ESM 121

Water Science
and Management

Exercise 4:
Tutorial for Simulation Modeling

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Overview

The aim of this exercise is to provide guidance on the construction of water resources simulation models using the Water Evaluation And Planning System (WEAP\(^1\)) software. The document is comprised of steps that will help you to build a simple water resources system model, including: one river, one aquifer and three water users (irrigation, rural and Watsonville city).

Introduction

The water system is shown in Figure 1. The Pajaro Valley aquifer (Green square) supply water to “City of Watsonville”, “Rural” and “Agriculture” water demands. The city of Watsonville discharge their waters to the Watsonville wastewater treatment plant (WTP Watsonville), and from this WTP to the Pajaro river. In this exercise we will learn how to construct a simulation model, and how to evaluate two scenarios, the *Baseline* scenario (business as usual) and a water *Conservation* scenario.

\(\text{http://www.weap21.org/}\)

\(^{1}\) http://www.weap21.org/
Part I – Modeling the River

Defining a Model

Create a New Area

Open the WEAP program. Select “Area” and then “Create Area” from the menu.

Name the new area “Tutorial_Exercise”, Select “Initially blank” and “No Password”; and click “OK”.

Click OK on the following window.

Select an area around Monterrey Bay in California. Hint: Use the small window on your bottom left to make a zoom in or out on the world map, use the scroll bars in the right window to locate Monterey Bay (Figure 5). Drag a rectangle around the central area of Monterey Bay. Click OK (Figure 6). After this steps, your model should look like Figure 7. Save your model, select “Area”, “Save...” menu or press \texttt{Ctrl+S}. Name your model “Ex_6”\textsuperscript{2}.

\textsuperscript{2} Tip – If you want to back up your model and take it with you to another computer, open the “Area” menu and select “Manage Areas”, click on “Back up to...” and select the folder where you want to back up your model (this can be on a removable disk). WEAP models are backed up as zip files. When you want to open your backed up model, open
the “Area” menu and select “Manage Areas”, click on “Restore from…” and browse to your model’s zip file and click on “open”. This way you will be able to save, backup and restore your models.
Set General Parameters

By default, the model stars in 1999 with 12 time steps per year, based on calendar years and starting in January. We will use 12 time steps per year from 1999 to 2030. Select the “General” menu, and select “Years and Time Steps” (Figure 8).

Let’s modify the time horizon. In the “time horizon” box change the “Current Accounts Year” to 1999 and the “Last Year of Scenarios:” to 2030. In the “Time Steps per Year” box, verify that there are 12 time steps per year. Verify that in “Time Step Boundary” you have selected the “Based on calendar month” option. Also verify that you have selected “Water Year Start” in January. (Figure 9).
Save your model by typing “Ctrl+S” (Figure 10).
Water Sources

Surface Water Sources: Pajaro River

Now, let’s define our water resources. Let’s start with the Pajaro River. Click on the “River” symbol in the “Element window” and hold the click as you drag the symbol over to the map. Release the click when you have positioned the cursor over the upper left starting point of the main section of the river. Move the cursor, and you will notice a line being generated from that starting point. Draw a river on the map that is similar to the one drew in Figure 11.

When you double click to finish drawing the river, a dialog box appears asking for the name of the river (see below). Name the river “Pajaro River” (Figure 12). Click “Finish”.

Now your map should look like Figure 13.
Let’s declare the inflows to the river called headflows in WEAP. These are the upstream inflows to major tributaries for the model. These values are stored in the file “River_Headflow.csv”. First, unzip the compressed archive (Input_files.zip) and copy all the files “River_Headflow.csv”, “Aquifer_Recharge.csv” and “Water_Demands.csv” to the folder “C:\Users\your username\Documents\WEAP Areas\Ex_6” on your computer³. Then, double click on the file “River_Headflow.csv” and open it with excel. You will notice that this is a “CSV file”, or a Comma Separated Value file that stores 10 sets of inflows (in m³/sec) (Figure 14). Let’s take a look inside the “River_Headflow.csv” file, which is shown below:

³ If you are using the latest version of WEAP (Version: 3.3001, September 12, 2012), then the path should be: C:\Users\your user name\Documents\WEAP Areas\Ex_6
monthly flow values (from Jan/1999 to Dec/2030); each column is a separate realization of the inflows for the 32 year period of analysis. Notice that each realization of flows (column “C” through column “L”) has a number in the header (row 4), this is because WEAP has a different counting system for columns. WEAP will read the first and second column (Column “A” and “B”) to locate in time the input values. Then, it will count the following column after this (column “C”) as the “First” column. So for WEAP, column 1 is column “C”, column “2” is column “D” and so on. To begin with we will focus on the first realization in column “C”. Close the file “River_Headflow.csv”.

Now, let’s go back to WEAP and enter the data for the river. To enter and edit data for the Pajaro River right-click on the Pajaro River and select “Edit data” and select “Headflows” (Figure 15).

![Figure 15](image)

Now you will are located in the Data section of WEAP (Figure 16).
The "Inflows and Outflows" window should be open - if it isn't, click on the “Inflows and Outflows” button located in the upper center of WEAP. Click on the "Headflow" tab. Be sure that the input window “Data for” has “Current Accounts (1999) selected. If it doesn’t, then select it from the drop down menu. Click on the area just beneath the bar labeled “1999” in the data input window to view a pull-down menu as shown in Figure 17. Select the “Expression Builder” from the drop--down menu.
In the Expression Builder select the “Functions” tag (Figure 18); scroll down and find, select and drag down into the text field the “ReadFromFile” expression from the list of built in expressions (Figure 18).

![Expression Builder](image1.png)

Figure 18

Type the following expression in the parentheses: “River_Headflow.csv,1”; so, the expression should look like:

```
ReadFromFile(River_Headflow.csv,1)
```

![Expression Builder](image2.png)

Figure 19

The “1” in this expression refers to the number in the column that according WEAP counting will be read, in this case column “C” of the file: River_Headflow.csv. If you wanted to read the inflows from the second realization of inflows (Column “D”), you would enter “2”. Click on “Verify”, then a window will appear that says your expression is verified (Figure 20). If the expression is not verified, please check that you have copied the file “River_Headflow.csv” into the folder “C:\Users\your username\Documents\WEAP Areas\Ex_6” and that the command you have written is correct.

---

4 Actually, you can just copy this expression from this document and paste it into Expression Builder.
Just to remember, WEAP is reading the data from the “River_Headflow.csv” file in column “C”. WEAP reads the year and time step columns (column “A” and “B”), after this it starts counting the column numbers; this is the reason we are declaring column “1” in the expression. Click on “Finish”. Note that now there is inflow declared for the river (Figure 21). Save your model using “Ctrl+S”.

**Groundwater Sources: Pajaro Valley Aquifer**

Now, lets define our groundwater resources. Creating an aquifer node is similar to the process you used to create a river. Click on the “Schematic” icon, the little “map” icon in upper left-hand corner of WEAP. Click on the “Groundwater” symbol in the “Element window” and hold the click as you drag the symbol over to the map. Release the click when you have positioned the cursor just right of the Pajaro River (Figure 22).
When you have released the icon into the map, a dialog box appears asking for the name of the groundwater source (see Figure 23). Name the groundwater source "Pajaro Valley Aquifer" (Figure 23). Click “Finish”.

Now your map should look like Figure 24.
Let’s declare the recharge to the aquifer that is called Natural Recharge in WEAP. These are the natural recharge estimated for this aquifer. These values are stored in the file “Aquifer_Recharge.csv”. Let’s open the file “Aquifer_Recharge.csv” located in the folder “C:\Users\your username\Documents\WEAP Areas\Ex_6” on your computer. Double click on it to open it with excel. You will notice that this file has 10 sets of recharge inflows (in million m$^3$ per month) (Figure 25).
This file has a similar organization such as the previous “CSV” file; it also contains 10 sets of recharge values to the aquifer. Close the file “Aquifer_Recharge.csv”.

