.00	317	318	1.00	318	319	1.00	319	320
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1.00	324	325	1.00	325	326	1.00	326	327	1.00	327	328
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1.00	332	333	1.00	333	334	1.00	334	335	1.00	335	336
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1.00	340	341	1.00	341	342	1.00	342	343	1.00	343	344
1.00	344	345	1.00	345	346	1.00	346	347	1.00	347	348
1.00	348	349	1.00	349	350	1.00	350	351	1.00	351	352
1.00	352	353	1.00	353	354	1.00	354	355	1.00	355	356
1.00	356	357	1.00	357	358	1.00	358	359	1.00	359	360
1.00	360	361	1.00	361	362	1.00	362	363	1.00	363	364
1.00	364	365	1.00	365	366	1.00	366	367	1.00	367	368
1.00	368	369	1.00	369	370	1.00	370	371	1.00	371	372
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1.00	380	381	1.00	381	382	1.00	382	383	1.00	383	384
1.00	384	385	1.00	385	386	1.00	386	387	1.00	387	388
1.00	388	389	1.00	389	390	1.00	390	391	1.00	391	392
1.00	392	393	1.00	393	394	1.00	394	395	1.00	395	396
1.00	396	397	1.00	397	398	1.00	398	399	1.00	399	400
1.00	400	401	1.00	401	402	1.00	402	403	1.00	403	404
1.00	404	405	1.00	405	406	1.00	406	407	1.00	407	408
1.00	408	409	1.00	409	410	1.00	410	411	1.00	411	412
1.00	412	413	1.00	413	414	1.00	414	415	1.00	415	416
1.00	416	417	1.00	417	418	1.00	418	419	1.00	419	420
1.00	420	421	1.00	421	422	1.00	422	423	1.00	423	424
1.00	424	425	1.00	425	426	1.00	426	427	1.00	427	428
1.00	428	429	1.00	429	430	1.00	430	431	1.00	431	432
1.00	432	433	1.00	433	434	1.00	434	435	1.00	435	436
1.00	436	437	1.00	437	438	1.00	438	439	1.00	439	440
1.00	440	441	1.00	441	442	1.00	442	443	1.00	443	444
1.00	444	445	1.00	445	446	1.00	446	447	1.00	447	448
1.00	448	449	1.00	449	450	1.00	450	451	1.00	451	452
1.00	452	453	1.00	453	454	1.00	454	455	1.00	455	456
1.00	456	457	1.00	457	458	1.00	458	459	1.00	459	460
1.00	460	461	1.00	461	462	1.00	462	463	1.00	463	464
1.00	464	465	1.00	465	466	1.00	466	467	1.00	467	468
1.00	468	469	1.00	469	470	1.00	470	471	1.00	471	472
1.00	472	473	1.00	473	474	1.00	474	475	1.00	475	476
1.00	476	477	1.00	477	478	1.00	478	479	1.00	479	480
1.00	480	481	1.00	481	482	1.00	482	483	1.00	483	484
1.00	484	485	1.00	485	486	1.00	486	487	1.00	487	488
1.00	488	489	1.00	489	490	1.00	490	491	1.00	491	492
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1.00	500	501	1.00	501	502	1.00	502	503	1.00	503	504
1.00	504	505	1.00	505	506	1.00	506	507	1.00	507	508

