EFDC+ Computer Implementation Guide

Release 8.5.0

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CHAPTER ONE

INTRODUCTION

One of the purposes of this guide is to provide users and developers information about how to build, run, and develop the EFDC+ code. Additionally, there will be discussion on how to setup a basic EFDC+ model and post process the results. Finally, several sample EFDC+ models will be provided.

1.1 Getting Started

The EFDC+ source code and associated utilities can be access by cloning the repository from the EFDC+ GitHub repository. From the command line execute the following:

```
git clone https://github.com/dsi-llc/EFDCPlus
```

After cloning the EFDC+ repository the folders listed below will be available under the root directory.

EFDC - Contains source code to build EFDC+, sample executables for different build options.

NetCDFLib - Necessary library files for building EFDC+ so it can write NetCDF files out.

GridGenerator - Contains the executable for the simple Grid Generator for EFDC+

GetEFDC - Contains source code for building utility that helps extract EFDC+ formatted binary time series data.

WASP - Provides some files necessary for linkage with the WASP code (advanced user feature).

SampleModels - Contains several sample EFDC+ models.

docs - Contains the computer implementation guide and the theory documentation for EFDC+.

1.1.1 Build Instructions

Building EFDC+ from the source code is most easily carried out with Visual Studio (VS). The Intel Fortran compiler is the preferred compiler and the most tested for building EFDC+. The simplest build method is to open the VS solution file that comes with the source code. The solution file is located in the root directory of the `EFDC` folder and will have the '.sln' extension. The following discussion assumes the user is running Windows 7 (or greater) and has access to Visual Studio 2015 (or greater). These tools have been most throughly tested. However, it is likely that EFDC+ can be built with other versions of the Intel compiler and Visual Studio.

In addition to the source code, pre-built executables are available under each of the following folders:

- EFDC/DebugSP64/
- EFDC/ReleaseDP64/
- EFDC/ReleaseSP/
- EFDC/ReleaseSP64/

Next, the differences in each of the build configurations will be explained.

Build Configurations

The different build configurations are managed by VS. Visual studio provides a convenient way for maintaining different build configurations for the same project. The build configurations can be inspected by clicking the *Project* tab in the top of VS and selecting *properties*. Each of the build configurations is listed below:

- DEBUG SP
- DEBUG SP 64
- DEBUG DP
- DEBUG DP 64
- Release SP
- Release SP 64
- Release DP
- Release DP 64

For each of the bulleted build configurations listed above, if *64* is not specified, the executables is assumed to be compiled for a 32 bit system. The table below explains the shorthand used to signify the differences in build configurations.

SP	Single Precision
DP	Double Precision
64	64 bit compilation

OpenMP Compilation

Compilation of EFDC+ with OpenMP allows multithreading, which typical results in a reduction of the total calculation time. The build configuration requires specifying several things in the VS *Properties* page. These settings are already configured in the builds provided. However, the details are given below in case a user wants to make modifications or use an OpenMP library besides Intel's.

Under: Fortran\Preprocessor

OpenMP Conditional Compilation	Yes

Under: Fortran\Preprocessor

Process OpenMP Directives	Generate Parallel Code (/Qopenmp)

Under: Fortran\Libraries

Runtime Library	Multithreaded DLL (/libs.dll /threads)

Under: Linker\Input

Additional Dependencies	libiomp5md.lib

Below is a summary of the Intel compiler suite and Visual Studio versions that are known to work.

Intel Compiler Versions Tested

- Intel 15
- Intel 19.3
- Intel 19.4

Visual Studio Versions Tested

- 2015
- 2019 (Preview 4)

1.1.2 Running

Running EFDC+ on a local computer can be done in several different ways. By far the simplest way is to use the EFDC Explorer. The EFDC Explorer is a Graphical User Interface (GUI) that allows EFDC+ models to be visualized and run with ease. Details on the EFDC Explorer can be found here. Alternatively, the EFDC executable can be run through the command prompt or using a batch script.

For this discussion it is assumed the user is not using the EFDC Explorer.

Execution Options

- Serial: EFDC+ can be run simply on a single core of a user's desktop. No special compilation is required for this option.
- Multithreaded: If the executable was compiled with OpenMP libraries, multiple cores on a single machine may be utilized.

Multithreading with OpenMP

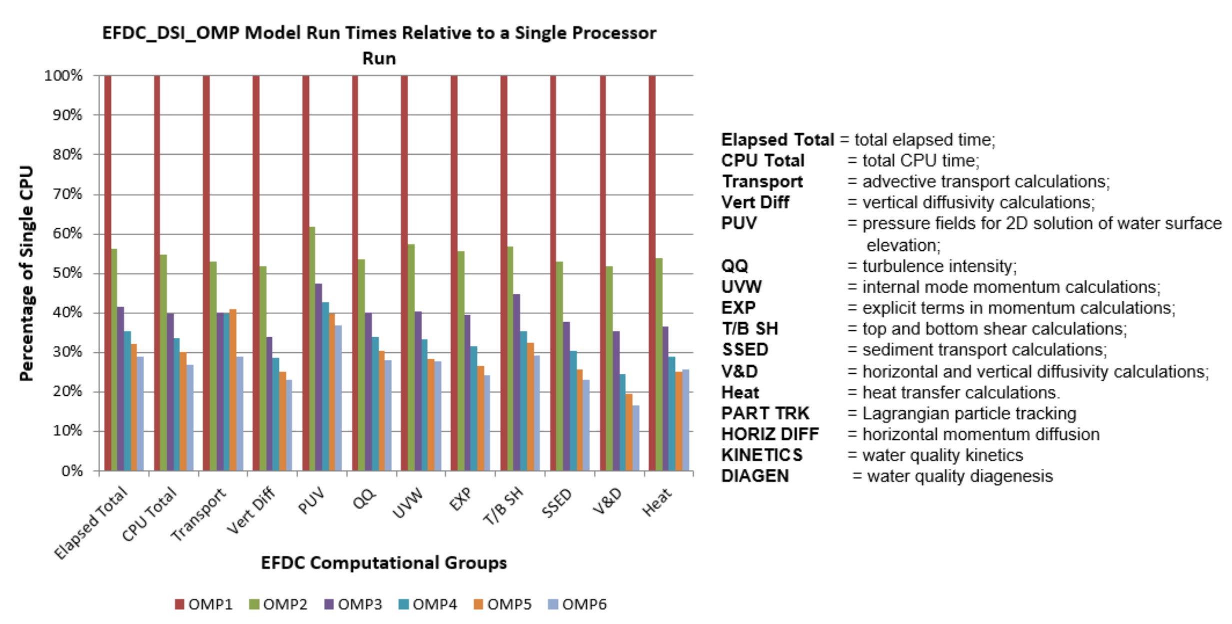
With the advent of Intel processors with multiple cores, various technologies have been employed to take advantage of this increased computational power. With DSI's knowledge of the EFDC+ code and its structure, the approach selected to apply multi-threading to EFDC was OpenMP.

Additionally, Intel has implemented Hyper-Threading for their multi-core implementation. This allows a program to utilize two threads for each physical core.

Tip: Since two threads share a single core, for computationally intensive applications, only using the number of threads equal to the number of cores provides the best throughput

OpenMP Performance

The performance of the different routines within EFDC+ using OpenMP is highlighted in the figure below.



It is DSI's commitment that the EFDC_DSI_OMP models produce exactly the same results regardless of how many threads are used. Model comparisons demonstrate model differences are equal to zero i.e. model results are exactly the same, within model precision.

Executing and EFDC+ Run

Once an EFDC+ executable is available, it can be run directly through the command prompt or through simple batch script. A sample of batch script is given below:

```
SET KMP_AFFINITY=granularity=fine,compact,1,0

TITLE Sample Title of the Problem

CD "C:\Path\To\WorkingDirectory\"

"C:\Path\To\Exectuable\EFDCPlus.exe" -NT2 -NOP
```

Each line the script is described in greater detail below.

- SET KMP_AFFINITY=granularity=fine,compact,1,0 - Specifies an environment variable that binds OpenMP threads to physical processing units. This generally gives the best performance. For additional information on what this environment variable is doing, go to this article, written by Intel.
- TITLE: A title is optional but can be helpful if you are running multiple calculations at the same time. This title will show up at the top of the command prompt.
- CD: This command precedes the location of your *Working Directory*, which is the folder containing your EFDC+ inputs.
- The path to the location of the executable must be known and specified in the script.

- -NT2: This command line argument after the executable specifies the number of threads to use. In this case only 2 are requested, but one could easily specify 3,4,5, etc. to run more threads.

Important: Do not specify a number of threads greater than the number of logical cores available on your computer.

Output Screen

The EFDC+ end of run screen contains the CPU usage for the run. The CPU usage is reported as the Total CPU/# Cores. This statistic is best for interpreting impacts to run times. A sample of an output screen is given below.

```
**********************************************************************
***          This EFDCPlus Run used:    4 thread(s)               ***
**********************************************************************

***TIMING (HOURS)
T HDMT       =  0.016  T SSEDTOX    =  0.000     0.000
T P&UV VELS =  0.001  T CONG GRAD =  0.000
T EXPLICIT  =  0.001  T C VERT V&D=  0.000
T CALC UVW  =  0.001  T TURB QQQ  =  0.001
T T&B SHEAR =  0.000  T HEAT PRCS =  0.000
T PART TRK  =  0.000  T ADV TRANSP=  0.001
T HORIZ DIF =  0.000  T VERT DFUSN=  0.000
WQ KINETICS =  0.001  WQ ADV TRANS=  0.004
WQ DIAGEN   =  0.000  WQ VERT DIFF=  0.001
CPU USER    =  0.015  CPU SYSTEM  =  0.001
ELAPSED TIME=  0.018  CPU TIME    =  0.017

TAP ANY KEY TO EXIT EFDC_DSI
```

1.2 Cartesian Grid Generator User Guide

A simple GUI has been provided to help generate and visualize EFDC+ grids. Additionally, this grid generator can write out the basic input file necessary for running EFDC+. Next, an overview of how to use this grid generator will be provided.

To launch the grid generator open the `GridGenerator.exe` executable under the folder `GridGenerator`.

The interface of the tool is shown in Figure 1. To create a grid, the user can click *File* then select *New Model* or click the grid symbol from the interface as shown in Figure 2.

Figure 1. Cartesian Grid Generator Interface.

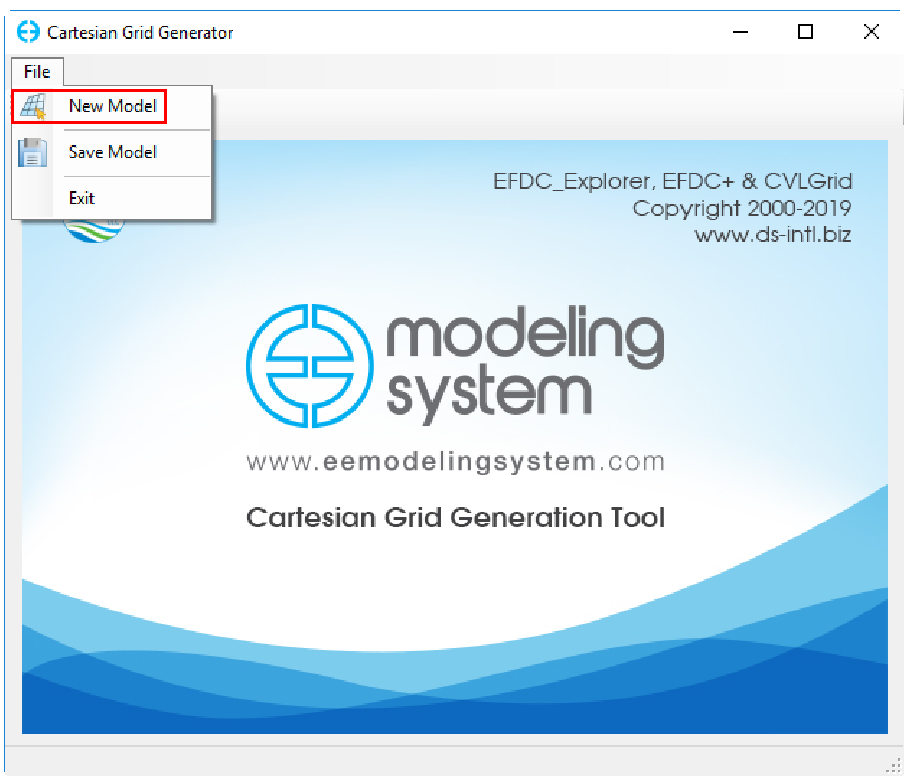


Figure 2. Create a New Model.**

The *Grid Generator* form will be displayed as shown in Figure 3.

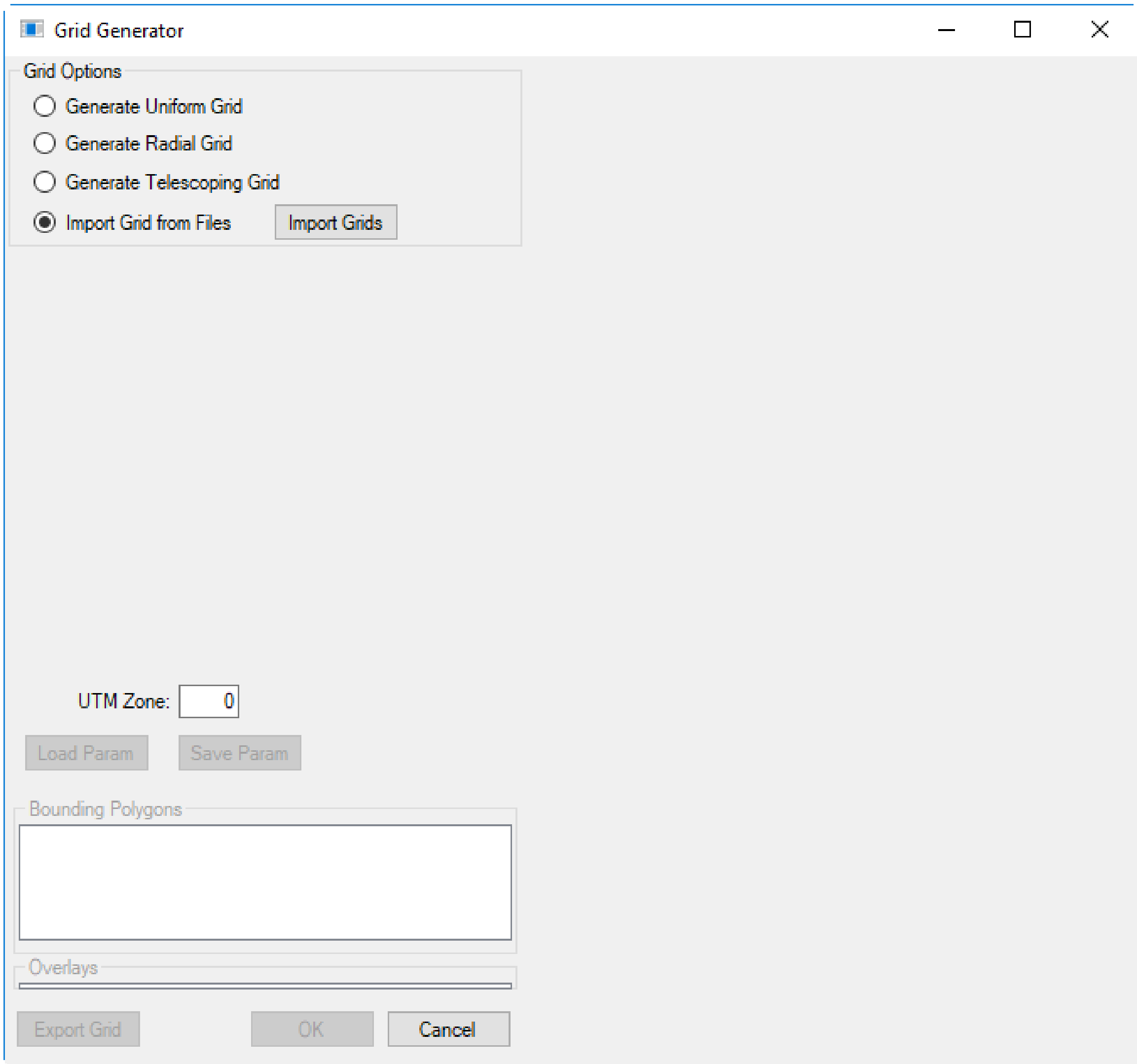


Figure 3. Grid Options.

There are three options for generating a new grid and one option for importing existing grid files. The options are: *Generate Uniform Grid, Generate Radial Grid, Generate Telescoping Grid,* and *Import Grid from Files.* Each of these options is described below:

1.2.1 Generate Uniform Grid

This option allows user to generate a Cartesian grid. When the radial button for this option is selected, the *Uniform Grid Options* frame is shown. In this frame the user needs to enter the *Lower-Left* and *Upper-Right* coordinates, these two corner points will temporarily limit the grid domain. Next, enter cell size in X and Y directions, which will define cell dimensions (width and length in meters of a cell), then click the calculator symbol for *Number of Cells*, the number of cells will be updated. Another option is that the user enters the number of cells desired first then click the calculator symbol for *Cell Size*, and the dimensions of the cell will be updated.

Rotation Angle: The user should enter angle in degrees which for the grid should be rotated.

UTM Zone: This is the Universal Transverse Mercator (UTM) zone, the user can enter the zone number, from 1 to 60.

The user can then click the *Generate* button, and the grid will appear on the right window as shown in Figure 4.

The user can also change the size of the domain by holding left-mouse click (LMC) on navigation points (P1, P2, P3, P4) and shifting to another place in the window. The values of fields of the *Uniform Grid Options* frame are updated as well.

To save the information entered into the *Uniform Grid Options* frame select the *Save Parameters* button. A *Save As* form will be displayed in order to enter a file name, then click the *Save* button to save as shown in Figure 5. This parameter settings file can be reused at another time by clicking on the *Load Param* button.

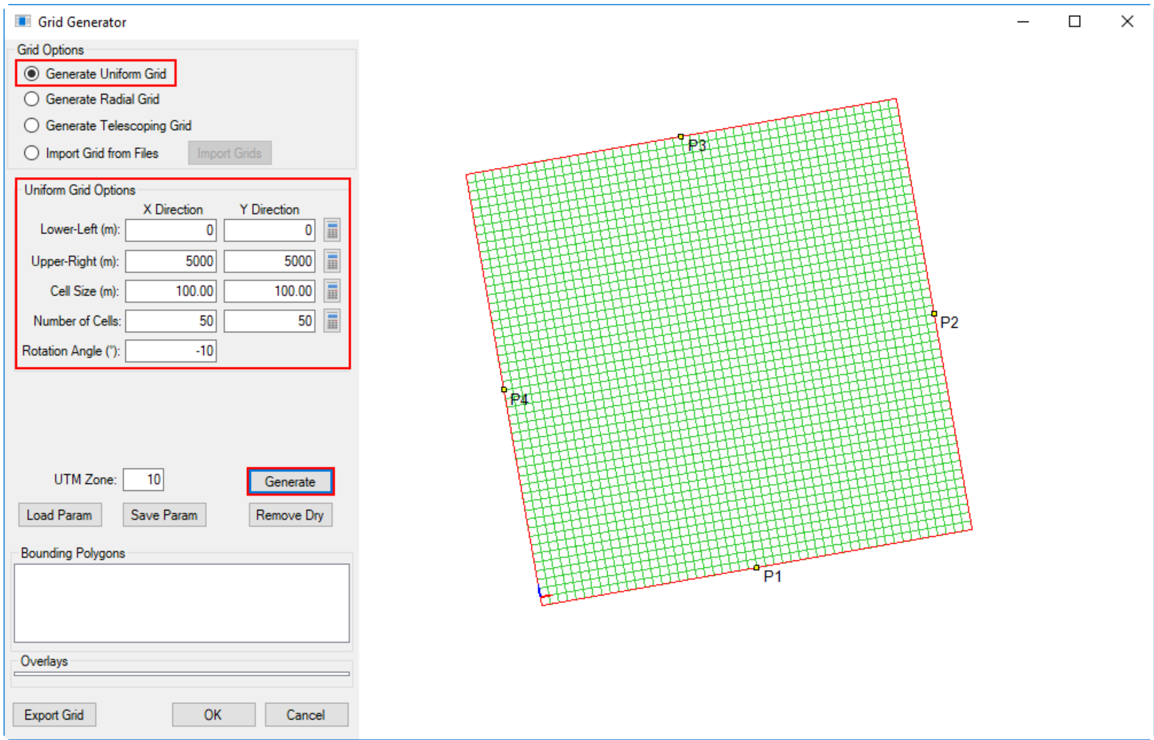


Figure 4. Generate Uniform Grid.

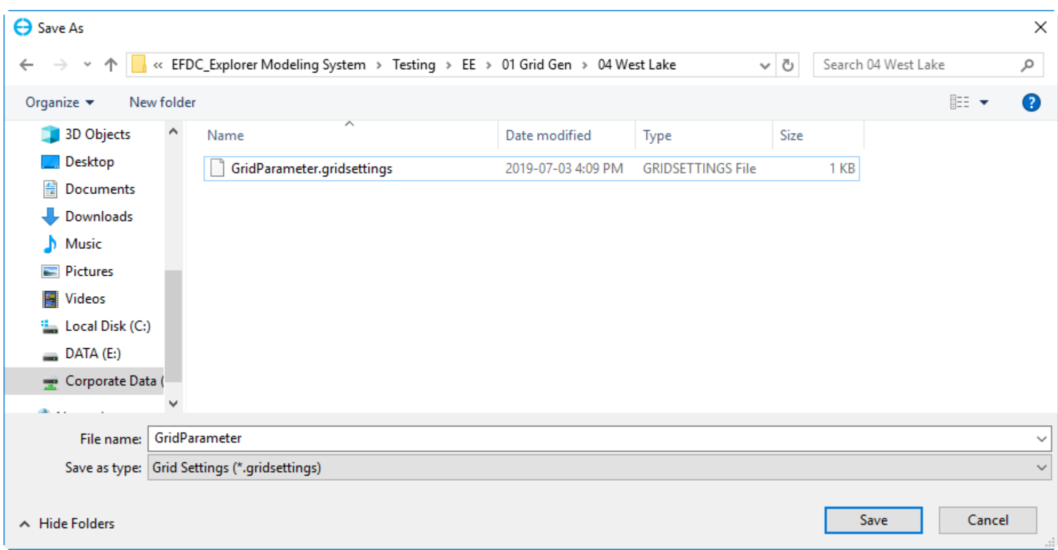


Figure 5. Save parameters.

To restrict the size of the domain use a bounding polygon, which is effectively serves as a shoreline. RMC on the *Bounding Polygons* text box and select *Add Files*. The *Open* form appears, and the user should select the file or files needs then click *Open* button as shown in Figure 6.

The polygon will be loaded and the *Lower-Left*, *Upper-Right* coordinates will be updated. The user now can generate a grid based on either cell size or the number of cells by clicking the *Generate* button. It is also possible inverse the selection, or remove the cells which are outside of the bounding polygon, by clicking the *Remove Dry* button as shown in Figure 7.

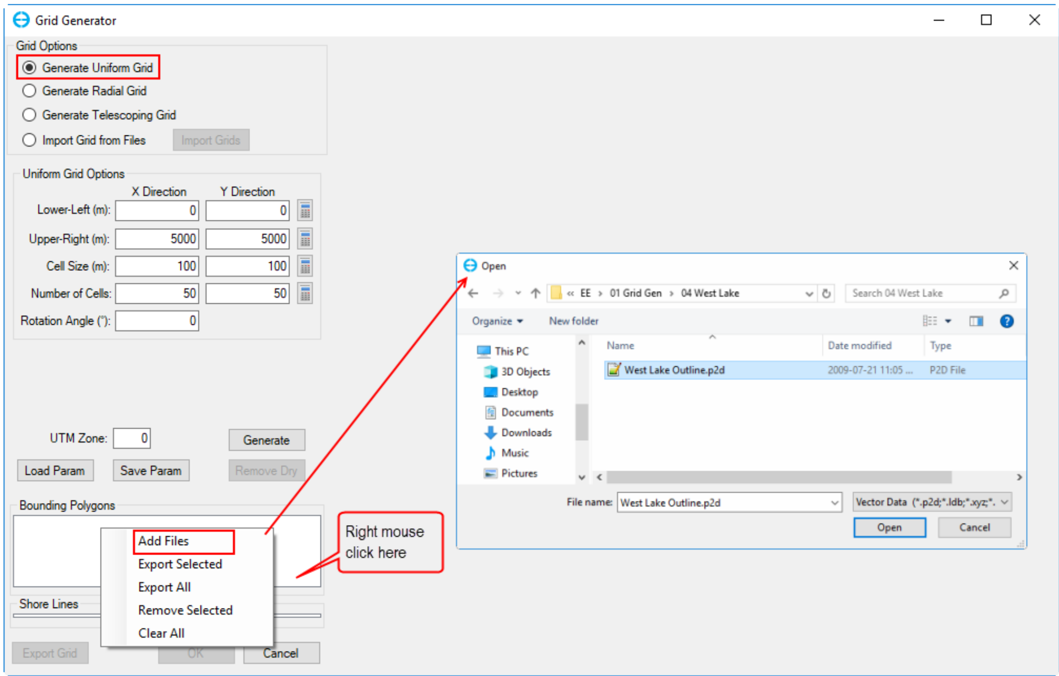


Figure 6. Load bounding polygon file.

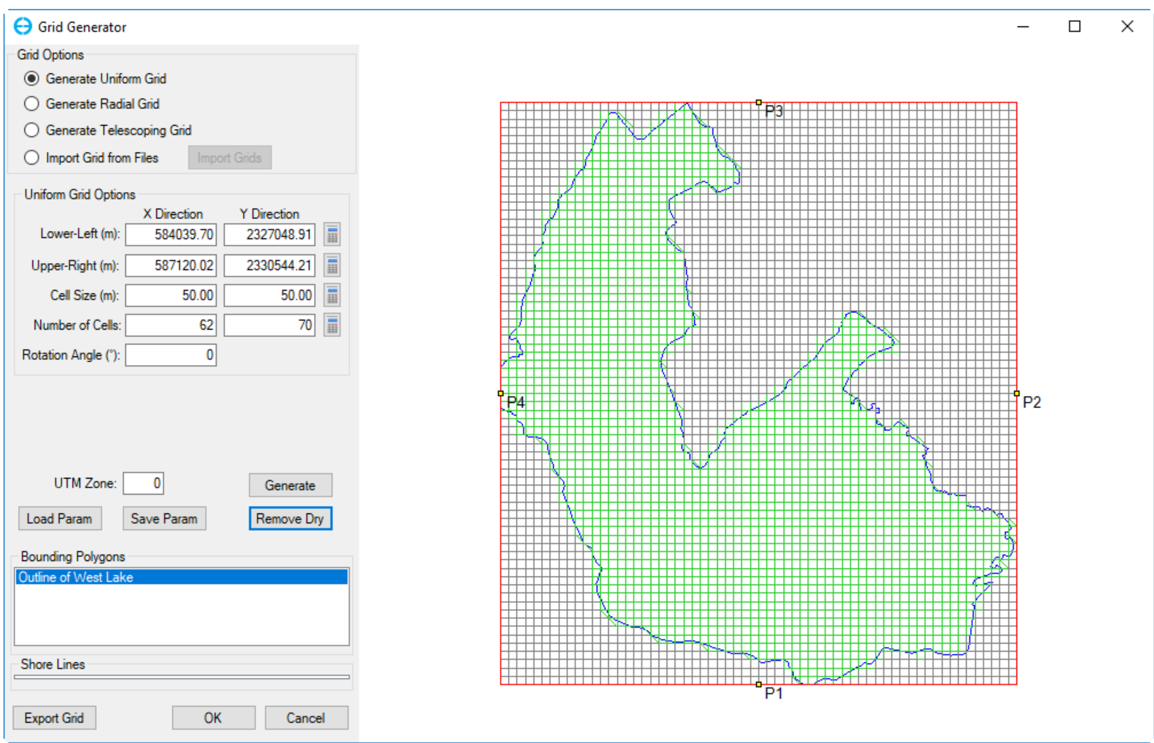


Figure 7. Grid generation by using bounding polygon.

Once the grid is generated, the user can save the grid by clicking the *Export Grid* button. The grid can be exported as *.CVL *or* *.GRD format. Click the *OK* button to finish generating the uniform grid.

After clicking *OK* button, the tool returns to the interface shown in Figure 1. Select the disk symbol or *Save Model* under *File* from the interface to save an EFDC+ model for this grid as shown in Figure 8. The files that saved are shown in Figure 9 and can be loaded by EE10.

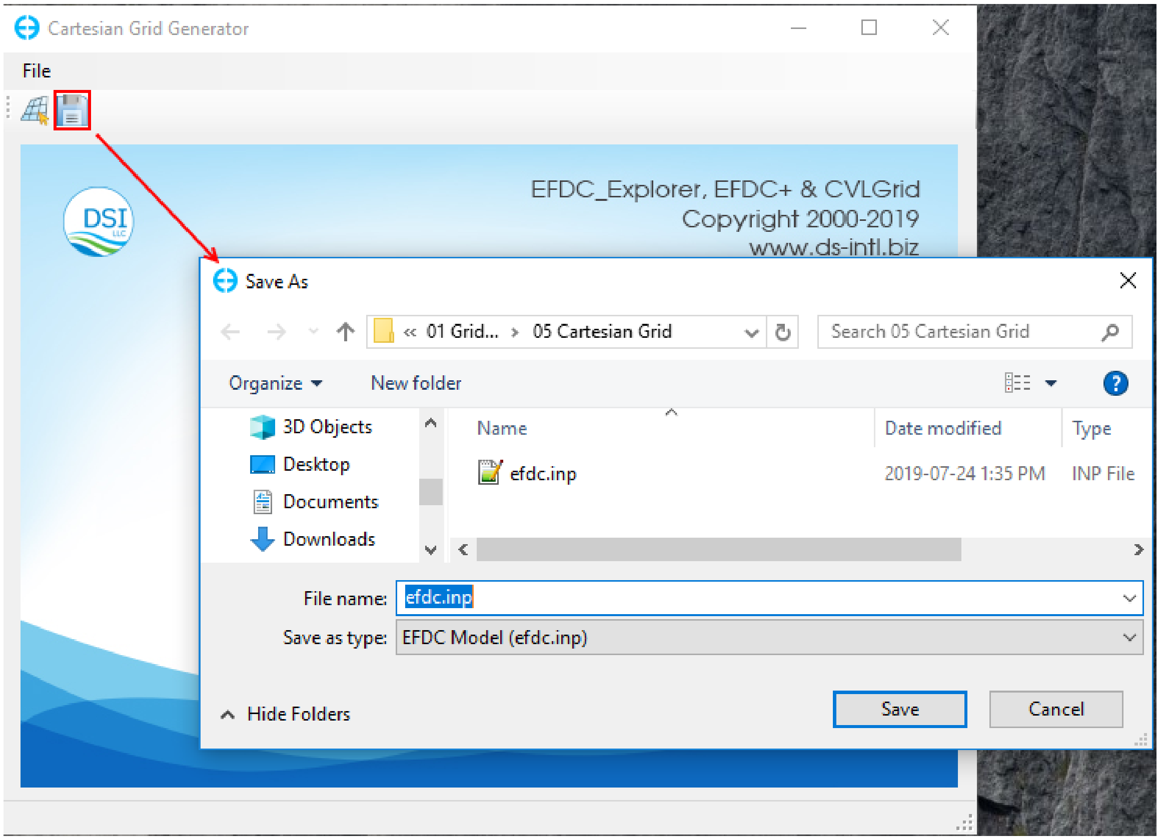


Figure 8. Save EFDC Model for generated grid.