Now, let’s go back to WEAP and enter the data for the aquifer. To enter and edit data for the Pajaro Valley Aquifer right-click on the Pajaro Valley Aquifer and select “Edit data” and select “Natural Recharge” (Figure 26).

Now you will are located in the Data section of WEAP (Figure 27).
The "Physical" window should be open - if it isn’t, click on the “Physical” button located in the upper-middle region of WEAP. Click on the "Natural Recharge" tab. Click on the area just beneath the bar labeled “1999” in the data input window to view a pull-down menu as shown in Figure 28 and select the “Expression Builder” from the drop--down menu.

![Figure 28](image)

To upload the recharge rate for the Pajaro Valley Aquifer we will use the similar procedure using the expression “ReadFromFile()”. Type the following expression in the parentheses:

“Aquifer_Recharge.csv,1”; so, the expression should look like:

ReadFromFile(Aquifer_Recharge.csv,1)

![Figure 29](image)
Click on “Verify”. Then a window will appear that says your expression is verified (Figure 30). If the expression is not verified, please check that you have closed the file or that you copied the file “Aquifer_Recharge.csv” into the folder “C:\Users\your user name\Documents\WEAP Areas\Ex_6” and that the command you have written is correct.

![Figure 30](image)

Click on “Finish”. Note that now there is inflow declared for the river (Figure 31).

![Figure 31](image)

Now select the tab called “Initial Storage”. Click on the area just beneath the bar labeled “1999” in the data input window to view a pull-down menu as shown in Figure 32 and select the “Expression Builder” from the drop-down menu.
Let’s declare an initial storage of 400 million m$^3$ for the Pajaro Valley Aquifer by typing “400” in the Expression Builder as shown in Figure 33.

Click on “Verify”, then a window will appear that says your expression is verified. Click on “Finish”. Note that now there is an initial storage declared for the aquifer (Figure 34). Save your model using “Ctrl+S”.

Figure 32

Figure 33
Figure 34

Save your model using “Ctrl+S”.

**Water Demands**

**Agriculture**

Creating a demand node is similar to the process you used to create an aquifer. Click on the “Schematic view” (little “map” icon in upper left-hand corner). Select and pull a “Demand Site” node symbol over to the map from the “Element window”, releasing the mouse when you have positioned the node on the Left bank of the river (facing downstream) below the aquifer (see Figure 35). Enter the name of this demand node as “Agriculture” (see Figure 36). Declare a Demand Priority of 2. Click on Finish.
We are going to declare the water demand for the Irrigation District that is stored in the file “Water_Demands.csv” located in the folder “C:\Users\your user name\Documents\WEAP Areas\Ex_6”. This file is reproduced in the Figure 37 (demands in million m³ per year). These are the water demands estimated in Exercise 2 for the Watsonville City, Rural communities and agriculture for the Baseline scenario and Scenario I Water Conservation. For the Baseline scenario, water demands for Watsonville (Municipal), Rural and Agriculture are located in columns 1 (column “B”), 2 (column “C”) and 3 (column “D”), respectively, according to WEAP’ system Account. For the Scenario I Water Conservation, water demands for Watsonville (Municipal), Rural and Agriculture are located in columns 4 (column “B”), 5 (column “C”) and 6 (column “D”), respectively, according to WEAP’ column system account (Figure 37).
Go back to WEAP, right click on the “Agriculture” demand site and select "Edit data" and "Annual Water Use Rate" as shown in Figure 38.

Once again open the expression builder and let’s read the demands from the file “Water_Demands.csv” using the “ReadFromFile()” function (Figure 39). The expression should look like:

ReadFromFile(Water_Demands.csv,3)

Click on “Verify.” The expression should be right. Then Click on “Finish.”

The previous expression should be verified OK. If not, double check that the “Water_Demands.csv” file was copied to the correct directory (see above) and that the expression was written correctly. Then Click
on “Finish.” Click below the “Scale” label and select Million because the data uploaded has this unit (Figure 40).

