# The Wind Erosion Prediction System

**WEPS 1.6**

**(WebStart WEPS)**

**User Manual**

USDA-ARS Rangeland Resources and Systems Research Unit
Fort Collins, Colorado USA

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# Preface

Wind erosion is a serious problem on agricultural lands throughout the United States as well as the world. The ability to accurately predict soil loss by wind is essential for, among other things, conservation planning, natural resource inventories, and reducing air pollution from wind blown sources. The Wind Erosion Equation (WEQ) was widely used for assessing average annual soil loss by wind from agricultural fields. The primary user of WEQ was the United States Department of Agriculture, Natural Resources Conservation Service (USDA-NRCS). When WEQ was developed more than 55 years ago, it was necessary to make it a simple mathematical expression, readily solvable with the computational tools available at the time. Since its inception, there have been a number of efforts to improve the accuracy, ease of application, and range of WEQ. Despite these efforts, the structure of WEQ precluded adaptation to many wind erosion problems.

In the mid-1980's, USDA appointed a team of scientists to take a leading role in combining the latest wind erosion science and technology with databases and computers, to develop what would become a significant advancement in wind erosion prediction technology. The Wind Erosion Prediction System (WEPS) incorporates this new technology and was designed to replace WEQ. WEPS version 1.1.16 was eventually installed for use on 15,000 computers in 2200 NRCS Field Offices in October of 2010. Several iterations of improvements to WEPS have resulted in multiple revision upgrades since then. WEPS 1.6 (or WebStart WEPS) is the current iteration, which includes major updates since WEPS 1.5 to its databases, the addition of remote data access services and remote execution of WEPS simulations made in the cloud.

Unlike WEQ, WEPS is a process-based, continuous, daily time-step model that simulates weather, field conditions, management, and erosion. WEPS 1.6 consists of the WEPS science model with a user-friendly interface that has the capability of simulating spatial and temporal variability of field conditions and soil loss/deposition within a field. WEPS 1.6 can also simulate simple field shapes and barriers on the field boundaries. The saltation/creep, suspension, PM10 and PM2.5 components of eroding material also are reported separately by direction in WEPS 1.6. WEPS is designed to be used under a wide range of conditions in the United States and is adaptable to other parts of the world. For further information regarding WEPS contact:

WEPS
USDA-ARS Rangeland Resources & Systems Research Unit
2150 Centre Ave., Bldg. D Suite 200
Fort Collins, CO 80526

Phone: 970-492-7322
E-mail: weps@ars.usda.gov
WebStart WEPS URL: https://infosys.ars.usda.gov/wepstart
ARS Wind Erosion URL: https://infosys.ars.usda.gov/WindErosion

# Acknowledgements

The Wind Erosion Prediction System (WEPS) resulted from the work of many individuals representing several agencies and institutions. In particular, appreciation is extended to the WEPS Core Team members:, D.V Armbrust (retired), J.D. Bilbro (retired), G.W. Cole (retired), K. Taylor, A.A. Durar, F. Fox, D.W. Fryrear (retired), R.B. Grossman (retired), L.J. Hagen (retired), L. Lyles (retired), A. Retta, A. Saleh, H.H. Schomberg, H.R. Sinclair (retired), E.L. Skidmore (retired), J.L. Steiner, J. Tatarko (retired), P.W. Unger (retired), S. Van Donk, and T.M. Zobeck (retired); the Agency liaisons to the Core Team, including: M.S. Argabright, NRCS (retired), H. Bogusch, NRCS (retired), R. Dunkins, EPA, and C. Voight, BLM; the ARS NPL, including: C.R. Amerman (retired), W.D. Kemper (retired), S. Rawlins (retired) and M. Weltz (retired); and NRCS leaders including K. Flach (retired), M. Hubbs, A. King (retired), C. Lander (deceased), D. Schertz (retired), N. Widman (retired), B. Dierberger, M. Sporcic (Retired), G.L.Tibke (retired), D. Woodward (retired), Joel Poore (retired), M. Kucera (retired), C. Coreil, D. Troxell, A. Reed and T. Alme.

Gratitude is also expressed to the many cooperators and other individuals who have contributed to the development of WEPS through their valuable research, criticisms, testing, and comments. These individuals include: J.K. Aase, A. Black, W. Blackburn, P. Bullock, D.J. Ding, G. Foster, D.A. Gillette, J. Gregory, J.R. Kiniry, D. Koeltzow, J. Laflen, J.A. Lamb, F. Larney, J.B. Layton, M.J. Lindstrom, S.D. Merrill, C. Meyer, N. Mirzamostafa, D.L. Mokma, A. Moulin, A. Nicks, K.N. Potter, R. Savabi, K. Saxton, J. Stout, L. Sutherland, E.D. Vories, and J. Williams. The work of L. Ascough, W. Gu, M. Haas, A. Hawkins, S. Kaul, S. Kota, J. Levin, S. Liu, W. Rust, and M. Uttarwar along with all of our unnamed temporary and student programmers who have assisted in coding and maintaining the WEPS modelling system over the years are also greatly appreciated.

Recognition is given to the support of many agencies and universities that made WEPS a reality. These include the USDA Agricultural Research Service, USDA Natural Resources Conservation Service, the US Department of Interior - Bureau of Land Management, the US Forest Service, the US Environmental Protection Agency, the US Army Corps of Engineers, and Kansas State University.

The contribution of the NRCS state and field offices and other individuals who participated in the WEPS validation studies is also recognized.

Finally, acknowledgment is made of the many other individuals who have made this release of WEPS possible by reviewing this document and those who contributed through fundamental research on which many of the underlying concepts of WEPS are based.

Larry Wagner
WEPS Project Leader
USDA-ARS-RRSRU
Fort Collins, CO 80526

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# 1. Introduction

The Wind Erosion Prediction System (WEPS) is a process-based, daily time-step, wind erosion simulation model. It represents the latest in wind erosion prediction technology and is designed to provide wind erosion soil loss estimates from cultivated, agricultural fields. WEPS 1.6 consists of the computer implementation of the WEPS science model with a graphical user interface designed to provide easy to use methods of entering inputs to the model and obtaining useful user output reports. WEPS was developed by the former Wind Erosion Research Unit (WERU), now Rangeland Resources & Systems Research Unit (RRSRU) of the United States Department of Agriculture, Agricultural Research Service.

## 1.1 WebStart WEPS New Features

New features incorporated into WEPS 1.6 (WebStart WEPS) include the following:

(A) **Web Browser Access to WEPS** - Java WebStart (or OpenWebStart) provides the ability to download, cache and execute WebStart WEPS by simply clicking on a URL link. Automatic updating is also provided through this access method.

(B) **CRLMOD Data Availability** – CRLMOD (Conservation Resources Land Management Operations Database) is an NRCS nationwide database of land management/cropping practices including crops, operations and commonly used, region based, NRCS Crop Management Zone (CMZ) management sequence templates.

(C) **Remote Data Access** - The WEPS interface has been enhanced to provide most data remotely from internet connected outside (cloud based) sources. They are made accessible via Colorado State University's Cloud Services Integration Platform (CSIP). CSIP is a "Model-as-a-Service" platform tailored for the delivery of model and data services within the environmental domain. The CSIP specific data sources consist of:

**CRLMOD Operation records** - Operation records used in management rotations.

**CRLMOD Crop/Residue records** - Crop and residue only records used in management rotations.

**CMZ (Crop Management Zone) Management Rotations** - NRCS defined region based template management sequence records.

**Site specific NRCS Soil data** - The NRCS national Soil Survey Geographic (SSURGO) soil database is accessed and the data provided based upon the simulation site's latitude and longitude coordinates.

(D) **Remote Execution** - Remote execution of all processes required for a WEPS simulation are available via the following CSIP services:

**Interpolation of Windgen stations** - Interpolation is used for site specific wind data in some regions of the U.S.

**Windgen generator** - The selected (sometimes intepolated) Windgen station data is used to stochastically generate hourly wind speeds for a WEPS simulation.

**Cligen generator** - The selected Cligen station (usually with PRISM adjusted monthly averaged data) is used to stochastically generate daily weather for a WEPS simulation.

**WEPS Science model** - The WEPS science model applies the specified management practices on the site using the selected soil as well as the Windgen and Cligen generated weather inputs to conduct the model's simulation to assess the risk and extent of soil loss by wind erosion on the specified site.

(E) **Interface Enhancements** - Numerous interface improvements have been added to the WEPS interface. The most important new features are listed here:

**New MCREW display mode** - The Management/Crop Rotation Editor (MCREW) has been extended for WebStart WEPS through an alternative display/editing mode allowing creation (and some limited editing) of management and crop rotation sequences to begin with any management operation in the rotation sequence.

**Enhanced Map Viewer** - The Map Viewer has been updated to provide satellite imagery allowing a user to select a site (field) from the map and set the appropriate lat/lon coordinates accordingly.

**QuickPlots** - The addition of a number of default plots provide the WebStart WEPS user with the ability to review critical WEPS results quickly in a graphical presentation format.

## 1.2 How to use this Document

The WebStart WEPS 1.6 User guide is designed to provide information to different levels of users. Those users who are completely new to WEPS should start by reading all of this chapter to get an introduction to WEPS. It is recommended that, as a minimum preparation to use WEPS, the user should read the "Overview of the Wind Erosion Prediction System".

The minimum and recommended computer requirements as well as the steps to install WEPS onto your computer are described in this chapter. Once WEPS has been installed on your computer, you should learn how to make a simple simulation run using the Quick Simulation using WebStart WEPS section of this chapter. More experienced users should become familiar with the WEPS Interface Reference chapter, which goes into detail of how to use all of the capabilities of WebStart WEPS 1.6. These details are also available in the Online Help, accessible through the toolbars on the WebStart WEPS 1.6 interface screen.

The chapter Using WEPS In Conservation Planning contains sections on Interpreting Outputs, Special Field Configurations, and Using Barriers for Erosion Control in WEPS. This section also contains "Exercises", which guide the user through a few specific scenarios that describe how to use WEPS to design conservation systems.

**The following text section needs to be rewritten and updated once the final outline of the WEPS User Guide is completed - LEW**

The **Science Overview** chapters contains information for more advanced users. For users interested in more detail on the interface and science behind WEPS, the "Interface Implementation and Science Model" chapter is recommended. An even more detailed description of the science of the WEPS model is available in the "WEPS Technical Description", published as USDA Handbook Number 727 (https://naldc.nal.usda.gov/catalog/7105679). It is also included as a component of WebStart WEPS 1.6 and is accessible via an option under the "Help" menu in the WEPS interface. The **Science Overview** also contains information for more advanced users, such as the WEPS Databases and a listing of "Submodel Report Flags and Command Line Options". Databases are described for the Weather, Soil, Management, Crop, Operation and Barrier sections of WEPS. Submodel Report Flags and Command Line Options are set under the "Configuration Panel" tabs available through the "Tools" menu on the Main Screen of the interface. Certain permissions may be required to alter some of these flags and options. There is a section on "Using WEPS with Measured Data" that will be useful to researchers and other users, such as those outside the United States who do not have their soils data in the SSURGO database format.

Finally, this guide contains a series of "How To" Guides which provide the user with in-depth detail of simulating barriers and special considerations for strip cropping simulations with WEPS 1.6. There are also "How To" Guides that assist the user in developing additional crop and operation database records. Throughout this guide, the term "user" refers to the person(s) using WebStart WEPS 1.6 to set up and make a simulation run. The term "operator" refers to the producer or land manager whose actual field is being simulated with WEPS. This guide contains many graphics that are examples of what can be seen on the computer screen using WEPS. In addition, WEPS will continually be improved and the screens may change. Therefore, the user may or may not see the exact same screens as those illustrated in this guide.

WEPS is a model developed primarily for use by the USDA, Natural Resources Conservation Service (NRCS). As such, many of the capabilities of WEPS reflect the needs of NRCS for use in cultivated agricultural systems. But, WEPS has capabilities to be used in many other situations where wind affected soil movement is a problem. Contact us if you wish to use WEPS to predict erosion for situations other than traditional cultivated agricultural systems.

WEPS
USDA-ARS Rangeland Resources & Systems Research Unit
2150 Centre Ave., Bldg. D Suite 200
Fort Collins, CO 80526

Phone: 970-492-7322
E-mail: weps@ars.usda.gov
URL: https://infosys.ars.usda.gov/WindErosion

## 1.3 Computer Requirements

The minimum recommended requirements to install and operate WebStart WEPS 1.6 are:

- 64-bit Intel I-3 class processor or equivalent personal computer.
- 64-bit Windows 8 or newer Microsoft operating system (it can also be run on Linux systems too, but it has not been as well tested under that environment).
- 4 Gb RAM.
- 4 Gb free disk space.
- Internet web access to download for installation and to access the CSIP remote services.
- VGA color monitor with a minimum screen resolution of 800 x 600 pixels.

WEPS also requires 32-bit or 64-bit Java 8 (must be installed prior to installing WEPS) to download and install WEPS via Java WebStart. Java 11 and later Java versions no longer include Java WebStart. So, either OpenWebStart, a drop-in replacement for Java WebStart, can be used (https://openwebstart.com/download) or by using a special Windows MSI WEPS Bootloader package (available here: https://infosys.ars.usda.gov/builds/bootloader/1/WEPS_Bootloader.msi), if needed.

WEPS has been run in the past on older releases of Windows, but is no longer tested on them. The default configurations provided should also work with Linux. Contact RRSRU if you need to modify the configuration for a specific version of Linux or need assistance with running WEPS on such systems.

The recommended requirements to install and operate WebStart WEPS 1.6 effectively are:

- An equivalent of a 64-bit Intel Core I-3 processor, or better, personal computer.
- 64-bit Windows 10 or newer Microsoft (or Linux) operating system.
- Greater than 4 Gb RAM.
- Greater than 20 Gb of free disk space.
- Internet web access to download WebStart WEPS for installation and to utilize the CSIP remote services.
- Color monitor with 1024 x 800 or better pixel resolution.
- Java 8 (preferably 64-bit version) must be installed prior to installing WebStart WEPS 1.6. Note that a later Java version can be used with OpenWebStart or when using the WEPS Bootloader.

## 1.4 Reporting Errors and Submitting Questions/Comments

To submit a bug report manually, ask a non-urgent WEPS related question, or to propose a suggested feature/modification for WEPS, directly from within WebStart WEPS, a user can do so by clicking on the button on the WEPS Button Bar or via the *Send Bug/Comment Report* option under the *Tools* menu. This will bring up the **Error/Comment Submission Form** window as shown in Fig. 1.1. Fill in the email address, if not auto-populated with the email provided when filling out the Wizard form the first time WEPS was started up after the initial installation. Provide a brief subject in the appropriately labeled field and a description of the concern, question, feature request, bug reported, etc. in the *Description* field.

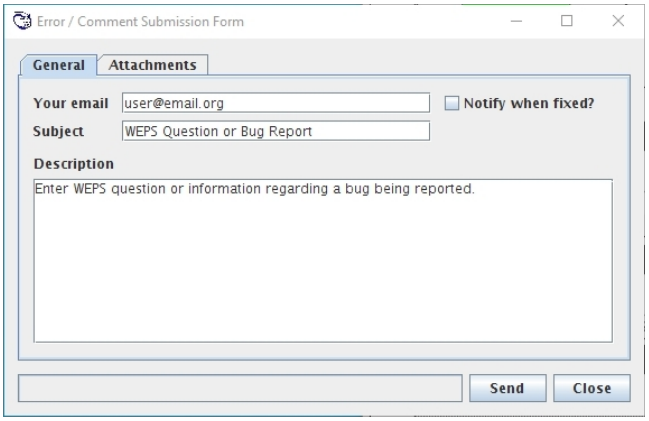



Figure 1.1: Error/Comment Submission Form.

If an error happens to occur while running WEPS, the same **Error/Comment Submission Form** window will popup giving the user the option to submit a bug report. If the user provides an affirmative answer, this same reporting window will appear with the *Description* field populated with the generated error message. It is usually helpful to the WEPS developers in tracking down the source of the problem if the user adds some additional text preceding that error message in the *Description* field by providing a brief narrative about what they were attempting to do or accomplish immediately prior to the error being generated.

Clicking on the window's *Attachments* tab (Fig. 1.2) will display additional files which will be submitted with the error report. These files may also be useful in deciphering the cause of the error by the WEPS developers. Typical files include the WEPS log file and local configuration file. In addition, if a soil and management file has been selected in the WEPS GUI, those files will be provided as well. If it occurs during a WEPS simulation it should also include a zipped copy of the entire WEPS Run folder. A user can attach other files/folders if instructed to do so as well[1].

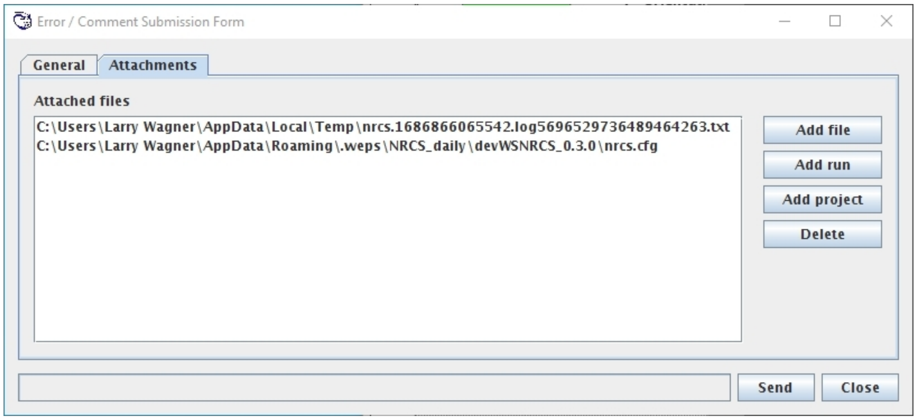



Figure 1.2: Error/Comment Submission Form displaying the Attachments tab.

If you are connected to the Internet, clicking the **Send** button will transmit the message to ARS, along with any attached directories/files, so that your inquiry or bug report can be answered. The user cannot send a submission from WEPS unless they have provided an email address and are connected to the Internet at the time the submission is attempted.

[1] Because of the number of potential files within a Project folder, attaching a WEPS Project could create an attachment too large to transmit to USDA-ARS.

Note that an individual can also still send an email message directly from within WebStart WEPS as an alternative method of communication, but that method is deprecated and requires the user to have correctly configured the WEPS e-mail client in the WEPS *Configuration* settings.

# 2. WebStart WEPS Installation

There are now three fully supported methods (and a fourth unsupported method) to install WebStart WEPS:

1. Standard Java WebStart installation (works for Java versions 8, 9 and 10) - Section 2.1

   The standard Java WebStart installation utilizes Java's built-in functionality of Java WebStart to connect to a specified web server to install a cached copy of the WEPS package onto the machine. This is the original and preferred installation/execution method for WebStart WEPS.

2. WEPS bootloader installation (requires the WEPS bootloader to be pre-installed) - Section 2.2

   Since Java WebStart functionality has been removed from Java versions beginning with Java 11, ARS developed a small WEPS bootloader program to replace this missing functionality required for WebStart WEPS installations. Once the WEPS bootloader is installed, it can then install the various releases and builds of WebStart WEPS available from the specified WEPS server. This is the intended preferred installation method for NRCS configured/managed Windows based computers.

   The WEPS Bootloader (currently Windows version only) is available here:
   https://infosys.ars.usda.gov/builds/bootloader/1/WEPS_Bootloader.msi

3. OpenWebStart installation (requires OpenWebStart to be pre-installed) - Section 2.3

   OpenWebStart is the open source community's response to Oracle's removal of Java WebStart functionality from Java 11 and later Java versions. OpenWebStart is intended to be a drop-in replacement for the previous built-in Java WebStart functionality. It has received limited testing on both Windows and Linux platforms with a variety of Java versions with success. Since OpenWebStart is basically a GUI/management layer on top of the "IcedTea-web" open source project, which is often provided with some Linux distributions, OpenWebStart may not be strictly required to install WebStart WEPS on those systems. It is primarily intended to be used for Java 11 and later releases of Java. However, it is currently not a part of the standard Java 11 and later packages, thus OpenWebStart does require a separate installation from Java itself.

   OpenWebStart is available here: https://openwebstart.com/download

4. Traditional MSI Windows installation (unsupported but available upon request)- Section 2.4

   The traditional MSI installation does a standard permanent per machine installation of the application on a Windows PC.

## 2.1 Java WebStart Install

To install WebStart WEPS using Java WebStart, one must have Java 8 (or Java 9 or 10) installed on their computer. No "Administrator" privileges are required to either download/install or run WebStart WEPS using Java WebStart. The user simply navigates to the WebStart WEPS home page via a web browser and completes the following steps:

1. Navigate to the WebStart WEPS home page: https://infosys.ars.usda.gov/wepstart
2. First install the WEPS self-signed certificate, if it has not been previously installed on this machine. The **blue arrow, balloon and text** locates the **HERE** link on the web page as shown above. Note that this step only needs to be completed the first time the system is used with WEPS. Once the certificate is installed, the user can skip this step when coming to the WEPS home page to execute/update WEPS afterwards.

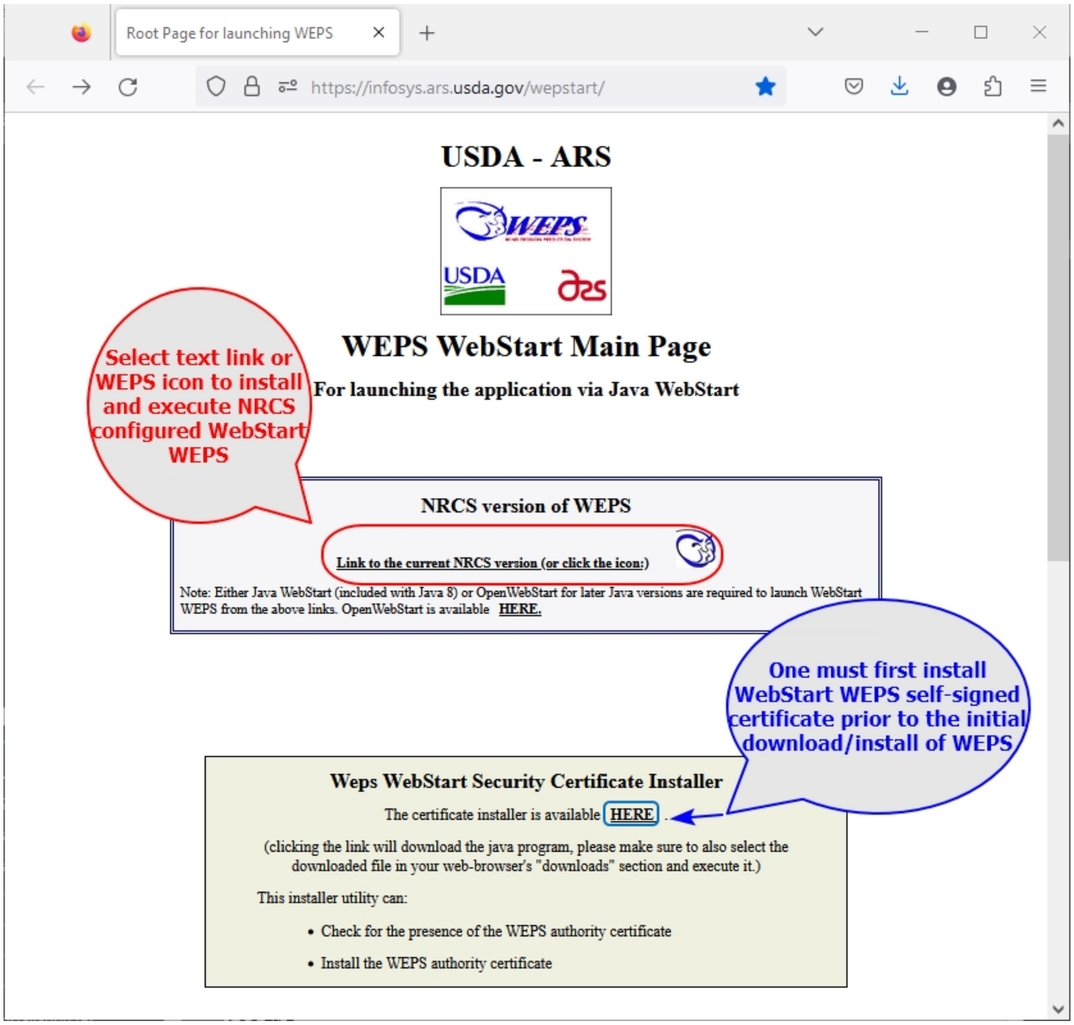
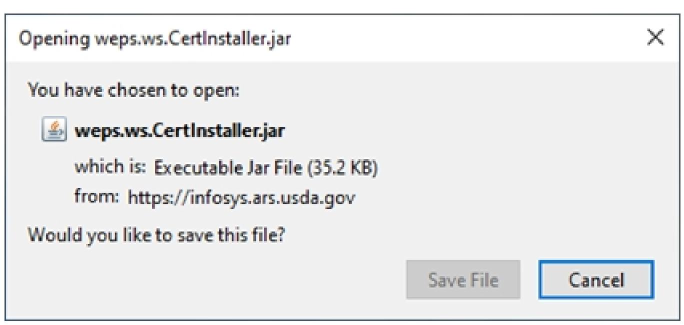
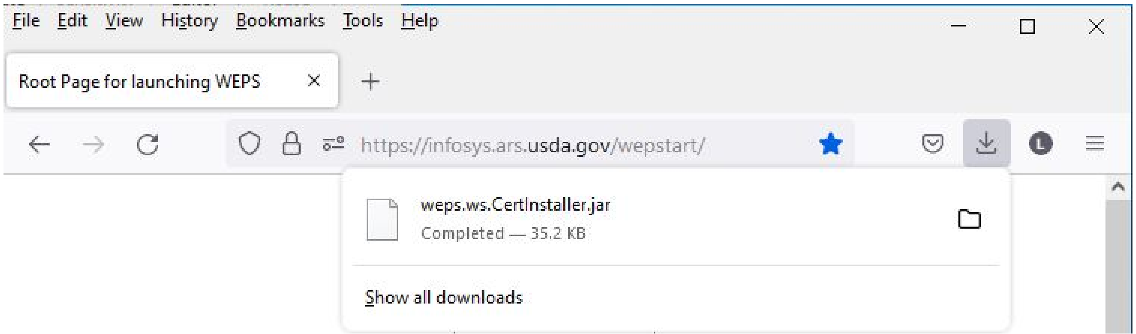



Figure 2.1: Webpage for starting WebStart WEPS

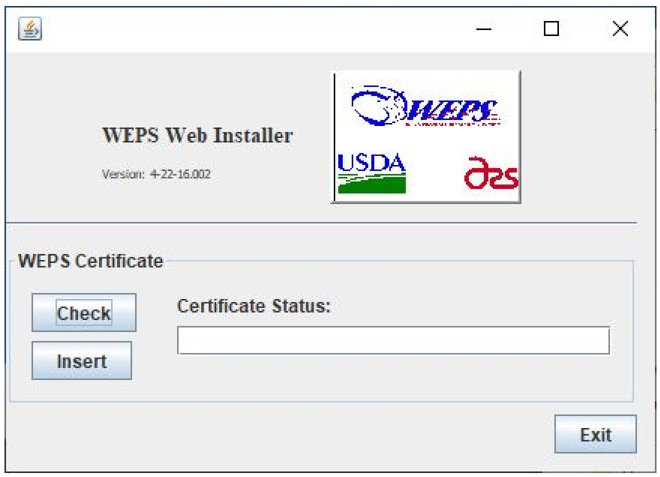
3. Clicking on the link will bring up the following dialog (with the Firefox browser) to save the downloaded Java jar file.




4. Save the certificate installer jar file and then execute the saved jar file:




5. Click on the “Check” button to see if it was installed. If not, Click on the “Insert” button to install the self-signed certificate.




6. Once the certificate has been installed, click on the “Exit” button to close the certificate installer.
7. The user can now download/install the desired WebStart WEPS configuration and build.
8. The **red balloon and text** locates the wind erosion icon link (shown in Fig. 2.1 above) for the NRCS Release build on the WebStart WEPS homepage. Other builds are also available via the links listed in the table(s) below on the WebStart WEPS homepage (not shown in Fig. 2.1).
9. Click on the link for the desired WebStart WEPS configuration and build to initiate the initial download/install by Java WebStart).
10. If allowed on the computer the user will end up with a menu entry and a desktop icon they can access to initiate WebStart WEPS after the initial download/install has completed[1].

After completing a WEPS install, if one does not get a desktop icon or a WEPS menu entry (they should get them on most computers but likely will not get them on NRCS configured/managed computers). They will need a “link” (not a copy) to the correct jnlp file to properly execute WEPS locally and still get automated updates.

* The jnlp file to execute is the one with “boot” in its name, e.g: boot-local-weps-NRCS_release.jnlp
* We should only execute that jnlp file in the “.weps” folder. On a Windows 10 system it is located in this folder (for the NRCS Release build):
  C:/Users/**USERNAME**[2]/AppData/Roaming/.weps/NRCS_release/WEPSBoot/WebStartBoot/

[1] Note that NRCS configured computers do not allow an installation program to create a menu entry without Administrator privileges, nor do they currently allow a desktop icon to be placed on the desktop. NRCS users can create their own WEPS desktop shortcuts and add an entry into the Windows menu system manually, if desired. Those steps are outlined below.

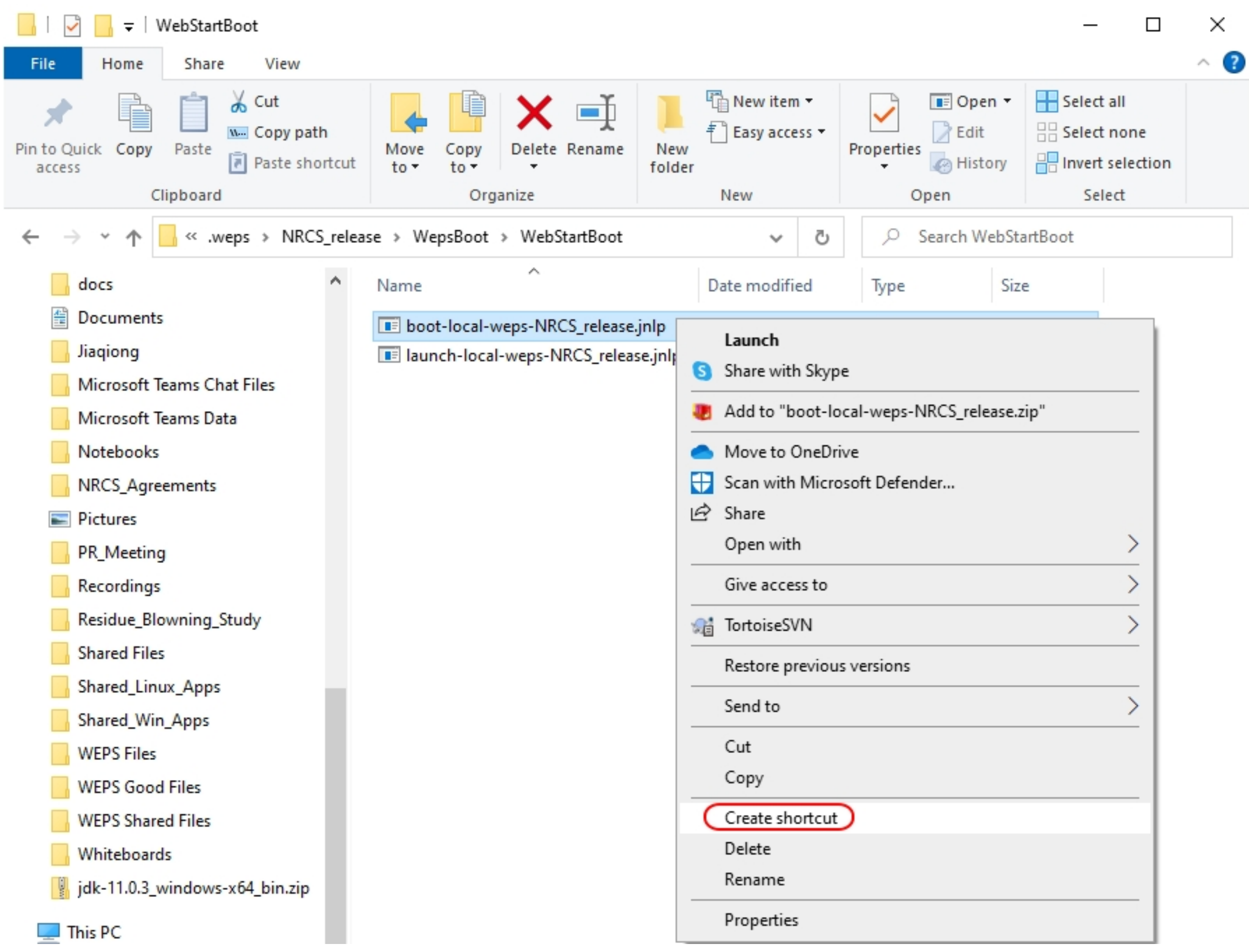
[2] Replace **USERNAME** with the User’s Windows login name.

* Never execute the "launch" jnlp file directly in that same folder (the "launch" jnlp file is executed from within the "boot" jnlp file).
* Since that jnlp file may get updated from time to time, if we want to execute it from somewhere other than that folder specified above, we must make a "link" (shortcut) to the jnlp file in that location and not a copy (a copy will not automatically get WEPS updates for us).

### 2.1.1 Manual Creation of Desktop Shortcut for WebStart WEPS

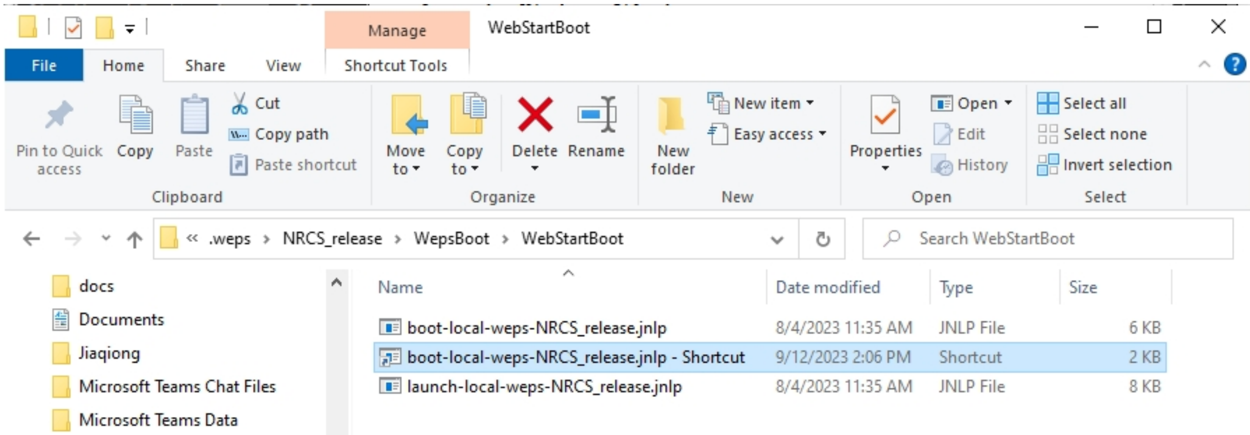
Here are specific instructions for creating a proper desktop shortcut to the WebStart WEPS jnlp file on a Windows 10 computer:

1. Open the Windows filechooser.




2. Go to the following folder:
   C:/Users/**USERNAME**[3]/AppData/Roaming/.weps/NRCS_release/WEPSBoot/WebStartBoot/
3. Select the "boot-local-weps-NRCS_release.jnlp" file.
4. With the mouse, click the right mouse button to bring up the dropdown choice list menu.
5. Select "Create Shortcut" from that menu.
6. This should create a new file with " – Shortcut" appended to the name in that same folder. Open the Windows filechooser.

[3]Replace **USERNAME** with the User's Windows login name.




7. You can then move this shortcut file to the desired location on your computer, e.g. on the desktop for example.
8. Once you have moved it, it can be renamed as desired (e.g. remove the "- Shortcut" extension text, change the icon image, etc.)

### 2.1.2 Manual Creation of Menu Entry for WebStart WEPS

To add the previously described shortcut extension into the Windows 10 menu system, do the following:

1. Go to the following folder:

   **C:/Users/USERNAME/AppData/Roaming/Microsoft/Windows/Start Menu/Programs**

2. Create a subdirectory here called **WEPS**
3. Place the shortcut extension into that **WEPS** folder
4. It should now show up in the user's *Start Menu* underneath **WEPS**

NOTE: Use only the shortcut (or the original file in the above specified location) to execute WEPS locally on the PC. Never execute from a copy of that jnlp file. Also, do not run any old jnlp files that were previously downloaded from the WebStart WEPS download page after running it at the time of the download, just to ensure you never run an older version by accident. You can always go to the website though and download the most recent jnlp file and run it if desired.

Contact RRSRU if you need download/installation assistance at:

USDA-ARS Rangeland Resources & Systems Research Unit
2150 Centre Ave., Bldg. D Suite 200
Fort Collins, CO 80526

Phone: 970-492-7322
E-mail: weps@ars.usda.gov

## 2.2 WEPS Bootloader Install (Windows only)

Due to Oracle removing the Java WebStart functionality from Java, beginning with Java 11, we needed an alternative installation process for WebStart WEPS as there was no immediate direct replacement for Java WebStart at the time. Thus, we developed a small WebStart WEPS bootloader program that could replace the Java WebStart functionality in Java 11 and later releases. The WebStart WEPS bootloader program is currently a standard MSI Windows application that is installed under Windows 10 or later. It should also work on earlier versions of Windows such as Windows 7, 8.x, etc. and possibly Windows XP, but it has not been tested on these older, obsolete versions of Windows.

Note that currently we are only providing the WebStart WEPS Bootloader as a Windows MSI build only. Let the ARS WEPS developers know if you have a compelling need for a Linux or other OS version of the WEPS Bootloader.

To install the WebStart WEPS Bootloader program, one must download the MSI executable from the WebStart WEPS home page: https://infosys.ars.usda.gov/wepstart. The pertinent URL link is highlighted in the red **rectangle** in the following partial screenshot of the WebStart WEPS home page (Fig. 2.2).

**Other versions of WEPS**

This section contains links to pages with previous versions. Each page has links for the types of releases made with that build.

| Version | Date | Link |
|---|---|---|
| **Current Release** | | |
| ARS released | 07-25-23 | ARS production build |
| NRCS released | 07-25-23 | NRCS production build |
| **Pre-release (Beta)** | | |
| ARS pre_release | 07-25-23 | ARS pre-release build |
| ARS International pre_release | 07-25-23 | ARS international pre_release build |
| NRCS pre-release | 07-25-23 | NRCS pre_release build |
| NRCS pre-release development | 07-25-23 | NRCS pre_release development build |
| **Development** | | |
| ARS daily | 08-08-23 | ARS daily build |
| ARS International daily | 08-08-23 | ARS international daily build |
| NRCS daily | 08-08-23 | NRCS daily build |
| NRCS daily development | 08-08-23 | NRCS daily development build |

| Utilities | Date | Link |
|---|---|---|
| WEPS utility to clean the Java cache | | Cache Utility |
| WEPS Security certificate utility | | Certificate Utility |
| WEPS Windows MSI Installer | | Windows Installer |
| WEPS Windows MSI Installer configuration file | | Windows Installer cfg file |

Figure 2.2: Links to alternative WebStart WEPS builds, tools, etc.

Since it is a standard Windows MSI installation, one must have ”Administrator Rights” to install the WEPS Bootloader program. It will create an entry in the Windows menu system under ”USDA Applications” for the Bootloader executable as well as a PDF user manual labeled ”WEPS Bootloader 1.0” and ”WEPS Bootloader Manual” respectively. It will also create a desktop shortcut, if allowed, labeled ”WEPS_Bootloader 1.0”.

There are two modes that the MSI Bootloader can be configured to run in:

1. Standard mode.

   In the standard or basic mode, the Bootloader code will immediately execute the install/update process and then bring up WebStart WEPS. There is no interactive GUI windows that the user has to interact with, only a progress window (Fig. 2.3) will display until WebStart WEPS comes up. The default WebStart WEPS configuration is the ”NRCS Release” build, which will be installed/updated and run from the Bootloader code in this mode.

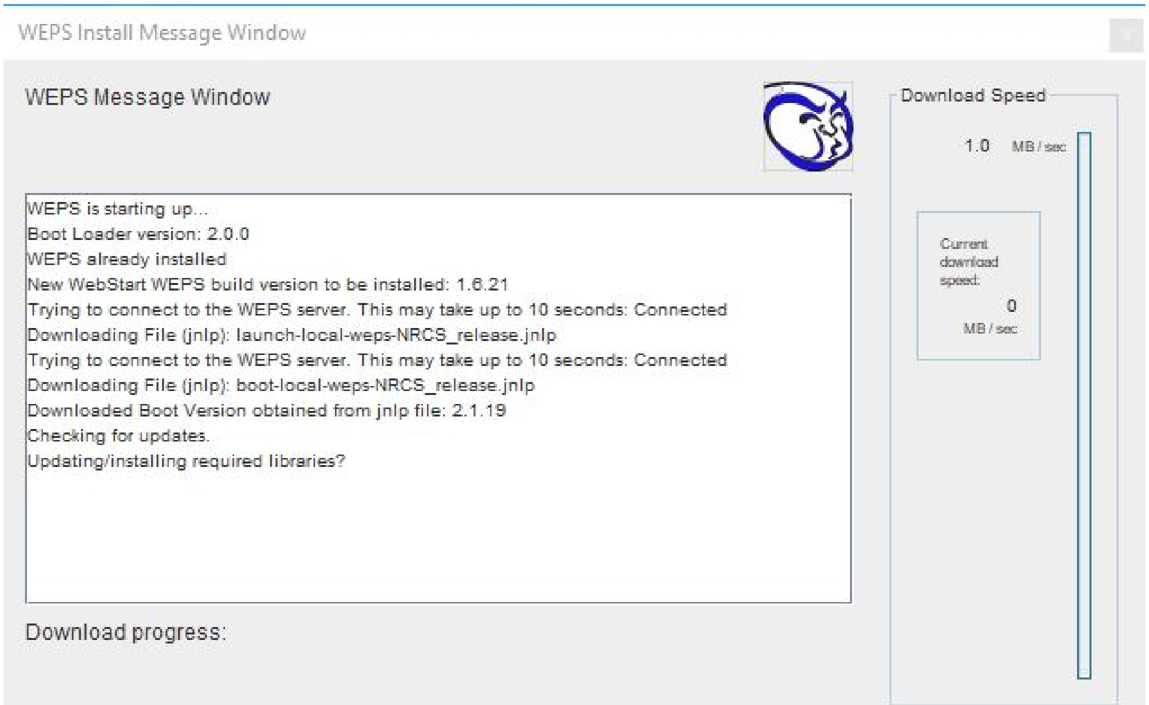



Figure 2.3: WEPS Bootloader Popup Progress Window.

2. Advanced mode.

   To run the Bootloader program in advanced mode, obtain a copy from the link directly below the MSI Bootloader link identified in the WebStart WEPS partial home page screenshot shown in Fig. 2.2, which is also available directly here:
   https://infosys.ars.usda.gov/svn/code/weps_webstart/branches/[ ...] /WEPS_Bootloader_choices.cfg

   Simply place the downloaded **WEPS_Bootloader_choices.cfg** file in the WEPS_Bootloader folder residing in the ”.weps” folder within the user’s home directory. For Windows 10 that location is here:
   **∼/AppData/Roaming/.weps/WEPS_Bootloader**

   The user will, upon execution of the WEPS Bootloader, select which operation they want to perform from an interactive GUI window. Once they have made that selection, the user will then be able to select from the available WebStart WEPS build options listed in the WEPS_Bootloader_choices.cfg file.

   Here is the complete list of WebStart WEPS builds that can currently be specified within the Bootloader’s WEPS_Bootloader_choices.cfg file:

   NRCS Release
   NRCS Pre-Release
   NRCS Daily
   NRCS Release Development
   NRCS Pre-Release Development
   NRCS Daily Development
   ARS Release
   ARS Pre-Release
   ARS Daily
   ARS International Release

ARS International Pre-Release
ARS International Daily

When running in advanced mode, the WEPS Bootloader will first present a window with the following user options:

**Install/Update**

Installs and/or updates the selected WEPS build (selection choices are offered after clicking on this button).

**Launch As-Is**

The WEPS Bootloader skips the update check and immediately executes the selected cached WebStart WEPS copy previously installed (selection choices are offered after clicking on this button).

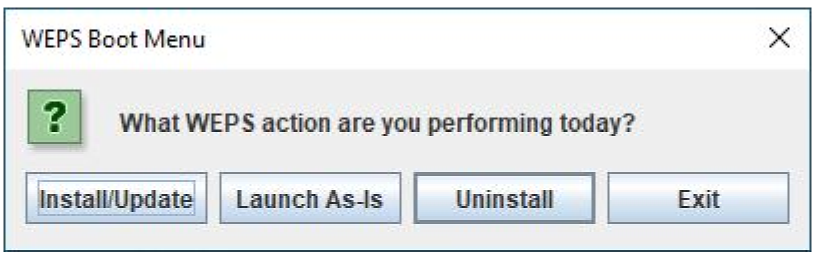
**Uninstall**

Uninstalls the selected WEPS build (selection choices are offered after clicking on this button).

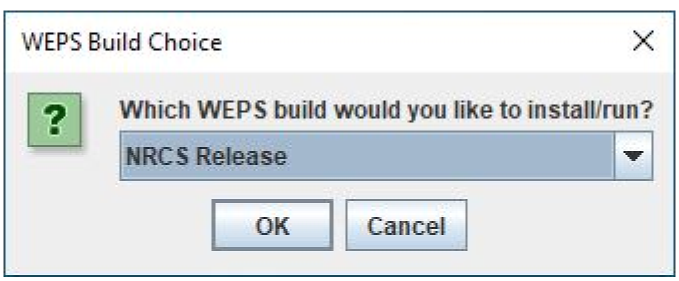
**Exit**

Exits the WEPS Bootloader program.

For the advanced mode, the following window will first display with the options mentioned earlier as shown here.




Per the initial window buttons, the user is then given the opportunity to select which WebStart WEPS build to perform the previous action upon.




After making the WebStart WEPS build choice selection and clicking on the ”OK” button, the Bootloader will then display the WEPS Bootloader progress window shown earlier until WebStart WEPS comes up.

## 2.3 Java OpenWebStart Install

If one has Java 11 or later versions (as well as earlier Java versions too) they can install and use OpenWebStart, which is an open source alternative to the previously built in Java WebStart functionality (in Java 10 and earlier releases), which was removed in Java 11, to install WebStart WEPS.

OpenWebStart is available from here to download:
https://openwebstart.com/download

The user simply needs to download and install OpenWebStart as a separate program. It can be installed without requiring Administrator rights on a "per user" install or with Administrator rights on a "per machine" installation. OpenWebStart provides some additional capabilities such as specifying which installed JDK or JVM is used for a specific application, maintain specified installed JDK installations from specified sources, etc. It can also be configured to keep itself current with its latest release as well.

After installing OpenWebStart, the user should follow the instructions for a Java WebStart Install described previously in that section within this chapter.

## 2.4 Windows MSI Install

A traditional Windows MSI desktop installation of WebStart WEPS is available but not formally maintained at this time. If a prospective user has a compelling need for this installer, they should contact the ARS developers for a copy via email at weps@ars.usda.gov.

## 2.5 Running the WEPS Welcome Wizard

The WEPS Wizard automatically runs the first time WEPS is initiated. The WEPS Wizard ensures that the user registers their contact information (name and email address) so that if they submit questions/comments/bug reports, we will know who sent the message and can respond back to them via email, etc.

The first window that will appear following the splash screen will be the WEPS Welcome Wizard screen (Fig. 2.4). Select the "Next" button to proceed to the next Wizard screen.

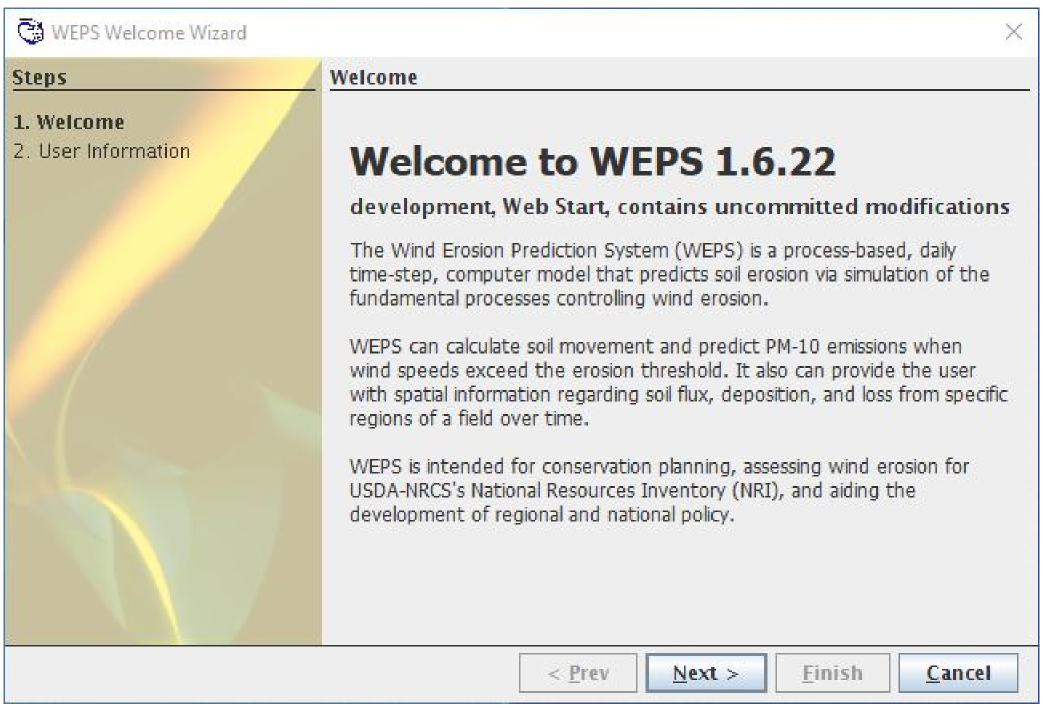



Figure 2.4: WEPS Welcome Wizard window.

The Welcome Wizard requests the user's full name and email address (Fig. 2.5). Fill in the appropriate information (the email address field will not accept text that does not contain an "@" character), then select the "Next" button at the bottom of the screen.

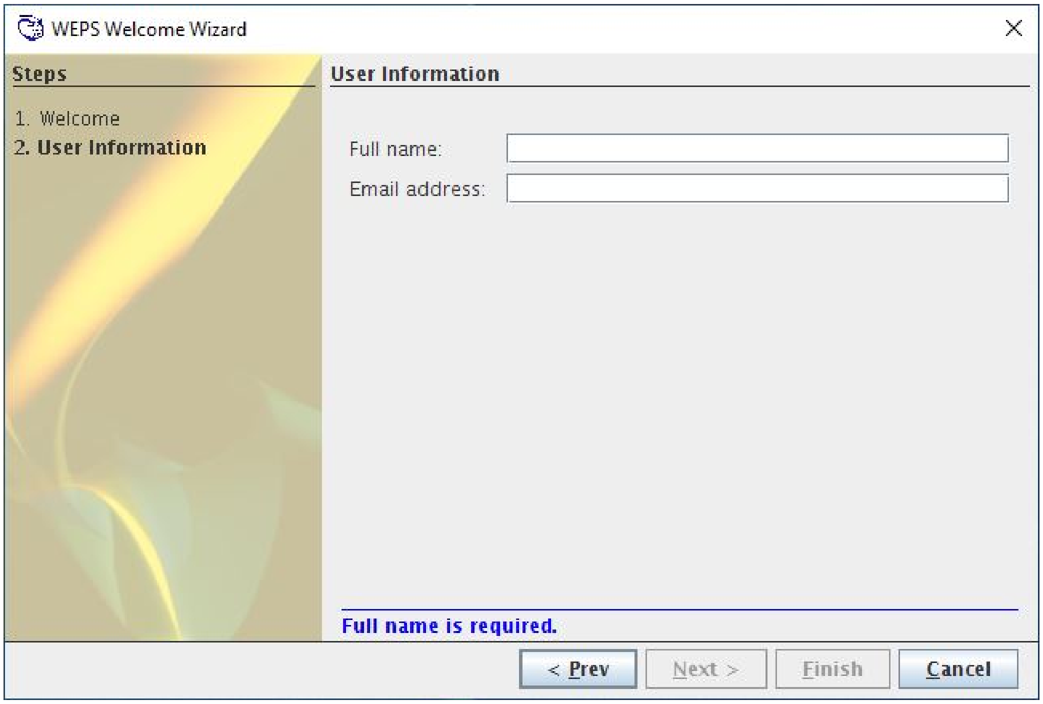



Figure 2.5: WEPS Welcome Wizard window requesting name and email address.

The final WEPS Welcome Wizard screen will now display, showing the absolute path and filename containing the user's local WEPS configuration file (Fig. 2.6). Select the "Close" button to finish the Welcome Wizard and close the window to begin work with WEPS.

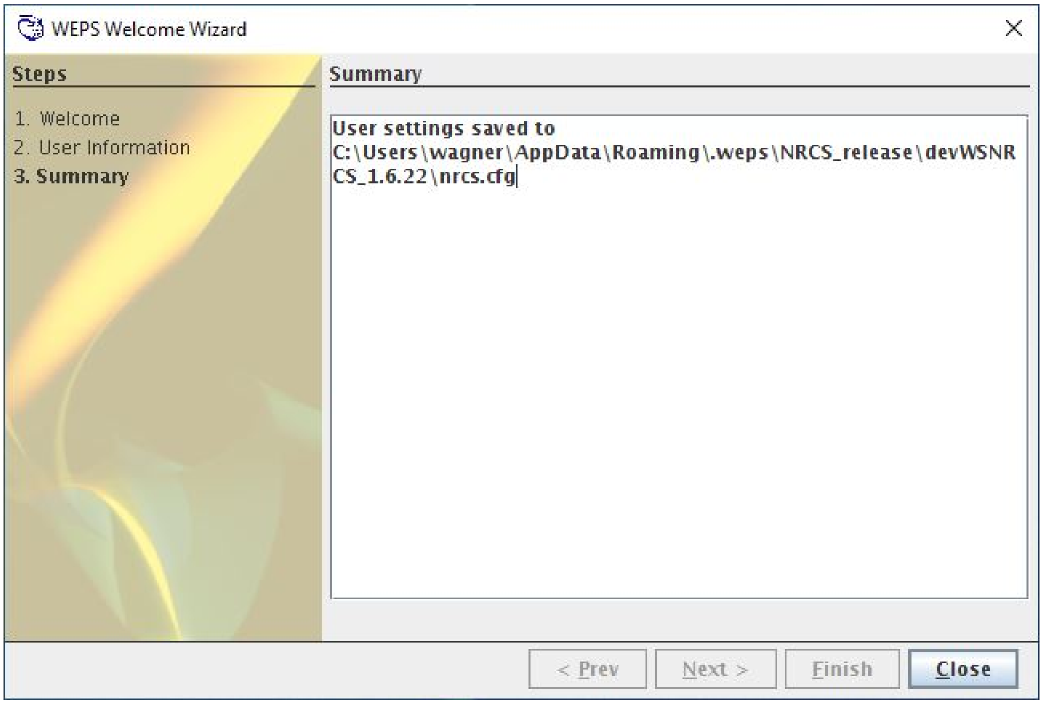



Figure 2.6: WEPS Welcome Wizard summary window.

## 2.6 Quick Simulation using WebStart WEPS

WEPS is a comprehensive wind erosion model with many options for inputs and outputs. For basic simulations however, WEPS is simple to operate. The following quick start guide will describe how to make a simple simulation run. To learn the more detailed features of WEPS, refer to the full WEPS User Manual.

After WebStart WEPS has been installed, initiate it from the Startup Menu or Desktop shortcut:

a) Select “All Programs”, “USDA Applications”, “WEPS Bootloader 1.0” for users that installed WebStart WEPS with the Bootloader.

   or

b) Select ”All Programs”, ”WEPS” and then select the desired WEPS build from the Start Menu list.

**A Simple Simulation**

For a simple simulation, only four types of information are entered on the main WEPS screen.

1. Describe the simulation site geometry by selecting the field shape, dimensions and orientation in the **Region** labeled panel.

   Type in the specific coordinate and/or area information (dependent upon the *shape* selected), e.g.: X-Length and Y-Length field dimensions for a *Rectangle* shape, etc., as well as specific field orientation (±45° max) relative to true north, in the *Orientation* box.

2. Select the field/site location (for weather station selections).

   In the panel labeled **Location**, use the mouse to select a *Country* (if enabled), *State* (or other country specific designation) and *County* (or other local designation) from the drop down menu.

   Coordinates for a location will be automatically selected near the center of the selected County. The weather stations, both **Cligen** and **Windgen**, for the selected location will be automatically determined and displayed immediately below the elevation field. The*Elevation* field itself will be automatically populated with the value from the currently selected **Cligen** station, which can overridden by the user, if desired.

   If the user knows or desires a more accurate location for the field site, they can use the **MapViewer** to select the location from a satellite map or enter lat/lon coordinates of the field site directly into their respective latitude and longitude input fields.

3. Select a soil.

   In the bottom panel of the window, to the far right of the button labeled **Soil**, use the mouse to select a soil from the drop down menu. To see and select a soil that exists on the field site, use the *CSIP Soil Service* option.

4. Select a management scenario.

   In the bottom panel of the window, to the far right of the button labeled **Man**, use the mouse to select a crop rotation from the drop down menu. If one uses the *CRLMOD Managements*, which are subdivided by NRCS CMZ (Crop Management Zones), be aware that these rotations do not contain irrigation operations, if irrigated rotations, and are generic, so they very likely require some editing for most purposes. Click on the **Man** button to open **MCREW** (Management/Crop Rotation Editor for WEPS) to review and modify the selected management rotation as necessary.

Once these items are complete, click the ”Run” button on the tool bar at the top of the screen. You will be asked to enter a name for the simulation run and click *OK*. Once a run name is entered, you will then see indicators that WEPS is running. When the simulation run is finished, the **Run Summary** report screen will automatically appear on the computer screen.

**Run Summary**

The Run Summary displays user information, input parameter files, and basic soil loss information by rotation year, crop interval and the average annual soil loss for the total simulation. Soil loss (erosion) output in the Run Summary includes: **Gross Loss**, the average erosion within the field; **Total**, the average total net soil loss from the field;

**Creep/Salt**, the average creep plus saltation ($\geq$100$\mu$m dia. particles) net erosion from the field; **Suspension**, the average net suspension size (<100$\mu$m dia. particles) soil loss from the field; **PM10**, the average net loss of particulate matter less than 10 microns in size from the field; **PM2.5**, the average net loss of particulate matter less than 2.5 microns in size from the field.

**Exiting WEPS**

To exit WEPS click on the *Project* (or *File*) menu option on the far left of the menu bar at the top right corner of the main screen, then click *Exit*. You will be asked if you want to save your current WEPS Project (state of selections made on the interface screen). You will also be asked to confirm if you really want to exit WEPS. Select *Yes* to exit WEPS.

**Additional Information**

WEPS has the capability for many simulation input options, including adding barriers and specifying numerous management options. WEPS also can optionally produce very detailed output to provide the user with a better understanding of what field conditions and management situations cause soil loss by wind and when. Consult the WEPS User Manual for complete details.

For further information regarding WEPS, users should contact:

WEPS
USDA-ARS Rangeland Resources & Systems Research Unit
2150 Centre Ave., Bldg. D Suite 200
Fort Collins, CO 80526

Phone: 970-492-7322
E-mail: weps@ars.usda.gov
WebStart WEPS URL: https://infosys.ars.usda.gov/wepstart
ARS Wind Erosion URL: https://infosys.ars.usda.gov/WindErosion

For NRCS employees, WEPS users should contact:

Chris Coriel
NRCS National Erosion Specialist
501 W. Felix St., FWFC, Bldg. 23
Fort Worth, TX 76115

Phone: 817-509-3213
Cell 817-471-0122
Fax: 817-509-3337
E-mail: chris.coreil@usda.gov
NRCS Wind Erosion URL: https://www.nrcs.usda.gov/resources/tech-tools/wind-erosion-prediction-system

# 3. Overview: Wind Erosion Prediction System

## 3.1 Introduction

Soil erosion by wind is a serious problem in the United States and the world. Wind erosion is a threat to agriculture and the earth's natural resources. It renders soil less productive by removing the most fertile part of the soil, namely, the clays and organic matter. This removal of clays and organic matter also damages soil structure. In addition to the soil, wind erosion can damage plants, primarily by the abrasive action of saltating particles on seedlings and fruits. Eroded soil can also be deposited into waterways where it impacts water quality and emitted into the air where it degrades the air resources. By affecting these resources, wind erosion can also become a health hazard to humans and other animals. The ability to accurately simulate soil loss by wind is essential for, among other things, environmental and conservation planning, natural resource inventories, and reducing air and water pollution from wind blown sources.

The Wind Erosion Equation (WEQ) was published in 1965 by Woodruff and Siddoway (1965). For many years, WEQ has represented the most comprehensive and widely used model in the world for estimating soil loss by wind from agricultural fields. The functional form of WEQ is:

$$E = f(I, C, K, L, V) \tag{3.1}$$

Where, E is the average soil loss (tons/acre/year), I is the soil erodibility, K is the soil ridge roughness, C is the climatic factor, L is the field length along the prevailing wind erosion direction, and V is the vegetative factor. WEQ is largely empirical in nature and was derived from nearly 20 years of field and laboratory studies by scientists at the USDA-Agricultural Research Service (ARS), Wind Erosion Research Unit (Chepil, 1958, 1959, 1960; Chepil and Woodruff, 1959). Many improvements were made to WEQ over the next 30 years (Tatarko, et al. 2013). Because of the limitations of adapting WEQ to many problems and environments, as well as advancements in wind erosion science and computer technology, the USDA Natural Resources Conservation Service requested that ARS develop a replacement for WEQ (Hagen, 1991).

## 3.2 Development of WEPS

Research in the 1980's (Cole et. al., 1983; Cole, 1984; and Lyles, et. al., 1985) provided the initial attempt to outline a processed based approach to simulating wind erosion that would replace WEQ. Following this initial work, the initial modular structure used in the current WEPS model was developed (Hagen, 1991), which was later revised (Wagner, 1996) and the experimental research needed to support that structure was outlined. Numerous field and laboratory studies were conducted to develop relationships for surface conditions and erosion. Experimental data were collected for weather (Skidmore and Tatarko, 1990), hydrology (Durar and Skidmore, 1995), crop growth (Retta and Armbrust, 1995), residue decomposition (Steiner et. al., 1995), soil (Hagen, et. al., 1995; Potter, 1990, Zobeck and Popham, 1990, 1992), management (Wagner and Ding, 1995), and erosion (Hagen, 1995). Experiments were also conducted to validate that the erosion routines were producing accurate and precise erosion estimates (Fryrear, et. al, 1991). A brief history of WEPS development has been documented (Wagner, 2013).

A multi-disciplinary team was assembled to develop WEPS that included climate modelers, agronomists, agricultural engineers, soil scientists, and crop modelers. The WEPS development project had a multi-agency commitment consisting of the Agricultural Research Service, Natural Resources Conservation Service, and the Forest Service from the U.S. Department of Agriculture, along with the Environmental Protection Agency, the Army Corps of Engineers, and the Bureau of Land Management. In 2005, WEPS was released to the NRCS for testing and further development for field office conservation planning. In 2008, WEPS was released to NRCS for field office implementation. In 2010 NRCS officially adopted WEPS and is now their primary tool for wind erosion assessments on cropland agricultural fields.

## 3.3 WEPS User Requirements

Early in the WEPS development process, input was requested from potential users on the needed capabilities of a new wind erosion simulation model. These user requirements were summarized by Hagen (1991). Based on these requirements, WEPS was designed to:

1. **Provide more accurate and detailed estimates of soil loss by wind from agricultural fields.** Results for WEQ were an annual average soil loss based essentially on average weather and field conditions. Since erosion is often the result of extreme weather events (e.g., high wind or dry soil conditions), an approach that accounts for such extreme conditions was needed to simulate the extreme soil loss for these situations. In addition, WEPS is capable of outputting erosion loss and surface conditions on a relatively fine temporal scale (e.g., hourly). However, for practical purposes, the default time step for WEPS output is two weeks. Such detail allows the user to observe the periods when excessive erosion occurs and the wind or surface conditions which caused the soil loss (e.g., low vegetative cover, etc.). These conditions can then be addressed by altering management or other control measures.
2. **Develop more cost-effective erosion control methods.** Because of the detail in the soil loss and field conditions provided by WEPS, it is a valuable tool for testing various management scenarios or control methods through simulation. Each scenario can be evaluated before a change in farming practices is made in the field. Surface conditions and management can be observed during periods of excessive loss and adjusted to minimize erosion.
3. **Simulate the amount of soil loss by direction.** With increasing concern of the offsite impacts of wind erosion on soil, water, and air quality, the capability of WEPS to provide the direction of soil loss is useful. For example, creep and saltation loss to a roadside ditch or waterway will impact water quality, so attention can be focused in these scenarios to controlling loss in that direction. Similarly, suspension loss in the direction of highly populated areas or nearby heavily trafficked roadways can be simulated with WEPS and specific control strategies simulated.
4. **Separate soil loss into creep/saltation, suspension, and PM10 components.** Each of these components have specific characteristics and effects. Creep/saltation are typically deposited locally where they can affect soil and water quality, bury crops, roads, and irrigation ditches, or be deposited as dunes in fences or windbreaks. Suspension, by definition, can be lifted into the air and carried great distances. As such, it can be a detriment to air quality, become a health hazard, and reduce visibility along transportation systems. PM10 has been determined by the U.S. Environmental Protection Agency to be a hazard to air quality and a respiratory hazard in particular (U.S. EPA, 1996). Estimating soil loss of each of these components can aid in environmental assessments.

Taking all user requirements into consideration, WEPS is designed to be an aid in: 1) soil conservation planning, 2) environmental assessment and planning; and 3) determining off-site impacts of wind erosion.

## 3.4 WEPS Modeling Approach

WEPS is a process-based, daily time-step model that simulates weather, field conditions, and erosion. As such, it simulates not only the basic wind erosion processes, but also the field management and weathering processes that modify a soil's susceptibility to wind erosion. The current model release is WEPS 1.6 (or WebStart WEPS)and is designed to provide the user with a simple tool for inputting initial field conditions, calculating soil loss, and displaying either simple or detailed outputs for conservation planning and design of erosion control systems.

## 3.5 WEPS 1.6 Geometries

To simplify inputs, WEPS 1.6 is designed with specific geometric constraints when specifying the simulation region or field (Fig. 3.1). The simulation region is limited to a rectangular area. However other field shapes such as circles or half circles can also be simulated by defining a rectangle of the same length, width, or area of the desired field shape. The simulation area may be rotated to orient the field correctly on the landscape to account for the effects of varying tillage, planting, and wind directions.

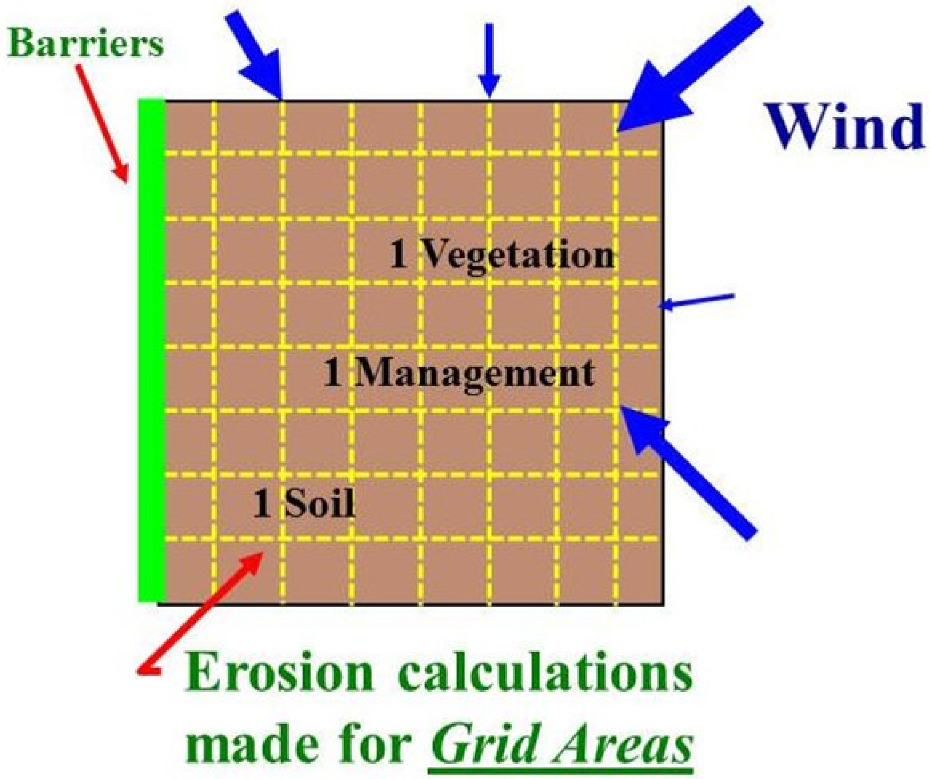



Figure 3.1: WEPS simulation geometries.

A uniform simulation region surface is assumed in that only one soil type (uniform soil properties), crop type (biomass properties), and management are uniformly distributed over the field. In reality, fields are often not uniform so the user may select the dominant-critical (i.e., most erodible) soil or crop condition for a simulation. Barriers may be placed on any or all field boundaries. When barriers are present, the wind speed is reduced in the sheltered area on both the upwind and downwind sides of the barriers. Thus, WEPS can simulate deposition in front of downwind barriers. The erosion submodel determines the threshold friction velocity at which erosion can begin for each day's surface condition. When wind speeds exceed the threshold, the submodel calculates the loss/deposition over a series of individual grid cells representing the field. The soil loss and deposition is divided into components of saltation/creep and suspension, because each has unique transport modes, as well as off-site impacts. The field surface is periodically updated during erosion events to simulate the surface changes caused by erosion. Surface updating during an erosion event includes changes to aggregate size distribution of the surface as fine particles are removed and surface aggregates breakdown into smaller sizes due to impacts from moving particles, smoothing of ridge roughness as ridges are eroded and furrows fill with eroded materials, etc.

## 3.6 Model Implementation

The structure of WEPS 1.6 is modular and consists of the science model, coded in FORTRAN 95 coupled with a graphical user interface, which is coded in JAVA. The model also includes five databases, two weather simulation generators, and six submodels (Fig. 3.2).

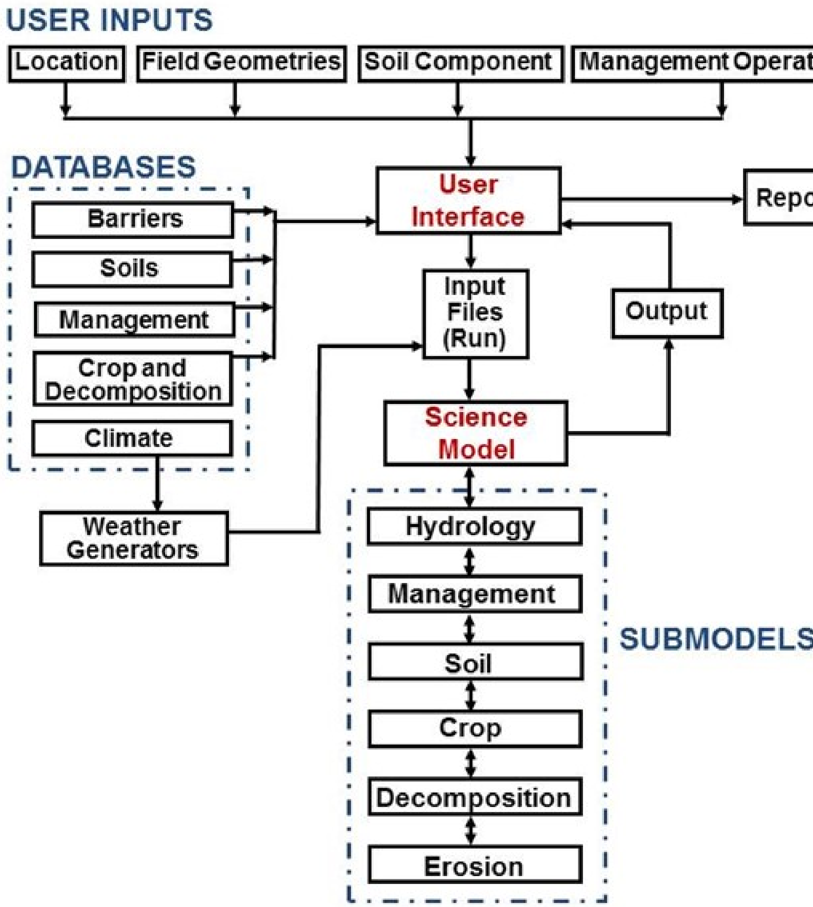



Figure 3.2: Structure of the WEPS Model.

The user interface provides a means for the user to enter initial conditions such as the field dimensions, orientation, barriers, location, management operations, and soil component desired for the simulation region. Field dimensions are entered as a length and width and orientation as an angle deviation from north. The user selects the barrier type from a list accessed through the interface. For location, the user can either select the country (if configured for non-U.S. usage), state and county or enter a latitude and longitude directly for simulation. Based upon the latitude and longitude of the location, the interface then selects the weather stations for which statistical weather parameters based upon historical measured meteorological data are used to simulate daily (and hourly for wind) weather parameters. The soil component is selected from a list of soils supplied by the NRCS Soil Survey Geographic (SSURGO) database for the Soil Survey Area of the simulation region or, when online, directly from the NRCS Soil Data Mart website (http://soildatamart.nrcs.usda.gov). Management operation and dates are compiled in the Management/Crop Rotation Editor for WEPS (MCREW) in a spreadsheet style table editor.

Given the user supplied inputs, the interface accesses five databases for climate, soils, management, barriers, and crop growth and residue decomposition for the simulation. These databases provide needed parameters for location and conditions simulated as specified by the user. The interface writes the information needed for a WEPS simulation, obtained from the user and the databases, into WEPS input files. The interface also executes the weather generators which create weather files containing daily precipitation, maximum and minimum temperatures, solar radiation, and dew-point temperature as well as daily wind direction and subdaily (e.g., hourly) wind speeds. These input files for a given simulation are collectively known in WEPS as a “WEPS Run”. To reduce computation time, a daily time step is used in WEPS, except for selected subroutines in the Hydrology and Erosion submodels, which may use hourly or sub-hourly time steps (e.g., 15 minutes). The science model reads the input run files and calls the Hydrology, Soil, Crop, and Decomposition submodels daily which account for changes in the soil surface erodibility as influenced by management and weather. If surface conditions for a given day are such that erosion can occur for the maximum wind speed for that day, Erosion submodel routines are called to calculate soil loss and deposition. Soil erosion by wind is initiated when the wind speed exceeds the saltation threshold speed for a given soil and biomass condition. After initiation, the duration and severity of an erosion event depend on the wind speeds and the evolution of the surface conditions.

## 3.7 WEPS Model Use

WEPS is a comprehensive wind erosion model with many options for inputs and outputs. For basic simulations however, WEPS 1.6 is simple to operate. Only four types of information are entered on the main screen: 1) description of the simulation region geometry by defining the field dimensions and field orientation; 2) select the field location for which to generate simulated weather; 3) select the soil; and 4) select a management scenario. For U.S. simulations, the last three may be selected from lists provided with the WEPS model or from NRCS. New input files will usually be created using previous input files as templates modified within the user-interface. By varying inputs, particularly the field management, users can compare various alternatives to control soil loss by wind. Interpreting the outputs of WEPS is an integral part of using WEPS as a tool to develop conservation plans for controlling wind erosion. WEPS provides options for viewing very detailed outputs by periods (default is two weeks) including soil loss as saltation/creep, suspension, and PM10. Period output is also available for weather parameters such as wind energy, as well as surface conditions such as soil erodibility and biomass amounts. Such information is useful in determining which period is resulting in severe erosion and the conditions that are contributing to the loss. WEPS outputs also include amount of loss for each direction which aid the user in the placement of barriers, strip cropping, or other directional erosion control methods. More detailed features of WEPS and information on use of WEPS outside the U.S. are covered later in this manual. WEPS also has a Multiple Run Management View option to allow easier comparisons of alternative outputs.

## 3.8 Conclusion

The Wind Erosion Prediction System is a process-based, daily time-step model that simulates weather, field conditions, and erosion. WEPS development was in response to customer requests for improved wind erosion technology. It was intended to replace the predominately empirical Wind Erosion Equation as a prediction tool for those who plan soil conservation systems, conduct environmental planning, or assess offsite impacts caused by wind erosion. The WEPS model is continually being improved with periodic updates. Plans are in place to develop the following enhancements to WEPS for future upgrades: i) provide plant damage estimates, ii) integration with the Water Erosion Prediction Project (WEPP) model, iii) add capabilities for other, non-cropped lands such as range lands, iv) predict visibility effects of dust storms, v) dust prediction via weather forecasting, vi) prediction of PM2.5 and PM-coarse (PM10 minus PM2.5), and vii) include capabilities for complex fields in terms of relief (terrain elevation), multiple soils, crops, and management on one simulated field.

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# 4. Building and Making a WEPS Run

## 4.1 Preparing/Building a WEPS Simulation

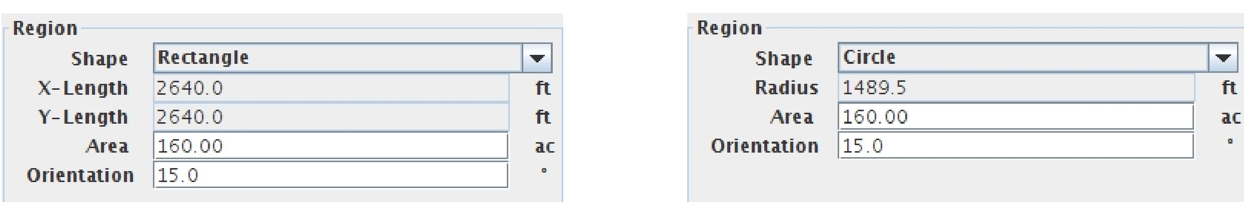
For a WEPS simulation, only four types of information are required to be entered on the main WEPS screen:

1. Select field shape and specify the site area and orientation in the **Region** panel.
2. Select field site location in the **Location** panel, which also automatically selects the Cligen and Windgen stations to be used.
3. Select the desired soil component for the simulation via the dropdown choice list next to the **Soil** button at the bottom of the WEPS screen.
4. Select the desired management/crop rotation scenario via the dropdown choice list next to the **Man** button near the bottom of the WEPS screen[1].
5. (Optional) Select wind barrier(s) which are placed along the field borders via the **Barriers** panel.

Now that we know which inputs are required for a WEPS simulation to be performed, we will look at each of them in more detail:

### 4.1.1 Specifying Field Information

Describe field shape, size (area) and orientation within the **Region** panel (see examples in Fig. 4.1). Field shapes and orientations are displayed below the **Region** panel (see examples in Fig. 4.2).



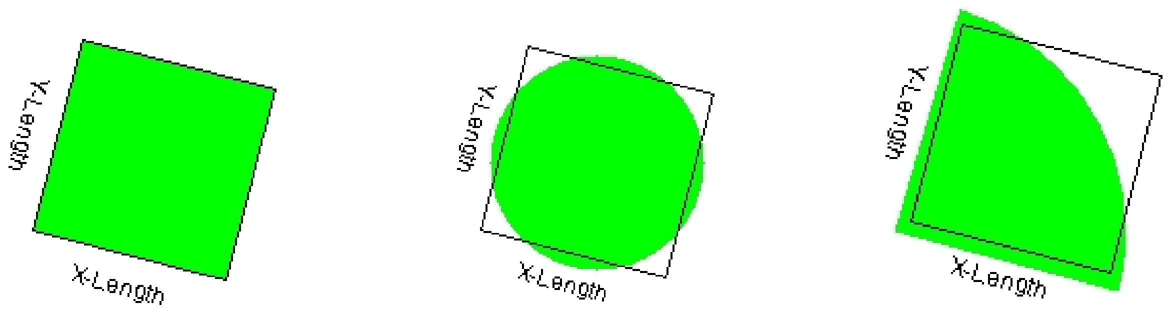

(a) Rectangle Shape Field Inputs (b) Circle Shape Field Inputs

Figure 4.1: Field Site specification within the Region Panel.

A) Select field shape via the dropdown choice list, which will automatically get depicted in the field display area when selected (Fig. 4.2). The options are:

| | | |
|---|---|---|
| Rectangle | Half Circle VE | Quarter Circle NE |
| Square | Half Circle VW | Quarter Circle SE |
| Circle | Half Circle HS | Quarter Circle NW |
| | Half Circle HN | Quarter Circle SW |

[1]Note that most previously built management/crop rotations require modification for each specific simulation site.




(a) Rectangle Shape Field (b) Circle Shape Field (c) Quarter Circle Shape Field

Figure 4.2: Example Field Shape displays located below the Region Panel.

B) Specify the field orientation (±45° max) relative to true north, in the *Orientation* box, which the orientation will automatically get depicted in the field display when selected (Fig. 4.2).

C) Enter the specific field boundary length(s), field radius, etc., based upon the field shape selected or specify the field area for the site.

### 4.1.2 Selecting Site Location

Select the field/site location (which also automatically obtains the default Cligen and Windgen weather station selections).

In the panel labeled **Location**, use the mouse to select a *Country* (if enabled), *State* (or other country specific designation) and *County* (or other local designation) from the drop down menu (Fig. 4.3).

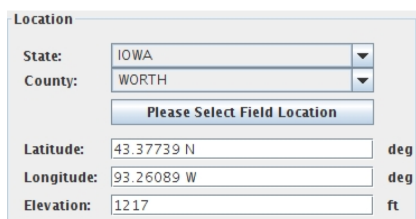



Figure 4.3: State/County Location Selection.

Coordinates for a location will be automatically selected near the center (centroid) of the selected County. This can be visually displayed in the Map Viewer as shown in Fig. 4.4, which is accessible by clicking on the Map Viewer button (Fig. 4.3) currently containing the text ”*Please Select Field Location*”. The weather stations, both **Cligen** and **Windgen**, for the selected location will also be automatically determined and displayed immediately below the elevation field (Fig. 4.3). The *Elevation* field itself will be automatically populated with the value from the currently selected **Cligen** station, which can overridden by the user, if desired.

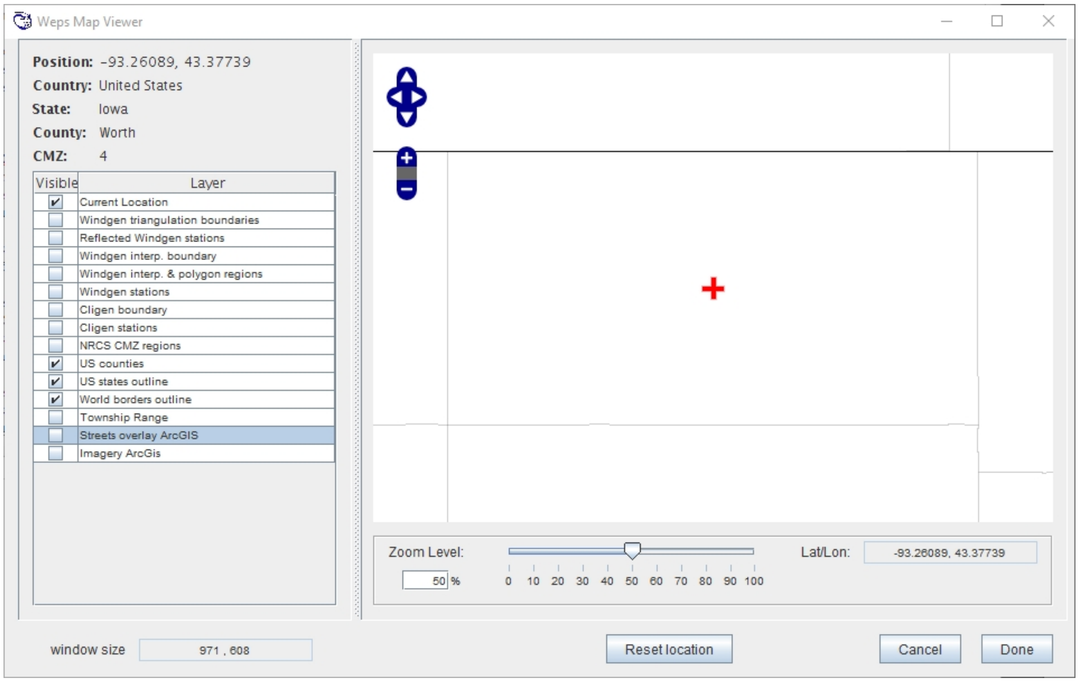



Figure 4.4: Map Viewer County centroid display.

However, it is desirable to provide the actual field site location for WebStart WEPS, if available. This is because WebStart WEPS can make PRISM local monthly average temperature adjustments to the Cligen station data inputs for the Cligen generator, allowing Cligen to create a more accurate representation of the weather inputs driving the WEPS simulation for the selected site. In addition, the new CSIP Soil service will also provide the user with a list of the actual soils present on the field site for the user to select from, rather than selecting the soil component from the entire county listing of soil components via the NRCS SoilDataMart service. Therefore, specifying the actual field site is usually preferred for WebStart WEPS simulations.

If the user knows the site location's lat/long coordinates, they can enter them directly into their respective fields (Fig. 4.5)[2].

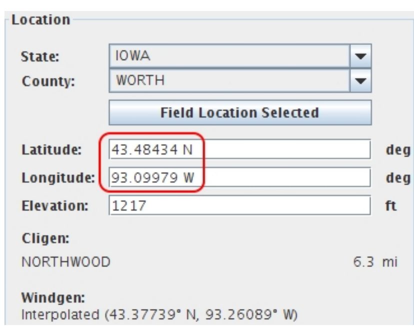



Figure 4.5: Field Lat/Long coordinates site selection.

If not, the user can use the **MapViewer** to select the location from a satellite map image, which will provide the lat/long coordinates of the field site directly (Fig. 4.6).

[2]Note that the Map Viewer button changes its text to "*Field Location Selected*" to inform the user that they have now specified a specific field site location

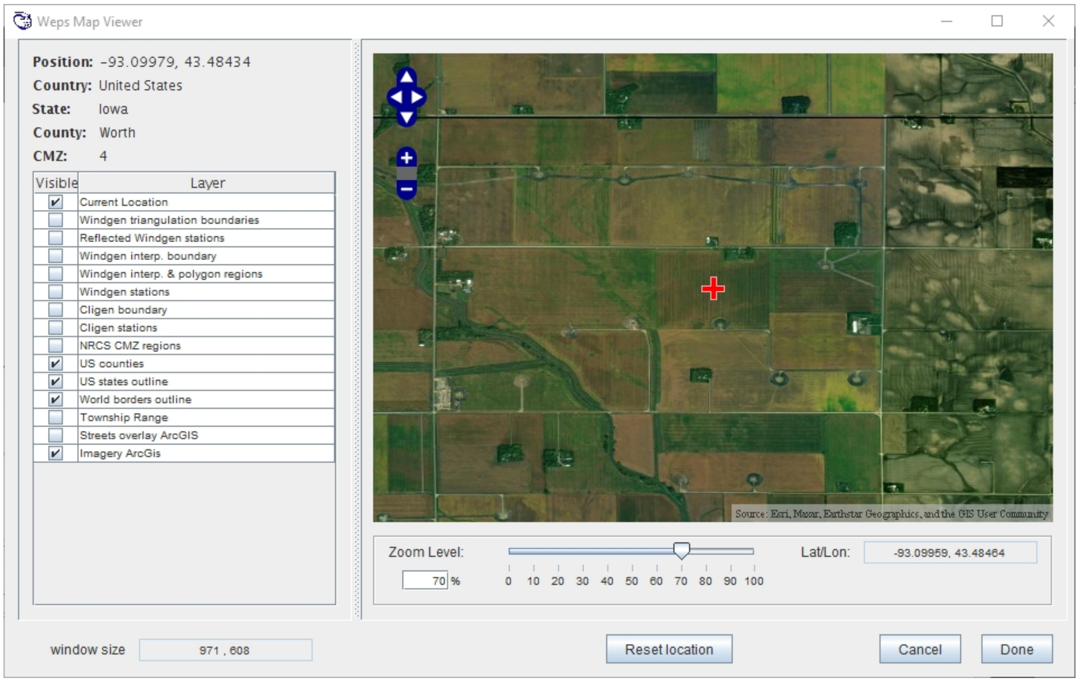



Figure 4.6: Map Viewer County displaying site selection.

### 4.1.3 Selecting Soil Component

In the bottom panel of the window, to the far right of the button labeled **Soil**, use the mouse to select a soil from the drop down menu . To see and select a soil that exists on the field site, use the *CSIP Soil Service* option as shown in Fig. 4.7.

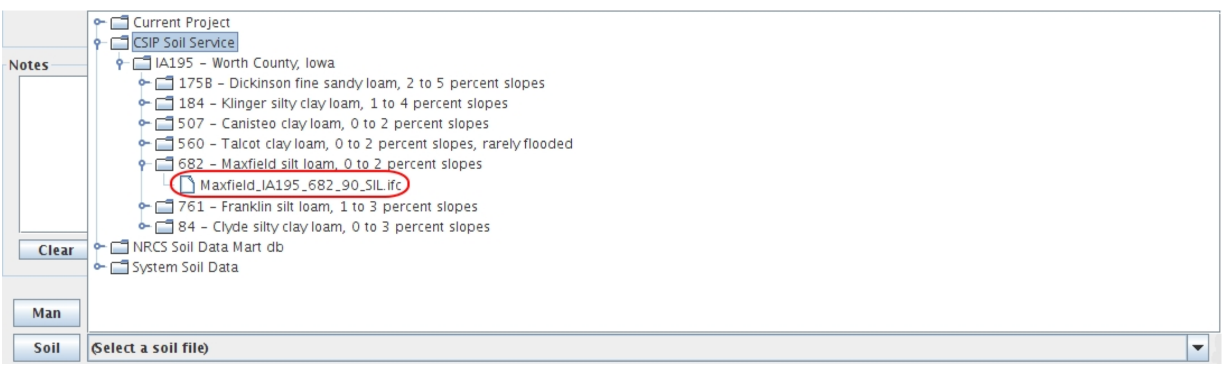



Figure 4.7: Soil dropdown choice list displaying CSIP soil component selection.

### 4.1.4 Selecting Management/Crop Rotation Scenario

In the bottom panel of the window, to the far right of the button labeled **Man**, use the mouse to select a management/crop rotation from the drop down menu . If one uses the *CRLMOD Managements* templates (as shown in Fig. 4.8) which are subdivided by NRCS CMZ (Crop Management Zones), be aware that these rotations are generic and very likely will require editing for most uses. They also do not contain irrigation operations, so if the rotation is to be used in an irrigated site, irrigation operation(s) must be added. Click on the **Man** button to open **MCREW** (Management/Crop Rotation Editor for WEPS) to review and modify the selected management/crop rotation as necessary.

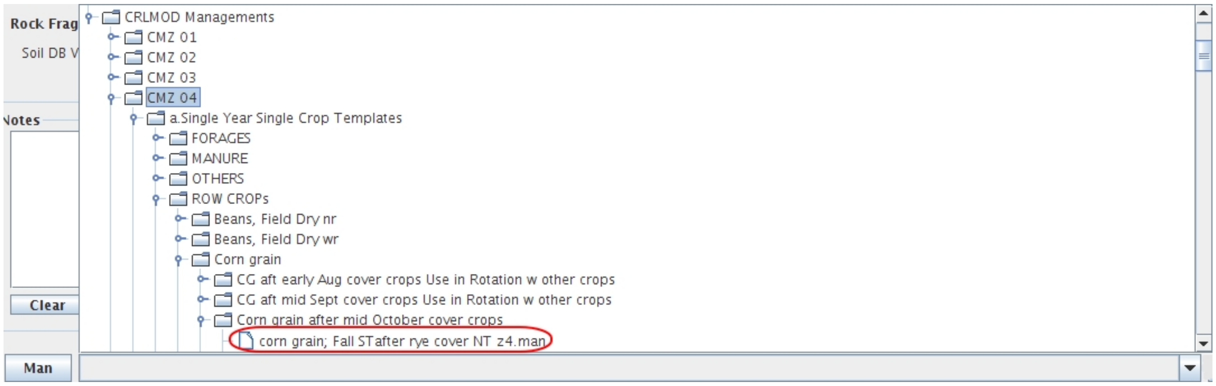



Figure 4.8: Management dropdown choice list displaying a CMZ management template selection.

## 4.2 Making a Standard WEPS Run

Once the desired information discussed above is entered through the interface screen, a simulation run can be initiated. Clicking on the **Run** menu, then selecting **Make a WEPS Run** (Figure 4.9), begins a WEPS simulation run. One can also click the run button on the button bar or use the keyboard shortcut key by pressing the **Ctrl-R** keys simultaneously to begin the process of executing a WEPS simulation run. Once the simulation begins, you will then see indicators (popup window displaying progress of the simulation) that WEPS is running. When the simulation run is finished, the **Run Summary** report will automatically appear on the computer screen.

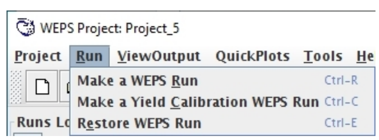



Figure 4.9: The Run menu on the main WEPS screen.

After initiating a WEPS Run, the “WEPS Run Name” window will appear (Figure 4.10), allowing the user to edit the default WEPS Run folder name displayed in the first (top) field labeled **Run Name**. Note that some special characters are not allowed in file names[3]. Note also that the WEPS Run Name is actually a folder that will automatically get a ”.wpj” extension appended to it, if not provided.

The user also has the option to change the default **WEPS Run** location in the middle (center) field labeled **Run Location**. If the user does not remember the exact path they desire the WEPS Run to be placed in, they can use the folder icon on the right side of the field to bring up a file chooser to select the WEPS Run directory location for this WEPS Run. The complete WEPS Run folder name and path are displayed in the third (bottom) **Run File** read-only field.

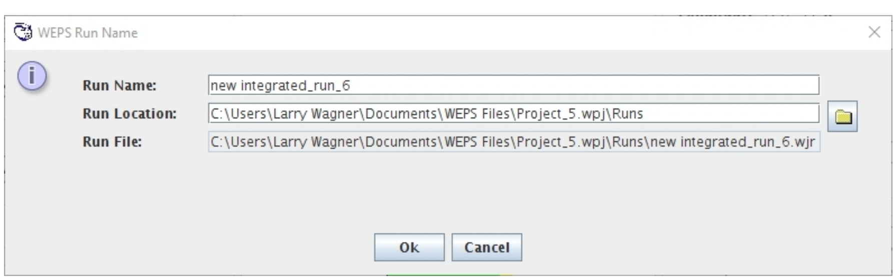



Figure 4.10: WEPS Run Name window.

[3]Known characters that are not allowed include: **: & ” ‘ * ?** <>|\

When a Run name folder has been entered and the used selects the **OK** button, the simulation begins and a window appears that shows the status and progress of the WEPS Run (Figure 4.11). At the conclusion of the run, a window may appear, if warranted, displaying any warnings that have been generated. These warnings are for informational purposes and may or may not be of interest to the user.

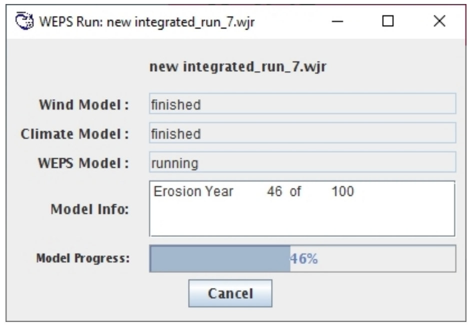



Figure 4.11: WEPS Run status window.

Upon completion of the WEPS Run, a WEPS Run Summary report will appear for the user to review and print if desired. The Run Summary report (Figure 4.12) is saved in the WEPS Run folder, along with other more detailed output reports for later retrieval.

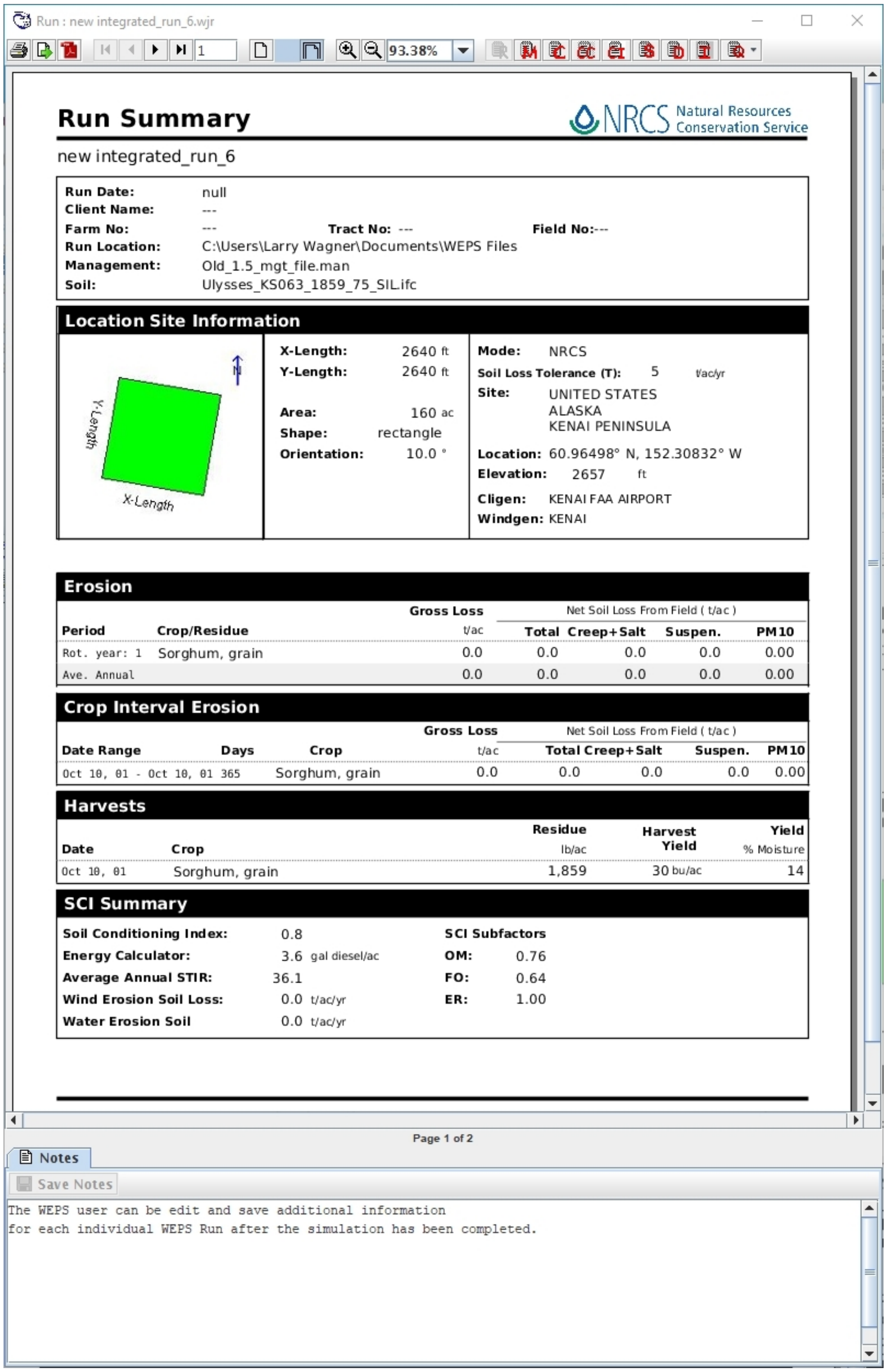



Figure 4.12: WEPS Run Summary Report.

The summary and detailed reports for a WEPS Run can be viewed or created any time by the user. See the following chapters in this document, Viewing WEPS Output Reports and Viewing Tabular Detail Reports for more detailed descriptions of the WEPS report types and how to select them for viewing or printing.

If a crop does not reach maturity, a warning will appear (Figure 4.13), indicating that the crop only reached the specified percent of the expected maturity for a given year. This warning can result from one of three causes. First, the crop variety chosen has a growing season too short for the climate being simulated with the specified planting and harvesting dates. For example, a 120-day corn variety may be specified for a location that usually grows 110-day corn. In this case, a variety that matures over a longer period for that location should be chosen. If a variety of suitable length is not available in the crop drill-down list, a new variety can be created by following the method outlined in the WEPS How To Guide: Crop Database Record Development. Another cause of this warning may be that the growing season is too short based upon the specified planting and harvesting dates for the location's climate, not allowing the crop enough days to reach maturity. In this case, be sure the planting and harvesting dates are correct and adjust accordingly. If a crop is typically harvested before it reaches full maturity (e.g., for alfalfa or silage), this warning message will also appear, but can be ignored in this situation.

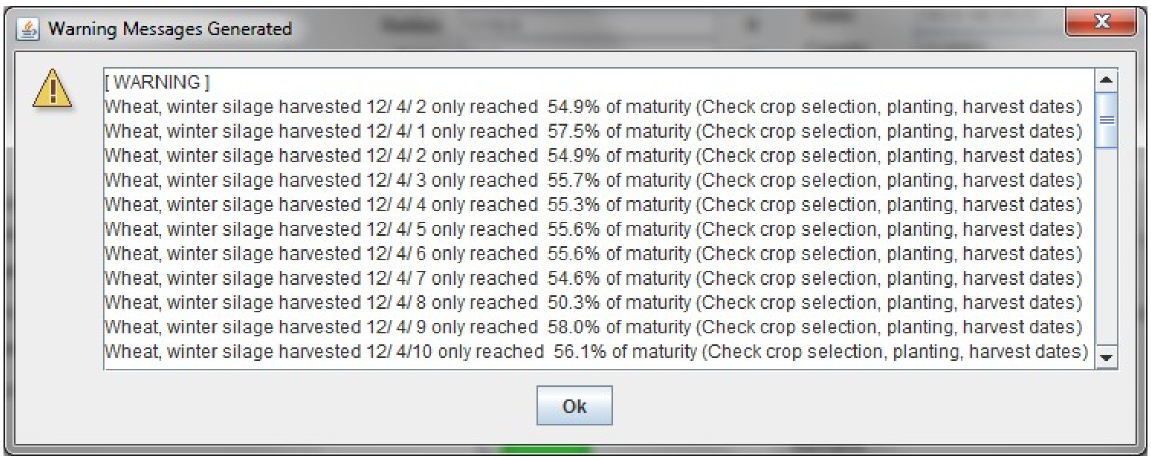



Figure 4.13: Crop growth/maturity warning message pop-up window.

## 4.3 Make a Yield Calibration WEPS Run

Differences in crop management by producers or local climate and soil variances may result in crop yields, generated by WEPS, that do not reflect the actual yields observed by a producer. WEPS provides a method to "calibrate" yields and associated crop residue biomass from WEPS, so that they more accurately reflect those of individual producers or a county as a whole. Default values are specified to reduce the need for user input, but the WEPS user must inspect/set specific parameters to their desired values, if necessary. The following steps describe how, to make a yield calibration run.

- Within MCREW, press the **Yield Calibrate** button  to display additional columns related to the crop-yield calibration function in WEPS (Figure 4.14). Resize and/or scroll horizontally as necessary the MCREW window to view the additional columns.

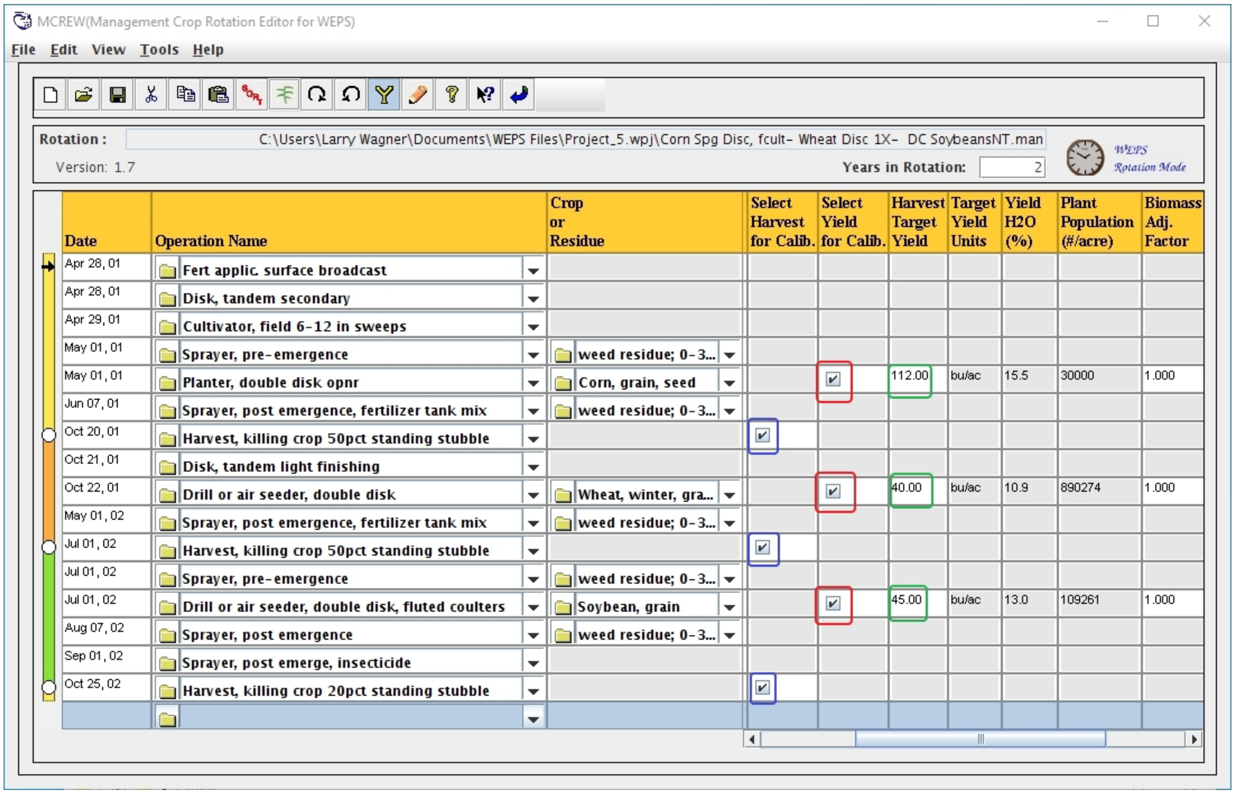


Figure 4.14: MCREW window with Yield Calibration display enabled.

- Within MCREW, select the crop (or crops) that you want to calibrate by checking the box in the **Select Yield for Calib.** column of the respective row for the crop planting operation (see red framed boxes as shown in Figure 4.14).
- Fill in the desired **Harvest Target Yield** value for the selected crop(s) (shown with green boxed regions in Figure 4.14). The yield units are displayed but not editable within MCREW.
- Within MCREW, select the harvest operation(s) for the crop (or crops) that you want to calibrate by checking the box in the **Select Harvest for Calib.** column for the respective row each crop harvesting operation is in (blue boxed regions in Figure 4.14).
- Save the rotation management file in MCREW. This currently can be done by: i) pressing the **Save** icon, ii) selecting the **File** menu's **Save** sub-menu option, iii) using the **Ctrl-S** keyboard shortcut, or iv) by clicking the **Save and Close** button, which saves the displayed data to the current file name and also closes MCREW.
- Optionally exit MCREW. This can be done either by: i) clicking on the operating system's **Close Window** button × in the top right corner of the MCREW window frame or ii) selecting the **File** menu's **Exit** sub-menu option. Note that if one forgets to save the management file before attempting to exit MCREW, the user will be notified and given the opportunity to do so before exiting MCREW.
- Click the **Make a Yield Calibration WEPS Run** sub-menu option from the **Run** menu bar option on the main screen (Figure 4.9) or the **Calibrate Run** button on the main screen button bar. The shortcut **Ctrl-C** will also work if the main WEPS screen has focus. All of these methods will bring up the following **WEPS Run Name** file chooser window (Figure 4.15). This file chooser window will automatically append **_calib** to the WEPS Run file name by default.

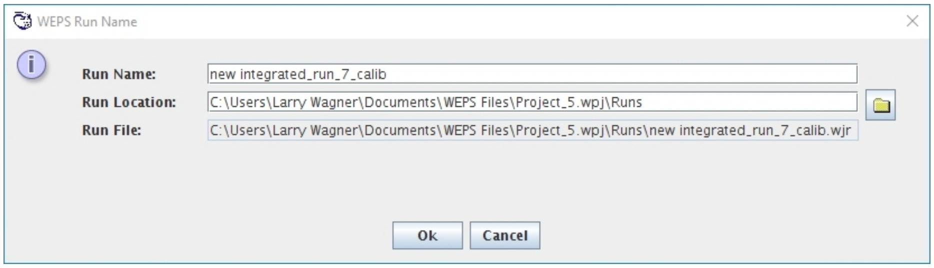



Figure 4.15: WEPS Yield Calibration Run Name window.

- After the Calibration Run has completed, a pop-up dialog window (Figure 4.16) will appear that displays the **'Calibration Factors'** for each crop selected for calibration (see figure to the left). One may then save each crop record as a new crop by clicking the "Save As" Save As button for each crop. These calibrated crop records are usually saved in the "local" **crops** folder. The user may also select the new management file which contains the newly calibrated crop records to be loaded into WEPS for subsequent use. The string "_CALIB" will be appended to the original management file name to identify it as now containing calibrated crop records. This can be done by clicking on the **Use in Current Project** button at the bottom of the window (Figure 4.16). The new biomass adjustment factor determined for each crop is also written into the 'notes' file for the calibration run as well as the "notes" section of the new "calibrated" management file.

Note that users should use a typical management practice rotation for the region the site is located which will produce the long term average yields being set for crop calibration purposes. Once the crop(s) are calibrated, the user should use the calibrated crop records for future simulation for alternative management scenarios. This ensures that the crop yields will respond correctly to different management practices that provide more or less available soil water for plant growth. Re-calibrating the crops for each management scenario will defeat that capability in WEPS and in some situations dramatically affect predicted wind erosion frequency and levels of soil loss.

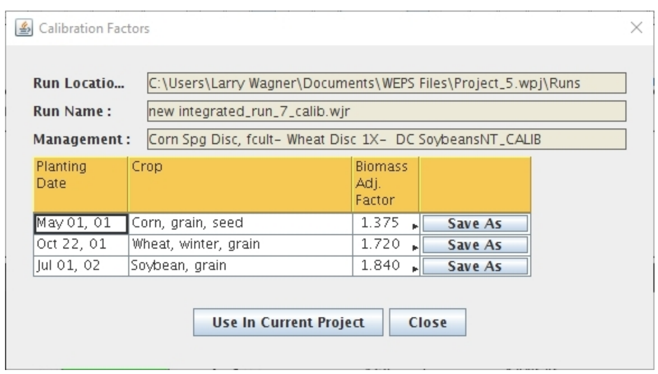



Figure 4.16: WEPS Run Calibration Factors window.

## 4.4 Restore a WEPS Run

A previously created WEPS run can be restored by clicking on the **Run** menu and selecting **Restore a WEPS Run**. This will open a file chooser that allows the user to select a previously created WEPS run. One can also click the restore button R to restore a WEPS Run. **Restoring a WEPS Run** actually loads the inputs of the previous WEPS Run into the WEPS interface. These inputs can be modified and a new simulation run again with a new WEPS Run name. The new WEPS Run will be saved into a new folder. Previous WEPS Runs cannot be overwritten. Runs can be removed via the **Project** menu's **Delete Run** sub-menu option. It is recommended that the user remove unwanted WEPS Runs regularly to prevent these directories and their contents from taking up too much storage space.

# 5. Configuring WEPS for Building and Executing Runs Locally (even without Internet access)

WebStart WEPS by default is configured to execute simulations remotely, "in the cloud" via the CSIP services. However, WEPS can still be run locally, even without requiring internet access, if desired. It just requires the user to make a few necessary configuration changes specifying the WEPS GUI to use the local executables rather than the CSIP services to conduct the simulations. All the required executables are still provided in the download package, but users must make sure they have all the necessary inputs stored or downloaded locally on their PC prior to executing the simulations, if they do not have internet connectivity.

## 5.1 Local Execution Configuration Settings

The following WEPS Configuration Panel settings need to be changed from the defaults. From the WEPS Configuration Panel (Server tab/Model Executables sub-tab) page, un-check all five of the options in the checkboxes as shown in Fig. 5.1, and click on the "OK" button to save the changes.

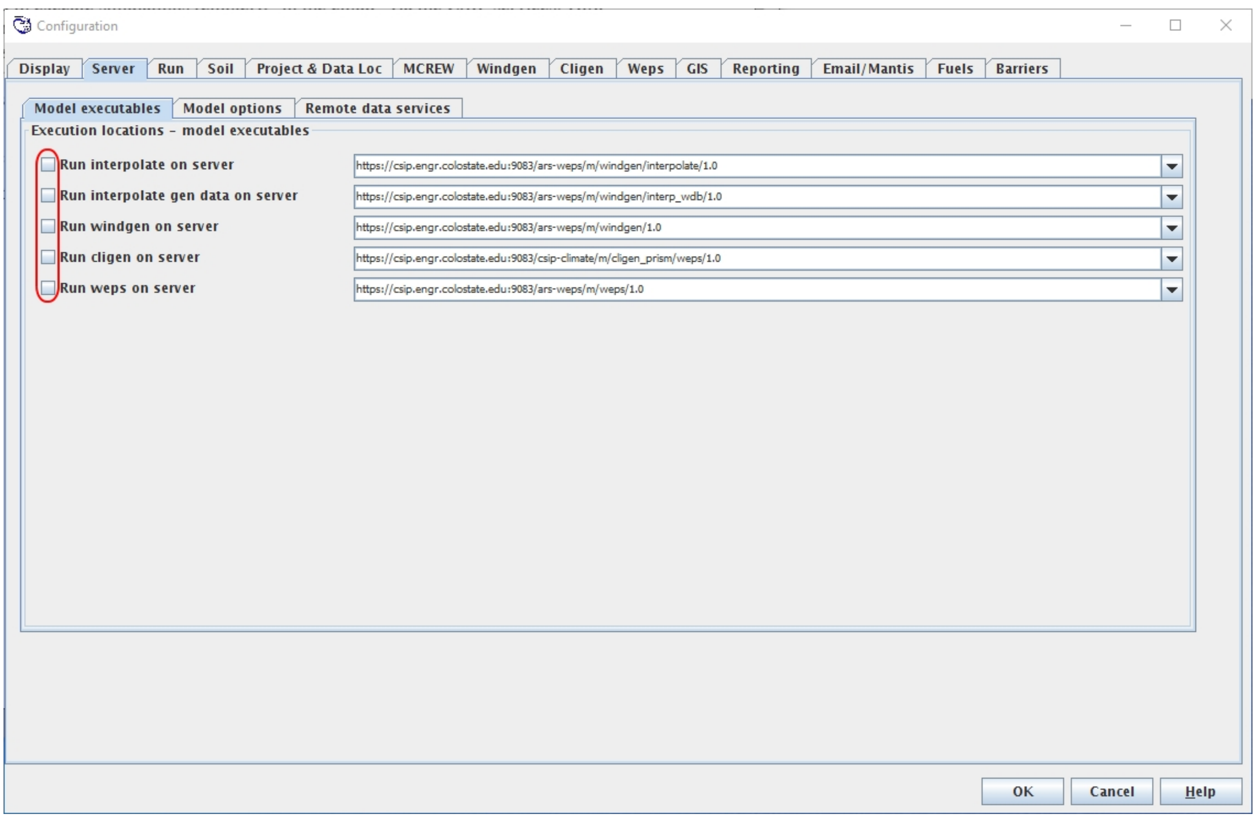



Figure 5.1: Configuration Panel (Server tab) set for local execution of WEPS simulations.

Note that the user can select some services to be run remotely and others to run locally if desired or if specific remote execution services are (temporarily) unavailable.

## 5.2 Considerations for running WebStart WEPS without internet connectivity

To build and conduct local WEPS simulations without internet connectivity, besides re-configuring WEPS to employ the local executables, one must also ensure that all the desired inputs are readily available on the local PC. So, any soil IFC files and template management rotation files desired should be obtained (downloaded) prior to the loss of internet connectivity.

# 6. WEPS Project and Run Folders (and other special WEPS files/folders)

WEPS has several special folders with specific folder suffix extensions. The most important are the **WEPS Project** and **WEPS Run** folders. They each contain the following folder suffix extensions of ”**.wpj**” and ”**.wjr**”. We will discuss each of them first along with where they are typically located and why, along with how they are normally used within the WEPS GUI. We will follow up by mentioning the remaining special file and file suffix extensions used by WEPS. We will conclude with a brief table listing and describing each of the special WEPS folders and files, along with any pertinent WEPS specific folder/file suffix extensions expected.

## 6.1 Definitions of WEPS Projects and WEPS Runs

A **WEPS Project** folder is a location where temporary files are stored in preparation for a WEPS simulation Run. It is expected to contain a ”**.wpj**” extension. This folder may be referred to as the **Project**, **WEPS Project** or **WEPS Project Folder**, especially the latter when referring to its location and/or folder name.

This **WEPS Project** folder may also contain a subfolder (this is the default configuration, where that subfolder name is **Runs**), where WEPS simulation Run results (along with the simulation inputs) are stored in independently named **WEPS Run** folders. These **WEPS Run** folders usually contain a ”**.wjr**” extension.

**WEPS Project** folders are typically placed beneath a ***Parent*** **WEPS Project** folder, but this can be changed in the WEPS settings via the Configuration Panel. Likewise for the ***Parent*** **WEPS Runs** folder, which defaults to the **Runs** subfolder name located within each **WEPS Project** folder.

Fig. 6.1 displays the pertinent WEPS Config Panel screen[1] where the default ***Parent folder*** for the **WEPS Project** folder path and name are specified for the WEPS interface, along withe initial default **Project** folder name. Likewise, the default **WEPS Runs** folder location is also specified here. It is defined to be the **Runs** folder as a subfolder of the *current* active **WEPS Project** in the WEPS interface.

