

# REALM WORKED EXAMPLES

(REALM Version 6.0 16/12/2008)

VICTORIA UNIVERSITY

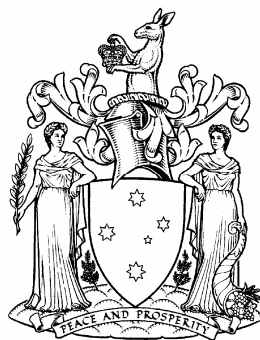
AND

DEPARTMENT OF SUSTAINABILITY AND ENVIRONMENT

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**Department of  
Sustainability and Environment**



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## Conventions used in this text

|                                |   |
|--------------------------------|---|
| <i>c:\REALM\WorkedExamples</i> | Phrase in Italic is either a name of a file/ directory or complete path of a file or both |
| <b>Bold</b>                    | Phrases in Bold format is used to highlight.  |

# Chapter

# 1

**1 INTRODUCTION**

The **REALM Getting Started** manual trains the novice user to get acquainted with REALM, while the **REALM User Manual** contains detailed information on various aspects of the software, including theory. The **REALM Worked Examples** manual leads the user through a set of worked examples of gradually increasing complexity. Once the user completes these worked examples, it is anticipated that he/she is sufficiently skilled in using REALM for typical water resource planning applications.

The user is advised to create a separate directory for these worked examples. In this manual, it is assumed that the user has created a directory called *work* under *c:\realm* (ie. *c:\realm\work*) using REALM Program Manager.

This manual is prepared mainly for use in REALM workshops. Therefore, the instructions on how to use REALM for these examples are not given in the manual. Instead, the purpose of the worked example problems and the procedure on how to use REALM for these problems are briefly outlined. The solutions to these problems are given in the second part of the manual.

The function of each worked example problem is briefly described below.

- **Worked Example 1:** Preparation of REALM format streamflow and demand files from MS EXCEL files.
- **Worked Example 2:** Illustration of basic REALM capabilities using a water resource system of a single reservoir and a single demand zone. The System Editor, System Listing, Run Setup, Run Model, utility Plot and utility Merger will be used. The reservoir evaporation losses, the demand restrictions and different types of carriers will also be considered.
- **Worked Example 3:** Use of target storage curves in allocating water within a water resource system of two reservoirs and two demand zones.
- **Worked Example 4:** Illustration of above and below target zones and drawdown priority in allocating water within a water resource system of three reservoirs and two demand zones.
- **Worked Example 5:** Illustration of demand shortfall zones and shortfall priority in allocating water within a water resource system of a single reservoir and two demand zones.
- **Worked Example 6:** Water quality modelling.
- **Worked Example 7:** Modelling of irrigation demand restrictions.
- **Worked Example 8:** Modelling of a capacity shared water resource system. Several methods of capacity sharing modelling are considered.

All relevant input data files (ie. streamflow, demand, system and scenario files), which can be used in the worked examples are in the *c:\REALM\WorkedExamples* directory. The user can use these files (without creating them) to run REALM. However, the user is required to be in *c:\REALM\WorkedExamples* directory and necessary to load the relevant scenario file for the worked example under consideration using Run Setup of REALM.

# Chapter

# 2

**2 PROBLEM DEFINITIONS**



## 2.1 WORKED EXAMPLE 1

### 2.1.1 PREPARATION OF STREAMFLOW AND DEMAND DATA FILES

Generally, streamflow and demand files are prepared initially using a spreadsheet package. They are then translated into a REALM format file. Alternatively, these files can be prepared through a standard editor such as Notepad in Windows or File Viewer (or editor) available in REALM. This tutorial is designed to illustrate the process of translating an MS EXCEL file into a REALM format file.

#### 2.1.1.1 STREAMFLOW DATA FILE

An MS EXCEL spreadsheet containing streamflow data is given as a computer file named *stream1.xls* in the *c:\REALM\WorkedExamples* directory. The file contains only the numeric data in 5 columns. They are the month, the year and three columns of streamflow data for a 3-year period. Using this file, prepare a REALM format file with streamflow column names as

STREAM A  
STREAM B  
INFLOW 1

Follow the steps given below.

- Open the file *stream1.xls* using MS EXCEL.
- Save the file as a *space delimited formatted text file* (use any file name with any extension; default is *stream1.prn*).
- Edit the saved file (ie. *stream1.prn*) using Notepad in Windows, File Viewer in REALM or any other editor. Add the required header information, including the format statement.
- Save the file under the same name or any other name.

This is the REALM format streamflow file.

#### 2.1.1.2 DEMAND FILE

A MS EXCEL spreadsheet containing demand data is given as a computer file named *demand1.xls* in the *c:\REALM\WorkedExamples* directory. The file contains only the numeric data in 3 columns. They are the month, the year and one column of demand data for a 3-year period. Using this file, prepare a REALM format file with demand column name as DEMAND 1.

Follow the steps in (a) above with appropriate header information for the demand file.

## 2.2 WORKED EXAMPLE 2

### 2.2.1 SINGLE RESERVOIR AND SINGLE DEMAND ZONE SYSTEM

This worked example is designed to illustrate the use of System Editor, System Listing, Run Setup, Run Model, utility Plot and utility Merger. Furthermore, the modelling of reservoir evaporation losses and urban demand restrictions are also considered. The use of different types of carriers are also considered, together with the effect of carrier capacity on supply to demand zones. (ie. demand shortfalls). Several sub-problems are considered to illustrate these concepts.

The streamflow files (*sf1.dat* and *sf2.dat*) and the demand file (*dem.dat*) corresponding to these examples are given in the *c:\REALM\WorkedExamples* directory. The user is advised to study the contents and formats of these files.

### 2.2.2 SUB-PROBLEMS

- a) A water supply system consists of a single reservoir and a single urban demand centre. The reservoir minimum and maximum capacities are 0 and 12,000 ML respectively. The streamflow input to the reservoir is via the column name 'STREAM1' in the streamflow file (*sf1.dat*). The demand input is via the column name 'DEMAND 1' in the demand file (*dem.dat*). The reservoir and the demand centre are connected by a pipe (ie. 'Pipe' type carrier), which has a constant capacity of 12,000 ML/month. Spilled waer goes to the river. The reservoir evaporation and restrictions are not to be modelled in this case. Create the system file using the System Editor and save as *Ex2A.sys*. Look at *EX2A.sys* in the *c:\REALM\WorkedExamples* directory in case of difficulty in using the System Editor. Use System Listing to obtain a listing (with headings). Look at the contents of this file.

The simulation period is from January 1982 to December 1984 and the initial storage volume is 9,000 ML. Use Run Setup for setting up the simulation with the simulation log file name of *EX2A.log*. Select the output options at least for reservoir storage volume and flow in the pipe. Save the scenario file as *scn2a.scn*. Use *scn2a.scn* in the *c:\REALM\WorkedExamples* directory in case of difficulty in using Run Setup.

Use Run Model to perform the simulation. Look at the contents of the log file. Use utility Plot to plot the reservoir storage volume and flow in the pipe.

- b) The system is same as in (a), but the reservoir evaporation is to be modelled. The evaporation is modelled through the column names 'PAN EVAP' and 'LOCAL RAIN' in the streamflow file *sf2.dat*. The coefficients A and B are 0.5 and 3 respectively. The volume-surface area relationship is given in Table 2.2-1.

The demand file is *dem.dat*. The other details are same as in (a). Edit *EX2A.sys* using the System Editor and save as *Ex2B.sys* after changes. Look at *EX2B.sys* in the *c:\REALM\WorkedExamples* directory in case of difficulty in using the System Editor.

Use Run Setup to set up the simulation with the log file name as *EX2B.log*. Select the reservoir evaporation as an output option in addition to those of (a). Save the scenario file as *scn2b.scn*. Use *scn2b.scn* in the *c:\REALM\WorkedExamples* directory in case of difficulty in using Run Setup.

Compare the storage behaviour with and without modelling evaporation graphically using utility Plot. Create an ASCII (or text) file showing the storage volume for cases (a) and (b). Study how evaporation is modelled in REALM

**Table 2.2-1 Volume-Surface Area Relationship for Reservoir**

| Volume (ML) | Surface Area (ha) |
|-------------|-------------------|
| 0           | 0                 |
| 500         | 10                |
| 1000        | 30                |
| 4000        | 40                |
| 6000        | 50                |
| 8000        | 60                |
| 9000        | 70                |
| 10000       | 80                |
| 11000       | 90                |
| 12000       | 100               |

- c) The system is same as in (a), except that the carrier connecting the reservoir and the demand centre has a constant capacity of 2,350 ML/month. This example is designed to illustrate the demand shortfalls. The other details (including streamflow and demand files) are same as in (a). Edit *Ex2A.sys* using the System Editor and save as *Ex2C.sys* after changes. Look at *EX2C.sys* in the *c:\REALM\WorkedExamples* directory in case of difficulty in using the System Editor.

Use Run Setup to set up the simulation with the log file name as *EX2C.log*. Select the output options of unrestricted, shortfalls and actually supplied from the demand data compartment, and carrier capacity from the carrier data compartment when running Run Setup, apart from the output options of (a). Save the scenario file as *scn2c.scn*. Use *scn2c.scn* in the *c:\REALM\WorkedExamples* directory in case of difficulty in using Run Setup.

Use utility Plot to investigate the effect of carrier capacity on supply to the demand zone.

- d) The system is same as in (a), except that the capacity of the interconnecting carrier depends on the reservoir storage volume. This carrier is a variable capacity carrier. The volume-capacity relationship for the carrier is given in Table 2.2-2.

**Table 2.2-2 Volume-Capacity Relationship for Carrier**

| Volume (ML) | Capacity (ML) |
|-------------|---------------|
| 0           | 0             |
| 6,000       | 1,200         |
| 12,000      | 2,400         |

The other details (including streamflow and demand files) are same as in (a). Edit *EX2A.sys* using the System Editor and save as *EX2D.sys* after changes. Look at *EX2D.sys* in the *c:\REALM\WorkedExamples* directory in case of difficulty in using the System Editor.

Use Run Setup to set up the simulation with the log file name as *EX2D.log*. All scenario details are as in (c) when running Run Setup. Save the scenario file as *scn2d.scn*. Use *scn2d.scn* in the *c:\REALM\WorkedExamples* directory in case of difficulty in using Run Setup.

Use utility Plot to investigate the effect of carrier capacity on supply to the demand zone.

- e) The system is same as in (a), except that the restrictions are imposed when the storage volume falls below 6,500 ML. The upper rule curve and the lower rule curve are defined by the reservoir storage volumes of 6,500 and 3,500 ML respectively for each month, and the base demand is given as 500 ML/month. Four restriction zones are to be considered. The details of the restriction zones are given in Table 2.2-3.

The other details (including streamflow and demand files) are same as in (a). Edit *EX2A.sys* using the System Editor and save as *EX2E.sys* after changes. Look at *EX2E.sys* in the *c:\REALM\WorkedExamples* directory in case of difficulty in using the System Editor.

**Table 2.2-3 Restriction Rule Curve Details**

| Level | Relative Position | Percentage Restriction |
|-------|-------------------|------------------------|
| 1     | 25                | 10                     |
| 2     | 50                | 20                     |
| 3     | 75                | 50                     |
| 4     | 100               | 70                     |

Use Run Setup to set up the simulation with the log file name as *Ex2E.log*. Select the output options as in (c) and two additional output options (ie. restricted demand and restriction levels), when running Run Setup. Save the scenario file as *scn2e.scn*. Use *scn2e.scn* in the *c:\REALM\WorkedExamples* directory in case of difficulty in using Run Setup.

Note the restriction details. Use System Listing and utility Plot to investigate the effect of the restrictions on supply to the demand zone. Create an ASCII (or text) file using utility Plot to show the above effect.

- f) The system is same as in (e), except that the reservoir evaporation is to be modelled as in (b) and the capacity of the interconnecting carrier as in (c). The streamflow and demand files are *sf2.dat* and *dem.dat* respectively. Edit *EX2E.sys* using the System Editor and save as *EX2F.sys* after changes. Look at *EX2F.sys* in the *c:\REALM\WorkedExamples* directory in case of difficulty in using the System Editor.

Use Run Setup to set up the simulation with the log file name as *EX2F.log*. All scenario details are as in (e). Save the scenario file as *scn2f.scn*. Use *scn2f.scn* in the *c:\REALM\WorkedExamples* directory in case of difficulty in using Run Setup.

Use utility Merger to create an ASCII (or text) file with unrestricted and restricted demands, carrier flow and capacity, and demand shortfalls, and investigate the results.

- g) The system is same as in (d), except that the capacity of the interconnecting carrier during a simulation time step depends on both start and end reservoir storage volume of that time step. The carrier is a variable capacity carrier. The volume–capacity relationship is given in Table 2.2-2. The volume in the volume–capacity relationship is computed from the following expression. This volume is used to compute the capacity of the carrier.

$$0.75 * \text{start storage} + 0.5 * \text{end storage} - 5000$$

The other details are exactly same as in (d). Edit *EX2C.sys* or *EX2D.sys* using the System Editor, and change the carrier connecting the reservoir and the demand zone to a variable

capacity carrier. Save the file as *Ex2G.sys*. Look at *Ex2G.sys* in the *c:\REALM\WorkedExamples* directory in case of difficulty in using the System Editor.

Use Run Setup to set up the simulation with the log file name as *Ex2G.log*. All scenario details are as in (d), when running Run Setup. Save the scenario file as *scn2g.scn*. Use *scn2g.scn* in the *c:\REALM\WorkedExamples* directory in case of difficulty in using Run Setup. Study the results and investigate how ‘Type 3’ carriers work.

Use utility Plot to investigate the effect of carrier capacity on supply to the demand zone.

## 2.3 WORKED EXAMPLE 3

### 2.3.1 TWO RESERVOIR AND TWO DEMAND ZONE SYSTEM

This worked example is designed to illustrate the use of target storage curves in allocating water within a water resource system. Again, several sub-problems are considered.

A streamflow file (*sf3.dat*) and a demand file (*dem2.dat*) corresponding to these examples are given in the *c:\REALM\WorkedExamples* directory. The user is advised to study the contents and formats of these files.

### 2.3.2 SUB-PROBLEMS

- a) Two reservoirs supply water to two urban demand zones. The first reservoir which has a maximum capacity of 12,000 ML supplies the first demand zone; the second reservoir which has a maximum capacity of 24,000 ML supplies the second demand zone. Both reservoirs have minimum capacities of 0 ML. Water from either reservoir can go to the other reservoir. Spilled water goes down the river. The streamflow inputs to the first and the second reservoirs are via the column names 'STREAM1' and 'STREAM2' respectively in the streamflow file (*sf3.dat*). The demand input is via the column names 'DEMAND 1' and 'DEMAND 2' in the demand file (*dem2.dat*). The reservoir evaporation and restrictions are not to be modelled in this case.

All four carriers are pipes. The monthly capacities of all carriers are constant over the year and given in Table 2.3-1. Use the linear target option.

**Table 2.3-1 Monthly Capacities of Carriers**

| Description                            | Min Capacity (ML) | Max Capacity (ML) |
|--|-------------------|-------------------|
| First reservoir to first demand zone   | 0                 | 12,000            |
| First reservoir to second reservoir    | 0                 | 24,000            |
| Second reservoir to second demand zone | 0                 | 24,000            |
| Second reservoir to first reservoir    | 0                 | 24,000            |

Create the system file using the System Editor and save as *EX3A.sys*. Look at *EX3A.sys* in the *c:\REALM\WorkedExamples* directory in case of difficulty in using the System Editor. The user can enter the number of above and below target zones for this case as 1. Why?

The simulation period is from January 1982 to December 1984. The initial storage volumes are 9,000 and 8,000 ML respectively for the first and the second reservoirs. Use Run Setup to set up the simulation with the log file name as *EX3A.log*. Select the output options for at least reservoir storage volume, target storage volume and flow in the pipes. Save the scenario file as *scn3a.scn*. Use *scn3a.scn* in the *c:\REALM\WorkedExamples* directory in case of difficulty in using Run Setup. Investigate the output files. Why are the trajectories of reservoir storage volume and target storage volume the same?

- b) The system is same as in (a), except that the non-linear (user-defined) targets are used. These targets are specified to achieve lower water levels in 12,000 ML reservoir. Ten target points (including maximum and minimum values) are to be considered, as given in Table 2.3-2.

**Table 2.3-2 Non-Linear Targets**

| Total System Storage (ML) | First Reservoir Volume (ML) | Second Reservoir Volume (ML) |
|---------------------------|-----------------------------|------------------------------|
| 0                         | 0                           | 0                            |
| 4,000                     | 1,000                       | 3,000                        |
| 8,000                     | 1,000                       | 7,000                        |
| 12,000                    | 2,000                       | 10,000                       |
| 16,000                    | 2,000                       | 14,000                       |
| 20,000                    | 3,000                       | 17,000                       |
| 24,000                    | 3,000                       | 21,000                       |
| 28,000                    | 4,000                       | 24,000                       |
| 32,000                    | 8,000                       | 24,000                       |
| 36,000                    | 12,000                      | 24,000                       |

The other details are same as in (a). Edit *EX3A.sys* using the System Editor and save as *EX3B.sys* after changes. Look at *EX3B.sys* in the *c:\REALM\WorkedExamples* directory in case of difficulty in using the System Editor.

Use Run Setup to set up the simulation with the log file name as *EX3B.log*. All scenario details are as in (a). Save the scenario file as *scn3b.scn*. Use *scn3b.scn* in the *c:\REALM\WorkedExamples* directory in case of difficulty in using Run Setup.

Investigate the differences in results of (a) and (b).

- c) The system is same as in (a), except that the carrier from the second reservoir to the first reservoir is taken off. Edit *EX3A.sys* using the System Editor and save as *EX3C.sys* after changes. Look at *EX3C.sys* in the *c:\REALM\WorkedExamples* directory in case of difficulty in using the System Editor.

Use Run Setup to set up the simulation with the log file name as *EX3C.log*. All scenario details are as in (a). Save the scenario file as *scn3c.scn*. Use *scn3c.scn* in the *c:\REALM\WorkedExamples* directory in case of difficulty in using Run Setup.

Study the results to find out how the targets control the flow in the network.

Use utility Plot to compare the total system storage and the total target storage. Why are they the same?

- d) The system is same as in (c), except that the maximum capacity of the carrier connecting the first reservoir to the first demand zone is reduced to 2,000 ML/month. Also, a carrier with a minimum and maximum capacities of 0 and 24,000 ML/month is established between the second reservoir and the demand zone 1. The other details are same as in (c). Edit *EX3C.sys* using the System Editor and save as *EX3D.sys* after changes. Look at *EX3D.sys* in the *c:\REALM\WorkedExamples* directory in case of difficulty in using the System Editor.

Use Run Setup to set up the simulation with the log file name as *EX3D.log*. All scenario details are as in (a). Save the scenario file as *scn3d.scn*. Use *scn3d.scn* in the *c:\REALM\WorkedExamples* directory in case of difficulty in using Run Setup.

Compare the individual storage and target storage volumes of the reservoirs. Investigate why the targets and storage volumes are different only for 5/1984. Also study the carrier flows.

## 2.4 WORKED EXAMPLE 4

### 2.4.1 ILLUSTRATION OF ABOVE AND BELOW TARGET ZONES AND DRAWDOWN PRIORITY

This worked example is designed to illustrate the use of above/below target zones and drawdown priority of reservoirs in allocating water within the water resource system. This tutorial uses three reservoirs and two demand centres.

Why is it necessary to have at least three reservoirs to illustrate these concepts?

A streamflow file (*sf3.dat*) and a demand file (*dem2.dat*) are given in the *c:\REALM\WorkedExamples* directory for use in this worked example. The user is advised to study the contents and formats of these files.

### 2.4.2 SUB-PROBLEMS

- a) Three reservoirs supply water to two urban demand zones. The first and the second reservoirs have maximum capacities of 12,000 ML and 20,000 ML respectively, and supply the first demand zone. The third reservoir with a maximum capacity of 10,000 ML supply the second demand zone. All three reservoirs have minimum capacities of 0 ML. A pipe is used for inter-reservoir transfer from the second reservoir to the third reservoir. Spill water goes down the river. The streamflow inputs to the first, second and third reservoirs are via the column names 'STREAM1', 'STREAM2' and 'STREAM1' respectively in the streamflow file (*sf3.dat*). The demand inputs are via the column names 'DEMAND 1' and 'DEMAND 2' in the demand file (*dem2.dat*). The reservoir evaporation and restrictions are not to be modelled in this case.

All four carriers are pipes. The monthly capacities of all carriers are constant and the minimum and maximum values for each carrier are 0 and 99,999,999 ML respectively. (99,999,999 is the unlimited capacity of carriers in REALM). Use the number of above and below target zones for each reservoir as 1. Drawdown priorities for the first, second and third reservoirs are 1, 2 and 3 respectively. Use the linear targets option.

Create the system file using the System Editor and save as *EX4A.sys*. Look at *EX4A.sys* in the *c:\REALM\WorkedExamples* directory in case of difficulty in using the System Editor.

The simulation period is from January 1982 to December 1984. The initial storage volumes are 8,000, 10,000 and 8,000 ML respectively for first, second and third reservoirs. Use Run Setup to set up the simulation with the log file name as *EX4A.log* and select the output options at least for reservoir storage volume, target storage volume, demand shortfalls, and flow and capacity in the pipes. Save the scenario file as *scn4a.scn*. Use *scn4a.scn* in the *c:\REALM\WorkedExamples* directory in case of difficulty in using Run Setup.

- b) The system is same as in (a), except that the number of below target zones for the first reservoir, which is to be arbitrarily set at 25, to illustrate the concepts in this worked example. (In this case, it is possible only to illustrate the storage going below target. Why?) The other details are same as in (a). Edit *EX4A.sys* using the System Editor and save as *Ex4B.sys* after changes. Look at *Ex4B.sys* in the *c:\REALM\WorkedExamples* directory in case of difficulty in using the System Editor.

Use Run Setup to set up the simulation with the log file name as *EX4B.log*. All scenario details are as in (a). Save the scenario file as *scn4b.scn*. Use *scn4b.scn* in the



*c:\REALM\WorkedExamples* directory in case of difficulty in using Run Setup.

Use utility Plot to plot the individual reservoir storage and target storage volumes for the cases (a) and (b). Perform manual calculations to investigate the difference in storage volumes in cases (a) and (b), and to study how the below target zones and drawdown priority control the storage levels. Consider January 1982 for manual calculations.

Why are the reservoir target storage volumes same for cases (a) and (b)?

Use utility Merger to create an ASCII (or text) file for reservoir storage volume and target storage volume for all reservoirs.

## 2.5 WORKED EXAMPLE 5

### 2.5.1 ILLUSTRATION OF DEMAND SHORTFALL ZONES AND SHORTFALL PRIORITY

This worked example is designed to illustrate the use of demand shortfall zones (or bypass zones) and shortfall priority in allocating water within the water resource system. The example involves one reservoir and two demand centres.

Why is it necessary to have at least two demand zones to illustrate these concepts?

A streamflow file (*sf3.dat*) and a demand file (*dem2.dat*) are given in the *c:\REALM\WorkedExamples* directory for use in this example. The user is advised to study the contents and formats of the files.

### 2.5.2 SUB-PROBLEMS

- a) A reservoir with minimum and maximum capacities of 0 and 12,000 ML respectively supplies water to two urban demand zones. The streamflow input to the reservoir is via the column name 'STREAM1' in the streamflow file (*sf3.dat*). The demand inputs are via the column names 'DEMAND 1' and 'DEMAND 2' in the demand file (*dem2.dat*). Spill water goes down the river. Use the number of demand shortfall zones for DEMAND 1 and DEMAND 2 as 1, and the shortfall priority for DEMAND 1 and DEMAND 2 as 1 and 2 respectively. The reservoir evaporation and restrictions are not to be modelled in this example.

Both carriers are pipes and the monthly capacities of the carriers are constant. The minimum and maximum capacities of both carriers are 0 and 99,999,999 ML respectively.

Create the system file using the System Editor and save as *EX5A.sys*. Look at *EX5A.sys* in the *c:\REALM\WorkedExamples* directory in case of difficulty in using the System Editor.

Use System Listing to get a listing of the system file with captions. Note that the number of shortfall zones in this file is given as 'No Bypass'.

The simulation period is from January 1982 to December 1984 and the initial storage volume is 8,000 ML. Use Run Setup to set up the simulation with the log file name as *EX5A.log* and select the output options at least for reservoir storage volume, unrestricted demand, demand shortfalls and flow in the pipes. Save the scenario file as *scn5a.scn*. Use *scn5a.scn* in the *c:\REALM\WorkedExamples* directory in case of difficulty in using Run Setup.

- b) The system is same as in (a), except that the number of demand shortfall zones for DEMAND 1 and DEMAND 2 are 2 and 4 respectively. Edit *EX5A.sys* using the System Editor and save as *EX5B.sys* after changes. Look at *EX5B.sys* in the *c:\REALM\WorkedExamples* directory in case of difficulty in using the System Editor.

Use Run Setup to set up the simulation with the log file name as *EX5B.log*. All scenario details are as in (a). Save the scenario file as *scn5b.scn*. Use *scn5b.scn* in the *c:\REALM\WorkedExamples* directory in case of difficulty in using Run Setup.

Use utility Plot to plot the demand shortfalls for cases (a) and (b). Investigate the output files.

Perform manual calculations to investigate how the demand shortfall zones and shortfall priority work in supplying the required demand. Consider March 1982.

## 2.6 WORKED EXAMPLE 6

### 2.6.1 WATER QUALITY MODELLING

This worked example is designed to illustrate the water quality modelling capabilities of REALM. Water quality modelling in REALM is based on pure mixing. The rejection of flows in certain flow paths based on water quality and the effect of evaporation losses on the water quality of reservoirs are demonstrated.

It is important to note that in this example the water quality constituents are considered to have constant concentrations during the month, which may not be the case in a real application. However, the fixed monthly concentrations are used to illustrate the features of water quality modelling with the same streamflow and demand files used in the other worked examples. The water quality should be modelled with a daily REALM model, where daily variations are considered necessary.

The streamflow files (*sf4.dat* and *sf5.dat*) and the demand file (*dem.dat*) corresponding to these examples are given in the *c:\REALM\WorkedExamples* directory. The user is advised to study the contents and formats of these files.

### 2.6.2 SUB-PROBLEMS

- a) A reservoir with minimum and maximum capacities of 0 and 20,000 ML respectively supplies water to an urban demand centre via a pipe. When the reservoir is full, the excess water is spilled to a natural water course. Water is not used by the demand centre, if the EC of water is greater than 400 EC units. This flow rejection is to be modelled with two pipes. Note that this can be modelled with one variable capacity pipe. However, this network is used in subproblem (b) to illustrate additional water quality modelling capabilities. The first pipe is from the reservoir to a pipe junction with unlimited capacity and the second pipe is from the pipe junction to the demand centre, which depends on the EC concentration of reservoir. Two water quality parameters, EC and turbidity, are to be considered.

The streamflow inputs to the reservoir is via the column name 'STREAM1' in the streamflow file (*sf4.dat*), while EC values corresponding to these flows are given by the column name EC\_VALUES in the same file. The turbidity concentration of reservoir is a fixed concentration of 1,000 turbidity units. The demand input is via the column name 'DEMAND 1' in the demand file (*dem.dat*). The reservoir evaporation and restrictions are not to be modelled in this example.

Create the system file using the System Editor and save as *EX6A.sys*. Look at *EX6A.sys* in the *c:\REALM\WorkedExamples* directory in case of difficulty in using the System Editor.

The simulation period is from January 1982 to December 1984 and the initial storage volume is 10,000 ML. The initial concentration of EC and turbidity are 200 EC units and 1000 turbidity units respectively. Use Run Setup to set up the simulation with the log file name as *EX6A.log* and select the output options at least for reservoir storage volume, water quality of reservoirs, and flow and capacity of carriers. Save the scenario file as *scn6a.scn*. Use *scn6a.scn* in the *c:\REALM\WorkedExamples* directory in case of difficulty in using Run Setup.

Use the utility Merger to create an ASCII (or text) file with reservoir EC, and flow and capacity of the variable capacity carrier. Note that the reservoir EC given in REALM output time series file is the concentration at the end of the simulation time step.

- (b) The system is same as in (a), except that the reservoir evaporation is to be modelled. The evaporation is modelled through the column names 'PAN EVAP' and 'LOCAL RAIN' in the streamflow file *sf5.dat*. The coefficients A and B are 0.5 and 3 respectively. The volume-surface area relationship is given in Table 2.2-1. The demand file is *dem.dat*. The other details are same as in (a).

Edit *EX6A.sys* using the System Editor and save as *EX6B.sys* after changes. Look at *ex6b.sys* in the *c:\REALM\WorkedExamples* directory in case of difficulty in using the System Editor.

Use Run Setup to set up the simulation with the log file name as *EX6B.log*. Select the reservoir evaporation as an output option in addition to those of (a), and other scenario details are same as in (a). Save the scenario file as *scn6b.scn*. Use *scn6b.scn* in the *c:\REALM\WorkedExamples* directory in case of difficulty in using Run Setup.

Compare the water quality in the reservoir with and without modelling evaporation graphically using utility Plot. Use utility Plot to create an ASCII (or text) file showing the water quality for cases (a) and (b). Do manual calculations to investigate how REALM water quality module works.

## 2.7 WORKED EXAMPLE 7

### 2.7.1 MODELLING OF IRRIGATION DEMAND RESTRICTIONS

Modelling of irrigation demand restrictions is considered in this worked example. The system used for this example is a component of the Werribee system model, which was developed in 1997.

The system is fairly complex and all data relevant to the example are not explained here. Therefore, the user is not required to create the system file. Instead, the user should look at the contents of the system data file for node, carrier and demand restriction details, using the System Editor. In addition, the user should use System Listing to study the contents of the system file. The system data file used in this example is *WERRIRRG.sys* and is given in the *c:\REALM\WorkedExamples* directory.

The streamflow file *WERRFLOW.SF* and the demand file *WERRIRR.DEM* are used in this example and are given in the *c:\REALM\WorkedExamples* directory. The user is advised to study the contents and formats of these files.

Some details are given below to describe the system. Water is supplied to the system from a number of weirs and Pykes Creek reservoir (which has minimum and maximum capacities of 1,190 and 23,920 ML respectively). The demands to be supplied from this system are:

Bacchus Marsh (BM) irrigation district  
 CSR industrial demand  
 Lerderderg private diverters

The environmental releases are to be provided in certain carriers and they are modelled through 'minimum capacities' in carriers.

The demand restriction policy, which has been modelled in this example, is:

- CSR industrial demand and Lerderderg private diverters are not to be restricted at any time, provided water is available.
- The irrigation demands in the BM irrigation district (defined by DC2 nodes of BM IRRIGATION and BM OUTSIDE SALES) are considered to form one demand group. This demand group is restricted based on the available water for release.

The simulation period is from July 1920 to June 1990 and the initial storage volume of the Pykes Creek reservoir is 20,000 ML. Use Run Setup to set up the simulation with the log file name as *IRRG.log* and select the output options at least for reservoir storage volume, reservoir evaporation, unrestricted, restricted and supplied demands, restriction levels, and flow and capacity of carriers. Select the following (important) carriers.

PYKES DIV2  
 WERRIBEE D/S PYKES  
 TO BM IRRIGATION  
 TO CSR FACTORY  
 BM-OFFTAKE

WERRIBEE U/S BM WEIR  
TO BM OUTSIDE SALES  
WERRIBEE D/S BM  
FROM INFL U/S MELTON  
LERD DIS GOOD.  
LOWER LERD  
FROM PARWON CK  
BM OPERATIONAL SPILL  
END SECTION 1  
END SECTION 2

Save the scenario file as *scn7.scn*. Use *scn7.scn* in the *c:\REALM\WorkedExamples* directory in case of difficulty in using Run Setup. Study the log file and the other output files. Note that only the System Listing output file and log files are given in the Solutions section, since the streamflow and demand input files, and the output files generated from REALM are too long (i.e. planning period is 70 years). Note that under ‘Demand data’ of the log file, the LEADERBERG DV irrigation demand has the maximum restriction level as 1,000, which indicates no restrictions.

Create an ASCII (or text) file using utility Plot with the following details and study how the irrigation restriction policy works.

- unrestricted, restricted and supplied demands of two irrigation demand zones (i.e. BM IRRIGATION and BM OUTSIDE SALES)
- demand restriction levels of these irrigation demand zones, and
- storage volume of the reservoir.

Study whether the minimum flows are met at all times.

## 2.8 WORKED EXAMPLE 8

### 2.8.1 MODELLING OF CAPACITY SHARED SYSTEMS

Two techniques in modelling capacity shared systems are considered in this worked example. They are:

- 'Explicit' capacity sharing, and
- 'Implicit' capacity sharing.

Explicit capacity sharing uses separate notional storages and carriers for each capacity sharing group and the 'actual' storages and carriers are modelled indirectly (by summing up the notional storages and the carriers respectively). Implicit capacity sharing, on the other hand, models the 'actual' storages and carriers directly, and capacity sharing features are modelled through an accounting network. Although the modelling techniques are different, they should yield the same (more or less) result.

In this example, the capacity sharing of reservoirs, carriers, losses (both reservoir evaporation and carrier losses) and internal spills between notional storages are considered.

The system used for this example is a component of the Werribee system model, which was developed in 1997. Two system files are considered, one for explicit modelling and the other for implicit modelling. The system files are fairly complex, and all data relevant to the creation of these system files are not explained here. Therefore, the user is not required to create the system files. Instead, the user should look at the contents of the system data files for node, carrier and demand restriction details, using the System Editor. In addition, the user should use System Listing to study the contents of the system file.

The streamflow file *WERRCAPC.SF* and the demand file *WERRIRR.DEM* are used in this example, and are given in the *c:\REALM\WorkedExamples* directory. The user is advised to study the contents and formats of these files.

Some details are given below to describe the system. The system consists of the Merrimu and Djerriwarrh reservoirs, and Melton and Bacchus Marsh townships as urban demand centres. Merrimu also supplements the irrigation requirements of the Werribee irrigation district. This irrigation demand is modelled through a volume dependent carrier with a high negative penalty. In addition, the system supplies the required environmental releases. The system has (currently) unused storage capacity, which is to be reserved for future requirements. The system is planned to operate as a capacity shared system. The Merrimu reservoir has a minimum and maximum capacity of 300 and 35,000 ML respectively.

The capacity sharing details are given as follows. Three user groups are considered namely:

- Urban group
- Irrigation group
- Unallocated resource group

The resources of the Merrimu reservoir are to be shared between the user groups. The maximum storage capacity reserved for capacity sharing purposes for urban, irrigation and unallocated are 21,000 (60%), 7,500 (21.4%) and 6,500 (18.6%) ML respectively. The rain on to the reservoir and the evaporation from the reservoir are to be shared in the proportion of 60%, 30% and 10% respectively. Similarly, the inflows that can be physically shared between all three groups (i.e. inflows at the Merrimu reservoir and other inflows that are accessible to all user groups) are to be shared according to the same proportion. When the environmental flows are to be supplied from the resources of all three user groups, they are also shared according to the same proportion.

The internal spills from one user group are shared between the other two user groups based on user-specified ratios. The internal spills are handled by 'internal spill' carriers, which are capacity shared. When all three notional storages spill, external spills will occur.

The urban demands are represented by Melton and Bacchus Marsh township demands, while the unallocated reservoir share supplies a notional urban demand. The demand restriction policy, which has been modelled in this example, is:

- Bacchus March township demand is not to be restricted at any time, provided water is available.
- A single demand group is to be considered for demand restrictions. The restrictions are based on the storage volumes of Merrimu and Djerriwarrh reservoirs. This demand group consists of the Melton township demand and the notional demand. A four-level urban restriction demand policy is considered for this demand group.

## 2.8.2 EXPLICIT CAPACITY SHARING

The system data file used for explicit capacity sharing is *WERREXPL.sys* and is given in the *c:\REALM\WorkedExamples* directory.

The simulation period is from July 1920 to June 1990, and the initial storage volumes of the Merrimu reservoir shares and Djerriwarrh reservoir are as given in the Table 2.8-1.

**Table 2.8-1 Initial Storage Volumes of Reservoirs**

|                     |           |
|---------------------|-----------|
| Merrimu urban       | 16,314 ML |
| Merrimu irrigation  | 5,123 ML  |
| Merrimu unallocated | 5,123 ML  |
| Djerriwarrh         | 500 ML    |

Use Run Setup to set up the simulation with the log file name as *EXPL.log* and select the output options at least for reservoir storage volume, unrestricted, restricted and supplied demands, restriction levels, and flow and capacity of carriers. Save the scenario file as *scn8e.scn*. Use *scn8e.scn* in the *c:\REALM\WorkedExamples* directory in case of difficulty in using Run Setup.

Study the log file and the other output files. Note that only the System Listing output file and the log file are given in the Solutions section, since the streamflow and demand input files, and the output files generated from REALM are too long (i.e. planning period is 70 years).

Create an ASCII (or text) file using utility Plot with appropriate columns to study how explicit modelling of capacity sharing works.



### 2.8.3 IMPLICIT CAPACITY SHARING

The system data file used for implicit capacity sharing is *WERRIMPL.sys* and is given in the *c:\REALM\WorkedExamples* directory.

The simulation period is from July 1920 to June 1990, and the initial storage volumes of the Merrimu reservoir shares and Djerriwarrh reservoir are as given in the Table 2.8-2.

**Table 2.8-2 Initial Storage Volumes of Reservoirs**

|                     |           |
|---------------------|-----------|
| Merrimu urban       | 16,314 ML |
| Merrimu irrigation  | 5,123 ML  |
| Merrimu unallocated | 5,123 ML  |
| Djerriwarrh         | 500 ML    |

Use Run Setup to set up the simulation with the log file name as *IMPL.log* and select the output options at least for reservoir storage volume, unrestricted, restricted and supplied demands, restriction levels, and flow and capacity of carriers. Save the scenario file as *scn8i.scn*. Use *scn8i.scn* in the *c:\REALM\WorkedExamples* directory in case of difficulty in using Run Setup.

Study the log file and the other output files. Note that only the System Listing output file and the log file are given in the Solutions section, since the streamflow and demand input files, and the output files generated from REALM are too long (i.e. planning period is 70 years).

Create an ASCII (or text) file using utility Plot with appropriate columns to study how implicit modelling of capacity sharing works.

Compare the results from explicit and implicit capacity sharing modelling.

# Chapter 3

**3 SOLUTIONS**

### **3.1 WORKED EXAMPLE 1**

## **PREPARATION OF STREAMFLOW AND DEMAND FILES**

**WORKED EXAMPLE 1 – STREAMFLOW FILE**

```

####2
STREAMFLOW DATA FILE
EALM WORKED EXAMPLES - TUTORIAL 1
TEST DATA
DATE: 20 JULY 1997
(I8,I11,2I12,I7)
5
SEASON
YEAR
STREAM A
STREAM B
INFLOW 1
  1      1982      416      400  4988
  2      1982      288      600  2249
  3      1982     1025     1200  1234
  4      1982      450      90   2273
  5      1982     4988     120  2160
  6      1982     2249     700  1216
  7      1982     1234      10  1338
  8      1982     2273     1200 1200
  9      1982     2160     2000  90
 10     1982     1216     450  120
 11     1982     1338     900  700
 12     1982     1269     3000  10
  1      1983      172      500  1200
  2      1983      160      900  2000
  3      1983      566      200  450
  4      1983     3848     100  900
  5      1983     3220      50  2360
  6      1983     1500      700  2023
  7      1983     4640      900  2967
  8      1983     3900     1500 4426
  9      1983     4600     2500  246
 10     1983     2360     1500 2526
 11     1983     2023      600  1513
 12     1983     2967      650  1500
  1      1984     4426      950  4640
  2      1984      246      200  3900
  3      1984     2526      350  4600
  4      1984     1513      200  2360
  5      1984      525     7000  2023
  6      1984     2833     2500 2967
  7      1984      908      900  4426
  8      1984     2029     500  246
  9      1984     4600      450  350
 10     1984     5910     1000  200
 11     1984      249     1100 7000
 12     1984      353      670  2500

```

**WORKED EXAMPLE 1 – DEMAND FILE**

```

####3
DEMAND DATA FILE
REALM WORKED EXAMPLES - TUTORIAL 1
TEST DATA
DATE: 20 JUL 1997
(3F12.2)
3
SEASON
YEAR
DEMAND 1
  1.00    1982.00    2700.00
  2.00    1982.00    1300.00
  3.00    1982.00    2100.00
  4.00    1982.00    1500.00
  5.00    1982.00    1600.00
  6.00    1982.00     700.00
  7.00    1982.00    1200.00
  8.00    1982.00    1800.00
  9.00    1982.00    2200.00
 10.00    1982.00    1300.00
 11.00    1982.00    1400.00
 12.00    1982.00    1400.00
  1.00    1983.00    1900.00
  2.00    1983.00    1100.00
  3.00    1983.00    1300.00
  4.00    1983.00     800.00
  5.00    1983.00     500.00
  6.00    1983.00     600.00
  7.00    1983.00     900.00
  8.00    1983.00     300.00
  9.00    1983.00     600.00
 10.00    1983.00    1400.00
 11.00    1983.00    2100.00
 12.00    1983.00    2100.00
  1.00    1984.00    1100.00
  2.00    1984.00    2300.00
  3.00    1984.00    2800.00
  4.00    1984.00    1900.00
  5.00    1984.00     300.00
  6.00    1984.00     600.00
  7.00    1984.00     600.00
  8.00    1984.00     100.00
  9.00    1984.00    1600.00
 10.00    1984.00    1300.00
 11.00    1984.00    2400.00
 12.00    1984.00    2100.00

```

### **3.2 WORKED EXAMPLE 2**

# **SINGLE RESERVOIR AND SINGLE DEMAND ZONE SYSTEM**

## DATA FILE: SF1.DAT

```

####2
STREAMFLOW DATA FILE
HISTORICAL MONTHLY STREAMFLOW DATAFILE
TEST DATA
DATE : 20 JUL 1990
( 3F12.2)
3
SEASON
YEAR
STREAM1
  1.00    1982.00    416.00
  2.00    1982.00    288.00
  3.00    1982.00   1025.00
  4.00    1982.00    450.00
  5.00    1982.00   4988.00
  6.00    1982.00   2249.00
  7.00    1982.00   1234.00
  8.00    1982.00   2273.00
  9.00    1982.00   2160.00
 10.00    1982.00   1216.00
 11.00    1982.00   1338.00
 12.00    1982.00   1269.00
  1.00    1983.00    172.00
  2.00    1983.00    160.00
  3.00    1983.00    566.00
  4.00    1983.00   3848.00
  5.00    1983.00   3220.00
  6.00    1983.00   1500.00
  7.00    1983.00   4640.00
  8.00    1983.00   3900.00
  9.00    1983.00   4600.00
 10.00    1983.00   2360.00
 11.00    1983.00   2023.00
 12.00    1983.00   2967.00
  1.00    1984.00   4426.00
  2.00    1984.00    246.00
  3.00    1984.00   2526.00
  4.00    1984.00   1513.00
  5.00    1984.00    525.00
  6.00    1984.00   2833.00
  7.00    1984.00    908.00
  8.00    1984.00   2029.00
  9.00    1984.00   4600.00
 10.00    1984.00   5910.00
 11.00    1984.00    249.00
 12.00    1984.00    353.00

```

## DATA FILE: SF2.DAT

```

####2
STREAMFLOW DATA FILE
HISTORICAL MONTHLY STREAMFLOW DATAFILE
TEST DATA
DATE : 20 JUL 1990
( 5F12.2)
5
SEASON
YEAR
STREAM1
PAN EVAP
LOCAL RAIN
  1.00    1982.00    416.00    32.10    33.80
  2.00    1982.00    288.00    32.40    32.40
  3.00    1982.00   1025.00    27.60    29.10
  4.00    1982.00    450.00    21.40   123.90
  5.00    1982.00   4988.00    16.00   119.60
  6.00    1982.00   2249.00    12.30   214.60
  7.00    1982.00   1234.00    11.90   315.50
  8.00    1982.00   2273.00    17.10   121.40
  9.00    1982.00   2160.00    17.00    20.60
 10.00    1982.00   1216.00    22.40    24.00
 11.00    1982.00   1338.00    30.00    31.50
 12.00    1982.00   1269.00    30.20    31.40
  1.00    1983.00    172.00    30.80    31.30
  2.00    1983.00    160.00    34.40    35.20
  3.00    1983.00    566.00    28.50   128.90
  4.00    1983.00   3848.00    19.70   221.10
  5.00    1983.00   3220.00    16.40   319.40
  6.00    1983.00   1500.00    11.30   216.00
  7.00    1983.00   4640.00    11.70   114.80
  8.00    1983.00   3900.00    13.70    17.50
  9.00    1983.00   4600.00    16.60    20.30
 10.00    1983.00   2360.00    20.10   123.20
 11.00    1983.00   2023.00    22.80    26.80
 12.00    1983.00   2967.00    29.00    30.80
  1.00    1984.00   4426.00    27.30    29.00
  2.00    1984.00    246.00    28.50    32.10
  3.00    1984.00   2526.00    24.10    26.70
  4.00    1984.00   1513.00    21.30    22.70
  5.00    1984.00    525.00    16.80    20.10
  6.00    1984.00   2833.00    14.60   117.30
  7.00    1984.00    908.00    11.60   214.40
  8.00    1984.00   2029.00    14.00   116.90
  9.00    1984.00   4600.00    15.40    17.80
 10.00    1984.00   5910.00    20.50    23.90
 11.00    1984.00    249.00    25.80    27.50
 12.00    1984.00    353.00    26.50   230.10

```

**DATA FILE: DEM.DAT**

####3  
 DEMANDS DATAFILE  
 HISTORICAL DATA  
 DATA ASSEMBLED AND REFORMATED ON  
 DATE : 9 JUL 1990  
 (3F12.2)

3

SEASON

YEAR

DEMAND 1

|       |         |         |
|-------|---------|---------|
| 1.00  | 1982.00 | 2700.00 |
| 2.00  | 1982.00 | 1300.00 |
| 3.00  | 1982.00 | 2100.00 |
| 4.00  | 1982.00 | 1500.00 |
| 5.00  | 1982.00 | 1600.00 |
| 6.00  | 1982.00 | 700.00  |
| 7.00  | 1982.00 | 1200.00 |
| 8.00  | 1982.00 | 1800.00 |
| 9.00  | 1982.00 | 2200.00 |
| 10.00 | 1982.00 | 1300.00 |
| 11.00 | 1982.00 | 1400.00 |
| 12.00 | 1982.00 | 1400.00 |
| 1.00  | 1983.00 | 1900.00 |
| 2.00  | 1983.00 | 1100.00 |
| 3.00  | 1983.00 | 1300.00 |
| 4.00  | 1983.00 | 800.00  |
| 5.00  | 1983.00 | 0.00    |
| 6.00  | 1983.00 | 600.00  |
| 7.00  | 1983.00 | 900.00  |
| 8.00  | 1983.00 | 300.00  |
| 9.00  | 1983.00 | 600.00  |
| 10.00 | 1983.00 | 1400.00 |
| 11.00 | 1983.00 | 2100.00 |
| 12.00 | 1983.00 | 2100.00 |
| 1.00  | 1984.00 | 1100.00 |
| 2.00  | 1984.00 | 2300.00 |
| 3.00  | 1984.00 | 2800.00 |
| 4.00  | 1984.00 | 1900.00 |
| 5.00  | 1984.00 | 300.00  |
| 6.00  | 1984.00 | 600.00  |
| 7.00  | 1984.00 | 600.00  |
| 8.00  | 1984.00 | 100.00  |
| 9.00  | 1984.00 | 1600.00 |
| 10.00 | 1984.00 | 1300.00 |
| 11.00 | 1984.00 | 2400.00 |
| 12.00 | 1984.00 | 2100.00 |

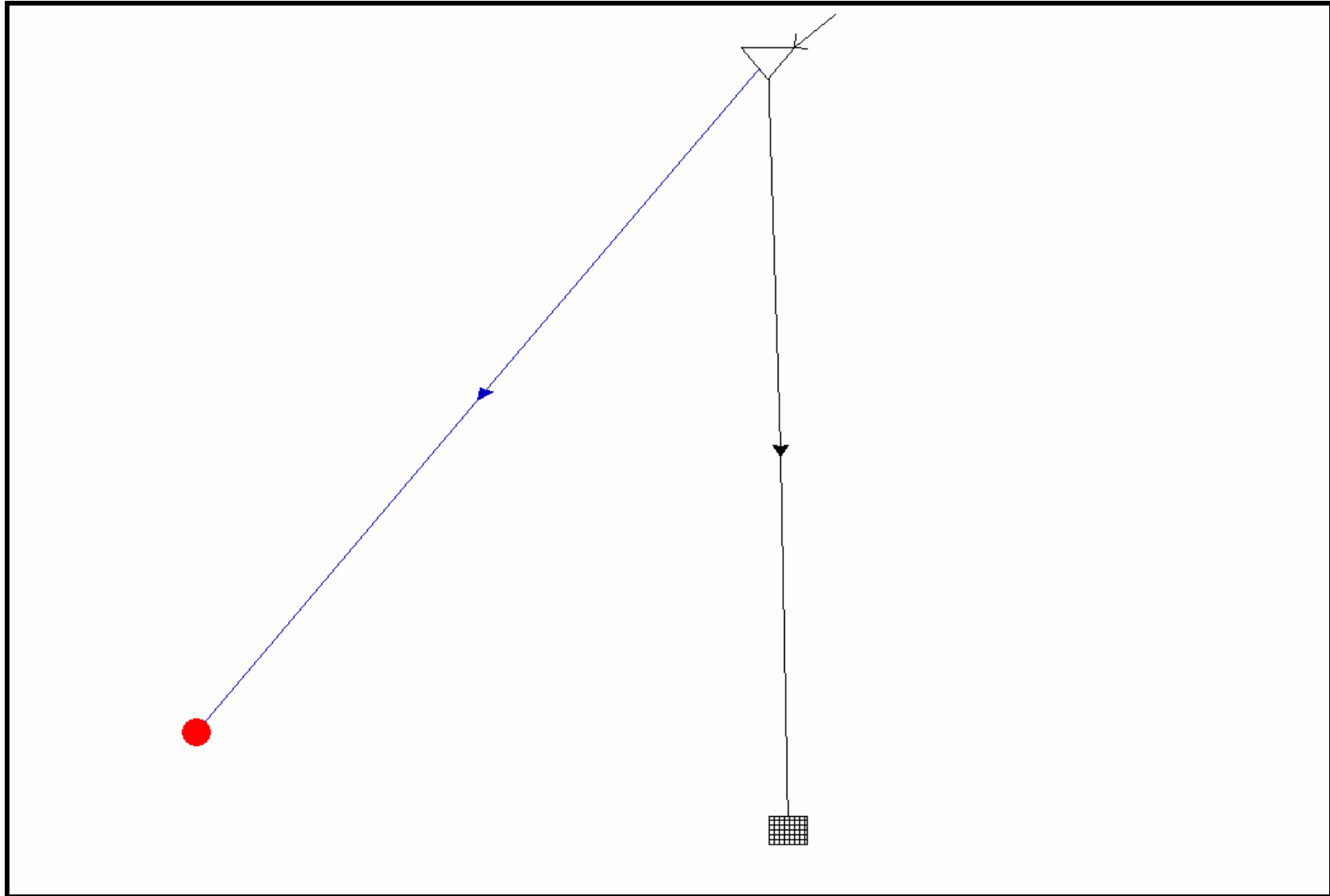


Figure 3.2-1 Worked Example 2(a) – System Plot (*EX2A.sys*)







**WORKED EXAMPLE 2(a) – LOG FILE**

```

HHHHH      HHHHHHHH      HHHHHH      H      HHHHHHHHHH
H  H      H      H  H  H      H  H  H
HHHHHHHHH  HHHHHH      HHHHHHHH  HHH      HHH  H  H
HHH  H  HHH      HHH  H  HHH      HHH  H  H
HHH  H  HHH      HHH  H  HHH      HHH  H  H
HHH  H  HHHHHHHH  HHH  H  HHHHHHHH  HHH  H  H

```

```

*****
*   SIMULATION LOG FILE   *
*****

```

Log filename : EX2A.log

Scenario file: scn2a.scn

Simulation label:

Tutorial 2 Sub-Problem (a)

Streamflow file(s):

C:\REALM\WorkedExamples\Sf1.dat

Demand file(s):

C:\REALM\WorkedExamples\Dem.dat

Restrictions are OFF

Instream flow requirements NOT limited to natural

Water quality calculations are OFF

Number of S/F Sequences: 1

```

Convergence tolerance (storage)  1 10th%
Other convergence tolerance      5 %
Arc convergence tolerance (abs)  100
Minimum iteration count          3
Maximum iteration count          51
Do convergence twice             No

```

Date: 14:47:49 12/04/01

Time Step = Monthly

SYSTEM CHANGES:

| No | Seas | Year | System File                      |
|----|------|------|----------------------------------|
| 1  | 1    | 1982 | C:\REALM\WorkedExamples\EX2A.sys |

Total number of seasons:- 36

\*\*\*\*\* RUN TIME MESSAGES:- \*\*\*\*\*

\*\*\*\*INPUT DATA TYPE= 1 \*\*\*\*

1982

C:\REALM\WorkedExamples\EX2A.sys

1983

1984

\*\*\*\*\* END RUN TIME MESSAGES \*\*\*\*\*

SUMMARY INFORMATION

Reservoir data:

|       | Name        | Start<br>Storage | File<br>Inflow | Min<br>Storage | Average<br>Storage | Evapn | Release<br>to river | Spill | End<br>Storage |
|-------|-------------|------------------|----------------|----------------|--------------------|-------|---------------------|-------|----------------|
| 1     | RESERVOIR 1 | 9000.            | 2083.          | 3579.          | 9427.              | 0.    | 736.                | 0.    | 8102.          |
| ----- |             |                  |                |                |                    |       |                     |       |                |
|       |             | 9000.            | 2083.          | 0.             | 9427.              | 0.    | 736.                | 0.    | 8102.          |
| ----- |             |                  |                |                |                    |       |                     |       |                |

## Demand data:

| Name       | Unrestrict | Restrict | Rationed | Shortfall | Supplied |
|------------|------------|----------|----------|-----------|----------|
| 1 DEMAND 1 | 1372.      | 1372.    | 1372.    | 0.        | 1372.    |
| -----      |            |          |          |           |          |
|            | 1372.      | 1372.    | 1372.    | 0.        | 1372.    |
| -----      |            |          |          |           |          |

| Name       | No Rest | Ave Rest lvl | Max Rest lvl | No Ration | Ave % Ration | Max % Ration | No Short | Ave % Short | Max % Short |
|------------|---------|--------------|--------------|-----------|--------------|--------------|----------|-------------|-------------|
| 1 DEMAND 1 | 0.0     | 0.0          | 0.0          | 0.0       | 0.0          | 0.0          | 0.0      | 0.0         | 0.0         |
| -----      |         |              |              |           |              |              |          |             |             |

## Pipe/River flows:

| Name      | flow   | Capacity   | Min | Max    | Loss |
|-----------|--------|------------|-----|--------|------|
| 1 PIPE 1  | 1372.2 | 12000.0    | 0.0 | 2800.0 | 0.0  |
| 2 River 1 | 735.5  | 99999999.0 | 0.0 | 4610.0 | 0.0  |
|           |        |            |     |        | 0.   |
| -----     |        |            |     |        |      |

End run

**WORKED EXAMPLE 2(a) – RESERVOIR VOLUME**

RESERVOIR STORAGE

EX2A.log

Tutorial 2(a)

Time :00:02:20 Date :07/21/97

(F4.0,2F6.0, 1f12.2 )

4

SEASON

YEAR

REPLICATE

RESERVOIR 1

ESTO

|     |       |    |          |
|-----|-------|----|----------|
| 1.  | 1982. | 1. | 6716.00  |
| 2.  | 1982. | 1. | 5704.00  |
| 3.  | 1982. | 1. | 4629.00  |
| 4.  | 1982. | 1. | 3579.00  |
| 5.  | 1982. | 1. | 6967.00  |
| 6.  | 1982. | 1. | 8516.00  |
| 7.  | 1982. | 1. | 8550.00  |
| 8.  | 1982. | 1. | 9023.00  |
| 9.  | 1982. | 1. | 8983.00  |
| 10. | 1982. | 1. | 8899.00  |
| 11. | 1982. | 1. | 8837.00  |
| 12. | 1982. | 1. | 8706.00  |
| 1.  | 1983. | 1. | 6978.00  |
| 2.  | 1983. | 1. | 6038.00  |
| 3.  | 1983. | 1. | 5304.00  |
| 4.  | 1983. | 1. | 8352.00  |
| 5.  | 1983. | 1. | 11572.00 |
| 6.  | 1983. | 1. | 12000.00 |
| 7.  | 1983. | 1. | 12000.00 |
| 8.  | 1983. | 1. | 12000.00 |
| 9.  | 1983. | 1. | 12000.00 |
| 10. | 1983. | 1. | 12000.00 |
| 11. | 1983. | 1. | 11923.00 |
| 12. | 1983. | 1. | 12000.00 |
| 1.  | 1984. | 1. | 12000.00 |
| 2.  | 1984. | 1. | 9946.00  |
| 3.  | 1984. | 1. | 9672.00  |
| 4.  | 1984. | 1. | 9285.00  |
| 5.  | 1984. | 1. | 9510.00  |
| 6.  | 1984. | 1. | 11743.00 |
| 7.  | 1984. | 1. | 12000.00 |
| 8.  | 1984. | 1. | 12000.00 |
| 9.  | 1984. | 1. | 12000.00 |
| 10. | 1984. | 1. | 12000.00 |
| 11. | 1984. | 1. | 9849.00  |
| 12. | 1984. | 1. | 8102.00  |

**WORKED EXAMPLE 2(a) – CARRIER FLOW**

CARRIER FLOWS

EX2A.log

Tutorial 2 Sub-Problem (a)

Time :14:47:49 Date :12/04/01

(F4.0,2F6.0, 2f12.2 )

5

SEASON

YEAR

REPLICATE

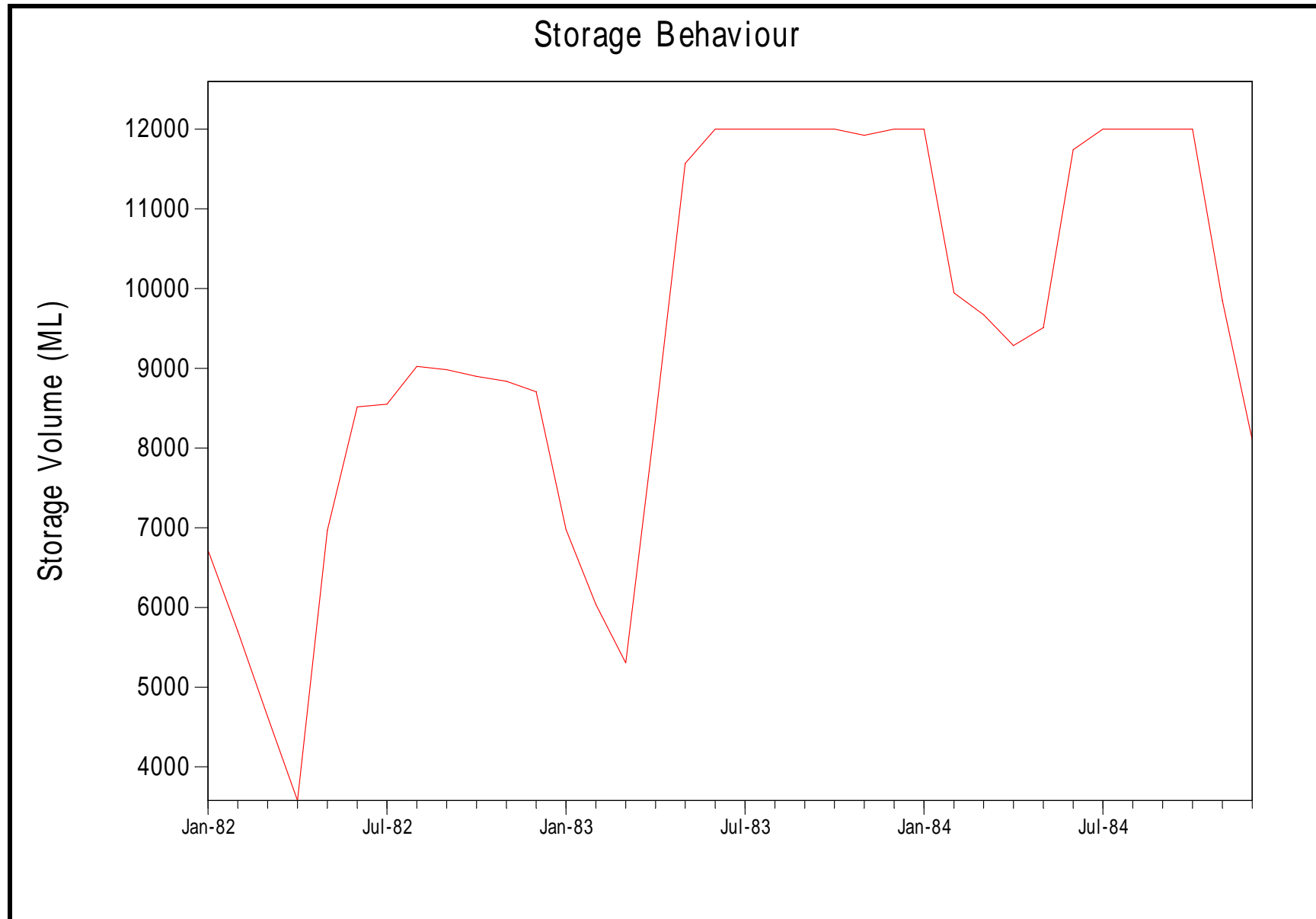
PIPE 1

FLOW

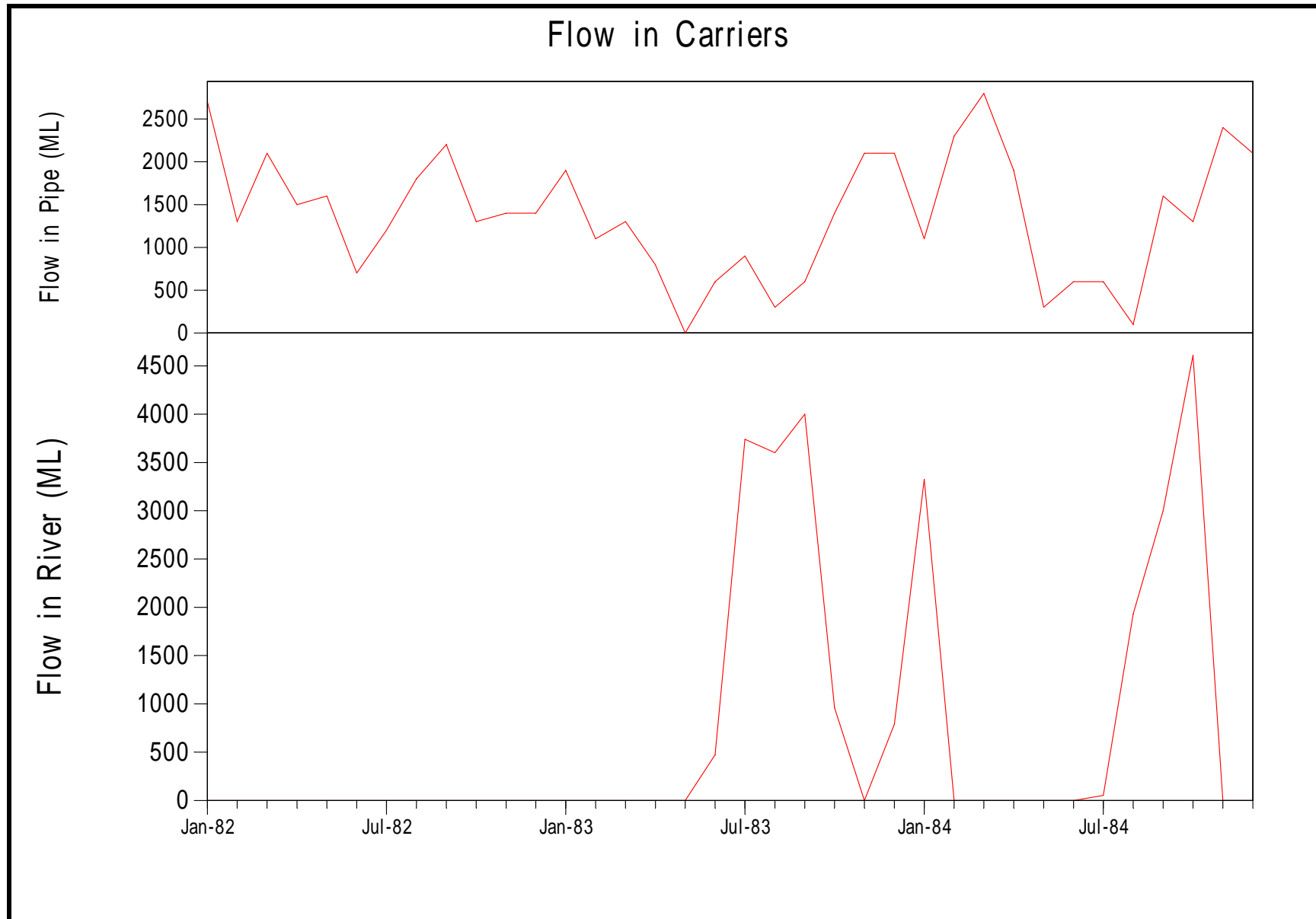
River 1

FLOW

|     |       |    |         |         |
|-----|-------|----|---------|---------|
| 1.  | 1982. | 1. | 2700.00 | 0.00    |
| 2.  | 1982. | 1. | 1300.00 | 0.00    |
| 3.  | 1982. | 1. | 2100.00 | 0.00    |
| 4.  | 1982. | 1. | 1500.00 | 0.00    |
| 5.  | 1982. | 1. | 1600.00 | 0.00    |
| 6.  | 1982. | 1. | 700.00  | 0.00    |
| 7.  | 1982. | 1. | 1200.00 | 0.00    |
| 8.  | 1982. | 1. | 1800.00 | 0.00    |
| 9.  | 1982. | 1. | 2200.00 | 0.00    |
| 10. | 1982. | 1. | 1300.00 | 0.00    |
| 11. | 1982. | 1. | 1400.00 | 0.00    |
| 12. | 1982. | 1. | 1400.00 | 0.00    |
| 1.  | 1983. | 1. | 1900.00 | 0.00    |
| 2.  | 1983. | 1. | 1100.00 | 0.00    |
| 3.  | 1983. | 1. | 1300.00 | 0.00    |
| 4.  | 1983. | 1. | 800.00  | 0.00    |
| 5.  | 1983. | 1. | 0.00    | 0.00    |
| 6.  | 1983. | 1. | 600.00  | 472.00  |
| 7.  | 1983. | 1. | 900.00  | 3740.00 |
| 8.  | 1983. | 1. | 300.00  | 3600.00 |
| 9.  | 1983. | 1. | 600.00  | 4000.00 |
| 10. | 1983. | 1. | 1400.00 | 960.00  |
| 11. | 1983. | 1. | 2100.00 | 0.00    |
| 12. | 1983. | 1. | 2100.00 | 790.00  |
| 1.  | 1984. | 1. | 1100.00 | 3326.00 |
| 2.  | 1984. | 1. | 2300.00 | 0.00    |
| 3.  | 1984. | 1. | 2800.00 | 0.00    |
| 4.  | 1984. | 1. | 1900.00 | 0.00    |
| 5.  | 1984. | 1. | 300.00  | 0.00    |
| 6.  | 1984. | 1. | 600.00  | 0.00    |
| 7.  | 1984. | 1. | 600.00  | 51.00   |
| 8.  | 1984. | 1. | 100.00  | 1929.00 |
| 9.  | 1984. | 1. | 1600.00 | 3000.00 |
| 10. | 1984. | 1. | 1300.00 | 4610.00 |
| 11. | 1984. | 1. | 2400.00 | 0.00    |
| 12. | 1984. | 1. | 2100.00 | 0.00    |



**Figure 3.2-2 Worked Example 2(a) – Time Series Plot of Storage Behaviour**



**Figure 3.2-3 Worked Example 2(a) – Time Series Plot of Flow in Carriers**



**WORKED EXAMPLE 2(b) - SYSTEM LISTING**


---

R     E     A     L     M

---

\*\*\*\*\*  
 \*     SYSTEM FILE LISTING     \*  
 \*\*\*\*\*

File: C:\REALM\WorkedExamples\EX2B.sys

Simulation label:  
 Tutorial 2 - Sub-Problem (b)

Date: 14:53:10 12/04/01

-----  
 |    NODE INFORMATION    |  
 -----

-----  
 |    NODE INFORMATION    |  
 -----

| No | Name              | Type            | X     | Y     | Z    | Size | Aux Input | No |
|----|-------------------|-----------------|-------|-------|------|------|-----------|----|
| 1  | RESERVOIR 1       | Reservoir       | 48.63 | 93.12 | 0.00 | 1.00 | STREAM1   | 1  |
| 2  | DEMAND 1          | Demand          | 49.84 | 7.46  | 0.00 | 1.00 |           | 2  |
| 3  | Stream Terminator | Strm terminator | 14.44 | 18.32 | 0.00 | 1.00 |           | 3  |

Reservoir data:

| No | Name        | Min<br>Cap | Max<br>Cap | No<br>Above | No<br>Below | Spill<br>Type |
|----|-------------|------------|------------|-------------|-------------|---------------|
| 1  | RESERVOIR 1 | 0          | 12000      | 1           | 1           | Downstream    |



**WORKED EXAMPLE 2(b) – LOG FILE**

```

HHHHH      HHHHHHHH      HHHHHH      H      HHHHHHHHHH
H   H      H              H   H      H      H   H   H
HHHHHHHHH  HHHHHH      HHHHHHHH  HHH      HHH H   H
HHH   H   HHH          HHH   H   HHH      HHH H   H
HHH   H   HHH          HHH   H   HHH      HHH H   H
HHH   H   HHHHHHHH    HHH   H   HHHHHHHH  HHH H   H

```

```

*****
*   SIMULATION LOG FILE   *
*****

```

Log filename : EX2B.log

Scenario file: scn2b.scn

Simulation label:

Tutorial 2 Sub-Problem (b)

Streamflow file(s):

C:\REALM\WorkedExamples\Sf2.dat

Demand file(s):

C:\REALM\WorkedExamples\Dem.dat

Restrictions are OFF

Instream flow requirements NOT limited to natural

Water quality calculations are OFF

Number of S/F Sequences: 1

```

Convergence tolerance (storage)  1 10th%
Other convergence tolerance      5 %
Arc convergence tolerance (abs)  100
Minimum iteration count          3
Maximum iteration count          51
Do convergence twice              No

```

Date: 14:51:53 12/04/01

Time Step = Monthly

SYSTEM CHANGES:

| No | Seas | Year | System File                      |
|----|------|------|----------------------------------|
| 1  | 1    | 1982 | C:\REALM\WorkedExamples\EX2B.sys |

Total number of seasons:- 36

\*\*\*\*\* RUN TIME MESSAGES:- \*\*\*\*\*

\*\*\*\*INPUT DATA TYPE= 1 \*\*\*\*

1982

C:\REALM\WorkedExamples\EX2B.sys

1983

1984

\*\*\*\*\* END RUN TIME MESSAGES \*\*\*\*\*

SUMMARY INFORMATION

Reservoir data:

|   | Name        | Start<br>Storage | File<br>Inflow | Min<br>Storage | Average<br>Storage | Evapn | Release<br>to river | Spill | End<br>Storage |
|---|-------------|------------------|----------------|----------------|--------------------|-------|---------------------|-------|----------------|
| 1 | RESERVOIR 1 | 9000.            | 2083.          | 3501.          | 9460.              | -17.  | 750.                | 0.    | 8166.          |
|   |             | 9000.            | 2083.          | 0.             | 9460.              | -17.  | 750.                | 0.    | 8166.          |

## Demand data:

| Name       | Unrestrict | Restrict | Rationed | Shortfall | Supplied |
|------------|------------|----------|----------|-----------|----------|
| 1 DEMAND 1 | 1372.      | 1372.    | 1372.    | 0.        | 1372.    |
|            | 1372.      | 1372.    | 1372.    | 0.        | 1372.    |

| Name       | No Rest | Ave Rest lvl | Max Rest lvl | No Ration | Ave % Ration | Max % Ration | No Short | Ave % Short | Max % Short |
|------------|---------|--------------|--------------|-----------|--------------|--------------|----------|-------------|-------------|
| 1 DEMAND 1 | 0.0     | 0.0          | 0.0          | 0.0       | 0.0          | 0.0          | 0.0      | 0.0         | 0.0         |

## Pipe/River flows:

| Name      | flow   | Capacity   | Min | Max    | Loss |
|-----------|--------|------------|-----|--------|------|
| 1 PIPE 1  | 1372.2 | 12000.0    | 0.0 | 2800.0 | 0.0  |
| 2 River 1 | 750.3  | 99999999.0 | 0.0 | 4571.0 | 0.0  |
|           |        |            |     |        | 0.   |

End run

**WORKED EXAMPLE 2(b) – RESERVOIR VOLUME**

RESERVOIR STORAGE

EX2B.log

Tutorial 2 Sub-Problem (b)

Time :12:02:35 Date :12/04/01

(F4.0,2F6.0, 1f12.2 )  
4

SEASON

YEAR

REPLICATE

| RESERVOIR 1 | ESTO |          |
|-------------|------|----------|
| 1. 1982.    | 1.   | 6673.00  |
| 2. 1982.    | 1.   | 5627.00  |
| 3. 1982.    | 1.   | 4526.00  |
| 4. 1982.    | 1.   | 3501.00  |
| 5. 1982.    | 1.   | 6916.00  |
| 6. 1982.    | 1.   | 8561.00  |
| 7. 1982.    | 1.   | 8776.00  |
| 8. 1982.    | 1.   | 9295.00  |
| 9. 1982.    | 1.   | 9234.00  |
| 10. 1982.   | 1.   | 9120.00  |
| 11. 1982.   | 1.   | 9017.00  |
| 12. 1982.   | 1.   | 8845.00  |
| 1. 1983.    | 1.   | 7075.00  |
| 2. 1983.    | 1.   | 6098.00  |
| 3. 1983.    | 1.   | 5384.00  |
| 4. 1983.    | 1.   | 8505.00  |
| 5. 1983.    | 1.   | 11900.00 |
| 6. 1983.    | 1.   | 12000.00 |
| 7. 1983.    | 1.   | 12000.00 |
| 8. 1983.    | 1.   | 12000.00 |
| 9. 1983.    | 1.   | 12000.00 |
| 10. 1983.   | 1.   | 12000.00 |
| 11. 1983.   | 1.   | 11881.00 |
| 12. 1983.   | 1.   | 12000.00 |
| 1. 1984.    | 1.   | 12000.00 |
| 2. 1984.    | 1.   | 9891.00  |
| 3. 1984.    | 1.   | 9582.00  |
| 4. 1984.    | 1.   | 9165.00  |
| 5. 1984.    | 1.   | 9368.00  |
| 6. 1984.    | 1.   | 11653.00 |
| 7. 1984.    | 1.   | 12000.00 |
| 8. 1984.    | 1.   | 12000.00 |
| 9. 1984.    | 1.   | 12000.00 |
| 10. 1984.   | 1.   | 12000.00 |
| 11. 1984.   | 1.   | 9799.00  |
| 12. 1984.   | 1.   | 8166.00  |

**WORKED EXAMPLE 2(b) – RESERVOIR EVAPORATION**

RESERVOIR EVAPS

EX2B.log

Tutorial 2 Sub-Problem (b)

Time :12:02:35 Date :12/04/01

(F4.0,2F6.0, 1f12.2 )  
4

SEASON

YEAR

REPLICATE

| RESERVOIR 1 | EVAP |         |
|-------------|------|---------|
| 1. 1982.    | 1.   | 43.00   |
| 2. 1982.    | 1.   | 34.00   |
| 3. 1982.    | 1.   | 26.00   |
| 4. 1982.    | 1.   | -25.00  |
| 5. 1982.    | 1.   | -27.00  |
| 6. 1982.    | 1.   | -96.00  |
| 7. 1982.    | 1.   | -181.00 |
| 8. 1982.    | 1.   | -46.00  |
| 9. 1982.    | 1.   | 21.00   |
| 10. 1982.   | 1.   | 30.00   |
| 11. 1982.   | 1.   | 41.00   |
| 12. 1982.   | 1.   | 41.00   |
| 1. 1983.    | 1.   | 42.00   |
| 2. 1983.    | 1.   | 37.00   |
| 3. 1983.    | 1.   | -20.00  |
| 4. 1983.    | 1.   | -73.00  |
| 5. 1983.    | 1.   | -175.00 |
| 6. 1983.    | 1.   | -180.00 |
| 7. 1983.    | 1.   | -78.00  |
| 8. 1983.    | 1.   | 24.00   |
| 9. 1983.    | 1.   | 31.00   |
| 10. 1983.   | 1.   | -62.00  |
| 11. 1983.   | 1.   | 42.00   |
| 12. 1983.   | 1.   | 55.00   |
| 1. 1984.    | 1.   | 52.00   |
| 2. 1984.    | 1.   | 55.00   |
| 3. 1984.    | 1.   | 35.00   |
| 4. 1984.    | 1.   | 30.00   |
| 5. 1984.    | 1.   | 22.00   |
| 6. 1984.    | 1.   | -52.00  |
| 7. 1984.    | 1.   | -170.00 |
| 8. 1984.    | 1.   | -74.00  |
| 9. 1984.    | 1.   | 27.00   |
| 10. 1984.   | 1.   | 39.00   |
| 11. 1984.   | 1.   | 50.00   |
| 12. 1984.   | 1.   | -114.00 |

