C H A P T E R 3

Working with HEC-GeoRAS - An Overview

HEC-GeoRAS is a package of arc macro language (AML) macros that allows the user to view and process geospatial data in ARC/INFO through a graphical user interface (GUI). The user can create a geometric attribute data file for import into HEC-RAS and view inundation maps from exported RAS water surface profile data.

To create the import file, the user must have an existing digital terrain model (DTM) of the river system. Currently, the DTM must be represented by a TIN. The user creates a series of line coverages pertinent to extracting the geometric attributes from the DTM. A map of the terrain contours is created to help the user lay out the line coverages. The line coverages created are the Main Channel Invert, Main Channel Bank Stations *(optional)*, Overbank Flow Paths *(optional)*, and Cross Section Cut Lines and are referred to, herein, as the RAS Coverages.

Water surface profile data exported from HEC-RAS simulations are read into HEC-GeoRAS and processed. The processed water surface profile coverages may then be viewed.

The collection of the DTM, Contour Coverage, RAS Coverages, and processed water surface profile coverages is termed a project.

Chapter 3 provides an overview of the steps in developing a HEC-GeoRAS project. Chapters 4-6 more completely discuss project development.

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- Exiting HEC-GeoRAS

Getting Started

Start up ARC/INFO and change directories to the workspace containing your DTM using ARC/INFO's WORKSPACE command. WORKSPACE is similar to *cd* on UNIX or at the DOS prompt. Type **HEC-GeoRAS**.

The main window for HEC-GeoRAS is the project manager window. The project manager window allows the user to establish and manage projects and gain access to the preprocessing and postprocessing components. The HEC-GeoRAS Project Manager is shown in Figure 3.1.

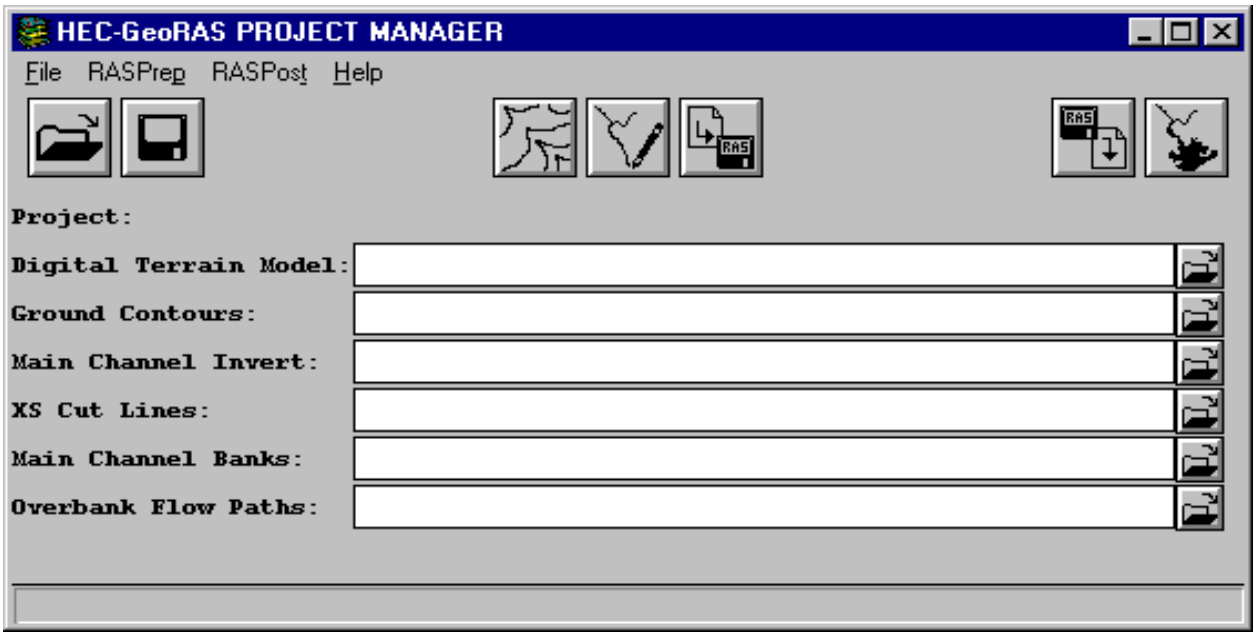

Figure 3.1 HEC-GeoRAS Project Manager Window

At the top of the project manger window is a menu bar. As shown in Figure 3.2, the following menus are available:

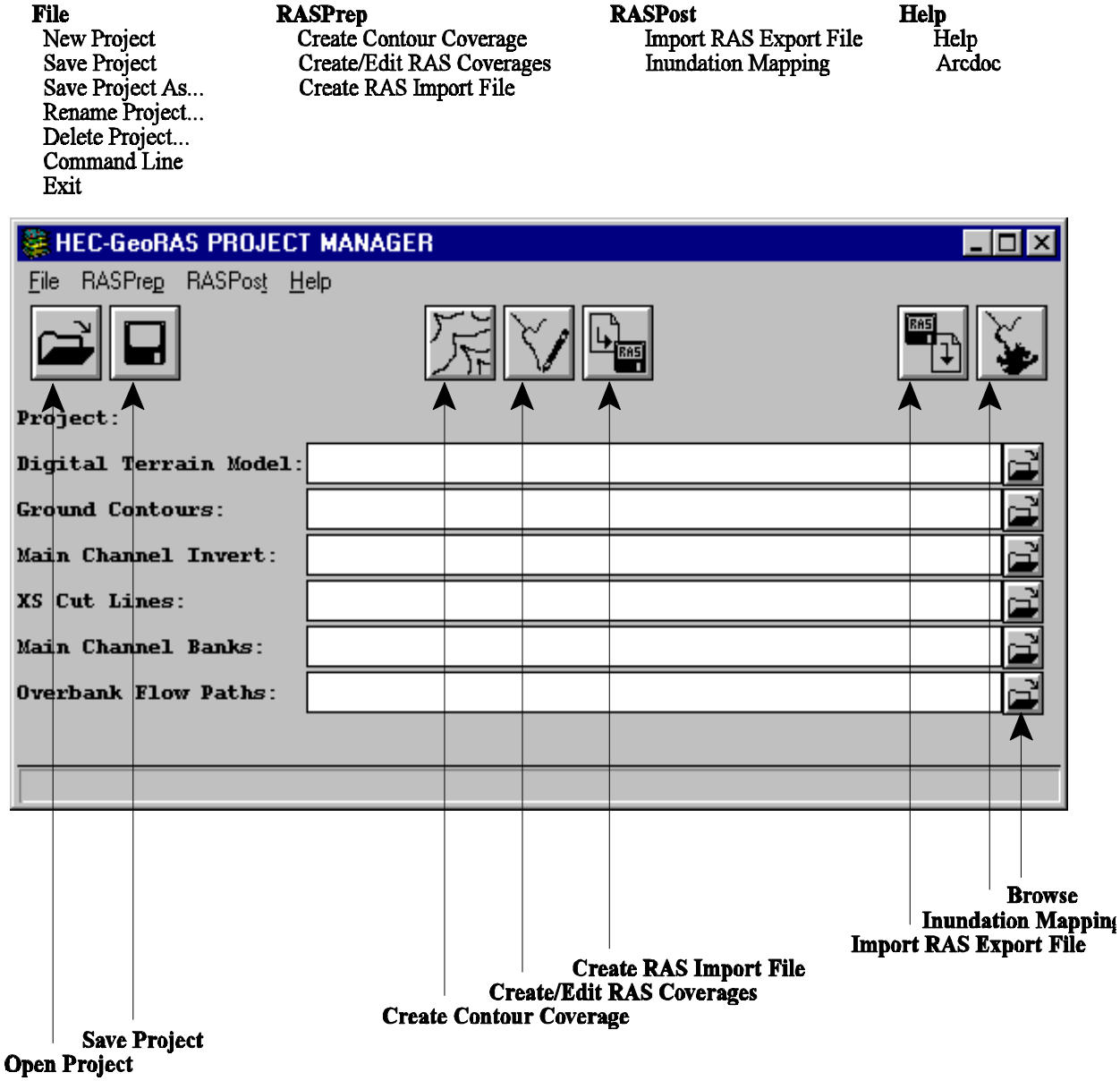

Figure 3-2 HEC-GeoRAS Project Manager options

File: This menu is used for file management. Options under the File menu include: New Project; Open Project; Save Project; Save Project As; Rename Project; Delete Project; Command Line; and Exit.

RASPrep: This menu is used for preprocessing. Preprocessing options are Create Contour Coverage; Create/Edit RAS Coverages; and Create RAS Import File.

RASPost: This menu is used for postprocessing. Postprocessing options are Import RAS Export File and Inundation Mapping.

Help: This option allows the user to get on-line help.

The project window also includes buttons for frequently used options. The description of the button options is shown in Figure 3.2. A description of the button's function is displayed at the bottom of the window by selecting the button and pressing the right mouse button. The message box is delineated by a recessed message box in windows on Windows NT systems but not on UNIX systems.

The *Digital Terrain Model* input field will only allow the user to enter the name of an existing TIN. The other coverage input fields will only allow the user to type in the name of existing line coverages. To import existing coverages, select them using the browser, and they will import when the editor is invoked. Clicking the right mouse button over an input field invokes a selection list of all the valid data sets in the current workspace.