Note: Change field prompts in Config Panel screen to **Parent folder for WEPS Projects** instead of **Projects Folder** and the **Default Project** field to **Initial Default WEPS Project** to better identify these fields' content.

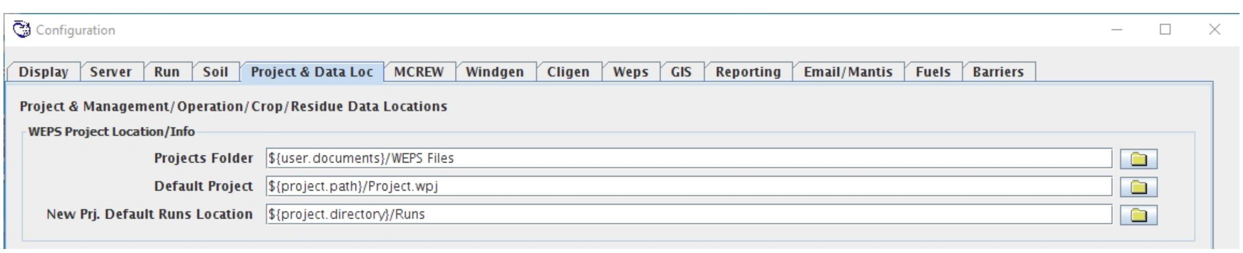



Figure 6.1: WEPS Config Panel displaying default *Parent* folders for the WEPS Project and WEPS Run folders.

[1]The following variables used in this Config Panel screenshot are:

${user.documents} refers to the User's **Document** folder on the computer system.
${project.path} refers to the ***parent*** folder where the **WEPS Project** folders reside.
${project.directory} refers to the ***current*** **WEPS Project** folder.

## 6.2 Working with WEPS Projects

WebStart WEPS enables its multiple **Projects** feature by default. A **WEPS Project** folder is the primary location used by the WEPS GUI to store files being selected for use in making a future WEPS simulation run. This, it can be thought of as a temporary location since it also stores management files that may be edited within MCREW and any soil component IFC files that a user may modify through the Soil Viewer/Editor.

The multiple **Projects** feature also opens up the potential to use separate **Project** folders for each client, or even for each individual field/site for a specific client, etc. So, it creates a lot of flexibility for the WebStart WEPS user on how they decide to manage their client's files and simulation results.

### 6.2.1 Suggested Locations for WEPS Projects

The default location for WebStart WEPS **Project** folders is within the installation configured **WEPS Runs** folder within the WEPS User's system **Documents** folder. This **Documents** folder usually exists within the user's home directory, but it could be located elsewhere on the PC. For example, it may be linked to a **MS OneDrive** location, presumably for automated back purposes, etc.

If a user desires a different location for the ***Parent*** folder for the **WEPS Project** folders, they can manually change it via the Configuration Panel settings. Fig. 6.2 shows the necessary configuration parameter being changed to a OneDrive location on a USDA computer. Note that the OneDrive location on this computer resides under the user's home directory. The paths that are often different for different systems and users have WEPS shortcut variable names to reference those locations. For example, the user's home directory in Fig. 6.2 is referenced by the **${user.home}** variable name in the provided path. However, the complete absolute path can always be specified instead, if desired.

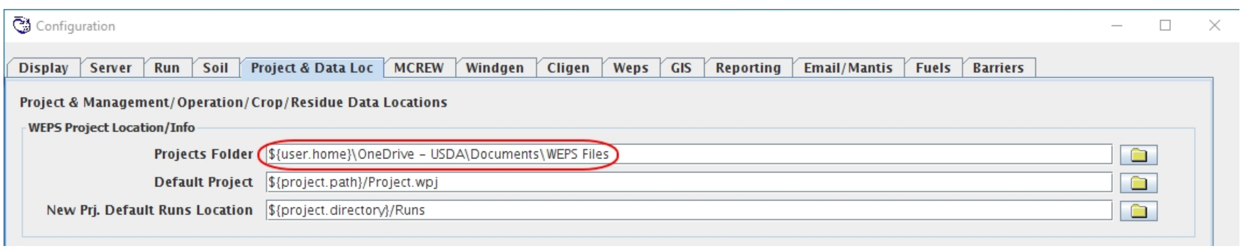



Figure 6.2: WEPS Config Panel displaying a OneDrive location for *Parent* folder of the WEPS Project folders.

Note that this is the default location for **WEPS Project** folders to be placed. A user can select/access WEPS **Projects** from other locations too. It is just a matter of convenience for them to be created and accessed from the same defined location.

### 6.2.2 Suggested Naming Conventions for WEPS Projects

WEPS **Projects** can be named whatever the user desires, as long as they include the **.wpj** suffixe extension. Many users elect to create and name WEPS **Projects** for each client, which automatically separates the resulting WEPS Runs for that particular client from other clients (if the default configuration is retained for where **WEPS Runs** are placed, which is under the **Runs** folder within the current WEPS **Project** folder).

### 6.2.3 Creating new WEPS Projects

The initial default WEPS Project folder is named **Project.wpj**. New WEPS Projects are given default unique names (if in the same parent folder as the current WEPS Project) by appending ”_#” to the current WEPS Project name. For example, if the current WEPS Project name is **Project.wpj** then when creating new WEPS Projects will be **Project_1.wpj**, **Project_2.wpj**, etc. However, the user always has the option to name any new WEPS Project to whatever name they desire, as long as they include the **.wpj** suffix extension.

### 6.2.4 Switching WEPS Projects

When one switches between WEPS **Projects**, they will be asked via a popup message (Fig. 6.3) if they want to save the state of the WEPS interface for the current Project.

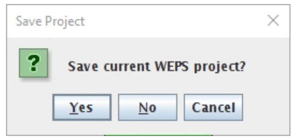



Figure 6.3: Save Current WEPS Project popup message.

After they have answered that question, they will be presented with a WEPS FileChooser window (Fig. 6.4) where the user can select the desired WEPS **Project**.

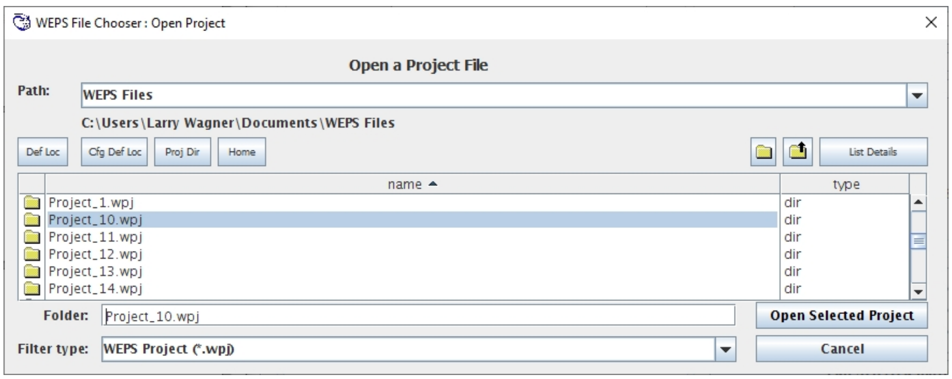



Figure 6.4: Selecting a WEPS Project with the WEPS FileChooser.

The WEPS GUI will then restore the state of the WEPS interface that was last saved for the selected WEPS **Project**, including the last WEPS Run for that Project.

## 6.3 Working with WEPS Runs

As mentioned previously, **WEPS Run** folders are individually named WEPS folders where WEPS simulation Run results (along with the simulation inputs) are stored. These folders usually contain a ”**.wjr**” extension to quickly identify them from ordinary folders.

By default, the **WEPS Run** folders are usually placed in a subfolder of the current **WEPS Project**, where that subfolder name is **Runs**. This default location can be changed/set as previously noted via the Config Panel field setting, shown in Fig. 6.1 via the **New Prj. Default Runs Location** field, which specifies the location for **WEPS Runs** for any newly specified **WEPS Project**. The user can override this system default location for the current WEPS Project via the **Runs Location** panel on the main WEPS GUI screen shown here (Fig. 6.5). Clicking on the folder icon will bring up a WEPS FileChooser window to select a new default **WEPS Runs** folder location for the current WEPS Project.

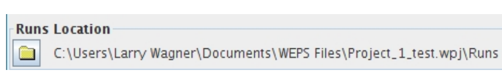



Figure 6.5: Main WEPS Interface *Runs Location* Panel.

However, the user always has the option of overriding the default location and specifying where each individual **WEPS Run** is placed anywhere on the computer’s file system, even on networked drives, if desired. They can do so on each invocation of a WEPS simulation run, either a regular WEPS Run or a Yield Calibration Run, which can be initiated via the labeled WEPS Run menu options or by left mouse button clicking either of the two toolbar buttons, which will bring up the **WEPS Run Name** window (Fig. 6.6). The **WEPS Run** name is entered in the **Run Name:** field. A default name will be displayed here. If a WEPS Run has previously been specified, it will auto-append an underscore and a digit (auto-incremented if necessary) to make the default name unique within the WEPS Run location currently displayed in the next field.

The **Run Location:** field (encircled in **red**) can either be edited directly within the field manually or by clicking on the folder icon to the right of that field, which will bring up a WEPS FileChooser to select the WEPS Run location. The third non-editable field **Run File:** displays the full path and name for the WEPS Run.

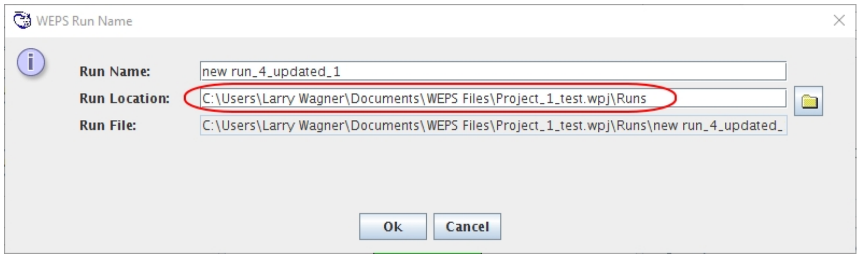



Figure 6.6: WEPS Run Location Window for specifying the WEPS Run name and overriding default location if desired.

### 6.3.1 Suggested Locations for WEPS Runs

The default location for **WEPS Runs** to be placed within a **Runs** folder within the current **WEPS Project** folder was setup because it was expected that most users would create separate **WEPS Projects** for individual clients and/or field sites. Several **WEPS Runs** would be expected to be made for either National Program qualifications or for evaluating and comparing multiple management scenario options to reduce erosion risk levels on specific sites. Also, this approach would group those **WEPS Runs** together and also separate them from other clients' and/or other site location simulations. In addition, it makes it easier to select the **WEPS Runs** to display within the WEPS Multiple Run Manager (WMRM) tool for evaluating baseline and alternative management scenario results.

However, the user can place their **WEPS Runs** outside the current **WEPS Project** folder and optionally group them under other subfolders, possibly naming those subfolders for the client(s) and/or the field sites being evaluated. We have provided the user with the flexibility to do so, if desired.

### 6.3.2 Suggested Naming Conventions for WEPS Runs

There is a default name for a **WEPS Run** (new_run.wjr) and a programmatic method to ensure that subsequent **WEPS Runs** are named uniquely. However, it is far better that the user manually rename the default **WEPS Run** name to something that helps the user remember what is unique about that particular simulation. This will often mean that the user should probably include some mnemonics of the management scenario and possibly other unique attributes about this particular simulation (barrier type/location used, change in primarily field tillage direction, etc.) in the **WEPS Run** name.

If a user is comparing an existing management scenario to several alternatives, they may want to name the existing management scenario simulation run with the words ”baseline” in the name and the alternative scenarios, for example, using mnemonics of the alternative management scenarios and appeding the phrase **alt_#** to easily distinguish them from each other. In the end, it is up to the user to decide how they want to name their textbfWEPS Runs. We have merely attempted to provide the users with the flexibility to hopefully meet their individual needs.

### 6.3.3 Re-loading Previous WEPS Run contents into the WEPS Interface

Note that users can **Reload** previous WEPS Runs into the WEPS interface. This is accomplished via the WEPS interface **Run** menu option **Restore a WEPS Run** or by clicking on the **Reload WEPS Run** toolbar button. Either method brings up a WEPS FileChooser window opened in the current Project's default WEPS Run location. The user can select a previous WEPS Run from that folder or they can retrieve a WEPS Run from anywhere else within the computer's file system, even from networked drives/folders.

# 7. WEPS FileChoosers (Features and Functionality)

WEPS users often have the need to select files and folders within the WEPS user interface, whether it be management and soil records, WEPS Projects, selecting WEPS Run names, etc. For WebStart WEPS, these files and records could be located within the local computer file system, available on shared drive locations or even obtained remotely via a CSIP service. The standard Java FileChooser did not have the ability to provide all of that functionality through a single interface window. Therefore we developed the WEPS FileChooser that provides the necessary functionality that WebStart WEPS requires through a common FileChooser interface. This FileChooser contains some unique features that probably don't exist in most other FileChooser interfaces, so we have provided this chapter documenting all of the WEPS FileChooser features and functionality.

## 7.1 WEPS FileChooser Elements

An example of a WebStart WEPS FileChooser (Fig. 7.1) is shown here.

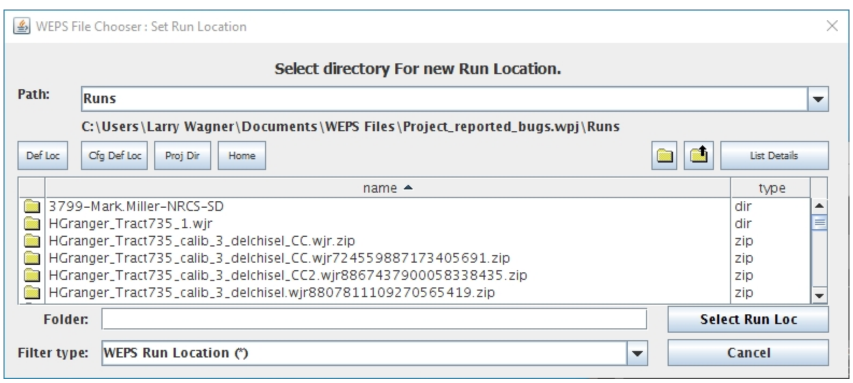



Figure 7.1: A standard WebStart WEPS FileChooser.

The standard WebStart WEPS FileChooser may contain the following elements:

- WEPS FileChooser title (e.g. **Select directory for new Run Location.** in Fig. 7.1)
- **Path:** prompt and folder field with a drop down choice list selection option on right side of field
- Full path displayed as text
- **Button Toolbar** with button shortcuts to specific locations (e.g. Def Loc Cfg Def Loc Proj Dir Home in Fig. 7.1)
- **Create new subfolder** button icon
- **Move into parent folder location** button icon
- **List Details** button (provides additional table columns)
- Tabular display containing the following columns:
  - Col 1: folder or file icon
  - Col 2: file and folder names
  - Col 3: file or folder type
  - Col 4: file or folder date (if List Details button enabled)
  - Col 5: file size in bytes (if List Details button enabled)
- **File:** prompt and input field (prompt could be named differently, e.g. **Folder:** as in Fig. 7.1)

- **Filter type:** prompt and filter field with a drop down choice list selection option on right side of field
- **Select** button (could be named differently, e.g. Select Run Loc as in Fig. 7.1)
- **Cancel** button

Additional elements may exist on individual WEPS FileChoosers, such as this one (Fig. 7.2)

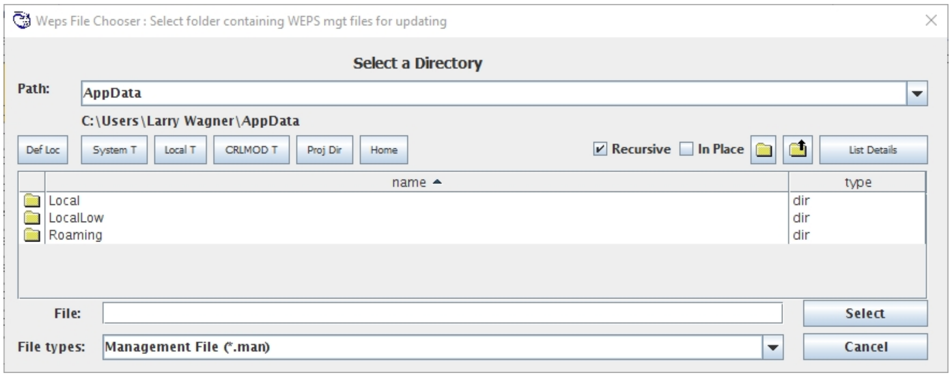



Figure 7.2: WEPS FileChooser containing **Recursive** and **In Place** check box elements.

The two additional check box elements shown in Fig. 7.2 are:

- **Recursive** check box for applying the action recursively below the selected folder
- **In Place** check box for applying the action within the current selected folder

## 7.2 WEPS FileChooser Features

As mentioned previously WEPS FileChoosers are used to select either files or folders and in some FileChooser instances possibly multiple files or folders. The FileChooser prompts may adjust depending on whether it is being used to select files or folders. In addition, the **Filter** (or **File**) type specification determines what kind of files or folders are displayed and selectable based upon their name extensions.

### 7.2.1 WEPS FileChooser Selection Methods

For example a FileChooser intended to select an existing **WEPS Project**, which is a folder with a **.prj** extension, will allow immediate selection and close the FileChooser with a left mouse button double click. If the folder does not contain that **.prj** extension (as specified via the **Filter type**), then a left mouse button double click will instead simply change the current folder displayed to having the selected folder become the current folder displayed.

The user can also simply select a file or folder with a single left button mouse click and then click the FileChooser's **Select** Select button to initiate the FileChooser's action and close the displayed window.

### 7.2.2 WEPS FileChooser Path Traversing and Shortcut Buttons

The user has several options available to traverse the currently selected path within the FileChooser or switch to other locations for the desired file(s) or folder(s) to select.

The user can traverse up the path tree one folder at a time by clicking on the up arrow folder icon and selecting folders within the display to traverse down the path. Or, they can select a subfolder from within the current path displayed via the **Path:** field by using the drop down choice list. An example is shown here in Fig. 7.3 using the mouse to select the **WEPS Files** subfolder. The current path of the selected subfolder will immediately update after the selection is made as shown in Fig. 7.4.

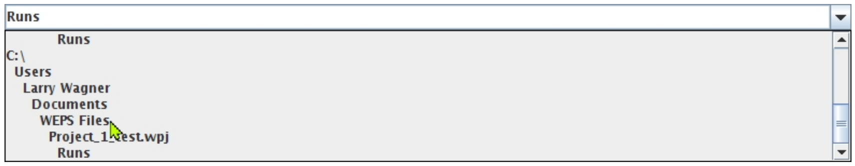



Figure 7.3: WEPS FileChooser drop down choice list displaying subfolders.

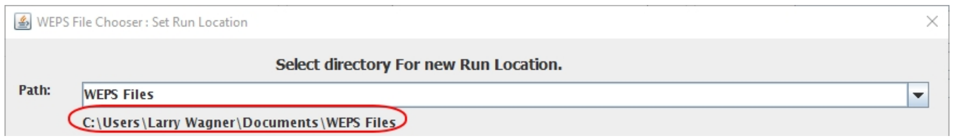
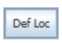
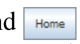
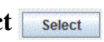



Figure 7.4: WEPS FileChooser current path display.

There are usually a shortcut button available that can take the user back to the original default location, e.g. the  button. Other shortcut buttons are normally available on individual FileChoosers based upon what the individual FileChooser's intent is. For example, some common generic shortcut buttons are the  and  buttons, which go to the current WEPS Project folder and the user's "home" folder on their computer system respectively.

### 7.2.3 WEPS FileChooser Action Options

In some FileChoosers, there may be actions initiated when clicking on the FileChooser's **Select**  button. Those actions may be modified by other options available in a specific FileChooser, such as the **Recursive** and **In Place** check boxes shown in the Management Updating folder selection's FileChooser window as shown in Fig. 7.2 (which is accessible via the MCREW **Tools/Update WEPS Management files/Select Directory** menu sub-option).

# 8. WEPS Interface Reference

## 8.1 WEPS Interface Main Screen Components

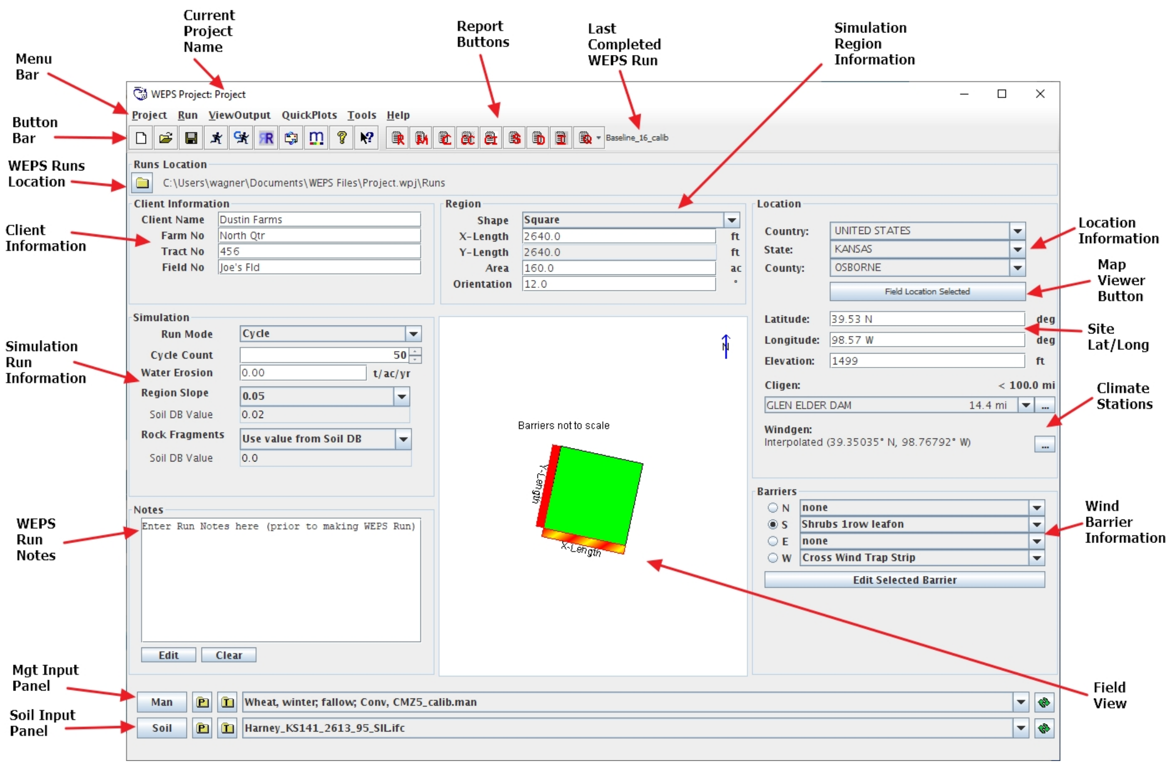



Figure 8.1: Main screen of the Wind Erosion Prediction System.

The WEPS main screen (Fig. 8.1) should appear at model startup. Each part of the main screen is labeled in the figure with regard to its function. A brief description of each part is given below. More detailed descriptions of their functions and use follow later in this chapter. Add specific links to later sections of the Tech Chapter(s) that will cover the complete details of those items mentioned here)

- The **Current Project Name** is listed in the title (first physical row) of the main WEPS screen window. It provides the current WEPS Project folder's name here, sans the path and ".wpj" extension.
- The **Button Bar** and **Menu Bar** are collectively referred to as Toolbars. The **Menu Bar** provides the user with access to many of the operational functions of WEPS. The **Button Bar** provides a shortcut method of executing some of the **Menu Bar** functions.
- The **Report Buttons** are part of the **Button Bar** and provide quick access to the most commonly referred to WEPS reports. The **Last Completed WEPS Run** is also displayed just to the right of the last WEPS report

button on the **Button Bar**.

- The current **WEPS Runs Location** (**Runs Location** panel) is displayed immediately below the **Button Bar** which lists the default directory where individual WEPS Runs are stored.
- The current **Site Lat/Long** in the(**Location** panel) specifies the actual latitude and longitude coordinates selected for the simulation.
- The **Client Information** (**Client Information** panel) is used to enter customer information for a simulation run. The customer information is for information use only and is not required for the operation of WEPS.
- The **Simulation Region Information** (**Region** panel) provides the physical dimensions (i.e., shape, length and width or radius, and area) and the orientation with respect to north of the simulation field.
- The **Simulation Run Information** (**Simulation** panel) is used to enter specific information for a simulation run, as well as information regarding the run mode.
- **WEPS Run Notes** (**Notes** panel) in the lower left section of the screen is where the user can enter specific information regarding the upcoming WEPS simulation run. These notes are retained as part of the upcoming WEPS simulation run and can also be further edited and printed from the Run Summary report after the conclusion of the WEPS simulation run.
- Access to **MCREW** (Management/Crop Rotation Editor for WEPS) and management rotation selection is provided in the (**Mgt Input Panel**) and allows for the selection, creation, and editing of management scenarios. Only one management rotation sequence is currently allowed for the WEPS simulation region.
- Access to the **Soil** viewer/editor and soil selection is available from the (**Soil Input Panel**) and is where the user can select and view the soil information for the upcoming WEPS simulation run. Only one soil is currently allowed for the WEPS simulation region.
- The **Location Information** (**Location** panel) is used to specify the location of the simulation field. This information is used to assist in determining the climate and wind stations (**Climate Stations**) selected for the upcoming WEPS simulation run. The **Map Viewer Button** is used to access a map viewer displaying weather and wind station locations as well as other GIS related information.
- **Wind Barrier Information** (**Barriers** panel) is where the selection and placement of wind barriers on the specified field borders is entered.
- The **Field View** (**Field View** panel) displays the physical dimensions and orientation of the field and location of wind barriers. This panel is for information only and is not directly editable. The **Field View** panel contents are updated automatically when information is changed in the **Region** and **Barriers** panels.

## 8.2 WEPS Toolbars

The main WEPS screen consists of two rows referred to collectively as the ”Toolbars” and individually as the ”Menu Bar” and the ”Button Bar” (Figure 8.1).

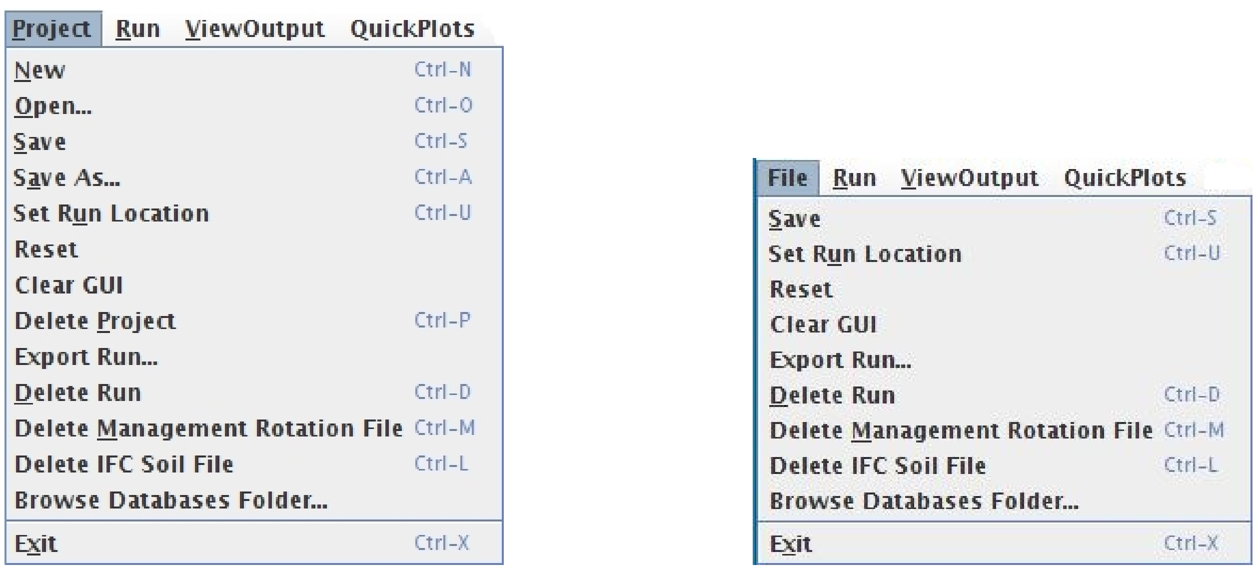
### 8.2.1 WEPS Menu Bar

The menu bar is the second to the top line of the WEPS main screen window.


A description of each item on the menu bar is given below. Note that some WEPS configurations can contain a slightly modified version of the menu bar. For example, if the ”Single Project” mode is specified in the configuration file rather than the ”Multiple Project” mode, the **Project** menu option is replaced with the **File** menu option and the Project specific submenu options will not exist. The specific differences between the two lists of menu sub-options are identified below.

**Project (or File) menu options**

The **Project** (or **File**) menu is a drop down list of various computer operations pertaining to WEPS Projects, Runs and files as shown in Fig. 8.2.




(a) WEPS Project Menu (b) WEPS File Menu

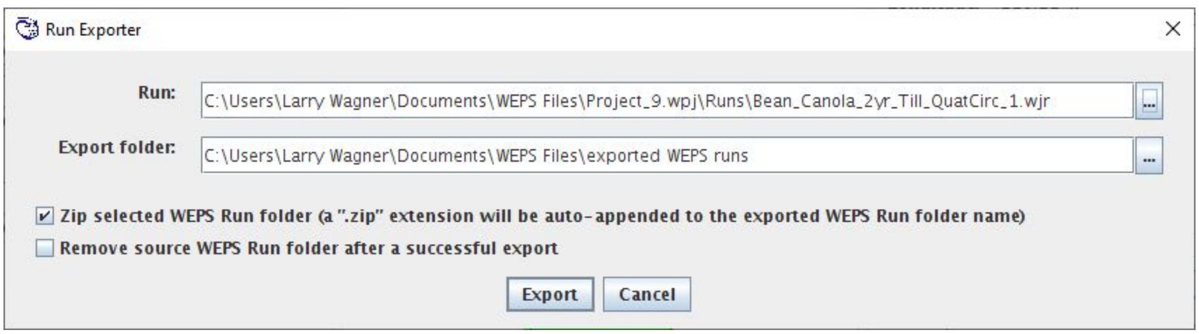
Figure 8.2: WEPS Project and File menu options.

The **Project** (and **File**) menus contain the following options. If an option is not available in the **Files** menu it is explicitly noted for those options.

- **New** (Ctrl-N) - Allows user to create a new Project folder. Note that WEPS configurations restricted to a single fixed Project folder (Single Project mode) does not contain this submenu option.
- **Open...** (Ctrl-O) - Allows user to open a different pre-existing Project folder. Note that WEPS configurations restricted to a single fixed Project folder (Aingle Project mode) does not contain this submenu option.
- **Save** (Ctrl-S) - Saves currently displayed information on the main WEPS screen to the current Project folder.
- **Save As...** (Ctrl-A) - Saves the currently displayed information under a different Project folder. Note that WEPS configurations restricted to a single fixed Project folder (Single Project mode) does not contain this submenu

option.

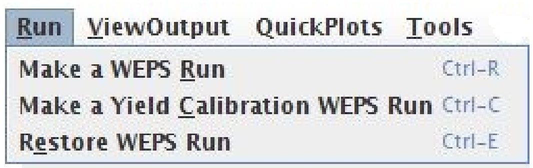
- **Set Run Location** (Ctrl-U) - Allows the user to change the default WEPS Runs folder location. Note that this location can be set to be Project specific, if desired. The current default is to have the WEPS Runs reside within each Project folder inside a ”Runs” subfolder.
- **Reset** - Resets the main WEPS screen to the initial installation default values and clean the current Project folder of all existing, temporary files. It DOES NOT delete any subfolders or their contents in the current Project folder.
- **Clear GUI** – Clears and resets the main WEPS screen to the initial installation default values. It DOES NOT delete any files or subfolders in the current Project folder.
- **Delete Project** (Ctrl-P) - Opens a file chooser window in the folder containing the current Project to allow the user to select WEPS Projects for deletion. Note that WEPS configurations restricted to a single fixed Project folder does not contain this submenu option.
- **Export Run...** - Opens a popup window to allow the user to move or copy previous WEPS Runs into other folder locations. A user specified toggle in the popup screen determines if the original WEPS Run is deleted or not after successful completion of the export action. Also, the user can specify whether the exported Run is compressed (zipped) or not. The default setting is to zip the exported Run.




- **Delete Run** (Ctrl-D) - Opens a file chooser window in the folder containing WEPS Runs for the current Project to delete user selected WEPS Runs.
- **Delete Management Rotation File** (Ctrl-M) -Opens a file chooser window in the current Project folder to delete user selected WEPS management files.
- **Delete IFC Soil File** (Ctrl-L) - Opens a file chooser window in the current Project folder to delete user selected WEPS soil files.
- **Browse Database Folder…** - Opens up a copy of the computer system’s file manager (Windows Explorer in Windows). The default starting location is the folder specified in the WEPS configuration settings where the WEPS system database files reside.
- **Exit** (Ctrl-X) - Exit the WEPS program.

**Run menu options**

This allows the user to run WEPS using the current inputs specified on the WEPS main screen or to restore inputs from previous WEPS Runs. Details of each of these options are provided in detail here (Making a WEPS Run) and here (Restore a WEPS Run).

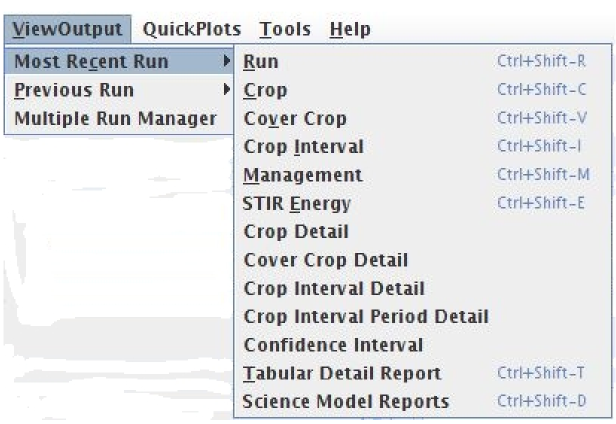



The Run menu on the WEPS Main Screen displays the following options:

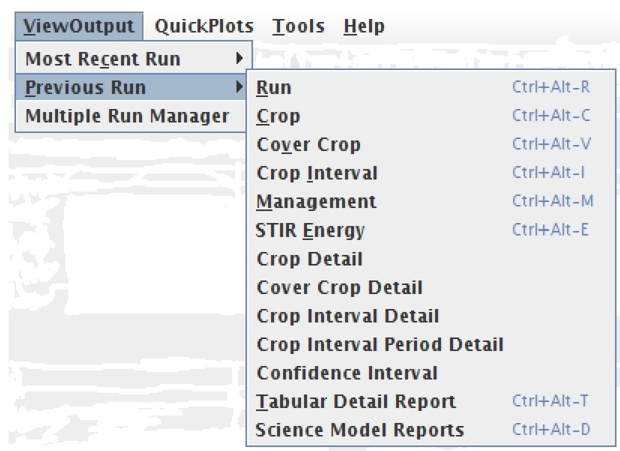
- **Make a WEPS Run** (Ctrl-R) - Begin a WEPS simulation using the currently selected inputs specified on the main WEPS screen.
- **Make a Yield Calibration WEPS Run** (Ctrl-C) - Begins a WEPS simulation running WEPS in "yield calibration mode" using the currently selected inputs specified on the main WEPS screen. See section titled "Making a WEPS Run" for more information on yield calibration runs.
- **Restore WEPS Run** (Ctrl-E) - Opens a file viewer listing previous WEPS Runs from which the user can select one from and load that previous WEPS Run inputs into the WEPS interface screen.

**ViewOutput menu options**

This menu allows the user to view WEPS output. The "Most Recent Run" menu option provides access to either the last completed or reloaded WEPS Run results. The "Previous Run" menu option provides access to any other selected previous WEPS Run.




(a) Most Recent Run Menu



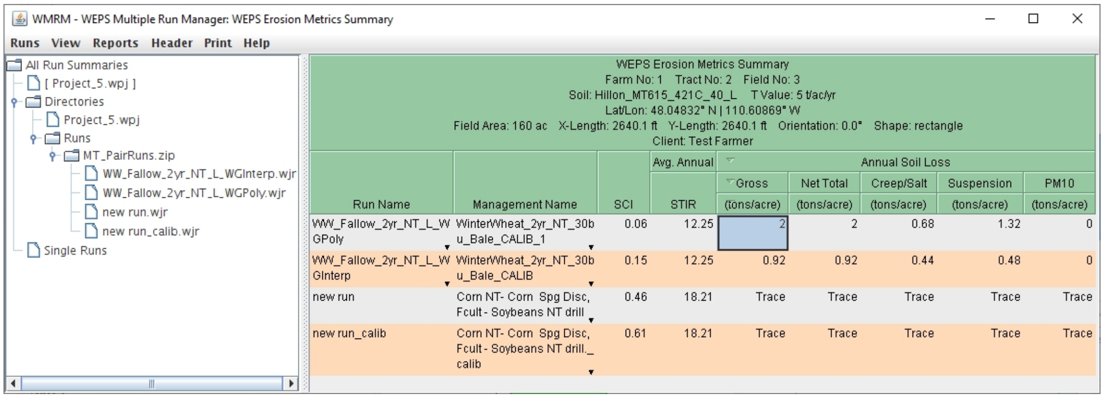

(b) Previous Run Menu

Discussion of the specific contents of all the reports are provided here (Viewing WEPS Output). Some of the **Most Recent Run** options have hot keys that use "Ctrl+Shift+Char" and the identified character. The **Previous Run** options use the "Ctrl+Alt+Char" keys along with the identified character. The **Previous Run** options will bring up a file chooser window to select the desired previous WEPS Run for the identified report.

- **Most Recent Run** and **Previous Run** – Clicking on either of these menu items opens the following list of output options:
  - **Run** (Ctrl+Shift-R) or (Ctrl+Alt-R) - Displays a brief output summary for the most recent or selected WEPS simulation.

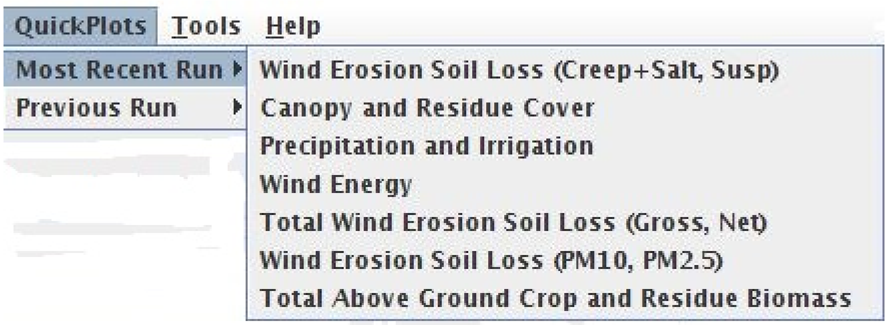
  - **Crop** (Ctrl+Shift-C) or (Ctrl+Alt-C) - Displays a summary of crop yields and water usage statistics for the most recent or selected WEPS simulation.
  - **Cover Crop** (Ctrl+Shift-V) or (Ctrl+Alt-V) - Displays a summary of all cover crops (non-harvested crops) biomass production parameters and water usage statistics for the most recent or selected WEPS simulation.
  - **Crop Interval** (Ctrl+Shift-I) or (Ctrl+Alt-I) - Displays a summary of each crop interval's biomass production parameters and water usage statistics for the most recent or selected WEPS simulation.
  - **Management** (Ctrl+Shift-M) or (Ctrl+Alt-M) - Displays a summary of management operations, operation dates and crops associated with the planting and harvesting operations for the most recent or selected WEPS simulation.
  - **STIR Energy** (Ctrl+Shift-E) or (Ctrl+Alt-E) - Displays an SCI (Soil Quality Index) summary and both Rotation STIR Energy and Crop Interval Stir Energy reports for the most recent or selected WEPS simulation.
  - **Crop Detail** - Displays a detail year by year, rotation cycle report of all crop yields and water usage statistics for the most recent or selected WEPS simulation.
  - **Cover Crop Detail** - Displays a detail year by year, rotation cycle report for all cover crops (non-harvested crops) biomass production parameters and water usage statistics for the most recent or selected WEPS simulation.
  - **Crop Interval Detail** - Displays a detail of each crop interval and breaks each crop interval into its component "Crop Periods" and reports their summarized biomass production parameters and water usage statistics for the most recent or selected WEPS simulation.
  - **Crop Interval Period Detail** - Breaks each crop interval into its component "Crop Periods" and displays a detail of each crop interval period, reporting for each individual rotation cycle their biomass production parameters and water usage statistics for the most recent or selected WEPS simulation.
  - **Confidence Interval** - Displays the "Confidence Interval" information on the wind erosion soil loss in a yearly plot and a quartile distribution plot, which includes outliers for the most recent or selected WEPS simulation.
  - **Tabular Detailed Report** (Ctrl+Shift-T) or (Ctrl+Alt-T) - Displays a detailed output in a spreadsheet format for the most recent or selected WEPS simulation.
  - **Science Model Reports** (Ctrl+Shift-D) or (Ctrl+Alt-D) - Displays a window to view additional science model text-based output files from the most recent or selected WEPS simulation.

- **Multiple Run Manager** - Opens the WEPS Multiple Run Manager (WMRM) window displaying output information from multiple WEPS Runs for "side-by-side" comparisons of the selected results. The "Runs" menu at the top of the screen contains items that allow the user to add a directory of runs, or a single run. The user can also restore a selected run in WEPS so that its results can be viewed in more detail or modified for another run. The "View" menu allows the user to select the desired data elements to be viewed in the table display. the "Reports menu provides selected default reports and the "Header" menu allows the header contents to be changed as desired. So, custom reports are possible, but must be recreated manually for each invocation of WEPS. The "Help" menu item allows the user to display version information about the Multiple Run Manager. Additional information regarding WMRM, its functionality and the specific menu sub-options available, etc. are provided later. The Multiple Run Manager is discussed in more detail here ( WEPS Multiple Run Manager (WMRM)). Add link to WMRM section later




### QuickPlots menu options

This menu contains various default graphs of common data elements plotted versus time.




- **Most Recent Run** and **Previus Run** - Displays a submenu of QuickPlot reports for either the most recent WEPS Run or the selected WEPS Run. The **Previous Run** submenu options bring up a file chooser window for the user to select the desired WEPS Run to display the report.
  - **Wind Erosion Soil Loss (Creep+Salt, Susp)** - Displays a plot of the erosion results for the specified particle sizes.
  - **Canopy and Residue Cover** - Displays a plot of the crop canopy and residue cover over time.
  - **Precipitation and Irrigation** - Displays a plot of the water received on the site over time.
  - **Wind Energy** - Displays a plot of the wind energy received for the site over time.
  - **Total Wind Erosion Soil Loss (Gross, Net)** - Displays a plot of the total gross and net erosion results for the site.
  - **Total Above Ground Crop and Residue Biomass** - Displays a plot of the total above ground crop and residue biomass produced on the site over time.

**Tools menu options**

This menu contains various tools available for use with WEPS.


- **Database Reports** - Display reports of the "user notes" for the following WEPS crop, operation and management database records:
  - **Crops** - Prints out the "user notes" for each crop record in the crops database folder(s), if available, else only the name of the crop record is printed.
  - **Operations** - Prints out the "user notes" for each operation record in the operations database folder(s), if available, else only the name of the operation record is printed.
  - **Managements** - Prints out the "user notes" for each management/crop rotation file in the management database template folder(s), if available, else only the name of the management/crop rotation file is printed.
- **Send Email** (Alt-E) - Send email comments to ARS, providing the computer is connected to the internet and the email configuration options are properly configured. The "Send Bug/Comment Report" (the next menu option and mentioned next) is now the preferred communication method.
- **Send Bug/Comment Report** (Alt-B) - Send comments and bug reports directly to ARS, provided the computer is connected to the internet. Selecting this option brings up an "Error/Comment Submission Form" (Figure 8.4) that requests the user's email address and name. It also provides a "Description" field to allow the user to enter a message.

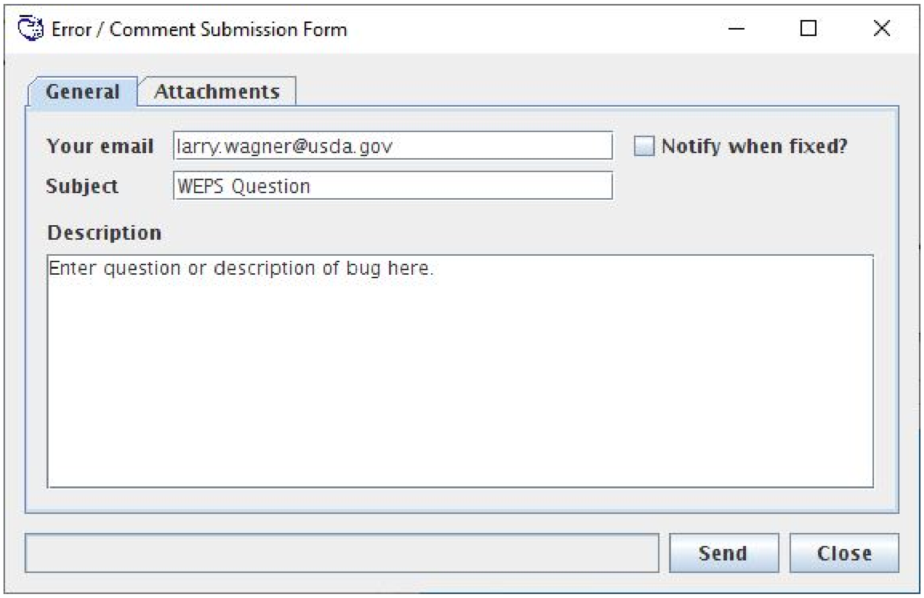



Figure 8.4: Error/Comment submission form displaying the "General" tab.

In addition, the user can also attach individual files, the most current WEPS run and also an entire WEPS Project directory to the message, if desired (Figure 8.5). The WEPS log file is automatically zipped and attached to the message by default. This is the preferred communication method to use.

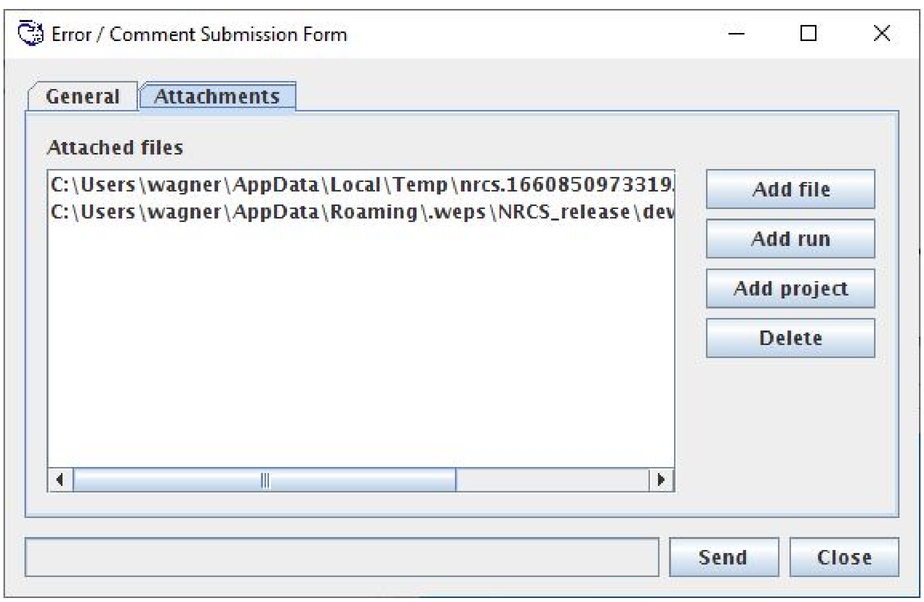



Figure 8.5: Error/Comment submission form displaying the "Attachments" tab.

- **Display Wind Station Info** (Alt-W) - Displays wind information for the selected Windgen station, including wind parameters by month in a popup window. For the selected Windgen wind station and the specified wind speed threshold (m/s), the average wind energy for the year (kJ/m2/day), the percent of winds greater than the specified threshold, the monthly percent of the annual erosive wind energy, the preponderance (maximum ratio of parallel to perpendicular erosive winds) and prevalence of prevailing erosive wind direction for each month). The parameters are displayed for each month. Additional information regarding the Wind Station Data information popup window is fully described here (Displaying Wind Station Data Information).

- **Diff WEPS Files** - Opens a window that allows a comparison of differences in two WEPS files. Additional information regarding the WEPS Diff tool is provided here (Comparing WEPS Files for Differences).
- **SDM Soil Selections for Local Access** - Opens up a soil selection window where the user selects the range of soils desired to be accessible when there is no internet connection. More info here
- **Refresh Mgt and Soil Selection Choice List** (Alt-Y) - The user can refresh the drop down choice lists for both the soil and management fields at the bottom of the WEPS GUI screen. It is possible for a user to add/remove soil and/or mgt files outside of WEPS, e.g. using the OS's features (for example via Windows Explorer). So, this option is convenient to ensure that the dropdown choice list is brought up to date following such external to WEPS operations.
- **Refresh CSIP Soil Cache** - This option forces the CSIP soil cache to be brought up to date. This is useful if the user thinks that the backend soil database used by the CSIP service has been updated and believes the current cached copies are no longer current, etc.
- **Edit Configuration** (Alt-C) - Opens up the tabbed configuration window allowing the user to view/set various configuration options for WEPS. Details on the Configuration panel and all options, etc. are provided here (WEPS Configuration Options and Settings).

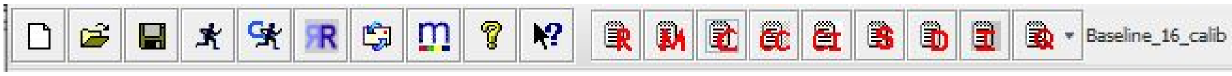
**Help menu options**

Help Menu Option This menu contains various help related and miscellaneous options for WEPS.


- **Help Topics** (Ctrl+Alt-H) - Displays a window containing the WEPS online help system.
- **User Manual** (Ctrl+Alt-U) - Displays a copy of the PDF formatted WEPS User's Guide (a PDF viewer must be installed on the computer for this function to work).
- **Technical Documentation** (Ctrl+Alt-T) - Displays a copy of the PDF formatted WEPS Technical Documentation, USDA Handbook Number 727 (a PDF viewer must be installed on the computer for this function to work).
- **Welcome Wizard** - Runs the initial configuration wizard which requests the user's name and email address and places those responses into the local WEPS configuration file.
- **View Log Messages** (Ctrl+Alt-L) - Displays the WEPS log file contents in a separate window. This is useful for tracking down WEPS installation and execution issues.
- **About WEPS** (Ctrl+Alt-A) - Displays the Build Date, Release Number, and Java Runtime Version used for WEPS, etc.
- **WebStart User Guide (DRAFT)** (Ctrl+Alt-W) - Displays a draft copy of the new PDF formatted WebStart WEPS User's Guide (a PDF viewer must be installed on the computer for this function to work). Need to see if t (Ctrl+Alt-t) is being used in place of the specified W (Ctrl+Alt-W)

### 8.2.2 WEPS Button Bar

At the top of the main WEPS window (below the menu bar) is a series of buttons with icons. They provide shortcuts to some of the menu option functions to assist the user in the operation of WEPS.




Some report buttons may or may not be visible because WEPS can be configured to not display some of them or disable specific features that these button bar icons are used with.

**WEPS Project Buttons**

This button allows a user to create a new WEPS Project folder. This has the same function as selecting **New** under the **Project** on the menu bar. If multiple WEPS Project functionality is not enabled, this button is not available on such configured versions of WEPS.

This button opens an existing WEPS Project. This has the same function as selecting **Open** under **Project** on the menu bar. If multiple WEPS Project functionality is not enabled, this button is not available on such configured versions of WEPS.

This button saves the currently displayed WEPS Project to its current file name (the current WEPS Project filename is displayed in the upper left corner of the main WEPS screen). This has the same function as selecting the **Save** menu option under the **Project** menu on the menu bar. If multiple WEPS Project functionality is not enabled, this button is equivalent to the **Save** menu option under the **File** menu on the menu bar.

**WEPS Run Buttons**

The Run button begins a WEPS simulation run. This has the same function as the **Make a WEPS Run** menu option under the **Run** menu on the menu bar.

The Run Calibration button begins a WEPS yield calibration simulation run. This has the same function as the **Make a Yield Calibration WEPS Run** menu option under the **Run** menu on the menu bar.

The Reload button allows the user to "restore the inputs from a previous WEPS run" into the main WEPS interface window. This has the same function as the **Restore a WEPS Run** menu option under the **Run** menu on the menu bar.

**WEPS Communications and Help Buttons**

The Email button allows the user to email comments to ARS WEPS developers. Clicking the Email button brings up the user's email window, if appropriately configured. This has the same function as the **Send Email** menu option under the **Tools** menu on the menu bar.

The Mantis button allows the user to send comments and/or bug reports to ARS, along with the contents of a WEPS Project, WEPS Run or individual files, if desired. Clicking this button brings up a separate window. That window's functions are described fully here (Reporting Errors and Submitting Questions/Comments). This has the same function as the **Send Bug/Comment Report** menu option under the **Tools** menu on the menu bar.

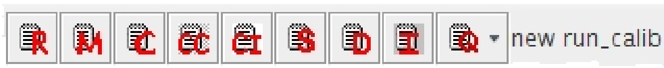
The Question button opens the general online help system for WEPS.

The Context Help button provides help for a particular item on the WEPS screen. Clicking the Context Help button on the tool bar and then clicking on the item on the screen for which help is desired brings up a help screen for that specific item.

**WEPS Report Buttons**

These buttons display the last (current) WEPS Run results, e.g. **Run Summary, Management/Crop Rotation, Crop Summary, Cover Crop Summary, Crop Interval Summary, Stir Energy, Detailed Report, Confidence Interval** and the **QuickPlot** reports respectively. All of these reports are also accessible under the **ViewOutput** menu via the

**Previous Run** menu options along with additional, more detailed reports for both current and previous WEPS Runs. Full explanations of each report and their contents are described here (Viewing WEPS Output).




Following the report icon buttons, the last (current) WEPS Run name is displayed. If the Run name is too long to fit on the button bar row, it will be truncated. The main WEPS interface screen can be resized though, so it is usually possible for one to widen the main WEPS screen to see the complete WEPS Run name if desired.

## 8.3 Specifying WEPS Run Information

There are several items that a user needs to address prior to using WEPS. Most of these items are not critical for most WEPS Runs, but are beneficial for keeping track of previous simulation runs, documenting what was done for each run, listing who the client is and why the WEPS Run(s)were being made, etc. Other items are purely useful for better organization of previous WEPS Runs, clean up of temporary results and deletion of old preliminary simulation runs, etc.

### 8.3.1 WEPS Runs Location

The first item is determining where one wants to store WEPS Runs and setting the default location for them. For new Projects, this can be configured within the Configuration panel, which is accessible via the "Tools/Edit Configuration" menu option in the Config Panel's "Project & Data Loc" tab. The specific field is labeled: **New Prj. Default Runs Location** as shown here:

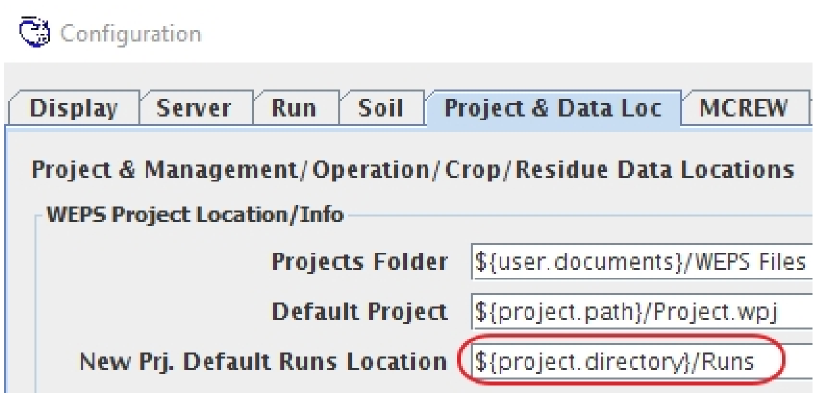



Figure 8.6: Configuration Panel: New Project Default WEPS Runs Location.

The user has the ability to override that location and reset the default location from the main WEPS screen, if desired. The WEPS Runs Location panel (Fig. 8.7) is located immediately below the "Button Bar" on the Main WEPS screen (Fig. 8.1).

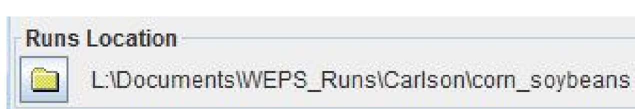



Figure 8.7: WEPS Runs Location panel on main WEPS screen.

 This "Set Run Location" folder button allows the user to change the default WEPS Run Directory by bringing up a modified file chooser window (Fig. 8.8). This file chooser window defaults to the current default WEPS Runs Location folder, which is displayed in the field immediately to the right of the folder icon, as shown in (Fig. 8.7). The user changes this system wide default path to whatever they select via this file chooser. One can

also revert back to the current default "WEPS Runs Location" setting by clicking on the "Cfg Def Loc" button in the FileChooser window. The "Dev Loc" button will take the user to the currently specified location shown in Fig. 8.7. If the user has previously changed from the original "New Prj. Default Runs Location, they can use the "Config Def Loc" button as a shortcut method to easily go back to that location, if desired.

We need to add a separate reference section regarding the general use of the WEPS FileChooser windows and how they (are supposed to) work.

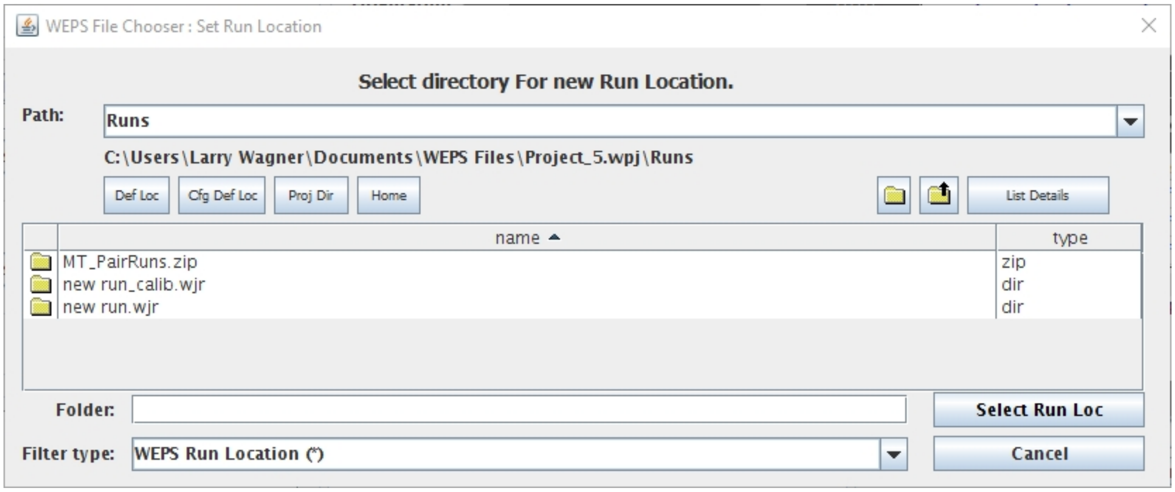



Figure 8.8: WEPS Runs Location FileChooser for selecting/setting the desired default "WEPS Runs Location".

### 8.3.2 Simulation Run Information

Simulation information is entered in the Simulation panel (Fig. 8.9 on the left side, center of the WEPS main screen (Fig. 8.1). The following fields in the Simulation panel are: a) **Run Mode**: b) **Water Erosion**; c) **Region Slope**; and d) **Rock Fragments**.

Some of these fields can be set "readonly" (greyed out) and not allow modification, depending upon how WEPS has been configured for a specific set of users. For example, the "Run Mode" setting cannot be changed, if WEPS has been configured for NRCS use.

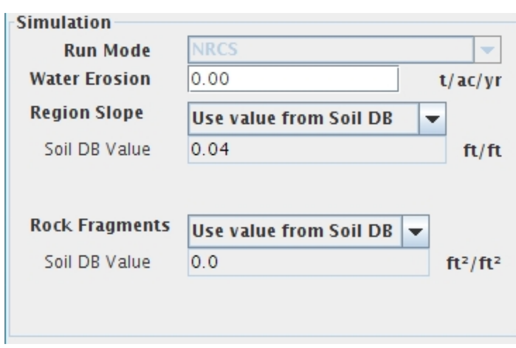



Figure 8.9: Full Simulation panel display.

#### Run Mode

The run-length mode determines the length and type of WEPS Run that will be simulated. There are three options for **Run Mode**: 1) An **NRCS** mode which indicates that the number of simulation cycles which is currently fixed to "50 cycles per rotation year in the selected management rotation". This option is specified and locked (read-only) for official NRCS field use in the "NRCS configured" release of WEPS; 2) The **Cycle** mode indicates that the user can specify the number of simulation cycles to run (number of years to simulate for each rotation year in the selected management rotation). The larger the value specified, in general the more accurate (consistent) the simulation results will be. The default value of 50 cycles is generally considered a good compromise between accuracy and simulation runtime. The default length of run (number of cycles) is controlled through the "Run" tab in the "Configuration Settings" panel (see the discussion on "Configuration" for more details); 3) The **Dates** mode allows the user to specify the exact starting and ending dates for the simulation. This mode is only intended for researchers and developers for when specific experimental scenarios are being evaluated. The "Dates" mode does not guarantee that the WEPS interface reports will display accurate information like the "NRCS" and "Cycle" modes do.

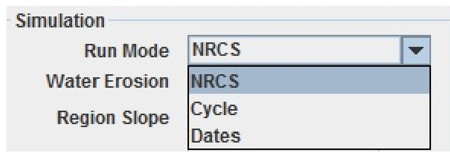



Figure 8.10: Simulation panel displaying the "Run Mode" input field and options.

### Water Erosion

The **Water Erosion** value is required for true estimates of the Soil Quality Index, which uses both wind and water erosion estimates in its computation. The Soil Quality Index is used by NRCS as an indicator of whether a particular set of management practices are improving or degrading the relative quality of the soil based upon the management practices specified for a WEPS simulation run. NRCS requested that the index be computed as an ancillary byproduct of each WEPS wind erosion simulation. This input field therefore has no impact on wind erosion estimates and is not required to be properly populated for a non-NRCS WEPS simulation run.

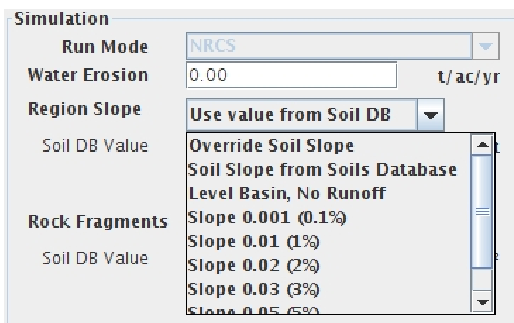



Figure 8.11: Region Slope field choices in the Simulation panel display.

### Region Slope

The **Region Slope** field (Fig. 8.11) provides the user with the option to override the default slope value specified in the selected soil record. The **Soil DB Value** field displays the soil record value immediately below this field. The slope value is used within the WEPS model to determine the amount of rainfall and applied irrigation water that will runoff the site and not infiltrate into the soil under the surface conditions present at the time the water is received. The reason this input is made available for user modification is because NRCS specifies a "typical" slope for all the soil components in their NASIS soil database. However, there is usually a range of slopes that a soil component may exist on. Providing the **Region Slope** field allows the user to easily specify a more representative slope value for a particular field site, if it is significantly different than the soil record default value. The possible values are: **Override Soil Slope** (user specifies the specific slope value); **Use Soil Slope from Soils Database**; **Level Basin**, **No Runoff (0 degree slope)**; **Slope 0.001 (0.1%)**; **Slope 0.01 (1%)**; **Slope 0.02 (2%)**; **Slope 0.03 (3%)**; **Slope 0.04 (4%)**; **Slope 0.05 (5%)**; and **Slope 0.1 (10%)**.

**Rock Fragments**

The **Rock Fragments** field (Fig. 8.12) provides the user with the option to override the surface rock fragments value specified in the selected soil record. The Soil DB Value field displays the soil record value immediately below this field. The rock fragments value is used within the WEPS model when determining the fraction of the surface considered non-erodible, which directly impacts the soil surface's overall susceptibility to soil loss by wind erosion. The reason this input is made available for user modification is because of the known variability of the values within specific soil components listed in the NRCS NASIS soil database and the level of sensitivity to erosion estimates from this input parameter. The possible values are: **Override Rock Fragments** (user specifies the specific rock fragments ratio); and **Rock Fragments from Soils Database**.

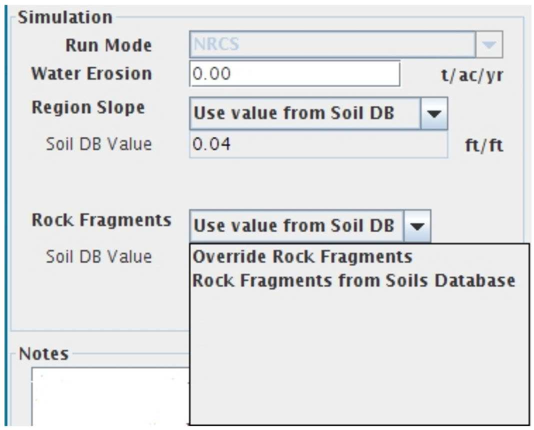



Figure 8.12: Rock Fragments field choices in the Simulation panel display.

### 8.3.3 WEPS Simulation Run Notes

If desired, each pending WEPS simulation run can be documented with specific user specified information into the **Notes** text panel on the main WEPS screen (Fig. 8.13) which is located on the left side of the WEPS main screen (Fig. 8.1). The "Clear" button clears the **Notes** field of any previous WEPS Run's content. Should we re-introduce the "Edit" button but name it "Edit in larger window"?

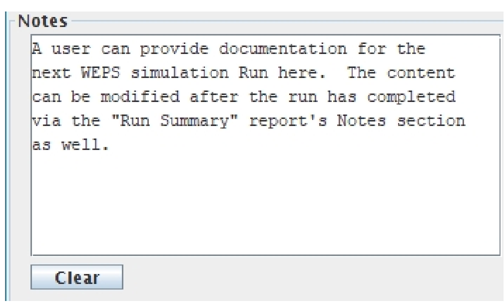



Figure 8.13: Notes panel for documenting pending WEPS simulation run information.

The WEPS simulation run **Notes** content is also available for post-editing after completion of the WEPS simulation run. The **Notes** content displays at the bottom of the display page of the WEPS Summary Report. That onscreen report provides editing functionality where the **Notes** content is displayed (Fig. 8.14). Also, it gets written into the last page of the PDF version of the Run Summary report as well. Need to get the post-edit Notes section's "Save" function to work correctly again.

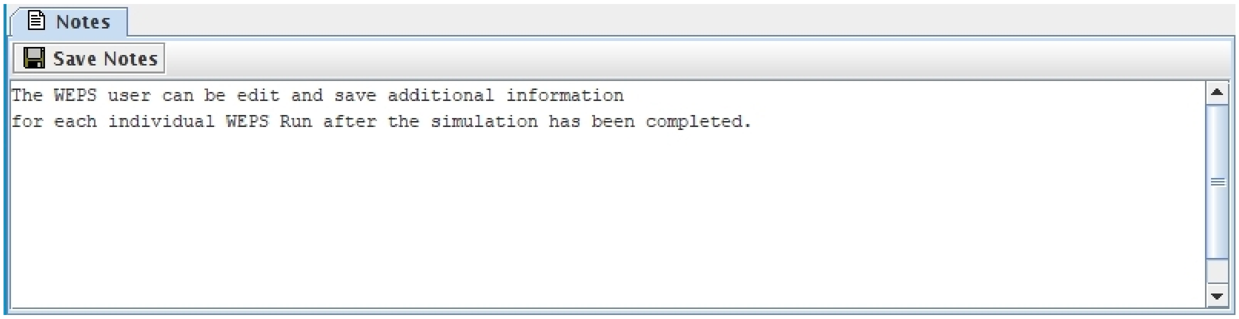



Figure 8.14: Notes panel for documenting post WEPS simulation run information.

### 8.3.4 Client Information

Customer information for a simulation run is entered in the panel labeled **Client Information** located on the upper left side of the WEPS main screen (Fig. 8.1). The **Client Name** as well as the **Farm No**, **Tract No**, and **Field No** for the simulation run can be entered by typing the information into the appropriate boxes in the panel. These four items are for informational purposes only and are not required to execute a WEPS simulation run. These fields and their names were provided primarily for NRCS business purposes, but any user can populate them with appropriate information to help them keep track of individual WEPS simulation runs.

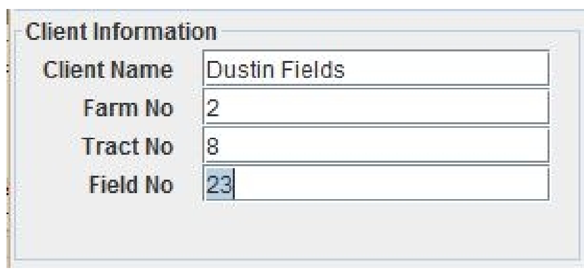



Figure 8.15: Client Information panel.

### 8.3.5 Simulation Region Information

The Simulation Region Information (**Region** panel) is shown in Fig. 8.16 and is located in the upper center region of the WEPS main screen (Fig. 8.1). To describe the simulation region, the field dimensions are entered. For example, the X-Length and Y-Length are entered for a rectangle. Note that the area of the region will be displayed. To orient the field, simply type in the angle in degrees of deviation from north for the north/south field border and accept the value (tab or click outside the field). Note that the field will only rotate in a range of ±45 degrees. By rotating and adjusting the field length and width, the user should be able to obtain the desired size and orientation for any field.

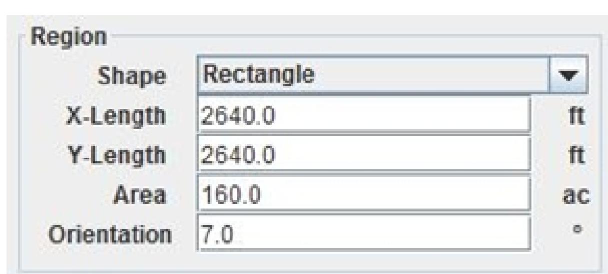



Figure 8.16: Simulation Region Information panel with rectangular field selected.

Other field shapes can be specified by clicking the down arrow to the right of the **Shape** box to display a list of valid field shapes (Fig. 8.17).

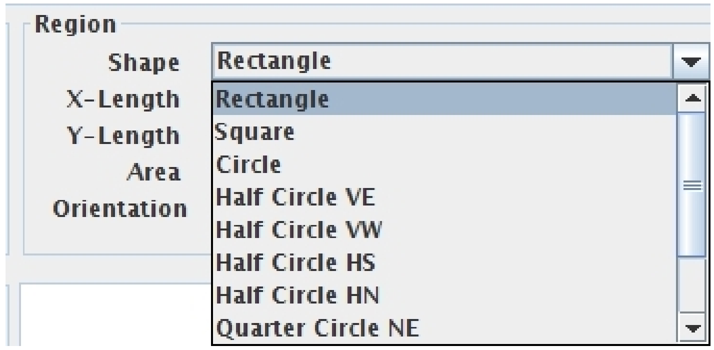



Figure 8.17: Dropdown list of some alternative Simulation Region Shape options available.

Fig. 8.18 illustrates the panel entry for a circular field. To describe a circular field, either the radius or the area of the field can be specified and the other value is automatically computed. For simulation purposes within WEPS, fields that are circles or partial circles (i.e., half or quarter circle)are approximated as a square or rectangular field with an area equal to that specified in the **Region** panel. Field shapes that can be selected include Rectangle, Square, Circle, Half Circle VE (vertical east), Half Circle VW (vertical west), Half Circle HS (horizontal south), Half Circle HN (horizontal north), Quarter Circle NE (northeast), Quarter Circle SE (southeast), Quarter Circle SW (southwest), and quarter Circle NW (northeast). For a square, enter either the X-Length, Y-length or the area. If area is entered, the field side length will be calculated and displayed. For rectangular fields enter either the X-Length and Y-Length or the area and one length. For circles or partial circles, enter the radius or the area and the other value is automatically calculated and displayed. The shape and orientation of the simulation region is displayed in the **Field View** and automatically updated when any of the field values are modified. If the user switches field shapes, the area will stay the same, unless the user later changes the dimensions.

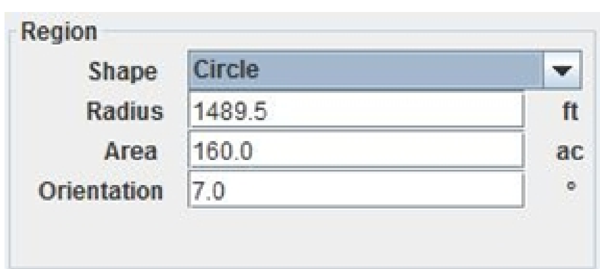



Figure 8.18: Simulation Region Information panel with circular field selected.

Special shapes or configurations such as circles and strip cropping are further discussed under the “Special Field Configurations” section of the chapter titled “Using WEPS for Conservation Planning” in the WEPS User Manual. Strip cropping is further discussed in detail in the “WEPS How To Guide” for Strip Cropping. The orientation of tillage direction is specified within the Management Crop Rotation Editor for WEPS (MCREW). (Add links here after the mentioned chapter(s) gets converted/updated to LaTeX))

The Simulation Region must be considered carefully. The boundaries of this region are assumed to be non-erodible. This is assumed so that unknown quantities of material will not be entering from a neighboring area. Typically, stable boundaries do not allow creep and saltation sized material to pass through and include barriers or a surface at least 15 feet wide that has vegetation sufficient to stop erosion. However, there are situations where one may want to simulate a field with erodible boundaries such as an area within an erodible field. In these situations, the user should consult their agency’s policy for simulating such areas.

### 8.3.6 Field View

The **Field View** panel (Fig. 8.19) is located in the center of the WEPS main screen (Fig. 8.1). It is designed to give the user a pictorial diagram of the field size, shape, and orientation (field shape displayed in green). The placement of any barriers present is also displayed in red. A yellow bar on the side of the field in the Field View panel indicates which side of the field has been selected for barrier placement using the radio buttons in the **Barriers** panel. This is useful for selecting field barrier placement when the field is oriented at angles close to 45 degrees. A red barrier shaded with yellow, as shown for the south barrier (Fig. 8.19), indicates a selected barrier that has already been placed on the field border. Note that if the ratio of length to width of the field or barriers is too great to display to scale, this will be indicated within the panel, and an approximation of the field or barrier shape will be displayed (see Fig. 8.20). This panel is for viewing only and is not directly editable.

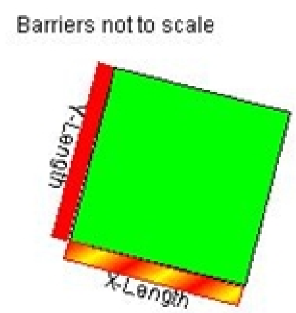



Figure 8.19: Field View panel for a rectangular field.

When a full, half, or quarter circle field is simulated (Fig. 8.20), it is approximated within WEPS as a square or rectangular field with an area equal to that specified in the **Region** panel. The **Field View** panel displays an approximate inscribed circle (or half or quarter circle) within the simulated rectangular field. When a non-rectangular field is selected, the field described in the **Region** panel has an area equal to that of the simulated rectangular field.

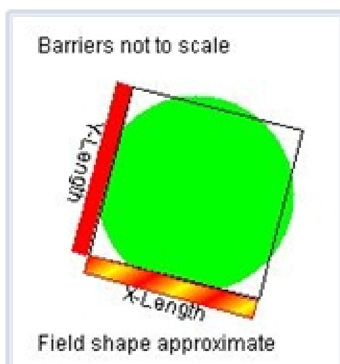



Figure 8.20: Field View panel for a circular field.

## 8.4 Choosing a Location

Choosing a location within WEPS defines the physical location of the field to be simulated. This location information is then normally used within WEPS to automatically select the representative climate stations (Cligen and Windgen) to be used for the simulation. There are multiple methods available to select the site location (or representative approximate site location). Location information is entered through the upper right panel of the main interface screen, labeled Location (Fig. 8.21).

By default, the Cligen and Windgen stations nearest to the latitude and longitude coordinates displayed in the **Latitude/Longitude** fields will automatically be determined and made available in a sorted list with the nearest stations selected by default.[1] The **Elevation** field will automatically be populated by default with the elevation of the selected Cligen station.

If configured, only the nearest station may be selected by default or if the polygon regions approach is used, then the assigned station for that polygon region is specified. Also, if configured, and the site is located within the ”interpolated” polygon region, then an interpolated station will be created and used.[2] Some or all of the station selection options can be made available and selected for use via the WEPS configuration settings and accessible via the Config Panel. A special ”NRCS” setting is also available that determines the specific criteria for the selection options applied under all siting scenarios for both Cligen and Windgen station determinations.

Notice that the **Cligen** and **Windgen** fields display not only the station name, but also the distance from the specified lat/long location above. By clicking on the down arrow ▾ to the right of the individual station fields, the user can override the default nearest station selection if desired. The radius range distance used for populating the nearest station lists is also displayed immediately above the weather station fields. There are other options available that can be used to determine the stations selected. They are accessible via the ... button left of the weather station fields. This button does not display if only one weather station selection option has been specified in the WEPS configuration settings. These options are discussed in more detail later in this section.[3]

Likewise, there are configuration options that control whether the **Country**, **State** and **County** fields are displayed, or the **lat/long** fields and even the **Map Viewer** button (labeled either ”Please Select Field Location” or ”Field Location Selected”). Thus, the **Location** panel will often appear somewhat differently than the one shown in Fig. 8.21 for those alternatively configured WEPS versions.

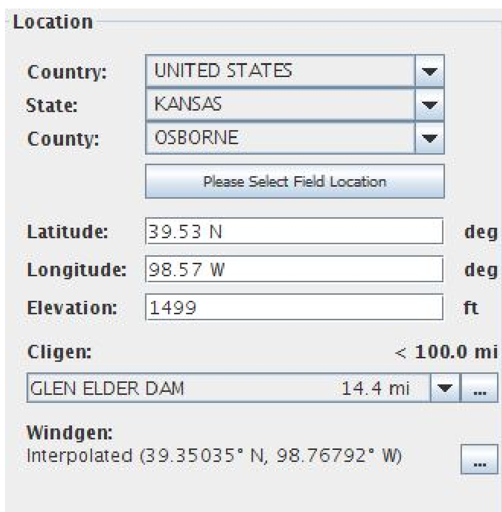



Figure 8.21: Location information panel on main WEPS screen.

### 8.4.1 Country/State/County Site Selection Method

This method provides an approximation of the site location. Select the **Country**, if configured to display that input field[4], then the **State** (or **Province**, etc.) and finally the **County** (or **Parish**, etc.) of interest from their respective

[1] Note that there are several station selection ”modes” available for Cligen and Windgen as well as a special ”NRCS” mode that determines which selection method is used based upon specific criteria. All of this is configurable within WEPS and can be specified via the Config Panel settings (if appropriately configured to do so).

[2] Interpolation currently only implemented for Windgen stations. PRISM adjustment of the selected Cligen station is used instead of station interpolation within the conterminous U.S.

[3] Note that the default weather station selection behavior can be modified and is in fact configured differently for various WEPS versions, including the NRCS WEPS releases.

[4] Note that the NRCS configured version of WEPS does not display the **Country** field and assumes the country is the United States. To display this field or not can be specified in the WEPS configuration settings.

drop-down lists by clicking the down arrow ▾ to the right of the individual fields. The centroid[5] latitude and longitude coordinates of the county will automatically be displayed.

### 8.4.2 Lat/Long Site Selection Method

As an alternative, the Latitude and Longitude of the site location can also be directly entered, which will automatically display the country(if configured for display), state and county in which the coordinates reside and then select the nearest Cligen and Windgen stations to those latitude/longitude coordinates. Note that the hemisphere is displayed in the lat/long fields. The "N" (northern) and "E" (eastern) hemispheres are represented as positive values and the "S" (southern) and "W" (western) hemispheres are represented as negative values when a user clicks in those fields to edit them. The default hemispheres are the Northern and Western hemispheres for the United States. If the Southern hemisphere is desired, the user should select Cligen stations and management files with appropriate operation dates for this hemisphere.

### 8.4.3 Map Viewer Site Selection Method

Another alternative method to choosing a site location is by using the **Map Viewer** (button labeled either "Please Select Field Location" or "Field Location Selected"), if configured to display the **Map Viewer** button. Clicking on the Map Viewer button (as shown in Fig. 8.21) will bring up a window containing a map of the world zoomed into the region centered about the currently listed lat/long coordinates, which is highlighted as a red cross (+ sign) on the map (Fig. 8.22). The current lat/long coordinates of the red cross are displayed in the upper left corner of the map screen.

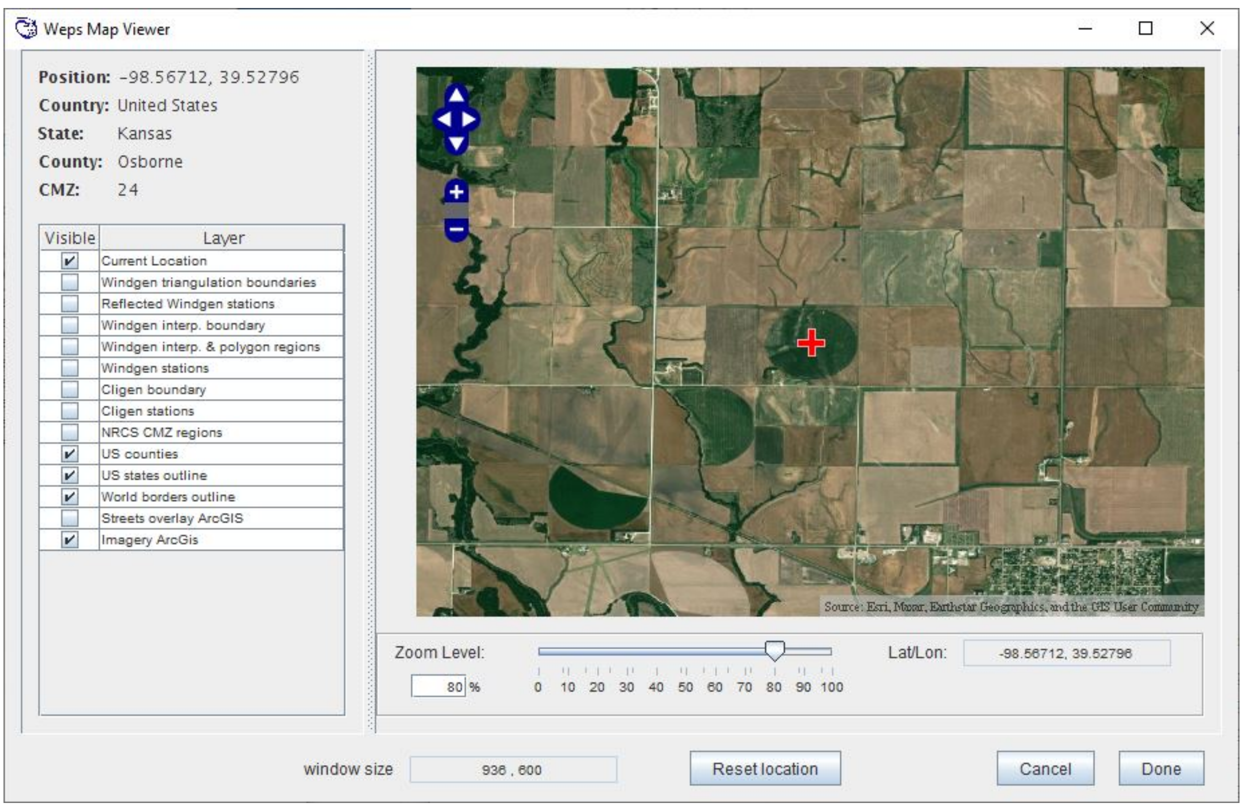



Figure 8.22: Default WEPS Map Viewer displayed with lat/long coordinates specified in the Location panel.

The user can select any location on the map to change the lat/long values in the **Location** panel on the main WEPS interface screen. They can move the mouse cursor to the desired site location within the map (current mouse cursor lat/long coordinates are displayed in the lower right side of the screen and are continuously updated when the mouse cursor is moved). The user can set the red cross (+ sign) by clicking the left mouse button once. Double clicking

[5]We use the term "centroid" in this document, but if the county polygon is shaped such that the true centroid is located outside the county (polygon) region, we adjust the coordinates such that the lat/long displayed will always fall within the county border.

the left mouse button will set the location at the cursor and automatically close the **Map Viewer** window. This will then execute the same function as clicking on the **Map Viewer** window's "Done" button, i.e. populate the **Location** panel Lat/Long fields, then update the Country, State and County fields as well as re-selecting the default Cligen and Windgen stations, if necessary.

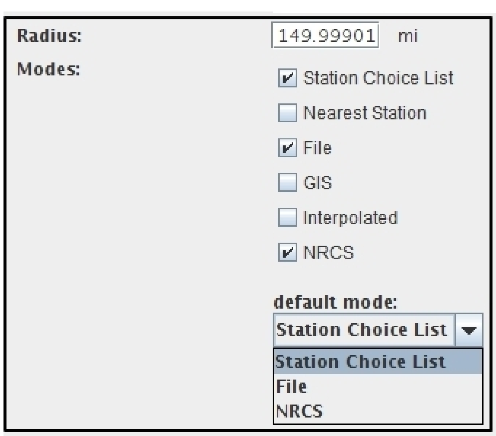
The user can move the map left, right, up and down by selecting the appropriate directional controls (4 white arrows surrounded by a blue background) at the top left of the screen. By clicking the appropriate arrows, the user can move the map in the specified direction in the window. Likewise, the user can zoom the map in or out by selecting the "+/-" controls (+/- symbols surrounded by a blue background) that are located directly beneath the directional controls. The user may also perform these functions directly with the mouse and mouse cursor. By selecting a location within the map using the mouse cursor. By pressing and holding the right mouse button down, the user can move (drag) the map left, right, up or down within the window. By clicking the left mouse button with the cursor in the map and then scrolling the mouse wheel, the user can zoom the map in and out on the screen. The currently selected lat/long coordinates are displayed in the upper left corner of the window and the Country, State and County, including the Crop Management Zone (CMZ) the lat/long coordinates reside in are also displayed.

Move the following paragraph to a new section to be created called "Additional Map Viewer Features", or something along those lines.

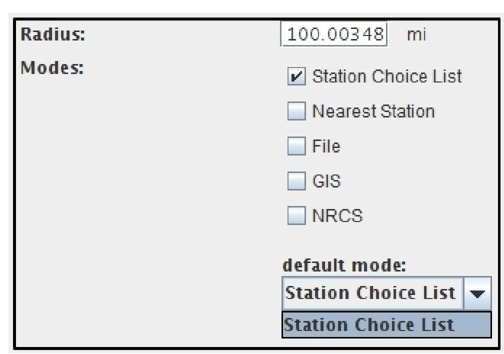
Clicking the check boxes at the left side of the **Map Viewer** window will enable (display) various GIS (Graphical Information System) layers on the map (Fig. 8.22). Map layers currently enabled by default are: a) World (country) borders outline; b) U.S. states (borders) outline; c) U.S. counties; d) (satellite) Imagery ArcGis; and e) the Current Location (identified by a red cross (+ sign) on the map) as listed in the Location panel on the main WEPS screen. Additional useful map layers available include: a) Cligen station names and locations; b) Windgen station names and locations; c) (nearest) Cligen station boundaries; d) NRCS CMZ (Crop Management Zone) regions; e) Windgen interpolation & polygon regions; f) Windgen triangulation lines (used for displaying station interpolation regions); g) Streets overlay ArcGIS (street map), etc. Additional layers are also available primarily for debugging/testing purposes and other WEPS builds provide access to some of them by default.

### 8.4.4 Weather Station Selection Methods

As mentioned previously, WEPS can be configured to automatically select both Cligen and Windgen stations differently than the default method(s) specified above. All methods will be described here, including the NRCS method (last method listed), which employs several of the other methods, depending upon where the lat/long location resides. The options made available and the default method to use are configurable and can be accessible via the Config Panel for both Windgen and Cligen. Here are the current list of all options as displayed in the Config Panel for station selection (Fig. 8.23). The "Windgen Modes" and "Cligen Modes" screenshot sections came from the "Windgen" and "Cligen" tabs respectively of the Config Panel. Include a reference to the Config Panel screen here after we add that section to the User's Manual.




(a) Windgen Modes



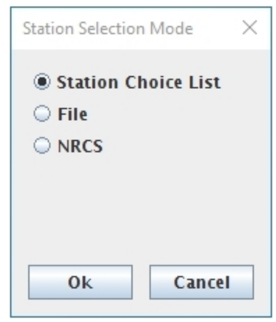

(b) Cligen Modes

Figure 8.23: WEPS Config Panel Windgen and Cligen Station Selection Modes.

The station selection methods made available for the current instantiation of WEPS are the checkmarked option **Modes** displayed in Fig. 8.23 with the default mode specified in the **default mode** field. The available options and default settings displayed in the Config Panel can be individually configured so some may be set "readonly" or "hidden". Therefore, specific WEPS build configurations may appear differently than shown in Fig. 8.23.

The weather station inputs on the main WEPS screen with the Fig. 8.23 settings displayed will appear like a) below in Fig. 8.24. If there are multiple station selection modes specified in the Config Panel for either weather station, there will appear an additional ... button next to the dropdown choice list arrow. If the ... button to the left of the Windgen station field is selected (highlighted) as shown in (a) below, it will display the popup window as shown in (b) within Fig. 8.24. This window displays the available Windgen station selection options with the default mode currently specified by the solid filled radio button. The user can change that selection here for this instance of WEPS, if desired.


(a) Weather Station Selection Input Fields




(b) Windgen Selection Mode Choices

Figure 8.24: Example Weather Station Inputs/Selections.

Here is the list of weather station selection modes. Those used for Cligen and/or Windgen are specified for each selection mode listed.

- **Station Choice list** - This is the default method and has been explained above. Briefly, a list of stations within a specified radius (note "Radius" fields in Fig. 8.23) of the lat/long location is determined and sorted by distance from the lat/long location. The nearest station in the list is displayed as the default choice, but the user has the option of overriding that selection, if desired.
- **Nearest Station** - This method selects and displays only the nearest station to the lat/long location specified. No option is available to override this selection.
- **File** - This method allows the user to specify a previously generated weather file to use (in the Cligen or Windgen generator output file format) rather than having the weather generators create them automatically prior to the WEPS simulation being executed. This option is useful for developers and researchers if they need to use field weather data for research needs, etc. This option is not normally selected for use in typical WEPS usage.
- **GIS** - This option allows GIS (Graphical Information System) map "shape" files consisting of polygon maps with stations assigned to the polygons to be used.[6] If the lat/long location resides within a polygon, the assigned station is selected and displayed. If the lat/long location does not reside within a polygon region, then the weather station field will display "None Selected", necessitating the user to manually make the choice, if no other options are made available. The user will not be allowed to make a WEPS run until both weather stations, Cligen and Windgen, are selected.
- **Interpolated** - This option only applies to Windgen stations at this time. Based upon a specific Windgen interpolation polygon map and a corresponding "reflected" Windgen stations map, if the lat/long location falls within an "interpolated region" polygon, then the Windgen record is interpolated from data within three nearby

[6]The current version of WebStart WEPS no longer has any polygons defined for Cligen. We are now applying the 4km grid PRISM adjustments by default in the conterminous U.S. to the Cligen monthly and yearly average temperatures and precipitation values, which provides improved representative station data for the Western U.S. where we previously employed the polygon mapping approach for Cligen.

Windgen stations. The lat/long location is used for the "interpolated" station's location. Note that since Windgen generated data is dependent upon the statistical parameters in the station record, having an interpolated station that is even slightly different, e.g. even a few feet from another location will give a completely different sequence of weather (wind) data, even though, statistically, the two interpolated stations would be essentially the same. Thus, care must be taken when selecting the use of the "interpolated" mode alone. (See NRCS mode for how this issue is addressed there.)

- **NRCS** - This option was developed for use by NRCS and is the default, and only option, specified for "NRCS configured specific versions of WEPS. It is also the recommended mode for most other WEPS users to use in the United States as well. The NRCS mode uniquely combines several of the above listed individual options. Note that this mode uses the list of NRCS Windgen stations for interpolation purposes, even if the entire list of available Windgen stations has been selected for use, e.g. like most alternative WEPS configurations available in the public release are configured. Here is the decision tree that defines the "NRCS" Windgen station selection when the "NRCS mode" is specified:

  1. For Windgen only, if the lat/long location is within an "interpolated" polygon, then an "interpolated" Windgen station is created and used. In this case, the lat/long used for interpolation is always the "centroid" lat/long for the specified county, which may or may not be the lat/long specified on the main WEPS Location panel. This guarantees that the NRCS user will always get the same sequence of generated wind data in that county because it will produce the same "interpolated" Windgen record for all locations within the county.

     Due to sometimes big differences in Windgen station data and the relatively large distances between stations (at least compared to Cligen stations), it was deemed beneficial to use interpolation rather than the "nearest station" approach and have potentially very large differences in generated wind data occur across those nearest station boundaries. Most of the eastern half of the U.S. is currently contained in the "interpolated" polygon region (see Fig. 8.25). These Windgen interpolated polygon region(s) are selectable for viewing within the **Map Viewer** (Fig. 8.22).

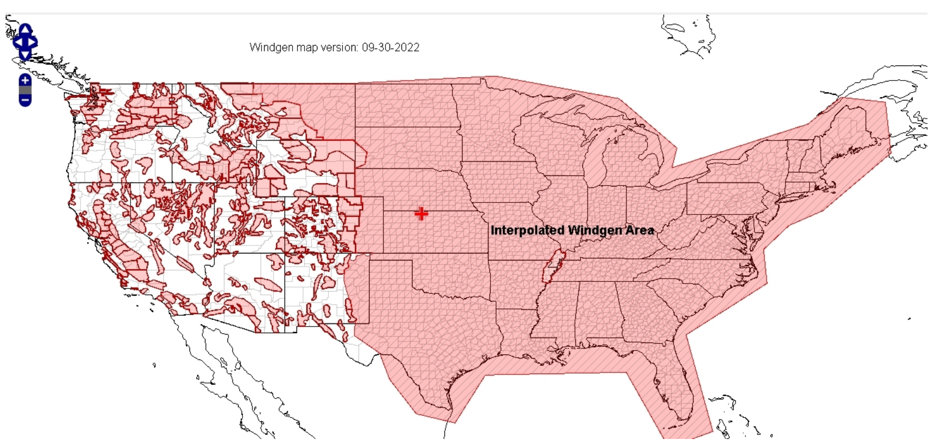



Figure 8.25: Windgen Interpolation Polgyon region as displayed within the WEPS Map Viewer.

  2. If the lat/long falls within a Cligen or Windgen polygon region, it will use the assigned station for that polygon.

     Most of the Cligen[7] and Windgen polygons have been created by NRCS for use in the western U.S. due to mountains separating neighboring valleys, large elevation differences between nearby weather stations, etc. not being conducive to allowing the nearest station or interpolation selection methods to work well in these regions. These polygon regions are selectable layers for viewing within the **Map Viewer** (Fig. 8.22).

[7] The current version of WebStart WEPS no longer has any polygons defined for Cligen. We are now applying the 4km grid PRISM adjustments by default in the conterminous U.S. to the Cligen monthly and yearly average temperatures and precipitation values, which provides improved representative station data for the Western U.S. where we previously employed the polygon mapping approach for Cligen.

3. If the lat/long location does not fall within either an “interpolated” polygon region (Windgen only) or a Windgen/Cligen polygon region, then the nearest station is automatically selected with the user having the option to override that selection from a sorted list of other nearby weather stations.

Add additional info on how the ”PRISM adjustment” is applied to Cligen records and where it can be changed within WebStart WEPS.

## 8.5 Selecting a Management Rotation

The management scenario can be selected and accessed for editing from the management input panel on the bottom of the main WEPS screen (Fig. 8.1) and is shown here (Fig. 8.26)


Figure 8.26: Management input panel on the WEPS main screen.

A management rotation scenario for a WEPS simulation run can be selected from pre-generated WEPS management (template) files and then modified as necessary. Management rotation scenarios can be selected from a drop-down choice list (Fig. 8.27) by using the down arrow box on the far right side of the bottom ”Management” panel of the WEPS main screen (Fig. 8.1). Navigation is performed by clicking on the ‘closed key’ symbol or select the folder and press the right arrow key to open the folder to display its contents. To close a folder, click the ‘open key’ symbol or press the left arrow key to quit displaying the folder contents.


Figure 8.27: Management selection drop down choice list.

The user can also select a management rotation by clicking on the **Template** folder to the left of the management rotation name, which will bring up a standard file chooser window (Fig. 8.28). The user may also select previously used management files stored in the current WEPS Project directory by clicking on the **Project** folder button.

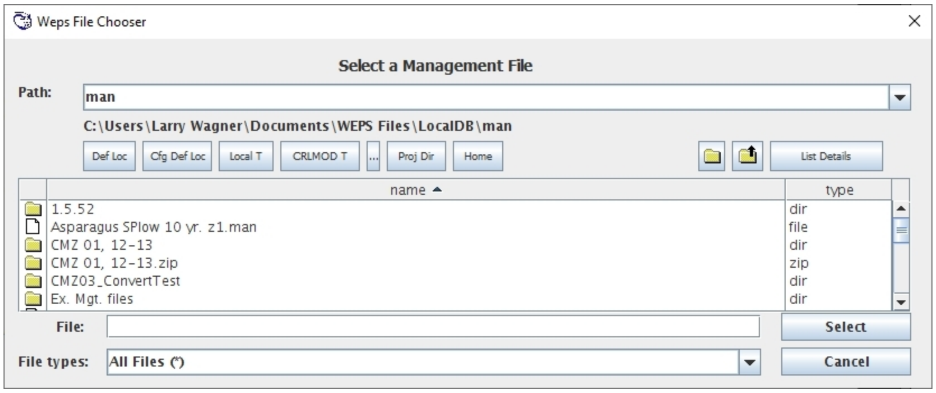



Figure 8.28: Template management file chooser window.

Management rotation files in a WEPS Project directory are usually derivatives of those selected previously from the Template directory with local "Project-specific" modifications. Note that the and buttons are not displayed by default for the official NRCS configured releases of WEPS. Therefore, these users can only use the down arrow box to access the drop-down choice list for selecting management rotation scenarios from the main WEPS screen.

Management rotation scenarios for a simulation run can also be created/selected within the rotation editor which can be opened by using the Man button on the left side of the bottom panel of the WEPS main screen (Fig. 8.26). To open the Management/Crop Rotation Editor for WEPS (MCREW), double click on the Man button on the left side of the management box. This will open the MCREW window (Fig. 8.29, which allows the user to view, edit, and save management rotation information. Details on editing a management rotation file are discussed here: Editing with the Management/Crop Rotation Editor for WEPS (MCREW).

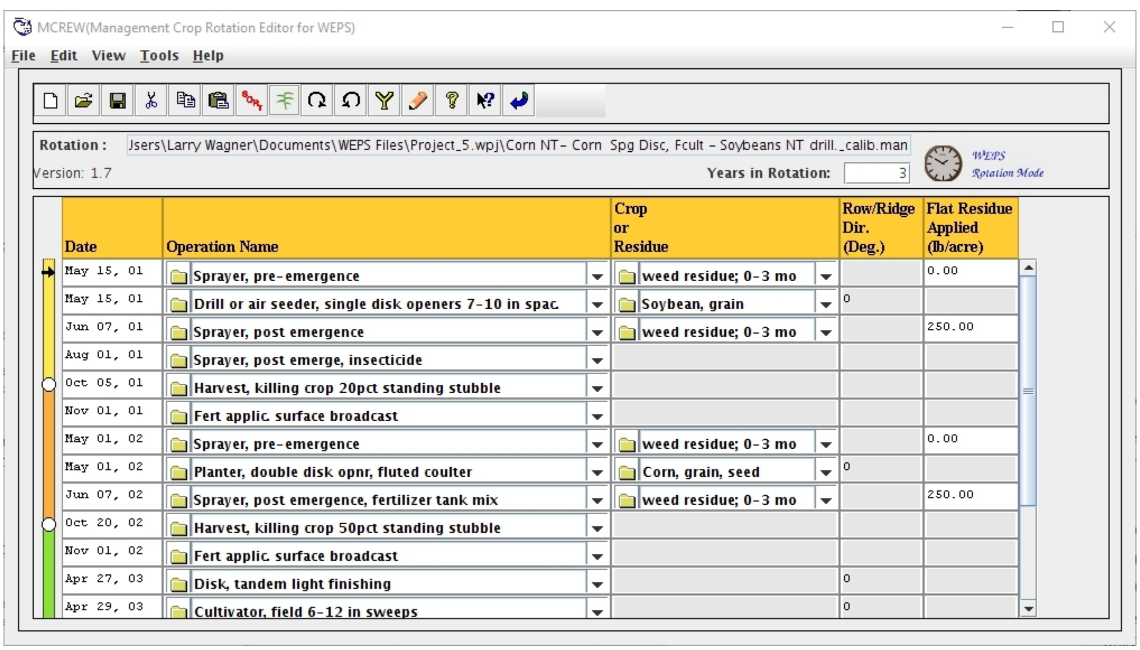



Figure 8.29: Management/Crop Rotation Editor for WEPS (MCREW) window.

## 8.6 Choosing a Soil

The desired soil can be selected and accessed for editing from the soil input panel on the bottom of the main WEPS screen (Fig. 8.1) and is shown here (Fig. 8.30).


Figure 8.30: Soil input panel at the bottom of the WEPS main screen.

Soil files can be selected from a drop-down choice list (Fig. 8.31) by using the down arrow box on the far right side of the bottom "Soil" panel of the WEPS main screen (Fig. 8.1). Navigation is performed by clicking on the 'closed key' symbol or select the folder and press the right arrow key to open the folder to display its contents. To close a folder, click the 'open key' symbol or press the left arrow key to quit displaying the folder contents.

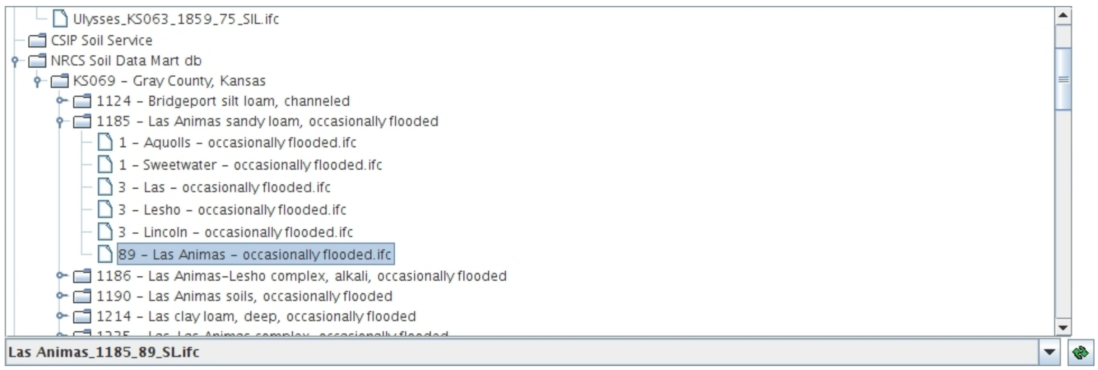



Figure 8.31: Soil selection drop down choice list.

The section below is not working 100 percent as documented yet: Mantis ticket 3791: Soil "P" and "T" button File-Chooser updates. The user can also select a soil by clicking on the **Template** folder to the left of the soil input field, which will bring up a standard file chooser window (Fig. 8.32). Similarly, the user may also select previously soil files stored in the current WEPS Project directory by clicking on the **Project** folder button.

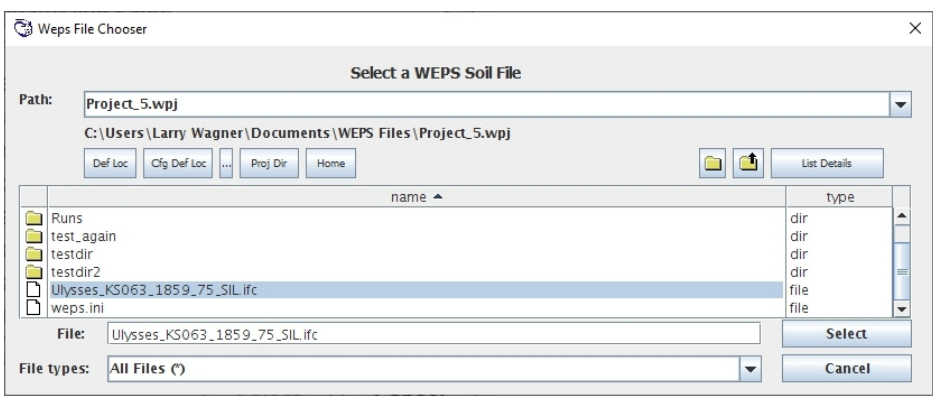



Figure 8.32: Template soil file chooser window.

Soil files in a WEPS Project directory are usually copies of previously selected soil files obtained from the NRCS NASIS (SSURGO) soil database. Note that the and buttons are not displayed by default for the official NRCS configured releases of WEPS. Therefore, these users can only use the down arrow box to access the drop-down choice list for selecting soil data from the main WEPS screen.

Soils that have been previously selected or modified and saved to another name (and stored in the current Project folder) can be opened by clicking on the **Project** folder button. This will open a soil filechooser window in which the user can select the desired soil or type in the soil file name.

Users have the option to view the parameters for the soil file displayed in the soil box by clicking on the button labeled **Soil** on the left side of the soil box. This will open the WEPS Soil User Interface screen (Fig. 8.33) which allows the user to view, edit, and save soil and initial condition information. Details on editing a soil ".ifc" formatted file are discussed here: Editing with the Soil Interface window.

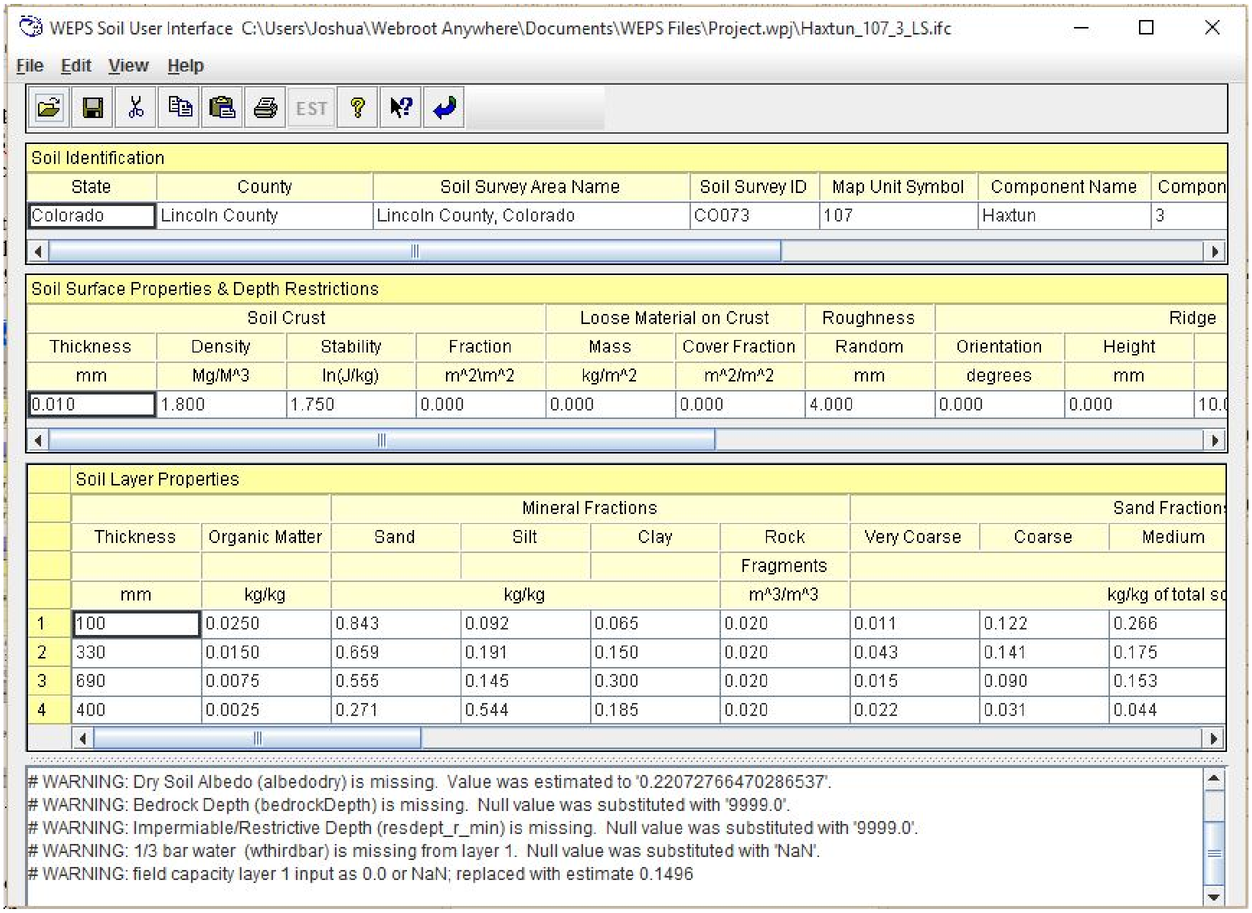



Figure 8.33: WEPS Soil User Interface screen.

## 8.7 Selecting a Wind Barrier

The Wind Barrier Information (**Barriers** panel) (Fig. 8.1) is used to add barriers to the field borders. Note that WEPS 1.6 interface currently only allows barriers on the borders of the field, not within the field. The barrier location is labeled for the side of the field on which the barrier is to be placed, such as 'N' for north, 'S' for south, 'E' for east, and 'W' for west. The **Field View** will automatically display the placement of selected barriers in red and highlight the currently selected location in yellow if no barrier exists there. If there is already a barrier for the selected location, it will display with a mixture of both red and yellow stripes (Fig. 8.34). Select a barrier location by selecting the appropriate radio button in the **Barriers** panel. To "unselect" all barrier locations, click the currently enabled radio button ◉ to the off ○ position. If the field is rotated, the location labels refer to the direction closest to one of the four cardinal directions. To remove a barrier from the field, click the radio button ◉ to select it, then select the barrier type "none" to remove it.

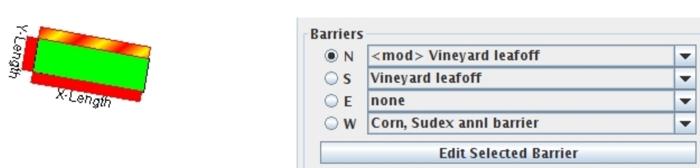



Figure 8.34: Field View and Wind Barrier Information panel.

The barrier type can be selected from the drop-down list in the panel by clicking the down arrow box to the right of the barrier type to bring up the list of available barriers and clicking on the appropriate barrier. Once a barrier type is selected, the barrier properties may be viewed and edited by clicking the Edit Selected Barrier button at the bottom of the panel (Fig. 8.35). This displays a separate panel where one may enter the barrier width, height, and porosity in the appropriate fields. Note that the area of the barrier is displayed but cannot be edited. If barrier properties have been modified, it will be noted in the barrier name list with a <**mod**> designation before the barrier name (Fig. 8.34).

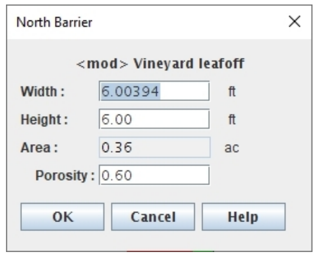



Figure 8.35: Wind Barrier Edit window.

See the “WEPS How To Guide” for Barriers for further explanations on how to use barriers within WEPS and how to modify the barrier database. Note that the **Barriers** panel is not the best way to simulate the effects of strip cropping, but it may be useful in strip cropping designs that include barriers along the edge of the strips. See the “WEPS How To Guide” for Strip Cropping for a detailed description of simulating strip cropping with WEPS 1.6.

## 8.8 WEPS Projects

A “WEPS Project” is a directory that can be thought of as a working area where WEPS simulation input data files are created, edited and stored. A WEPS Project stores all the parameters for the current simulation run being prepared within the WEPS interface, as well as any previous WEPS simulation runs made from within this Project folder. For example, a particular WEPS Project may represent a folder for an individual client under which all of the simulation runs for each field and management alternatives for that client’s farm can be stored.

When a WEPS Project is saved, the current ”state” of the WEPS interface is preserved with all of the information contained in the current WEPS interface screen is stored in a **weps.ini** file within the Project folder along with the currently selected management and crop files. Multiple WEPS Project folders can be created and given user defined names. WEPS Project folders use the default name extension of ”.wpj” to easily identify them. WEPS provides the ability to remove unnecessary WEPS Project folders from within the WEPS interface via the pertinent options under the **Project** menu. Note that the following characters cannot be used in WEPS file names: **: & ” ‘ * ?** <>|\

When leaving the current WEPS Project folder (or exiting WEPS), the user is always asked via a popup window (Fig. 8.36), if the user first wants to save the current Project’s ”state” (of the WEPS interface), unless no changes have yet been made in the WEPS interface during this instance of WEPS.

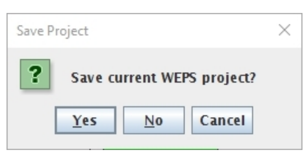



Figure 8.36: Save Current Project popup window.

If the user clicks **Yes**, the current parameters are saved to the old (current) Project. If the user clicks **No**, the current parameteres are not saved. If the user clicks **Cancel**, the selected WEPS Project process is aborted and the WEPS interface screen returns to the previous Project and its current interface settings.

### 8.8.1 Working with WEPS Projects

Clicking the **Project** menu item displays a list of various options pertaining to WEPS Projects. These options are discussed below. Note that multiple WEPS Projects functionality is now available by default for all WebStart WEPS builds, including NRCS configured builds.

The **New (Ctrl-N)** menu item (same as on the button bar) allows the user to create/name a new WEPS Project folder. Clicking on this menu item causes WEPS to first allow for any unsaved changes to be saved to the current Project via a popup window (Fig. 8.36). After the user appropriately dismisses the popup window, a file chooser window (Fig. 8.37)

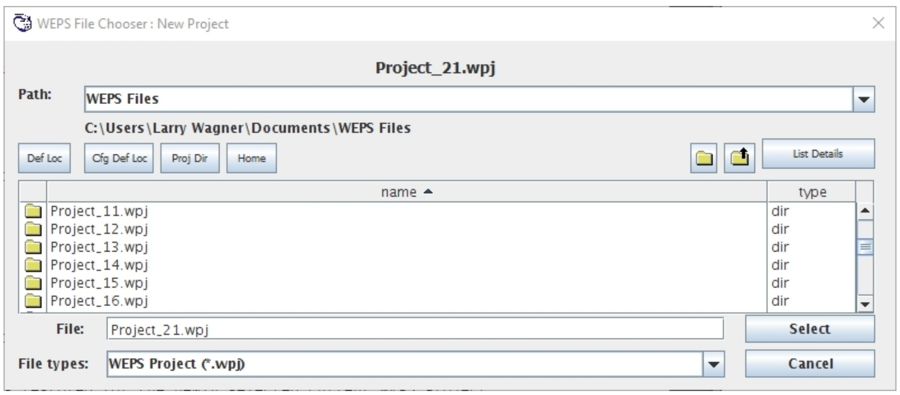



Figure 8.37: New Project FileChooser window.

appears which allows the user to specify a name for the new WEPS Project. The WEPS interface screen is then cleared, and the newly created WEPS Project becomes the current WEPS Project.

The **Open... (Ctrl-O)** menu item(same as on the button bar) opens an existing WEPS Project. Clicking on this menu item causes WEPS to first allow for any unsaved changes to be saved to the current Project via a popup window (Fig. 8.36). After the user appropriately dismisses the popup window, a file chooser window (similar to Fig. 8.37) appears which allows the user to select the name of an existing WEPS Project to re-open. The WEPS interface screen is then cleared, and the selected WEPS Project's last saved "state" (of the WEPS interface) is restored for the newly selected current WEPS Project.

The **Save (Ctrl-S)** menu item (same as on the button bar) saves the current WEPS Project "state" (of the WEPS interface) into the Project's **weps.ini** file for the current WEPS Project.

**Save As... (Ctrl-A)** allows the user to save a copy of the currently displayed WEPS Project's "state" (of the WEPS interface) into a new Project's **weps.ini** file. The new Project must not previously exist and it cannot overwrite (replace) an existing WEPS Project. The user must enter a unique name. The newly saved copy of the Project then becomes the current WEPS Project.

The **Delete Project (Ctrl-P)** menu items open a file chooser to delete a selected WEPS Project folder, including all of its contents.

The **Delete Management Rotation File (Ctrl-M)** menu item opens a file chooser to delete a WEPS management file.

The **Delete IFC Soil File (Ctrl-L)** item opens a file chooser to delete a WEPS soil file.

The **Reset** and **Clear GUI** menu options both clear the main WEPS interface fields and set them back to the defaults. The **Reset** option also removes all files from the current WEPS Project folder (it does not remove any subfolders or their contents from the current Project. This is to hopefully preserve any WEPS Runs that may exist under the current WEPS Project folder.

The **Exit (Ctrl-X)** menu option, exits the WEPS program.

The default WEPS Project folder location for these various WEPS Project menu options, under which new WEPS Projects will be created and existing WEPS Projects will be opened, can be specified under the **Project & Data Loc** tab of the **Configuration Panel** window (Fig. 8.38). This Config Panel is accessible via the **Tools/Edit Configuration** menu option in WEPS or by using the **Alt-C** key sequence.