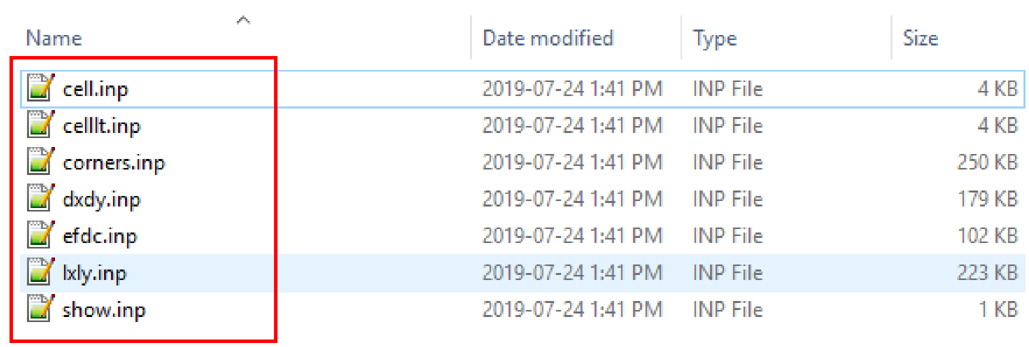


Figure 9. Files of EFDC Model save out.

1.2.2 Generate Radial Grid

When you select the *Generate Radial Grid* from *Grid Option* frame, the default values are filled in the *Radial Grid Options* frame as shown in Figure 10. The user can define those values as required.

The user can then click the *Generate* button, and the grid will appear on the right window as shown in Figure 10.

Export the generated grid and save the EFDC model in same way described in the section, *Generate Uniform Grid*.

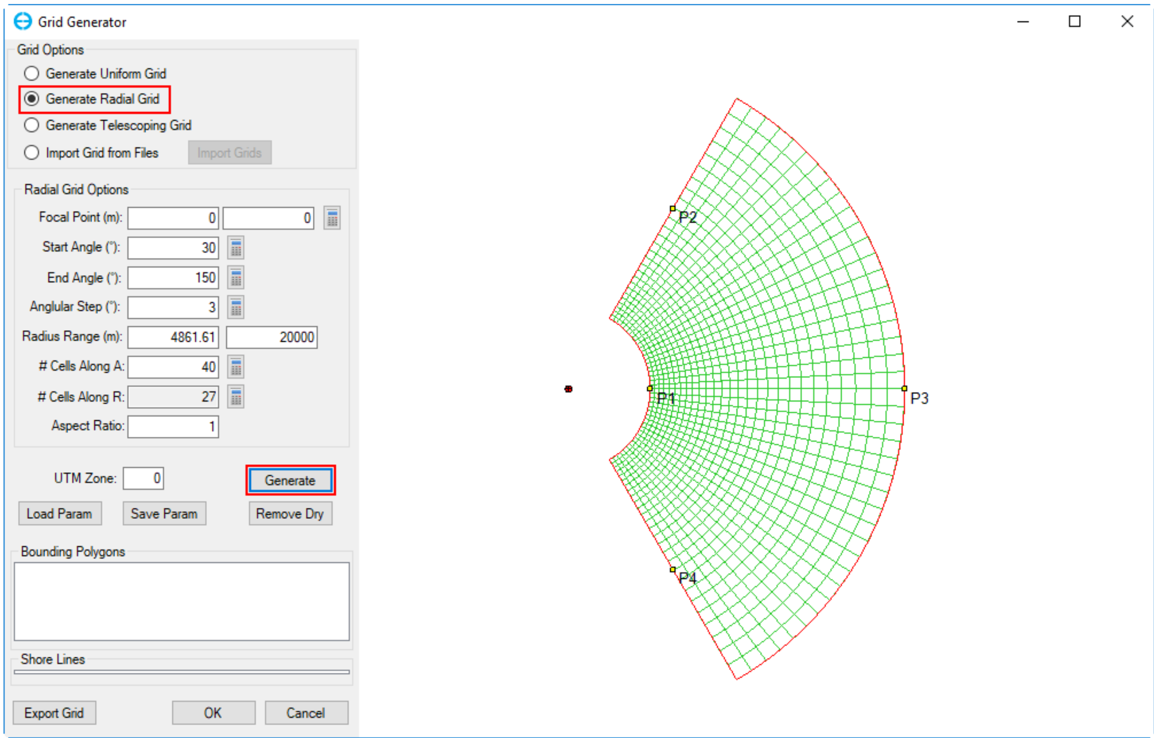


Figure 10. Generate Radial Grid.

1.2.3 Generate Telescoping Grid

When you select *Generate Telescoping Grid* from *Grid Option* frame, the default values are filled in to the *Telescoping Grid* frame as shown in Figure 11. The user can define those values as required.

Select the *Generate* button, and the grid will be displaye in the window as shown in Figure 11.

Export the generated grid and save the EFDC model as described in *Generate Uniform Grid* above.

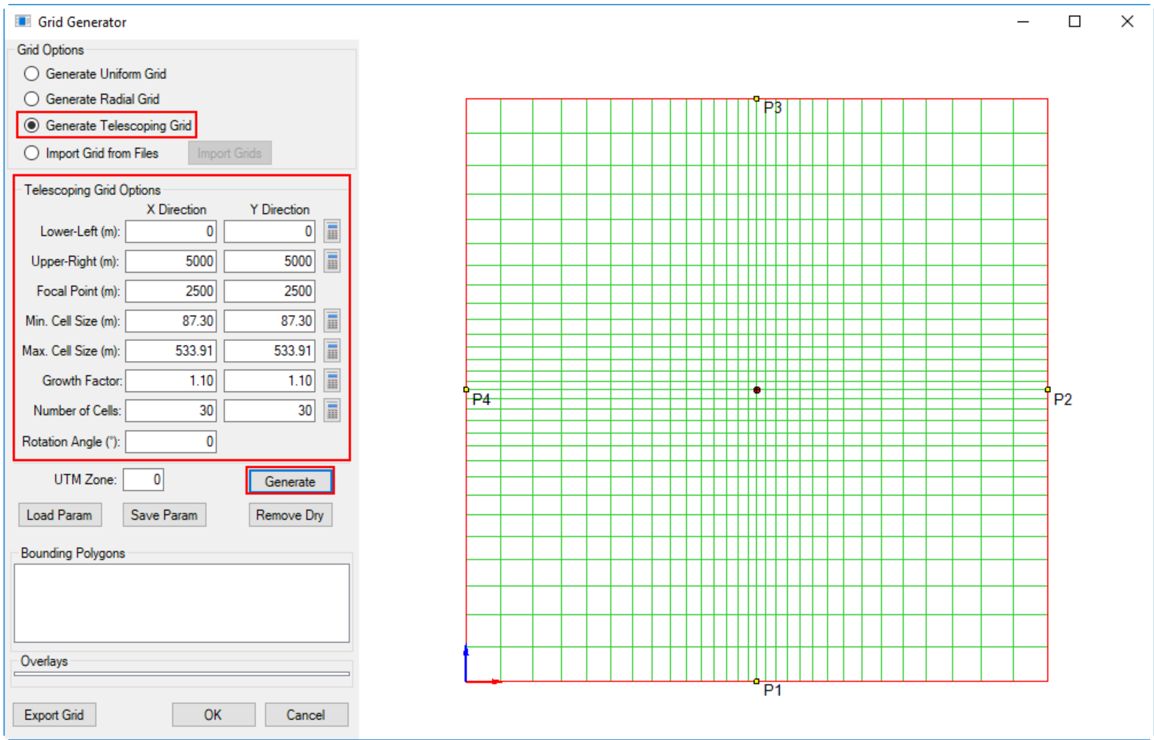


Figure 11. Generate Telescoping Grid.

1.2.4 Import Grids from Files

This option allows user to import an existing grid file. Grid file formats that are supported include:

- CVLGrid: DSI's curvilinear orthogonal grid generator - CVL Grid information
- RGFGrid: Deltares grid generator
- Grid95
- DXDY/LYLY: EFDC+ grid descriptors
- ECOMSED:
- SEAGRID
- CH3D: Army Corp of Engineers model
- Corners: file containing coordinates of four corners of each cell

The user should click the *Import Grids* radial button, and the *Import Grid* form will be displayed. From here the user should select the grid type from the drop-down list of *Grid types* as shown in Figure 12, then click the *Browse* button to browse to the grid file, and click *OK*.

In the case that there are a number of sub-grids for a water body, the *Multiple grid files* option needs to be checked, then the user may browse to the folder containing the grid files. To select multiple grid files at same time, hold the *Ctrl* key and select the grid files then click the *OK* button to load grid files (see Figure 13 and Figure 14).

Save the EFDC model in the same way described in section *Generate Uniform Grid*.

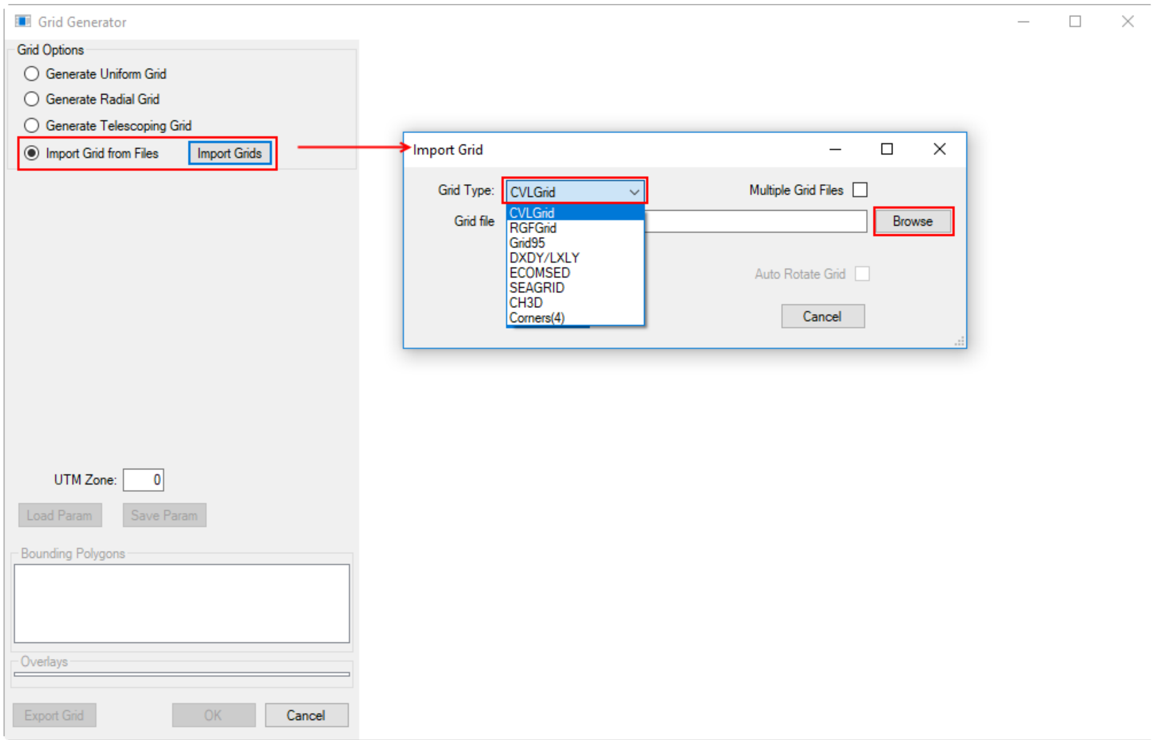


Figure 12 Import from a grid file.

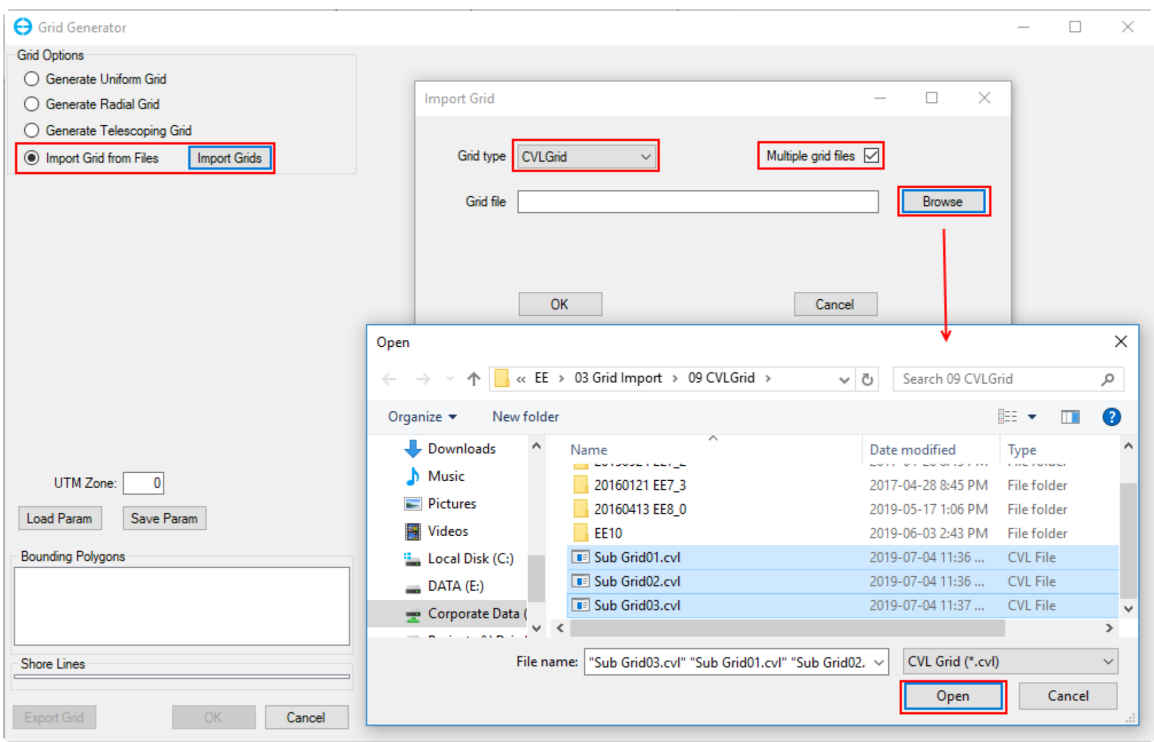


Figure 13. Import from multiple grid files – file selection.

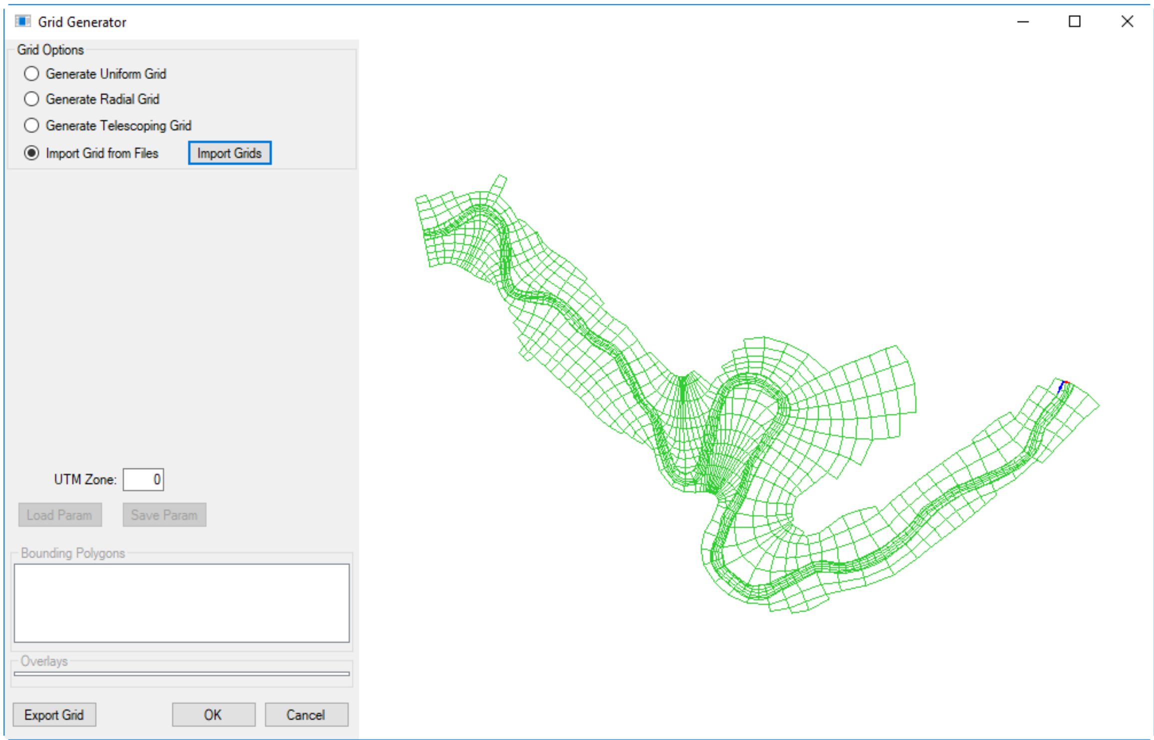
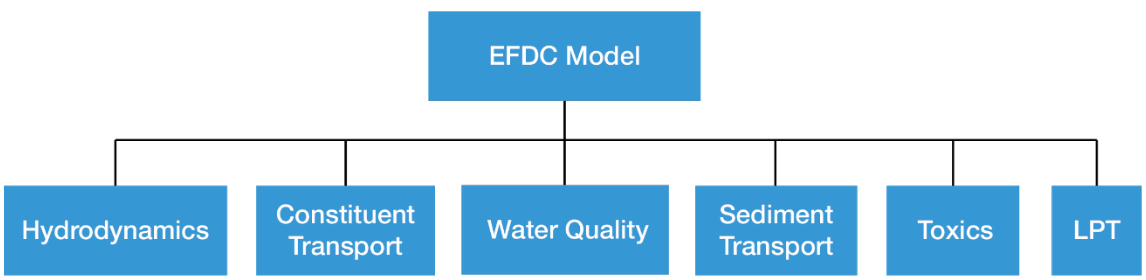


Figure 14. Import from multiple grid files – result display.

Note that the user should update the *UTM Zone* to the correct value before clicking the *OK* button to generate a new model. The *UTM Zone* is not used for model computation but it is important for coordinate conversion, exporting to GIS formats, and writing NetCDF outputs.

1.3 Input Files

This section lists and describes the input files required to run different modules within EFDC+. The primary modules within EFDC+ are distinguished in the figure below.



1.3.1 Primary Run Control

The run control files contain options to specify calculation types, time step sizes, output options, and other related controls. The most important of these files is the efdc.inp file and will be explained in detail later on.

Input File	Description
efdc.inp	Master EFDC+ control file
show.inp	Model run time reporting options
efdcwin.inp	Simplified control (deprecated)

Restart Related Files

The restart files allow an EFDC+ calculation to start up from a specified time step part way through a calculation. Use of these files may be necessary if a calculation ended prematurely and a user wishes to restart from the last saved time step.

Input File	File Description
restart.inp	hydrodynamic restart
rstwd.inp	wetting & drying
temp.rst	bed temperature restart
wqwcrst.inp	water quality restart
wqsdrst.inp	sediment diagenesis restart file
wqrpemrst.inp	rooted plant & epiphyte

EFDC.INP

The efdc.inp file is extensive and specifies all options for running a calculation. Historically, the options were organized by card types. As such, each card description and input parameter is given below. Each of these cards is placed in a single efdc.inp file and read in by EFDC+ at run time.

Note, when creating and efdc.inp file a line starting with * or - will be ignored and interpretted as a comment.

card1

```
******************************************************************************
C1 RUN TITLE
*   TEXT DESCRIPTION UP TO 80 CHARACTERS IN LENGTH FOR THIS INPUT FILE AND␣
↪RUN
C1 TITLE
EFDC+ Sample input
-----------------------------------------------------------------------------
↪-
C1A  GRID CONFIGURATION AND TIME INTEGRATION MODE SELECTION
*
*  IS2TIM:         0 THREE-TIME LEVEL INTEGRATION
*                  1 TWO-TIME LEVEL INTEGRATION
*
*  IGRIDH:         NOT USED
*
*  IGRIDV:         0 STANDARD SIGMA VERTICAL GRID OR SINGLE LAYER DEPTH␣
↪AVERAGE
```

(continues on next page)

(continued from previous page)

```
*                  1 SIGMA-ZED (SGZ) VERTICAL LAYERING ALLOWING VARYING␣
↪LAYERS FOR EACH CELL  (DSI)
*                  2 SIGMA-ZED (SGZ) VERTICAL GRID USING HORIZONTALLY UNIFORM␣
↪LAYER THICKNESS (DSI)
*  SGZMin:         MINIMUM NUMBER OF LAYERS FOR SIGMA-ZED
*  SGZHPDelta:     TYPICAL RISE OF WATER ABOVE THE INITIAL CONDITIONS WHEN␣
↪IGRIDV>0 (M)
*
C1A  IS2TIM  IGRIDH  IGRIDV  SGZMin  SGZHPDelta
```

card2

```
-----------------------------------------------------------------------------
↪-
C2 RESTART, GENERAL CONTROL AND DIAGNOSTIC SWITCHES
*
*  ISRESTI:  1 FOR READING INITIAL CONDITIONS FROM FILE restart.inp
*           -1 AS ABOVE BUT ADJUST FOR CHANGING BOTTOM ELEVATION
*           10 FOR READING IC'S FROM restart.inp WRITTEN BEFORE 8 SEPT 92
*
*  ISRESTO: -1 FOR WRITING RESTART FILE restart.out AT END OF RUN
*            N INTEGER.GE.0 FOR WRITING restart*.out EVERY N REF TIME PERIODS
*  ISRESTR:  1 FOR WRITING RESIDUAL TRANSPORT FILE RESTRAN.OUT
*  ISGREGOR:   0/1 NOT USE/USE DATE STAMPED RESTART FILES
*  ICONTINUE:  RUN CONTINUATION OPTION FOR EE LINKAGE FILES WHEN ISRESTI=1
*            0 NO RUN CONTINUATION - EFDC WRITES EE_*.OUT FILES AS USUAL
*            1 ACTIVATE RUN CONTINUATION - EE LINKAGE OUTPUT WILL BE␣
↪APPENDED TO THE EXISTING FILES
*  ISLOG:    1 FOR WRITING LOG FILE EFDC.LOG
*  IDUM:       NOT USED
*
*
*  ISDIVEX:  1 FOR WRITING EXTERNAL MODE DIVERGENCE TO SCREEN
*  ISNEGH:   1 FOR SEARCHING FOR NEGATIVE DEPTHS AND WRITING TO SCREEN
*  ISMMC:   <0 FLAG TO GLOBALLY ACTIVATE WRITING EXTRA MODEL RESULTS LOG␣
↪FILES
*
*  ISBAL:    1 FOR ACTIVATING MASS, MOMENTUM AND ENERGY BALANCES AND
*              WRITING RESULTS TO FILE bal.out
*  IDUM:       NOT USED
*  ISHOW:   >0 TO SHOW RUNTIME STATUS ON SCREEN, SEE INSTRUCTIONS FOR FILE␣
↪SHOW.INP
*
C2  ISRESTI ISRESTO ISRESTR ISGREGOR  ISLOG ISDIVEX  ISNEGH   ISMMC   ISBAL␣
↪ICONTINUE ISHOW
```

card3

```
--------------------------------------------------------------------------------
↪-
C3 EXTERNAL MODE SOLUTION OPTION PARAMETERS AND SWITCHES
*
*  RP:          OVER RELAXATION PARAMETER
*  RSQM:        TARGET SQUARE RESIDUAL OF ITERATIVE SOLUTION SCHEME
*  ITERM:       MAXIMUN NUMBER OF ITERATIONS
*  IRVEC:     0 CONJUGATE GRADIENT SOLUTION - NO SCALING
*             9 CONJUGATE GRADIENT SOLUTION - SCALE BY MINIMUM DIAGONAL
*            99 CONJUGATE GRADIENT SOLUTION - SCALE TO NORMAL FORM
*
*
*  IATMP:     0 DO NOT USE ATMOSPHERIC PRESSURE IN THE CALPUV SOLUTION
*             1 USE ATMOSPHERIC PRESSURE IN THE CALPUV SOLUTION IF NASER > 1
*  IWDRAG:    0 USE ORIGINAL EFDC WIND DRAG FORMULATION
*             1 USE ORIGINAL EFDC WIND DRAG FORMULATION WITH RELATIVE WATER␣
↪VELOCITY CORRECTION
*             2 HERSBACH 2011, EUROPEAN CENTRE FOR MEDIUM-RANGE WEATHER␣
↪FORECASTS (ECMWF)
*             3 USE SIMPLIFIED COARE 3.6 APPROACH AT NEUTRAL ATM AND RELATIVE␣
↪WATER VELOCITY CORRECTION
*  DUMMY:
*  ITERHPM:     NOT USED
*  IDRYCK:      ITERATIONS PER DRYING CHECK (ISDRY.GE.1)  2.LE.IDRYCK.LE.20
*  ISDSOLV: 1 TO WRITE DIAGNOSTICS FILES FOR EXTERNAL MODE SOLVER
*  FILT3TL:     FILTER COEFFICIENT FOR 3 TIME LEVEL EXPLICIT ( 0.0625 )
*
C3        RP     RSQM    ITERM    IRVEC    IATMP   IWDRAG   DUMMY ITERHPM  IDRYCK␣
↪ISDSOLV FILT3TL
```

card4

```
--------------------------------------------------------------------------------
↪-
C4 LONGTERM MASS TRANSPORT INTEGRATION ONLY SWITCHES
*
*  ISLTMT:    NOT USED
*  ISSSMMT: 0 WRITES MEAN MASS TRANSPORT TO RESTRAN.OUT AFTER EACH
*               AVERAGING PERIOD   (FOR WASP/ICM/RCA LINKAGE)
*             1 WRITES MEAN MASS TRANSPORT TO RESTRAN.OUT AFTER LAST
*               AVERAGING PERIOD   (FOR RESEARCH PURPOSES)
*             2 DISABLES MEAN MASS TRANSPORT FIELD CALCULATIONS & RESTRAN.OUT
*  ISLTMTS:   NOT USED
*  ISIA:      NOT USED
*  RPIA:      NOT USED
*  RSQMIA:    NOT USED
*  ITRMIA:    NOT USED
*  ISAVEC:    NOT USED
*
C4   ISLTMT ISSSMMT ISLTMTS     ISIA     RPIA   RSQMIA   ITRMIA   ISAVEC
```

card5

```
-------------------------------------------------------------------------------
↪-
C5 MOMENTUM ADVEC AND HORIZ DIFF SWITCHES AND MISC SWITCHES
*
*  ISCDMA:  1 FOR CENTRAL DIFFERENCE MOMENTUM ADVECTION (USED FOR 3TL ONLY)
*           0 FOR UPWIND DIFFERENCE MOMENTUM ADVECTION  (USED FOR 3TL ONLY)
*           2 FOR EXPERIMENTAL UPWIND DIFF MOM ADV (FOR RESEARCH PURPOSES)
*  ISHDMF:  1 TO ACTIVE HORIZONTAL MOMENTUM DIFFUSION
*           2 TO ACTIVE HORIZONTAL MOMENTUM DIFFUSION WITH WATER COLUMN␣
↪DIFFUSION
*  ISDISP:  1 CALCULATE MEAN HORIZONTAL SHEAR DISPERSION TENSOR OVER LAST␣
↪MEAN MASS TRANSPORT AVERAGING PERIOD
*  ISWASP:  4 OR 5 TO WRITE FILES FOR WASP4 OR WASP5 MODEL LINKAGE, 17-
↪WASP7HYDRO, 99 - CE-QUAL-ICM
*  ISDRY:   0 NO WETTING & DRYING OF CELLS ALLOWED
*          11 CONSTANT DRYING DEPTH SPECIFIED BY HDRY ON CARD 11
*             WITH NONLINEAR ITERATIONS
*          99 VARIABLE WETTING & DRYING DEPTHS USING CELL FACE MASKING
*             AND NONLINEAR ITERATIONS, USING HDRY AS THE NOMINAL DRY DEPTH
*  ISQQ:    1 TO USE STANDARD TURBULENT INTENSITY ADVECTION SCHEME
*  ISRLID:  1 TO RUN IN RIGID LID MODE (NO FREE SURFACE)
*  ISVEG:   1 TO IMPLEMENT VEGETATION RESISTANCE
*           2 IMPLEMENT WITH DIAGNOSTICS TO FILE CBOT.LOG
*  ISVEGL:  1 TO INCLUDE LAMINAR FLOW OPTION IN VEGETATION RESISTANCE
*  ISITB:   1 FOR IMPLICIT BOTTOM & VEGETATION RESISTANCE IN EXTERNAL MODE
*
*  IHMDSUB: 1 TO USE A SUBSET OF CELLS FOR HMD CALCULATIONS, MAPHMD.INP
*  IINTPG:  0 ORIGINAL INTERNAL PRESSURE GRADIENT FORMULATION
*           1 JACOBIAN FORMULATION
*           2 FINITE VOLUME FORMULATION
*
*
C5   ISCDMA  ISHDMF  ISDISP  ISWASP   ISDRY    ISQQ  ISRLID   ISVEG  ISVEGL ␣
↪ ISITB  IHMDSUB  IINTPG
```

card6

```
-------------------------------------------------------------------------------
↪-
C6 DISSOLVED AND SUSPENDED CONSTITUENT TRANSPORT SWITCHES
*  TURB INTENSITY=0,SAL=1,TEM=2,DYE=3,SFL=4,TOX=5,SED=6,SND=7,CWQ=8
*
*  ISTRAN:  1 OR GREATER TO ACTIVATE TRANSPORT
*  ISTOPT:    NONZERO FOR TRANSPORT OPTIONS, SEE USERS MANUAL
*  ISCDCA:  0 FOR STANDARD DONOR CELL UPWIND DIFFERENCE ADVECTION (3TL ONLY)
*           1 FOR CENTRAL DIFFERENCE ADVECTION FOR THREE TIME LEVEL STEPS␣
↪(3TL ONLY)
*           2 FOR EXPERIMENTAL UPWIND DIFFERENCE ADVECTION (FOR RESEARCH)␣
↪(3TL ONLY)
*  ISADAC:  1 TO ACTIVATE ANTI-NUMERICAL DIFFUSION CORRECTION TO
*             STANDARD DONOR CELL SCHEME
*  ISFCT:   1 TO ADD FLUX LIMITING TO ANTI-NUMERICAL DIFFUSION CORRECTION
*  ISPLIT:  1 TO OPERATOR SPLIT HORIZONTAL AND VERTICAL ADVECTION
```

