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STREAM2 Revision 1: An Aqueous Release Emergency Response Model

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ABSTRACT

This report documents the revision for STREAM2 code and its input files. STREAM2 is an aqueous transport module of the WIND system. As requested by the Emergency Response Department, two surface aqueous release locations (McQueen Branch and Tims Branch) were added in the STREAM2 code. In addition, the revised STREAM2 has the capability to vary the channel-segment volume based on channel flow to better represent the open channel hydraulics. Thus, the updated version of STREAM2 improves the contaminant transport calculation.

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1 Introduction

STREAM2 [1], an aqueous transport module of the Weather Information and Display (WIND) system [2] at the Savannah River Site (SRS), has been upgraded. This upgrade adds the capability to simulate contaminant transport for releases to McQueen Branch and Tims Branch, as requested by the SRS Emergency Response Department. In addition, the upgraded STREAM2 has the capability to vary the channel-segment volume according to channel flow to better represent the open channel hydraulics. Thus, the updated version of STREAM2 improves the contaminant transport calculation.

2 Improvement for Open Channel Hydraulics Representation

In general, two procedures are involved to calculate pollutant transport through streams. The first procedure uses an open channel hydraulics model to calculate the flow velocities and water elevations of the stream based on the flow and stream characteristics (cross section shape, slope, and roughness). The channel segment volume for a particular flow is determined from the channel cross-section shape, the water elevation, and the channel segment length. The second procedure involves a transport model that uses the flow and the channel segment volume to calculate the spatial and temporal pollutant concentration distribution through the stream. It would be very time consuming and not practical for emergency response to perform the hydraulics simulation and then the transport simulation. Therefore, STREAM2 performs only the transport simulation. Previously, the channel segment volumes, one of the STREAM2 input variables, were pre-determined based on dye studies. However, this could introduce errors when the flows were significantly different from those when the dye studies were conducted. To address this deficiency, the upgraded STREAM2 adjusts the channel segment volumes according to the channel flow. The implementation method is presented next.

Step 1. DYNHYD5 [3], a U.S. Environmental Protection Agency (EPA) one-dimensional open channel hydrodynamics model, was used to calculate channel flow cross-section areas for a given stream (channel geometry, slope, and roughness) at various flow conditions. The segment volumes that are used by the STREAM2 code are obtained by multiplying the cross-section areas by the segment length.

Step 2. A function that describes the relationship between the segment volume and flow for the particular stream was developed by a curve fitting method using the data (segment volume vs. flow) obtained from Step 1.

Step 3. The function from Step 2 was implemented in the STREAM2 code and the segment volumes used in the transport calculation were adjusted according to the channel flow.

2.1 DYNHYD Model

DYNHYD is maintained by the EPA and is in the public domain. DYNHYD, a one-dimensional hydrodynamic model, solves a system of conservation of momentum and mass equations describing the propagation of long waves through a shallow water system. The data required by DYNHYD to perform a simulation for a particular inlet flow and downstream water elevation are channel geometry, slope, and roughness.

For Savannah River simulations, the channel geometry was estimated from U.S. Army Corps of Engineers Navigation Charts for the Savannah River below Augusta. The river bottom slope was estimated from U.S. Geological Survey (USGS) 7.5-minute scale topographic maps and Navigation Charts. The roughness was adjusted to match the model travel time (distance divided by velocity) with the EPA 1990 and 1991 dye studies [3]. Flows used in simulations varied from 370 cfs (107 m^3/s) to 49200 cfs (1393 m^3/s), covering the range of measured flow from January 1, 1986 to December 31, 1995 at gauge station 02197000. The channel geometry, slope, and roughness for the Upper Three Runs, McQueen Branch, Tims Branch and Fourmile Branch were estimated from the data provided by Timothy H. Lanier of the USGS, Columbia, South Carolina Office [4 and 5]. Flows used in simulation for the Upper Three Runs Creek variy from 85 cfs (2.4 m^3/s) to 1740 cfs (49 m^3/s), covering the range of measured flows from January 1, 1986 to December 31, 1995 at gauge station 02197310. Flows for the Fourmile Branch vary from 2.8 cfs (0.08 m^3/s) to 1200 cfs (34 m^3/s), covering the range of measured flows from January 1, 1990 to December 31, 1995 at gauge station 02197342. Flows for the McQueen Branch vary from 0.35 cfs (0.01 m^3/s) to 53 cfs (1.5 m^3/s), covering 95 percent of the measured flows from January 1, 1991 to December 31, 1995 at gauge station 021973008. The remaining 5% of the measured data are flows less than 0.35 cfs. Flows for the Tims Branch vary from 3.5 cfs (0.1 m^3/s) to 92 cfs (2.6 m^3/s), covering 95 percent of the measured flows from January 1, 1990 to December 31, 1995 at gauge station 02197309. The remaining 5% of the measured data are flows less than 3.5 cfs.

Figures 1 through 5 show the functional relationship between the channel segment volumes and the channel flows for the Savannah River, Upper Three Runs Creek, McQueen Branch, Tims Branch, and Fourmile Branch, respectively. The curves for Pen Branch, Steel Creek, and Lower Three Runs Creek are of lower priority and will be developed later.

3 STREAM2 Input Files

3.1 McQueen Branch

The headwaters of McQueen Branch are near the SRS H-Area. McQueen Branch has a drainage area of 4.4 square miles. It flows north into Tinker Creek, just at its intersection with Upper Three Runs Creek. The stream valley is V-shaped, with relatively steep sides and little floodplain. The hilltops within the drainage basin are gently sloping. The pathway for releases to McQueen Branch includes McQueen Branch, Upper Three Runs Creek, and the Savannah River. Figure 6 depicts this

system. McQueen Branch in Figure 6 was divided into 9 segments, each with a segment length of 500 meters and a cross-sectional area of 0.21126 m^2. The segment volume is 105.63 m^3, corresponding to a flow of 0.03 m^3/s. As discussed in Section 2, the channel segment volumes are adjusted internally according to flows. Figure 7 depicts the schematic for the finite difference model.

3.2 Tims Branch

Tims Branch, a tributary of Upper Three Runs Creek, has a drainage area of 22.5 square miles. Tims Branch receives effluents from M-Area and A-Area. The stream flows south-southeast and discharges into Upper Three Runs Creek near Road C. Tims Branch has a gradient ranging from 10 to 30 feet per mile. The valley is V-shaped, and the sides vary from steep to gently sloping. The pathways for releases to Tims Branch include Tims Branch, Upper Three Runs Creek and the Savannah River. Figure 8 depicts this river system. Tims Branch in Figure 8 was divided into 18 segments, each with a segment length of 500 meters and a cross-sectional area of 0.66798 m^2. The segment volume is 333.99 m^3, corresponding to a flow of 0.172 m^3/s. As discussed in Section 2, the channel segment volumes are adjusted internally according to flows. Figure 9 depicts the schematic for the finite difference model.

3.3 Input Flows

The 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 time interval used for the onsite streams is shorter to exclude the influence of SRS production reactor discharge flows. The interval of the measured data for onsite streams is from January 1, 1990 to December 31, 1995.

4 Revised Input Manual

Appendix 1 presents the revised input manual. The revision was made to the Record 3 of Data Group C. Two input fields (ITR and IRR) were added in Record 3 to indicate the stream identification and the number of tributaries upstream of the segment volume, as described in Appendix 1. The remaining parts of the input manual were not changed. The sequence of input flow (Data Group D) is tributaries first and then the Savannah River. The tributaries should be from upstream to downstream. Figure A-2.1 in Appendix 2 shows the input example for variables ITY and IRR. Appendix 2 also presents an input file to model the transport of pollutant released from A-Area to Tims Branch.

5 References

1. Chen, Kuo-Fu, "STREAM2 for SRS Aqueous Release Emergency Response (U)," WSRC-TR-98-00234, Savannah River Site, June 1998.

2. Hunter, C. H., "Weather Information and Display (WIND) System User's Manual," WSRC-TM-90-14, Savannah River Site, 1990.

3. Chen, Kuo-Fu, "Revised STREAM Code and WASP5 Benchmark (U)," WSRC-RP-95-598, May 1995.

4. Lanier, T. H., "Determination of the 100-Year Flood Plain on Upper Three Runs and Selected Tributaries, and the Savannah River at the Savannah River Site, South Carolina, 1995," USGS Water-Resources Investigation Report 96-4014, 1996.

5. Lanier, T. H., "Determination of the 100-Year Flood Plain on Fourmile Branch at the Savannah River Site, South Carolina, 1996," USGS Water-Resources Investigation Report 96-4271, 1997.