1.00	508	509	1.00	509	510	1.00	510	511	1.00	511	512
1.00	512	513	1.00	513	514	1.00	514	515	1.00	515	516
1.00	516	517	1.00	517	518	1.00	518	519	1.00	519	520
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1.00	536	537	1.00	537	538	1.00	538	539	1.00	539	540
1.00	540	541	1.00	541	542	1.00	542	543	1.00	543	544
1.00	544	545	1.00	545	546	1.00	546	547	1.00	547	548
1.00	548	549	1.00	549	550	1.00	550	0			
305.0364	347.6387	407.8009	356.3662								
248.4805	228.2895	209.5899	229.1920								
200.2558	223.5691	234.1175	281.4851								
595											
1.00	0	551	1.00	551	552	1.00	552	553	1.00	553	554
1.00	554	555	1.00	555	556	1.00	556	557	1.00	557	558
1.00	558	559	1.00	559	560	1.00	560	561	1.00	561	562
1.00	562	563	1.00	563	564	1.00	564	565	1.00	565	566
1.00	566	567	1.00	567	568	1.00	568	569	1.00	569	570
1.00	570	571	1.00	571	572	1.00	572	573	1.00	573	574
1.00	574	575	1.00	575	576	1.00	576	577	1.00	577	578
1.00	578	579	1.00	579	580	1.00	580	581	1.00	581	582
1.00	582	583	1.00	583	584	1.00	584	585	1.00	585	586
1.00	586	587	1.00	587	588	1.00	588	589	1.00	589	590
1.00	590	591	1.00	591	592	1.00	592	593	1.00	593	594
1.00	594	595	1.00	595	596	1.00	596	597	1.00	597	598
1.00	598	599	1.00	599	600	1.00	600	601	1.00	601	602
1.00	602	603	1.00	603	604	1.00	604	605	1.00	605	606
1.00	606	607	1.00	607	608	1.00	608	609	1.00	609	610
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1.00	614	615	1.00	615	616	1.00	616	617	1.00	617	618
1.00	618	619	1.00	619	620	1.00	620	621	1.00	621	622
1.00	622	623	1.00	623	624	1.00	624	625	1.00	625	626
1.00	626	627	1.00	627	628	1.00	628	629	1.00	629	630
1.00	630	631	1.00	631	632	1.00	632	633	1.00	633	634
1.00	634	635	1.00	635	636	1.00	636	637	1.00	637	638
1.00	638	639	1.00	639	640	1.00	640	641	1.00	641	642
1.00	642	643	1.00	643	644	1.00	644	645	1.00	645	646
1.00	646	647	1.00	647	648	1.00	648	649	1.00	649	650
1.00	650	651	1.00	651	652	1.00	652	653	1.00	653	654
1.00	654	655	1.00	655	656	1.00	656	657	1.00	657	658
1.00	658	659	1.00	659	660	1.00	660	661	1.00	661	662
1.00	662	663	1.00	663	664	1.00	664	665	1.00	665	666
1.00	666	667	1.00	667	668	1.00	668	669	1.00	669	670
1.00	670	671	1.00	671	672	1.00	672	673	1.00	673	674
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1.00	330	331	1.00	331	332	1.00	332	333	1.00	333	334
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1.00	338	339	1.00	339	340	1.00	340	341	1.00	341	342
1.00	342	343	1.00	343	344	1.00	344	345	1.00	345	346
1.00	346	347	1.00	347	348	1.00	348	349	1.00	349	350
1.00	350	351	1.00	351	352	1.00	352	353	1.00	353	354
1.00	354	355	1.00	355	356	1.00	356	357	1.00	357	358
1.00	358	359	1.00	359	360	1.00	360	361	1.00	361	362
1.00	362	363	1.00	363	364	1.00	364	365	1.00	365	366
1.00	366	367	1.00	367	368	1.00	368	369	1.00	369	370
1.00	370	371	1.00	371	372	1.00	372	373	1.00	373	374
1.00	374	375	1.00	375	376	1.00	376	377	1.00	377	378
1.00	378	379	1.00	379	380	1.00	380	381	1.00	381	382
1.00	382	383	1.00	383	384	1.00	384	385	1.00	385	386
1.00	386	387	1.00	387	388	1.00	388	389	1.00	389	390
1.00	390	391	1.00	391	392	1.00	392	393	1.00	393	394
1.00	394	395	1.00	395	396	1.00	396	397	1.00	397	398