![Figure 40](image)

Table 1 shows the water demand distribution for the 3 anthropogenic water users:

<table>
<thead>
<tr>
<th>Monthly Water Distribution</th>
<th>Watsonville (%)</th>
<th>Rural (%)</th>
<th>Agriculture (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jan</td>
<td>6.50</td>
<td>5.40</td>
<td>1.90</td>
</tr>
<tr>
<td>Feb</td>
<td>6.50</td>
<td>5.40</td>
<td>1.90</td>
</tr>
<tr>
<td>Mar</td>
<td>6.50</td>
<td>5.40</td>
<td>1.90</td>
</tr>
<tr>
<td>Apr</td>
<td>8.50</td>
<td>7.90</td>
<td>8.80</td>
</tr>
<tr>
<td>May</td>
<td>8.50</td>
<td>7.90</td>
<td>8.80</td>
</tr>
<tr>
<td>Jun</td>
<td>8.50</td>
<td>7.90</td>
<td>8.80</td>
</tr>
<tr>
<td>Jul</td>
<td>9.80</td>
<td>11.30</td>
<td>16.20</td>
</tr>
<tr>
<td>Aug</td>
<td>9.80</td>
<td>11.30</td>
<td>16.20</td>
</tr>
<tr>
<td>Sep</td>
<td>9.80</td>
<td>11.30</td>
<td>16.20</td>
</tr>
<tr>
<td>Oct</td>
<td>8.50</td>
<td>8.70</td>
<td>6.40</td>
</tr>
<tr>
<td>Nov</td>
<td>8.50</td>
<td>8.70</td>
<td>6.40</td>
</tr>
<tr>
<td>Dec</td>
<td>8.50</td>
<td>8.70</td>
<td>6.40</td>
</tr>
<tr>
<td></td>
<td>99.9</td>
<td>99.9</td>
<td>99.9</td>
</tr>
</tbody>
</table>
Now, let’s declare the distribution of the water demand for Agriculture along every month of the year. Click on the tab of “Monthly Variation” Click below 1999 and select “Monthly Time-Series Wizard” as shown in Figure 41.

![Figure 41]

Declare the water distribution values for agriculture (Figure 42). Click “Finish” (Figure 43).

![Figure 42]
Save your model using “Ctrl+S”.

City of Watsonville

Now, we are going to repeat the same procedure create a water demand for the city of Watsonville. First, let’s create a demand node for the City of Watsonville. Click on the “Schematic view” (little “map” icon in upper left-hand corner). Select and pull a “Demand Site” node symbol over to the map from the “Element window”, releasing the mouse when you have positioned the node on the Left side of the Agriculture demand (see Figure 44). Enter the name of this demand node as “City of Watsonville” (see Figure 45). Declare a Demand Priority of 2. Click on Finish.
Right click on the “City of Watsonville” demand site and select "Edit data" and "Annual Water Use Rate" as shown in Figure 46.
Open the expression builder and let’s read the water demands for the City of Watsonville from the file “Water_Demands.csv” using the “ReadFromFile()” function (Figure 47). The expression should look like:

```
ReadFromFile(Water_Demands.csv,1)
```

Click on “Verify.” The expression should be right. Then Click on “Finish” (Figure 48). Click below the “Scale” label and select Million because the data uploaded has this unit (Figure 49).
Now, let’s declare the distribution of the water demand for the City of Watsonville for every month of the year. Click on the tab of “Monthly Variation” Click below 1999 and select “Monthly Time-Series Wizard” as shown in Figure 50. Insert the monthly distribution according to Table 1 as shown in figure 51. Click “Finish” (Figure 52).
Not all the water that is used in the City of Watsonville is consumed, in fact, only 44% of the water is consumed in the outdoor water use (Exercise 2), let’s consider this on the model. Click on the tab of
“Consumption” Click below 1999 and select “Expression Builder”; type “44”, then Click “Verify” and “Finish” (Figure 53). Insert the monthly distribution according to Table 1 as shown in figure 51. Click “Finish” (Figure 54). Save your model using “Ctrl+S”.