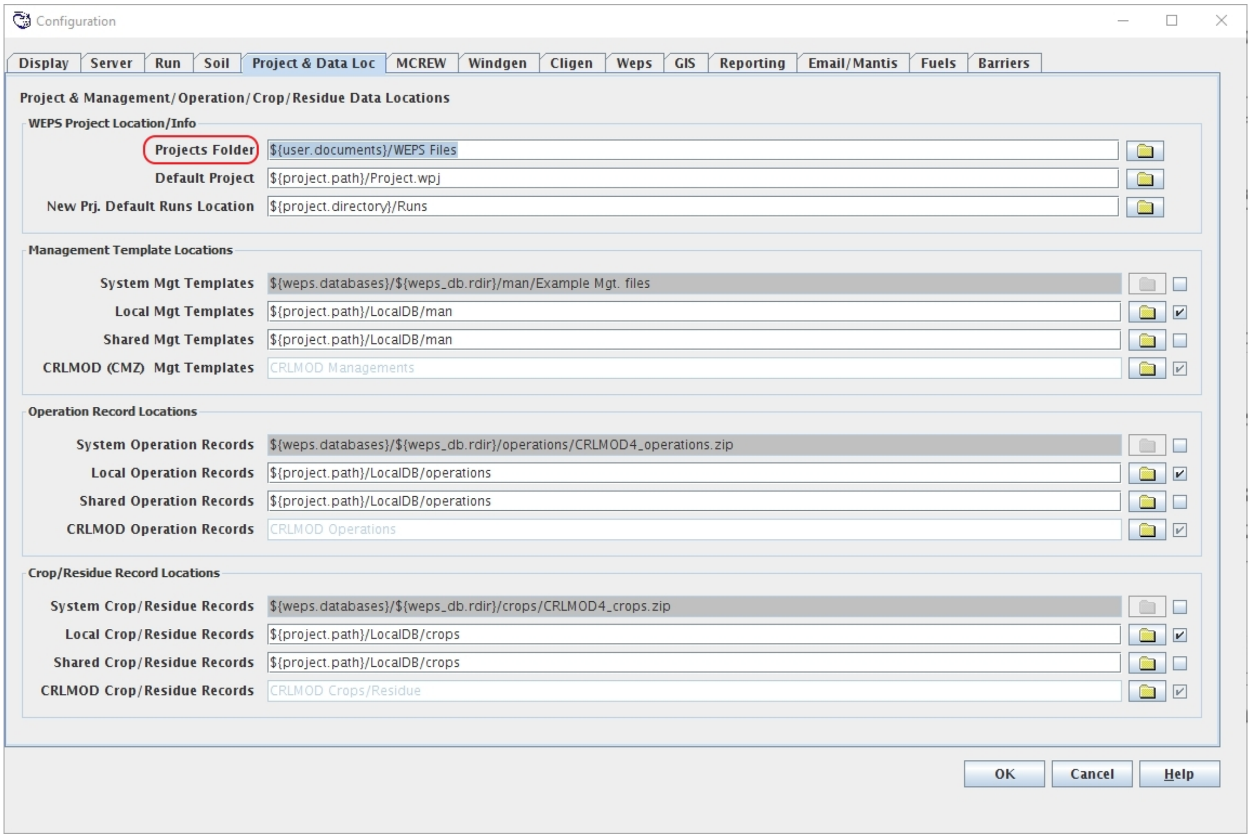



Figure 8.38: Configuration Panel settings for specifying the default WEPS Project and Run locations.

The location for all WEPS Projects to reside by default is specified in the **Projects Folder** field as shown in Fig. 8.38. This location is usually set to the user's **Documents** folder[8], but can be anywhere the user desires on there computer system. All new WEPS Projects will automatically be created under this folder location by default, unless overridden by the user.

WEPS will use the **Default Project**[9] name, (also shown in Fig. 8.38) as the base name for all new WEPS Projects with an "**_x**" (The "**x**" is a unique integer number) appended to this basename by default. The user has the option to override this default new WEPS Project name, if desired.

### 8.8.2 "WEPS Run" Folders

All WEPS simulation run results are stored in separate folders. A WEPS Run folder is created every time a simulation run is made. A WEPS Run folder stores a copy of all input files used to make the simulation run, together with the output files generated from those inputs by the WEPS science model. Thus, one is able to reproduce the identical WEPS Run at a later date (and get the same output results assuming they are using the same version of WEPS and weather generators/databases used when making the original simulation) because the original input files are still available. Typically, "re-executing" a previous WEPS Run is not necessary since the outputs are stored in the WEPS Run

[8] The **${user.documents}** variable shown in Fig. 8.38 in the **Projects Folder** field, refers to the operating system's **Documents** folder for the current user in WEPS.

[9] The **${project.path}** variable shown in Fig. 8.38 in the **Default Project** field, refers to the path represented by the **Projects Folder** field in Fig. 8.38.

directory and can be reviewed via the "ViewOutput" menu options. However, a user may want to "Restore" a previous WEPS Run and use it as a template for editing prior to making a subsequent simulation run. This functionality is available via the button or the **Restore WEPS Run** option under the **Run** menu. Storing the input and output files for each WEPS Run in individually named directories makes it relatively easy to manage, archive and remove selected WEPS Runs as necessary. WEPS is configured by default to place the WEPS Run folders within the current WEPS Project folder under the "Runs" subdirectory as shown in Fig. 8.38 in the **New Prj. Default Runs Location** field[10]. This keeps all the WEPS Runs made within each specific WEPS Project with that Project. An alternative default WEPS Runs location can be configured within the **Configuration Panel** if desired.

Also, the default WEPS Runs location for the current WEPS Project can be changed from the configured default specified in the **Configuration Panel** (Fig. 8.38) via the **Project/Set Run Location** menu option or on the WEPS interface screen (**Runs Location** panel in Fig. 8.1 and shown here in Fig. 8.39. Clicking on that folder icon (selecting the menu option) will bring up a file chooser to change the default WEPS Runs location (Fig. 8.40).

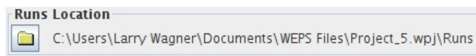



Figure 8.39: WEPS Runs Location Panel.

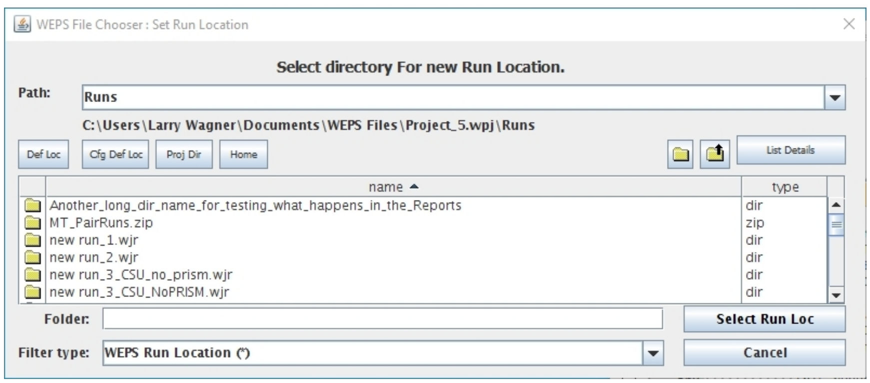



Figure 8.40: Set Default WEPS Runs Location FileChooser.

The user also has the ability to temporarily override the default WEPS Runs location when submitting a WEPS Run for execution. when specifying a WEPS Run via the options under the **Run** menu or the and buttons. Here is the filechooser that allows the user to specify both the WEPS Run location and the name of the WEPS Run (Fig. 8.41).

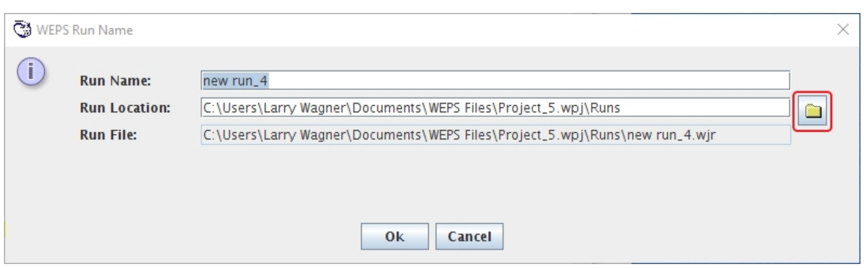



Figure 8.41: Set default WEPS Runs Location FileChooser.

The user can make the change for this WEPS Run instance by clicking on the folder icon or editing the path field directly. Note also that WEPS provides a unique default name for each WEPS Run, which the user can also change.

[10]The **${project.directory}** variable shown in Fig. 8.38 in the **New Prj. Default Runs Location** field, refers to the path represented by the **Default Project** field in Fig. 8.38.

WEPS also provides some additional **Project** menu options that refer to the WEPS Runs as well:

**Set Run Location - Ctrl-U**, as mentioned previously, allows the user to set the default WEPS Run location for the current WEPS Project.

**Export Run...** allows the user to copy and optionally zip the desired WEPS Run to conveniently archive or send copies to other individuals (Fig. 8.42).

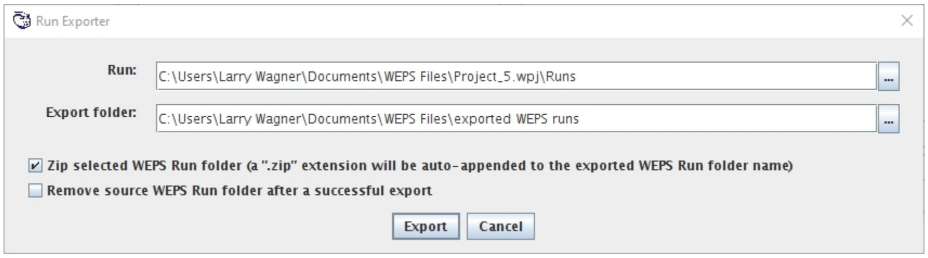



Figure 8.42: WEPS Run Exporter Window.

**Delete Run - Ctrl-D** allows the user to delete the specified WEPS Run.

# 9. Viewing WEPS Output Reports

WEPS provides numerous outputs to aid the user in conservation planning. These outputs are accessed through the **ViewOutput** menu on the main WEPS screen (Fig. 8.1) with some reports also being accessible via the button bar. Clicking on this menu displays two choices, **Most Recent Run** and **Previous Run**. Clicking on **Most Recent Run** displays a list of output options for the most recent (usually last) WEPS Run. The **Previous Run** choice allows the user to view results of previous WEPS Runs. A description of the choices under these two sub-menus are shown in Fig. 9.1.


(a) Most Recent Run Menu Options (b) Previous Run Menu Options

Figure 9.1: Report Menu Options.

For each of those same reports there is a button bar included at the top of the display screen (Fig. 9.2).


Figure 9.2: WEPS Output Reports button bar.

 This button allows the user to print the report.

 This button allows the user to create a file of the report in any of the following formats: a) PDF (Adobe Postscript), b) RTF (Rich Text Format), c) ODT (Open Document Format), d) HTML (Hypertext Markup Language), e) CSV (Comma Separated Values), f) XML (Extensible Markup Language), JasperReports and h) Embedded Images XML.

 This button allows the user to view the report using the operating system's default PDF viewer to display the PDF generated version of the report. If the selected report does not have a PDF version available, a pop-up message will alert the user to that fact. However, the user can use the previous button bar button  to generate the PDF file manually, if desired.

 This button allow the user to jump back to the 1st page of the report.

 This button allows the user to go to the previous page of the report.

This button allows the user to go to the next page of the report.

This button allow the user to go to the last page of the report.

3 This button allows the user to go to the specified page number entered into the field.

This button allows the user to resize the report display page to the default (100%) size.

This button allows the user to resize the report to fit the page vertically in the window.

This button allows the user to resize the report to fit the page horizontally in the window.

This button allows the user to magnify the report display page by 25% increments.

This button allows the user to shrink the report display page by 25% increments.

100% This button displays the current size of the report display page and allows the user to specify the desired size of the report display page or to select a specified size through the drop-down arrow button which provides a choice list menu of pre-selected sizes ranging from 50% to 800%.

The remaining buttons provide quick access to a subset of the WEPS Run reports for the selected WEPS Run:

This button allows the user to access the current WEPS Run Summary Report.

This button allows the user to access the current WEPS Management Rotation Summary Report.

This button allows the user to access the current WEPS Run Crop Summary Report.

This button allows the user to access the current WEPS Run Cover Crop Summary Report.

This button allows the user to access the current WEPS Run Crop Interval Summary Report.

This button allows the user to access the current WEPS Run Soil Report.

This button allows the user to access the current WEPS Run Tabular Detail Report.

This button allows the user to access the current WEPS Run Confidence Interval Report.

This button and dropdown arrow allows the user to access the current set of WEPS Run QuickPlot Reports. Clicking on the the QuickPlot icon displays the **Wind Erosion Soil Loss (Creep+Salt, Susp)** report. The dropdown arrow provides a list of seven QuickPlot reports to choose from. They are titled: **Wind Erosion Soil Loss (Creep+Salt, Susp)**, **Canopy and Residue Cover**, **Precipitation and Irrigation**, **Wind Energy**, **Total Wind Erosion Soil Loss (Gross, Net)**, and **Total Above Ground Crop and Residue Biomass**.

All of the regular WEPS reports (excluding the **Tabular Detail Report**, the **QuickPlot Reports** and the **Science Model Reports**) contain a header that also includes the following elements (Fig. 9.3):

- Name of WEPS Run
- WEPS Run folder location
- Client Name
- Farm No, Tract No and Field No
- WEPS Run Date
- Management scenario file name
- Soil file name

Figure 9.3: List of WEPS Output Reports header elements.

An example of an actual WEPS Report header section is shown in Fig. 9.4.

new integrated_run_7

| | | | | | |
|---|---|---|---|---|---|
| **Run Date:** | Tuesday, June 06, 2023, 09:08 AM | | | | |
| **Client Name:** | --- | | | | |
| **Farm No:** | --- | **Tract No:** | --- | **Field No:** | --- |
| **Run Location:** | C:\Users\Larry Wagner\Documents\WEPS Files\Project_5.wpj\Runs | | | | |
| **Management:** | Wheat, winter; fallow; Conv, CMZ5.man | | | | |
| **Soil:** | Ulysses_KS063_1859_75_SIL.ifc | | | | |

Figure 9.4: WEPS Output Reports header section.

## 9.1 Run Summary Report

The Run Summary report (Fig. 9.5) will automatically display at the conclusion of a WEPS simulation run. If the Run Summary report has been closed, the user can re-display the Run Summary for the most recent WEPS Run by selecting the button on the main WEPS screen button bar or a previous WEPS Run by clicking the “ViewOutput” menu and selecting the “Previous Run” and then the desired “Run” option from the WEPS main screen menu bar.

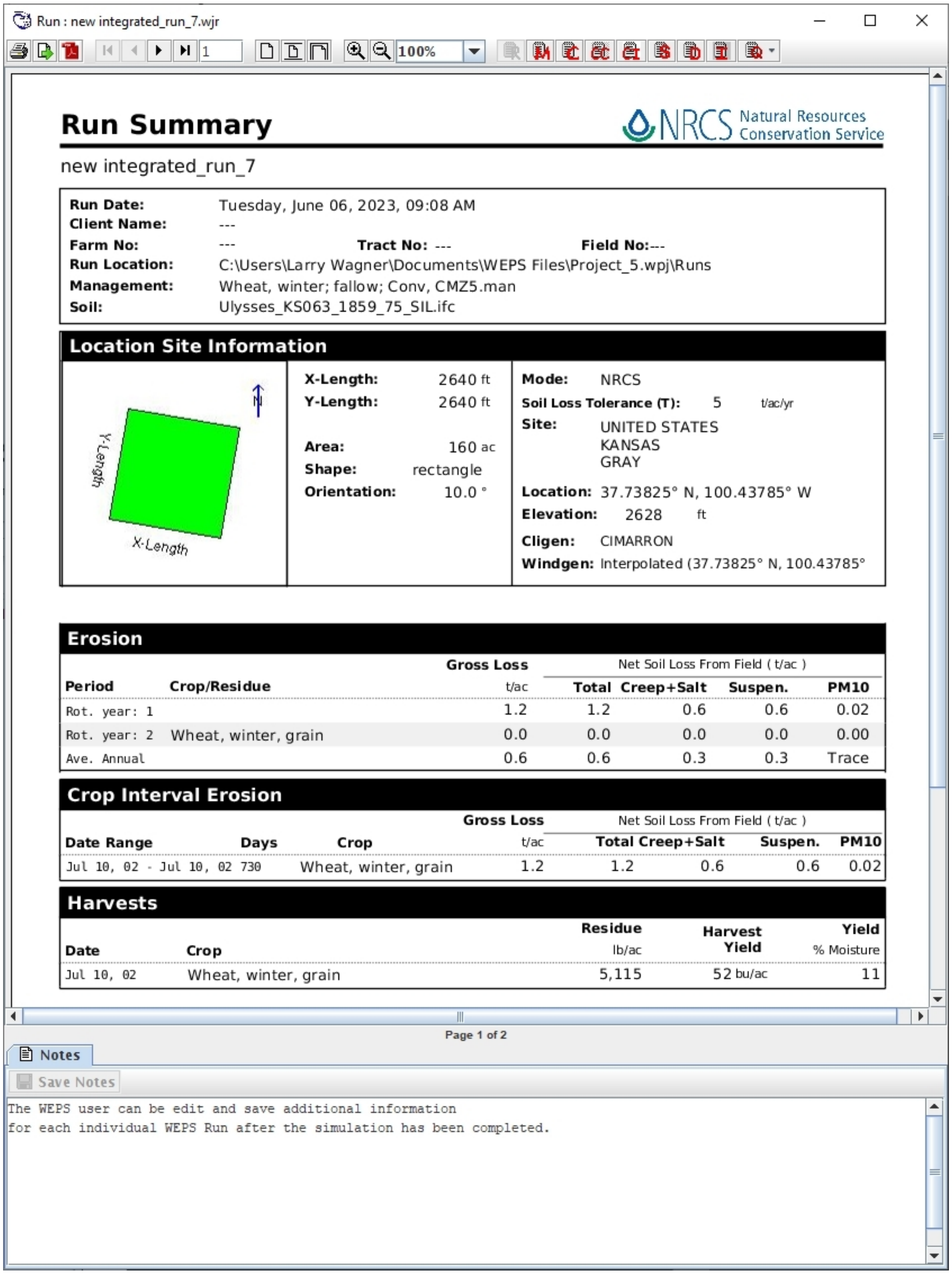



Figure 9.5: First page of WEPS Run Summary Report.

The Run Summary contains the header information, **previously mentioned here**, along with the following additional information:

- Graphical representation of the field site
- Dimensions, orientation, area and elevation of the field site
- What "simulation mode" was used for the WEPS Run

- Soil Loss Tolerance (T) value for the specified soil
- Site location, e.g. country, state and county, latitude and longitude coordinates, etc.
- Name of Cligen station used in WEPS Run
- Name of Windgen station, or if interpolated, the “lat/long” coordinates, used by Windgen

Here is an example of the Run Summary **Location Site Information** section as shown in Fig. 9.6.

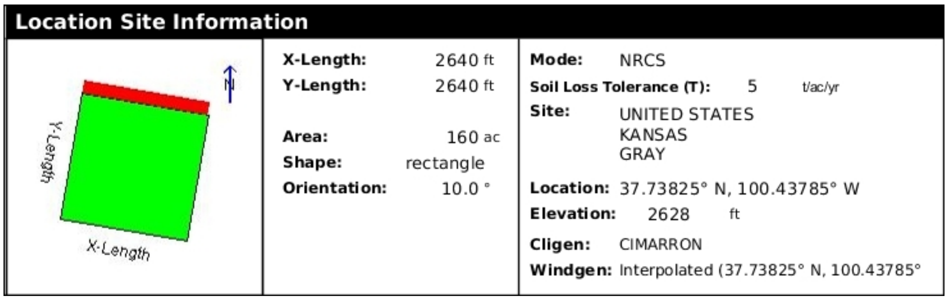



Figure 9.6: WEPS Run Summary Report’s ”Location Site Information” section.

The WEPS Run Summary report consists of the following report sections which provide:

- Wind erosion soil loss by rotation year and annual average
- Average erosion rates by Crop Interval periods
- Barrier type and properties (when present on the field borders)
- Summarized harvested crop information
- SCI (Soil Conditioning Index) summary
- Rotation Cover/Standing Silhouette/STIR summary for the management rotation
- Crop Interval period STIR Energy summary
- WEPS Run user notes
- WEPS Run user notes (editable section)

### 9.1.1 Erosion (Summary Report Section)

This section of the Run Summary reports the wind erosion results from the simulation by specific periods in a tabular section titled **Erosion** (Fig. 9.5 and Fig. 9.7). The values are reported in units of mass per unit area, e.g. for SI (kg/m$^2$) and English (t/ac). The columns of this report section consist of:

Column 1, labeled **Period**. This column consists of the individual rotation years within the management/crop rotation cycle (Rot. Year: #) and the complete management/crop rotation cycle (Ave. Annual).

Column 2, labeled **Crop/Residue**. This column consists of the crops harvested during the specified rotation years.

Column 3, labeled **Gross Loss**. This column contains the average erosion within the field (i.e., removal of soil with no deposition taken into account).

Columns 4-7 labeled **Net Soil Loss From Field**. These columns consists of the average total net soil losses from the field (net losses are gross losses minus deposition within the field). These values are broken down and reported by the size class of the particulates.

Column 4, labeled **Total**. This column contains the total average net soil loss from the field for all size classes.

Column 5, labeled **Creep/Salt.**. This column consists of the average net soil loss from the field for creep and saltation size particles ($\geq$100µ).

Column 6, labeled **Suspen.**. This column contains the average net soil loss from the field for suspension size particles ($<$100µ).

Column 7, labeled **PM10**. this column holds the average net soil loss from the field for the fraction of suspension size particles less than 10µ in size.

**Erosion**

| | | Gross Loss | Net Soil Loss From Field ( t/ac ) | | | |
|---|---|---|---|---|---|---|
| **Period** | **Crop/Residue** | t/ac | **Total** | **Creep+Salt** | **Suspen.** | **PM10** |
| Rot. year: 1 | | 1.2 | 1.2 | 0.6 | 0.6 | 0.02 |
| Rot. year: 2 | Wheat, winter, grain | 0.0 | 0.0 | 0.0 | 0.0 | 0.00 |
| Ave. Annual | | 0.6 | 0.6 | 0.3 | 0.3 | Trace |

Figure 9.7: WEPS Run Summary Erosion report.

Deposition occurs when the wind speed drops as it travels across the field or the surface conditions become less erodible in a downwind part of the field (i.e., transport capacity of the wind exceeds transport capacity for the surface conditions). In WEPS 1.6, deposition only occurs with a drop in wind speed across the field due to a barrier present on the downwind side of the field or surface conditions changing across the field because of the erosion process. Therefore, since WEPS 1.6only simulates an entire field as consisting of a single soil type and only one sequence of management practices applied uniformly to that field, it is not uncommon to have equal gross and net total soil loss when no field barriers are included in the simulation[1].

If an erosion event occurred, but values generated by the model are too small to be displayed on the output table (i.e., $<$0.001 kg/m$^2$ when displaying SI units or $<$0.1 t/ac for saltation/creep and $<$0.01 t/ac for PM10 when displaying English units), then the amount is listed as "trace". If amounts exceed the range of the measured data used for calibrating WEPS, the values are still reported, but are presented with a warning (Fig. 9.8). The values exceeding the specified value (i.e., $>$ 300 kg/m$^2$ or $>$100 t/ac) are noted with a yellow symbol ⚠ adjacent to those values. In these cases, erosion amounts are so large that they are generally unacceptable levels for conservation planning and erosion control purposes.

**Erosion**

| | | Gross Loss | Net Soil Loss From Field ( t/ac ) | | | |
|---|---|---|---|---|---|---|
| **Period** | **Crop/Residue** | t/ac | **Total** | **Creep+Salt** | **Suspen.** | **PM10** |
| Rot. year: 1 | | 181.5⚠ | 171.6⚠ | 61.2 | 110.3⚠ | 2.90 |
| Rot. year: 2 | | 183.0⚠ | 174.0⚠ | 62.0 | 112.0⚠ | 2.94 |
| Ave. Annual | | 182.3⚠ | 172.8⚠ | 61.6 | 111.2⚠ | 2.92 |

⚠ **WARNING: Erosion values exceeded the science model accuracy thresholds.**

Figure 9.8: WEPS Run Summary Erosion report displaying warnings.

### 9.1.2 Crop Interval Erosion (Summary Report Section)

This section of the Run Summary (Fig. 9.9) reports the wind erosion results from the simulation by crop interval, which is defined as the time from the previous crop's termination (final harvest or crop kill process) until the termination of this crop (final harvest or crop kill process). The soil loss values (last 5 columns) are reported exactly as they are for the **Erosion** sub-report previously described. The first three columns consist of:

Column 1, labeled **Date Range**. Column consists of the start and ending dates for each crop interval.

Column 2, labeled **Days**. Column consists of the crop interval period length in days.

Column 3, labeled **Crop**. Column consists of the crops defining each "crop interval".

Columns 4-7, labeled **Net Soil Loss From Field**. These columns consists of the average total net soil losses from the field (net losses are gross losses minus deposition within the field). These values are broken down and reported by the size class of the particulates.

Column 4, labeled **Total**. This column contains the total average net soil loss from the field for all size classes.

Column 5, labeled **Creep/Salt.**. This column consists of the average net soil loss from the field for creep and saltation size particles ($\geq$100µ).

[1]Later releases of WEPS will allow multiple soil types and management sequences to be simulated on a field, so the effects of soil type and management sequence changes across a field can be represented. This will also allow more sophisticated practices such as strip cropping to be properly represented in WEPS.

Column 6, labeled **Suspen.**. This column contains the average net soil loss from the field for suspension size particles (<100µ).

Column 7, labeled **PM10**. This column holds the average net soil loss from the field for the fraction of suspension size particles less than 10µ in size.

**Crop Interval Erosion**

| Date Range | Days | Crop | Gross Loss t/ac | Net Soil Loss From Field ( t/ac ) Total | Creep+Salt | Suspen. | PM10 |
|---|---|---|---|---|---|---|---|
| Jul 10, 02 - Jul 10, 02 | 730 | Wheat, winter, grain | 1.2 | 1.2 | 0.6 | 0.6 | 0.02 |

Figure 9.9: WEPS Run Summary Crop Interval report.

### 9.1.3 Harvests (Summary Report Section)

This section of the Run Summary (Fig. 9.10) provides a summarization of the average yield and after-harvest residue amounts for each harvested crop grown in the management/crop rotation scenario. The information is presented in tabular form where the columns consist of:

Column 1, labeled **Date**. This column consists of the harvest date for the specified crop.

Column 2, labeled **Crop**. This column consists of the crops that are harvested.

Column 3, labeled **Residue**. This column consists of the average after harvest crop residue left on the field and is reported in kg/m$^2$ when SI units are specified and lbs/ac when English units are used.

Column 4, labeled **Harvest Yield**. This column consists of the average yield produced by the crop and is reported in kg/m$^2$ when SI units are specified. When English units are used, the units displayed are obtained from the crop record, e.g. ton/ac, bu/ac, etc.

Column 5, labeled **Yield % Moisture**. This column consists of the percent water content value specified in the crop record and is used for reporting the yield.

**Harvests**

| Date | Crop | Residue lb/ac | Harvest Yield | Yield % Moisture |
|---|---|---|---|---|
| Jul 10, 02 | Wheat, winter, grain | 5,115 | 52 bu/ac | 11 |

Figure 9.10: WEPS Run Summary Harvests report.

### 9.1.4 SCI Summary (Summary Report Section)

This section of the Run Summary (Fig. 9.11) provides a summary of the SCI (Soil Condition Index), Energy Calculator, Average STIR, and other inputs required for computing the SCI, including the SCI subfactors. The SCI is an index developed by NRCS to reflect trends in soil organic matter, which are assumed to be an indicator of soil quality trends. A negative value generally implies that the soil organic matter is decreasing and thus soil quality would be degrading over time. A positive value implies that soil organic matter is increasing and thus soil quality is generally improving over time. A value of zero or near zero implies that soil organic matter is not changing over time and thus the soil quality is sustainable. The values presented in this summary are:

**Soil Condition Index** - Index developed and used by NRCS to reflect the relative quality of a soil due to the management/crop rotation practices being applied.

**Energy Calculator** - Average annual energy per acre expended for operations specified in the management/crop rotation.

**Average Annual STIR** - Computed for the management/crop rotation sequence from the listed operations

**Wind Erosion Soil Loss** - An input required for SCI calculation. Obtained from the WEP simulation run.

**Water Erosion Loss** - An input required for SCI calculation. User is expected to specify the value on the main WEPS screen prior to the WEPS simulation being executed.

**SCI Subfactors** presented in this sub-report are:

**OM** - It is the organic material or biomass subfactor. This component accounts for the effect of biomass returned to the soil, including material from plant or animal sources, and material either imported to the site or grown and retained on the site. It uses the initial soil surface/layer properties as provided at the beginning of a WEPS simulation.

**FO** - It is the field operations subfactor. This component accounts for the effect of field operations that stimulate organic matter breakdown. Tillage, planting, fertilizer application, spraying, harvesting, and other operations crush and shatter plant residues and aerate or compact the soil. These effects increase the rate of residue decomposition and affect the placement of organic material in the soil profile.

**ER** - It is the erosion subfactor. This component accounts for the effect of removal and sorting of surface soil organic matter by sheet, rill, or wind erosion processes as predicted by water and wind erosion models. It does not account for the effects of concentrated flow erosion, such as ephemeral or classic gullies.

**SCI Summary**

| | | | | |
|---|---|---|---|---|
| **Soil Conditioning Index:** | -0.1 | | **SCI Subfactors** | |
| **Energy Calculator:** | 3.4 | gal diesel/ac | **OM:** | -0.52 |
| **Average Annual STIR:** | 101.6 | | **FO:** | -0.01 |
| **Wind Erosion Soil Loss:** | 0.6 | t/ac/yr | **ER:** | 0.77 |
| **Water Erosion Soil** | 0.0 | t/ac/yr | | |

Figure 9.11: WEPS Run Summary SCI report.

### 9.1.5 Rotation Cover/Standing Silhouette/STIR (Summary Report Section)

This section of the Run Summary (Fig. 9.12) provides a summarization of the surface residue cover and effective standing silhouette area following each management operation as well as the STIR (Soil Tillage Intensity Rating) value for the operations listed in the management/crop rotation file. The flat and standing residue information provides the WEPS user with an indication of the amount of wind erosion protection provided by the residue on those dates following the listed operations. The STIR value is an indication of the overall "intensity" of the tillage applied for each specific operation in a given management/crop rotation scenario. The total rotation and average yearly rotation STIR values are also provided.

**Rotation Cover/Standing Silhouette/STIR**

| Date | Operation | Crop (planted) | Surface Cover % | Eff. Standing Silhouette ft²/ft² | STIR |
|---|---|---|---|---|---|
| May 01, 01 | Chisel, sweep shovel | | 38.7 | 0.0 | 45.5 |
| Jun 01, 01 | Chisel, sweep shovel | | 26.7 | 0.0 | 45.5 |
| Jul 01, 01 | Rodweeder | | 22.0 | 0.0 | 17.1 |
| Aug 15, 01 | Rodweeder | | 16.5 | 0.0 | 17.1 |
| Sep 01, 01 | Cultivator, field 6-12 in sweeps | | 12.7 | 0.0 | 26.0 |
| Sep 10, 01 | Drill or air seeder, double disk | Wheat, winter, grain | 11.1 | 0.0 | 6.3 |
| Jul 10, 02 | Harvest, killing crop 50pct standing stubble | | 78.5 | 0.9 | 0.1 |
| Oct 20, 02 | Chisel, sweep shovel | | 48.1 | 0.3 | 45.5 |
| | | **Full 2 yr rotation STIR** | | | 203.1 |
| | | **Avg yearly STIR** | | | 101.6 |

Figure 9.12: WEPS Run Summary Rotation Cover/Standing Silhouette/STIR report.

The Rotation Stir Energy table columns are:

Column 1, labeled **Date**. This column consists of operation date for the specified operation.

Column 2, labeled **Operation**. This column consists of the operation used on the specified date.

Column 3, labeled **Crop (planted)**. This column consists of crop planted by the specified operation.

Column 4, labeled **Surface Cover**. This column consists of the residue surface cover remaining following the specified operation.

Column 5, labeled **Eff. Standing Silhouette**. This column consists of the remaining standing residue, reported as effective standing silhouette area ($ft^2/ft^2$ in English units and $m^2/m^2$ in SI units) following the specified operation.

Column 6, labeled **STIR**. This column consists of the computed STIR value for the specified operation.

The last two rows display the full management rotation cycle's STIR value and the average annual STIR value.

### 9.1.6 Crop Interval Stir Energy (Summary Report Section)

This section of the Run Summary (Fig. 9.12) provides a summarization of the STIR (Soil Tillage Intensity Rating), Energy and Energy Costs associated with each specific crop interval. The STIR value is an indication of the overall "intensity" of the tillage applied during each specific crop interval in a given management/crop rotation scenario.

**Crop Interval STIR Energy**

| Date Range | Days | Crop | STIR | Energy diesel (gal)/ac | Cost USD/ac |
|---|---|---|---|---|---|
| Oct 10, 01 - Oct 10, 01 | 365 | Sorghum, grain | 36.1 | 3.6 | 14.28 |

Figure 9.13: WEPS Run Summary Crop Interval Stir Energy report.

The Crop Interval Stir Energy table columns are:

Column 1, labeled **Date Range**. This column consists of the beginning and ending dates for the specified crop interval.

Column 2, labeled **Days**. This column consists of the number of days for the specified crop interval.

Column 3, labeled **Crop**. This column consists of the crop grown during the specified crop interval.

Column 4, labeled **Stir**. This column consists of the computed Stir value for the specified crop interval.

Column 5, labeled **Energy**. This column consists of the total computed energy consumed per unit area (kJ/ha for SI units and diesel (gal)/ac for English units) for the specified crop interval.

Column 6, labeled **Cost**. This column consists of the total computed cost in dollars per unit area (US dollars/ha for SI units and US dollars/ac for English units) for the specified crop interval.

### 9.1.7 Notes (Summary Report Section)

This **Notes** section of the Run Summary (Fig. 9.14) consists of any text entered prior to the simulation on the main WEPS screen's **Notes** section (Fig. 8.1). Any notes entered on the main WEPS screen for this run are reproduced here.

**Notes**

```
The WEPS user can be edit and save additional information
for each individual WEPS Run after the simulation has been completed.
```

Figure 9.14: WEPS Run Notes listed in Run Summary.

### 9.1.8 Editable Notes (Summary Report Section)

This editable **Notes** section consists of two parts, the "Notes" tab and the "Warnings" tab (Fig. 9.15) They can be edited or added to, if desired, and saved via the appropriate button Save Notes at the top of the Notes form. Any warnings generated during the simulation are listed under the “Warnings” tab.

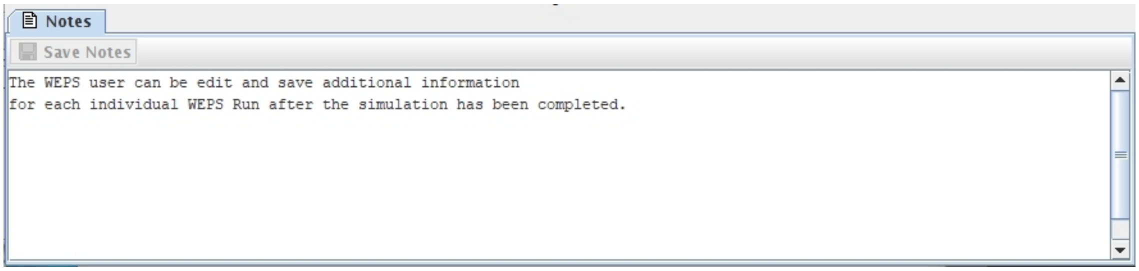
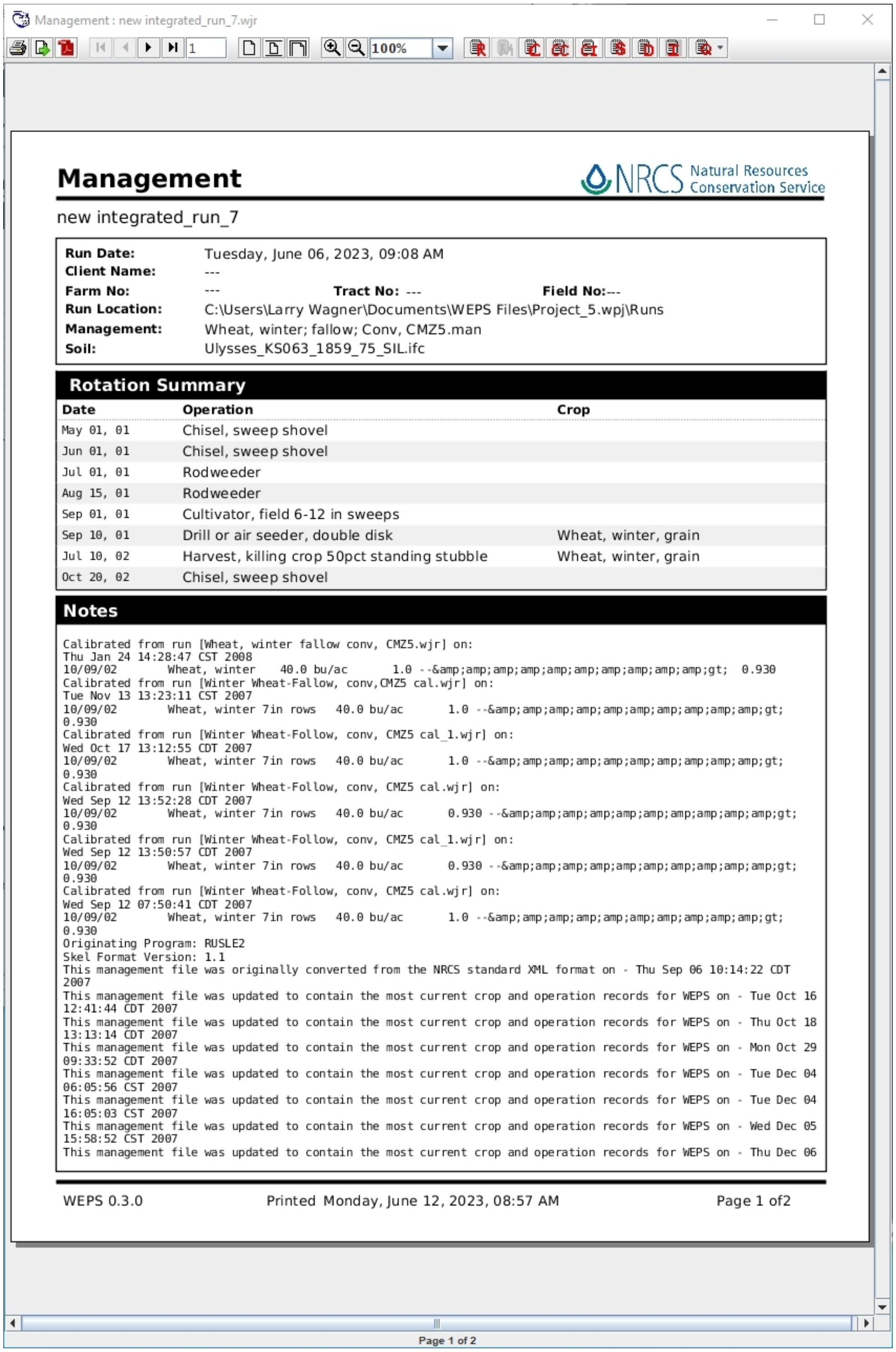



Figure 9.15: WEPS Run Notes listed in Run Summary (editable section).

## 9.2 Management Rotation Summary Report

The Management Summary Report (Fig. 9.16) contains general run information as well as a summary of the management information for the WEPS run. The Management Summary Report displays the management operation date, operation name and crop name for the run with the management notes content listed at the bottom of the screen.





# Management

new integrated_run_7

| | |
|---|---|
| **Run Date:** | Tuesday, June 06, 2023, 09:08 AM |
| **Client Name:** | --- |
| **Farm No:** | --- **Tract No:** --- **Field No:**--- |
| **Run Location:** | C:\Users\Larry Wagner\Documents\WEPS Files\Project_5.wpj\Runs |
| **Management:** | Wheat, winter; fallow; Conv, CMZ5.man |
| **Soil:** | Ulysses_KS063_1859_75_SIL.ifc |

**Rotation Summary**

| Date | Operation | Crop |
|---|---|---|
| May 01, 01 | Chisel, sweep shovel | |
| Jun 01, 01 | Chisel, sweep shovel | |
| Jul 01, 01 | Rodweeder | |
| Aug 15, 01 | Rodweeder | |
| Sep 01, 01 | Cultivator, field 6-12 in sweeps | |
| Sep 10, 01 | Drill or air seeder, double disk | Wheat, winter, grain |
| Jul 10, 02 | Harvest, killing crop 50pct standing stubble | Wheat, winter, grain |
| Oct 20, 02 | Chisel, sweep shovel | |

**Notes**

```
Calibrated from run [Wheat, winter fallow conv, CMZ5.wjr] on:
Thu Jan 24 14:28:47 CST 2008
10/09/02       Wheat, winter    40.0 bu/ac       1.0 --&amp;amp;amp;amp;amp;amp;amp;amp;amp;amp;gt;  0.930
Calibrated from run [Winter Wheat-Fallow, conv,CMZ5 cal.wjr] on:
Tue Nov 13 13:23:11 CST 2007
10/09/02       Wheat, winter 7in rows   40.0 bu/ac       1.0 --&amp;amp;amp;amp;amp;amp;amp;amp;amp;amp;gt;
0.930
Calibrated from run [Winter Wheat-Follow, conv, CMZ5 cal_1.wjr] on:
Wed Oct 17 13:12:55 CDT 2007
10/09/02       Wheat, winter 7in rows   40.0 bu/ac       1.0 --&amp;amp;amp;amp;amp;amp;amp;amp;amp;amp;gt;
0.930
Calibrated from run [Winter Wheat-Follow, conv, CMZ5 cal.wjr] on:
Wed Sep 12 13:52:28 CDT 2007
10/09/02       Wheat, winter 7in rows   40.0 bu/ac       0.930 --&amp;amp;amp;amp;amp;amp;amp;amp;amp;amp;gt;
0.930
Calibrated from run [Winter Wheat-Follow, conv, CMZ5 cal_1.wjr] on:
Wed Sep 12 13:50:57 CDT 2007
10/09/02       Wheat, winter 7in rows   40.0 bu/ac       0.930 --&amp;amp;amp;amp;amp;amp;amp;amp;amp;amp;gt;
0.930
Calibrated from run [Winter Wheat-Follow, conv, CMZ5 cal.wjr] on:
Wed Sep 12 07:50:41 CDT 2007
10/09/02       Wheat, winter 7in rows   40.0 bu/ac       1.0 --&amp;amp;amp;amp;amp;amp;amp;amp;amp;amp;gt;
0.930
Originating Program: RUSLE2
Skel Format Version: 1.1
This management file was originally converted from the NRCS standard XML format on - Thu Sep 06 10:14:22 CDT
2007
This management file was updated to contain the most current crop and operation records for WEPS on - Tue Oct 16
12:41:44 CDT 2007
This management file was updated to contain the most current crop and operation records for WEPS on - Thu Oct 18
13:13:14 CDT 2007
This management file was updated to contain the most current crop and operation records for WEPS on - Mon Oct 29
09:33:52 CDT 2007
This management file was updated to contain the most current crop and operation records for WEPS on - Tue Dec 04
06:05:56 CST 2007
This management file was updated to contain the most current crop and operation records for WEPS on - Tue Dec 04
16:05:03 CST 2007
This management file was updated to contain the most current crop and operation records for WEPS on - Wed Dec 05
15:58:52 CST 2007
This management file was updated to contain the most current crop and operation records for WEPS on - Thu Dec 06
```

WEPS 0.3.0 Printed Monday, June 12, 2023, 08:57 AM Page 1 of2

Figure 9.16: WEPS Management Rotation Summary Report.

### 9.2.1 Rotation Summary (Management Report Section)

This section of the Management reports provides a date ordered listing of the operations and crops grown during the management rotation. They are listed in a tabular section titled **Rotation Summary** (Fig. 9.16). The columns of this report section consist of:

Column 1, labeled **Date**. This column consists of the date (month, day and rotation year) for each operation listed for the management rotation.

Column 2, labeled **Operation**. This column consists of the operations used on the specified dates in the management rotation.

Column 3, labeled **Crop**. This column contains the crops grown on their seeding/planting dates and when they are harvested.

### 9.2.2 Notes (Management Report Section)

This **Notes** section of the Management report (Fig. 9.16) consists of any text entered in MCREW's **Notes** section where the specific details for the rotation can be provided. It is accessible via MCREW's "Notes" button on its toolbar (provide link to the MCREW figure, etc.)

WEPS automatically inserts text into the management rotation's "Notes" section when the rotation is part of a WEPS yield calibration run and when the rotation is updated with the most recent versions of the operation and crop/residue records.

## 9.3 Crop Reports

There are two crop reports, a **Crop Summary Report** (Fig. 9.17), which only contains a statistical summarization of the individual management rotation year crop data consisting of the mean, standard deviation, minimum and maximum values and a **Crop Detail Report** (Fig. 9.18), which also contains the individual management rotation year-by-year crop data results along with the statistical summarization data.

Both reports contain the standard simulation run information in its initial header section Fig. 9.4, including the names of the input files. All crops that are harvested are reported here. This includes any multiply harvested crops like alfalfa, which are reported for each cropping period harvest individually.

The table heading lists the beginning (usually planting date) and the end (harvest date) of the cropping period, the total numbers of days for the period and the name of the crop being harvested. The individual column labels are:

Column 1, labeled **Dry Yield**, consists of the crop yield reported on a dry matter basis in lbs/ac (English units) or kg/m$^2$ (SI units).

Column 2, labeled **Harvest Residue**, consists of the remaining above ground residue reported on a dry matter basis in lbs/ac (English units) or kg/m$^2$ (SI units) after the harvest operation.

Column 3, labeled **Rain**, consists of the total precipitation received in inches (English units) or mm (SI units) during the crop growing period specified.

Column 4, labeled **Irrig**, consists of the total irrigation water applied in inches (English units) or mm (SI units) during the crop growing period specified.

Column 5, labeled **Initial SWC**, consists of the initial soil water content in the soil profile reported in inches (English units) or mm (SI units) of water.

Column 6, labeled **Final SWC**, consists of the final soil water content in the soil profile reported in inches (English units) or mm (SI units) of water.

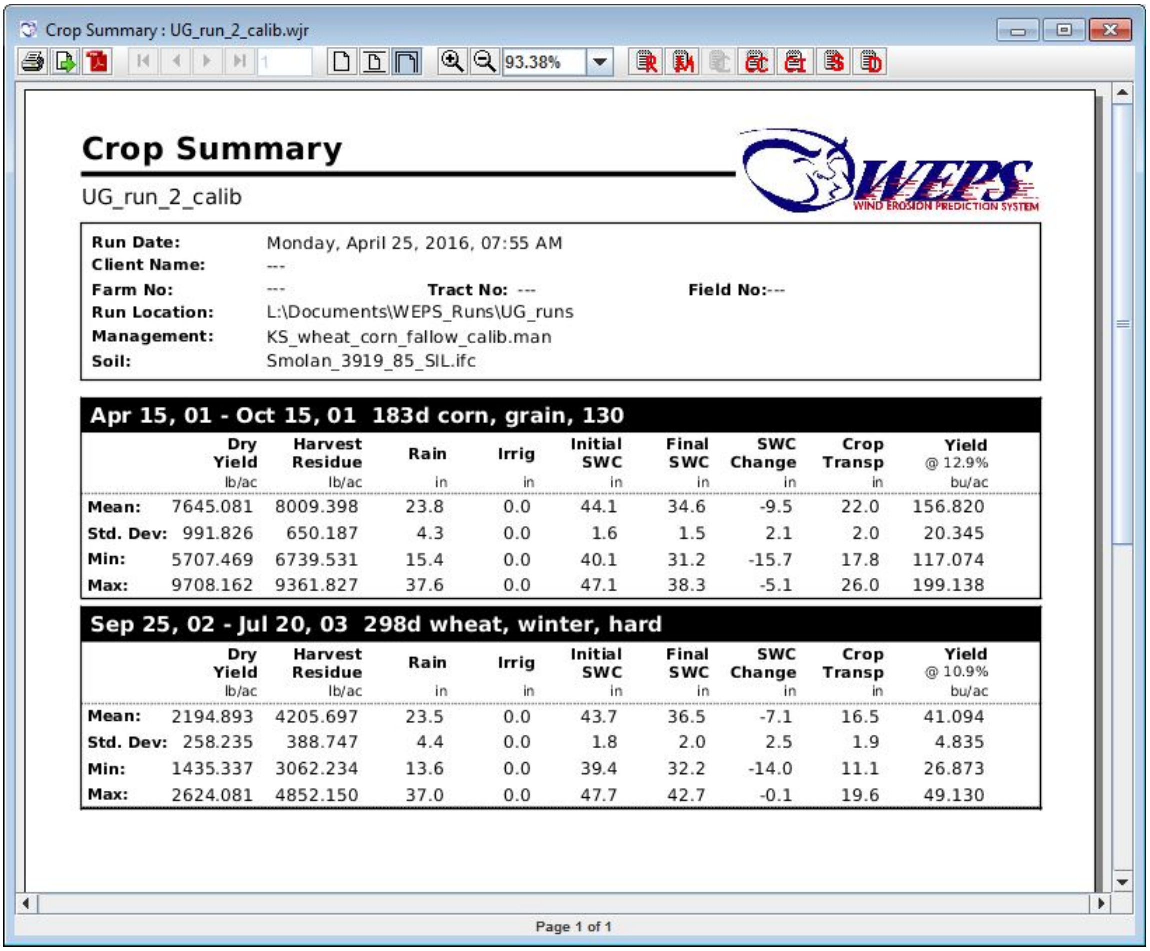
Column 7, labeled **SWC Change**, consists of the change in soil water content in the soil profile reported in inches (English units) or mm (SI units) of water for the crop growing period specified. A negative value means that the stored soil water amount has decreased during the period. A positive value means that the stored water increased during the period.

Column 8, labeled **Crop Transp**, consists of the water transpired through the crop reported in inches (English units) or mm (SI units) of water during the growing period specified.

Column 9, labeled **Yield**, consists of the crop yield reported at the water content specified(obtained from the value provided in the crop record) in the units specified (also obtained from the crop record) when English units are used and kg/m$^2$ for SI units.

### 9.3.1 Crop Summary Report

The Crop Summary Report screen only contains a statistical summarization of the individual management rotation year crop data consisting of the mean, standard deviation, minimum and maximum values for each harvested crop as shown in (Fig. 9.17).



Crop Summary : UG_run_2_calib.wjr

**Crop Summary**

UG_run_2_calib

| | |
|---|---|
| **Run Date:** | Monday, April 25, 2016, 07:55 AM |
| **Client Name:** | --- |
| **Farm No:** | --- **Tract No:** --- **Field No:**--- |
| **Run Location:** | L:\Documents\WEPS_Runs\UG_runs |
| **Management:** | KS_wheat_corn_fallow_calib.man |
| **Soil:** | Smolan_3919_85_SIL.ifc |

**Apr 15, 01 - Oct 15, 01 183d corn, grain, 130**

| | Dry Yield lb/ac | Harvest Residue lb/ac | Rain in | Irrig in | Initial SWC in | Final SWC in | SWC Change in | Crop Transp in | Yield @ 12.9% bu/ac |
|---|---|---|---|---|---|---|---|---|---|
| **Mean:** | 7645.081 | 8009.398 | 23.8 | 0.0 | 44.1 | 34.6 | -9.5 | 22.0 | 156.820 |
| **Std. Dev:** | 991.826 | 650.187 | 4.3 | 0.0 | 1.6 | 1.5 | 2.1 | 2.0 | 20.345 |
| **Min:** | 5707.469 | 6739.531 | 15.4 | 0.0 | 40.1 | 31.2 | -15.7 | 17.8 | 117.074 |
| **Max:** | 9708.162 | 9361.827 | 37.6 | 0.0 | 47.1 | 38.3 | -5.1 | 26.0 | 199.138 |

**Sep 25, 02 - Jul 20, 03 298d wheat, winter, hard**

| | Dry Yield lb/ac | Harvest Residue lb/ac | Rain in | Irrig in | Initial SWC in | Final SWC in | SWC Change in | Crop Transp in | Yield @ 10.9% bu/ac |
|---|---|---|---|---|---|---|---|---|---|
| **Mean:** | 2194.893 | 4205.697 | 23.5 | 0.0 | 43.7 | 36.5 | -7.1 | 16.5 | 41.094 |
| **Std. Dev:** | 258.235 | 388.747 | 4.4 | 0.0 | 1.8 | 2.0 | 2.5 | 1.9 | 4.835 |
| **Min:** | 1435.337 | 3062.234 | 13.6 | 0.0 | 39.4 | 32.2 | -14.0 | 11.1 | 26.873 |
| **Max:** | 2624.081 | 4852.150 | 37.0 | 0.0 | 47.7 | 42.7 | -0.1 | 19.6 | 49.130 |

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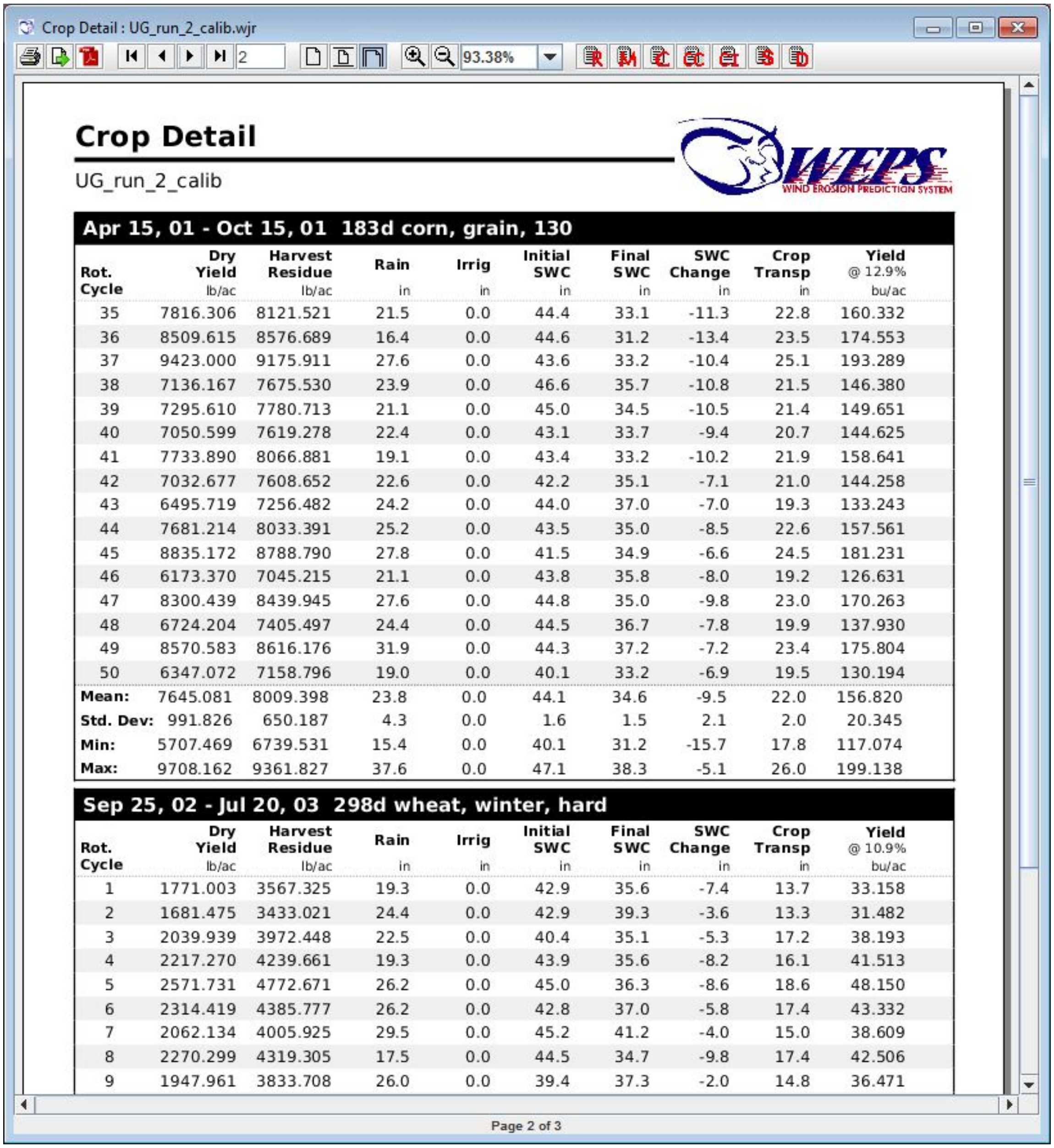
Figure 9.17: WEPS Crop Summary Report.

### 9.3.2 Crop Detail Report

The Crop Detail Report screen (Fig. 9.18), consists of the individual management rotation year-by-year crop data results along with the statistical summarization data provided in the Crop Summary Report. The individual management rotation crop years are listed with a column heading of **Rot. Cycle** to indicate which management rotation cycle is being reported for each row.




# Crop Detail

UG_run_2_calib

**Apr 15, 01 - Oct 15, 01 183d corn, grain, 130**

| Rot. Cycle | Dry Yield lb/ac | Harvest Residue lb/ac | Rain in | Irrig in | Initial SWC in | Final SWC in | SWC Change in | Crop Transp in | Yield @ 12.9% bu/ac |
|---|---|---|---|---|---|---|---|---|---|
| 35 | 7816.306 | 8121.521 | 21.5 | 0.0 | 44.4 | 33.1 | -11.3 | 22.8 | 160.332 |
| 36 | 8509.615 | 8576.689 | 16.4 | 0.0 | 44.6 | 31.2 | -13.4 | 23.5 | 174.553 |
| 37 | 9423.000 | 9175.911 | 27.6 | 0.0 | 43.6 | 33.2 | -10.4 | 25.1 | 193.289 |
| 38 | 7136.167 | 7675.530 | 23.9 | 0.0 | 46.6 | 35.7 | -10.8 | 21.5 | 146.380 |
| 39 | 7295.610 | 7780.713 | 21.1 | 0.0 | 45.0 | 34.5 | -10.5 | 21.4 | 149.651 |
| 40 | 7050.599 | 7619.278 | 22.4 | 0.0 | 43.1 | 33.7 | -9.4 | 20.7 | 144.625 |
| 41 | 7733.890 | 8066.881 | 19.1 | 0.0 | 43.4 | 33.2 | -10.2 | 21.9 | 158.641 |
| 42 | 7032.677 | 7608.652 | 22.6 | 0.0 | 42.2 | 35.1 | -7.1 | 21.0 | 144.258 |
| 43 | 6495.719 | 7256.482 | 24.2 | 0.0 | 44.0 | 37.0 | -7.0 | 19.3 | 133.243 |
| 44 | 7681.214 | 8033.391 | 25.2 | 0.0 | 43.5 | 35.0 | -8.5 | 22.6 | 157.561 |
| 45 | 8835.172 | 8788.790 | 27.8 | 0.0 | 41.5 | 34.9 | -6.6 | 24.5 | 181.231 |
| 46 | 6173.370 | 7045.215 | 21.1 | 0.0 | 43.8 | 35.8 | -8.0 | 19.2 | 126.631 |
| 47 | 8300.439 | 8439.945 | 27.6 | 0.0 | 44.8 | 35.0 | -9.8 | 23.0 | 170.263 |
| 48 | 6724.204 | 7405.497 | 24.4 | 0.0 | 44.5 | 36.7 | -7.8 | 19.9 | 137.930 |
| 49 | 8570.583 | 8616.176 | 31.9 | 0.0 | 44.3 | 37.2 | -7.2 | 23.4 | 175.804 |
| 50 | 6347.072 | 7158.796 | 19.0 | 0.0 | 40.1 | 33.2 | -6.9 | 19.5 | 130.194 |
| **Mean:** | 7645.081 | 8009.398 | 23.8 | 0.0 | 44.1 | 34.6 | -9.5 | 22.0 | 156.820 |
| **Std. Dev:** | 991.826 | 650.187 | 4.3 | 0.0 | 1.6 | 1.5 | 2.1 | 2.0 | 20.345 |
| **Min:** | 5707.469 | 6739.531 | 15.4 | 0.0 | 40.1 | 31.2 | -15.7 | 17.8 | 117.074 |
| **Max:** | 9708.162 | 9361.827 | 37.6 | 0.0 | 47.1 | 38.3 | -5.1 | 26.0 | 199.138 |

**Sep 25, 02 - Jul 20, 03 298d wheat, winter, hard**

| Rot. Cycle | Dry Yield lb/ac | Harvest Residue lb/ac | Rain in | Irrig in | Initial SWC in | Final SWC in | SWC Change in | Crop Transp in | Yield @ 10.9% bu/ac |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 1771.003 | 3567.325 | 19.3 | 0.0 | 42.9 | 35.6 | -7.4 | 13.7 | 33.158 |
| 2 | 1681.475 | 3433.021 | 24.4 | 0.0 | 42.9 | 39.3 | -3.6 | 13.3 | 31.482 |
| 3 | 2039.939 | 3972.448 | 22.5 | 0.0 | 40.4 | 35.1 | -5.3 | 17.2 | 38.193 |
| 4 | 2217.270 | 4239.661 | 19.3 | 0.0 | 43.9 | 35.6 | -8.2 | 16.1 | 41.513 |
| 5 | 2571.731 | 4772.671 | 26.2 | 0.0 | 45.0 | 36.3 | -8.6 | 18.6 | 48.150 |
| 6 | 2314.419 | 4385.777 | 26.2 | 0.0 | 42.8 | 37.0 | -5.8 | 17.4 | 43.332 |
| 7 | 2062.134 | 4005.925 | 29.5 | 0.0 | 45.2 | 41.2 | -4.0 | 15.0 | 38.609 |
| 8 | 2270.299 | 4319.305 | 17.5 | 0.0 | 44.5 | 34.7 | -9.8 | 17.4 | 42.506 |
| 9 | 1947.961 | 3833.708 | 26.0 | 0.0 | 39.4 | 37.3 | -2.0 | 14.8 | 36.471 |

Figure 9.18: WEPS Crop Detail Report.

## 9.4 Cover Crop Reports

There are two cover crop reports, a **Cover Crop Summary Report** (Fig. 9.19), which only contains a statistical summarization of the individual management rotation year cover crop data consisting of the mean, standard deviation, minimum and maximum values and a **Cover Crop Detail Report** (Fig. 9.20), which also contains the individual management rotation year-by-year cover crop data results along with the statistical summarization data.

Both reports contain the standard simulation run information in its initial header section Fig. 9.4, including the names of the input files. Crops that are not being harvested are considered cover crops. In addition, any multiply-harvested crop like alfalfa that is terminated on a later date than the last harvest operation will have that last “crop period” following the last reported harvest as a cover crop.

The table heading lists the beginning (usually planting date) and the end (cover crop termination date) of the cover crop period, the total numbers of days for the period and the name of the cover crop. The individual column labels are:

Column 1, labeled **Standing Stem**, consists of the cover crop standing stem mass reported on a dry matter basis in lbs/ac (English units) or $kg/m^2$ (SI units) on the cover crop termination date.

Column 2, labeled **Standing Leaf**, consists of the cover crop standing leaf mass reported on a dry matter basis in lbs/ac (English units) or $kg/m^2$ (SI units) on the cover crop termination date.

Column 3, labeled **Avg Height**, consists of the average cover crop height reported in inches (English units) or mm (SI units) on the cover crop termination date.

Column 4, labeled **Stem Count**, consists of the number of standing stems reported in number stems per $in^2$ (English units) or number stems per $m^2$ (SI units) on the cover crop termination date.

Column 5, labeled **Rain**, consists of the total precipitation received in inches (English units) or mm (SI units) during the cover crop growing period specified.

Column 6, labeled **Irrig**, consists of the total irrigation water applied in inches (English units) or mm (SI units) during the cover crop growing period specified.

Column 7, labeled **Initial SWC**, consists of the initial soil water content in the soil profile reported in inches (English units) or mm (SI units) of water.

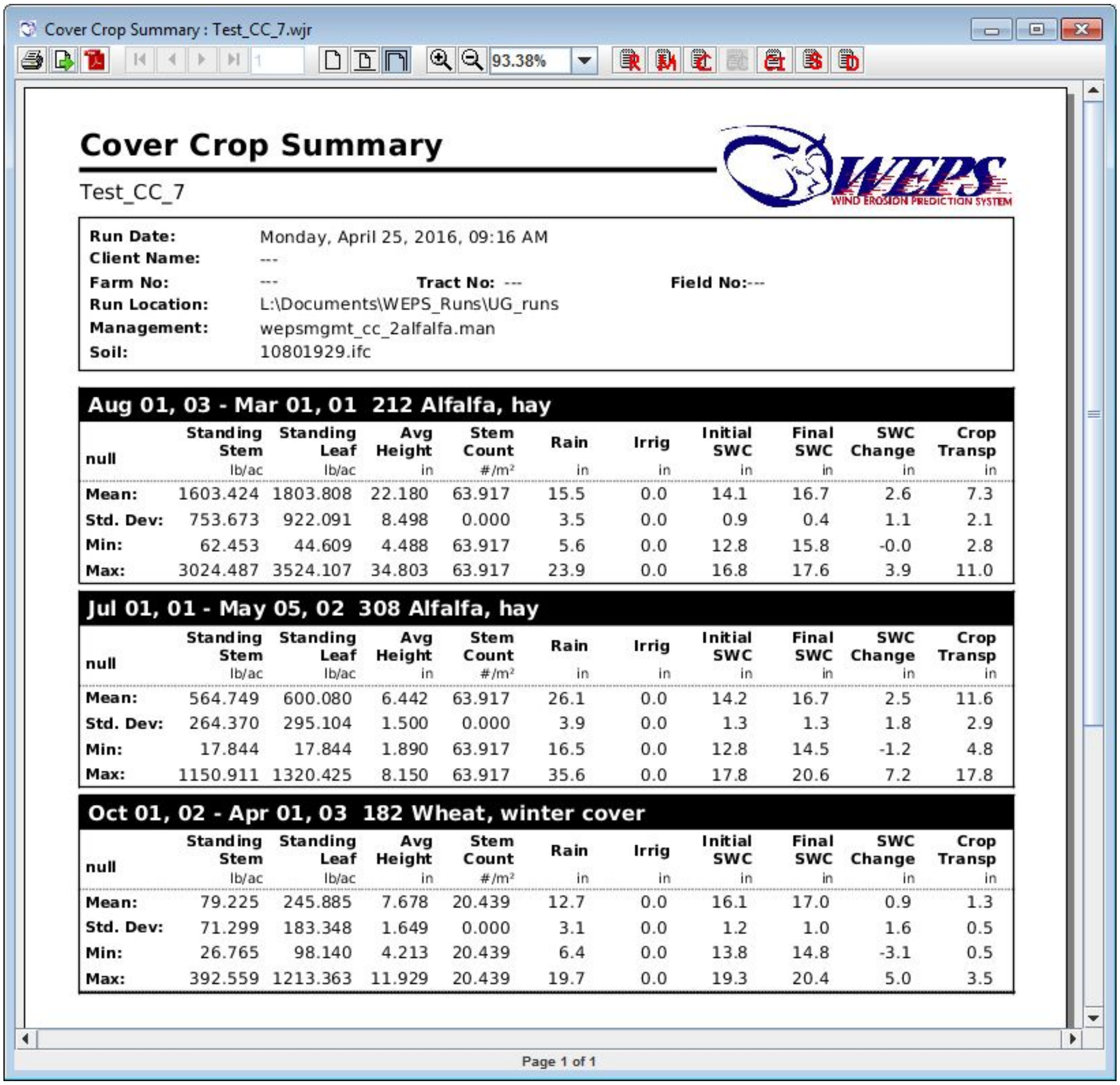
Column 8, labeled **Final SWC**, consists of the final soil water content in the soil profile reported in inches (English units) or mm (SI units) of water.

Column 9, labeled **SWC Change**, consists of the change in soil water content in the soil profile reported in inches (English units) or mm (SI units) of water for the cover crop growing period specified. A negative value means that the stored soil water amount has decreased during the period. A positive value means that the stored water increased during the period.

Column 10, labeled **Crop Transp**, consists of the water transpired through the cover crop reported in inches (English units) or mm (SI units) of water during the growing period specified.

### 9.4.1 Cover Crop Summary

The WEPS Cover Crop Summary Report screen only contains a statistical summarization of the individual management rotation year cover crop data consisting of the mean, standard deviation, minimum and maximum values for each harvested crop as shown in (Fig. 9.19).



Cover Crop Summary : Test_CC_7.wjr

# Cover Crop Summary

Test_CC_7

WEPS WIND EROSION PREDICTION SYSTEM

**Run Date:** Monday, April 25, 2016, 09:16 AM
**Client Name:** ---
**Farm No:** --- **Tract No:** --- **Field No:**---
**Run Location:** L:\Documents\WEPS_Runs\UG_runs
**Management:** wepsmgmt_cc_2alfalfa.man
**Soil:** 10801929.ifc

**Aug 01, 03 - Mar 01, 01 212 Alfalfa, hay**

| null | Standing Stem lb/ac | Standing Leaf lb/ac | Avg Height in | Stem Count #/m² | Rain in | Irrig in | Initial SWC in | Final SWC in | SWC Change in | Crop Transp in |
|---|---|---|---|---|---|---|---|---|---|---|
| Mean: | 1603.424 | 1803.808 | 22.180 | 63.917 | 15.5 | 0.0 | 14.1 | 16.7 | 2.6 | 7.3 |
| Std. Dev: | 753.673 | 922.091 | 8.498 | 0.000 | 3.5 | 0.0 | 0.9 | 0.4 | 1.1 | 2.1 |
| Min: | 62.453 | 44.609 | 4.488 | 63.917 | 5.6 | 0.0 | 12.8 | 15.8 | -0.0 | 2.8 |
| Max: | 3024.487 | 3524.107 | 34.803 | 63.917 | 23.9 | 0.0 | 16.8 | 17.6 | 3.9 | 11.0 |

**Jul 01, 01 - May 05, 02 308 Alfalfa, hay**

| null | Standing Stem lb/ac | Standing Leaf lb/ac | Avg Height in | Stem Count #/m² | Rain in | Irrig in | Initial SWC in | Final SWC in | SWC Change in | Crop Transp in |
|---|---|---|---|---|---|---|---|---|---|---|
| Mean: | 564.749 | 600.080 | 6.442 | 63.917 | 26.1 | 0.0 | 14.2 | 16.7 | 2.5 | 11.6 |
| Std. Dev: | 264.370 | 295.104 | 1.500 | 0.000 | 3.9 | 0.0 | 1.3 | 1.3 | 1.8 | 2.9 |
| Min: | 17.844 | 17.844 | 1.890 | 63.917 | 16.5 | 0.0 | 12.8 | 14.5 | -1.2 | 4.8 |
| Max: | 1150.911 | 1320.425 | 8.150 | 63.917 | 35.6 | 0.0 | 17.8 | 20.6 | 7.2 | 17.8 |

**Oct 01, 02 - Apr 01, 03 182 Wheat, winter cover**

| null | Standing Stem lb/ac | Standing Leaf lb/ac | Avg Height in | Stem Count #/m² | Rain in | Irrig in | Initial SWC in | Final SWC in | SWC Change in | Crop Transp in |
|---|---|---|---|---|---|---|---|---|---|---|
| Mean: | 79.225 | 245.885 | 7.678 | 20.439 | 12.7 | 0.0 | 16.1 | 17.0 | 0.9 | 1.3 |
| Std. Dev: | 71.299 | 183.348 | 1.649 | 0.000 | 3.1 | 0.0 | 1.2 | 1.0 | 1.6 | 0.5 |
| Min: | 26.765 | 98.140 | 4.213 | 20.439 | 6.4 | 0.0 | 13.8 | 14.8 | -3.1 | 0.5 |
| Max: | 392.559 | 1213.363 | 11.929 | 20.439 | 19.7 | 0.0 | 19.3 | 20.4 | 5.0 | 3.5 |

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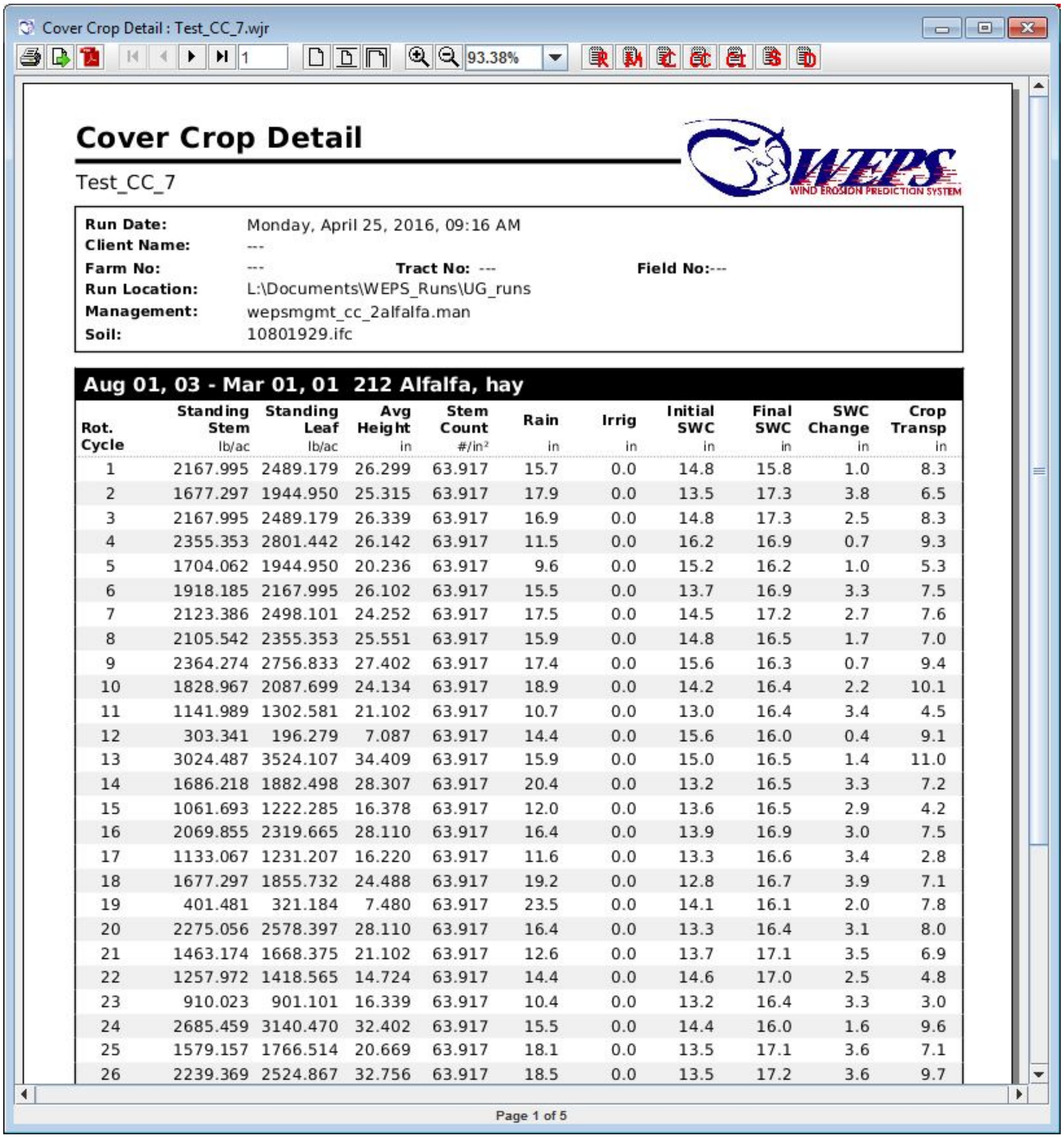
Figure 9.19: WEPS Cover Crop Summary Report.

### 9.4.2 Cover Crop Detail Report

The Cover Crop Detail Report screen (Fig. 9.20), consists of the individual management rotation year-by-year crop data results along with the statistical summarization data provided in the Cover Crop Summary Report. The individual management rotation cover crop years are listed with a column heading of **Rot. Cycle** to indicate which management rotation cycle is being reported for each row.




**Cover Crop Detail**

Test_CC_7

| | |
|---|---|
| **Run Date:** | Monday, April 25, 2016, 09:16 AM |
| **Client Name:** | --- |
| **Farm No:** | --- **Tract No:** --- **Field No:**--- |
| **Run Location:** | L:\Documents\WEPS_Runs\UG_runs |
| **Management:** | wepsmgmt_cc_2alfalfa.man |
| **Soil:** | 10801929.ifc |

**Aug 01, 03 - Mar 01, 01 212 Alfalfa, hay**

| Rot. Cycle | Standing Stem lb/ac | Standing Leaf lb/ac | Avg Height in | Stem Count #/in² | Rain in | Irrig in | Initial SWC in | Final SWC in | SWC Change in | Crop Transp in |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2167.995 | 2489.179 | 26.299 | 63.917 | 15.7 | 0.0 | 14.8 | 15.8 | 1.0 | 8.3 |
| 2 | 1677.297 | 1944.950 | 25.315 | 63.917 | 17.9 | 0.0 | 13.5 | 17.3 | 3.8 | 6.5 |
| 3 | 2167.995 | 2489.179 | 26.339 | 63.917 | 16.9 | 0.0 | 14.8 | 17.3 | 2.5 | 8.3 |
| 4 | 2355.353 | 2801.442 | 26.142 | 63.917 | 11.5 | 0.0 | 16.2 | 16.9 | 0.7 | 9.3 |
| 5 | 1704.062 | 1944.950 | 20.236 | 63.917 | 9.6 | 0.0 | 15.2 | 16.2 | 1.0 | 5.3 |
| 6 | 1918.185 | 2167.995 | 26.102 | 63.917 | 15.5 | 0.0 | 13.7 | 16.9 | 3.3 | 7.5 |
| 7 | 2123.386 | 2498.101 | 24.252 | 63.917 | 17.5 | 0.0 | 14.5 | 17.2 | 2.7 | 7.6 |
| 8 | 2105.542 | 2355.353 | 25.551 | 63.917 | 15.9 | 0.0 | 14.8 | 16.5 | 1.7 | 7.0 |
| 9 | 2364.274 | 2756.833 | 27.402 | 63.917 | 17.4 | 0.0 | 15.6 | 16.3 | 0.7 | 9.4 |
| 10 | 1828.967 | 2087.699 | 24.134 | 63.917 | 18.9 | 0.0 | 14.2 | 16.4 | 2.2 | 10.1 |
| 11 | 1141.989 | 1302.581 | 21.102 | 63.917 | 10.7 | 0.0 | 13.0 | 16.4 | 3.4 | 4.5 |
| 12 | 303.341 | 196.279 | 7.087 | 63.917 | 14.4 | 0.0 | 15.6 | 16.0 | 0.4 | 9.1 |
| 13 | 3024.487 | 3524.107 | 34.409 | 63.917 | 15.9 | 0.0 | 15.0 | 16.5 | 1.4 | 11.0 |
| 14 | 1686.218 | 1882.498 | 28.307 | 63.917 | 20.4 | 0.0 | 13.2 | 16.5 | 3.3 | 7.2 |
| 15 | 1061.693 | 1222.285 | 16.378 | 63.917 | 12.0 | 0.0 | 13.6 | 16.5 | 2.9 | 4.2 |
| 16 | 2069.855 | 2319.665 | 28.110 | 63.917 | 16.4 | 0.0 | 13.9 | 16.9 | 3.0 | 7.5 |
| 17 | 1133.067 | 1231.207 | 16.220 | 63.917 | 11.6 | 0.0 | 13.3 | 16.6 | 3.4 | 2.8 |
| 18 | 1677.297 | 1855.732 | 24.488 | 63.917 | 19.2 | 0.0 | 12.8 | 16.7 | 3.9 | 7.1 |
| 19 | 401.481 | 321.184 | 7.480 | 63.917 | 23.5 | 0.0 | 14.1 | 16.1 | 2.0 | 7.8 |
| 20 | 2275.056 | 2578.397 | 28.110 | 63.917 | 16.4 | 0.0 | 13.3 | 16.4 | 3.1 | 8.0 |
| 21 | 1463.174 | 1668.375 | 21.102 | 63.917 | 12.6 | 0.0 | 13.7 | 17.1 | 3.5 | 6.9 |
| 22 | 1257.972 | 1418.565 | 14.724 | 63.917 | 14.4 | 0.0 | 14.6 | 17.0 | 2.5 | 4.8 |
| 23 | 910.023 | 901.101 | 16.339 | 63.917 | 10.4 | 0.0 | 13.2 | 16.4 | 3.3 | 3.0 |
| 24 | 2685.459 | 3140.470 | 32.402 | 63.917 | 15.5 | 0.0 | 14.4 | 16.0 | 1.6 | 9.6 |
| 25 | 1579.157 | 1766.514 | 20.669 | 63.917 | 18.1 | 0.0 | 13.5 | 17.1 | 3.6 | 7.1 |
| 26 | 2239.369 | 2524.867 | 32.756 | 63.917 | 18.5 | 0.0 | 13.5 | 17.2 | 3.6 | 9.7 |

Figure 9.20: WEPS Cover Crop Detail Report.

## 9.5 Crop Interval Reports

There are three crop interval reports, a **Crop Interval Summary Report**, **Crop Interval Detail Report** and a **Crop Interval Period Detail Report**. The Crop Interval Summary Report (Fig. 9.21) only contains a statistical summarization of the individual management rotation year crop interval data consisting of the mean, standard deviation, minimum and maximum values. The Crop Interval Detail Report (Fig. 9.22) contains the summarized crop period data results along with the statistical summarization data. The Crop Interval Period Detail Report (Fig. 9.23) contains the individual management rotation year-by-year crop period and crop interval data results along with the statistical summarization data for the crop periods and crop intervals. All three reports contain the standard simulation run information in its initial header section Fig. 9.4, including the names of the input files.

Crops intervals consist of the period following the previous crop's termination until the termination of that crop. For typical row crops, these dates usually correspond to the previous crop's harvest date to this crop's harvest date, assuming the harvest dates terminate the crop. Cropping periods are defined as the period between the previous crops' termination and the planting of the current crop, if this period exists, and is identified as **CP_0** in the crop interval reports. The cropping (crop growth) period that refers to crop planting until harvest is identified as **CP_1** in the crop interval reports. For multiply harvested crops, such as alfalfa, the additional crop growth/harvest periods are referred to as **CP_2**, **CP_3**, etc. If a crop can continue to grow (re-grow) after the final harvest and is not explicitly terminated by that harvest operation, a final **cover crop** period (a period where a crop is growing but not harvested) is defined for that time interval.

The table heading lists the beginning and the end dates for the periods indicated, the total numbers of days for the period and the name of the crop (for crop intervals) or the operation that concludes the crop period. The individual column labels are:

Column 1, labeled **Biomass**, consists of the above ground biomass grown during the period indicated and reported on a dry matter basis in lbs/ac (English units) or kg/$m^2$(SI units).

Column 2, labeled **Rain**, consists of the total precipitation received in inches (English units) or mm (SI units) during the period specified.

Column 3, labeled **Irrig**, consists of the total irrigation water applied in inches (English units) or mm (SI units) during the period specified.

Column 4, labeled **Runoff**, consists of the total surface runoff of water in inches (English units) or mm (SI units) during the period specified.

Column 5, labeled **Drainage**, consists of the total drainage of water through the soil profile in inches (English units) or mm (SI units) during the period specified.

Column 6, labeled **Evap**, consists of the total soil surface evaporation of water in inches (English units) or mm (SI units) during the period specified.

Column 7, labeled **Crop Transp**, consists of the total water transpired through the growing crop reported in inches (English units) or mm (SI units) of water during the period specified.

Column 8, labeled Initial **SWC**, consists of the initial soil water content in the soil profile reported in inches (English units) or mm (SI units) of water.

Column 9, labeled **Final SWC**, consists of the final soil water content in the soil profile reported in inches (English units) or mm (SI units) of water.

Column 10, labeled **SWC Change**, consists of the change in soil water content in the soil profile reported in inches (English units) or mm (SI units) of water for the period specified. A negative value means that the stored soil water amount has decreased during the period. A positive value means that the stored water increased during the period.

Column 11, labeled **Runoff Loss**, consists of the percent of surface water runoff lost during the period specified.

Column 12, labeled **Drainage Loss**, consists of the percent of total water lost through the soil during the period specified.

Column 13, labeled **Evap Loss**, consists of the percent of total water lost to surface evaporation during the period specified.

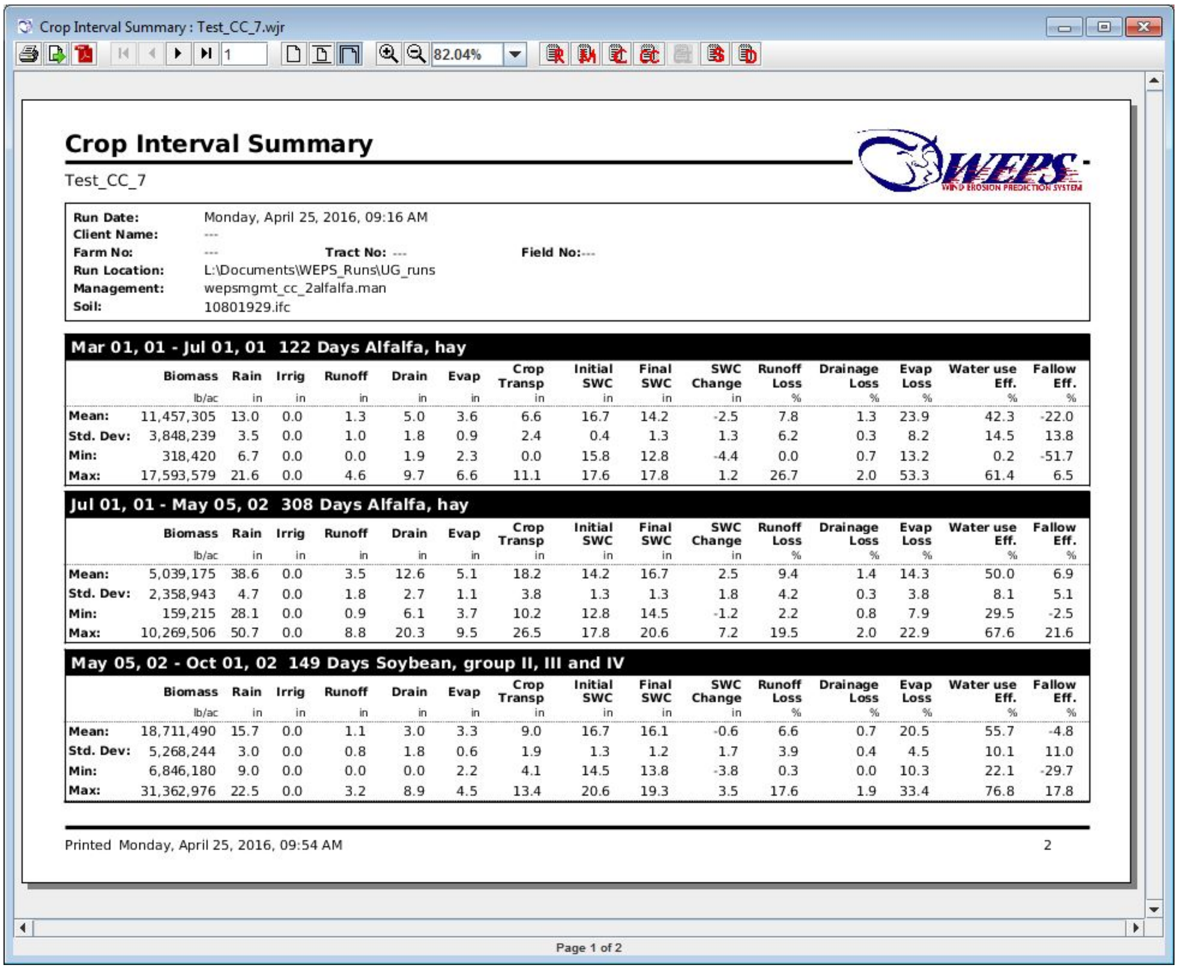
Column 14, labeled **Water use Eff.**, consists of the percent of total water transpired through the growing crop during the period specified. Note that not all periods contain a growing crop **(CP_0)**, thus not all report sections will display this column.

Column, 14, labeled **Water Storage Ratio**, consists of the fraction of water stored during a non-crop period **(CP_0)**. It is not displayed for periods consisting of a growing crop and the **Water use Eff.** value is displayed instead.

Column 15, labeled **Fallow Eff.**, consists of the total water gained or lost during the period specified and is expressed as a fraction. This term is only useful for periods where there is no crop growing, e.g. a "fallow period" or **CP_0** labeled periods in the Crop Interval Detail Report and the Crop Interval Period Detail Report.

### 9.5.1 Crop Interval Summary

The WEPS Crop Interval Summary Report screen only contains a statistical summarization of the individual management rotation year crop interval data consisting of the mean, standard deviation, minimum and maximum values for each crop interval as shown in (Fig. 9.21).


Crop Interval Summary : Test_CC_7.wjr

**Crop Interval Summary**

Test_CC_7

Run Date: Monday, April 25, 2016, 09:16 AM
Client Name: ---
Farm No: --- Tract No: --- Field No: ---
Run Location: L:\Documents\WEPS_Runs\UG_runs
Management: wepsmgmt_cc_2alfalfa.man
Soil: 10801929.ifc

**Mar 01, 01 - Jul 01, 01 122 Days Alfalfa, hay**

| | Biomass lb/ac | Rain in | Irrig in | Runoff in | Drain in | Evap in | Crop Transp in | Initial SWC in | Final SWC in | SWC Change in | Runoff Loss % | Drainage Loss % | Evap Loss % | Water use Eff. % | Fallow Eff. % |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Mean: | 11,457,305 | 13.0 | 0.0 | 1.3 | 5.0 | 3.6 | 6.6 | 16.7 | 14.2 | -2.5 | 7.8 | 1.3 | 23.9 | 42.3 | -22.0 |
| Std. Dev: | 3,848,239 | 3.5 | 0.0 | 1.0 | 1.8 | 0.9 | 2.4 | 0.4 | 1.3 | 1.3 | 6.2 | 0.3 | 8.2 | 14.5 | 13.8 |
| Min: | 318,420 | 6.7 | 0.0 | 0.0 | 1.9 | 2.3 | 0.0 | 15.8 | 12.8 | -4.4 | 0.0 | 0.7 | 13.2 | 0.2 | -51.7 |
| Max: | 17,593,579 | 21.6 | 0.0 | 4.6 | 9.7 | 6.6 | 11.1 | 17.6 | 17.8 | 1.2 | 26.7 | 2.0 | 53.3 | 61.4 | 6.5 |

**Jul 01, 01 - May 05, 02 308 Days Alfalfa, hay**

| | Biomass lb/ac | Rain in | Irrig in | Runoff in | Drain in | Evap in | Crop Transp in | Initial SWC in | Final SWC in | SWC Change in | Runoff Loss % | Drainage Loss % | Evap Loss % | Water use Eff. % | Fallow Eff. % |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Mean: | 5,039,175 | 38.6 | 0.0 | 3.5 | 12.6 | 5.1 | 18.2 | 14.2 | 16.7 | 2.5 | 9.4 | 1.4 | 14.3 | 50.0 | 6.9 |
| Std. Dev: | 2,358,943 | 4.7 | 0.0 | 1.8 | 2.7 | 1.1 | 3.8 | 1.3 | 1.3 | 1.8 | 4.2 | 0.3 | 3.8 | 8.1 | 5.1 |
| Min: | 159,215 | 28.1 | 0.0 | 0.9 | 6.1 | 3.7 | 10.2 | 12.8 | 14.5 | -1.2 | 2.2 | 0.8 | 7.9 | 29.5 | -2.5 |
| Max: | 10,269,506 | 50.7 | 0.0 | 8.8 | 20.3 | 9.5 | 26.5 | 17.8 | 20.6 | 7.2 | 19.5 | 2.0 | 22.9 | 67.6 | 21.6 |

**May 05, 02 - Oct 01, 02 149 Days Soybean, group II, III and IV**

| | Biomass lb/ac | Rain in | Irrig in | Runoff in | Drain in | Evap in | Crop Transp in | Initial SWC in | Final SWC in | SWC Change in | Runoff Loss % | Drainage Loss % | Evap Loss % | Water use Eff. % | Fallow Eff. % |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Mean: | 18,711,490 | 15.7 | 0.0 | 1.1 | 3.0 | 3.3 | 9.0 | 16.7 | 16.1 | -0.6 | 6.6 | 0.7 | 20.5 | 55.7 | -4.8 |
| Std. Dev: | 5,268,244 | 3.0 | 0.0 | 0.8 | 1.8 | 0.6 | 1.9 | 1.3 | 1.2 | 1.7 | 3.9 | 0.4 | 4.5 | 10.1 | 11.0 |
| Min: | 6,846,180 | 9.0 | 0.0 | 0.0 | 0.0 | 2.2 | 4.1 | 14.5 | 13.8 | -3.8 | 0.3 | 0.0 | 10.3 | 22.1 | -29.7 |
| Max: | 31,362,976 | 22.5 | 0.0 | 3.2 | 8.9 | 4.5 | 13.4 | 20.6 | 19.3 | 3.5 | 17.6 | 1.9 | 33.4 | 76.8 | 17.8 |

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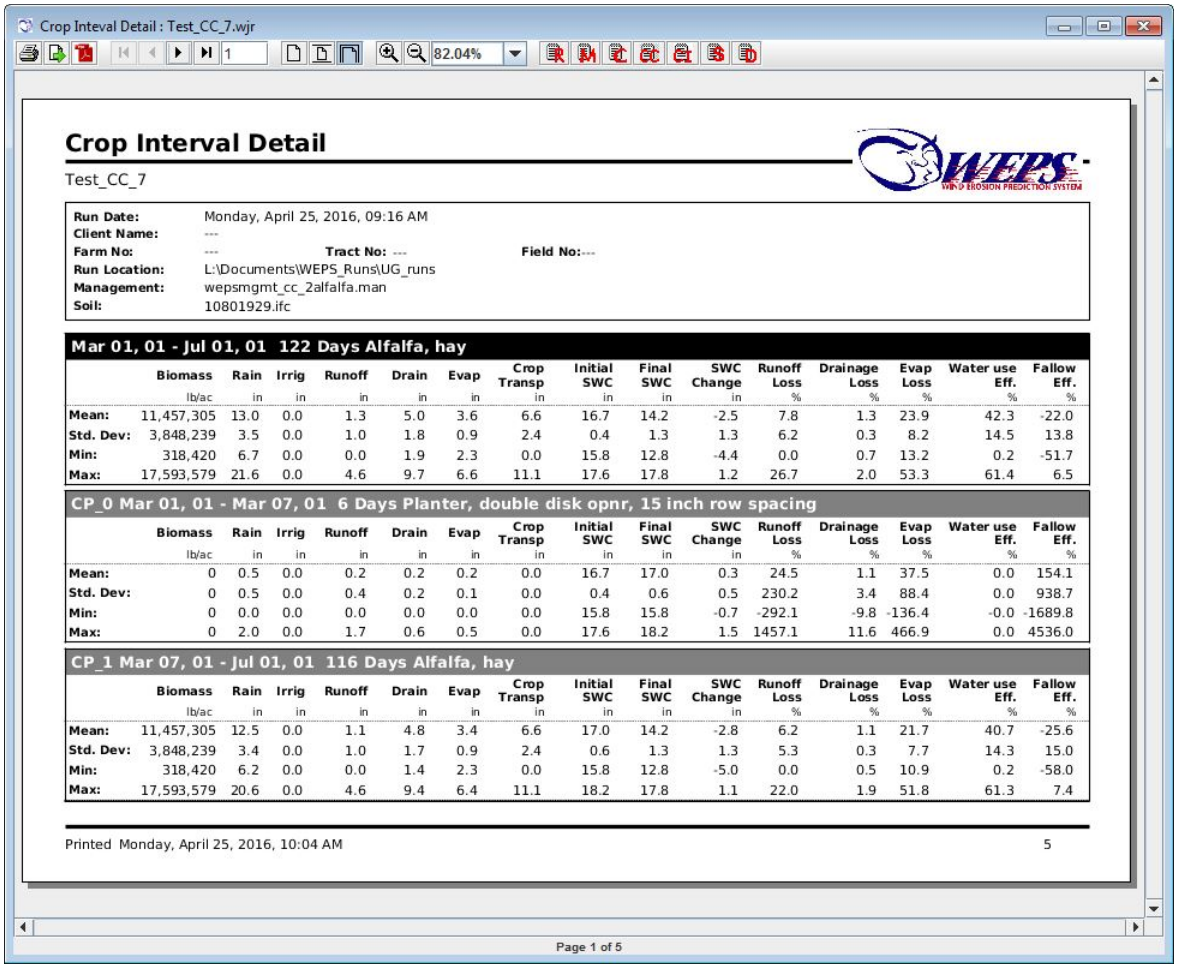
Figure 9.21: WEPS Crop Interval Summary Report.

### 9.5.2 Crop Interval Detail Report

The Crop Interval Detail Report screen (Fig. 9.22) consists of the individual crop periods (**CP_0, CP_1, CP_2,** etc.) results along with the statistical summarization of the crop interval data provided in the Crop Interval Summary Report.



Crop Inteval Detail : Test_CC_7.wjr

## Crop Interval Detail

Test_CC_7



**Run Date:** Monday, April 25, 2016, 09:16 AM
**Client Name:** ---
**Farm No:** --- **Tract No:** --- **Field No:**---
**Run Location:** L:\Documents\WEPS_Runs\UG_runs
**Management:** wepsmgmt_cc_2alfalfa.man
**Soil:** 10801929.ifc

**Mar 01, 01 - Jul 01, 01 122 Days Alfalfa, hay**

| | Biomass lb/ac | Rain in | Irrig in | Runoff in | Drain in | Evap in | Crop Transp in | Initial SWC in | Final SWC in | SWC Change in | Runoff Loss % | Drainage Loss % | Evap Loss % | Water use Eff. % | Fallow Eff. % |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Mean: | 11,457,305 | 13.0 | 0.0 | 1.3 | 5.0 | 3.6 | 6.6 | 16.7 | 14.2 | -2.5 | 7.8 | 1.3 | 23.9 | 42.3 | -22.0 |
| Std. Dev: | 3,848,239 | 3.5 | 0.0 | 1.0 | 1.8 | 0.9 | 2.4 | 0.4 | 1.3 | 1.3 | 6.2 | 0.3 | 8.2 | 14.5 | 13.8 |
| Min: | 318,420 | 6.7 | 0.0 | 0.0 | 1.9 | 2.3 | 0.0 | 15.8 | 12.8 | -4.4 | 0.0 | 0.7 | 13.2 | 0.2 | -51.7 |
| Max: | 17,593,579 | 21.6 | 0.0 | 4.6 | 9.7 | 6.6 | 11.1 | 17.6 | 17.8 | 1.2 | 26.7 | 2.0 | 53.3 | 61.4 | 6.5 |

**CP_0 Mar 01, 01 - Mar 07, 01 6 Days Planter, double disk opnr, 15 inch row spacing**

| | Biomass lb/ac | Rain in | Irrig in | Runoff in | Drain in | Evap in | Crop Transp in | Initial SWC in | Final SWC in | SWC Change in | Runoff Loss % | Drainage Loss % | Evap Loss % | Water use Eff. % | Fallow Eff. % |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Mean: | 0 | 0.5 | 0.0 | 0.2 | 0.2 | 0.2 | 0.0 | 16.7 | 17.0 | 0.3 | 24.5 | 1.1 | 37.5 | 0.0 | 154.1 |
| Std. Dev: | 0 | 0.5 | 0.0 | 0.4 | 0.2 | 0.1 | 0.0 | 0.4 | 0.6 | 0.5 | 230.2 | 3.4 | 88.4 | 0.0 | 938.7 |
| Min: | 0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 15.8 | 15.8 | -0.7 | -292.1 | -9.8 | -136.4 | -0.0 | -1689.8 |
| Max: | 0 | 2.0 | 0.0 | 1.7 | 0.6 | 0.5 | 0.0 | 17.6 | 18.2 | 1.5 | 1457.1 | 11.6 | 466.9 | 0.0 | 4536.0 |

**CP_1 Mar 07, 01 - Jul 01, 01 116 Days Alfalfa, hay**

| | Biomass lb/ac | Rain in | Irrig in | Runoff in | Drain in | Evap in | Crop Transp in | Initial SWC in | Final SWC in | SWC Change in | Runoff Loss % | Drainage Loss % | Evap Loss % | Water use Eff. % | Fallow Eff. % |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Mean: | 11,457,305 | 12.5 | 0.0 | 1.1 | 4.8 | 3.4 | 6.6 | 17.0 | 14.2 | -2.8 | 6.2 | 1.1 | 21.7 | 40.7 | -25.6 |
| Std. Dev: | 3,848,239 | 3.4 | 0.0 | 1.0 | 1.7 | 0.9 | 2.4 | 0.6 | 1.3 | 1.3 | 5.3 | 0.3 | 7.7 | 14.3 | 15.0 |
| Min: | 318,420 | 6.2 | 0.0 | 0.0 | 1.4 | 2.3 | 0.0 | 15.8 | 12.8 | -5.0 | 0.0 | 0.5 | 10.9 | 0.2 | -58.0 |
| Max: | 17,593,579 | 20.6 | 0.0 | 4.6 | 9.4 | 6.4 | 11.1 | 18.2 | 17.8 | 1.1 | 22.0 | 1.9 | 51.8 | 61.3 | 7.4 |

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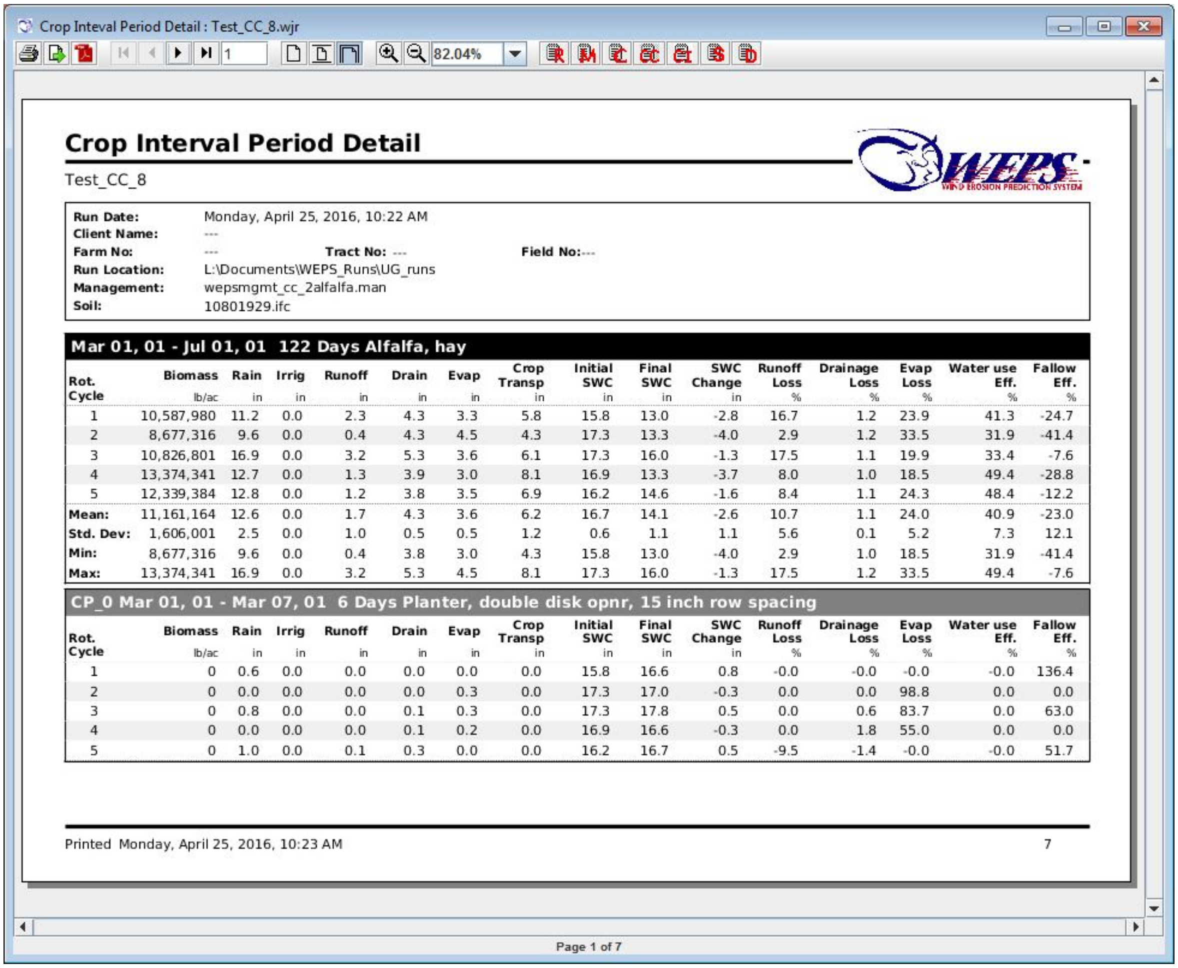
Figure 9.22: WEPS Crop Interval Detail Report.

### 9.5.3 Crop Interval Period Detail Report

The Crop Interval Period Detail Report screen (Fig. 9.23) consists of the individual management rotation year-by-year crop interval and crop period data results along with the statistical summarization of the crop interval and crop period data provided in the Crop Interval Detail Report. The individual management rotation crop period and crop interval years are listed with a column heading of **Rot. Cycle** to indicate which management rotation cycle is being reported for each row.


Crop Inteval Period Detail : Test_CC_8.wjr

## Crop Interval Period Detail

Test_CC_8

**Run Date:** Monday, April 25, 2016, 10:22 AM
**Client Name:** ---
**Farm No:** --- **Tract No:** --- **Field No:**---
**Run Location:** L:\Documents\WEPS_Runs\UG_runs
**Management:** wepsmgmt_cc_2alfalfa.man
**Soil:** 10801929.ifc

**Mar 01, 01 - Jul 01, 01 122 Days Alfalfa, hay**

| Rot. Cycle | Biomass lb/ac | Rain in | Irrig in | Runoff in | Drain in | Evap in | Crop Transp in | Initial SWC in | Final SWC in | SWC Change in | Runoff Loss % | Drainage Loss % | Evap Loss % | Water use Eff. % | Fallow Eff. % |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 10,587,980 | 11.2 | 0.0 | 2.3 | 4.3 | 3.3 | 5.8 | 15.8 | 13.0 | -2.8 | 16.7 | 1.2 | 23.9 | 41.3 | -24.7 |
| 2 | 8,677,316 | 9.6 | 0.0 | 0.4 | 4.3 | 4.5 | 4.3 | 17.3 | 13.3 | -4.0 | 2.9 | 1.2 | 33.5 | 31.9 | -41.4 |
| 3 | 10,826,801 | 16.9 | 0.0 | 3.2 | 5.3 | 3.6 | 6.1 | 17.3 | 16.0 | -1.3 | 17.5 | 1.1 | 19.9 | 33.4 | -7.6 |
| 4 | 13,374,341 | 12.7 | 0.0 | 1.3 | 3.9 | 3.0 | 8.1 | 16.9 | 13.3 | -3.7 | 8.0 | 1.0 | 18.5 | 49.4 | -28.8 |
| 5 | 12,339,384 | 12.8 | 0.0 | 1.2 | 3.8 | 3.5 | 6.9 | 16.2 | 14.6 | -1.6 | 8.4 | 1.1 | 24.3 | 48.4 | -12.2 |
| Mean: | 11,161,164 | 12.6 | 0.0 | 1.7 | 4.3 | 3.6 | 6.2 | 16.7 | 14.1 | -2.6 | 10.7 | 1.1 | 24.0 | 40.9 | -23.0 |
| Std. Dev: | 1,606,001 | 2.5 | 0.0 | 1.0 | 0.5 | 0.5 | 1.2 | 0.6 | 1.1 | 1.1 | 5.6 | 0.1 | 5.2 | 7.3 | 12.1 |
| Min: | 8,677,316 | 9.6 | 0.0 | 0.4 | 3.8 | 3.0 | 4.3 | 15.8 | 13.0 | -4.0 | 2.9 | 1.0 | 18.5 | 31.9 | -41.4 |
| Max: | 13,374,341 | 16.9 | 0.0 | 3.2 | 5.3 | 4.5 | 8.1 | 17.3 | 16.0 | -1.3 | 17.5 | 1.2 | 33.5 | 49.4 | -7.6 |

**CP_0 Mar 01, 01 - Mar 07, 01 6 Days Planter, double disk opnr, 15 inch row spacing**

| Rot. Cycle | Biomass lb/ac | Rain in | Irrig in | Runoff in | Drain in | Evap in | Crop Transp in | Initial SWC in | Final SWC in | SWC Change in | Runoff Loss % | Drainage Loss % | Evap Loss % | Water use Eff. % | Fallow Eff. % |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 0 | 0.6 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 15.8 | 16.6 | 0.8 | -0.0 | -0.0 | -0.0 | -0.0 | 136.4 |
| 2 | 0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.3 | 0.0 | 17.3 | 17.0 | -0.3 | 0.0 | 0.0 | 98.8 | 0.0 | 0.0 |
| 3 | 0 | 0.8 | 0.0 | 0.0 | 0.1 | 0.3 | 0.0 | 17.3 | 17.8 | 0.5 | 0.0 | 0.6 | 83.7 | 0.0 | 63.0 |
| 4 | 0 | 0.0 | 0.0 | 0.0 | 0.1 | 0.2 | 0.0 | 16.9 | 16.6 | -0.3 | 0.0 | 1.8 | 55.0 | 0.0 | 0.0 |
| 5 | 0 | 1.0 | 0.0 | 0.1 | 0.3 | 0.0 | 0.0 | 16.2 | 16.7 | 0.5 | -9.5 | -1.4 | -0.0 | -0.0 | 51.7 |

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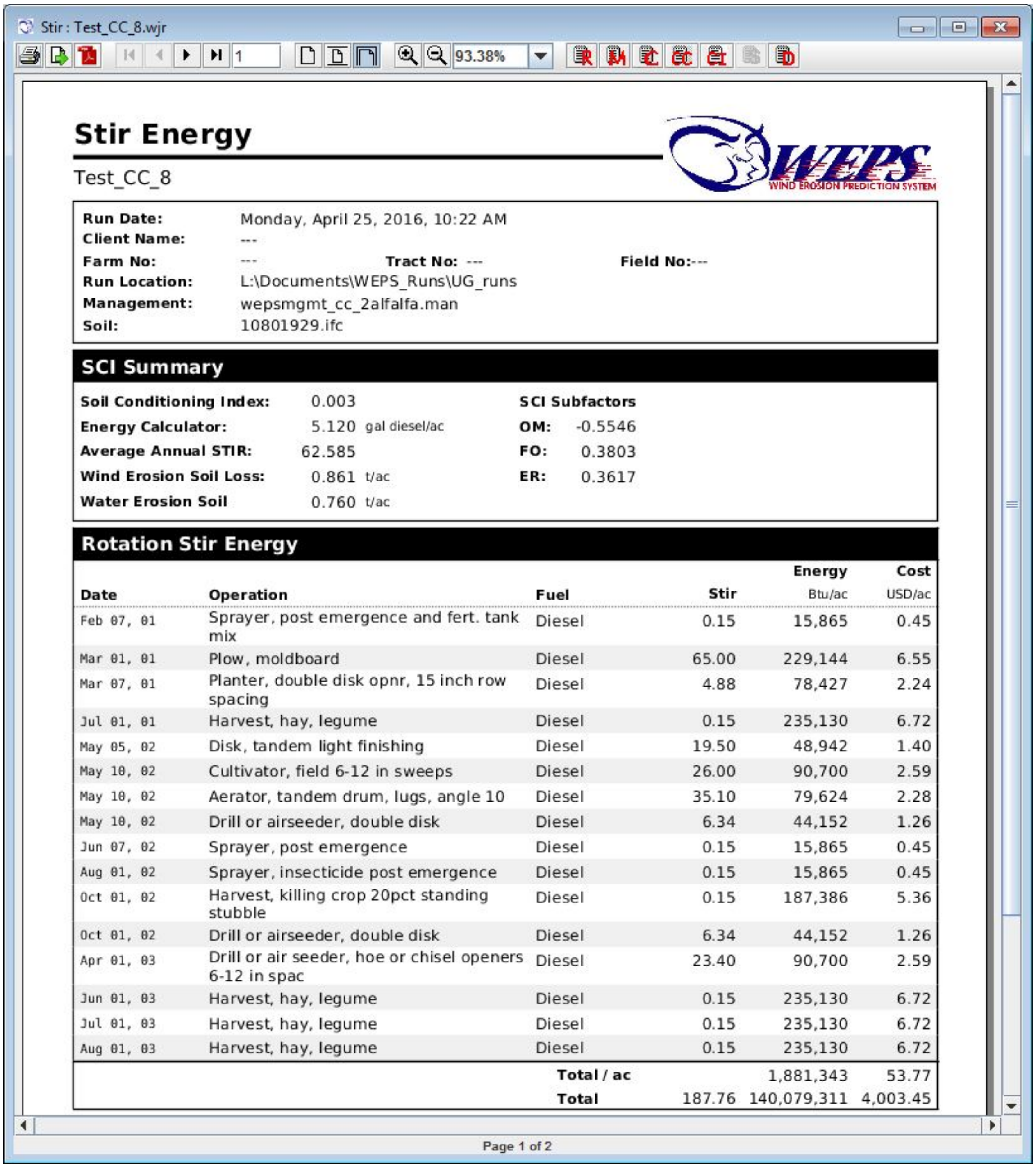
Figure 9.23: WEPS Crop Interval Period Detail Report.

## 9.6 STIR Energy Report

The STIR Energy Report screen (Fig. 9.24) contains general run information as well as a summary of the STIR energy and SCI (Soil Conditioning Index) information for the WEPS run. The STIR Energy Report displays the three sections (SCI Summary, Rotation STIR Energy and Crop Interval STIR Energy).



Stir : Test_CC_8.wjr

# Stir Energy

Test_CC_8

| | | | |
|---|---|---|---|
| **Run Date:** | Monday, April 25, 2016, 10:22 AM | | |
| **Client Name:** | --- | | |
| **Farm No:** | --- | **Tract No:** --- | **Field No:**--- |
| **Run Location:** | L:\Documents\WEPS_Runs\UG_runs | | |
| **Management:** | wepsmgmt_cc_2alfalfa.man | | |
| **Soil:** | 10801929.ifc | | |

## SCI Summary

| | | | |
|---|---|---|---|
| **Soil Conditioning Index:** | 0.003 | **SCI Subfactors** | |
| **Energy Calculator:** | 5.120 gal diesel/ac | **OM:** | -0.5546 |
| **Average Annual STIR:** | 62.585 | **FO:** | 0.3803 |
| **Wind Erosion Soil Loss:** | 0.861 t/ac | **ER:** | 0.3617 |
| **Water Erosion Soil** | 0.760 t/ac | | |

## Rotation Stir Energy

| Date | Operation | Fuel | Stir | Energy Btu/ac | Cost USD/ac |
|---|---|---|---|---|---|
| Feb 07, 01 | Sprayer, post emergence and fert. tank mix | Diesel | 0.15 | 15,865 | 0.45 |
| Mar 01, 01 | Plow, moldboard | Diesel | 65.00 | 229,144 | 6.55 |
| Mar 07, 01 | Planter, double disk opnr, 15 inch row spacing | Diesel | 4.88 | 78,427 | 2.24 |
| Jul 01, 01 | Harvest, hay, legume | Diesel | 0.15 | 235,130 | 6.72 |
| May 05, 02 | Disk, tandem light finishing | Diesel | 19.50 | 48,942 | 1.40 |
| May 10, 02 | Cultivator, field 6-12 in sweeps | Diesel | 26.00 | 90,700 | 2.59 |
| May 10, 02 | Aerator, tandem drum, lugs, angle 10 | Diesel | 35.10 | 79,624 | 2.28 |
| May 10, 02 | Drill or airseeder, double disk | Diesel | 6.34 | 44,152 | 1.26 |
| Jun 07, 02 | Sprayer, post emergence | Diesel | 0.15 | 15,865 | 0.45 |
| Aug 01, 02 | Sprayer, insecticide post emergence | Diesel | 0.15 | 15,865 | 0.45 |
| Oct 01, 02 | Harvest, killing crop 20pct standing stubble | Diesel | 0.15 | 187,386 | 5.36 |
| Oct 01, 02 | Drill or airseeder, double disk | Diesel | 6.34 | 44,152 | 1.26 |
| Apr 01, 03 | Drill or air seeder, hoe or chisel openers 6-12 in spac | Diesel | 23.40 | 90,700 | 2.59 |
| Jun 01, 03 | Harvest, hay, legume | Diesel | 0.15 | 235,130 | 6.72 |
| Jul 01, 03 | Harvest, hay, legume | Diesel | 0.15 | 235,130 | 6.72 |
| Aug 01, 03 | Harvest, hay, legume | Diesel | 0.15 | 235,130 | 6.72 |
| | | **Total / ac** | | 1,881,343 | 53.77 |
| | | **Total** | 187.76 | 140,079,311 | 4,003.45 |

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Figure 9.24: WEPS STIR Energy Report displaying the “SCI Summary” and “Rotation STIR Energy” sections.

This **SCI Summary** section consists of the SCI (Soil Conditioning Index) value, the Energy Calculator (fuel/ac for English units and fuel/ha for SI units), average annual STIR value, wind and water erosion values (t/ac for English units and kg/m$^2$ for SI units) and the SCI subfactors: OM, FO and ER. The SCI is an index developed by NRCS to reflect trends in soil organic matter, which are assumed to be an indicator of soil quality trends. A negative value generally implies that the soil organic matter is decreasing and thus soil quality would be degrading over time. A positive value implies that soil organic matter is increasing and thus soil quality is generally improving over time. A value of zero or near zero implies that soil organic matter is not changing over time and thus the soil quality is sustainable. The values presented in this summary are:

**Soil Condition Index** - Index developed and used by NRCS to reflect the relative quality of a soil due to the management/crop rotation practices being applied.

