

# GeoWEPP for ArcGIS 9.x

## Full Version Manual

(for GeoWEPP Version 2.2008 or earlier)

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# 1 System Requirements

The installation process for GeoWEPP is a simple, but there are a few requirements that you will need to know about. First, GeoWEPP uses two other pieces of software to run: the Water Erosion Prediction Project (WEPP) and ESRI's ArcGIS 9.x.

Since GeoWEPP is the geospatial interface for WEPP, you will need the latest version of WEPP to run GeoWEPP. This can be found at:

<http://topsoil.nserl.purdue.edu/nserlweb/weppmain/wepp.html>

When installing this program (and you may need administrative privileges to do so), record the location you have installed this program; you will need this the first time you run GeoWEPP.

GeoWEPP use GIS data to delineate the watershed to be used in WEPP. GeoWEPP was developed to run using ESRI's ArcGIS 9.0, 9.1, and 9.2. Therefore, you will need this program along with its Spatial Analyst extension. Without this extension, GeoWEPP will not run properly. You will also need to know where this program has been installed on your computer.

You should have at least 250MB of free hard drive space to install and run GeoWEPP. You will need more as you begin to accumulate your own project runs. The space required will depend on the size of your study watershed and the number of runs you perform on it; the example sets provided for you each use about 50 to 100MB of disk space. Fortunately, in the age where e-mail inbox space is measured in Gigabytes, hard drive space shouldn't be an issue.

One other issue that you should be aware of is the amount of internal RAM your computer has. While this is not essential for GeoWEPP to run, computers with small amounts of RAM may require more time to process and will limit the size of your study area when using the flowpath method. Most computers these days have at least 512MB of RAM; some have as much as 4GB. Keep this in mind when you select your watershed.

One final piece you will need to run GeoWEPP is the .NET Framework. Much of GeoWEPP was written using VB.NET, thus your computer needs to have the .NET framework installed. If you try running GeoWEPP without the framework installed, your computer will let you know that you don't have it. You should contact your Administrator to install it, or, if it is your own computer, you can follow the link below and install it yourself:

<http://www.microsoft.com/downloads/details.aspx?displaylang=en&FamilyID=262D25E3-F589-4842-8157-034D1E7CF3A3>

## **System Requirements**

- Latest version of the WEPP (currently May 2006)
- ESRI's ArcGIS 9.x (9.0, 9.1, or 9.2) with Spatial Analysis Extension
- .Net Framework (version 1.0 or 1.1; later version may not be backwards compatible)

- 250MB of disk space; plus 50-100MB for each example set run
- 256MB of RAM (Highly recommended: 512MB or more)

## 2 GeoWEPP Installation

The Installation process for GeoWEPP was designed to be the least intrusive as possible; this means that you will not need Administrative privileges to load GeoWEPP on your computer. Once you have downloaded the install executable from the GeoWEPP webpage, all you need to do is double click on the file and follow the directions. This executable is simply a self-extracting zip file; it just unpacks and copies the files to the specified location. The default unpack location is “C:\GeoWEPPArcMap”. If you decide to change this, make note of this for future reference.

**Important Note:** The location you provide should not contain any spaces in the folder names. For Example, you shouldn't use “C:\My GeoWEPP”, but you can use “C:\MyGeoWEPP” or “C:\My\_GeoWEPP”. This also means you can not save the GeoWEPP folder on to your desktop, since its location is actually “C:\Documents and Settings\All Users\Desktop”. It is also recommended you limit the folder name to no more than 13 characters. Both of these have to do with the way pathways were used and created in older operating systems and in older versions of ArcGIS.

### 2.1 Installation Steps

1. Double-click on the GeoWEPP installer you downloaded.
2. Click **OK** on the Thank You message.
3. Determine where you want GeoWEPP to be installed. The default is “C:\GeoWEPP”; you can change this by either entering the destination path in the white box or by clicking the ... button to navigate to your desired install destination (figure 1a). The **Extract to:** window (figure 1b) will help locate your destination folder. Select it and click **OK**. If you still need to create the folder, click **New** first. Once you have selected the destination folder, click **Extract**. **NOTE:** The installer will overwrite any previous installs of GeoWEPP located in the destination folder without warning. This method can be change before you click **Extract** by selecting the conditions in the **Existing File(s)** section (figure 1a).
4. Click **OK** in the message box to complete the installation.

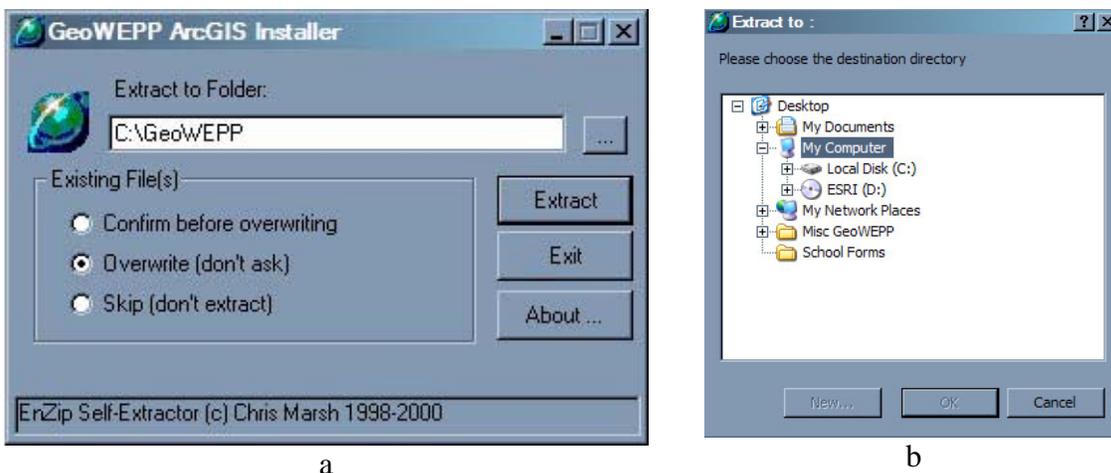


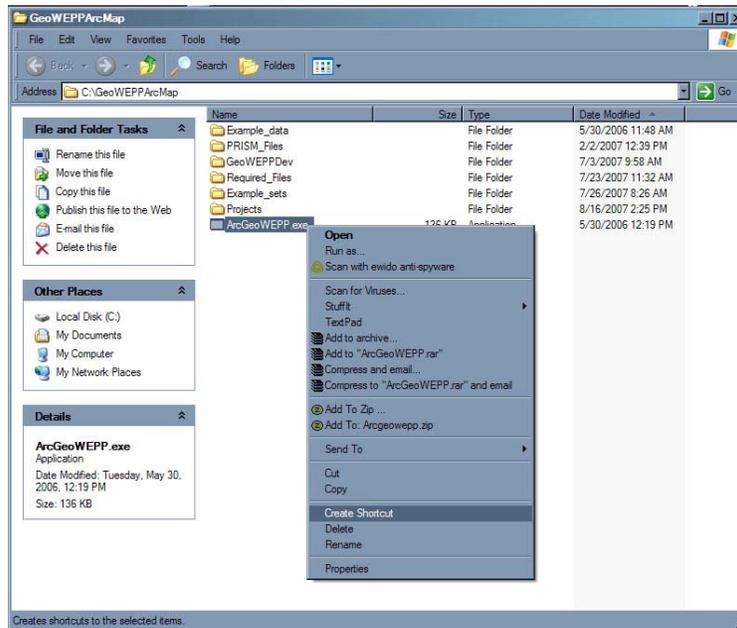
Figure 1 – a) GeoWEPP Installer; b) Navigation Window

## 2.2 Creating a Shortcut

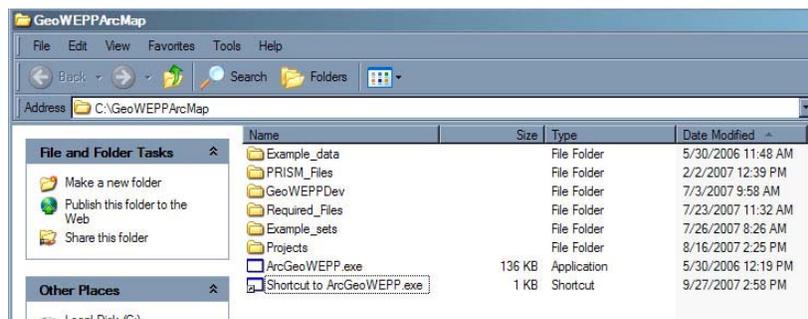
The easiest way to run GeoWEPP is to create a shortcut to the executable file and put it on your desktop. As discussed earlier, GeoWEPP was developed to be as least intrusive as possible; therefore you won't find any GeoWEPP links in your Start Menu.

### Steps to Create a Shortcut

1. Navigate to the folder where you installed GeoWEPP
2. Right-click on the ArcGeoWEPP.exe file
3. Select **Create Shortcut** from the popup menu (figure 2a)
4. Once the shortcut has been created (figure 2b), click and drag the shortcut to your desktop



a



b

Figure 2 – a) Right-click Popup Menu; b) Shortcut has been created

## 2.3 Before you Begin: Preparing ArcMap for GeoWEPP

Before you can start playing with GeoWEPP, you will need to activate the *Spatial Analyst* extension in ArcMap. If this extension is not activated, many of the tools and features of GeoWEPP will not work. Once you activate it, you will not need to do it again (unless you happen to deactivate it somehow).

If you get any kind of license error, you may not have Spatial Analysis installed on your computer. You will not be able to GeoWEPP until it is installed; either contact your System Administrator or ESRI to correct this.

### To Activate Spatial Analyst

1. Start ArcMap
2. Select **Tools** from the menu bar and then select **Extensions** (figure 3a)
3. The Extensions window will appear (figure 3b); if the box next to *Spatial Analyst* is not checked, click the box to “check” it (figure 3c)
4. Click **Close**
5. Exit ArcMap

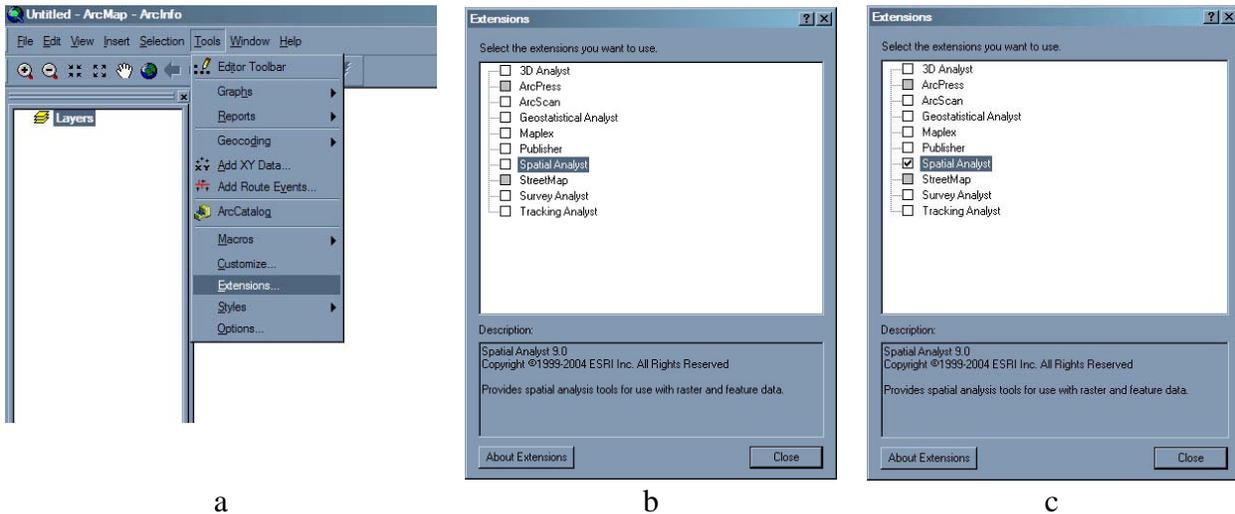


Figure 3 – a) ArcMap Tools Menu; b) Extension Window, Spatial Analysis Not Activated; c) Spatial Analysis now Activated

## 2.4 Starting GeoWEPP for the First Time

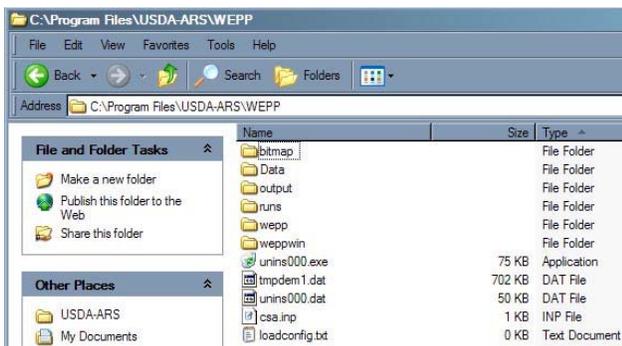
The first time you start GeoWEPP, you will need to provide some directory information. You will need to provide the location (pathname) for WEPP and GeoWEPP. This is a simple task if you don't have this information already recorded.



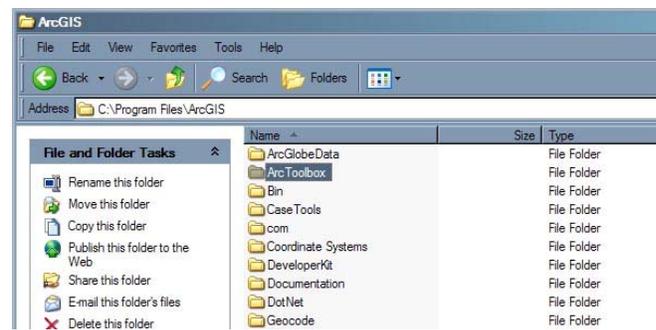
Figure 4 – No Directory Information Found

There are two ways to start GeoWEPP. You can either double click on the shortcut that you may have created using the instructions above, or you can navigate to the GeoWEPP folder and double-click ArcGeoWEPP.exe. Either way is acceptable, but the shortcut will save you time.

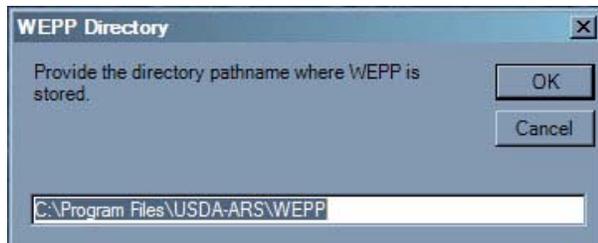
First, GeoWEPP needs to know where WEPP is installed. To get this pathway, navigate to the folder in which the “weppwin” folder is located. If you used the default install, it should be “C:\Program Files\USDA-ARS\WEPP” (figure 5a). For ArcGIS, you need to navigate to where the “Arc Toolbox” folder is located. It is most likely located in “C:\Program Files\ArcGIS” (figure 5b). Both of these defaults are provided for you by GeoWEPP (figure 5c and 5d); please make sure you have the correct information or GeoWEPP will not run. Also note that the given example pathways do not end in a “\”; make sure yours don’t either.



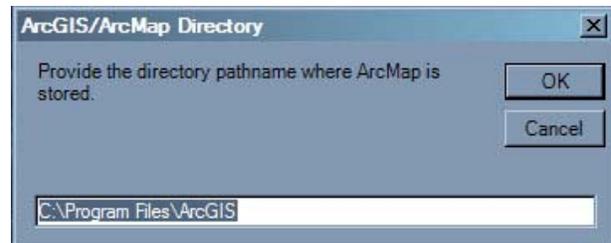
a



b



c



d

**Figure 5 – a) WEPP Install Directory; b) ArcGIS Install Directory; c) GeoWEPP default WEPP directory; d) GeoWEPP default ArcGIS directory**

### 3 Windows and Tool Descriptions

This section discusses the tools that are available to use in GeoWEPP, while the next section covers the new tool PRISM. It is important to get a basic understanding of what these tools do before your first simulation run. All the tools you need for GeoWEPP are located on the GeoWEPP toolbar (figure 6). The toolbar is broken into several sections, based on their purpose. The order the tools presented on the toolbar is also important; they are positioned in the order in which you will most likely use them.

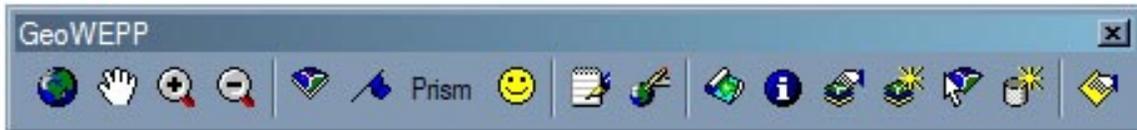


Figure 6 – GeoWEPP Toolbar

#### 3.1 Basic Navigation Tools

The first section of the toolbar contains the four basic navigation tools you will need to move around your map; these tools can be used at anytime within GeoWEPP. They function exactly like the same tools in ArcMap.

: This tool allows you to click and drag your map to move it around.

: By clicking, or clicking and dragging to create a rectangle, you will be able to zoom in to your map.

: By clicking, or clicking and dragging to create a rectangle, you will be able to zoom out of your map.

: Clicking this tool will zoom the map out to its fullest extent.

#### 3.2 Channel Network and Watershed Tools

GeoWEPP generates a channel network and a watershed for your study area based on your DEM and the outlet point you select. Sometimes, the network or watershed is not exactly how you want them. GeoWEPP provides you with tools to modify these. These tools are used before you run your first simulation. Attempting to use these tools after a simulation will begin a new project within your study area, but they will not affect your current watershed. The tutorial presented later in this chapter discusses this further.

## Modify Channel Network Delineation Tool



GeoWEPP generates a network based on your DEM using two parameters: the **Critical Source Area (CSA)** and the **Minimum Source Channel Length (MSCL)**. Both of these parameters are dependant on the resolution of your DEM. The CSA is the minimum source area needed to generate a channel. The default value is 5 hectares; therefore for a channel to be generated, an area of no less than 5 hectares needs to drain into the channels starting point. The MSCL is the shortest distance a first order channel needs to travel before it converges with another channel. The default setting is 100 meters, which means a first order channel must be at least 100 meters long before it converges with another channel. If either one of these criteria are not met the channel does not appear in the network.

*Modify Channel Network Delineation* tool allows you to modify these values to get the channel network you are looking for (figure 7). Both values can be increased or decreased as you see fit; the smaller the values, the more dense your network will become (see figure 8a versus 8b). It is important to know your DEM's resolution when determining these values. The DEMs used in the example sets have a 30m resolution, this means that at least 56 30m x 30m cells are needed for a 5 hectare CSA (50,000 m<sup>2</sup>). If you use a 10m DEM, the number to cells increases to 500 cells; a 1m DEM would require 50,000 cells. This means for some of the DEMs you provide, an initial channel may not be generated. All you need to do is use this tool to make the modifications.

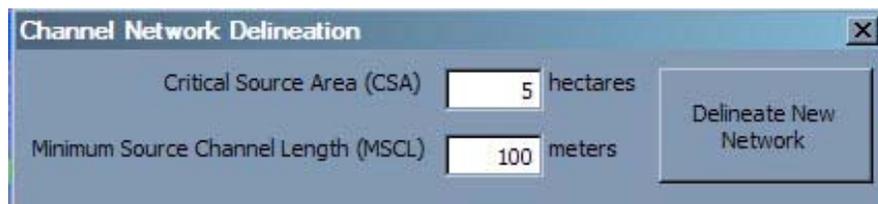


Figure 7 – Channel Network Delineation window

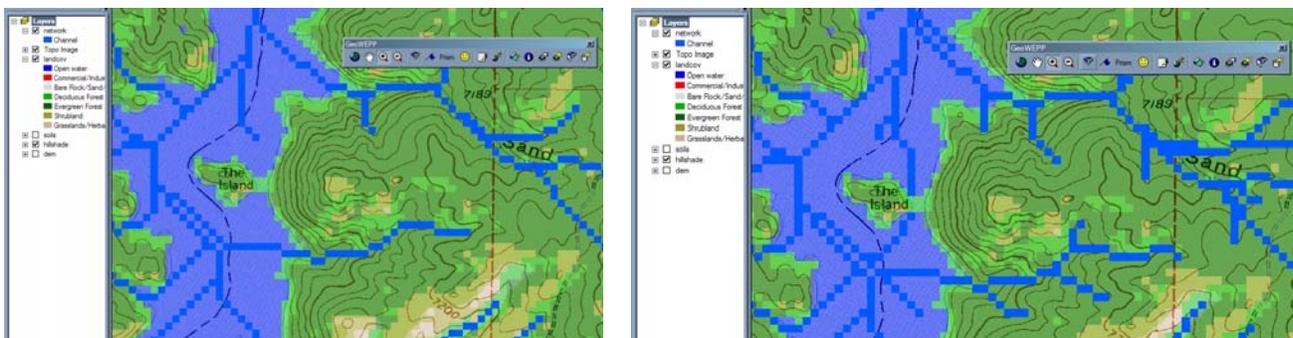
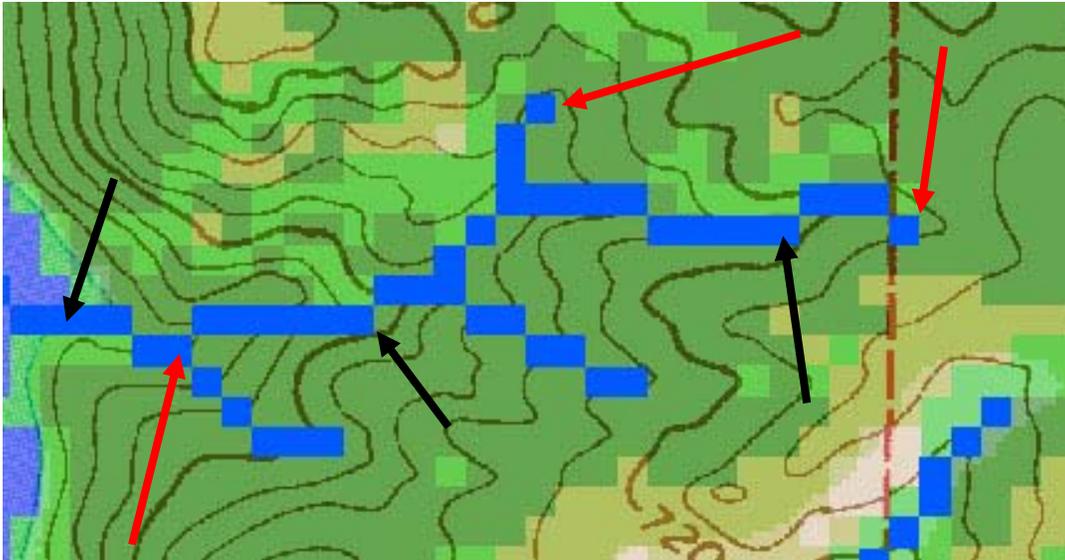


Figure 8 – a) Study Site Network with a CSA of 5 and a MSCL of 100; b) Same Study Site with a Network using a CSA of 2 and a MSCL of 100

### Watershed/Subcatchment Generation Tool

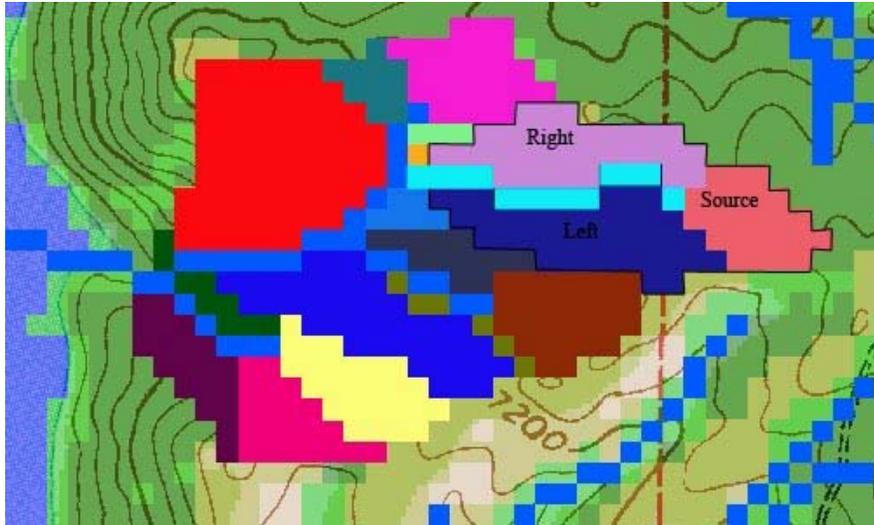


Once you have the channel network appropriate for your study area, you can now select a channel cell as an outlet point. You can select any channel cell to be the outlet point except the first cell of a first order channel or any cell that has two or more channel cells flowing into it (a convergence cell). In other words, the cell you choose must have only one channel cell flowing into it (figure 9). In most cases, GeoWEPP will alert you if you choose the wrong cell; steps to correct this are discussed in the FAQ portion later in this manual.



**Figure 9 – Acceptable (black) and Unacceptable (red) Channel Cells**

GeoWEPP will generate the watershed, also called the subcatchment, based on the outlet point you select and your DEM. Each channel within the network will have up to three hillslopes flowing into it (left, right, and source; see figure 10). Note that a channel in GeoWEPP is considered the part of the network that either starts with a head cell or a convergence cell; it ends with the cell that flows into a convergence cell or at the outlet point.



**Figure 10 – Outlined Hillslopes flow into the light blue channel**

If the watershed generated by GeoWEPP is not to your liking, all you need to do is select a new outlet point and a new watershed will be generated. If you decide to generate a new channel network after a watershed has been generated, GeoWEPP will discard the current watershed if you continue and create a new channel network.

### *Parameter-Regressions on Independent Slopes Model (PRISM)*



The PRISM tool is a new feature that allows you to modify the climate files used in WEPP to more closely match your study area's climate. PRISM is discussed in Section 4. If you wish to modify the climate, you will need to do so before you run the WEPP simulation (i.e. before accepting the watershed or rerunning WEPP).

### *Accept the Watershed*



Once you are satisfied with the network and watershed GeoWEPP has generated for you, you can begin your first WEPP simulation by clicking the *Accept Watershed* button on the tool bar. The WEPP simulation will be discussed in the tutorial.

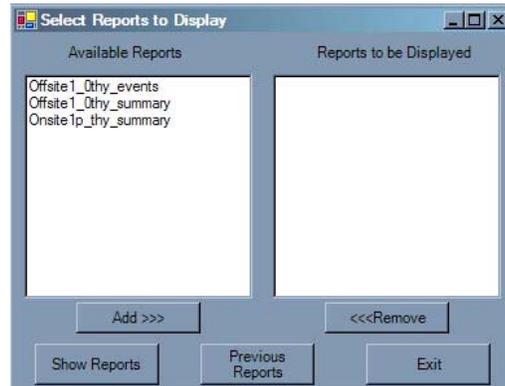
## **3.3 Viewing Reports and Saving the Project**

GeoWEPP will generate up to four reports for each simulation run. These reports can be viewed by clicking on the *View Reports* button . You will be able to select one or more reports to view and you can even view reports from previous runs in this project. These reports are simple text files and can be also be accessed via your project's folder; each Report is discussed at the end of this manual.

To view a report, just select the report you wish to view from the left side of the **Display Reports** window (see figure 11) and click the **Add>>>** button; you can remove any of the reports listed on the right side of the window by select it and click <<<**Remove**. Once you have selected all the reports you wish to view, click **Show**

**Reports.** You can view reports from previous watershed in this project or reports from other projects by clicking on the **Previous Reports** button. Navigate to the report you wish to view and it will load for you.

You don't need to run GeoWEPP to view any of your project reports. All the reports are stored in the **Reports** folder within your project's folder. These reports are stored as text files and be viewed using any text editor program (like Word or Notepad).



**Figure 11 – Select Reports to Display window**

One of the most important tools you will need in GeoWEPP is the **Save** button . This will insure that you will not lose any data or cause issues when you need to reload the project. **Save often.** In some cases, if the program crashes for some reason, you may need to start from the beginning. Saving often can help prevent this or minimize the amount of work needed to return to the point of the problem.

For added security, GeoWEPP has automatic save points built into it. GeoWEPP will save the project at the beginning and/or end of a tool's use. This feature has been added to most of the tools, but you should not rely on the automated save feature.

### **3.4 Tools Available after the First Run**

Once you have finished your first run, a number of new tasks will be available to you. These include changing hillslope WEPP parameters, rerunning WEPP, remapping the erosion results to a new T-Value, or starting up WEPP to run simulation of a hillslope or the entire watershed.

#### *Remap with New T-Value*

When GeoWEPP generates the initial results from the first simulation, it reports the values based on an erosion loss/sediment yield threshold called the T-Value. The default value used is **1 tonne per hectare per year**. This value may be too high or too low depending on the study area. The *Remap with New T-Value* tool allows you to remap the results using a new value. You can either enter English Units or Metric Units (default).

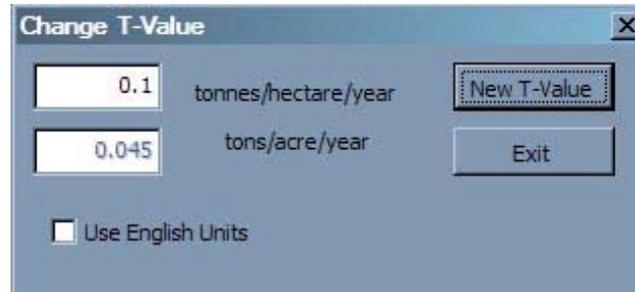


Figure 12 – Change T-Value window

When you rerun the WEPP simulation, GeoWEPP will be asked which T-Value you wish to use instead of just using the default value.

### *WEPP Hillslope Information*

Each hillslope within the subcatchment has two parameters associated with it: soil and management/landuse/plant. When GeoWEPP prepares the hillslopes for the WEPP simulations, each hillslope is assigned one soil and one landuse; this is based on the dominate soil/landuse found on the hillslope. The *WEPP Hillslope Info* tool allows you to determine which soil and landuse has been assigned to a particular hill. This tool also provides the WEPP Hill Number and the TOPAZ Hill Number, which you may need when viewing your reports.

### *Change WEPP Hillslope Parameters*

You may wish to change the soil and/or landuse WEPP file associated with a particular hillslope. Select this tool from the toolbar and then click on the hillslope you wish to change. You'll be able to change the soil, the landuse, or both. This will only change these WEPP parameters for this hillslope. If you wish to change a particular landuse or soil for the entire watershed, you will need to do this when you begin a new WEPP simulation using the **GIS Lookup Window** (discussed in the tutorial).

### *Rerun WEPP*

Once you have made changes to any hillslope WEPP parameters, you will need to rerun WEPP to get the new results; clicking on the *Rerun WEPP* button will begin this process. You will not need to select a climate since the same one will be used. Most of the steps used for the first simulation will also be required any time you rerun the WEPP simulations.

As stated above, you will be asked to provide a T-Value to be mapped (figure 13).



**Figure 13 – Provide a T-Value for Rerun Results**

### *WEPP on a Hillslope*

By selecting this tool and clicking on a hillslope, you will be able to load all the WEPP parameters for that hillslope into WEPP. The WEPP windows interface will load and all the hillslope information will be present. All you need to do is click “Cancel” and you are set to run any of WEPP’s tools and functions on the hillslope.

**Important Note:** Any changes to the hillslope you make will **NOT** be reflected in the GeoWEPP hillslopes. The hillslopes in GeoWEPP are spatially distributed, while the WEPP hillslope is a representative profile of the GeoWEPP hillslope. Changes to the profile can not be reliably spatially translated back into GeoWEPP.

### *Goto WEPP*

Clicking this button will load WEPP. From here you will be able to load the WEPP watershed file generated by GeoWEPP or any of the WEPP hillslopes in your study area. Note that the hillslope that appears when WEPP starts up using this tool is a default hillslope and not one of the hillslopes found in your study area.

### *Exit GeoWEPP and Save*

You can end your GeoWEPP session the same way you end any ArcMap project, but ArcMap may not save your progress. If you get in the habit of using the *Exit GeoWEPP and Save* button, GeoWEPP will save your current project and exit ArcMap for you.

## **3.5 Don’t Remember Which Tool is Which?**

In the beginning you may not remember which tool on the toolbar does what. GeoWEPP will remind you what a particular tool is whenever you move the mouse pointer over a tool; a small textbox will appear telling you which tool you are currently hovering over. Text will also appear in the lower left hand corner of ArcMap, providing you with some more information.

Also, keep in mind that the tools are list in the order you will most likely use them.

## 4 PRISM – Topographic Adjusted Weather Generation

In this section we will discuss the *PRISM*  tool briefly mentioned above. **Parameter-elevation Regressions on Independent Slopes Model (PRISM)** allows you to modify an existing WEPP Climate parameter file – the files WEPP uses to generate the climate events for a simulation. PRISM allows you to make modification to the WEPP climate parameter files so that it can more closely match the climate found in your study area.

*[Author’s Note: Much of the material present here was modified from the help information provide on the Forest Service WEPP Interface website (<http://forest.moscowfsl.wsu.edu/fswcpp/>). Modifications made were based on the tool built for GeoWEPP.]*

### 4.1 Starting PRISM

Since PRISM will modify the climate parameter file for your study area, you must run PRISM before accepting your watershed. To start PRISM, click the PRISM button located on the toolbar. This will open the **Climate Selector** window (figure 14). A different **Climate Selector** window will appear based on if you have selected your Outlet Point yet or not. If you have not, the **Climate Selector** window (figure 14a) will allow you to select a climate file based on the state and weather station name or allow you to load your own parameter file. If you have already selected the outlet point, the **Climate Selector** window (Figure 14b) will display the closet climate station to your outlet point; you can either select that station or choose a different one based on state and station name.

**IMPORTANT NOTE:** PRISM will only work for outlet points selected within the continental United States. If your study site is outside this area, you will need to start PRISM before selecting the outlet point; if PRISM is started after the outlet point is selected, the displayed station may not be the closest one.

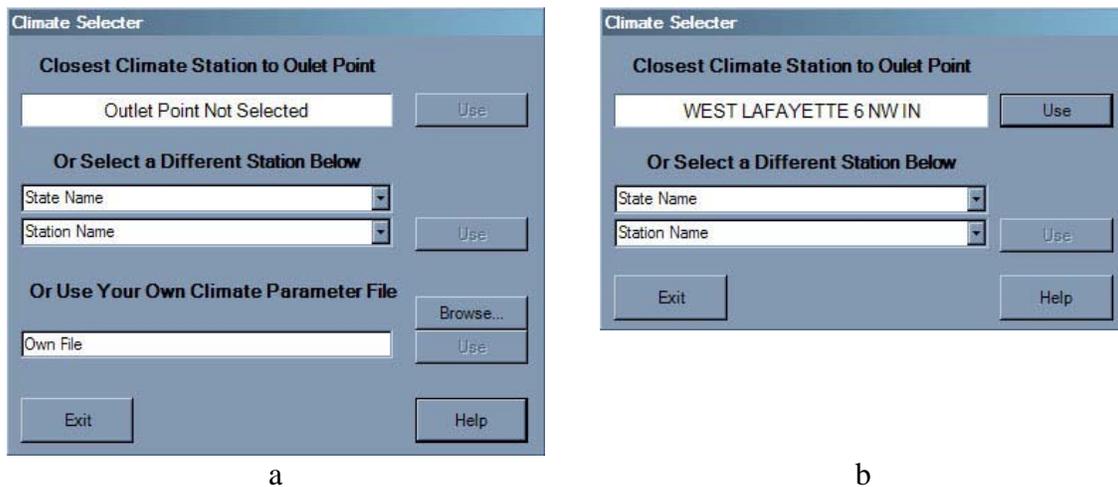


Figure 14 – a) PRISM started before Outlet Point selected; b) PRISM started after watershed generated

Once you have decided which station or climate parameter file you will be using click the **Use** button next to your selection. This will bring up the **Climate Modification** window.

## 4.2 Modify Climate Parameters

“Generally, users who wish to customize a climate have knowledge of mean precipitation or temperatures for a given site. They seldom have enough information to develop values for standard deviation or skew statistics. Hence, a technology was developed to allow users to customize the mean values for the site of interest, while using the other statistics from an existing (presumably nearby) CLIGEN station. As a minimum, users can enter the average monthly precipitation amounts. Users can either enter exact values, or specify a percent increase or decrease over those at the existing station. If they have the data, they can also enter the number of wet days in a month, and the average monthly maximum and minimum temperatures” (from the PRISM help documentation, Forest Service WEPP Interface website).

Climate Modification window showing parameters for ANDALUSIA AL. Modified Climate Name: Mod ANDALUSIA AL. Latitude: 31.32°N, Longitude: 86.50°W, Elevation: 350 feet. The table below shows monthly climate data.

Mean Maximum Temperature (°F)	Mean Minimum Temperature (°F)	Mean Precipitation (in)	Number of Wet Days	Month	Mean Maximum Temperature (°F)	Mean Minimum Temperature (°F)	Mean Precipitation (in)	Number of Wet Days
59.81	35.32	4.90	9.60	January	59.81	35.32	4.90	9.60
63.66	37.52	5.11	8.97	February	63.66	37.52	5.11	8.97
70.92	43.52	6.12	9.57	March	70.92	43.52	6.12	9.57
79.07	50.34	4.66	6.95	April	79.07	50.34	4.66	6.95
85.53	58.35	4.57	7.75	May	85.53	58.35	4.57	7.75
90.65	65.29	5.00	10.00	June	90.65	65.29	5.00	10.00
91.81	68.25	6.06	13.18	July	91.81	68.25	6.06	13.18
91.44	67.81	5.12	11.38	August	91.44	67.81	5.12	11.38
87.34	63.44	4.21	7.94	September	87.34	63.44	4.21	7.94
78.91	51.21	2.72	5.55	October	78.91	51.21	2.72	5.55
69.50	42.05	4.15	7.41	November	69.50	42.05	4.15	7.41
62.06	36.88	5.26	9.57	December	62.06	36.88	5.26	9.57
Annual					57.88	107.87		
Change entire column (enter 0 to reset) >>					0.00	0.00	0.0%	0.0%

Buttons: Accept These Values, Clear All Changes, Help, Exit. Checkboxes: Adjust temperature for elevation by lapse rate.

Figure 15 – Climate Modification window

This process of modifying the data found in a climate station's parameter file is done through the **Climate Modification** window (figure 15). This window allows you to change some, most, or all of the necessary temperature and precipitation data for the select climate station. There are a number of ways to do this: monthly changes, annual changes, changes based on lapse rate, elevation, or by latitude and longitude. Before we can discuss how to make these changes, you need to know what you are looking at. The **Climate Modification** window can be broken down into two sections: left and right.

The left side of the **Climate Modification** window contains the data found in the current climate station's parameter file: temperature, precipitation, wet days, latitude/longitude, elevation, and climate station name. The station name is displayed at the top of the window. Underneath the station name is the latitude and longitude of the station; below this is the station's elevation.

The table below the basic station information contains the precipitation and temperature day for the selected station. This data is broken down into monthly data and, for precipitation and wet days, annual data. The first two columns of the table correspond to the mean maximum and mean minimum temperatures (displayed in degrees Fahrenheit). The third column displays the mean monthly precipitation (in inches); below this column is the mean annual precipitation. The last column holds the number of wet days for each month; under which is the annual number of wet days.

*What is "Number of Wet Days"?* The *Number of Wet Days* refers to the number of days in a particular month where precipitation is recorded. So, if the *Number of Wet Days* is 10 for June, it means that 10 out of the 30 days will have recordable precipitation. *What about a wet day value of 5.55?* Remember, this data was compiled using many years of recorded weather day and put into a statistical format.

The right side of the window is almost exactly the same as the left side, with one major exception: you can modify these values. One way or another, you can change any of the values displayed on the right side so they can more closely match your study area's climate data.

If you decide not to modify the climate parameter file, you can click **Exit** at any point to return to GeoWEPP. If you wish to start over, clicking **Clear All Changes** will return all values back to the original climate station values found on the right of the window.

#### How to change the climate parameter values:

**Modified Climate Name:** This is the name you wish to give your climate station. Initially, GeoWEPP just enters "Mod" before the climate name. You can enter any name you wish; since this will also be the name of the climate parameter file, you will need to avoid special characters like "/", "\", "+", "&", "\*", etc. To change the name, just click on the white textbox and replace the name.

**Latitude and Longitude:** Depending on when you started PRISM from GeoWEPP, the latitude and longitude with either be for the selected climate station (i.e. the one on the left) or the coordinates of the outlet point you selected. You can change these values by click on the boxes and enter new values. Changing these values will not have an effect on the climate parameter file itself, but will allow you to adjust the corresponding elevation and monthly and annual mean precipitation values once you clicked the **PRISM** button. This is discussed a little later.

**Elevation:** You can change the elevation either manually or by clicking the **PRISM** button. Manual changes will not cause any changes to the climate values until you check the Adjust temperature for elevation by lapse rate.

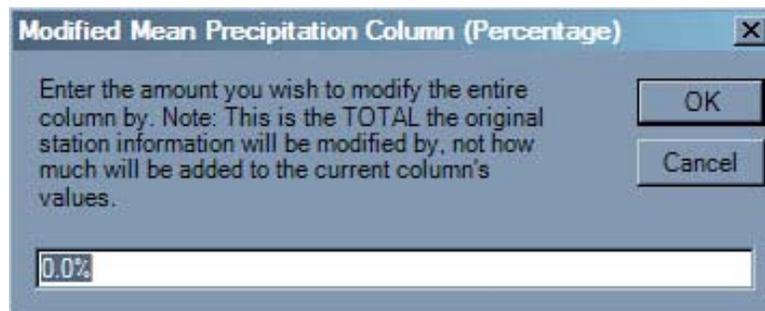
**The Parameter Table:**

There are four ways to change the values in this table: on a month to month basis, adding a single value to all months (a global column change), changing the annual value (which will also change the monthly values), or by clicking the **PRISM** button.

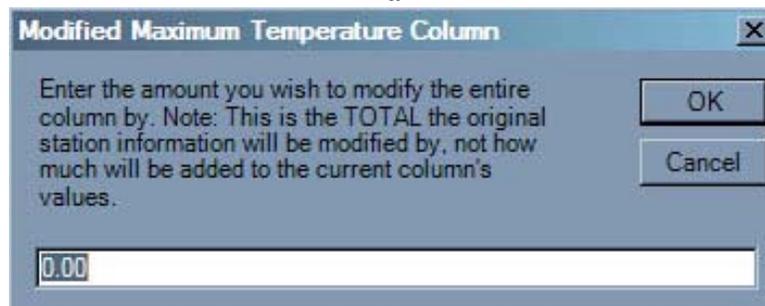
Every “cell” in the parameter table can be manually changed by clicking on the cell and entering the new value. This can be a time consuming process, but it allows you to “personalize” your climate parameter file so in more closely matches the climate within your study area.

