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Management Strategies for Flood Protection in the Lower Illinois River

Phase II: Real-Time Simulation of Flooding with UNET Model

by
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Illinois State Water Survey
Watershed Science Section
Champaign, Illinois

A Division of the Illinois Department of Natural Resources

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Abstract

This report documents the structure and the use of a windows-based interface developed by the Illinois State Water Survey for the Office of Water Resources, Illinois Department of Natural Resources. The current version of the interface program is able to download historic, real-time, and forecasted stage and flow data from the U.S. Geological Survey, U.S. Army Corps of Engineers, and the National Weather Service websites interactively. These data are used to update existing Data Storage System (DSS) database or to create new ones; to run the UNET model for historic, design, real-time, and forecasted flood events in the Lower Illinois River; and to post-process model outputs from DSS files in tabular and graphical formats. This interface program uses the original UNET geometry and boundary condition files to maintain the same level of accuracy as the UNET model. The real-time simulation of a flood event simulates the flood stage profiles using forecasted stage and real-time flow data downloaded from related websites. With the primary focus on simulations of levee failures, the interface program lets the users modify parameters to simulate simple levee failures through the simple spillway approach for two types of complicated embankment failures, overtopping and piping. A new simulation can be performed using the modified levee information. The change of water surface elevation induced by modifying the levees can be compared with another simulation graphically and also in table format. Stage profiles from all the simulations can be plotted together with the levee heights on both sides of the channel along the Lower Illinois River to provide a visual view of the locations of overtopping. Overtopping locations and magnitudes will be tabulated should they occur.

Introduction

Floodplains of the Lower Illinois River from Peoria to Grafton have been claimed for agricultural purposes through the construction of Levee Drainage Districts (LDDs). Construction of LDDs was mostly completed between 1879 and 1916 (Thompson, 1989). Levee heights have been a concern in bottomland areas, and current heights reportedly provide protection at a level of flood magnitude that corresponds to 20- to 50-year return intervals (Singh, 1996; USACOE 1994) for different LDDs.

These levees were built along the main channel and did not meet the floodplain encroachment regulation later specified by the Federal Emergency Management Agency or FEMA (1987). Evidence has shown that levee alignment can affect the flood elevations (Hall, 1991); and therefore the actual level of protection provided by the levee system is doubtful. In addition, observations also indicate a trend of increased flood heights since 1970 (Singh, 1996). These increased flood peaks have further threatened the protection levels for the levees. For example, the stage exceeded the top elevation of levees at Globe, Coal Creek, Lost Creek, and South Beardstown LDDs between Kingston Mines and Meredosia during the 1985 flood; levees at Nutwood, Eldred, Hillview, Hartwell, Spankey, and many non-Corps levees were overtopped/breached during the 1993 flood (USACOE, 1994). Because floods have produced devastating damages and trauma to Society, there is an urgent need to develop management plans and flood protection strategies for the Lower Illinois River.

Since 1995, the Illinois State Water Survey (ISWS) has conducted several projects related to unsteady flow modeling of the Lower Illinois River, as sponsored by the Office of Water Resources, Illinois Department of Natural Resources. Singh (1996) examined stage and flood frequencies and Mississippi backwater effects; Akanbi and Singh (1997) validated the one-dimensional unsteady state flow UNET model for the La Grange and Alton Pools of the Lower Illinois River for large flood events; Akanbi, Lian, and Soong (1999) evaluated managed flood storage options using the Lower Illinois River UNET model constructed by Akanbi and Singh (1997); and Soong and Lian (2001) extended the Lower Illinois River UNET model to include Pool 26 of the Mississippi River and calibrated the model using real flood events. Studies with managed LDD options for flood reduction have shown reduction of peak stages near Meredosia

by more than a foot using a combination of LDDs converted to flood storage areas. If the Lacey, Langellier, W. Matanzas & Kerton Valley, and McGee Creek LDDs were converted to managed storage areas, the additional area protected against the 100-year flood could reach 65,262 acres upstream of River Mile 43.2. Levees downstream of this section will need to be raised by 1 to 3 feet to protect against a 100-year flood because of backwater from the Upper Mississippi River.

After developing models, hydraulic analysis of the modeling results is necessary to synthesize various alternatives for flood management and to develop options for emergency actions. Such alternatives are not only the basis for management practices but also of tremendous value in making decisions during emergency flooding situations. Modeling combined with analysis serves as a decision support tool capable of presenting up-to-date water surface profile and management options on a personal computer. A continuing focus of this project will be to conduct rigorous hydraulic analyses on the existing levee-channel system and to evaluate management and flood protection options for the Lower Illinois River.

The UNET modeling program (Barkau, 1995) is appropriate for the proposed work because it solves the full dynamic wave equation and has adopted many routings for the levee system and other complex channel-floodplain geometries. The new version of HEC-RAS 3.0 (HEC, 2001) has incorporated many UNET model functions, and it is easy for users to visualize and edit geometry data. However, because HEC-RAS 3.0 cannot simulate levee breaching, the UNET model will continue to be used for this study.

A windows-based interface has been developed with the capability for (1) downloading historic, real-time, and forecasted stage and flow data from the U.S. Geological Survey (USGS), U.S. Army Corps of Engineers (USACOE), and National Weather Service (NWS) websites, and saving the data into the DSS database; (2) running the UNET for historic, design, and forecasted flood events with levee raising and breaching options; and (3) visualizing input and output data such as stage and discharge hydrographs and water surface elevation profile along a reach and along the Lower Illinois River. With existing levee profiles plotted, together with the simulated water surface elevation profile, the model will be able to identify the potential location of levee overtopping and the magnitude of overtopping. This report documents the structure of the windows-based interface and instructs users in model use.

Acknowledgments

This study is supported by the Office of Water Resources (OWR), Illinois Department of Natural Resources (IDWR). Mr. Gary Clark and Mr. Robert Dalton, both of OWR, provided information and many helpful suggestions during the project. Mr. Clark also serves as the project manager. Ms. Eva Kingston edited the report, and Ms. Linda Hascall prepared final graphs for the report. Mr. Matt Joost, a freshman from the Department of Electrical and Computer Engineering at the University of Illinois at Urbana-Champaign checked and updated the DSS database for the UNET model. The authors also would like to thank Dr. David D. Soong, U.S. Geological Survey in Urbana, for his advice and comments on the project. Dr. Ben Chie Yen, Department of Civil and Environmental Engineering at the University of Illinois served as the technical adviser.

The views expressed in this report are those of the authors and do not necessarily reflect the views of the sponsor or the Illinois State Water Survey.

Interface Structure

Starting the Program

After a successful installation of the Windows-based interface program (Appendix A), the real-time icon will appear in the startup program menu. Click on ***Real-Time*** to start the program. Figure 1 shows the startup screen. Click on ***Continue*** to use the program or ***Exit*** to quit the program.

Open Files

After choose ***Continue***, the default working directory will open within the main window. All input and output files are located in this directory. If you make any changes, click the ***Update and Exit*** button to update the working directory and change the file locations. Make sure that the directory is set appropriately before attempting any further operations. To view or change the input and output files, click the ***Browse*** buttons. The **Project Files** selection screen (Figure 2) will appear and show the default file selections. Files are saved in a relational database. The screen will show the default working directory, input DSS database for the UNET model, input cross-sectional file, and boundary file. Also shown is the output DSS database from

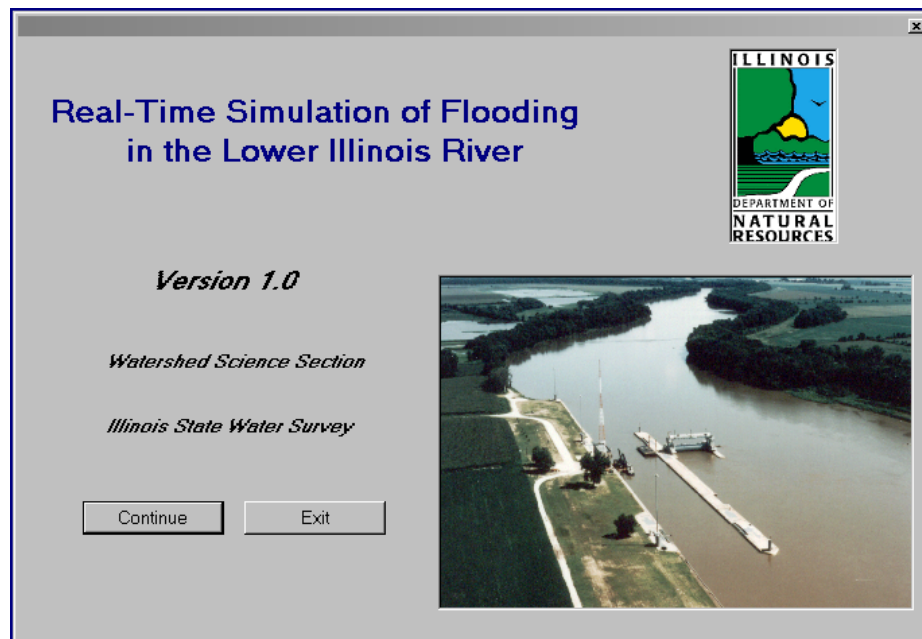


Figure 1. Opening screen of the Windows-based interface

UNET model simulation, output cross-sectional file, and boundary file for debugging. Use the browser to change the working directory or to select other existing files. Input files have to pre-exist in the working directory. Output files can be new. Browse buttons are provided to help you locate files if you do not know the name or path. All the files must be located in the same working directory.

Click on **Update and Exit** to save the path of the working directory and files to be used, and to close this window.

Downloading Data

Historic, real-time, and forecasted stage and discharge data can be downloaded from several websites. These data can be used to update an existing DSS database (for example, the one developed for historic data of stage and discharge gaging stations on the Lower Illinois River and its tributaries and Pool 26 of the Mississippi River and its tributaries) or to create a new DSS database.

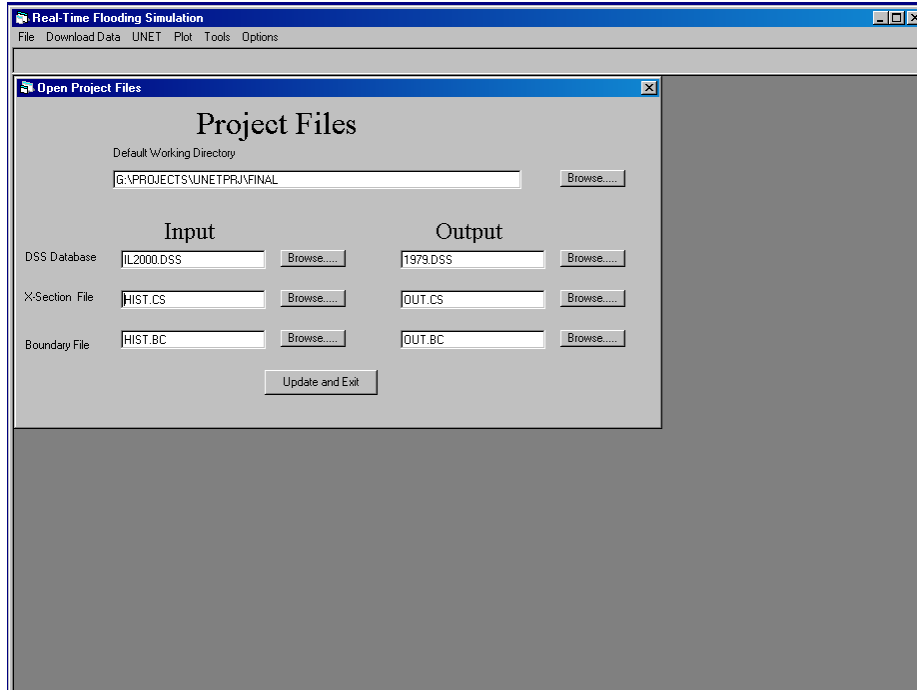


Figure 2. Window for project file selection

Downloading Historic Data

The window shown in Figure 3 was set up to download the stage and discharge from USGS and USACOE websites. Most USGS gaging stations measure discharges whereas most USACOE stations are for stages. **Note:** historic data for the USACOE St. Louis District are not available online.