**Energy Calculator** - Average annual energy per acre expended for operations specified in the management/crop rotation.

**Average Annual STIR** – STIR stands for Soil Tillage Intensity Rating and is computed for the entire management/crop rotation sequence from the listed operations.

**Wind Erosion Soil Loss** - An input required for SCI calculation. Obtained from the WEPS simulation run.

**Water Erosion Loss** - An input required for SCI calculation. User is expected to specify the value on the main WEPS screen prior to the WEPS simulation being executed.

**SCI Subfactors SCI Subfactors** presented in this sub-report are:

**OM** - It is the organic material or biomass subfactor. This component is an indicator of organic matter preservation and accounts for the effect of biomass returned to the soil, including material from plant or animal sources, and material either imported to the site or grown and retained on the site. It uses the initial soil surface/layer prooperties as provided at the beginning of a WEPS simulation.

**FO** - It is the field operations subfactor. This component accounts for the effect of field operations that stimulate organic matter breakdown. Tillage, planting, fertilizer application, spraying, harvesting, and other operations which crush and shatter plant residues and aerate or compact the soil. These effects increase the rate of residue decomposition and affect the placement of organic material in the soil profile.

**ER** - It is the erosion subfactor. This component accounts for the effect of removal and sorting of surface soil organic matter by sheet, rill, or wind erosion processes as predicted by water and wind erosion models. It does not account for the effects of concentrated flow erosion, such as ephemeral or classic gullies.

The Rotation STIR Energy section (Fig. 9.24) summarizes the effect of the management/crop rotation operations on the health of the soil and the energy required to perform them. It consists of the individual operation names, date of use, **STIR** values along with their **Fuel** type, estimated **Energy use** (Btu/ac for English units and kJ/ha for SI units) and **Costs** ($/ac for English units and $/ha for SI units). The total STIR energy value (But/ac if English units are used and kJ/ha if SI units are specified) and Cost ($/ac for English units and $/ha if SI units are specified) are also tallied and reported at the bottom of this section.

The **Crop Interval STIR Energy** section (Fig. 9.25) summarizes the effect of the management/crop rotation operations used over the specified crop interval dates (from termination of the last crop to the harvest or termination of this crop) values for **STIR, Energy** and **Cost** are displayed.

**Crop Interval STIR Energy**

| Date Range | Days | Crop | STIR | Energy<br>diesel (gal)/ac | Cost<br>USD/ac |
|---|---|---|---|---|---|
| Oct 10, 01 - Oct 10, 01 | 365 | Sorghum, grain | 36.1 | 3.6 | 14.28 |

Figure 9.25: WEPS STIR Energy Report (Crop Interval STIR Energy section).

## 9.7 Confidence Interval Report

The WEPS Confidence Interval Report screen (Fig. 9.26) contains a statistical summarization of the estimated erosion loss from the field in terms of a "confidence interval" and reports the non-linearity of the erosion data in terms of quartiles. A **Final Cycle Gross Loss Confidence Interval** box and whisker graph is shown in the first section. In the middle section, a **Cycle Gross Loss Confidence Interval** graph of the gross average soil for each rotation cycle, the gross soil loss upper and lower 90% confidence intervals and the running average soil loss are plotted against the rotation cycles. There is also an **Annual Gross Loss Quartile Distribution** box and whisker graph that plots the "Mean", Median" and "Extreme-Outlier annual soil loss data against erosion loss. In addition, there is a table starting on page 2 displaying the individual rotation cycle values reporting the annual soil loss for the individual cycle, a running average annual soil loss, and the upper and lower confidence 90% interval values through each rotation cycle.

**Final Cycle Gross Loss Confidence Interva**l: A box and whisker graph providing a statistical picture of the final minimum, maximum and median annual erosion values, the annual average (mean) erosion total and 90% confidence interval values are shown. Each data point is the average of the individual year values for each rotation cycle, e.g. a 3-year cycle would be the average of the 3 individual yearly average values. The whiskers show the maximum and minimum values for the cycles. The box ends indicate the upper and lower values of the 90% confidence interval and the box itself representing the confidence interval range. The black dot is placed at the mean value and the black vertical bar at the median value.

**Cycle Gross Loss Confidence Interval Plot**: Each value of the annual erosion total is averaged over each rotation cycle (blue line), and the running average mean (red line) and confidence interval (green line/fill region) values are calculated as each cycle is added. When fewer cycles have been simulated, the mean and confidence interval values can change dramatically when a large cycle erosion value is included in the calculation. As more years are simulated, the mean and confidence interval become more stable, even when large cycle erosion values occur. The final results at the end of the plot are presented more clearly in the previous box and whisker graph. Note that the auto-scaling is based upon the maximum average annual erosion value, so the upper 90% CI values are truncated if they exceed that maximum Y-axis plot limit.

**Annual Gross Loss Quartile Distribution**: A box and whisker graph providing a statistical picture of total erosion for each year, irrespective of the cycles, is shown. The lower quartile is the 25% of values which are below the lower end of the red bar. When at least 25% of the years have no erosion, then the lower end of the red bar would be at zero, signifying a zero erosion amount. The second quartile is the 25% of values which are between the lower end of the red bar and the median (as shown by the black vertical bar). The third quartile are the 25% of values which are between the median and the upper end of the red bar. The fourth quartile is all values above the upper end of the red bar. The inter-quartile range is the distance between the lower and upper ends of the red bar (represented by the red box). The lower and upper "fences" are shown by the lower and upper whiskers, which are the values which are 1.5 times the inter-quartile range below the lower end of the red bar, or 1.5 times the inter-quartile range above the upper end of the red bar. All values below the lower whisker or above the upper whisker are considered to be extreme outliers and are plotted with a blue × symbol. Note that this graph is plotting the individual yearly erosion values and not the individual rotation cycle average values.

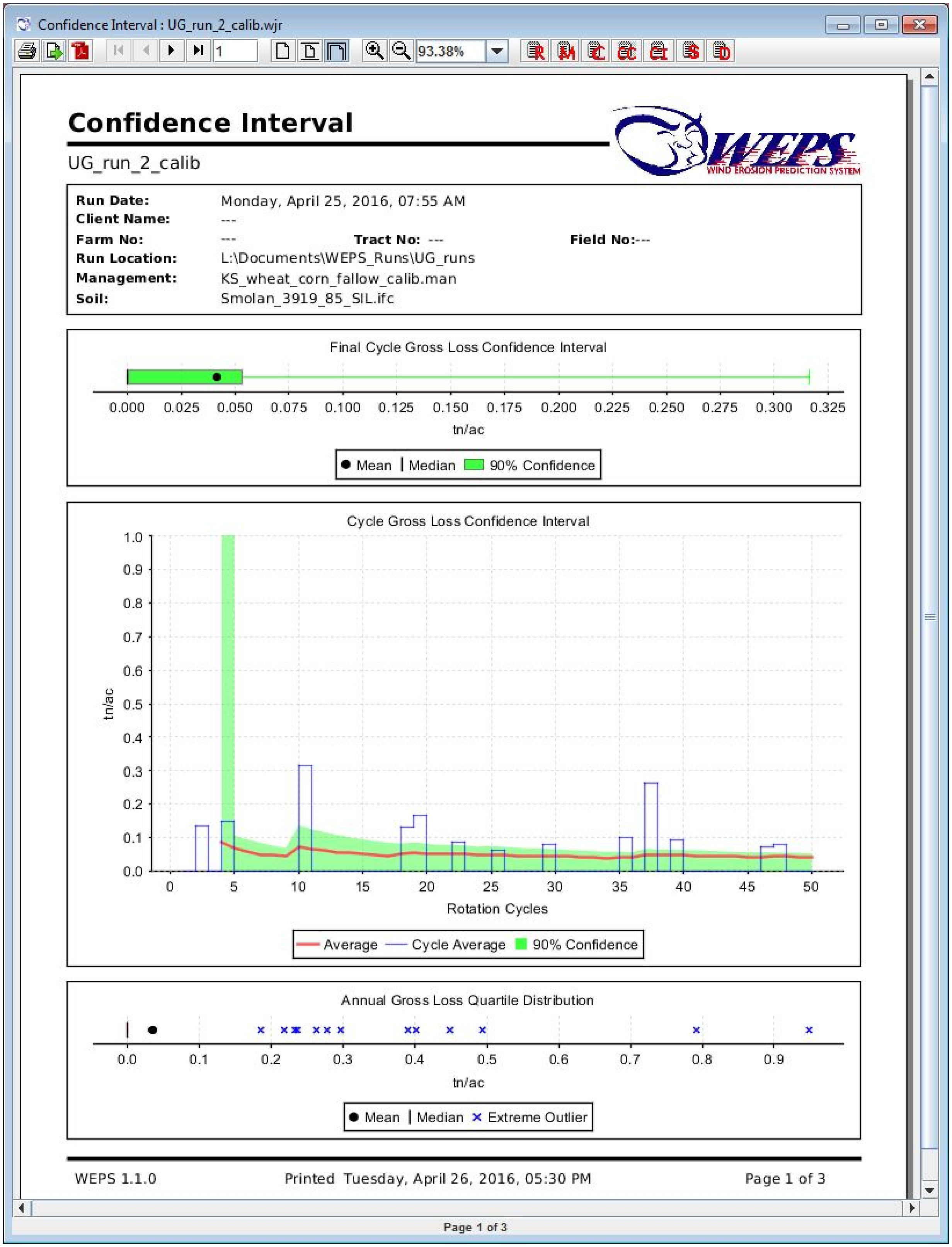



Figure 9.26: WEPS Confidence Interval Report.

## 9.8 Viewing Previous WEPS Output Reports

Output from either the current run or previous runs can be viewed by using the **ViewOutput** menu. This menu allows the user to view output for the most recent (current) or previous runs. Clicking on the **Current Run** menu item displays a list of output reports for the current (last completed WEPS simulation) run. Clicking on the **Previous Run** menu item displays a list of output reports for previous runs. For this menu option, a file chooser opens to allow the user to pick the desired run for which to view the output. The **Multiple Run Manager** also allows the user to open a list of previous WEPS runs. See the section of the WEPS User Manual titled: "Viewing WEPS Output Reports", "Viewing Tabular Detail Reports" and "Viewing Science Model Reports" for a more detailed description of the individual WEPS output reports available

## 9.9 Viewing Science Model Reports

The Science Model Reports screen (Fig. 9.27), accessible from the ViewOutput menu on the WEPS main screen, provides a means of directly accessing all output files generated by the WEPS science model, including those that are used by the WEPS user interface to generate reports.

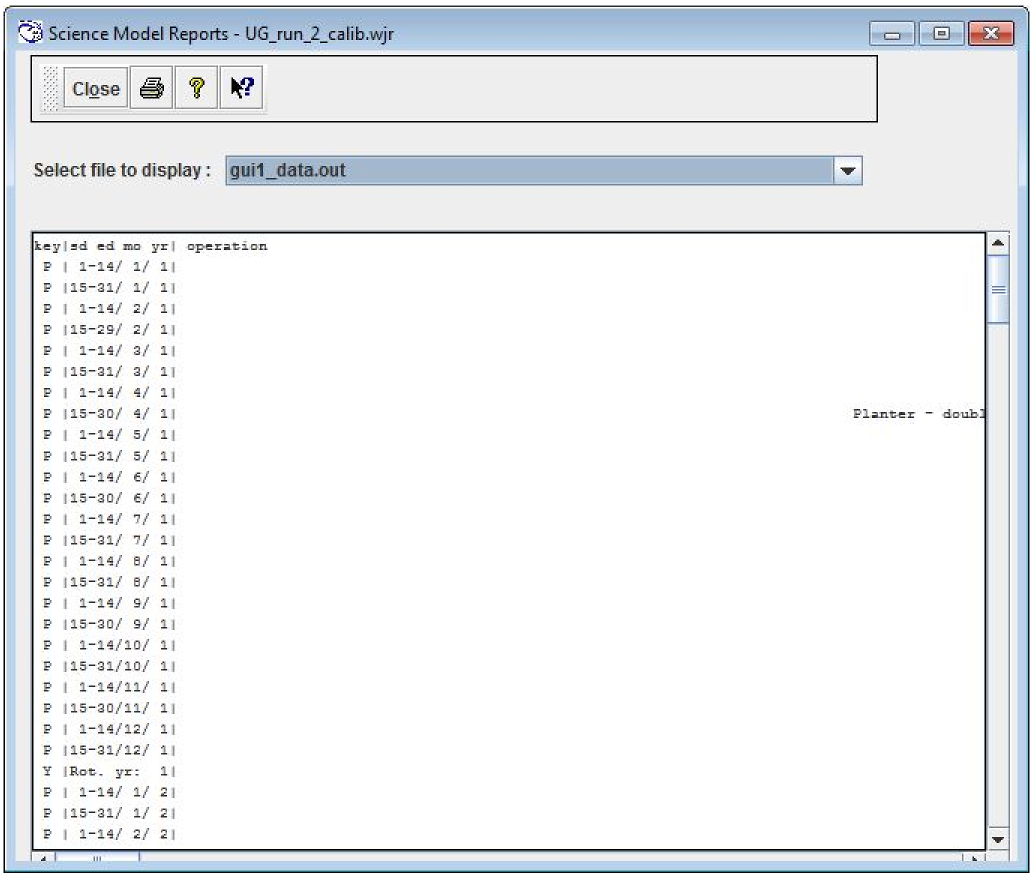



Figure 9.27: WEPS science model report window.

The Science Model Report contains a toolbar which consists of the following functions:

Close This button allows the user to close the Science Model Report window.

This button allows the user to print the Science Model Report.

This button allows the user to bring up the online help for the Science Model Report.

Selecting this button produces a question mark mouse pointer which allows the user to select a specific location on the Science Model Report to obtain specific context sensitive help regarding the selected location on the screen.

A list of selectable output files are available on a drop-down list. Clicking the down arrow to the right of **Select file to display** will show a list of ASCII text output files available for viewing. Click the desired list entry and it will be displayed below in the view area of the window. These files are generally for advanced users and model developers. For more information on accessing and interpreting the WEPS science model output files, contact WEPS support.

# 10. Viewing Tabular Detail Reports

The **Tabular Detail Reports** screen (Fig. 10.1) displays a multitude of data in a table (spreadsheet) format. The data is provided on a *period* basis with the *periods* being roughly biweekly in length (half of month) with these period intervals being spit into smaller sub-periods when an operation event is specified on a date within a *period*. In addition, the rotation year averages are also provided along with the entire rotation averages. Data that is cumulative through a period are reported as the average values for all rotation cycles. Data that has a fixed value for a given date have the *end of period* values reported as the average *end of period* values for all rotation cycles.

The Tabular Detail Report includes some WEPS Run heading information in the upper left corner of the table section consisting of:

- The WEPS Run name.
- The Client name.
- The Farm, Tract and Field numbers.
- The Management scenario file name.
- The Soil file name.

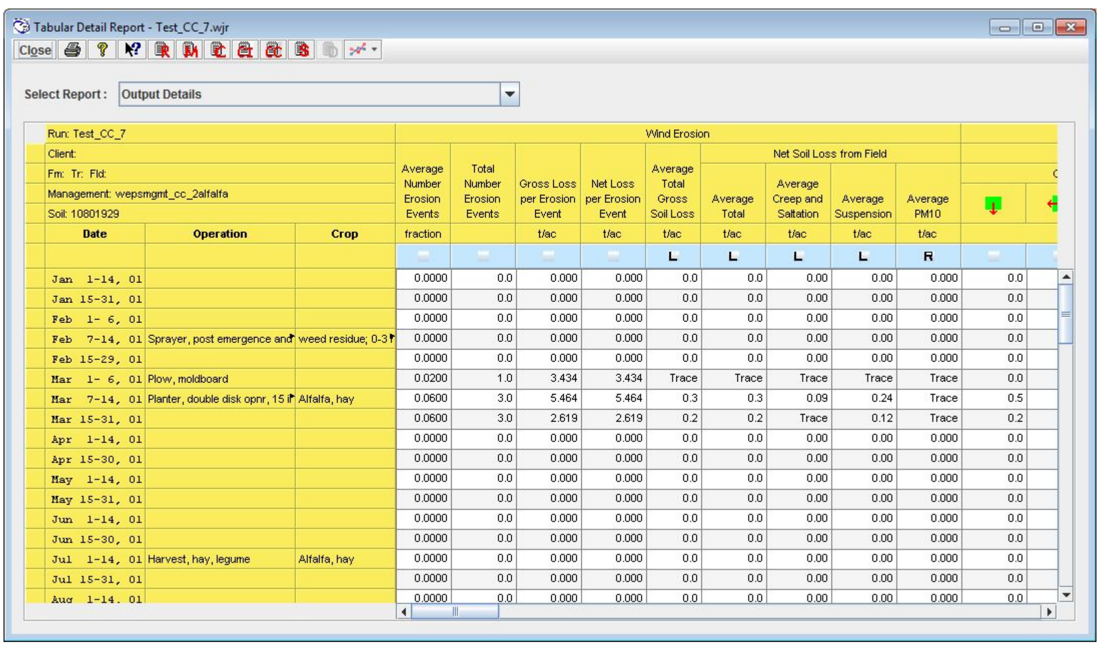



Figure 10.1: Tabular Detail Report.

## 10.1 Tabular Detail Report Toolbar

The Tabular Detail Report contains a toolbar which consists of the following functions:

Close This button allows the user to close the Tabular Detail Report window.

This button allows the user to print the Tabular Detail Report.

This button allows the user to bring up the online help for the Tabular Detail Report.

Selecting this button produces a question mark mouse pointer which allows the user to select a specific location on the Tabular Detail Report to obtain specific context sensitive help regarding the selected location on the screen.

This button allows the user to access the current WEPS Run Summary Report.

This button allows the user to access the current WEPS Run Crop Summary Report.

This button allows the user to access the current WEPS Run Cover Crop Summary Report.

This button allows the user to access the current WEPS Run Crop Interval Summary Report.

This button allows the user to access the current WEPS Run Soil Report.

This button allows the user to graph the selected columns of data in a "Quick Plot". Selecting the "down arrow" component on this button will present the user with a dropdown menu of choices:

- Plot Style (sets the default plot style to be graphed)
  - Line (default plot style)
  - Bar
  - Bar Stacked
  - Area
  - Scatter
- Restore Defaults (resets the selected columns to the defaults)
- Select All (selects all columns to be plotted)
- Clear All (clears all columns from being selected for plotting)

The specifics on how to manually configure QuickPlot graphs are described below.

## 10.2 Tabular Report Column and Row Definitions

The three left side columns include the row date range, the operation(s) on that date (first date of listed range) and the crop seeding (or transplanting) date (also first date of listed range):

**Date** - The start and end dates (day/month/rotation year) of the reporting period.

**Operation** - The management operation that occurred on the specified date.

**Crop** - The crop planted on the specified date.

The columns of the Tabular Detail Report are defined as follows (Note that not all columns listed here are available for NRCS and other specially configured versions of WEPS):

**Wind Erosion**: Field erosion related data are presented here, e.g. the number of erosion event:, gross, net and average value per period specified as well as particulate size classification.

***Average Number Erosion Events*** - This column displays the average number of erosion events per period (fraction).

***Total Number Erosion Events*** - The total number of erosion events during that period for the simulation.

***Gross Loss per Erosion Event*** - The gross erosion within the field for each event, averaged across the field, as well as averaged over the number of simulation years in each rotation year ($kg/m^2$ or tons/acre).

***Net Loss per Erosion Event*** - The net erosion within the field for each event, averaged across the field, as well as averaged over the number of simulation years in each rotation year ($kg/m^2$ or tons/acre). Some deposition within a field can occur, especially when barriers are present downwind. Net soil loss is the amount of gross loss minus deposition.

***Average Total Gross Soil Loss*** - The average erosion (soil loss) within the field, averaged across the field, as well as averaged over the number of simulation years in each rotation year ($kg/m^2$) or tons/acre). This value is the total amount of soil being removed from the surface of the field. It does not take into consideration the amount of that entrained soil that may be re-deposited downwind within the field due to wind barriers, etc. The *gross* soil loss values are most important when evaluating the *onsite* effects of wind erosion.

***Net Soil Loss From Field*** - The *Net Soil Loss from Field* columns display the *actual* soil loss from the field (net losses are gross losses minus deposition within the field). Specific areas within the field may experience: 1) a net soil loss; 2) a net soil gain (deposition); 3) no soil movement; or 4) soil movement, but the soil loss is equal to the deposition within the specified area. Under some scenarios, a portion of soil entrained upwind can get deposited within the field borders, due to a reduction in wind speed (and thus its soil-carrying capacity) caused by downwind barriers, changes in surface roughness across the field, etc. Therefore, the *net* soil loss reported will be less than the *gross* soil loss in these situations. The *net* soil loss values are most important when evaluating *offsite* effects of wind erosion.

*Average Total* - The average total net soil loss from the field (kg/$m^2$ or tons/acre). This value represents the average amount of soil actually leaving the field boundaries. If there are any downwind barriers, this value will be somewhat less than the *Average Total Gross Soil Loss* value due to deposition occurring within the field.

*Average Creep and Saltation* - The quantity of creep plus saltation-size material leaving the field for the period, averaged across the field grid areas, as well as averaged over the number of simulation years in each year of the crop rotation (kg/$m^2$ or tons/acre).

*Average Suspension* - The quantity of suspension-size material leaving the field for the period, averaged across the field grid areas, as well as averaged over the number of simulation years in each rotation year (kg/$m^2$ or tons/acre).

*Average PM10* - The quantity of PM10 (particulate matter less than 10 microns) material leaving the field for the period, averaged across the field grid areas, as well as averaged over the number of simulation years in each rotation year (kg/$m^2$ or tons/acre).

*Average PM2.5* - The quantity of PM2.5 (particulate matter less than 2.5 microns) material leaving the field for the period, averaged across the field grid areas, as well as averaged over the number of simulation years in each rotation year (kg/$m^2$ or tons/acre).

**Mass of Soil Passing Indicated Field Boundary (per Unit Length of Field Border)**: These columns display the average soil loss across the indicated field boundary, per unit length of field border, for the specified size range of eroding material.

***Creep and Saltation*** - Average mass of creep and saltation size material passing each field boundary (kg/m or tons/1000 ft of field border length) in the direction indicated by the graphic symbol.

***Suspension*** - Average mass of suspension-size material passing each field boundary (kg/m or tons/1000 ft of field border length) in the direction indicated by the graphic symbol.

***PM10*** - Average mass of PM10 size material passing each field boundary (kg/m or tons/1000 ft of field border length) in the direction indicated by the graphic symbol.

***PM10*** - Average mass of PM2.5 size material passing each field boundary (kg/m or tons/1000 ft of field border length) in the direction indicated by the graphic symbol.

**Within Field Wind Erosion Activity** - The information in this section is useful in determining how much of the field is actively eroding and how much is not, which may impact what control measures, if any, should be applied and where. This information is also useful in understanding how much of the field is actively eroding, and thus may be causing plant or soil damage, or how much is subject to burial. Finally, this information is useful in understanding how much of the field is contributing to overall (net) field loss.

***Saltating Emission Region***

*Soil Loss* - The amount of soil loss from that area of the field that had significant saltation emission (kg/$m^2$ or tons/acre).

*Field Area* - Both the area (acres or hectares) and fraction of the field area that had saltation emission.

***Deposition Region***

*Soil Deposition* – The amount of soil deposited in that area of the field where deposition is the primary activity (kg/m$^2$ or tons/acre).

*Deposition Field Area* - Both the area (acres or hectares) and fraction of the field area that had deposition.

***High Flux Region***

*High Flux Field Area* - Both the area (acres or hectares) and fraction of the field area that was near transport capacity.

***Sheltered Region***

*Sheltered Field Area* - Both the area (acres or hectares) and fraction of the field area that had no saltation or suspension material being emitted. Sheltered areas are typically those immediately downwind of barriers.

**Weather Information**

***Wind Energy > 8 m/s*** - The average daily wind energy for the period for winds greater than 8 m/s (18 mi/h), averaged over the simulation years in each year of the crop rotation (KJ/m$^2$/day).

***Snow Depth > 20 mm*** - The total average fraction of time that snow cover on the field which is greater than 20 mm (0.787 in) in depth (mm or inches).

***Total Period Precipitation*** - The total precipitation for the period averaged over the simulation years in each year of the crop rotation (mm or inches).

**Crop/Soil Water Information**

***Irrigation*** - The total average irrigation water applied for the period (mm or inches).

***Runoff*** - Quantity of water (precipitation and irrigation) for the period that does not infiltrate into the soil and leaves the field (mm or inches).

***Drainage*** - Quantity of water in the soil that drains out of the bottom of the soil profile for the period (mm or inches).

***Soil Water*** - Quantity of water stored in the soil profile at the end of the period (mm or inches).

***Soil Surface Evaporation*** - Quantity of water lost to surface evaporation for the period (mm or inches).

***Plant Transpiration*** - Quantity of water used by the crop (growing plants) for the period (mm or inches).

**Average Biomass Surface Conditions on Date (at end of period)**

***Crop Vegetation (Live)***

*Canopy Cover* - The fraction of live crop biomass cover (vertical view) at the period end, averaged over the simulation years for the period listed (fraction).

*Surface Cover* - The fraction of live crop biomass surface cover (vertical view), e.g. stem area and vines lying on the surface, etc. at the period end, averaged over the simulation years for the period listed (fraction).

*Effective Standing Silhouette* - The standing silhouette area index of live plants, expressed on a fraction basis. If the plants are planted in the furrow, as opposed to the ridge top, the index is adjusted (down) to have less of an effect on the wind. These are values at the period end, averaged over the simulation years in each rotation year.

*Leaf and Stem Mass* - The total above ground live crop biomass, including only leaves and stems (excluding reproductive material), at the period end, averaged over the simulation years for the period listed (kg/m$^2$ or lbs/acre).

*Total Above Ground Mass* - All total above ground live crop biomass (leaves, stems and reproductive material), at the period end, averaged over the simulation years for the period listed (kg/m$^2$ or lbs/acre).

*Root Mass* - The total live crop biomass, below ground, at the period end, averaged over the simulation years for the period listed (kg/m$^2$ or lbs/acre).

*Crop Height* - The height of the crop above the soil surface (mm or inches).

*Number of Crop Stems* - The number of live crop stems at the end of the period (number per m$^2$ or per acre).

***Crop Residue (Dead)***

*Crop Residue Surface Cover* - The amount of flat residue cover (dead) on the soil surface, expressed as a fraction. These are values at the period end, averaged over the simulation years in each rotation year (fraction).

*Effective Standing Silhouette* - The standing silhouette area index of plant residues, expressed on a fraction basis. These are values at the period end, averaged over the simulation years in each rotation year.

*Flat Mass* - The amount of flat residue mass on the soil surface. These are values at the period end, averaged over the simulation years in each rotation year (kg/m$^2$ or lbs/acre).

*Standing Mass* - The amount of standing residue mass on the soil surface, which includes leaves and stems only (excluding any existing reproductive material). These are values at the period end, averaged over the simulation years in each rotation year (kg/m$^2$ or lbs/acre).

*Total Above Ground Mass* - The amount of all standing residue mass left above the soil surface, which includes leaves, stems and any existing reproductive material. These are values at the period end, averaged over the simulation years in each rotation year (kg/m$^2$ or lbs/acre).

*Buried Mass* - The amount of buried residue mass including roots, below the soil surface. These are values at the period end, averaged over the simulation years in each rotation year (kg/m$^2$ or lbs/acre).

*Buried Root Mass* - The amount of root mass, below the soil surface. These are values at the period end, averaged over the simulation years in each rotation year (kg/m$^2$ or lbs/acre).

*Weighted Residue Height* - The height of residue weighted by residue pool (residue is various stages of decomposition) (mm or inches).

*Number of Residue Stems* - The number of standing residue stems per m$^2$ or per acre.

***Vegetation and Residue Biomass***

*Surface Cover* - The amount of flat surface cover from live vegetation and dead plant residue (flat cover) biomass on the soil surface, expressed on a fraction basis. These are values at the period end, averaged over the simulation years in each rotation year (fraction).

*Effective Standing Silhouette* - The standing silhouette area index of live vegetation plus dead plant residue. If the plants are planted in the furrow, as opposed to the ridge top, the index is adjusted (down) to have less of an effect on the wind. These are values at the period end, averaged over the simulation years in each rotation year (fraction).

*Flat Mass* - The amount of flat live vegetation (air dried) and dead plant residue biomass on the soil surface. These are values at the period end, averaged over the simulation years in each rotation year (kg/m$^2$ or lbs/acre).

*Effective Standing Mass* - The amount of standing live vegetation and plant residue biomass, which includes leaves and stems only (excluding any existing reproductive material). If the plants are planted in the furrow, as opposed to the ridge top, the index is adjusted (down) to have less of an effect on the wind. These are values at the period end, averaged over the simulation years in each rotation year ($kg/m^2$ or lbs/acre).

*Total Above Ground Mass* - The amount of all standing live vegetation and plant residue biomass which includes leaves, stems and any existing reproductive material. If the plants are planted in the furrow, as opposed to the ridge top, the index is adjusted (down) to have less of an effect on the wind. These are values at the period end, averaged over the simulation years in each rotation year ($kg/m^2$ or lbs/acre).

*All Buried Mass* - The amount of vegetative material, both live and dead below the soil surface. These are values at the period end, averaged over the simulation years in each rotation year ($kg/m^2$ or lbs/acre).

**Average Soil Surface Conditions on Date (at end of period)**

***Oriented Roughness***

*Ridge Orientation* - The orientation of soil ridges, with zero degrees (0°) representing north/south ridges.

*Ridge Height* - The height of ridges. This is the value, at the period end, averaged over the simulation years in each rotation year (mm or inches).

*Ridge Spacing* - The spacing between ridges. This is the value at the period end, averaged over the simulation years in each rotation year (mm or inches).

***Random Roughness***

*Standard Deviation* - The standard deviation of the soil surface random roughness. This is the value at the period end, averaged over the simulation years in each rotation year (mm or inches).

***Aggregation***

*Aggregates $<$ 0.03 mm* - The fraction of aggregates less than 0.84 mm (0.033 inches). Aggregates $<$ 0.84 mm are generally considered to be erodible. This is the value at the period end, averaged over the simulation years in each rotation year.

*Dry Aggregate Stability* - The dry aggregate stability is the log of crushing energy of dry soil aggregates (ln(J/kg)), which is related to abrasion resistance. This is the value at the period end, averaged over the simulation years in each rotation year.

*Aggregate Density* - The density of the surface aggregates ($Mg/m^2$ or $lbs/in^2$).

*Aggregate Coefficient of Abrasion* - The wind erosion abrasion coefficient for the surface aggregates ($m^{-1}$ or $ft^{-1}$).

***Crust Properties***

*Crust Cover* - The fraction of the soil surface that is crusted. This is the value at the period end, averaged over the simulation years in each rotation year.

*Crust Stability* - The stability is related to abrasion resistance. This is the value at the period end, averaged over the simulation years in each rotation year.

*Loose Material on Crust* - The quantity of loose material on the crusted surface ($kg/m^2$ or lbs/ac).

*Crust Thickness* - The thickness of the surface crust (mm or inches).

*Crust Density* - The density of the surface crust($Mg/m^3$ or $lbs/ft^3$).

*Crust Loose Fraction* - Fraction of the crusted surface that contains loose, erodible material.

*Crust Coefficient of Abrasion* - The wind erosion abrasion coefficient for the crust ($m^{-1}$ or $ft^{-1}$).

The *rows* in the **Tabular Details Report** table differ, depending on the number of cropping years in the rotation and the number of management operations in each year of the rotation.

Each year of the rotation has output displayed for the two week periods, as well as for each management operation date. This output allows the user to view the erosion and other output for each year of the rotation. At the end of each year in the rotation is a row that contains the average annual value for that rotation year.

The last row in the complete table contains the average annual values for all parameters that can be averaged for the complete crop rotation.

## 10.3 Tabular Detail Report Display Options

A dropdown choice list is available, via the **Select Report:** button, where the user can select various subsets of the tabular output data for display. Note that the default report option and the available reports may be different for various configured versions of WEPS, like the NRCS configured version. The specific view report options are listed here:

**Output Details** - The Output Details report option contains all of the erosion, weather, and surface information available by period, by rotation year, and for the entire simulation run. The remaining menu list items on the Tabular Detail Reports screen are essentially a subset of the Output Details report option.

**Erosion** - The Erosion report displays soil loss parameters for each rotation year and the average annual for all rotation years.

**Field Loss (summary)** - The Field Loss summary report displays average soil loss by rotation year and for the entire simulation run. The values displayed include: Average Total Gross Soil Loss, the average erosion within the field; Net Average Total, the average total net loss from the field; Net Average Creep/Salt, the average creep plus saltation net loss from the field; Net Average Suspension, the average suspension net loss from the field; Net Average PM10, the average PM10 net loss from the field; and Net Average PM2.5, the average PM2.5 net loss from the field.

**Field Loss (details)** - The Field Loss detailed report displays average soil loss by period, by rotation year, and for the entire simulation run. The values displayed include: Average Total Gross Soil Loss, the average erosion within the field; Net Average Total, average total net loss from the field; Net Average Creep/Salt, the average creep plus saltation net loss from the field; Net Average Suspension, the average suspension net loss from the field; Net Average PM10, the average PM10 net loss from the field; and Net Average PM2.5, the average PM2.5 net loss from the field.

**Boundary Loss (summary)** - The Boundary Loss summary report displays the average mass passing each field boundary (kg/m or tons/1000 ft of field border length) in the direction indicated. These parameters are reported for each rotation year and for the simulation run. The columns labeled 'Creep + Saltation' contain the mass per unit boundary length of creep plus saltation-size material that passed the field boundary for each direction. The Suspension columns contain the mass per unit boundary length of suspension-size material that passed the field boundary for each direction. The PM10 columns contain the mass per unit boundary length of PM10-size material that passed the field boundary for each direction. The PM2.5 columns contain the mass per unit boundary length of PM2.5-size material that passed the field boundary for each direction.

**Boundary Loss (details)** - The Boundary Loss detailed report displays the average (by period, rotation year, and simulation run) mass passing each field boundary (kg/m or tons/1000 ft of field border length) in the direction indicated. These parameters are reported by period, for each rotation year, and for the simulation run. The columns labeled 'Creep + Saltation' contain the mass per unit boundary length of creep plus saltation-size material that passed the field boundary for each direction. The Suspension columns contain the mass per unit boundary length of suspension-size material that passed the field boundary for each direction. The PM10 columns contain the mass per unit boundary length of PM10-size material that passed the field boundary for each direction. The PM2.5 columns contain the mass per unit boundary length of PM2.5-size material that passed the field boundary for each direction.

**Within-field Erosion (summary)** - The Within-field Erosion summary report displays information for various types of erosion activity by rotation year and for the simulation run. These activities include amounts, as well as area and fraction of the field that had significant saltation emission and deposition. In addition, high flux and sheltered areas and fraction of the field are given. The high flux region is that area that is near transport capacity. A sheltered area is one that had no saltation or suspension material being emitted. Sheltered areas are typically those immediately downwind of barriers. This information is useful in determining how much of the field is actively eroding and how much is not, which may impact what control measures, if any, should be applied and where. This information is also useful in understanding how much of the field is actively causing plant or soil damage or how much is subject to burial. Finally, this information is useful in understanding how much of the field is contributing to overall (net) field loss.

**Within-Field Erosion (details)** - The Within-Field Erosion detailed report displays information for various types of erosion activity by period, by rotation year, and for the simulation run. These activities include amounts, as well as areas and fraction of the field that had significant saltation emission and deposition. In addition, high flux and sheltered area and fraction of the field are given. The high flux region is that area that is near transport capacity. A sheltered area is one that had no saltation or suspension material being emitted. Sheltered areas are typically those immediately downwind of barriers. This information is useful in determining how much of the field is actively eroding and how much is not, which may impact what control measures, if any, should be applied and where. This information is also useful in understanding how much of the field is actively causing plant or soil damage, or how much is subject to burial. Finally, this information is useful in understanding how much of the field is contributing to overall (net) field loss.

**Erosion (summary)** - The erosion summary report displays all of the information available on erosion contained in the Field Loss (summary), Boundary Loss (summary), and Within-field Loss (summary) reports.

**Erosion (details)** - The erosion detailed report displays all of the information available on erosion contained in the Field Loss (details), Boundary Loss (details), and Within-field Loss (details) reports.

**Erosion (monthly details)** - The erosion monthly detailed report displays all of the information available on erosion contained in the Erosion (summary) report, but includes monthly average values (averaged across rotation years).

**Erosion (yearly details)** - The erosion yearly detailed report displays all of the information available on erosion contained in the Erosion (summary) report, but includes individual simulation-year values.

**Weather (summary)** - The weather summary report displays average total precipitation, the average wind energy for erosive winds greater than 8 m/s (18mph),, and average fraction of time that snow cover on the field is greater than 20 mm (0.75 in). These parameters are reported for each rotation year and for the simulation run.

**Weather (details)** - The weather detailed report displays average total precipitation, the average wind energy for erosive winds greater than 8 m/s (18mph), and average fraction of time that snow cover on the field is greater than 20 mm (0.75 in). These parameters are reported by period, for each rotation year, and for the simulation run.

**Weather (monthly details)** - The weather monthly detailed report displays average total precipitation, the average wind energy for erosive winds greater than 8 m/s (18mph), and average fraction of time that snow cover on the field is greater than 20 mm (0.75 in). These parameters are reported for each rotation year, by month and for the simulation run.

**Weather (yearly details)** - The weather monthly detailed report displays average total precipitation, the average wind energy for erosive winds greater than 8 m/s (18mph), and average fraction of time that snow cover on the field is greater than 20 mm (0.75 in). These parameters are reported for each rotation year, by month and for the simulation run.

**Crop Vegetation (details)** - The crop vegetation detailed report displays average live above-ground biomass conditions that existed on the end date for the period reported. The conditions displayed include canopy cover, effective standing silhouette, leaf and stemp mass only and above ground mass (also includes remaining reproductive material). Canopy cover is the fraction of live crop biomass cover from a vertical view. Effective standing silhouette is the standing silhouette area index of live plants. These values are standing silhouette area per area of soil surface, expressed as a fraction. If the plants are planted in the furrow, as opposed to the ridge top, the index is adjusted (down) to have less of an effect on the wind. Above-ground mass is the total above-ground biomass.

**Crop Residue (details)** - The crop residue detailed report displays average dead above-ground biomass conditions that existed on the end date for the period reported. The conditions displayed include flat cover, effective standing silhouette, flat mass, standing mass (leaf and stem mass only) and total above ground mass (also includes remaining reproductive material). Flat cover is the fraction of dead crop biomass cover from a vertical view. Effective standing silhouette is the standing silhouette area index of dead plants. These values are standing silhouette area per area of soil surface, expressed as a fraction. If the plants are planted in the furrow as opposed to the ridge top, the index is adjusted (down) to have less of an effect on the wind. Flat mass is the above-ground biomass that is lying flat on the soil surface. Standing mass is the above-ground biomass that is in a standing or upright position on the soil surface.

**Crop Biomass (details)** - The crop biomass detailed report displays the average live plus dead above-ground biomass conditions that existed on the end date for the period reported. The conditions displayed include flat cover, effective standing silhouette, flat mass, standing mass (leaf and stem mass only) and total above ground mass (also includes remaining reproductive material). Flat cover is the fraction of live plus dead crop biomass cover from a vertical view. Effective standing silhouette is the standing silhouette area index of live plus dead plants. These values are standing silhouette area per area of soil surface, expressed as a fraction. If the plants are planted in the furrow as opposed to the ridge top, the index is adjusted (down) to have less of an effect on the wind. Flat mass is the above-ground biomass that is lying flat on the soil surface. Standing mass is the above-ground biomass that is in a standing or upright position on the soil surface.

**Crop Veg, Res and Biomass (details)** - The crop vegetation, residue and biomass detailed report displays the all information on vegetative material contained in the Crop reports as described above.

**The remaining items in the list still need to be reviewed for completeness and additional items need to be added to the list yet.**

**Soil Surface (details)** - The soil surface detailed report displays average soil conditions at the surface that existed on the end date for the period reported. The conditions displayed includes ridge orientation, ridge height, ridge spacing, random roughness, aggregates greater than 0.84 mm (0.033 in), aggregate stability, and crust cover. Ridge orientation is the orientation of the ridges, with zero degrees (0°) representing north/south ridges. Random roughness is the standard deviation of the soil surface roughness height. Aggregates greater than 0.84 mm (0.033 in) are expressed as a fraction and are those aggregates generally considered to be non-erodible. Aggregate stability is the log of crushing energy of dry soil aggregates (ln(J/kg)).

**Surface Conditions (details)** - The surface conditions detailed report displays all of the information available on the field surface contained in the Crop, Residue, Biomass, and Soil Surface reports.

**Erosion and Crop (details)** - These reports contain a combination of the erosion and crop reports as described above.

Need to also document the specific QuickPlots functionality, etc. here.

# 11. Editing with the Management/Crop Rotation Editor for WEPS (MCREW)

To open the Management/Crop Rotation Editor for WEPS (MCREW), double click on the *Man* button Man on the left side of the management box as shown in Fig. 8.1. This will open the MCREW window (Fig. 11.1), which allows the user to view, edit, and save management rotation information.

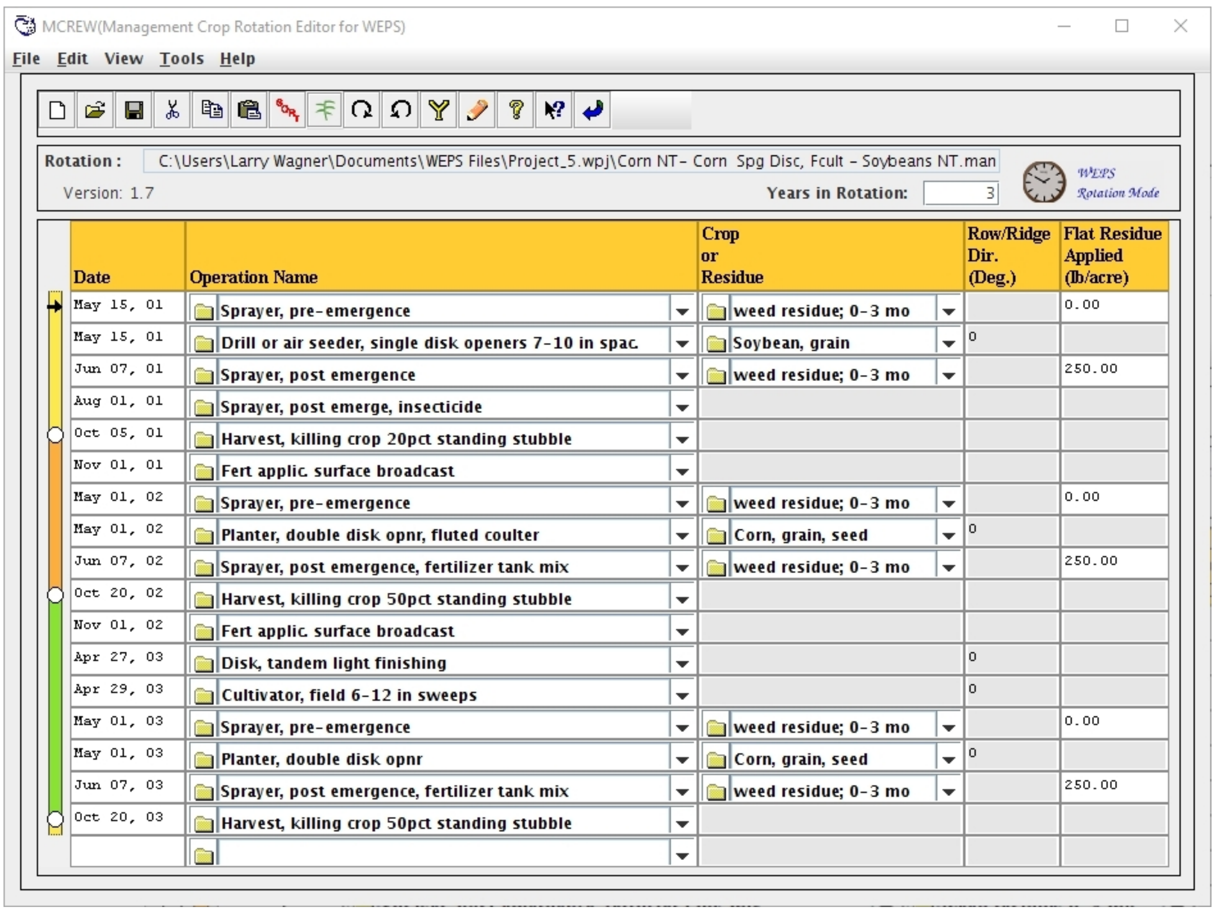



Figure 11.1: Management/Crop Rotation Editor for WEPS (MCREW) window.

MCREW's principle purpose is to create/modify/construct management rotation files required for making WEPS simulation runs. Although it is an integral component of the WEPS 1.6interface, it can be used as a stand-alone program to edit management rotation files independent of the WEPS interface and was designed to be configurable for uses outside of WEPS. Much of MCREW's functionality, behavior, and visual appearance is controlled via ASCII XML-based configuration files. Changing the appropriate configuration files allows one to specify the structure and definition of the management/crop rotation file format and control the user's ability to view and edit specific operation, and/or crop properties, etc.

MCREW is fundamentally a calendar date-ordered list of management operations labeled *WEPS Rotation Mode*[1]. MCREW provides the user with a tabular, row-oriented view of the operations and their associated dates. In WEPS, a management operation is defined as any human-initiated process, such as a tillage event, seeding, irrigation application, etc. If the operation triggers the WEPS model to start simulating the growth of a crop and/or decomposition of residue (or any other plant vegetation or residue supported with a crop database record containing the necessary vegetation growth and/or residue decay parameters), e.g., a planting/seeding/transplanting operation, then the name of that crop is listed in the same row in the column next to the name of the operation.

Since surface roughness (both random and oriented) affects a surface's susceptibility to wind erosion, especially when little or no vegetation cover exists, it is important to represent not only the degree of roughness, but the direction it is oriented. Since many management operations have a direction associated with them, e.g., many tillage operations for example, these operations will create an oriented roughness with the direction of travel. Since this direction of travel is not known until it is associated with a particular site, the final column displayed by default in the table provides the user the option of setting that direction in the management file and is labeled **Row/Ridge Dir. (Deg.)**

If a *residue* is being applied to the soil and/or surface, then the additional amount of flat residue applied (lbs/acre or kg/$m^2$) is specified in an additional column which is labeled **Flat Residue Applied (lb/acre)** as shown in Fig. 11.1. An example of this is when existing weeds are killed with a herbicide, the additional weed residue can then be represented in this manner[2].

## 11.1 Using MCREW

MCREW is designed to allow easy creation and editing of management rotation files for WEPS. The MCREW screen consists of 5 major components:

1. **Menu bar** - The menu bar consists of assorted menu options that provide access to MCREW's functions. Functions of the menu bar are discussed later in this document.


2. **Button bar** - The button bar consists of an assortment of icons that provide quick access to special functions for MCREW. Those functions are discussed later in this document.

3. **MCREW Display Mode** - MCREW now features two different display/editing modes. The mode displayed here is the *WEPS Rotation Mode* which is a calendar based, date ordered listing and is shown on the upper right side of the MCREW window. The alternative view, the *Crop Interval Mode* displays the rotation with whatever operation was selected first during the creation of the rotation in this mode or the operation selected via a special pointer in the *WEPS Rotation Mode* view. These display/editing modes are discussed later in this document.



[1] This release of MCREW also allows an alternative view of the rotation, e.g. beginning with any operation and proceeding forward in time. This mode is labeled *Crop Interval Mode*. One can easily switch between the two modes via a button click. At this time, the *Crop Interval Mode* should only be used for creating new WEPS rotation files from scratch until all the bugs have been worked out.

[2] Note that weeds are not typically "grown" within WEPS as a *crop* and cannot be grown while a crop is growing (this release of WEPS can only grow one *crop* at a time), so usually growing weeds are not taken into account in WEPS. However, if weeds are "grown" as a *crop*, not only will the growing plant biomass be represented in WEPS, but when they die or are killed, the weed residue mass will also be appropriately accounted for and not require an *addition* of flat residue biomass to be applied to the field.

4. **Rotation** - This window displays the name and full path of the management rotation file that is loaded. If the management rotation name is too large, a scroll bar is automatically provided so the user can view the entire rotation name.

Rotation : C:\Users\Larry Wagner\Documents\WEPS Files\Project_5.wpj\Corn NT- Corn Spg Disc, Fcult - Soybeans NT.man

5. **Version** - On the left side under the *Rotation* field, the current management file version number is displayed. Version number 1.7 is the current version. Some older version management files can be loaded into MCREW (currently versions 1.5 and 1.6). A user will usually be given the option to "update" on older version management file during selection[3]. Usually a user will want to be working with updated management files, but occasionally they may want to actually select and use an old version management file, e.g. to re-run an older previous WEPS Run for specific reasons.

Version: 1.7

6. **Years in Rotation** - Below and at left of the *Rotation* field, the user may view and edit the number of years in a rotation cycle.

Years in Rotation: 3

7. **Table View** - The Table View displays the sequence of operations, with their associated dates and any crops planted, in a tabular format. Spreadsheet-style editing functions are available to manipulate the order, selection, and removal of operations and/or crops, etc. More details of the editing functions of the Table View are given later in this section.

| Date | Operation Name | Crop or Residue | Row/Ridge Dir. (Deg.) | Flat Residue Applied (lb/acre) |
|---|---|---|---|---|
| May 15, 01 | Sprayer, pre-emergence | weed residue; 0-3 mo | | 0.00 |
| May 15, 01 | Drill or air seeder, single disk openers 7-10 in spac | Soybean, grain | 0 | |
| Jun 07, 01 | Sprayer, post emergence | weed residue; 0-3 mo | | 250.00 |
| Aug 01, 01 | Sprayer, post emerge, insecticide | | | |
| Oct 05, 01 | Harvest, killing crop 20pct standing stubble | | | |
| Nov 01, 01 | Fert applic. surface broadcast | | | |
| May 01, 02 | Sprayer, pre-emergence | weed residue; 0-3 mo | | 0.00 |
| May 01, 02 | Planter, double disk opnr, fluted coulter | Corn, grain, seed | 0 | |
| Jun 07, 02 | Sprayer, post emergence, fertilizer tank mix | weed residue; 0-3 mo | | 250.00 |
| Oct 20, 02 | Harvest, killing crop 50pct standing stubble | | | |
| Nov 01, 02 | Fert applic. surface broadcast | | | |
| Apr 27, 03 | Disk, tandem light finishing | | 0 | |
| Apr 29, 03 | Cultivator, field 6-12 in sweeps | | 0 | |
| May 01, 03 | Sprayer, pre-emergence | weed residue; 0-3 mo | | 0.00 |
| May 01, 03 | Planter, double disk opnr | Corn, grain, seed | 0 | |
| Jun 07, 03 | Sprayer, post emergence, fertilizer tank mix | weed residue; 0-3 mo | | 250.00 |
| Oct 20, 03 | Harvest, killing crop 50pct standing stubble | | | |
| | | | | |

[3] A user may not get the option to update an old version management file if WEPS is configured to automatically update old version management files upon selection in WEPS. Older management files may not contain the most current revisions of the operation and crop/residue records. Auto-updating the old management files ensures that users are working with the most current data.

## 11.2 Opening and Saving MCREW files

In WEPS 1.6, there are several locations in which management rotation files exist. Management rotation files can be selected and edited from previously built management rotation files (templates), or they can be constructed and then edited from several partial management rotation template files located in these folders.

1. **WEPS Projects** or **Current Project** folder - Any edited or viewed management rotation file used in a WEPS Project simulation run is always located in thw current WEPS Project's folder. There can be more than one management rotation file in a WEPS Project folder. The current management rotation file to be used when making a WEPS run is the one specified in the *weps.run* file, e.g., the one listed in the *management* input field on the WEPS main screen prior to making a WEPS Run. Management rotation files in a WEPS Project usually are simply copies of those selected from the *Template* directory, with local *Project* or *run-specific* modifications.

2. **Local Templates** folder - This is the usual location in which complete or partial (single or multi-crop year) management rotation files are stored for local use. Files in this directory normally show up on the management rotation selection choice lists, as they are usually specified for use within the *Project & Data Loc* tab setttings in the Configuration Panel.

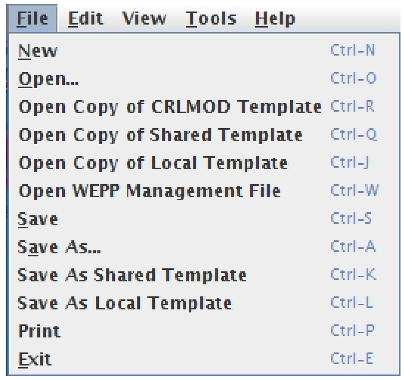
3. **Shared Templates** folder - This is the shared location in which complete or partial (single or multi-crop year) management rotation files are stored for use by more than one individual. It is usually a shared network folder location. Files in this directory show up on the management rotation selection choice lists, if specified within the *Project & Data Loc* tab setttings in the Configuration Panel.

4. **System Templates** folder - This is the location in which complete or partial (single or multi-crop year) management rotation files are stored by WEPS for use in the example WEPS simulations mentioned in the User Guide, etc. Files in this directory show up on the management rotation selection choice lists, if specified within the *Project & Data Loc* tab setttings in the Configuration Panel. Note that this folder usually contains the *Example* and *Exercise* management rotation files featured in the WEPS 1.6 User Guide.

5. **CRLMOD Managements** folder - This is the location in which complete or partial (single or multi-crop year) management rotation files are available for WEPS use. They consist of NRCS prepared management templates for each specific *Crop Management Zone* (CMZ) (a region where NRCS considers is relatively consistent regarding the typical practices and the dates of operations used are similar). The CMZ management rotation templates should almost always require at least limited editing for any individual WEPS Run. For example, CMZ management rotation templates do not (yet) contain any irrigation operations, so any management rotations requiring irrigation where a CMZ record is selected will require those operation(s) to be inserted into the management rotation file used in a WEPS simulation. The sole purpose of the CMZ management records is to reduce the effort required to create a WEPS management rotation file specific for its intended WEPS simulation run. They are **NOT** to be used as is, without editing, as ready to go WEPS management rotation files in WEPS simulations. Files in this folder show up on the management rotation selection choice lists, if specified and selected within the *Project & Data Loc* tab setttings in the Configuration Panel.

## 11.3 MCREW Menu Bar Functions

### 11.3.1 File Menu (Alt-F)




Once the MCREW window is open, rotation files can be created from scratch and saved in the desired location, and/or other rotation files may be opened for editing. The **"File"** menu allows access to the file management functions for MCREW. It contains all of the options listed here, with the common functions **("New", "Open"**, and **"Save")** also being available on the button bar:

**New (Ctrl-N)** - Opens an empty, unnamed rotation file.

**Open ... (Ctrl-O)** - Displays an *Open File* file chooser window from which the user can select the desired rotation file from those in the current Project. This is not accessible if the *Enable full MCREW editing functionality in WEPS* option is not enabled in the *Display* tab of the WEPS interface Configuration panel.

**Open Copy of CRLMOD Template (Ctrl-R)** - Displays an *Open File* file chooser window that defaults to the CRLMOD Template location (usually via a remote CSIP service access URL) from which the user can select the desired rotation file from the *CRLMOD Templates folder*. A copy of the selected file is then added to the current WEPS Project and made available for editing in MCREW. To edit a management file, the *Enable full MCREW editing functionality in WEPS* option must be enabled in the *Display* tab of the WEPS interface Configuration panel. If desired, the actual default location (CSIP URL in this case) can be changed under the *Project & Data Loc* tab in the WEPS interface Configuration panel as well.

**Open Copy of Shared Template (Ctrl-Q)** - Displays an *Open File* file chooser window that defaults to the Shared Template location from which the user can select the desired rotation file from the *Shared Templates folder*. A copy of the selected file is then added to the current WEPS Project and made available for editing in MCREW. To edit a management file, the *Enable full MCREW editing functionality in WEPS* option must be enabled in the *Display* tab of the WEPS interface Configuration panel. If desired, the actual default location can be changed under the *Project & Data Loc* tab in the WEPS interface Configuration panel as well.

**Open Copy of Local Template (Ctrl-J)** - Displays an *Open File* file chooser window that defaults to the Local Template location from which the user can select the desired rotation file from the *Local Templates folder*. A copy of the selected file is then added to the current WEPS Project and made available for editing in MCREW. To edit a management file, the *Enable full MCREW editing functionality in WEPS* option must be enabled in the *Display* tab of the WEPS interface Configuration panel. If desired, the actual default location can be changed under the *Project & Data Loc* tab in the WEPS interface Configuration panel as well.

**Save (Ctrl-S)** - Saves the current Project's rotation file being edited (in the current WEPS Project directory). The *Saved* filename will become the selected management file in the main WEPS interface screen upon exit of MCREW.

**Save As... (Ctrl-A)** - Displays a *Save File* dialog box from which the user can specify the desired filename with which to save the rotation file for the current Project (the default location is in the current WEPS Project directory). The *Saved* filename will become the selected management file in the main WEPS interface screen upon exit of MCREW.

**Save As Shared Template (Ctrl-K)** - Displays a *Save File* dialog box from which the user can specify the desired filename with which to save a copy of the currently edited rotation file into the *Shared Management Templates* directory. The original file is still the current file being edited within MCREW.

**Save As Local Template (Ctrl-L)** - Displays a *Save File* dialog box from which the user can specify the desired filename with which to save a copy of the currently edited rotation file into the *Local Management Templates* directory. The original file is still the current file being edited within MCREW.

**Print (Ctrl-P)** - Displays a print dialog box through which the MCREW table view can be printed.

**Exit (Ctrl-E)** - Exits MCREW. If MCREW finds that the rotation file has been modified and not saved, it will display a pop-up message and ask if the user wants to save it before leaving.

### 11.3.2 Edit Menu (Alt-E)


A WEPS 1.6 management rotation file is a date-ordered list of management operations. MCREW provides basic editing functionality to insert, delete, modify, and change dates for those operations. In WEPS, each operation is defined by a list of physical processes, such as residue burial, soil inversion, flattening standing residue, creation of ridges, planting a crop, etc., which are described to the model via one or more parameter values.

In its most basic form then, a WEPS management rotation file can be viewed within MCREW via the table view.

The primary editing functions available are accessible via the 'Edit' menu option. The table view editing functions are:

**Cut Row(s) (Ctrl-X)** - Removes the currently selected operation row(s) from the rotation and stores in a temporary buffer for possible pasting back into the rotation table later. This function is also via the cut rows button available on the toolbar.

**Copy Row(s) (Ctrl-C)** - Copies the selected operation row(s) from the rotation and stores in a temporary buffer for possible future pasting back into the rotation table. This function is also via the copy rows button available on the toolbar.

**Paste Row(s) (Ctrl-V)** - Pastes the previously cut or copied operation row(s) above the selected operation row. This function is also via the paste rows button available on the toolbar.

**Delete Row(s) (Ctrl-D)** - Deletes the selected operation row(s).

**Undo Delete (Ctrl-Z)** - Restore a deleted item. Active only if a previous item was deleted.

**Sort by Date (Ctrl-E)** - Sorts the operations in ascending order by date. See *Management File Date Adjustment Functions* section later in this chapter for alternate methods of manipulating dates.

**Insert Row (Ctrl-I)**- Inserts a blank row above the selected row.

**Insert Operation** - Inserts a row, then opens a window that allows the selection of an operation to be placed in that new blank row.

**Cycle Forward (Ctrl-F)** - Causes the last year in the rotation to become the first year in the rotation, while the other rotation years are incremented by one year. See *Management File Date Adjustment Functions* section later in this chapter for alternate methods of manipulating dates. Note that this function is not active for single year rotations.

**Cycle Backward (Ctrl-B)** - Causes the first year in the rotation to become the last year in the rotation, while the other rotation years are decremented by one year. See *Management File Date Adjustment Functions* section later in this chapter for alternate methods of manipulating dates. Note that this function is not active for single year rotations.

**Notes (Ctrl-M)** – Displays the Management Field Notes, where the user may enter notes regarding the management file. These notes are saved with the management file and can also be accessed and viewed by clicking the Notes button on the toolbar.

### 11.3.3 View Menu


The **View** menu provides two functions: 1) Select which view mode is being displayed and 2) Allow a user to select from a list of optional columns to display in the MCREW window's table.

The first two options set the MCREW rotation view mode, either the *WEPS Rotation Mode* or the *Crop Interval Mode*. The greyed out option is deselected. Add link here to more info - LEW

The options under the *Default Table View* heading provide a list of items that may be selected to be displayed as additional columns in the MCREW table by clicking on that item's checkbox. To remove any of these items from the display columns in the table, simply uncheck the item(s) in the *View* menu. The items available for selection are:

**Calibration** - This item triggers multiple columns related to making Yield Calibration runs. Note that these columns can also be selected/deselected via the toolbar button as well. The additional column headings are:

**Select Harvest for Calib.** - This column specifies whether the operation is selected for use in WEPS Yield Calibration runs. Useful for easily selecting/deselecting specific operations used for crops harvested multiple times

**Select Yield for Calib.** - This column specifies whether the crop is selected for use in WEPS Yield Calibration runs.

**Harvest Target Yield** - This column specifies the target yield value for the crop for use in WEPS Yield Calibration runs.

**Target Yield Units** - This column specifies the units assigned to the target yield value for the crop. This field is currently not editable within MCREW.

**Yield H2O** - This column specifies the fraction, in *(%)*, of water the crop yield value will be reported in.

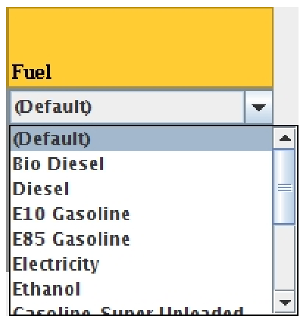
**Plant Population** - This column specifies the crop plant population. The units are specified in the heading based upon the WEPS units setting in *(#/acre)* or *(#/m$\hat{2}$)*. Fix this

**Biomass Adj. Factor** - This column specifies the adjustment factor (multiplier) applied to the growth parameter(s) in the plant growth submodel in WEPS. It is the parameter that is adjusted during a WEPS Yield Calibration run for each crop being calibrated.

**Yield Coef.** - The column specifying the residue/yield ratio for each crop. The units are specified in the heading based upon the WEPS units setting *(lb/lb)* or *(kg/kg)*.

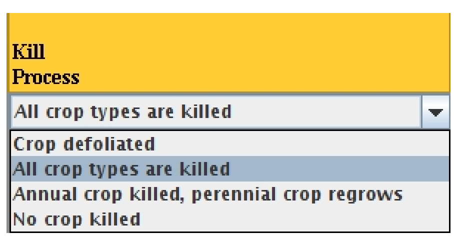
**Residue Intercept** - The column specifying the intercept offset of the residue/yield line. The units are specified in the heading based upon the WEPS units setting *(lb/acre)* or *(kg/m$\hat{2}$)*. Fix this

**Fuels** - Displays the *Fuel* type column. A dropdown menu allows the user to select an alternative to the *(Default)* fuel type setting. Here is a partial list of the available fuel type options via dropdown menu:




It appears that we are not displaying exactly what we want here. The "Default" fuel, I think should be Diesel - LEW

**Kill Process** - Displays the *Kill Process* column. Since the *Kill Process* flag for the operation may not be defaulting to the correct option for all management scenarios, this column provides easy access to allow changes via a dropdown menu list to the flag setting. Here are the available flag setting choices:




**Surface Roughness** - Displays the surface *Random Roughness* column with the units listed as *(in)* or *(mm)*, depending up the WEPS display units setting. This column displays the random roughness value assigned to the listed operation. Note that this roughness value is the value expected under very heavy (maximum) surface residue conditions on a standard silt loam soil. The value is automatically modified within WEPS dynamically by soil texture and the amount (or lack thereof) of very heavy flat residue on the surface.

**Ridges/Dikes** - This item triggers multiple columns related to the *Ridges/Dikes* process parameters. The additional column headings are:

**Ridge Height** - The oriented roughness ridge height in *(in)* or *(mm)* depending upon the WEPS units setting.

**Ridge Spacing** - The oriented roughness ridge spacing in *(in)* or *(mm)*, depending upon the WEPS units setting.

**Ridge Width** - The oriented roughness ridge width in *(in)* or *(mm)*, depending upon the WEPS units setting.

**Dike Height** - The oriented roughness dike height in *(in)* or *(mm)*, depending upon the WEPS units setting.

**Dike Spacing** - The oriented roughness dike spacing in *(in)* or *(mm)*, depending upon the WEPS units setting.

Note that the final Ridge/Dike parameter is listed in the *Row/Ridge Direction* column for each operation, which is always displayed in the MCREW table display.

**Irrigation** - This item triggers multiple columns related to the automated (management scheduled) *Irrigation* process parameters. The additional column headings are:

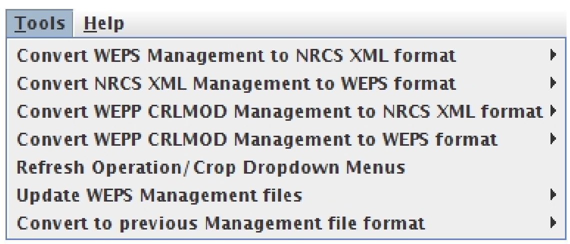
**Irrig. water Applied (max)** - The maximum water applied in *(in)* or *(mm)*, depending upon the WEPS units setting.

**Irrig. water Applied (min)** - The miminum water applied in *(in)* or *(mm)*, depending upon the WEPS units setting.

**Min. Irrig. Interval** - The minimum irrigation interval in *(days)*.

**Mgt Allowed Depletion** - The management allowed soil water depletion *(0-1)* before automatic irrigation occurs again.

### 11.3.4 Tools Menu (Alt-T)




The **Tools** menu provides access to tools and utilities related to the use of MCREW.

**Convert WEPS Management to NRCS XML Format** - (this menu item has two options)

**Select individual files** - Converts a single WEPS management file to the NRCS standardized summary management XML file format.

**Select directory** - Converts multiple WEPS management files (recursively if that FileChooser option is selected) in a single directory to the NRCS standardized summary management XML file format. Converted files are placed in the "LocalDB/skel" folder by default, unless specified to go elsewhere.

**Convert NRCS XML Management to WEPS Format** - (this menu item has two options)

**Select individual files** - Converts single NRCS standardized summary management XML format files to the WEPS management file format.

**Select directory** - Converts multiple NRCS standardized summary management XML format files (recursively if that FileChooser option is selected) to the WEPS management file format. Converted files are placed in the "LocalDB/man" folder by default, unless specified to go elsewhere.

**Convert WEPP CRLMOD Management to NRCS XML Format** - (this menu item has two options)

**Select individual files** - Converts single WEPP CRLMOD Management formatted files to NRCS standardized summary management XML format files.

**Select directory** - Converts multiple WEPP CRLMOD Management formatted files (recursively if that FileChooser option is selected) to NRCS standardized summary management XML format files. Converted files are placed in the "LocalDB/skel" folder by default, unless specified to go elsewhere.

**Converts WEPP CRLMOD Management formatted files to WEPS Format** - (this menu item has two options)

**Select individual files** - Converts single WEPP CRLMOD Management formatted files to the WEPS management file format.

**Select directory** - Converts multiple WEPP CRLMOD Management formatted files (recursively if that FileChooser option is selected) to the WEPS management file format. Converted files are placed in the "LocalDB/man" folder by default, unless specified to go elsewhere.

**Refresh Operation/Crop Dropdown Menus** This menu option performs the same task as the

**Update WEPS Management Files** - (this menu item has two options)

**Select individual files** - Updates individual WEPS management files with the most current CRLMOD crop/residue and operation database parameters.

**Select directory** - Updates selected folder containing WEPS management files (recursively if that FileChooser option is selected) with the most current CRLMOD crop/residue and operation database parameters. Updated files are placed in the current "WEPS Project" folder by default, unless specified to go elsewhere or if the "In Place" option has been selected in the initial FileChooser.

**Convert to previous management file format** - (this menu item has two options)

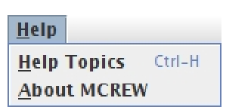
Issues to be addressed with this menu item and sub-menu option settings, FileChoosers, etc: - LEW

a) Change sub-menu title from "Select directory (recursively)" to "Select directory"
b) Correct the list of shortcut buttons in the two FileChoosers for each sub-menu option
c) Get the "Select directory" FileChooser(s) to correctly select directories as stated rather than generating an error saying it can only select "files"
d) Set the default locations for all of these FileChoosers appropriately

**Select individual files** - Converts individual WebStart WEPS management files (version 1.7) to the previous version (1.6) so that the older WEPS desktop version 1.5.52 can load/use these WebStart WEPS management files.

**Select directory** - Converts the selected folder (recursively if that FileChooser option is selected) containing WebStart WEPS management files (version 1.7) to the previous version (1.6) so that the older WEPS desktop version 1.5.52 can load/use these WebStart WEPS management files. Converted files are placed in the current "WEPS Project" folder by default, unless specified to go elsewhere or if the "In Place" option has been selected in the initial FileChooser.

### 11.3.5 Help Menu (Alt-H)

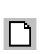



The **Help** menu item displays help options about MCREW and includes:

**Help Topics (Ctrl-H)** – Opens a window containing the MCREW online help system.

**About MCREW** – Displays the current version, build date, and other information about the current version/build of MCREW.

## 11.4 MCREW Button Bar Functions

 Opens a blank MCREW screen. This has the same function as selecting **New** under **File** on the menu bar.

Opens an existing MCREW file. This has the same function as selecting **Open** under **File** on the menu bar.

Saves the rotation file being edited to the current Project. This has the same function as selecting **Save** under **File** on the menu bar.

Cuts a selected row or rows of the management file and places into the clipboard. This has the same function as selecting **Cut Row(s)** under **Edit** on the menu bar.

Copies a selected row or rows of the management file and places into the clipboard. This has the same function as selecting **Copy Row(s)** under **Edit** on the menu bar.

Pastes a row or rows of the management file from the clipboard above the selected row. This has the same function as selecting **Paste Row(s)** under **Edit** on the menu bar.

Sorts the rows of the management operations into date order. This has the same function as selecting **Sort by Date** under **Edit** on the menu bar.

Selects the alternative view mode to display the management rotation data in the table. The plant button switches to the *Crop Interval* view. This button has the same function as selecting **Crop Interval View** under the **View** menu item on the menu bar.

Selecting this button switches back to the default WEPS view mode to display the management rotation data in the table. The clock button switches to the *WEPS Rotation* view. This button has the same functions as selecting **WEPS Rotation View** under the **View** menu item on the menu bar.

Cycles the rotation year for the management operations forward. This has the same function as selecting **Cycle Forward** under **Edit** on the menu bar.

Cycles the rotation year for the management operations backward. This has the same function as selecting **Cycle Backward** under **Edit** on the menu bar.

Toggles the display of extra columns in the table for yield calibration use. When this option is on (columns displayed), a red border surrounds the button.

Opens the Management File Notes display, where the user may enter notes regarding the management file. These notes are saved with the management file and can be viewed by clicking the Notes Button or the **Edit** menu item **Notes**.

Enables online help. It will bring up a separate window displaying MCREW help information.

Enables context-sensitive help. Click on this button, then click on any item on the screen for popup help specific to that item.

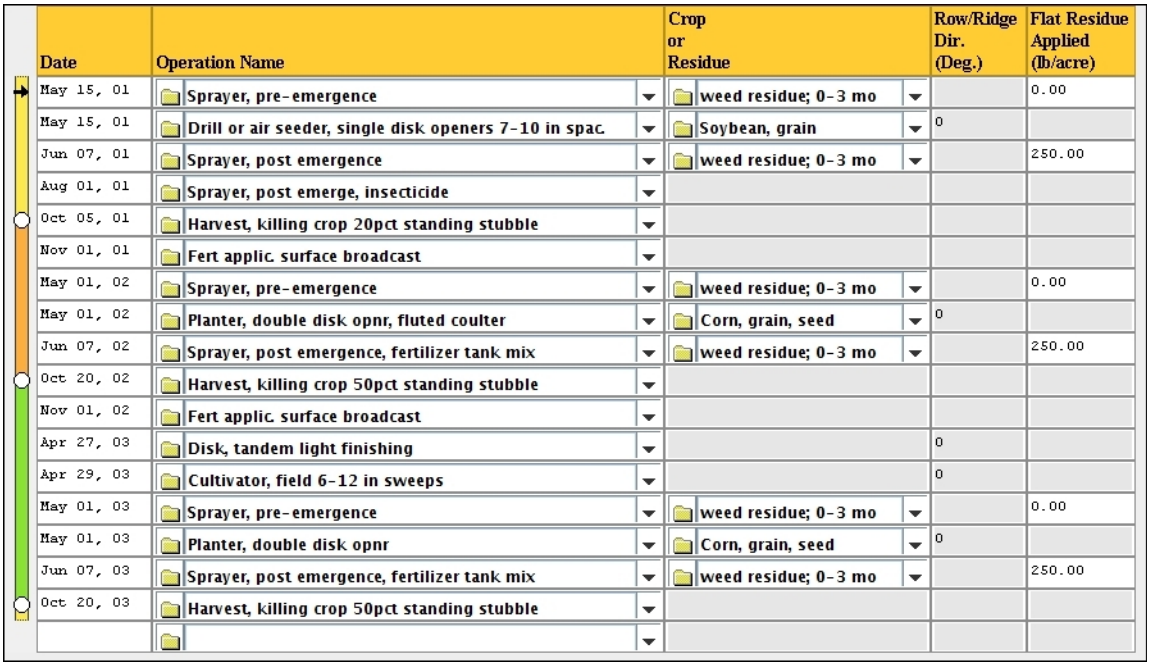
Saves the displayed data to the current file name and closes MCREW.

## 11.5 MCREW Table View Editing

MCREW's table view is where most of the editing occurs when working with management/crop rotation sequences.

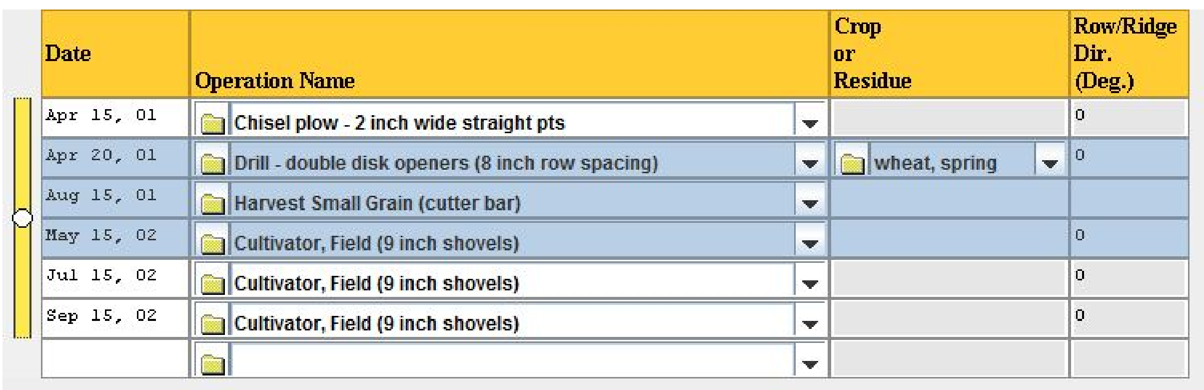
### 11.5.1 MCREW Row and Cell Selection Functions

The mouse is currently the primary method used to "select" either a row and/or an individual table cell. If a particular table cell cannot be directly edited within the cell, this is indicated by a gray background, (e.g., Date, Operation Name, or Crop) and the row is selected (indicated by the blue background in all cells within the row). The following figure shows an example of a row selection after a left mouse click within the "Date" column.



| Date | Operation Name | Crop or Residue | Row/Ridge Dir. (Deg.) | Flat Residue Applied (lb/acre) |
|---|---|---|---|---|
| May 15, 01 | Sprayer, pre-emergence | weed residue; 0-3 mo | | 0.00 |
| May 15, 01 | Drill or air seeder, single disk openers 7-10 in spac | Soybean, grain | 0 | |
| Jun 07, 01 | Sprayer, post emergence | weed residue; 0-3 mo | | 250.00 |
| Aug 01, 01 | Sprayer, post emerge, insecticide | | | |
| Oct 05, 01 | Harvest, killing crop 20pct standing stubble | | | |
| Nov 01, 01 | Fert applic. surface broadcast | | | |
| May 01, 02 | Sprayer, pre-emergence | weed residue; 0-3 mo | | 0.00 |
| May 01, 02 | Planter, double disk opnr, fluted coulter | Corn, grain, seed | 0 | |
| Jun 07, 02 | Sprayer, post emergence, fertilizer tank mix | weed residue; 0-3 mo | | 250.00 |
| Oct 20, 02 | Harvest, killing crop 50pct standing stubble | | | |
| Nov 01, 02 | Fert applic. surface broadcast | | | |
| Apr 27, 03 | Disk, tandem light finishing | | 0 | |
| Apr 29, 03 | Cultivator, field 6-12 in sweeps | | 0 | |
| May 01, 03 | Sprayer, pre-emergence | weed residue; 0-3 mo | | 0.00 |
| May 01, 03 | Planter, double disk opnr | Corn, grain, seed | 0 | |
| Jun 07, 03 | Sprayer, post emergence, fertilizer tank mix | weed residue; 0-3 mo | | 250.00 |
| Oct 20, 03 | Harvest, killing crop 50pct standing stubble | | | |
| | | | | |

One can select multiple rows at one time by depressing and holding down the left mouse button on the first row to be selected and dragging the mouse cursor over the additional contiguous rows to also be selected. Release the left mouse button on the last row to be selected. All selected rows will be highlighted with a blue background (see following figure for example of multiple row selection).



| Date | Operation Name | Crop or Residue | Row/Ridge Dir. (Deg.) |
|---|---|---|---|
| Apr 15, 01 | Chisel plow - 2 inch wide straight pts | | 0 |
| Apr 20, 01 | Drill - double disk openers (8 inch row spacing) | wheat, spring | 0 |
| Aug 15, 01 | Harvest Small Grain (cutter bar) | | |
| May 15, 02 | Cultivator, Field (9 inch shovels) | | 0 |
| Jul 15, 02 | Cultivator, Field (9 inch shovels) | | 0 |
| Sep 15, 02 | Cultivator, Field (9 inch shovels) | | 0 |
| | | | |

The user can append contiguous rows adjacent to a previously selected row or multi-row selection, by holding down the "shift" key and clicking the left mouse button on the last desired contiguous row to append to the selection. This is similar to how Microsoft Windows append selection works with the "shift" key depressed.

Similarly, one can append non-contiguous rows by holding down the "ctrl" key and making an additional multi-row (or single row) selection similar to the original row or multi-row selection (see following figure for example of non-contiguous row selection). As many non-contiguous rows can be selected, as desired, via this method. Again this is similar to how Microsoft Windows non-contiguous selection method works with the "ctrl" key depressed.

| Date | Operation Name | Crop or Residue | Row/Ridge Dir. (Deg.) |
|---|---|---|---|
| May 01, 01 | Cultivator, Field (9 inch shovels) | | 0 |
| May 05, 01 | Planter - double disk openers (30 inch row spacing) | corn, grain, 130 | 0 |
| Oct 20, 01 | Harvest (cut or break stalks high) | | |
| Nov 01, 01 | Disk harrow, tandem, inline (18 inch dia blades, 9 inch spaci... | | 0 |
| May 25, 02 | Cultivator, Field (9 inch shovels) | | 0 |
| Jun 05, 02 | Planter - double disk openers (30 inch row spacing) | Sunflower | 0 |
| Oct 20, 02 | Harvest (cut or break stalks high) | | |
| Nov 01, 02 | Disk harrow, tandem, inline (18 inch dia blades, 9 inch spaci... | | 0 |
| Apr 10, 03 | Cultivator, Field (9 inch shovels) | | 0 |
| Apr 15, 03 | Drill - double disk openers (8 inch row spacing) | wheat, spring | 0 |
| Jul 10, 03 | Harvest Small Grain (cutter bar) | | |
| Sep 15, 03 | Disk harrow, tandem, inline (18 inch dia blades, 9 inch spaci... | | 0 |
| | | | |

Any row or multi-row selection can be de-selected and replaced by simply clicking the left mouse button anywhere within the MCREW table display (with no keyboard keys pressed).

### 11.5.2 MCREW Row Editing Functions

Using the **Edit menu**, the user can cut, copy, paste, and delete rows. One can also insert a new blank row **(Insert Row)** immediately above the currently selected row. In addition, the user can press the right mouse menu button (when the mouse is in any row cell except in the date column to display a popup menu that contains row editing functions. The **Set Date** and **Adjust Date** options will be described under "Management File Date Adjustment Functions".

The contents of another (previously created) management file can also be inserted via the **Insert Management File** option immediately above the currently selected row. The "File Chooser" dialog will pop up, allowing the user to select the desired management file from which to include all the operations and their associated dates into the current management file being edited.

The **Cut, Copy** and **Paste** functions apply to the selected (both single and multiple) rows. These functions are accessible via the **Edit** menu, button bar and the drop-down operation and crop column menus. The **Paste** function should only be active if there has been a previous **Cut** or **Copy** function conducted previously. The **Delete** function applies to all selected rows. Only if a previous **Delete** function has been conducted will the **Undelete** function be accessible.

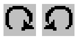
The **Insert Row** and **Insert Operation** functions insert a blank row or selected operation respectively above the currently selected row. The date for this new row will automatically be set to the date f the row above the previously selected (now the newly inserted) row.

### 11.5.3 MCREW Date Adjustment Functions

There are several date adjustment functions available in MCREW, in the **Edit** menu and the icon button bar. These operations are:

**Sort by Date** - The *Sort by Date* function sorts the management operations by ascending date order. Thus, the user can adjust/set the dates of management operations without having to worry about whether they are in the correct sequential order at that time. When the user wants to see the list of operations in the correct date-ordered format, they can simply select the **Sort by Date** function from the button bar icon or the **Edit** menu.

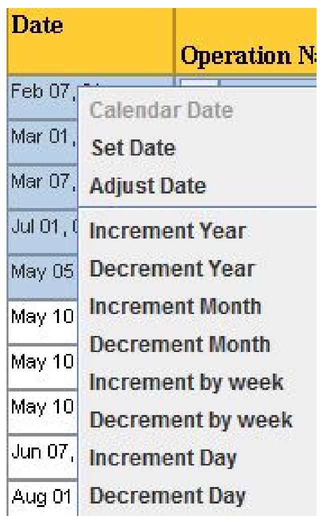
Note that MCREW will not allow the user to save a WEPS management file without the operations being listed in date order. The user is given the options to automatically sort them, if they are not sorted during a management file save operation, or to go back to the editor and allow the user to correct the date order problem(s) manually.


**Cycle Forward** and **Cycle Backward** - The *Cycle Forward* and *Cycle Backward* functions will rotate the ”rotation year” of the management operation dates forward or backward in increments of one year. For example, a three-year management file rotation ”cycled forward” would change the operation dates in the first year to the 2nd year, those in the 2nd year to the 3rd year and those in the 3rd year to the 1st year. Thus, the crops grown and harvested in the first year would now occur in the second year, etc. Likewise, a rotation ”cycled backward” would shift the rotation the opposite direction, making the 2nd year operations occur in the first year, etc.

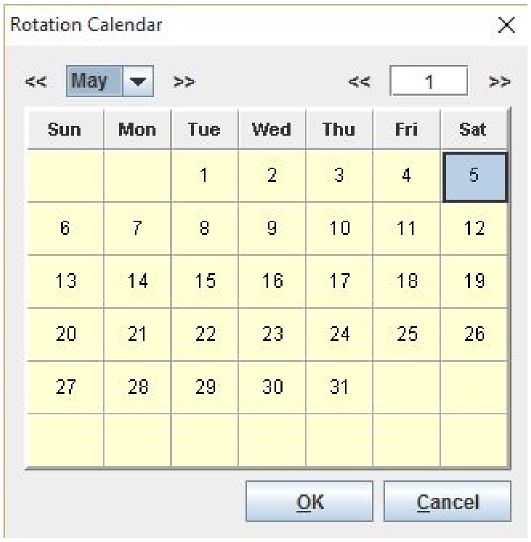
Note that the *Sort* function will be required after ”rotating” the operations to again re-sort the list of operations in the correct date order before saving the rotated management file.

### 11.5.4 MCREW Date Column Editing Functions

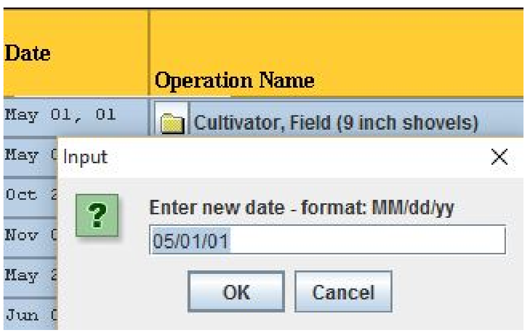
Limited date editing functions are available by right clicking on a cell in any column. Clicking the right mouse button while the cursor is on a date column cell causes a date editing popup menu to appear that has additional date editing functions (see figure to the left). These functions allow the user to adjust dates for one row or all operation rows selected (highlighted in blue) simultaneously (single-row date editing operations are made inaccessible and are greyed out if multiple rows are selected). Currently, the top item, **Calendar Date**, is the only function specific to single rows, and if multiple rows are selected, the **Calendar Date** item will be greyed out and inaccessible.



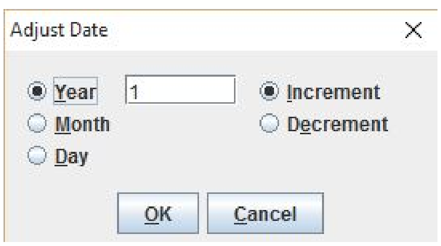

The **Calendar Date** option displays a popup calendar to aid in adjusting dates. A shortcut to accessing the **Calendar Date** is available by double left mouse clicking in a date cell, which will also display the popup calendar. This calendar window allows the user to select the desired date. The calendar allows the user to increment (>>) or decrement (<<) the month and year values if desired. Then the day of the operation within that month/year can be selected. The user can either double right mouse click on the day value or click on the ”OK” button to accept the specified date (see the figure to the left). The **Calendar Date** function is only applicable when a single date cell is selected.




Selecting the **Set Date** option will display a dialog box that allows the user to type in a specific date (day/month/rotation year) for the selected operation row (highlighted in blue). The following figure shows an example of the **Set Date** popup window.




The *Adjust Date* function is available from this menu, with year, month, and day increment and decrement functions available. They apply to all dates in the rows that are selected. The user can adjust the operation dates on the selected rows. Selecting the *Adjust Date* option will display a dialog box allowing the user to adjust the operation dates in the selected rows by a specified ± number of days, months, or years (see figure below). Additional menu options are also available to increment (increase) or decrement (decrease) the dates of selected rows by a day, week, month, or year.




The remaining date menu options below the popup Date menu line are specific menu shortcuts to the **Adjust Date** function and are listed here:

**Increment Year** - Increments the selected rows by one rotation year.

**Decrement Year** - Decrements the selected rows by one rotation year.

**Increment Month** - Increments the selected rows by one month.

**Decrement Month** - Decrements the selected rows by one month.

**Increment by week** - Increments the selected rows by one week.

**Decrement by week** - Decrements the selected rows by one week.

**Increment Day** - Increments the selected rows by one day.

**Decrement Day** - Decrements the selected rows by one day.

## 11.6 MCREW General Editing Functions within the Column Menus

All left mouse click menus that come up when one has the cursor in any column cell other than the date column contain general functions that pertain to the row and are not necessarily specific to the column the user produced the menu from. These general functions are confined to the bottom of the column menus and are always located below the horizontal line in the menu. Some of these functions do not apply when multiple rows have been selected, in which case those functions will still display but be greyed out and inaccessible for use under those conditions. The complete list of "general editing functions are:

**Set Date** - Set the date of the selected row(s) to the specified date.

**Adjust Date** - Brings up the **Adjust Date** dialog box, which allows the user to increment or decrement the rotation year, month or day by the specified value.

**Insert Blank Row** - Inserts a blank row immediately above the selected row or cell. This function is inaccessible if multiple rows have been selected.

**Insert Operation** - Inserts a new row immediately above the selected row or cell and brings up a file chooser window allowing the user to select the desired operation to place in that new row. If the user aborts the operation selection process, the new row is removed from the table. This function is inaccessible if multiple rows have been selected.

**Insert Rotation** - Inserts a management rotation file (".rot" extension filenames) only if the bottom row is selected, otherwise it will be greyed out and inaccessible. Note this function has not been completely implemented at this time. There are no ".rot" management rotation files available for WEPS yet.

**Insert Management** - Brings up a file chooser window allowing the user to select the desired management rotation file to be placed immediately above the selected row. The rotation year dates are automatically altered to make the first operation in the newly selected management rotation file to follow chronologically the operation immediately above the selected operation row. This function is inaccessible if multiple rows have been selected.

**Insert Management Unadjusted** - Brings up a file chooser window allowing the user to select the desired management rotation file to be placed immediately above the selected row, but does not modify the dates within the newly selected management rotation file. This function is inaccessible if multiple rows have been selected.

**Cut Row(s)** - Cut the selected row(s) and store them in a temporary buffer for possible re-insertion in the management rotation file with the **Paste** function later.

**Copy Row(s)** - Copy the selected row(s) and store them in a temporary buffer for possible re-insertion in the management rotation file with the Paste function later.

**Paste Row(s)** - Paste (insert) previously cut or copied row(s) immediately above the selected row in the management rotation file. This function is inaccessible if multiple rows have been selected.

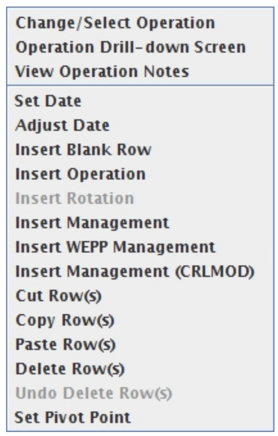
**Delete Row(s)** - Delete the selected row(s) and store them in a temporary buffer for possible re-insertion into the management rotation file with the **Undelete Row(s)** function later.

**Undelete Row(s)** - Undoes a previous **Delete Row(s)** operation, if possible, and re-inserts the previously deleted rows into the management rotation file where they were prior to executing the delete function. If other editing functions have been conducted after deleting the row(s), then the undelete function may no longer be accessible (greyed out) because it cannot correctly perform the undelete function any more. One can best think of and use this function as an "immediate undelete" function to undo the previous delete action.

## 11.7 MCREW Operation Column Editing Functions

A new operation can be added to a blank line or a different operation can be selected to replace an existing operation by clicking the down arrow to the right of the **Operation Name** column and selecting the desired operation. An operation can also be replaced in the selected cell by double clicking the left mouse button with the mouse cursor in an operation cell (including the blank cell at the bottom of the table where it will insert a new operation) This action will display the operation file chooser window. It allows the user to select a management operation record and place it into the selected row. The user can also access this operation file chooser dialog from the **Change/Select Operation** menu option via the right mouse menu.

Additional editing functions for the Operation column are displayed by right clicking within the column (see figure below). Clicking on one of the menu options available will apply the function to the highlighted row(s). The top items above the line in the menu are specific to the operation column. The items below the line are the general editing functions described previously in the **MCREW General Editing Functions within the Column Menus** section.




The **Change/Select Operation** menu option via the right mouse menu will also bring up the operation file chooser window. It allows the user to select a management operation record and place it into the selected row(s). This function works with multiple selected rows and replaces the specified operation in each of the selected rows.

The **Operation Drill-down Screen** option provides access to the operation's process list and its parameters, which is discussed in more detail later in the **MCREW Operation and Crop Dialog Drill-Down** Screens section.

The **View Operation Notes** shows the user notes content in a pop-up screen for the selected operation. These two functions will be greyed out and not accessible if multiple rows are selected.

**Set Date** - Pops up a date dialog window for the user to enter the desired date for the selected operation(s) to be perform.

**Adjust Date** - Pops up the *Adjust Date* dialog window for the user to specify the desired date adjustments for the selected operation(s)to be perform.

**Insert Blank Row**- Inserts a blank row above the selected row.

**Insert Operation** - Inserts a blank row above the selected row, then opens a window that allows the selection of an operation to be placed in that new blank row.

**Insert Rotation** - This menu option is intended to insert specially formatted WEPS ".rot" management rotation files. However, this feature has not been fully implemented and there are no ".rot" files available at this time. So, this menu option is currently unavailable and greyed out at this time.

**Insert Management** - Opens a FileChooser window to select a WEPS management rotation file to insert above the selected row. Usually, the user will also need to adjust the operation dates to properly accommodate the additional operation records.

**Insert WEPP Management** - Opens a FileChooser window to select a WEPP management rotation file to insert above the selected row. The WEPP management rotation file will be automatically converted to the WEPS management file format during this process. Usually, the user will also need to adjust the operation dates to properly accommodate the additional operation records.

**Insert Management (CRLMOD)** - Opens a FileChooser window to select a WEPS management rotation file to insert above the selected row. This identical to the **Insert Management** menu option, except the FileChooser opens up by default displaying the CRLMOD management records. Usually, the user will also need to adjust the operation dates to properly accommodate the additional operation records.

**Cut Row(s)** - Removes the currently selected operation row(s) from the rotation and stores in a temporary buffer for possible pasting back into the rotation table later. This function is also via the cut rows button available on the toolbar.

**Copy Row(s)** - Copies the selected operation row(s) from the rotation and stores in a temporary buffer for possible future pasting back into the rotation table. This function is also via the copy rows button available on the toolbar.

**Paste Row(s)** - Pastes the previously cut or copied operation row(s) above the selected operation row. This function is also via the paste rows button available on the toolbar.

**Delete Row(s)** - Deletes the selected operation row(s).

**Undo Delete Row(s)** - Restore a deleted item. Active only if a previous item was deleted. If MCREW cannot perform an *Undo* or *Undelete* function, it will be greyed out as a menu option.

**Set Pivot Point** - Sets the black horizontal arrow pointer located just to the left of the table rows to mark the first operation to show in the table when the tabular display is switched from *WEPS Rotation Mode* to *Crop Interval Mode*.

## 11.8 MCREW Operation and Crop Dialog Drill-Down Screens

Both the MCREW *Operation* and *Crop or Residue* columns have a ”drill-down” function available that allows the user to display a pop-up screen that makes many of the specific operation or crop/residue parameter values viewable or editable. The operation parameters specify how WEPS operations simulate specific processes upon soil and biomass properties that influence wind erosion. Similarly, the crop parameters specify how WEPS simulates crop planting, growth, and harvest, as well as residue decomposition.

The specific content of these screens depends upon both the type of crop or operation and specific configuration file settings. The configuration files describe which parameters are viewable or hidden to the user and, if viewable, whether or not they are editable by the user. In addition, for each parameter that is displayed, the prompt information for the parameter is described in these configuration files. Examples of the Operation and Crop Dialog drill-down screens are shown in Fig. 11.2 and Fig. 11.3.

The drill-down functions are cell specific and are available only when a single operation or crop/reisdue cell is selected. The Operation drill-down screen is accessible if the selected cell is in the operation column and a Crop drill-down screen is accessible if the selected cell is in the crop column.

To access the Operation or Crop drill-down screen, click the folder icon to the right of the Operation or Crop name in the MCREW table. An alternative method is to left click in the operation or crop/residue cell and selecting **Operation Drill-down Screen** or **Crop Drill-down Screen** respectively.

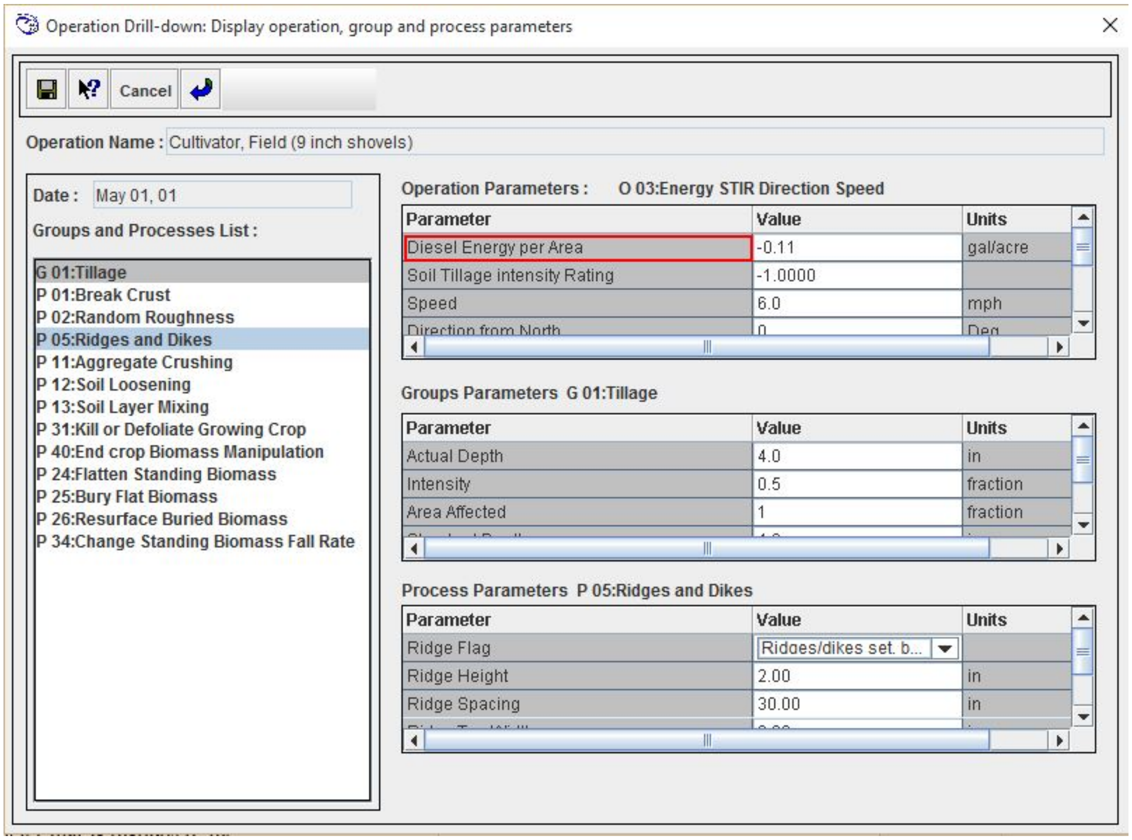



Figure 11.2: Example Operation Dialog drill-down screen.

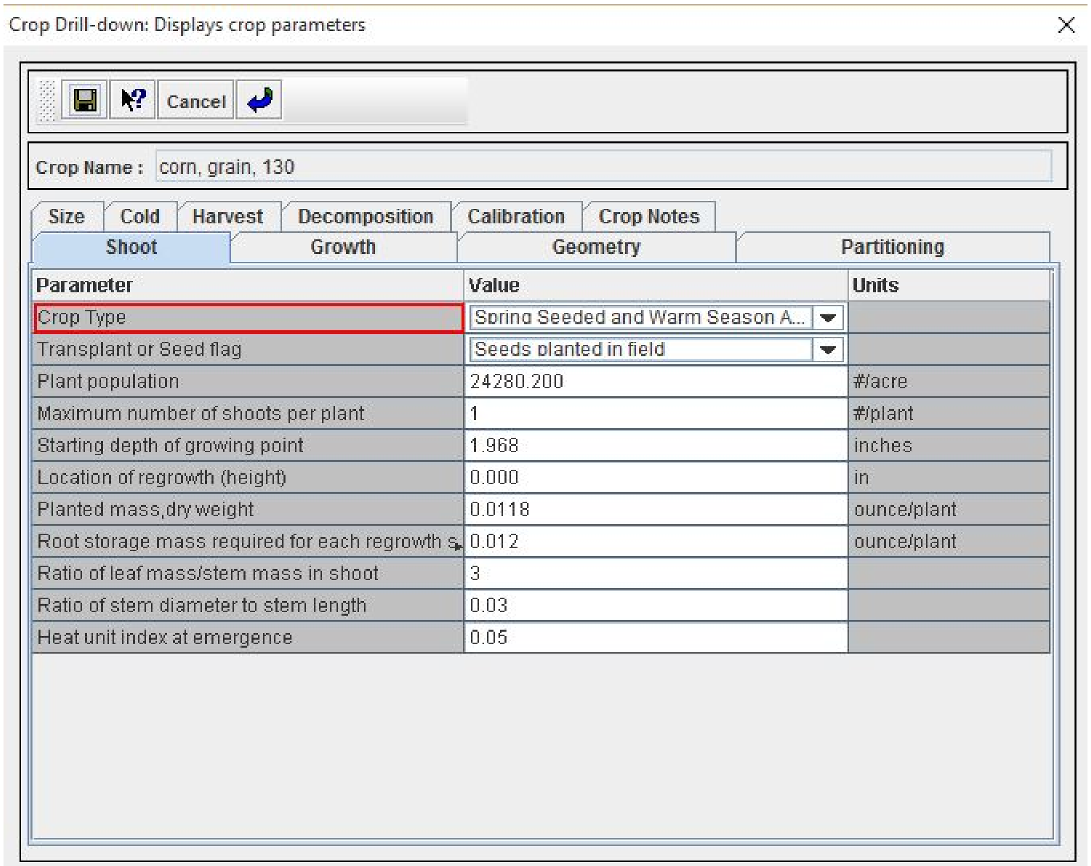



Figure 11.3: Example Crop Dialog drill-down screen.

Definitions and ranges for specific operation parameters are also available in the WEPS How To Guide, **"Management Operation Database Record Development"**. Definitions and ranges for specific crop/residue parameters are available in the WEPS How To Guide, **"Crop Database Record Development"**. These guides also provide guidelines for determining parameters for developing operation and/or crop/residue records not currently available in the operation or crop/residue databases.

# 12. Viewing and Editing a Soil Record

Users have the option to view and edit the parameters for the soil record displayed in the soil selection field by clicking on the button labeled **Soil**, on the left side of the soil field in the bottom left corner of the main WEPS screen (Fig. 8.1). This will open the WEPS Soil User Interface screen (Fig. 12.1).

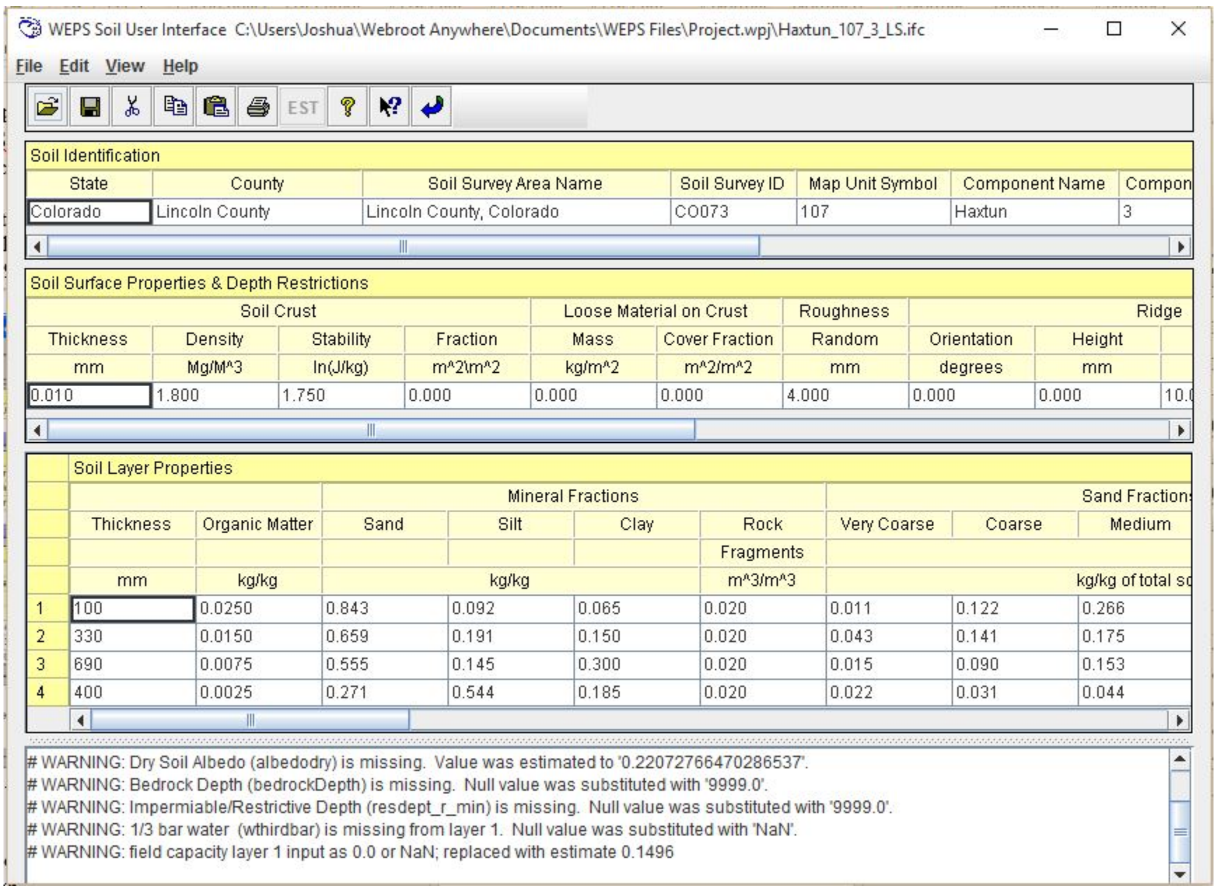



Figure 12.1: WEPS Soil User Interface screen.

Many soil properties that affect soil wind erodibility vary with time as a result of weather and management. The parameters displayed in the *Soil User Interface* only represent the initial soil conditions and properties that exist prior to the first day of simulation. Beginning with the first day of simulation, the soil parameters change in response to weather and management conditions.

Soil properties greatly affect the erodibility of a field surface directly through their effects on such things as roughness and aggregate size distribution. The soil properties also affect erodibility indirectly through their effects on soil hydrology and plant growth.

The *Soil User Interface* allows the user to view, edit (disabled for NRCS by default), and save the initial soil information under a new file name for the current WEPS Project. Users typically are discouraged from editing parameters derived from a SSURGO database record unless the user has specific knowledge of the parameters and more suitable values for them. A more detailed description of the soil parameters required by WEPS, as well as directions for obtaining a SSURGO database file for WEPS use, are found in Appendix 2 of the WEPS User Manual.

Users whose soils are not contained in a SSURGO database can create their own soil file by opening a new file and entering the appropriate parameters. It is recommended that in this case, the user enter the minimum set of parameters and let the *Soil User Interface* generate all parameter fields.

The *Generate soil property estimates* function is described under the **View** menu option on the Menu Bar, later in this section. Again, if the user has specific knowledge of the parameter and more suitable values, they may then edit those values. As an alternative, the user may wish to find an existing soil file within a SSURGO database with properties similar to the soil they want to simulate with WEPS and edit any parameters that may differ.

The various functions of the WEPS *Soil User Interface* are described next. More detailed definitions of soil parameters are available in Appendix 2 of the WEPS User Manual.

## 12.1 Soil Menu Bar Functions

The menu bar provides the following options:

**File** – This menu displays a drop-down list of various file options.

**New (Ctrl-N)** – Opens an empty, unnamed soil screen.

**Open... (Ctrl-O)** – Displays an "Open a Soil File" dialog box from which the user can select a soil (ifc) file from those in the current Project..

**Open Database (Ctrl-L)** – Opens the "Select Soil" window (Fig. 8.26) to select a soil from a file, local database residing on your computer or from the NRCS SSURGO (NASIS) database.

**Save (Ctrl-S)** – Saves the current file.

**Save As... (Ctrl-A)** – Saves the current soil file to a new name in the current Project directory.

**Save As Template... (Ctrl-T)** – Save the current soil file to a new name in the default soil database directory location.

**Print (Ctrl-P)** – Opens a print dialog window to allow printing the soil file table display.

**Exit** – Exits the soil interface.

**Edit** – This menu displays a drop-down list of various layer editing functions.

**Estimate Values (Ctrl-E)** – Estimates the values for all fields that can be estimated. Usually used when building a new soil record manually. Can only be used in conjunction with the **Minimum Fields** option under the **View** menu.

**Cut Layer (Ctrl-X)** – Cuts a soil layer or layers and places it into the clipboard. The layer(s) (contiguous only) must be first selected by dragging the mouse while holding the left mouse button down.

**Copy Layer (Ctrl-C)** – Copies a soil layer or layers and places it into the clipboard. The layer(s) (contiguous only) must be first selected by dragging the mouse while holding the left mouse button.

**Paste Before Layer (Ctrl-B)** – Pastes a soil layer or layers from the clipboard above the highlighted row.

**Paste After Layer (Ctrl-V)** – Pastes a soil layer f or layers from the clipboard after the highlighted row.

**Insert Before Layer (Ctrl-Insert)** – Inserts a blank soil layer before the highlighted row.

**Insert After Layer (Insert)** – Inserts a soil layer after the highlighted row.

**Delete Layer (Delete)** – Deletes the selected soil layer or layers that are highlighted.

The edit functions for layers are also available by highlighting a row or set of contiguous rows then right clicking within the selected row(s) to display the edit functions.

**View** – This menu displays options for changing the parameters displayed in the Soil User Interface. Two exclusive options are available, of which only one can be chosen.

**All Fields** – When selected, it displays all the fields required by WEPS in the Soil User Interface screen.

**Minimum Fields** – When selected, it displays only the minimum input parameters required by the Soil User Interface. The minimum parameters displayed when the **Minimum fields** box is checked are used by the soil interface as inputs to estimate or generate the parameters required by WEPS. This functionality is accessible from the **Edit** menu with the **Estimate Values** menu option or using **Ctrl-E**. These generated parameters are displayed when the **All fields** box is checked. Any parameters that were adjusted because of out-of-range values, as well as the old and new values, are displayed in the Notes table at the bottom of the Soil User Interface screen.

**Help** – This menu displays a drop down list of help options.

**<u>H</u>elp Topics (Ctrl-H)** – Opens the Soil User Interface online help system.

**<u>A</u>bout Soil** – Displays the current version of the Soil User Interface.

## 12.2 Soil Button Bar Functions

The button bar provides a shortcut to some of the menu items.

 Opens an existing soil file. This has the same function as selecting **<u>O</u>pen...** under **<u>F</u>ile** in the menu bar.

 Cuts the row or rows of the soil file and places into the clipboard. This has the same function as selecting **'Cut Layer'** under **'Edit'** on the menu bar.

 Copies a row or rows of the soil file and places into the clipboard. This has the same function as selecting **'Copy Layer'** under 'Edit' on the menu bar.

 Pastes a row or rows of the soil file from the clipboard to a row above the currently selected row. This has the same function as selecting **'Paste Before Layer'** under **'Edit'** on the menu bar.

 Prints the soil properties currently displayed.

Estimates the values for all fields that can be estimated. Active only when used in conjunction with the **Minimum Fields** option under the **View** menu.

 Opens the general help system for the Soil User Interface.

 Enables context-sensitive help. Click on this button, then on any item on the screen, for help on that item.

 Saves the currently displayed data and closes the Soil User Interface.

The Soil User Interface displays data in four sections with three of them being parameter tables:

The **Soil Surface Properties and Depth Restrictions** table provides information regarding the soil identification, location, and classification. The Soil Identification parameters are not critical to the operation of WEPS and are used for identification purposes only.

The **Soil Identification** table provides information pertaining to the configuration of the soil surface in terms of crusts, roughness, albedo, slope, and rock cover. It also contains the depth to root and water restrictive layers.

The **Soil Layer Properties** table contains soil properties by layer or horizon. At the bottom of the screen is the Soil Notes table. The user may enter any notes pertaining to the soil file. These notes are appended to the bottom of the Soil file.

The **Soil Notes** may also contain notes generated by the interface. These generated notes specify parameters that were adjusted because of out-of-range values, and lists the old and new values. The notes are not critical to the operation of WEPS and are used for information purposes only.

## 12.3 Downloading Soil Data

This section describes how to download soil data from the NRCS Soil Data Mart and how to extract it for use within WEPS. A Microsoft Access database template is also available for importing the data from a Soil Data Mart export file. One must have Microsoft Access 97 or later installed on their PC to use that template.

Soil data for NRCS and most other users in the US, is currently available for download from the NRCS Soil Data Access site's URL at: http://sdmdataaccess.nrcs.usda.gov/ for specific soil data requests using custom scripts, etc. For simpler manual downloads, use the NRCS Web Soil Survey site at:

http://websoilsurvey.sc.egov.usda.gov/App/WebSoilSurvey.aspx

The soil survey data that is exported from the Soil Data Access and the Web Soil Survey sites are in what is referred to as *SSURGO* (Soil Survey Geographic) format. There are multiple ways to obtain WEPS soil data from these sites. The easiest method is to select the **Download Soils Data** tab on the NRCS Web Soil Survey site and follow the instructions provided to download the desired soil data. Note that there may be both "tabular" and "spatial" data available. **Only the "tabular" data is required for this release of WEPS.**

After the zipped file has been downloaded to your PC, it must be unzipped by using either **WinZip** or a similar program. For additional information, please see the file named **README.txt** in the root directory that is created by unzipping the zipped soil file. For additional soil survey areas, each zipped file should be copied and unzipped into individual directories. When a file is unzipped, the following directory hierarchy is produced in the directory to which the file was unzipped:

\spatial

\tabular

The **top-level directory** contains the following files:

**soil_metadata_ssasymbol.txt** - a Federal Geographic Data Committee (FGDC) metadata file in plain ASCII format.

**soil_metadata_ssasymbol.xml** - the same FGDC metadata file in XML format.

**readme.txt** - a text file containing additional information.

The **root directory** will also contain an empty MS Access SSURGO template database, if one was requested as part of the download. This file is currently named "soildb_US_2003.mdb".

The directory **"tabular"** contains any tabular data that was requested. The directory "spatial" contains any spatial data that was requested. Note that spatial data is not required nor recommended (due to large file sizes) for WEPS. It should still be possible to request tabular data from the Soil Survey download site without including the corresponding spatial data, and vice versa.

Tabular data is provided as a set of ASCII delimited files. Each file corresponds to a table in the SSURGO 2.1 data model. The tabular data isn't particularly useful until it has been imported into the MS Access SSURGO template database. Current Web Soil Survey downloads include a template database, if requested. The database is the *soildb_US_2003.mdb*.

To import tabular data, load the template file into MS Access. A *SSURGO Import* screen will display, asking for the full path to the tabular data directory (Fig. 12.2). Type (or cut and paste) the full path of the tabular directory and click *OK*. A list of database tables will appear and a folder will be created in the top level directory. The folder will have the base name (non-extension part) of the template name. At the same time, an MS Access database file (*.mdb), which contains the data required for WEPS, will be created in the template folder.

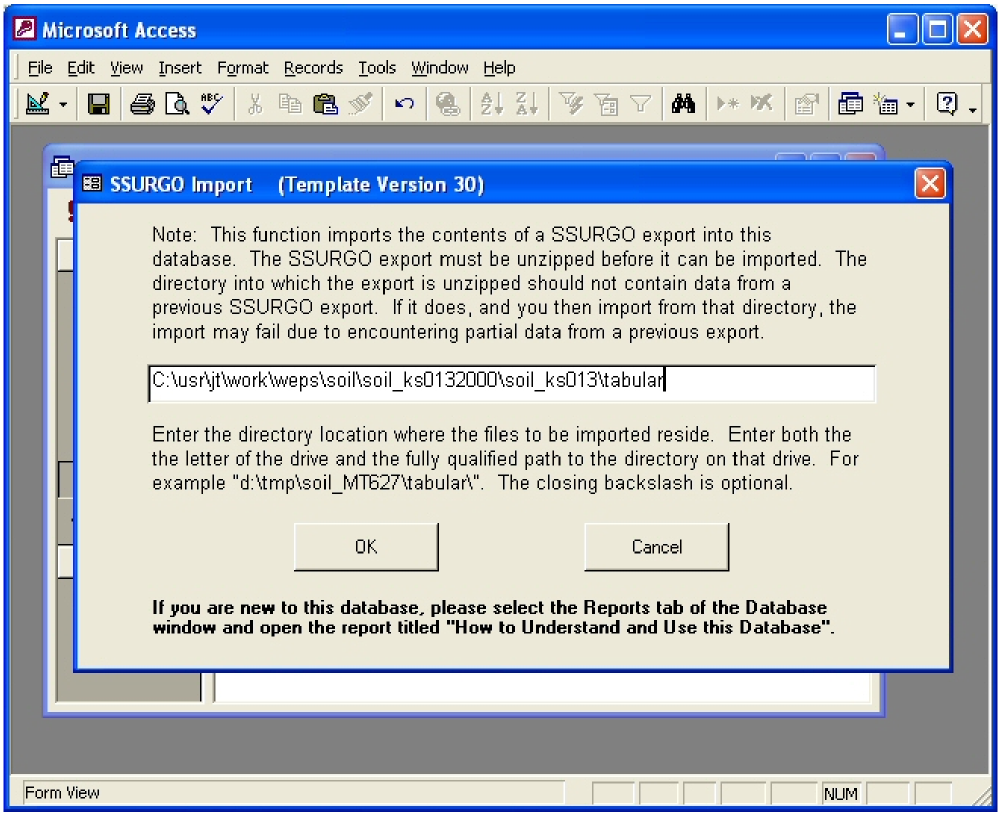



Figure 12.2: WEPS SSURGO Import screen.

To import more than one soil survey area into a single MS Access database, run the Import macro specifying the full path to the directory the SSURGO data was unzipped into. Repeat the Import macro for each area desired. When done, save the template database with the imported data to a new name (*.mdb).

The WEPS 1.5 soil selection process extracts data elements stored in the following SSURGO text data files located in the \tabular directory (tables in the MS Access database), when connected to a Microsoft Access SSURGO database file:

- chfrags.txt
- chorizon.txt
- chtexgrp.txt
- comp.txt
- crstrcts.txt
- legend.txt
- mapunit.txt
- muaggatt.txt
- version.txt

If multiple soil survey areas are imported into a single MS Access database, the database may become very large. To reduce the size of the Access database file, one may run the Export macro and delete the SSURGO data (*.txt) files created in the tabular directory that are not listed above before importing into a template Access database.