You can also apply a global change to a column. This is done by clicking the button located at the bottom of the columns. When you first start the Climate Modification Window, these buttons will either be labeled “0.00” (for the Mean Maximum and Minimum Temperature columns) or “0.0% (for the Mean Precipitation and Number of Wet Days). An input box will appear asking you what value you wish to modify the original values by (see figure 16). In the case of temperature, you can enter a number that will be added or subtracted from the original values found on the left. For precipitation and number of wet days, this value will be a percentage increase or decrease from the initial values. Once you change this value, the button label will change to the value of the current column modifier; in other words, if you enter 2.3% for Number of Wet Days, the corresponding button label will change to 2.3%.

What is most important to remember is that the value you are entering is the **TOTAL** modification of the original value. For example, if you first add 7.5 degrees to the Mean Maximum Temperature and decide to add an additional 3 degrees, you will need to enter 10.5. If you wish to change a column to its original value, all you need to enter is 0.



a



b

Figure 16 – a) Column Percentage Change; b) Column Value Change

The annual values can be changed in the same manner. To change an annual value, click on the button that corresponds to the parameter you wish to change; these buttons are labeled with the current annual value. An input box (figure 17) will appear; enter the annual value you wish to use. Once you click OK, two things will happen. First, the button label will change to the value you entered. Next, the values found in the corresponding column will change to reflect the new annual value. For example, if you change the Annual Mean Precipitation from 57.88 to 75.44, the button label will change to “75.44” and all of the monthly Mean Precipitations will change to account for this new annual value.

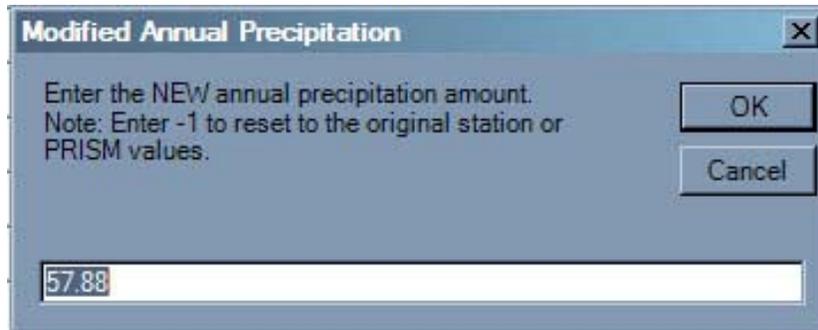


Figure 17 – Modify an Annual Value

#### **The PRISM Button:**

The final method for changing the values in the table is by clicking on the **PRISM** button near the top right of the **Climate Modification** window. This will bring up a new window: the **PRISM Modification** window (figure 18). The purpose of this window is to allow you to adjust the Mean Precipitation values based on either the elevation or on the annual precipitation of area surrounding the climate station or outlet point location.

The **PRISM Modification** window contains a table that lists the selected station’s Mean Precipitation (values found on the left side of the **Climate Modification** window) on the left and the PRISM calculated Mean Precipitation on the right.

There are two navigation grids located on the right side of the window: one for Annual Precipitation and one for Elevation. The center of these grids corresponds to the latitude and longitude of your current location. This location could either be the station location (if you haven’t selected a watershed yet), the outlet location (if you have selected your outlet point), or the latitude and longitude you entered in the latitude/longitude boxes on the left side of the **Climate Modification** window.

*If it is where the climate station is located, why are there different values?* The values from a particular climate station are based on the data gathered from that climate station. The values shown in the PRISM Modification Window is based on the PRISM database:

“The PRISM (Parameter-Regressions on Independent Slopes Model) database was developed cooperatively by the USDA-NRCS and ARS, and Oregon State University (Daly et al. 1997). The database contains the average monthly precipitation values and average elevations for a 2.5-min. grid covering the entire conterminous U.S. It was developed by interpolating and extrapolating precipitation amounts between weather stations. Factors to allow for elevation, aspect, and other local effects were considered in the development. Numerous state climatologists have reviewed the PRISM database, and their observations incorporated into it” (from the PRISM help documentation, Forest Service WEPP Interface website).

**PRISM Modification Window**

For modifying CLIMATE at 31.32 N 86.50 W and 350.

PRISM Location: 31.31 N 86.52 W and 348 ft elevation

Select a value in the annual precipitation or elevation tables to move north, south, east, or west in the PRISM 2.5 minute (approximately 2.5 mi) grid of values. The value in the center is your current location.

Station Mean Precipitation (in)	Month	PRISM Mean Precipitation (in)
4.90	<b>January</b>	5.28
5.11	<b>February</b>	5.67
6.12	<b>March</b>	6.73
4.66	<b>April</b>	4.26
4.57	<b>May</b>	4.57
5.00	<b>June</b>	5.27
6.06	<b>July</b>	5.96
5.12	<b>August</b>	5.25
4.21	<b>September</b>	4.10
2.72	<b>October</b>	3.01
4.15	<b>November</b>	4.21
5.26	<b>December</b>	5.39
57.88	<b>Annual</b>	59.72

Annual Precipitation (in)

59.70	59.68	59.60
59.77	<b>59.72</b>	59.67
59.89	59.78	59.69

<W-----E>

Elevation (ft)

226	308	361
236	<b>348</b>	344
321	295	298

<W-----E>

Accept Values    Return with no Changes    Help    Exit

Figure 18 – PRISM Modification Window

This window allows you to move around the 2.5-min grid to find the elevation or annual precipitation that best represents your study area. To do this, click on any of the eight cells surrounding the white center box of a grid. When you do this, the grid will move so that the selected cell becomes the new center cell. This will also change the monthly and annual precipitations, latitude and longitude of the location, and the elevation. A shift in one grid will be accompanied by a shift in the other grid so that the annual precipitation and elevation of your location will always be displayed in the center grid cell.

When finished, you can either accept these values by clicking **Accept** or return to the Climate Modification window without any changes by clicking the **Return with no Changes** button. If you choose to accept the PRISM Mean Precipitation values, the Mean Precipitation column in the **Climate Modification** window will change to reflect these values (including a change in the column header). The latitude, longitude, and elevation is also changed based on the location determined from the **PRISM Modification** window.

**Lapse Rate Change:** One last modification you can make to the right side of the table is to adjust the temperature based on the Lapse Rate. This adjustment is based on the change of elevation from the climate station information on the left and any changes in the elevation (for example, accepting PRISM Mean Precipitation data). To change the temperature based on the lapse rate, just check the box at the bottom of the window. If there hasn't been any change to the elevation, checking this box will have no effect on the temperatures. Unchecking the box will remove the lapse rate adjustments.

Once you have made all the changes you need to make to the climate, all you need to do is click the **Accept These Values** button. A new climate parameter file will be created based on these changes and PRISM will end. You will then be able to continue on with your GeoWEPP simulation.

### **PRISM References**

(from the PRISM help documentation, Forest Service WEPP Interface website)

Daly, C., G. Taylor, and W. Gibson, 1997, *The PRISM Approach to Mapping Precipitation and Temperature*, **10th Conf. on Applied Climatology**, Reno, NV, Amer. Meteor. Soc., 10-12.

Johnson, G. L., C. Daly and C. L. Hanson. 1998. *Weather generator parameter spatial variability and mapping*. Presented at the **1998 ASAE Annual International Meeting**, Orlando, Florida. St. Joseph, Mich. : ASAE. July 12-16, 1998. [Technical papers: call No. CD-ROM S671.3.A5 1998]

Trewartha, G. T. and L. H. Horn. 1980. **An Introduction to Climate**. New York: McGraw-Hill Book Co. pp 56-57.

## 5 GeoWEPP Tutorial

All the tools found in the GeoWEPP toolbar are discussed above, but there are several steps in the GeoWEPP simulation process that are not covered. This section provides you with a step-by-step process that will guide you through each of the tools and how they work. It will also explain all the steps in the simulation process including terminology and how to customize your study area and simulation run.

This tutorial uses the “Use Your Own ASCII Data” feature of GeoWEPP, but uses data found in one of the example data. By going through the steps now, you will be familiar with the process when it is time to use your own data. The two sections following this tutorial will guide you through the preprocessing stages to get your data into a “GeoWEPP friendly” form.

If you have done so yet, make sure your Spatial Analyst extension has been activated and you have provided the directory information discussed above.

### 5.1 Start GeoWEPP and Load ASCII Data

1. Double click on the ArcGeoWEPP shortcut on your desktop (if you have one) or navigate to the ArcGeoWEPP folder (default install at “C:\GeoWEPPArcMap”) and double click on ArcGeoWEPP.exe. A “Welcome to GeoWEPP for ArcGIS 9” splash screen will appear. Please read through the greeting and click OK.

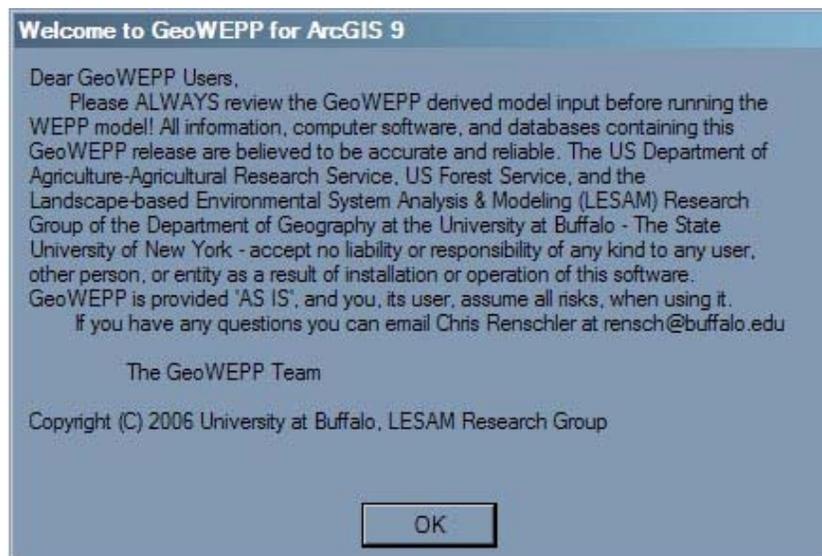


Figure 19 – Welcome to GeoWEPP for ArcGIS 9

2. The next window that appears is the GeoWEPP Wizard. This window provides a starting place for all your GeoWEPP needs, including starting a new project or continuing a previously saved one. The Wizard also provides you with links to the GeoWEPP webpage and the webpage for each of its collaborators and supporters. In this case study, we will be using example data but we will be loading it as if it was your own GIS ASCII data.

**Click on Use your own GIS ASCII Data button.**



Figure 20 – GeoWEPP for ArcGIS 9 Wizard window

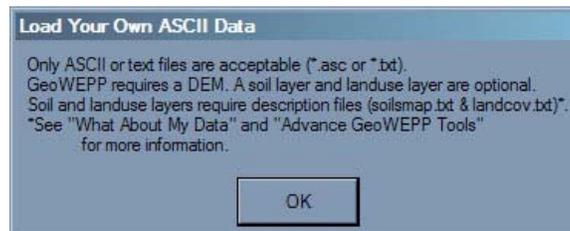


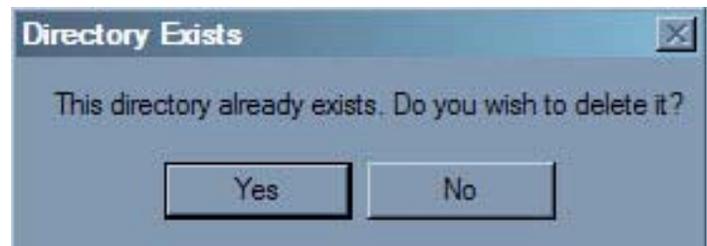
Figure 21 – Load Your Own ASCII Data Message

3. Each time you start a new project, a project folder will be created to store all the needed files to run GeoWEPP for that project. GeoWEPP will ask you to provide a name; remember do not use spaces, commas, or any other special characters in the project name. This project folder will be stored in the **Projects** folder found in the GeoWEPP folder. If you provide a name that already exists, GeoWEPP will delete that folder's contents (with your approval).

**Enter an acceptable name and click ok.**



a



b

Figure 22 – a) Enter a Project Folder name; b) An alert message will appear if folder already exists.

4. Once the project folder has been created, GeoWEPP transfers most of the needed files into this folder. The next step is to load your GIS data to be used in GeoWEPP. First you will be asked to load an ASCII DEM. This is required; without a DEM, GeoWEPP will not run.

Navigate to the **CWE** folder found in the “**Example\_Sets**” folder and select the **dem.asc** file. This file will be copied to your project file.

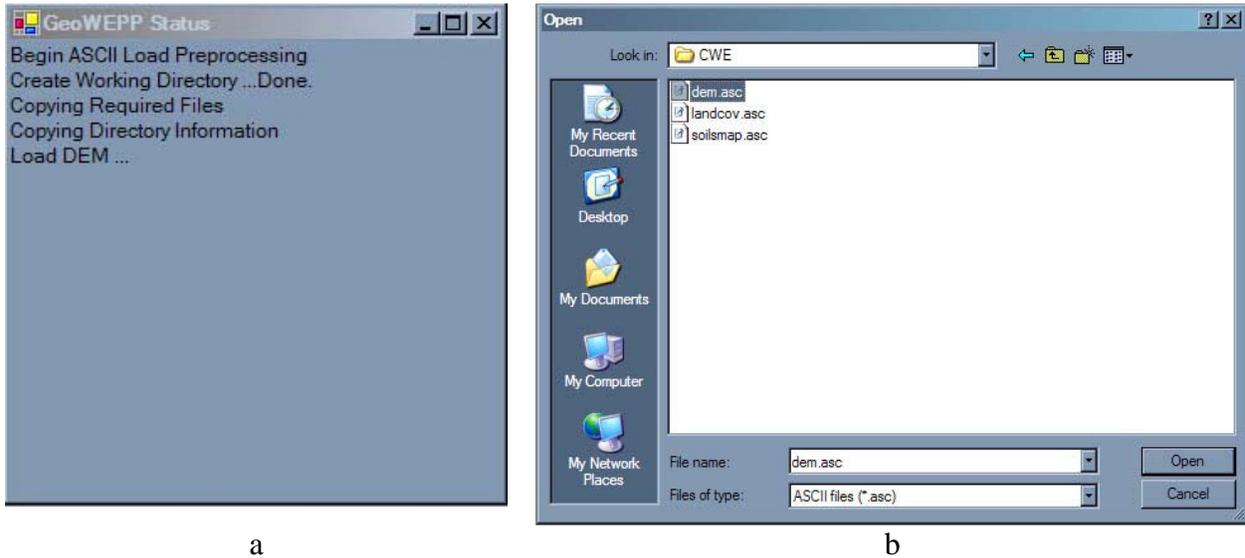


Figure 23 – a) GeoWEPP Status - Load DEM ...; b) Navigate to your DEM and select it

*A note about naming conventions:* In the earlier versions of GeoWEPP, you needed to name all the files in a certain way. In this version, you can name the files anyway you want, as long as they are ASCII files. When you select a file, like your DEM, GeoWEPP will copy the file to the project folder and rename it, in this case dem.asc.

**NOTE:** If you click Cancel in the DEM Open window (figure 23b), GeoWEPP will cancel the entire data loading process. GeoWEPP requires a DEM to run; without it, GeoWEPP is useless.



Figure 24 – DEM Required Warning

5. Next, you'll be asked if you would like to add a soil layer to your project. This is an ASCII raster file similar to the DEM file you just provided and is discussed later in this manual. This file is not required, but without it a global soil will be applied to your entire watershed. You will only be able to change the soils for each hillslope after the first WEPP run.

Navigate to the **CWE** folder found in the **Example\_Sets** folder and select the **soilsmap.asc** file.



Figure 25 – Add Soil Layer?

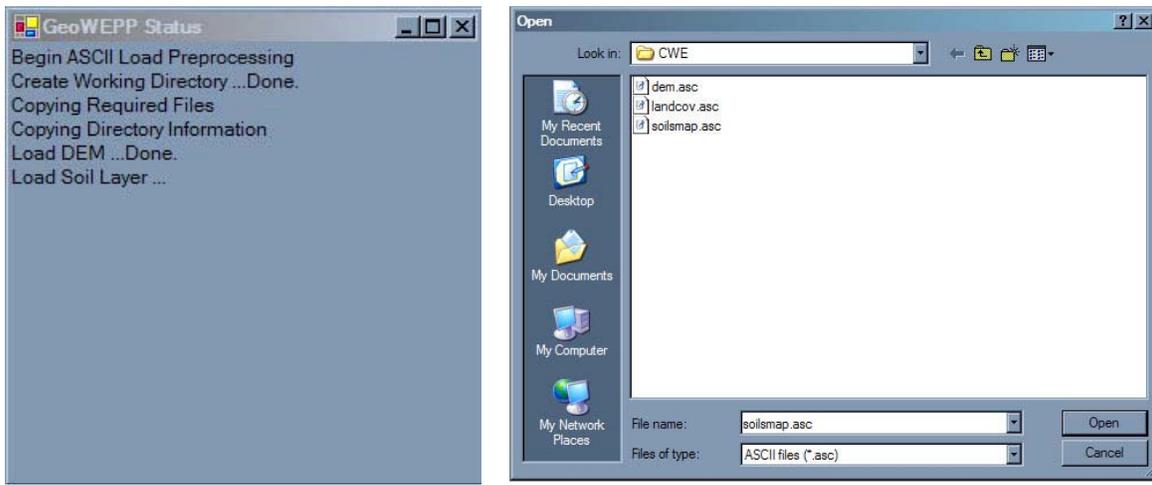


Figure 26 – a) GeoWEPP Status - Soil Layer ...; b) Similar process to the DEM loading process

5a. Once the soil layer has been added, you will be asked if you have a **soilsmap.txt** file. The purpose of this file is to link the soil values located in the ASCII soil file to soil names you provide. The creation of this file is detailed in “Advanced GeoWEPP Tools – A Revisit” later in this manual.

Navigate to the **CWE** folder found in the **Example\_Sets** folder and select the **soilsmap.txt** file.



Figure 27 – Add Soilsmap.txt File?

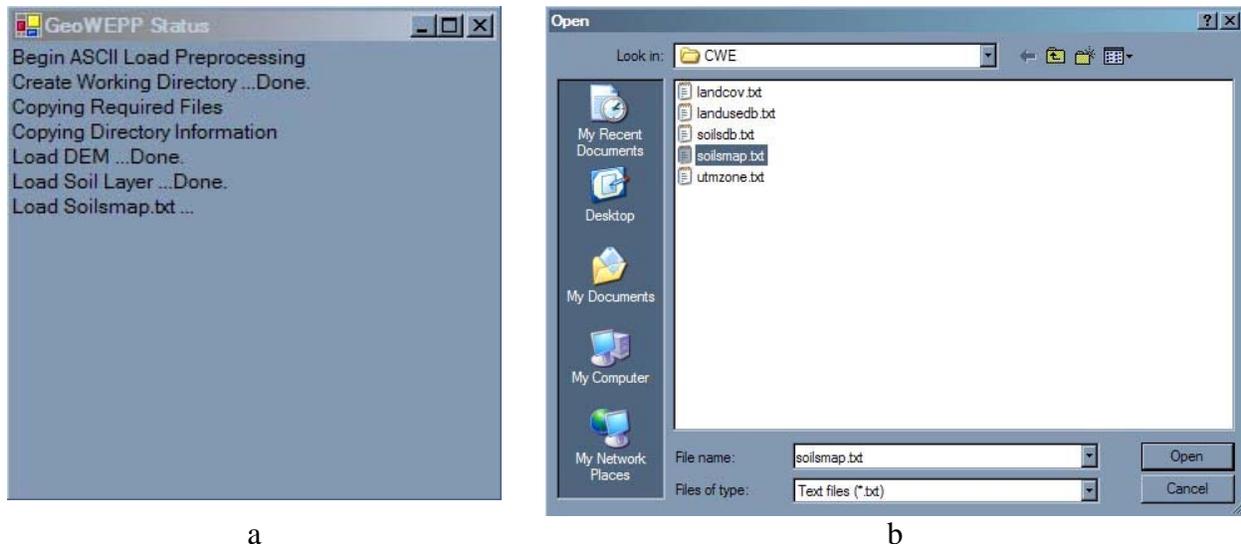


Figure 28 – a) GeoWEPP Status – Load Soilsmap.txt ...; b) Soilsmap.txt in CWE folder

You are not required to create this file, but it is necessary for GeoWEPP to run properly; if you do not load this file, GeoWEPP will create a default one for you.



Figure 29 – Default Soilsmap.txt file created

5b. The final step in loading the soil parameter is the addition of the **soilsdb.txt** file. This file links the name you provide to the soils with WEPP soil layer files; this file is also discussed in “Advanced GeoWEPP Tools – A Revisit” later in this manual. You are not required to create this file, but it is necessary for GeoWEPP to run properly; if you do not load this file, GeoWEPP will create a default one for you (you will not be alerted). If you did not load a soilsmap.txt file (above), GeoWEPP will not ask you for the soilsdb.txt and will just create the default file.

**Navigate to the CWE folder found in the Example\_Sets folder and select the soilsdb.txt file.**

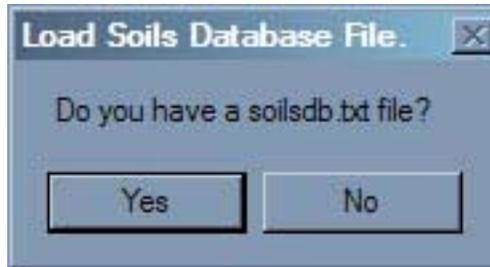


Figure 30 – Add Soilsdb.txt?

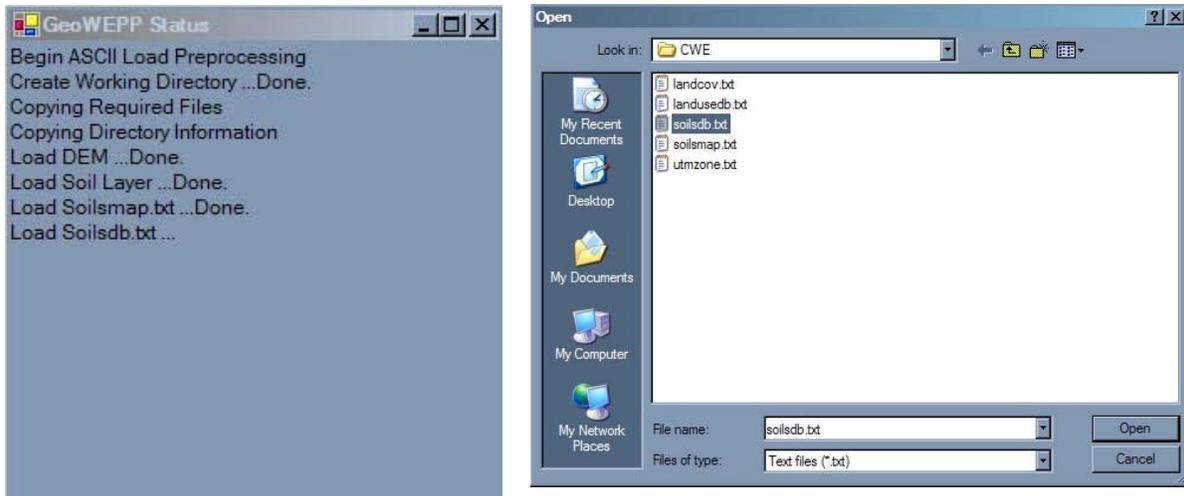


Figure 31 – a) GeoWEPP Status – Load Soilsdb.txt ...; b) Soilsdb.txt file in CEW folder

6. The next layer that needs to load is the landuse (also called the landcover, land management, or vegetation layer). This loading process is exactly the same as the soil layer loading process. First you will be asked to supply a landuse ASCII file. Just like the soil layer, this layer is not required. And, just like the soil layer, if this layer is not loaded you will only be able to select one landuse for the entire study area until after the first WEPP simulation.

**Navigate to the CWE folder found in the Example\_Sets folder and select the landcov.asc file.**

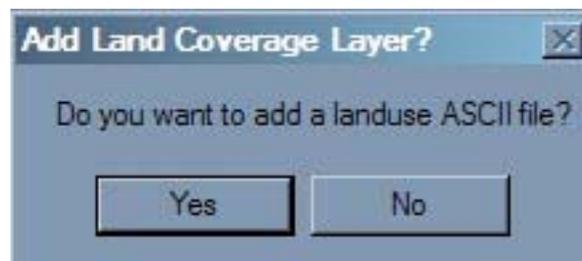
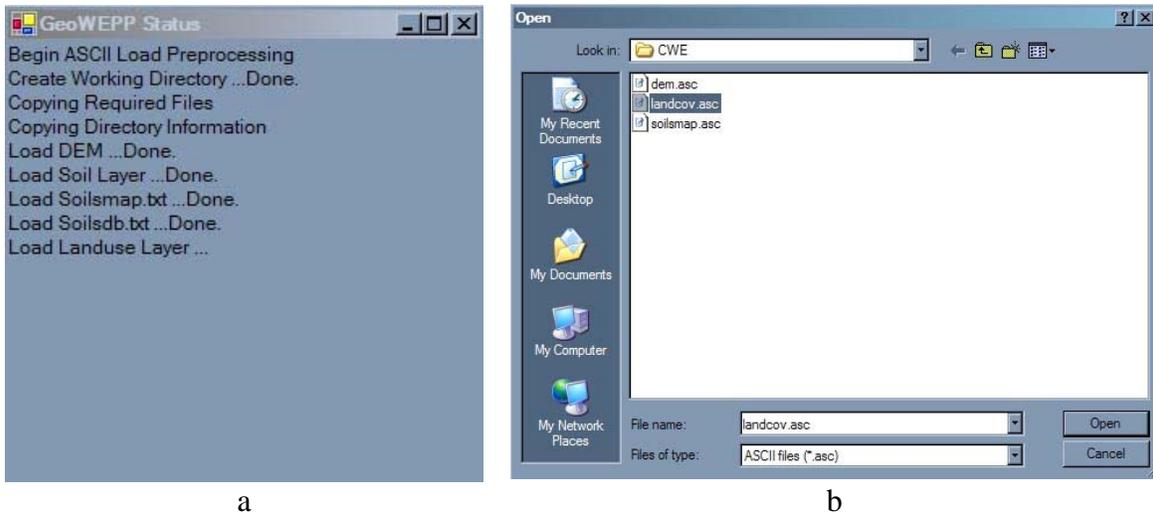


Figure 32 – Add Landuse Layer?



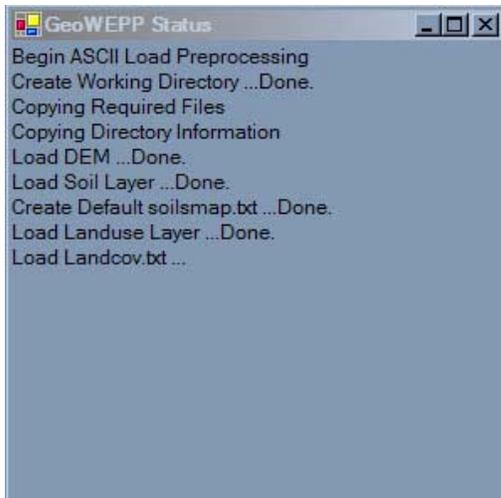
**Figure 33 – a) GeoWEPP Status – Load Landuse Layer ...; b) Landcov.asc located in CWE folder**

6a. Next is the landcov.txt file. This file is the same as the soilsmap.txt file; it associates a landuse name you provide to the values stored in the ASCII file. The names you provide in this file will be used to create the landuse legend in ArcMap (discussed later). This file also is not required, but a default file will be created if you don't provide one.

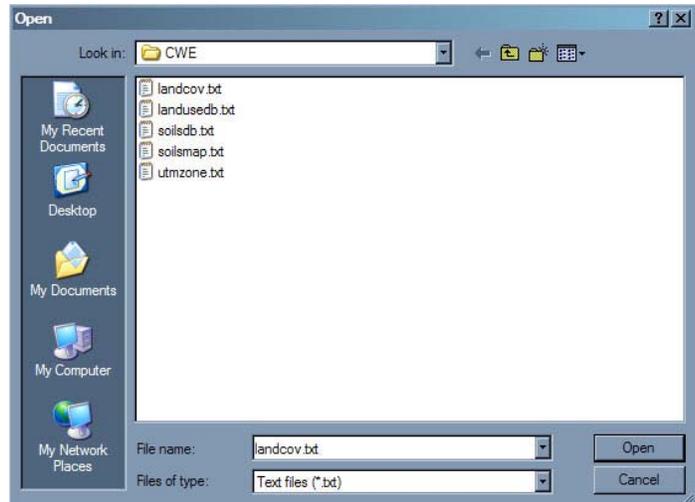
**Navigate to the CWE folder found in the Example\_Sets folder and select the landcov.txt file.**



**Figure 34 – Load Landcov.txt?**



a



b

Figure 35 – a) GeoWEPP Status – Load Landcov.txt ...; b) Landcov.txt in CWE folder



Figure 36 – Default Landcov.txt File Created

6b. Finally, you will be asked to supply the landusedb.txt file; this file links the landuse name to the WEPP management layer file. GeoWEPP will create a default file if you do not provide one or if a default landcov.txt file was generated.

**Navigate to the CWE folder found in the Example\_Sets folder and select the landusedb.txt file.**

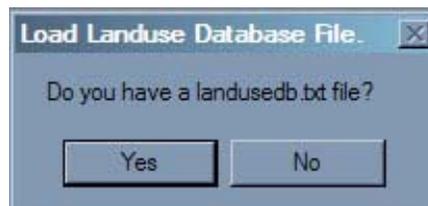
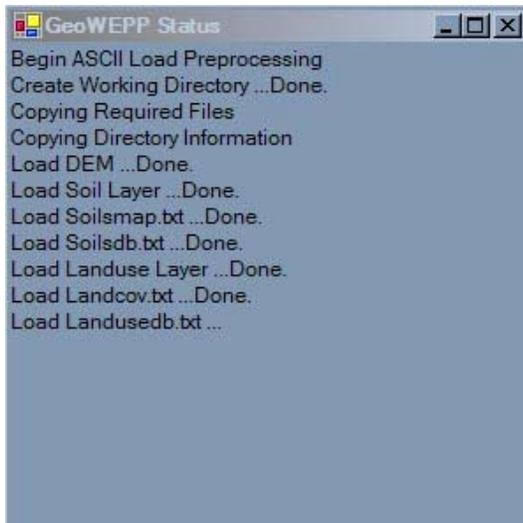
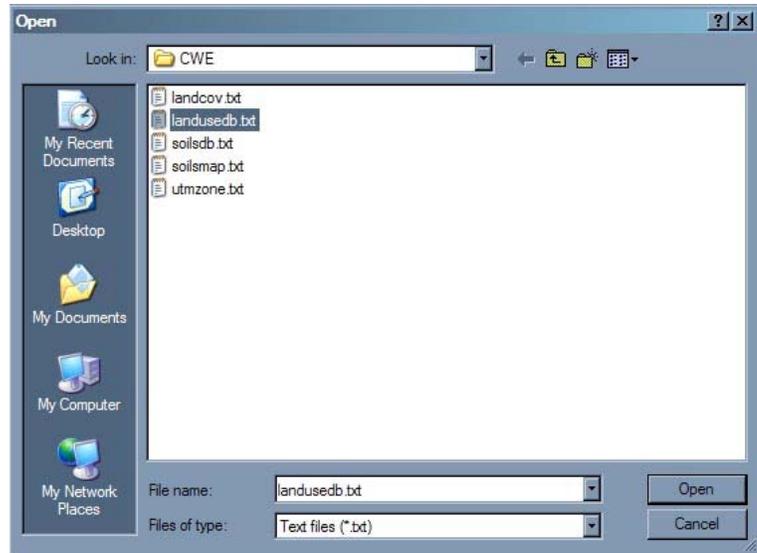


Figure 37 – Add Landusedb.txt?



a



b

Figure 38 – a) GeoWEPP Status – Load Landusedb.txt ...; b) Landusedb.txt in CWE folder

7. There is once last layer that can be added to GeoWEPP. GeoWEPP allows you to load one of more topographic TIFF images to GeoWEPP. GeoWEPP doesn't use this layer in any of its simulations; its purpose is only to aid you in recognizing areas in your study site.

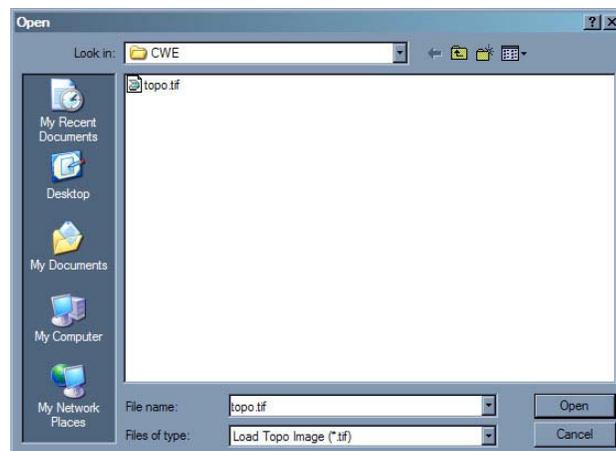
**Navigate to the CWE folder found in the Example\_Sets folder and select the topo.tiff file. When prompted for another Topo Image, select No.**



Figure 39 – Add a Topo Image?



a



b

Figure 40 – a) GeoWEPP Status – Load Topo Image (\*.tif) ...; b) Topo.tif in CWE



Figure 41 – Another Topo Image?

Note about TOPO tiff images: There appears to be an error in the TIFF World File that causes many TOPO images to be off when loaded. In GeoWEPP, these images can be way off because the GeoWEPP layers do not have any spatial reference with them. You should be able to correct this problem by reprojecting the TOPO image (it is a raster) using the same projection used for your DEM. Reprojecting raster layers is discussed in “What About My Data?” later in this manual.

8. Once all the parameters have been added, GeoWEPP run TOPAZ to delineate the channel network. This network is based on the default values of 5 hectares for the critical source area (CSA) and 100 meters for the minimum source channel length (MSCL). In some cases, TOPAZ will not be able to create a channel network based on these values; you will be alerted once all the parameter layers have been loaded when this occurs. Not to worry, you’ll be able to use different CSA and MSCL values later.

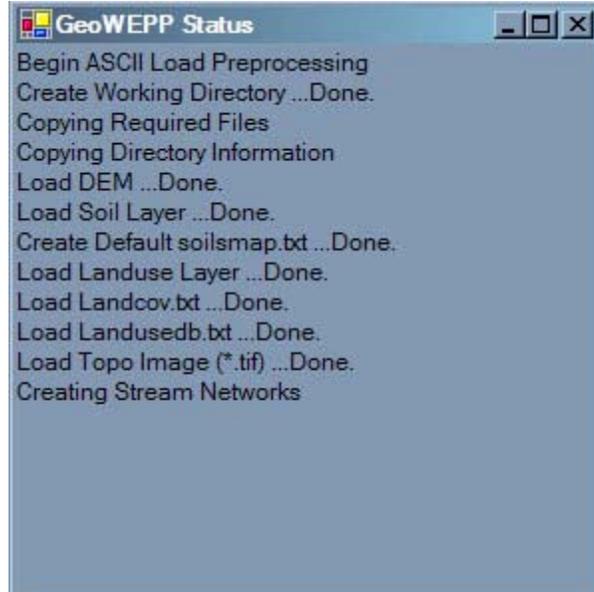


Figure 42 – TOPAZ creating channel network

9. Once ArcMap begins, GeoWEPP will convert the ASCII grid data to raster layers. This process may take some time depending on the speed of your computer. **Click OK** on the **Possible Time Intensive Function** alert window to begin the conversion process.



**Figure 43 – Possible Time Intensive Function**

As the conversion process proceeds, each layer will be added after it has been converted.

### *USGS Legend?*

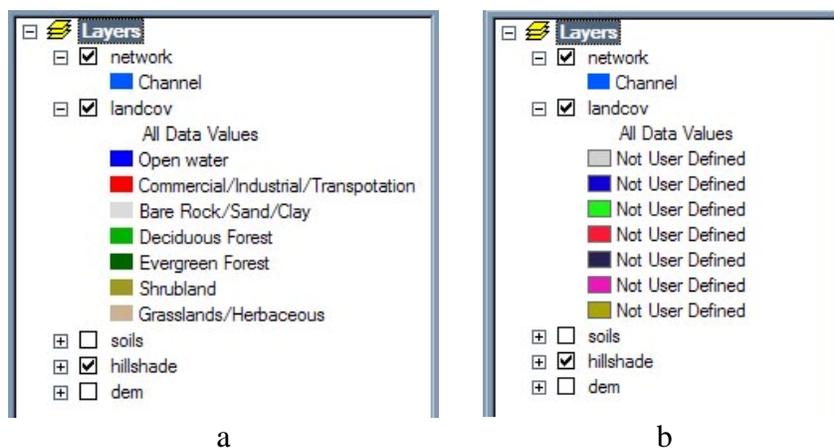
When GeoWEPP begins to convert your landuse layer, it will ask you if you are using the USGS land classification values for your landuse layer. Why? At this point, GeoWEPP is customizing the landuse legend in ArcMap. If you are using the USGS values, it will make the appropriate changes to the legend. If you aren't using this system, GeoWEPP will read your landcov.txt file to load the names you have assigned to each value in the landuse ASCII file.

If GeoWEPP finds a value that isn't part of the USGS classification or is not in your landcov.txt, it will just assign it a default value. If you didn't supply a landcov.txt file, all legend values will be assigned the default value.

This process is only a visual aid for you; it has no effect on what GeoWEPP uses for its simulations. If you don't like the names given, you can change the name the same way you would change any legend name in ArcMap without effecting GeoWEPP.



**Figure 44 – Use USGS Legend Classes?**



**Figure 45 – a) USGS Legend for CWE Landuse; b) Possible Legend if USGS Classes not used**

You should see six layers once the process has been completed (figure 46): **dem**, **hillshade**, **soils**, **landcov**, **Topo Image**, and **network**. GeoWEPP has completed the loading process.

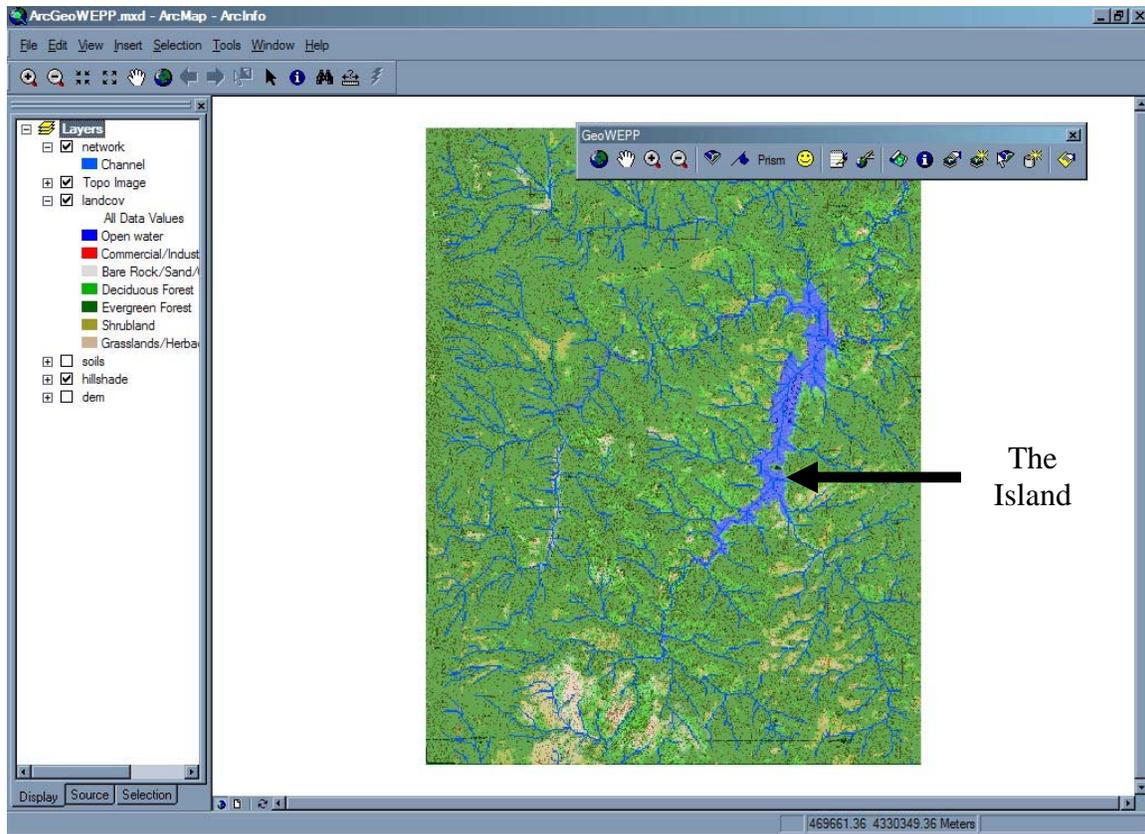


Figure 46 – All necessary data has been converted and loaded into ArcMap

## 5.2 Modifying the Network and Creating the Watershed

Now that the data has been added to ArcMap, we can delineate our watershed.

*Um ... Where's my Channel Network?*

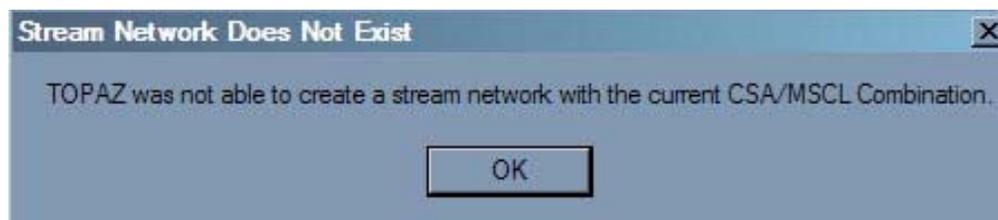


Figure 47 – Channel Network Delineation Unsuccessful Alert

As mentioned earlier, sometimes the default CSA and MSCL values will not produce a channel network; there could be several reasons why this occurs. In most cases, the values are just too large. This issue was discussed in the tool description earlier in this

manual. All you need to do is run the Network Delineation  tool with more appropriate values. You may have to make several attempts to define a channel network that approximates your study area's network.