Select ***Download Data***, and then ***Historic Data*** in the main window as indicated in Figure 3. A sub-window (Figure 3) will appear with a list of gaging stations (Appendix B). Use the ***Select All*** button or manually select one or more stations in the list (move the scroll bar to see more stations). The default end date is the current date, and the start date is three days earlier. You can change both the start date and end date for downloading. (**Note:** USGS historic data are recorded for the water year). In most cases, data for active stations only date back to the previous September.

After stations have been selected and dates are set, click on ***Get File*** to start downloading. A progress bar will appear, and the panel at the bottom of the window will show the gaging station for which data are being downloaded. Error messages will appear in the fourth box of that panel if data are not available. The error also will be written to a warning file that can be viewed in Notepad or through the ***View Errors*** button that will appear if errors are present.

The downloaded data are saved in an ASCII file that can be used to update or create a new DSS database. **Note:** You must enter the name of the DSS file before choosing ***Get File***. The DSS file named on the screen will be written to the update file. You can name a new DSS database so the program creates a new DSS database from the downloaded data or update a database if the file already exists. Close the window after completing all tasks.

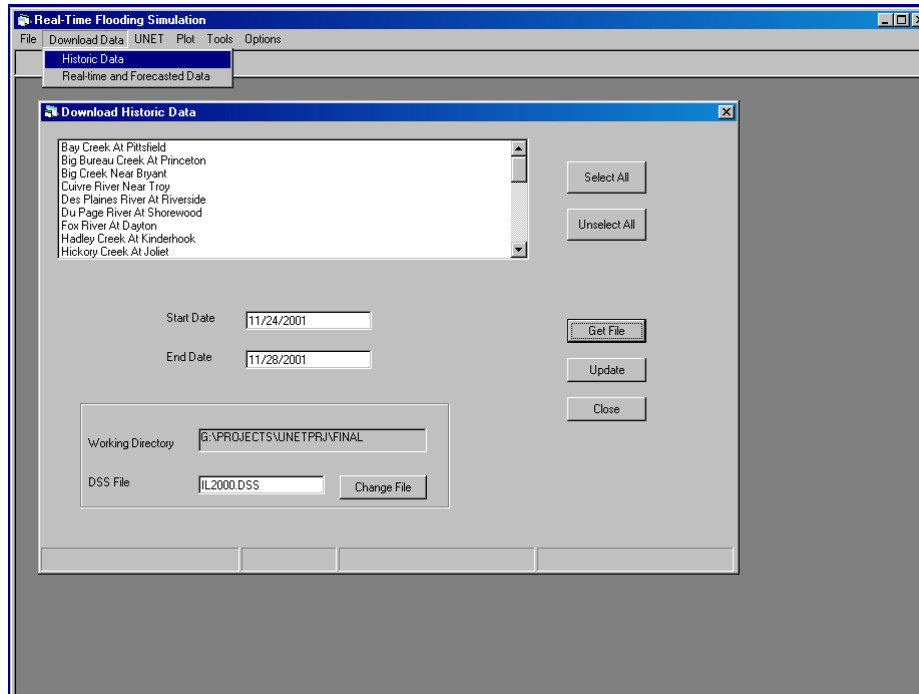


Figure 3. Historic data download

Downloading Real-time and Forecasted Stage or Discharge Data

The second option for data downloading is the real-time or the forecasted data (Figure 4). Most functions are the same as in the historic data download window (Figure 3), but the user can select locations and dates to download (Appendix C). By choosing check boxes, a list of stations will show in the window. These stations will change depending on the location selected. Stations are listed only if data are known to be available from that location for that station. You can then select all stations with the ***Select All*** button or manually select or unselect a particular station. It is recommended that you save real-time and forecasted data to a new DSS database file that will be used for real-time simulation of forecasted floods. **Note:** Discharges from some tributaries are extrapolated for five more days by assuming the discharges remain the same as those for the current day.

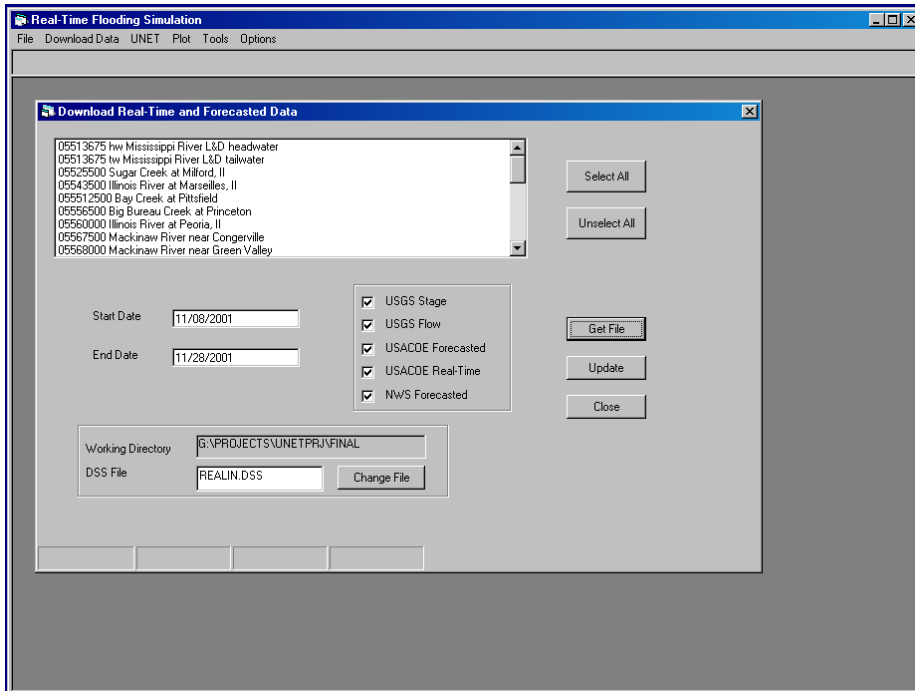


Figure 4. Site selection for real-time data download

Modeling with UNET

This program was designed to simulate historic, design, and real-time flood events. The simulations can be performed with existing LDD conditions or with modified LDD conditions for management purposes or scenario studies. The interface is designed to execute the generic UNET program without any change to the structure and the functionalities of the UNET model. Thus the results preserve credibility and accuracy of the UNET model.

Levee Options

The UNET model can simulate levee breaching by two procedures, simple failure and embankment failure. The simple failure procedure applies to the simple spillway concept in which the available storage area receives the flow from the channel by a linear routing factor. Embankment failure simulates failure by overtopping or by piping.

Simple Levee Failure

The simple embankment failure in the UNET model is simulated by a simple spillway similar to the illustration in Figure 5. A levee is viewed as an offline area. Initially, the storage is dry. Flow starts to fill the levee storage when the river stage exceeds a preset elevation at the breach. The rate of flow, $Q(t)$, into the storage area at a specified time t is determined by the total available storage and a simple routing factor with the unit of time^{-1} (hour^{-1}) as follows:

$$Q(t) = k\Delta V(t)$$

where ΔV is the levee storage available to be filled and k is a linear routing factor. The current UNET model allows up to 12 incremental volumes of levee storage.

If the river stage still overtops the embankment after levee storage is full, then the overflow is distributed along the length of the embankment and the breach is ignored. When the river stage drops below the embankment, the flow in the levee storage will drain back into the river. A modeler needs to determine the routing factor k through experience or calibration with

observed stage data when available. Note that simple levee failure does not assume any failure of the embankment, and the breach on the levee is preset by the modeler.

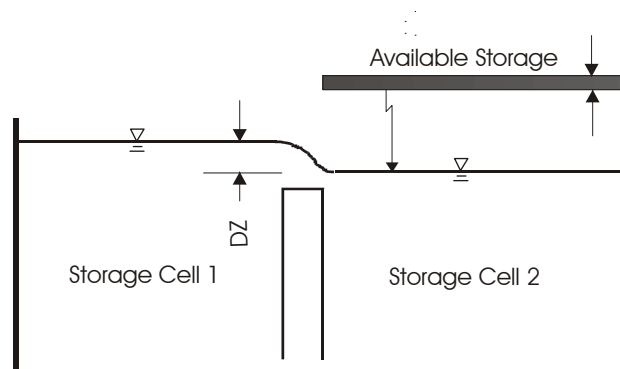


Figure 5. Schematic of levee breach through simple spillway

Embankment Failure

The UNET model simulates two types of embankment failures, overtopping and piping. It does not simulate the erosion of the breaching for both failures. It is assumed that the final shape of breaching is trapezoidal with side slope of 1:1 (Figure 6).

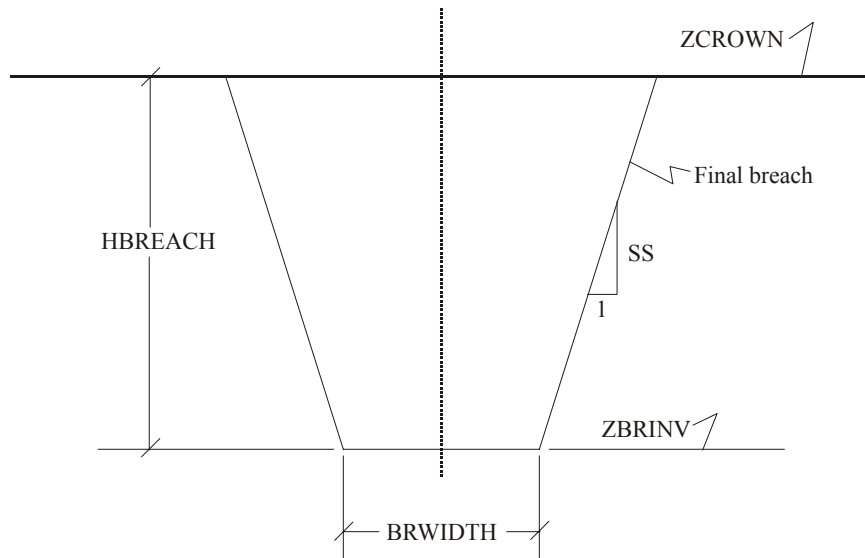


Figure 6. Schematic of a trapezoidal breach by overtopping

Embankment Failure with Overtopping

Overtopping failure of an embankment begins when the water level in the channel exceeds a specified water surface elevation. The elevation at which the embankment fails is ZFAIL. If ZFAIL is higher than the top of an embankment, flow overtopping the embankment is simulated by a weir without embankment failure. Breaching starts from the top of the embankment and increases linearly in width and depth until a defined final width and depth are reached (Figure 6).

The parameters for embankment failure are entered in the UNET model by an EF card. It defines the overtopping breach by setting the starting elevation of the pipe through the embankment, ZBREACH, as zero or blank.

Embankment Failure with Piping

Piping failure assumes greater seepage through the embankment into a conduit (Figure 7) that will consume the embankment and form a trapezoidal breach (USACOE, 1997). Piping failure starts when water levels exceed the elevation ZFAIL. If ZFAIL is higher than the top of embankment, ZCROWN, and the water level is higher than ZCROWN but below ZFAIL, overtopping is assumed and the weir simulates the flow.

For piping failure, the pipe cross section is assumed to be a hexagon. The cross-sectional area starts from zero when failure begins at a defined elevation, ZBREACH. The breach enlarges around the axis of the centroid to its final trapezoidal shape during an assumed time period, DTFAIL (hour). Some test runs are recommended to choose a proper DTFAIL value. Side slopes remain constant. The breach stops when it reaches the final breaching width, BRWIDTH, and invert elevation, ZBRINV, as shown in Figure 8.

With the computational mechanism being explained, you can change the variable values in the window and save the modified information for UNET simulation. See Figure 9 for the simple levee failure option and Figure 10 for the complicated levee failure option for each LDD.

