

CHAPTER FIVE

Risk Assessment Model

Manual of Risk Assessment for Contaminant Intrusion into Water Distribution Systems

Chapter-1
IRA-WDS: Overview



Chapter-2
Data Preparation



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Contaminant Ingress Model



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Pipe Condition Assessment Model



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Risk Assessment Model

Chapter 5: Risk Assessment Model

5.1 Introduction

There are several submenus under the 'Risk Assessment' menu. This chapter describes the use of these submenus and associated commands for running the Risk Assessment Model. Figure 5.1 show the steps involved in executing this component of the software.

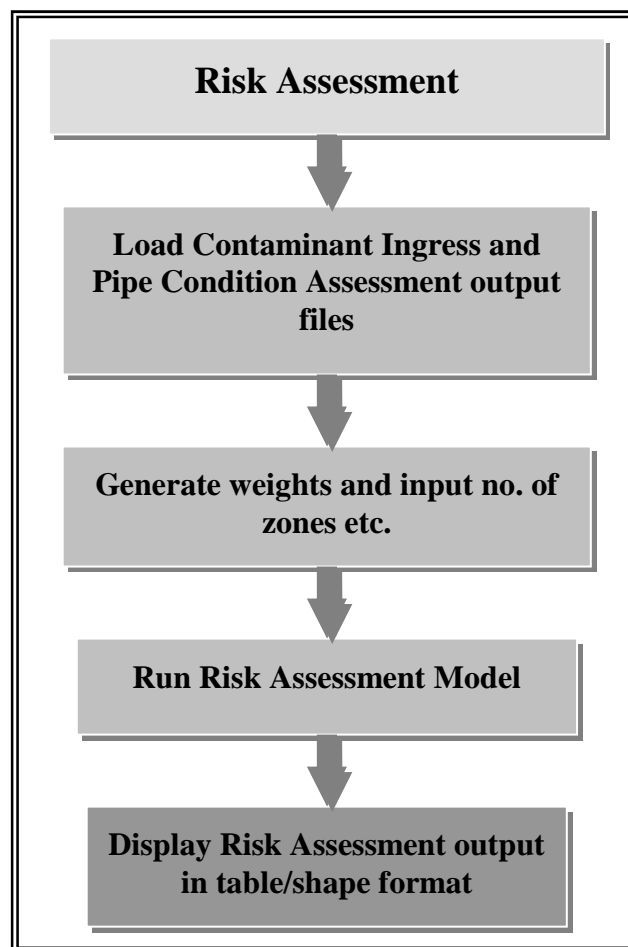


Figure 5.1. Overview of Risk Assessment Model of IRA-WDS


The following steps need to be performed in order to run the Risk Assessment Model.

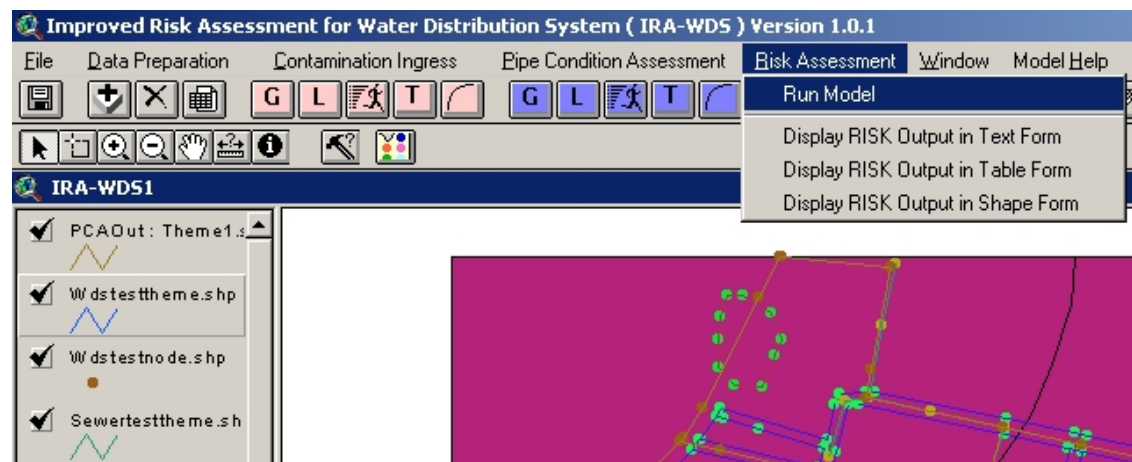
- Run Model
- Display output (optional)

The example files given in Table 5.1 are to be used for illustration purposes while describing the use of the Risk Assessment Model with the help of IRA-WDS.