### 12.3.1 Using SSURGO Data in Microsoft Access format with WEPS

Within WEPS, open the **Configuration** window, then click the **Directories** tab. Fill out the full path and SSURGO soil database file name (*.mdb) for **"Soil DB"** and close the configuration window (click *Save* if you want to use that path in subsequent WEPS runs). Selecting the Soil Template folder at the bottom of the main WEPS screen will display the list of soil survey areas to choose from. Select the desired soil survey area and select the soil map unit and component for the simulation run. If the SSURGO database is not populated with data required by WEPS, you will get an error message when selecting that soil. More detailed information on selecting soils, see the **Interface Reference: Choosing a Soil** section of the WEPS User Manual.

### 12.3.2 How to Handle Missing Soil Data

In one mode of operation the Soil User Interface estimates limited values if they are not populated in the SSURGO database. NRCS users must click the check box for **Do not estimate missing values from SSURGO database** under the **Miscellaneous** tab of the **Configuration** window so that these values are not estimated. If a soil database record generates an error listing missing data upon loading, contact your local NRCS office for assistance.

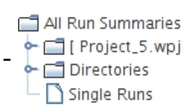
# 13. WEPS Multiple Run Manager (WMRM)

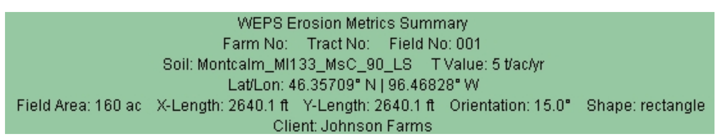
One can view erosion results from multiple WEPS Runs simultaneously from the WEPS Multiple Run Manager (WMRM) shown in (Fig. 13.1). It is accessible from the Main WEPS window (Fig. 8.1) by selecting the Multiple Run Manager option under the **ViewOutput** menu. WMRM provides a tabular display format intended to allow quick comparisons of selected WEPS Runs. A common anticipated usage is to make a baseline or existing management scenario WEPS Run and then additional WEPS simulation runs using variations on that management scenario, or completely different management scenarios. WMRM can then be used to quickly compare/assess the different sets of practices on erosion control, Soil Conditioning Index values, crop water usage, etc.

The WMRM window is user configurable, with the desired columns displayed selectable for specific reporting and analysis purposes. In fact, multiple WMRM windows can be displayed, each configured independently of each other. By default, all the WEPS Runs for the current Project are displayed. However, the user can *hide* WEPS Runs not wanted in the display and select additional Runs from other folder, Projects, etc. One can click on the mouse button with the mouse pointer in any data cell for a selected WEPS Run and the full Report that data came will then be displayed. The user can even select the WEPS Run under the "Run Name" column heading and *Reload* that WEPS Run's inputs into the WEPS interface so that those inputs can be modified/edited for another WEPS simulation run.

WMRM windows consists of the following major components:

Menu bar - **Runs View Reports Header Print Help**

Left window pane for selecting WEPS Runs from various folders - 


WMRM table heading - 


WMRM table view - Consists of a table of columns displaying selected Run output data. The columns displayed can be selected or de-selected via the **View** menu options. The default columns are shown here:

| | | | Avg. Annual | Annual Soil Loss | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | Gross | Net Total | Creep/Salt | Suspension | PM10 |
| Run Name | Management Name | SCI | STIR | (tons/acre) | (tons/acre) | (tons/acre) | (tons/acre) | (tons/acre) |
| new run_5_badname_calib_8 | Old_1.5_mgt_file_bad_opname_CALIB_1 | 0.5 | 36.06 | 0 | 0 | 0 | 0 | 0 |

The WMRM table consists of the following columns by default (columns can be selectively displayed or hidden) as shown in (Fig. 13.1).

**Run Name** - The WEPS Run name. No path included in this column cell entry. The **Run Location** column, which can be optionally specified, provides the path to the WEPS Run.

**Management Name** - The name of the management/crop rotation file used in the WEPS Run.

**SCI** - The Soil Conditioning Index for the WEPS Run.

**Energy** - The Rotation Energy value for the WEPS Run.

**STIR** - The STIR value for the WEPS Run.

**Gross** - The gross annual soil loss on the field.

**Net Total** - The annual net soil loss leaving the field.

**Net Creep/Salt** - The annual net creep and saltation size particles leaving the field.

**Net Suspension** - The annual net suspension size particles leaving the field.

**PM10** - The annual net PM10 (<10µ) particles leaving the field.

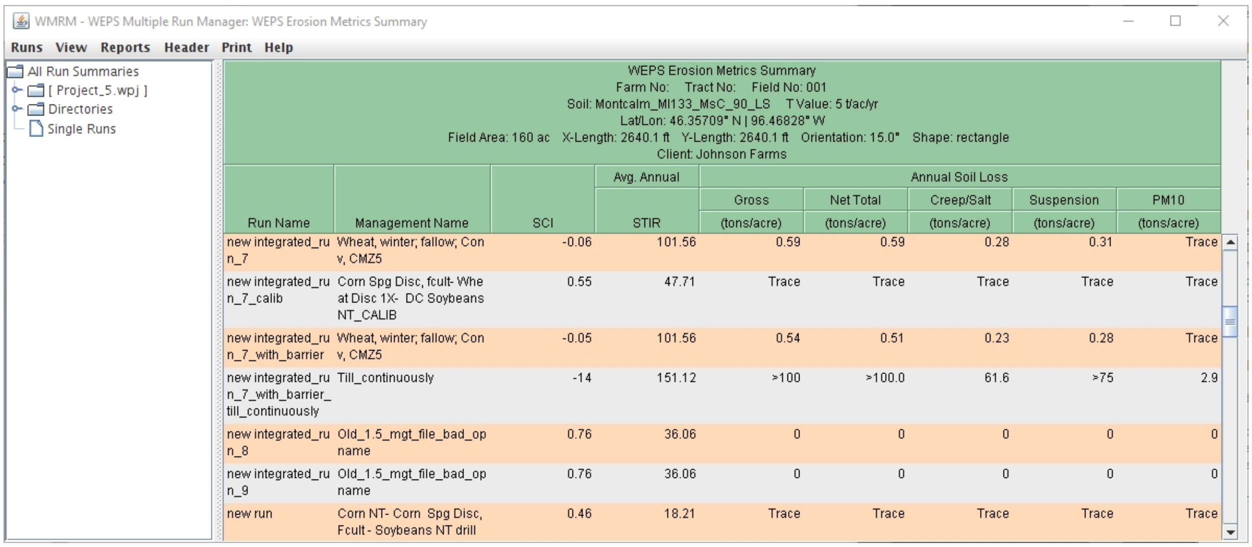



Figure 13.1: WEPS Multiple Run Manager (WMRM).

The **Runs** menu consists of:

**Add Directory** - Add a directory containing WEPS Runs for display in WMRM.

**Add Single Run** - Add a single WEPS Run for display in WMRM.

**Restore Selected Run in WEPS** - Restore the selected WEPS Run inputs into the main WEPS interface screen.

**Export Selected Run...** - Export the selected WEPS Run into the user specified directory location in a popup window. The user has the option of deleting the original copy (folder and contents) if desired from within that window.

**Delete Selected Run** - Delete the selected WEPS Run. Note that this truly deletes the selected WEPS Run's folder and contents. Therefore, one cannot retrieve that WEPS Run's contents after deletion.

**Re-display Run(s)** - Re-display previously hidden WEPS Run(s). A choice list of previously hidden WEPS Runs will be displayed for selection and re-display.

**Hide Run in Tabular Display** - Hide selected WEPS Run within the WMRM table from displaying in a table row within WMRM.

**Refresh Table** - Refresh the WMRM table so that it contains all the WEPS Runs in the specified locations. Useful if the WMRM window is open and additional WEPS Runs have been made since opening it that may be desired to be displayed within the existing open WMRM window. Note that if the user does not want all the new WEPS Runs from being included in the WMRM window, they can select the individual new WEPS Runs desired via the **Add Single Run** menu option.

**Close** - Close the WMRM window.

**New WMRM Window** - Open a new WMRM window.

The **View** menu consists of the following data options. If the adjacent box is checkmarked, the column is displayed in the WMRM table. If the adjacent box is not checked, the column will not display in the WMRM table.

**Select All** - Selects all available data columns.

**Run Location** - Selects the WEPS Run location name column to be displayed. If the Run location path is too long to fit on one line within the current cell width, the path will be wrapped onto multiple lines within the cell to allow the user to see the full path.

**Run Name** - Selects the WEPS Run name column to be displayed. If the Run name is too long to fit on one line within the current cell width, the Run name will be wrapped onto multiple lines within the cell to allow the user to see the full Run name.

**Soil Name** - Selects the WEPS Run Soil name column to be displayed. If the Soil name is too long to fit on one line within the current cell width, the Soil name will be wrapped onto multiple lines within the cell to allow the user to see the full name.

**Management Name** - Selects the WEPS Run Management name column to be displayed. If the Management name is too long to fit on one line within the current cell width, the Management name will be wrapped onto multiple lines within the cell to allow the user to see the full name.

**Client Name** - Selects the WEPS Run Client Name column to be displayed. If the client's name is too long to fit on one line within the current cell width, the name will be wrapped onto multiple lines within the cell to allow the user to see the full client name.

**Farm No** - Selects the WEPS Run Farm No. column to be displayed.

**Tract No** - Selects the WEPS Run Tract No. column to be displayed.

**Field No** - Selects the WEPS Run Field No. column to be displayed.

**Field Size** - Selects the WEPS Run Field Size column to be displayed.

**SCI** - Selects the WEPS Run Soil Conditioning Index column to be displayed.

**Energy** - Selects the WEPS Run Rotation Energy value column to be displayed.

**STIR** - Selects the WEPS Run STIR column to be displayed.

**OM** - Selects the WEPS Run Soil Conditioning Index OM subfactor column to be displayed.

**ER** - Selects the WEPS Run Soil Conditioning Index ER subfactor column to be displayed.

**FO** - Selects the WEPS Run Soil Conditioning Index FO subfactor column to be displayed.

**Precip** - Selects the WEPS Run Precipitation column to be displayed.

**Irrig** - Selects the WEPS Run Irrigation column to be displayed.

**Runoff** - Selects the WEPS Run Runoff column to be displayed.

**Drainage** - Selects the WEPS Run Drainage column to be displayed.

**Gross** - Selects the average annual Gross soil loss column to be displayed.

**Net Total** - Selects the average annual Net Total soil loss column to be displayed.

**Creep/Salt** - Selects the average annual Net Creep/Salt column to be displayed.

**Suspension** - Selects the average annual Net Suspension column to be displayed.

**PM10** - - Selects the average annual Net PM10 ($<10\mu$ particle size) column to be displayed.

The **Reports** menu consists of:

**WEPS Basic Run Metrics Summary** - Displays the basic WEPS Run information in the WMRM table.

**WEPS Erosion Metrics Summary** - Displays the WEPS Erosion information in the WMRM table.

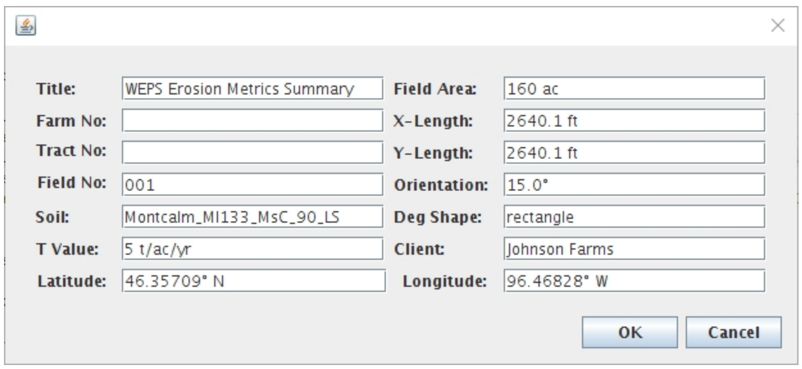
**WEPS Soil Condition Index Metrics Summary** - Displays the SCI and its subfactor information in the WMRM table.

**WEPS Water Use Metrics Summary** - Displays the water usage information in the WMRM table.

**WEPS Expanded Metrics Summary** - Displays expanded WEPS Run information in the WMRM table.

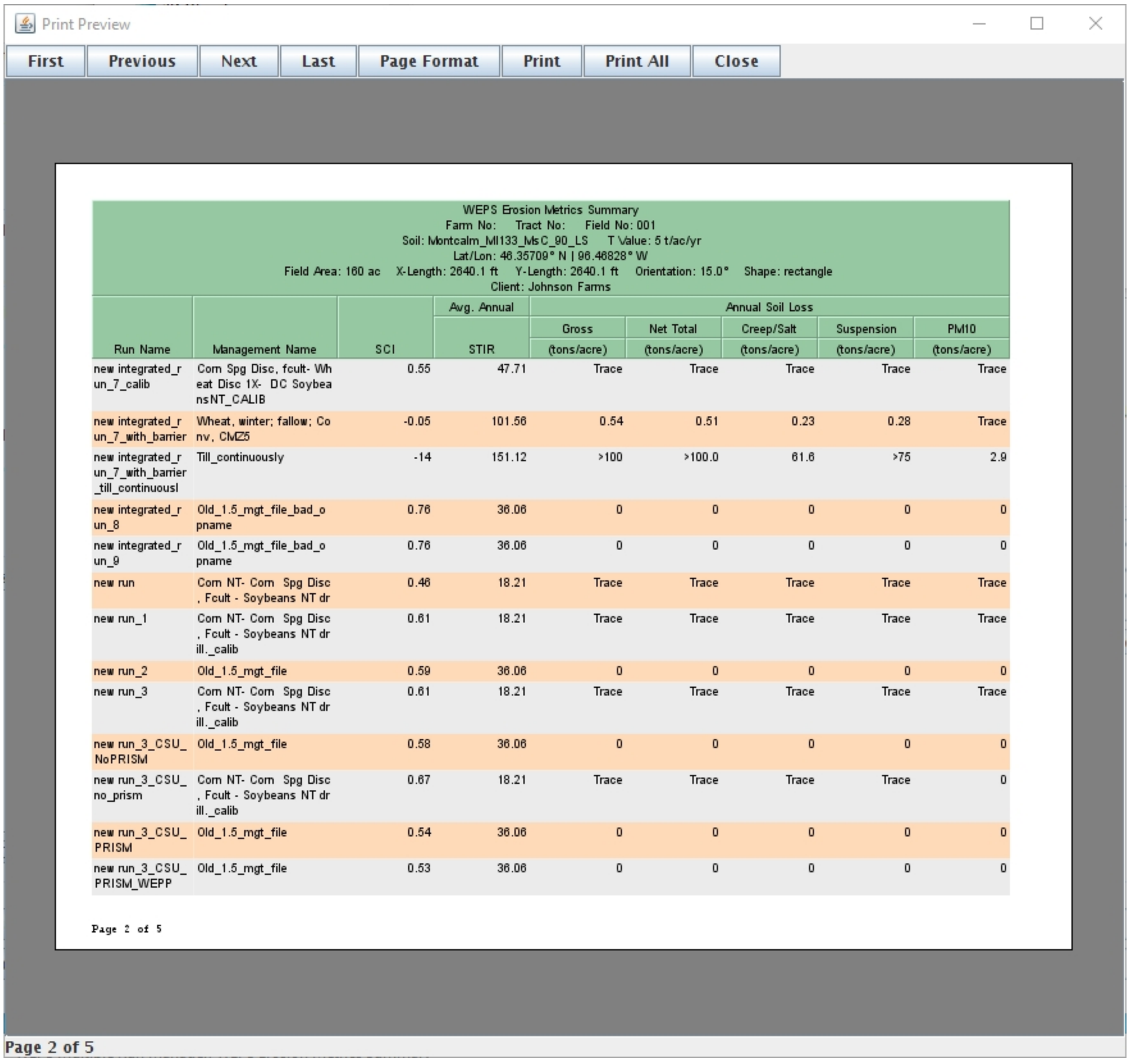
The **Header** menu consists of:

**Edit** - Displays a pop up window where the user can edit the individual header fields as desired. The default header field values are obtained from the first WEPS Run displayed in the table. This allows the user to override the default heading info for hard copy printouts, etc. Here is an example display of the pop up window allowing editing of the individual WMRM header fields.




The **Print** menu consists of:

**Print...** - Print the contents of the WMRM table. The default page format is "Letter" (8 1/2" by 11") in landscape mode. Other printing options, margin settings and mode (Portrait) are available for selection under the **Page Format** menu button. Here is an example display of the "Print Preview" window.




WEPS Erosion Metrics Summary
Farm No: Tract No: Field No: 001
Soil: Montcalm_MI133_MsC_90_LS T Value: 5 t/ac/yr
Lat/Lon: 46.35709° N | 96.46828° W
Field Area: 160 ac X-Length: 2640.1 ft Y-Length: 2640.1 ft Orientation: 15.0° Shape: rectangle
Client: Johnson Farms

| | | | Avg. Annual | Annual Soil Loss | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | Gross | Net Total | Creep/Salt | Suspension | PM10 |
| Run Name | Management Name | SCI | STIR | (tons/acre) | (tons/acre) | (tons/acre) | (tons/acre) | (tons/acre) |
| new integrated_run_7_calib | Corn Spg Disc, fcult- Wheat Disc 1X- DC SoybeansNT_CALIB | 0.55 | 47.71 | Trace | Trace | Trace | Trace | Trace |
| new integrated_run_7_with_barrier | Wheat, winter; fallow; Conv, CMZ5 | -0.05 | 101.56 | 0.54 | 0.51 | 0.23 | 0.28 | Trace |
| new integrated_run_7_with_barrier_till_continuousl | Till_continuously | -14 | 151.12 | >100 | >100.0 | 61.6 | >75 | 2.9 |
| new integrated_run_8 | Old_1.5_mgt_file_bad_opname | 0.76 | 36.06 | 0 | 0 | 0 | 0 | 0 |
| new integrated_run_9 | Old_1.5_mgt_file_bad_opname | 0.76 | 36.06 | 0 | 0 | 0 | 0 | 0 |
| new run | Corn NT- Corn Spg Disc, Fcult - Soybeans NT dr | 0.46 | 18.21 | Trace | Trace | Trace | Trace | Trace |
| new run_1 | Corn NT- Corn Spg Disc, Fcult - Soybeans NT drill._calib | 0.61 | 18.21 | Trace | Trace | Trace | Trace | Trace |
| new run_2 | Old_1.5_mgt_file | 0.59 | 36.06 | 0 | 0 | 0 | 0 | 0 |
| new run_3 | Corn NT- Corn Spg Disc, Fcult - Soybeans NT drill._calib | 0.61 | 18.21 | Trace | Trace | Trace | Trace | Trace |
| new run_3_CSU_NoPRISM | Old_1.5_mgt_file | 0.58 | 36.06 | 0 | 0 | 0 | 0 | 0 |
| new run_3_CSU_no_prism | Corn NT- Corn Spg Disc, Fcult - Soybeans NT drill._calib | 0.67 | 18.21 | Trace | Trace | Trace | Trace | 0 |
| new run_3_CSU_PRISM | Old_1.5_mgt_file | 0.54 | 36.06 | 0 | 0 | 0 | 0 | 0 |
| new run_3_CSU_PRISM_WEPP | Old_1.5_mgt_file | 0.53 | 36.06 | 0 | 0 | 0 | 0 | 0 |

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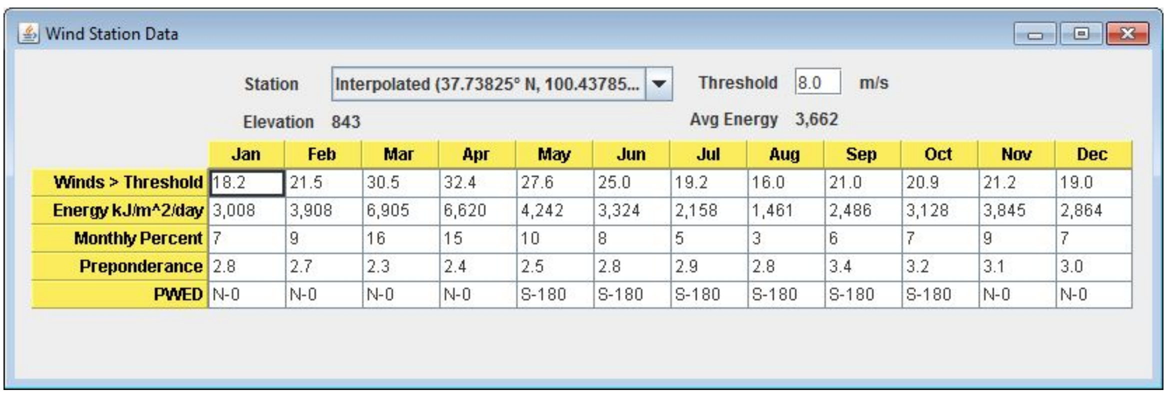
The **Help** menu consists of:

**About WMRM** - Displays a pop-up window that provides information about the WMRM and WEPS in general.

The left side of the screen consists of a tree of directories that contain WEPS Runs that can be selected for display. A subset of the total available runs can be selected by clicking on the desired WEPS Runs to display. Use Ctrl-right mouse button to select multiple, non-contiguous WEPS Runs for display.

# 14. Displaying Wind Station Data Information

One can view wind information on selected Windgen records (even interpolated Windgen records) from the Main WEPS window (Fig. 8.1) by selecting the **Display Wind Station Info** option under the WEPS **Tools** menu or by pressing the **Alt+W** keys simultaneously to bring up the *Wind Station Data* window (Fig. 14.1). The wind statistics displayed in the window for the currently selected Windgen station from within the WEPS main screen, includes relevant wind parameters by month for evaluating the suitability of the wind station for the specified location of WEPS simulation runs. Clicking the down arrow to the right of the station name displays a list of alternative available wind stations from which to choose. Multiple windows can be displayed simultaneously, so a WEPS user can compare two or more station's wind statistics if desired.




| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Winds > Threshold | 18.2 | 21.5 | 30.5 | 32.4 | 27.6 | 25.0 | 19.2 | 16.0 | 21.0 | 20.9 | 21.2 | 19.0 |
| Energy kJ/m^2/day | 3,008 | 3,908 | 6,905 | 6,620 | 4,242 | 3,324 | 2,158 | 1,461 | 2,486 | 3,128 | 3,845 | 2,864 |
| Monthly Percent | 7 | 9 | 16 | 15 | 10 | 8 | 5 | 3 | 6 | 7 | 9 | 7 |
| Preponderance | 2.8 | 2.7 | 2.3 | 2.4 | 2.5 | 2.8 | 2.9 | 2.8 | 3.4 | 3.2 | 3.1 | 3.0 |
| PWED | N-0 | N-0 | N-0 | N-0 | S-180 | S-180 | S-180 | S-180 | S-180 | S-180 | N-0 | N-0 |

Figure 14.1: Wind Station Data information window.

The assumed wind speed threshold, default set to 8 m/s, for the calculations, the station elevation in meters and the average wind energy for the year in $kJ/m^2/day$ are displayed at the header section at the top of the window.

The following parameters are displayed for each month in tabular form:

**Winds > Threshold** - The percentage of the time the wind is above the given threshold. This parameter will give the user an indication of the percentage of time winds are near or above erosive speeds and should only be used for general purposes. The actual threshold of wind erosion used in WEPS varies with the surface conditions. The default threshold value is 8.0 m/s.

**Energy** - The erosive wind energy greater than the given threshold ($kJ/m^2/day$).

**Monthly Percent** - Percentage of the annual erosive wind energy.

**Preponderance** - The prevalence of the prevailing wind erosion direction for the month (maximum ratio of parallel to perpendicular erosion forces). A preponderance value of 1.0 indicates no prevailing wind erosion direction. A value of 2.0 indicates a prevailing wind erosion direction, with wind erosion forces twice as great parallel as perpendicular to prevailing wind erosion direction.

**PWED** - The **Prevailing Wind Energy Direction** is presented as one of the sixteen cardinal directions as well as the angle in degrees from north.

# 15. Comparing WEPS Files for Differences

One can compare WEPS Runs, WEPS *weps.run* files, WEPS Management files and WEPS Soil files and determine what is different between them. The **Diff WEPS Files** menu option is accessible under the **Tools** menu on the main WEPS Screen. The differencing window is shown in (Fig. 15.1). This function is very useful to determine exactly what is different between two WEPS Runs or other WEPS input files when the WSEPS user is not exactly sure what is different between them.

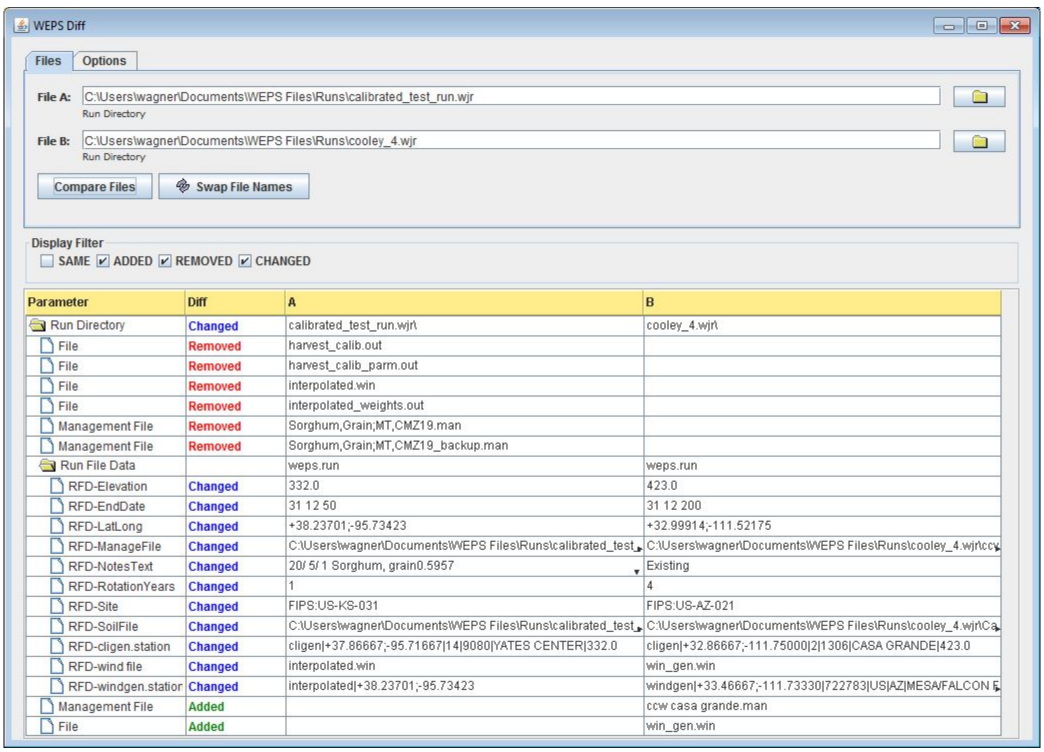



Figure 15.1: WEPS Differencing Window (Files tab).

There are two tabs in the top section **Files** and **Options**:

**Files** tab - This tabbed section, as shown in (Fig. 15.1), allows the user to select the two files or directories to compare. The comparison is made when the Compare Files button is pressed. The Swap File Names button switches the selected files between *File A* and *File B* positions.

The **Display Filter** section allows one to specify (checkmark) what is to be displayed in the differencing window below. The options are: **Same**, **Added**, **Removed** and **Changed**.

The differencing window in the bottom section displays a table with the *Differences* displayed. The column headings of the table are:

**Parameter** – The specific parameter or object being compared on the line.

**Diff** - The type of difference between the two files/directories being compared. The differences are labeled: ***Changed***, ***Removed*** and ***Added***.

**A** - The *File A:* file or directory being compared.

**B** - The *File B:* file or directory being compared.

**Options** tab - This tabbed section, shown in (Fig. 15.2), contains the available options that WEPS operations are matched on: *Operation Date*, *Operation Name* and *Crop Name* and whether an AND or OR comparison is made.


Figure 15.2: WEPS Differencing Window (Options tab).

# 16. WEPS Configuration Options and Settings

The Configuration Panel window is accessible from the main WEPS screen menu as **Edit Configuration**, which is the last option under the **Tools menu**. It can also be accessed with the **Alt-C** key combination when the main WEPS screen has focus. The Configuration Panel consists of several labeled tabs and three buttons at the bottom of the screen.

The WEPS Configuration Panel buttons are:

**OK** - Saves the changes permanently to the WEPS local configuration file and closes the Configuration Panel window.

**Cancel** - Cancels all changes and closes the WEPS Configuration Panel window.

**Help** - Opens the general help for the WEPS Configuration Panel window.

The WEPS Configuration Panel consists of the following tabs:

**Display** - Provides numerous general settings and options for the WEPS interface.

**Server** - Provides settings and options for the server (CSIP cloud) services which are divided up into three sub-tabs within this panel frame labeled: **Model executables**, **Model options** and **Remote data services**.

**Run** - Specifies the WEPS Run length settings and other related parameters.

**Soil** - Specifies the location of the soil database directory, organic soil file and other options and settings specific to how WEPS treats the soil data provided.

**Project & Data Loc** - A list of directories and configuration files used by the WEPS interface.

**MCREW** - Displays the Management/Crop Rotation Editor for WEPS (MCREW) related settings.

**Windgen** - Displays the settings pertaining to the Windgen generator, interpolation functions available and settings on how the interface determines which Windgen record to use for a specified WEPS Run.

**Cligen** - Displays the settings pertaining to the Cligen generator and settings on how the interface determines which Cligen record to use for a specified WEPS Run.

**WEPS** - Displays the command-line options for the WEPS science model.

**GIS** - Provides the location of the GIS files needed by the MAP tool in the WEPS interface.

**Reporting** - Provides setting options for specific detail and debug reports available from the WEPS science model.

**Email/Mantis** - Provides settings for the built-in email function and the Mantis ticket system connectivity for the WEPS interface.

**Fuels** - Provides access to the Fuels database and displays the current contents of that file.

**Barriers** - Provides access to the wind barrier records file path/name.

## 16.1 Configuration Panel - Display Tab

The Display tab is shown here (Fig. 16.1). It consists of general configuration options for the WEPS interface.

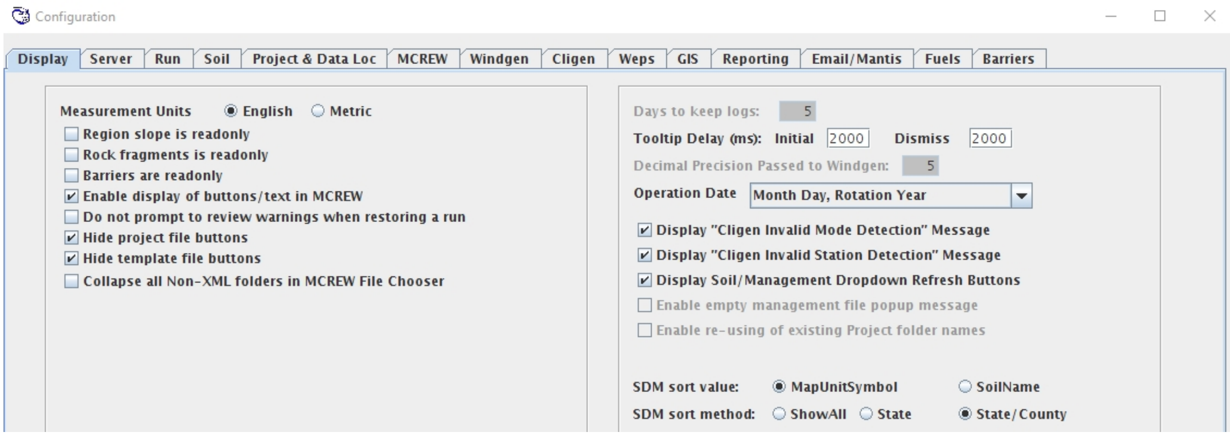



Figure 16.1: WEPS Configuration Panel displaying the Display tab.

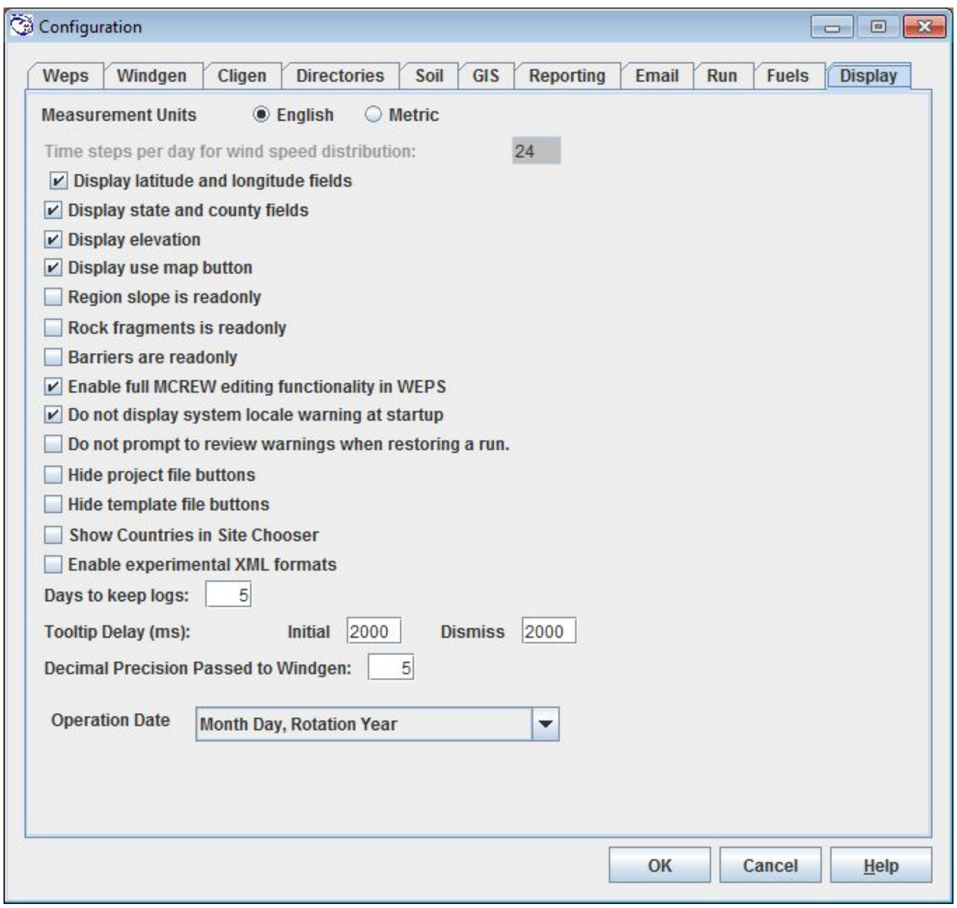



Figure 16.2: WEPS Configuration Panel displaying the Display tab (old).

**Measurement Units** - Display either Metric (SI) or English units on WEPS screens.

**Time steps per day for wind speed distribution** - Enter the number of time steps used for the daily distribution of simulated wind speed. It cannot be changed and should be greyed out or not displayed at all.

**Display latitude and longitude fields** - Check box to display the latitude and longitude fields in the **Location Information** panel on the Main screen. Un-check the box to hide these fields.

**Display state and county fields** - Check box to display the state and county fields in the **Location Information** panel on the Main screen. Un-check the box to hide these fields.

**Display elevation** - Check box to display the elevation field in the **Location Information** panel on the Main screen. Un-check the box to hide this field.

**Display use map button** - Check box to display the **Use Map** button in the **Location Information** panel on the Main screen. Un-check the box to hide this button.

**Region slope is read only** - Check box to only display the simulation region slope field on the main WEPS interface screen and not allow it to be edited.

**Rock fragments is read only** - Check box to only display the rock fragments field on the main WEPS interface screen and not allow it to be edited.

**Barriers are read only** - Check box to only display the barriers information and not allow them to be edited.

**Enable full MCREW editing functionality in WEPS** - Check box to enable the full MCREW editing functionality in WEPS. Allows additional editing functionality of MCREW. Un-check the box to disable this functionality. When this functionality is disabled, the MCREW File Open and Open Copy of Template menu items are disabled.

**Allow estimations in the Soil UI** - Check box to enable the estimation of soil parameters in the WEPS Soil user interface (UI) when they are missing from the soil database.

**Do not display system locale warning at startup** - Check box to turn off the display of a warning when WEPS is installed in a non-US locale. To avoid problems, WEPS is always installed using the "US locale", regardless of the local PC settings. The following is an example of the warning message displayed if the box is not checked and WEPS is installed in a non-US locale:

> *WEPS has detected that this machine is using the German (Germany) locale. WEPS uses the English (United States) locale. You do not need to change your machine's locale, but be aware that numbers will be formatted in the English (United States) style. For more info about what a "locale" is, see : www.microsoft.com/globaldev/DrIntl/faqs/Locales.mspx*

**Do not estimate missing soil values from SSURGO database** - Check box to disable the estimation of soil parameters in the user interface when they are missing from the soil database.

**Organic matter fraction minimum** - Enter the minimum fraction of organic matter in the soil surface.

**Do not prompt to review warnings when restoring a run** - Check box to turn off warnings displayed from a previous WEPS Run when it is restored.

**Hide project file buttons** - Check box to turn off the Project button displayed on the Man and Soil fields on the main WEPS screen.

**Hide template file buttons** - Check box to turn off the Template button displayed on the Man and Soil fields on the main WEPS screen.

**Show Countries in Site Chooser** - Check box to turn on the **Country** field above the **State** and **County** fields on the main WEPS screen.

**Enable experimental XML formats** - Check box to turn on use of XML formatted files. This field should not be checked, if displayed for normal WEPS users.

**Tooltip Delay** - Sets the delay time for the initial appearance of the tooltip and for the dismissal of the tooltip box from the screen. The units are in milliseconds. To disable tooltip display, set the *Initial* value to 1000 (1 second) and the *Dismiss* value to zero.

**Decimal Precision Passed to Windgen** - Sets the number of digits right of the decimal to be passed for writing out the lat/lon values in the weps.run file and for use in the interpolation functions. This value should be set to 5 for WEPS releases 1.5 or greater. A value of 2 should be used if strict compatibility with WEPS version 1.3.9 is required.

**Operation Date** - Click the down arrow to the right of the box displays a list of available formats for the operation date. The format is displayed on this tab, next to "Operation Date" when a format is selected.

**Search Radius** - Enter the search radius for the climate station choice lists (kilometers or miles, depending upon the "Measurement Units" setting). The user usually will want the nearest station to their simulation site. The user may want to select a different station more typical of the climate for the field being simulated if the nearest station doesn't meet their criteria. An example of not selecting the closest station might occur in mountainous areas where the nearest station does not always typify the climate for the simulated field.

## 16.2 Configuration Panel – Server Tab

Server Tab needs filled in here.

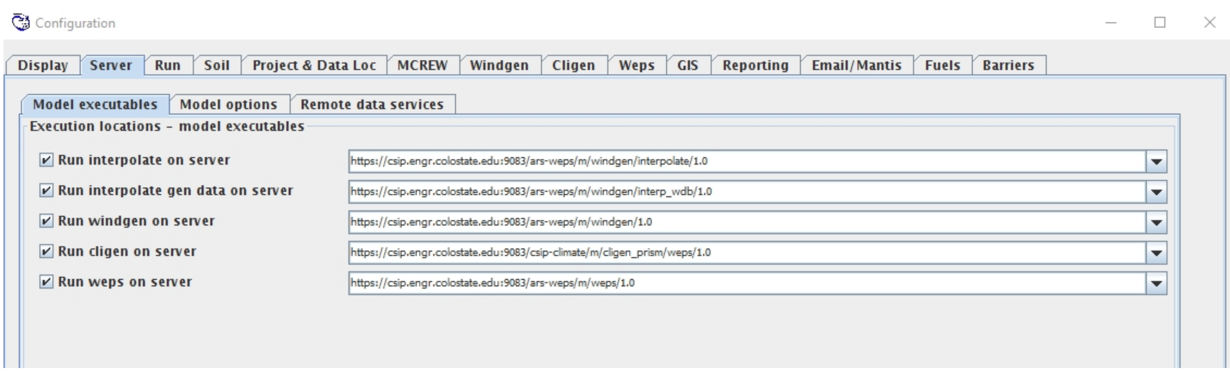



Figure 16.3: WEPS Configuration Panel displaying the Server tab (Model executables sub-tab).

## 16.3 Configuration Panel – Run tab

The **Run** tab (Fig. 16.4) allows the user to specify default required WEPS runtime configuration settings.

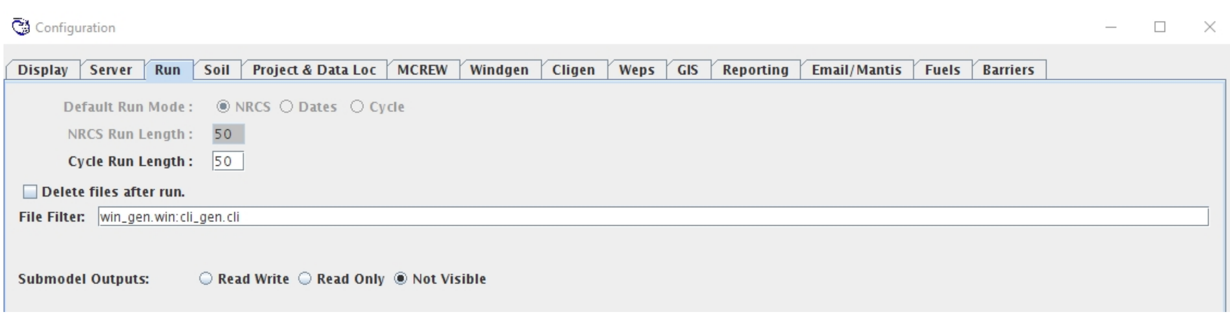



Figure 16.4: Configuration Panel displaying the Run tab.

**Default Run Mode** options are:

**NRCS** - This mode is specified for NRCS users. Note that if this mode is selected, the user cannot change the run mode from the WEPS interface screen nor change the number of cycles that are simulated in a

WEPS Run.

**Dates** - This mode allows the user to set the beginning and ending dates for a simulation run. It is intended for advanced users and developers who may be wanting to compare real world field results with what WEPS is simulating. Thus, it is generally used with real weather data rather than generated data. Note that the beginning date should be set to January 1 of the calendar year selected and the ending date being December 31 of the calendar year selected. Also, the user must be aware that the WEPS interface reports assume that the length of a management cycle divides evenly into the total simulation runtime length in years. If not, then those reports will likely be in error.

**Cycle** - The mode that ensures that the total WEPS simulation length gets set to a value that is evenly divisible by the length of the management rotation (rotation years). The number of "cycles" can be specified by the user on the main WEPS interface screen. Note that the NRCS mode is identical to **Cycle** mode, except the number of cycles is fixed and not allowed to be changed.

**NRCS Run Length** - The length of a WEPS simulation run in management rotation "cycles" for an NRCS mode WEPS run.

**Delete files after run** - If checked, delete the files listed in the **File Filter** field at the conclusion of a WEPS run.

**File Filter** - The list of files that are to be deleted if the **Delete files after run** option is enabled. Display batch script creation option – Determines if the batch script option is presented at the start of a WEPS run.

**Submodel Outputs** - Specifies whether the submodel output options are presented to the user at the start of a WEPS run. The options are: Read Write, Read Only and Not Visible.

## 16.4 Configuration Panel – Soil Tab

The **Soil** tab allows the user to select the directories and specify specific options related to WEPS soil data (Fig. 16.5. One can click on the folder icon  to display a file chooser to select the files or locations for those type of configuration fields.

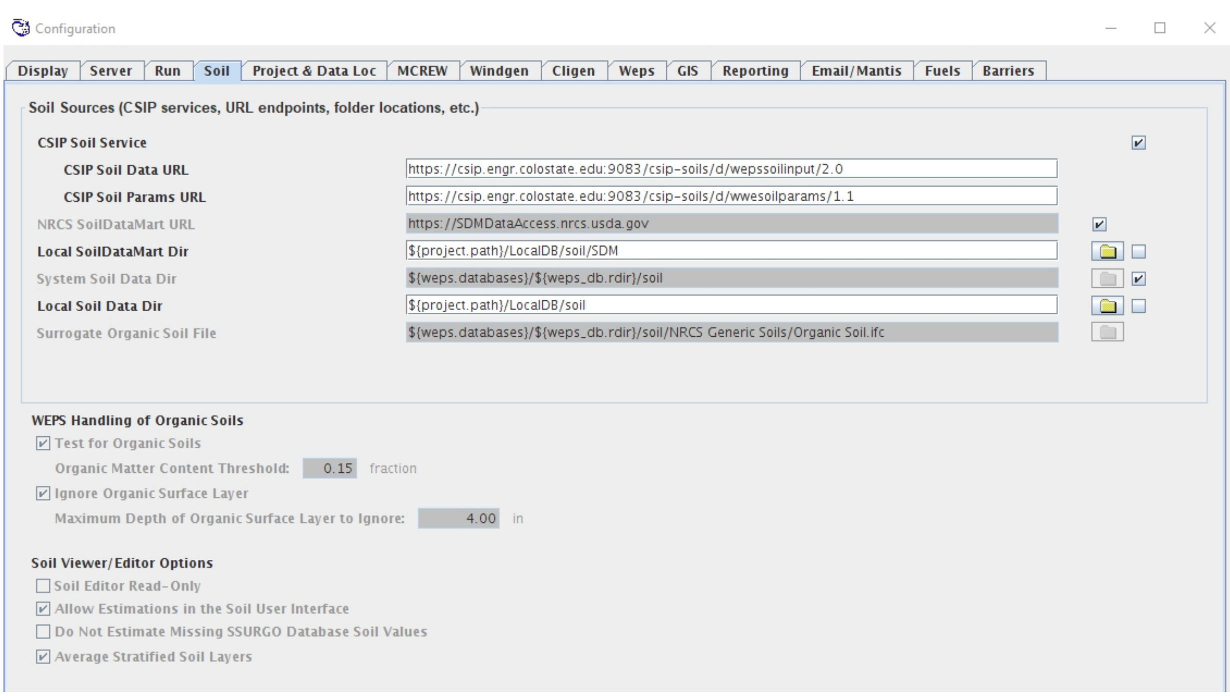



Figure 16.5: WEPS Configuration Panel displaying the Soil tab.

**Soil Database** - The default directory for local "ifc" and NRCS SSURGO Microsoft Access "mdb" soil database files. It is also where the "SDMDataAccess.nrc.usda.gov.db" file resides containing the link information to the NRCS online SSURGO soil database.

**Organic Soil File** - The default directory location and filename of the WEPS soil file used as a surrogate for organic soils by NRCS.

**Test for Organic Soils** - Enables the check for organic soils that is used by NRCS.

**Organic Matter Threshold** - Sets the threshold value for organic matter that the NRCS Organic Soils test uses.

**Ignore Organic Surface Layer** - Enables the feature to ignore a surface layer that is high in organic matter when reading in a soil file within WEPS.

**Maximum Depth of Organic Surface Layer to Ignore** - Sets the maximum depth for the **Ignore Organic Surface Layer** feature.

**Average Stratified Soil Layers** - Enables the feature to average "stratified" soil layers specified in an NRCS soil data record.

**Allow Estimations in the Soil User Interface** - Enables the manually triggered soil property estimation functions in the Soil User Interface to work if specific soil properties are missing in the displayed soil record.

**Do Not Estimate Missing SSURGO Database Soil Values** - Disables the automated soil property estimation functions in WEPS if specific soil properties are missing in the selected soil record.

**Soil Editor Readonly** - Configures the Soil User Interface editor to not allow editing.

## 16.5 Configuration Panel – Project & Data Loc Tab

The **Project & Data Loc** tab allows the user to select the directories used for templates, skeleton files, databases, and Projects as well as other WEPS related configuration files, etc. by entering the path/file name or clicking the folder icon  to display a file chooser to select the files or locations (Fig. 16.6).

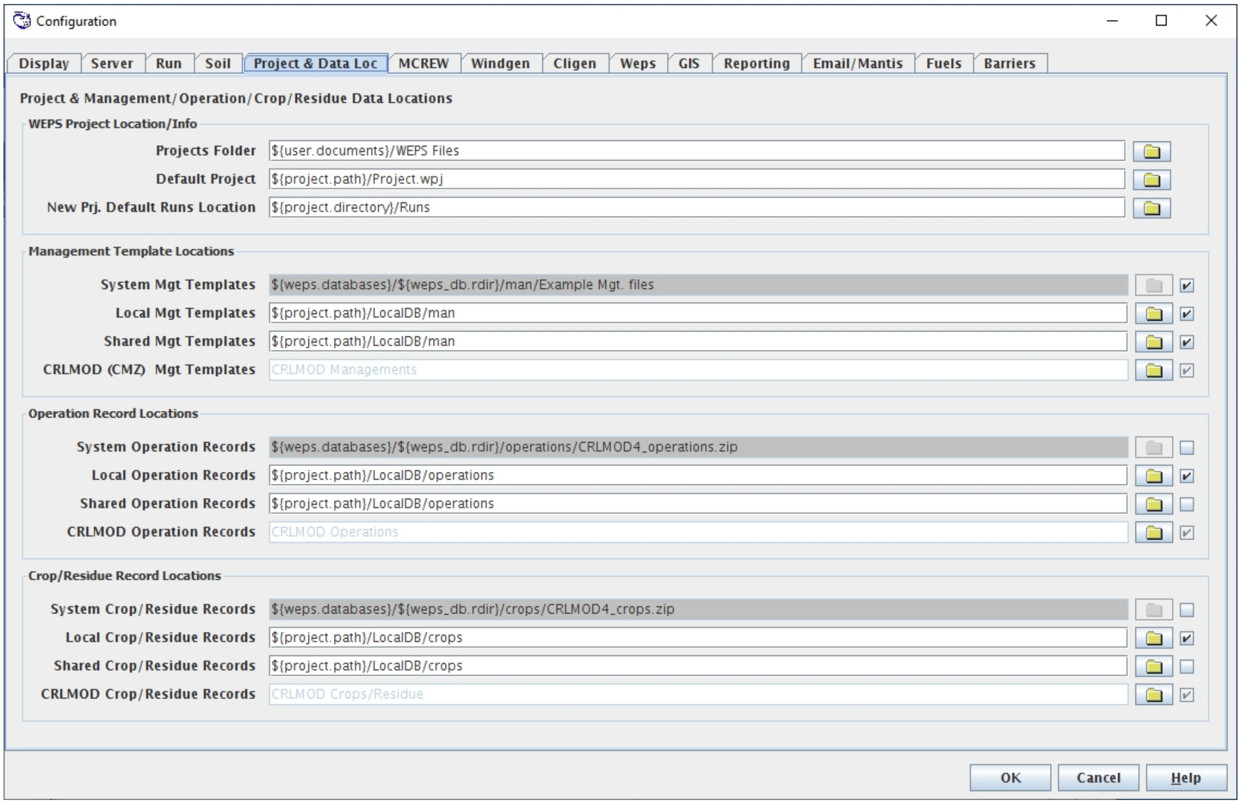



Figure 16.6: WEPS Configuration Panel displaying the Directories tab.

**Projects Directory** - The default directory for WEPS Projects. ${user.documents} is an operating system variable that defines the user's documents directory (typically the **My Documents** folder in Microsoft Windows).

**New Project Default Runs Locat...** - The default WEPS Runs location that is used when a new Project directory is specified from within the WEPS main screen **Projects** menu.

**Man Template Open** - The default directory location for storing management template files.

**Man Template Save** - The default directory for saving management template files.

**Man Conversion Dir** - The directory specified for use when converting management files between the intermediate RUSLE2/WEPS "skel" format and the WEPS format.

**Operation Records** - The default directory location for the management operation database files.

**Crop Records** - The default directory location for the management crop database files.

**Field Barriers** - The default directory location and filename for the WEPS wind barrier data file.

**MCREW Directory** - The default directory location for MCREW configuration files.

**MCREW Data Config** - The default directory and filename for the MCREW data configuration file.

**Management Translation File** - The translation file used for converting NRCS RUSLE2 "skel" format management files to WEPS format management files.

**Report Image Filename** - The file name of the image to be displayed on the WEPS report files such as an Agency logo.

**Detail Report Filters** - The default directory location and filename for the WEPS Tabular Detail Report filters.

## 16.6 Configuration Panel – MCREW Tab

MCREW Tab needs filled in here.

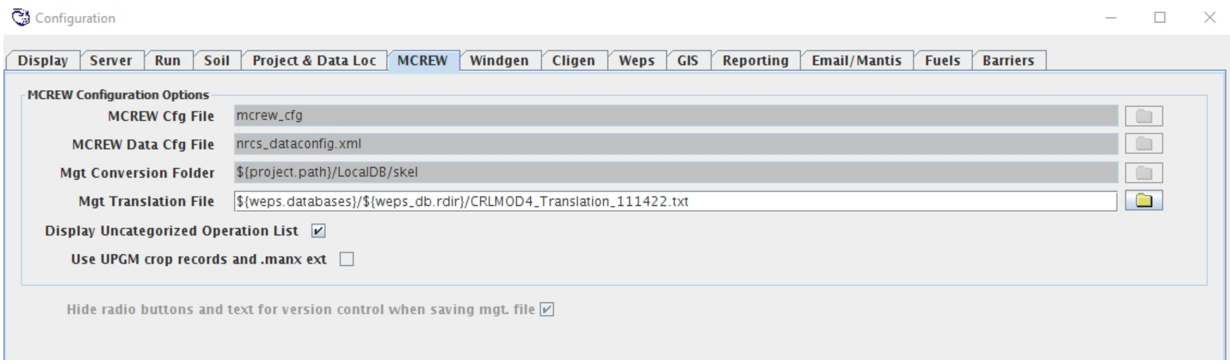



Figure 16.7: WEPS Configuration Panel displaying the MCREW tab.

## 16.7 Configuration Panel – Windgen Tab

Displays the settings pertaining to the Windgen generator, interpolation functions available and settings on how the interface determines which Windgen record to use for a specified WEPS Run (Fig. 16.8).

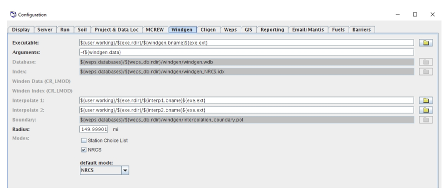


Figure 16.8: WEPS Configuration Panel displaying Windgen tab.

**Executable** - Displays the path and file name of the Windgen generator executable. The folder button allows the user to browse and select an alternate Windgen generator executable if desired.

**Arguments** - Displays the Windgen generator executable default command line arguments (see Appendix for argument list). The "${windgen.data}" argument option refers to the default location of the Windgen station database file, which is defined in the **Database** field on this form.

**Database** - Displays the path and file to the Windgen station database file. The folder button allows the user to browse and select an alternate Windgen database file if desired. The "${weps.databases}" property is set to the default location where the WEPS database file resides.

**Index** - Displays the path and file to the Windgen station database index file. This file contains a list of the Windgen stations in the corresponding database file to use in WEPS. The folder button allows the user to browse and select an alternate Windgen database index file if desired. This file must be kept in sync with the Windgen database file listed above, otherwise WEPS may not find the desired Windgen station for WEPS Runs.

**Interpolate 1** - Displays the path and file to the spatial interpolation executable file which determines which three Windgen stations to use for station parameter interpolation at a given location. The folder button allows the user to browse and select an alternate interpolation executable file if desired.

**Interpolate 2** - Displays the path and file to the interpolation executable file which interpolates the station parameters for the three Windgen stations obtained from the **Interpolate 1** program listed above. The folder button allows the user to browse and select an alternate interpolation executable file if desired.

**Boundary** - Displays the path and file to the GIS polygon "interpolation boundary" file which specifies the spatial polygon boundary that defines the region where Windgen stations are interpolated. The folder button allows the user to browse and select an alternate GIS polygon boundary file if desired.

**Radius** - Displays the radius limit that is used in the Windgen station selection field on the main WEPS screen when the **Station Choice List** option is active. It constrains the number of stations to be displayed in the dropdown choice list.

**Modes** - Lists the modes that can be enabled for Windgen station selection on the main WEPS screen. There are several Windgen station selection methods described here: **Alternative Weather Station Selection Methods** that employ these modes, when set. The mode options are:

**Station Choice List** Provides a dropdown list of stations sorted by distance from the specified lat/lon on the main WEPS screen, with the nearest station the default option.

**Nearest Station** - Provides the nearest Windgen station to the specified lat/lon coordinates on the main WEPS screen.

**File** – Allows the user to select a file that is in the format of a Windgen generator created Windgen hourly wind data file for use in WEPS.

**GIS** - Allows the user to use the GIS polygon map for selecting Windgen stations.

**Interpolated** - Allows Windgen station records to be interpolated if they fall within the polygon boundary specified in the GIS polygon **Boundary** file listed above.

**NRCS** - A special mode that employs several other modes in a prescribed sequence for determining the Windgen station, based upon the selected lat/lon coordinates specified in the WEPS main screen. The sequence is defined in the **Alternative Weather Station Selection Methods** section.

## 16.8 Configuration Panel – Cligen Tab

Displays the settings pertaining to the Cligen generator, interpolation functions available and settings on how the interface determines which Cligen record to use for a specified WEPS Run (Fig. 16.9)

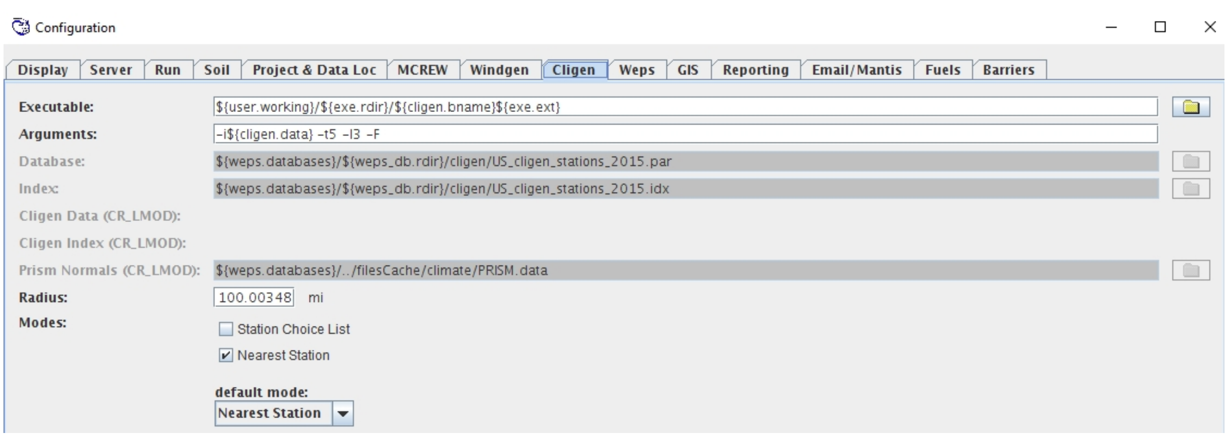



Figure 16.9: WEPS Configuration Panel displaying Cligen tab.

**Executable** - Displays the path and file name of the Cligen generator executable. The folder button allows the user to browse and select an alternate Cligen generator executable if desired.

**Arguments** - Displays the Cligen generator executable default command line arguments (see Appendix for argument list). The "${cligen.data}" argument option refers to the default location of the Cligen station database file, which is defined in the **Database** field on this form.

**Database** - Displays the path and file to the Cligen station database file. The folder button allows the user to browse and select an alternate Cligen database file if desired. The "${weps.databases}" property is set to the default location where the WEPS database file resides.

**Index** - Displays the path and file to the Cligen station database index file. This file contains a list of the Cligen stations in the corresponding database file to use in WEPS. The folder button allows the user to browse and select an alternate Cligen database index file if desired. This file must be kept in sync with the Cligen database file listed above, otherwise WEPS may not find the desired Cligen station for WEPS Runs.

**Radius** - Displays the radius limit that is used in the Cligen station selection field on the main WEPS screen when the Station Choice List option is active. It constrains the number of stations to be displayed in the drop-down choice list.

**Modes** - Lists the modes that can be enabled for Cligen station selection on the main WEPS screen. There are several Cligen station selection methods described here: **Alternative Weather Station Selection Methods** that employ these modes, when set. The mode options are:

**Station Choice List** - Provides a dropdown list of stations sorted by distance from the specified lat/lon on the main WEPS screen, with the nearest station the default option.

**Nearest Station** - Provides the nearest Cligen station to the specified lat/long coordinates on the main WEPS screen.

**File** - Allows the user to select a file that is in the format of a Cligen generator created Cligen daily weather data file for use in WEPS.

**GIS** – Allows the user to use the GIS polygon map for selecting Cligen stations.

**NRCS** – A special mode that employs several other modes in a prescribed sequence for determining the Cligen station, based upon the selected lat/lon coordinates specified in the WEPS main screen. The sequence is defined in the **Alternative Weather Station Selection Methods** section.

## 16.9 Configuration Panel - WEPS Tab

The WEPS tab is shown here (Fig. 16.10). It displays the command line options for the WEPS science model and its directory location, etc.

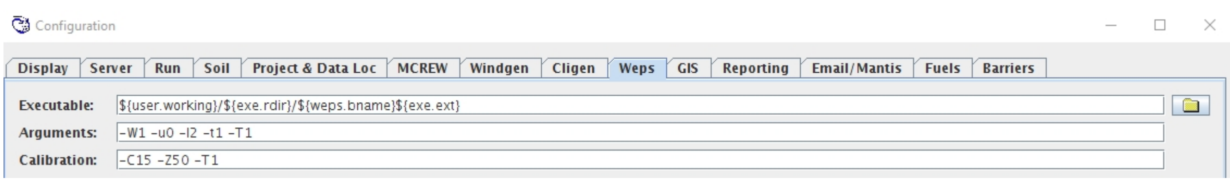



Figure 16.10: WEPS Configuration Panel displaying the WEPS tab.

**Executable** - Displays the path and file name of the WEPS science executable. The folder button allows the user to browse and select an alternate WEPS executable if desired.

**Arguments** - Displays the WEPS science model command line arguments(see Appendix for argument list).

**Calibration** - Display the WEPS science model command line arguments to be used for a yield calibration run (see Appendix for argument list).

## 16.10 Configuration Panel – GIS tab

The **GIS tab** (Fig. 16.11) allows the user to specify the GIS directory containing GIS files used in the MAP component that is accessible from the main WEPS interface screen.

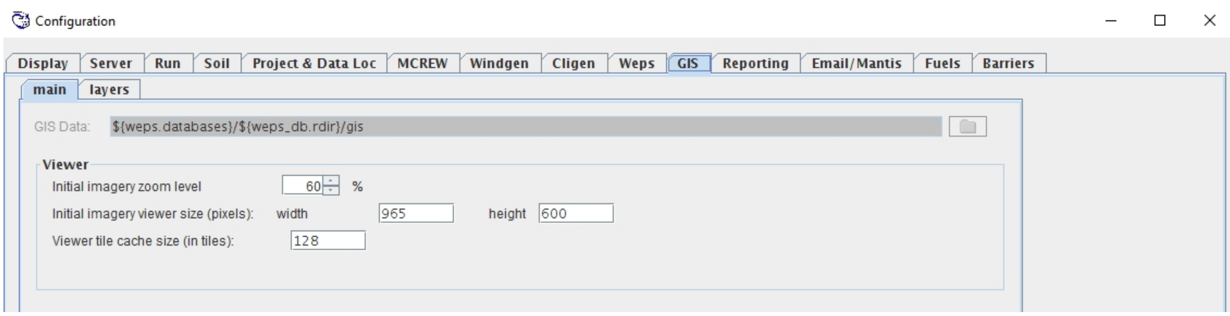



Figure 16.11: WEPS Configuration Panel displaying the GIS tab (main sub-tab).

(Needs to be fleshed out here):

**GIS Data** – Sets the directory location that the GIS files used by the MAP component, which is accessed from the WEPS Interface screen. The folder icon can be clicked on to display a file chooser to select an alternative location, if desired.

Here is the next "layers" sub-tab (Needs to be fleshed out here):

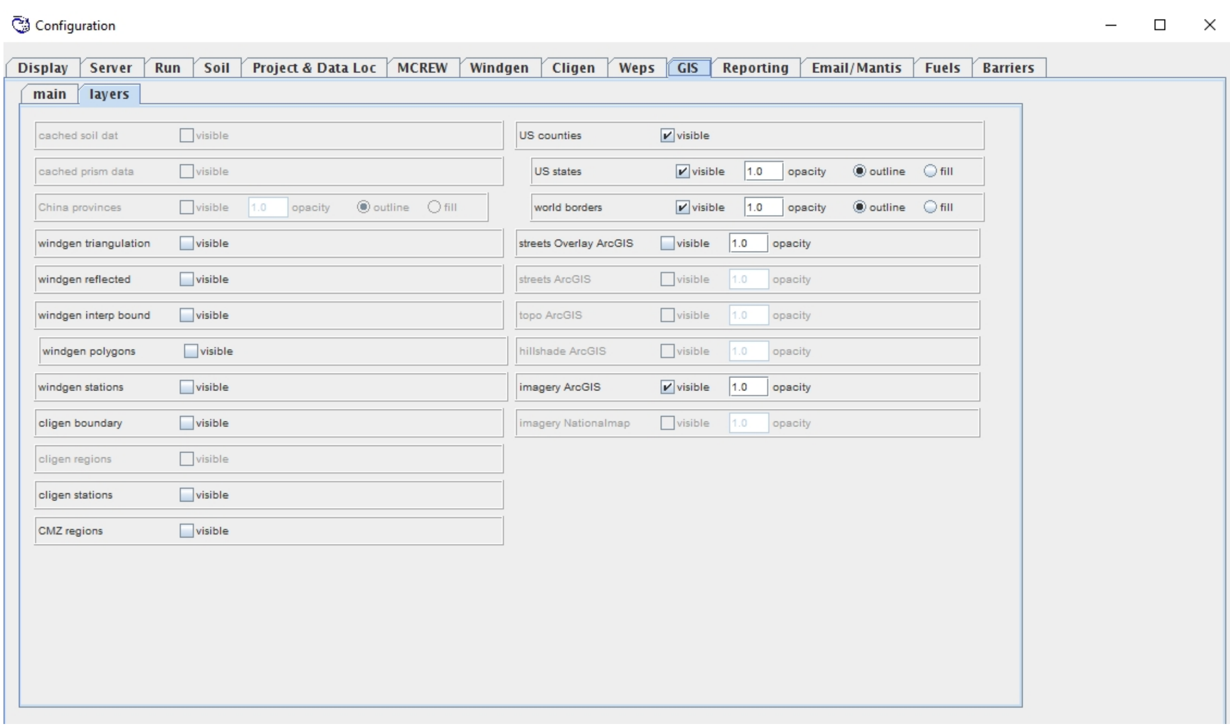



Figure 16.12: WEPS Configuration Panel displaying the GIS tab (layers sub-tab).

## 16.11 Configuration Panel – Reporting Tab

The **Reporting** tab (Fig. 16.13) allows the user to specify additional WEPS science model output. The additional output is specified by setting the values to numbers greater than zero for the selected submodels. Larger numbers produce reports with more detail, if the submodel has multiple levels of reports. There are two levels of reports, Detail and Debug. The specific type of output produced at the different levels are provided here:

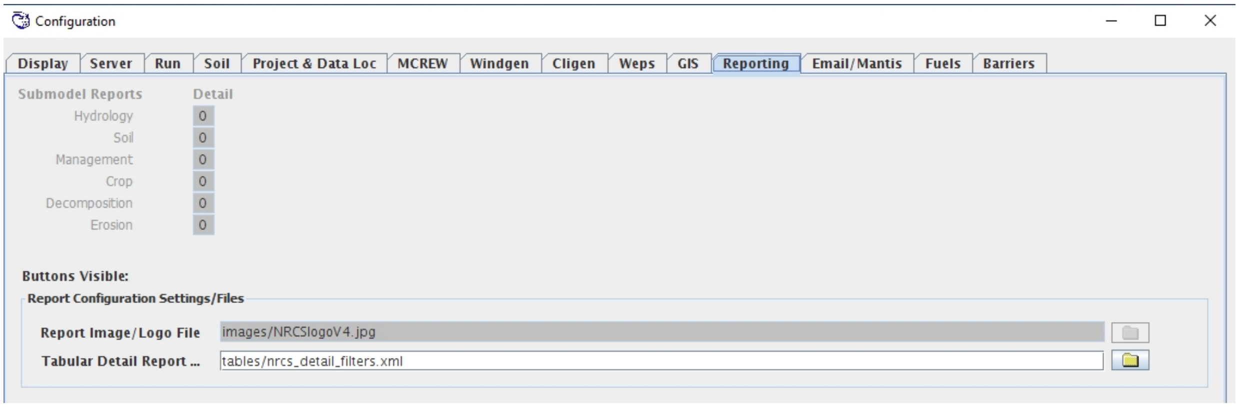



Figure 16.13: WEPS Configuration Panel displaying the Reporting tab.

**Confidence Interval** - Determines whether the WEPS interface Confidence Interval report is made available to users or not.

## 16.12 Configuration Panel – Email/Mantis Tab

The **Email** tab (Fig. 16.14) allows the user to specify the necessary information for the built-in WEPS email client and the Mantis bug/comment reporting system.


Figure 16.14: Configuration Panel displaying the Email tab.

**User Name** – Contains the user name. It is normally set from the WEPS Wizard that runs the first time a user executes the WEPS interface and requests their name and email address.

**Email Settings**

**Use SMTP server (obsolete option)** - Selecting this option allows the user to use the SMTP server specified in the fields immediately below this option.

**Use default mail client** Selecting this option allows the user to use their default email client, such as Thunderbird, for sending email messages from WEPS. Note that this setting does not work for all clients.

**Use Outlook client** - Selecting this option allows the user to use their Microsoft Outlook email client when sending email messages from WEPS. This is the preferred setting for NRCS users.

**Server Name** - The default name of the email server to use.

**Send From** - The default name of the individual sending the email message.

**Send Comments To** - The default email address for sending email comments regarding WEPS.

**Send Bug Reports** ... - The default email address for sending email bug reports regarding WEPS.

**Mantis Settings**

**Your email** - The user's email address.

**Mantis URL** - The URL internet address for the WEPS Mantis ticket system.

**Mantis user id** - The Mantis user id (tickets are submitted anonymously from WEPS so it is not required to fill out this field). Note that the user can be identified and replied to if they complete the **User Name** and **Your email** fields above.

**Mantis Password** - The Mantis user's password (since tickets are submitted anonymously, it is also not required to fill out this field).

**Mantis project** - The default Mantis project that submitted tickets are assigned to.

## 16.13 Configuration Panel – Fuels tab

The **Fuels tab** (Fig. 16.15 allows the user to specify default related information in WEPS.

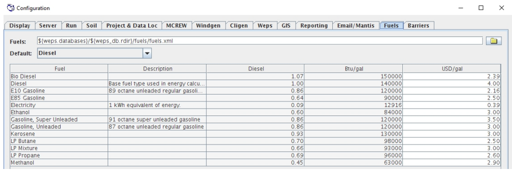


Figure 16.15: Configuration Panel displaying the Fuels tab.

**Fuels** - Sets the directory location and name for the fuel data file. The folder icon can be clicked on to display a file chooser to select an alternative location and file, if desired.

**Default** – The default fuel type to use for displaying operation fuel usage in WEPS.

**Fuel Table** – The fuel table consists of the following columns:

**Column 1** – Fuel type.
**Column 2** – Description of fuel type.
**Column 3** – Diesel energy equivalent of fuel type.
**Column 4** – Btu/gal for the specified fuel type.
**Column 5** – USD/gal for the specified fuel type.

## 16.14 Configuration Panel – Barrier Tab

Barrier Tab needs filled in here.


Figure 16.16: Configuration Panel displaying the Barriers tab.

# 17. WEPS How To Guide

## 17.1 Exercise: Selecting Critical Dominant Soil

### 17.1.1 Skill Building

WEPS currently estimates only one soil map unit in a field at a time. Therefore, it is recommended that the user select the most erodible soil of a "manageable size". This is called the **Critical Dominant Soil**. The Critical Dominant Soil is that which typically is the first to blow on the field and dominate the wind erosion process and is therefore critical for conservation planning.

The most erodible soil can be considered to be the one with the highest percentage of sand. For example, a fine sandy loam will be more susceptible to erosion than a loam. It is important to pay attention to the soils within the field when setting up a WEPS run. The WEQ (Wind Erosion Equation) **I factor** or the **Wind Erodibility Index** ratings as shown in Fig. 17.1 may be used to get some idea of the erodibility of the soils.

### 17.1.2 Scenario

Consider the soil map of a field in Grant County, Washington (Fig. 17.1). The approximate location coordinates for the actual field site are: **46.90713º N, 119.80210º W**. There are three map units in the semi-circle field.

When determining the Critical Dominant Soil, the general guideline is to use the **most erodible** soil composing **greater than 10**% of the field **or greater than 10 acres** in size (i.e., a manageable size).

**Question: What soil should be used to estimate the soil loss?**

**Answer**: From the figures we see that the Royal loamy fine sand (map unit 113) and Taunton loamy fine sand (map unit 151), comprise the majority of the field with 77.4% and 9.4% respectively of the area. The Ekrub fine sand (map unit 36) only makes up 13.1% of the area (Fig. 17.1).

However, the Ekrub fine sand should be used since it is the Critical Dominant Soil. It was selected because:

- It is the most erodible soil in the field. It has a Wind Erodibility Index value of 250 and the loamy fine sands only have a value of 134 (Fig. 17.1). Also, the Ekrub soil has the most sand, which the Wind Erodibility Index is heavily based upon. It is easy to check the surface sand content for any soil via the WEPS Soil Viewer as a WEPS in-tool guide for selecting soils without needing to resort to the WebSoilSurvey tool (Fig. 17.2).
- It comprises more than 10% of the field.
- It is upwind of the damaging westerly spring winds (Fig. 17.3).

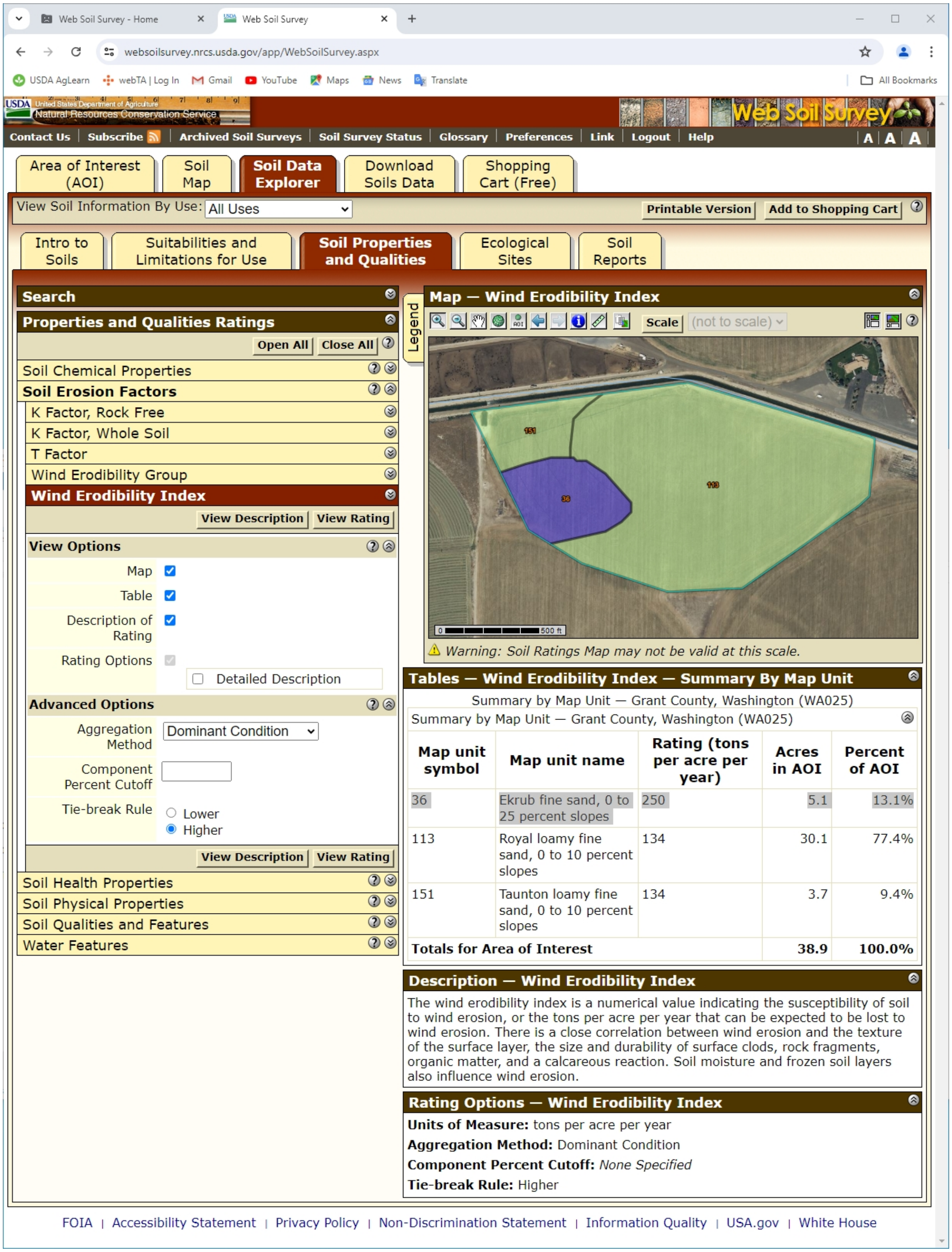



Figure 17.1: WebSoilSurvey Map showing soil map units of a field. Total field size is 38.9 acres.

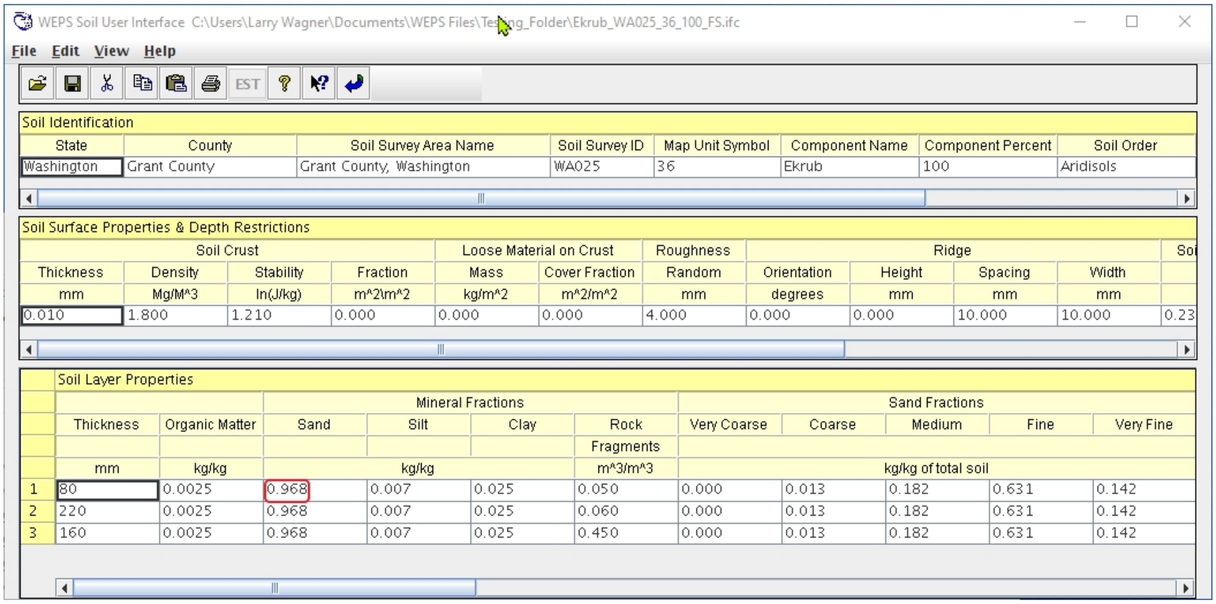



Figure 17.2: WEPS Soil Viewer is useful for determining the surface sand content of the selected soil.

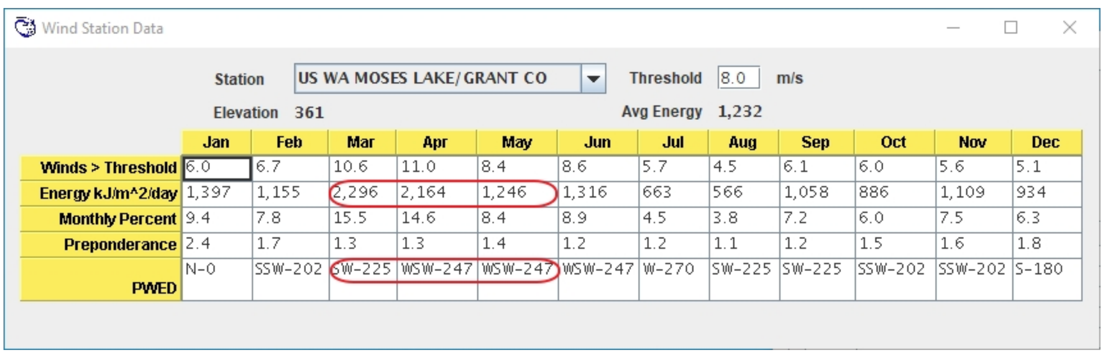



Figure 17.3: WEPS Wind Station Data table showing SW and WSW wind directions dominating in the spring.

## 17.2 Exercise: Selecting Correct Simulation Region Shape and Size

### 17.2.1 Skill Building

The **X-length** is the longest (one dimension) distance from a stable boundary to the opposite side of the field running east-west with the orientation angle set at 0°. The **Y-length** is the longest (perpendicular to the X-length) distance from a stable boundary to the opposite side of the field running north-south with the orientation angle set to 0. These are the **unsheltered distances** which WEPS uses to calculate the erosion rate. A **stable boundary** is one that stops surface creep and saltation phases of wind erosion. A grass strip at least 13 feet wide and 1.5 feet high is an example of a stable boundary. Vegetation width, height, and porosity are to be considered when declaring a stable boundary. Most barriers, such as a windbreak, also can function as a stable boundary.

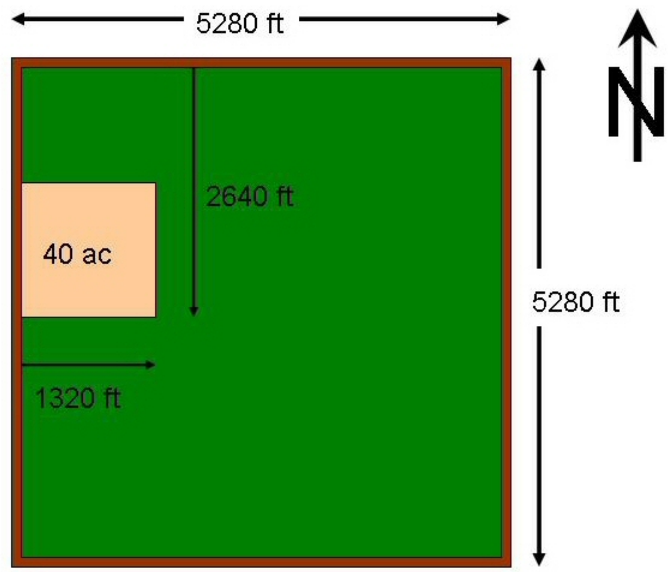
This exercise is intended to assist the user in selecting the correct distance to enter for the X-length and the Y-length in the Simulation Region panel of the WEPS interface.

### 17.2.2 Scenario

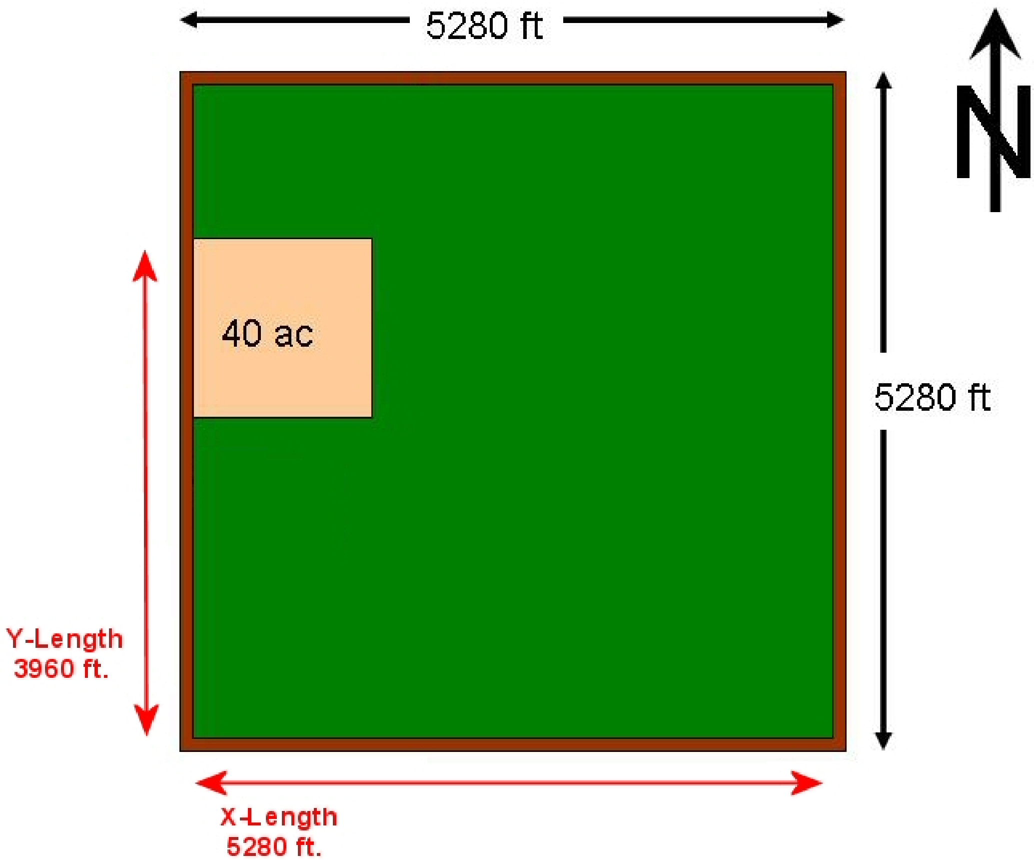
- A 40-acre field (shown in light tan) is to be evaluated for wind erosion. The remaining land (green) is not controlled by the owner of the 40 acres and the management on this remaining land cannot be changed by the owner of the 40-acre field. The remaining land may however contribute to the wind erosion process on the 40-acre field.
- The green land (one section in size, 640 ac) has a road on all sides with a 50-ft band of green vegetation (grass, 1.5 ft perimeter buffer).
- The non-erodible buffer is represented in dark brown.
- Both the 40 acres and the remaining 600 acres are farmed in a winter wheat-summer fallow, conventional tillage rotation.

**Question**: Which of the following selections is the correct X-Length and Y-Length combination to evaluate or enter in the Simulation Region panel on the WEPS interface?

- **A** X=2640 ft by Y=1320 ft
- **B** X=5280 ft by Y=3960 ft
- **C** X=1320 ft by Y=1320 ft
- **D** X=5280 ft by Y=5280 ft



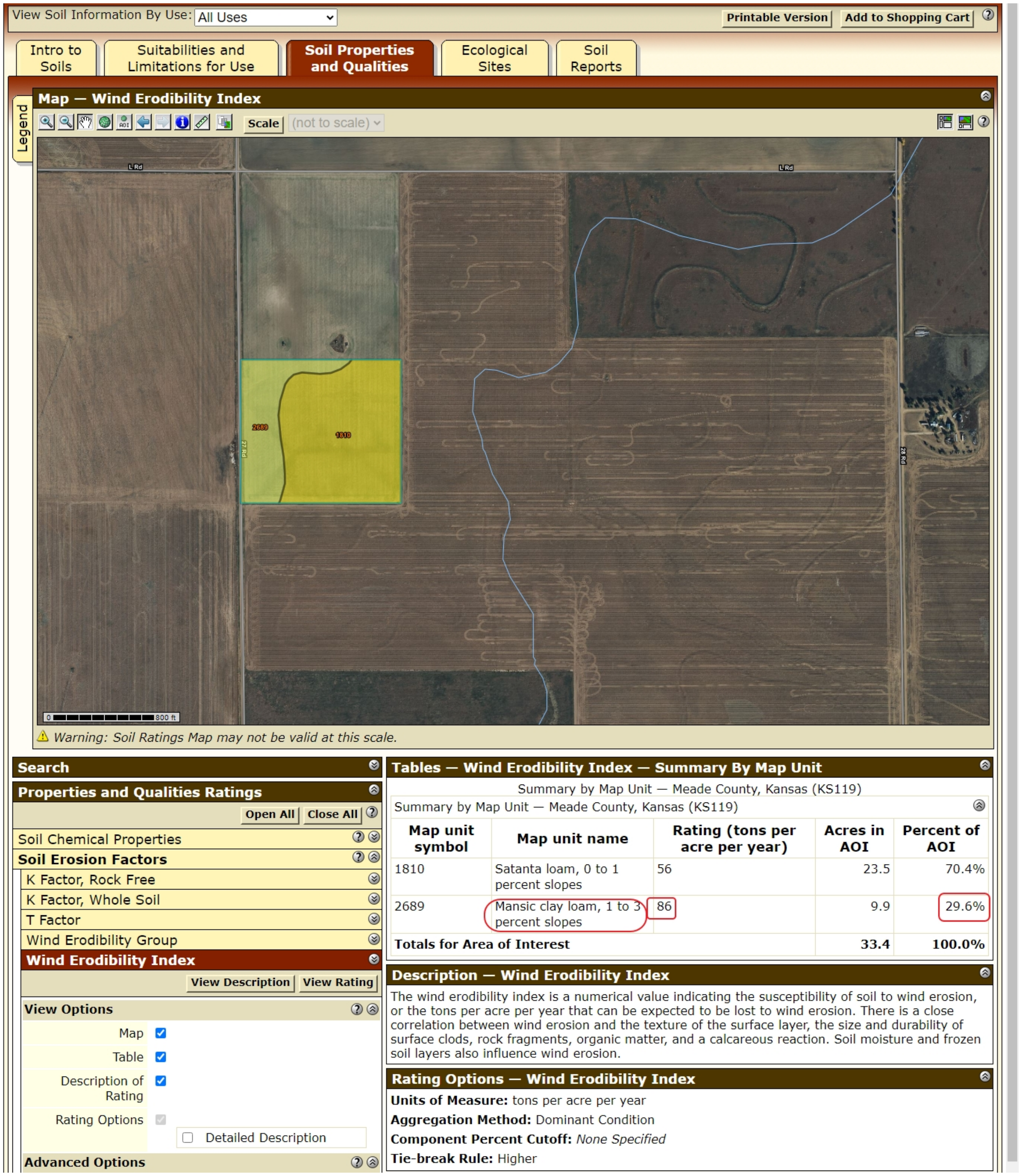

In WEPS, wind directions are simulated to vary from day to day throughout the simulation. Because the management outside the field is not controlled by the same owner for conservation planning purposes, the unsheltered distance should be the **longest distance** from a stable boundary through the length of the field to the down-wind edge of the field. On the X axis, the longest distance (X-Length) starts at the east boundary and extends west all the way through the 40 acre field (5280 ft). On the Y axis, the longest distance (Y-Length) starts at the south boundary and extends north all the way though the 40 acre field (3960 ft). Therefore, the dimensions (X-Length, Y-Length, and acres) entered on the WEPS interface will be larger than the actual field for this scenario. Thus, the **Answer** is: **B**




By using the Critical Dominant Soil within the field, we can ensure that we are considering the most erodible part of the field. By controlling wind erosion on that portion, it is highly likely that erosion will controlled on the entire field.

To demonstrate this in a real world example (note that this example site does not exactly represent the scenario mentioned above, but it is close enough for demonstration purposes), let's look at the following scenario:

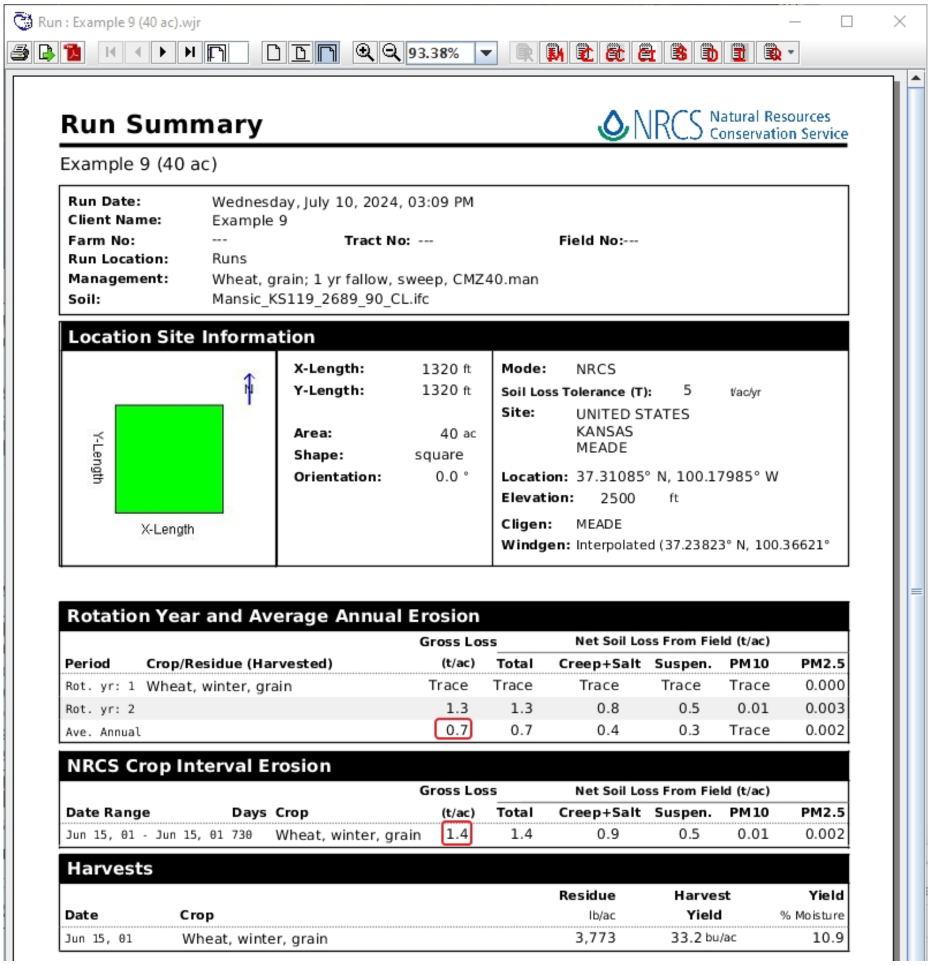
- Select a field located approximately at **37.23823º N, 100.17985º W** in Meade county, Kansas.
- Specify a field size of **40 ac** square (**1320 ft x 1320 ft**)
- Select the *CRLMOD Managements* CSIP service from the management dropdown choice list. Go into the *CMZ 40* management folder and then into the *b. Multi-year Rotation Templates* folder. From there, select the **Wheat, grain; 1 yr fallow, sweep, CMZ40** two year management rotation.
- Select the most erosive soil via the CSIP Soil Service for the field located approximately at **37.23823º N, 100.17985º W** which is the **Manis_KS119_2689_90_CL** soil (Fig. 17.4.




| Map unit symbol | Map unit name | Rating (tons per acre per year) | Acres in AOI | Percent of AOI |
|---|---|---|---|---|
| 1810 | Satanta loam, 0 to 1 percent slopes | 56 | 23.5 | 70.4% |
| 2689 | Mansic clay loam, 1 to 3 percent slopes | 86 | 9.9 | 29.6% |
| **Totals for Area of Interest** | | | **33.4** | **100.0%** |

Figure 17.4: WebSoilSurvey Map showing soil map units of a field.

**Step 1**: Make a WEPS Run with the 40 acre field size specified. The Run Summary is presented in Fig. 17.5.



Run : Example 9 (40 ac).wjr

93.38%

**Run Summary**

NRCS Natural Resources Conservation Service

Example 9 (40 ac)

| | |
|---|---|
| **Run Date:** | Wednesday, July 10, 2024, 03:09 PM |
| **Client Name:** | Example 9 |
| **Farm No:** | --- **Tract No:** --- **Field No:**--- |
| **Run Location:** | Runs |
| **Management:** | Wheat, grain; 1 yr fallow, sweep, CMZ40.man |
| **Soil:** | Mansic_KS119_2689_90_CL.ifc |

**Location Site Information**



| | | | |
|---|---|---|---|
| **X-Length:** | 1320 ft | **Mode:** | NRCS |
| **Y-Length:** | 1320 ft | **Soil Loss Tolerance (T):** | 5 t/ac/yr |
| | | **Site:** | UNITED STATES KANSAS MEADE |
| **Area:** | 40 ac | | |
| **Shape:** | square | | |
| **Orientation:** | 0.0 ° | **Location:** | 37.31085° N, 100.17985° W |
| | | **Elevation:** | 2500 ft |
| | | **Cligen:** | MEADE |
| | | **Windgen:** | Interpolated (37.23823° N, 100.36621° |

**Rotation Year and Average Annual Erosion**

| Period | Crop/Residue (Harvested) | Gross Loss (t/ac) | Net Soil Loss From Field (t/ac) Total | Creep+Salt | Suspen. | PM10 | PM2.5 |
|---|---|---|---|---|---|---|---|
| Rot. yr: 1 | Wheat, winter, grain | Trace | Trace | Trace | Trace | Trace | 0.000 |
| Rot. yr: 2 | | 1.3 | 1.3 | 0.8 | 0.5 | 0.01 | 0.003 |
| Ave. Annual | | 0.7 | 0.7 | 0.4 | 0.3 | Trace | 0.002 |

**NRCS Crop Interval Erosion**

| Date Range | Days | Crop | Gross Loss (t/ac) | Net Soil Loss From Field (t/ac) Total | Creep+Salt | Suspen. | PM10 | PM2.5 |
|---|---|---|---|---|---|---|---|---|
| Jun 15, 01 - Jun 15, 01 | 730 | Wheat, winter, grain | 1.4 | 1.4 | 0.9 | 0.5 | 0.01 | 0.002 |

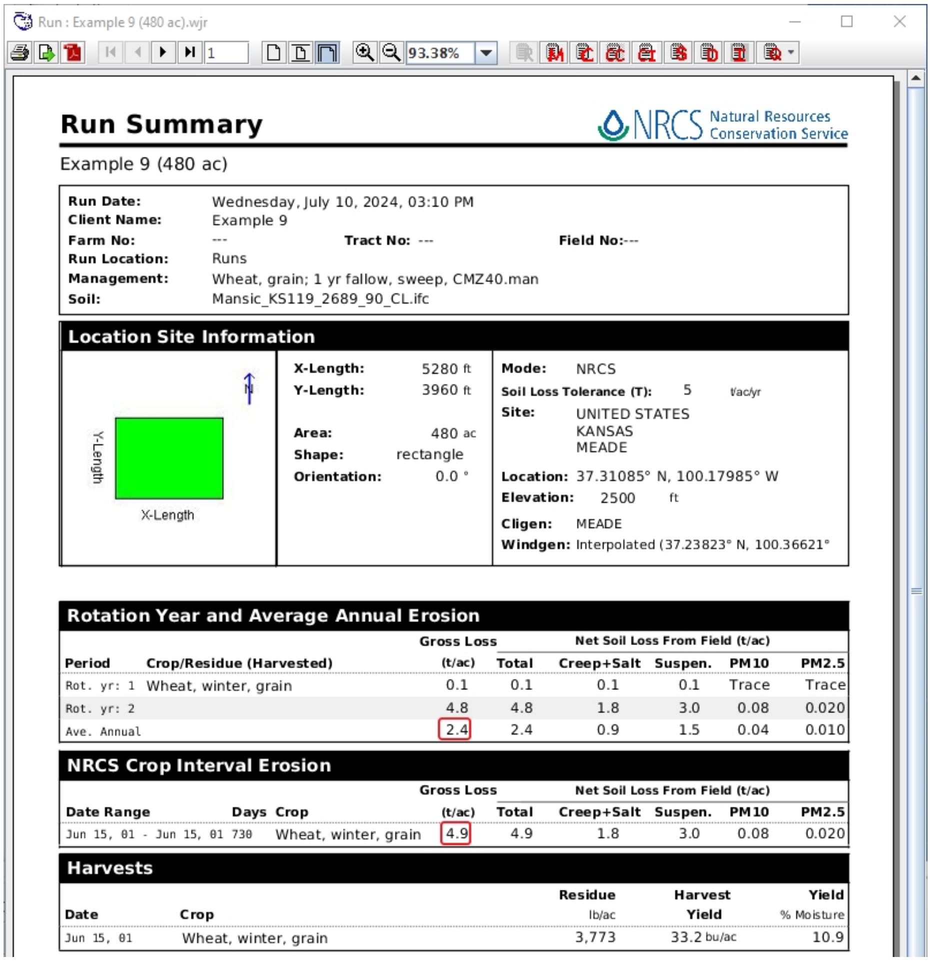
**Harvests**

| Date | Crop | Residue lb/ac | Harvest Yield | Yield % Moisture |
|---|---|---|---|---|
| Jun 15, 01 | Wheat, winter, grain | 3,773 | 33.2 bu/ac | 10.9 |

Figure 17.5: Run Summary results for 40 acre field only.

**Step 2**: Change the field size to an **X-Length = 5280 ft** and a **Y-length = 3960 ft** (480 acres). The field shape must be set to **Rectangle** to make these changes, if it is not already set to that shape.

**Step 3**: Make another WEPS Run with the 480 acre field size specified The Run Summary is presented in Fig. 17.6.


Run : Example 9 (480 ac).wjr

## Run Summary

NRCS Natural Resources Conservation Service

Example 9 (480 ac)

| | |
|---|---|
| **Run Date:** | Wednesday, July 10, 2024, 03:10 PM |
| **Client Name:** | Example 9 |
| **Farm No:** | --- **Tract No:** --- **Field No:**--- |
| **Run Location:** | Runs |
| **Management:** | Wheat, grain; 1 yr fallow, sweep, CMZ40.man |
| **Soil:** | Mansic_KS119_2689_90_CL.ifc |

**Location Site Information**

Y-Length

X-Length

| | |
|---|---|
| **X-Length:** | 5280 ft |
| **Y-Length:** | 3960 ft |
| **Area:** | 480 ac |
| **Shape:** | rectangle |
| **Orientation:** | 0.0 ° |

| | |
|---|---|
| **Mode:** | NRCS |
| **Soil Loss Tolerance (T):** | 5 t/ac/yr |
| **Site:** | UNITED STATES KANSAS MEADE |
| **Location:** | 37.31085° N, 100.17985° W |
| **Elevation:** | 2500 ft |
| **Cligen:** | MEADE |
| **Windgen:** | Interpolated (37.23823° N, 100.36621° |

**Rotation Year and Average Annual Erosion**

| | | Gross Loss | Net Soil Loss From Field (t/ac) | | | | |
|---|---|---|---|---|---|---|---|
| **Period** | **Crop/Residue (Harvested)** | **(t/ac)** | **Total** | **Creep+Salt** | **Suspen.** | **PM10** | **PM2.5** |
| Rot. yr: 1 | Wheat, winter, grain | 0.1 | 0.1 | 0.1 | 0.1 | Trace | Trace |
| Rot. yr: 2 | | 4.8 | 4.8 | 1.8 | 3.0 | 0.08 | 0.020 |
| Ave. Annual | | 2.4 | 2.4 | 0.9 | 1.5 | 0.04 | 0.010 |

**NRCS Crop Interval Erosion**

| | | | Gross Loss | Net Soil Loss From Field (t/ac) | | | | |
|---|---|---|---|---|---|---|---|---|
| **Date Range** | **Days** | **Crop** | **(t/ac)** | **Total** | **Creep+Salt** | **Suspen.** | **PM10** | **PM2.5** |
| Jun 15, 01 - Jun 15, 01 | 730 | Wheat, winter, grain | 4.9 | 4.9 | 1.8 | 3.0 | 0.08 | 0.020 |

**Harvests**

| **Date** | **Crop** | **Residue** lb/ac | **Harvest Yield** | **Yield** % Moisture |
|---|---|---|---|---|
| Jun 15, 01 | Wheat, winter, grain | 3,773 | 33.2 bu/ac | 10.9 |

Figure 17.6: Run Summary results for 480 acre field (stable boundary).

Note that the erosion rate from the field went from 0.7 tons/ac per year rate for the 40 acre field only to 2.4 tons/ac per year for the 480 ac field size to reach a non-erodible boundary. Our erosion estimate is almost 3.5 times greater for the larger field size. In this case, the management practices, even though significant tillage is being conducted, still keeps sufficient residue on the surface during the fallow season at this site, to keep it under the Soil Loss Tolerance value, even for the larger sized field simulated.

However, it still demonstrates the impact homogeneous management practices have on large fields and there potential affect on adjacent fields if there are no non-erodible boundaries present to reduce or eliminate the saltation process on the site. If the site was more susceptible to erosion, e.g. less residue cover being maintained on the site or the erosive winds were more extreme during that period, the difference in erosion rates for the two simulations would have been much greater. This is a prime example where a reduction in the distances to non-erodible boundaries would significantly reduce wind erosion susceptibility and its magnitude when it does occur. A suitable example practice here would be strip cropping the large field by alternating the fallow and crop growth periods in this two year rotation.

## 17.3 Barriers

Wind barriers in WEPS include any structure designed to reduce the wind speed on the downwind side of the barrier. They also trap moving soil. Barriers include, but are not limited to, linear plantings of single or multiple rows of trees, shrubs, or grasses established for wind erosion control, crop protection, and snow management. Snow fences, board walls, bamboo and willow fences, earthen banks, hand-inserted straw rows, and rock walls have also been used as barriers for wind erosion control in limited situations. Barriers also reduce evapotranspiration, shelter livestock, and provide wildlife habitat. One advantage of barriers over most other types of wind erosion control is that they are relatively permanent. During drought years, barriers may be the only effective and persistent control measure on crop land. Barriers primarily alter the effect of the wind force on the soil surface by reducing wind speed on the downwind side of the barrier, but they also reduce wind speed to a lesser extent upwind of the barrier (Fig. 17.7)

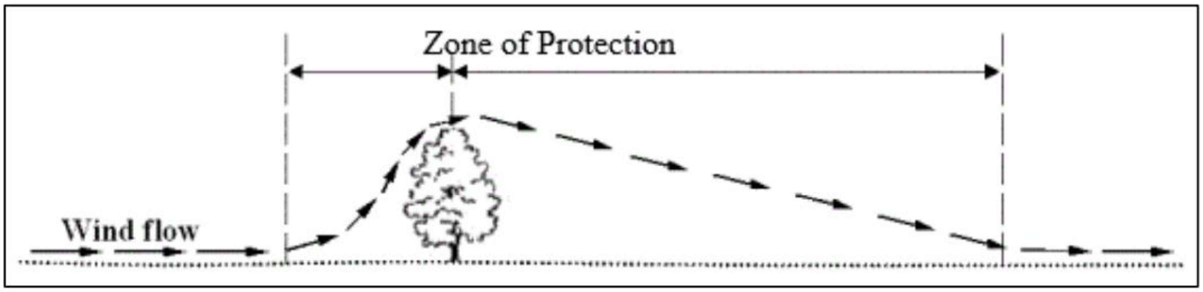



Figure 17.7: Diagram showing wind flow pattern over a barrier.

Research has shown that barriers significantly reduce wind speed downwind, sheltering a portion of the field from erosion and in effect, reducing the field length along the erosive wind direction. The protected zone of any barrier diminishes as porosity increases, and is reduced significantly when barrier porosity exceed 60 percent. Protection is also reduced as wind velocity increases, but the protected area diminishes as the wind direction deviates from the perpendicular to the barrier. Various types of barriers are used for wind erosion control in WEPS. The WEPS interface provides a method of selecting from a list of barriers to place on the field and editing the barrier properties. The user can also modify properties in the barrier database that appear in the drop-down list. Each of these properties are described in this section.

### 17.3.1 Adding and Removing Barriers Using the Interface

The Field View panel (Fig. 17.8), located in the center of the WEPS main screen, is designed to give the user a view of the field size, shape, and orientation (green). The placement of any barriers present is displayed in red. Note that if the ratio of actual length to width of the field or barriers is too great to display to scale, this will beindicated within the panel, and an approximation of the field or barrier shape will be displayed. This panel is for viewing only and is not editable.

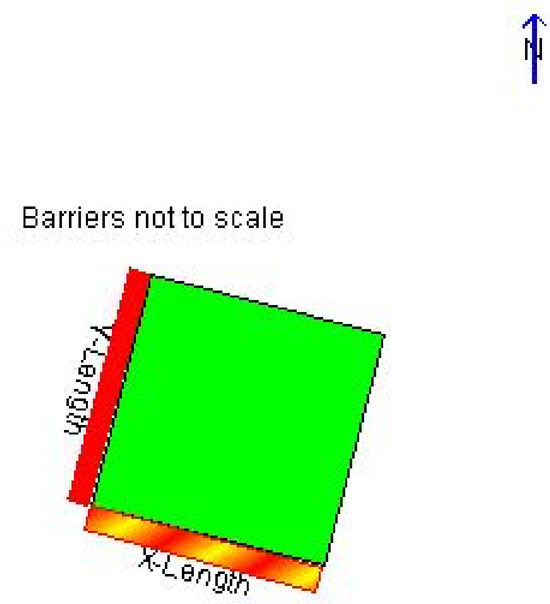



Figure 17.8: Field View Panel.

The Wind Barrier Information panel (Fig. 17.9) is used to add barriers to the field. Note that WEPS only allows barriers on the borders of the field. The barrier location for each field border is labeled ‘N’ for north, ‘S’ for south, ‘E’ for east, and ‘W’ for west. The barrier type can be selected from the drop-down list in the panel by clicking the down arrow to the right of the barrier type to bring up the list of available barriers, and then clicking on the appropriate barrier. Once a barrier type is selected, the barrier properties may be viewed and edited by clicking the ‘Edit Selected Barrier’ button at the bottom of the panel. A separate panel opens, in which the user may change the default barrier width, height, and porosity values in the appropriate fields. The modified barrier parameters are stored with the project. If a barrier other than ‘None’ is selected, the ‘Edit Selected Barrier’ button will open the properties panel when the radio button is clicked on for that barrier. To remove a barrier from the field, click the radio button to select it (notice the barrier in the View Panel will be ‘highlighted’ when selected), then select the barrier type ‘None’ to remove it.

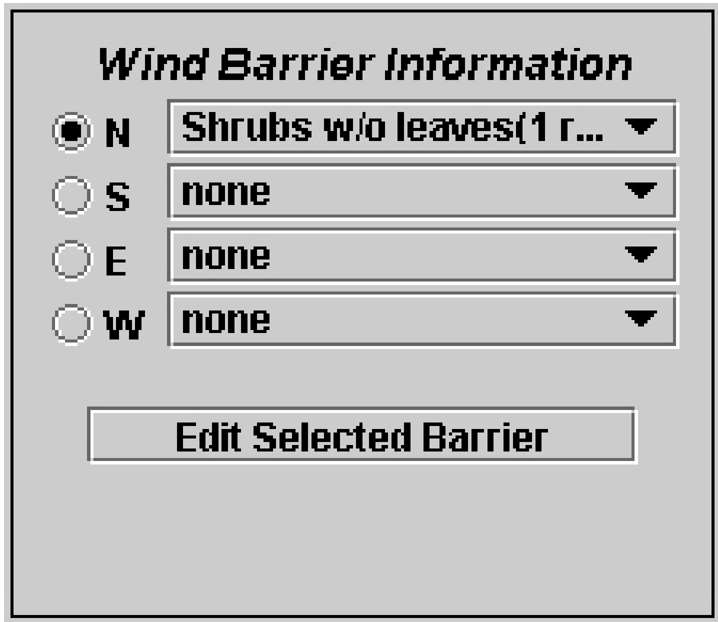



Figure 17.9: Wind Barrier Information Panel.

### 17.3.2 Edit Selected Barrier

To view and edit the properties of a barrier, click the radio button for the corresponding barrier  , then click the ‘Edit Selected Barrier’ button. A window will open displaying the properties described next. If properties are modified by the user through the interface, the barrier type will display ‘<mod>’ in front of the barrier type name.

**Length** The length of a barrier is defined by the field length along the border on which the barrier is placed.

**Width** The width of a barrier is defined as the distance from one side of the barrier to the other, in the units of measure displayed on the screen (feet or meters) (Fig. 17.10). For a single-row wind barrier, the width is equal to the diameter of the tree, shrub, or grass, or for artificial barriers, the thickness of the material (e.g., slat fence). This is illustrated as “a” in Fig. 17.10. For multiple-row barriers, the width is the distance from one side of the barrier to the other as illustrated by “b” in Fig. 17.10.

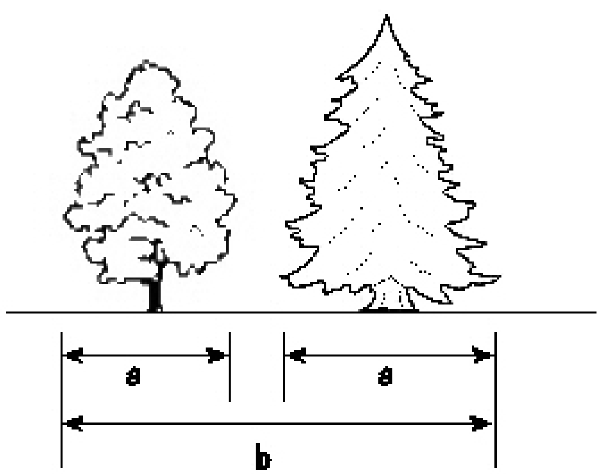



Figure 17.10: Barrier width for single row (a) and multiple row (b) barriers.

**Height** The height of a barrier is the average height of individual elements (e.g., trees) in the barrier ("a" in Fig. 17.11 for single-row barriers). The units of measure for barrier height are displayed on the input screen in feet or meters. For multiple-row barriers, use the height of the tallest barrier row ('b" in Fig. 17.11).

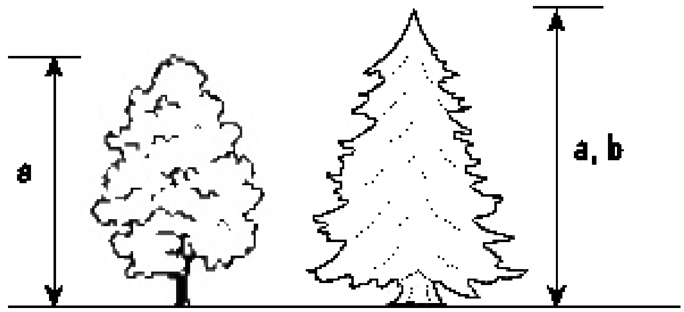



Figure 17.11: Barrier height for single row (a) and multiple row (b) barriers.

**Area** The area of the barrier is calculated from the barrier width and length (i.e., barrier width x field length). This is not an editable item, but is calculated within WEPS.

**Porosity** Barrier porosity is defined as the total optical porosity of all rows in the barrier. It is the open space (i.e., absence of leaves and stems) as viewed looking perpendicular to the barrier, expressed as a percentage of the total area (i.e., (1.0 - silhouette area) x 100). WEPS does not "grow" living barriers. They do not increase or decrease porosity with leaf growth and leaf drop (senescence), nor do they increase in size from one year to the next. As such, the porosity of barriers in WEPS does not change with the seasons nor from year to year. Therefore, the user should input the porosity of the barrier that is present when the erosion hazard is the greatest. Fig. 17.12 illustrates the effect of porosity on the near-surface wind speed, relative to an open field without a barrier (see also Fig. 17.7).

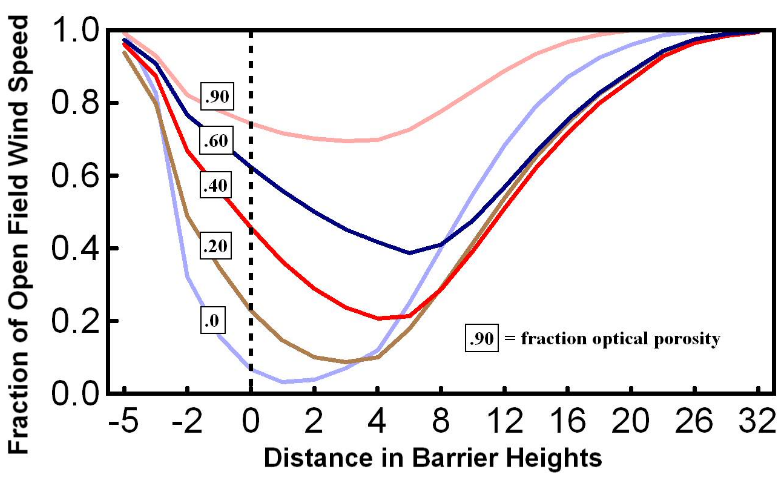



Figure 17.12: Effect of the fraction of optical porosity on near-surface wind speed along the wind direction relative to barrier. The "Distance in Barrier Heights" refers to the distance from the barrier at 0, measured in multiples of the barrier height.

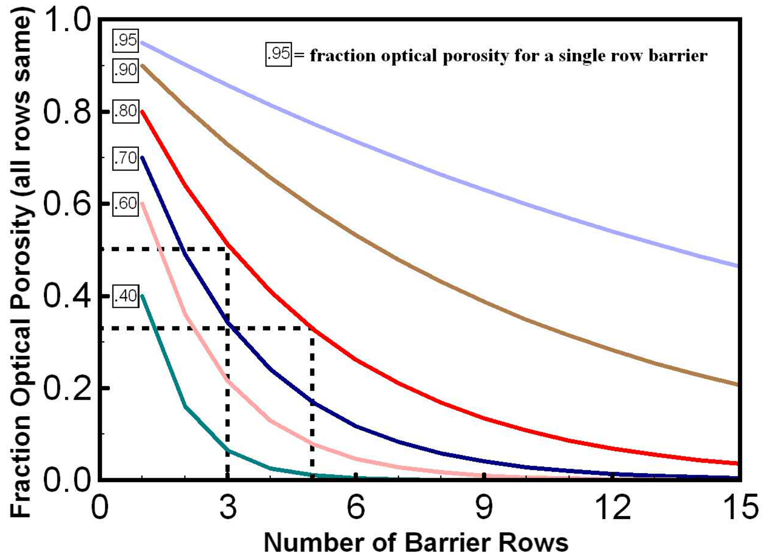



Figure 17.13: Effect of number of barrier rows on optical porosity when all barrier rows are the same.

