Integrated Water Flow Model
IWFM-2015
Revision 257

User's Manual

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Summary of Features for Components with Multiple Versions

Some of the hydrologic simulation components in IWFM have multiple versions that offer different simulation capabilities. To aid the user in choosing the right component version, below is a list of these component versions and a summary of the simulation capabilities they offer.

Version	Capabilities
Root Zone Component	
4.0	• Simulation of non-ponded and ponded (rice and managed refuges) crops, urban lands, native and riparian vegetation at each element • Simulation of generic moisture (seepage from extra source of water, fog, etc.) • Ability to deliver water to an element, group of elements or a subregion to meet water demand • Ability to compute physical crop water demand dynamically based on crop, irrigation management, soil and atmospheric conditions or to pre-specify water demand to represent contractual demand
4.1	• All features listed for version 4.0 above • Simulation of riparian vegetation access to stream water to meet all or part of their evapotranspirative water demand • Simulation of root water uptake from groundwater that meets part or all of the plant evapotranspirative demand
Stream Component	
4.0	• Instantaneous routing (storage is not tracked) of stream flow • Wetted perimeter is constant
4.1	• All features listed for version 4.0 above • Simulation of varied wetted perimeter given as a flow vs. wetted perimeter rating table

5.0

- Kinematic wave routing to simulate stream flows and to track storage change in the stream channel
- Simulation of flow in rectangular, triangular and trapezoidal channels
- Flow-stage relationship is represented by the Manning's equation
- Wetted perimeter is calculated as a function of stage and channel geometry

1. Introduction

The purpose of the IWFM user's manual is to serve as a guide for populating input files, running IWFM and understanding the model results. This chapter briefly describes IWFM and the development of the model. A summary of this manual is included in this chapter to help guide the user when working with IWFM.

1.1. IWFM Description

IWFM is a Fortran code written using Fortran 2003 standards. The model is comprised of a pre-processor, simulation component and post-processors (Figure 1.1). IWFM must be run sequentially and the output generated from one program must be transferred to the next before beginning a model run.

1.2. Summary of IWFM User's Manual

Chapter 1	Introduction
Chapter 2	Discusses general topics related to time-tracking simulation option, preparation of time series input data and file formats recognized by IWFM
Chapter 3	Descriptions of the pre-processor input and output files
Chapter 4	Descriptions of the simulation input data files and output files generated

Chapter 5	Descriptions of the budget tables and the required input needed to tabulate simulation results
Chapter 6	Step-by-step guide of how to run IWFM, which includes running the pre-processor, simulation and budget portions of the program

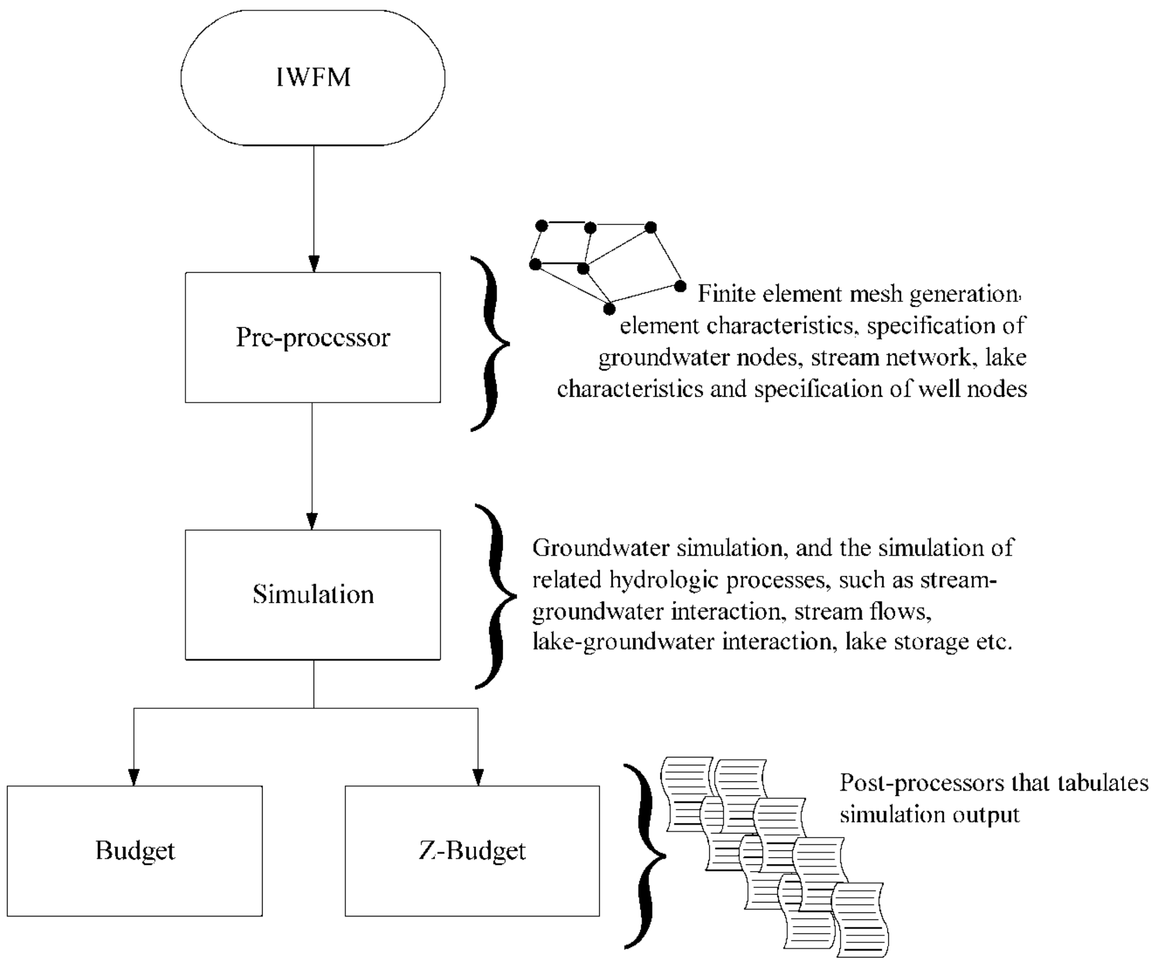


Figure 1.1 IWFM program structure

2. General Topics

2.1. Simulation Time Tracking

IWFM offers two simulation options, namely *time tracking* and *non-time tracking* simulations. In a time tracking simulation, IWFM is aware of the actual dates and times of the start and end of the simulation period. In a non-time tracking simulation, the start of the simulation period is always tagged as time zero and the simulation time is referenced simply by the number of time steps elapsed.

i. Time Tracking Simulation

During a time tracking simulation IWFM keeps track of the date and time of each time step. In such simulations, each data entry in input time series data files is required to have a date and time stamp which allows IWFM to retrieve time series data correctly. This, in return, allows the user to maintain a single set of time series input data files for applications where the starting and ending date and time of the simulation may change. For example, during the calibration stage of a project, the simulation is run for two periods: calibration period and the verification period. In a time tracking simulation, time series input data files can be prepared so that the data covers both the calibration and verification periods. Then the same time series data files can be used for both calibration and verification runs without the need for modification. Since a time tracking simulation keeps track of actual date and time of each of the simulation time steps, IWFM can retrieve the correct data from the time series data files.

Time tracking simulations allow usage of HEC-DSS files as well as ASCII text files for time series data input and output. HEC-DSS is a database format designed by Hydrologic Engineering Center (HEC) of U.S. Army Corps of Engineers specifically for time-series data encountered in hydrologic applications. These files allow efficient storage and retrieval of hydrologic time series data, and HEC offers free utilities (HEC-DSSVue and DSS Excel add-in) for manipulation, visualization and analysis of data stored in DSS files. These utilities and instructions on how to use DSS files can be downloaded from HEC web site at www.hec.usace.army.mil.

Another advantage of time tracking simulations is that results that are printed to output files have date and time stamps associated with them. This allows easy comparison of simulation results to observed values which generally come with the date and time of observation.

It is anticipated that most IWFM applications will use the time tracking simulation option.

ii. Non-time Tracking Simulation

In this simulation option, IWFM is not aware of the actual date and time for the start and end of the simulation period. The start of the simulation period is always zero, and the time during the simulation period is referred to by the elapsed time steps. For instance, assuming length of simulation time step is a month, elapsed simulation time will be referred as month 1, month 2, month 3, etc.

Since IWFM has no means to keep track of actual date and time in a non-time tracking simulation, it is up to the user to arrange the time series input data for proper data reading. For instance, in the calibration stage of a project where the simulation is run for a calibration period and for a verification period, the user will have to maintain two sets of time series input data files. One of these sets will be for the calibration period where the first data corresponds to the first time step in the calibration period, and the other set will be for the verification period where the first data corresponds to the first time step in the verification period.

In non-time tracking simulations, the results will be printed to the output files for each time step without a specific date and time. It is up to the user to convert absolute time steps to actual dates and times to compare them to observed values which generally come with the actual date and time of the observation. Furthermore, in such simulations only the usage of ASCII text files are allowed and the DSS files cannot be used for input or output of time series data.

It is anticipated that non-time tracking simulation option will be used mainly for theoretical problems such as the validation of numerical methods used in IWFM.

2.1.1. Length of Simulation Time Step

i. Time Tracking Simulation

In order to be consistent with the standards of HEC-DSS database files, IWFM restricts the length of simulation time step that can be used in an application. The allowable time step lengths are listed in Table 2.1.

ii. Non-time Tracking Simulation

The length of the simulation time step can be any number that is greater than zero. The user specifies a "tag" for the length of time step but IWFM does not recognize this tag. For example, the length of the time step can be 0.25 and the tag can be "month" IWFM uses the value 0.25 when the numerical methods require a value for Δt (see IWFM Theoretical Documentation), but the "month" tag does not represent anything for IWFM;

Time Step Length	IWFM Notation
1 minute	1MIN
2 minutes	2MIN
3 minutes	3MIN
4 minutes	4MIN
5 minutes	5MIN
10 minutes	10MIN
15 minutes	15MIN
20 minutes	20MIN
30 minutes	30MIN
1 hour	1HOUR
2 hours	2HOUR
3 hours	3HOUR
4 hours	4HOUR
6 hours	6HOUR
8 hours	8HOUR
12 hours	12HOUR
1 day	1DAY
1 week	1WEEK
1 month	1MON
1 year	1YEAR

Table 2.1 List of allowable time step lengths in time tracking simulations

it does not know that 0.25 month represents 7.75 days in March, and 7.5 days in April.

2.1.2. Time Stamp Format

In time tracking simulations, start and end date and time of simulation period as well as the date and time of each data entry in time series data input files are required to be specified by using a time stamp. The format of the time stamp is as follows:

MM/DD/YYYY_hh:mm

where

MM	=	two digit month index;
DD	=	two digit day index;
YYYY	=	four digit year;
hh	=	two digit hour in terms of military time (e.g. 1:00pm is represented as 13:00);
mm	=	two digit minute.

The time is represented in military time and midnight is referred to as 24:00. For instance, 05/28/1973_24:00 represents the midnight on the night of May 28, 1973. Another example is the starting date and time of a simulation period: if the initial conditions for a monthly simulation is given for the end of September 30, 1975, then the time stamp for the starting date and time of the simulation will be 09/30/1975_24:00. The first simulation result will be printed for October 31, 1975 at midnight with the time stamp 10/31/1975_24:00.

2.1.3. Preparation of Time Series Data Input Files

i. Time Tracking Simulation

In time tracking simulations, the user is allowed to use a mixture of ASCII text and DSS files for time series input data. In preparing these files, the user should follow the rules listed below:

1. The data should have a regular interval. Gaps in the data are not allowed. For instance, if the data is monthly a value for every month should be entered.
2. The time stamp of the data represents the end of the interval for which the data is valid. For instance, in monthly time series stream inflow data, a data point time stamped with 08/31/1995_24:00 represents the inflow that occurred in August of 1995. As another example, if the starting date and time of the simulation period is 12/31/1970_24:00 (i.e. initial conditions are given at the midnight of December 31, 1970) in a monthly simulation, then IWFM will search for the time series data time stamped as 01/31/1971_24:00 (data for the month of January in 1971) in the time series input files.
3. The smallest interval that can be used for time series data is 1 minute.
4. A time series input data can be constant throughout the simulation period. If an ASCII text file is used for data input, the time stamp for the constant value can be set to a date and time that is greater than the ending date and time of the simulation period. For instance, if the simulation period ends at 06/15/2003_18:00 (6:00pm on June 15, 2003), then the constant value can

have a time stamp 12/31/2100_24:00 (midnight on the night of December 31, 2100). IWFM reads the constant value for the midnight of December 31, 2100 and uses this value for all simulation times before this date and time. Generally, time series input files include conversion factors to convert only the "spatial" component of the input data unit. The temporal unit is deduced from the time interval of the input data. In the case of constant time series data, IWFM is not able to obtain the time interval and, hence, the temporal unit. If a constant value for time series data is used, the user should make sure that appropriate conversion factors are supplied so that the temporal and spatial units of the input data are consistent with those used internally in Simulation. Time series data that is constant can also be represented in DSS files but this is not suggested.

5. For rate-type time series data (e.g. stream inflow data), the time unit is assumed to be the interval of data. For instance, if the stream inflow data is entered monthly, IWFM assumes that the time unit of the flow rates is 1 month. When time series data is a constant value for the entire simulation period IWFM has no way to figure out the time unit of the input data. In this case the user should make sure that the time unit of data is the same as the consistent time unit of simulation

6. For recycled time series data (e.g. fraction of total urban water that is used indoors given for each month but do not change from one year to the other), the year of the time stamp can be set to 4000. Year 4000 is a special flag for IWFM such that it replaces year 4000 with the simulation year to retrieve

the appropriate data from the input file. As an example consider the time series data in Table 2.2 for the fraction of total urban water that is used indoors. This data set represents that for the first third of each simulation year the urban water indoors usage fraction is 0.7, for the second third it is 0.5 and for the last third it is 0.35. Recycled time series data can be used in both ASCII text and DSS files. If a monthly time series data is to be recycled the user should enter the time stamp for the last day of February as 02/29/4000_24:00 to address both the leap and non-leap years.

7. The interval of time series data is required to be synchronized with the simulation time step. Table 2.3 shows examples of accepted and unaccepted situations. It should be noted that IWFM will continue to read data from the input files even if the data interval is not properly synchronized with the simulation time step. However, in such cases there is no guarantee that the correct data will be retrieved from the input file. Therefore, it is up to the user to ensure correct synchronization between the input data and the simulation time step.

Time Stamp	Fraction of Urban Indoors Water
04/30/4000_24:00	0.70
08/31/4000_24:00	0.50
12/31/4000_24:00	0.35

Table 2.2 Example for representation of recycled time series data

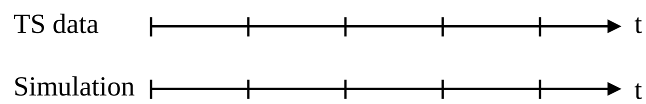
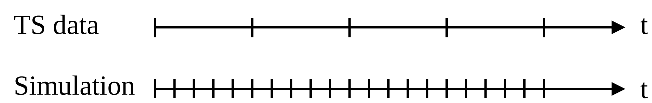
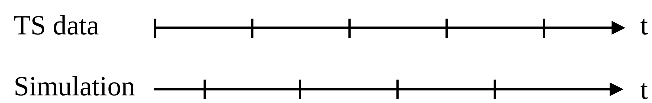
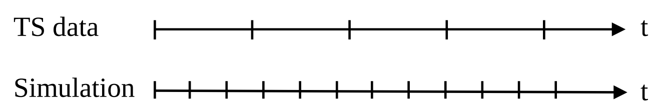
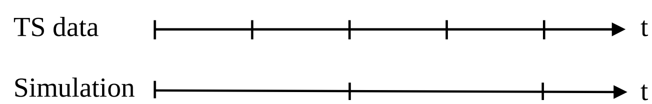
Situation	Graphical Representation	Accepted
Monthly time series data, monthly simulation		Yes
Monthly time series data, daily simulation		Yes
Monthly time series data, monthly simulation (TS data times don't match simulation times)		No
Monthly time series data, weekly simulation		No
Monthly time series data, yearly simulation		No

Table 2.3 Examples for acceptable and unacceptable cases for the synchronization of time series data interval and the simulation time step

ii. Non-time Tracking Simulation

In this case, the first data entry in the input data file should always correspond to the first time step in the simulation. Recycled time series data as well as data that is constant throughout the simulation period can be represented using NSP_ and NFQ_ variables (see the chapter on Simulation for more details). The time tag for each entry in the data file should be an integer number. This number is simply for the user to track the time series data; IWFM does not use it for any purposes.

2.2. Input and Output Data File Types

IWFM can access multiple file formats: (i) ASCII text, (ii) Fortran binary, and (iii) HEC-DSS files. The user can use several file formats in a single application. For instance, some of the input time series data can be read from HEC-DSS files whereas the rest can be read from ASCII text files. Some of the time series simulation results can be printed out to ASCII text files and the others can be printed out to HEC-DSS files.

Although IWFM allows usage of several file formats in a single application, some of the input and output files are required to be in specific formats. For instance, all budget output files generated by Simulation and read in by Budget or Z-Budget post-processors are required to be in Fortran binary format. Another example is the main control input files for all IWFM components; these files are all required to be in ASCII text file format.

IWFM recognizes the file formats from the file name extensions. Table 2.4 lists the file name extensions that are recognized by IWFM for each of the file formats.

File Type	Recognized Filename Extensions
ASCII	.DAT .TXT .OUT .IN .IN1 .IN2 .BUD
Fortran binary	.BIN
HEC-DSS	.DSS

Table 2.4. Filename extensions recognized by IWFM

2.3. Using Different Versions of a Simulation Component

For some of the simulation components, IWFM offers different versions with different capabilities and input data needs (e.g. stream component version 4.0 and 4.1, or root zone component versions 4.0 and 4.1). The first line of the main input file for these simulation components lists the version number for the component preceded by a "#" symbol. IWFM first reads this line to figure out the component version and, consequently, what input data to read and how to simulate the relevant flow processes. Therefore, it is important not to delete or modify the first data line in these files.

3. Pre-Processor

The pre-processor is the first part of IWFM that is executed when running the model. The program compiles time-independent data such as the spatial, hydrologic, and stratigraphic characteristics specific to a simulation project. Specification of the finite element mesh, stratigraphy, stream network and lakes within the model domain are processed in this part of IWFM. This chapter gives a description of the pre-processor input and output files.

3.1. Input Files

This section consists of input file explanations, the description of variables in each pre-processing input file and sample input files. The user should not judge input file spacing based on the sample input files provided in this documentation, instead refer to the input files from a copy of IWFM.

Table 3.1 specifies the input files that contain required and optional data to run the pre-processing portion of IWFM. The status is based on the input files required to simulate groundwater flow with IWFM, versus groundwater flow simulation in conjunction with other model features, such as stream flows, and lakes.

Pre-Processor Main Input File

The main input file allows a maximum of three lines for a title that is printed to the Pre-processor Standard Output File (PreprocessorMessages.out). ‘C’, ‘c’, or ‘*’

Description	**Status**
Element configuration	Required
Spatial location of all nodes	Required
Aquifer stratigraphy data	Required
Stream configuration	Optional
Lake configuration	Optional

Table 3.1 List of IWFM Pre-Processor input files

should not be in the first column of any of the title lines since IWFM treats these lines comments and skips them. All pre-processor input file names are read from the main input file. File names can include relative or absolute paths but must be no more than 500 characters long. Simply leave any file name specification columns blank if an input file is not used. Groundwater simulation requires element configuration data, nodal coordinates, and stratigraphy data. The pre-processor can output all units of length and area, given that the user specifies the conversion factor from simulation units to output units of length and area. The following list represents each input variable specified in the Pre-Processor Main Input File:

KOUT Option to print time-independent data read by the pre-processor program

KDEB This print option allows the user to print program messages on the screen during execution of the pre-processor or print the non-zero finite element stiffness matrix components

FACTLTOU Factor to convert simulation unit of length to the user specified output unit of length

UNITLTOU	The output unit of length, described in maximum of 10 characters
FACTAROU	Factor to convert simulation unit of area to the user specified output unit of area
UNITAROU	The output unit of area, described in a maximum of 10 characters

```
C*******************************************************************************
C
C                   INTEGRATED WATER FLOW MODEL (IWFM)
C                        *** Version ### ***
C
C*******************************************************************************
C
C                            MAIN INPUT FILE
C                        for IWFM Pre-Processing
C
C
C             Project:  IWFM Version ### Release
C                       California Department of Water Resources
C             Filename: PreProcessor_MAIN.DAT
C
C*****************************************************************************
C                       Titles Printed in the Output
C
C   *A Maximum of 3 title lines can be printed.
C   *Do not use '*' , 'c' or 'C' in the first column.
C
C                          **********************
                                  IWFM
                           Version ### Release
                                  DWR
C                          **********************
C*****************************************************************************
C                            File Description
C
C  *Listed below are all input and output file names used when running the
C   pre-processor for IWFM simulation.
C
C  *Each file name has a maximum length of 500 characters
C
C  *If a file does not exist for a project, leave the filename blank
C   For example, if lakes are not modeled in the project, the file name and
C   description columns for lake configuration file will appear as:
C
C   FILE NAME                                      DESCRIPTION
C                                                  / 6: LAKE DATA FILE
C-----------------------------------------------------------------------------
C   FILE NAME                                      DESCRIPTION
C-----------------------------------------------------------------------------
    OUTPUT1.BIN                                    / 1: BINARY OUTPUT FOR SIMULATION (OUTPUT, REQUIRED)
    ELEMENT.DAT                                    / 2: ELEMENT CONFIGURATION FILE (INPUT, REQUIRED)
    NODEXY.DAT                                     / 3: NODE X-Y COORDINATE FILE (INPUT, REQUIRED))
    STRATA.DAT                                     / 4: STRATIGRAPHIC DATA FILE (INPUT, REQUIRED))
    STREAM.DAT                                     / 5: STREAM GEOMETRIC DATA FILE (INPUT, OPTIONAL)
                                                   / 6: LAKE DATA FILE (INPUT, OPTIONAL)
C------------------------------------------------------------------------------
C******************************************************************************
C                   Pre-Processor Output Specifications
C
C    KOUT; Enter 1 - Print geometric and stratigraphic information
C          Enter 0 - Otherwise
C
C    KDEB; Enter 2 - Print messages on the screen during program execution
C          Enter 1 - Print non-zero Finite Element Stiffness Matrix Components
C          Enter 0 - Otherwise
C-----------------------------------------------------------------------------
C  VALUE                        DESCRIPTION
C-----------------------------------------------------------------------------
     1                          / KOUT
     1                          / KDEB
C-----------------------------------------------------------------------------
C*****************************************************************************
C                   Unit Specifications of Pre-Processor Output
C
C    FACTLTOU; Factor to convert simulation unit of length to specified output unit of length
C    UNITLTOU; The output unit of length (maximum of 10 characters)
C    FACTAROU; Factor to convert simulation unit of area to specified output unit of area
C    UNITAROU; The output unit of area (maximum of 10 characters)
C
C-----------------------------------------------------------------------------
C   VALUE                      DESCRIPTION
C-----------------------------------------------------------------------------
    1.0                        /FACTLTOU  (ft -> ft)
    FEET                       /UNITLTOU
    0.000022957                /FACTAROU  (sq.ft. -> acres)
    ACRES                      /UNITAROU
```

Element Configuration File

Element Configuration File details the element configuration for each element represented in the finite element mesh, number of subregions that the model domain is divided into, the name of the subregions and the subregion number that each element belongs to. Each element is configured using three or four nodal points. All elements that represent the model domain are either triangular or quadrilateral. A zero value for IDE(4) indicates that the element is triangular. Nodes corresponding to each element are specified in a counterclockwise manner. Element size should be based on observed or predicted groundwater head gradients throughout the model domain. Therefore, in areas where the flux is large, the size of the elements should be smaller than those located in areas of relatively small flow gradients. IWFM Mesh Generator that is available for download from the IWFM web site can be used to quickly generate the finite element grid. The following variables are required as input in Element Configuration File:

NE	Number of elements within the model domain
NREGN	Number of subregions the model domain is divided into
RNAME	Name of each subregion (maximum 50 characters long)
IE	Element number
IDE	Nodes corresponding to each element number; 3 nodes are associated with each triangular element (4^{th} node should be set to zero) and 4 nodes are associated with each quadrilateral element
IRGE	Subregion number that element IE belongs to

```
C*******************************************************************************
C
C                  INTEGRATED WATER FLOW MODEL (IWFM)
C
C*******************************************************************************
C
C                        ELEMENT CONFIGURATION FILE
C                         Discretization Component
C                           *** Version 4.0 ***
C
C
C             Project:  IWFM Version ### Release
C                       California Department of Water Resources
C             Filename: ELEMENT.DAT
C
C*******************************************************************************
C                             File Description
C
C   This file  contains the element configuration for each element.
C   The nodes that make a finite element are listed for each element in
C   a counter-clock wise fashion starting with any node. For triangular elements,
C   the fourth node is specified as zero.
C
C
C   For example,
C
C                    13-------------14----------17
C                     I              I         I
C                     I      2       I   3   I
C                     I              I     I
C                     I              I   I
C                    15------------- 16
C
C
C   The configuration for elements 2 and 3 will be listed as,
C
C            element   node 1    node 2    node 3   node 4
C               2        13        15        16       14
C               3        14        16        17        0
C
C*******************************************************************************
C                         Element Configuration Data
C
C    NE    ;   Number of elements within the model domain
C    NREGN ;   Number of subregions
C
C-------------------------------------------------------------------------------
C   VALUE                             DESCRIPTION
C-------------------------------------------------------------------------------
    400                               / NE
    4                                 / NREGN
C*******************************************************************************
C                             Sub-region Names
C
C   The following lists the names for each sub-region in a sequential order.
C
C--------------------------------------------------------------------------------
C
C   RNAME; Sub-region name (max. 50 characters)
C
C--------------------------------------------------------------------------------
C   VALUE                            DESCRIPTION
C--------------------------------------------------------------------------------
    Region1                          / RNAME1
    Region2                          / RNAME2
    Region3                          / RNAME3
    Region4                          / RNAME4
C*******************************************************************************
C
C   The data listed below represents all elements and corresponding nodes
C   within the model domain.
C
C   IE;      Element number
C   IDE;     Nodes corresponding to each element
C            *Note* IDE(4) is zero for all triangular elements
C   IRGE;    Subregion number to which element IE belongs to
C
C-------------------------------------------------------------------------------
C   Element     ------------Corresponding Nodes------------------      Subregion
C   IE          IDE(1)        IDE(2)       IDE(3)       IDE(4)            IRGE
C-------------------------------------------------------------------------------
     1           1             2            23           22                1
     2           2             3            24           23                1
     3           3             4            25           24                1
     4           4             5            26           25                1
     5           5             6            27           26                1
     .           .             .            .            .                 .
     .           .             .            .            .                 .
     .           .             .            .            .                 ,
     397         416           417          438          437               4
     398         417           418          439          438               4
     399         418           419          440          439               4
     400         419           420          441          440               4
```

Nodal X-Y Coordinate File

The nodal coordinate file contains node numbers and corresponding x and y coordinates (in relation to a specific origin). Any coordinate units may be used as long as the appropriate conversion factor is given. This file sets up the spatial orientation of the groundwater nodes in the model domain. The finite element mesh is generated from the nodal coordinates, as well as relationship between elements and corresponding groundwater nodes (refer to the Element Configuration File).

ND	Number of groundwater nodes
FACT	Factor to convert nodal coordinates to simulation unit of length
ID	Groundwater node identification number
X	x-coordinate of groundwater node location
Y	y-coordinate of groundwater node location

```
C*******************************************************************************
C
C                     INTEGRATED WATER FLOW MODEL (IWFM)
C
C*******************************************************************************
C
C                           NODAL X-Y COORDINATE FILE
C                            Discretization Component
C                              *** Version 4.0 ***
C
C
C             Project:  IWFM Version ### Release
C                       California Department of Water Resources
C             Filename: NODEXY.DAT
C
C*******************************************************************************
C                               File Description
C
C   *This file includes all groundwater nodes that represent the model domain,
C    as well as the x and y coordinates that correspond with each node.
C
C   *The coordinates can be specified for any reference point and coordinate
C    system
C
C*******************************************************************************
C                     Groundwater Node Specifications
C
C   ND;    Number of groundwater nodes
C   FACT;  Conversion factor for nodal coordinates
C-------------------------------------------------------------------------------
C   VALUE                         DESCRIPTION
C-------------------------------------------------------------------------------
    441                           /ND
    1.0                           /FACT
C-------------------------------------------------------------------------------
C*******************************************************************************
C                       Groundwater Node Locations
C   The following lists the node number and x & y coordinate of each node
C
C   ID;   Groundwater node number
C   X,Y;  Coordinates of groundwater node location; [L]
C
C-------------------------------------------------------------------------------
C   Node     ----------Coordinates----------
C    ID           X                 Y
C-------------------------------------------------------------------------------
      1        0.0               0.0
      2        2000.0            0.0
      3        4000.0            0.0
      4        6000.0            0.0
      5        8000.0            0.0
      .        .                 .
      .        .                 .
      .        .                 .
    437        32000.0           40000.0
    438        34000.0           40000.0
    439        36000.0           40000.0
    440        38000.0           40000.0
    441        40000.0           40000.0
```

Stratigraphy File

The stratigraphy data represents the composition, distribution, and succession of aquifer layers. Each aquifer layer can be classified as confined or unconfined. For a confined layer, information must be provided about confining layer (aquiclude or aquitard). The data file specifies each aquifer layer. The conversion factor in the data file converts elevations and thicknesses to simulation unit of length. The ground surface elevation and the thickness of each layer (and corresponding confining layer) at each node are required stratigraphy input data.

If the thickness of the aquiclude or aquitard is set to zero, there is no separating confining layer that distinguishes an aquifer layer from the adjacent layer. If thickness of an aquifer layer is set to zero, this implies that the groundwater node at that aquifer layer is an inactive node and the aquifer layer does not exist at that location. The following input is required in the stratigraphy data file:

NL	Number of aquifer layers modeled in IWFM; each layer consists of an aquifer and aquiclude or aquitard
FACT	Factor to convert stratigraphic data from user input units to the simulation unit of length
ID	Groundwater node
ELV	Ground surface elevation relative to a common datum, [L]
W	Thickness of the aquifer layer, and its confining layer (if the layer is confined). If the layer is unconfined, specify the aquitard thickness as zero

```
C*******************************************************************************
C
C                  INTEGRATED WATER FLOW MODEL (IWFM)
C
C*******************************************************************************
C
C                           STRATIGRAPHY FILE
C                         Discretization Component
C                           *** Version 4.0 ***
C
C
C             Project:  IWFM Version ### Release
C                       California Department of Water Resources
C             Filename: STRATA.DAT
C
C*******************************************************************************
C                          File Description
C
C   This data file contains:
C   *the ground surface elevation,
C   *the number of aquifer layers to be modeled, and
C   *the thickness of each aquifer and corresponding confining layer (if any)
C   at each groundwater node within the model domain.
C
C*******************************************************************************
C                    Stratigraphy Specification Data
C
C   NL;    Number of layers to be modeled
C   FACT;  Conversion factor for elevations and thicknesses in the
C          stratigraphic data
C-------------------------------------------------------------------------------
C   VALUE                          DESCRIPTION
C-------------------------------------------------------------------------------
    2                          /NL
    1.0                        /FACT
C-------------------------------------------------------------------------------
C*******************************************************************************
C                         Stratigraphy Data
C
C  *The stratigraphy data represents the geology that deals with the origin,
C   composition, distribution and succession of groundwater layers.
C
C  *Each groundwater layer is specified as an aquifer and aquiclude or aquitard.
C   If there is no aquiclude or aquitard within the layer, specify a thickness
C   of zero
C
C  *The stratigraphy data includes the ground surface elevation, as well as the
C   thickness of the aquifer, aquitard, or aquiclude at each groundwater node
C
C   ID;      Groundwater node
C   ELV;     Ground surface elevation with respect to a common datum; [L]
C   W(1);    Thickness of aquiclude in Layer 1; [L]
C   W(2);    Thickness of aquifer in Layer 1; [L]
C   W(3);    Thickness of aquiclude in Layer 2; [L]
C   W(4);    Thickness of aquifer in Layer 2; [L]
C   W(5);    Thickness of aquiclude in Layer 3; [L]
C   W(6);    Thickness of aquifer in Layer 3; [L]
C
C------------------------------------------------------------------------------
C    Node  Elevation   --Layer #1--     --Layer #2--     --Layer #3--   ...
C     ID     ELV        W(1)   W(2)     W(3)    W(4)     W(5)    W(6)  ...
C------------------------------------------------------------------------------
        1    500.0       0.0    500.0    10.0    100.0
        2    500.0       0.0    500.0    10.0    100.0
        3    500.0       0.0    500.0    10.0    100.0
        4    500.0       0.0    500.0    10.0    100.0
        5    500.0       0.0    500.0    10.0    100.0
        .    .           .      .         .      .
        .    .           .      .         .      .
        .    .           .      .         .      .
      436    500.0       0.0    500.0     0.0    100.0
      437    500.0       0.0    500.0     0.0    100.0
      438    500.0       0.0    500.0     0.0    100.0
      439    500.0       0.0    500.0     0.0    100.0
      440    500.0       0.0    500.0     0.0    100.0
      441    500.0       0.0    500.0     0.0    100.0
```

Stream Configuration File

IWFM offers multiple versions of stream simulation component. Each version differs in how stream flows are simulated and the input data required. Based on the modeling needs, the user must choose one of the stream component versions that IWFM will use by proving the name of the Stream Configuration File. The first line of the Stream Configuration File lists the version number of the stream component which instructs IWFM about the input data to read. The Stream Configuration File for each version of the stream component is discussed below.

Stream Configuration File for Version 4.0

Stream flow is modeled using one-dimensional line segments. The Stream Configuration File contains all of the stream nodes and their spatial orientation. The first line of the data file lists the version number of the IWFM stream component preceded by a # sign. IWFM checks this version number for consistency; therefore, this line must not be deleted or modified. The Stream Configuration File includes the stream network configuration, which is specified for each reach. Following the stream reach data is the rating table for each of the stream nodes. Based on the rating table values, interpolation is used to determine the stream flow for a specific stream elevation. The following parameters must be specified at the beginning of the stream configuration file for the simulation of stream flows:

NRH	Number of stream reaches modeled
NR	Number of stream nodes modeled

NRTB	Number of data points in each rating table. A rating table is given for each stream node specified within the model domain

Stream Reaches

For each reach of a river, the following items are specified: reach identification number (ID), first upstream node of reach ID, last downstream node of reach ID, and the stream node that reach ID flows into. The stream nodes are then listed, followed by the groundwater node that the stream node corresponds to.

If flow from a stream reach contributes to a lake, then the lake number preceded by a negative sign should be entered instead of the stream node number that reach ID flows into. The lake numbers are listed in the lake data file. The following parameters are specified in the stream reach specification portion of the Stream Configuration File:

ID	Reach identification number
IBUR	First upstream node of reach ID
IBDR	Last downstream node of reach ID
IDWN	Stream node that reach ID flows into (enter zero if stream flow leaves the modeled area; enter –*nlk* if stream flow enters lake number *nlk*)
NAME	Name of the stream reach (maximum 20 characters long)
IRV	Stream node number
IGW	Groundwater node that the stream node IRV corresponds to

Rating Table

Each stream node and corresponding stream bottom elevation are specified in this file, along with a rating table for each stream node that specifies the flow rate for various stream elevations. The purpose of a rating table is to determine stream flow rate, given a specific stream elevation. Factors to convert stream depths and stream bottom elevations to simulation unit of length and stream flows to simulation unit of flow rate are required.

FACTLT	Factor to convert stream bottom elevation and depth to simulation unit of length
FACTQ	Factor to convert the spatial component of the rating table flow rates into simulation unit of volume. For instance, if the rating table flow rates are given in ac.ft./month and the consistent simulation units for volume and time are cu.ft. and day, respectively, then this variable should be set to 2.29568E-05 (to convert ac.ft./month to cu.ft./month). The conversion of cu.ft./month to cu.ft./day is performed dynamically in the Simulation part since each month has a different number of days. This variable can also be used to convert flow rate units that are not recognized by IWFM to units that are recognized. For instance, if the flow rates are given in units of cfs (IWFM doesn't recognize second as a unit of time), this variable can be set to 60 to convert cfs into cu.ft./min and variable TUNIT can be set to 1MIN.
TUNIT	Time unit of the rating table flow rates
ID	Stream node number

BOTR	Stream bottom elevation relative to a common datum, [L]
HRTB	Stream depth, [L]
QRTB	Flow rate at stream depth HRTB, [L^3/T]

```
#4.0
C *** DO NOT DELETE ABOVE LINE ***
C
C*******************************************************************************
C
C                  INTEGRATED WATER FLOW MODEL (IWFM)
C
C*******************************************************************************
C
C                       STREAM SPECIFICATION FILE
C                           Stream Component
C                          *** Version 4.0 ***
C
C
C             Project:  IWFM Version ### Release
C                       California Department of Water Resources
C             Filename: STREAM.DAT
C
C*******************************************************************************
C                             File Description
C
C   *All stream/river nodes modeled in IWFM are specified with respect to their
C    corresponding groundwater nodes
C
C   *A flow versus depth rating table is specified for each stream node
C
C*******************************************************************************
C                     Stream Reach Specifications
C
C   NRH;   Number of stream reaches modeled
C   NR;    Number of stream nodes modeled
C   NRTB;  Number of data points in stream rating tables
C
C-------------------------------------------------------------------------------
C   VALUE                       DESCRIPTION
C-------------------------------------------------------------------------------
    3                           / NRH
    23                          / NR
    5                           / NRTB
C-------------------------------------------------------------------------------
C*******************************************************************************
C                      Description of Stream Reaches
C
C   The following lists the stream nodes and corresponding groundwater
C   nodes for each stream reach modeled in IWFM.
C
C   ID;    Reach number
C   IBUR;  First upstream stream node of the reach
C   IBDR;  Last downstream node of the reach
C   IDWN;  Stream node into which the reach flows into
C             0: If stream flow leaves the modeled area
C          -nlk: If stream flows into lake number nlk
C   NAME;  Name of the reach (maximum 20 characters)
C
C   In addition, for each stream node within the reach the corresponding
C   groundwater node and subregion number is listed.
C
C   IRV;   Stream node
C   IGW;   Corresponding groundwater node
C
C-------------------------------------------------------------------------------
C     REACH  1
C   Reach  Upstream  Downstream  Outflow   Reach
C           Node       Node      Node      Name
C   ID      IBUR       IBDR      IDWN      NAME
C-------------------------------------------------------------------------------
     1        1          10       -1       Reach1
C-------------------------------------------------------------------------------
C   Stream    Groundwater
C   node         node
C   IRV          IGW
C-------------------------------------------------------------------------------
     1           433
     2           412
     .           .
     .           .
     .           .
     9           265
    10           264
C-------------------------------------------------------------------------------
C     REACH 2
C   Reach  Upstream  Downstream  Outflow   Reach
C           Node       Node      Node      Name
C   ID      IBUR       IBDR      IDWN      NAME
C-------------------------------------------------------------------------------
     2       11         16        17       Reach2
C-------------------------------------------------------------------------------
C   Stream    Groundwater
C   node         node
C   IRV          IGW
C-------------------------------------------------------------------------------
    11           222
     .           .
     .           .
    16           139
C-------------------------------------------------------------------------------
C     REACH  3
C   Reach  Upstream  Downstream  Outflow   Reach
C           Node       Node      Node      Name
C   ID      IBUR       IBDR      IDWN      NAME
C-------------------------------------------------------------------------------
     3       17         23         0       Reach3
C-------------------------------------------------------------------------------
C   Stream    Groundwater
C   node         node
C   IRV          IGW
C-------------------------------------------------------------------------------
    17           139
     .           .
     .           .
     .           .
    23           13
```

```
C*******************************************************************************
C                              Stream rating tables
C
C   FACTLT; Conversion factor for stream bottom elevation and stream depth
C   FACTQ;  Conversion factor for rating table flow rates
C             It is used to convert only the spatial component of the unit;
C             DO NOT include the conversion factor for time component of the unit.
C             * e.g. Unit of flow rate listed in this file      = AC.FT./MONTH
C                    Consistent unit used in simulation         = CU.FT/DAY
C                    Enter FACTQ (AC.FT./MONTH -> CU.FT./MONTH) = 2.29568E-05
C                     (conversion of MONTH -> DAY is performed automatically)
C   TUNIT;  Time unit of flow rate.  This should be one of the units
C             recognized by HEC-DSS that are listed in the Simulation Main
C             Control File.
C
C-------------------------------------------------------------------------------
C   VALUE                       DESCRIPTION
C-------------------------------------------------------------------------------
      1.0                       / FACTLT
      60.0                      / FACTQ  [cfs -> cu.ft/min since seconds cannot be represented in Simulation]
      1MIN                      / TUNIT
C-------------------------------------------------------------------------------
C   The following lists a stream rating table for each of the stream nodes
C   *Note* In order to define a specified stream depth, enter all HRTB values
C             as equal to the specified depth value
C
C   ID;    Stream node number
C   BOTR;  Stream bottom elevation relative to a common datum [L]
C   HRTB;  Stream depth [L]
C   QRTB;  Flow rate at stream depth HRTB [L^3/T]
C
C-------------------------------------------------------------
C   Stream    Bottom   Stream      Flow
C   node     elevation  depth      rate
C   ID         BOTR     HRTB       QRTB
C-------------------------------------------------------------
     1         300.0     0.0       0.00
                         2.0       734.94
                         5.0       3299.29
                         15.0      19033.60
                         25.0      41568.45
     2         298.0     0.0       0.00
                         2.0       734.94
                         5.0       3299.29
                         15.0      19033.60
                         25.0      41568.45
     3         296.0     0.0       0.00
                         2.0       734.94
                         5.0       3299.29
                         15.0      19033.60
                         25.0      41568.45
     .         .         .         .
                         .         .
                         .         .
     .         .         .         .
                         .         .
                         .         .
    23         260.0     0.0       0.00
                         2.0       734.94
                         5.0       3299.29
                         15.0      19033.60
                         25.0      41568.45
```

Stream Configuration File for Version 4.1

Stream routing component version 4.1 is very similar to version 4.0 except that wetted perimeter is specified as function of stream stage through a user-specified rating table. The only new variable, WRTB, is described below. For all other variables, refer to the file description that is already presented above for *Stream Configuration File for Version 4.0*.

WRTB	Wetted perimeter at stream depth HRTB, [L]

```
#4.1
C *** DO NOT DELETE ABOVE LINE ***
C
C*******************************************************************************
C
C                   INTEGRATED WATER FLOW MODEL (IWFM)
C
C*******************************************************************************
C
C                        STREAM SPECIFICATION FILE
C                            Stream Component
C                           *** Version 4.1 ***
C
C
C              Project:  IWFM Version ### Release
C                        California Department of Water Resources
C              Filename: STREAM.DAT
C
C*******************************************************************************
C                              File Description
C
C   *All stream/river nodes modeled in IWFM are specified with respect to their
C    corresponding groundwater nodes
C
C   *Rating tables for flow versus depth and flow versus wetted perimeter are
C    specified for each stream node
C
C*******************************************************************************
C                          Stream Reach Specifications
C
C   NRH;   Number of stream reaches modeled
C   NR;    Number of stream nodes modeled
C   NRTB;  Number of data points in stream rating tables
C
C-------------------------------------------------------------------------------
C   VALUE                       DESCRIPTION
C-------------------------------------------------------------------------------
    3                           / NRH
    23                          / NR
    5                           / NRTB
C-------------------------------------------------------------------------------
C*******************************************************************************
C                           Description of Stream Reaches
C
C   The following lists the stream nodes and corresponding groundwater
C   nodes for each stream reach modeled in IWFM.
C
C   ID;    Reach number
C   IBUR;  First upstream stream node of the reach
C   IBDR;  Last downstream node of the reach
C   IDWN;  Stream node into which the reach flows into
C               0: If stream flow leaves the modeled area
C            -nlk: If stream flows into lake number nlk
C   NAME;  Name of the reach (maximum 20 characters)
C
C   In addition, for each stream node within the reach the corresponding
C   groundwater node and subregion number is listed.
C
C   IRV;   Stream node
C   IGW;   Corresponding groundwater node
C
C-------------------------------------------------------------------------------
C     REACH  1
C   Reach  Upstream  Downstream  Outflow   Reach
C           Node       Node      Node      Name
C   ID      IBUR       IBDR      IDWN      NAME
C-------------------------------------------------------------------------------
     1        1          10       -1       Reach1
C-------------------------------------------------------------------------------
C   Stream    Groundwater
C   node        node
C   IRV         IGW
C-------------------------------------------------------------------------------
     1          433
     2          412
     .          .
     .          .
     .          .
     9          265
    10          264
C-------------------------------------------------------------------------------
C     REACH 2
C   Reach  Upstream  Downstream  Outflow   Reach
C           Node       Node      Node      Name
C   ID      IBUR       IBDR      IDWN      NAME
C-------------------------------------------------------------------------------
     2       11          16        17      Reach2
C-------------------------------------------------------------------------------
C   Stream    Groundwater
C   node        node
C   IRV         IGW
C-------------------------------------------------------------------------------
    11          222
     .          .
     .          .
    16          139
C-------------------------------------------------------------------------------
C     REACH  3
C   Reach  Upstream  Downstream  Outflow   Reach
C           Node       Node      Node      Name
C   ID      IBUR       IBDR      IDWN      NAME
C-------------------------------------------------------------------------------
     3       17          23        0       Reach3
C-------------------------------------------------------------------------------
C   Stream    Groundwater
C   node        node
C   IRV         IGW
C-------------------------------------------------------------------------------
    17          139
     .          .
     .          .
     .          .
```

```
    23          13
C*******************************************************************************
C                             Stream rating tables
C
C   FACTLT; Conversion factor for stream bottom elevation, stream depth and
C             wetted perimeter
C   FACTQ;  Conversion factor for rating table flow rates
C             It is used to convert only the spatial component of the unit;
C             DO NOT include the conversion factor for time component of the unit.
C             * e.g. Unit of flow rate listed in this file      = AC.FT./MONTH
C                    Consistent unit used in simulation         = CU.FT/DAY
C                    Enter FACTQ (AC.FT./MONTH -> CU.FT./MONTH) = 2.29568E-05
C                     (conversion of MONTH -> DAY is performed automatically)
C   TUNIT;  Time unit of flow rate.  This should be one of the units
C             recognized by HEC-DSS that are listed in the Simulation Main
C             Control File.
C
C-------------------------------------------------------------------------------
C   VALUE                       DESCRIPTION
C-------------------------------------------------------------------------------
    1.0                         / FACTLT
    60.0                        / FACTQ  [cfs -> cu.ft/min since seconds cannot be represented in Simulation]
    1MIN                        / TUNIT
C-------------------------------------------------------------------------------
C   The following lists a stream rating table for each of the stream nodes
C   *Note* In order to define a specified stream depth, enter all HRTB values
C             as equal to the specified depth value
C
C   ID;    Stream node number
C   BOTR;  Stream bottom elevation relative to a common datum [L]
C   HRTB;  Stream depth [L]
C   QRTB;  Flow rate at stream depth HRTB [L^3/T]
C   WPTB;  Wetted perimeter at stream depth HRTB [L]
C
C-------------------------------------------------------------
C   Stream    Bottom   Stream      Flow        Wetted
C   node     elevation  depth      rate        perimeter
C   ID         BOTR     HRTB       QRTB          WRTB
C-------------------------------------------------------------
     1         300.0     0.0       0.00          0.0
                         2.0       734.94        10.0
                         5.0       3299.29       15.0
                         15.0      19033.60      36.0
                         25.0      41568.45      2000.0
     2         298.0     0.0       0.00          0.0
                         2.0       734.94        10.0
                         5.0       3299.29       15.0
                         15.0      19033.60      36.0
                         25.0      41568.45      2000.0
     3         296.0     0.0       0.00          0.0
                         2.0       734.94        10.0
                         5.0       3299.29       15.0
                         15.0      19033.60      36.0
                         25.0      41568.45      2000.0
     .          .        .         .             .
                         .         .             .
                         .         .             .
     .          .        .         .             .
                         .         .             .
                         .         .             .
    23         260.0     0.0       0.00          0.0
                         2.0       734.94        10.0
                         5.0       3299.29       15.0
                         15.0      19033.60      36.0
                         25.0      41568.45      2000.0
```

Stream Configuration File for Version 5.0

Unlike for stream routing component versions 4.0 and 4.1, Stream Configuration File for Version 5.0 only lists the stream reach and node connectivity; there are no rating tables that need to be specified. There are no new variables that occur in Stream Configuration File for Version 5.0, so refer to the file description that is already presented above for *Stream Configuration File for Version 4.0* for an explanation of the variables.

```
#5.0
C *** DO NOT DELETE ABOVE LINE ***
C
C*******************************************************************************
C
C                   INTEGRATED WATER FLOW MODEL (IWFM)
C
C*******************************************************************************
C
C                        STREAM SPECIFICATION FILE
C                            Stream Component
C                          *** Version 5.0 ***
C
C
C             Project:  IWFM Version ### Release
C                       California Department of Water Resources
C             Filename: STREAM.DAT
C
C*******************************************************************************
C                              File Description
C
C    Modeled stream nodes are specified with respect to their corresponding
C    groundwater nodes. Stream reach connectivity is also specified in this file.
C
C*******************************************************************************
C                       Stream Reach Specifications
C
C   NRH;   Number of stream reaches modeled
C   NR;    Number of stream nodes modeled
C
C-------------------------------------------------------------------------------
C   VALUE                       DESCRIPTION
C-------------------------------------------------------------------------------
    3                           / NRH
    23                          / NR
C-------------------------------------------------------------------------------
C*******************************************************************************
C                        Description of Stream Reaches
C
C   The following lists the stream nodes and corresponding groundwater
C   nodes for each stream reach modeled in IWFM.
C
C   ID;    Reach number
C   IBUR;  First upstream stream node of the reach
C   IBDR;  Last downstream node of the reach
C   IDWN;  Stream node into which the reach flows into
C               0: If stream flow leaves the modeled area
C            -nlk: If stream flows into lake number nlk
C   NAME;  Name of the reach (maximum 20 characters)
C
C   In addition, for each stream node within the reach the corresponding
C   groundwater node and subregion number is listed.
C
C   IRV;   Stream node
C   IGW;   Corresponding groundwater node
C
C-------------------------------------------------------------------------------
C     REACH  1
C   Reach  Upstream  Downstream  Outflow   Reach
C           Node       Node      Node      Name
C   ID      IBUR       IBDR      IDWN      NAME
C-------------------------------------------------------------------------------
     1       1          10        -1       Reach1
C-------------------------------------------------------------------------------
C   Stream    Groundwater
C   node        node
C   IRV         IGW
C-------------------------------------------------------------------------------
     1          433
     2          412
     .           .
     .           .
     .           .
     9          265
    10          264
C-------------------------------------------------------------------------------
C     REACH 2
C   Reach  Upstream  Downstream  Outflow   Reach
C           Node       Node      Node      Name
C   ID      IBUR       IBDR      IDWN      NAME
C-------------------------------------------------------------------------------
     2      11          16        17       Reach2
C-------------------------------------------------------------------------------
C   Stream    Groundwater
C   node        node
C   IRV         IGW
C-------------------------------------------------------------------------------
    11          222
     .           .
     .           .
    16          139
C-------------------------------------------------------------------------------
C     REACH  3
C   Reach  Upstream  Downstream  Outflow   Reach
C           Node       Node      Node      Name
C   ID      IBUR       IBDR      IDWN      NAME
C-------------------------------------------------------------------------------
     3      17          23        0        Reach3
C-------------------------------------------------------------------------------
C   Stream    Groundwater
C   node        node
C   IRV         IGW
C-------------------------------------------------------------------------------
    17          139
     .           .
     .           .
     .           .
    23          13
```

Lake Configuration File

The Lake Configuration File specifies the number of lakes modeled and the elements that make up each lake. The first line of the data file lists the version number of the IWFM lake component preceded by a # sign. IWFM checks this version number for consistency; therefore, this line must not be deleted or modified. Each lake is specified by an identification number. The destination for the outflow from each lake is required, followed by the number of elements that each lake encompasses and the element numbers that correspond to the lake region. The following lists the lake input:

NLAKE	Number of lakes modeled
ID	Lake identification number
TYPDST	Destination type for lake outflow (0 if lake outflow goes outside the model domain, 1 if lake outflow contributes to a stream node, or 3 if lake outflow contributes to a downstream lake)
DST	Destination number for lake outflow (any value if TYPDST is set to 0, stream node number if TYPDST is set to 1, and lake number if TYPDST is set to 3)
NELAKE	Number of elements that a lake encompasses
IELAKE	Element number over which the lake is located

```
#4.0
C *** DO NOT DELETE ABOVE LINE ***
C
C*****************************************************************************
C
C                     INTEGRATED WATER FLOW MODEL (IWFM)
C
C*****************************************************************************
C
C                    LAKE CONFIGURATION DATA FILE
C                          Lake Component
C                        *** Version 4.0 ***
C
C
C              Project:  IWFM Version ### Release
C                        California Department of Water Resources
C              Filename: LAKE.DAT
C
C*****************************************************************************
C
C                              File Description:
C
C   This data file contains the number of lakes being modeled,
C   destination for lake outflow and the finite elements included in each lake.
C
C*****************************************************************************
C                   Lake Configuration Data
C
C   NLAKE  ; Number of lakes that are being modeled
C
C-----------------------------------------------------------------------------
C   VALUE                      DESCRIPTION
C-----------------------------------------------------------------------------
      1                        / NLAKE
C-----------------------------------------------------------------------------
C
C   The following lists the area and elevation for the NLAKE number of lakes
C
C   ID    ;  Sequential number for the lakes
C   TYPDST;  Destination type for lake outflow
C              0 = Lake outflow goes outside the model domain
C              1 = Lake outflow goes to stream node DST (see below)
C              3 = Lake outflow goes to downstream lake DST (see below)
C   DST   ;  Destination number for lake outflow
C                * Note: Enter any number if TYPDST is 0
C   NELAKE;  Number of lake elements where lake lies
C   IELAKE;  Element in which the lake is located
C
C--------------------------------------------------------------------
C     ID    TYPDST     DST      NELAKE        IELAKE
C--------------------------------------------------------------------
      1       1         11        10            169
                                                170
                                                171
                                                188
                                                189
                                                190
                                                207
                                                208
                                                209
                                                210
```

3.2. Output Files

Binary Output File

The Binary Output File contains the pre-processing information used in the simulation portion of IWFM. This file must be copied to the folder with the IWFM simulation executable program.