Figure 1. Calculated Savannah River Segment Volume as a Function of Flow Segment Length: 500 Meters

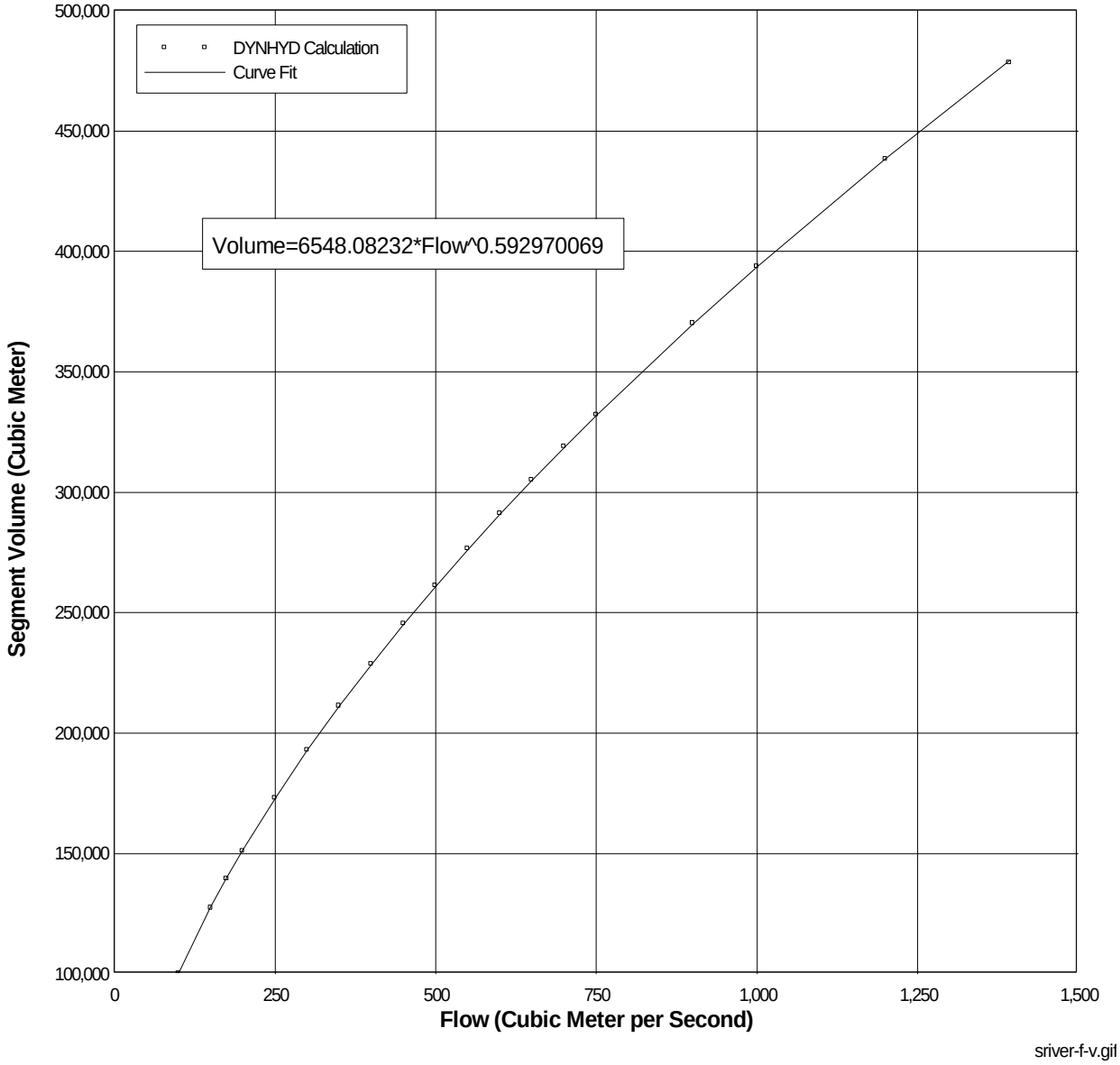


Figure 2. Calculated Upper Three Runs Segment Volume as a Function of Flow Segment Length: 500 Meters

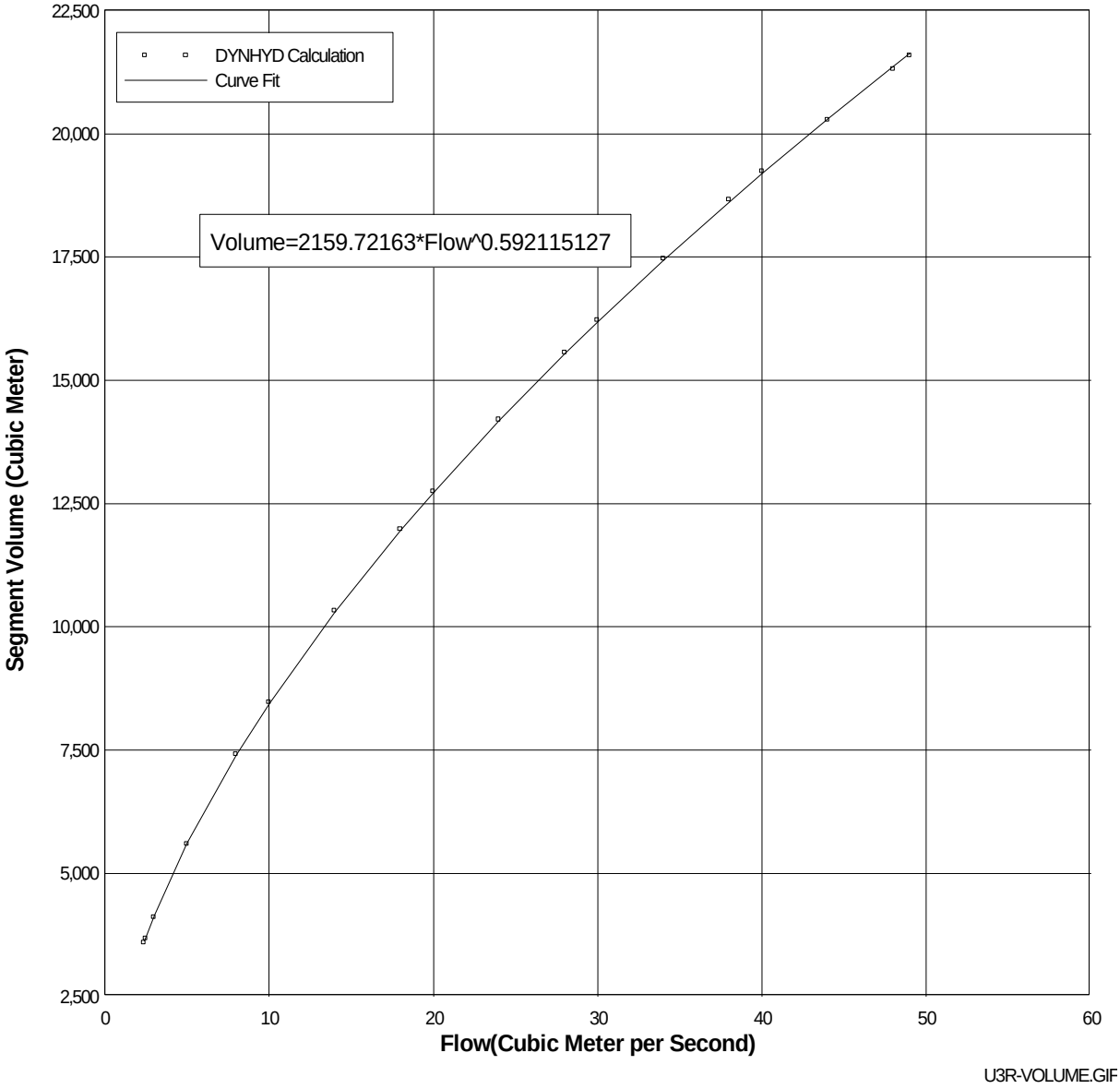


Figure 3. Calculated McQueen Branch Segment Volume as a Function of Flow Segment Length: 150 Meters