**WORKED EXAMPLE 2(b) - CARRIER FLOW**

CARRIER FLOWS

EX2B.log

Tutorial 2 Sub-Problem (b)

Time :12:02:35 Date :12/04/01

(F4.0,2F6.0, 1f12.2 )  
4

SEASON

YEAR

REPLICATE

PIPE 1

FLOW

|     |       |    |         |
|-----|-------|----|---------|
| 1.  | 1982. | 1. | 2700.00 |
| 2.  | 1982. | 1. | 1300.00 |
| 3.  | 1982. | 1. | 2100.00 |
| 4.  | 1982. | 1. | 1500.00 |
| 5.  | 1982. | 1. | 1600.00 |
| 6.  | 1982. | 1. | 700.00  |
| 7.  | 1982. | 1. | 1200.00 |
| 8.  | 1982. | 1. | 1800.00 |
| 9.  | 1982. | 1. | 2200.00 |
| 10. | 1982. | 1. | 1300.00 |
| 11. | 1982. | 1. | 1400.00 |
| 12. | 1982. | 1. | 1400.00 |
| 1.  | 1983. | 1. | 1900.00 |
| 2.  | 1983. | 1. | 1100.00 |
| 3.  | 1983. | 1. | 1300.00 |
| 4.  | 1983. | 1. | 800.00  |
| 5.  | 1983. | 1. | 0.00    |
| 6.  | 1983. | 1. | 600.00  |
| 7.  | 1983. | 1. | 900.00  |
| 8.  | 1983. | 1. | 300.00  |
| 9.  | 1983. | 1. | 600.00  |
| 10. | 1983. | 1. | 1400.00 |
| 11. | 1983. | 1. | 2100.00 |
| 12. | 1983. | 1. | 2100.00 |
| 1.  | 1984. | 1. | 1100.00 |
| 2.  | 1984. | 1. | 2300.00 |
| 3.  | 1984. | 1. | 2800.00 |
| 4.  | 1984. | 1. | 1900.00 |
| 5.  | 1984. | 1. | 300.00  |
| 6.  | 1984. | 1. | 600.00  |
| 7.  | 1984. | 1. | 600.00  |
| 8.  | 1984. | 1. | 100.00  |
| 9.  | 1984. | 1. | 1600.00 |
| 10. | 1984. | 1. | 1300.00 |
| 11. | 1984. | 1. | 2400.00 |
| 12. | 1984. | 1. | 2100.00 |

**WORKED EXAMPLE 2(b) - COMPARISON OF STORAGE VOLUME**

####4

EX2A.log + EX2B.log

:12/04/01

Tutorial 2 Sub-Problem (a) and (b)

Time :11:24:06 Date

( 4f12.2 )  
4

SEASON

YEAR

RESERVOIR 1

ESTO (without evap)

RESERVOIR 1

ESTO (with evap)

|       |         |          |          |
|-------|---------|----------|----------|
| 1.00  | 1982.00 | 6716.00  | 6673.00  |
| 2.00  | 1982.00 | 5704.00  | 5627.00  |
| 3.00  | 1982.00 | 4629.00  | 4526.00  |
| 4.00  | 1982.00 | 3579.00  | 3501.00  |
| 5.00  | 1982.00 | 6967.00  | 6916.00  |
| 6.00  | 1982.00 | 8516.00  | 8561.00  |
| 7.00  | 1982.00 | 8550.00  | 8776.00  |
| 8.00  | 1982.00 | 9023.00  | 9295.00  |
| 9.00  | 1982.00 | 8983.00  | 9234.00  |
| 10.00 | 1982.00 | 8899.00  | 9120.00  |
| 11.00 | 1982.00 | 8837.00  | 9017.00  |
| 12.00 | 1982.00 | 8706.00  | 8845.00  |
| 1.00  | 1983.00 | 6978.00  | 7075.00  |
| 2.00  | 1983.00 | 6038.00  | 6098.00  |
| 3.00  | 1983.00 | 5304.00  | 5384.00  |
| 4.00  | 1983.00 | 8352.00  | 8505.00  |
| 5.00  | 1983.00 | 11572.00 | 11900.00 |
| 6.00  | 1983.00 | 12000.00 | 12000.00 |
| 7.00  | 1983.00 | 12000.00 | 12000.00 |
| 8.00  | 1983.00 | 12000.00 | 12000.00 |
| 9.00  | 1983.00 | 12000.00 | 12000.00 |
| 10.00 | 1983.00 | 12000.00 | 12000.00 |
| 11.00 | 1983.00 | 11923.00 | 11881.00 |
| 12.00 | 1983.00 | 12000.00 | 12000.00 |
| 1.00  | 1984.00 | 12000.00 | 12000.00 |
| 2.00  | 1984.00 | 9946.00  | 9891.00  |
| 3.00  | 1984.00 | 9672.00  | 9582.00  |
| 4.00  | 1984.00 | 9285.00  | 9165.00  |
| 5.00  | 1984.00 | 9510.00  | 9368.00  |
| 6.00  | 1984.00 | 11743.00 | 11653.00 |
| 7.00  | 1984.00 | 12000.00 | 12000.00 |
| 8.00  | 1984.00 | 12000.00 | 12000.00 |
| 9.00  | 1984.00 | 12000.00 | 12000.00 |
| 10.00 | 1984.00 | 12000.00 | 12000.00 |
| 11.00 | 1984.00 | 9849.00  | 9799.00  |
| 12.00 | 1984.00 | 8102.00  | 8166.00  |

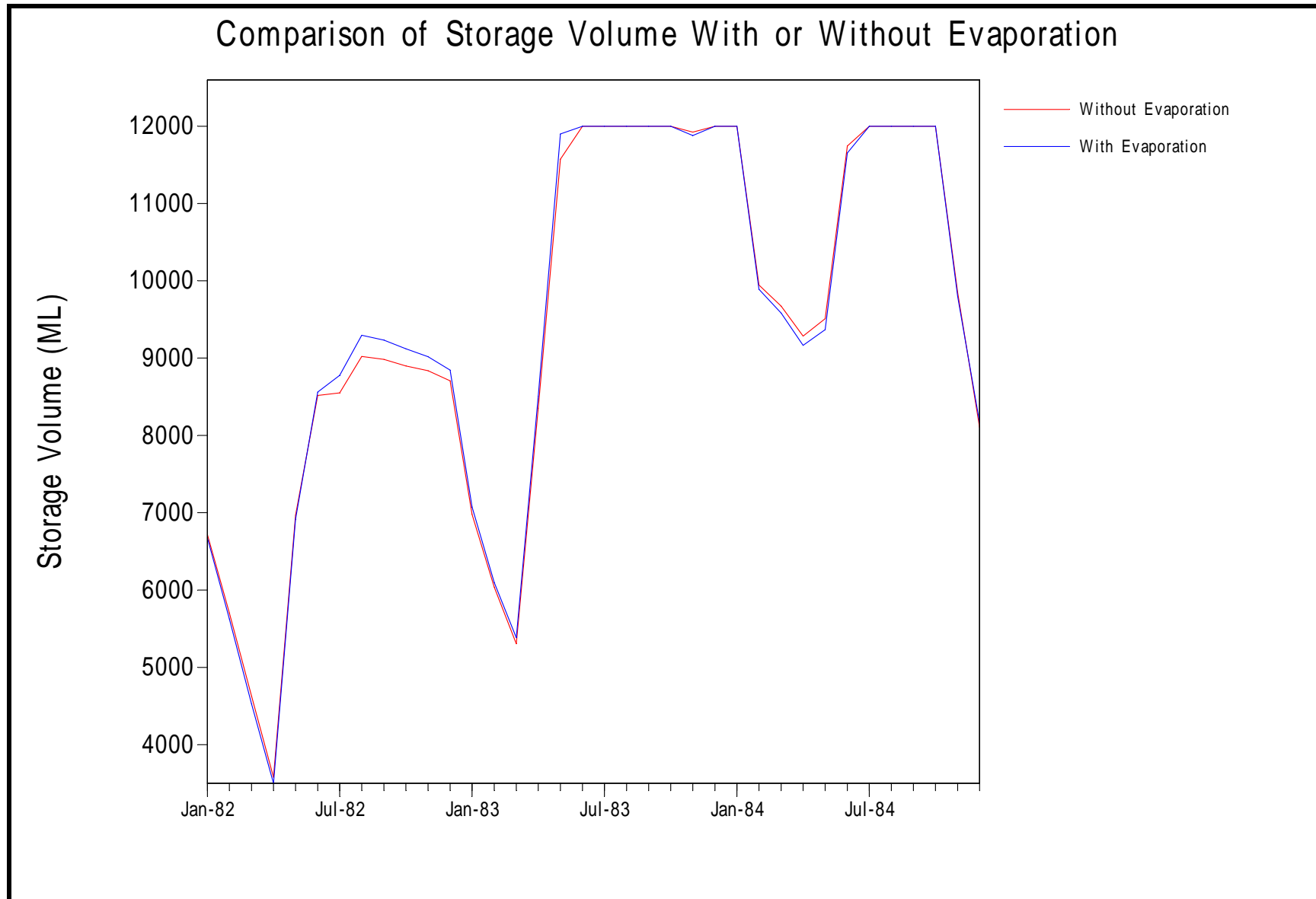


Figure 3.2-4 Worked Example 2(b) – Time Series Plot of Storage Behavior With and Without Evaporation







**WORKED EXAMPLE 2(c)- LOG FILE**

```

HHHHH      HHHHHHHH   HHHHHH   H      HHHHHHHHHH
H   H      H          H   H   H      H   H   H
HHHHHHHHH  HHHHHH    HHHHHHHH  HHH    HHH H   H
HHH   H   HHH        HHH   H   HHH    HHH H   H
HHH   H   HHH        HHH   H   HHH    HHH H   H
HHH   H   HHHHHHHH  HHH   H   HHHHHHHH  HHH H   H

```

```

*****
*   SIMULATION LOG FILE   *
*****

```

Log filename : EX2C.log

Scenario file: scn2c.scn

Simulation label:

Tutorial 2 Sub-Problem (c)

Streamflow file(s):

C:\REALM\WorkedExamples\Sf1.dat

Demand file(s):

C:\REALM\WorkedExamples\Dem.dat

Restrictions are OFF

Instream flow requirements NOT limited to natural

Water quality calculations are OFF

Number of S/F Sequences: 1

```

Convergence tolerance (storage)  1 10th%
Other convergence tolerance      5 %
Arc convergence tolerance (abs)  100
Minimum iteration count          3
Maximum iteration count          51
Do convergence twice              No

```

Date: 14:59:17 12/04/01

Time Step = Monthly

SYSTEM CHANGES:

| No | Seas | Year | System File                      |
|----|------|------|----------------------------------|
| 1  | 1    | 1982 | C:\REALM\WorkedExamples\EX2C.sys |

Total number of seasons:- 36

\*\*\*\*\* RUN TIME MESSAGES:- \*\*\*\*\*

\*\*\*\*INPUT DATA TYPE= 1 \*\*\*\*

1982

C:\REALM\WorkedExamples\EX2C.sys

1983

1984

\*\*\*\*\* END RUN TIME MESSAGES \*\*\*\*\*

SUMMARY INFORMATION

Reservoir data:

|   | Name        | Start<br>Storage | File<br>Inflow | Min<br>Storage | Average<br>Storage | Evapn | Release<br>to river | Spill | End<br>Storage |
|---|-------------|------------------|----------------|----------------|--------------------|-------|---------------------|-------|----------------|
| 1 | RESERVOIR 1 | 9000.            | 2083.          | 3929.          | 9640.              | 0.    | 758.                | 0.    | 8152.          |
|   |             | 9000.            | 2083.          | 0.             | 9640.              | 0.    | 758.                | 0.    | 8152.          |

## Demand data:

| Name       | Unrestrict | Restrict | Rationed | Shortfall | Supplied |
|------------|------------|----------|----------|-----------|----------|
| 1 DEMAND 1 | 1372.      | 1372.    | 1372.    | 24.       | 1349.    |
| -----      |            |          |          |           |          |
|            | 1372.      | 1372.    | 1372.    | 24.       | 1349.    |
| -----      |            |          |          |           |          |

| Name       | No Rest | Ave Rest lvl | Max Rest lvl | No Ration | Ave % Ration | Max % Ration | No Short | Ave % Short | Max % Short |
|------------|---------|--------------|--------------|-----------|--------------|--------------|----------|-------------|-------------|
| 1 DEMAND 1 | 0.0     | 0.0          | 0.0          | 0.0       | 0.0          | 0.0          | 3.0      | 10.0        | 16.0        |
| -----      |         |              |              |           |              |              |          |             |             |

## Pipe/River flows:

| Name      | flow   | Capacity   | Min | Max    | Loss |
|-----------|--------|------------|-----|--------|------|
| 1 PIPE 1  | 1348.6 | 2350.0     | 0.0 | 2350.0 | 0.0  |
| 2 River 1 | 757.7  | 99999999.0 | 0.0 | 4610.0 | 0.0  |
|           |        |            |     |        | 0.   |
| -----     |        |            |     |        |      |

End run

**WORKED EXAMPLE 2(c) - RESERVOIR VOLUME**

RESERVOIR STORAGE

EX2C.log

Tutorial 2 Sub-Problem (c)

Time :14:59:17 Date :12/04/01

(F4.0,2F6.0, 1f12.2 )  
4

SEASON

YEAR

REPLICATE

| RESERVOIR 1 | ESTO |          |
|-------------|------|----------|
| 1. 1982.    | 1.   | 7066.00  |
| 2. 1982.    | 1.   | 6054.00  |
| 3. 1982.    | 1.   | 4979.00  |
| 4. 1982.    | 1.   | 3929.00  |
| 5. 1982.    | 1.   | 7317.00  |
| 6. 1982.    | 1.   | 8866.00  |
| 7. 1982.    | 1.   | 8900.00  |
| 8. 1982.    | 1.   | 9373.00  |
| 9. 1982.    | 1.   | 9333.00  |
| 10. 1982.   | 1.   | 9249.00  |
| 11. 1982.   | 1.   | 9187.00  |
| 12. 1982.   | 1.   | 9056.00  |
| 1. 1983.    | 1.   | 7328.00  |
| 2. 1983.    | 1.   | 6388.00  |
| 3. 1983.    | 1.   | 5654.00  |
| 4. 1983.    | 1.   | 8702.00  |
| 5. 1983.    | 1.   | 11922.00 |
| 6. 1983.    | 1.   | 12000.00 |
| 7. 1983.    | 1.   | 12000.00 |
| 8. 1983.    | 1.   | 12000.00 |
| 9. 1983.    | 1.   | 12000.00 |
| 10. 1983.   | 1.   | 12000.00 |
| 11. 1983.   | 1.   | 11923.00 |
| 12. 1983.   | 1.   | 12000.00 |
| 1. 1984.    | 1.   | 12000.00 |
| 2. 1984.    | 1.   | 9946.00  |
| 3. 1984.    | 1.   | 10122.00 |
| 4. 1984.    | 1.   | 9735.00  |
| 5. 1984.    | 1.   | 9960.00  |
| 6. 1984.    | 1.   | 12000.00 |
| 7. 1984.    | 1.   | 12000.00 |
| 8. 1984.    | 1.   | 12000.00 |
| 9. 1984.    | 1.   | 12000.00 |
| 10. 1984.   | 1.   | 12000.00 |
| 11. 1984.   | 1.   | 9899.00  |
| 12. 1984.   | 1.   | 8152.00  |

**WORKED EXAMPLE 2(c) - DEMAND SHORTFALLS**

DEMAND SHORTFALL

EX2C.log

Tutorial 2 Sub-Problem (c)

Time :14:59:17 Date :12/04/01

(F4.0,2F6.0, 1f12.2 )  
4

SEASON

YEAR

REPLICATE

| DEMAND 1  | SHRT |        |
|-----------|------|--------|
| 1. 1982.  | 1.   | 350.00 |
| 2. 1982.  | 1.   | 0.00   |
| 3. 1982.  | 1.   | 0.00   |
| 4. 1982.  | 1.   | 0.00   |
| 5. 1982.  | 1.   | 0.00   |
| 6. 1982.  | 1.   | 0.00   |
| 7. 1982.  | 1.   | 0.00   |
| 8. 1982.  | 1.   | 0.00   |
| 9. 1982.  | 1.   | 0.00   |
| 10. 1982. | 1.   | 0.00   |
| 11. 1982. | 1.   | 0.00   |
| 12. 1982. | 1.   | 0.00   |
| 1. 1983.  | 1.   | 0.00   |
| 2. 1983.  | 1.   | 0.00   |
| 3. 1983.  | 1.   | 0.00   |
| 4. 1983.  | 1.   | 0.00   |
| 5. 1983.  | 1.   | 0.00   |
| 6. 1983.  | 1.   | 0.00   |
| 7. 1983.  | 1.   | 0.00   |
| 8. 1983.  | 1.   | 0.00   |
| 9. 1983.  | 1.   | 0.00   |
| 10. 1983. | 1.   | 0.00   |
| 11. 1983. | 1.   | 0.00   |
| 12. 1983. | 1.   | 0.00   |
| 1. 1984.  | 1.   | 0.00   |
| 2. 1984.  | 1.   | 0.00   |
| 3. 1984.  | 1.   | 450.00 |
| 4. 1984.  | 1.   | 0.00   |
| 5. 1984.  | 1.   | 0.00   |
| 6. 1984.  | 1.   | 0.00   |
| 7. 1984.  | 1.   | 0.00   |
| 8. 1984.  | 1.   | 0.00   |
| 9. 1984.  | 1.   | 0.00   |
| 10. 1984. | 1.   | 0.00   |
| 11. 1984. | 1.   | 50.00  |
| 12. 1984. | 1.   | 0.00   |

**WORKED EXAMPLE 2(c) - CARRIER FLOW**

CARRIER FLOWS

EX2C.log

Tutorial 2 Sub-Problem (c)

Time :11:16:34 Date :12/05/01

(F4.0,2F6.0, 1f12.2 )

4

SEASON

YEAR

REPLICATE

| PIPE 1 |       | FLOW       |
|--------|-------|------------|
| 1.     | 1982. | 1. 2350.00 |
| 2.     | 1982. | 1. 1300.00 |
| 3.     | 1982. | 1. 2100.00 |
| 4.     | 1982. | 1. 1500.00 |
| 5.     | 1982. | 1. 1600.00 |
| 6.     | 1982. | 1. 700.00  |
| 7.     | 1982. | 1. 1200.00 |
| 8.     | 1982. | 1. 1800.00 |
| 9.     | 1982. | 1. 2200.00 |
| 10.    | 1982. | 1. 1300.00 |
| 11.    | 1982. | 1. 1400.00 |
| 12.    | 1982. | 1. 1400.00 |
| 1.     | 1983. | 1. 1900.00 |
| 2.     | 1983. | 1. 1100.00 |
| 3.     | 1983. | 1. 1300.00 |
| 4.     | 1983. | 1. 800.00  |
| 5.     | 1983. | 1. 0.00    |
| 6.     | 1983. | 1. 600.00  |
| 7.     | 1983. | 1. 900.00  |
| 8.     | 1983. | 1. 300.00  |
| 9.     | 1983. | 1. 600.00  |
| 10.    | 1983. | 1. 1400.00 |
| 11.    | 1983. | 1. 2100.00 |
| 12.    | 1983. | 1. 2100.00 |
| 1.     | 1984. | 1. 1100.00 |
| 2.     | 1984. | 1. 2300.00 |
| 3.     | 1984. | 1. 2350.00 |
| 4.     | 1984. | 1. 1900.00 |
| 5.     | 1984. | 1. 300.00  |
| 6.     | 1984. | 1. 600.00  |
| 7.     | 1984. | 1. 600.00  |
| 8.     | 1984. | 1. 100.00  |
| 9.     | 1984. | 1. 1600.00 |
| 10.    | 1984. | 1. 1300.00 |
| 11.    | 1984. | 1. 2350.00 |
| 12.    | 1984. | 1. 2100.00 |

**WORKED EXAMPLE 2(c) - COMPARISON OF DEMAND, FLOW IN PIPE AND DEMAND SHORTFALLS**

####4

EX2C.log

Tutorial 2 Sub-Problem (c)

Time :09:49:34 Date :01/11/02

( 6f12.2 )

6

SEASON

YEAR

PIPE 1

PIPE 1

DEMAND 1

DEMAND 1

FLOW

CAPC

SHRT

UNRS

| 1.00  | 1982.00 | 2350.00 | 2350.00 | 350.00 | 2700.00 |  |
|-------|---------|---------|---------|--------|---------|--|
| 2.00  | 1982.00 | 1300.00 | 2350.00 | 0.00   | 1300.00 |  |
| 3.00  | 1982.00 | 2100.00 | 2350.00 | 0.00   | 2100.00 |  |
| 4.00  | 1982.00 | 1500.00 | 2350.00 | 0.00   | 1500.00 |  |
| 5.00  | 1982.00 | 1600.00 | 2350.00 | 0.00   | 1600.00 |  |
| 6.00  | 1982.00 | 700.00  | 2350.00 | 0.00   | 700.00  |  |
| 7.00  | 1982.00 | 1200.00 | 2350.00 | 0.00   | 1200.00 |  |
| 8.00  | 1982.00 | 1800.00 | 2350.00 | 0.00   | 1800.00 |  |
| 9.00  | 1982.00 | 2200.00 | 2350.00 | 0.00   | 2200.00 |  |
| 10.00 | 1982.00 | 1300.00 | 2350.00 | 0.00   | 1300.00 |  |
| 11.00 | 1982.00 | 1400.00 | 2350.00 | 0.00   | 1400.00 |  |
| 12.00 | 1982.00 | 1400.00 | 2350.00 | 0.00   | 1400.00 |  |
| 1.00  | 1983.00 | 1900.00 | 2350.00 | 0.00   | 1900.00 |  |
| 2.00  | 1983.00 | 1100.00 | 2350.00 | 0.00   | 1100.00 |  |
| 3.00  | 1983.00 | 1300.00 | 2350.00 | 0.00   | 1300.00 |  |
| 4.00  | 1983.00 | 800.00  | 2350.00 | 0.00   | 800.00  |  |
| 5.00  | 1983.00 | 0.00    | 2350.00 | 0.00   | 0.00    |  |
| 6.00  | 1983.00 | 600.00  | 2350.00 | 0.00   | 600.00  |  |
| 7.00  | 1983.00 | 900.00  | 2350.00 | 0.00   | 900.00  |  |
| 8.00  | 1983.00 | 300.00  | 2350.00 | 0.00   | 300.00  |  |
| 9.00  | 1983.00 | 600.00  | 2350.00 | 0.00   | 600.00  |  |
| 10.00 | 1983.00 | 1400.00 | 2350.00 | 0.00   | 1400.00 |  |
| 11.00 | 1983.00 | 2100.00 | 2350.00 | 0.00   | 2100.00 |  |
| 12.00 | 1983.00 | 2100.00 | 2350.00 | 0.00   | 2100.00 |  |
| 1.00  | 1984.00 | 1100.00 | 2350.00 | 0.00   | 1100.00 |  |
| 2.00  | 1984.00 | 2300.00 | 2350.00 | 0.00   | 2300.00 |  |
| 3.00  | 1984.00 | 2350.00 | 2350.00 | 450.00 | 2800.00 |  |
| 4.00  | 1984.00 | 1900.00 | 2350.00 | 0.00   | 1900.00 |  |
| 5.00  | 1984.00 | 300.00  | 2350.00 | 0.00   | 300.00  |  |
| 6.00  | 1984.00 | 600.00  | 2350.00 | 0.00   | 600.00  |  |
| 7.00  | 1984.00 | 600.00  | 2350.00 | 0.00   | 600.00  |  |
| 8.00  | 1984.00 | 100.00  | 2350.00 | 0.00   | 100.00  |  |
| 9.00  | 1984.00 | 1600.00 | 2350.00 | 0.00   | 1600.00 |  |
| 10.00 | 1984.00 | 1300.00 | 2350.00 | 0.00   | 1300.00 |  |
| 11.00 | 1984.00 | 2350.00 | 2350.00 | 50.00  | 2400.00 |  |
| 12.00 | 1984.00 | 2100.00 | 2350.00 | 0.00   | 2100.00 |  |

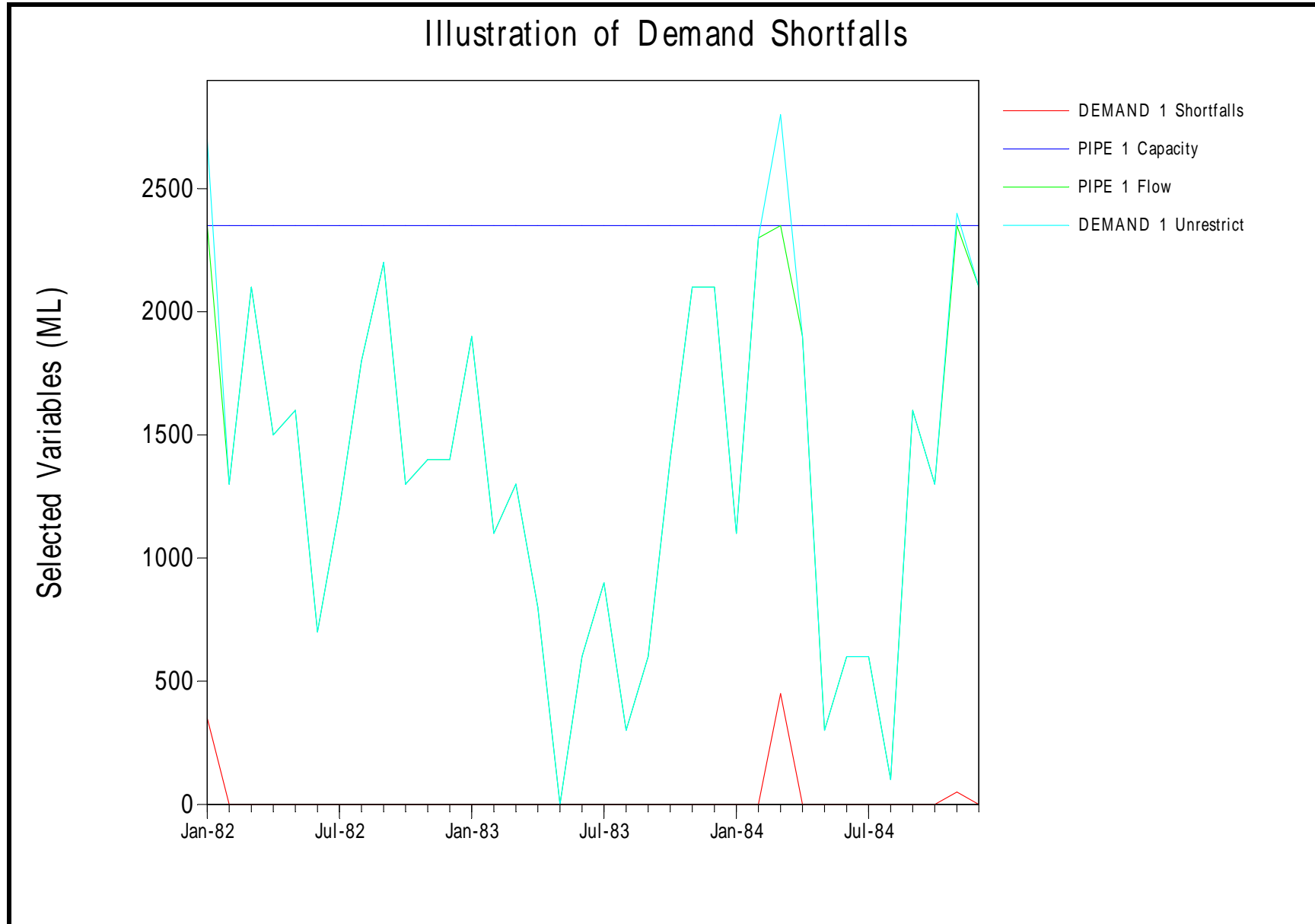


Figure 3.2-5 Worked Example 2(c) – Illustration of Demand Shortfalls





Demand data:

| No | Name     | No Bypass | S/F Priority | Monthly Factors |       |       |       |       |       |       |       |       |       |       |       |       |
|----|----------|-----------|--------------|-----------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
|    |          |           |              | Jan             | Feb   | Mar   | Apl   | May   | Jun   | Jul   | Aug   | Sep   | Oct   | Nov   | Dec   |       |
| 2  | DEMAND 1 | 1         | 1 min        | 0.000           | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
|    |          |           | max          | 1.000           | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |

-----  
 | CARRIER INFORMATION |  
 -----

| No | Name    | Type  | From | To | Cost | Offset | Loss | Ann Vol | Shr Gp | Shr% | No |
|----|---------|-------|------|----|------|--------|------|---------|--------|------|----|
| 1  | PIPE 1  | Pipe  | 1    | 2  | 0    | 0      | 0fix |         | 0      | 0%   | 1  |
| 2  | River 1 | River | 1    | 3  | 1000 | 0      | 0fix |         | 0      | 0%   | 2  |

Maximum Flows

| No | Name    | Jan      | Feb      | Mar      | Apl      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec      |
|----|---------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|
| 2  | River 1 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 |

Functional Capacities

| No | Name     | pt1 | pt2 | pt3  | pt4   | pt5 | pt6 | pt7 | pt8 | pt9 | pt10 | pt11 | pt12 |
|----|----------|-----|-----|------|-------|-----|-----|-----|-----|-----|------|------|------|
| 1  | PIPE 1   | V   | 0   | 6000 | 12000 | 0   | 0   | 0   | 0   | 0   | 0    | 0    | 0    |
|    | Fn Name: | C   | 0   | 1200 | 2400  | 0   | 0   | 0   | 0   | 0   | 0    | 0    | 0    |

Equation used: '1  
 ' 1 = RESERVOIR 1 Type: STOR  
 Capacity set option (0-off 1-prev 2-recalc) Jan=2 Feb=2 Mar=2 Apl=2 May=2 Jun=2 Jul=2 Aug=2 Sep=2 Oct=2 Nov=2 Dec=2

**WORKED EXAMPLE 2(d) - LOG FILE**

```

HHHHH      HHHHHHHH      HHHHHH      H      HHHHHHHHHH
H  H      H      H  H  H      H  H  H
HHHHHHHHH  HHHHHH      HHHHHHHH  HHH      HHH  H  H
HHH  H  HHH      HHH  H  HHH      HHH  H  H
HHH  H  HHH      HHH  H  HHH      HHH  H  H
HHH  H  HHHHHHHH  HHH  H  HHHHHHHH  HHH  H  H

```

```

*****
*      SIMULATION LOG FILE      *
*****

```

Log filename : EX2D.log

Scenario file: scn2d.scn

Simulation label:

Tutorial 2 Sub-Problem (d)

Streamflow file(s):

C:\REALM\WorkedExamples\Sf1.dat

Demand file(s):

C:\REALM\WorkedExamples\Dem.dat

Restrictions are OFF

Instream flow requirements NOT limited to natural

Water quality calculations are OFF

Number of S/F Sequences: 1

```

Convergence tolerance (storage)  1 10th%
Other convergence tolerance      5 %
Arc convergence tolerance (abs)  100
Minimum iteration count          3
Maximum iteration count          51
Do convergence twice              No

```

Date: 12:20:18 01/11/02

Time Step = Monthly

SYSTEM CHANGES:

| No | Seas | Year | System File                      |
|----|------|------|----------------------------------|
| 1  | 1    | 1982 | C:\REALM\WorkedExamples\EX2D.sys |

Total number of seasons:- 36

\*\*\*\*\* RUN TIME MESSAGES:- \*\*\*\*\*

\*\*\*\*INPUT DATA TYPE= 1 \*\*\*\*

1982

C:\REALM\WorkedExamples\EX2D.sys

1983

1984

\*\*\*\*\* END RUN TIME MESSAGES \*\*\*\*\*

SUMMARY INFORMATION

Reservoir data:

|   | Name        | Start<br>Storage | File<br>Inflow | Min<br>Storage | Average<br>Storage | Evapn | Release<br>to river | Spill | End<br>Storage |
|---|-------------|------------------|----------------|----------------|--------------------|-------|---------------------|-------|----------------|
| 1 | RESERVOIR 1 | 9000.            | 2083.          | 5496.          | 10473.             | 0.    | 825.                | 0.    | 8232.          |
|   |             | 9000.            | 2083.          | 0.             | 10473.             | 0.    | 825.                | 0.    | 8232.          |

## Demand data:

| Name       | Unrestrict | Restrict | Rationed | Shortfall | Supplied |
|------------|------------|----------|----------|-----------|----------|
| 1 DEMAND 1 | 1372.      | 1372.    | 1372.    | 93.       | 1279.    |
| -----      |            |          |          |           |          |
|            | 1372.      | 1372.    | 1372.    | 93.       | 1279.    |
| -----      |            |          |          |           |          |

| Name       | No Rest | Ave Rest lvl | Max Rest lvl | No Ration | Ave % Ration | Max % Ration | No Short | Ave % Short | Max % Short |
|------------|---------|--------------|--------------|-----------|--------------|--------------|----------|-------------|-------------|
| 1 DEMAND 1 | 0.0     | 0.0          | 0.0          | 0.0       | 0.0          | 0.0          | 6.0      | 25.0        | 37.0        |
| -----      |         |              |              |           |              |              |          |             |             |

## Pipe/River flows:

| Name      | flow   | Capacity   | Min | Max    | Loss |
|-----------|--------|------------|-----|--------|------|
| 1 PIPE 1  | 1278.9 | 2098.9     | 0.0 | 2400.0 | 0.0  |
| 2 River 1 | 825.2  | 99999999.0 | 0.0 | 4610.0 | 0.0  |
|           |        |            |     |        | 0.   |
| -----     |        |            |     |        |      |

End run

**WORKED EXAMPLE 2(d) - RESERVOIR VOLUME**

RESERVOIR STORAGE

EX2D.log

Tutorial 2 Sub-Problem (d)

Time :15:17:50 Date :12/04/01

(F4.0,2F6.0, 1f12.2 )  
4

SEASON

YEAR

REPLICATE

| RESERVOIR 1 | ESTO |          |
|-------------|------|----------|
| 1. 1982.    | 1.   | 7616.00  |
| 2. 1982.    | 1.   | 6604.00  |
| 3. 1982.    | 1.   | 6308.00  |
| 4. 1982.    | 1.   | 5496.00  |
| 5. 1982.    | 1.   | 9385.00  |
| 6. 1982.    | 1.   | 10934.00 |
| 7. 1982.    | 1.   | 10968.00 |
| 8. 1982.    | 1.   | 11441.00 |
| 9. 1982.    | 1.   | 11401.00 |
| 10. 1982.   | 1.   | 11317.00 |
| 11. 1982.   | 1.   | 11255.00 |
| 12. 1982.   | 1.   | 11124.00 |
| 1. 1983.    | 1.   | 9396.00  |
| 2. 1983.    | 1.   | 8456.00  |
| 3. 1983.    | 1.   | 7722.00  |
| 4. 1983.    | 1.   | 10770.00 |
| 5. 1983.    | 1.   | 12000.00 |
| 6. 1983.    | 1.   | 12000.00 |
| 7. 1983.    | 1.   | 12000.00 |
| 8. 1983.    | 1.   | 12000.00 |
| 9. 1983.    | 1.   | 12000.00 |
| 10. 1983.   | 1.   | 12000.00 |
| 11. 1983.   | 1.   | 11923.00 |
| 12. 1983.   | 1.   | 12000.00 |
| 1. 1984.    | 1.   | 12000.00 |
| 2. 1984.    | 1.   | 9946.00  |
| 3. 1984.    | 1.   | 10483.00 |
| 4. 1984.    | 1.   | 10096.00 |
| 5. 1984.    | 1.   | 10321.00 |
| 6. 1984.    | 1.   | 12000.00 |
| 7. 1984.    | 1.   | 12000.00 |
| 8. 1984.    | 1.   | 12000.00 |
| 9. 1984.    | 1.   | 12000.00 |
| 10. 1984.   | 1.   | 12000.00 |
| 11. 1984.   | 1.   | 9849.00  |
| 12. 1984.   | 1.   | 8232.00  |

**WORKED EXAMPLE 2(d) - CARRIER CAPACITY**

ARC CAPACITIES

EX2D.log

Tutorial 2 Sub-Problem (d)

Time :12:20:18 Date :01/11/02

(F4.0,2F6.0, 1f12.2 )  
4

SEASON

YEAR

REPLICATE

| PIPE 1    | CAPC |         |
|-----------|------|---------|
| 1. 1982.  | 1.   | 1800.00 |
| 2. 1982.  | 1.   | 1523.00 |
| 3. 1982.  | 1.   | 1321.00 |
| 4. 1982.  | 1.   | 1262.00 |
| 5. 1982.  | 1.   | 1099.00 |
| 6. 1982.  | 1.   | 1877.00 |
| 7. 1982.  | 1.   | 2187.00 |
| 8. 1982.  | 1.   | 2194.00 |
| 9. 1982.  | 1.   | 2288.00 |
| 10. 1982. | 1.   | 2280.00 |
| 11. 1982. | 1.   | 2263.00 |
| 12. 1982. | 1.   | 2251.00 |
| 1. 1983.  | 1.   | 2225.00 |
| 2. 1983.  | 1.   | 1879.00 |
| 3. 1983.  | 1.   | 1691.00 |
| 4. 1983.  | 1.   | 1544.00 |
| 5. 1983.  | 1.   | 2154.00 |
| 6. 1983.  | 1.   | 2400.00 |
| 7. 1983.  | 1.   | 2400.00 |
| 8. 1983.  | 1.   | 2400.00 |
| 9. 1983.  | 1.   | 2400.00 |
| 10. 1983. | 1.   | 2400.00 |
| 11. 1983. | 1.   | 2400.00 |
| 12. 1983. | 1.   | 2385.00 |
| 1. 1984.  | 1.   | 2400.00 |
| 2. 1984.  | 1.   | 2400.00 |
| 3. 1984.  | 1.   | 1989.00 |
| 4. 1984.  | 1.   | 2097.00 |
| 5. 1984.  | 1.   | 2019.00 |
| 6. 1984.  | 1.   | 2064.00 |
| 7. 1984.  | 1.   | 2400.00 |
| 8. 1984.  | 1.   | 2400.00 |
| 9. 1984.  | 1.   | 2400.00 |
| 10. 1984. | 1.   | 2400.00 |
| 11. 1984. | 1.   | 2400.00 |
| 12. 1984. | 1.   | 1970.00 |

**WORKED EXAMPLE 2(d) - DEMAND SHORTFALLS**

DEMAND SHORTFALL

EX2D.log

Tutorial 2 Sub-Problem (d)

Time :15:17:50 Date :12/04/01

(F4.0,2F6.0, 1f12.2 )

4

SEASON

YEAR

REPLICATE

| DEMAND 1  | SHRT |        |
|-----------|------|--------|
| 1. 1982.  | 1.   | 900.00 |
| 2. 1982.  | 1.   | 0.00   |
| 3. 1982.  | 1.   | 779.00 |
| 4. 1982.  | 1.   | 238.00 |
| 5. 1982.  | 1.   | 501.00 |
| 6. 1982.  | 1.   | 0.00   |
| 7. 1982.  | 1.   | 0.00   |
| 8. 1982.  | 1.   | 0.00   |
| 9. 1982.  | 1.   | 0.00   |
| 10. 1982. | 1.   | 0.00   |
| 11. 1982. | 1.   | 0.00   |
| 12. 1982. | 1.   | 0.00   |
| 1. 1983.  | 1.   | 0.00   |
| 2. 1983.  | 1.   | 0.00   |
| 3. 1983.  | 1.   | 0.00   |
| 4. 1983.  | 1.   | 0.00   |
| 5. 1983.  | 1.   | 0.00   |
| 6. 1983.  | 1.   | 0.00   |
| 7. 1983.  | 1.   | 0.00   |
| 8. 1983.  | 1.   | 0.00   |
| 9. 1983.  | 1.   | 0.00   |
| 10. 1983. | 1.   | 0.00   |
| 11. 1983. | 1.   | 0.00   |
| 12. 1983. | 1.   | 0.00   |
| 1. 1984.  | 1.   | 0.00   |
| 2. 1984.  | 1.   | 0.00   |
| 3. 1984.  | 1.   | 811.00 |
| 4. 1984.  | 1.   | 0.00   |
| 5. 1984.  | 1.   | 0.00   |
| 6. 1984.  | 1.   | 0.00   |
| 7. 1984.  | 1.   | 0.00   |
| 8. 1984.  | 1.   | 0.00   |
| 9. 1984.  | 1.   | 0.00   |
| 10. 1984. | 1.   | 0.00   |
| 11. 1984. | 1.   | 0.00   |
| 12. 1984. | 1.   | 130.00 |

**WORKED EXAMPLE 2(d) – COMPARISON OF DEMAND, FLOW AND CAPACITY OF PIPE 1 AND SHORTFALLS**

####4

EX2D.log

Tutorial 2 Sub-Problem (d)

Time :12:20:18 Date :01/11/02

( 6f12.2 )

6

SEASON

YEAR

PIPE 1

PIPE 1

DEMAND 1

DEMAND 1

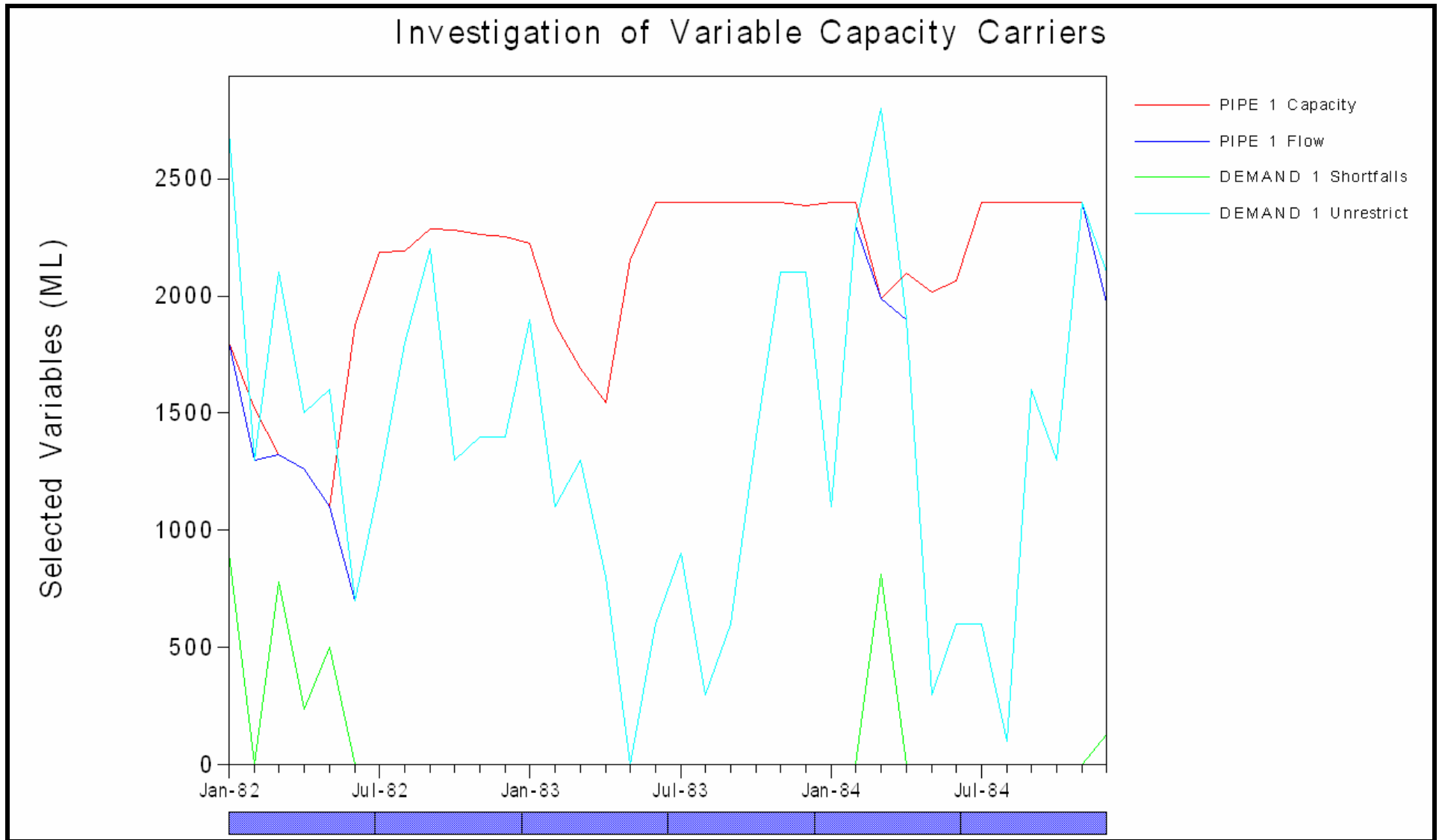
FLOW

CAPC

SHRT

UNRS

|       |         |         |         |        |         |
|-------|---------|---------|---------|--------|---------|
| 1.00  | 1982.00 | 1800.00 | 1800.00 | 900.00 | 2700.00 |
| 2.00  | 1982.00 | 1300.00 | 1523.00 | 0.00   | 1300.00 |
| 3.00  | 1982.00 | 1321.00 | 1321.00 | 779.00 | 2100.00 |
| 4.00  | 1982.00 | 1262.00 | 1262.00 | 238.00 | 1500.00 |
| 5.00  | 1982.00 | 1099.00 | 1099.00 | 501.00 | 1600.00 |
| 6.00  | 1982.00 | 700.00  | 1877.00 | 0.00   | 700.00  |
| 7.00  | 1982.00 | 1200.00 | 2187.00 | 0.00   | 1200.00 |
| 8.00  | 1982.00 | 1800.00 | 2194.00 | 0.00   | 1800.00 |
| 9.00  | 1982.00 | 2200.00 | 2288.00 | 0.00   | 2200.00 |
| 10.00 | 1982.00 | 1300.00 | 2280.00 | 0.00   | 1300.00 |
| 11.00 | 1982.00 | 1400.00 | 2263.00 | 0.00   | 1400.00 |
| 12.00 | 1982.00 | 1400.00 | 2251.00 | 0.00   | 1400.00 |
| 1.00  | 1983.00 | 1900.00 | 2225.00 | 0.00   | 1900.00 |
| 2.00  | 1983.00 | 1100.00 | 1879.00 | 0.00   | 1100.00 |
| 3.00  | 1983.00 | 1300.00 | 1691.00 | 0.00   | 1300.00 |
| 4.00  | 1983.00 | 800.00  | 1544.00 | 0.00   | 800.00  |
| 5.00  | 1983.00 | 0.00    | 2154.00 | 0.00   | 0.00    |
| 6.00  | 1983.00 | 600.00  | 2400.00 | 0.00   | 600.00  |
| 7.00  | 1983.00 | 900.00  | 2400.00 | 0.00   | 900.00  |
| 8.00  | 1983.00 | 300.00  | 2400.00 | 0.00   | 300.00  |
| 9.00  | 1983.00 | 600.00  | 2400.00 | 0.00   | 600.00  |
| 10.00 | 1983.00 | 1400.00 | 2400.00 | 0.00   | 1400.00 |
| 11.00 | 1983.00 | 2100.00 | 2400.00 | 0.00   | 2100.00 |
| 12.00 | 1983.00 | 2100.00 | 2385.00 | 0.00   | 2100.00 |
| 1.00  | 1984.00 | 1100.00 | 2400.00 | 0.00   | 1100.00 |
| 2.00  | 1984.00 | 2300.00 | 2400.00 | 0.00   | 2300.00 |
| 3.00  | 1984.00 | 1989.00 | 1989.00 | 811.00 | 2800.00 |
| 4.00  | 1984.00 | 1900.00 | 2097.00 | 0.00   | 1900.00 |
| 5.00  | 1984.00 | 300.00  | 2019.00 | 0.00   | 300.00  |
| 6.00  | 1984.00 | 600.00  | 2064.00 | 0.00   | 600.00  |
| 7.00  | 1984.00 | 600.00  | 2400.00 | 0.00   | 600.00  |
| 8.00  | 1984.00 | 100.00  | 2400.00 | 0.00   | 100.00  |
| 9.00  | 1984.00 | 1600.00 | 2400.00 | 0.00   | 1600.00 |
| 10.00 | 1984.00 | 1300.00 | 2400.00 | 0.00   | 1300.00 |
| 11.00 | 1984.00 | 2400.00 | 2400.00 | 0.00   | 2400.00 |
| 12.00 | 1984.00 | 1970.00 | 1970.00 | 130.00 | 2100.00 |



**Figure 3.2-6 Worked Example 2(d) – Investigation of Variable Capacity Carriers**





demand data:

| No | Name     | No Bypass | S/F Priority | Monthly Factors |       |       |       |       |       |       |       |       |       |       |       |       |
|----|----------|-----------|--------------|-----------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
|    |          |           |              | Jan             | Feb   | Mar   | Apr   | May   | Jun   | Jul   | Aug   | Sep   | Oct   | Nov   | Dec   |       |
| 2  | DEMAND 1 | 1         | 1 min        | 0.000           | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
|    |          |           | max          | 1.000           | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |

-----  
 | CARRIER INFORMATION |  
 -----

| No | Name    | Type  | From | To | Cost | Offset | Loss | Ann Vol | Shr Gp | Shr% | No |
|----|---------|-------|------|----|------|--------|------|---------|--------|------|----|
| 1  | PIPE 1  | Pipe  | 1    | 2  | 0    | 0      | Ofix |         | 0      | 0%   | 1  |
| 2  | River 1 | River | 1    | 3  | 1000 | 0      | Ofix |         | 0      | 0%   | 2  |

-----  
 Maximum Flows

| No | Name    | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec      |
|----|---------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|
| 1  | PIPE 1  | 12000    | 12000    | 12000    | 12000    | 12000    | 12000    | 12000    | 12000    | 12000    | 12000    | 12000    | 12000    |
| 2  | River 1 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 |

-----  
 | RESTRICTION INFORMATION |  
 -----

Number of restriction groups: 1

NB. Each restriction group is treated separately with its own rule curve definitions; for irrigation demand groups by its allocations functions.

-----  
 Restriction Group: 1      Type: Urban/industrial demand centers  
 -----

| Reservoirs/<br>arcs in Group | Demands<br>in Group |
|------------------------------|---------------------|
| RESERVOIR 1                  | DEMAND 1            |

| Restriction Level   | Relative Position | % of Restrictable Demand Restricted | Storage as % of Average Annual Demand |          |          |          |          |          |          |          |          |          |          |          |          |
|---------------------|-------------------|-------------------------------------|---------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|
|                     |                   |                                     | Jan                                   | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec      |          |
| 0                   | 0.0               | 0.0                                 | -6500.00                              | -6500.00 | -6500.00 | -6500.00 | -6500.00 | -6500.00 | -6500.00 | -6500.00 | -6500.00 | -6500.00 | -6500.00 | -6500.00 | -6500.00 |
| 1                   | 25.0              | 10.0                                | -5750.00                              | -5750.00 | -5750.00 | -5750.00 | -5750.00 | -5750.00 | -5750.00 | -5750.00 | -5750.00 | -5750.00 | -5750.00 | -5750.00 | -5750.00 |
| 2                   | 50.0              | 20.0                                | -5000.00                              | -5000.00 | -5000.00 | -5000.00 | -5000.00 | -5000.00 | -5000.00 | -5000.00 | -5000.00 | -5000.00 | -5000.00 | -5000.00 | -5000.00 |
| 3                   | 75.0              | 50.0                                | -4250.00                              | -4250.00 | -4250.00 | -4250.00 | -4250.00 | -4250.00 | -4250.00 | -4250.00 | -4250.00 | -4250.00 | -4250.00 | -4250.00 | -4250.00 |
| 4                   | 100.0             | 70.0                                | -3500.00                              | -3500.00 | -3500.00 | -3500.00 | -3500.00 | -3500.00 | -3500.00 | -3500.00 | -3500.00 | -3500.00 | -3500.00 | -3500.00 | -3500.00 |
| Base levels (% AAD) |                   |                                     | -500.00                               | -500.00  | -500.00  | -500.00  | -500.00  | -500.00  | -500.00  | -500.00  | -500.00  | -500.00  | -500.00  | -500.00  | -500.00  |

NB. Negative values will be interpreted as absolute values

**WORKED EXAMPLE 2(e) - LOG FILE**

```

HHHHH      HHHHHHHH      HHHHHH      H      HHHHHHHHHH
H  H      H      H  H  H      H  H  H
HHHHHHHHH  HHHHHH      HHHHHHHH  HHH      HHH  H  H
HHH      H  HHH      HHH      H  HHH      HHH  H  H
HHH      H  HHH      HHH      H  HHH      HHH  H  H
HHH      H  HHHHHHHH  HHH      H  HHHHHHHH  HHH  H  H

```

```

*****
*   SIMULATION LOG FILE   *
*****

```

Log filename : EX2E.log

Scenario file: scn2e.scn

Simulation label:

Tutorial 2 Sub-Problem (e)

Streamflow file(s):

C:\REALM\WorkedExamples\Sf1.dat

Demand file(s):

C:\REALM\WorkedExamples\Dem.dat

Restrictions are ON

Instream flow requirements NOT limited to natural

Water quality calculations are OFF

Number of S/F Sequences: 1

```

Convergence tolerance (storage)  1 10th%
Other convergence tolerance      5 %
Arc convergence tolerance (abs) 100
Minimum iteration count          3
Maximum iteration count          51
Do convergence twice             No

```

Date: 15:51:35 12/04/01

Time Step = Monthly

SYSTEM CHANGES:

| No | Seas | Year | System File                      |
|----|------|------|----------------------------------|
| 1  | 1    | 1982 | C:\REALM\WorkedExamples\EX2E.sys |

Total number of seasons:- 36

\*\*\*\*\* RUN TIME MESSAGES:- \*\*\*\*\*

\*\*\*\*INPUT DATA TYPE= 1 \*\*\*\*

1982

C:\REALM\WorkedExamples\EX2E.sys

1983

1984

\*\*\*\*\* END RUN TIME MESSAGES \*\*\*\*\*

SUMMARY INFORMATION

Reservoir data:

|       | Name        | Start<br>Storage | File<br>Inflow | Min<br>Storage | Average<br>Storage | Evapn | Release<br>to river | Spill | End<br>Storage |
|-------|-------------|------------------|----------------|----------------|--------------------|-------|---------------------|-------|----------------|
| 1     | RESERVOIR 1 | 9000.            | 2083.          | 4399.          | 9928.              | 0.    | 774.                | 0.    | 8102.          |
| ----- |             |                  |                |                |                    |       |                     |       |                |
|       |             | 9000.            | 2083.          | 0.             | 9928.              | 0.    | 774.                | 0.    | 8102.          |
| ----- |             |                  |                |                |                    |       |                     |       |                |

## Demand data:

| Name       | Unrestrict | Restrict | Rationed | Shortfall | Supplied |
|------------|------------|----------|----------|-----------|----------|
| 1 DEMAND 1 | 1372.      | 1334.    | 1334.    | 0.        | 1334.    |
| -----      |            |          |          |           |          |
|            | 1372.      | 1334.    | 1334.    | 0.        | 1334.    |
| -----      |            |          |          |           |          |

| Name       | No Rest | Ave Rest lvl | Max Rest lvl | No Ration | Ave % Ration | Max % Ration | No Short | Ave % Short | Max % Short |
|------------|---------|--------------|--------------|-----------|--------------|--------------|----------|-------------|-------------|
| 1 DEMAND 1 | 3.0     | 2.7          | 3.0          | 0.0       | 0.0          | 0.0          | 0.0      | 0.0         | 0.0         |
| -----      |         |              |              |           |              |              |          |             |             |

## Pipe/River flows:

| Name      | flow   | Capacity   | Min | Max    | Loss |
|-----------|--------|------------|-----|--------|------|
| 1 PIPE 1  | 1334.2 | 12000.0    | 0.0 | 2800.0 | 0.0  |
| 2 River 1 | 773.6  | 99999999.0 | 0.0 | 4610.0 | 0.0  |
|           |        |            |     |        | 0.   |
| -----     |        |            |     |        |      |

End run

**WORKED EXAMPLE 2(e) - RESERVOIR VOLUME**

RESERVOIR STORAGE

EX2E.log

:12/04/01

Tutorial 2 Sub-Problem (e)

Time :15:51:35 Date

(F4.0,2F6.0, 1f12.2 )  
4

SEASON

YEAR

REPLICATE

| RESERVOIR 1 | ESTO |          |
|-------------|------|----------|
| 1. 1982.    | 1.   | 6716.00  |
| 2. 1982.    | 1.   | 5704.00  |
| 3. 1982.    | 1.   | 4949.00  |
| 4. 1982.    | 1.   | 4399.00  |
| 5. 1982.    | 1.   | 8337.00  |
| 6. 1982.    | 1.   | 9886.00  |
| 7. 1982.    | 1.   | 9920.00  |
| 8. 1982.    | 1.   | 10393.00 |
| 9. 1982.    | 1.   | 10353.00 |
| 10. 1982.   | 1.   | 10269.00 |
| 11. 1982.   | 1.   | 10207.00 |
| 12. 1982.   | 1.   | 10076.00 |
| 1. 1983.    | 1.   | 8348.00  |
| 2. 1983.    | 1.   | 7408.00  |
| 3. 1983.    | 1.   | 6674.00  |
| 4. 1983.    | 1.   | 9722.00  |
| 5. 1983.    | 1.   | 12000.00 |
| 6. 1983.    | 1.   | 12000.00 |
| 7. 1983.    | 1.   | 12000.00 |
| 8. 1983.    | 1.   | 12000.00 |
| 9. 1983.    | 1.   | 12000.00 |
| 10. 1983.   | 1.   | 12000.00 |
| 11. 1983.   | 1.   | 11923.00 |
| 12. 1983.   | 1.   | 12000.00 |
| 1. 1984.    | 1.   | 12000.00 |
| 2. 1984.    | 1.   | 9946.00  |
| 3. 1984.    | 1.   | 9672.00  |
| 4. 1984.    | 1.   | 9285.00  |
| 5. 1984.    | 1.   | 9510.00  |
| 6. 1984.    | 1.   | 11743.00 |
| 7. 1984.    | 1.   | 12000.00 |
| 8. 1984.    | 1.   | 12000.00 |
| 9. 1984.    | 1.   | 12000.00 |
| 10. 1984.   | 1.   | 12000.00 |
| 11. 1984.   | 1.   | 9849.00  |
| 12. 1984.   | 1.   | 8102.00  |

**WORKED EXAMPLE 2(e) - RESTRICTION LEVELS**

DEMAND RESTN LVLS

EX2E.log

Tutorial 2 Sub-Problem (e)

Time :15:51:35 Date :12/04/01

(F4.0,2F6.0, 1F4.0)  
4

SEASON

YEAR

REPLICATE

DEMAND 1

RLVS

|           |    |    |
|-----------|----|----|
| 1. 1982.  | 1. | 0. |
| 2. 1982.  | 1. | 0. |
| 3. 1982.  | 1. | 2. |
| 4. 1982.  | 1. | 3. |
| 5. 1982.  | 1. | 3. |
| 6. 1982.  | 1. | 0. |
| 7. 1982.  | 1. | 0. |
| 8. 1982.  | 1. | 0. |
| 9. 1982.  | 1. | 0. |
| 10. 1982. | 1. | 0. |
| 11. 1982. | 1. | 0. |
| 12. 1982. | 1. | 0. |
| 1. 1983.  | 1. | 0. |
| 2. 1983.  | 1. | 0. |
| 3. 1983.  | 1. | 0. |
| 4. 1983.  | 1. | 0. |
| 5. 1983.  | 1. | 0. |
| 6. 1983.  | 1. | 0. |
| 7. 1983.  | 1. | 0. |
| 8. 1983.  | 1. | 0. |
| 9. 1983.  | 1. | 0. |
| 10. 1983. | 1. | 0. |
| 11. 1983. | 1. | 0. |
| 12. 1983. | 1. | 0. |
| 1. 1984.  | 1. | 0. |
| 2. 1984.  | 1. | 0. |
| 3. 1984.  | 1. | 0. |
| 4. 1984.  | 1. | 0. |
| 5. 1984.  | 1. | 0. |
| 6. 1984.  | 1. | 0. |
| 7. 1984.  | 1. | 0. |
| 8. 1984.  | 1. | 0. |
| 9. 1984.  | 1. | 0. |
| 10. 1984. | 1. | 0. |
| 11. 1984. | 1. | 0. |
| 12. 1984. | 1. | 0. |

**WORKED EXAMPLE 2(e) - ACTUAL DEMAND SUPPLIED**

DEMAND SUPPLIED

EX2E.log

:12/04/01

Tutorial 2 Sub-Problem (e)

Time :15:51:35 Date

(F4.0,2F6.0, 1f12.2 )

4

SEASON

YEAR

REPLICATE

DEMAND 1

SUPP

|     |       |    |         |
|-----|-------|----|---------|
| 1.  | 1982. | 1. | 2700.00 |
| 2.  | 1982. | 1. | 1300.00 |
| 3.  | 1982. | 1. | 1780.00 |
| 4.  | 1982. | 1. | 1000.00 |
| 5.  | 1982. | 1. | 1050.00 |
| 6.  | 1982. | 1. | 700.00  |
| 7.  | 1982. | 1. | 1200.00 |
| 8.  | 1982. | 1. | 1800.00 |
| 9.  | 1982. | 1. | 2200.00 |
| 10. | 1982. | 1. | 1300.00 |
| 11. | 1982. | 1. | 1400.00 |
| 12. | 1982. | 1. | 1400.00 |
| 1.  | 1983. | 1. | 1900.00 |
| 2.  | 1983. | 1. | 1100.00 |
| 3.  | 1983. | 1. | 1300.00 |
| 4.  | 1983. | 1. | 800.00  |
| 5.  | 1983. | 1. | 0.00    |
| 6.  | 1983. | 1. | 600.00  |
| 7.  | 1983. | 1. | 900.00  |
| 8.  | 1983. | 1. | 300.00  |
| 9.  | 1983. | 1. | 600.00  |
| 10. | 1983. | 1. | 1400.00 |
| 11. | 1983. | 1. | 2100.00 |
| 12. | 1983. | 1. | 2100.00 |
| 1.  | 1984. | 1. | 1100.00 |
| 2.  | 1984. | 1. | 2300.00 |
| 3.  | 1984. | 1. | 2800.00 |
| 4.  | 1984. | 1. | 1900.00 |
| 5.  | 1984. | 1. | 300.00  |
| 6.  | 1984. | 1. | 600.00  |
| 7.  | 1984. | 1. | 600.00  |
| 8.  | 1984. | 1. | 100.00  |
| 9.  | 1984. | 1. | 1600.00 |
| 10. | 1984. | 1. | 1300.00 |
| 11. | 1984. | 1. | 2400.00 |
| 12. | 1984. | 1. | 2100.00 |

**WORKED EXAMPLE 2(e) - INVESTIGATION OF RESTRICTED DEMAND**

####4

EX2E.log

Tutorial 2 Sub-Problem (e)

Time :15:51:35 Date :12/04/01

( 6f12.2 )

6

SEASON

YEAR

RESERVOIR 1

DEMAND 1

DEMAND 1

DEMAND 1

ESTO

UNRS

REST

RLVS

|       |         |          |         |         |      |
|-------|---------|----------|---------|---------|------|
| 1.00  | 1982.00 | 6716.00  | 2700.00 | 2700.00 | 0.00 |
| 2.00  | 1982.00 | 5704.00  | 1300.00 | 1300.00 | 0.00 |
| 3.00  | 1982.00 | 4949.00  | 2100.00 | 1780.00 | 2.00 |
| 4.00  | 1982.00 | 4399.00  | 1500.00 | 1000.00 | 3.00 |
| 5.00  | 1982.00 | 8337.00  | 1600.00 | 1050.00 | 3.00 |
| 6.00  | 1982.00 | 9886.00  | 700.00  | 700.00  | 0.00 |
| 7.00  | 1982.00 | 9920.00  | 1200.00 | 1200.00 | 0.00 |
| 8.00  | 1982.00 | 10393.00 | 1800.00 | 1800.00 | 0.00 |
| 9.00  | 1982.00 | 10353.00 | 2200.00 | 2200.00 | 0.00 |
| 10.00 | 1982.00 | 10269.00 | 1300.00 | 1300.00 | 0.00 |
| 11.00 | 1982.00 | 10207.00 | 1400.00 | 1400.00 | 0.00 |
| 12.00 | 1982.00 | 10076.00 | 1400.00 | 1400.00 | 0.00 |
| 1.00  | 1983.00 | 8348.00  | 1900.00 | 1900.00 | 0.00 |
| 2.00  | 1983.00 | 7408.00  | 1100.00 | 1100.00 | 0.00 |
| 3.00  | 1983.00 | 6674.00  | 1300.00 | 1300.00 | 0.00 |
| 4.00  | 1983.00 | 9722.00  | 800.00  | 800.00  | 0.00 |
| 5.00  | 1983.00 | 12000.00 | 0.00    | 0.00    | 0.00 |
| 6.00  | 1983.00 | 12000.00 | 600.00  | 600.00  | 0.00 |
| 7.00  | 1983.00 | 12000.00 | 900.00  | 900.00  | 0.00 |
| 8.00  | 1983.00 | 12000.00 | 300.00  | 300.00  | 0.00 |
| 9.00  | 1983.00 | 12000.00 | 600.00  | 600.00  | 0.00 |
| 10.00 | 1983.00 | 12000.00 | 1400.00 | 1400.00 | 0.00 |
| 11.00 | 1983.00 | 11923.00 | 2100.00 | 2100.00 | 0.00 |
| 12.00 | 1983.00 | 12000.00 | 2100.00 | 2100.00 | 0.00 |
| 1.00  | 1984.00 | 12000.00 | 1100.00 | 1100.00 | 0.00 |
| 2.00  | 1984.00 | 9946.00  | 2300.00 | 2300.00 | 0.00 |
| 3.00  | 1984.00 | 9672.00  | 2800.00 | 2800.00 | 0.00 |
| 4.00  | 1984.00 | 9285.00  | 1900.00 | 1900.00 | 0.00 |
| 5.00  | 1984.00 | 9510.00  | 300.00  | 300.00  | 0.00 |
| 6.00  | 1984.00 | 11743.00 | 600.00  | 600.00  | 0.00 |
| 7.00  | 1984.00 | 12000.00 | 600.00  | 600.00  | 0.00 |
| 8.00  | 1984.00 | 12000.00 | 100.00  | 100.00  | 0.00 |
| 9.00  | 1984.00 | 12000.00 | 1600.00 | 1600.00 | 0.00 |
| 10.00 | 1984.00 | 12000.00 | 1300.00 | 1300.00 | 0.00 |
| 11.00 | 1984.00 | 9849.00  | 2400.00 | 2400.00 | 0.00 |
| 12.00 | 1984.00 | 8102.00  | 2100.00 | 2100.00 | 0.00 |

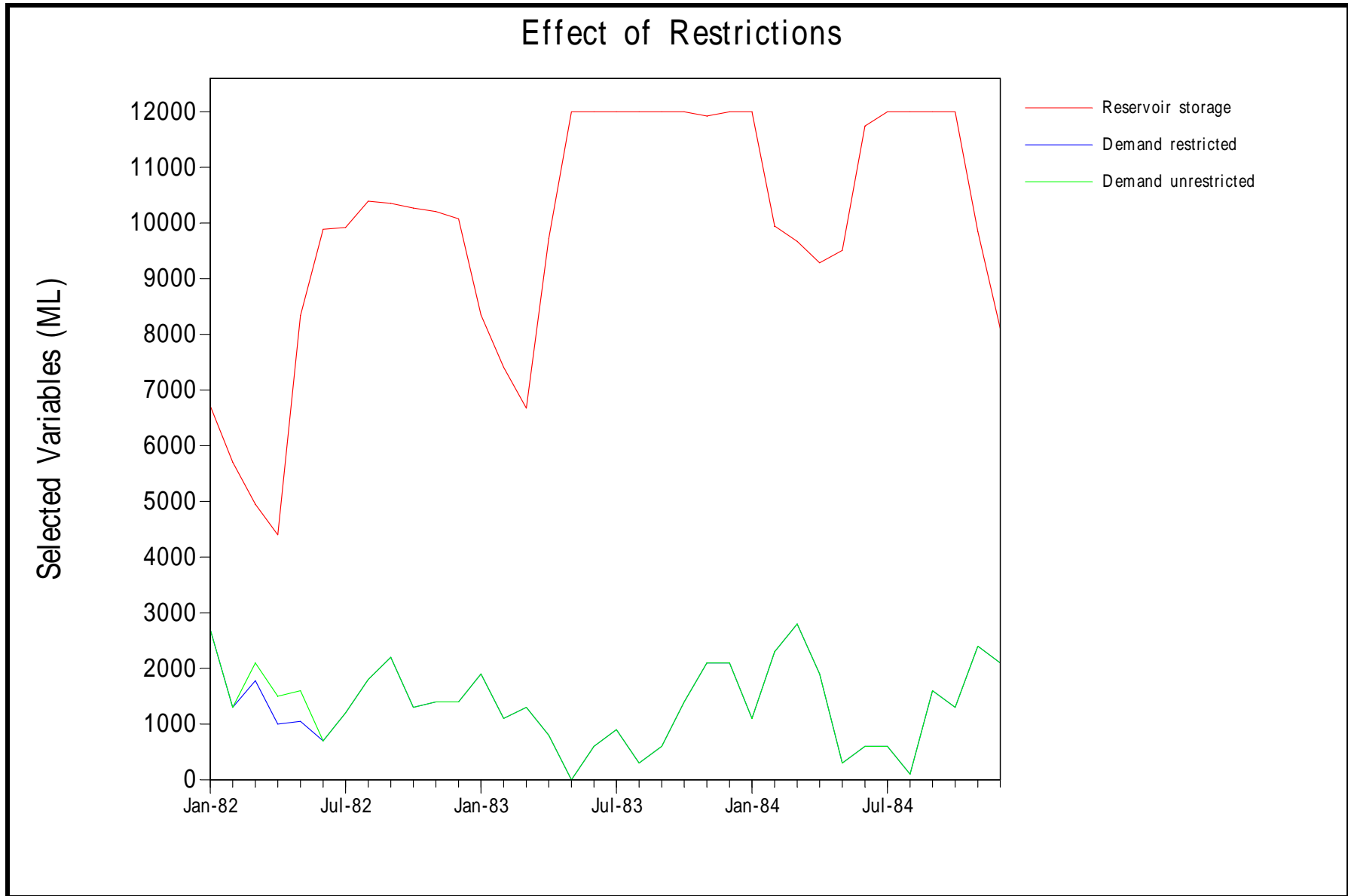


Figure 3.2-7 Worked Example 2(e) – Plot for Studying Effect of Restrictions



**WORKED EXAMPLE 2(f) – SYSTEM LISTING**


---

R     E     A     L     M

---

\*\*\*\*\*  
 \*    SYSTEM FILE LISTING    \*  
 \*\*\*\*\*

File: C:\REALM\WorkedExamples\EX2F.sys

Simulation label:  
 Tutorial 2 - Sub-Problem (f)

Date: 16:20:59 12/04/01

-----  
 |    NODE INFORMATION    |  
 -----

-----  
 |    NODE INFORMATION    |  
 -----

| No | Name              | Type            | X     | Y     | Z    | Size | Aux Input | No |
|----|-------------------|-----------------|-------|-------|------|------|-----------|----|
| 1  | RESERVOIR 1       | Reservoir       | 48.63 | 93.12 | 0.00 | 1.00 | STREAM1   | 1  |
| 2  | DEMAND 1          | Demand          | 49.84 | 7.46  | 0.00 | 1.00 |           | 2  |
| 3  | Stream Terminator | Strm terminator | 14.44 | 18.32 | 0.00 | 1.00 |           | 3  |

Reservoir data:

| No | Name        | Min<br>Cap | Max<br>Cap | No<br>Above | No<br>Below | Spill<br>Type |
|----|-------------|------------|------------|-------------|-------------|---------------|
| 1  | RESERVOIR 1 | 0          | 12000      | 1           | 1           | Downstream    |



-----  
 | RESTRICTION INFORMATION |  
 -----

Number of restriction groups: 1

NB. Each restriction group is treated separately  
 with its own rule curve definitions;  
 for irrigation demand groups by its allocations functions.