Pre-processor Standard Output File (PreprocessorMessages.out)

The Pre-processor Standard Output File provides the user with data that was processed in the pre-processor portion of IWFM. The following list indicates the information available in this output file:

- Project title (specified in the Pre-Processor Main Input File)
- Date and time of run, which is determined internally within the program
- List of input files read in the pre-processing program
- Various warning and/or error messages
- Subregional areas
- Number of nodes, triangular elements, quadrilateral elements and groundwater layers
- Nodal x-y coordinates and areas associated with each node
- Elements, corresponding nodes, and elemental areas
- Top and bottom elevations of aquifer layers
- IUD variable at a node of an aquifer layer

IUD = 1 : the node is active; i.e. the aquifer layer exists at the particular node

IUD = –99 : the node is inactive; i.e. the aquifer layer thickness is zero and the layer does not exist at the particular node

- Stream reach information
- Number of active layers at each node
- Node numbers surrounding each groundwater node
- Non-zero components of conductance matrix
- Execution time for the pre-processor program

```
************************************************************************************************************************************
                                                          IWFM
                                                    Version ### Release
                                                           DWR
************************************************************************************************************************************

THIS RUN IS MADE ON 04/25/2012 AT 15:41:32

THE FOLLOWING FILES ARE USED IN THIS SIMULATION:
 1                                  ..\Simulation\OUTPUT1.BIN
 2                                  ELEMENT.DAT
 3                                  NODEXY.DAT
 4                                  STRATA.DAT
 5                                  STREAM.DAT
 6                                  LAKE.DAT

REGION =   1   197680.87  ACRES
REGION =   2   197680.87  ACRES
      TOTAL    395361.73  ACRES

NO. OF NODES                           ( ND): 441
NO. OF TRIANGULAR ELEMENTS             (NET): 0
NO. OF QUADRILATERAL ELEMENTS          (NEQ): 400
NO. OF TOTAL ELEMENTS                  ( NE): 400
NO. OF LAYERS                          ( NL): 2
SUM OF CONNECTING NODES FOR EACH NODE  ( NJ): 9335


    NODE             X              Y      AREA(ACRES)
       1    1804440.00    14435520.00        247.10
       .             .              .             .
       .             .              .             .
       .             .              .             .
     441    1935672.00    14566752.00        247.10


   ELEMENT             NODE            AREA(ACRES)
        1       1     2    23    22       988.40
        .       .     .     .     .            .
        .       .     .     .     .            .
        .       .     .     .     .            .
      400     419   420   441   440       988.40


    *** TOP AND BOTTOM ELEVATIONS OF AQUIFER LAYERS (FEET) ***
  NODE  GRND.SURF.          LAYER  1                     LAYER  2
                    IUD        TOP      BOTTOM     IUD        TOP      BOTTOM
     1      500.00    1     500.00        0.00       1     -10.00     -110.00
     .           .    .          .           .       .          .           .
     .           .    .          .           .       .          .           .
     .           .    .          .           .       .          .           .
   441      500.00    1     500.00        0.00       1       0.00     -100.00

REACH STREAM GRID     GROUND   INVERT              AQUIFER   ALLUVIAL    UPSTREAM
  NO.   NO.   NO.      ELEV.    ELEV.     DEPTH     BOTTOM  THICKNESS     NODES
                          (ALL UNITS ARE IN FEET)
     1     1   433     500.0    300.0     200.0       0.0     300.0
     1     2   412     500.0    298.0     202.0       0.0     298.0        1
     .     .     .         .        .         .         .         .        .
     .     .     .         .        .         .         .         .        .
     .     .     .         .        .         .         .         .        .
     3    22    34     500.0    262.0     238.0       0.0     262.0       21
     3    23    13     500.0    260.0     240.0       0.0     260.0       22


 NODE   # OF ACTIVE LAYERS   TOP ACTIVE LAYER   SURROUNDING GW NODES
    1                  2                  1        2    22    23
    .                  .                  .        .     .     .
    .                  .                  .        .     .     .
    .                  .                  .        .     .     .
  441                  2                  1      419   420   440

 ELEMENT              ELEMENT MATRIX COMPONENTS
     1        -0.17     -0.33     -0.17     -0.17     -0.33     -0.17
     .            .         .         .         .         .         .
     .            .         .         .         .         .         .
     .            .         .         .         .         .         .
   400        -0.17     -0.33     -0.17     -0.17     -0.33     -0.17

**************************************************
TOTAL RUN TIME:  0.220 SECONDS
**************************************************
```

4. Simulation

The simulation portion of IWFM models the groundwater flow, stream flows, lake storages, and land surface and root zone flow processes within the project domain for a simulation time period. This chapter details the input and output files associated with this portion of the program.

4.1. Input Files

This section consists of input file explanations, the description of variables in each simulation input file and a sample of each input file.

In setting the spatial and temporal input data to be used in IWFM runs, the user is free to specify data with any units as long as the correct conversion factors are specified. IWFM does not use a particular set of units internally. Instead, the user decides on the units to be used and it is the user's responsibility to specify appropriate conversion factors in the input data files to convert a particular data unit to the unit used during simulation. Preparation of each data file includes the entry of relevant conversion factors that need to be specified by the user.

All time series data files require specifying the NSP_ and NFQ_ variables. For instance, in the Stream Inflow Data File these variables appear as NSPSTRM and NFQSTRM, respectively. These variables are included in time-series data files in order to make the entry of repetitive data more convenient. NSP_ variable is the number of time steps before a particular time-series data is updated. NFQ_ variable is the repetition frequency of the particular data file. As an example, consider irrigation months (i.e. growing period) for a specific crop. The irrigation month (specified as 1 if the crop is grown in a given month, or 0 if it is not) will change in a given water year but will likely stay the same from one year to another. Therefore, generally one value of irrigation period flag is defined for each month of the year and these values are used for the corresponding months of all simulation years. The repetitive irrigation period data entry can be avoided by the use of NSP_ and NFQ_ variables. If IWFM is run on a monthly time step, then NSPIP in the Irrigation Period Data File can be set as 1, NFQIP as 12 and the 12 monthly irrigation period flags can be listed afterwards with the first irrigation period flag corresponding to the first simulation month. This means that IWFM will read an irrigation period flag at the beginning of every time step (NSPIP = 1) and when it reads in 12 values (NFQIP = 12) it will rewind the data file and start reading irrigation period flags from the beginning of the file.

As another example, consider using the same monthly irrigation period flags with a daily IWFM run. Assuming that there are 30 days in each month (IWFM does not make such assumptions internally. It is up to the user to make and defend such assumptions) the same 12-value irrigation period data can be used by setting NSPIP to 30 and NFQIP to 12. This time IWFM will read an irrigation period flag and use it for 30 time steps (NSPIP = 30), i.e. 30 days. At the beginning of the 31^{st} time step, i.e. 31^{st} day, it will read in the next irrigation period flag and use it for another 30 time steps. When a total of 12 readings from the Irrigation Period Data File is made (NFQIP = 12), IWFM will rewind the data file and continue reading values from the start of the file. If, on the other hand, the full time series data for the entire simulation period is supplied then NFQ_ variable should be set to zero.

Although NSP_ and NFQ_ values are used only in non-time tracking simulations, the user is required to input a value for these variables in time tracking simulations as well. The following sections give detailed descriptions of each input and output data file involved in simulation part of IWFM.

Simulation Main Input File

The main input file for IWFM simulation is similar to the Pre-processor Main Input File, in that it contains the file names for all data files, output files, and binary files as well as unit output specifications. The character ‘c’, ‘C’, or ‘*’, in the first column indicates a comment line in the data file. These characters cannot be placed in the first column to be read as input. The title of the model run is specified in this file and is printed to the Simulation Standard Output File (SimulationMessages.out). The program accepts a maximum of three title lines.

The names of the input data files are also listed in this file. Most of these input data files are the main data files for individual simulation components included in model along with some timeseries data files that are used across multiple simulation components (namely irrigation fractions, supply adjustment specifications, precipitation and evapotranspiration data). The simulation period start and time as well as time step length are also specified. The simulation option as time tracking or non-time tracking is specified with the format of the time for the start of the simulation period.

Three output and debugging options are available in IWFM. A value of 1 directs the program to print messages regarding the program execution to the screen. A value of 0 instructs IWFM not to print any messages on the screen except the simulation timestep. Finally, setting KDEB to –1 turns off all screen output. This option may decrease program execution times on some operating systems.

Solution scheme control parameters (namely the solution method, the relaxation parameter, maximum number of iterations and convergence criteria for the solution of equation system and the supply adjustment) are also specified in this file. The user can choose between two matrix inversion methods, namely the successive over-relaxation (SOR) and the generalized preconditioned conjugate gradient (GMRES) methods. If SOR method is used then the over-relaxation parameter should be set to a value between 1.0 and 2.0. For GMRES method this parameter is not used even though some value has to be entered to avoid immature stopping of the Simulation program. The convergence criteria and the maximum iteration number for the supply adjustment are used if automated supply adjustment is turned on.

The functionality of adjusting surface water diversions and/or pumping internally can be activated by setting KOPTDV to a value other than 00.

The following is a list of the variables used in this data file:

BDT	Beginning date and time for the simulation. If it is a time tracking simulation , it should have a MM/DD/YYYY_hh:mm format. If it is a non-time tracking simulation, it should be a real number.
DELTAT	Time step used in the simulation of hydrologic processes. This variable is used only for non-time tracking simulations. At this

point, this value is hard coded as 1.0.

UNITT — For time tracking simulation, this is the time step length and unit. The user is expected to choose one of the options listed in the Simulation Main Input File. If non-time tracking simulation, then this is the unit of time step DELTAT with a maximum of 10 characters.

EDT — Ending time of simulation period. If it is a time tracking simulation, it should have the MM/DD/YYYY_hh:mm format. In non-time tracking simulations it is a real number. For instance, assume that BDT is set to 5.0 and DELTAT to 1.0 in a non-time tracking simulation. If the length of simulation period is 100.0 then this variable should be set to 105.0.

KDEB — Switch for output and debugging options (1 = print messages on the screen to monitor execution; 0 = turn off message printing, except for the simulation timesteps, on the screen; -1 = suppress all message printing, including simulation timesteps, on the screen)

CACHE — This is the minimum number of simulation results for each time series output data that is stored in the computer memory before saved onto the hard disk. The actual number is specified internally in IWFM based on the characteristics of the output data. For instance, if a model domain has a total of 200 groundwater nodes and if CACHE is set to 2000, then 10 time step worth of groundwater head values will be stored in the memory before being saved onto the hard disk. If CACHE is set to 200, only 1 time step worth of groundwater head values will be stored in the memory. If it is set to 20, still 1 time step worth of head values will be stored in the memory. The value set for the CACHE variable can have a substantial effect on the speed of the simulation especially if DSS files are being used for output.

MSOLVE	Matrix solution method. Enter 1 to use the successive over-relaxation (SOR) method, or 2 to use the generalized preconditioned conjugate gradient method
RELAX	Relaxation parameter for the successive overrelaxation method used in solving the system of equations (value should be between 1.0 and 2.0). A value must still be supplied even if generalized preconditioned conjugate gradient method (MSOLVE = 2) is chosen to invert the coefficient matrix.
MXITER	Maximum number of iterations for the solution of system of equations that represent the mass conservation for streams, lakes and groundwater
MXITERSP	Maximum number of iterations for supply adjustment
STOPC	Convergence criteria for groundwater, stream and lake head difference, [L]
STOPCSP	Fraction of water demand to be used as a convergence criteria for iterative supply adjustment. If the difference between the water supply and water demand at agricultural and/or urban lands in a

grid cell is less than this convergence criteria, then supply adjustment is skipped.

KOPTDV	Switch to turn on or off the automated water supply adjustment functionality of IWFM. It is specified as a two digit number. First digit from left turns on or off the adjustment of groundwater pumping (0 = no adjustment; 1 = adjust groundwater pumping). Second digit from left turns on or off the adjustment of surface water diversions (0 = no adjustment for diversions; 1 = adjust diversions so that diversions meet the total water demand less the groundwater pumping). If both diversions and pumping are specified to be adjusted, then diversions are adjusted first and pumping is adjusted second. If KOPTDV is set to a value other than 00, then the Supply Adjustment Specification File should also be supplied.

```
C*******************************************************************************
C
C                    INTEGRATED WATER FLOW MODEL (IWFM)
C                           *** Version ### ***
C
C*******************************************************************************
C
C                              MAIN INPUT FILE
C                            for IWFM Simulation
C
C
C               Project:  IWFM Version ### Release
C                         California Department of Water Resources
C               Filename: Simulation_MAIN.IN
C
C*******************************************************************************
C                                File Description
C
C    This file contains the title of the run to be printed in the output,
C    the names and descriptions of all simulation input files, conversion
C    factors and output control options for running the simulation model.
C
C*******************************************************************************
C                          Titles Printed in the Output
C
C   *A maximum of 3 title lines can be printed.
C   *Do not use '*' , 'c' or 'C' in the first column of the title lines.
C
C                            **********************
                                    IWFM
                             Version ### Release
                                     DWR
C                            **********************
C*****************************************************************************
C                              File Description
C
C  *Listed below are all input and output file names used when running the
C   IWFM simulation.
C
C  *Each file name has a maximum length of 1000 characters
C
C  *If a file does not exist for a project, leave the filename blank
C   For example, if tile drains are not modeled in the project, the file name and
C   description columns for unit 14 will appear as:
C
C   FILE NAME                                      DESCRIPTION
C                                                  / 3: STREAM COMPONENT MAIN FILE (INPUT, OPTIONAL)
C-------------------------------------------------------------------------------
C    FILE NAME                                     DESCRIPTION
C---------------------------------------------------------------------------------------------
     PreProcessor.bin                              / 1: BINARY INPUT GENERATED BY PRE-PROCESSOR (INPUT, REQUIRED)
     GW\Groundwater_MAIN.dat                       / 2: GROUNDWATER COMPONENT MAIN FILE (INPUT, REQUIRED)
     Stream\Stream_MAIN.dat                        / 3: STREAM COMPONENT MAIN FILE (INPUT, OPTIONAL)
     Lake\Lake_MAIN.dat                            / 4: LAKE COMPONENT MAIN FILE (INPUT, OPTIONAL)
     RootZone\RootZone_MAIN.dat                    / 5: ROOT ZONE COMPONENT MAIN FILE (INPUT, OPTIONAL)
     SWShed.dat                                    / 6: SMALL WATERSHED COMPONENT MAIN FILE (INPUT, OPTIONAL)
     UnsatZone.dat                                 / 7: UNSATURATED ZONE COMPONENT MAIN FILE (INPUT, OPTIONAL)
     IrigFrac.dat                                  / 8: IRRIGATION FRACTIONS DATA FILE (INPUT, OPTIONAL)
     SupplyAdjust.dat                              / 9: SUPPLY ADJUSTMENT SPECIFICATION DATA FILE (INPUT, OPTIONAL)
     Precip.dat                                    /10: PRECIPITATION DATA FILE (INPUT, OPTIONAL)
     ET.dat                                        /11: EVAPOTRANSPIRATION DATA FILE (INPUT, OPTIONAL)
C*******************************************************************************
C                           Model Simulation Period
C
C   The following lists the simulation beginning time, ending time and time step length.
C   Based on the entry for BDT below, the actual simulation date and time can be tracked.
C
C   BDT    ; Beginning date and time for the simulation.  Use one of the following formats:
C              MM/DD/YYYY_hh:mm  = Simulation date and time will be tracked
C                                    (Midnight is 24:00);
C              #.##              = Simulation date and time will NOT be tracked
C                                    (any real number greater than or equal to zero can be entered).
C
C-------------------------------------------------------------------------------
C      VALUE                      DESCRIPTION
C-------------------------------------------------------------------------------
       09/30/1990_24:00           / BDT
C-------------------------------------------------------------------------------
C                          Simulation Date and Time Tracked
C
C   If the simulation date and time will be tracked (i.e. BDT above is entered in
C   MM/DD/YYYY_hh:mm format) enter values for parameters below.  Otherwise, comment
C   out the value entry lines below and use the "Simulation Date and Time NOT Tracked"
C   option below.
C
C   UNITT  ; Time step length and unit. Choose one of the following:
C                   1MIN
C                   2MIN
C                   3MIN
C                   4MIN
C                   5MIN
C                   10MIN
C                   15MIN
C                   20MIN
C                   30MIN
C                   1HOUR
C                   2HOUR
C                   3HOUR
C                   4HOUR
C                   6HOUR
C                   8HOUR
C                   12HOUR
C                   1DAY
C                   1WEEK
C                   1MON
C                   1YEAR
C   EDT   ; Ending simulation date and time.  Use MM/DD/YYYY_hh:mm format
C             (midnight is 24:00).
C
C-------------------------------------------------------------------------------
C      VALUE                  DESCRIPTION
C-------------------------------------------------------------------------------
```

```
       1DAY                     / UNITT
       09/30/2000_24:00         / EDT
C-----------------------------------------------------------------------------
C                        Simulation Date and Time NOT Tracked
C
C   If the simulation date and time will not be tracked (i.e. BDT above is entered in
C   #.## format) enter values for parameters below.  Otherwise, comment
C   out the value entry lines below and use the above "Simulation Date and Time Tracked"
C   option.
C
C   DELTAT ; Time step to be used in the simulation of hydrologic processes;
C              any entry that is greater than zero is acceptable.
C   UNITT  ; Unit of time step DELTAT (maximum 10 characters);
C              any entry is acceptable.
C   EDT    ; Ending simulation date and time.  Use #.## format.
C
C-----------------------------------------------------------------------------
C       VALUE                   DESCRIPTION
C-----------------------------------------------------------------------------
*                               / DELTAT
*                               / UNITT
*                               / EDT
C*********************************************************************************
C                      Processing, Output and Debugging Options
C
C   The following lists the options for detailed output and debugging.
C   KDEB;    Enter  1 - print messages on the screen to monitor execution
C            Enter  0 - do not print messages on the screen to monitor execution (except simulation timestep)
C            Enter -1 - suppress printing of timestep on the screen
C   CACHE;   Cache size in terms of number of values stored for time series data output
C
C---------------------------------------------------------------------------------
C   VALUE                       DESCRIPTION
C-----------------------------------------------------------------------------
    0                           / KDEB
    50000                       / CACHE
C*****************************************************************************
C                           Solution Scheme Control
C
C   The following lists the solution scheme control parameters used in SIMULATION
C
C   MSOLVE  ; Matrix solution method
C               1 = SOR method
C               2 = Generalized preconditioned conjugate method
C   RELAX   ; Relaxation parameter for SOR (value should be between 1.0 and 2.0)
C   MXITER  ; Maximum number of iterations for the solution of system of equations
C   MXITERSP; Maximum number of iterations for pumping adjustment
C   STOPC   ; Convergence criteria for groundwater, stream and lake head difference; [L]
C   STOPCSP ; Fraction of water demand to be used as convergence criteria for
C              iterative supply adjustment
C-----------------------------------------------------------------------------
C   VALUE                       DESCRIPTION
C-----------------------------------------------------------------------------
    2                           / MSOLVE
    1.0                         / RELAX
    1500                        / MXITER
    50                          / MXITERSP
    0.0001                      / STOPC
    0.001                       / STOPCSP
C*****************************************************************************
C                    Supply Adjustment Control Options
C
C   KOPTDV;  Enter two digits as follows:
C            1st digit(from left):
C                       0 = No adjustment for groundwater pumping
C                       1 = YES: Adjust groundwater pumping
C
C            2nd digit(from left):
C                       0 = No adjustment for streamflow diversion
C                       1 = YES: Adjust surface water diversions
C            ** Note: When this flag is set to a value other than 00, SupplyAdjustment
C                     Specifications Data File is required.
C-----------------------------------------------------------------------------
C   VALUE                       DESCRIPTION
C-----------------------------------------------------------------------------
    11                         / KOPTDV
```

Groundwater Component Files

The Simulation Main Input File points to the Groundwater Main Input File which is the gateway to all other files that include data for the simulation of groundwater flows, tile drainage, subsidence and pumping. These data files are described in the following sections.

Groundwater Component Main File

Groundwater Component Main File is the gateway to additional data files that are used in simulating the groundwater flows, subsidence, tile drainage and pumping. The name of the additional input data files and optional output files, and factors to convert simulation units to the desired units of output as well as the output unit names, groundwater hydrograph print-out data, aquifer parameters and initial groundwater heads are listed in this file.

The Groundwater Component Main File is divided into multiple sections:

General Input and Output Filenames and Output Conversion Factors

This section lists the input data files that the groundwater component uses to simulate boundary flow conditions, tile drains, pumping and subsidence. Factors to convert simulation units to output data units as well as the output unit names are also given in this section. Finally, optional output data filenames are listed.

There are 3 separate types of output files: i) files that require no post-processing (vertical flows, groundwater head at each node, end-of-simulation groundwater heads), ii) files that require post-processing by either Budget or Z-Budget post-processors of IWFM (binary output for groundwater budget at each subregion, binary output for zone budget post-processing), and iii) one file that require post-processing by the proprietary software TECPLOT (TECPLOT output for groundwater heads). All these output files are optional and are further discussed later in this document.

The following variables are used in this section:

BCFL	Boundary conditions data file (maximum 1000 characters); leave blank if no boundary conditions (other than zero-flow boundary condition) are specified
TDFL	Tile drains/subsurface irrigation data file (maximum 1000 characters); leave blank if tile drains/subsurface irrigation are not simulated
PUMPFL	Pumping/recharge data file (maximum 1000 characters); leave blank if pumping/recharge is not simulated
SUBSFL	Subsidence parameter file (maximum 1000 characters); leave blank if subsidence is not simulated
OVRWRTFL	Aquifer parameter overwrite file (maximum 1000 characters); this file can be used to overwrite selected aquifer parameters that are defined in the Groundwater Component Main File; leave blank if aquifer parameters will not be overwritten
FACTLTOU	Factor to convert simulation unit of groundwater heads and the coordinates of cell centroids for velocity print-out into intended output unit

UNITLTOU	Output unit of groundwater heads and the coordinates of cell centroids (maximum 10 characters)
FACTVLOU	Factor to convert simulation unit of groundwater flows into intended output unit
UNITVLOU	Output unit of groundwater flow (maximum 10 characters)
FACTVROU	Factor to convert simulation unit of groundwater flow velocities at cell centroids into intended output unit
UNITVROU	Output unit of groundwater flow velocities at cell centroids (maximum 10 characters)
VELOUTFL	Output file for groundwater velocities at cell centroids (maximum 1000 characters); leave blank if this output is not required
VFLOWOUTFL	Output file for vertical flow (maximum 1000 characters); leave blank if this output is not required
GWALLOUTFL	Output file for groundwater head at every node (maximum 1000 characters); leave blank if this output is not required
HTPOUTFL	TECPLOT output file for groundwater heads (maximum 1000 characters); leave blank if this output is not required
VTPOUTFL	TECPLOT output file for groundwater velocities (maximum 1000 characters); leave blank if this output is not required
GWBUDFL	Binary output file for groundwater budget at each subregion (maximum 1000 characters); leave blank if this output is not required

ZBUDFL	Binary output file for zone budget post-processor (maximum 1000 characters); leave blank if this output is not required
FNGWFL	Output file for end-of-simulation groundwater heads (maximum 1000 characters); leave blank if this output is not required

Debugging

IWFM optionally can print aquifer parameters at each node that are processed and used for the simulation of the groundwater flows for debugging purposes. Printing of the aquifer parameters can be useful, for instance, when the parameters are specified using parametric grids (see below for a detailed discussion on parametric grids) and the parameters at finite element nodes are established through interpolation done internally in IWFM. The aquifer parameters are printed to the Simulation Standard Output File (SimulationMessages.out) that is discussed later in this chapter. The following variable is used for turning on or off this print-out:

KDEB	Switch to turn on or off the printing of aquifer parameters at each node (0 = do not print aquifer parameters; 1 = print aquifer parameters)

Groundwater Hydrograph Output Data

This section contains instructions for printing groundwater hydrographs at user-selected locations. Groundwater hydrographs can be printed at specified groundwater nodes or at locations defined by x-y coordinates and aquifer layers. The number of groundwater hydrographs to be printed (NOUTH), the conversion factor for nodal coordinates (FACTXY) and the name of the output file (GWHYDOUTFL) are required. In a given model run, both types of hydrograph locations (specified either as node number or through x-y coordinates) can be defined. The user is also required to specify the aquifer layer number (IOUTHL) for which the hydrograph print-out is desired. A value of zero for the aquifer layer number directs IWFM to print the arithmetic average of the groundwater heads at all layers at the specified location. Groundwater hydrograph print-out is an optional output; it can be turned off by specifying the number of hydrograph locations (NOUTH) as zero (and by not listing any hydrograph locations) or by leaving blank the name for the output file.

The following variables are used for groundwater head hydrograph print-out:

NOUTH	Total number of groundwater hydrographs to be printed; set NOUTH = 0 if no groundwater hydrograph data is to be printed
FACTXY	Factor to convert hydrograph location coordinates into simulation unit of length
GWHYDOUTFL	Filename for groundwater hydrograph output (maximum 1000 characters); leave blank if this output is not required
ID	Sequential hydrograph ID number (1 through NOUTH)
HYDTYP	Hydrograph location type (0 = hydrograph location is given as x-y coordinates; 1 = hydrograph location is given as groundwater node number)
IOUTHL	Aquifer layer number for hydrograph print-out enter 0 to print average head for all layers
X	The x-coordinate of the hydrograph location (enter any value if

HYDTYP = 1; i.e. hydrograph location is specified as a node number), [L]

Y — The y-coordinate of the hydrograph location (enter any value if HYDTYP = 1; i.e. hydrograph location is specified as a node number), [L]

IOUTH — Groundwater node number (enter any value if HYDTYP = 0; i.e. hydrograph location is specified as an x-y coordinate)

NAME — Name of the hydrograph print location such as the observation well number (maximum 30 characters)

Element Face Flow Output Data

IWFM allows optional printing of the flow rates at element faces. Each element face for which a flow hydrograph is desired is specified by listing the two node numbers that make up the face as well as the aquifer layer in which the element face lies. To turn off the element face flow print-out either set the number of flow hydrographs to be printed to zero or leave blank the name of the output file. The following variables are used:

NOUTF — Number of element faces for flow printing (set NOUTF to zero if element face flow hydrographs will not be printed)

FCHYDOUTFL — Filename for element face flow output (maximum 1000 characters); leave blank if this output is not required

ID — Sequential hydrograph ID number (1 through NOUTF)

IOUTFL — Aquifer layer number where the element face is located

IOUTFA — The first groundwater node number that defines the element face

IOUTFB — The second groundwater node number that defines the element face

Aquifer Parameters

Aquifer parameters can be specified using parametric grids (NGROUP > 0) or for each groundwater node (NGROUP = 0). The NGROUP value indicates the number of parametric grids used to define aquifer parameters. Regardless of the value specified for NGROUP, the following list specifies the variables that must be defined in the Groundwater Component Main File:

NGROUP — Number of parametric grid groups (0 = aquifer parameters will be specified at each aquifer node; otherwise aquifer parameters are specified using parametric grids)

FX — Conversion factor for parametric grid coordinates

FKH — Conversion factor for the spatial component for the unit of aquifer horizontal hydraulic conductivity

FS — Conversion factor for specific storage coefficient

FN — Factor to weight specific yield value

FV — Conversion factor for the spatial component for the unit of aquitard vertical hydraulic conductivity

FL — Conversion factor for the spatial component for the unit of aquifer vertical hydraulic conductivity

TUNITKH	Time unit of horizontal hydraulic conductivity; this should be one of the units recognized by HEC-DSS that are listed in the Simulation Main Input File
TUNITV	Time unit of aquitard vertical conductivity; this should be one of the units recognized by HEC-DSS that are listed in the Simulation Main Input File
TUNITL	Time unit of aquifer vertical conductivity; this should be one of the units recognized by HEC-DSS that are listed in the Simulation Main Input File

From the parametric grid information, aquifer parameters at parametric nodes are interpolated to obtain parameter values at finite element nodes within the model domain. A parametric grid group may zoom in closer on groundwater nodes associated with the group and overwrite values given in the previous group. A value of –1 for any parameter specified for a node within a parametric grid group indicates that the parameter value specified in the previous group for the parametric node remains the same value. For NGROUP value greater than zero, the following information must be defined for each parametric grid group:

NDP	Number of parametric nodes in the parametric grid
NEP	Number of parametric elements in the parametric grid
IE	Parametric element number
NODE	Parametric nodes that make up the parametric element IE listed in counter-clockwise directyion
ID	Parametric node number

PX, PY	Parametric node coordinates, [L]
PKH	Aquifer horizontal hydraulic conductivity, [L/T]
PS	Specific storage, [1/L]
PN	Specific yield, [L/L]
PV	Aquitard vertical hydraulic conductivity, [L/T]
PL	Aquifer vertical hydraulic conductivity, [L/T]

In order to set parameters at specified finite element nodes to values defined at an individual parametric node, the number of parametric nodes, NDP, should be given as 1 and number of parametric elements, NEP, should be given as 0. This is useful when a portion or the entire model domain is homogeneous, and parameters at specified finite element nodes are required to be set to the same values. If this feature is utilized (i.e. NDP is set to 1 and NEP is set to 0) then the construction of parametric elements needs to be skipped (i.e. specification of IE and NODE).

If no parametric grids are specified, advance to the point in the data file where aquifer parameters are specified by each groundwater node (Option 2). In this case, the above parameter values (PKH through PL) are specified for each finite element node. The conversion factors specified above are used to convert input data units to the units that are used in the simulation.

Anomaly in Hydraulic Conductivity

If there are hydraulic conductivity values defined in the previous section that need to be overwritten, the following parameters in this file must be defined:

NEBK	Number of elements where hydraulic conductivity values will be overwritten (set NEBK = 0 if there are no anomalies in the hydraulic conductivity)
FACT	Conversion factor for the spatial component for the unit of anomaly hydraulic conductivity values
TUNITH	Time unit of anomaly hydraulic conductivity; this should be one of the units recognized by HEC-DSS that are listed in the Simulation Main Input File
IC	Sequential identification number of the element for which anomaly hydraulic conductivity is defined
IEBK	Element number corresponding to counter IC
BK	Hydraulic conductivity at the specified element; this value should be given for each aquifer layer modeled in IWFM, [L/T]

Initial Groundwater Heads

In this section initial groundwater heads are listed for each node at each aquifer layer:

FACTHP	Conversion factor for initial heads
ID	Groundwater node number listed sequentially
HP	Initial head at corresponding groundwater node; [L]

```
#4.0
C***  DO NOT DELETE ABOVE LINE ***
C
C*****************************************************************************
C
C                 INTEGRATED WATER FLOW MODEL (IWFM)
C
C*****************************************************************************
C
C                 GROUNDWATER COMPONENT MAIN DATA FILE
C                       Groundwater Component
C                        *** Version 4.0 ***
C
C
C            Project :  IWFM Version ### Release
C                       California Department of Water Resources
C            Filename:  GW_MAIN.dat
C
C*****************************************************************************
C                         File Description
C
C   This data file contains the parameters and data file names for the simulation
C   of groundwater and related flow processes.
C
C*****************************************************************************
C                    Input and Output Data File Names
C
C   BCFL      ;  Boundary conditions data file (max. 1000 characters)
C                 * Leave blank if no boundary conditions (other than zero flow b.c.)
C                   are specified
C   TDFL      ;  Tile drains/subsurface irrigation data file (max. 1000 characters)
C                 * Leave blank if tile drains/subsurface irrigation are not simulated
C   PUMPFL    ;  Pumping/recharge data file (max. 1000 characters)
C                 * Leave blank if pumping/recharge is not simulated
C   SUBSFL    ;  Subsidence parameter file (max. 1000 characters)
C                 * Leave blank if subsidence is not simulated
C   OVRWRTFL  ;  Aquifer parameter overwrite file (max. 1000 characters)
C                 * Leave blank if aquifer parameters will not be overwritten
C   FACTLTOU  ;  Factor to convert simulation unit of groundwater heads and the coordinates
C                 of cell centroids for velocity print-out into intented output unit
C   UNITLTOU  ;  Output unit of groundwater heads and the coordinates of cell
C                 centroids (max. 10 characters)
C   FACTVLOU  ;  Factor to convert simulation unit of groundwater flows into
C                 intented output unit
C   UNITVLOU  ;  Output unit of groundwater flow (max. 10 characters)
C   FACTVROU  ;  Factor to convert simulation unit of groundwater flow velocities at cell
C                 centroids into intended output unit
C   UNITVROU  ;  Output unit of groundwater flow velocities at cell centroids (max. 10 characters)
C   VELOUTFL  ;  Output file for groundwater velocities at cell centroids (max. 1000 characters)
C                 * Leave blank if this output is not required
C   VFLOWOUTFL;  Output file for vertical flow (max. 1000 characters)
C                 * Leave blank if this output is not required
C   GWALLOUTFL;  Output file for groundwater head at every node (max. 1000 characters)
C                 * Leave blank if this output is not required
C   HTPOUTFL  ;  TecPlot output file for groundwater heads (max. 1000 characters)
C                 * Leave blank if this output is not required
C   VTPOUTFL  ;  TecPlot output file for groundwater velocities (max. 1000 characters)
C                 * Leave blank if this output is not required
C   GWBUDFL   ;  Binary output file for groundwater budget at each subregion (max. 1000 characters)
C                 * Leave blank if this output is not required
C   ZBUDFL    ;  Binary output file for zone budget post-processor (max. 1000 characters)
C                 * Leave blank if this output is not required
C   FNGWFL    ;  Output file for end-of-simulation groundwater heads (max. 1000 characters)
C                 * Leave blank if this output is not required
C
C-----------------------------------------------------------------------------------------
C         VALUE                                       DESCRIPTION
C-----------------------------------------------------------------------------------------
   BoundCond.dat                                     / BCFL
                                                     / TDFL
   Pumping_MAIN.dat                                  / PUMPFL
   Subsidence_MAIN.dat                               / SUBSFL
                                                     / OVRWRTFL
   1.0                                               / FACTLTOU
   ft.                                               / UNITLTOU
   2.295684e-5                                       / FACTVLOU
   ac.ft.                                            / UNITVLOU
   1.0                                               / FACTVROU
   fpd                                               / UNITVROU
   GWVelocities.out                                  / VELOUTFL
   VertFlow.out                                      / VFLOWOUTFL
   GWHeadAll.out                                     / GWALLOUTFL
   GWTecPlot.out                                     / HTPOUTFL
                                                     / VTPOUTFL
   GWBudget.bin                                      / GWBUDFL
   ZBudget.bin                                       / ZBUDFL
   GWFinal.out                                       / FNGWFL
C*****************************************************************************
C                             Debugging
C
C   KDEB       ;   Enter 1 - print aquifer parameter data
C                  Enter 0 - DO NOT print aquifer parameter data
C
C-----------------------------------------------------------------------------
C   VALUE                        DESCRIPTION
C-----------------------------------------------------------------------------
     1                           / KDEB
C*****************************************************************************
C                       Groundwater Hydrograph Output Data
C
C   The following lists the node and layer numbers for which groundwater
C   hydrograph will be printed
C
C   NOUTH      ; Total number of hydrographs to be printed
C                 (NOUTH = 0 if no hydrograph is to be printed)
C   FACTXY     ; Conversion factor for nodal coordinates of the hydrograph location
C                 if given in x-y coordinates
C   GWHYDOUTFL ; File name for groundwater hydrograph output (max. 1000 characters)
C                 * Leave blank if this output is not required
C
C-----------------------------------------------------------------------------
C   VALUE                        DESCRIPTION
```

```
C-------------------------------------------------------------------------------
    42                          / NOUTH
    3.2808                      / FACTXY      (m -> ft)
    GWHyd.out                   / GWHYDOUTFL
C-------------------------------------------------------------------------------
C
C   The following lists the hydrograph location type (x-y coordinates or node number),
C   layer number, and x-y coordinates or groundwater node number for each groundwater
C   hydrograph to be printed (skip if no hydrographs are to be printed, i.e. NOUTH = 0)
C
C   ID    ;  Sequential hydrograph ID number (1 through NOUTH)
C   HYDTYP;  Hydrograph location type
C               0 = hydrograph location is given as x-y coordinates
C               1 =    "          "      "   "    " groundwater node number
C   IOUTHL;  Layer number
C               * Enter 0 to print average head for all layers
C   X     ;  The x-coordinate of the hydrograph location; [L]
C               * Leave blank if HYDTYP = 1
C   Y     ;  The y-coordinate of the hydrograph location; [L]
C               * Leave blank if HYDTYP = 1
C   IOUTH ;  Groundwater node number
C               * Leave blank if HYDTYP = 0
C   NAME  ;  Name of the hydrograph print location such as the well name (max. 30 characters)
C
C-------------------------------------------------------------------------------
C   ID    HYDTYP    IOUTHL       X           Y           IOUTH    NAME
C-------------------------------------------------------------------------------
    1       0         1         875002.0    3885167.0            ObsWell1
    2       0         1         871491.0    3917354.0            ObsWell2
    3       1         1                                  391     ObsWell3
    .       .         .             .           .         .         .
    .       .         .             .           .         .         .
    .       .         .             .           .         .         .
    40      1         2                                  55      ObsWell40
    41      1         2                                  34      ObsWell41
    42      1         2                                  13      ObsWell42
C*******************************************************************************
C                          Element Face Flow Output Data
C
C   The following lists the element faces for which the groundwater flow output
C   is desired.
C
C-------------------------------------------------------------------------------
C
C   NOUTF      ; Number of element faces for flow output
C                  (NOUTF = 0 if no hydrograph is to be printed)
C   FCHYDOUTFL ; File name for element face flow output (max. 1000 characters)
C                  * Leave blank if this output is not required
C
C-------------------------------------------------------------------------------
C   VALUE                       DESCRIPTION
C-------------------------------------------------------------------------------
     3                          / NOUTF
     FaceFlow.out               / FCHYDOUTFL
C-------------------------------------------------------------------------------
C
C   The following lists the layer number and groundwater node numbers that
C   defines the element face for each face flow hydrograph to be printed (skip
C   if no element face flow hydrograph is to be printed, ie. NOUTF = 0)
C
C   ID     ; Sequential hydrograph ID number (1 through NOUTF)
C   IOUTFL ; Layer number
C   IOUTFA ; The first groundwater node number that defines the element face
C   IOUTFB ; The second groundwater node number that defines the element face
C   NAME   ; Name for the hydrograph (max. 30 characters)
C
C-------------------------------------------------------------------------------
C   ID    IOUTFL     IOUTFA     IOUTFB    NAME
C-------------------------------------------------------------------------------
    1      1          89         90       Face1
    2      1          91         90       Face2
    3      2          91         90       Face3
C*******************************************************************************
C                            Aquifer Parameters
C
C-------------------------------------------------------------------------------
C   Option 1 - Set aquifer parameters by use of a parametric grid(NGROUP > 0)
C   Option 2 - Set aquifer parameters at every groundwater node  (NGROUP = 0)
C
C   NGROUP;  Number of parametric grid groups
C
C-------------------------------------------------------------------------------
C       VALUE                   DESCRIPTION
C-------------------------------------------------------------------------------
        6                       / NGROUP
C-------------------------------------------------------------------------------
C   OPTIONS 1 & 2 : The following lists the factors to convert the aquifer
C   parameters and grid coordinates to the appropriate units
C
C   FX     ;  Conversion factor for parametric grid coordinates
C   FKH    ;  Conversion factor for horizontal hydraulic conductivity
C               It is used to convert only the spatial component of the unit;
C               DO NOT include the conversion factor for time component of the unit.
C               * e.g. Unit of hydraulic conductivity listed in this file = FT/MONTH
C                      Consistent unit used in simulation                 = IN/DAY
C                      Enter FKH (FT/MONTH -> IN/MONTH)                   = 8.33333E-02
C                       (conversion of MONTH -> DAY is performed automatically)
C   FS     ;  Conversion factor for specific storage coefficient
C   FN     ;  Weighting factor for specific yield value
C   FV     ;  Conversion factor for aquitard vertical hydraulic conductivity
C               It is used to convert only the spatial component of the unit;
C               DO NOT include the conversion factor for time component of the unit.
C               * e.g. Unit of hydraulic conductivity listed in this file  = FT/MONTH
C                      Consistent unit used in simulation                 = IN/DAY
C                      Enter FV (FT/MONTH -> IN/MONTH)                    = 8.33333E-02
C                       (conversion of MONTH -> DAY is performed automatically)
C   FL     ;  Conversion factor for aquifer vertical hydraulic conductivity
C               It is used to convert only the spatial component of the unit;
C               DO NOT include the conversion factor for time component of the unit.
C               * e.g. Unit of hydraulic conductivity listed in this file = FT/MONTH
C                      Consistent unit used in simulation                 = IN/DAY
C                      Enter FL (FT/MONTH -> IN/MONTH)                    = 8.33333E-02
```

```
C                      (conversion of MONTH -> DAY is performed automatically)
C   TUNITKH;  Time unit of horizontal hydraulic conductivity.  This should be one of the units
C              recognized by HEC-DSS that are listed in the Main Control File.
C   TUNITV ;  Time unit of aquitard vertical conductivity.  This should be one of the units
C              recognized by HEC-DSS that are listed in the Main Control File.
C   TUNITL ;  Time unit of aquifer vertical conductivity.  This should be one of the units
C              recognized by HEC-DSS that are listed in the Main Control File.
C
C-------------------------------------------------------------------------------
C  FX        FKH        FS          FN         FV        FL
C-------------------------------------------------------------------------------
   3.281     1.0      0.000001       1.0        1.0       1.0
C-------------------------------------------------------------------------------
C   VALUE              DESCRIPTION
C-------------------------------------------------------------------------------
    1MON               / TUNITKH
    1MON               / TUNITV
    1MON               / TUNITL
C*******************************************************************************
C                  OPTION 1
C*******************************************************************************
C-------------------------------------------------------------------------------
C   *** GROUP 1 ***
C-------------------------------------------------------------------------------
C   Enter node numbers from FE grid for the 1st parametric group
C     (e.g. 1-100,101,301-359,567)
C     * Enter 0 if no nodes will be affected with this parametric grid
C-------------------------------------------------------------------------------
    1-1393
C-------------------------------------------------------------------------------
C
C   NDP;     Number of nodes in the 1st parametric grid
C   NEP;     Number of elements in the 1st parametric grid
C
C-------------------------------------------------------------------------------
C   VALUE                      DESCRIPTION
C-------------------------------------------------------------------------------
     33                        / NDP
     20                        / NEP
C-------------------------------------------------------------------------------
C
C   The following is a list of the parametric elements and
C   corresponding parametric nodes for the 1st parametric group
C   (to be used only when NEP > 0)
C
C   IE  ;    Parametric element number
C   NODE;    Corresponding parametric node
C
C-------------------------------------------------------------------------------
C            Node 1    Node 2    Node 3     Node 4
C    IE       NODE      NODE      NODE       NODE
C-------------------------------------------------------------------------------
      1         1         3         4          2
      2         3         5         6          4
      .         .         .         .          .
      .         .         .         .          .
      .         .         .         .          .
     19        28        31        32         29
     20        29        32        33         30
C-------------------------------------------------------------------------------
C
C   List the paramatric nodes, nodal coordinates and aquifer
C   parameters for each layer of the 1st parametric group
C   (enter -1.0 not to overwrite the previously set values)
C
C   ID   ;   Parametric node number
C   PX,PY;   Parametric node coordinates; [L]
C   PKH  ;   Hydraulic conductivity; [L/T]
C   PS   ;   Specific storage; [1/L]
C   PN   ;   Specific yield; [L/L]
C   PV   ;   Aquitard vertical hydraulic conductivity; [L/T]
C   PL   ;   Aquifer vertical hydraulic conductivity; [L/T]
C
C-------------------------------------------------------------------------------
C            NODAL   COORDINATES
C            OF PARAMETRIC  GRID     Hydr.   Spec.    Spec.   Aquitard    Aquifer
C                                    cond.   Stor.    Yld.     Vert. K    Vert. K
C  ID         PX        PY           PKH     PS       PN        PV          PL
C-------------------------------------------------------------------------------
    1       526411   4488044      100.00    1.0     0.08       0.20       1.0
                                   60.00    5.0     0.05       1.00       1.0
                                   60.00    5.0     0.05       0.60       0.6
    2       576022   4510977       80.00    1.0     0.09       0.20       1.0
                                   40.00    5.0     0.05       1.00       1.0
                                   40.00    5.0     0.05       0.60       0.6
    .            .         .           .      .        .          .         .
                                       .      .        .          .         .
                                       .      .        .          .         .
    .            .         .           .      .        .          .         .
                                       .      .        .          .         .
                                       .      .        .          .         .
   33       899721   3868499       80.00    1.0     0.12       0.20       1.0
                                   50.00    2.0     0.07       0.0001     0.1
                                   20.00    3.0     0.07       0.60       0.6
C-------------------------------------------------------------------------------
C    *** GROUP 2 ***
C-------------------------------------------------------------------------------
C   Enter node numbers from the FE grid for the 2nd parametric group
C     (e.g. 1-100,101,301-359,567)
C     * Enter 0 if no nodes will be affected with this parametric grid
C-------------------------------------------------------------------------------
    1318-1321,1325,1329-1336,1339-1347,1349-1358,1360-1393
C-------------------------------------------------------------------------------
C
C   NDP;     Number of nodes in the 2nd parametric grid
C   NEP;     Number of elements in the 2nd parametric grid
C
C-------------------------------------------------------------------------------
C   VALUE                       DESCRIPTION
C-------------------------------------------------------------------------------
     6                          / NDP
     2                          / NEP
```

```
C-------------------------------------------------------------------------------
C   Element   Node 1    Node 2    Node 3     Node 4
C    IE        NODE      NODE      NODE       NODE
C-------------------------------------------------------------------------------
      1         34        37        38         35
      2         35        38        39         36
C-------------------------------------------------------------------------------
C
C   List the paramatric nodes, nodal coordinates and aquifer
C   parameters for each layer of the 2nd parametric group
C   (enter -1.0 not to overwrite the previously set values)
C
C   ID   ;   Parametric node number
C   PX,PY;   Parametric node coordinates; [L]
C   PKH  ;   Hydraulic conductivity; [L/T]
C   PS   ;   Specific storage; [1/L]
C   PN   ;   Specific yield; [L/L]
C   PV   ;   Aquitard vertical hydraulic conductivity; [L/T]
C   PL   ;   Aquifer vertical hydraulic conductivity; [L/T]
C
C-------------------------------------------------------------------------------
C            NODAL   COORDINATES
C            OF PARAMETRIC  GRID    Hydr.   Spec.    Spec.   Aquitard    Aquifer
C                                   cond.   Stor.    Yld.     Vert. K    Vert. K
C  ID          PX        PY         PKH     PS       PN        PV         PL
C-------------------------------------------------------------------------------
   34       795918   3906758       100.0    1.0     0.12      0.2        1.0
                                    80.0    5.0     0.07      0.002      0.5
                                    20.0    3.0     0.07      0.6        0.6
    .           .         .          .       .        .        .           .
                                     .       .        .        .           .
                                     .       .        .        .           .
    .           .         .          .       .        .        .           .
                                     .       .        .        .           .
                                     .       .        .        .           .
   39       905818   3868499        80.0    1.0     0.12      0.2        1.0
                                    50.0   10.0     0.07      0.0015     0.4
                                     5.0    8.0     0.07      0.6        0.6
C-------------------------------------------------------------------------------
C    *** GROUP 3 ***
C-------------------------------------------------------------------------------
   .          .
   .          .
   .          .
C-------------------------------------------------------------------------------
C    *** GROUP 6 ***
C-------------------------------------------------------------------------------
C   Enter node numbers from the FE grid for the 6th parametric group
C     (e.g. 1-100,101,301-359,567)
C-------------------------------------------------------------------------------
 792  791  790  789  788  787  786  785
 784  769  768
 757  756  755  754  753  752  751  750
 749  728
 741  740  739  738  737  736  729
 715  702
 701  700  699  698  697  696  695  694
 693  683
 681  682
 671  660  649
 657  656  655  654  653  652  651  650  633
 623  622  621  620  619  618  617  616
 615  605  592  576  567  558
C-------------------------------------------------------------------------------
C
C   NDP;     Number of nodes in the 6th parametric grid
C   NEP;     Number of elements in the 6th parametric grid
C
C-------------------------------------------------------------------------------
C   VALUE                        DESCRIPTION
C-------------------------------------------------------------------------------
    1                            / NDP
    0                            / NEP
C-------------------------------------------------------------------------------
C   Element   Node 1    Node 2    Node 3     Node 4
C    IE        NODE      NODE      NODE       NODE
C-------------------------------------------------------------------------------
*
*
C-------------------------------------------------------------------------------
C
C   List the paramatric nodes, nodal coordinates and aquifer
C   parameters for each layer of the 2nd parametric group
C   (enter -1.0 not to overwrite the previously set values)
C
C   ID   ;   Parametric node number
C   PX,PY;   Parametric node coordinates; [L]
C   PKH  ;   Hydraulic conductivity; [L/T]
C   PS   ;   Specific storage; [1/L]
C   PN   ;   Specific yield; [L/L]
C   PV   ;   Aquitard vertical hydraulic conductivity; [L/T]
C   PL   ;   Aquifer vertical hydraulic conductivity; [L/T]
C
C-------------------------------------------------------------------------------
C            NODAL   COORDINATES
C            OF PARAMETRIC  GRID    Hydr.   Spec.    Spec.   Aquitard    Aquifer
C                                   cond.   Stor.    Yld.     Vert. K    Vert. K
C  ID          PX        PY         PKH     PS       PN        PV         PL
C-------------------------------------------------------------------------------
   43     742369.0  3867036.0       40.0  -1        -1     -1       -1        -1
                                    -1    -1        -1     -1       -1        -1
                                    -1    -1        -1     -1       -1        -1
C*******************************************************************************
C                 OPTION 2
C*******************************************************************************
C
C    List the groundwater nodes, and aquifer parameters for
C    each layer (skip if option 1 is used)
C
C   ID   ;   Groundwater node number
C   PKH  ;   Hydraulic conductivity; [L/T]
C   PS   ;   Specific storage; [1/L]
```

```
C   PN   ;   Specific yield; [L/L]
C   PV   ;   Aquitard vertical hydraulic conductivity; [L/T]
C   PL   ;   Aquifer vertical hydraulic conductivity; [L/T]
C
C-------------------------------------------------------------------------------
C                          Layer  1
C                          Layer  2
C                             .
C                             .
C                          Layer  NL
C
C        Hydr.   Spec.    Spec.   Aquitard    Aquifer
C        cond.   Stor.    Yld.     Vert. K    Vert. K
C  ID     PKH     PS       PN       PV          PL
C-------------------------------------------------------------------------------
*
C-------------------------------------------------------------------------------
C*******************************************************************************
C                    Anomaly in Hydraulic Conductivity
C
C   List the groundwater elements and corresponding hydraulic conductivities
C   that will overwrite the above aquifer data
C
C   NEBK;   Number of elements where hydraulic conductivity values will be overwritten
C            (NEBK = 0 if there are no anomalies)
C   FACT;   Conversion factor for the anomaly hydraulic conductivity
C            It is used to convert only the spatial component of the unit;
C            DO NOT include the conversion factor for time component of the unit.
C            * e.g. Unit of anomaly hydraulic conductivity listed in this file = FT/MONTH
C                   Consistent unit used in simulation                         = IN/DAY
C                   Enter FACT (FT/MONTH -> IN/MONTH)                          = 8.33333E-02
C                    (conversion of MONTH -> DAY is performed automatically)
C   TUNITH; Time unit of anomaly hydraulic conductivity.  This should be one of the units
C             recognized by HEC-DSS that are listed in the Main Control File.
C
C-------------------------------------------------------------------------------
C   VALUE                        DESCRIPTION
C-------------------------------------------------------------------------------
      7                          / NEBK
      1.0                        / FACT
      1MON                       / TUNITH
C-------------------------------------------------------------------------------
C
C   The following lists the element numbers and the hydraulic conductivity anomalies
C   at these elements (skip if there are no anomalies, i.e. NEBK = 0)
C
C   IC  ;    Sequential counter for number of overwrite options
C   IEBK;    Element number corresponding to counter IC
C   BK  ;    Hydraulic conductivity at the specified node; [L/T]
C
C-------------------------------------------------------------------------------
C                      LAYER 1    LAYER 2    LAYER 3
C     IC      IEBK       BK         BK         BK
C-------------------------------------------------------------------------------
       1        55      0.2         0.2       0.2
       2        56      0.2         0.2       0.2
       3        57      0.2         0.2       0.2
       4        58      0.2         0.2       0.2
       5      1383      0.001       0.001     0.001
       6      1384      0.001       0.001     0.001
       7      1385      0.001       0.001     0.001
C*******************************************************************************
C                       Initial Groundwater Head Values
C
C   FACTHP; Conversion factor for initial heads
C   ID    ; Groundwater node number listed sequentially
C   HP    ; Initial head at corresponding groundwater node; [L]
C
C-------------------------------------------------------------------------------
C   VALUE                        DESCRIPTION
C-------------------------------------------------------------------------------
     1.0                         / FACTHP
C-------------------------------------------------------------------------------
C   ID       HP[1]      HP[2]      HP[3]
C-------------------------------------------------------------------------------
    1        243.0      446.5      446.4
    2        498.1      494.1      493.9
    3        532.9      528.4      528.2
    .          .          .          .
    .          .          .          .
    .          .          .          .
    1391     478.2      458.3      447.3
    1392     486.7      457.0      448.1
    1393     521.3      464.8      453.6
```

Groundwater Boundary Conditions Data File

This data file is used to specify the boundary conditions for the groundwater component. The following types of boundary conditions can be defined for each aquifer layer modeled:

1. Specified flow
2. Specified head
3. General head
4. Constrained general head

By default, all boundary nodes are assumed to have a zero-flow boundary condition. Therefore, it is not necessary to define zero-flow at each boundary node. Each boundary condition is specified through separate files. Any of the boundary conditions above can be constant or time-dependent.

The Boundary Conditions Data File is also used to list the boundary nodes, if any, for which the boundary node flow hydrographs are to be printed.

The following sections describe the variables used in this file.