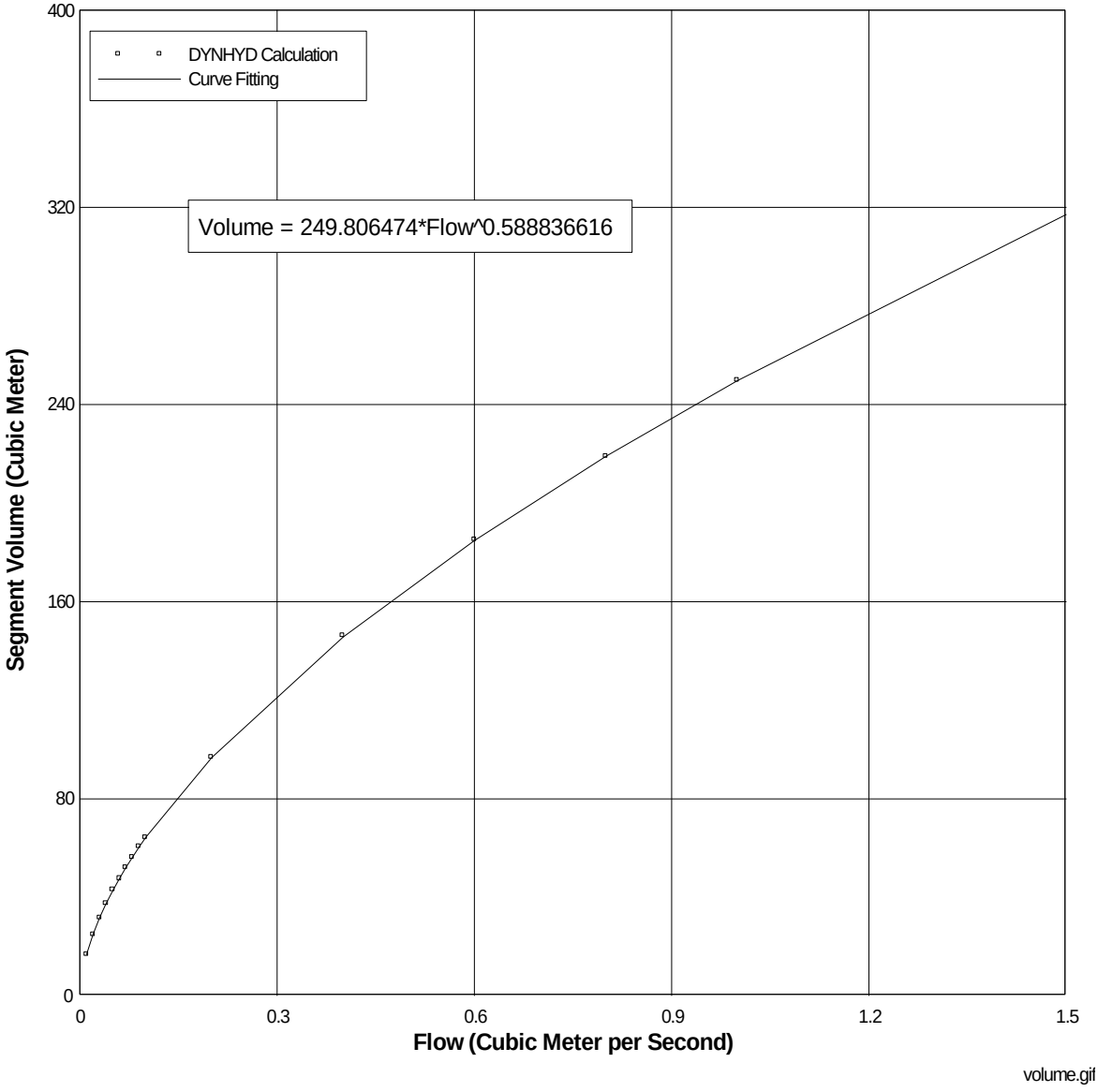


Figure 4. Calculated Tims Branch Segment Volume as a Function of Flow Segment Length: 500 Meters

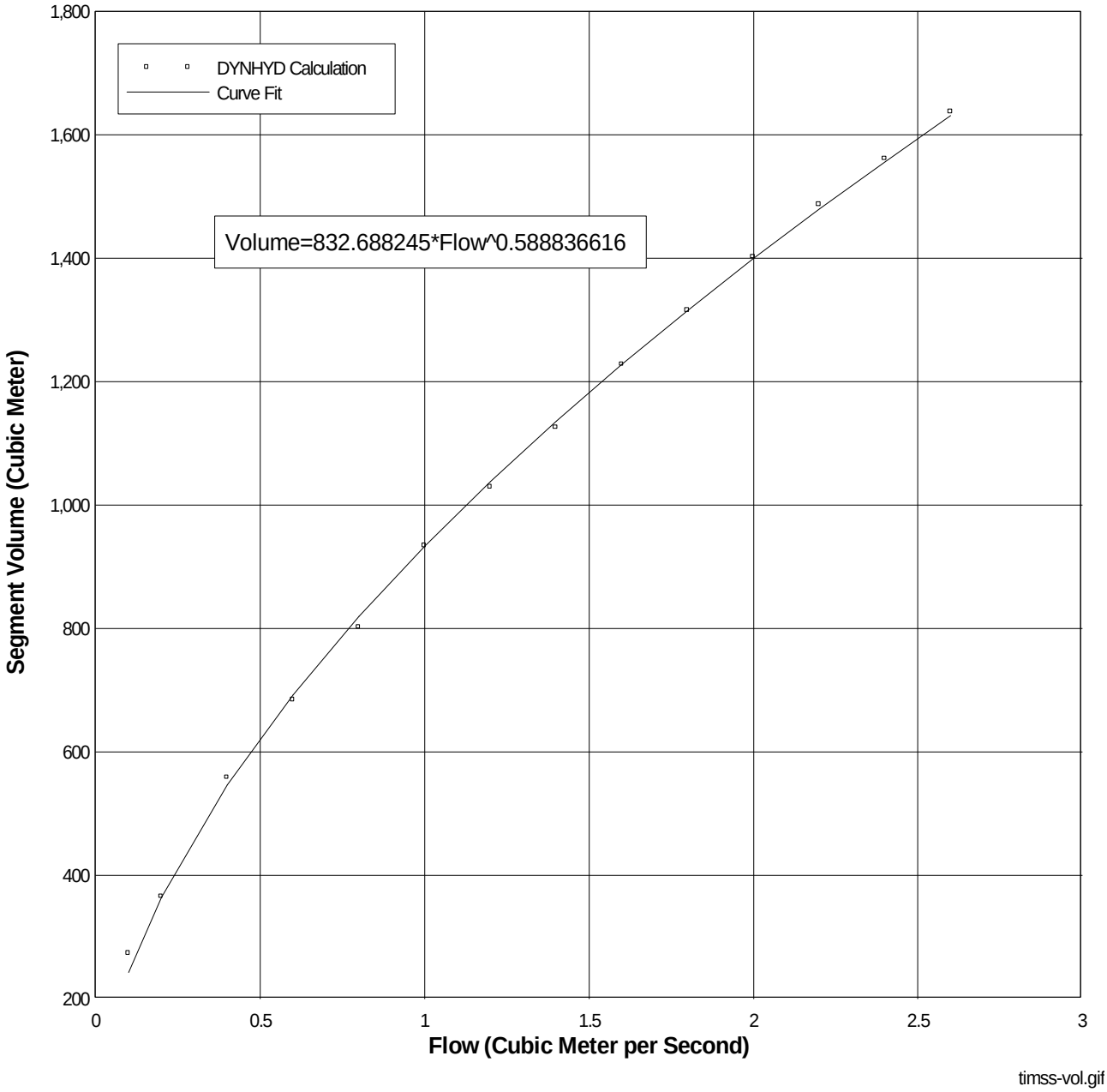


Figure 5. Calculated Fourmile Branch Segment Volume as a Function of Flow Segment Length: 150 Meters