Table 5.1. Example input files	
Filename	Descriptions
Pcaoutput.out	Pipe Condition Assessment Model output
Ingressoutput.out	Ingress Model output


5.2 Running the Risk Assessment Model

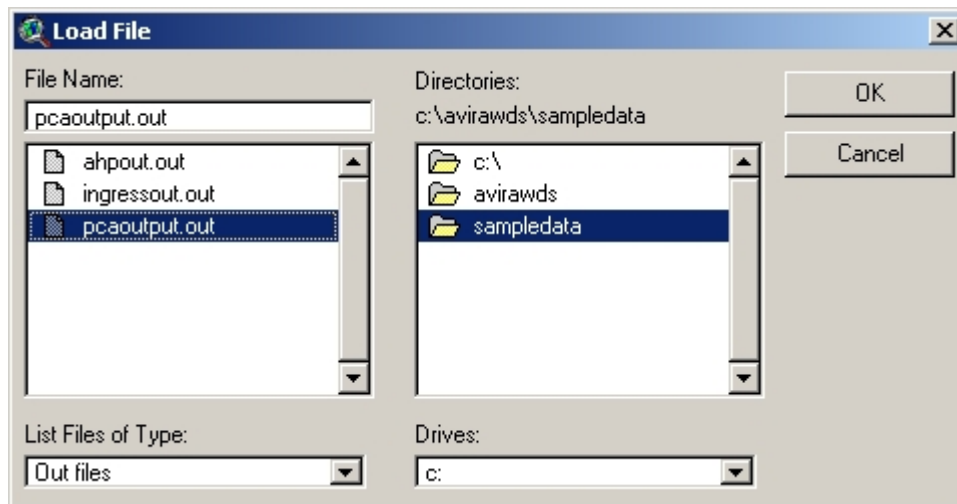
The Risk Assessment Model can be run by clicking on the Tool , which is just below the 'Risk Assessment' menu or by clicking on the 'Risk Assessment' menu and then clicking on the submenu 'Run Model', as shown on the screen below:




5.2.1 Loading the files

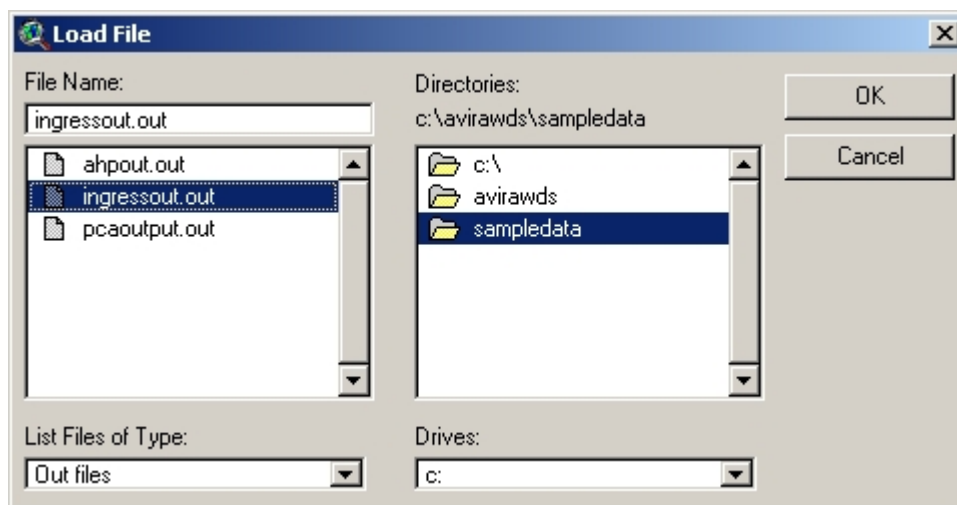
To run the Risk Assessment Model, the output files from the Contamination Ingress and Pipe Condition Assessment models are to be loaded onto the interface. To load

the PCA output file, the user should click on the  button on the interface in front of the 'PCA Output File' text box. This opens the 'Load File' dialogue box, as shown on next page.