Developing the HEC-RAS Import File

The main steps in developing a HEC-RAS Import File are as follow:

- Starting a new project
- Creating a Contour Coverage
- Creating/Editing RAS Coverages
- Creating a RAS Import File

Starting a New Project

The current ARC/INFO workspace (or current directory) was established before starting HEC-GeoRAS using the WORKSPACE command. Therefore, the default directory will be the current directory and the project, as well as all newly created coverages, will be saved in the default directory. To save the coverages to a different directory, the *entire* pathname must be given.

To start a new project, go to the **File** menu on the HEC-GeoRAS Project Manager and select **New Project**. The response window shown in Figure

3.3 will be displayed. Enter the name of the new project. The file extension *.prj* will be added to the project name. The user is not allowed to change the file extension.

After specifying the project name, press **OK**. If the project name is in conflict with a currently existing project, a message will appear asking the user if the project is to be overwritten. Pressing the **Cancel** button will return the user to the project manager.

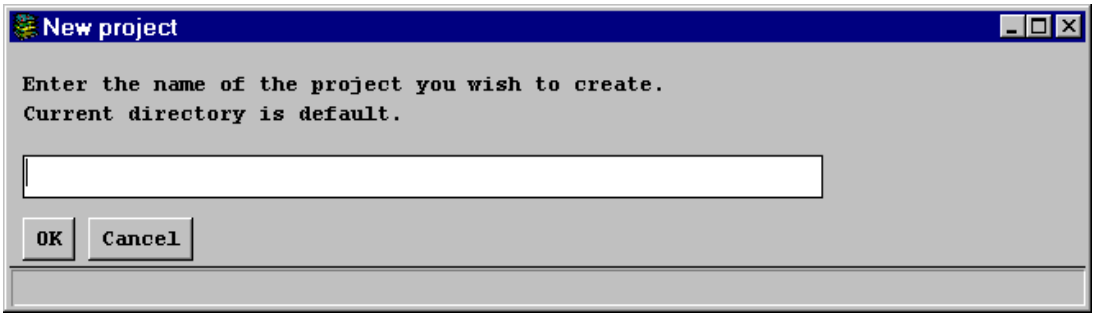

Figure 3.3 New Project window

Creating the Contour Coverage

After a new project is created, the DTM of the river basin must be selected. Press the  button to the right of the input field to invoke a data set browser. Select the DTM using the browsing options. Alternatively, if the DTM is in the current directory, press the right mouse button while the cursor is over the *Digital Terrain Model* input field and select the DTM from the popup list. At this time, only TINs may be selected.

Next, the Contour Coverage is created from the DTM by selecting **Create Contour Coverage** from the **RASPrep** menu on the project manager. This will bring up the Create Contour Coverage window shown in Figure 3.4.

After entering the Contour Coverage name and the Contour Interval, the coverage is created by pressing the **Create Contour Coverage** button. The contour coverage name must be 13 characters or less. The default *Contour Interval* of 1.0 unit may be edited by clicking in the input field. If the interval is too fine in relation to the resolution of the DTM ARC/INFO

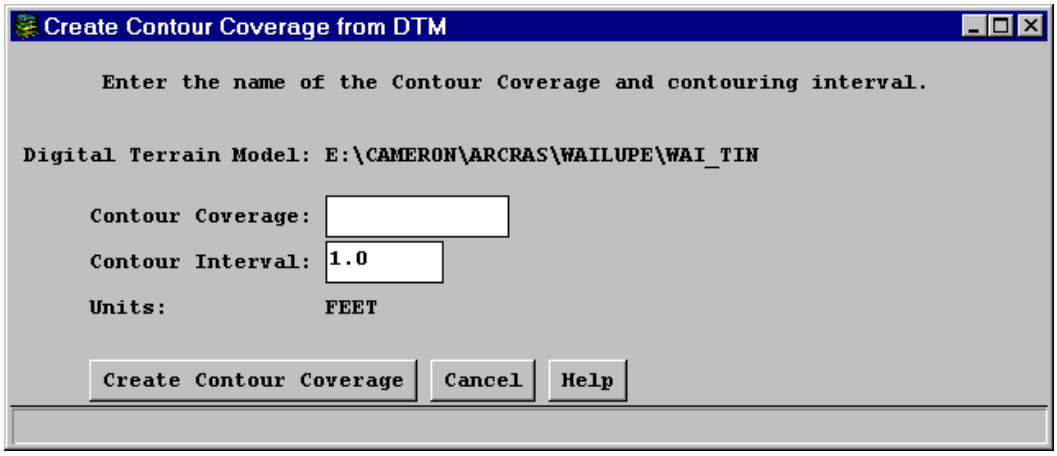

Figure 3.4 Create contour coverage window

will not create the Contour Coverage. If the interval specified is too large, the Contour Coverage created will provide an inadequate description of the land surface for the user when creating RAS Coverages. Pressing the **Cancel** button returns the user to the project window.