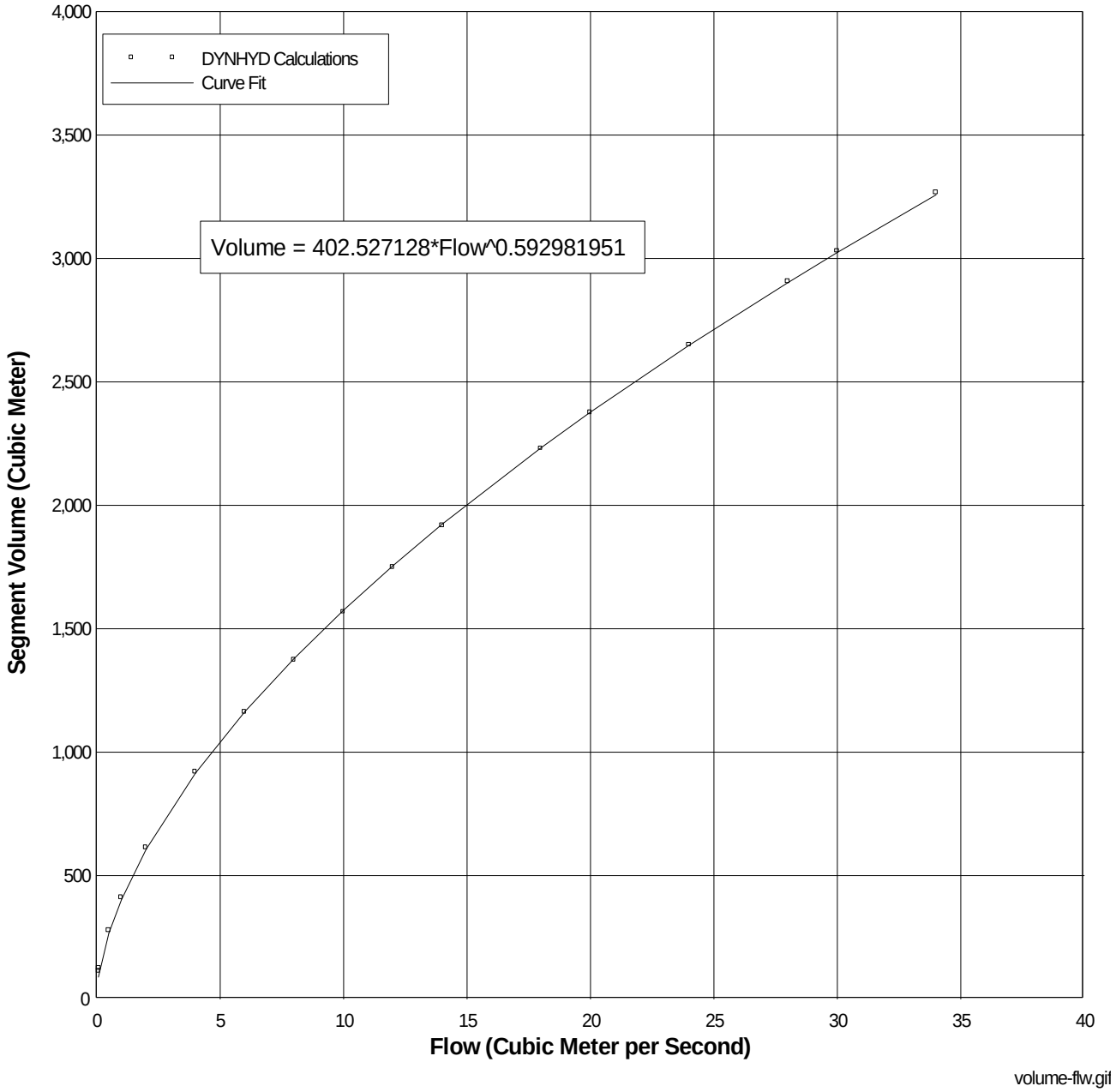


Figure 6. McQueen Branch

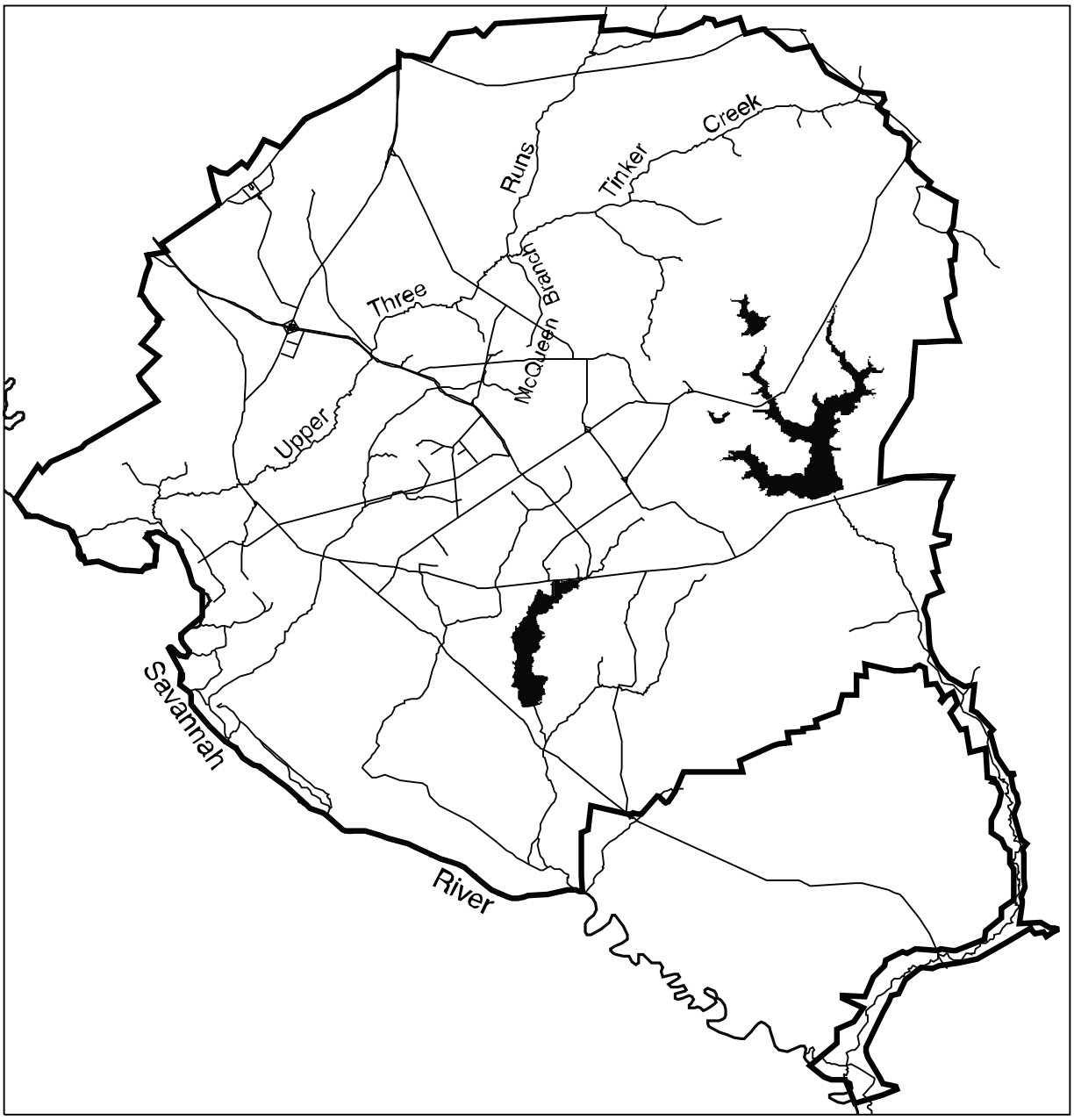


Figure 7. Model Schematics for McQueen Branch (not to scale)