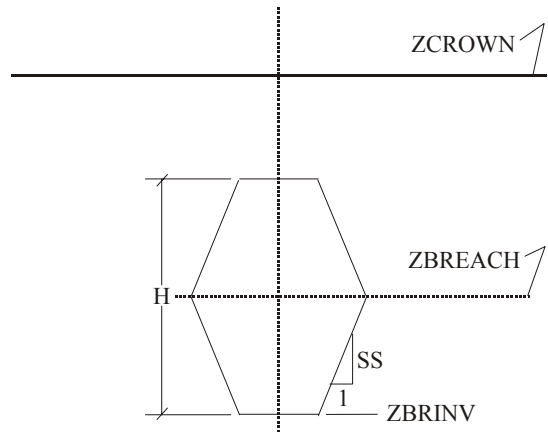


Figure 7. Schematic of a hexagonal breach by piping

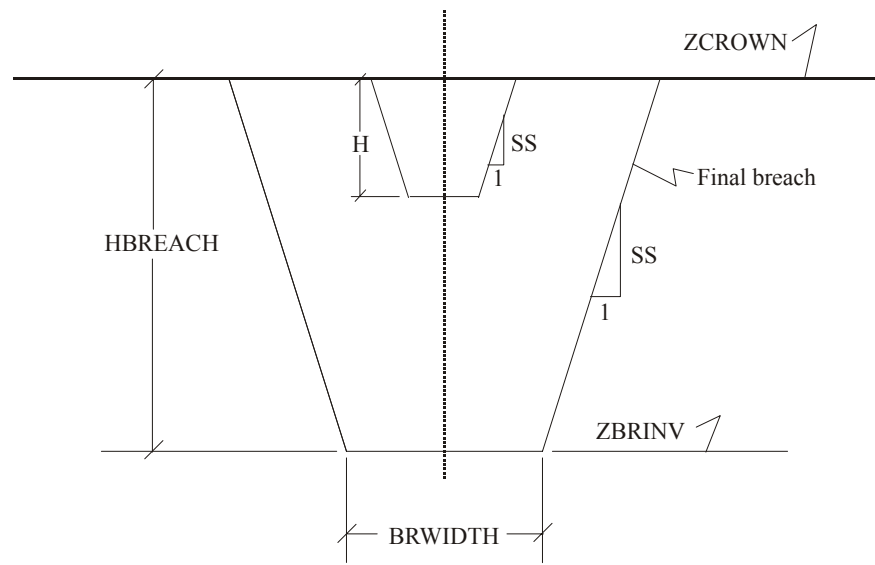


Figure 8. Final trapezoidal breach through the top of the embankment

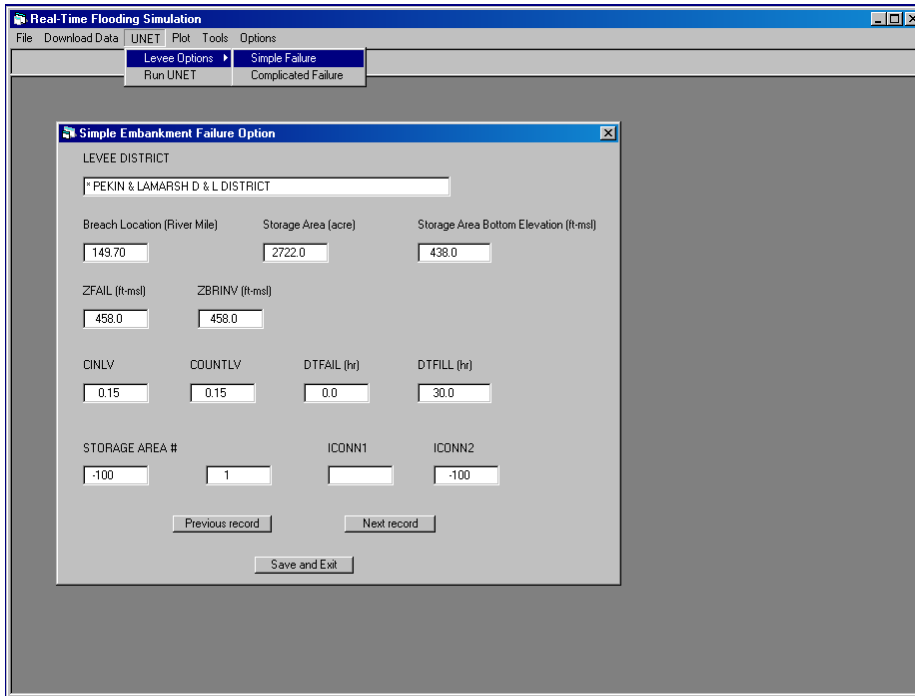


Figure 9. Simple levee failure option

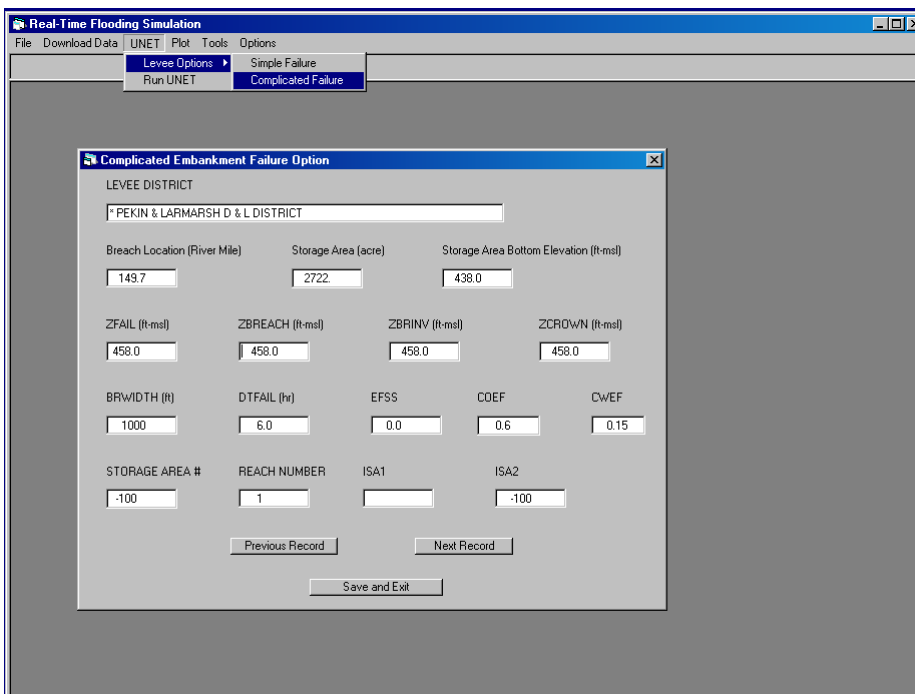


Figure 10. Complicated levee failure option

The default levee system information displayed in Figures 9 and 10 is for existing conditions without any modifications of the levees. Each window shows the name of the LDD, river mile, storage area in acres, and the bottom elevation of the LDD in feet above mean sea level. Do not change any of these parameters unless you have modified the geometry of the LDD. The “ZFAIL” selection allows simulation of the raising or lowering of the levee crown elevation. Levee breaching stops at the invert elevation. The time required for the LDD to fill (the total storage of the LDD is filled with flow from the channel by levee breaching) can be changed to any reasonable value. You can modify other LDDs by clicking *Next Record* or *Previous Record*. Click on *Save and Exit* to save the file containing the LDD information for use in the UNET model later.

Flood Event Options

This program is designed to simulate historic flood events, real-time or forecasted flood events, and design floods.

Figure 11 is the schematic of the UNET model for simulations of historic events and design floods. The model contains three reaches on the Lower Illinois River and four reaches on Pool 26 of the Mississippi River:

- Reach 1: segment from the tail of Peoria Lock and Dam to the upstream of the confluence of the Sangamon River and the Illinois River.
- Reach 2: portion of the Sangamon River from Oakford to its mouth at the Illinois River.
- Reach 3: segment on the Illinois River from the downstream of the confluence of the Sangamon River and the Illinois River to the mouth of the Illinois River at Grafton.
- Reach 4: segment from the tail of Lock and Dam 25 to the junction of the Cuivre River and the Mississippi River.
- Reach 5: portion of the Cuivre River from Troy to the confluence of the Cuivre River and the Mississippi River.

- Reach 6: portion from the downstream of the junction of the Cuivre River and the Mississippi River to the upstream of the junction of the Illinois River and the Mississippi River.
- Reach 7: portion from the downstream of the confluence of the Illinois River and the Mississippi River at Grafton to Pool 26 at the Melvin Price Lock and Dam.

Due to limited geometry data, other tributaries of the Illinois River are treated as lateral point flow.

A three-reach UNET model as shown in Figure 12 was used to simulate a design flood in the 1998 project. It was also used for the real-time and forecasted flood event simulations.

- Reach 1: segment from the tail of Peoria Lock and Dam to the upstream of the confluence of the Sangamon River and the Illinois River.
- Reach 2: portion of the Sangamon River from Oakford to its mouth at the Illinois River.
- Reach 3: segment on the Illinois River from the downstream confluence of the Sangamon River and the Illinois River to the mouth of the Illinois River at Grafton.

The tributaries are simulated as lateral inflows, and the near river watersheds are considered as uniform lateral inflow sources.

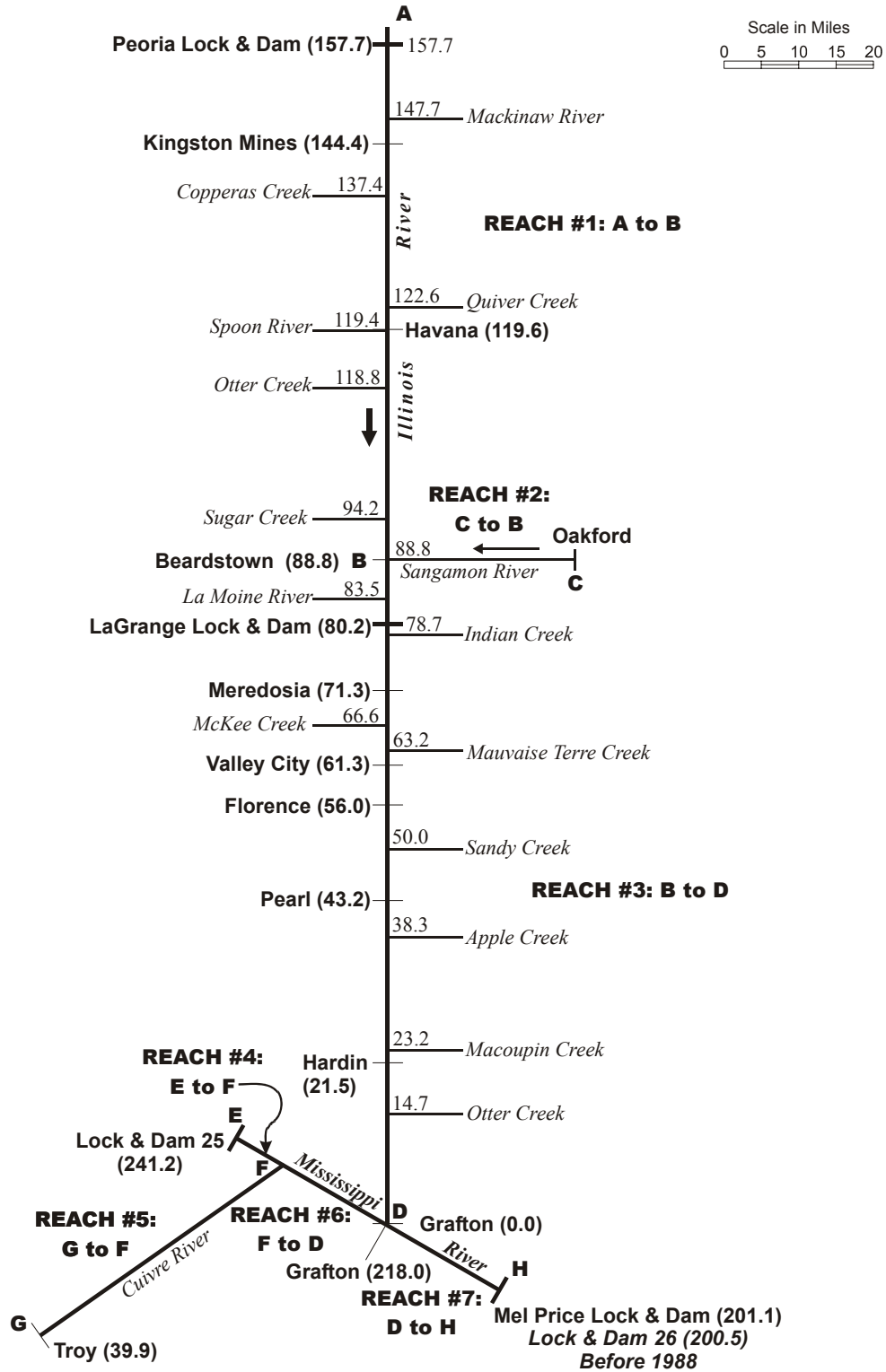


Figure 11. Schematic of the Lower Illinois River - Pool 26 of the Mississippi River UNET model (river miles)