Creating RAS Coverages

The next step is to create the four RAS Coverages that will be used to extract geometric data from the DTM. The line coverages to be created are the Main Channel Invert, Main Channel Banks *(optional)*, Flow Paths *(optional)*, and Cross Section Cut Lines. Select **Create/Edit RAS Coverages** from the **RASPrep** menu on the project manager to bring up the Edit RAS Coverages window, shown in Figure 3.5. The Edit RAS Coverages window will appear with a display window. The windows may be moved as desired. The display window may be resized to the user's preference, as well. RAS Coverages are created and edited in ARCEDIT which may take a few seconds to load.

From the Edit RAS Coverages window select the *Ground Contours* checkbox and press **Refresh Display,** to draw the Contour Coverage (created earlier) in the editing window. If the terrain is not represented appropriately, create the Contour Coverage again, using a different contouring interval. Coverages are selected and drawn in the display window to assist the user in creating the RAS Coverages.

The following section provides instructions for creating the RAS Coverages. For a more detailed discussion on creating RAS Coverages using the editing tools refer to Chapter 5.

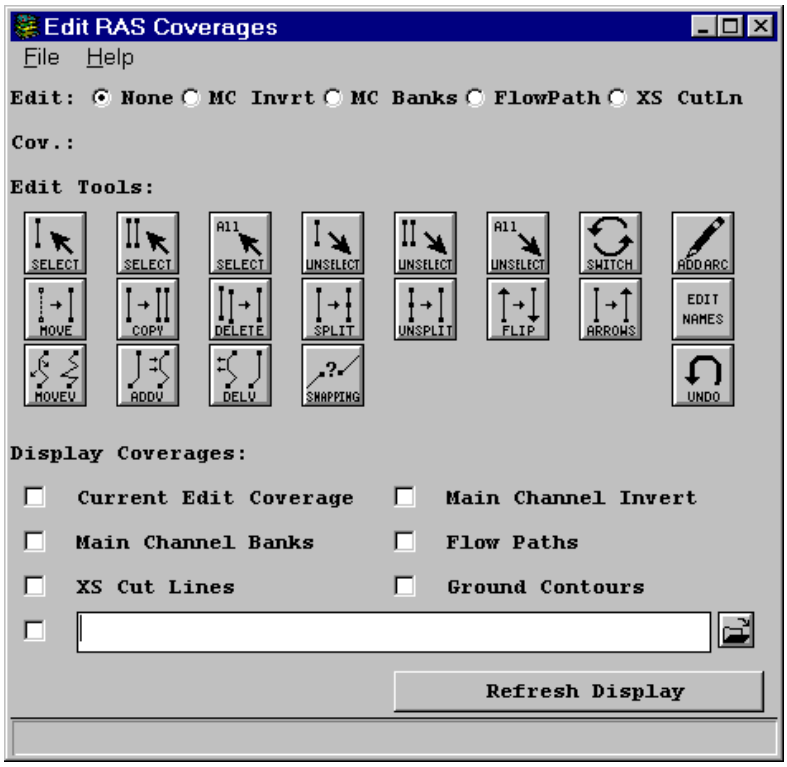

Figure 3.5 Edit RAS Coverages window

Main Channel Invert. The Main Channel Invert Coverage should be created first. From the Edit RAS Coverages window, select the **MC Invert** choice to invoke the window shown in Figure 3.6. Enter the name of the new coverage and press **Create New Coverage**. The coverage name must be 13 characters or less. Pressing the **Cancel** button will return the user to the Edit RAS Coverages window.

After pressing the **ADD ARC** button from the *Edit Tools* palette, cross-hairs will appear over the editing window. Draw the river reaches one by one, from upstream to downstream, using the mouse. Each reach is represented by an arc. An arc is defined by a line containing an upstream and downstream node. A series of vertices may separate the nodes. Each reach may contain no more than 500 points (2 nodes with 498 vertices). To create a node, place the cross-hairs at the desired node location and

press the right mouse button. To create a vertices, press the left mouse button.