Input Data Files for the Specification of Boundary Conditions

SPFLOWFL	Specified flow boundary conditions data file (maximum 1000 characters); leave blank if this boundary condition is not simulated
SPHEADFL	Specified head boundary conditions data file (maximum 1000 characters); leave blank if this boundary condition is not simulated
GHBCFL	General head boundary conditions data file (maximum 1000 characters); leave blank if this boundary condition is not simulated

CONGHBCFL	Constrained general head boundary conditions data file (maximum 1000 characters); leave blank if this boundary condition is not simulated
TSBCFL	Time series boundary conditions data file (maximum 1000 characters); leave blank if no time series boundary conditions are specified

Boundary Node Flow Output Data

NOUTB	Number of boundary nodes for hydrograph printing; set NOUTB = 0 if no hydrographs are to be printed
BHYDOUTFL	Filename for boundary node flow output (maximum 1000 characters); leave blank if this output is not required
ID	Sequential hydrograph ID number (1 through NOUTB)
IOUTBL	Aquifer layer number at which boundary flow hydrograph is desired
IOUTB	Groundwater boundary node number for flow hydrograph output
NAME	Name for the hydrograph (maximum 30 characters)

```
C*******************************************************************************
C
C                  INTEGRATED WATER FLOW MODEL (IWFM)
C
C*******************************************************************************
C
C                  BOUNDARY CONDITIONS DATA FILE
C                      Groundwater Component
C                       *** Version 4.0 ***
C
C
C             Project :  IWFM Version ### Release
C                        California Department of Water Resources
C             Filename:  BoundCond.dat
C
C*******************************************************************************
C                          File Description:
C
C   This data file contains the name of the data files that includes information
C   about four boundary conditions that can be simulated: specified flow, specified
C   head, general head and constrained general head boundary conditions. If any of
C   these boundary conditions are specified as time series data, the name of the
C   time series boundary conditions data file is also listed in this file.
C
C*******************************************************************************
C
C   SPFLOWFL ;  Specified flow boundary conditions data file (max. 1000 characters)
C                 * Leave blank if this boundary condition is not simulated
C   SPHEADFL ;  Specified head boundary conditions data file (max. 1000 characters)
C                 * Leave blank if this boundary condition is not simulated
C   GHBCFL   ;  General head boundary conditions data file (max. 1000 characters)
C                 * Leave blank if this boundary condition is not simulated
C   CONGHBCFL;  Constrained general head boundary conditions data file (max. 1000 characters)
C                 * Leave blank if this boundary condition is not simulated
C   TSBCFL   ;  Time series boundary conditions data file (max. 1000 characters)
C                 * Leave blank if no time series boundary conditions are specified
C
C-------------------------------------------------------------------------------
C     VALUE                         DESCRIPTION
C-------------------------------------------------------------------------------
                                    / SPFLOWFL
      SpecHeadBC.dat                / SPHEADFL
      GenHeadBC.dat                 / GHBCFL
                                    / CONGHBCFL
      TSBoundCond.dat               / TSBCFL
C*******************************************************************************
C                         Boundary Node Flow Output Data
C
C   The following lists the boundary nodes and layers for which flow values
C   will be printed
C
C   NOUTB     ; Number of boundary nodes for hydrograph printing
C                  * NOUTB = 0 if no hydrograph is to be printed
C   BHYDOUTFL ; File name for boundary node flow output (max. 1000 characters)
C                  * Leave blank if this output is not required
C-------------------------------------------------------------------------------
C   VALUE                         DESCRIPTION
C-------------------------------------------------------------------------------
    2                             / NOUTB
    BoundFlow.out                 / BHYDOUTFL
C-------------------------------------------------------------------------------
C
C   The following lists the layer number and groundwater node number for each
C   boundary node flow hydrograph to be printed (skip if no flow hydrograph is
C   to be printed, ie. NOUTB = 0)
C
C   ID     ; Sequential hydrograph ID number (1 through NOUTB)
C   IOUTBL ; Layer number
C   IOUTB  ; Groundwater boundary node number for flow hydrograph output
C   NAME   ; Name for the hydrograph (max. 30 characters)
C
C-------------------------------------------------------------------------------
C   ID     IOUTBL      IOUTB      NAME
C-------------------------------------------------------------------------------
    1        1          524       BCFlow1
    2        1          768       BCFlow2
```

Specified Flow Boundary Conditions Data File

Specified flow boundary conditions are defined when the flow is known across surfaces bounding the model domain. The specified flow rates can be constant throughout the simulation period or they can be specified as time-series data. If any of the flow boundary conditions are given as time-series data, then the Time-Series Boundary Conditions Data File (discussed later in this document) must be defined and the column number within this file that stores the time-series flow data must be specified. The variables used to describe the specified flow boundary conditions are as follows:

NQB	Number of nodes with specified flow boundary condition (nodes with no-flow boundary condition need not be listed)
FACT	Conversion factor for spatial component of the specified flow data
TUNIT	Time unit of specified flow boundary conditions; this should be of the units recognized by HEC-DSS that are listed in the Simulation Main Control File
INODE	Groundwater node with specified flow boundary condition
ILAYER	Aquifer layer that INODE belongs to
ITSCOL	Time-series specified flow boundary condition; this number corresponds to the appropriate data column in the Time-Series Boundary Conditions Data File (enter 0 if this is not a time-series boundary condition)
BQ	Specified flow value at groundwater node INODE (enter any value if ITSCOL is non-zero; i.e. if this is a time-dependent boundary

condition and the time-series data is given in the Time-Series Boundary Conditions Data File), [L^3/T]

```
C*******************************************************************************
C
C                   INTEGRATED WATER FLOW MODEL (IWFM)
C
C*******************************************************************************
C
C               SPECIFIED FLOW BOUNDARY CONDITIONS DATA FILE
C                         Groundwater Component
C                          *** Version 4.0 ***
C
C
C              Project :  IWFM Version ### Release
C                         California Department of Water Resources
C              Filename:  SpecifiedFlowBC.dat
C
C*******************************************************************************
C                           File Description:
C
C   This data file lists specified flow boundary conditions (except the no-flow
C   boundary conditions).
C
C*******************************************************************************
C
C            Specified flow boundary conditions specifications
C
C   NQB   ;  Number of nodes with specified flow boundary condition
C              * Note: Nodes with no-flow boundary condition need not be listed
C   FACT  ;  Conversion factor for specified flow data
C             It is used to convert only the spatial component of the unit;
C             DO NOT include the conversion factor for time component of the unit.
C             * e.g. Unit of flow listed in this file        = AC-FT/MONTH
C                   Consistent unit used in simulation      = CU.FT/DAY
C                   Enter FACT (AC-FT/MONTH -> CU.FT/MONTH) = 2.29568E-05
C                    (conversion of MONTH -> DAY is performed automatically)
C   TUNIT ;  Time unit of specified flow boundary conditions. This should be one
C             of the units recognized by HEC-DSS that are listed in the Main Control
C             File.
C   INODE ;  Groundwater node with specified flow boundary condition
C   ILAYER;  Aquifer layer that INODE belongs to
C   ITSCOL;  Time series specified flow boundary condition - this number corresponds
C             to the appropriate data column in the Time Series Boundary Conditions
C             Data File.
C             * Enter 0 if this is not a time series boundary condition
C   BQ    ;  Specified flow value at groundwater node INODE; [L^3/T]
C             * Enter any value if ITSCOL is non-zero
C
C-------------------------------------------------------------------------------
C   VALUE                      DESCRIPTION
C-------------------------------------------------------------------------------
    21                         / NQB
    43560.0                    / FACT   (AF -> cu.ft.)
    1mon                       / TUNIT
C-------------------------------------------------------------------------------
C     INODE     ILAYER    ITSCOL     BQ
C-------------------------------------------------------------------------------
      1          1         0        10000.0
      22         1         0        10000.0
      43         1         0        10000.0
      .          .         .          .
      .          .         .          .
      .          .         .          .
      378        2         0        10000.0
      399        2         0        10000.0
      420        2         0        10000.0
```

Specified Head Boundary Conditions Data File

Specified head boundary conditions are defined when the hydraulic head is known for surfaces bounding the model domain. The specified heads can be constant throughout the simulation period or they can be specified as time-series data. If any of the head boundary conditions are given as time-series data, then the Time-Series Boundary Conditions Data File (discussed later in this document) must be defined and the column number within this file that stores the time-series head data must be specified. The variables used to describe the specified head boundary conditions are as follows:

NHB	Number of nodes with specified head boundary condition
FACT	Conversion factor for specified head data
INODE	Groundwater node with specified head boundary condition
ILAYER	Aquifer layer that INODE belongs to
ITSCOL	Time-series specified head boundary condition; this number corresponds to the appropriate data column in the Time-Series Boundary Conditions Data File (enter 0 if this is not a time-series boundary condition)
BH	Specified head value at groundwater node INODE (enter any value if ITSCOL is non-zero; i.e. if this is a time-dependent boundary condition and the time-series data is given in the Time-Series Boundary Conditions Data File), [L]

```
C*******************************************************************************
C
C                  INTEGRATED WATER FLOW MODEL (IWFM)
C
C*******************************************************************************
C
C              SPECIFIED HEAD BOUNDARY CONDITIONS DATA FILE
C                        Groundwater Component
C                         *** Version 4.0 ***
C
C
C             Project :  IWFM Version ### Release
C                        California Department of Water Resources
C             Filename:  SpecifiedHeadBC.dat
C
C*******************************************************************************
C                          File Description:
C
C   This data file lists specified head boundary conditions.
C
C*******************************************************************************
C
C            Specified head boundary conditions specifications
C
C   NHB   ;  Number of nodes with specified head boundary condition
C   FACT  ;  Conversion factor for specified head data
C   INODE ;  Groundwater node number with specified head boundary condition
C   ILAYER;  Aquifer layer that INODE belongs to
C   ITSCOL;  Time series specified head boundary condition - this number corresponds
C             to the appropriate data column in the Time Series Boundary Conditions
C             Data File.
C             * Enter 0 if this is not a time series boundary condition
C   BH    ;  Specified head value at groundwater node INODE; [L]
C             * Enter any value if ITSCOL is non-zero
C
C-------------------------------------------------------------------------------
C   VALUE                       DESCRIPTION
C-------------------------------------------------------------------------------
    42                          / NHB
    1.0                         / FACT
C-------------------------------------------------------------------------------
C     INODE    ILAYER   ITSCOL      BH
C-------------------------------------------------------------------------------
      1          1        0       290.0
      22         1        0       290.0
      43         1        0       290.0
      64         1        0       290.0
      85         1        0       290.0
      106        1        0       290.0
      127        1        0       290.0
      148        1        0       290.0
      169        1        0       290.0
      190        1        0       290.0
      211        1        0       290.0
      232        1        0       290.0
      253        1        0       290.0
      274        1        0       290.0
      295        1        0       290.0
      316        1        0       290.0
      337        1        0       290.0
      358        1        0       290.0
      379        1        0       290.0
      400        1        0       290.0
      421        1        0       290.0
      21         1        1       -99.9
      42         1        1       -99.9
      63         1        1       -99.9
      84         1        1       -99.9
      105        1        1       -99.9
      126        1        1       -99.9
      147        1        1       -99.9
      168        1        1       -99.9
      189        1        1       -99.9
      210        1        1       -99.9
      231        1        1       -99.9
      252        1        1       -99.9
      273        1        1       -99.9
      294        1        1       -99.9
      315        1        1       -99.9
      336        1        1       -99.9
      357        1        1       -99.9
      378        1        1       -99.9
      399        1        1       -99.9
      420        1        1       -99.9
      441        1        1       -99.9
```

General Head Boundary Conditions Data File

General head boundary condition is defined when head values at a specified distance from a boundary node is known. The heads for general head boundary conditions can be constant throughout the simulation period or they can be specified as time-series data. If any of the general heads are given as time-series data, then the Time-Series Boundary Conditions Data File (discussed later in this document) must be defined and the column number within this file that stores the time-series head data must be specified. The variables used to describe the general head boundary conditions are as follows:

NGB	Number of nodes with general head boundary condition
FACTH	Conversion factor for the boundary head
FACTC	Conversion factor for the spatial component of the conductance used for general head boundary condition
TUNITC	Time unit of conductance; this should be one of the units recognized by HEC-DSS that are listed in the Simulation Main Control File
INODE	Groundwater node with general head boundary condition
ILAYER	Aquifer layer that INODE belongs to
ITSCOL	Time-series boundary head boundary value; this number corresponds to the appropriate data column in the Time-Series Boundary Conditions Data File (enter 0 if this is not a time-series boundary condition)

BH	General boundary head at the groundwater node INODE (enter any value if ITSCOL is non-zero; i.e. if this is a time-dependent boundary condition and the time-series data is given in the Time-Series Boundary Conditions Data File), [L]
BC	Conductance used for the general head boundary condition, [L^2/T]

```
C*******************************************************************************
C
C                   INTEGRATED WATER FLOW MODEL (IWFM)
C
C*******************************************************************************
C
C               GENERAL HEAD BOUNDARY CONDITIONS DATA FILE
C                         Groundwater Component
C                          *** Version 4.0 ***
C
C
C              Project :  IWFM Version ### Release
C                         California Department of Water Resources
C              Filename:  GeneralHeadBC.dat
C
C*******************************************************************************
C                           File Description:
C
C   This data file lists general head boundary conditions.
C
C*******************************************************************************
C
C             General head boundary conditions specifications
C
C   NGB   ;  Number of nodes with general head boundary condition
C   FACTH ;  Conversion factor for the boundary head (see variable BH below)
C   FACTC ;  Conversion factor for conductance used for general head boundary condition
C              It is used to convert only the spatial component of the unit;
C              DO NOT include the conversion factor for time component of the unit.
C              * e.g. Unit of conductance listed in this file = AC/MONTH
C                     Consistent unit used in simulation      = SQ.FT/DAY
C                     Enter FACTC (AC/MONTH -> SQ.FT/MONTH)   = 2.29568E-05
C                      (conversion of MONTH -> DAY is performed automatically)
C   TUNITC ;  Time unit of conductance.  This should be one  of the units
C              recognized by HEC-DSS that are listed in the Main Control
C              File.
C   INODE  ;  Groundwater node with general head boundary condition
C   ILAYER ;  Aquifer layer that INODE belongs to
C   ITSCOL ;  Time series boundary head value (for BH variable below) - this number
C              corresponds to the appropriate data column in the Time Series Boundary
C              Conditions Data File.
C              * Enter 0 if this is not a time series boundary condition
C   BH     ;  General boundary head at the groundwater node INODE; [L]
C              * Enter any value if ITSCOL is non-zero
C   BC     ;  Conductance used for the general head boundary condition; [L^2/T]
C
C-------------------------------------------------------------------------------
C   VALUE                        DESCRIPTION
C-------------------------------------------------------------------------------
    10                           / NGB
    1.0                          / FACTH
    43560.0                      / FACTC   (ac. -> sq.ft.)
    1day                         / TUNITC
C-------------------------------------------------------------------------------
C     INODE     ILAYER    ITSCOL    BH        BC
C-------------------------------------------------------------------------------
      21         1         0        500.0     150.0
      42         1         0        500.0     150.0
      63         1         0        500.0     150.0
      84         1         0        500.0     150.0
      105        1         0        500.0     150.0
      126        1         0        500.0     150.0
      147        1         0        500.0     150.0
      168        1         0        500.0     150.0
      189        1         0        500.0     150.0
      210        1         0        500.0     150.0
```

Constrained General Head Boundary Conditions Data File

Constrained general head boundary condition can be used to simulate, for instance, stream-aquifer interaction when stream flows are simulated outside IWFM and are introduced as general head boundary conditions with the stream bed elevation being the limiting head and stream flows the maximum boundary flow when streams are losing. The heads and maximum boundary flow values for the constrained general head boundary conditions can be constant throughout the simulation period or they can be specified as time-series data. If any of the general heads or maximum boundary flows are given as time-series data, then the Time-Series Boundary Conditions Data File (discussed later in this document) must be defined and the column number within this file that stores the time-series head and maximum flow data must be specified. The variables used to describe the constrained general head boundary conditions are as follows:

NCGB	Number of nodes with constrained general head boundary condition
FACTH	Conversion factor for boundary head (see variable BH below) and constraining head (see variable LBH below)
FACTVL	Conversion factor for the spatial component of the maximum boundary flow (see variable CFLOW below)
TUNITVL	Time unit of maximum boundary flow; this should be one of the units recognized by HEC-DSS that are listed in the Simulation Main Control File
FACTC	Conversion factor for the spatial component of the conductance (see variable BC below)

TUNITC	Time unit of conductance; this should be one of the units recognized by HEC-DSS that are listed in the Simulation Main Control File
INODE	Groundwater node with constrained general head boundary condition
ILAYER	Aquifer layer that INODE belongs to
ITSCOL	Time-series boundary head value (for BH variable below) - this number corresponds to the appropriate data column in the Time-Series Boundary Conditions Data File (enter 0 if this is not a time-series boundary head)
BH	General head head boundary condition (enter any value if ITSCOL is non-zero; i.e. if this is a time-dependent boundary condition and the time-series data is given in the Time-Series Boundary Conditions Data File), [L]
BC	Conductance used for constrained general head boundary condition, [L^2/T]
LBH	Limiting head, [L]
ITSCOLF	Time-series maximum boundary flow value (for CFLOW variable below) - this number corresponds to the appropriate data column in the Time-Series Boundary Conditions Data File (enter 0 if this is not a time-series data)
CFLOW	Maximum amount of flow for the constrained general head boundary (enter any value if ITSCOLF is non-zero; i.e. if this is a

time-dependent flow and the time-series data is given in the Time-Series Boundary Conditions Data File)

```
C*******************************************************************************
C
C                   INTEGRATED WATER FLOW MODEL (IWFM)
C
C*******************************************************************************
C
C             CONSTRAINED GENERAL HEAD BOUNDARY CONDITIONS DATA FILE
C                         Groundwater Component
C                          *** Version 4.0 ***
C
C
C              Project :  IWFM Version ### Release
C                         California Department of Water Resources
C              Filename:  ConstrainedGeneralHeadBC.dat
C
C*******************************************************************************
C                           File Description:
C
C   This data file lists constrained general head boundary conditions.
C
C*******************************************************************************
C
C             Constrained general head boundary conditions specifications
C
C   NCGB   ;  Number of nodes with constrained general head boundary condition
C   FACTH  ;  Conversion factor for boundary head (see variable BH below) and constraining
C              head (see variable LBH below)
C   FACTVL ;  Conversion factor for maximum boundary flow (see variable CFLOW below)
C              It is used to convert only the spatial component of the unit;
C              DO NOT include the conversion factor for time component of the unit.
C              * e.g. Unit of flow listed in this file         = AC-FT/MONTH
C                     Consistent unit used in simulation        = CU.FT/DAY
C                     Enter FACTVL (AC-FT/MONTH -> CU.FT/MONTH) = 2.29568E-05
C                      (conversion of MONTH -> DAY is performed automatically)
C   TUNITVL;  Time unit of maximum boundary flow.  This should be one  of the
C              units recognized by HEC-DSS that are listed in the Main Control
C              File.
C   FACTC  ;  Conversion factor for conductance (see variable BC below)
C              It is used to convert only the spatial component of the unit;
C              DO NOT include the conversion factor for time component of the unit.
C              * e.g. Unit of conductance listed in this file = AC/MONTH
C                     Consistent unit used in simulation      = SQ.FT/DAY
C                     Enter FACTC (AC/MONTH -> SQ.FT/MONTH)   = 2.29568E-05
C                      (conversion of MONTH -> DAY is performed automatically)
C   TUNITC ;  Time unit of conductance.  This should be one
C              of the units recognized by HEC-DSS that are listed in the Main Control
C              File.
C   INODE  ;  Groundwater node with constrained general head boundary condition
C   ILAYER ;  Aquifer layer that INODE belongs to
C   ITSCOL ;  Time series boundary head value (for BH variable below) - this number
C              corresponds to the appropriate data column in the Time Series Boundary
C              Conditions Data File.
C              * Enter 0 if this is not a time series boundary condition
C   BH     ;  Head as the boundary conditions; [L]
C              * Enter any value if ITSCOL is non-zero
C   BC     ;  Conductance used for constrained general head boundary condition; [L^2/T]
C   LBH    ;  Limiting head; [L]
C   ITSCOLF;  Time series maximum boundary flow value (for CFLOW variable below) - this
C              number corresponds to the appropriate data column in the Time Series
C              Boundary Conditions Data File.
C              * Enter 0 if this is not a time series boundary condition
C   CFLOW  ;  Maximum amount of flow for the constrained general head boundary; [L^3/T]
C              * Enter any value if ITSCOLF is non-zero
C
C-------------------------------------------------------------------------------
C   VALUE                       DESCRIPTION
C-------------------------------------------------------------------------------
    21                          / NGB
    1.0                         / FACTH
    43560.0                     / FACTVL    (ac.ft. -> cu.ft.)
    1day                        / TUNITVL
    43560.0                     / FACTC     (ac. -> sq.ft.)
    1day                        / TUNITC
C-------------------------------------------------------------------------------
C     INODE     ILAYER    ITSCOL    BH     BC      LBH     ITSCOLF    CFLOW
C-------------------------------------------------------------------------------
      11        1         1         0.0    150.0   500.0   22         0.0
      32        1         2         0.0    150.0   498.0   23         0.0
      53        1         3         0.0    150.0   496.0   24         0.0
      .         .         .         .      .       .       .          .
      .         .         .         .      .       .       .          .
      .         .         .         .      .       .       .          .
      389       1         19        0.0    150.0   464.0   40         0.0
      410       1         20        0.0    150.0   462.0   41         0.0
      431       1         21        0.0    150.0   460.0   42         0.0
```

Time-Series Boundary Conditions Data File

This file lists the time-series data for specified head, specified flow, general head and constrained general head boundary conditions. The boundary node numbers that correspond to the columns listed in this file are specified in the Specified Flow, Specified Head, General Head and Constrained General Head Boundary Conditions Data Files.

Each data column in this file may represent a time-series head or time-series flow data. IWFM figures out the type of data stored in each data column based on the information specified in the other boundary conditions data files. For instance, if boundary node 500 is assigned a time-series specified head boundary condition through the Specified Head Boundary Conditions Data File and linked to the data column 5 in the Time-Series Boundary Conditions Data File, IWFM reads and treats the data in column 5 as head data. On the other hand, if boundary node 400 is assigned a time-series specified flow boundary condition through the Specified Flow Boundary Conditions Data File and linked to the data column 4 in this file, IWFM reads and treats the data in column 4 as flow data.

The time series input boundary conditions data can be either listed in this file or in a DSS file. If a DSS file is used for data input, then the name of the DSS file and the pathnames corresponding to each of the time-series data are required.

The parameters specified in this file are as follows:

NBTSD	Number of data columns (or pathnames if DSS files are used)
FACTHTS	Conversion factor for head values
FACTQTS	Conversion factor for the spatial component of the unit for the flow values

NSPHTS	Number of time steps to update the boundary condition head values; if time tracking simulation enter any number
NFQHTS	Repetition frequency of the time-series boundary condition data (enter zero if full time series data is supplied); if time tracking simulation, enter any number
DSSFL	If the time-series data is stored in a DSS file, name of the file; leave blank if the data is listed in the Time-Series Boundary Conditions Data File

Data Input from Time-Series Boundary Conditions Data File

If the time-series data is listed in the Time-Series Boundary Conditions Data File, then the following variables need to be populated. Otherwise, these variables should be commented out using "C", "c" or "*", and the variables in the "Data Input from DSS File" section below should be populated.

ITHTS	Time; for time tracking simulations use MM/DD/YYYY_hh:mm format, for non-time tracking simulations enter an integer number.
HQTS	Time series boundary values, [L] or [L^3/T] depending if specified head or specified flow values are listed in a column

Data Input from DSS File

If time series data is stored in a DSS file then the following variables should be populated.

REC	Record number that coincides with the data column number for the time-series data
PATH	Pathname for the time-series record that will be used for data retrieval

```
C*******************************************************************************
C
C                   INTEGRATED WATER FLOW MODEL (IWFM)
C
C*******************************************************************************
C
C                    TIME SERIES BOUNDARY CONDITION DATA
C                         Groundwater Component
C                          *** Version 4.0 ***
C
C
C             Project :  IWFM Version ### Release
C                        California Department of Water Resources
C             Filename:  TimeSeriesBC.dat
C
C*******************************************************************************
C                           File Description
C
C   This data file contains the time series data for the specified flow, specified
C   head, general head and/or constrained general head boundary conditions. The file
C   provides time series data for the groundwater nodes specified in Boundary Conditions
C   Data File.
C
C*******************************************************************************
C                     Time Series Boundary Condition Specifications
C
C   The following lists the time series values for the groundwater nodes
C   specified in Boundary Conditions Data File.
C
C   NBTSD  ; Number of columns (or pathnames if DSS files are used)
C   FACTHTS; Conversion factor for head values
C   FACTQTS; Conversion factor for flow values
C             It is used to convert only the spatial component of the unit;
C             DO NOT include the conversion factor for time component of the unit.
C             * e.g. Unit of flow listed in this file          = AC-FT/MONTH
C                    Consistent unit used in simulation        = CU.FT/DAY
C                    Enter FACTQTS (AC-FT/MONTH -> CU.FT/MONTH)= 2.29568E-05
C                     (conversion of MONTH -> DAY is performed automatically)
C   NSPHTS;  Number of time steps to update the time series boundary condition data
C             * Enter any number if time-tracking option is on
C   NFQHTS;  Repetition frequency of the time series boundary condition data
C             * Enter 0 if full time series data is supplied
C             * Enter any number if time-tracking option is on
C   DSSFL ;  The name of the DSS file for data input (maximum 50 characters);
C             * Leave blank if DSS file is not used for data input
C
C-------------------------------------------------------------------------------
C         VALUE                                     DESCRIPTION
C-------------------------------------------------------------------------------
          1                                        / NBTSD
          1.0                                      / FACTHTS
          1.0                                      / FACTQTS
          1                                        / NSPHTS
          0                                        / NFQHTS
                                                   / DSSFL
C-------------------------------------------------------------------------------
C                     Time Series Boundary Condition Data
C                          (READ FROM THIS FILE)
C
C   List the time series boundary condition data below, if it will not be read
C   from a DSS file (i.e. DSSFL is left blank above).
C
C   ITHTS;  Time
C   HQTS ;  Time series boundary values; [L] or [L^3/T]
C
C--------------------------------------------------------------------------------------------
C   ITHTS              HQTS(1)  HQTS(2)  HQTS(3) ...
C--------------------------------------------------------------------------------------------
    09/30/1991_24:00   310.0
    09/30/1992_24:00   310.0
    09/30/1993_24:00   310.0
    09/30/1994_24:00   310.0
    09/30/1995_24:00   310.0
    09/30/1996_24:00   350.0
    09/30/1997_24:00   350.0
    09/30/1998_24:00   350.0
    09/30/1999_24:00   350.0
    09/30/2000_24:00   350.0
C-------------------------------------------------------------------------------
C                     Pathnames for Time Series Boundary Condition Data
C                                 (READ FROM DSS FILE)
C
C   List the pathnames for the time series boundary condition data below, if it will be read
C   from a DSS file (i.e. DSSFL is specified above).
C
C   REC  ;  Time series record number
C   PATH ;  Pathname for the time series record
C
C--------------------------------------------------------------------------------------------
C   REC       PATH
C--------------------------------------------------------------------------------------------
*
*
```

Tile Drain and Subsurface Irrigation Parameter File

This data file includes all the required input to model tile drains and subsurface irrigation in IWFM as well as the data to print out tile drain and subsurface irrigation hydrographs at desired locations. The first part of the data file lists the number of groundwater nodes with tile drains and parameters to simulate tile drain flows. The second part lists the number of groundwater nodes with subsurface irrigation and the relevant parameters. The last part of this data file includes information to print out tile drain and subsurface irrigation hydrographs at specified locations.

The following lists different parts of the data file and all required input to simulate tile drains and subsurface irrigation in IWFM.

Tile Drain Data Specifications

NTD	Number of groundwater nodes with tile drains; enter 0 if there are no tile drains simulated
FACTH	Conversion factor for tile drain elevations
FACTCDC	Conversion factor for the spatial component of the unit for the tile drain conductances
TUNITDR	Time unit of conductance; this should be one of the units recognized by HEC-DSS that are listed in the Simulation Main Input File
IDDR	Tile drain identification number specified in sequential order
NODEDR	Groundwater node number corresponding to the tile drain
ELEVDR	Elevation of the tile drain, [L]

CDCDR	Hydraulic conductance of the interface between the aquifer and the tile drain, [L^2/T]
TYPDST	Destination type for drain flow (0 = drain flow goes outside the model domain; 1 = drain flow goes to stream node DST as described below)
DST	Stream node number that receives the drain flow; enter any number if TYPDST is set to zero

Subsurface Irrigation Data Specifications

NSI	Number of groundwater nodes with subsurface irrigation; enter 0 if subsurface irrigation is not modeled
FACTHSI	Conversion factor for subsurface irrigation elevations
FACTCDCSI	Conversion factor for the spatial component of the unit for the subsurface irrigation conductances
TUNITSI	Time unit of conductance; this should be one of the units recognized by HEC-DSS that are listed in the Simulation Main Input File
IDSI	Subsurface irrigation identification number listed in sequential order
NODESI	Groundwater node number corresponding to the subsurface irrigation
ELEVSI	Elevation of the subsurface irrigation; [L]

CDCSI — Hydraulic conductance of the interface between the aquifer and subsurface irrigation; [L^2/T]

Tile Drain and Subsurface Irrigation Hydrograph Print Control

NOUTTD — Number of hydrographs to be printed; enter 0 if hydrograph print-out is not required

FACTVLOU — Factor to convert simulation unit of tile drain and subsurface irrigation flows into intended unit of output

UNITVLOU — Output unit of flows (maximum 10 characters long)

TDOUTFL — Filename for tile drain and subsurface irrigation hydrograph output (maximum 1000 characters)

ID — Tile drain or subsurface irrigation identification number as listed in IDDR or IDSI for hydrograph printing

IDTYP — Type of hydrograph (1 = tile drain hydrograph, 2 = subsurface irrigation hydrograph)

```
#4.0
C *** DO NOT DELETE ABOVE LINE ***
C
C*****************************************************************************
C
C                  INTEGRATED WATER FLOW MODEL (IWFM)
C
C*****************************************************************************
C
C              TILE DRAIN AND SUB_IRRIGATION PARAMETER DATA FILE
C                         Tile Drain Component
C                         *** Version 4.0 ***
C
C
C             Project : IWFM Version ### Release
C                       California Department of Water Resources
C             Filename: TileDrain.dat
C
C*****************************************************************************
C                           File Description:
C
C   This data file contains tile drain and subsurface irrigation parameter values.
C
C*****************************************************************************
C                  Tile Drain Data Specifications
C
C   NTD    ; Number of groundwater nodes with tile drains
C   FACTH  ; Conversion factor for tile drain elevations
C   FACTCDC; Conversion factor for tile drain conductances
C            It is used to convert only the spatial component of the unit;
C             DO NOT include the conversion factor for time component of the unit.
C             * e.g. Unit of conductance listed in this file = AC/MONTH
C                    Consistent unit used in simulation      = SQ.FT/DAY
C                    Enter FACTQ (AC/MONTH -> SQ.FT/MONTH)   = 2.29568E-05
C                     (conversion of MONTH -> DAY is performed automatically)
C   TUNITDR; Time unit of conductance.  This should be one of the units
C            recognized by HEC-DSS that are listed in the Main Control File.
C-----------------------------------------------------------------------------
C       VALUE                   DESCRIPTION
C-----------------------------------------------------------------------------
        21                      / NTD
        1.0                     / FACTH
        1.0                     / FACTCDC
        1day                    / TUNIT
C-----------------------------------------------------------------------------
C                     Tile Drain Parameters
C
C   The following lists the groundwater node number, elevation and conductance
C   for each tile drain. The destination type and destination ID that the tile
C   drain flows into is also listed.
C
C   IDDR   ; Tile drain ID in sequential order
C   NODEDR ; Groundwater node number corresponding to the tile drain
C   ELEVDR ; Elevation of the drain; [L]
C   CDCDR  ; Hydraulic conductance of the interface between the aquifer and
C             the drain; [L^2/T]
C   TYPDST ; Destination type for drain flow
C              0 = Drain flow goes outside the model domain
C              1 = Drain flow goes to stream node DST (see below)
C   DST    ;  Destination number for drain flow
C              * Note: Enter any number if TYPDST is 0
C
C-----------------------------------------------------------------------------
C   IDDR  NODEDR    ELEVDR     CDCDR    TYPDST    DST
C-----------------------------------------------------------------------------
     1      6        280.0     20000.0     1       20
     2      27       280.0     20000.0     1       20
     3      48       280.0     20000.0     1       20
     4      69       280.0     20000.0     1       20
     5      90       280.0     20000.0     1       20
     6      111      280.0     20000.0     1       20
     7      132      280.0     20000.0     1       20
     8      153      280.0     20000.0     1       20
     9      174      280.0     20000.0     1       20
    10      195      280.0     20000.0     1       20
    11      216      280.0     20000.0     1       20
    12      237      280.0     20000.0     1       20
    13      258      280.0     20000.0     1       20
    14      279      280.0     20000.0     1       20
    15      300      280.0     20000.0     1       20
    16      321      280.0     20000.0     1       20
    17      342      280.0     20000.0     1       20
    18      363      280.0     20000.0     1       20
    19      384      280.0     20000.0     1       20
    20      405      280.0     20000.0     1       20
    21      426      280.0     20000.0     1       20
C*****************************************************************************
C                  Subsurface Irrigation Data Specifications
C
C   NSI       ;  Number of groundwater nodes with subsurface irrigation
C   FACTHSI   ;  Conversion factor for subsurface irrigation elevations
C   FACTCDCSI;   Conversion factor for subsurface irrigation conductances
C                It is used to convert only the spatial component of the unit;
C                DO NOT include the conversion factor for time component of the unit.
C                * e.g. Unit of conductance listed in this file = AC/MONTH
C                       Consistent unit used in simulation      = SQ.FT/DAY
C                       Enter FACTQ (AC/MONTH -> SQ.FT/MONTH)   = 2.29568E-05
C                        (conversion of MONTH -> DAY is performed automatically)
C   TUNITSI  ; Time unit of conductance.  This should be one of the units
C                recognized by HEC-DSS that are listed in the Main Control File.
C
C-----------------------------------------------------------------------------
C       VALUE                   DESCRIPTION
C-----------------------------------------------------------------------------
         0                       / NSI
         1.0                     / FACTHSI
         1.0                     / FACTCDCSI
         1day                    / TUNITSI
C-----------------------------------------------------------------------------
C                     Subsurface Irrigation Parameters
C
C   The following lists the groundwater node number, elevation and conductance
```

```
C   for each subsurface irrigation.
C
C   IDSI   ; Subsurface irrigation in sequential order
C   NODESI ; Groundwater node number corresponding to the subsurface irrigation
C   ELEVSI ; Elevation of the subsurface irrigation; [L]
C   CDCSI  ; Hydraulic conductance of the interface between the aquifer and
C             subsurface irrigation; [L^2/T]
C
C-------------------------------------------------------------------------------
C   IDSI  NODESI    ELEVSI    CDCSI
C-------------------------------------------------------------------------------
*
*
C*******************************************************************************
C                       Hydrograph Print Control
C
C   The following lists the tile drain and subsurface irrigation IDs for which
C   a hydrograph printing is needed, as well as output control options.
C
C   NOUTTD  ;  Number of hydrographs to be printed
C   FACTVLOU; Factor to convert simulation unit of tile drain/subsurface irrigation
C                flows into intented output unit
C   UNITVLOU; Output unit of flows (max. 10 characters long)
C   TDOUTFL ;  Filename for tile drain/subsurface irrigation hydrograph output
C                (max. 1000 characters)
C   ID      ;  Tile drain or subsurface irrigation ID for hydrograph printing
C   IDTYP   ;  Type of hydrograph
C                1 = Tile drain hydrograph
C                2 = Subsurface irrigation hydrograph
C
C-------------------------------------------------------------------------------
C       VALUE                   DESCRIPTION
C-------------------------------------------------------------------------------
         6                       / NOUTTD
         2.295684e-5             / FACTVLOU     (cu.ft. -> ac.ft.)
         ac.ft.                  / UNITVLOU
         TileDrainFlows.out      / TDOUTFL
C-------------------------------------------------------------------------------
C  ID    IDTYP
C-------------------------------------------------------------------------------
    1     1
    4     1
    7     1
   10     1
   13     1
   16     1
```

Pumping Component Files

Groundwater Component Main File points to the Pumping Component Main File which is the gateway for all other data files that are needed to simulate well and element pumping and recharge in IWFM. Data for pumping or recharge are entered similar to each other. IWFM distinguishes pumping and recharge from each other based on the sign: a negative value represents pumping and a positive value recharge. Data input files that are used in simulating pumping are described in the following sections.

Pumping Component Main File

Pumping Component Main File is the gateway to additional data files that are used in simulating well and element pumping. Well pumping in IWFM is used when the actual coordinates of individual wells are known, whereas element pumping represents a cluster of wells located in an element and whose coordinates are not known. Element pumping can also be used even when the coordinates of individual wells are known but simulating individual wells is impractical.

The following variables are used:

WELLFL	Well pumping specifications data file (maximum 1000 characters); leave blank if no wells are simulated
ELEMPUMPFL	Element pumping specifications data file (maximum 1000 characters); leave blank if element pumping is not simulated
PUMPFL	Time series pumping data file (maximum 1000 characters)

```
#4.0
C *** DO NOT DELETE ABOVE LINE ***
C
C*****************************************************************************
C
C                  INTEGRATED WATER FLOW MODEL (IWFM)
C
C*****************************************************************************
C
C                        PUMPING MAIN DATA FILE
C                           Pumping Component
C                          *** Version 4.0 ***
C
C
C             Project:  IWFM Version ### Release
C                       California Department of Water Resources
C             Filename: Pump_MAIN.dat
C
C*****************************************************************************
C                              File Description:
C
C   This data file contains the file names and other relevant data that are
C   used for the simulation of pumping.
C
C*****************************************************************************
C
C  WELLFL     ; Well pumping specifications data file (max. 1000 characters)
C                  * Leave blank if no wells are simulated
C  ELEMPUMPFL ; Element pumping specifications data file (max. 1000 characters)
C                  * Leave blank if element pumping is not simulated
C  PUMPFL     ; Time series pumping data file (max. 1000 characters)
C
C-----------------------------------------------------------------------------
C     VALUE                        DESCRIPTION
C-----------------------------------------------------------------------------
                                / WELLFL
    Pumping\ElemPump.dat        / ELEMPUMPFL
    Pumping\TSPumping.dat       / PUMPFL
```

Well Specifications Data File

Well Specifications Data File lists the parameters for the simulated wells such as well coordinates, diameter, screening depths, pumping amounts, maximum pumping rates, pumping delivery destinations, distribution of pumping at the delivery destination, pumping irrigation fractions (i.e. fraction of the well pumping that is used for agricultural purposes) and well pumping adjustment specifications so that well pumping meets either agricultural or urban, or both agricultural and urban water demands at the delivery destination.

Each simulated well is associated with a data column in the Time-Series Pumping File. All or a fraction of the pumping rate specified in the data column can be applied to the specified well using user-specified fractions (FRACWL) that may be further weighted (using the IOPTWL option) with respect to the agricultural and urban area in the destination where the pumping is delivered. For instance, there may be 10 wells serving a city and the surrounding farms, each well serving a group of grid cells. Rather than specifying individual pumping rates for each well, the user might choose to specify total pumping from all 10 wells and allow IWFM to distribute the total pumping based on the proportional area of agricultural and urban lands at the destination. This setup allows IWFM to distribute total pumping among 10 wells based on the water demand for which each well is supplying water. For such a setup, assuming that the total pumping rate is given in column 1 of the Time-Series Pumping File, ICOLWL variable for all 10 wells will be set to 1, FRACWL to 1.0 and IOPTWL to 2 (see below for the explanation of the variables). This way of specifying well pumping would be particularly useful in planning studies when the future water demands are calculated dynamically and IWFM is asked to adjust well pumping to meet the water demands.

The Well Specifications Data File is divided into several sections and the following variables are used for the simulation of wells:

List of Simulated Wells

NWELL	Number of wells modeled
FACTXY	Conversion factor for well coordinates
FACTRW	Conversion factor for well diameter
FACTLT	Conversion factor for perforation depths
ID	Well identification number
XWELL	x-coordinate of well location, [L]
YWELL	y-coordinate of well location, [L]
RWELL	Well diameter, [L]
PERFT	Elevation of or depth to the top of well screen, [L]; if PERFT is greater than PERFB, then PERFT represents the elevation of the top of well screen, otherwise it represents the depth to the top of the well screen
PERFB	Elevation of or depth to the bottom of well screen, [L]; if PERFT is greater than PERFB, then PERFB represents the elevation of the bottom of well screen, otherwise it represents the depth to the bottom of the well screen

Well Pumping Characteristics

ID	Well identification number
ICOLWL	Well pumping rate; this number corresponds to the appropriate data column in the Time-Series Pumping File
FRACWL	Relative proportion of the pumping in column ICOLWL of the Time-Series Pumping File to be applied to the well
IOPTWL	Option for distribution of pumping in column ICOLWL at the delivery destination (0 = distribute the pumping according to the given relative fraction, FRACWL; 1 = distribute the pumping in proportion to FRACWL times the total area of the delivery destination; 2 = distribute the pumping in proportion to FRACWL times the developed area (agricultural. and urban) at the delivery destination; 3 = distribute the pumping in proportion to FRACWL times the agricultural area at the delivery destination; 4 = distribute the pumping in proportion to FRACWL times the urban area at the delivery destination)
TYPDSTWL	Destination where the pumping is delivered to (−1 = pumping is used in the same element that pumping occurs; 0 = pumping goes outside the model domain; 2 = pumping goes to element DSTWL; 4 = pumping goes to subregion DSTWL; 6 = pumping goes to a group of elements with group identification number DSTDL where element groups are specified later in the file)

DSTWL	Pumping delivery destination identification number; enter any number if TYPDSTWL is set to −1 (i.e. pumping is delivered to the same element that the well is located) or 0 (i.e. pumping is delivered to outside the model area)
ICFIRIGWL	Fraction of the pumping that is used for irrigation purposes; this number corresponds to the appropriate data column in the Irrigation Fractions Data File
ICADJWL	Supply adjustment specification; this number corresponds to the data column in the Supply Adjustment Specifications File
ICWLMAX	Maximum pumping amount; this number corresponds to the appropriate data column in the Time-Series Pumping File; enter 0 if a maximum diversion amount does not apply
FWLMAX	Fraction of data value specified in column ICWLMAX to be used as maximum pumping amount

Element Groups for Well Pumping Deliveries

NGRP	Number of element groups; enter 0 if there are no element groups where well pumping is delivered
ID	Element group identification number entered sequentially
NELEM	Number of elements in element group ID
IELEM	Element numbers that are in group ID

```
C*******************************************************************************
C
C                 INTEGRATED WATER FLOW MODEL (IWFM)
C
C*******************************************************************************
C
C                       WELL SPECIFICATION FILE
C                          Pumping Component
C                         *** Version 4.0 ***
C
C
C            Project:  IWFM Version ### Release
C                      California Department of Water Resources
C            Filename: Wells.dat
C
C*******************************************************************************
C                            File Description:
C
C   This data file includes the relevant data for the wells that are simulated
C   in the model.
C
C*******************************************************************************
C              List of modeled wells and their corresponding parameters
C
C   NWELL ; Number of wells modeled
C   FACTXY; Conversion factor for well coordinates
C   FACTRW; Conversion factor for well diameter
C   FACTLT; Conversion factor for perforation depths
C
C-------------------------------------------------------------------------------
C     VALUE                        DESCRIPTION
C-------------------------------------------------------------------------------
      87                         / NWELL
      3.2808                     / FACTXY  (m -> ft)
      1.0                        / FACTRW
      1.0                        / FACTLT
C-------------------------------------------------------------------------------
C*******************************************************************************
C                   Well Location and Structure Characteristics
C
C   ID      ;  Well identification number
C   XWELL   ;  X coordinate of well location, [L]
C   YWELL   ;  Y-coordinate of well location, [L]
C   RWELL   ;  Well diameter, [L]
C   PERFT   ;  Elevation of or depth to the top of well screen, [L]
C   PERFB   ;  Elevation of or depth to the bottom of well screen, [L]
C                 *** Note: If PERFT > PERFB screening interval is given as elevations
C                           If PERFT < PERFB screening interval is given as depth-to
C                                       top/bottom of screening
C
C-------------------------------------------------------------------------------
C    ID       XWELL     YWELL       RWELL      PERFT      PERFB
C-------------------------------------------------------------------------------
     1        609534    4267260     8          237        510
     2        609695    4267817     7          321        330
     3        609448    4268184     7          217        344
     .        .         .           .          .          .
     .        .         .           .          .          .
     .        .         .           .          .          .
     85       623703    4270056     6          125        212
     86       623778    4269934     6          50         80
     87       623660    4269747     6          200        287
C*******************************************************************************
C                       Well Pumping Characteristics
C
C   ID        ; Well identification number
C   ICOLWL    ; Well pumping - this number corresponds to the appropriate data column
C                in the Time Series Pumping File
C   FRACWL    ; Relative proportion of the pumping in column ICOLWL to be applied
C                to well ID
C   IOPTWL    ; Option for distribution of pumping at the delivery destination
C                0 = to distribute the pumping according to the given relative
C                      fraction, FRACWL
C                1 = to distribute the pumping in proportion to FRACWL
C                      times the total area of the destination for pumping
C                2 = to distribute the pumping in proportion to FRACWL
C                      times the developed area (ag. and urban) at the destination
C                      for pumping
C                3 = to distribute the pumping in proportion to FRACWL
C                      times the ag. area at the destination for pumping
C                4 = to distribute the pumping in proportion to FRACWL
C                      times the urban area at the destination for pumping
C   TYPDSTWL ; Destination where the pumping is delivered to
C               -1 = pumping is used in the same element that pumping occurs
C                0 = Pumping goes outside the model domain
C                2 = Pumping goes to element DSTWL (see below)
C                4 = Pumping goes to subregion DSTWL (see below)
C                6 = Pumping goes to a group of elements with ID DSTDL
C                      (element groups are listed after this section)
C   DSTWL     ; Destination number for well pumping delivery
C                * Note: Enter any number if TYPDSTWL is set to -1 or 0
C   ICFIRIGWL; Fraction of the pumping that is used for irrigation purposes -
C                this number corresponds to the appropriate data column in the
C                Irrigation Fractions Data File
C   ICADJWL   ; Supply adjustment specification - this number corresponds to
C                the data column in the Supply Adjustment Specifications
C                Data File
C   ICWLMAX   ; Maximum pumping amount - this number corresponds to the
C                appropriate data column in the Time Series Pumping File
C                * Enter 0 if a maximum diversion amount does not apply.
C   FWLMAX    ; Fraction of data value specified in column ICWLMAX to be used as
C                maximum pumping amount
C
C---------------------------------------------------------------------------------------------------
C    ID      ICOLWL   FRACWL    IOPTWL   TYPDSTWL    DSTWL    ICFIRIGWL   ICADJWL  ICWLMAX   FWLMAX
C---------------------------------------------------------------------------------------------------
     1       49       1.0       4        4           15       2           3        112       1.0
     2       50       1.0       4        4           15       2           3        113       1.0
     3       51       1.0       4        4           15       2           3        114       1.0
     .       .        .         .        .           .        .           .        .         .
     .       .        .         .        .           .        .           .        .         .
     .       .        .         .        .           .        .           .        .         .
```

```
     85      17       3.0        4       4            17     2           3       196       1.0
     86      17       3.0        4       4            17     2           3       197       1.0
     87      17       3.0        4       4            17     2           3       198       1.0
C---------------------------------------------------------------------------------------------------
C
C                Element Groups for Well Pumping Deliveries
C
C   List the elements in each group where selected well pumping above is delivered to. All
C   elements in each group must belong to the same subregion.
C
C   NGRP  ; Number of element groups
C            * Enter 0 if there are no element groups where well pumping is delivered
C   ID    ; Element group ID entered sequentially
C   NELEM ; Number of elements in element group ID
C   IELEM ; Element numbers that are in group ID
C
C--------------------------------------------------------------------------------
     0                 / NGRP
C--------------------------------------------------------------------------------
C    ID         NELEM      IELEM
C--------------------------------------------------------------------------------
*
*
```

Element Pumping Specifications Data File

Element Pumping Specifications Data File lists the parameters for the simulated element pumping such as pumping amounts, maximum pumping rates, pumping delivery destinations, distribution of pumping at the delivery destinations, pumping irrigation fractions (i.e. fraction of the element pumping that is used for agricultural purposes) and element pumping adjustment specifications so that pumping meets either agricultural or urban, or both agricultural and urban water demands at the delivery destination.

Each simulated element pumping is associated with a data column in the Time Series Pumping File. All or a fraction of the pumping rate specified in the data column can be applied to the specified element using user-specified fractions (FRACSK) that may be further weighted (using the IOPTSK option) with respect to the agricultural and urban area in the destination where the pumping is delivered. For instance, the total pumping in a subregion may be known but the locations of the wells and the actual pumping amounts at each well may be unknown. In such a case, the user can specify the total pumping for the subregion in the Time Series Pumping File, and let IWFM distribute subregional pumping among the elements in that subregion based on the agricultural and urban water demand in each element. For this set-up, assuming the subregional pumping is stored in column 1 of the Time-Series Pumping File, ICOLSK for all elements in the subregion will be 1, FRACSK will be 1.0 and IOPTSK will be 2 (see the description of the variables below).

The Element Pumping Specifications Data File is divided into several sections and the following variables are used for the simulation of element pumping:

Element Pumping Characteristics:

NSINK — Number of elements where element pumping is specified

ID — Element identification number corresponding to the pumping

ICOLSK — Element pumping; this number corresponds to the appropriate data column in the Time-Series Pumping File

FRACSK — Relative proportion of the pumping in column ICOLSK to be applied to element ID

IOPTSK — Option for distribution of pumping in column at the delivery destination (0 = distribute the pumping according to the given relative fraction, FRACSK; 1 = distribute the pumping in proportion to FRACSK times the total area of the delivery destination; 2 = distribute the pumping in proportion to FRACSK times the developed area (agricultural and urban) at the delivery destination; 3 = distribute the pumping in proportion to FRACSK times the agricultural area at the delivery destination; 4 = distribute the pumping in proportion to FRACSK times the urban area at the delivery destination

FRACSKL — The distribution factor of pumping for each aquifer layer

TYPDSTSK — Destination where the pumping is delivered to (–1 = pumping is used in the same element where pumping occurs; 0 = pumping goes outside the model domain; 2 = pumping goes to element DSTSK; 4 = pumping goes to subregion DSTSK; 6 = pumping goes to a group of elements with group identification number

	DSTDL where element group identifications are specified later in the file)
DSTSK	Delivery destination identification number; enter any number if TYPDSTSK is set to –1 (i.e. pumping is used in the same element where pumping occurs) or 0 (i.e. pumping is delivered to outside the model area)
ICFIRIGSK	Fraction of the pumping that is used for irrigation purposes; this number corresponds to the appropriate data column in the Irrigation Fractions Data File
ICADJSK	Supply adjustment specification; this number corresponds to the data column in the Supply Adjustment Specifications Data File
ICSKMAX	Maximum pumping amount; this number corresponds to the appropriate data column in the Time Series Pumping File (enter 0 if a maximum pumping amount does not apply)
FSKMAX	Fraction of data value specified in column ICSKMAX to be used as maximum pumping amount

Element Groups for Element Pumping Deliveries

NGRP	Number of element groups; enter 0 if there are no element groups where well pumping is delivered
ID	Element group identification number entered sequentially
NELEM	Number of elements in element group ID
IELEM	Element numbers that are in group ID

```
C*******************************************************************************
C
C                  INTEGRATED WATER FLOW MODEL (IWFM)
C
C*******************************************************************************
C
C                  ELEMENT PUMPING SPECIFICATION FILE
C                          Pumping Component
C                         *** Version 4.0 ***
C
C
C             Project:  IWFM Version ### Release
C                       California Department of Water Resources
C             Filename: ElemPump.dat
C
C*******************************************************************************
C                          File Description
C
C   This data file contains the specification data for element pumping.
C
C*******************************************************************************
C
C   NSINK ;  Number of elements used for element pumping
C
C-------------------------------------------------------------------------------
C   VALUE                        DESCRIPTION
C-------------------------------------------------------------------------------
     5                           / NSINK
C-------------------------------------------------------------------------------
C*******************************************************************************
C              List of elements for pumping and their corresponding parameters
C
C   ID       ; Element identification number corresponding to the pumping
C   ICOLSK   ; Element pumping - this number corresponds to the appropriate data
C               column in the Time Series Pumping File
C   FRACSK    ; Relative proportion of the pumping in column ICOLSK to be applied
C               to element ID
C   IOPTSK   ; Option for distribution of pumping at the delivery destination
C               0 = to distribute the pumping according to the given relative
C                     fraction, FRACSK
C               1 = to distribute the pumping in proportion to FRACSK
C                     times the total area of the destination for pumping
C               2 = to distribute the pumping in proportion to FRACSK
C                     times the developed area (ag. and urban) at the destination
C                     for pumping
C               3 = to distribute the pumping in proportion to FRACSK
C                     times the ag. area at the destination for pumping
C               4 = to distribute the pumping in proportion to FRACSK
C                     times the urban area at the destination for pumping
C   FRACSKL  ; The distribution factor of pumping for each aquifer layer; i.e. for
C               layers 1 to NL
C   TYPDSTSK ; Destination where the pumping is delivered to
C              -1 = pumping is used in the same element that pumping occurs
C               0 = Pumping goes outside the model domain
C               2 = Pumping goes to element DSTSK (see below)
C               4 = Pumping goes to subregion DSTSK (see below)
C               6 = Pumping goes to a group of elements with ID DSTDL
C                     (element groups are listed after this section)
C   DSTSK    ; Destination number for element pumping delivery
C               * Note: Enter any number if TYPDSTSK is set to -1 or 0
C   ICFIRIGSK; Fraction of the pumping that is used for irrigation purposes -
C               this number corresponds to the appropriate data column in the
C               Irrigation Fractions Data File
C   ICADJSK  ; Supply adjustment specification - this number corresponds to
C               the data column in the Supply Adjustment Specifications
C               Data File
C   ICSKMAX  ; Maximum pumping amount - this number corresponds to the
C               appropriate data column in the Time Series Pumping File
C               * Enter 0 if a maximum pumping amount does not apply
C   FSKMAX   ; Fraction of data value specified in column ICSKMAX to be used as
C               maximum pumping amount
C
C----------------------------------------------------------------------------------------------------------------
C ID  ICOLSK   FRACSK   IOPTSK   FRACSKL(1)   FRACSKL(2)   TYPDSTSK   DSTSK   ICFIRIGSK   ICADJSK  ICSKMAX  FSKMAX
C----------------------------------------------------------------------------------------------------------------
  73    1       1.0       0         1.0          1.0          4         1        2          4        0       1.0
  193   1       1.0       0         1.0          1.0          4         1        2          4        0       1.0
  333   1       1.0       0         1.0          1.0          4         2        1          4        0       1.0
  134   2       1.0       0         1.0          1.0          0         0        0          4        0       1.0
  274   2       1.0       0         1.0          1.0          0         0        0          4        0       1.0
C-----------------------------------------------------------------------------------------------
C
C                Element Groups for Element Pumping Deliveries
C
C   List the elements in each group where selected element pumping above is delivered to. All
C   elements in each group must belong to the same subregion.
C
C   NGRP  ; Number of element groups
C            * Enter 0 if there are no element groups where well pumping is delivered
C   ID    ; Element group ID entered sequentially
C   NELEM ; Number of elements in element group ID
C   IELEM ; Element numbers that are in group ID
C
C-------------------------------------------------------------------------------
    0                   / NGRP
C-------------------------------------------------------------------------------
C    ID          NELEM      IELEM
C-------------------------------------------------------------------------------
*
*
```

Time-Series Pumping File

The Time Series Pumping File contains the time series information for the specified wells and/or elemental pumping. This file lists the number of pumping data columns followed by conversion factor for the pumping data, number of time steps to update pumping and the repetition frequency for the pumping data. In time tracking simulations the time series pumping data can be either listed in this file or in a DSS file. If a DSS file is used for data input, then the name of the DSS file and the pathnames corresponding to each of the time series data are required.