![Figure 53](image1)

![Figure 54](image2)

**Rural Water Demand**

We are going to repeat the same procedure create a water demand for the Rural settlements. First, let’s create a demand node for the Rural water demands. Click on the “Schematic view” (little “map” icon in upper left-hand corner). Select and pull a “Demand Site” node symbol over to the map from the
“Element window”, releasing the mouse when you have positioned the node on the Top of the Agriculture demand (see Figure 55). Enter the name of this demand node as “Rural” (see Figure 56). Declare a Demand Priority of 2. Click on Finish.

Figure 55

![General Info](image)

Figure 56

Right click on the “Rural” demand site and select "Edit data" and "Annual Water Use Rate" (Figure 57).
Open the expression builder and let’s read the water demands for Rural from the file “Water_Demands.csv” using the “ReadFromFile()” function (Figure 58). The expression should look like:

ReadFromFile(Water_Demands.csv,2)

Click on “Verify.” The expression should be right. Then Click on “Finish.” Click below the “Scale” label and select Million because the data uploaded has this unit (Figure 59).
Now, let's declare the distribution of the water demand for Rural for every month of the year. Click on the tab of “Monthly Variation” Click below 1999 and select “Monthly Time-Series Wizard”. Insert the monthly distribution according to Table 1 as shown in figure 60. Click “Finish” (Figure 61). Save your model using “Ctrl+S”.

Figure 59

Figure 60

Figure 61
Linking Water Sources and Water Demand

Now, you need to tell WEAP where the water will come from; this is accomplished by connecting a supply resource to the demand site through a “transmission link”. Return to the “Schematic view” and create a “Transmission Link” from the “Pajaro Valley Aquifer” to the “Agriculture”. Do this by dragging the “Transmission Link” first to a position on the aquifer (Figure 62), releasing the mouse, then pulling the link to “Agriculture” and double clicking on this demand node (Figure 63). Select a Supply Preference of 1 for the Transmission Link (Figure 64).

Figure 62

Figure 63
Let’s connect the City of Watsonville water demand with its water source, Pajaro Valley aquifer as shown in Figure 65. Select a Supply Preference of 1 for the Transmission Link (Figure 66).
Finally, let’s connect the “Rural” water demand with its water source, Pajaro Valley aquifer as shown in Figure 67. Select a Supply Preference of 1 for the Transmission Link (Figure 68).

![Figure 67](image)

Return Flows

Let’s create a Water Treatment Plant (WTP) for the City of Watsonville. In the schematic view drag a “Wastewater Treatment Plant” from the element window to a location below the “City of Watsonville” water demand, as shown in Figure 69. Let’s call this wastewater treatment plant “WTP Watsnoville” and click Finish (Figure 70).
Water for the City of Watsonville is collected by the sewage system and treated in the WTP. To account for this, we need to create a “Return Flow” in WEAP. Do this by dragging the “Return Flow” first to a position on top of the “City of Watsonville” water demand, releasing the mouse, then pulling the link to “WTP Watsonville” and double clicking on this demand node (Figure 71).
Finally, water from the WTP is disposed in the Pajaro River, let create a “Return flow” link to account for this. Do this by dragging the “Return Flow” first to a position on top of the “WTP Watsonville”, releasing the mouse, then pulling the link to a location on top of “Pajaro River” and double clicking on this river (arc) (Figure 72).
Run the Model
Let see the first result of our model. Click on “Results” and “Yes” (Figure 73).

Open the drop menu in the upper middle part of the screen. Select “Demand” and then “Reliability” (Figure 74).
The “Reliability” calculated by WEAP refers to the percentage of time that a water demand was fully supplied (i.e. a water supply of 100% of the water demand). Notice that more than 85% of the time the demand for the three water demands are supplied fully. Click on the “Table” tab and you will see that the reliability for the three water demands are 89.32% (Figure 76).