-----  
 Restriction Group: 1      Type: Urban/industrial demand centers  
 -----

| Reservoirs/<br>arcs in Group |          | Demands<br>in Group                    |  | Storage as % of Average Annual Demand |          |          |          |          |          |          |          |          |          |          |          |         |
|------------------------------|----------|--|--|---------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------|
| Level                        | Position | % of Restrictable<br>Demand Restricted |  | Jan                                   | Feb      | Mar      | Apl      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec      |         |
| RESERVOIR 1                  |          | DEMAND 1                               |  |                                       |          |          |          |          |          |          |          |          |          |          |          |         |
| 0                            | 0.0      | 0.0                                    |  | -6500.00                              | -6500.00 | -6500.00 | -6500.00 | -6500.00 | -6500.00 | -6500.00 | -6500.00 | -6500.00 | -6500.00 | -6500.00 | -6500.00 |         |
| 1                            | 25.0     | 10.0                                   |  | -5750.00                              | -5750.00 | -5750.00 | -5750.00 | -5750.00 | -5750.00 | -5750.00 | -5750.00 | -5750.00 | -5750.00 | -5750.00 | -5750.00 |         |
| 2                            | 50.0     | 20.0                                   |  | -5000.00                              | -5000.00 | -5000.00 | -5000.00 | -5000.00 | -5000.00 | -5000.00 | -5000.00 | -5000.00 | -5000.00 | -5000.00 | -5000.00 |         |
| 3                            | 75.0     | 50.0                                   |  | -4250.00                              | -4250.00 | -4250.00 | -4250.00 | -4250.00 | -4250.00 | -4250.00 | -4250.00 | -4250.00 | -4250.00 | -4250.00 | -4250.00 |         |
| 4                            | 100.0    | 70.0                                   |  | -3500.00                              | -3500.00 | -3500.00 | -3500.00 | -3500.00 | -3500.00 | -3500.00 | -3500.00 | -3500.00 | -3500.00 | -3500.00 | -3500.00 |         |
| Base levels (% AAD)          |          |  |  | -500.00                               | -500.00  | -500.00  | -500.00  | -500.00  | -500.00  | -500.00  | -500.00  | -500.00  | -500.00  | -500.00  | -500.00  | -500.00 |

NB. Negative values will be interpreted as absolute values

**WORKED EXAMPLE 2(f) - LOG FILE**

```

HHHHH      HHHHHHHH      HHHHHH      H      HHHHHHHHHH
H  H      H      H  H  H      H  H  H
HHHHHHHHH  HHHHHH      HHHHHHHH  HHH      HHH  H  H
HHH      H  HHH      HHH  H  HHH      HHH  H  H
HHH      H  HHH      HHH  H  HHH      HHH  H  H
HHH      H  HHHHHHHH  HHH  H  HHHHHHHH  HHH  H  H

```

```

*****
*      SIMULATION LOG FILE      *
*****

```

Log filename : EX2F.log

Scenario file: scn2f.scn

Simulation label:

Tutorial 2 Sub-Problem (f)

Streamflow file(s):

C:\REALM\WorkedExamples\Sf2.dat

Demand file(s):

C:\REALM\WorkedExamples\Dem.dat

Restrictions are ON

Instream flow requirements NOT limited to natural

Water quality calculations are OFF

Number of S/F Sequences: 1

Convergence tolerance (storage) 1 10th%

Other convergence tolerance 5 %

Arc convergence tolerance (abs) 100

Minimum iteration count 3

Maximum iteration count 51

Do convergence twice No

Date: 16:27:31 12/04/01

Time Step = Monthly

SYSTEM CHANGES:

| No | Seas | Year | System File                      |
|----|------|------|----------------------------------|
| 1  | 1    | 1982 | C:\REALM\WorkedExamples\EX2F.sys |

Total number of seasons:- 36

\*\*\*\*\* RUN TIME MESSAGES:- \*\*\*\*\*

\*\*\*\*INPUT DATA TYPE= 1 \*\*\*\*

1982

C:\REALM\WorkedExamples\EX2F.sys

1983

1984

\*\*\*\*\* END RUN TIME MESSAGES \*\*\*\*\*

SUMMARY INFORMATION

Reservoir data:

|   | Name        | Start<br>Storage | File<br>Inflow | Min<br>Storage | Average<br>Storage | Evapn | Release<br>to river | Spill | End<br>Storage |
|---|-------------|------------------|----------------|----------------|--------------------|-------|---------------------|-------|----------------|
| 1 | RESERVOIR 1 | 9000.            | 2083.          | 4211.          | 10073.             | -19.  | 807.                | 0.    | 8217.          |
|   |             | 9000.            | 2083.          | 0.             | 10073.             | -19.  | 807.                | 0.    | 8217.          |

## Demand data:

| Name       | Unrestrict | Restrict | Rationed | Shortfall | Supplied |
|------------|------------|----------|----------|-----------|----------|
| 1 DEMAND 1 | 1372.      | 1341.    | 1341.    | 24.       | 1317.    |
| -----      |            |          |          |           |          |
|            | 1372.      | 1341.    | 1341.    | 24.       | 1317.    |
| -----      |            |          |          |           |          |

| Name       | No Rest | Ave Rest lvl | Max Rest lvl | No Ration | Ave % Ration | Max % Ration | No Short | Ave % Short | Max % Short |
|------------|---------|--------------|--------------|-----------|--------------|--------------|----------|-------------|-------------|
| 1 DEMAND 1 | 3.0     | 2.3          | 4.0          | 0.0       | 0.0          | 0.0          | 3.0      | 10.0        | 16.0        |
| -----      |         |              |              |           |              |              |          |             |             |

## Pipe/River flows:

| Name      | flow   | Capacity   | Min | Max    | Loss |
|-----------|--------|------------|-----|--------|------|
| 1 PIPE 1  | 1317.2 | 2350.0     | 0.0 | 2350.0 | 0.0  |
| 2 River 1 | 806.5  | 99999999.0 | 0.0 | 4571.0 | 0.0  |
|           |        |            |     |        | 0.   |
| -----     |        |            |     |        |      |

End run

**WORKED EXAMPLE 2(f) - RESERVOIR VOLUME**

RESERVOIR STORAGE

EX2F.log

Tutorial 2 Sub-Problem (f)

Time :16:27:31 Date :12/04/01

(F4.0,2F6.0, 1f12.2 )  
4

SEASON

YEAR

REPLICATE

| RESERVOIR 1 | ESTO |          |
|-------------|------|----------|
| 1. 1982.    | 1.   | 7023.00  |
| 2. 1982.    | 1.   | 5976.00  |
| 3. 1982.    | 1.   | 5034.00  |
| 4. 1982.    | 1.   | 4211.00  |
| 5. 1982.    | 1.   | 8398.00  |
| 6. 1982.    | 1.   | 10059.00 |
| 7. 1982.    | 1.   | 10316.00 |
| 8. 1982.    | 1.   | 10846.00 |
| 9. 1982.    | 1.   | 10780.00 |
| 10. 1982.   | 1.   | 10660.00 |
| 11. 1982.   | 1.   | 10548.00 |
| 12. 1982.   | 1.   | 10367.00 |
| 1. 1983.    | 1.   | 8588.00  |
| 2. 1983.    | 1.   | 7605.00  |
| 3. 1983.    | 1.   | 6895.00  |
| 4. 1983.    | 1.   | 10029.00 |
| 5. 1983.    | 1.   | 12000.00 |
| 6. 1983.    | 1.   | 12000.00 |
| 7. 1983.    | 1.   | 12000.00 |
| 8. 1983.    | 1.   | 12000.00 |
| 9. 1983.    | 1.   | 12000.00 |
| 10. 1983.   | 1.   | 12000.00 |
| 11. 1983.   | 1.   | 11881.00 |
| 12. 1983.   | 1.   | 12000.00 |
| 1. 1984.    | 1.   | 12000.00 |
| 2. 1984.    | 1.   | 9891.00  |
| 3. 1984.    | 1.   | 10032.00 |
| 4. 1984.    | 1.   | 9613.00  |
| 5. 1984.    | 1.   | 9815.00  |
| 6. 1984.    | 1.   | 12000.00 |
| 7. 1984.    | 1.   | 12000.00 |
| 8. 1984.    | 1.   | 12000.00 |
| 9. 1984.    | 1.   | 12000.00 |
| 10. 1984.   | 1.   | 12000.00 |
| 11. 1984.   | 1.   | 9849.00  |
| 12. 1984.   | 1.   | 8217.00  |

**WORKED EXAMPLE 2(f) - RESERVOIR EVAPORATION**

RESERVOIR EVAPS

EX2F.log

Tutorial 2 Sub-Problem (f)

Time :16:27:31 Date :12/04/01

(F4.0,2F6.0, 1f12.2 )  
4

SEASON

YEAR

REPLICATE

| RESERVOIR 1 | EVAP |         |
|-------------|------|---------|
| 1. 1982.    | 1.   | 43.00   |
| 2. 1982.    | 1.   | 35.00   |
| 3. 1982.    | 1.   | 27.00   |
| 4. 1982.    | 1.   | -27.00  |
| 5. 1982.    | 1.   | -29.00  |
| 6. 1982.    | 1.   | -112.00 |
| 7. 1982.    | 1.   | -223.00 |
| 8. 1982.    | 1.   | -57.00  |
| 9. 1982.    | 1.   | 26.00   |
| 10. 1982.   | 1.   | 36.00   |
| 11. 1982.   | 1.   | 50.00   |
| 12. 1982.   | 1.   | 50.00   |
| 1. 1983.    | 1.   | 51.00   |
| 2. 1983.    | 1.   | 43.00   |
| 3. 1983.    | 1.   | -24.00  |
| 4. 1983.    | 1.   | -86.00  |
| 5. 1983.    | 1.   | -216.00 |
| 6. 1983.    | 1.   | -182.00 |
| 7. 1983.    | 1.   | -78.00  |
| 8. 1983.    | 1.   | 24.00   |
| 9. 1983.    | 1.   | 31.00   |
| 10. 1983.   | 1.   | -62.00  |
| 11. 1983.   | 1.   | 42.00   |
| 12. 1983.   | 1.   | 55.00   |
| 1. 1984.    | 1.   | 52.00   |
| 2. 1984.    | 1.   | 55.00   |
| 3. 1984.    | 1.   | 35.00   |
| 4. 1984.    | 1.   | 32.00   |
| 5. 1984.    | 1.   | 23.00   |
| 6. 1984.    | 1.   | -55.00  |
| 7. 1984.    | 1.   | -177.00 |
| 8. 1984.    | 1.   | -74.00  |
| 9. 1984.    | 1.   | 27.00   |
| 10. 1984.   | 1.   | 39.00   |
| 11. 1984.   | 1.   | 50.00   |
| 12. 1984.   | 1.   | -115.00 |

**WORKED EXAMPLE 2(f) - RESTRICTION LEVELS**

DEMAND RESTN LVLS

EX2F.log

Tutorial 2 Sub-Problem (f)

Time :16:27:31 Date :12/04/01

(F4.0,2F6.0, 1F4.0)

4

SEASON

YEAR

REPLICATE

| DEMAND 1  | RLVS  |
|-----------|-------|
| 1. 1982.  | 1. 0. |
| 2. 1982.  | 1. 0. |
| 3. 1982.  | 1. 1. |
| 4. 1982.  | 1. 2. |
| 5. 1982.  | 1. 4. |
| 6. 1982.  | 1. 0. |
| 7. 1982.  | 1. 0. |
| 8. 1982.  | 1. 0. |
| 9. 1982.  | 1. 0. |
| 10. 1982. | 1. 0. |
| 11. 1982. | 1. 0. |
| 12. 1982. | 1. 0. |
| 1. 1983.  | 1. 0. |
| 2. 1983.  | 1. 0. |
| 3. 1983.  | 1. 0. |
| 4. 1983.  | 1. 0. |
| 5. 1983.  | 1. 0. |
| 6. 1983.  | 1. 0. |
| 7. 1983.  | 1. 0. |
| 8. 1983.  | 1. 0. |
| 9. 1983.  | 1. 0. |
| 10. 1983. | 1. 0. |
| 11. 1983. | 1. 0. |
| 12. 1983. | 1. 0. |
| 1. 1984.  | 1. 0. |
| 2. 1984.  | 1. 0. |
| 3. 1984.  | 1. 0. |
| 4. 1984.  | 1. 0. |
| 5. 1984.  | 1. 0. |
| 6. 1984.  | 1. 0. |
| 7. 1984.  | 1. 0. |
| 8. 1984.  | 1. 0. |
| 9. 1984.  | 1. 0. |
| 10. 1984. | 1. 0. |
| 11. 1984. | 1. 0. |
| 12. 1984. | 1. 0. |

**WORKED EXAMPLE 2(f) - ACTUAL DEMAND SUPPLIED**

DEMAND SUPPLIED

EX2F.log

Tutorial 2 Sub-Problem (f)

Time :16:27:31 Date :12/04/01

(F4.0,2F6.0, 1f12.2 )

4

SEASON

YEAR

REPLICATE

| DEMAND 1  | SUPP       |
|-----------|------------|
| 1. 1982.  | 1. 2350.00 |
| 2. 1982.  | 1. 1300.00 |
| 3. 1982.  | 1. 1940.00 |
| 4. 1982.  | 1. 1300.00 |
| 5. 1982.  | 1. 830.00  |
| 6. 1982.  | 1. 700.00  |
| 7. 1982.  | 1. 1200.00 |
| 8. 1982.  | 1. 1800.00 |
| 9. 1982.  | 1. 2200.00 |
| 10. 1982. | 1. 1300.00 |
| 11. 1982. | 1. 1400.00 |
| 12. 1982. | 1. 1400.00 |
| 1. 1983.  | 1. 1900.00 |
| 2. 1983.  | 1. 1100.00 |
| 3. 1983.  | 1. 1300.00 |
| 4. 1983.  | 1. 800.00  |
| 5. 1983.  | 1. 0.00    |
| 6. 1983.  | 1. 600.00  |
| 7. 1983.  | 1. 900.00  |
| 8. 1983.  | 1. 300.00  |
| 9. 1983.  | 1. 600.00  |
| 10. 1983. | 1. 1400.00 |
| 11. 1983. | 1. 2100.00 |
| 12. 1983. | 1. 2100.00 |
| 1. 1984.  | 1. 1100.00 |
| 2. 1984.  | 1. 2300.00 |
| 3. 1984.  | 1. 2350.00 |
| 4. 1984.  | 1. 1900.00 |
| 5. 1984.  | 1. 300.00  |
| 6. 1984.  | 1. 600.00  |
| 7. 1984.  | 1. 600.00  |
| 8. 1984.  | 1. 100.00  |
| 9. 1984.  | 1. 1600.00 |
| 10. 1984. | 1. 1300.00 |
| 11. 1984. | 1. 2350.00 |
| 12. 1984. | 1. 2100.00 |



**WORKED EXAMPLE 2(f) - DEMAND SHORTFALLS**

DEMAND SHORTFALL

EX2F.log

Tutorial 2 Sub-Problem (f)

Time :16:27:31 Date :12/04/01

(F4.0,2F6.0, 1f12.2 )

4

SEASON

YEAR

REPLICATE

| DEMAND 1  |    | SHRT   |
|-----------|----|--------|
| 1. 1982.  | 1. | 350.00 |
| 2. 1982.  | 1. | 0.00   |
| 3. 1982.  | 1. | 0.00   |
| 4. 1982.  | 1. | 0.00   |
| 5. 1982.  | 1. | 0.00   |
| 6. 1982.  | 1. | 0.00   |
| 7. 1982.  | 1. | 0.00   |
| 8. 1982.  | 1. | 0.00   |
| 9. 1982.  | 1. | 0.00   |
| 10. 1982. | 1. | 0.00   |
| 11. 1982. | 1. | 0.00   |
| 12. 1982. | 1. | 0.00   |
| 1. 1983.  | 1. | 0.00   |
| 2. 1983.  | 1. | 0.00   |
| 3. 1983.  | 1. | 0.00   |
| 4. 1983.  | 1. | 0.00   |
| 5. 1983.  | 1. | 0.00   |
| 6. 1983.  | 1. | 0.00   |
| 7. 1983.  | 1. | 0.00   |
| 8. 1983.  | 1. | 0.00   |
| 9. 1983.  | 1. | 0.00   |
| 10. 1983. | 1. | 0.00   |
| 11. 1983. | 1. | 0.00   |
| 12. 1983. | 1. | 0.00   |
| 1. 1984.  | 1. | 0.00   |
| 2. 1984.  | 1. | 0.00   |
| 3. 1984.  | 1. | 450.00 |
| 4. 1984.  | 1. | 0.00   |
| 5. 1984.  | 1. | 0.00   |
| 6. 1984.  | 1. | 0.00   |
| 7. 1984.  | 1. | 0.00   |
| 8. 1984.  | 1. | 0.00   |
| 9. 1984.  | 1. | 0.00   |
| 10. 1984. | 1. | 0.00   |
| 11. 1984. | 1. | 50.00  |
| 12. 1984. | 1. | 0.00   |

**WORKED EXAMPLE 2(f) - CARRIER FLOWS**

CARRIER FLOWS

EX2F.log

Tutorial 2 Sub-Problem (f)

Time :16:27:31 Date :12/04/01

(F4.0,2F6.0, 1f12.2 )

4

SEASON

YEAR

REPLICATE

| PIPE 1    |    | FLOW    |
|-----------|----|---------|
| 1. 1982.  | 1. | 2350.00 |
| 2. 1982.  | 1. | 1300.00 |
| 3. 1982.  | 1. | 1940.00 |
| 4. 1982.  | 1. | 1300.00 |
| 5. 1982.  | 1. | 830.00  |
| 6. 1982.  | 1. | 700.00  |
| 7. 1982.  | 1. | 1200.00 |
| 8. 1982.  | 1. | 1800.00 |
| 9. 1982.  | 1. | 2200.00 |
| 10. 1982. | 1. | 1300.00 |
| 11. 1982. | 1. | 1400.00 |
| 12. 1982. | 1. | 1400.00 |
| 1. 1983.  | 1. | 1900.00 |
| 2. 1983.  | 1. | 1100.00 |
| 3. 1983.  | 1. | 1300.00 |
| 4. 1983.  | 1. | 800.00  |
| 5. 1983.  | 1. | 0.00    |
| 6. 1983.  | 1. | 600.00  |
| 7. 1983.  | 1. | 900.00  |
| 8. 1983.  | 1. | 300.00  |
| 9. 1983.  | 1. | 600.00  |
| 10. 1983. | 1. | 1400.00 |
| 11. 1983. | 1. | 2100.00 |
| 12. 1983. | 1. | 2100.00 |
| 1. 1984.  | 1. | 1100.00 |
| 2. 1984.  | 1. | 2300.00 |
| 3. 1984.  | 1. | 2350.00 |
| 4. 1984.  | 1. | 1900.00 |
| 5. 1984.  | 1. | 300.00  |
| 6. 1984.  | 1. | 600.00  |
| 7. 1984.  | 1. | 600.00  |
| 8. 1984.  | 1. | 100.00  |
| 9. 1984.  | 1. | 1600.00 |
| 10. 1984. | 1. | 1300.00 |
| 11. 1984. | 1. | 2350.00 |
| 12. 1984. | 1. | 2100.00 |

## WORKED EXAMPLE 2(f) – INVESTIGATION OF RESTRICTIONS

####4

EX2F.log

Time :16:27:31 Date :12/04/01

Tutorial 2 Sub-Problem (f)

( 6f12.2 )  
6

SEASON

YEAR

RESERVOIR 1

DEMAND 1

DEMAND 1

DEMAND 1

ESTO

UNRS

REST

RLVS

|       |         |          |         |         |      |
|-------|---------|----------|---------|---------|------|
| 1.00  | 1982.00 | 7023.00  | 2700.00 | 2700.00 | 0.00 |
| 2.00  | 1982.00 | 5976.00  | 1300.00 | 1300.00 | 0.00 |
| 3.00  | 1982.00 | 5034.00  | 2100.00 | 1940.00 | 1.00 |
| 4.00  | 1982.00 | 4211.00  | 1500.00 | 1300.00 | 2.00 |
| 5.00  | 1982.00 | 8398.00  | 1600.00 | 830.00  | 4.00 |
| 6.00  | 1982.00 | 10059.00 | 700.00  | 700.00  | 0.00 |
| 7.00  | 1982.00 | 10316.00 | 1200.00 | 1200.00 | 0.00 |
| 8.00  | 1982.00 | 10846.00 | 1800.00 | 1800.00 | 0.00 |
| 9.00  | 1982.00 | 10780.00 | 2200.00 | 2200.00 | 0.00 |
| 10.00 | 1982.00 | 10660.00 | 1300.00 | 1300.00 | 0.00 |
| 11.00 | 1982.00 | 10548.00 | 1400.00 | 1400.00 | 0.00 |
| 12.00 | 1982.00 | 10367.00 | 1400.00 | 1400.00 | 0.00 |
| 1.00  | 1983.00 | 8588.00  | 1900.00 | 1900.00 | 0.00 |
| 2.00  | 1983.00 | 7605.00  | 1100.00 | 1100.00 | 0.00 |
| 3.00  | 1983.00 | 6895.00  | 1300.00 | 1300.00 | 0.00 |
| 4.00  | 1983.00 | 10029.00 | 800.00  | 800.00  | 0.00 |
| 5.00  | 1983.00 | 12000.00 | 0.00    | 0.00    | 0.00 |
| 6.00  | 1983.00 | 12000.00 | 600.00  | 600.00  | 0.00 |
| 7.00  | 1983.00 | 12000.00 | 900.00  | 900.00  | 0.00 |
| 8.00  | 1983.00 | 12000.00 | 300.00  | 300.00  | 0.00 |
| 9.00  | 1983.00 | 12000.00 | 600.00  | 600.00  | 0.00 |
| 10.00 | 1983.00 | 12000.00 | 1400.00 | 1400.00 | 0.00 |
| 11.00 | 1983.00 | 11881.00 | 2100.00 | 2100.00 | 0.00 |
| 12.00 | 1983.00 | 12000.00 | 2100.00 | 2100.00 | 0.00 |
| 1.00  | 1984.00 | 12000.00 | 1100.00 | 1100.00 | 0.00 |
| 2.00  | 1984.00 | 9891.00  | 2300.00 | 2300.00 | 0.00 |
| 3.00  | 1984.00 | 10032.00 | 2800.00 | 2800.00 | 0.00 |
| 4.00  | 1984.00 | 9613.00  | 1900.00 | 1900.00 | 0.00 |
| 5.00  | 1984.00 | 9815.00  | 300.00  | 300.00  | 0.00 |
| 6.00  | 1984.00 | 12000.00 | 600.00  | 600.00  | 0.00 |
| 7.00  | 1984.00 | 12000.00 | 600.00  | 600.00  | 0.00 |
| 8.00  | 1984.00 | 12000.00 | 100.00  | 100.00  | 0.00 |
| 9.00  | 1984.00 | 12000.00 | 1600.00 | 1600.00 | 0.00 |
| 10.00 | 1984.00 | 12000.00 | 1300.00 | 1300.00 | 0.00 |
| 11.00 | 1984.00 | 9849.00  | 2400.00 | 2400.00 | 0.00 |
| 12.00 | 1984.00 | 8217.00  | 2100.00 | 2100.00 | 0.00 |

## WORKED EXAMPLE 2(f) – INVESTIGATION OF DEMAND SHORTFALLS

####4

EX2F.log

Time :16:27:31 Date :12/04/01

Tutorial 2 Sub-Problem (f)

( 6f12.2 )  
6

SEASON

YEAR

DEMAND 1

PIPE 1

PIPE 1

DEMAND 1

SHRT

FLOW

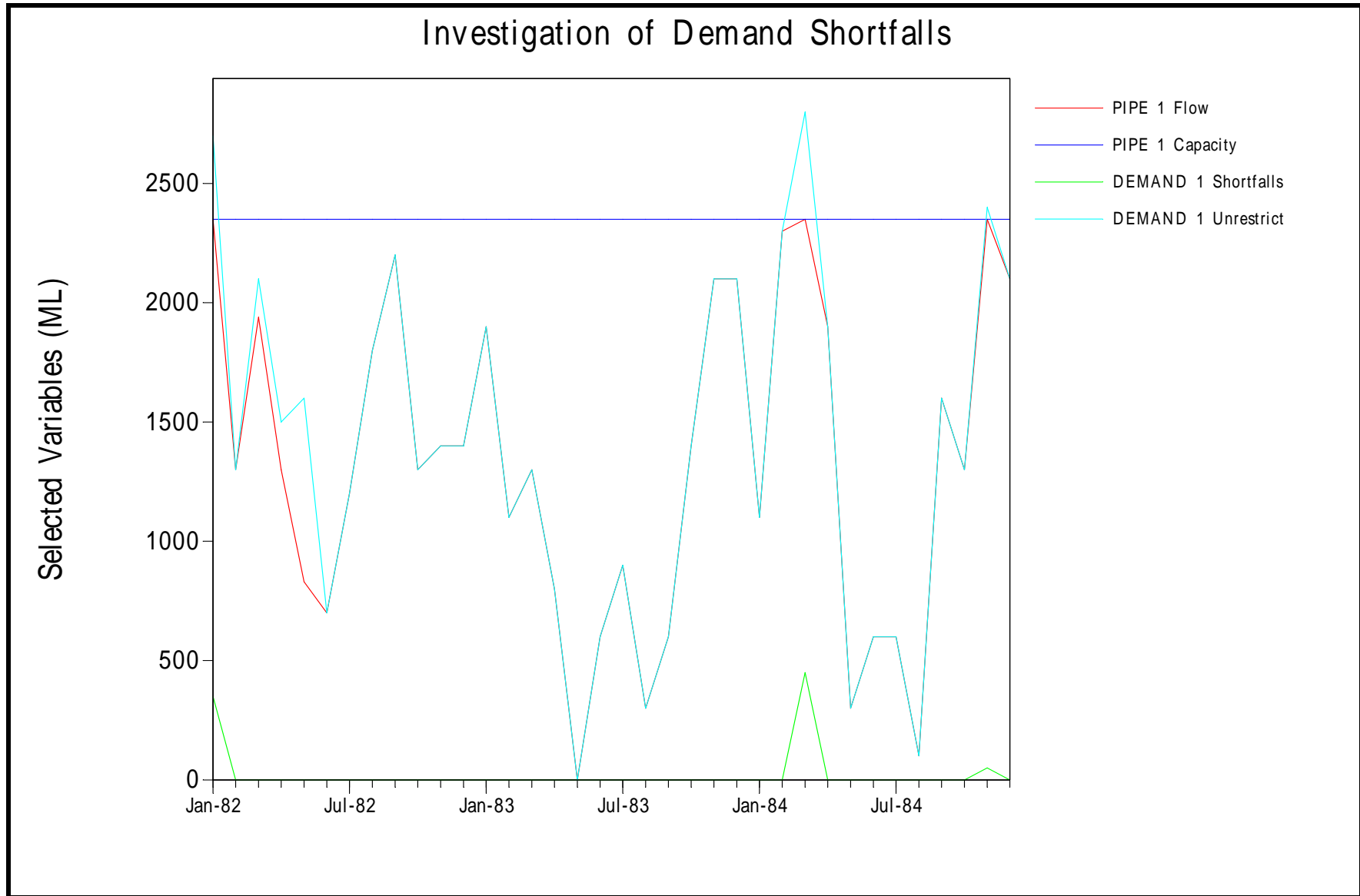
CAPC

UNRS

|       |         |        |         |         |         |
|-------|---------|--------|---------|---------|---------|
| 1.00  | 1982.00 | 350.00 | 2350.00 | 2350.00 | 2700.00 |
| 2.00  | 1982.00 | 0.00   | 1300.00 | 2350.00 | 1300.00 |
| 3.00  | 1982.00 | 0.00   | 1940.00 | 2350.00 | 2100.00 |
| 4.00  | 1982.00 | 0.00   | 1300.00 | 2350.00 | 1500.00 |
| 5.00  | 1982.00 | 0.00   | 830.00  | 2350.00 | 1600.00 |
| 6.00  | 1982.00 | 0.00   | 700.00  | 2350.00 | 700.00  |
| 7.00  | 1982.00 | 0.00   | 1200.00 | 2350.00 | 1200.00 |
| 8.00  | 1982.00 | 0.00   | 1800.00 | 2350.00 | 1800.00 |
| 9.00  | 1982.00 | 0.00   | 2200.00 | 2350.00 | 2200.00 |
| 10.00 | 1982.00 | 0.00   | 1300.00 | 2350.00 | 1300.00 |
| 11.00 | 1982.00 | 0.00   | 1400.00 | 2350.00 | 1400.00 |
| 12.00 | 1982.00 | 0.00   | 1400.00 | 2350.00 | 1400.00 |
| 1.00  | 1983.00 | 0.00   | 1900.00 | 2350.00 | 1900.00 |
| 2.00  | 1983.00 | 0.00   | 1100.00 | 2350.00 | 1100.00 |
| 3.00  | 1983.00 | 0.00   | 1300.00 | 2350.00 | 1300.00 |
| 4.00  | 1983.00 | 0.00   | 800.00  | 2350.00 | 800.00  |
| 5.00  | 1983.00 | 0.00   | 0.00    | 2350.00 | 0.00    |
| 6.00  | 1983.00 | 0.00   | 600.00  | 2350.00 | 600.00  |
| 7.00  | 1983.00 | 0.00   | 900.00  | 2350.00 | 900.00  |
| 8.00  | 1983.00 | 0.00   | 300.00  | 2350.00 | 300.00  |
| 9.00  | 1983.00 | 0.00   | 600.00  | 2350.00 | 600.00  |
| 10.00 | 1983.00 | 0.00   | 1400.00 | 2350.00 | 1400.00 |
| 11.00 | 1983.00 | 0.00   | 2100.00 | 2350.00 | 2100.00 |
| 12.00 | 1983.00 | 0.00   | 2100.00 | 2350.00 | 2100.00 |
| 1.00  | 1984.00 | 0.00   | 1100.00 | 2350.00 | 1100.00 |
| 2.00  | 1984.00 | 0.00   | 2300.00 | 2350.00 | 2300.00 |
| 3.00  | 1984.00 | 450.00 | 2350.00 | 2350.00 | 2800.00 |
| 4.00  | 1984.00 | 0.00   | 1900.00 | 2350.00 | 1900.00 |
| 5.00  | 1984.00 | 0.00   | 300.00  | 2350.00 | 300.00  |
| 6.00  | 1984.00 | 0.00   | 600.00  | 2350.00 | 600.00  |
| 7.00  | 1984.00 | 0.00   | 600.00  | 2350.00 | 600.00  |
| 8.00  | 1984.00 | 0.00   | 100.00  | 2350.00 | 100.00  |
| 9.00  | 1984.00 | 0.00   | 1600.00 | 2350.00 | 1600.00 |
| 10.00 | 1984.00 | 0.00   | 1300.00 | 2350.00 | 1300.00 |
| 11.00 | 1984.00 | 50.00  | 2350.00 | 2350.00 | 2400.00 |
| 12.00 | 1984.00 | 0.00   | 2100.00 | 2350.00 | 2100.00 |



**Figure 3.2-8 Worked Example 2(f) – Plot for Studying Restrictions**



**Figure 3.2-9 Worked Example 2(f) – Plot for Studying Demand Shortfalls**



demand data:

| No | Name     | No Bypass | S/F Priority | Monthly Factors |       |       |       |       |       |       |       |       |       |       |       |       |
|----|----------|-----------|--------------|-----------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
|    |          |           |              | Jan             | Feb   | Mar   | Apl   | May   | Jun   | Jul   | Aug   | Sep   | Oct   | Nov   | Dec   |       |
| 2  | DEMAND 1 | 1         | 1 min<br>max | 0.000           | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |

-----  
 | CARRIER INFORMATION |  
 -----

| No | Name    | Type  | From | To | Cost | Offset | Loss | Ann Vol | Shr Gp | Shr% | No |
|----|---------|-------|------|----|------|--------|------|---------|--------|------|----|
| 1  | PIPE 1  | Pipe  | 1    | 2  | 0    | 0      | 0fix |         | 0      | 0%   | 1  |
| 2  | River 1 | River | 1    | 3  | 1000 | 0      | 0fix |         | 0      | 0%   | 2  |

Maximum Flows

| No | Name    | Jan      | Feb      | Mar      | Apl      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec      |
|----|---------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|
| 2  | River 1 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 |

Functional Capacities

| No  | Name     | pt1        | pt2 | pt3  | pt4   | pt5 | pt6 | pt7 | pt8 | pt9 | pt10 | pt11 | pt12 |
|---|----------|------------|-----|------|-------|-----|-----|-----|-----|-----|------|------|------|
| 1   | PIPE 1   | V          | 0   | 6000 | 12000 | 0   | 0   | 0   | 0   | 0   | 0    | 0    | 0    |
|   | Fn Name: | C          | 0   | 1200 | 2400  | 0   | 0   | 0   | 0   | 0   | 0    | 0    | 0    |
| Equation used: (0.75*'1)+(0.5*'2)-5000  |          |            |     |      |       |     |     |     |     |     |      |      |      |
| ' 1 = RESERVOIR 1   |          | Type: STOR |     |      |       |     |     |     |     |     |      |      |      |
| ' 2 = RESERVOIR 1   |          | Type: ESTO |     |      |       |     |     |     |     |     |      |      |      |
| Capacity set option (0-off 1-prev 2-recalc) Jan=2 Feb=2 Mar=2 Apl=2 May=2 Jun=2 Jul=2 Aug=2 Sep=2 Oct=2 Nov=2 Dec=2 |          |            |     |      |       |     |     |     |     |     |      |      |      |

**WORKED EXAMPLE 2(g) – LOG FILE**

```

HHHHH      HHHHHHHH   HHHHHH   H      HHHHHHHHHH
H   H      H          H   H   H      H   H   H
HHHHHHHHH  HHHHHH    HHHHHHHH  HHH    HHH H   H
HHH   H   HHH        HHH   H   HHH    HHH H   H
HHH   H   HHH        HHH   H   HHH    HHH H   H
HHH   H   HHHHHHHH  HHH   H   HHHHHHHH  HHH H   H

```

```

*****
*      SIMULATION LOG FILE      *
*****

```

Log filename : EX2G.log

Scenario file: scn2g.scn

Simulation label:

Tutorial 2 Sub-Problem (g)

Streamflow file(s):

C:\REALM\WorkedExamples\Sf1.dat

Demand file(s):

C:\REALM\WorkedExamples\Dem.dat

Restrictions are OFF

Instream flow requirements NOT limited to natural

Water quality calculations are OFF

Number of S/F Sequences: 1

```

Convergence tolerance (storage)  1 10th%
Other convergence tolerance      5 %
Arc convergence tolerance (abs)  100
Minimum iteration count          3
Maximum iteration count          51
Do convergence twice              No

```

Date: 16:51:41 12/04/01

Time Step = Monthly

SYSTEM CHANGES:

| No | Seas | Year | System File                      |
|----|------|------|----------------------------------|
| 1  | 1    | 1982 | C:\REALM\WorkedExamples\EX2G.sys |

Total number of seasons:- 36

\*\*\*\*\* RUN TIME MESSAGES:- \*\*\*\*\*

\*\*\*\*INPUT DATA TYPE= 1 \*\*\*\*

1982

C:\REALM\WorkedExamples\EX2G.sys

1983

1984

\*\*\*\*\* END RUN TIME MESSAGES \*\*\*\*\*

SUMMARY INFORMATION

Reservoir data:

|       | Name        | Start<br>Storage | File<br>Inflow | Min<br>Storage | Average<br>Storage | Evapn | Release<br>to river | Spill | End<br>Storage |
|-------|-------------|------------------|----------------|----------------|--------------------|-------|---------------------|-------|----------------|
| 1     | RESERVOIR 1 | 9000.            | 2083.          | 7241.          | 11003.             | 0.    | 912.                | 0.    | 9270.          |
| ----- |             |                  |                |                |                    |       |                     |       |                |
|       |             | 9000.            | 2083.          | 0.             | 11003.             | 0.    | 912.                | 0.    | 9270.          |
| ----- |             |                  |                |                |                    |       |                     |       |                |



## Demand data:

| Name       | Unrestrict | Restrict | Rationed | Shortfall | Supplied |
|------------|------------|----------|----------|-----------|----------|
| 1 DEMAND 1 | 1372.      | 1372.    | 1372.    | 209.      | 1163.    |
| -----      |            |          |          |           |          |
|            | 1372.      | 1372.    | 1372.    | 209.      | 1163.    |
| -----      |            |          |          |           |          |

| Name       | No Rest | Ave Rest lvl | Max Rest lvl | No Ration | Ave % Ration | Max % Ration | No Short | Ave % Short | Max % Short |
|------------|---------|--------------|--------------|-----------|--------------|--------------|----------|-------------|-------------|
| 1 DEMAND 1 | 0.0     | 0.0          | 0.0          | 0.0       | 0.0          | 0.0          | 15.0     | 23.1        | 57.0        |
| -----      |         |              |              |           |              |              |          |             |             |

## Pipe/River flows:

| Name      | flow   | Capacity   | Min | Max    | Loss |
|-----------|--------|------------|-----|--------|------|
| 1 PIPE 1  | 1163.2 | 1750.0     | 0.0 | 2000.0 | 0.0  |
| 2 River 1 | 912.1  | 99999999.0 | 0.0 | 4610.0 | 0.0  |
|           |        |            |     |        | 0.   |
| -----     |        |            |     |        |      |

End run

**WORKED EXAMPLE 2(g) – RESERVOIR VOLUME**

RESERVOIR STORAGE

EX2G.log

Tutorial 2 Sub-Problem (g)

Time :16:51:41 Date :12/04/01

(F4.0,2F6.0, 1f12.2 )  
4

SEASON

YEAR

REPLICATE

| RESERVOIR 1 | ESTO |          |
|-------------|------|----------|
| 1. 1982.    | 1.   | 8242.00  |
| 2. 1982.    | 1.   | 7539.00  |
| 3. 1982.    | 1.   | 7666.00  |
| 4. 1982.    | 1.   | 7241.00  |
| 5. 1982.    | 1.   | 11038.00 |
| 6. 1982.    | 1.   | 12000.00 |
| 7. 1982.    | 1.   | 12000.00 |
| 8. 1982.    | 1.   | 12000.00 |
| 9. 1982.    | 1.   | 12000.00 |
| 10. 1982.   | 1.   | 11916.00 |
| 11. 1982.   | 1.   | 11854.00 |
| 12. 1982.   | 1.   | 11723.00 |
| 1. 1983.    | 1.   | 10123.00 |
| 2. 1983.    | 1.   | 9183.00  |
| 3. 1983.    | 1.   | 8519.00  |
| 4. 1983.    | 1.   | 11567.00 |
| 5. 1983.    | 1.   | 12000.00 |
| 6. 1983.    | 1.   | 12000.00 |
| 7. 1983.    | 1.   | 12000.00 |
| 8. 1983.    | 1.   | 12000.00 |
| 9. 1983.    | 1.   | 12000.00 |
| 10. 1983.   | 1.   | 12000.00 |
| 11. 1983.   | 1.   | 12000.00 |
| 12. 1983.   | 1.   | 12000.00 |
| 1. 1984.    | 1.   | 12000.00 |
| 2. 1984.    | 1.   | 10404.00 |
| 3. 1984.    | 1.   | 11244.00 |
| 4. 1984.    | 1.   | 10972.00 |
| 5. 1984.    | 1.   | 11197.00 |
| 6. 1984.    | 1.   | 12000.00 |
| 7. 1984.    | 1.   | 12000.00 |
| 8. 1984.    | 1.   | 12000.00 |
| 9. 1984.    | 1.   | 12000.00 |
| 10. 1984.   | 1.   | 12000.00 |
| 11. 1984.   | 1.   | 10407.00 |
| 12. 1984.   | 1.   | 9270.00  |

**WORKED EXAMPLE 2(g) – CARRIER FLOW**

CARRIER FLOWS

EX2G.log

Tutorial 2 Sub-Problem (g)

Time :16:51:41 Date :12/04/01

(F4.0,2F6.0, 1f12.2 )  
4

SEASON

YEAR

REPLICATE

| PIPE 1    | FLOW |         |
|-----------|------|---------|
| 1. 1982.  | 1.   | 1174.00 |
| 2. 1982.  | 1.   | 991.00  |
| 3. 1982.  | 1.   | 898.00  |
| 4. 1982.  | 1.   | 875.00  |
| 5. 1982.  | 1.   | 1191.00 |
| 6. 1982.  | 1.   | 700.00  |
| 7. 1982.  | 1.   | 1200.00 |
| 8. 1982.  | 1.   | 1800.00 |
| 9. 1982.  | 1.   | 2000.00 |
| 10. 1982. | 1.   | 1300.00 |
| 11. 1982. | 1.   | 1400.00 |
| 12. 1982. | 1.   | 1400.00 |
| 1. 1983.  | 1.   | 1772.00 |
| 2. 1983.  | 1.   | 1100.00 |
| 3. 1983.  | 1.   | 1230.00 |
| 4. 1983.  | 1.   | 800.00  |
| 5. 1983.  | 1.   | 0.00    |
| 6. 1983.  | 1.   | 600.00  |
| 7. 1983.  | 1.   | 900.00  |
| 8. 1983.  | 1.   | 300.00  |
| 9. 1983.  | 1.   | 600.00  |
| 10. 1983. | 1.   | 1400.00 |
| 11. 1983. | 1.   | 2000.00 |
| 12. 1983. | 1.   | 2000.00 |
| 1. 1984.  | 1.   | 1100.00 |
| 2. 1984.  | 1.   | 1842.00 |
| 3. 1984.  | 1.   | 1686.00 |
| 4. 1984.  | 1.   | 1785.00 |
| 5. 1984.  | 1.   | 300.00  |
| 6. 1984.  | 1.   | 600.00  |
| 7. 1984.  | 1.   | 600.00  |
| 8. 1984.  | 1.   | 100.00  |
| 9. 1984.  | 1.   | 1600.00 |
| 10. 1984. | 1.   | 1300.00 |
| 11. 1984. | 1.   | 1842.00 |
| 12. 1984. | 1.   | 1490.00 |

## WORKED EXAMPLE 2(g) – DEMAND SHORTFALLS

DEMAND SHORTFALL

EX2G.log

Tutorial 2 Sub-Problem (g)

Time :16:51:41 Date :12/04/01

(F4.0,2F6.0, 1f12.2 )

4

SEASON

YEAR

REPLICATE

DEMAND 1

SHRT

|     |       |    |         |
|-----|-------|----|---------|
| 1.  | 1982. | 1. | 1526.00 |
| 2.  | 1982. | 1. | 309.00  |
| 3.  | 1982. | 1. | 1202.00 |
| 4.  | 1982. | 1. | 625.00  |
| 5.  | 1982. | 1. | 409.00  |
| 6.  | 1982. | 1. | 0.00    |
| 7.  | 1982. | 1. | 0.00    |
| 8.  | 1982. | 1. | 0.00    |
| 9.  | 1982. | 1. | 200.00  |
| 10. | 1982. | 1. | 0.00    |
| 11. | 1982. | 1. | 0.00    |
| 12. | 1982. | 1. | 0.00    |
| 1.  | 1983. | 1. | 128.00  |
| 2.  | 1983. | 1. | 0.00    |
| 3.  | 1983. | 1. | 70.00   |
| 4.  | 1983. | 1. | 0.00    |
| 5.  | 1983. | 1. | 0.00    |
| 6.  | 1983. | 1. | 0.00    |
| 7.  | 1983. | 1. | 0.00    |
| 8.  | 1983. | 1. | 0.00    |
| 9.  | 1983. | 1. | 0.00    |
| 10. | 1983. | 1. | 0.00    |
| 11. | 1983. | 1. | 100.00  |
| 12. | 1983. | 1. | 100.00  |
| 1.  | 1984. | 1. | 0.00    |
| 2.  | 1984. | 1. | 458.00  |
| 3.  | 1984. | 1. | 1114.00 |
| 4.  | 1984. | 1. | 115.00  |
| 5.  | 1984. | 1. | 0.00    |
| 6.  | 1984. | 1. | 0.00    |
| 7.  | 1984. | 1. | 0.00    |
| 8.  | 1984. | 1. | 0.00    |
| 9.  | 1984. | 1. | 0.00    |
| 10. | 1984. | 1. | 0.00    |
| 11. | 1984. | 1. | 558.00  |
| 12. | 1984. | 1. | 610.00  |

## WORKED EXAMPLE 2(g) - INVESTIGATION OF DEMAND SHORTFALLS

####4

EX2G.log

Tutorial 2 Sub-Problem (g)

Time :16:51:41 Date :12/04/01

( 6f12.2 )

6

SEASON

YEAR

PIPE 1

PIPE 1

DEMAND 1

DEMAND 1

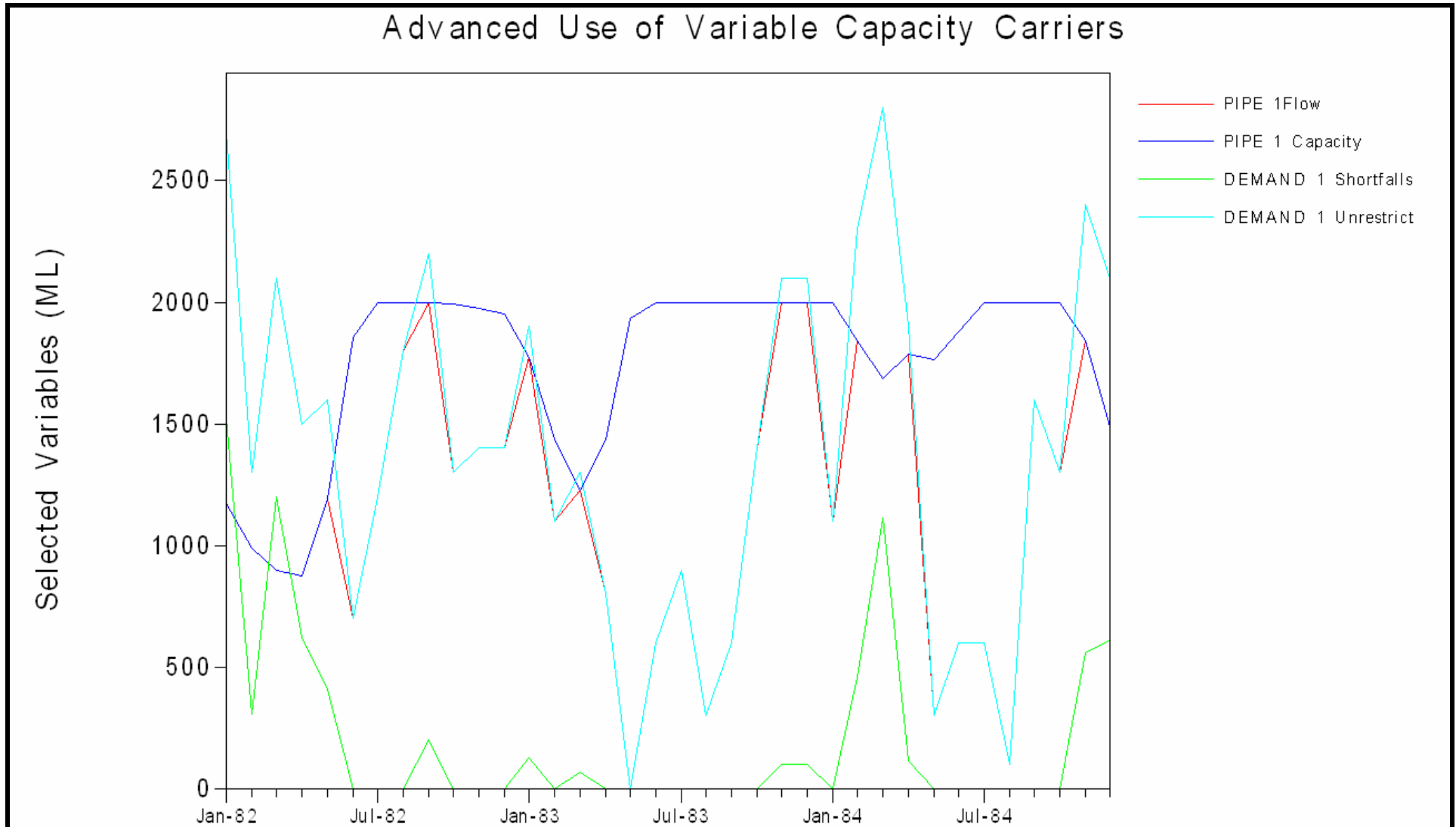
FLOW

CAPC

SHRT

UNRS

|       |         |         |         |         |         |
|-------|---------|---------|---------|---------|---------|
| 1.00  | 1982.00 | 1174.00 | 1174.00 | 1526.00 | 2700.00 |
| 2.00  | 1982.00 | 991.00  | 991.00  | 309.00  | 1300.00 |
| 3.00  | 1982.00 | 898.00  | 898.00  | 1202.00 | 2100.00 |
| 4.00  | 1982.00 | 875.00  | 875.00  | 625.00  | 1500.00 |
| 5.00  | 1982.00 | 1191.00 | 1191.00 | 409.00  | 1600.00 |
| 6.00  | 1982.00 | 700.00  | 1856.00 | 0.00    | 700.00  |
| 7.00  | 1982.00 | 1200.00 | 2000.00 | 0.00    | 1200.00 |
| 8.00  | 1982.00 | 1800.00 | 2000.00 | 0.00    | 1800.00 |
| 9.00  | 1982.00 | 2000.00 | 2000.00 | 200.00  | 2200.00 |
| 10.00 | 1982.00 | 1300.00 | 1992.00 | 0.00    | 1300.00 |
| 11.00 | 1982.00 | 1400.00 | 1973.00 | 0.00    | 1400.00 |
| 12.00 | 1982.00 | 1400.00 | 1950.00 | 0.00    | 1400.00 |
| 1.00  | 1983.00 | 1772.00 | 1772.00 | 128.00  | 1900.00 |
| 2.00  | 1983.00 | 1100.00 | 1437.00 | 0.00    | 1100.00 |
| 3.00  | 1983.00 | 1230.00 | 1230.00 | 70.00   | 1300.00 |
| 4.00  | 1983.00 | 800.00  | 1435.00 | 0.00    | 800.00  |
| 5.00  | 1983.00 | 0.00    | 1935.00 | 0.00    | 0.00    |
| 6.00  | 1983.00 | 600.00  | 2000.00 | 0.00    | 600.00  |
| 7.00  | 1983.00 | 900.00  | 2000.00 | 0.00    | 900.00  |
| 8.00  | 1983.00 | 300.00  | 2000.00 | 0.00    | 300.00  |
| 9.00  | 1983.00 | 600.00  | 2000.00 | 0.00    | 600.00  |
| 10.00 | 1983.00 | 1400.00 | 2000.00 | 0.00    | 1400.00 |
| 11.00 | 1983.00 | 2000.00 | 2000.00 | 100.00  | 2100.00 |
| 12.00 | 1983.00 | 2000.00 | 2000.00 | 100.00  | 2100.00 |
| 1.00  | 1984.00 | 1100.00 | 2000.00 | 0.00    | 1100.00 |
| 2.00  | 1984.00 | 1842.00 | 1842.00 | 458.00  | 2300.00 |
| 3.00  | 1984.00 | 1686.00 | 1686.00 | 1114.00 | 2800.00 |
| 4.00  | 1984.00 | 1785.00 | 1785.00 | 115.00  | 1900.00 |
| 5.00  | 1984.00 | 300.00  | 1766.00 | 0.00    | 300.00  |
| 6.00  | 1984.00 | 600.00  | 1880.00 | 0.00    | 600.00  |
| 7.00  | 1984.00 | 600.00  | 2000.00 | 0.00    | 600.00  |
| 8.00  | 1984.00 | 100.00  | 2000.00 | 0.00    | 100.00  |
| 9.00  | 1984.00 | 1600.00 | 2000.00 | 0.00    | 1600.00 |
| 10.00 | 1984.00 | 1300.00 | 2000.00 | 0.00    | 1300.00 |
| 11.00 | 1984.00 | 1842.00 | 1842.00 | 558.00  | 2400.00 |
| 12.00 | 1984.00 | 1490.00 | 1490.00 | 610.00  | 2100.00 |



**Figure 3.2-10 Worked Example 2(g) – Advanced Use of Variable Capacity Carriers**

### **3.3 WORKED EXAMPLE 3**

## **TWO RESERVOIR AND TWO DEMAND ZONE SYSTEM**

## WORKED EXAMPLE 3(a) - STREAMFLOW FILE (SF3.DAT)

```
####2
STREAMFLOW DATA FILE
HISTORICAL MONTHLY STREAMFLOW DATAFILE
TEST DATA
DATE : 20 JUL 1990
( 4F12.2)
```

```
4
SEASON
YEAR
STREAM1
STREAM2
1.00 1982.00 416.00 1340.00
2.00 1982.00 288.00 1160.00
3.00 1982.00 1025.00 1320.00
4.00 1982.00 450.00 1740.00
5.00 1982.00 4988.00 3700.00
6.00 1982.00 2249.00 2000.00
7.00 1982.00 1234.00 820.00
8.00 1982.00 2273.00 890.00
9.00 1982.00 2160.00 870.00
10.00 1982.00 1216.00 850.00
11.00 1982.00 1338.00 580.00
12.00 1982.00 1269.00 720.00
1.00 1983.00 172.00 440.00
2.00 1983.00 160.00 400.00
3.00 1983.00 566.00 1810.00
4.00 1983.00 3848.00 2420.00
5.00 1983.00 3220.00 5100.00
6.00 1983.00 1500.00 1040.00
7.00 1983.00 4640.00 1270.00
8.00 1983.00 3900.00 5890.00
9.00 1983.00 4600.00 11730.00
10.00 1983.00 2360.00 9090.00
11.00 1983.00 2023.00 3770.00
12.00 1983.00 2967.00 3250.00
1.00 1984.00 4426.00 5150.00
2.00 1984.00 246.00 1080.00
3.00 1984.00 2526.00 1350.00
4.00 1984.00 1513.00 1870.00
5.00 1984.00 525.00 3140.00
6.00 1984.00 2833.00 640.00
7.00 1984.00 908.00 620.00
8.00 1984.00 2029.00 4020.00
9.00 1984.00 4600.00 3820.00
10.00 1984.00 5910.00 3190.00
11.00 1984.00 249.00 4080.00
12.00 1984.00 353.00 1590.00
```

## WORKED EXAMPLE 3(a) - DEMAND FILE (DEM2.DAT)

```
####3
DEMANDS DATAFILE
HISTORICAL DATA
DATA ASSEMBLED AND REFORMATED ON
DATE : 9 JUL 1990
( 4F12.2)
```

```
4
SEASON
YEAR
DEMAND 1
DEMAND 2
1.00 1982.00 2700.00 2700.00
2.00 1982.00 1300.00 1300.00
3.00 1982.00 2100.00 2100.00
4.00 1982.00 1500.00 1500.00
5.00 1982.00 1600.00 1600.00
6.00 1982.00 700.00 1700.00
7.00 1982.00 1200.00 1200.00
8.00 1982.00 1800.00 1800.00
9.00 1982.00 2200.00 1200.00
10.00 1982.00 1300.00 1300.00
11.00 1982.00 1400.00 2400.00
12.00 1982.00 1400.00 1400.00
1.00 1983.00 1900.00 1900.00
2.00 1983.00 1100.00 3100.00
3.00 1983.00 1300.00 1300.00
4.00 1983.00 800.00 1800.00
5.00 1983.00 0.00 2000.00
6.00 1983.00 600.00 1600.00
7.00 1983.00 900.00 1900.00
8.00 1983.00 300.00 1300.00
9.00 1983.00 600.00 1600.00
10.00 1983.00 1400.00 1400.00
11.00 1983.00 2100.00 2100.00
12.00 1983.00 2100.00 2100.00
1.00 1984.00 1100.00 1100.00
2.00 1984.00 2300.00 2300.00
3.00 1984.00 2800.00 2800.00
4.00 1984.00 1900.00 1900.00
5.00 1984.00 300.00 300.00
6.00 1984.00 600.00 600.00
7.00 1984.00 600.00 1600.00
8.00 1984.00 100.00 1100.00
9.00 1984.00 1600.00 1600.00
10.00 1984.00 1300.00 1300.00
11.00 1984.00 2400.00 2400.00
12.00 1984.00 2100.00 2100.00
```

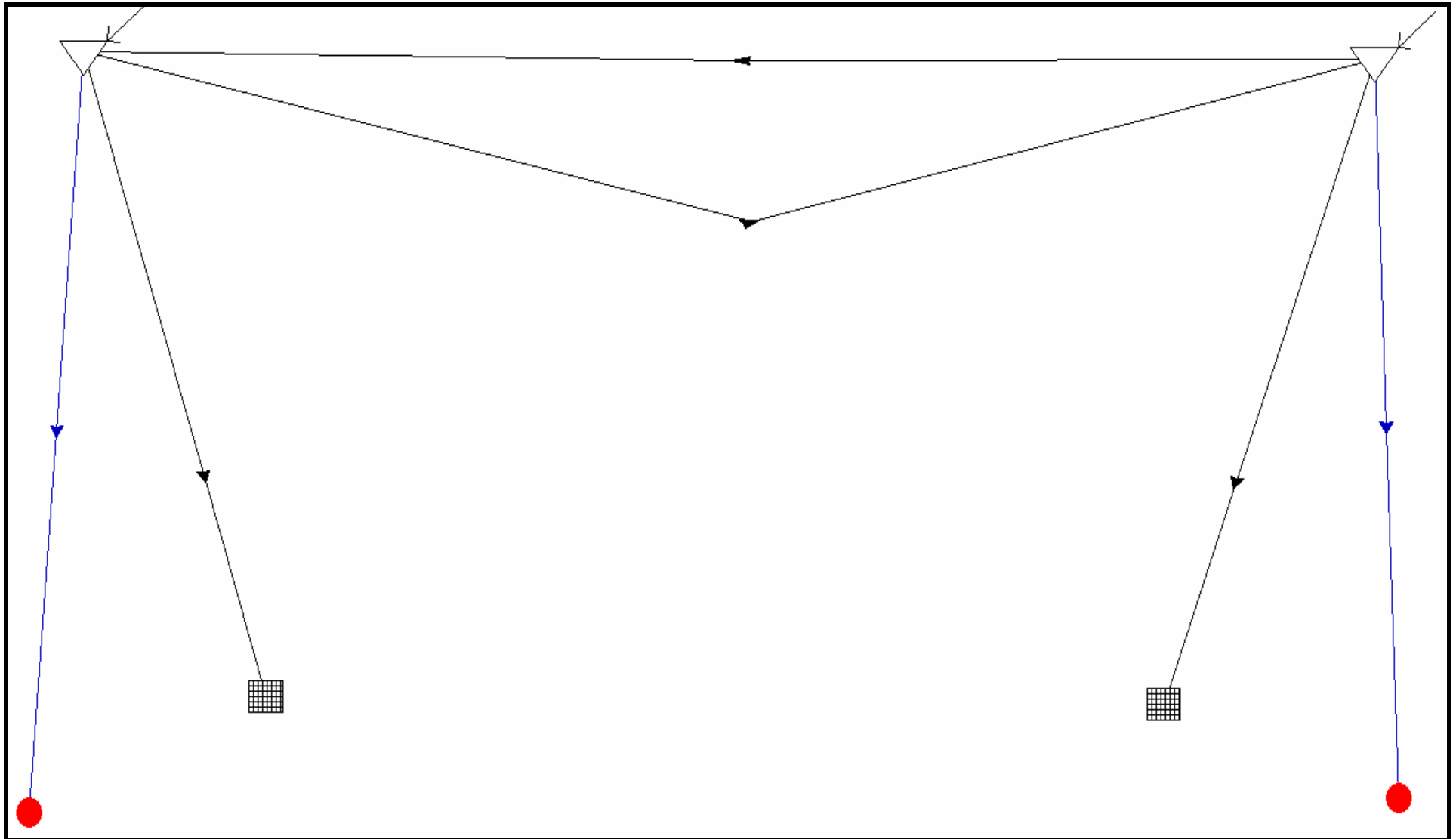


Figure 3.3-1 Worked Example 3(a) – System Plot (*EX3A.sys*)





demand data:

| No | Name     | No Bypass | S/F Priority | Monthly Factors |       |       |       |       |       |       |       |       |       |       |       |       |
|----|----------|-----------|--------------|-----------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
|    |          |           |              | Jan             | Feb   | Mar   | Apl   | May   | Jun   | Jul   | Aug   | Sep   | Oct   | Nov   | Dec   |       |
| 3  | DEMAND 1 | 1         | 1 min        | 0.000           | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
|    |          |           | max          | 1.000           | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 4  | DEMAND 2 | 1         | 1 min        | 0.000           | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
|    |          |           | max          | 1.000           | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |

-----  
| CARRIER INFORMATION |  
-----

| No | Name      | Type  | From | To | Cost | Offset | Loss | Ann Vol | Shr Gp | Shr% | No |
|----|-----------|-------|------|----|------|--------|------|---------|--------|------|----|
| 1  | CARRIER 1 | Pipe  | 1    | 3  | 0    | 0      | Ofix |         | 0      | 0%   | 1  |
| 2  | CARRIER 2 | Pipe  | 2    | 4  | 0    | 0      | Ofix |         | 0      | 0%   | 2  |
| 3  | CARRIER 3 | Pipe  | 1    | 2  | 0    | 0      | Ofix |         | 0      | 0%   | 3  |
| 4  | CARRIER 4 | Pipe  | 2    | 1  | 0    | -1     | Ofix |         | 0      | 0%   | 4  |
| 5  | River 1   | River | 1    | 5  | 1000 | 0      | Ofix |         | 0      | 0%   | 5  |
| 6  | River 2   | River | 2    | 6  | 1000 | 0      | Ofix |         | 0      | 0%   | 6  |

-----  
Maximum Flows

| No | Name      | Jan      | Feb      | Mar      | Apl      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec      |
|----|-----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|
| 1  | CARRIER 1 | 12000    | 12000    | 12000    | 12000    | 12000    | 12000    | 12000    | 12000    | 12000    | 12000    | 12000    | 12000    |
| 2  | CARRIER 2 | 24000    | 24000    | 24000    | 24000    | 24000    | 24000    | 24000    | 24000    | 24000    | 24000    | 24000    | 24000    |
| 3  | CARRIER 3 | 24000    | 24000    | 24000    | 24000    | 24000    | 24000    | 24000    | 24000    | 24000    | 24000    | 24000    | 24000    |
| 4  | CARRIER 4 | 24000    | 24000    | 24000    | 24000    | 24000    | 24000    | 24000    | 24000    | 24000    | 24000    | 24000    | 24000    |
| 5  | River 1   | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 |
| 6  | River 2   | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 |

-----  
| TARGET INFORMATION |  
-----

Number of target sets: 1

-----  
Target set 1 ( Jan Feb Mar Apl May Jun Jul Aug Sep Oct Nov Dec)

| Name        | Draw | Pri | Targets |      |       |       |       |       |       |       |       |  |  |
|-------------|------|-----|---------|------|-------|-------|-------|-------|-------|-------|-------|--|--|
| RESERVOIR 1 | 1    | 0   | 1333    | 2667 | 4000  | 5333  | 6667  | 8000  | 9333  | 10667 | 12000 |  |  |
| RESERVOIR 2 | 2    | 0   | 2667    | 5333 | 8000  | 10667 | 13333 | 16000 | 18667 | 21333 | 24000 |  |  |
| totals      |      | 0   | 4000    | 8000 | 12000 | 16000 | 20000 | 24000 | 28000 | 32000 | 36000 |  |  |

---

| MULTI SYSTEM INFORMATION |

---

---

Reservoirs

---

|             |   |
|-------------|---|
| RESERVOIR 1 | 1 |
| RESERVOIR 2 | 1 |

**WORKED EXAMPLE 3(a) – LOG FILE**

```

HHHHH      HHHHHHHH      HHHHHH      H      HHHHHHHHHH
H  H      H      H      H      H      H      H      H
HHHHHHHHH  HHHHHH      HHHHHHHH      HHH      HHH  H  H
HHH      H  HHH      HHH      H  HHH      HHH  H  H
HHH      H  HHH      HHH      H  HHH      HHH  H  H
HHH      H  HHHHHHHH      HHH      H  HHHHHHHH      HHH  H  H

```

```

*****
*   SIMULATION LOG FILE   *
*****

```

Log filename : EX3A.log

Scenario file: scn3a.scn

Simulation label:

Tutorial 3 Sub-Problem (a)

Streamflow file(s):

C:\REALM\WorkedExamples\Sf3.dat

Demand file(s):

C:\REALM\WorkedExamples\Dem2.dat

Restrictions are OFF

Instream flow requirements NOT limited to natural

Water quality calculations are OFF

Number of S/F Sequences: 1

```

Convergence tolerance (storage)  1 10th%
Other convergence tolerance      5 %
Arc convergence tolerance (abs)  100
Minimum iteration count          3
Maximum iteration count          51
Do convergence twice             No

```

Date: 14:54:28 12/05/01

Time Step = Monthly

SYSTEM CHANGES:

| No | Seas | Year | System File                      |
|----|------|------|----------------------------------|
| 1  | 1    | 1982 | C:\REALM\WorkedExamples\EX3A.sys |

Total number of seasons:- 36

\*\*\*\*\* RUN TIME MESSAGES:- \*\*\*\*\*

\*\*\*\*INPUT DATA TYPE= 1 \*\*\*\*

1982

C:\REALM\WorkedExamples\EX3A.sys

1983

1984

\*\*\*\*\* END RUN TIME MESSAGES \*\*\*\*\*

SUMMARY INFORMATION

Reservoir data:

|   | Name        | Start<br>Storage | File<br>Inflow | Min<br>Storage | Average<br>Storage | Evapn | Release<br>to river | Spill | End<br>Storage |
|---|-------------|------------------|----------------|----------------|--------------------|-------|---------------------|-------|----------------|
| 1 | RESERVOIR 1 | 9000.            | 2083.          | 1815.          | 7679.              | 0.    | 0.                  | 0.    | 11091.         |
| 2 | RESERVOIR 2 | 8000.            | 2576.          | 3629.          | 15357.             | 0.    | 0.                  | 0.    | 22181.         |
|   |             | 17000.           | 4659.          | 0.             | 23037.             | 0.    | 0.                  | 0.    | 33272.         |

## Demand data:

|   | Name     | Unrestrict | Restrict | Rationed | Shortfall | Supplied |
|---|----------|------------|----------|----------|-----------|----------|
| 1 | DEMAND 1 | 1372.      | 1372.    | 1372.    | 0.        | 1372.    |
| 2 | DEMAND 2 | 1706.      | 1706.    | 1706.    | 0.        | 1706.    |
|   |          | 3078.      | 3078.    | 3078.    | 0.        | 3078.    |

|   | Name     | No Rest | Ave Rest lvl | Max Rest lvl | No Ration | Ave % Ration | Max % Ration | No Short | Ave % Short | Max % Short |
|---|----------|---------|--------------|--------------|-----------|--------------|--------------|----------|-------------|-------------|
| 1 | DEMAND 1 | 0.0     | 0.0          | 0.0          | 0.0       | 0.0          | 0.0          | 0.0      | 0.0         | 0.0         |
| 2 | DEMAND 2 | 0.0     | 0.0          | 0.0          | 0.0       | 0.0          | 0.0          | 0.0      | 0.0         | 0.0         |

## Pipe/River flows:

|   | Name      | flow   | Capacity   | Min   | Max    | Loss |
|---|-----------|--------|------------|-------|--------|------|
| 1 | CARRIER 1 | 1372.2 | 12000.0    | 0.0   | 2800.0 | 0.0  |
| 2 | CARRIER 2 | 1705.6 | 24000.0    | 300.0 | 3100.0 | 0.0  |
| 3 | CARRIER 3 | 452.3  | 24000.0    | 0.0   | 2703.0 | 0.0  |
| 4 | CARRIER 4 | 229.5  | 24000.0    | 0.0   | 1995.0 | 0.0  |
| 5 | River 1   | 429.6  | 99999999.0 | 0.0   | 4610.0 | 0.0  |
| 6 | River 2   | 699.8  | 99999999.0 | 0.0   | 7690.0 | 0.0  |

0.

End run

**WORKED EXAMPLE 3(a) – RESERVOIR VOLUME**

RESERVOIR STORAGE

EX3A.log

Time :14:54:28 Date :12/05/01

Tutorial 3 Sub-Problem (a)

(F4.0,2F6.0, 2f12.2 )  
5

SEASON

YEAR

REPLICATE

RESERVOIR 1

ESTO

RESERVOIR 2

ESTO

|     |       |    |          |          |
|-----|-------|----|----------|----------|
| 1.  | 1982. | 1. | 4452.00  | 8904.00  |
| 2.  | 1982. | 1. | 4068.00  | 8136.00  |
| 3.  | 1982. | 1. | 3450.00  | 6899.00  |
| 4.  | 1982. | 1. | 3180.00  | 6359.00  |
| 5.  | 1982. | 1. | 5009.00  | 10018.00 |
| 6.  | 1982. | 1. | 5626.00  | 11250.00 |
| 7.  | 1982. | 1. | 5510.00  | 11020.00 |
| 8.  | 1982. | 1. | 5365.00  | 10728.00 |
| 9.  | 1982. | 1. | 5241.00  | 10482.00 |
| 10. | 1982. | 1. | 5063.00  | 10126.00 |
| 11. | 1982. | 1. | 4436.00  | 8871.00  |
| 12. | 1982. | 1. | 4166.00  | 8330.00  |
| 1.  | 1983. | 1. | 3103.00  | 6205.00  |
| 2.  | 1983. | 1. | 1890.00  | 3778.00  |
| 3.  | 1983. | 1. | 1815.00  | 3629.00  |
| 4.  | 1983. | 1. | 3038.00  | 6074.00  |
| 5.  | 1983. | 1. | 5144.00  | 10288.00 |
| 6.  | 1983. | 1. | 5258.00  | 10514.00 |
| 7.  | 1983. | 1. | 6295.00  | 12587.00 |
| 8.  | 1983. | 1. | 9024.00  | 18048.00 |
| 9.  | 1983. | 1. | 12000.00 | 24000.00 |
| 10. | 1983. | 1. | 12000.00 | 24000.00 |
| 11. | 1983. | 1. | 12000.00 | 24000.00 |
| 12. | 1983. | 1. | 12000.00 | 24000.00 |
| 1.  | 1984. | 1. | 12000.00 | 24000.00 |
| 2.  | 1984. | 1. | 10909.00 | 21817.00 |
| 3.  | 1984. | 1. | 10335.00 | 20667.00 |
| 4.  | 1984. | 1. | 10196.00 | 20389.00 |
| 5.  | 1984. | 1. | 11217.00 | 22433.00 |
| 6.  | 1984. | 1. | 11975.00 | 23948.00 |
| 7.  | 1984. | 1. | 11751.00 | 23500.00 |
| 8.  | 1984. | 1. | 12000.00 | 24000.00 |
| 9.  | 1984. | 1. | 12000.00 | 24000.00 |
| 10. | 1984. | 1. | 12000.00 | 24000.00 |
| 11. | 1984. | 1. | 11844.00 | 23685.00 |
| 12. | 1984. | 1. | 11091.00 | 22181.00 |

**WORKED EXAMPLE 3(a) – TARGET STORAGE VOLUME**

RESERVOIR TARGETS

EX3A.log

Time :14:54:28 Date :12/05/01

Tutorial 3 Sub-Problem (a)

(F4.0,2F6.0, 2f12.2 )  
5

SEASON

YEAR

REPLICATE

RESERVOIR 1

TARG

RESERVOIR 2

TARG

|     |       |    |          |          |
|-----|-------|----|----------|----------|
| 1.  | 1982. | 1. | 4452.00  | 8904.00  |
| 2.  | 1982. | 1. | 4068.00  | 8136.00  |
| 3.  | 1982. | 1. | 3450.00  | 6899.00  |
| 4.  | 1982. | 1. | 3180.00  | 6359.00  |
| 5.  | 1982. | 1. | 5009.00  | 10018.00 |
| 6.  | 1982. | 1. | 5626.00  | 11250.00 |
| 7.  | 1982. | 1. | 5510.00  | 11020.00 |
| 8.  | 1982. | 1. | 5365.00  | 10728.00 |
| 9.  | 1982. | 1. | 5241.00  | 10482.00 |
| 10. | 1982. | 1. | 5063.00  | 10126.00 |
| 11. | 1982. | 1. | 4436.00  | 8871.00  |
| 12. | 1982. | 1. | 4166.00  | 8330.00  |
| 1.  | 1983. | 1. | 3103.00  | 6205.00  |
| 2.  | 1983. | 1. | 1890.00  | 3778.00  |
| 3.  | 1983. | 1. | 1815.00  | 3629.00  |
| 4.  | 1983. | 1. | 3038.00  | 6074.00  |
| 5.  | 1983. | 1. | 5144.00  | 10288.00 |
| 6.  | 1983. | 1. | 5258.00  | 10514.00 |
| 7.  | 1983. | 1. | 6295.00  | 12587.00 |
| 8.  | 1983. | 1. | 9024.00  | 18048.00 |
| 9.  | 1983. | 1. | 12000.00 | 24000.00 |
| 10. | 1983. | 1. | 12000.00 | 24000.00 |
| 11. | 1983. | 1. | 12000.00 | 24000.00 |
| 12. | 1983. | 1. | 12000.00 | 24000.00 |
| 1.  | 1984. | 1. | 12000.00 | 24000.00 |
| 2.  | 1984. | 1. | 10909.00 | 21817.00 |
| 3.  | 1984. | 1. | 10335.00 | 20667.00 |
| 4.  | 1984. | 1. | 10196.00 | 20389.00 |
| 5.  | 1984. | 1. | 11217.00 | 22433.00 |
| 6.  | 1984. | 1. | 11975.00 | 23948.00 |
| 7.  | 1984. | 1. | 11751.00 | 23500.00 |
| 8.  | 1984. | 1. | 12000.00 | 24000.00 |
| 9.  | 1984. | 1. | 12000.00 | 24000.00 |
| 10. | 1984. | 1. | 12000.00 | 24000.00 |
| 11. | 1984. | 1. | 11844.00 | 23685.00 |
| 12. | 1984. | 1. | 11091.00 | 22181.00 |

**WORKED EXAMPLE 3(a) – CARRIER FLOW**

CARRIER FLOWS

EX3A.log

Tutorial 3 Sub-Problem (a)

Time :14:54:28 Date :12/05/01

(F4.0,2F6.0, 4f12.2 )

7

SEASON

YEAR

REPLICATE

CARRIER 1 FLOW

CARRIER 2 FLOW

CARRIER 3 FLOW

CARRIER 4 FLOW

|     |       |    |         |         |         |         |
|-----|-------|----|---------|---------|---------|---------|
| 1.  | 1982. | 1. | 2700.00 | 2700.00 | 2264.00 | 0.00    |
| 2.  | 1982. | 1. | 1300.00 | 1300.00 | 0.00    | 628.00  |
| 3.  | 1982. | 1. | 2100.00 | 2100.00 | 0.00    | 457.00  |
| 4.  | 1982. | 1. | 1500.00 | 1500.00 | 0.00    | 780.00  |
| 5.  | 1982. | 1. | 1600.00 | 1600.00 | 1559.00 | 0.00    |
| 6.  | 1982. | 1. | 700.00  | 1700.00 | 932.00  | 0.00    |
| 7.  | 1982. | 1. | 1200.00 | 1200.00 | 150.00  | 0.00    |
| 8.  | 1982. | 1. | 1800.00 | 1800.00 | 618.00  | 0.00    |
| 9.  | 1982. | 1. | 2200.00 | 1200.00 | 84.00   | 0.00    |
| 10. | 1982. | 1. | 1300.00 | 1300.00 | 94.00   | 0.00    |
| 11. | 1982. | 1. | 1400.00 | 2400.00 | 565.00  | 0.00    |
| 12. | 1982. | 1. | 1400.00 | 1400.00 | 139.00  | 0.00    |
| 1.  | 1983. | 1. | 1900.00 | 1900.00 | 0.00    | 665.00  |
| 2.  | 1983. | 1. | 1100.00 | 3100.00 | 273.00  | 0.00    |
| 3.  | 1983. | 1. | 1300.00 | 1300.00 | 0.00    | 659.00  |
| 4.  | 1983. | 1. | 800.00  | 1800.00 | 1825.00 | 0.00    |
| 5.  | 1983. | 1. | 0.00    | 2000.00 | 1114.00 | 0.00    |
| 6.  | 1983. | 1. | 600.00  | 1600.00 | 786.00  | 0.00    |
| 7.  | 1983. | 1. | 900.00  | 1900.00 | 2703.00 | 0.00    |
| 8.  | 1983. | 1. | 300.00  | 1300.00 | 871.00  | 0.00    |
| 9.  | 1983. | 1. | 600.00  | 1600.00 | 0.00    | 0.00    |
| 10. | 1983. | 1. | 1400.00 | 1400.00 | 0.00    | 0.00    |
| 11. | 1983. | 1. | 2100.00 | 2100.00 | 0.00    | 77.00   |
| 12. | 1983. | 1. | 2100.00 | 2100.00 | 0.00    | 0.00    |
| 1.  | 1984. | 1. | 1100.00 | 1100.00 | 0.00    | 0.00    |
| 2.  | 1984. | 1. | 2300.00 | 2300.00 | 0.00    | 963.00  |
| 3.  | 1984. | 1. | 2800.00 | 2800.00 | 300.00  | 0.00    |
| 4.  | 1984. | 1. | 1900.00 | 1900.00 | 0.00    | 248.00  |
| 5.  | 1984. | 1. | 300.00  | 300.00  | 0.00    | 796.00  |
| 6.  | 1984. | 1. | 600.00  | 600.00  | 1475.00 | 0.00    |
| 7.  | 1984. | 1. | 600.00  | 1600.00 | 532.00  | 0.00    |
| 8.  | 1984. | 1. | 100.00  | 1100.00 | 0.00    | 0.00    |
| 9.  | 1984. | 1. | 1600.00 | 1600.00 | 0.00    | 0.00    |
| 10. | 1984. | 1. | 1300.00 | 1300.00 | 0.00    | 0.00    |
| 11. | 1984. | 1. | 2400.00 | 2400.00 | 0.00    | 1995.00 |
| 12. | 1984. | 1. | 2100.00 | 2100.00 | 0.00    | 994.00  |

**WORKED EXAMPLE 3(a) – COMPARISON OF STORAGE VOLUMES AND TARGETS**

####4

EX3A.log

Tutorial 3 Sub-Problem (a)

Time :14:54:28 Date :12/05/01

( 6f12.2 )

6

SEASON

YEAR

RESERVOIR 1

ESTO

RESERVOIR 1

TARG

RESERVOIR 2

ESTO

RESERVOIR 2

TARG

|       |         |          |          |          |          |
|-------|---------|----------|----------|----------|----------|
| 1.00  | 1982.00 | 4452.00  | 4452.00  | 8904.00  | 8904.00  |
| 2.00  | 1982.00 | 4068.00  | 4068.00  | 8136.00  | 8136.00  |
| 3.00  | 1982.00 | 3450.00  | 3450.00  | 6899.00  | 6899.00  |
| 4.00  | 1982.00 | 3180.00  | 3180.00  | 6359.00  | 6359.00  |
| 5.00  | 1982.00 | 5009.00  | 5009.00  | 10018.00 | 10018.00 |
| 6.00  | 1982.00 | 5626.00  | 5626.00  | 11250.00 | 11250.00 |
| 7.00  | 1982.00 | 5510.00  | 5510.00  | 11020.00 | 11020.00 |
| 8.00  | 1982.00 | 5365.00  | 5365.00  | 10728.00 | 10728.00 |
| 9.00  | 1982.00 | 5241.00  | 5241.00  | 10482.00 | 10482.00 |
| 10.00 | 1982.00 | 5063.00  | 5063.00  | 10126.00 | 10126.00 |
| 11.00 | 1982.00 | 4436.00  | 4436.00  | 8871.00  | 8871.00  |
| 12.00 | 1982.00 | 4166.00  | 4166.00  | 8330.00  | 8330.00  |
| 1.00  | 1983.00 | 3103.00  | 3103.00  | 6205.00  | 6205.00  |
| 2.00  | 1983.00 | 1890.00  | 1890.00  | 3778.00  | 3778.00  |
| 3.00  | 1983.00 | 1815.00  | 1815.00  | 3629.00  | 3629.00  |
| 4.00  | 1983.00 | 3038.00  | 3038.00  | 6074.00  | 6074.00  |
| 5.00  | 1983.00 | 5144.00  | 5144.00  | 10288.00 | 10288.00 |
| 6.00  | 1983.00 | 5258.00  | 5258.00  | 10514.00 | 10514.00 |
| 7.00  | 1983.00 | 6295.00  | 6295.00  | 12587.00 | 12587.00 |
| 8.00  | 1983.00 | 9024.00  | 9024.00  | 18048.00 | 18048.00 |
| 9.00  | 1983.00 | 12000.00 | 12000.00 | 24000.00 | 24000.00 |
| 10.00 | 1983.00 | 12000.00 | 12000.00 | 24000.00 | 24000.00 |
| 11.00 | 1983.00 | 12000.00 | 12000.00 | 24000.00 | 24000.00 |
| 12.00 | 1983.00 | 12000.00 | 12000.00 | 24000.00 | 24000.00 |
| 1.00  | 1984.00 | 12000.00 | 12000.00 | 24000.00 | 24000.00 |
| 2.00  | 1984.00 | 10909.00 | 10909.00 | 21817.00 | 21817.00 |
| 3.00  | 1984.00 | 10335.00 | 10335.00 | 20667.00 | 20667.00 |
| 4.00  | 1984.00 | 10196.00 | 10196.00 | 20389.00 | 20389.00 |
| 5.00  | 1984.00 | 11217.00 | 11217.00 | 22433.00 | 22433.00 |
| 6.00  | 1984.00 | 11975.00 | 11975.00 | 23948.00 | 23948.00 |
| 7.00  | 1984.00 | 11751.00 | 11751.00 | 23500.00 | 23500.00 |
| 8.00  | 1984.00 | 12000.00 | 12000.00 | 24000.00 | 24000.00 |
| 9.00  | 1984.00 | 12000.00 | 12000.00 | 24000.00 | 24000.00 |
| 10.00 | 1984.00 | 12000.00 | 12000.00 | 24000.00 | 24000.00 |
| 11.00 | 1984.00 | 11844.00 | 11844.00 | 23685.00 | 23685.00 |
| 12.00 | 1984.00 | 11091.00 | 11091.00 | 22181.00 | 22181.00 |





demand data:

| No | Name     | No Bypass | S/F Priority | Monthly Factors |       |       |       |       |       |       |       |       |       |       |       |       |
|----|----------|-----------|--------------|-----------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
|    |          |           |              | Jan             | Feb   | Mar   | Apl   | May   | Jun   | Jul   | Aug   | Sep   | Oct   | Nov   | Dec   |       |
| 3  | DEMAND 1 | 1         | 1 min        | 0.000           | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
|    |          |           | max          | 1.000           | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 4  | DEMAND 2 | 1         | 1 min        | 0.000           | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
|    |          |           | max          | 1.000           | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |

-----  
| CARRIER INFORMATION |  
-----

| No | Name      | Type  | From | To | Cost | Offset | Loss | Ann Vol | Shr Gp | Shr% | No |
|----|-----------|-------|------|----|------|--------|------|---------|--------|------|----|
| 1  | CARRIER 1 | Pipe  | 1    | 3  | 0    | 0      | Ofix |         | 0      | 0%   | 1  |
| 2  | CARRIER 2 | Pipe  | 2    | 4  | 0    | 0      | Ofix |         | 0      | 0%   | 2  |
| 3  | CARRIER 3 | Pipe  | 1    | 2  | 0    | 0      | Ofix |         | 0      | 0%   | 3  |
| 4  | CARRIER 4 | Pipe  | 2    | 1  | 0    | -1     | Ofix |         | 0      | 0%   | 4  |
| 5  | River 2   | River | 2    | 6  | 1000 | 0      | Ofix |         | 0      | 0%   | 5  |
| 6  | River 1   | River | 1    | 5  | 1000 | 0      | Ofix |         | 0      | 0%   | 6  |

-----  
Maximum Flows

| No | Name      | Jan      | Feb      | Mar      | Apl      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec      |
|----|-----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|
| 1  | CARRIER 1 | 12000    | 12000    | 12000    | 12000    | 12000    | 12000    | 12000    | 12000    | 12000    | 12000    | 12000    | 12000    |
| 2  | CARRIER 2 | 24000    | 24000    | 24000    | 24000    | 24000    | 24000    | 24000    | 24000    | 24000    | 24000    | 24000    | 24000    |
| 3  | CARRIER 3 | 24000    | 24000    | 24000    | 24000    | 24000    | 24000    | 24000    | 24000    | 24000    | 24000    | 24000    | 24000    |
| 4  | CARRIER 4 | 24000    | 24000    | 24000    | 24000    | 24000    | 24000    | 24000    | 24000    | 24000    | 24000    | 24000    | 24000    |
| 5  | River 2   | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 |
| 6  | River 1   | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 |

-----  
| TARGET INFORMATION |  
-----

Number of target sets: 1

-----  
Target set 1 ( Jan Feb Mar Apl May Jun Jul Aug Sep Oct Nov Dec)

| Name        | Draw | Pri | Targets |      |       |       |       |       |       |       |       |  |  |
|-------------|------|-----|---------|------|-------|-------|-------|-------|-------|-------|-------|--|--|
| RESERVOIR 1 | 1    | 0   | 1000    | 1000 | 2000  | 2000  | 3000  | 3000  | 4000  | 8000  | 12000 |  |  |
| RESERVOIR 2 | 2    | 0   | 3000    | 7000 | 10000 | 14000 | 17000 | 21000 | 24000 | 24000 | 24000 |  |  |
| totals      |      | 0   | 4000    | 8000 | 12000 | 16000 | 20000 | 24000 | 28000 | 32000 | 36000 |  |  |

-----  
| MULTI SYSTEM INFORMATION |  
-----

-----  
Reservoirs  
-----

RESERVOIR 1        1  
RESERVOIR 2        1

**WORKED EXAMPLE 3(b) – LOG FILE**

```

HHHHH      HHHHHHHH      HHHHHH      H      HHHHHHHHHH
H  H      H      H  H  H      H  H  H
HHHHHHHHH  HHHHHH      HHHHHHHH  HHH      HHH  H  H
HHH  H  HHH      HHH  H  HHH      HHH  H  H
HHH  H  HHH      HHH  H  HHH      HHH  H  H
HHH  H  HHHHHHHH  HHH  H  HHHHHHHH  HHH  H  H

```

```

*****
*      SIMULATION LOG FILE      *
*****

```

Log filename : EX3B.log

Scenario file: scn3b.scn

Simulation label:

Tutorial 3 Sub-Problem (b)

Streamflow file(s):

C:\REALM\WorkedExamples\Sf3.dat

Demand file(s):

C:\REALM\WorkedExamples\Dem2.dat

Restrictions are OFF

Instream flow requirements NOT limited to natural

Water quality calculations are OFF

Number of S/F Sequences: 1

```

Convergence tolerance (storage)  1 10th%
Other convergence tolerance      5 %
Arc convergence tolerance (abs)  100
Minimum iteration count          3
Maximum iteration count          51
Do convergence twice             No

```

Date: 15:27:04 12/05/01

Time Step = Monthly

SYSTEM CHANGES:

| No | Seas | Year | System File                      |
|----|------|------|----------------------------------|
| 1  | 1    | 1982 | C:\REALM\WorkedExamples\EX3B.sys |

Total number of seasons:- 36

\*\*\*\*\* RUN TIME MESSAGES:- \*\*\*\*\*

\*\*\*\*INPUT DATA TYPE= 1 \*\*\*\*

1982

C:\REALM\WorkedExamples\EX3B.sys

1983

1984

\*\*\*\*\* END RUN TIME MESSAGES \*\*\*\*\*

SUMMARY INFORMATION

Reservoir data:

|   | Name        | Start<br>Storage | File<br>Inflow | Min<br>Storage | Average<br>Storage | Evapn | Release<br>to river | Spill | End<br>Storage |
|---|-------------|------------------|----------------|----------------|--------------------|-------|---------------------|-------|----------------|
| 1 | RESERVOIR 1 | 9000.            | 2083.          | 1000.          | 5844.              | 0.    | 0.                  | 0.    | 9272.          |
| 2 | RESERVOIR 2 | 8000.            | 2576.          | 4444.          | 17193.             | 0.    | 0.                  | 0.    | 24000.         |
|   |             | 17000.           | 4659.          | 0.             | 23037.             | 0.    | 0.                  | 0.    | 33272.         |

## Demand data:

|   | Name     | Unrestrict | Restrict | Rationed | Shortfall | Supplied |
|---|----------|------------|----------|----------|-----------|----------|
| 1 | DEMAND 1 | 1372.      | 1372.    | 1372.    | 0.        | 1372.    |
| 2 | DEMAND 2 | 1706.      | 1706.    | 1706.    | 0.        | 1706.    |
|   |          | -----      |          |          |           |          |
|   |          | 3078.      | 3078.    | 3078.    | 0.        | 3078.    |
|   |          | -----      |          |          |           |          |

|   | Name     | No    | Ave      | Max      | No     | Ave %  | Max %  | No    | Ave % | Max % |
|---|----------|-------|----------|----------|--------|--------|--------|-------|-------|-------|
|   |          | Rest  | Rest lvl | Rest lvl | Ration | Ration | Ration | Short | Short | Short |
| 1 | DEMAND 1 | 0.0   | 0.0      | 0.0      | 0.0    | 0.0    | 0.0    | 0.0   | 0.0   | 0.0   |
| 2 | DEMAND 2 | 0.0   | 0.0      | 0.0      | 0.0    | 0.0    | 0.0    | 0.0   | 0.0   | 0.0   |
|   |          | ----- |          |          |        |        |        |       |       |       |

## Pipe/River flows:

|   | Name      | flow   | Capacity   | Min   | Max    | Loss |
|---|-----------|--------|------------|-------|--------|------|
| 1 | CARRIER 1 | 1372.2 | 12000.0    | 0.0   | 2800.0 | 0.0  |
| 2 | CARRIER 2 | 1705.6 | 24000.0    | 300.0 | 3100.0 | 0.0  |
| 3 | CARRIER 3 | 707.0  | 24000.0    | 0.0   | 4716.0 | 0.0  |
| 4 | CARRIER 4 | 391.3  | 24000.0    | 0.0   | 4232.0 | 0.0  |
| 5 | River 1   | 387.3  | 99999999.0 | 0.0   | 4610.0 | 0.0  |
| 6 | River 2   | 742.1  | 99999999.0 | 0.0   | 7690.0 | 0.0  |
|   |           | -----  |            |       |        |      |
|   |           |        |            |       | 0.     |      |
|   |           | -----  |            |       |        |      |

End run

**WORKED EXAMPLE 3(b) – RESERVOIR VOLUME**

RESERVOIR STORAGE

EX3B.log

Tutorial 3 Sub-Problem (b)

Time :15:27:04 Date :12/05/01

```
(F4.0,2F6.0, 2f12.2 )
5
SEASON
YEAR
REPLICATE
RESERVOIR 1      ESTO
RESERVOIR 2      ESTO
  1. 1982.  1.    2000.00  11356.00
  2. 1982.  1.    2000.00  10204.00
  3. 1982.  1.    1588.00   8761.00
  4. 1982.  1.    1385.00   8154.00
  5. 1982.  1.    2000.00  13027.00
  6. 1982.  1.    2219.00  14657.00
  7. 1982.  1.    2133.00  14397.00
  8. 1982.  1.    2024.00  14069.00
  9. 1982.  1.    2000.00  13723.00
 10. 1982.  1.    2000.00  13189.00
 11. 1982.  1.    2000.00  11307.00
 12. 1982.  1.    2000.00  10496.00
  1. 1983.  1.    1327.00   7981.00
  2. 1983.  1.    1000.00   4668.00
  3. 1983.  1.    1000.00   4444.00
  4. 1983.  1.    1278.00   7834.00
  5. 1983.  1.    2000.00  13432.00
  6. 1983.  1.    2000.00  13772.00
  7. 1983.  1.    2721.00  16161.00
  8. 1983.  1.    3768.00  23304.00
  9. 1983.  1.   12000.00  24000.00
 10. 1983.  1.   12000.00  24000.00
 11. 1983.  1.   12000.00  24000.00
 12. 1983.  1.   12000.00  24000.00
  1. 1984.  1.   12000.00  24000.00
  2. 1984.  1.    8726.00  24000.00
  3. 1984.  1.    7002.00  24000.00
  4. 1984.  1.    6585.00  24000.00
  5. 1984.  1.    9650.00  24000.00
  6. 1984.  1.   11923.00  24000.00
  7. 1984.  1.   11251.00  24000.00
  8. 1984.  1.   12000.00  24000.00
  9. 1984.  1.   12000.00  24000.00
 10. 1984.  1.   12000.00  24000.00
 11. 1984.  1.   11529.00  24000.00
 12. 1984.  1.    9272.00  24000.00
```

**WORKED EXAMPLE 3(b) – TARGET STORAGE VOLUME**

RESERVOIR TARGETS

EX3B.log

Tutorial 3 Sub-Problem (b)

Time :15:27:04 Date :12/05/01

```
(F4.0,2F6.0, 2f12.2 )
5
SEASON
YEAR
REPLICATE
RESERVOIR 1      TARG
RESERVOIR 2      TARG
  1. 1982.  1.    2000.00  11356.00
  2. 1982.  1.    2000.00  10204.00
  3. 1982.  1.    1588.00   8761.00
  4. 1982.  1.    1385.00   8154.00
  5. 1982.  1.    2000.00  13027.00
  6. 1982.  1.    2219.00  14657.00
  7. 1982.  1.    2133.00  14397.00
  8. 1982.  1.    2024.00  14069.00
  9. 1982.  1.    2000.00  13723.00
 10. 1982.  1.    2000.00  13189.00
 11. 1982.  1.    2000.00  11307.00
 12. 1982.  1.    2000.00  10496.00
  1. 1983.  1.    1327.00   7981.00
  2. 1983.  1.    1000.00   4668.00
  3. 1983.  1.    1000.00   4444.00
  4. 1983.  1.    1278.00   7834.00
  5. 1983.  1.    2000.00  13432.00
  6. 1983.  1.    2000.00  13772.00
  7. 1983.  1.    2721.00  16161.00
  8. 1983.  1.    3768.00  23304.00
  9. 1983.  1.   12000.00  24000.00
 10. 1983.  1.   12000.00  24000.00
 11. 1983.  1.   12000.00  24000.00
 12. 1983.  1.   12000.00  24000.00
  1. 1984.  1.   12000.00  24000.00
  2. 1984.  1.    8726.00  24000.00
  3. 1984.  1.    7002.00  24000.00
  4. 1984.  1.    6585.00  24000.00
  5. 1984.  1.    9650.00  24000.00
  6. 1984.  1.   11923.00  24000.00
  7. 1984.  1.   11251.00  24000.00
  8. 1984.  1.   12000.00  24000.00
  9. 1984.  1.   12000.00  24000.00
 10. 1984.  1.   12000.00  24000.00
 11. 1984.  1.   11529.00  24000.00
 12. 1984.  1.    9272.00  24000.00
```

**WORKED EXAMPLE 3(b) – CARRIER FLOW**

CARRIER FLOWS  
 EX3B.log Time :15:27:04 Date :12/05/01  
 Tutorial 3 Sub-Problem (b)

(F4.0,2F6.0, 4f12.2 )  
 7

| SEASON | YEAR  | REPLICATE | CARRIER 1 | FLOW    | CARRIER 2 | FLOW    | CARRIER 3 | FLOW | CARRIER 4 | FLOW |
|--------|-------|-----------|-----------|---------|-----------|---------|-----------|------|-----------|------|
| 1.     | 1982. | 1.        | 2700.00   | 2700.00 | 4716.00   | 0.00    |           |      |           |      |
| 2.     | 1982. | 1.        | 1300.00   | 1300.00 | 0.00      | 1012.00 |           |      |           |      |
| 3.     | 1982. | 1.        | 2100.00   | 2100.00 | 0.00      | 663.00  |           |      |           |      |
| 4.     | 1982. | 1.        | 1500.00   | 1500.00 | 0.00      | 847.00  |           |      |           |      |
| 5.     | 1982. | 1.        | 1600.00   | 1600.00 | 2773.00   | 0.00    |           |      |           |      |
| 6.     | 1982. | 1.        | 700.00    | 1700.00 | 1330.00   | 0.00    |           |      |           |      |
| 7.     | 1982. | 1.        | 1200.00   | 1200.00 | 120.00    | 0.00    |           |      |           |      |
| 8.     | 1982. | 1.        | 1800.00   | 1800.00 | 582.00    | 0.00    |           |      |           |      |
| 9.     | 1982. | 1.        | 2200.00   | 1200.00 | 0.00      | 16.00   |           |      |           |      |
| 10.    | 1982. | 1.        | 1300.00   | 1300.00 | 0.00      | 84.00   |           |      |           |      |
| 11.    | 1982. | 1.        | 1400.00   | 2400.00 | 0.00      | 62.00   |           |      |           |      |
| 12.    | 1982. | 1.        | 1400.00   | 1400.00 | 0.00      | 131.00  |           |      |           |      |
| 1.     | 1983. | 1.        | 1900.00   | 1900.00 | 0.00      | 1055.00 |           |      |           |      |
| 2.     | 1983. | 1.        | 1100.00   | 3100.00 | 0.00      | 613.00  |           |      |           |      |
| 3.     | 1983. | 1.        | 1300.00   | 1300.00 | 0.00      | 734.00  |           |      |           |      |
| 4.     | 1983. | 1.        | 800.00    | 1800.00 | 2770.00   | 0.00    |           |      |           |      |
| 5.     | 1983. | 1.        | 0.00      | 2000.00 | 2498.00   | 0.00    |           |      |           |      |
| 6.     | 1983. | 1.        | 600.00    | 1600.00 | 900.00    | 0.00    |           |      |           |      |
| 7.     | 1983. | 1.        | 900.00    | 1900.00 | 3019.00   | 0.00    |           |      |           |      |
| 8.     | 1983. | 1.        | 300.00    | 1300.00 | 2553.00   | 0.00    |           |      |           |      |
| 9.     | 1983. | 1.        | 600.00    | 1600.00 | 0.00      | 4232.00 |           |      |           |      |
| 10.    | 1983. | 1.        | 1400.00   | 1400.00 | 0.00      | 0.00    |           |      |           |      |
| 11.    | 1983. | 1.        | 2100.00   | 2100.00 | 0.00      | 77.00   |           |      |           |      |
| 12.    | 1983. | 1.        | 2100.00   | 2100.00 | 0.00      | 0.00    |           |      |           |      |
| 1.     | 1984. | 1.        | 1100.00   | 1100.00 | 0.00      | 0.00    |           |      |           |      |
| 2.     | 1984. | 1.        | 2300.00   | 2300.00 | 1220.00   | 0.00    |           |      |           |      |
| 3.     | 1984. | 1.        | 2800.00   | 2800.00 | 1450.00   | 0.00    |           |      |           |      |
| 4.     | 1984. | 1.        | 1900.00   | 1900.00 | 30.00     | 0.00    |           |      |           |      |
| 5.     | 1984. | 1.        | 300.00    | 300.00  | 0.00      | 2840.00 |           |      |           |      |
| 6.     | 1984. | 1.        | 600.00    | 600.00  | 0.00      | 40.00   |           |      |           |      |
| 7.     | 1984. | 1.        | 600.00    | 1600.00 | 980.00    | 0.00    |           |      |           |      |
| 8.     | 1984. | 1.        | 100.00    | 1100.00 | 0.00      | 0.00    |           |      |           |      |
| 9.     | 1984. | 1.        | 1600.00   | 1600.00 | 0.00      | 0.00    |           |      |           |      |
| 10.    | 1984. | 1.        | 1300.00   | 1300.00 | 0.00      | 0.00    |           |      |           |      |
| 11.    | 1984. | 1.        | 2400.00   | 2400.00 | 0.00      | 1680.00 |           |      |           |      |
| 12.    | 1984. | 1.        | 2100.00   | 2100.00 | 510.00    | 0.00    |           |      |           |      |

**WORKED EXAMPLE 3(b) - EFFECT OF TARGETS ON STORAGE VOLUMES**

####4  
 EX3A.log + EX3B.log Time :14:54:28 Date :12/05/01  
 Tutorial 3 Sub-Problem (a) and (b)

( 6f12.2 )  
 6

| SEASON      | YEAR    | RESERVOIR 1     | ESTO               | Sub problem (a) | linear targets |                 |                |
|-------------|---------|-----------------|--------------------|-----------------|----------------|-----------------|----------------|
| RESERVOIR 1 | ESTO    | Sub problem (b) | non-linear targets | RESERVOIR 2     | ESTO           | Sub problem (a) | linear targets |
| RESERVOIR 2 | ESTO    | Sub problem (b) | non-linear targets |                 |                |                 |                |
| 1.00        | 1982.00 | 4452.00         | 2000.00            | 8904.00         | 11356.00       |                 |                |
| 2.00        | 1982.00 | 4068.00         | 2000.00            | 8136.00         | 10204.00       |                 |                |
| 3.00        | 1982.00 | 3450.00         | 1588.00            | 6899.00         | 8761.00        |                 |                |
| 4.00        | 1982.00 | 3180.00         | 1385.00            | 6359.00         | 8154.00        |                 |                |
| 5.00        | 1982.00 | 5009.00         | 2000.00            | 10018.00        | 13027.00       |                 |                |
| 6.00        | 1982.00 | 5626.00         | 2219.00            | 11250.00        | 14657.00       |                 |                |
| 7.00        | 1982.00 | 5510.00         | 2133.00            | 11020.00        | 14397.00       |                 |                |
| 8.00        | 1982.00 | 5365.00         | 2024.00            | 10728.00        | 14069.00       |                 |                |
| 9.00        | 1982.00 | 5241.00         | 2000.00            | 10482.00        | 13723.00       |                 |                |
| 10.00       | 1982.00 | 5063.00         | 2000.00            | 10126.00        | 13189.00       |                 |                |
| 11.00       | 1982.00 | 4436.00         | 2000.00            | 8871.00         | 11307.00       |                 |                |
| 12.00       | 1982.00 | 4166.00         | 2000.00            | 8330.00         | 10496.00       |                 |                |
| 1.00        | 1983.00 | 3103.00         | 1327.00            | 6205.00         | 7981.00        |                 |                |
| 2.00        | 1983.00 | 1890.00         | 1000.00            | 3778.00         | 4668.00        |                 |                |
| 3.00        | 1983.00 | 1815.00         | 1000.00            | 3629.00         | 4444.00        |                 |                |
| 4.00        | 1983.00 | 3038.00         | 1278.00            | 6074.00         | 7834.00        |                 |                |
| 5.00        | 1983.00 | 5144.00         | 2000.00            | 10288.00        | 13432.00       |                 |                |
| 6.00        | 1983.00 | 5258.00         | 2000.00            | 10514.00        | 13772.00       |                 |                |
| 7.00        | 1983.00 | 6295.00         | 2721.00            | 12587.00        | 16161.00       |                 |                |
| 8.00        | 1983.00 | 9024.00         | 3768.00            | 18048.00        | 23304.00       |                 |                |
| 9.00        | 1983.00 | 12000.00        | 12000.00           | 24000.00        | 24000.00       |                 |                |
| 10.00       | 1983.00 | 12000.00        | 12000.00           | 24000.00        | 24000.00       |                 |                |
| 11.00       | 1983.00 | 12000.00        | 12000.00           | 24000.00        | 24000.00       |                 |                |
| 12.00       | 1983.00 | 12000.00        | 12000.00           | 24000.00        | 24000.00       |                 |                |
| 1.00        | 1984.00 | 12000.00        | 12000.00           | 24000.00        | 24000.00       |                 |                |
| 2.00        | 1984.00 | 10909.00        | 8726.00            | 21817.00        | 24000.00       |                 |                |
| 3.00        | 1984.00 | 10335.00        | 7002.00            | 20667.00        | 24000.00       |                 |                |
| 4.00        | 1984.00 | 10196.00        | 6585.00            | 20389.00        | 24000.00       |                 |                |
| 5.00        | 1984.00 | 11217.00        | 9650.00            | 22433.00        | 24000.00       |                 |                |
| 6.00        | 1984.00 | 11975.00        | 11923.00           | 23948.00        | 24000.00       |                 |                |
| 7.00        | 1984.00 | 11751.00        | 11251.00           | 23500.00        | 24000.00       |                 |                |
| 8.00        | 1984.00 | 12000.00        | 12000.00           | 24000.00        | 24000.00       |                 |                |
| 9.00        | 1984.00 | 12000.00        | 12000.00           | 24000.00        | 24000.00       |                 |                |
| 10.00       | 1984.00 | 12000.00        | 12000.00           | 24000.00        | 24000.00       |                 |                |
| 11.00       | 1984.00 | 11844.00        | 11529.00           | 23685.00        | 24000.00       |                 |                |
| 12.00       | 1984.00 | 11091.00        | 9272.00            | 22181.00        | 24000.00       |                 |                |



**Figure 3.3-2 Worked Example 3(b) –Investigation of Target Storage Curves on Storage Volumes**



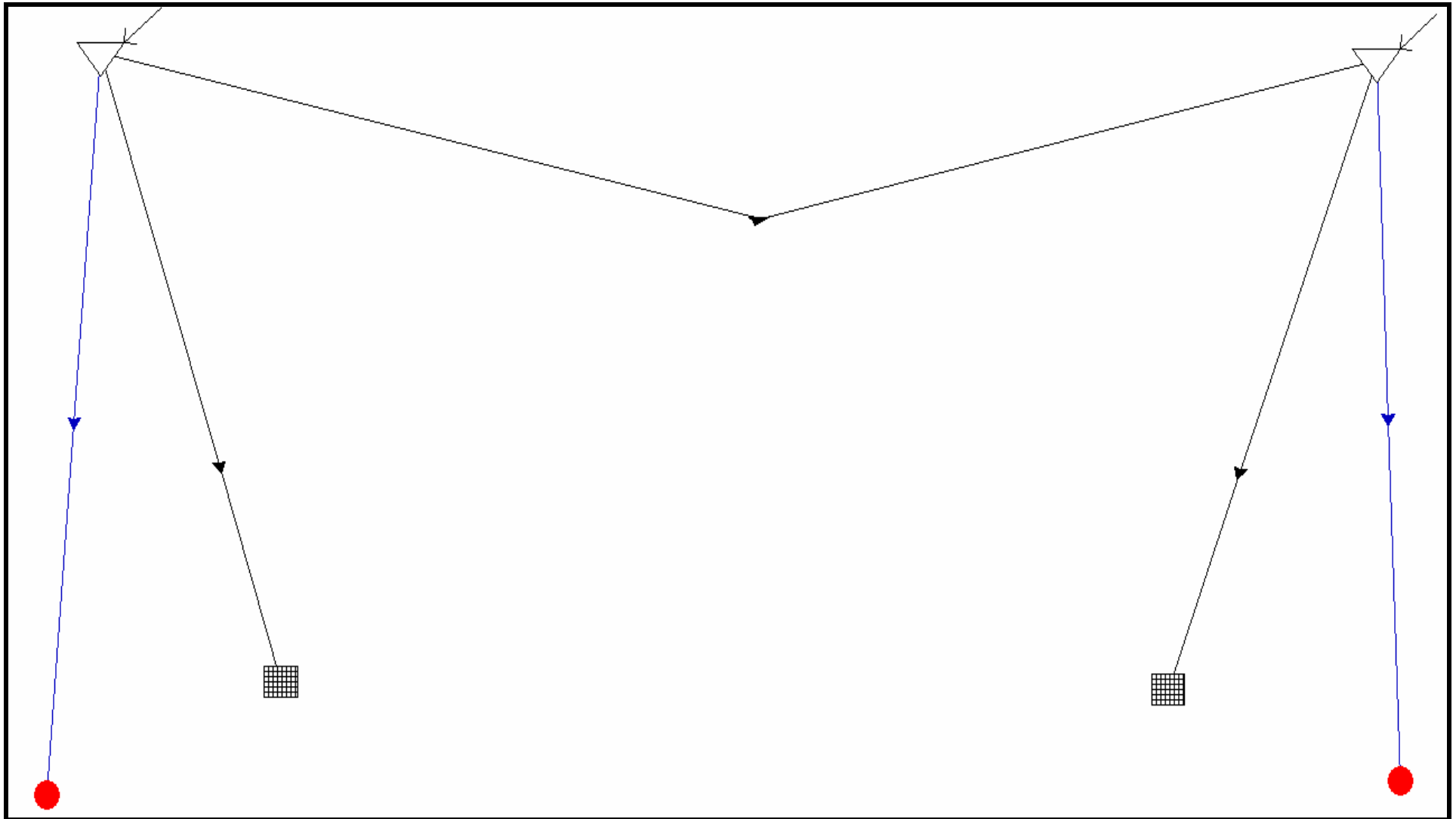


Figure 3.3-3 Worked Example 3(c) – System Plot (*EX3C.sys*)

**WORKED EXAMPLE 3(c) – SYSTEM LISTING**


---

R     E     A     L     M

---

\*\*\*\*\*  
 \*     SYSTEM FILE LISTING     \*  
 \*\*\*\*\*

File: C:\REALM\WorkedExamples\EX3C.SYS

Simulation label:  
 Tutorial 3 - Sub-Problem (a)

Date: 06:37     15/03/2005

-----  
 |     NODE INFORMATION     |  
 -----

| No | Name        | Type            | X     | Y     | Z    | Size | Aux Input | No |
|----|-------------|-----------------|-------|-------|------|------|-----------|----|
| 1  | RESERVOIR 1 | Reservoir       | 8.25  | 95.00 | 0.00 | 1.00 | STREAM1   | 1  |
| 2  | RESERVOIR 2 | Reservoir       | 94.64 | 94.30 | 0.00 | 1.00 | STREAM2   | 2  |
| 3  | DEMAND 1    | Demand          | 20.43 | 28.86 | 0.00 | 1.00 |           | 3  |
| 4  | DEMAND 2    | Demand          | 80.54 | 28.07 | 0.00 | 1.00 |           | 4  |
| 5  | STRM TERM 1 | Strm terminator | 4.59  | 16.95 | 0.00 | 1.00 |           | 5  |
| 6  | STRM TERM 2 | Strm terminator | 96.23 | 18.54 | 0.00 | 1.00 |           | 6  |

Reservoir data:

| No | Name        | Min Cap | Max Cap | No Above | No Below | Spill Type |
|----|-------------|---------|---------|----------|----------|------------|
| 1  | RESERVOIR 1 | 0       | 12000   | 1        | 1        | Downstream |
| 2  | RESERVOIR 2 | 0       | 24000   | 1        | 1        | Downstream |



```

-----
| TARGET INFORMATION |
-----

```

Number of target sets: 1

```

-----
Target set 1 ( Jan Feb Mar Apl May Jun Jul Aug Sep Oct Nov Dec)
Name          Draw Pri          Targets
-----
RESERVOIR 1      1          0      1333      2667      4000      5333      6667      8000      9333      10667      12000
RESERVOIR 2      2          0      2667      5333      8000      10667      13333      16000      18667      21333      24000

totals          0          0      4000      8000      12000      16000      20000      24000      28000      32000      36000

```

**WORKED EXAMPLE 3(c) – LOG FILE**

```

HHHHH      HHHHHHHH      HHHHHH      H      HHHHHHHHHH
H  H      H      H  H  H      H  H  H
HHHHHHHHH  HHHHHH      HHHHHHHH  HHH      HHH  H  H
HHH      H  HHH      HHH  H  HHH      HHH  H  H
HHH      H  HHH      HHH  H  HHH      HHH  H  H
HHH      H  HHHHHHHH  HHH  H  HHHHHHHH  HHH  H  H

```

```

*****
*      SIMULATION LOG FILE      *
*****

```

Log filename : EX3C.log

Scenario file: scn3c.scn

Simulation label:

Tutorial 3 Sub-Problem (c)

Streamflow file(s):

C:\REALM\WorkedExamples\Sf3.dat

Demand file(s):

C:\REALM\WorkedExamples\Dem2.dat

Restrictions are OFF

Instream flow requirements NOT limited to natural

Water quality calculations are OFF

Number of S/F Sequences: 1

Convergence tolerance (storage) 1 10th%

Other convergence tolerance 5 %

Arc convergence tolerance (abs) 100

Minimum iteration count 3

Maximum iteration count 51

Do convergence twice No

Date: 16:18:42 12/05/01

Time Step = Monthly

SYSTEM CHANGES:

| No | Seas | Year | System File                      |
|----|------|------|----------------------------------|
| 1  | 1    | 1982 | C:\REALM\WorkedExamples\EX3C.sys |

Total number of seasons:- 36

\*\*\*\*\* RUN TIME MESSAGES:- \*\*\*\*\*

\*\*\*\*INPUT DATA TYPE= 1 \*\*\*\*

1982

C:\REALM\WorkedExamples\EX3C.sys

1983

1984

\*\*\*\*\* END RUN TIME MESSAGES \*\*\*\*\*

SUMMARY INFORMATION

Reservoir data:

|   | Name        | Start<br>Storage | File<br>Inflow | Min<br>Storage | Average<br>Storage | Evapn | Release<br>to river | Spill | End<br>Storage |
|---|-------------|------------------|----------------|----------------|--------------------|-------|---------------------|-------|----------------|
| 1 | RESERVOIR 1 | 9000.            | 2083.          | 764.           | 7246.              | 0.    | 426.                | 0.    | 8102.          |
| 2 | RESERVOIR 2 | 8000.            | 2576.          | 4170.          | 15681.             | 0.    | 750.                | 0.    | 23490.         |
|   |             | 17000.           | 4659.          | 0.             | 22927.             | 0.    | 1176.               | 0.    | 31592.         |

Demand data:

|   | Name     | Unrestrict | Restrict | Rationed | Shortfall | Supplied |
|---|----------|------------|----------|----------|-----------|----------|
| 1 | DEMAND 1 | 1372.      | 1372.    | 1372.    | 0.        | 1372.    |
| 2 | DEMAND 2 | 1706.      | 1706.    | 1706.    | 0.        | 1706.    |
|   |          | 3078.      | 3078.    | 3078.    | 0.        | 3078.    |

|   | Name     | No Rest | Ave Rest lvl | Max Rest lvl | No Ration | Ave % Ration | Max % Ration | No Short | Ave % Short | Max % Short |
|---|----------|---------|--------------|--------------|-----------|--------------|--------------|----------|-------------|-------------|
| 1 | DEMAND 1 | 0.0     | 0.0          | 0.0          | 0.0       | 0.0          | 0.0          | 0.0      | 0.0         | 0.0         |
| 2 | DEMAND 2 | 0.0     | 0.0          | 0.0          | 0.0       | 0.0          | 0.0          | 0.0      | 0.0         | 0.0         |

Pipe/River flows:

|   | Name      | flow   | Capacity   | Min   | Max    | Loss |
|---|-----------|--------|------------|-------|--------|------|
| 1 | CARRIER 1 | 1372.2 | 12000.0    | 0.0   | 2800.0 | 0.0  |
| 2 | CARRIER 2 | 1705.6 | 24000.0    | 300.0 | 3100.0 | 0.0  |
| 3 | CARRIER 3 | 309.7  | 24000.0    | 0.0   | 2703.0 | 0.0  |
| 4 | River 1   | 425.8  | 99999999.0 | 0.0   | 4610.0 | 0.0  |
| 5 | River 2   | 750.2  | 99999999.0 | 0.0   | 7690.0 | 0.0  |
|   |           |        |            |       |        | 0.   |

End run

**WORKED EXAMPLE 3(c) – RESERVOIR VOLUME**

RESERVOIR STORAGE

EX3C.log

Tutorial 3 Sub-Problem (c)

Time :16:18:42 Date :12/05/01

```

(F4.0,2F6.0, 2f12.2 )
5
SEASON
YEAR
REPLICATE
RESERVOIR 1      ESTO
RESERVOIR 2      ESTO
  1. 1982.  1.    4452.00    8904.00
  2. 1982.  1.    3440.00    8764.00
  3. 1982.  1.    2365.00    7984.00
  4. 1982.  1.    1315.00    8224.00
  5. 1982.  1.    4703.00   10324.00
  6. 1982.  1.    5626.00   11250.00
  7. 1982.  1.    5510.00   11020.00
  8. 1982.  1.    5365.00   10728.00
  9. 1982.  1.    5241.00   10482.00
 10. 1982.  1.    5063.00   10126.00
 11. 1982.  1.    4436.00    8871.00
 12. 1982.  1.    4166.00    8330.00
  1. 1983.  1.    2438.00    6870.00
  2. 1983.  1.    1498.00    4170.00
  3. 1983.  1.     764.00    4680.00
  4. 1983.  1.    3038.00    6074.00
  5. 1983.  1.    5144.00   10288.00
  6. 1983.  1.    5258.00   10514.00
  7. 1983.  1.    6295.00   12587.00
  8. 1983.  1.    9024.00   18048.00
  9. 1983.  1.   12000.00   24000.00
 10. 1983.  1.   12000.00   24000.00
 11. 1983.  1.   11923.00   24000.00
 12. 1983.  1.   12000.00   24000.00
  1. 1984.  1.   12000.00   24000.00
  2. 1984.  1.    9946.00   22780.00
  3. 1984.  1.    9672.00   21330.00
  4. 1984.  1.    9285.00   21300.00
  5. 1984.  1.    9510.00   24000.00
  6. 1984.  1.   11743.00   24000.00
  7. 1984.  1.   11691.00   23380.00
  8. 1984.  1.   12000.00   24000.00
  9. 1984.  1.   12000.00   24000.00
 10. 1984.  1.   12000.00   24000.00
 11. 1984.  1.    9849.00   24000.00
 12. 1984.  1.    8102.00   23490.00

```

**WORKED EXAMPLE 3(c) – TARGET STORAGE VOLUME**

RESERVOIR TARGETS

EX3C.log

Tutorial 3 Sub-Problem (c)

Time :16:18:42 Date :12/05/01

```

(F4.0,2F6.0, 2f12.2 )
5
SEASON
YEAR
REPLICATE
RESERVOIR 1      TARG
RESERVOIR 2      TARG
  1. 1982.  1.    4452.00    8904.00
  2. 1982.  1.    4068.00    8136.00
  3. 1982.  1.    3450.00    6899.00
  4. 1982.  1.    3180.00    6359.00
  5. 1982.  1.    5009.00   10018.00
  6. 1982.  1.    5626.00   11250.00
  7. 1982.  1.    5510.00   11020.00
  8. 1982.  1.    5365.00   10728.00
  9. 1982.  1.    5241.00   10482.00
 10. 1982.  1.    5063.00   10126.00
 11. 1982.  1.    4436.00    8871.00
 12. 1982.  1.    4166.00    8330.00
  1. 1983.  1.    3103.00    6205.00
  2. 1983.  1.    1890.00    3778.00
  3. 1983.  1.    1815.00    3629.00
  4. 1983.  1.    3038.00    6074.00
  5. 1983.  1.    5144.00   10288.00
  6. 1983.  1.    5258.00   10514.00
  7. 1983.  1.    6295.00   12587.00
  8. 1983.  1.    9024.00   18048.00
  9. 1983.  1.   12000.00   24000.00
 10. 1983.  1.   12000.00   24000.00
 11. 1983.  1.   11975.00   23948.00
 12. 1983.  1.   12000.00   24000.00
  1. 1984.  1.   12000.00   24000.00
  2. 1984.  1.   10909.00   21817.00
  3. 1984.  1.   10335.00   20667.00
  4. 1984.  1.   10196.00   20389.00
  5. 1984.  1.   11171.00   22339.00
  6. 1984.  1.   11928.00   23855.00
  7. 1984.  1.   11691.00   23380.00
  8. 1984.  1.   12000.00   24000.00
  9. 1984.  1.   12000.00   24000.00
 10. 1984.  1.   12000.00   24000.00
 11. 1984.  1.   11284.00   22565.00
 12. 1984.  1.   10531.00   21061.00

```



**WORKED EXAMPLE 3(c) – CARRIER FLOWS**

CARRIER FLOWS

EX3C.log

Tutorial 3 Sub-Problem (c)

Time :16:03:52 Date :12/05/01

(F4.0,2F6.0, 4f12.2 )

7

SEASON

YEAR

REPLICATE

CARRIER 1 FLOW

CARRIER 2 FLOW

CARRIER 3 FLOW

River 2 FLOW

|     |       |    |         |         |         |         |
|-----|-------|----|---------|---------|---------|---------|
| 1.  | 1982. | 1. | 2700.00 | 2700.00 | 2264.00 | 0.00    |
| 2.  | 1982. | 1. | 1300.00 | 1300.00 | 0.00    | 0.00    |
| 3.  | 1982. | 1. | 2100.00 | 2100.00 | 0.00    | 0.00    |
| 4.  | 1982. | 1. | 1500.00 | 1500.00 | 0.00    | 0.00    |
| 5.  | 1982. | 1. | 1600.00 | 1600.00 | 0.00    | 0.00    |
| 6.  | 1982. | 1. | 700.00  | 1700.00 | 626.00  | 0.00    |
| 7.  | 1982. | 1. | 1200.00 | 1200.00 | 150.00  | 0.00    |
| 8.  | 1982. | 1. | 1800.00 | 1800.00 | 618.00  | 0.00    |
| 9.  | 1982. | 1. | 2200.00 | 1200.00 | 84.00   | 0.00    |
| 10. | 1982. | 1. | 1300.00 | 1300.00 | 94.00   | 0.00    |
| 11. | 1982. | 1. | 1400.00 | 2400.00 | 565.00  | 0.00    |
| 12. | 1982. | 1. | 1400.00 | 1400.00 | 139.00  | 0.00    |
| 1.  | 1983. | 1. | 1900.00 | 1900.00 | 0.00    | 0.00    |
| 2.  | 1983. | 1. | 1100.00 | 3100.00 | 0.00    | 0.00    |
| 3.  | 1983. | 1. | 1300.00 | 1300.00 | 0.00    | 0.00    |
| 4.  | 1983. | 1. | 800.00  | 1800.00 | 774.00  | 0.00    |
| 5.  | 1983. | 1. | 0.00    | 2000.00 | 1114.00 | 0.00    |
| 6.  | 1983. | 1. | 600.00  | 1600.00 | 786.00  | 0.00    |
| 7.  | 1983. | 1. | 900.00  | 1900.00 | 2703.00 | 0.00    |
| 8.  | 1983. | 1. | 300.00  | 1300.00 | 871.00  | 0.00    |
| 9.  | 1983. | 1. | 600.00  | 1600.00 | 0.00    | 4178.00 |
| 10. | 1983. | 1. | 1400.00 | 1400.00 | 0.00    | 7690.00 |
| 11. | 1983. | 1. | 2100.00 | 2100.00 | 0.00    | 1670.00 |
| 12. | 1983. | 1. | 2100.00 | 2100.00 | 0.00    | 1150.00 |
| 1.  | 1984. | 1. | 1100.00 | 1100.00 | 0.00    | 4050.00 |
| 2.  | 1984. | 1. | 2300.00 | 2300.00 | 0.00    | 0.00    |
| 3.  | 1984. | 1. | 2800.00 | 2800.00 | 0.00    | 0.00    |
| 4.  | 1984. | 1. | 1900.00 | 1900.00 | 0.00    | 0.00    |
| 5.  | 1984. | 1. | 300.00  | 300.00  | 0.00    | 140.00  |
| 6.  | 1984. | 1. | 600.00  | 600.00  | 0.00    | 40.00   |
| 7.  | 1984. | 1. | 600.00  | 1600.00 | 360.00  | 0.00    |
| 8.  | 1984. | 1. | 100.00  | 1100.00 | 0.00    | 2300.00 |
| 9.  | 1984. | 1. | 1600.00 | 1600.00 | 0.00    | 2220.00 |
| 10. | 1984. | 1. | 1300.00 | 1300.00 | 0.00    | 1890.00 |
| 11. | 1984. | 1. | 2400.00 | 2400.00 | 0.00    | 1680.00 |
| 12. | 1984. | 1. | 2100.00 | 2100.00 | 0.00    | 0.00    |

**WORKED EXAMPLE 3(c) – COMPARISON OF RESERVOIR STORAGE AND TARGET STORAGE VOLUMES**

####4

EX3C.log

Tutorial 3 Sub-Problem (c)

Time :16:18:42 Date :12/05/01

( 6f12.2 )

6

SEASON

YEAR

RESERVOIR 1

ESTO

RESERVOIR 1

TARG

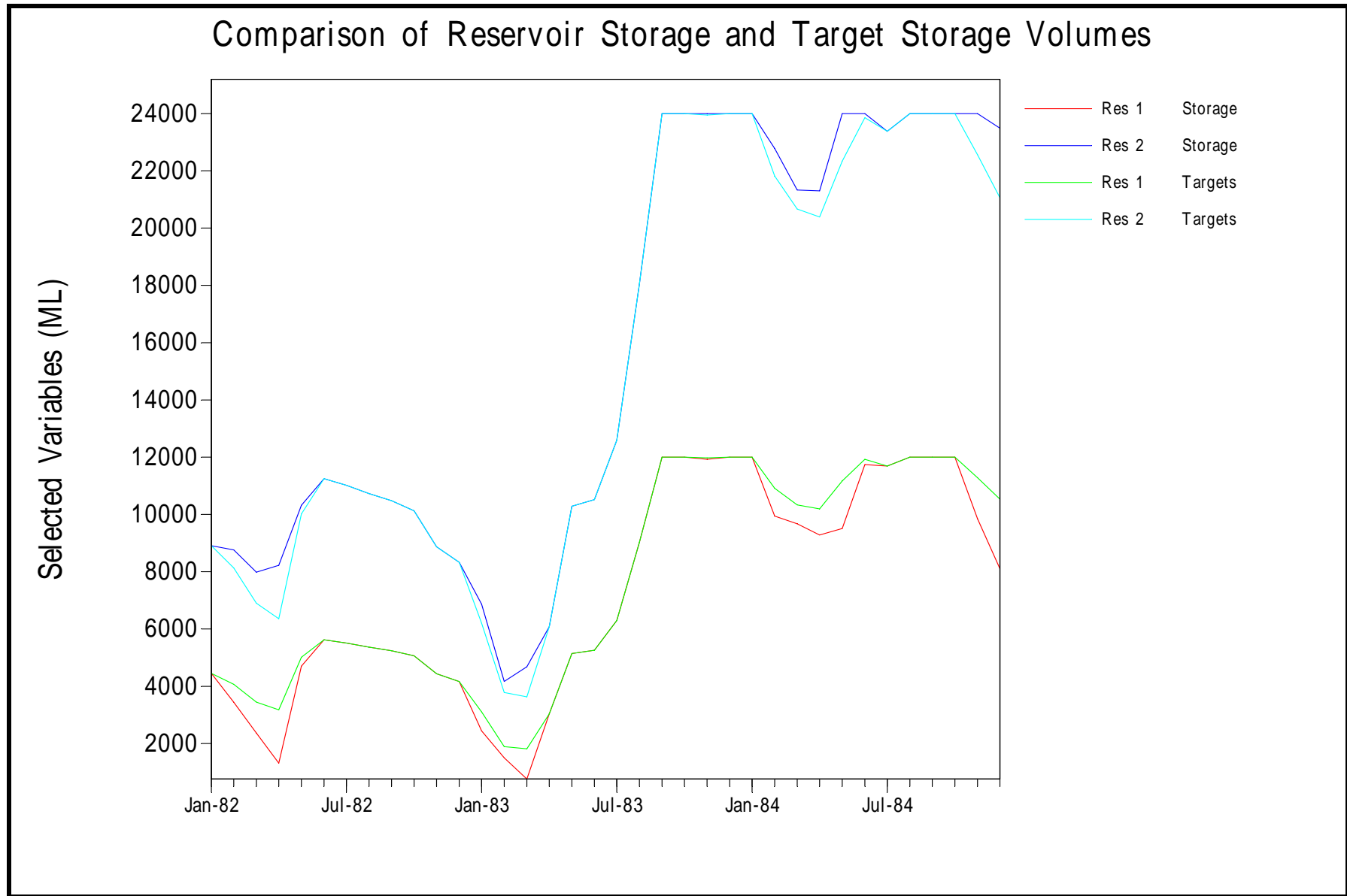
RESERVOIR 2

ESTO

RESERVOIR 2

TARG

|       |         |          |          |          |          |
|-------|---------|----------|----------|----------|----------|
| 1.00  | 1982.00 | 4452.00  | 4452.00  | 8904.00  | 8904.00  |
| 2.00  | 1982.00 | 3440.00  | 4068.00  | 8764.00  | 8136.00  |
| 3.00  | 1982.00 | 2365.00  | 3450.00  | 7984.00  | 6899.00  |
| 4.00  | 1982.00 | 1315.00  | 3180.00  | 8224.00  | 6359.00  |
| 5.00  | 1982.00 | 4703.00  | 5009.00  | 10324.00 | 10018.00 |
| 6.00  | 1982.00 | 5626.00  | 5626.00  | 11250.00 | 11250.00 |
| 7.00  | 1982.00 | 5510.00  | 5510.00  | 11020.00 | 11020.00 |
| 8.00  | 1982.00 | 5365.00  | 5365.00  | 10728.00 | 10728.00 |
| 9.00  | 1982.00 | 5241.00  | 5241.00  | 10482.00 | 10482.00 |
| 10.00 | 1982.00 | 5063.00  | 5063.00  | 10126.00 | 10126.00 |
| 11.00 | 1982.00 | 4436.00  | 4436.00  | 8871.00  | 8871.00  |
| 12.00 | 1982.00 | 4166.00  | 4166.00  | 8330.00  | 8330.00  |
| 1.00  | 1983.00 | 2438.00  | 3103.00  | 6870.00  | 6205.00  |
| 2.00  | 1983.00 | 1498.00  | 1890.00  | 4170.00  | 3778.00  |
| 3.00  | 1983.00 | 764.00   | 1815.00  | 4680.00  | 3629.00  |
| 4.00  | 1983.00 | 3038.00  | 3038.00  | 6074.00  | 6074.00  |
| 5.00  | 1983.00 | 5144.00  | 5144.00  | 10288.00 | 10288.00 |
| 6.00  | 1983.00 | 5258.00  | 5258.00  | 10514.00 | 10514.00 |
| 7.00  | 1983.00 | 6295.00  | 6295.00  | 12587.00 | 12587.00 |
| 8.00  | 1983.00 | 9024.00  | 9024.00  | 18048.00 | 18048.00 |
| 9.00  | 1983.00 | 12000.00 | 12000.00 | 24000.00 | 24000.00 |
| 10.00 | 1983.00 | 12000.00 | 12000.00 | 24000.00 | 24000.00 |
| 11.00 | 1983.00 | 11923.00 | 11975.00 | 24000.00 | 23948.00 |
| 12.00 | 1983.00 | 12000.00 | 12000.00 | 24000.00 | 24000.00 |
| 1.00  | 1984.00 | 12000.00 | 12000.00 | 24000.00 | 24000.00 |
| 2.00  | 1984.00 | 9946.00  | 10909.00 | 22780.00 | 21817.00 |
| 3.00  | 1984.00 | 9672.00  | 10335.00 | 21330.00 | 20667.00 |
| 4.00  | 1984.00 | 9285.00  | 10196.00 | 21300.00 | 20389.00 |
| 5.00  | 1984.00 | 9510.00  | 11171.00 | 24000.00 | 22339.00 |
| 6.00  | 1984.00 | 11743.00 | 11928.00 | 24000.00 | 23855.00 |
| 7.00  | 1984.00 | 11691.00 | 11691.00 | 23380.00 | 23380.00 |
| 8.00  | 1984.00 | 12000.00 | 12000.00 | 24000.00 | 24000.00 |
| 9.00  | 1984.00 | 12000.00 | 12000.00 | 24000.00 | 24000.00 |
| 10.00 | 1984.00 | 12000.00 | 12000.00 | 24000.00 | 24000.00 |
| 11.00 | 1984.00 | 9849.00  | 11284.00 | 24000.00 | 22565.00 |
| 12.00 | 1984.00 | 8102.00  | 10531.00 | 23490.00 | 21061.00 |



**Figure 3.3-4 Worked Example 3(c) – Comparison of Reservoir Storage and Target Storage Volumes**

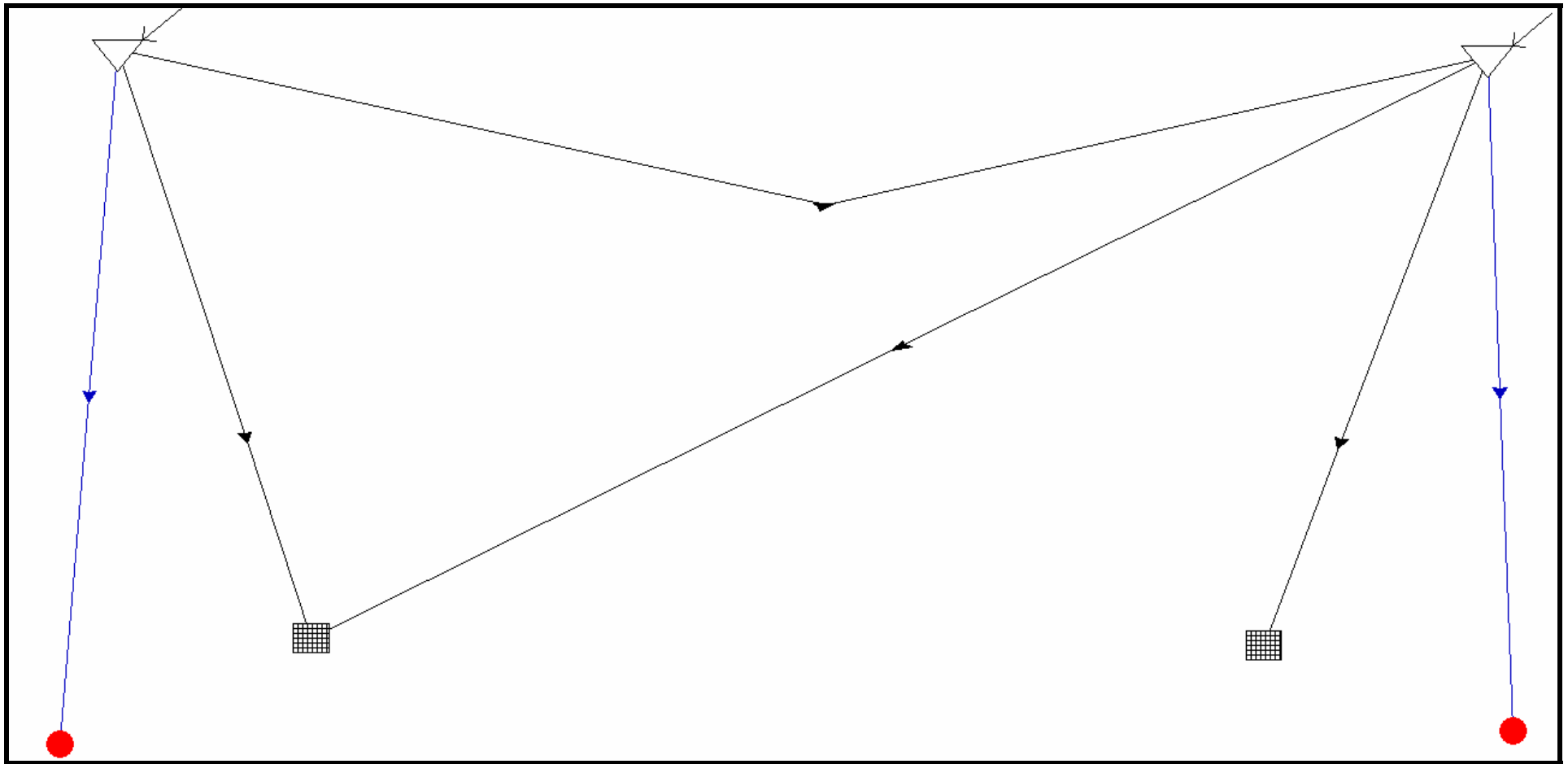


Figure 3.3-5 Worked Example 3(d) – System Plot (*EX3D.sys*)



demand data:

| No | Name     | No Bypass | S/F Priority | Monthly Factors |       |       |       |       |       |       |       |       |       |       |       |       |
|----|----------|-----------|--------------|-----------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
|    |          |           |              | Jan             | Feb   | Mar   | Apl   | May   | Jun   | Jul   | Aug   | Sep   | Oct   | Nov   | Dec   |       |
| 3  | DEMAND 1 | 1         | 1 min        | 0.000           | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
|    |          |           | max          | 1.000           | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 4  | DEMAND 2 | 1         | 1 min        | 0.000           | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
|    |          |           | max          | 1.000           | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |

-----  
 | CARRIER INFORMATION |  
 -----

| No | Name      | Type  | From | To | Cost | Offset | Loss | Ann Vol | Shr Gp | Shr% | No |
|----|-----------|-------|------|----|------|--------|------|---------|--------|------|----|
| 1  | CARRIER 1 | Pipe  | 1    | 3  | 0    | 0      | Ofix |         | 0      | 0%   | 1  |
| 2  | CARRIER 2 | Pipe  | 2    | 4  | 0    | 0      | Ofix |         | 0      | 0%   | 2  |
| 3  | CARRIER 3 | Pipe  | 1    | 2  | 0    | 0      | Ofix |         | 0      | 0%   | 3  |
| 4  | River 1   | River | 1    | 5  | 1000 | 0      | Ofix |         | 0      | 0%   | 6  |
| 5  | River 2   | River | 2    | 6  | 1000 | 0      | Ofix |         | 0      | 0%   | 5  |
| 6  | CARRIER 5 | Pipe  | 2    | 3  | 0    | 0      | Ofix |         | 0      | 0%   | 4  |

-----  
 Maximum Flows

| No | Name      | Jan      | Feb      | Mar      | Apl      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec      |
|----|-----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|
| 1  | CARRIER 1 | 2000     | 2000     | 2000     | 2000     | 2000     | 2000     | 2000     | 2000     | 2000     | 2000     | 2000     | 2000     |
| 2  | CARRIER 2 | 24000    | 24000    | 24000    | 24000    | 24000    | 24000    | 24000    | 24000    | 24000    | 24000    | 24000    | 24000    |
| 3  | CARRIER 3 | 24000    | 24000    | 24000    | 24000    | 24000    | 24000    | 24000    | 24000    | 24000    | 24000    | 24000    | 24000    |
| 4  | River 1   | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 |
| 5  | River 2   | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 |
| 6  | CARRIER 5 | 24000    | 24000    | 24000    | 24000    | 24000    | 24000    | 24000    | 24000    | 24000    | 24000    | 24000    | 24000    |

-----  
 | TARGET INFORMATION |  
 -----

Number of target sets: 1

-----  
 Target set 1 ( Jan Feb Mar Apl May Jun Jul Aug Sep Oct Nov Dec)

| Name        | Draw | Pri | Targets |      |       |       |       |       |       |       |       |  |  |
|-------------|------|-----|---------|------|-------|-------|-------|-------|-------|-------|-------|--|--|
| RESERVOIR 1 | 1    | 0   | 1333    | 2667 | 4000  | 5333  | 6667  | 8000  | 9333  | 10667 | 12000 |  |  |
| RESERVOIR 2 | 2    | 0   | 2667    | 5333 | 8000  | 10667 | 13333 | 16000 | 18667 | 21333 | 24000 |  |  |
| totals      |      | 0   | 4000    | 8000 | 12000 | 16000 | 20000 | 24000 | 28000 | 32000 | 36000 |  |  |

-----  
| MULTI SYSTEM INFORMATION |  
-----

-----  
Reservoirs  
-----

|             |   |
|-------------|---|
| RESERVOIR 1 | 1 |
| RESERVOIR 2 | 1 |

**WORKED EXAMPLE 3(d) – LOG FILE**

```

HHHHH      HHHHHHHH      HHHHHH      H      HHHHHHHHHH
H  H      H      H  H  H      H  H  H
HHHHHHHHH  HHHHHH      HHHHHHHH  HHH      HHH  H  H
HHH      H  HHH      HHH  H  HHH      HHH  H  H
HHH      H  HHH      HHH  H  HHH      HHH  H  H
HHH      H  HHHHHHHH  HHH  H  HHHHHHHH  HHH  H  H

```

```

*****
*      SIMULATION LOG FILE      *
*****

```

Log filename : EX3D.log

Scenario file: scn3d.scn

Simulation label:

Tutorial 3 Sub-Problem (d)

Streamflow file(s):

C:\REALM\WorkedExamples\Sf3.dat

Demand file(s):

C:\REALM\WorkedExamples\Dem2.dat

Restrictions are OFF

Instream flow requirements NOT limited to natural

Water quality calculations are OFF

Number of S/F Sequences: 1

```

Convergence tolerance (storage)  1 10th%
Other convergence tolerance      5 %
Arc convergence tolerance (abs)  100
Minimum iteration count          3
Maximum iteration count          51
Do convergence twice             No

```

Date: 16:56:11 12/05/01

Time Step = Monthly

SYSTEM CHANGES:

| No | Seas | Year | System File                      |
|----|------|------|----------------------------------|
| 1  | 1    | 1982 | C:\REALM\WorkedExamples\EX3D.sys |

Total number of seasons:- 36

\*\*\*\*\* RUN TIME MESSAGES:- \*\*\*\*\*

\*\*\*\*INPUT DATA TYPE= 1 \*\*\*\*

1982

C:\REALM\WorkedExamples\EX3D.sys

1983

1984

\*\*\*\*\* END RUN TIME MESSAGES \*\*\*\*\*

SUMMARY INFORMATION

Reservoir data:

|   | Name        | Start<br>Storage | File<br>Inflow | Min<br>Storage | Average<br>Storage | Evapn | Release<br>to river | Spill | End<br>Storage |
|---|-------------|------------------|----------------|----------------|--------------------|-------|---------------------|-------|----------------|
| 1 | RESERVOIR 1 | 9000.            | 2083.          | 1815.          | 7665.              | 0.    | 603.                | 0.    | 11091.         |
| 2 | RESERVOIR 2 | 8000.            | 2576.          | 3629.          | 15371.             | 0.    | 527.                | 0.    | 22181.         |
|   |             | 17000.           | 4659.          | 0.             | 23037.             | 0.    | 1129.               | 0.    | 33272.         |



## Demand data:

|   | Name     | Unrestrict | Restrict | Rationed | Shortfall | Supplied |
|---|----------|------------|----------|----------|-----------|----------|
| 1 | DEMAND 1 | 1372.      | 1372.    | 1372.    | 0.        | 1372.    |
| 2 | DEMAND 2 | 1706.      | 1706.    | 1706.    | 0.        | 1706.    |
|   |          | 3078.      | 3078.    | 3078.    | 0.        | 3078.    |

|   | Name     | No Rest | Ave Rest lvl | Max Rest lvl | No Ration | Ave % Ration | Max % Ration | No Short | Ave % Short | Max % Short |
|---|----------|---------|--------------|--------------|-----------|--------------|--------------|----------|-------------|-------------|
| 1 | DEMAND 1 | 0.0     | 0.0          | 0.0          | 0.0       | 0.0          | 0.0          | 0.0      | 0.0         | 0.0         |
| 2 | DEMAND 2 | 0.0     | 0.0          | 0.0          | 0.0       | 0.0          | 0.0          | 0.0      | 0.0         | 0.0         |

## Pipe/River flows:

|   | Name      | flow   | Capacity   | Min   | Max    | Loss |
|---|-----------|--------|------------|-------|--------|------|
| 1 | CARRIER 1 | 936.4  | 2000.0     | 0.0   | 2000.0 | 0.0  |
| 2 | CARRIER 2 | 1705.6 | 24000.0    | 300.0 | 3100.0 | 0.0  |
| 3 | CARRIER 3 | 513.3  | 24000.0    | 0.0   | 2964.0 | 0.0  |
| 4 | River 1   | 575.0  | 99999999.0 | 0.0   | 5910.0 | 0.0  |
| 5 | River 2   | 554.4  | 99999999.0 | 0.0   | 6290.0 | 0.0  |
| 6 | CARRIER 5 | 435.8  | 24000.0    | 0.0   | 1995.0 | 0.0  |

0.

End run

**WORKED EXAMPLE 3(d) – RESERVOIR VOLUME**

RESERVOIR STORAGE

EX3D.log

Tutorial 3 Sub-Problem (d)

Time :16:56:11 Date :12/05/01

```
(F4.0,2F6.0, 2f12.2 )
5
SEASON
YEAR
REPLICATE
RESERVOIR 1      ESTO
RESERVOIR 2      ESTO
 1. 1982. 1.      4452.00      8904.00
 2. 1982. 1.      4068.00      8136.00
 3. 1982. 1.      3450.00      6899.00
 4. 1982. 1.      3180.00      6359.00
 5. 1982. 1.      5009.00     10018.00
 6. 1982. 1.      5626.00     11250.00
 7. 1982. 1.      5510.00     11020.00
 8. 1982. 1.      5365.00     10728.00
 9. 1982. 1.      5241.00     10482.00
10. 1982. 1.      5063.00     10126.00
11. 1982. 1.      4436.00      8871.00
12. 1982. 1.      4166.00      8330.00
 1. 1983. 1.      3103.00      6205.00
 2. 1983. 1.      1890.00      3778.00
 3. 1983. 1.      1815.00      3629.00
 4. 1983. 1.      3038.00      6074.00
 5. 1983. 1.      5144.00     10288.00
 6. 1983. 1.      5258.00     10514.00
 7. 1983. 1.      6295.00     12587.00
 8. 1983. 1.      9024.00     18048.00
 9. 1983. 1.     12000.00     24000.00
10. 1983. 1.     12000.00     24000.00
11. 1983. 1.     12000.00     24000.00
12. 1983. 1.     12000.00     24000.00
 1. 1984. 1.     12000.00     24000.00
 2. 1984. 1.     10909.00     21817.00
 3. 1984. 1.     10335.00     20667.00
 4. 1984. 1.     10196.00     20389.00
 5. 1984. 1.     10721.00     22929.00
 6. 1984. 1.     11975.00     23948.00
 7. 1984. 1.     11751.00     23500.00
 8. 1984. 1.     12000.00     24000.00
 9. 1984. 1.     12000.00     24000.00
10. 1984. 1.     12000.00     24000.00
11. 1984. 1.     11844.00     23685.00
12. 1984. 1.     11091.00     22181.00
```

**WORKED EXAMPLE 3(d) – TARGET STORAGE**

RESERVOIR TARGETS

EX3D.log

Tutorial 3 Sub-Problem (d)

Time :16:56:11 Date :12/05/01

```
(F4.0,2F6.0, 2f12.2 )
5
SEASON
YEAR
REPLICATE
RESERVOIR 1      TARG
RESERVOIR 2      TARG
 1. 1982. 1.      4452.00      8904.00
 2. 1982. 1.      4068.00      8136.00
 3. 1982. 1.      3450.00      6899.00
 4. 1982. 1.      3180.00      6359.00
 5. 1982. 1.      5009.00     10018.00
 6. 1982. 1.      5626.00     11250.00
 7. 1982. 1.      5510.00     11020.00
 8. 1982. 1.      5365.00     10728.00
 9. 1982. 1.      5241.00     10482.00
10. 1982. 1.      5063.00     10126.00
11. 1982. 1.      4436.00      8871.00
12. 1982. 1.      4166.00      8330.00
 1. 1983. 1.      3103.00      6205.00
 2. 1983. 1.      1890.00      3778.00
 3. 1983. 1.      1815.00      3629.00
 4. 1983. 1.      3038.00      6074.00
 5. 1983. 1.      5144.00     10288.00
 6. 1983. 1.      5258.00     10514.00
 7. 1983. 1.      6295.00     12587.00
 8. 1983. 1.      9024.00     18048.00
 9. 1983. 1.     12000.00     24000.00
10. 1983. 1.     12000.00     24000.00
11. 1983. 1.     12000.00     24000.00
12. 1983. 1.     12000.00     24000.00
 1. 1984. 1.     12000.00     24000.00
 2. 1984. 1.     10909.00     21817.00
 3. 1984. 1.     10335.00     20667.00
 4. 1984. 1.     10196.00     20389.00
 5. 1984. 1.     11217.00     22433.00
 6. 1984. 1.     11975.00     23948.00
 7. 1984. 1.     11751.00     23500.00
 8. 1984. 1.     12000.00     24000.00
 9. 1984. 1.     12000.00     24000.00
10. 1984. 1.     12000.00     24000.00
11. 1984. 1.     11844.00     23685.00
12. 1984. 1.     11091.00     22181.00
```

**WORKED EXAMPLE 3(d) – CARRIER FLOW**

CARRIER FLOWS

EX3D.log

Tutorial 3 Sub-Problem (d)

Time :16:56:11 Date :12/05/01

(F4.0,2F6.0, 4f12.2 )

7

SEASON

YEAR

REPLICATE

CARRIER 1 FLOW

CARRIER 2 FLOW

CARRIER 3 FLOW

CARRIER 5 FLOW

|     |       |    |         |         |         |         |
|-----|-------|----|---------|---------|---------|---------|
| 1.  | 1982. | 1. | 2000.00 | 2700.00 | 2964.00 | 700.00  |
| 2.  | 1982. | 1. | 672.00  | 1300.00 | 0.00    | 628.00  |
| 3.  | 1982. | 1. | 1643.00 | 2100.00 | 0.00    | 457.00  |
| 4.  | 1982. | 1. | 720.00  | 1500.00 | 0.00    | 780.00  |
| 5.  | 1982. | 1. | 1600.00 | 1600.00 | 1559.00 | 0.00    |
| 6.  | 1982. | 1. | 700.00  | 1700.00 | 932.00  | 0.00    |
| 7.  | 1982. | 1. | 1200.00 | 1200.00 | 150.00  | 0.00    |
| 8.  | 1982. | 1. | 1800.00 | 1800.00 | 618.00  | 0.00    |
| 9.  | 1982. | 1. | 2000.00 | 1200.00 | 284.00  | 200.00  |
| 10. | 1982. | 1. | 1300.00 | 1300.00 | 94.00   | 0.00    |
| 11. | 1982. | 1. | 1400.00 | 2400.00 | 565.00  | 0.00    |
| 12. | 1982. | 1. | 1400.00 | 1400.00 | 139.00  | 0.00    |
| 1.  | 1983. | 1. | 1235.00 | 1900.00 | 0.00    | 665.00  |
| 2.  | 1983. | 1. | 1100.00 | 3100.00 | 273.00  | 0.00    |
| 3.  | 1983. | 1. | 641.00  | 1300.00 | 0.00    | 659.00  |
| 4.  | 1983. | 1. | 800.00  | 1800.00 | 1825.00 | 0.00    |
| 5.  | 1983. | 1. | 0.00    | 2000.00 | 1114.00 | 0.00    |
| 6.  | 1983. | 1. | 600.00  | 1600.00 | 786.00  | 0.00    |
| 7.  | 1983. | 1. | 900.00  | 1900.00 | 2703.00 | 0.00    |
| 8.  | 1983. | 1. | 300.00  | 1300.00 | 871.00  | 0.00    |
| 9.  | 1983. | 1. | 0.00    | 1600.00 | 0.00    | 600.00  |
| 10. | 1983. | 1. | 0.00    | 1400.00 | 0.00    | 1400.00 |
| 11. | 1983. | 1. | 2000.00 | 2100.00 | 0.00    | 100.00  |
| 12. | 1983. | 1. | 2000.00 | 2100.00 | 0.00    | 100.00  |
| 1.  | 1984. | 1. | 0.00    | 1100.00 | 0.00    | 1100.00 |
| 2.  | 1984. | 1. | 1337.00 | 2300.00 | 0.00    | 963.00  |
| 3.  | 1984. | 1. | 2000.00 | 2800.00 | 1100.00 | 800.00  |
| 4.  | 1984. | 1. | 1652.00 | 1900.00 | 0.00    | 248.00  |
| 5.  | 1984. | 1. | 0.00    | 300.00  | 0.00    | 300.00  |
| 6.  | 1984. | 1. | 600.00  | 600.00  | 979.00  | 0.00    |
| 7.  | 1984. | 1. | 600.00  | 1600.00 | 532.00  | 0.00    |
| 8.  | 1984. | 1. | 0.00    | 1100.00 | 0.00    | 100.00  |
| 9.  | 1984. | 1. | 0.00    | 1600.00 | 0.00    | 1600.00 |
| 10. | 1984. | 1. | 0.00    | 1300.00 | 0.00    | 1300.00 |
| 11. | 1984. | 1. | 405.00  | 2400.00 | 0.00    | 1995.00 |
| 12. | 1984. | 1. | 1106.00 | 2100.00 | 0.00    | 994.00  |

**WORKED EXAMPLE 3(d) – COMPARISON OF RESERVOIR STORAGE AND TARGET STORAGE VOLUMES**

####4

EX3D.log

Tutorial 3 Sub-Problem (d)

Time :16:56:11 Date :12/05/01

( 6f12.2 )

6

SEASON

YEAR

RESERVOIR 1

RESERVOIR 1

RESERVOIR 2

RESERVOIR 2

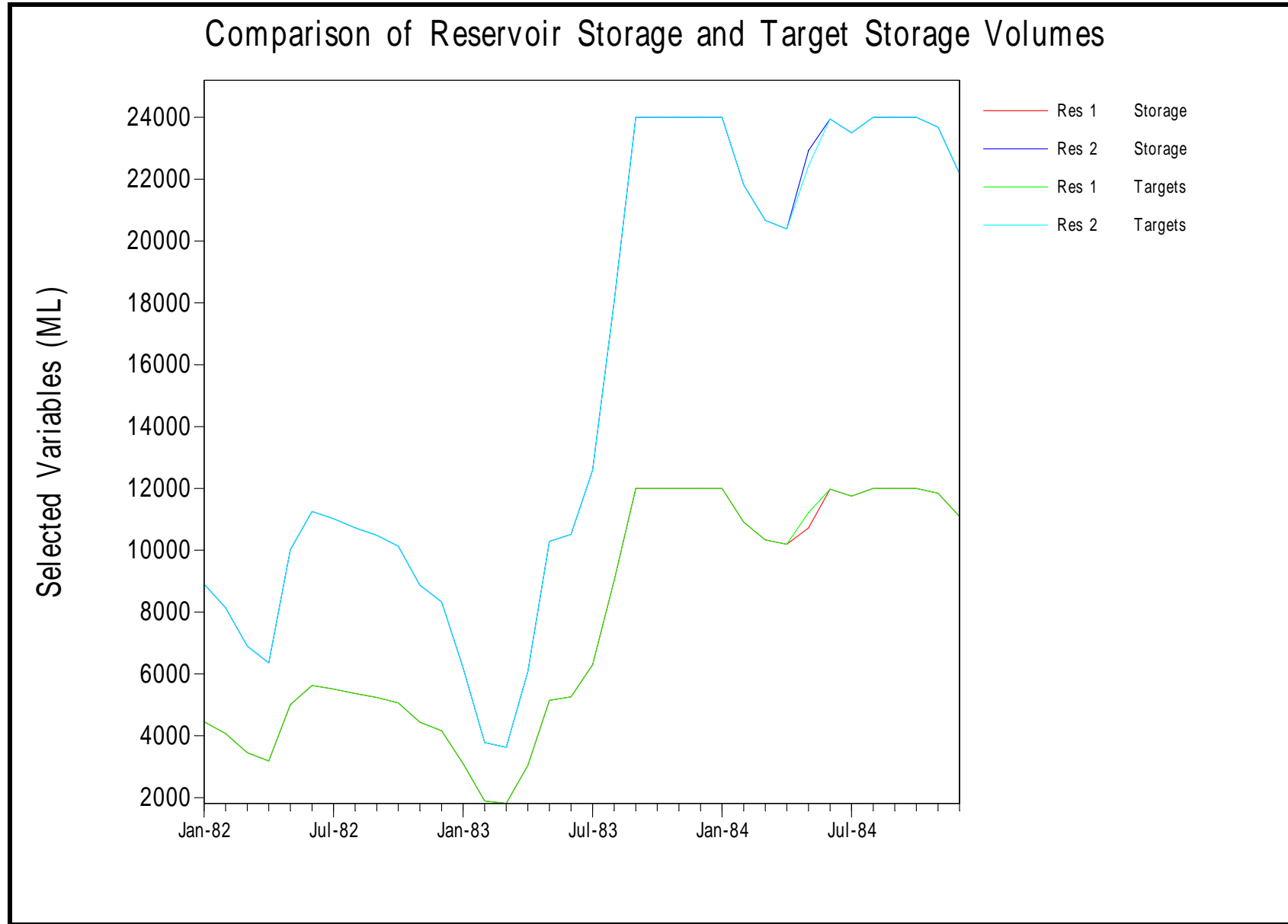
ESTO

TARG

ESTO

TARG

|       |         |          |          |          |          |
|-------|---------|----------|----------|----------|----------|
| 1.00  | 1982.00 | 4452.00  | 4452.00  | 8904.00  | 8904.00  |
| 2.00  | 1982.00 | 4068.00  | 4068.00  | 8136.00  | 8136.00  |
| 3.00  | 1982.00 | 3450.00  | 3450.00  | 6899.00  | 6899.00  |
| 4.00  | 1982.00 | 3180.00  | 3180.00  | 6359.00  | 6359.00  |
| 5.00  | 1982.00 | 5009.00  | 5009.00  | 10018.00 | 10018.00 |
| 6.00  | 1982.00 | 5626.00  | 5626.00  | 11250.00 | 11250.00 |
| 7.00  | 1982.00 | 5510.00  | 5510.00  | 11020.00 | 11020.00 |
| 8.00  | 1982.00 | 5365.00  | 5365.00  | 10728.00 | 10728.00 |
| 9.00  | 1982.00 | 5241.00  | 5241.00  | 10482.00 | 10482.00 |
| 10.00 | 1982.00 | 5063.00  | 5063.00  | 10126.00 | 10126.00 |
| 11.00 | 1982.00 | 4436.00  | 4436.00  | 8871.00  | 8871.00  |
| 12.00 | 1982.00 | 4166.00  | 4166.00  | 8330.00  | 8330.00  |
| 1.00  | 1983.00 | 3103.00  | 3103.00  | 6205.00  | 6205.00  |
| 2.00  | 1983.00 | 1890.00  | 1890.00  | 3778.00  | 3778.00  |
| 3.00  | 1983.00 | 1815.00  | 1815.00  | 3629.00  | 3629.00  |
| 4.00  | 1983.00 | 3038.00  | 3038.00  | 6074.00  | 6074.00  |
| 5.00  | 1983.00 | 5144.00  | 5144.00  | 10288.00 | 10288.00 |
| 6.00  | 1983.00 | 5258.00  | 5258.00  | 10514.00 | 10514.00 |
| 7.00  | 1983.00 | 6295.00  | 6295.00  | 12587.00 | 12587.00 |
| 8.00  | 1983.00 | 9024.00  | 9024.00  | 18048.00 | 18048.00 |
| 9.00  | 1983.00 | 12000.00 | 12000.00 | 24000.00 | 24000.00 |
| 10.00 | 1983.00 | 12000.00 | 12000.00 | 24000.00 | 24000.00 |
| 11.00 | 1983.00 | 12000.00 | 12000.00 | 24000.00 | 24000.00 |
| 12.00 | 1983.00 | 12000.00 | 12000.00 | 24000.00 | 24000.00 |
| 1.00  | 1984.00 | 12000.00 | 12000.00 | 24000.00 | 24000.00 |
| 2.00  | 1984.00 | 10909.00 | 10909.00 | 21817.00 | 21817.00 |
| 3.00  | 1984.00 | 10335.00 | 10335.00 | 20667.00 | 20667.00 |
| 4.00  | 1984.00 | 10196.00 | 10196.00 | 20389.00 | 20389.00 |
| 5.00  | 1984.00 | 10721.00 | 11217.00 | 22929.00 | 22433.00 |
| 6.00  | 1984.00 | 11975.00 | 11975.00 | 23948.00 | 23948.00 |
| 7.00  | 1984.00 | 11751.00 | 11751.00 | 23500.00 | 23500.00 |
| 8.00  | 1984.00 | 12000.00 | 12000.00 | 24000.00 | 24000.00 |
| 9.00  | 1984.00 | 12000.00 | 12000.00 | 24000.00 | 24000.00 |
| 10.00 | 1984.00 | 12000.00 | 12000.00 | 24000.00 | 24000.00 |
| 11.00 | 1984.00 | 11844.00 | 11844.00 | 23685.00 | 23685.00 |
| 12.00 | 1984.00 | 11091.00 | 11091.00 | 22181.00 | 22181.00 |



**Figure 3.3-6 Worked Example 3(d) – Comparison of Reservoir Storage and Target Storage Volume**

### **3.4 WORKED EXAMPLE 4**

## **ILLUSTRATION OF ABOVE AND BELOW TARGET ZONES AND DRAWDOWN PRIORITY**

**WORKED EXAMPLE 4(a) - STREAMFLOW FILE (SF3.DAT)**

```
####2
STREAMFLOW DATA FILE
HISTORICAL MONTHLY STREAMFLOW DATAFILE
TEST DATA
DATE : 20 JUL 1990
( 4F12.2)
```

4

```
SEASON
YEAR
STREAM1
STREAM2
```

|       |         |         |          |
|-------|---------|---------|----------|
| 1.00  | 1982.00 | 416.00  | 1340.00  |
| 2.00  | 1982.00 | 288.00  | 1160.00  |
| 3.00  | 1982.00 | 1025.00 | 1320.00  |
| 4.00  | 1982.00 | 450.00  | 1740.00  |
| 5.00  | 1982.00 | 4988.00 | 3700.00  |
| 6.00  | 1982.00 | 2249.00 | 2000.00  |
| 7.00  | 1982.00 | 1234.00 | 820.00   |
| 8.00  | 1982.00 | 2273.00 | 890.00   |
| 9.00  | 1982.00 | 2160.00 | 870.00   |
| 10.00 | 1982.00 | 1216.00 | 850.00   |
| 11.00 | 1982.00 | 1338.00 | 580.00   |
| 12.00 | 1982.00 | 1269.00 | 720.00   |
| 1.00  | 1983.00 | 172.00  | 440.00   |
| 2.00  | 1983.00 | 160.00  | 400.00   |
| 3.00  | 1983.00 | 566.00  | 1810.00  |
| 4.00  | 1983.00 | 3848.00 | 2420.00  |
| 5.00  | 1983.00 | 3220.00 | 5100.00  |
| 6.00  | 1983.00 | 1500.00 | 1040.00  |
| 7.00  | 1983.00 | 4640.00 | 1270.00  |
| 8.00  | 1983.00 | 3900.00 | 5890.00  |
| 9.00  | 1983.00 | 4600.00 | 11730.00 |
| 10.00 | 1983.00 | 2360.00 | 9090.00  |
| 11.00 | 1983.00 | 2023.00 | 3770.00  |
| 12.00 | 1983.00 | 2967.00 | 3250.00  |
| 1.00  | 1984.00 | 4426.00 | 5150.00  |
| 2.00  | 1984.00 | 246.00  | 1080.00  |
| 3.00  | 1984.00 | 2526.00 | 1350.00  |
| 4.00  | 1984.00 | 1513.00 | 1870.00  |
| 5.00  | 1984.00 | 525.00  | 3140.00  |
| 6.00  | 1984.00 | 2833.00 | 640.00   |
| 7.00  | 1984.00 | 908.00  | 620.00   |
| 8.00  | 1984.00 | 2029.00 | 4020.00  |
| 9.00  | 1984.00 | 4600.00 | 3820.00  |
| 10.00 | 1984.00 | 5910.00 | 3190.00  |
| 11.00 | 1984.00 | 249.00  | 4080.00  |
| 12.00 | 1984.00 | 353.00  | 1590.00  |

**WORKED EXAMPLE 4(a) - DEMAND FILE (DEM2.DAT)**

```
####3
DEMANDS DATAFILE
HISTORICAL DATA
DATA ASSEMBLED AND REFORMATED ON
DATE : 9 JUL 1990
( 4F12.2)
```

4

```
SEASON
YEAR
DEMAND 1
DEMAND 2
```

|       |         |         |         |
|-------|---------|---------|---------|
| 1.00  | 1982.00 | 2700.00 | 2700.00 |
| 2.00  | 1982.00 | 1300.00 | 1300.00 |
| 3.00  | 1982.00 | 2100.00 | 2100.00 |
| 4.00  | 1982.00 | 1500.00 | 1500.00 |
| 5.00  | 1982.00 | 1600.00 | 1600.00 |
| 6.00  | 1982.00 | 700.00  | 1700.00 |
| 7.00  | 1982.00 | 1200.00 | 1200.00 |
| 8.00  | 1982.00 | 1800.00 | 1800.00 |
| 9.00  | 1982.00 | 2200.00 | 1200.00 |
| 10.00 | 1982.00 | 1300.00 | 1300.00 |
| 11.00 | 1982.00 | 1400.00 | 2400.00 |
| 12.00 | 1982.00 | 1400.00 | 1400.00 |
| 1.00  | 1983.00 | 1900.00 | 1900.00 |
| 2.00  | 1983.00 | 1100.00 | 3100.00 |
| 3.00  | 1983.00 | 1300.00 | 1300.00 |
| 4.00  | 1983.00 | 800.00  | 1800.00 |
| 5.00  | 1983.00 | 0.00    | 2000.00 |
| 6.00  | 1983.00 | 600.00  | 1600.00 |
| 7.00  | 1983.00 | 900.00  | 1900.00 |
| 8.00  | 1983.00 | 300.00  | 1300.00 |
| 9.00  | 1983.00 | 600.00  | 1600.00 |
| 10.00 | 1983.00 | 1400.00 | 1400.00 |
| 11.00 | 1983.00 | 2100.00 | 2100.00 |
| 12.00 | 1983.00 | 2100.00 | 2100.00 |
| 1.00  | 1984.00 | 1100.00 | 1100.00 |
| 2.00  | 1984.00 | 2300.00 | 2300.00 |
| 3.00  | 1984.00 | 2800.00 | 2800.00 |
| 4.00  | 1984.00 | 1900.00 | 1900.00 |
| 5.00  | 1984.00 | 300.00  | 300.00  |
| 6.00  | 1984.00 | 600.00  | 600.00  |
| 7.00  | 1984.00 | 600.00  | 1600.00 |
| 8.00  | 1984.00 | 100.00  | 1100.00 |
| 9.00  | 1984.00 | 1600.00 | 1600.00 |
| 10.00 | 1984.00 | 1300.00 | 1300.00 |
| 11.00 | 1984.00 | 2400.00 | 2400.00 |
| 12.00 | 1984.00 | 2100.00 | 2100.00 |

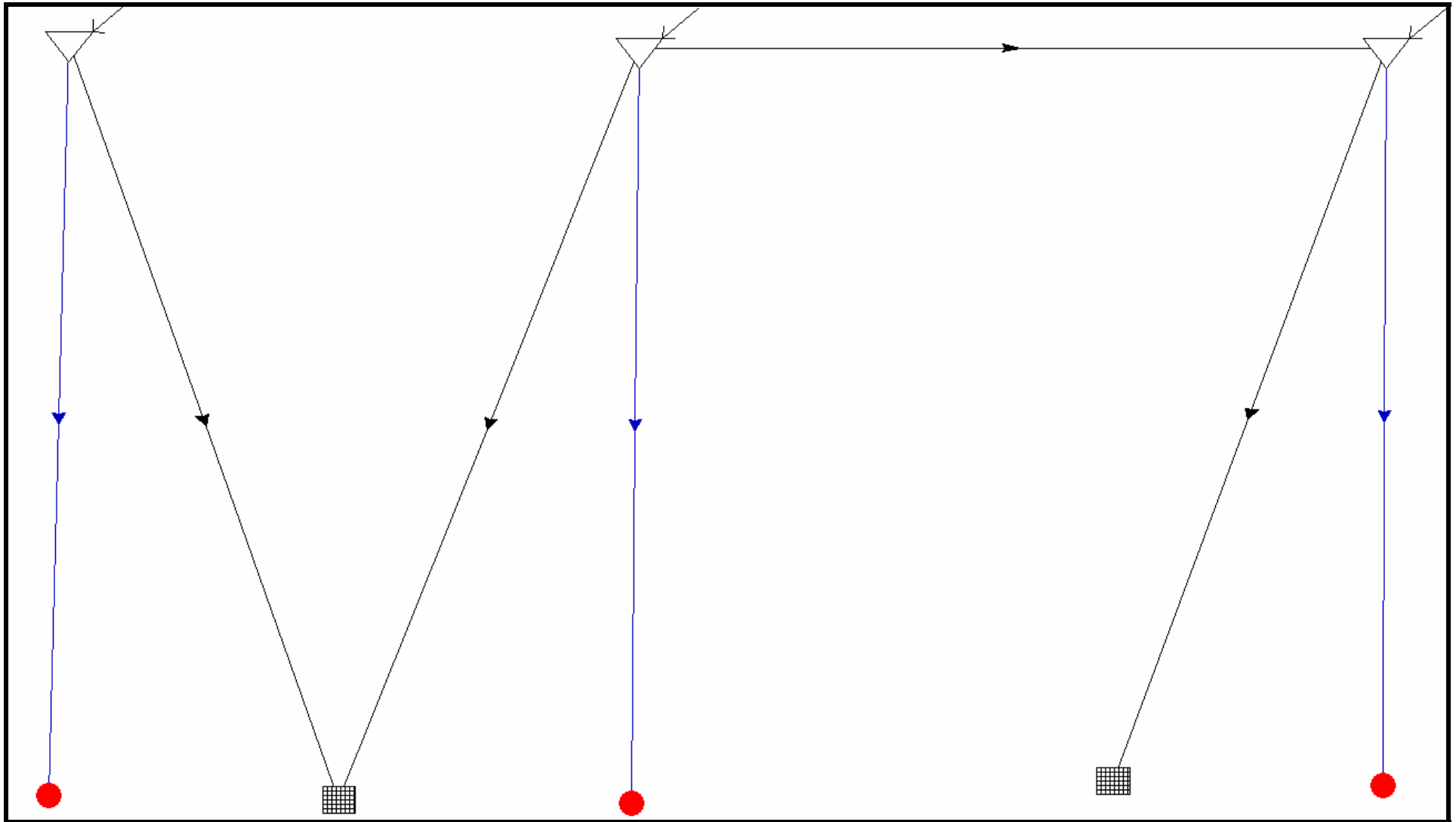


Figure 3.4-1 Worked Example 4(a) – System Plot (*EX4A.sys*)

**WORKED EXAMPLE 4(a) – SYSTEM LISTING**


---

R E A L M

---

```

*****
*   SYSTEM FILE LISTING   *
*****

```

File: C:\REALM\WorkedExamples\EX4A.sys

Simulation label:  
 Tutorial 4 - Sub-Problem (a)

Date: 14:37:52 01/11/02

```

-----
|  NODE INFORMATION  |
-----

```

```

-----
No      Name          Type          X      Y      Z      Size  Aux Input  No
-----
1 RESERVOIR A      Reservoir     5.00   95.00   0.00   1.00  STREAM1    1
2 RESERVOIR B      Reservoir    43.95   94.24   0.00   1.00  STREAM2    2
3 RESERVOIR C      Reservoir    95.00   94.24   0.00   1.00  STREAM1    3
4 DEMAND 1         Demand       23.42    5.00   0.00   1.00                    4
5 DEMAND 2         Demand       76.32    7.27   0.00   1.00                    5
6 STRM TERM 1      Strm terminator  3.60    5.56   0.00   1.00                    6
7 STRM TERM 2      Strm terminator 43.40    4.68   0.00   1.00                    7
8 STRM TERM 3      Strm terminator 94.71    6.70   0.00   1.00                    8
-----

```



Reservoir data:

| No | Name        | Min Cap | Max Cap | No Above | No Below | Spill Type |
|----|-------------|---------|---------|----------|----------|------------|
| 1  | RESERVOIR A | 0       | 12000   | 1        | 1        | Downstream |
| 2  | RESERVOIR B | 0       | 20000   | 1        | 1        | Downstream |
| 3  | RESERVOIR C | 0       | 10000   | 1        | 1        | Downstream |

| No | Name        |     | Levels/volume relationships |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
|----|-------------|-----|-----------------------------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|
|    |             |     | pt1                         | pt2  | pt3  | pt4  | pt5  | pt6  | pt7  | pt8  | pt9  | pt10 | pt11 | pt12 | pt13 | pt14 | pt15 |
| 1  | RESERVOIR A | Vol | 0                           | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    |
|    |             | Lvl | 0.00                        | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 2  | RESERVOIR B | Vol | 0                           | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    |
|    |             | Lvl | 0.00                        | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 3  | RESERVOIR C | Vol | 0                           | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    |
|    |             | Lvl | 0.00                        | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

demand data:

| No | Name     | No Bypass | S/F Priority | Monthly Factors |       |       |       |       |       |       |       |       |       |       |       |       |
|----|----------|-----------|--------------|-----------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
|    |          |           |              | Jan             | Feb   | Mar   | Apr   | May   | Jun   | Jul   | Aug   | Sep   | Oct   | Nov   | Dec   |       |
| 4  | DEMAND 1 | 1         | 1 min        | 0.000           | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
|    |          |           |              | max             | 1.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 5  | DEMAND 2 | 1         | 1 min        | 0.000           | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |       |
|    |          |           |              | max             | 1.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |

CARRIER INFORMATION

| No | Name              | Type  | From | To | Cost | Offset | Loss | Ann Vol | Shr Gp | Shr% | No |
|----|-------------------|-------|------|----|------|--------|------|---------|--------|------|----|
| 1  | RES C TO DEMAND 2 | Pipe  | 3    | 5  | 0    | 0      | Ofix |         | 0      | 0%   | 1  |
| 2  | RES B TO DEMAND 1 | Pipe  | 2    | 4  | 0    | 0      | Ofix |         | 0      | 0%   | 2  |
| 3  | RES A TO DEMAND 1 | Pipe  | 1    | 4  | 0    | 0      | Ofix |         | 0      | 0%   | 3  |
| 4  | RES B TO RES C    | Pipe  | 2    | 3  | 0    | 0      | Ofix |         | 0      | 0%   | 4  |
| 5  | River 1           | River | 1    | 6  | 1000 | 0      | Ofix |         | 0      | 0%   | 5  |
| 6  | River 2           | River | 2    | 7  | 1000 | 0      | Ofix |         | 0      | 0%   | 6  |
| 7  | River 3           | River | 3    | 8  | 1000 | 0      | Ofix |         | 0      | 0%   | 7  |

| Maximum Flows |                   | Jan      | Feb      | Mar      | Apl      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec      |
|---------------|-------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|
| No            | Name              |          |          |          |          |          |          |          |          |          |          |          |          |
| 1             | RES C TO DEMAND 2 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 |
| 2             | RES B TO DEMAND 1 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 |
| 3             | RES A TO DEMAND 1 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 |
| 4             | RES B TO RES C    | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 |
| 5             | River 1           | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 |
| 6             | River 2           | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 |
| 7             | River 3           | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 |

| TARGET INFORMATION |

Number of target sets: 1

| Target set 1 ( Jan Feb Mar Apl May Jun Jul Aug Sep Oct Nov Dec ) |      |     |         |      |       |       |       |       |       |       |       |  |
|--|------|-----|---------|------|-------|-------|-------|-------|-------|-------|-------|--|
| Name   | Draw | Pri | Targets |      |       |       |       |       |       |       |       |  |
| RESERVOIR A  | 1    | 0   | 1333    | 2667 | 4000  | 5333  | 6667  | 8000  | 9333  | 10667 | 12000 |  |
| RESERVOIR B  | 2    | 0   | 2222    | 4444 | 6667  | 8889  | 11111 | 13333 | 15556 | 17778 | 20000 |  |
| RESERVOIR C  | 3    | 0   | 1112    | 2222 | 3333  | 4445  | 5555  | 6667  | 7778  | 8888  | 10000 |  |
| totals   |      | 0   | 4667    | 9333 | 14000 | 18667 | 23333 | 28000 | 32667 | 37333 | 42000 |  |

| MULTI SYSTEM INFORMATION |

Reservoirs

|             |   |
|-------------|---|
| RESERVOIR A | 1 |
| RESERVOIR B | 1 |
| RESERVOIR C | 1 |

**WORKED EXAMPLE 4(a) – LOG FILE**

```

HHHHH      HHHHHHHH      HHHHHH      H      HHHHHHHHHH
H  H      H      H  H  H      H  H  H
HHHHHHHHH  HHHHHH      HHHHHHHH  HHH      HHH  H  H
HHH      H  HHH      HHH      H  HHH      HHH  H  H
HHH      H  HHH      HHH      H  HHH      HHH  H  H
HHH      H  HHHHHHHH  HHH      H  HHHHHHHH  HHH  H  H

```

```

*****
*      SIMULATION LOG FILE      *
*****

```

Log filename : EX4A.log

Scenario file: scn4a.scn

Simulation label:

Tutorial 4 Sub-Problem (a)

Streamflow file(s):

C:\REALM\WorkedExamples\Sf3.dat

Demand file(s):

C:\REALM\ WorkedExamples\Dem2.dat

Restrictions are OFF

Instream flow requirements NOT limited to natural

Water quality calculations are OFF

Number of S/F Sequences: 1

```

Convergence tolerance (storage)  1 10th%
Other convergence tolerance      5 %
Arc convergence tolerance (abs)  100
Minimum iteration count          3
Maximum iteration count          51
Do convergence twice             No

```

Date: 14:58:37 01/11/02

Time Step = Monthly

SYSTEM CHANGES:

| No | Seas | Year | System File                      |
|----|------|------|----------------------------------|
| 1  | 1    | 1982 | C:\REALM\WorkedExamples\EX4A.sys |

Total number of seasons:- 36

\*\*\*\*\* RUN TIME MESSAGES:- \*\*\*\*\*

\*\*\*\*INPUT DATA TYPE= 1 \*\*\*\*

1982

C:\REALM\WorkedExamples\EX4A.sys

1983

1984

\*\*\*\*\* END RUN TIME MESSAGES \*\*\*\*\*

SUMMARY INFORMATION

Reservoir data:

|   | Name        | Start<br>Storage | File<br>Inflow | Min<br>Storage | Average<br>Storage | Evapn | Release<br>to river | Spill | End<br>Storage |
|---|-------------|------------------|----------------|----------------|--------------------|-------|---------------------|-------|----------------|
| 1 | RESERVOIR A | 8000.            | 2083.          | 5921.          | 10878.             | 0.    | 929.                | 0.    | 11394.         |
| 2 | RESERVOIR B | 10000.           | 2576.          | 9865.          | 17864.             | 0.    | 1630.               | 0.    | 18987.         |
| 3 | RESERVOIR C | 8000.            | 2083.          | 4932.          | 9112.              | 0.    | 721.                | 0.    | 9493.          |
|   |             | 26000.           | 6742.          | 0.             | 37854.             | 0.    | 3279.               | 0.    | 39874.         |

## Demand data:

|   | Name     | Unrestrict | Restrict | Rationed | Shortfall | Supplied |
|---|----------|------------|----------|----------|-----------|----------|
| 1 | DEMAND 1 | 1372.      | 1372.    | 1372.    | 0.        | 1372.    |
| 2 | DEMAND 2 | 1706.      | 1706.    | 1706.    | 0.        | 1706.    |
|   |          | -----      |          |          |           |          |
|   |          | 3078.      | 3078.    | 3078.    | 0.        | 3078.    |
|   |          | -----      |          |          |           |          |

|   | Name     | No<br>Rest | Ave<br>Rest lvl | Max<br>Rest lvl | No<br>Ration | Ave %<br>Ration | Max %<br>Ration | No<br>Short | Ave %<br>Short | Max %<br>Short |
|---|----------|------------|-----------------|-----------------|--------------|-----------------|-----------------|-------------|----------------|----------------|
| 1 | DEMAND 1 | 0.0        | 0.0             | 0.0             | 0.0          | 0.0             | 0.0             | 0.0         | 0.0            | 0.0            |
| 2 | DEMAND 2 | 0.0        | 0.0             | 0.0             | 0.0          | 0.0             | 0.0             | 0.0         | 0.0            | 0.0            |
|   |          | -----      |                 |                 |              |                 |                 |             |                |                |

## Pipe/River flows:

|   | Name              | flow   | Capacity   | Min   | Max     | Loss |
|---|-------------------|--------|------------|-------|---------|------|
| 1 | RES C TO DEMAND 2 | 1705.6 | 99999999.0 | 300.0 | 3100.0  | 0.0  |
| 2 | RES B TO DEMAND 1 | 312.4  | 99999999.0 | 0.0   | 2088.0  | 0.0  |
| 3 | RES A TO DEMAND 1 | 1059.9 | 99999999.0 | 0.0   | 2297.0  | 0.0  |
| 4 | RES B TO RES C    | 384.9  | 99999999.0 | 0.0   | 2112.0  | 0.0  |
| 5 | River 1           | 928.6  | 99999999.0 | 0.0   | 4610.0  | 0.0  |
| 6 | River 2           | 1629.5 | 99999999.0 | 0.0   | 11730.0 | 0.0  |
| 7 | River 3           | 720.6  | 99999999.0 | 0.0   | 4610.0  | 0.0  |
|   |                   | -----  |            |       |         |      |
|   |                   |        |            |       |         | 0.   |
|   |                   | -----  |            |       |         |      |

End run

**WORKED EXAMPLE 4(a) – RESERVOIR VOLUME**

RESERVOIR STORAGE

EX4A.log

Time :14:58:37 Date :01/11/02

Tutorial 4 Sub-Problem (a)

```

(F4.0,2F6.0, 3f12.2      )
6
SEASON
YEAR
REPLICATE
RESERVOIR A      ESTO
RESERVOIR B      ESTO
RESERVOIR C      ESTO
 1. 1982. 1. 6213.00 10843.00 5716.00
 2. 1982. 1. 6260.00 10432.00 5216.00
 3. 1982. 1. 6023.00 10037.00 5018.00
 4. 1982. 1. 5921.00 9865.00 4932.00
 5. 1982. 1. 9309.00 13565.00 8320.00
 6. 1982. 1. 10858.00 15565.00 8869.00
 7. 1982. 1. 10892.00 16385.00 8903.00
 8. 1982. 1. 11365.00 17275.00 9376.00
 9. 1982. 1. 11325.00 18145.00 10000.00
10. 1982. 1. 11241.00 18995.00 9916.00
11. 1982. 1. 11317.00 18861.00 9430.00
12. 1982. 1. 11448.00 19079.00 9539.00
 1. 1983. 1. 10587.00 17643.00 8820.00
 2. 1983. 1. 9647.00 15931.00 7992.00
 3. 1983. 1. 9690.00 16148.00 8074.00
 4. 1983. 1. 12000.00 18568.00 10000.00
 5. 1983. 1. 12000.00 20000.00 10000.00
 6. 1983. 1. 12000.00 20000.00 10000.00
 7. 1983. 1. 12000.00 20000.00 10000.00
 8. 1983. 1. 12000.00 20000.00 10000.00
 9. 1983. 1. 12000.00 20000.00 10000.00
10. 1983. 1. 12000.00 20000.00 10000.00
11. 1983. 1. 12000.00 20000.00 10000.00
12. 1983. 1. 12000.00 20000.00 10000.00
 1. 1984. 1. 12000.00 20000.00 10000.00
 2. 1984. 1. 11136.00 18558.00 9278.00
 3. 1984. 1. 11365.00 18940.00 9469.00
 4. 1984. 1. 11679.00 19461.00 9730.00
 5. 1984. 1. 12000.00 20000.00 10000.00
 6. 1984. 1. 12000.00 20000.00 10000.00
 7. 1984. 1. 12000.00 19928.00 10000.00
 8. 1984. 1. 12000.00 20000.00 10000.00
 9. 1984. 1. 12000.00 20000.00 10000.00
10. 1984. 1. 12000.00 20000.00 10000.00
11. 1984. 1. 11937.00 19894.00 9947.00
12. 1984. 1. 11394.00 18987.00 9493.00

```

**WORKED EXAMPLE 4(a) – TARGET STORAGE**

RESERVOIR TARGETS

EX4A.log

Time :14:58:37 Date :01/11/02

Tutorial 4 Sub-Problem (a)

```

(F4.0,2F6.0, 3f12.2      )
6
SEASON
YEAR
REPLICATE
RESERVOIR A      TARG
RESERVOIR B      TARG
RESERVOIR C      TARG
 1. 1982. 1. 6508.00 10843.00 5421.00
 2. 1982. 1. 6260.00 10432.00 5216.00
 3. 1982. 1. 6023.00 10037.00 5018.00
 4. 1982. 1. 5921.00 9865.00 4932.00
 5. 1982. 1. 8913.00 14854.00 7427.00
 6. 1982. 1. 10084.00 16806.00 8402.00
 7. 1982. 1. 10339.00 17228.00 8613.00
 8. 1982. 1. 10863.00 18103.00 9050.00
 9. 1982. 1. 11278.00 18795.00 9397.00
10. 1982. 1. 11473.00 19120.00 9559.00
11. 1982. 1. 11317.00 18861.00 9430.00
12. 1982. 1. 11448.00 19079.00 9539.00
 1. 1983. 1. 10587.00 17643.00 8820.00
 2. 1983. 1. 9592.00 15986.00 7992.00
 3. 1983. 1. 9690.00 16148.00 8074.00
 4. 1983. 1. 11592.00 19318.00 9658.00
 5. 1983. 1. 12000.00 20000.00 10000.00
 6. 1983. 1. 12000.00 20000.00 10000.00
 7. 1983. 1. 12000.00 20000.00 10000.00
 8. 1983. 1. 12000.00 20000.00 10000.00
 9. 1983. 1. 12000.00 20000.00 10000.00
10. 1983. 1. 12000.00 20000.00 10000.00
11. 1983. 1. 12000.00 20000.00 10000.00
12. 1983. 1. 12000.00 20000.00 10000.00
 1. 1984. 1. 12000.00 20000.00 10000.00
 2. 1984. 1. 11136.00 18558.00 9278.00
 3. 1984. 1. 11365.00 18940.00 9469.00
 4. 1984. 1. 11679.00 19461.00 9730.00
 5. 1984. 1. 12000.00 20000.00 10000.00
 6. 1984. 1. 12000.00 20000.00 10000.00
 7. 1984. 1. 12000.00 20000.00 10000.00
 8. 1984. 1. 12000.00 20000.00 10000.00
 9. 1984. 1. 12000.00 20000.00 10000.00
10. 1984. 1. 12000.00 20000.00 10000.00
11. 1984. 1. 11937.00 19894.00 9947.00
12. 1984. 1. 11394.00 18987.00 9493.00

```

**WORKED EXAMPLE 4(a) – CARRIER FLOW**

CARRIER FLOWS

EX4A.log

Time :14:58:37 Date :01/11/02

Tutorial 4 Sub-Problem (a)

(F4.0,2F6.0, 4f12.2 )

7

SEASON

YEAR

REPLICATE

RES C TO DEMAND FLOW

RES B TO DEMAND FLOW

RES A TO DEMAND FLOW

RES B TO RES C FLOW

|     |       |    |         |         |         |         |
|-----|-------|----|---------|---------|---------|---------|
| 1.  | 1982. | 1. | 2700.00 | 497.00  | 2203.00 | 0.00    |
| 2.  | 1982. | 1. | 1300.00 | 1059.00 | 241.00  | 512.00  |
| 3.  | 1982. | 1. | 2100.00 | 838.00  | 1262.00 | 877.00  |
| 4.  | 1982. | 1. | 1500.00 | 948.00  | 552.00  | 964.00  |
| 5.  | 1982. | 1. | 1600.00 | 0.00    | 1600.00 | 0.00    |
| 6.  | 1982. | 1. | 1700.00 | 0.00    | 700.00  | 0.00    |
| 7.  | 1982. | 1. | 1200.00 | 0.00    | 1200.00 | 0.00    |
| 8.  | 1982. | 1. | 1800.00 | 0.00    | 1800.00 | 0.00    |
| 9.  | 1982. | 1. | 1200.00 | 0.00    | 2200.00 | 0.00    |
| 10. | 1982. | 1. | 1300.00 | 0.00    | 1300.00 | 0.00    |
| 11. | 1982. | 1. | 2400.00 | 138.00  | 1262.00 | 576.00  |
| 12. | 1982. | 1. | 1400.00 | 262.00  | 1138.00 | 240.00  |
| 1.  | 1983. | 1. | 1900.00 | 867.00  | 1033.00 | 1009.00 |
| 2.  | 1983. | 1. | 3100.00 | 0.00    | 1100.00 | 2112.00 |
| 3.  | 1983. | 1. | 1300.00 | 777.00  | 523.00  | 816.00  |
| 4.  | 1983. | 1. | 1800.00 | 0.00    | 800.00  | 0.00    |
| 5.  | 1983. | 1. | 2000.00 | 0.00    | 0.00    | 0.00    |
| 6.  | 1983. | 1. | 1600.00 | 0.00    | 600.00  | 100.00  |
| 7.  | 1983. | 1. | 1900.00 | 0.00    | 900.00  | 0.00    |
| 8.  | 1983. | 1. | 1300.00 | 0.00    | 300.00  | 0.00    |
| 9.  | 1983. | 1. | 1600.00 | 0.00    | 600.00  | 0.00    |
| 10. | 1983. | 1. | 1400.00 | 0.00    | 1400.00 | 0.00    |
| 11. | 1983. | 1. | 2100.00 | 77.00   | 2023.00 | 77.00   |
| 12. | 1983. | 1. | 2100.00 | 0.00    | 2100.00 | 0.00    |
| 1.  | 1984. | 1. | 1100.00 | 0.00    | 1100.00 | 0.00    |
| 2.  | 1984. | 1. | 2300.00 | 1190.00 | 1110.00 | 1332.00 |
| 3.  | 1984. | 1. | 2800.00 | 503.00  | 2297.00 | 465.00  |
| 4.  | 1984. | 1. | 1900.00 | 701.00  | 1199.00 | 648.00  |
| 5.  | 1984. | 1. | 300.00  | 96.00   | 204.00  | 45.00   |
| 6.  | 1984. | 1. | 600.00  | 0.00    | 600.00  | 0.00    |
| 7.  | 1984. | 1. | 1600.00 | 0.00    | 600.00  | 692.00  |
| 8.  | 1984. | 1. | 1100.00 | 0.00    | 100.00  | 0.00    |
| 9.  | 1984. | 1. | 1600.00 | 0.00    | 1600.00 | 0.00    |
| 10. | 1984. | 1. | 1300.00 | 0.00    | 1300.00 | 0.00    |
| 11. | 1984. | 1. | 2400.00 | 2088.00 | 312.00  | 2098.00 |
| 12. | 1984. | 1. | 2100.00 | 1204.00 | 896.00  | 1293.00 |

**WORKED EXAMPLE 4(b) – SYSTEM LISTING**


---

R     E     A     L     M

---

\*\*\*\*\*  
 \*    SYSTEM FILE LISTING    \*  
 \*\*\*\*\*

File: C:\REALM\WorkedExamples\EX4B.sys

Simulation label:  
 Tutorial 4 - Sub-Problem (b)

Date: 15:17:27 01/11/02

-----  
 |    NODE INFORMATION    |  
 -----

| No | Name        | Type            | X     | Y     | Z    | Size | Aux Input | No |
|----|-------------|-----------------|-------|-------|------|------|-----------|----|
| 1  | RESERVOIR A | Reservoir       | 5.00  | 95.00 | 0.00 | 1.00 | STREAM1   | 1  |
| 2  | RESERVOIR B | Reservoir       | 43.95 | 94.24 | 0.00 | 1.00 | STREAM2   | 2  |
| 3  | RESERVOIR C | Reservoir       | 95.00 | 94.24 | 0.00 | 1.00 | STREAM1   | 3  |
| 4  | DEMAND 1    | Demand          | 23.42 | 5.00  | 0.00 | 1.00 |           | 4  |
| 5  | DEMAND 2    | Demand          | 76.32 | 7.27  | 0.00 | 1.00 |           | 5  |
| 6  | STRM TERM 1 | Strm terminator | 3.60  | 5.56  | 0.00 | 1.00 |           | 6  |
| 7  | STRM TERM 2 | Strm terminator | 43.40 | 4.68  | 0.00 | 1.00 |           | 7  |
| 8  | STRM TERM 3 | Strm terminator | 94.71 | 6.70  | 0.00 | 1.00 |           | 8  |



Reservoir data:

| No | Name        | Min Cap | Max Cap | No Above | No Below | Spill Type |
|----|-------------|---------|---------|----------|----------|------------|
| 1  | RESERVOIR A | 0       | 12000   | 1        | 25       | Downstream |
| 2  | RESERVOIR B | 0       | 20000   | 1        | 1        | Downstream |
| 3  | RESERVOIR C | 0       | 10000   | 1        | 1        | Downstream |

| No | Name        | Levels/volume relationships |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
|----|-------------|-----------------------------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|
|    |             | pt1                         | pt2  | pt3  | pt4  | pt5  | pt6  | pt7  | pt8  | pt9  | pt10 | pt11 | pt12 | pt13 | pt14 | pt15 |      |
| 1  | RESERVOIR A | Vol                         | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    |
|    |             | Lvl                         | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 2  | RESERVOIR B | Vol                         | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    |
|    |             | Lvl                         | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 3  | RESERVOIR C | Vol                         | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    |
|    |             | Lvl                         | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

demand data:

| No | Name     | No Bypass | S/F Priority | Monthly Factors |       |       |       |       |       |       |       |       |       |       |       |       |
|----|----------|-----------|--------------|-----------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
|    |          |           |              | Jan             | Feb   | Mar   | Apr   | May   | Jun   | Jul   | Aug   | Sep   | Oct   | Nov   | Dec   |       |
| 4  | DEMAND 1 | 1         | 1 min        | 0.000           | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
|    |          |           |              | max             | 1.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 5  | DEMAND 2 | 1         | 1 min        | 0.000           | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |       |
|    |          |           |              | max             | 1.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |

CARRIER INFORMATION

| No | Name              | Type  | From | To | Cost | Offset | Loss | Ann Vol | Shr Gp | Shr% | No |
|----|-------------------|-------|------|----|------|--------|------|---------|--------|------|----|
| 1  | RES C TO DEMAND 2 | Pipe  | 3    | 5  | 0    | 0      | Ofix |         | 0      | 0%   | 1  |
| 2  | RES B TO DEMAND 1 | Pipe  | 2    | 4  | 0    | 0      | Ofix |         | 0      | 0%   | 2  |
| 3  | RES A TO DEMAND 1 | Pipe  | 1    | 4  | 0    | 0      | Ofix |         | 0      | 0%   | 3  |
| 4  | RES B TO RES C    | Pipe  | 2    | 3  | 0    | 0      | Ofix |         | 0      | 0%   | 4  |
| 5  | River 1           | River | 1    | 6  | 1000 | 0      | Ofix |         | 0      | 0%   | 5  |
| 6  | River 2           | River | 2    | 7  | 1000 | 0      | Ofix |         | 0      | 0%   | 6  |
| 7  | River 3           | River | 3    | 8  | 1000 | 0      | Ofix |         | 0      | 0%   | 7  |

| Maximum Flows |                   | Jan      | Feb      | Mar      | Apl      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec      |
|---------------|-------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|
| No            | Name              |          |          |          |          |          |          |          |          |          |          |          |          |
| 1             | RES C TO DEMAND 2 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 |
| 2             | RES B TO DEMAND 1 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 |
| 3             | RES A TO DEMAND 1 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 |
| 4             | RES B TO RES C    | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 |
| 5             | River 1           | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 |
| 6             | River 2           | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 |
| 7             | River 3           | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 |

| TARGET INFORMATION |

Number of target sets: 1

| Target set 1 ( Jan Feb Mar Apl May Jun Jul Aug Sep Oct Nov Dec ) |      |     |         |      |       |       |       |       |       |       |       |  |
|--|------|-----|---------|------|-------|-------|-------|-------|-------|-------|-------|--|
| Name   | Draw | Pri | Targets |      |       |       |       |       |       |       |       |  |
| RESERVOIR A  | 1    | 0   | 1333    | 2667 | 4000  | 5333  | 6667  | 8000  | 9333  | 10667 | 12000 |  |
| RESERVOIR B  | 2    | 0   | 2222    | 4444 | 6667  | 8889  | 11111 | 13333 | 15556 | 17778 | 20000 |  |
| RESERVOIR C  | 3    | 0   | 1112    | 2222 | 3333  | 4445  | 5555  | 6667  | 7778  | 8888  | 10000 |  |
| totals   |      | 0   | 4667    | 9333 | 14000 | 18667 | 23333 | 28000 | 32667 | 37333 | 42000 |  |

| MULTI SYSTEM INFORMATION |

Reservoirs

|             |   |
|-------------|---|
| RESERVOIR A | 1 |
| RESERVOIR B | 1 |
| RESERVOIR C | 1 |

**WORKED EXAMPLE 4(b) – LOG FILE**

```

HHHHH      HHHHHHHH      HHHHHH      H      HHHHHHHHHH
H  H      H      H  H  H      H  H  H
HHHHHHHHH  HHHHHH      HHHHHHHH  HHH      HHH  H  H
HHH  H  HHH      HHH  H  HHH      HHH  H  H
HHH  H  HHH      HHH  H  HHH      HHH  H  H
HHH  H  HHHHHHHH  HHH  H  HHHHHHHH  HHH  H  H

```

```

*****
*      SIMULATION LOG FILE      *
*****

```

Log filename : EX4B.log

Scenario file: scn4b.scn

Simulation label:

Tutorial 4 Sub-Problem (b)

Streamflow file(s):

C:\REALM\WorkedExamples\Sf3.dat

Demand file(s):

C:\REALM\WorkedExamples\Dem2.dat

Restrictions are OFF

Instream flow requirements NOT limited to natural

Water quality calculations are OFF

Number of S/F Sequences: 1

```

Convergence tolerance (storage)  1 10th%
Other convergence tolerance      5 %
Arc convergence tolerance (abs)  100
Minimum iteration count          3
Maximum iteration count          51
Do convergence twice             No

```

Date: 15:20:10 01/11/02

Time Step = Monthly

SYSTEM CHANGES:

| No | Seas | Year | System File                      |
|----|------|------|----------------------------------|
| 1  | 1    | 1982 | C:\REALM\WorkedExamples\EX4B.sys |

Total number of seasons:- 36

\*\*\*\*\* RUN TIME MESSAGES:- \*\*\*\*\*

\*\*\*\*INPUT DATA TYPE= 1 \*\*\*\*

1982

C:\REALM\WorkedExamples\EX4B.sys

1983

1984

\*\*\*\*\* END RUN TIME MESSAGES \*\*\*\*\*

SUMMARY INFORMATION

Reservoir data:

|   | Name        | Start<br>Storage | File<br>Inflow | Min<br>Storage | Average<br>Storage | Evapn | Release<br>to river | Spill | End<br>Storage |
|---|-------------|------------------|----------------|----------------|--------------------|-------|---------------------|-------|----------------|
| 1 | RESERVOIR A | 8000.            | 2083.          | 5921.          | 10879.             | 0.    | 929.                | 0.    | 11394.         |
| 2 | RESERVOIR B | 10000.           | 2576.          | 9865.          | 17863.             | 0.    | 1630.               | 0.    | 18987.         |
| 3 | RESERVOIR C | 8000.            | 2083.          | 4932.          | 9112.              | 0.    | 721.                | 0.    | 9493.          |
|   |             | 26000.           | 6742.          | 0.             | 37854.             | 0.    | 3279.               | 0.    | 39874.         |

Demand data:

| Name       | Unrestrict | Restrict | Rationed | Shortfall | Supplied |
|------------|------------|----------|----------|-----------|----------|
| 1 DEMAND 1 | 1372.      | 1372.    | 1372.    | 0.        | 1372.    |
| 2 DEMAND 2 | 1706.      | 1706.    | 1706.    | 0.        | 1706.    |
| -----      |            |          |          |           |          |
|            | 3078.      | 3078.    | 3078.    | 0.        | 3078.    |
| -----      |            |          |          |           |          |

| Name       | No Rest | Ave Rest lvl | Max Rest lvl | No Ration | Ave % Ration | Max % Ration | No Short | Ave % Short | Max % Short |
|------------|---------|--------------|--------------|-----------|--------------|--------------|----------|-------------|-------------|
| 1 DEMAND 1 | 0.0     | 0.0          | 0.0          | 0.0       | 0.0          | 0.0          | 0.0      | 0.0         | 0.0         |
| 2 DEMAND 2 | 0.0     | 0.0          | 0.0          | 0.0       | 0.0          | 0.0          | 0.0      | 0.0         | 0.0         |
| -----      |         |              |              |           |              |              |          |             |             |

Pipe/River flows:

| Name                | flow   | Capacity   | Min   | Max     | Loss |
|---------------------|--------|------------|-------|---------|------|
| 1 RES C TO DEMAND 2 | 1705.6 | 99999999.0 | 300.0 | 3100.0  | 0.0  |
| 2 RES B TO DEMAND 1 | 312.4  | 99999999.0 | 0.0   | 2088.0  | 0.0  |
| 3 RES A TO DEMAND 1 | 1059.9 | 99999999.0 | 0.0   | 2297.0  | 0.0  |
| 4 RES B TO RES C    | 384.9  | 99999999.0 | 0.0   | 2112.0  | 0.0  |
| 5 River 1           | 928.6  | 99999999.0 | 0.0   | 4610.0  | 0.0  |
| 6 River 2           | 1629.5 | 99999999.0 | 0.0   | 11730.0 | 0.0  |
| 7 River 3           | 720.6  | 99999999.0 | 0.0   | 4610.0  | 0.0  |
|                     |        |            |       |         | 0.   |
| -----               |        |            |       |         |      |

End run

**WORKED EXAMPLE 4(b) – RESERVOIR VOLUME**

RESERVOIR STORAGE

EX4B.log

Tutorial 4 Sub-Problem (b)

Time :15:20:10 Date :01/11/02

```
(F4.0,2F6.0, 3f12.2 )
6
SEASON
YEAR
REPLICATE
RESERVOIR A      ESTO
RESERVOIR B      ESTO
RESERVOIR C      ESTO
1. 1982. 1. 6248.00 10808.00 5716.00
2. 1982. 1. 6260.00 10432.00 5216.00
3. 1982. 1. 6023.00 10037.00 5018.00
4. 1982. 1. 5921.00 9865.00 4932.00
5. 1982. 1. 9309.00 13565.00 8320.00
6. 1982. 1. 10858.00 15565.00 8869.00
7. 1982. 1. 10892.00 16385.00 8903.00
8. 1982. 1. 11365.00 17275.00 9376.00
9. 1982. 1. 11325.00 18145.00 10000.00
10. 1982. 1. 11241.00 18995.00 9916.00
11. 1982. 1. 11317.00 18861.00 9430.00
12. 1982. 1. 11448.00 19079.00 9539.00
1. 1983. 1. 10587.00 17643.00 8820.00
2. 1983. 1. 9647.00 15931.00 7992.00
3. 1983. 1. 9690.00 16148.00 8074.00
4. 1983. 1. 12000.00 18568.00 10000.00
5. 1983. 1. 12000.00 20000.00 10000.00
6. 1983. 1. 12000.00 20000.00 10000.00
7. 1983. 1. 12000.00 20000.00 10000.00
8. 1983. 1. 12000.00 20000.00 10000.00
9. 1983. 1. 12000.00 20000.00 10000.00
10. 1983. 1. 12000.00 20000.00 10000.00
11. 1983. 1. 12000.00 20000.00 10000.00
12. 1983. 1. 12000.00 20000.00 10000.00
1. 1984. 1. 12000.00 20000.00 10000.00
2. 1984. 1. 11136.00 18558.00 9278.00
3. 1984. 1. 11365.00 18940.00 9469.00
4. 1984. 1. 11679.00 19461.00 9730.00
5. 1984. 1. 12000.00 20000.00 10000.00
6. 1984. 1. 12000.00 20000.00 10000.00
7. 1984. 1. 12000.00 19928.00 10000.00
8. 1984. 1. 12000.00 20000.00 10000.00
9. 1984. 1. 12000.00 20000.00 10000.00
10. 1984. 1. 12000.00 20000.00 10000.00
11. 1984. 1. 11937.00 19894.00 9947.00
12. 1984. 1. 11394.00 18987.00 9493.00
```

**WORKED EXAMPLE 4(b) – TARGET STORAGE**

RESERVOIR TARGETS

EX4B.log

Tutorial 4 Sub-Problem (b)

Time :15:20:10 Date :01/11/02

```
(F4.0,2F6.0, 3f12.2 )
6
SEASON
YEAR
REPLICATE
RESERVOIR A      TARG
RESERVOIR B      TARG
RESERVOIR C      TARG
1. 1982. 1. 6508.00 10843.00 5421.00
2. 1982. 1. 6260.00 10432.00 5216.00
3. 1982. 1. 6023.00 10037.00 5018.00
4. 1982. 1. 5921.00 9865.00 4932.00
5. 1982. 1. 8913.00 14854.00 7427.00
6. 1982. 1. 10084.00 16806.00 8402.00
7. 1982. 1. 10339.00 17228.00 8613.00
8. 1982. 1. 10863.00 18103.00 9050.00
9. 1982. 1. 11278.00 18795.00 9397.00
10. 1982. 1. 11473.00 19120.00 9559.00
11. 1982. 1. 11317.00 18861.00 9430.00
12. 1982. 1. 11448.00 19079.00 9539.00
1. 1983. 1. 10587.00 17643.00 8820.00
2. 1983. 1. 9592.00 15986.00 7992.00
3. 1983. 1. 9690.00 16148.00 8074.00
4. 1983. 1. 11592.00 19318.00 9658.00
5. 1983. 1. 12000.00 20000.00 10000.00
6. 1983. 1. 12000.00 20000.00 10000.00
7. 1983. 1. 12000.00 20000.00 10000.00
8. 1983. 1. 12000.00 20000.00 10000.00
9. 1983. 1. 12000.00 20000.00 10000.00
10. 1983. 1. 12000.00 20000.00 10000.00
11. 1983. 1. 12000.00 20000.00 10000.00
12. 1983. 1. 12000.00 20000.00 10000.00
1. 1984. 1. 12000.00 20000.00 10000.00
2. 1984. 1. 11136.00 18558.00 9278.00
3. 1984. 1. 11365.00 18940.00 9469.00
4. 1984. 1. 11679.00 19461.00 9730.00
5. 1984. 1. 12000.00 20000.00 10000.00
6. 1984. 1. 12000.00 20000.00 10000.00
7. 1984. 1. 12000.00 20000.00 10000.00
8. 1984. 1. 12000.00 20000.00 10000.00
9. 1984. 1. 12000.00 20000.00 10000.00
10. 1984. 1. 12000.00 20000.00 10000.00
11. 1984. 1. 11937.00 19894.00 9947.00
12. 1984. 1. 11394.00 18987.00 9493.00
```

**WORKED EXAMPLE 4(b) – CARRIER FLOW**

CARRIER FLOWS

EX4B.log

Time :15:20:10 Date :01/11/02

Tutorial 4 Sub-Problem (b)

(F4.0,2F6.0, 4f12.2 )

7

SEASON

YEAR

REPLICATE

RES C TO DEMAND FLOW

RES B TO DEMAND FLOW

RES A TO DEMAND FLOW

RES B TO RES C FLOW

|     |       |    |         |         |         |         |
|-----|-------|----|---------|---------|---------|---------|
| 1.  | 1982. | 1. | 2700.00 | 532.00  | 2168.00 | 0.00    |
| 2.  | 1982. | 1. | 1300.00 | 1024.00 | 276.00  | 512.00  |
| 3.  | 1982. | 1. | 2100.00 | 838.00  | 1262.00 | 877.00  |
| 4.  | 1982. | 1. | 1500.00 | 948.00  | 552.00  | 964.00  |
| 5.  | 1982. | 1. | 1600.00 | 0.00    | 1600.00 | 0.00    |
| 6.  | 1982. | 1. | 1700.00 | 0.00    | 700.00  | 0.00    |
| 7.  | 1982. | 1. | 1200.00 | 0.00    | 1200.00 | 0.00    |
| 8.  | 1982. | 1. | 1800.00 | 0.00    | 1800.00 | 0.00    |
| 9.  | 1982. | 1. | 1200.00 | 0.00    | 2200.00 | 0.00    |
| 10. | 1982. | 1. | 1300.00 | 0.00    | 1300.00 | 0.00    |
| 11. | 1982. | 1. | 2400.00 | 138.00  | 1262.00 | 576.00  |
| 12. | 1982. | 1. | 1400.00 | 262.00  | 1138.00 | 240.00  |
| 1.  | 1983. | 1. | 1900.00 | 867.00  | 1033.00 | 1009.00 |
| 2.  | 1983. | 1. | 3100.00 | 0.00    | 1100.00 | 2112.00 |
| 3.  | 1983. | 1. | 1300.00 | 777.00  | 523.00  | 816.00  |
| 4.  | 1983. | 1. | 1800.00 | 0.00    | 800.00  | 0.00    |
| 5.  | 1983. | 1. | 2000.00 | 0.00    | 0.00    | 0.00    |
| 6.  | 1983. | 1. | 1600.00 | 0.00    | 600.00  | 100.00  |
| 7.  | 1983. | 1. | 1900.00 | 0.00    | 900.00  | 0.00    |
| 8.  | 1983. | 1. | 1300.00 | 0.00    | 300.00  | 0.00    |
| 9.  | 1983. | 1. | 1600.00 | 0.00    | 600.00  | 0.00    |
| 10. | 1983. | 1. | 1400.00 | 0.00    | 1400.00 | 0.00    |
| 11. | 1983. | 1. | 2100.00 | 77.00   | 2023.00 | 77.00   |
| 12. | 1983. | 1. | 2100.00 | 0.00    | 2100.00 | 0.00    |
| 1.  | 1984. | 1. | 1100.00 | 0.00    | 1100.00 | 0.00    |
| 2.  | 1984. | 1. | 2300.00 | 1190.00 | 1110.00 | 1332.00 |
| 3.  | 1984. | 1. | 2800.00 | 503.00  | 2297.00 | 465.00  |
| 4.  | 1984. | 1. | 1900.00 | 701.00  | 1199.00 | 648.00  |
| 5.  | 1984. | 1. | 300.00  | 96.00   | 204.00  | 45.00   |
| 6.  | 1984. | 1. | 600.00  | 0.00    | 600.00  | 0.00    |
| 7.  | 1984. | 1. | 1600.00 | 0.00    | 600.00  | 692.00  |
| 8.  | 1984. | 1. | 1100.00 | 0.00    | 100.00  | 0.00    |
| 9.  | 1984. | 1. | 1600.00 | 0.00    | 1600.00 | 0.00    |
| 10. | 1984. | 1. | 1300.00 | 0.00    | 1300.00 | 0.00    |
| 11. | 1984. | 1. | 2400.00 | 2088.00 | 312.00  | 2098.00 |
| 12. | 1984. | 1. | 2100.00 | 1204.00 | 896.00  | 1293.00 |

**WORKED EXAMPLE 4(b) – COMPARISON OF TARGETS AND STORAGE VOLUMES FOR CASES (a) AND (b)**

####

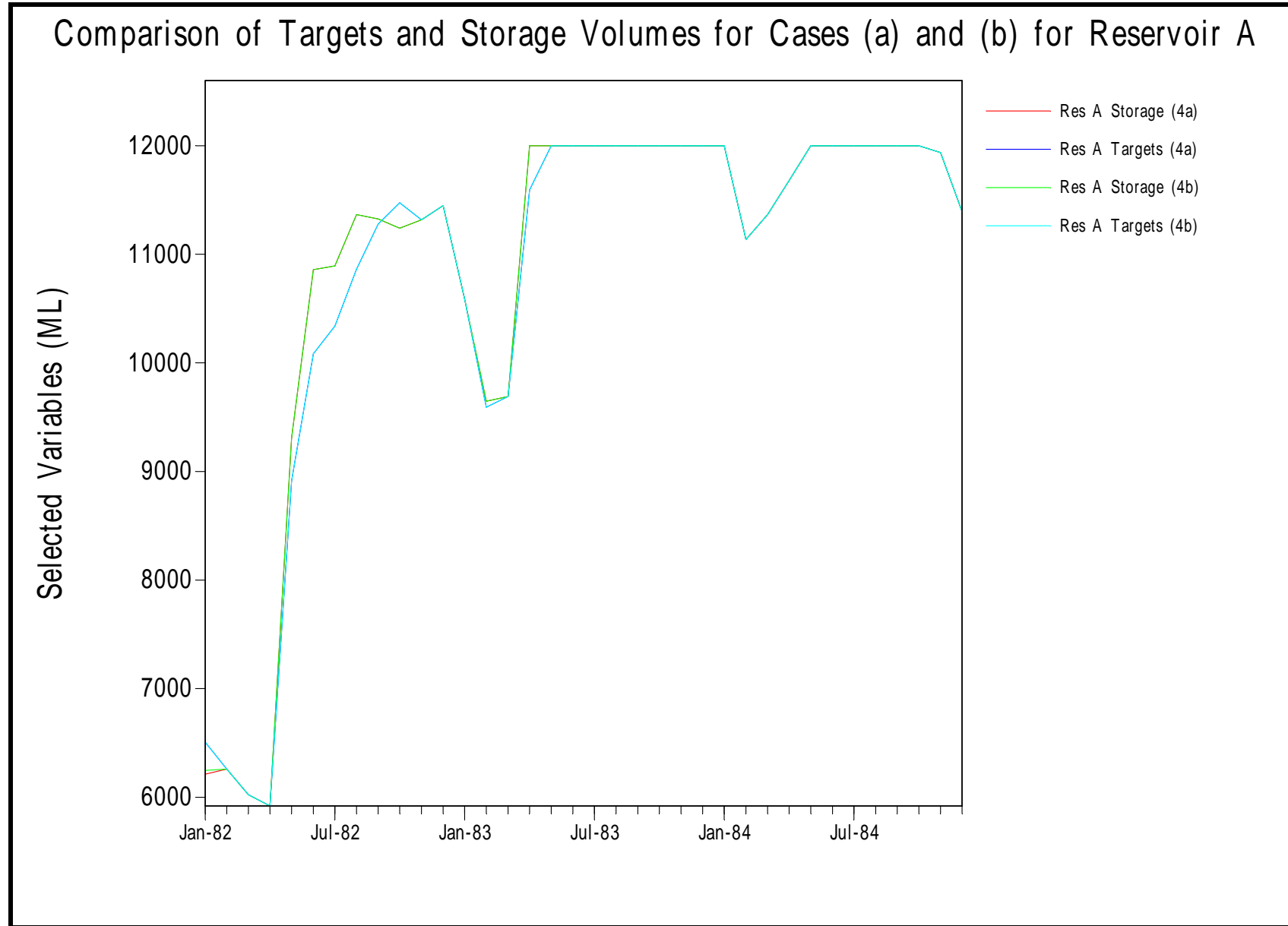
EX4A.log + EX4B.log

Time :14:30:11 Date :12/11/01

Tutorial 4 Sub-Problem (a)

| ( 14f12.2 ) |         |          |          |          |          |          |          |          |          |          |          |          |          |
|-------------|---------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|
| 14          |         |          |          |          |          |          |          |          |          |          |          |          |          |
| SEASON      |         |          |          |          |          |          |          |          |          |          |          |          |          |
| YEAR        |         |          |          |          |          |          |          |          |          |          |          |          |          |
| RESERVOIR A | TARG    | case (a) |          |          |          |          |          |          |          |          |          |          |          |
| RESERVOIR B | TARG    | case (a) |          |          |          |          |          |          |          |          |          |          |          |
| RESERVOIR C | TARG    | case (a) |          |          |          |          |          |          |          |          |          |          |          |
| RESERVOIR A | TARG    | case (b) |          |          |          |          |          |          |          |          |          |          |          |
| RESERVOIR B | TARG    | case (b) |          |          |          |          |          |          |          |          |          |          |          |
| RESERVOIR C | TARG    | case (b) |          |          |          |          |          |          |          |          |          |          |          |
| RESERVOIR A | ESTO    | case (a) |          |          |          |          |          |          |          |          |          |          |          |
| RESERVOIR B | ESTO    | case (a) |          |          |          |          |          |          |          |          |          |          |          |
| RESERVOIR C | ESTO    | case (a) |          |          |          |          |          |          |          |          |          |          |          |
| RESERVOIR A | ESTO    | case (b) |          |          |          |          |          |          |          |          |          |          |          |
| RESERVOIR B | ESTO    | case (b) |          |          |          |          |          |          |          |          |          |          |          |
| RESERVOIR C | ESTO    | case (b) |          |          |          |          |          |          |          |          |          |          |          |
| 1.00        | 1982.00 | 6508.00  | 10843.00 | 5421.00  | 6508.00  | 10843.00 | 5421.00  | 6213.00  | 10843.00 | 5716.00  | 6248.00  | 10808.00 | 5716.00  |
| 2.00        | 1982.00 | 6260.00  | 10432.00 | 5216.00  | 6260.00  | 10432.00 | 5216.00  | 6260.00  | 10432.00 | 5216.00  | 6260.00  | 10432.00 | 5216.00  |
| 3.00        | 1982.00 | 6023.00  | 10037.00 | 5018.00  | 6023.00  | 10037.00 | 5018.00  | 6023.00  | 10037.00 | 5018.00  | 6023.00  | 10037.00 | 5018.00  |
| 4.00        | 1982.00 | 5921.00  | 9865.00  | 4932.00  | 5921.00  | 9865.00  | 4932.00  | 5921.00  | 9865.00  | 4932.00  | 5921.00  | 9865.00  | 4932.00  |
| 5.00        | 1982.00 | 8913.00  | 14854.00 | 7427.00  | 8913.00  | 14854.00 | 7427.00  | 9309.00  | 13565.00 | 8320.00  | 9309.00  | 13565.00 | 8320.00  |
| 6.00        | 1982.00 | 10084.00 | 16806.00 | 8402.00  | 10084.00 | 16806.00 | 8402.00  | 10858.00 | 15565.00 | 8869.00  | 10858.00 | 15565.00 | 8869.00  |
| 7.00        | 1982.00 | 10339.00 | 17228.00 | 8613.00  | 10339.00 | 17228.00 | 8613.00  | 10892.00 | 16385.00 | 8903.00  | 10892.00 | 16385.00 | 8903.00  |
| 8.00        | 1982.00 | 10863.00 | 18103.00 | 9050.00  | 10863.00 | 18103.00 | 9050.00  | 11365.00 | 17275.00 | 9376.00  | 11365.00 | 17275.00 | 9376.00  |
| 9.00        | 1982.00 | 11278.00 | 18795.00 | 9397.00  | 11278.00 | 18795.00 | 9397.00  | 11325.00 | 18145.00 | 10000.00 | 11325.00 | 18145.00 | 10000.00 |
| 10.00       | 1982.00 | 11473.00 | 19120.00 | 9559.00  | 11473.00 | 19120.00 | 9559.00  | 11241.00 | 18995.00 | 9916.00  | 11241.00 | 18995.00 | 9916.00  |
| 11.00       | 1982.00 | 11317.00 | 18861.00 | 9430.00  | 11317.00 | 18861.00 | 9430.00  | 11317.00 | 18861.00 | 9430.00  | 11317.00 | 18861.00 | 9430.00  |
| 12.00       | 1982.00 | 11448.00 | 19079.00 | 9539.00  | 11448.00 | 19079.00 | 9539.00  | 11448.00 | 19079.00 | 9539.00  | 11448.00 | 19079.00 | 9539.00  |
| 1.00        | 1983.00 | 10587.00 | 17643.00 | 8820.00  | 10587.00 | 17643.00 | 8820.00  | 10587.00 | 17643.00 | 8820.00  | 10587.00 | 17643.00 | 8820.00  |
| 2.00        | 1983.00 | 9592.00  | 15986.00 | 7992.00  | 9592.00  | 15986.00 | 7992.00  | 9647.00  | 15931.00 | 7992.00  | 9647.00  | 15931.00 | 7992.00  |
| 3.00        | 1983.00 | 9690.00  | 16148.00 | 8074.00  | 9690.00  | 16148.00 | 8074.00  | 9690.00  | 16148.00 | 8074.00  | 9690.00  | 16148.00 | 8074.00  |
| 4.00        | 1983.00 | 11592.00 | 19318.00 | 9658.00  | 11592.00 | 19318.00 | 9658.00  | 12000.00 | 18568.00 | 10000.00 | 12000.00 | 18568.00 | 10000.00 |
| 5.00        | 1983.00 | 12000.00 | 20000.00 | 10000.00 | 12000.00 | 20000.00 | 10000.00 | 12000.00 | 20000.00 | 10000.00 | 12000.00 | 20000.00 | 10000.00 |
| 6.00        | 1983.00 | 12000.00 | 20000.00 | 10000.00 | 12000.00 | 20000.00 | 10000.00 | 12000.00 | 20000.00 | 10000.00 | 12000.00 | 20000.00 | 10000.00 |
| 7.00        | 1983.00 | 12000.00 | 20000.00 | 10000.00 | 12000.00 | 20000.00 | 10000.00 | 12000.00 | 20000.00 | 10000.00 | 12000.00 | 20000.00 | 10000.00 |
| 8.00        | 1983.00 | 12000.00 | 20000.00 | 10000.00 | 12000.00 | 20000.00 | 10000.00 | 12000.00 | 20000.00 | 10000.00 | 12000.00 | 20000.00 | 10000.00 |
| 9.00        | 1983.00 | 12000.00 | 20000.00 | 10000.00 | 12000.00 | 20000.00 | 10000.00 | 12000.00 | 20000.00 | 10000.00 | 12000.00 | 20000.00 | 10000.00 |
| 10.00       | 1983.00 | 12000.00 | 20000.00 | 10000.00 | 12000.00 | 20000.00 | 10000.00 | 12000.00 | 20000.00 | 10000.00 | 12000.00 | 20000.00 | 10000.00 |
| 11.00       | 1983.00 | 12000.00 | 20000.00 | 10000.00 | 12000.00 | 20000.00 | 10000.00 | 12000.00 | 20000.00 | 10000.00 | 12000.00 | 20000.00 | 10000.00 |
| 12.00       | 1983.00 | 12000.00 | 20000.00 | 10000.00 | 12000.00 | 20000.00 | 10000.00 | 12000.00 | 20000.00 | 10000.00 | 12000.00 | 20000.00 | 10000.00 |
| 1.00        | 1984.00 | 12000.00 | 20000.00 | 10000.00 | 12000.00 | 20000.00 | 10000.00 | 12000.00 | 20000.00 | 10000.00 | 12000.00 | 20000.00 | 10000.00 |
| 2.00        | 1984.00 | 11136.00 | 18558.00 | 9278.00  | 11136.00 | 18558.00 | 9278.00  | 11136.00 | 18558.00 | 9278.00  | 11136.00 | 18558.00 | 9278.00  |
| 3.00        | 1984.00 | 11365.00 | 18940.00 | 9469.00  | 11365.00 | 18940.00 | 9469.00  | 11365.00 | 18940.00 | 9469.00  | 11365.00 | 18940.00 | 9469.00  |
| 4.00        | 1984.00 | 11679.00 | 19461.00 | 9730.00  | 11679.00 | 19461.00 | 9730.00  | 11679.00 | 19461.00 | 9730.00  | 11679.00 | 19461.00 | 9730.00  |
| 5.00        | 1984.00 | 12000.00 | 20000.00 | 10000.00 | 12000.00 | 20000.00 | 10000.00 | 12000.00 | 20000.00 | 10000.00 | 12000.00 | 20000.00 | 10000.00 |
| 6.00        | 1984.00 | 12000.00 | 20000.00 | 10000.00 | 12000.00 | 20000.00 | 10000.00 | 12000.00 | 20000.00 | 10000.00 | 12000.00 | 20000.00 | 10000.00 |
| 7.00        | 1984.00 | 12000.00 | 20000.00 | 10000.00 | 12000.00 | 20000.00 | 10000.00 | 12000.00 | 19928.00 | 10000.00 | 12000.00 | 19928.00 | 10000.00 |
| 8.00        | 1984.00 | 12000.00 | 20000.00 | 10000.00 | 12000.00 | 20000.00 | 10000.00 | 12000.00 | 20000.00 | 10000.00 | 12000.00 | 20000.00 | 10000.00 |
| 9.00        | 1984.00 | 12000.00 | 20000.00 | 10000.00 | 12000.00 | 20000.00 | 10000.00 | 12000.00 | 20000.00 | 10000.00 | 12000.00 | 20000.00 | 10000.00 |
| 10.00       | 1984.00 | 12000.00 | 20000.00 | 10000.00 | 12000.00 | 20000.00 | 10000.00 | 12000.00 | 20000.00 | 10000.00 | 12000.00 | 20000.00 | 10000.00 |
| 11.00       | 1984.00 | 11937.00 | 19894.00 | 9947.00  | 11937.00 | 19894.00 | 9947.00  | 11937.00 | 19894.00 | 9947.00  | 11937.00 | 19894.00 | 9947.00  |
| 12.00       | 1984.00 | 11394.00 | 18987.00 | 9493.00  | 11394.00 | 18987.00 | 9493.00  | 11394.00 | 18987.00 | 9493.00  | 11394.00 | 18987.00 | 9493.00  |





**Figure 3.4-2 Worked Example 4(b) – Comparison of Targets and Storage Volumes for Cases (a) and (b) for Reservoir A**



**Figure 3.4-3 Worked Example 4(b) – Comparison of Targets and Storage Volumes for Cases (a) and (b) for Reservoir B**

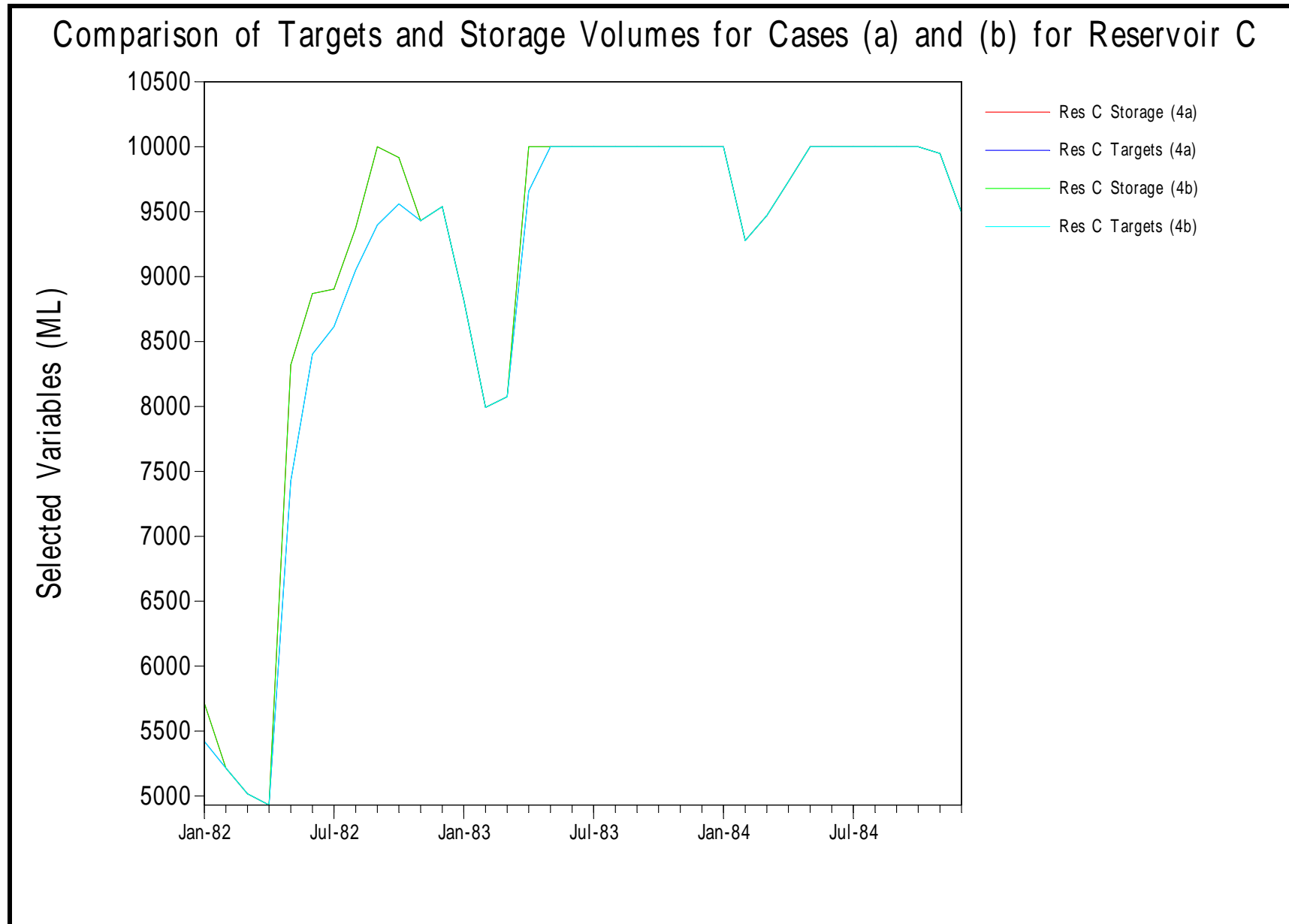


Figure 3.4-4 Worked Example 4(b) – Comparison of Targets and Storage Volumes for Cases (a) and (b) for Reservoir C

### **3.5 WORKED EXAMPLE 5**

# **ILLUSTRATION OF DEMAND SHORTFALL ZONES AND SHORTFALL PRIORITY**

**WORKED EXAMPLE 5(a) - STREAMFLOW FILE (SF3.DAT)**

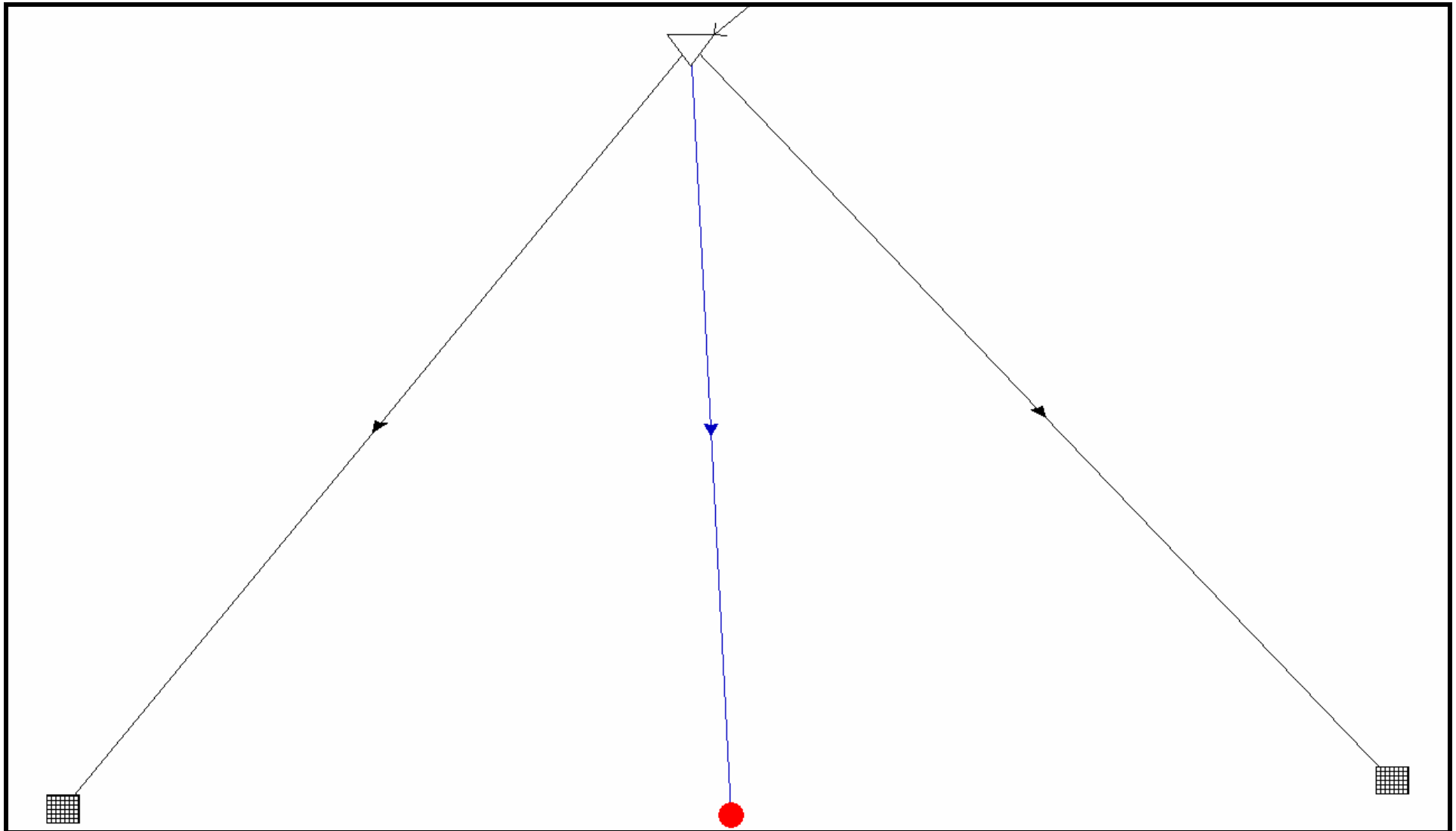
```
####2
STREAMFLOW DATA FILE
HISTORICAL MONTHLY STREAMFLOW DATAFILE
TEST DATA
DATE : 20 JUL 1990
( 4F12.2)
```

```
4
SEASON
YEAR
STREAM1
STREAM2
1.00 1982.00 416.00 1340.00
2.00 1982.00 288.00 1160.00
3.00 1982.00 1025.00 1320.00
4.00 1982.00 450.00 1740.00
5.00 1982.00 4988.00 3700.00
6.00 1982.00 2249.00 2000.00
7.00 1982.00 1234.00 820.00
8.00 1982.00 2273.00 890.00
9.00 1982.00 2160.00 870.00
10.00 1982.00 1216.00 850.00
11.00 1982.00 1338.00 580.00
12.00 1982.00 1269.00 720.00
1.00 1983.00 172.00 440.00
2.00 1983.00 160.00 400.00
3.00 1983.00 566.00 1810.00
4.00 1983.00 3848.00 2420.00
5.00 1983.00 3220.00 5100.00
6.00 1983.00 1500.00 1040.00
7.00 1983.00 4640.00 1270.00
8.00 1983.00 3900.00 5890.00
9.00 1983.00 4600.00 11730.00
10.00 1983.00 2360.00 9090.00
11.00 1983.00 2023.00 3770.00
12.00 1983.00 2967.00 3250.00
1.00 1984.00 4426.00 5150.00
2.00 1984.00 246.00 1080.00
3.00 1984.00 2526.00 1350.00
4.00 1984.00 1513.00 1870.00
5.00 1984.00 525.00 3140.00
6.00 1984.00 2833.00 640.00
7.00 1984.00 908.00 620.00
8.00 1984.00 2029.00 4020.00
9.00 1984.00 4600.00 3820.00
10.00 1984.00 5910.00 3190.00
11.00 1984.00 249.00 4080.00
12.00 1984.00 353.00 1590.00
```

**WORKED EXAMPLE 5(a) - DEMAND FILE (DEM2.DAT)**

```
####3
DEMANDS DATAFILE
HISTORICAL DATA
DATA ASSEMBLED AND REFORMATED ON
DATE : 9 JUL 1990
( 4F12.2)
```

```
4
SEASON
YEAR
DEMAND 1
DEMAND 2
1.00 1982.00 2700.00 2700.00
2.00 1982.00 1300.00 1300.00
3.00 1982.00 2100.00 2100.00
4.00 1982.00 1500.00 1500.00
5.00 1982.00 1600.00 1600.00
6.00 1982.00 700.00 1700.00
7.00 1982.00 1200.00 1200.00
8.00 1982.00 1800.00 1800.00
9.00 1982.00 2200.00 1200.00
10.00 1982.00 1300.00 1300.00
11.00 1982.00 1400.00 2400.00
12.00 1982.00 1400.00 1400.00
1.00 1983.00 1900.00 1900.00
2.00 1983.00 1100.00 3100.00
3.00 1983.00 1300.00 1300.00
4.00 1983.00 800.00 1800.00
5.00 1983.00 0.00 2000.00
6.00 1983.00 600.00 1600.00
7.00 1983.00 900.00 1900.00
8.00 1983.00 300.00 1300.00
9.00 1983.00 600.00 1600.00
10.00 1983.00 1400.00 1400.00
11.00 1983.00 2100.00 2100.00
12.00 1983.00 2100.00 2100.00
1.00 1984.00 1100.00 1100.00
2.00 1984.00 2300.00 2300.00
3.00 1984.00 2800.00 2800.00
4.00 1984.00 1900.00 1900.00
5.00 1984.00 300.00 300.00
6.00 1984.00 600.00 600.00
7.00 1984.00 600.00 1600.00
8.00 1984.00 100.00 1100.00
9.00 1984.00 1600.00 1600.00
10.00 1984.00 1300.00 1300.00
11.00 1984.00 2400.00 2400.00
12.00 1984.00 2100.00 2100.00
```



**Figure 3.5-1 Worked Example 5(a) System Plot**



demand data:

| No | Name     | No Bypass | S/F Priority | Monthly Factors |       |       |       |       |       |       |       |       |       |       |       |       |
|----|----------|-----------|--------------|-----------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
|    |          |           |              | Jan             | Feb   | Mar   | Apl   | May   | Jun   | Jul   | Aug   | Sep   | Oct   | Nov   | Dec   |       |
| 2  | DEMAND 1 | 1         | 1            | min             | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
|    |          |           |              | max             | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 1.000 |
| 3  | DEMAND 2 | 1         | 2            | min             | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
|    |          |           |              | max             | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 1.000 |

-----  
 | CARRIER INFORMATION |  
 -----

| No | Name      | Type  | From | To | Cost | Offset | Loss | Ann Vol | Shr Gp | Shr% | No |
|----|-----------|-------|------|----|------|--------|------|---------|--------|------|----|
| 1  | Carrier 1 | Pipe  | 1    | 2  | 0    | 0      | Ofix |         | 0      | 0%   | 1  |
| 2  | Carrier 2 | Pipe  | 1    | 3  | 0    | 0      | Ofix |         | 0      | 0%   | 2  |
| 3  | River 1   | River | 1    | 4  | 1000 | 0      | Ofix |         | 0      | 0%   | 3  |

-----  
 Maximum Flows

| No | Name      | Jan      | Feb      | Mar      | Apl      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec      |
|----|-----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|
| 1  | Carrier 1 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 |
| 2  | Carrier 2 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 |
| 3  | River 1   | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 |

-----  
 | TARGET INFORMATION |  
 -----

Number of target sets: 1

-----  
 Target set 1 ( Jan Feb Mar Apl May Jun Jul Aug Sep Oct Nov Dec )

| Name        | Draw | Pri | Targets |      |      |      |      |      |      |       |       |  |
|-------------|------|-----|---------|------|------|------|------|------|------|-------|-------|--|
| RESERVOIR A | 1    | 0   | 1333    | 2667 | 4000 | 5333 | 6667 | 8000 | 9333 | 10667 | 12000 |  |
| totals      |      | 0   | 1333    | 2667 | 4000 | 5333 | 6667 | 8000 | 9333 | 10667 | 12000 |  |

-----  
 | MULTI SYSTEM INFORMATION |  
 -----

-----  
 Reservoirs

-----  
 RESERVOIR A 1  
 -----



**WORKED EXAMPLE 5(a) - LOG FILE**

```

HHHHH      HHHHHHHH      HHHHHH      H      HHHHHHHHHH
H  H      H      H  H  H  H  H  H  H  H  H
HHHHHHHHH  HHHHHH      HHHHHHHH  HHH      HHH  H  H
HHH  H  HHH      HHH  H  HHH      HHH  H  H
HHH  H  HHH      HHH  H  HHH      HHH  H  H
HHH  H  HHHHHHHH  HHH  H  HHHHHHHH  HHH  H  H

```

```

*****
*      SIMULATION LOG FILE      *
*****

```

Log filename : EX5A.log

Scenario file: scn5a.scn

Simulation label:

Tutorial 5 Sub-Problem (a)

Streamflow file(s):

C:\REALM\WorkedExamples\Sf3.dat

Demand file(s):

C:\REALM\WorkedExamples\Dem2.dat

Restrictions are OFF

Instream flow requirements NOT limited to natural

Water quality calculations are OFF

Number of S/F Sequences: 1

```

Convergence tolerance (storage)  1 10th%
Other convergence tolerance      5 %
Arc convergence tolerance (abs)  100
Minimum iteration count          3
Maximum iteration count          51
Do convergence twice             No

```

Date: 15:46:52 01/11/02

Time Step = Monthly

SYSTEM CHANGES:

| No | Seas | Year | System File                     |
|----|------|------|---------------------------------|
| 1  | 1    | 1982 | C:\REALM\WorkedExamplesEX5A.sys |

Total number of seasons:- 36

\*\*\*\*\* RUN TIME MESSAGES:- \*\*\*\*\*

\*\*\*\*INPUT DATA TYPE= 1 \*\*\*\*

1982

C:\REALM\WorkedExamples\EX5A.sys

1983

1984

\*\*\*\*\* END RUN TIME MESSAGES \*\*\*\*\*

SUMMARY INFORMATION

Reservoir data:

|       | Name        | Start<br>Storage | File<br>Inflow | Min<br>Storage | Average<br>Storage | Evapn | Release<br>to river | Spill | End<br>Storage |
|-------|-------------|------------------|----------------|----------------|--------------------|-------|---------------------|-------|----------------|
| 1     | RESERVOIR A | 8000.            | 2083.          | 0.             | 1969.              | 0.    | 0.                  | 0.    | 0.             |
| ----- |             |                  |                |                |                    |       |                     |       |                |
|       |             | 8000.            | 2083.          | 0.             | 1969.              | 0.    | 0.                  | 0.    | 0.             |
| ----- |             |                  |                |                |                    |       |                     |       |                |

## Demand data:

|   | Name     | Unrestrict | Restrict | Rationed | Shortfall | Supplied |
|---|----------|------------|----------|----------|-----------|----------|
| 1 | DEMAND 1 | 1372.      | 1372.    | 1372.    | 525.      | 847.     |
| 2 | DEMAND 2 | 1706.      | 1706.    | 1706.    | 247.      | 1458.    |
|   |          | 3078.      | 3078.    | 3078.    | 773.      | 2305.    |

|   | Name     | No<br>Rest | Ave<br>Rest lvl | Max<br>Rest lvl | No<br>Ration | Ave %<br>Ration | Max %<br>Ration | No<br>Short | Ave %<br>Short | Max %<br>Short |
|---|----------|------------|-----------------|-----------------|--------------|-----------------|-----------------|-------------|----------------|----------------|
| 1 | DEMAND 1 | 0.0        | 0.0             | 0.0             | 0.0          | 0.0             | 0.0             | 14.0        | 82.4           | 100.0          |
| 2 | DEMAND 2 | 0.0        | 0.0             | 0.0             | 0.0          | 0.0             | 0.0             | 10.0        | 42.5           | 94.0           |

## Pipe/River flows:

|   | Name      | flow   | Capacity   | Min   | Max    | Loss |
|---|-----------|--------|------------|-------|--------|------|
| 1 | Carrier 1 | 846.8  | 99999999.0 | 0.0   | 2700.0 | 0.0  |
| 2 | Carrier 2 | 1458.2 | 99999999.0 | 160.0 | 2800.0 | 0.0  |
| 3 | River 1   | 0.0    | 99999999.0 | 0.0   | 0.0    | 0.0  |
|   |           |        |            |       |        | 0.   |

End run

**WORKED EXAMPLE 5(a) – RESERVOIR VOLUME**

RESERVOIR STORAGE

EX5A.log

Tutorial 5 Sub-Problem (a)

Time :15:46:52 Date :01/11/02

(F4.0,2F6.0, 1f12.2 )  
4

SEASON

YEAR

REPLICATE

| RESERVOIR A | ESTO       |
|-------------|------------|
| 1. 1982.    | 1. 3016.00 |
| 2. 1982.    | 1. 704.00  |
| 3. 1982.    | 1. 0.00    |
| 4. 1982.    | 1. 0.00    |
| 5. 1982.    | 1. 1788.00 |
| 6. 1982.    | 1. 1637.00 |
| 7. 1982.    | 1. 471.00  |
| 8. 1982.    | 1. 0.00    |
| 9. 1982.    | 1. 0.00    |
| 10. 1982.   | 1. 0.00    |
| 11. 1982.   | 1. 0.00    |
| 12. 1982.   | 1. 0.00    |
| 1. 1983.    | 1. 0.00    |
| 2. 1983.    | 1. 0.00    |
| 3. 1983.    | 1. 0.00    |
| 4. 1983.    | 1. 1248.00 |
| 5. 1983.    | 1. 2468.00 |
| 6. 1983.    | 1. 1768.00 |
| 7. 1983.    | 1. 3608.00 |
| 8. 1983.    | 1. 5908.00 |
| 9. 1983.    | 1. 8308.00 |
| 10. 1983.   | 1. 7868.00 |
| 11. 1983.   | 1. 5691.00 |
| 12. 1983.   | 1. 4458.00 |
| 1. 1984.    | 1. 6684.00 |
| 2. 1984.    | 1. 2330.00 |
| 3. 1984.    | 1. 0.00    |
| 4. 1984.    | 1. 0.00    |
| 5. 1984.    | 1. 0.00    |
| 6. 1984.    | 1. 1633.00 |
| 7. 1984.    | 1. 341.00  |
| 8. 1984.    | 1. 1170.00 |
| 9. 1984.    | 1. 2570.00 |
| 10. 1984.   | 1. 5880.00 |
| 11. 1984.   | 1. 1329.00 |
| 12. 1984.   | 1. 0.00    |

**WORKED EXAMPLE 5(a) – CARRIER FLOWS**

CARRIER FLOWS

EX5A.log

Tutorial 5 Sub-Problem (a)

Time :15:46:52 Date :01/11/02

(F4.0,2F6.0, 3f12.2 )  
6

SEASON

YEAR

REPLICATE

| Carrier 1 | FLOW |         |         |      |
|-----------|------|---------|---------|------|
| Carrier 2 | FLOW |         |         |      |
| River 1   | FLOW |         |         |      |
| 1. 1982.  | 1.   | 2700.00 | 2700.00 | 0.00 |
| 2. 1982.  | 1.   | 1300.00 | 1300.00 | 0.00 |
| 3. 1982.  | 1.   | 0.00    | 1729.00 | 0.00 |
| 4. 1982.  | 1.   | 0.00    | 450.00  | 0.00 |
| 5. 1982.  | 1.   | 1600.00 | 1600.00 | 0.00 |
| 6. 1982.  | 1.   | 700.00  | 1700.00 | 0.00 |
| 7. 1982.  | 1.   | 1200.00 | 1200.00 | 0.00 |
| 8. 1982.  | 1.   | 944.00  | 1800.00 | 0.00 |
| 9. 1982.  | 1.   | 960.00  | 1200.00 | 0.00 |
| 10. 1982. | 1.   | 0.00    | 1216.00 | 0.00 |
| 11. 1982. | 1.   | 0.00    | 1338.00 | 0.00 |
| 12. 1982. | 1.   | 0.00    | 1269.00 | 0.00 |
| 1. 1983.  | 1.   | 0.00    | 172.00  | 0.00 |
| 2. 1983.  | 1.   | 0.00    | 160.00  | 0.00 |
| 3. 1983.  | 1.   | 0.00    | 566.00  | 0.00 |
| 4. 1983.  | 1.   | 800.00  | 1800.00 | 0.00 |
| 5. 1983.  | 1.   | 0.00    | 2000.00 | 0.00 |
| 6. 1983.  | 1.   | 600.00  | 1600.00 | 0.00 |
| 7. 1983.  | 1.   | 900.00  | 1900.00 | 0.00 |
| 8. 1983.  | 1.   | 300.00  | 1300.00 | 0.00 |
| 9. 1983.  | 1.   | 600.00  | 1600.00 | 0.00 |
| 10. 1983. | 1.   | 1400.00 | 1400.00 | 0.00 |
| 11. 1983. | 1.   | 2100.00 | 2100.00 | 0.00 |
| 12. 1983. | 1.   | 2100.00 | 2100.00 | 0.00 |
| 1. 1984.  | 1.   | 1100.00 | 1100.00 | 0.00 |
| 2. 1984.  | 1.   | 2300.00 | 2300.00 | 0.00 |
| 3. 1984.  | 1.   | 2056.00 | 2800.00 | 0.00 |
| 4. 1984.  | 1.   | 0.00    | 1513.00 | 0.00 |
| 5. 1984.  | 1.   | 225.00  | 300.00  | 0.00 |
| 6. 1984.  | 1.   | 600.00  | 600.00  | 0.00 |
| 7. 1984.  | 1.   | 600.00  | 1600.00 | 0.00 |
| 8. 1984.  | 1.   | 100.00  | 1100.00 | 0.00 |
| 9. 1984.  | 1.   | 1600.00 | 1600.00 | 0.00 |
| 10. 1984. | 1.   | 1300.00 | 1300.00 | 0.00 |
| 11. 1984. | 1.   | 2400.00 | 2400.00 | 0.00 |
| 12. 1984. | 1.   | 0.00    | 1682.00 | 0.00 |

**WORKED EXAMPLE 5(a) – DEMAND SHORTFALLS**

DEMAND SHORTFALL

EX5A.log

Tutorial 5 Sub-Problem (a)

Time :15:46:52 Date :01/11/02

```
(F4.0,2F6.0, 2f12.2 )
5
SEASON
YEAR
REPLICATE
DEMAND 1          SHRT
DEMAND 2          SHRT
1. 1982. 1.      0.00      0.00
2. 1982. 1.      0.00      0.00
3. 1982. 1.    2100.00    371.00
4. 1982. 1.    1500.00   1050.00
5. 1982. 1.      0.00      0.00
6. 1982. 1.      0.00      0.00
7. 1982. 1.      0.00      0.00
8. 1982. 1.    856.00      0.00
9. 1982. 1.    1240.00     0.00
10. 1982. 1.    1300.00     84.00
11. 1982. 1.    1400.00   1062.00
12. 1982. 1.    1400.00    131.00
1. 1983. 1.    1900.00   1728.00
2. 1983. 1.    1100.00   2940.00
3. 1983. 1.    1300.00    734.00
4. 1983. 1.      0.00      0.00
5. 1983. 1.      0.00      0.00
6. 1983. 1.      0.00      0.00
7. 1983. 1.      0.00      0.00
8. 1983. 1.      0.00      0.00
9. 1983. 1.      0.00      0.00
10. 1983. 1.      0.00      0.00
11. 1983. 1.      0.00      0.00
12. 1983. 1.      0.00      0.00
1. 1984. 1.      0.00      0.00
2. 1984. 1.      0.00      0.00
3. 1984. 1.      744.00     0.00
4. 1984. 1.    1900.00    387.00
5. 1984. 1.      75.00      0.00
6. 1984. 1.      0.00      0.00
7. 1984. 1.      0.00      0.00
8. 1984. 1.      0.00      0.00
9. 1984. 1.      0.00      0.00
10. 1984. 1.      0.00      0.00
11. 1984. 1.      0.00      0.00
12. 1984. 1.    2100.00    418.00
```

**WORKED EXAMPLE 5(a) – UNRESTRICTED DEMAND**

DEMAND UNREST

EX5A.log

Tutorial 5 Sub-Problem (a)

Time :15:46:52 Date :01/11/02

```
(F4.0,2F6.0, 2f12.2 )
5
SEASON
YEAR
REPLICATE
DEMAND 1          UNRS
DEMAND 2          UNRS
1. 1982. 1.    2700.00   2700.00
2. 1982. 1.    1300.00   1300.00
3. 1982. 1.    2100.00   2100.00
4. 1982. 1.    1500.00   1500.00
5. 1982. 1.    1600.00   1600.00
6. 1982. 1.     700.00   1700.00
7. 1982. 1.    1200.00   1200.00
8. 1982. 1.    1800.00   1800.00
9. 1982. 1.    2200.00   1200.00
10. 1982. 1.    1300.00   1300.00
11. 1982. 1.    1400.00   2400.00
12. 1982. 1.    1400.00   1400.00
1. 1983. 1.    1900.00   1900.00
2. 1983. 1.    1100.00   3100.00
3. 1983. 1.    1300.00   1300.00
4. 1983. 1.     800.00   1800.00
5. 1983. 1.      0.00   2000.00
6. 1983. 1.     600.00   1600.00
7. 1983. 1.     900.00   1900.00
8. 1983. 1.     300.00   1300.00
9. 1983. 1.     600.00   1600.00
10. 1983. 1.    1400.00   1400.00
11. 1983. 1.    2100.00   2100.00
12. 1983. 1.    2100.00   2100.00
1. 1984. 1.    1100.00   1100.00
2. 1984. 1.    2300.00   2300.00
3. 1984. 1.    2800.00   2800.00
4. 1984. 1.    1900.00   1900.00
5. 1984. 1.     300.00    300.00
6. 1984. 1.     600.00    600.00
7. 1984. 1.     600.00   1600.00
8. 1984. 1.     100.00   1100.00
9. 1984. 1.    1600.00   1600.00
10. 1984. 1.    1300.00   1300.00
11. 1984. 1.    2400.00   2400.00
12. 1984. 1.    2100.00   2100.00
```



demand data:

| No | Name     | No Bypass | S/F Priority | Monthly Factors |       |       |       |       |       |       |       |       |       |       |       |       |
|----|----------|-----------|--------------|-----------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
|    |          |           |              | Jan             | Feb   | Mar   | Apl   | May   | Jun   | Jul   | Aug   | Sep   | Oct   | Nov   | Dec   |       |
| 2  | DEMAND 1 | 2         | 1            | min             | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
|    |          |           |              | max             | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 1.000 |
| 3  | DEMAND 2 | 4         | 2            | min             | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
|    |          |           |              | max             | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 1.000 |

-----  
 | CARRIER INFORMATION |  
 -----

| No | Name      | Type  | From | To | Cost | Offset | Loss | Ann Vol | Shr Gp | Shr% | No |
|----|-----------|-------|------|----|------|--------|------|---------|--------|------|----|
| 1  | Carrier 1 | Pipe  | 1    | 2  | 0    | 0      | Ofix |         | 0      | 0%   | 1  |
| 2  | Carrier 2 | Pipe  | 1    | 3  | 0    | 0      | Ofix |         | 0      | 0%   | 2  |
| 3  | River 1   | River | 1    | 4  | 1000 | 0      | Ofix |         | 0      | 0%   | 3  |

-----  
 Maximum Flows

| No | Name      | Jan      | Feb      | Mar      | Apl      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec      |
|----|-----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|
| 1  | Carrier 1 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 |
| 2  | Carrier 2 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 |
| 3  | River 1   | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 |

-----  
 | TARGET INFORMATION |  
 -----

Number of target sets: 1

-----  
 Target set 1 ( Jan Feb Mar Apl May Jun Jul Aug Sep Oct Nov Dec )

| Name        | Draw | Pri | Targets |      |      |      |      |      |      |       |       |  |
|-------------|------|-----|---------|------|------|------|------|------|------|-------|-------|--|
| RESERVOIR A | 1    | 0   | 1333    | 2667 | 4000 | 5333 | 6667 | 8000 | 9333 | 10667 | 12000 |  |
| totals      |      | 0   | 1333    | 2667 | 4000 | 5333 | 6667 | 8000 | 9333 | 10667 | 12000 |  |

-----  
 | MULTI SYSTEM INFORMATION |  
 -----

-----  
 Reservoirs

RESERVOIR A 1

**WORKED EXAMPLE 5(b) – LOG FILE**

```

HHHHH      HHHHHHHH      HHHHHH      H      HHHHHHHHHH
H  H      H      H  H  H      H  H  H
HHHHHHHHH  HHHHHH      HHHHHHHH  HHH      HHH  H  H
HHH      H  HHH      HHH      H  HHH      HHH  H  H
HHH      H  HHH      HHH      H  HHH      HHH  H  H
HHH      H  HHHHHHHH  HHH      H  HHHHHHHH  HHH  H  H

```

```

*****
*      SIMULATION LOG FILE      *
*****

```

Log filename : EX5B.log

Scenario file: scn5b.scn

Simulation label:

Tutorial 5 Sub-Problem (b)

Streamflow file(s):

C:\REALM\WorkedExamples\Sf3.dat

Demand file(s):

C:\REALM\WorkedExamples\Dem2.dat

Restrictions are OFF

Instream flow requirements NOT limited to natural

Water quality calculations are OFF

Number of S/F Sequences: 1

```

Convergence tolerance (storage)  1 10th%
Other convergence tolerance      5 %
Arc convergence tolerance (abs)  100
Minimum iteration count          3
Maximum iteration count          51
Do convergence twice              No

```

Date: 15:57:53 01/11/02



Time Step = Monthly

SYSTEM CHANGES:

| No | Seas | Year | System File                      |
|----|------|------|----------------------------------|
| 1  | 1    | 1982 | C:\REALM\WorkedExamples\EX5B.sys |

Total number of seasons:- 36

\*\*\*\*\* RUN TIME MESSAGES:- \*\*\*\*\*

\*\*\*\*INPUT DATA TYPE= 1 \*\*\*\*

1982

C:\REALM\WorkedExamples\EX5B.sys

1983

1984

\*\*\*\*\* END RUN TIME MESSAGES \*\*\*\*\*

SUMMARY INFORMATION

Reservoir data:

|       | Name        | Start<br>Storage | File<br>Inflow | Min<br>Storage | Average<br>Storage | Evapn | Release<br>to river | Spill | End<br>Storage |
|-------|-------------|------------------|----------------|----------------|--------------------|-------|---------------------|-------|----------------|
| 1     | RESERVOIR A | 8000.            | 2083.          | 0.             | 1969.              | 0.    | 0.                  | 0.    | 0.             |
| ----- |             |                  |                |                |                    |       |                     |       |                |
|       |             | 8000.            | 2083.          | 0.             | 1969.              | 0.    | 0.                  | 0.    | 0.             |
| ----- |             |                  |                |                |                    |       |                     |       |                |

## Demand data:

|   | Name     | Unrestrict | Restrict | Rationed | Shortfall | Supplied |
|---|----------|------------|----------|----------|-----------|----------|
| 1 | DEMAND 1 | 1372.      | 1372.    | 1372.    | 499.      | 873.     |
| 2 | DEMAND 2 | 1706.      | 1706.    | 1706.    | 274.      | 1432.    |
|   |          | 3078.      | 3078.    | 3078.    | 773.      | 2305.    |

|   | Name     | No Rest | Ave Rest lvl | Max Rest lvl | No Ration | Ave % Ration | Max % Ration | No Short | Ave % Short | Max % Short |
|---|----------|---------|--------------|--------------|-----------|--------------|--------------|----------|-------------|-------------|
| 1 | DEMAND 1 | 0.0     | 0.0          | 0.0          | 0.0       | 0.0          | 0.0          | 14.0     | 78.1        | 100.0       |
| 2 | DEMAND 2 | 0.0     | 0.0          | 0.0          | 0.0       | 0.0          | 0.0          | 11.0     | 44.5        | 94.0        |

## Pipe/River flows:

|   | Name      | flow   | Capacity   | Min   | Max    | Loss |
|---|-----------|--------|------------|-------|--------|------|
| 1 | Carrier 1 | 873.2  | 99999999.0 | 0.0   | 2700.0 | 0.0  |
| 2 | Carrier 2 | 1431.8 | 99999999.0 | 160.0 | 2800.0 | 0.0  |
| 3 | River 1   | 0.0    | 99999999.0 | 0.0   | 0.0    | 0.0  |
|   |           |        |            |       |        | 0.   |

End run

**WORKED EXAMPLE 5(b) – RESERVOIR VOLUME**

RESERVOIR STORAGE

EX5B.log

Tutorial 5 Sub-Problem (b)

Time :15:57:53 Date :01/11/02

(F4.0,2F6.0, 1f12.2 )  
4

SEASON

YEAR

REPLICATE

| RESERVOIR A | ESTO |         |
|-------------|------|---------|
| 1. 1982.    | 1.   | 3016.00 |
| 2. 1982.    | 1.   | 704.00  |
| 3. 1982.    | 1.   | 0.00    |
| 4. 1982.    | 1.   | 0.00    |
| 5. 1982.    | 1.   | 1788.00 |
| 6. 1982.    | 1.   | 1637.00 |
| 7. 1982.    | 1.   | 471.00  |
| 8. 1982.    | 1.   | 0.00    |
| 9. 1982.    | 1.   | 0.00    |
| 10. 1982.   | 1.   | 0.00    |
| 11. 1982.   | 1.   | 0.00    |
| 12. 1982.   | 1.   | 0.00    |
| 1. 1983.    | 1.   | 0.00    |
| 2. 1983.    | 1.   | 0.00    |
| 3. 1983.    | 1.   | 0.00    |
| 4. 1983.    | 1.   | 1248.00 |
| 5. 1983.    | 1.   | 2468.00 |
| 6. 1983.    | 1.   | 1768.00 |
| 7. 1983.    | 1.   | 3608.00 |
| 8. 1983.    | 1.   | 5908.00 |
| 9. 1983.    | 1.   | 8308.00 |
| 10. 1983.   | 1.   | 7868.00 |
| 11. 1983.   | 1.   | 5691.00 |
| 12. 1983.   | 1.   | 4458.00 |
| 1. 1984.    | 1.   | 6684.00 |
| 2. 1984.    | 1.   | 2330.00 |
| 3. 1984.    | 1.   | 0.00    |
| 4. 1984.    | 1.   | 0.00    |
| 5. 1984.    | 1.   | 0.00    |
| 6. 1984.    | 1.   | 1633.00 |
| 7. 1984.    | 1.   | 341.00  |
| 8. 1984.    | 1.   | 1170.00 |
| 9. 1984.    | 1.   | 2570.00 |
| 10. 1984.   | 1.   | 5880.00 |
| 11. 1984.   | 1.   | 1329.00 |
| 12. 1984.   | 1.   | 0.00    |

**WORKED EXAMPLE 5(b) – CARRIER FLOWS**

CARRIER FLOWS

EX5B.log

Tutorial 5 Sub-Problem (b)

Time :15:57:53 Date :01/11/02

(F4.0,2F6.0, 3f12.2 )  
6

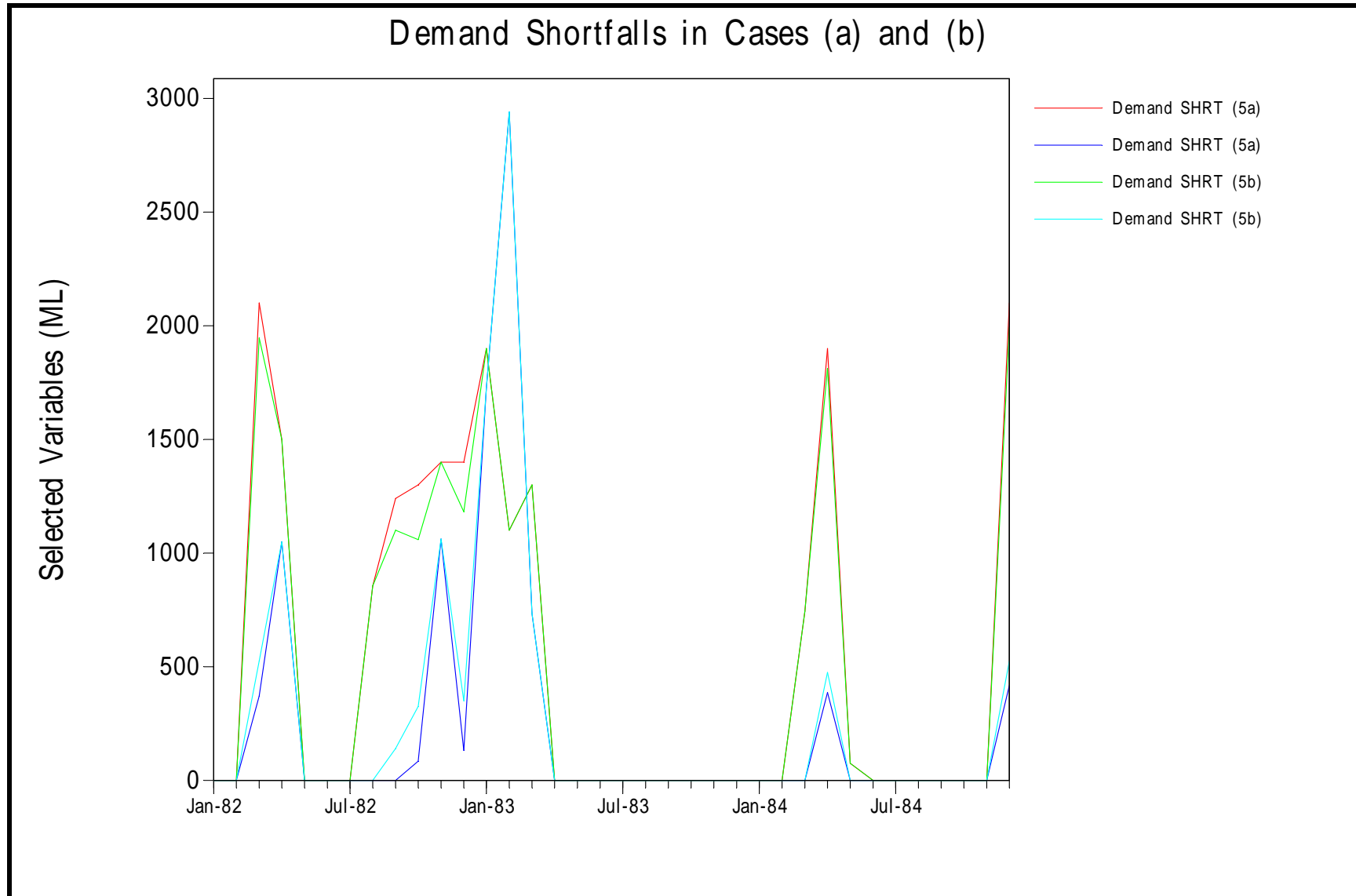
SEASON

YEAR

REPLICATE

| Carrier 1 | FLOW |         |         |      |
|-----------|------|---------|---------|------|
| Carrier 2 | FLOW |         |         |      |
| River 1   | FLOW |         |         |      |
| 1. 1982.  | 1.   | 2700.00 | 2700.00 | 0.00 |
| 2. 1982.  | 1.   | 1300.00 | 1300.00 | 0.00 |
| 3. 1982.  | 1.   | 154.00  | 1575.00 | 0.00 |
| 4. 1982.  | 1.   | 0.00    | 450.00  | 0.00 |
| 5. 1982.  | 1.   | 1600.00 | 1600.00 | 0.00 |
| 6. 1982.  | 1.   | 700.00  | 1700.00 | 0.00 |
| 7. 1982.  | 1.   | 1200.00 | 1200.00 | 0.00 |
| 8. 1982.  | 1.   | 944.00  | 1800.00 | 0.00 |
| 9. 1982.  | 1.   | 1100.00 | 1060.00 | 0.00 |
| 10. 1982. | 1.   | 241.00  | 975.00  | 0.00 |
| 11. 1982. | 1.   | 0.00    | 1338.00 | 0.00 |
| 12. 1982. | 1.   | 219.00  | 1050.00 | 0.00 |
| 1. 1983.  | 1.   | 0.00    | 172.00  | 0.00 |
| 2. 1983.  | 1.   | 0.00    | 160.00  | 0.00 |
| 3. 1983.  | 1.   | 0.00    | 566.00  | 0.00 |
| 4. 1983.  | 1.   | 800.00  | 1800.00 | 0.00 |
| 5. 1983.  | 1.   | 0.00    | 2000.00 | 0.00 |
| 6. 1983.  | 1.   | 600.00  | 1600.00 | 0.00 |
| 7. 1983.  | 1.   | 900.00  | 1900.00 | 0.00 |
| 8. 1983.  | 1.   | 300.00  | 1300.00 | 0.00 |
| 9. 1983.  | 1.   | 600.00  | 1600.00 | 0.00 |
| 10. 1983. | 1.   | 1400.00 | 1400.00 | 0.00 |
| 11. 1983. | 1.   | 2100.00 | 2100.00 | 0.00 |
| 12. 1983. | 1.   | 2100.00 | 2100.00 | 0.00 |
| 1. 1984.  | 1.   | 1100.00 | 1100.00 | 0.00 |
| 2. 1984.  | 1.   | 2300.00 | 2300.00 | 0.00 |
| 3. 1984.  | 1.   | 2056.00 | 2800.00 | 0.00 |
| 4. 1984.  | 1.   | 88.00   | 1425.00 | 0.00 |
| 5. 1984.  | 1.   | 225.00  | 300.00  | 0.00 |
| 6. 1984.  | 1.   | 600.00  | 600.00  | 0.00 |
| 7. 1984.  | 1.   | 600.00  | 1600.00 | 0.00 |
| 8. 1984.  | 1.   | 100.00  | 1100.00 | 0.00 |
| 9. 1984.  | 1.   | 1600.00 | 1600.00 | 0.00 |
| 10. 1984. | 1.   | 1300.00 | 1300.00 | 0.00 |
| 11. 1984. | 1.   | 2400.00 | 2400.00 | 0.00 |
| 12. 1984. | 1.   | 107.00  | 1575.00 | 0.00 |





**Figure 3.5-2 Worked Example 5(b) – Demand Shortfalls in Cases (a) and (b)**

### **3.6 WORKED EXAMPLE 6**

# **WATER QUALITY MODELLING**

**WORKED EXAMPLE 6 - DATA FILE: DEM.DAT**

```
#####3
DEMANDS DATA FILE
HISTORICAL DATA
DATA ASSEMBLED AND REFORMATED ON
DATE : 9 JUL 1990
( 3F12.2)
```

```
3
SEASON
YEAR
DEMAND 1
1.00 1982.00 2700.00
2.00 1982.00 1300.00
3.00 1982.00 2100.00
4.00 1982.00 1500.00
5.00 1982.00 1600.00
6.00 1982.00 700.00
7.00 1982.00 1200.00
8.00 1982.00 1800.00
9.00 1982.00 2200.00
10.00 1982.00 1300.00
11.00 1982.00 1400.00
12.00 1982.00 1400.00
1.00 1983.00 1900.00
2.00 1983.00 1100.00
3.00 1983.00 1300.00
4.00 1983.00 800.00
5.00 1983.00 0.00
6.00 1983.00 600.00
7.00 1983.00 900.00
8.00 1983.00 300.00
9.00 1983.00 600.00
10.00 1983.00 1400.00
11.00 1983.00 2100.00
12.00 1983.00 2100.00
1.00 1984.00 1100.00
2.00 1984.00 2300.00
3.00 1984.00 2800.00
4.00 1984.00 1900.00
5.00 1984.00 300.00
6.00 1984.00 600.00
7.00 1984.00 600.00
8.00 1984.00 100.00
9.00 1984.00 1600.00
10.00 1984.00 1300.00
11.00 1984.00 2400.00
12.00 1984.00 2100.00
```

**WORKED EXAMPLE 6 - DATA FILE: SF4.DAT**

```
#####2
STREAMFLOW DATA FILE
HISTORICAL MONTHLY STREAMFLOW DATAFILE
TEST DATA
DATE : 20 JUL 1990
( 4F12.2)
```

```
4
SEASON
YEAR
STREAM1
EC_VALUES
1.00 1982.00 416.00 500.00
2.00 1982.00 288.00 600.00
3.00 1982.00 1025.00 500.00
4.00 1982.00 450.00 450.00
5.00 1982.00 4988.00 420.00
6.00 1982.00 2249.00 400.00
7.00 1982.00 1234.00 380.00
8.00 1982.00 2273.00 350.00
9.00 1982.00 2160.00 400.00
10.00 1982.00 1216.00 450.00
11.00 1982.00 1338.00 480.00
12.00 1982.00 1269.00 500.00
1.00 1983.00 172.00 520.00
2.00 1983.00 160.00 600.00
3.00 1983.00 566.00 580.00
4.00 1983.00 3848.00 550.00
5.00 1983.00 3220.00 340.00
6.00 1983.00 1500.00 300.00
7.00 1983.00 4640.00 280.00
8.00 1983.00 3900.00 300.00
9.00 1983.00 4600.00 350.00
10.00 1983.00 2360.00 400.00
11.00 1983.00 2023.00 420.00
12.00 1983.00 2967.00 480.00
1.00 1984.00 4426.00 500.00
2.00 1984.00 246.00 520.00
3.00 1984.00 2526.00 500.00
4.00 1984.00 1513.00 450.00
5.00 1984.00 525.00 420.00
6.00 1984.00 2833.00 380.00
7.00 1984.00 908.00 350.00
8.00 1984.00 2029.00 400.00
9.00 1984.00 4600.00 500.00
10.00 1984.00 5910.00 550.00
11.00 1984.00 249.00 420.00
12.00 1984.00 353.00 480.00
```

## WORKED EXAMPLE 6 - DATA FILE: SF5.DAT

```

####2
STREAMFLOW DATA FILE
HISTORICAL MONTHLY STREAMFLOW DATAFILE
TEST DATA
DATE : 20 JUL 1990
( 6F12.2)
  6
SEASON
YEAR
STREAM1
PAN EVAP
LOCAL RAIN
EC_VALUES
  1.00    1982.00    416.00    32.10    33.80    500.00
  2.00    1982.00    288.00    32.40    32.40    600.00
  3.00    1982.00    1025.00   27.60    29.10    500.00
  4.00    1982.00    450.00    21.40    123.90   450.00
  5.00    1982.00    4988.00   16.00    119.60   420.00
  6.00    1982.00    2249.00   12.30    214.60   400.00
  7.00    1982.00    1234.00   11.90    315.50   380.00
  8.00    1982.00    2273.00   17.10    121.40   350.00
  9.00    1982.00    2160.00   17.00    20.60    400.00
 10.00    1982.00    1216.00   22.40    24.00    450.00
 11.00    1982.00    1338.00   30.00    31.50    480.00
 12.00    1982.00    1269.00   30.20    31.40    500.00
  1.00    1983.00    172.00    30.80    31.30    520.00
  2.00    1983.00    160.00    34.40    35.20    600.00
  3.00    1983.00    566.00    28.50    128.90   580.00
  4.00    1983.00    3848.00   19.70    221.10   550.00
  5.00    1983.00    3220.00   16.40    319.40   340.00
  6.00    1983.00    1500.00   11.30    216.00   300.00
  7.00    1983.00    4640.00   11.70    114.80   280.00
  8.00    1983.00    3900.00   13.70    17.50    300.00
  9.00    1983.00    4600.00   16.60    20.30    350.00
 10.00    1983.00    2360.00   20.10    123.20   400.00
 11.00    1983.00    2023.00   22.80    26.80    420.00
 12.00    1983.00    2967.00   29.00    30.80    480.00
  1.00    1984.00    4426.00   27.30    29.00    500.00
  2.00    1984.00    246.00    28.50    32.10    520.00
  3.00    1984.00    2526.00   24.10    26.70    500.00
  4.00    1984.00    1513.00   21.30    22.70    450.00
  5.00    1984.00    525.00    16.80    20.10    420.00
  6.00    1984.00    2833.00   14.60    117.30   380.00
  7.00    1984.00    908.00    11.60    214.40   350.00
  8.00    1984.00    2029.00   14.00    116.90   400.00
  9.00    1984.00    4600.00   15.40    17.80    500.00
 10.00    1984.00    5910.00   20.50    23.90    550.00
 11.00    1984.00    249.00    25.80    27.50    420.00
 12.00    1984.00    353.00    26.50    230.10   480.00

```



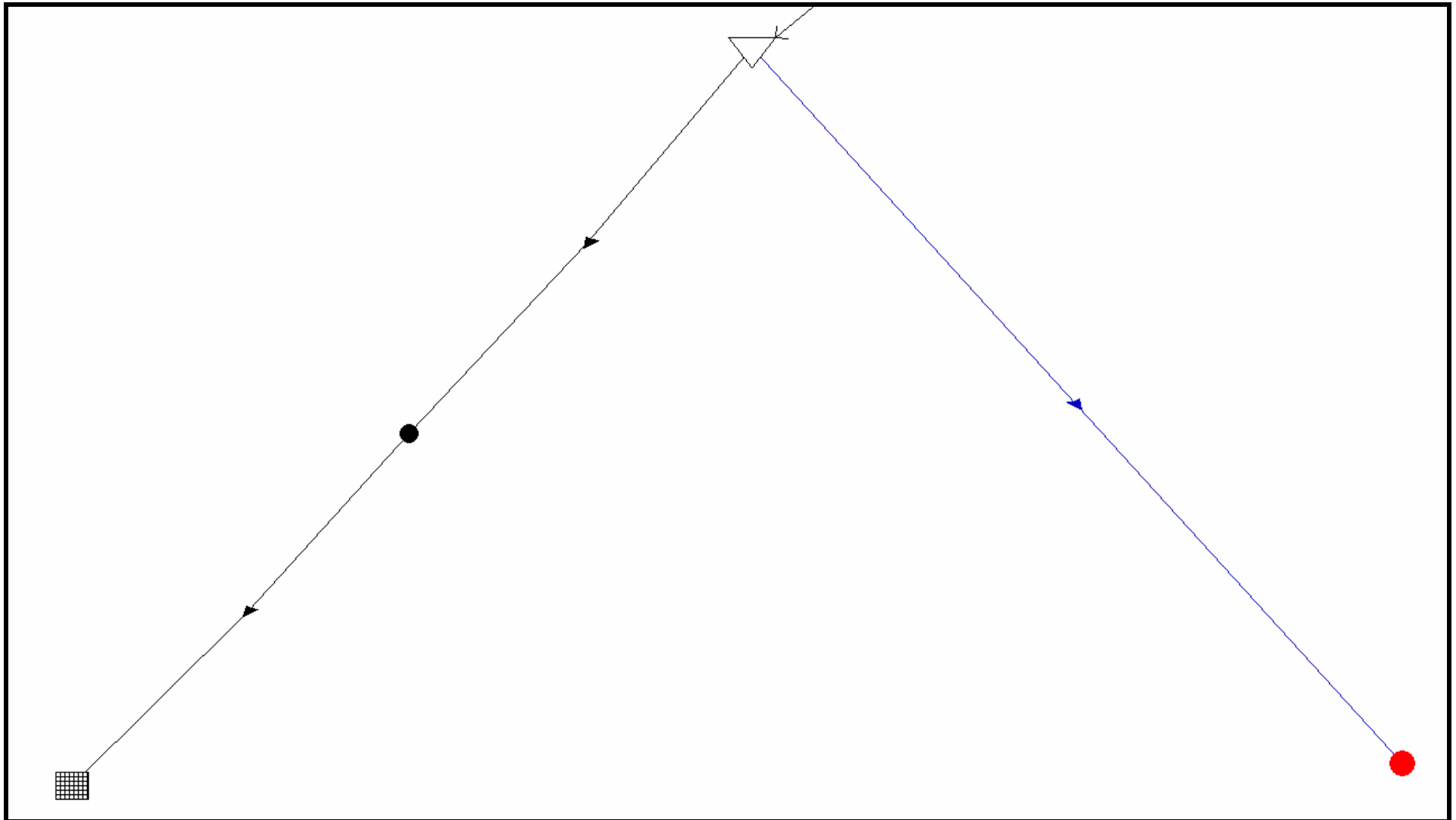


Figure 3.6-1 Worked Example 6 (a) – System Plot



demand data:

| No | Name     | No Bypass | S/F Priority | Monthly Factors |       |       |       |       |       |       |       |       |       |       |       |       |
|----|----------|-----------|--------------|-----------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
|    |          |           |              | Jan             | Feb   | Mar   | Apl   | May   | Jun   | Jul   | Aug   | Sep   | Oct   | Nov   | Dec   |       |
| 3  | DEMAND 1 | 1         | 1            | min             | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
|    |          |           |              | max             | 1.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |

-----  
 | CARRIER INFORMATION |  
 -----

| No | Name      | Type  | From | To | Cost | Offset | Loss | Ann Vol | Shr Gp | Shr% | No |
|----|-----------|-------|------|----|------|--------|------|---------|--------|------|----|
| 1  | Carrier 1 | Pipe  | 1    | 2  | 0    | 0      | Ofix |         | 0      | 0%   | 1  |
| 2  | Carrier 2 | Pipe  | 2    | 3  | 0    | 0      | Ofix |         | 0      | 0%   | 2  |
| 3  | Carrier 3 | River | 1    | 4  | 1000 | 0      | Ofix |         | 0      | 0%   | 3  |

Maximum Flows

| No | Name      | Jan      | Feb      | Mar      | Apl      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec      |
|----|-----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|
| 1  | Carrier 1 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 |
| 3  | Carrier 3 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 |

Functional Capacities

| No  | Name      | pt1      | pt2              | pt3   | pt4        | pt5   | pt6   | pt7   | pt8   | pt9   | pt10  | pt11  | pt12  |
|---|-----------|----------|------------------|-------|------------|-------|-------|-------|-------|-------|-------|-------|-------|
| 2   | Carrier 2 | V        | 0                | 400   | 4019999999 | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     |
|   | Fn Name:  | C        | 9999999999999999 | 0     | 0          | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     |
| Equation used: '1                           |           |          |                  |       |            |       |       |       |       |       |       |       |       |
| ' 1 = Reservoir 1                           |           | Type: EC |                  |       |            |       |       |       |       |       |       |       |       |
| Capacity set option (0-off 1-prev 2-recalc) |           | Jan=2    | Feb=2            | Mar=2 | Apl=2      | May=2 | Jun=2 | Jul=2 | Aug=2 | Sep=2 | Oct=2 | Nov=2 | Dec=2 |

-----  
 | W/QUALITY INFORMATION |  
 -----

| No | Carrier Name | ec | turb | Blocked out to | W/qual Reference |
|----|--------------|----|------|----------------|------------------|
|    |              |    |      |                |                  |

1 = blocked out, 0 = still allowed

| No | Node Name   | W/qual Ref | W/qual S/F Name | W/Qual Fixed | Wqual loss |
|----|-------------|------------|-----------------|--------------|------------|
| 1  | Reservoir 1 | ec         | EC_VALUES       | 0.0000       | 0.0000     |
|    |             | turb       |                 | 1000.0000    | 0.0000     |

**WORKED EXAMPLE 6(a) – LOG FILE**

```

HHHHH      HHHHHHHH      HHHHHH      H      HHHHHHHHHH
H  H      H      H  H  H      H  H  H
HHHHHHHHH  HHHHHH      HHHHHHHH  HHH      HHH  H  H
HHH  H  HHH      HHH  H  HHH      HHH  H  H
HHH  H  HHH      HHH  H  HHH      HHH  H  H
HHH  H  HHHHHHHH  HHH  H  HHHHHHHH  HHH  H  H

```

```

*****
*      SIMULATION LOG FILE      *
*****

```

Log filename : EX6A.log

Scenario file: scn6a.scn

Simulation label:

Tutorial 6 - Sub-Problem (a)

Streamflow file(s):

C:\REALM\WorkedExamples\sف4.dat

Demand file(s):

C:\REALM\WorkedExamples\Dem.dat

Restrictions are OFF

Instream flow requirements NOT limited to natural

Water quality calculations are ON

Water qual start file = startec

Water qual start file = starturb

Number of S/F Sequences: 1

Convergence tolerance (storage) 1 10th%

Other convergence tolerance 5 %

Arc convergence tolerance (abs) 100

Minimum iteration count 3

Maximum iteration count 51

Do convergence twice No

Date: 16:53:44 12/11/01

Time Step = Monthly

SYSTEM CHANGES:

| No | Seas | Year | System File                      |
|----|------|------|----------------------------------|
| 1  | 1    | 1982 | C:\REALM\WorkedExamples\EX6A.sys |

Total number of seasons:- 36

\*\*\*\*\* RUN TIME MESSAGES:- \*\*\*\*\*

\*\*\*\*INPUT DATA TYPE= 1 \*\*\*\*

1982

C:\REALM\WorkedExamples\EX6A.sys

1983

1984

\*\*\*\*\* END RUN TIME MESSAGES \*\*\*\*\*

SUMMARY INFORMATION

Reservoir data:

| Name          | Start Storage | File Inflow | Min Storage | Average Storage | Evapn | Release to river | Spill | End Storage |
|---------------|---------------|-------------|-------------|-----------------|-------|------------------|-------|-------------|
| 1 Reservoir 1 | 10000.        | 2083.       | 4579.       | 15079.          | 0.    | 1061.            | 0.    | 20000.      |
|               | 10000.        | 2083.       | 0.          | 15079.          | 0.    | 1061.            | 0.    | 20000.      |

Demand data:

| Name       | Unrestrict | Restrict | Rationed | Shortfall | Supplied |
|------------|------------|----------|----------|-----------|----------|
| 1 DEMAND 1 | 1372.      | 1372.    | 1372.    | 628.      | 744.     |
|            | 1372.      | 1372.    | 1372.    | 628.      | 744.     |

| Name       | No Rest | Ave Rest lvl | Max Rest lvl | No Ration | Ave % Ration | Max % Ration | No Short | Ave % Short | Max % Short |
|------------|---------|--------------|--------------|-----------|--------------|--------------|----------|-------------|-------------|
| 1 DEMAND 1 | 0.0     | 0.0          | 0.0          | 0.0       | 0.0          | 0.0          | 17.0     | 100.0       | 100.0       |

## Pipe/River flows:

|   | Name      | flow   | Capacity   | Min | Max    | Loss |
|---|-----------|--------|------------|-----|--------|------|
| 1 | Carrier 1 | 744.4  | 99999999.0 | 0.0 | 2700.0 | 0.0  |
| 2 | Carrier 2 | 744.4  | 50000000.0 | 0.0 | 2700.0 | 0.0  |
| 3 | Carrier 3 | 1060.6 | 99999999.0 | 0.0 | 5910.0 | 0.0  |

---

0.

---

## Reservoir water quality summary (averages)

|   | Name        | ec    | turb   |
|---|-------------|-------|--------|
| 1 | Reservoir 1 | 387.0 | 1000.0 |

---

387.0      1000.0

---

## Reservoir water quality summary (maximums)

|   | Name        | ec    | turb   |
|---|-------------|-------|--------|
| 1 | Reservoir 1 | 458.0 | 1000.0 |

## Carrier water quality summary (averages)

|   | Name      | ec    | turb  |
|---|-----------|-------|-------|
| 1 | Carrier 1 | 174.0 | 500.0 |
| 2 | Carrier 2 | 174.0 | 500.0 |
| 3 | Carrier 3 | 196.4 | 472.2 |

---

544.4      1472.2

---

## Carrier water quality summary (maximums)

|   | Name      | ec    | turb   |
|---|-----------|-------|--------|
| 1 | Carrier 1 | 412.4 | 1000.0 |
| 2 | Carrier 2 | 412.4 | 1000.0 |
| 3 | Carrier 3 | 458.0 | 1000.0 |

---

End run

## WORKED EXAMPLE 6(a)

####4

EX6A.log

Time :16:53:44 Date :12/11/01

Tutorial 6 - Sub-Problem (a)

( 9f12.2 )  
9

SEASON

YEAR

Reservoir 1

ec

Carrier 1

FLOW

Carrier 2

FLOW

Carrier 3

FLOW

Carrier 1

CAPC

Carrier 2

CAPC

Carrier 3

CAPC

|       |         |        |         |         |  |
|-------|---------|--------|---------|---------|--|
| 1.00  | 1982.00 | 212.00 | 2700.00 | 2700.00 | 0.001000000000.001000000000.001000000000.00    |
| 2.00  | 1982.00 | 226.00 | 1300.00 | 1300.00 | 0.001000000000.001000000000.001000000000.00    |
| 3.00  | 1982.00 | 262.00 | 2100.00 | 2100.00 | 0.001000000000.001000000000.001000000000.00    |
| 4.00  | 1982.00 | 276.00 | 1500.00 | 1500.00 | 0.001000000000.001000000000.001000000000.00    |
| 5.00  | 1982.00 | 351.00 | 1600.00 | 1600.00 | 0.001000000000.001000000000.001000000000.00    |
| 6.00  | 1982.00 | 362.00 | 700.00  | 700.00  | 0.001000000000.001000000000.001000000000.00    |
| 7.00  | 1982.00 | 364.00 | 1200.00 | 1200.00 | 0.001000000000.001000000000.001000000000.00    |
| 8.00  | 1982.00 | 361.00 | 1800.00 | 1800.00 | 0.001000000000.001000000000.001000000000.00    |
| 9.00  | 1982.00 | 368.00 | 2200.00 | 2200.00 | 0.001000000000.001000000000.001000000000.00    |
| 10.00 | 1982.00 | 377.00 | 1300.00 | 1300.00 | 0.001000000000.001000000000.001000000000.00    |
| 11.00 | 1982.00 | 389.00 | 1400.00 | 1400.00 | 0.001000000000.001000000000.001000000000.00    |
| 12.00 | 1982.00 | 402.00 | 1400.00 | 1400.00 | 0.001000000000.001000000000.001000000000.00    |
| 1.00  | 1983.00 | 404.00 | 0.00    | 0.00    | 0.001000000000.00 0.001000000000.00            |
| 2.00  | 1983.00 | 407.00 | 0.00    | 0.00    | 0.001000000000.00 0.001000000000.00            |
| 3.00  | 1983.00 | 416.00 | 0.00    | 0.00    | 0.001000000000.00 0.001000000000.00            |
| 4.00  | 1983.00 | 452.00 | 0.00    | 0.00    | 0.001000000000.00 0.001000000000.00            |
| 5.00  | 1983.00 | 432.00 | 0.00    | 0.00    | 0.001000000000.00 0.001000000000.00            |
| 6.00  | 1983.00 | 421.00 | 0.00    | 0.00    | 0.001000000000.00 0.001000000000.00            |
| 7.00  | 1983.00 | 394.00 | 0.00    | 0.00    | 3812.001000000000.00 0.001000000000.00         |
| 8.00  | 1983.00 | 378.00 | 300.00  | 300.00  | 3600.001000000000.001000000000.001000000000.00 |
| 9.00  | 1983.00 | 373.00 | 600.00  | 600.00  | 4000.001000000000.001000000000.001000000000.00 |
| 10.00 | 1983.00 | 376.00 | 1400.00 | 1400.00 | 960.001000000000.001000000000.001000000000.00  |
| 11.00 | 1983.00 | 380.00 | 2100.00 | 2100.00 | 0.001000000000.001000000000.001000000000.00    |
| 12.00 | 1983.00 | 393.00 | 2100.00 | 2100.00 | 790.001000000000.001000000000.001000000000.00  |
| 1.00  | 1984.00 | 412.00 | 1100.00 | 1100.00 | 3326.001000000000.001000000000.001000000000.00 |
| 2.00  | 1984.00 | 414.00 | 0.00    | 0.00    | 246.001000000000.00 0.001000000000.00          |
| 3.00  | 1984.00 | 423.00 | 0.00    | 0.00    | 2526.001000000000.00 0.001000000000.00         |
| 4.00  | 1984.00 | 425.00 | 0.00    | 0.00    | 1513.001000000000.00 0.001000000000.00         |
| 5.00  | 1984.00 | 425.00 | 0.00    | 0.00    | 525.001000000000.00 0.001000000000.00          |
| 6.00  | 1984.00 | 419.00 | 0.00    | 0.00    | 2833.001000000000.00 0.001000000000.00         |
| 7.00  | 1984.00 | 416.00 | 0.00    | 0.00    | 908.001000000000.00 0.001000000000.00          |
| 8.00  | 1984.00 | 415.00 | 0.00    | 0.00    | 2029.001000000000.00 0.001000000000.00         |
| 9.00  | 1984.00 | 431.00 | 0.00    | 0.00    | 4600.001000000000.00 0.001000000000.00         |
| 10.00 | 1984.00 | 458.00 | 0.00    | 0.00    | 5910.001000000000.00 0.001000000000.00         |
| 11.00 | 1984.00 | 458.00 | 0.00    | 0.00    | 249.001000000000.00 0.001000000000.00          |
| 12.00 | 1984.00 | 458.00 | 0.00    | 0.00    | 353.001000000000.00 0.001000000000.00          |

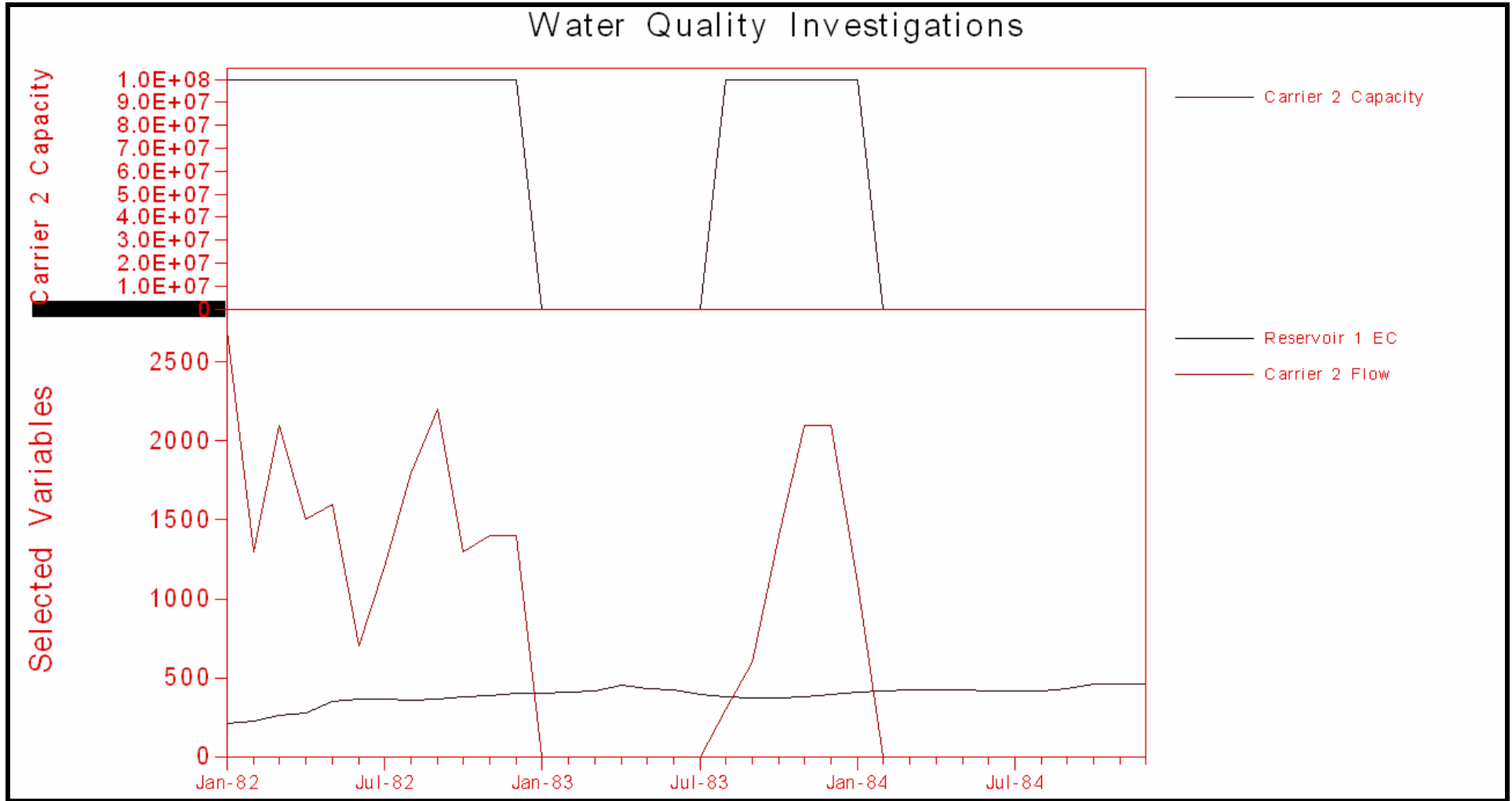


Figure 3.6-2 Worked Example 6(a) – Water Quality Investigations



**WORKED EXAMPLE 6(b) – SYSTEM LISTING**


---

R     E     A     L     M

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\*\*\*\*\*  
 \*    SYSTEM FILE LISTING    \*  
 \*\*\*\*\*

File: C:\REALM\WorkedExamples\EX6B.sys

Simulation label:  
 Tutorial 6 - Sub-Problem (b)

Date: 10:14:19 12/18/01

-----  
 |    NODE INFORMATION    |  
 -----

| No | Name              | Type            | X     | Y     | Z    | Size | Aux Input | No |
|----|-------------------|-----------------|-------|-------|------|------|-----------|----|
| 1  | Reservoir 1       | Reservoir       | 51.01 | 95.00 | 0.00 | 1.00 | STREAM1   | 1  |
| 2  | Pipe Junction 1   | Pipe junction   | 27.78 | 47.99 | 0.00 | 1.00 |           | 2  |
| 3  | DEMAND 1          | Demand          | 5.00  | 5.00  | 0.00 | 1.00 |           | 3  |
| 4  | Stream Terminator | Strm terminator | 95.00 | 7.73  | 0.00 | 1.00 |           | 4  |

Reservoir data:

| No | Name        | Min<br>Cap | Max<br>Cap | No<br>Above | No<br>Below | Spill<br>Type |
|----|-------------|------------|------------|-------------|-------------|---------------|
| 1  | Reservoir 1 | 0          | 20000      | 1           | 1           | Downstream    |

Reservoir evaps: (if A=B=0 evaps not calculated!)

| No | Name        | NET EVAP = | (A    | +        | B          | * EVAPORATION) | - | RAINFALL |
|----|-------------|------------|-------|----------|------------|----------------|---|----------|
| 1  | Reservoir 1 | 0.500      | 3.000 | PAN EVAP | LOCAL RAIN |                |   |          |

| No | Name        | Surface area/volume relationships |     |     |      |      |      |      |      |       |       |       |
|----|-------------|-----------------------------------|-----|-----|------|------|------|------|------|-------|-------|-------|
|    |             | pt1                               | pt2 | pt3 | pt4  | pt5  | pt6  | pt7  | pt8  | pt9   | pt10  |       |
| 1  | Reservoir 1 | Vol                               | 0   | 500 | 1000 | 4000 | 6000 | 8000 | 9000 | 10000 | 11000 | 12000 |
|    |             | Area                              | 0   | 10  | 30   | 40   | 50   | 60   | 70   | 80    | 90    | 100   |

| No | Name        | Levels/volume relationships |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
|----|-------------|-----------------------------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|
|    |             | pt1                         | pt2  | pt3  | pt4  | pt5  | pt6  | pt7  | pt8  | pt9  | pt10 | pt11 | pt12 | pt13 | pt14 | pt15 |
| 1  | Reservoir 1 | Vol                         | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    |
|    |             | Lvl                         | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

demand data:

| No | Name     | No Bypass | S/F Priority | Monthly Factors |       |       |       |       |       |       |       |       |       |       |       |
|----|----------|-----------|--------------|-----------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
|    |          |           |              | Jan             | Feb   | Mar   | Apl   | May   | Jun   | Jul   | Aug   | Sep   | Oct   | Nov   | Dec   |
| 3  | DEMAND 1 | 1         | 1            | min             | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
|    |          |           |              | max             | 1.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |

-----  
 | CARRIER INFORMATION |  
 -----

| No | Name      | Type  | From | To | Cost | Offset | Loss | Ann Vol | Shr Gp | Shr% | No |
|----|-----------|-------|------|----|------|--------|------|---------|--------|------|----|
| 1  | Carrier 1 | Pipe  | 1    | 2  | 0    | 0      | Ofix |         | 0      | 0%   | 1  |
| 2  | Carrier 2 | Pipe  | 2    | 3  | 0    | 0      | Ofix |         | 0      | 0%   | 2  |
| 3  | Carrier 3 | River | 1    | 4  | 1000 | 0      | Ofix |         | 0      | 0%   | 3  |

| Maximum Flows |           |          |          |          |          |          |          |          |          |          |          |          |          |  |  |
|---------------|-----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|--|--|
| No            | Name      | Jan      | Feb      | Mar      | Apl      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec      |  |  |
| 1             | Carrier 1 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 |  |  |
| 3             | Carrier 3 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 | 99999999 |  |  |

| Functional Capacities   |           |     |                  |     |            |     |     |     |     |     |      |      |      |  |  |  |
|---|-----------|-----|------------------|-----|------------|-----|-----|-----|-----|-----|------|------|------|--|--|--|
| No  | Name      | pt1 | pt2              | pt3 | pt4        | pt5 | pt6 | pt7 | pt8 | pt9 | pt10 | pt11 | pt12 |  |  |  |
| 2   | Carrier 2 | V   | 0                | 400 | 4019999999 | 0   | 0   | 0   | 0   | 0   | 0    | 0    | 0    |  |  |  |
|   | Fn Name:  | C   | 9999999999999999 | 0   | 0          | 0   | 0   | 0   | 0   | 0   | 0    | 0    | 0    |  |  |  |
| Equation used: '1   |           |     |                  |     |            |     |     |     |     |     |      |      |      |  |  |  |
| ' 1 = Reservoir 1                      Type: EC   |           |     |                  |     |            |     |     |     |     |     |      |      |      |  |  |  |
| Capacity set option (0-off 1-prev 2-recalc) Jan=2   Feb=2   Mar=2   Apl=2   May=2   Jun=2   Jul=2   Aug=2   Sep=2   Oct=2   Nov=2   Dec=2 |           |     |                  |     |            |     |     |     |     |     |      |      |      |  |  |  |



**WORKED EXAMPLE 6(b) – LOG FILE**

```

HHHHH      HHHHHHHH      HHHHHH      H      HHHHHHHHHH
H  H      H      H  H  H      H  H  H
HHHHHHHHH  HHHHHH      HHHHHHHH  HHH      HHH  H  H
HHH  H  HHH      HHH  H  HHH      HHH  H  H
HHH  H  HHH      HHH  H  HHH      HHH  H  H
HHH  H  HHHHHHHH  HHH  H  HHHHHHHH  HHH  H  H

```

```

*****
*      SIMULATION LOG FILE      *
*****

```

Log filename : EX6B.log

Scenario file: scn6b.scn

Simulation label:

Tutorial 6 - Sub-Problem (b)

Streamflow file(s):

C:\REALM\WorkedExamples\sف5.dat

Demand file(s):

C:\REALM\WorkedExamples\Dem.dat

Restrictions are OFF

Instream flow requirements NOT limited to natural

Water quality calculations are ON

Water qual start file = startec

Water qual start file = starturb

Number of S/F Sequences: 1

Convergence tolerance (storage) 1 10th%

Other convergence tolerance 5 %

Arc convergence tolerance (abs) 100

Minimum iteration count 3

Maximum iteration count 51

Do convergence twice No

Date: 10:19:02 12/18/01

Time Step = Monthly

SYSTEM CHANGES:

| No | Seas | Year | System File                      |
|----|------|------|----------------------------------|
| 1  | 1    | 1982 | C:\REALM\WorkedExamples\EX6B.sys |

Total number of seasons:- 36

\*\*\*\*\* RUN TIME MESSAGES:- \*\*\*\*\*

\*\*\*\*INPUT DATA TYPE= 1 \*\*\*\*

1982

C:\REALM\WorkedExamples\EX6B.sys

1983

1984

\*\*\*\*\* END RUN TIME MESSAGES \*\*\*\*\*

SUMMARY INFORMATION

Reservoir data:

| Name          | Start Storage | File Inflow | Min Storage | Average Storage | Evapn | Release to river | Spill | End Storage |
|---------------|---------------|-------------|-------------|-----------------|-------|------------------|-------|-------------|
| 1 Reservoir 1 | 10000.        | 2083.       | 4492.       | 14839.          | -26.  | 1034.            | 0.    | 20000.      |
|               | 10000.        | 2083.       | 0.          | 14839.          | -26.  | 1034.            | 0.    | 20000.      |

Demand data:

| Name       | Unrestrict | Restrict | Rationed | Shortfall | Supplied |
|------------|------------|----------|----------|-----------|----------|
| 1 DEMAND 1 | 1372.      | 1372.    | 1372.    | 575.      | 797.     |
|            | 1372.      | 1372.    | 1372.    | 575.      | 797.     |

| Name       | No Rest | Ave Rest lvl | Max Rest lvl | No Ration | Ave % Ration | Max % Ration | No Short | Ave % Short | Max % Short |
|------------|---------|--------------|--------------|-----------|--------------|--------------|----------|-------------|-------------|
| 1 DEMAND 1 | 0.0     | 0.0          | 0.0          | 0.0       | 0.0          | 0.0          | 16.0     | 100.0       | 100.0       |

## Pipe/River flows:

|   | Name      | flow   | Capacity   | Min | Max    | Loss |
|---|-----------|--------|------------|-----|--------|------|
| 1 | Carrier 1 | 797.2  | 99999999.0 | 0.0 | 2700.0 | 0.0  |
| 2 | Carrier 2 | 797.2  | 52341630.7 | 0.0 | 2700.0 | 0.0  |
| 3 | Carrier 3 | 1034.1 | 99999999.0 | 0.0 | 5839.0 | 0.0  |

-----  
0.  
-----

## Reservoir water quality summary (averages)

|   | Name        | ec    | turb  |
|---|-------------|-------|-------|
| 1 | Reservoir 1 | 383.8 | 991.3 |

-----  
383.8      991.3  
-----

## Reservoir water quality summary (maximums)

|   | Name        | ec    | turb   |
|---|-------------|-------|--------|
| 1 | Reservoir 1 | 457.0 | 1011.8 |

## Carrier water quality summary (averages)

|   | Name      | ec    | turb  |
|---|-----------|-------|-------|
| 1 | Carrier 1 | 183.2 | 522.8 |
| 2 | Carrier 2 | 183.2 | 522.8 |
| 3 | Carrier 3 | 194.5 | 467.9 |

-----  
560.9      1513.4  
-----

## Carrier water quality summary (maximums)

|   | Name      | ec    | turb   |
|---|-----------|-------|--------|
| 1 | Carrier 1 | 410.4 | 1011.8 |
| 2 | Carrier 2 | 410.4 | 1011.8 |
| 3 | Carrier 3 | 457.0 | 1009.8 |

-----  
End run

## WORKED EXAMPLE 6(b) TURBIDITY

####4

EX6Aturb.rv + EX6Bturb.rv + EX6Bevap.rv Time :16:53:44 Date :12/11/01  
 water quality modelling without evaps - ex6a  
 water quality modelling with evaps - ex6b

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SEASON

YEAR

| Reservoir 1 | turb    |         |         |         |
|-------------|---------|---------|---------|---------|
| Reservoir 1 | turb    |         |         |         |
| Reservoir 1 | EVAP    |         |         |         |
| 1.00        | 1982.00 | 1000.00 | 1005.00 | 49.00   |
| 2.00        | 1982.00 | 1000.00 | 1009.00 | 37.00   |
| 3.00        | 1982.00 | 1000.00 | 1012.00 | 29.00   |
| 4.00        | 1982.00 | 1000.00 | 1006.00 | -28.00  |
| 5.00        | 1982.00 | 1000.00 | 1000.00 | -30.00  |
| 6.00        | 1982.00 | 1000.00 | 990.00  | -105.00 |
| 7.00        | 1982.00 | 1000.00 | 972.00  | -209.00 |
| 8.00        | 1982.00 | 1000.00 | 973.00  | -54.00  |
| 9.00        | 1982.00 | 1000.00 | 980.00  | 25.00   |
| 10.00       | 1982.00 | 1000.00 | 985.00  | 34.00   |
| 11.00       | 1982.00 | 1000.00 | 990.00  | 47.00   |
| 12.00       | 1982.00 | 1000.00 | 996.00  | 47.00   |
| 1.00        | 1983.00 | 1000.00 | 1001.00 | 48.00   |
| 2.00        | 1983.00 | 1000.00 | 1005.00 | 40.00   |
| 3.00        | 1983.00 | 1000.00 | 1002.00 | -25.00  |
| 4.00        | 1983.00 | 1000.00 | 993.00  | -107.00 |
| 5.00        | 1983.00 | 1000.00 | 977.00  | -289.00 |
| 6.00        | 1983.00 | 1000.00 | 965.00  | -259.00 |
| 7.00        | 1983.00 | 1000.00 | 967.00  | -125.00 |
| 8.00        | 1983.00 | 1000.00 | 974.00  | 44.00   |
| 9.00        | 1983.00 | 1000.00 | 981.00  | 56.00   |
| 10.00       | 1983.00 | 1000.00 | 978.00  | -112.00 |
| 11.00       | 1983.00 | 1000.00 | 983.00  | 76.00   |
| 12.00       | 1983.00 | 1000.00 | 990.00  | 100.00  |
| 1.00        | 1984.00 | 1000.00 | 996.00  | 94.00   |
| 2.00        | 1984.00 | 1000.00 | 1001.00 | 99.00   |
| 3.00        | 1984.00 | 1000.00 | 1004.00 | 81.00   |
| 4.00        | 1984.00 | 1000.00 | 1007.00 | 72.00   |
| 5.00        | 1984.00 | 1000.00 | 1010.00 | 56.00   |
| 6.00        | 1984.00 | 1000.00 | 1003.00 | -128.00 |
| 7.00        | 1984.00 | 1000.00 | 988.00  | -319.00 |
| 8.00        | 1984.00 | 1000.00 | 983.00  | -134.00 |
| 9.00        | 1984.00 | 1000.00 | 988.00  | 49.00   |
| 10.00       | 1984.00 | 1000.00 | 994.00  | 71.00   |
| 11.00       | 1984.00 | 1000.00 | 998.00  | 90.00   |
| 12.00       | 1984.00 | 1000.00 | 985.00  | -267.00 |

## WORKED EXAMPLE 6(b) ELECTRICAL CONDUCTIVITY

####4

EX6Aec.rv + EX6Bec.rv + EX6Bevap.rv Time :16:53:44 Date :12/11/01  
 water quality modelling without evap - ex6a  
 water quality modelling with evap - ex6b

( 5f12.2 )  
 5

SEASON

YEAR

| Reservoir 1 | ec      |        |        |         |
|-------------|---------|--------|--------|---------|
| Reservoir 1 | ec      |        |        |         |
| Reservoir 1 | EVAP    |        |        |         |
| 1.00        | 1982.00 | 212.00 | 213.00 | 49.00   |
| 2.00        | 1982.00 | 226.00 | 228.00 | 37.00   |
| 3.00        | 1982.00 | 262.00 | 266.00 | 29.00   |
| 4.00        | 1982.00 | 276.00 | 278.00 | -28.00  |
| 5.00        | 1982.00 | 351.00 | 352.00 | -30.00  |
| 6.00        | 1982.00 | 362.00 | 359.00 | -105.00 |
| 7.00        | 1982.00 | 364.00 | 354.00 | -209.00 |
| 8.00        | 1982.00 | 361.00 | 352.00 | -54.00  |
| 9.00        | 1982.00 | 368.00 | 361.00 | 25.00   |
| 10.00       | 1982.00 | 377.00 | 371.00 | 34.00   |
| 11.00       | 1982.00 | 389.00 | 386.00 | 47.00   |
| 12.00       | 1982.00 | 402.00 | 400.00 | 47.00   |
| 1.00        | 1983.00 | 404.00 | 404.00 | 48.00   |
| 2.00        | 1983.00 | 407.00 | 410.00 | 40.00   |
| 3.00        | 1983.00 | 416.00 | 420.00 | -25.00  |
| 4.00        | 1983.00 | 452.00 | 455.00 | -107.00 |
| 5.00        | 1983.00 | 432.00 | 425.00 | -289.00 |
| 6.00        | 1983.00 | 421.00 | 408.00 | -259.00 |
| 7.00        | 1983.00 | 394.00 | 380.00 | -125.00 |
| 8.00        | 1983.00 | 378.00 | 367.00 | 44.00   |
| 9.00        | 1983.00 | 373.00 | 365.00 | 56.00   |
| 10.00       | 1983.00 | 376.00 | 367.00 | -112.00 |
| 11.00       | 1983.00 | 380.00 | 373.00 | 76.00   |
| 12.00       | 1983.00 | 393.00 | 389.00 | 100.00  |
| 1.00        | 1984.00 | 412.00 | 410.00 | 94.00   |
| 2.00        | 1984.00 | 414.00 | 414.00 | 99.00   |
| 3.00        | 1984.00 | 423.00 | 425.00 | 81.00   |
| 4.00        | 1984.00 | 425.00 | 428.00 | 72.00   |
| 5.00        | 1984.00 | 425.00 | 429.00 | 56.00   |
| 6.00        | 1984.00 | 419.00 | 421.00 | -128.00 |
| 7.00        | 1984.00 | 416.00 | 411.00 | -319.00 |
| 8.00        | 1984.00 | 415.00 | 408.00 | -134.00 |
| 9.00        | 1984.00 | 431.00 | 426.00 | 49.00   |
| 10.00       | 1984.00 | 458.00 | 455.00 | 71.00   |
| 11.00       | 1984.00 | 458.00 | 457.00 | 90.00   |
| 12.00       | 1984.00 | 458.00 | 452.00 | -267.00 |

**WORKED EXAMPLE 6(b) CARRIER FLOW/CAPACITY**

####4

EX6Bec.rv + EX6Bflow.ar + EX6Bcapc.ar  
 water quality modelling - ex6b  
 Reservoir evaporation considered

Time :10:19:02 Date :12/18/01

( 9f12.2 )  
 9

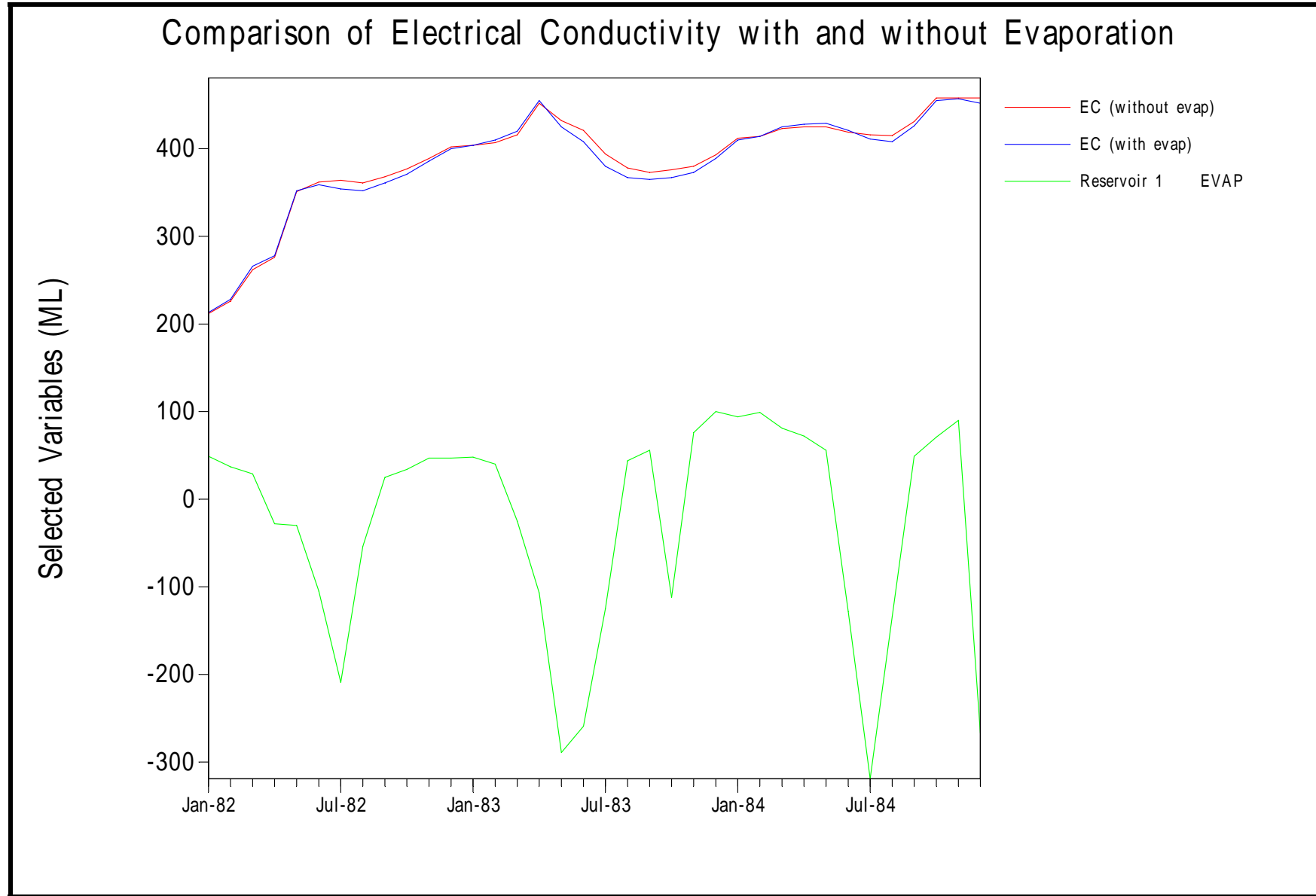
SEASON  
 YEAR

Reservoir 1  
 Carrier 1  
 Carrier 2  
 Carrier 3  
 Carrier 1  
 Carrier 2  
 Carrier 3

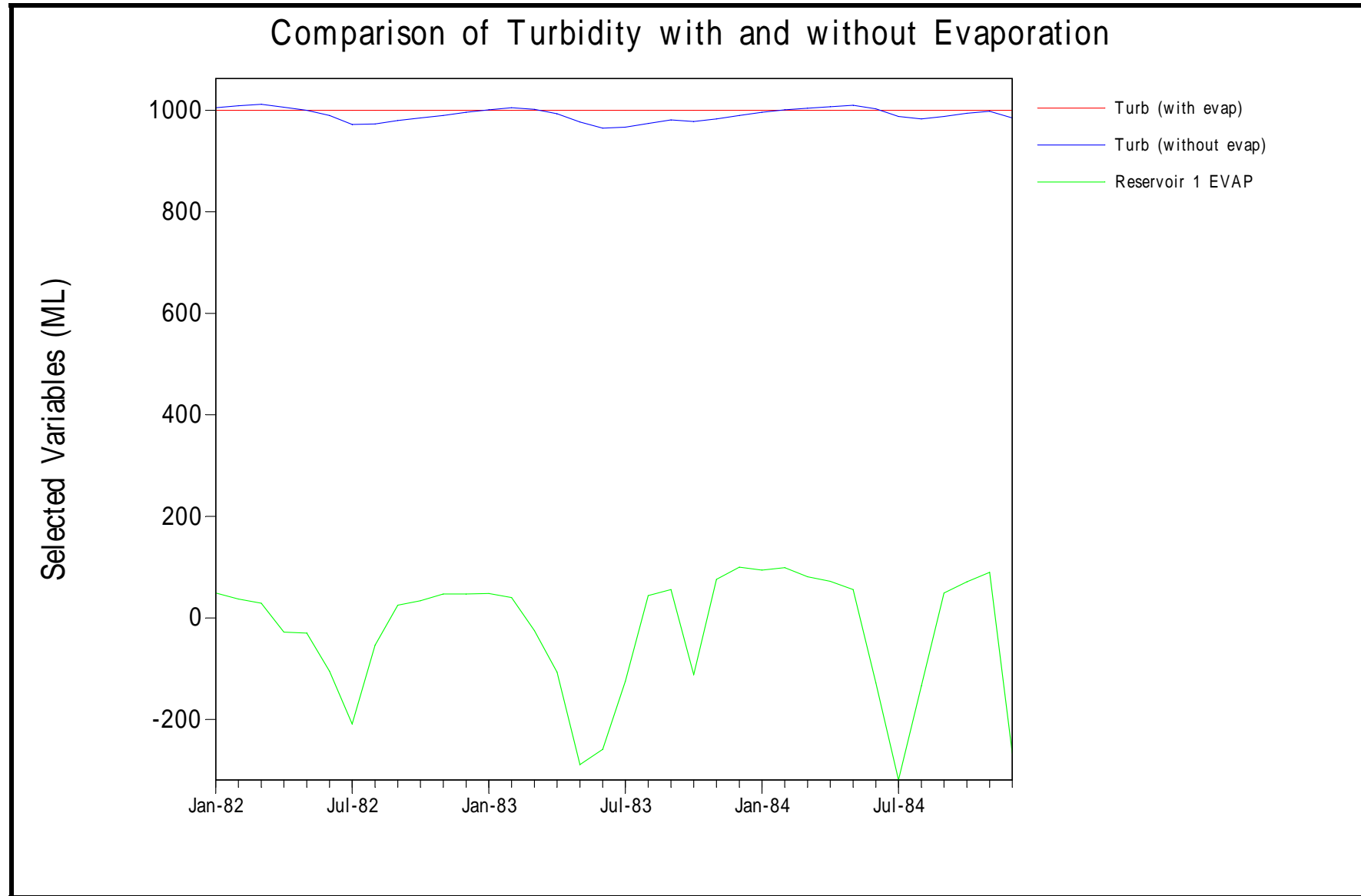
ec  
 FLOW  
 FLOW  
 FLOW  
 CAPC  
 CAPC  
 CAPC

|       |         |        |         |         |  |
|-------|---------|--------|---------|---------|--|
| 1.00  | 1982.00 | 213.00 | 2700.00 | 2700.00 | 0.001000000000.001000000000.001000000000.00    |
| 2.00  | 1982.00 | 228.00 | 1300.00 | 1300.00 | 0.001000000000.001000000000.001000000000.00    |
| 3.00  | 1982.00 | 266.00 | 2100.00 | 2100.00 | 0.001000000000.001000000000.001000000000.00    |
| 4.00  | 1982.00 | 278.00 | 1500.00 | 1500.00 | 0.001000000000.001000000000.001000000000.00    |
| 5.00  | 1982.00 | 352.00 | 1600.00 | 1600.00 | 0.001000000000.001000000000.001000000000.00    |
| 6.00  | 1982.00 | 359.00 | 700.00  | 700.00  | 0.001000000000.001000000000.001000000000.00    |
| 7.00  | 1982.00 | 354.00 | 1200.00 | 1200.00 | 0.001000000000.001000000000.001000000000.00    |
| 8.00  | 1982.00 | 352.00 | 1800.00 | 1800.00 | 0.001000000000.001000000000.001000000000.00    |
| 9.00  | 1982.00 | 361.00 | 2200.00 | 2200.00 | 0.001000000000.001000000000.001000000000.00    |
| 10.00 | 1982.00 | 371.00 | 1300.00 | 1300.00 | 0.001000000000.001000000000.001000000000.00    |
| 11.00 | 1982.00 | 386.00 | 1400.00 | 1400.00 | 0.001000000000.001000000000.001000000000.00    |
| 12.00 | 1982.00 | 400.00 | 1400.00 | 1400.00 | 0.001000000000.001000000000.001000000000.00    |
| 1.00  | 1983.00 | 404.00 | 1900.00 | 1900.00 | 0.001000000000.00 84298704.001000000000.00     |
| 2.00  | 1983.00 | 410.00 | 0.00    | 0.00    | 0.001000000000.00 0.001000000000.00            |
| 3.00  | 1983.00 | 420.00 | 0.00    | 0.00    | 0.001000000000.00 0.001000000000.00            |
| 4.00  | 1983.00 | 455.00 | 0.00    | 0.00    | 0.001000000000.00 0.001000000000.00            |
| 5.00  | 1983.00 | 425.00 | 0.00    | 0.00    | 0.001000000000.00 0.001000000000.00            |
| 6.00  | 1983.00 | 408.00 | 0.00    | 0.00    | 0.001000000000.00 0.001000000000.00            |
| 7.00  | 1983.00 | 380.00 | 0.00    | 0.00    | 2787.001000000000.00 0.001000000000.00         |
| 8.00  | 1983.00 | 367.00 | 300.00  | 300.00  | 3556.001000000000.001000000000.001000000000.00 |
| 9.00  | 1983.00 | 365.00 | 600.00  | 600.00  | 3944.001000000000.001000000000.001000000000.00 |
| 10.00 | 1983.00 | 367.00 | 1400.00 | 1400.00 | 1072.001000000000.001000000000.001000000000.00 |
| 11.00 | 1983.00 | 373.00 | 2100.00 | 2100.00 | 0.001000000000.001000000000.001000000000.00    |
| 12.00 | 1983.00 | 389.00 | 2100.00 | 2100.00 | 614.001000000000.001000000000.001000000000.00  |
| 1.00  | 1984.00 | 410.00 | 1100.00 | 1100.00 | 3232.001000000000.001000000000.001000000000.00 |
| 2.00  | 1984.00 | 414.00 | 0.00    | 0.00    | 147.001000000000.00 0.001000000000.00          |
| 3.00  | 1984.00 | 425.00 | 0.00    | 0.00    | 2445.001000000000.00 0.001000000000.00         |
| 4.00  | 1984.00 | 428.00 | 0.00    | 0.00    | 1441.001000000000.00 0.001000000000.00         |
| 5.00  | 1984.00 | 429.00 | 0.00    | 0.00    | 469.001000000000.00 0.001000000000.00          |
| 6.00  | 1984.00 | 421.00 | 0.00    | 0.00    | 2961.001000000000.00 0.001000000000.00         |
| 7.00  | 1984.00 | 411.00 | 0.00    | 0.00    | 1227.001000000000.00 0.001000000000.00         |
| 8.00  | 1984.00 | 408.00 | 0.00    | 0.00    | 2163.001000000000.00 0.001000000000.00         |
| 9.00  | 1984.00 | 426.00 | 0.00    | 0.00    | 4551.001000000000.00 0.001000000000.00         |
| 10.00 | 1984.00 | 455.00 | 0.00    | 0.00    | 5839.001000000000.00 0.001000000000.00         |
| 11.00 | 1984.00 | 457.00 | 0.00    | 0.00    | 159.001000000000.00 0.001000000000.00          |
| 12.00 | 1984.00 | 452.00 | 0.00    | 0.00    | 620.001000000000.00 0.001000000000.00          |





**Figure 3.6-3 Worked Example 6(b) Comparison of EC with and without Reservoir Evaporation**



**Figure 3.6-4 Worked Example 6(b) Comparison of Turbidity with and without Reservoir Evaporation**

### **3.7 WORKED EXAMPLE 7**

# **MODELLING OF IRRIGATION DEMAND RESTRICTIONS**

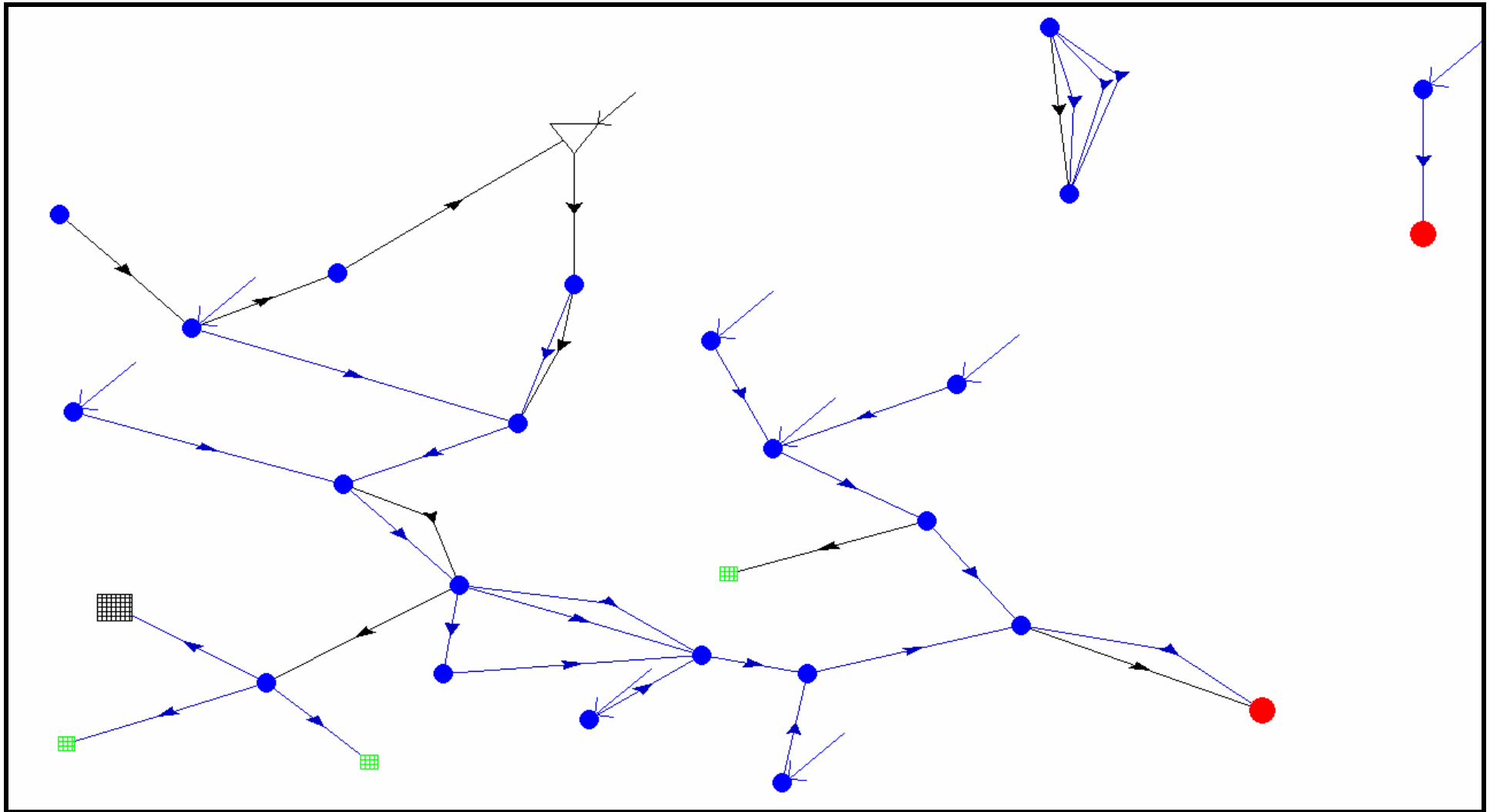


Figure 3.7-1 Worked Example 7 – System Plot

**WORKED EXAMPLE 7 - SYSTEM LISTING**

R E A L M

\*\*\*\*\*  
 \* SYSTEM FILE LISTING \*  
 \*\*\*\*\*

File: C:\REALM\WorkedExamples\WERRIRRG.sys

Simulation label:

Werrabee System: WERR0001.sys; As in WERRK317.SYS but with  
 system truncated to Werrabee R. u/s of Pyrites ck.

Date: 11:17:27 12/18/01

-----  
 | NODE INFORMATION |  
 -----

| No | Name  | Type          | X     | Y     | Z    | Size | Aux Input           | No |
|----|---|---------------|-------|-------|------|------|---------------------|----|
| 1  | PYKES CK RES.   | Reservoir     | 38.93 | 82.33 | 0.00 | 1.00 | PYKES CK INFLOWS    | 1  |
|    | Comment: Pykes Creek Reservoir  |               |       |       |      |      |                     |    |
| 2  | PYKES CK OUTFALL  | Strm junction | 35.21 | 47.83 | 0.00 | 1.00 |                     | 2  |
|    | Comment: Pykes Creek junction with Werrabee River                                       |               |       |       |      |      |                     |    |
| 3  | UPPER WERRIBEE WEIR   | Strm junction | 13.72 | 59.22 | 0.00 | 1.00 | WERRIBEE @ BALLAN   | 3  |
|    | Comment: Upper Werrabee Weir.   |               |       |       |      |      |                     |    |
| 4  | BM WEIR   | Strm junction | 31.39 | 28.58 | 0.00 | 1.00 |                     | 4  |
|    | Comment: Bacchus Marsh Weir on the Werrabee R.  |               |       |       |      |      |                     |    |
| 5  | DIVERSION DECISION  | Strm junction | 23.30 | 65.72 | 0.00 | 1.00 |                     | 5  |
|    | Comment: Pykes tunnel. Second condition for flow.                                       |               |       |       |      |      |                     |    |
| 6  | BM IRRIGATION   | Irr Demand    | 5.43  | 9.60  | 0.00 | 1.00 | B                   | 6  |
|    | Comment: BM irrigation supply   |               |       |       |      |      |                     |    |
| 7  | CSR FACTORY   | Demand        | 8.63  | 25.87 | 0.00 | 1.00 |                     | 7  |
|    | Comment: CSR factory supply.  |               |       |       |      |      |                     |    |
| 8  | BM OFFTAKE  | Strm junction | 18.62 | 16.92 | 0.00 | 1.00 |                     | 8  |
|    | Comment: Offtake to supply irrigation area demand& other demand supplied from channels. |               |       |       |      |      |                     |    |
| 9  | INFLOW BETWEEN WEIRS  | Strm junction | 5.86  | 49.19 | 0.00 | 1.00 | INFLOW BET.N WEIRS  | 9  |
|    | Comment: Inflow between weirs.  |               |       |       |      |      |                     |    |
| 10 | BM OUTSIDE SALES  | Irr Demand    | 25.43 | 7.44  | 0.00 | 1.00 | B                   | 10 |
|    | Comment: BM outside sales. Excess returns to Werrabee River.                            |               |       |       |      |      |                     |    |
| 11 | INFLOW U/S MELTON   | Strm junction | 39.90 | 12.58 | 0.00 | 1.00 | INFLOW BM TO MELTON | 11 |
|    | Comment: General inflow upstream Melton Res.  |               |       |       |      |      |                     |    |
| 12 | .INFLOW JUNCTION  | Strm junction | 23.73 | 40.51 | 0.00 | 1.00 |                     | 12 |
|    | Comment: Inflow junction @ Werrabee R. upstream Melton Res.                             |               |       |       |      |      |                     |    |
| 13 | NODE PARWON CK  | Strm junction | 52.66 | 5.00  | 0.00 | 1.00 | PARWON CK           | 13 |
|    | Comment: Parwon Creek.  |               |       |       |      |      |                     |    |



demand data:

| No | Name             | No Bypass | S/F Priority | Monthly Factors |       |       |       |       |       |       |       |       |       |       |       |       |
|----|------------------|-----------|--------------|-----------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
|    |                  |           |              | Jan             | Feb   | Mar   | Apr   | May   | Jun   | Jul   | Aug   | Sep   | Oct   | Nov   | Dec   |       |
| 6  | BM IRRIGATION    | 5         | 7            | min             | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
|    |                  |           |              | max             | 1.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 7  | CSR FACTORY      | 10        | 11           | min             | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
|    |                  |           |              | max             | 1.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 10 | BM OUTSIDE SALES | 5         | 5            | min             | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |       |
|    |                  |           |              | max             | 1.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |       |
| 20 | LERDERDERG DIV   | 2         | 3            | min             | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |       |
|    |                  |           |              | max             | 1.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |       |

| No                                   | Name             | Parameters for demand restriction by limit curves |   |      |      |      |      |      |       |      |      |     |   |   |   |   |
|--------------------------------------|------------------|---|---|------|------|------|------|------|-------|------|------|-----|---|---|---|---|
| 6                                    | BM IRRIGATION    | % allocation                                      | 0 | 50   | 100  | 200  | 220  | 220  | 220   | 220  | 220  | 220 | 0 | 0 | 0 | 0 |
|                                      | Frac (%) =       | 5; limit  | 0 | 2050 | 3470 | 5730 | 6460 | 9000 | 9000  | 9000 | 9000 | 0   | 0 | 0 | 0 |   |
| No off quota supplies to this demand |                  |   |   |      |      |      |      |      |       |      |      |     |   |   |   |   |
| 10                                   | BM OUTSIDE SALES | % allocation                                      | 0 | 50   | 100  | 200  | 220  | 220  | 220   | 220  | 0    | 0   | 0 | 0 | 0 |   |
|                                      | Frac (%) =       | 5; limit  | 0 | 75   | 125  | 200  | 240  | 260  | 260   | 0    | 0    | 0   | 0 | 0 |   |   |
| No off quota supplies to this demand |                  |   |   |      |      |      |      |      |       |      |      |     |   |   |   |   |
| 20                                   | LERDERDERG DIV   | % allocation                                      | 0 | 50   | 100  | 200  | 220  | 400  | 99999 | 0    | 0    | 0   | 0 | 0 |   |   |
|                                      | Frac (%) =       | 5; limit  | 0 | 100  | 140  | 190  | 300  | 350  | 350   | 0    | 0    | 0   | 0 |   |   |   |
| No off quota supplies to this demand |                  |   |   |      |      |      |      |      |       |      |      |     |   |   |   |   |

-----  
 | CARRIER INFORMATION |  
 -----

| No | Name  | Type  | From | To | Cost | Offset | Loss | Ann Vol | Shr Gp | Shr% | No |
|----|---|-------|------|----|------|--------|------|---------|--------|------|----|
| 1  | PYKES DIV1  | Pipe  | 3    | 5  | 10   | 0      | 0fix |         | 0      | 0%   | 1  |
|    | Comment: Diversions to Pykes Res from Werribee River.                             |       |      |    |      |        |      |         |        |      |    |
| 2  | PYKES DIV2  | Pipe  | 5    | 1  | 10   | 0      | 0fix |         | 0      | 0%   | 2  |
|    | Comment: Pykes tunnel diversion 2 from Werribee River.                            |       |      |    |      |        |      |         |        |      |    |
| 3  | UPPER WEIR OVERFLOW   | River | 3    | 2  | 100  | 0      | 0fix |         | 0      | 0%   | 3  |
|    | Comment: Spill over upper Werribee Weir.  |       |      |    |      |        |      |         |        |      |    |
| 4  | PYKES CK SPILL  | River | 29   | 2  | 10   | 0      | 0fix |         | 0      | 0%   | 4  |
|    | Comment: Pykes Ck spills below Reservior.   |       |      |    |      |        |      |         |        |      |    |
| 5  | WERRIBEE D/S PYKES  | River | 2    | 12 | 10   | 0      | 1%   |         | 0      | 0%   | 5  |
|    | Comment: Werribee River downstream of Pykes Ck junction.                          |       |      |    |      |        |      |         |        |      |    |
| 6  | TO BM IRRIGATION  | River | 8    | 6  | 10   | 0      | 15%  |         | 0      | 0%   | 6  |
|    | Comment: Supply channel to BM irrigation area                                     |       |      |    |      |        |      |         |        |      |    |
| 7  | TO CSR FACTORY  | River | 8    | 7  | 10   | 0      | 15%  |         | 0      | 0%   | 7  |
|    | Comment: Supply channel to CSR factory  |       |      |    |      |        |      |         |        |      |    |
| 8  | BM-OFFTAKE  | Pipe  | 4    | 8  | 10   | 0      | 0fix |         | 0      | 0%   | 8  |
|    | Comment: Irrigation offtake from above BM weir.                                   |       |      |    |      |        |      |         |        |      |    |
| 9  | WERRIBEE U/S BM WEIR  | River | 12   | 4  | 10   | 0      | 1%   |         | 0      | 0%   | 9  |
|    | Comment: Werribee River upstream Bacchus Marsh weir. Min. operational flow 5 ML/d |       |      |    |      |        |      |         |        |      |    |
| 10 | FROM INFL BTWN WEIRS  | River | 9    | 12 | 10   | 0      | 0fix |         | 0      | 0%   | 10 |
|    | Comment: Inflows between weirs to the werribee river.                             |       |      |    |      |        |      |         |        |      |    |
| 11 | TO BM OUTSIDE SALES   | River | 8    | 10 | 10   | 0      | 15%  |         | 0      | 0%   | 11 |

|   |                      |       |    |    |           |    |    |      |   |    |    |  |
|---|----------------------|-------|----|----|-----------|----|----|------|---|----|----|--|
| Comment: Bacchus Marsh outside district sales of irrigation water.                        |                      |       |    |    |           |    |    |      |   |    |    |  |
| 12  | WERRIBEE D/S BM      | River | 4  | 16 | 10        | 0  | 0  | 0fix | 0 | 0% | 12 |  |
| Comment: Werribee downstream of BM weir & u/s of 'Above Melton' inflow.                   |                      |       |    |    |           |    |    |      |   |    |    |  |
| 13  | WERRIBEE U/S PARWON  | River | 16 | 14 | 10        | 0  | 0  | 0fix | 0 | 0% | 13 |  |
| Comment: Werribee River upstream of Parwon Creek  |                      |       |    |    |           |    |    |      |   |    |    |  |
| 14  | WERRIBEE U/S LERD    | River | 14 | 15 | 10        | 0  | 0  | 0fix | 0 | 0% | 14 |  |
| Comment: Werribee River upstream of Lerderderg River junction.                            |                      |       |    |    |           |    |    |      |   |    |    |  |
| 15  | FROM INFL U/S MELTON | River | 11 | 16 | 10        | 0  | 0  | 0fix | 0 | 0% | 15 |  |
| Comment: Inflow upstream Melton   |                      |       |    |    |           |    |    |      |   |    |    |  |
| 16  | FROM PARWON CK       | River | 13 | 14 | 10        | 0  | 0  | 0fix | 0 | 0% | 16 |  |
| Comment: Parwon Creek   |                      |       |    |    |           |    |    |      |   |    |    |  |
| 17  | LERD D/S GOOD.       | River | 19 | 18 | 10        | 0  | 0  | 0fix | 0 | 0% | 17 |  |
| Comment: Lerderderg River below Goodman's Creek junction. Min. 80 ML/d (Aug-Oct)          |                      |       |    |    |           |    |    |      |   |    |    |  |
| 18  | LOWER LERD           | River | 18 | 15 | 10        | 0  | 0  | 0fix | 0 | 0% | 18 |  |
| Comment: Lerderderg River d/s of Goodman Ck. conf to confl. Werr R. Section Environ flows |                      |       |    |    |           |    |    |      |   |    |    |  |
| 19  | UPPER DIVERSIONS     | Pipe  | 18 | 20 | 10        | 0  | 0  | 0fix | 0 | 0% | 19 |  |
| Comment: Diversions off Lerderderg River.   |                      |       |    |    |           |    |    |      |   |    |    |  |
| 20  | NEWLYN SUPPLY        | Pipe  | 17 | 3  | 10        | 0  | 0  | 0fix | 0 | 0% | 20 |  |
| Comment: Goodman's diversion tunnel   |                      |       |    |    |           |    |    |      |   |    |    |  |
| 21  | PYKES CK REL         | Pipe  | 29 | 2  | 50        | 1  | 4% | 0    | 0 | 0% | 21 |  |
| Comment: Pykes Creek releases.  |                      |       |    |    |           |    |    |      |   |    |    |  |
| 22  | BM OPER SPILL        | River | 4  | 21 | -5000000  | 0  | 0  | 0fix | 0 | 0% | 22 |  |
| 23  | LIMIT OPER SPILL     | River | 21 | 16 | -10       | 0  | 0  | 0fix | 0 | 0% | 23 |  |
| 24  | EXCESS RELIEF        | River | 24 | 25 | 10        | 0  | 0  | 0fix | 0 | 0% | 24 |  |
| 25  | ENV SECTION 1        | River | 22 | 23 | -1        | 4  | 0  | 0fix | 0 | 0% | 25 |  |
| Comment: SECTION 1 - Recommended Env. min. flows d/s LERDERDERG WEIR                      |                      |       |    |    |           |    |    |      |   |    |    |  |
| 26  | SPILLS+MIN ENV FLOWS | River | 26 | 19 | 1         | 0  | 0  | 0fix | 0 | 0% | 26 |  |
| Comment: Carrier to tranship spills & min. env. flows                                     |                      |       |    |    |           |    |    |      |   |    |    |  |
| 27  | ENV SECTION 2        | River | 22 | 23 | 1         | -1 | 0  | 0fix | 0 | 0% | 27 |  |
| Comment: Recommended env. min. flow d/s Lerderderweir - Section 2.                        |                      |       |    |    |           |    |    |      |   |    |    |  |
| 28  | ENV FLOW 2 ML/D      | River | 22 | 23 | 0         | -3 | 0  | 0fix | 0 | 0% | 28 |  |
| Comment: Env. flow of 2 ML/d  |                      |       |    |    |           |    |    |      |   |    |    |  |
| 29  | #1 D/S BM WEIR ENV   | River | 4  | 16 | -5000000  | -2 | 0  | 0fix | 0 | 0% | 29 |  |
| Comment: Werr R. d/s BM weir & u/s of 'Above Melton' inflows; Env. flow = 12 ML/d         |                      |       |    |    |           |    |    |      |   |    |    |  |
| 30  | NAT FLOW U/S BM      | Pipe  | 22 | 23 | 1         | 0  | 0  | 0fix | 0 | 0% | 30 |  |
| Comment: Sum of natural inflows u/s of BM weir  |                      |       |    |    |           |    |    |      |   |    |    |  |
| 31  | GOODMANS D/S WEIR    | River | 28 | 19 | 10        | 0  | 0  | 0fix | 0 | 0% | 31 |  |
| 32  | ENV D/S PYKES CK     | Pipe  | 12 | 4  | -50000000 | 2  | 0  | 0fix | 0 | 0% | 32 |  |
| Comment: Minimum env. flow in Werribee R. d/s Pykes Ck. (forces thro' high -ve penalty    |                      |       |    |    |           |    |    |      |   |    |    |  |
| 33  | WERRIBEE U/S PYRITES | River | 15 | 27 | -50000000 | -2 | 0  | 0fix | 0 | 0% | 33 |  |
| 34  | EXCESS FLOW          | Pipe  | 15 | 27 | 100       | 0  | 0  | 0fix | 0 | 0% | 34 |  |
| Comment: Discharge excess   |                      |       |    |    |           |    |    |      |   |    |    |  |
| 35  | RELEASES FROM PYKES  | Pipe  | 1  | 29 | 0         | 0  | 0  | 0fix | 0 | 0% | 35 |  |
| Comment: to model the dead storage explicitly   |                      |       |    |    |           |    |    |      |   |    |    |  |

-----  
Minimum Flows

| No | Name           | Jan  | Feb  | Mar  | Apl  | May  | Jun  | Jul  | Aug  | Sep  | Oct  | Nov  | Dec  |
|----|----------------|------|------|------|------|------|------|------|------|------|------|------|------|
| 17 | LERD D/S GOOD. | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 2480 | 2400 | 2480 | 0    | 0    |
| 18 | LOWER LERD     | 1178 | 1074 | 1178 | 1140 | 1178 | 1140 | 1178 | 3100 | 3000 | 3100 | 1800 | 1178 |
| 25 | ENV SECTION 1  | 930  | 848  | 930  | 900  | 930  | 900  | 1550 | 1550 | 1500 | 1550 | 1500 | 930  |
| 27 | ENV SECTION 2  | 1178 | 1074 | 1178 | 1140 | 1178 | 1140 | 1178 | 3100 | 3000 | 3100 | 1800 | 1178 |





```

Capacity set option (0-off 1-prev 2-recalc) Jan=2  Feb=2  Mar=2  Apl=2  May=2  Jun=2  Jul=2  Aug=2  Sep=2  Oct=2  Nov=2  Dec=2
29 #1 D/S BM WEIR ENV          V          0   100 999999          0    0    0    0    0    0    0    0
  Fn Name:                      C          0   100 999999          0    0    0    0    0    0    0    0
  Equation used: IF(('3-('1*2.5)), '3, '3, (MIN(('3-'2), (('1*6.0)-'2))))
  ' 1 = ENV FLOW 2 ML/D          Type: CAPC(# 28)
  ' 2 = BM OPER SPILL           Type: FLOW(# 22)
  ' 3 = NAT FLOW U/S BM         Type: CAPC(# 30)
Capacity set option (0-off 1-prev 2-recalc) Jan=2  Feb=2  Mar=2  Apl=2  May=2  Jun=2  Jul=2  Aug=2  Sep=2  Oct=2  Nov=2  Dec=2
30 NAT FLOW U/S BM             V -999999          0 999999          0    0    0    0    0    0    0    0
  Fn Name:                      C -999999          0 999999          0    0    0    0    0    0    0    0
  Equation used: ('1+'2+'3)
  ' 1 = WERRIBEE @ BALLAN       Type: STRM
  ' 2 = PYKES CK INFLOWS        Type: STRM
  ' 3 = INFLOW BET.N WEIRS      Type: STRM
Capacity set option (0-off 1-prev 2-recalc) Jan=2  Feb=2  Mar=2  Apl=2  May=2  Jun=2  Jul=2  Aug=2  Sep=2  Oct=2  Nov=2  Dec=2
33 WERRIBEE U/S PYRITES       V          0*****          0    0    0    0    0    0    0    0
  Fn Name:                      C          0*****          0    0    0    0    0    0    0    0
  Equation used: '1
  ' 1 = DISCHARGE               Type: STRM
Capacity set option (0-off 1-prev 2-recalc) Jan=0  Feb=0  Mar=0  Apl=0  May=0  Jun=0  Jul=0  Aug=0  Sep=0  Oct=0  Nov=0  Dec=0
35 RELEASES FROM PYKES       V -999999          0 999999          0    0    0    0    0    0    0    0
  Fn Name:                      C -999999          0 999999          0    0    0    0    0    0    0    0
  Equation used: '1-'2
  ' 1 = PYKES CK RES.           Type: ESTO
  ' 2 = 1190                    Type: NUMB
  Previous flow solution is added to new capacity
Capacity set option (0-off 1-prev 2-recalc) Jan=2  Feb=2  Mar=2  Apl=2  May=2  Jun=2  Jul=2  Aug=2  Sep=2  Oct=2  Nov=2  Dec=2

```

-----  
| TARGET INFORMATION |  
-----

Number of target sets: 1

```

-----
Target set 1 ( Jan Feb Mar Apl May Jun Jul Aug Sep Oct Nov Dec)
Name          Draw Pri          Targets
-----
PYKES CK RES.          1          1190    3716    6241    8767    11292    13818    16343    18869    21394    23920
totals          1190    3716    6241    8767    11292    13818    16343    18869    21394    23920

```

-----  
 | RESTRICTION INFORMATION |  
 -----

Number of restriction groups: 1

NB. Each restriction group is treated separately  
 with its own rule curve definitions;  
 for irrigation demand groups by its allocations functions.

-----  
 Restriction Group: 1      Type: Irrigation demand centers  
 -----

|                                  |                                   |
|----------------------------------|-----------------------------------|
| Reservoirs/<br>Carriers in Group | Demands<br>in Group               |
| -----                            | -----                             |
| PYKES CK RES.                    | BM IRRIGATION<br>BM OUTSIDE SALES |

Allocation period from 8 to 4

Only +ve midseasonal changes in allocation allowed

The unrestricted allocation reference is 220

The average efficiency of deliveries from Headworks to the farm gate is assumed to be 72% for seasonal allocation purposes.

1 year planning period of 1 planning periods to be considered.

The group reserve (additional to common reserve) is 0

The trigger for special accounting is 0

The trigger for group reserve reduction is 0

| Factor<br>No | FIXED FACTORS |     |     |     |     |     |     |     |     |     |     |     |
|--------------|---------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
|              | Jan           | Feb | Mar | Apl | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
| 1            | 0             | 41  | 0   | 21  | 0   | 0   | 0   | 105 | 420 | 400 | 125 | 21  |
| 2            | 0             | 0   | 0   | 0   | 0   | 0   | 0   | 0   | 0   | 0   | 0   | 0   |
| 3            | 0             | 0   | 0   | 0   | 0   | 0   | 0   | 0   | 0   | 0   | 0   | 0   |
| 4            | 0             | 0   | 0   | 0   | 0   | 0   | 0   | 0   | 0   | 0   | 0   | 0   |

|                      |     |      |      |      |      |       |       |       |       |       |       |          |
|----------------------|-----|------|------|------|------|-------|-------|-------|-------|-------|-------|----------|
| Allocation function: | pt1 | pt2  | pt3  | pt4  | pt5  | pt6   | pt7   | pt8   | pt9   | pt10  | pt11  | pt12     |
|                      | 938 | 8047 | 8905 | 9576 | 9798 | 10671 | 11310 | 12181 | 12763 | 15740 | 16816 | 99999999 |
|                      | 0   | 100  | 110  | 120  | 130  | 150   | 160   | 180   | 200   | 220   | 220   | 220      |

-----  
 | MULTI SYSTEM INFORMATION |  
 -----

-----  
 Reservoirs  
 -----

PYKES CK RES.      1

**WORKED EXAMPLE 7 - LOG FILE**

```

HHHHH      HHHHHHHH   HHHHHH   H      HHHHHHHHHH
H  H      H      H  H  H      H  H  H
HHHHHHHHH  HHHHHH   HHHHHHHH  HHH   HHH  H  H
HHH  H  HHH      HHH  H  HHH      HHH  H  H
HHH  H  HHH      HHH  H  HHH      HHH  H  H
HHH  H  HHHHHHHH  HHH  H  HHHHHHHH  HHH  H  H

```

```

*****
*      SIMULATION LOG FILE      *
*****

```

Log filename : IRRG.log

Scenario file: scn7.scn

Simulation label:

Tutorial 7 - Irrigation Demand Modelling

Streamflow file(s):

C:\REALM\WorkedExamples\WERRFLOW.SF

Demand file(s):

C:\REALM\WorkedExamples\WERRIRR.DEM

Restrictions are ON

Instream flow requirements NOT limited to natural

Water quality calculations are OFF

Number of S/F Sequences: 1

Convergence tolerance (storage) 1 10th%

Other convergence tolerance 5 %

Arc convergence tolerance (abs) 100

Minimum iteration count 3

Maximum iteration count 51

Do convergence twice No

Date: 11:26:49 12/18/01

Time Step = Monthly

SYSTEM CHANGES:

| No | Seas | Year | System File                          |
|----|------|------|--------------------------------------|
| 1  | 7    | 1920 | C:\REALM\WorkedExamples\WERRIRRG.sys |

Total number of seasons:- 840

\*\*\*\*\* RUN TIME MESSAGES:- \*\*\*\*\*

\*\*\*\*INPUT DATA TYPE= 1 \*\*\*\*

1920  
C:\REALM\WorkedExamples\WERRIRRG.sys  
1921  
1922  
1923  
1924  
1925  
1926  
1927  
1928  
1929  
1930  
1931  
1932  
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1982  
1983  
1984  
1985  
1986  
1987  
1988  
1989  
1990

\*\*\*\*\* END RUN TIME MESSAGES \*\*\*\*\*

## SUMMARY INFORMATION

## Reservoir data:

|   | Name          | Start<br>Storage | File<br>Inflow | Min<br>Storage | Average<br>Storage | Evapn | Release<br>to river | Spill | End<br>Storage |
|---|---------------|------------------|----------------|----------------|--------------------|-------|---------------------|-------|----------------|
| 1 | PYKES CK RES. | 20000.           | 1263.          | 3206.          | 20549.             | 103.  | 0.                  | 0.    | 23920.         |
|   |               | 20000.           | 1263.          | 0.             | 20549.             | 103.  | 0.                  | 0.    | 23920.         |

## Demand data:

|   | Name             | Unrestrict | Restrict | Rationed | Shortfall | Supplied |
|---|------------------|------------|----------|----------|-----------|----------|
| 1 | BM IRRIGATION    | 426.       | 424.     | 424.     | 0.        | 424.     |
| 2 | CSR FACTORY      | 44.        | 44.      | 44.      | 0.        | 44.      |
| 3 | BM OUTSIDE SALES | 17.        | 16.      | 16.      | 0.        | 16.      |
| 4 | LERDERDERG DIV   | 21.        | 21.      | 21.      | 1.        | 20.      |
|   |                  | 508.       | 505.     | 505.     | 1.        | 504.     |

|   | Name             | No<br>Rest | Ave<br>Rest lvl | Max<br>Rest lvl | No<br>Ration | Ave %<br>Ration | Max %<br>Ration | No<br>Short | Ave %<br>Short | Max %<br>Short |
|---|------------------|------------|-----------------|-----------------|--------------|-----------------|-----------------|-------------|----------------|----------------|
| 1 | BM IRRIGATION    | 630.0      | 217.9           | 80.0            | 0.0          | 0.0             | 0.0             | 0.0         | 0.0            | 0.0            |
| 2 | CSR FACTORY      | 0.0        | 0.0             | 0.0             | 0.0          | 0.0             | 0.0             | 0.0         | 0.0            | 0.0            |
| 3 | BM OUTSIDE SALES | 630.0      | 217.9           | 80.0            | 0.0          | 0.0             | 0.0             | 0.0         | 0.0            | 0.0            |
| 4 | LERDERDERG DIV   | 0.0        | 0.0             | 1000.0          | 0.0          | 0.0             | 0.0             | 39.0        | 35.5           | 90.0           |

## Stream Junc:

|    | Name                 | file<br>inflow |
|----|----------------------|----------------|
| 1  | PYKES CK OUTFALL     | 0.             |
| 2  | UPPER WERRIBEE WEIR  | 1701.          |
| 3  | BM WEIR              | 0.             |
| 4  | DIVERSION DECISION   | 0.             |
| 5  | BM OFFTAKE           | 0.             |
| 6  | INFLOW BETWEEN WEIRS | 408.           |
| 7  | INFLOW U/S MELTON    | 1320.          |
| 8  | .INFLOW JUNCTION     | 0.             |
| 9  | NODE PARWON CK       | 753.           |
| 10 | .PARWON CK OUTFALL   | 0.             |
| 11 | .LERDERDERG OUTFALL  | 0.             |

|    |                     |         |
|----|---------------------|---------|
| 12 | .INFLOW U/S MELTON  | 0.      |
| 13 | NEWLYN RES.         | 0.      |
| 14 | .LERD DIV OFFTAKE   | 0.      |
| 15 | .GOODMAN CK OUTFALL | 152.    |
| 16 | .EXCESS DEMAND      | 0.      |
| 17 | SOURCE              | 0.      |
| 18 | SINK                | 0.      |
| 19 | JUNCTION INFLOW     | 100000. |
| 20 | D/S LERD. WEIR      | 2353.   |
| 21 | D/S GOOD WEIR       | 134.    |
| 22 | BELOW PYKES RES     | 0.      |

-----  
106821.  
-----

## Pipe/River flows:

|    | Name                 | flow     | Capacity   | Min      | Max      | Loss |
|----|----------------------|----------|------------|----------|----------|------|
| 1  | PYKES DIV1           | 324.8    | 1399.9     | 0.0      | 6003.0   | 0.0  |
| 2  | PYKES DIV2           | 324.8    | 3691.3     | 0.0      | 6003.0   | 0.0  |
| 3  | UPPER WEIR OVERFLOW  | 1376.0   | 99999999.0 | 0.0      | 21434.0  | 0.0  |
| 4  | PYKES CK SPILL       | 0.0      | 0.0        | 0.0      | 0.0      | 0.0  |
| 5  | WERRIBEE D/S PYKES   | 2797.8   | 99999999.0 | 0.0      | 40269.0  | 27.5 |
| 6  | TO BM IRRIGATION     | 497.7    | 3202.5     | 0.0      | 1737.0   | 74.0 |
| 7  | TO CSR FACTORY       | 51.5     | 3193.3     | 29.0     | 62.0     | 7.2  |
| 8  | BM-OFFTAKE           | 568.0    | 3202.5     | 49.0     | 1824.0   | 0.0  |
| 9  | WERRIBEE U/S BM WEIR | 3026.1   | 99999999.0 | 0.0      | 46269.0  | 29.8 |
| 10 | FROM INFL BTWN WEIRS | 408.0    | 99999999.0 | 0.0      | 6986.0   | 0.0  |
| 11 | TO BM OUTSIDE SALES  | 18.8     | 3202.5     | 0.0      | 75.0     | 2.3  |
| 12 | WERRIBEE D/S BM      | 2273.9   | 99999999.0 | 0.0      | 45548.0  | 0.0  |
| 13 | WERRIBEE U/S PARWON  | 3900.9   | 99999999.0 | 0.0      | 67124.0  | 0.0  |
| 14 | WERRIBEE U/S LERD    | 4653.8   | 99999999.0 | 0.0      | 78102.0  | 0.0  |
| 15 | FROM INFL U/S MELTON | 1320.3   | 99999999.0 | 0.0      | 22535.0  | 0.0  |
| 16 | FROM PARWON CK       | 752.9    | 99999999.0 | 0.0      | 10978.0  | 0.0  |
| 17 | LERD D/S GOOD.       | 2639.0   | 99999999.0 | 5.0      | 42256.0  | 0.0  |
| 18 | LOWER LERD           | 2619.2   | 99999999.0 | 0.0      | 42254.0  | 0.0  |
| 19 | UPPER DIVERSIONS     | 19.8     | 200.0      | 2.0      | 57.0     | 0.0  |
| 20 | NEWLYN SUPPLY        | 0.0      | 820.0      | 0.0      | 0.0      | 0.0  |
| 21 | PYKES CK REL         | 1480.4   | 99999999.0 | 0.0      | 19619.0  | 58.6 |
| 22 | BM OPER SPILL        | 93.2     | 113.6      | 0.0      | 297.0    | 0.0  |
| 23 | LIMIT OPER SPILL     | 93.2     | 233.3      | 0.0      | 297.0    | 0.0  |
| 24 | EXCESS RELIEF        | 100000.0 | 99999999.0 | 100000.0 | 100000.0 | 0.0  |
| 25 | ENV SECTION 1        | 0.0      | 1168.2     | 0.0      | 0.0      | 0.0  |
| 26 | SPILLS+MIN ENV FLOWS | 2353.2   | 99999999.0 | 0.0      | 37055.0  | 0.0  |
| 27 | ENV SECTION 2        | 0.0      | 1687.0     | 0.0      | 0.0      | 0.0  |
| 28 | ENV FLOW 2 ML/D      | 0.0      | 60.8       | 0.0      | 0.0      | 0.0  |
| 29 | #1 D/S BM WEIR ENV   | 213.5    | 213.5      | 0.0      | 372.0    | 0.0  |
| 30 | NAT FLOW U/S BM      | 0.0      | 3371.6     | 0.0      | 0.0      | 0.0  |
| 31 | GOODMANS D/S WEIR    | 134.1    | 99999999.0 | 0.0      | 4070.0   | 0.0  |
| 32 | ENV D/S PYKES CK     | 152.3    | 152.3      | 142.0    | 155.0    | 0.0  |



|    |                      |        |            |     |          |     |
|----|----------------------|--------|------------|-----|----------|-----|
| 33 | WERRIBEE U/S PYRITES | 0.0    | 0.0        | 0.0 | 0.0      | 0.0 |
| 34 | EXCESS FLOW          | 7273.0 | 99999999.0 | 3.0 | 120356.0 | 0.0 |
| 35 | RELEASES FROM PYKES  | 1480.4 | 20839.4    | 0.0 | 19619.0  | 0.0 |

---

199.

---

End run

### **3.8 WORKED EXAMPLE 8**

## **MODELLING OF A CAPACITY SHARED SYSTEM**

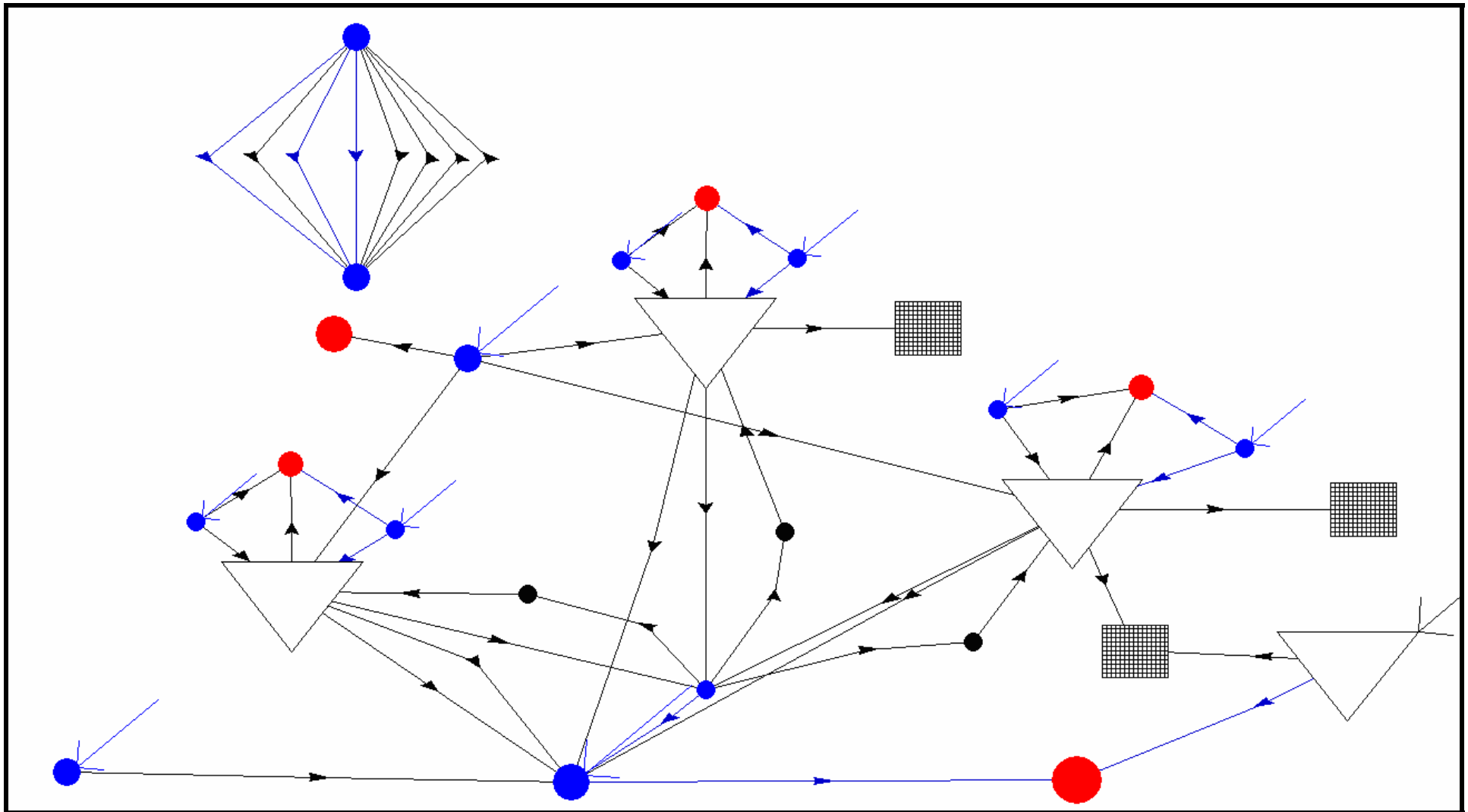


Figure 3.8-1 Worked Example 8(a) – System Plot

**WORKED EXAMPLE 8(a) - SYSTEM LISTING (EXPLICIT CAPACITY SHARING)**


---

R     E     A     L     M

---

\*\*\*\*\*  
 \*     SYSTEM FILE LISTING     \*  
 \*\*\*\*\*

File: C:\REALM\WorkedExamples\WERREXPL.SYS

Simulation label:

Werribee System: Merrimu 3 cap shares WERREXPL.sys; As in  
 run 0320 with a third capacity share for surplus resource  
 but without Pyrites Ck Res and Melton Res.; explicit share

Date: 05:04     21/03/2005

-----  
 |     NODE INFORMATION     |  
 -----

| No | Name  | Type            | X     | Y     | Z    | Size | Aux Input           | No |
|----|---|-----------------|-------|-------|------|------|---------------------|----|
| 1  | .PYRITES CK OUTFALL   | Strm junction   | 39.31 | 5.00  | 0.00 | 2.00 | W_usPyrites         | 1  |
|    | Comment: Pyrities Creek outfall to Werribee R.                                |                 |       |       |      |      |                     |    |
| 2  | MERR_IRR  | Reservoir       | 20.32 | 27.93 | 0.00 | 3.00 |                     | 2  |
|    | Comment: Merrimu Reservoir.   |                 |       |       |      |      |                     |    |
| 3  | BM URBAN  | Demand          | 93.27 | 37.92 | 0.00 | 2.00 |                     | 3  |
|    | Comment: Bacchus Marsh urban supply from Merrimu Res.                         |                 |       |       |      |      |                     |    |
| 4  | DJERRIWARRH RES   | Reservoir       | 92.20 | 19.56 | 0.00 | 3.00 | DJERRIWARRH INFLOWS | 4  |
|    | Comment: Djerriwarrh Reservoir.   |                 |       |       |      |      |                     |    |
| 5  | MELTON URBAN  | Demand          | 77.74 | 20.78 | 0.00 | 2.00 |                     | 5  |
|    | Comment: Melton urban supply from Merrimu Res.                                |                 |       |       |      |      |                     |    |
| 6  | MERR_URB  | Reservoir       | 73.44 | 37.92 | 0.00 | 3.00 |                     | 6  |
|    | Comment: MERRIMU URBAN STORAGE  |                 |       |       |      |      |                     |    |
| 7  | IRR INFLOW SHARE  | Strm junction   | 27.31 | 35.50 | 0.00 | 1.00 | INFLOW              | 7  |
| 8  | NODE 52   | Strm junction   | 48.47 | 16.11 | 0.00 | 1.00 |                     | 8  |
| 9  | MERR RAIN#1   | Strm junction   | 13.77 | 36.41 | 0.00 | 1.00 | INFLOW              | 9  |
| 10 | NODE 54   | Strm terminator | 20.20 | 43.41 | 0.00 | 1.00 |                     | 10 |
| 11 | NODE 55   | Strm terminator | 78.15 | 52.72 | 0.00 | 1.00 |                     | 11 |
| 12 | DUMMYAREA1  | Strm junction   | 24.67 | 95.00 | 0.00 | 1.50 |                     | 12 |
| 13 | DUMMYAREA2  | Strm junction   | 24.67 | 65.94 | 0.00 | 1.50 |                     | 13 |
| 14 | MERR RAIN#2   | Strm junction   | 68.33 | 49.99 | 0.00 | 1.00 | INFLOW              | 14 |
| 15 | NOTIONAL DEMAND   | Demand          | 63.60 | 59.73 | 0.00 | 2.00 |                     | 15 |
| 16 | MERR_UNK  | Reservoir       | 48.47 | 59.73 | 0.00 | 3.00 |                     | 16 |
|    | Comment: Share of Merrimu - unallocated after urban & irrigation committments |                 |       |       |      |      |                     |    |
| 17 | URB INFLOW SHARE  | Strm junction   | 85.22 | 45.32 | 0.00 | 1.00 | INFLOW              | 17 |
| 18 | UNK INFLOW SHARE  | Strm junction   | 54.69 | 68.22 | 0.00 | 1.00 | INFLOW              | 18 |
| 19 | MERR RAIN#3   | Strm junction   | 42.72 | 67.92 | 0.00 | 1.00 | INFLOW              | 19 |



-----  
 | CARRIER INFORMATION |  
 -----

| No | Name   | Type  | From | To | Cost      | Offset | Loss | Ann Vol | Shr Gp | Shr% | No |
|----|--|-------|------|----|-----------|--------|------|---------|--------|------|----|
| 1  | WERRIBEE U/S MELTON  | River | 1    | 24 | 10        | 0      | 0fix |         | 0      | 0%   | 1  |
|    | Comment: Werribee River upstream of Melton Res.                                      |       |      |    |           |        |      |         |        |      |    |
| 2  | MERRIMU SPILLS   | River | 8    | 1  | -5000000  | -2     | 0fix |         | 0      | 0%   | 2  |
|    | Comment: Merrimu Res. spills into Pyrites Creek.                                     |       |      |    |           |        |      |         |        |      |    |
| 3  | DJERRIWARRH CK   | River | 4    | 24 | 1000      | 2      | 0fix |         | 0      | 0%   | 3  |
|    | Comment: Djerriwarrh Creek below Reservior.  |       |      |    |           |        |      |         |        |      |    |
| 4  | MERRIMU TO MELT URB  | Pipe  | 6    | 5  | 100       | 0      | 0fix |         | 0      | 0%   | 4  |
|    | Comment: Melton urban supply from Merrimu Res.                                       |       |      |    |           |        |      |         |        |      |    |
| 5  | MERRIMU TO BM URBAN  | Pipe  | 6    | 3  | 100       | 0      | 0fix |         | 0      | 0%   | 5  |
|    | Comment: Bacchus Marsh urban supply from Merrimu Reservior.                          |       |      |    |           |        |      |         |        |      |    |
| 6  | DJERR TO MELTON URB  | Pipe  | 4    | 5  | 200       | 0      | 0fix |         | 0      | 0%   | 6  |
|    | Comment: Melton urban supply from Djerriwarrh Reservior. Transfer capacity = 19 ML/d |       |      |    |           |        |      |         |        |      |    |
| 7  | MERR_IRR ABOVE SHARE   | Pipe  | 2    | 8  | -5000000  | 0      | 0fix |         | 0      | 0%   | 7  |
|    | Comment: Prevents MERR_IRR going ABOVE its capacity share                            |       |      |    |           |        |      |         |        |      |    |
| 8  | MERR_IRR BELOW SHARE   | Pipe  | 21   | 2  | 10        | 0      | 0fix |         | 0      | 0%   | 8  |
|    | Comment: Allows int. spill from MERR_URB to MERR_IRR                                 |       |      |    |           |        |      |         |        |      |    |
| 9  | MERR_URB ABOVE SHARE   | Pipe  | 6    | 8  | -5000000  | 0      | 0fix |         | 0      | 0%   | 9  |
|    | Comment: Prevents MERR_URB going .g.t. its capacity share                            |       |      |    |           |        |      |         |        |      |    |
| 10 | MERR_URB BELOW SHARE   | Pipe  | 22   | 6  | 10        | 0      | 0fix |         | 0      | 0%   | 10 |
|    | Comment: Allows int. spills from MERR_IRR to MERR_URB                                |       |      |    |           |        |      |         |        |      |    |
| 11 | MERRIMU AREA   | Pipe  | 12   | 13 | 0         | 5      | 0fix |         | 0      | 0%   | 11 |
|    | Comment: Accounting arc to calculate area of main merrimu reservoir                  |       |      |    |           |        |      |         |        |      |    |
| 12 | MERR_IRR RAIN  | Pipe  | 9    | 2  | 0         | 0      | 0fix |         | 0      | 0%   | 12 |
|    | Comment: Adds share of Merrimu rain to MERR_IRR                                      |       |      |    |           |        |      |         |        |      |    |
| 13 | MIRR XS RAINFALL   | Pipe  | 9    | 10 | 1000      | 0      | 0fix |         | 0      | 0%   | 13 |
| 14 | MERR_URB RAIN  | Pipe  | 14   | 6  | 0         | 0      | 0fix |         | 0      | 0%   | 14 |
|    | Comment: Adds share of Merrimu rain to MERR_URB                                      |       |      |    |           |        |      |         |        |      |    |
| 15 | EVAP MERR_URB  | Pipe  | 6    | 11 | -53000000 | 0      | 0fix |         | 0      | 0%   | 15 |
|    | Comment: Takes share of evap out of MERR_URB   |       |      |    |           |        |      |         |        |      |    |
| 16 | MURB XS RAINFALL   | Pipe  | 14   | 11 | 1000      | 0      | 0fix |         | 0      | 0%   | 16 |
| 17 | MERR_URB INFLOWS   | River | 17   | 6  | 0         | 0      | 0fix |         | 0      | 0%   | 17 |
|    | Comment: Merr Urb share of inflows   |       |      |    |           |        |      |         |        |      |    |
| 18 | MERR_IRR INFLOWS   | River | 7    | 2  | 0         | 0      | 0fix |         | 0      | 0%   | 18 |
| 19 | EVAP MER_IRR   | Pipe  | 2    | 10 | -53000000 | 0      | 0fix |         | 0      | 0%   | 19 |
|    | Comment: Takes out the irrigation share of evaporation from merrimu reservoir        |       |      |    |           |        |      |         |        |      |    |
| 20 | MERR_IRR ENVIRON REL   | Pipe  | 2    | 1  | -53000000 | -3     | 0fix |         | 0      | 0%   | 20 |
|    | Comment: Merrimu irrigation share of env. flow                                       |       |      |    |           |        |      |         |        |      |    |
| 21 | MERR_IRR RELEASES  | Pipe  | 2    | 1  | 100000    | 0      | 3%   |         | 0      | 0%   | 21 |
| 22 | MERR_URB ENVIRON REL   | Pipe  | 6    | 1  | -53000000 | 6      | 3%   |         | 0      | 0%   | 22 |
|    | Comment: Merrimu urban share of environ. flow  |       |      |    |           |        |      |         |        |      |    |
| 23 | MERR_UNK TO NOTIONAL   | Pipe  | 16   | 15 | 0         | 0      | 0fix |         | 0      | 0%   | 23 |
| 24 | ENV SECTION 1  | River | 12   | 13 | -1        | -9     | 0fix |         | 0      | 0%   | 24 |
|    | Comment: SECTION 1 - Recommended Env. min. flows d/s LERDERDERG WEIR                 |       |      |    |           |        |      |         |        |      |    |
| 25 | ENV SECTION 2  | River | 12   | 13 | 1         | 0      | 0fix |         | 0      | 0%   | 25 |
|    | Comment: Recommended env. min. flow d/s Lerderderweir - Section 2.                   |       |      |    |           |        |      |         |        |      |    |
| 26 | DJERR ENV REL  | River | 4    | 24 | -5000000  | -2     | 0fix |         | 0      | 0%   | 26 |
|    | Comment: Min. env. flow of 1.5 ML/d or natural inflow in Djerriwarrh (lesser of)     |       |      |    |           |        |      |         |        |      |    |









```

' 1 = ENV FLOW 2 ML/D          Type: CAPC(# 27)
' 2 = MERRIMU RES INFLOWS     Type: STRM
Capacity set option (0-off 1-prev 2-recalc) Jan=2  Feb=2  Mar=2  Apl=2  May=2  Jun=2  Jul=2  Aug=0  Sep=0  Oct=0  Nov=0  Dec=2

26 DJERR ENV REL              V      0   100 9999999      0      0      0      0      0      0      0      0      0
  Fn Name:                    C      0   100 9999999      0      0      0      0      0      0      0      0      0
Equation used: MIN('1*0.75,'2)
' 1 = ENV FLOW 2 ML/D          Type: CAPC(# 27)
' 2 = DJERRIWARRH INFLOWS     Type: STRM
Capacity set option (0-off 1-prev 2-recalc) Jan=2  Feb=2  Mar=2  Apl=2  May=2  Jun=2  Jul=2  Aug=2  Sep=2  Oct=2  Nov=2  Dec=2

28 MERR_UNK INFLOWS           V      0 9999999      0      0      0      0      0      0      0      0      0      0
  Fn Name:                    C      0 9999999      0      0      0      0      0      0      0      0      0      0
Equation used: ('1*0.1)
' 1 = MERRIMU RES INFLOWS     Type: STRM
Capacity set option (0-off 1-prev 2-recalc) Jan=2  Feb=2  Mar=2  Apl=2  May=2  Jun=2  Jul=2  Aug=2  Sep=2  Oct=2  Nov=2  Dec=2

29 MERR_UNK RAIN              V      0 9999999      0      0      0      0      0      0      0      0      0      0
  Fn Name:                    C      0 9999999      0      0      0      0      0      0      0      0      0      0
Equation used: '1*'2*0.01*0.1
' 1 = MERRIMU AREA            Type: CAPC(# 11)
' 2 = RAINFALL(87002)         Type: STRM
Capacity set option (0-off 1-prev 2-recalc) Jan=2  Feb=2  Mar=2  Apl=2  May=2  Jun=2  Jul=2  Aug=2  Sep=2  Oct=2  Nov=2  Dec=2

31 EVAP MERR_UNK             V      0 9999999      0      0      0      0      0      0      0      0      0      0
  Fn Name:                    C      0 9999999      0      0      0      0      0      0      0      0      0      0
Equation used: '1*(('2*0.85)+5)*0.01*0.1
' 1 = MERRIMU AREA            Type: CAPC(# 11)
' 2 = EVAPORATION             Type: STRM
Capacity set option (0-off 1-prev 2-recalc) Jan=2  Feb=2  Mar=2  Apl=2  May=2  Jun=2  Jul=2  Aug=2  Sep=2  Oct=2  Nov=2  Dec=2

35 MERR_UNK ABOVE SHARE      V  -99999      0 99999      0      0      0      0      0      0      0      0      0
  Fn Name:                    C  -99999      0 99999      0      0      0      0      0      0      0      0      0
Equation used: '1-'2-6500
' 1 = MERR_UNK                Type: ESTO
' 2 = MERR_UNK BELOW SHARE     Type: FLOW(# 36)
  Previous flow solution is added to new capacity
Capacity set option (0-off 1-prev 2-recalc) Jan=2  Feb=2  Mar=2  Apl=2  May=2  Jun=2  Jul=2  Aug=2  Sep=2  Oct=2  Nov=2  Dec=2

36 MERR_UNK BELOW SHARE      V  -99999      0 999999      0      0      0      0      0      0      0      0      0
  Fn Name:                    C  -99999      0 999999      0      0      0      0      0      0      0      0      0
Equation used: 6500-'1
' 1 = MERR_UNK                Type: ESTO
  Previous flow solution is added to new capacity
Capacity set option (0-off 1-prev 2-recalc) Jan=2  Feb=2  Mar=2  Apl=2  May=2  Jun=2  Jul=2  Aug=2  Sep=2  Oct=2  Nov=2  Dec=2

37 IRR_URB SHARE             V  -99999      0 99999      0      0      0      0      0      0      0      0      0
  Fn Name:                    C  -99999      0 99999      0      0      0      0      0      0      0      0      0
Equation used: '1*1.0
' 1 = MERR_IRR ABOVE SHARE     Type: CAPC(# 7)
Capacity set option (0-off 1-prev 2-recalc) Jan=2  Feb=2  Mar=2  Apl=2  May=2  Jun=2  Jul=2  Aug=2  Sep=2  Oct=2  Nov=2  Dec=2

38 UNK_URB SHARE             V  -99999      0 99999      0      0      0      0      0      0      0      0      0
  Fn Name:                    C  -99999      0 99999      0      0      0      0      0      0      0      0      0
Equation used: '1*1.0
' 1 = MERR_UNK ABOVE SHARE     Type: CAPC(# 35)
Capacity set option (0-off 1-prev 2-recalc) Jan=2  Feb=2  Mar=2  Apl=2  May=2  Jun=2  Jul=2  Aug=2  Sep=2  Oct=2  Nov=2  Dec=2

```

|   |   |        |           |       |   |   |   |   |   |   |   |   |   |   |   |   |
|---|---|--------|-----------|-------|---|---|---|---|---|---|---|---|---|---|---|---|
| 40 URB_UNK SHARE  | V | -99999 | 0         | 99999 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Fn Name:  | C | -99999 | 0         | 99999 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Equation used: '1*1.0   |   |        |           |       |   |   |   |   |   |   |   |   |   |   |   |   |
| ' 1 = MERR_URB ABOVE SHARE Type: CAPC(# 9)  |   |        |           |       |   |   |   |   |   |   |   |   |   |   |   |   |
| Capacity set option (0-off 1-prev 2-recalc) Jan=2 Feb=2 Mar=2 Apl=2 May=2 Jun=2 Jul=2 Aug=2 Sep=2 Oct=2 Nov=2 Dec=2 |   |        |           |       |   |   |   |   |   |   |   |   |   |   |   |   |
| 43 MERR_UNK ENVIRON REL   | V | 0      | 9999999   | 0     | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Fn Name:  | C | 0      | 9999999   | 0     | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Equation used: (MIN('1','2))*0.1  |   |        |           |       |   |   |   |   |   |   |   |   |   |   |   |   |
| ' 1 = ENV FLOW 2 ML/D Type: CAPC(# 27)  |   |        |           |       |   |   |   |   |   |   |   |   |   |   |   |   |
| ' 2 = MERRIMU RES INFLOWS Type: STRM  |   |        |           |       |   |   |   |   |   |   |   |   |   |   |   |   |
| Capacity set option (0-off 1-prev 2-recalc) Jan=2 Feb=2 Mar=2 Apl=2 May=2 Jun=2 Jul=2 Aug=0 Sep=0 Oct=0 Nov=0 Dec=2 |   |        |           |       |   |   |   |   |   |   |   |   |   |   |   |   |
| 44 EXCESS OF MERR_IRR   | V | 0      | 999999999 | 0     | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Fn Name:  | C | 0      | 999999999 | 0     | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Equation used: '1   |   |        |           |       |   |   |   |   |   |   |   |   |   |   |   |   |
| ' 1 = TOTAL FLOW Type: STRM   |   |        |           |       |   |   |   |   |   |   |   |   |   |   |   |   |
| Capacity set option (0-off 1-prev 2-recalc) Jan=2 Feb=2 Mar=2 Apl=2 May=2 Jun=2 Jul=2 Aug=2 Sep=2 Oct=2 Nov=2 Dec=2 |   |        |           |       |   |   |   |   |   |   |   |   |   |   |   |   |
| 45 MERR_IRR TUNL SHARE  | V | 0      | 999999    | 0     | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Fn Name:  | C | 0      | 999999    | 0     | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Equation used: '1*0.3   |   |        |           |       |   |   |   |   |   |   |   |   |   |   |   |   |
| ' 1 = GOOD TUNNEL Type: STRM  |   |        |           |       |   |   |   |   |   |   |   |   |   |   |   |   |
| Capacity set option (0-off 1-prev 2-recalc) Jan=2 Feb=2 Mar=2 Apl=2 May=2 Jun=2 Jul=2 Aug=2 Sep=2 Oct=2 Nov=2 Dec=2 |   |        |           |       |   |   |   |   |   |   |   |   |   |   |   |   |
| 46 MERR_URB TUNL SHARE  | V | 0      | 999999    | 0     | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Fn Name:  | C | 0      | 999999    | 0     | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Equation used: '1*0.6   |   |        |           |       |   |   |   |   |   |   |   |   |   |   |   |   |
| ' 1 = GOOD TUNNEL Type: STRM  |   |        |           |       |   |   |   |   |   |   |   |   |   |   |   |   |
| Capacity set option (0-off 1-prev 2-recalc) Jan=2 Feb=2 Mar=2 Apl=2 May=2 Jun=2 Jul=2 Aug=2 Sep=2 Oct=2 Nov=2 Dec=2 |   |        |           |       |   |   |   |   |   |   |   |   |   |   |   |   |
| 47 MERR_UNK TUNL SHARE  | V | 0      | 999999    | 0     | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Fn Name:  | C | 0      | 999999    | 0     | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Equation used: '1*0.1   |   |        |           |       |   |   |   |   |   |   |   |   |   |   |   |   |
| ' 1 = GOOD TUNNEL Type: STRM  |   |        |           |       |   |   |   |   |   |   |   |   |   |   |   |   |
| Capacity set option (0-off 1-prev 2-recalc) Jan=2 Feb=2 Mar=2 Apl=2 May=2 Jun=2 Jul=2 Aug=2 Sep=2 Oct=2 Nov=2 Dec=2 |   |        |           |       |   |   |   |   |   |   |   |   |   |   |   |   |
| 50 TOT INFLOW   | V | 0      | 999999999 | 0     | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Fn Name:  | C | 0      | 999999999 | 0     | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Equation used: '1+'2+'3+'4+'5+'6  |   |        |           |       |   |   |   |   |   |   |   |   |   |   |   |   |
| ' 1 = MERR_IRR TUNL SHARE Type: FLOW(# 45)  |   |        |           |       |   |   |   |   |   |   |   |   |   |   |   |   |
| ' 2 = MERR_URB TUNL SHARE Type: FLOW(# 46)  |   |        |           |       |   |   |   |   |   |   |   |   |   |   |   |   |
| ' 3 = MERR_UNK TUNL SHARE Type: FLOW(# 47)  |   |        |           |       |   |   |   |   |   |   |   |   |   |   |   |   |
| ' 4 = MERR_IRR INFLOWS Type: FLOW(# 18)   |   |        |           |       |   |   |   |   |   |   |   |   |   |   |   |   |
| ' 5 = MERR_URB INFLOWS Type: FLOW(# 17)   |   |        |           |       |   |   |   |   |   |   |   |   |   |   |   |   |
| ' 6 = MERR_UNK INFLOWS Type: FLOW(# 28)   |   |        |           |       |   |   |   |   |   |   |   |   |   |   |   |   |
| Capacity set option (0-off 1-prev 2-recalc) Jan=2 Feb=2 Mar=2 Apl=2 May=2 Jun=2 Jul=2 Aug=2 Sep=2 Oct=2 Nov=2 Dec=2 |   |        |           |       |   |   |   |   |   |   |   |   |   |   |   |   |
| 51 TOT EVAP   | V | 0      | *****     | 0     | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Fn Name:  | C | 0      | *****     | 0     | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Equation used: '1+'2+'3   |   |        |           |       |   |   |   |   |   |   |   |   |   |   |   |   |
| ' 1 = EVAP MERR_UNK Type: FLOW(# 31)  |   |        |           |       |   |   |   |   |   |   |   |   |   |   |   |   |
| ' 2 = EVAP MERR_URB Type: FLOW(# 15)  |   |        |           |       |   |   |   |   |   |   |   |   |   |   |   |   |
| ' 3 = EVAP MERR_IRR Type: FLOW(# 19)  |   |        |           |       |   |   |   |   |   |   |   |   |   |   |   |   |
| Capacity set option (0-off 1-prev 2-recalc) Jan=2 Feb=2 Mar=2 Apl=2 May=2 Jun=2 Jul=2 Aug=2 Sep=2 Oct=2 Nov=2 Dec=2 |   |        |           |       |   |   |   |   |   |   |   |   |   |   |   |   |

```

52 TOT RAIN          V      0*****      0      0      0      0      0      0      0      0      0      0
  Fn Name:          C      099999999      0      0      0      0      0      0      0      0      0      0
  Equation used: '1+'2+'3
' 1 = MERR_IRR RAIN      Type: FLOW(# 12)
' 2 = MERR_URB RAIN      Type: FLOW(# 14)
' 3 = MERR_UNK RAIN      Type: FLOW(# 29)
Capacity set option (0-off 1-prev 2-recalc) Jan=2  Feb=2  Mar=2  Apl=2  May=2  Jun=2  Jul=2  Aug=2  Sep=2  Oct=2  Nov=2  Dec=2

53 TOT RELEASES     V      099999999      0      0      0      0      0      0      0      0      0      0
  Fn Name:          C      099999999      0      0      0      0      0      0      0      0      0      0
  Equation used: '1+'2+'3+'4+'5+'6+'7+'8
' 1 = MERR_UNK TO NOTIONAL  Type: FLOW(# 23)
' 2 = MERRIMU TO BM URBAN   Type: FLOW(# 5)
' 3 = MERRIMU TO MELT URB   Type: FLOW(# 4)
' 4 = MERR_IRR RELEASES     Type: FLOW(# 21)
' 5 = MERR_URB ENVIRON REL  Type: FLOW(# 22)
' 6 = MERR_UNK ENVIRON REL  Type: FLOW(# 43)
' 7 = MERR_IRR ENVIRON REL  Type: FLOW(# 20)
' 8 = EXCESS OF MERR_IRR    Type: FLOW(# 44)
Capacity set option (0-off 1-prev 2-recalc) Jan=2  Feb=2  Mar=2  Apl=2  May=2  Jun=2  Jul=2  Aug=2  Sep=2  Oct=2  Nov=2  Dec=2

```

-----  
| TARGET INFORMATION |  
-----

Number of target sets: 1

-----

Target set 1 ( Jan Feb Mar Apl May Jun Jul Aug Sep Oct Nov Dec)

| Name            | Draw | Pri | Jan  | Feb  | Mar   | Apl   | May   | Jun   | Jul   | Aug   | Sep   | Oct   | Nov | Dec | Targets |
|-----------------|------|-----|------|------|-------|-------|-------|-------|-------|-------|-------|-------|-----|-----|---------|
| MERR_IRR        | 1    | 0   |      |      | 800   | 1200  | 2200  | 3000  | 3800  | 4600  | 5400  | 7000  |     |     | 35000   |
| DJERRIWARRH RES | 1    | 0   | 400  | 700  | 900   | 980   | 980   | 980   | 980   | 980   | 980   | 980   |     |     | 980     |
| MERR_URB        | 1    | 0   | 1200 | 3600 | 6600  | 9000  | 11400 | 13800 | 16200 | 19000 | 19000 | 19000 |     |     | 35000   |
| MERR_UNK        | 1    | 0   | 400  | 1200 | 2200  | 3000  | 3800  | 4600  | 5400  | 7000  | 7000  | 7000  |     |     | 35000   |
| totals          |      | 0   | 2800 | 6700 | 11900 | 15980 | 19980 | 23980 | 27980 | 33980 | 33980 | 33980 |     |     | 105980  |

-----  
 | RESTRICTION INFORMATION |  
 -----

Number of restriction groups: 1

NB. Each restriction group is treated separately  
 with its own rule curve definitions for urban demand groups;  
 for irrigation demand groups by its allocations functions.

-----  
 Restriction Group: 1      Type: Urban/industrial demand centers  
 -----

|   |                              |
|---|------------------------------|
| Reservoirs/<br>carriers in Group<br>----- | Demands<br>in Group<br>----- |
| MERR_IRR                                  | MELTON URBAN                 |
| DJERRIWARRH RES                           | NOTIONAL DEMAND              |
| MERR_URB                                  |                              |
| MERR_UNK                                  |                              |

| Restriction Level   | Relative Position | % of Restrictable Demand Restricted | Storage as % of Average Annual Demand |          |          |          |          |          |          |          |          |          |          |          |   |
|---------------------|-------------------|-------------------------------------|---------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---|
|                     |                   |                                     | Jan                                   | Feb      | Mar      | Apl      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      |          |   |
| Dec                 | 0                 | 0.0                                 | 0.0                                   | -9000.00 | -7000.00 | -6000.00 | -4000.00 | -2500.00 | -3000.00 | -4000.00 | -7000.00 | -7500.00 | -8000.00 | -9000.00 | - |
| 10000.00            | 1                 | 25.0                                | 30.0                                  | -7375.00 | -5750.00 | -5000.00 | -3450.00 | -2125.00 | -2500.00 | -3500.00 | -6000.00 | -6500.00 | -6875.00 | -7650.00 | - |
| 8275.00             | 2                 | 50.0                                | 50.0                                  | -5750.00 | -4500.00 | -4000.00 | -2900.00 | -1750.00 | -2000.00 | -3000.00 | -5000.00 | -5500.00 | -5750.00 | -6300.00 | - |
| 6550.00             | 3                 | 75.0                                | 70.0                                  | -4125.00 | -3250.00 | -3000.00 | -2350.00 | -1375.00 | -1500.00 | -2500.00 | -4000.00 | -4500.00 | -4625.00 | -4950.00 | - |
| 4825.00             | 4                 | 100.0                               | 90.0                                  | -2500.00 | -2000.00 | -2000.00 | -1800.00 | -1000.00 | -1000.00 | -2000.00 | -3000.00 | -3500.00 | -3500.00 | -3600.00 | - |
| 3100.00             |                   |                                     |                                       |          |          |          |          |          |          |          |          |          |          |          |   |
| Base levels (% AAD) |                   |                                     |                                       | -742.00  | -672.00  | -601.00  | -424.00  | -353.00  | -300.00  | -318.00  | -318.00  | -353.00  | -442.00  | -530.00  | - |
| 672.00              |                   |                                     |                                       |          |          |          |          |          |          |          |          |          |          |          |   |

NB. Negative values will be interpreted as absolute values

-----  
 | MULTI SYSTEM INFORMATION |  
 -----

-----  
 Reservoirs  
 -----

|                 |   |
|-----------------|---|
| MERR_IRR        | 1 |
| DJERRIWARRH RES | 1 |
| MERR_URB        | 1 |
| MERR_UNK        | 1 |

```
-----  
| CAPACITY SHARING INFORMATION |  
-----
```

(a negative represents capacity key for group)

```
-----  
Carrier      Name      Group No.  % Share  
-----  
 37 IRR_URB SHARE      -1      75 <- capacity key  
 39 IRR_UNK SHARE       1      25  
  
 38 UNK_URB SHARE      -2      75 <- capacity key  
 42 UNK_IRR SHARE       2      25  
  
 40 URB_UNK SHARE      -3      50 <- capacity key  
 41 URB_IRR SHARE       3      50
```

**WORKED EXAMPLE 8(a) - LOG FILE (EXPLICIT CAPACITY SHARING)**

```

HHHHH      HHHHHHHH      HHHHHH      H      HHHHHHHHHH
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HHHHHHHHH  HHHHHH      HHHHHHHH  HHH      HHH  H  H
HHH  H  HHH      HHH  H  HHH      HHH  H  H
HHH  H  HHH      HHH  H  HHH      HHH  H  H
HHH  H  HHHHHHHH  HHH  H  HHHHHHHH  HHH  H  H

```

```

*****
*      SIMULATION LOG FILE      *
*****

```

Log filename : EXPL.log

Scenario file: scn8e.scn

Simulation label:

Tutorial 8 - Explicit Capacity Sharing

Streamflow file(s):

C:\REALM\WorkedExamples\WERRCAPC.SF

Demand file(s):

C:\REALM\WorkedExamples\WERRIRR.DEM

Restrictions are ON

Instream flow requirements NOT limited to natural

Water quality calculations are OFF

Number of S/F Sequences: 1

```

Convergence tolerance (storage)  1 10th%
Other convergence tolerance      5 %
Arc convergence tolerance (abs)  100
Minimum iteration count          3
Maximum iteration count          51
Do convergence twice             No

```

Date: 10:03:15 01/14/02

Time Step = Monthly

SYSTEM CHANGES:

| No | Seas | Year | System File                          |
|----|------|------|--------------------------------------|
| 1  | 7    | 1920 | C:\REALM\WorkedExamples\WERREXPL.sys |

Total number of seasons:- 840

-

\*\*\*\*\* RUN TIME MESSAGES:- \*\*\*\*\*

\*\*\*\*INPUT DATA TYPE= 1 \*\*\*\*

1920  
C:\REALM\WorkedExamples\WERREXPL.sys  
1921  
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 1986  
 1987  
 1988  
 1989  
 1990

\*\*\*\*\* END RUN TIME MESSAGES \*\*\*\*\*

—  
 SUMMARY INFORMATION

Reservoir data:

|       | Name            | Start<br>Storage | File<br>Inflow | Min<br>Storage | Average<br>Storage | Evapn | Release<br>to river | Spill | End<br>Storage |
|-------|-----------------|------------------|----------------|----------------|--------------------|-------|---------------------|-------|----------------|
| 1     | MERR_IRR        | 5123.            | 0.             | 32.            | 7179.              | 0.    | 0.                  | 0.    | 7500.          |
| 2     | DJERRIWARRH RES | 500.             | 117.           | 0.             | 908.               | 5.    | 32.                 | 0.    | 980.           |
| 3     | MERR_URB        | 16314.           | 0.             | 0.             | 17495.             | 0.    | 0.                  | 0.    | 20131.         |
| 4     | MERR_UNK        | 5123.            | 0.             | 0.             | 4702.              | 0.    | 0.                  | 0.    | 4830.          |
| ----- |                 |                  |                |                |                    |       |                     |       |                |
|       |                 | 27060.           | 117.           | 0.             | 30284.             | 5.    | 32.                 | 0.    | 33441.         |
| ----- |                 |                  |                |                |                    |       |                     |       |                |

## Demand data:

|   | Name            | Unrestrict | Restrict | Rationed | Shortfall | Supplied |
|---|-----------------|------------|----------|----------|-----------|----------|
| 1 | BM URBAN        | 282.       | 282.     | 282.     | 0.        | 282.     |
| 2 | MELTON URBAN    | 394.       | 393.     | 393.     | 0.        | 393.     |
| 3 | NOTIONAL DEMAND | 212.       | 211.     | 211.     | 3.        | 208.     |
|   |                 | 888.       | 886.     | 886.     | 3.        | 883.     |

|   | Name            | No Rest | Ave Rest lvl | Max Rest lvl | No Ration | Ave % Ration | Max % Ration | No Short | Ave % Short | Max % Short |
|---|-----------------|---------|--------------|--------------|-----------|--------------|--------------|----------|-------------|-------------|
| 1 | BM URBAN        | 0.0     | 0.0          | 0.0          | 0.0       | 0.0          | 0.0          | 1.0      | 12.0        | 12.0        |
| 2 | MELTON URBAN    | 14.0    | 2.6          | 5.0          | 0.0       | 0.0          | 0.0          | 1.0      | 19.0        | 19.0        |
| 3 | NOTIONAL DEMAND | 14.0    | 2.6          | 5.0          | 0.0       | 0.0          | 0.0          | 21.0     | 73.4        | 100.0       |

## Stream Junc:

|    | Name                 | file inflow |
|----|----------------------|-------------|
| 1  | .PYRITES CK OUTFALL  | 7270.       |
| 2  | IRR INFLOW SHARE     | 100000.     |
| 3  | NODE 52              | 0.          |
| 4  | MERR RAIN#1          | 100000.     |
| 5  | DUMMYAREA1           | 0.          |
| 6  | DUMMYAREA2           | 0.          |
| 7  | MERR RAIN#2          | 100000.     |
| 8  | URB INFLOW SHARE     | 100000.     |
| 9  | UNK INFLOW SHARE     | 100000.     |
| 10 | MERR RAIN#3          | 100000.     |
| 11 | GOODMAN TUNNEL INFLO | 803.        |
| 12 | LOWER LERD INFLOW    | 2537.       |
|    |                      | 610610.     |

## Pipe/River flows:

|    | Name                 | flow   | Capacity   | Min   | Max      | Loss |
|----|----------------------|--------|------------|-------|----------|------|
| 1  | WERRIBEE U/S MELTON  | 9986.0 | 99999999.0 | 147.0 | 126663.0 | 0.0  |
| 2  | MERRIMU SPILLS       | 118.1  | 118.1      | 0.0   | 5681.0   | 0.0  |
| 3  | DJERRIWARRH CK       | 32.0   | 99999999.0 | 0.0   | 1757.0   | 0.0  |
| 4  | MERRIMU TO MELT URB  | 335.5  | 2000.0     | 0.0   | 795.0    | 0.0  |
| 5  | MERRIMU TO BM URBAN  | 282.2  | 1300.0     | 180.0 | 555.0    | 0.0  |
| 6  | DJERR TO MELTON URB  | 57.2   | 579.2      | 0.0   | 558.0    | 0.0  |
| 7  | MERR_IRR ABOVE SHARE | 251.3  | 256.3      | 0.0   | 3591.0   | 0.0  |
| 8  | MERR_IRR BELOW SHARE | 0.0    | 326.5      | 0.0   | 0.0      | 0.0  |
| 9  | MERR_URB ABOVE SHARE | 77.9   | 78.6       | 0.0   | 3468.0   | 0.0  |
| 10 | MERR_URB BELOW SHARE | 103.3  | 3609.0     | 0.0   | 2408.0   | 0.0  |
| 11 | MERRIMU AREA         | 0.0    | 273.3      | 0.0   | 0.0      | 0.0  |
| 12 | MERR_IRR RAIN        | 36.2   | 36.2       | 0.0   | 181.0    | 0.0  |

|    |                      |         |            |         |          |     |
|----|----------------------|---------|------------|---------|----------|-----|
| 13 | MIRR XS RAINFALL     | 99963.8 | 99999999.0 | 99819.0 | 100000.0 | 0.0 |
| 14 | MERR_URB RAIN        | 72.4    | 72.4       | 0.0     | 363.0    | 0.0 |
| 15 | EVAP MERR_URB        | 153.0   | 153.0      | 12.0    | 391.0    | 0.0 |
| 16 | MURB XS RAINFALL     | 99927.6 | 99999999.0 | 99637.0 | 100000.0 | 0.0 |
| 17 | MERR_URB INFLOWS     | 210.0   | 210.0      | 0.0     | 3478.0   | 0.0 |
| 18 | MERR_IRR INFLOWS     | 105.1   | 105.1      | 0.0     | 1739.0   | 0.0 |
| 19 | EVAP MER_IRR         | 76.5    | 76.5       | 6.0     | 196.0    | 0.0 |
| 20 | MERR_IRR ENVIRON REL | 7.3     | 7.3        | 0.0     | 19.0     | 0.0 |
| 21 | MERR_IRR RELEASES    | 0.0     | 99999999.0 | 0.0     | 0.0      | 0.0 |
| 22 | MERR_URB ENVIRON REL | 14.4    | 14.4       | 0.0     | 37.0     | 0.3 |
| 23 | MERR_UNK TO NOTIONAL | 207.7   | 99999999.0 | 0.0     | 423.0    | 0.0 |
| 24 | ENV SECTION 1        | 1057.0  | 1168.2     | 351.0   | 1550.0   | 0.0 |
| 25 | ENV SECTION 2        | 0.0     | 1687.0     | 0.0     | 0.0      | 0.0 |
| 26 | DJERR ENV REL        | 23.0    | 23.0       | 0.0     | 47.0     | 0.0 |
| 27 | ENV FLOW 2 ML/D      | 0.0     | 60.8       | 0.0     | 0.0      | 0.0 |
| 28 | MERR_UNK INFLOWS     | 35.0    | 35.0       | 0.0     | 580.0    | 0.0 |
| 29 | MERR_UNK RAIN        | 12.1    | 12.1       | 0.0     | 60.0     | 0.0 |
| 30 | MUNK XS RAINFALL     | 99987.9 | 99999999.0 | 99940.0 | 100000.0 | 0.0 |
| 31 | EVAP MERR_UNK        | 25.5    | 25.5       | 1.0     | 65.0     | 0.0 |
| 32 | MIRR XS INFLOW       | 99894.9 | 99999999.0 | 98261.0 | 100000.0 | 0.0 |
| 33 | MURB XS INFLOW       | 99790.0 | 99999999.0 | 96522.0 | 100000.0 | 0.0 |
| 34 | MUNK XS INFLOW       | 99965.0 | 99999999.0 | 99420.0 | 100000.0 | 0.0 |
| 35 | MERR_UNK ABOVE SHARE | 0.6     | 0.6        | 0.0     | 257.0    | 0.0 |
| 36 | MERR_UNK BELOW SHARE | 108.4   | 1906.9     | 0.0     | 4574.0   | 0.0 |
| 37 | IRR_URB SHARE        | 103.3   | 192.3      | 0.0     | 2408.0   | 0.0 |
| 38 | UNK_URB SHARE        | 0.0     | 0.3        | 0.0     | 0.0      | 0.0 |
| 39 | IRR_UNK SHARE        | 88.3    | 115.2      | 0.0     | 2580.0   | 0.0 |
| 40 | URB_UNK SHARE        | 20.1    | 48.4       | 0.0     | 1994.0   | 0.0 |
| 41 | URB_IRR SHARE        | 0.0     | 39.7       | 0.0     | 0.0      | 0.0 |
| 42 | UNK_IRR SHARE        | 0.0     | 0.1        | 0.0     | 0.0      | 0.0 |
| 43 | MERR_UNK ENVIRON REL | 2.4     | 2.4        | 0.0     | 6.0      | 0.0 |
| 44 | EXCESS OF MERR_IRR   | 37.2    | 37.2       | 0.0     | 2969.0   | 0.0 |
| 45 | MERR_IRR TUNL SHARE  | 240.9   | 241.0      | 0.0     | 6101.0   | 7.1 |
| 46 | MERR_URB TUNL SHARE  | 481.9   | 481.9      | 0.0     | 12202.0  | 0.0 |
| 47 | MERR_UNK TUNL SHARE  | 80.3    | 80.3       | 0.0     | 2034.0   | 0.0 |
| 48 | LOWER LERD FLOW ARC  | 2537.0  | 99999999.0 | 0.0     | 41960.0  | 0.0 |
| 49 | EXCESS FLOW ARC      | 0.0     | 99999999.0 | 0.0     | 1.0      | 0.0 |
| 50 | TOT INFLOW           | 358.1   | 1153.3     | 0.0     | 1550.0   | 0.0 |
| 51 | TOT EVAP             | 109.4   | 255.0      | 0.0     | 556.0    | 0.0 |
| 52 | TOT RAIN             | 0.0     | 120.6      | 0.0     | 0.0      | 0.0 |
| 53 | tOT RELEASES         | 589.6   | 886.5      | 0.0     | 1500.0   | 0.0 |

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7.  
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End run

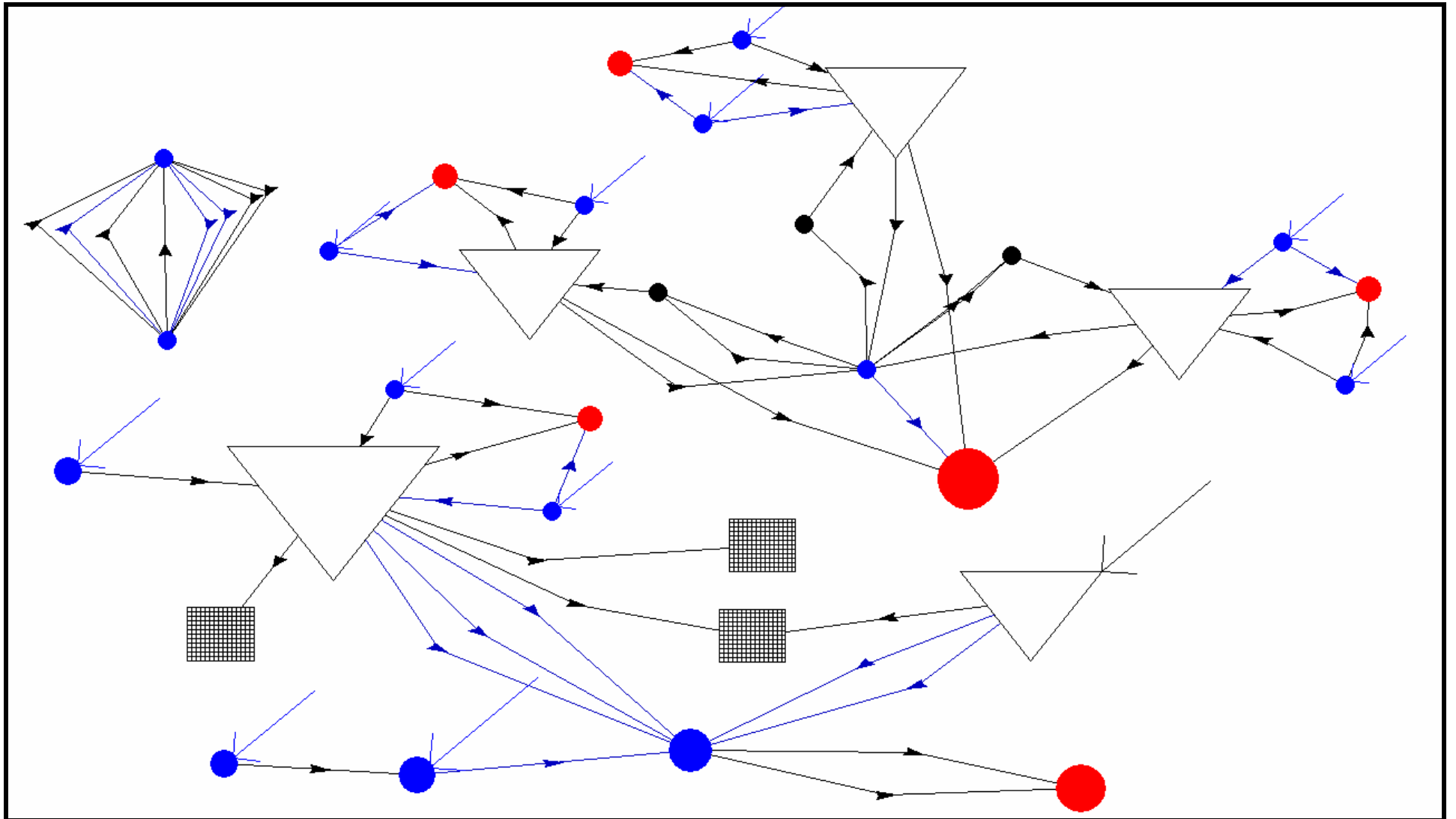


Figure 3.8-2 Worked Example 8(b) – System Plot

WORKED EXAMPLE 8(b) - SYSTEM LISTING (IMPLICIT CAPACITY SHARING)

R E A L M

\*\*\*\*\*  
 \* SYSTEM FILE LISTING \*  
 \*\*\*\*\*

File: C:\REALM\WorkedExamples\WERRIMPL.SYS

Simulation label:

MERRIMU 3 CAPASITY SHARES WERRimpl.SYS (IMPLICIT)  
 WITHOUT WERRIBE IRRIGATION MELTON RESERVOIR AND PYRITES CK R  
 ESERVOIR.(FOR VUT)

Date: 05:29 21/03/2005

-----  
 | NODE INFORMATION |  
 -----

| No | Name  | Type            | X     | Y     | Z    | Size | Aux Input           | No |
|----|---|-----------------|-------|-------|------|------|---------------------|----|
| 1  | .PYRITES CK OUTFALL   | Strm junction   | 28.72 | 6.63  | 0.00 | 2.00 | W_usPyrites         | 1  |
|    | Comment: Pyrities Creek outfall to Werribee R.                                |                 |       |       |      |      |                     |    |
| 2  | MERR_IRR  | Reservoir       | 36.35 | 66.17 | 0.00 | 3.00 |                     | 2  |
|    | Comment: Merrimu Reservoir.   |                 |       |       |      |      |                     |    |
| 3  | BM URBAN  | Demand          | 15.36 | 23.57 | 0.00 | 2.00 |                     | 3  |
|    | Comment: Bacchus Marsh urban supply from Merrimu Res.                         |                 |       |       |      |      |                     |    |
| 4  | DJERRIWARRH RES   | Reservoir       | 70.44 | 27.54 | 0.00 | 3.00 | DJERRIWARRH INFLOWS | 4  |
|    | Comment: Djerriwarrh Reservoir.   |                 |       |       |      |      |                     |    |
| 5  | MELTON URBAN  | Demand          | 51.51 | 23.35 | 0.00 | 2.00 |                     | 5  |
|    | Comment: Melton urban supply from Merrimu Res.                                |                 |       |       |      |      |                     |    |
| 6  | MERR_URB  | Reservoir       | 80.53 | 61.40 | 0.00 | 3.00 |                     | 6  |
|    | Comment: MERRIMU URBAN STORAGE  |                 |       |       |      |      |                     |    |
| 7  | MERRIMU INFLOW  | Strm junction   | 37.87 | 38.38 | 0.00 | 1.00 | MERRIMU RES INFLOWS | 7  |
| 8  | NODE 52   | Strm junction   | 59.29 | 55.32 | 0.00 | 1.00 |                     | 8  |
| 9  | MERR RAIN#4   | Strm junction   | 27.20 | 52.94 | 0.00 | 1.00 | INFLOW              | 9  |
| 10 | NODE 54   | Strm terminator | 40.48 | 49.50 | 0.00 | 1.00 |                     | 10 |
| 11 | NODE 55   | Strm terminator | 93.35 | 65.06 | 0.00 | 1.00 |                     | 11 |
| 12 | DUMMYAREA1  | Strm junction   | 11.49 | 80.69 | 0.00 | 1.00 |                     | 12 |
| 13 | DUMMYAREA2  | Strm junction   | 11.69 | 58.84 | 0.00 | 1.00 |                     | 13 |
| 14 | MERR RAIN#2   | Strm junction   | 91.76 | 53.53 | 0.00 | 1.00 | INFLOW              | 14 |
| 15 | NOTIONAL DEMAND   | Demand          | 52.19 | 34.21 | 0.00 | 2.00 |                     | 15 |
| 16 | MERR_UNK  | Reservoir       | 61.22 | 87.98 | 0.00 | 3.00 |                     | 16 |
|    | Comment: Share of Merrimu - unallocated after urban & irrigation committments |                 |       |       |      |      |                     |    |
| 17 | URB INFLOW SHARE  | Strm junction   | 87.56 | 70.66 | 0.00 | 1.00 | INFLOW              | 17 |
| 18 | UNK INFLOW SHARE  | Strm junction   | 48.13 | 84.94 | 0.00 | 1.00 | INFLOW              | 18 |



Demand data:

| No | Name            | No Bypass | S/F Priority | Monthly Factors |       |       |       |       |       |       |       |       |       |       |       |       |
|----|-----------------|-----------|--------------|-----------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
|    |                 |           |              | Jan             | Feb   | Mar   | Apr   | May   | Jun   | Jul   | Aug   | Sep   | Oct   | Nov   | Dec   |       |
| 3  | BM URBAN        | 10        | 10           | min             | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
|    |                 |           |              | max             | 1.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 5  | MELTON URBAN    | 10        | 9            | min             | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
|    |                 |           |              | max             | 1.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 15 | NOTIONAL DEMAND | 10        | 8            | min             | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
|    |                 |           |              | max             | 1.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |

CARRIER INFORMATION

| No | Name   | Type  | From | To | Cost      | Offset | Loss | Ann Vol | Shr Gp | Shr% | No |
|----|--|-------|------|----|-----------|--------|------|---------|--------|------|----|
| 1  | WERRIBEE U/S MELTON  | River | 1    | 30 | 10        | 0      | Ofix |         | 0      | 0%   | 1  |
|    | Comment: Werribee River upstream of Melton Res.                                      |       |      |    |           |        |      |         |        |      |    |
| 2  | MERRIMU CAPA SPILLS  | River | 8    | 25 | -5000000  | 0      | Ofix |         | 0      | 0%   | 2  |
|    | Comment: Merrimu Res. spills into Pyrites Creek.                                     |       |      |    |           |        |      |         |        |      |    |
| 3  | DJERRIWARRH CK   | River | 4    | 30 | 1000      | 3      | Ofix |         | 0      | 0%   | 3  |
|    | Comment: Djerriwarrh Creek below Reservoir.  |       |      |    |           |        |      |         |        |      |    |
| 4  | MERRIMU TO MELT URB  | Pipe  | 24   | 5  | 100       | 0      | Ofix |         | 0      | 0%   | 4  |
|    | Comment: Melton urban supply from Merrimu Res.                                       |       |      |    |           |        |      |         |        |      |    |
| 5  | MERRIMU TO BM URBAN  | Pipe  | 24   | 3  | 100       | 0      | Ofix |         | 0      | 0%   | 5  |
|    | Comment: Bacchus Marsh urban supply from Merrimu Reservoir.                          |       |      |    |           |        |      |         |        |      |    |
| 6  | DJERR TO MELTON URB  | Pipe  | 4    | 5  | 200       | 0      | Ofix |         | 0      | 0%   | 6  |
|    | Comment: Melton urban supply from Djerriwarrh Reservoir. Transfer capacity = 19 ML/d |       |      |    |           |        |      |         |        |      |    |
| 7  | MERR_IRR ABOVE SHARE   | Pipe  | 2    | 8  | -5000000  | 2      | Ofix |         | 0      | 0%   | 7  |
|    | Comment: Prevents MERR_IRR going ABOVE its capacity share                            |       |      |    |           |        |      |         |        |      |    |
| 8  | MERR_IRR BELOW SHARE   | Pipe  | 21   | 2  | 10        | 0      | Ofix |         | 0      | 0%   | 8  |
|    | Comment: Allows int. spill from MERR_URB to MERR_IRR                                 |       |      |    |           |        |      |         |        |      |    |
| 9  | MERR_URB ABOVE SHARE   | Pipe  | 6    | 8  | -5000000  | -1     | Ofix |         | 0      | 0%   | 9  |
|    | Comment: Prevents MERR_URB going .g.t. its capacity share                            |       |      |    |           |        |      |         |        |      |    |
| 10 | MERR_URB BELOW SHARE   | Pipe  | 22   | 6  | 10        | 0      | Ofix |         | 0      | 0%   | 10 |
|    | Comment: Allows int. spills from MERR_IRR to MERR_URB                                |       |      |    |           |        |      |         |        |      |    |
| 11 | MERR EVAP  | Pipe  | 24   | 10 | -53000000 | 0      | Ofix |         | 0      | 0%   | 11 |
|    | Comment: Takes share of evap out of MERRIMU RESERVOIR                                |       |      |    |           |        |      |         |        |      |    |
| 12 | MERR RAIN  | Pipe  | 9    | 24 | 0         | 0      | Ofix |         | 0      | 0%   | 12 |
|    | Comment: Adds share of Merrimu rain to MERRIMU RESERVOIR                             |       |      |    |           |        |      |         |        |      |    |
| 13 | MER RAIN#4 XS SUPPLY   | Pipe  | 9    | 10 | 1000      | 0      | Ofix |         | 0      | 0%   | 13 |
| 14 | MERR_URB RAIN  | Pipe  | 14   | 6  | 0         | 0      | Ofix |         | 0      | 0%   | 14 |
|    | Comment: Adds share of Merrimu rain to MERR_URB                                      |       |      |    |           |        |      |         |        |      |    |
| 15 | EVAP MERR_URB  | Pipe  | 6    | 11 | -53000000 | 0      | Ofix |         | 0      | 0%   | 15 |
|    | Comment: Takes share of evap out of MERR_URB   |       |      |    |           |        |      |         |        |      |    |
| 16 | MER RAIN#2 XS SUPPLY   | Pipe  | 14   | 11 | 1000      | 0      | Ofix |         | 0      | 0%   | 16 |
| 17 | MERR INFLOWS   | River | 7    | 24 | 0         | 0      | Ofix |         | 0      | 0%   | 17 |
| 18 | MERR_URB INFLOWS   | River | 17   | 6  | 0         | 0      | Ofix |         | 0      | 0%   | 18 |
| 19 | MERRIMU AREA   | Pipe  | 13   | 12 | 0         | -3     | Ofix |         | 0      | 0%   | 19 |
| 20 | MERR_UNK TO NOTIONAL   | Pipe  | 24   | 15 | 0         | 0      | Ofix |         | 0      | 0%   | 20 |
| 21 | ENV SECTION 1  | River | 13   | 12 | -1        | -6     | Ofix |         | 0      | 0%   | 21 |
|    | Comment: SECTION 1 - Recommended Env. min. flows d/s LERDERDERG WEIR                 |       |      |    |           |        |      |         |        |      |    |

|    |  |       |    |    |           |    |      |    |     |    |
|----|--|-------|----|----|-----------|----|------|----|-----|----|
| 22 | ENV SECTION 2  | River | 12 | 13 | 1         | 3  | 0fix | 0  | 0%  | 22 |
|    | Comment: Recommended env. min. flow d/s Lerderderweir - Section 2.                     |       |    |    |           |    |      |    |     |    |
| 23 | DJERR ENV REL  | River | 4  | 30 | -5000000  | 6  | 0fix | 0  | 0%  | 23 |
|    | Comment: Min. env. flow of 1.5 ML/d or natural inflow in Djerriwarrh (lesser of)       |       |    |    |           |    |      |    |     |    |
| 24 | ENV FLOW 2 ML/D  | River | 12 | 13 | 0         | -4 | 0fix | 0  | 0%  | 24 |
|    | Comment: Env. flow of 2 ML/d   |       |    |    |           |    |      |    |     |    |
| 25 | MERR_UNK INFLOWS   | River | 18 | 16 | 1000      | 0  | 0fix | 0  | 0%  | 25 |
| 26 | MERR_UNK RAIN  | Pipe  | 19 | 16 | 0         | 0  | 0fix | 0  | 0%  | 26 |
|    | Comment: Share of Merrimu rainfall to unallocated water store                          |       |    |    |           |    |      |    |     |    |
| 27 | MER RAIN#3 XS SUPPLY   | Pipe  | 19 | 20 | 1000      | 0  | 0fix | 0  | 0%  | 27 |
| 28 | EVAP MERR_UNK  | Pipe  | 16 | 20 | -53000000 | 0  | 0fix | 0  | 0%  | 28 |
|    | Comment: Take share of evap out of MERR_UNK  |       |    |    |           |    |      |    |     |    |
| 29 | MERR XS INFLOW   | River | 7  | 10 | 1000      | 0  | 0fix | 0  | 0%  | 29 |
|    | Comment: Surplus Merrimu rain ex irr   |       |    |    |           |    |      |    |     |    |
| 30 | MERR_URB XS INFLOW   | River | 17 | 11 | 1000      | 0  | 0fix | 0  | 0%  | 30 |
|    | Comment: Excess Merrimu rain ex. urb   |       |    |    |           |    |      |    |     |    |
| 31 | MERR_UNK XS INFLOW   | River | 18 | 20 | 1000      | 0  | 0fix | 0  | 0%  | 31 |
|    | Comment: Excess Merrimu rainfall ex unk  |       |    |    |           |    |      |    |     |    |
| 32 | MERR_UNK ABOVE SHARE   | Pipe  | 16 | 8  | -5000000  | 1  | 0fix | 0  | 0%  | 32 |
|    | Comment: Prevents MERR_UNK going above share   |       |    |    |           |    |      |    |     |    |
| 33 | MERR_UNK BELOW SHARE   | Pipe  | 23 | 16 | 10        | 0  | 0fix | 0  | 0%  | 33 |
|    | Comment: Allows internal spills from MERR_IRR and/or MERR_URB                          |       |    |    |           |    |      |    |     |    |
| 34 | IRR_URB SHARE  | Pipe  | 8  | 22 | 10        | 1  | 0fix | -1 | 75% | 34 |
|    | Comment: Share of above share internal spill from MERR_IRR to MERR_URB                 |       |    |    |           |    |      |    |     |    |
| 35 | UNK_URB SHARE  | Pipe  | 8  | 22 | 10        | -2 | 0fix | -2 | 75% | 35 |
|    | Comment: Share of internal spill from MERR_UNK to MERR_URB                             |       |    |    |           |    |      |    |     |    |
| 36 | IRR_UNK SHARE  | Pipe  | 8  | 23 | 10        | -2 | 0fix | 1  | 25% | 36 |
|    | Comment: Share of internal spill from MERR_IRR to MERR_UNK                             |       |    |    |           |    |      |    |     |    |
| 37 | URB_UNK SHARE  | Pipe  | 8  | 23 | 10        | 2  | 0fix | -3 | 50% | 37 |
|    | Comment: Share of internal spill from MERR_URB to MERR_UNK                             |       |    |    |           |    |      |    |     |    |
| 38 | URB_IRR SHARE  | Pipe  | 8  | 21 | 10        | 2  | 0fix | 3  | 50% | 38 |
|    | Comment: Share of internal spill from MERR_URB to MERR_IRR                             |       |    |    |           |    |      |    |     |    |
| 39 | UNK_IRR SHARE  | Pipe  | 8  | 21 | 10        | -2 | 0fix | 2  | 25% | 39 |
|    | Comment: Share of internal spill from MERR_UNK to MERR_IRR                             |       |    |    |           |    |      |    |     |    |
| 40 | MERRIMU SPILL  | River | 24 | 30 | 0         | 3  | 0fix | 0  | 0%  | 40 |
| 41 | MERRIMU ENV FLOWS  | River | 24 | 30 | -5000000  | -2 | 0fix | 0  | 0%  | 41 |
|    | Comment: ENV FLOW OF MINIMUM OF 2 ML/D OR NATURAL FROM DEC TO JULY                     |       |    |    |           |    |      |    |     |    |
| 42 | MERRIMU IRRIGATION   | River | 24 | 30 | -4500000  | 0  | 3%   | 0  | 0%  | 42 |
| 43 | FLOWS ABOVE MELTON   | Pipe  | 30 | 29 | 100000    | -2 | 3%   | 0  | 0%  | 43 |
| 44 | MERR_IRR ENVIRON REL   | Pipe  | 2  | 25 | -5000000  | 5  | 3%   | 0  | 0%  | 44 |
|    | Comment: Merrimu irrigation share of env. flow if spills+irr. rel. lt. env requirement |       |    |    |           |    |      |    |     |    |
| 45 | EXCESS FLOWS TO MEL  | Pipe  | 30 | 29 | -50000000 | 1  | 0fix | 0  | 0%  | 45 |
|    | Comment: To force out flow required to be sent to Melton                               |       |    |    |           |    |      |    |     |    |
| 46 | MERR_URB ENVIRON REL   | Pipe  | 6  | 25 | -50000000 | 4  | 0fix | 0  | 0%  | 46 |
|    | Comment: Merrimu urban share of environ, flow if spills+irr rel lt. env requirement    |       |    |    |           |    |      |    |     |    |
| 47 | MERR_UNK ENVIRON REL   | Pipe  | 16 | 25 | -5000000  | -1 | 0fix | 0  | 0%  | 47 |
|    | Comment: Share of flow from Merr_unk to meet env flows in Pyrites @ 2 ml/d             |       |    |    |           |    |      |    |     |    |
| 48 | MER RAIN#1 XS SUPPLY   | Pipe  | 26 | 27 | 10000     | 0  | 0fix | 0  | 0%  | 48 |
| 49 | MERR_IRR XS INFLOW   | River | 28 | 27 | 1000      | 0  | 0fix | 0  | 0%  | 49 |
| 50 | MERR_IRR INFLOWS   | River | 28 | 2  | 0         | 0  | 0fix | 0  | 0%  | 50 |
| 51 | MERR_IRR RAIN  | Pipe  | 26 | 2  | 0         | 0  | 0fix | 0  | 0%  | 51 |
| 52 | EVAP MERR_IRR  | Pipe  | 2  | 27 | -53000000 | 1  | 0fix | 0  | 0%  | 52 |
| 53 | GOODMANS TUNNEL  | Pipe  | 31 | 24 | 0         | 0  | 0fix | 0  | 0%  | 53 |
| 54 | LOWER LERD FLOW ARC  | Pipe  | 32 | 1  | 0         | 0  | 0fix | 0  | 0%  | 54 |
| 55 | TRACK TOT RAIN   | Pipe  | 12 | 13 | 0         | 6  | 0fix | 0  | 0%  | 55 |
| 56 | TRACK TOT EVAP   | Pipe  | 13 | 12 | 0         | 7  | 0fix | 0  | 0%  | 56 |
| 57 | TRACK TOT INFLOWS  | Pipe  | 12 | 13 | 0         | -7 | 0fix | 0  | 0%  | 57 |





| Capacity set option (0-off 1-prev 2-recalc)     |                  | Jan=2     | Feb=2 | Mar=2 | Apl=2 | May=2 | Jun=2 | Jul=2 | Aug=2 | Sep=2 | Oct=2 | Nov=2 | Dec=2 |
|---|------------------|-----------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| 9 MERR_URB ABOVE SHARE                          | V                | -99999    | 0     | 99999 | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     |
| Fn Name:  | C                | -99999    | 0     | 99999 | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     |
| Equation used: '1-'2-21000                      |                  |           |       |       |       |       |       |       |       |       |       |       |       |
| ' 1 = MERR_URB                                  | Type: ESTO       |           |       |       |       |       |       |       |       |       |       |       |       |
| ' 2 = MERR_URB BELOW SHARE                      | Type: FLOW(# 10) |           |       |       |       |       |       |       |       |       |       |       |       |
| Previous flow solution is added to new capacity |                  |           |       |       |       |       |       |       |       |       |       |       |       |
| Capacity set option (0-off 1-prev 2-recalc)     |                  | Jan=2     | Feb=2 | Mar=2 | Apl=2 | May=2 | Jun=2 | Jul=2 | Aug=2 | Sep=2 | Oct=2 | Nov=2 | Dec=2 |
| 10 MERR_URB BELOW SHARE                         | V                | -99999    | 0     | 99999 | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     |
| Fn Name:  | C                | -99999    | 0     | 99999 | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     |
| Equation used: 21000-'1                         |                  |           |       |       |       |       |       |       |       |       |       |       |       |
| ' 1 = MERR_URB                                  | Type: ESTO       |           |       |       |       |       |       |       |       |       |       |       |       |
| Previous flow solution is added to new capacity |                  |           |       |       |       |       |       |       |       |       |       |       |       |
| Capacity set option (0-off 1-prev 2-recalc)     |                  | Jan=2     | Feb=2 | Mar=2 | Apl=2 | May=2 | Jun=2 | Jul=2 | Aug=2 | Sep=2 | Oct=2 | Nov=2 | Dec=2 |
| 11 MERR EVAP                                    | V                | -99999    | 0     | 99999 | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     |
| Fn Name:  | C                | -99999    | 0     | 99999 | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     |
| Equation used: ('1*(('2*0.85)+5)*0.01)          |                  |           |       |       |       |       |       |       |       |       |       |       |       |
| ' 1 = MERRIMU AREA                              | Type: CAPC(# 19) |           |       |       |       |       |       |       |       |       |       |       |       |
| ' 2 = EVAPORATION                               | Type: STRM       |           |       |       |       |       |       |       |       |       |       |       |       |
| Capacity set option (0-off 1-prev 2-recalc)     |                  | Jan=2     | Feb=2 | Mar=2 | Apl=2 | May=2 | Jun=2 | Jul=2 | Aug=2 | Sep=2 | Oct=2 | Nov=2 | Dec=2 |
| 12 MERR RAIN                                    | V                | 0         | 99999 | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     |
| Fn Name:  | C                | 0         | 99999 | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     |
| Equation used: ('1*'2)*0.01                     |                  |           |       |       |       |       |       |       |       |       |       |       |       |
| ' 1 = MERRIMU AREA                              | Type: CAPC(# 19) |           |       |       |       |       |       |       |       |       |       |       |       |
| ' 2 = RAINFALL(87002)                           | Type: STRM       |           |       |       |       |       |       |       |       |       |       |       |       |
| Capacity set option (0-off 1-prev 2-recalc)     |                  | Jan=2     | Feb=2 | Mar=2 | Apl=2 | May=2 | Jun=2 | Jul=2 | Aug=2 | Sep=2 | Oct=2 | Nov=2 | Dec=2 |
| 14 MERR_URB RAIN                                | V                | 0         | 99999 | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     |
| Fn Name:  | C                | 0         | 99999 | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     |
| Equation used: '1*0.60                          |                  |           |       |       |       |       |       |       |       |       |       |       |       |
| ' 1 = MERR RAIN                                 | Type: FLOW(# 12) |           |       |       |       |       |       |       |       |       |       |       |       |
| Capacity set option (0-off 1-prev 2-recalc)     |                  | Jan=2     | Feb=2 | Mar=2 | Apl=2 | May=2 | Jun=2 | Jul=2 | Aug=2 | Sep=2 | Oct=2 | Nov=2 | Dec=2 |
| 15 EVAP MERR_URB                                | V                | -99999    | 0     | 99999 | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     |
| Fn Name:  | C                | -99999    | 0     | 99999 | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     |
| Equation used: ('1*0.6)                         |                  |           |       |       |       |       |       |       |       |       |       |       |       |
| ' 1 = MERR EVAP                                 | Type: FLOW(# 11) |           |       |       |       |       |       |       |       |       |       |       |       |
| Capacity set option (0-off 1-prev 2-recalc)     |                  | Jan=2     | Feb=2 | Mar=2 | Apl=2 | May=2 | Jun=2 | Jul=2 | Aug=2 | Sep=2 | Oct=2 | Nov=2 | Dec=2 |
| 17 MERR INFLOWS                                 | V                | 099999999 | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     |
| Fn Name:  | C                | 099999999 | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     |
| Equation used: '1                               |                  |           |       |       |       |       |       |       |       |       |       |       |       |
| ' 1 = MERRIMU RES INFLOWS                       | Type: STRM       |           |       |       |       |       |       |       |       |       |       |       |       |
| Capacity set option (0-off 1-prev 2-recalc)     |                  | Jan=2     | Feb=2 | Mar=2 | Apl=2 | May=2 | Jun=2 | Jul=2 | Aug=2 | Sep=2 | Oct=2 | Nov=2 | Dec=2 |
| 18 MER_URB INFLOWS                              | V                | 0 9999999 | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     |
| Fn Name:  | C                | 0 9999999 | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     |
| Equation used: ('1+'2)*0.6                      |                  |           |       |       |       |       |       |       |       |       |       |       |       |
| ' 1 = MERR INFLOWS                              | Type: FLOW(# 17) |           |       |       |       |       |       |       |       |       |       |       |       |
| ' 2 = GOODMAN'S TUNNEL                          | Type: FLOW(# 53) |           |       |       |       |       |       |       |       |       |       |       |       |
| Capacity set option (0-off 1-prev 2-recalc)     |                  | Jan=2     | Feb=2 | Mar=2 | Apl=2 | May=2 | Jun=2 | Jul=2 | Aug=2 | Sep=2 | Oct=2 | Nov=2 | Dec=2 |
| 19 MERRIMU AREA                                 | V                | 0         | 1326  | 4150  | 10115 | 19100 | 21100 | 37830 | 99999 | 0     | 0     | 0     | 0     |

|   |                  |        |         |         |       |       |       |       |       |       |       |       |       |
|---|------------------|--------|---------|---------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| Fn Name:  | C                | 0      | 30      | 64      | 140   | 211   | 226   | 326   | 326   | 0     | 0     | 0     | 0     |
| Equation used: '1+'2+'3                         |                  |        |         |         |       |       |       |       |       |       |       |       |       |
| ' 1 = MERR_IRR                                  | Type: STOR       |        |         |         |       |       |       |       |       |       |       |       |       |
| ' 2 = MERR_URB                                  | Type: STOR       |        |         |         |       |       |       |       |       |       |       |       |       |
| ' 3 = MERR_UNK                                  | Type: STOR       |        |         |         |       |       |       |       |       |       |       |       |       |
| Capacity set option (0-off 1-prev 2-recalc)     |                  | Jan=2  | Feb=2   | Mar=2   | Apl=2 | May=2 | Jun=2 | Jul=2 | Aug=2 | Sep=2 | Oct=2 | Nov=2 | Dec=2 |
| 23 DJERR ENV REL                                | V                | 0      | 100     | 9999999 | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     |
| Fn Name:  | C                | 0      | 100     | 9999999 | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     |
| Equation used: MIN('1*0.75,'2)                  |                  |        |         |         |       |       |       |       |       |       |       |       |       |
| ' 1 = ENV FLOW 2 ML/D                           | Type: CAPC(# 24) |        |         |         |       |       |       |       |       |       |       |       |       |
| ' 2 = DJERRIWARRH INFLOWS                       | Type: STRM       |        |         |         |       |       |       |       |       |       |       |       |       |
| Capacity set option (0-off 1-prev 2-recalc)     |                  | Jan=2  | Feb=2   | Mar=2   | Apl=2 | May=2 | Jun=2 | Jul=2 | Aug=2 | Sep=2 | Oct=2 | Nov=2 | Dec=2 |
| 25 MERR_UNK INFLOWS                             | V                | 0      | 9999999 | 0       | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     |
| Fn Name:  | C                | 0      | 9999999 | 0       | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     |
| Equation used: ('1+'2)*0.1                      |                  |        |         |         |       |       |       |       |       |       |       |       |       |
| ' 1 = MERR INFLOWS                              | Type: FLOW(# 17) |        |         |         |       |       |       |       |       |       |       |       |       |
| ' 2 = GOODMANS TUNNEL                           | Type: FLOW(# 53) |        |         |         |       |       |       |       |       |       |       |       |       |
| Capacity set option (0-off 1-prev 2-recalc)     |                  | Jan=2  | Feb=2   | Mar=2   | Apl=2 | May=2 | Jun=2 | Jul=2 | Aug=2 | Sep=2 | Oct=2 | Nov=2 | Dec=2 |
| 26 MERR_UNK RAIN                                | V                | 0      | 99999   | 0       | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     |
| Fn Name:  | C                | 0      | 99999   | 0       | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     |
| Equation used: '1*0.1                           |                  |        |         |         |       |       |       |       |       |       |       |       |       |
| ' 1 = MERR RAIN                                 | Type: FLOW(# 12) |        |         |         |       |       |       |       |       |       |       |       |       |
| Capacity set option (0-off 1-prev 2-recalc)     |                  | Jan=2  | Feb=2   | Mar=2   | Apl=2 | May=2 | Jun=2 | Jul=2 | Aug=2 | Sep=2 | Oct=2 | Nov=2 | Dec=2 |
| 28 EVAP MERR_UNK                                | V                | -99999 | 0       | 99999   | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     |
| Fn Name:  | C                | -99999 | 0       | 99999   | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     |
| Equation used: ('1*0.1)                         |                  |        |         |         |       |       |       |       |       |       |       |       |       |
| ' 1 = MERR EVAP                                 | Type: FLOW(# 11) |        |         |         |       |       |       |       |       |       |       |       |       |
| Capacity set option (0-off 1-prev 2-recalc)     |                  | Jan=2  | Feb=2   | Mar=2   | Apl=2 | May=2 | Jun=2 | Jul=2 | Aug=2 | Sep=2 | Oct=2 | Nov=2 | Dec=2 |
| 32 MERR_UNK ABOVE SHARE                         | V                | -99999 | 0       | 99999   | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     |
| Fn Name:  | C                | -99999 | 0       | 99999   | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     |
| Equation used: '1-'2-6500                       |                  |        |         |         |       |       |       |       |       |       |       |       |       |
| ' 1 = MERR_UNK                                  | Type: ESTO       |        |         |         |       |       |       |       |       |       |       |       |       |
| ' 2 = MERR_UNK BELOW SHARE                      | Type: FLOW(# 33) |        |         |         |       |       |       |       |       |       |       |       |       |
| Previous flow solution is added to new capacity |                  |        |         |         |       |       |       |       |       |       |       |       |       |
| Capacity set option (0-off 1-prev 2-recalc)     |                  | Jan=2  | Feb=2   | Mar=2   | Apl=2 | May=2 | Jun=2 | Jul=2 | Aug=2 | Sep=2 | Oct=2 | Nov=2 | Dec=2 |
| 33 MERR_UNK BELOW SHARE                         | V                | -99999 | 0       | 999999  | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     |
| Fn Name:  | C                | -99999 | 0       | 999999  | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     |
| Equation used: 6500-'1                          |                  |        |         |         |       |       |       |       |       |       |       |       |       |
| ' 1 = MERR_UNK                                  | Type: ESTO       |        |         |         |       |       |       |       |       |       |       |       |       |
| Previous flow solution is added to new capacity |                  |        |         |         |       |       |       |       |       |       |       |       |       |
| Capacity set option (0-off 1-prev 2-recalc)     |                  | Jan=2  | Feb=2   | Mar=2   | Apl=2 | May=2 | Jun=2 | Jul=2 | Aug=2 | Sep=2 | Oct=2 | Nov=2 | Dec=2 |
| 34 IRR_URB SHARE                                | V                | -99999 | 0       | 99999   | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     |
| Fn Name:  | C                | -99999 | 0       | 99999   | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     |
| Equation used: '1*1.0                           |                  |        |         |         |       |       |       |       |       |       |       |       |       |
| ' 1 = MERR_IRR ABOVE SHARE                      | Type: CAPC(# 7)  |        |         |         |       |       |       |       |       |       |       |       |       |
| Capacity set option (0-off 1-prev 2-recalc)     |                  | Jan=2  | Feb=2   | Mar=2   | Apl=2 | May=2 | Jun=2 | Jul=2 | Aug=2 | Sep=2 | Oct=2 | Nov=2 | Dec=2 |
| 35 UNK_URB SHARE                                | V                | -99999 | 0       | 99999   | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     |
| Fn Name:  | C                | -99999 | 0       | 99999   | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     |
| Equation used: '1*1.0                           |                  |        |         |         |       |       |       |       |       |       |       |       |       |

|   |                  |           |       |       |       |       |       |       |       |       |       |       |       |
|---|------------------|-----------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| ' 1 = MERR_UNK ABOVE SHARE                  | Type: CAPC(# 32) |           |       |       |       |       |       |       |       |       |       |       |       |
| Capacity set option (0-off 1-prev 2-recalc) |                  | Jan=2     | Feb=2 | Mar=2 | Apl=2 | May=2 | Jun=2 | Jul=2 | Aug=2 | Sep=2 | Oct=2 | Nov=2 | Dec=2 |
| 37 URB_UNK SHARE                            | V -99999         | 0         | 99999 | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     |
| Fn Name:                                    | C -99999         | 0         | 99999 | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     |
| Equation used: '1*1.0                       |                  |           |       |       |       |       |       |       |       |       |       |       |       |
| ' 1 = MERR_URB ABOVE SHARE                  | Type: CAPC(# 9)  |           |       |       |       |       |       |       |       |       |       |       |       |
| Capacity set option (0-off 1-prev 2-recalc) |                  | Jan=2     | Feb=2 | Mar=2 | Apl=2 | May=2 | Jun=2 | Jul=2 | Aug=2 | Sep=2 | Oct=2 | Nov=2 | Dec=2 |
| 41 MERRIMU ENV FLOWS                        | V 0*****         | 0         | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     |
| Fn Name:                                    | C 0*****         | 0         | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     |
| Equation used: MIN('1','2)                  |                  |           |       |       |       |       |       |       |       |       |       |       |       |
| ' 1 = ENV FLOW 2 ML/D                       | Type: CAPC(# 24) |           |       |       |       |       |       |       |       |       |       |       |       |
| ' 2 = MERRIMU RES INFLOWS                   | Type: STRM       |           |       |       |       |       |       |       |       |       |       |       |       |
| Capacity set option (0-off 1-prev 2-recalc) |                  | Jan=2     | Feb=2 | Mar=2 | Apl=2 | May=2 | Jun=2 | Jul=2 | Aug=0 | Sep=0 | Oct=0 | Nov=0 | Dec=2 |
| 42 MERRIMU IRRIGATION                       | V 0 999999       | 0         | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     |
| Fn Name:                                    | C 0 999999       | 0         | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     |
| Equation used: '1                           |                  |           |       |       |       |       |       |       |       |       |       |       |       |
| ' 1 = TOTAL FLOW                            | Type: STRM       |           |       |       |       |       |       |       |       |       |       |       |       |
| Capacity set option (0-off 1-prev 2-recalc) |                  | Jan=2     | Feb=2 | Mar=2 | Apl=2 | May=2 | Jun=2 | Jul=2 | Aug=0 | Sep=0 | Oct=0 | Nov=0 | Dec=2 |
| 44 MERR_IRR ENVIRON REL                     | V -9999999       | 0 9999999 | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     |
| Fn Name:                                    | C -9999999       | 0 9999999 | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     |
| Equation used: ('1+('2*0.3))                |                  |           |       |       |       |       |       |       |       |       |       |       |       |
| ' 1 = MERRIMU IRRIGATION                    | Type: FLOW(# 42) |           |       |       |       |       |       |       |       |       |       |       |       |
| ' 2 = MERRIMU ENV FLOWS                     | Type: FLOW(# 41) |           |       |       |       |       |       |       |       |       |       |       |       |
| Capacity set option (0-off 1-prev 2-recalc) |                  | Jan=2     | Feb=2 | Mar=2 | Apl=2 | May=2 | Jun=2 | Jul=2 | Aug=2 | Sep=2 | Oct=2 | Nov=2 | Dec=2 |
| 45 EXCESS FLOWS TO MEL                      | V 099999999      | 0         | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     |
| Fn Name:                                    | C 099999999      | 0         | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     |
| Equation used: '1                           |                  |           |       |       |       |       |       |       |       |       |       |       |       |
| ' 1 = MELTON U/S FLOW                       | Type: STRM       |           |       |       |       |       |       |       |       |       |       |       |       |
| Capacity set option (0-off 1-prev 2-recalc) |                  | Jan=0     | Feb=0 | Mar=0 | Apl=0 | May=0 | Jun=0 | Jul=0 | Aug=0 | Sep=0 | Oct=0 | Nov=0 | Dec=0 |
| 46 MERR_URB ENVIRON REL                     | V -9999999       | 0 9999999 | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     |
| Fn Name:                                    | C -9999999       | 0 9999999 | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     |
| Equation used: ('1+('2*0.6)+'3)             |                  |           |       |       |       |       |       |       |       |       |       |       |       |
| ' 1 = MERRIMU TO MELT URB                   | Type: FLOW(# 4)  |           |       |       |       |       |       |       |       |       |       |       |       |
| ' 2 = MERRIMU ENV FLOWS                     | Type: FLOW(# 41) |           |       |       |       |       |       |       |       |       |       |       |       |
| ' 3 = MERRIMU TO BM URBAN                   | Type: FLOW(# 5)  |           |       |       |       |       |       |       |       |       |       |       |       |
| Capacity set option (0-off 1-prev 2-recalc) |                  | Jan=2     | Feb=2 | Mar=2 | Apl=2 | May=2 | Jun=2 | Jul=2 | Aug=2 | Sep=2 | Oct=2 | Nov=2 | Dec=2 |
| 47 MERR_UNK ENVIRON REL                     | V -9999999       | 0 9999999 | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     |
| Fn Name:                                    | C *****          | 0 9999999 | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     |
| Equation used: (('1*0.1)+'2)                |                  |           |       |       |       |       |       |       |       |       |       |       |       |
| ' 1 = MERRIMU ENV FLOWS                     | Type: FLOW(# 41) |           |       |       |       |       |       |       |       |       |       |       |       |
| ' 2 = MERR_UNK TO NOTIONAL                  | Type: FLOW(# 20) |           |       |       |       |       |       |       |       |       |       |       |       |
| Capacity set option (0-off 1-prev 2-recalc) |                  | Jan=2     | Feb=2 | Mar=2 | Apl=2 | May=2 | Jun=2 | Jul=2 | Aug=2 | Sep=2 | Oct=2 | Nov=2 | Dec=2 |
| 50 MERR_IRR INFLOWS                         | V 099999999      | 0         | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     |
| Fn Name:                                    | C 099999999      | 0         | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     |
| Equation used: ('1+'2)*0.3                  |                  |           |       |       |       |       |       |       |       |       |       |       |       |
| ' 1 = MERR INFLOWS                          | Type: FLOW(# 17) |           |       |       |       |       |       |       |       |       |       |       |       |
| ' 2 = GOODMANS TUNNEL                       | Type: FLOW(# 53) |           |       |       |       |       |       |       |       |       |       |       |       |
| Capacity set option (0-off 1-prev 2-recalc) |                  | Jan=2     | Feb=2 | Mar=2 | Apl=2 | May=2 | Jun=2 | Jul=2 | Aug=2 | Sep=2 | Oct=2 | Nov=2 | Dec=2 |

|   |   |                  |       |       |       |       |       |       |       |       |       |       |       |       |
|---|---|------------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| 51 MERR_IRR RAIN                            | V | 0 9999999        | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     |       |
| Fn Name:                                    | C | 0 9999999        | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     |       |
| Equation used: (0.3*1)                      |   |                  |       |       |       |       |       |       |       |       |       |       |       |       |
| ' 1 = MERR_RAIN                             |   | Type: FLOW(# 12) |       |       |       |       |       |       |       |       |       |       |       |       |
| Capacity set option (0-off 1-prev 2-recalc) |   |                  | Jan=2 | Feb=2 | Mar=2 | Apr=2 | May=2 | Jun=2 | Jul=2 | Aug=2 | Sep=2 | Oct=2 | Nov=2 | Dec=2 |
| 52 EVAP MERR_IRR                            | V | 0 9999999        | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     |       |
| Fn Name:                                    | C | 0 9999999        | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     |       |
| Equation used: (0.3*1)                      |   |                  |       |       |       |       |       |       |       |       |       |       |       |       |
| ' 1 = MERR_EVAP                             |   | Type: FLOW(# 11) |       |       |       |       |       |       |       |       |       |       |       |       |
| Capacity set option (0-off 1-prev 2-recalc) |   |                  | Jan=2 | Feb=2 | Mar=2 | Apr=2 | May=2 | Jun=2 | Jul=2 | Aug=2 | Sep=2 | Oct=2 | Nov=2 | Dec=2 |
| 55 TRACK TOT RAIN                           | V | 099999999        | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     |       |
| Fn Name:                                    | C | 099999999        | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     |       |
| Equation used: '1'+2+'3                     |   |                  |       |       |       |       |       |       |       |       |       |       |       |       |
| ' 1 = MERR_IRR RAIN                         |   | Type: FLOW(# 51) |       |       |       |       |       |       |       |       |       |       |       |       |
| ' 2 = MERR_UNK RAIN                         |   | Type: FLOW(# 26) |       |       |       |       |       |       |       |       |       |       |       |       |
| ' 3 = MERR_URB RAIN                         |   | Type: FLOW(# 14) |       |       |       |       |       |       |       |       |       |       |       |       |
| Capacity set option (0-off 1-prev 2-recalc) |   |                  | Jan=2 | Feb=2 | Mar=2 | Apr=2 | May=2 | Jun=2 | Jul=2 | Aug=2 | Sep=2 | Oct=2 | Nov=2 | Dec=2 |
| 56 TRACK TOT EVAP                           | V | 099999999        | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     |       |
| Fn Name:                                    | C | 099999999        | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     |       |
| Equation used: '1'+2+'3                     |   |                  |       |       |       |       |       |       |       |       |       |       |       |       |
| ' 1 = EVAP MERR_IRR                         |   | Type: FLOW(# 52) |       |       |       |       |       |       |       |       |       |       |       |       |
| ' 2 = EVAP MERR_URB                         |   | Type: FLOW(# 15) |       |       |       |       |       |       |       |       |       |       |       |       |
| ' 3 = EVAP MERR_UNK                         |   | Type: FLOW(# 28) |       |       |       |       |       |       |       |       |       |       |       |       |
| Capacity set option (0-off 1-prev 2-recalc) |   |                  | Jan=2 | Feb=2 | Mar=2 | Apr=2 | May=2 | Jun=2 | Jul=2 | Aug=2 | Sep=2 | Oct=2 | Nov=2 | Dec=2 |
| 57 TRACK TOT INFLOWS                        | V | 0 9999999        | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     |       |
| Fn Name:                                    | C | 099999999        | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     |       |
| Equation used: '1'+2+'3                     |   |                  |       |       |       |       |       |       |       |       |       |       |       |       |
| ' 1 = MERR_IRR INFLOWS                      |   | Type: FLOW(# 50) |       |       |       |       |       |       |       |       |       |       |       |       |
| ' 2 = MER_URB INFLOWS                       |   | Type: FLOW(# 18) |       |       |       |       |       |       |       |       |       |       |       |       |
| ' 3 = MERR_UNK INFLOWS                      |   | Type: FLOW(# 25) |       |       |       |       |       |       |       |       |       |       |       |       |
| Capacity set option (0-off 1-prev 2-recalc) |   |                  | Jan=2 | Feb=2 | Mar=2 | Apr=2 | May=2 | Jun=2 | Jul=2 | Aug=2 | Sep=2 | Oct=2 | Nov=2 | Dec=2 |
| 58 TOT RELEASE                              | V | 099999999        | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     |       |
| Fn Name:                                    | C | 099999999        | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     |       |
| Equation used: '1'+2+'3                     |   |                  |       |       |       |       |       |       |       |       |       |       |       |       |
| ' 1 = MERR_IRR ENVIRON REL                  |   | Type: FLOW(# 44) |       |       |       |       |       |       |       |       |       |       |       |       |
| ' 2 = MERR_UNK ENVIRON REL                  |   | Type: FLOW(# 47) |       |       |       |       |       |       |       |       |       |       |       |       |
| ' 3 = MERR_URB ENVIRON REL                  |   | Type: FLOW(# 46) |       |       |       |       |       |       |       |       |       |       |       |       |
| ' 4 = MERRIMU IRRIGATION                    |   | Type: FLOW(# 42) |       |       |       |       |       |       |       |       |       |       |       |       |
| Capacity set option (0-off 1-prev 2-recalc) |   |                  | Jan=2 | Feb=2 | Mar=2 | Apr=2 | May=2 | Jun=2 | Jul=2 | Aug=2 | Sep=2 | Oct=2 | Nov=2 | Dec=2 |



Base levels (% AAD)                         -742.00   -672.00   -601.00   -424.00   -353.00   -300.00   -318.00   -318.00   -353.00   -442.00   -530.00   -

672.00

NB. Negative values will be interpreted as absolute values

-----  
 | MULTI SYSTEM INFORMATION |  
 -----

-----  
 Reservoirs  
 -----

MERR\_IRR             2  
 DJERRIWARRH RES    1  
 MERR\_URB            2  
 MERR\_UNK            2  
 MERRIMU RESERVO    1

-----  
 | CAPACITY SHARING INFORMATION |  
 -----

(a negative represents capacity key for group)

| Carrier | Name          | Group No. | % Share            |
|---------|---------------|-----------|--------------------|
| 34      | IRR_URB SHARE | -1        | 75 <- capacity key |
| 36      | IRR_UNK SHARE | 1         | 25                 |
| 35      | UNK_URB SHARE | -2        | 75 <- capacity key |
| 39      | UNK_IRR SHARE | 2         | 25                 |
| 37      | URB_UNK SHARE | -3        | 50 <- capacity key |
| 38      | URB_IRR SHARE | 3         | 50                 |

**WORKED EXAMPLE 8(b) - LOG FILE (IMPLICIT CAPACITY SHARING)**

```

HHHHH      HHHHHHHH   HHHHHH   H       HHHHHHHHHH
H  H      H           H  H   H       H  H  H
HHHHHHHHH  HHHHHH     HHHHHHHH  HHH     HHH H  H
HHH   H   HHH         HHH   H   HHH     HHH H  H
HHH   H   HHH         HHH   H   HHH     HHH H  H
HHH   H   HHHHHHHH   HHH   H   HHHHHHHH  HHH H  H

```

```

*****
*   SIMULATION LOG FILE   *
*****

```

Log filename : IMPL.log

Scenario file: scn8i.scn

Simulation label:

Tutorial 8 - Implicit Capacity Sharing

Streamflow file(s):

C:\REALM\WorkedExamples\WERRCAPC.SF

Demand file(s):

C:\REALM\WorkedExamples\WERRIRR.DEM

Restrictions are ON

Instream flow requirements NOT limited to natural

Water quality calculations are OFF

Number of S/F Sequences: 1

Convergence tolerance (storage) 1 10th%

Other convergence tolerance 5 %

Arc convergence tolerance (abs) 100

Minimum iteration count 3

Maximum iteration count 51

Do convergence twice No

Date: 10:35:09 01/14/02



Time Step = Monthly

SYSTEM CHANGES:

| No | Seas | Year | System File                          |
|----|------|------|--------------------------------------|
| 1  | 7    | 1920 | C:\REALM\WorkedExamples\WERRIMPL.sys |

Total number of seasons:- 840

-

\*\*\*\*\* RUN TIME MESSAGES:- \*\*\*\*\*

\*\*\*\*INPUT DATA TYPE= 1 \*\*\*\*

1920  
C:\REALM\WorkedExamples\WERRIMPL.sys  
1921  
1922  
1923  
1924  
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1930  
1931  
1932  
1933  
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 1983  
 1984  
 1985  
 1986  
 1987  
 1988  
 1989  
 1990

\*\*\*\*\* END RUN TIME MESSAGES \*\*\*\*\*

SUMMARY INFORMATION

Reservoir data:

|       | Name              | Start<br>Storage | File<br>Inflow | Min<br>Storage | Average<br>Storage | Evapn | Release<br>to river | Spill | End<br>Storage |
|-------|-------------------|------------------|----------------|----------------|--------------------|-------|---------------------|-------|----------------|
| 1     | MERR_IRR          | 5123.            | 0.             | 2461.          | 7265.              | 0.    | 0.                  | 0.    | 7596.          |
| 2     | DJERRIWARRH RES   | 500.             | 117.           | 303.           | 922.               | 5.    | 0.                  | 34.   | 980.           |
| 3     | MERR_URB          | 16314.           | 0.             | 0.             | 17541.             | 0.    | 0.                  | 0.    | 20087.         |
| 4     | MERR_UNK          | 5123.            | 0.             | 0.             | 4846.              | 0.    | 0.                  | 0.    | 4819.          |
| 5     | MERRIMU RESERVOIR | 2000.            | 0.             | 1849.          | 25274.             | 0.    | 0.                  | 66.   | 32504.         |
| ----- |                   |                  |                |                |                    |       |                     |       |                |
|       |                   | 29060.           | 117.           | 0.             | 55848.             | 5.    | 0.                  | 100.  | 65986.         |
| ----- |                   |                  |                |                |                    |       |                     |       |                |

## Demand data:

|   | Name            | Unrestrict | Restrict | Rationed | Shortfall | Supplied |
|---|-----------------|------------|----------|----------|-----------|----------|
| 1 | BM URBAN        | 282.       | 282.     | 282.     | 0.        | 282.     |
| 2 | MELTON URBAN    | 394.       | 392.     | 392.     | 0.        | 392.     |
| 3 | NOTIONAL DEMAND | 212.       | 210.     | 210.     | 0.        | 210.     |
|   |                 | 888.       | 884.     | 884.     | 0.        | 884.     |

|   | Name            | No<br>Rest | Ave<br>Rest lvl | Max<br>Rest lvl | No<br>Ration | Ave %<br>Ration | Max %<br>Ration | No<br>Short | Ave %<br>Short | Max %<br>Short |
|---|-----------------|------------|-----------------|-----------------|--------------|-----------------|-----------------|-------------|----------------|----------------|
| 1 | BM URBAN        | 0.0        | 0.0             | 0.0             | 0.0          | 0.0             | 0.0             | 0.0         | 0.0            | 0.0            |
| 2 | MELTON URBAN    | 29.0       | 2.7             | 5.0             | 0.0          | 0.0             | 0.0             | 0.0         | 0.0            | 0.0            |
| 3 | NOTIONAL DEMAND | 29.0       | 2.7             | 5.0             | 0.0          | 0.0             | 0.0             | 0.0         | 0.0            | 0.0            |

## Stream Junc:

|    | Name                | file<br>inflow |
|----|---------------------|----------------|
| 1  | .PYRITES CK OUTFALL | 7270.          |
| 2  | MERRIMU INFLOW      | 350.           |
| 3  | NODE 52             | 0.             |
| 4  | MERR RAIN#4         | 100000.        |
| 5  | DUMMYAREA1          | 0.             |
| 6  | DUMMYAREA2          | 0.             |
| 7  | MERR RAIN#2         | 100000.        |
| 8  | URB INFLOW SHARE    | 100000.        |
| 9  | UNK INFLOW SHARE    | 100000.        |
| 10 | MERR RAIN#3         | 100000.        |
| 11 | MERR RAIN#1         | 100000.        |
| 12 | IRR INFLOW SHARE    | 100000.        |
| 13 | ABOVE MELTON        | 0.             |
| 14 | GOODMANS TUN INFLOW | 803.           |
| 15 | LOWER LERD FLOW ARC | 2537.          |
|    |                     | 710960.        |

## Pipe/River flows:

|   | Name                 | flow   | Capacity   | Min   | Max      | Loss |
|---|----------------------|--------|------------|-------|----------|------|
| 1 | WERRIBEE U/S MELTON  | 9806.9 | 99999999.0 | 26.0  | 125653.0 | 0.0  |
| 2 | MERRIMU CAPA SPILLS  | 98.3   | 98.3       | 0.0   | 5624.0   | 0.0  |
| 3 | DJERRIWARRH CK       | 34.0   | 99999999.0 | 0.0   | 1757.0   | 0.0  |
| 4 | MERRIMU TO MELT URB  | 336.6  | 2000.0     | 0.0   | 795.0    | 0.0  |
| 5 | MERRIMU TO BM URBAN  | 282.2  | 1300.0     | 180.0 | 555.0    | 0.0  |
| 6 | DJERR TO MELTON URB  | 55.0   | 579.2      | 0.0   | 552.0    | 0.0  |
| 7 | MERR_IRR ABOVE SHARE | 256.8  | 269.7      | 0.0   | 3955.0   | 0.0  |

|    |                      |         |            |         |          |       |
|----|----------------------|---------|------------|---------|----------|-------|
| 8  | MERR_IRR BELOW SHARE | 0.0     | 256.9      | 0.0     | 0.0      | 0.0   |
| 9  | MERR_URB ABOVE SHARE | 57.3    | 57.3       | 0.0     | 3484.0   | 0.0   |
| 10 | MERR_URB BELOW SHARE | 104.5   | 3563.3     | 0.0     | 2482.0   | 0.0   |
| 11 | MERR_EVAP            | 257.1   | 257.1      | 23.0    | 652.0    | 0.0   |
| 12 | MERR_RAIN            | 112.9   | 121.5      | 0.0     | 521.0    | 0.0   |
| 13 | MER_RAIN#4 XS SUPPLY | 99887.1 | 99999999.0 | 99479.0 | 100000.0 | 0.0   |
| 14 | MERR_URB RAIN        | 67.7    | 67.7       | 0.0     | 313.0    | 0.0   |
| 15 | EVAP MERR_URB        | 154.2   | 154.2      | 14.0    | 391.0    | 0.0   |
| 16 | MER_RAIN#2 XS SUPPLY | 99932.3 | 99999999.0 | 99687.0 | 100000.0 | 0.0   |
| 17 | MERR_INFLOWS         | 324.0   | 350.1      | 0.0     | 5178.0   | 0.0   |
| 18 | MER_URB INFLOWS      | 676.4   | 676.4      | 0.0     | 13102.0  | 0.0   |
| 19 | MERRIMU AREA         | 0.0     | 275.3      | 0.0     | 0.0      | 0.0   |
| 20 | MERR_UNK TO NOTIONAL | 210.3   | 99999999.0 | 111.0   | 423.0    | 0.0   |
| 21 | ENV SECTION 1        | 1153.0  | 1168.2     | 62.0    | 1550.0   | 0.0   |
| 22 | ENV SECTION 2        | 214.5   | 1687.0     | 0.0     | 1488.0   | 0.0   |
| 23 | DJERR ENV REL        | 23.0    | 23.0       | 0.0     | 47.0     | 0.0   |
| 24 | ENV FLOW 2 ML/D      | 49.0    | 60.8       | 0.0     | 62.0     | 0.0   |
| 25 | MERR_UNK INFLOWS     | 112.8   | 112.8      | 0.0     | 2184.0   | 0.0   |
| 26 | MERR_UNK RAIN        | 11.3    | 11.3       | 0.0     | 52.0     | 0.0   |
| 27 | MER_RAIN#3 XS SUPPLY | 99988.7 | 99999999.0 | 99948.0 | 100000.0 | 0.0   |
| 28 | EVAP MERR_UNK        | 25.7    | 25.8       | 2.0     | 65.0     | 0.0   |
| 29 | MERR_XS INFLOW       | 26.1    | 99999999.0 | 0.0     | 2999.0   | 0.0   |
| 30 | MERR_URB XS INFLOW   | 99323.6 | 99999999.0 | 86898.0 | 100000.0 | 0.0   |
| 31 | MERR_UNK XS INFLOW   | 99887.2 | 99999999.0 | 97816.0 | 100000.0 | 0.0   |
| 32 | MERR_UNK ABOVE SHARE | 0.7     | 0.7        | 0.0     | 261.0    | 0.0   |
| 33 | MERR_UNK BELOW SHARE | 112.0   | 1765.8     | 0.0     | 3741.0   | 0.0   |
| 34 | IRR_URB SHARE        | 104.5   | 200.4      | 0.0     | 2482.0   | 0.0   |
| 35 | UNK_URB SHARE        | 0.0     | 0.5        | 0.0     | 0.0      | 0.0   |
| 36 | IRR_UNK SHARE        | 88.4    | 109.4      | 0.0     | 2332.0   | 0.0   |
| 37 | URB_UNK SHARE        | 23.6    | 39.5       | 0.0     | 3484.0   | 0.0   |
| 38 | URB_IRR SHARE        | 0.0     | 28.6       | 0.0     | 0.0      | 0.0   |
| 39 | UNK_IRR SHARE        | 0.0     | 0.2        | 0.0     | 0.0      | 0.0   |
| 40 | MERRIMU SPILL        | 65.6    | 0.0        | 0.0     | 5622.0   | 0.0   |
| 41 | MERRIMU ENV FLOWS    | 24.1    | 24.1       | 0.0     | 62.0     | 0.0   |
| 42 | MERRIMU IRRIGATION   | 27.9    | 27.9       | 0.0     | 2969.0   | 0.8   |
| 43 | FLOWS ABOVE MELTON   | 9980.8  | 99999999.0 | 148.0   | 127418.0 | 298.9 |
| 44 | MERR_IRR ENVIRON REL | 35.2    | 35.2       | 0.0     | 2988.0   | 0.8   |
| 45 | EXCESS FLOWS TO MEL  | 0.0     | 0.0        | 0.0     | 0.0      | 0.0   |
| 46 | MERR_URB ENVIRON REL | 632.5   | 633.2      | 0.0     | 1352.0   | 0.0   |
| 47 | MERR_UNK ENVIRON REL | 209.9   | 212.6      | 0.0     | 423.0    | 0.0   |
| 48 | MER_RAIN#1 XS SUPPLY | 99966.1 | 99999999.0 | 99844.0 | 100000.0 | 0.0   |
| 49 | MERR_IRR XS INFLOW   | 99661.8 | 99999999.0 | 93449.0 | 100000.0 | 0.0   |
| 50 | MERR_IRR INFLOWS     | 338.2   | 338.2      | 0.0     | 6551.0   | 0.0   |
| 51 | MERR_IRR RAIN        | 33.9    | 33.9       | 0.0     | 156.0    | 0.0   |
| 52 | EVAP MERR_IRR        | 77.2    | 77.2       | 7.0     | 196.0    | 0.0   |
| 53 | GOODMANS TUNNEL      | 803.2   | 99999999.0 | 0.0     | 20337.0  | 0.0   |
| 54 | LOWER LERD FLOW ARC  | 2537.0  | 99999999.0 | 0.0     | 41960.0  | 0.0   |
| 55 | TRACK TOT RAIN       | 23.2    | 107.5      | 0.0     | 287.0    | 0.0   |
| 56 | TRACK TOT EVAP       | 0.0     | 251.1      | 0.0     | 0.0      | 0.0   |
| 57 | TRACK TOT INFLOWS    | 866.4   | 11273.7    | 0.0     | 1550.0   | 0.0   |
| 58 | TOT RELESE           | 0.0     | 878.1      | 0.0     | 0.0      | 0.0   |

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301.  
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End run