The following is a list of the variables used in this data file:

NCOLPUMP	Number of pumping data columns
FACTPUMP	Conversion factor for the spatial component of the unit for the pumping data
NSPPUMP	Number of time steps to update pumping data; if time tracking simulation, enter any number
NFQPUMP	Repetition frequency of the pumping data (enter 0 if full time series data is supplied); if time tracking simulation, enter any number
DSSFL	If the time series data is stored in a DSS file, name of the file; leave blank if the data is listed in the Time Series Pumping File

Data Input from Time-Series Pumping File

If the time series data is listed in the Time-Series Pumping File, then the following variables need to be populated. Otherwise, these variables should be

commented out using “C”, “c” or “*”, and the variables in the “Data Input from DSS File” section below should be populated.

ITPU	Time. For time tracking simulations use MM/DD/YYYY_hh:mm format, for non-time tracking simulations enter an integer number.
APUMP	Pumping rate (a negative value represents pumping whereas a positive value represents recharge), [L^3/T]

Data Input from DSS File

If time series data is stored in a DSS file then the following variables should be populated:

REC	Record number that coincides with the data column number for the time series data
PATH	Pathname for the time series record that will be used for data retrieval

```
C*******************************************************************************
C
C                  INTEGRATED WATER FLOW MODEL (IWFM)
C
C*******************************************************************************
C
C                       PUMPING DATA FILE
C                       Pumping Component
C                      *** Version 4.0 ***
C
C
C             Project : IWFM Version ### Release
C                       California Department of Water Resources
C             Filename: TSPumping.dat
C
C*******************************************************************************
C                            File Description:
C
C   This data file contains the time series pumping/recharge data.
C
C*******************************************************************************
C                         Pumping Data Specifications
C
C   NCOLPUMP; Number of pumping sets (or pathnames if DSS files are used)
C   FACTPUMP; Conversion factor for pumping data
C              It is used to convert only the spatial component of the unit;
C              DO NOT include the conversion factor for time component of the unit.
C              * e.g. Unit of pumping listed in this file        = AC-FT/MONTH
C                     Consistent unit used in simulation         = CU.FT/DAY
C                     Enter FACTPUMP (AC-FT/MONTH -> CU.FT/MONTH)= 2.29568E-05
C                      (conversion of MONTH -> DAY is performed automatically)
C   NSPPUMP ; Number of time steps to update pumping data
C              * Enter any number if time-tracking option is on
C   NFQPUMP ; Repetition frequency of the pumping data
C              * Enter 0 if full time series data is supplied
C              * Enter any number if time-tracking option is on
C   DSSFL   ; The name of the DSS file for data input (maximum 50 characters);
C              * Leave blank if DSS file is not used for data input
C
C-------------------------------------------------------------------------------
C         VALUE                                     DESCRIPTION
C-------------------------------------------------------------------------------
          2                                       / NCOLPUMP
          43560000.0                              / FACTPUMP    (taf -> cu.ft.)
          1                                       / NSPPUMP
          0                                       / NFQPUMP
                                                  / DSSFL
C-------------------------------------------------------------------------------
C                              Pumping Data
C                          (READ FROM THIS FILE)
C
C   List the pumping data below if it will not be read from a DSS file (i.e.
C   DSSFL is left blank above).
C
C   For pumping enter negative values, for recharge enter positive values.
C
C   ITPU ;   Time
C   APUMP;   Pumping rate; [L^3/T]
C             * Negative values: Pumping
C             * Positive values: Recharge
C
C-------------------------------------------------------------------------------
C ITPU                APUMP(1)  APUMP(2)  APUMP(3) ...
C-------------------------------------------------------------------------------
01/31/4000_24:00      -3.50      0.00
02/29/4000_24:00      -3.50      0.00
03/31/4000_24:00      -3.50      0.00
04/30/4000_24:00       0.00      6.00
05/31/4000_24:00       0.00      6.00
06/30/4000_24:00       0.00      6.00
07/31/4000_24:00       0.00      6.00
08/31/4000_24:00       0.00      6.00
09/30/4000_24:00       0.00      6.00
10/31/4000_24:00      -3.50      0.00
11/30/4000_24:00      -3.50      0.00
12/31/4000_24:00      -3.50      0.00
C-------------------------------------------------------------------------------
C                       Pathnames for Pumping Data
C                          (READ FROM DSS FILE)
C
C   List the pathnames for pumping data below if it will be read from a DSS file
C   (i.e. DSSFL is specified above).
C
C   REC  ;   Time series record number
C   PATH ;   Pathname for the time series record
C
C-------------------------------------------------------------------------------
C   REC       PATH
C-------------------------------------------------------------------------------
*
*
```

Subsidence Component Files

Groundwater Component Main File points to the Subsidence Component Main File which is the gateway for all other data files that are needed to simulate elastic and inelastic subsidence in IWFM. Data input files that are used in simulating subsidence are described in the following sections.

Subsidence Component Main File

Subsidence Component Main File is the gateway to the simulation of elastic and inelastic subsidence. Aquifer parameters, interbed thickness and pre-compaction heads to simulate subsidence can be specified at each node or through the use of parametric grids. Optionally, interbed thickness and pre-compaction heads can be listed in a separate, initial conditions file. This setup is useful when the user would like to run a model up to a certain simulation time and then he/she wants to restart the model from where it was stopped. In this case, end-of-simulation output for subsidence can be used as initial conditions for the model restart. The only thing the user has to do in this case is to save the end-of simulation results and then use this output as initial interbed thickness and pre-compaction heads for the model restart.

Additional subsidence-related output can also be specified through the Subsidence Component Main File: a TECPLOT-ready output can be generated to create, for instance, animations of subsidence using the proprietary software TECPLOT, or subsidence hydrographs at user-defined locations can be printed out.

This file is divided into multiple sections:

General Input and Output Filenames and Output Conversion Factors

INISUBFL	Initial conditions input file for interbed thickness and pre-compaction head (maximum 1000 characters); leave blank if these parameters are defined later in the Subsidence Component Main File. However, if the file is specified, the initial conditions will override interbed thickness and pre-compaction head defined the Subsidence Component Main File
TPSOUTFL	TECPLOT output file for subsidence (maximum 1000 characters); leave blank if this output is not required
FNSUBFL	Output file for end-of-simulation interbed thicknesses and pre-compaction heads (maximum 1000 characters); leave blank if this output is not required
FACTLTOU	Factor to convert simulation unit of subsidence into intended unit of output
UNITLTOU	Output unit of subsidence (maximum 10 characters)

Subsidence Hydrograph Output Data

This section lists the locations where subsidence hydrograph output is desired.

NOUTS	Total number of subsidence data to be printed (set NOUTS to 0 if no subsidence data is to be printed)
FACTXY	Conversion factor for nodal coordinates of the subsidence data location if given in x-y coordinates
SUBHYDOUTFL	Filename for subsidence data output (maximum 1000 characters);

	leave blank if this output is not required
ID	Sequential ID number for subsidence hydrograph output (1 through NOUTS)
SUBTYP	Subsidence data location type (0 = subsidence data location is given as x-y coordinates; 1 = subsidence data location is given as groundwater node number)
IOUTSL	Aquifer layer number for subsidence hydrograph output (enter 0 to print total subsidence for all layers)
X	The x-coordinate of the subsidence data location (enter any value if SUBTYP = 1; i.e. if subsidence hydrograph location is given as a groundwater node number), [L]
Y	The y-coordinate of the subsidence data location (enter any value if SUBTYP = 1; i.e. if subsidence hydrograph location is given as a groundwater node number), [L]
IOUTS	Groundwater node number for subsidence data output (enter any value if SUBTYP = 0; i.e. if subsidence hydrograph location is given as an x-y coordinate)
NAME	Name of the subsidence data print location (maximum 30 characters)

Subsidence Parameters

Parameters to simulate subsidence can be specified at each groundwater node or through the use of parametric grids. The use of parametric grids are described in detail for the Groundwater Component Main File in this document. The following variables are used in this section:

NGROUP	Number of parametric grid groups (set NGROUP to 0 if the subsidence parameters will be defined at each groundwater node)
FX	Conversion factor for parametric grid coordinates
FSCE	Conversion factor for elastic storage coefficient
FSCI	Conversion factor for inelastic storage coefficient
FDC	Conversion factor for interbed thickness
FDCMIN	Conversion factor for minimum interbed thickness
FHC	Conversion factor for pre-compaction hydraulic head
NDP	Number of nodes in the parametric grid
NEP	Number of elements in the parametric grid
IE	Parametric element number
NODE	Parametric nodes in counter clock-wise direction corresponding to parametric element IE
ID	Parametric node number
PX	x-coordinate for the parametric node, [L]
PY	y-coordinate for the parametric node, [L]
SCE	Elastic storage coefficient, [1/L]
SCI	Inelastic storage coefficient, [1/L]
DC	Interbed thickness, [L]
DCMIN	Minimum interbed thickness; [L]

HC Pre-compaction hydraulic head (use 99999. to use initial heads), [L]

Parameters ID through HC are defined when these parameters are specified using parametric grids at each parametric node; i.e. when NGROUP is greater than 0 (option 1). When NGROUP is set to 0, then subsidence parameters must be specified for each groundwater node (option 2). In this case parameter ID represents the groundwater node number, PX and PY parameters are not used, and parameters SCE through HC are all specified for each groundwater node at each aquifer layer.

```
#4.0
C***  DO NOT DELETE ABOVE LINE ***
C
C*****************************************************************************
C
C                   INTEGRATED WATER FLOW MODEL (IWFM)
C
C*****************************************************************************
C
C                     SUBSIDENCE COMPONENT MAIN DATA FILE
C                           Subsidence Component
C                            *** Version 4.0 ***
C
C
C              Project :  IWFM Version ### Release
C                         California Department of Water Resources
C              Filename:  Subsidence_MAIN.dat
C
C*****************************************************************************
C                           File Description
C
C   This data file contains the parameters and data file names for the simulation
C   of aquifer subsidence.
C
C*****************************************************************************
C                    Input and Output Data File Names
C
C   INISUBFL  ;  Initial conditions input file for interbed thickness and pre-compaction
C                 head (max. 1000 characters)
C                 * Leave blank if these parameters are defined below
C                 * If the file is specified, the initial conditions will over-write
C                    interbed thickness and pre-compaction head defined below
C   TPSOUTFL  ;  TecPlot output file for subsidence (max. 1000 characters)
C                 * Leave blank if this output is not required
C   FNSUBFL   ;  Output file for end-of-simulation interbed thicknesses and pre-compaction
C                 heads (max. 1000 characters)
C                 * Leave blank if this output is not required
C   FACTLTOU  ;  Factor to convert simulation unit of subsidence into intented output unit
C   UNITLTOU  ;  Output unit of subsidence (max. 10 characters)
C
C--------------------------------------------------------------------------------------
C         VALUE                                       DESCRIPTION
C--------------------------------------------------------------------------------------
                                                    / INISUBFL
     Subsidence_Tecplot.out                         / TPSOUTFL
     SubsidenceFinal.out                            / FNSUBFL
     1.0                                            / FACTLTOU
     ft.                                            / UNITLTOU
C*****************************************************************************
C                           Subsidence Output Data
C
C   The following lists the node and layer numbers for which subsidence data
C   will be printed
C
C   NOUTS      ; Total number of subsidence data to be printed
C                 (NOUTS = 0 if no subsidence data is to be printed)
C   FACTXY     ; Conversion factor for nodal coordinates of the subsidence data
C                 location if given in x-y coordinates
C   SUBHYDOUTFL; File name for subsidence data output (max. 1000 characters)
C                 * Leave blank if this output is not required
C
C-----------------------------------------------------------------------------
C   VALUE                      DESCRIPTION
C-----------------------------------------------------------------------------
    10                         / NOUTS
    3.2808                     / FACTXY         (m -> ft)
    SubsidenceHyd.out          / SUBHYDOUTFL
C-----------------------------------------------------------------------------
C
C   The following lists the subsidence data location type (x-y coordinates or node number),
C   layer number, and x-y coordinates or groundwater node number for each subsidence
C   data to be printed (skip if no subsidence data are to be printed, i.e. NOUTS = 0)
C
C   ID    ;  Sequential ID number (1 through NOUTS)
C   SUBTYP;  Subsidence data location type
C              0 = subsidence data location is given as x-y coordinates
C              1 =    "          "       "      "  "    " groundwater node number
C   IOUTSL;  Layer number
C              * Enter 0 to print total subsidence for all layers
C   X     ;  The x-coordinate of the subsidence data location; [L]
C              * Leave blank if SUBTYP = 1
C   Y     ;  The y-coordinate of the subsidence data location; [L]
C              * Leave blank if SUBTYP = 1
C   IOUTS ;  Groundwater node number for subsidence data output
C              * Leave blank if SUBTYP = 0
C   NAME  ;  Name of the subsidence data print location (max. 30 characters)
C
C-----------------------------------------------------------------------------
C   ID   SUBTYP   IOUTSL        X           Y         IOUTS    NAME
C-----------------------------------------------------------------------------
    1    1         1                                    531      SubsHyd1
    2    1         2                                    531      SubsHyd2
    3    0         1        547412.9   4477114.0                 SubsHyd3
    .    .         .              .           .           .        .
    .    .         .              .           .           .        .
    .    .         .              .           .           .        .
    8    1         3                                    768      SubsHyd8
    9    0         1        577672.3   4471303.0                 SubsHyd9
   10    0         0        534420.0   4456477.0                 SubsHyd10
C*****************************************************************************
C                            SUBSIDENCE PARAMETERS
C
C-----------------------------------------------------------------------------
C   Option 1 - Set subsidence parameters by use of a parametric grid(NGROUP > 0)
C   Option 2 - Set subsidence parameters at every groundwater node  (NGROUP = 0)
C
C   NGROUP;  Number of parametric grid groups
C
C-----------------------------------------------------------------------------
C       VALUE                  DESCRIPTION
C-----------------------------------------------------------------------------
         0                     / NGROUP
```

```
C-----------------------------------------------------------------------------
C   OPTIONS 1 & 2 : The following lists the factors to convert the subsidence
C   parameters and grid coordinates to the appropriate units
C
C   FX     ;  Conversion factor for parametric grid coordinates
C   FSCE   ;  Conversion factor for elastic storage coefficient
C   FSCI   ;  Conversion factor for inelastic storage coefficient
C   FDC    ;  Conversion factor for interbed thickness
C   FDCMIN ;  Conversion factor for minimum interbed thickness
C   FHC    ;  Conversion factor for pre-compaction hydraulic head
C
C-----------------------------------------------------------------------------
C  FX       FSCE      FSCI    FDC     FDCMIN    FHC
C-----------------------------------------------------------------------------
   3.2808    1.0       1.0    1.0      1.0       1.0
C*****************************************************************************
C                 OPTION 1
C*****************************************************************************
C-----------------------------------------------------------------------------
C   *** GROUP 1 ***
C-----------------------------------------------------------------------------
C   Enter node numbers from FE grid for the 1st parametric group
C     (e.g. 1-100,101,301-359,567)
C     * Enter 0 if no nodes will be affected with this parametric grid
C-----------------------------------------------------------------------------
*
C-----------------------------------------------------------------------------
C
C   NDP;     Number of nodes in the 1st parametric grid
C   NEP;     Number of elements in the 1st parametric grid
C
C-----------------------------------------------------------------------------
C   VALUE                        DESCRIPTION
C-----------------------------------------------------------------------------
*                                / NDP
*                                / NEP
C-----------------------------------------------------------------------------
C
C   The following is a list of the parametric elements and
C   corresponding parametric nodes for the 1st parametric group
C   (to be used only when NEP > 0)
C
C   IE  ;    Parametric element number
C   NODE;    Corresponding parametric node
C
C-----------------------------------------------------------------------------
C             Node 1    Node 2    Node 3     Node 4
C    IE        NODE      NODE      NODE       NODE
C-----------------------------------------------------------------------------
*
C-----------------------------------------------------------------------------
C
C   List the paramatric nodes, nodal coordinates and subsidence
C   parameters for each layer of the 1st parametric group
C   (enter -1.0 not to overwrite the previously set values)
C
C   ID   ;   Parametric node number
C   PX,PY;   Parametric node coordinates; [L]
C   SCE  ;   Elastic storage coefficient; [1/L]
C   SCI  ;   Inelastic storage coefficient; [1/L]
C   DC   ;   Interbed thickness;[L]
C   DCMIN;   Minimum interbed thickness; [L]
C   HC   ;   Pre-compaction hydraulic head (use 99999. to use initial heads); [L]
C            *Note* The above land subsidence parameters are only for interbed layers (i.e. clay layers)
C
C---------------------------------------------------------------------------------------------------------
C            NODAL   COORDINATES
C            OF PARAMETRIC  GRID         Elastic   Inelastic   Interbed   Min. Intrbd   Precompc
C                                        Stg. Coef. Stg. Coef.  Thickness   Thickness    Hyd. Head
C  ID         PX             PY            SCE        SCI         DC         DCMIN          HC
C---------------------------------------------------------------------------------------------------------
*
C-----------------------------------------------------------------------------------
C    *** GROUP 2 ***
C-----------------------------------------------------------------------------
C   Enter node numbers from the FE grid for the 2nd parametric group
C     (e.g. 1-100,101,301-359,567)
C     * Enter 0 if no nodes will be affected with this parametric grid
C-----------------------------------------------------------------------------
*
C-----------------------------------------------------------------------------
C
C   NDP;     Number of nodes in the 2nd parametric grid
C   NEP;     Number of elements in the 2nd parametric grid
C
C-----------------------------------------------------------------------------
C   VALUE                         DESCRIPTION
C-----------------------------------------------------------------------------
*                                 / NDP
*                                 / NEP
C-----------------------------------------------------------------------------
C
C   The following is a list of the parametric elements and
C   corresponding parametric nodes for the 2nd parametric group
C   (to be used only when NEP > 0)
C
C   IE  ;    Parametric element number
C   NODE;    Corresponding parametric node
C
C-----------------------------------------------------------------------------
C   Element   Node 1    Node 2    Node 3     Node 4
C    IE        NODE      NODE      NODE       NODE
C-----------------------------------------------------------------------------
*
C-----------------------------------------------------------------------------
C
C   List the paramatric nodes, nodal coordinates and subsidence
C   parameters for each layer of the 1st parametric group
C   (enter -1.0 not to overwrite the previously set values)
C
C   ID   ;   Parametric node number
C   PX,PY;   Parametric node coordinates; [L]
```

```
C   SCE  ;   Elastic storage coefficient; [1/L]
C   SCI  ;   Inelastic storage coefficient; [1/L]
C   DC   ;   Interbed thickness;[L]
C   DCMIN;   Minimum interbed thickness; [L]
C   HC   ;   Pre-compaction hydraulic head (use 99999. to use initial heads); [L]
C            *Note* The above land subsidence parameters are only for interbed layers (i.e. clay layers)
C
C-----------------------------------------------------------------------------------------------
C            NODAL   COORDINATES
C            OF PARAMETRIC  GRID          Elastic   Inelastic   Interbed  Min. Intrbd   Precompc
C                                        Stg. Coef. Stg. Coef.  Thickness  Thickness    Hyd. Head
C  ID         PX            PY             SCE        SCI         DC       DCMIN          HC
C-----------------------------------------------------------------------------------------------
*
C-----------------------------------------------------------------------------
C*****************************************************************************
C                  OPTION 2
C*****************************************************************************
C
C    List the groundwater nodes, and subsidence parameters for
C    each layer (skip if option 1 is used)
C
C   ID   ;   Groundwater node number
C   SCE  ;   Elastic storage coefficient; [1/L]
C   SCI  ;   Inelastic storage coefficient; [1/L]
C   DC   ;   Interbed thickness; [L]
C   DCMIN;   Minimum interbed thickness; [L]
C   HC   ;   Pre-compaction hydraulic head (use 99999. to use initial heads); [L]
C            *Note* The above land subsidence parameters are only for interbed layers (i.e. clay layers)
C
C-----------------------------------------------------------------------------
C                           Layer  1
C                           Layer  2
C                              .
C                              .
C
C          Elastic   Inelastic   Interbed   Min. Intrbd   Precompc
C         Stg. Coef. Stg. Coef.  Thickness   Thickness    Hyd. Head
C  ID        SCE        SCI         DC        DCMIN          HC
C-----------------------------------------------------------------------------
    1      4.500E-06    1.010E-06    13.0       2.0          605.7
           4.890E-06    1.010E-06     4.0       2.0          636.7
           4.500E-06    1.010E-06     2.0       2.0          663.4
    2      4.500E-06    1.010E-06    12.0       2.0          605.8
           4.760E-06    1.010E-06     4.0       2.0          635.3
           4.500E-06    1.010E-06     2.0       2.0          661.9
    3      4.500E-06    1.010E-06    12.0       2.0          622.8
           4.490E-06    1.010E-06     4.0       2.0          651.9
           4.510E-06    1.010E-06     2.0       2.0          678.6
    .          .            .          .         .              .
               .            .          .         .              .
               .            .          .         .              .
    .          .            .          .         .              .
               .            .          .         .              .
               .            .          .         .              .
 1391     4.510E-06    1.010E-06    65.0       2.0         1006.6
          4.430E-06    1.010E-06     3.0       3.0         1203.4
          4.480E-06    1.010E-06     3.0       3.0         1472.1
 1392     4.510E-06    1.010E-06    63.0       2.0         1312.1
          4.450E-06    1.010E-06     3.0       3.0         1562.8
          4.480E-06    1.010E-06     3.0       3.0         1808.4
 1393     4.510E-06    1.010E-06    63.0       2.0         1412.7
          4.450E-06    1.010E-06     3.0       3.0         1699.4
          4.470E-06    1.010E-06     3.0       3.0         1942.2
```

Subsidence Initial Conditions Data File

The interbed thickness and pre-compaction heads that are defined within the Subsidence Component Main Data File can be overridden by data specified in the optional Subsidence Initial Conditions Data File. This file may be used, for instance, when a model run needs to be restarted from a mid-point in the simulation period using the interbed thickness and pre-compaction heads printed out as end-of-simulation results from a previous model run.

The following variables are defined in this file:

FACT	Conversion factor for the initial interbed thickness and pre-compaction heads
ID	Groundwater node number listed sequentially
DC	Initial interbed thickness at the corresponding groundwater node, [L]
HC	Initial pre-compaction head at the corresponding groundwater node, [L]

```
C*******************************************************************************
C
C                   INTEGRATED WATER FLOW MODEL (IWFM)
C
C*******************************************************************************
C
C                   SUBSIDENCE INITIAL CONDITIONS DATA FILE
C                           Subsidence Component
C                            *** Version 4.0 ***
C
C
C              Project :  IWFM Version ### Release
C                         California Department of Water Resources
C              Filename:  SubsidenceIC.dat
C
C*******************************************************************************
C                           File Description
C
C   This data file contains the initial interbed thickness and pre-compaction head
C   at each aquifer node. The values specified in this file will over-write those
C   defined in the Subsidence Data Main Input File.
C
C*******************************************************************************
C              Initial Interbed Thickness and Pre-Compaction Head
C               (These values will over-write those defined above)
C
C   FACT ;  Conversion factor
C   ID   ;  Groundwater node number listed sequentially
C   DC   ;  Initial interbed thickness at corresponding groundwater node; [L]
C   HC   ;  Initial pre-compaction head at corresponding groundwater node; [L]
C
C-------------------------------------------------------------------------------
C   VALUE                      DESCRIPTION
C-------------------------------------------------------------------------------
    1.0                            / FACT
C-------------------------------------------------------------------------------
C          DC[1]    DC[2]  ...  DC[NLayers]   HC[1]    HC[2]  ...  HC[NLayers]
C          ----------------------------------------------------------------
C   ID     DC[1]    DC[2]     DC[3]    HC[1]    HC[2]    HC[3]
C-------------------------------------------------------------------------------
    1     13.0006   3.9998    1.9999   482.93   396.39   396.23
    2     11.9994   3.9997    1.9998   445.67   412.31   412.13
    3     11.9990   3.9996    1.9998   446.95   421.00   420.91
    .       .         .         .        .        .        .
    .       .         .         .        .        .        .
    .       .         .         .        .        .        .
 1391     64.9898   2.9995    2.9995   322.29   284.41   296.76
 1392     62.9917   2.9996    2.9996   356.87   310.43   316.77
 1393     62.9925   2.9996    2.9996   403.38   332.80   330.74
```

Aquifer Parameter Over-write Data File

This data file can be used to over-write selected aquifer parameter values at selected groundwater nodes. IWFM initially assigns parameter values to groundwater nodes through the information specified in the Groundwater Component Main File and Subsidence Component Main File. Sometimes it becomes necessary to modify some of the parameter values at selected groundwater nodes. One such situation is when IWFM is used in conjunction with an automated calibration program such as PEST (Paramater ESTimation program). PEST can automatically generate parameter values at specific groundwater nodes and this file can be used to over-write the previously specified values at these nodes. This file also allows the user to bypass the need to generate excessive numbers of parametric grid groups when only a few parameter values at a few groundwater nodes need to be modified. The following variables are used in this data file:

NWRITE	Total number of groundwater nodes at which previously defined parameter values will be over-written
FKH	Conversion factor for the spatial component of the unit of horizontal hydraulic conductivity
FS	Conversion factor for specific storage coefficient
FN	Weighting factor for specific yield value
FV	Conversion factor for the spatial component of the unit of aquitard vertical hydraulic conductivity
FL	Conversion factor for the spatial component of the unit of aquifer vertical hydraulic conductivity

FSCE	Conversion factor for elastic storage coefficient
FSCI	Conversion factor for inelastic storage coefficient
TUNITKH	Time unit of horizontal hydraulic conductivity; this should be one of the units recognized by HEC-DSS that are listed in the Simulation Main Input File
TUNITV	Time unit of aquitard vertical conductivity; this should be one of the units recognized by HEC-DSS that are listed in the Simulation Main Input File
TUNITL	Time unit of aquifer vertical conductivity; this should be one of the units recognized by HEC-DSS that are listed in the Simulation Main Input File
ID	Groundwater node number for which one or more parameter values will be modified
LAYER	Aquifer layer in which groundwater node ID resides
PKH	Hydraulic conductivity that will over-write the previously defined value (enter −1.0 if hydraulic conductivity at this node will not be modified), [L/T]
PS	Specific storage that will over-write the previously defined value (enter −1.0 if specific storage at this node will not be modified), [1/L]
PN	Specific yield that will over-write the previously defined value (enter −1.0 if specific yield at this node will not be modified), [L/L]

PV	Aquitard vertical hydraulic conductivity that will over-write the previously defined value (enter −1.0 if aquitard vertical hydraulic conductivity at this node will not be modified), [L/T]
PL	Aquifer vertical hydraulic conductivity that will over-write the previously defined value (enter −1.0 if aquifer vertical hydraulic conductivity at this node will not be modified), [L/T]
SCE	Elastic storage coefficient that will over-write the previously defined value (enter −1.0 if elastic storage coefficient at this node will not be modified), [1/L]
SCI	Inelastic storage coefficient that will over-write the previously defined value (enter −1.0 if inelastic storage coefficient at this node will not be modified), [1/L]

```
C*******************************************************************************
C
C                  INTEGRATED WATER FLOW MODEL (IWFM)
C
C*******************************************************************************
C
C                AQUIFER PARAMETER OVER-WRITE DATA FILE
C                        Groundwater Component
C                         *** Version 4.0 ***
C
C
C             Project :  IWFM Version ### Release
C                        California Department of Water Resources
C             Filename:  Overwrite.dat
C
C*******************************************************************************
C                           File Description
C
C   This data file contains node and layer numbers, and associated parameter
C   values to over-write values specified in the Parameter Data File.
C
C*******************************************************************************
C               Over-writing Parameter Value Data Specifications
C
C   NWRITE; Total number of groundwater nodes at which previously defined
C            parameter values will be over-written.
C
C-------------------------------------------------------------------------------
C   VALUE                      DESCRIPTION
C-------------------------------------------------------------------------------
    4179                       / NWRITE
C-------------------------------------------------------------------------------
C
C        Conversion factors for over-writing parameter values
C
C   FKH    ;  Conversion factor for horizontal hydraulic conductivity
C              It is used to convert only the spatial component of the unit;
C              DO NOT include the conversion factor for time component of the unit.
C              * e.g. Unit of hydraulic conductivity listed in this file = FT/MONTH
C                     Consistent unit used in simulation                = IN/DAY
C                     Enter FKH (FT/MONTH -> IN/MONTH)                  = 8.33333E-02
C                      (conversion of MONTH -> DAY is performed automatically)
C   FS     ;  Conversion factor for specific storage coefficient
C   FN     ;  Weighting factor for specific yield value
C   FV     ;  Conversion factor for aquitard vertical hydraulic conductivity
C              It is used to convert only the spatial component of the unit;
C              DO NOT include the conversion factor for time component of the unit.
C              * e.g. Unit of hydraulic conductivity listed in this file = FT/MONTH
C                     Consistent unit used in simulation                = IN/DAY
C                     Enter FKH (FT/MONTH -> IN/MONTH)                  = 8.33333E-02
C                      (conversion of MONTH -> DAY is performed automatically)
C   FL     ;  Conversion factor for aquifer vertical hydraulic conductivity
C              It is used to convert only the spatial component of the unit;
C              DO NOT include the conversion factor for time component of the unit.
C              * e.g. Unit of hydraulic conductivity listed in this file = FT/MONTH
C                     Consistent unit used in simulation                = IN/DAY
C                     Enter FKH (FT/MONTH -> IN/MONTH)                  = 8.33333E-02
C                      (conversion of MONTH -> DAY is performed automatically)
C   FSCE   ;  Conversion factor for elastic storage coefficient
C   FSCI   ;  Conversion factor for inelastic storage coefficient
C   TUNITKH;  Time unit of horizontal hydraulic conductivity.  This should be one of the units
C              recognized by HEC-DSS that are listed in the Main Control File.
C   TUNITV ;  Time unit of aquitard vertical conductivity.  This should be one of the units
C              recognized by HEC-DSS that are listed in the Main Control File.
C   TUNITL ;  Time unit of aquifer vertical conductivity.  This should be one of the units
C              recognized by HEC-DSS that are listed in the Main Control File.
C
C-------------------------------------------------------------------------
C  FKH         FS          FN          FV         FL       FSCE        FSCI
C-------------------------------------------------------------------------
   1.00        1.00        1.00        1.00       1.00     1.00        1.00
C-----------------------------------------------------------------------------------------------
C   VALUE              DESCRIPTION
C-----------------------------------------------------------------------------------------------
    1mon               / TUNITKH
    1mon               / TUNITV
    1mon               / TUNITL
C-------------------------------------------------------------------------
C
C   The following lists the groundwater nodenumber, aquifer layer number and the
C    associated parameter values that will over-write the previously defined
C    values.
C    *** Enter -1.0 not to over-write the previously set values ***
C
C
C   ID   ;   Groundwater node number
C   LAYER;   Aquifer layer
C   PKH  ;   Hydraulic conductivity; [L/T]
C   PS   ;   Specific storage; [1/L]
C   PN   ;   Specific yield; [L/L]
C   PV   ;   Aquitard vertical hydraulic conductivity; [L/T]
C   PL   ;   Aquifer vertical hydraulic conductivity; [L/T]
C   SCE  ;   Elastic storage coefficient (Use SCE*DC if DC=0); [1/L]
C   SCI  ;   Inelastic storage coefficient (Use SCI*DC if DC=0); [1/L]
C            *Note* The above land subsidence parameters are only for interbed
C                   layers (i.e. clay layers)
C
C----------------------------------------------------------------------------------------------
C                Hydr.        Spec.          Spec.       Aquitard  Aquifer   Elastic    Inelastic
C                cond.        Stor.          Yld.         Vert. K  Vert. K  Stg. Coef. Stg. Coef.
C  ID   LAYER     PKH          PS             PN            PV        PL       SCE        SCI
C----------------------------------------------------------------------------------------------
     1     1   2404.766   9.9999997E-06  2.0151161E-02  -1.00    334.3762   -1.00      -1.00
     1     2   1052.881   5.0065097E-05  3.3468835E-02  -1.00    240.6059   -1.00      -1.00
     1     3   9706.813   1.0849720E-04  5.8463603E-02  -1.00    214.9347   -1.00      -1.00
     2     1   2407.003   1.0000001E-05  1.9952139E-02  -1.00    331.9574   -1.00      -1.00
     2     2   1044.410   5.0159750E-05  3.4741677E-02  -1.00    239.1580   -1.00      -1.00
     2     3   9612.228   1.1174077E-04  6.1085913E-02  -1.00    215.6135   -1.00      -1.00
     .     .      .             .              .           .        .         .          .
     .     .      .             .              .           .        .         .          .
     .     .      .             .              .           .        .         .          .
  1392     2   1393.980   1.9578732E-04  7.3446646E-02  -1.00    2.911047   -1.00      -1.00
```

1392	3	680.7024	1.4334776E-04	5.9957355E-02	-1.00	7.285010	-1.00	-1.00
1393	1	2391.534	9.9999997E-06	0.1486767	-1.00	4.609168	-1.00	-1.00
1393	2	1437.810	2.3690333E-04	8.9009784E-02	-1.00	3.107419	-1.00	-1.00
1393	3	759.8795	1.6385839E-04	9.4242930E-02	-1.00	6.028072	-1.00	-1.00

Stream Component Files

Simulation Main Input File points to the Stream Component Main File which is the gateway for all other data files that are needed to simulate stream flows, diversions, bypasses and interaction of streams with other hydrologic components simulated. The first line of the Stream Component Main File lists the version number of the stream component. Parameters to be read for the stream component and how the stream flow processes are simulated differ from one stream component version to another. After reading the stream component version number from the Stream Component Main File, IWFM checks that this version number is the same as that used in the Pre-Processor part of IWFM (see section 3.1 for Stream Component Configuration File). Data input files that are used in simulating stream flows, diversions and bypasses in each stream component version are described in the following sections.

Stream Component Version 4.0 Files

The main characteristics of the Stream Component Version 4.0 are

i) Stream flow is assumed to be instantaneous such that an amount of water that enters the modeled stream network at its upstream end travels through the network in a single simulation time step; therefore, changes in stream storage are not tracked

ii) Stream channel is assumed to be wide enough compared to the stream flow depth so that wetted perimeter is also assumed constant with respect to flow depth

The input files for stream component version 4.0 are structured based on the assumptions listed above. The following sections describe these input files.

Stream Component Main File

Stream Component Main File is the gateway to additional data files that are used in routing stream flows as well as simulating diversions and bypasses. The names of the data files that are used in simulating stream related flow processes as well as the names of the output files are listed in this file. Stream bed parameters are also specified in this file.

All stream-component related input and output files are optional. For instance, if a particular output is not required, then the user simply does not specify the output file name, or if the stream diversions are not modeled then the use does not need to specify the names of the diversion specifications and time-series diversion rates data files.

The Stream Component Main File is divided into multiple sections:

General Input and Output Filenames

This section lists the input filenames that stream component uses to retrieve data to simulate diversions, bypasses as well as to define inflows at specified stream nodes. If desired, filenames for stream reach budget and diversion details output can also be specified. The following variables are used in this section:

INFLOWFL	Stream inflow data file (maximum 1000 characters); leave this file name blank if there are no stream inflows defined
DIVSPECFL	Diversion specifications data file (maximum 1000 characters); leave this file name blank if there are no diversions modeled

BYPSPECFL	Bypass specifications data file (maximum 1000 characters); leave this file name blank if there are no bypasses modeled
DIVFL	Diversion rate data file (maximum 1000 characters); leave this file name blank if there are no diversions modeled
STRMRCHBUDFL	Binary output file for detailed stream flow budget at each stream reach (maximum 1000 characters); leave this file name blank if this output is not required
DIVDTLBUDFL	Binary output file for diversion details (maximum 1000 characters); leave this file name blank if this output is not required

Stream Flow Hydrograph Output Data

In this section, information to print-out hydrographs at specified stream nodes is supplied:

NOUTR	Total number of hydrographs to be printed; enter 0 if no stream hydrograph data is to be printed
IHSQR	Switch for the output of stream surface elevations or stream flows (0 = print-out stream flows, 1= print-out stream stages; a value must still be specified even if NOUTR is set to zero)
FACTVROU	Factor to convert simulation unit of stream flows into intended output unit (a value must still be specified even if NOUTR is set to zero)
UNITVROU	Output unit of stream flow (maximum 10 characters long; a value must still be specified even if NOUTR is set to zero)

FACTLTOU — Factor to convert simulation unit of stream surface elevations into intended output unit (a value must still be specified even if NOUTR is set to zero)

UNITLTOU — Output unit of stream surface elevation (maximum 10 characters long; a value must still be specified even if NOUTR is set to zero)

STHYDOUTFL — File name for stream hydrograph output (maximum 1000 characters; leave blank if NOUTR is set to zero)

IOUTR — Stream node number for printing hydrograph output; list NOUTR stream nodes for which hydrographs will be printed

Stream Flow Budget at Selected Nodes

In this section the user can list stream nodes for which detailed water budget terms will be printed out to a binary file specified by the user. These water budgets are similar to those printed out to file STRMRCHBUDFL as described above, except that values printed out to STRMRCHBUDFL file are for stream reaches (i.e. collection of stream nodes specified by the user in Pre-processor). The following variables are used:

NBUDR — Total number of stream nodes for which budget output is desired; enter 0 if no stream node budget is required

STNDBUDFL — Binary output file for stream node budget (maximum 1000 characters; leave blank if stream node water budget output is not required)

IBUDR — Stream node for budget output; list NBUDR stream nodes for which water budget will be printed out

Stream Bed Parameters

In this section, stream bed characteristics for each node are specified. These parameters are used in computing stream-aquifer interaction.

FACTK	Conversion factor for the spatial component of stream bed conductivity
TUNITSK	Time unit of conductivity; this should be one of the units recognized by HEC-DSS that are listed in the Simulation Main Input File
FACTL	Conversion factor for stream bed thickness and wetted perimeter
IR	Stream node number
CSTRM	Hydraulic conductivity of stream bed; [L/T]
DSTRM	Thickness of stream bed; [L]
WETPR	Wetted perimeter; [L]

```
#4.0
C *** DO NOT DELETE ABOVE LINE ***
C
C*****************************************************************************
C
C                  INTEGRATED WATER FLOW MODEL (IWFM)
C
C*****************************************************************************
C
C                      STREAM PARAMETERS DATA FILE
C                           Stream Component
C                          *** Version 4.0 ***
C
C
C             Project:  IWFM Version ### Release
C                       California Department of Water Resources
C             Filename: Stream_MAIN.dat
C
C*****************************************************************************
C                              File Description
C
C    This file contains parameters and data file names for the simulation
C    of stream flows.
C
C*****************************************************************************
C
C                        Input and Output Data File Names
C
C  INFLOWFL    ; Stream inflow data file (max. 1000 characters)
C                 * Leave blank if no stream inflow data exists
C  DIVSPECFL   ; Diversion specifications data file (max. 1000 characters)
C                 * Leave blank if diversions are not simulated
C  BYPSPECFL   ; Bypass specifications data file (max. 1000 characters)
C                 * Leave blank if bypasses are not simulated
C  DIVFL       ; Diversion data file (max. 1000 characters)
C                 * Leave blank if diversions are not simulated
C  STRMRCHBUDFL; Binary output file for stream flow budget at each
C                 stream reach (max. 1000 characters)
C                 * Leave blank if this output is not required
C  DIVDTLBUDFL ; Binary output file for diversion details (max. 1000 characters)
C                 * Leave blank if this output is not required
C-----------------------------------------------------------------------------
C   VALUE                        DESCRIPTION
C-----------------------------------------------------------------------------
    Stream\StreamInflow.dat      / INFLOWFL
    Stream\DiverSpecs.dat        / DIVSPECFL
    Stream\BypassSpecs.dat       / BYPSPECFL
    Stream\Diversions.dat        / DIVFL
    ..\Budget\StrmBud.bin        / STRMRCHBUDFL
    ..\Budget\DiverDetail.bin    / DIVDTLBUDFL
C*****************************************************************************
C                        Stream Flow Hydrograph Output Data
C
C  NOUTR      ; Total number of hydrographs to be printed
C                (NOUTR = 0 if no stream hydrograph data is to be printed)
C  IHSQR      ; Switch for the output of stream surface elevations or stream flows;
C                IHSQR = 0 if output of stream flows is desired,
C                IHSQR = 1 if output of stream stage is desired
C  FACTVROU   ; Factor to convert simulation unit of stream flows into
C                intented output unit
C  UNITVROU   ; Output unit of stream flow (max. 10 characters long)
C  FACTLTOU   ; Factor to convert simulation unit of stream surface
C                elevations into intented output unit
C  UNITLTOU   ; Output unit of stream surface elevation (max. 10 characters long)
C  STHYDOUTFL ; File name for stream hydrograph output (max. 1000 characters)
C                 * Leave blank if this output is not required
C
C-----------------------------------------------------------------------------
C   VALUE                        DESCRIPTION
C-----------------------------------------------------------------------------
    23                           / NOUTR
    0                            / IHSQR
    0.000022957                  / FACTVROU     (cu.ft./day -> ac.ft./day)
    ac.ft./day                   / UNITVROU
    1.0                          / FACTLTOU
    ft                           / UNITLTOU
    StrmHyd.out                  / STHYDOUTFL
C-----------------------------------------------------------------------------
C
C   The following lists the stream node number for hydrograph to be printed
C   (skip if no hydrographs are to be printed, ie. NOUTR = 0)
C
C   IOUTR;   Stream node number for printing hydrograph output
C-----------------------------------------------------------------------------
C    IOUTR
C-----------------------------------------------------------------------------
       1
       2
       .
       .
       .
       22
       23
C*****************************************************************************
C                        Stream Flow Budget at Selected Nodes
C
C  NBUDR      ; Total number of stream nodes for which budget output is desired
C                (NBUDR = 0 if no stream node budget is required)
C  STNDBUDFL  ; Binary output file for stream node budget (max. 1000 characters)
C                 * Leave blank if this output is not required
C
C-----------------------------------------------------------------------------
C   VALUE                        DESCRIPTION
C-----------------------------------------------------------------------------
     3                           / NBUDR
     ..\Budget\StrmNodeBud.bin   / STNDBUDFL
C-----------------------------------------------------------------------------
C
C   The following lists the stream nodes for budget output
C   (skip if no budget output is required, ie. NBUDR = 0)
C
C   IBUDR;   Stream node for budget output
```

```
C-------------------------------------------------------------------------------
C    IBUDR
C-------------------------------------------------------------------------------
       1
       8
       19
C*******************************************************************************
C                       STREAM BED PARAMETERS
C
C     The following lists the parameters to model streams.
C
C   FACTK ;   Conversion factor for stream bed conductivity
C              It is used to convert only the spatial component of the unit;
C              DO NOT include the conversion factor for time component of the unit.
C              * e.g. Unit of conductivity listed in this file = FT/MONTH
C                     Consistent unit used in simulation       = IN/DAY
C                     Enter FACTK (FT/MONTH -> IN/MONTH)       = 8.33333E-02
C                      (conversion of MONTH -> DAY is performed automatically)
C   TUNITSK;  Time unit of conductivity.  This should be one of the units
C              recognized by HEC-DSS that are listed in the Main Control File.
C   FACTL ;   Conversion factor for stream bed thickness and wetted perimeter
C   IR    ;   Stream node number
C   CSTRM ;   Hydraulic conductivity of stream bed; [L/T]
C   DSTRM ;   Thickness of stream bed; [L]
C   WETPR ;   Wetted perimeter; [L]
C
C------------------------------------------------------------------------------
C   VALUE                 DESCRIPTION
C------------------------------------------------------------------------------
    1.0                   / FACTK
    1day                  / TUNITSK
    1.0                   / FACTL
C------------------------------------------------------------------------------
C    IR       CSTRM       DSTRM      WETPR
C------------------------------------------------------------------------------
     1         10.0        1.0       150.0
     2         10.0        1.0       150.0
     .         .           .         .
     .         .           .         .
     .         .           .         .
     22        10.0        1.0       150.0
     23        10.0        1.0       150.0
```

Stream Inflow File

The Stream Inflow File contains the time series for all inflows into the modeled streams. Number of time steps to update the inflow data and repetition frequency are both set by the user. Stream nodes that receive inflow from outside the modeled area are specified, as well as the columns containing the values of stream inflow data to each of the listed stream nodes. If there is a zero for any given stream flow, then that column is not used in the simulation. To help identify the nodes, a description preceded by a back slash ("/") following the stream node number can be used. In time tracking simulations the time series stream inflow data can be either listed in this file or in a DSS file. If a DSS file is used for data input, then the name of the DSS file and the pathnames corresponding to each of the time series data are required.

The following variables are specified in this file:

NCOLSTRM	Total number of stream inflows
FACTSTRM	Conversion factor for the spatial component of the unit for the stream inflows
NSPSTRM	Number of time steps to update the stream inflows; if time tracking simulation enter any number
NFQSTRM	Repetition frequency of the stream inflow data; if time tracking simulation enter any number
DSSFL	If the time series data is stored in a DSS file, name of the file; leave blank if the data is listed in the Stream Inflow File
IRST	Stream node where inflow occurs

Data Input from Stream Inflow File

If the time series data is listed in the same file, then the following variables need to be populated. Otherwise, these variables should be commented out using “C”, “c” or “*”, and the variables in the “Data Input from DSS File” section below should be populated.

ITST	Time. For time tracking simulations use MM/DD/YYYY_hh:mm format, for non-time tracking simulations enter an integer number.
ASTRM	Stream inflow at the specified stream node

Data Input from DSS File

If time series data is stored in a DSS file then the following variables should be populated:

REC	Record number that coincides with the data column number for the time series data
PATH	Pathname for the time series record that will be used for data retrieval

```
C*******************************************************************************
C
C                   INTEGRATED WATER FLOW MODEL (IWFM)
C
C*******************************************************************************
C
C                   STREAM INFLOW DATA FILE
C                      Stream Component
C                     *** Version 4.0 ***
C
C
C              Project : IWFM Version ### Release
C                        California Department of Water Resources
C              Filename: StreamInflow.dat
C
C*******************************************************************************
C                            File Description
C
C    This data file contains the inflows to the stream nodes that are modeled.
C
C*******************************************************************************
C                       Stream Inflow Data Specifications
C
C    NCOLSTRM; Total number of stream inflows (or pathnames if DSS files are used)
C    FACTSTRM; Conversion factor for stream inflow
C               It is used to convert only the spatial component of the unit;
C               DO NOT include the conversion factor for time component of the unit.
C               * e.g. Unit of flow listed in this file           = AC-FT/MONTH
C                      Consistent unit used in simulation         = CU.FT/DAY
C                      Enter FACTSTRM (AC-FT/MONTH -> CU.FT/MONTH)= 2.29568E-05
C                       (conversion of MONTH -> DAY is performed automatically)
C    NSPSTRM ; Number of time steps to update the stream inflows
C               * Enter any number if time-tracking option is on
C    NFQSTRM ; Repetition frequency of the stream inflow data
C               * Enter 0 if full time series data is supplied
C               * Enter any number if time-tracking option is on
C    DSSFL   ; The name of the DSS file for data input (maximum 50 characters);
C               * Leave blank if DSS file is not used for data input
C
C-------------------------------------------------------------------------------
C     VALUE                      DESCRIPTION
C-------------------------------------------------------------------------------
    58                           /NCOLSTRM
    86400.0                      /FACTSTRM    (cfs -> cu.ft./day)
    1                            /NSPSTRM
    0                            /NFQSTRM
                                 /DSSFL
C-------------------------------------------------------------------------------
C                       Stream Inflow Location Information
C
C    List the list nodes below where the inflow occurs.
C
C    IRST;    Stream node where inflow occurs
C
C-------------------------------------------------------------------------------
C    IRST
C-------------------------------------------------------------------------------
    205                          / 1:
    211                          / 2:
    220                          / 3:
      .                            .
      .                            .
      .                            .
     43                          /53:
     57                          /54:
     11                          /55:
    424                          /56:
     69                          /57:
     80                          /58:
C-------------------------------------------------------------------------------
C                            Stream Inflow Data
C                           (READ FROM THIS FILE)
C
C    List the stream inflow data below, if it will not be read from a DSS
C    file (i.e. DSSFL is left blank above).
C
C    ITST ;   Time
C    ASTRM;   Stream inflow at the stream node specified above; [L^3/T]
C
C-------------------------------------------------------------------------------
C    ITST            ASTRM(1)  ASTRM(2)  ASTRM(3) ...
C-------------------------------------------------------------------------------
C                       1         2         3      ......  56       57       58
10/31/1921_24:00    232.00      7.50     15.70    ......  0.00     0.00     0.00
11/30/1921_24:00    237.00     22.50     19.50    ......  0.00     0.00     0.00
12/31/1921_24:00    335.00     49.60     29.10    ......  0.00     0.00     0.00
        .              .         .         .      ......   .        .        .
        .              .         .         .      ......   .        .        .
        .              .         .         .      ......   .        .        .
07/31/1998_24:00    912.60     19.92     50.24    ......  4.90     1.20     6.00
08/31/1998_24:00    903.68      9.10     33.20    ......  7.00     0.00     0.00
09/30/1998_24:00    660.97      7.14     26.72    ......  0.00     0.00     0.00
C-------------------------------------------------------------------------------
C                      Pathnames for Stream Inflow Data
C                           (READ FROM DSS FILE)
C
C    List the pathnames for the stream inflow data below, if it will be read
C    from a DSS file (i.e. DSSFL is specified above).
C
C    REC  ;  Time series record number
C    PATH ;  Pathname for the time series record
C
C-----------------------------------------------------------------------------------
C    REC       PATH
C-----------------------------------------------------------------------------------
*
*
```

Diversion Specifications File

This data file specifies the surface water diversion locations and the recharge zones for the recoverable losses from all modeled diversions. Deliveries, recoverable losses, non-recoverable losses, maximum diversion rates, diversion adjustment specifications and the percentage of each diversion that is used for agricultural purposes are specified in this file.

Surface Water Diversion Specifications

The first portion of the data file includes the number of surface water diversions modeled and the diversion specifications for each diversion modeled.