After selecting the appropriate file, the user should click on the 'OK' button; this will close the 'Load File' dialogue box and will write the name of the selected file in the 'PCA Output File' text box.

To load the Contamination Ingress output file, the user should click on the  button on the interface in front of the 'Ingress Output File' text box. This opens the 'Load File' dialogue box, as shown below:



After selecting the appropriate file, the user should click on the 'OK' button; this will close the 'Load File' dialogue box and will write the name of selected file in the 'Ingress Output File' text box.

After selection of the output files from the Pipe Condition Assessment and Contamination Ingress models, the interface will look as shown on next page.

Risk Assessment Input Form :

☒ Assign Weights ☐ Weights by AHP

PCA Output File :

Ingress Output File :

No. of Groups : 3

	Hazard	Vulnerability	Weights
Hazard	<input type="text"/>	<input type="text"/>	<input type="text"/>
Vulnerability	<input type="text"/>	<input type="text"/>	<input type="text"/>

5.2.2 Weights

The 'Risk Assessment Input Form' has two options for giving importance to the Risk Assessment parameters ('Pipe Condition', 'Length of Contamination' and 'Concentration of Contamination'). These options are:

1. Assign Weights
2. Weights by AHP

The '**Assign Weights**' option allows the user to input weights directly. The user needs to type in the weights in the text box below the 'Weights' label and in front of the 'Hazard and Vulnerability' text boxes, as shown below:

Risk Assessment Input Form :

☒ Assign Weights ☐ Weights by AHP

PCA Output File :

Ingress Output File :

No. of Groups : 3

	Hazard	Vulnerability	Weights
Hazard	<input type="text"/>	<input type="text"/>	0.4
Vulnerability	<input type="text"/>	<input type="text"/>	0.6

The **‘Weights by AHP’** option allows the user to perform a pair-wise comparison and generate the weights using AHP. In this case, the user needs to enter pair-wise comparison values for the ‘Hazard and Vulnerability’ text boxes as shown below:

The 'Risk Assessment Input Form' dialog box contains the following elements:


- Two radio buttons at the top: 'Assign Weights' (selected) and 'Weights by AHP'.
- Two text input fields for 'PCA Output File' and 'Ingress Output File', each with a file selection icon to its right.
- A slider for 'No. of Groups' with a corresponding text box containing the value '3'.
- A sub-dialog box titled 'Risk' containing a table for pair-wise comparisons:

	Hazard	Vulnerability	Weights
Hazard	1.000	0.500	
Vulnerability	2.000	1.000	

At the bottom of the main dialog are 'Run' and 'Close' buttons.

The interface also allows the user to select the number of groups in which the risk is to be categorized by sliding the bar in front of ‘No. of Groups’ on the ‘Risk Assessment Input Form’ or by entering the number of groups in the box provided, as shown above.