Worst case scenario, there may have been issues with your DEM. This usually occurs when the DEM is in the wrong projection or the wrong UTM Zone was used for the projection. There are two reports in the project file that will tell you if this was the issue: DEDNM.RPT and RASFOR.RPT; these can be viewed in any text editor. Scroll to the bottom of the report to view the error.

If the report states that the coordinates are wrong, then your DEM is in the wrong projection. If it mentions a negative value, then you will need to modify your DEM to remove the negative values; in other words, TOPAZ will not work with DEMs that have areas below sea level.

1. We are interested in the network channels and the watershed that is next to **The Island** in Cheesman Lake (see arrow in Figure 46). Using the **Zoom In**  tool from the **GeoWEPP toolbar**, zoom into the area around **The Island**.

We are interested in the slope that is south east of **The Island** (figure 48).



Figure 48 – Zoomed in view of The Island and our study area. NOTE: Your view may vary.

2. In this case study, we want to work with multiple subcatchments (also know as hillslopes). The current channel network will only generate 3 subcatchments; we need more. To modify the channel network, click on the **Modify Channel Network Delineation**  tool. This will open the **Channel Network Delineation** window.

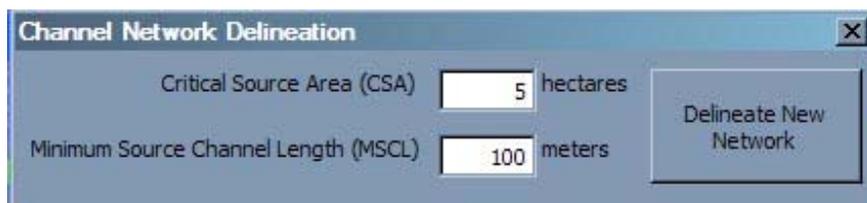


Figure 49 – Channel Network Delineation window

3. Change the **CSA** to 2; leave the **MSCL** as 100. Click the **Delineate New Network** button to delineate the new channel network. Once this button is clicked, GeoWEPP will remove the current channel network and create a new one. You will notice that a DOS window will appear; this is the channel network delineation program, TOPographic Parameterization (**TOPAZ**), running.

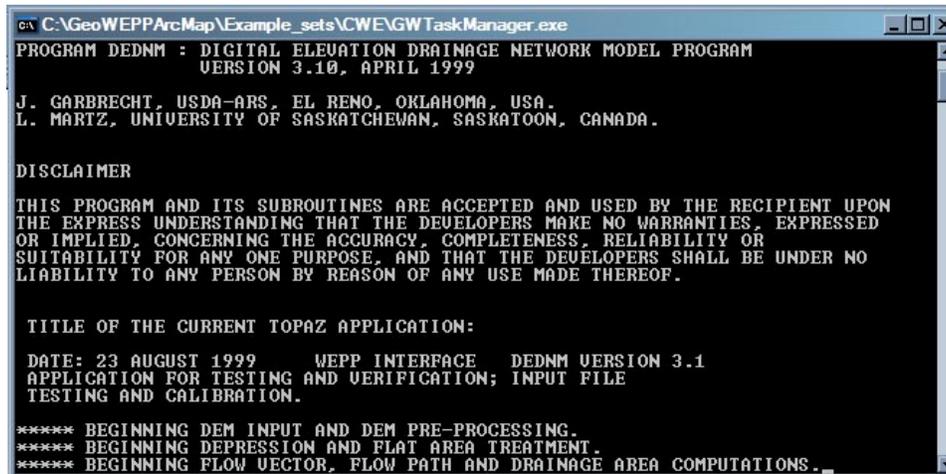


Figure 50 – DOS window. Other DOS windows may appear during GeoWEPP’s operation.

Once the process is completed, the DOS window will disappear and the new channel network will be loaded.



Figure 51 – New channel network has been generated. Compare this network with Figure 6.

When working with your own data, you can configure your channel network a number of times until you are satisfied with the resulting network. The lower the **csa** and **mscl**, the denser your network will be. As noted in the tool discussion earlier, keep in mind the resolution of your DEM; this will have an effect on the numbers you choose.

4. The next step is to create a watershed by selecting the watershed’s outlet point. To do this, click on the **Select a Watershed Outlet Point (channel cell only)**  tool from

the toolbar. Now click on the channel cell near the lake shore (see figure 51). A message box will appear to prevent you from double clicking on the channel cell. Click **OK** to continue.

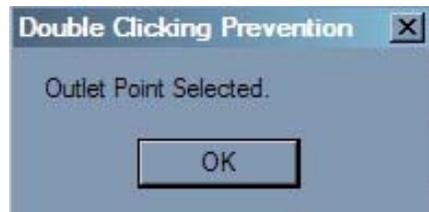


Figure 52 – Double Click Prevention

Once again you will see a DOS window appear. TOPAZ is now analyzing the DEM and network to generate the subcatchments for the watershed based on the outlet point.

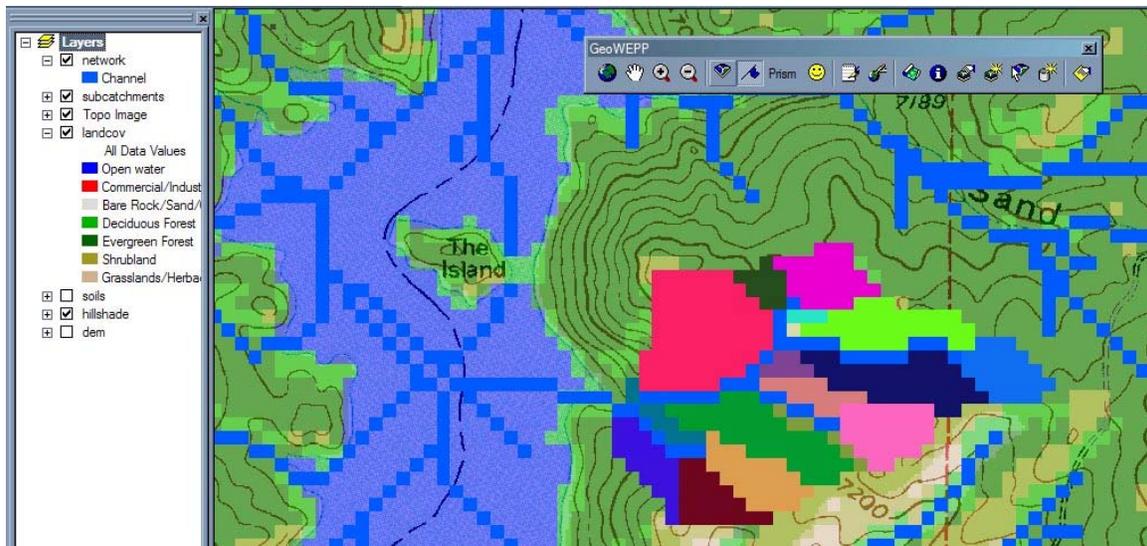


Figure 53 – Watershed has been delineated.

If you generate a different watershed than what can be seen in figure 53, all you need to do is click on a different channel cell to generate a new watershed. You will be asked if you wish to discard the current one and generate a new one. Click **Yes** to generate a new subcatchment.

If you decide after you have generated your watershed that the channel network just isn't working for you, you can change the network as discussed earlier. In this case, you will be asked if you wish to discard the delineated watershed. Selecting yes will delete the watershed and allow you to generate a new channel network. You will then need to select a new outlet point to generate the watershed.

### 5.3 Saving the Project

It is very important that you save your projects periodically. There is nothing worse than spending hours working on a study site to only have it all ruined because of a computer or program error. There are several ways you can save the current GeoWEPP project. You can save it as you would any other ArcMap project by selecting **File→Save**

or by clicking the **Save Project**  tool on the GeoWEPP toolbar. If you wish to exit this case study and return later, you can load your project from the GeoWEPP Wizard or by navigating to the project folder and double-clicking the MXD document.

GeoWEPP has automatic save points incorporated into it, just in case. Please do not count on these; the save points are during certain stages, not during certain times. You can spend hours on one section and never reach a save point. I highly recommend getting in the habit of saving often.

### 5.4 The First WEPP Simulation

We have now generated our case study's watershed and can now proceed with the first WEPP simulation.

**NOTE:** If you plan to use PRISM to create a specialized climate file for your first simulation, you will need to do this before accepting the watershed and running your first simulation. You can still use PRISM after the first simulation, but you will need to change the climate in the translator portion of the simulation (discussed below).

1. Click on the **Accept Watershed Delineation**  button on the **GeoWEPP toolbar**. This will begin the WEPP simulation process.

#### *Know Your UTM Zone*

You will need to provide GeoWEPP with one more piece of information – your study site's UTM Zone. This is used to determine some important information, like climate station location, in the simulation. GeoWEPP will prompt you to enter the correct UTM Zone. In most cases, providing the incorrect UTM Zone will only affect the initial climate station selected for your study area (which can be changed below). But, there may be some other unforeseen problems that can occur. It is best to verify the zone you will enter before actually entering it.

**When prompted, enter 13 for the UTM zone.**

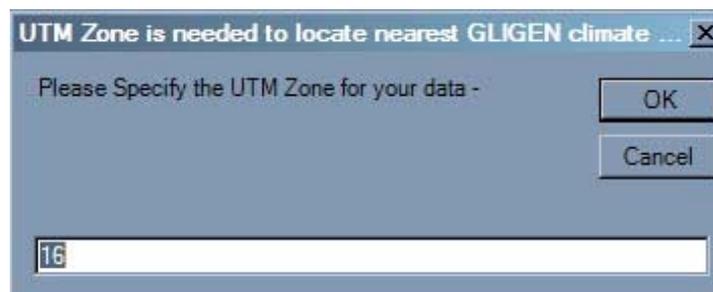


Figure 54 – UTM Zone Needed Input Box

2. First, we need to generate the climate for the study area. We will use the Cheesman County, Colorado climate station data as the source of our climate data. In the **WEPP Climate Selection** window, click the **Use Selected Station** button to accept the current weather station. This will create 100 years of climate input data for the study area. Click **OK**. The climate for this and future runs is now set to this station, we can change this later using the Translator (see below).

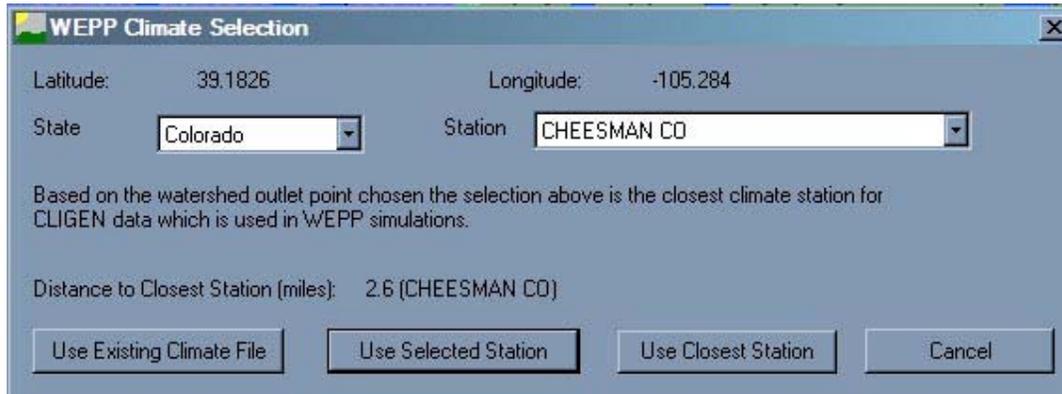


Figure 55 – WEPP Climate Selection window.



Figure 56 – 100 years of climate data generated.

#### *How do I change the station?*

You can change the station in a number of ways. If the correct state is displayed, you can select a new station using the dropdown list (click on the triangle to the right of the current station name). A list will appear listing all the available stations for that station.

If you want to use a station from another state, you can change the state by click on the dropdown list for the state. Then select that state's climate station using the method described above.

When you have finished changing the state and/or station, click **Use Selected Station**. The displayed station will be used.

#### *What is "Use Closest Station"?*

When you click on this button, the station that is closest to your outlet point will be selected. This is based on the coordinates displayed; usually the closest station is the one initially displayed. Use this button if you changed the state and/or station displayed and do not remember what the closest station is.

*What if I already have a climate file?*

If you used PRISM to create your own climate file, you can click on the “Use Existing Climate File” to load that climate into GeoWEPP. You will notice a similar **Climate Selection** window to the one in WEPP (figure 57). Use the same method for adding the climate file as you use in WEPP.

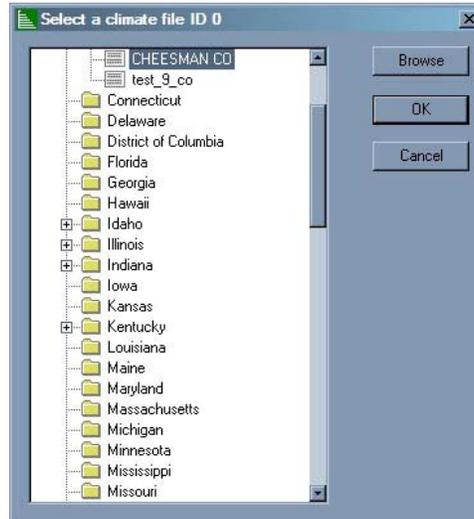


Figure 57 – Select Climate File to Use

3. The next step is to review the management and soil WEPP files used in the simulation; this is done in the **WEPP Management and Soil Lookup** window. This window allows you to compare the GIS Landuse and GIS Soil information with the corresponding WEPP management and soil data files to insure that they are assign properly. We will need to change some of the management WEPP files so that the entire watershed is considered a 20 year old forest.

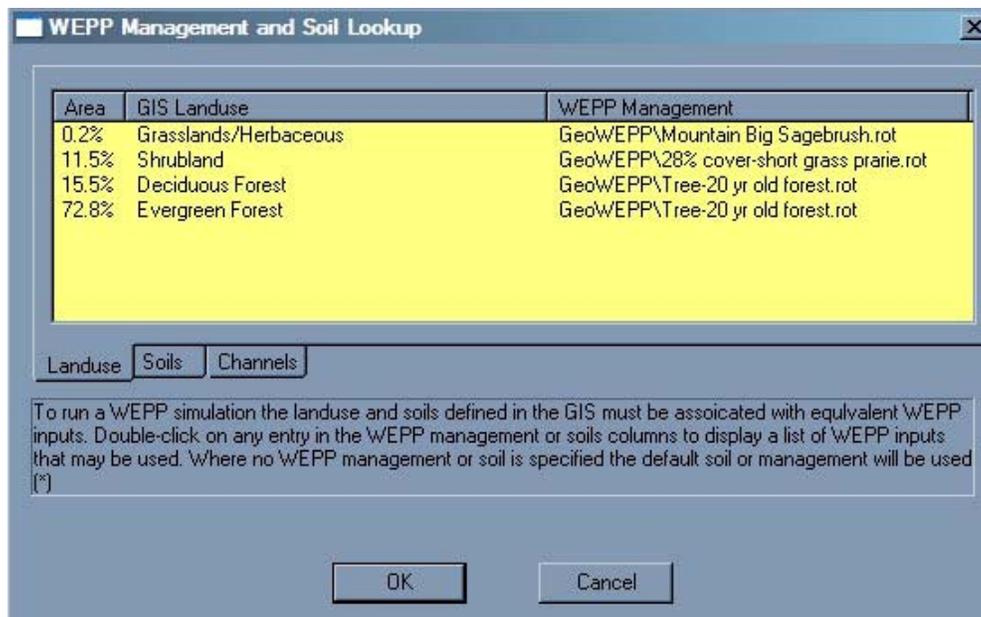
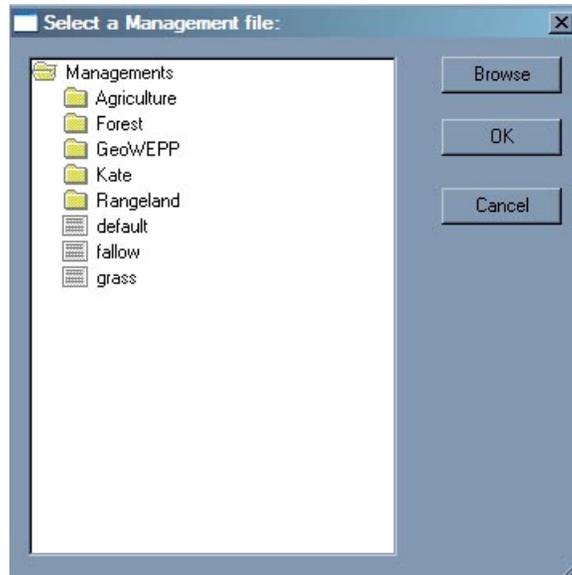


Figure 58 – WEPP Management and Soil Lookup window displaying land management information

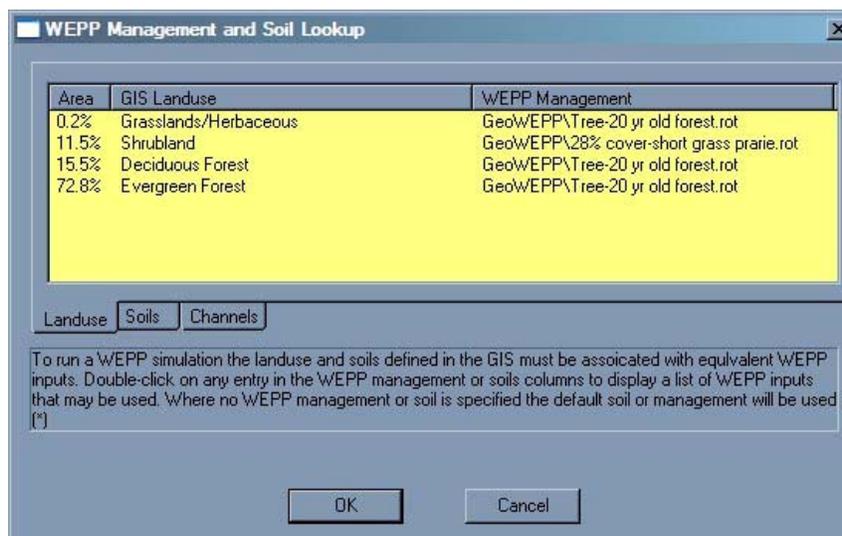
To change the management file, double-click on the name you wish to change. We need to change the “Mountain Big Sagebrush.rot” file to “Tree-20 yr old forest.rot”, so double-click on the “GeoWEPP\Mountain Big Sagebrush.rot”. This will bring up the **Select a Management file:** window (figure 59) – the same window that appears when changing the management layer within WEPP. Double click on the **GeoWEPP** folder and then click on **Tree-20 yr old forest.rot** to highlight the file name. Click **OK**.

At this stage, any changes that are made affect the entire watershed. In the case above, any portion of the watershed that has the Grasslands/Herbaceous GIS Landuse designation will be changed from Mountain Big Sagebrush to 20 Year Forest.



**Figure 59 – Select a Management file window**

You will notice that the WEPP Management for “Grasslands/Herbaceous” has been changed to “GeoWEPP\Tree-20 yr old forest.rot” (figure 60).



**Figure 60 – Land management file has been changed.**

Repeat this process for the “28% cover-short grass prairie.rot”. Change it to “Tree-20 yr old forest.rot” as well.

4. You will also need to change the WEPP soil files as well. Click on the Soils tab to display the Soils Lookup Table. You will notice that all the soils use the “KEITH.sol” WEPP file.

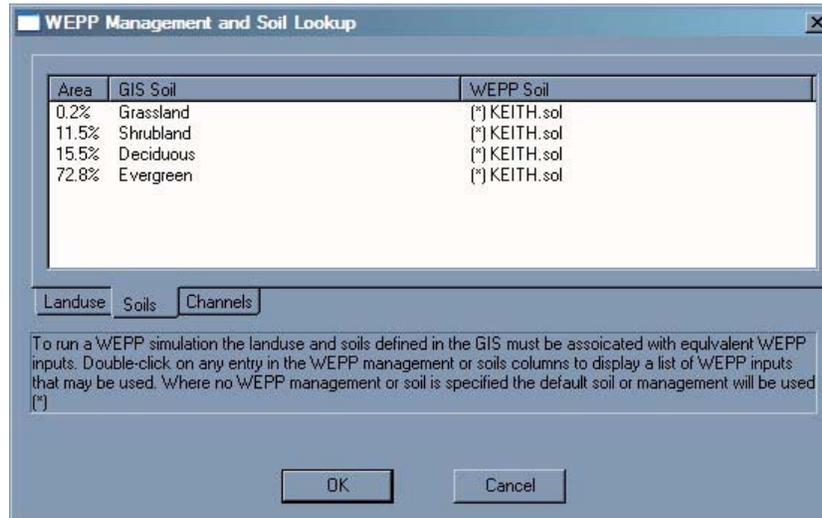


Figure 61 – WEPP Management and Soil Lookup window displaying soil information

Use the same steps you used to change the land management above to change all the soil files to match those displayed in figure 62. These files can be found by double-clicking the **Forest** folder and then double-clicking the **Disturbed WEPP** folder.

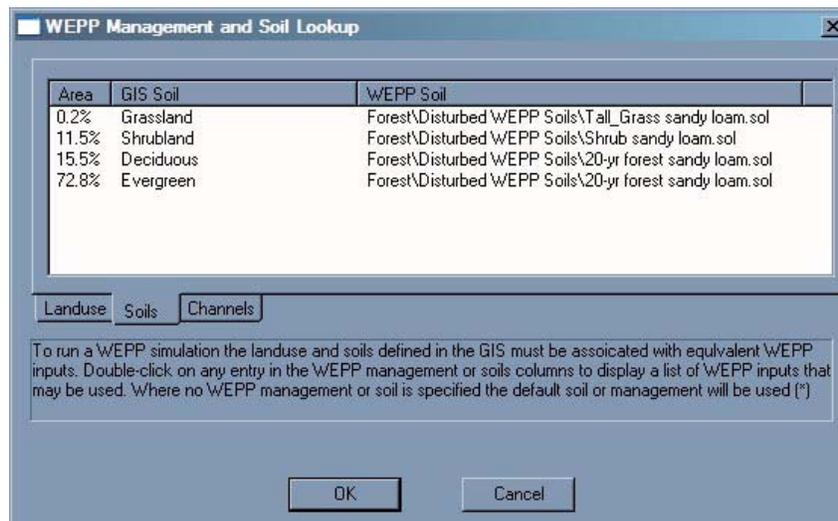


Figure 62 – All soil files have been changed.

Once you have changed all the soil files, click **OK**.

5. Now we can set our WEPP simulation parameters. This is done in the **WEPP/TOPAZ Translator** window (see figure 63). For this study we will be running a 30 year simulation using both the **Watershed and Flowpaths** method. Change the **Number of Years** from 2 to 30. The **Simulation Method** has already been set to “Watershed and Flowpaths”. This is the final window before the WEPP simulation begins; it is also your last chance to change any of the parameters for this run. A list of the soil and management parameters for each hillslope is displayed on the right. We have made all of our changes so we can now start the WEPP simulation run. Click **Run WEPP**.

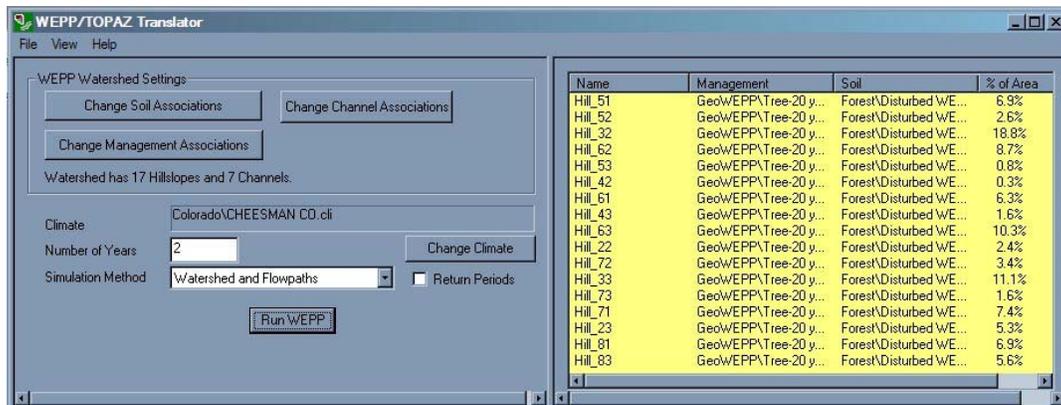


Figure 63 – WEPP/TOPAZ Translator window

**NOTE:** This is the last screen before the simulation runs; it is also the last chance you can change any of the parameters. You can click on any of the “**Change**” buttons to change a parameter. For example, if you created a climate file using PRISM after your first simulation, you would click the **Change Climate** button to change the current selected climate to the new PRISM climate file

#### *What is the Watershed Method?*

The Watershed Method takes each hillslope in the subcatchment, determines a representative profile for the hillslope and assigns one soil and one landuse to the hillslope.

The representative profile is based on the combined profiles of all the flowpaths found in the hillslope; they are aggregated to create a profile that best represents the hillslope as a whole.

For each hillslope, GeoWEPP determines what the dominate soil is for that hillslope and assigns it to the profile. It then repeats the process for the landuse.

Once this is done, the WEPP simulation runs on each hillslope and the results are compiled. This method is called the offsite assessment because the values reported represent the amount of sediment leave each hillslope and being reported at the outlet point.

There is a maximum number of hillslopes you are allowed to have in your study area for this method; you can have no more than 2900 hillslopes and 1000 channels.

### *What is the Flowpath Method?*

The Flowpath Method concentrates on each flowpath within the subcatchment. Unlike the Watershed Method, the slope used for the simulation is the slope for the flowpath itself; there is no representative profile.

Also, this method keeps the diversity and spatial distribution of the soil and landuse layers. Each section of the flowpath is assigned the soil and landuse found in that section, thus a flowpath can have a number of different soils and landuses in the simulation. When the simulation is complete, the results are compiled.

**Note:** Some aggregation does take place. Each flowpath has a source and a destination; while no two flowpaths have the same source, multiple flowpaths can share the same destination. In other words, when flowpaths converge, there is some aggregation.

This method is also called the onsite assessment. The values it reports refer to the amount of erosion or deposition occurring in each raster cell of the subcatchment.

There is no set camp on the number of flowpaths your study area can have, but there are other issues that having large numbers of flowpaths will cause (see below).

### *What's the difference between the two methods?*

First, the Watershed method will only use one soil and one management for each hillslope. Thus, you will lose the spatial variability of your study area for these parameters. The Flowpath method retains the diversity of your study area.

Second, the Watershed method reports the sediment yield of your study area. The flowpath method shows the soil loss for each portion of the watershed.

The best way to look at it is this: the Watershed method reports which hillslopes are the problem areas in the study site; the Flowpath method shows which portions of a particular hill are the main contributors to this problem.

### *How do these effect the simulation run time?*

The watershed method is the quickest to simulate since it is only running one simulation per hillslope. The flowpath method takes more time since it needs to run each flowpath in a hillslope and then aggregate the results. If you don't have a lot of time to wait for the results, you should run the watershed method first.

For example, I ran a simulation that contained close to 10,000 flowpaths. Each simulation took between 1.5 to 2 hours when I ran the Flowpath Method. The Watershed Method took about 10 minutes.

Remember, the larger study areas have more flowpaths but may not have more hillslopes.

### *How do these effect my computer?*

You should not have any issues when running the Watershed Method. You may experience some slow down, but nothing that should cause any problems.

The flowpath method is far more intensive and will use a lot more RAM. If you run out of RAM, the simulation will crash. If you have a lot of flowpaths, you may want to make sure that only GeoWEPP is running. Other active programs will reduce the amount of available RAM (and virtual RAM).

GeoWEPP will now perform the WEPP simulation using the Watershed and Flowpaths method for each hillslope in the watershed. A progress window is displayed to let you know how far along the process is. This process may take some time depending on the amount of RAM installed in your computer and your computers CPU speed; please be patient. The more hillslopes and flowpaths within the watershed and the more years in the simulation run both increase the amount of time it will take to complete the WEPP simulation.



Figure 64 – WEPP Progress window

**IMPORTANT:** Switching between applications will cause the progress and translator windows to become blank. Do not worry; GeoWEPP and WEPP are still running. In a few minutes they will return to normal, but it is a good idea not to switch between applications while the simulation is running. You may notice that clicking on the progress window causes it to turn white and “(not responding)” will appear in the window’s title bar. The program has not crashed; the internal process is still running but windows registers it as not responding. This will change over time.

6. Once the WEPP simulation is done, you will get a **WEPP Completed** window. Click **OK**.



Figure 65 – WEPP simulation has finished.

7. The final step before the results can be displayed is to name the output raster layers. A window will appear with a default name for each result layer (one for the **Watershed** method results called “offsite” and one for the **Flowpaths** method results call “onsite”). You can either accept the defaults or change the name. If you decide to change the name, you will only have a maximum of 13 characters to use for the name and it can not be the same name as an already existing raster layer; this is also displayed in a message box to remind you. Also, since the release of ArcGIS 9.2, you can no longer use commas or other special characters in the name; doing so will cause GeoWEPP to crash. It is best to stick with letters, numbers, and underscores “\_”.

Click **OK** in the reminder window. For this example, accept the default names by clicking **OK** for each naming window.

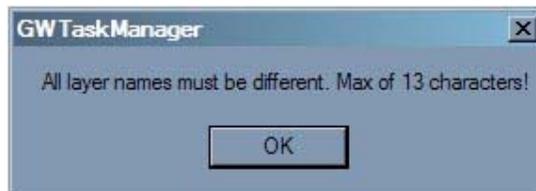
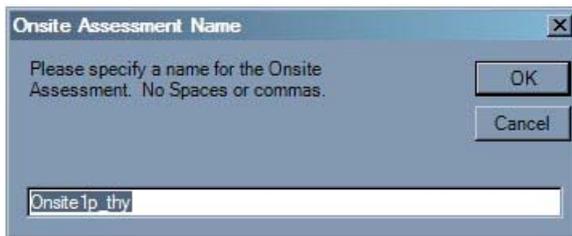


Figure 66 – GeoWEPP naming convention reminder.



(a) (b)  
Figure 67 – a) Onsite and b) Offsite naming windows

### 5.5 The Results of the First Run

Several new layers have been added to ArcMap. These layers correspond to the WEPP simulation results of the Watershed and Flowpaths methods. We only need to concern ourselves with the **Offsite** (figure 68) and **Onsite** (figure 69) layers. The legends of each are based on a T-Value that corresponds to a number of tonnes per hectare per year. The default used for the first run is 1 t/ha/yr. You will notice that there is little or no soil loss/sediment yield in the watershed based on this default value.



Figure 68 – Watershed or Offsite results

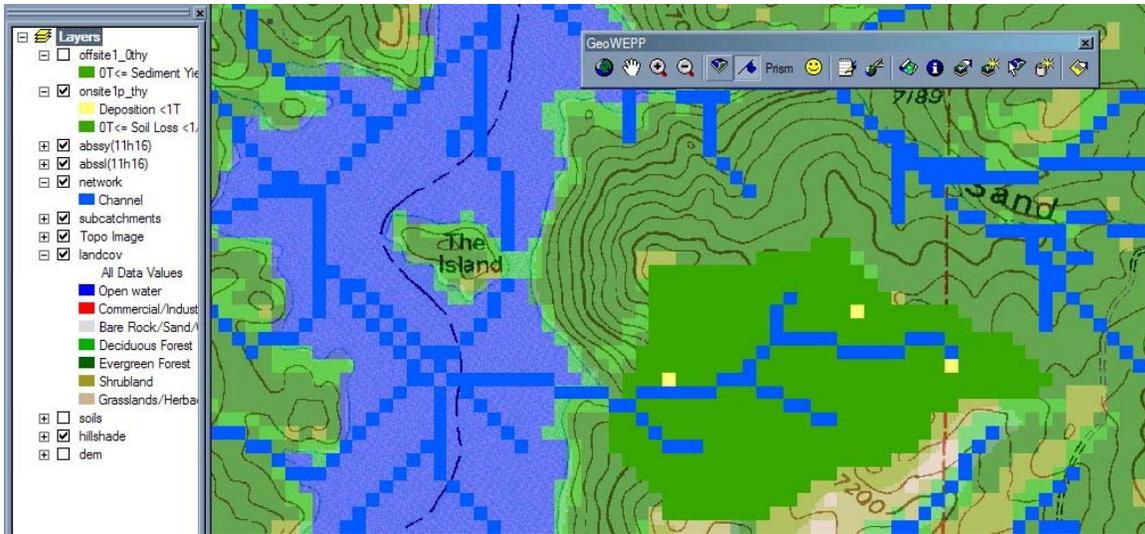


Figure 69 – Flowpaths or Onsite results

*What are the abssl and abssy layers?*

During one of the BLM workshops, several users suggested including the actual results along with the categorized layers. The “abssy” layer is the “**Absolute Sediment Yield**” values from the watershed method (figure 70a). The “abssl” layer refers to the “**Absolute Soil Loss**” values; it contains the results from the flowpath method before they are categorized (figure 70b).

These layers help give you an idea of how much or how little erosion is occurring. Use this as an aid in determining which T-Value you wish to remap the results to (discussed shortly).

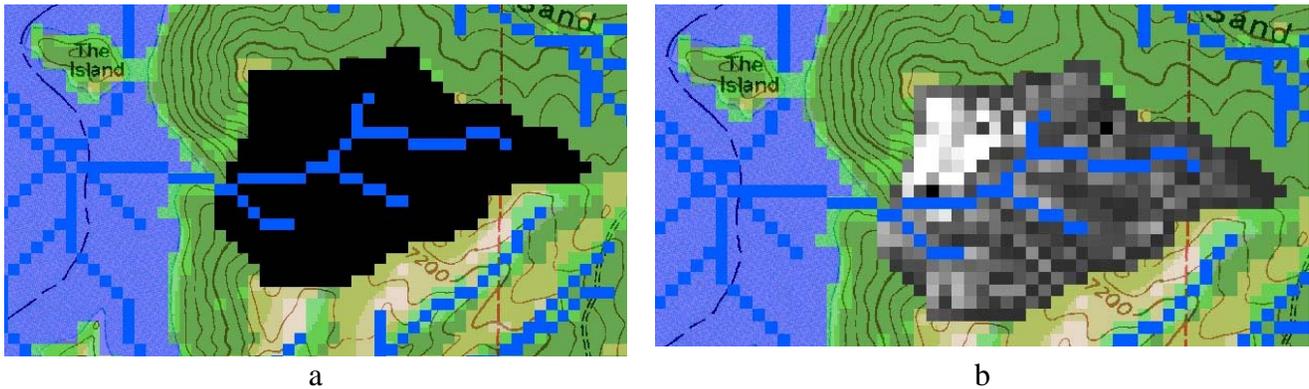
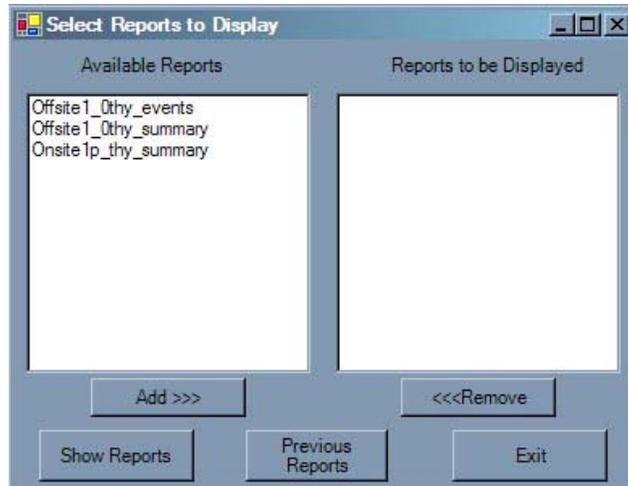


Figure 70 – a) Absolute Sediment Yield (abssy); b) Absolute Soil Loss (abssl)

## 5.6 Viewing Reports

The WEPP simulation also generated several useful reports based. These reports can be accessed by clicking the **Reports**  button on the toolbar. This will open the **Select Reports to Display** window. On the left you will see a list of reports available for display. All reports will be opened using Notepad (or WordPad depending on you system defaults).



**Figure 71 – Select Reports to Display window**

Each WEPP simulation will generate 2 to 4 reports depending on which simulation methods you are using and if you wish to generate a Return Periods Analysis report (discussed later in this case study). In the case of our example, three reports are created: Onsite1p\_0thysummary, Onsite1\_0thysummary, Offsite1\_0thyevents. The summary reports display the summary information for the onsite and offsite results. The events file lists information for each precipitation event that occurs during the simulation. Below are examples of each report.

These reports can also be accessed by going to the Reports folder with the project folder and double-clicking on the report to be viewed. Each simulation generates a new report.

30 YEAR AVERAGE ANNUAL VALUES FOR WATERSHED

\*\*\*WEPP watershed simulation for Representative Hillslopes and Channels (watershed method)\*\*\*

----- WATERSHED SUMMARY (watershed method, off-site assesment) -----

Hillslopes WEPP TOPAZ	Runoff Volume (m <sup>3</sup> /yr)	Soil Loss (tonne/yr)	Sediment Yield (tonne/yr)	Area (ha)	soil Loss (tonne/ha/yr)	*Mapped Sediment Yield (tonne/ha/yr)
1	22	1.8	0.0	0.8	0.0	0.0
2	23	2.1	0.0	1.8	0.0	0.0
3	32	8.2	0.1	6.4	0.0	0.0
4	33	5.9	0.0	3.8	0.0	0.0
5	42	0.3	0.0	0.1	0.0	0.0
6	43	2.1	0.0	0.5	0.0	0.0
7	51	5.2	0.0	2.3	0.0	0.0
8	52	3.5	0.0	0.9	0.0	0.0
9	59	1.1	0.0	0.3	0.0	0.0
10	62	11.7	0.0	3.0	0.0	0.0
11	61	2.0	0.0	2.2	0.0	0.0
12	63	7.5	0.0	3.5	0.0	0.0
13	72	4.6	0.0	1.2	0.0	0.0
14	73	2.1	0.0	0.5	0.0	0.0
15	71	3.0	0.0	2.5	0.0	0.0
16	81	2.4	0.0	2.3	0.0	0.0
17	83	3.8	0.0	1.9	0.0	0.0

----- CHANNEL SUMMARY (watershed method, off-site assesment) -----

Channels NUM WEPP TOPAZ	Discharge Volume (m <sup>3</sup> /yr)	Soil Loss (tonne/yr)	Sediment Yield (tonne/yr)	Length (m)	Length (cells)
1	4	8.3	n.a.	102.4	3
2	3	21.9	n.a.	427.3	13
3	2	10.5	n.a.	247.3	7
4	1	6.9	n.a.	187.3	5
5	5	33.1	n.a.	127.3	3
6	6	57.4	n.a.	264.9	8
7	7	71.3	n.a.	72.4	2

\*\*\*WEPP watershed simulation for all flowpaths averaged over subcatchments (flowpath method)\*\*\*

**Figure 72 – Example of an Onsite Summary report.**

Offsite\_0thy\_summary.txt - Notepad

MEPP watershed Simulation for Representative Hillslopes and Channels

30 YEAR AVERAGE ANNUAL VALUES FOR WATERSHED

Hillslopes	Runoff volume (m <sup>3</sup> )	Subrunoff volume (m <sup>3</sup> )	Soil Loss (kg)	Sediment Deposition (kg)	Sediment Yield (kg)
Hill 1 (22)	1.78	0.12	13.89	0.00	13.89
Hill 2 (23)	2.06	0.15	31.56	0.00	31.56
Hill 3 (32)	8.21	0.56	144.96	0.00	144.96
Hill 4 (33)	5.86	0.31	30.96	0.00	30.96
Hill 5 (42)	0.35	0.17	0.15	0.00	0.15
Hill 6 (43)	2.13	0.22	7.03	0.00	7.03
Hill 7 (51)	3.16	0.15	18.66	0.00	18.66
Hill 8 (52)	3.55	0.14	18.18	0.00	18.18
Hill 9 (53)	1.06	0.15	2.06	0.00	2.06
Hill 10 (62)	11.70	0.36	25.79	0.00	25.79
Hill 11 (61)	1.96	0.08	6.04	0.00	6.04
Hill 12 (63)	7.52	0.39	17.55	0.00	17.55
Hill 13 (72)	4.61	0.27	10.90	0.00	10.90
Hill 14 (73)	2.13	0.24	1.44	0.00	1.44
Hill 15 (71)	3.00	0.15	15.35	0.00	15.35
Hill 16 (81)	5.41	0.11	18.71	0.00	18.71
Hill 17 (83)	3.77	0.20	15.13	0.00	15.13

Channels and Impoundments	Discharge volume (m <sup>3</sup> /yr)	Sediment yield (tonne/yr)
Channel 1 (84)	6.9	0.1
Channel 2 (74)	10.5	0.1
Channel 3 (64)	21.9	0.1
Channel 4 (54)	8.3	0.1
Channel 5 (44)	33.1	0.3
Channel 6 (34)	57.4	0.8
Channel 7 (24)	71.3	0.9

83 storms produced 421.99 mm. of rainfall on an AVERAGE ANNUAL basis

5 events produced 0.21 mm. of runoff passing through the watershed outlet on an AVERAGE ANNUAL basis

Average Annual Delivery From Channel Outlet:

Figure 73 – Example of an Offsite Summary report.