NRDV	Number of surface water diversions in the model
ID	Surface water diversion identification number
IRDV	Stream node from where the diversion takes place. Enter '0' if the stream node is not within the model domain
ICDVMAX	Maximum diversion amount; this number corresponds to the data column in the Diversion Data File; enter 0 if there is no maximum diversion rate
FDVMAX	Fraction of data value specified in column ICDVMAX to be used as maximum diversion amount
ICOLRL	Column number in the Diversion Data File used to define the recoverable loss corresponding to diversion number ID
FRACRL	Relative proportion of the data value that is specified by ICOLRL to be used as recoverable loss

ICOLNL	Column number in the Diversion Data File that corresponds to the non-recoverable loss from diversion number ID
FRACNL	Relative proportion of the data value that is specified by ICOLNL to be used as non-recoverable loss
TYPDSTDL	Diversion destination type (0 = diversion goes outside the model domain, 2 = diversion goes to element DSTDL, 4 = diversion goes to subregion DSTDL, 6 = diversion goes to a group of elements with ID DSTDL where element groups are listed later in this file)
DSTDL	Destination ID for diversion (enter any number if TYPDSTDL is 0, i.e. diversion is delivered to outside the model area)
ICOLDL	Delivery to destination DSTDL; this number corresponds to the appropriate data column in the Diversion Data File
FRACDL	Relative proportion of the data value that is specified by ICOLDL to be used as delivery to destination DSTDL
ICFSIRIG	Fraction of the delivery that is used for irrigation purposes (remaining amount will be used to supply the user specified urban demand); this number corresponds to the appropriate data column in the Irrigation Fractions Data File
ICADJ	Supply adjustment specification; this number corresponds to the appropriate data column in the Supply Adjustment Specifications File (enter 0 if diversion will not be adjusted)
NAME	Name of the diversion (maximum 20 characters); this name is later used in reporting the diversion details

Element Groups for Diversion Deliveries

Diversions can be delivered to user specified groups of elements. The following variables are used to describe the element groups:

NGRP	Number of element groups; enter 0 if there are no element groups where diversions are delivered
ID	Element group ID entered sequentially
NELEM	Number of elements in element group ID
IELEM	Element numbers that are in group ID

Recharge Zone for Each Diversion Point

Each diversion point must have a related recharge zone where the recoverable loss specified above becomes groundwater recharge. The following list describes the variables used to indicate a recharge zone for each diversion point:

ID	Recharge zone identification number; recharge zone ID should be the same as diversion identification number
NERELS	Total number of elements through which recharge occurs
IERELS	Element number through which recharge occurs
FERELS	Relative proportion of the recoverable loss to be applied to element IERELS as recharge

```
C*******************************************************************************
C
C                    INTEGRATED WATER FLOW MODEL (IWFM)
C
C*******************************************************************************
C
C               SURFACE WATER DIVERSION SPECIFICATION DATA FILE
C                             Stream Component
C                            *** Version 4.0 ***
C
C
C               Project : IWFM Version ### Release
C                         California Department of Water Resources
C               Filename: DiversionSpecs.dat
C
C*******************************************************************************
C                            File Description
C
C  This data file contains the specification data for surface water diversions.
C
C*******************************************************************************
C                   Surface Water Diversion Specifications
C
C   The following lists the number of surface water diversions and
C   specifications for each diversion that is included in the model.
C
C   NRDV;    Number of surface water diversions included in the model.
C-------------------------------------------------------------------------------
C   VALUE                        DESCRIPTION
C-------------------------------------------------------------------------------
     5                           / NRDV
C-------------------------------------------------------------------------------
C
C   The following lists the specifications for each surface water diversion
C   (skip if no diversions are modeled, i.e. NRDV = 0)
C
C   ID      ; Surface water diversion identification number
C   IRDV    ; Stream node from where the diversion takes place. Enter '0' if
C              the stream node is outside the model area.
C   ICDVMAX ; Maximum diversion amount - this number corresponds to the
C              appropriate data column in the Diversion Data File
C              * Enter 0 if a maximum diversion amount does not apply.
C   FDVMAX  ; Fraction of data value specified in column ICDVMAX to be used as
C              maximum diversion amount
C   ICOLRL  ; Recoverable loss -  this number corresponds to the appropriate
C              data column in the Diversion Data File
C   FRACRL  ; Fraction of the data value that is specified by ICOLRL
C              to be used as recoverable loss
C   ICOLNL  ; Non-recoverable loss - this number corresponds to the appropriate
C              data column in the Diversion Data File
C   FRACNL  ; Fraction of the data value that is specified by ICOLNL
C              to be used as non-recoverable loss
C   TYPDSTDL; Diversion destination type
C               0 = Diversion goes outside the model domain
C               2 = Diversion goes to element DSTDL (see below)
C               4 = Diversion goes to subregion DSTDL (see below)
C               6 = Diversion goes to a group of elements with ID DSTDL
C                    (element groups are listed after this section)
C   DSTDL   ; Destination ID for diversion
C              * Note: Enter any number if TYPDSTDL is 0
C   ICOLDL  ; Delivery to destination DSTDL - this number corresponds to the
C              appropriate data column in the Diversion Data File
C   FRACDL  ; Fraction of the data value that is specified by ICOLDL
C              to be used as delivery to destination DSTDL
C   ICFSIRIG; Fraction of the delivery that is used for irrigation purposes -
C              this number corresponds to the appropriate data column in the
C              Irrigation Fractions Data File (remaining amount will be used to
C              supply the user specified urban demand)
C   ICADJ   ; Supply adjustment specification - this number corresponds to the appropriate
C              data column in the Supply Adjustment Specifications Data File
C               * Enter 0 if diversion will not be adjusted
C   NAME    ; Name of the diversion (maximum 20 characters)
C
C---- -----------------------------------------------------------------------------------------------------
C ID  IRDV  ICDVMAX  FDVMAX  ICOLRL  FRACRL  ICOLNL  FRACNL  TYPDSTDL  DSTDL  ICOLDL  FRACDL  ICFSIRIG  ICADJ  NAME
C---- -----------------------------------------------------------------------------------------------------
  1    9     0         0.0     1       0.01    1       0.01    4          2      1       0.98     1         2     UrbDiv1
  2   12     0         0.0     2       0.02    2       0.02    4          2      2       0.96     1         2     UrbDiv2
  3   12     0         0.0     3       0.01    3       0.02    4          1      3       0.97     2         1     AgDiv1
  4   22     0         0.0     4       0.00    4       0.01    0          0      4       0.99     2         3     DivOut
  5    0     0         0.0     5       0.00    5       0.01    6          1      5       0.99     2         1     RiceDiv
C----------------------------------------------------------------------------------------------------------------
C
C                    Element Groups for Diversion Deliveries
C
C   List the elements in each group where selected diversions above are delivered to. All
C   elements in each group must belong to the same subregion.
C
C   NGRP  ; Number of element groups
C            * Enter 0 if there are no element groups where diversions
C              are delivered.
C   ID    ; Element group ID entered sequentially
C   NELEM ; Number of elements in element group ID
C   IELEM ; Element numbers that are in group ID
C
C-------------------------------------------------------------------------------
    1                  / NGRP
C-------------------------------------------------------------------------------
C    ID         NELEM      IELEM
C-------------------------------------------------------------------------------
    1            50          211
                             212
                             213
                             .
                             .
                             .
                             298
                             299
                             300
C-------------------------------------------------------------------------------
C
C                    Recharge zone for each diversion point
```

```
C       (Skip if no diversions are being modeled, i.e. NRDV = 0)
C
C   ID    ;  Recharge zone identification number
C             (*Note* Recharge zone ID's should match river diversion ID numbers)
C   NERELS;  Total number of elements through which recharge occurs
C   IERELS;  Element number through which recharge occurs
C   FERELS;  Relative proportion of the recoverable loss to be applied to
C               element IERELS as recharge
C
C-------------------------------------------------------------------------------
C    ID         NERELS      IERELS     FERELS
C-------------------------------------------------------------------------------
     1            2           251        1.0
                              270        1.0
     2            1           191        1.0
     3            3           193        1.0
                              174        1.0
                              155        1.0
     4            0           0          0.0
     5            0           0          0.0
```

Bypass Specifications File

This data file specifies the stream nodes where bypasses are taken from and streams node where they are returned, as well as the recharge zones for the recoverable losses from all modeled bypasses.

Bypass Configuration Specifications

This part of the data file describes the configuration of the modeled bypasses

NDIVS	Number of bypasses
FACTX	Conversion factor for the spatial component of the variable DIVX (the stream flow in the bypass rating table if the bypass amount is specified using a rating table)
TUNITX	Time unit of stream flow; his should be one of the units recognized by HEC-DSS that are listed in the Simulation Main Input File.
FACTY	Conversion factor for the spatial component of the variable DIVY (the bypass rate in the bypass rating table if the bypass amount is specified using a rating table)
TUNITY	Time unit of bypass rate; this should be one of the units recognized by HEC-DSS that are listed in the Simulation Main Input File.
ID	Bypass identification number
IA	Stream node number where bypass is exported from
TYPEDEST	Destination type for the bypass (0 = bypass is taken to outside the model boundary, 1 = bypass goes to a downstream node, 3 = bypass goes to a lake)

DEST	Destination for the bypass; enter any number if TYPEDEST is set to 0
IDIVC	If positive, IDIVC is the column number in the Diversion Data File for bypass flow; if negative, IDIVC is the number of points in the diversion rating table
DIVRL	Fraction of the diversion assigned as recoverable loss
DIVNL	Fraction of the diversion assigned as non-recoverable loss
DIVX	Stream flow available at stream node IA; [L^3/T]; enter only if IDIVC is less than zero. If IDIVC is less than zero then –IDVC values of DIVX must be entered
DIVY	Bypass rate amount corresponding to DIVX; [L^3/T]; enter only if IDIVC is less than zero. If IDIVC is less than zero then –IDVC values of DIVY must be entered
NAME	Name of the bypass (maximum 20 characters)

Seepage Locations for Bypass Canals

In this section elements that receive the recoverable losses from each bypass are listed. Recoverable losses from bypasses become recharge to groundwater at the designated elements. The following variables are used to specify the seepage locations for bypasses:

ID	Bypass identification number
NERELS	Total number of elements that receive the bypass recoverable loss
IERELS	Element number that receives the bypass recoverable loss

FERELS Relative proportion of the recoverable loss to be applied to element IERELS as recharge

```
C*******************************************************************************
C
C                   INTEGRATED WATER FLOW MODEL (IWFM)
C                          *** Version ### ***
C
C*******************************************************************************
C
C                  STREAM BYPASS SPECIFICATION DATA FILE
C                           Stream Component
C                          for IWFM Simulation
C
C
C              Project:  IWFM Version ### Release
C                        California Department of Water Resources
C              Filename: BypassSpecs.dat
C
C*******************************************************************************
C                           File Description
C
C  This data file contains the specification data for stream bypasses.
C
C*******************************************************************************
C
C                  Bypass Configuration Specifications
C
C   NDIVS   ; Number of bypasses
C   FACTX   ; Conversion factor for DIVX
C              It is used to convert only the spatial component of the unit;
C              DO NOT include the conversion factor for time component of the unit.
C              * e.g. Unit of stream flow listed in this file   = AC-FT/MONTH
C                     Consistent unit used in simulation        = CU.FT/DAY
C                     Enter FACTX (AC-FT/MONTH -> CU.FT/MONTH)  = 2.29568E-05
C                      (conversion of MONTH -> DAY is performed automatically)
C   TUNITX  ; Time unit of stream flow.  This should be one of the units
C              recognized by HEC-DSS that are listed in the Main Control File.
C   FACTY   ; Conversion factor for DIVY
C              It is used to convert only the spatial component of the unit;
C              DO NOT include the conversion factor for time component of the unit.
C              * e.g. Unit of diversion listed in this file     = AC-FT/MONTH
C                     Consistent unit used in simulation        = CU.FT/DAY
C                     Enter FACTY (AC-FT/MONTH -> CU.FT/MONTH)  = 2.29568E-05
C                      (conversion of MONTH -> DAY is performed automatically)
C   TUNITY  ; Time unit of diversion.  This should be one of the units
C              recognized by HEC-DSS that are listed in the Main Control File.
C   ID      ; Bypass identification number
C   IA      ; Stream node number where bypass is exported from
C   TYPEDEST; Destination type for the bypass
C               0 = bypass goes to outside the model boundary
C               1 = bypass goes to a downstream node
C               3 = bypass goes to a lake
C   DEST    ; Destination for the bypass
C               * Note: Enter any number if TYPEDEST is set to 0
C   IDIVC   ; If positive, IDIVC is the column number in the Diversion Data File  for bypass flow
C             If negative, IDIVC is the number of points in the diversion rating table
C               * Note: A rating table cannot be specified if the bypass originates outside the model area
C   DIVRL   ; Fraction of the diversion assigned as recoverable loss
C   DIVNL   ; Fraction of the diversion assigned as non-recoverable loss
C   DIVX    ; Stream flow available at stream node IA; [L^3/T]
C               * Note: Enter only if IDIVC is less than zero
C   DIVY    ; Diversion amount corresponding to DIVX; [L^3/T]
C               * Note: Enter only if IDIVC is less than zero
C   NAME    ; Name of the bypass (maximum 20 characters)
C
C-------------------------------------------------------------------------------
C   VALUE                         DESCRIPTION
C-------------------------------------------------------------------------------
     2                            / NDIVS
     43560.0                      / FACTX      (ac.ft. -> cu.ft.)
     1DAY                         / TUNITX
     43560.0                      / FACTY      (ac.ft. -> cu.ft.)
     1DAY                         / TUNITY
C----------------------------------------------------------------------------------
C  ID   IA   TYPEDEST  DEST   IDIVC   DIVRL  DIVNL    NAME
C                                     DIVX   DIVY
C----------------------------------------------------------------------------------
   1    13      0        0     6       0.0     0.0     Bypass1
   2    17      1       22    -4       0.0     0.1     Bypass2
                                       0.0     0.0
                                       1.0     0.5
                                      18.0     9.0
                                    8000.0  4000.0
C----------------------------------------------------------------------------------
C
C               Seepage locations for bypass canals
C
C      The following information specifies the recharge zone for each bypass.
C      (Skip if no bypass is being modeled, i.e. NDIVS = 0)
C
C   ID    ;  Recharge zone identification number
C             (* Note: Recharge zone ID's should match bypass ID numbers)
C   NERELS;  Total number of elements through which recharge occurs
C   IERELS;  Element number through which recharge occurs
C   FERELS;  Relative proportion of the recoverable loss to be applied to
C             element IERELS as recharge.
C
C-------------------------------------------------------------------------------
C    ID         NERELS      IERELS     FERELS
C-------------------------------------------------------------------------------
   1              0            0         0
   2              0            0         0
```

Diversion Data File

The Diversion Data File contains the diversion and bypass amounts as well as the maximum diversion rates. This data file is used in conjunction with the Diversion Specification File and the Bypass Specification File to route the water to delivery points, indicate bypass flows, the recoverable losses with respect to recharge zone and the non-recoverable losses. In time tracking simulations the time series diversions data can be either listed in this file or in a DSS file. If a DSS file is used for data input, then the name of the DSS file and the pathnames corresponding to each of the time series data are required.

The following is a list of the variables used in this data file:

NCOLDV	Number of data columns included in this file
FACTDV	Conversion factor for the spatial component of the unit for the diversion data
NSPDV	Number of time steps to update the surface water diversion data; if time tracking simulation, enter any number
NFQDV	Repetition frequency of the surface water diversion data; a value of zero indicates that a full time series data set is supplied. If time tracking simulation, enter any number.
DSSFL	If the time series data is stored in a DSS file, name of the file; leave blank if the data is listed in this file

Data Input from Diversion Data File

If the time series data is listed in the Diversion Data File, then the following variables need to be populated. Otherwise, these variables should be commented out using “C”, “c” or “*”, and the variables in the “Data Input from DSS File” section below should be populated.

ITDV	Time. For time tracking simulations use MM/DD/YYYY_hh:mm format, for non-time tracking simulations enter an integer number.
ADIVS	Diversion or bypass rate corresponding to the stream node specified in Diversion Specification File or the Bypass Specification File, [L^3/T]

Data Input from DSS File

If time series data is stored in a DSS file then the following variables should be populated:

REC	Record number that coincides with the data column number for the time series data
PATH	Pathname for the time series record that will be used for data retrieval

```
C*******************************************************************************
C
C                   INTEGRATED WATER FLOW MODEL (IWFM)
C
C*******************************************************************************
C
C                   SURFACE WATER DIVERSION DATA FILE
C                            Stream Component
C                           *** Version 4.0 ***
C
C
C              Project : IWFM Version ### Release
C                        California Department of Water Resources
C              Filename: Diversions.dat
C
C*******************************************************************************
C                              File Description
C
C   This data file contains the surface water diversion and bypass data
C   for the stream nodes that have been specified in the surface water
C   diversion specification data file. Maximum diversion rates to be used
C   in supply adjutment computations are also listed in this file.
C
C*******************************************************************************
C                     Surface Water Diversion Data Specifications
C
C   The following lists the time-series surface water diversions for
C   each of the stream nodes where surface diversions have been specified.
C
C   NCOLDV;  Number of surface water diversions (or pathnames if DSS files are used)
C   FACTDV;  Conversion factor for surface water diversions
C             It is used to convert only the spatial component of the unit;
C             DO NOT include the conversion factor for time component of the unit.
C             * e.g. Unit of diversion listed in this file    = AC-FT/MONTH
C                    Consistent unit used in simulation       = CU.FT/DAY
C                    Enter FACTDV (AC-FT/MONTH -> CU.FT/MONTH)= 2.29568E-05
C                     (conversion of MONTH -> DAY is performed automatically)
C   NSPDV ;  Number of time steps to update the surface water diversion data
C             * Enter any number if time-tracking option is on
C   NFQDV ;  Repetition frequency of the surface water diversion data
C             * Enter 0 if full time series data is supplied
C             * Enter any number if time-tracking option is on
C   DSSFL ;  The name of the DSS file for data input (maximum 50 characters);
C             * Leave blank if DSS file is not used for data input
C
C-------------------------------------------------------------------------------
C    VALUE                      DESCRIPTION
C-------------------------------------------------------------------------------
     6                          / NCOLDV
     43560000.0                 / FACTDV     (taf -> cu.ft.)
     1                          / NSPDV
     0                          / NFQDV
     TSDATA_IN.DSS              / DSSFL
C*******************************************************************************
C                        Surface Water Diversion Data
C                           (READ FROM THIS FILE)
C
C   List the diversion data below, if it will not be read from a DSS file (i.e.
C   DSSFL is left blank above).
C
C   ITDV ;  Time
C   ADIVS;  Diversion rate and maximum diversion rates (if any) corresponding to
C            the stream node specified in diversion specification file; [L^3/T]
C
C-------------------------------------------------------------------------------
C   ITDV   ADIVS(1)  ADIVS(2)  ADIVS(3) ...
C-------------------------------------------------------------------------------
*
*
C-------------------------------------------------------------------------------
C                 Pathnames for Surface Water Diversion Data
C                           (READ FROM DSS FILE)
C
C   List the pathnames for diversion data below, if it will be read from a DSS file
C   (i.e. DSSFL is specified above).
C
C   REC  ;   Time series record number
C   PATH ;   Pathname for the time series record
C
C-------------------------------------------------------------------------------
C   REC       PATH
C-------------------------------------------------------------------------------
     1         /IWFM/DIV1/FLOW//1DAY/DIVERSION/
     2         /IWFM/DIV2/FLOW//1DAY/DIVERSION/
     3         /IWFM/DIV3/FLOW//1DAY/DIVERSION/
     4         /IWFM/DIV4/FLOW//1DAY/DIVERSION/
     5         /IWFM/DIV5/FLOW//1DAY/DIVERSION/
     6         /IWFM/BYPASS1/FLOW//1DAY/BYPASS/
```

Stream Component Version 4.1 Files

The main characteristics of the Stream Component Version 4.1 are

i) Stream flow is assumed to be instantaneous such that an amount of water that enters the modeled stream network at its upstream end travels through the network in a single simulation time step; therefore, changes in stream storage are not tracked

ii) Wetted perimeter is a function of flow depth such that flow through and groundwater interaction at stream channels with flood plains on one or both sides can be simulated properly

The input files for stream component version 4.1 are structured based on the assumptions listed above. The following sections describe these input files.

Stream Component Main File

Stream Component Main File for Stream Component Version 4.1 is exactly the same as the one for Version 4.0 except that the variable WETPR is not specified. Please refer to the description of this file for Version 4.0 above.

Stream Inflow File

Stream Inflow File for Stream Component Version 4.1 is exactly the same as the one for Version 4.0. The user is referred to the description of this file for Version 4.0 above.

Diversion Specifications File

Diversion Specifications File for Stream Component Version 4.1 is exactly the same as the one for Version 4.0. The user is referred to the description of this file for Version 4.0 above.

Bypass Specifications File

Bypass Specifications File for Stream Component Version 4.1 is exactly the same as the one for Version 4.0. The user is referred to the description of this file for Version 4.0 above.

Diversion Data File

Diversion Data File for Stream Component Version 4.1 is exactly the same as the one for Version 4.0. The user is referred to the description of this file for Version 4.0 above.

Stream Component Version 5.0 Files

The main characteristics of the Stream Component Version 5.0 are

i) Stream flow is routed through the stream network using the kinematic wave approach

ii) Storage along the stream network is tracked, therefore it may take several time steps for a stream inflow to travel through the entire stream system

iii) Flow-stage relationship is described using the Manning's equation

iv) Stream flows in rectangular, triangular and trapezoidal channels can be simulated

v) Wetted perimeter is calculated as a function of the a function of the flow depth and the stream channel geometry; however, flood plains along stream channels are not simulated

The input files for stream component version 5.0 are structured based on the characteristics listed above. The following sections describe these input files.

Stream Component Main File

Stream Component Main File is the gateway to additional data files that are used in routing stream flows as well as simulating diversions and bypasses. The names of the data files that are used in simulating stream related flow processes as well as the names of the output files are listed in this file. Parameters for the stream channel cross section and the stream bed are also specified in this file.

All stream-component related input and output files are optional. For instance, if a particular output is not required, then the user simply does not specify the output file name, or if the stream diversions are not modeled then the use does not need to specify the names of the diversion specifications and time-series diversion rates data files.

The Stream Component Main File is divided into multiple sections:

General Input and Output Filenames

This section lists the input filenames that stream component uses to retrieve data to simulate diversions, bypasses as well as to define inflows at specified stream nodes. If desired, filenames for stream reach budget, diversion details output and end-of-simulation stream flow output can also be specified. The following variables are used in this section:

INFLOWFL	Stream inflow data file (maximum 1000 characters); leave this file name blank if there are no stream inflows defined
DIVSPECFL	Diversion specifications data file (maximum 1000 characters); leave this file name blank if there are no diversions modeled
BYPSPECFL	Bypass specifications data file (maximum 1000 characters); leave this file name blank if there are no bypasses modeled
DIVFL	Diversion rate data file (maximum 1000 characters); leave this file name blank if there are no diversions modeled
STRMRCHBUDFL	Binary output file for detailed stream flow budget at each stream reach (maximum 1000 characters); leave this file name blank if this output is not required
DIVDTLBUDFL	Binary output file for diversion details (maximum 1000 characters); leave this file name blank if this output is not required

FNSTRMFL	Output file for end-of-simulation stream flows (maximum 1000 characters); leave blank if this output is not required

Stream Flow Hydrograph Output Data

The parameters that appear in this section are exactly the same as those that are in the Stream Component Main File for Version 4.0. Refer to the variable descriptions above.

Stream Flow Budget at Selected Nodes

The parameters that appear in this section are exactly the same as those that are in the Stream Component Main File for Version 4.0. Refer to the variable descriptions above.

Stream Bed Parameters

The parameters that appear in this section are exactly the same as those that are in the Stream Component Main File for Version 4.0 except that WETPR parameter does not exist in this version. Refer to the variable descriptions above.

Stream Cross Section and Manning's Roughness

In this section, parameters that describe the channel cross section as well as the Manning's roughness coefficient at each stream node are specified.

Additionally, the maximum stream flow depth is specified for each stream node in this section. In testing the kinematic wave approach, it was noticed that, in certain cases, some of the iterative estimates of the stream flow depths were far off from the actual solution and it took many iterations for the estimates to approach back to the solution. To remedy this problem and speed up the simulation run-times, the maximum stream flow depth is used to limit the upper range of the Newton-Raphson iterative estimates. The following variables are used in this section:

FACTN	Factor to convert meters to simulation unit of length; this variable is used to calculate the coefficient in Manning's equation
FACTLT	Conversion factor for stream bed elevation, stream channel bottom width, channel side slope and the maximum stream flow depth
ID	Stream node number listed sequentially
BOTR	Stream bottom elevation relative to a common datum; [L]
B0	Channel bottom width (B0 = 0.0 represents a triangular channel); [L]
s	Side slope for the stream channel (s = 0.0 represents a rectangular channel); [L]
n	Manning's roughness coefficient; [seconds/meter^0.333]
HMAX	Maximum stream flow depth – this value is used to limit the upper range of iterative estimates for the flow depth; [L]. This variable can affect the convergence of the model profoundly. If it is set too low, IWFM may never convergence if the solution for the flow depth is above HMAX (this issue manifests itself by a constant convergence error repeated for the same stream node in the SimulationMessages.out file). On the other hand, if HMAX is set

too high, an estimate for the flow depth at a stream node may be too far from the solution and Newton-Raphson iteration method may never recover the solution within the given number of iterations. However, it is generally advisable to set HMAX a bit too high instead of a bit too low.

Initial Conditions

In this section, initial conditions for the streams are given either in terms of flow rates or flow depths through following variables:

ICTYPE	Type of initial conditions specified (0 = flow depths are specified as initial conditions; 1 = volumetric flow rates are specified as initial conditions)
TUNITQ	Time unit of the initial volumetric flow rates; this should be one of the units recognized by HEC-DSS that are listed in the Simulation Main Input File
FACTHQ	Conversion factor for the initial conditions
IR	Stream node number entered sequentially
HQS	Initial flow depth or volumetric flow rate, depending on the value of ICTYPE described above, at stream node IR; [L] or [L^3/T]

```
#5.0
C *** DO NOT DELETE ABOVE LINE ***
C
C*******************************************************************************
C
C                  INTEGRATED WATER FLOW MODEL (IWFM)
C
C*******************************************************************************
C
C                      STREAM PARAMETERS DATA FILE
C                           Stream Component
C                          *** Version 5.0 ***
C
C
C             Project:  IWFM Version ### Release
C                       California Department of Water Resources
C             Filename: Stream_MAIN.dat
C
C*******************************************************************************
C                               File Description
C
C    This file contains parameters and data file names for the simulation
C    of stream flows.
C
C*******************************************************************************
C
C                        Input and Output Data File Names
C
C  INFLOWFL    ; Stream inflow data file (max. 1000 characters)
C                 * Leave blank if no stream inflow data exists
C  DIVSPECFL   ; Diversion specifications data file (max. 1000 characters)
C                 * Leave blank if diversions are not simulated
C  BYPSPECFL   ; Bypass specifications data file (max. 1000 characters)
C                 * Leave blank if bypasses are not simulated
C  DIVFL       ; Diversion data file (max. 1000 characters)
C                 * Leave blank if diversions are not simulated
C  STRMRCHBUDFL; Binary output file for stream flow budget at each
C                 stream reach (max. 1000 characters)
C                 * Leave blank if this output is not required
C  DIVDTLBUDFL ; Binary output file for diversion details (max. 1000 characters)
C                 * Leave blank if this output is not required
C  FNSTRMFL    ; Output file for end-of-simulation stream flows (max. 1000 characters)
C                 * Leave blank if this output is not required
C
C-------------------------------------------------------------------------------
C   VALUE                         DESCRIPTION
C-------------------------------------------------------------------------------
    Stream\StreamInflow.dat       / INFLOWFL
    Stream\DiverSpecs.dat         / DIVSPECFL
    Stream\BypassSpecs.dat        / BYPSPECFL
    Stream\Diversions.dat         / DIVFL
    ..\Budget\StrmBud.bin         / STRMRCHBUDFL
    ..\Budget\DiverDetail.bin     / DIVDTLBUDFL
                                  / FNSTRMFL
C*******************************************************************************
C                        Stream Flow Hydrograph Output Data
C
C  NOUTR      ; Total number of hydrographs to be printed
C                (NOUTR = 0 if no stream hydrograph data is to be printed)
C  IHSQR      ; Switch for the output of stream surface elevations or stream flows;
C                IHSQR = 0 if output of stream flows is desired,
C                IHSQR = 1 if output of stream stage is desired
C  FACTVROU   ; Factor to convert simulation unit of stream flows into
C                intented output unit
C  UNITVROU   ; Output unit of stream flow (max. 10 characters long)
C  FACTLTOU   ; Factor to convert simulation unit of stream surface
C                elevations into intented output unit
C  UNITLTOU   ; Output unit of stream surface elevation (max. 10 characters long)
C  STHYDOUTFL ; File name for stream hydrograph output (max. 1000 characters)
C                 * Leave blank if this output is not required
C
C-------------------------------------------------------------------------------
C   VALUE                         DESCRIPTION
C-------------------------------------------------------------------------------
    23                            / NOUTR
    0                             / IHSQR
    0.000022957                   / FACTVROU     (cu.ft./day -> ac.ft./day)
    ac.ft./day                    / UNITVROU
    1.0                           / FACTLTOU
    ft                            / UNITLTOU
    StrmHyd.out                   / STHYDOUTFL
C-------------------------------------------------------------------------------
C
C   The following lists the stream node number for hydrograph to be printed
C   (skip if no hydrographs are to be printed, ie. NOUTR = 0)
C
C   IOUTR;   Stream node number for printing hydrograph output
C-------------------------------------------------------------------------------
C    IOUTR
C-------------------------------------------------------------------------------
       1
       2
       .
       .
       .
       22
       23
C*******************************************************************************
C                        Stream Flow Budget at Selected Nodes
C
C  NBUDR      ; Total number of stream nodes for which budget output is desired
C                (NBUDR = 0 if no stream node budget is required)
C  STNDBUDFL  ; Binary output file for stream node budget (max. 1000 characters)
C                 * Leave blank if this output is not required
C
C-------------------------------------------------------------------------------
C   VALUE                         DESCRIPTION
C-------------------------------------------------------------------------------
     3                            / NBUDR
     ..\Budget\StrmNodeBud.bin    / STNDBUDFL
C-------------------------------------------------------------------------------
```

```
C   The following lists the stream nodes for budget output
C   (skip if no budget output is required, ie. NBUDR = 0)
C
C   IBUDR;   Stream node for budget output
C-------------------------------------------------------------------------------
C    IBUDR
C-------------------------------------------------------------------------------
       1
       8
       19
C*******************************************************************************
C                       Stream Bed Parameters
C
C     The following lists the parameters to model stream bed parameters to model
C     stream-groundwater interaction.
C
C   FACTK ;   Conversion factor for stream bed conductivity
C              It is used to convert only the spatial component of the unit;
C              DO NOT include the conversion factor for time component of the unit.
C              * e.g. Unit of conductivity listed in this file = FT/MONTH
C                     Consistent unit used in simulation       = IN/DAY
C                     Enter FACTK (FT/MONTH -> IN/MONTH)       = 8.33333E-02
C                      (conversion of MONTH -> DAY is performed automatically)
C   TUNITSK;  Time unit of conductivity.  This should be one of the units
C              recognized by HEC-DSS that are listed in the Main Control File.
C   FACTL ;   Conversion factor for stream bed thickness
C   IR    ;   Stream node number
C   CSTRM ;   Hydraulic conductivity of stream bed; [L/T]
C   DSTRM ;   Thickness of stream bed; [L]
C
C------------------------------------------------------------------------------
C   VALUE                 DESCRIPTION
C------------------------------------------------------------------------------
    1.0                   / FACTK
    1day                  / TUNITSK
    1.0                   / FACTL
C------------------------------------------------------------------------------
C    IR       CSTRM       DSTRM
C------------------------------------------------------------------------------
     1         10.0        1.0
     2         10.0        1.0
     .          .          .
     .          .          .
     .          .          .
     22        10.0        1.0
     23        10.0        1.0
C*******************************************************************************
C                   Stream Cross Section And Manning's Roughness
C
C     The following lists the stream channnel parameters at each stream node.
C
C   FACTN ;  Factor to convert meters to simulation unit of length
C   FACTLT;  Conversion factor for variables BOTR, B0,s and HMAX (see below
C            for the definitions of these variables)
C
C-------------------------------------------------------------------------------
C   VALUE                       DESCRIPTION
C-------------------------------------------------------------------------------
    3.2808                      / FACTN     (m -> ft)
    1.0                         / FACTLT
C-------------------------------------------------------------------------------
C   The following lists channel parameters and Manning's roughness coefficient
C   for each stream node. Refer to the drawing below for cross section parameters.
C
C
C
C          0                                       0
C           0                                     0|
C            0                                   0 | 1
C             0                                 0  |
C              0                               0___|
C               0                             0  s
C                000000000000000000000000000000
C                |                            |
C                |<---------- B0 ----------->|
C                |                            |
C
C
C   ID  ;  Stream node number
C   BOTR;  Stream bottom elevation relative to a common datum; [L]
C   B0  ;  Bottom width for the main channel; [L]
C           * B0 = 0.0 represents triangular channel
C   s   ;  Side slope for the main channel; [L]
C           * s = 0.0 represents rectangular channel
C   n   ;  Manning's roughness coefficient for the main channel; [seconds/meter^0.333]
C   HMAX;  Maximum stream flow depth; [L]
C            * This value is used to limit the range of Newton-Raphson
C              iterative estimates for the flow depth
C
C-----------------------------------------------------------------
C   Stream    Bottom      Bottom    Side    Manning's   Maximum
C    Node    Elevation    Width     Slope    Coeff.      Depth
C     ID       BOTR        B0         s        n         HMAX
C-----------------------------------------------------------------
      1       420.0       300.0      0.0      0.035     100.0
      2       400.0       300.0      0.0      0.035     100.0
      3       378.3       300.0      0.0      0.035     100.0
      .         .           .         .         .          .
      .         .           .         .         .          .
      .         .           .         .         .          .
     21       170.8       420.0      0.0      0.035     100.0
     22       170.7       420.0      0.0      0.035     100.0
     23       465.5       475.0      0.0      0.035     100.0
C*******************************************************************************
C                       Initial Conditions
C
C     The following lists the initial conditions at each stream node either as
C     flow depth or volumetric flow rate.
C
C   ICTYPE;   Type of initial conditions specified
C               0 = Flow depths are specified as initial conditions
C               1 = Volumetric flow rates are specified as initial conditions
```

```
C   TUNITQ;   Time unit of the initial volumetric flow rates. This should be one
C               of the units recognized by HEC-DSS that are listed in the Main
C               Control File.
C   FACTHQ;   Conversion factor for the initial conditions
C   IR    ;   Stream node number entered sequentially
C   HQS   ;   Initial flow depth or volumetric flow rate at stream node IR; [L] or [L^3/T]
C
C-------------------------------------------------------------------------------
C   VALUE                 DESCRIPTION
C-------------------------------------------------------------------------------
     1                    / ICTYPE
     1day                 / TUNITQ
     43560.0              / FACTHQ   (AF -> cu.ft.)
C-------------------------------------------------------------------------------
C    IR       HQS
C-------------------------------------------------------------------------------
       1      100.0
       2      100.0
       3      100.0
       .         .
       .         .
       .         .
      21      100.0
      22      100.0
      23      100.0
```

Stream Inflow File

Stream Inflow File for Stream Component Version 5.0 is exactly the same as the one for Version 4.0. Refer to the description of this file for Version 4.0 above.

Diversion Specifications File

Diversion Specifications File for Stream Component Version 5.0 is exactly the same as the one for Version 4.0. Refer to the description of this file for Version 4.0 above.

Bypass Specifications File

Bypass Specifications File for Stream Component Version 5.0 is exactly the same as the one for Version 4.0. Refer to the description of this file for Version 4.0 above.

Diversion Data File

Diversion Data File for Stream Component Version 5.0 is exactly the same as the one for Version 4.0. Refer to the description of this file for Version 4.0 above.

Lake Component Files

Simulation Main Input File points to the Lake Component Main File which is the gateway for all other data files that are needed to simulate lake storages and lake-aquifer interaction. Data input files that are used in simulating lakes are described in the following sections.

Lake Component Main File

Lake Component Main File is the gateway to additional data files that are used in simulating lake storages and the lake-aquifer interaction. The names of the input and output files are listed in this file. Lake bed parameters and initial lake surface elevations are also specified.

The Lake Component Main File is divided into multiple sections:

Input and Output Filenames

This section lists the data file that lists the time series maximum lake elevations and the optional output file for detailed lake water budgets. The following variables are used in this section:

MXLKELVFL	File name that lists the time series maximum lake elevations (maximum 1000 characters)
LKBUDFL	Binary output file for lake water budget (maximum 1000 characters); leave blank if this output is not required

FNLKELVFL	Output file for end-of-simulation lake elevations (maximum 1000 characters); leave blank if this output is not required

Lake Parameters

In this section lake bed parameters, lake evaporation and precipitation data are listed:

FACTK	Conversion factor for the spatial component of the lake bed hydraulic conductivity
TUNITK	Time unit of hydraulic conductivity; this should be one of the units recognized by HEC-DSS that are listed in the Simulation Main Input File
FACTL	Conversion factor for thickness of lake bed
IL	Lake number
CLAKE	Hydraulic conductivity of the lake bed; [L/T]
DLAKE	Thickness of the lake bed; [L]
ICHLMAX	Column number in MXLKELVFL file that lists the time series maximum lake elevation
ICETLK	Lake evapotranspiration rate; this number corresponds to the appropriate data column in the Evapotranspiration Data File listed in the Simulation Main Input File.
ICPCPLK	Lake precipitation rate; this number corresponds to the appropriate data column in the Precipitation Data File listed in the Simulation Main Input File.

NAMELK	Name of the lake; maximum 1000 characters

Initial Lake Elevations

In this section, initial conditions for the modeled lakes are specified:

FACT	Conversion factor for initial lake elevations
ILAKE	Lake identification number
HLAKE	Initial lake elevation; [L]

```
#4.0
C***  DO NOT DELETE ABOVE LINE ***
C
C******************************************************************************
C
C                  INTEGRATED WATER FLOW MODEL (IWFM)
C
C******************************************************************************
C
C                       LAKE PARAMETERS DATA FILE
C                           Lake Component
C                         *** Version 4.0 ***
C
C
C            Project:  IWFM Version ### Release
C                      California Department of Water Resources
C            Filename: Lake_MAIN.dat
C
C******************************************************************************
C                          File Description
C
C   This data file contains the parameters and data file names for the simulation
C   of lakes.
C
C******************************************************************************
C                          Lake Data File Names
C
C   MXLKELVFL;  File name that lists the maximum lake elevations (max. 1000 characters)
C   LKBUDFL  ;  Binary output file for lake budget (max. 1000 characters)
C                 * Leave blank if this output is not required
C   FNLKELVFL;  Output file for end-of-simulation lake elevations (max. 1000 characters)
C                  * Leave blank if this output is not required
C
C-----------------------------------------------------------------------------------------
C         VALUE                                      DESCRIPTION
C-----------------------------------------------------------------------------------------
          Lake\MaxLakeElev.dat                       / MXLKELVFL
          ..\Budget\LakeBud.bin                      / LKBUDFL
                                                     / FNLKELVFL
C******************************************************************************
C                           Lake Parameters
C
C     The parameters required to model lakes are listed below.
C
C   FACTK  ;   Conversion factor for lake bed hydraulic conductivity
C              It is used to convert only the spatial component of the unit;
C              DO NOT include the conversion factor for time component of the unit.
C              * e.g. Unit of hydraulic conductivity listed in this file = FT/MONTH
C                     Consistent unit used in simulation               = IN/DAY
C                     Enter FACT (FT/MONTH -> IN/MONTH)                = 8.33333E-02
C                      (conversion of MONTH -> DAY is performed automatically)
C   TUNITK ;   Time unit of hydraulic conductivity.  This should be one of the units
C              recognized by HEC-DSS that are listed in the Main Control File.
C   FACTL  ;   Conversion factor for thickness of lake bed
C   IL     ;   Lake number
C   CLAKE  ;   Hydraulic conductivity of the lake bed; [L/T]
C   DLAKE  ;   Thickness of the lake bed; [L]
C   ICHLMAX;   Column number in MXLKELVFL file that gives maximum lake elevation
C   ICETLK ;   Evapotranspiration - this number corresponds to the appropriate data
C               column in the ET data file listed in the Main Control Data file.
C   ICPCPLK;   Precipitation - this number corresponds to the appropriate data column
C               in the Precipitation data file listed in the Main Control Data file.
C   NAMELK ;   Name of the lake (max. 1000 characters)
C
C------------------------------------------------------------------------------
C   VALUE                 DESCRIPTION
C------------------------------------------------------------------------------
    1.0                   / FACTK
    1day                  / TUNITK
    1.0                   / FACTL
C------------------------------------------------------------------------------
C   IL       CLAKE      DLAKE      ICHLMAX    ICETLK   ICPCPLK   NAMELK
C------------------------------------------------------------------------------
    1        10.0       1.0          1          7        2       Lake1
C******************************************************************************
C                           Initial Lake Elevations
C
C     Initial lake surface elevations are listed below.
C
C   FACT  ;  Conversion factor for initial lake elevations
C   ILAKE ;  Sequential lake number
C   HLAKE ;  Initial lake elevations; [L]
C
C------------------------------------------------------------------------------
C   VALUE                       DESCRIPTION
C------------------------------------------------------------------------------
    1.0                         / FACT
C------------------------------------------------------------------------------
C    ILAKE     HLAKE
C------------------------------------------------------------------------------
      1        280.0
```

Maximum Lake Elevation Data File

This data file contains the time series data for the maximum lake elevations at the modeled lakes. The time-dependent maximum lake elevations at the modeled lakes are associated with each of the data columns through the ICHLMAX variable specified in the Lake Component Main File. In time tracking simulations the time series maximum lake elevation data can be either listed in this file or in a DSS file. If a DSS file is used for data input, then the name of the DSS file and the pathnames corresponding to each of the time series data are required.

The following is a list of the variables used in this data file:

NCOLHLMX	Total number of time series data columns for maximum lake elevations
FACTHLMX	Conversion factor for maximum lake elevations
NSPHLMX	Number of time steps to update the maximum lake elevations; if time tracking simulation, enter any number
NFQHLMX	Repetition frequency of the maximum lake elevation data; if time tracking simulation, enter any number
DSSFL	If the time series data is stored in a DSS file, name of the file; leave blank if the data is listed in the Maximum Lake Elevation Data File

Data Input from Maximum Lake Elevation Data File

If the time series data is listed in the Maximum Lake Elevation Data File, then the following variables need to be populated. Otherwise, these variables should be

commented out using “C”, “c” or “*”, and the variables in the “Data Input from DSS File” section below should be populated.

ITHLMX — Time. For time tracking simulations use MM/DD/YYYY_hh:mm format, for non-time tracking simulations enter an integer number.

HLMAX — Maximum lake elevation; [L]

Data Input from DSS File

If time series data is stored in a DSS file then the following variables should be populated:

REC — Record number that coincides with the data column number for the time series data

PATH — Pathname for the time series record that will be used for data retrieval

```
C*******************************************************************************
C
C                  INTEGRATED WATER FLOW MODEL (IWFM)
C
C*******************************************************************************
C
C                  MAXIMUM LAKE ELEVATION DATA FILE
C                          Lake Component
C                        *** Version 4.0 ***
C
C
C             Project:  IWFM Version ### Release
C                       California Department of Water Resources
C             Filename: MaxLakeElev.dat
C
C*******************************************************************************
C                            File Description
C
C   This data file contains the time series data for the maximum lake elevations
C   at the modeled lakes.
C
C*******************************************************************************
C                        Maximum Lake Elevation Data Specifications
C
C   NCOLHLMX; Total number of time series data columns (or pathanmes if DSS files
C              are used)for maximum lake elevations
C   FACTHLMX; Conversion factor for maximum lake elevations
C   NSPHLMX ; Number of time steps to update the maximum lake elevations
C              * Enter any number if time-tracking option is on
C   NFQHLMX ; Repetition frequency of the maximum lake elevation data
C              * Enter 0 if full time series data is supplied
C              * Enter any number if time-tracking option is on
C   DSSFL  ;  The name of the DSS file for data input (maximum 50 characters);
C              * Leave blank if DSS file is not used for data input
C
C-------------------------------------------------------------------------------
C     VALUE                     DESCRIPTION
C-------------------------------------------------------------------------------
      1                         / NCOLHLMX
      1.0                       / FACTHLMX
      1                         / NSPHLMX
      1                         / NFQHLMX
                                / DSSFL
C-------------------------------------------------------------------------------
C                        Maximum Lake Elevations Data
C                           (READ FROM THIS FILE)
C
C   List the maximum lake elevations data below, if it will not be read from
C   a DSS file (i.e. DSSFL is left blank above).
C
C   ITHLMX ;   Time
C   HLMAX  ;   Maximum lake elevation; [L]
C
C-------------------------------------------------------------------------------
C   ITHLMX          HLMAX(1)  HLMAX(2)  HLMAX(3) ...
C-------------------------------------------------------------------------------
09/30/2100_24:00    285.0
*
C-------------------------------------------------------------------------------
C                       Pathnames for Maximum Lake Elevations Data
C                                (READ FROM DSS FILE)
C
C   List the pathnames for maximum lake elevations data below, if it will be read
C   from a DSS file (i.e. DSSFL is specified above).
C
C   REC  ;  Time series record number
C   PATH ;  Pathname for the time series record
C
C---------------------------------------------------------------------------------
C   REC       PATH
C---------------------------------------------------------------------------------
*
*
```

Root Zone Component Files

Simulation Main Input File points to the Root Zone Component Main File which is the gateway to additional data files that are used in simulating land surface and root zone flow processes at agricultural, urban, native vegetation and riparian vegetation lands. Agricultural and urban water demands are also computed in the root zone component. There are multiple versions of the Root Zone Component based on the available features. The user can choose one of these versions to be used in their modeling studies based on the modeling needs. The input and output files used in the root zone component are described in detail in the document titled *IDC-2015 Theoretical Documentation and User's Manual*. To turn off the simulation of the land surface and root zone flow processes as well as the computation of water demands, one can leave the filename for the Root Zone Component Main File in the Simulation Main Input File blank.

Small Watershed Component Files

The Simulation Main Input File points to the Small Watershed Parameter Data File which stores all the data for the simulation of flow processes in small watersheds and their contribution to stream flows and groundwater. It also includes names of files that are used to print out simulation results.

Small Watershed Parameter Data File

Small Watershed Parameter Data File contains parameters that are used to simulate surface and subsurface inflows to the model domain from adjacent small watersheds as well as output filenames to print out simulation results.

The file is divided into several sections:

Output Filenames

This section includes names of the files where simulation results for small watersheds will be printed.

SWBUDFL	Binary output file for small watershed budget data (maximum 1000 characters); leave blank if this output is not required
FNSWFL	Output file for end-of-simulation root zone moisture and groundwater storage for small watersheds (maximum 1000 characters); leave blank if this output is not required

General Small Watershed Parameters

In this section number of the simulated small watersheds, their geographical features (drainage area, stream and groundwater nodes they contribute flow to) and maximum recharge rates (QMAXWB) at each groundwater node they contribute to are specified. A negative value for the maximum recharge rate indicates that subsurface flow from the small watershed will directly contribute to groundwater node, whereas a positive value indicates the maximum amount of water that can percolate to the groundwater when routed from the small watershed to a stream node within the model domain. The following variables are used in this section:

NSW	Number of simulated small watersheds
FACTA	Conversion factor for small watershed drainage area
FACTQ	Conversion factor for the spatial component of the unit of the maximum recharge rate
TUNITQ	Time unit of maximum recharge rate; this should be one of the units recognized by HEC-DSS that are listed in the Simulation Main Input File
ID	Small watershed identification number (1 to NSW, sequentially)
AREAS	Drainage area of the small watershed, [L^2]
IWBTS	Stream node that receives the surface runoff from the small watershed
NWB	Number of groundwater nodes that receive the base flow and the percolation of surface flow from the small watershed
IWB	Groundwater node numbers small watershed baseflow and percolation contributes to (NWB node numbers must be listed)

QMAXWB	Maximum recharge rate for each groundwater node (enter the negative of layer number to specify which groundwater node(s) at which layer receive baseflow from the small watersheds; e.g. -1 means layer 1, -2 means layer 2, etc; positive values represent maximum recharge rate to the groundwater node when surface flow is routed from the small watershed to a stream node within the model domain), $[L^3/T]$

Small Watershed Root Zone Parameters

In this section, root zone soil parameters that are used to simulate the vertical movement of the moisture in the root zone in small watersheds are defined.

TOLER	Convergence criteria for iterative soil moisture routing as a fraction of total porosity, [L/L]
ITERMAX	Maximum number of iterations for the soil moisture routing
FACTL	Conversion factor for small watershed root zone depth
FACTCN	Factor to convert inches to the simulation unit of length
FACTK	Conversion factor for the spatial component of the unit of the small watershed root zone hydraulic conductivity
TUNITK	Time unit of small watershed root zone hydraulic conductivity; this should be one of the units recognized by HEC-DSS that are listed in the Simulation Main Input File
ID	Small watershed identification number (1 to NSW, sequentially)

IRNS	Column number in the Precipitation Data File that lists the time-series rainfall rate for the small watershed
FRNS	Conversion factor for the rainfall rate
ICETS	Column number in the Evapotranspiration Data File that lists the evapotranspiration rate at the small watershed
WPS	Wilting point, [L/L]
FLDCAS	Field capacity, [L/L]
TPOROS	Total porosity, [L/L]
LAMBDAS	Pore size distribution index, [dimensionless]
CROOT	Root zone depth in the small watershed, [L]
SOILKS	Hydraulic conductivity of the root zone, [L/T]
RHCS	Method to represent hydraulic conductivity versus moisture content curve (1 = Campbell's equation; 2 = van Genucten-Mualem equation)
CN	Curve number for small watershed area

Small Watershed Aquifer Parameters

Parameters to simulate the groundwater flows at the small watersheds in a simplistic manner are listed in this section:

FACTGW	Conversion factor for threshold and maximum groundwater depths
FACTT	Conversion factor for recession coefficients
TUNITT	Time unit of recession coefficients; this should be one of the units recognized by HEC-DSS that are listed in the Simulation Main

Input File

ID	Small watershed identification number (1 to NSW, sequentially)
GWSOS	Threshold value of groundwater depth above which groundwater storage of small watershed contributes to surface runoff, [L]
GWSOX	Maximum groundwater storage depth, [L]
SWKS	Recession coefficient for surface outflow, [1/T]
GWKS	Recession coefficient for base flow, [1/T]

Initial Conditions

Initial root zone moisture and groundwater storage at each simulated small watershed are specified in this section:

FACT	Conversion factor for initial groundwater storage
ISW	Sequential small watershed number
SOILS	Initial soil moisture content for each watershed, [L/L]
GWSTS	Initial groundwater storage for each watershed, [L]

```
#4.0
C***  DO NOT DELETE ABOVE LINE ***
C
C*****************************************************************************
C
C                  INTEGRATED WATER FLOW MODEL (IWFM)
C
C*****************************************************************************
C
C                    SMALL WATERSHED PARAMETERS DATA FILE
C                          Small Watershed Component
C                             *** Version 4.0 ***
C
C
C             Project:  IWFM Version ### Release
C                       California Department of Water Resources
C             Filename: SWShed.dat
C
C*****************************************************************************
C                          File Description
C
C   This data file contains the parameters and data file names for the simulation
C   of small watersheds that are adjacent to a model boundary.
C
C*****************************************************************************
C                          Small Watersheds Data File Names
C
C   SWBUDFL ;  Binary output file for small watershed budget data (max. 1000 characters)
C                * Leave blank if this output is not required
C   FNSWFL  ;  Output file for end-of-simulation root zone moisture and groundwater
C               storage for small watersheds  (max. 1000 characters)
C                * Leave blank if this output is not required
C
C-------------------------------------------------------------------------------------
C         VALUE                                     DESCRIPTION
C-------------------------------------------------------------------------------------
      SWShedBud.bin                                 / SWBUDFL
      SWShedFin.out                                 / FNSWFL
C*****************************************************************************
C                    Small Watershed Parameters
C
C   NSW     ;  Number of small watersheds
C   FACTA   ;  Conversion factor for small watershed drainage area
C   FACTQ   ;  Conversion factor for maximum recharge rate
C               It is used to convert only the spatial component of the unit;
C               DO NOT include the conversion factor for time component of the unit.
C               * e.g. Unit of max. recharge rate listed in this file   = AC-FT/MONTH
C                      Consistent unit used in simulation               = CU.FT/DAY
C                      Enter FACT (AC-FT/MONTH -> CU.FT/MONTH)          = 2.29568E-05
C                       (conversion of MONTH -> DAY is performed automatically)
C   TUNITQ  ;  Time unit of max. recharge rate.  This should be one of the units
C               recognized by HEC-DSS that are listed in the Main Control File.
C   ID      ;  Small watershed identification number (1 to NSW, sequentially)
C   AREAS   ;  Drainage area of the small watershed; [L^2]
C   IWBTS   ;  Stream node that receives the surface runoff from the small watershed
C   NWB     ;  Number of groundwater nodes that receive the base flow and the
C               percolation of surface flow from the small watershed
C   IWB     ;  Groundwater node number small watershed baseflow is routed through
C   QMAXWB  ;  Maximum recharge rate for each node; [L^3/T]
C              (Enter the negative of layer number to specify which groundwater node(s)
C               at which layer receive baseflow from the small watersheds; e.g. -1 means
C               layer 1, -2 means layer 2, etc)
C
C-----------------------------------------------------------------------------
C         VALUE                                     DESCRIPTION
C-----------------------------------------------------------------------------
          52                                        / NSW
          43560.0                                   / FACTA   (ac. -> sq.ft.)
          43560.0                                   / FACTQ   (ac.ft. -> cu.ft.)
          1day                                      / TUNITQ
C-----------------------------------------------------------------------------
C   ID     AREAS     IWBTS     NWB      IWB      QMAXWB
C-----------------------------------------------------------------------------
     1    1989.64    122        2       17       -2
                                        22       -2
     2     505.04    125        2       27       -2
                                        27        4.3
     3     521.55    126        2       27       -2
                                        29       -2
     4    1626.12    136        9       36       -2
                                        41       -2
                                        41        5.1
                                        42        5.1
                                        45        4.8
                                        49        1.1
                                        53        5.0
                                        58        5.2
                                        59        5.3
     .       .        .         .        .        .
     .       .        .         .        .        .
     .       .        .         .        .        .
     .       .        .         .        .        .
    50     397.06    193        4       765      -2
                                        669      -2
                                        669       5.0
                                        668       5.0
    51    1287.83    193        4       579      -2
                                        494      -2
                                        579       5.0
                                        494       5.0
    52     206.30    193        5       414      -2
                                        494      -2
                                        414       5.0
                                        413       5.0
                                        412       5.0
C*****************************************************************************
C                    Small Watershed Root Zone Parameters
C
C   TOLER   ;  Convergence criteria for iterative soil moisture routing as a
C               fraction of total porosity; [L/L]
C   ITERMAX ;  Maximum number of iterations for the soil moisture routing
C   FACTL   ;  Conversion factor for small watershed root zone depth
```

```
C   FACTCN  ;  Conversion factor to convert inches to the simulation unit of length
C   FACTK   ;  Conversion factor for small watershed root zone hydraulic conductivity
C              It is used to convert only the spatial component of the unit;
C              DO NOT include the conversion factor for time component of the unit.
C              * e.g. Unit of hydraulic conductivity listed in this file = FT/MONTH
C                     Consistent unit used in simulation                 = IN/DAY
C                     Enter FACT (FT/MONTH -> IN/MONTH)                  = 8.33333E-02
C                      (conversion of MONTH -> DAY is performed automatically)
C   TUNITK  ;  Time unit of small watershed root zone hydraulic conductivity.  This
C               should be one of the units recognized by HEC-DSS that are listed in
C               the Main Control File.
C   ID      ;  Small watershed identification number (1 to NSW, sequentially)
C   IRNS    ;  Rainfall station number associated with the small watershed - this number
C               corresponds to the appropriate data column in the Precipitation Data File
C   FRNS    ;  Factor to convert rainfall at the precipitation data column to
C               rainfall at watershed ID
C   ICETS   ;  Evapotranspiration rate for the small watershed - this number corresponds
C               to the appropriate data column in the ET Data File
C   WPS     ;  Wilting point; [L/L]
C   FLDCAS  ;  Field capacity; [L/L]
C   TPOROS  ;  Total porosity; [L/L]
C   LAMBDAS ;  Pore size distribution index; [dimensionless]
C   CROOT   ;  Root zone depth in the small watershed; [L]
C   SOILKS  ;  Hydraulic conductivity of the root zone; [L/T]
C   RHCS    ;  Method to represent hydraulic conductivity vs. moisture content curve
C               1 = Campbell's equation
C               2 = van Genucten-Mualem equation
C   CN      ;  Curve number for small watershed area (Reference: USDA, 1985)
C
C-------------------------------------------------------------------------------
C         VALUE                                      DESCRIPTION
C-------------------------------------------------------------------------------
          0.01                                       / TOLER
          50                                         / ITERMAX
          1.0                                        / FACTL
          0.0833                                     / FACTCN   (in -> ft)
          0.283461                                   / FACTK    (micrometer/sec -> ft/day)
          1day                                       / TUNITK
C-----------------------------------------------------------------------------------------------
C   ID     IRNS    FRNS    ICETS    WPS    FLDCAS    TPOROS     LAMBDAS   CROOT     SOILKS   RHCS    CN
C-----------------------------------------------------------------------------------------------
    1       3      1.0      1       0.0   0.035      0.046    0.051       5.0       0.628     2     63
    2       3      1.0      1       0.0   0.107      0.142    0.114       5.0       1.066     2     63
    3       3      1.0      1       0.0   0.171      0.223    0.297       5.0       4.145     2     63
    .       .       .       .        .     .          .        .           .          .       .      .
    .       .       .       .        .     .          .        .           .          .       .      .
    .       .       .       .        .     .          .        .           .          .       .      .
    50      3      1.0      1       0.0   0.252      0.330    0.395       5.0       4.633     2     57
    51      3      1.0      1       0.0   0.257      0.339    0.381       5.0       4.482     2     57
    52      3      1.0      1       0.0   0.308      0.415    0.330       5.0       3.047     2     48
C*******************************************************************************
C                    Small Watershed Aquifer Parameters
C
C   FACTGW  ;  Conversion factor for threshold and maximum groundwater depths
C   FACTT   ;  Conversion factor for recession coefficients
C   TUNITT  ;  Time unit of recession coefficients.  This should be one of the units
C               recognized by HEC-DSS that are listed in the Main Control File.
C   ID      ;  Small watershed identification number (1 to NSW, sequentially)
C   GWSOS   ;  Threshold value of groundwater depth above which groundwater
C               storage of small watershed contributes to surface runoff; [L]
C   GWSOX   ;  Maximum groundwater storage depth; [L]
C   SWKS    ;  Recession coefficient for surface outflow; [1/T]
C   GWKS    ;  Recession coefficient for base flow; [1/T]
C
C-------------------------------------------------------------------------------
C         VALUE                                      DESCRIPTION
C-------------------------------------------------------------------------------
          1.0                                        / FACTGW
          1.0                                        / FACTT
          1day                                       / TUNITT
C-------------------------------------------------------------------------------
C   ID     GWSOS    GWSOX    SWKS     GWKS
C-------------------------------------------------------------------------------
    1      1.0       30.0     0.4     8.1122E-5
    2      1.0       30.0     0.4     5.4513E-5
    3      1.0       30.0     0.4     6.0741E-5
    .       .          .       .       .
    .       .          .       .       .
    .       .          .       .       .
    50     1.0       30.0     0.4     6.6000E-5
    51     1.0       30.0     0.4     6.6000E-5
    52     1.0       30.0     0.4     6.6000E-5
C*******************************************************************************
C               Initial Root Zone Moisture and Groundwater Storage
C
C   FACT  ;  Conversion factor for initial groundwater storage
C   ISW   ;  Sequential small watershed number
C   SOILS ;  Initial soil moisture content for each watershed; [L/L]
C   GWSTS ;  Initial groundwater storage for each watershed; [L]
C
C-------------------------------------------------------------------------------
C   VALUE                     DESCRIPTION
C-------------------------------------------------------------------------------
     1.0                      / FACT
C-------------------------------------------------------------------------------
C    ISW    SOILS    GWSTS
C-------------------------------------------------------------------------------
     1      0.0007    1.28
     2      0.0007    1.25
     3      0.0006    1.16
     .        .        .
     .        .        .
     .        .        .
     50     0.0006    1.16
     51     0.0006    1.16
     52     0.0006    1.16
```

Unsaturated Zone Component Files

The Simulation Main Input File points to the Unsaturated Zone Parameter Data File which stores all the data for the simulation of vertical flow in the unsaturated zone as well as the names for the output files that store simulation results.