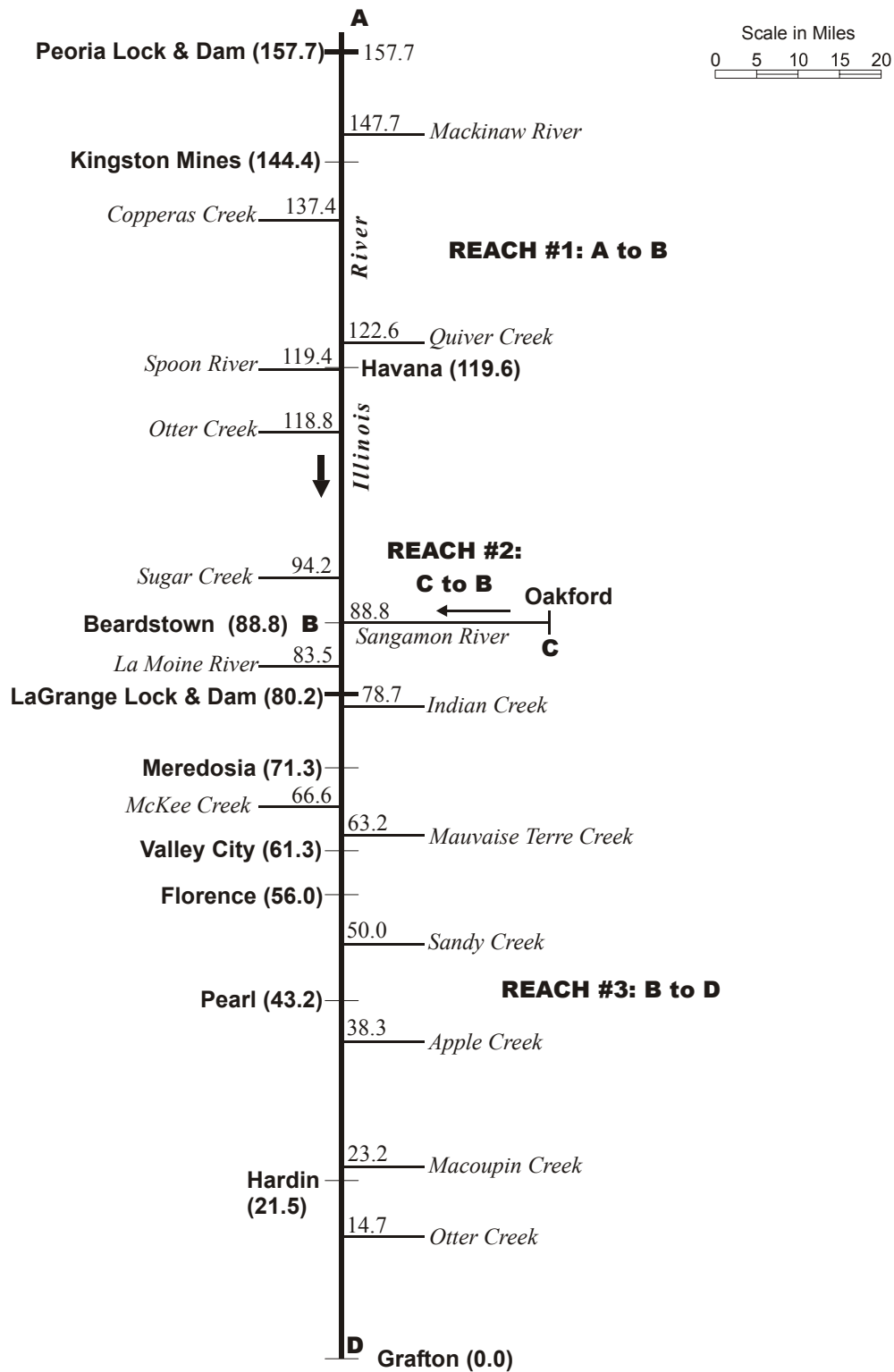


Figure 12. Schematic of the Lower Illinois River UNET model (river miles)

Simulation of Historic Flood Events

Historic flood events are simulated with the extended Lower Illinois River UNET model that includes Pool 26 of the Mississippi River. To run the program, select **UNET** in the main window then **Run UNET** in the pulldown menu as indicated in Figure 13. If you choose “*Historic Flood Events*,” the input and output cross-sectional files and boundary condition files will appear in four text boxes. Click on **Save Information**. Files listed will be used to create a batch file to execute the UNET program. Click on **Run UNET**. After the simulation is completed, click on **Exit** to leave this window. You can also execute the UNET program with the existing geometry and boundary condition files by entering file names into the appropriate boxes and then following the steps in this section.

You also may modify the parameters in the boundary file for the UNET model. While in the window shown in Figure 13, click the “*Modify Boundary Conditions*” choice, and a separate window (Figure 14) will come up. *Time Interval* and *Theta* are allowed to change for numerical stability of the model. A smaller time interval and greater theta value achieve better stability, but a larger time interval, which means less time steps, will take less time to simulate. A theta of

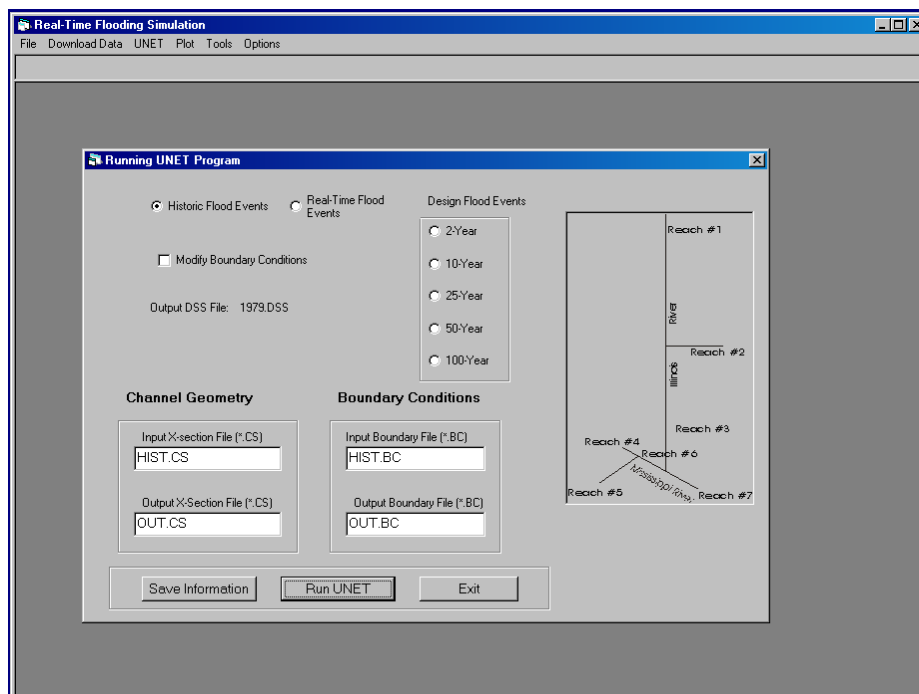


Figure 13. Executing the UNET program

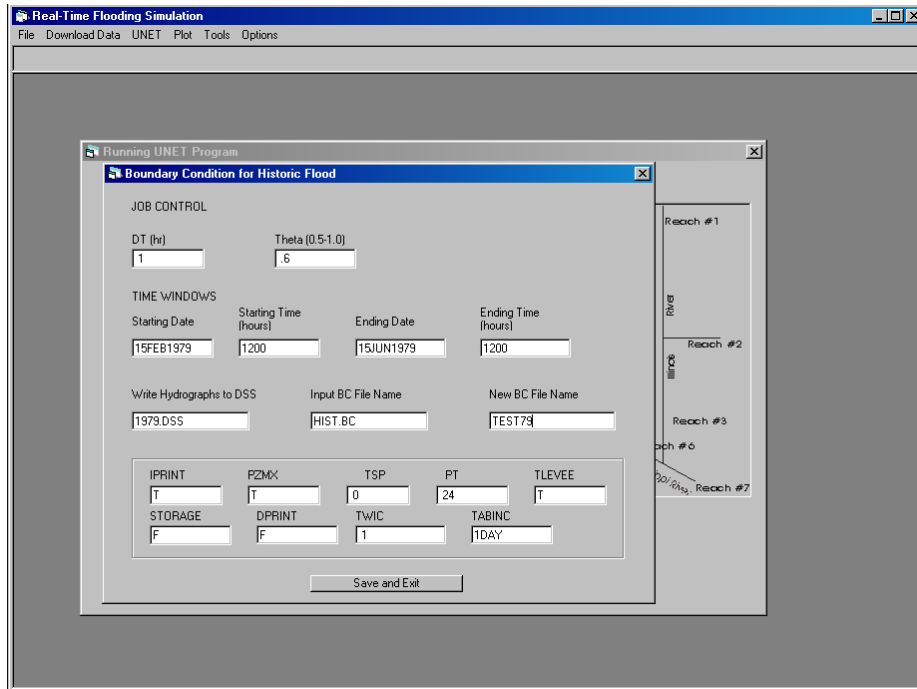


Figure 14. Modifying boundary conditions

about 0.6 to 0.7 is suggested for better accuracy. You also can change the starting and ending times within the window for the selected simulation period of interest. The input boundary condition (BC) file and a default output DSS file will show in the text boxes; however, you can change the output DSS file name and save the boundary condition file under a new name. After all modifications are completed, click on ***Save and Exit*** to close the window.

Simulation of Real-time Flood Events

The real-time simulation of floods is based on the three-reach UNET model. Figure 15 and Figure 16 display the windows for UNET program execution and modification of the boundary condition file. A simplified schematic of the reach is displayed on the right side of window (Figure 15). You can modify the boundary condition parameter for real-time flood simulation as shown in Figure 16.