Offsite\_0thy\_events.txt - Notepad

WATERSHED OUTPUT: DISCHARGE FROM WATERSHED OUTLET  
(Results listed for Runoff Volume > 0.005m<sup>3</sup>)

Day	Month	Year	Precip. Depth (mm)	Runoff Volume (m <sup>3</sup> )	Peak Runoff (m <sup>3</sup> /s)	Sediment Yield (kg)
14	7	1	11.0	0.36	0.00045	0.5
18	7	1	20.9	1.51	0.00161	2.0
3	8	1	11.2	0.24	0.00032	0.3
6	8	1	8.3	0.07	0.00010	0.1
22	8	1	13.9	0.67	0.00078	0.9
29	8	1	11.5	0.35	0.00044	0.4
21	9	1	11.4	0.25	0.00033	0.3
7	6	2	13.2	0.58	0.00069	0.8
9	6	2	16.9	0.71	0.00083	0.9
5	7	2	12.2	0.35	0.00044	0.4
23	7	2	10.9	0.33	0.00041	0.4
6	8	2	13.6	0.59	0.00071	0.8
26	8	2	22.1	1.69	0.00178	2.2
28	8	2	13.1	0.48	0.00058	0.6
8	10	2	12.0	0.37	0.00046	0.5
13	10	2	21.2	1.48	0.00159	1.9
16	7	3	13.4	0.67	0.00079	0.9
20	7	3	10.9	0.01	0.00002	0.0
17	9	3	11.5	0.24	0.00031	0.3
5	6	4	17.2	1.05	0.00117	1.4
11	6	4	18.4	1.30	0.00141	1.7
4	7	4	18.5	1.06	0.00118	1.4
5	7	4	16.8	0.95	0.00107	1.3
6	7	4	23.0	1.31	0.00142	1.7
21	7	4	10.7	0.13	0.00018	0.1
11	8	4	17.5	0.69	0.00080	0.9
30	8	4	15.3	0.57	0.00068	0.7
2	9	4	43.5	0.05	0.00008	8.3
9	9	4	18.0	0.84	0.00096	1.1
22	10	4	13.7	0.62	0.00074	0.8
24	7	5	19.2	0.96	0.00108	1.3
31	7	5	19.4	1.30	0.00142	1.7
27	9	5	30.5	0.01	0.00002	1.3
2	6	6	14.4	0.76	0.00088	1.0
17	7	6	15.7	0.92	0.00104	1.2
24	7	6	9.1	0.02	0.00003	0.0
27	7	6	21.1	1.30	0.00141	1.7
28	7	6	17.3	0.82	0.00094	1.1
15	8	6	15.9	0.63	0.00074	0.8
2	10	6	24.9	2.05	0.00211	2.6
6	8	7	14.8	0.60	0.00071	0.8
10	8	7	24.7	1.82	0.00190	2.3
8	9	7	25.0	2.03	0.00210	2.6
19	9	7	11.7	0.10	0.00014	0.1

Figure 74 – Example of an Events report.

## 5.7 Remapping the T-Value

As stated above, the WEPP Onsite and Offsite results are displayed using the default T-Value of 1 t/ha/yr. In most cases this will not adequately show what is occurring in the watershed. GeoWEPP provides a tool that will remap the results using a new T-Value, one more fitting for your study area. We will now change the T-Value to get better understanding of what is going on within the watershed.

Click the **Remap with New T-Value**  tool. This will open the **Change T-Value** window. Change 1.0 to 0.1 and click the **New T-Value** button.

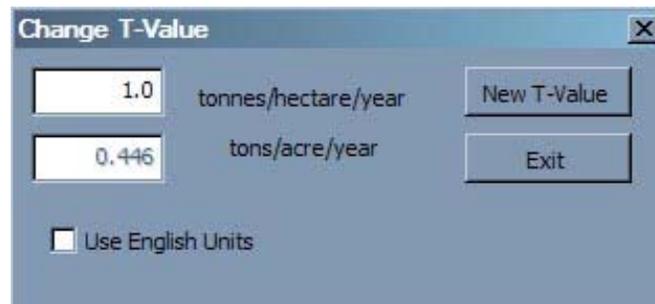


Figure 75 – Change T-Value window

By remapping the T-Value, you will be creating new raster layers in Arc Map. You will need to name these new layers using the same conventions as before. We will be taking the default values again.

As you can see below, two new layers with the new T-Values were created. There is no change between the Offsite layers, but if you compare Onsite1p\_thy and Onsite0\_1thy, you see that Onsite0\_1thy now has lighter green pixels as well as some red pixels, meaning less tolerable levels of erosion.



Figure 76 – New Onsite layer based on new T-Value.

**It is best to save the project again before we continue on.**

## 5.8 Watershed Mitigation

Now that we have completed our first WEPP simulation, we can begin the mitigation of the subcatchments. We want to change the land management of a subcatchment to reduce the amount of erosion that is occurring. Note that often the tops and bottoms of many hills do not need mitigation, only the mid slopes; also some low/medium burn severity areas can function as a buffer strip. In this case, we will be changing the land management for Hillslope 83 to simulate the application of grass to the hillslope.

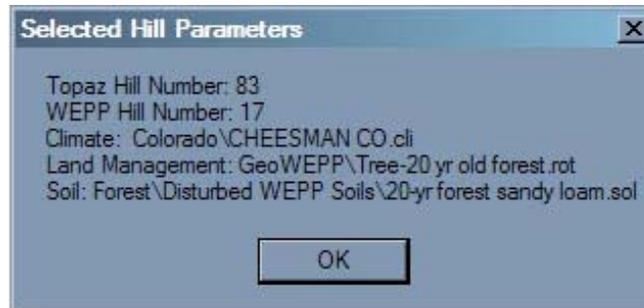


Figure 77 – Current WEPP Parameters for Hillslope 83

1. Click on the **Change Hillslope WEPP Parameter**  tool and then click on Hillslope 83. You will notice another double-click prevention message box. Click **OK** to continue.

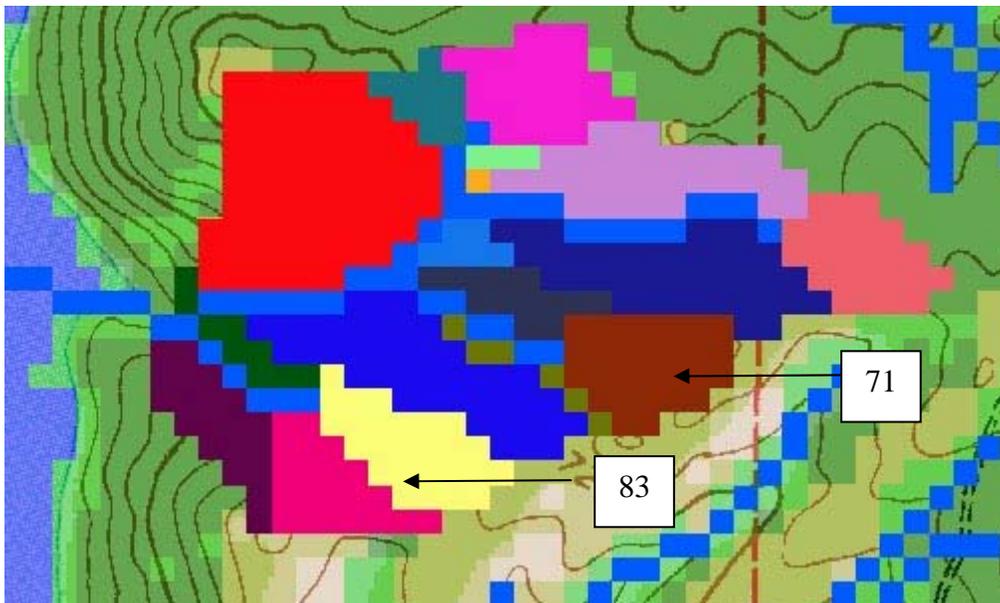


Figure 78 – Our study site watershed with Hillslope 83 and 71 labeled.

2. You will be then asked if you wish to change the land management for Hill 83 from the current landuse. Click **Yes**.

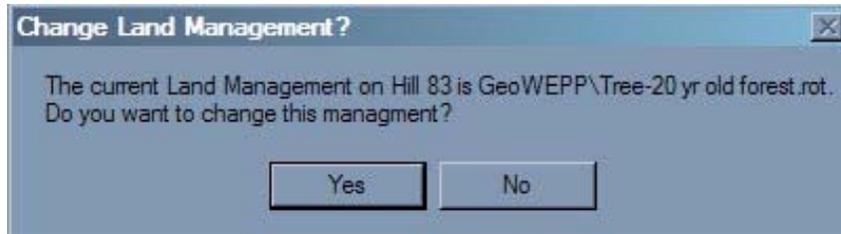


Figure 79 – Change Land Management window

3. A new window will appear similar to the one used when we change the management files before the first WEPP simulation. In this window, double-click the **GeoWEPP** folder and select **grass**. Click **OK**. The land management has been changed.

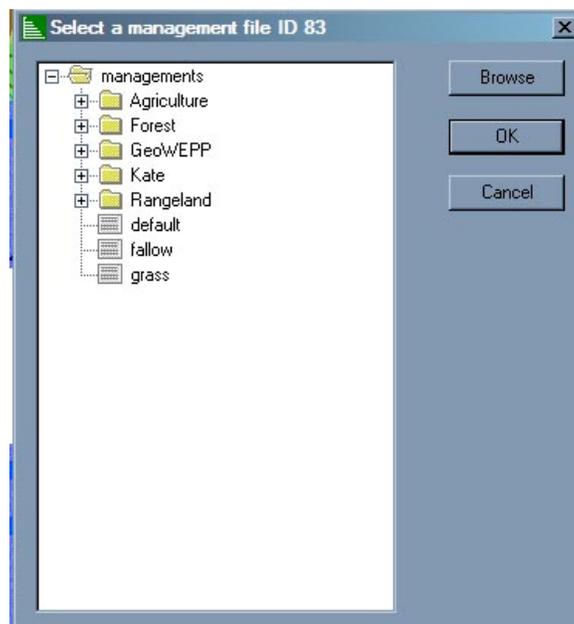


Figure 80 – Select a Management File for Hill 83 window

4. Next you will be asked if you wish to change the WEPP soil parameter for Hill 83. We will not need to change the soil, so click **No**.



Figure 81 – Change Soil window

This method only affects the hillslope, not the watershed. In this case, we are setting the management of the entire hillslope to one management.

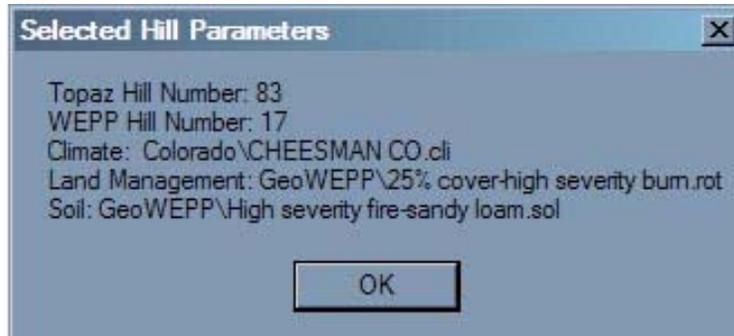


Figure 82 – Hillslope 83 Parameters after the changes have been made

5. We have finished modifying the hillslope parameters, so now we need to run a new WEPP. Click on the **Rerun WEPP**  button on the toolbar. You will notice a new window that will appear (figure 83). This window allows you to set the T-Value you wish to use before running the simulation. So, instead of the default value of being used, the results will be mapped based on the T-Value you enter.

Enter **5.0 tonnes/hectare/year** and click **Run WEPP**.

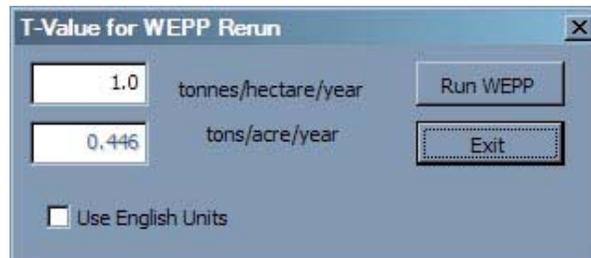


Figure 83 – Select T-Value for WEPP Rerun

The **WEPP Management and Soil Lookup** window will appear again. Notice that there is a new land management that was not there earlier. This is for hillslope we just changed. Click **OK** to continue.

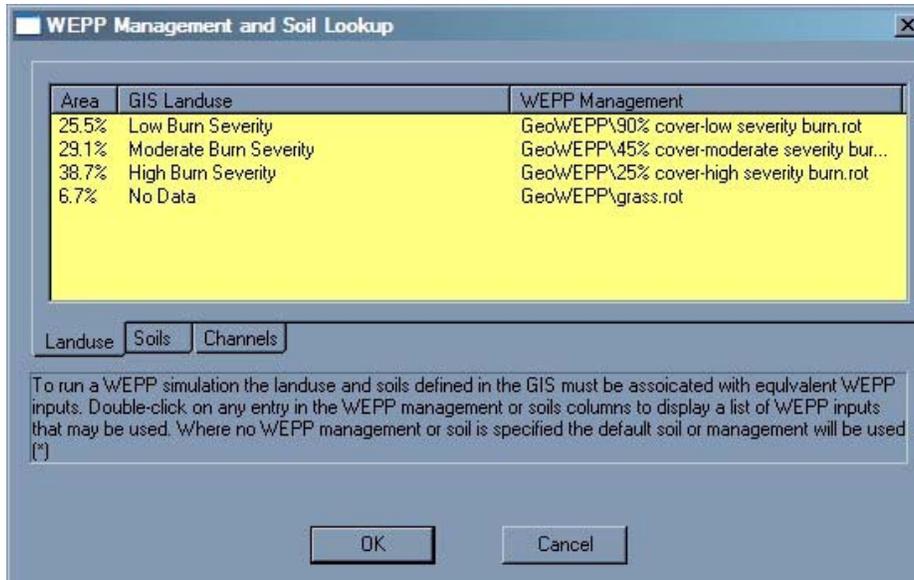
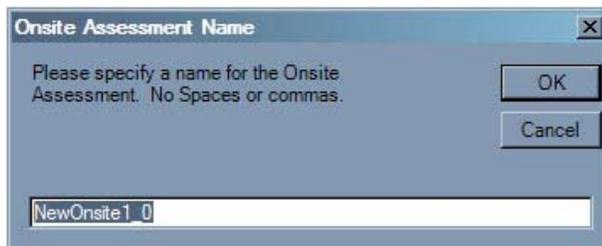


Figure 84 – New land management appears in WEPP Management and Soil Lookup window

6. We will be running a 2-year simulation using the **Watershed and Flowpaths** method. In the **WEPP/TOPAZ Translator** window change the **Number of Years** to 2 and click **Run WEPP**.

7. Just like in the first simulation, WEPP result layers are generated and need to be named. We will be using the default names again. Note that GeoWEPP is aware of the new simulation and has modified the default names.



(a)



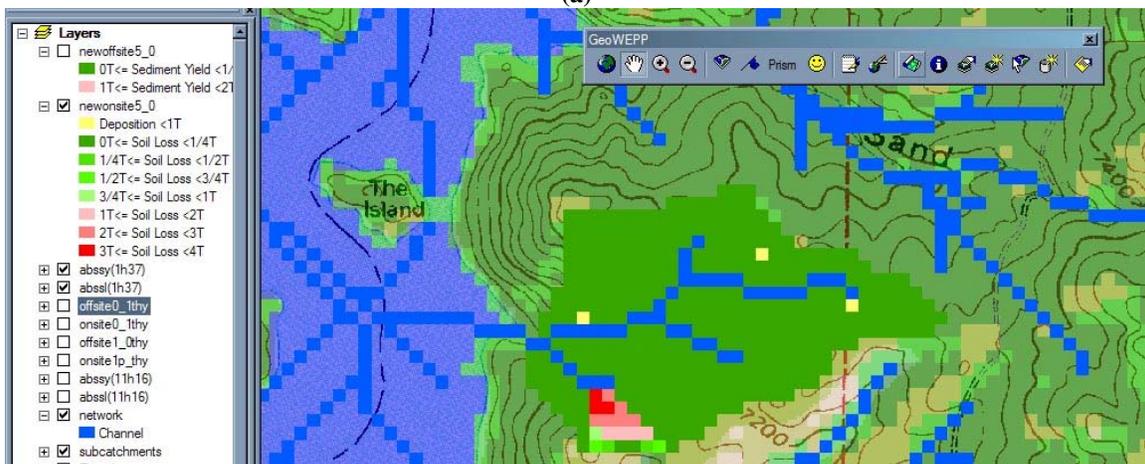
(b)

Figure 85 – a) New Onsite and b) New Offsite naming windows

You can see from the figures below that a change has occurred in the soil loss and sediment yield for Hillslope 71. Compare these results with those from the first WEPP simulation with a T-Value of 1 t/ha/yr.



(a)



(b)

Figure 86 – New erosion results for Hillslope 83 using 5.0 T-Value for a) offsite and b) onsite

You can view the reports for this run the same way you viewed the first simulation's runs. The good news is that the previous reports are still available to view. All you need to do is select the reports you wish to see – any combination of the first and second simulations – by using View Reports.

### 5.9 WEPP on a Hillslope and Return Period Analysis

At some point during your analysis, you may wish to modify a hillslope the same way you do within the WEPP interface. GeoWEPP provides you with the ability to load a single hillslope into WEPP with all of the current parameters. In this next section, we will load Hillslope 71 into WEPP and run a longer simulation. We will also generate a Return Period Analysis report.

**IMPORTANT:** Any modification you make to the hillslope will **NOT** be reflected in GeoWEPP.

1. To enter WEPP using the data for a particular hillslope, click on **Run WEPP on a Hillslope**  tool from the toolbar. Next click on the hillslope you wish to export into

WEPP. In our case, we want to export Hillslope 71 into WEPP, so click on Hillslope 71. This will bring up a familiar double-clicking prevention window. Click **OK** to continue.



Figure 87 – Double-clicking prevention window

2. The WEPP Model for Windows interface will appear. All of the necessary parameters for Hillslope 71 are already loaded into WEPP, so click **Cancel** in the **Welcome to WEPP for Windows** window.

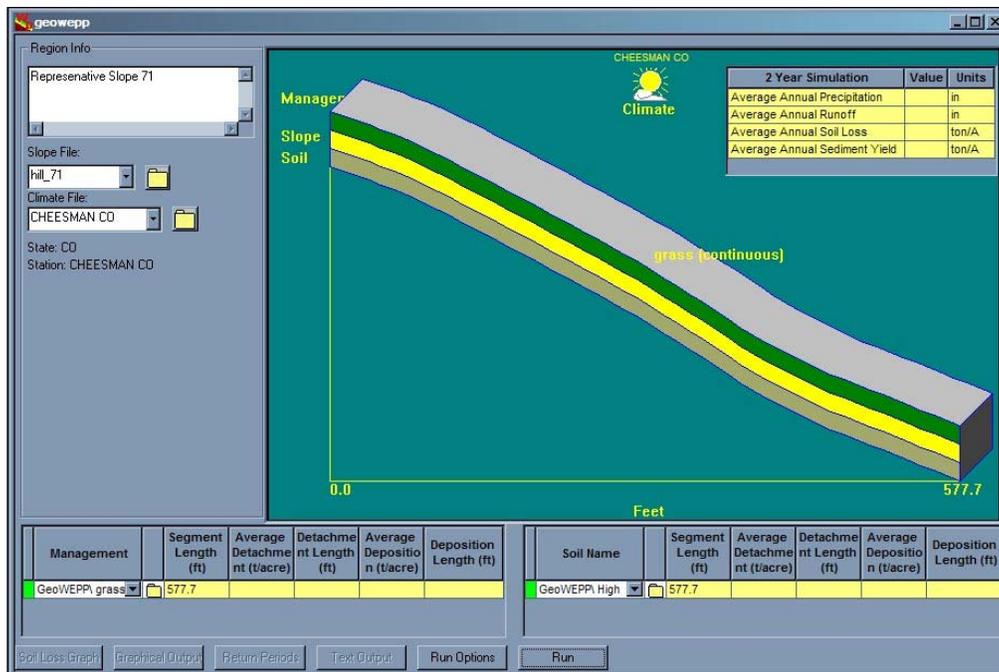


Figure 88 – Welcome to WEPP for Windows; all parameters for Hillslope 71 are already loaded.

3. We need to set up the run options for Hillslope 71. On the bottom of the window, click **Run Options**; this will bring up the **WEPP Run Options** window. We want to run a 50 year simulation for Hillslope 71 and produce a Return Period Analysis report. Check the box next to **Return Period Summary** and change the **Simulation Years** to 50. Once you **WEPP Run Options** window looks like the one on figure 89, click **OK**.

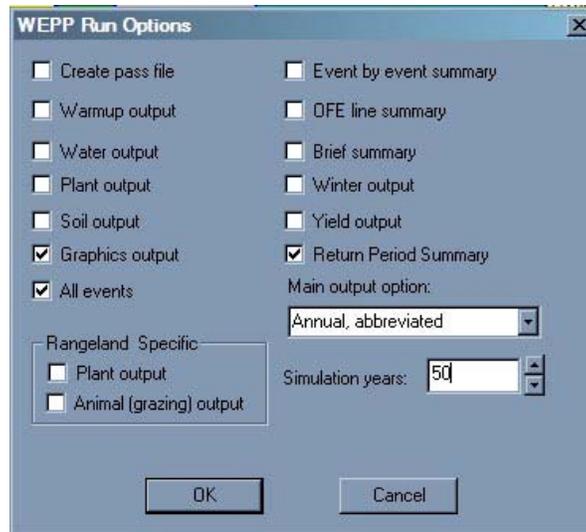


Figure 89 – WEPP Run Options window

4. You will return to the WEPP window displaying Hillslope 71. We are now ready to run the simulation. Click **Run** to begin the simulation. After the simulation runs, you will get a new screen. You can see depicted in red that erosion is heaviest towards the bottom of the slope.

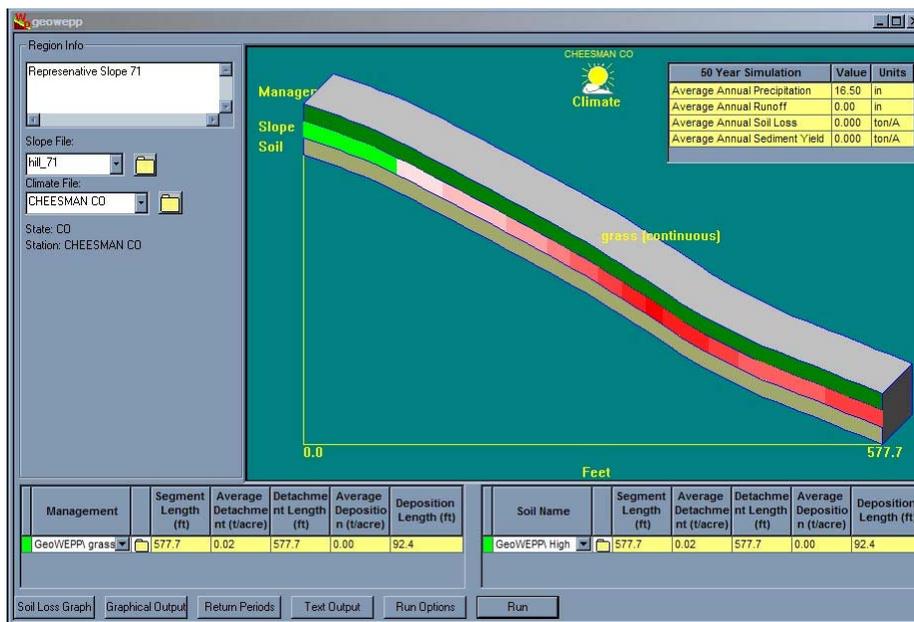
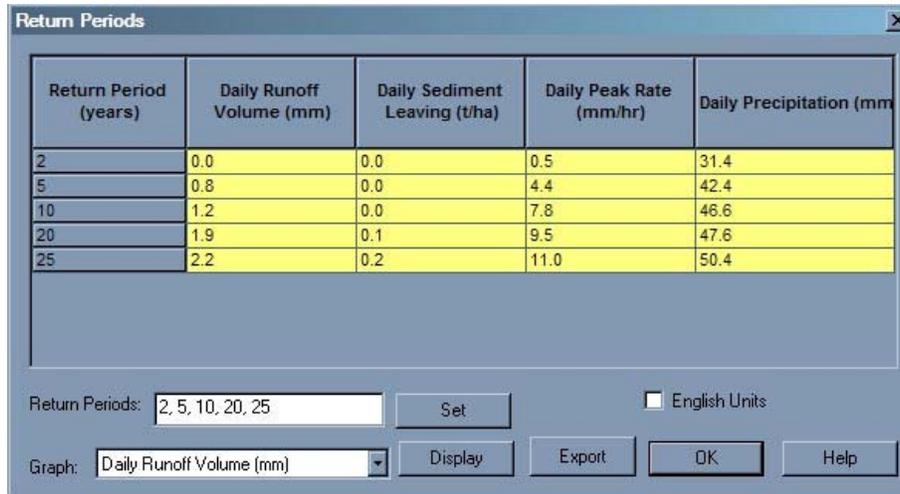


Figure 90 – Results on the WEPP simulation will appear.

5. We know what to look at the Return Period Analysis report. Click onto **Return Periods** at the bottom of the screen to get a summary of the results. Once you have reviewed the results, click **OK**.



**Figure 91 – Return Periods window**

**Note:** The columns are independent from each other. The 25 year event listed in one column may not be the same event listed in another column. For example, one event may be the 25-year event for Daily Runoff Volume, but it may only be the 5-year event for Daily Precipitation. Please refer to the WEPP documentation if you have any questions regarding the **Return Period Analysis Report**.

You may continue to experiment with WEPP and Hillslope 71 if you wish. Remember that any changes you make here will not translate back to GeoWEPP. When you are ready to return to GeoWEPP, just exit out of WEPP.

### ***5.10 Return Period Analysis for the Entire Watershed***

In the previous section, we generated a Return Period Analysis report for a single hillslope, but what if you want one for the entire watershed. GeoWEPP has a feature that will generate a Return Period Analysis report for the simulated watershed without the need to enter WEPP. Remember, the same criteria for generating a Return Period Analysis report within WEPP applies when generating the report within GeoWEPP (i.e. number of simulation years required to generate a report).

1. The Return Period Analysis report is generated during a WEPP run, therefore we need to perform another WEPP simulation. Click on the **Rerun WEPP**  button on the toolbar.
2. Since we will not need change any of the land management or soil parameters, click OK in the **WEPP Management and Soil Lookup** window.
3. We will be running a 50-year simulation using only the **Watershed** method. Change the **Number of Years** to 50 and change the **Simulation Method** to “Watershed Only”. Next to the **Simulation Method** drop-down box and below the **Change Climate** button is the **Return Periods** checkbox. You need to check this box to have GeoWEPP generate

a return Period Analysis report during the WEPP simulation. Click on this box; a check mark should appear. Click **Run WEPP**.

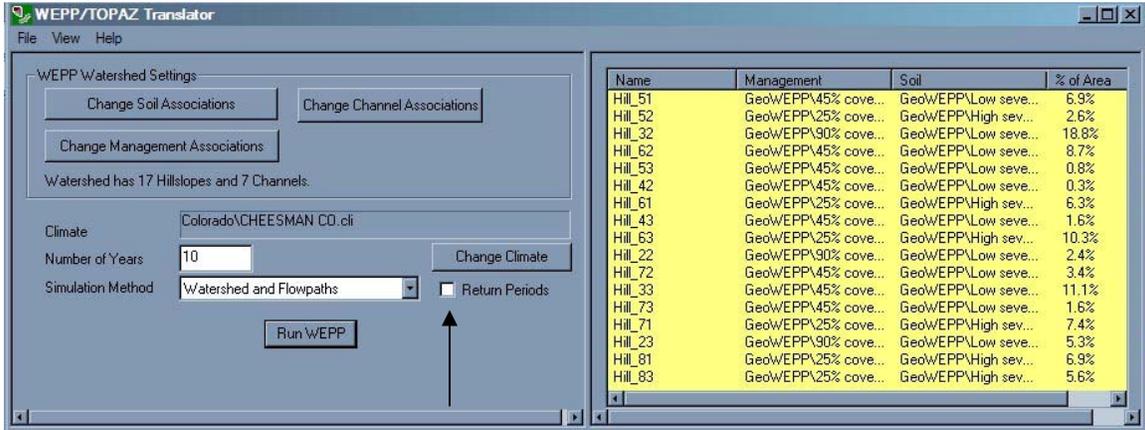


Figure 92 – WEPP/TOPAZ Translator window.

4. Follow the same procedures for saving the new layer as before. **Note:** Since we only ran the Watershed method, there will only be on layer to rename.

5. Once the layer has been loaded, click on the **Reports**  button on the toolbar. You will notice a new report name in the display call return\_periods. Display this report. The structure is the same as the **Return Period Analysis** report generated in WEPP.

Return Period Precipitation (years)	Runoff volume (m <sup>3</sup> )	Sediment Leaving (t)	Peak Runoff Rate (m <sup>3</sup> /sec)	Daily (mm)
1	45.3	0.2	0.0	24.1
2	510.5	66.8	0.3	32.8
5	1337.1	632.9	0.8	43.5
10	1666.6	890.0	0.9	47.1
25	2040.3	1381.0	1.1	54.9

Figure 93 – Return Period Analysis report generated for the entire watershed within GeoWEPP

## 5.11 Go to WEPP

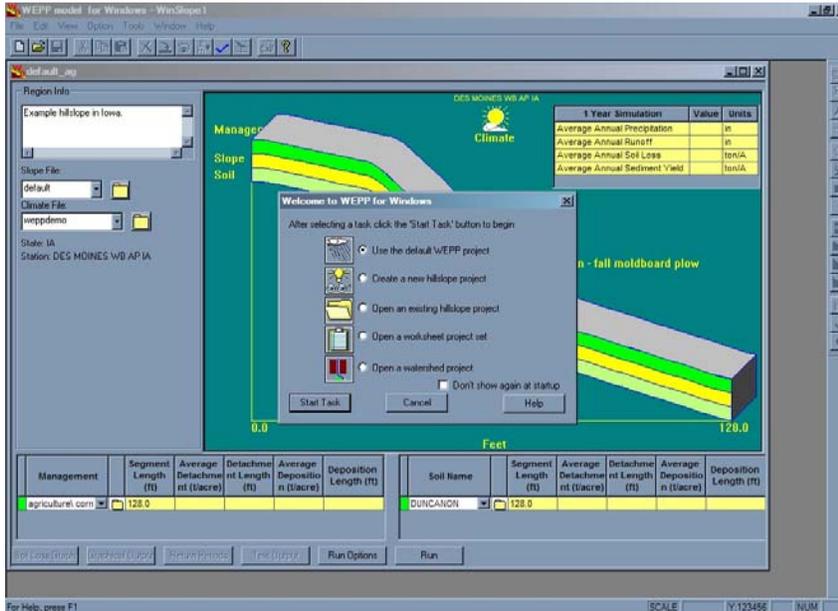
You have seen how to go into WEPP to run simulations on hillslope with GeoWEPP. You may want to use the Watershed Project function in WEPP as well. This

is done using the **Goto WEPP**  button on the GeoWEPP toolbar. This time, the GeoWEPP information is not automatically loaded; you will need to load it manually.

1. You will notice that WEPP will load up the same way it does when you normally run WEPP (i.e. not through GeoWEPP). There are two ways to load the Watershed Project for your GeoWEPP project.

The first is to select “Open a watershed project” from the **Welcome to WEPP for Windows** (figure 94a) and then click **Start Task**.

The second way is from the WEPP menu bar (click **Cancel** to get rid of the **Welcome to WEPP for Windows**). From the menu, select File→Open Watershed (figure 94b).



a



b

Figure 94 – a) WEPP opening window; b) Open Watershed from File Menu

Both methods will bring up the **Select a Watershed Project File** window. In this window, navigate to your GeoWEPP project folder and select **ww2.prw** and click **Open**. All GeoWEPP projects are saved as ww2.prw, which is a WEPP Watershed Project file.



Figure 95 – WEPP Watershed file ww2.prw in a project folder

WEPP will then load the watershed project for your GeoWEPP simulation. The watershed representation can be very scary looking (figure 96). But, not to worry; it may look scary but WEPP understands this grouping of rectangles. You can now run any hillslope or watershed WEPP simulations using this WEPP watershed project data.

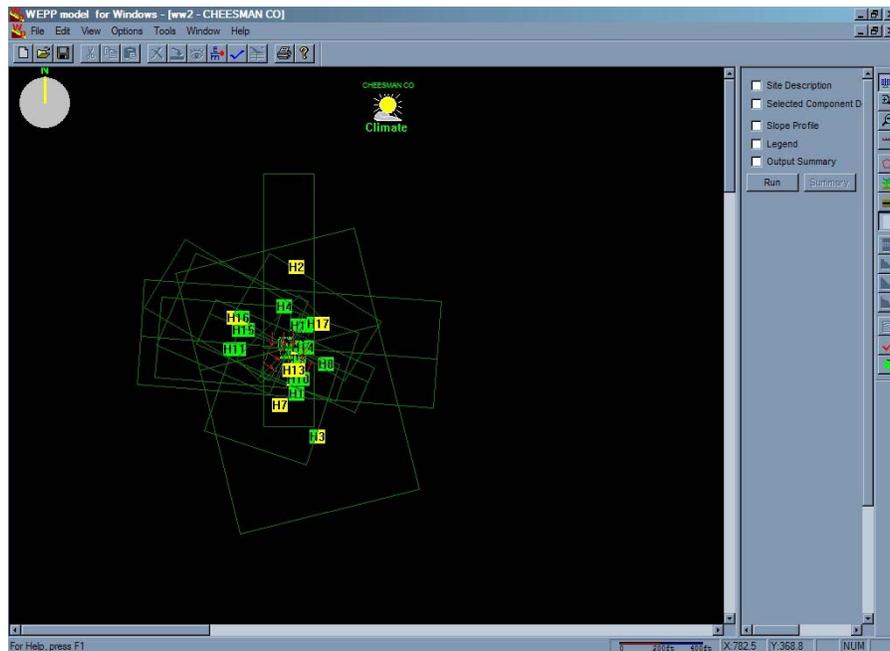


Figure 96 – Your GeoWEPP project in the WEPP Watershed mode

Any changes you make to the watershed or any of its hillslopes **WILL NOT** be translated back to your GeoWEPP project.

## 5.12 Exit (and Save)

There are several ways you can exit GeoWEPP, but only one of them is guaranteed to save your progress. To exit GeoWEPP, all you need to do is exit ArcMap either by clicking the close (“x”) button in the upper right corner or by select File→Exit. But, you may not be asked if you wish to save the current document; this could be a problem if you try to return to this project.

The safest way is to click the Exit GeoWEPP button  at the right end of the toolbar. Once you confirm that you do wish to leave GeoWEPP (figure 97), this will save the current GeoWEPP project and exit GeoWEPP for you. It is wise to get in the habit of exiting GeoWEPP this way.

**NOTE:** You shouldn’t change the name of the MXD Document or save it in a different folder than the current project’s folder. Doing so will prevent GeoWEPP from working properly. Using this button will prevent these mistakes.

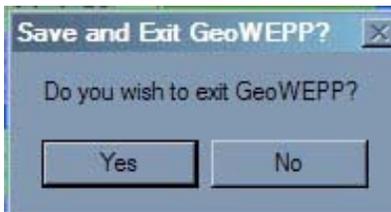


Figure 97 – Exit GeoWEPP Alert

## 5.13 Reload a Project

It is pretty much guaranteed you will need to exit GeoWEPP before you are actually finished with your analysis. Fortunately, you’ll be able to reload the project with little difficulty (as long as you’ve been saving often and used the Exit GeoWEPP button on the toolbar). You can reload a project in one of two ways: either by double-clicking on the MXD Document located in your project folder or by starting GeoWEPP normally and selecting “Load Previously Saved Project”.

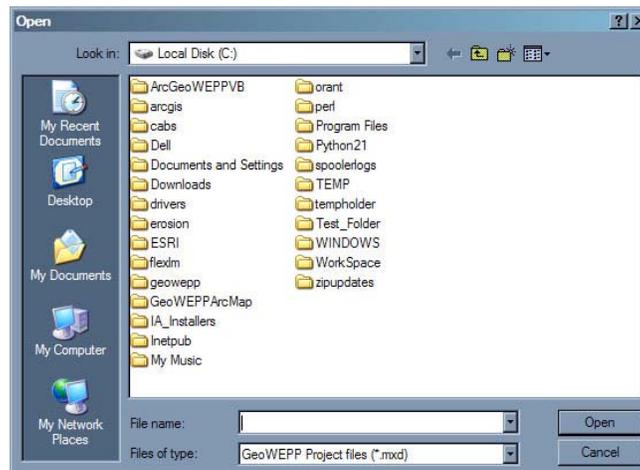


Figure 98 – Navigate to your project folder and select ArcGeoWEPP.mxd

## 5.14 New Watershed Using the Same Data

One of the major added features to this version of GeoWEPP compared to previous version is the ability to do more than one watershed without having to start from the beginning again. To do this, all you need to do is select a new outlet point once you are finished with your current watershed analysis. You will be asked if you wish to start a new project. Select yes to continue.

Now, any modifications you make will be done on the new watershed. The results of your previous runs will also be present so you can compare them to new results. The previous runs reports will be placed in a new folder.

**Important Note:** Even though you are using a different watershed, you can not use any of the names you used earlier as result names. Each result layer must be unique. For example, if you used Hill01T1, you can not use that name again.

You can start a new subcatchment by selecting the Outlet Point tool and create a new subcatchment like you did previously. You will be asked if you would like to start a new project (figure 99a), just to make sure you are aware of what you are doing.

If you choose to start a new project, you will be asked if you wish to use the same climate (figure 99b). If you click **Yes**, the last used climate will be used for the new watershed.

This may seem unnecessary for watersheds near each other, but what if there is some distance between the two watersheds? What if one is at a higher elevation than the other? You may want to use different climates for each watershed; this is why GeoWEPP asks. If you change your mind, you can still change the climate before any simulation.



a b  
Figure 99 – a) Start a New Study Area Project?; b) Use Same Climate?

Once you have created your new watershed, you can continue with all the tools you used on the previous watershed. Any simulations or changes made will be done on the new watershed; you will not be able to return to your previous watershed.

All resulting layers will be displayed with previous layers – unless you remove them from the legend yourself. This allows you to display all the results from all of your simulations in ArcMap; thus, you can create maps display all the results.

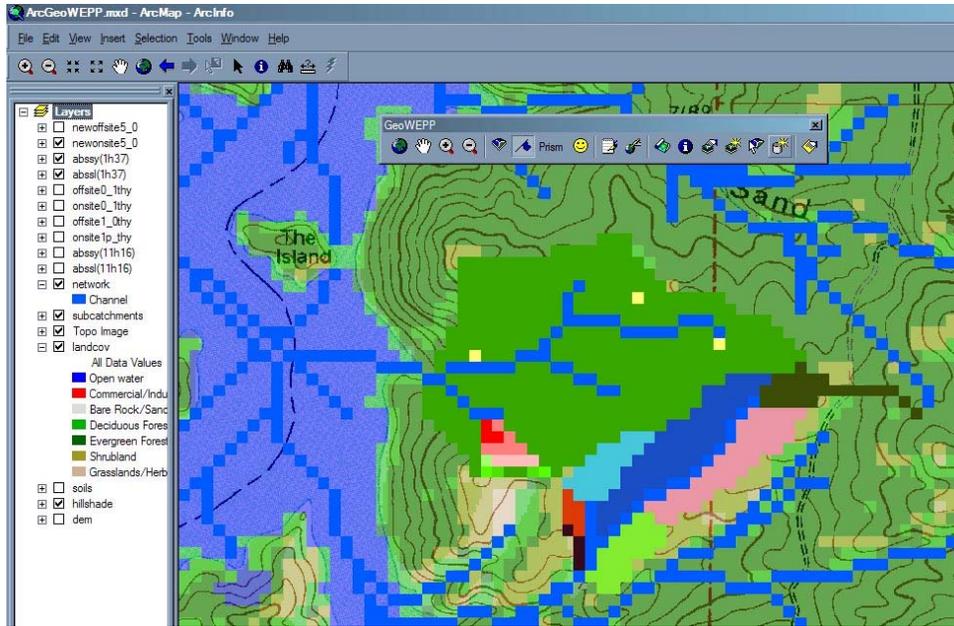


Figure 100 – New Subcatchment displayed with previous subcatchments onsite results

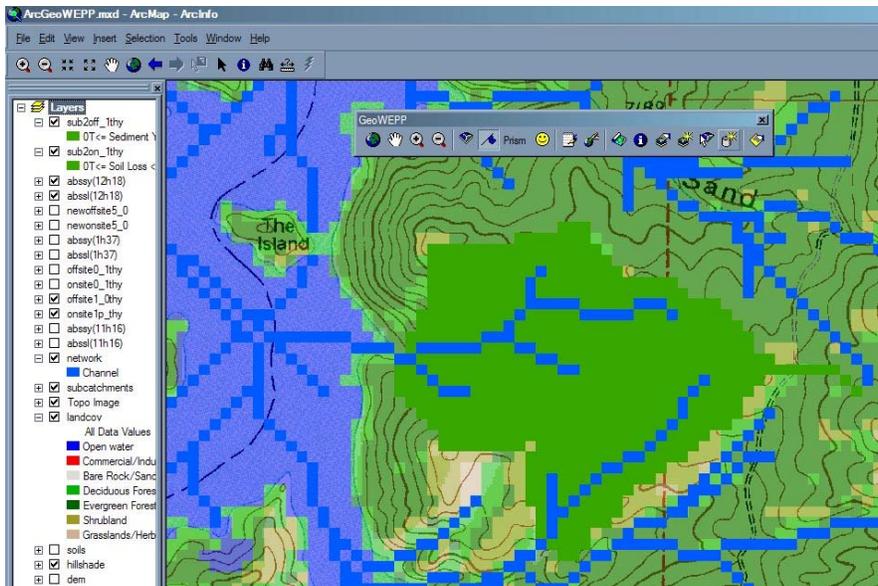
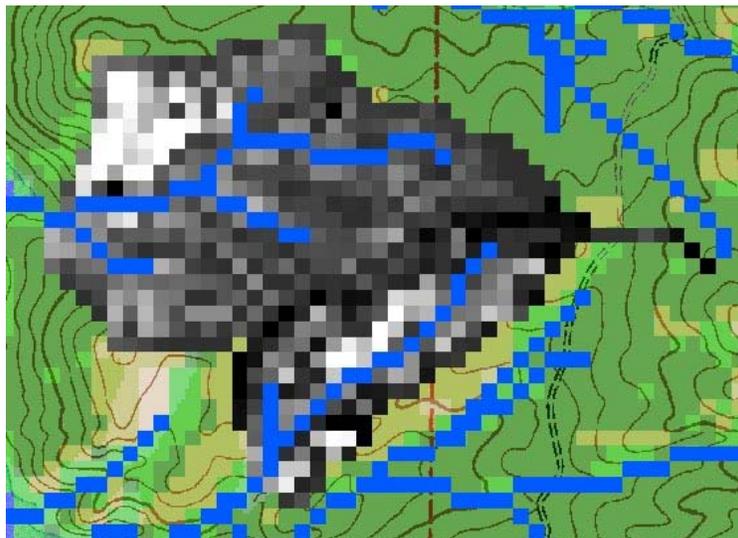


Figure 101 – The Offsite results for two adjacent subcatchments



**Figure 102 – The Onsite results for two adjacent subcatchments**



**Figure 103 – The absll layers for two adjacent subcatchments**

*What about the reports from previous simulations?*

You can view all the previous reports using the View Reports function in GeoWEPP. When you begin a new simulation, the previous simulations reports are moved to a different folder. All you need to do is to click **Previous Reports**; you'll be able to load any and all the previous reports. All you need to do is to navigate to any folder that begins with Run, for example Run(12,58) which refers to the simulation run that I stopped working on at 12:58pm.