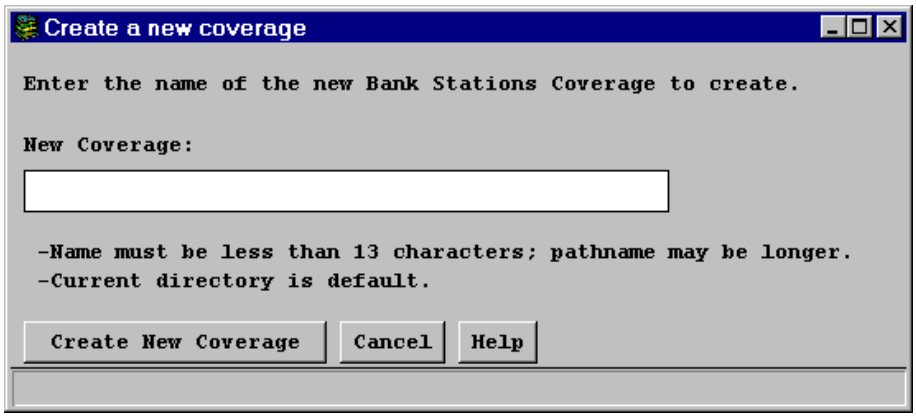

Figure 3.6 New coverage window

After drawing each river reach, the window shown in Figure 3.7 will appear to allow the user to supply the *River Name* and *Reach Name*. The **?** button invokes a selection list of river names previously entered for the current coverage and may be useful for rivers with many reaches. *Reach names for the same river must be unique*. River and reach names may be up to 16 characters long. Pressing **OK** will save the entered names. **Cancel** will quit the window without saving the names.

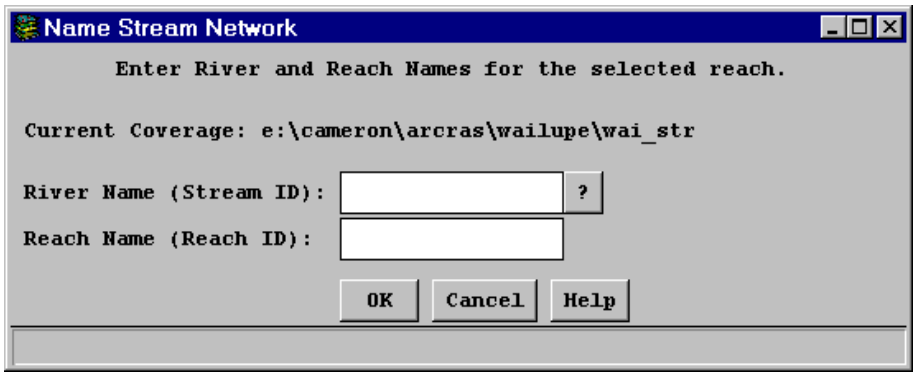

Figure 3.7 Stream and reach identifier window

After the river network coverage has been completed, save the coverage by selecting **Save** from the **File** menu.

Main Channel Banks. Select the **MC Banks** choice from the editor. After supplying the coverage name, create the Main Channel Banks Coverage by

pressing the **Create New Coverage** button from the new coverage window.

Use the **ADD ARC** button from the Edit RAS Coverages window to draw the location of the channel banks. Separate arcs should be used for each bank of each river. Bank lines from tributary rivers may overlap the bank lines of the mainstem. *Creating the Main Channel Banks Coverage is optional.*

Flow Paths. Create the Flow Path coverage by selecting the **FlowPath** choice, on the editor and entering the coverage name. If the Main Channel Invert Coverage already exists, the flow path defining the main channel will be copied to the edit coverage. Add arcs using the **ADD ARC** button for the hydraulic flow path in the left overbank, right overbank and main channel (if necessary). Be sure to check that the flow paths are drawn from upstream to downsteam. *Creating the overbank flow path coverage is optional.*

Cross Section Cut Lines. Create the new Cross Section Cut Lines Coverage by selecting the **Cut Line** choice and entering the coverage name. Add cut lines using the **ADD ARC** option where cross-section data should be extracted from the DTM. Each cut line is represented by an arc drawn from the left overbank to the right overbank when facing downstream. Cut lines must cross the main channel only once and no two cross sections may intersect. Cross section cut lines are multi-segment lines that should be drawn perpendicular to the flow lines.

When finished creating the RAS Coverages, select **Exit** from the **File** menu to quit from the Edit Coverage window.

Creating a RAS Import File

The RAS Coverages are used to extract geometric attribute data from the DTM. After creating the RAS Coverages, select **Create RAS Import File** from the **RASPrep** menu on the project manager. The window shown in Figure 3.8 will be displayed.

Check that the coverage names are correct and select the DTM sampling interval method. Enter the import filename and press the **Create Import File** button to proceed. **Cancel** dismisses the window and returns the user to the project manager.