1.00	398	399	1.00	399	400	1.00	400	401	1.00	401	402
1.00	402	403	1.00	403	404	1.00	404	405	1.00	405	406
1.00	406	407	1.00	407	408	1.00	408	409	1.00	409	410
1.00	410	411	1.00	411	412	1.00	412	413	1.00	413	414
1.00	414	415	1.00	415	416	1.00	416	417	1.00	417	418
1.00	418	419	1.00	419	420	1.00	420	421	1.00	421	422
1.00	422	423	1.00	423	424	1.00	424	425	1.00	425	426
1.00	426	427	1.00	427	428	1.00	428	429	1.00	429	430
1.00	430	431	1.00	431	432	1.00	432	433	1.00	433	434
1.00	434	435	1.00	435	436	1.00	436	437	1.00	437	438
1.00	438	439	1.00	439	440	1.00	440	441	1.00	441	442
1.00	442	443	1.00	443	444	1.00	444	445	1.00	445	446
1.00	446	447	1.00	447	448	1.00	448	449	1.00	449	450
1.00	450	451	1.00	451	452	1.00	452	453	1.00	453	454
1.00	454	455	1.00	455	456	1.00	456	457	1.00	457	458
1.00	458	459	1.00	459	460	1.00	460	461	1.00	461	462
1.00	462	463	1.00	463	464	1.00	464	465	1.00	465	466
1.00	466	467	1.00	467	468	1.00	468	469	1.00	469	470
1.00	470	471	1.00	471	472	1.00	472	473	1.00	473	474
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1.00	478	479	1.00	479	480	1.00	480	481	1.00	481	482
1.00	482	483	1.00	483	484	1.00	484	485	1.00	485	486
1.00	486	487	1.00	487	488	1.00	488	489	1.00	489	490
1.00	490	491	1.00	491	492	1.00	492	493	1.00	493	494
1.00	494	495	1.00	495	496	1.00	496	497	1.00	497	498
1.00	498	499	1.00	499	500	1.00	500	501	1.00	501	502
1.00	502	503	1.00	503	504	1.00	504	505	1.00	505	506
1.00	506	507	1.00	507	508	1.00	508	509	1.00	509	510
1.00	510	511	1.00	511	512	1.00	512	513	1.00	513	514
1.00	514	515	1.00	515	516	1.00	516	517	1.00	517	518
1.00	518	519	1.00	519	520	1.00	520	521	1.00	521	522
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1.00	526	527	1.00	527	528	1.00	528	529	1.00	529	530
1.00	530	531	1.00	531	532	1.00	532	533	1.00	533	534
1.00	534	535	1.00	535	536	1.00	536	537	1.00	537	538
1.00	538	539	1.00	539	540	1.00	540	541	1.00	541	542
1.00	542	543	1.00	543	544	1.00	544	545	1.00	545	546
1.00	546	547	1.00	547	548	1.00	548	549	1.00	549	550
1.00	550	0									
0.640174	0.705743	0.959271	0.524617								
0.352590	0.506321	0.663391	0.742160								
0.509090	0.659402	0.530170	0.506202								
1	0	1	1	1	1						
6					*	+	*	+	*	+	E:BOUNDARIES
1.00	1.00				*	+	*	+	*	+	* Chem 1
1	2										
0.00	0.00	0.00	365.00								
550	2										
0.00	0.00	0.00	365.00								
551	2										
0.00	0.00	0.00	365.00								
709	2										
0.00	0.00	0.00	365.00								
710	2										
0.00	0.00	0.00	365.00								
711	2										
0.00	0.00	0.00	365.00								
6					*	+	*	+	*	+	E:BOUNDARIES
1.00	1.00				*	+	*	+	*	+	* Solids 1
1	2										
0.00	0.00	0.00	365.00								
550	2										
0.00	0.00	0.00	365.00								
551	2										
0.00	0.00	0.00	365.00								
709	2										
0.00	0.00	0.00	365.00								
710	2										
0.00	0.00	0.00	365.00								
711	2										
0.00	0.00	0.00	365.00								
555					*	+	*	+	*	+	(Chem 1) F:LOADS
555					*	+	*	+	*	+	(Solids 1) F:LOADS
.\INP\HH.NPS	*	*	+	*	(NPS)	F:LOADS					
0					*	+	*	+	*	+	G:PARAMETERS
GLOBALS	0				*	+	*	+	*	+	H:CONSTANTS
Chem1	0										
Solids1	0										
0					*	+	*	+	*	+	I:TIME FUNCTIONS