All the reports for the current subcatchment are stored in the **Reports** folder with your project's folder. All reports from any of the simulations you ran can be accessed without having to start GeoWEPP; just open them in any text editor.

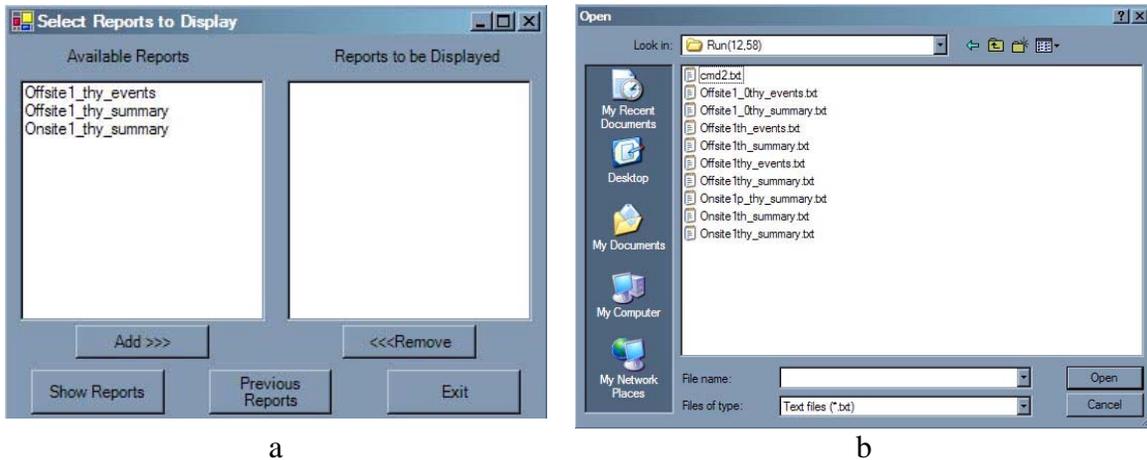


Figure 104 – a) Select Reports to Display window; b) Reports from previous simulation in the Run() folder

### 5.15 Other layers in GeoWEPP

The layers you see in GeoWEPP do not have a spatial reference, so adding other layers may become an issue. If you want to generate a map for a report that includes other layers, you have two choices: reproject all your layers into the same UTM Zone projection as your GeoWEPP source data or reproject the GeoWEPP layers. It may be easier to reproject the GeoWEPP layers, especially if you have a number of other layers to add or if you have orthophotographs.

**NOTE:** There is a chance that a layer may be position correctly if you just add it to the current GeoWEPP run, but there is no guarantee. Sometimes ArcMap will overlay the layers properly and sometimes it won't. You can increase the odds of having the layers in the proper position by projecting your data into UTMs; make sure you use the correct UTM zone.

## 6 GeoWEPP Data Preprocessing – “What About My Data?”

So, now you know how GeoWEPP works. The biggest question you have now is how to prepare your own data so you can use GeoWEPP. Several years ago, I wrote a step by step guide to preparing data for use in GeoWEPP using ArcView 3.x. This section provides a new step by step process using ArcGIS 9.x. While the procedures have changed, the principles and their importance have remained the same.

You or someone else may know different methods than the ones presented here to prepare data for GeoWEPP; use whatever you feel comfortable with. What’s important is that the resolution of all three layers is the same and all the cells line up with on another. Any overlap between cells or the presence of multiple cells within a cell (i.e. different resolutions) will cause problems; some will be apparent (like GeoWEPP crashes), while others may cause unseen errors in the results. The steps below prevent these issues from occurring.

I have met a number of GeoWEPP users that have a wide range of GIS experience, so the only assumption I have made when writing the steps below is that the reader knows how to start ArcMap.

### 6.1 *Preparing Your Data for GeoWEPP Use*

In a nutshell, your data needs to be projected into UTM and converted into ASCII files. This is a relatively simple process, but could become time consuming depending on the amount of data you have. I do have a few suggestions that will speed this process. First, create folders to store all you data; this will make navigations quicker. Create one to store all the data you need to preprocess and one to store all the finished data. You may even want to create a junk folder to store all the in between steps listed below; this folder can be deleted once you are done.

My second suggestion is to keep it small. The larger your files, the longer some of the preprocessing steps will become. Also, if you provide a large DEM, GeoWEPP will take a long time to generate the channel network (I discussed this in the steps how to clip your DEM). I strongly suggest reducing the size of your DEM to what you actually need for your study area (unless you enjoy vacantly staring at a screen for long periods of time).

Finally, to reduce any confusion you may have, grab a pen and paper and take notes. Record the location of your files and folders, which files go with which GeoWEPP layers, which layer you are currently working on, what your study area coordinates are, and which UTM zone your area is in. These notes will help you through the steps below.

As stated about, your raster files need to be projected in UTM coordinates. There are a number of websites that will convert latitude/longitude coordinate into UTM and tell you the correct zone. But, for a quick reference, you can use the following table:

<b>Longitude</b>	<b>UTM zone</b>
>120°W	10
114°W-120°W	11
108°W-114°W	12
102°W-108°W	13
96°W-102°W	14
90°W-96°W	15
84°W-90°W	16
78°W-84°W	17
72°W-78°W	18
<72°W	19

The files I will be using below come from several sources, including the US Geological Survey (USGS) and the Natural Resources Conservation Service (NRCS). Your sources may be different but the files should still be the same type. In the steps below, the DEM is a GRID, the Landuse is a TIFF, the soil layer is a shapefile, and the topographic image is a TIFF. Also, the steps listed below use ArcGIS 9.0; if you are using later versions, the tool input windows may appear differently or the parameters may be in different orders. As long as you are using the same tools, there is little difference between the steps below and what is required for when using other versions.

**IMPORTANT:** If your DEM is a TIFF image file, you will need to clip the DEM before you begin. The TIFF DEMs are very large and will slow down GeoWEPP to the point where it could be a long time before it has finished. It is best to clip the DEM to a point where you are comfortable that your study area's watersheds will not go beyond the DEM boundary. **DO NOT** use the **Extract by Mask** tool described in some of the steps below to clip your TIFF DEM. This tool will produce a file with the same extent as the original TIF DEM; in other words, you will not be saving any processing time using this tool. It is best to use the Clip tool (**Data Management Tools**→**Raster**) described in section 6.2.3. This will reduce the size of the final ASCII file and allow GeoWEPP to run smoother and more efficient.

All of the steps below use ArcMap and the tools found in the ArcToolbox. Before you begin, load ArcMap; then open the ArcToolbox.

## **6.2 Preparing the DEM**

The DEM is used to delineate the channel network, determine the subcatchments in your watershed, and generate the hillslope information (slope, length, etc.) for WEPP. While the other layers can be left out, the DEM is required; without it you can not run GeoWEPP.

Before we begin, there are several assumptions I will be making. First, the DEM's elevation is in meters. Second, if you are using more than one DEM, they all have the same cell resolution; it is important that you know the cell resolution of your DEM(s) and record this value for future reference. And third, all the DEMs are located in the same UTM zone. If the DEMs are not in the same UTM zone, you may have projection issues when trying to merge them and GeoWEPP may not accept the DEM. To correct this, use

the Clip tool to extract the portion of the DEM that is in the correct UTM. If your study area crosses UTM zones, use the zone in which most of your study are is in.

## 6.2.1 Working with Only One DEM

### 1. Load your DEM.

The first step is to load your DEM. Select **File**→ **Add Data** from the menu (figure 105a). This will open the **Add Data dialog window** (figure 105b); **navigate to the folder in which you stored your DEM, select the DEM and click Add**. Your DEM has been added to ArcMap (figure 106).

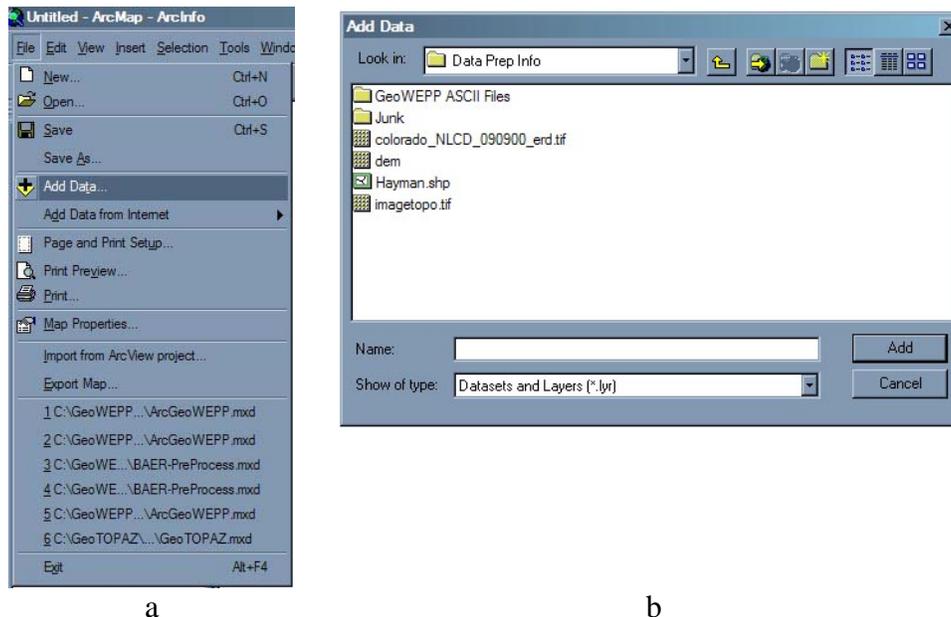


Figure 105 – a) File→Add Data... from menu; b) Add Data dialog window

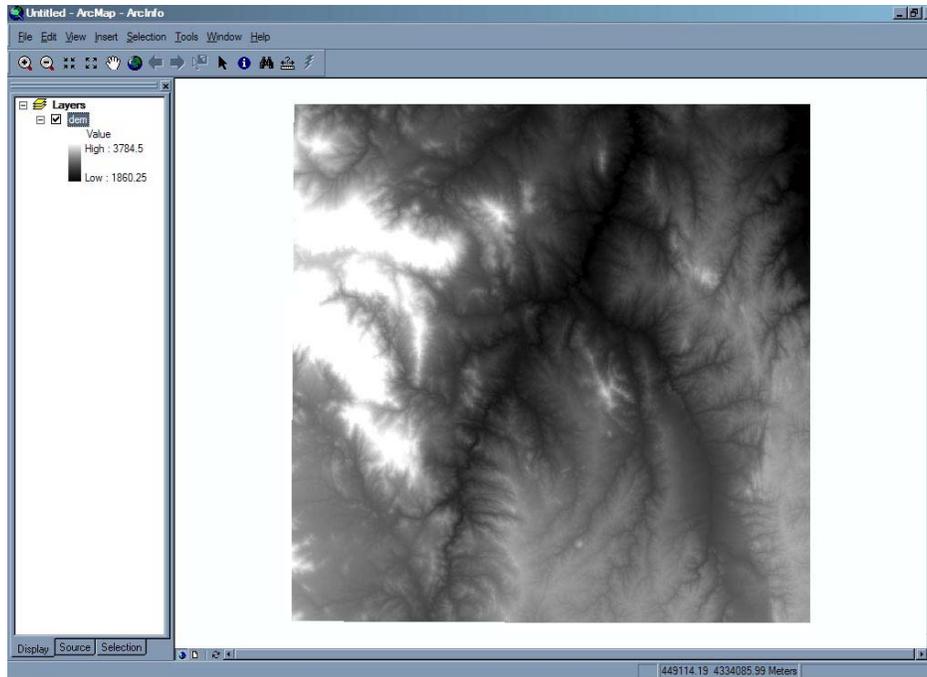
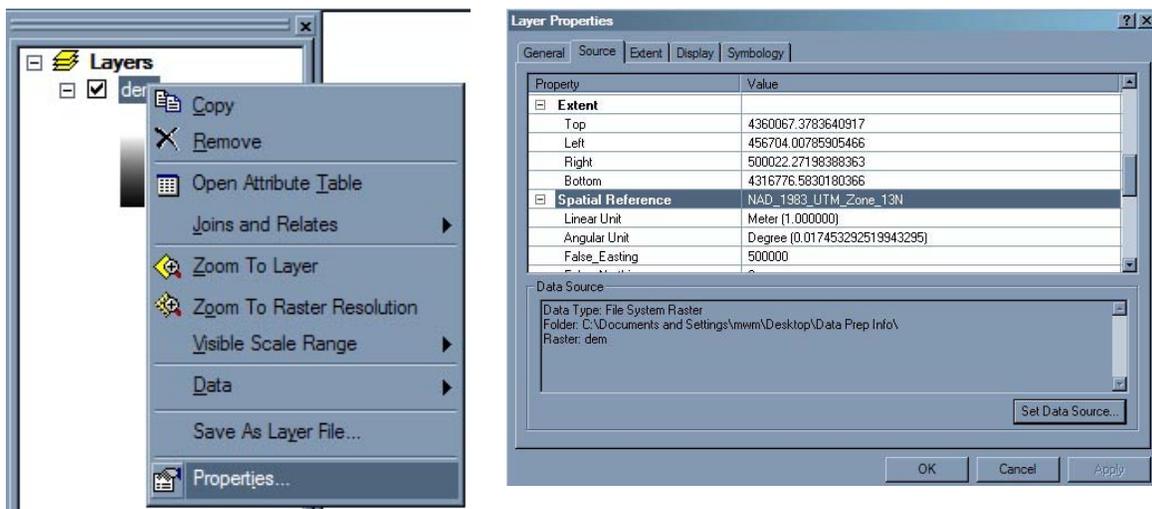


Figure 106 – DEM loaded into ArcMap

2. Your DEM may not be in the projection GeoWEPP requires; GeoWEPP requires all layers to be projected into UTMs. To determine the projection of your DEM, **right-click on the DEM's name** and **select Properties...** from the popup menu (figure 107a). This will bring up the **Layer Properties** window (figure 107b).



a b  
Figure 107 – a) Right-click popup menu; b) DEM Spatial Reference

**Click on the Source tab** and **scroll done** until you see the **Spatial Reference** section. The DEM used in this example is already projected in UTM coordinates (NAD 1983 UTM Zone 13N), so it doesn't need to be projected. But, what if your DEM isn't in UTM coordinates? The following steps will guide us through the projection process; if

your DEM is already in the correct projection, you can skip ahead to step 5. **Click OK** to close the **Layer Properties** window.

**3. We need to determine which UTM zone** our study site is in. As previously mentioned, there are a number of websites that will convert latitude/longitude coordinate into UTM's and tell you the correct zone. You can also use the quick reference table above. However you determine the UTM zone, make sure you record this; we will need this information later. For this example, our study area is located in UTM Zone 13.

**4.** Now that we know the UTM zone of our study site, we can change the projection by using the **Project Raster** tool in ArcToolbox. This tool is found in:

Data Management Tools → Projections and Transformations → Raster (figure 108a)

**4a. Double-click on the tool** to open the **Project Raster** tool window (figure 108b). The tool window shows you which required and optional parameters are needed to run the tool. We need to provide four parameters: the raster we want to project (**Input Raster**), the name and location we want the new projected raster to be stored (**Output Raster**), the project we want the output raster to be in (**Output Coordinate System**), and the new projected raster's cell resolution (**Output Cell Size**).

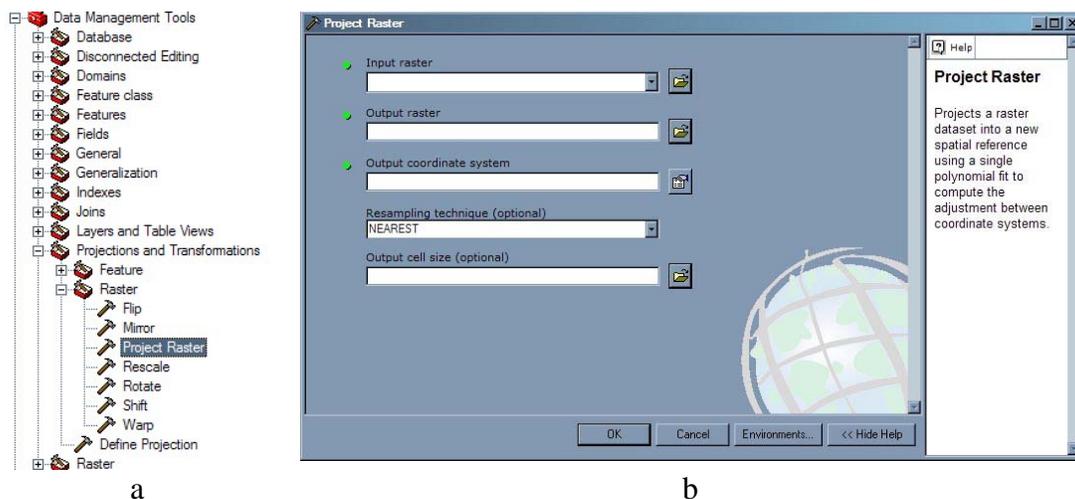


Figure 108 – a) Project Raster in ArcToolbox tree; b) Project Raster tool window

**4b.** First, we will enter the **Input Raster**. There are two ways to supply this parameter: you can either **select from a raster layer already loaded** in ArcMap by **clicking on the dropdown list** (triangle on the right) or by loading a raster from a folder by **clicking on the Open button** (the folder on the right). Since our DEM is already loaded, we can **click on the dropdown box and select the DEM from the list** (figure 109a).

**4c.** Now we need to supply the **Output Raster** information. While we could just type in the pathway – if we happen to know it – it is easier just to use the **Open** button on the right. **Click the Open** button; once the standard **ArcMap Open** window appears (figure 109b), **navigate to the folder** in which you want to save the new raster. Since this is an

intermediate step, you can navigate to a “junk” folder. Once you get to your folder, **supply a raster name** that will make sense; this example uses “ReprojectDEM” as the raster name (see figure 109b).

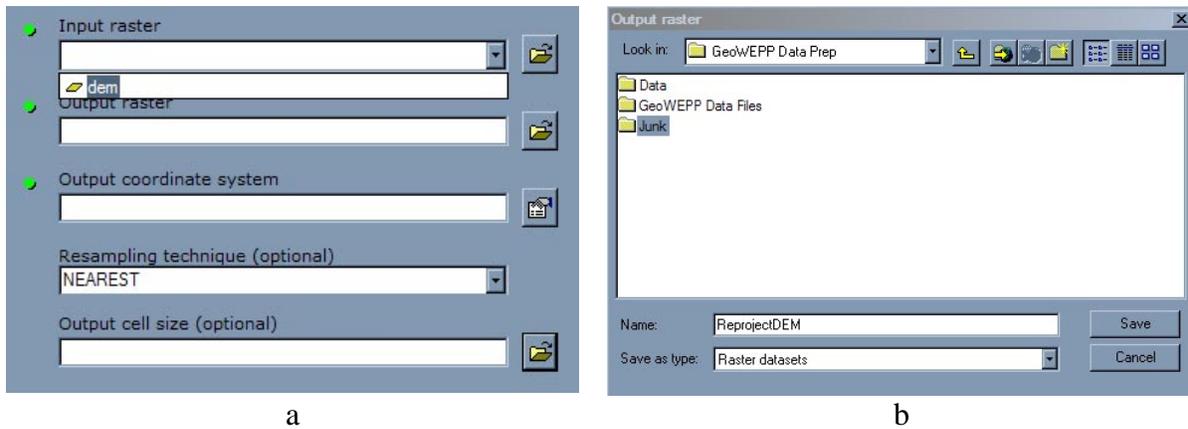


Figure 109 – a) Available raster dropdown list; b) Output Raster location and name

4d. The next step is to supply the **Output Coordinate System** for the **Output Raster**. **Click on the button** to the right of the **Output Coordinate System** textbox; this will open the **Spatial Reference Properties** window (figure 110b). We will select a predefined coordinate system for our **Output Raster**. **Click Select...** to browse for a coordinate system.

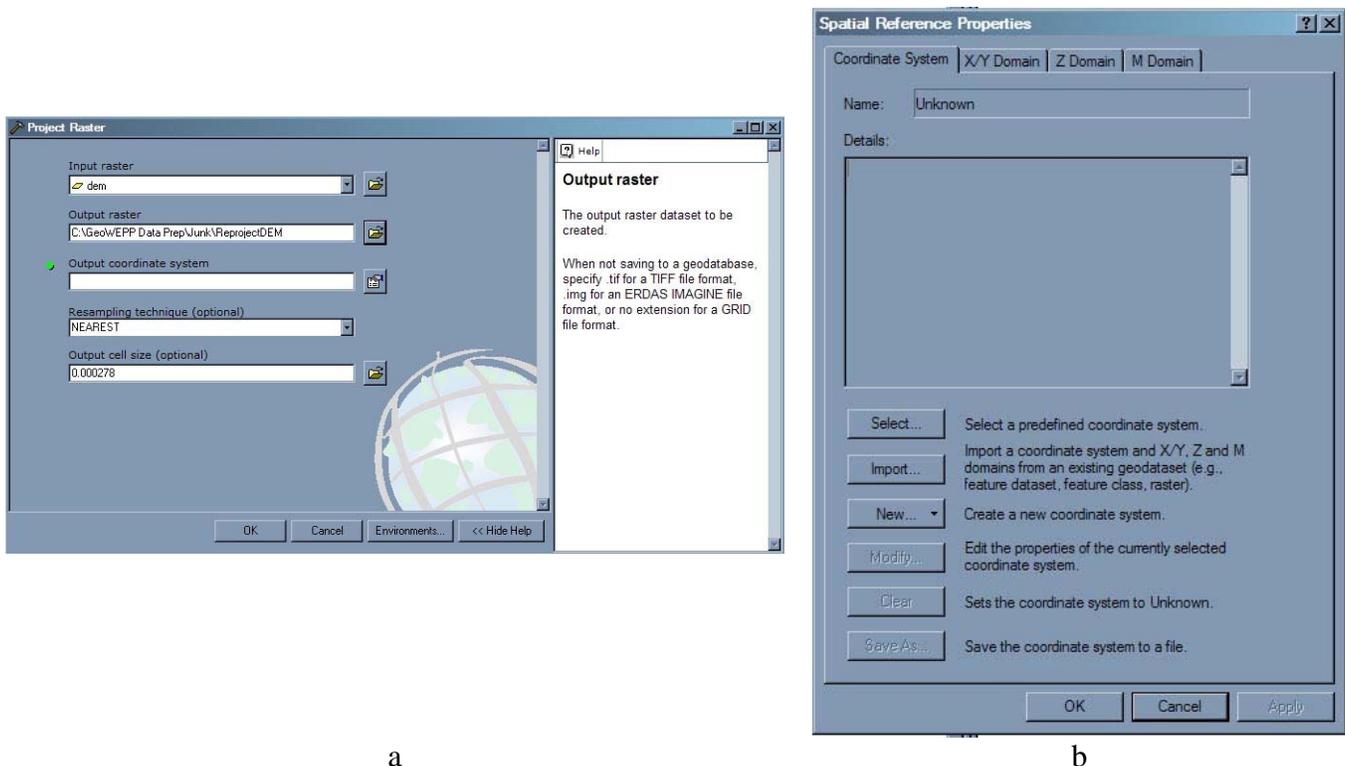
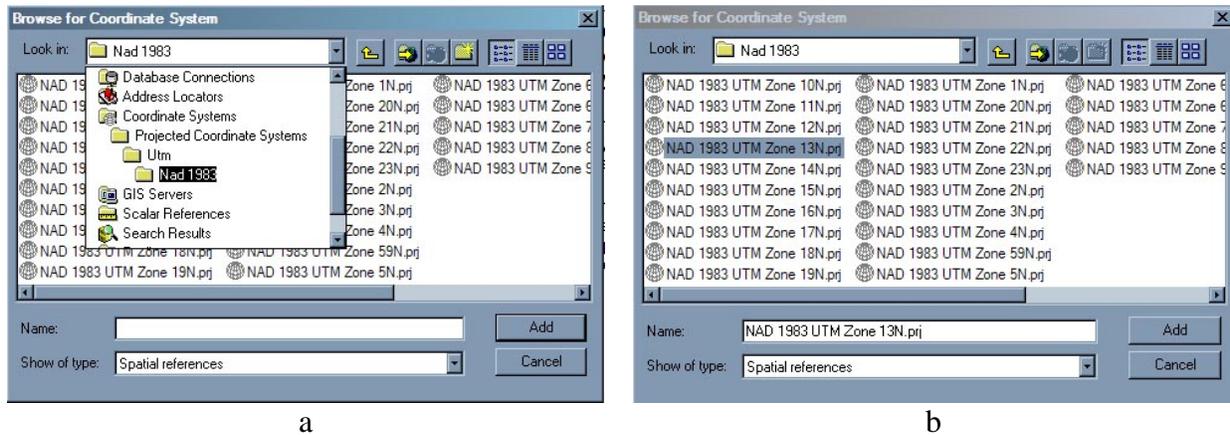


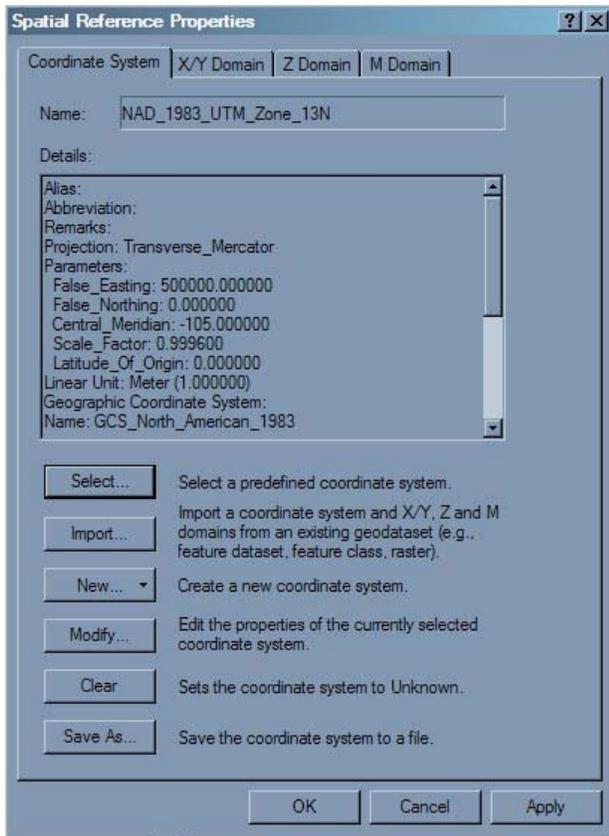
Figure 110 – a) Input and Output Raster parameters are set; b) Spatial Reference Properties window

A **Browse for Coordinate System** window will appear. Since we want to project the raster into UTM coordinates for zone 13, we want to use the **NAD 83 UTM Zone 13N projection** which is located in the **Projected Coordinate Systems\Utm\Nad 1983** folder (figure 111a). Once you open this folder, you will see all the projections that use UTM's and the NAD 1983 Datum (figure 111b). **Select NAD 83 UTM Zone 13N.prj** and **click Add**.

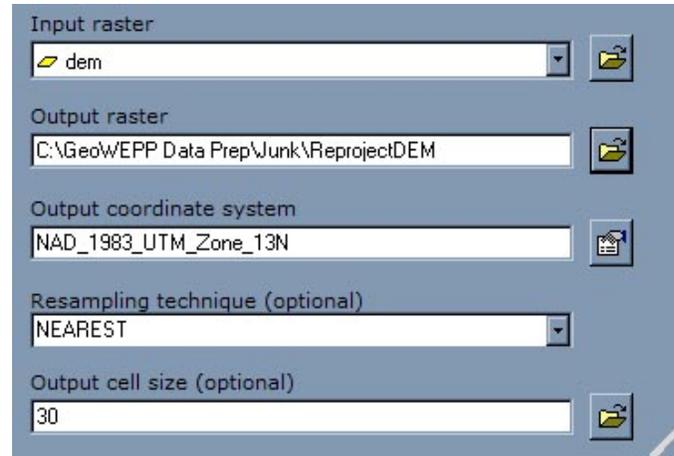


**Figure 111 – a) Project folder location; b) Available UTM NAD 1983 projections**

The details for the **UTM Zone 13N projection** will be added to the **Spatial Reference Properties** window (figure 112a); **double check that you selected the correct projection** and then **click OK**. The **Output Coordinate System** box will now display the UTM projection we are going to use (figure 112b).



a



b

**Figure 112 – a) Spatial Reference Properties window with UTM projection details; b) All parameters have been added**

4e. Depending on your version of ArcGIS, the **Output Cell Size** may already be filled in for you or it may be blank. You should either enter the cell resolution of your DEM (in meters) or confirm the default value presented; it is best you **don't just accept the default value without confirmation**. In this example, the DEM has a **cell resolution of 30m**, so **30 is entered for the Output Cell Size** (figure 112b). All the parameters are set, so **click OK** in the Project Raster window to start the tool.

When the tool is executed, a progress window will appear (figure 113a). This window provides information about the tool's progress, including if any errors that have occurred. Once **the tool has completed** its process (figure 113b), **click Close**. The projected USGS DEM should now appear in ArcMap.

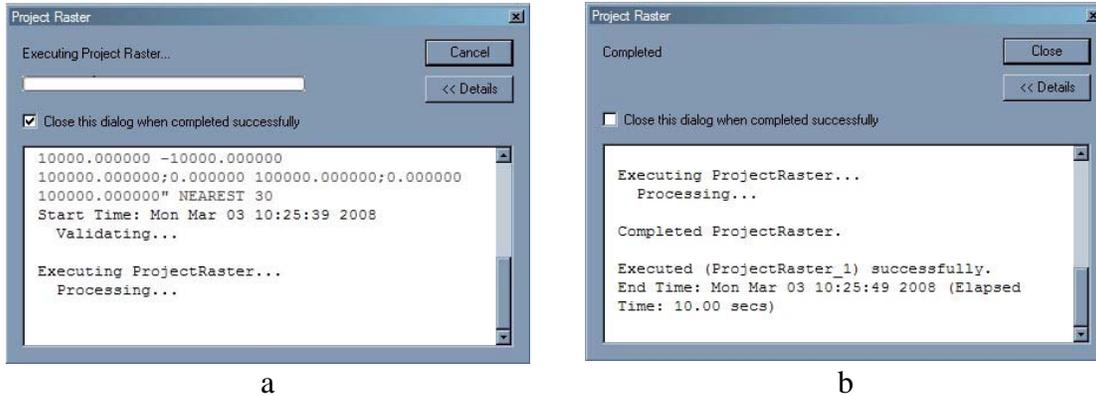


Figure 113 – a) Tool progress window; b) Tool has successfully been executed

The remainder of the steps will be applied to the newly projected DEM. To reduce any confuse, **remove the original DEM from ArcMap**. This can be done by **right-clicking on the DEM's name** and **selecting Remove from the popup menu**. The only layer that should now be available is the newly projected DEM.

5. The DEM is now in the projection we need for GeoWEPP, but it isn't in the file format GeoWEPP uses. We need to convert this raster grid into an ASCII raster file. This is done using the **Raster to ASCII** conversion tool, and is found in:

Conversion Tools → From Raster (figure 114a)

5a. **Navigate to the tool's location** and **double-click on the tool** to open it. The **Raster to ASCII** tool only requires to parameters: the **Input Raster** and the **Output ASCII Raster File** (figure 114b).

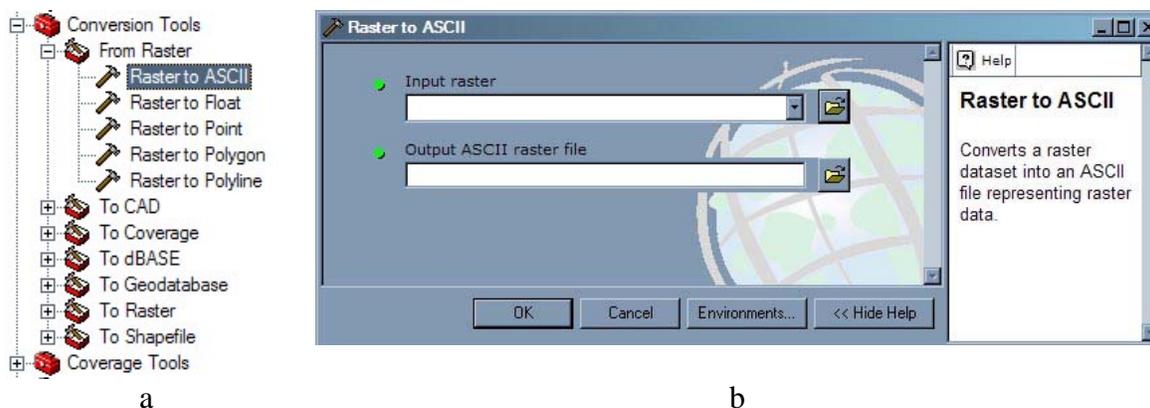
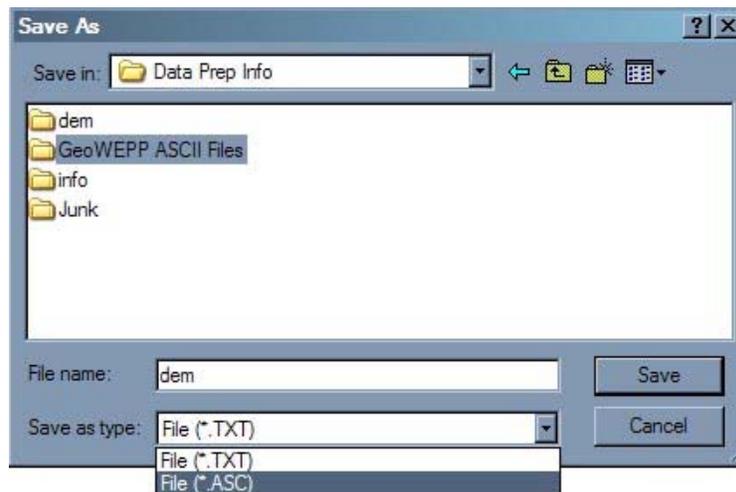


Figure 114 – a) Raster to ASCII tool in ArcToolbox tree; b) Raster to ASCII tool window

5b. The **projected DEM** we created above will be used as the **Input Raster**; **select the projected raster from the dropdown list** for the **Input Raster**. If you haven't removed the original DEM, you will notice that there are two raster available: the **original DEM** and the **projected DEM**; make sure you choose the projected DEM.

5c. We need to supply a name and a location for the raster ASCII file. **Click on the Open button** to the right of the **Output ASCII Raster File** textbox. **Navigate to the folder** in which you want to save the ASCII raster file. Since this is the file format we need for GeoWEPP, you should save it in a different folder that you have been using. **Enter an appropriate name**, like **DEM**; **make sure the extension is set for ASCII (\*.asc)**, not Text (\*.txt) (figure 115). **Click Save**; the tool is now ready to run. **Click OK** to run the tool and **Close** when it has completed.



**Figure 115 – Make sure the DEM is saved as an ASCII file**

You have now completed the DEM preparation stage for GeoWEPP. You can now start GeoWEPP and begin your simulations using the ASCII file you just created, but you will only be able to use one WEPP soil type and one WEPP management type for the initial simulation and only one WEPP soil and WEPP management type for each hillslope in your watershed after the first simulation. The sections 6.3 and 6.4 discuss how to convert GIS landuse and soil data to be used in GeoWEPP. If you plan to continue from this point, remove all layers from ArcMap **EXCEPT** the reprojected DEM you just converted to ASCII. We will use this layer to format the soil and landuse data; I will explain why in the next sections.

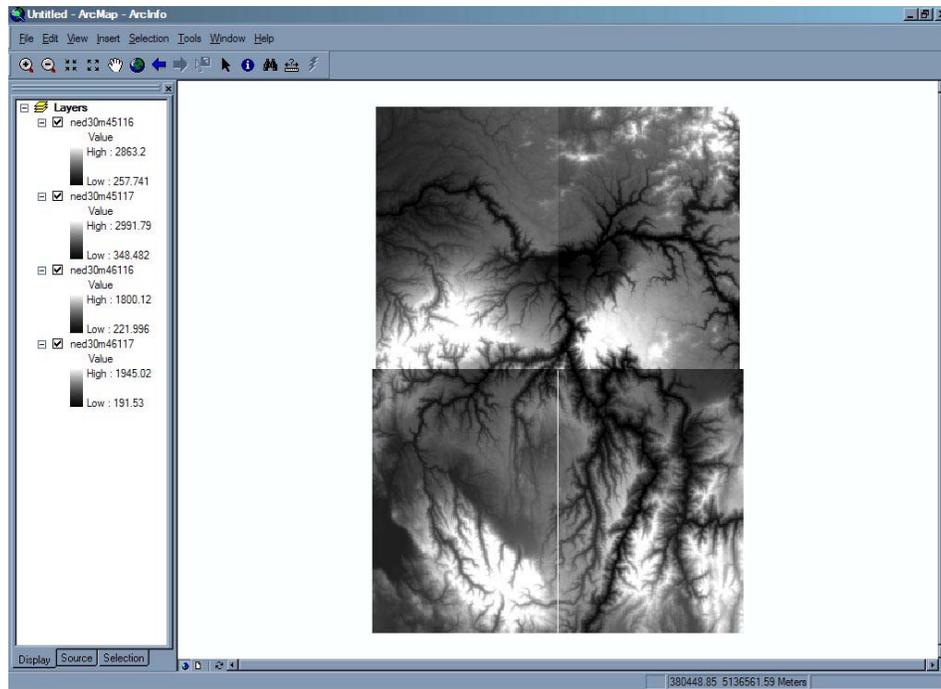
### **6.2.2 What if I have More Than One DEM?**

GeoWEPP can only work on one DEM at a time. The good news is that you can merge your DEMs into one larger DEM. Once that is done, all you need to do is follow the steps outlined above to convert the DEM to ASCII.

There are two ways to merge DEMs: you can use the **Mosaic** tool or the **Mosaic to New Raster** tool. The “problem” with the **Mosaic** tool is that the DEMs will be **merged into an already existing** DEM file, which will **destroy the original data**. It is better to use the **Mosaic to New Raster** tool, which will create a new DEM instead of overwriting an existing one. An added benefit of this tool is that the new raster can be projected during the same process.

**1. Load all of the DEMs you wish to merge.**

Add all the DEMs to ArcMap the same way you added the single DEM in the previous section. This example uses four DEMs (figure 116).



**Figure 116 – ArcMap with four different DEMs**

**2. Once the DEMs are loaded we can begin the merging process. Navigate to the Mosaic to New Raster tool (figure 117a) and double-click the tool to open it (figure 117b). The tool is located in:**

Data Management → Raster

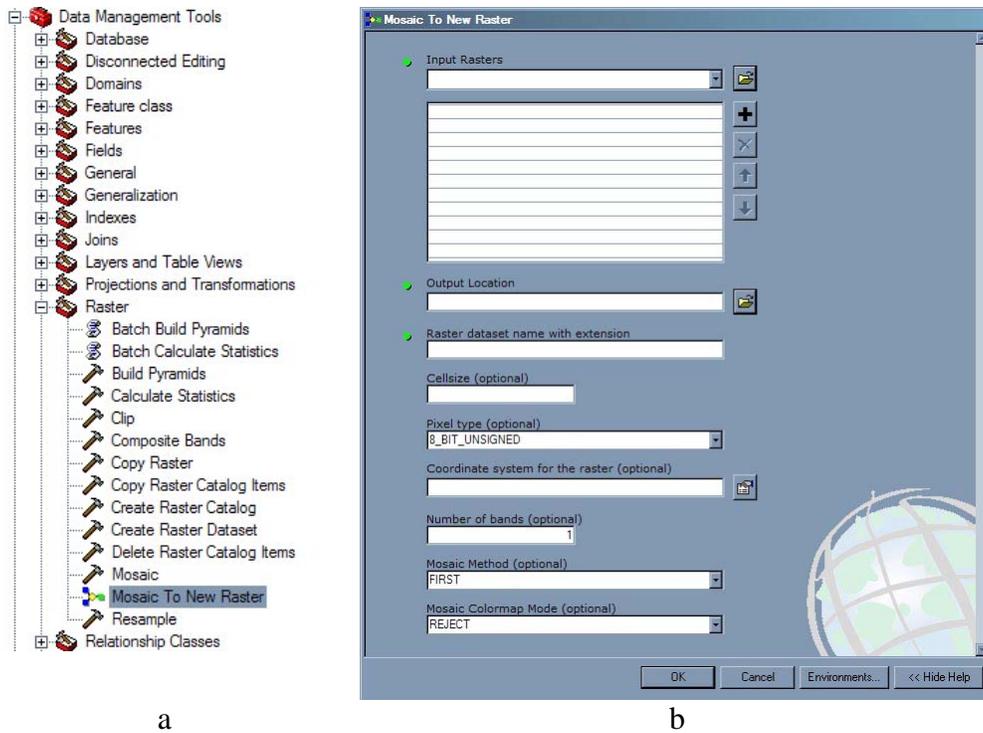


Figure 117 – a) Mosaic to New Raster tool in Arctoolbox tree; b) Mosaic to New Raster tool window

3. We will need to enter the input and output parameters for the tool. You will notice some similarities to some of the tools you have already used.

3a. First, we need to add the DEMs that we want to merge. You can select them using the dropdown list (figure 118a). **Select one of the DEMs.** You will notice that once you select the DEM, it is added to the list below the **Input Raster** textbox (figure 118b); **add the remaining DEMs** the same way.

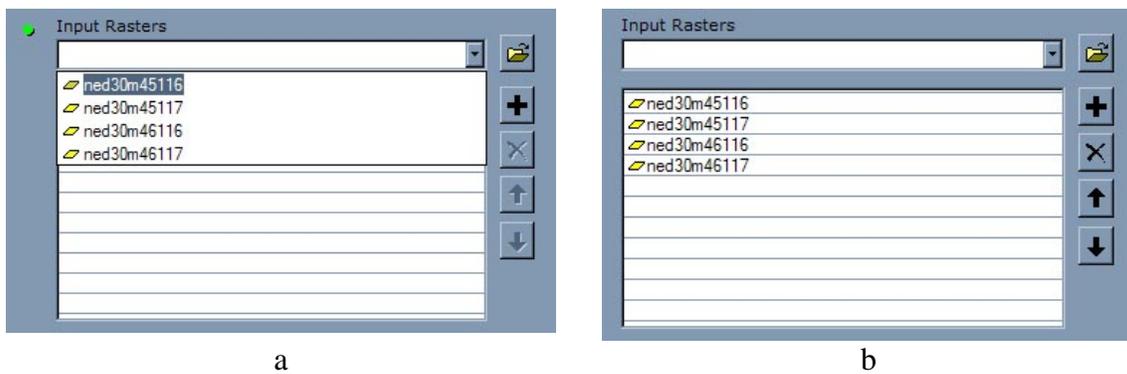


Figure 118 – a) Dropdown list containing all available rasters; b) Rasters appear in box after being selected

3b. The **Output Raster** is divided into two sections: **Location** and **Dataset Name**. **Click the Open button** to the right to **navigate to the folder that contains the folder in which you want the Output Raster to be saved** (figure 119a); since this is an intermediate step, you can save the merged DEM in the “junk” folder. In figure 119a, I

navigated to the “Data Prep Info” folder, entered “Junk” for the name, and then clicked Add.

*Note:* the folder in which you wish to save the new raster must already exist. You will notice that the pathway to your selected output location is now displayed in the box (figure 119b).

Next, **enter a name for the Output Raster in the Raster Dataset Name with Extension** text box; **use the same naming methods we used earlier**, like ReprojectDEM or MergedDEM.

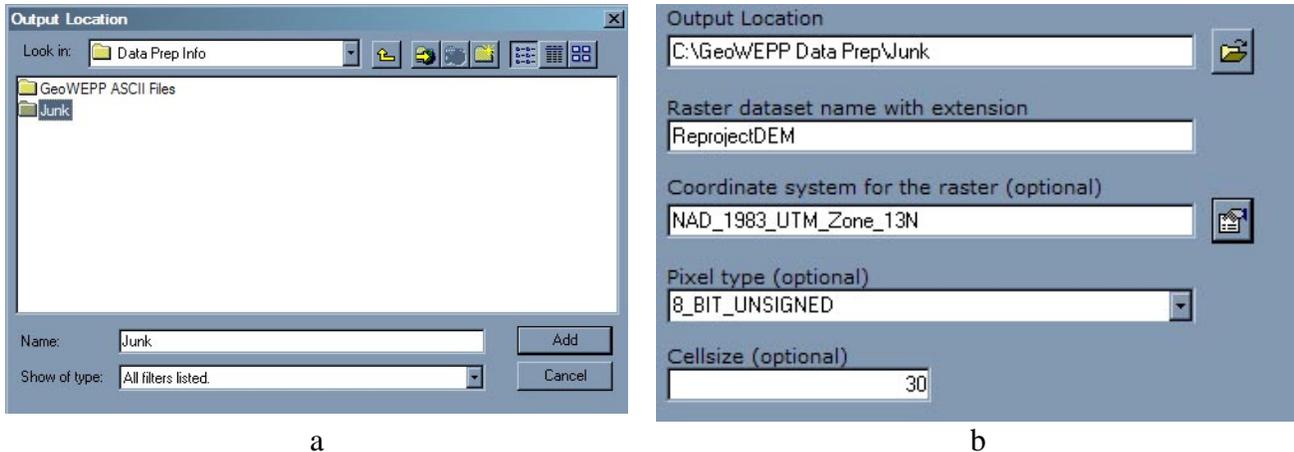


Figure 119 – a) Output Raster Location; b) Output Raster name

**4.** The next step is to select the coordinate system we want the new raster to be projected. **Use the same steps for this tool as we used in Project Raster tool above.**

**5.** Depending on your version of ArcGIS, the **Cellsize** may already be filled in for you or it may be blank. You should either enter the cell resolution of your DEM (in meters) or confirm the default value presented; it is best you **don't just accept the default value without confirmation**. In this example, the DEM has a cell resolution of 30m, so **30 is entered for the Cellsize** (figure 119b). **Click OK** when finished to start the tool.

**6.** Once the **Raster to New Mosaic** tool has finished, **close the progress window**. The new raster should now be visible in ArcMap (figure 120). The final step is to convert the newly create DEM to ASCII. **Use the Raster to ASCII tool and the same steps previously discussed to convert the new DEM**; use an appropriate name like **dem.asc**.

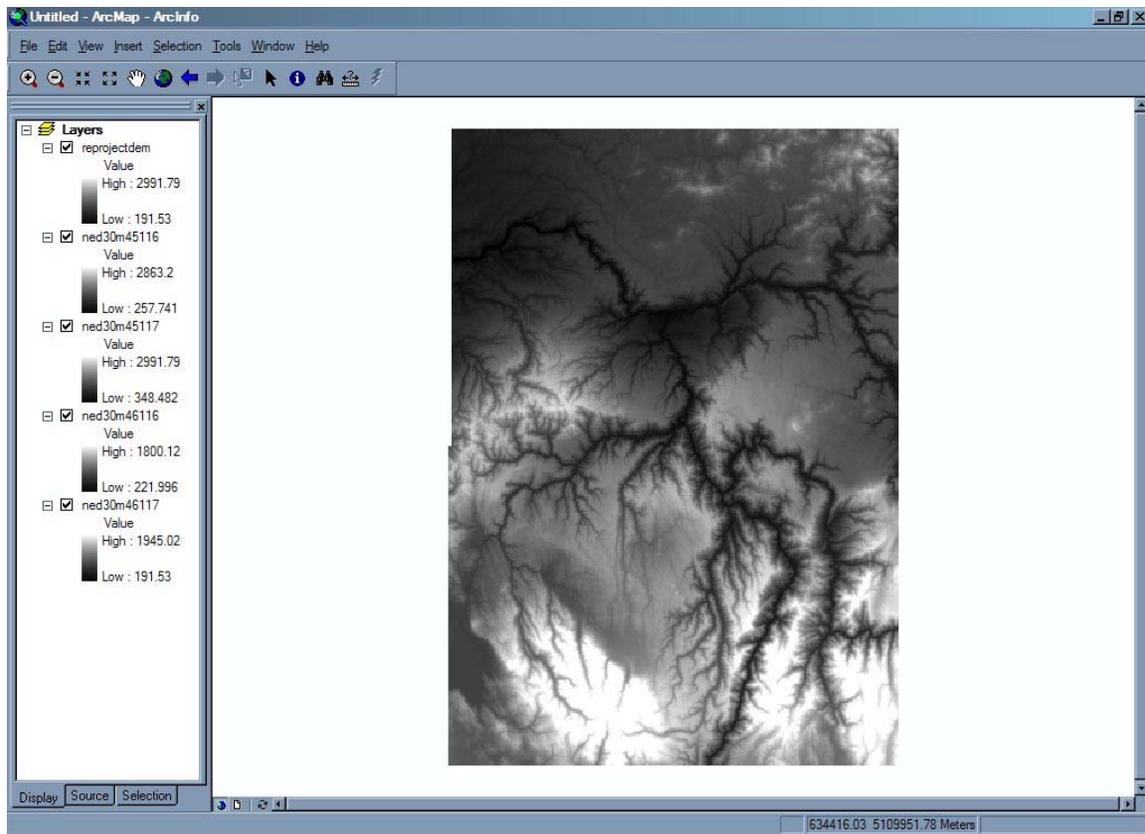


Figure 120 – The Merged (Mosaiced) DEM

### 6.2.3 What if My DEM is Just Too Big?

Since GeoWEPP is primarily used on smaller watershed, your DEM is probably larger than you need it to be. To reduce its size, you can use the **Clip** tool located in **Data Management Tools**→**Raster** portion of the ArcToolbox (figure 121a). While this is not required, it will help reduce the time needed to convert the DEM to ASCII (discussed above) and in many of the GeoWEPP processes. If your DEM is large, like the mosaic DEM in figure 120, it may take 20 minutes to convert your DEM to and from ASCII and it could take at least as long to generate a channel network for the DEM within GeoWEPP. Think of it this way: if it takes 15 minutes to generate a channel network in GeoWEPP and you need to modify the channel network four times, you have just spent one hour to get the correct channel network. But, if you clip your DEM and it takes 5 minutes to create the channel network you would only spend 20 minutes to get the same channel network. It is all a matter of time.

The **Clip** tool we will be using **requires you to enter minimum and maximum X and Y coordinates of the region you wish to clip out**. Essentially, you are clipping out a box that surrounds your watershed. Navigate around the DEM to determine the extent of the area you wish to use. You can load other layers to help, like topographic images, orthographic photos, or even watershed shapefiles. Once you have determined the extent of your study area (and a little more as a buffer), write down the minimum and maximum X and Y coordinates.

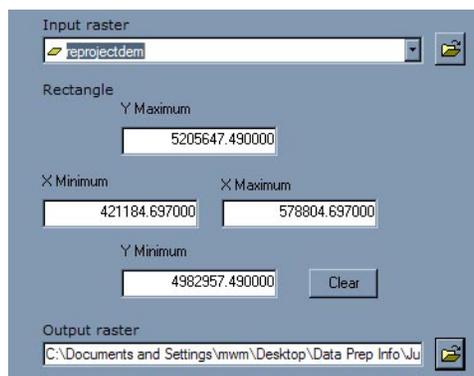
In this example, I will be using the merged DEM in figure 120. Looking at this DEM, I have determined that my watershed is located in the middle of the DEM. I have determined the X and Y coordinates I will need, which includes a buffer around my watershed. I am now ready to clip the DEM.

**Double-click on the Clip tool to start it (figure 121b).**



**Figure 121 – a) Clip tool location in ArcToolbox tree; b) Clip tool parameter window**

The Clip tool requires an **Input Raster** and an **Output Raster**, along with the **coordinates discussed above**. You will need to **select the DEM you wish to clip** as the **Input Raster**; this is done the same way as in previous examples: **click on the dropdown arrow to the right of the Input Raster box and select the DEM you wish to clip** from the dropdown list. In my example, I want to clip from **ReprojectDEM** (figure 120). You will notice that the coordinates of your DEM appear in the Minimum and Maximum X and Y boxes (figure 122).



**Figure 122 – DEM Min and Max Coordinates**

You will need to enter the coordinates you recorded earlier for your study area. Figure 123 shows the coordinates I will be using; they are different from the ones shown in figure 122.

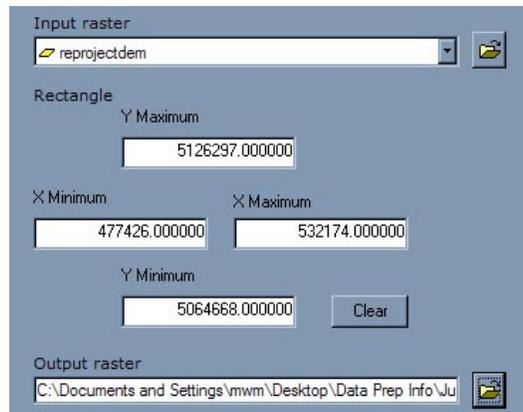


Figure 123 – Study Area Min and Max Coordinates

The last step is to **provide a name for your new clipped DEM**. You can use the default given to you, but ArcMap isn't very creative when it comes to naming; you'll get something like DEMtoClip01. It is best to **name the clipped DEM something you will remember**; I will use ClipDEM. **Click on the browse button to the right**; an **Output Raster** dialog window will appear (figure 124). **Navigate to the folder you wish to save the clipped DEM to and enter the name in the Name: box**. My ClipDEM will be stored in the Junk folder.

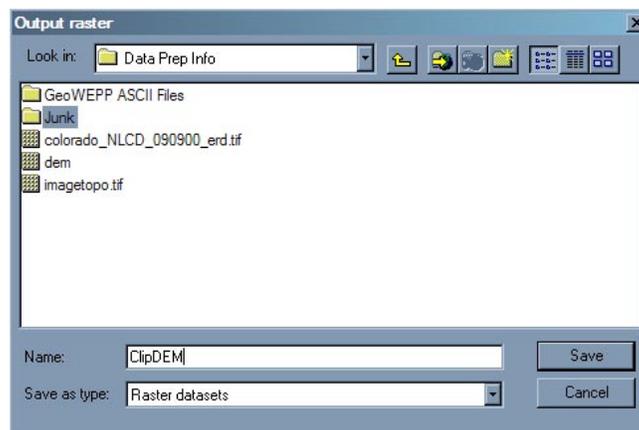


Figure 124 – Save location and name for clipped DEM

Now that the coordinates have been entered and the output raster location and name has been provided, you can **click OK**. The clipped DEM will have the same projection as the original DEM, so you will not need to reproject it. Once the tool has finished, the clipped DEM will appear in ArcMap. Figure 125 shows the new clipped DEM (yellow-orange gradient) overlaying the larger DEM (grey scale). [**Note:** the gradient for the clipped DEM was changed so it can be seen in the image; your clipped DEM will be the same gradient as the original].

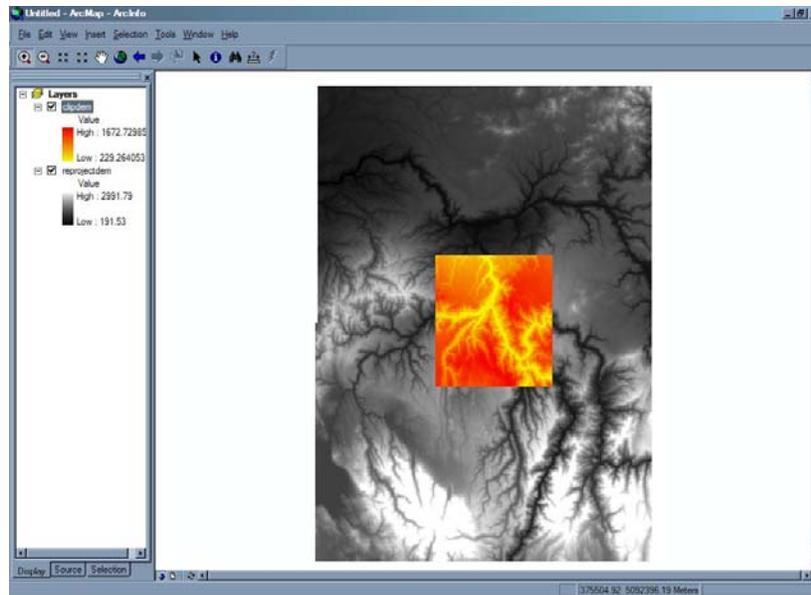


Figure 125 – Clipped DEM (orange) over the original DEM (grey)

You can now convert the clipped DEM to ASCII following the steps outlined earlier. If you plan to continue on in the data preparation steps, you should remove all layers except for your final DEM (the one you converted to ASCII); this will help reduce confusion during later data preprocessing steps.

### 6.3 Preparing the Landuse

In this section, we will be converting a landuse TIFF image into an ASCII raster file just like we did with the DEMs. The landuse is stored as a **TIFF image**, but it is **not a GeoTIFF**; this piece of data has its spatial reference saved in a separate **TIFF World File (\*.tfw)**. Without the file, the TIFF image will not be projected properly when loaded into ArcMap.

You will use the **same tools** you used when **converting the DEM** (discussed earlier), but **with one additional step**. As you can see from figure 126, the landuse layer is far bigger than we need (it covers an entire state!); trying to work with this layer may tax your computer's processing speed and use up a lot of storage space. To reduce these issues, **we will use the projected DEM as a cookie cutter and remove the portion of the landuse layer we will be working with**. This is done using the **Extract by Mask** tool. This tool has a second function; it will align the raster cells of the landuse layer with those of the DEM. If the cells are not aligned, GeoWEPP may not accurately assign the data or worse – GeoWEPP could just crash.

**1. Load your landuse layer into ArcMap.** If you are continuing the preprocessing steps from above, **you should also have your projected DEM loaded as well**. If you don't have it loaded, **load it now**; we will use this DEM in the steps outlined below.

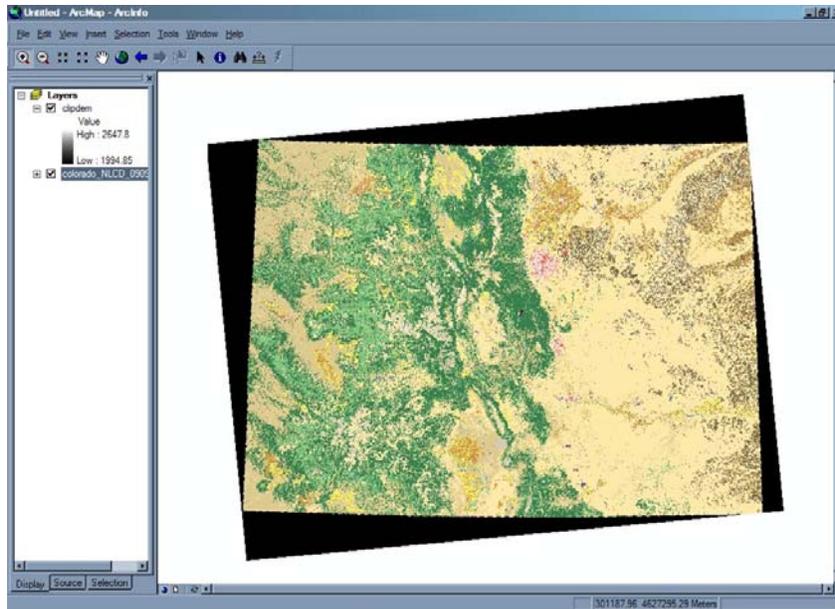


Figure 126 – Landuse layer to be used for the example study site. Landuse is for the entire state of Colorado

2. We will need to determine the projection of the landuse. Right-click on name and select properties from the popup menu. Click on the Source tab and scroll until the Spatial Reference information is visible (figure 127).

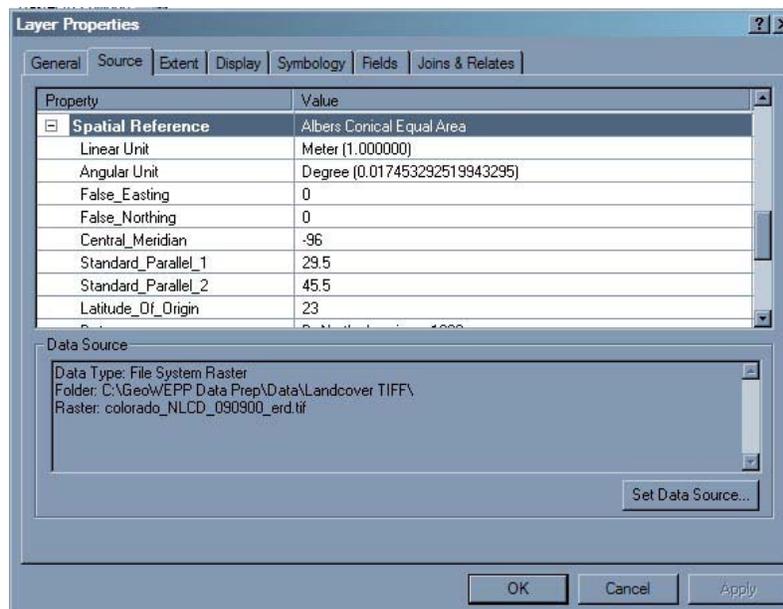
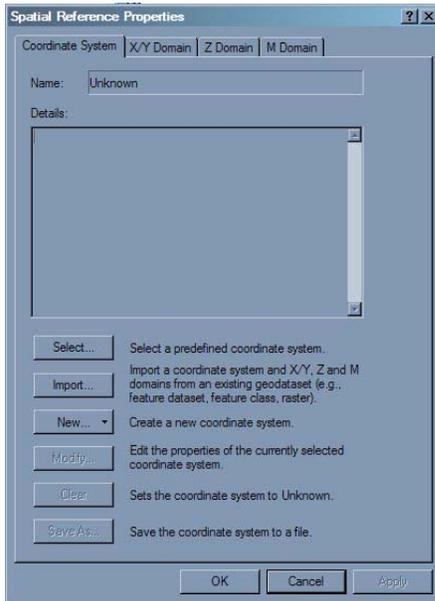


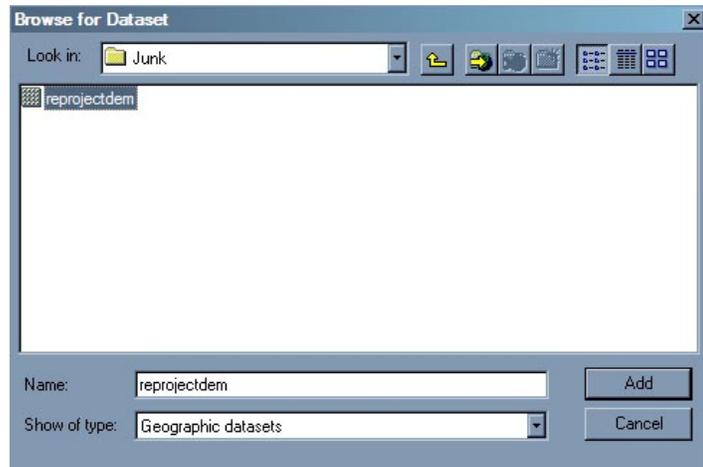
Figure 127 – Landuse spatial reference

3. Just like before, we need to project the landuse layer into UTM. You can follow the same steps using the **Project Raster** tool outlined in *Section 6.2.1, step 4*; as an alternative, you can **click Import... instead of Select... in the Spatial Reference Properties window** (figure 128a). **Navigate to where your projected DEM is stored, select it, and click Add** (figure 128b). The projected DEM's projection information will

be loaded in the **Spatial Reference Properties** window (figure 129a); this will insure that we select the same projection for the landuse as the one we used for the projected DEM. **Click OK in the Spatial Reference Window** to accept the projection. All the parameters are set (figure 129b), so **click OK in the Project Raster tool window** to start the tool.

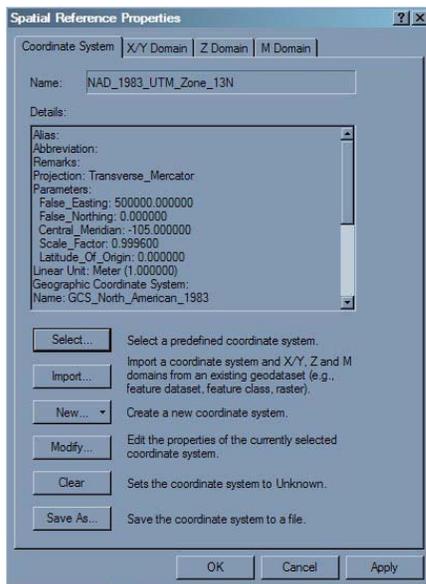


a

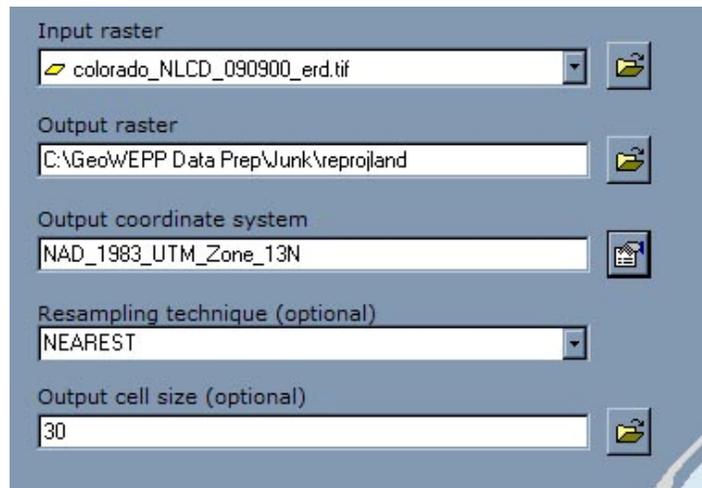


b

**Figure 128 – a) Spatial Reference Properties window; b) Location of the Reprojected DEM**



a



b

**Figure 129 – a) Projected DEM projection information in Properties window; b) All Projection parameters have been entered**

Once the tool has finished the projection process, remove the original landuse layer to reduce any confusion in future steps. You should only have the reprojected landuse and reprojected DEM loaded in ArcMap.

4. We can now clip the landuse data to match the same extent as the projected DEM. Not only will this reduce the amount of storage needed for the landuse layer, it will reduce the amount of time it takes to convert the data to ASCII. The **Extract by Mask** tool will allow us to this; the tool is located in:

Spatial Analyst Tools→Extraction (figure 130a)

4a. **Double-click the tool** to load the tool's parameter window (figure 130b). The **Extract by Mask** tool requires three parameters; the layer to be clipped (**Input Raster**), the raster layer used as a mask (**Input Raster or Feature Mask Data**), and the name and location of the clipped raster layer (**Output Raster**).

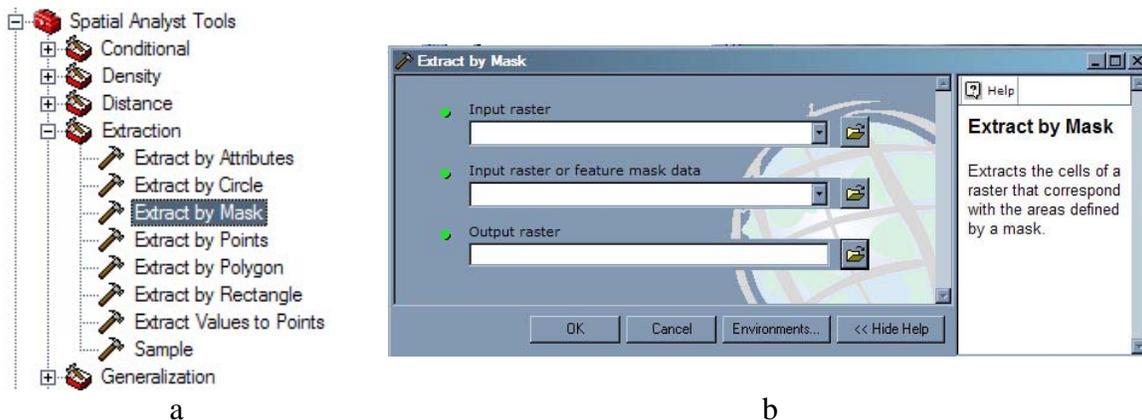


Figure 130 – a) Extract by Mask tool in the ArcToolbox tree; b) Extract by Mask tool window

4b. Use the dropdown list to select the landuse layer for the **Input Raster**. Select the **projected DEM** from the dropdown list for the **Input Raster or Feature Mask Data**. For the **Output Raster**, click on the **Open** button and navigate to the location in which you want to store the clipped raster layer, like the “junk” folder; enter an **appropriate name** for the new raster like **clip\_land**. Once the parameters have been entered (figure 131), **click OK** to start the tool.

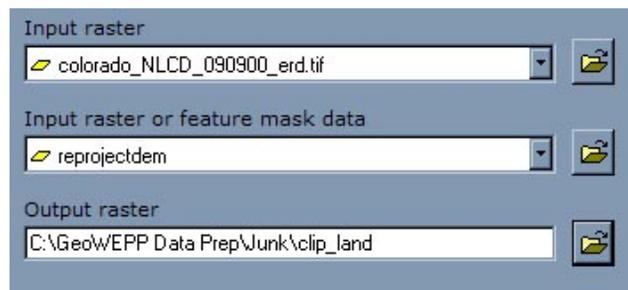
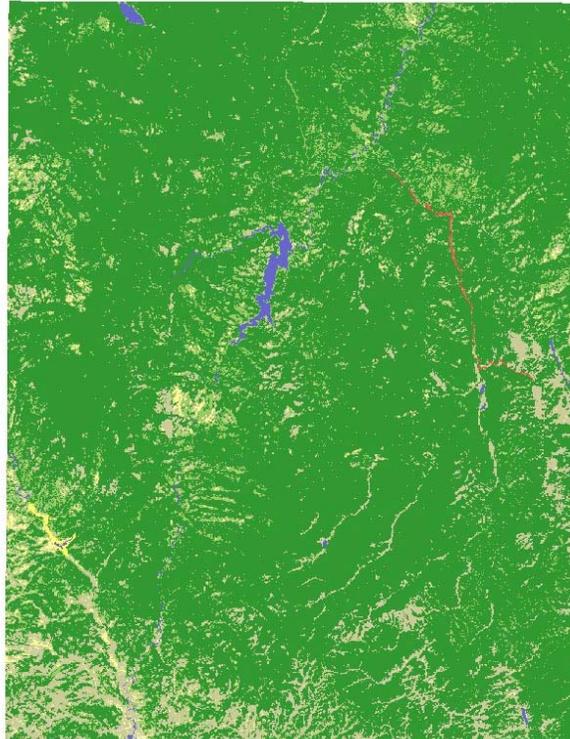


Figure 131 – All Extract by Mask tool parameters entered



**Figure 132 – Resulting clipped landuse layer**

The result is a new landuse layer with the same extent as your DEM (figure 132). **Remove the projected landuse layer**; the remaining steps will be done on the newly clipped landuse layer.

**5.** There is one more step that needs to be done before you convert the landuse layer to ASCII. GeoWEPP requires two text files to link the GIS data you are preparing now with the WEPP parameter files used in the simulation process. One of these files links the raster cell values with a description. For the landuse layer, the file called landcov.txt will store a list of cell values along with its corresponding description, like “11 Water”; the value 11 is given the description “Water”. The creation of these files is covered in section **7 Advanced GeoWEPP Tools – A Revisit**, but we can start the creation process here by exporting the landuse layer’s attribute table.

**5a. Open the attribute table for the newly create landuse layer** (figure 132). This is done by **right-clicking on the layer’s name** and **selecting Open Attribute Table from the popup menu** (figure 133a). The value column of the attribute table (figure 133b) contains the values that are stored in each of the raster cells; this is the value we need to create the landcov.txt file.

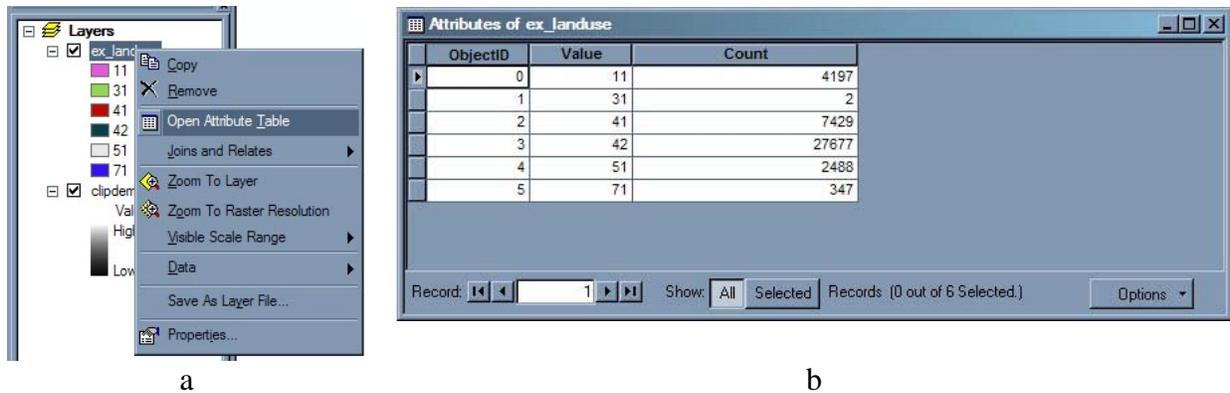


Figure 133 – a) Right-click popup menu; b) Clipped landuse layer attribute table

5b. To export this table, **click Options to open the Attribute Table Menu** (figure 134a); **select Export from this menu**. This will open the **Export Data** window (figure 134b).

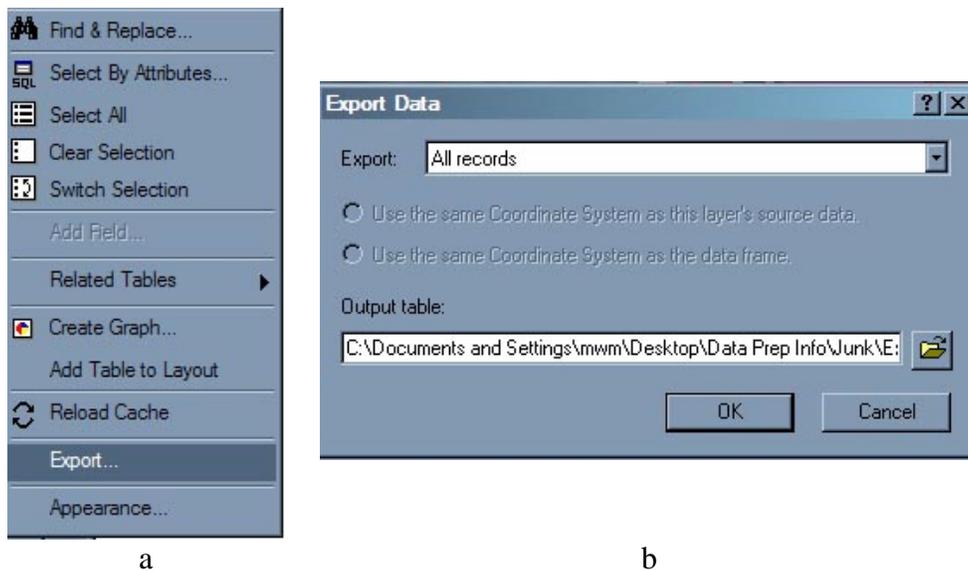


Figure 134 – a) Attribute Table Option menu; b) Export Data window

5c. We want to export all the records, so **make sure “All records” appears in the box next to Export:**. You can export the table as several different file types, including the same dbf used by shapefiles. We want to export the table as a text file; **click on the Open button** to the right of the **Output Table** text box.

**Navigate to the folder where you are storing your GeoWEPP ASCII files;** in this example, I am storing my ASCII file in “GeoWEPP ASCII Files” folder. **Enter “landcov” as the name and use Text File as the Save as Type** (figure 135). **Click Save** on the **Saving Data** window (figure 135), then **click OK** on the **Export Data** window (figure 134b). The table has been exported.

The landcov.txt file is not yet ready for use in GeoWEPP, but at least we started the process. You can also create this file manually, but the steps above ensure that all the cell values found in the landuse layer have been accounted for.

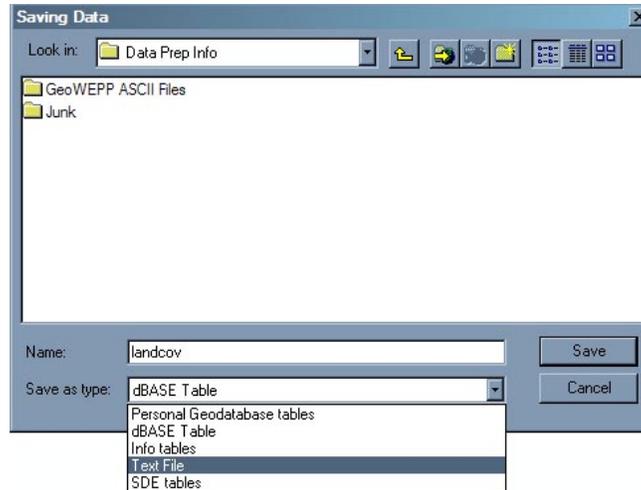


Figure 135 – Saving Data widow

7. We can now **convert the clipped landuse layer** (figure 132) to an ASCII raster file using the **Raster to ASCII** tool. Follow the same steps you used in the DEM conversion process above to convert the landuse to ASCII. This ASCII file should be saved in the same location you stored the ASCII DEM file; **use an appropriate name** like **landuse.asc**. Make sure the file is saved as an **ASCII file**.

You have now completed the preprocessing stage for your landuse. If you plan to continue on to the soil layer preprocessing stage, you should **remove all your layer except for the reprojected DEM** you used in the section; the DEM will be used for the soils in the same manner.

## 6.4 Preparing the Soil

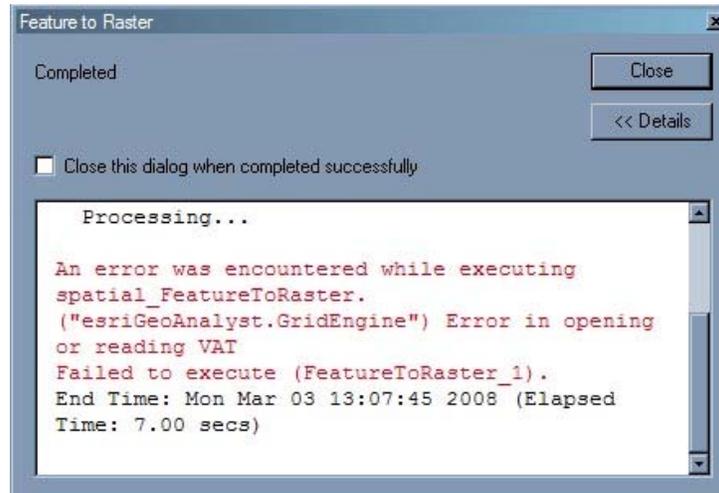
So far we have only been working with raster data; your soil data may not be available in raster format especially if you are using SURGO soil data, which is stored as a shapefile; to use this data, we will need to convert the shapefile format into raster. This conversion process can become rather complex depending on the data stored in the shapefile.

Raster data cells contain a value; in a DEM, it is the elevation of that raster cell, while the land usage code is store in a landuse raster cell. This value is always a number, which means we need to find a number within the shapefile data that we can use to store in the raster cell. One of the fields in the SURGO soil shapefile’s attribute table stores a value called MUKEY; this value links the shapefile to soil data stored in another tables.

There is one problem with this value. While it appears to be a number, it is actually stored as text. What is the difference? We may not see the difference, but computers and ArcMap do. Think of it this way: the number you need to store in the raster cell is similar to the number you use when entering a dollar amount; the numbers stored in the shapefile are the same type of numbers you use in a phone number or a street address. You can perform mathematical operations on the money value, but not on the phone number or street address.

Confusing? Yes, it can be. But, as long as you are aware that the shapefiles you obtain could have data stored in this fashion, you can work around it. If you try

converting the shapefile as is to a raster, the conversion tool will fail (figure 136). This section will show you how to prepare the shapefile for conversion.



**Figure 136 – Shapefile conversion error.**

*How do I know which I have?* Try converting the shapefile to raster and select the attribute your wish to store in the raster cell (these steps are discussed later). If you get the error shown in figure 136, then the value you chose is a “text” number and you will need to follow the steps below. If it works, then you have a “number” number and you can skip the table creation and joining steps.

Another way is to load the DBF file into excel following the sets below. Once the file has been loaded, click on the first cell of the attribute you wish to use. You may see an Excel icon that looks like an exclamation point; if you put your mouse over it, you should get a message like the one in figure 138a. You may also see a green triangle in the cell (figure 138a); this also indicates that the number in the cell is not a number. If either of these are the case, you need to continue with the steps below; if not, you can skip to the reprojection and raster conversion steps.

### **6.4.1 Before You Begin**

Since the MUKEY in the soil’s attribute table has text numbers stored in it, we need to come up with a way of converting these text numbers into actual numbers. There are several different ways of doing this; the easiest method is to create a new table where the MUKEY values are stored as numbers. This is done by creating a table based on the soil’s attribute table using Excel, which will be joined to the soil’s attribute table. This process will become clearer as we progress through the steps.

**IMPORTANT:** This example uses a SURGO soil shapefile; your soil layer may differ. **What you need to determine before you begin is which soil attribute you want to store in the raster cell.** In this example, I want to store the MUKEY value. **You will also need to determine which attribute you will use to join the new table with the soil shapefile’s table;** in this example, I am using the MUSYM attribute. Once you have decide which attributes you will be using, you may continue. **If you are unsure,** read through the steps below to get a better idea of what is being done.

1. As discussed above, we will use the soil's original attribute table to create a new table using Excel. **Start Excel and load the soil layer's attribute table, stored as a database file (\*.dbf);** to see the file, you may need to change the **Files of Type** to **All Files (\*.\*)**. In this example, I am looking for **soilmu\_a\_co622.dbf** (figure 137). **Select your soil's attribute table and click Open.**

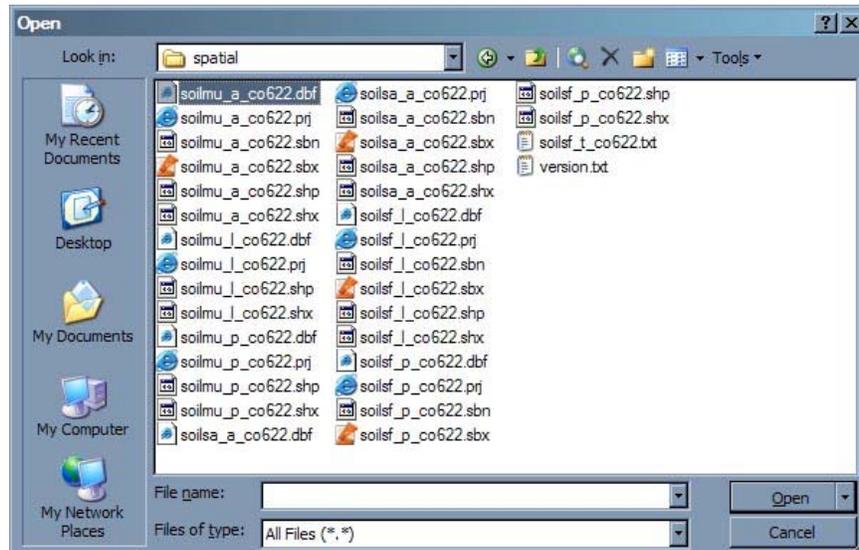


Figure 137 – Soil attribute table within the spatial folder

2. Once the file loads into Excel, you will notice a number of columns (figure 138a). In this example, we only need the last two columns: **MUSYM** and **MUKEY**; **MUKEY** is the value we need to be stored in the raster cells and **MUSYM** will be used to join the table we are about to create with the soil's attribute table. **Remove all the other columns.** Next, we need to **rename MUKEY to MUKEY\_2** (figure 138b); if this column is not renamed, the **Feature to Raster** tool we will use later will cause an error.

	A	B	C	D	E	F	G	H
1	AREASymbol	SPATIALVER	MUSYM	MUKEY				
2	CO622	2 Sa	498761					
3	CO622	2 BwD	498710					
4	CO622	2 FoD	The number in this cell is formatted as text or preceded by an apostrophe.					
5	CO622	2 BrD	498704					
6	CO622	2 Sn	498764					
7	CO622	2 BtE	498706					
8	CO622	2 Lo	498738					
9	CO622	2 RnE	498758					
10	CO622	2 FoD	498718					
11	CO622	2 NeE	498742					
12	CO622	2 Se	498763					
13	CO622	2 FoD	498718					
14	CO622	2 NsE	498743					
15	CO622	2 Sd	498762					
16	CO622	2 Lu	498739					
17	CO622	2 FoB	498717					
18	CO622	2 Lo	498738					
19	CO622	2 RmE	498757					
20	CO622	2 BsE	498705					

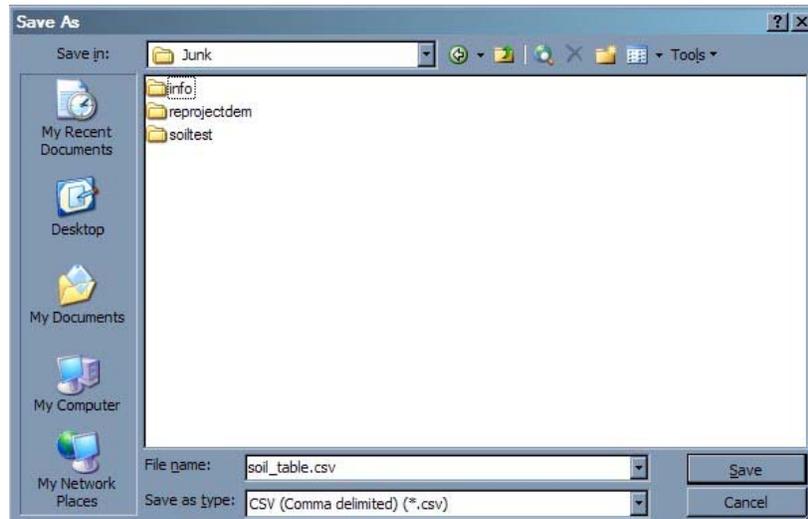
a

	A	B	C
1	MUSYM	MUKEY_2	
2	Sa	498761	
3	BwD	498710	
4	FoD	498718	
5	BrD	498704	
6	Sn	498764	
7	BtE	498706	
8	Lo	498738	
9	RnE	498758	
10	FoD	498718	
11	NeE	498742	
12	Se	498763	
13	FoD	498718	
14	NsE	498743	
15	Sd	498762	
16	Lu	498739	
17	FoB	498717	
18	Lo	498738	
19	RmE	498757	
20	BsE	498705	

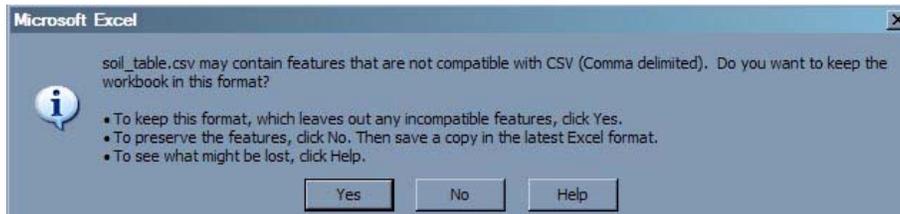
b

Figure 138 – a) The original soil attribute table; b) renamed MUKEY column to MUKEY\_2

3. Finally, we need to save this table; we will save **this file as a CVS (comma delimited) file (\*.csv)**. Select **Save As...** from the **File** menu; navigate to your **“junk” folder** and **save the file as soil\_table**; select **CVS as the Save as Type** (figure 139a) and **click Save**. You will get an Excel Message box (figure 139b); **click Yes** to continue.



a



b

Figure 139 – a) Excel Save As...window; b) Excel information window that can be ignored

4. Once the file has been saved, **close Excel**; if asked to save the file, **select No**. You have now created the table we will use to properly convert the soil shapefile to raster.

## 6.4.2 Converting the Soil Shapefile

Now we can begin the conversion process from shapefile to raster.

**1. Load your soil layer into ArcMap.** You will also need have your projected DEM loaded into ArcMap; we will use this DEM the same we did when converting the landuse layer discussed above.

**2. Add the table you create in Section 6.4.1 to ArcMap;** this is done the same way you add any piece of GIS data to ArcMap. **Navigate to the folder in which you stored the table, select it and click Add.**

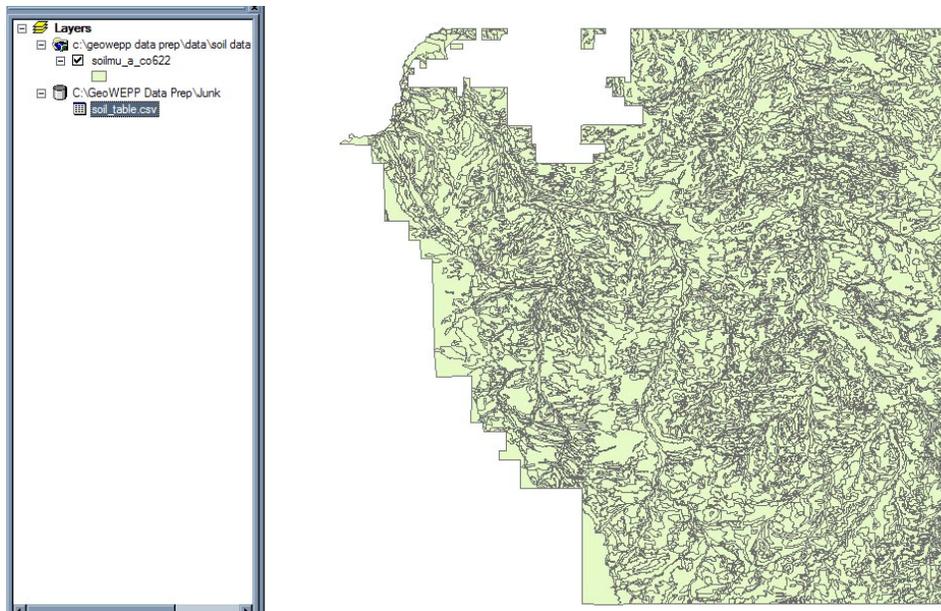


Figure 140 – Soil shapefile and soil\_table.cvs loaded into ArcMap

3. We need to **determine the Spatial Reference** of the soil layer; the soil layer needs to be in the same projection as the DEM and landuse layers. Right-click on the soil layer’s name and select Properties from the popup menu; click on the source tab to view the soil shapefile’s spatial information (figure 141). If the soil’s coordinate system is not the same as the DEM projection, we will need to project the soil layer before we continue.

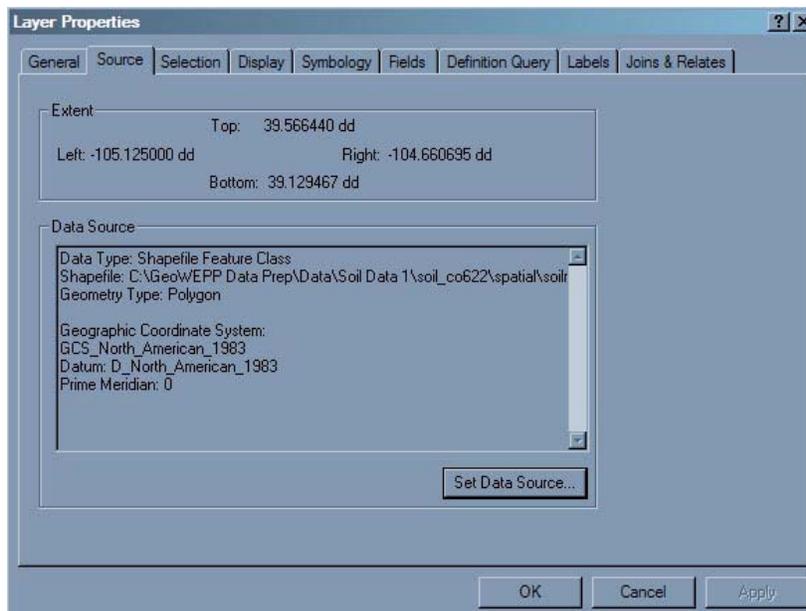


Figure 141 – Soil Layer Spatial Reference

4. Like the other layers, the **shapefile needs to be in the same project as the DEM**. Its best if we do this before we convert the shapefile to raster. The **Project** tool is used to project shapefiles the same way the **Project Raster** tool is used for raster files. The **Project tool is located in:**

Data Management→Projections and Transformations→Feature

4a. **Double-click on the Project tool** to open the tool's parameter window (figure 142a). This tool **requires three parameters**: the original shapefile (**Input Dataset or Feature Class**), the name and location of the newly projected shapefile (**Output Dataset or Feature Class**), and the projection the output shapefile will be in (**Output Coordinate System**).

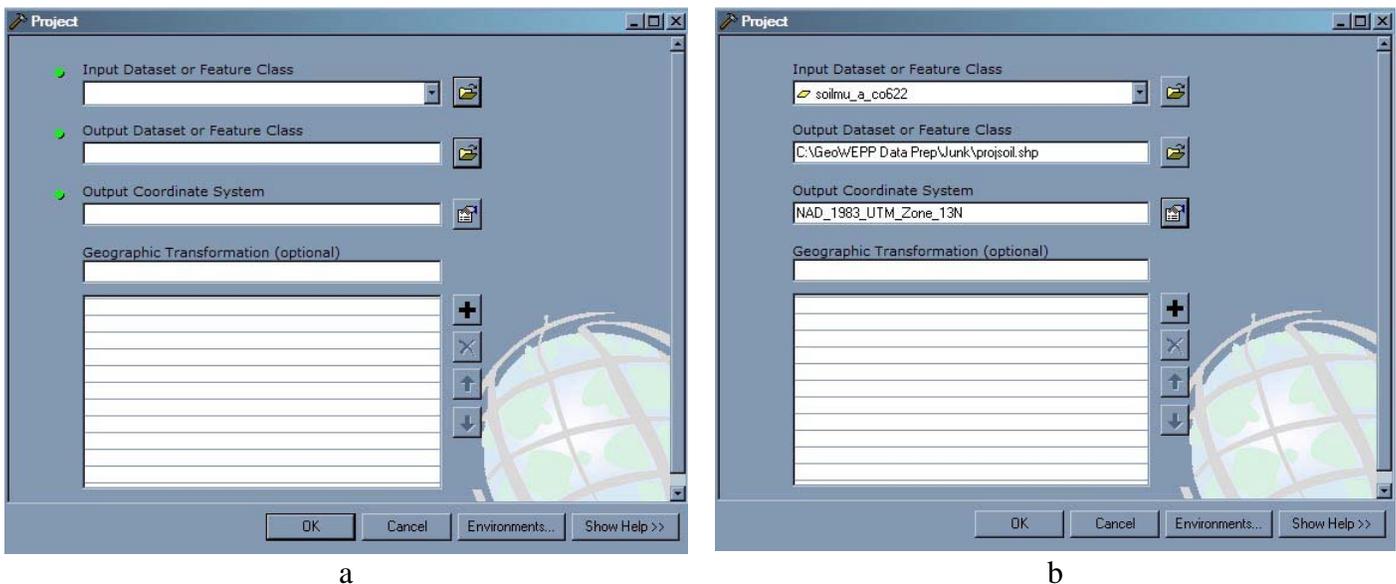


Figure 142 – a) Project tool parameter window; b) Project parameters entered

4b. **Select the soil layer from the dropdown list for the Input Dataset or Feature Class**. Since this is an intermediate step, we can **save the new projected shapefile in a “junk” folder**; **click the Open button** next to the **Output Dataset or Feature Class** textbox and **navigate to where you want to store the shapefile and enter a name for the new shapefile** – something like projsoil.

4c. You have already learned **two ways to select the output coordinate system**. Use **either method to assign the same projection used for the DEM and landuse to the new shapefile**.

4d. Once all the parameters have been entered (figure 142b), **click OK** to run the **Project** tool. When the tool has finished running, **remove the original soil shapefile leaving the newly projected soil layer**.

6. Now that the shapefile is in the correct projection, **we can begin the conversion to raster process**. First, we need to **join the projected soil layer's attribute table with the**

table we created in Excel; there are two ways to do this: using the **Add Join** tool or through the **right-click popup menu**. We will use the popup menu to perform the join.

6a. If you wish to look at the soil layer's attribute table by **right-clicking on the soil layer's name** and **selecting Open Attribute Table from the popup menu**; similar steps can be followed to open the soil\_table.csv table. Both of these tables are shown in figure 143.

FID	Shape*	AREASymbol	SPATIALVER	MUSYM	MUKEY
0	Polygon	CO622		2 Sa	498761
1	Polygon	CO622		2 BwD	498710
2	Polygon	CO622		2 FoD	498718
3	Polygon	CO622		2 BrD	498704
4	Polygon	CO622		2 Sn	498764
5	Polygon	CO622		2 BtE	498706
6	Polygon	CO622		2 Lo	498738
7	Polygon	CO622		2 RnE	498758
8	Polygon	CO622		2 FoD	498718
9	Polygon	CO622		2 NeE	498742
10	Polygon	CO622		2 Se	498763
11	Polygon	CO622		2 FoD	498718
12	Polygon	CO622		2 NsE	498743
13	Polygon	CO622		2 Sd	498762
14	Polygon	CO622		2 Lu	498739
15	Polygon	CO622		2 FoB	498717
16	Polygon	CO622		2 Lo	498738

a

MUSYM	MUKEY_2
Sa	498761
BwD	498710
FoD	498718
BrD	498704
Sn	498764
BtE	498706
Lo	498738
RnE	498758
FoD	498718
NeE	498742
Se	498763
FoD	498718
NsE	498743
Sd	498762
Lu	498739
FoB	498717
Lo	498738

b

Figure 143 – a) Soil Layer attribute table; b) soil\_table.csv table

6b. **Right-click on the projected soil's name** to bring up the popup menu. **Select Joins and Relates from the menu**; this will create a smaller menu to the right of the popup menu. **Select Join...** from this new menu. This will bring up the **Join Data** window (figure 144).

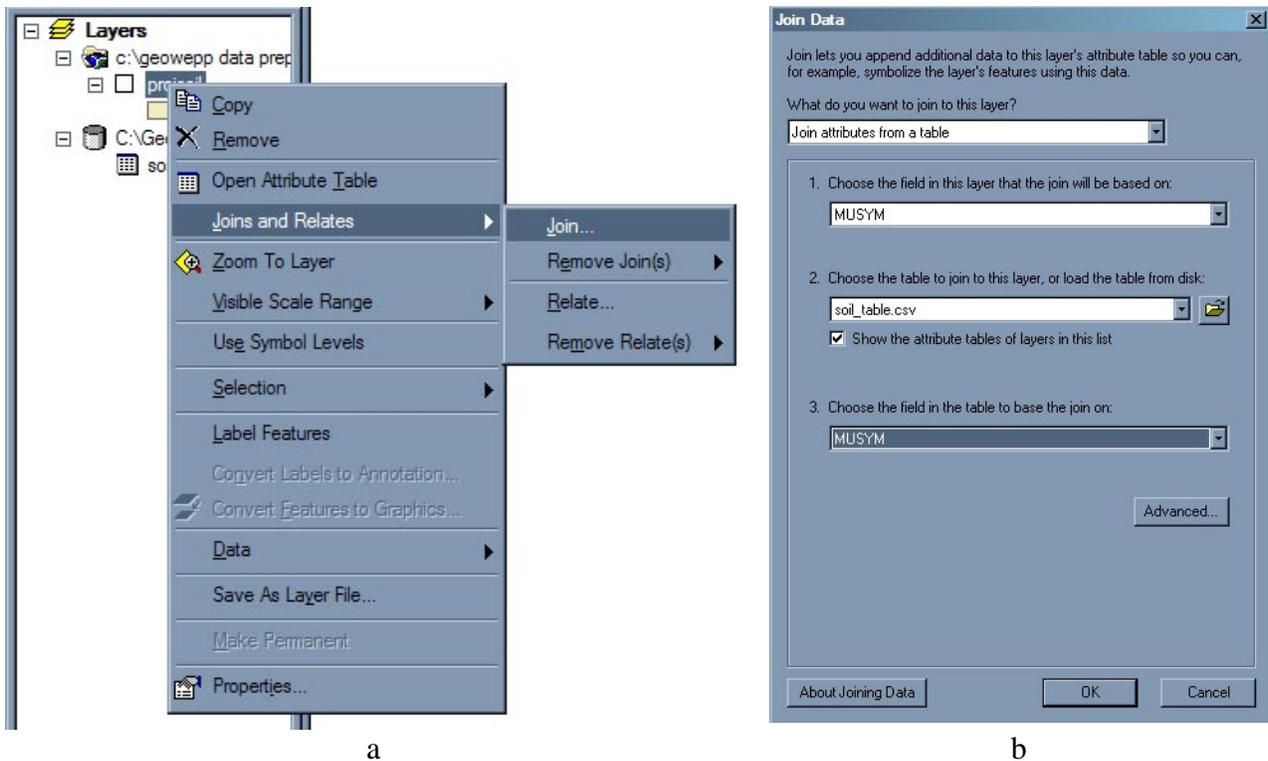


Figure 144 – a) Right-click popup menu with Joins and Relates menu; b) Join Data window

6c. Some of the parameters may have already been entered into the **Join Data** window; all we need to do is **supply which field will be used to join the table**. Use the dropdown list for **“1. Choose the field in this layer that the join will be based on:”** and for **“3. Choose the field in the table to base the join on:”** to select the attribute you plan to use to join the tables; in this example I use MUSYM (see figure 144). When done, **click OK**. The join has now been made; figure 145 shows what the newly joined table looks like. This is the attribute table attached to the projected soil shapefile. We are now ready to convert this shapefile to raster.

Figure 145 shows a screenshot of a table window titled 'Attributes of projsoil'. The table has five columns: projsoil.SPATIALVER, projsoil.MUSYM, projsoil.MUKEY, MUSYM, and MUKEY\_2. The data consists of 20 rows of soil profile information. At the bottom of the window, there is a record navigation bar showing 'Record: 1' and 'Show: All Selected'.

projsoil.SPATIALVER	projsoil.MUSYM	projsoil.MUKEY	MUSYM	MUKEY_2
2	Sa	498761	Sa	498761
2	BwD	498710	BwD	498710
2	FoD	498718	FoD	498718
2	BrD	498704	BrD	498704
2	Sn	498764	Sn	498764
2	BlE	498706	BlE	498706
2	Lo	498738	Lo	498738
2	RnE	498758	RnE	498758
2	FoD	498718	FoD	498718
2	NeE	498742	NeE	498742
2	Se	498763	Se	498763
2	FoD	498718	FoD	498718
2	NsE	498743	NsE	498743
2	Sd	498762	Sd	498762
2	Lu	498739	Lu	498739
2	FoB	498717	FoB	498717

Figure 145 – The joined soil layer attribute table

7. We will use the **Feature to Raster** conversion tool to convert the shapefile. The tool is located in:

Conversion Tools→To Raster

7a. **Double-click on the tool** to open the tool's parameter window (figure 146a). This tool has **three required parameters and one optional one**: the shapefile we want to convert (**Input Feature**), the shapefile's attribute we wish to store in the raster cells (**Field**), the name and location of the new raster (**Output Raster**), and the new raster's cell size (**Output Cell Size**). We will need to use all four parameters.

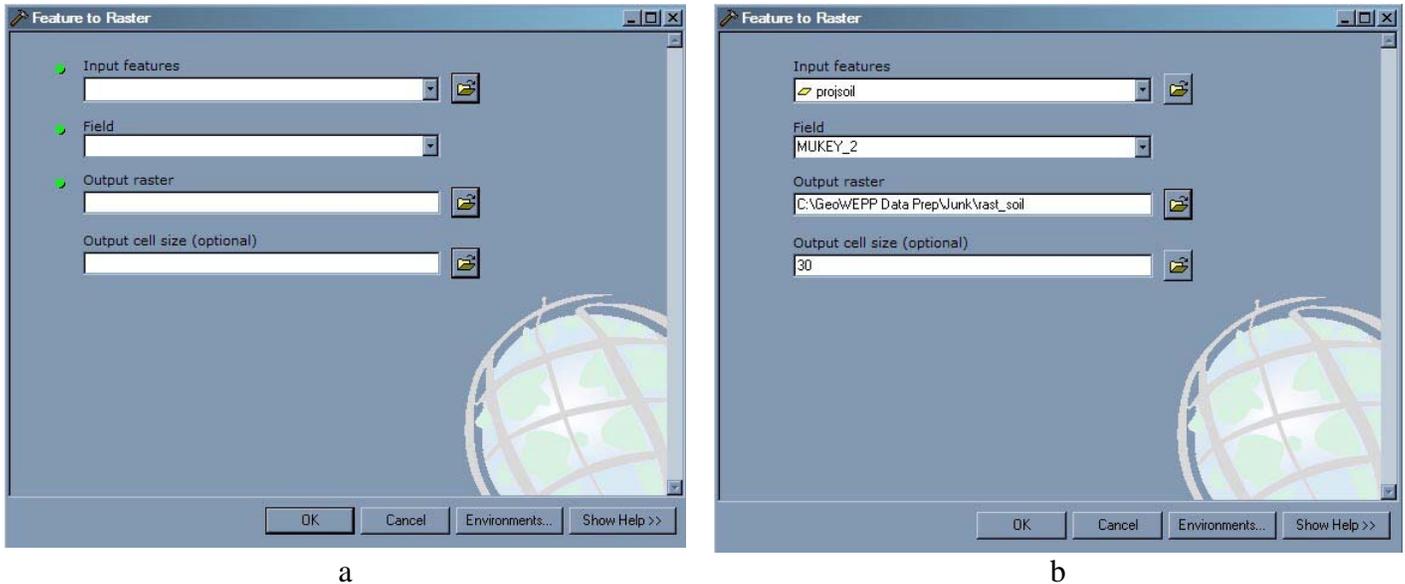
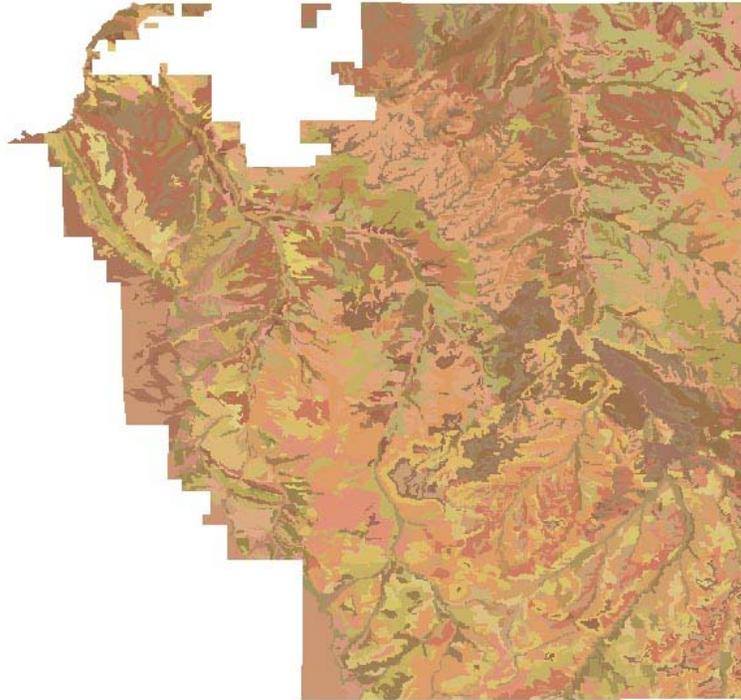


Figure 146 – a) The Feature to Raster tool parameter window; b) All parameters entered into tool

7b. **Select the projected soil layer shapefile from the Input Feature drop down list.** Next, **select column you wish to store in the raster cells from the dropdown list for the Field parameter.** This column is the one you renamed in *Section 6.4.1*; in this example I am selecting MUKEY\_2.

7c. For the **Output Raster**, use the **Open** button to **navigate the folder in which we want the shapefile raster to be stored**; once again, this is an intermediate step, so we can use a “junk” folder. **Enter a name that described the raster file**, like rast\_soil.

7d. We want the new **raster's cell size to be the same as the DEM** we are using. This cell size is based on the projection of the shapefile; our shapefile is in UTM's, which means the value we enter will be in meters. **The cell size of the DEM used in this example is 30m, so enter 30 in the Output Cell Size.** Click **OK** to start the tool. Figure 147 shows the resulting raster layer.



**Figure 147 – Soil data as raster**

After the tool has finished converting the shapefile, you can remove all the layers except for the new soil raster layer and the reprojected DEM.

**8.** If your soil layer happens to be larger than you projected DEM, it may be wise to clip it before continuing on. This will help reduce the time GeoWEPP needs to complete some tasks. Follow the same steps for the **Extract by Mask** tool that were used in the landuse section.

**9.** Just like for the landuse, GeoWEPP uses two text files to link the soil GIS data with the WEPP soil parameter files. To start the process, you should export the new soil raster layer's attribute table to text file, just like you did for the landuse; you should save this file as soilsmap.txt and store it in the same folder as all you GeoWEPP ASCII files. Once you have finished the preprocessing steps presented here, continue on to section **7 Advanced GeoWEPP Tools – A Revisit** to complete the text file creations process.

**10.** You can now complete the process by following the same step we used for the anduse layer. You will need to convert the soil raster layer to an ASCII raster file using the **Raster to ASCII** tool. If your soil layer is large than your DEM, you can use the Extract by Mask tool to reduce you soil layer size (just like we did with the landuse).

*What if I have more than one soil shapefile?*

In some cases you may have more than one shapefile for your study area, but GeoWEPP can only use one layer. You will need to merge these files to create one soil layer.

To do this you will need to convert each shapefile using the steps discussed above. Once you have converted them all to raster, you can use the **Mosaic to New Raster** tool (discussed in *Section 6.2.2*) to merge the soil layer together. Make sure you complete the merge processes before you use the **Extract by Mask** tool and/or before you export the soil's attribute table.

You have not completed all the steps necessary to prepare the GIS data for use in GGeoWEPP. If you wish, you can now start GeoWEPP and load you GIS data (the ASCII files you just created). But, you will need to change a number of default values before you continue on with any simulation. This can be fixed by reading the next section, which guides you through the steps necessary to link the text files you created above to the WEPP parameter files for the simulations.

## 7 Linking GIS Data to WEPP Parameter Files – Creating the Text File Bridges

The previous section provided a brief introduction to the text files that GeoWEPP uses to connect the GIS data with the WEPP parameter files. This section will expand upon that introduction by explaining how these files are used and how to finish the creation process begun in the previous section.

Depending on the size of your study area and the number of vegetation and soil types you use, creating these files can become time consuming. The good news is, as long as you are using the same descriptions and raster cell values, you can use these text files in all you GeoWEPP projects.

If you are running low on time, GeoWEPP can create these files for you when you load the ASCII data into GeoWEPP. This prevents problems that will occur if the files are not present. But, the files are filled with default values and will take some time for you to correct before you can run your simulations. Either way, you will need to make some corrections before you can continue on with your simulations.

### 7.1 The Landuse Text Files

If you have read through the manual up to this point, you are aware that the landuse layer uses two text files along with the raster ASCII file: landcov.txt and landusedb.txt. The tutorial and data preparation sections of this manual gave a brief introduction to these files. Now a more detailed explanation of how these files work and how to create them will be presented.

You are not required to create any of these files; if they are not present GeoWEPP will create default files. If this is done, you will need to make some changes to your parameter setup before running your simulations. While this may not seem like much, the more areas you work on, the more time you will spend making corrections to the parameters.

Also, you may not need to create a separate landcov.txt or landusedb.txt file for each of your study areas. If you are using the same coding system, like the USGS Landuse coding system below:

<b>Code</b>	<b>Description</b>	<b>Code</b>	<b>Description</b>
11	Open Water	51	Shrubland
12	Perennial Ice/Snow	61	Orchards/Vineyards/Other
21	Low Intensity Residential	71	Grasslands/Herbaceous
22	High Intensity Residential	81	Pasture/Hay
23	Commercial/Industrial/Transportation	82	Row Crops
31	Bare Rock/Sand/Clay	83	Small Grains
32	Quarries/Strip Mines/Gravel Pits	84	Fallow
33	Transitional	85	Urban/Recreational Grasses
41	Deciduous Forest	91	Woody Wetlands
42	Evergreen Forest	92	Emergent Herbaceous Wetlands
43	Mixed Forest		

and assigning the same WEPP management files to each description, you can create one file and use it for all your projects.

### 7.1.1 Creating the Landcov.txt File

There are two ways you can create the landcov.txt file; one of which you may have already started if you used the steps in *Section 6*. The first method is just to open any text editor and started adding your code and descriptions. The other method involves editing the exported attribute table of the raster landuse layer. Either method is acceptable, but using the exported table guarantees that all the values found in the raster layer will have a description in the landcov.txt file.

The basic idea of the landcov.txt file is to provide a number and then a description. The number is the value found in the landuse raster layer; the description is anything that will describe what the raster cell value represents. It could be as simple as the USGS codes listed above or as complex as scientific species names. It is up to you to decide.

Figure 148a shows an example of what an exported raster attribute table looks like; depending on your version of ArcGIS, it may look different. What we are really need from this table is the “Value” column; this is the value found in each raster cell. The first task is to remove everything else so that on the value column is left. The next step is to add the description. There is no set format for the description; all you need to do is enter a single space after the value and then enter the description. Figure 148b shows the results of this editing process.

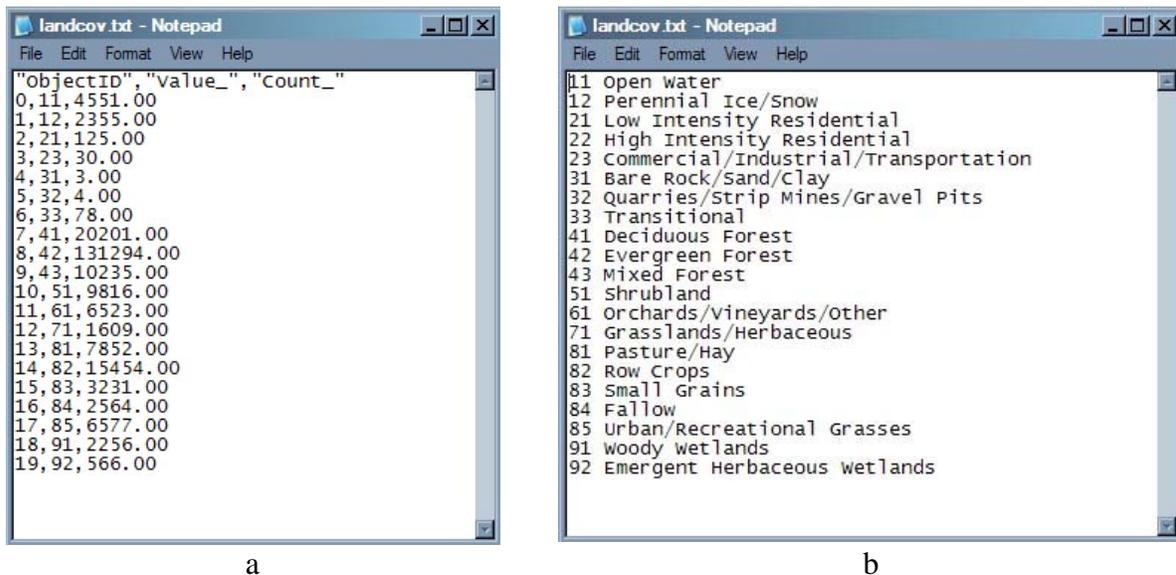


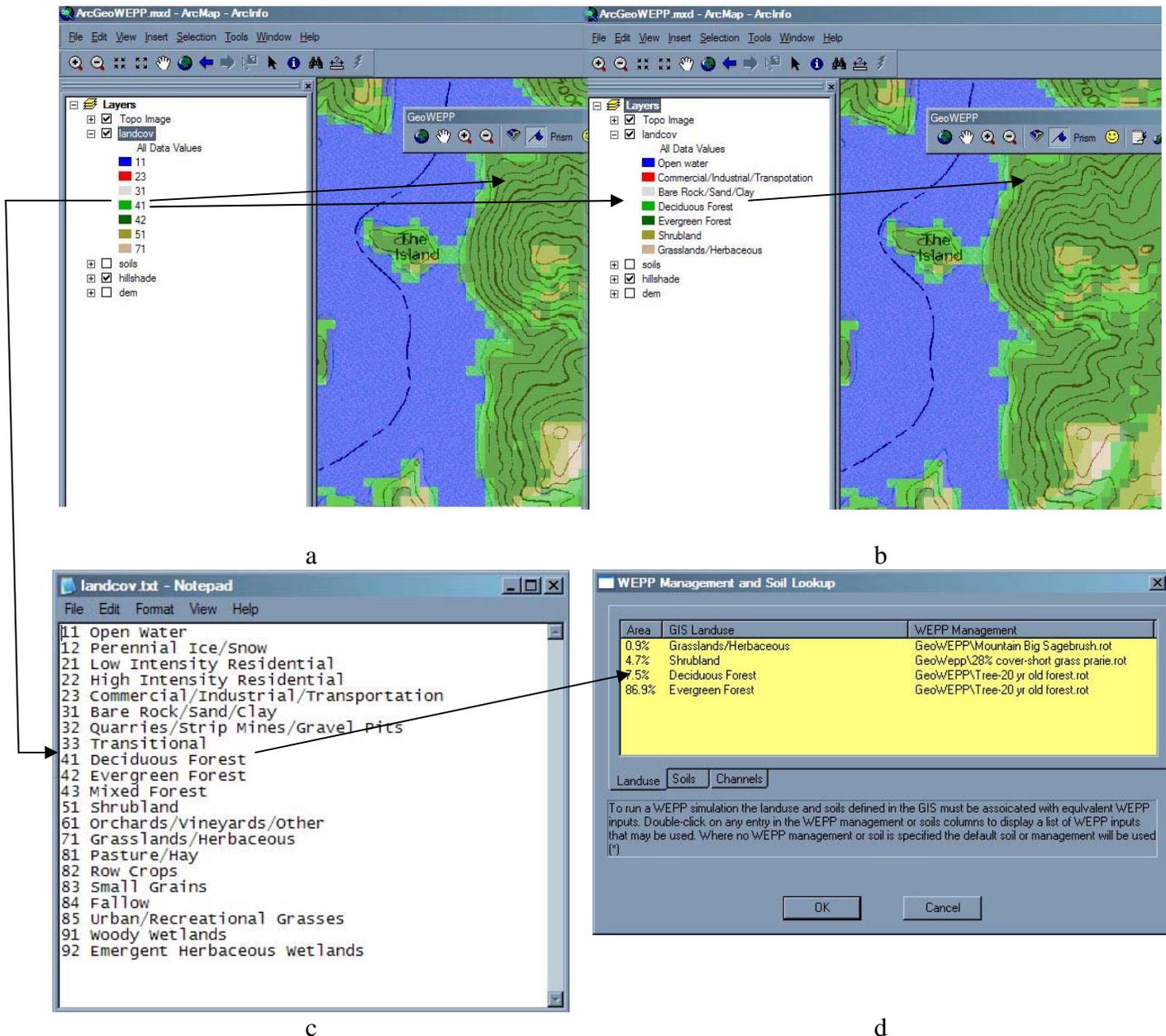
Figure 148 – a) Exported landuse layer attribute table; b) the final landcov.txt file

If you don't have an exported attribute table, all you need to do is open any text editor and enter a number and a description. And you don't have to worry about having more numbers in the landcov.txt file than you have in the landuse raster; GeoWEPP will only pick the descriptions it needs. Because of this, you can create one large landcov.txt that holds all the codes and descriptions you may ever need.

Once you have finished editing, save the file.

## 7.1.2 How the Landcov.txt Works within GeoWEPP

Figure 149 details how the landcov.txt file is used within GeoWEPP.



**Figure 149 – Linkage between GeoWEPP, landuse text files and WEPP: a) GeoWEPP without legend descriptions; b) GeoWEPP with legend descriptions; c) landcov.txt; d) WEPP/TOPAZ Translator**

In the case above (which is from the Pre-Fire Forest example set), the user would see image in figure 149b on their screen with a legend. In reality, GeoWEPP only “sees” numbers for the different cells of the landuse layer (figure 149a). To pass on what the user “sees” to the WEPP/TOPAZ Translator, the landcov.txt is used as a bridge. The number value is read from GeoWEPP and landcov.txt (figure 149c) is referenced to

determine what the WEPP/TOPAZ Translator should display in the GIS Landuse column (figure 149d).

For example, the user would see that the light green color is for Deciduous Forest, but GeoWEPP would only “see” 41. WEPP/TOPAZ Translator would “look up” the number 41 in the landcov.txt and would then display Deciduous Forest in its GIS Landuse column.

### 7.1.3 Creating the Landusedb.txt File

Now that you have linked the raster cell values with a description, you will need to link that description to a WEPP parameter file (for landuse, it would be a .ROT file). This linkage is done through the landusedb.txt file; creating this file will take some time since you need to look up each file you wish to use.

The easiest way to create this file is to first open the landcov.txt file you just created and save it as landusedb.txt; this way you won’t accidentally overwrite the wrong file. Next, remove all the number codes from the file leaving only the description. After each description, enter a vertical line “|”; the key used for this is above the enter key on your keyboard. Now you are ready to add the WEPP parameter paths.

By modifying the landcov.txt file, you are making sure that the description in the landusedb.txt file is exactly the same as the one in the landcov.txt file; if these descriptions aren’t the same, the linkage will not work.

The easiest way to determine the path you need for the WEPP parameter file is to use WEPP itself. The path used is not the same as a file’s pathname. The path we need describes how WEPP stores the different parameter files.

To determine the WEPP path for a management file:

1. Open any hillslope in WEPP
2. Select the Management layer of the hillslope
3. Right-click on the Management layer and choose import from the popup menu
4. Navigate to the management file you desire using the **Select a Management file:** window (figure 150). The displayed hierarchy is the path you need to enter into the landusedb.txt file

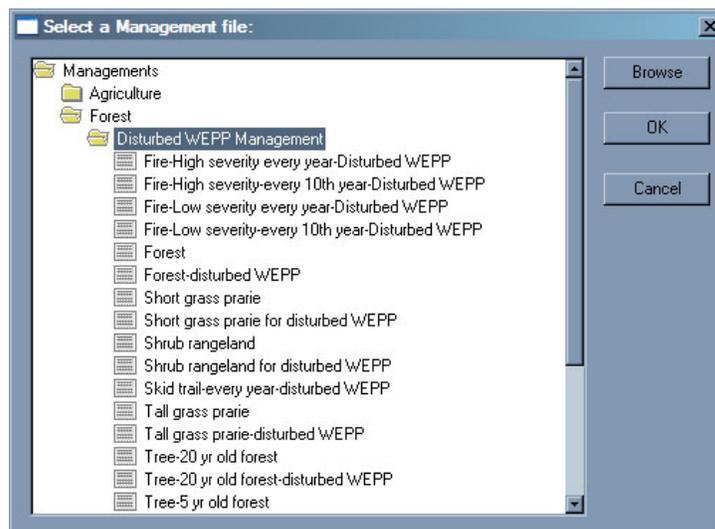


Figure 150 – WEPP Management pathway hierarchy

For example, in your landcov.txt file you have the description “Shrubland”. The WEPP parameter file you want to associate with this description is “Shrub rangeland.rot”. By using the method above, you are able to determine the this WEPP file is located in the “Forest/Disturbed WEPP Management” (figure 150). You would then enter:

Shrubland| Forest/Disturbed WEPP Management/Shrub rangeland.rot

in the your landusedb.txt file.

Note: All the management files have the extension “.rot”; you need to supply this when enter the path information in the landusedb.txt file. As you can see from figure 150, the “.rot” is not present in the description.

Figure 151 shows an example of a landusedb.txt file based on the landcov.txt file depicted above.

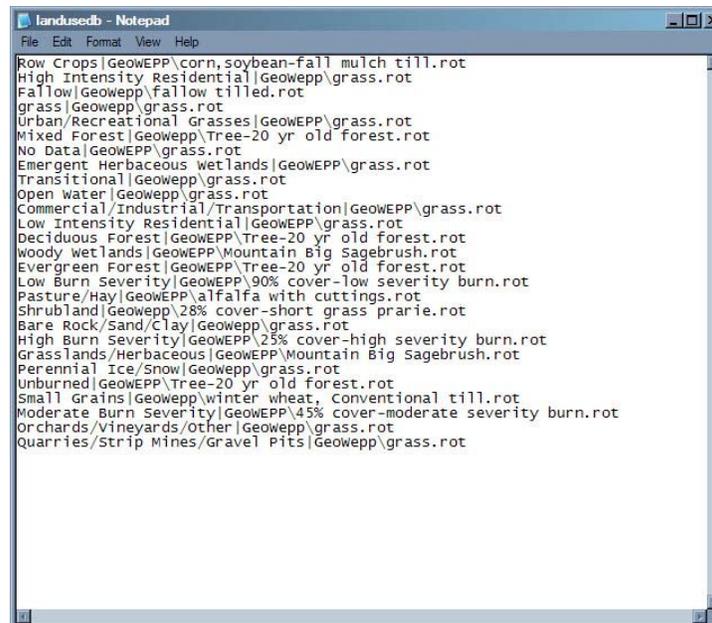
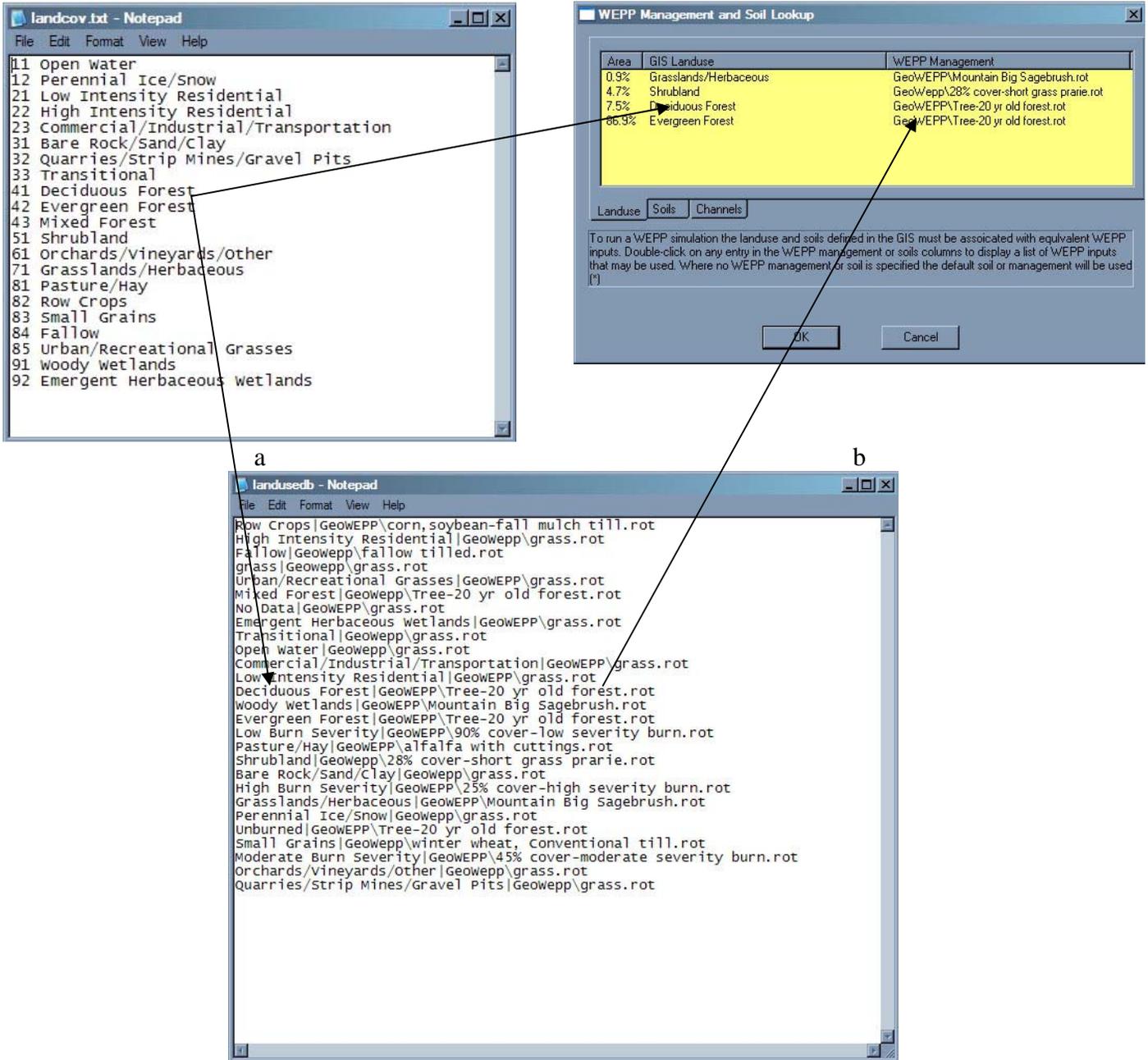


Figure 151 – The landusedb.txt based on the landcov.txt file

#### 7.1.4 How Landcov.txt and Lanusedb.txt Work Together within GeoWEPP

You already know how the landcov.txt file works in GeoWEPP. Figure 151 depicts how the landcov.txt and landusedb.txt files work together.