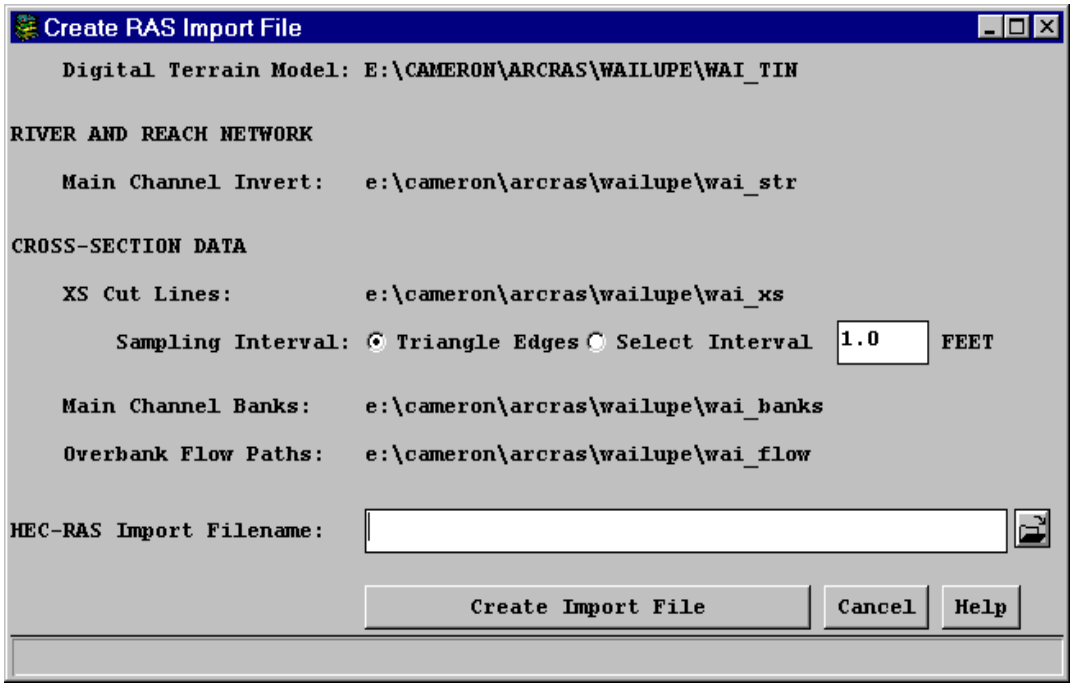

Figure 3.8 Create RAS Import File window

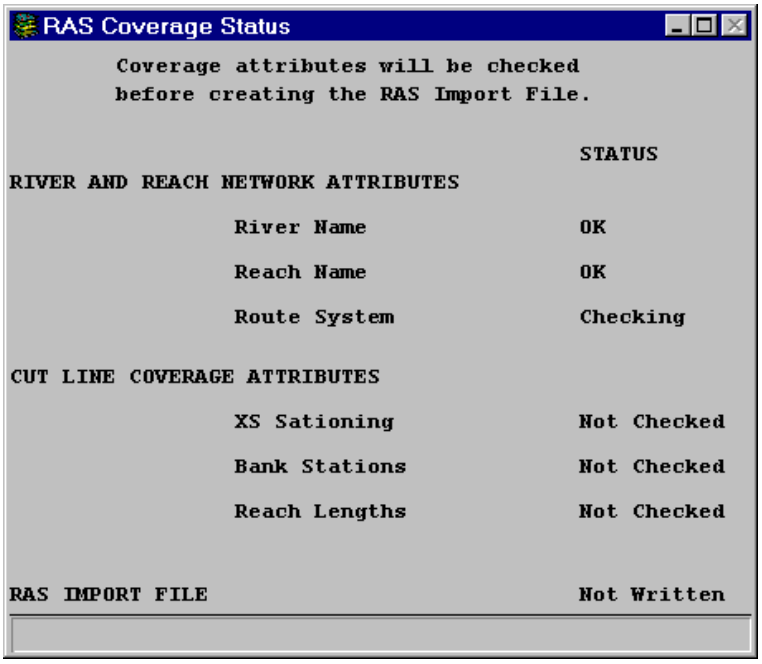

Figure 3.9 RAS Coverage Status window

Once the **Create Import File** button is pressed, the RAS Coverage attributes will be checked for missing data. Progress updates will be displayed in the Create RAS Import File status window shown in Figure 3.9. The user will be asked to verify updates to the geometric attribute data before the import file is written. If any data is missing, the user will be prompted to return to the editor to make the appropriate changes.

Running HEC-RAS

After importing the geometric data extracted from the GIS, completion of hydraulic data will be necessary. Hydraulic data that is not imported includes roughness coefficients, expansion and contraction losses, and hydraulic structure data. Complete the required data entry before running any simulations for your hydraulic model. For a more complete discussion on importing geometric data refer to the HEC-RAS User's Manual, Chapter 13 (Hydrologic Engineering Center, 1998).