At times, it is most efficient to estimate optical porosity for a single row, particularly for crop barriers. Then for multiple row barriers, the optical porosity decreases for the entire barrier as illustrated in Fig. 17.13. For example, a single row of corn has an optical porosity of 0.80. Three rows of corn have an optical porosity of 0.50, and five rows of corn have an optical porosity of 0.33.

### 17.3.3 Supplemental Barrier Information for Users Manual

Default barrier properties specified in the barrier property database cannot be permanently changed through the WEPS interface. But they can be modified and stored with the current project. Barrier properties may, however, be modified in the barrier database file. Fig. 17.14 shows the barrier database file, 'barrier.dat', which is located in the "WEPS Install" directory. This ASCII file may be edited (for NRCS only by designated qualified agronomists) by using a standard text editor to add new barriers or modify parameters of existing barriers. The file separates barriers into various categories (i.e., TREES, SHRUBS, HERBACEOUS, etc.). The user interface does not read nor display these barrier categories, and they only serve as a visual aid within the database. Actual database values are in rows which begin with a blank in column one, and each database parameter is separated by the pipe symbol, '—'. The parameters are listed as follows: barrier name — height (meters) — number of rows (not used) — porosity (fraction) — width (meters). Barrier height, width, and porosity were defined previously in this document. The barrier name is a character descriptor of the barrier and is the name displayed in the choice lists. The 'number of barrier rows' parameter is not currently used by WEPS nor is it displayed in the interface. Once the barrier database file has been updated, restart WEPS and the new barrier and/or modified parameter values should appear in the barrier drop-down list on the WEPS user interface.

```
TREES
 Trees w/o leaves(1 row)|8|1|0.8|3
 Trees w/o leaves(2 row)|8|2|0.7|7
 Trees w/o leaves(4 row)|8|4|0.6|15
 Trees w/ leaves(1 row)|8|1|0.6|3
 Trees w/ leaves(2 row)|8|2|0.5|7
 Trees w/ leaves(4 row)|8|4|0.4|15
SHRUBS
 Shrubs w/o leaves(1 row)|2|1|0.7|2
 Shrubs w/o leaves(2 row)|2|2|0.5|5
 Shrubs w/ leaves(1 row)|2|1|0.5|2
 Shrubs w/ leaves(2 row)|2|2|0.3|5
HERBACEOUS
 Grass Barrier(1 row)|0.8|1|0.7|0.5
 Grass Barrier(2 row)|0.8|2|0.5|1.0
CROP
 Kenaf(1 row)|2.5|1|0.7|1
 Kenaf(2 row)|2.5|2|0.5|2
 Sorghum(1 row)|2|1|0.7|1
 Sorghum(2 row)|2|2|0.5|2
 Flax(1 row)|0.5|1|0.7|0.5
 Flax(2 row)|0.5|2|0.5|1
 Corn(2 row)|1.5|2|0.7|2
 Corn(3 row)|1.5|2|0.6|3
 Corn(4 row)|1.5|2|0.5|4
 Wheat/Rye(1 row)|0.8|1|0.7|0.5
 Wheat/Rye(2 row)|0.8|2|0.6|0.6
 Wheat/Rye(3 row)|0.8|3|0.6|0.8
 Wheat/Rye(4 row)|0.8|4|0.5|1.0
 Wheat/Rye(1 row)|0.8|4|0.5|1.0
ARTIFICIAL
```

Figure 17.14: Barrier database file ”barrier.dat”.

### 17.3.4 Barrier Property Database

The following are some of the assumptions used in building the default property values for the barriers. For the Tree and Shrub barriers, the heights used are based on the 20-year heights which is the standard height used for designing windbreaks. Since the model does not grow the barriers, it needs to be recognized that erosion rates will gradually decrease during the growth of the barrier. Because of this, alternative treatment options will need to be used during this growth period such as annual barriers, herbaceous barriers and/or changes in crop residue management.

The Herbaceous barriers were divided between perennial and annual. The perennial barriers include species such as switchgrass, tall wheatgrass, elephant grass, etc. The annual barriers were divided into three height categories: short, medium and tall. The short annual barriers could include small grains e.g, wheat, barley, or rye. These small grains provide protection to wind sensitive crops in the early growth stages and are usually sprayed with herbicide. The medium annual barriers also include the small grains as well as flax that are allowed to grow nearly to maturity before being sprayed. The tall annual barriers may include corn, sunflowers, or sorghum reaching heights of 4 to 5 feet. The default porosities assigned to these annual barriers are based on the assumption that the planting rate/acre is the same whether it is one row or two rows or three rows. The porosity of a single row could be altered by increasing the number of plants per acre.

The orchard default values include two age categories: one year old and mature height. They are also divided into three size classes: dwarf, semi-dwarf, and standard. The height of some fruit trees can be controlled by the type of root stock such as an apple tree that is dwarf may have a 7 to 8 foot mature size while a standard tree may reach 16 to 18 feet. It was assumed that the dwarf size trees were spaced about 12 feet apart, the semi-dwarf about 20 feet and the standard up to 30 feet for the larger nut trees such as walnut and pecan.

The “Forest Edge” example is trying to account for large patches of forest on the field edge. These forest patches are assumed to be “wide” i.e. several hundred feet wide. These patches do not function the same as a windbreak in modifying wind flow. The tendency is for the wind reduction profile adjacent to these wide patches to be reduced in length acting more similarly to the wind profile of a more porous barrier where the wind will return to open field velocity more quickly than a narrower windbreak.

Two artificial fences were also included. One assumes a four foot height with a 50 percent porosity similar to a slatted snow fence. The other is a solid board fence with a similar height but very low porosity.

## 17.4 Strip Cropping (Field Design)

**WEPS How To Guide**

### Introduction

Dividing large fields into smaller fields is a design practice that often aids in controlling both wind and water erosion. The main effect achieved by reducing field size for wind erosion control is to reduce the amount of damaging abrader composed of saltating aggregates that impact immobile clod or crust surfaces, as well as to reduce the breakage of the mobile saltation and creep aggregates. Reducing abrader permits the surface to become armored with immobile material as the loose soil is removed or moved into a sheltered area on rough surfaces. But merely reducing field size with strips provides only a small amount of wind erosion reduction on fields that lack significant amounts of clods, crust, growing biomass, or residues. Reducing abrader is also important for seedling protection. The Wind Erosion Prediction System (WEPS) provides a means of evaluating the effectiveness of strip cropping in reducing wind erosion. The objectives of this guide are to provide an overview of the effects of field size on wind erosion as simulated in the WEPS model and to suggest some possible field designs to enhance wind erosion control. Examples using WEPS to evaluate strip-cropping scenarios are also provided.

One method to accomplish a reduction in field size is to divide large fields into alternating strips. This practice is referred to as strip cropping, and an example is illustrated in Fig. 17.24. In low rainfall areas, one-half the strips may be fallowed on alternate years. In other areas, one-half the strips may be producing low-residue crops. Comparison of Fig. 17.15 (a vs. b) illustrates important differences between the large fallow field and the same field when farmed in strips. On the large field, both moving soil and snow are removed. In contrast, when strip-cropped, part of the moving soil and snow are typically trapped in the next strip, and this results in a gain in both moisture and soil on portions of the stripped field. The saltation/creep crossing eroding strip boundaries may be used in WEPS to estimate the soil gain on adjacent non-eroding strips.

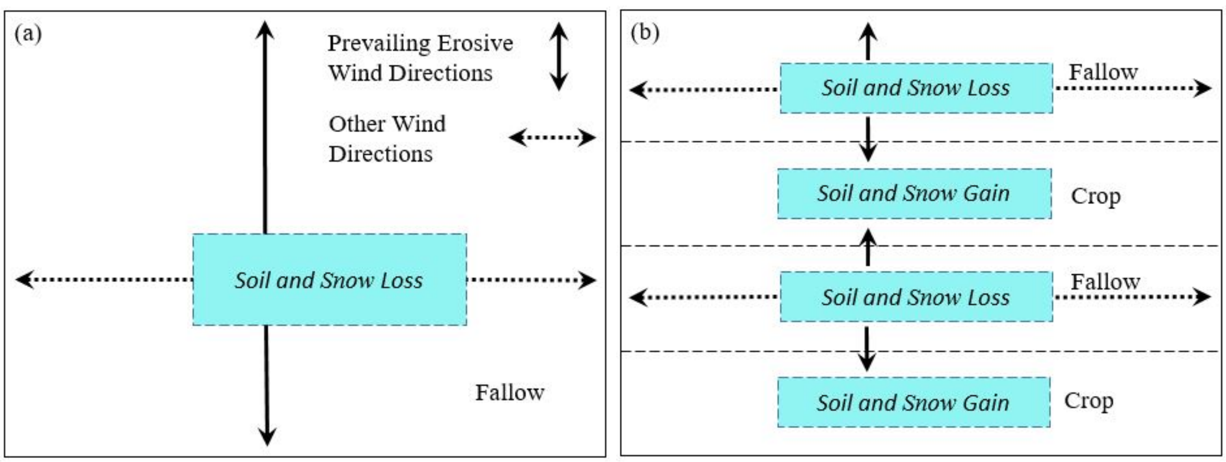



Figure 17.15: Comparison of (a) large fallow field and (b) the same field strip cropped with alternating crop and fallow strips.

### Effects of Field Scale on Wind Erosion

The erosion processes in WEPS are simulated for an initially uniform field, and these include: emission (entrainment) of loose soil, abrasion of immobile clods/crusts, breakage of saltation/creep-size aggregates to suspension size, and trapping of saltation/creep-size aggregates in sheltered depressions between clods, ridges, and plants or residues (Fig. 17.16). If standing biomass is present, a reduction of wind drag at the soil surface, and biomass interception of mobile aggregates, are also simulated. Using these processes, the model simulates a horizontal discharge (i.e., amount removed up to a downwind distance) of mobile saltation/creep (Fig. 17.17) and suspension-size aggregates (Fig. 17.18). On long erodible fields, the saltation/creep discharge may reach transport capacity. Transport capacity is defined as the maximum horizontal discharge of saltation/creep possible for a given wind speed and surface condition. At transport capacity, the deposition of saltation/creep from the air stream per unit area equals the amount entrained into the air stream. There generally is still a net removal of saltation/creep aggregates from the surface to replace those lost by breakage to suspension size. In this case, saltation-creep can only approach transport capacity. In contrast, the suspended discharge is not limited by transport capacity, because these particles continually diffuse into the atmosphere. As a consequence, the mass of suspended material increases over the entire length of eroding fields, with the rate of increase controlled by the erosion processes.

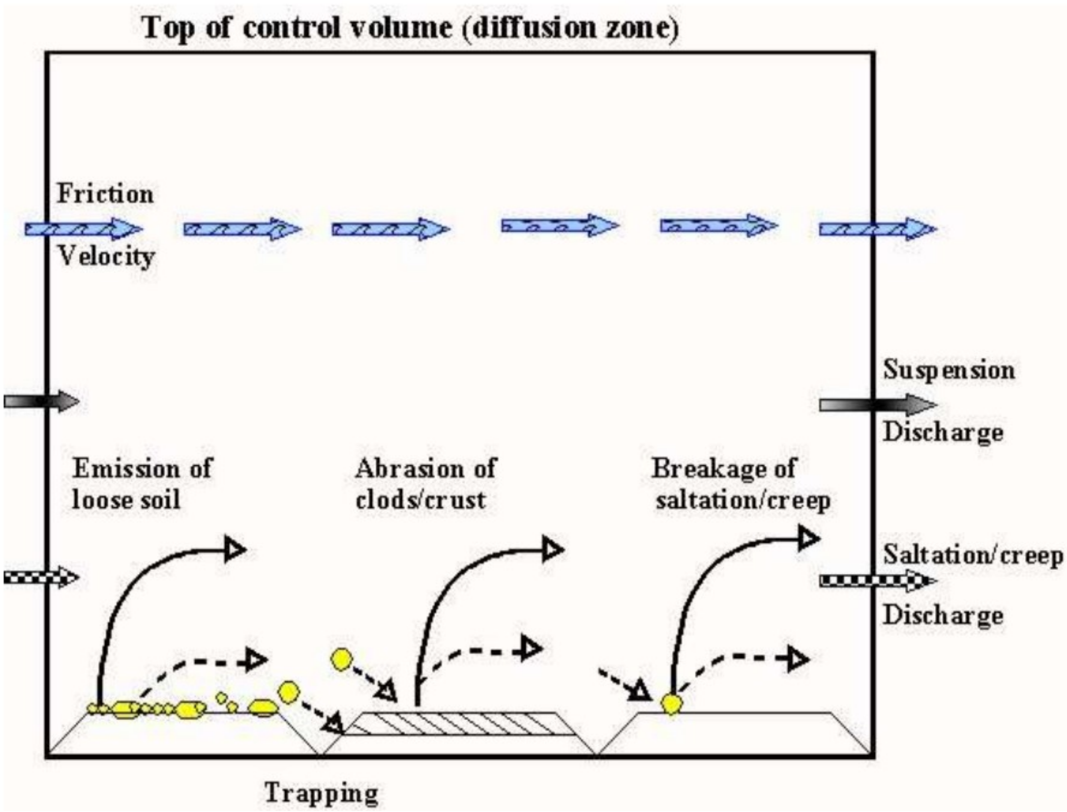



Figure 17.16: Wind erosion processes on a bare field simulated in WEPS.

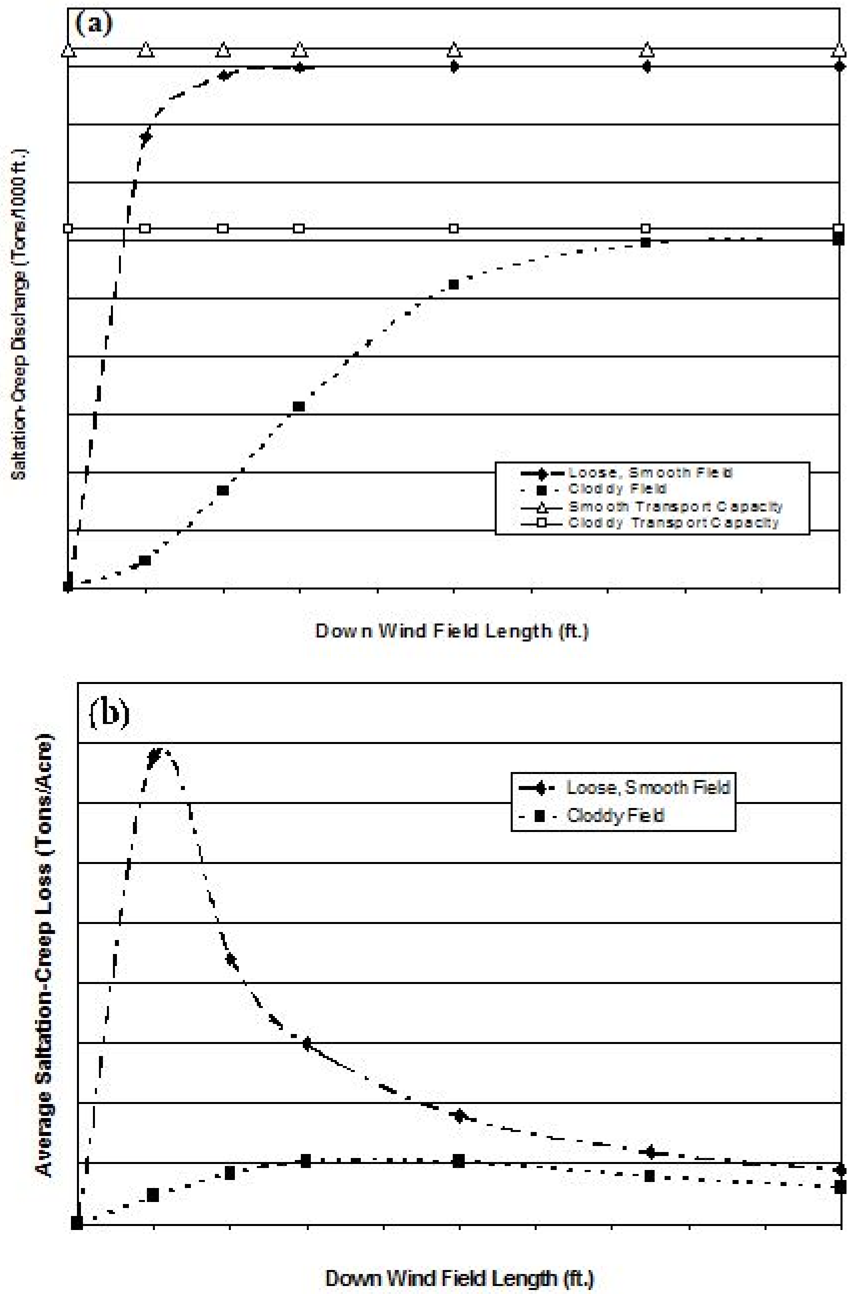



Figure 17.17: Comparison of (a) downwind discharge per 100 ft. of border width and (b) average soil loss for saltation-creep.

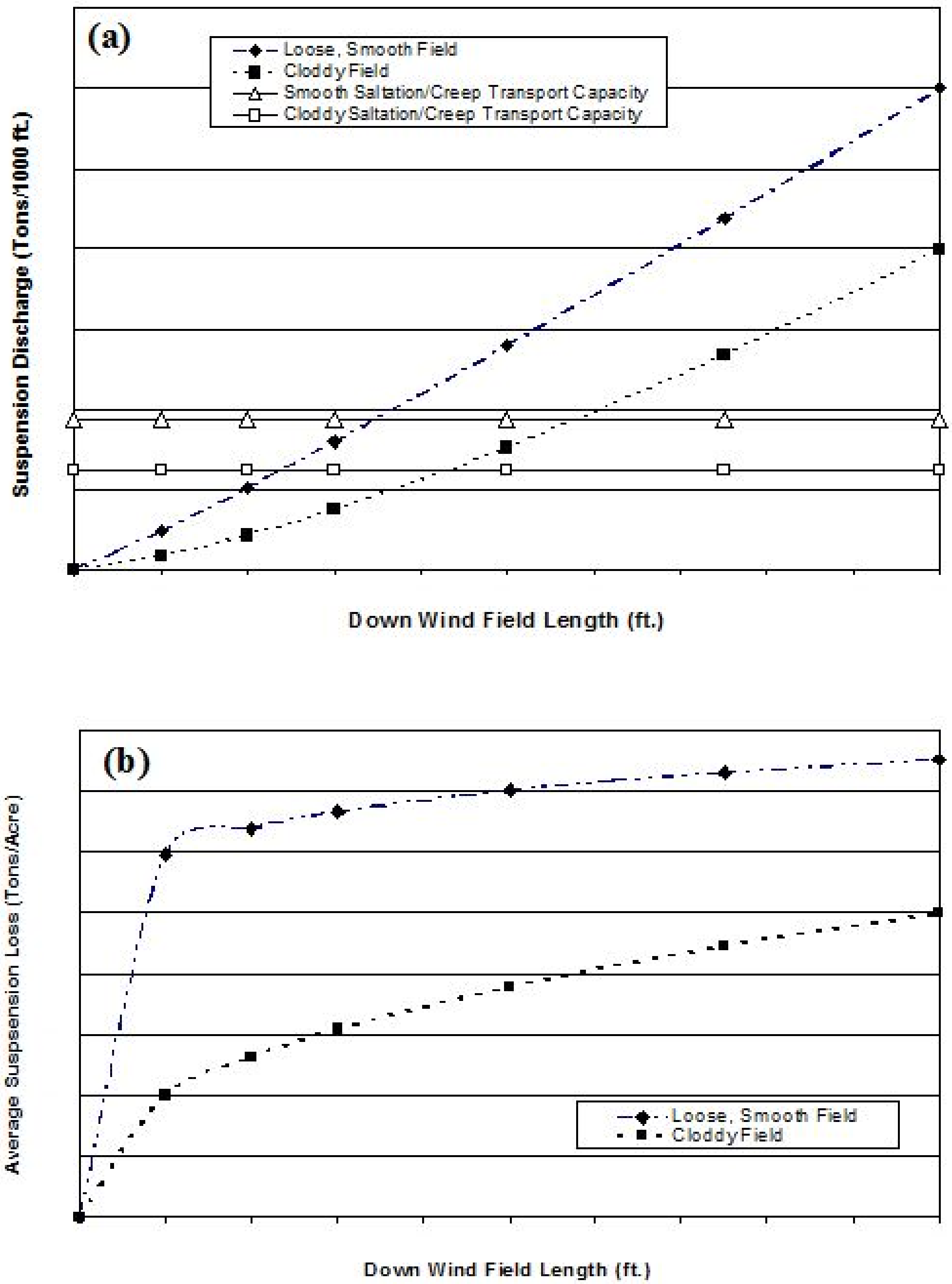



Figure 17.18: Downwind (a) discharge per 100 ft. of border width and (b) average soil loss of suspended soil.

Conservation planners often design control systems based on average soil loss (i.e., amount removed per area). Total horizontal discharge at any downwind distance divided by the upwind field length represents the average soil loss over the upwind area. Using this calculation, one can illustrate the effects of different field lengths on soil loss. Depending upon field surface conditions, the erosion processes cause differing patterns of horizontal soil discharge and, consequently, differing soil loss for the saltation/creep-size (Fig. 17.17) and the suspension-size soil (Fig. 17.18). After saltation/creep reaches transport capacity, dividing the nearly-constant transport capacity by field length to give average soil loss shows that there is a steady decrease in loss per unit area with increasing field length (i.e., area increases, whereas transport remains essentially the same). In contrast, there is generally a large net loss of suspension-size soil over the entire field length. Total soil loss for any field length is determined by adding the average suspension and saltation/creep soil losses (Fig. 17.19). In general, the maximum average soil loss occurs at a field length at which both the saltation/creep and suspension components are contributing significant net soil loss. On far downwind portions of long fields, the increases in the soil discharge comes mainly from suspended soil, so the average soil loss may decrease somewhat with field length. Thus, on long fields, suspension soil loss typically exceeds the saltation/creep loss. Of course, if the mobile soil is composed mainly of sand larger than suspension size ($>$ 0.1 mm diameter), then saltation/creep will remain the dominant form of soil loss.

Smooth, loose fields often have a length at which there is a maximum soil loss, and the average loss then decreases beyond that field length (Fig. 17.19a). In this scenario, very short field lengths are necessary to control wind erosion. Thus, on all fields subject to wind erosion, planners should consider using other erosion controls in combination with strip cropping.

Suspended soil lost from long eroding fields can be considerable and is subject to long-range transport. Other detrimental effects also accompany this soil loss. These include an increase in sorting of the initial soil so that the removed soil is enriched in nutrients, organic matter, clay and silt fractions- the productive elements of the soil. The increased abrasion and breakage processes on long fields also increase the PM10 content (particulate matter ¡10 microns diameter) that is regulated as a health hazard. Thus, not only the amount, but also the quality and size distribution of the removed soil, changes as field length increases.

For simplicity, the Wind Erosion Equation (WEQ) predicts that average soil loss on long fields approaches a constant value. In WEPS, on the other hand, the average soil loss may increase or decrease on long fields, depending on whether creep/saltation or suspension is the dominant transport mode. Both the WEPS and WEQ models show that, for effective erosion control, the field length along the prevailing wind erosion direction needs to be significantly less than the distance to the point of maximum soil loss. The effect of reducing field length on erosion is not linear, but varies approximately with the logarithm of the distance to transport capacity.

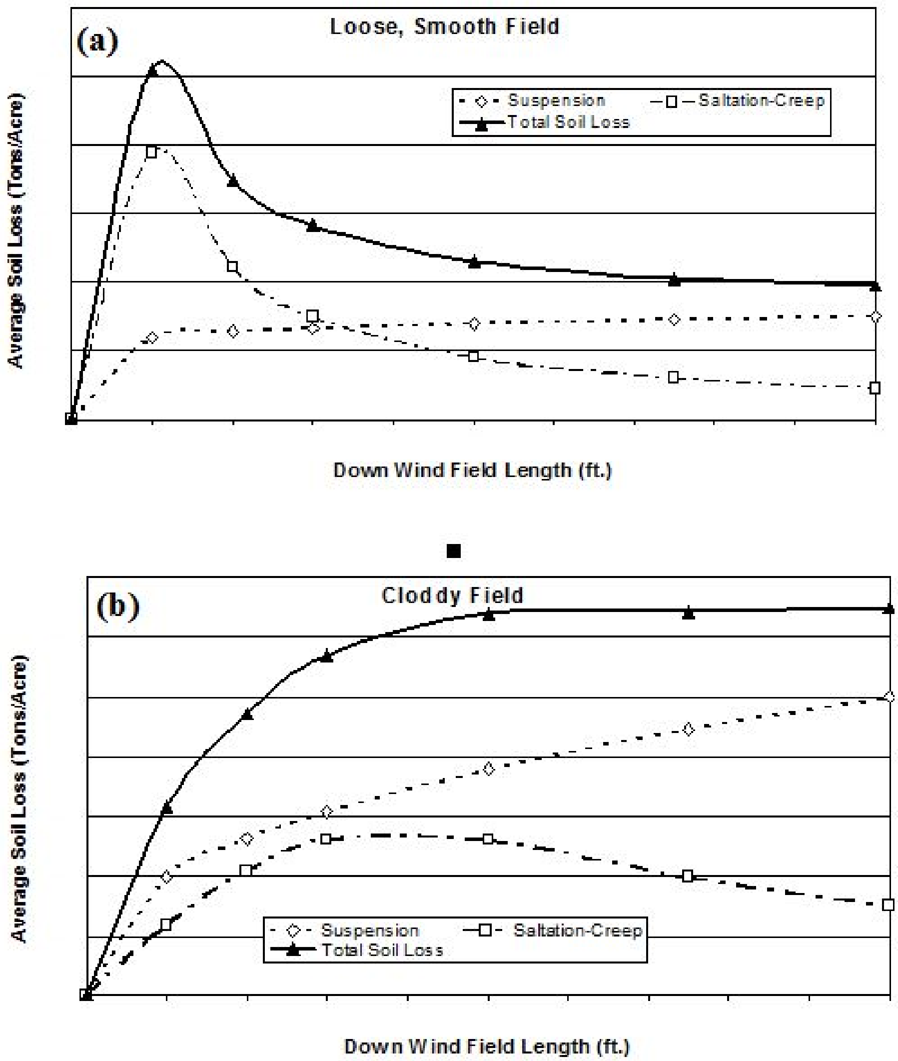



Figure 17.19: Comparison of average soil loss at various downwind distances on (a) a smooth, loose field and (b) a cloddy field.

### Designs to Enhance Erosion Control

On fields susceptible to large amounts of erosion or fields with inclusions of highly erodible soil, conventional strip crop systems such as that shown in Fig. 17.20a may not provide the needed extent of erosion control. It is then the task of those designing erosion controls to recommend additional measures. There are a number of ways to enhance a strip crop system to provide additional control, and several of these are illustrated.

*Reduce Strip Width*

One control option is to reduce the strip width in critical areas (Fig. 17.20). Wind erosion often begins within areas of a field that include a soil highly susceptible to wind erosion or in areas exposed to accelerated wind speeds. Saltating aggregates from these areas abrade downwind areas and break down immobile clods and crusts, thus increasing erodibility of the entire downwind area. On stripped fields there is potential to cover part of the problem area with a protective crop every year and thereby reduce the source area. In addition, the downwind area subject to abrasion may also be reduced. One may estimate the effect of strip width on these problem areas by choosing a soil representative of the problem area in the WEPS simulation.

*Reduce Strip Width and Barriers*

A second option to reduce effective strip width is to employ wind barriers (Fig. 17.20). Correctly oriented barriers serve to shelter part of the erosive strip (Fig. 17.20a). They may also be used to divide the erosive strips to trap moving soil and further reduce the unsheltered lengths (Fig. 17.20b). If the barriers are short in height, relative to the unsheltered distance (e.g. herbaceous barriers), the latter design will reduce the unsheltered length by about one-half. When barriers or cross-wind strips trap moving saltation/creep, they effectively create a new non-erodible (stable) boundary. WEPS evaluates field conditions on each individual strip or field interval between barriers. Therefore, various field designs can be easily evaluated in WEPS by changing the field strip width and adding appropriate wind barriers as model inputs.

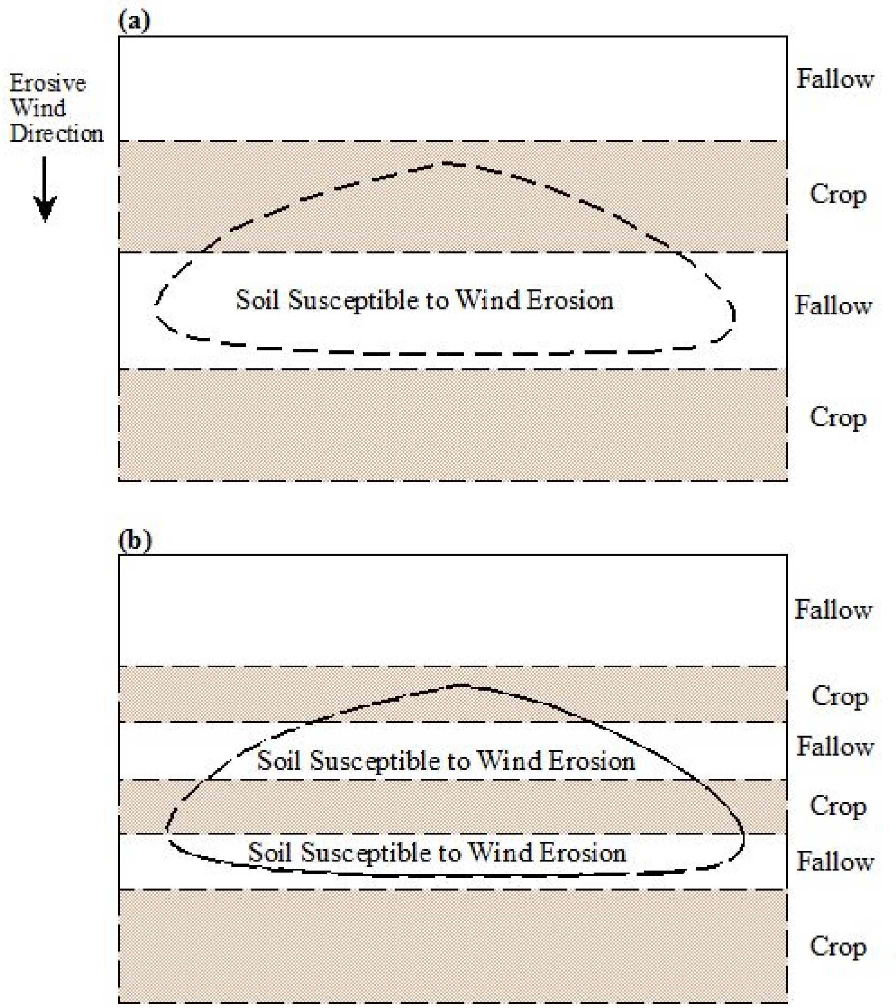



Figure 17.20: Erosion control designs illustrating (a) strips on erodible soils and (b) using narrow strips in critical areas with soils highly susceptible to wind erosion.

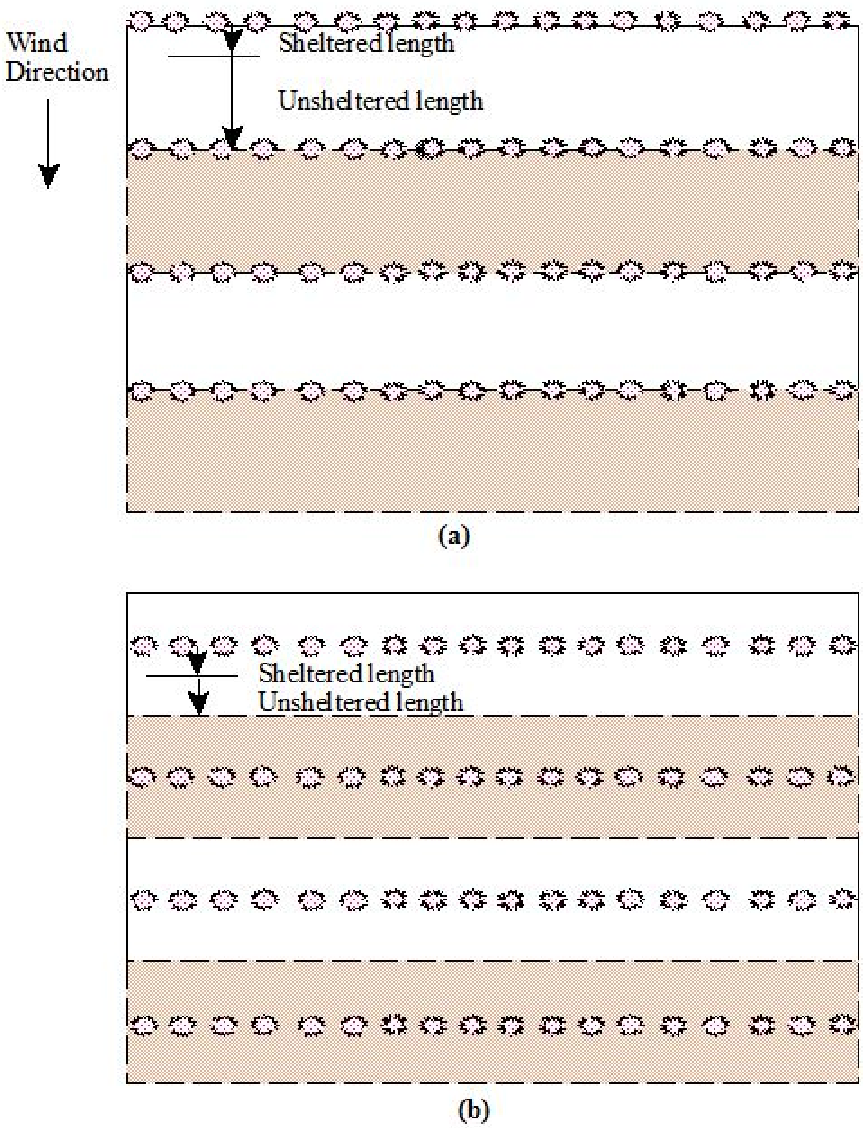



Figure 17.21: Erosion control designs using wind barriers (a) on strip borders and (b) in the middle of all strips.

*Surface Roughness*

Another option to enhance strip effectiveness is to employ surface roughness such as tillage ridges (Fig. 17.22). Adding tillage ridges provides additional trapping capacity for mobile soil (Fig. 17.22a). But it is often useful to orient ridges so they are not parallel to the long side of the strip, because this provides some erosion control when wind directions are parallel to the strip (Fig. 17.22b). As a starting point, consider orienting ridges about 30 degrees from parallel to the strip and along the direction of the least erosive winds during critical wind erosion periods. For example, in Fig. 17.22b, we assumed that the southeast-northwest winds were less erosive than southwest-northeast winds. WEPS can be used to help optimize design of these systems by comparing various tillage directions.

*Other Options*

Other options are particularly useful when there are erosive winds parallel to conventional strips. These options include avoiding long, straight tillage ridges (Fig. 17.23a). Saltation along the furrows parallel to tillage ridges often undercuts the ridge crust, which reduces the ridge effectiveness and leaves an accumulation of mobile material. Periodically changing ridge direction can provide sheltered accumulation zones for saltating soil. Furrow diking is also highly effective in reducing saltation/creep parallel to ridges. Field strips may also be designed with curvature (Fig. 17.23b) and (Fig. 17.24). In terraced farming systems, curvature of strips is usually a necessity, but the practice can often be useful in other systems. The curvature of the strip provides trapping areas for eroding soil moving along a given wind direction. WEPS can be used to evaluate these systems by inputting the strip width and then estimating the length between zones where saltation/creep material is trapped.

In summary, strip cropping is most effective when appropriate strip width and orientation are determined and combined with other wind erosion control practices such as maintaining a rough, cloddy surface and residue cover or cover crop.

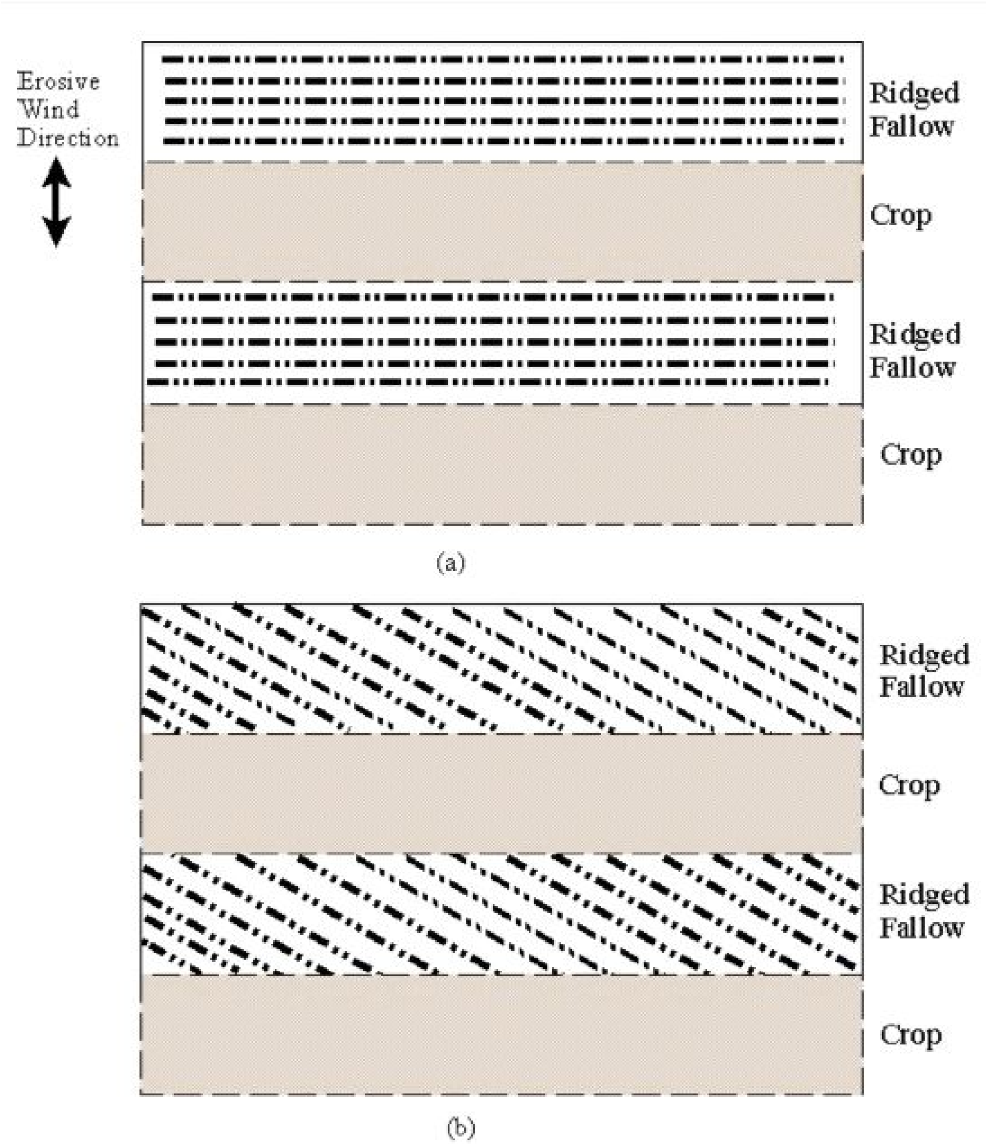



Figure 17.22: Designs using (a) parallel tillage ridges and (b) angled tillage ridges.

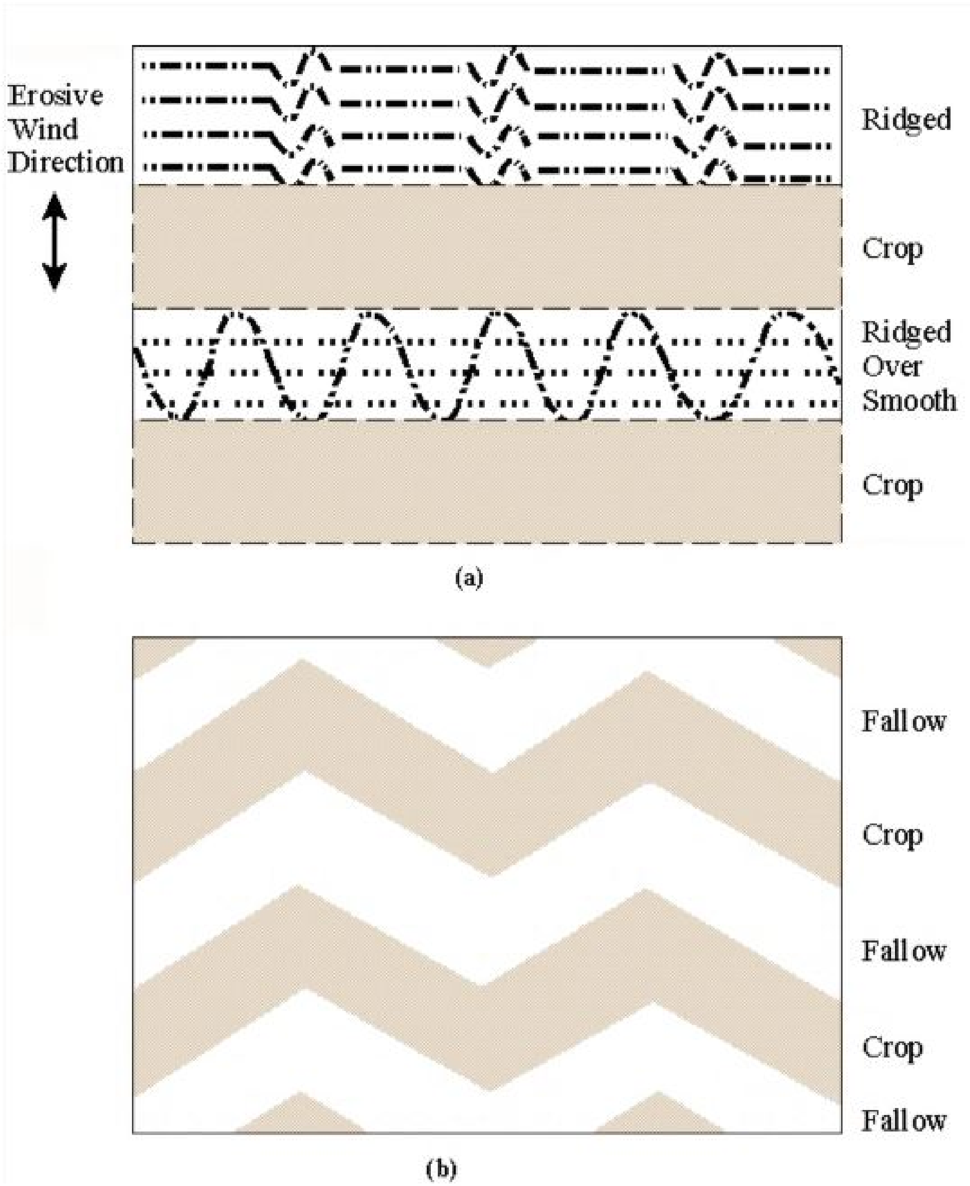



Figure 17.23: Erosion control designs using (a) variations of curved ridges and (b) curved strips.

Figure 17.24: Example of field strips designed with curvature.

### 17.4.1 Examples of Strip Cropping Using WEPS

The WEPS model can be used to evaluate strip cropping for the reduction of soil loss by wind. Here, some example simulation runs are provided, which illustrate the procedure and effectiveness of breaking up a large field into narrow strips.

No Strip Cropping

The beginning scenario for this example (Fig. 17.25) is defined as follows:

Farm is located near Saint Francis in Cheyenne County, Kansas

Soil is silt loam

Wheat-fallow rotation as shown in the MCREW screen (Fig. 17.26)

Field size of 2640’ x 2640’, 160 acres

No barriers, 0.0 degree field orientation (North-South)

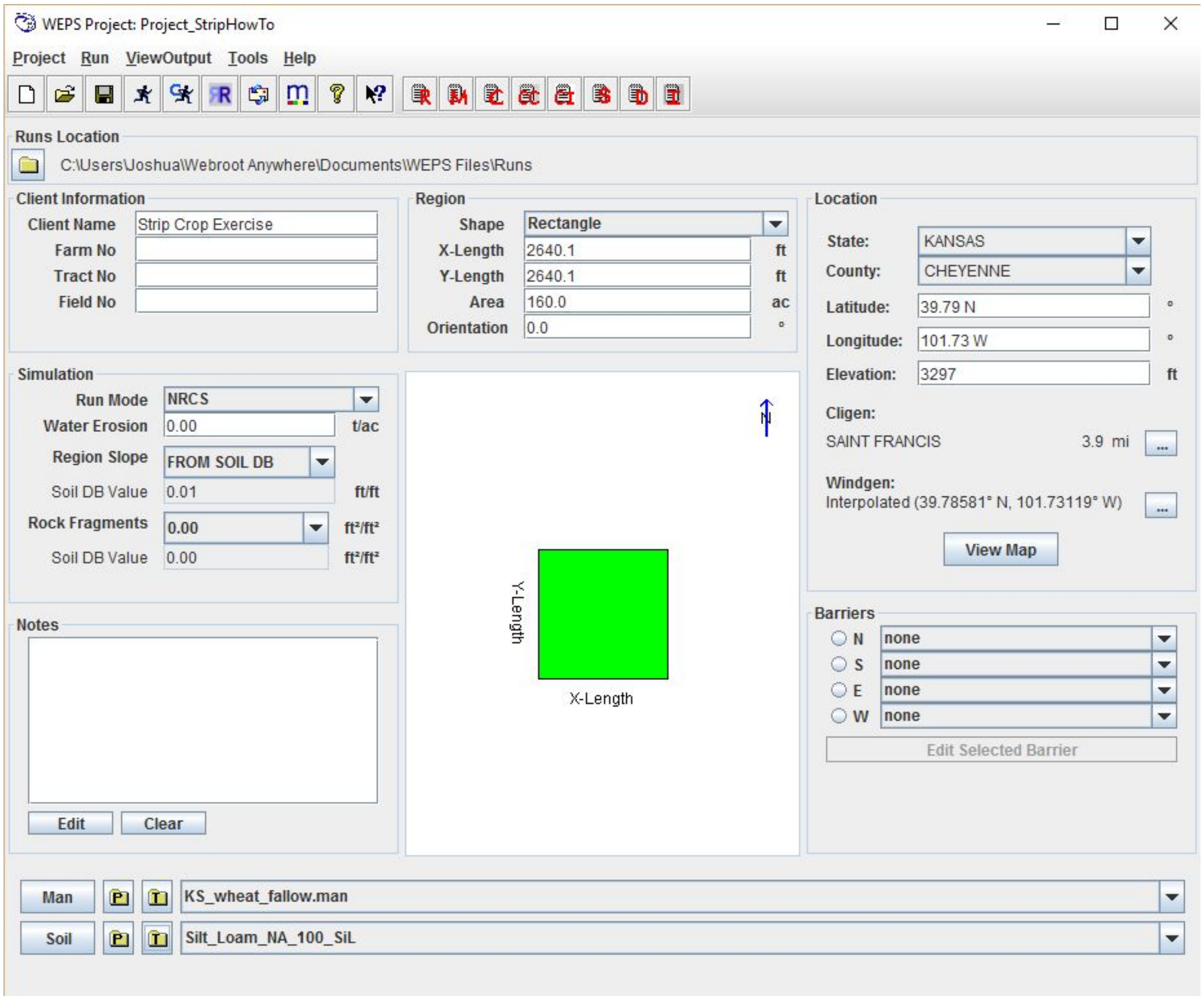



Figure 17.25: Main screen showing setup for non-strip cropped field.

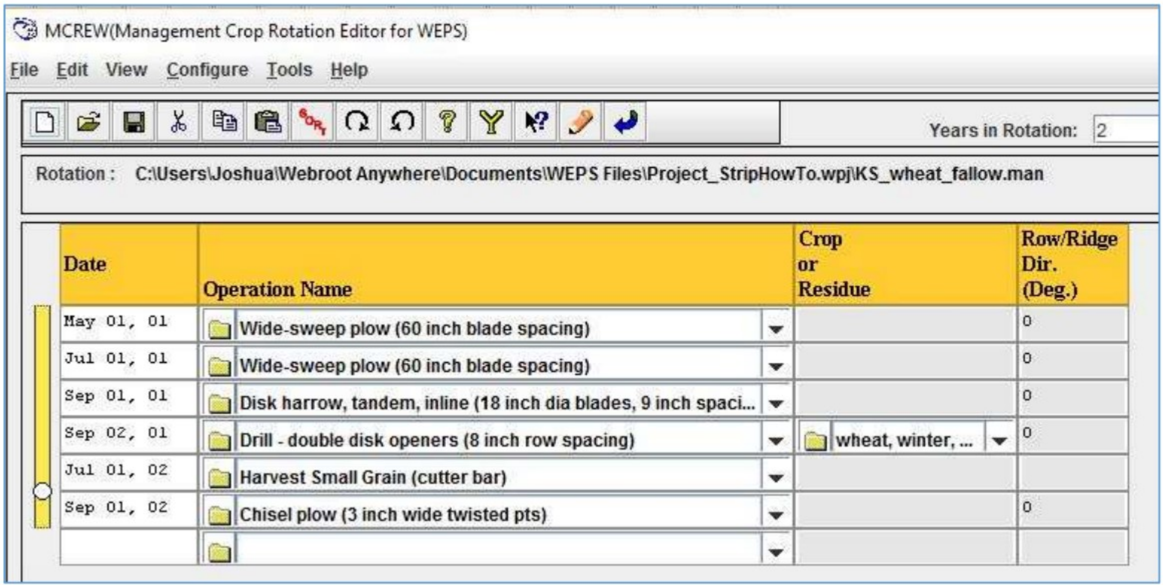



Figure 17.26: Management Crop Rotation Editor for a conventional wheat fallow rotation.

As can be seen in the Run Summary Report (Fig. 17.24), the simulation run for this non-strip cropped scenario resulted in an annual average soil loss of 21.2 tons /acre/year, with 26.9 tons/acre/year lost during the first year (fallow) of the rotation and 15.4 tons/acre/year lost during the second year (wheat) of the rotation. Note that because no barriers are present to affect loss across the field, the gross loss is equal to the net soil loss for the field. In addition, the amount of creep/saltation and suspension soil loss are presented. Notice that the suspension made up a majority of the field and boundary loss (Fig. 17.24) on the non-stripped field because the field was probably wide enough to allow creep/saltation to approach transport capacity and suspension material to continually diffuse into the atmosphere (Fig. 17.16 and Fig. 17.17) .

The soil loss in this scenario would generally be considered an unacceptable amount, and conservation measures should be recommended. To determine if strip cropping would be effective, the user should first view the Boundary Loss summary report for the non-stripped field as shown in Fig. 17.28. In this example, almost all of the eroding soil mass is crossing the south and east field boundaries, indicating northerly and westerly prevailing wind directions. Most of the mass is crossing the southern field border, so dividing the field in east-west oriented strips will shorten the field length in the direction having the most loss.

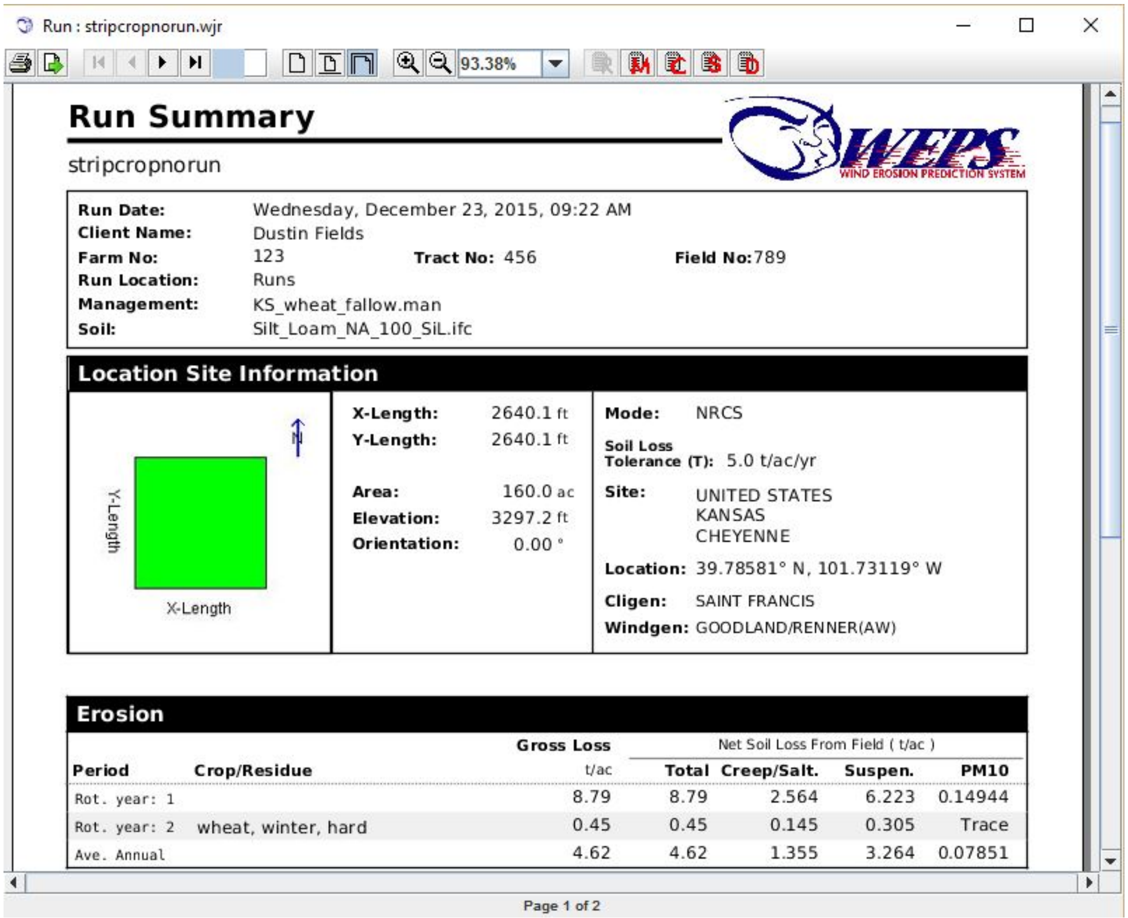



Figure 17.27: Run Summary for the non-stripped scenario.

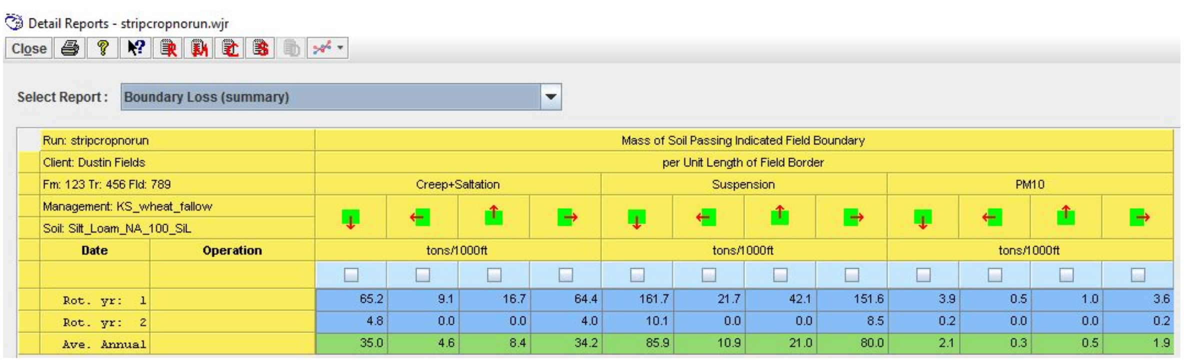



Figure 17.28: Boundary Loss summary for the non-stripped scenario.

Strip Crop

In an attempt to reduce soil loss along the direction having the greatest loss, the field is divided into eight 330-foot-wide strips (20 rods each) with strips alternating the wheat and fallow part of the rotation Fig. 17.28. The strips are oriented with the long sides aligned east-west. We simulate one strip of the field, with the wheat fallow management rotation. All other conditions remain the same as the original non-stripped field.

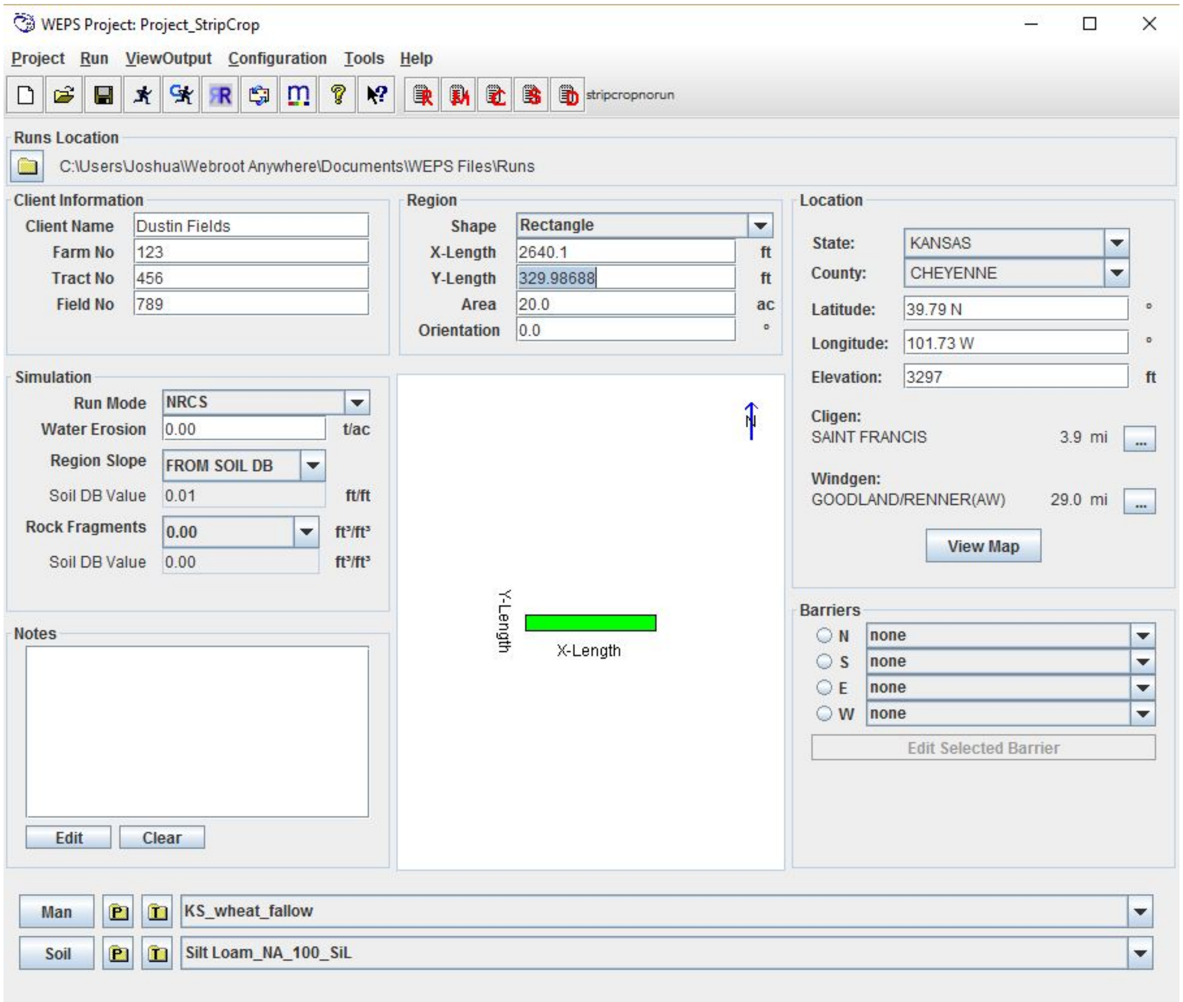



Figure 17.29: Main screen showing the setup for a strip-cropped field.

As can be seen in the Run Summary report Fig. 17.29, breaking the field into strips reduced the annual average soil loss to 1.7 tons/acre/year, with 2.1 tons/acre/year lost during the first year (fallow) of the rotation and 1.4 tons/acre/year lost during the second year (wheat) of the rotation. Because loss is reported on a per acre basis, the loss for the strip represents the loss rate per acre for the entire field.

The Run Summary report also shows that suspension loss was less than the creep/saltation loss on the stripped field. Recall that suspension made up a majority of the loss on the non-stripped field Fig. 17.29. Because the processes of creep/saltation increase downwind, so an increasing amount of suspension is generated (Fig. 17.16 and Fig. 17.17). Limiting the field length therefore, limits these suspension-generating processes.

On stripped fields, creep/saltation-sized aggregates will be deposited within the alternating strips that have adequate wheat or residue cover to stop the movement. This deposition of creep/saltation material in adjacent strips is not modeled within WEPS, but can be estimated from creep/saltation crossing the strip boundaries and should be considered in control strategies.

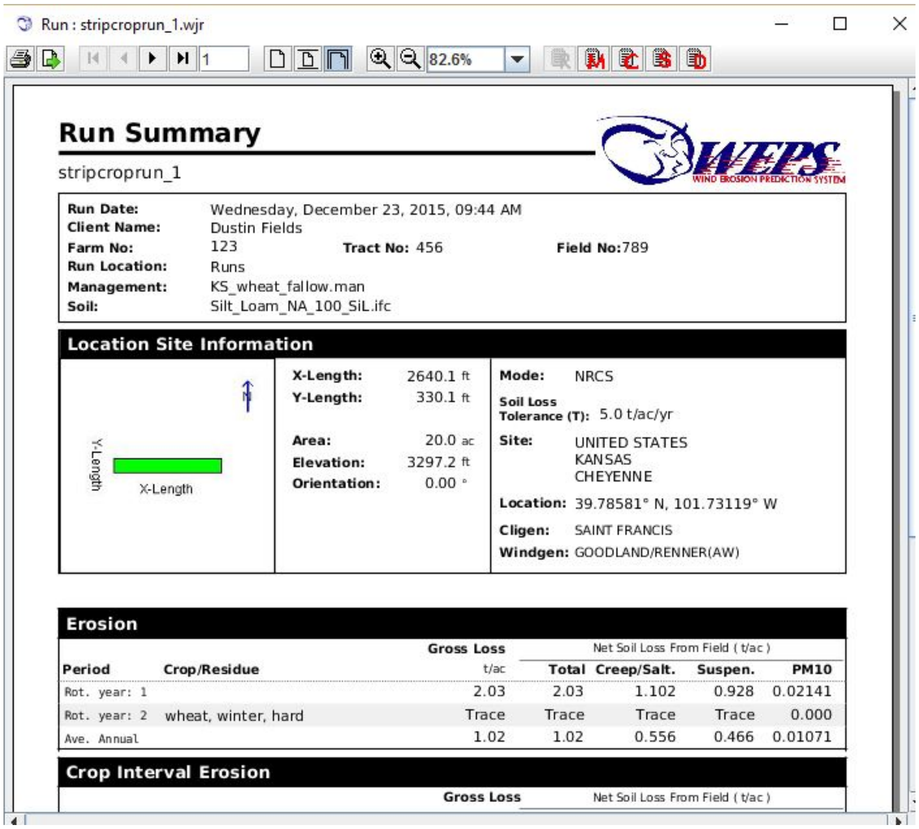



Figure 17.30: Run Summary report for the strip-cropped scenario.

The Boundary Loss summary (Fig. 17.30) shows that, although field length was unchanged in the east-west direction, a significant reduction in loss still occurred on the eastern boundary. This indicates that much of the original soil loss on the eastern boundary was the result of winds that were not directly out of the west. Therefore, some winds deviated from the westerly direction, causing soil loss across the east boundary. As a result of this deviation, stripping the field provided some reduction in field length along the wind direction, resulting in a reduction of soil loss in the eastern direction.

Although the Boundary Loss for creep/saltation generally stays on the field within the adjacent strip, suspension boundary loss can potentially leave the field area. Therefore, the suspension boundary loss along the long field border should be multiplied by the number of strips to determine total suspension boundary loss for the total 160-acre field. **Note!** In our example the suspension loss for the South border would be 3.2 x 8 or 25.6 tons/1000 ft and for the ease border, it would be 12.7 x 8 or 101.6 tons/ 1000 ft.

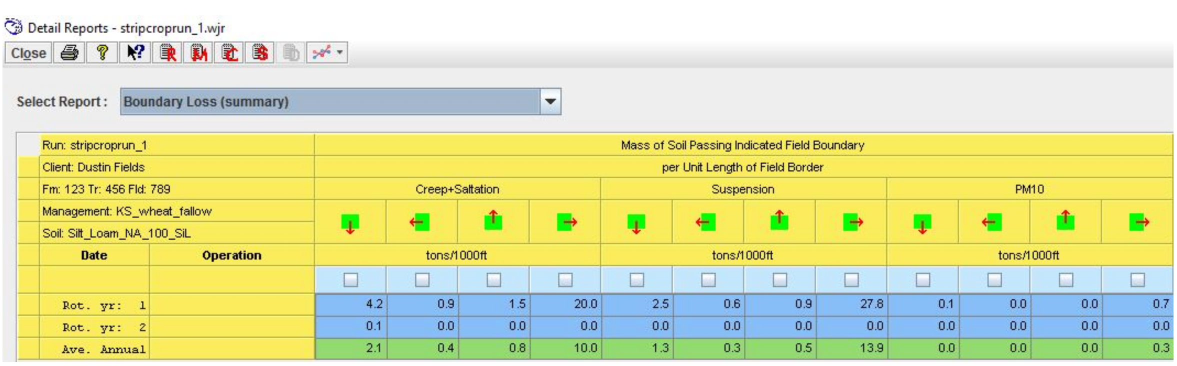



Figure 17.31: Run Summary report for the strip-cropped scenario.

Strip Crop with Grass Barriers

Even though stripping the field significantly reduced erosion rates, additional reduction can be obtained by adding a herbaceous barrier between the strips. An example of strip cropping with herbaceous barriers is illustrated in Fig. 17.30, and the WEPS main screen setup for this scenario is shown in Fig. 17.32. In this example, we added a one-row grass barrier on each side of the strip (height = 3.0 ft., width = 1.6 ft., and porosity = 0.3).

Figure 17.32: Example of field strip-cropped with herbaceous barriers.

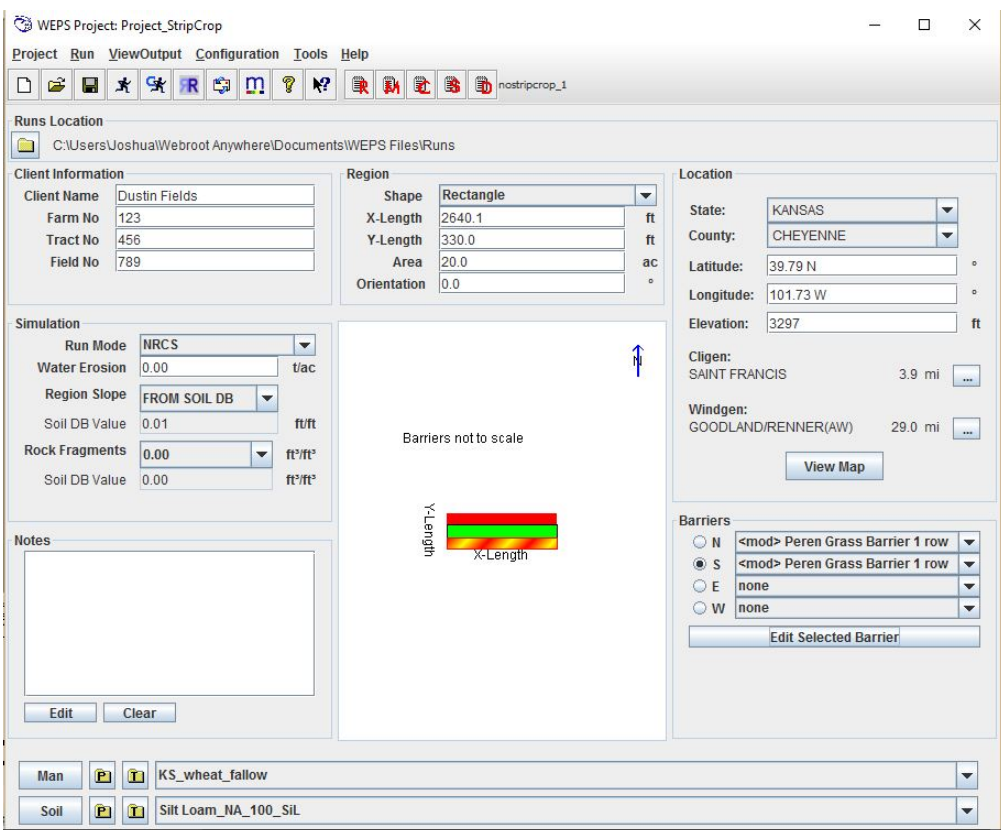



Figure 17.33: Main screen showing the setup for a field strip-cropped with grass barriers

As can be seen by the Run Summary (Fig. 17.33), adding a barrier on each side of the strip further reduced average gross loss for the rotation to 0.9 tons/acre/year. The loss for first year (fallow) of the rotation was reduced to 1.2 and for the second year (wheat) it was reduced to 0.6 tons/acre/year. Note in this scenario that because barriers are present, the net loss is less than the gross soil loss for the field. This difference is due to deposition that occurs just before the downwind barrier. The net creep/saltation was reduced to 0.18 tons/acre/year, and suspension was reduces to 0.28 tons/acre/year. Again, creep/saltation deposition in adjacent strips is not modeled within WEPS. Because almost no creep/saltation is available to generate suspension-size material, one can conclude that most of the suspension is from loose suspension-size material on the surface.

The boundary loss for this scenario is shown in Fig. 17.34. Both creep/saltation and suspension leaving the field were significantly reduced on the south boundary, compared with strip-cropping without the barriers. Loss on the eastern boundary was only slightly reduced.

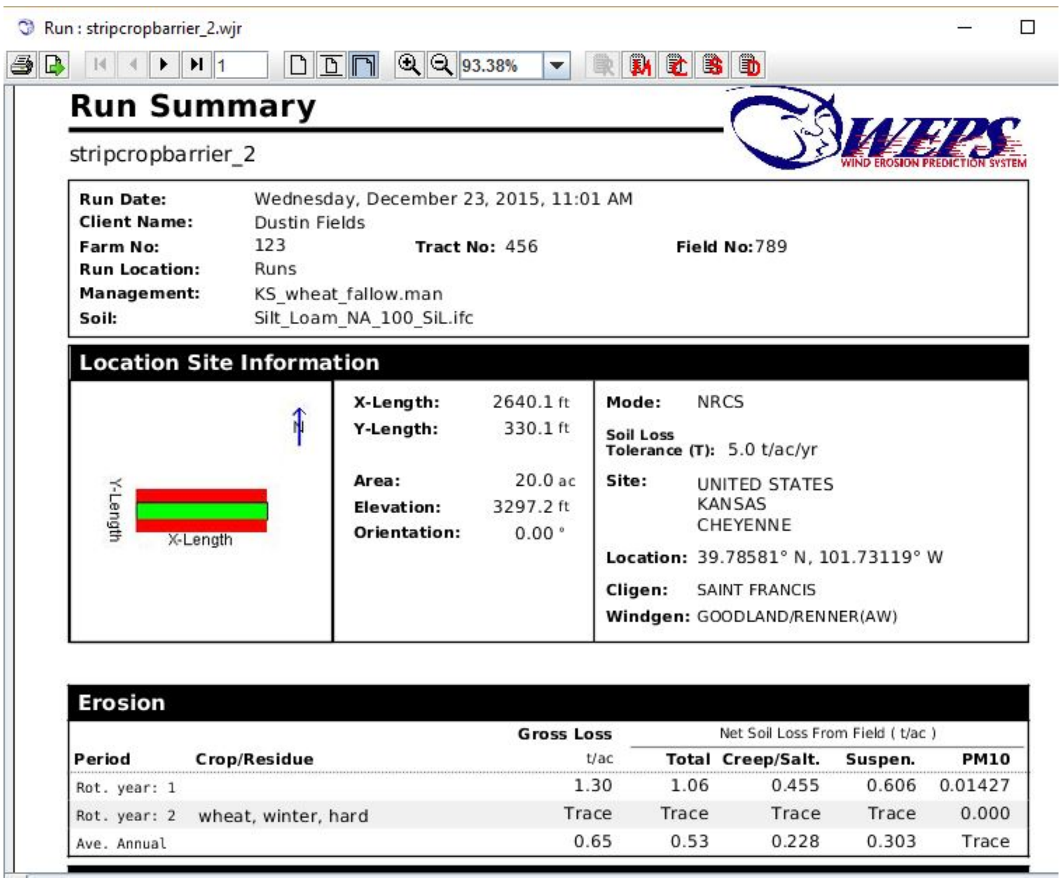



Figure 17.34: Run Summary report for the strip-cropped field with barriers.

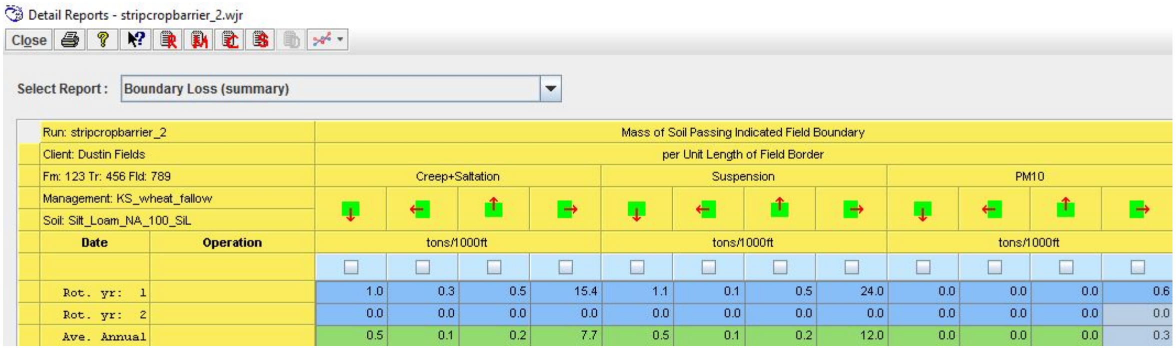



Figure 17.35: Boundary Loss summary for the strip-cropped field with barriers.

<u>Strip Cropping on a Soil with Excessive Erosion</u>

This set of examples contains field and management conditions that are the same as the previous examples, except that the soil is a loamy sand, which is susceptible to large amounts of erosion. The Run Summary for the non-stripped scenario (Fig. 17.35) indicates an annual average loss of 96.0 tons/acre/year, with an average of greater than 150 tons/acre/year being lost in the first year (wheat) of the rotation. Note the net loss for creep/saltation is 22.53 tons/acre/year and suspension is 73.40 tons/acre/year. Again, the boundary loss (Fig. 17.36) shows that the most loss passes the southern boundary, so shortening the field in the north-south direction by stripping is a control strategy that should be considered.

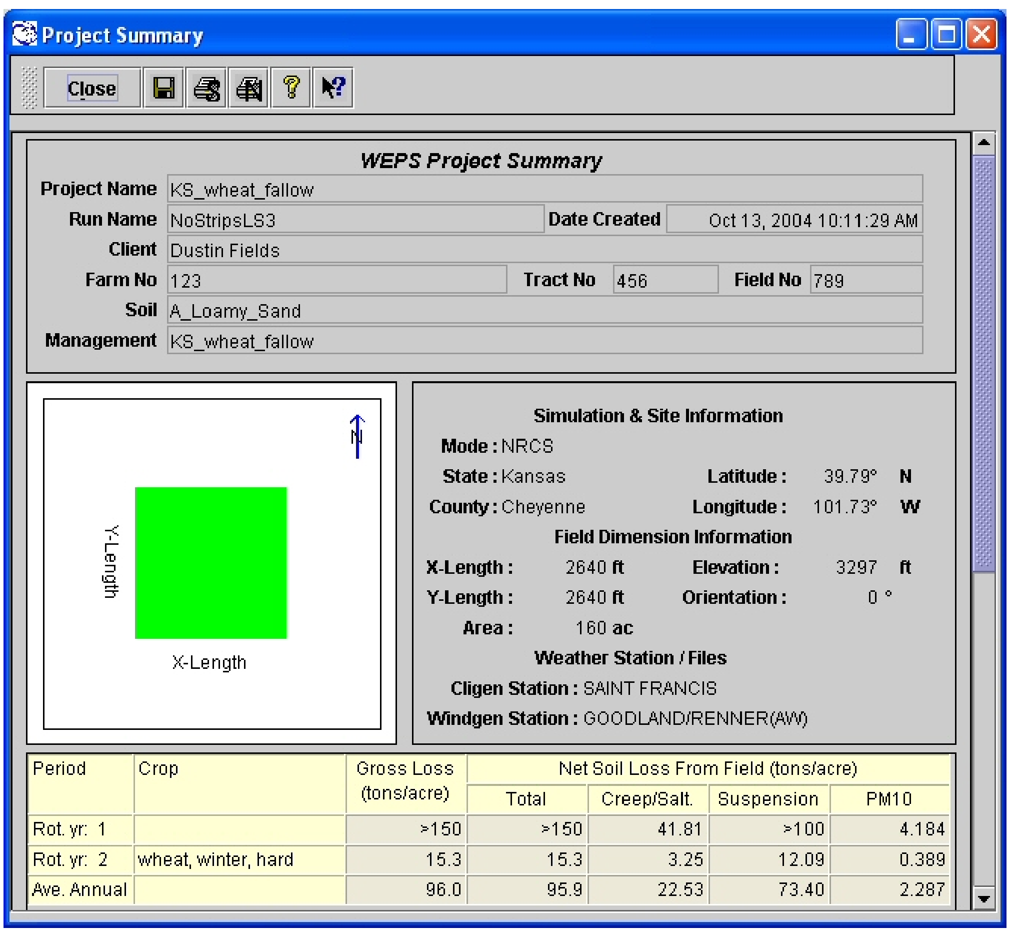



Figure 17.36: Run Summary for the non-stripped scenario with a loamy sand soil.

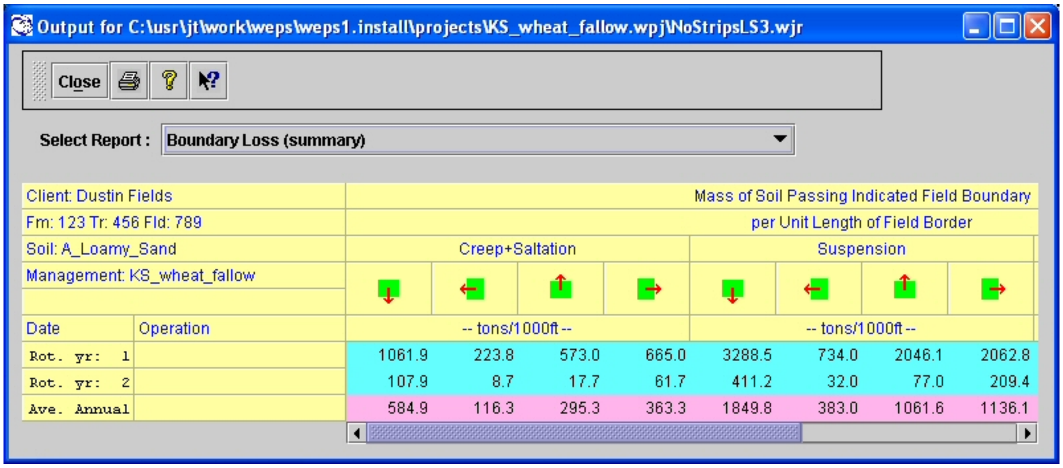



Figure 17.37: Boundary Loss summary for the non-stripped field with a loamy sand soil.

To observe the effects of strip width on this loamy sand field, we begin with a field divided into thirty-two, 82- foot-wide strips (5 rods each) with the long sides aligned in the east-west direction in an attempt to reduce soil loss. All other conditions for the field remain constant for the simulation. We continue to successively double the width of the strips (i.e., 82, 165, 330, 660, 1320, 2640 ft.) and simulate the soil loss as strips get wider. The results of these simulations are shown in Table 17.1 and indicate that average annual total loss continually increases with increases in the strip width. The net creep/saltation loss, however, shows an increase as width increases from the narrow-stripped scenario to a maximum loss at 660 ft width. As widths become wider than 660 ft., the creep/saltation loss decreases.

| Strip Width | | Average Net Loss from Field (tons/acre/year) | | | South Boundary Loss (tons/1000 ft.) | |
|---|---|---|---|---|---|---|
| feet | rods | Total | Creep/Salt. | Suspension | Creep/Salt. | Suspension |
| 82 | 5 | 35.1 | 25.77 | 10.31 | 32.6 | 10.6 |
| 165 | 10 | 48.9 | 33.67 | 15.24 | 84.6 | 33.5 |
| 330 | 20 | 68.1 | 43.13 | 24.99 | 204.4 | 111.1 |
| 660 | 40 | 88.7 | 46.23 | 42.46 | 404.2 | 359.8 |
| 1320 | 80 | 95.1 | 34.52 | 60.59 | 539.4 | 917.8 |
| 2640 (no strip) | 160 | 95.9 | 22.53 | 73.40 | 584.9 | 1849.8 |

Table 17.1: Change in soil loss with changing strip width.

To discuss these changes in loss with field length, it is important to review the concepts of "net loss" and "discharge". The model simulates a horizontal discharge (i.e. amount removed up to a downwind distance) of mobile saltation/creep (Fig. 17.16) and suspension-size aggregates (Fig. 17.17). On long erodible fields, the saltation/creep discharge may reach transport capacity. **Transport capacity** is defined as the maximum horizontal discharge of saltation/creep possible for a given wind speed and surface condition. At transport capacity, the deposition of saltation/creep from the air stream per unit area equals the amount entrained into the air stream. There generally is still a net removal of saltation/creep aggregates from the surface to replace those lost by breakage to suspension size. In this scenario, saltation-creep can only approach transport capacity. In contrast, the suspended discharge is not limited by transport capacity, because these particles continually diffuse into the atmosphere. As a consequence, the mass of suspended material increases over the entire length of eroding fields, with the rate of increase controlled by the erosion processes. Remember to add the suspension soil loss from all the strips to the total loss.

Conservation planners often design control systems based on average soil loss (i.e., amount removed per area). Total horizontal discharge at any downwind distance divided by the upwind field length represents the average soil loss over the upwind area. Using this calculation, one can illustrate the effects of field length on soil loss. Depending upon field surface conditions, the erosion processes cause differing patterns of horizontal soil discharge and, consequently, causing differing soil loss for the saltation/creep-size (Fig. 17.16) and the suspension size soil (Fig. 17.17). After saltation/creep reaches transport capacity, dividing the nearly-constant transport capacity by field length to give average soil loss shows that there is a steady decrease in loss per unit area with increasing field length (i.e., area increases, whereas transport remains essentially the same). In contrast, there is generally a large net loss of suspension-size soil over the entire field length. Total soil loss for any field length is determined by adding the average suspension and saltation/creep soil losses (Fig. 17.19). In general, the maximum average soil loss occurs at a field length at which both the saltation/creep and suspension components are contributing significant net soil loss. On far downwind portions of long fields, the increases in the soil discharge come mainly from suspended soil, so the average soil loss may decrease somewhat with field length. Thus, on long fields, suspension soil loss typically exceeds the saltation/creep loss. Of course, if the mobile soil is composed mainly of sand larger than suspension size ($>$ 0.1 mm diameter), then saltation/creep will remain the dominant form of soil loss.

Smooth, loose fields often have a length at which there is a maximum soil loss, and the average loss then decreases beyond that field length (Fig. 17.19a). In this example, very short field lengths are necessary to control wind erosion. Thus, on all fields subject to wind erosion, planners should consider using other erosion controls in combination with strip cropping. Cross wind ridges, cover crops, and residue management are good examples.

Suspended soil lost from long eroding fields can be considerable and is subject to long-range transport. Other detrimental effects also accompany this soil loss. These include an increase in sorting of the initial soil so that the removed soil is enriched in nutrients, organic matter, clay and silt fractions- the productive elements of the soil. The increased abrasion and breakage processes on long fields also increase the PM10 content (particulate matter $<$10 microns diameter) that is regulated as a health hazard. Thus, not only the amount, but also the quality and size distribution of the removed soil, changes as field length increases.

For simplicity, the Wind Erosion Equation (WEQ) predicts that average soil loss on long fields approaches a constant value. In WEPS, on the other hand, the average soil loss may increase or decrease on long fields, depending on whether creep/saltation or suspension is the dominant transport mode. Both the WEPS and WEQ models show that, for effective erosion control, the field length along the prevailing wind erosion direction needs to be significantly less than the distance to the point of maximum soil loss. The effect of reducing field length on erosion is not linear, however, but varies approximately with the logarithm of the distance to transport capacity.

Recall that, in the current version of WEPS, individual field strips are modeled as a single field. The initial increase in creep/saltation loss, as the loamy sand field get wider (Table 17.1), is a result of large increases in discharge relative to small increases in field area (i.e., left part of curve in Fig. 17.16a and Fig. 17.16b for the loose, smooth field). But at some point downwind on wide fields, the creep/saltation discharge reaches transport capacity, and loss and deposition are equal (i.e., where Fig. 17.16a becomes nearly flat for the loose, smooth field). Thus, an increase in field width from that point does not result in any further net discharge of creep/saltation-size material Fig. 17.16a and actually shows a decrease in loss of creep/saltation material as strips get wider (Fig. 17.16b and Fig. 17.19a). This decrease in loss as strips get wider occurs because net loss is calculated by dividing the constant discharge (transport capacity) by the increasing area (tons/acre). This decrease in creep/saltation loss as wide fields get wider may, under some field conditions, even occur with the total net loss from the field. In the present example, however, even though the creep/saltation rate increased as wide strips got narrower, the suspension was continually reduced. The reduction in suspension was more than enough to compensate for the increase in creep/saltation and, thus, the total loss rate was reduced as strip width decreased.

It is very important to note that the boundary loss for the south boundary (Table 17.1) shows a significant reduction in both the creep/saltation and suspension leaving the field as width decreases. Notice that there was not an increase in boundary loss of creep/saltation with field distance on wide strips, as there was with the field loss. This is because boundary loss is divided by a constant distance (tons/1000 ft) as strips get wider. The boundary loss represents the amount leaving the field boundary and illustrates the value of dividing the field into strips to control erosion by wind, especially on fields susceptible to large amounts of erosion.

Adding a grass barrier on each side of a 330-foot strip, as in the previous example, further reduces soil loss over the similar-size strip without barriers Fig. 17.37. Total gross loss was reduced to 21.2 tons/acre/year. Note that again the net loss was cut almost in half because of deposition just before the downwind barrier within the simulated strip. But, this erosion rate is still unacceptable, and much more aggressive control strategies should be examined. More aggressive residue retention with a stubble mulch system will be attempted next.

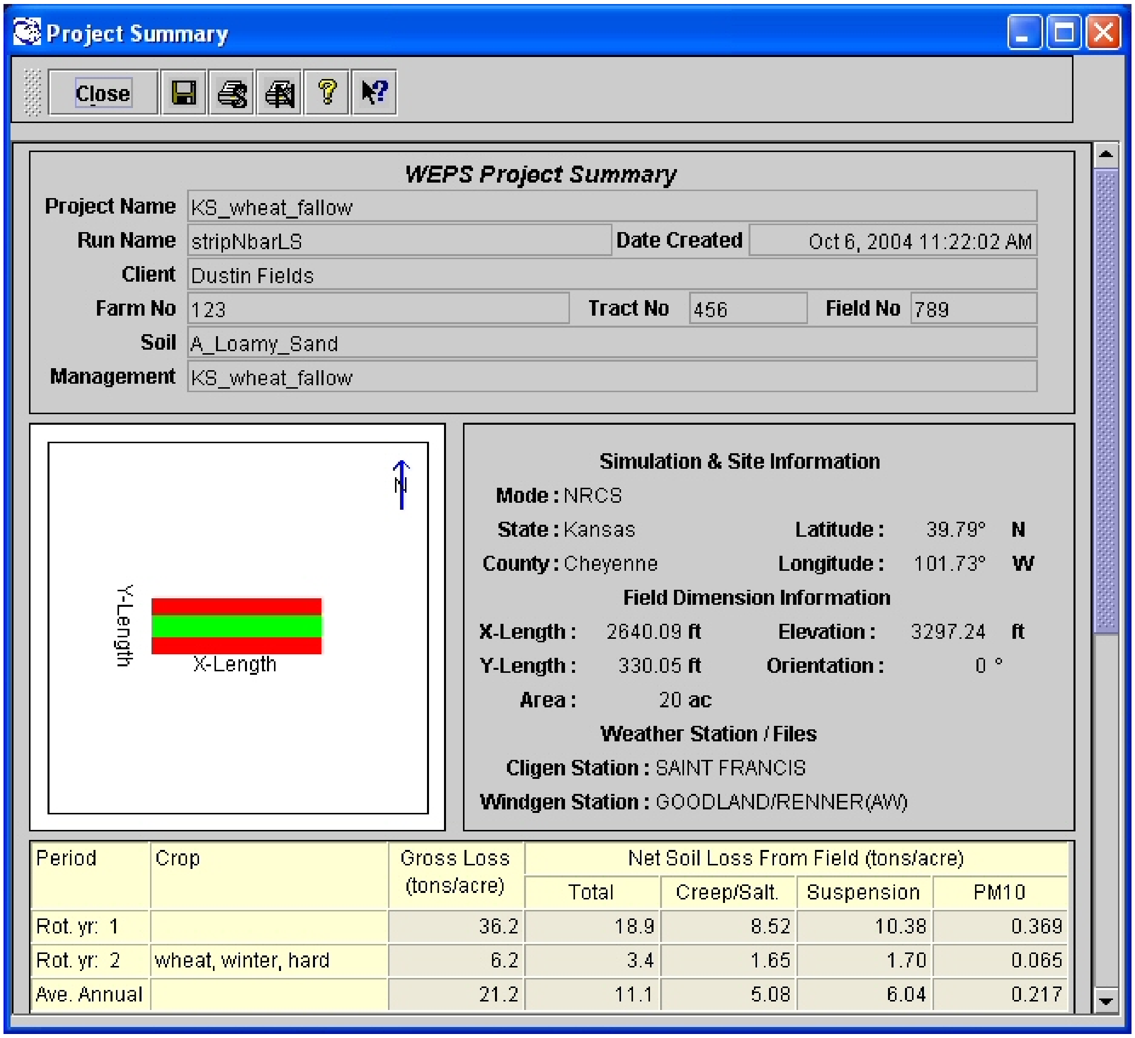



Figure 17.38: Run Summary for the strip-cropped scenario of loamy sand with barriers.

Finally, to further reduce erosion loss the management used on the previous example is changed to a stubble mulch system designed to retain more crop residue throughout the rotation. The modified management is shown in Fig. 17.38 and was created by delaying the sweep operations and eliminating a chisel operation in the fall of the second year.

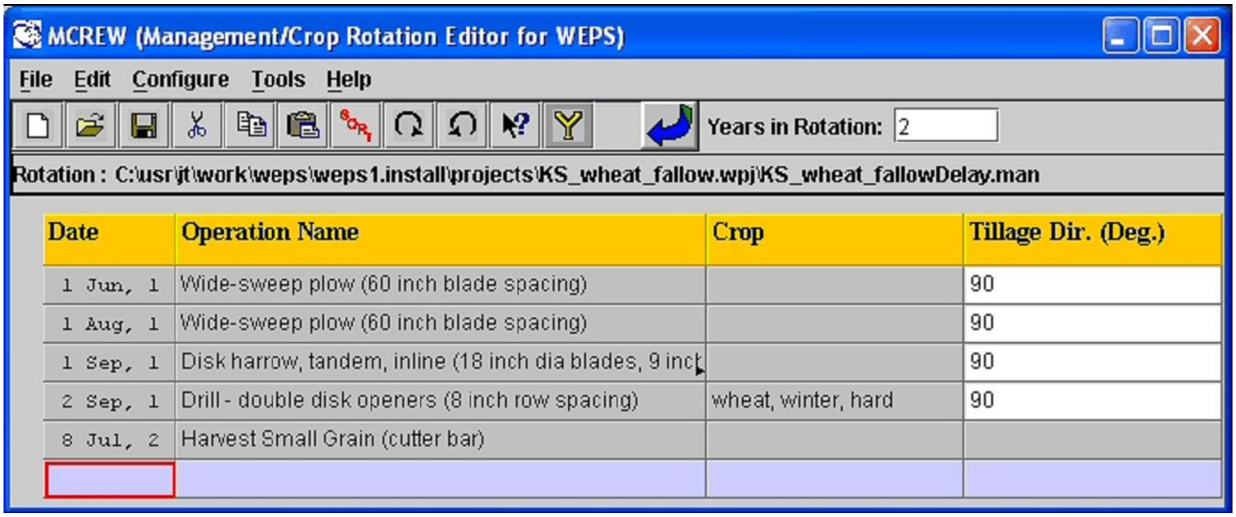



Figure 17.39: Management Crop Rotation Editor for a conventional wheat fallow rotation.

Switching to a stubble mulch in addition to a grass barrier on each side of a 330 ft strip, as in the previous example, further reduces gross soil loss to 7.0 tons/acre/year on the field with a loamy sand. The net loss, however, was reduced to 3.8 tons/acre/year (Fig. 17.39). Note that again the net loss was cut almost in half because of deposition just before the downwind barrier within the simulated strip. This erosion rate is still unacceptable, and more intensive control strategies should be examined. To reduce loss even further, more aggressive residue retention should be tried; even the retirement of the land into permanent grass should be considered.

## 17.5 Crop Database Record Development

WEPS How To Guide

### Introduction

In the plant growth submodel of the Wind Erosion Prediction System (WEPS), biomass is converted from solar radiation and partitioned to root and shoot parts (Fig. 17.40). The shoot mass is partitioned into leaf, stem, and reproductive masses. Finally, the reproductive mass is partitioned into grain and chaff parts. Development of the crop in WEPS is a function of the heat-unit index, which is the ratio of the heat units (growing degree days) at any time during the growing season to the total amount of heat units required to grow a crop from planting to maturity. The heat-unit index is 0 at planting, and the crop reaches maturity when the heat-unit index is 1.

To perform these and other operations, crop growth in WEPS is configured by a set of parameters that define and drive the growth processes represented in the model code. Reasonable crop growth in different environments is achieved by setting the appropriate parameter values for the type of crop being grown. The purpose of this guide is to define and describe the process of obtaining reasonable parameter values based on knowledge of crop characteristics.

After estimating a parameter value, specific WEPS output can be examined to see if the parameter setting gives reasonable results. Not all WEPS output is available through the WEPS interface output reports. Therefore, the user is sometimes referred to other output files, such as 'crop.out' which contains daily output for many crop variables and 'decomp.out', which contains daily output for many decomposition variables. A parameter should be adjusted if a related simulated variable does not look reasonable. After adjusting the parameter(s), run WEPS again and inspect the variable again to see if it matches what is expected. If not, continue to adjust the parameter values on this trial-and-error basis. Be sure to look at simulation output for more than one growing season.

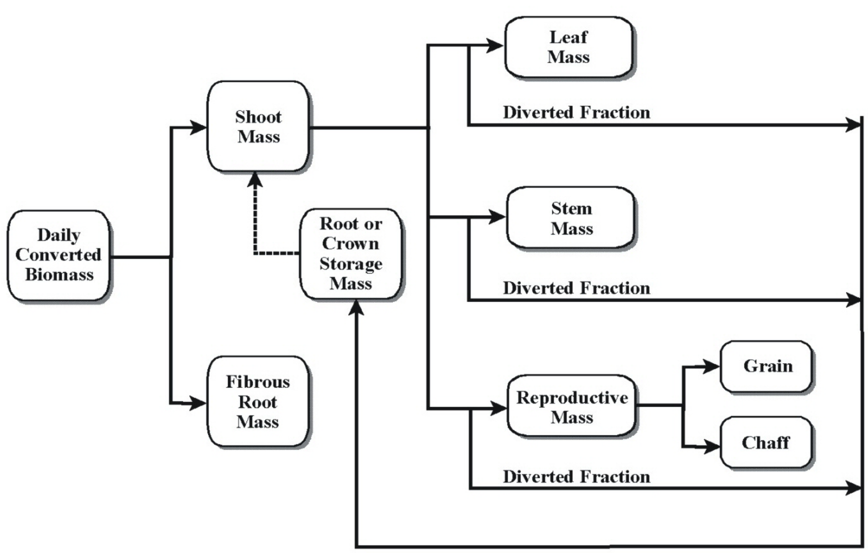



Figure 17.40: Schematic of biomass partitioning in WEPS. Biomass is converted from solar radiation and partitioned to 'fibrous root' and 'shoot' parts. The shoot mass is partitioned into leaf, stem, and reproductive masses, with some fraction of these masses diverted into a storage pool for crop regrowth. Finally, the reproductive mass is partitioned into grain and chaff parts.

### 17.5.1 Crop Database Structure Files and Definitions

Crop database records are stored in an XML format file with the extension ***.crop*** for use by the WEPS interface. Supporting files that define the database structure are part of the MCREW configuration files. New individual crop database records are most directly created by using MCREW to edit an existing crop file and saving it to a new name. New files can also be created with a text editor to edit the ***.crop*** file directly. The parameter descriptions herein provide the keys to enable the reader to know which parameter is being edited by either method.

The parameters are defined with units and are identified by a **Parameter Prompt**, which is the text that appears in the MCREW Crop drill-down screen. Some parameters have **Parameter Choices**, a list of choices that will be displayed when the parameter is defined as a discrete set of values, often integer flags. The parameters are grouped according to similar function, just as they are grouped by tabs on the Crop drill-down screen. Some parameters have both primary and alternate units which, along with a conversion factor, are given in Table 17.2. Note that for NRCS most parameter choices will not be editable by Field Office Users. NRCS will use a database manager to adjust and distribute new or revised database file.

| *Parameter Prompt* | *Primary Units* | *Alternative Units* | *Conversion Factor* |
|---|---|---|---|
| Plant Population | #/m$^2$ | #/acre | 4046.7 |
| Planted mass, dry weight | mg/plant | ounce/plant | 3.5274*10$^{-5}$ |
| Root storage mass required for each regrowth shoot | mg/shoot | ounce/shoot | 3.5274*10$^{-5}$ |
| Heat units to maturity | °C day | °F day | 1.8 |
| Minimum temperature for plant growth | °C day | °F day | 1.8 +32 |
| Optimum temperature for plant growth | °C day | °F day | 1.8 +32 |
| Maximum growth diameter of a single plant | m | ft | 3.281 |
| Residue : Yield intercept | kg/m$^2$ | lb/acre | 8921.8 |
| Maximum root depth | m | ft | 3.2808 |
| Maximum crop height | m | ft | 3.2808 |
| Lower temperature | °C day | °F day | 1.8 +32 |
| Higher temperature | °C day | °F day | 1.8 +32 |
| Stalk diameter | m | inches | 39.3696 |
| Mass to cover factor | m$^2$ / kg | acre/lb | 0.00011209 |

Table 17.2: Management Operation Classes.

#### Crop Parameter Definitions

<u>Shoot Tab</u>

The emergence of plant shoots, from either seeds, stored root mass, or the pseudo emergence of transplants, is controlled by four crop parameters: “Planted mass, dry weight”, $m_p$ , “Root storage mass required for each regrowth shoot”, $m_{sh}$ , “Ratio of leaf mass/stem mass in shoot”, $r_{ls}$ , and “Ratio of stem diameter to stem length”, $r_{dl}$ , and two parameters described later in this document: “Stem silhouette area coefficient *a*” and “Stem silhouette area coefficient *b*”. Note that the “Root storage mass required for each regrowth shoot” is mostly used in regrowth calculations. If the “Planted mass, dry weight” is greater than the “Root storage mass required for each regrowth shoot”, then multiple shoots per plant will be generated. The number of shoots per plant, $n_{sh}$ , that will grow from the planted (stored) mass, is calculated from:

$$n_{sh} = max[1, min[n_{ms}, \frac{m_p}{m_{sh}}]]$$

$$N_{sh} = N_p n_{sh}$$

where nms is the “Maximum number of shoots per plant” and $N_{sh}$ is the number of shoots per square meter. Note that $n_s h$ does not have to be an integer. The shoot growth subroutines assume a 40% conversion efficiency from stored to live biomass. When growth is from seed or a transplant, 40% of growth biomass will become roots. The stem length at full extension is calculated as:

$$m_{st} = \frac{0.7(1-0.4)m_p}{(r_{ls}+1)}$$

$$A_{st} = a(\frac{m_{st}}{10^6}\frac{N_{sh}}{N_p})^b \frac{N_p}{N_s h}$$

$$l_{st} = \sqrt{\frac{A_{st}}{r_{dl}}}$$

where $m_{st}$ is the mass of stem generated in the complete emergence process, $A_{st}$ is the silhouette area of a single stem, and $l_{st}$ is the length of stem generated at full extension. Full extension has been realized when all of the planted (stored) mass ($m_p$) has been converted to generated shoot mass. Emergence occurs when $l_{st}$ is greater than the "Starting depth of growing point". An error message is generated if emergence never occurs.

*Parameter Prompt:* Crop Type

*Parameter Choices:*

1 - Warm-season legume (soybeans, etc.)

2 - Cool-season legume (peas, etc.)

3 - Perennial legume (alfalfa, etc.)

4 -Spring seeded and warm-season annuals (spring wheat, cotton, sunflowers, corn, etc.)

5 - Cool-season annuals (winter wheat, winter canola)

6 - Perennials (pasture, etc.)

*Parameter Prompt:* Transplant or Seed flag

*Parameter Choices:*

0 - Seeds planted in field.

1 - Transplants planted in field (mass immediately divided into root, leaf, stem).

This flag is set to indicate that plant growth begins with a transplant or with a seed being placed in the field. If growth begins with a transplant (as opposed to grown from seed), a number of additional parameters need to be adjusted: the length of the growing season will need to be shortened, by either days or heat-units, to represent the time from transplant to maturity; the planted mass, dry weight, should be adjusted to represent the size of the transplant; and the heat-unit index at (pseudo) emergence, should be adjusted to represent a reasonable transplant-shock recovery time.

*Parameter Prompt*: Plant population, $N_p$ (# / m$^2$)

The number of plants expected in a normal stand. This should be the estimated plant population after germination. If the maximum number of shoots per plant (next parameter) is set to one, then this is the total number of stems expected.

*Parameter Prompt*: Maximum number of shoots per plant, $n_{ms}$ (# / plant)

Growth of multiple shoots occurs when this value is greater than one and root (crown) storage mass is greater than "Root storage mass required for each regrowth shoot" at the time regrowth commences. The number of stems produced can be examined by viewing the number of stems per square meter (the variable '# stems' in the output file 'crop.out') and comparing it with the "Plant Population" (previous parameter).

*Parameter Prompt*: Starting depth of growing point (m)

Crop growth begins at this depth in the soil. Root extension proceeds downward from this depth, while shoot extension proceeds upward from this depth at equal rates. It is necessary that the shoot growth parameters result in a shoot length greater than this depth or seedlings will not emerge. This depth is used as the depth from which regrowth begins for crop types 3 and 6 at all times. For crop types 1 and 4, the growing point is moved to the surface at the completion of seedling emergence. For crop types 2 and 5, the growing point is moved to the surface after the initiation of spring growth.

*Parameter Prompt*: Planted mass, dry weight, $m_p$ (mg/plant)

At planting time, total plant biomass is initialized to this value. From the time of growth initialization until the completion of emergence, this mass is allocated to roots, stems, and leaves. For a crop grown from a seed, the mass should be set to the individual seed weight. For a crop that is placed in the field as a transplant, the total plant dry weight, including roots, should be entered.

*Parameter Prompt*: Root storage mass required for each regrowth shoot, $m_{sh}$ (mg/shoot)

As described previously, the number of shoots that grow from stored root mass is calculated based on this parameter. For crops that can regrow from stored root or crown mass, this value is used, along with the “Maximum number of shoots per plant” and the stored root mass of the crop to determine how many shoots will re-sprout. The partitioning of mass to be stored for regrowth is set by using the parameters “Fraction of leaf mass partitioning diverted to root storage”, “Fraction of stem mass partitioning diverted to root storage”, and “Fraction of standing store mass partitioning diverted to root storage”. The quantity stored varies depending on growth conditions.

*Parameter Prompt*: Ratio of leaf mass/stem mass in shoot, $r_{ls}$

This is the ratio at full extension. When the growth of a shoot from stored mass occurs, as in germination, regrowth after cutting, or the pseudo growth used to initialize a transplant, mass is divided into leaf and stem according to this ratio. This value should be large enough to generate the leaf area required to get crop growth started. If a crop does not grow adequately, examine the variable ‘eff_lai’ in the output file ‘crop.out’. It should show a value of 0.01 or greater at the heat-unit index at emergence.

*Parameter Prompt*: Ratio of stem diameter to stem length, $r_{dl}$

This is the ratio at full extension. When the growth of a shoot from stored mass occurs, as in germination, regrowth after cutting, or the pseudo growth used to initialize a transplant, stem length is calculated from stem mass according to this ratio. This parameter is the prime candidate for adjustment to ensure that plant emergence occurs when growing from seed.

*Parameter Prompt*: Heat-unit index at emergence

Setting this value to zero will cause the program to fail.

<u>Growth Tab</u>

*Parameter Prompt*: Crop Maturity measurement method

*Parameter Choices*:

0 - Crop matures on average in Days shown

1 - Crop matures in Heat Units shown

For some types of crops, corn being the best example, the length of the growing season is genetically manipulated, and the average length of the crop growth period for that area is expressed in days, not heat units. When this option is set to 0, the average weather for the location being simulated is used to find the heat unit accumulation from the planting day through the number of days shown in the “Days to maturity” parameter. The simulation is then run using this heat unit total as the season length. For option 1, the value entered for “Heat units to maturity” is used directly, regardless of location. Because the effect of vernalization on the calculation of average heat units is not implemented, all crop types 2 (cool season legumes like peas) and 5 (cool season annuals like winter wheat and winter canola) should be configured to use option 1.

*Parameter Prompt*: Days to maturity (days)

For annual grain crops, the average number of days from planting to maturity of seed. For vegetable, fruit, and root crops; sugarcane; and tobacco, it is the number of days from planting (or ratooning) to harvest. For perennials (e.g., alfalfa), it is the number of days from spring growth to maturity of seed.

*Parameter Prompt*: Heat units to maturity (°C day)

For annual grain crops, the average seasonal heat units from planting to maturity of seed. For vegetable, fruit, and root crops; sugarcane; and tobacco, it is the average seasonal heat units from planting (or ratooning) to harvest. For perennials (e.g., alfalfa), it is the average seasonal heat units from spring growth to maturity of seed.

*Parameter Prompt*: Heat unit index at start of senescence (fraction)

This is the fraction of the growing season (expressed as heat-unit index) during which plant senescence begins. Examine the variable 'eff_lai' in the output file 'crop.out' to see the effect of adjusting this parameter.

*Parameter Prompt*: Minimum temperature for plant growth (°C)

The average daily air temperature below which the model will not allow plant growth (full temperature stress). This is commonly known as the minimum cardinal growth temperature and forms the base temperature for calculating heat-unit accumulation.

*Parameter Prompt*: Optimum temperature for plant growth (°C)

The average daily air temperature at which the model will allow maximum growth (no temperature stress). This is commonly known as the maximum cardinal growth temperature and forms the upper temperature for calculating heat unit accumulation. When the average daily air temperature exceeds this value, heat-units accumulate at the maximum rate for the day, and temperature stress increases.

Geometry Tab

*Parameter Prompt*: Maximum growth diameter (m) of a single plant

Some cropping systems use plant densities that do not result in canopy closure. In these systems, the plant will grow to cover a ground area that is characteristic of the plant. WEPS assumes that the covered ground area is round. This parameter is the diameter of the circle that encloses the covered area. Biomass production is reduced by the decrease in intercepted light (some of the light reaches the soil), unless the reduced densities are used to reduce water stress for the remaining plants.

*Parameter Prompt*: Stem silhouette area coefficient a

*Parameter Prompt*: Stem silhouette area coefficient b

For many crops, the relationship of stem silhouette area to its mass is described well by a 2-parameter power function, which is used to compute stem silhouette area from stem mass: SSA = a $M^b$, where SSA is stem silhouette area ($m^2$/ plant), M is stem mass (kg / plant), and a and b are coefficients. Retta and Armbrust (1995) obtained values for alfalfa, corn, sorghum, oat, winter wheat, and soybean.

*Parameter Prompt*: Specific leaf area ($m^2$/ kg)

For many crops, the relationship of leaf area to its mass is described well by a linear relationship, which is used to compute leaf area from leaf mass: LA = a M, where LA is leaf area ($m^2$/ plant), M is leaf mass (kg / plant), and a is specific leaf area ($m^2$/ kg).

*Parameter Prompt*: Light extinction coefficient

Canopy light utilization is specified by an exponential relationship for the attenuation of light with distance into the canopy. Combined with the leaf-area index, this coefficient determines the amount of light interception by the canopy according to the relationship:

$$fraction = 1 - exp^{-kLAI}$$

where fraction is the ratio of photosynthetically active radiation (PAR) that is intercepted by the crop and total PAR received above the crop canopy, k is light extinction coefficient, and LAI is leaf area index (Fig. 17.41). A higher number indicates more light interception by a given leaf area index, as occurs with broadleaf plants with a horizontal leaf orientation, such as cotton. A lower number indicates decreased light interception by a given leaf area index, as occurs with narrow leaf plants with a vertical leaf orientation, such as the grasses.

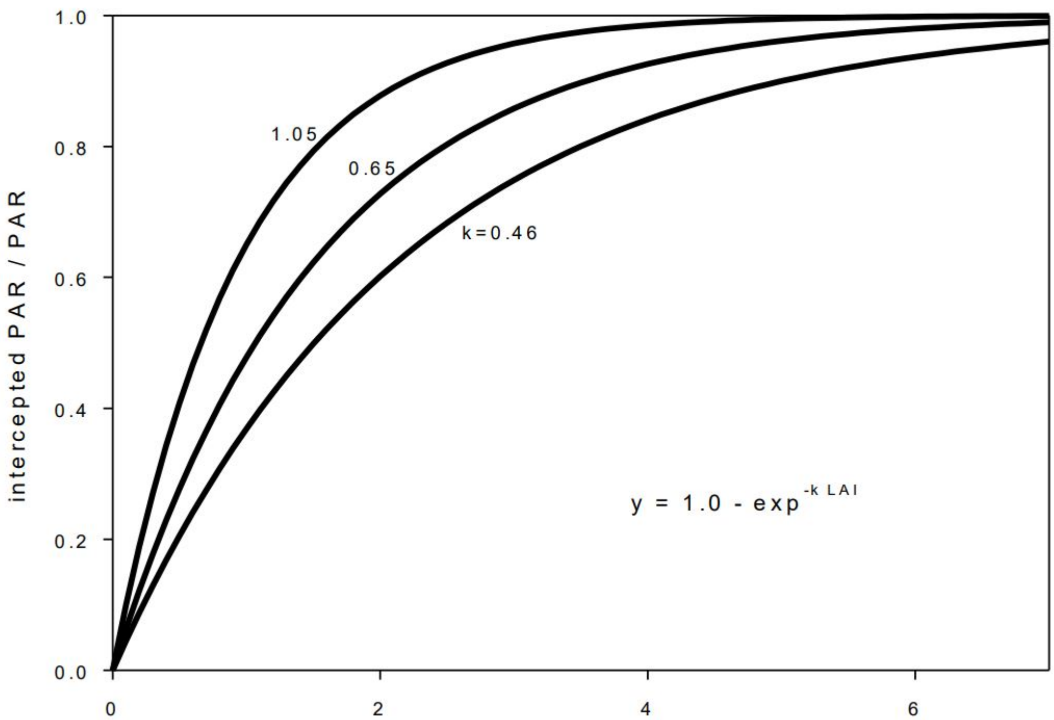



Figure 17.41: Relationship between leaf-area index and fraction of light intercepted (intercepted PAR / PAR) for three different values of the light extinction coefficient k. WEPS uses k = 1.05 for cotton; k = 0.65 for corn, soybean, potato and sugar beet; and k = 0.46 for sorghum and millet.

*Parameter Prompt*: Biomass Conversion Efficiency (t/ha) / (MJ/$m^2$)

The unstressed (potential) growth rate per unit of intercepted photosynthetically active radiation. EPIC values were used as a starting point for the major crops. Literature searches revealed that this value is difficult to measure exactly. This parameter is key to making the crop grow correctly.

Partitioning Tab

The daily converted (grown) biomass is partitioned between root and shoot mass (Fig. 17.40). The shoot mass (aboveground biomass) is further partitioned into leaf, stem, and reproductive mass (Fig. 17.42). Both the leaf curve and the reproductive curve are defined by a 4-parameter function. The remaining mass is considered stem mass. The three fractions always add to 1.0.

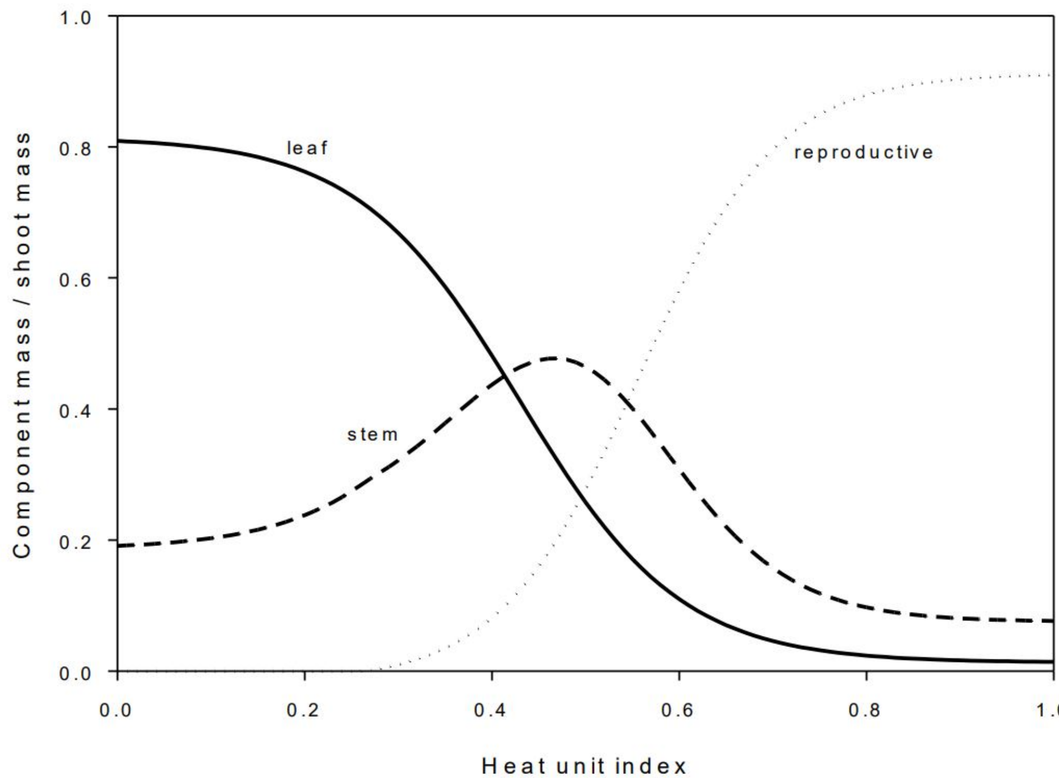



Figure 17.42: Partitioning of shoot mass (above-ground biomass) into component mass for winter wheat. Components are leaf, stem, and reproductive mass. By definition, these three fractions always add to 1.0.

Specify the four parameters for the leaf curve (Fig. 17.43):

*Parameter Prompt*: Leaf fraction coefficient a

The lower asymptote.

*Parameter Prompt*: Leaf fraction coefficient b

The range between the upper and lower asymptote.

*Parameter Prompt*: Leaf fraction coefficient c

The heat-unit index at the inflection point. The leaf mass / shoot mass ratio at the inflection point is half way between the lower and upper asymptote (a + b/2).

*Parameter Prompt*: Leaf fraction coefficient d

Determines the slope of the curve. A negative d produces a descending curve (leaf) and a positive d gives an ascending curve (reproductive)

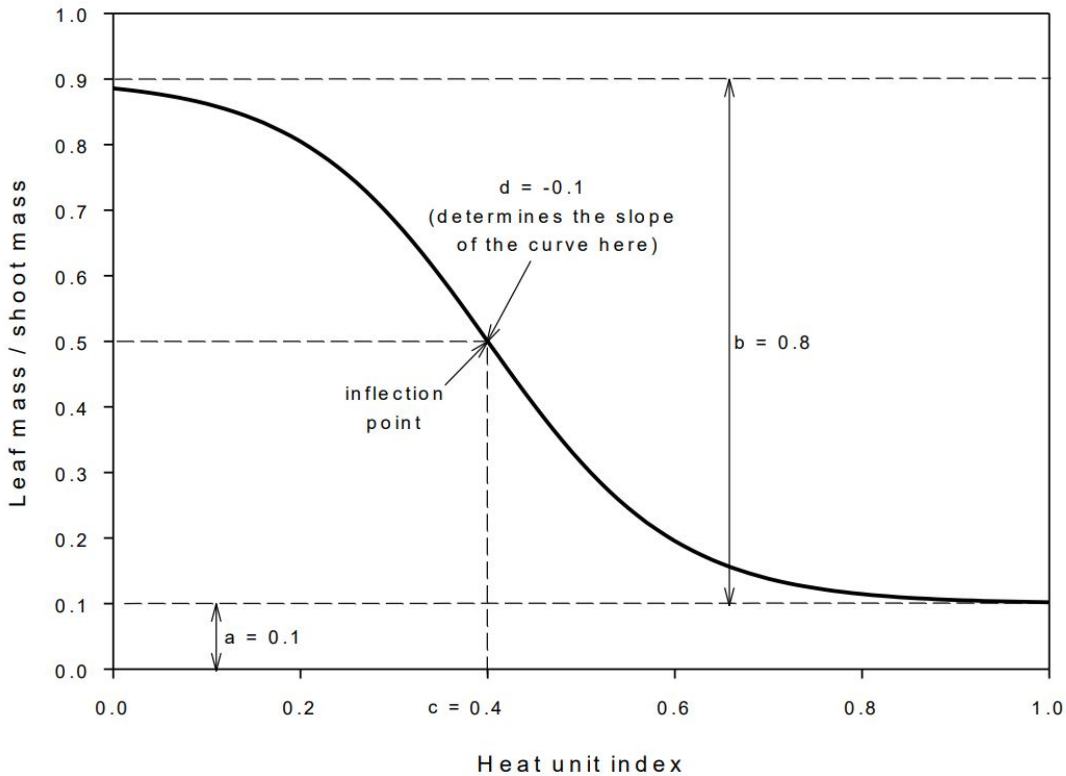



Figure 17.43: Partitioning of shoot mass into leaf mass. In this example, a = 0.1, b = 0.8, c = 0.4, and d = -0.1. The leaf mass / shoot mass ratio at the inflection point = a +b/2 = 0.5.