Go back to the “Chart view”, open the drop menu in the upper-middle part the screen and select “Demand\Supply Delivered” (Figure 76). At the bottom of the screen select “All Years”, and check the option “Annual Total.” On the icons of the left side, click the icon of Stacked Columns ( ) and select “Stacked”. You will have a chart like Figure 77.
If you Uncheck “Rural” and “City of Watsonville” you will be able to take a closer look to the water supplied to “Agriculture” (Figure 78). You can notice that there were several years with fewer water supply (years in red circles in Figure 78) compared to the rest of the years.
Similarly, if you uncheck “Agriculture” and check “Rural” and “City of Watsonville” you will be able to take a closer look to the drinking water supply (Figure 79). You can notice that there were several years with fewer water supply (years in red circles in Figure 79) compared to the rest of the years.

![Figure 79](image)

Now let’s confirm these by asking WEAP where deficit in the water demand happened. As a side note, a deficit in water demand is when there was no water in the system to meet water demands. Click on the “Chart” tab, and then open the drop menu on top of “All month (12)”, select “Demand/Unmet Demand” (Figure 79). Notice that the deficits happened in several years, 9 to be precise.

![Figure 79](image)
Click on the “Table” tab. Use the scroll bar of the bottom to see the results for 2030. Notice that the total deficit (Unmet demand) for each water demand in this Baseline scenario is 230.38 MCM (under “Sum” in the table) (Figure 80).

Finally, let’s take a look at the condition of the “Pajaro Valley Aquifer”. Click on the “Chart” tab, and then open the drop menu on top of “All month (12)”, select “Supply and Resources/Groundwater/Storage” (Figure 81). Notice that there is a constant downward trend of the aquifer storage, in fact, the aquifer got emptied by 2020. This means that there is much more water extraction (water demands) than water recharge. Remember that water demands are estimated to be from 69 to 73 million m³/year and aquifer recharge is estimated to be 51 million m³/year. Water in this aquifer is been “mined” meaning there is more water extracted than the water recharged. In Pajaro Valley Water Management Agency term: “it is been overdrafted.”
Save your model (Ctrl+S).

**Part I: To be turned in**

a) A screen shot of the schematic view of your model,

b) A screen shoot of the aquifer storage results,

c) A summary table of the unmet demand of each water demand,

d) what do you think is happening with the overdraft of water from the aquifer, is the aquifer being emptied or is it being filled with saline water?

e) Let’s think about the hypothetical case where this model no longer represent the conditions of the central coast of California, now this model represents a small aquifer in the central valley. In this case, *will the overdraft empty the aquifer or is it going to be replaced by other substance?* Take a look at Figure 82.
Part II – Scenarios

Define Scenarios
The previous results are based on the assumption that water consumption will keep the same trends as today. One of the purposes of modeling is to answer “What if ...” questions. In this case, we are interested in the question, “How will the water sources (groundwater aquifer) will react if the water demand is reduced in the future?”

We are going to define 2 scenarios:

1. Baseline: current water demand trends; and
2. Conservation: policies to reduce the future water demand.

Go to the Schematic view, open the “Area” menu and select “Manage Scenarios” (Figure 83).
Select the “Reference” Scenario and then click on “Rename”. Rename the “Reference” Scenario as “Baseline.” Click “OK”. We are going to keep this scenario as a reference (Baseline) for what would happen with no conservation policies implemented (Figure 84).

In the scenario description, describe the scenario with your own words, something like Figure 85.
Now, let's create another scenario that will consider the reduction in water demand due to conservation practices. Select “Current Accounts” and then click on “Add” and name the new scenario “Conservation”. Click “OK” (Figure 86).

Add a brief description using your own word of this scenario in the description box, something like Figure 87.

Click on “Close”. Save your model (Ctrl+“S”).

**Modifying the water demand for the Scenarios**

In the schematic view, right click on top of the “Agriculture” water demand, go to “Edit Data” and select “Annual Water Use Rate” (Figure 88).
WEAP has the ability to simulate different scenarios. In order to do this, you have to select the scenario that you want to represent (“that you want to model”). In the drop menu of “Data for:” that is located in the upper-middle part of WEAP, please select the “Conservation” scenario (Figure 89).