After running various simulations in HEC-RAS, export the water surface profile results. For a more complete discussion on exporting GIS data refer to the HEC-RAS User's Manual, Chapter 13 (Hydrologic Engineering Center, 1998).

Viewing the HEC-RAS Exported Water Surface Profiles

The main steps in viewing HEC-RAS exported water surface profiles are as follow:

- Importing a RAS Export File
- Viewing Inundation Extent and Depth

Importing a RAS Export File

Import the exported RAS data file by selecting **Import RAS Export File** from the **RASPost** menu. The window shown in Figure 3.10 will appear. Specify the file (*.*gis*) to import and enter the name of a new coverage that

will be created. The new coverage will contain the water surface elevations for each profile (selected later) at each cross section. Press **OK**

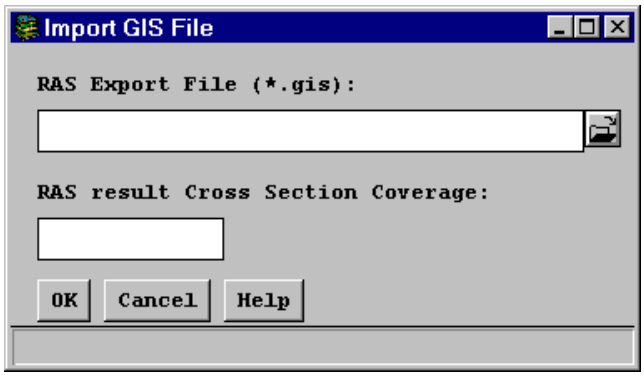

Figure 3.10 Import GIS File window

to import the data file or **Cancel** to quit.

Importing the GIS data file results in creating an index file (*tempindex9999*) of the water surface profile names. The index file is written to the current workspace, and will be referred to as the user creates water surface coverages for mapping. **Currently, water surface profile names must be 11 characters or less (including spaces)**. (Caution: HEC-RAS allows the user to provide water surface profile names up to 16 characters long when creating the export file.)

Pressing **OK** will invoke the window, previously written to the current workspace (filename *wsp.menu*) displayed in Figure 3.11. From the

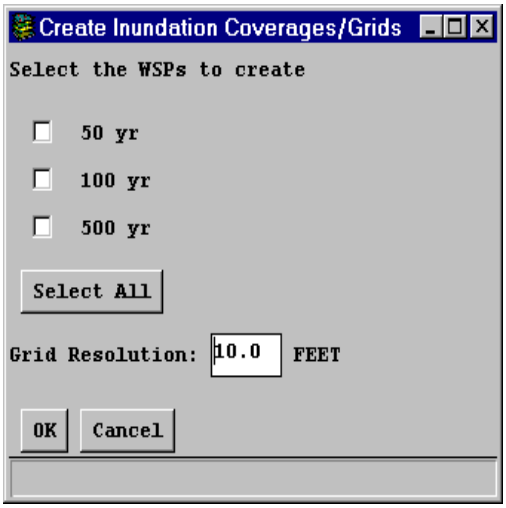

Figure 3.11 Create mapping coverages window

window, select the water surface profiles coverages to create and enter the grid-cell resolution for the associated depth grid. The grid-cell resolution refers to the dimensions of a square cell having a single water depth as averaged value of the surrounding depths. Press **OK** to create the coverages or **Cancel** to quit.

Two coverages will be created for mapping each water surface profile. A polygon coverage having the prefix *f_* and a grid having the prefix *d_* followed by the water surface profile name. A TIN having the prefix *t_* will be temporarily created, but will be deleted after the water surface profile processing is complete. Underscores replace any blanks in the water surface profile names. The coverages are created in the current workspace.

Viewing Inundation Extent and Depth

The extent of inundation and flow depth grids may be viewed by selecting **Inundation Mapping** from the **RASPost** menu on the project manager. The Inundation Mapping window shown in Figure 3.12 will be displayed on the screen along with a viewing window. Inundation mapping options are performed in ARCPLOT, which may take a few seconds to load.

Select the water surface profile data to be displayed by selecting the corresponding *Fill* and *Bndry* checkboxes. Press **Refresh Display** to view the extent of inundation for the various profiles. Selecting *Bndry* will map an outline of the inundation polygon, while checking *Fill* will color the entire polygon.

To view the variation in depth for a profile, select a *Depth Grid* by right clicking over the input box. A popup menu will appear and allow the user to select from the list of available grids. Next from the *Display* choice, select *Grid* and press **Refresh Display**. The variation in depth for the selected profile will be displayed as shades of blue. To interactively determine the water depth at a certain location, press the **Depth?** button. Use the cross-hairs displayed to select the location with the left mouse button. The water depth is displayed to the right of the **Depth?** button. Press the right mouse button to finish selecting locations.