Chem 1				3	1.0E+4	+	j: initial con
1:	0.00	0.00	0.00	0.00	3:	0.00	0.00
4:	0.00	0.00	0.00	0.00	6:	0.00	0.00
7:	0.00	0.00	0.00	0.00	9:	0.00	0.00
10:	0.00	0.00	0.00	0.00	12:	0.00	0.00
13:	0.00	0.00	0.00	0.00	15:	0.00	0.00
16:	0.00	0.00	0.00	0.00	18:	0.00	0.00
19:	0.00	0.00	0.00	0.00	21:	0.00	0.00
22:	0.00	0.00	0.00	0.00	24:	0.00	0.00
25:	0.00	0.00	0.00	0.00	27:	0.00	0.00
28:	0.00	0.00	0.00	0.00	30:	0.00	0.00
31:	0.00	0.00	0.00	0.00	33:	0.00	0.00
34:	0.00	0.00	0.00	0.00	36:	0.00	0.00
37:	0.00	0.00	0.00	0.00	39:	0.00	0.00
40:	0.00	0.00	0.00	0.00	42:	0.00	0.00
43:	0.00	0.00	0.00	0.00	45:	0.00	0.00
46:	0.00	0.00	0.00	0.00	48:	0.00	0.00
49:	0.00	0.00	0.00	0.00	51:	0.00	0.00
52:	0.00	0.00	0.00	0.00	54:	0.00	0.00
55:	0.00	0.00	0.00	0.00	57:	0.00	0.00
58:	0.00	0.00	0.00	0.00	60:	0.00	0.00
61:	0.00	0.00	0.00	0.00	63:	0.00	0.00
64:	0.00	0.00	0.00	0.00	66:	0.00	0.00
67:	0.00	0.00	0.00	0.00	69:	0.00	0.00
70:	0.00	0.00	0.00	0.00	72:	0.00	0.00
73:	0.00	0.00	0.00	0.00	75:	0.00	0.00
76:	0.00	0.00	0.00	0.00	78:	0.00	0.00
79:	0.00	0.00	0.00	0.00	81:	0.00	0.00
82:	0.00	0.00	0.00	0.00	84:	0.00	0.00
85:	0.00	0.00	0.00	0.00	87:	0.00	0.00
88:	0.00	0.00	0.00	0.00	90:	0.00	0.00
91:	0.00	0.00	0.00	0.00	93:	0.00	0.00
94:	0.00	0.00	0.00	0.00	96:	0.00	0.00
97:	0.00	0.00	0.00	0.00	99:	0.00	0.00
100:	0.00	0.00	0.00	0.00	102:	0.00	0.00
103:	0.00	0.00	0.00	0.00	105:	0.00	0.00
106:	0.00	0.00	0.00	0.00	108:	0.00	0.00
109:	0.00	0.00	0.00	0.00	111:	0.00	0.00
112:	0.00	0.00	0.00	0.00	114:	0.00	0.00
115:	0.00	0.00	0.00	0.00	117:	0.00	0.00
118:	0.00	0.00	0.00	0.00	120:	0.00	0.00
121:	0.00	0.00	0.00	0.00	123:	0.00	0.00
124:	0.00	0.00	0.00	0.00	126:	0.00	0.00
127:	0.00	0.00	0.00	0.00	129:	0.00	0.00
130:	0.00	0.00	0.00	0.00	132:	0.00	0.00
133:	0.00	0.00	0.00	0.00	135:	0.00	0.00
136:	0.00	0.00	0.00	0.00	138:	0.00	0.00
139:	0.00	0.00	0.00	0.00	141:	0.00	0.00
142:	0.00	0.00	0.00	0.00	144:	0.00	0.00
145:	0.00	0.00	0.00	0.00	147:	0.00	0.00
148:	0.00	0.00	0.00	0.00	150:	0.00	0.00
151:	0.00	0.00	0.00	0.00	153:	0.00	0.00
154:	0.00	0.00	0.00	0.00	156:	0.00	0.00
157:	0.00	0.00	0.00	0.00	159:	0.00	0.00
160:	0.00	0.00	0.00	0.00	162:	0.00	0.00
163:	0.00	0.00	0.00	0.00	165:	0.00	0.00
166:	0.00	0.00	0.00	0.00	168:	0.00	0.00
169:	0.00	0.00	0.00	0.00	171:	0.00	0.00
172:	0.00	0.00	0.00	0.00	174:	0.00	0.00
175:	0.00	0.00	0.00	0.00	177:	0.00	0.00
178:	0.00	0.00	0.00	0.00	180:	0.00	0.00
181:	0.00	0.00	0.00	0.00	183:	0.00	0.00
184:	0.00	0.00	0.00	0.00	186:	0.00	0.00
187:	0.00	0.00	0.00	0.00	189:	0.00	0.00
190:	0.00	0.00	0.00	0.00	192:	0.00	0.00
193:	0.00	0.00	0.00	0.00	195:	0.00	0.00
196:	0.00	0.00	0.00	0.00	198:	0.00	0.00
199:	0.00	0.00	0.00	0.00	201:	0.00	0.00
202:	0.00	0.00	0.00	0.00	204:	0.00	0.00
205:	0.00	0.00	0.00	0.00	207:	0.00	0.00
208:	0.00	0.00	0.00	0.00	210:	0.00	0.00
211:	0.00	0.00	0.00	0.00	213:	0.00	0.00
214:	0.00	0.00	0.00	0.00	216:	0.00	0.00
217:	0.00	0.00	0.00	0.00	219:	0.00	0.00
220:	0.00	0.00	0.00	0.00	222:	0.00	0.00
223:	0.00	0.00	0.00	0.00	225:	0.00	0.00
226:	0.00	0.00	0.00	0.00	228:	0.00	0.00
229:	0.00	0.00	0.00	0.00	231:	0.00	0.00
232:	0.00	0.00	0.00	0.00	234:	0.00	0.00
235:	0.00	0.00	0.00	0.00	237:	0.00	0.00