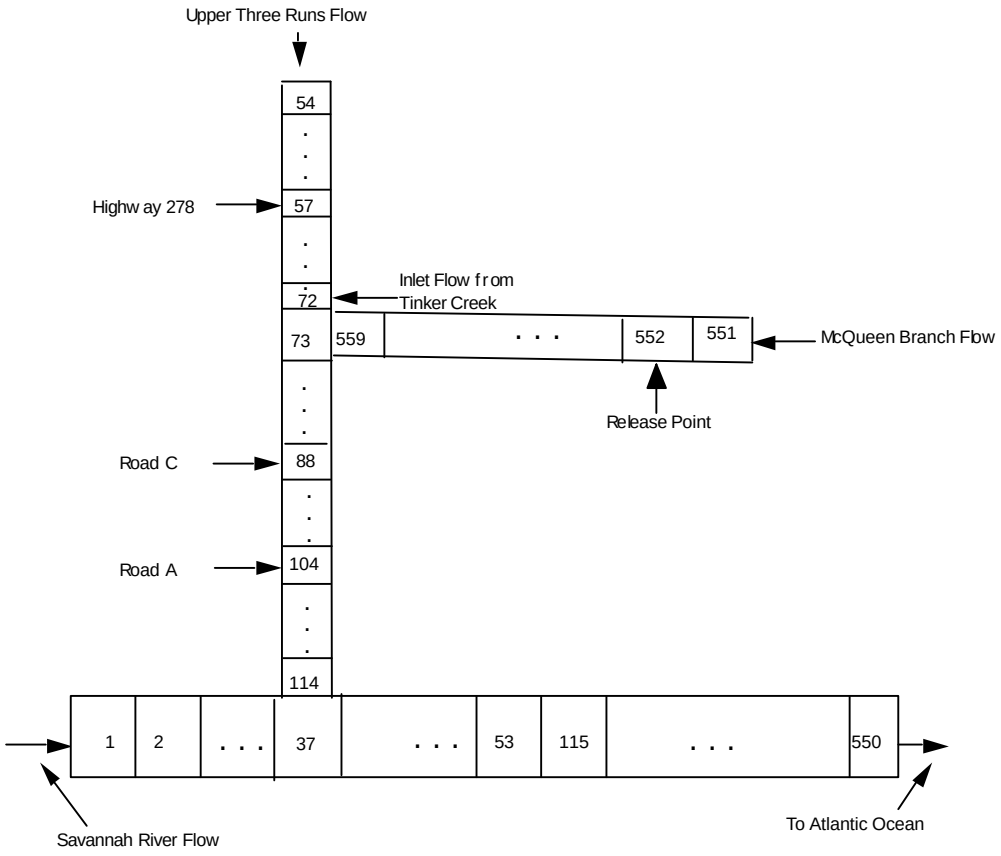


Figure 8 Tims Branch

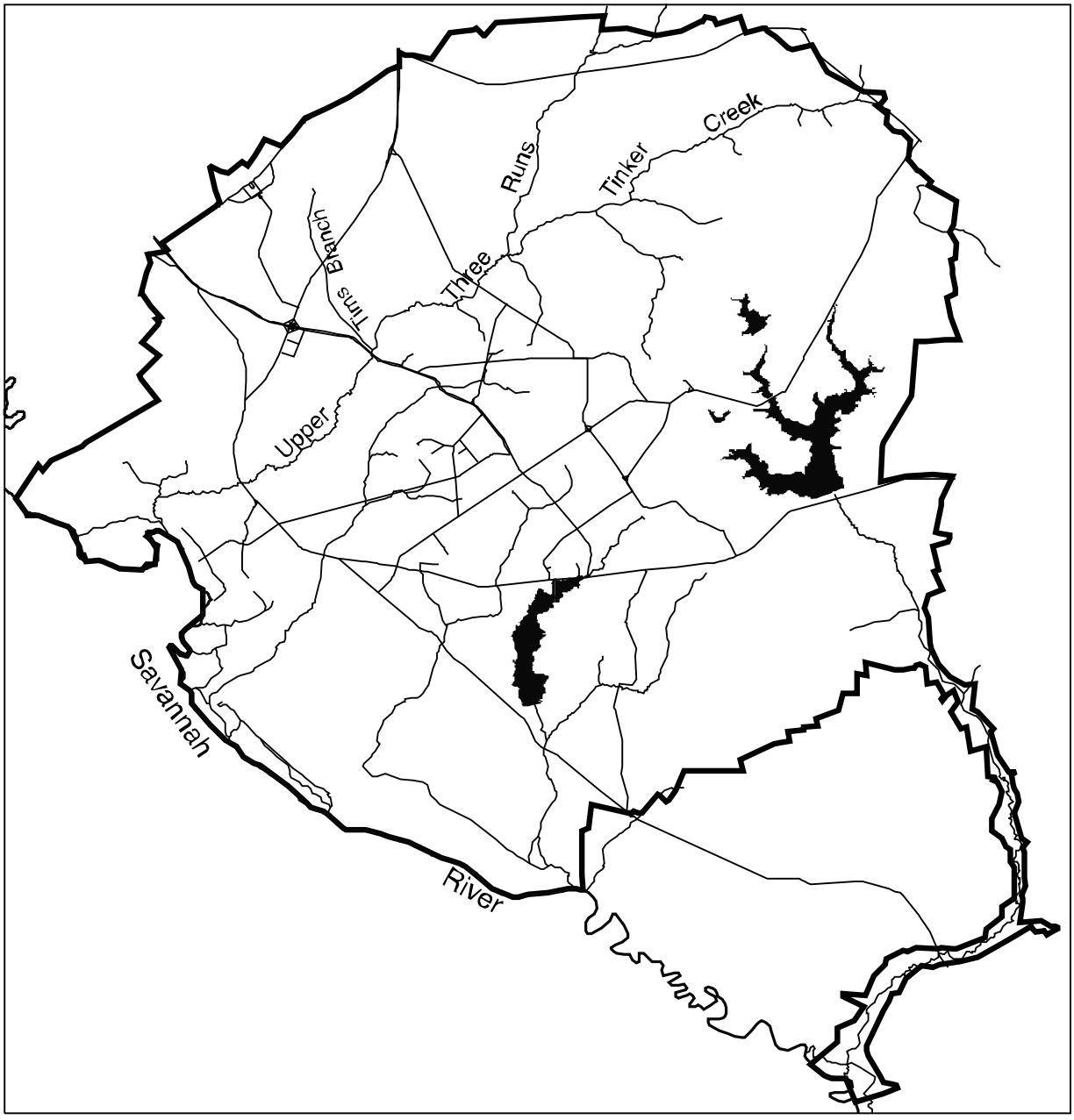
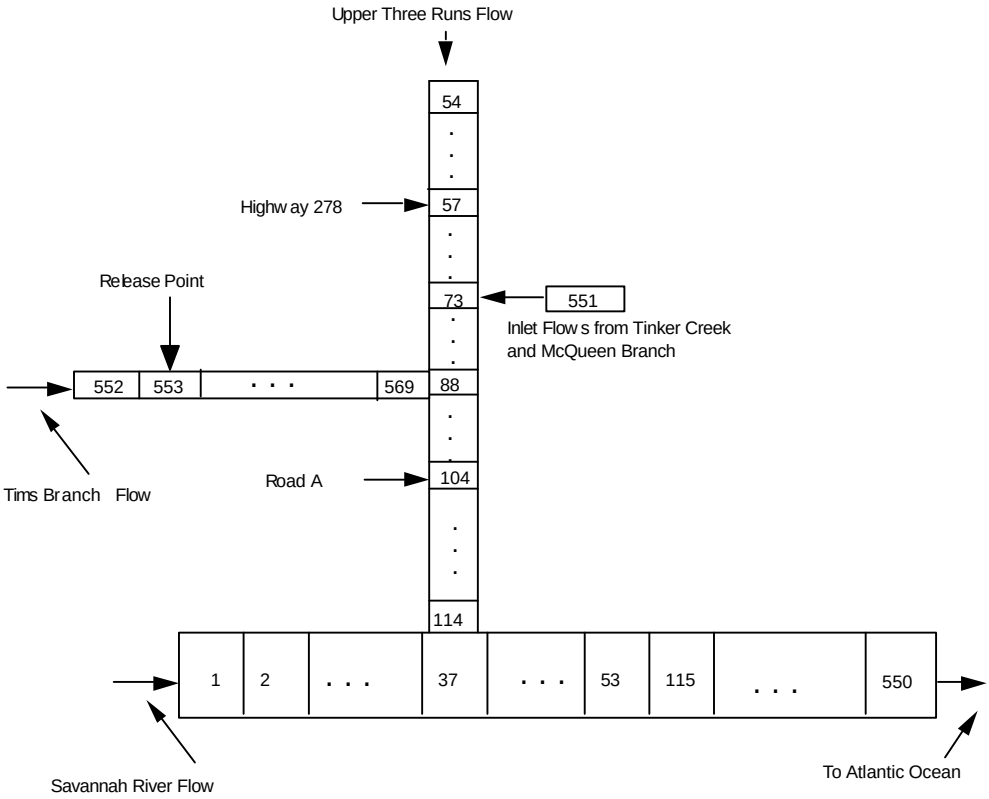


Figure 9 Model Schematics for Tims Branch (not to scale)



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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)

RBY(K)* = RBY(1)=1 and RBY(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 (5I6,5F10.0)

ISEG	=	segment number. (I6)
IBOTSG	=	segment immediately below ISEG. (I6)
ITYPE(ISEG)*	=	segment types: 1 = surface water segment. (I6)
ITY	=	segment's stream type used to associate with the function to

perform segment volume adjustment according to flow: (I6)
1 = Savannah River
2 = Upper Three Runs
3 = McQueen Branch
4 = Tims Branch
5 = Beaver Dam Creek
6 = Fourmile Branch
7 = Pen Branch
8 = Steel Creek
9 = Lower Three Runs

IRR = number of tributaries upstream of the channel segment. IRR is used to determine the total flow through the segment and then the flow is used to adjust the segment volume accordingly. If IRR is 9999 then no volume adjustment will be performed for that segment. It is used for the segment representing the tributary to provide means to input flow to the main stream; this segment has nothing to do with the pollutant transport calculation. (I6)

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. Figure A-2.1 in Appendix 2 shows the input example for variables ITY and IRR.

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 m^3/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. The sequence of flow time functions input starts with tributaries from upstream to downstream and ends with followed by the Savannah River.

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/m^3), 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)

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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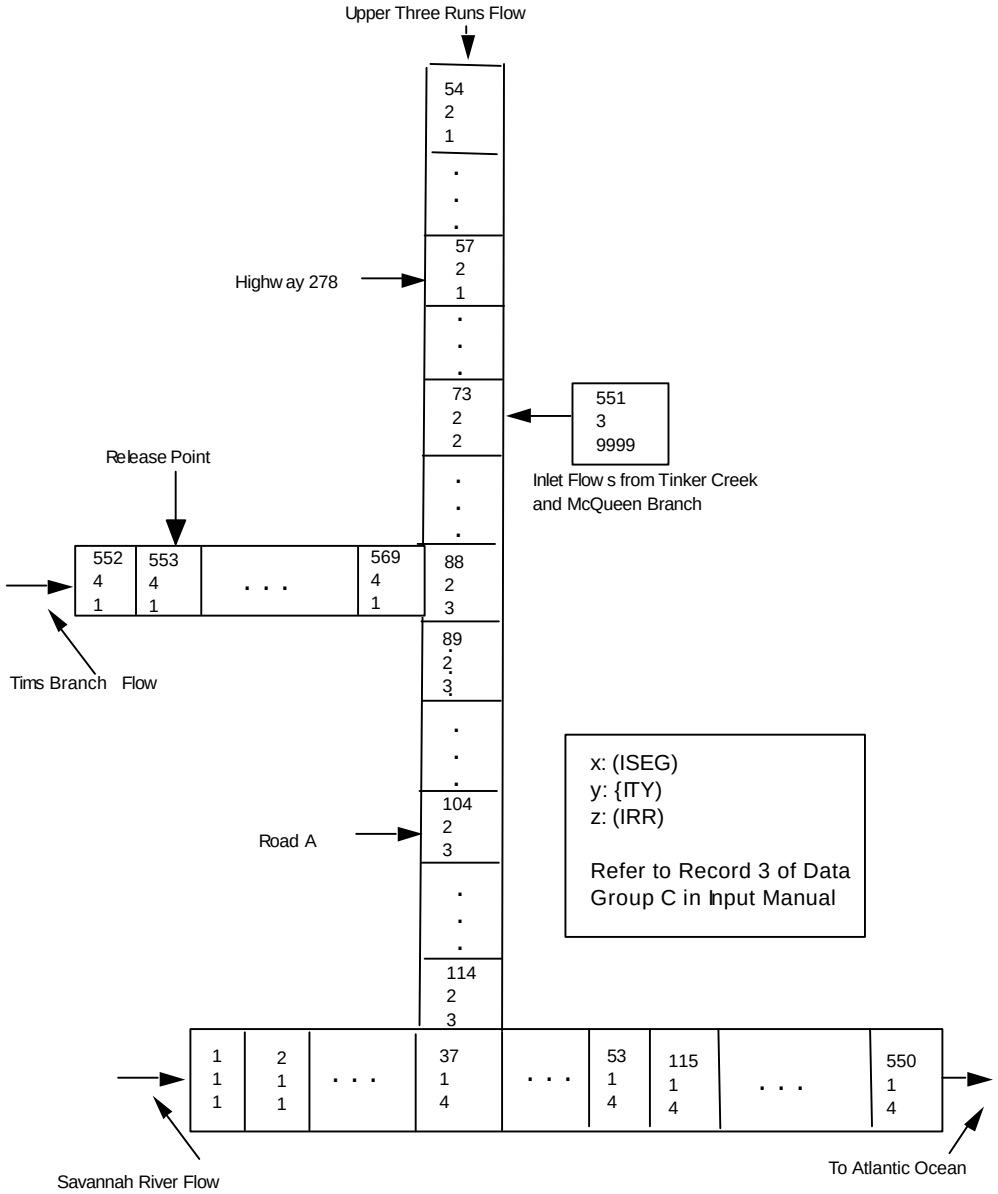
Appendix 2 Input Example