Unsaturated Zone Parameter Data File

Unsaturated Zone Parameter Data File includes parameters to simulate the vertical flows in the unsaturated zone that lies between the root zone and the saturated groundwater system as well as the output filenames to print the simulation results.

The parameters for the unsaturated zone are defined for each grid cell. These parameters can be specified either through the use of parametric grids (option 1) or for each cell at each aquifer layer directly (option 2). The methodology to setup parametric grids is explained for the Groundwater Component Main File earlier in this document.

Unsaturated Zone Parameter Data File is divided into several sections:

Simulation Control and Output Filenames

In this section number of unsaturated zone layers, convergence criteria for the iterative solution of the unsaturated zone flow equations and the output filenames are specified. The following variables are used:

NUNSAT	Number of layers in the unsaturated zone
UZCONV	Convergence criteria for iterative soil moisture accounting as a fraction of total porosity, [L/L]

UZITERMX	Maximum number of iterations for iterative soil moisture accounting
UZBUDFL	Unsaturated zone budget binary output file (maximum1000 characters); leave blank if this output is not required
UZFNFL	Output file for end-of-simulation unsaturated zone moisture content (maximum 1000 characters); leave blank if this output is not required

Unsaturated Zone Parameters

Parameters to simulate the vertical flow in the unsaturated zone can be specified at grid cell or through the use of parametric grids. The use of parametric grids is described in detail for the Groundwater Component Main File earlier in this document. The following variables are used in this section:

NGROUP	Number of parametric grid groups
FX	Conversion factor for parametric grid coordinates
FD	Conversion factor for the thickness of the unsaturated layer
FK	Conversion factor for the spatial component of the unit of the unsaturated zone hydraulic conductivity
TUNITZ	Time unit of hydraulic conductivity; this should be one of the units recognized by HEC-DSS that are listed in the Simulation Main Control File
NDP	Number of nodes in the parametric grid
NEP	Number of elements in the parametric grid

IEP	Parametric element number
NODE	Parametric nodes in counter clock-wise direction corresponding to parametric element IEP
ID	Parametric node number
IE	Cell number in the computational grid
PX	x-coordinate of the parametric node, [L]
PY	y-coordinate of the parametric node, [L]
PD	Thickness of the unsaturated layer, [L]
PN	Total porosity, [L/L]
PI	Pore size distribution index, [dimensionless]
PK	Hydraulic conductivity, [L/T]
PRHC	Method to represent hydraulic conductivity versus moisture content curve (1 = Campbell's equation; 2 = van Genucten-Mualem equation)

When unsaturated zone parameters are specified using parametric grids (option 1, NGROUP > 0), parametric node IDs are specified along with parameters PD through PRHC for each parametric node. IWFM then interpolates these data onto computational grid cells. If the unsaturated zone parameters are specified for each grid cell (option 2, NGROUP = 0), then element numbers, IE, are specified along with the parameters PD through PRHC for each element IE.

Unsaturated Zone Initial Conditions

In this section initial soil moisture content at each grid cell at each unsaturated zone layer is specified:

IE	Element number; enter 0 if the specified initial soil moisture content will be used for all elements
UNSATM	Initial soil moisture content for each layer of the unsaturated zone, [L/L]

```
#4.0
C***  DO NOT DELETE ABOVE LINE ***
C
C*******************************************************************************
C
C                   INTEGRATED WATER FLOW MODEL (IWFM)
C
C*******************************************************************************
C
C                  UNSATURATED ZONE PARAMETER DATA FILE
C                       Unsaturated Zone Component
C                          *** Version 4.0 ***
C
C
C              Project:  IWFM Version ### Release
C                        California Department of Water Resources
C              Filename: UnsatZone.dat
C
C*******************************************************************************
C                                File Description:
C
C   This data file contains the parameters for the simulation of the unsaturated
C   zone component.
C
C*******************************************************************************
C                  Unsaturated Zone Simulation Control and File Names
C
C   NUNSAT  ; Number of layers in the unsaturated zone
C   UZCONV  ; Convergence criteria for iterative soil moisture accounting as a
C              fraction of total porosity; [L/L]
C   UZITERMX; Maximum number of iterations for iterative soil moisture accounting
C   UZBUDFL ; Unsaturated zone budget binary output file (max. 1000 charcaters)
C               * Leave blank if this output is not required
C   UZFNFL  ; Output file for end-of-simulation unsaturated zone moisture content
C              (max. 1000 characters)
C               * Leave blank if this output is not required
C
C-------------------------------------------------------------------------------
C   VALUE                           DESCRIPTION
C-------------------------------------------------------------------------------
    2                               / NUNSAT
    1e-8                            / UZCONV
    50                              / UZITERMX
    UnsatBud.bin                    / UZBUDFL
                                    / UZFNFL
C-------------------------------------------------------------------------------
C
C   Option 1 - Set unsaturated zone parameters by use of a parametric grid(NGROUP > 0)
C   Option 2 - Set unsaturated zone parameters at every groundwater node  (NGROUP = 0)
C
C   NGROUP;  Number of parametric grid groups
C
C-------------------------------------------------------------------------------
C   VALUE                           DESCRIPTION
C-------------------------------------------------------------------------------
    0                               / NGROUP
C------------------------------------------------------------------------------
C   OPTIONS 1 & 2 : The following lists the factors to convert the unsaturated
C                   zone parameters and grid coordinates to the appropriate units
C
C
C   FX;      Conversion factor for grid coordinates
C   FD;      Conversion factor for the thickness of the unsaturated layer
C   FK;      Conversion factor for hydraulic conductivity
C              It is used to convert only the spatial component of the unit;
C              DO NOT include the conversion factor for time component of the unit.
C              * e.g. Unit of hydraulic conductivity listed in this file = FT/MONTH
C                     Consistent unit used in simulation                = IN/DAY
C                     Enter FACT (FT/MONTH -> IN/MONTH)                 = 8.33333E-02
C                      (conversion of MONTH -> DAY is performed automatically)
C   TUNITZ;  Time unit of hydraulic conductivity.  This should be one of the units
C              recognized by HEC-DSS that are listed in the Main Control File.
C
C-------------------------------------------------------------------------------
C    FX             FD            FK
C-------------------------------------------------------------------------------
     1.0            1.0           1.0
C-------------------------------------------------------------------------------
C   VALUE                           DESCRIPTION
C-------------------------------------------------------------------------------
    1DAY                            / TUNITZ
C-------------------------------------------------------------------------------
C*******************************************************************************
C            OPTION 1
C*******************************************************************************
C-------------------------------------------------------------------------------
C   *** GROUP 1 ***
C-------------------------------------------------------------------------------
C   Enter element numbers from FE grid for the 1st parametric group
C     (e.g. 1-100,101,301-359,567)
C-------------------------------------------------------------------------------
*
C-------------------------------------------------------------------------------
C
C   NDP;     Number of nodes in the 1st parametric grid
C   NEP;     Number of elements in the 1st parametric grid
C
C-------------------------------------------------------------------------------
C   VALUE                           DESCRIPTION
C-------------------------------------------------------------------------------
*                                    / NDP
*                                    / NEP
C-------------------------------------------------------------------------------
C
C   The following is a list of the parametric elements and
C   corresponding parametric nodes for the 1st parametric group
C   (to be used only when parametric option is used, ie. NDP > 0)
C
C   IEP ;    Parametric element number
C   NODE;    Corresponding parametric node
C
C-------------------------------------------------------------------------------
```

```
C             Node 1    Node 2    Node 3     Node 4
C    IEP       NODE      NODE      NODE       NODE
C---------------------------------------------------------------------------
*
C----------------------------------------------------------------------------
C    List the parametric nodes,coordinates, and unsaturated zone parameters for
C    each layer of the 1st parametric group (skip if option 2 is used)
C
C   ID   ;   Parametric node number
C   PX   ;   x-coordinate of the parametric node; [L]
C   PY   ;   y-coordinate of the parametric node; [L]
C   PD   ;   Thickness of unsaturated layer; [L]
C   PN   ;   Total porosity; [L/L]
C   PI   ;   Pore size distribution index [dimensionless]
C   PK   ;   Hydraulic conductivity; [L/T]
C   PRHC ;   Method to represent hydraulic conductivity vs. moisture content curve
C               1 = Campbell's equation
C               2 = van Genucten-Mualem equation
C-----------------------------------------------------------------------------------------------------
C          NODAL COORDINATES     Thickness     Porosity    Pore Size Dist.In.    Hyd. Cond.    Method
C   ID       PX      PY             PD            PN            PI                  PK            PRHC
C-----------------------------------------------------------------------------------------------------
*
C----------------------------------------------------------------------------------------------
C    *** GROUP 2 ***
C-----------------------------------------------------------------------------
C   Enter element numbers from FE grid for the 2nd parametric group
C     (e.g. 1-100,101,301-359,567)
C-----------------------------------------------------------------------------
*
C----------------------------------------------------------------------------
C
C   NDP;     Number of nodes in the 2nd parametric grid
C   NEP;     Number of elements in the 2nd parametric grid
C
C----------------------------------------------------------------------------
C   VALUE                        DESCRIPTION
C-----------------------------------------------------------------------------
*                                 / NDP
*                                 / NEP
C----------------------------------------------------------------------------
C
C   The following is a list of the parametric elements and
C   corresponding parametric nodes for the 1st parametric group
C   (to be used only when parametric option is used, ie. NDP > 0)
C
C   IEP ;    Parametric element number
C   NODE;    Corresponding parametric node
C
C----------------------------------------------------------------------------
C             Node 1    Node 2    Node 3     Node 4
C    IEP       NODE      NODE      NODE       NODE
C---------------------------------------------------------------------------
*
C----------------------------------------------------------------------------
C    List the parametric nodes,coordinates, and unsaturated zone parameters for
C    each layer of the 2nd parametric group (skip if option 2 is used)
C
C   ID   ;   Parametric node number
C   PX   ;   x-coordinate of the parametric node; [L]
C   PY   ;   y-coordinate of the parametric node; [L]
C   PD   ;   Thickness of unsaturated layer; [L]
C   PN   ;   Total porosity; [L/L]
C   PI   ;   Pore size distribution index [dimensionless]
C   PK   ;   Hydraulic conductivity; [L/T]
C   PRHC ;   Method to represent hydraulic conductivity vs. moisture content curve
C               1 = Campbell's equation
C               2 = van Genucten-Mualem equation
C-----------------------------------------------------------------------------------------------------
C          NODAL COORDINATES     Thickness     Porosity    Pore Size Dist.In.    Hyd. Cond.    Method
C   ID       PX      PY             PD            PN            PI                  PK            PRHC
C-----------------------------------------------------------------------------------------------------
*
C----------------------------------------------------------------------------
C****************************************************************************
C            OPTION 2
C****************************************************************************
C
C   List the unsaturated zone parameters for each layer and grid cell (skip if
C   option 1 is used)
C
C   IE   ;   Element number
C   PD   ;   Thickness of unsaturated layer; [L]
C   PN   ;   Total porosity; [L/L]
C   PI   ;   Pore size distribution index; [dimensionless]
C   PK   ;   Hydraulic conductivity; [L/T]
C   PRHC ;   Method to represent hydraulic conductivity vs. moisture content curve
C               1 = Campbell's equation
C               2 = van Genucten-Mualem equation
C------------------------------------------------------------------------------------------
C                            LAYER 1                                   LAYER 2
C               --------------------------------          --------------------------------
C    IE         PD     PN     PI     PK     PRHC         PD     PN     PI     PK     PRHC
C------------------------------------------------------------------------------------------
     1          50.0   0.46   0.452  4.04    1           0.0    0.46   0.452  4.04    1
     2          50.0   0.46   0.452  4.04    1           0.0    0.46   0.452  4.04    1
     3          50.0   0.46   0.452  4.04    1           0.0    0.46   0.452  4.04    1
     .            .      .      .      .     .            .      .      .      .     .
     .            .      .      .      .     .            .      .      .      .     .
     .            .      .      .      .     .            .      .      .      .     .
     398        50.0   0.46   0.452  4.04    1           0.0    0.46   0.452  4.04    1
     399        50.0   0.46   0.452  4.04    1           0.0    0.46   0.452  4.04    1
     400        50.0   0.46   0.452  4.04    1           0.0    0.46   0.452  4.04    1
C****************************************************************************
C       Initial Soil Moisture Condition for Unsaturated Zone
C
C   IE    ;  Element number
C             * Enter 0 if following values are to be used for all elements
C   UNSATM;  Initial soil moisture content for each layer of the unsaturated
C             zone [L/L]
C
C----------------------------------------------------------------------------
```

```
C                              Unsaturated Layers
C         ---------------------------------------------------------------------
C    IE            1           2   ......
C-----------------------------------------------------------------------------
     0            0.05         0.08
```

Irrigation Fractions Data File

This data file contains the time series data for the fraction of pumping and surface water diversions to be used for agricultural purposes. The pumping and surface water diversions are associated with each of the data columns through the Pumping Specifications File and the Diversion Specifications File. In time tracking simulations the time series irrigation fractions data can be either listed in this file or in a DSS file. If a DSS file is used for data input, then the name of the DSS file and the pathnames corresponding to each of the time series data are required.

The following is a list of the variables used in this data file:

NCOLIRF	Number of columns in the irrigation fractions data file
NSPIRF	Number of time steps to update the irrigation fractions; if time tracking simulation, enter any number
NFQIRF	Repetition frequency of the irrigation fractions data; a value of zero indicates that a full time series data set is supplied; if time tracking simulation, enter any number
DSSFL	If the time series data is stored in a DSS file, name of the file; leave blank if the data is listed in the Irrigation Specifications Data File.

Data Input from Irrigation Specifications Data File

If the time series data is listed in the Irrigation Specifications Data File, then the following variables need to be populated. Otherwise, these variables should be

commented out using “C”, “c” or “*”, and the variables in the “Data Input from DSS File” section below should be populated.

ITIRF — Time. For time tracking simulations use MM/DD/YYYY_hh:mm format, for non-time tracking simulations enter an integer number.

FIRIG — Irrigation fraction used for agricultural purposes; (1−FIRIG) is used for urban water requirements

Data Input from DSS File

If time series data is stored in a DSS file then the following variables should be populated:

REC — Record number that coincides with the data column number for the time series data

PATH — Pathname for the time series record that will be used for data retrieval

```
C*******************************************************************************
C
C                   INTEGRATED WATER FLOW MODEL (IWFM)
C                          *** Version ### ***
C
C*******************************************************************************
C
C        IRRIGATION FRACTIONS FOR PUMPING AND SURFACE WATER DIVERSIONS
C                         for IWFM Simulation
C
C
C              Project : IWFM Version ### Release
C                        California Department of Water Resources
C              Filename: IrigFrac.dat
C
C*******************************************************************************
C                           File Description
C
C    This data file contains the time series data for the fraction of pumping
C    and surface water diversions to be used for agricultural purposes.
C
C*******************************************************************************
C                         Irrigation Fractions Data Specifications
C
C    NCOLIRF;  Number of columns (or pathnames if DSS files are used) in the
C               irrigation fractions data file
C    NSPIRF ;  Number of time steps to update the irrigation fractions
C               * Enter any number if time-tracking option is on
C    NFQIRF ;  Repetition frequency of the irrigation fractions data
C               * Enter 0 if full time series data is supplied
C               * Enter any number if time-tracking option is on
C    DSSFL  ;  The name of the DSS file for data input (maximum 50 characters);
C               * Leave blank if DSS file is not used for data input
C
C-------------------------------------------------------------------------------
C          VALUE                                      DESCRIPTION
C-------------------------------------------------------------------------------
          2                                         / NCOLIRF
          1                                         / NSPIRF
          0                                         / NFQIRF
                                                    / DSSFL
C-------------------------------------------------------------------------------
C                         Irrigation Fractions Data
C                           (READ FROM THIS FILE)
C
C    List the irrigation fractions data below, if it will not be read from
C    a DSS file (i.e. DSSFL is left blank above).
C
C    ITIRF;  Time
C    FIRIG;  Irrigation fraction
C
C-------------------------------------------------------------------------------
C    ITIRF            FIRIG(1)  FIRIG(2)  FIRIG(3) ...
C-------------------------------------------------------------------------------
C                     UrbIrrig    AgIrrig
  09/30/2500_24:00    0.0         1.0
*
C-------------------------------------------------------------------------------
C                        Pathnames for Irrigation Fractions Data
C                                (READ FROM DSS FILE)
C
C    List the pathnames for irrigation fractions data below, if it will be read
C    from a DSS file (i.e. DSSFL is specified above).
C
C    REC  ;  Time series record number
C    PATH ;  Pathname for the time series record
C
C-------------------------------------------------------------------------------
C    REC       PATH
C-------------------------------------------------------------------------------
*
*
```

Supply Adjustment Specifications File

This data file contains the time series specifications for the adjustment of surface water diversions and groundwater pumping in order to minimize the discrepancy between the agricultural and urban water demand and water supply. The data contains information to specify if a diversion or pumping should be adjusted to meet agricultural demand, urban demand or both. Each diversion or pumping scheme is associated with a column in this file through the Diversion Specifications File or through the Pumping Specifications File. This file is required when the variable KOPTDV is set to a value other than 00 in the Simulation Main Input File. The time series supply adjustment specifications data can be either listed in this file or in a DSS file. If a DSS file is used for data input, then the name of the DSS file and the pathnames corresponding to each of the time series data are required. Also note that the file example given below specifies time series data that are constant throughout the simulation period by setting the year of the time series data to a value (year 2500) that covers the entire period.

The following variables are required to be set:

NCOLADJ	Number of time-series data columns
NSPADJ	Number of time steps to update the supply adjustment specifications data; if time tracking simulation, enter any number
NFQADJ	Repetition frequency of the supply adjustment specifications data (enter zero if full time series data is supplied); if time tracking simulation, enter any number

DSSFL — If the time series data is stored in a DSS file, name of the file; leave blank if the data is listed in the Supply Adjustment Specifications File

Data Input from Supply Adjustment Specifications File

If the time series data is listed in the Supply Adjustment Specifications File, then the following variables need to be populated. Otherwise, these variables should be commented out using "C", "c" or "*", and the variables in the "Data Input from DSS File" section below should be populated.

ITADJ — Time. For time tracking simulations use MM/DD/YYYY_hh:mm format, for non-time tracking simulations enter an integer number.

KADJ — Supply adjustment option specified as a two digit number; first digit from left specifies if the water supply (diversion or pumping) is to be adjusted to meet agricultural supply requirement (0 = no adjustment is required; 1 = adjust water supply to meet agricultural water requirement); second digit from left specifies if the water supply (diversion or pumping) is to be adjusted to meet urban supply requirement (0 = no adjustment is required; 1 = adjust water supply to meet urban supply requirement)

Data Input from DSS File

If time series data is stored in a DSS file then the following variables should be populated:

REC	Record number that coincides with the data column number for the time series data
PATH	Pathname for the time series record that will be used for data retrieval

```
C*******************************************************************************
C
C                   INTEGRATED WATER FLOW MODEL (IWFM)
C                          *** Version ### ***
C
C*******************************************************************************
C
C                      SUPPLY ADJUSTMENT SPECIFICATIONS
C                            for IWFM Simulation
C
C
C              Project : IWFM Version ### Release
C                        California Department of Water Resources
C              Filename: SupplyAdjust.dat
C
C*******************************************************************************
C                            File Description
C
C   This data file contains the time series specifications for the adjustment of
C   surface water diversions and groundwater pumping. The data contains information
C   to specify if a diversion or pumping should be adjusted to meet agricultural
C   demand, urban demand or both. This file is required when KOPTDV is set to a
C   value other than 00 in the Main Control Input file.
C
C*******************************************************************************
C                     Supply Adjustment Specifications
C
C   The following lists the time-series specifications for supply adjustment options
C   for surface water diversions and groundwater pumping.
C
C   NCOLADJ;  Number of columns (or pathnames if DSS files are used) in the supply
C              adjustment specifications data file
C   NSPADJ ;  Number of time steps to update the supply adjustment specifications data
C              * Enter any number if time-tracking option is on
C   NFQADJ ;  Repetition frequency of the supply adjustment specifications data
C              * Enter 0 if full time series data is supplied
C              * Enter any number if time-tracking option is on
C   DSSFL  ;  The name of the DSS file for data input (maximum 50 characters);
C              * Leave blank if DSS file is not used for data input
C
C-------------------------------------------------------------------------------
C         VALUE                                      DESCRIPTION
C-------------------------------------------------------------------------------
          4                                          / NCOLADJ
          1                                          / NSPADJ
          0                                          / NFQADJ
                                                     / DSSFL
C*******************************************************************************
C                     Supply Adjustment Specifications Data
C                          (READ FROM THIS FILE)
C
C   List the time series supply adjustment specifications data below, if it will
C   not be read from a DSS file (i.e. DSSFL is left blank above).
C
C   ITADJ;  Time
C   KADJ;   Supply adjustment option. Enter two digits as follows:
C           1st digit(from left):
C                  0 = NO adjustment of supply to meet agricultural water demand
C                  1 = YES, adjust supply to meet agricultural water demand
C           2nd digit(from left):
C                  0 = NO adjustment of supply to meet urban water demand
C                  1 = YES, adjust supply to meet urban water demand
C
C-------------------------------------------------------------------------------
C       ITADJ            KADJ
C-------------------------------------------------------------------------------
C                      AgAdjust  UrbAdjust   NoAdjust    AgUrbAdjust
  09/30/2500_24:00    10         01           00            11
*
C-------------------------------------------------------------------------------
C                     Pathnames for Supply Adjustment Specifications Data
C                                 (READ FROM DSS FILE)
C
C   List the pathnames for supply adjustment specifications data below, if it will
C   be read from a DSS file (i.e. DSSFL is specified above).
C
C   REC  ;  Time series record number
C   PATH ;  Pathname for the time series record
C
C--------------------------------------------------------------------------------------
C   REC       PATH
C--------------------------------------------------------------------------------------
*
*
```

Precipitation File

This file contains the time series rainfall values for each of the rainfall stations used in the simulation. Each element is associated with a rainfall station in the Root Zone Component Main File as described in the *IDC-2015 Theoretical Documentation and User's Manual*. The simulated lakes and small stream watersheds also use the data in this file by using pointers to link each lake and small watershed with a precipitation data column. The factors that convert the precipitation at rainfall stations to the precipitation over the elements are also listed in the Root Zone Component Main File. The rainfall data for a station associated with an element is multiplied by the corresponding factor to obtain the rainfall rate over an element. Small watersheds are also linked to individual data columns in the Precipitation File through the IRNS variable defined in the Parameter Data File, while precipitation rates over individual lakes are defined through the ICPCPLK variable specified in the Lake Component Main File.

In non-time tracking simulations a time-series precipitation data set of any frequency can be used as the precipitation data in IWFM. NSPRN and NFQRN must be specified according to the frequency of the data entered. If the precipitation data is specified for the entire simulation period, NFQRN should be set to zero. In time tracking simulations the time series precipitation data can be either listed in this file or in a DSS file. If a DSS file is used for data input, then the name of the DSS file and the pathnames corresponding to each of the time series data are required.

The following variables are used:

NRAIN Number of rainfall stations used in the model

FACTRN Conversion factor for the spatial component of the unit for the

	rainfall rate
NSPRN	Number of time steps to update the precipitation data; if time tracking simulation, enter any number
NFQRN	Repetition frequency of the precipitation data (enter zero if full time series data is supplied); if time tracking simulation, enter any number
DSSFL	If the time series data is stored in a DSS file, name of the file; leave blank if the data is listed in the Precipitation File

Data Input from Precipitation File

If the time series data is listed in the Precipitation File, then the following variables need to be populated. Otherwise, these variables should be commented out using "C", "c" or "*", and the variables in the "Data Input from DSS File" section below should be populated.

ITRN	Time. For time tracking simulations use MM/DD/YYYY_hh:mm format, for non-time tracking simulations enter an integer number.
ARAIN	Rainfall rate at the corresponding rainfall station, [L/T]

Data Input from DSS File

If time series data is stored in a DSS file then the following variables should be populated:

REC	Record number that coincides with the data column number for the time series data

PATH	Pathname for the time series record that will be used for data retrieval

```
C*******************************************************************************
C
C                   INTEGRATED WATER FLOW MODEL (IWFM)
C
C*******************************************************************************
C
C                          PRECIPITATION DATA FILE
C                Precipitation and Evapotranspiration Component
C                            *** Version 4.0 ***
C
C
C              Project : IWFM Version ### Release
C                        California Department of Water Resources
C              Filename: Precip.dat
C
C*******************************************************************************
C                              File Description:
C
C   This data file contains the time-series rainfall at each rainfall station used
C   in the model.
C
C*******************************************************************************
C                          Rainfall Data Specifications
C
C   NRAIN ;  Number of rainfall stations (or pathnames if DSS files are used)
C             used in the model
C   FACTRN;  Conversion factor for rainfall rate
C             It is used to convert only the spatial component of the unit;
C             DO NOT include the conversion factor for time component of the unit.
C             * e.g. Unit of rainfall rate listed in this file = INCHES/MONTH
C                    Consistent unit used in simulation        = FEET/DAY
C                    Enter FACTRN (INCHES/MONTH -> FEET/MONTH) = 8.33333E-02
C                     (conversion of MONTH -> DAY is performed automatically)
C   NSPRN ;  Number of time steps to update the precipitation data
C             * Enter any number if time-tracking option is on
C   NFQRN ;  Repetition frequency of the precipitation data
C             * Enter 0 if full time series data is supplied
C             * Enter any number if time-tracking option is on
C   DSSFL ;  The name of the DSS file for data input (maximum 50 characters);
C             * Leave blank if DSS file is not used for data input
C
C-------------------------------------------------------------------------------
C         VALUE                                       DESCRIPTION
C-------------------------------------------------------------------------------
          2                                           / NRAIN
          8.33333E-2                                  / FACTRN   (in -> ft)
          1                                           / NSPRN
          0                                           / NFQRN
          TSDATA_IN.DSS                               / DSSFL
C-------------------------------------------------------------------------------
C                              Rainfall Data
C                          (READ FROM THIS FILE)
C
C   List the rainfall rates for each of the rainfall station below, if it will
C   not be read from a DSS file (i.e. DSSFL is left blank above).
C
C   ITRN ;   Time
C   ARAIN;   Rainfall rate at the corresponding rainfall station; [L/T]
C
C-------------------------------------------------------------------------------
C ITRN    ARAIN(1)  ARAIN(2)  ARAIN(3) ...
C-------------------------------------------------------------------------------
*
*
C-------------------------------------------------------------------------------
C                        Pathnames for Rainfall Data
C                          (READ FROM DSS FILE)
C
C   List the pathnames for the rainfall data below, if it will be read
C   from a DSS file (i.e. DSSFL is specified above).
C
C   REC    ;  Time series record number
C   PATH   ;  Pathname for the time series record
C
C----------------------------------------------------------------------------------
C   REC        PATH
C----------------------------------------------------------------------------------
     1         /SAMPLE_PROBLEM/GAGE1/PRECIP//1MON/PRECIPITATION/
     2         /SAMPLE_PROBLEM/GAGE2/PRECIP//1MON/PRECIPITATION/
```

Evapotranspiration File

The Evapotranspiration File contains time series ET data for all crop types, non-agricultural land use types, lakes and small watersheds. The conversion factor for the ET rates is a required input, as well as the number of time steps to update the data and the repetition frequency of the data. In time tracking simulations the time series evapotranspiration data can be either listed in this file or in a DSS file. If a DSS file is used for data input, then the name of the DSS file and the pathnames corresponding to each of the time series data are required. The ET rates listed in this file are associated with individual land-use types in each element using the related root zone component files (see *IDC-2015 Theoretical Documentation and User's Manual* for details). ET rates over each lake are associated with the data columns in this file through the ICETLK variable in the Lake Component Main File, while they are associated with small watersheds using the variable ICETS in the Parameter Data File.

The example file given below shows how recycled time series data in a time tracking simulation can be specified using the special year 4000 flag. The following is a list of the variables that need to be specified:

NCOLET	Number of evapotranspiration data columns
FACTET	Conversion factor for the spatial component of the unit for the evapotranspiration rate
NSPET	Number of time steps to update the ET data; if time tracking simulation, enter any number
NFQET	Repetition frequency of the ET data (enter zero if full time series data is supplied); if time tracking simulation, enter any number

DSSFL — If the time series data is stored in a DSS file, name of the file; leave blank if the data is listed in the Evapotranspiration File

Data Input from Evapotranspiration File

If the time series data is listed in the Evapotranspiration File, then the following variables need to be populated. Otherwise, these variables should be commented out using “C”, “c” or “*”, and the variables in the “Data Input from DSS File” section below should be populated.

ITEV — Time. For time tracking simulations use MM/DD/YYYY_hh:mm format, for non-time tracking simulations enter an integer number.

AEVAP — Evapotranspiration rate, [L/T]

Data Input from DSS File

If time series data is stored in a DSS file then the following variables should be populated:

REC — Record number that coincides with the data column number for the time series data

PATH — Pathname for the time series record that will be used for data retrieval

```
C*****************************************************************************
C
C                   INTEGRATED WATER FLOW MODEL (IWFM)
C
C*****************************************************************************
C
C                        EVAPOTRANSPIRATION DATA FILE
C                Precipitation and Evapotranspiration Component
C                            *** Version 4.0 ***
C
C
C             Project : IWFM Version ### Release
C                       California Department of Water Resources
C             Filename: ET.dat
C
C*****************************************************************************
C                          File Description:
C
C   This data file contains sets of evapotranspiration values that are used in
C   root zone, lake and small watershed components of Simulation.
C
C*****************************************************************************
C                      Evapotranspiration Data Specifications
C
C   NCOLET;  Number of ET columns (or pathnames if DSS files are used)
C   FACTET:  Conversion factor for evapotranspiration rate
C             It is used to convert only the spatial component of the unit;
C             DO NOT include the conversion factor for time component of the unit.
C             * e.g. Unit of ET rate listed in this file       = INCHES/MONTH
C                    Consistent unit used in simulation        = FEET/DAY
C                    Enter FACTET (INCHES/MONTH -> FEET/MONTH) = 8.33333E-02
C                     (conversion of MONTH -> DAY is performed automatically)
C   NSPET ;  Number of time steps to update the ET data
C             * Enter any number if time-tracking option is on
C   NFQET ;  Repetition frequency of the ET data
C             * Enter 0 if full time series data is supplied
C             * Enter any number if time-tracking option is on
C   DSSFL ;  The name of the DSS file for data input (maximum 50 characters);
C             * Leave blank if DSS file is not used for data input
C
C-----------------------------------------------------------------------------
C         VALUE                                       DESCRIPTION
C-----------------------------------------------------------------------------
          7                                          / NCOLET
          0.083333                                   / FACTET  (in/month -> ft/month)
          1                                          / NSPET
          0                                          / NFQET
                                                     / DSSFL
C-----------------------------------------------------------------------------
C                              Evapotranspiration Data
C                               (READ FROM THIS FILE)
C
C   ITEV ;   Time
C   AEVAP;   Evapotranspiration rate; [L/T]
C
C-----------------------------------------------------------------------------
C ITEV  AEVAP[1]  AEVAP[2]  AEVAP[3] ...  AEVAP[NCOLET]
C-----------------------------------------------------------------------------
C                    Tomatoes  Alfalfa     Rice    Urban    Native   SmallWatershed      Lake
  10/31/4000_24:00     3.4       3.5       2.2      3.4       3.4        3.4             3.7
  11/30/4000_24:00     1.6       1.6       1.6      1.6       1.6        1.6             1.8
  12/31/4000_24:00     1.0       1.0       1.0      0.5       1.0        1.2             1.2
  01/31/4000_24:00     1.0       1.0       1.0      0.5       1.0        1.1             1.1
  02/29/4000_24:00     1.8       1.8       1.8      1.8       1.8        1.8             1.8
  03/31/4000_24:00     3.0       3.0       3.0      3.0       3.0        2.8             2.8
  04/30/4000_24:00     4.5       4.1       8.0      4.5       4.5        3.9             3.9
  05/31/4000_24:00     5.9       5.4       9.1      5.9       5.9        5.1             5.1
  06/30/4000_24:00     7.3       6.8      10.4      7.3       7.3        7.2             7.2
  07/31/4000_24:00     7.9       7.7       9.7      7.9       7.9        7.5             7.5
  08/31/4000_24:00     6.6       6.8       7.0      6.6       6.6        6.4             6.4
  09/30/4000_24:00     5.2       5.4       1.9      5.2       5.2        4.8             4.8
C-----------------------------------------------------------------------------
C                        Pathnames for Evapotranspiration Data
C                               (READ FROM DSS FILE)
C
C   List the pathnames for evapotranspiration  data below, if it will
C   be read from a DSS file (i.e. DSSFL is specified above).
C
C   REC  ;  Time series record number
C   PATH ;  Pathname for the time series record
C
C--------------------------------------------------------------------------------------------
C   REC       PATH
C--------------------------------------------------------------------------------------------
*
*
```

4.2. Output Files

IWFM generates text, DSS and binary files based on the user preference in order to view and analyze the simulation results. To generate an output file, it is only necessary to specify a name for the file in the relevant input data file. Omitting the name for an output file will suppress the generation of that file. Generation of some output files is dependent on the system being modeled. For instance, if a groundwater system with a single aquifer layer is modeled, defining a file name for layer vertical flow output file will fail to generate the required file since there are no vertical flows being calculated. Binary output files require either the Budget or the Z-Budget post-processors to convert them into meaningful tabular data. Alternatively, simulation results stored in Budget binary files can be directly imported into Microsoft Excel by using the *IWFM Tools Add-in for Excel 2007-2010* which can be downloaded from the IWFM's web page.

The following sections describe each of the text and DSS output files in detail. The output files generated after post-processing Budget binary files are described in the next chapter in this document. For the description of the output file that is generated after post-processing Z-Budget binary file, please consult *Z-Budget: Sub-Domain Water Budgeting Post-Processor for IWFM – Theoretical Documentation and User's Manual*.

Simulation Standard Output File (SimulationMessages.out)

This file provides the user with information that was processed in the simulation portion of IWFM. The user is encouraged to check the contents of this file after every run. The following list indicates the information available in this output file:

- Project title (specified in the Simulation Main Input File)
- Date and time of the run
- List of data files specified in the Simulation Main Input File
- Various warning messages and errors
- Aquifer parameters depending on the value of the variable KDEB set by the user in the Groundwater Component Main Data File
- Convergence information on the iterative procedures at each time step
- Total CPU time consumed by the execution of the Simulation program

```
*****************************************************************************************************************************
                                                       IWFM
                                                 Version ### Release
                                                        DWR
*****************************************************************************************************************************

 THIS RUN IS MADE ON 07/14/2014 AT 14:00:56

 THE FOLLOWING FILES ARE USED IN THIS SIMULATION:
  2       GW\GW_MAIN.dat
  3       Streams_v40_MAIN.dat
  4       Lake_MAIN.dat
  5       RootZone_v41_MAIN.dat
  6       SWShed\SWShed_MAIN.dat
  7       UnsatZone\UnsatZone_MAIN.dat
  8       IrigFrac.dat
  9       SupplyAdjust.dat
  10      Precip.dat
  11      ET.dat

NOTE: BOTH SURFACE WATER DIVERSION AND PUMPING WERE ADJUSTED.

--------------------------------------------------
*   TIME STEP 1 AT 10/01/1970_24:00
--------------------------------------------------

                         *** SUPPLY ADJUSTMENT ITERATION:     1 ***
   ITER      CONVERGENCE          MAX.DIFF    VARIABLE        PUMP.CONV.    DRY LOCATION
   ---------------------------------------------------------------------------------------
      1      72.6924          9.77971           7133      0.00000              0()
      2      31.3041         -29.8517           3568      0.00000              0()
      3      1.15484          0.274996          2222      0.00000              0()
      4     0.337990E-01      0.266014E-01       311      0.00000              0()
      5     0.735350E-03      0.404626E-03      4387      0.00000              0()

                         *** SUPPLY ADJUSTMENT ITERATION:     2 ***
   ITER      CONVERGENCE          MAX.DIFF    VARIABLE        PUMP.CONV.    DRY LOCATION
   ---------------------------------------------------------------------------------------
      1      72.7152          9.77971           7133      0.00000              0()
      2      31.2976         -29.8517           3568      0.00000              0()
      3      1.15490          0.274997          2222      0.00000              0()
      4     0.337990E-01      0.266014E-01       311      0.00000              0()
      5     0.735351E-03      0.404626E-03      4387      0.00000              0()

                         *** SUPPLY ADJUSTMENT ITERATION:     3 ***
   ITER      CONVERGENCE          MAX.DIFF    VARIABLE        PUMP.CONV.    DRY LOCATION
   ---------------------------------------------------------------------------------------
      1      71.0165          9.77848           7133      0.00000              0()
      2      31.2850         -29.8517           3568      0.00000              0()
      3      1.29971          0.274472          2222      0.00000              0()
      4     0.337160E-01      0.265348E-01       311      0.00000              0()
      5     0.735819E-03      0.404726E-03      4387      0.00000              0()

--------------------------------------------------
*   TIME STEP 3 AT 10/03/1970_24:00
--------------------------------------------------
      .       .                 .                 .          .                 .
      .       .                 .                 .          .                 .
      .       .                 .                 .          .                 .

**************************************************
TOTAL RUN TIME: 3 MINUTES 56.145 SECONDS
**************************************************
```

Groundwater Component Output Files

Groundwater Flow Velocities at Cell Centroids Output File

This output file is divided into two sections. First section lists the coordinates of the centroids of the computational grid cells whereas the second section lists components of the groundwater flow velocities along the x, y and z axes at each grid cell in each aquifer layer at each simulation time step. The velocities reported at the cell centroids are interpolated from the velocities computed at finite element nodes. A negative velocity along z axis represents downward flow.

The groundwater velocities can only be printed out to text files. Binary files or DSS file formats are not allowed.

```
*                                 ***********************************************
*                                 *        COORDINATES OF ELEMENT CENTROIDS     *
*                                 *                  (UNIT=ft.)                 *
*                                 ***********************************************
*  ELEMENT               X                Y
      1        1807720.8000     14438800.8000
      2        1814282.4000     14438800.8000
      3        1820844.0000     14438800.8000
      .             .                .
      .             .                .
      .             .                .

    398        1919268.0000     14563471.2000
    399        1925829.6000     14563471.2000
    400        1932391.2000     14563471.2000

*                                 ***********************************************
*                                 *          VELOCITIES AT CELL CENTROIDS       *
*                                 *                  (UNIT=fpd)                 *
*                                 ***********************************************
*                     LAYER            1            1            1            2            2            2
*     TIME          ELEMENT           VX           VY           VZ           VX           VY           VZ
10/01/1990_24:00          1       0.0908       0.0124      -0.0024       0.0274      -0.0000      -0.0024
                          2       0.0291      -0.0000      -0.0063       0.0276      -0.0000      -0.0063
                          3       0.0000      -0.0000      -0.0058       0.0002      -0.0000      -0.0058
                          .         .            .            .            .            .            .
                          .         .            .            .            .            .            .
                          .         .            .            .            .            .            .
                        398      -0.0001      -0.0000      -0.0051      -0.0022      -0.0000      -0.0051
                        399      -0.0904      -0.0000      -0.0063      -0.0762      -0.0000      -0.0063
                        400      -0.2819      -0.0383       0.0005      -0.0740      -0.0000       0.0005
10/02/1990_24:00          1       0.0916       0.0125       0.0005       0.0282      -0.0000       0.0005
                          2       0.0291      -0.0000      -0.0007       0.0284      -0.0000      -0.0007
                          3       0.0001      -0.0000      -0.0002       0.0003      -0.0000      -0.0002
                          .         .            .            .            .            .            .
                          .         .            .            .            .            .            .
                          .         .            .            .            .            .            .
                        398      -0.0003      -0.0000      -0.0008      -0.0029      -0.0000      -0.0008
                        399      -0.0905      -0.0000      -0.0023      -0.0822      -0.0000      -0.0023
                        400      -0.2676      -0.0355       0.0013      -0.0795      -0.0000       0.0013
                          .         .            .            .            .            .            .
                          .         .            .            .            .            .            .
                          .         .            .            .            .            .            .
                          .         .            .            .            .            .            .
                          .         .            .            .            .            .            .
09/30/2000_24:00          1       0.0713       0.0085       0.0005       0.0267      -0.0000       0.0005
                          2       0.0355      -0.0005      -0.0004       0.0349      -0.0000      -0.0004
                          3       0.0100      -0.0003      -0.0001       0.0097      -0.0000      -0.0001
                          .         .            .            .            .            .            .
                          .         .            .            .            .            .            .
                          .         .            .            .            .            .            .
                        398      -0.0286      -0.0001      -0.0004      -0.0299      -0.0002      -0.0004
                        399      -0.1076      -0.0000      -0.0010      -0.1020      -0.0000      -0.0010
                        400      -0.2107      -0.0255       0.0016      -0.0766      -0.0000       0.0016
```

Layer Vertical Flow Output File

This output file lists the vertical flows between aquifer layers at each subregion for multi-layered aquifer systems. The values listed in this file are vertical flows between an aquifer layer and the lower adjacent layer at every time step of the simulation period. The units of the flow values are specified by the user in the Groundwater Component Main File. A negative value represents downward flow direction, whereas a positive value represents upward flow direction.

If the subregional vertical flows are desired to be printed out to a DSS file, a file name with the extension ".DSS" should be supplied. The following pathname parts are used for output to a DSS file:

Part A:

IWFM

Part B:

SR*XXX*:L*YYY*-L*ZZZ* where *XXX* is the subregion number, *YYY* is the aquifer layer number and *ZZZ* is the aquifer layer number below layer *YYY*

Part C:

FLOW

Part D:

Start date of the time series depending on the time step used in the Simulation and the value of the BDT variable (starting date and time of simulation period) set in the Simulation Main Input File

Part E:

Time step used in the Simulation

Part F:

VERTICAL_FLOW

```
*                                                 ***************************************
*                                                 *             VERTICAL FLOW           *
*                                                 *             (UNIT=AC.FT.)           *
*                                                 *    [POSITIVE IN UPWARD DIRECTION]   *
*                                                 ***************************************
```

* REGION	1		2		3	
* LAYER	L1-L2	L2-L3	L1-L2	L2-L3	L1-L2	L2-L3
* TIME						
10/31/1921_24:00	-49611.25	-26545.81	-70299.78	-27968.47	6415.07	-12948.10
11/30/1921_24:00	-35199.56	-22570.65	-42002.04	-25412.38	-2655.11	-8903.49
12/31/1921_24:00	-27561.39	-17531.45	-30188.69	-22912.35	-7136.24	-7322.48
01/31/1922_24:00	-23149.77	-14552.24	-24113.13	-20841.37	-8504.42	-6404.39
02/28/1922_24:00	-20293.05	-12440.25	-21115.48	-19180.71	-9480.44	-5807.09
03/31/1922_24:00	-18127.96	-10894.92	-18722.80	-17791.58	-9077.82	-5333.00
04/30/1922_24:00	-17066.00	-9648.41	-20588.96	-16318.18	-19695.60	-4199.87
05/31/1922_24:00	-14979.36	-9022.10	-19950.91	-15282.95	-15360.50	-4161.90
06/30/1922_24:00	-12529.45	-8176.90	-19972.24	-14280.78	-11101.21	-4087.27
07/31/1922_24:00	-11741.99	-7725.82	-20292.02	-13360.37	-9418.21	-3910.27
08/31/1922_24:00	-9112.85	-7301.80	-19461.42	-12607.80	-8664.68	-3737.56
09/30/1922_24:00	-8607.45	-6892.54	-17844.19	-11988.42	-8110.35	-3575.72
10/31/1922_24:00	-7834.85	-6582.88	-13928.76	-11580.70	-7213.94	-3420.80
11/30/1922_24:00	-7364.13	-6280.89	-11771.88	-11135.02	-6849.40	-3276.61
12/31/1922_24:00	-7011.36	-6023.94	-10704.04	-10703.95	-7132.52	-3173.19
01/31/1923_24:00	-6755.30	-5810.41	-9982.81	-10298.80	-7212.04	-3101.16
02/28/1923_24:00	-6450.23	-5613.76	-9230.00	-9909.71	-6467.46	-2995.67
03/31/1923_24:00	-6942.59	-5301.88	-10012.55	-9401.25	-6606.87	-2819.46
04/30/1923_24:00	-6163.79	-5253.35	-10932.62	-9001.99	-16771.53	-2163.60
05/31/1923_24:00	-6020.86	-5091.87	-12376.02	-8551.54	-12927.73	-2262.07
06/30/1923_24:00	-5330.12	-5006.71	-12488.83	-8193.43	-8953.24	-2396.17
.	.	.	.	.	.	.
.	.	.	.	.	.	.
.	.	.	.	.	.	.
.	.	.	.	.	.	.
06/30/1929_24:00	-41.18	-128.58	-6158.20	-1739.28	-6160.02	-1366.90
07/31/1929_24:00	171.88	-146.61	-7556.22	-1590.48	-6385.72	-1361.71
08/31/1929_24:00	282.00	-146.08	-7766.35	-1522.39	-6531.56	-1367.42
09/30/1929_24:00	419.24	-145.61	-6993.08	-1515.24	-6273.37	-1366.07
10/31/1929_24:00	498.04	-130.04	-5463.52	-1553.78	-5906.08	-1353.75
11/30/1929_24:00	560.29	-99.14	-3604.03	-1618.91	-5622.06	-1344.98
12/31/1929_24:00	466.72	-97.13	-2377.00	-1678.06	-5941.73	-1370.27
01/31/1930_24:00	406.55	-102.69	-2315.91	-1726.65	-5929.78	-1395.37
02/28/1930_24:00	288.21	-125.66	-2288.80	-1770.91	-5872.92	-1419.78
03/31/1930_24:00	209.65	-146.47	-1913.73	-1794.41	-5487.56	-1415.10
04/30/1930_24:00	-180.51	-90.58	-2699.81	-1686.30	-7664.89	-1191.29
05/31/1930_24:00	125.59	-148.92	-3807.46	-1618.14	-6646.55	-1315.00
06/30/1930_24:00	213.71	-153.15	-5416.16	-1474.06	-6312.25	-1334.39
07/31/1930_24:00	18.46	-106.56	-6749.40	-1341.40	-6362.15	-1331.23
08/31/1930_24:00	174.56	-114.61	-6932.39	-1284.49	-6448.21	-1336.58
09/30/1930_24:00	294.48	-113.68	-6028.20	-1293.81	-6197.88	-1340.42
10/31/1930_24:00	374.34	-97.15	-4412.63	-1346.91	-5902.11	-1317.90
11/30/1930_24:00	443.06	-65.00	-2487.50	-1424.36	-5517.79	-1307.23
12/31/1930_24:00	492.57	-37.73	-1506.47	-1447.37	-5267.86	-1285.32
01/31/1931_24:00	475.96	-24.45	-1260.46	-1459.67	-5571.25	-1287.47
02/28/1931_24:00	460.79	-18.34	-1121.43	-1463.01	-5209.33	-1269.62
03/31/1931_24:00	264.09	12.33	-1504.41	-1415.69	-5297.28	-1233.29
04/30/1931_24:00	393.57	-19.09	-4090.52	-1217.64	-5631.67	-1210.72
05/31/1931_24:00	415.78	-24.88	-4781.27	-1143.81	-6333.39	-1234.72
06/30/1931_24:00	436.10	-21.71	-5257.21	-1069.47	-6498.52	-1244.72
07/31/1931_24:00	207.00	23.21	-6679.01	-933.00	-6812.59	-1254.06
08/31/1931_24:00	353.55	10.27	-6890.77	-877.25	-6878.80	-1271.76
09/30/1931_24:00	470.97	4.74	-5970.82	-895.43	-6522.20	-1275.98

Groundwater Level Output at Every Node

This output file displays the groundwater levels at each groundwater node in every layer modeled. If the groundwater head values at all nodes are desired to be printed out to a DSS file, a file name with the extension ".DSS" should be supplied. The following pathname parts are used for output to a DSS file:

Part A:

IWFM

Part B:

L*XXX*:GW*YYY* where *XXX* is the aquifer layer number and *YYY* is the groundwater node number

Part C:

HEAD

Part D:

Start date of the time series depending on the time step used in the Simulation and the value of the BDT variable (starting date and time of simulation period) set in the Simulation Main Input File

Part E:

Time step used in the Simulation

Part F:

GW_HEAD_AT_ALL_NODES

```
*                                             ***************************************
*                                             *     GROUNDWATER HEAD AT ALL NODES   *
*                                             *             (UNIT=FEET)             *
*                                             ***************************************
*                            NODE
*        TIME                   1          2          3          4 .....       1392       1393
10/31/1921_24:00         603.8759   607.5278   625.7092   581.1468 .....  1303.5031  1406.4968
                         587.3636   589.6517   609.4789   568.8487 .....   551.9865   541.2226
                         524.0269   536.3722   539.5226   520.9363 .....   512.7689   500.6641
11/30/1921_24:00         602.3052   607.6252   626.7251   583.3910 .....  1294.1678  1399.5461
                         574.1580   590.7881   611.6388   571.4923 .....   584.5448   577.6066
                         539.0812   554.0353   564.0575   538.2114 .....   512.9973   501.1272
12/31/1921_24:00         600.6682   607.3225   627.1661   584.8115 .....  1284.4702  1392.1206
                         572.5843   591.9127   614.0963   574.2521 .....   611.9763   609.1765
                         547.9035   565.6898   580.5905   550.1930 .....   513.3568   501.7591
01/31/1922_24:00         599.0127   606.9224   627.3983   585.8409 .....  1274.6344  1384.4100
                         571.7971   592.5587   615.8182   576.3203 .....   635.4563   636.7428
                         553.1150   573.3486   591.7580   558.5589 .....   513.8258   502.5345
02/28/1922_24:00         598.0007   606.5556   627.5793   586.6836 .....  1264.7956  1376.5410
                         571.4039   592.9258   617.0151   577.8796 .....   655.8388   660.9555
                         556.2206   578.3657   599.3163   564.4426 .....   514.3876   503.4325
03/31/1922_24:00         597.0432   606.0911   627.6306   587.3178 .....  1255.0360  1368.5925
                         570.9003   592.9970   617.7758   579.0182 .....   673.7538   682.3411
                         557.9847   581.5971   604.4169   568.5969 .....   515.0290   504.4355
04/30/1922_24:00         596.1069   605.4711   627.5004   587.6851 .....  1245.4098  1360.6211
                         569.9882   592.6191   617.9707   579.4381 .....   689.6646   701.3244
                         558.7786   583.5345   607.7490   571.3987 .....   515.7395   505.5288
      .                     .          .          .          .    .....       .          .
      .                     .          .          .          .    .....       .          .
      .                     .          .          .          .    .....       .          .
      .                     .          .          .          .    .....       .          .
03/31/1923_24:00         578.0787   595.6276   622.0552   586.3809 .....  1153.5250  1277.9583
                         555.8630   584.1644   613.8140   578.9021 .....   790.2306   816.2195
                         549.0497   580.4291   610.7209   576.5111 .....   526.3051   520.8205
04/30/1923_24:00         577.2108   594.6909   621.4323   586.0505 .....  1146.5714  1271.1487
                         555.7621   583.5216   613.4354   578.9625 .....   795.9619   822.1808
                         548.3036   579.6329   610.1929   576.2712 .....   527.4204   522.3596
05/31/1923_24:00         575.8130   593.7533   620.7987   585.7040 .....  1139.8494  1264.4745
                         555.4580   582.6953   612.8598   578.6788 .....   801.1448   827.5237
                         547.7248   578.8390   609.6516   576.0152 .....   528.5522   523.9093
06/30/1923_24:00         574.4749   592.8085   620.1464   585.3284 .....  1133.3543  1257.9365
                         555.1210   581.8381   612.2211   578.2846 .....   805.7389   832.2964
                         547.2408   578.0372   609.0800   575.7105 .....   529.6977   525.4665
07/31/1923_24:00         573.0619   591.8635   619.4856   584.9411 .....  1127.0784  1251.5323
                         554.5952   580.9833   611.6030   577.9300 .....   809.8029   836.5370
                         546.7502   577.2295   608.4959   575.3880 .....   530.8541   527.0284
08/31/1923_24:00         571.8148   590.9178   618.8145   584.5388 .....  1121.0136  1245.2584
                         554.0270   580.1375   610.9685   577.5478 .....   813.3713   840.2619
                         546.2428   576.4217   607.8981   575.0442 .....   532.0192   528.5923
09/30/1923_24:00         570.7008   589.9711   618.1329   584.1204 .....  1115.1568  1239.1155
                         553.3986   579.2833   610.3159   577.1388 .....   816.9789   843.8726
                         545.7051   575.6108   607.2851   574.6773 .....   533.1935   530.1578
```

Groundwater Heads for TECPLOT

This file lists the model grid and groundwater heads at each node to be used by TECPLOT, a commercially available software. TECPLOT can be used for analysis of the simulation results including the animation of the groundwater elevations. This must be a text file for TECPLOT to process.