238:	0.00	0.00	239:	0.00	0.00	240:	0.00	0.00
241:	0.00	0.00	242:	0.00	0.00	243:	0.00	0.00
244:	0.00	0.00	245:	0.00	0.00	246:	0.00	0.00
247:	0.00	0.00	248:	0.00	0.00	249:	0.00	0.00
250:	0.00	0.00	251:	0.00	0.00	252:	0.00	0.00
253:	0.00	0.00	254:	0.00	0.00	255:	0.00	0.00
256:	0.00	0.00	257:	0.00	0.00	258:	0.00	0.00
259:	0.00	0.00	260:	0.00	0.00	261:	0.00	0.00
262:	0.00	0.00	263:	0.00	0.00	264:	0.00	0.00
265:	0.00	0.00	266:	0.00	0.00	267:	0.00	0.00
268:	0.00	0.00	269:	0.00	0.00	270:	0.00	0.00
271:	0.00	0.00	272:	0.00	0.00	273:	0.00	0.00
274:	0.00	0.00	275:	0.00	0.00	276:	0.00	0.00
277:	0.00	0.00	278:	0.00	0.00	279:	0.00	0.00
280:	0.00	0.00	281:	0.00	0.00	282:	0.00	0.00
283:	0.00	0.00	284:	0.00	0.00	285:	0.00	0.00
286:	0.00	0.00	287:	0.00	0.00	288:	0.00	0.00
289:	0.00	0.00	290:	0.00	0.00	291:	0.00	0.00
292:	0.00	0.00	293:	0.00	0.00	294:	0.00	0.00
295:	0.00	0.00	296:	0.00	0.00	297:	0.00	0.00
298:	0.00	0.00	299:	0.00	0.00	300:	0.00	0.00
301:	0.00	0.00	302:	0.00	0.00	303:	0.00	0.00
304:	0.00	0.00	305:	0.00	0.00	306:	0.00	0.00
307:	0.00	0.00	308:	0.00	0.00	309:	0.00	0.00
310:	0.00	0.00	311:	0.00	0.00	312:	0.00	0.00
313:	0.00	0.00	314:	0.00	0.00	315:	0.00	0.00
316:	0.00	0.00	317:	0.00	0.00	318:	0.00	0.00
319:	0.00	0.00	320:	0.00	0.00	321:	0.00	0.00
322:	0.00	0.00	323:	0.00	0.00	324:	0.00	0.00
325:	0.00	0.00	326:	0.00	0.00	327:	0.00	0.00
328:	0.00	0.00	329:	0.00	0.00	330:	0.00	0.00
331:	0.00	0.00	332:	0.00	0.00	333:	0.00	0.00
334:	0.00	0.00	335:	0.00	0.00	336:	0.00	0.00
337:	0.00	0.00	338:	0.00	0.00	339:	0.00	0.00
340:	0.00	0.00	341:	0.00	0.00	342:	0.00	0.00
343:	0.00	0.00	344:	0.00	0.00	345:	0.00	0.00
346:	0.00	0.00	347:	0.00	0.00	348:	0.00	0.00
349:	0.00	0.00	350:	0.00	0.00	351:	0.00	0.00
352:	0.00	0.00	353:	0.00	0.00	354:	0.00	0.00
355:	0.00	0.00	356:	0.00	0.00	357:	0.00	0.00
358:	0.00	0.00	359:	0.00	0.00	360:	0.00	0.00
361:	0.00	0.00	362:	0.00	0.00	363:	0.00	0.00
364:	0.00	0.00	365:	0.00	0.00	366:	0.00	0.00
367:	0.00	0.00	368:	0.00	0.00	369:	0.00	0.00
370:	0.00	0.00	371:	0.00	0.00	372:	0.00	0.00
373:	0.00	0.00	374:	0.00	0.00	375:	0.00	0.00
376:	0.00	0.00	377:	0.00	0.00	378:	0.00	0.00
379:	0.00	0.00	380:	0.00	0.00	381:	0.00	0.00
382:	0.00	0.00	383:	0.00	0.00	384:	0.00	0.00
385:	0.00	0.00	386:	0.00	0.00	387:	0.00	0.0