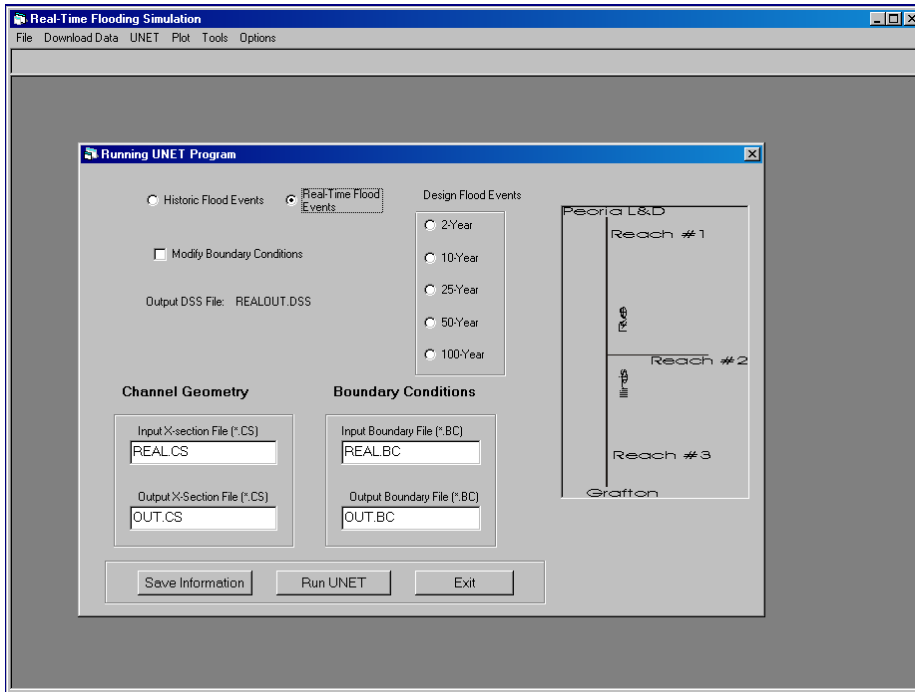


Figure 15. Choosing real-time flood events

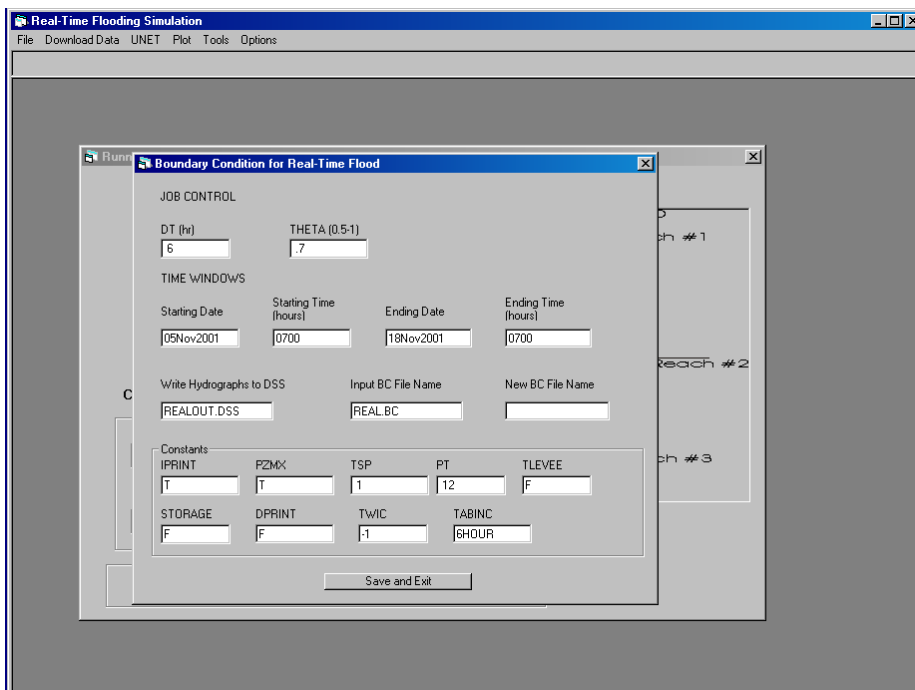


Figure 16. Setup for the real-time boundary file

Simulation of Design Floods

The UNET program can simulate design floods for 2-, 10-, 25-, 50-, and 100-year periods. The current simulation uses a three-reach UNET model. A seven-reach UNET model will be added in the future. Figure 17 shows a 50-year design flood. Some of the parameters in the boundary condition file can be changed, as shown in Figure 18.

It is suggested that users change only the job control parameters and the output DSS and boundary condition file. Because input design hydrographs are 20-day duration floods, starting and ending times should not be changed.

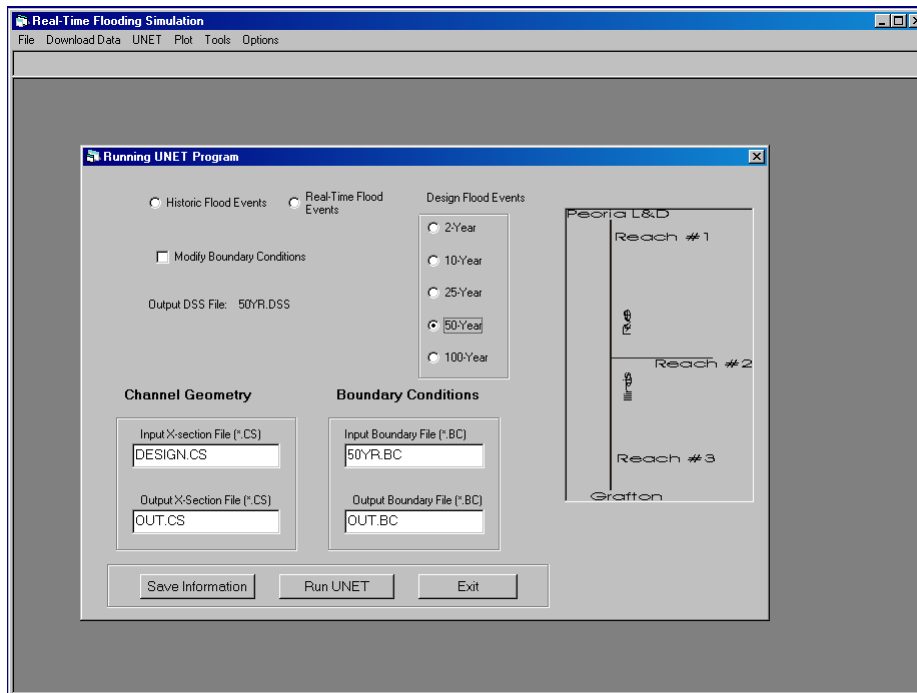


Figure 17. Selecting a 50-year design flood

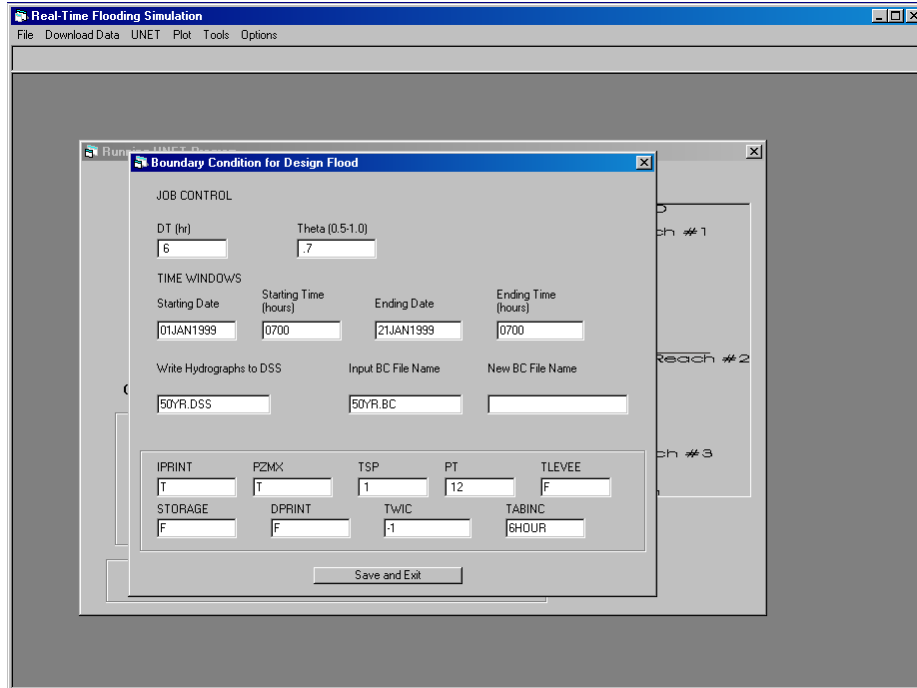


Figure 18. Boundary setup for a design flood

Plotting Hydrographs and Stage Profiles

The program can display stage and discharge hydrographs, as well as the simulated stage profiles in the input and output DSS databases.

Stage Profiles

If you choose to plot data, the screen shown in Figure 19 will appear. Use the browser button to select the DSS file to be plotted. An open window (Figure 20) will appear, and you can choose the file to use or enter the file name if you know it.

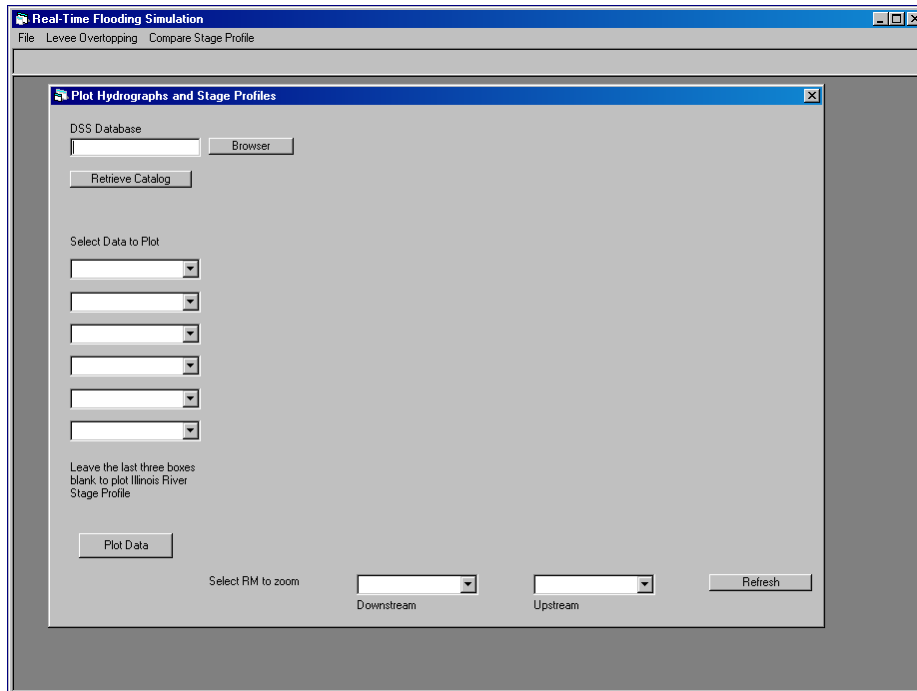


Figure 19. Plotting data

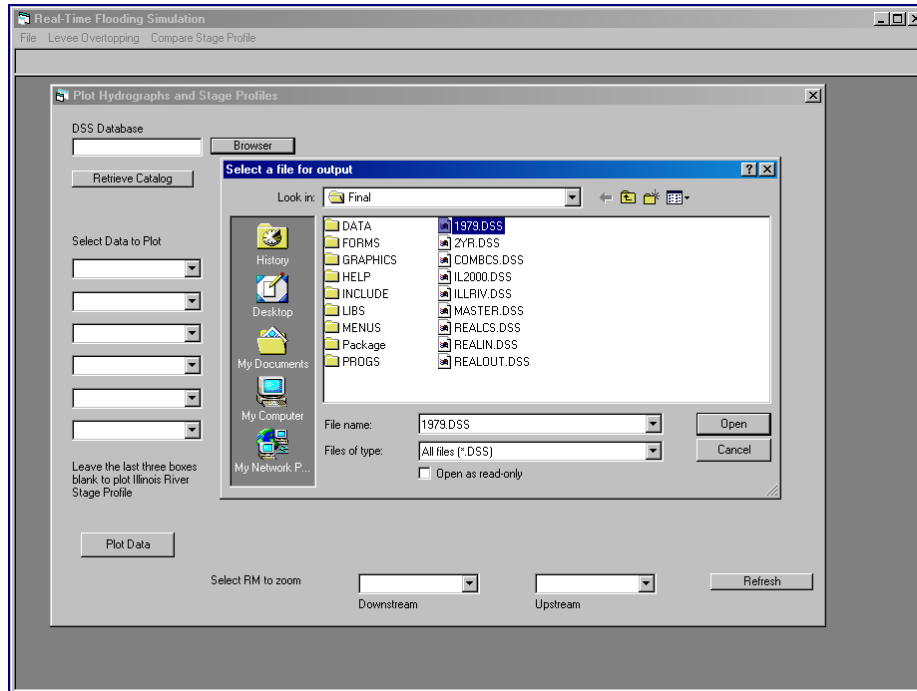


Figure 20. Selecting DSS file to plot

Click **Retrieve Catalog** to load the paths given in the DSS database. The paths will appear in the pulldown menus on the left side of the active window. The pathname used in the HEC-DSS database consists of up to 80 characters in six parts referenced by A, B, C, D, E, and F, respectively. All parts are delimited by a slash “/”. For example, a typical pathname in the input DSS database for the Lower Illinois River UNET model is: /ILLINOIS RIVER/LA GRANGE POOL/STAGE/01JAN1979/1DAY/OBS/

where:

A=ILLINOIS RIVER, river basin or project name

B=LA GRANGE POOL, location or gage identifier

C=STAGE, data variable

D=01JAN1979, starting date for block of data

E=1DAY, time interval

F=OBS, a user-defined description to further define the data

The program lists only the first four significant parts to form a pathname for retrieving data from the DSS database. To plot the maximum water surface elevation profile from Peoria to Grafton, select **ILLINOIS RIVER** in the first pulldown menu, **MAX W S** in the second menu, **LOCATION-ELEV** in the third menu, and leave the fourth menu blank. Click on **Plot Data**, and the water surface elevation profile is plotted together with levee elevations on both sides of the river. One small window (Figure 21) will pop up and allow you to select **Save** or **Don't Save** the maximum water surface elevation data. It is suggested that you save the file for comparison with other simulations. Click on the **Levee Overtopping** menu as shown in figure 19. Locations and magnitudes of levee overtopping will be displayed in a table format as in Figure 22.