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```
*               (FOR RESEARCH PURPOSES)
*   ISADAH:  1 TO ACTIVATE ANTI-NUM DIFFUSION CORRECTION TO HORIZONTAL
*              SPLIT ADVECTION STANDARD DONOR CELL SCHEME (FOR RESEARCH)
*   ISADAV:  1 TO ACTIVATE ANTI-NUM DIFFUSION CORRECTION TO VERTICAL
*              SPLIT ADVECTION STANDARD DONOR CELL SCHEME (FOR RESEARCH)
*   ISCI:    1 TO READ CONCENTRATION FROM FILE restart.inp
*   ISCO:    1 TO WRITE CONCENTRATION TO FILE restart.out
*
C6   ISTRAN  ISTOPT  ISCDCA  ISADAC   ISFCT  ISPLIT  ISADAH  ISADAV    ISCI ␣
↪  ISCO
```

card7

```
-----------------------------------------------------------------------------
↪-
C7 TIME-RELATED INTEGER PARAMETERS
*
*  NTC:      NUMBER OF REFERENCE TIME PERIODS IN RUN
*  NTSPTC:   NUMBER OF TIME STEPS PER REFERENCE TIME PERIOD
*  NLTC:     NUMBER OF LINEARIZED REFERENCE TIME PERIODS
*  NLTC:     NUMBER OF TRANSITION REF TIME PERIODS TO FULLY NONLINEAR
*  NTCPP:    NUMBER OF REFERENCE TIME PERIODS BETWEEN FULL PRINTED OUTPUT
*            TO FILE EFDC.OUT
*  NTSTBC:   NUMBER OF TIME STEPS BETWEEN USING A TWO TIME LEVEL TRAPEZOIDAL
*            CORRECTION TIME STEP, ** MASS BALANCE PRINT INTERVAL **
 * NTCNB:    NUMBER OF REFERENCE TIME PERIODS WITH NO BUOYANCY FORCING(NOT␣
↪USED)
*  NTCVB:    NUMBER OF REF TIME PERIODS WITH VARIABLE BUOYANCY FORCING
*  NTSMMT:   NUMBER OF NUMBER OF TIME STEPS TO AVERAGE OVER TO OBTAIN
*            MASS BALANCE RESIDUALS OR MEAN MASS TRANSPORT VARIABLES (e.g.␣
↪WASP Linkage)
*  NFLTMT:   USE 1 (FOR RESEARCH PURPOSES)
*  NDRYSTP: IF > 0 THEN NUMBER OF TIME STEPS BEFORE AN ISOLATED CELL WILL BE␣
↪FORCED TO GO DRY
*            EFDC+ WILL TRACK THE 'WASTED' WATER IN QDWASTE
*  NRAMPUP: NUMBER OF INITIAL LOOPS TO HOLD TIMESTEP CONSTANT FOR DYNAMIC␣
↪TIME-STEPPING
*  NUPSTEP: MINIMUM NUMBER OF ITERATIONS FOR EACH TIME STEP WHEN GROWING␣
↪DTDYN
*
C7       NTC  NTSPTC    NLTC    NTTC    NTCPP  NTSTBC   NTCNB   NTCVB  NTSMMT ␣
↪NFLTMT NDRYSTP NRAMPUP NUPSTEP
```

card8

```
-----------------------------------------------------------------------------
↪-
C8 TIME-RELATED REAL PARAMETERS
*
*  TCON:      CONVERSION MULTIPLIER TO CHANGE TBEGIN TO SECONDS
*  TBEGIN:    TIME ORIGIN OF RUN
*  TREF:      REFERENCE TIME PERIOD IN sec (i.e. 44714.16S OR 86400S)
```

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```
*  CORIOLIS: CONSTANT CORIOLIS PARAMETER IN 1/sec =2*7.29E-5*SIN(LAT)
*  ISCORV:   1 TO READ VARIABLE CORIOLIS COEFFICIENT FROM LXLY.INP FILE
*  ISCCA:    WRITE DIAGNOSTICS FOR MAX CORIOLIS-CURV ACCEL TO FILEEFDC.LOG
*  ISCFL:    1 WRITE DIAGNOSTICS OF MAX THEORETICAL TIME STEP TO CFL.OUT
*            GT 1  TIME STEP ONLY AT INTERVAL ISCFL FOR ENTIRE RUN
*  ISCFLM:   1  TO MAP LOCATIONS OF MAX TIME STEPS OVER ENTIRE RUN
*  DTSSFAC:  DYNAMIC TIME STEPPING IF DTSSFAC > 0.0
*  DTSSDHDT: DYNAMIC TIME STEPPING RATE OF DEPTH CHANGE FACTOR (USED WHEN >␣
↪0)
*  DTMAX:    MAXIMUM TIME STEP FOR DYNAMIC STEPPING (SECONDS)
*
C8        TCON     TBEGIN      TREF     CORIOLIS   ISCORV    ISCCA    ISCFL ␣
↪ISCFLM   DTSSFAC  DTSSDHDT     DTMAX
```

card9

```
-----------------------------------------------------------------------------
↪-
C9 SPACE-RELATED AND SMOOTHING  PARAMETERS
*
*  IC:         NUMBER OF CELLS IN I DIRECTION
*  JC:         NUMBER OF CELLS IN J DIRECTION
*  LC:         NUMBER OF ACTIVE CELLS IN HORIZONTAL + 2
*  LVC:        NUMBER OF VARIABLE SIZE HORIZONTAL CELLS
*  ISCO:       1 FOR CURVILINEAR-ORTHOGONAL GRID (LVC=LC-2)
*  NDM:        NUMBER OF DOMAINS FOR HORIZONTAL DOMAIN DECOMPOSITION
*              ( NDM=1, FOR MODEL EXECUTION ON A SINGLE PROCESSOR SYSTEM OR
*                NDM=MM*NCPUS, WHERE MM IS AN INTEGER AND NCPUS IS THE NUMBER
*                OF AVAILABLE CPU'S FOR MODEL EXECUTION ON A PARALLEL␣
↪MULTIPLE PROCESSOR SYSTEM )
*  LDM:        NUMBER OF WATER CELLS PER DOMAIN (LDM=(LC-2)/NDM, FOR MULTIPLE␣
↪VECTOR PROCESSORS,
*                LDM MUST BE AN INTEGER MULTIPLE OF THE VECTOR LENGTH OR
*                STRIDE NVEC THUS CONSTRAINING LC-2 TO BE AN INTEGER MULTIPLE␣
↪OF NVEC )
*  ISMASK:     1 FOR MASKING WATER CELL TO LAND OR ADDING THIN BARRIERS
*                USING INFORMATION IN FILE MASK.INP
*  ISCONNECT: 1 FOR USER DEFINED N-S CONNECTION OF CELLS USING INFO IN FILE␣
↪MAPPGNS.INP
*              2 FOR USER DEFINED E-W CONNECTION OF CELLS USING INFO IN FILE␣
↪MAPPGEW.INP
*              3 FOR BOTH E-W AND N-S CONNECTIONS
*  NSHMAX:     NUMBER OF DEPTH SMOOTHING PASSES
*  NSBMAX:   NUMBER OF INITIAL SALINITY FIELD SMOOTHING PASSES
*  WSMH:     DEPTH SMOOTHING WEIGHT
*  WSMB:     SALINITY SMOOTHING WEIGHT
*
*
*
C9        IC       JC       LC      LVC     ISCO      NDM      LDM  ISMASK CONNECT ␣
↪NSHMAX  NSBMAX    WSMH    WSMB
```

card10

```
-------------------------------------------------------------------------------
↪-
C10 LAYER THICKNESS IN VERTICAL
*
*    K:  LAYER NUMBER, K=1,KC
*  DZC:  DIMENSIONLESS LAYER THICKNESS (THICKNESSES MUST SUM TO 1.0)
*
*
*
C10  K   DZC
```

card11

```
-------------------------------------------------------------------------------
↪-
C11 GRID, ROUGHNESS AND DEPTH PARAMETERS
*
*  DX:        CARTESIAN CELL LENGTH IN X OR I DIRECTION
*  DY:        CARTESIAN CELL LENGTH IN Y OR J DIRECTION
*  DXYCVT:    MULTIPLY DX AND DY BY TO OBTAIN METERS
*  IMDXDY:    GREATER THAN 0 TO READ MODDXDY.INP FILE
*  ZBRADJ:    LOG BDRY LAYER CONST OR VARIABLE ROUGH HEIGHT ADJ IN METERS
*  ZBRCVRT:   LOG BDRY LAYER VARIABLE ROUGHNESS HEIGHT CONVERT TO METERS
*  HMIN:      MINIMUM DEPTH OF INPUTS DEPTHS IN METERS
*  HADJ:      ADJUSTMENT TO DEPTH FIELD IN METERS
*  HCVRT:     CONVERTS INPUT DEPTH FIELD TO METERS
*  HDRY:      DEPTH AT WHICH CELL OR FLOW FACE BECOMES DRY
*  HWET:      DEPTH AT WHICH WITHDRAWALS FROM CELL ARE TURNED OFF
*  BELADJ:    ADJUSTMENT TO BOTTOM BED ELEVATION FIELD IN METERS
*  BELCVRT:   CONVERTS INPUT BOTTOM BED ELEVATION FIELD TO METERS
*
C11       DX       DY    DXYCVT    IMD  ZBRADJ ZBRCVRT    HMIN    HADJ   HCVRT ␣
↪   HDRY     HWET  BELADJ BELCVRT
```

card11a

```
-------------------------------------------------------------------------------
↪-
C11A TWO-LAYER MOMENTUM FLUX AND CURVATURE ACCELERATION CORRECTION FACTORS
*   (ONLY USED FOR 2 TIME LEVEL SOLUTION & ISDRY=0  PMC-Check to see if still␣
↪true)
*  ICK2COR: 0 NO CORRECTION
*  ICK2COR: 1 CORRECTION USING CK2UUC,CK2VVC,CK2UVC FOR CURVATURE
*  ICK2COR: 2 CORRECTION USING CK2FCX,CK2FCY FOR CURVATURE
*  CK2UUM:  CORRECTION FOR UU MOMENTUM FLUX
*  CK2VVM:  CORRECTION FOR UU MOMENTUM FLUX
*  CK2UVM:  CORRECTION FOR UU MOMENTUM FLUX
*  CK2UUC:  CORRECTION FOR UU CURVATURE ACCELERATION   (NOT ACTIVE)
*  CK2VVC:  CORRECTION FOR VV CURVATURE ACCELERATION   (NOT ACTIVE)
*  CK2UVC:  CORRECTION FOR UV CURVATURE ACCELERATION   (NOT ACTIVE)
*  CK2FCX:  CORRECTION FOR X EQUATION CURVATURE ACCELERATION
```

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```
*  CK2FCY:  CORRECTION FOR Y EQUATION CURVATURE ACCELERATION
*
C11A ICK2COR CK2UUM  CK2VVM  CK2UVM  CK2UUC  CK2VVC  CK2UVC  CK2FCX  CK2FCY
```

card11b

```
------------------------------------------------------------------------------
↪-
C11B CORNER CELL BOTTOM STRESS CORRECTION OPTIONS (2TL ONLY)
*
*    ISCORTBC: 1 TO CORRECT BED STRESS AVERAGING TO CELL CENTERS IN CORNERS
*              2 TO USE SPATIALLY VARYING CORRECTION FOR CELLS IN CORNERC.INP
*   ISCORTBCD: 1 WRITE DIAGNOSTICS EVERY NSPTC TIME STEPS (NOT USED)
*    FSCORTBC: CORRECTION FACTOR, 0.0 GE FSCORTBC LE 1.0
*              1.0 = NO CORRECTION, 0.0 = MAXIMUM CORRECTION, 0.5 SUGGESTED
*
C11B ISCORTBC ISCORTBCD  FSCORTBC
```

card12

```
------------------------------------------------------------------------------
↪-
C12 TURBULENT DIFFUSION PARAMETERS
*
*  AHO:      CONSTANT HORIZONTAL MOMENTUM AND MASS DIFFUSIVITY m*m/s
*  AHD:      DIMESIONLESS HORIZONTAL MOMENTUM DIFFUSIVITY (ONLY FOR ISHDMF>0)
*  AVO:      BACKGROUND, CONSTANT OR EDDY (KINEMATIC) VISCOSITY m*m/s
*  ABO:      BACKGROUND, CONSTANT OR MOLECULAR DIFFUSIVITY m*m/s
*  AVMX:     MAXIMUM KINEMATIC EDDY VISCOSITY m*m/s (DS-INTL)
*  ABMX:     MAXIMUM EDDY DIFFUSIVITY m*m/s (DS-INTL)
*  VISMUD:   CONSTANT FLUID MUD VISCOSITY m*m/s
*  AVCON:    EQUALS ZERO FOR CONSTANT VERTICAL VISCOSITY AND DIFFUSIVITY
*              WHICH ARE SET EQUAL TO AVO AND ABO, OTHERWISE SET TO 1.0
*  ZBRWALL:  SIDE WALL LOG LAW ROUGHNESS HEIGHT. USED WHEN HORIZONTAL
*              MOMENTUM DIFFUSION IS ACTIVE AND AHO OR AHD ARE NONZERO
*
C12       AHO       AHD       AVO       ABO      AVMX      ABMX    VISMUD    ␣
↪ AVCON   ZBRWALL
```

card12a

```
------------------------------------------------------------------------------
↪-
C12A TURBULENCE CLOSURE OPTIONS
*
*      ISSTAB:    0 FOR GALPERIN et al. STABILITY FUNCTIONS IN CALAVBOLD␣
↪(ISQQ=1)
*                 1 FOR GALPERIN et al. STABILITY FUNCTIONS              ␣
↪(ISQQ=1)
*                 2 FOR KANTHA AND CLAYSON (1994) STABILITY FUNCTIONS    ␣
↪(ISQQ=1)
```

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```
*                 3 FOR KANTHA (2003) STABILITY FUNCTIONS                          ␣
↪(ISQQ=1)
*                   (NOTE: OPTION SELECTED HERE OVERRIDES ISTOPT(0) ON C6)
*                 4 VINCON-LEITE, ET.AL. (2014) APPROACH                           ␣
↪(ISQQ=1)
*       ISSQL:    0 SETS QQ AND QQL STABILITY FUNCTIONS PROPORTIONAL TO
*                   MOMENTUM STABILITY FUNCTIONS (EXCEPT FOR ISSTAB=3)
*                 1 SETS QQ AND QQL STABILITY FUNCTIONS TO CONSTANTS
*                     (FOR ISSTAB = 0,1,2) THIS OPTION NOT ACTIVE
*       ISAVBMX:  SET TO 1 TO ACTIVATE MAX VISCOSITY AND DIFFUSIVITY OF AVMX␣
↪AND ABMX
*       ISFAVB:   SET TO 1 OR 2 TO AVG OR SQRT FILTER AVO AND AVB
*       ISINWV:   SET TO 2 TO WRITE EE_ARRAYS.OUT
*       ISLLIM:   0 FOR NO LENGTH SCALE AND RIQMAX LIMITATIONS
*                 1 LIMIT RIQMAX IN STABILITY FUNCTION ONLY
*                 2 DIRECTLY LIMIT LENGTH SCALE AND LIMIT RIQMAX IN STABILITY␣
↪FUNCTION
*       IFPROX:   0 FOR NO WALL PROXIMITY FUNCTION
*                 1 FOR PARABOLIC OVER DEPTH WALL PROXIMITY FUNCTION
*                 2 FOR OPEN CHANNEL WALL PROXIMITY FUNCTION
*       XYRATIO:  LARGE ASPECT RATIOS, IF XYRATIO>1.1 AND >DX:DY THEN ZERO XY␣
↪TERMS FMDUY AND FMDVX (EFDC+)
* BC_EDGEFACTOR: BOUNDARY CELLS MOMENTUM CORRECTION FACTOR (0 TO 1)
*
C12A ISSTAB   ISSQL ISAVBMX  ISFAVB  ISINWV  ISLLIM  IFPROX XYRATIO BC_
↪EDGEFACTOR
```

card13

```
-----------------------------------------------------------------------------
↪-
C13 TURBULENCE CLOSURE PARAMETERS
*
*  VKC:     VON KARMAN CONSTANT
*  CTURB1: TURBULENT CONSTANT (UNIVERSAL)
*  CTURB2: TURBULENT CONSTANT (UNIVERSAL)
*  CTE1:    TURBULENT CONSTANT (UNIVERSAL)
*  CTE2:    TURBULENT CONSTANT (UNIVERSAL)
*  CTE3:    TURBULENT CONSTANT (UNIVERSAL)
*  CTE4:    TURBULENCE CONSTANT E4 (SOMETIMES CALL E3) WALL FUNCTION IN Q*Q*L␣
↪EQUATION
*  CTE5:    TURBULENCE CONSTANT E5 - 2ND OPEN CHANNEL WALL FUNCTION IN Q*Q*L␣
↪EQUATION
*  RIQMAX: MAXIMUM TURBULENT INTENSITY RICHARDSON NUMBER FOR STABLE␣
↪CONDITIONS
*  QQMIN:  MINIMUM TURBULENT INTENSITY SQUARED
*  QQLMIN: MINIMUM TURBULENT INTENSITY SQUARED * LENGTH-SCALE
*  DMLMIN: MINIMUM DIMENSIONLESS LENGTH SCALE
*
C13      VKC  CTURB1  CTURB2    CTE1    CTE2    CTE3    CTE4    CTE5  RIQMAX ␣
↪ QQMIN  QQLMIN  DMLMIN
```

card14

```
-----------------------------------------------------------------------------
↪-
C14 TIDAL & ATMOSPHERIC FORCING, GROUND WATER AND SUBGRID CHANNEL PARAMETERS
*
*   MTIDE:     NUMBER OF PERIOD (TIDAL) FORCING CONSTITUENTS
*   NWSER:     NUMBER OF WIND TIME SERIES (0 SETS WIND TO ZERO)
*   NASER:     NUMBER OF ATMOSPHERIC CONDITION TIME SERIES (0 SETS ALL  ZERO)
*  ISGWIT:     0 DISABLE GROUND WATER
*              1 TO ACTIVATE SOIL MOISTURE BALANCE WITH DRYING AND WETTING
*              2 TO ACTIVATE GROUNDWATER INTERACTION WITH BED AND WATER␣
↪COLUMN (GWMAP & GWSER)
*              3 TO ZONED TEMPORALLY CONSTANT IN(+)/OUT(-) SEEPAGE RATE (M/
↪S)  (GWSEEP & GWMAP)
*  ISCHAN:    >0 ACTIVATE SUBGRID CHANNEL MODEL AND READ MODCHAN.INP
*  ISWAVE:     1-FOR BOUNDARY LAYER IMPACTS ONLY (WAVEBL.INP),
*              2-FOR BOUNDARY LAYER & CURRENT IMPACTS (WVnnn.INP)
*              3-FOR INTERNALLY COMPUTED WIND WAVE BOUNDARY LAYER IMPACTS␣
↪(DSI)
*              4-FOR INTERNALLY COMPUTED WIND WAVE BOUNDARY LAYER AND␣
↪CURRENT IMPACTS (DSI)
* ITIDASM:     1 FOR TIDAL ELEVATION ASSIMILATION (NOT ACTIVE)
*  ISPERC:     1 TO PERCOLATE OR ELIMINATE EXCESS WATER IN DRY CELLS
* ISBODYF:     TO INCLUDE EXTERNAL MODE BODY FORCES FROM FBODY.INP
*              1 FOR UNIFORM OVER DEPTH, 2 FOR SURFACE LAYER ONLY
* ISPNHYDS: 1 FOR QUASI-NONHYDROSTATIC OPTION
*
C14   MTIDE   NWSER   NASER  ISGWIT  ISCHAN  ISWAVE ITIDASM  ISPERC ISBODYF␣
↪ISPNHYDS
```

card14a

```
-----------------------------------------------------------------------------
↪-
C14C TIME & SPACE VARYING FORCING
*
*  INTERGER FLAGS:  0 NOT USE TIME & SPACE VARYING DATA FILE
*                   1 READ FROM AN ASCII FILE *FLD.INP
*                   2 READ FROM A BINARY FILE *FLD.FLD
*
*   ITOPO:     TOPOGRAPHIC UPDATES (E.G., DREDGING/DUMPING, LAND␣
↪RECLAIMATION)
*   IROUG:     BOTTOM ROUGHNESS (E.G., SEASONAL ROUGHNESS)
*   IVEGE:     VEGETATION (E.G., SEASONAL VEGETATION)
*   ISEEP:     GROUNDWATER/SEEPAGE
*   IWIND:     WIND (CYCLONES)
*   IPRES:     BAROMETRIC PRESSURE (CYCLONES)
*   ISHEL:     WIND SHELTER
*   ISHAD:     ATMOSPHERIC SHADING
*   IRAIN:     RAINFALL
*   IEVAP:     EVAPORATION
*   ISNFL:     SNOW FALL
*   ISNTK:     SNOW THICKNESS
*   IICTK:     ICE THICKNESS
```

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```
*   ZLJER:      SEDZLJ EROSION RATE
*
C14C  ITOPO    IROUG    IVEGE    ISEEP    IWIND    IPRES    IRAIN    IEVAP    ISHEL ␣
↪ ISHAD    ISNFL    ISNTK    IICTK    ZLJER
```

card15

```
------------------------------------------------------------------------------
↪-
C15 PERIODIC FORCING (TIDAL) CONSTITUENT SYMBOLS AND PERIODS
*
*  SYMBOL:  FORCING SYMBOL (CHARACTER VARIABLE) FOR TIDES, THE NOS SYMBOL
*  PERIOD:  FORCING PERIOD IN SECONDS
*
C15 SYMBOL   PERIOD
```

card16

```
------------------------------------------------------------------------------
↪-
C16 SURFACE ELEVATION OR PRESSURE BOUNDARY CONDITION PARAMETERS
*
*  NPBS:    NUMBER OF SURFACE ELEVATION OR PRESSURE BOUNDARY CONDITIONS
*           CELLS ON SOUTH OPEN BOUNDARIES
*  NPBW:    NUMBER OF SURFACE ELEVATION OR PRESSURE BOUNDARY CONDITIONS
*           CELLS ON WEST OPEN BOUNDARIES
*  NPBE:    NUMBER OF SURFACE ELEVATION OR PRESSURE BOUNDARY CONDITIONS
*           CELLS ON EAST OPEN BOUNDARIES
*  NPBN:    NUMBER OF SURFACE ELEVATION OR PRESSURE BOUNDARY CONDITIONS
*           CELLS ON NORTH OPEN BOUNDARIES
*  NPFOR:   NUMBER OF HARMONIC FORCINGS
*  NPFORT:  FORCING TYPE, 0=CONSTANT, 1=LINEAR, 2= QUADRATIC VARIATION
*  NPSER:   NUMBER OF TIME SERIES FORCINGS
*  PDGINIT: ADD THIS CONSTANT ADJUSTMENT GLOBALLY TO THE SURFACE ELEVATION
*
C16    NPBS    NPBW    NPBE    NPBN    NPFOR  NPFORT   NPSER PDGINIT
```

card17

```
------------------------------------------------------------------------------
↪-
C17 PERIODIC FORCING (TIDAL) SURF ELEV OR PRESSURE BOUNDARY COND. FORCINGS
*
*  NPFOR:     FORCING NUMBER
*  SYMBOL:    FORCING SYMBOL (FOR REFERENCE HERE ONLY)
*  AMPLITUDE:  AMPLITUDE IN M (PRESSURE DIVIDED BY RHO*G), NPFORT=0
*               COSINE AMPLITUDE IN M, NPFORT.GE.1
*  PHASE:      FORCING PHASE RELATIVE TO TBEGIN IN SECONDS, NPFORT=0
*               SINE AMPLITUDE IN M, NPFORT.GE.1
*  NOTE:  FOR NPFORT=0 SINGLE AMPLITUDE AND PHASE ARE READ, FOR NPFORT=1
```

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```
*         CONST AND LINEAR COS AND SIN AMPS ARE READ FOR EACH FORCING, FOR
*         NPFORT=2, CONST, LINEAR, QUAD COS AND SIN AMPS ARE READ FOR EACH
*         FOR EACH FORCING
*
C17   NPFOR   SYMBOL  AMPLITUDE   PHASE
```

card18

```
-----------------------------------------------------------------------------
↪-
C18 PERIODIC FORCING (TIDAL) SURF ELEV OR PRESSURE ON SOUTH OPEN BOUNDARIES
*  IPBS:     I CELL INDEX OF BOUNDARY CELL
*  JPBS:     J CELL INDEX OF BOUNDARY CELL
*  ISPBS: 0 FOR ELEVATION SPECIFIED
*         1 FOR RADIATION-SEPARATION CONDITION, ZERO TANGENTIAL VELOCITY
*         2 FOR RADIATION-SEPARATION CONDITION, FREE TANGENTIAL VELOCITY
*         3  FOR ELEVATION SPECIFIED, FREE TANGENTIAL VELOCITY
*  NPFORS:   APPLY HARMONIC FORCING NUMBER NPFORS
*  NPSERS:   APPLY TIME SERIES FORCING NUMBER NPSERS
*  NPSERS1:  APPLY TIME SERIES FORCING NUMBER NPSERS1 FOR 2ND SERIES (NPFORT.
↪GE.1)
*  TPCOORDS: TANGENTIAL COORDINATE ALONG BOUNDARY                    (NPFORT.
↪GE.1)
*  GRPID:    ID NUMBER OF BOUNDARY GROUP
*
C18    IPBS    JPBS   ISPBS  NPFORS  NPSERS      GRPID ! ID
```

card19

```
-----------------------------------------------------------------------------
↪-
C19 PERIODIC FORCING (TIDAL) SURF ELEV OR PRESSURE ON WEST OPEN BOUNDARIES
*
*  IPBW: SEE CARD 18
*  JPBW:
*  ISPBW:
*  NPFORW:
*  NPSERW:
*  TPCOORDW:
*  GRPID: ID NUMBER OF BOUNDARY GROUP
*
C19    IPBW    JPBW   ISPBW  NPFORW  NPSERW      GRPID ! ID
```

card20

```
-------------------------------------------------------------------------------
↪-
C20 PERIODIC FORCING (TIDAL) SURF ELEV OR PRESSURE ON EAST OPEN BOUNDARIES
*
*  IPBE: SEE CARD 18
*  JPBE:
*  ISPBE:
*  NPFORE:
*  NPSERE:
*  TPCOORDE:
*  GRPID: ID NUMBER OF BOUNDARY GROUP
*
C20     IPBE     JPBE    ISPBE   NPFORE   NPSERE      GRPID ! ID
```

card21

```
-------------------------------------------------------------------------------
↪-
C21 PERIODIC FORCING (TIDAL) SURF ELEV OR PRESSURE ON NORTH OPEN BOUNDARIES
*
*  IPBN: SEE CARD 18
*  JPBN:
*  ISPBN:
*  NPFORN:
*  NPSERN:
*  TPCOORDN:
*  GRPID: ID NUMBER OF BOUNDARY GROUP
*
C21     IPBN     JPBN    ISPBN   NPFORN   NPSERN      GRPID ! ID
```

card22

```
-------------------------------------------------------------------------------
↪-
C22 SPECIFY NUM OF SEDIMENT AND TOXICS AND NUM OF CONCENTRATION TIME SERIES
*
*  NDYE: NUMBER OF DYE CLASSES (DEFAULT = 1)
*  NTOX:    NUMBER OF TOXIC CONTAMINANTS (DEFAULT = 1)
*  NSED:    NUMBER OF COHESIVE SEDIMENT SIZE CLASSES (DEFAULT = 1)
*  NSND:    NUMBER OF NON-COHESIVE SEDIMENT SIZE CLASSES (DEFAULT = 1)
*  NCSER1: NUMBER OF SALINITY TIME SERIES
*  NCSER2: NUMBER OF TEMPERATURE TIME SERIES
*  NCSER3: NUMBER OF DYE CONCENTRATION TIME SERIES
*  NCSER4: NUMBER OF SHELLFISH LARVAE CONCENTRATION TIME SERIES
*  NCSER5: NUMBER OF TOXIC CONTAMINANT CONCENTRATION TIME SERIES
*          EACH TIME SERIES MUST HAVE DATA FOR NTOX TOXICANTS
*  NCSER6: NUMBER OF COHESIVE SEDIMENT CONCENTRATION TIME SERIES
*          EACH TIME SERIES MUST HAVE DATA FOR NSED COHESIVE SEDIMENTS
*  NCSER7: NUMBER OF NON-COHESIVE SEDIMENT CONCENTRATION TIME SERIES
*          EACH TIME SERIES MUST HAVE DATA FOR NSND NON-COHESIVE SEDIMENTS
*  ISSBAL: SET TO 1 FOR SEDIMENT MASS BALANCE
```

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```
*
C22    NDYE    NTOX    NSED    NSND  NCSER1  NCSER2  NCSER3  NCSER4  NCSER5 ␣
↪NCSER6  NCSER7  ISSBAL
```

card22b

```
-----------------------------------------------------------------------------
↪-
C22B Shellfish
*
*
C22B   NSF   ISFFARM   NSFCELLS
```

card23

```
-----------------------------------------------------------------------------
↪-
C23 VELOCITY, VOLUME SOURCE/SINK, FLOW CONTROL, AND WITHDRAWAL/RETURN DATA
*
*  NQSIJ:    NUMBER OF CONSTANT AND/OR TIME SERIES SPECIFIED SOURCE/SINK
*            LOCATIONS (RIVER INFLOWS,ETC)                 .
*  NQJPIJ:   NUMBER OF CONSTANT AND/OR TIME SERIES SPECIFIED SOURCE
*            LOCATIONS TREATED AS JETS/PLUMES              .
*  NQSER:    NUMBER OF VOLUME SOURCE/SINK TIME SERIES
*  NQCTL:    NUMBER OF PRESSURE CONTROLLED WITHDRAWAL/RETURN PAIRS
*  NQCTLT:   NUMBER OF PRESSURE CONTROLLED WITHDRAWAL/RETURN TABLES
*  NHYDST:   NUMBER OF HYDRAULIC STRUCTURE DEFINITIONS
*  NQWR:     NUMBER OF CONSTANT OR TIME SERIES SPECIFIED WITHDRAWAL/RETURN
*            PAIRS
*  NQWRSR:   NUMBER OF TIME SERIES SPECIFYING WITHDRAWAL,RETURN AND
*            CONCENTRATION RISE SERIES
*  ISDIQ:    SET TO 1 TO WRITE DIAGNOSTIC FILE, DIAQ.OUT
*  NQCTLSER: NUMBER OF GATE OPENING TIME-SERIES FOR HYDRAULIC STRUCTURE␣
↪CONTROL
*  NQCRULES: NUMBER OF OPERATIONAL RULES FOR HYDRAULIC STRUCTURE CONTROL
*
C23   NQSIJ  NQJPIJ   NQSER   NQCTL  NQCTLT  NHYDST    NQWR  NQWRSR   ISDIQ␣
↪NQCTLSER  NQCRULES
```

card24