We have already calculated the future water demand in Exercise 2, let’s remember that this data is located in the file “Water_Demands.csv”, column 6 for “Agriculture”, column 4 for “City of Watsonville” and column 5 for “Rural” Figure 90.
Let's tell WEAP that read the water demand of Agriculture from the sixth column. Open the expression builder (Figure 91) and change the column that WEAP reads the water demand from column 1 to column 4 (Figure 92). The equation should be as follows: “ReadFromFile(Water_Demands.csv,6)”. Click “Verify”, the expression should be fine, and then click “Finish”.

![Figure 90](image1.png)

![Figure 91](image2.png)
Figure 92

The color of the expressions have changed to “red”, this is how WEAP tells you that the expression in this scenario is different from the reference (Baseline) scenario (Figure 93).

Figure 93

Now let’s do the same for “City of Watsonville” and “Rural” water demands. In the data view (where we are right now), on the left side there is a tree file arrangement under “Demand Sites” that says “Agriculture,” “City of Watsonville” and “Rural” (Figure 94). Select “City of Watsonville”

Figure 94

Open the expression builder and change the column that WEAP reads the water demand from column 1 to column 4 (Figure 95). The equation should be as follows: “ReadFromFile(Water_Demands.csv,4)”.

48
Click “Verify”, the expression should be fine, and then click “Finish”. Verify that the color of the expressions have changed to red.

Figure 95

Now let’s do the same for “Rural”. In the data view (where we are right now), on the left side there is a tree file arrangement under “Demand Sites” that says “Agriculture,” “City of Watsonville” and “Rural” (Figure 94). Select “Rural”. Open the expression builder and change the column that WEAP reads the water demand from column 2 to column 5 (Figure 96). The equation should be as follows: “ReadFromFile(Water_Demands.csv,5)”. Click “Verify”, the expression should be fine, and then click “Finish”. Verify that the color of the expressions have changed to red.

Figure 96

Finally, let’s go to schematic view “General/Years and time steps” (Figure 97). Let’s change the “Time Horizon” from 2010 to 2030. At this moment we are interested in what will be the consequences of our
policies in the future, not much in the past. Change the Current accounts year to “2010”. (Figure 98). Click on “Close”.

Save your model (Ctrl + "S").

**Re-run the model**
Click on “Results”. A dialogue window will appear asking you to recalculate the results, click on “Yes” (Figure 99).
Look at the results. Select “Supply and Resources/Groundwater/Storage” (Figure 100). On the right drop menu select “All Scenarios”. For the type of chart (the following icon on the right side bar of results) select line (Figure 101). The chart should look like figure 102.
You can export this chart by clicking on the icon of copy ( ) located in the right side bar Figure 103. When you paste the chart in a word file, it looks like figure 104.
Notice that the aquifer depletion is reduced in the scenario of Conservation, compared to the Baseline scenario, but yet, the trend is to overdraft the aquifer. Click on the tab of “Table”, scroll to the right until you can see the results for December 2030 for both scenarios (Figure 105). For the Baseline scenario the expected storage is 33.63 million m$^3$, while for the Conservation scenario is 136.56 million m$^3$, 102.93 million m$^2$ more!!! This means that the Conservation strategies will improve the status of the water supply resources, they are not going to be depleted as much as in Baseline scenario, although the trends are still down.

Part II: To be turned in

a) Submit the aquifer storage results like figure 102 or figure 104,

b) Based on the initial storage (400 million m$^3$), how much water was extracted by the end of the simulation period (December 2030) in Baseline scenario?
c) Based on the initial storage (400 million m³), how much water was extracted by the end of the simulation period (December 2030) in the Conservation Scenario?

d) How much this extraction represents in terms of percentage of the initial storage? Build a summary table where you present the Initial storage, end of storage in 2030, water extracted, and % of depletion compared to the initial storage.

**Note – make sure you didn’t skip over “Part I: To be turned in”

References