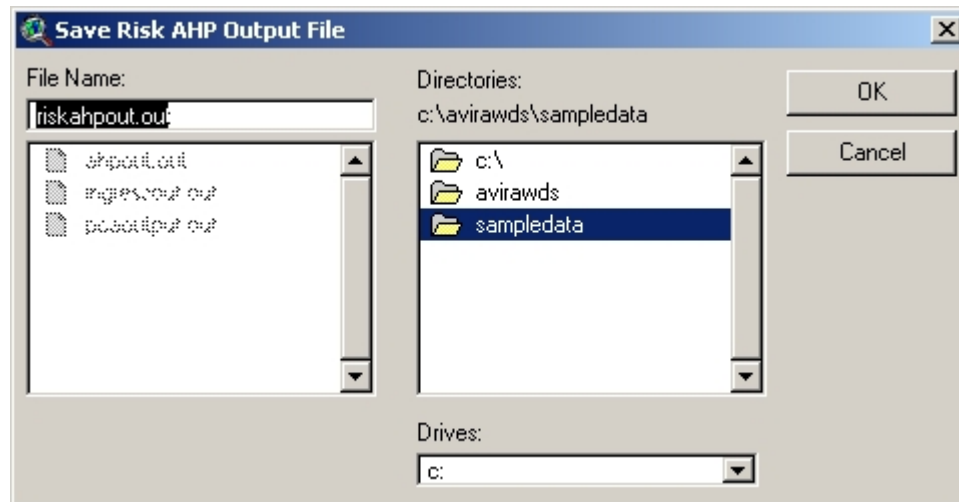
5.2.3 Running the Risk Model

To run the risk model, the user should click on the  button on the ‘Risk Assessment Input Form’. If ‘Weights by AHP’ has been selected, the model first writes the AHP input file for generating the weights. It then opens the ‘Save AHP Input File’ dialogue box to save the AHP input file generated, as shown below:

The 'Save AHP Input File' dialog box contains the following elements:

- A 'File Name' text box containing 'riskahpinput.inp'.
- A 'Directories' list box showing 'c:\avirawds\sampladata'.
- A file list on the left showing 'shpinput.inp', 'ingress.inp', and 'pcainput.inp'.
- A 'Drives' dropdown menu at the bottom showing 'c:'.
- 'OK' and 'Cancel' buttons on the right.

After the user clicks on the 'OK' button on the 'Save AHP Input File' dialogue box, the program runs the AHP model and opens the 'Save Risk AHP Output File' dialogue box, as shown below:

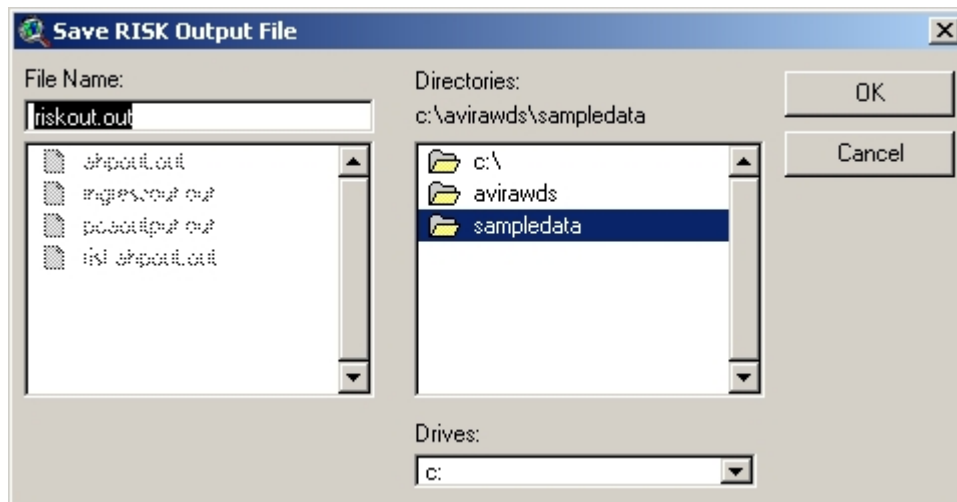


After choosing the output file to write, the weights are generated and generated weights are written in text box 'Weights' as shown below:

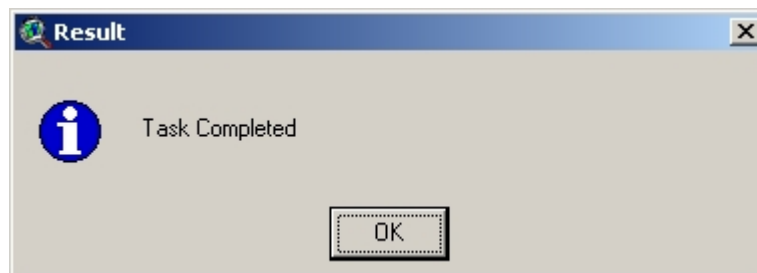
	Hazard	Vulnerability	Weights
Hazard	1.000	0.500	0.33
Vulnerability	2.000	1.000	0.67

If the weights so generated are not consistent, then '-99 will' be displayed in the weights box. In this case, the user should change the matrix of 'Hazard and Vulnerability' and run the model once again.