**Figure 152 – The interaction between a) landcov.txt, b) WEPP/TOPAZ Translator, and c) landusedb.txt**

Continuing our example from earlier, the description for the Deciduous Forest has already been entered. GeoWEPP now references the landusedb.txt file to file the Deciduous Forest description. Once it has found it, it reads the path of the WEPP parameter file and enters it into the **WEPP Management** column of the Translator. The GIS data is now linked to the WEPP parameter file.

## 7.2 The Soil Text Files

The soil layer also uses two text files – soilsmap.txt and soilsdb.txt – to create a bridge between the GIS raster data and the WEPP soil parameter files - \*.sol files. The process for creating these files is similar to the creation process discussed above; the relationship between these files and how they are used in GeoWEPP is the same as those text files used for the landuse layer.

### 7.2.1 Creating the Soilsmap.txt File

The soilsmap.txt file serves the same purpose as the landcov.txt file does for the landuse layer; it links the soil raster cell values with a soil description you provide. You can create this file using the same methods discussed above. The easiest is to modify the exported attribute table text file created in *Section 6*.

There are two differences between the format used in the soilsmap.txt file compared to the one used in the landcov.txt file. First, the code value must be followed by two commas in the soilsmap.txt file. The soilsmap.txt file shown in figure 153a is the exported attribute table from a soil raster file. The center column contains the raster cell value we need to create a working soilsmap.txt; the column you may need will depend on the version of ArcGIS you are using.

To complete the process, we would need to remove all other information from the text file and then add two commas after each soil raster cell value. Once this is done, we can add any soil description we wanted to; figure 153b shows the final soilsmap.txt file.

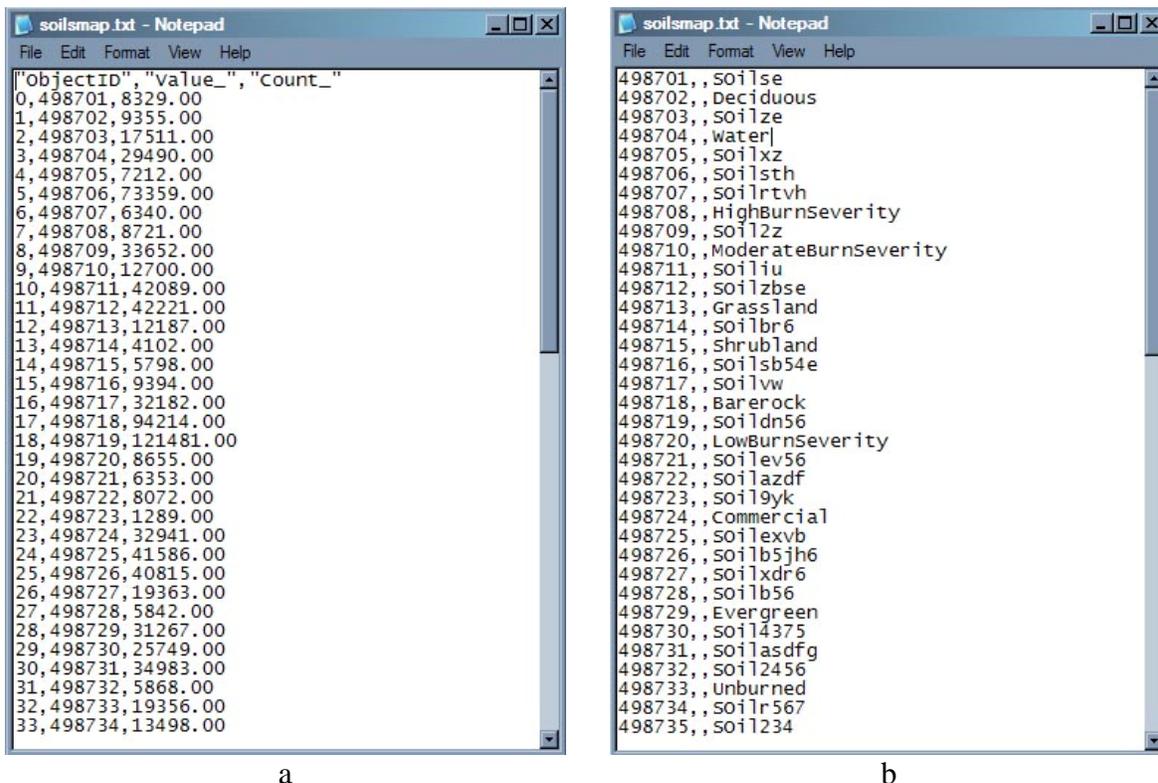


Figure 153 – a) Exported soil layer attribute table; b) the final soilsmap.txt file

The second formatting difference involves the description we would use; you will not be able to use spaces in the description. Everything entered after the space in the description will be ignored. An example of this is shown in figure 154. The description assigned to value 41 is Deciduous Forest, but the **GIS Soil** column shown in figure 154b only provides the description Deciduous. This means if you have one soil description as “Loam, Sandy” and another as “Loam, Silt”, they may both be considered “Loam,” in the description and will result in calculation errors.

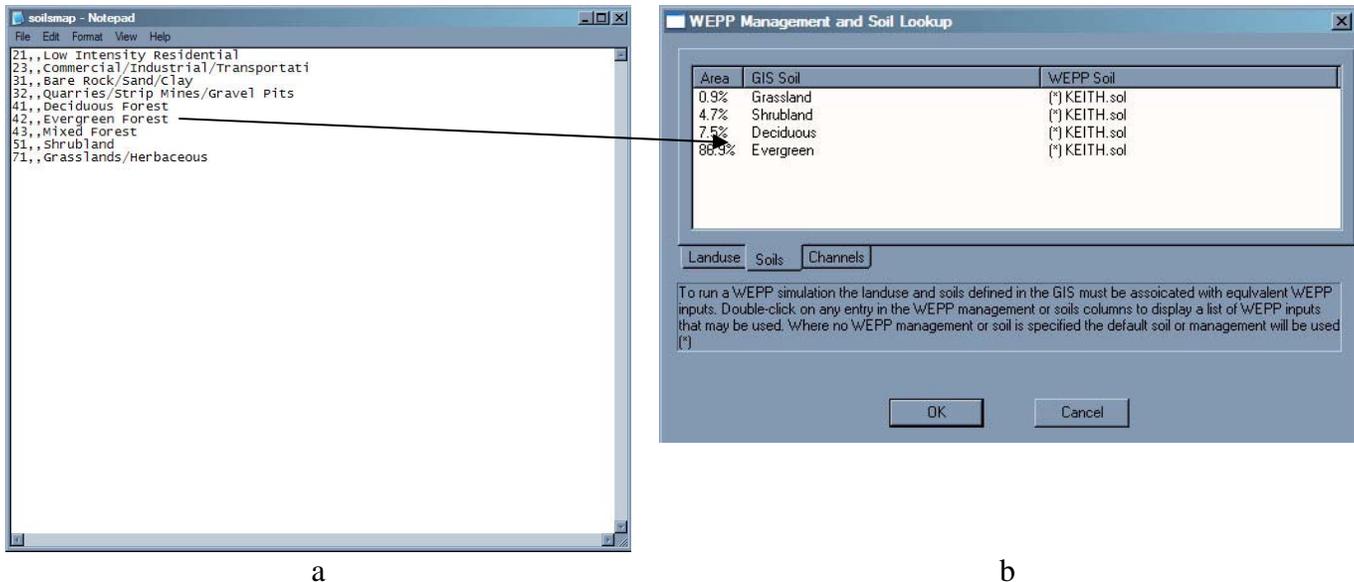


Figure 154 – The interaction between a) soilsmap.txt, and b) the WEPP/TOPAZ Translator

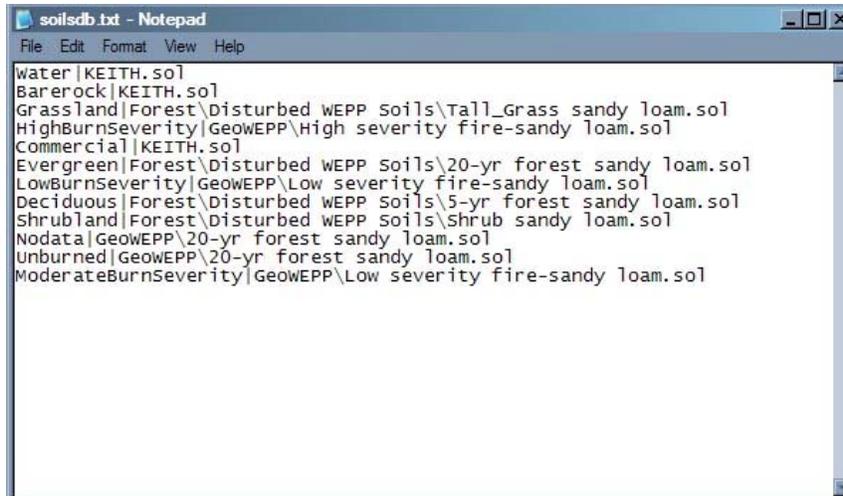
## 7.2.2 Creating the Soilsdb.txt File

The process involved in creating the soilsdb.txt is exactly the same as the one for the landusedb.txt file. The only difference is that each WEPP soil parameter file needs to end in “.sol”, instead of “.rot”. You still need to use exactly the same description as the one supplied in the soilsmap.txt file and the description is followed by a”|”.

To determine the WEPP path for a soil file:

1. Open any hillslope in WEPP
2. Select the Soil layer of the hillslope
3. Right-click on the Soil layer and choose import from the popup menu
4. Navigate to the soil file you desire. The displayed hierarchy is the path you need to enter into the soilsdb.txt file

A finalized version of a soilsdb.txt file can be seen in figure 155. Note the similarities between the soilsdb.txt file and the landusedb.txt file (figure 151).



```
water|KEITH.so1
Barerock|KEITH.so1
Grassland|Forest\Disturbed WEPP Soils\Tall_Grass sandy loam.so1
HighBurnSeverity|GeowEPP\High severity fire-sandy loam.so1
Commercial|KEITH.so1
Evergreen|Forest\Disturbed WEPP Soils\20-yr forest sandy loam.so1
LowBurnSeverity|GeowEPP\Low severity fire-sandy loam.so1
Deciduous|Forest\Disturbed WEPP Soils\5-yr forest sandy loam.so1
Shrubland|Forest\Disturbed WEPP Soils\Shrub sandy loam.so1
Nodata|GeowEPP\20-yr forest sandy loam.so1
Unburned|GeowEPP\20-yr forest sandy loam.so1
ModerateBurnSeverity|GeowEPP\Low severity fire-sandy loam.so1
```

**Figure 155 – An example of a soilsdb.txt file**

### **7.3 The Benefits with the DB files**

The second text file you created in both sets is considered the database, or db, file. As you have seen, it links the description associated with the raster cell value with a WEPP soil or management file. The good news is that you can create a large db file that holds all the possible soil/management and WEPP file combinations you will ever use. This allows you to use the same db text file for all of your projects. The benefit of these files means that you don't have to create a new db file for every project you create; all you need to do is assign the description to a raster cell value in the landcov.txt file

## 8 GeoWEPP Example Sets

Since you may be new to GeoWEPP, or at least this version of it, we have provided four different example sets for you to play with. This way, you have three different locations with preprocessed “GeoWEPP-friendly” data that allows you to experiment with the tools and processes in GeoWEPP before attempting them using your own data. Two of these example sets, the Pre-Fire Forest and the Post-Fire Forest (BAER), are used with the two exercises we have provided for GeoWEPP. The Pre-Fire forest data set is also the one used in the tutorial presented in this manual.

We feel that this will allow you to worry more about how GeoWEPP works than the results. Once you get use to GoWEPP, you’ll be able to analyze your study area more efficiently.

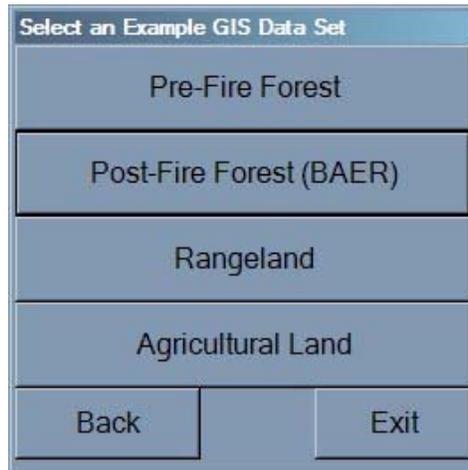


Figure 156 – Available Example Sets

### 8.1 Pre-fire Assessment (CWE)

#### Description

This example set is used for the Cumulative Watershed Effects (CWE) exercise. This site, located near the Cheesman Reservoir in Colorado, displays the landcover and soil information for the region before a wildfire had occurred.

#### Coordinates (UTM Zone 13)

	<b>X</b>	<b>Y</b>
<b>Minimum</b>	467536.2	4330678.5
<b>Maximum</b>	478366.2	4344598.5

#### WEPP parameters files associated with the data

	<b>WEPP Files</b>
<b>Soil</b>	GeoWEPP\20-yr forest sandy loam.sol
<b>Management</b>	GeoWEPP\Tree-20yr old forest.rot
<b>Climate</b>	Colorado\CHEESMAN CO.cli

Files in example set

<b>Layer</b>	<b>Associated Files</b>
DEM	dem.asc
Landuse	landcov.asc, landcov.txt, landusedb.txt
Soil	soilsmap.asc, soilsmap.txt, soilsdb.txt
Topo Image	topo.aux, topo.rrd, topo.tfw, topo.tiff
UTM	utmzone.txt

## **8.2 Post Fire Assessment (BAER)**

Description

This example set is used for the Post Fire Assessment (BAER) Exercise. This site, located near the Cheesman Reservoir in Colorado, displays the landcover and soil information for the region after a wildfire had occurred.

Coordinates (UTM Zone 13)

	<b>X</b>	<b>Y</b>
<b>Minimum</b>	467536.2	4330678.5
<b>Maximum</b>	478366.2	4344598.5

WEPP parameters files associated with the data

	<b>WEPP Files</b>
<b>Soil</b>	GeoWEPP\Low severity fire-sandy loam.sol GeoWEPP\High severity fire-sandy loam.sol
<b>Management</b>	GeoWEPP\90% cover-low severity burn.rot GeoWEPP\45% cover-moderate severity burn.rot GeoWEPP\25% cover-high severity burn.rot
<b>Climate</b>	Colorado\CHEESMAN CO.cli

Files in example set

<b>Layer</b>	<b>Associated Files</b>
DEM	dem.asc
Landuse	landcov.asc, landcov.txt, landusedb.txt
Soil	soilsmap.asc, soilsmap.txt
Topo Image	topo.aux, topo.rrd, topo.tfw, topo.tiff
UTM	utmzone.txt

## **8.3 Rangeland**

Description

This example set is located within the USDA-ARS Walnut Gulch Experimental Watershed near Tombstone, Arizona. The vegetation is primarily shrubs and brush; the climate is monsoonal with most rainfall occurring late summer.

Coordinates (UTM Zone 12)

	<b>X</b>	<b>Y</b>
<b>Minimum</b>	582812.2	3499214.4
<b>Maximum</b>	594782.2	3513164.4

WEPP parameters files associated with the data

	<b>WEPP Files</b>
<b>Soil</b>	User dependent; no set files
<b>Management</b>	Location dependant; see landusedb.txt for listing
<b>Climate</b>	Arizona\TOMBSTONE AZ.cli

Files in example set

<b>Layer</b>	<b>Assocaited Files</b>
DEM	dem.asc
Landuse	landcov.asc, landcov.txt, landusedb.txt
Soil	soilsmap.asc, soilsmap.txt
Topo Image	topo.aux, topo.rrd, topo.tfw, topo.tiff
UTM	utmzone.txt

## **8.4 Agricultural**

Description

This example set is located near West Lafayette, Indiana.

Coordinates (UTM Zone 16)

	<b>X</b>	<b>Y</b>
<b>Minimum</b>	500000.0	4469379.9
<b>Maximum</b>	521210.0	4483269.9

WEPP parameters files associated with the data

	<b>WEPP Files</b>
<b>Soil</b>	User dependent; no set files
<b>Management</b>	Location dependant; see landusedb.txt for listing
<b>Climate</b>	Indiana\WEST LAFAYETTE 6 NW IN.cli

Files in example set

<b>Layer</b>	<b>Assocaited Files</b>
DEM	dem.asc
Landuse	landcov.asc, landcov.txt, landusedb.txt
Soil	soilsmap.asc, soilsmap.txt
Topo Images	topo1.aux, topo1.rrd, topo1.tfw, topo1.tiff, topo2.aux, topo2.rrd, topo2.tfw, topo2.tiff
UTM	utmzone.txt

## 9 Reporting GeoWEPP Bugs

During your use of GeoWEPP, you may encounter what you think is a bug. Some of these may be actual bugs, but some of them may be caused by your computer, your data, or some other source.

The best course of action is to first check our website. We list all of our known issues on the website in a FAQ (Frequently Asked Questions). Any issue that you may be facing could be listed there. By checking the website first, you won't have to sit and wait for a response from us.

If your problem isn't listed, then feel free to contact us. When you do, please remember to give me the following:

- Which version of ArcGIS and WEPP you are using
- What stage in the process you were at when the issue occurred
- What was the error description that came up
- If no error alert appeared, why do you think what has occurred is an error

This will help me narrow down what the problem may be.

While you are waiting for my response, the best course of action is to try it again from the beginning. I have noticed that GeoWEPP will work fine 100 times in a row. On the 101<sup>st</sup> try, the planets align improperly, a butterfly in Australia flaps its wings, the internal temperature of my laptop goes up by a degree, or any other number of seemingly unconnected variables change and GeoWEPP doesn't work. Then, the 102<sup>nd</sup> try works fine and I clean up the hair I just pulled out. So, try it again. If it doesn't work, call it a day.

### 9.1 Common errors that may seem like bugs

There are a few issues with GeoWEPP that may cause you to think that an error has occurred; usually, this is not the case. Here are a few issues that you need to be aware of:

TOPAZ will not work if there is a space in any of the GeoWEPP folders. GeoWEPP will prevent you from using spaces in any folder except in the installation or if you manually change a folder name. To prevent these problems, get in the habit of not using spaces. Instead, try using the underscore “\_”.

During the GIS loading phase, if focus is changed from the load status window (figure 42), the window goes blank. GeoWEPP is still preparing the data, but the progress info will not be visible. This has no effect on the load process.

Every so often, one of the alert windows – like the input window asking for an offsite layer name (figure 67) or the WEPP window for changing a hillslope parameter (figure 80) – will seem not to appear. What actually happens is that the window does appear, but it is behind some other window like ArcMap. If you are waiting for a window to appear and don't see it, check the programs on your taskbar. The window you are looking for may be there.

*Can this be fixed?* All attempts to fix this have not worked. What makes it more frustrating is that a window will appear properly 99% of the time, for 1% of the time it is loaded behind another window.

The Translator window (figure 63) does not appear on the Taskbar. If you move from the Translator window to another window, you will need to use the Alt+Tab method to get back to the translator

If your DEM, soil, or landuse layers are very large, GeoWEPP will take a long time to perform some of its tasks. This becomes apparent whenever you try to delineate a new channel network on a very large DEM. You will first see this during the initial GIS data loading phase just prior to ArcMap starting up.

The best solution is to reduce the size of your parameter files. Use the techniques presented in *Section 6*.

## 9.2 Crashes and Infinite loops

Sometimes, something just doesn't go right and GeoWEPP doesn't want to respond or is stuck in a loop. This will most commonly occur when you select an invalid channel cell and GeoWEPP doesn't catch it. The best way to get GeoWEPP working again is to delete a certain text file or files from your project folder. These files are **NotDone.txt** and **NotDone2.txt** (figure 158).

What are these you ask? GeoWEPP combine several different pieces of software that need to wait until one or the other has finished processing before it can continue. For channel delineation, GeoWEPP needs to wait until TOPAZ has finished. The easiest way is for GeoWEPP to wait until one of the above text files doesn't exist. So, in the case of the infinite loop when creating a subcatchment, all you would need to do is close the DOS window and then delete NotDone.txt from your project folder.

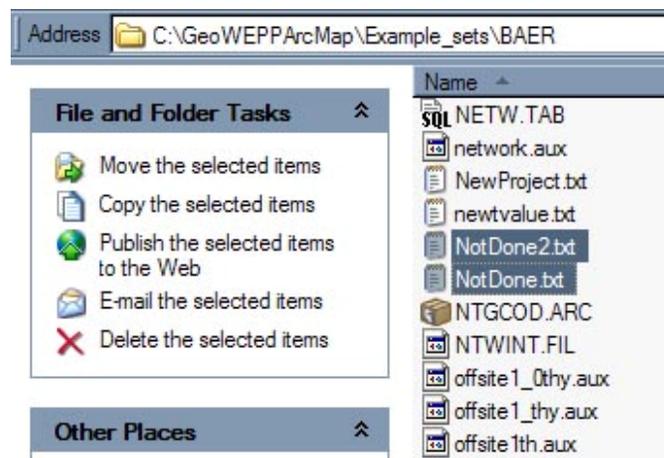


Figure 157 – NotDone.txt and NotDone2.txt in a project folder

If you see both files present, delete NotDone2.txt before NotDone.txt. In most cases, you'll just have to redo the procedure you were attempting (like selecting a channel cell, but pick a different one this time). But, sometimes you may have to start

over (or from a previous save). This is the main reason why I highly recommend saving often.

You may be wondering why it can't just fix the problem. The reason why this occurs varies so much that it can not all be programmed in. The most common occurrence involves the subcatchment delineation. A fix is in place, but if the mouse click is off just right, the error occurs anyway. Fortunately, all you need to do is close the DOS window and delete the NotDone.txt file and you'll be able to select a new channel cell without starting over.

### **9.3 Web Page FAQ**

Below are the Frequently Asked Questions posted on our website as of March 7, 2008.

*How do I report bugs?*

See beginning of this section.

**One important note about bugs:** If you receive an error while working with GeoWEPP, the best course of action is to exit GeoWEPP, delete the project folder you were working in, and start again. If the error occurs again, then e-mail us about the issue. We have noticed that we can run the same simulation a large number of times and then, suddenly one of the simulations has an error. We would start over and we would receive an error. This could be the result of any number of factors beyond GeoWEPP (like a read/write lag on the hard drive).

*Whom do I contact to make suggestions or comments, or criticize ArcGeoWEPP?*

We look forward to all comments, suggestions, and criticisms; these help us improve GeoWEPP. See *Section 9.4*

*I don't have the .NET Framework, can I still use GeoWEPP?*

No. Several of the components that GeoWEPP uses are built into VB.NET executable files. At this time, you need to have the .NET framework installed on your computer. Microsoft has a free download that will install this for you (a link is provided on our website).

*I don't have the .NET Framework, how do I get it?*

Microsoft has a free download that will install the .NET Framework for you (a link is provided on our website).

*I received a "Unable to locate dll. The dynamic link library <insert dll here> could not be found in the specified path" error. What does that mean?*

Your computer does not have the .NET framework installed on it. Without the .NET Framework, GeoWEPP will not run.

*I have tried a number of CSA and MSCL combinations, but GeoWEPP says a network can't be created. What do I not know?*

The **TOPographic PArametriZation** software (TOPAZ) used to delineate the stream channels will not be able to create a network if there are "holes" in the DEM.

TOPAZ classifies a "hole" as being any cell that has an elevation value less than 1 and greater than 9999. GeoWEPP analyzes your DEM and fills in any "holes" it finds (and reports to you where these were found). Sometimes, TOPAZ still finds holes; these are more like phantom holes since there doesn't appear to be a hole in the DEM.

To determine if this is the case, open the folder that contains your current project's files (for example, C:\ArcGeoWEPP\Project\My\_Project2). Right-click on the file "DEDNM.RPT" and open with notepad. If there is an error, it will be located at the end of the file. If the report states that a value that is not between 1 and 9999 has been found, you have a hole.

To fix this, reduce the size of your DEM. In most cases, you actually have a much larger DEM than you need. Clip the DEM so that it mostly contains your study area. Convert the DEM to ASCII and try GeoWEPP again.

Another reason why this may occur is that you have installed GeoWEPP within a folder with a space in the name (for example: "My GeoWEPP"). TOPAZ uses DOS to execute all of its commands and, like most older DOS programs, it doesn't like spaces in the pathnames. The most common occurrence of this is when GeoWEPP folder is located on the Desktop. All you need to fix this is to move the entire folder to a new location.

**Additional Note Not on Website:** If your DEM was projected using the wrong UTM zone, TOPAZ will not work. This will also appear at the bottom of the DEDNM.RPT report.

*When I run the "flowpath method" or the "watershed and flowpath method", I get a "soil type not defined at row \_ and column \_" error or a "management type not defined at row \_ and column \_" error and the program hangs, crashes, or no results are displayed. If I run the "watershed only method" on my study site, I get results and no problems. Why does this occur? What can I do to correct this?*

The short answer is that your watershed is too large; use a smaller watershed. The long answer involves the flowpaths within the watershed and the amount of RAM your computer has. During the "flowpath method" portion of the run, GeoWEPP and WEPP simulate every possible flowpath within the watershed and compile the results. This takes a lot of memory; if you run out of memory you get this error and the results can not be compiled.

*Well, how many flowpaths can I have in my watershed before it becomes a problem?*

Unknown. The amount of memory used depends on the number and the length of the flowpaths. We ran a simulation on a 1m DEM; when we had just over 10,000 flowpaths, GeoWEPP would crash. If we had fewer than 10,000 flowpaths, we would get results (512MB of RAM). This value will change depending on the number of other programs are running at the same time; the more programs running, the less flowpaths you can run.

*What should I do?*

There are two ways you can handle this, depending on your personality. If you are the type that wants a definite answer, has plenty of time, and doesn't mind pulling your hair out, then you can try running simulation after simulation to determine what the maximum size watershed you can use for your current study. If you are like everyone else, the best way is to run the "watershed only method" on your study area to determine

where your problem areas are within your watershed. Then run GeoWEPP simulations on those areas; since these will be smaller areas, your flowpath runs should work fine.

*Will this get fix?*

Part of the problem is the memory intensive functions involved; there is not much that can be done with this. We are currently working on a solution that will allow a user to run GeoWEPP on larger watersheds that will bypass this problem, but we are still in the initial development phase of this procedure.

*I have just selected my outlet point. A DOS window appears and begins to repeat the same thing over and over again. What is wrong? How do I fix it?*

Once you have selected an outlet point, GeoWEPP sends that point's location to TOPAZ to create the subcatchments within the watershed. This point can not be located at the beginning of a channel or at a converging point, or TOPAZ will not be able to create the subcatchments. When one of these points is selected, TOPAZ will run a continuous loop stating the error. To stop this loop, close the DOS window. Then go to your current working directory and delete the "NotDone2.txt" file. This will stop the process. You can now select another point.

Steps have been made to prevent this from occurring by analyzing the point you select before it is passes on to TOPAZ, but some points do slip by for some reason. We are currently looking into why this occurs and should have a solution in the future.

**NOTE:** This is discussed in *Section 9.2* above

*After I select my climate, GeoWEPP states "User Canceled Run. WEPP Run Canceled." What's going on here?*

It appears that the Translator will only read text files that are in ANSI format, not in Unicode-8. Double check how your text files were created; if they are in UNICODE-8, either convert it or try to rewrite it.

*I have installed and tried to run GeoWEPP. When I either finish inputting my own ASCII data or after I click the example set I wish to use, GeoWEPP does some stuff and then stops. What happened?*

In most cases, your pathways for ArcGIS are not set up properly. Here is a simple test: Go to the project folder you just created (either the example folder in the Example\_Sets folder or your own folder in the Projects folder). Find the ArcGeoWEPP.mxd file and double click on it. Once the MXD opens, click OK in the message box. Most likely, you'll see a number of error messages and only have a topographic image layer. If this is the case, the pathway is set up incorrectly.

To solve this, all you need to do is 1) determine the correct pathway for ArcGIS (it would be the folder that contains ArcToolbox), 2) delete GeoDirInfo.txt, and 3) start GeoWEPP. When prompted, enter the correct pathway. The defaults given are the default installs for ArcGIS and for WEPP.

## **9.4 Contact Information**

If you wish to contact us, please go to the GeoWEPP website. The individual currently working on the GeoWEPP project will change over time; we will keep out current contact information on our website.

<http://geowepp.geog.buffalo.edu/>

## **9.5 Manual or Exercise Errata**

Please check our website for any corrections to information presented in this manual or in any of our exercises.

If you notice some spelling or grammar errors, if you feel something needs to be explained better, or if you need some clarification please let us know. We will be more than happy to make corrections or clarifications.

## 10 GeoWEPP Output Reports

Below are examples of each of the four reports generated by GeoWEPP. Please note that some modifications have been made to the structure (spacing, font size, etc.) to improve viewing; no changes have been made to the data or the general flow of the reports.

### 10.1 Offsite

#### EXAMPLE:

WEPP Watershed Simulation for Representative Hillslopes and Channels

#### 1 YEAR AVERAGE ANNUAL VALUES FOR WATERSHED

<b>Hillslopes</b>	<b>Runoff Volume (m<sup>3</sup>)</b>	<b>Subrunoff Volume (m<sup>3</sup>)</b>	<b>Soil Loss (kg)</b>	<b>Sediment Deposition (kg)</b>	<b>Sediment Yield (kg)</b>
Hill 1 (22)	0.00	0.34	0.00	0.00	0.00
Hill 2 (21)	0.00	0.04	0.00	0.00	0.00
Hill 3 (23)	0.00	0.22	0.00	0.00	0.00

<b>Channels and Impoundments</b>	<b>Discharge Volume (m<sup>3</sup>/yr)</b>	<b>Sediment Yield (tonne/yr)</b>
Channel 1 (24)	19.5	0.1

86 storms produced 373.70 mm. of rainfall on an AVERAGE ANNUAL basis

11 events produced 0.05 mm. of runoff passing through the watershed outlet on an AVERAGE ANNUAL basis

#### Average Annual Delivery From Channel Outlet:

Total contributing area to outlet	=	35.80 ha
Avg. Ann. Precipitation volume in contributing area	=	133802. m <sup>3</sup> /yr
Avg. Ann. irrigation volume in contributing area	=	0. m <sup>3</sup> /yr
Avg. Ann. water discharge from outlet	=	20. m <sup>3</sup> /yr
Avg. Ann. sediment discharge from outlet	=	0.1 tonnes/yr
Avg. Ann. Sed. delivery per unit area of watershed	=	0.0 T/ha/yr
Sediment Delivery Ratio for Watershed	=	1.000

#### Sediment Particle Information Leaving Channel:

<b>Class</b>	<b>Particle</b>		<b>Composition</b>				<b>Fraction In Flow Exiting</b>
	<b>Diameter (mm)</b>	<b>Specific Gravity</b>	<b>% Sand</b>	<b>% Silt</b>	<b>% Clay</b>	<b>% O.M.</b>	
1	0.002	2.60	0.0	0.0	100.0	8.2	0.064
2	0.010	2.65	0.0	100.0	0.0	0.0	0.250
3	0.030	1.80	0.0	73.8	26.2	2.1	0.441
4	0.490	1.60	21.0	50.3	28.7	2.3	0.230
5	0.200	2.65	100.0	0.0	0.0	0.0	0.016

Distribution of Primary Particles and  
Organic Matter in the Eroded Sediment:

<b>type</b>	<b>fraction</b>
clay	0.245
silt	0.691
sand	0.064
organic matter	0.020

Index of specific surface = 62.31 m<sup>2</sup>/g of total sediment

Enrichment ratio of specific surface = 1.00

### **Report Description**

The Offsite Report provides the results measured at the outlet point. Values based on the contributions by the hillslopes and channels. This report focuses on the sediment yield delivered from hillslopes/small watersheds into channels to the outlet point; soil loss and deposition on the hillslopes themselves can be found in the Onsite Report.

Please note, that onsite and offsite simulations are produced with the same model code, but processed differently: 1) offsite soil erosion, deposition, and sediment yield based on the watershed method is simulated by WEPP after aggregating the information for representative hillslopes [aggregation before WEPP model run], 2) onsite soil erosion based on flowpath method is calculated through aggregating the information of multiple WEPP hillslope runs [aggregation after WEPP model run]. Depending on your spatial representation of your flowpaths these values can be different.

### **Column Definitions**

#### Year Average Annual Values for Watershed

**Hillslopes:** The WEPP hillslope being reported. The WEPP hillslope number is different from TOPAZ hillslope number, which is display in the parentheses.

**Runoff and Subrunoff Volumes:** This is the amount of runoff from each hillslope. This value is measured in cubic meters.

**Soil Loss:** The amount of soil loss recorded for each hillslope.

**Sediment Deposition:** The amount of soil deposition recorded for each hillslope.

**Sediment Yield:** The amount of sediment yield recorded for each hillslope at the outlet point.

**Channels and Impoundments:** The WEPP channel being reported. The WEPP channel number is different from the TOPAZ number, which is display in the parentheses.

**Discharge Volume:** The amount of discharged from the WEPP channel.

**Sediment Yield:** The sediment yield from the channel.

#### Average Annual Delivery From Channel Outlet:

**Total contributing area to outlet:** The area of the watershed measure in hectares.

**Avg. Ann. Precipitation volume in contributing area:** Average annual precipitation of the watershed measured in cubic meters per year.

**Avg. Ann. irrigation volume in contributing area:** Contribution from irrigation within the watershed.

**Avg. Ann. water discharge from outlet:** Average annual water discharge recorded at the outlet point measured in cubic meters per year.

**Avg. Ann. sediment discharge from outlet:** Average annual sediment yield recorded at the outlet point for the watershed measured in tonnes per year.

**Avg. Ann. Sed. delivery per unit area of watershed:** Average annual sediment yield divided by the watershed area measure in tonnes per hectare per year

**Sediment Delivery Ratio for Watershed:** Delivery ratio

Sediment Particle Information Leaving Channel

**Class:** Particle Class.

**Particle Diameter:** Diameter of particle measure in millimeters.

**Specific Gravity:** Specific gravity of particle.

**Composition % Sand:** Percent of sand in particle.

**Composition % Silt:** Percent of silt in particle.

**Composition % Clay:** Percent of clay in particle.

**Composition % O.M.:** Percent of organic matter in particle.

**Fraction in Flow Exiting:** Fraction of particles exiting the outlet point.

## 10.2 Onsite

### EXAMPLE:

#### 1 YEAR AVERAGE ANNUAL VALUES FOR WATERSHED

\*\*\*WEPP Watershed Simulation for Representative Hillslopes and Channels (watershed method)\*\*\*

----- WATERSHED SUMMARY (watershed method, off-site assessment) -----

Hillslopes		Runoff Volume (m <sup>3</sup> /yr)	Soil Loss (tonne/yr)	Sediment Yield (tonne/yr)	Area (ha)	*Mapped	
WEPP	TOPAZ					Soil Loss (tonne/ha/yr)	Sediment Yield (tonne/ha/yr)
1	22	0.0	0.0	0.0	12.4	0.0	0.0
2	21	0.0	0.0	0.0	5.3	0.0	0.0
3	23	0.0	0.0	0.0	18.0	0.0	0.0

----- CHANNEL SUMMARY (watershed method, off-site assessment) -----

Channels NUM	WEPP	TOPAZ	Discharge Volume (m <sup>3</sup> /yr)	Soil Loss (tonne/yr)	Sediment Yield (tonne/yr)	Length (m)	Length (cells)
1	1	24	19.5	n.a.	0.1	747.0	22

\*\*\*WEPP Watershed Simulation for all flowpaths averaged over subcatchments (flowpath method)\*\*\*

----- FLOWPATH SUMMARY (flowpath method, on-site assessment) -----

Hillslopes		Runoff Volume (m <sup>3</sup> /yr)	Soil Loss (tonne/yr)	Sediment Yield (tonne/yr)	Area (ha)	*Mapped	
WEPP	TOPAZ					Soil Loss (tonne/ha/yr)	Sediment Yield (tonne/ha/yr)
1	22	26.3	13.2	n.a.	12.4	1.1	n.a.
2	21	55.2	5.2	n.a.	5.3	1.0	n.a.
3	23	11.5	8.4	n.a.	18.0	0.5	n.a.

### Report Descriptions

The Onsite Report provides the results measured within the watershed. Values are based on the fluctuations within hillslopes. This report focuses on the soil loss occurring within each hillslope of the watershed; sediment yield information can be found in the offsite report.

Please note, that onsite and offsite simulations are produced with the same model code, but processed differently: 1) offsite soil erosion, deposition, and sediment yield based on the watershed method is simulated by WEPP after aggregating the information for representative hillslopes [aggregation before WEPP model run], 2) onsite soil erosion based on flowpath method is calculated through aggregating the information of multiple WEPP hillslope runs [aggregation after WEPP model run]. Depending on your spatial representation of your flowpaths these values can be different.

## **Column Definitions**

### **Watershed Summary**

**Hillslope – WEPP:** The WEPP hillslope number being reported.

**Hillslope – TOPAZ:** The TOPAZ hillslope number being reported.

**Runoff Volume:** Runoff, measure in cubic meters per year, for the hillslope.

**Soil Loss:** The soil loss for the hillslope measured in tonnes per year.

**Sediment Yield:** The sediment yield for the hillslope measured in tonnes per year.

**Area:** The area, in hectares, of the hillslope.

**Mapped Soil Loss:** The soil loss value used for mapping.

**Mapped Sediment Yield:** The sediment yield value used for mapping.

### **Channel Summary**

**Channel – Num:** Number assigned to a particular channel.

**Channel – WEPP:** The WEPP number for the reported channel.

**Channel – TOPAZ:** The TOPAZ number for a particular channel.

**Discharge Volume:** The discharge volume from a particular channel measured in cubic meters per year.

**Soil Loss:** The amount of soil loss occurring in a particular channel.

**Sediment Yield:** The amount of sediment yield from a particular channel.

**Length (m):** Length of the channel in meters.

**Length (cells):** Length of the channel in raster cells (cell resolution dependent).

### **Flowpath Summary**

**Hillslope – WEPP:** The WEPP hillslope number being reported.

**Hillslope – TOPAZ:** The TOPAZ hillslope number being reported.

**Runoff Volume:** Runoff, measure in cubic meters per year, for the hillslope.

**Soil Loss:** The soil loss for the hillslope measured in tonnes per year.

**Sediment Yield:** The sediment yield for the hillslope measured in tonnes per year.

**Area:** The area, in hectares, of the hillslope.

**Mapped Soil Loss:** The soil loss value used for mapping.

**Mapped Sediment Yield:** The sediment yield value used for mapping.

## 10.3 Events

### EXAMPLE:

WATERSHED OUTPUT: DISCHARGE FROM WATERSHED OUTLET  
(Results listed for Runoff Volume > 0.005m<sup>3</sup>)

Day	Month	Year	Precip. Depth (mm)	Runoff Volume (m <sup>3</sup> )	Peak Runoff (m <sup>3</sup> /s)	Sediment Yield (kg)
3	2	1	0.0	0.30	0.00043	9.6
14	7	1	11.0	0.01	0.00002	0.3
18	7	1	20.9	1.25	0.00152	34.6
3	8	1	11.2	0.05	0.00009	1.8
4	8	1	40.7	17.68	0.01597	1.8
6	8	1	8.3	0.03	0.00005	1.8
22	8	1	13.9	0.07	0.00011	2.2
29	8	1	11.5	0.10	0.00017	3.5
21	9	1	11.4	0.03	0.00005	0.9

### Report Description

This report displays the basic information for each event in a simulation that produced runoff.

### Column Definitions

**Day:** The simulation day the event occurs

**Month:** The simulation month the event occurs

**Year:** The simulation year the event occurs

**Precip. Depth (mm):** The depth of the overland flow for the event measured in millimeters

**Runoff Volume (m<sup>3</sup>):** The volume of the overland flow for the event measured in cubic meters

**Peak Runoff (m<sup>3</sup>/s):** The peak runoff of the event measure in cubic meters per second

**Sediment Yield (kg):** The sediment yield at the outlet for the event measure in kilograms

## 10.4 Return Period Analysis

### EXAMPLE:

#### Return Period Analysis

Return Period (years)	Runoff Volume (m <sup>3</sup> )	Sediment Leaving (t)	Peak Runoff Rate (m <sup>3</sup> /sec)	Daily Precipitation (mm)
1	1603.1	4.1	0.9	28.7
2	3673.0	12.9	1.8	35.3
5	7043.4	37.4	3.2	44.8
10	9920.5	52.2	4.4	47.6
25	13469.2	91.9	5.8	57.8

This report is displayed the same way the Return Period Analysis report is displayed in WEPP. **One very important note:** the columns are not related to one another. This means that the Runoff Volume event for year 1 may not be the same event as the Daily Precipitation event. Therefore, do not assume that each column is related to one another.

For more information on this report, please review the Return Period Analysis Report function in WEPP.