Solids 1

4:	0.00	0.00	5:	0.00	0.00	6:	0.00	0.00
7:	0.00	0.00	8:	0.00	0.00	9:	0.00	0.00
10:	0.00	0.00	11:	0.00	0.00	12:	0.00	0.00
13:	0.00	0.00	14:	0.00	0.00	15:	0.00	0.00
16:	0.00	0.00	17:	0.00	0.00	18:	0.00	0.00
19:	0.00	0.00	20:	0.00	0.00	21:	0.00	0.00
22:	0.00	0.00	23:	0.00	0.00	24:	0.00	0.00
25:	0.00	0.00	26:	0.00	0.00	27:	0.00	0.00
28:	0.00	0.00	29:	0.00	0.00	30:	0.00	0.00
31:	0.00	0.00	32:	0.00	0.00	33:	0.00	0.00
34:	0.00	0.00	35:	0.00	0.00	36:	0.00	0.00
37:	0.00	0.00	38:	0.00	0.00	39:	0.00	0.00
40:	0.00	0.00	41:	0.00	0.00	42:	0.00	0.00
43:	0.00	0.00	44:	0.00	0.00	45:	0.00	0.00
46:	0.00	0.00	47:	0.00	0.00	48:	0.00	0.00
49:	0.00	0.00	50:	0.00	0.00	51:	0.00	0.00
52:	0.00	0.00	53:	0.00	0.00	54:	0.00	0.00
55:	0.00	0.00	56:	0.00	0.00	57:	0.00	0.00
58:	0.00	0.00	59:	0.00	0.00	60:	0.00	0.00
61:	0.00	0.00	62:	0.00	0.00	63:	0.00	0.00
64:	0.00	0.00	65:	0.00	0.00	66:	0.00	0.00
67:	0.00	0.00	68:	0.00	0.00	69:	0.00	0.00
70:	0.00	0.00	71:	0.00	0.00	72:	0.00	0.00
73:	0.00	0.00	74:	0.00	0.00	75:	0.00	0.00
76:	0.00	0.00	77:	0.00	0.00	78:	0.00	0.00
79:	0.00	0.00	80:	0.00	0.00	81:	0.00	0.00
82:	0.00	0.00	83:	0.00	0.00	84:	0.00	0.00
85:	0.00	0.00	86:	0.00	0.00	87:	0.00	0.00
88:	0.00	0.00	89:	0.00	0.00	90:	0.00	0.00
91:	0.00	0.00	92:	0.00	0.00	93:	0.00	0.00
94:	0.00	0.00	95:	0.00	0.00	96:	0.00	0.00
97:	0.00	0.00	98:	0.00	0.00	99:	0.00	0.00
100:	0.00	0.00	101:	0.00	0.00	102:	0.00	0.00
103:	0.00	0.00	104:	0.00	0.00	105:	0.00	0.00
106:	0.00	0.00	107:	0.00	0.00	108:	0.00	0.00
109:	0.00	0.00	110:	0.00	0.00	111:	0.00	0.00
112:	0.00	0.00	113:	0.00	0.00	114:	0.00	0.00
115:	0.00	0.00	116:	0.00	0.00	117:	0.00	0.00
118:	0.00	0.00	119:	0.00	0.00	120:	0.00	0.00
121:	0.00	0.00	122:	0.00	0.00	123:	0.00	0.00
124:	0.00	0.00	125:	0.00	0.00	126:	0.00	0.00
127:	0.00	0.00	128:	0.00	0.00	129:	0.00	0.00
130:	0.00	0.00	131:	0.00	0.00	132:	0.00	0.00
133:	0.00	0.00	134:	0.00	0.00	135:	0.00	0.00