If 'Assign Weights' is selected the above-mentioned steps are not performed, the program opens the 'Save RISK Output File' dialogue box; this asks the user to input the filename to 'Save Risk Output File', as shown below:



It then runs the Risk Assessment model and writes it to the file specified by the user. After completion, the program displays the 'Task Completed' Result message box, as shown below:




The user should click on OK to complete the task.

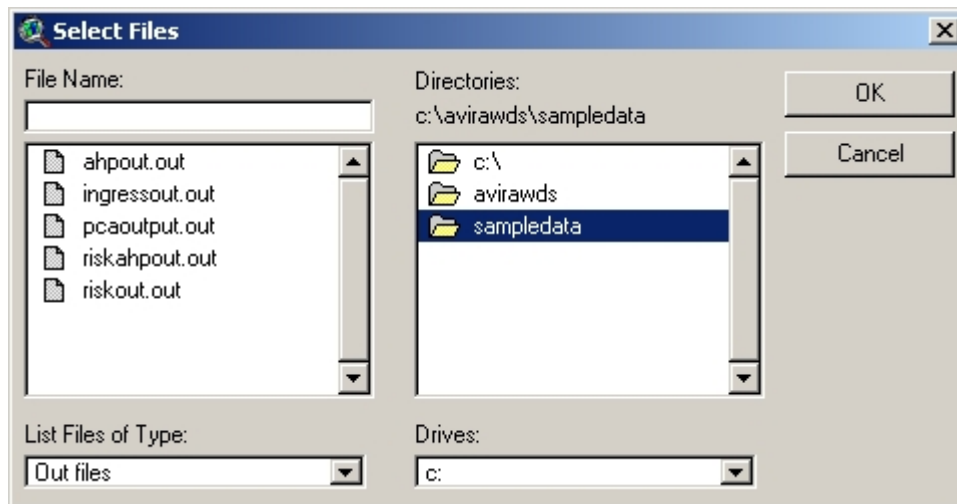
5.3 Displaying output

The output can be displayed in following three forms:

1. Display RISK Output in Text form
2. Display RISK Output in Table form
3. Display RISK Output in Shape form

5.3.1 Displaying Risk output in text form

The user can view the output file in text form in notepad by clicking on the  button or by selecting the 'Display RISK Output in Text Form' submenu from the 'Risk Assessment' menu and browsing the appropriate output file to view.



riskout - Notepad

File Edit Format Help

```

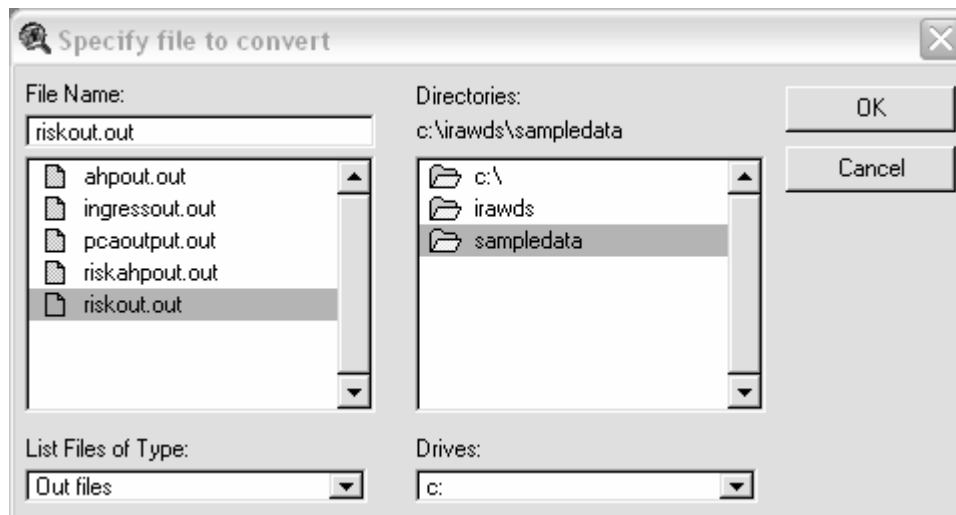
=====;
:      RISK ASSESSMENT
:=====;

[WATER PIPE]
=====;
:Pipe ID      Risk Index      Rank Group
:=====;
950      0.298093      2
944      0.368137      2
1043     0.56834      3
1074     0.409249      3
1025     0.583766      3
994      0.831248      4
976      0.831797      4
915      0.665181      4
993      0.665284      4
995      0.832362      4
989      0.665435      4
1045     0.832651      4
957      0.832838      4
880      0.833034      4
942      0.836465      4
920      0.836502      4
883      0.839585      4
885      0.839728      4
1029     0.672643      4
918      0.672743      4
1016     0.674518      4
1012     0.67552      4
898      0.675893      4
1017     0.845095      4
975      0.678689      4
899      0.846812      4
1046     0.847327      4
1083     0.849551      4