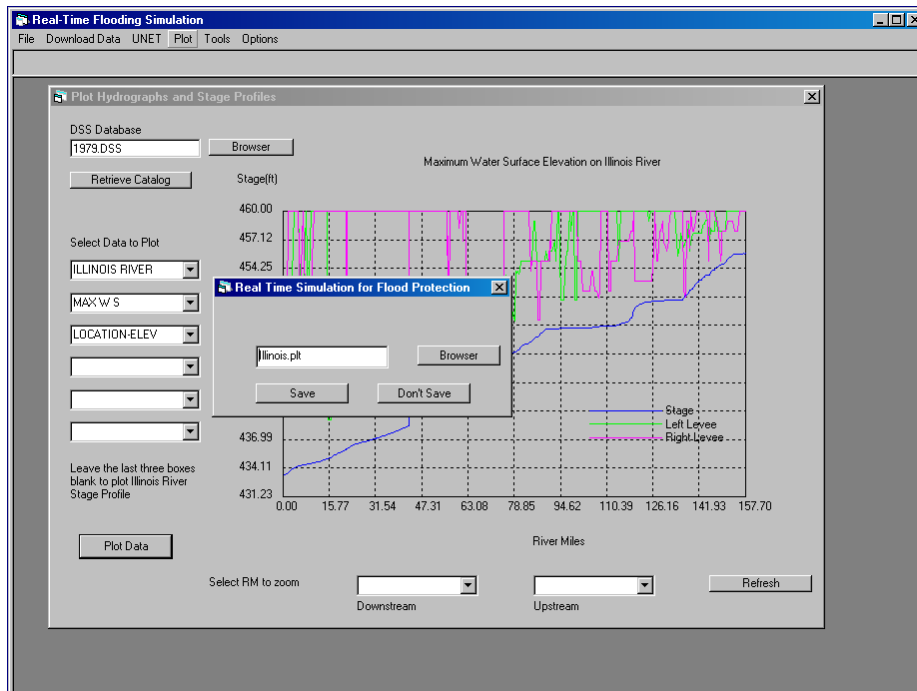


Figure 21. Saving the plotting file

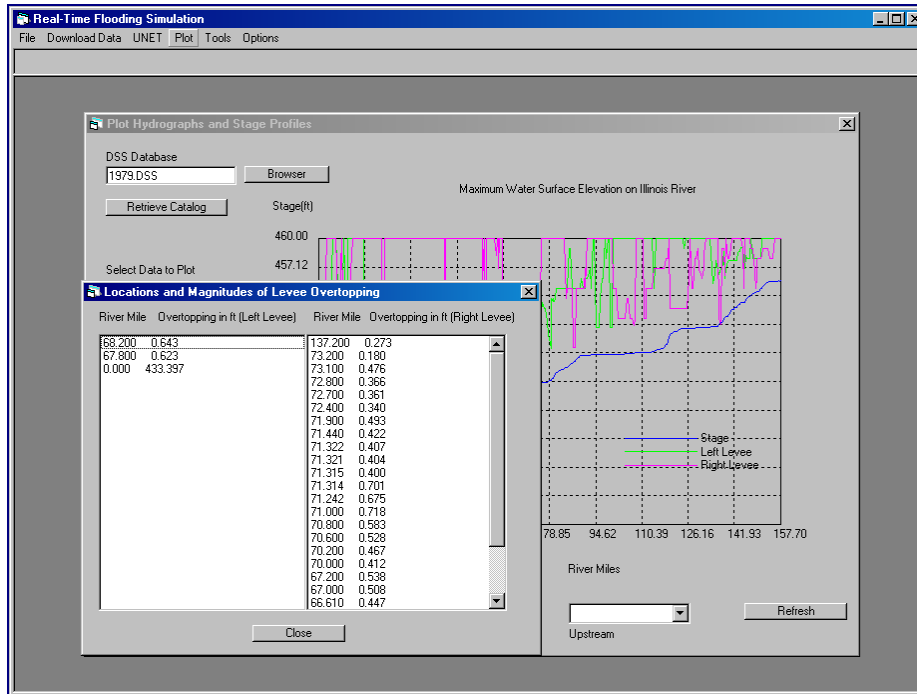


Figure 22. Displaying levee overtopping information

To have a larger view of the stage profile, use the two pulldown menus at the bottom of the plot to select the downstream and upstream river mile as in Figure 23; make sure that the upstream river mile is greater than the downstream river mile. Click on the **Refresh** button to have an enlarged view as shown in Figure 24.

Figure 25 compares two simulated stage profiles from Peoria to Grafton. This option can be used to see stage reduction/increase with managed LDD options. Use the browser to select data files for two chosen profiles, for example, “Illinois79-1” and “Illinois79-2”, as indicated in Figure 26.

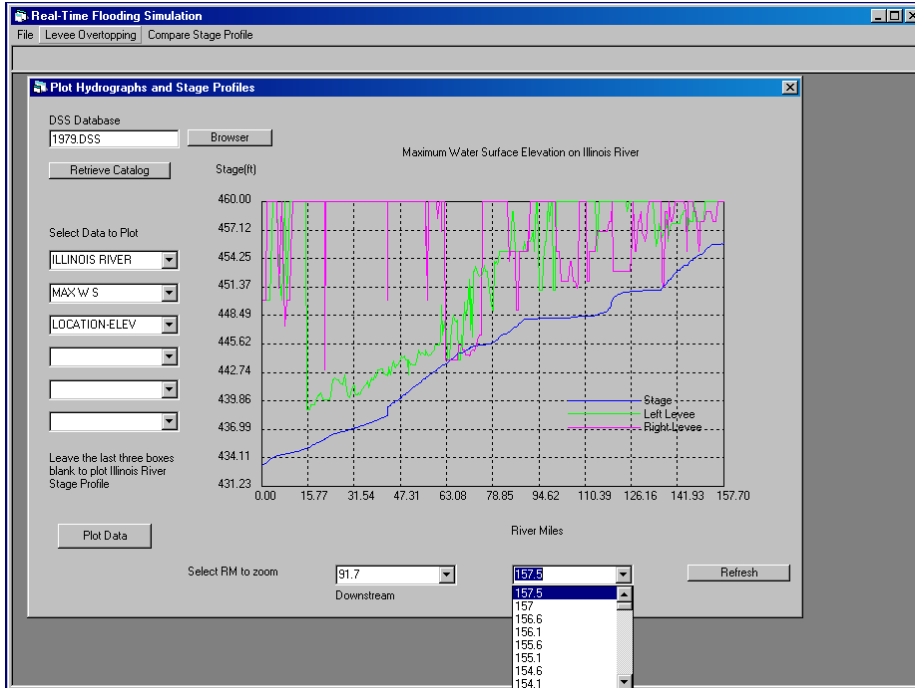


Figure 23. Selecting a section of plot to enlarge

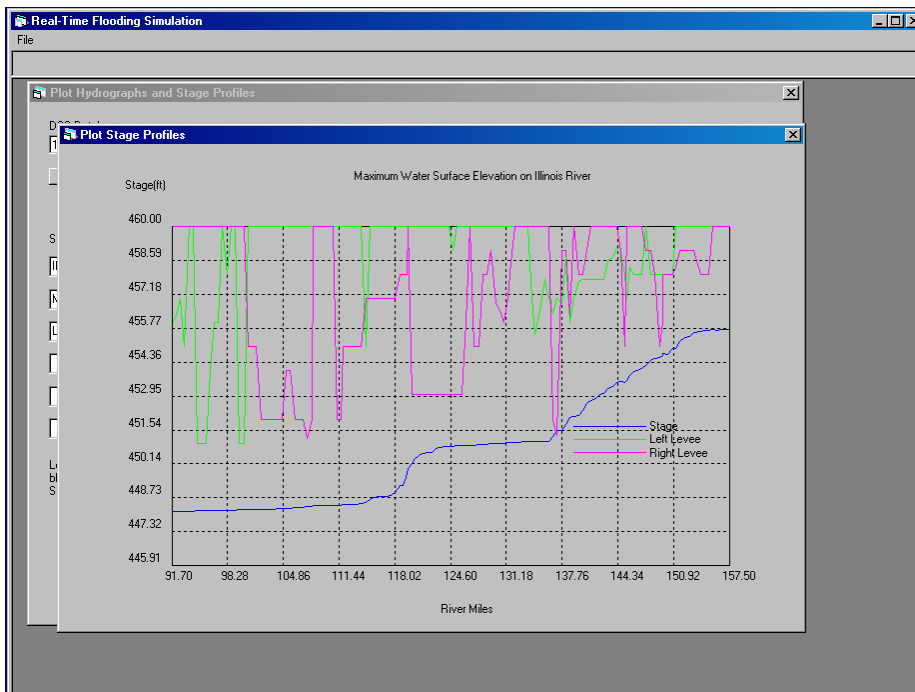


Figure 24. An enlarged plot section

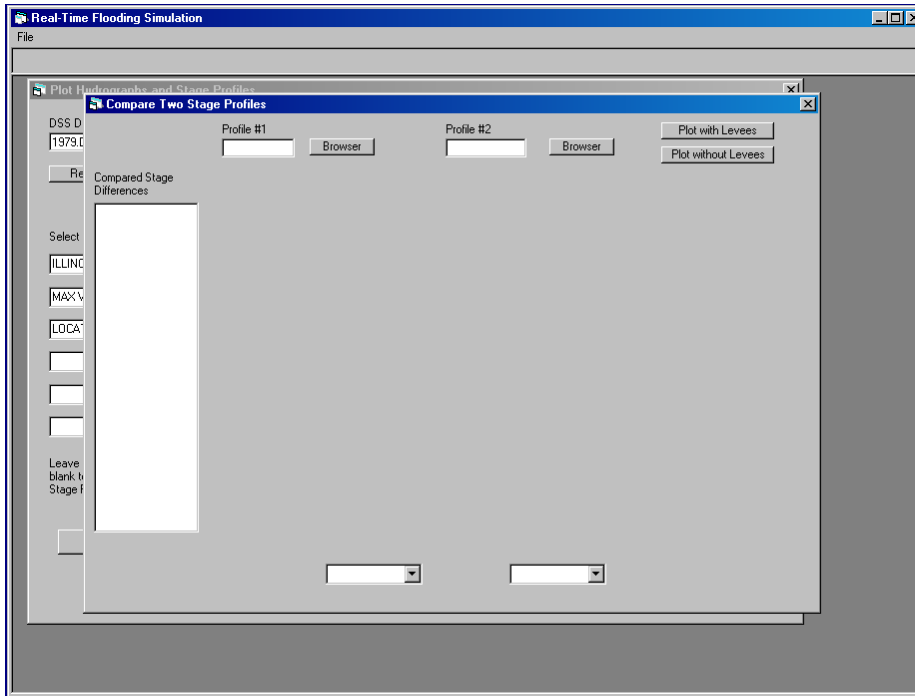


Figure 25. Comparing two profiles

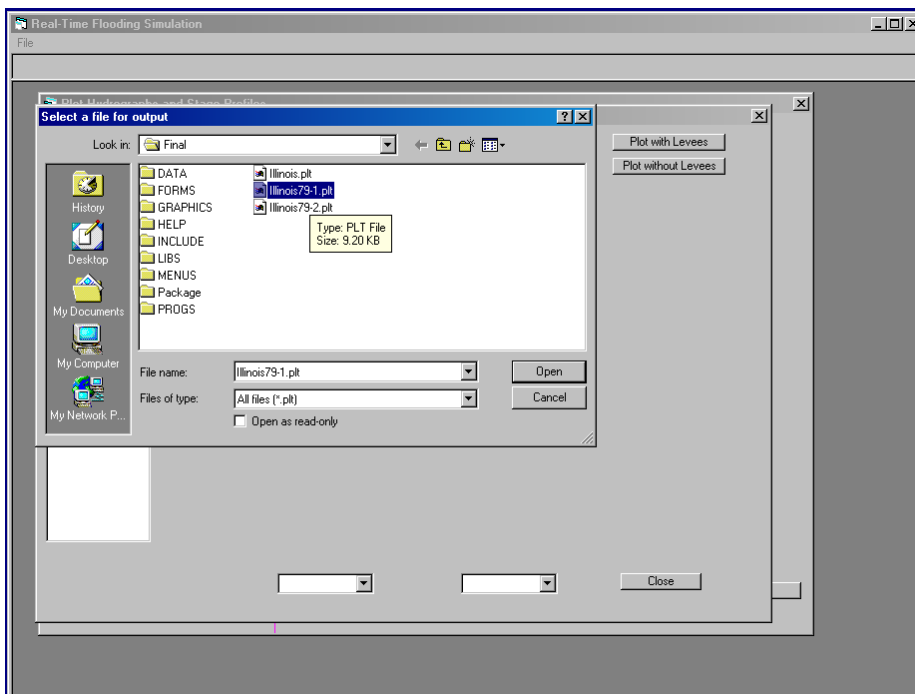


Figure 26. Selecting a plotting file

Click **Plot with Levees** to plot both profiles together with the levees (Figure 27). The difference between profile one and two are listed to the left of the plot. At the bottom of the plot two pulldown menus allow you to select the river miles in order to replot the profiles for an enlarged view (Figure 28).