136:	0.00	0.00	137:	0.00	0.00	138:	0.00	0.00
139:	0.00	0.00	140:	0.00	0.00	141:	0.00	0.00
142:	0.00	0.00	143:	0.00	0.00	144:	0.00	0.00
145:	0.00	0.00	146:	0.00	0.00	147:	0.00	0.00
148:	0.00	0.00	149:	0.00	0.00	150:	0.00	0.00
151:	0.00	0.00	152:	0.00	0.00	153:	0.00	0.00
154:	0.00	0.00	155:	0.00	0.00	156:	0.00	0.00
157:	0.00	0.00	158:	0.00	0.00	159:	0.00	0.00
160:	0.00	0.00	161:	0.00	0.00	162:	0.00	0.00
163:	0.00	0.00	164:	0.00	0.00	165:	0.00	0.00
166:	0.00	0.00	167:	0.00	0.00	168:	0.00	0.00
169:	0.00	0.00	170:	0.00	0.00	171:	0.00	0.00
172:	0.00	0.00	173:	0.00	0.00	174:	0.00	0.00
175:	0.00	0.00	176:	0.00	0.00	177:	0.00	0.00
178:	0.00	0.00	179:	0.00	0.00	180:	0.00	0.00
181:	0.00	0.00	182:	0.00	0.00	183:	0.00	0.00
184:	0.00	0.00	185:	0.00	0.00	186:	0.00	0.00
187:	0.00	0.00	188:	0.00	0.00	189:	0.00	0.00
190:	0.00	0.00	191:	0.00	0.00	192:	0.00	0.00
193:	0.00	0.00	194:	0.00	0.00	195:	0.00	0.00
196:	0.00	0.00	197:	0.00	0.00	198:	0.00	0.00
199:	0.00	0.00	200:	0.00	0.00	201:	0.00	0.00
202:	0.00	0.00	203:	0.00	0.00	204:	0.00	0.00
205:	0.00	0.00	206:	0.00	0.00	207:	0.00	0.00
208:	0.00	0.00	209:	0.00	0.00	210:	0.00	0.00
211:	0.00	0.00	212:	0.00	0.00	213:	0.00	0.00
214:	0.00	0.00	215:	0.00	0.00	216:	0.00	0.00
217:	0.00	0.00	218:	0.00	0.00	219:	0.00	0.00
220:	0.00	0.00	221:	0.00	0.00	222:	0.00	0.00
223:	0.00	0.00	224:	0.00	0.00	225:	0.00	0.00
226:	0.00	0.00	227:	0.00	0.00	228:	0.00	0.00
229:	0.00	0.00	230:	0.00	0.00	231:	0.00	0.00
232:	0.00	0.00	233:	0.00	0.00	234:	0.00	0.00
235:	0.00	0.00	236:	0.00	0.00	237:	0.00	0.00
238:	0.00	0.00	239:	0.00	0.00	240:	0.00	0.00
241:	0.00	0.00	242:	0.00	0.00	243:	0.00	0.00

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Input File: HH.NPS

Houtfall to 4mb 1 1 1

555

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SOLID 1

1.0

SOLID 1 0.0000

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June 1998

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