Figure A-2.1 Example for Record 3 of Data Group C Input
(Release from A-Area to Tims Branch)



```
RELEASE from A-Area to Tims Branch
USING ARMY CORPS OF ENGINEERING MILES  Flows are function of month
 NSEG NSYS ICRD MFLG JMAS NSLN INTY ADFC   DD HHMM               A:MODEL
OPTIONS
  569    2    0    1    2    0    1  0.0    0 0000    1
   88   37  222  406  478  511
    1
    0.0064      10.0
    3
      0.01      0.00      0.01       3.0      0.02      20.0
    1    0    1    1    1    1
    1                        *    +    *    +    *    +    *    +
B:EXCHANGES
    5      1.00     1.000
  490
   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
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277.966     500.0  536  537
277.966     500.0  537  538
277.966     500.0  538  539
277.966     500.0  539  540
277.966     500.0  540  541
277.966     500.0  541  542
277.966     500.0  542  543
277.966     500.0  543  544
277.966     500.0  544  545
277.966     500.0  545  546
277.966     500.0  546  547
277.966     500.0  547  548
277.966     500.0  548  549
277.966     500.0  549  550
```

```
277.966     250.0  550  0
 2
   15.0        0.      15.0      20.0
19
11.0369     250.0    0   54
11.0369     500.0   54   55
11.0369     500.0   55   56
11.0369     500.0   56   57
11.0369     500.0   57   58
11.0369     500.0   58   59
11.0369     500.0   59   60
11.0369     500.0   60   61
11.0369     500.0   61   62
11.0369     500.0   62   63
11.0369     500.0   63   64
11.0369     500.0   64   65
11.0369     500.0   65   66
11.0369     500.0   66   67
11.0369     500.0   67   68
11.0369     500.0   68   69
11.0369     500.0   69   70
11.0369     500.0   70   71
11.0369     500.0   71   72
 2
    0.0        0.       0.0      20.0
43
30.0000     500.0   72   73
30.0000     500.0   73   74
30.0000     500.0   74   75
30.0000     500.0   75   76
30.0000     500.0   76   77
30.0000     500.0   77   78
30.0000     500.0   78   79
30.0000     500.0   79   80
30.0000     500.0   80   81
30.0000     500.0   81   82
30.0000     500.0   82   83
30.0000     500.0   83   84
30.0000     500.0   84   85
30.0000     500.0   85   86
30.0000     500.0   86   87
30.0000     500.0   87   88
30.0000     500.0   88   89
30.0000     500.0   89   90
30.0000     500.0   90   91
30.0000     500.0   91   92
30.0000     500.0   92   93
30.0000     500.0   93   94
30.0000     500.0   94   95
30.0000     500.0   95   96
30.0000     500.0   96   97
30.0000     500.0   97   98
30.0000     500.0   98   99
30.0000     500.0   99  100
30.0000     500.0  100  101
30.0000     500.0  101  102
30.0000     500.0  102  103
30.0000     500.0  103  104
30.0000     500.0  104  105
30.0000     500.0  105  106
30.0000     500.0  106  107
30.0000     500.0  107  108
30.0000     500.0  108  109
```

```
   30.0000     500.0  109  110
   30.0000     500.0  110  111
   30.0000     500.0  111  112
   30.0000     500.0  112  113
   30.0000     500.0  113  114
   30.0000     500.0  114   37
    2
       1.5        0.       1.5      20.0
    2
   11.0369     250.0    0  551
   11.0369     500.0  551   73
    2
       0.0        0.       0.0      20.0
   19
   0.66798     500.0    0  552
   0.66798     500.0  552  553
   0.66798     500.0  553  554
   0.66798     500.0  554  555
   0.66798     500.0  555  556
   0.66798     500.0  556  557
   0.66798     500.0  557  558
   0.66798     500.0  558  559
   0.66798     500.0  559  560
   0.66798     500.0  560  561
   0.66798     500.0  561  562
   0.66798     500.0  562  563
   0.66798     500.0  563  564
   0.66798     500.0  564  565
   0.66798     500.0  565  566
   0.66798     500.0  566  567
   0.66798     500.0  567  568
   0.66798     500.0  568  569
   0.66798     500.0  569   88
    2
       1.5        0.       1.5      20.0
    1    0
    2    0      1.20         *    +    *    +    *    +    *    +    *
C:VOLUMES
     1.000      1.00
     1     0     1     1     1 138983.00     0.054      0.43    0.4497
0.45
     2     0     1     1     1 138983.00     0.054      0.43    0.4497
0.45
     3     0     1     1     1 138983.00     0.054      0.43    0.4497
0.45
     4     0     1     1     1 138983.00     0.054      0.43    0.4497
0.45
     5     0     1     1     1 138983.00     0.054      0.43    0.4497
0.45
     6     0     1     1     1 138983.00     0.054      0.43    0.4497
0.45
     7     0     1     1     1 138983.00     0.054      0.43    0.4497
0.45
     8     0     1     1     1 138983.00     0.054      0.43    0.4497
0.45
     9     0     1     1     1 138983.00     0.054      0.43    0.4497
0.45
    10     0     1     1     1 138983.00     0.054      0.43    0.4497
0.45
    11     0     1     1     1 138983.00     0.054      0.43    0.4497
0.45
    12     0     1     1     1 138983.00     0.054      0.43    0.4497
0.45
```

```
    13     0     1     1     1 138983.00     0.054      0.43    0.4497
0.45
    14     0     1     1     1 138983.00     0.054      0.43    0.4497
0.45
    15     0     1     1     1 138983.00     0.054      0.43    0.4497
0.45
    16     0     1     1     1 138983.00     0.054      0.43    0.4497
0.45
    17     0     1     1     1 138983.00     0.054      0.43    0.4497
0.45
    18     0     1     1     1 138983.00     0.054      0.43    0.4497
0.45
    19     0     1     1     1 138983.00     0.054      0.43    0.4497
0.45
    20     0     1     1     1 138983.00     0.054      0.43    0.4497
0.45
    21     0     1     1     1 138983.00     0.054      0.43    0.4497
0.45
    22     0     1     1     1 138983.00     0.054      0.43    0.4497
0.45
    23     0     1     1     1 138983.00     0.054      0.43    0.4497
0.45
    24     0     1     1     1 138983.00     0.054      0.43    0.4497
0.45
    25     0     1     1     1 138983.00     0.054      0.43    0.4497
0.45
    26     0     1     1     1 138983.00     0.054      0.43    0.4497
0.45
    27     0     1     1     1 138983.00     0.054      0.43    0.4497
0.45
    28     0     1     1     1 138983.00     0.054      0.43    0.4497
0.45
    29     0     1     1     1 138983.00     0.054      0.43    0.4497
0.45
    30     0     1     1     1 138983.00     0.054      0.43    0.4497
0.45
    31     0     1     1     1 138983.00     0.054      0.43    0.4497
0.45
    32     0     1     1     1 138983.00     0.054      0.43    0.4497
0.45
    33     0     1     1     1 138983.00     0.054      0.43    0.4497
0.45
    34     0     1     1     1 138983.00     0.054      0.43    0.4497
0.45
    35     0     1     1     1 138983.00     0.054      0.43    0.4497
0.45
    36     0     1     1     1 138983.00     0.054      0.43    0.4497
0.45
    37     0     1     1     4 138983.00     0.054      0.43    0.4497
0.45
    38     0     1     1     4 138983.00     0.054      0.43    0.4497
0.45
    39     0     1     1     4 138983.00     0.054      0.43    0.4497
0.45
    40     0     1     1     4 138983.00     0.054      0.43    0.4497
0.45
    41     0     1     1     4 138983.00     0.054      0.43    0.4497
0.45
    42     0     1     1     4 138983.00     0.054      0.43    0.4497
0.45
    43     0     1     1     4 138983.00     0.054      0.43    0.4497
0.45
    44     0     1     1     4 138983.00     0.054      0.43    0.4497
```