```
-----------------------------------------------------------------------------
↪-
C24 VOLUMETRIC SOURCE/SINK LOCATIONS, MAGNITUDES, AND CONCENTRATION SERIES
*
*  IQS:      I CELL INDEX OF VOLUME SOURCE/SINK
*  JQS:      J CELL INDEX OF VOLUME SOURCE/SINK
*  QSSE:     CONSTANT INFLOW/OUTFLOW RATE IN (m^3/s)
*  NQSMUL:   MULTIPLIER SWITCH FOR CONSTANT AND TIME SERIES VOL S/S
*            = 0  MULT BY 1. FOR NORMAL IN/OUTFLOW (L*L*L/T)
```

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```
*              = 1  MULT BY DY FOR LATERAL IN/OUTFLOW (L*L/T) ON U FACE
*              = 2  MULT BY DX FOR LATERAL IN/OUTFLOW (L*L/T) ON V FACE
*              = 3  MULT BY DX+DY FOR LATERAL IN/OUTFLOW (L*L/T) ON U&V FACES
*  NQSMF:   IF NON ZERO ACCOUNT FOR VOL S/S MOMENTUM FLUX (NEGATIVE VALUES␣
↪REVERSE FLOW DIRECTION)
*              = 1  MOMENTUM FLUX ON WEST U FACE
*              = 2  MOMENTUM FLUX ON SOUTH V FACE
*              = 3  MOMENTUM FLUX ON EAST U FACE
*              = 4  MOMENTUM FLUX ON NORTH V FACE
*  IQSERQ:    ID NUMBER OF ASSOCIATED VOLUME FLOW TIME SERIES
*  ICSER1:    ID NUMBER OF ASSOCIATED SALINITY TIME SERIES
*  ICSER2:    ID NUMBER OF ASSOCIATED TEMPERATURE TIME SERIES
*  ICSER3:    ID NUMBER OF ASSOCIATED DYE CONC TIME SERIES
*  ICSER4:    ID NUMBER OF ASSOCIATED SHELL FISH LARVAE RELEASE TIME SERIES
*  ICSER5:    ID NUMBER OF ASSOCIATED TOXIC CONTAMINANT CONC TIME SERIES
*  ICSER6:    ID NUMBER OF ASSOCIATED COHESIVE SEDIMENT CONC TIME SERIES
*  ICSER7:    ID NUMBER OF ASSOCIATED NON-COHESIVE SED CONC TIME SERIES
*  QWIDTH:    WIDTH OF THE DISCHARGE FOR FOR MOMENTUM FLUX (M)(NQSMF /= 0)
*  QSFACTOR: FRACTION OF TIME SERIES FLOW NQSERQ ASSIGNED TO THIS CELL
*  GRPID:     ID NUMBER OF BOUNDARY GROUP
*
C24      IQS      JQS         QSSE   NQSMUL   NQSMF  IQSERQ  ICSER1  ICSER2 ␣
↪ICSER3  ICSER4  ICSER5  ICSER6  ICSER7   QWIDTH    QSFACTOR    GRPID ! ID
```

card25

```
-----------------------------------------------------------------------------
↪-
C25 TIME CONSTANT INFLOW CONCENTRATIONS FOR TIME CONSTANT VOLUMETRIC SOURCES
*
*    SAL: SALT CONCENTRATION CORRESPONDING TO INFLOW ABOVE
*    TEM: TEMPERATURE CORRESPONDING TO INFLOW ABOVE
*    DYE: DYE CONCENTRATION CORRESPONDING TO INFLOW ABOVE
*    SFL: SHELL FISH LARVAE CONCENTRATION CORRESPONDING TO INFLOW ABOVE
*    TOX: NTOX TOXIC CONTAMINANT CONCENTRATIONS CORRESPONDING TO
*         INFLOW ABOVE  WRITTEN AS TOXC(N), N=1,NTOX A SINGLE DEFAULT
*         VALUE IS REQUIRED EVEN IF TOXIC TRANSPORT IS NOT ACTIVE
*  GRPID: ID NUMBER OF BOUNDARY GROUP
*
C25        SAL       TEM      DYE1       SFL      GRPID ! ID
             0        20         0         0          1 ! Chehalis River
             0        20         0         0          2 ! Humptulips River
```

card26

```
-----------------------------------------------------------------------------
↪-
C26 TIME CONSTANT INFLOW CONCENTRATIONS FOR TIME CONSTANT VOLUMETRIC SOURCES
*
*    SED: NSED COHESIVE SEDIMENT CONCENTRATIONS CORRESPONDING TO
*         INFLOW ABOVE  WRITTEN AS SEDC(N), N=1,NSED. I.E., THE FIRST
*         NSED VALUES ARE COHESIVE A SINGLE DEFAULT VALUE IS REQUIRED
```

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```
*          EVEN IF COHESIVE SEDIMENT TRANSPORT IS INACTIVE
*     SND: NSND NON-COHESIVE SEDIMENT CONCENTRATIONS CORRESPONDING TO
*          INFLOW ABOVE  WRITTEN AS SND(N), N=1,NSND. I.E., THE LAST
*          NSND VALUES ARE NON-COHESIVE. A SINGLE DEFAULT VALUE IS
*          REQUIRED EVEN IF NON-COHESIVE SEDIMENT TRANSPORT IS INACTIVE
*   GRPID: ID NUMBER OF BOUNDARY GROUP
*
C26       SED1       SED2       SED3       SED4       SED5       SED6       SED7   ␣
↪ SED8       GRPID ! ID (8 SEDS + 0 SNDS)
           100        100          0          0          0          0          0  ␣
↪     0           1 ! Chehalis River
           100        100          0          0          0          0          0  ␣
↪     0           2 ! Humptulips River
```

card27

```
-----------------------------------------------------------------------------
↪-
C27 JET/PLUME SOURCE LOCATIONS, GEOMETRY AND ENTRAINMENT PARAMETERS
*
*     ID: ID COUNTER FOR JET/PLUME
*   ICAL: 0 BYPASS,  1 ACTIVE (NORMAL - TOTAL LAYER FLOW AT DIFFUSER),  2 - W/
↪R (USE W/R SERIES)
*   IQJP: I CELL INDEX OF JET/PLUME
*   JQJP: J CELL INDEX OF JET/PLUME
*   KQJP: K CELL INDEX OF JET/PLUME (DEFAULT, QJET=0 OR JET COMP DIVERGES)
* NPORT: NUMBER OF IDENTICAL PORTS IN THIS CELL
*   XJET: LOCAL EAST JET LOCATION RELATIVE TO DISCHARGE CELL CENTER (m) (NOT␣
↪USED)
*   YJET: LOCAL NORTH JET LOCATION RELATIVE TO DISCHARGE CELL CENTER (m)(NOT␣
↪USED)
*   ZJET: ELEVATION OF DISCHARGE (m)
* PHJET: VERTICAL JET ANGLE POSITIVE FROM HORIZONTAL (DEGREES)
* THJET: HORIZONTAL JET ANGLE POS COUNTER CLOCKWISE FROM EAST (DEGREES)
*   DJET: DIAMETER OF DISCHARGE PORT (m)
*   CFRD: ADJUSTMENT FACTOR FOR FROUDE NUMBER
* DJPER: ENTRAINMENT ERROR CRITERIA
* GRPID: ID NUMBER OF BOUNDARY GROUP
*
C27       ID     ICAL     IQJP     JQJP     KQJP    NPORT     XJET     YJET     ZJET ␣
↪ PHJET   THJET     DJET     CFRD    DJPER      GRPID ! ID
```

card28

```
-----------------------------------------------------------------------------
↪-
C28 JET/PLUME SOLUTION CONTROL AND OUTPUT CONTROL PARAMETERS
*
*      ID:  ID COUNTER FOR JET/PLUME
*    NJEL:  MAXIMUM NUMBER OF ELEMENTS ALONG JET/PLUME LENGTH
*   NJPMX:  MAXIMUM NUMBER OF ITERATIONS
*   ISENT:  0 USE MAXIMUM OF SHEAR AND FORCED ENTRAINMENT
```

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```
*           1 USE SUM OF SHEAR AND FORCED ENTRAINMENT
*   ISTJP:  0 STOP AT SPECIFIED NUMBER OF ELEMENTS
*           1 STOP WHEN CENTERLINE PENETRATES BOTTOM OR SURFACE
*           2 STOP WITH BOUNDARY PENETRATES BOTTOM OR SURFACE
*   NUDJP: FREQUENCY FOR UPDATING JET/PLUME (NUMBER OF TIME STEPS)
*    IOJP: 1 FOR FULL ASCII, 2 FOR COMPACT ASCII OUTPUT AT EACH UPDATE
*          3 FOR FULL AND COMPACT ASCII OUTPUT, 4 FOR BINARY OUTPUT
*    IPJP: NUMBER OF SPATIAL PRINT/SAVE POINT IN VERTICAL
*   ISDJP: 1 WRITE DIAGNOSTICS TO JPLOG__.OUT
*   IUPJP:   I INDEX OF UPSTREAM WITHDRAWAL CELL IF ICAL=2
*   JUPJP:   J INDEX OF UPSTREAM WITHDRAWAL CELL IF ICAL=2
*   KUPJP:   K INDEX OF UPSTREAM WITHDRAWAL CELL IF ICAL=2
*   GRPID:   ID NUMBER OF BOUNDARY GROUP
*
C28       ID    NJEL   NJPMX   ISENT   ISTJP   NUDJP    IOJP    IPJP   ISDJP ␣
↪ IUPJP   JUPJP   KUPJP     GRPID ! ID
```

card29

```
-----------------------------------------------------------------------------
↪-
C29 JET/PLUME SOURCE PARAMETERS AND DISCHARGE/CONCENTRATION SERIES IDS
*
*         ID: ID COUNTER FOR JET/PLUME
*       QQJP: CONSTANT JET/PLUME FLOW RATE IN (m^3/s)
*               FOR ICAL = 1 OR 2  (FOR SINGLE PORT)
*    NQSERJP: ID NUMBER OF ASSOCIATED VOLUME FLOW TIME SERIES
*  NQWRSERJP: ID NUMBER OF ASSOCIATED WITHDRAWAL-RETURN TIME SERIES (ICAL=2)
*     ICSER1: ID NUMBER OF ASSOCIATED SALINITY TIME SERIES
*     ICSER2: ID NUMBER OF ASSOCIATED TEMPERATURE TIME SERIES
*     ICSER3: ID NUMBER OF ASSOCIATED DYE CONC TIME SERIES
*     ICSER4: ID NUMBER OF ASSOCIATED SHELL FISH LARVAE RELEASE TIME SERIES
*     ICSER5: ID NUMBER OF ASSOCIATED TOXIC CONTAMINANT CONC TIME SERIES
*     ICSER6: ID NUMBER OF ASSOCIATED COHESIVE SEDIMENT CONC TIME SERIES
*     ICSER7: ID NUMBER OF ASSOCIATED NON-COHESIVE SED CONC TIME SERIES
*      GRPID: ID NUMBER OF BOUNDARY GROUP
*
C29       ID    QQJP NQSERJP NQWRSERJP ICSER1 ICSER2  ICSER3  ICSER4  ICSER5 ␣
↪ICSER6  ICSER7      GRPID ! ID
```

card30

```
-----------------------------------------------------------------------------
↪-
C30 TIME CONSTANT INFLOW CONCENTRATIONS FOR TIME CONSTANT JET/PLUME SOURCES
*
*     SAL: SALT CONCENTRATION CORRESPONDING TO INFLOW ABOVE
*     TEM: TEMPERATURE CORRESPONDING TO INFLOW ABOVE
*     DYE: DYE CONCENTRATION CORRESPONDING TO INFLOW ABOVE
*     SFL: SHELL FISH LARVAE CONCENTRATION CORRESPONDING TO INFLOW ABOVE
*     TOX: NTOX TOXIC CONTAMINANT CONCENTRATIONS CORRESPONDING TO
*          INFLOW ABOVE  WRITTEN AS TOXC(N), N=1,NTOX A SINGLE DEFAULT
```

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```
*          VALUE IS REQUIRED EVEN IF TOXIC TRANSPORT IS NOT ACTIVE
*   GRPID: ID NUMBER OF BOUNDARY GROUP
*
C30        SAL        TEM       DYE1        SFL       GRPID ! ID
```

card31

```
------------------------------------------------------------------------------
↪-
C31 TIME CONSTANT INFLOW CONCENTRATIONS FOR TIME CONSTANT JET/PLUME SOURCES
*
*    SED: NSED COHESIVE SEDIMENT CONCENTRATIONS CORRESPONDING TO
*         INFLOW ABOVE  WRITTEN AS SEDC(N), N=1,NSED. I.E., THE FIRST
*         NSED VALUES ARE COHESIVE A SINGLE DEFAULT VALUE IS REQUIRED
*         EVEN IF COHESIVE SEDIMENT TRANSPORT IS INACTIVE
*    SND: NSND NON-COHESIVE SEDIMENT CONCENTRATIONS CORRESPONDING TO
*         INFLOW ABOVE  WRITTEN AS SND(N), N=1,NSND. I.E., THE LAST
*         NSND VALUES ARE NON-COHESIVE. A SINGLE DEFAULT VALUE IS
*         REQUIRED EVEN IF NON-COHESIVE SEDIMENT TRANSPORT IS INACTIVE
*   GRPID: ID NUMBER OF BOUNDARY GROUP
*
C31       SED1       SED2       SED3       SED4       SED5       SED6       SED7   ␣
↪   SED8       GRPID ! ID (8 SEDS + 0 SNDS)
```

card32

```
------------------------------------------------------------------------------
↪-
C32 SURFACE ELEV OR PRESSURE DEPENDENT FLOW INFORMATION
*
*   IQCTLU:  I INDEX OF UPSTREAM OR WITHDRAWAL CELL
*   JQCTLU:  J INDEX OF UPSTREAM OR WITHDRAWAL CELL
*   IQCTLD:  I INDEX OF DOWNSTREAM OR RETURN CELL
*   JQCTLD:  J INDEX OF DOWNSTREAM OR RETURN CELL
*   NQCTYP:  FLOW CONTROL TYPE
*            = -2 FLOW AS FUNCTION OF UPSTREAM ELEVATION RATING CURVE OF A␣
↪GROUP OF CELLS
*            = -1 FLOW AS FUNCTION OF UPSTREAM DEPTH (STAGE RATING CURVE)
*            = 0  FLOW AS FUNCTION OF ELEVATION OR PRESSURE DIFFERENCE TABLE
*            = 1  SAME AS 0 WITH ACCELERATING FLOW (E.G. TIDAL INLET)
*            = 2  FLOW DERIVED FROM UPSTREAM AND DOWNSTREAM WS ELEVATIONS
*            = 3  LOWER CHORD OPTION USING UPSTREAM DEPTH       WHEN WSEL >␣
↪BQCLCE
*            = 4  LOWER CHORD OPTION USING ELEVATION DIFFERENCE WHEN WSEL >␣
↪BQCLCE
*            = 5  CULVERT
*            = 6  SLUICE GATE
*            = 7  WEIR
*            = 8  ORIFICE
*            = 9  FLOATING SKIMMER WALL (NOT AVAILABLE)
*            = 10 SUBMERGED WEIR (NOT AVAILABLE)
*   NQCTLQ:  ID NUMBER OF CONTROL CHARACTERIZATION TABLE
```

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```
*  NQCMUL:  MULTIPLIER SWITCH FOR FLOWS FROM UPSTREAM CELL
*           = 0  MULT BY 1. FOR CONTROL TABLE IN (L*L*L/T)
*           = 1  MULT BY DY FOR CONTROL TABLE IN (L*L/T) ON U FACE
*           = 2  MULT BY DX FOR CONTROL TABLE IN (L*L/T) ON V FACE
*           = 3  MULT BY DX+DY FOR CONTROL TABLE IN (L*L/T) ON U&V FACES
*  HQCTLU:      OFFSET FOR UPSTREAM HEAD (m)
*               SET TO CELL'S BOTTOM ELEVATION TO USE ELEVATION INSTEAD OF␣
↪DEPTH FOR NQCTYP = -1 or 3
*  HQCTLD:      OFFSET FOR DOWNSTREAM HEAD (m)
*  QTCLMU:      MULTIPLIER TO SPLIT THE TOTAL QCTL RATING TABLE INTO CELL␣
↪SPECIFIC FLOWS  [ONLY USED IF NQCTYP = -2]
*  QTCLGRP:     NUMBER IDENTIFIER TO ASSOCIATE PHYSICALLY BASED FLOW GROUPS ␣
↪              [ONLY USED IF NQCTYP = -2]
*  BQCLCE:      LOWER CHORD ELEVATION (m)                             [ONLY␣
↪USED IF NQCTYP = 3 OR 4]
*  NQCMINS:     MINIMUM NUMBER OF STEPS REQUIRED ABOVE LOWER CHORD   [ONLY␣
↪USED IF NQCTYP = 3 OR 4]
*
*               *** LOOKUP TABLE HEAD DETERMINATION (HUP & HDW) FOR LOW CHORD
*               *** NQCTYP = 3:  HUP = HP(LU) + HCTLUA(NCTLT) + HQCTLU(NCTL)
*               *** NQCTYP = 4:  HUP = HP(LU) + BELV(LU) + HCTLUA(NCTLT) +␣
↪HQCTLU(NCTL)
*               *** NQCTYP = 4:  HDW = HP(LD) + BELV(LD) + HCTLDA(NCTLT) +␣
↪HQCTLD(NCTL)
*
*HS_FACTOR:     DISCHARGE DISTRIBUTION FACTOR  (ONLY USED FOR NQCTYP>4)
*HS_NTIMES:     NUMBER OF TIMES HYDRAULIC STRUCTURE DEFINITION CHANGES      ␣
↪(IN DEVELOPMENT)
*HS_TRANSITION: NUMBER OF SECONDS TO TRANSITION FROM TIME (T) TO TIME (T+1) ␣
↪(IN DEVELOPMENT)
*GRPID:         ID NUMBER OF BOUNDARY GROUP
*
C32  IQCTLU  JQCTLU  IQCTLD  JQCTLD  NQCTYP  NQCTLQ  NQCMUL  HQCTLU  HQCTLD ␣
↪QTCLMU QTCLGRP  BQCLCE NQCMINS  FACTOR  NTIMES  TRANSIT   GRPID ! ID
```

card33

```
-----------------------------------------------------------------------------
↪-
C33 FLOW WITHDRAWAL, HEAT OR MATERIAL ADDITION, AND RETURN DATA
*
*  IWRU:      I INDEX OF UPSTREAM OR WITHDRAWAL CELL
*  JWRU:      J INDEX OF UPSTREAM OR WITHDRAWAL CELL
*  KWRU:      K INDEX OF UPSTREAM OR WITHDRAWAL LAYER
*  IWRD:      I INDEX OF DOWNSTREAM OR RETURN CELL
*  JWRD:      J INDEX OF DOWNSTREAM OR RETURN CELL
*  KWRD:      J INDEX OF DOWNSTREAM OR RETURN LAYER
*  QWRE:        CONSTANT VOLUME FLOW RATE FROM WITHDRAWAL TO RETURN
*  NQWRSERQ: ID NUMBER OF ASSOCIATED VOLUME WITHDRAWAL-RETURN FLOW AND
*               CONCENTRATION RISE TIME SERIES
*  NQWRMFU:   IF NON ZERO ACCOUNT FOR WITHDRAWAL FLOW MOMENTUM FLUX
*             = 1  MOMENTUM FLUX ON WEST U FACE
*             = 2  MOMENTUM FLUX ON SOUTH V FACE
*             = 3  MOMENTUM FLUX ON EAST U FACE
```

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```
*              = 4  MOMENTUM FLUX ON NORTH V FACE
*  NQWRMFD:    IF NON ZERO ACCOUNT FOR RETURN FLOW MOMENTUM FLUX
*              = 1  MOMENTUM FLUX ON WEST U FACE
*              = 2  MOMENTUM FLUX ON SOUTH V FACE
*              = 3  MOMENTUM FLUX ON EAST U FACE
*              = 4  MOMENTUM FLUX ON NORTH V FACE
*  BQWRMFU:    UPSTREAM MOMENTUM FLUX WIDTH (m)
*  BQWRMFD:    DOWNSTREAM MOMENTUM FLUX WIDTH (m)
*  ANGWRMFD:   ANGLE FOR HORIZONTAL FOR RETURN FLOW MOMENTUM FLUX
*  GRPID:      ID NUMBER OF BOUNDARY GROUP
*
C33    IWRU    JWRU    KWRU    IWRD    JWRD    KWRD    QWRE  NQW_RQ  NQWR_U ␣
↪NQWR_D  BQWR_U  BQWR_D   ANG_D   GRPID ! ID
```

card34

```
-----------------------------------------------------------------------------
↪-
C34 TIME CONSTANT WITHDRAWAL AND RETURN CONCENTRATION RISES
*
*  SAL:   SALINITY RISE
*  TEM:   TEMPERATURE RISE
*  DYE:   DYE CONCENTRATION RISE
*  SFL:   SHELLFISH LARVAE CONCENTRATION RISE
*  TOX#:  NTOX TOXIC CONTAMINANT CONCENTRATION RISES
*  GRPID: ID NUMBER OF BOUNDARY GROUP
*
C34        SAL        TEM       DYE1        SFL       GRPID ! ID
```

card35

```
-----------------------------------------------------------------------------
↪-
C35 TIME CONSTANT WITHDRAWAL AND RETURN CONCENTRATION RISES
*
*   SED#:  NSEDC COHESIVE SEDIMENT CONCENTRATION RISE
*   SND#:  NSEDN NON-COHESIVE SEDIMENT CONCENTRATION RISE
*  GRPID:  ID NUMBER OF BOUNDARY GROUP
*
C35       SED1       SED2       SED3       SED4       SED5       SED6       SED7   ␣
↪   SED8       GRPID ! ID (8 SEDS + 0 SNDS)
```

card36

```
----------------------------------------------------------------------------
↪-
C36 SEDIMENT INITIALIZATION AND WATER COLUMN/BED REPRESENTATION OPTIONS
*   DATA REQUIRED IF ISTRAN(6) OR ISTRAN(7) <> 0
*
*   ISEDINT: 0 FOR CONSTANT INITIAL CONDITIONS
*            1 FOR SPATIALLY VARIABLE WATER COLUMN INITIAL CONDITIONS
*              FROM SEDW.INP AND SNDW.INP
*            2 FOR SPATIALLY VARIABLE BED INITIAL CONDITIONS
*              FROM SEDB.INP AND SNDB.INP
*            3 FOR SPATIALLY VARIABLE WATER COL AND BED INITIAL CONDITIONS
*  ISEDBINT: 0 FOR SPATIALLY VARYING BED INITIAL CONDITIONS IN MASS/AREA
*            1 FOR SPATIALLY VARYING BED INITIAL CONDITIONS IN MASS FRACTION
*              OF TOTAL SEDIMENT MASS (REQUIRES BED LAYER THICKNESS
*              FILE BEDLAY.INP)
* NSEDFLUME: 0 USE THE SEDIMENT TRANSPORT FUNCTIONS IN EFDC MAIN CODE
*            1 USE SEDZLJ SUB-MODEL WITH EE8.X/SNL EROSION RATE LOOKUP␣
↪TABLES   AND BED PROPERTIES BY COREID
*            2 USE SEDZLJ SUB-MODEL WITH COMPUTED EROSION RATES  E =␣
↪A*TAU**N   AND BED PROPERTIES BY COREID
*            3 USE SEDZLJ SUB-MODEL WITH COMPUTED EROSION RATES  E =␣
↪A*TAU**N   AND FULL BED PROPERTY
*              SPECIFICATION USING SEDB, BEDLAY, BEDBDN AND BEDDDN
*
*     ISMUD: 1 INCLUDE COHESIVE FLUID MUD VISCOUS EFFECTS USING EFDC
*              FUNCTION CSEDVIS(SEDT)
*  ISBEDMAP: 0 DO NOT USE USE BEDMAP.INP, ALL CELLS COMPUTED
*            1 USE BEDMAP.INP TO SPECIFIED HARD BOTTOM
*
*    ISEDVW: 0 FOR CONSTANT OR SIMPLE CONCENTRATION DEPENDENT
*              COHESIVE SEDIMENT SETTLING VELOCITY
*           >1 CONCENTRATION AND/OR SHEAR/TURBULENCE DEPENDENT COHESIVE
*              SEDIMENT SETTLING VELOCITY. VALUE INDICATES OPTION TO BE USED
*              IN EFDC FUNCTION CSEDSET(SED,SHEAR,ISEDVWC)
*            1 HUANG AND MEHTA - LAKE OKEECHOBEE
*            2 SHRESTHA AND ORLOB - FOR KRONES SAN FRANCISCO BAY DATA
*            3 ZIEGLER AND NESBIT  - FRESH WATER
*           98 LICK FLOCCULATION
*           99 LICK FLOCCULATION WITH FLOC DIAMETER ADVECTION
*    ISNDVW: 0 USE CONSTANT SPECIFIED NON-COHESIVE SED SETTLING VELOCITIES
*              OR CALCULATE FOR CLASS DIAMETER IF SPECIFIED VALUE IS NEG
*           >1 FOLLOW OPTION 0 PROCEDURE BUT APPLY HINDERED SETTLING
*              CORRECTION. VALUE INDICATES OPTION TO BE USED WITH EFDC
*              FUNCTION CSNDSET(SND,SDEN,ISNDVW) VALUE OF ISNDVW INDICATES
*              EXPONENTIAL IN CORRECT (1-SDEN(NS)*SND(NS)**ISNDVW
*        KB:   MAXIMUM NUMBER OF BED LAYERS (EXCLUDING ACTIVE LAYER)
*  ISDTXBUG: 1 TO ACTIVATE SEDIMENT AND TOXICS DIAGNOSTICS
*
C36 ISEDINT ISEDBINT NSEDFLUME ISMUD ISBEDMAP  ISEDVW  ISNDVW      KB ␣
↪ISDTXBUG
```

card36a

```
-------------------------------------------------------------------------------
↪-
C36A SEDIMENT INITIALIZATION AND WATER COLUMN/BED REPRESENTATION OPTIONS
*    DATA REQUIRED EVEN IF ISTRAN(6) AND ISTRAN(7) ARE 0
*
* ISBEDSTR:  0 USE HYDRODYNAMIC MODEL STRESS FOR SEDIMENT TRANSPORT
*            1 SEPARATE GRAIN STRESS FROM TOTAL IN COHESIVE AND NON-COHESIVE␣
↪COMPONENTS
*            2 SEPARATE GRAIN STRESS FROM TOTAL APPLY TO COHESIVE AND NON-
↪COHESIVE SEDS
*            3 USE INDEPENDENT LOG LAW ROUGHNESS HEIGHT FOR SEDIMENT␣
↪TRANSPORT
*              READ FROM FILE SEDROUGH.INP
*            4 SEPARATE GRAIN STRESS FROM TOTAL USING COHESIVE/NON-COHESIVE␣
↪WEIGHTED
*              ROUGHNESS AND LOG LAW RESISTANCE (IMPLEMENTED 5/31/05)
*            5 SEPARATE GRAIN STRESS FROM TOTAL USING COHESIVE/NON-COHESIVE␣
↪WEIGHTED
*              ROUGHNESS AND POWER LAW RESISTANCE (IMPLEMENTED 5/31/05)
* ISBSDIAM:  0 USE D50 DIAMETER FOR NON-COHESIVE ROUGHNESS
*            1 USE 2*D50 FOR NON-COHESIVE ROUGHNESS
*            2 USE D90 FOR NON-COHESIVE ROUGHNESS
*            3 USE 2*D90 FOR NON-COHESIVE ROUGHNESS
* ISBSDFUF:  1 CORRECT GRAIN STRESS PARTITIONING FOR NON-UNIFORM FLOW EFFECTS
*              DO NOT USE FOR ISBEDSTR = 4 AND 5
* COEFTSBL:    COEFFICIENT SPECIFYING THE HYDRODYNAMIC SMOOTHNESS OF
*              TURBULENT BOUNDARY LAYER OVER COHESIVE BED IN TERMS OF
*              EQUIVALENT GRAIN SIZE FOR COHESIVE GRAIN STRESS
*              CALCULATION, FULLY SMOOTH = 4, FULLY ROUGH = 100.
*              NOT USED FOR ISBEDSTR = 4 AND 5
* VISMUDST:    KINEMATIC VISCOSITY TO USE IN DETERMINING COHESIVE GRAIN␣
↪STRESS
* ISBKERO:   1 FOR BANK EROSION SPECIFIED BY EXTERNAL TIME SERIES
*            2 FOR BANK EROSION INTERNALLY CALCULATED BY STABILITY ANALYSIS␣
↪(Not Active)
*
C36A ISBEDSTR ISBSDIAM ISBSDFUF COEFTSBL VISMUDST ISBKERO
```

card36b