```

5.3.2 Displaying Risk output in table form

The user can view the output file in table form by selecting the 'Display RISK Output in Table Form' submenu from the 'Risk Assessment' menu and specifying the appropriate output file to view by browsing, as shown on next page.

 Specify file to convert

File Name: riskout.out

Directories: c:\irawds\sampledata

OK

Cancel

List Files of Type: Out files


Drives: c:

Files in list:

- ahpout.out
- ingressout.out
- pcaoutput.out
- riskahpout.out
- riskout.out


Directories in list:

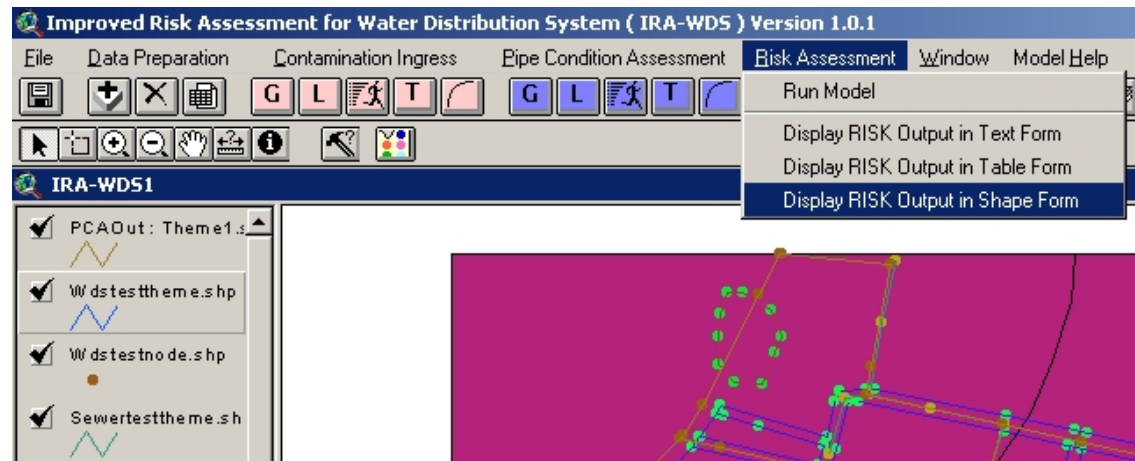
- c:\
- irawds
- sampledata

 c:\irawds\sampledata\riskout.dbf

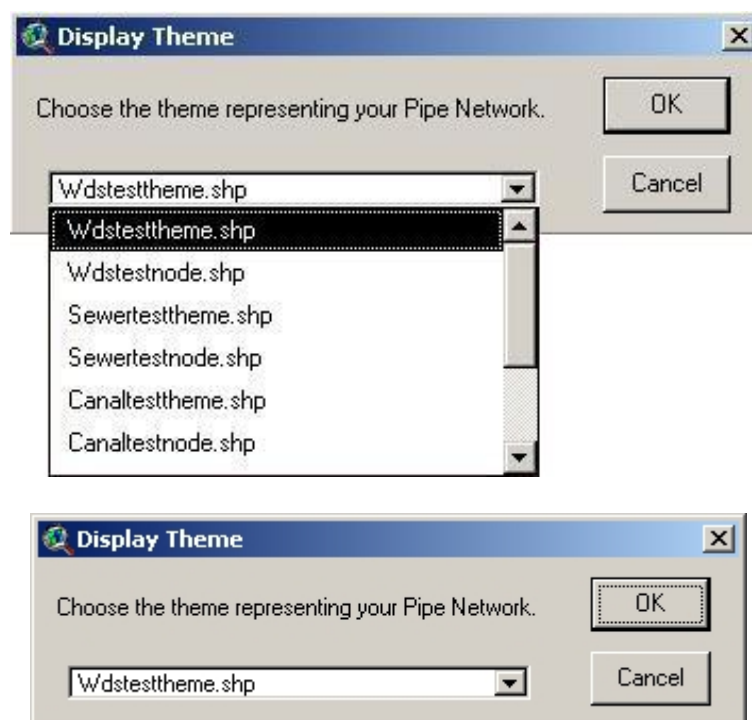
PipeID	RiskIndex	Rank
950	0.336	2
944	0.430	3
1043	0.810	4
1074	0.485	3
1025	0.830	4
831	0.925	5
975	0.594	3