Specify the four parameters for the reproductive curve:

*Parameter Prompt*: Reproductive mass coefficient a

The lower asymptote.

*Parameter Prompt*: Reproductive mass coefficient b

The range between the upper and lower asymptote.

*Parameter Prompt*: Reproductive mass coefficient c

The heat-unit index at the inflection point.

*Parameter Prompt*: Reproductive mass coefficient d

For a new crop, the four leaf parameters can be adjusted on the basis of total leaf mass development (the variable ‘total leaf’ in the output file ‘crop.out’). Check total stem mass development by inspecting the variable ‘total stem’ in the output file ‘crop.out’. If stem mass development seems unsatisfactory, adjust both leaf and reproductive parameters to change the stem partitioning curve.

Reproductive mass should be equal to zero before time of flowering. This may be used as a point on the reproductive partitioning curve. Inspect the variable ‘standing store’ in the output file ‘crop.out’. If ‘standing store’ is greater than zero before flowering is expected, partitioning to reproductive mass starts too early in the growing season. Adjust the reproductive parameters accordingly.

By default (option Y1), WEPS does not use the reproductive parameters. WEPS will only use them if the Y0 option is specified. If using the reproductive parameters for partitioning then harvest index is also something to look at.

Adjust partitioning parameters if the harvest index seems incorrect. Remember that adjusting leaf and/or reproductive parameters will automatically affect stem mass partitioning.

The default method for partitioning and to calculate crop yield from total above-ground biomass uses parameters r and b to specify the relationship between yield and residue, where yield (at market-standard moisture content) plus residue (dry weight) equals total above-ground biomass. The equation is:

$$residue = rxyield + b$$

where *b* is the minimum above ground biomass required for a crop to generate any yield, and *r* is the incremental increase in residue for each additional unit of yield in excess of the minimum. The two parameters were estimated for the major crops from field data gathered for this purpose.

*Parameter Prompt: Residue* : Yield ratio (kg/kg)

Parameter *r*. As defined for the residue equation, this is the incremental increase in residue for each additional unit of yield in excess of the minimum (i.e., yield mass / residue mass).

*Parameter Prompt*: Residue : Yield intercept (kg/$m^2$ or lbs/ac)

Parameter *b*. As defined for the residue equation, this is the minimum biomass required for a crop to generate any yield.

Biomass is estimated to be stored in the root (or crown) storage pool on the basis of the values of the following three parameters. They are tied to the three biomass partitioning components (leaf, stem, reproductive) of plant growth, allowing the modeling of plants that store biomass during different periods of the growing season (Fig. 17.43).

*Parameter Prompt*: Fraction of leaf mass partitioning diverted to root storage

For crops that store biomass early in the growth season, set this value greater than zero.

*Parameter Prompt*: Fraction of stem mass partitioning diverted to root storage

For crops that store biomass in the middle of the growth season, set this value greater than zero.

*Parameter Prompt*: Fraction of reproductive mass partitioning diverted to root storage

For crops that store biomass late in the growth season, set this value greater than zero. For root crops, this value should be very close to 1, indicating that most reproductive biomass is stored below ground.

<u>Size Tab</u>

*Parameter Prompt*: Maximum root depth (m)

The maximum depth of roots attained by the crop under ideal (unstressed) growth conditions. The main modeling impact of this value is the depth of soil water extraction. Examine the variable 'rootd' in the output file 'crop.out' to see the effect of adjusting this parameter.

*Parameter Prompt*: Maximum crop height (m)

The maximum height attained by the crop under ideal (unstressed) growth conditions. For a new crop, this parameter can be adjusted based on the crop height (the variable 'height' in the output file 'crop.out'). If WEPS simulates a crop that is too tall (inspect 'height'), then decrease the parameter value. After adjustment, inspect the height variable again to see if it matches what is expected. If not, continue to adjust the parameter values on this trial-and-error basis. Be sure to look at simulation output for more than one growing season. Note that the crop height at the end of the growing season will usually be less than this maximum crop height. Only if the crop grows under unstressed conditions for the entire growing season will the crop height at the end of the season be equal to the maximum crop height.

Crop height development through the growing season, as it would be without any stresses (potential), is defined by a 2-parameter function (Fig. 17.44). This curve should be in harmony with the partitioning curves discussed earlier (i.e., the greatest increase in plant height should coincide with the greatest stem partitioning ratio).

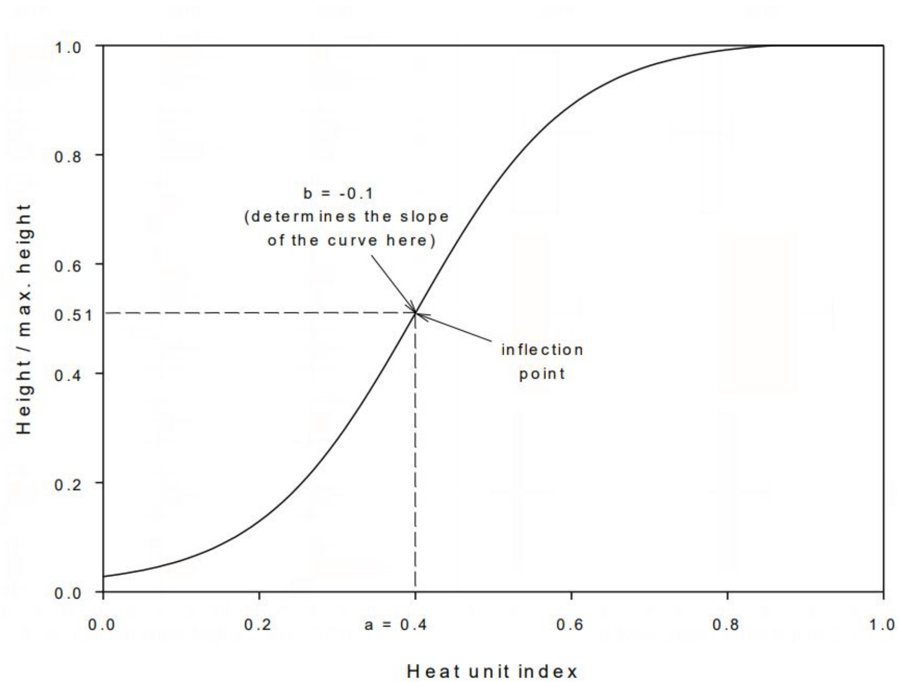



Figure 17.44: Crop height development function as it would be without any stresses. In this example, a = 0.4 and b = -0.1. The height ratio at the inflection point = 0.51

Specify the two parameters for the crop height development curve (Fig. 17.44):

*Parameter Prompt*: Crop height coefficient a The heat unit index at the inflection point.

*Parameter Prompt*: Crop height coefficient b Determines the slope of the curve at the inflection point. A negative b produces an ascending curve.

For a new crop, the two crop height parameters can be adjusted based on the crop height (the variable 'height' in the output file 'crop.out'). If WEPS simulates a crop that is too tall too early in the growing season (inspect 'height'), then increase the "a" parameter value. If WEPS simulates too gradual a crop height increase (inspect 'height'), then increase the "b" parameter value (make b less negative). Changing a and/or b may cause the final crop height to change. This can be adjusted by changing the maximum plant height.

Cold Tab:

In WEPS, freezing temperatures can reduce green leaf area. This reduction is calculated from a curve (Fig. 17.45). For example, using Fig. 17.45, if the daily minimum temperature of the top soil layer equals -15 °C, the green leaf area is reduced by 95% on this day.

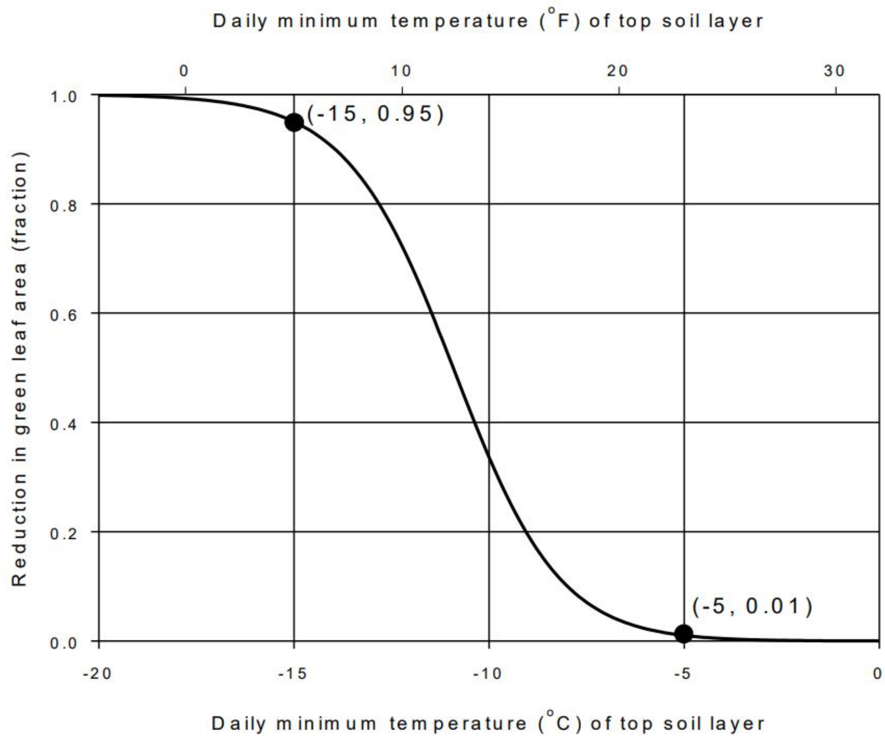



Figure 17.45: Reduction in green leaf area due to frost damage for corn.

The user can specify the frost damage curve by specifying two points on the curve. The curve for corn in Fig. 17.45 is specified by the points (-5, 0.01) and (-15, 0.95). Use the Excel spreadsheet tool to visualize the curve after specifying two points on the curve. The following four parameters specify the two points:

*Parameter Prompt*: Higher temperature (°C) This is -5 °C (23 °F) for the example in Fig. 17.45

*Parameter Prompt*: Reduction in green leaf area at higher temperature (fraction) This is 0.01 (1%) for the example in Fig. 17.45

*Parameter Prompt*: Lower temperature (°C) This is -15 °C (5 °F) for the example in Fig. 17.45

*Parameter Prompt*: Reduction in green leaf area at lower temperature (fraction)

This is 0.95 (95%) for the example in Fig. 17.45

For a new crop, these four parameters can be adjusted based on the green leaf area (the variable 'eff_lai' in the output file 'crop.out'). Example: the new crop is a winter crop. If WEPS simulates too much reduction in green leaf area over the winter (inspect eff_lai), then adjust the four parameter values so that there is less reduction in green leaf area for the same freezing temperatures.

*Parameter Prompt*: Thermal delay coefficient pre-vernalization

For winter annual crops (crop types 2 and 5), the rate of heat-unit accumulation is reduced if the plants have not been exposed to cool temperatures. The method implemented is from Ritchie, J.T. (1991). For crops that do not experience vernalization, the value is set to 0.0. A crop requiring a high degree of vernalization would have a value around 0.04. Examine the variable 'hu_del' in the output file 'crop.out' to see the effect of adjusting this parameter. This variable is 0.0 when vernalization has not yet started, and it is 1.0 when the crop is fully vernalized.

<u>Harvest Tab</u>

*Parameter Prompt*: Which plant component is (partly) harvested?

*Parameter Choices*:

0 - constant fraction of reproductive mass (grain+)

1 - increasing fraction of reproductive mass (grain)

2 - all or fraction of aboveground biomass

4 - all or fraction of the leaf mass

5 - all or fraction of the stem mass

6 - all or fraction of underground mass

Crop harvesting operations remove parts of plants that are not explicitly specified as a plant part in the model. To compensate for this, a mass fraction can be specified (see parameter "Harvested fraction of plant component") to divide the plant component into harvested fraction (fraction removed from the field) and fraction left in the field. For example, the reproductive component of wheat is divided into grain and chaff during harvest, and only the grain is removed from the field. This entry specifies the plant component that will be divided if that plant component is harvested. Choice 1 specifies a type of crop in which early-season reproductive development is all chaff and awns, not grain. If the crop is harvested before maturity, grain development is incomplete. The model internally, increases the actual harvested fraction from zero early in the season, until the value entered in "Harvested fraction of plant component" is reached at maturity.

**Examples:**

0 - Stripper cotton, for which all the reproductive mass is removed from the field. In this instance, the "Harvested fraction of plant component" for this example would be set to 1. Expression of final yield in bales of lint then requires accounting for the amount of trash and seed in the yield conversion factor;

1 - harvested grains, such as wheat, oats, barley, milo, corn. For a crop like corn, ear corn would have a larger value for the "Harvested fraction of plant component" than shelled corn has, for which the cob is left in the field;

2 - hay or forage crops, green vegetable crops. The "Harvested fraction of plant component" in most instances would be 1.0, indicating that all above-ground biomass above the cutting height is removed from the field. It should be less than 1.0 for a crop in which significant portions of the above-ground biomass above the cutting height are left behind in the field. This comment also applies to choices 3 and 4.

3 - tobacco and similar crops;

4 - Sugarcane and similar crops;

5 - Potatoes, peanuts, sugar beets.

In all crops, this setting and the corresponding "Yield fraction of harvested yield component" should be used to divide mass removed from mass left in the field, NOT mass removed from mass actually counted as yield. The parameter "Harvested yield conversion factor" should be used to account for post-harvest processing into marketable components.

*Parameter Prompt*: Harvested fraction of plant component (grain fraction etc.) See parameter "Which plant component is (partly) harvested" for a full explanation.

*Parameter Prompt*: Units for reporting harvested yield

This field contains the units label that will be displayed for yield reporting. It should match the "Harvested yield conversion factor (kg/m$^2$ to units shown)" value that is entered.

*Parameter Prompt*: Moisture content for reporting harvested yield (%) In WEPS, all biomass values are tracked as oven-dry weight. Crop yields are normally reported at a "standard" moisture content other than oven dry weight. For yield reporting, oven-dry weight is converted to the moisture content entered in this field. To match yield numbers from other sources, this value should be the "standard" moisture content used for this product.

*Parameter Prompt*: Harvested yield conversion factor (kg/m$^2$ to units shown)

This parameter should match the "Units for reporting harvested yield" value that is entered. The conversion factor is applied to the WEPS internal yield amount units (which is in kilograms per square meter) to report the yield in the units that are specified. This conversion is applied directly to the material removed from the field, as defined in

"Which plant component is (partially) harvested?" and "Harvested fraction of plant component" and implemented by the appropriate harvest operation. If the component removed from the field is post-processed into a marketable product and a byproduct, and the yield reported in units of marketable product (cotton lint yield is an excellent example), the fraction of marketable product should be included in this conversion factor.

Decomposition Tab

For a better understanding of the decomposition parameters, also consult the Residue Decomposition Sub-model technical documentation.

*Parameter Prompt*: Residue size/toughness class

*Parameter Choices*:

1 - Fragile, very small residue (e.g., soybeans)

2 - Moderately tough, short residue (e.g., wheat)

3 - Non-fragile, medium residue (e.g., corn)

4 - Sugarcane and similar crops;

5 - Gravel, rock

This class is used to determine what percentage of residue should be buried by certain management operations. For example, a tillage operation such as disking will bury a larger percentage of small, fragile residue and a smaller percentage of large, woody residue.

*Parameter Prompt*: Decomposition days after which stalks begin to fall (day)

The Number of days after which stalks begin to fall under optimum moisture and temperature conditions. After this threshold has been reached, stalks will begin to fall at the rate discussed. Example: a threshold of 20 decomposition days means that standing stalks begin to fall 20 days after harvest if moisture and temperature conditions are optimum during these 20 days. If conditions are not optimum, the number of days that stalks remain standing increases.

For a new crop, this parameter can be adjusted based on the number of stalks in residue pool 1 (the variable 'stem1' in the output file 'decomp.out'). Example: the new crop is a winter crop that is harvested in July. It is known that, on average, stalks begin to fall down in the middle of October. If WEPS simulates that stalks begin to fall down only in the next Spring (inspect stem1), then decrease the parameter value to start stem fall earlier. Increase the parameter value if WEPS makes the stalks fall too early.

*Parameter Prompt*: Fall rate for standing stalks (day$^{-1}$)

The rate at which standing stalks fall to a flattened (horizontal) position on the soil surface. A larger number means that stalks fall faster. Only after a threshold has been reached, will stalks begin to fall at this rate. Example: a fall rate of 0.12 day$^{-1}$ means that 12% of the total number of standing stalks fall down per day if moisture and temperature conditions are optimum on this day. If conditions are not optimum, the fall rate is reduced.

For a new crop, this parameter can be adjusted based on the number of stalks in residue pool 1 (the variable 'stem1' in the output file 'decomp.out'). Example: the new crop is a winter crop that is harvested in July. There is a fallow period of 14 months in which it is known that, on average, 50% of the stalks fall down. If WEPS simulates that less than 50% falls down (inspect stem1), then increase the parameter value to increase stem fall. Decrease the parameter value if WEPS makes the stalks fall too fast. Adjust 'Decomposition days after which stalks begin to fall' before adjusting this parameter.

*Parameter Prompt*: Decomposition rate for standing stalks (kg kg$^{-1}$ day-1$^{-1}$)

The rate at which standing stalks decompose under optimum conditions. A larger number means faster decomposition. Example: a decomposition rate of 0.02 kg kg$^{-1}$ day$^{-1}$ means a 2% standing stalk mass loss per day if moisture and temperature conditions are optimum for decomposition on this day. If conditions are not optimum, the rate is reduced. Leaves, if any are present, decompose at 3 times the rate of stalks, and reproductive material, if any is present, decomposes at 1.5 times the rate of stalks. Other models, such as WEPP and RUSLE, simulate the effect of moisture and temperature on decomposition differently from WEPS (see WEPS technical documentation). Thus, the same parameter value results in different rates of decomposition. Therefore, if a new WEPS crop already exists in one of these other models, this parameter value should not be used in WEPS.

For a new crop, this parameter can be adjusted based on the amount of standing residue biomass in residue pool 1 (the variable ‘stand1’ in the output file ‘decomp.out’). Be sure to look at this variable only before stalks start falling. After stalks start falling, stand1 decreases due to two things: decomposition and stem fall. Example: the new crop is a winter crop that is harvested in July. It is known that, on average, stalks begin to fall down in the middle of the next April. Inspect stand1 between July and April. If stand1 is decreasing too rapidly, then decrease the parameter value. Increase the parameter value if stand1 decreases too slowly.

*Parameter Prompt*: Decomposition rate for surface (flat) stalks (kg $kg^{-1}$ $day^{-1}$)

The decomposition rate (under optimum conditions) of stalks that have fallen to a flattened (horizontal) position on the soil surface. For a new crop, this parameter can be adjusted based on the amount of flat residue biomass in residue pool 1 (the variable ‘flat1’ in the output file ‘decomp.out’). Be sure to only look at this variable before stalks start falling. After stalks start falling, flat1 is affected by two things: decomposition and stem fall. It will actually increase if the mass received from the standing pool exceeds the flat mass that is decomposed. Example: the new crop is a winter crop that is harvested in July. It is known that, on average, stalks begin to fall down in the middle of the next April. Inspect flat1 between July and April. If flat1 is decreasing too rapidly, then decrease the parameter value. Increase the parameter value if flat1 decreases too slowly.

*Parameter Prompt*: Decomposition rate for buried stalks (kg $kg^{-1}$ $day^{-1}$)

The decomposition rate (under optimum conditions) of stalks that have been buried below the soil surface by tillage. For a new crop, this parameter can be adjusted based on the amount of buried residue biomass in residue pool 1 (the variable ‘belo1’ in the output file ‘decomp.out’).

*Parameter Prompt*: Decomposition rate for roots (kg $kg^{-1}$ $day^{-1}$)

The rate at which roots decompose under optimum conditions. For a new crop, this parameter can be adjusted based on the amount of root residue biomass in residue pool 1 (the variable ‘root1’ in the output file ‘decomp.out’).

In WEPS, the four parameters (decomposition rate for standing, flat, buried, and root mass) currently have the same values for a given crop. It is recommended to also do this for new crops, unless there is solid research data to do otherwise. For these six decomposition parameters, be sure to look at a no-till situation, because tillage operations will also make stalks fall down.

*Parameter Prompt*: Stalk diameter (m)

Stalk diameter at the base (at the soil surface) of a fully grown plant.

*Parameter Prompt*: Mass to cover factor ($m^2$ $kg^{-1}$)

WEPS calculates soil cover from flat residue mass:

$$C_f = 1 - exp^{-bM_f}$$

where Cf is flat residue cover ($m^2$ $m^{-2}$), b is mass-to-cover factor ($m^2$ $kg^{-1}$), and Mf is flat residue mass (kg $m^{-2}$) (Fig. 17.46, FIG)

Use the Excel spreadsheet to estimate a b value for a new crop, comparing with curves for crops that already exist in WEPS. If reliable mass and cover data are available for the new crop, the spreadsheet can be used to calculate a b value from this data.

RUSLE also uses the mass-to-cover equation to calculate soil cover from flat residue mass. Therefore, if a new WEPS crop already exists in RUSLE, and there is a high degree of confidence in the value of the RUSLE b parameter, this value could be used in WEPS.

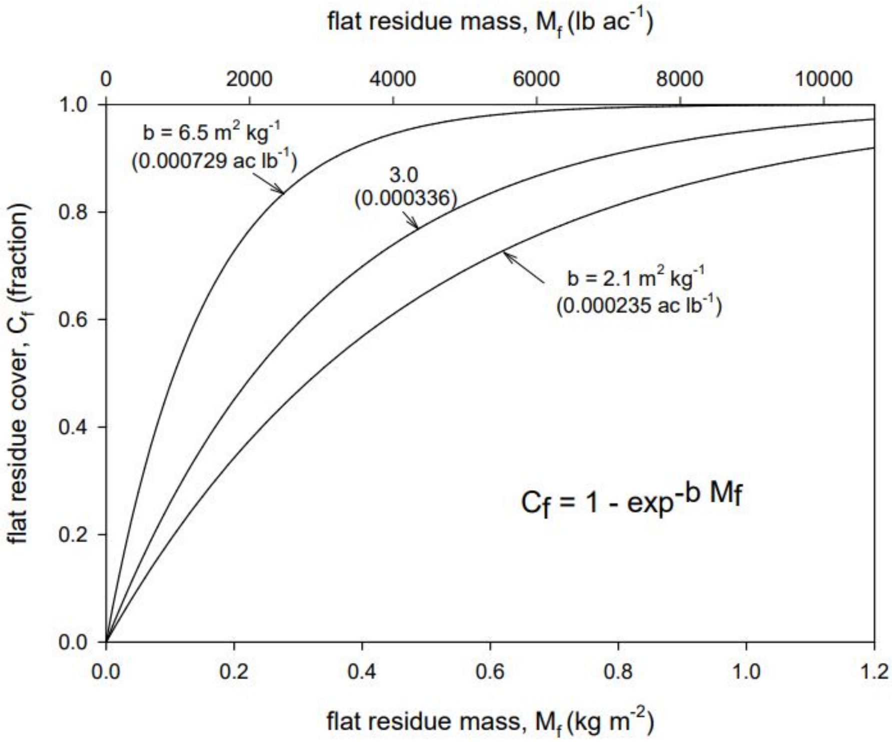



Figure 17.46: Relationship between flat residue mass and the cover provided by this flat residue for three different values of the mass-to-cover factor b. WEPS uses b = 6.5 m$^2$ kg$^{-1}$ for wheat, barley, oats, rye, and triticale; b = 3.0 m$^2$ kg$^{-1}$ for corn, sorghum, and millet; and 2.1 m$^2$ kg$^{-1}$ for cotton and sunflower.

Crop residue laying flat on the soil surface has the effect of reducing the water evaporation rate from the soil surface. Research done by Steiner (1989) showed that the effect varied for different crops. The data from Steiner for cotton, sorghum, and wheat, was refit to an exponential power relationship:

$$r_e = exp^{a_e M_f}$$

where $r_e$ is the ratio of evaporation from residue covered soil to bare soil evaporation and $M_f$ is flat residue mass (kg/m$^2$). This equation has better mathematical properties than the curve used by Steiner. If additional research is available, intermediate curves can be developed by using the “evaporation suppression” tab within the spreadsheet “howtopcropdb.xls” (available from WERU). Otherwise, use the numbers for the crop that most closely characterize the evaporation-suppression characteristics of the crop you are developing.

*Parameter Prompt*: Residue Evaporation Suppression multiplier coefficient $a_e$

*Parameter Prompt*: Residue Evaporation Suppression exponent coefficient $b_e$

Calibration Tab

*Parameter Prompt*: Crop growth calibration selection

0 - Crop NOT selected for calibration

1 - Select Crop for calibration to match target harvested yield

This flag is only effective when the model is run in calibration mode. It should be set to zero for all crop records.

*Parameter Prompt*: Target harvested yield

This value is only used when the model is run in calibration mode. It should be set to 0 for all crop records. NRCS will add RUSLE yield values as a starting point for calibration.

*Parameter Prompt:* Biomass adjustment factor

Multiplier used with the “Yield/biomass ratio adjustment factor” to enhance or suppress the conversion of solar radiation to biomass. This is the factor that is automatically adjusted when calibrating a crop. When developing a new crop record, this value should be set to 1.0. Locally adjusted records can be saved with numbers other than 1.0.

*Parameter Prompt*: Yield/biomass ratio adjustment factor

Intended use has not been implemented. Was to allow adjusting the ratio between total yield and total biomass for calibration purposes. Set to 1.0 for all crop records.

We created a new crop (flax), and documented the process in Appendices A and B. Appendix A is a list of questions about flax that was given to people with knowledge about how flax grows. Some questions are directly related to a parameter; others are more indirectly related. Appendix B shows how the answers to these questions were used to determine parameter values for flax.

**References**

Retta, A. and D.V. Armbrust. 1995. Estimation of leaf and stem area in the Wind Erosion Prediction System (WEPS). Agron. J. 87:93-98.

Ritchie, J.T. 1991. Wheat Phasic development. In: J. Hanks and J.T. Ritchie eds. Modeling plant and soil systems. Agronomy Monograph 31, pp. 34-36.

Steiner, J.L. 1989. Tillage and surface residue effects on evaporation from soils. Soil Sci. Soc. Am. J. 53:911-916.

## 17.6 Management Operation Database Record Development

*WEPS How To Guide*

**Introduction**

In the Wind Erosion Prediction System (WEPS), changes in the "state" of the surface, soil, and biomass (residue and live vegetation) during a simulation are modeled, because they have a direct impact upon a site's susceptibility to wind erosion. Cultural practices applied during management of a site can significantly influence a site's "surface, soil, and biomass" state over time. It is an important variable because it is the primary factor that a land manager can most easily change in the field to affect a site's susceptibility to wind erosion. Therefore, WEPS simulates many management practices, which typically include operations like tillage, cultivation, planting, harvesting, irrigation, residue burning, etc.

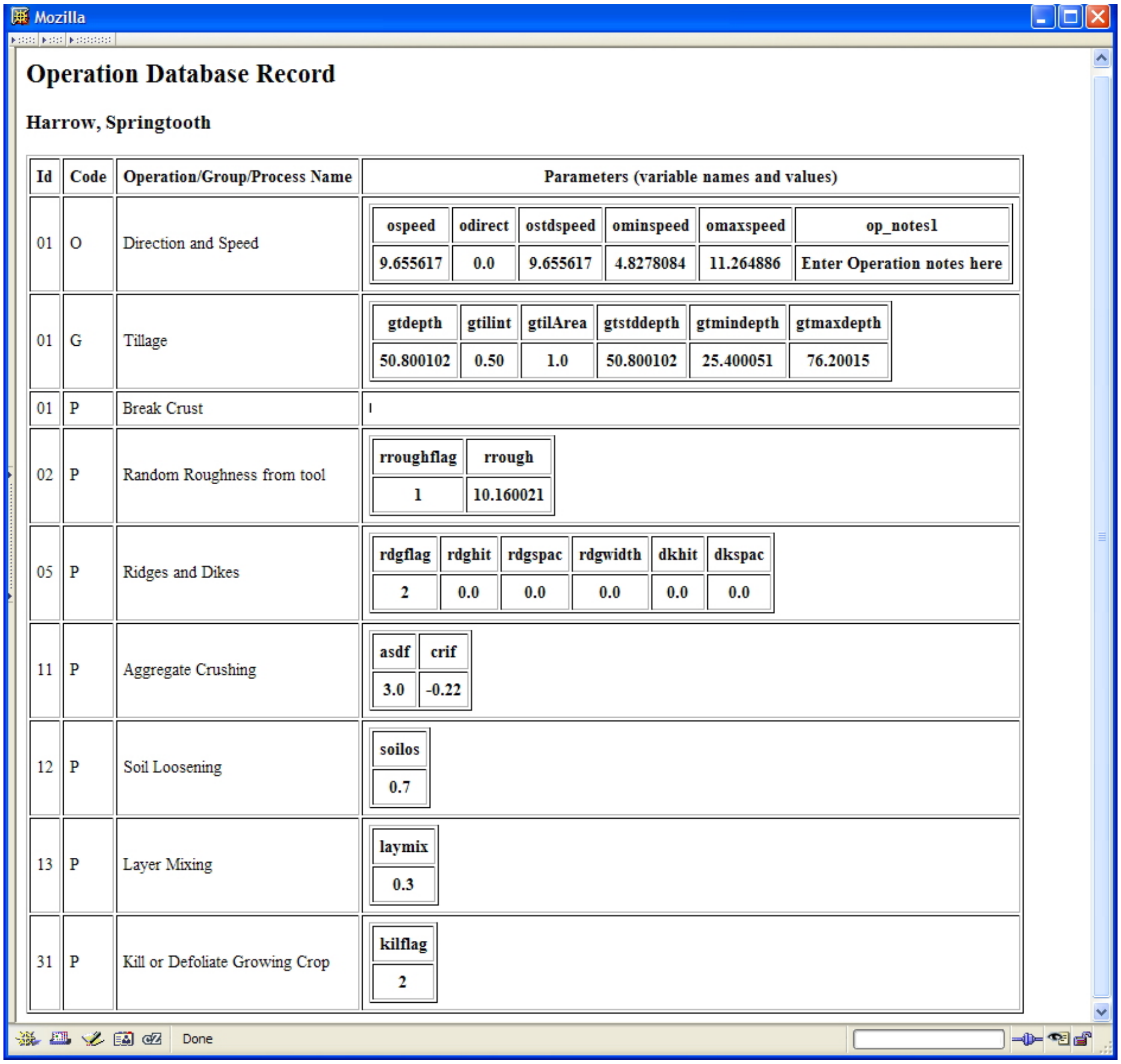
WEPS can represent a wide range of typical management operations used on agricultural crop land. It does so by defining each operation as an ordered list of "processes", which represent physical actions like residue burial, soil loosening and mixing, etc., that occur when that operation is performed on the field. By simulating these physical processes, WEPS can reflect the changes made by an operation to a site's "surface, soil, and biomass" state.

The purpose of this guide is to describe the process of: a) developing accurate WEPS representations of management operations as correctly ordered lists of processes or actions; b) obtaining reasonable parameter values for the list of individual processes describing each management operation, based upon knowledge of that operation's characteristics; and c) providing a reference description for each of the physical "processes" simulated by WEPS.

**Operation Database Records**

WEPS management operation database records are stored in an XML file format with the extension .oprn for use by the WEPS interface. Supporting files, which define the database structure are part of the MCREW (Management/Crop Rotation Editor for WEPS) configuration files. New individual operation database records can be created in several ways: 1) using a text editor to edit the .oprn file (operation record) directly; 2) using MCREW to edit an existing operation record, via its "operation drill-down" feature, and saving it to a new name; or 3) using the WEPS crop/op database viewer/editor program. We will be focusing on the use of the WEPS crop/op database viewer/editor program here because it provides the best user environment for creating and editing WEPS management operation records. Note that for NRCS most parameter choices will not be editable by Field Office Users. NRCS will use a database manager to adjust and distribute new or revised database file.

Each operation record is simply an ordered list of "actions" or "processes" that represent the physical effects that a management operation is to perform. An example operation record for a springtooth harrow is shown in Fig. 17.47.




## Operation Database Record

**Harrow, Springtooth**

| Id | Code | Operation/Group/Process Name | Parameters (variable names and values) |
|---|---|---|---|
| 01 | O | Direction and Speed | ospeed: 9.655617; odirect: 0.0; ostdspeed: 9.655617; ominspeed: 4.8278084; omaxspeed: 11.264886; op_notes1: Enter Operation notes here |
| 01 | G | Tillage | gtdepth: 50.800102; gtilint: 0.50; gtilArea: 1.0; gtstddepth: 50.800102; gtmindepth: 25.400051; gtmaxdepth: 76.20015 |
| 01 | P | Break Crust | |
| 02 | P | Random Roughness from tool | rroughflag: 1; rrough: 10.160021 |
| 05 | P | Ridges and Dikes | rdgflag: 2; rdghit: 0.0; rdgspac: 0.0; rdgwidth: 0.0; dkhit: 0.0; dkspac: 0.0 |
| 11 | P | Aggregate Crushing | asdf: 3.0; crif: -0.22 |
| 12 | P | Soil Loosening | soilos: 0.7 |
| 13 | P | Layer Mixing | laymix: 0.3 |
| 31 | P | Kill or Defoliate Growing Crop | kilflag: 2 |

Figure 17.47: Partial WEPS definition of a springtooth harrow tillage operation.

Note in Fig. 17.47 that the definition of the operation simply consists of a list of parameters that are grouped under an “operation”, “group” or “process” name. An “operation” line, which is labeled with a code letter of “O”, contains parameters that apply to the operation as a whole. For example, the direction and speed of travel are specified by the parameters “odirect” and “ospeed”. Each operation will contain a single “operation” line in its definition. There are several types of valid “operation” lines defined for WEPS operations, each of which has a unique identification number. All the valid operation lines are listed and defined later.

The second line in Fig. 17.47 is a “group” line. To explain the purpose of a “group” line, we must first define the “process” lines that follow. WEPS attempts to simulate the “physical effects” a management operation has on the soil, surface, and vegetation. Within WEPS, the individual, specific identified actions that represent an operation are simulated in the order specified in the management operation record. In this example, the springtooth harrow performs the following actions in the given order: 1) breaks surface crust if it exists; 2) creates a specified random roughness on the surface; 3) removes any ridges and dikes that may be present before to this tillage operation; 4) breaks down (crushes) soil aggregates, resulting in a new distribution of the aggregate sizes; 5) reduces the soil bulk density (loosens the soil); 6) does some mixing of the soil within the depth of tillage; and 7) kills any growing vegetation.

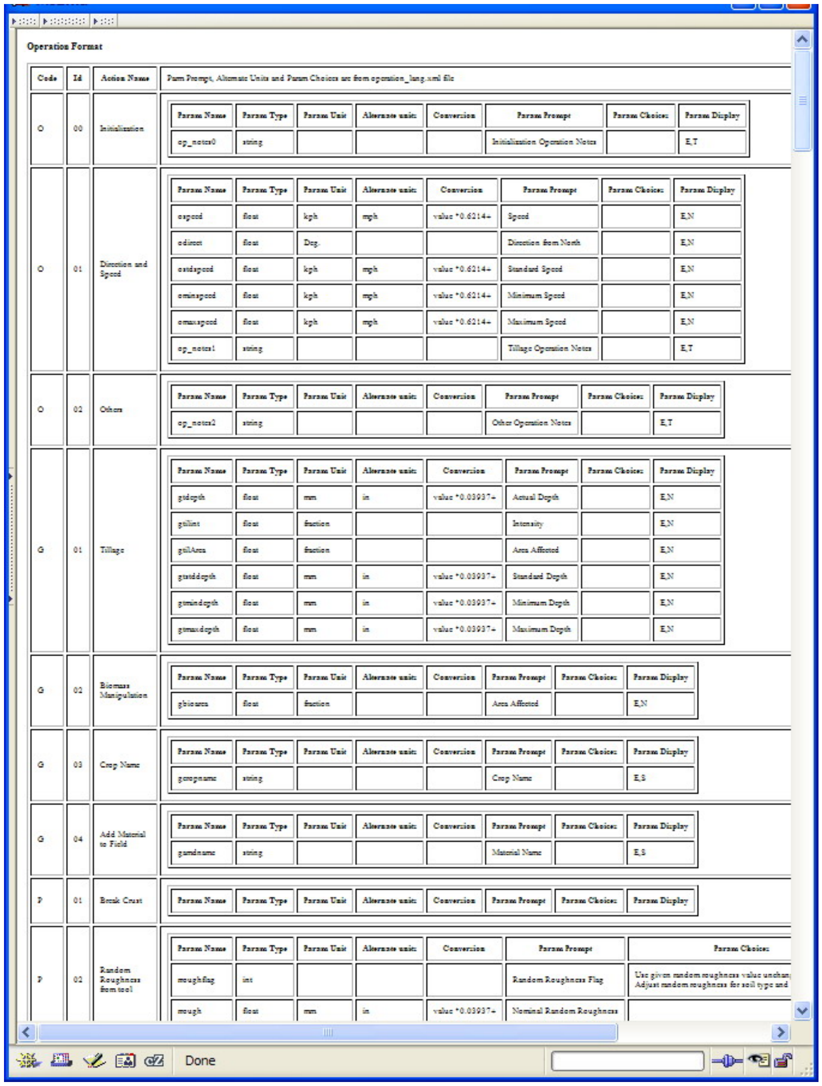
Therefore, each “process” line may contain one or more parameters required for WEPS to simulate the particular physical process or action represented by that line in the model. Some of these physical processes may require additional parameters needed by other, related processes. For example, the “Layer Mixing” and the “Soil Loosening” process lines represent the physical loosening and mixing of the soil by the springtooth. The parameter values “soilos” and “laymix” define the degree of mixing and loosening of soil that will occur. To properly simulate these physical actions, however we need the depth of tillage so that we know how deep the mixing and loosening of the soil will occur. That information is provided in the “group” line by the variable “gtdepth”. Thus, the “shared” tillage depth parameter value required to simulate both the mixing and loosening actions is made available in one place, because it will have the same value for both the mixing and loosening actions being simulated. This is desirable because there is only one tillage depth parameter whose value needs to be changed if the tillage depth is altered for the operation.

So, in summary, each WEPS management operation will consist of a single “operation” line and one or more “process” lines, where each “process” line typically represents a single physical action or event that the operation does on the field. If specific “process” lines require additional “shared” parameters for WEPS to simulate the physical action they represent, then the appropriate “group” line containing those parameters will be specified before those “process” lines. Because WEPS simulates the physical actions represented by the “process” lines in the order they are specified in the management operation record, the order of the listed “process” lines is important and must be correct for WEPS to properly simulate the operation’s total effect on the field.

**Operation Database Structure Files and Definitions**

The parameter descriptions provide the keys to enable the user to know which parameter is being edited. A current reference table is easily viewed by opening the ***operation_defn.xml*** file in the ***mcrew_cfg*** directory using a web browser, as seen in Fig. 17.48.

The parameters defined in this section are described by a **Parameter Prompt**, the text that appears in MCREW; **Parameter Unit**, the named unit that the WEPS science model expects the parameter value to be in; **Conversion Factor**, the combination of multiplier and additive terms that will convert the parameter value from the default **Parameter Units**; **Param Units (SI)**, to the specified Alternate Units, Alternate Units (English), the named unit that values will be displayed in, given the selection of units in the WEPS configuration; and **Parameter Choices**, a list of choices displayed when the parameter is defined as a discrete set of values, often integer flags. The parameters are grouped according to the specific “process”, “group”, or “operation” line they pertain to.



Operation Format

Parm Prompt, Alternate Units and Parm Choices are from operation_lang.xml file

| Code | Id | Action Name | Param Name | Param Type | Param Unit | Alternate units | Conversion | Param Prompt | Param Choices | Param Display |
|---|---|---|---|---|---|---|---|---|---|---|
| O | 00 | Initialization | op_notes0 | string | | | | Initialization Operation Notes | | E,T |
| O | 01 | Direction and Speed | ospeed | float | kph | mph | value *0.6214+ | Speed | | E,N |
| | | | odirect | float | Deg. | | | Direction from North | | E,N |
| | | | ostdspeed | float | kph | mph | value *0.6214+ | Standard Speed | | E,N |
| | | | ominspeed | float | kph | mph | value *0.6214+ | Minimum Speed | | E,N |
| | | | omaxspeed | float | kph | mph | value *0.6214+ | Maximum Speed | | E,N |
| | | | op_notes1 | string | | | | Tillage Operation Notes | | E,T |
| O | 02 | Others | op_notes2 | string | | | | Other Operation Notes | | E,T |
| G | 01 | Tillage | gtdepth | float | mm | in | value *0.03937+ | Actual Depth | | E,N |
| | | | gtilint | float | fraction | | | Intensity | | E,N |
| | | | gtilArea | float | fraction | | | Area Affected | | E,N |
| | | | gtstddepth | float | mm | in | value *0.03937+ | Standard Depth | | E,N |
| | | | gtmindepth | float | mm | in | value *0.03937+ | Minimum Depth | | E,N |
| | | | gtmaxdepth | float | mm | in | value *0.03937+ | Maximum Depth | | E,N |
| G | 02 | Biomass Manipulation | gbioarea | float | fraction | | | Area Affected | | E,N |
| G | 03 | Crop Name | gcropname | string | | | | Crop Name | | E,S |
| G | 04 | Add Material to Field | gamdname | string | | | | Material Name | | E,S |
| P | 01 | Break Crust | | | | | | | | |
| P | 02 | Random Roughness from tool | roughflag | int | | | | Random Roughness Flag | Use given random roughness value unchan<br>Adjust random roughness for soil type and | |
| | | | rough | float | mm | in | value *0.03937+ | Nominal Random Roughness | | |

Figure 17.48: Partial listing of a WEPS "operation_defn.xml" file that defines management operation actions, their parameters, and their various attributes.

**Management Operation Parameter Definitions**

<u>O 00: Initialization</u>

The "Initialization" operation line represents a special type of operation. It is intended to be used when one needs to "initialize" a WEPS simulation run in a special manner. Therefore, any operation defined with an "Initialization" operation line will only be executed once, during the initialization cycle, and will not be repeated like other normal operations. This type of operation will usually only be created and used by researchers or for special WEPS uses.

*Parameter Prompt*: Initialization Operation Notes

The "Initialization" operation line contains only this one parameter. It allows the user to document the specific purpose of the operation, special considerations specific to its use, creation date, author, any subsequent changes, etc.

<u>O 01: Direction and Speed</u>

In many management events, like tillage operations, the actual speed of the operation and/or the direction in which the operation is performed on the field can influence the degree to which it impacts the physical state of the soil, surface, and vegetation. These types of management events will be defined with the "Direction and Speed" operation line.

*Parameter Prompt*: Speed

Actual speed at which the operation is performed.

*Parameter Unit*: m/s

*Conversion factor*: mph = 2.237 * (m/s)

Alternate units: mph

Parameter Prompt: Direction from North

This parameter defines the principle direction, relative to north, in which the operation is performed. Zero (0.0) degrees represents a north/south direction. 90.0 degrees represents an east/west direction. This parameter defines the predominant direction of tillage ridges and/or planted rows. It is important because oriented surface roughness and row direction relative to wind direction affect the susceptibility of the field to wind erosion.

*Parameter Unit*: degrees

*Parameter Prompt*: Standard Speed

Speed at which some of the physical processes, like residue burial efficiency, have coefficients specified. In WEPS, many of these coefficients are then adjusted internally based upon actual travel speed, as well as other parameters.

*Parameter Unit*: m/s

*Conversion factor*: mph = 2.237 * (m/s)

*Alternate units*: mph

*Parameter Prompt*: Minimum Speed

Minimum speed at which the operation would typically be performed. This speed value is used to determine the lower limit at which WEPS will adjust certain process-specific parameters that are influenced by travel speed.

*Parameter Unit*: m/s

*Conversion factor*: mph = 2.237 * (m/s)

*Alternate units*: mph

*Parameter Prompt*: Maximum Speed

Maximum speed at which the operation would typically be performed. This speed value is used to determine the upper limit at which WEPS will adjust certain process-specific parameters that are influenced by travel speed.

*Parameter Unit*: m/s

*Conversion factor*: mph = 2.237 * (m/s)

*Alternate units*: mph

*Parameter Prompt*: Tillage Operation Notes

This parameter allows the user to document the specific purpose of the operation, special considerations specific to its use, creation date, author, any subsequent changes, etc.

O 02: Others

Management events that are not influenced by speed of operation or direction of travel. Examples would be most grain-harvest, herbicide-spraying, baling, burning, and irrigation operations.

*Parameter Prompt*: Other Operation Notes

This parameter allows the user to document the specific purpose of the operation, special considerations specific to its use, creation date, author, any subsequent changes, etc.

G 01: Tillage

Many tillage operations perform several physical processes as they modify the soil and surface condition (e.g., loosening the soil, mixing soil properties within the tillage zone, burial of residue, etc.). All of these physical processes require some information that is common among them. These “shared” parameter values, like tillage depth, surface area disturbed, etc., have been grouped together into a single “group” line so that they don’t have to be specified repeatedly as parameters for each individual process that needs them. This allows one to conveniently make a single change to a “shared” parameter listed in a group line and have it impact all the succeeding processes that require it. But it also requires one to ensure that any process line that requires a “shared” parameter has the appropriate “group” line specified before the process line in the definition file of that operation.

Often, a tillage operation may contain multiple tillage tool components on a single implement (e.g., disk gang, followed by a row of chisel shanks) or consist of a several individual implements one behind the other (e.g. a springtooth harrow with a straight tine drag harrow behind it). These types of tillage operations/implements can be represented as a single operation in WEPS by specifying the physical processes each tillage tool component performs on the soil/surface/vegetation. Often, this is done by specifying a “Tillage” group line, followed by the appropriate “process” lines to represent the tillage/residue burial effects of the individual tillage tool components. Thus, multiple tillage “group” lines, followed immediately by several “process” lines, will be used to represent multi-tool and multi-implement tillage operations in WEPS.

*Parameter Prompt*: Actual Depth

Actual tillage depth of the implement or tillage tool component represented.

*Parameter Unit*: mm

*Conversion factor*: inches = 0.03937 * (mm)

*Alternate units*: inches

*Parameter Prompt*: Intensity

Tillage intensity of the implement or tillage tool component represented. It can have a value from 0.0 to 1.0, where zero represents no soil disturbance and 1.0 would represent maximum soil disturbance. This parameter value impacts the soil layer “mixing” process simulated within WEPS, as well as soil loosening. An example of a tool with a high tillage intensity would be a rotary tiller.

*Parameter Unit*: fraction

Parameter Prompt: Area Affected The fractional surface area affected by the tillage processes. It can have a value from 0.0 to 1.0, where zero would represent no surface area disturbed. A value of 1.0 would mean that the tillage processes occurred across the entire width of the implement. A value between 0.0 and 1.0 would mean that only a fraction of the surface and the soil below would be disturbed, (e.g., a row crop cultivator may only till the soil between the plant rows).

*Parameter Unit*: fraction

*Parameter Prompt*: Standard Depth

Tillage depth at which some of the physical processes, like residue burial efficiency, have coefficients specified. In WEPS, many of these coefficients are then internally adjusted based upon actual tillage depth, as well as other parameters.

*Parameter Unit*: mm

*Conversion factor*: inches = 0.03937 * (mm)

*Alternate units*: inches

*Parameter Prompt*: Minimum Depth

Minimum tillage depth at which the operation would typically be performed. This depth value is used to determine the lower limit at which WEPS will adjust certain process-specific parameters that are influenced by tillage depth.

*Parameter Unit*: mm

*Conversion factor*: inches = 0.03937 * (mm)

*Alternate units*: inches

*Parameter Prompt*: Maximum Depth Maximum tillage depth at which the operation would typically be performed. This depth value is used to determine the upper limit at which WEPS will adjust certain process specific parameters are influenced by tillage depth.

*Parameter Unit*: mm

*Conversion factor*: inches = 0.03937 * (mm)

*Alternate units*: inches

G 02: Biomass Manipulation The "Biomass Manipulation" group contains a "shared" parameter that is required by many WEPS processes that simulate the manipulation of biomass (e.g., the removal of biomass, flattening of standing residue, etc.). This "group" line is commonly used for operations that do not affect (till) the soil, where the "shared" parameters dealing with tillage depth in the "Tillage" group are not required. Examples of operations that would use this group line are harvesting and spraying operations.

*Parameter Prompt*: Area Affected

The fractional surface area affected by the tillage processes. It can have a value from 0.0 to 1.0, where zero would represent no surface area disturbed. A value of 1.0 would mean that the biomass manipulation processes occurred across the entire width of the implement. A value between 0.0 and 1.0 would mean that only a fraction of the surface and biomass would be affected (e.g., a grain harvesting operation in which 1/3 of the crop was to be left in the field for wildlife purposes or in which the implement's wheel tracks flattened a fraction of the standing residue during the operation.

*Parameter Unit*: fraction

G 03: Crop Name

The "Crop Name" group consists of a single parameter, the name of a crop being planted or transplanted. It is required by the planting/seeding and transplanting processes.

*Parameter Prompt*: Crop Name

This parameter specifies the name of the crop being planted/seeded or transplanted.

G 04: Add Material to Field

The "Add Material to Field" group consists of a single parameter, the name of the residue type being applied. It is required by the "Add Residue" and "Set Residue" processes.

*Parameter Prompt*: Material Name

This parameter specifies the name of the type of residue added to the field.

P 01: Break Crust

If this process is specified, it means that the operation will physically remove any crust on the soil surface. No process-level parameters are required for the simulation of this effect in WEPS. It does require a shared, group-level parameter that specifies the fraction of the surface area to which this effect applies.

P 02: Random Roughness

*Parameter Prompt*: Random Roughness Flag Some tillage operations will create a specific random surface roughness, regardless of the pre-existing soil surface/biomass conditions, and others are highly dependent upon the soil type, pre-tillage surface cloddiness, and quantity of buried residue present. To allow for these differences, a "Random Roughness Flag" is used to specify how WEPS should treat a specific tillage tool.

*Parameter Choices*:

0 - Always use specified random roughness value

1 - Allow WEPS to auto-adjust random roughness value

*Parameter Prompt*: Nominal Random Roughness

If the “Random Roughness Flag” is set to zero (0), then this value is the Allmaras random roughness value that the soil surface will have after using this tillage tool.

If the “Random Roughness Flag” is set to one (1), then this is to be the typical Allmaras random roughness value expected on a silt loam soil with lots of buried residue present. Internally, WEPS will use the “shared” group parameter values of “tillage intensity”, soil type, and residue quantity to determine the actual surface roughness created by the tillage tool. In general, a high tillage intensity value will mean that the “Nominal Random Roughness” will not be affected much by the pre-tillage surface roughness. A low tillage intensity value would affect the final random roughness. In general, a sandier soil will result in a lower random roughness value, and a soil with more clay will create a surface with a higher random roughness value. Because most field conditions are performed with less residue than specified for the “Nominal Random Roughness” value, the resulting surface roughness will be less than the specified value.

*Parameter Unit*: mm

*Conversion factor*: inches = 0.03937 * (mm)

*Alternate units*: inches

<u>P 05: Ridges and Dikes</u>

*Parameter Prompt*: Ridge Flag

Tillage operations will either: a) leave existing ridges alone; b) create a specified ridged and/or diked surface, regardless of pre-existing surface conditions; or c) create a specific ridged and/or diked surface based upon tillage depth. The “Ridge Flag” specifies which of these situations should represent how WEPS should treat a specific tillage tool.

*Parameter Choices*:

0 - Pre-existing ridges/dikes left unchanged

1 - Ridges/dikes set to specified values

2 - Ridges/dikes set, based upon tillage depth

*Parameter Prompt*: Ridge Height

Ridge height is measured from the top of the ridge to the bottom of the furrow.

*Parameter Unit*: mm

*Conversion factor*: inches = 0.03937 * (mm)

*Alternate units*: inches

*Parameter Prompt*: Ridge Spacing

Ridge spacing is measured from ridge top to ridge top across the furrow.

*Parameter Unit*: mm

*Conversion factor*: inches = 0.03937 * (mm)

*Alternate units*: inches

*Parameter Prompt*: Ridge Top Width

Ridge width is measured across the top of the ridge.

*Parameter Unit*: mm

*Conversion factor*: inches = 0.03937 * (mm)

*Alternate units*: inches

*Parameter Promp*t: Dike Height

Dike height is measured from the top of the dike to the bottom of the furrow.

*Parameter Unit*: mm

*Conversion factor*: inches = 0.03937 * (mm)

*Alternate units*: inches

*Parameter Prompt*: Dike Spacing

Dike spacing is measured from dike top to dike top down the furrow.

*Parameter Unit*: mm

*Conversion factor*: inches = 0.03937 * (mm)

*Alternate units*: inches

<u>P 11: Aggregate Crushing</u>

*Parameter Prompt*: Aggregate Size Distribution Factor

*Parameter Unit*: unitless

*Parameter Prompt*: Crushing Intensity Factor

*Parameter Unit*: unitless

<u>P 12: Soil Loosening</u>

*Parameter Prompt*: Soil Loosening Factor

Specifies degree to which air is added to the soil layers within the tillage zone. A minimum value of zero (0.0) means no change in soil layer bulk density occurs. A maximum value of 1.0 means the soil layers reach their “loosest” state (i.e., the lowest bulk density possible for the soil type, based upon the pre-tilled bulk density value).

*Parameter Unit*: fraction

<u>P 13: Soil Layer Mixing</u>

*Parameter Prompt*: Layer Mixing Factor

Specifies degree of mixing among soil layer properties. A minimum value of zero (0.0) means no mixing occurs, and a maximum value of 1.0 means full mixing occurs, (i.e., all layers within the tillage zone become homogeneous).

*Parameter Unit*: fraction

<u>P 14 Soil Layer Inversion</u>

Specifies that the current tillage tool inverts the soil layers within the specified tillage zone. This process line has no parameter values.

<u>P 24 Flatten Standing Biomass</u>

This process specifies the degree to which standing crops and/or residue are flattened. There are “flattening coefficients” specified for each type of “residue”, on the basis of its “toughness/size”. The five types of residue classes are:

fragile – Residue that is easily broken down (e.g., soybean residue)

moderately tough – Similar to size and toughness of wheat residue

non-fragile/large – Similar to size and toughness of corn residue

woody – Similar to size and toughness of woody brush residue

small stones/gravel – Non-decomposing material

*Parameter Prompt:* Flatten Biomass Flag

This parameter specifies which type of biomass is flattened, the “growing crop” and/or the standing crop residue remaining after previous crop harvests.

*Parameter Choices*:

0 - Flatten crop and residue

1 - Flatten crop only

2 - Flatten residue only

*Parameter Prompt*: Mass Flattened (fragile residue)

Fraction of standing crop and/or residue flattened, if considered ”fragile residue”.

*Parameter Unit*: fraction

*Parameter Prompt*: Mass Flattened (moderately tough residue)

Fraction of standing crop and/or residue flattened, if considered ”moderately tough residue”.

*Parameter Unit*: fraction

*Parameter Prompt*: Mass Flattened (non-fragile/large residue)

Fraction of standing crop and/or residue flattened, if considered ”non-fragile/large residue”.

*Parameter Unit*: fraction

*Parameter Prompt*: Mass Flattened (woody residue)

Fraction of standing crop and/or residue flattened, if considered ”woody residue”.

*Parameter Unit*: fraction

*Parameter Prompt*: Mass Flattened (small stones/gravel residue)

Fraction of standing crop and/or residue flattened, if considered ”small stones/gravel residue”. Tire traffic areas should be included in this fraction.

*Parameter Unit*: fraction

P 25: Bury Flat Biomass

This process specifies distribution and the degree to which crops and/or residue are buried. There are “burial coefficients” specified for each type of “residue”, on the basis of its “toughness/size”. The five types of residue classes are specified under “Flatten Standing Biomass”. The burial distribution pattern by depth is specified based upon the “Bury Biomass Flag” values. The five types of burial distribution patterns are:

Uniform – Biomass is buried uniformly by depth

Mixing and inversion – Biomass is inverted and mixing during burial

Mixing – More biomass is buried near the soil surface

Inversion – Biomass buried at bottom of tillage zone

Lifting, fracturing – Biomass buried similar to a chisel plow

*Parameter Prompt*: Bury Biomass Flag

This parameter specifies how residue is buried into the tillage zone.

*Parameter Choices*:

0 - Uniform burial distribution

1 - Mixing and inversion burial distribution

2 - Mixing burial distribution

3 - Inversion burial distribution

4 - Lifting/fracturing burial distribution

*Parameter Prompt*: Mass Buried (fragile residue)

Fraction of above ground crop and/or residue buried, if considered ”fragile residue”.

*Parameter Unit*: fraction

*Parameter Prompt*: Mass Buried (moderately tough residue)

Fraction of above ground crop and/or residue buried, if considered ”moderately tough residue”.

*Parameter Unit*: fraction

*Parameter Prompt*: Mass Buried (non-fragile/large residue)

Fraction of above ground crop and/or residue buried, if considered ”non-fragile/large residue”.

*Parameter Unit*: fraction

*Parameter Prompt*: Mass Buried (small stones/gravel residue)

Fraction of above ground crop and/or residue buried, if considered ”small stones/gravel residue”.

*Parameter Unit*: fraction

P 26: Resurface Buried Biomass

This process specifies the degree to which buried residue are brought back to the surface. There are “re-surfacing coefficients” specified for each type of “residue”, on the basis of its “toughness/size”. The five types of residue classes are specified under “Flatten Standing Biomass”.

*Parameter Prompt*: Mass Resurfaced (fragile residue)

Fraction of below-ground crop and/or residue resurfaced, if considered ”fragile residue”.

*Parameter Unit*: fraction

*Parameter Prompt*: Mass Resurfaced (moderately tough residue)

Fraction of below-ground crop and/or residue resurfaced, if considered ”moderately tough residue”.

*Parameter Unit*: fraction

*Parameter Prompt*: Mass Resurfaced (non-fragile/large residue)

Fraction of below-ground crop and/or residue resurfaced, if considered ”non-fragile/large residue”.

*Parameter Unit*: fraction

*Parameter Prompt*: Mass Resurfaced (woody residue)

Fraction of below-ground crop and/or residue resurfaced, if considered ”woody residue”.

*Parameter Unit*: fraction

*Parameter Prompt*: Mass Resurfaced (small stones/gravel residue)

Fraction of below-ground crop and/or residue resurfaced, if considered ”small stones/gravel residue”.

*Parameter Unit*: fraction

P 31: Kill or Defoliate Growing Crop

This process determines whether a growing crop is defoliated or killed, based upon the type of crop (perennial or annual).

*Parameter Prompt*: Kill/Defoliate Flag

This parameter specifies how different crop types are treated (e.g., killed or defoliated).

*Parameter Choices:*

1 - Annual crop killed, perennial crop regrows

2 - All crop types are killed

3 - Crop defoliated

P 32: Cut/Remove Biomass to Height

This process cuts the specified standing biomass (crop and residue if present) to the specified height. This process is also a harvest process if components of the cut material are removed from the field as specified by the removal parameter values. Based upon the “Cut Biomass Flag” setting, the cut height is measured from the ground up or from the top of the crop down.

*Parameter Prompt*: Cut Biomass Flag

This parameter specifies how different crop types are treated (e.g., killed or defoliated).

*Parameter Choices:*

0 - Cut Value = Height of standing stubble remaining

1 - Cut Value = Length of standing plant stalks removed

*Parameter Prompt*: Cut Value

Either the cutting height of the length (height) of crop removed, based upon the ”Cut Biomass Flag” value.

*Parameter Unit*: mm

*Conversion factor*: inches = 0.03937 * (mm)

*Alternate units*: inches

*Parameter Prompt*: Cut Yield Removed

Mass fraction of crop yield removed during the ”Cut/Remove Biomass to Height” process.

*Parameter Unit*: fraction

*Parameter Prompt*: Cut Plant Removed

Mass fraction of “cut” crop biomass removed during the “Cut/Remove Biomass to Height” process.

*Parameter Unit*: fraction

*Parameter Prompt*: Cut Standing Residue Removed

Mass fraction of “cut” standing residue removed during the “Cut/Remove Biomass to Height” process.

*Parameter Unit*: fraction

P 33: Cut/Remove Biomass by Fraction

This process cuts the specified standing biomass (crop and residue if present) to a fraction of the crop height. This process is also a harvest process if components of the cut material are removed from the field as specified by the removal parameter values.

*Parameter Prompt*: Plant Height Removed

Fraction of crop (and residue if present) height removed during the “Cut/Remove Biomass by Fraction” process.

*Parameter Unit*: fraction

*Parameter Prompt*: Cut Yield Removed

Mass Fraction of crop yield removed during the “Cut/Remove Biomass by Fraction” process.

*Parameter Unit*: fraction

*Parameter Prompt*: Cut Plant Removed

Mass fraction of “cut” crop biomass removed during the “Cut/Remove Biomass by Fraction” process.

*Parameter Unit*: fraction

*Parameter Prompt*: Cut Standing Residue Removed

Mass fraction of “cut” standing residue removed during the “Cut/Remove Biomass to Height” process.

*Parameter Unit*: fraction

P 34: Change Standing Biomass Fall Rate

This process allows an operation to modify the fall rate of decay for standing residue stalks. The purpose is to simulate the effects of undercutting the supporting roots, which decreases the ability of residue stalks to remain standing over time.

*Parameter Prompt:* Select Biomass Pool Type

This parameter specifies how the cut height is determined.

*Parameter Choices:*

1 - Crop

2 - Temporary

3 - Crop and Temporary

4 - Residue

5 - Crop and Residue

6 - Temporary and Residue

7 - Crop, Temporary and Residue

*Parameter Prompt*: Standing Biomass Fall Rate Multiplier (fragile residue)

Multiplier value to increase or decrease the fall rate value for the specified type of residue.

*Parameter Unit*: multiplier

*Parameter Prompt*: Standing Biomass Fall Rate Multiplier (moderately tough residue)

Multiplier value to increase or decrease the fall rate value for the specified type of residue.

*Parameter Unit*: multiplier

*Parameter Prompt*: Standing Biomass Fall Rate Multiplier (non-fragile/large residue)

Multiplier value to increase or decrease the fall rate value for the specified type of residue.

*Parameter Unit*: multiplier

*Parameter Prompt*: Standing Biomass Fall Rate Multiplier (woody residue)

Multiplier value to increase or decrease the fall rate value for the specified type of residue.

*Parameter Unit*: multiplier

*Parameter Prompt*: Standing Biomass Fall Rate Multiplier (small stones/gravel residue)

Multiplier value to increase or decrease the fall rate value for the specified type of residue.

*Parameter Unit*: multiplier

*Parameter Prompt*: Standing Biomass Fall Threshold Multiplier (fragile residue)

Multiplier value to increase or decrease the threshold fall value for the specified type of residue.

*Parameter Unit*: multiplier

*Parameter Prompt*: Standing Biomass Fall Threshold Multiplier (moderately tough residue)

Multiplier value to increase or decrease the threshold fall value for the specified type of residue.

*Parameter Unit*: multiplier

*Parameter Prompt*: Standing Biomass Fall Threshold Multiplier (non-fragile/tough residue)

Multiplier value to increase or decrease the threshold fall value for the specified type of residue.

*Parameter Unit*: multiplier

*Parameter Prompt*: Standing Biomass Fall Threshold Multiplier (woody residue)

Multiplier value to increase or decrease the threshold fall value for the specified type of residue.

*Parameter Unit*: multiplier

*Parameter Prompt*: Standing Biomass Fall Threshold Multiplier (small stones/gravel residue)

Multiplier value to increase or decrease the threshold fall value for the specified type of residue.

*Parameter Unit*: multiplier

P 37: Thin Biomass to Population

This process reduces the crop plant population to the specified value. This process is also a harvest process if components of the “thinned” plants are removed from the field as specified by the removal parameter values.

*Parameter Prompt*: Thinning Value

Resulting plant population desired.

*Parameter Unit*: $\#/m^2$

*Conversion factor*: $\#/ft^2 = 0.0929 * (\#/m^2)$

*Alternate units*: $\#/ft^2$

*Parameter Prompt*: Thinned Yield Removed

Mass fraction of “thinned” crop yield removed during the “Thin Biomass to Population” process.

*Parameter Unit*: fraction

*Thinned Plant Removed*

Mass fraction of “thinned” crop plants removed during the “Thin Biomass to Population” process.

*Thinned Standing Residue Removed*

Mass fraction of ”thinned” standing residue removed during the ”Thin Biomass to population” process.

*Parameter Unit*: fraction

P 38: Thin Biomass by Fraction

This process reduces the crop plant population by the specified value. This process is also a harvest process if components of the “thinned” plants are removed from the field as specified by the removal parameter values.

*Parameter Prompt*: Thinning Value

Reduction factor to reach desired population

*Parameter Unit*: fraction

*Parameter Prompt*: Thinned Yield Removed

Mass fraction of ”thinned” crop yield removed during the ”Thin Biomass by fraction” process.

*Parameter Unit*: fraction

*Parameter Prompt:* Thinned Plant Removed

Mass fraction of ”thinned” crop plants remove during the ”Thin Biomass by Fraction” process.

*Parameter Unit*: fraction

*Parameter Prompt*: Thinned Standing Residue Removed

Mass fraction of ”thinned” standing residue removed during the ”Thin Biomass by Fraction” process.

*Parameter Unit*: fraction

<u>P 40: End Crop Biomass Manipulation</u>

This process is required after all ”crop” related biomass manipulation processes have been completed, for WEPS to correctly account for changes in vegetation pools within the simulation. There are no parameters associated with this process line.

<u>P 50: Set Crop Residue Amounts</u>

*Parameter Prompt*: Number of Standing Residue Stems

Desired residue standing stem population.

*Parameter Unit*: #/m$^2$

*Conversion factor*: #/ft$^2$ = 0.0929 * (#/m$^2$)

*Alternate units*: #/ft$^2$

*Parameter Prompt*: Standing Residue Height

Desired standing residue height.

*Parameter Unit*: mm

*Conversion factor*: inches = 0.03937 * (mm)

*Alternate units*: inches

*Parameter Prompt*: Standing Residue Mass

Desired standing residue mass.

*Parameter Unit*: kg/m$^2$

*Conversion factor*: lb/acre = 8921.8 * (kg/m$^2$)

*Alternate units*: lb/acre

*Flat Surface Residue Mass*

Desired flat residue mass.

*Parameter Unit*: kg/m$^2$

*Conversion factor*: lb/acre = 8921.8 * (kg/ m$^2$)

Alternate units: lb/acre

*Parameter Prompt*: Residue Size/toughness Class

This flag specifies the ”class” of residue on the basis of its relative size and toughness.

*Parameter Choices:*

1 - Fragile, very small residue (e.g., soybeans)

2 - Moderately tough, short residue (e.g., wheat)

3 - Non fragile, medium residue (e.g., corn)

4 - Woody, large residue

5 - Gravel, rock

*Parameter Prompt*: Buried Residue Mass

Desired buried residue mass (not roots)

*Parameter Unit*: kg/m$^2$

*Conversion factor*: lb/acre = 8921.8 * (kg/m$^2$)

*Alternate units*: lb/acre

*Parameter Prompt*: Buried Residue Depth

Desired buried residue depth.

*Parameter Unit*: mm

*Conversion factor*: inches = 0.03937 * (mm)

*Alternate units*: inches

*Parameter Prompt*: Root Residue Mass

Desired root residue mass.

*Parameter Unit*: kg/m$^2$

*Conversion factor*: lb/acre =,8921.8 * (kg/m$^2$)

*Alternate units*: lb/acre

*Parameter Prompt*: Root Residue Depth

Desired root residue depth.

*Parameter Unit*: mm

*Conversion factor*: inches = 0.03937 * (mm)

*Alternate units*: inches

*Parameter Prompt:* Decomposition Rate for Standing Stalks

The rate at which standing stalks decompose under optimum conditions. Example: a decomposition rate of 0.02 kg kg$^{-1}$ day$^{-1}$ means a 2% standing stalk mass loss per day if moisture and temperature conditions are optimum for decomposition on this day. If conditions are not optimum, the rate is reduced. Leaves, if any are present, decompose at 3 times the rate of stalks, and reproductive material, if any is present, decomposes at 1.5 times the rate of stalks.

*Parameter Unit:* kg kg$^{-1}$ day$^{-1}$

*Parameter Prompt:*Decomposition Rate for Surface (flat) Stalks

The decomposition rate of stalks that have fallen to a flattened (horizontal) position on the soil surface. See comments for standing stalks.

*Parameter Unit:* kg kg$^{-1}$ day$^{-1}$

*Parameter Prompt:* Decomposition Rate for Buried Stalks

The decomposition rate of stalks that have been buried below the soil surface by tillage. See comments for standing stalks.

*Parameter Unit*: kg $kg^{-1}$ $day^{-1}$

*Parameter prompt*: Decomposition Rate for Roots See comments for standing stalks.

*Parameter Unit*: kg $kg^{-1}$ $day^{-1}$

*Parameter Prompt*: Fall Rate for Standing Stalks

The rate at which standing stalks fall to a flattened (horizontal) position on the soil surface. Only after a threshold has been reached, stalks will begin to fall at this rate. Example: a fall rate of 0.12 $day^{-1}$ means a 12% of the total number of standing stalks fall down per day if moisture and temperature conditions are optimum on this day. If conditions are not optimum, the fall rate is reduced.

*Parameter Unit*: $day^{-1}$

*Parameter Prompt*: Average Stalk Diameter

*Parameter Unit*: m

*Conversion factor*: inches = 39.3696 * (m)

*Alternate units*: inches

*Parameter Prompt*: Decomposition Days After Which Stalks Begin to Fall

Only after this threshold has been reached, stalks will begin to fall at the rate previously discussed. Example: a threshold of 20 decomposition days means that standing stalks only begin to fall after 20 days after harvest if moisture and temperature conditions are optimum, during these 20 days. If conditions are not optimum the number of days increases.

*Parameter Unit*: day

*Parameter Prompt*: Mass to Cover Factor

Soil cover from flat residue mass is predicted by equation:

$$C_f = 1 - exp^{-bM_f}$$

where Cf is flat residue cover ($m^2$ $m^{-2}$), b is mass-to-cover factor ($m^2$ $kg^{-1}$), and Mf is flat residue mass (kg $m^{-2}$)

*Parameter Unit*: $m^2$ $kg^{-1}$

*Conversion factor*: value * 0.00011209

*Alternate units*: acres $lb^{-1}$

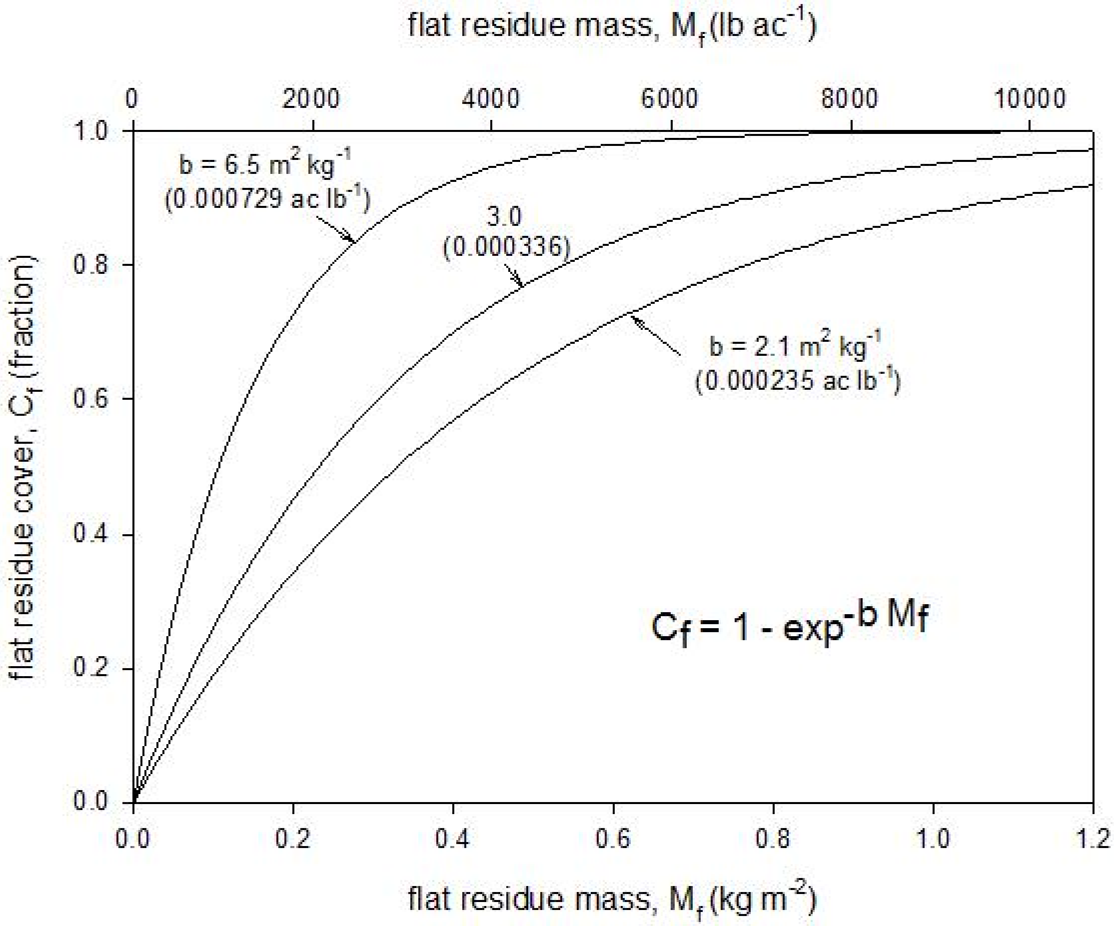



Figure 17.49: Relationship between flat residue mass and the cover provided by this flat residue.

*Parameter Prompt*: Residue Evaporation Suppression Multiplier Coefficient a

*Parameter Unit*: eratio = resevapa (kg m$^2$)**resevapb

*Parameter Choices*:

*Parameter Prompt*: Residue Evaporation Suppression Multiplier Coefficient b

*Paramater Unit*: eratio = resevapa (kg m$^2$)**resevapb

<u>P 51: Seeding Configuration</u>

*Parameter Prompt*: Type of Planting

Specifies how the crop is being planted.

*Parameter Choices:*

0 - Broadcast Planting

2 - Use Implement Ridge Spacing

3 - Use Specified Row Spacing

*Parameter Prompt*: Crop Row Spacing

*Parameter Unit*: mm

*Conversion factor*: inches = 0.03937 * (mm)

*Alternate units*: inches

*Parameter Prompt*: Seed Placement (ridge/furrow)

Specifies where seed is to be placed when planting in rows.

*Parameter Choices*:

0 - Seed row placed in bottom of furrow.

2 - Seed row placed on ridge top.

*Parameter Prompt*: Plant Population

*Parameter Unit*: #/m$^2$

*Conversion factor*: #/acre = 4046.7 * (#/m$^2$)

*Alternate units*: #/acre

*Parameter Prompt*: Maximum number of Tillers (stems) per Plant

*Parameter Unit*: #/plant

NOTE: All remaining process 51 parameters consist of the ”crop” database record parameters. They are fully defined in the crop ”how to” guide. One normally would not need to deal with those parameters when defining/modifying an operation record, so they are not individually listed here.

P 61: Remove Plant/Residue Material

*Parameter Prompt: Select Plant/residue Material*

This flag specifies the ”location” of the biomass to be removed.

*Parameter Choices:*

1 - Standing with Roots

2 - Flat

3 - Standing with Roots and Flat

4 - Buried

5 - Standing with Roots and Buried

6 - Flat and Buried

7 - Standing with Roots, Flat, and Buried

*Parameter Prompt*: Select Plant/residue Material

This flag specifies the biomass pool type(s) to be removed.

*Parameter Choices*:

1 - Crop

2 - Temporary

3 - Crop and Temporary

4 - Residue

5 - Crop and Residue

6 - Temporary and Residue

7 - Crop, Temporary, and Residue

*Parameter Prompt*: Grain (fruit) Removed

*Parameter Unit*: fraction

*Parameter Prompt*: Leaf Removed

*Parameter Unit*: fraction

*Parameter Prompt*: Stem Removed

*Parameter Unit*: fraction

*Parameter Prompt*: Storage Root Removed

*Parameter Unit*: fraction

*Parameter Prompt*: Fibrous Roots Removed

*Parameter Unit*: fraction

P 71: Irrigation

This process simulates the application of water.

*Parameter Prompt*: Irrigation Application Method

This flag specifies the type of irrigation method.

*Parameter Choices*:

1 - Sprinkler

2 - Other

*Parameter Prompt*: Depth of Water Applied

*Parameter Unit*: mm

*Conversion factor*: inches = 0.3937 * (mm)

*Alternate units*: inches

## 17.7 Using WEPS with Measured Data

**WEPS How To Guide**

## 17.8 Introduction

The Wind Erosion Prediction System (WEPS) is designed to simulate soil loss by wind from cultivated fields by simulating weather and field conditions (Wagner, 1997). In some situations however, WEPS may be run using measured or simulated data from other models. This is typically done to validate various components or submodels of WEPS, particularly the erosion portion of the model. For example, a user may have measured soil loss data and limited weather and soil data. This user can input the measured weather and soil data to compare the model soil loss with the measured loss. This section will explore the use of WEPS with measured or other simulated data.

WEPS is a process-based, continuous, daily time-step model that simulates weather, field conditions, and erosion by wind. It has the capability of simulating spatial and temporal variability of a field's soil, crop, and residue conditions and soil loss/deposition within a field. The saltation/creep, suspension, and PM10 components of eroding material are also reported separately by direction. The WEPS model is modular, with submodels that simulate weather, soil conditions, crop growth, residue decomposition, management operations, and soil loss by wind. It is designed to be used by the USDA-NRCS, under a wide range of conditions throughout the United States. With proper inputs however, WEPS is easily adapted to other parts of the world.

In typical applications, input files are created within the user interface, which supplies these files to the science portion of the model to calculate field conditions and erosion. WEPS requires the following input files for a simulation run: a 'Run file', WINDGEN file', 'CLIGEN file', 'Soil file', and a 'Management file'. These files can be modified with measured or other data and run with WEPS under certain constraints. All input files except the Management file, may be easily altered using a standard text editor or the WEPS user interface to reflect measured data. All input files must be formatted to meet the requirements for WEPS. These input files and considerations for their creation with measured data are described in this Appendix.

It is important to note that the purpose of the WEPS model is to simulate changes in field conditions as a result of management and weather to estimate wind erosion. To simulate these changes in field conditions, WEPS is intended for simulations of multiple-day periods of time. If one desires to simulate only a single storm, field conditions are essentially static and the full WEPS model is not necessary. To simulate single erosion events of one day or less, the standalone erosion submodel is recommended. The use of the standalone submodel is also described in this Appendix.

WEPS can be run from either the interface or the command line. Users typically will run the model through the interface, in which modified input files can be selected. See the individual input file descriptions for information on how to select modified files within the interface. Some input files are best modified within the interface (e.g., soil and management files), whereas others require some sort of separate editing or creation with a separate program (e.g., weather files). Files that are modified by the user but input via the interface must be placed in the appropriate project directory (i.e., folder). Those wishing to run WEPS via the command line are advised to see the section titled "Flags and Command Line Options" in the WEPS User Manual.

Output files obtained from WEPS are described elsewhere in the WEPS User Manual. For additional assistance using measured data with WEPS, please contact the USDA-ARS Rangeland & Systems Research Unit (weps@ars.usda.gov) or call 970-492-7322.

## 17.9 Run File

The default file name of the WEPS run file is 'weps.run'. This file contains general information for a simulation run, including the dates of the simulation, the field and barrier dimensions, the field location, and the path and names of the other input files. The 'run file' parameters can be modified to match the parameters for the field simulated. The list of the other input files should specify the path and name of measured data to be used. This file contains comments (indicated by a '#' in column one) which describes each line of input data to aid in checking and modifying input data.

An example Run File is shown in Fig. 17.50. Note that lines beginning with '#' character are comment lines. Lines beginning with '# RFD' are comments used by the interface. Some of the parameters are critical to the science model (SC), some are critical to the operation of the interface (IC), and some are critical to both (SC+IC); others are not critical to either (NC). An example of non-critical parameters would be the User Name, which does not affect the operation of WEPS and is used for informational purposes only. In all cases however, some sort of placeholder is required, even for non-critical parameters. In other words, each expected line must be present and filled with some characters.

The interface is a simple way to input data into the Run file and is recommended. The information herein is presented for the benefit of those users who wish to modify the input file manually themselves.

# 17.10 Run File Parameters

## 17.10.1 Run File User Info

UserName - This character variable holds the user name. (NC)

FieldNo - This character variable is a part of a field tract that is separated by permanent boundaries. (NC) Note that FieldNo, TractNo, FarmNo, RunMode, RunCycle, and RotCycle are all entered on one line, with each parameter separated by the pipe "|" symbol.

TractNo - This character variable is often used by FSA and NRCS to identify a field. (NC)

FarmNo - This character variable is a farm identification number. (NC)

RunMode - This character variable specifies the type of run length as either the NRCS method (specifies a fixed number of cycles), use simulation run start and end dates on the main screen, or specify the use of management rotation cycles on the main screen. (IC)

RunCylce - This variable specifies the number of management rotation cycles to simulate in a WEPS run. (IC)

RotCycle - This character variable specifies the number of years in the rotation cycle. (IC)

SiteCounty and SiteState - This character variable specifies the county and state to be simulated.(NC)

## 17.10.2 Run File Site Info

LatitudeSign – This parameter is used to specify the specify the hemisphere of the latitude. Enter a plus sign (+) for the Northern hemisphere and a minus sign (-) for the Southern hemisphere. (IC)

Latitude – The latitude of the location modeled in degrees and fraction of degrees. The CLIGEN and WINDGEN stations nearest to the center of the location county will then be determined by the interface and listed. Latitude is also used by the science model to determine day length and time of sunrise. (SC+IC)

LongitudeSign – This parameter is used to specify the specify the hemisphere of the longitude. Enter a plus sign (+) for the Eastern hemisphere and a minus sign (-) for the Western hemisphere. (IC)

Longitude -The longitude of the location modeled in degrees and fraction of degrees. The CLIGEN and WINDGEN stations nearest to the center of the location county will be determined by the interface. Longitude is used by the science model to determine day length and time of sunrise. (SC+IC)

Elevation (meters) – The average elevation for the location to be modeled in the units of measure displayed on the screen (feet or meters). The science model requires elevation in meters, and converts feet to meters. (SC+IC)

CliGenStationID - The name of the CLIGEN station used to generate many of the weather parameters for WEPS. (IC)

WindGenStationID - The name of WINDGEN station used to generate the wind parameters for WEPS. (IC)

## 17.10.3 Run File Simulation Period Info

StartDate (day, month, year) - The "Start Date" is the date from which you want the simulation to begin. The format is the numerical value for day, month (e.g., 03 for March), and year (two or four characters), each value separated by a blank space. (SC+IC)

- A typical run begins on January 1 and ends on December 31 with multiple years of simulation. For those using WEPS with historical data however, other start and ending days and months may be entered. The correctness of output has not been tested in these situations.

EndDate (day, month, year) - The ”End Date” is the date on which you want the simulation to end. The format is the numerical value for day, month (e.g., 03 for March), and year (two or four characters), each separated by a blank space. (SC+IC)

- A typical run begins on January 1 and ends on December 31 with multiple years of simulation. For those using WEPS with historical data however, other start and ending days and months may be entered. The correctness of output has not been tested in these situations.

TimeSteps (per day) - The number of time steps per day used for the daily distribution of simulated wind speed for erosion calculations. If none is entered through the interface Configuration Screen, the number of time steps is assumed to be 24. (SC)

### 17.10.4 Run File Filenames (Input) Info

climate file - This character variable holds the path and CLIGEN input file name. (SC+IC)

wind file - This character variable holds the path and WINDGEN input file name. (SC+IC)

soil file - This character variable holds the path and soil input file name. (SC+IC) management file - This character variable holds the path and management input file name. (SC+IC)

### 17.10.5 Run File Output Options Info

OutputFile - This character variable holds the path and general output file name. (SC+IC)

ReportForm - This variable was intended to hold six (6) flags for selecting various general report forms, but is not used in the current version of WEPS. (NC)

OutputPeriod - This variable was intended to hold a flag for selecting the period of output, but is not used in the current version of WEPS. (NC)

SubmodelOutput - This variable holds numerical flags to print detailed reports for various submodels. Submodel detail report flags are described elsewhere in the WEPS User Manual. (SC+IC)

DebugOutput - This variable holds numerical flags to print debug reports for various submodels. Submodel debug report flags are described elsewhere in the WEPS User Manual. (SC+IC)

### 17.10.6 Run File Simulation Region Info

RegionAngle (degrees from North) - This is the angle of the field with respect to North. (SC enter angle 0-360 decrees, clockwise from North) or (IC enter angle up to +/- 45 degrees)

SimCoords1 (meters) - These two variables hold the X and Y coordinates of the origin of the simulation region. This is typically the lower left corner for the North-South oriented rectangular simulation region. (SC+IC)

SimCoords2 (meters) - These two variables hold the X and Y coordinates of the opposite corner of the simulation region (furthest from the origin). This is typically the upper right corner for the North-South oriented rectangular simulation regions. (SC+IC)

ScaleFactors - These two variables were intended to hold scale factors for displaying the simulation region in the interface, but are not used in the current version of WEPS. (NC)

AcctRegNo - This variable holds the number of accounting regions in the simulation region. If more than one accounting region is present (i.e., AcctRegNo $>$ 1), then the accounting region coordinates are repeated in succession to account for each accounting region. (SC+IC)

AcctCoords1 (meters) - These two variables hold the X and Y coordinates of the origin of the accounting region. This is typically the lower left corner for the North-South oriented rectangular accounting region. (SC+IC)

AcctCoords2 (meters)- These two variables hold the X and Y coordinates of the opposite corner of the accounting region (furthest from the origin). This is typically the upper right corner for the North-South oriented rectangular accounting regions. (SC+IC)

SubRegNo - This variable holds the number of subregions in the simulation region. If more than one accounting region is present (i.e., SubRegNo $> 1$), then the subregion coordinates are repeated in succession to account for each subregion. (SC+IC)

SubCoords1 (meters) - These two variables hold the X and Y coordinates of the origin of the current subregion. This is typically the lower left corner for the North-South oriented rectangular subregion. (SC+IC)

SubCoords2 (meters) - These two variables hold the X and Y coordinates of the opposite corner of the subregion (furthest from the origin). This is typically the upper right corner for the North-South oriented rectangular subregions. (SC+IC)

AverageSlope (%) - The average slope of the subregion. This information is now obtained from the soil input file. (NC)

### 17.10.7 Run File Barrier Info

NumberBar - This variable holds the number of barriers in the simulation region. If more than one barrier is present (i.e., NumberBar $> 1$), then the barrier information (i.e., barrier coordinates and parameters) are repeated in succession to account for each barrier. (SC+IC)

BarrierCoords1 (meters) - These two variables hold the X and Y coordinates of the origin of the barrier. This is typically the lower left corner of the barrier. (SC+IC)

BarrierCoords2 (meters) -These two variables hold the X and Y coordinates of the opposite corner of the barrier (furthest from the origin). This is typically the upper right corner of the barrier. (SC+IC)

BarrierType - This character variable specifies the name of the type of barrier. (NC)

BarrierHeight (meters) - This parameter is the barrier average height. (SC+IC)

BarrierWidth (meters) - This parameter is the barrier average width (not length). (SC+IC)

BarrierPorosity (%) - The barrier porosity is expressed as an optical porosity. It is the open space as viewed looking perpendicular through the barrier expressed as a percentage of the total area (i.e., ((1.0 - silhouette area) x 100).

```
#------------ WEPS SIMULATION RUN FILE ------------
# Note: Lines beginning with '#' are comment lines.
#       Lines beginning with '#   RFD' are comments used by the interface.
#
# --USER INFORMATION
#   RFD-UserName
Dustin Fields
#   RFD-FieldNo RFD-TractNo RFD-FarmNo RFD-RunMode RFD-RunCycle RFD-RotCycle
789 | 456 | 123 | cycle | 2 | 2
#   RFD-SiteCounty and SiteState
Finney, Kansas
#
# --SITE INFORMATION
#   RFD-LatitudeSign RFD-Latitude
+38.00
#   RFD-LongitudeSign RFD-Longitude
-100.66
#   RFD-Elevation (meters)
801
#   RFD-CliGenStationID
CIMARRON
#   RFD-WindGenStationID
GARDEN CITY MUNI
#
# --SIMULATION PERIOD
#   RFD-StartDate (day_month_year)
01 01 01
#   RFD-EndDate (day_month_year)
31 12 4
#   RFD-TimeSteps (per_day)
24
#
# --RUN FILE NAMES (INPUT)
#   RFD-climate file
cli_gen.cli
#   RFD-wind file
win_gen.win
#   RFD-sub-daily file
none
#   RFD-SoilFile
Otero_101OF_100_FSL.ifc
#   RFD-ManageFile
KS_wheat_fallow.man
#
# --WEPS OUTPUT OPTIONS
#   RFD-OutputFile
output.tmp
#   RFD-ReportForm
0 0 0 0 0 0
#   RFD-OutputPeriod
2
#   RFD-SubmodelOutput
0 0 0 0 0 0
#   RFD-DebugOutput
0 0 0 0 0
#
# --SIMULATION REGION INFORMATION
#   RFD-RegionAngle (deg_clockwise_north)
21
#   RFD-SimCoords1 (meters)
0.0   0.0
#   RFD-SimCoords2 (meters)
1500.2   1500
#   RFD-ScaleFactors (place holder - needed for older versions of WEPS)
5.5 5.5
#
#   RFD-AcctRegNo
1
#   RFD-AcctCoords1 (meters)
    0.0   0.0
#   RFD-AcctCoords2 (meters)
1500.2   1500
#
#   RFD-SubregionNo
1
#   RFD-SubCoords1 (meters)
0.0   0.0
#   RFD-SubCoords2 (meters)
1500.2   1500
#   RFD-AverageSlope (%)
0.50
#  --BARRIERS
#   RFD-NumberBar
2
#   RFD-BarrierCoord1 (meters)
-1 0
#   RFD-BarrierCoords2 (meters)
0 1500
#   RFD-BarrierType
Snow fence
#   RFD-BarrierHeight (meters)
1.2
#   RFD-BarrierWidth (meters)
1
#   RFD-BarrierPorosity (%)
0.6
#   RFD-BarrierCoord (meters)
0 -2
1500.2 0
#   RFD-BarrierType
Sorghum(2 row)
#   RFD-BarrierHeight (meters)
2
#   RFD-BarrierWidth (meters)
2
#   RFD-BarrierPorosity (%)
0.5
#
#---------- END OF SIMULATION RUN FILE ------------
```

Figure 17.50: Example WEPS Run file.

## 17.11 Weather Files

WEPS runs are made for multiple years in full-year increments beginning on January 1. If only a partial year of weather data is available (typical), the user has two options. One option is to substitute measured data within the simulated weather file for the desired location, and observe the output for the period with measured data. For this option, the user should note that the field conditions cannot be input into the simulation at the point the measured data begins (although future versions of WEPS with this capability are planned). The field conditions will be the result of the simulation up to that point and may not exactly match actual field conditions for the measured data site. The second option is to use the stand-alone Erosion model (described later) for single-day simulations. Two weather files are required by the full WEPS model, a WINDGEN file and a CLIGEN file.

If alternative weather files are to be used in the full WEPS model, they are input through the interface. Alternative weather files are designated by first checking the appropriate wind or climate box in the “Run” tab of the “Configuration” window, then entering the file name and path or choosing the file by clicking the folder icon on the “Location Information” panel of the main screen.

## 17.12 Windgen File Description

The WINDGEN file extension is “win” (e.g., wind_gen.win). This file contains both the wind speed (m $s^{-1}$) on a subdaily time step and one wind direction (degrees clockwise from North) for each day of the simulation. If more than one wind direction is measured for the day (typical), an average wind direction should be calculated. A wind direction can be calculated by using average weighted by wind speed. This weighting is recommended to provide more weight to stronger, erosive winds. Average wind direction for a day is calculated as:

Equation 6.7:

$$Ue = \sum_{i=1}^{k} (Si * sinTi)$$

Equation 6.8:

$$Un = \sum_{i=1}^{k} (Si * cosTi)$$

Equation 6.9:

$$Tu = arctan\frac{Ue}{Un}$$

where

*k* = number of directions per day,

*Si* = wind speed (any units),

*Ti* wind directions (0-360 degrees),

*Tu* = average wind direction (0-360 degrees). If *Tu* ¡0, then *Tu* = *Tu* + 360

The subdaily wind speeds, are by default, the average hourly speeds (i.e., 24, 1-hour averages of point measurements), but can be of other time steps of equal length (e.g., 96, 15-minute averages of point measurements) if specified in the weps.run file. If data are available, it is recommended that time steps less than or equal to one hour be used, because the smaller the time step (more periods) are more accurate representation of the true winds. Also, the height of the wind measurement in WEPS is assumed to be 10 meters. If wind speeds were taken at a height other than 10 meters, speeds should be adjusted to what they would be at a 10-meter height. WEPS ignores the WINDGEN file header information which is in the first seven rows. Fig. 17.51 shows an example WINDGEN generated ASCII output file.

### 17.12.1 WINDGEN File Parameters

Lines 1-7: Comment lines (ignored). These do not need to be filled out, but WEPS does need to have these seven lines present beginning with a ‘#’ character.

Line 2: Station ID (integer), Windgen station name (city) and the state and country two letter abbreviations.

Line 3: Station location: Latitude and Longitude in deg, min and corresponding N/S and E/W character designations.

Line 4: Station data period of record: year,month day (4, 2 and 2 digits respectively) and Station elevation in meters.

Line 5: Column headings

Line 6: Column data units

Line 7: Comment line (dashes) separating heading information from hourly data

Lines 8+: Wind data, one day per line as described next.

Columns 1,2,3: **day mo year** - the day, month, and year of simulation (integer).

Column 4: **dir** - wind direction for the day. WEPS assumes that the direction is constant for the day (real - degrees clockwise from North = 0.0, East = 90.0, South = 180.0, etc.).

Columnd 5-29: **hr1, hr2, hr3 . . hr24** - average 1-hour wind speeds, distributed throughout the entire day. These represent by default, twenty-four 1-hour average wind speeds (real - m/s). If other time steps are used, they should be of equal length and the number of these periods should be specified in the weps.run file.

```
1  #    WIND_GEN5  $Revision: 1.1 $ Hourly values per day output
2  # station: 13985 DODGE_CITY, KS  US
3  # lat:   37deg  46min N  lon:   99deg  58min W
4  # period: 19610421-19781231   el: 796m
5  # day mo year  dir   hr1   hr2   hr3   hr4   hr5   hr6   hr7   hr8   hr9  .  .  .
6  #               deg   m/s   m/s   m/s   m/s   m/s   m/s   m/s   m/s   m/s  .  .  .
7  # ---------------------------------------------------------------------------------
8   1  1   1   0.0   3.7   4.7   6.1   6.4   6.9   7.7   8.3   9.3  14.4  .  .  .
9   2  1   1 180.0   3.5   4.7   5.5   5.8   6.4   6.9   7.5   7.9   8.5  .  .  .
10  3  1   1   0.0   3.7   4.7   6.1   6.4   6.8   7.7   8.1   9.3  12.1  .  .  .
11  4  1   1 157.5   2.9   3.5   4.1   4.3   4.6   5.0   5.4   5.6   7.4  .  .  .
12  5  1   1 135.0   2.3   2.9   3.5   3.8   4.5   4.8   5.4   6.0   8.2  .  .  .
13  6  1   1  22.5   3.5   4.6   5.2   5.8   6.6   7.2   7.9   8.8  11.0  .  .  .
14  7  1   1 180.0   3.8   4.9   5.6   5.8   6.5   7.1   7.7   8.0   9.4  .  .  .
15  8  1   1 202.5   4.0   4.8   5.2   5.7   5.9   6.2   6.7   7.2   8.1  .  .  .
16  9  1   1  22.5   3.5   4.6   5.1   5.8   6.4   7.1   7.7   8.8  10.3  .  .  .
17 10  1   1 135.0   2.1   2.8   3.4   3.8   4.4   4.7   5.3   5.8   6.7  .  .  .
18 11  1   1 202.5   4.2   5.0   5.3   5.7   5.9   6.4   6.9   7.4   9.5  .  .  .
19 12  1   1 337.5   3.1   3.6   4.4   4.9   5.5   6.5   7.1   8.0   9.0  .  .  .
20 13  1   1 270.0   3.0   3.3   3.8   4.2   4.6   4.8   5.0   5.5   6.3  .  . .
21 14  1   1   0.0   3.6   4.4   5.7   6.3   6.6   7.2   7.9   9.0  10.1  .  .  .
22 15  1   1   0.0   3.7   4.5   6.1   6.3   6.7   7.7   8.0   9.1  11.3  .  .  .
23 16  1   1 157.5   2.5   3.4   3.9   4.3   4.5   4.9   5.2   5.6   6.1  .  .  .
24 17  1   1 292.5   3.4   4.0   4.3   4.6   5.2   5.4   5.8   6.2   7.2  .  .  .
25 18  1   1  22.5   3.3   4.5   5.0   5.6   6.2   7.0   7.7   8.5   9.0  .  .  .
26 19  1   1 157.5   3.0   3.6   4.1   4.4   4.7   5.1   5.4   5.7   8.2  .  .  .
27 20  1   1 180.0   3.8   4.8   5.6   5.8   6.4   7.0   7.7   8.0   8.9  .  .  .
28 21  1   1   0.0   3.7   4.4   6.0   6.3   6.7   7.5   8.0   9.1  10.5  .  .  .
29 22  1   1  22.5   3.5   4.7   5.2   5.8   6.6   7.3   8.0   8.9  11.7  .  .  .
30 23  1   1 270.0   3.1   3.4   3.9   4.2   4.6   4.8   5.0   5.5   6.5  .  .  .
31 24  1   1 135.0   2.0   2.8   3.4   3.7   4.2   4.7   5.3   5.8   6.5  .  .  .
32 25  1   1 157.5   2.7   3.5   4.0   4.3   4.5   5.0   5.2   5.6   6.9  .  .  .
33 26  1   1  22.5   3.4   4.6   5.1   5.7   6.2   7.1   7.7   8.6   9.7  .  .  .
34 27  1   1 180.0   3.8   4.9   5.6   6.0   6.6   7.1   7.7   8.0  10.0  .  .  .
35 28  1   1 315.0   2.8   3.5   4.1   4.5   4.9   5.5   6.1   6.4   7.1  .  .  .
36 29  1   1 202.5   4.0   4.9   5.2   5.7   5.9   6.2   6.7   7.2   8.4  .  .  .
37 30  1   1 247.5   2.6   3.1   3.6   4.2   4.5   4.9   5.2   5.6   6.7  .  .  .
38 31  1   1   0.0   3.7   4.4   5.9   6.5   7.4   8.2   9.2  10.1  12.2  .  .  .
39  .  .   .     .     .     .     .     .     .     .     .     .     .  .  .  .
40  .  .   .     .     .     .     .     .     .     .     .     .     .  .  .  .
41  .  .   .     .     .     .     .     .     .     .     .     .     .  .  .  .
```

Figure 17.51: Sample of a Windgen generated ASCII output file.

## 17.13 Cligen File Description

The default CLIGEN file extension is "cli" (e.g., cligen.cli). The CLIGEN weather generator was developed for use with the Water Erosion Prediction Project (WEPP) (Flanagan, et.al., 2001) and is used by WEPS to simulate other weather parameters. The input file created by CLIGEN includes precipitation amount (mm), duration (hr), time to peak (fraction of duration), and peak intensity (mm $hr^{-1}$), as well as maximum and minimum air temperature (°C), solar radiation (ly $d^{-1}$), and dew point temperature (°C). This file also contains historical monthly averages for maximum and minimum temperature (°C), which are required by WEPS.

Although WEPS ignores non-needed data in the CLIGEN file, WEPS reads the entire file, so each line and column in WEPS must be populated, even though some elements may be 'dummy' variables not used by WEPS. For example, line 2 contains information not used by WEPS, but it must be present with any characters present. The CLIGEN file is read in free format. Fig. 17.52 shows a sample of a CLIGEN generated ASCII file.

### 17.13.1 CLIGEN File Parameters

Line 1: CLIGEN version number. Must be "5.30004" for the file format described in this document.

Lines 2-6: Information in these lines are not required by WEPS, but must be present as placeholders.

Line 7: Observed monthly average maximum temperatures (degree °C).

Line 8: Comment line.

Line 9: Observed Monthly average minimum temperatures (degree °C)

Line 10: Comment line

Line 11: Observed monthly average solar radiation (Langleys/day)

Line 12: Comment line

Line 13: Observed monthly average precipitation (mm)

Line 14: Comment line (column heading text)

Line 15: Comment line (column data units)

Line 16+: Daily weather data

Columns 1,2,3: **day mo year** - the day, month, and year of simulation (integers)

Column 4: **prcp** - precipitation for the day, including snow, ice, and rain (real - mm)

Column 5: **dur** - duration of the rainfall event (real - hours)

Column 6: **tp** - fraction of time to peak (real - time to peak duration in hours)

Column 7: **ip** - peak precipitation intensity (real - mm/hr)

Columns 8,9: **tmax tmin** - maximum and minimum daily air temperature (real - degrees Celsius)

Column 10: **rad** - daily solar radiation (real - Langleys/day)

Columns 11-12: **w-vl w-dir** daily wind velocity and direction, ignored by WEPS (real - m/s and degrees relative to North)

Column 13: **tdew** - dew point temperature (real - degrees Celsius)

```
5.30004
   1    0    0
  Station:  +CIMARRON KS                                     CLIGEN VER. 5.30004 -r:    0 -I: 3
 Latitude Longitude Elevation (m) Obs. Years   Beginning year  Years simulated Command Line:
    37.74   -100.44          801          40          1            150          -S14 -s1522 -i /tmp/csip/work/07/10/cffc4817-2ec7-11ed-83b4-1555bb28cf1e/cligenRecordPrism.par -o/tmp/csip/work/07/10/cffc4817-2ec7-11ed-83b4-1555bb28cf1e/cli_gen.cli -b1 -y150 -t5 -I3
 Observed monthly ave max temperature (C)
   7.0    9.2   14.3   19.7   24.7   30.0   33.3   32.3   28.0   21.1   13.6    7.2
 Observed monthly ave min temperature (C)
  -7.8   -5.9   -1.6    3.5    9.9   15.4   18.2   17.6   12.4    5.2   -2.1   -7.1
 Observed monthly ave solar radiation (Langleys/day)
 203.0  278.0  376.0  466.0  546.0  591.0  616.0  533.0  433.0  321.0  224.0  192.0
 Observed monthly ave precipitation (mm)
  13.9   15.8   38.4   44.6   72.8   88.7   76.7   69.8   40.5   41.4   18.9   18.0
 da mo year  prcp  dur   tp     ip  tmax  tmin  rad  w-vl w-dir  tdew
             (mm)  (h)               (C)   (C) (l/d) (m/s)(Deg)   (C)
  1  1    1   0.0  0.00 0.00   0.00  -3.9 -11.6 149.  5.0  272. -13.3
  2  1    1   0.0  0.00 0.00   0.00  -1.6 -11.4 231.  3.4   80.  -8.1
  3  1    1   0.0  0.00 0.00   0.00  10.3 -12.4 186.  5.8  303. -19.9
  4  1    1   0.0  0.00 0.00   0.00  12.1  -2.2 142.  4.5  251.   0.5
  5  1    1   0.0  0.00 0.00   0.00  25.5   4.6 131.  5.2  262.  12.4
  6  1    1   0.0  0.00 0.00   0.00   9.9  -0.2 165.  5.9   21.  -0.1
  7  1    1   0.0  0.00 0.00   0.00  16.3  -3.7 238.  3.5  163.  -2.4
  8  1    1   0.0  0.00 0.00   0.00  12.3  -2.7 227.  8.8  357.  -9.5
```

Figure 17.52: Sample of a Cligen generated ASCII output file.

## 17.14 Soil File

The default soil file name has an "ifc" extension (e.g., amarillo.ifc). This file contains the initial soil conditions at the start of a simulation run. The soil and management submodels then simulate changes in these conditions as affected by weather, management, and erosion for each simulation day. Even intrinsic parameters such as particle size distribution will change with tillage as layers are mixed. If simulated soil parameters differ significantly from measured values, it is recommended that the user use the stand-alone Erosion model (described in this chapter) to simulate single storms using measured values. The soil input file includes the taxonomic order, number, and thickness (mm) of soil layers; detailed particle size distribution (fraction); wet and dry bulk density ($Mg^{-3}$); aggregate stability ($\ln(J\ m^{-2})$), density ($Mg\ m^{-3}$), and size distribution (fraction); soil crust properties (varies); random and oriented (ridge) roughness (mm); soil water characterization parameters (varies); dry albedo (fraction); organic matter (fraction); pH; calcium carbonate (fraction); and cation exchange capacity (meq $100g^{-1}$). This file also contains comments (indicated by a '#' in column one) that describe each line of input data to aid in checking and modifying input data. A description of the items required by WEPS follows, which can be viewed and edited within soil panel of the WEPS interface. The absolute range is that allowable by WEPS; the typical range lists the range of values to be expected with typical soils. An example Soil file is shown in Fig. 17.53.

The WEPS soil interface is a simple way to edit input data in the Soil file and is recommended. It is also recommended that the user select an existing soil file from the database with similar properties to the desired soil and modify its properties. Soil database files that were derived from the NRCS SSURGO database are accessed through the bottom of the WEPS main screen. Once a soil is selected, the soil interface is accessed by clicking the "Soil" button at the bottom of the main screen. The information presented here is for the benefit of those users who wish to modify the input file themselves.

### 17.14.1 Soil File Parameters

***Version***:

*Version* - A version number to allow the user to choose between an older ifc file format and the newer format, which is Version 1.0 (described here). Contact WERU if you have ifc files in an older format that you want to use with WEPS.

***Soil Identification***:

*Soil ID* - Soil identifying information consisting of the following (separated by a dash). Note that these items are not critical to the operation of WEPS, and are used for identification purposes only.

*Soil Survey Area ID* - The soil survey area identification for the soil (character). The soil survey area identification is not critical to the operation of WEPS, and is used for identification purposes only.

Estimated by: “Unknown”.

*Map Unit Symbol* - The symbol used to uniquely identify the soil map unit in the soil survey (character). The map unit symbol is not critical to the operation of WEPS, and is used for identification purposes only.

Estimated by: “Unknown”

*Component Name* - The name of the soil (character). The soil component name is not critical to the operation of WEPS, and is used for identification purposes only.

Estimated by: “Unknown”

*Component Percent* - The percentage of the soil component of the map unit (integer). The soil component percentage is not critical to the operation of WEPS, and is used for identification purposes only.

Absolute range = $>$ 0 to 100 Typical range = $>$ 0 to 100

Estimated by: “Unknown”

*Surface Texture Class* - The class of the surface layer based on USDA system for particle size (character). The texture class is not critical to the operation of WEPS, and is used for identification purposes only.

Estimated by: “Unknown”

*State* - The state in which the soil occurs (character). The state is not critical to the operation of WEPS, and is used for identification purposes only.

Estimated by: “Unknown”

*County* - The county in which the soil occurs (character). The county is not critical to the operation of WEPS, and is used for identification purposes only.

Estimated by: “Unknown”

*Soil Survey Area Name* - The soil survey area name in which the soil occurs (character). The soil survey area name is not critical to the operation of WEPS, and is used for identification purposes only.

Estimated by: “Unknown”

*Local Phase* - Phase criterion used at the local level to help identify soil components (character). The local phase is not critical to the operation of WEPS, and is used for identification purposes only.

Estimated by: “Unknown”

*Soil Order* - The taxonomic soil order is the name for the highest level in soil taxonomy (character). The taxonomic soil order is not critical to the operation of WEPS, and is used for identification purposes only.

Estimated by: “Unknown”

*Soil Loss Tolerance (T factor)* - The maximum amount of erosion at which the quality of a soil as a medium for plant growth can be maintained. (Tons/acre/year) The soil loss tolerance is not critical to the operation of WEPS, and is used for identification purposes only.

Absolute range = 1 - 5 Typical range = 1 - 5 Estimated by: “Unknown”

*Dry Soil Albedo* - The estimated ratio of the incident short-wave (solar) radiation that is reflected by the air dry, less than 2 mm fraction of the soil surface (unitless).

Absolute range = 0.00 to 1.00 Typical range = 0.05 to 0.25

Estimated by: method of method of Post et.al., (2000) or Baumer (1990).

*Slope Gradient* - The difference in elevation between two points on the overall field surface, expressed as a fraction of the distance between those points. (real fraction).

Absolute range = 0.0 - 0.999 Typical range = 0.0 - 0.3

Estimated by: slope = 0.01

**Soil Surface Properties & Depth Restrictions**

*Surface Fragment Cover* - The fraction of the surface area covered by rock greater than 2.0 mm ($m^3/m^3$).

Absolute range = 0.0 to 1.0 Typical range = 0.0 - 0.5

Estimated by: Surface layer fragment volume

*Depth to Bedrock* - The observed depth to the top of the bedrock layer, if present (mm).

Absolute range = 0.0 to 99990.0 Typical range = ?

Estimated by: depth to bedrock = 99990.0

*Depth to Root Restricting Layer* - The depth to the upper boundary of a restrictive layer, if present (mm).

Absolute range = 0.0 to 99990.0 Typical range = ?

Estimated by: depth to bedrock = 99990.0

***Soil Layer Properties***

*Number of Soil Layers* - The number of soil horizons of layers for which properties are reported.

*Layer Thickness* - The thickness of each soil layer (mm). WEPS requires a specific layer structure, which is determined by the soil interface.

Estimated by: user defined (required)

*Sand* - Mineral particles 0.05 to 2.0 mm in equivalent diameter as a weight fraction of the less than 2.0 mm fraction (kg/kg).

Absolute range = (¿0.0) to 1.0 Typical range = [1.0 - (silt + clay)]

Estimated by: sand = 1.0 - (silt + clay)

*Silt* - Mineral particles 0.002 to 0.05 mm in equivalent diameter as a weight fraction of the less than 2.0 mm fraction (kg/kg).

Absolute range = (¿0.0) to 1.0 Typical range = [1.0 - (sand + clay)]

Estimated by: silt = 1.0 - (sand + clay)

*Clay* - Mineral particles less than 0.002 mm in equivalent diameter as a weight fraction of the less than 2.0 mm fraction (kg/kg).

Absolute range = (¿0.0) to 1.0 Typical range = [1.0 - (sand + silt)]

Estimated by: clay = 1.0 - (silt + sand)

*Rock Fragment* - The volume fraction of the layer occupied by the 2.0 mm or larger (20 mm or larger for wood fragments) on a whole soil basis (m3/m3).

Absolute range = 0.0 to 1.0 Typical range = 0.0 - 0.5

Estimated by: rock fragments = 0.0

***Sand Fractions***

*Sand Fractions: Coarse* - Mineral particles 0.5 to 1.0 mm in equivalent diameter as a weight fraction of the less than 2 mm fraction (kg/kg).

Absolute range = 0.0 to 1.0 Typical range = 0.0 to 1.0

Estimated by: CS = 0.0

*Sand Fractions: Very Coarse* - Mineral particles 1.0 to 2.0 mm in equivalent diameter as a weight fraction of the less than 2 mm fraction (kg/kg).

Absolute range = 0.0 to 1.0 Typical range = 0.0 to 1.0

Estimated by: VCS = 0.0

*Sand Fractions: Medium* - Mineral particles 0.2 to 0.5 mm in equivalent diameter as a weight fraction of the less than 2 mm fraction (kg/kg).

Absolute range = 0.0 to 1.0 Typical range = 0.0 to 1.0

Estimated by: MS = 0.0

*Sand Fractions: Fine* - Mineral particles 0.1 to 0.2 mm in equivalent diameter as a weight fraction of the less than 2 mm fraction (kg/kg).

Absolute range = 0.0 to 1.0 Typical range = 0.0 to 1.0

Estimated by: FS = 0.0

Sand Fractions: Very Fine - Mineral particles 0.05 to 0.1 mm in equivalent diameter as a weight fraction of the less than 2 mm fraction (kg/kg).

Absolute range = 0.0 to 1.0 Typical range = 0.0 to 1.0

Estimated by: user defined (required)

***Bulk Density***

Bulk Density 1/3 Bar - The oven dry weight of the less than 2 mm soil material per unit volume of soil at a tension of 1/3 bar ($Mg/m^3$).

Absolute Range = (¿0.0) to 10.0 Typical range = 0.8 to 1.6 Estimated by: user defined (required)

***Other Layer Properties***

*Organic Matter* - The amount by weight of decomposed plant and animal residue expressed as a weight fraction of the less than 2 mm soil material (kg/kg).

Absolute range = 0.0 to 1.0 Typical range = 0.0005 to 0.05

Estimated by: user defined (required)

*pH* - The negative logarithm to the base 10, of the hydrogen ion activity in the soil according to the 1:1 soil:water ratio method (unitless). A numerical expression of the relative acidity or alkalinity of a soil sample.

Absolute range = 1.0 to 14.0 Typical range = 4.0 to 9.0

Estimated by: pH = 7.0

*CaCO3* - The quantity of carbonate (CO3) in the soil expressed as CaCO3 and as a weight percentage of the less than 2 mm size fraction (kg/kg).

Absolute range = 0.0 to 1.0 Typical range = 0.0 to 0.3

Estimated by: user defined (required)

*CEC* - The cation exchange capacity (meq/100g).

Absolute range = 0.0 to 400.0 Typical range = 0 to 400.0

Estimated by: user defined (required)

*Linear Extensibility Percent* - The linear expression of the volume difference of natural soil fabric at 1/3 or 1/10 bar water content and oven dryness. The volume change is reported as a percentage change for the whole soil (%).

Absolute range = 0.0 to 30.0 Typical range = ?

Estimated by: Soil Survey Staff (1996).

***Aggregates***

*Aggregate Geometric Mean Diameter* - Soil aggregate geometric mean diameter of the modified log-normal distribution (mm).

Absolute range = 0.03 to 30.0 Typical range = 0.1 to 15.0

Estimated by: aggr. gmd = exp(3.44 – 7.21*(0.2909 + 0.31*sand 0.17* silt + 0.0033*sand/clay -4.66 * om – 0.95 * CaCO3) * (1.0 + 0.006 * layer depth)

*Aggregate Geometric Standard Deviation* - Soil aggregate geometric standard deviation of the modified log-normal distribution (dimensionless).

Absolute range = 1.0 to 20.0 Typical range = 4.0 to 15.0

Estimated by: aggr. gsd = 1.0 / (0.0203 + 0.00193(aggr. gmd) + 0.074 / $(aggr.gmd)^{0.5}$)

Absolute range = 1.0 to 1000.0 Typical range = 2.0 to 100.0

Estimated by: aggr.max. size = $(aggr.\ gsd)^{p}$ * (aggr. gmd) + 0.84 where p = 1.52 * $(aggr.gmd)^{-0.449}$

*Minimum Aggregate Size* - Lower limit of the modified log-normal aggregate size distribution (mm).

Absolute range = 0.001 to 5.0 Typical range = 0.006 to 0.020 Estimated by: aggr min. size = 0.01

*Aggregate Density* - The aggregate density for ($Mg/m^3$).

Absolute range = 0.6 to 2.5 Typical range = 0.8 to 2.0

Estimated by: Rawls (1983)

aggr density = 2.0 for layer depth ¿ 300 mm

aggr density = 2.01 *(0.72 + 0.00092 * layer depth) for layer depth ¡ 300 mm

*Aggregate Stability* - Mean of natural log of aggregate crushing energies (ln(J/kg)).

Absolute range = 0.1 to 7.0 Typical range = 0.5 to 5.0

Estimated by: aggr. stability = 0.83 + 15.7 * clay - 23.8 * $clay^2$

***Soil Crust***

*Soil Crust Thickness* - Average thickness of the consolidated zone in the surface layer (mm).

Absolute range = 0.0 to 23.0 Typical range = 0.0 to 10.0

Estimated by: crust thickness = 0.01

*Soil Crust Density* - The density of the soil crust ($Mg/m^3$).

Absolute range = 0.6 to 2.0 Typical range = 0.8 to 1.6

Estimated by: aggregate density

*Soil Crust Stability* - Mean of natural log of crust crushing energies (ln(J/kg)).

Absolute range = 0.1 to 7.0 Typical range = 0.3 to 5.0 Estimated by: aggregate stability

*Crust Surface Fraction* - Fraction of surface covered with consolidated soil, as opposed to aggregated soil ($m^2/m^2$)

Absolute range = 0.0 to 1.0 Typical range = 0.0 to 1.0

Estimated by: 0.0

*Mass of Loose Material on Crust* - Mass of the loose, saltation-size soil on the surface soil crusted area ($kg/m^2$)

Absolute range = 0.0 to 3.0 Typical range = 0.0 to 1.0

Estimated by: 0.0

*Fraction of Loose Material on Crust* - Fraction of total soil surface area covered with loose material on the crust ($m^2/m^2$).

Absolute range = 0.0 to soil crust fraction Typical range = 0.0 to 0.5

Estimated by: 0.0

***Roughness***

*Random Roughness* - The standard deviation of elevation from a plane of a random soil surface, including any flat biomass adjusted as suggested by Allmaras et.al., (1966) (mm).

Absolute range = 1.0 to 70.0 Typical range = 2.0 to 10.0

Estimated by: 4.0

*Ridge Orientation* - Direction of the tillage ridge, clockwise from true north (degrees).