```
-------------------------------------------------------------------------------
↪-
C36B SEDIMENT INITIALIZATION AND WATER COLUMN/BED REPRESENTATION OPTIONS
*    DATA REQUIRED EVEN IF ISTRAN(6) AND ISTRAN(7) ARE 0
*
*   ISEDAL:    NOT USED
*   ISNDAL:  1 TO ACTIVATE NON-COHESIVE ARMORING EFFECTS (GARCIA & PARKER)
*            2 SAME AS 1 WITH ACTIVE-PARENT LAYER FORMULATION
*   IALTYP:  0 CONSTANT THICKNESS ARMORING LAYER
*            1 CONSTANT TOTAL SEDIMENT MASS ARMORING LAYER
*   IALSTUP: 1 CREATE ARMORING LAYER FROM INITIAL TOP LAYER AT START UP
*   ISEDEFF: 1 MODIFY NON-COHESIVE RESUSPENSION TO ACCOUNT FOR COHESIVE␣
↪EFFECTS
```

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```
*              USING MULTIPLICATION FACTOR: EXP(-COEHEFF*FRACTION COHESIVE)
*            2 MODIFY NON-COHESIVE CRITICAL STRESS TO ACCOUNT FOR COHESIVE␣
↪EFFECTS
*              USING MULT FACTOR: 1+(COEHEFF2-1)*(1-EXP(-COEHEFF*FRACTION␣
↪COHESIVE))
*   HBEDAL:    ACTIVE ARMORING LAYER THICKNESS
*   COEHEFF:   COHESIVE EFFECTS COEFFICIENT
*   COEHEFF2:  COHESIVE EFFECTS COEFFICIENT
*
C36B ISEDAL  ISNDAL  IALTYP IALSTUP ISEDEFF  HBEDAL COEHEFF COEHEFF2
```

card37

```
----------------------------------------------------------------------------
↪-
C37 BED MECHANICAL PROPERTIES PARAMETER SET 1
*   DATA REQUIRED IF NSED>0, EVEN IF ISTRAN(6) = 0
*
*  SEDSTEP :   SEDIMENT BED INTERACTION TIME STEP          (SECONDS)
*  SEDSTART:   START TIME FOR BED/WATER COLUMN INTERACTION    (DAYS)
*  IBMECH: 0 TIME INVARIANT CONSTANT BED MECHANICAL PROPERTIES (UNIFORM BED␣
↪ONLY)
*          1 SIMPLE CONSOLIDATION CALCULATION WITH CONSTANT COEFFICIENTS
*          2 SIMPLE CONSOLIDATION WITH VARIABLE COEFFICIENTS DETERMINED
*            EFDC FUNCTIONS CSEDCON1,2,3(IBMECH)
*          3 COMPLEX CONSOLIDATION WITH VARIABLE COEFFICIENTS DETERMINED
*            EFDC FUNCTIONS CSEDCON1,2,3(IBMECH). IBMECH > 0 SETS THE
*            C38 PARAMETER ISEDBINT=1 AND REQUIRES INITIAL CONDITIONS
*            FILES BEDLAY.INP, BEDBDN.INP AND BEDDDN.IN
*          9 TYPE OF CONSOLIDATION VARIES BY CELL WITH IBMECH FOR EACH
*            DEFINED IN INPUT FILE CONSOLMAP.INP
*  IMORPH: 0 CONSTANT BED MORPHOLOGY (IBMECH=0, ONLY)
*          1 ACTIVE BED MORPHOLOGY: NO WATER ENTRAIN/EXPULSION EFFECTS
*          2 ACTIVE BED MORPHOLOGY: WITH WATER ENTRAIN/EXPULSION EFFECTS
*  HBEDMAX:  TOP BED LAYER THICKNESS (m) AT WHICH NEW LAYER IS ADDED OR IF
*            KBT(I,J)=KB, NEW LAYER ADDED AND LOWEST TWO LAYERS COMBINED
*  BEDPORC:  CONSTANT BED POROSITY (IBMECH=0, OR NSED=0)
*            ALSO USED AS POROSITY OF DEPOSITION NON-COHESIVE SEDIMENT
*  SEDMDMX:  MAXIMUM FLUID MUD COHESIVE SEDIMENT CONCENTRATION (MG/L)
*  SEDMDMN:  MINIMUM FLUID MUD COHESIVE SEDIMENT CONCENTRATION (MG/L)
*  SEDVDRD:  VOID RATIO OF DEPOSITING COHESIVE SEDIMENT
*  SEDVDRM:  MINIMUM COHESIVE SEDIMENT BED VOID RATIO (IBMECH > 0)
*  SEDVDRT:  BED CONSOLIDATION RATE CONSTANT (sec) (IBMECH = 1,2), EXP(-DELT/
↪SEDVDRT)
*              > 0 CONSOLIDATE OVER TIME TO SEDVDRM
*              = 0 CONSOLIDATE INSTANTANEOUSLY TO SEDVDRM (0.0>=SEDVDRT<=0.
↪0001)
*              < 0 CONSOLIDATE TO INITIAL VOID RATIOS
*
C37 SEDSTEP SEDSTART  IBMECH  IMORPH HBEDMAX BEDPORC SEDMDMX SEDMDMN SEDVDRD␣
↪SEDVDRM SEDVRDT
```

card38

```
-------------------------------------------------------------------------------
↪-
C38 BED MECHANICAL PROPERTIES PARAMETER SET 2
*   DATA REQUIRED IF NSED>0, EVEN IF ISTRAN(6) = 0
*
*  IBMECHK: 0 FOR HYDRAULIC CONDUCTIVITY, K, FUNCTION K=KO*EXP((E-EO)/EK)
*           1 FOR HYD COND/(1+VOID RATIO),K', FUNCTION K'=KO'*EXP((E-EO)/EK)
*   BMECH1:   REFERENCE EFFECTIVE STRESS/WATER SPECIFIC WEIGHT, SEO (m)
*             IF BMECH1<0 USE INTERNAL FUNCTION, BMECH1,BMECH2,BMECH3 NOT␣
↪USED
*   BMECH2:   REFERENCE VOID RATIO FOR EFFECTIVE STRESS FUNCTION, EO
*   BMECH3:   VOID RATIO RATE TERM ES IN SE=SEO*EXP(-(E-EO)/ES)
*   BMECH4:   REFERENCE HYDRAULIC CONDUCTIVITY, KO (m/s)
*             IF BMECH4<0 USE INTERNAL FUNCTION, BMECH1,BMECH2,BMECH3 NOT␣
↪USED
*   BMECH5:   REFERENCE VOID RATIO FOR HYDRAULIC CONDUCTIVITY, EO
*   BMECH6:   VOID RATIO RATE TERM EK IN (K OR K')=(KO OR KO')*EXP((E-EO)/EK)
*
C38 IBMECHK  BMECH1  BMECH2  BMECH3  BMECH4  BMECH5  BMECH6
```

card39

```
-------------------------------------------------------------------------------
↪-
C39 COHESIVE SEDIMENT PARAMETER SET 1 REPEAT DATA LINE NSED TIMES
*   DATA REQUIRED IF NSED>0, EVEN IF ISTRAN(6) = 0
*
*  SEDO:   CONSTANT INITIAL COHESIVE SEDIMENT CONC IN WATER COLUMN
*           (MG/LITER=GM/M^3)
*  SEDBO:  CONSTANT INITIAL COHESIVE SEDIMENT IN BED PER UNIT AREA
*           (GM/SQ METER)  IE 1CM THICKNESS BED WITH SSG=2.5 AND
*           N=.6,.5 GIVES SEDBO 1.E4, 1.25E4
*  SDEN:   SEDIMENT SPEC VOLUME (IE 1/2.25E6 M^3/GM)
*  SSG:    SEDIMENT SPECIFIC GRAVITY
*  WSEDO:  CONSTANT OR REFERENCE SEDIMENT SETTLING VELOCITY
*            IN FORMULA WSED=WSEDO*( (SED/SEDSN)^SEXP )
*  SEDSN:  (NOT USED)
*  SEXP:   (NOT USED)
*  TAUD:   BOUNDARY STRESS BELOW WHICH DEPOSITION TAKES PLACE ACCORDING
*           TO (TAUD-TAU)/TAUD
*  ISEDSCOR:  1 TO CORRECT BOTTOM LAYER CONCENTRATION TO NEAR BED␣
↪CONCENTRATION
*  ISPROBDEP: 0 KRONE PROBABILITY OF DEPOSITION USING COHESIVE GRAIN STRESS
*             1 KRONE PROBABILITY OF DEPOSITION USING TOTAL BED STRESS
*             2 PARTHENIADES PROBABILITY OF DEPOSITION USING COHESIVE GRAIN␣
↪STRESS
*             3 PARTHENIADES PROBABILITY OF DEPOSITION USING TOTAL BED STRESS
*
C39    SEDO    SEDBO    SDEN     SSG   WSEDO   SEDSN    SEXP    TAUD ISEDSCOR␣
↪ISPROBDEP
```

card40

```
-------------------------------------------------------------------------------
↪-
C40 COHESIVE SEDIMENT PARAMETER SET 2 REPEAT DATA LINE NSED TIMES
*   DATA REQUIRED IF NSED>0, EVEN IF ISTRAN(6)  = 0
*
*  IWRSP: 0 USE RESUSPENSION RATE AND CRITICAL STRESS BASED ON PARAMETERS
*           ON THIS DATA LINE
*        >0 USE BED PROPERTIES DEPENDEDNT RESUSPENSION RATE AND CRITICAL
*           STRESS GIVEN BY EFDC FUNCTIONS CSEDRESS,CSEDTAUS,CSEDTAUB
*           FUNCTION ARGUMENTS ARE (BDENBED,IWRSP)
*         1 HWANG AND MEHTA - LAKE OKEECHOBEE
*         2 HAMRICK'S MODIFICATION OF SANFORD AND MAA
*         3 SAME AS 2 EXCEPT VOID RATIO OF COHESIVE SEDIMENT FRACTION IS USED
*         4 SEDFLUME WITHOUT CRITICAL STRESS
*         5 SEDFLUME WITH CRITICAL STRESS
*      >= 99 SITE SPECIFIC
*  IWRSPB:0 NO BULK EROSION
*         1 USE BULK EROSION CRITICAL STRESS AND RATE IN FUNCTIONS
*           CSEDTAUB AND CSEDRESSB
*  WRSPO:   REF SURFACE EROSION  RATE IN FORMULA
*           WRSP=WRSP0*( ((TAU-TAUR)/TAUN)**TEXP )  (gm/M^2/sec)
*  TAUR:    BOUNDARY STRESS ABOVE WHICH SURFACE EROSION OCCURS (m/s)**2
*  TAUN:    (NOT USED, TAUN=TAUR SET IN CODE)
*  TEXP:    EXPONENT OF   WRSP=WRSP0*( ((TAU-TAUR)/TAUN)**TEXP )
*  VDRRSPO: REFERENCE VOID RATIO FOR CRITICAL STRESS AND RESUSPENSION RATE
*            IWRSP=2,3
* COSEDHID: COHESIVE SEDIMENT RESUSPENSION HIDING FACTOR TO REDUCE COHESIVE
*           RESUSPENSION BY FACTOR = (COHESIVE FRACTION OF␣
↪SEDIMENT)**COSEDHID
*
C40   IWRSP  IWRSPB   WRSPO     TAUR     TAUN     TEXP VDRRSPO COSEDHID
```

card41

```
-------------------------------------------------------------------------------
↪-
C41 NON-COHESIVE SEDIMENT PARAMETER SET 1 REPEAT DATA LINE NSND TIMES
*    DATA REQUIRED IF NSND>0, EVEN IF ISTRAN(7)  = 0
*
*  SNDO:     CONSTANT INITIAL NON-COHESIVE SEDIMENT CONC IN WATER COLUMN
*             (MG/LITER=GM/M^3)
*  SNDBO:    CONSTANT INITIAL NON-COHESIVE SEDIMENT IN BED PER UNIT AREA
*             (GM/SQ METER)  IE 1CM THICKNESS BED WITH SSG=2.5 AND
*             N=.6,.5 GIVES SNDBO 1.E4, 1.25E4
*  SDEN:     SEDIMENT SPEC VOLUME (IE 1/2.65E6 M^3/GM)
*  SSG:      SEDIMENT SPECIFIC GRAVITY
*  SNDDIA:   REPRESENTATIVE DIAMETER OF SEDIMENT CLASS (m)
*  WSNDO:    CONSTANT OR REFERENCE SEDIMENT SETTLING VELOCITY
*            WSNDO < 0, SETTLING VELOCITY INTERNALLY COMPUTED
*  SNDN:     (NOT USED)
*  SEXP:     (NOT USED)
*  TAUD:     (NOT USED)
*  ISNDSCOR: (NOT USED)
```

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```
*
C41     SNDO    SNDBO     SDEN      SSG   SNDDIA    WSNDO     SNDN     SEXP     TAUD␣
↪ISNDSCOR
```

card42

```
-----------------------------------------------------------------------------
↪-
C42 NON-COHESIVE SEDIMENT PARAMETER SET 2 REPEAT DATA LINE NSND TIMES
*    DATA REQUIRED IF NSND>0, EVEN IF ISTRAN(7) = 0
*
*    ISNDEQ:  0 USER SPECIFIED SPATIALLY AND TEMPORALLY CONSTANT EQUILIBRIUM␣
↪CONCENTRATION
*    ISNDEQ: >1 CALCULATE ABOVE BED REFERENCE NON-COHESIVE SEDIMENT
*               EQUILIBRIUM CONCENTRATION USING EFDC FUNCTION
*               CSNDEQC(SNDDIA,SSG,WS,TAUR,TAUB,SIGPHI,SNDDMX,IOTP)
*               WHICH IMPLEMENT FORMULATIONS OF
*             1 GARCIA AND PARKER
*             2 SMITH AND MCLEAN
*             3 VAN RIJN
*             4 SEDFLUME WITHOUT CRITICAL STRESS
*             5 SEDFLUME WITH CRITICAL STRESS
*    ISBDLD:  0 BED LOAD PHI FUNCTION IS CONSTANT, SBDLDP
*             1 VAN RIJN PHI FUNCTION
*             2 MODIFIED ENGULAND-HANSEN
*             3 WU, WANG, AND JIA
*             4 (NOT USED)
*             5 (NOT USED)
*      TAUR:  EQUILIBRIUM CONCENTRATION (g/m**3)
*      TAUN:  Not Used
* TCSHIELDS:  Not Used
*   ISLTAUC:  Not Used
*   IBLTAUC:  1 TO IMPLEMENT BEDLOAD ONLY WHEN STRESS EXCEEDS TAUC FOR EACH␣
↪GRAINSIZE
*             2 TO IMPLEMENT BEDLOAD ONLY WHEN STRESS EXCEEDS TAUCD50
*             3 TO USE TAUC FOR NONUNIFORM BEDS, THESE APPLY ONLY TO BED LOAD
*               FORMULAS NOT EXPLICITLY CONTAINING CRITICAL SHIELDS STRESS␣
↪SUCH AS E-H
*    IROUSE:  0 USE TOTAL STRESS FOR CALCULATING ROUSE NUMBER
*             1 USE GRAIN STRESS FOR ROUSE NUMBER
*    ISNDM1:  0 SET BOTH BEDLOAD AND SUSPENDED LOAD FRACTIONS TO 1.0
*             1 SET BEDLOAD FRACTION TO 1. USE BINARY RELATIONSHIP FOR␣
↪SUSPENDED
*             2 SET BEDLOAD FRACTION TO 1, USE LINEAR RELATIONSHIP FOR␣
↪SUSPENDED
*             3 USE BINARY RELATIONSHIP FOR BEDLOAD AND SUSPENDED LOAD
*             4 USE LINEAR RELATIONSHIP FOR BEDLOAD AND SUSPENDED LOAD
*    ISNDM2:  0 USE TOTAL SHEAR VELOCITY IN USTAR/WSET RATIO
*             1 USE GRAIN SHEAR VELOCITY IN USTAR/WSET RATIO
*     RSNDM:    VALUE OF USTAR/WSET FOR BINARY SWITCH BETWEEN BEDLOAD AND␣
↪SUSPENDED LOAD
*
C42  ISNDEQ  ISBDLD      TAUR      TAUN TCSHIELDS ISLTAUC IBLTAUC IROUSE ␣
↪ISNDM1  ISNDM2   RSNDM
```

card42a

```
--------------------------------------------------------------------------
↪-
C42A NON-COHESIVE SEDIMENT PARAMETER SET 3 (BED LOAD FORMULA PARAMETERS)
*    DATA REQUIRED IF NSND>0, EVEN IF ISTRAN(7) = 0
*
*   ISBDLDBC:  0 DISABLE BEDLOAD
*              1 ACTIVATE BEDLOAD OPTION.  USES SEDBLBC.INP TO SPECIFY CELLS
*     SBDLDA:    ALPHA EXPONENTIAL FOR BED LOAD FORMULA
*     SBDLDB:    BETA EXPONENTIAL FOR BED LOAD FORMULA
*    SBDLDG1:    GAMMA1 CONSTANT FOR BED LOAD FORMULA
*    SBDLDG2:    GAMMA2 CONSTANT FOR BED LOAD FORMULA
*    SBDLDG3:    GAMMA3 CONSTANT FOR BED LOAD FORMULA
*    SBDLDG4:    GAMMA4 CONSTANT FOR BED LOAD FORMULA
*     SBDLDP:    CONSTANT PHI FOR BED LOAD FORMULA
*    ISBLFUC:    BED LOAD FACE FLUX , 0 FOR DOWN WIND PROJECTION,1 FOR DOWN␣
↪WIND
*                WITH CORNER CORRECTION,2 FOR CENTERED AVERAGING
*     BLBSNT:    ADVERSE BED SLOPE (POSITIVE VALUE) ACROSS A CELL FACE ABOVE
*                WHICH NO BED LOAD TRANSPORT CAN OCCUR.  NOT ACTIVE FOR␣
↪BLBSNT=0.0
*
C42A  IBEDLD  SBDLDA  SBDLDB SBDLDG1 SBDLDG2 SBDLDG3 SBDLDG4  SBDLDP ISBLFUC␣
↪ BLBSNT
```

card43a

```
--------------------------------------------------------------------------
↪-
C43A TOXIC CONTAMINANT INITIAL CONDITIONS
*  USER MAY CHANGE ORDER OF MAGNITUDE OF WATER AND SED PHASE TOXIC␣
↪CONCENTRATIONS
*  AND PARTITION COEFFICIENTS ON C44 - C46 BUT MUST BE CONSISTENT UNITS
*
*   NTOXN: TOXIC CONTAMINANT NUMBER ID
*   ITXINT: 0 FOR SPATIALLY CONSTANT WATER COL AND BED INITIAL CONDITIONS
*           1 FOR SPATIALLY VARIABLE WATER COLUMN INITIAL CONDITIONS
*           2 FOR SPATIALLY VARIABLE BED INITIAL CONDITIONS
*           3 FOR SPATIALLY VARIABLE WATER COL AND BED INITIAL CONDITION
*  ITXBDUT: SET TO 0 FOR INITIAL BED GIVEN BY TOTAL TOXIC CONCENTRATION (mg/
↪m^3)
*           SET TO 1 FOR INITIAL BED GIVEN BY TOTAL SEDIMENT NORMALIZED␣
↪CONCENTRATION  (mg/kg)
*  TOXINTW: INIT WATER COLUMN TOT TOXIC VARIABLE CONCENTRATION (ug/L)
*  TOXINTB: INIT SED BED TOXIC CONCENTRATION.  SEE ITXBDUT FOR UNITS
*   UNITS : UNITS OF TOXIC CLASS (text)
*
C43A   NTOXN  ITXINT ITXBDUT TOXINTW TOXINTB    UNITS  COMMENTS
```

card43b

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------------------------------------------------------------------------------
↪-
C43B TOXIC KINETIC OPTION FLAGS
*
*       NTOXN: TOXIC CONTAMINANT NUMBER ID
*  ITOXKIN(1): 0 DO NOT USE BULK DECAY
*            : 1 USE BULK DECAY FOR WATER COLUMN AND SEDIMENT
*  ITOXKIN(2): 0 DO NOT USE BIODEGRADATION
*            : 1 USE BIODEGRADATION FOR WATER COLUMN AND SEDIMENT
*  ITOXKIN(3): 0 DO NOT USE VOLATILIZATION
*            : 1 USE VOLATILIZATION FOR RIVER AND LAKE CONDITIONS. LAKE USES␣
↪O'CONNOR
*            : 2 USE VOLATILIZATION FOR RIVER AND LAKE CONDITIONS. LAKE USES␣
↪MACKAY & YEUN
*  ITOXKIN(4): 0 DO NOT USE PHOTOLYSIS             (NOT IMPLEMENTED)
*            : 1 USE PHOTOLYSIS FOR WATER COLUMN   (NOT IMPLEMENTED)
*  ITOXKIN(5): 0 DO NOT USE HYDROLYSIS             (NOT IMPLEMENTED)
*            : 1 USE HYDROLYSIS FOR WATER COLUMN   (NOT IMPLEMENTED)
*  ITOXKIN(6): 0 DO NOT USE DAUGHTER PRODUCTS      (NOT IMPLEMENTED)
*            : 1 USE DAUGHTER PRODUCTS             (NOT IMPLEMENTED)
*
C43B   NTOXN  KIN(1)  KIN(2)  KIN(3)  KIN(4)  KIN(5)  KIN(6)  COMMENTS
```

card43c

```
------------------------------------------------------------------------------
↪-
C43C TOXIC TIME STEPS AND VOLATILIZATION SWITCHES
*
*    TOXSTEPW:  TIME STEP IN SECONDS FOR TOXIC KINETICS IN WATER COLUMN AND␣
↪BED
*    TOXSTEPB:  TIME STEP IN SECONDS FOR TOXIC BED PROCESSES OF DIFFUSION␣
↪AND MIXING
* TOX_VEL_MAX:  VELOCITY SWITCH FOR VOLATILIZATION APPROACH:  LAKE < TOX_VEL_
↪MAX > RIVER
* TOX_DEP_MAX:  DEPTH SWITCH FOR VOLATILIZATION APPROACH:     LAKE > TOX_DEP_
↪MAX < RIVER
*    ITOXTEMP: TEMPERATURE OVERRIDE IF ISTRAN(2)=0
*              1  - CONSTANT TEMPERATURE = TOXTEMP
*              >1 - TIME VARYING TEMPERATURE SERIES FROM TSER(ITOXTEMP-1)
*     TOXTEMP: CONSTANT TEMPERATURE FOR TOXICS CALCULATIONS(DEG C)
*
C43C   STEPW   STEPB VEL_MAX DEP_MAX ITOXTEMP TOXTEMP
```

card43d

```
--------------------------------------------------------------------------------
↪-
C43D TOXIC BULK DECAY AND BIODEGRADATION PARAMETERS
*
*       NTOXN: TOXIC CONTAMINANT NUMBER ID
*  TOX_BLK_KW: BULK DECAY RATE IN THE WATER COLUMN  (1/SECOND)
*  TOX_BLK_KB: BULK DECAY RATE IN THE SEDIMENT BED  (1/SECOND)
* TOX_BLK_MXD: MAXIMUM DEPTH OF BULK DECAY IN THE SEDIMENT BED  (METERS)
*  TOX_BIO_KW: BIODEGRADATION RATE IN THE WATER COLUMN  (1/SECOND)
*  TOX_BIO_KB: BIODEGRADATION RATE IN THE SEDIMENT BED  (1/SECOND)
* TOX_BIO_MXD: MAXIMUM DEPTH OF BIODEGRADATION IN THE SEDIMENT BED  (METERS)
*TOX_BIO_Q10W: Q10 TEMPERATURE ADJUSTMENT COEFFICIENT FOR WATER COLUMN
*              BIODEGRADATION(dimensionless)
*TOX_BIO_Q10B: Q10 TEMPERATURE ADJUSTMENT COEFFICIENT FOR SEDIMENT BED
*              BIODEGRADATION(dimensionless)
*  TOX_BIO_TW: REFERENCE TEMPERATURE FOR BIODEGRADATION IN WATER COLUMN (DEG␣
↪C)
*     COEFF = TOX_BIO_KW(NT)*TOX_BIO_Q10W(NT)^((TEM(L,K)-TOX_BIO_TB(NT))/10)
*  TOX_BIO_TB: REFERENCE TEMPERATURE FOR BIODEGRADATION IN SEDIMENT BED (DEG␣
↪C)
*     COEFF = TOX_BIO_KB(NT)*TOX_BIO_Q10B(NT)^((TEMB(L)-TOX_BIO_TB(NT))/10)
*
C43D   NTOXN  BLK_KW  BLK_KB BLK_MXD  BIO_KW  BIO_KB BIO_MXD    Q10W    Q10B␣
↪ BIO_TW  BIO_TW  COMMENTS
```

card43e

```
--------------------------------------------------------------------------------
↪-
C43E TOXIC VOLATILIZATION PARAMETERS
*
*         NTOXN: TOXIC CONTAMINANT NUMBER ID
*        TOX_MW: MOLECULAR WEIGHT                                 (G/MOLE)
*        TOX_HE: HENRY'S LAW COEFFICIENT FOR THE TOXIC     (ATM-M3/MOLE)
* TOX_KV_TCOEFF: MASS TRANSFER TEMPERATURE COEFFICIENT   (DIMENSIONLESS)
*                TOX_KV_TCOEFF**(TEM(L,KC)-20)
*       TOX_ATM: ATMOSPHERIC CONCENTRATION OF TOXIC          (micro G/L)
*   TOX_VOL_ADJ: ADJUSTMENT FACTOR                       (DIMENSIONLESS)
*
C43E  NTOXN  TOX_MW  TOX_HE  TCOEFF     ATM VOL_ADJ  COMMENTS
```

card44

```
--------------------------------------------------------------------------------
↪-
C44 TOXIC SORPTION OPTION, DIFFUSION AND MIXING
*
*    NTOXN: TOXIC CONTAMINANT NUMBER ID (1 LINE OF DATA BY DEFAULT)
*    ISTOC: 0 INORGANIC SOLIDS BASED PARTITIONING ONLY (Kd APPROACH)
*           1 FOR DISS AND PART ORGANIC CARBON SORPTION, POC IS SPECIFIED
*           2 FOR DISS ORGANIC CARBON SORPTION AND POC FRACTIONALLY
```

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```
*              DISTRIBUTED TO INORGANIC SEDIMENT CLASSES
*            3 FOR NO DISS ORGANIC CARBON SORPTION AND POC FRACTIONALLY
*              DISTRIBUTED TO INORGANIC SEDIMENT CLASSES
*    DIFTOX:   DIFFUSION COEFF FOR TOXICANT IN SED BED PORE WATER (M^2/s)
*    DIFTOXS:  DIFFUSION COEFF FOR TOXICANT BETWEEN WATER COLUMN AND
*               PORE WATER IN TOP LAYER OF THE BED(M^2/s)
*               > 0.0 INTERPRET AS DIFFUSION COEFFICIENT (M^2/s)
*               < 0.0 INTERPRET AS FLUX VELOCITY (m/s)
*    PDIFTOX:  PARTICLE MIXING DIFFUSION COEFF FOR TOXICANT IN SED BED (M^2/s)
*              (if negative use zonal files PARTMIX.INP and PMXMAP.INP)
*    DPDIFTOX: DEPTH IN BED OVER WHICH PARTICLE MIXING IS ACTIVE (m)
*
C44    NTOXN   ISTOC DIFTOX DIFTOXS PDIFTOX DPDIFTOX
```

card45

```
-----------------------------------------------------------------------------
↪-
C45 TOXIC CONTAMINANT SEDIMENT INTERACTION PARAMETERS
*
*
*    NTOXC: TOXIC CONTAMINANT NUMBER ID.  NSEDC+NSEDN LINES OF DATA
*              FOR EACH TOXIC CONTAMINANT (DEFAULT = 2)
* NSEDN/NSNDN: FIRST NSED LINES COHESIVE, NEXT NSND LINES NON-COHESIVE.
*            REPEATED FOR EACH CONTAMINANT
*   ITXPARW: O FOR NORMAL WC PARTITIONING
*            1 FOR SOLIDS DEPENDENT WC PARTITIONING     ␣
↪TOXPAR=PARO*(CSED**CONPAR)
*   TOXPARW: WATER COLUMN PARO (ITXPARW=1) OR EQUIL TOX CON PART COEFF BETWEEN
*            EACH TOXIC IN WATER AND ASSOCIATED SEDIMENT PHASES (LITERS/MG)
*   CONPARW: EXPONENT IN  TOXPAR=PARO*(CSED**CONPARW) IF ITXPARW=1
*   ITXPARB: Not Used
*   TOXPARB: SEDIMENT BED PARO (ITXPARB=1) OR EQUIL TOX CON PART COEFF BETWEEN
*            EACH TOXIC IN WATER AND ASSOCIATED SEDIMENT PHASES (LITERS/MG)
*   CONPARB: Not Used
*                       1     0.8770  -0.943         0.025
C45    NTOXN    NSEDN ITXPARW TOXPARW CONPARW ITXPARB TOXPARB CONPARB
```

card45a

```
-----------------------------------------------------------------------------
↪-
C45A TOXIC CONTAMINANT  NON-SEDIMENT BASED ORGANIC CARBON (OC) INTERACTION␣
↪PARAMETERS
*
* ISTDOCW: 0 CONSTANT DOC IN WATER COLUMN OF STDOCWC (DEFAULT=0.)
*          1 TIME CONSTANT, SPATIALLY VARYING DOC IN WATER COLUMN FROM docw.
↪inp
* ISTPOCW: 0 CONSTANT POC IN WATER COLUMN OF STPOCWC (DEFAULT=0.)
*          1 TIME CONSTANT, SPATIALLY VARYING POC IN WATER COLUMN FROM pocw.
↪inp
*          2 TIME CONSTANT, FPOC IN WATER COLUMN, SEE C45C
```

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```
*           3 TIME CONSTANT, SPATIALLY VARYING FPOC IN WATER COLUMN FORM␣
↪fpocw.inp
*           4 FUNCTIONAL SPECIFICATION OF TIME AND SPATIALLY VARYING
*             FPOC IN WATER COLUMN
* ISTDOCB: 0 CONSTANT DOC IN BED OF STDOCBC (DEFAULT=0.)
*           1 TIME CONSTANT, SPATIALLY VARYING DOC IN BED FROM docb.inp
* ISTPOCB: 0 CONSTANT POC IN BED OF STPOCBC (DEFAULT=0.)
*           1 TIME CONSTANT, SPATIALLY VARYING POC IN BED FROM pocb.inp
*           2 TIME CONSTANT, FPOC IN BED, SEE C45D
*           3 TIME CONSTANT, SPATIALLY VARYING FPOC IN BED FROM fpocb.inp
*           4 FUNCTIONAL SPECIFICATION OF TIME AND SPATIALLY VARYING
*             FPOC IN BED, REQUIRES CODE MODIFICATION FOR EACH APPLICATION␣
↪(ADVANCED)
* STDOCWC:   CONSTANT WATER COLUMN DOC (ISTDOCW=0)
* STPOCWC:   CONSTANT WATER COLUMN POC (ISTPOCW=0)
* STDOCBC:   CONSTANT BED DOC (ISTDOCB=0)
* STPOCBC:   CONSTANT BED POC (ISTPOCB=0)
*
C45A ISTDOCW ISTPOCW ISTDOCB ISTPOCB STDOCWC STPOCWC STDOCBC STPOCBC
```

card45b

```
-----------------------------------------------------------------------------
↪-
C45B TOXIC CONTAMINANT NON-SEDIMENT BASED ORGANIC CARBON (OC) INTERACTION␣
↪PARAMETERS
*
*
*    NTOXC: TOXIC CONTAMINANT NUMBER ID. FOR EACH TOXIC CONTAMINANT
*     NOC : FIRST  LINE FOR DISSOLVED   ORGANIC CARBON (DOC)
*           SECOND LINE FOR PARTICULATE ORGANIC CARBON (POC)
*             REPEATED FOR EACH CONTAMINANT
*  ITXPARWC: O FOR NORMAL WC PARTITIONING
*             1 FOR SOLIDS DEPENDENT WC PARTITIONING     ␣
↪TOXPAR=PARO*(CSED**CONPAR)
*  TOXPARWC: WATER COLUMN PARO (ITXPARW=1) OR EQUIL TOX CON PART COEFF␣
↪BETWEEN
*           EACH TOXIC IN WATER AND ASSOCIATED SEDIMENT PHASES (liters/mg)
*  CONPARWC: EXPONENT IN  TOXPAR=PARO*(CSED**CONPARW) IF ITXPARW=1
*  ITXPARBC: Not Used
*  TOXPARBC: SEDIMENT BED PARO (ITXPARB=1) OR EQUIL TOX CON PART COEFF␣
↪BETWEEN
*           EACH TOXIC IN WATER AND ASSOCIATED SEDIMENT PHASES (liters/mg)
*  CONPARBC: Not Used
*               1       0.8770  -0.943          0.025
C45B   NTOXN     NOC ITXPARWC TOXPARWC CONPARWC ITXPARBC TOXPARBC CONPARBC ␣
↪*CARBON*
```

card45c

```
-----------------------------------------------------------------------------
↪-
C45C TOXIC CONTAMINANT POC FRACTIONAL DISTRIBUTIONS IN WATER COLUMN
*    1 LINE  OF DATA REQUIRED EVEN IT ISTRAN(5) IS 0. DATA USED WHEN
*      ISTOC(NT)=1 OR 2
*
*     NTOXN:      TOXIC CONTAMINANT NUMBER ID.  NSEDC+NSEDN 1 LINE OF DATA
*                 FOR EACH TOXIC CONTAMINANT (DEFAULT = 2)
*  FPOCSED1-NSED: FRACTION OF OC ASSOCIATED WITH SED CLASSES 1,NSED
*  FPOCSND1-NSND: FRACTION OF OC ASSOCIATED WITH SND CLASSES 1,NSND
*
C45C     NTOXN  FPOCSED1  FPOCSED2  FPOCSED3  FPOCSED4  FPOCSED5  FPOCSED6 ␣
↪FPOCSED7  FPOCSED8      GRPID ! ID (8 SEDS + 0 SNDS)
```

card45d

```
-----------------------------------------------------------------------------
↪-
C45D TOXIC CONTAMINANT POC FRACTIONAL DISTRIBUTIONS IN SEDIMENT BED
*   1 LINE  OF DATA REQUIRED EVEN IT ISTRAN(5) IS 0. DATA USED WHEN
*   ISTOC(NT)=1 OR 2
*
*     NTOXN:      TOXIC CONTAMINANT NUMBER ID.  NSEDC+NSEDN 1 LINE OF DATA
*                FOR EACH TOXIC CONTAMINANT (DEFAULT = 2)
* FPOCSED1-NSED: FRACTION OF OC ASSOCIATED WITH SED CLASSES 1,NSED
* FPOCSND1-NSND: FRACTION OF OC ASSOCIATED WITH SND CLASSES 1,NSND
*
C45D     NTOXN  FPOCSED1  FPOCSED2  FPOCSED3  FPOCSED4  FPOCSED5  FPOCSED6 ␣
↪FPOCSED7  FPOCSED8      GRPID ! ID (8 SEDS + 0 SNDS)
```

card46

```
-----------------------------------------------------------------------------
↪-
C46 BUOYANCY, TEMPERATURE, DYE DATA AND CONCENTRATION BC DATA
*
* BSC:          BUOYANCY INFLUENCE COEFFICIENT 0 TO 1, BSC=1. FOR REAL PHYSICS
* TEMO:         REFERENCE, INITIAL, EQUILIBRIUM AND/OR ISOTHERMAL TEMP IN DEG␣
↪C
* HEQT:         EQUILIBRIUM TEMPERATURE TRANSFER COEFFICIENT M/sec
* ISBEDTEMI: 0 READ INITIAL BED TEMPERATURE FROM TEMPB.INP
*            1 INITIALIZE AT START OF COLD RUN
* KBH:       NOT USED
* RKDYE:        FIRST ORDER DECAY RATE FOR DYE VARIABLE IN 1/sec
* NCBS:         NUMBER OF CONCENTRATION BOUNDARY CONDITIONS ON SOUTH OPEN
*                BOUNDARIES
* NCBW:         NUMBER OF CONCENTRATION BOUNDARY CONDITIONS ON WEST OPEN
*                BOUNDARIES
* NCBE:         NUMBER OF CONCENTRATION BOUNDARY CONDITIONS ON EAST OPEN
*                BOUNDARIES
* NCBN:         NUMBER OF CONCENTRATION BOUNDARY CONDITIONS ON NORTH OPEN
```

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```
*                BOUNDARIES
*
C46      BSC     TEMO         HEQT ISBEDTEMI      KBH         RKDYE     NCBS    ␣
↪NCBW     NCBE     NCBN
```

card46a

```
-----------------------------------------------------------------------------
↪-
C46A   ICE EFFECTS
C
      ISICE:        0 ICE IMPACTS NOT SIMULATED.  AUTOMATICALLY LIMITS ASER.
↪INP DRY BULB TO > 0.0
                    1 READ ICE THICKNESS FROM FILE ISER.INP (LEGACY ICECOVER.
↪INP)
                    2 SPECIFIED ON/OFF DATES FOR ICE (ENTIRE MODEL)
                    3 CALCULATION COUPLED WITH HEAT MODEL
                    4 CALCULATION COUPLED WITH HEAT MODEL AND FRAZIL TRANSPORT
      NISER:          NUMBER OF ICE TIME SERIES FOR ISICE=1
      TEMPICE:        WATER TEMPERATURE AT WATER ICE INTERFACE FOR ISICE <= 2
      CDICE:          DRAG COEFFICIENT BETWEEN ICE/WATER (DEFAULT = 0.001)
      ICETHMX:        MAXIMUM ICE COVER THICKNESS FOR ISICE>2,  METERS
      RICETHK0:       ICE THICKNESS FOR ISICE=2 (CONSTANT, METERS)
C
C46A   ISICE    NISER TEMPICE   CDICE ICETHMX RICETHK0
```

card46c

```
-----------------------------------------------------------------------------
↪-
C46C ATMOSPHERIC LOCATION AND WIND FUNCTION COEFFICIENTS
*
* SOLAR_LNG = LONGITUDE TO BE USED TO COMPUTE SOLAR RADIATION (Decimal␣
↪degree)
* SOLAR_LAT = LATITUDE  TO BE USED TO COMPUTE SOLAR RADIATION (Decimal␣
↪degree)
* COMPUTESR = OVERRIDE SOLAR RADIATION IN ASER.INP WITH COMPUTED [.TRUE/.
↪FALSE.]
* USESHADE  = USE CELL SPECIFIC SHADE VALUES USING SHADE.INP [.TRUE/.FALSE.]
* IEVAP     = EVAPORATION OPTION FOR WATER FLUX ONLY (ALWAYS USED FOR HEAT␣
↪EXCHANGE)
*              0    - DO NOT INCLUDE IN WATER BUDGET
*              1    - USE SPECIFIED EVAP FROM ASER.INP
*              2    - COMPUTE EVAP USING ORIGINAL EFDC EQUATION
*              3-10 - COMPUTE USING WIND FUNCTION USING WINDFA, WINDFB, WINDFC
*              11   - COMPUTE EVAP USING RYAN-HARLEMAN
*              12 - COMPUTE EVAP USING ARIFIN ET AL. (2016)
* WINDFA     = WIND FUNCTION FACTOR A     FUNCTION = A + B*WIND2M + C*WIND2M^2
* WINDFB     = WIND FUNCTION FACTOR B               UNITS:  W/M^2/millibar
* WINDFC     = WIND FUNCTION FACTOR C
C46C  SOLAR_LNG   SOLAR_LAT COMPUTESR  USESHADE     IEVAP    WINDFA    ␣
↪WINDFB    WINDFC
```

card46e

```
-------------------------------------------------------------------------------
↪-
C46E DYE CLASS PARAMETERS
*
*  CLASS #
*  ITYPE    = DYE CLASS TYPE
*             0 - CONSERVATIVE
*             1 - NON-CONSERVATIVE WTIH OPTIONAL SETTLING AND/OR DECAY
*             2 - AGE OF WATER
*  KRATE0   = 0th ORDER DECAY/GROWTH RATE AT REFERENCE TEMPERATURE (TREF)␣
↪degC (1/s)
*  KRATE1   = FIRST ORDER DECAY/GROWTH RATE AT REFERENCE TEMPERATURE (TREF)␣
↪degC (1/s)
*  TADJ     = TEMPERATURE ADJUSTMENT COEFFICIENT (DIMENSIONLESS)
*  TREF     = REFERENCE TEMPERATURE (degC)
*  ICFLAG   = TYPE OF INITIAL CONDITION
*             0 - USE CONSTANT INITIAL CONCENTRATION SPECIFIED IN DYEIC
*             1 - READ FROM DYE.INP
*  DYEIC    = CONSTANT INITIAL CONCENTRATION (MG/L)
*  SETTLE   = SETTLING RATE (M/DAY)
*  UNITS    = UNITS OF DYE CLASS (text)
*
C46E   CLASS   ITYPE  KRATE0  KRATE1    TADJ    TREF      SETTLE  ICFLAG    ␣
↪DYEIC   UNITS
```

card47

```
-------------------------------------------------------------------------------
↪-
C47 LOCATION OF CONC BC'S ON SOUTH BOUNDARIES
*
*  ICBS:     I CELL INDEX
*  JCBS:     J CELL INDEX
*  NTSCRS:   NUMBER OF TIME STEPS TO RECOVER SPECIFIED VALUES ON CHANGE
*            TO INFLOW FROM OUTFLOW
*  NSSERS:   SOUTH BOUNDARY CELL SALINITY TIME SERIES ID NUMBER
*  NTSERS:   SOUTH BOUNDARY CELL TEMPERATURE TIME SERIES ID NUMBER
*  NDSERS:   SOUTH BOUNDARY CELL DYE CONC TIME SERIES ID NUMBER
*  NSFSERS: SOUTH BOUNDARY CELL SHELLFISH LARVAE TIME SERIES ID NUMBER
*  NTXSERS: SOUTH BOUNDARY CELL TOXIC CONTAMINANT CONC TIME SERIES ID NUM.
*  NSDSERS: SOUTH BOUNDARY CELL COHESIVE SED CONC TIME SERIES ID NUMBER
*  NSNSERS: SOUTH BOUNDARY CELL NON-COHESIVE SED CONC TIME SERIES ID NUMBER
*    GRPID: ID NUMBER OF BOUNDARY GROUP
C
C47    IBBS    JBBS  NTSCRS  NSSERS  NTSERS  NDSERS NSFSERS NTXSERS NSDSERS␣
↪NSNSERS      GRPID ! ID
```

card48

```
-------------------------------------------------------------------------------
↪-
C48 TIME CONSTANT BOTTOM CONC ON SOUTH CONC BOUNDARIES
*
*    SAL: ULTIMATE INFLOWING BOTTOM LAYER SALINITY
*    TEM: ULTIMATE INFLOWING BOTTOM LAYER TEMPERATURE
*    DYE: ULTIMATE INFLOWING BOTTOM LAYER DYE CONCENTRATION
*    SFL: ULTIMATE INFLOWING BOTTOM LAYER SHELLFISH LARVAE CONCENTRATION
*    TOX: NTOX ULTIMATE INFLOWING BOTTOM LAYER TOXIC CONTAMINANT
*         CONCENTRATIONS NTOX VALUES TOX(N), N=1,NTOX
*  GRPID: ID NUMBER OF BOUNDARY GROUP
*
C48        SAL       TEM      DYE1       SFL      GRPID ! ID
```

card49

```
-------------------------------------------------------------------------------
↪-
C49 TIME CONSTANT BOTTOM CONC ON SOUTH CONC BOUNDARIES
*
*    SED: NSED ULTIMATE INFLOWING BOTTOM LAYER COHESIVE SEDIMENT
*         CONCENTRATIONS  FIRST NSED VALUES SED(N), N=1,NSND
*    SND: NSND ULTIMATE INFLOWING BOTTOM LAYER NON-COHESIVE SEDIMENT
*         CONCENTRATIONS LAST NSND VALUES SND(N), N=1,NSND
*  GRPID: ID NUMBER OF BOUNDARY GROUP
*
C49       SED1      SED2      SED3      SED4      SED5      SED6      SED7     ␣
↪   SED8      GRPID ! ID
```

card50

```
-------------------------------------------------------------------------------
↪-
C50 TIME CONSTANT SURFACE CONC ON SOUTH CONC BOUNDARIES
*
*    SAL: ULTIMATE INFLOWING SURFACE LAYER SALINITY
*    TEM: ULTIMATE INFLOWING SURFACE LAYER TEMPERATURE
*    DYE: ULTIMATE INFLOWING SURFACE LAYER DYE CONCENTRATION
*    SFL: ULTIMATE INFLOWING SURFACE LAYER SHELLFISH LARVAE CONCENTRATION
*    TOX: NTOX ULTIMATE INFLOWING SURFACE LAYER TOXIC CONTAMINANT
*         CONCENTRATIONS NTOX VALUES TOX(N), N=1,NTOX
*  GRPID: ID NUMBER OF BOUNDARY GROUP
*
C50        SAL       TEM      DYE1       SFL      GRPID ! ID
```

card51

```
----------------------------------------------------------------------------
↪-
C51 TIME CONSTANT SURFACE CONC ON SOUTH CONC BOUNDARIES
*
*    SED: NSED ULTIMATE INFLOWING SURFACE LAYER COHESIVE SEDIMENT
*         CONCENTRATIONS  FIRST NSED VALUES SED(N), N=1,NSND
*    SND: NSND ULTIMATE INFLOWING SURFACE LAYER NON-COHESIVE SEDIMENT
*         CONCENTRATIONS LAST NSND VALUES SND(N), N=1,NSND
*  GRPID: ID NUMBER OF BOUNDARY GROUP
*
C51       SED1      SED2      SED3      SED4      SED5      SED6      SED7   ␣
↪  SED8      GRPID ! ID
```

card52

```
----------------------------------------------------------------------------
↪-
C52 LOCATION OF CONC BC'S ON WEST BOUNDARIES AND SERIES IDENTIFIERS
*
*  ICBW:     I CELL INDEX
*  JCBW:     J CELL INDEX
*  NTSCRW:   NUMBER OF TIME STEPS TO RECOVER SPECIFIED VALUES ON CHANGE
*            TO INFLOW FROM OUTFLOW
*  NSSERW:   WEST BOUNDARY CELL SALINITY TIME SERIES ID NUMBER
*  NTSERW:   WEST BOUNDARY CELL TEMPERATURE TIME SERIES ID NUMBER
*  NDSERW:   WEST BOUNDARY CELL DYE CONC TIME SERIES ID NUMBER
*  NSFSERW:  WEST BOUNDARY CELL SHELLFISH LARVAE TIME SERIES ID NUMBER
*  NTXSERW:  WEST BOUNDARY CELL TOXIC CONTAMINANT CONC TIME SERIES ID NUM.
*  NSDSERW:  WEST BOUNDARY CELL COHESIVE SED CONC TIME SERIES ID NUMBER
*  NSNSERW:  WEST BOUNDARY CELL NON-COHESIVE SED CONC TIME SERIES ID NUMBER
*    GRPID:  ID NUMBER OF BOUNDARY GROUP
*
C52     IBBW    JBBW  NTSCRW  NSSERW  NTSERW  NDSERW NSFSERW NTXSERW NSDSERW␣
↪NSNSERW      GRPID ! ID
```

card53

```
----------------------------------------------------------------------------
↪-
C53 TIME CONSTANT BOTTOM CONC ON WEST CONC BOUNDARIES
*
*    SAL: ULTIMATE INFLOWING BOTTOM LAYER SALINITY
*    TEM: ULTIMATE INFLOWING BOTTOM LAYER TEMPERATURE
*    DYE: ULTIMATE INFLOWING BOTTOM LAYER DYE CONCENTRATION
*    SFL: ULTIMATE INFLOWING BOTTOM LAYER SHELLFISH LARVAE CONCENTRATION
*    TOX: NTOX ULTIMATE INFLOWING BOTTOM LAYER TOXIC CONTAMINANT
*         CONCENTRATIONS NTOX VALUES TOX(N), N=1,NTOX
*  GRPID: ID NUMBER OF BOUNDARY GROUP
*
C53        SAL        TEM      DYE1        SFL      GRPID ! ID
```

card54

```
-------------------------------------------------------------------------------
↪-
C54 TIME CONSTANT BOTTOM CONC ON WEST CONC BOUNDARIES
*
*    SED: NSED ULTIMATE INFLOWING BOTTOM LAYER COHESIVE SEDIMENT
*         CONCENTRATIONS  FIRST NSED VALUES SED(N), N=1,NSND
*    SND: NSND ULTIMATE INFLOWING BOTTOM LAYER NON-COHESIVE SEDIMENT
*         CONCENTRATIONS LAST NSND VALUES SND(N), N=1,NSND
*  GRPID: ID NUMBER OF BOUNDARY GROUP
*
C54       SED1       SED2       SED3       SED4       SED5       SED6       SED7   ␣
↪   SED8       GRPID ! ID
```

card55

```
-------------------------------------------------------------------------------
↪-
C55 TIME CONSTANT SURFACE CONC ON WEST CONC BOUNDARIES
*
*    SAL: ULTIMATE INFLOWING SURFACE LAYER SALINITY
*    TEM: ULTIMATE INFLOWING SURFACE LAYER TEMPERATURE
*    DYE: ULTIMATE INFLOWING SURFACE LAYER DYE CONCENTRATION
*    SFL: ULTIMATE INFLOWING SURFACE LAYER SHELLFISH LARVAE CONCENTRATION
*    TOX: NTOX ULTIMATE INFLOWING SURFACE LAYER TOXIC CONTAMINANT
*         CONCENTRATIONS NTOX VALUES TOX(N), N=1,NTOX
*  GRPID: ID NUMBER OF BOUNDARY GROUP
*
C55        SAL        TEM       DYE1        SFL       GRPID ! ID
```

card56

```
-------------------------------------------------------------------------------
↪-
C56 TIME CONSTANT SURFACE CONC ON WEST CONC BOUNDARIES
*
*    SED: NSED ULTIMATE INFLOWING SURFACE LAYER COHESIVE SEDIMENT
*         CONCENTRATIONS  FIRST NSED VALUES SED(N), N=1,NSND
*    SND: NSND ULTIMATE INFLOWING SURFACE LAYER NON-COHESIVE SEDIMENT
*         CONCENTRATIONS LAST NSND VALUES SND(N), N=1,NSND
*  GRPID: ID NUMBER OF BOUNDARY GROUP
*
C56       SED1       SED2       SED3       SED4       SED5       SED6       SED7   ␣
↪   SED8       GRPID ! ID
```

card57

```
-------------------------------------------------------------------------------
↪-
C57 LOCATION OF CONC BC'S ON EAST BOUNDARIES AND SERIES IDENTIFIERS
*
*  ICBE:    I CELL INDEX
*  JCBE:    J CELL INDEX
*  NTSCRE:  NUMBER OF TIME STEPS TO RECOVER SPECIFIED VALUES ON CHANGE
*           TO INFLOW FROM OUTFLOW
*  NSSERE:  EAST BOUNDARY CELL SALINITY TIME SERIES ID NUMBER
*  NTSERE:  EAST BOUNDARY CELL TEMPERATURE TIME SERIES ID NUMBER
*  NDSERE:  EAST BOUNDARY CELL DYE CONC TIME SERIES ID NUMBER
*  NSFSERE: EAST BOUNDARY CELL SHELLFISH LARVAE TIME SERIES ID NUMBER
*  NTXSERE: EAST BOUNDARY CELL TOXIC CONTAMINANT CONC TIME SERIES ID NUM.
*  NSDSERE: EAST BOUNDARY CELL COHESIVE SED CONC TIME SERIES ID NUMBER
*  NSNSERE: EAST BOUNDARY CELL NON-COHESIVE SED CONC TIME SERIES ID NUMBER
*    GRPID: ID NUMBER OF BOUNDARY GROUP
*
C57    IBBE    JBBE  NTSCRE  NSSERE  NTSERE  NDSERE NSFSERE NTXSERE NSDSERE␣
↪NSNSERE      GRPID ! ID
```

card58

```
-------------------------------------------------------------------------------
↪-
C58 TIME CONSTANT BOTTOM CONC ON EAST CONC BOUNDARIES
*
*    SAL: ULTIMATE INFLOWING BOTTOM LAYER SALINITY
*    TEM: ULTIMATE INFLOWING BOTTOM LAYER TEMPERATURE
*    DYE: ULTIMATE INFLOWING BOTTOM LAYER DYE CONCENTRATION
*    SFL: ULTIMATE INFLOWING BOTTOM LAYER SHELLFISH LARVAE CONCENTRATION
*    TOX: NTOX ULTIMATE INFLOWING BOTTOM LAYER TOXIC CONTAMINANT
*         CONCENTRATIONS NTOX VALUES TOX(N), N=1,NTOX
*  GRPID: ID NUMBER OF BOUNDARY GROUP
*
C58        SAL        TEM       DYE1        SFL       GRPID ! ID
```

card59

```
-------------------------------------------------------------------------------
↪-
C59 TIME CONSTANT BOTTOM CONC ON EAST CONC BOUNDARIES
*
*    SED: NSED ULTIMATE INFLOWING BOTTOM LAYER COHESIVE SEDIMENT
*         CONCENTRATIONS  FIRST NSED VALUES SED(N), N=1,NSND
*    SND: NSND ULTIMATE INFLOWING BOTTOM LAYER NON-COHESIVE SEDIMENT
*         CONCENTRATIONS LAST NSND VALUES SND(N), N=1,NSND
*  GRPID: ID NUMBER OF BOUNDARY GROUP
*
C59       SED1       SED2       SED3       SED4       SED5       SED6       SED7     ␣
↪   SED8       GRPID ! ID (8 SEDS + 0 SNDS)
```

card60

```
-------------------------------------------------------------------------------
↪-
C60 TIME CONSTANT SURFACE CONC ON EAST CONC BOUNDARIES
*
*    SAL: ULTIMATE INFLOWING SURFACE LAYER SALINITY
*    TEM: ULTIMATE INFLOWING SURFACE LAYER TEMPERATURE
*    DYE: ULTIMATE INFLOWING SURFACE LAYER DYE CONCENTRATION
*    SFL: ULTIMATE INFLOWING SURFACE LAYER SHELLFISH LARVAE CONCENTRATION
*    TOX: NTOX ULTIMATE INFLOWING SURFACE LAYER TOXIC CONTAMINANT
*         CONCENTRATIONS NTOX VALUES TOX(N), N=1,NTOX
*  GRPID: ID NUMBER OF BOUNDARY GROUP
*
C60       SAL       TEM      DYE1       SFL      GRPID ! ID
```

card61

```
-------------------------------------------------------------------------------
↪-
C61 TIME CONSTANT SURFACE CONC ON EAST CONC BOUNDARIES
*
*    SED: NSED ULTIMATE INFLOWING SURFACE LAYER COHESIVE SEDIMENT
*         CONCENTRATIONS  FIRST NSED VALUES SED(N), N=1,NSND
*    SND: NSND ULTIMATE INFLOWING SURFACE LAYER NON-COHESIVE SEDIMENT
*         CONCENTRATIONS LAST NSND VALUES SND(N), N=1,NSND
*  GRPID: ID NUMBER OF BOUNDARY GROUP
*
C61      SED1      SED2      SED3      SED4      SED5      SED6      SED7    ␣
↪  SED8      GRPID ! ID (8 SEDS + 0 SNDS)
```

card62

```
-------------------------------------------------------------------------------
↪-
C62 LOCATION OF CONC BC'S ON NORTH BOUNDARIES AND SERIES IDENTIFIERS
*
*  ICBN:     I CELL INDEX
*  JCBN:     J CELL INDEX
*  NTSCRN:  NUMBER OF TIME STEPS TO RECOVER SPECIFIED VALUES ON CHANGE
*           TO INFLOW FROM OUTFLOW
*  NSSERN:  NORTH BOUNDARY CELL SALINITY TIME SERIES ID NUMBER
*  NTSERN:  NORTH BOUNDARY CELL TEMPERATURE TIME SERIES ID NUMBER
*  NDSERN:  NORTH BOUNDARY CELL DYE CONC TIME SERIES ID NUMBER
*  NSFSERN: NORTH BOUNDARY CELL SHELLFISH LARVAE TIME SERIES ID NUMBER
*  NTXSERN: NORTH BOUNDARY CELL TOXIC CONTAMINANT CONC TIME SERIES ID NUM.
*  NSDSERN: NORTH BOUNDARY CELL COHESIVE SED CONC TIME SERIES ID NUMBER
*  NSNSERN: NORTH BOUNDARY CELL NON-COHESIVE SED CONC TIME SERIES ID NUMBER
*    GRPID: ID NUMBER OF BOUNDARY GROUP
*
C62    IBBN    JBBN  NTSCRN  NSSERN  NTSERN  NDSERN NSFSERN NTXSERN NSDSERN␣
↪NSNSERN      GRPID ! ID
```

card63

```
--------------------------------------------------------------------------------
↪-
C63 TIME CONSTANT BOTTOM CONC ON NORTH CONC BOUNDARIES
*
*    SAL: ULTIMATE INFLOWING BOTTOM LAYER SALINITY
*    TEM: ULTIMATE INFLOWING BOTTOM LAYER TEMPERATURE
*    DYE: ULTIMATE INFLOWING BOTTOM LAYER DYE CONCENTRATION
*    SFL: ULTIMATE INFLOWING BOTTOM LAYER SHELLFISH LARVAE CONCENTRATION
*    TOX: NTOX ULTIMATE INFLOWING BOTTOM LAYER TOXIC CONTAMINANT
*         CONCENTRATIONS NTOX VALUES TOX(N), N=1,NTOX
*  GRPID: ID NUMBER OF BOUNDARY GROUP
*
C63        SAL        TEM       DYE1       SFL       GRPID ! ID
```

card64

```
--------------------------------------------------------------------------------
↪-
C64 TIME CONSTANT BOTTOM CONC ON NORTH CONC BOUNDARIES
*
*    SED: NSED ULTIMATE INFLOWING BOTTOM LAYER COHESIVE SEDIMENT
*         CONCENTRATIONS  FIRST NSED VALUES SED(N), N=1,NSND
*    SND: NSND ULTIMATE INFLOWING BOTTOM LAYER NON-COHESIVE SEDIMENT
*         CONCENTRATIONS LAST NSND VALUES SND(N), N=1,NSND
*  GRPID: ID NUMBER OF BOUNDARY GROUP
*
C64       SED1       SED2       SED3       SED4       SED5       SED6       SED7  ␣
↪   SED8      GRPID ! ID
```

card65

```
--------------------------------------------------------------------------------
↪-
C65 TIME CONSTANT SURFACE CONC ON NORTH CONC BOUNDARIES
*
*    SAL: ULTIMATE INFLOWING SURFACE LAYER SALINITY
*    TEM: ULTIMATE INFLOWING SURFACE LAYER TEMPERATURE
*    DYE: ULTIMATE INFLOWING SURFACE LAYER DYE CONCENTRATION
*    SFL: ULTIMATE INFLOWING SURFACE LAYER SHELLFISH LARVAE CONCENTRATION
*    TOX: NTOX ULTIMATE INFLOWING SURFACE LAYER TOXIC CONTAMINANT
*         CONCENTRATIONS NTOX VALUES TOX(N), N=1,NTOX
*  GRPID: ID NUMBER OF BOUNDARY GROUP
*
C65        SAL        TEM       DYE1       SFL       GRPID ! ID
```

card66

```
-----------------------------------------------------------------------------
↪-
C66 TIME CONSTANT SURFACE CONC ON NORTH CONC BOUNDARIES
*
*    SED: NSED ULTIMATE INFLOWING SURFACE LAYER COHESIVE SEDIMENT
*         CONCENTRATIONS  FIRST NSED VALUES SED(N), N=1,NSND
*    SND: NSND ULTIMATE INFLOWING SURFACE LAYER NON-COHESIVE SEDIMENT
*         CONCENTRATIONS LAST NSND VALUES SND(N), N=1,NSND
*  GRPID: ID NUMBER OF BOUNDARY GROUP
*
C66      SED1      SED2      SED3      SED4      SED5      SED6      SED7  ␣
↪  SED8      GRPID ! ID
```

Card66a

```
------------------------------------------------------------------------------
C66A CONCENTRATION DATA ASSIMILATION
*
*  NLCDA: NUMBER OF HORIZONTAL LOCATIONS FOR DATA ASSIMILATION
*  TSCDA: WEIGHTING FACTOR, 0 to 1, 1 = FULL ASSIMILATION
*  ISCDA: 1 FOR CONCENTRATION DATA ASSIMILATION VALUES (NC=1,7)
*
C66A  NLCDA   TSCDA   ISCDA
```

card66b

```
-----------------------------------------------------------------------------
↪-
C66B CONCENTRATION DATA ASSIMILATION
*
*  ITPCDA: 0 ASSIMILATED DATA FROM TIME SERIES
*          1 ASSIMILATED DATA FROM ANOTHER CELL IN GRID
*    ICDA: I INDEX OF CELL ASSIMILATING DATA
*    JCDA: J INDEX OF CELL ASSIMILATING DATA
*   ICCDA: I INDEX OF CELL PROVIDING DATA, ITPCDA=1
*   JCCDA: J INDEX OF CELL PROVIDING DATA, ITPCDA=1
*  NCSERA:   ID OF TIME SERIES PROVIDING DATA
*
C66B ITPCDA    ICDA    JCDA   ICCDA   JCCDA      NS      NT      ND     NSF ␣
↪   NTX     NSD     NSN
```

card67

```
-----------------------------------------------------------------------------
↪-
C67 DRIFTER DATA (FIRST 4 PARAMETERS FOR SUB DRIFTER, SECOND 6 FOR SUB␣
↪LAGRANGIAN)
*
*  ISPD:    1 TO ACTIVE SIMULTANEOUS RELEASE AND LAGRANGIAN TRANSPORT OF
*             NEUTRALLY BUOYANT PARTICLE DRIFTERS AT LOCATIONS INPUT ON C68
*           2 TO ACTIVATE DS-INTERNATIONAL'S LPT DRIFTER COMPUTATIONS␣
↪(DRIFTER.INP)
*  NPD:       NUMBER OF PARTICLE DRIFTERS
*  NPDRT:     TIME STEP AT WHICH PARTICLES ARE RELEASED
*  NWPD:      NUMBER OF TIME STEPS BETWEEN WRITING TO TRACKING FILE
*             DRIFTER.OUT
*  ISLRPD: 1 TO ACTIVATE CALCULATION OF LAGRANGIAN MEAN VELOCITY OVER TIME
*             INTERVAL TREF AND SPATIAL INTERVAL ILRPD1<I<ILRPD2,
*             JLRPD1<J<JLRPD2, 1<K<KC, WITH MLRPDRT RELEASES.  ANY AVERAGE
*             OVER ALL RELEASE TIMES IS ALSO CALCULATED
*           2 SAME BUT USES A HIGHER ORDER TRAJECTORY INTEGRATION
*  ILRPD1     WEST BOUNDARY OF REGION
*  ILRPD2     EAST BOUNDARY OF REGION
*  JLRPD1     NORTH BOUNDARY OF REGION
*  JLRPD2     SOUTH BOUNDARY OF REGION
*  MLRPDRT    NUMBER OF RELEASE TIMES
*  IPLRPD     1,2,3 WRITE FILES TO PLOT ALL,EVEN,ODD HORIZ LAG VEL VECTORS
*
C67    ISPD     NPD   NPDRT    NWPD  ISLRPD  ILRPD1  ILRPD2  JLRPD1  JLRPD2␣
↪MLRPDRT  IPLRPD
```

card68

```
-----------------------------------------------------------------------------
↪-
C68 INITIAL DRIFTER POSITIONS (FOR USE WITH SUB DRIFTER)
*
*  RI: I CELL INDEX IN WHICH PARTICLE IS RELEASED IN
*  RJ: J CELL INDEX IN WHICH PARTICLE IS RELEASED IN
*  RK: K CELL INDEX IN WHICH PARTICLE IS RELEASED IN
*
C68      RI      RJ      RK
```

card69

```
-----------------------------------------------------------------------------
↪-
C69 CONSTANTS FOR CARTESIAN GRID CELL CENTER LONGITUDE AND LATITUDE
*
*  CDLON1: 6 CONSTANTS TO GIVE CELL CENTER LAT AND LON OR OTHER
*  CDLON2: COORDINATES FOR CARTESIAN GRIDS USING THE FORMULAS
*  CDLON3: DLON(L)=CDLON1+(CDLON2*FLOAT(I)+CDLON3)/60.
*  CDLAT1: DLAT(L)=CDLAT1+(CDLAT2*FLOAT(J)+CDLAT3)/60.
*  CDLAT2:
```

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```
*  CDLAT3:
*
C69  CDLON1  CDLON2  CDLON3  CDLAT1  CDLAT2  CDLAT3
```

card70

```
-----------------------------------------------------------------------------
↪-
C70 CONTROLS FOR WRITING ASCII OR BINARY DUMP FILES
*
*  ISDUMP: GREATER THAN 0 TO ACTIVATE
*          1 SCALED ASCII INTEGER (0<VAL<65535)
*          2 SCALED 16BIT BINARY INTEGER (0<VAL<65535) OR (-32768<VAL<32767)
*          3 UNSCALED ASCII FLOATING POINT
*          4 UNSCALED BINARY FLOATING POINT
*  ISADMP: GREATER THAN 0 TO APPEND EXISTING DUMP FILES
*  NSDUMP: NUMBER OF TIME STEPS BETWEEN DUMPS
*  TSDUMP: STARTING TIME FOR DUMPS - DAYS (NO DUMPS BEFORE THIS TIME)
*  TEDUMP: ENDING TIME FOR DUMPS - DAYS (NO DUMPS AFTER THIS TIME)
*  ISDMPP: GREATER THAN 0 FOR WATER SURFACE ELEVATION DUMP
*  ISDMPU: GREATER THAN 0 FOR HORIZONTAL VELOCITY DUMP
*  ISDMPW: GREATER THAN 0 FOR VERTICAL VELOCITY DUMP
*  ISDMPT: GREATER THAN 0 FOR TRANSPORTED VARIABLE DUMPS
*  IADJDMP: 0 FOR SCALED BINARY INTEGERS (0<VAL<65535)
*           -32768 FOR SCALED BINARY INTEGERS (-32768<VAL<32767)
*
C70  ISDUMP  ISADMP  NSDUMP  TSDUMP  TEDUMP  ISDMPP  ISDMPU  ISDMPW  ISDMPT␣
↪IADJDMP
```

card71

```
-----------------------------------------------------------------------------
↪-
C71 CONTROLS FOR HORIZONTAL PLANE SCALAR FIELD CONTOURING - RESIDUAL ONLY
*
*  ISSPH:    NOT USED
*
*  NPSPH:    NOT USED
*  ISRSPH: 1 TO WRITE FILE FOR RESIDUAL SCALAR VARIABLE IN HORIZONTAL PLANE
*
*  ISPHXY: 0 DOES NOT WRITE I,J,X,Y IN ***CNH.OUT AND R***CNH.OUT FILES␣
↪(RESIDUAL ONLY)
*          1 WRITES I,J ONLY IN ***CNH.OUT AND R***CNH.OUT FILES (RESIDUAL␣
↪ONLY)
*          2 WRITES I,J,X,Y  IN ***CNH.OUT AND R***CNH.OUT FILES (RESIDUAL␣
↪ONLY)
*
*  DATA LINE REPEATS 7 TIMES FOR SAL,TEM,DYE,SFL,TOX,SED,SND
*
C71   ISSPH   NPSPH  ISRSPH  ISPHXY
```

card71a

```
--------------------------------------------------------------------------------
↪-
C71A CONTROLS FOR HORIZONTAL PLANE SEDIMENT BED PROPERTIES CONTOURING
*
*   ISBPH:     NOT USED
*
*  ISBEXP:  0 >0 EXPLORER BINARY FORMAT, OUTPUT FREQUENCY
*   NPBPH:     NOT USED
*  ISRBPH:     NOT USED
*  ISBBDN:     NOT USED
*  ISBLAY:     NOT USED
*  ISBPOR:     NOT USED
*   SBSED:     NOT USED
*
*  ISBSED:     NOT USED
*
*  ISBVDR:     NOT USED
*  ISBARD:     NOT USED
*
C71A   ISBPH  ISBEXP   NPBPH  ISRBPH  ISBBDN  ISBLAY  ISBPOR  ISBSED  ISBSND ␣
↪ISBVDR  ISBARD
```

card71b

```
--------------------------------------------------------------------------------
↪-
C71B FOOD CHAIN MODEL OUTPUT CONTROL
*
*      ISFDCH: 1 TO WRITE OUTPUT FOR HOUSATONIC RIVER FOOD CHAIN MODEL
*      NFDCHZ:   NUMBER OF SPATIAL ZONES
*      HBFDCH:   AVERAGING DEPTH FOR TOP PORTION OF BED (METERS)
*      TFCAVG:   TIME AVERAGING INTERVAL FOR FOOD CHAIN OUTPUT (SECONDS)
*
C71B ISFDCH  NFDCHZ  HBFDCH  TFCAVG
```

card72

```
--------------------------------------------------------------------------------
↪-
C72 CONTROLS FOR EFDC_EXPLORER LINKAGE
*
*   ISPPH:  >0  TO WRITE FILE FOR EFDC_EXPLORER LINKAGE (EE_WS.OUT, EE_VEL.
↪OUT, EE_WC.OUT)
*          100  TO ACTIVATE THE HIGH FREQUENCY DOMAIN OUTPUT READING SNAPSHOT.
↪INP
*   NPPPH:      NUMBER OF WRITES PER REFERENCE TIME PERIOD
*   ISBEXP:  0  DO NOT WRITE SEDIMENT BED RESULTS TO EE_BED.OUT
*           >0  WRITE TO EE_BED EVERY ISBEXP EE LINKAGE SNAPSHOTS
*
C72   ISPPH   NPPPH  ISBEXP NRPEMEE
```

card73

```
--------------------------------------------------------------------------------
↪-
C73  CONTROLS FOR HORIZONTAL PLANE RESIDUAL VELOCITY VECTOR PLOTTING
*
*  ISVPH:    NOT USED
*            NOT USED
*  NPVPH:    NOT USED
*  ISRVPH: 1 TO WRITE FILE FOR RESIDUAL VELOCITY PLOTTING IN
*            HORIZONTAL PLANE
*  IVPHXY:   NOT USED
*            NOT USED
*            NOT USED
*            NOT USED
*
C73   ISVPH   NPVPH  ISRVPH  IVPHXY
```

card74

```
--------------------------------------------------------------------------------
↪-
C74  NOT USED
*
*  ISECSPV:  NOT USED
*
*  NPSPV:    NOT USED
*  ISSPV:    NOT USED
*
*  ISRSPV:   NOT USED
*  ISHPLTV:  NOT USED
*
*
*
C74 ISECSPV   NPSPV   ISSPV  ISRSPV ISHPLTV
```

card75

```
--------------------------------------------------------------------------------
↪-
C75  NOT USED
*
*  ISECSPV: NOT USED
*  NIJSPV:  NOT USED
*  SEC ID:  NOT USED
*
C75 ISECSPV  NIJSPV     SEC ID
```

card76

```
-----------------------------------------------------------------------------
↪-
C76  NOT USED
*
*  ISECSPV: NOT USED
*  ISPV:    NOT USED
*  JSPV:    NOT USED
*
C76 ISECSPV    ISPV    JSPV
```

card77

```
-----------------------------------------------------------------------------
↪-
C77  NOT USED
*
*  ISECVPV: NOT USED
*
*  NPVPV:   NOT USED
*  ISVPV:   NOT USED
*
*  ISRSPV:  NOT USED
*
C77 ISECVPV   NPVPV   ISVPV  ISRSPV
```

card78

```
-----------------------------------------------------------------------------
↪-
C78  NOT USED
*
*  ISCEVPV: NOT USED
*  NIJVPV:  NOT USED
*  ANGVPV:  NOT USED
*  SEC ID:  NOT USED
*
C78 ISECVPV  NIJVPV  ANGVPV     SEC     ID
```

card79

```
-----------------------------------------------------------------------------
↪-
C79  NOT USED
*
*  ISECVPV: NOT USED
*  IVPV:    NOT USED
*  JVPV:    NOT USED
*
C79 ISECVPV    IVPV    JVPV
```

card80

```
----------------------------------------------------------------------------
↪-
C80 CONTROLS FOR 3D FIELD OUTPUT
*
*  IS3DO:  1 TO WRITE TO 3D ASCII INTEGER FORMAT FILES, JS3DVAR.LE.2     SEE|
*          1 TO WRITE TO 3D ASCII FLOAT POINT FORMAT FILES, JS3DVAR.EQ.3 C57|
*          2 TO WRITE TO 3D CHARACTER ARRAY FORMAT FILES (NOT ACTIVE)
*          3 TO WRITE TO 3D HDF IMAGE FORMAT FILES (NOT ACTIVE)
*          4 TO WRITE TO 3D HDF FLOATING POINT FORMAT FILES (NOT ACTIVE)
*  ISR3DO:   SAME AS IS3DO EXCEPT FOR RESIDUAL VARIABLES
*  NP3DO:    NUMBER OF WRITES PER LAST REF TIME PERIOD FOR INST VARIABLES
*  KPC:      NUMBER OF UNSTRETCHED PHYSICAL VERTICAL LAYERS
*  NWGG:     IF NWGG IS GREATER THAN ZERO, NWGG DEFINES THE NUMBER OF !2877|
*            WATER CELLS IN CARTESIAN 3D GRAPHICS GRID OVERLAY OF THE
*            CURVILINEAR GRID. FOR NWGG>0 AND EFDC RUNS ON A CURVILINEAR
*            GRID, I3DMI,I3DMA,J3DMI,J3DMA REFER TO CELL INDICES ON THE
*            ON THE CARTESIAN GRAPHICS GRID OVERLAY DEFINED BY FILE
*            GCELL.INP.  THE FILE GCELL.INP IS NOT USED BY EFDC, BUT BY
*            THE COMPANION GRID GENERATION CODE GEFDC.F.  INFORMATION
*            DEFINING THE OVERLAY IS READ BY EFDC.F FROM THE FILE
*            GCELLMP.INP. IF NWGG EQUALS 0, I3DMI,I3DMA,J3DMI,J3DMA REFER
*            TO INDICES ON THE EFDC GRID DEFINED BY CELL.INP.
*            ACTIVATION OF THE REWRITE OPTION I3DRW=1 WRITES TO THE FULL
*            GRID DEFINED BY CELL.INP AS IF CELL.INP DEFINES A CARTESIAN
*            GRID.  IF NWGG EQ 0 AND THE EFDC COMP GRID IS CO, THE REWRITE
*            OPTION IS NOT RECOMMENDED AND A POST PROCESSOR SHOULD BE USED
*            TO TRANSFER THE SHORT FORM, I3DRW=0, OUTPUT TO AN APPROPRIATE
*            FORMAT FOR VISUALIZATION. CONTACT DEVELOPER FOR MORE DETAILS
*  I3DMI:    MINIMUM OR BEGINNING I INDEX FOR 3D ARRAY OUTPUT
*  I3DMA:    MAXIMUM OR ENDING I INDEX FOR 3D ARRAY OUTPUT
*  J3DMI:    MINIMUM OR BEGINNING J INDEX FOR 3D ARRAY OUTPUT
*  J3DMA:    MAXIMUM OR ENDING J INDEX FOR 3D ARRAY OUTPUT
*  I3DRW:  0 FILES WRITTEN FOR ACTIVE CO WATER CELLS ONLY
*          1 REWRITE FILES TO CORRECT ORIENTATION DEFINED BY GCELL.INP
*            AND GCELLMP.INP FOR CO WITH NWGG.GT.O OR BY CELL.INP IF THE
*            COMPUTATIONAL GRID IS CARTESIAN AND NWGG.EQ.0
*  SELVMAX:  MAXIMUM SURFACE ELEVATION FOR UNSTRETCHING (ABOVE MAX SELV )
*  BELVMIN:  MINIMUM BOTTOM ELEVATION FOR UNSTRETCHING (BELOW MIN BELV)
*
C80   IS3DO  ISR3DO   NP3DO     KPC    NWGG   I3DMI   I3DMA   J3DMI   J3DMA ␣
↪ I3DRW SELVMAX BELVMIN
```

card81

```
----------------------------------------------------------------------------
↪-
C81 OUTPUT ACTIVATION AND SCALES FOR 3D FIELD OUTPUT
*
*  VARIABLE:     DUMMY VARIABLE ID (DO NOT CHANGE ORDER)
*  IS3(VARID): 1 TO ACTIVATE THIS VARIABLE
*  JS3(VARID): 0 FOR NO SCALING OF THIS VARIABLE
*              1 FOR AUTO SCALING OF THIS VARIABLE OVER RANGE 0<VAL<255
*                AUTO SCALES FOR EACH FRAME OUTPUT IN FILES OUT3D.DIA AND
```

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```
*                ROUT3D.DIA  OUTPUT IN I4 FORMAT
*              2 FOR SCALING SPECIFIED IN NEXT TWO COLUMNS WITH OUTPUT
*                DEFINED OVER RANGE  0<VAL<255 AND WRITTEN IN I4 FORMAT
*              3 FOR MULTIPLIER SCALING BY MAX SCALE VALUE WITH OUTPUT
*                WRITTEN IN F7.2 FORMAT (IS3DO AND ISR3DO MUST BE 1)
*
C81 VARIABLE    IS3D    JS3D    SMAX    SMIN
```

card82

```
-----------------------------------------------------------------------------
↪-
C82 INPLACE HARMONIC ANALYSIS PARAMETERS
*
*  ISLSHA:  1 FOR IN PLACE LEAST SQUARES HARMONIC ANALYSIS
*  MLLSHA:  NUMBER OF LOCATIONS FOR LSHA
*  NTCLSHA: LENGTH OF LSHA IN INTEGER NUMBER OF REFERENCE TIME PERIODS
*  ISLSTR:  1 FOR TREND REMOVAL
*  ISHTA :  1 FOR SINGLE TREF PERIOD SURFACE ELEV ANALYSIS
*                    90
C82  ISLSHA  MLLSHA NTCLSHA  ISLSTR   ISHTA
```

card83

```
-----------------------------------------------------------------------------
↪-
C83 HARMONIC ANALYSIS LOCATIONS AND SWITCHES
*
*  ILLSHA:   I CELL INDEX
*  JLLSHA:   J CELL INDEX
*  LSHAP:  1 FOR ANALYSIS OF SURFACE ELEVATION
*  LSHAB:  1 FOR ANALYSIS OF SALINITY
*  LSHAUE: 1 FOR ANALYSIS OF EXTERNAL MODE HORIZONTAL VELOCITY
*  LSHAU:  1 FOR ANALYSIS OF HORIZONTAL VELOCITY IN EVERY LAYER
*  CLSL:     LOCATION AS A CHARACTER VARIABLE
*
C83  ILLSHA  JLLSHA   LSHAP   LSHAB  LSHAUE   LSHAU    CLSL
```

card84

```
-----------------------------------------------------------------------------
↪-
C84 CONTROLS FOR WRITING TO TIME SERIES FILES
*
*  ISTMSR:  1 OR 2 TO WRITE TIME SERIES OF SURF ELEV, VELOCITY, NET
*           INTERNAL AND EXTERNAL MODE VOLUME SOURCE-SINKS, AND
*           CONCENTRATION VARIABLES,  2 APPENDS EXISTING TIME SERIES FILES
*  MLTMSR:  NUMBER HORIZONTAL LOCATIONS TO WRITE TIME SERIES OF SURF ELEV,
*           VELOCITY, AND CONCENTRATION VARIABLES
*  NBTMSR:  TIME STEP TO BEGIN WRITING TO TIME SERIES FILES (Inactive)
```

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```
*  NSTMSR:  TIME STEP TO STOP WRITING TO TIME SERIES FILES (Inactive)
*  NWTMSR:  NUMBER OF TIME STEPS TO SKIP BETWEEN OUTPUT
*  NTSSTSP: NUMBER OF TIME SERIES START-STOP SCENARIOS,  1 OR GREATER
*  TCTMSR:  UNIT CONVERSION FOR TIME SERIES TIME.  FOR SECONDS, MINUTES,
*           HOURS,DAYS USE 1.0, 60.0, 3600.0, 86400.0 RESPECTIVELY
*
*
C84  ISTMSR  MLTMSR  NBTMSR  NSTMSR  NWTMSR NTSSTSP   TCTMSR
```

card85

```

-----------------------------------------------------------------------------
↪-
C85 CONTROLS FOR WRITING TO TIME SERIES FILES
*
*  ITSSS:   START-STOP SCENARIO NUMBER 1.GE.ISSS.LE.NTSSTSP
*  MTSSTSP: NUMBER OF STOP-START PAIRS FOR SCENARIO ISSS
*
C85 ITSSS MTSSTSP
```

card86

```
-----------------------------------------------------------------------------
↪-
C86 CONTROLS FOR WRITING TO TIME SERIES FILES
*
*  ITSSS:  START-STOP SCENARIO NUMBER 1.GE.ISSS.LE.NTSSTSP
*  MTSSS:  NUMBER OF STOP-START PAIRS FOR SCENARIO ISSS
*  TSSTRT: STARTING TIME FOR SCENARIO ITSSS, SAVE INTERVAL MTSSS
*  TSSTOP: STOPPING TIME FOR SCENARIO ITSSS, SAVE INTERVAL MTSSS
*                    -1000.
C86    ISSS   MTSSS  TSSTRT  TSSTOP   COMMENT
```

card87

```
-----------------------------------------------------------------------------
↪-
C87 CONTROLS FOR WRITING TO TIME SERIES FILES
*
*  ILTS:    I CELL INDEX
*  JLTS:    J CELL INDEX
*  NTSSSS:  WRITE SCENARIO FOR THIS LOCATION
*  MTSP:  1 FOR TIME SERIES OF SURFACE ELEVATION
*  MTSC:  1 FOR TIME SERIES OF TRANSPORTED CONCENTRATION VARIABLES
*  MTSA:  1 FOR TIME SERIES OF EDDY VISCOSITY AND DIFFUSIVITY
*  MTSUE: 1 FOR TIME SERIES OF EXTERNAL MODE HORIZONTAL VELOCITY
*  MTSUT: 1 FOR TIME SERIES OF EXTERNAL MODE HORIZONTAL TRANSPORT
*  MTSU:  1 FOR TIME SERIES OF HORIZONTAL VELOCITY IN EVERY LAYER
*  MTSQE: 1 FOR TIME SERIES OF NET EXTERNAL MODE VOLUME SOURCE/SINK
```

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```
*  MTSQ:  1 FOR TIME SERIES OF NET EXTERNAL MODE VOLUME SOURCE/SINK
*  CLTS:    LOCATION AS A CHARACTER VARIABLE
*
C87    ILTS    JLTS  NTSSSS   MTSP    MTSC    MTSA   MTSUE   MTSUT    MTSU ␣
↪ MTSQE    MTSQ    CLTS
```

card88

```
-----------------------------------------------------------------------------
↪-
C88  High frequency output for specific locations and times
*
* HFREOUT:  1 use high frequency dates for output
*           0 specific output option is not used
*
C88 HFREOUT
```

card89

```
-----------------------------------------------------------------------------
↪-
C89 NOT USED
*
*  MMDVSFP:  NOT USED
*  DMSFP:    NOT USED
*
C89 MMDVSFP  DMVSFP
```

card90

```
-----------------------------------------------------------------------------
↪-
C90 NOT USED
*
*  MMLVSFP: NOT USED
*  TIMVSFP: NOT USED
*  IVSFP:   NOT USED
*  JVSFP:   NOT USED
*
C90 MMLVSFP TIMVSFP   IVSFP   JVSFP
```

card91

```
------------------------------------------------------------------------------
↪-
C91 OPTIONS FOR GENERATION OF NETCDF FILE(S)
*
*  NCDFOUT:          OPTION FOR NETCDF EXPORT
*                =1  GENERATE NETCDF FILE NC
*                =0  NO GENERATION
*  DEFLEV:           LEVEL OF COMPRESSION OF NETCDF FILE FROM 0 TO 9
*  ROTA:         =1  ROTATING 2D VELOCITY FIELD TO THE TRUE EAST AND TRUE␣
↪NORTH
*                =0  NO ROTATION TO TRUE EAST AND TRUE NORTH
*  UTMZ:             UTM ZONE
*                    >0 FOR NORTHERN HEMISPHERE; <0 FOR SOUTHERN HEMISPHERE,␣
↪0 TO IGNORE
*  BASEDATE:         YYYY-MM-DD  (NO BLANK)
*  BASETIME:         HH:MM:SS    (NO BLANK)
*  PROJ:             PROJECT NAME IS A STRING OF MAXIMUM LENGTH 20
*                    WITHOUT ANY BLANKS
*
C91 NCDFOUT  DEFLEV    ROTA     BLK     UTMZ    HREST    BASEDATE BASETIME   ␣
↪PROJ
```

card91a

```
------------------------------------------------------------------------------
↪-
C91A OPTIONS FOR NETCDF OUTPUT
*
*  TYPE       File creation option
*               =1:  Single file
*               =0:  Multiple daily files
*  BEGIN             Start julian day of writing netcdf file
*  END               End julian day of writing netcdf file
C91A   TYPE   BEGIN     END
```

card91b

```
------------------------------------------------------------------------------
↪-
C91B OPTIONS FOR NETCDF OUTPUT
*
*  ISNCDF(I)       OPTION FOR OUTPUT, I=1:12
*                  = 0: NO
*                  = 1: YES
*
*          1       2       3       4       5       6       7      8        9 ␣
↪    10      11      12
C91B    SAL     TEM     DYE     SLF     TOX     SED     SND     WQL     LPT ␣
↪    SHR     WIN     WAV
```

1.3.2 Required Spatial Files

Input File	Description
cell.inp	Describes the cell mapping and which type of cell goes where.
celllt.inp	Auxiliary cell type file
dxdy.inp	Horizontal cell dimensions, depth, bottom elevation, roughness, vegetation class
lxly.inp	Horizontal cell center coordinates and cell orientation
corners.inp	Provides x,y coordinates corners for Lagrangian Particle Tracking module

Optional Spatial Files

Input File	Description
mask.inp	Specifies thin barriers if NMASK > 0
layermask.inp	Specifies thin barriers for layer faces if NBLOCKED > 0 (for EFDC+ 10.1 and later)
mappgns.inp	Specifies north-south (J/V face) direction grid connections
mappgew.inp	Specifies east-west (I/U face) direction grid connections
moddxdy.inp	Modifies cell dimensions originally specified in dxdy.inp
sgzlayer.inp	Specifies the bottom active water layer if IGRIDV=1

The primary input files that specify the geometry of the problem are given in greater detail below.

Cell Input File

The cell.inp file is a 2x2 matrix with length in the *i* or *x* direction equal to *IC* and a length in the *j* or *y* direction of *JC*. IC and JC are specified on *card9* of EFDC.INP

In the table below each cell type is described. These numbers are what are inputted into the ICxJC matrix in the cell.inp file.

Cell Number	Description
0	dry land cell not bordering a water cell on a side or corner.
1	triangular water cell with land to the northeast
2	triangular water cell with land to the southeast
3	triangular water cell with land to the southwest
4	triangular water cell with land to the northwest
5	quadrilateral water cell
9	dry land cell bordering a water cell on a side or corner or a fictitious dry land cell bordering an open boundary water cell on a side or a corner

In the example file listed below IC=10 and JC=6. Note, the first 4 rows are comments as well as the first 4 rows. The cell mapping begins from the bottom left corner.

```
C cell.inp file, i columns and j rows
C    0        1
C    1234567890
C
  6  999999000
  5  945519999
  4  955555559
```

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```
  3  955555559
  2  935529999
  1  999999000
```

DXDY Input File

The dxdy.inp file specifies many of the physical properties of each cell. Every cell described in the cell.inp file must be described in this file.

Variable	Description
I	Array index in x direction
J	Array index in y direction
DX	Cell dimension in x direction, meters
DY	Cell dimension in y direction, meters
DEPTH	Initial water depth, meters
BOTTOM ELEV	Bottom bed elevation, meters
ZROUGH	Log law roughness height, zo, meters
VEG TYPE	Vegetation type class, integer value

Below is part of a sample input file that specifies part of a single column of the geometry.

```
C DXDY.INP FILE, IN FREE FORMAT ACROSS COLUMNS for  the first 25 Active Cells
C  Project:  EFDC+ Test Case
C                                          BOTTOM                     Veg
C   I    J        DX         DY       DEPTH     ELEV     ZROUGH       TYPE
    4   30    0.115800  0.021000    0.1100    0.0000  2.0000E-03
    4   31    0.115800  0.022100    0.1100    0.0000  2.0000E-03
    4   32    0.115800  0.023200    0.1100    0.0000  2.0000E-03
    4   33    0.115800  0.024300    0.1100    0.0000  2.0000E-03
    4   34    0.115800  0.025500    0.1100    0.0000  2.0000E-03
    4   35    0.115800  0.026800    0.1100    0.0000  2.0000E-03
    4   36    0.115800  0.028100    0.1100    0.0000  2.0000E-03
    4   37    0.115800  0.029500    0.1100    0.0000  2.0000E-03
    4   38    0.115800  0.031000    0.1100    0.0000  2.0000E-03
    4   39    0.115800  0.032600    0.1100    0.0000  2.0000E-03
    4   40    0.115800  0.034200    0.1100    0.0000  2.0000E-03
    4   41    0.115800  0.035900    0.1100    0.0000  2.0000E-03
    4   42    0.115800  0.037700    0.1100    0.0000  2.0000E-03
    4   43    0.115800  0.039600    0.1100    0.0000  2.0000E-03
    4   44    0.115800  0.041600    0.1100    0.0000  2.0000E-03
    4   45    0.115800  0.043700    0.1100    0.0000  2.0000E-03
    4   46    0.115800  0.045800    0.1100    0.0000  2.0000E-03
    4   47    0.115800  0.048100    0.1100    0.0000  2.0000E-03
    4   48    0.115800  0.050000    0.1100    0.0000  2.0000E-03
    4   49    0.115800  0.050000    0.1100    0.0000  2.0000E-03
    4   50    0.115800  0.050000    0.1100    0.0000  2.0000E-03
    4   51    0.115800  0.050000    0.1100    0.0000  2.0000E-03
    4   52    0.115800  0.050000    0.1100    0.0000  2.0000E-03
    4   53    0.115800  0.050000    0.1100    0.0000  2.0000E-03
    4   54    0.115800  0.050000    0.1100    0.0000  2.0000E-03
    4   55    0.115800  0.050000    0.1100    0.0000  2.0000E-03
```

LXLY Input File

The lxly.inp file specifies the cell centered location and the rotation of each cell.