824	0.926	5
880	0.927	5
852	0.931	5
866	0.932	5
837	0.932	5
951	0.932	5
936	0.602	4
1083	0.933	5
957	0.933	5
809	0.603	4
989	0.604	4
883	0.935	5
994	0.935	5
945	0.935	5
956	0.935	5
915	0.605	4
786	0.605	4
885	0.937	5
1017	0.938	5
949	0.938	5
855	0.607	4
976	0.939	5
856	0.939	5
993	0.608	4
1016	0.608	4
995	0.939	5
1045	0.940	5
1012	0.609	4
800	0.941	5
918	0.610	4
803	0.942	5
898	0.611	4
1029	0.612	4

5.3.3 Displaying Risk output in shape form

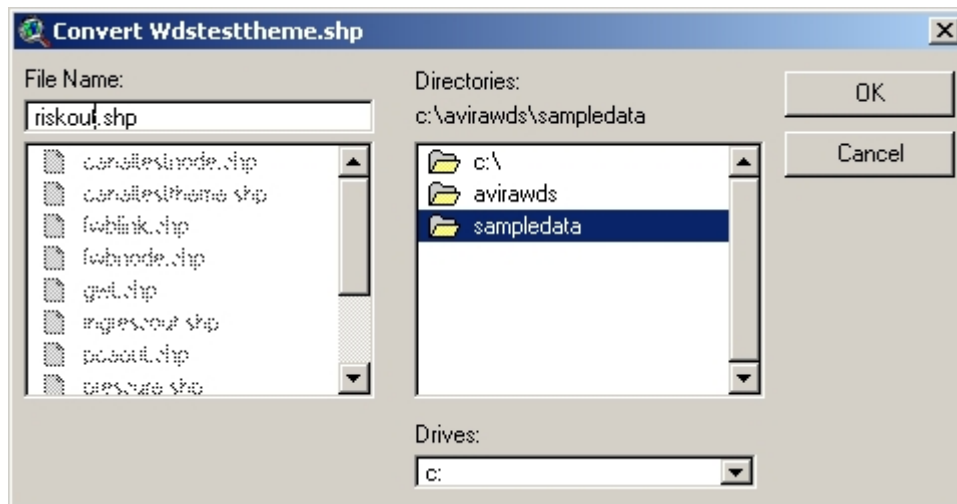
To view the Risk Assessment output in shape file form, the user should click on the  button, which is just below the 'Risk Assessment' menu or he or she should click on the 'Risk Assessment' menu and then click on the submenu 'Display RISK Output in Shape Form', as shown on the screen below:



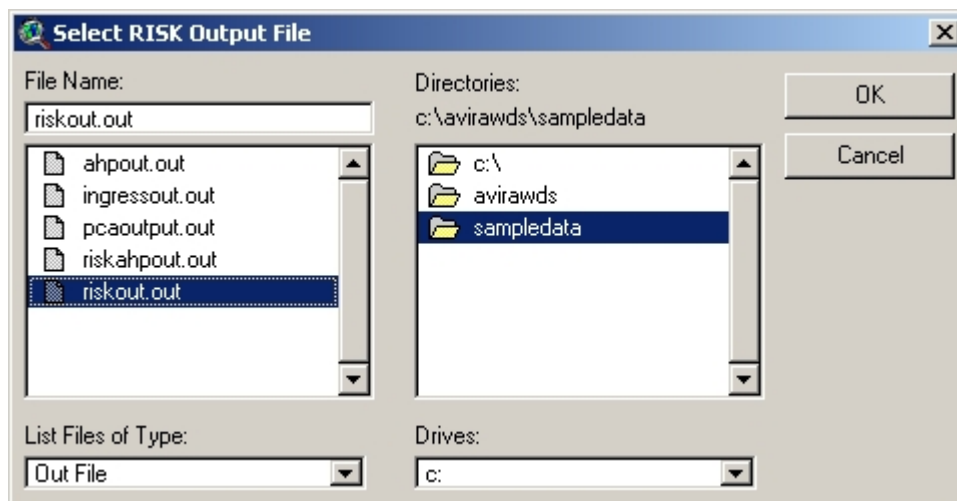
This opens the 'Display Theme' message box asking the user to specify which theme represents the water distribution system pipe theme, as shown below:



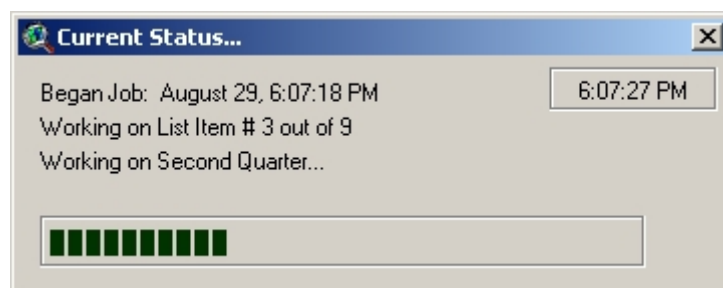
Once the user has selected the appropriate theme representing the water distribution system pipe network and has clicked on the 'OK' button, the 'Convert Theme' dialogue box appears on the screen; this asks the user to give the name with which he or she wants to store or convert the selected theme, as shown on next page.



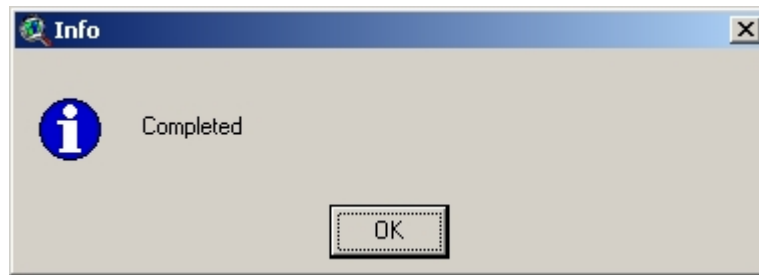
The program then opens the 'File Select' dialogue box for selecting the Risk Assessment output file as *.out, from which attributes for 'Risk Index' (RISKIndex and RISKRank) are to be added to the output theme, as shown below:



Once the user has selected the appropriate filename and clicked 'OK', the program shows the progress meter, as shown below:



On completion of theme generation and attribute addition, it displays the 'Completed' Info message box, as shown on next page.



After clicking the 'OK' button on this message box, the new shape-file is added to the IRA-WDS data viewer. The 'RISKOut' theme legend needs to be changed by the user and rather than viewing the theme in a single colour, it can be viewed by unique values of 'RISKRank', as shown below:

