

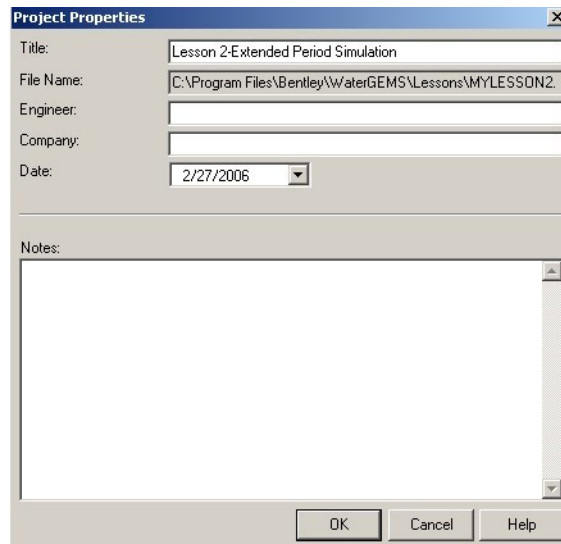
Extended Period Simulation

This lesson will illustrate how Bentley WaterCAD V8i can model the behavior of a water distribution system through time using an extended period simulation (EPS). An EPS can be conducted for any duration you specify. System conditions are computed over the given duration at a specified time increment. Some of the types of system behaviors that can be analyzed using an EPS include how tank levels fluctuate, when pumps are running, whether valves are open or closed, and how demands change throughout the day.

This lesson is based on the project created in [Building a Network and Performing a Steady-State Analysis](#). If you have not completed it, then open the project **LESSON2.WTG** from the Bentley\WaterGEMS\Lessons directory. If you completed Lesson 1, then you can use the **MYLESSON1** file you created.

To open the existing project

1. Open **MYLESSON1.WTG**.
2. After you have opened the file, choose **File > Save As**.
3. Enter the filename **MYLESSON2** and click **Save**.
4. Choose **File > Project Properties**, and change the Project Title to **Lesson 2—Extended Period Simulation**.



5. Click **OK**.

Step 1: To Create Demand Patterns

2-60

Water demand in a distribution system fluctuates over time. For example, residential water use on a typical weekday is higher than average in the morning before people choose work, and is usually highest in the evening when residents are preparing dinner, washing clothes, etc. This variation in demand over time can be modeled using demand patterns. Demand patterns are multipliers that vary with time and are applied to a given base demand, most typically the average daily demand.

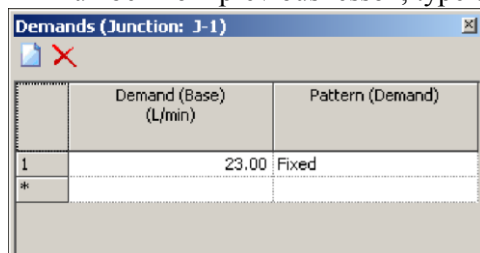
In this lesson, you will be dividing the single fixed demands for each junction node in Lesson 1 into two individual demands with different demand patterns. One demand pattern will be created for residential use, and another for commercial use. You will enter demand patterns at the junction nodes through the junction editors.

1. Open the Properties editor for Junction J-1 (double-click junction J-1) and click

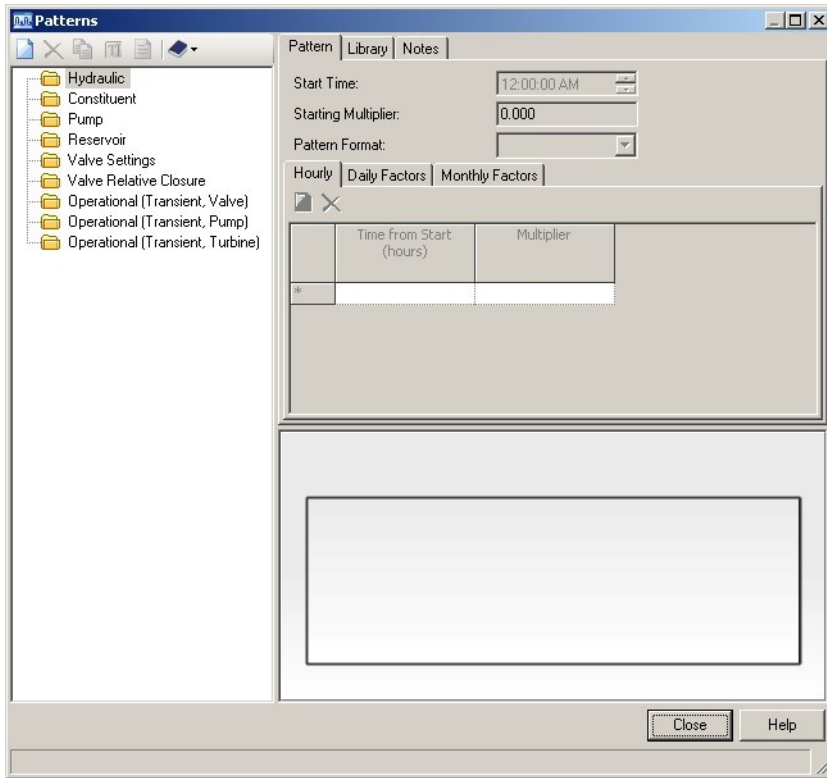
the ellipsis  in the Demand Collection field to open the Demands box.



2. By default, the demand pattern is set to Fixed. Enter **23** l/min for Flow. (If field already has a number from previous lesson, type over it.)



3. Click in the Pattern (Demand) field and click the ellipsis  to open the Patterns manager.



4.



Highlight the Hydraulic

folder and click New to create a hydraulic pattern. a. Rename the new pattern

Residential.

- b. Leave the Start Time **12:00:00 AM**.
- c. Enter 0.5 as the Starting Multiplier.
- d. In the Pattern Format menu select **Stepwise**.

The resulting demand pattern will have multipliers that remain constant until the next pattern time increment is reached.

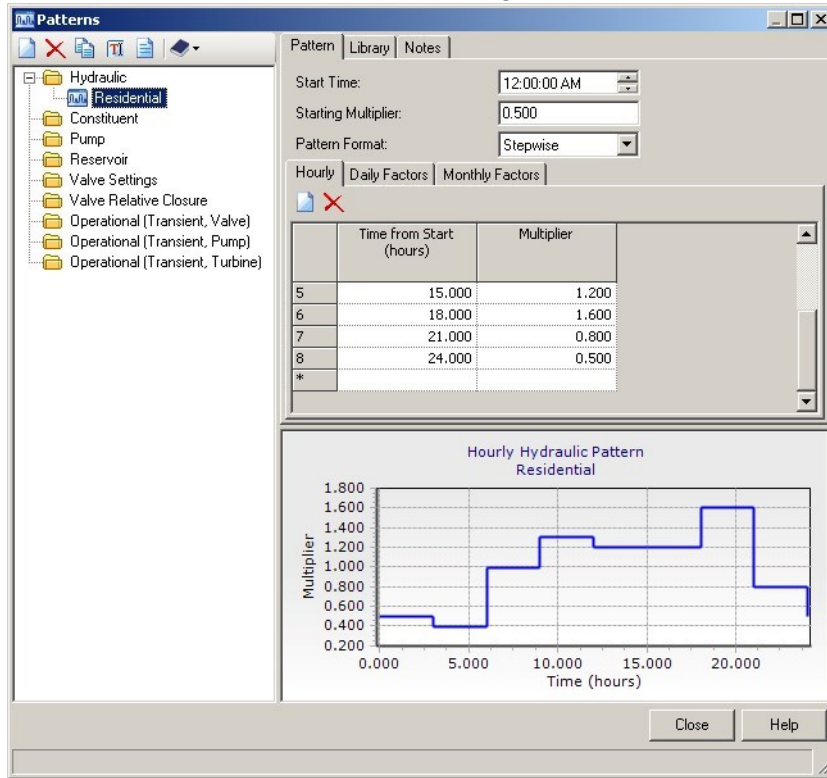
Note that the multiplier for the last time given (24 hrs.) must be the same as the Starting Multiplier (0.5). These values are equal because the demand curve represents a complete cycle, with the last point the same as the first.


e. Under the Hourly tab, enter the following times and multipliers:

| Time from Start | Multiplier |
|-----------------|------------|
| 3 | .4 |
| 6 | 1 |
| 9 | 1.3 |

| | |
|----|-----|
| 12 | 1.2 |
| 15 | 1.2 |
| 18 | 1.6 |
| 21 | .8 |
| 24 | .5 |

f. The Residential Patterns dialog box should look like the following:

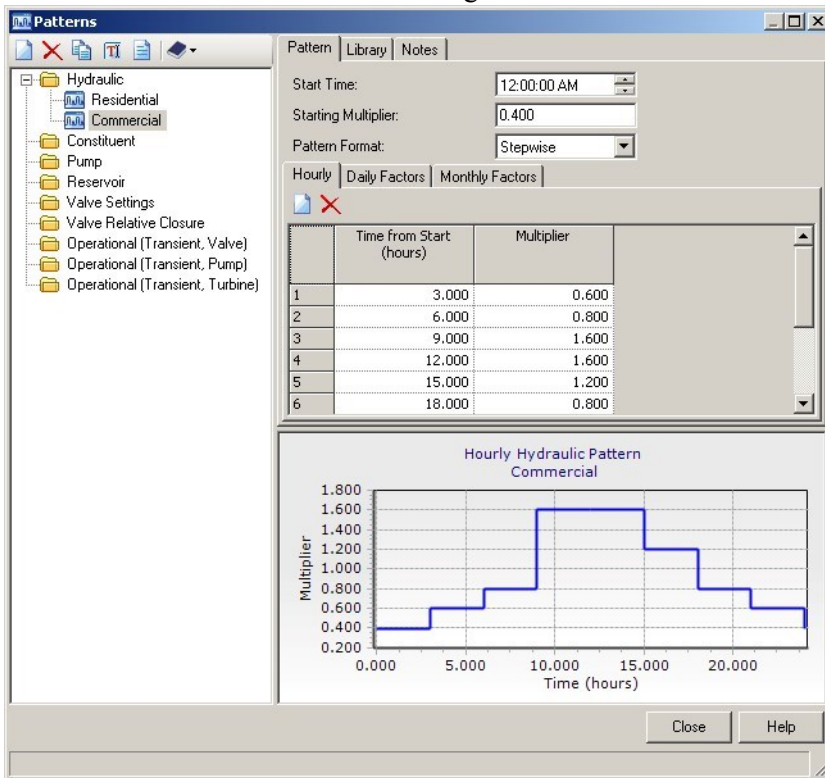


5. Click New  to create a new hydraulic pattern for commercial demands.
 - a. Rename the new pattern **Commercial**.
 - b. Leave the Start Time **12:00:00 AM**.
 - c. Enter 0.4 as the Starting Multiplier.
 - d. In the Pattern Format menu select **Stepwise**.
 - e. Under the Hourly tab, enter the following times and multipliers:

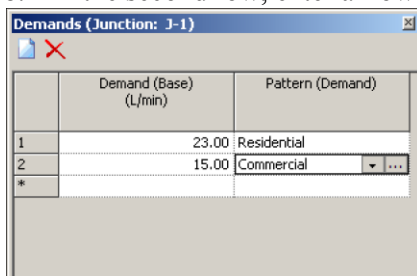
| Time from Start | Multiplier |
|-----------------|------------|
| 3 | .6 |
| 6 | .8 |

| | |
|----|-----|
| 9 | 1.6 |
| 12 | 1.6 |
| 15 | 1.2 |
| 18 | .8 |
| 21 | .6 |
| 24 | .4 |

f. The Commercial Patterns dialog box should look like the following:



6. Click Close.
7. In the Demands dialog box, in the Pattern field, select Residential from the menu.
8. In the second row, enter a flow of 15 l/min and select Commercial as the pattern for this row.






9. Close the Demands dialog box.

10. Choose Demand Collection in the properties for junctions J-2, J-3, J-4, J-5 and J-6 and enter the following demand data using the **Residential** and **Commercial** demand patterns already created.

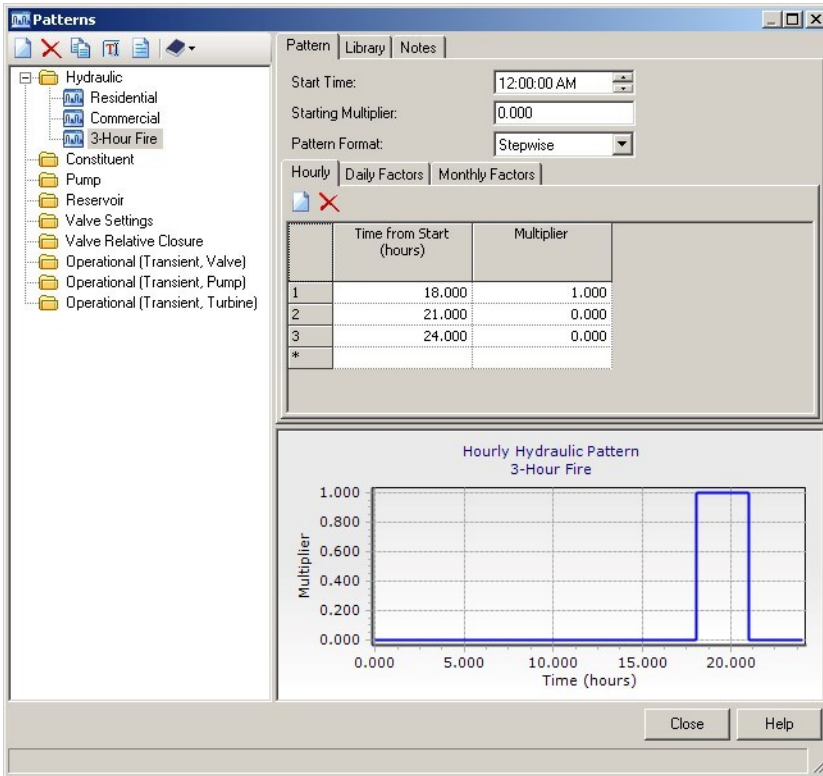
| Junction | Residential Demand (l/min) | Commercial Demand (l/min) |
|----------|----------------------------|---------------------------|
| J-2 | 23 | 8 |
| J-3 | 23 | 11 |
| J-4 | 23 | 15 |
| J-5 | 350 | N/A |
| J-6 | 280 | 76 |

11. Now, you will set up an additional demand pattern to simulate a three-hour fire at node J-6.

- In the Demand Collection field for J-6, click the ellipsis  to insert an additional Flow of 2000 l/min in row three of the Demands table.
- Click the Pattern column for row three and select the ellipsis  to open the Pattern Manager.
- Click New  to create a new Hydraulic pattern.
- Rename the new pattern **3-Hour Fire**
- Leave the Start Time **12:00:00 AM**
- Enter 0.00 as the Starting Multiplier.
- Select the Stepwise format.
- Under the Hourly tab, enter the following times and multipliers:

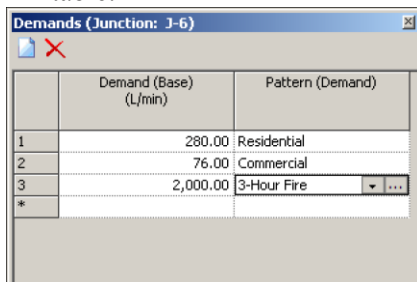
| Time from Start | Multiplier |
|-----------------|------------|
| 18 | 1 |
| 21 | 0 |
| 24 | 0 |

- After you have filled in the table, look at the Graph in the lower section of the Patterns box.




- j. The value of the multiplier is zero, except for the period between 18 and 21 hours, when it is 1.0. Since the input the demand as 2000 l/min., the result will be a 2000 l/min. fire flow at junction J-6 between hours 18 and 21.
- k. Click Close.

12. Select the new pattern, **3-Hour Fire**, from the Pattern selection box in row three of the demands table.




- 13. Close the Demands dialog box.
- 14. Close the Properties editor.

Step 2: To run an Extended Period Simulation (EPS)

1. Click Calculation Options  to open the Calculation Options dialog.
2. Double-click Base Calculation Options under Steady State/EPS Solver to open the properties manager and select EPS from the Time Analysis Type menu.

| Calculation Times | |
|-----------------------------|-------------|
| Simulation Start Date | 1/1/2000 |
| Time Analysis Type | EPS |
| Start Time | 12:00:00 AM |
| Duration (hours) | 24.000 |
| Hydraulic Time Step (hours) | 1.000 |
| Reporting Time Step | <All> |

3. Click Compute  to analyze the model.
4. When there are errors or warnings then the User Notifications dialog box opens. A blue light is an informational message, a yellow light indicates warnings, and a red light indicates issues.
5. Close the User Notifications dialog box and other open dialogs..



6. Click Save or choose File > Save to save the project.

Scenario Management

One of the many project tools in Bentley WaterCAD V8i is [Scenarios](#) Management. Scenarios allow you to calculate multiple “What If?” situations in a single project file. You may wish to try several designs and compare the results, or analyze an existing system using several different demand alternatives and compare the resulting system pressures.

A scenario is a set of [Alternatives](#), while alternatives are groups of actual model data. Scenarios and alternatives are based on a parent/child relationship where a child scenario or alternative inherits data from the parent scenario or alternative.

In Lessons 1 and 2, you constructed the water distribution network, defined the characteristics of the various elements, entered demands and demand patterns, and performed steady-state and extended period simulations. In this lesson, you will set up the scenarios needed to test four “What If?” situations for our water distribution system. These “What If?” situations will involve changing demands and pipe sizes. At the end of the lesson, you will compare all of the results using the Scenario Comparison tool.

To open the existing project