Variable	Description
I	Array index in x direction
J	Array index in y direction
X	x cell center coordinate, longitude, meters, or km
Y	y cell center coordinate, longitude, meters, or km
CUE	Rotation matrix component, i
CVE	Rotation matrix component
CUN	Rotation matrix component
CVN	Rotation matrix component
Wind Shelter	

Below is part of a sample input file that specifies part of a single column of the geometry.

```
C LXLY.INP FILE, IN FREE FORMAT ACROSS LINE for  25 Active Cells
C  Project:  EFDC+ Test Case
C                                                                                  WIND
C   I    J           X            Y         CUE        CVE        CUN        CVN   SHELTER
    4   30    0.045400    1.010500    1.00000    0.00000    0.00000    1.00000    0.00
    4   31    0.045400    1.032000    1.00000    0.00000    0.00000    1.00000    0.00
    4   32    0.045400    1.054600    1.00000    0.00000    0.00000    1.00000    0.00
    4   33    0.045400    1.078400    1.00000    0.00000    0.00000    1.00000    0.00
    4   34    0.045400    1.103300    1.00000    0.00000    0.00000    1.00000    0.00
    4   35    0.045400    1.129400    1.00000    0.00000    0.00000    1.00000    0.00
    4   36    0.045400    1.156900    1.00000    0.00000    0.00000    1.00000    0.00
    4   37    0.045400    1.185750    1.00000    0.00000    0.00000    1.00000    0.00
    4   38    0.045400    1.216000    1.00000    0.00000    0.00000    1.00000    0.00
    4   39    0.045400    1.247800    1.00000    0.00000    0.00000    1.00000    0.00
    4   40    0.045400    1.281200    1.00000    0.00000    0.00000    1.00000    0.00
    4   41    0.045400    1.316250    1.00000    0.00000    0.00000    1.00000    0.00
    4   42    0.045400    1.353100    1.00000    0.00000    0.00000    1.00000    0.00
    4   43    0.045400    1.391800    1.00000    0.00000    0.00000    1.00000    0.00
    4   44    0.045400    1.432400    1.00000    0.00000    0.00000    1.00000    0.00
    4   45    0.045400    1.475000    1.00000    0.00000    0.00000    1.00000    0.00
    4   46    0.045400    1.519700    1.00000    0.00000    0.00000    1.00000    0.00
    4   47    0.045400    1.566700    1.00000    0.00000    0.00000    1.00000    0.00
    4   48    0.045400    1.615800    1.00000    0.00000    0.00000    1.00000    0.00
    4   49    0.045400    1.665800    1.00000    0.00000    0.00000    1.00000    0.00
    4   50    0.045400    1.715800    1.00000    0.00000    0.00000    1.00000    0.00
    4   51    0.045400    1.765800    1.00000    0.00000    0.00000    1.00000    0.00
    4   52    0.045400    1.815800    1.00000    0.00000    0.00000    1.00000    0.00
    4   53    0.045400    1.865800    1.00000    0.00000    0.00000    1.00000    0.00
    4   54    0.045400    1.915800    1.00000    0.00000    0.00000    1.00000    0.00
    4   55    0.045400    1.965800    1.00000    0.00000    0.00000    1.00000    0.00
```

1.3.3 General Transport

Hydrodynamic Parameter Files

Input File	Description
AHMAP.INP	Spatially varying Smagorinsky (AHD) and background eddy viscosity (AHO) if AHD < 0.0
AVMAP.INP	Spatially varying AVO/ABO if AVO < 0.0
MAPHMD.INP	List of cells to compute horizontal momentum diffusion if IHMDSUB > 0
VEGE.INP	Vegetation class definitions
VEGSER.INP	Vegetation class time series
WSER.INP	Time series file for wind speed and direction
WNDMAP.INP	Cell weightings file for WSER series when NWSER > 1
SUBSET.INP	List of cells and timing for high frequency time series output
SNAPSHOTS.INP	List of additional times to write the EE_*.OUT linkage files
RESTART.INP	Primary restart/hot start file for hydrodynamics and most other modules
RSTWD.INP	Restart file for wetting & drying parameters (ISDRY > 0)

Volumetric and Level Boundary Conditions

Input File	Description
QSER.INP	Time series file for flow type boundary conditions
PSER.INP	Time series file for pressure type open boundary conditions
QWRS.INP	Time series file for withdrawl-return flows and concentration rise/fall
QCTL.INP	Lookup tables for free surface elevation or pressure controlled flow
QCTLSER.INP	Time series of equation based parameters control time-series
QCRULES.INP	Operation rules for hydraulic structure control
GWATER.INP	Groundwater interaction by infiltration and evapotranspiration
GWSEEP.INP	Groundwater interaction by ambient groundwater flow
GWSER.INP	Groundwater inflow/outflow and concentration
GWMAP.INP	Spatially varying map of GSWER series ID

Salt Module

Input File	Description
SALT.INP	Water column initial conditions for salinity
SSER.INP	Time series file for salinity boundary conditions

Lagrangian Particle Tracking

Input File	Description
DRIFTER.INP	Particle group settings and particle seeding locations

Shellfish Module

Input File	Description
SFBSER.INP	Shellfish larave behavior settings
SFL.INP	Water column initial conditions for shellfish
SFSER.INP	Time series file for shellfish boundary conditions

Dye Module

Input File	Description
DYE.INP	Water column initial conditions for dye
DSER.INP	Time series file for dye boundary conditions

1.3.4 Sediment

Original Sediment Module

Input File	Description
SEDW.INP	Water column initial conditions for cohesive sediments
SEDB.INP	Sediment bed initial conditions for cohesive sediments
SDSER.INP	Time series file for cohesive boundary conditions
SNDW.INP	Water column initial conditions for non-cohesive sediments
SNDB.INP	Sediment bed initial conditions for non-cohesive sediments
SNSER.INP	Time series file for non-cohesive boundary conditions
BEDBDN.INP	Sediment bed initial conditions for bulk density
BEDDDN.INP	Sediment bed initial conditions for dry density, porosity or void ratio
BEDLAY.INP	Sediment bed initial conditions for layer thickness
SEDBLBC.INP	Non-cohesive bedload outflow or recirculation boundary conditions
SEDROUGH.INP	Spatially varying grain roughness height for determining grain stress, ISBEDSTR = 3
CONSOLMAP.INP	Spatially varying consolidation approach when IBMECH = 9
SSCOHSEDPMAP.INP	Spatially varying cohesive critical bed shear stress and surface erosion rate, IWRSP(1) > 98
BEDMAP.INP	Spatially varying flag for hard-bottom bypass of erosion/deposition calculations
BEMAP.INP	Bank erosion cell map
BESER.INP	Bank erosion time series

SEDZLJ Module

Input File	Description
BED.SDF	SEDZLJ control file with active and deposited erosion parameters
ERATE.SDF	SEDFlume core properties for existing sediment bed
CORE_FIELD.SDF	Sptially varying assignment of core ID's from ERATE.SDF
SEDW.INP	Water column initial conditions for cohesive sediments
SDSER.INP	Time series file for cohesive boundary conditions
SNSER.INP	Time series file for non-cohesive boundary conditions
SNDW.INP	Water column initial conditions for non-cohesive sediments
SEDB.INP	Sediment bed initial conditions for cohesive sediments NSEDFLUME = 2 (10.0)
SNDB.INP	Sediment bed initial conditions for non-cohesive sediments NSEDFLUME = 2 (10.0)
BEDBDN.INP	Sediment bed initial conditions for bulk density NSEDFLUME = 2 (10.0)
BEDDDN.INP	Sediment bed initial conditions for dry density, porosity or void ratio NSEDFLUME = 2 (10.0)
BEDLAY.INP	Sediment bed initial conditions for layer thickness NSEDFLUME = 2 (10.0)
SEDBLBC.INP	Non-cohesive bedload outflow or recirculation boundary conditions
SEDBED_HOT.SDF	Restart/hot start file of SEDZLJ sediment conditions

1.3.5 Wave Parameter Files

Input File	Description
WAVE.INP	External wave model linkage file
WAVETIME.INP	List of times in days that correspond to the wave conditions in external wave linkage files
WAVECELLS.INP	List of cells to compute wave action if IUSEWVCELLS > 0 and ISWAVE > 2
WAVEBL.INP	External wave model linkage file for boundary layer only (deprecated)
SWAN_GRP.INP	SWAN wave model linkage control file
SWAN_LOC.INP	X and Y locations of the SWAN models cell centriods
SWAN_TBL.INP	SWAN model results for linking to EFDC+

1.3.6 Eutrophication Module

Input File	Description
WQ3DWC.INP	Eutrophication module control file for the water column processes
KINETICS.INP	Dissolved oxygen kinetics by zone definitions
WQALGG.INP	Water column algae kinetic zone definitions
MACALGMP.INP	Macroalgae/Periphyton kinetic zone definitions
WQSETL.INP	Algal and particulate ettling rate zone definitions
WQWCMAP.INP	Spatially varying kinetic zones
WQICI.INP	Eutrophication constituent
CWQSRxx.INP	Eutrophication constituent [xx] concentration time series (IWQPSL = 2)
WQPSL.INP	Eutrophication constituents mass loading time series
SUNDAY.INP	Time series of daily average solar radiation and fraction of day
WQWCRST.INP	Eutrophication restart file for the water column

Diagensis Sub-Module

Input File	Description
WQ3DSD.INP	Sediment diagenesis control file
WQSDICI.INP	Sediment diagenesis initial conditions file
WQSDMAP.INP	Sediment diagenesis cell zone map
WQBENMAP.INP	Spatially varying mud & sand fractions if IWQBEN = 2
WQSDRST.INP	Sediment diagenesis restart file ASCII format
WQSDRST.BIN	Sediment diagenesis restart file binary format

RPEM Sub-Module

Input File	Description
WQRPEM.INP	Rooted Plant and Epiphyte (RPEM) control file
WQRPEMSIC.INP	Spatially varying carbon initial conditions for roots and shoots
WQRPEMRST.INP	RPEM restart file

Mechanical Hydrokinetic Device Files

Input File	Description
MHK.INP	Mechanical Hydrokinetic device control file

1.3.7 Toxics Module

Input File	Description
TOXW.INP	Water column initial conditions for toxics
TOXB.INP	Sediment bed initial conditions for toxics
TXSER.INP	Time series file for toxics
PARTMIX.INP	Particle mixing properties in the sediment bed
PMXMAP.INP	Spatially varying sediment bed particle mixing zones
DOCW.INP	Spatial varying, time constant dissolved organic carbon in water column
DOCB.INP	Spatial varying, time constant dissolved organic carbon in sediment bed
FOCB.INP	Particulate organic carbon in bed and pseudo-poc in bed
FPOCB.INP	Spatialy varying, time constant particulate organic carbon fraction for each sediment class in bed
FPOCW.INP	Spatial varying, time constant particulate organic carbon fraction for each sediment class in water column
POCB.INP	Spatialy varying, time constant particulate organic carbon in bed
POCW.INP	Spatial varying, time constant particulate organic carbon in water column
FOOD-CHAIN.INP	Spatial averaging map for food chain model output
PSEUDO_FOCB.INP	Spatialy varying, time constant psueo-POC fraction for each sediment class in bed for food chain

1.3.8 Temperature Module

Input File	Description
TEMP.INP	Water column initial conditions for temperature
TSER.INP	Time series file for temperature boundary conditions
ASER.INP	Time series file for atmospheric parameters
ATMMAP.INP	Cell weightings file for ASER series when NASER > 1
PSHADE.INP	Spatially varying solar radiation shading
SVHTFACT.INP	Spatially varying surface heat exchange parameters for DSI full heat balance if ISVHEAT > 0
TEMB.INP	Spatially varying initial bed temperature and bed thermal thickness

Ice Sub-Module

Input File	Description
ISER.INP	Time series of user specified ice cover for ISICE = 1
ICEMAP.INP	Cell weightings file for ISER series when NISER > 1 for ISICE = 1
ISTAT.INP	Time series of user specified ice for whole domain when ISICE = 2
ICE.INP	Initial conditions for ice cover when using heat coupled ice (ISICE > 2)

1.4 Output Files

This section describes the binary output files produced by EFDC+ during a calculation.

1.4.1 Output Files

These output files are written out by EFDC+ in a binary format. The easiest way to view the results is using EE Modeling System (EEMS). A demo of EEMS is available and can be accessed by going to the EEMS website. Alternatively, a rudimentary postprocessing tool is available, referred to as *GetEFDC*. *GetEFDC* is a Fortran 90 program that can read the binary formats and can be modified to output into another format like a text file. A detailed description of *GetEFDC* is found on the next page.

In the table below each of the binary output files is listed and described.

Output file name	Description
EE_WS.OUT	Water depth
EE_WC.OUT	Water column and top layer of sediments
EE_BC.OUT	Computed boundary flows
EE_BED.OUT	Sediment bed layer information
EE_WQ.OUT	Water quality information for the water column
EE_SD.OUT	Sediment diagensis information
EE_RPEM.OUT	Rooted plant and epiphyte model
EE_SEDZLJ.OUT	Sediment bed data for sedzlj sub-model
EE_HYD.OUT	Water depth and velocity

Some of these outputs are optional based on the options set in the efdc.inp file.

1.4.2 GetEFDC

GetEFDC is a Fortran utility to read the binary output files produced by EFDC+. *GetEFDC* is a a starting point for the user to create their own analysis of EFDC+ output. It is expected that a user utilizing this tool has knowledge of Fortran and can modify *GetEFDC* to meet their specific needs.

Source Code

The source code for *GetEFDC* is listed below. It written all in Fortran and is straightforward to compile with a modern compiler (e.g. gfortran or Intel).

Main program:

- getefdc.f90

and 8 Modules:

- infomod.f90
- efdcpromod.f90
- tecmod.f90
- geteeoutmod.f90
- xyijconv.f90
- gethfreqout.f90
- globalvars.f90

If IGRIDV > 0 then the output is based on the vertical layer defined in sgzlayer.inp.

Build GetEFDC

A `makefile` is located under the /GetEFDC/src directory. This can be used to compile on a Linux machine. Alternatively, this program can be compiled on Windows using Visual Studio.

Running GetEFDC

The syntax for running the utility is as follows:

```
GetEFDC.exe getefdc.inp
```

Input File

`getefdc.inp` is the master file that stores all the information about the parameters of interest which the user is trying to extract. This file must be edited for every change to input parameters. A sample of the master file is included in the GetEFDC folder. The input parameters in this file are as follows:

- The full path of the folder containing `efdc.inp` file
- LAYK The number of layer in the vertical to get data for 2DH display (>0)
  - = 0 Extract the depth-averaged data
  - >0 Extract the data at layer of k
  - =-1 Extract High Frequency output

  - =-2 Extract data for time series (TS) at a height above bed (m)
  - =-3 Read TMP.DAT file and write an array data file for TECPLOT
- ZOPT This parameter is used in case of LAYK=-2
  - =1 Extract TS data at the depth under water surface
  - =2 Extract TS data at the height above bottom
- JULTIME Julian time point for a selected layer, if > MAXTIME then JULTIME=MAXTIME JULTIME = 0 Extract data for all snapshots
- NLOC Number of locations (cells) to extract data. The location can be given as Index (I,J) or UTM coordinates (X,Y) via the parameter INDEX.
- ROTA The option for rotation of velocity components (U,V)
  - = 0 Extract (U,V) without rotation
  - = 1 (U,V) components are rotated to the true east and true north directions
- INDEX
  - = 0 UTM (X,Y) of cells are used
  - = 1 Indices (I,J) of cells are used
- VPROF The option to extract data for vertical profile, 0 (No)/ 1(Yes)
- TECPLOT The option to extract data for 2DH Tecplot, 0 (No)/ 1(Yes)
- NDRIFTER: A successive set of number of particles to extract data for (X,Y,Z)
- I/X I Indices or X abscissa of cells to extract data
- J/Y J Indices or Y coordinates of cells to extract data
- ZINT Height under water surface or above bed to extract data in case LAYK=-2

Please note that the lines which start with ** in the `getefdc.inp` file are comments and will be ignored.

Sample GetEFDC Input File

```
** COMMENT LINES START WITH "*"
** GETEFDC VER. 161128 IS USED TO:
** EXTRACT EFDC BINARY FILES *.OUT (EFDC 6.0 OR LATER) TO NETCDF AND ASCII FILES FOR:
**  1.TIME SERIES AT SOME LOCATIONS DETERMINED BY (I,J) OR (X,Y)
**  2.TECPLOT OF ONE LAYER (K>=0) AT OME SPECIFIC SNAPSHOT
**  3.ARRAYS OF DATA
**
** OBLIGATORY INPUT FILES:
**  0.GETEFDC.INP: THIS FILE
**  1.EFDC.INP
**  2.LXLY.INP
**  3.DXDY.INP
**  4.CELL.INP
**  5.CORNERS.INP
**  6.MAPPGNS.INP
**  7.MAPPGEW.INP
**
** THE FOLLOWING BINARY FILES WILL BE READ ACCORDING TO SELECTED ITEMS
**  1.EE_WS.OUT
```

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```
**   2.EE_VEL.OUT
**   3.EE_WC.OUT
**   4.EE_WQ.OUT
**   5.EE_DRIFTER.OUT
**   6.EE_BC.OUT
**   7.EE_BED.OUT
**   8.EE_TUR.OUT
**
**   OUPUT OF GETEFDC IS STORED IN RESULT FOLDER
**
*****************************************************************************
** THE FULL PATH OF INP FILES is determined by the file efdc.inp:
**
E:\Projects\EFDC_Testing\restart\caloo-autorun_1\efdc.inp
**
*****************************************************************************
** OPTIONS FOR OUTPUT:
** LAYK         = K>0: DATA AT LAYER NUMBER K TO BE EXPORTED AT TIME=JULTIME
**                  0: DEPTH-AVERAGED DATA IS EXPORTED
**                 -1: Get High Frequency output FOR CELLS
**                 -2: Extract data for Time series at a height above bed (m)
**                 -3: LOAD TMP.DAT AND EXPORT TECPLOT
**
** ZOPT           = 1: FOR THE DEPTH UNDER WATER SURFACE IF LAYK=-2
**                  2: FOR THE HEIGHT ABOVE BOTTOM IF LAYK=-2
** NDRIFTER           : N1:N2 A SET OF DRIFTER TO GET (X,Y,Z)
**
**
** JULTIME            : JULIAN TIME FOR SELECTED LAYER
**                  > MAXTIME THEN JULTIME=MAXTIME
**                    0 DATA FOR ALL SNAPSHOT
** NLOC               : NUMBER OF CELLS TO EXTRACT TIMESERIES
** ROTA           = 1: (U,V) AT CELL CENTER ROTATED TO TRUE EAST AND TRUE NORTH
**                  0: (U,V) AT CELL  FACES WITHOUT ROTATION
** INDEX          = 1: (I,J) OF CELLS ARE GIVEN
**                  0: (X,Y) OF CELLS ARE GIVEN
** VPROF          = 1: EXPORT VERTICAL PROFILE
**                = 0: NO EXPORTATION FOR VERTICAL PROFILE
**
** TECPLOT        = 1: EXPORT DATA FOR TECPLOT
**                = 0: NO TECPLOT EXPORTATION
**
*****************************************************************************
** LAYK    JULTIME      NLOC    ROTA  INDEX  VPROF  TECPLOT   ZOPT  NDRIFTER
    4           0         2        1      1      1        1        1       1:5
*****************************************************************************
**   I/X              : I Index or X of cell
**
**   J/Y              : J Index or Y of cell
**
**   ZINT             : THE DEPTH UNDER WS OR HEIGHT ABOVE BED (m)
**                      FOR TIME SERIES EXTRACTION IF LAYK=-2
**
*****************************************************************************
**    I/X           J/Y           ZINT(m)
**    314782.0     3941547.0       0.5
      3 44             0.5
```

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```
    3  45   0.7
```

Output Files

After running GetEFDC a sub-folder `RESULT` is generated in the folder `#output` of the working model. The extracted files are ASCII with the following conventions for the file names:

- First characters group shows the constituent, such as SAL for salinity
- Second character group is *TSK_* which is the time series of the layer K, such as *TSK_4* is time series for the layer K=4
- The last character group is _DOM for the domain or CEL for the selected cells
- The vertical profiles for the constituents at the selected cells use the group _PROF in the file names, such as `SAL_PROF.DAT`

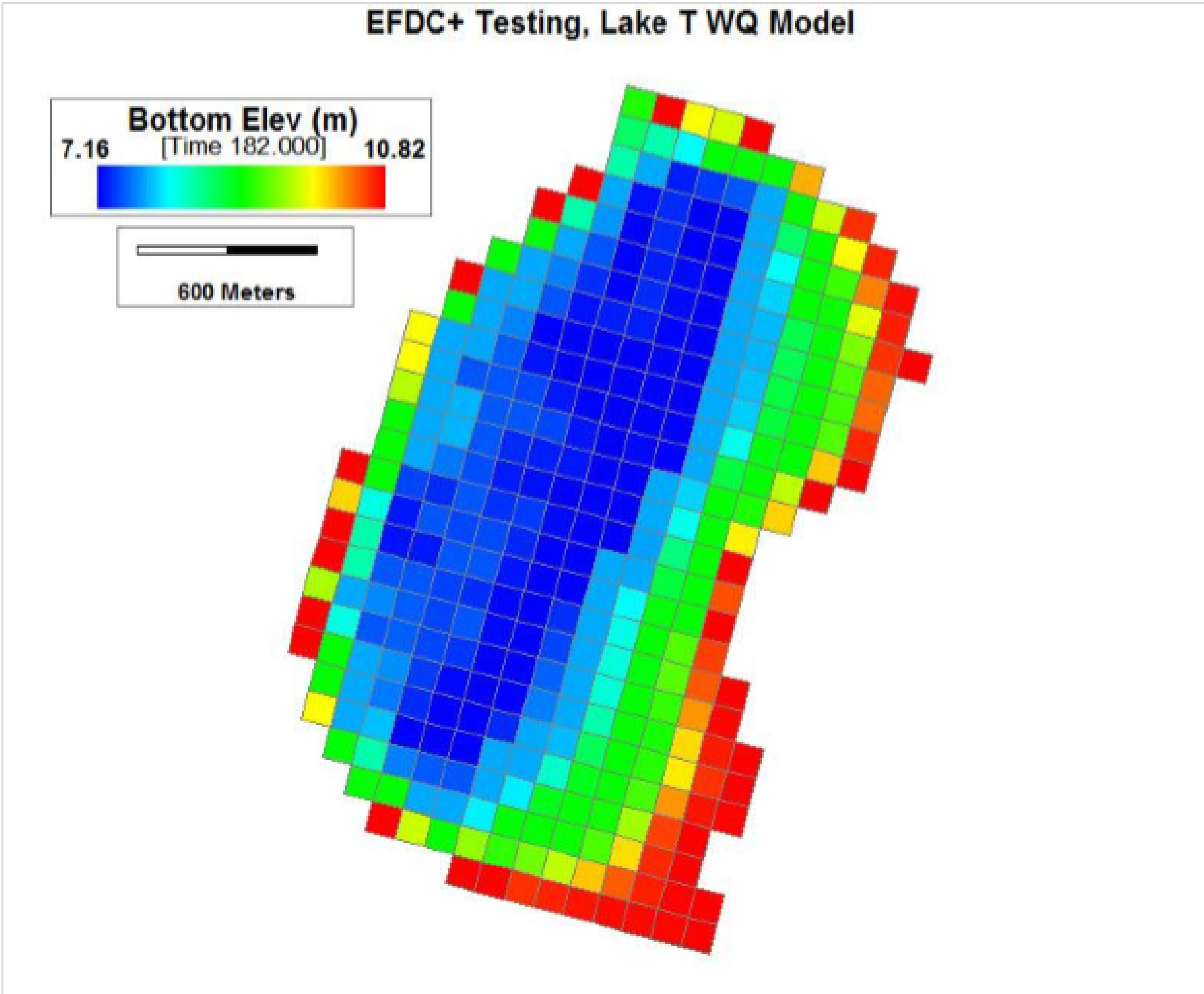
1.5 Sample Models

Several completed model input files are provided under `SampleModels`. All of these models can be run with EFDC+ version 8.5 and the grid can be visualized with the *GridGenerator* utility.

Next, Each of these models is decribed in greater detail.

1.5.1 Lake 2D Test Case

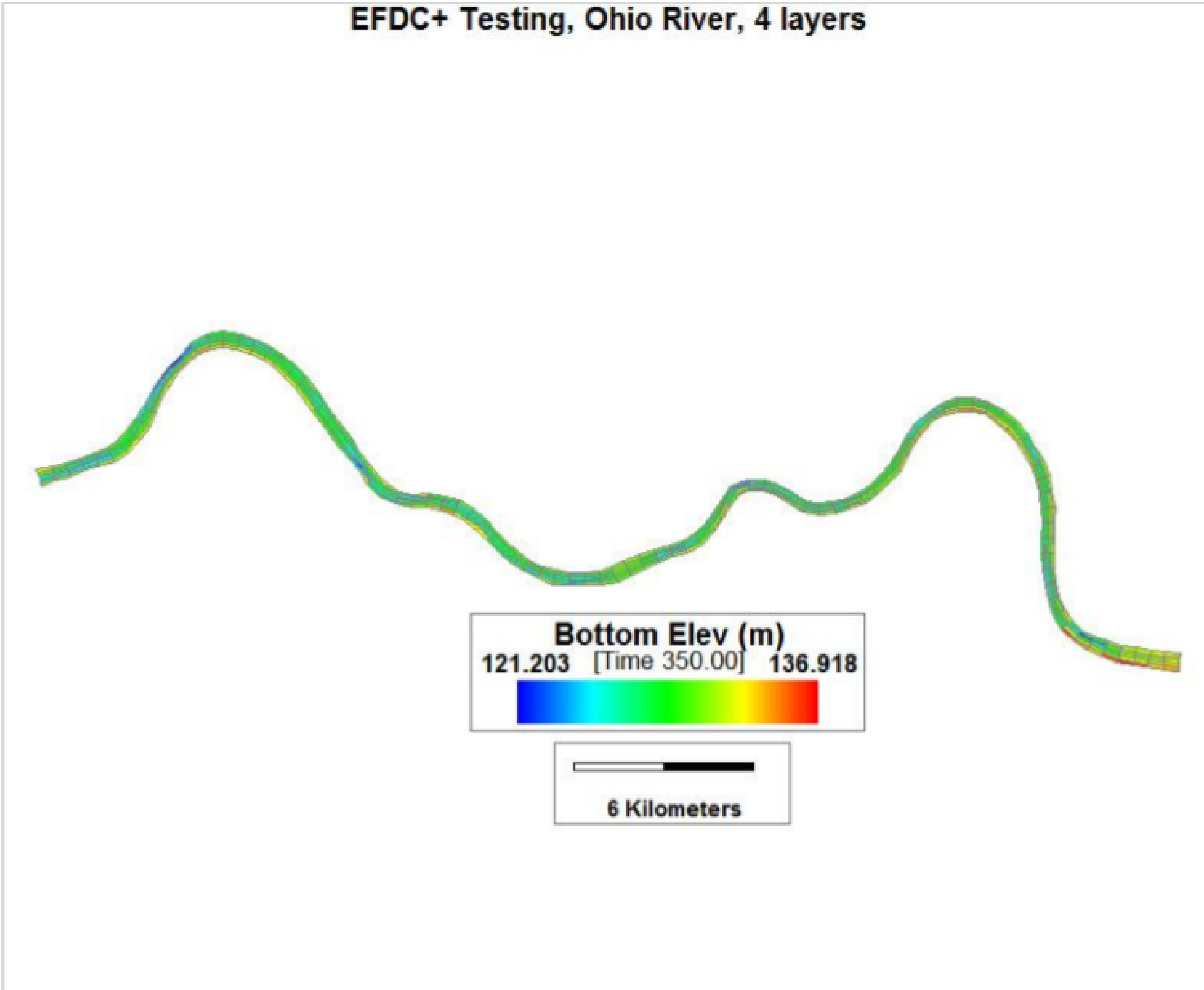
A complete sample model of a lake is provided to highlight the ability of EFDC+ to simulate the hydrodynamics, temperature, and water quality. The model can be found in `SampleModels\Lake_T_HYD_WQ`. In the model there are 355 horizontal grid cells 1 vertical layer.



1.5.2 Ohio River Test Case

A complete model is given which simulates the hydrodynamics in the Ohio River. This model can be found in `SampleModels\Ohio_River_4`. In addition to hydrodynamics, the dye module is used to simulate pulses into the Ohio River from Mill Creek in Cincinnati.

In the model there are 510 horizontal grid cells and 1 and 4 vertical layers. An overview of the grid is provided in the figure below.

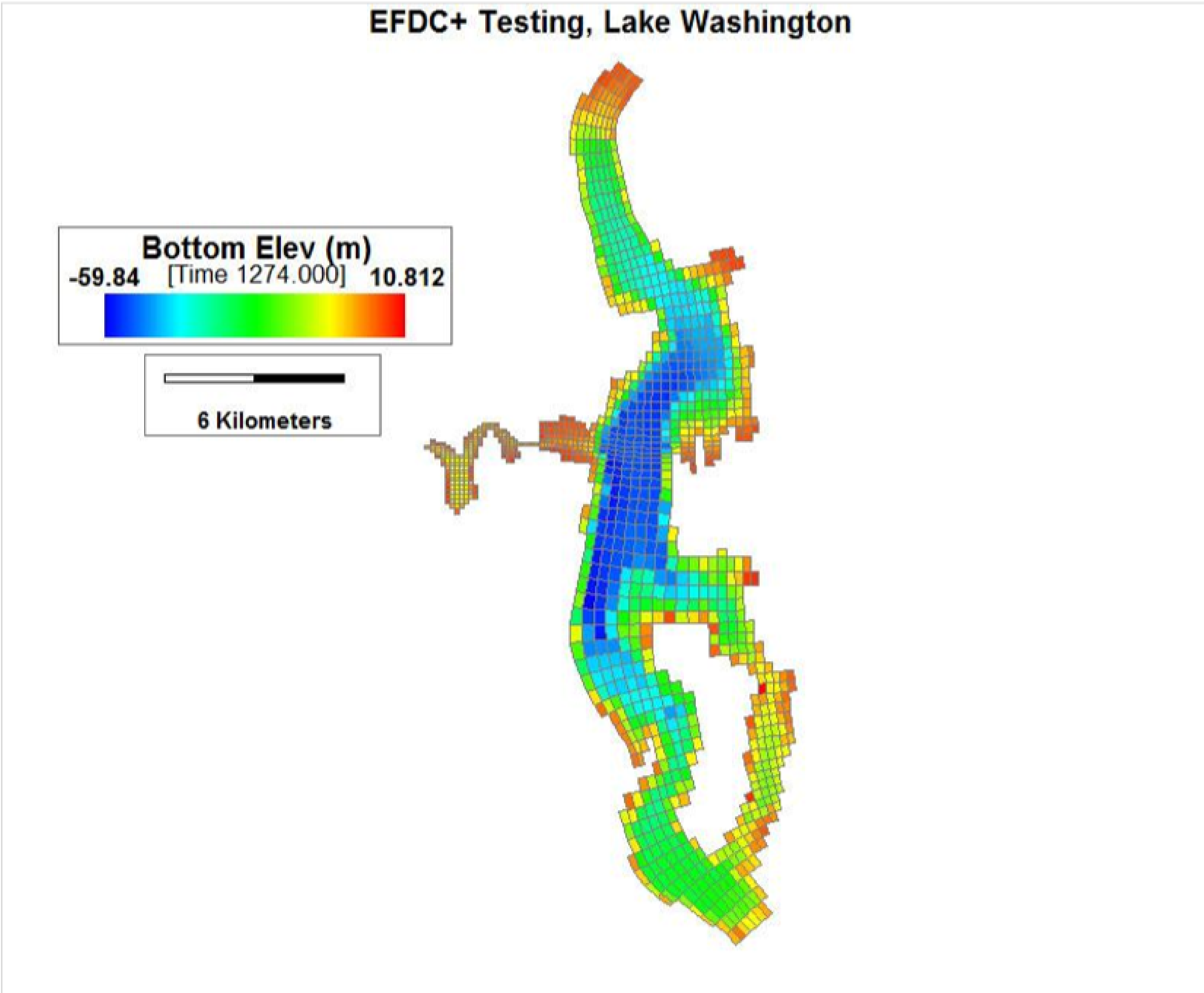


1.5.3 Lake Washington Test Case

A completed sample model of Lake Washington is provided `SampleModels/Lake_Washington`. This model can be run with EFDC+ version 8.5 and the grid can be visualized with the *GridGenerator*.

This model simulates hydrodynamics in Lake Washington. The model uses temperature modules with the Sigma-Zed vertical layering option to simulate thermal stratification in Lake Washington, Seattle, USA. The Sigma Zed model is unique to EFDC+ and is designed to reduce pressure gradient errors with an approach that is computationally efficient.

The model has 1,183 horizontal grid cells and 55 vertical layers. The model domain is shown in the figure below.


EFDC+ Testing, Lake Washington
Bottom Elev (m)
-59.84
[Time 1274.000]
10.812
6 Kilometers

1.6 License