Groundwater Velocities for TECPLOT

This file lists the model grid and groundwater velocities at each node to be used by TECPLOT, a commercially available software. TECPLOT can be used for analysis of the simulation results including the animation of the groundwater velocity field. This must be a text file for TECPLOT to process.

Final Groundwater Heads File

This file lists the groundwater head values at the end of the simulation period. It is in a format that can readily be used to set the initial conditions for the groundwater system for the following simulation periods. For instance, consider an initial IWFM run performed for a simulation period that starts at January 1, 1973 and ends at December 31, 1992. Final Groundwater Heads File will include groundwater heads at all finite element nodes at the end of December 31, 1992. To perform a second IWFM run for a simulation period that starts at January 1, 1993 the values stored in the Final Groundwater Heads File can be used as initial conditions. The contents of this file can be copied and pasted into the Groundwater Component Main File as the initial conditions.

```
C*****************************************************************************
C ***** GROUNDWATER HEADS AT 11/30/1970_24:00
C*****************************************************************************
C
C-----------------------------------------------------------------------------
     1.0                          / FACTHP
C-----------------------------------------------------------------------------
C      ID           HP[1]             HP[2]             HP[3]
C-----------------------------------------------------------------------------
        1      1564.000000        963.495714        964.000000
        2      1136.000000        443.969489        444.000000
        3      1229.000000        420.863153        420.820000
        4      1101.000000        408.992616        408.900000
        5       901.000000        440.209524        440.000000
        6       972.000000        439.403521        439.310000
        7       954.000000        429.275979        429.240000
        8      1137.000000        415.916895        415.800000
        9       510.000000        429.869028        430.000000
       10       620.000000        429.566683        430.000000
       11       765.000000        445.697252        446.040000
       12       785.000000        437.616461        437.760000
       13       398.029762        404.143900        390.000000
       14       405.892913        408.786594        401.310000
       15       747.000000        443.416120        443.930000
        .           .                 .                 .
        .           .                 .                 .
        .           .                 .                 .
     2826         0.384172         -5.192631         -5.312199
     2827         1.454519         -3.807567         -4.243618
     2828         1.363825         -5.582945         -6.142733
     2829         3.142341         -5.199945         -5.904548
     2830         3.381566         -4.863670         -5.561168
     2831         2.601651         -5.075991         -5.707982
     2832         2.194671         -5.328524         -5.707625
     2833        -0.152319         -3.298287         -3.317631
     2834         0.552897         -4.099500         -4.153775
     2835        -0.037255         -6.040454         -6.137602
     2836        -0.152994         -5.605096         -5.706634
     2837         0.002105         -4.224187         -4.280002
     2838        -0.178985         -4.458168         -4.526385
     2839        -0.519374         -5.984173         -6.136707
     2840        -0.719113         -7.328938         -7.548605
```

Groundwater Level Hydrograph Output File

The Groundwater Level Hydrograph Output File includes the groundwater level at aquifer layers and nodes specified by the user in the Groundwater Component Main File. The layer and node numbers or the coordinates for which hydrographs are desired are specified by the user. If groundwater head averaged over all the aquifer layers is desired, then a value of zero appears for the layer number at the heading of this file. IWFM also prints out the finite element numbers where the hydrograph locations fall into.

If the groundwater head hydrographs are desired to be printed out to a DSS file, a file name with the extension ".DSS" should be supplied. The following pathname parts are used for output to a DSS file:

Part A:

IWFM

Part B:

ID:L*XXX*:E*YYY*:GW*ZZZ* where *ID* is the groundwater hydrograph number listed sequentially in the Groundwater Component Main File, *XXX* is the aquifer layer number, *YYY* is the element number where the hydrograph location falls into and *ZZZ* is the groundwater node number if the hydrograph location is given as a finite element node (*ZZZ* is zero if the hydrograph location is given as a coordinate)

Part C:

HEAD

Part D:

Start date of the time series depending on the time step used in the Simulation and the value of the BDT variable (starting date and time of simulation period) set in the Simulation Main Input File

Part E:

Time step used in the Simulation

Part F:

GROUNDWATER_HYDROGRAPHS

```
*                                           ***************************************
*                                           *        GROUNDWATER HYDROGRAPH       *
*                                           *              (UNIT=ft.)             *
*                                           ***************************************
*          HYDROGRAPH ID          1           2           3           4  . . . .        208         209         210
*                  LAYER          1           1           1           1  . . . .          2           2           2
*                   NODE          0           0           0           0  . . . .          0           0           0
*                ELEMENT         29          48          46          77  . . . .       1146        1252        1468
*        TIME
09/30/1970_24:00           379.4922    336.8708    436.0004    290.1144  . . . .    17.2177    -10.2170      9.2929
10/01/1970_24:00           379.5744    336.9122    436.1618    290.2373  . . . .    19.0749      7.7060     11.0008
10/02/1970_24:00           379.6688    337.0004    436.3609    290.3706  . . . .    21.0611     11.4492     11.6611
10/03/1970_24:00           379.7609    337.1005    436.4940    290.5041  . . . .    22.1906     12.6471     11.9815
10/04/1970_24:00           379.8491    337.1933    436.6173    290.6363  . . . .    22.8439     13.1976     12.1502
10/05/1970_24:00           379.9349    337.2804    436.7341    290.7024  . . . .    23.3147     13.5570     12.2529
10/06/1970_24:00           380.0190    337.3601    436.8238    290.7538  . . . .    23.7594     13.8766     12.3312
10/07/1970_24:00           380.1017    337.4241    436.8475    290.8025  . . . .    24.2663     14.2193     12.4044
10/08/1970_24:00           380.1820    337.4713    436.8547    290.8502  . . . .    24.9005     14.6192     12.4814
10/09/1970_24:00           380.2598    337.5089    436.8550    290.8974  . . . .    25.7274     15.1037     12.5666
10/10/1970_24:00           380.3365    337.5421    436.8521    290.9442  . . . .    26.8259     15.7039     12.6626
10/11/1970_24:00           380.4126    337.5726    436.8478    290.9909  . . . .    28.3005     16.4609     12.7700
10/12/1970_24:00           380.4793    337.5981    436.8429    291.0370  . . . .    30.2931     17.4331     12.8949
10/13/1970_24:00           380.5493    337.6208    436.8377    291.0859  . . . .    32.8830     18.6926     13.0419
10/14/1970_24:00           380.6191    337.6425    436.8326    291.1385  . . . .    35.6486     20.2627     13.2149
       .                      .           .           .           .      . . . .       .           .           .
       .                      .           .           .           .      . . . .       .           .           .
       .                      .           .           .           .      . . . .       .           .           .
       .                      .           .           .           .      . . . .       .           .           .
11/16/1970_24:00           382.7211    338.1732    436.6808    292.7569  . . . .    42.4495     33.5267     18.1495
11/17/1970_24:00           382.7803    338.1880    436.6767    292.8041  . . . .    42.3911     33.4782     18.1694
11/18/1970_24:00           382.8385    338.2025    436.6727    292.8511  . . . .    42.3332     33.4304     18.1899
11/19/1970_24:00           382.8956    338.2166    436.6686    292.8979  . . . .    42.2760     33.3834     18.2116
11/20/1970_24:00           382.9518    338.2305    436.6646    292.9444  . . . .    42.2197     33.3374     18.2344
11/21/1970_24:00           383.0071    338.2442    436.6606    292.9908  . . . .    42.1642     33.2923     18.2582
11/22/1970_24:00           383.0616    338.2577    436.6567    293.0371  . . . .    42.1096     33.2482     18.2826
11/23/1970_24:00           383.1154    338.2712    436.6527    293.0831  . . . .    42.0553     33.2049     18.3073
11/24/1970_24:00           383.1685    338.2846    436.6488    293.1290  . . . .    42.0012     33.1621     18.3320
11/25/1970_24:00           383.2211    338.2983    436.6449    293.1757  . . . .    41.9480     33.1199     18.3564
11/26/1970_24:00           383.2736    338.3131    436.6410    293.2233  . . . .    41.8995     33.0808     18.3916
11/27/1970_24:00           383.3305    338.3339    436.6372    293.2719  . . . .    41.8529     33.0438     18.4291
11/28/1970_24:00           383.4522    338.4133    436.7994    293.4120  . . . .    41.8321     33.0246     18.5422
11/29/1970_24:00           383.5854    338.5372    436.9242    293.5209  . . . .    41.8625     33.0387     18.7649
11/30/1970_24:00           383.7010    338.6477    436.9525    293.6016  . . . .    41.9034     33.0615     18.9677
```

Element Face Flow Output File

This output file is generated when simulated flows at specified element faces are required to be printed. The element faces and aquifer layer numbers for which flow values are printed and their units are specified by the user in the Groundwater Component Main File. The flow rates are printed for every time step of the simulation period. The element numbers that interface at the specified face are listed at the top of the output file in the format *EXXX-EYYY*, where *XXX* and *YYY* are the element numbers. If the element face is located at the model boundary, then *EXXX* is reported as *E0*. If the flow rate is positive then the flow at the element face is towards the element listed first (i.e. towards *EXXX*); if the flow rate is negative then the flow at the element face is towards the element listed second (i.e. towards *EYYY*).

If the element face flow values are desired to be printed out to a DSS file, a file name with the extension ".DSS" should be supplied. The following pathname parts are used for output to a DSS file:

Part A:

IWFM

Part B:

L*ZZZ*:E*XXX*-E*YYY* where *ZZZ* is the aquifer layer number, *XXX* is the first element number interfacing at the face, and *YYY* is the second element number

Part C:

FLOW

Part D:

Start date of the time series depending on the time step used in the Simulation and the value of the BDT variable (starting date and time of simulation period) set in the Simulation Main Input File

Part E:

Time step used in the Simulation

Part F:

ELEMENT_FACE_FLOW

```
*                                           ***************************************
*                                           *         ELEMENT FACE FLOW           *
*                                           *           (UNIT=ac.ft.)             *
*                                           ***************************************
*                LAYER              2              2              2              1              1              2
*                 FACE      E0-E1598       E0-E1599    E2030-E2107    E2030-E2107    E2486-E2527    E2486-E2527
*        TIME                  Face1          Face2          Face3          Face4          Face5          Face6
10/01/1970_24:00               -2.52           0.52          -1.06          -0.02           0.01           0.00
10/02/1970_24:00               -2.33           0.64          -1.07          -0.15           0.01           0.05
10/03/1970_24:00               -2.19           0.68          -1.21          -1.99           0.01           0.07
10/04/1970_24:00               -2.06           0.72          -1.55          -7.17           0.01           0.08
10/05/1970_24:00               -1.94           0.75          -2.33         -18.94           0.01           0.09
10/06/1970_24:00               -1.82           0.78          -4.15         -47.49           0.01           0.12
10/07/1970_24:00               -1.72           0.81          -5.94         -11.66           0.01           0.17
10/08/1970_24:00               -1.63           0.83          -5.73          62.63           0.01           0.21
10/09/1970_24:00               -1.54           0.86          -5.21          15.17           0.01           0.24
10/10/1970_24:00               -1.45           0.89          -4.82          -0.70           0.01           0.26
10/11/1970_24:00               -1.38           0.91          -4.57          -0.86           0.01           0.24
10/12/1970_24:00               -1.30           0.94          -4.17          -0.94           0.01           0.28
10/13/1970_24:00               -1.23           0.97          -3.97          -1.60           0.01           0.29
10/14/1970_24:00               -1.16           0.99          -3.83          -1.68           0.01           0.29
10/15/1970_24:00               -1.10           1.01          -3.72          -1.64           0.01           0.29
10/16/1970_24:00               -1.03           1.04          -3.62          -1.60           0.01           0.30
10/17/1970_24:00               -0.98           1.06          -3.56          -1.57           0.01           0.30
10/18/1970_24:00               -0.92           1.08          -3.49          -1.54           0.01           0.30
10/19/1970_24:00               -0.87           1.10          -3.42          -1.51           0.01           0.28
10/20/1970_24:00               -0.82           1.12          -3.83          -1.47           0.01           0.28
      .                          .              .              .              .              .              .
      .                          .              .              .              .              .              .
      .                          .              .              .              .              .              .
11/16/1970_24:00                0.05           1.58          -2.54          -0.86           0.01           0.37
11/17/1970_24:00                0.07           1.60          -2.53          -0.84           0.01           0.38
11/18/1970_24:00                0.10           1.61          -2.51          -0.83           0.01           0.38
11/19/1970_24:00                0.12           1.63          -2.49          -0.81           0.01           0.38
11/20/1970_24:00                0.14           1.64          -2.48          -0.80           0.01           0.38
11/21/1970_24:00                0.16           1.66          -2.47          -0.79           0.01           0.38
11/22/1970_24:00                0.18           1.67          -2.45          -0.77           0.01           0.39
11/23/1970_24:00                0.21           1.69          -2.44          -0.76           0.01           0.40
11/24/1970_24:00                0.23           1.70          -2.43          -0.75           0.01           0.40
11/25/1970_24:00                0.25           1.72          -2.41          -0.73           0.01           0.40
11/26/1970_24:00                0.27           1.73          -2.40          -0.72           0.01           0.40
11/27/1970_24:00                0.29           1.74          -2.39          -0.70           0.01           0.40
11/28/1970_24:00                0.32           1.76          -2.42          -0.68           0.01           0.40
11/29/1970_24:00                0.35           1.79          -2.45          -0.66           0.01           0.41
11/30/1970_24:00                0.38           1.81          -2.49          -0.67           0.01           0.41
```

Boundary Flow Output File

This output file is generated when simulated flows at the groundwater boundary nodes are required to be printed. The groundwater node and aquifer layer numbers for which flow values are printed are specified by the user in the Groundwater Boundary Conditions Data File. The flow rates are printed in the units specified by the user in the Groundwater Component Main File for every time step of the simulation period. A negative flow value represents outflow from the model area, and a positive value represents an inflow into the model area.

If the boundary flow values are desired to be printed out to a DSS file, a file name with the extension ".DSS" should be supplied. The following pathname parts are used for output to a DSS file:

Part A:

IWFM

Part B:

L*ZZZ*:GW*XXX* where *ZZZ* is the aquifer layer number, *XXX* is the groundwater node number

Part C:

FLOW

Part D:

Start date of the time series depending on the time step used in the Simulation and the value of the BDT variable (starting date and time of simulation period) set in the Simulation Main Input File

Part E:

Time step used in the Simulation

Part F:

BOUNDARY_NODE_FLOW

```
*                                              ********************************************
*                                              *            BOUNDARY FLOW                  *
*                                              *             (UNIT=AC-FT)                  *
*                                              * [NOTE: INFLOW TO THE BASIN IS POSITIVE]   *
*                                              ********************************************
```

* LAYER	1	1	1	1	1	1
* NODE	435	451	460	463	473	475
* TIME						
10/31/1921_24:00	-399.57	-516.08	-420.01	-509.60	-389.90	-276.87
11/30/1921_24:00	-326.65	-355.41	-366.47	-301.16	-224.97	-64.41
12/31/1921_24:00	-289.29	-297.24	-320.69	-326.56	-274.25	-231.77
01/31/1922_24:00	-328.24	-338.35	-311.73	-389.64	-338.59	-361.52
02/28/1922_24:00	-313.12	-286.25	-394.69	-299.31	-232.86	-153.19
03/31/1922_24:00	-275.79	-247.78	-319.95	-214.82	-135.93	-33.21
04/30/1922_24:00	-264.61	-221.95	-261.04	-165.59	-76.50	28.35
05/31/1922_24:00	-371.96	-292.24	-284.77	-296.43	-214.53	-240.87
06/30/1922_24:00	-308.81	-293.54	-236.83	-304.59	-268.18	-369.21
07/31/1922_24:00	-164.90	-261.67	-198.62	-239.45	-242.11	-280.61
08/31/1922_24:00	-123.78	-246.60	-196.72	-204.27	-207.61	-181.80
09/30/1922_24:00	-169.78	-250.10	-234.31	-198.68	-165.01	-75.68
10/31/1922_24:00	-155.49	-239.69	-223.61	-187.58	-136.45	-56.91
11/30/1922_24:00	-187.10	-268.61	-235.40	-236.25	-179.53	-149.79
12/31/1922_24:00	-292.93	-334.48	-278.71	-355.62	-303.55	-376.68
01/31/1923_24:00	-372.04	-401.90	-493.96	-478.66	-451.25	-588.30
02/28/1923_24:00	-266.23	-305.53	-355.21	-284.25	-259.55	-188.00
03/31/1923_24:00	-252.96	-296.84	-319.70	-276.76	-242.56	-192.71
04/30/1923_24:00	772.03	487.36	610.48	784.93	535.35	448.91
05/31/1923_24:00	99.96	-29.09	31.57	86.76	-84.57	-93.48
06/30/1923_24:00	-232.22	-341.51	-261.01	-356.12	-456.53	-509.08
07/31/1923_24:00	-216.26	-325.23	-265.84	-326.47	-415.36	-407.59
.	.	.	.	.	.	.
.	.	.	.	.	.	.
.	.	.	.	.	.	.
.	.	.	.	.	.	.
09/30/1929_24:00	-74.59	-251.38	-398.55	-311.36	-508.91	-311.78
10/31/1929_24:00	-43.76	-220.08	-377.14	-271.70	-442.54	-282.59
11/30/1929_24:00	-35.84	-211.92	-368.61	-265.93	-421.42	-308.39
12/31/1929_24:00	-299.23	-473.69	-541.51	-723.76	-905.95	-1340.36
01/31/1930_24:00	-422.66	-561.38	-604.47	-865.43	-1133.35	-1354.20
02/28/1930_24:00	-261.33	-341.41	-594.03	-444.98	-674.44	-430.10
03/31/1930_24:00	-213.66	-277.91	-497.97	-342.79	-526.90	-336.88
04/30/1930_24:00	24.15	-90.65	-298.63	-86.08	-294.66	-125.49
05/31/1930_24:00	780.49	435.11	202.74	669.42	467.43	529.81
06/30/1930_24:00	-7.41	-266.40	-390.45	-390.01	-620.68	-801.72
07/31/1930_24:00	-14.11	-250.19	-378.64	-352.75	-634.15	-642.72
08/31/1930_24:00	49.66	-191.56	-340.93	-290.06	-540.86	-442.35
09/30/1930_24:00	-49.08	-220.39	-405.30	-281.13	-505.72	-292.20
10/31/1930_24:00	-35.30	-197.85	-391.37	-249.67	-446.68	-270.63
11/30/1930_24:00	-64.01	-225.37	-405.81	-296.62	-484.51	-436.86
12/31/1930_24:00	-166.72	-349.29	-478.09	-504.33	-701.18	-860.51
01/31/1931_24:00	-208.63	-369.38	-679.26	-527.71	-754.21	-775.75
02/28/1931_24:00	-136.91	-268.69	-630.96	-340.67	-556.82	-338.45
03/31/1931_24:00	-128.99	-252.23	-499.00	-324.42	-528.25	-409.83
04/30/1931_24:00	194.45	-69.60	-212.76	-113.78	-429.06	-569.94
05/31/1931_24:00	-107.51	-333.96	-463.15	-471.28	-760.04	-804.14
06/30/1931_24:00	-124.46	-353.02	-452.29	-538.87	-809.90	-859.91
07/31/1931_24:00	107.94	-340.19	-404.25	-464.39	-819.29	-758.80
08/31/1931_24:00	17.81	-333.54	-447.97	-450.26	-763.44	-645.46
09/30/1931_24:00	-35.38	-233.99	-437.98	-306.70	-567.62	-329.26

Tile Drain Hydrograph Output

This output file is generated when simulated flows at the tile drains or subsurface irrigation locations are required to be printed. The corresponding groundwater node numbers for which flow values are printed are specified by the user in the Tile Drain and Subsurface Irrigation Parameter File. The flow rates are printed in the units specified by the user in the Groundwater Component Main File for every time step of the simulation period. A negative flow value represents tile drain outflow at the specified groundwater node, and a positive value represents subsurface irrigation inflow.

If the tile drain/subsurface irrigation flow values are desired to be printed out to a DSS file, a file name with the extension ".DSS" should be supplied. The following pathname parts are used for output to a DSS file:

Part A:

IWFM

Part B:

GW*XXX* where *XXX* is the groundwater node number

Part C:

FLOW

Part D:

Start date of the time series depending on the time step used in the Simulation and the value of the BDT variable (starting date and time of simulation period) set in the Simulation Main Input File

Part E:

Time step used in the Simulation

Part F:

i. *TILE_DRAIN_HYDROGRAPH* (if the print-out is a tile drain hydrograph)

ii. *SUBSURFACE_IRIG_HYDROGRAPH* (if the print-out is a subsurface irrigation hydrograph)

```
*                                       ************************************************
*                                       *  TILE DRAIN/SUBSURFACE IRRIGATION HYDROGRAPH  *
*                                       *               (UNIT=AC-FT)                    *
*                                       *      [(+): SUBSURFACE IRRIGATION INFLOW]      *
*                                       *      [(-): TILE DRAIN OUTFLOW         ]       *
*                                       ************************************************
*                          NODES
*        TIME               861         862         863         670         682
10/31/1921_24:00            0.00        0.00       -0.03       -0.39        0.00
11/30/1921_24:00            0.00        0.00       -0.04       -0.46        0.00
12/31/1921_24:00            0.00        0.00       -0.05       -0.52        0.00
01/31/1922_24:00            0.00        0.00       -0.05       -0.57        0.00
02/28/1922_24:00            0.00        0.00       -0.05       -0.61        0.00
03/31/1922_24:00            0.00        0.00       -0.06       -0.65        0.00
04/30/1922_24:00            0.00        0.00       -0.06       -0.69        0.00
05/31/1922_24:00            0.00        0.00       -0.06       -0.74        0.00
06/30/1922_24:00            0.00        0.00       -0.06       -0.78        0.00
07/31/1922_24:00            0.00        0.00       -0.06       -0.82        0.00
08/31/1922_24:00            0.00        0.00       -0.06       -0.84        0.00
09/30/1922_24:00            0.00        0.00       -0.07       -0.87        0.00
10/31/1922_24:00            0.00        0.00       -0.07       -0.89        0.00
11/30/1922_24:00            0.00        0.00       -0.07       -0.92        0.00
12/31/1922_24:00            0.00        0.00       -0.07       -0.94        0.00
01/31/1923_24:00            0.00        0.00       -0.08       -0.96        0.00
02/28/1923_24:00            0.00        0.00       -0.08       -0.98        0.00
03/31/1923_24:00            0.00        0.00       -0.08       -1.00        0.00
04/30/1923_24:00            0.00        0.00       -0.09       -1.03        0.00
05/31/1923_24:00            0.00        0.00       -0.09       -1.06        0.00
06/30/1923_24:00            0.00        0.00       -0.09       -1.08        0.00
      .                      .           .           .           .           .
      .                      .           .           .           .           .
      .                      .           .           .           .           .
      .                      .           .           .           .           .
11/30/1929_24:00            0.00        0.00       -0.34       -1.43        0.00
12/31/1929_24:00            0.00        0.00       -0.34       -1.43        0.00
01/31/1930_24:00            0.00        0.00       -0.34       -1.43        0.00
02/28/1930_24:00            0.00        0.00       -0.35       -1.42        0.00
03/31/1930_24:00            0.00        0.00       -0.35       -1.42        0.00
04/30/1930_24:00            0.00        0.00       -0.35       -1.42        0.00
05/31/1930_24:00            0.00        0.00       -0.36       -1.43        0.00
06/30/1930_24:00            0.00        0.00       -0.36       -1.43        0.00
07/31/1930_24:00            0.00        0.00       -0.36       -1.42        0.00
08/31/1930_24:00            0.00        0.00       -0.36       -1.41        0.00
09/30/1930_24:00            0.00        0.00       -0.36       -1.41        0.00
10/31/1930_24:00            0.00        0.00       -0.37       -1.41        0.00
11/30/1930_24:00            0.00        0.00       -0.37       -1.40        0.00
12/31/1930_24:00            0.00        0.00       -0.37       -1.40        0.00
01/31/1931_24:00            0.00        0.00       -0.37       -1.40        0.00
02/28/1931_24:00            0.00        0.00       -0.37       -1.39        0.00
03/31/1931_24:00            0.00        0.00       -0.38       -1.38        0.00
04/30/1931_24:00            0.00        0.00       -0.38       -1.38        0.00
05/31/1931_24:00            0.00        0.00       -0.38       -1.38        0.00
06/30/1931_24:00            0.00        0.00       -0.38       -1.37        0.00
07/31/1931_24:00            0.00        0.00       -0.39       -1.35        0.00
08/31/1931_24:00            0.00        0.00       -0.39       -1.33        0.00
09/30/1931_24:00            0.00        0.00       -0.39       -1.33        0.00
```

Subsidence Component Output Files

Subsidence Hydrograph Output File

The Subsidence Hydrograph Output File includes the simulated subsidence values (i.e. cumulative change in the interbed thickness) at aquifer layers and nodes or coordinates specified by the user in the Subsidence Component Main File. Aquifer layer number, finite element node number and the element number where the print-out location falls into are printed for each subsidence hydrograph. If total subsidence over all the aquifer layers is desired, then a value of zero appears for the layer number. If print-out at a coordinate is desired, then IWFM prints out zero for the finite element node number. A negative subsidence value indicates that interbed thickness is decreasing due to falling groundwater heads, while a positive subsidence indicates expanding interbed thickness due to rising groundwater heads.

If the subsidence values are desired to be printed out to a DSS file, a file name with the extension ".DSS" should be supplied. The following pathname parts are used for output to a DSS file:

Part A:

IWFM

Part B:

ID:L*XXX*:E*YYY*:GW*ZZZ* where *ID* is the subsidence hydrograph number listed sequentially in the Subsidence Component Main File, *XXX* is the aquifer layer number, *YYY* is the element number where the hydrograph location falls into and *ZZZ* is the groundwater node number if the hydrograph location is given as a finite element node (*ZZZ* is zero if the hydrograph location is given as a coordinate)

Part C:

TOTAL_CHANGE_THICK

Part D:

Start date of the time series depending on the time step used in the Simulation and the value of the BDT variable (starting date and time of simulation period) set in the Simulation Main Input File

Part E:

Time step used in the Simulation

Part F:

SUBSIDENCE_HYDROGRAPHS

```
*                                         ***************************************
*                                         *        SUBSIDENCE HYDROGRAPH        *
*                                         *             (UNIT=ft.)              *
*                                         ***************************************
*          HYDROGRAPH ID        1           2           3           4           5
*                  LAYER        1           2           3           0           1
*                   NODE        0        1234           0         357           0
*                ELEMENT     1423        1293        1418         311        1633
*         TIME
09/30/1970_24:00           0.0000      0.0000      0.0000      0.0000      0.0000
10/01/1970_24:00          -0.0000     -0.0000      0.0000     -0.0000      0.0000
10/02/1970_24:00          -0.0000     -0.0000      0.0000     -0.0000      0.0000
10/03/1970_24:00          -0.0000     -0.0000      0.0000     -0.0000      0.0000
10/04/1970_24:00          -0.0000     -0.0000      0.0000     -0.0000      0.0000
10/05/1970_24:00          -0.0000     -0.0000      0.0000     -0.0000      0.0000
10/06/1970_24:00          -0.0001     -0.0000      0.0000     -0.0000      0.0000
10/07/1970_24:00          -0.0001     -0.0000      0.0000     -0.0000      0.0000
10/08/1970_24:00          -0.0001     -0.0000      0.0000     -0.0000      0.0000
10/09/1970_24:00          -0.0001     -0.0000      0.0000     -0.0000      0.0000
10/10/1970_24:00          -0.0002     -0.0000      0.0000     -0.0000      0.0000
10/11/1970_24:00          -0.0002     -0.0000      0.0000     -0.0000      0.0000
10/12/1970_24:00          -0.0003     -0.0000      0.0000     -0.0000      0.0000
10/13/1970_24:00          -0.0004     -0.0000      0.0000     -0.0000      0.0000
10/14/1970_24:00          -0.0004     -0.0000      0.0000     -0.0000      0.0000
10/15/1970_24:00          -0.0005     -0.0000      0.0000     -0.0000      0.0000
      .                      .           .           .           .           .
      .                      .           .           .           .           .
      .                      .           .           .           .           .
      .                      .           .           .           .           .
09/16/1975_24:00          -0.0003      0.0002      0.0000     -0.0003      0.0001
09/17/1975_24:00          -0.0003      0.0002      0.0000     -0.0003      0.0001
09/18/1975_24:00          -0.0003      0.0002      0.0000     -0.0003      0.0001
09/19/1975_24:00          -0.0003      0.0002      0.0000     -0.0003      0.0001
09/20/1975_24:00          -0.0003      0.0002      0.0000     -0.0003      0.0001
09/21/1975_24:00          -0.0003      0.0002      0.0000     -0.0003      0.0001
09/22/1975_24:00          -0.0003      0.0002      0.0000     -0.0003      0.0001
09/23/1975_24:00          -0.0003      0.0002      0.0000     -0.0003      0.0001
09/24/1975_24:00          -0.0003      0.0002      0.0000     -0.0003      0.0001
09/25/1975_24:00          -0.0003      0.0002      0.0000     -0.0003      0.0001
09/26/1975_24:00          -0.0003      0.0002      0.0000     -0.0003      0.0001
09/27/1975_24:00          -0.0003      0.0002      0.0000     -0.0003      0.0001
09/28/1975_24:00          -0.0003      0.0002      0.0000     -0.0003      0.0001
09/29/1975_24:00          -0.0003      0.0002      0.0000     -0.0003      0.0001
09/30/1975_24:00          -0.0003      0.0002      0.0000     -0.0003      0.0001
```

Final Subsidence Values File

The Final Subsidence Values File lists the interbed thicknesses and pre-compaction heads at the end of the simulation period. It is in a format that can readily be used to set the initial conditions for the simulation of subsidence for the following simulation periods. For instance, consider an initial IWFM run performed for a simulation period that starts at January 1, 1973 and ends at December 31, 1992. Final Subsidence Values File will include interbed thicknesses and pre-compaction heads at each finite element node at the end of December 31, 1992. To perform a second IWFM run for a simulation period that starts at January 1, 1993 the values stored in the Final Subsidence Values File can be used as initial conditions by listing the name of this file as the Subsidence Initial Conditions Data File (variable INISUBFL) in the Subsidence Component Main File.

```
C*******************************************************************************
C ***** SUBSIDENCE DATA AT 11/30/1970_24:00
C*******************************************************************************
C
C-------------------------------------------------------------------------------
     1.0                           / FACT
C-------------------------------------------------------------------------------
C      ID           DC[1]            DC[2]            DC[3]            HC[1]            HC[2]            HC[3]
C-------------------------------------------------------------------------------
        1       13.000000         3.999990         2.000000       605.700000       636.700000       663.400000
        2       13.000000         4.000000         2.000000       605.700000       443.969489       444.000000
        3       13.000000         4.000001         2.000000       605.700000       420.820000       420.820000
        4       13.000000         4.000002         2.000000       605.700000       408.900000       408.900000
        5       13.000000         4.000004         2.000000       605.700000       440.000000       440.000000
        6       13.000000         4.000002         2.000000       605.700000       439.310000       439.310000
        7       13.000000         4.000001         2.000000       605.700000       429.240000       429.240000
        8       13.000000         4.000002         2.000000       605.700000       415.800000       415.800000
        9       13.000000         4.000000         2.000000       510.000000       429.858615       430.000000
       10       13.000000         3.999998         2.000000       605.700000       429.566683       430.000000
       11       13.000000         3.999999         2.000000       605.700000       445.697252       446.040000
       12       13.000000         3.999999         2.000000       605.700000       437.616461       437.760000
       13       13.000050         4.000277         2.000000       397.170000       390.000000       390.000000
       14       13.000034         4.000146         2.000000       405.310000       401.310000       401.310000
       15       13.000000         3.999998         2.000000       605.700000       443.416120       443.930000
        .           .                .                .                .                .                .
        .           .                .                .                .                .                .
        .           .                .                .                .                .                .
        .           .                .                .                .                .                .
     2826       13.000026         3.999997         2.000000        -0.157102        -5.243795        -4.240000
     2827       13.000060         4.000008         2.000000         0.221000        -4.230000        -4.230000
     2828       13.000071         3.999999         2.000000        -0.034707        -5.721506        -4.820000
     2829       13.000130         4.000002         2.000000         0.855626        -5.393404        -5.010000
     2830       13.000144         4.000003         2.000000         0.845408        -5.069541        -4.890000
     2831       13.000094         3.999998         2.000000         0.864725        -5.237650        -3.950000
     2832       13.000068         3.999991         2.000000         0.630232        -5.432669        -2.810000
     2833       13.000053         3.999996         2.000000        -1.430561        -3.330284        -2.090000
     2834       13.000057         3.999993         2.000000        -0.749005        -4.133701        -2.170000
     2835       13.000037         3.999987         2.000000        -1.047498        -6.073493        -2.690000
     2836       13.000024         3.999989         2.000000        -0.879602        -5.639702        -2.690000
     2837       13.000027         3.999994         2.000000        -0.691072        -4.264111        -2.610000
     2838       13.000024         3.999994         2.000000        -0.767314        -4.496519        -2.930000
     2839       13.000011         3.999991         2.000000        -0.926708        -6.016482        -3.730000
     2840       13.000011         3.999988         2.000000        -1.123281        -7.360927        -4.270000
```

Subsidence Values for TECPLOT

This file lists the model grid and subsidence values at each node to be used by TECPLOT, a commercially available software. TECPLOT can be used for analysis of the simulation results including the animation of the subsidence.

Stream Component Output Files

Stream Component Version 4.0 Output Files

Stream Hydrograph Output File

The Stream Hydrograph Output File can either contain stream flows or stream surface elevations, depending on the option set by the user in the Stream Component Main File. The flow or elevation values are printed for the stream nodes specified by the user for each time step of the simulation period in units as specified in The Stream Component Main File.

If the stream flow or elevation values are desired to be printed out to a DSS file, a file name with the extension ".DSS" should be supplied. The following pathname parts are used for output to a DSS file:

Part A:

IWFM

Part B:

R*XXX* where *XXX* is the stream node number

Part C:

One of the following, depending on the output data

i. *FLOW* (when stream flows are printed)

ii. *STAGE* (when stream flow depths are printed)

Part D:

Start date of the time series depending on the time step used in the Simulation and the value of the BDT variable (starting date and time of simulation period) set in the Simulation Main Input File

Part E:

Time step used in the Simulation

Part F:

STREAM_HYDROGRAPHS

```
*                                       ***************************************
*                                       *          STREAM HYDROGRAPH          *
*                                       *            (UNIT=ac.ft.)            *
*                                       ***************************************
*       HYDROGRAPH ID           1             2             3             4             5             6             7
*               NODES           1             2             3             4             5             6             7
*        TIME
10/01/1990_24:00          1738.80       1327.33       1013.23        773.45        590.42        911.74        695.98
10/02/1990_24:00          1738.80       1327.33       1013.23        773.45        590.42        914.19        697.85
10/03/1990_24:00          1738.80       1327.33       1013.23        773.45        590.42        916.70        699.77
10/04/1990_24:00          1738.80       1327.33       1013.23        773.45        590.42        919.28        701.74
10/05/1990_24:00          1738.80       1327.33       1013.23        773.45        590.42        921.92        703.75
10/06/1990_24:00          1738.80       1327.33       1013.23        773.45        590.42        924.62        705.82
10/07/1990_24:00          1738.80       1327.33       1013.23        773.45        590.42        927.38        707.92
10/08/1990_24:00          1738.80       1327.33       1013.23        773.45        590.42        930.20        710.07
10/09/1990_24:00          1738.80       1327.33       1013.23        773.45        590.42        956.55        730.19
10/10/1990_24:00          1738.80       1327.33       1013.23        773.45        590.42       1064.93        898.52
10/11/1990_24:00          1820.80       1392.25       1062.78        811.28        619.30       1155.14       1041.42
10/12/1990_24:00          1892.04       1637.11       1249.70        953.97        728.22       1290.60       1201.50
10/13/1990_24:00          1930.36       1779.18       1452.72       1108.94        846.52       1424.85       1350.32
10/14/1990_24:00          1950.96       1858.29       1665.33       1328.70       1014.28       1608.76       1542.56
10/15/1990_24:00          1962.05       1902.34       1785.86       1574.72       1270.38       1872.71       1815.11
10/16/1990_24:00          1968.02       1926.87       1853.93       1726.65       1527.19       2135.61       2082.78
10/17/1990_24:00          1971.24       1940.54       1892.37       1813.36       1692.18       2311.74       2267.15
10/18/1990_24:00          1972.97       1948.16       1914.09       1862.83       1787.31       2419.37       2383.77
10/19/1990_24:00          1973.91       1952.42       1926.36       1891.07       1842.15       2485.54       2457.58
10/20/1990_24:00          1974.42       1954.80       1933.31       1907.19       1873.75       2526.72       2504.61
10/21/1990_24:00          1974.70       1956.15       1937.25       1916.41       1891.98       2552.89       2534.98
       .                        .             .             .             .             .             .             .
       .                        .             .             .             .             .             .             .
       .                        .             .             .             .             .             .             .
09/19/2000_24:00          1981.48       1978.12       1975.51       1973.97       1974.44       1989.57       1999.05
09/20/2000_24:00          1981.48       1978.12       1975.51       1973.97       1974.46       1989.59       1999.08
09/21/2000_24:00          1981.48       1978.12       1975.51       1973.98       1974.47       1989.61       1999.11
09/22/2000_24:00          1981.48       1978.12       1975.52       1973.98       1974.48       1989.62       1999.14
09/23/2000_24:00          1981.48       1978.12       1975.51       1973.44       1973.43       1988.64       1998.23
09/24/2000_24:00          1981.48       1978.12       1975.52       1973.68       1973.88       1989.04       1998.59
09/25/2000_24:00          1981.48       1978.12       1975.52       1973.82       1974.15       1989.29       1998.83
09/26/2000_24:00          1981.48       1978.12       1975.52       1973.90       1974.30       1989.45       1998.99
09/27/2000_24:00          1981.47       1978.12       1975.52       1973.63       1973.78       1988.98       1998.56
09/28/2000_24:00          1981.47       1978.12       1975.53       1973.80       1974.09       1989.26       1998.83
09/29/2000_24:00          1981.47       1978.12       1975.53       1973.89       1974.28       1989.44       1999.01
09/30/2000_24:00          1981.47       1978.12       1975.53       1973.95       1974.38       1989.55       1999.13
```

Stream Component Version 4.1 Output Files

Stream Hydrograph Output File

This file is exactly the same as the one for Stream Component Version 4.0. Please refer to the section above for details.

Stream Component Version 5.0 Output Files

Stream Hydrograph Output File

This file is exactly the same as the one for Stream Component Version 4.0. Please refer to the section above for details.

Final Stream Flows File

This file lists the stream flows at every stream node at the end of the simulation. . It is in a format that can readily be used to set the initial conditions for the stream flows for the following simulation periods. For instance, consider an initial IWFM run performed for a simulation period that starts at January 1, 1973 and ends at December 31, 1992. Final Stream Flows File will include flow at each stream node at the end of December 31, 1992. To perform a second IWFM run for a simulation period that starts at January 1, 1993 the values stored in the Final Stream Flows File can be copied and pasted into the Stream Component Main File to be used as the initial stream flows.

The final stream flows are printed out using the simulation unit of volumetric flow.

```
C*******************************************************************************
C ***** STREAM FLOWS AT 09/30/2009_24:00
C*******************************************************************************
C
C-------------------------------------------------------------------------------
     1                   / ICTYPE
     1DAY                / TUNITQ
     1.0                 / FACTHQ
C-------------------------------------------------------------------------------
C     IR              HQS
C-------------------------------------------------------------------------------
       1      18524241.290
       2      20418985.313
       3      22862384.810
       4      31583903.431
       5      39438246.913
       6      49593410.548
       7      40696060.887
       8      24177571.795
       9      41249473.224
      10       8163144.000
       .            .
       .            .
       .            .
     437      40432091.802
     438      43160747.636
     439      40915947.148
     440      54526798.754
     441      62796383.757
     442      55511743.717
     443      54256947.837
     444      54880849.249
     445      44007496.372
     446      34095715.657
     447      34253723.531
     448      35545041.982
     449      80205886.458
```

Lake Component Output Files

Final Lake Elevations File

The Final Lake Elevations File lists the lake elevations at the end of the simulation period. It is in a format that can readily be used to set the initial conditions for the simulation of lake storages for the following simulation periods. For instance, consider an initial IWFM run performed for a simulation period that starts at January 1, 1973 and ends at December 31, 1992. Final Lake Elevations File will include lake elevations at each simulated lake at the end of December 31, 1992. To perform a second IWFM run for a simulation period that starts at January 1, 1993 the values stored in the Final Lake Elevations File can be copied and pasted into the Lake Component Main File to be used as the initial lake elevations.

```
C*******************************************************************************
C ***** LAKE ELEVATIONS AT 09/30/1971_24:00
C*******************************************************************************
C
C-------------------------------------------------------------------------------
     1.0                             / FACT
C-------------------------------------------------------------------------------
C    ILAKE         HLAKE
C-------------------------------------------------------------------------------
       1       22.846940
       2        1.437124
```

Root Zone Component Output Files

The text, DSS and binary files that are generated by the root zone component are discussed in detail in the document titled *IDC-2015 Theoretical Documentation and User's Manual*.

Final Small Watersheds Data File

This file lists the small watershed root zone moisture content and groundwater depth at the end of the simulation period. It is in a format that can readily be used to set the initial conditions for the simulation of flow processes in small watersheds for the following simulation periods. For instance, consider an initial IWFM run performed for a simulation period that starts at January 1, 1973 and ends at December 31, 1992. Final Small Watersheds Data File will include root zone moisture content and groundwater depth at each simulated small watershed at the end of December 31, 1992. To perform a second IWFM run for a simulation period that starts at January 1, 1993 the values stored in the Final Small Watershed Data File can be copied and pasted into the Small Watershed Parameters Data File to be used as the initial conditions.

```
C*****************************************************************************************************
C ***** SMALL WATERSHED ROOT ZONE MOISTURE AND GROUNDWATER STORAGE AT 09/30/1971_24:00
C*****************************************************************************************************
C
C-----------------------------------------------------------------------------------------------------
     1.0                           / FACT
C-----------------------------------------------------------------------------------------------------
C    ISW    SOILS      GWSTS
C-----------------------------------------------------------------------------------------------------
       1   0.0001     0.9801
       2   0.0002     0.9902
       3   0.0004     0.9903
       4   0.0005     0.9378
       5   0.0002     1.0000
       .    .          .
       .    .          .
       .    .          .
      18   0.0035     0.9910
      19   0.0044     0.9911
      20   0.0027     0.9907
      21   0.0033     0.9910
      22   0.0115     0.9920
```

Final Unsaturated Zone Moisture Content File

This file lists the moisture content at each element and unsaturated zone layer at the end of the simulation period. It is in a format that can readily be used to set the initial conditions for the simulation of unsaturated zone flow processes for the following simulation periods. For instance, consider an initial IWFM run performed for a simulation period that starts at January 1, 1973 and ends at December 31, 1992. Final Unsaturated Zone Moisture Content File will include the moisture content at each unsaturated zone layer and finite element at the end of December 31, 1992. To perform a second IWFM run for a simulation period that starts at January 1, 1993 the values stored in the Final Unsaturated Zone Moisture Content File can be copied and pasted into the Unsaturated Zone Parameter Data File to be used as the initial conditions.

```
C*********************************************************************************************
C ***** UNSATURATED ZONE MOISTURE AT 09/30/1971_24:00
C*********************************************************************************************
C
C---------------------------------------------------------------------------------------------
C                              Unsaturated Layers
C         ----------------------------------------------------------------------
C    ID            1           2
C---------------------------------------------------------------------------------------------
      1       0.0007      0.0000
      2       0.0007      0.0000
      3       0.0013      0.0001
      4       0.0007      0.0001
      5       0.0007      0.0001
      6       0.0007      0.0001
      7       0.0012      0.0006
      8       0.0012      0.0006
      9       0.0012      0.0004
     10       0.0007      0.0001
      .         .           .
      .         .           .
      .         .           .
      .         .           .
   3061       0.0012      0.0000
   3062       0.0017      0.0000
   3063       0.0011      0.0000
   3064       0.0014      0.0000
   3065       0.0011      0.0000
   3066       0.0023      0.0000
   3067       0.0017      0.0000
   3068       0.0022      0.0000
```

Binary Output Files

The binary files contain the simulation results and they are used in the post-processing portion (Budget and Z-Budget) of IWFM in order to generate detailed water budget tables for modeled hydrologic processes. The binary files that can be generated are

- Binary output for groundwater zone budget
- Binary output for small watershed flow components
- Binary output for diversion details
- Binary output for stream budget by reach
- Binary output for stream budget at user-specified stream nodes
- Binary output for lake budget
- Binary output for unsaturated zone budget
- Binary output for subregional land and water use budget
- Binary output for land and water use budget for user-specified crops
- Binary output for subregional root zone moisture budget
- Binary output for root zone moisture budget for user-specified crops
- Binary output for groundwater budget

5. Budget

The Budget program tabulates the simulation output, allowing the user to generate the following tables based on output files created in the Simulation part of IWFM: land and water use, root zone moisture accounting, groundwater, small watersheds, lakes, unsaturated zone, stream flows at reaches or individual nodes and diversion details. This chapter describes the input and output files, and provides file samples.

All output files the Budget post-processor generates are text files that include tabular data. To perform any analysis, these data are generally needed to be imported into other software such as Microsoft Excel. Alternatively, the user can download and install the *IWFM Tools Add-in for Excel 2007-2010* from IWFM's web site (http://baydeltaoffice.water.ca.gov/modeling/hydrology/IWFM/SupportTools/index_SupportTools.cfm). This tool allows easy import of the data stored in the binary budget files into Microsoft Excel.

5.1. Input Files

The main input file and at least one of the binary output files generated during IWFM simulation is required to run the Budget program. The binary files contain results produced by the Simulation part of IWFM. The following sections describe the input variables in the Budget Main Input File that are used to process the binary files and create tabulated data as well as the details of the processed output files.

Budget Main Input File

The Budget Main Input File contains output unit controls, beginning and ending simulation times for the budget print-out, names of the binary files to be processed, budget print-out locations and the print-out interval of the budget data.

The values stored in the binary files have units used in the Simulation. The output unit control information allows the user to print out the budget data in a different set of units. Depending on the time-tracking option used in Simulation, the user is required to enter beginning time (TBEGIN for non-time tracking simulation, BDT for time tracking simulation) and the ending time (TLAST for non-time tracking simulation, EDT for time tracking simulation) for the budget outputs. The user can process as many budget binary files as needed. A single binary file can be processed multiple times with different output intervals or for different *locations* (e.g. different subregions, lakes, stream reaches, etc.). For each binary file to be processed, the user is required to enter the name of the binary file, the name of the output file, output interval for time-tracking simulations, number of *locations* for budget print-out and a list of the location indices. If the output interval is greater than the simulation time step, the budget flow terms will be accumulated over the output interval.

The meaning of *location* depends on the type of the budget binary file being processed. For instance, groundwater budgets are reported for each subregion. Therefore, for groundwater budget, *location* represents a subregion. For lakes, water budgets are reported for individual lakes so a *location* represents an individual lake. For stream reach budgets a *location* is an individual stream reach, while for stream node budgets a *location* is a stream node. When location is specified as –1, IWFM prints out water budget for all locations in that particular budget class. If a value of 0 is specified for the location, then IWFM suppresses the processing of the budget tables.

The following is a list of variables that need to be defined in this file:

FACTLTOU	Factor to convert simulation unit of length to output unit of length
UNITLTOU	Output unit of length (maximum of 8 characters)
FACTAROU	Factor to convert simulation unit of area to output unit of area
UNITAROU	Output unit of area (maximum of 8 characters)
FACTVLOU	Factor to convert simulation unit of volume to output unit of volume
UNITVLOU	Output unit of volume (maximum of 8 characters)
CACHE	Cache size in terms of number of output values stored in the memory before being printed to the output file; a large CACHE value (e.g. 50000 or more depending on the memory resources of the computer where Budget runs are taking place) can drastically decrease the program run-time especially when the budget tables are printed out to a DSS file.
TBEGIN	Beginning time step for the budget tables; used only for non-time-tracking simulations
TLAST	Ending time step for the budget tables; used only for non-time-tracking simulations
BDT	Beginning date and time for the budget tables; used only for time-tracking simulations

EDT Ending date and time for the budget tables; used only for time-tracking simulations

NBUDGET Number of budget binary files to be processed

NBUDGET, described above, informs the Budget post-processor about the number of binary files that will be processed. For each of the binary files to be processed the following variables need to be set:

BINFILE Name of the input binary budget file (maximum 1000 characters)

OUTFILE Name of the budget output file (maximum 1000 characters); the filename extension dictates if the output file will be text file or a DSS file (see Chapter 2 for file types and corresponding filename extensions)

INTPRNT Interval for budget print-out (budget flow terms will be accumulated over the output interval); for time-tracking simulations, this should be one of the units recognized by HEC-DSS that are listed in the Simulation Main Input File. If left blank, the print-out interval will be the same as the Simulation time step. For non-time-tracking simulations, this variable has no effect.

NLPRNT Number of *locations* for budget table print-out; a *location* corresponds to different spatial attributes depending on the type of the budget table being processed (e.g. a subregion for groundwater budgets, a stream reach for stream reach budget, a stream node for

	stream node budget, a lake for lake budget, a specific subregion-crop combination for crop root zone budget, etc.)
LPRNT	Index for locations (i.e. subregions, lakes, stream reaches, etc. depending on the budget class) for which a budget table will be generated; for budget tables at subregions, the index for the entire domain is the number of subregions plus 1 (–1 = print budget tables for all locations, 0 = suppress printing of all budget tables)

```
C*******************************************************************************
C
C                    INTEGRATED WATER FLOW MODEL (IWFM)
C                           *** Version ### ***
C
C*******************************************************************************
C
C                             BUDGET INPUT FILE
C                         for IWFM Post-Processing
C
C
C              Project:  IWFM Version ### Release
C                        California Department of Water Resources
C              Filename: Budget.in
C
C*******************************************************************************
C
C                              File Description
C
C     This file contains the the names of all binary input files,
C     conversion factors and output control options for running the post-processor.
C
C*******************************************************************************
C                     Output Unit Control
C
C     FACTLTOU; Factor to convert simulation unit of length to output unit of length
C     UNITLTOU; Output unit of length (8 characters max.)
C     FACTAROU; Factor to convert simulation unit of area to output unit of area
C     UNITAROU; Output unit of area (8 characters max.)
C     FACTVLOU; Factor to convert simulation unit of volume to output unit of volume
C     UNITVLOU; Output unit of volume (8 characters max.)
C
C-----------------------------------------------------------------------------
C    VALUE                          DESCRIPTION
C-----------------------------------------------------------------------------
    1.0                             / FACTLTOU
    ft.                             / UNITLTOU
    0.000022957                     / FACTAROU    (sq.ft. -> ac.)
    acres                           / UNITAROU
    0.000022957                     / FACTVLOU    (cu.ft. -> ac.ft.)
    ac.ft.                          / UNITVLOU
C*******************************************************************************
C                     Output Cache Size
C
C     CACHE;   Cache size in terms of number of values stored for time series
C              data output
C
C-------------------------------------------------------------------------------------
C    VALUE                          DESCRIPTION
C-------------------------------------------------------------------------------
    50000                           / CACHE
C*******************************************************************************
C                         Budget Output Control Options
C                     (Simulation Date and Time NOT Tracked)
C
C     If the actual simulation date and time is NOT tracked enter the following
C     variables. Otherwise, comment out the following variables and use the
C     "Simulation Date and Time NOT Tracked" option below.
C
C     TBEGIN ; Beginning time for the budget tables
C                * Use ##.# format
C     TLAST  ; Ending time for the budget tables
C                * Use ##.# format
C
C-------------------------------------------------------------------------------
C    VALUE                        DESCRIPTION
C-------------------------------------------------------------------------------
*                                 / TBEGIN
*                                 / TLAST
C-------------------------------------------------------------------------------
C                         Budget Output Control Options
C                      (Simulation Date and Time Tracked)
C
C     If the actual simulation date and time is tracked enter the following
C     variables. Otherwise, comment out the following variables and use the
C     "Simulation Date and Time NOT Tracked" option above.
C
C     BDT    ; Begining date and time for the budget output
C                * Use MM/DD/YYYY HH:MM format
C                * Midnight is 24:00
C     EDT    ; Ending date and time for the budget output
C                * Use MM/DD/YYYY HH:MM format
C                * Midnight is 24:00
C
C-------------------------------------------------------------------------------
C    VALUE                        DESCRIPTION
C-------------------------------------------------------------------------------
    09/30/1990 24:00              / BDT
    09/30/2000 24:00              / EDT
C*******************************************************************************
C                           Budget Output Data
C
C    List below the number of budget classes (i.e. groundwater budget, stream
C    budget, small watershed budget, etc.), and for each budget class list the
C    input file, output file and the locations for which a budget table will
C    be generated.
C
C    NBUDGET ;  Number of budget classes to be printed
C    BINFILE ;  Name of the input binary budget file (max. 1000 characters)
C    OUTFILE ;  Name of the budget output file (max. 1000 characters)
C    INTPRNT ;  Interval for budget print out (e.g. 1DAY, 1MONTH, etc.). The interval
C                 must be a one of those listed in the Main Input File for the
```

```
C               executable that generated the input binary files.
C               * Leave blank to use the same interval as the data.
C               * This interval will only be used for simulation with
C                 date and time tracked
C   NLPRNT  ;  Number of location indices for budget table print-out
C   LPRNT   ;  Index for locations (i.e. subregions, lakes, stream reaches, etc.
C               depending on the budget class) for which a budget table will be
C               generated.  For budget tables at subregions, the index for the
C               entire domain is the number of subregions plus 1.
C               * Enter -1: to print budget tables for all locations
C                        0: to suppress printing of any budget tables
C
C-------------------------------------------------------------------------------
C   VALUE                          DESCRIPTION
C-------------------------------------------------------------------------------
     4                            / NBUDGET
C*******************************************************************************
C                         Data for Budget Class 1
C
C-------------------------------------------------------------------------------
C   VALUE                          DESCRIPTION
C-------------------------------------------------------------------------------
    GW.bin                        / BINFILE
    GW.bud                        / OUTFILE
    1YEAR                         / INTPRNT
    5                             / NLPRNT
    1                             / LPRNT[1]
    3                             / LPRNT[2]
    4                             / LPRNT[3]
    5                             / LPRNT[4]
    12                            / LPRNT[5]
C*******************************************************************************
C                         Data for Budget Class 2
C
C-------------------------------------------------------------------------------
C   VALUE                          DESCRIPTION
C-------------------------------------------------------------------------------
    LakeBud.bin                   / BINFILE
    Lake.bud                      / OUTFILE
                                  / INTPRNT
    1                             / NLPRNT
    -1                            / LPRNT[1]
C*******************************************************************************
C                         Data for Budget Class 3
C
C-------------------------------------------------------------------------------
C   VALUE                          DESCRIPTION
C-------------------------------------------------------------------------------
    StrmBud.bin                   / BINFILE
    Strm.bud                      / OUTFILE
    1DAY                          / INTPRNT
    1                             / NLPRNT
    -1                            / LPRNT[1]
C*******************************************************************************
C                         Data for Budget Class 4
C
C-------------------------------------------------------------------------------
C   VALUE                          DESCRIPTION
C-------------------------------------------------------------------------------
    StrmBud.bin                   / BINFILE
    StrmBud.DSS                   / OUTFILE
    1YEAR                         / INTPRNT
    1                             / NLPRNT
    -1                            / LPRNT[1]
```

Binary Input Files

The Budget program binary input files are created during IWFM Simulation. The binary files generated for post-processing are specified by the user either in the IWFM Simulation Main Input File or the relevant Simulation component (i.e. groundwater component, root zone component, stream component, lake component,).

5.2. Output Files

The Budget program generates as many output files as required and set by the NBUDGET variable in the Budget Main Input File. The type of the output file (text versus DSS) depends on the filename extension specified by the user. The output files include information generated by IWFM Simulation. The beginning time, ending time and interval of each output file is based on the values of TBEGIN (or BDT), TLAST (or EDT) and INTPRNT specified in the Budget Main Input File.

The output terms for each budget table will be explained in the following sections.

Groundwater Budget

A groundwater budget table is produced for each subregion listed for processing in the Budget Main Input File. The title printed for each subregional groundwater budget includes IWFM version number, subregion name given by the user, the unit of data columns and the area of the subregion. The output units and the conversion factors are specified by the user in the Budget Main Input File.

The groundwater budget reports the inflows and outflows as well as the beginning and ending groundwater storages. The deep percolation of water from the root zone to the unsaturated zone to compare to the net deep percolation into the groundwater and cumulative subsidence are also reported for informational purposes.

The following list describes the columns in the groundwater budget table as printed to a text file:

GROUNDWATER BUDGET

COL. #	COLUMN NAME	DESCRIPTION
1	Time	Simulation date and time
2	Deep Percolation	Total deep percolation from the root zone to the unsaturated zone in a subregion; this column is included to compare deep percolation to net deep percolation and is not included in the groundwater mass balance
3	Beginning Storage (+)	Groundwater storage at the beginning of the time step
4	Ending Storage (–)	Groundwater storage at the end of time step
5	Net Deep Percolation (+)	Recharge to the groundwater; this column represents the outflow from the unsaturated layer directly into the saturated groundwater system
6	Gain from Stream (+)	Amount of stream flow that contributes to groundwater; a positive value represents flow from stream into groundwater, a negative value represents flow from groundwater into stream
7	Recharge (+)	Recharge to the aquifer from injection wells and recoverable loss of diversions and bypasses
8	Gain from Lake (+)	Lake-groundwater interaction; a positive value represents flow from lake into groundwater, a negative value represents flow from groundwater into lake
9	Boundary Inflow (+)	Net inflow into groundwater due to boundary conditions

10	Subsidence (+)	Amount of flow released out of groundwater storage due to subsidence; a negative value represents expanding interbed material which takes water out of groundwater storage
11	Subsurface Irrigation (+)	Contribution of subsurface irrigation to groundwater storage
12	Tile Drain Outflow (–)	Groundwater that flows into tile drains
13	Pumping (–)	Total subregional groundwater pumping
14	Outflow to Root Zone (–)	Amount of groundwater that is consumed by plants to meet a part or all of their evapotranspirative needs
15	Net Subsurface Inflow (+)	Net groundwater inflow into the subregion from the surrounding subregions
16	Discrepancy (=)	Error in the groundwater mass balance based on the preceding columns
17	Cumulative Subsidence	Cumulative volume of groundwater storage lost due to land subsidence

If a DSS file is used for print-out, the following pathnames parts are used:

Part A:

IWFM_GW_BUD

Part B:

TTT (SR*XXX*) where *TTT* is the name of the subregion and *XXX* is the subregion number

Part C:

VOLUME

Part D:

Start date of the time series depending on the values of the BDT and EDT variables (starting and ending date and time of budget print-out)

Part E:

Print-out interval for the groundwater budget as specified in the Budget Main Input File

Part F:

One of the following, depending on the output data (refer to the table above for further details):

i. *DEEP_PERC* (corresponds to column 2 in text output file)

ii. *BEGIN_STORAGE* (corresponds to column 3 in text output file)

iii. *END STORAGE* (corresponds to column 4 in text output file)

iv. *NET_DEEP_PERC* (corresponds to column 5 in text output file)

v. *GAIN_FROM_STRM* (corresponds to column 6 in text output file)

vi. *RECHARGE* (corresponds to column 7 in text output file)

vii. *GAIN_FROM_LAKE* (corresponds to column 8 in text output file)

viii. *BOUNDARY_INFLOW* (corresponds to column 9 in text output file)

ix. *SUBSIDENCE* (corresponds to column 10 in text output file)

x. *SUBSURF_IRRIGATION* (corresponds to column 11 in text output file)

xi. *TILE_DRAINS* (corresponds to column 12 in text output file)

xii. *PUMPING* (corresponds to column 13 in text output file)

xiii. *FLOW_TO_ROOTZONE* (corresponds to column 14 in text output file)

xiv. *NET_SUBSURF_INFLOW* (corresponds to column 15 in text output file)

xv. *DISCREPANCY* (corresponds to column 16 in text output file)

xvi. *CUM_SUBSIDENCE* (corresponds to column 17 in text output file)

Budget Output Files from Stream Component

Three different budget binary files can be generated by the IWFM stream component which can be processed by the Budget post-processor, namely stream reach budget, stream node budget and the diversion detail report. All versions of the stream component produces the same budget output files that store the same type of information for diversion detail report. Stream reach and stream node budget outputs are the same for stream component versions 4.0 and 4.1, but they are slightly different for version 5.0. The following sections explain the components of each of these budget output files.

Stream Reach Budget for Stream Component Versions 4.0 and 4.1

Stream reach budgets are generated for all stream reaches specified to be printed in the Budget Main Input File. The title printed for each stream reach budget includes IWFM version number, reach name given by the user and the unit of the data columns. The entire stream reach budget is in volumetric units. The output units (UNITVLOU) and conversion factor (FACTVLOU) for volume are specified by the user in the Budget Main Input File.

The stream reach budget tables provide information on the flows in and out of the reaches as well as the impacts of other processes on stream flows such as small stream watershed flows, tile drainage, surface runoff, return flows, diversions and bypass flows. The mass balance check for the reach is listed in the *Discrepancy* column. The *Diversion Shortage* column reports the difference between simulated diversions and the user specified diversion requirements. This term does not affect the mass balance in the reach but is listed as an informational term.

The following table defines each column in the stream reach budget table printed out to text file:

STREAM REACH BUDGET

COL. #	COLUMN NAME	DESCRIPTION
1	Time	Simulation date and time
2	Upstream Inflow (+)	Stream inflows to the reach which includes inflows listed in the Stream Inflow Data File and flows from upstream reaches
3	Downstream Outflow (–)	Stream flow leaving the reach and either entering another reach or exiting the modeled area
4	Tributary Inflow (+)	Surface flows from small stream watersheds to the reach
5	Tile Drain (+)	Inflows from tile drains
6	Runoff (+)	Direct runoff from rainfall into the reach
7	Return Flow (+)	Return flow of the irrigation water into streams
8	Gain from Groundwater (+)	Stream-groundwater interaction; a positive value denotes a gaining stream and a negative value indicates a losing stream

9	Gain from Lake (+)	Inflow from upstream lakes
10	Riparian ET (–)	Amount of water taken out of the stream to meet the evapotranspirative need of riparian vegetation
11	Diversion (–)	Diversions from the reach
12	Bypass Flow (–)	Net bypass flow within the reach; for example, the bypass flow from one stream node to another within the reach is the amount of water loss during the bypass process whereas bypass flow from a stream node within the reach to a different reach is the total amount bypassed from the stream reach
13	Discrepancy (=)	Error in the stream flow mass balance based on the preceding columns
14	Diversion Shortage	This column indicates whether the simulated stream flows are sufficient to meet the surface water diversion requirements; a value of zero indicates that stream flows are sufficient to meet the specified diversion requirements; a positive value represents the shortage of stream flows in a reach

If a DSS file is used for print-out, the following pathnames are used:

Part A:

IWFM_STRMRCH_BUD

Part B:

REACH *XXX* where *XXX* is the reach number

Part C:

VOLUME

Part D:

Start date of the time series depending on the values of the BDT and EDT variables (starting and ending date and time of budget print-out)

Part E:

Print-out interval for the stream reach budget as specified in the Budget Main Input File

Part F:

One of the following, depending on the output data (refer to the table above for further details):

i. *UPSTRM_INFLOW* (corresponds to column 2 in text output file)
ii. *DOWNSTRM_OUTFLOW* (corresponds to column 3 in text output file)
iii. *TRIB_INFLOW* (corresponds to column 4 in text output file)
iv. *TILE_DRN* (corresponds to column 5 in text output file)
v. *RUNOFF* (corresponds to column 6 in text output file)
vi. *RETURN_FLOW* (corresponds to column 7 in text output file)
vii. *GAIN_FROM_GW* (corresponds to column 8 in text output file)
viii. *GAIN_FROM_LAKE* (corresponds to column 9 in text output file)
ix. *RIPARIAN_ET* (corresponds to column 10 in text output file)
x. *DIVERSION* (corresponds to column 11 in text output file)
xi. *BYPASS* (corresponds to column 12 in text output file)
xii. *DISCREPANCY* (corresponds to column 13 in text output file)
xiii. *DIVER_SHORTAGE* (corresponds to column 14 in text output file)

Stream Reach Budget for Stream Component Version 5.0

Stream reach budgets are generated for all stream reaches specified to be printed in the Budget Main Input File. The title printed for each stream reach budget includes IWFM version number, reach name given by the user and the unit of the data columns. The entire stream reach budget is in volumetric units. The output units (UNITVLOU) and conversion factor (FACTVLOU) for volume are specified by the user in the Budget Main Input File.

The stream reach budget tables for stream component version 5.0 provide information on the flows in and out of the reaches and change in storage at each stream reach as well as the impacts of other processes on stream flows such as small stream watershed flows, tile drainage, surface runoff, return flows, diversions and bypass flows. A positive value for storage change represents an increase in the storage and a negative value represents a decrease in the storage. The mass balance check for the reach is listed in the *Discrepancy* column. The *Diversion Shortage* column reports the difference between simulated diversions and the user specified diversion requirements. This term does not affect the mass balance in the reach but is listed as an informational term.

The following table defines each column in the stream reach budget table printed out to text file:

STREAM REACH BUDGET

COL. #	COLUMN NAME	DESCRIPTION
1	Time	Simulation date and time
2	Upstream Inflow (+)	Stream inflows to the reach which includes inflows listed in the Stream Inflow Data File and flows from upstream reaches

3	Downstream Outflow (–)	Stream flow leaving the reach and either entering another reach or exiting the modeled area
4	Change in Storage (–)	Storage change in the stream reach; a positive value represents an increase and a negative value represents a decrease
5	Tributary Inflow (+)	Surface flows from small stream watersheds to the reach
6	Tile Drain (+)	Inflows from tile drains
7	Runoff (+)	Direct runoff from rainfall into the reach
8	Return Flow (+)	Return flow of the irrigation water into streams
9	Gain from Groundwater (+)	Stream-groundwater interaction; a positive value denotes a gaining stream and a negative value indicates a losing stream
10	Gain from Lake (+)	Inflow from upstream lakes
11	Riparian ET (–)	Amount of water taken out of the stream to meet the evapotranspirative need of riparian vegetation
12	Diversion (–)	Diversions from the reach
13	Bypass Flow (–)	Net bypass flow within the reach; for example, the bypass flow from one stream node to another within the reach is the amount of water loss during the bypass process whereas bypass flow from a stream node within the reach to a different reach is the total amount bypassed from the stream reach
14	Discrepancy (=)	Error in the stream flow mass balance based on the preceding columns
15	Diversion Shortage	This column indicates whether the simulated stream flows are sufficient to meet the surface water diversion requirements; a value of zero indicates that stream flows are sufficient to meet the specified diversion requirements; a positive value represents the shortage of stream flows in a reach

If a DSS file is used for print-out, the following pathnames are used:

Part A:

IWFM_STRMRCH_BUD

Part B:

REACH *XXX* where *XXX* is the reach number

Part C:

VOLUME

Part D:

Start date of the time series depending on the values of the BDT and EDT variables (starting and ending date and time of budget print-out)

Part E:

Print-out interval for the stream reach budget as specified in the Budget Main Input File

Part F:

One of the following, depending on the output data (refer to the table above for further details):

i. *UPSTRM_INFLOW* (corresponds to column 2 in text output file)

ii. *DOWNSTRM_OUTFLOW* (corresponds to column 3 in text output file)

iii. *STORAGE_CHANGE* (corresponds to column 4 in text output file)

iv. *TRIB_INFLOW* (corresponds to column 5 in text output file)

v. *TILE_DRN* (corresponds to column 6 in text output file)

vi. *RUNOFF* (corresponds to column 7 in text output file)

vii. *RETURN_FLOW* (corresponds to column 8 in text output file)

viii. *GAIN_FROM_GW* (corresponds to column 9 in text output file)

ix. *GAIN_FROM_LAKE* (corresponds to column 10 in text output file)

x. *RIPARIAN_ET* (corresponds to column 11 in text output file)

xi. *DIVERSION* (corresponds to column 12 in text output file)

xii. *BYPASS* (corresponds to column 13 in text output file)

xiii. *DISCREPANCY* (corresponds to column 14 in text output file)

xiv. *DIVER_SHORTAGE* (corresponds to column 15 in text output file)

Stream Node Budget for Stream Component Versions 4.0 and 4.1

Stream node budgets are generated for stream nodes specified to be printed in the Budget Main Input File. The structure of the stream node budget is exactly the same as that of the stream reach budget for stream component versions 4.0 and 4.1. It should be noted that the budget flow terms for a stream node are for the part of the stream channel that is associated with that node which starts from the mid-point of the stream segment upstream of the node and ends at the mid-point of the stream segment downstream from the node.

For completeness, the following table defines each column in the stream node budget table printed out to text file:

STREAM NODE BUDGET

COL. #	COLUMN NAME	DESCRIPTION
1	Time	Simulation date and time
2	Upstream Inflow (+)	Stream inflows to the node which includes inflows listed in the Stream Inflow Data File and flows from upstream nodes
3	Downstream Outflow (–)	Stream flow leaving the node and either entering another node or exiting the modeled area
4	Tributary Inflow (+)	Surface flows from small stream watersheds to the node
5	Tile Drain (+)	Inflows from tile drains
6	Runoff (+)	Direct runoff from rainfall into the node
7	Return Flow (+)	Return flow of the irrigation water into the node
8	Gain from Groundwater (+)	Stream-groundwater interaction; a positive value denotes a gaining stream node and a negative value indicates a losing stream node
9	Gain from Lake (+)	Inflow from upstream lakes
10	Riparian ET (–)	Amount of water taken out of the stream to meet the evapotranspirative need of riparian vegetation
11	Diversion (–)	Diversions from the node
12	Bypass Flow (–)	Bypass flow from the node
13	Discrepancy (=)	Error in the stream flow mass balance based on the preceding columns
14	Diversion Shortage	This column indicates whether the simulated stream flows at the node are sufficient to meet the surface water diversion requirements; a value of zero indicates that stream flows are sufficient to meet the specified diversion requirements; a positive value represents the shortage of stream flows at the node

If a DSS file is used for print-out, the following pathnames are used:

Part A:

IWFM_STRMNODE_BUD

Part B:

NODE *XXX* where *XXX* is the stream node number

Part C:

VOLUME

Part D:

Start date of the time series depending on the values of the BDT and EDT variables (starting and ending date and time of budget print-out)

Part E:

Print-out interval for the stream node budget as specified in the Budget Main Input File

Part F:

One of the following, depending on the output data (refer to the table above for further details):

i. *UPSTRM_INFLOW* (corresponds to column 2 in text output file)

ii. *DOWNSTRM_OUTFLOW* (corresponds to column 3 in text output file)

iii. *TRIB_INFLOW* (corresponds to column 4 in text output file)

iv. *TILE_DRN* (corresponds to column 5 in text output file)

v. *RUNOFF* (corresponds to column 6 in text output file)

vi. *RETURN_FLOW* (corresponds to column 7 in text output file)

vii. *GAIN_FROM_GW* (corresponds to column 8 in text output file)

viii. *GAIN_FROM_LAKE* (corresponds to column 9 in text output file)

ix. *RIPARIAN_ET* (corresponds to column 10 in text output file)

x. *DIVERSION* (corresponds to column 11 in text output file)

xi. *BYPASS* (corresponds to column 12 in text output file)

xii. *DISCREPANCY* (corresponds to column 13 in text output file)

xiii. *DIVER_SHORTAGE* (corresponds to column 14 in text output file)

Stream Node Budget for Stream Component Version 5.0

Stream node budgets are generated for stream nodes specified to be printed in the Budget Main Input File. The structure of the stream node budget is exactly the same as that of the stream reach budget for stream component version 5.0. The stream node budget flow terms in stream component version 5.0 are defined for the stream segment upstream from the node; i.e. they represent flows at the stream segment between nodes *i* and *i–1*.

For completeness, the following table defines each column in the stream node budget table printed out to text file:

STREAM NODE BUDGET

COL. #	COLUMN NAME	DESCRIPTION
1	Time	Simulation date and time
2	Upstream Inflow (+)	Stream inflows to the node which includes inflows listed in the Stream Inflow Data File and flows from upstream nodes
3	Downstream Outflow (–)	Stream flow leaving the node and either entering another node or exiting the modeled area

4	Change in Storage (–)	Storage change in the stream reach; a positive value represents an increase and a negative value represents a decrease
5	Tributary Inflow (+)	Surface flows from small stream watersheds to the node
6	Tile Drain (+)	Inflows from tile drains
7	Runoff (+)	Direct runoff from rainfall into the node
8	Return Flow (+)	Return flow of the irrigation water into the node
9	Gain from Groundwater (+)	Stream-groundwater interaction; a positive value denotes a gaining stream node and a negative value indicates a losing stream node
10	Gain from Lake (+)	Inflow from upstream lakes
11	Riparian ET (–)	Amount of water taken out of the stream to meet the evapotranspirative need of riparian vegetation
12	Diversion (–)	Diversions from the node
13	Bypass Flow (–)	Bypass flow from the node
14	Discrepancy (=)	Error in the stream flow mass balance based on the preceding columns
15	Diversion Shortage	This column indicates whether the simulated stream flows at the node are sufficient to meet the surface water diversion requirements; a value of zero indicates that stream flows are sufficient to meet the specified diversion requirements; a positive value represents the shortage of stream flows at the node

If a DSS file is used for print-out, the following pathnames are used:

Part A:

IWFM_STRMNODE_BUD

Part B:

NODE *XXX* where *XXX* is the stream node number

Part C:

VOLUME

Part D:

Start date of the time series depending on the values of the BDT and EDT variables (starting and ending date and time of budget print-out)

Part E:

Print-out interval for the stream node budget as specified in the Budget Main Input File

Part F:

One of the following, depending on the output data (refer to the table above for further details):

i. *UPSTRM_INFLOW* (corresponds to column 2 in text output file)

ii. *DOWNSTRM_OUTFLOW* (corresponds to column 3 in text output file)

iii. *STORAGE_CHANGE* (corresponds to column 4 in text output file)

iv. *TRIB_INFLOW* (corresponds to column 5 in text output file)

v. *TILE_DRN* (corresponds to column 6 in text output file)

vi. *RUNOFF* (corresponds to column 7 in text output file)

vii. *RETURN_FLOW* (corresponds to column 8 in text output file)

viii. *GAIN_FROM_GW* (corresponds to column 9 in text output file)

ix. *GAIN_FROM_LAKE* (corresponds to column 10 in text output file)

x. *RIPARIAN_ET* (corresponds to column 11 in text output file)

xi. *DIVERSION* (corresponds to column 12 in text output file)

xii. *BYPASS* (corresponds to column 13 in text output file)

xiii. *DISCREPANCY* (corresponds to column 14 in text output file)

xiv. *DIVER_SHORTAGE* (corresponds to column 15 in text output file)

Diversion Detail Report

This data file reports surface water deliveries and diversions, as well as the difference between the required and actual deliveries and diversions for each diversion listed for processing in the Budget Main Input File. Each report title indicates the stream component version number, diversion identification number, stream node from which the diversion is taken and the unit of output data. If the diversion is imported from outside the model area, the report title shows the stream node where the diversion is taken from as zero.

Each diversion is associated with a required diversion amount, along with recoverable and non-recoverable losses, and a required delivery amount. Diversions can be delivered to outside the model area, to an individual element, a group of elements or to a subregion. The required diversion and delivery can either be specified using the Diversion Data File in the Simulation part of IWFM, or they can be computed dynamically using the supply adjustment feature of IWFM to meet the water demands in the delivery destination. The full amounts of required diversions and deliveries can only be achieved if there is enough flow at the stream nodes where the diversions are taken out. If there is not enough flow at the stream nodes to meet the entire diversion requirements, then the actual diversions and deliveries will be less. The diversion detail reports list the actual diversions and deliveries as well as the shortages.

The actual delivery and delivery shortage columns also list the delivery destinations. The destination can be a subregion, an element, a group of elements or the delivery can be made to outside the model domain. In the latter case, the delivery destination is listed as subregion 0.

The following list defines the columns in the diversion details report as printed to a text file:

DIVERSION DETAIL REPORT

COL. #	COLUMN NAME	DESCRIPTION
1	Time	Simulation date and time
2	Actual Diversion	Actual diversion amount which may be less than the required diversion amount
3	Diversion Shortage	Amount of diversion that is not met due to lack of water at the stream node where the diversion takes place; if this term is zero then the actual diversion is equal to the required diversion
4	Recoverable Loss	Portion of the actual diversion that is lost due to seepage to the groundwater from the diversions canals
5	Non Recoverable Loss	Portion of the actual diversion that is lost to evapotranspiration
6	Actual Delivery to *XXX*	Actual delivery to the delivery destination which may be less than the required delivery; *XXX* is a qualifier for the delivery destination which can be a subregion, element, element group or outside the model area
7	Delivery Shortage for *XXX*	Amount of delivery that is not met due to lack of water at the stream node where the corresponding diversion takes place; if this term is zero then actual delivery is equal to the required delivery (*XXX* is a qualifier for the delivery destination)

If a DSS file is used for print-out, the following pathnames are used:

Part A:

IWFM_DIVER_DETAIL

Part B:

DIVER*XXX*_SN*YYY* where *XXX* is the diversion identification number and *YYY* is the stream node from which the diversion originates (*YYY* is set to 0 for diversions that originate from outside the model area)

Part C:

VOLUME

Part D:

Start date of the time series depending on the values of the BDT and EDT variables (starting and ending date and time of budget print-out)

Part E:

Print-out interval for the diversion detail report as specified in the Budget Main Input File

Part F:

One of the following, depending on the output data (refer to the table above for further details):

i. *ACT_DIV* (corresponds to column 2 in text output file)

ii. *DIV_SHORT* (corresponds to column 3 in text output file)

iii. *RECVRBL_LOSS* (corresponds to column 4 in text output file)

iv. *NON_RCVRBL_LOSS* (corresponds to column 5 in text output file)

v. *ACT_DELI*_TTT_XXX (corresponds to column 6 in text output file; TTT is the delivery destination type and XXX is the delivery destination identification number)

vi. *DELI_SHORT*_TTT_XXX (corresponds to column 7 in text output file; TTT is the delivery destination type and XXX is the delivery destination identification number)

Lake Budget

Lakes are modeled to determine their interaction with the groundwater and the stream system. The lake budget provides the lake water balance, lake storage and lake surface elevation at the end of each time interval. The title lines for each lake budget include IWFM version number, name and area of the lake, and the unit of output data.

The following list defines the columns in the lake budget as printed to a text file:

LAKE BUDGET

COL. #	COLUMN NAME	DESCRIPTION
1	Time	Simulation date and time
2	Beginning Storage (+)	Lake storage at the beginning of the time step
3	Ending Storage (–)	Lake storage at the end of the time step
4	Flow from Upstream Lake (+)	Inflow from lake(s) that are located upstream of the lake
5	Flow from Streams (+)	Inflow into the lake through streams flowing directly into the lake
6	Flow from Bypasses (+)	Inflow into the lake through bypasses

7	Runoff (+)	Rainfall runoff into the lake
8	Return Flow (+)	Inflow into the lake due to urban and agricultural applied water return flow
9	Precipitation (+)	Amount of precipitation that falls on the lake surface
10	Gain from Groundwater (+)	Lake-groundwater interaction; a positive value indicates flow from the groundwater into the lake, whereas a negative value indicates flow from the lake to the groundwater system
11	Lake Evaporation (–)	Evaporation from the lake surface
12	Lake Outflow (–)	Spill from lake as the lake surface elevation raises above the maximum lake elevation
13	Discrepancy (=)	Mass balance error for the lake based on the data listed in preceding columns
14	Lake Surface Elevation	Lake elevation that corresponds to the simulated lake storage

If a DSS file is used for print-out, the following pathnames are used:

Part A:

IWFM_LAKE_BUD

Part B:

TTT where *TTT* is the name of the lake specified by the user

Part C:

One of the following, depending on the output:

i. *ELEV*

ii. *VOLUME*

Part D:

Start date of the time series depending on the values of the BDT and EDT variables (starting and ending date and time of budget print-out)

Part E:

Print-out interval for the lake budget as specified in the Budget Main Input File

Part F:

One of the following, depending on the output data (refer to the table above for further details):

i. *BEGIN_STORAGE* (corresponds to column 2 in text output file)

ii. *END_STORAGE* (corresponds to column 3 in text output file)

iii. *FLOW_FROM_UP_LAKE* (corresponds to column 4 in text output file)

iv. *FLOW_FROM_STRM* (corresponds to column 5 in text output file)

v. *FLOW_FROM_BYPASS* (corresponds to column 6 in text output file)

vi. *RUNOFF* (corresponds to column 7 in text output file)

vii. *RETURN_FLOW* (corresponds to column 8 in text output file)

viii. *PRECIP* (corresponds to column 9 in text output file)

ix. *GAIN_FROM_GW* (corresponds to column 10 in text output file)

x. *EVAPOTR* (corresponds to column 11 in text output file)

xi. *OUTFLOW* (corresponds to column 12 in text output file)

xii. *DISCREPANCY* (corresponds to column 13 in text output file)

xiii. *SURFACE_ELEV* (corresponds to column 14 in text output file)

Budget Output Files from Root Zone Component

The root zone component can generate several different budget binary files to be processed by the Budget post-processor. The component of these budget output files are discussed in detail in the document titled *IDC-2015 Theoretical Documentation and User's Manual*.

One of the budget binary files that the root zone component generates is the Land and Water Use Budget which lists the water demands for urban and agricultural lands, and the water supplies (in terms of stream diversions, pumping or root water uptake from groundwater) to meet these demands. In IWFM, it is possible that the water demand may not be met fully if there are water shortages in the modeled hydrologic system, or there may be surplus water supplies with respect to the simulated water demands. In short, water demand and supply may not be equal in IWFM (this is not the case in IDC since IDC only simulates the root zone flow processes and assumes that all water demand is met since it has no "knowledge" of pumping or diversions). The Land and Water Use Budget file also lists the water supply shortages or surpluses in meeting the water demand at every simulation time step.

It should be noted that the accumulation of the water demand listed in the Land and Water Use Budget over time is not a linear process and can lead to incorrect results if performed carelessly, particularly when shortages exist. For instance, a model with daily time step will produce daily water demands. The user might be tempted to transfer these daily values to a spreadsheet application and try to calculate monthly or annual water demands by direct summation of the daily values. This approach will result in incorrect monthly or annual demands because it will involve double-counting of water demands if shortages occur in two or more consecutive simulation time steps. To avoid this problem, IWFM Budget post-processor uses special algorithms to detect and avoid double-counting of water demands when accumulating these values. Therefore, it is strongly recommended that Budget post-processor is used in accumulating land and water use budget data.

Small Watershed Budget

Small stream watersheds surrounding the study domain are modeled as dynamic boundary conditions, and contribute surface water and groundwater flows to the model domain. The small stream watershed budget provides information on the root zone and groundwater components of the small watersheds. It also lists the small watersheds' net surface and subsurface flow contributions to the model domain. The data is listed for each of the small watersheds listed for processing in the Budget Main Input File. The title for each small watershed includes IWFM version number, small stream watershed identification number, watershed area and the unit of output values.

The following list defines the columns in the small watershed budget as printed to a text file:

SMALL WATERSHED FLOW COMPONENTS

COL. #	COLUMN NAME	DESCRIPTION
1	Time	Simulation date and time
Root Zone		
2	Precipitation	Amount of precipitation that falls on the small watershed
3	Runoff	Rainfall runoff generated by precipitation

4	Beginning Storage (+)	Amount of moisture stored in the root zone at the beginning of the time step
5	Infiltration (+)	Amount of precipitation that infiltrates into the root zone and contributes to the root zone moisture storage; it is equal to Precipitation (column 2) less Infiltration (column 3)
6	Actual ET (–)	Actual evapotranspiration occurring at the small watershed
7	Deep Percolation (–)	Vertical flow that leaves the root zone at the bottom and becomes recharge to the groundwater system underlying the small watershed
8	Ending Storage (–)	Amount of moisture storage in the root zone at the end of the time step
9	Discrepancy (=)	Mass balance error check for the moisture storage in the root zone based on the data listed in columns 4 through 8
Groundwater		
10	Beginning Storage (+)	Amount of water stored in the groundwater system of the small watershed at the beginning of the time step
11	Recharge (+)	Vertical flow that leaves the root zone at the bottom and becomes recharge to the groundwater; its magnitude is equal to Deep Percolation (column 7)
12	Base Flow (–)	Amount of groundwater flow that leaves the small watershed and contributes to the groundwater system of the modeled domain
13	GW Return Flow (–)	Amount of groundwater that seeps back onto the land surface and leaves the small watershed as surface runoff
14	Ending Storage (–)	Amount of water stored in the groundwater system of the small watershed at the end of the time step
15	Discrepancy (=)	Mass balance error check for the groundwater storage in the small watershed based on the data listed in columns 10 through 14
Surface Outflow		
16	Total Surface Outflow (+)	Total amount of surface flow that leaves the small watershed and flows into the model domain; it is equal to the Runoff (column 3) plus GW Return Flow (column 13)
17	Percolation to GW (–)	Amount of surface flow from small watershed that percolates into the groundwater underlying the model domain on its way to a modeled stream node

18	Net Stream Inflow (=)	Amount of surface flow from the small watershed that actually contributes to the flow in a modeled stream node; it is equal to the Total Surface Flow (column 16) less the Percolation to GW (column 17)
19	Total GW Inflow	The net flow contribution from the small watershed to the groundwater system underlying the model domain; it is equal to the Base Flow (column 12) plus Percolation to GW (column 17)

If a DSS file is used for print-out, the following pathnames are used:

Part A:

IWFM_SWSHED_BUD

Part B:

WSHED_*XXX* where *XXX* is the small watershed number

Part C:

VOLUME

Part D:

Start date of the time series depending on the values of the BDT and EDT variables (starting and ending date and time of budget print-out)

Part E:

Print-out interval for the small stream watershed flow components as specified in the Budget Main Input File

Part F:

One of the following, depending on the output data (refer to the table above for further details):

i. *PRECIP* (corresponds to column 2 in text output file)

ii. *RUNOFF* (corresponds to column 3 in text output file)

iii. *RZ_BEGIN_STOR* (corresponds to column 4 in text output file)

iv. *INFILTR* (corresponds to column 5 in text output file)

v. *ET* (corresponds to column 6 in text output file)

vi. *DEEP_PERC* (corresponds to column 7 in text output file)

vii. *RZ_END_STOR* (corresponds to column 8 in text output file)

viii. *RZ_DISCREPANCY* (corresponds to column 9 in text output file)

ix. *GW_BEGIN_STOR* (corresponds to column 10 in text output file)

x. *RECHARGE* (corresponds to column 11 in text output file)

xi. *BASEFLOW* (corresponds to column 12 in text output file)

xii. *GW_RTRN_FLOW* (corresponds to column 13 in text output file)

xiii. *GW_END_STOR* (corresponds to column 14 in text output file)

xiv. *GW_DISCREPANCY* (corresponds to column 15 in text output file)

xv. *TOTAL_SRFC_FLOW* (corresponds to column 16 in text output file)

xvi. *PERC_TO_GW* (corresponds to column 17 in text output file)

xvii. *NET_STRM_INFLOW* (corresponds to column 18 in text output file)

xviii. *TOTAL_GW_INFLOW* (corresponds to column 19 in text output file)

Unsaturated Zone Budget

An unsaturated zone budget table is created for each subregion that is listed for processing in the Budget Main Input File. The title printed for each subregional unsaturated zone budget includes IWFM version number, subregion name given by the user, the unit of data columns and the area of the subregion. The output units and the conversion factors are specified by the user in the Budget Main Input File.

The unsaturated zone budget reports the inflows and outflows as well as the beginning and ending moisture storage. The inflow to the unsaturated zone is the deep percolation that leaves the root zone above, and the outflow from the unsaturated zone is the net deep percolation which becomes recharge to the underlying aquifer system.

The following list describes the columns in the unsaturated zone budget table as printed to a text file:

UNSATURATED ZONE BUDGET

COL. #	COLUMN NAME	DESCRIPTION
1	Time	Simulation date and time
2	Beginning Storage (+)	Total moisture storage in the unsaturated zone at the beginning of the time step
3	Ending Storage (–)	Total moisture storage in the unsaturated zone at the end of the time step
4	Deep Percolation (+)	Vertical moisture flow that leaves the root zone and contributes to the unsaturated zone
5	Net Deep Percolation (+)	Vertical flow that leaves the unsaturated zone at the bottom and becomes recharge to the underlying groundwater
6	Discrepancy (=)	Error in the unsaturated zone mass balance based on the preceding columns

If a DSS file is used for print-out, the following pathnames are used:

Part A:

IWFM_UNSATZONE_BUD

Part B:

TTT (SR*XXX*) where *TTT* is the name of the subregion and *XXX* is the subregion number

Part C:

VOLUME

Part D:

Start date of the time series depending on the values of the BDT and EDT variables (starting and ending date and time of budget print-out)

Part E:

Print-out interval for the small stream watershed flow components as specified in the Budget Main Input File

Part F:

One of the following, depending on the output data (refer to the table above for further details):

i. *BEGIN_STORAGE* (corresponds to column 2 in text output file)

ii. *END_STORAGE* (corresponds to column 3 in text output file)

iii. *DEEP_PERC* (corresponds to column 4 in text output file)

iv. *NET_DEEP_PERC* (corresponds to column 5 in text output file)

v. *DISCREPANCY* (corresponds to column 6 in text output file)

6. Running IWFM

Running IWFM is a three step procedure the first time the model is run for a specific application. The pre-processing program is executed to set geometric, hydrologic and stratigraphic characteristics of the model domain. The pre-processing information is used, in conjunction with boundary conditions, initial conditions, and hydrologic data to run the simulation model. The binary output generated from IWFM simulation is then processed into tabular form using the Budget and Z-Budget executable programs. It is not necessary to execute the pre-processor for subsequent runs of a specific study area, given the characteristics of the domain are the same. Simply use the binary file generated in the previous Pre-processor run as input to the new Simulation run.

To run IWFM, install a copy of the Pre-processor, Simulation, Budget and Z-Budget executable programs, as well as the input files necessary to run each portion of the program for a specific application. Figure 6.1 is a suggested way to organize your files within a folder structure.

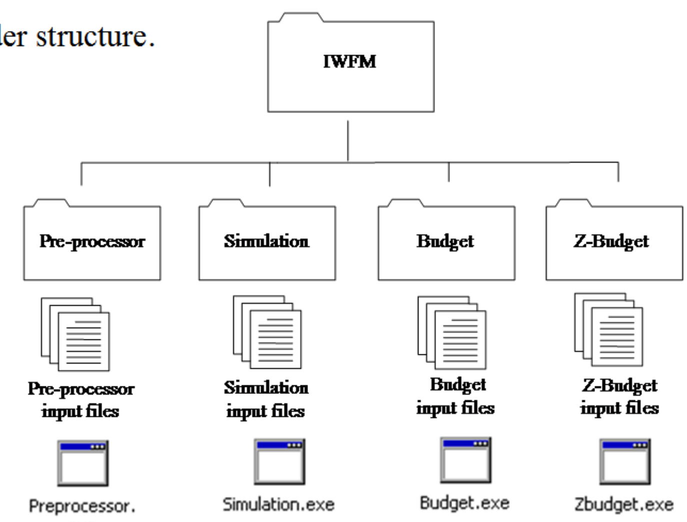
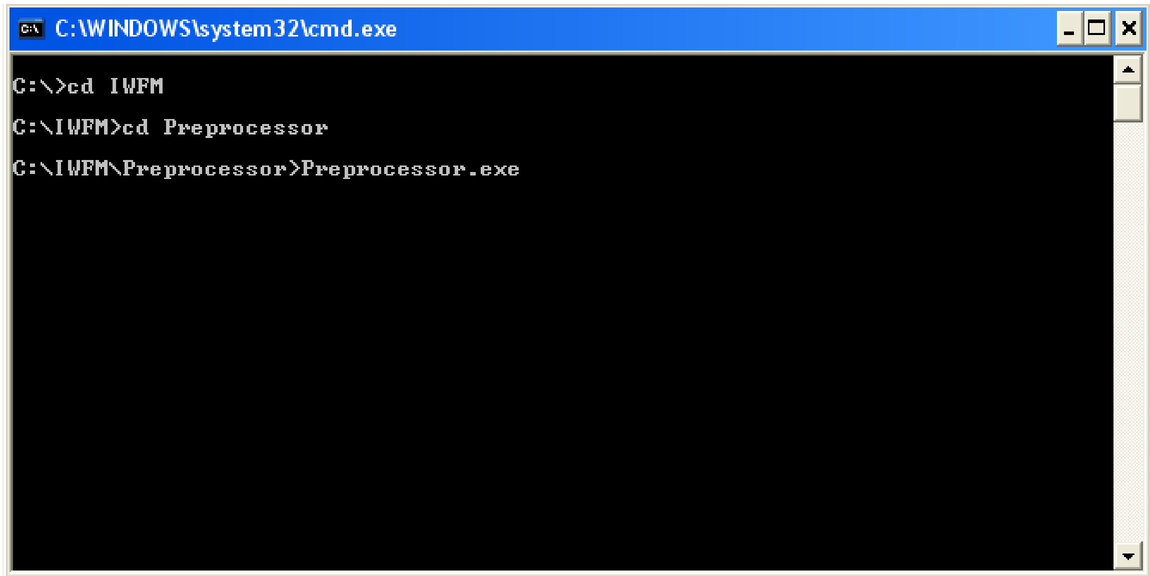
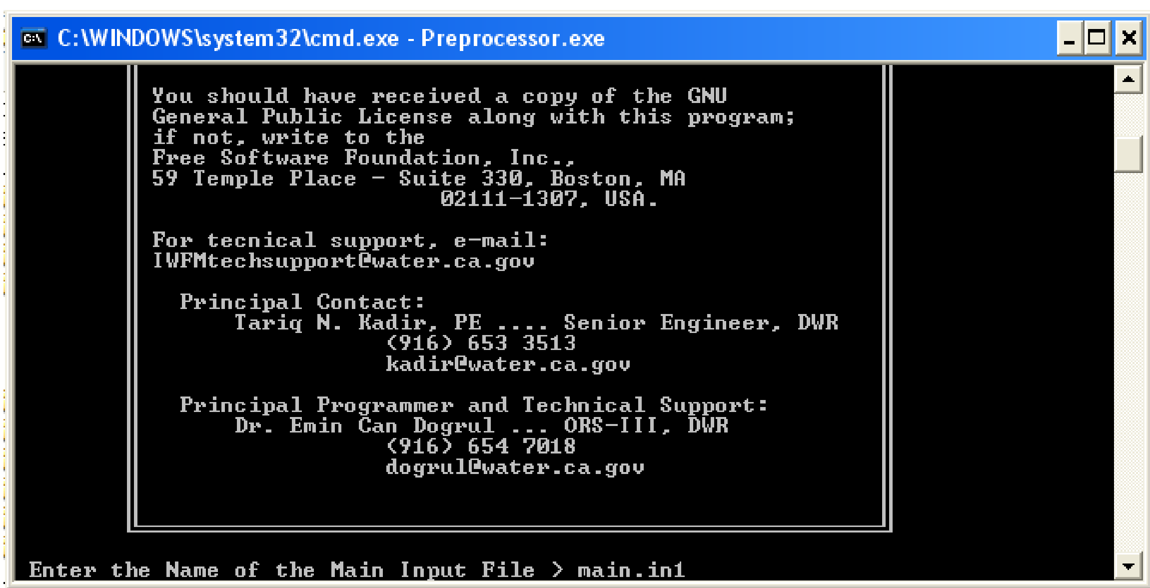


Figure 6.1 Suggested organization of IWFM folder structure

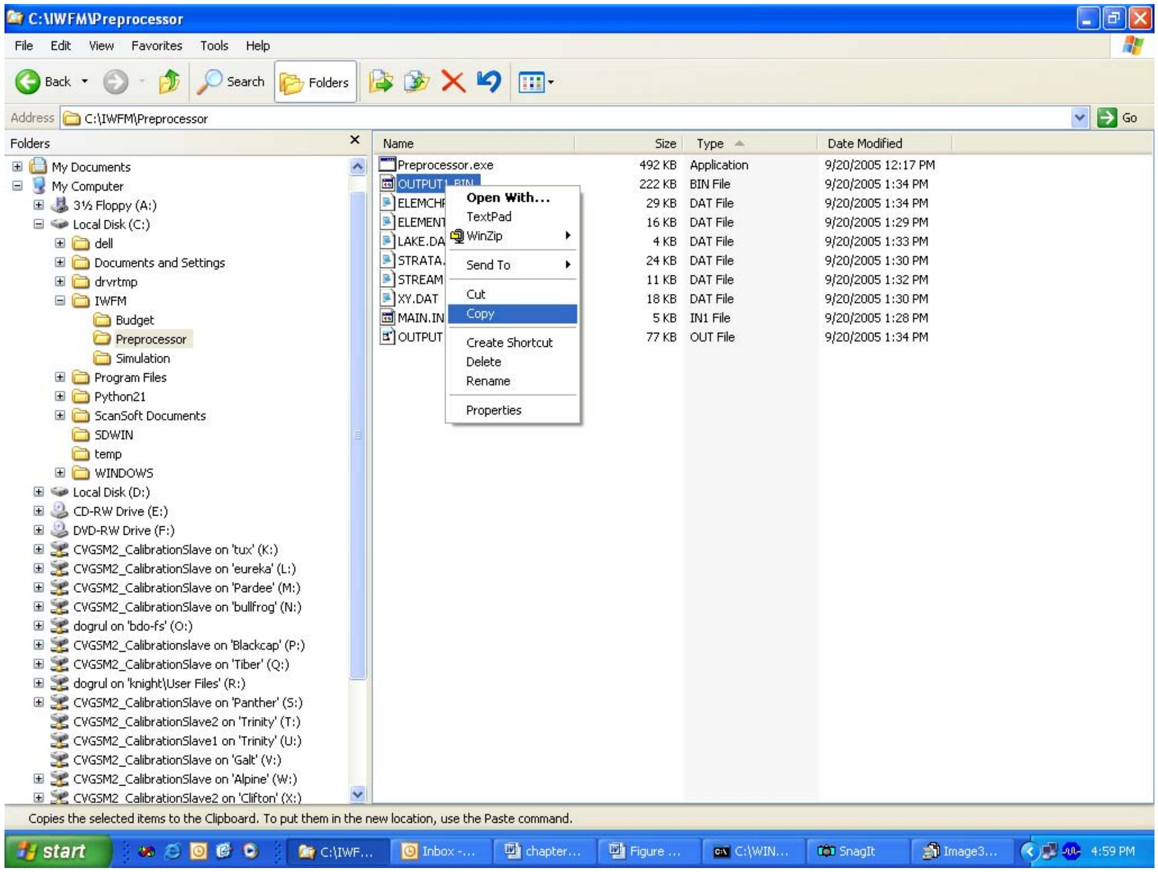
The folder structure illustrated in Figure 6.1 is used in the explanation of how to run IWFM. Once the folder structure is organized, open an MS-DOS prompt window, navigate to the directory that contains the IWFM Pre-processor executable, and enter the executable name.



The Pre-processor will then prompt the user to enter the main input control file.

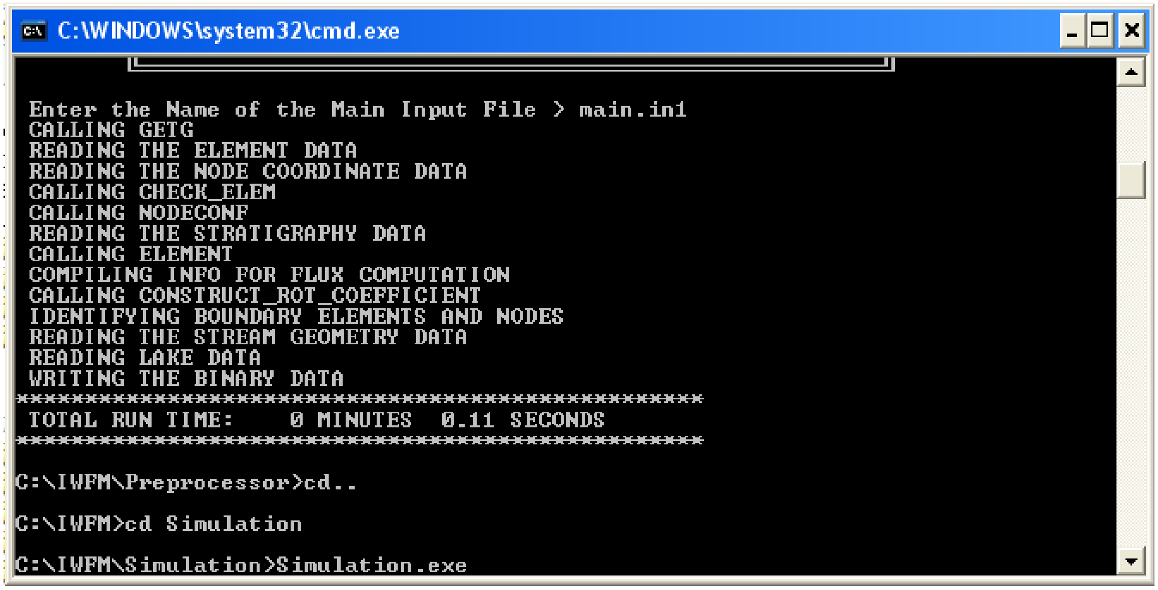


Upon completion of running the Pre-processor, the user must copy the binary output generated to the Simulation folder.

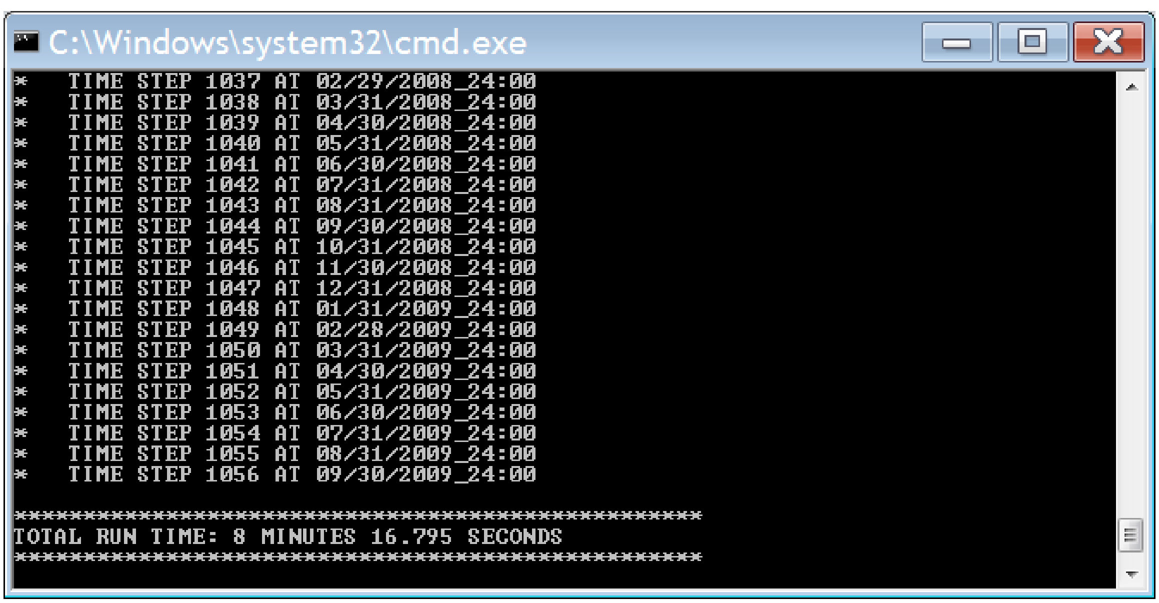


Given that the Simulation folder already includes the executable program and necessary input files, pasting a copy of the binary output file generated from the Pre-processor is the last step before running the simulation portion of IWFM.

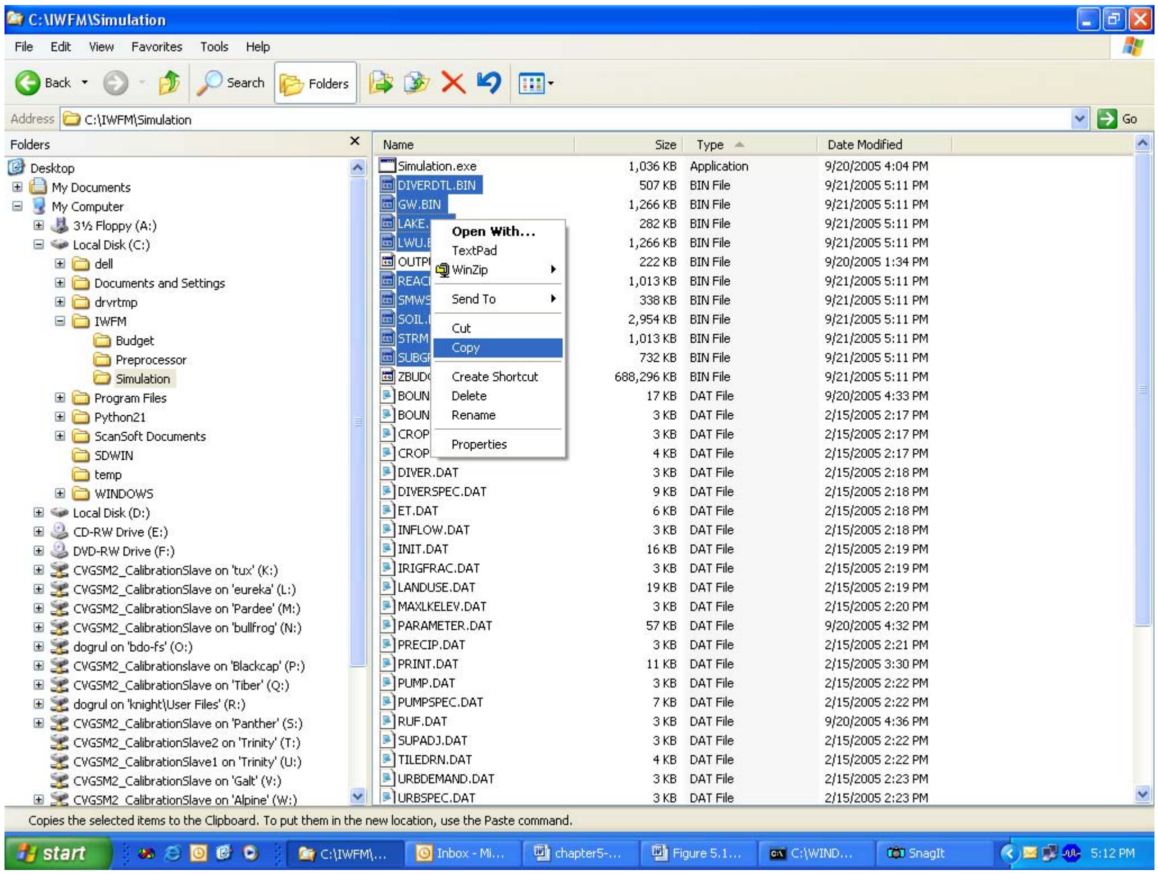
Within the MS-DOS prompt window, navigate to the Simulation folder, and enter the Simulation executable name.



The program then prompts the user to specify the main input file for Simulation. Once Simulation is completed, the program will specify the total run time required for the simulation.



The next step is to process the information generated from Simulation into tables. Copy relevant binary files generated in the Simulation and paste them into the Budget and Z-Budget folders, as shown below.



Running the Budget and Z-Budget is done in the same manner as running the first two portions of the IWFM. The user must navigate to the relevant folder (that contains the files necessary to run the executable), execute the program, and provide the main input file name. The Budget and Z-Budget executable programs organize and tabulate the Simulation output.

Compilation of IWFM requires all source code and a Fortran compiler. The California Department of Water Resources (DWR) has used Intel Visual Fortran Composer XE for the development and testing of this version of IWFM and supplies technical support on this version. However, DWR does not provide technical support for versions of IWFM modified by other users.