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0.45
    45     0     1     1     4 138983.00     0.054      0.43    0.4497
0.45
    46     0     1     1     4 138983.00     0.054      0.43    0.4497
0.45
    47     0     1     1     4 138983.00     0.054      0.43    0.4497
0.45
    48     0     1     1     4 138983.00     0.054      0.43    0.4497
0.45
    49     0     1     1     4 138983.00     0.054      0.43    0.4497
0.45
    50     0     1     1     4 138983.00     0.054      0.43    0.4497
0.45
    51     0     1     1     4 138983.00     0.054      0.43    0.4497
0.45
    52     0     1     1     4 138983.00     0.054      0.43    0.4497
0.45
    53     0     1     1     4 138983.00     0.054      0.43    0.4497
0.45
    54     0     1     2     1 5518.4406     0.054      0.43    0.4497
0.45
    55     0     1     2     1 5518.4406     0.054      0.43    0.4497
0.45
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0.45
    57     0     1     2     1 5518.4406     0.054      0.43    0.4497
0.45
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0.45
    59     0     1     2     1 5518.4406     0.054      0.43    0.4497
0.45
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0.45
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0.45
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0.45
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0.45
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0.45
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0.45
    66     0     1     2     1 5518.4406     0.054      0.43    0.4497
0.45
    67     0     1     2     1 5518.4406     0.054      0.43    0.4497
0.45
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0.45
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0.45
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0.45
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0.45
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0.45
    73     0     1     2     2 15000.000     0.054      0.43    0.4497
0.45
    74     0     1     2     2 15000.000     0.054      0.43    0.4497
0.45
    75     0     1     2     2 15000.000     0.054      0.43    0.4497
0.45
```

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    76     0     1     2     2 15000.000     0.054      0.43    0.4497
0.45
    77     0     1     2     2 15000.000     0.054      0.43    0.4497
0.45
    78     0     1     2     2 15000.000     0.054      0.43    0.4497
0.45
    79     0     1     2     2 15000.000     0.054      0.43    0.4497
0.45
    80     0     1     2     2 15000.000     0.054      0.43    0.4497
0.45
    81     0     1     2     2 15000.000     0.054      0.43    0.4497
0.45
    82     0     1     2     2 15000.000     0.054      0.43    0.4497
0.45
    83     0     1     2     2 15000.000     0.054      0.43    0.4497
0.45
    84     0     1     2     2 15000.000     0.054      0.43    0.4497
0.45
    85     0     1     2     2 15000.000     0.054      0.43    0.4497
0.45
    86     0     1     2     2 15000.000     0.054      0.43    0.4497
0.45
    87     0     1     2     2 15000.000     0.054      0.43    0.4497
0.45
    88     0     1     2     3 15000.000     0.054      0.43    0.4497
0.45
    89     0     1     2     3 15000.000     0.054      0.43    0.4497
0.45
    90     0     1     2     3 15000.000     0.054      0.43    0.4497
0.45
    91     0     1     2     3 15000.000     0.054      0.43    0.4497
0.45
    92     0     1     2     3 15000.000     0.054      0.43    0.4497
0.45
    93     0     1     2     3 15000.000     0.054      0.43    0.4497
0.45
    94     0     1     2     3 15000.000     0.054      0.43    0.4497
0.45
    95     0     1     2     3 15000.000     0.054      0.43    0.4497
0.45
    96     0     1     2     3 15000.000     0.054      0.43    0.4497
0.45
    97     0     1     2     3 15000.000     0.054      0.43    0.4497
0.45
    98     0     1     2     3 15000.000     0.054      0.43    0.4497
0.45
    99     0     1     2     3 15000.000     0.054      0.43    0.4497
0.45
   100     0     1     2     3 15000.000     0.054      0.43    0.4497
0.45
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0.45
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0.45
   103     0     1     2     3 15000.000     0.054      0.43    0.4497
0.45
   104     0     1     2     3 15000.000     0.054      0.43    0.4497
0.45
   105     0     1     2     3 15000.000     0.054      0.43    0.4497
0.45
   106     0     1     2     3 15000.000     0.054      0.43    0.4497
0.45
   107     0     1     2     3 15000.000     0.054      0.43    0.4497
```

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0.45
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0.45
   109     0     1     2     3 15000.000     0.054      0.43    0.4497
0.45
   110     0     1     2     3 15000.000     0.054      0.43    0.4497
0.45
   111     0     1     2     3 15000.000     0.054      0.43    0.4497
0.45
   112     0     1     2     3 15000.000     0.054      0.43    0.4497
0.45
   113     0     1     2     3 15000.000     0.054      0.43    0.4497
0.45
   114     0     1     2     3 15000.000     0.054      0.43    0.4497
0.45
   115     0     1     1     4 138983.00     0.054      0.43    0.4497
0.45
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0.45
   117     0     1     1     4 138983.00     0.054      0.43    0.4497
0.45
   118     0     1     1     4 138983.00     0.054      0.43    0.4497
0.45
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0.45
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0.45
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0.45
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0.45
   123     0     1     1     4 138983.00     0.054      0.43    0.4497
0.45
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0.45
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0.45
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0.45
   127     0     1     1     4 138983.00     0.054      0.43    0.4497
0.45
   128     0     1     1     4 138983.00     0.054      0.43    0.4497
0.45
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0.45
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0.45
   131     0     1     1     4 138983.00     0.054      0.43    0.4497
0.45
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0.45
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0.45
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0.45
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0.45
   136     0     1     1     4 138983.00     0.054      0.43    0.4497
0.45
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0.45
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0.45
```

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0.45
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0.45
   141     0     1     1     4 138983.00     0.054      0.43    0.4497
0.45
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0.45
   143     0     1     1     4 138983.00     0.054      0.43    0.4497
0.45
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0.45
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0.45
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0.45
   147     0     1     1     4 138983.00     0.054      0.43    0.4497
0.45
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0.45
   149     0     1     1     4 138983.00     0.054      0.43    0.4497
0.45
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0.45
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0.45
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0.45
   153     0     1     1     4 138983.00     0.054      0.43    0.4497
0.45
   154     0     1     1     4 138983.00     0.054      0.43    0.4497
0.45
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0.45
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0.45
   157     0     1     1     4 138983.00     0.054      0.43    0.4497
0.45
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0.45
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0.45
   160     0     1     1     4 138983.00     0.054      0.43    0.4497
0.45
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0.45
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0.45
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0.45
   164     0     1     1     4 138983.00     0.054      0.43    0.4497
0.45
   165     0     1     1     4 138983.00     0.054      0.43    0.4497
0.45
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0.45
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0.45
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0.45
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0.45
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```