When finished viewing the water surface profile coverages, choose **Exit** from the **File** menu to quit from the Inundation Mapping window and exit ARCPLOT.

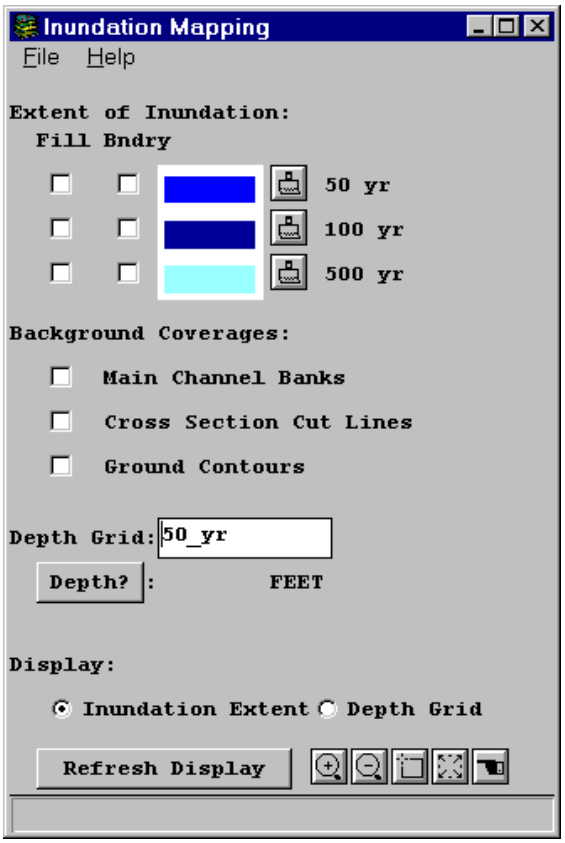

Figure 3.12 Inundation Mapping window

Printing Map Results

Maps viewed using the Inundation Mapping window option may be printed using the options provided by Print Map window. To access the Print Map window select **Print** from the **File** menu on the Inundation Mapping window. The Print Map window shown in Figure 3.13 will be displayed.

Using the page presentation options provided in concert with **Preview** to prepare the map for printing. Pressing the **Print** button will write the map to a temporary file (permanent, if specified) and then invoke the ARC/INFO printing interface. Using the interface options select the printer *Driver* and press **Print**. The image, as viewed during preview, will be printed.

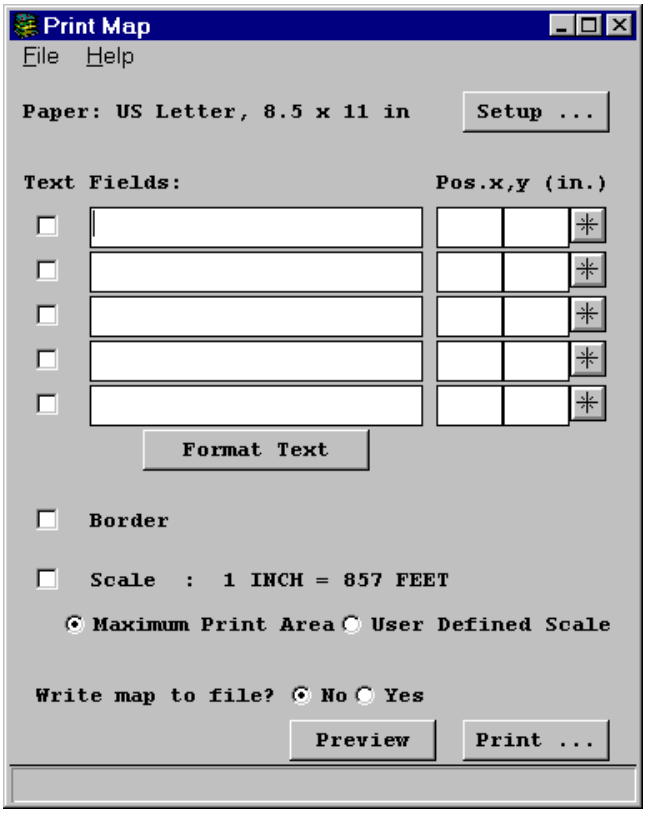

Figure 3.13 Print Map window

Exiting HEC-GeoRAS

When finished editing coverages and viewing water surfaces return to the project manager. From the **File** menu on the HEC-GeoRAS Project Manager select **Exit**. Upon exiting, the user will always be asked to save the current project. The user will be returned to the ARC prompt.