You have the option to plot the profiles without levees (Figure 29) and to use the zoom feature (Figure 30).

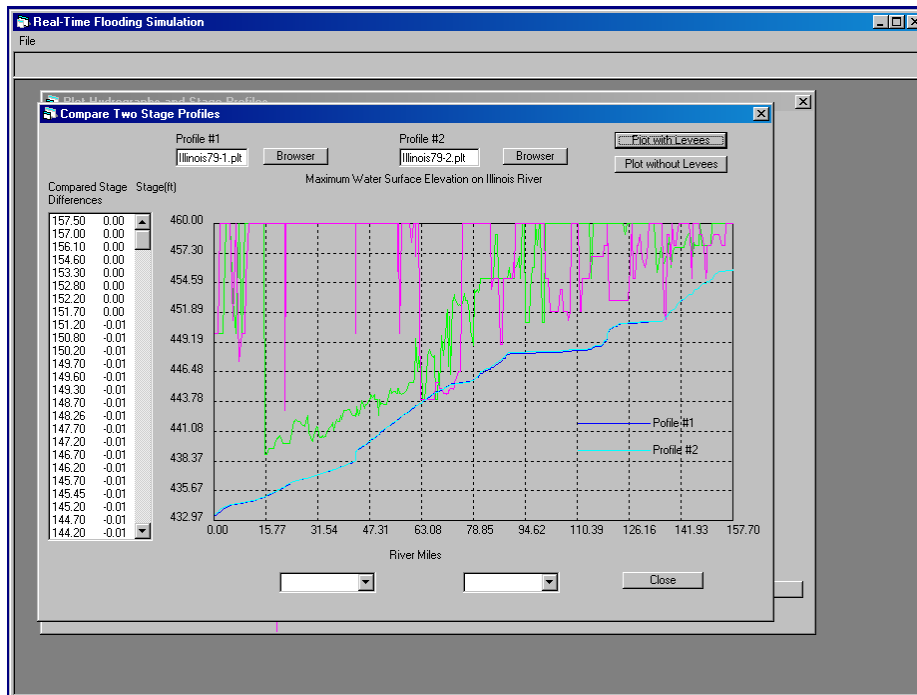


Figure 27. Comparing two stage profiles (with levees)

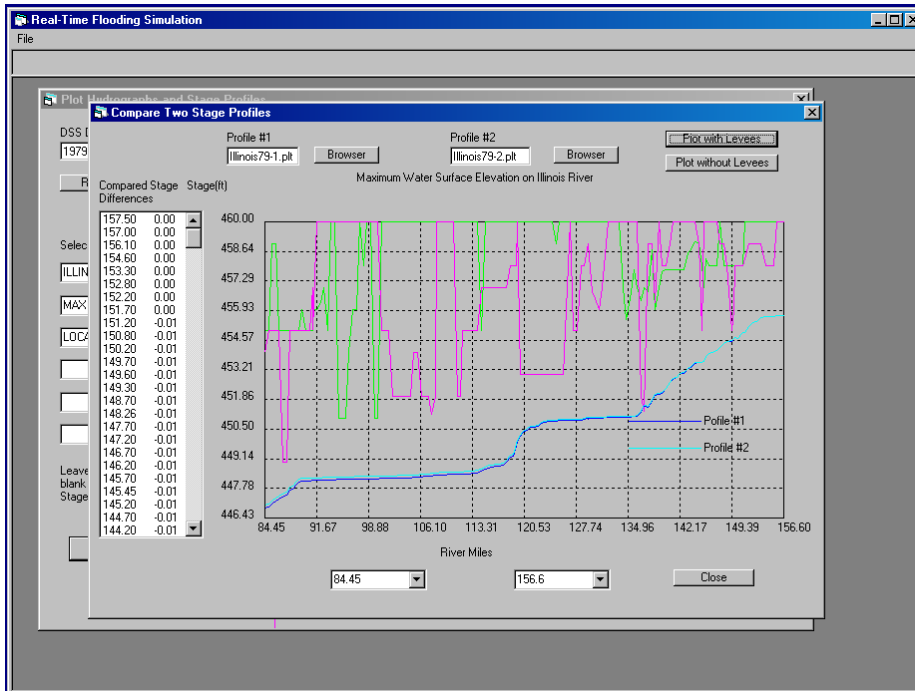


Figure 28. Comparing enlarged view of two stage profiles (with levees)

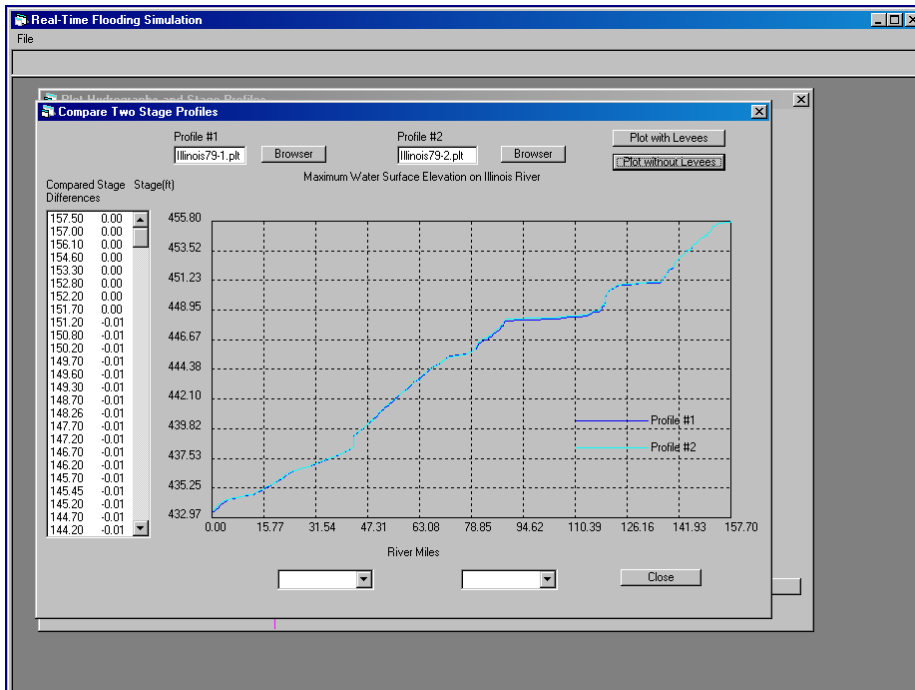


Figure 29. Comparing two stage profiles (without levee)

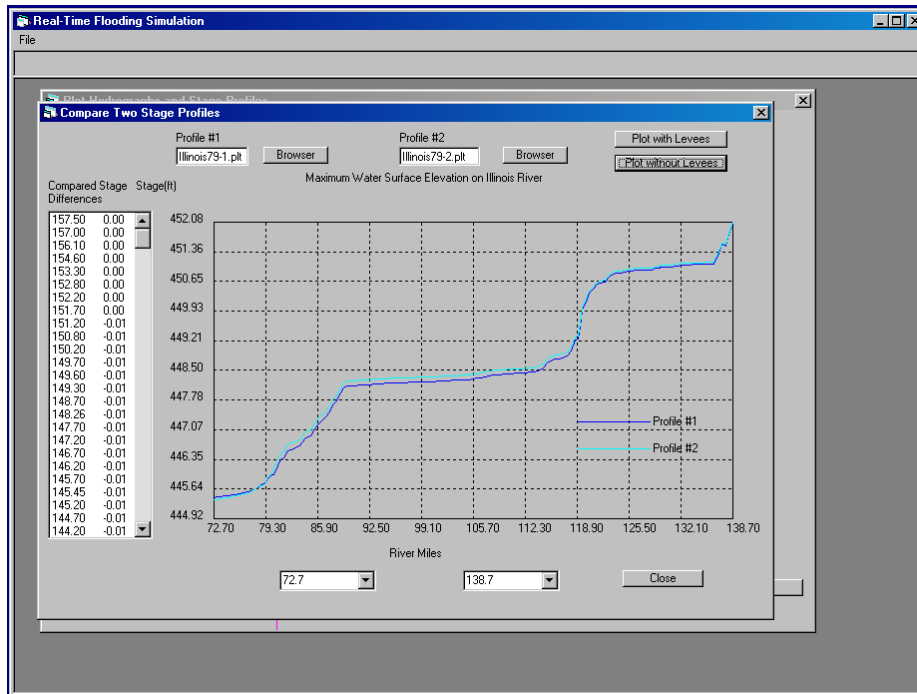


Figure 30. Comparing enlarged view of two stage profiles (without levee)

Hydrographs

Stage and discharge hydrographs can be plotted from this section of the program. The sample plot shows a discharge hydrograph at La Grange Lock and Dam Tail water on the Illinois River. To plot this hydrograph, select part 1: **ILLINOIS RIVER**; part 2: **BEARDSTOWN**; part 3: **Flow** (for discharge); and part 4: **01JAN1979** (starting date of the data). Parts must be chosen in order. As you choose a part, the pulldown menus for the remaining choices will be filtered and filled in with the available data choices. After selection is completed, click on **Plot Data** to display the discharge hydrograph in the window (Figure 31). Near the bottom of the window, the maximum discharge and the time will be shown.

The stage hydrograph also can be plotted by choosing **STAGE** in the third part of the selection. The peak stage and the time it occurred are displayed in the window in place of the maximum flow information. Figure 32 shows an example of a plotted stage hydrograph.