```
0.45
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0.45
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0.45
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0.45
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0.45
   175     0     1     1     4 138983.00     0.054      0.43    0.4497
0.45
   176     0     1     1     4 138983.00     0.054      0.43    0.4497
0.45
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0.45
   178     0     1     1     4 138983.00     0.054      0.43    0.4497
0.45
   179     0     1     1     4 138983.00     0.054      0.43    0.4497
0.45
   180     0     1     1     4 138983.00     0.054      0.43    0.4497
0.45
   181     0     1     1     4 138983.00     0.054      0.43    0.4497
0.45
   182     0     1     1     4 138983.00     0.054      0.43    0.4497
0.45
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0.45
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0.45
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0.45
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0.45
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0.45
   188     0     1     1     4 138983.00     0.054      0.43    0.4497
0.45
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0.45
   422     0     1     1     4 138983.00     0.054      0.43    0.4497
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0.45
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0.45
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0.45
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0.45
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0.45
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0.45
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0.45
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0.45
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0.45
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0.45
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0.45
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0.45
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   536     0     1     1     4 138983.00     0.054      0.43    0.4497
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   539     0     1     1     4 138983.00     0.054      0.43    0.4497
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0.45
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0.45
   551     0     1     3  9999 5518.4406     0.054      0.43    0.4497
0.45
   552     0     1     4     1 333.98995     0.054      0.43    0.4497
0.45
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0.45
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0.45
   569     0     1     4     1 333.98995     0.054      0.43    0.4497
0.45
    1    1                              *D:FLOWS depend on month
    4       1.0      1.00
  515
      1.00    0   54      1.00   54   55      1.00   55   56      1.00   56
57
      1.00   57   58      1.00   58   59      1.00   59   60      1.00   60
61
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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
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97
      1.00   97   98      1.00   98   99      1.00   99  100      1.00  100
101
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105
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109
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      1.00   39   40      1.00   40   41      1.00   41   42      1.00   42
43
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140
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   54    2
      0.00      0.00      0.00     20.00
  550    2
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      0.00      0.00      0.00     20.00
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E:BOUNDARIES
      1.00      1.00                  *    +    *    +    *    +    *  Solids
1
    1    2
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   54    2
      0.00      0.00      0.00     20.00
  550    2
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  551    2
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  552    2
      0.00      0.00      0.00     20.00
  553                               *    +    *    +    * (Chem 1)
F:LOADS
  553                               *    +    *    +    * (Solids 1)
F:LOADS
.\INP\AA.NPS                        *    +    *    +    *   (NPS)
F:LOADS
        0                           *    +    *    +    *    +
G:PARAMETERS
                                    *    +    *    +    *    +
H:CONSTANTS
GLOBALS            0
Chem1              0
Solids1            0
        0                           *    +    *    +    *    I:TIME
FUNCTIONS
    Chem 1                                  3 1.00    1.0E+4    + j: initial
con
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  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
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82:	0.00	0.00	83:	0.00	0.00	84:	0.00	0.00
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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
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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
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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
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163:	0.00	0.00	164:	0.00	0.00	165:	0.00	0.00
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187:	0.00	0.00	188:	0.00	0.00	189:	0.00	0.00
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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
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214:	0.00	0.00	215:	0.00	0.00	216:	0.00	0.00
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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
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244:	0.00	0.00	245:	0.00	0.00	246:	0.00	0.00
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253:	0.00	0.00	254:	0.00	0.00	255:	0.00	0.00
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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
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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
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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
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337:	0.00	0.00	338:	0.00	0.00	339:	0.00	0.00
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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
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379:	0.00	0.00	380:	0.00	0.00	381:	0.00	0.00
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394:	0.00	0.00	395:	0.00	0.00	396:	0.00	0.00
397:	0.00	0.00	398:	0.00	0.00	399:	0.00	0.00
400:	0.00	0.00	401:	0.00	0.00	402:	0.00	0.00
403:	0.00	0.00	404:	0.00	0.00	405:	0.00	0.00
406:	0.00	0.00	407:	0.00	0.00	408:	0.00	0.00
409:	0.00	0.00	410:	0.00	0.00	411:	0.00	0.00
412:	0.00	0.00	413:	0.00	0.00	414:	0.00	0.00
415:	0.00	0.00	416:	0.00	0.00	417:	0.00	0.00
418:	0.00	0.00	419:	0.00	0.00	420:	0.00	0.00
421:	0.00	0.00	422:	0.00	0.00	423:	0.00	0.00
424:	0.00	0.00	425:	0.00	0.00	426:	0.00	0.00
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430:	0.00	0.00	431:	0.00	0.00	432:	0.00	0.00
433:	0.00	0.00	434:	0.00	0.00	435:	0.00	0.00
436:	0.00	0.00	437:	0.00	0.00	438:	0.00	0.00
439:	0.00	0.00	440:	0.00	0.00	441:	0.00	0.00
442:	0.00	0.00	443:	0.00	0.00	444:	0.00	0.00
445:	0.00	0.00	446:	0.00	0.00	447:	0.00	0.00
448:	0.00	0.00	449:	0.00	0.00	450:	0.00	0.00
451:	0.00	0.00	452:	0.00	0.00	453:	0.00	0.00
454:	0.00	0.00	455:	0.00	0.00	456:	0.00	0.00
457:	0.00	0.00	458:	0.00	0.00	459:	0.00	0.00

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460:      0.00      0.00 461:      0.00      0.00 462:      0.00      0.00
463:      0.00      0.00 464:      0.00      0.00 465:      0.00      0.00
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469:      0.00      0.00 470:      0.00      0.00 471:      0.00      0.00
472:      0.00      0.00 473:      0.00      0.00 474:      0.00      0.00
475:      0.00      0.00 476:      0.00      0.00 477:      0.00      0.00
478:      0.00      0.00 479:      0.00      0.00 480:      0.00      0.00
481:      0.00      0.00 482:      0.00      0.00 483:      0.00      0.00
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493:      0.00      0.00 494:      0.00      0.00 495:      0.00      0.00
496:      0.00      0.00 497:      0.00      0.00 498:      0.00      0.00
499:      0.00      0.00 500:      0.00      0.00 501:      0.00      0.00
502:      0.00      0.00 503:      0.00      0.00 504:      0.00      0.00
505:      0.00      0.00 506:      0.00      0.00 507:      0.00      0.00
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  1:      0.00      0.00   2:      0.00      0.00   3:      0.00      0.00
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  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
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 73:      0.00      0.00  74:      0.00      0.00  75:      0.00      0.00
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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
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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
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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
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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
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	0.00
388:	0.00	0.00	389:	0.00	0.00	390:	0.00	0.00
391:	0.00	0.00	392:	0.00	0.00	393:	0.00	0.00
394:	0.00	0.00	395:	0.00	0.00	396:	0.00	0.00
397:	0.00	0.00	398:	0.00	0.00	399:	0.00	0.00
400:	0.00	0.00	401:	0.00	0.00	402:	0.00	0.00
403:	0.00	0.00	404:	0.00	0.00	405:	0.00	0.00
406:	0.00	0.00	407:	0.00	0.00	408:	0.00	0.00
409:	0.00	0.00	410:	0.00	0.00	411:	0.00	0.00
412:	0.00	0.00	413:	0.00	0.00	414:	0.00	0.00
415:	0.00	0.00	416:	0.00	0.00	417:	0.00	0.00
418:	0.00	0.00	419:	0.00	0.00	420:	0.00	0.00
421:	0.00	0.00	422:	0.00	0.00	423:	0.00	0.00
424:	0.00	0.00	425:	0.00	0.00	426:	0.00	0.00
427:	0.00	0.00	428:	0.00	0.00	429:	0.00	0.00
430:	0.00	0.00	431:	0.00	0.00	432:	0.00	0.00
433:	0.00	0.00	434:	0.00	0.00	435:	0.00	0.00
436:	0.00	0.00	437:	0.00	0.00	438:	0.00	0.00
439:	0.00	0.00	440:	0.00	0.00	441:	0.00	0.00
442:	0.00	0.00	443:	0.00	0.00	444:	0.00	0.00
445:	0.00	0.00	446:	0.00	0.00	447:	0.00	0.00
448:	0.00	0.00	449:	0.00	0.00	450:	0.00	0.00
451:	0.00	0.00	452:	0.00	0.00	453:	0.00	0.00

454:	0.00	0.00	455:	0.00	0.00	456:	0.00	0.00
457:	0.00	0.00	458:	0.00	0.00	459:	0.00	0.00
460:	0.00	0.00	461:	0.00	0.00	462:	0.00	0.00
463:	0.00	0.00	464:	0.00	0.00	465:	0.00	0.00
466:	0.00	0.00	467:	0.00	0.00	468:	0.00	0.00
469:	0.00	0.00	470:	0.00	0.00	471:	0.00	0.00
472:	0.00	0.00	473:	0.00	0.00	474:	0.00	0.00
475:	0.00	0.00	476:	0.00	0.00	477:	0.00	0.00
478:	0.00	0.00	479:	0.00	0.00	480:	0.00	0.00
481:	0.00	0.00	482:	0.00	0.00	483:	0.00	0.00
484:	0.00	0.00	485:	0.00	0.00	486:	0.00	0.00
487:	0.00	0.00	488:	0.00	0.00	489:	0.00	0.00
490:	0.00	0.00	491:	0.00	0.00	492:	0.00	0.00
493:	0.00	0.00	494:	0.00	0.00	495:	0.00	0.00
496:	0.00	0.00	497:	0.00	0.00	498:	0.00	0.00
499:	0.00	0.00	500:	0.00	0.00	501:	0.00	0.00
502:	0.00	0.00	503:	0.00	0.00	504:	0.00	0.00
505:	0.00	0.00	506:	0.00	0.00	507:	0.00	0.00
508:	0.00	0.00	509:	0.00	0.00	510:	0.00	0.00
511:	0.00	0.00	512:	0.00	0.00	513:	0.00	0.00
514:	0.00	0.00	515:	0.00	0.00	516:	0.00	0.00
517:	0.00	0.00	518:	0.00	0.00	519:	0.00	0.00
520:	0.00	0.00	521:	0.00	0.00	522:	0.00	0.00
523:	0.00	0.00	524:	0.00	0.00	525:	0.00	0.00
526:	0.00	0.00	527:	0.00	0.00	528:	0.00	0.00
529:	0.00	0.00	530:	0.00	0.00	531:	0.00	0.00
532:	0.00	0.00	533:	0.00	0.00	534:	0.00	0.00
535:	0.00	0.00	536:	0.00	0.00	537:	0.00	0.00
538:	0.00	0.00	539:	0.00	0.00	540:	0.00	0.00
541:	0.00	0.00	542:	0.00	0.00	543:	0.00	0.00
544:	0.00	0.00	545:	0.00	0.00	546:	0.00	0.00
547:	0.00	0.00	548:	0.00	0.00	549:	0.00	0.00
550:	0.00	0.00	551:	0.00	0.00	552:	0.00	0.00
553:	0.00	0.00	554:	0.00	0.00	555:	0.00	0.00
556:	0.00	0.00	557:	0.00	0.00	558:	0.00	0.00
559:	0.00	0.00	560:	0.00	0.00	561:	0.00	0.00
562:	0.00	0.00	563:	0.00	0.00	564:	0.00	0.00
565:	0.00	0.00	566:	0.00	0.00	567:	0.00	0.00
568:	0.00	0.00	569:					

WESTINGHOUSE SAVANNAH RIVER CO.
Report WSRC-TR-2000-00072

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