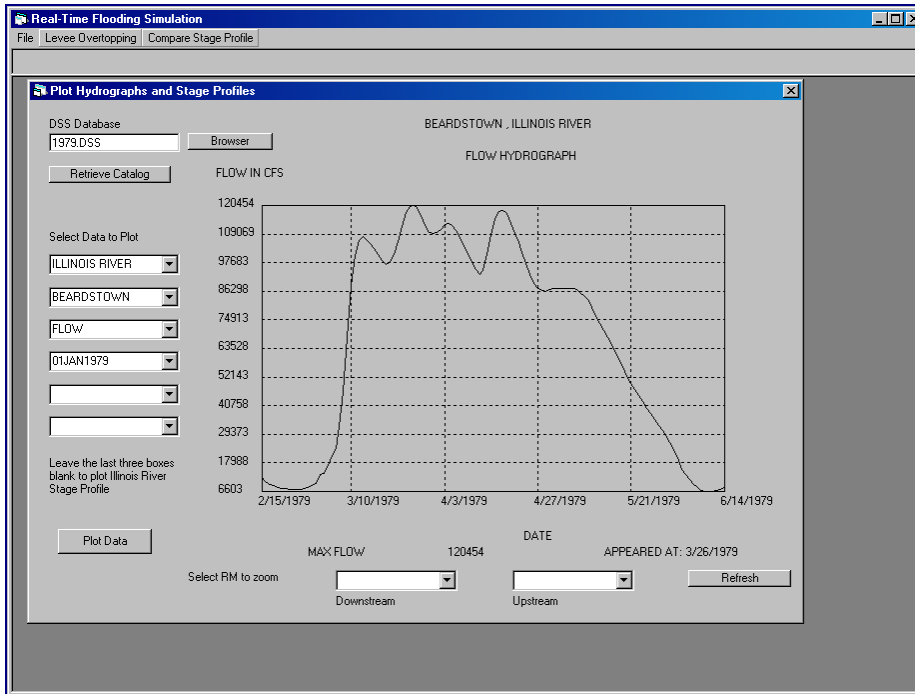


Figure 31. Flow hydrograph

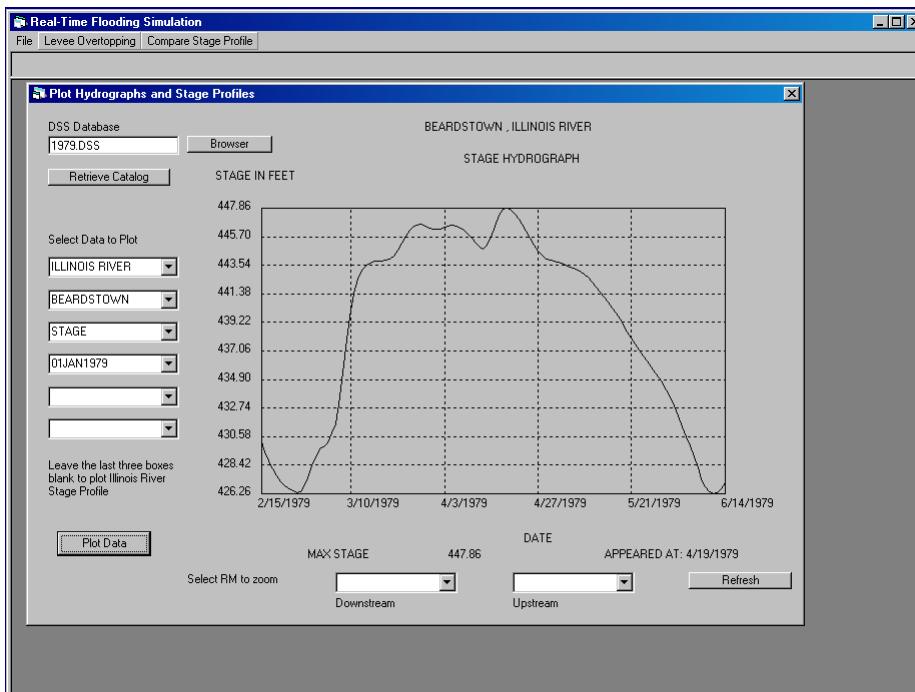


Figure 32. Stage hydrograph

Utility Tool

Two utility tools included in the program are the HEC DSSUTL program for DSS database editing and Notepad for text editing the boundary condition and cross section files. These can be accessed through the *Tools* menu on the main screen of the program. Text files used for the program also can be edited outside the real-time program using any text editor. The DSSUTL program also can be executed outside the real-time program and can be found in the directory where the real-time program has been installed.

Summary

The windows-based interface developed in this project has the capability to download real-time and historical stage and discharge data of gaging stations on the lower portion of the Illinois River and its tributaries, and of the gaging stations on Pool 26 of the Mississippi River and its tributaries from the USGS, the USACOE and the NWS websites. It executes the UNET model using existing geometry and boundary condition files and post-processes the DSS database to visualize the stage and discharge hydrographs and stage profiles with the existing levee systems on both sides of the river from Grafton to Peoria Lock and Dam. The real-time flooding event and forecasted flood is simulated with the forecasted stages at Peoria Lock and Dam and at Grafton. Because there is no forecasted flow data for any of the tributaries of the Lower Illinois River, the lateral inflow from the tributaries for the forecasted period are assumed to be the same as the last observed real-time flow at the time of downloading. The interface allows you to select the levee failure option (simple overtopping or piping failure) and modify the parameters of levee failure, thus enabling the model to simulate the management option of levee failure during a flooding event. The interface also can display the simulated results in graph and table formats. You also can analyze the change by comparing the stage profiles from two separate simulations (for example, existing levee conditions and the levee failure options). A table associated with it displays the differences at every cross section.

This interface is designed to prepare and input file for the UNET model and post-process the output from the DSS database without changing the functionality and capability of the UNET core model, thereby maintaining the accuracy and reliability of the UNET model. However, the

interface is still at the preliminary development stage. Improvements will be made for the program to be more robust and more functional.

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Appendix A: Installation

To install:

Insert the CD-ROM into your CD drive. The CD will autoplay to start the installation. Select “Install” to install the program. Select “Extract Data” to extract the data for the UNET model from the same directory in which the program was just installed. Data extraction uses the windows version shareware PKZIP. You need to make several selections to extract the data within the PKZIP window. Click “Exit” to finish the installation and remove the CD from you computer. You may also install the program though the control panel “Add/Remove programs” option in Windows. Follow the instructions given here. Due to the older programs referenced within the real-time program, directories and files with names of less than eight characters are required.

Appendix B: DSS Database of Observed Historic Stage and Flow Data Used for Historic Flood Simulation

<i>Stations</i>	<i>ID</i>	<i>Source</i>	<i>Type</i>	<i>Duration</i>
Illinois River at Peoria	5560000		Flow	1903-1906 1910-1938
Peoria L&D Tail		Rock Island COE	Stage	1988-1999
Bay Creek at Pittsfield	5512500	USGS	Stage	1993-1998
Bay Creek at Pittsfield	5512500	USGS	Flow	1939-1999
Big Bureau Creek at Princeton	5556500	USGS	Stage	1993-1998
Big Bureau Creek at Princeton	5556500	USGS	Flow	1936-1999
Illinois River at Beardstown	5584000	USGS	Flow	1920-1938
Illinois River at Florence		St Louis COE	Stage	1930-1938; 1942-2000
Illinois River at Hardin	5587060	USGS	Stage	1987-1998
Illinois River at Hardin	5587060	St Louis COE	Stage	1878-1880; 1932-2000
Illinois River at Havana	5570500	USGS	Flow	1921-1927; 1985-1989
Illinois River at Kingston Mines	5568500	USGS	Stage	1993-1998
Illinois River at Kingston Mines	5568500	USGS	Flow	1939-1999
Illinois River at Pearl		St Louis COE	Stage	1878-1881; 1885-1938; 1942-2000
Illinois River at Valley City	5586100	USGS	Flow	1938-1999
Illinois River at Valley City	5586100	St Louis COE	Stage	1883-1999
Illinois River near Copperas Creek		Rock Island COE	Stage	1988-1999
Illinois River near Havana	5570500	Rock Island COE	Stage	1988-1999
Illinois River near Kingston Mines	5568500	Rock Island COE	Stage	1988-1999
Illinois River near Meredosia	5585500	USGS	Stage	1988-1999
Illinois River near Meredosia	5585500	Rock Island COE	Flow	1989; 1991-1994
L&D 25, Tail water		St Louis COE	Stage	1938-1999
L&D 25 Pool		St Louis COE	Stage	1939-1995
L&D 26 Pool		St Louis COE	Stage	1938-1995
L&D 26 Tail		St Louis COE	Stage	1891-1990
L&D 26 Tail		St Louis COE	Stage	1992-1995
Mel Price Pool		St Louis COE	Stage	1990-1999
Mel Price Tail water		St Louis COE	Stage	1990-1995
La Moine River at Ripley	5585000	USGS	Stage	1993-1998
La Moine River at Ripley	5585000	USGS	Flow	1921-1999
Mackinaw River at Congerville	5567500	USGS	Stage	1993-1998
Mackinaw River at Congerville	5567500	USGS	Flow	1944-1999
Mackinaw River near Green Valley	5568000	USGS	Stage	1993-1998

Appendix B (concluded)

<i>Stations</i>	<i>ID</i>	<i>Source</i>	<i>Type</i>	<i>Duration</i>
Mackinaw River near Green Valley	5568000	USGS	Flow	1921-1956
Mackinaw River near Green Valley	5568000	USGS	Flow	1988-1999
Macoupin Creek near Kane	5587000	USGS	Stage	1993-1998
Macoupin Creek near Kane	5587000	USGS	Flow	1921-1999
Mississippi River at Alton	5587498	St Louis COE	Stage	1990-2000
Mississippi River at Alton	5587498	USGS	Flow	1933-1987
Mississippi River at Dixon		St Louis COE	Stage	1930-2000
Mississippi River at Grafton	5587450	St Louis COE	Stage	1879-1904; 1929-1999
Mississippi River at Grafton	5587450	USGS	Flow	1933-1998
Mississippi River at Keokuk	5474500	USGS	Flow	1878-1999
Mississippi River at St. Louis	7010000	USGS	Flow	1933-1999
Missouri River at Hermann	6934500	USGS	Flow	1928-1998
Sangamon River near Oakford	5583000	USGS	Stage	1993-1999
Sangamon River near Oakford	5583000	Rock Island, COE	Stage	1988-1999
Sangamon River near Oakford	5583000	USGS	Flow	1909-1911; 1914-1919; 1921-1922; 1928-1933; 1939-1999
Spoon River at Seville	5570000	USGS	Stage	1993-1998
Spoon River at Seville	5570000	USGS	Flow	1914-1999
Spring Creek at Springfield	5577500	USGS	Stage	1993-1998
Spring Creek at Springfield	5577500	USGS	Flow	1948-1999
Troy on Cuivre River	5514500	USGS	Flow	1922-1998
Mississippi River at Grafton	5587450	COE, St. Louis	Flow	1929-1999

Appendix C: Gaging Stations for Real-Time and Forecasted Stage and Flow Data

<i>Stations</i>	<i>ID</i>	<i>USGS</i>	<i>Real-time COE</i>	<i>Forecasted COE</i>	<i>NWS</i>
Mississippi River at Hannibal	05501600	Flow		Stage	
Bear Creek at Hannibal	05502000	Flow			
Mississippi River L&D Headwater	05513675	Flow, Stage	Stage	Stage	
Mississippi River L&D Tailwater	05513675	Flow, Stage	Stage	Stage	
Sugar Creek at Milford	05525500	Flow, Stage			
Illinois River at Marseilles	05543500	Flow, Stage			Stage
Bay Creek at Pittsfield	05551250	Flow, Stage			
Big Bureau Creek at Princeton	05556500	Flow, Stage			
Illinois River at Peoria	05560000	Flow, Stage		Stage	Stage
Mackinaw River near Congerville	05567500	Flow, Stage			
Mackinaw River near Green Valley	05568000	Flow, Stage			
Illinois River at Kingston Mines	05568500	Flow, Stage			
Spoon River near Seville	05570000	Flow, Stage			
Illinois River at Havana	05570500	Flow, Stage			Stage
Spring Creek at Springfield	05577500	Flow, Stage			
Illinois River at Henry	0558300	Flow, Stage			Stage
Sangamon River near Oakford	05583000	Flow, Stage			
Illinois River at Beardstown	05584000	Flow, Stage		Stage	Stage
La Moine River at Ripley	05585000	Flow, Stage			
Illinois River at Meredosia	05585500	Flow, Stage	Stage	Stage	
Illinois River at Valley City	05586100	Flow, Stage	Stage	Stage	
Macoupin Creek near Kane	05587000	Flow, Stage			
Illinois River near Hardin	05587060	Flow, Stage	Stage	Stage	
Mississippi River at Grafton	05587450	Flow, Stage	Stage	Stage	
Mississippi River at Alton	05587498	Flow, Stage	Stage		
Mississippi River at Hartford	05587750	Flow		Stage	
Mississippi River at St Louis	07010000	Flow	Stage	Stage	
Mississippi River at Chester	07020500	Flow		Stage	
Mississippi River at Cape Girardeau	07020850	Flow	Stage	Stage	Stage
Mississippi river at Thebes	07022000	Flow		Stage	
Illinois River at Peoria L & D					Stage
Illinois River at Florence			Stage		
Mel Price Pool			Stage		
Mel Price Tail			Stage		