Absolute range = 0.0 to 179.99 Typical range = 0.0 to 179.99

Estimated by: 0.0

*Ridge Height* - The height of soil ridges from bottom of furrow to top of ridge (mm).

Absolute range = 0.0 to 500. Typical range = 0.0 to 300.0

Estimated by: 0.0

*Spacing Between Ridge Tops* - Spacing between ridge tops (mm).

Absolute range = 10.0 to 2000.0 Typical range = 60.0 to 1000.0

Estimated by: 10.0

*Ridge Width* - Width of the top of the ridge (i.e. bed width) (mm).

Absolute range = 10.0 to 4000.0 Typical range = 100.0 to 2000.0

Estimated by: 10.0

***Hydrologic properties***

*Initial Bulk Density (1/3 Bar)* - The oven dry weight of the less than 2 mm soil material per unit volume of soil at a tension of 1/3 bar ($Mg/m^3$).

Absolute range = (¿0.0) to 10.0 Typical range = 0.8 to 1.6

Estimated by: user defined (required)

*Initial Water Content* - Soil water content at the beginning of the simulation ($cm^3/cm^3$)

Absolute range = 0.0 to field capacity Typical range = varies with soil texture

Estimated by: ½ (field capacity + wilting point)

*Saturation Water Content* - Soil water content when soil pores are completely filled (i.e. zero soil matric potential) ($cm^3/cm^3$).

Absolute range = 0.0 to $>$ field capacity Typical range = varies with soil texture

Estimated by: Saxton, et al. (1986)

*Note*: Note: Saturated water content > Field capacity water content > Wilting point water content

*Field Capacity Water Content* - The amount of soil water retained at 1/3 bar (33 kPa), expressed as a fraction of the less than 2 mm, oven-dry soil by volume ($cm^3/cm^3$).

Absolute range = 0.0 to < saturation Typical range = varies with soil texture

Estimated by: Saxton, et al. (1986)

*Note*: Note: Saturated water content > Field capacity water content > Wilting point water content

*Wilting Point Water Content* - The amount of soil water retained at 15 bars (1500 kPa), expressed as a percentage of the less than 2 mm, oven-dry soil by volume ($cm^3/cm^3$).

Absolute range = 0.0 to ¡ field capacity Typical range = varies with soil texture

Estimated by: Saxton, et al. (1986)

Note: Saturated water content ¿ Field capacity water content ¿ Wilting point water content

*Soil CB Value* - The power of Campbell's model of the soil water characteristics curve (unitless).

Absolute range = 0.917 to 27.027 Typical range = varies with soil texture

Estimated by: Saxton, et al. (1986)

*Air Entry Potential* - The air entry potential is defined as the potential at which the largest water-filled pores start to drain and hence gas flow can be observed (Joules/kg).

Absolute range = -17.91 to 0.0 Typical range = varies with soil texture

Estimated by: Saxton, et al. (1986)

*Saturated Hydraulic Conductivity* - The amount of water that would move vertically through a unit area of saturated soil in a unit time under unit hydraulic gradient (m/s).

Absolute range = 0.0 to 1E-3 Typical range = 0.0 to 1E-3

Estimated by: Saxton, et al. (1986)

Notes - The user may enter any notes pertaining to the soil file. These notes are appended to the bottom of the soil file. The soil notes may also contain notes generated by the interface. These generated notes specify parameters that were adjusted because of out-of-range values, and lists the old and new values. The notes are not critical to the operation of WEPS and are used for information purposes only.

```
Version: 1.0
#
# Soil ID
CO631-Se-San Luis-100-SL-Colorado-Rio Grande County Area-Rio Grande County Area, Colorado
#
# Local Phase
DRAINED
# Soil Order
Aridisols
# Soil Loss Tolerance (tons/acre/year)
3
# Dry soil albedo (fraction)
0.230
# Slope gradient (fraction)
0.010
# Surface fragment cover or surface layer fragments (area fraction)
0.000
#
# Depth to bedrock (mm)
99990
# Depth to root restricting layer (mm)
99990
#
# Number of layers
3
# Layer thickness (mm)
150      460      910
#
# Sand fraction
0.659      0.340      0.960
# Silt fraction
0.191      0.370      0.015
# Clay fraction
0.150      0.290      0.025
# Rock fragments
0.000      0.000      0.260
# Sand fraction very coarse
0.043      0.030      0.007
# Sand fraction coarse
0.141      0.043      0.131
# Sand fraction medium
0.175      0.059      0.372
# Sand fraction fine
0.196      0.106      0.378
# Sand fraction very fine
0.104      0.102      0.072
#
# Bulk Density (1/3 bar)(Mg/m^3)
1.350      1.250      1.400
# Organic matter (kg/kg)
0.0075      0.0025      0.0025
# Soil PH (0-14)
8.50      9.80      7.90
# Calcium carbonate equivalent (CaCO3)
0.08      0.15      0.06
# Cation exchange capacity (CEC) (meq/100g)
10.00      15.00      2.50
# Linear extensibility
0.015      0.045      0.015
#
# Aggregate geometric mean diameter (mm)
2.647      15.675      2.929
# Aggregate geometric standard deviation
13.086      13.393      13.463
# Maximum aggregate size (mm)
33.055      49.322      33.579
# Minimum aggregate size (mm)
0.010      0.010      0.010
# Aggregate density (Mg/m^3)
1.725      2.000      2.000
# Aggregate stability (ln(J/m^2))
2.650      3.381      1.208
#
# Crust thickness (mm)
0.010
# Crust density (Mg/m^3)
1.725
# Crust stability (ln(J/m^2))
2.65
# Crust surface fraction (m^2/m^2)
0.00
# Mass of loose material on crust (kg/m^2)
0.00
# Fraction of loose material on crust (m^2/m^2)
0.00
#
# Random roughness (mm)
4.00
# Ridge orientation (deg)
0.00
# Ridge height (mm)
0.00
# Spacing between ridge tops (mm)
10.00
# Ridge width (mm)
10.00
#
# Initial Bulk Density (1/3 bar)(Mg/m^3)
1.350      1.250      1.400
# Initial soil water content (m^3/m^3)
0.140      0.222      0.037
# Saturation soil water content (m^3/m^3)
0.434      0.494      0.313
# Field capacity water content (m^3/m^3)
0.188      0.296      0.060
# Wilting point water content (m^3/m^3)
0.091      0.148      0.014
#
# Soil CB value (exponent to Campbell's SWRC)
5.909      6.175      3.957
# Air entry potential (J/kg)
-0.429      -1.633      -0.423
# Saturated hydraulic conductivity (m/s)
2.821E-5      2.819E-6      9.174E-5
#
# Notes:
#  The user may enter notes here.
```

Figure 17.53: Example WEPS Soil file.

## 17.15 Management File

The default file name is **'*.man'.** This file contains parameters for the manipulation of soil and biomass properties as a result of various management operations performed on the field on a given date. These operations include planting, harvesting, cultivation, defoliation, fertilization, and irrigation. The management file should only be altered by using the Management Crop Rotation Editor for WEPS (MCREW), to guarantee that parameters are correct. MCREW is accessed through the WEPS user interface.

## 17.16 Stand-alone Erosion Submodel (SWEEP)

The Erosion submodel (SWEEP) can also be operated as a stand-alone model to simulate erosion for a single storm (i.e., daily). Input parameters that must be provided for the day include the field and barrier dimensions, as well as biomass, soil, hydrology and weather parameters. Wind speed can be entered either as Weibull distribution parameters or listed as average wind speeds for each time period throughout the day. Valid command line options for the stand-alone erosion submodel are:

### 17.16.1 Stand-alone Erosion Submodel (SWEEP) Command Line Options

Usage: tsterode - "_filename" -x# -y# -t# -u -E -Plot -? -h

Valid command line options:

-? or -h

Display the available command line options.

-x#

Number of grid points in x direction (min. = 3; max. = 500). The submodel calculates the loss/deposition over a series of individual, equal-sized grid cells representing the entire simulation region. The more grid points, the smaller the area in each grid cell. The recommended total number of grid cells is 30 for a field without a barrier and 60 for a field with a barrier. Increasing the number of grid cells increases the accuracy of the soil loss/deposition estimates, as well as increases the run time. If not specified, the number of grid points is calculated within the model.

-y#

Number of grid points in y direction (min. = 3; max. = 500). The submodel calculates the loss/deposition over a series of individual, equal-sized grid cells representing the entire simulation region. The more grid points, the smaller the area in each grid cell. The recommended total number of grid cells is 30 for a field without a barrier and 60 for a field with a barrier. Increasing the number of grid cells increases the accuracy of the soil loss/deposition estimates, as well as increases the run time. If not specified, the number of grid points is calculated within the model.

-t#

Interval for surface updating in seconds (min. = 60 seconds; max. = 86400 seconds). This is used to specify a fixed surface updating interval and is primarily for testing and evaluation purposes. Because the erosion code contains an update loop dependent upon the number of time intervals/day and an inner loop that allows more frequent surface updating to occur, the updating interval must be evenly divisible into both the number of time intervals/day and 24 (hours in a day). If these conditions are not met, the program aborts with an error message.

-u

Disable erosion surface updating.

-i "input_filename"

Specify input filename. The input filename must be specified and listed before the -Einp, -Erod, -Egrd, and -Emit options. Quotes are required if spaces are within the file name.

-Einp

Writes (echos) the input file to "input_filename.einp". This is useful for debugging purposes. The "input_filename" is the same name as the input filename with a ".eimp" extension, and will be created in the same directory specified for the input filename.

-Erod

Output erosion summary (kg/m$^2$) (positive values are soil loss). The one line output in the file contains the following:

Total loss, saltation plus creep, suspension, PM10, and the input filename

The "-Erod" option requires that the input file (-i"input_filename") be specified as a command line argument before the "-Erod" option, e.g.:

tsterode -iinput_filename.ext -Erod

The "input_filename" in the erosion summary is the same name as the input filename with a ".erod" extension, and will be created in the same directory specified for the input filename.

-Egrd

Output grid summary results (kg/m$^2$) (positive values are soil loss). The "-Egrd" option requires that the input file (-i"input_filename") be specified as a command line argument before the "-Egrd" option, e.g.:

tsterode -iinput_filename.ext -Egrd

The "input_filename" in the grid summary is the same name as the input filename with a ".egrd" extension, and will be created in the same directory specified for the input filename.

-Emit

Output hourly erosion results (kg/m$^2$) (positive values are soil loss). The "-Emit" option requires that the input file (-i"input_filename") be specified as a command line argument before the "-Emit" option, e.g.:

tsterode -iinput_filename.ext -Emit

The "input_filename" in the hourly erosion results is the same name as the input filename with a ".emit" extension, and will be created in the same directory specified for the input filename.

-Eplt

Enable printing of a file that can be used to plot various data. The data is appended to the file for each run.

-Esgrd

Output all grid cell values for selected grid cell variables (e.g., RR, ridge ht, friction velocity, etc.) as well as the standard erosion results for each subdaily period. Each "period" is identified by the "yy mm dd hr variable_name_title" prior to the grid cell values. The "-Esgrd' option requires that the input file (-i"input_filename") be specified as a command line argument before the "-Esgrd" option, e.g.:

tsterode -iinput_filename.ext -Esgrd

The "input_filename" in the grid summary is the same name as the input filename with a ".sgrd" extension, and will be created in the same directory specified for the input filename.

Default options are set to:

-t900

Note that these command line options cannot be specified when the erosion submodel is run through the WEPS interface.

### 17.16.2 Stand-alone Erosion Submodel (SWEEP) Input File

Figs. 17.54 to 17.61 is an example of a stand-alone erosion submodel input file. The input file contains comments (indicated by a '# ' in column one) that describe each line of input data to aid in checking and modifying input data, which follows the comments. Specific definitions of these parameters are documented within the comment lines within the input file (see below).

```
#************************************************************
#    erod_template.in    Template INPUT DATA FILE
#                        Updated January 2006 - LEW
#************************************************************
#
#     +++ PURPOSE +++
#
#     Input file for standalone erosion submodel program (tsterode)
#
#     All lines beginning with a "#" character are assumed to
#     be comment lines and are skipped.
#
#     +++ DEFINITIONS +++
#
#     All comments prior to each line of data input
#     in this template input file have the following format:
#
#     Variable_Name, Var_type, Text Definition
#
#     where Var_type is: I = integer L = logical R = real
#
#
# +++ DEBUG STUFF +++
#
#     debugflg - debug flag for providing different levels of debug info
#                currently useful to debug/check input file data format
#
#                value of 0 will print no debug information
#                value of 1 will print out and number all input file lines
#                value of 2 will print out and number all data input lines
#                value of 3 will do both 1 and 2
 0
#
#
# +++ INIT STUFF +++
#
#     am0eif, L, EROSION "initialization" flag
#                Must be set to .TRUE. for standalone erosion runs
 .TRUE.
#
#     am0efl, I, EROSION "print" flag
#               NOTE:  Not sure if all of these have yet been replaced by
#                      "tsterode" cmdline options.  Regardless, this flag
#                      should be considered deprecated in this file. - LEW
#               Range: 0 to 6
#               0 = print input, no output
#               1 = print input, standard output
#               2 = print input, 1 line output
#               3 = used in WEPS to print input, then create file "emit.out"
#                      containing hourly suspended emission rates
#               4 = used in standalone to print input, then create file "emit.out"
#                      containing hourly suspended emission rates
#               5 = not used at present
#               6 = print input, detail output each step using calls
#                      to sb1out and sb2out
1
#
```

Figure 17.54: Example WEPS Standalone Erosion (SWEEP input) file (pg 1 of 8).

```
# +++ SIMULATION REGION +++
#
#     amxsim(x,y), R, Simulation Region diagonal coordinates (meters)
#                     Input (x,y) coordinates in this form: x1,y1 x2,y2
#                      Typical Range: 10.0 to 1600.0
#
#                     NOTE:  Accounting region and Subregion coordinates
#                            must also be set to the same values
#
  0.0, 0.0 1000.0, 200.0
#
#
#     amasim, R, Simulation Region orientation angle (degrees from North)
 0.0
#
#
# +++ ACCOUNTING REGIONS +++
#
#     nacctr, I, Number of accounting regions (must always be 1 for now)
 1
#
#     amxar(x,y,a), R, Accounting Region diagonal coordinates (meters)
#                      Input (x,y) coordinates in this form: x1,y1 x2,y2
#                      for each Accounting Region specified (nacctr)
#
#                     NOTE:  Accounting Region coordinate values must
#                            match Simulation Region coordinates above
#
 0.0, 0.0 1000.0, 200.0
#
#
# +++ BARRIERS +++
#
#     nbr, I, Number of barriers (0-5)
 2
#     NOTE: Remaining BARRIER inputs are repeated for each barrier specified
#           If no barriers specified (nbr=0), then no BARRIER inputs will
#           be listed here.
#
#     amxbr(x,y,b), R, Barrier linear coordinates (meters)
#                      Input (x,y) coordinates in this form: x1,y1 x2,y2
#                      for each barrier specified (nbr)
 0.0, 0.0 0.0, 200.0
#
#       amzbr(b),  R, Barrier height (meters)
#       ampbr(b),  R, Barrier porosity (m^2/m^2)
#       amxbrw(b), R, Barrier width (meters)
#
 0.2 0.5 15.0
#
#       Repeat previous two input lines for each additional barrier
#
#       Barrier #2 coordinates (x1,y1) (x2,y2)
 0.0, 0.0 1000.0, 0.0
#       Barrier #2 height, porosity and width
 0.2 0.5 15.0
#
#
```

Figure 17.55: Example WEPS Standalone Erosion (SWEEP input) file (pg 2 of 8).

```
# +++ SUBREGION REGIONS +++
#
#     nsubr, I, Number of subregions (1-5)
#                NOTE:  Currently not fully tested for multiple subregions
#                       Only use value of 1
#
 1
#
#     NOTE: Remaining SUBREGION inputs (BIOMASS, SOIL, and HYDROLOGY,
#     ie. variables defined by subregion) are repeated for "nsubr"
#     subregions specified
#
#     amxsr(x,y,s), R, Subregion diagonal coordinates (m)
#                       Input (x,y) coordinates in this form: x1,y1 x2,y2
#                       for each subregion specified (subr)
#
#                       NOTE:  Since only one subregion is currently supported,
#                              subregion coordinate values must match
#                              Simulation Region coordinates above
#
 0.0, 0.0 1000.0, 200.0
#
#
#     +++ BIOMASS +++
#
#
#       adzht_ave(s), R, Height of standing residue (meters)
#                         WEPS generated input files will provide
#                         "SAI weighted" average residue height
#                         across all residue pools.
#               Typical Range: 0.0 to 3.0
 0.21
#
#       aczht(s), R, Average height of growing crop (meters)
 0.0
#
#       acrsai(s), R, Growing crop stem area index (m^2/m^2)
#               Typical Range: 0.0 to 3.0
#       acrlai(s), R, Growing crop leaf area index (m^2/m^2)
#               Typical Range: 0.0 to 8.0
 0.0 0.0
#
#       adrsaitot(s), R, Residue stem area index (m^2/m^2)
#       adrlaitot(s), R, Residue leaf area index (m^2/m^2)
#                         WEPS generated input files will provide
#                         total "SAI" and "LAI" values
#                         across all residue pools.
 0.02 0.00
#
#      acxrow(s), R, Growing crop row spacing (meters)
#                     Use value of 0.0 if not planted in rows,
#                     e.g. broadcast seeded
#      ac0rg(s) , I, Specify seed location (0=furrow,1=ridge)
#                     Value doesn't matter if no ridges exist
 0.3, 0
#
#       abffcv(s), R, Flat biomass cover (m^2/m^2)
 0.0
#
#
```

Figure 17.56: Example WEPS Standalone Erosion (SWEEP input) file (pg 3 of 8).

```
#     +++ SOIL +++
#
#     nslay(s), I, (s1layr.inc) Number of soil layers (1-100)
#                 NOTE:  Only surface soil layer necessary
 1
#
#     NOTE: Remaining SOIL inputs are repeated on each input line
#           for each layer specified
#
#     aszlyt(l,s), R, Thickness (mm)
 1000.0
#
#     asdblk(l,s), R, Bulk density of soil layer (Mg/m^3)
#                 Typical Range: >0.0 to 10.0
 1.8
#     asfsan(l,s), R, Fraction of sand content in soil layer (Mg/Mg)
#                 Range: 0.0 to 1.0 (sand + silt + clay = 1.0)
 0.90
#     asfvfs(l,s), R  Fraction of very fine sand in soil layer (Mg/Mg)
#                 Range: 0.0 to 1.0 (fraction of total soil < 2.0 mm)
 0.21
#     asfsil(l,s), R, Fraction of silt content in soil layer (Mg/Mg)
#                 Range: 0.0 to 1.0 (sand + silt + clay = 1.0)
 0.08
#     asfcla(l,s), R, Fraction of clay content in soil layer (Mg/Mg)
#                 Range: 0.0 to 1.0 (sand + silt + clay = 1.0)
 0.02
#
#     asvroc(l,s), R, Rock volume in soil layer (m^3/m^3)
#                 Range: 0.0 to 1.0
 0.30
#
#     asdagd(l,s), R, Average aggregate density of soil layer (Mg/m^3)
#                 Typical Range: 0.5 to 2.5
 1.8
#     aseags(l,s), R, Average dry aggregate stability of soil layer [ln(J/kg)]
#                 Typical Range: 0.1 to 7.0
 2.50
#
#       ---- Size distribution of soil aggregates ----
#         GMD - Geometric Mean Diameter of aggregates
#         GSD - Geometric Mean Standard Deviation of aggregates
#
#     aslagm(l,s), R, GMD of aggregate sizes in soil layer (mm)
#                 Typical Range: 0.03 to 30.0
 0.47
#     aslagn(l,s), R, Minimum aggregate size in soil layer (mm)
#                 Typical Range: 0.001 to 5.0
 0.043
#     aslagx(l,s), R, Maximum aggregate size in soil layer (mm)
#                 Typical Range: 1.0 to 1000.0
 89.8
#     as0ags(l,s), R, GSD of aggregate sizes in soil layer (mm/mm)
#                 Typical Range: 1.0 to 40.0
 12.0
#
```

Figure 17.57: Example WEPS Standalone Erosion (SWEEP input) file (pg 4 of 8).

```
#     +++ SOIL SURFACE +++
#
#     asfcr(s),  R, Surface crust fraction (m^2/m^2)
#                Range: 0.0 to 1.0
#     aszcr(s),  R, Surface crust thickness (mm)
#                Typical Range: 0.0 to 23.0
#     asflos(s), R, Fraction of crusted surface with loose material on top of crust # (m^2/m^2)
#                Range: 0.0 to 1.0
#     asmlos(s), R, Mass of loose material on top of crust (kg/m^2)
#                Typical Range: 0.0 to 3.0
#     asdcr(s),  R, Density of soil crust (Mg/m^3)
#                Typical Range: 0.6 to 2.0
#     asecr(s),  R, Dry crust stability [ln(J/kg)]
#                Typical Range: 0.0 to 7.0
 0.6 7.0 0.2 0.4 0.1 1.0
#
#     aslrr(s),  R, Allmaras random roughness (mm)
#                Typical Range: 1.0 to 60.0
 5.0
#     aszrgh(s), R, Ridge height (mm)
#                Typical Range: 0.0 to 500.0
#     asxrgs(s), R, Ridge spacing (mm)
#                Typical Range: 0.0 to 2000.0
#     asxrgw(s), R, Ridge width (mm)
#                Typical Range: 0.0 to 4000.0
#     asxrgo(s), R, Ridge orientation (degrees)
#                Range: 0.0 to 179.99
#                 NOTE: If no ridges, then specify 0.0 for height, width and spacing
 0.0 0.0 0.0 0
#     asxdks(s), R, Dike spacing (mm)
#                Typical Range: 0.0 to 1000.0
#                   NOTE: If no dikes, then specify 0.0
 0.0
#
#     +++ HYDROLOGY +++
#
#     ahzsnd(s), R, Snow depth (mm)
#                Typical Range: 0.0 to 1000.0
 0.0
#
#     ahrwcw(l,s), R, Wilting point water content of soil layer (Mg/Mg)
#                Typical Range: 0.0 to 0.25
 0.077
#
#     ahrwca(l,s), R, Current water content of soil layer (Mg/Mg)
#                Typical Range: 0.0 to 0.50
 0.0
#
#
#     ahrwc0(h,s), R, Surface layer water content (Mg/Mg)
#                Typical Range: 0.0 to 0.50
#                  NOTE: The near surface water content is specified on an
#                        hourly basis.  We read in the hourly water content
#                        on two lines, with 12 values in each line.
 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0
 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0
#
#
# NOTE: This is the end of the SUBREGION variables
```

Figure 17.58: Example WEPS Standalone Erosion (SWEEP input) file (pg 5 of 8).

```
#
#     +++ WEATHER +++
#
#     awdair, R, Air density (kg/m^3)
#                Typical Range: 0.7 to 1.5
 1.2
#
#     awadir, R, Wind direction (degrees) measured clockwise from North
#                Typical Range: 0.0 to 359.9
 270.0
#
#     ntstep, I, Number of intervals/day to run EROSION
#                Range: 24 to 96
#
#                NOTE:  ntstep = 24 means hourly updates
#                       ntstep = 48 means 30 minute updating
#                       ntstep = 96 means 15 minute updating
 24
#
#     anemht, R  anemometer height (m)
#                Typical Range: 0.5 to 30.0
#     awzzo,  R  aerodynamic roughness at anemometer site (mm)
#                Typical Range: 0.5 to 2000.0
#     wzoflg, I (global variable) zo location flag
#               (flag =0 - at weather station location - zo is a constant)
#               (flag = 1 - on field location - zo varies based on field surface)
    10.0,  10.00  0
#
#     wflg, I, Wind/Weibull flag
#              (0 - read in Weibull parameters, 1 - read in wind speeds)
 1
#
# NOTE: This is only present when (wflg=0)
#     wfcalm, R, Fraction of time winds are calm (hr/hr)
#                Range: 0.0 to 1.0
#     wuc, R, Weibull "c" factor (m/s)
#                Typical Range: >0.0 to 30.0
#     w0k, R, Weibull "k" factor
#                Typical Range: 1.0 to 3.0
#  0.217 7.125 2.971  <--- Example data line for wind expressed as Weibull parameters
#
# NOTE: The remaining data is only present when (wflg=1)
#     awu(i), R, Wind speed for (ntstep) intervals (m/s)
#                Typical Range: 0.0 to 30.0
#
#                NOTE: We can read multiple lines with 6 values per line
#                      Wind data should be AVERAGES for the period.
#                      Hourly averages will often under estimate wind erosion.
#                      30 minute averages or shorter time interval is more suitable.
8.181   4.068   4.068   4.426   5.052   5.052
4.739   4.292   4.515   3.353   3.621   2.280
5.275   6.750   7.242   7.868   9.835   13.814
17.211  12.651  11.712  12.964  10.014  8.583
#
#
```

Figure 17.59: Example WEPS Standalone Erosion (SWEEP input) file (pg 6 of 8).

```
# *****************************************************
#    NOTE:  Not necessary to modify any information below this line
#           unless one is interested in generating a "plot.out" file.
# *****************************************************
#
#    + + + DATA TO PLOT + + +
#
#      "xplot" flag for writing variables to file 'tsterode.eplt'.
#       -1 = write nothing
#        0 = write erosion variables;
#      Actual variables listed below are only written if flagged with a 1
#
#      NOTE:  This flag is deprecated.  Tsterode cmdline options determine
#             if this file is create and/or data appended to it.
  0
#
#      Next are 2 lines per variable:
#       1st line: flag (0=don't write, 1=do write) and variable description
#       2nd line: this info is used as a header in 'plot.out'
#           place header within first 12 positions of the line
#
# xin(i), R, (field length)
   1
  Length(m)
# abzht, R, (biomass ht.(m))
   1
 bio_ht(m)
# abrsai, R (stem area index)
  1
 stem_area
#   abrlai(s), R, Biomass leaf area index (m^2/m^2)
  1
 lai_area
# abffcv, R, (biomass flat fraction cover)
  0
 flat_cov
#     asfvfs(1,s), R, (soil fraction very fine sand in layer 1)
  0
  vfsand
#     asfsan(1,s), R, (soil fraction sand in layer 1)
  1
   sand
#     asfsil(1,s), R (soil fraction silt in layer 1)
  0
  silt
#     asfcla(1,s), R (soil fraction clay in layer 1)
  0
  clay
#     asvoc(1,s), R (soil volume roc in layer 1)(m^3/m^3)
  0
  rock_vol
#     aseags(1,s), R (soil aggregate stability) (ln J/m^3)
  0
  ag_stab
```

Figure 17.60: Example WEPS Standalone Erosion (SWEEP input) file (pg 7 of 8).

```
#     aslagm(1,s), R (soil aggregate geom. mean dia.) (mm)
  0
  ag_gmd
#     aslagn(1,s), R (soil aggregate min. dia.) (mm)
  0
  ag_min
#     aslagx(1,s), R (soil aggregate max. dia.) (mm)
  0
  ag_max
#     as0ags(1,s), R (soil aggregate geo. std. dev.)
  0
  ag_std
#     asfcr(s), R, (s1surf.inc) Surface crust fraction (m^2/m^2)
  0
  crust_cv
#     aszcr(s), R, (s1surf.inc) Surface crust thickness (mm)
  0
 crust_z(mm)
#     asflos(s), R, (s1surf.inc) Fraction of loose material on surface (m^2/m^2)
  0
  los_cv
#     asmlos(s), R, (s1surf.inc) Mass of loose material on crust (kg/m^2)
  0
  los(kg/m^2)
#     asdcr(s), R, (s1surf.inc) Soil crust density (Mg/m^3)
  0
  cr_den(Mg/m^3)
#     asecr(s), R, (s1surf.inc) Soil crust stability ln(J/kg)
  0
  cr_se
#     aslrr(s), R, (s1sgeo.inc) Allmaras random roughness (mm)
  0
  rr(mm)
#     aszrgh(s), R, (s1sgeo.inc) Ridge height (mm)
  0
  z_rgh(mm)
#     asxrgs(s), R, (s1sgeo.inc) Ridge spacing (mm)
  0
  x_rgs(mm)
#     asxrgw(s), R, (s1sgeo.inc) Ridge width (mm)
  0
  x_rgw(mm)
#     asxrgo(s), R, (s1sgeo.inc) Ridge orientation (deg)
  0
  a_rgo(deg)
#
```

Figure 17.61: Example WEPS Standalone Erosion (SWEEP input) file (pg 8 of 8).

### 17.16.3 Stand-alone Erosion Submodel (SWEEP) Output File

Figs. 17.62 to 17.66 is an example of a stand-alone erosion submodel output file. It contains a listing of the inputs to the submodel, followed by the generated results labeled 'OUTPUT FROM ERODOUT.FOR'. This section lists the amount of total, suspension, and PM10 leaving each boundary and field grid cell. At the bottom of the file is the field average of each of these grid cells.

```
REPORT OF INPUTS (read by erodin.for)

+++ Control Flags, etc. +++

ntstep  am0eif  nsubr  nacctr  nbr am0efl
 48      T       1       1       0      1

+++ SIMULATION REGION +++

orientation and dimensions of sim region
amasim(deg)  amxsim - (x1,y1) (x2,y2)
    0.00     0.00     0.00   276.00   276.00

+++ ACCOUNTING REGIONS +++

nacctr - number of accounting regions
1
accounting region dimensions (x1,y1) (x2,y2)
    0.00     0.00   276.00   276.00

+++ BARRIERS +++

 no barriers

+++ SUBREGIONS +++

nsubr - number of subregions
1
subregion dimensions (x1,y1) (x2,y2)
    0.00     0.00   276.00   276.00

********************** Subregion  1  **********************

+++ BIOMASS +++

Biomass ht, SAI,     LAI,   flat cover
   0.000    0.000    0.000    0.000

+++ SOIL +++

nslay - number of soil layers
3

layer depth b.density vfsand   sand    silt    clay    rock vol
  1   230.00    1.05     0.14    0.22    0.71    0.08    0.00
  2   680.00    1.05     0.14    0.22    0.71    0.08    0.00
  3   610.00    1.05     0.14    0.22    0.71    0.08    0.00

layer     AgD      AgS   GMD    GMDmn    GMDmx    GSD
  1      1.87     1.00    1.64    0.01   36.73   15.13
  2      2.00     1.87    7.68    0.01   41.79   16.17
  3      2.00     1.87   30.00    0.01   70.96    9.98

Cr frac mass LOS frac.LOS, density stability
    0.00     0.00     0.00     1.87     1.87

    RR,     Rg ht,   width,  spacing,  orient.,  dike spacing
    1.50     0.00     0.00     0.00     0.00     0.00
```

Figure 17.62: Example WEPS Standalone Erosion (SWEEP output) file (pg 1 of 5).

```
+++ HYDROLOGY +++

Snow depth (mm)
0.00000000E+00

layer   wilting and actual water contents
  1      0.05      0.02
  2      0.05      0.02
  3      0.05      0.02
Hourly water contents - ahrwc0
     0.02      0.02      0.02      0.02      0.02      0.02
     0.02      0.02      0.02      0.02      0.02      0.02
     0.02      0.02      0.02      0.02      0.02      0.02
     0.02      0.02      0.02      0.02      0.02      0.02
+++ WEATHER +++

 anemht     awwzo    wzoflg
2.00000000  25.0000000  1
 wind dir (deg) and max wind speed (m/s)
  250.00    11.86

Wind speeds (m/s) -  48  intervals
     0.00      0.00      0.00      0.00      0.00      1.19
     2.76      3.47      4.00      4.44      4.84      5.20
     5.54      5.87      6.20      6.53      6.86      7.20
     7.56      7.95      8.39      8.91      9.57     10.64
    11.86     10.02      9.21      8.64      8.16      7.75
     7.38      7.03      6.69      6.36      6.04      5.71
     5.37      5.02      4.64      4.23      3.75      3.15
     2.24      0.00      0.00      0.00      0.00      0.00

END OF INPUTS
```

Figure 17.63: Example WEPS Standalone Erosion (SWEEP output) file (pg 2 of 5).

```
OUTPUT FROM ERODOUT.FOR

 Total grid size: ( 31 , 31 )   Inner grid size: ( 29 , 29 )

   Passing Border Grid Cells - Total     egt (kg/m)
   top(i=1,imax-1,j=jmax) bottom(i=1,imax-1,j=0) right(i=imax,j=1,jmax-1) left(i=0, j=1,jmax-1)
        0.72       1.98       3.58       5.51       7.90      10.63      13.56      16.56      19.55
                  22.35      24.57      26.02      26.87      27.36      27.64      27.79      27.88
                  27.92      27.95      27.96      27.97      27.98      27.98      27.98      27.98
                  27.98      27.98      27.98      27.98
        0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00
                   0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00
                   0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00
                   0.00       0.00       0.00       0.00
       13.93      37.80      59.60      70.80      74.85      76.21      76.66      76.81      76.86
                 76.87      76.88      76.88      76.88      76.88      76.88      76.88      76.88
            76.88      76.88      76.88      76.88      76.88      76.88      76.88      76.88
            76.88      76.88      76.88      76.88
        0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00
                   0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00
                   0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00
                   0.00       0.00       0.00       0.00

   Passing Border Grid Cells - Suspension      egtss (kg/m)
   top (i=1,imax-1, j=jmax) bottom (i=1,imax-1, j=0) right (i=imax, j=1,jmax-1) left (i=0, j=1,
       jmax-1)
        0.21       0.72       1.65       3.09       5.03       7.52      10.57      14.18      18.34
                  23.03      28.15      33.59      39.21      44.95      50.76      56.59      62.45
                  68.32      74.20      80.08      85.96      91.85      97.73     103.61     109.50
             115.38     121.26     127.15     133.03
        0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00
                   0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00
                   0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00
                   0.00       0.00       0.00       0.00
       10.00      33.70      67.44     105.62     144.28     181.22     215.22     245.57     271.88
            294.03     312.14     326.54     337.67     346.04     352.18     356.56     359.62
            361.70     363.09     364.00     364.58     364.95     365.17     365.31     365.39
            365.44     365.46     365.48     365.49
        0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00
                   0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00
                   0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00
                   0.00       0.00       0.00       0.00

   Passing Border Grid Cells - PM10     egt10 (kg/m)
   top (i=1,imax-1, j=jmax) bottom (i=1,imax-1, j=0) right (i=imax, j=1,jmax-1) left (i=0, j=1,
       jmax-1)
      0.0046     0.0193     0.0473     0.0912     0.1488     0.2196     0.3027     0.3977     0.5039
           0.6207     0.7463     0.8784     1.0145     1.1531     1.2931     1.4338     1.5750
           1.7164     1.8579     1.9995     2.1412     2.2828     2.4245     2.5662     2.7079
           2.8496     2.9913     3.1329     3.2746
      0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
           0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
           0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
           0.0000     0.0000     0.0000     0.0000
      0.3050     0.9706     1.8304     2.7605     3.6919     4.5786     5.3937     6.1209     6.7510
           7.2814     7.7153     8.0603     8.3271     8.5281     8.6755     8.7810     8.8547
           8.9051     8.9387     8.9607     8.9748     8.9836     8.9891     8.9924     8.9944
           8.9956     8.9963     8.9966     8.9969
      0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
           0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
           0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
           0.0000     0.0000     0.0000     0.0000
```

Figure 17.64: Example WEPS Standalone Erosion (SWEEP output) file (pg 3 of 5).

```
 Leaving Field Grid Cells - Total    egt (kg/m^2)
    -0.27      -0.51      -0.73      -0.97      -1.25      -1.51      -1.73      -1.91      -2.06
            -2.16      -2.12      -1.99      -1.87      -1.80      -1.75      -1.73      -1.72
      -1.71      -1.70      -1.70      -1.70      -1.70      -1.70      -1.70      -1.70
      -1.70      -1.70      -1.70      -1.70
    -0.27      -0.51      -0.73      -0.97      -1.25      -1.51      -1.73      -1.91      -2.06
            -2.16      -2.12      -1.99      -1.87      -1.80      -1.75      -1.73      -1.72
      -1.71      -1.70      -1.70      -1.70      -1.70      -1.70      -1.70      -1.70
      -1.70      -1.70      -1.70      -1.70
    -0.27      -0.51      -0.73      -0.97      -1.25      -1.51      -1.73      -1.91      -2.06
            -2.16      -2.12      -1.99      -1.87      -1.80      -1.75      -1.73      -1.72
      -1.71      -1.70      -1.70      -1.70      -1.70      -1.70      -1.70      -1.70
      -1.70      -1.70      -1.70      -1.70
    -0.27      -0.51      -0.73      -0.97      -1.25      -1.51      -1.73      -1.91      -2.06
            -2.16      -2.12      -1.99      -1.87      -1.80      -1.75      -1.73      -1.72
      -1.71      -1.70      -1.70      -1.70      -1.70      -1.70      -1.70      -1.70
      -1.70      -1.70      -1.70      -1.70
    -0.27      -0.51      -0.73      -0.97      -1.25      -1.51      -1.73      -1.91      -2.06
            -2.16      -2.12      -1.99      -1.87      -1.80      -1.75      -1.73      -1.72
      -1.71      -1.70      -1.70      -1.70      -1.70      -1.70      -1.70      -1.70
      -1.70      -1.70      -1.70      -1.70
    -0.27      -0.51      -0.73      -0.97      -1.25      -1.51      -1.73      -1.91      -2.06
            -2.16      -2.12      -1.99      -1.87      -1.80      -1.75      -1.73      -1.72
      -1.71      -1.70      -1.70      -1.70      -1.70      -1.70      -1.70      -1.70
      -1.70      -1.70      -1.70      -1.70
    -0.27      -0.51      -0.73      -0.97      -1.25      -1.51      -1.73      -1.91      -2.06
            -2.16      -2.12      -1.99      -1.87      -1.80      -1.75      -1.73      -1.72
      -1.71      -1.70      -1.70      -1.70      -1.70      -1.70      -1.70      -1.70
      -1.70      -1.70      -1.70      -1.70
    -0.27      -0.51      -0.73      -0.97      -1.25      -1.51      -1.73      -1.91      -2.06
            -2.16      -2.12      -1.99      -1.87      -1.80      -1.75      -1.73      -1.72
      -1.71      -1.70      -1.70      -1.70      -1.70      -1.70      -1.70      -1.70
      -1.70      -1.70      -1.70      -1.70
    -0.27      -0.51      -0.73      -0.97      -1.25      -1.51      -1.73      -1.91      -2.06
            -2.16      -2.12      -1.99      -1.87      -1.80      -1.75      -1.73      -1.72
      -1.71      -1.70      -1.70      -1.70      -1.70      -1.70      -1.70      -1.70
      -1.70      -1.70      -1.70      -1.70
    -0.27      -0.51      -0.73      -0.97      -1.25      -1.51      -1.73      -1.91      -2.06
            -2.16      -2.12      -1.99      -1.87      -1.80      -1.75      -1.73      -1.72
      -1.71      -1.70      -1.70      -1.70      -1.70      -1.70      -1.70      -1.70
      -1.70      -1.70      -1.70      -1.70
    -0.27      -0.51      -0.73      -0.97      -1.25      -1.51      -1.73      -1.91      -2.06
            -2.16      -2.12      -1.99      -1.87      -1.80      -1.75      -1.73      -1.72
      -1.71      -1.70      -1.70      -1.70      -1.70      -1.70      -1.70      -1.70
      -1.70      -1.70      -1.70      -1.70
    -0.27      -0.51      -0.73      -0.97      -1.25      -1.51      -1.73      -1.91      -2.06
            -2.16      -2.12      -1.99      -1.87      -1.80      -1.75      -1.73      -1.72
      -1.71      -1.70      -1.70      -1.70      -1.70      -1.70      -1.70      -1.70
      -1.70      -1.70      -1.70      -1.70
    -0.27      -0.51      -0.73      -0.97      -1.25      -1.51      -1.73      -1.91      -2.06
            -2.16      -2.12      -1.99      -1.87      -1.80      -1.75      -1.73      -1.72
      -1.71      -1.70      -1.70      -1.70      -1.70      -1.70      -1.70      -1.70
      -1.70      -1.70      -1.70      -1.70
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                  .          .          .          .
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```

Figure 17.65: Example WEPS Standalone Erosion (SWEEP output) file (pg 4 of 5).

```

  Leaving Field Grid Cells - Suspension     egtss (kg/m^2)
     -0.06     -0.15     -0.27     -0.41     -0.56     -0.72     -0.88     -1.04     -1.20
             -1.35     -1.48     -1.57     -1.62     -1.66     -1.68     -1.69     -1.69
         -1.69     -1.70     -1.70     -1.70     -1.70     -1.70     -1.70     -1.70
         -1.70     -1.70     -1.70     -1.70
     -0.06     -0.15     -0.27     -0.41     -0.56     -0.72     -0.88     -1.04     -1.20
             -1.35     -1.48     -1.57     -1.62     -1.66     -1.68     -1.69     -1.69
         -1.69     -1.70     -1.70     -1.70     -1.70     -1.70     -1.70     -1.70
         -1.70     -1.70     -1.70     -1.70
     -0.06     -0.15     -0.27     -0.41     -0.56     -0.72     -0.88     -1.04     -1.20
             -1.35     -1.48     -1.57     -1.62     -1.66     -1.68     -1.69     -1.69
         -1.69     -1.70     -1.70     -1.70     -1.70     -1.70     -1.70     -1.70
         -1.70     -1.70     -1.70     -1.70
       .         .         .         .         .         .         .         .         .
                   .         .         .         .         .         .         .         .
                   .         .         .         .         .         .         .         .
                   .         .         .         .
       .
       .

  Leaving Field Grid Cells - PM10    egt10 (kg/m^2)
   -0.0013   -0.0043   -0.0081   -0.0127   -0.0166   -0.0204   -0.0240   -0.0274   -0.0307
       -0.0337   -0.0363   -0.0381   -0.0393   -0.0400   -0.0404   -0.0406   -0.0408
       -0.0408   -0.0409   -0.0409   -0.0409   -0.0409   -0.0409   -0.0409   -0.0409
       -0.0409   -0.0409   -0.0409   -0.0409
   -0.0013   -0.0043   -0.0081   -0.0127   -0.0166   -0.0204   -0.0240   -0.0274   -0.0307
       -0.0337   -0.0363   -0.0381   -0.0393   -0.0400   -0.0404   -0.0406   -0.0408
       -0.0408   -0.0409   -0.0409   -0.0409   -0.0409   -0.0409   -0.0409   -0.0409
       -0.0409   -0.0409   -0.0409   -0.0409
   -0.0013   -0.0043   -0.0081   -0.0127   -0.0166   -0.0204   -0.0240   -0.0274   -0.0307
       -0.0337   -0.0363   -0.0381   -0.0393   -0.0400   -0.0404   -0.0406   -0.0408
       -0.0408   -0.0409   -0.0409   -0.0409   -0.0409   -0.0409   -0.0409   -0.0409
       -0.0409   -0.0409   -0.0409   -0.0409
     .         .         .         .         .         .         .         .         .
                 .         .         .         .         .         .         .         .
                 .         .         .         .         .         .         .         .
                 .         .         .         .
     .
     .

**Averages - Field
     Total     salt/creep      susp       PM10
     egt                       egtss      egt10
   ----------------kg/m^2-------------------
     -1.58       -0.34       -1.24     -0.0308

**Averages - Crossing Boundaries
Location        Total      Suspension      PM10
-------------------kg/m-------------------
top             21.59        55.45         1.39
bottom           0.00         0.00         0.00
right           72.45       287.44         7.12
left             0.00         0.00         0.00

   Comparision of interior & boundary loss
      interior       boundary     int/bnd ratio
   -120593.77       120593.91            -1.00

repeat of total, salt/creep, susp, PM10:      1.58      0.34      1.24     0.0308
```

Figure 17.66: Example WEPS Standalone Erosion (SWEEP output) file (pg 5 of 5).

## 17.17 References

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# 18. Using WEPS In Conservation Planning

## 18.1 Interpreting Outputs

**We need to provide more info for this section here - LEW**

Interpreting outputs of WEPS is an important part of controlling wind erosion through conservation planning. By observing how the soil loss is affected by weather and field conditions, the management operations can be adjusted to reduce soil loss. In developing new conservation plans, the user should build or modify several different scenarios and compare outputs to determine the best management to control wind erosion. Existing or current field conditions should be evaluated to determine if an erosion problem exists.

## 18.2 Tabular Detail Report

The Tabular Detail Report screen (Fig. 18.1) is a date ordered list of parameters generated by the WEPS model. The Tabular Detail Report can be accessed by clicking the Tablular Detail Report button on the Main or Run Summary screens as well as through the ViewOutput menu. At the top of the Tabular Detail Report window is a button bar that allows the user to close the window Close, print the data, or view other summary reports via the toolbar buttons.

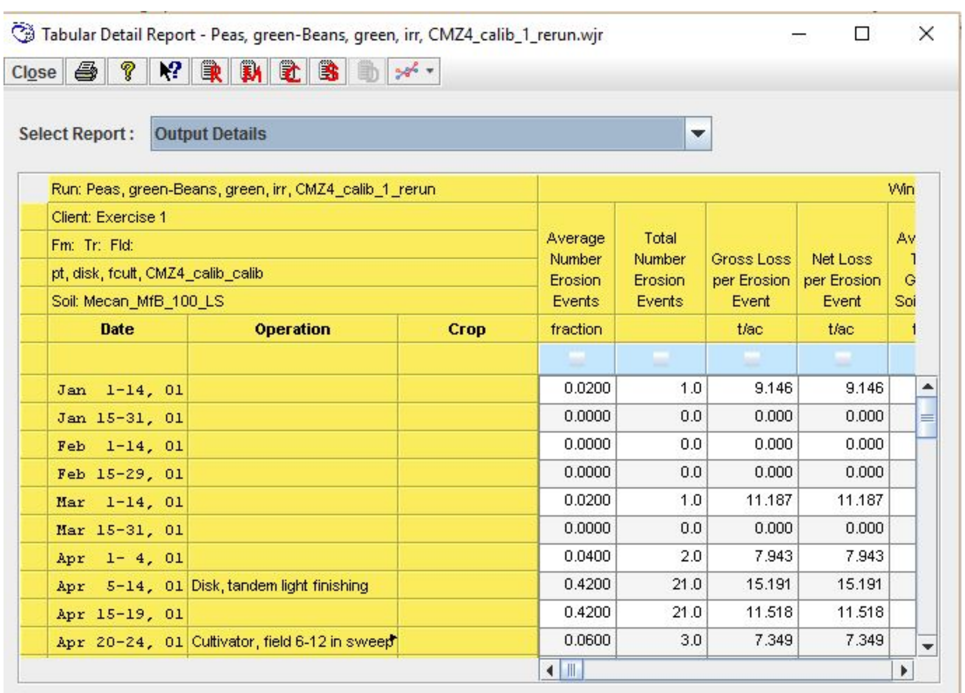



Figure 18.1: Tabular Detail Report window.

Since this report contains large amounts of information, a method is provided to select smaller portions of information to view. Below the menu bar is a drop down list labeled **Select Report**.

Clicking the down arrow to the right displays a list of reports that are subsets of all data available. This allows the user to pick a smaller, easier to view, subset of the complete report. The **Output Details** is the most comprehensive report and is displayed by default for most WEPS configurations. Note that the NRCS configured version of WEPS defaults to the **Erosion & Crop Veg, Res & Biomass (details)** report.

The following section outlines the content of the Output Details portion of the Detail Reports screen and describes how they can be used to interpret results and design management systems to control erosion by wind. The WEPS User Guide section titled "Interface Reference: Output" contains the definition of each row and column in the Tabular Detail report.

### 18.2.1 Date

This column contains the start and end date of the period for which the row information is reported (start day-end day, month, rotation year). Items in each row represent values from the end of the previous period to the current date (unless the parameter only makes sense for a specific date, then it represents the value on the ending date). The date column, along with soil loss, will indicate which periods have the greatest wind erosion and are thus in need of changes of management to control wind erosion.

The number of **rows** in the Output Details screen differ, depending on the number of cropping years in the rotation and the number of management operations in each year of the rotation. Each year of the rotation has regular output displayed for either fifteen day periods (1st of month to 14th and 15th to the end of the month) or from the date of an operation to the end of the regular period. Occasional reporting from the date of a management operation are reported since operations can change field conditions. This output allows the user to view the erosion and other output for each year of the rotation. At the end of each year in the rotation is a row that contains the average annual value for that rotation year. The last row in the output form contains the average annual values for the complete crop rotation.

### 18.2.2 Operation

This column contains the management operation that occurred on the specified date (start date of the listed period). It is the management operation or the date of operation that most users will modify to affect field conditions and thus wind erosion.

### 18.2.3 Crop

This column lists the name of the crop planted on the date shown (start date of the listed period). Crop is another choice the land manager may change to control wind erosion. Crops that produce substantial residue (e.g., corn or small grain) will tend to lower the erosion rate if the residue is managed properly.

### 18.2.4 Wind Erosion

The Wind Erosion columns provide a summary of all the wind erosion soil loss for the simulation run. The numbers in these columns are those that the user will try to affect by adjusting management dates and operations. If an erosion event occurred, but values generated by the model are too small to be displayed on the output table (i.e., $>$ 0.001 kg/m$^2$ or 0.00455 tons/acre), then the amount is listed as "trace". If amounts are too large to be accurately displayed then, the amount is listed simply as greater than a specified amount (i.e., $>$ 300 kg/m$^2$ or 1338 tons/acre). In these cases, erosion amounts are so large that they are generally considered unacceptable. The simulated absolute values are usually not relevant in such scenarios anyway (the model's accuracy is also questionable at these high erosion rates because they are outside the erosion levels the model has been validated against).

- <u>Number and Loss per Erosion Event</u> – These columns give the user an indication of the frequency and severity of erosion events. Some periods will have numerous events while others may have one, or even none. One event may have severe erosion while many others may have only slight erosion totaling less erosion than another single event.
- <u>Average Total Gross Soil Loss</u> – This column contain the gross erosion within the field, averaged across the field, as well as averaged over the number of simulation years in each rotation year (kg/m$^2$ or tons/acre).
- <u>Net Soil Loss from Field</u> – These columns contain net soil loss from the field averaged over the number of simulation years in each rotation year (kg/m2 or tons/acre). Some deposition within a field can occur, especially when barriers are present downwind. Net soil loss is the amount of gross loss minus deposition. **Average Total** is the average total net loss from the field, **Average Creep and Saltation** is the average creep plus saltation net

loss from the field, **Average Suspension** is the average suspension net loss from the field, and **Average PM10** is the average PM10 (particulate matter less than 10 microns) net loss from the field.

### 18.2.5 Mass Passing Indicated Field Boundary

These columns contain the mass per unit length of various-sized material that passed the field boundary for each direction (kg/m or tons/1000 ft). This information is useful in determining how much material is leaving the field in each direction. For the **Creep+Saltation** size, the material will most likely be deposited on the field boundary, such as a stream, fence, ditch, or road. If deposited in a ditch, subsequent rainfall may wash the material into waterways, where it can affect water quality. If deposited on a roadway, the roadway will likely need to be cleared. For **Suspension** and **PM10** sizes, the material may travel great distances, affecting air quality and possibly visibility, especially on nearby roadways. The material passing each boundary may indicate that barriers may be needed on the opposite or upwind side of the field to control wind erosion. The direction of soil loss may also indicate a needed change in the direction of tillage.

### 18.2.6 Within Field Wind Erosion Activity

The information in these columns is useful in determining how much of the field is actively eroding and how much is not, which may impact what control measures, if any, should be applied and where. This information is also useful in understanding to what extent the field is actively eroding and thus causing plant or soil damage, or how much is subject to burial. Finally, this information is useful in understanding how much of the field is contributing to overall (net) field loss. Acres indicate the size of the eroding area and the fraction is the proportion of the field eroding.

### 18.2.7 Weather Information

The Weather columns provide a summary of some of the weather information for the simulation run and help the user understand which periods are erosive and why.

- Average Total Precip. – This column contains the total precipitation for the period, averaged over the simulation years in each year of the crop rotation (mm or inches). This section is useful in determining how precipitation amounts may be affecting biomass production as well as residue and surface roughness decay.
- Average Wind Energy $>$ 8m/s (18 miles/hour) – This column contains the average daily wind energy for the period for winds greater than 8 m/s ( 18 mph), averaged over the simulation years in each year of the crop rotation (KJ/day). This will indicate which periods have the most erosive winds.
- Snow Depth $>$ 20 mm ( 0.75 in) – Fractions of the field covered with snow greater than 20 mm ( 0.75 in) deep are considered non-erodible.

### 18.2.8 Crop and Soil Water Information

The Crop and Soil Water columns provide a summary of important crop and soil water data for the simulation and help the user understand the amount of water available during specific periods and where it is going (crop growth, storage, runoff, etc.).

- Irrigation – This column provides the amount of irrigation water applied during the specified period in mm or inches.
- Runoff and Drainage – These columns provide the amounts of water lost due to surface runoff and drainage for the specified period in mm or inches. Reducing these losses usually will result in higher yields and biomass crop production, which tends to reduce a field's susceptibility to wind erosion if managed correctly.
- Soil Water – This column provides the amount water stored in the soil at the end of the specified period in mm or inches. The amount of stored water available during the crop growing season affects a crop's susceptibility to droughty conditions.
- Soil Water – This column provides the amount water stored in the soil at the end of the specified period in mm or inches. The amount of stored water available during the crop growing season affects a crop's susceptibility to droughty conditions.
- Soil Surface Evaporation – This column provides the amount of water lost to evaporation for the specified period in mm or inches. Reducing the amount of surface evaporation, for example with additional residue retained on

the surface, will usually mean more water for the crop and thus, indirectly reduce wind erosion susceptibility.

- Plant Transpiration – This column provides the amount of water that has transpired in the growing crop for the specified period in mm or inches.

### 18.2.9 Average Biomass Surface Conditions on Date

The Average Surface Biomass Conditions on Date columns provide a summary of average surface conditions, including crop biomass and soil roughness, for the simulation run on the ending date of the period.

- Crop Vegetation (Live) – These columns provide information on the structural configuration of live growing biomass. By observing the canopy cover, the standing silhouette area index, and the above-ground mass, the user can determine which periods are not providing sufficient cover to control wind erosion.
- Crop Residue (Dead) – These columns provide information on the structural configuration of dead biomass or residue. By observing the flat cover, the standing silhouette area index, the flat mass, and the standing mass, the user can determine which periods are not providing sufficient residue cover to control wind erosion.
- Live and Dead Biomass – These columns provide information on the structural configuration of both the live growing biomass and the dead biomass or residue. By observing the flat cover, the standing silhouette area index, the flat mass, and the standing mass, the user can determine which periods are not providing sufficient cover to control wind erosion.

### 18.2.10 Average Soil Surface Conditions on Date

The Average Soil Surface Conditions on Date columns provide a summary of average soil surface conditions for the simulation run on the ending date of the period.

- Roughness – For cropping systems that do not produce sufficient residue for erosion control (e.g., cotton and most vegetable crops), roughness management is often used to reduce wind surface friction velocity at the soil surface. This reduces the amount of soil detachment and transport and increases deposition and thus reduces soil loss.
  - *Oriented Roughness* – Oriented roughness is also known as ridge roughness. These columns refer to regularly spaced roughness elements caused by tillage implements such as ridges, furrows and dikes. Ridge orientation, width, and height may be adjusted for periods of high soil loss to determine its effect on wind erosion. The user can also follow the roughness decay over time as a result of rainfall or wind erosion.
  - *Random Roughness* – This column contains soil surface random roughness, defined as the standard deviation of the elevation from a plane across a tilled area. Random roughness does not take into account oriented roughness. Random roughness is the value at the period end, averaged over the simulation years in each rotation year (inches or mm). Random roughness is primarily the result of aggregate size distribution, but is also affected by various types of tillage tools. Random roughness values for typical field operations are listed in Table 15.1. Photographs (Figure 15.2 through Figure 15.10) can be used as a guide to determine relative random roughness values. These photos were taken at an oblique angle to provide an image similar to that seen by an observer standing a few feet from the plot.
- Aggregation – Soil aggregate size and aggregate dry stability affect erosion by wind. Soil aggregates less than 0.84 mm (0.03 inches) in diameter are generally considered to be erodible and so the higher the fraction of aggregates $< 0.84$mm, the more erodible the surface. Dry stability is related to abrasion resistance where harder, more stable aggregates result in a lower erodibility of the soil. The larger the dry stability value ($\ln(J/m^2)$), the more resistant the aggregates to abrasion and erosion by wind.
- Crust Cover – A soil crust will resist abrasion and erosion more than a loose, finely divided soil surface. In general, the more of the surface is covered by a crust, the less erosion occurs. Crusts are transient and generally represent a degraded soil quality, and therefore, crusts should not be relied upon to control erosion by wind. But a greater crust cover may explain a lesser erosion amount that would normally be expected.

| Field Operations | Random Roughness (inches) | Field Operations | Random Roughness (inches) |
|---|---|---|---|
| Chisel, sweeps | 1.2 | Fertilizer applicator, anhydrous knife | 0.6 |
| Chisel, straight point | 1.5 | Harrow, spike | 0.4 |
| Chisel, twisted shovels | 1.9 | Harrow, tine | 0.4 |
| Cultivator, field | 0.7 | Lister | 0.8 |
| Cultivator, row | 0.7 | Manure injector | 1.5 |
| Cultivator, ridge till | 0.7 | Moldboard plow | 1.9 |
| Disk, 1-way | 1.2 | Mulch threader | 0.4 |
| Disk, heavy plowing | 1.9 | Planter, no-till | 0.4 |
| Disk, Tandem | 0.8 | Planter, row | 0.4 |
| Drill, double disk | 0.4 | Rodweeder | 0.4 |
| Drill, deep furrow | 0.5 | Rotary hoe | 0.4 |
| Drill, no-till | 0.4 | Vee ripper | 1.2 |
| Drill, no-till into sod | 0.3 | | |

Table 18.1: Random roughness values for typical management operations, based on a silt loam soil (from USDA Agriculture Handbook 537 and National Agronomy Manual 703, Table 5-5).


Figure 18.2: Random roughness of 0.25 inches (6mm).


Figure 18.3: Random roughness of 0.40 inches (10 mm).


Figure 18.4: Random roughness of 0.65 inches (17 mm).


Figure 18.5: Random roughness of 0.75 inches (19 mm).


Figure 18.6: Random roughness of 0.85 inches (22 mm).


Figure 18.7: Random roughness of 1.05 inches (27 mm).


Figure 18.8: Random roughness of 1.60 inches (41 mm).


Figure 18.9: Random roughness of 1.70 inches (43 mm).


Figure 18.10: Random roughness of 2.15 inches (55 mm).

## 18.3 Special Field Configurations

Although WEPS 1.3.9 is designed to simulate rectangular field shapes, special field configurations such as circles or strip cropping can be simulated. By manipulating the field shape to represent a field with the same area and rotating the field along, with any barriers, many field shapes can be approximated.

### 18.3.1 Circular Fields

A circular field can be simulated by selecting a field shape **Circle** in the Simulation Region Information panel. Note that the circle is approximated within WEPS as a square field with an area equal to that specified in the Simulation Region Information panel. The Field View panel displays an approximate inscribed circle within the simulated rectangular field (Fig. 18.11). When a circular field is selected, the field described in the Simulation Region Information panel has an area equal to that of the simulated rectangular field. For such fields, barriers should be added and the field rotated to best approximate the actual field configuration.

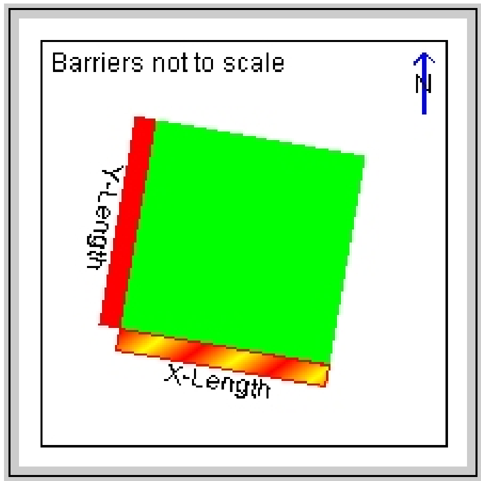



Figure 18.11: Example of the Field View panel for a circular field.

### 18.3.2 Irregular Field Shapes

Half circles can also be simulated by selecting **Half Circle** in the Simulation Region Information panel. A half circle is approximated within WEPS as a rectangular field with an area equal to that specified in the Simulation Region Information panel. The Field View panel displays an approximate inscribed half circle within the simulated rectangular field (Fig. 18.12). To simulate an irregular field shape such as a field along a stream, select the shape in Simulation Region Information panel that most represents the shape of the actual field with the same area.

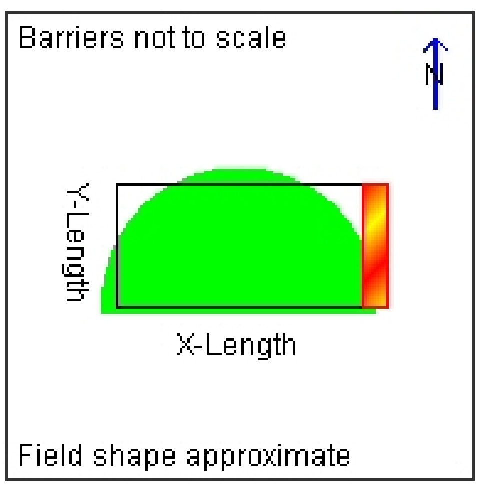



Figure 18.12: Example of the Field View panel for a half circle field.

### 18.3.3 Strip Cropping

Fields managed for wind erosion control by strip cropping in WEPS 1.5 are simulated as linear strips, with each strip of unique management as an individual rectangular field and the erosion losses for each unique strip multiplied by the number of those strips (for suspension and PM10 loss only). A tract of land where strips are installed ideally will have strips with the long side perpendicular to prevailing winds. They will also be of equal width across the field, thus allowing for the shortest width of the field against the most erosive winds. The field will usually be re-sized down to the strip width that a producer agrees with and accommodates the width(s) of his equipment. Multiple simulations can be run to demonstrate the effect of different strip widths for evaluation purposes. We can change the strip width and length by just typing in the field dimensions. See the Interface Reference section "How To Guide: Barriers" for more details on adding and modifying field barriers. Fig. 18.13 illustrates a field layout for simulating strip cropping with grass barriers.

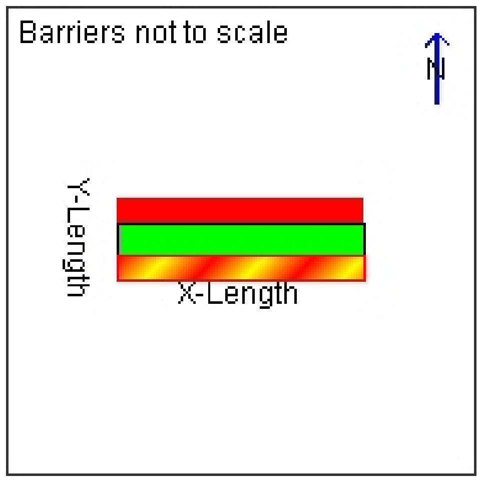



Figure 18.13: Example of the Field View panel for simulating strip cropping with grass barriers.

### 18.3.4 Tillage Direction

WEPS 1.5 only allows tillage in one direction, typically parallel to the field border (e.g., Northwest/Southeast for a field oriented in that direction). Observing the effects that tillage direction may have for a particular simulation may illustrate the need to alter tillage directions in the actual field to control wind erosion. Multiple tillage directions for an individual field, such as the operator tilling parallel to each border of the field in a spiraling pattern, or a circular tillage pattern on circular fields, cannot be directly simulated with WEPS 1.5. However, wind erosion on fields with tillage parallel to each border can be estimated by averaging outputs from two runs. Each run should be made with tillage direction perpendicular to each other and the results averaged.

## 18.4 Using Barriers for Erosion Control in WEPS

Using WEPS, we can quickly determine the field edge where the greatest amount of eroded soil is leaving the field. In most cases, a field windbreak would be most effective on the upwind side of this field.

Wind barriers in WEPS include any structure designed to reduce the wind speed on the downwind side of the barrier. Barriers trap moving soil and reduce abrasion of the downwind immobile clods, crusts, and residues along the prevailing wind erosion direction. Barriers include, but are not limited to, linear plantings of single or multiple rows of trees, shrubs, or grasses established for wind erosion control, crop protection, and snow management. Snow fences, board walls, bamboo and willow fences, earthen banks, hand-inserted straw rows, and rock walls have also been used as barriers for wind erosion control in limited situations. Barriers also reduce evapotranspiration, shelter livestock, and provide wildlife habitat. One advantage of barriers over most other types of wind erosion control is they are relatively permanent. During drought years, barriers (excepting annual types) may be the only effective and persistent control measure on crop land. Annual barriers such as small grain or corn are used primarily to provide temporary protection during the most critical wind erosion period and can be removed and replaced every year. Barriers can also be used in sand dune areas to aid the initial stabilization of the areas while grass and trees are being established.

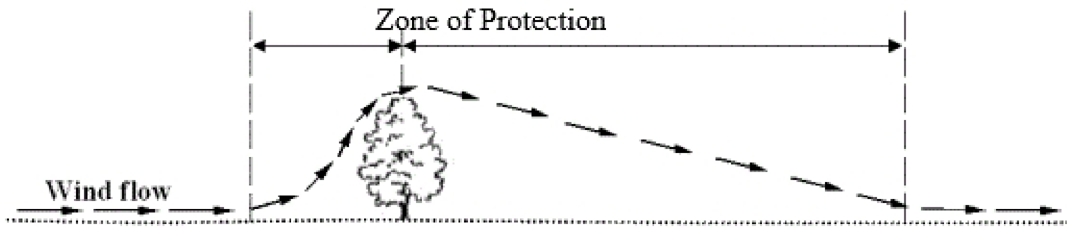



Figure 18.14: Diagram showing wind flow pattern over a barrier.

Barriers primarily alter the effect of the wind force on the soil surface by reducing wind speed on the downwind side of the barrier but also reduce wind speed to a lesser extent upwind of the barrier (Fig. 18.14). Research has shown that barriers significantly reduce wind speed downwind, sheltering a portion of the field from erosion and, in effect, reducing the field length along the erosive wind direction. The protected zone of any barrier diminishes as porosity increases however, and is reduced significantly when barrier porosity exceeds 60 percent. Protection is also reduced as wind velocity increases, but the protected area diminishes as the wind direction deviates from the perpendicular to the barrier. Various types of barriers are used for wind erosion control in WEPS 1.5. The WEPS interface provides a method of selecting from a list of barriers to place on the field and editing the barrier properties. The user can also modify properties in the barrier database that appear in the drop-down list. Each of these properties are described here:

- **Length** – The length of a barrier is defined by field length along the border on which the barrier is placed.
- **Width** – The width of a barrier is defined as the distance from one side of the barrier to the other, in the units of measure displayed on the screen (feet or meters) (Fig. 18.15). For a single-row wind barrier, the width is equal to the diameter of the tree, shrub, or grass; for artificial barriers, it is the thickness of the material (e.g. slat fence). This is illustrated as "a" in (Fig. 18.15). For multiple-row barriers, the width is the distance from one side of the barrier to the other as illustrated by "b" in (Fig. 18.15).

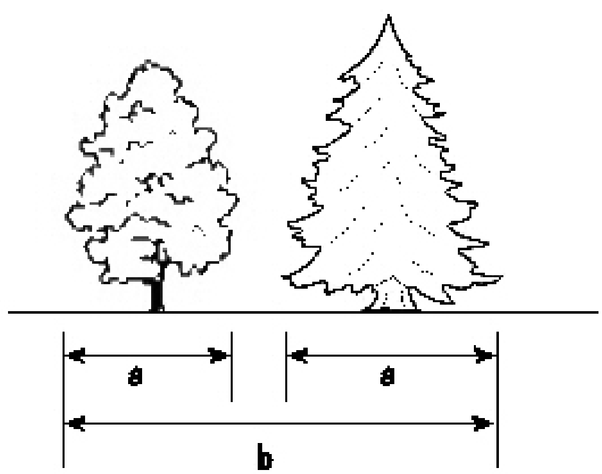



Figure 18.15: Barrier width for single (a) and multiple (b) row barriers.

- **Height** – The height of a barrier is the average height of individual elements (e.g., trees) in the barrier ("a" in Fig. 18.16 for single-row barriers). The units of measure for barrier height are displayed on the input screen in feet or meters. For multiple-row barriers, use the height of the tallest barrier row ("b" in Figure Fig. 18.16).

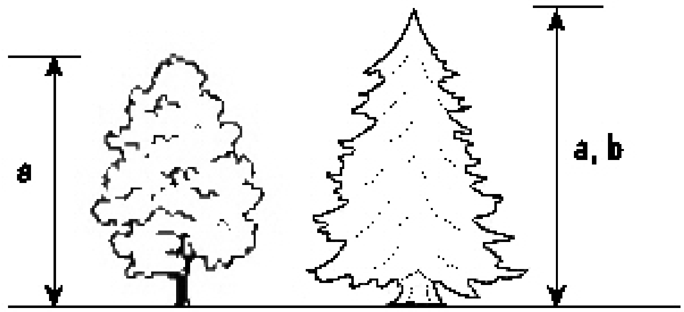



Figure 18.16: Barrier height for single (a) and multiple (b) row barriers.

- **Area** – The area of the barrier is calculated from the barrier width and length (i.e., barrier width x field length). This is not an editable item, but is calculated within WEPS 1.5.

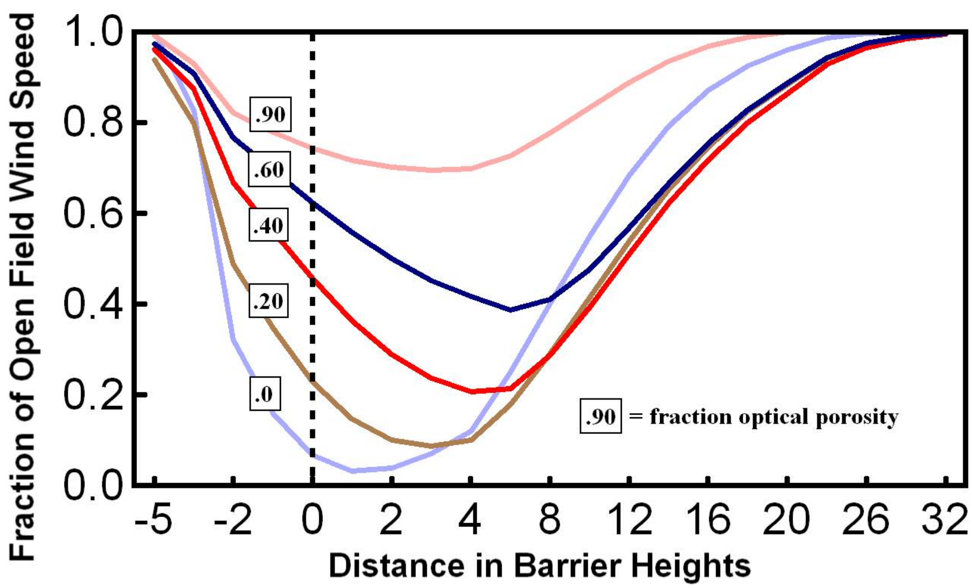



Figure 18.17: Effect of the fraction of optical porosity on near-surface wind speed along the wind direction relative to barrier.

- **Porosity** – Barrier porosity is defined as the total optical porosity of all rows in the barrier. It is the open space (i.e., absence of leaves and stems) as viewed looking perpendicular to the barrier, expressed as a percentage of the total area, i.e., (1.0 - silhouette area) x 100. WEPS 1.5 does not "grow" living barriers. Barriers in WEPS do not increase or decrease porosity with leaf growth and leaf drop (senescence) throughout the year, nor do they increase in size from one year to the next. As such, the porosity of barriers in WEPS does not change with the seasons nor from year to year. Therefore the user should input the porosity of the barrier that is present when the erosion hazard is the greatest. Fig. 18.17 illustrates the effect of porosity on the near-surface wind speed relative to an open field without a barrier (see also Fig. 18.16). The "Distance in Barrier Heights" refers to the distance from the barrier at distance 0, measured in multiples of the barrier height.

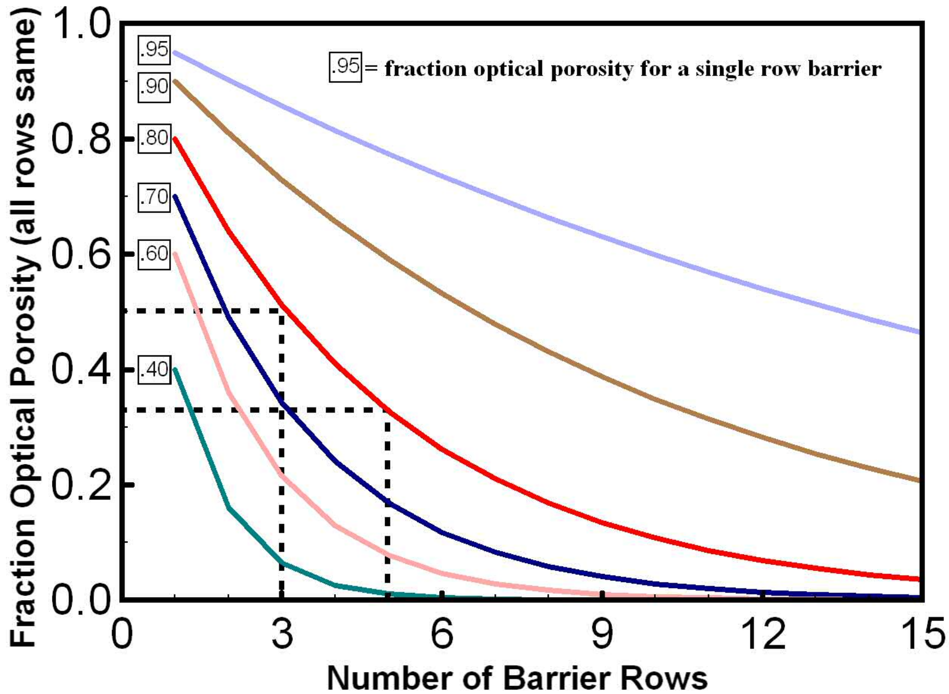



Figure 18.18: Effect of number of barrier rows on optical porosity where all barrier rows are the same.

At times, it is most efficient to estimate optical porosity for a single row, particularly for crop barriers. Then, for multiple-row barriers, the optical porosity decreases for the entire barrier as illustrated in Fig. 18.16. For example, a single row of corn has an optical porosity of 0.80. Three rows of corn have an optical porosity of 0.50, and five rows of corn have an optical porosity of 0.33.

## 18.5 Evaluating Wind Erosion Problems with WEPS

These exercises are designed to provide the user with step-by-step examples of some common tasks performed with the Wind Erosion Prediction System (WEPS) model. These exercises cover many topics, including basic model operation, file management, and building and editing field management rotations within the Management/Crop Rotation Editor of WEPS (MCREW). The focus of the exercises should be on learning to use WEPS for conservation planning.

The training scenarios use a variety of locations in the United States, as well as various crops, with the intention of building the users' proficiency to apply WEPS in many regions for different crops. Therefore, new users are encouraged to complete all the exercises regardless of location and crop in the scenario. Since WEPS is continually being improved and its parameters modified, the results you get may not exactly match those reported in the exercises. This is to be expected.

As the WEPS model finishes a given run, it may sometimes display a **warning message** that one or more of the crops simulated did not reach maturity prior to harvest (Fig. 18.19). This is not uncommon, especially for crops that are harvested before reaching maturity such as forage crops. However, this can also often occur if the user has selected a management template developed for a significantly different climatic zone than the location it is being used in. Since WEPS after harvest residue results are dependent upon crop yields, which often influence the wind erosion simulation results, it provides a quick check for the user that has not properly vetted his management rotation file for the conditions and location he is using it in.

If such a message is obtained, click "OK" to complete the run. If most of the year's crops reach about 95% maturity the run is OK to use. However, if many of the years are reporting crops with a value less than 95%, check to make sure planting and harvesting dates for the crop are as expected for the location being simulated. If it still does not reach 95%, NRCS users contact the Natural Resources Conservation Service (NRCS) Database Manager or NRCS Wind

Erosion Specialist. All other users should submit a Mantis ticket with a copy of the WEPS Run attached and a note about what the issue is. The user should always attempt to resolve such maturity issues for crops that are harvested prior to reaching maturity, if those crops are normally expected to reach maturity prior to harvest.

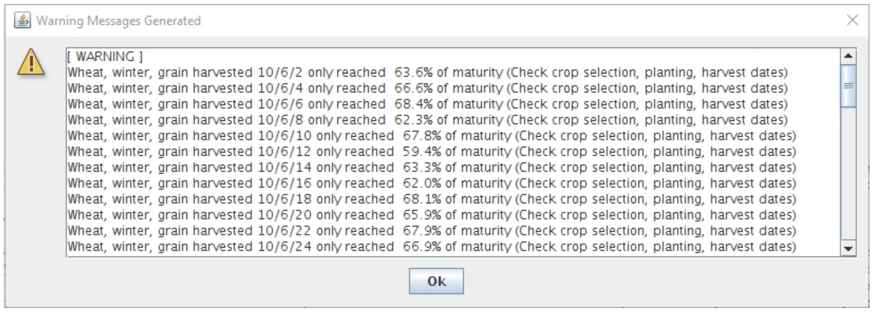



Figure 18.19: WEPS Warning Messages Generated window displaying warning messages about crop not reaching maturity.

## 18.6 Definitions and Considerations

### 18.6.1 Projects and Runs

A **WEPS Project** is a directory that can be thought of as a working area where WEPS simulation runs are created. The standard location for the Project.wpj is C:\Users\user.name\Documents\My WEPS Files\Project.wpj, where user.name refers to the user's login name on the computer. This default location applies to NRCS Field Office configured versions of WEPS running Windows 7. Other WEPS configurations and operating systems may vary as to the location of this directory. The Project directory stores all the parameters and files for the current simulation run being prepared within the WEPS interface, as well as any files used in the past for previous runs. For example, the Project will contain soils .ifc files and management .man files. The users should make it a habit to "clean out" those files when they are no longer needed. This is done by clicking the File menu on the main interface and selecting the appropriate delete functions.

A WEPS Run refers to a single simulation of a field with all associated input and output files. Each run is stored in a separate folder or subdirectory which by default is located under the current WEPS run directory. It is located at C:\user.name\Documents\My WEPS Files\Runs. Again, this default location applies to NRCS Field Office configured versions of WEPS running Microsoft Windows 7. Other WEPS configurations and operating systems may vary as to the location of this directory. A WEPS run subdirectory stores a copy of all input files used to make the simulation run, together with the output files generated from those inputs. Thus, one is able to recall the identical WEPS run at a later date (and get the same outputs when using the same version of WEPS 1.5 and the weather generators/databases) because the original input files are still available. Typically, "re-running" a previous run is not necessary since the outputs are stored in the Run directory and can be reviewed via the "ViewOutput" menu options. However, if additional outputs not generated with the original run are desired, it will be necessary to load the previous run and re-run it using the desired output options.

The Run directories make it relatively easy to archive or remove WEPS runs as alternative erosion planning scenarios are tested for a field or farm. For example, if a change is made to create a different management alternative, all the information pertaining to this new scenario will be saved to a new subdirectory under a new WEPS Run name, when the simulation is made. These Run directory files can also be sent to another location using the "Export Run" option under the "File" or "Project" menu on the main interface.

### 18.6.2 Naming WEPS Files

Naming of all runs and files in WEPS should be considered carefully. Management or run names should be long enough to uniquely describe them but not so long so that the name is difficult to view in file chooser windows. Some special characters are not allowed in file or directory names used in WEPS. Known characters not allowed or recommended include: @ ? ' | & > < / \ ∼ : * "

### 18.6.3 WEPS Templates

A **Template** is a pre-built management rotation file operation file or crop file. **Management templates** are accessible through the Management Template folder. For NRCS configured versions of WEPS running Microsoft Windows 7, they are located here:

*C:\Program Data\USDA\WEPS\Databases\nrcs\man*

Other WEPS configurations and operating systems may vary as to the location of this directory.

User-made **Management templates** are accessible through the Management Template folder. For NRCS configured versions of WEPS running Microsoft Windows 7, they are located here:

*C:\Program Data\USDA\WEPS\Databases\nrcs\man\local*

Other WEPS configurations and operating systems may vary as to the location of this directory.

User-made **Crop templates** are accessible through the Crop Template folder. For NRCS configured versions of WEPS running Microsoft Windows 7, they are located here:

*C:\Program Data\USDA\WEPS\Databases\nrcs\crops\local*

Other WEPS configurations and operating systems may vary as to the location of this directory.

User-made **Operation templates** are accessible through the Operation Template folder. For NRCS configured versions of WEPS running Microsoft Windows 7, they are located here:

*C:\Program Data\USDA\WEPS\Databases\nrcs\operations\local*

Other WEPS configurations and operating systems may vary as to the location of this directory.

These can be crops, operations or managements saved locally by users with a Biomass Adjustment Factor determined for their location and climatic conditions. It is very helpful to save a calibrated local management file to a place where all users in a work group can have access to it. The location for the local management files can be moved to a shared server location by selecting “Edit Configuration” option under the “Tools” menu on the main WEPS screen, then selecting the “Directories” tab and editing the appropriate field titled: “Management Template Open” and “Management Template Save” (Fig. 18.20).

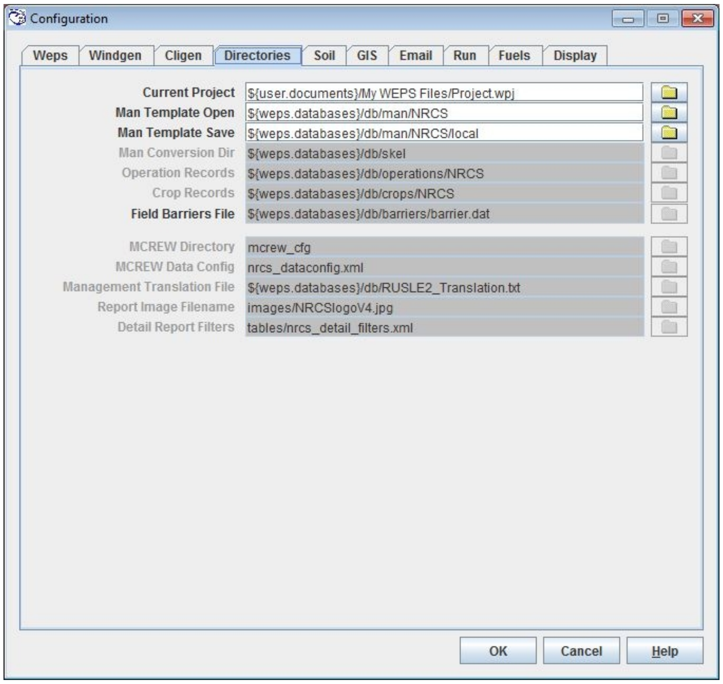



Figure 18.20: WEPS Configuration window opened to the Directories tab, showing directory locations which the user may change.

In Fig. 18.20, the bright yellow folders  indicate those directory paths which the user can change, while the shaded folders  show those the user cannot change. To change a location, click the yellow folder, select the directory or file, and click OK to save the configuration settings and close the window. Note: The database locations shown in (Fig. 18.20) are different for the official NRCS WEPS 1.5 release.

Soil files are accessible through the Soil folder. For NRCS configured versions of WEPS running Microsoft Windows 7, they are located here:

*C:\Program Data\USDA\WEPS\Databases\nrcs\soil*

Other WEPS configurations and operating systems may vary as to the location of this directory.

One set of soil files will usually be placed on a shared drive in an NRCS Field Office. Users must “map to” that drive to access the common group of soils. This can be done accessing the Configuration panel through the “Tools” menu on the main interface and selecting “Edit Configuration”. The user must then select the “Soil” tab and edit the “Soils Database” field. If the user needs to run the model separate from the server, the common soils directory can be reset to the local machine and the necessary soil files downloaded to that location.

Soil files may also be obtained directly from the National Soil Survey Center in Lincoln, NE by using the Soils pull down and selecting NRCS Soil Data Mart function. Users must have an Internet connection to use this function.

### 18.6.4 Simulation Region Orientations and Angles

Field orientation and direction of tillage within the simulation region in WEPS are independent and measured relative to true North (0 degrees). Angles are important in WEPS because wind directions are simulated to mimic the historic wind direction distribution for the selected location. Since wind direction varies from day to day, erosion losses will also vary relative to field angle or ridge orientation. The field orientation in WEPS should be rotated to represent the actual orientation on the landscape. Note that the field will only rotate in a range of ±45 degrees. By rotating and adjusting the field length and width, the user should be able to obtain the desired size and orientation for a field. Tillage direction should also be entered relative to true North in the Management Crop Rotation Editor (MCREW). For example, if a rectangular field has its long side oriented 20.0 degrees from true North and tillage is performed parallel to that long side of the field, the tillage direction should also be entered as 20.0 degrees within MCREW.

### 18.6.5 Plant Damage

Although soil loss is the primary concern in wind erosion, damage to plants should also be considered. Crops can be damaged by blowing soil particles, exposure of plant roots, burial of plants by drifting soil, or desiccation and twisting of plants by the wind. In two exercises, we will examine and take into account the crop tolerance to blowing soil, even though the erosion estimate may already be within NRCS guidelines. NRCS has published a table listing the tolerance of various crops to blowing soil (USDA-NRCS, 2000; National Agronomy Manual; Table 502-4, pg. 502-19). Refer to this table as needed during the exercises (Table 18.2). Crops can tolerate greater amounts of blowing soil than shown, but yield and quality may be adversely affected.

Table 18.2: Crop tolerances used by NRCS to design wind erosion control methods (USDA-NRCS, 2000)

| **Tolerant* "T"** | **Moderate (2 t/ac)** | **Low Tolerance (1 t/ac)** | **Very Low (0-0.5 t/ac)** |
|---|---|---|---|
| Barley | Alfalfa (mature) | Broccoli | Alfalfa (seedlings) |
| Buckwheat | Corn | Cabbage | Asparagus |
| Flax | Onions (> 30 days) | Cotton | Cantaloupe |
| Grain Sorghum | Orchard Crops | Cucumbers | Carrots |
| Millet | Soybeans | Garlic | Celery |
| Oats | Sunflowers | Green/Snap Beans | Eggplant |
| Rye | Sweet Corn | Lima Beans | Flowers |
| Wheat | | Peanuts | Kiwi Fruit |
| | | Peas | Lettuce |
| | | Potatoes | Muskmelons |
| | | Sweet Potatoes | Onion (seedlings) |
| | | Tobacco | Peppers |
| | | | Spinach |
| | | | Squash |
| | | | Strawberries |
| | | | Sugar Beets |
| | | | Table Beets |
| | | | Tomatoes |
| | | | Watermelons |

* USDA-NRCS. 2011. National Agronomy Manual, Part 502-Wind Erosion, 190-V NAM. 4th Edition. Washington, D. C.

# 19. Example Exercises

This Exercise section of the WEPS User Guide is useful for introducing some basic skills needed to perform simple wind erosion simulations with WebStart WEPS and to explain step by step how specific scenarios can be handled using WebStart WEPS.[1]

## 19.1 Configuring WEPS to run these Exercises

Startup WebStart WEPS to open the main WEPS interface. The user's name and email address are required to help track any comment or error messages sent by the user. If it is the user's first time running WEPS, the "WEPS Wizard" should display and lead the user through the process of setting their name and email address into the WEPS local configuration file. Alternatively, if WEPS has been initiated previously and the user did not complete their name and email as desired, the user can select the **Welcome Wizard** option in the **Help** menu from the main WEPS screen to redisplay the Welcome Wizard panels again.

For training purposes, the default WEPS Run location should be specified as a *Runs* folder inside the current WEPS Project and displayed as such in the upper left corner of the main WEPS interface screen (Runs Location panel) which is highlighted within a red box frame in Fig. 19.1.[2] Note that this is the initial default configured WEPS Run folder name and location upon installation of WebStart WEPS. That default WEPS Run folder name and path are defined as follows on a Microsoft Windows computer system:

***C:\Users\\${user.name}\Documents\WEPS Files\\${current_proj.name}\Runs***

where:

***\${user.name}*** refers to the user's login name (**Larry Wagner** as shown in Fig. 19.1)

and

***\${current_proj.name}*** refers to the current WEPS Project (**Project.wpj** as shown in Fig. 19.1).

Thus, the default Runs location translates to the following path shown in Fig. 19.1 to:

***C:\Users\Larry Wagner\Documents\WEPS Files\Project.wpj\Runs***

[1] Note that these exercises are run using the NRCS configured build of WebStart WEPS. Other configured builds of WebStart WEPS should generally produce the same (or at least very similar) results and may also report values in SI units, depending upon configuration settings. It is also possible that the results may not be identical due to recent changes/updates made to the science model code and/or the database records since these exercises were last reviewed.

[2] Note that red box frames are added for instructional/identification purposes in select images throughout these exercises and are not seen in the actual WEPS display windows.

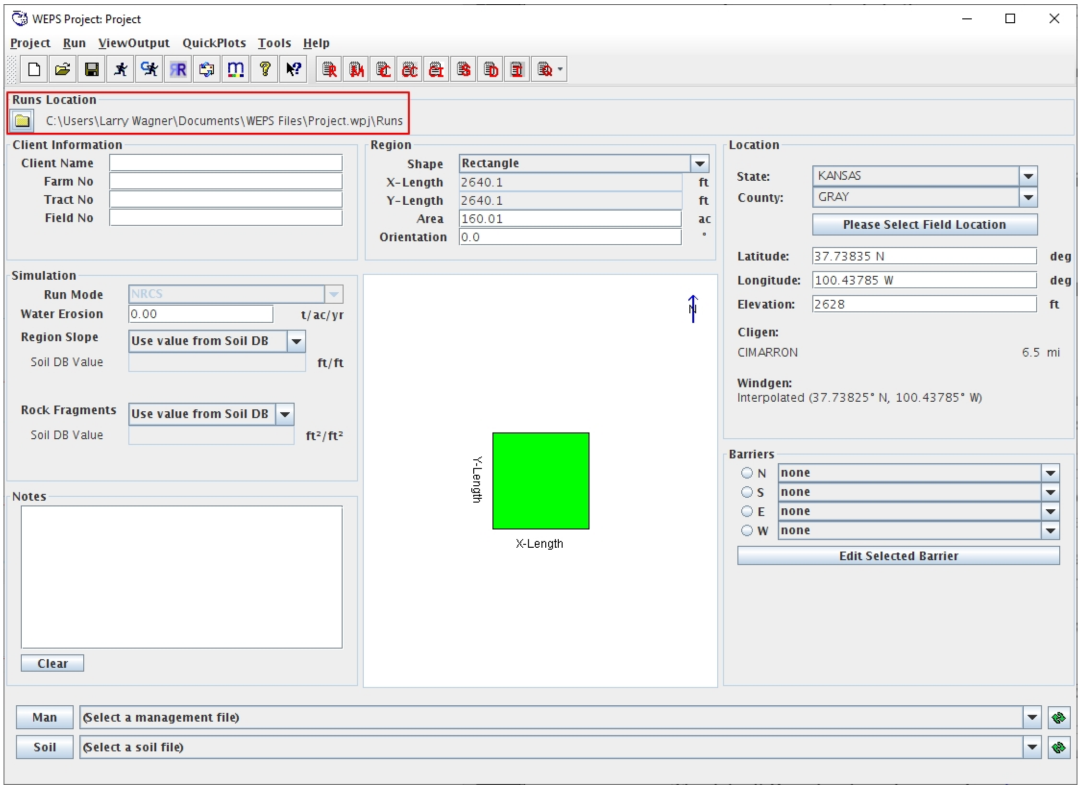



Figure 19.1: The WEPS main interface with default **Runs Location** setting.

**Enable System Templates**: We will be using NRCS Crop Management Zone (CMZ) templates as well as templates specially created for several exercises. Ensure that both *System Mgt. Templates* and *CRLMOD (CMZ) Mgt. Templates* are enabled in the Configuration Panel. To access the Configuration Panel, select the **Edit Configuration** option under the **Tools** menu within the main WEPS interface. Within the Configuration window, click on the *Project and Data Loc* tab. Look under the *Management Template Locations* section and make sure there is a check mark in the box just right of the *System Mgt Templates* and *CRLMOD (CMZ) Mgt. Templates* fields (Fig. 19.2). Note that the *CRLMOD (CMZ) mgt. Templates* field should already be checkmarked by default.

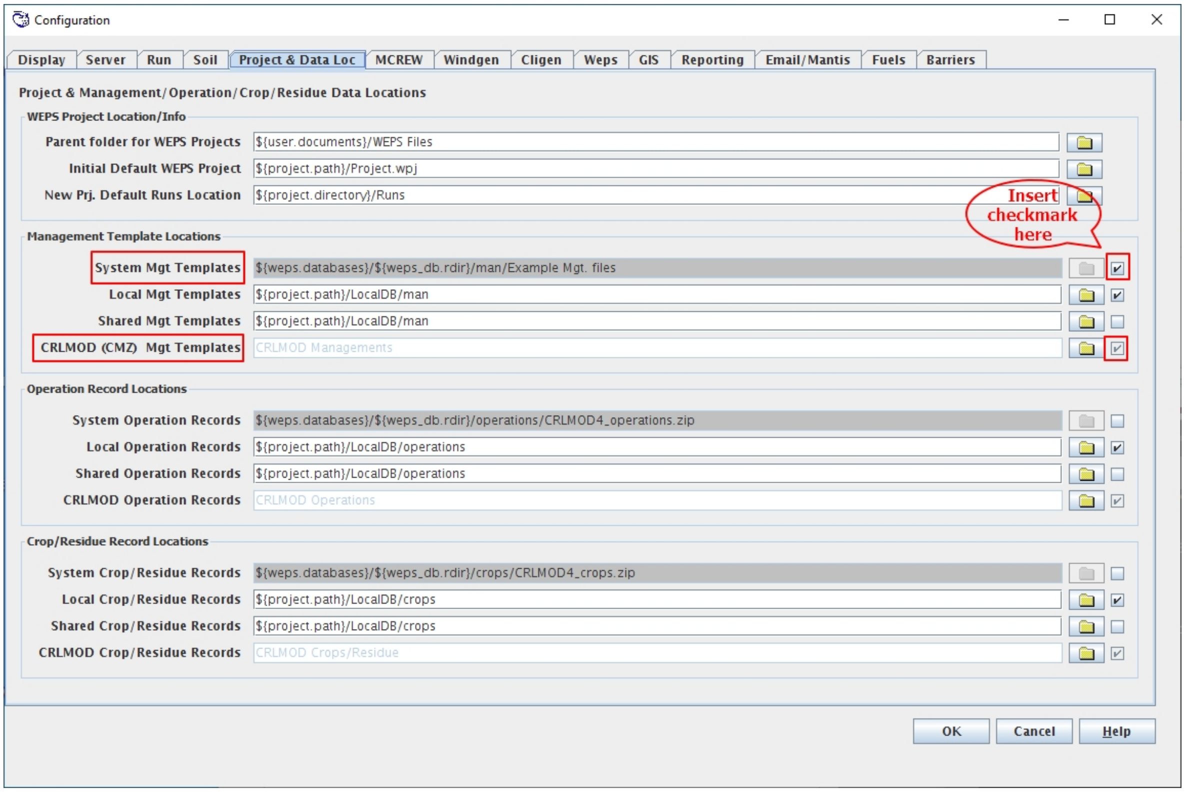



Figure 19.2: Enabling **System Mgt Templates** under the WEPS Configuration Panel's *Project and Data Loc* Tab.

After making this change in the Configuration Panel, one can force the *System Mgt Templates* option to immediately display in the drop down choice list (Fig. 19.3). The user can do so either by selecting the **Refresh the Mgt and Soil Dropdown Choice List** option under the **Tools** menu or click on the refresh button located just left of the management field's drop down choice list down arrow button to trigger the refresh.

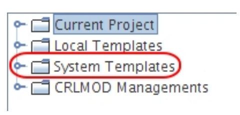



Figure 19.3: Management drop down choice list displaying the **System Templates** option.

After ensuring that WebStart WEPS is configured as specified, the user should now be able to follow the steps outlined for each Exercise as specified in this User's Guide.

## 19.2 Ex 1 - A Basic WEPS Simulation

### 19.2.1 Skill Building

This example introduces some basic skills needed to perform simple wind erosion simulations with WebStart WEPS.

- It uses a previously built management record as a starting template that is then modified via MCREW (Management/Crop Rotation Editor for WEPS).
- It outlines how to: Select and/or specify WEPS inputs
  - Select a management template for editing
  - Properly select a site location using the Map Viewer
  - Select a soil record for a site
  - Specify the size and shape of the field
  - Perform a regular (normal) WEPS simulation run
  - Perform a Yield Calibration run to calibrate the average yields for selected crop records
  - Insert cover crops into a management rotation
- It demonstrates how to: Modify existing management rotations within MCREW using basic editing functions:
  - Changing operation dates
  - Replacing operation and crop entries
  - Inserting operation and crop records
  - Making Target Yield adjustments
- Learn to: Evaluate output reports and interpret results relevant to achieving specific erosion risk goals:
  - Determine if erosion exceeds the Soil Loss Tolerance (T) value for the specified soil
  - Determine whether ground cover is adequate to protect seedlings from wind erosion damage

### 19.2.2 Scenario

- The farm is located near **Stevens Point, Wisconsin**, in **Portage County**. Note that the centroid latitude and longitude coordinates for this county are: 44.47603º N, 89.50148º W.
- The approximate location coordinates we will use for the actual field site are: **44.46143º N, 89.51388º W**.
- Use the default Climate and interpolated Windgen stations automatically selected within the county for the field site.
- The Soil Map Unit to be selected for this evaluation is **Richford_W1097_RfA_90_LS.ifc**, a Richford loamy silt soil.
- The grower's two-year cropping system is sweet corn (**Corn, sweet, ears**) the first year followed the next year with green snap beans (**Bean, Pea, field green).**
- The harvest machine for the beans are viners that remove the beans, returning all residue to the field surface (**Harvest, vine crops, mechanical**.
- The field is circular with a size of about **126 acres** and is fully irrigated with a circle center pivot system.
- The WEPS evaluation of the cropping system will be run for the standard 50 rotation cycles (**NRCS** Run Mode), which is the default Run Mode setting. Thus, we will have 50 simulated years of data for each year of the specified management rotation cycle. Since it is a two year rotation, the WEPS model will then run this simulation for a total of 100 years.

### 19.2.3 Populate inputs

We need to populate the inputs based upon the information provided above. Once that is done, we will execute a WEPS simulation Run.

**Complete the following steps**

*Step 1:* Under the *Client Information* panel, enter ***Exercise 1*** for **Client Name** as shown in Fig. 19.4. All of the fields under the *Client Information* panel are optional and are not required for a WEPS simulation.

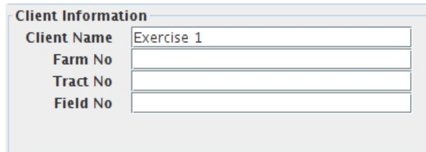



Figure 19.4: **Client Name** field under the *Client Information* panel.

*Step 2:* Under the *Region* panel, for the **Shape** field select ***Circle*** by clicking the drop-down arrow. For the **Area** field enter ***126*** acres. The circle radius automatically synchronizes with field area when the acreage value is accepted (**Radius** value should then be 1321.8 ft). A schematic diagram of the field shape and orientation are also displayed as shown in Fig. 19.5.

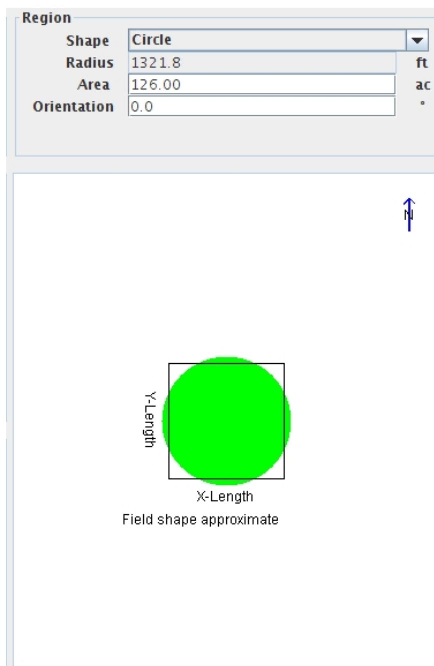



Figure 19.5: Field site **Shape** and **Area** fields under the *Region* panel.

*Step 3:* Under the *Location* panel, first select ***Wisconsin*** in the **State** field, then select ***Portage*** in the **County** field. This will then automatically select the centroid location for the county location, which is: 44.47603º N, 89.50148º W (Fig. 19.6).

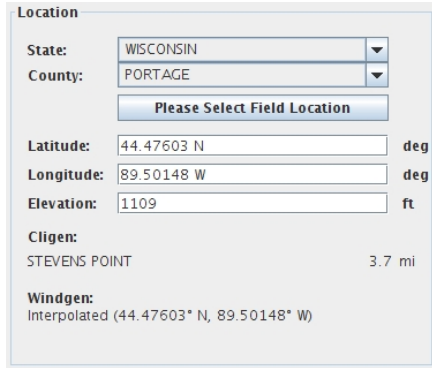



Figure 19.6: **State** and **County** selection fields under the *Location* panel.

WebStart WEPS can now take advantage of the actual field location to provide a list of all the soils present on the field site as well as providing site specific adjustments to some of the Cligen station parameters. To take advantage of this new capability, we will do the following to select the actual exact field site:

*Step 4:* Under the *Location* panel, click on the Map Viewer button 

which will normally be labeled **Please Select Field Location** as shown in Fig. 19.6. This will open up the WEPS Map Viewer Window with the red cross (+) locating the current lat/long coordinates displayed on the main WEPS window, e.g. the centroid of Portage County, WI (Fig. 19.7).

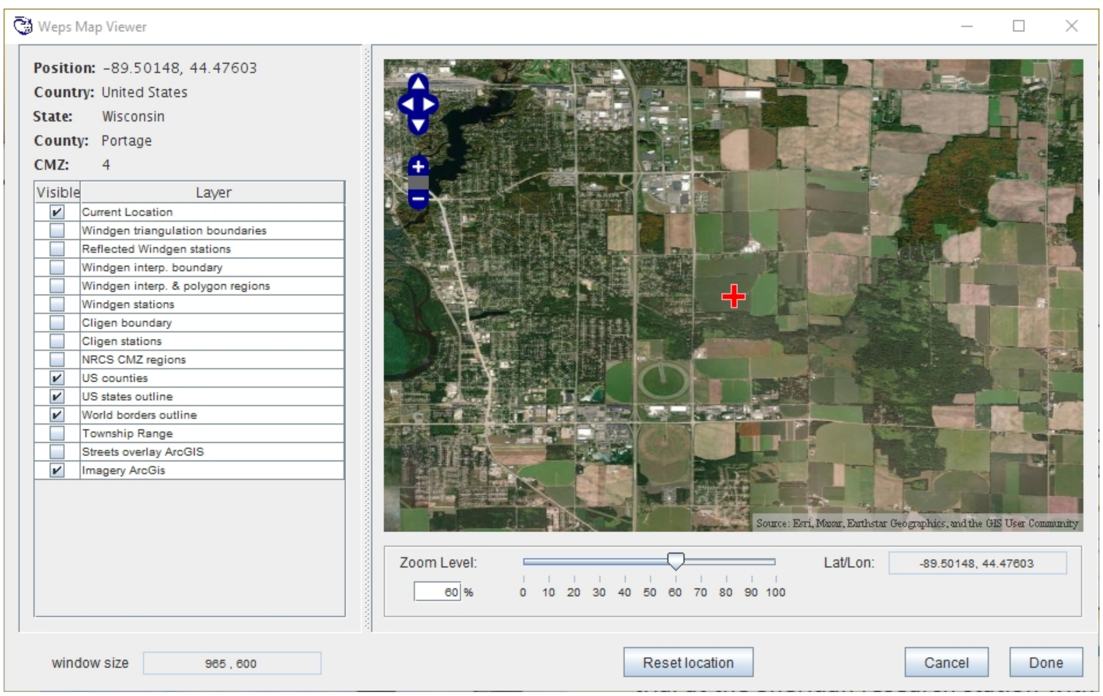



Figure 19.7: Map Viewer displaying State/County centroid location.

This current county centroid location is not referencing the desired center pivot irrigation system field. That center pivot system is just to the left and below this location at approximately 44.46143° N, 89.51388° W. Using the mouse, move the mouse pointer to the center of that circular field (as shown in Fig) and single click the left mouse button. The Map Viewer will now display the red cross (+) on the newly selected location

(Fig. 19.8). One can then select the Map Viewer **Done** button to close the Map Viewer[3].

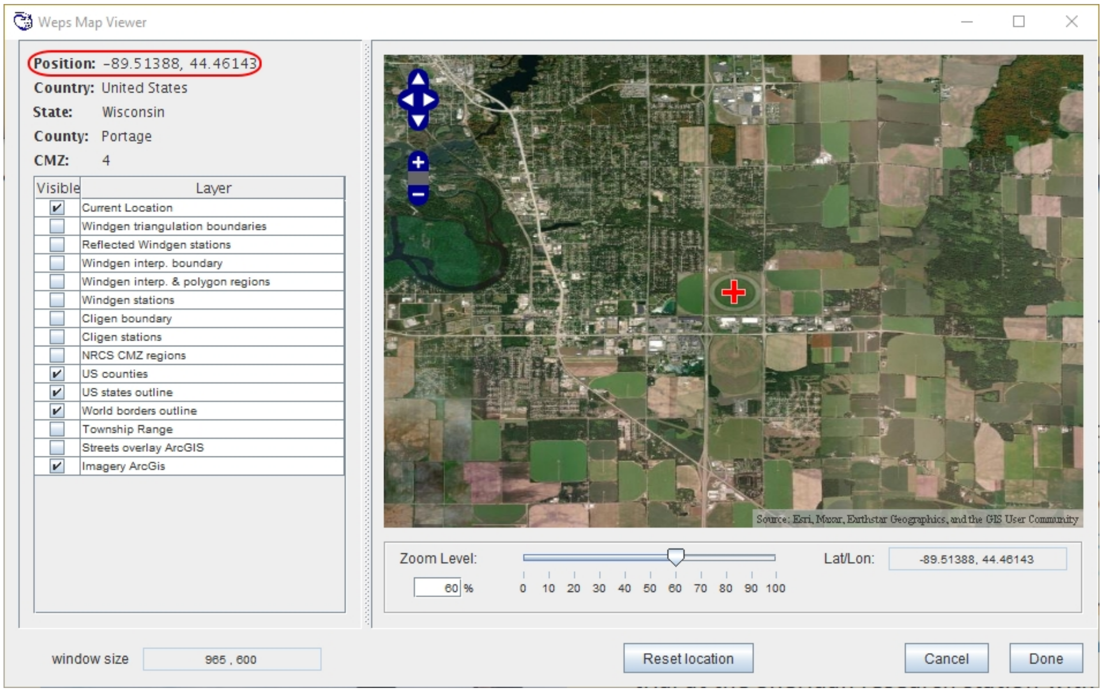



Figure 19.8: Map Viewer displaying actual field site location.

Note that the Map Viewer button's 

text has now changed to **Field Location Selected** upon closing the Map Viewer Window as shown in Fig. 19.9. In addition the **Latitude** and **Longitude** fields now reflect the selected field site coordinates.

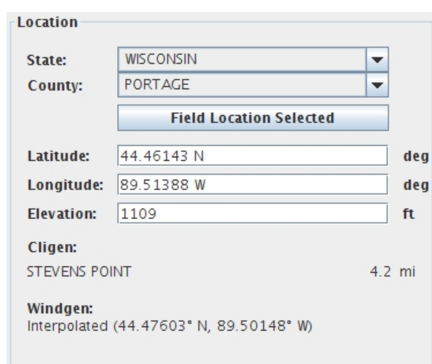



Figure 19.9: Actual Field Site selection displayed in the *Location* panel.

Note that the location you selected may not exactly match the coordinates provided above, but that is ok as we only need to get a set of coordinates that reside within the field. The results should still be the same (or at least very close) to those presented in this example. If desired though, the coordinates mentioned above can be entered into the **Latitude** and **Longitude** fields (Fig. 19.9) so that they exactly match this example.

The weather stations (Cligen and Windgen) are auto-selected based upon the field location coordinates. For Cligen, it will use the Cligen station closest to the county's centroid and apply a PRISM adjustment to the

[3] Note that one can also select a new location and automatically close the Map Viewer by doing a double left mouse button click.

monthly average min/max temperatures and precipitation values[4]. For Windgen, WEPS will provide an interpolated Windgen station from nearby Windgen stations, also based upon the county's centroid location[5] (Notice the county centroid lat/long coordinates in the interpolated Windgen station name). Note that the default methods used for selecting both Cligen and Windgen stations are constrained to pick the same stations regardless of field location within a county. This is necessary for consistency of Run results among nearby field sites within the same county.

The selected Cligen station should read **STEVENS POINT** with the station site 4.2 miles from the field site and the selected Windgen station should read **Interpolated (44.47603º N, 89.50148º W)** as shown in Fig. 19.9.

For the contiguous continental United States, WEPS selects the nearest Cligen station and applies the PRISM adjustments to the monthly values, based upon the specific site's location. In other regions where no PRISM data is currently available, the user is given a choice list to select the most appropriate Cligen station with the default selection being the nearest station.

Generally, east of the Rocky Mountains region of the United States WEPS uses wind station interpolation, where the three surrounding wind stations' data are combined to make an interpolated wind record for each site. Most sites west of the Rocky Mountains generally use polygon regions covering cropland agricultural areas with assigned Windgen stations. Outside of these polygon areas, WEPS provides a list of Windgen stations, sorted by distance from the site, for the user to select from.

To confirm that the desired field site location is nearest to the Stevens Point Cligen station, we can check via the WEPS Map Viewer. Click the **Field Location Selected** button [Field Location Selected] for an overhead view of the station location relative to the selected site location (Fig. 19.10). To see the same Map Viewer window view displayed in Fig. 19.10, do the following: a) disable the **Imagery ArcGis** layer; b) enable the the **Cligen boundary** and **Cligen stations** layers; and c) change the zoom level to **50%**. One can also enlarge the Map Viewer window as well as enable the **Streets overlay ArcGIS** layer for a larger more complete overhead view.

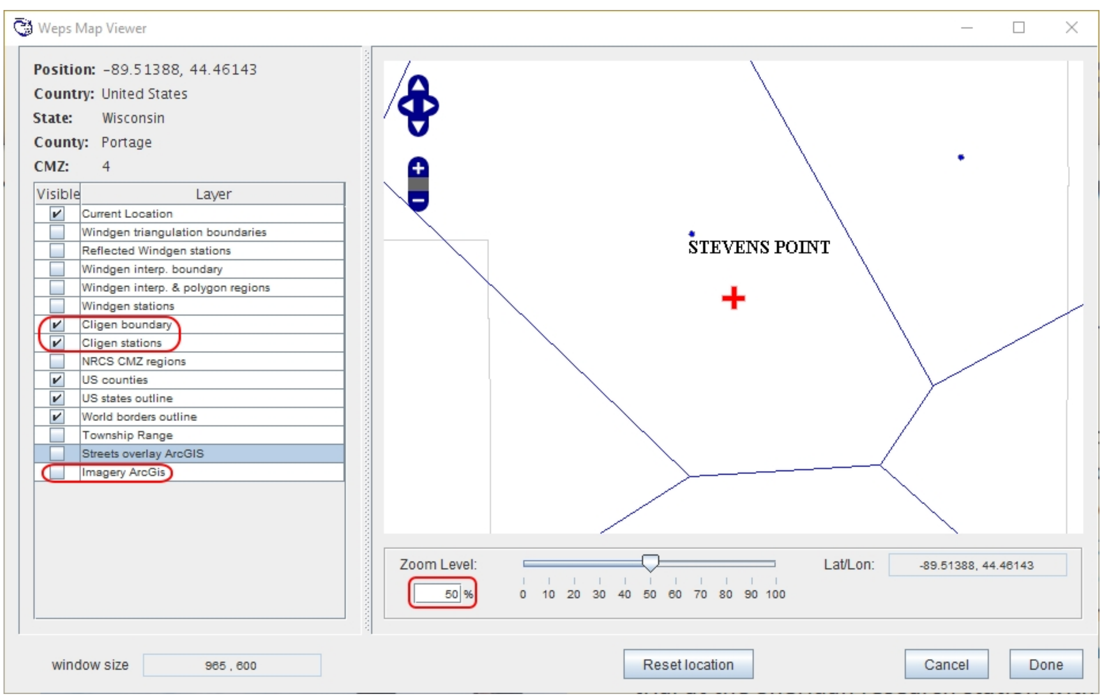



Figure 19.10: Map Viewer with **Cligen stations** layer enabled.

[4] Cligen station selections are determined differently in different regions of the U.S.
[5] Windgen station interpolation or selection are determined differently for different regions within the U.S.

The red cross (+) denotes the current location. The blue dot above the STEVENS POINT text denotes that Cligen station, which falls within the blue line polygon borders for the selected location, indicating it is the nearest Cligen station to the selected site[6]. One can close the Map Viewer to return to the main interface screen by clicking on the window's Cancel button.

Likewise, one can also determine which Windgen stations are being used in the interpolation procedure that generates the interpolated Windgen station selected via the Map Viewer window (Fig. 19.11). To see the same Map Viewer window view displayed in Fig. 19.11, do the following: a) disable the **Imagery ArcGis** layer; b) enable the the **Windgen triangulation boundaries** and **Windgen stations** layers; and c) change the zoom level to **40%**.

The red cross (+) again denotes the current location. The red dots denote the Windgen stations and the green lines display the station interpolation boundaries. The designated location[7] falls within an interpolation boundary that utilizes the Windgen station data from the following Windgen stations: a) MOSINEE/CENTRAL WI; b) VOLK/CAMP DOUGLAS[8]; and c) OSHKOSH/WITTMAN FLD. One can again close the Map Viewer to return to the main interface screen by clicking on the window's Cancel button.

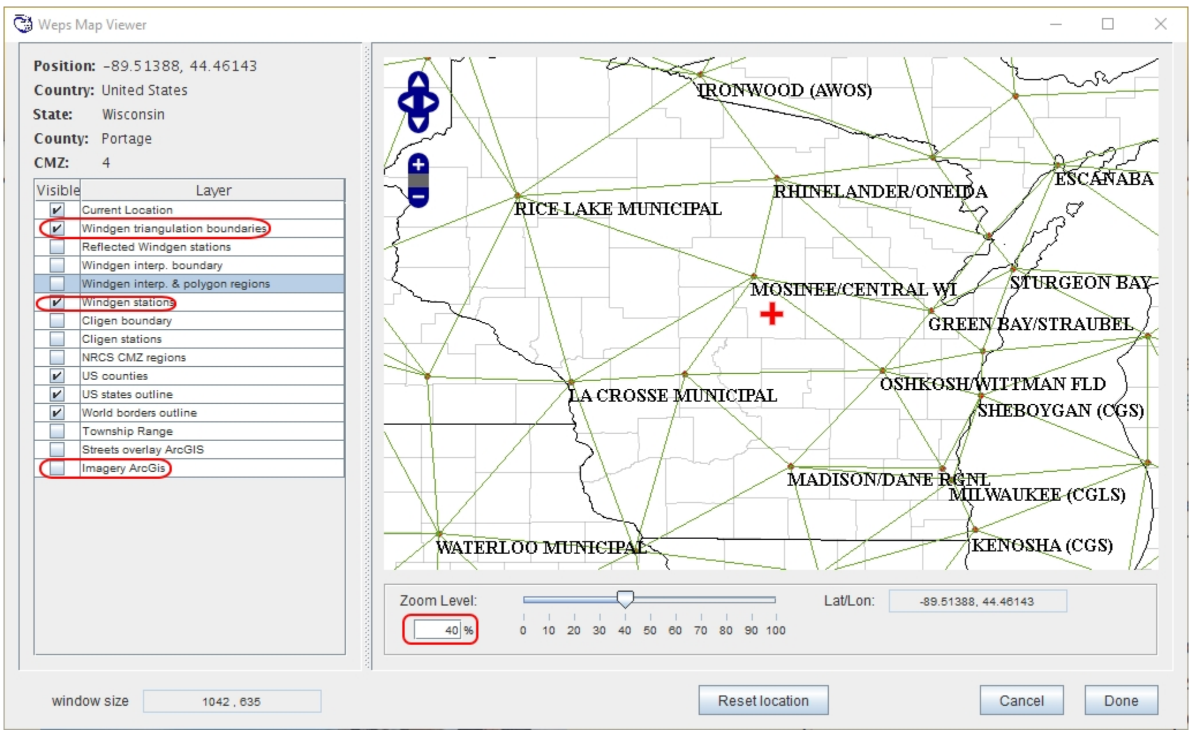



Figure 19.11: Map Viewer with **Windgen stations** layer enabled.

*Step 5:* Click the drop-down arrow opposite the Man button to the right of the management input field near the bottom of the WEPS screen (Fig. 19.12). To open or close a folder on the list, click the key symbol beside it. To select a management file, click the desired file. From the drop-down list, select *System Templates*, then pick the following management template file: ***Peas, green, drilled, st pt, disk, fcult,-Bean, green snap, st pt, disk, fcult, CMZ4.man***.

[6] Actually, the county centroid lat/long coordinates are being used to determine the nearest Cligen station record, but these coordinates are very close to the field coordinates in this scenario. This constraint is applied to obtain consistency between Run results among nearby field sites within the same county.

[7] Actually, the county centroid lat/long coordinates are being used to determine the interpolated Windgen station record, but these coordinates are very close to the field coordinates in this scenario. This constraint is applied to obtain consistency between Run results among nearby field sites within the same county.

[8] Note that this Windgen station's name does not appear at this zoom level in Fig. 19.11, but can be displayed at a zoom level of 50% with the window enlarged.

While this template file does list peas and beans in the template file name, the simulation (and thus yield and erosion estimates) for this example will be modified such that it will only be based on *sweet corn* and *green beans* only. This template is only being used as our starting point for developing the actual rotation used.

Once you have selected the management file, click the Man button Man to open MCREW (Management/Crop Rotation Editor for WEPS). Note, the management files are displayed with a *.man* file extension. The crop rotation management file name will be displayed in the management selection field near the bottom of the WEPS interface when selected.

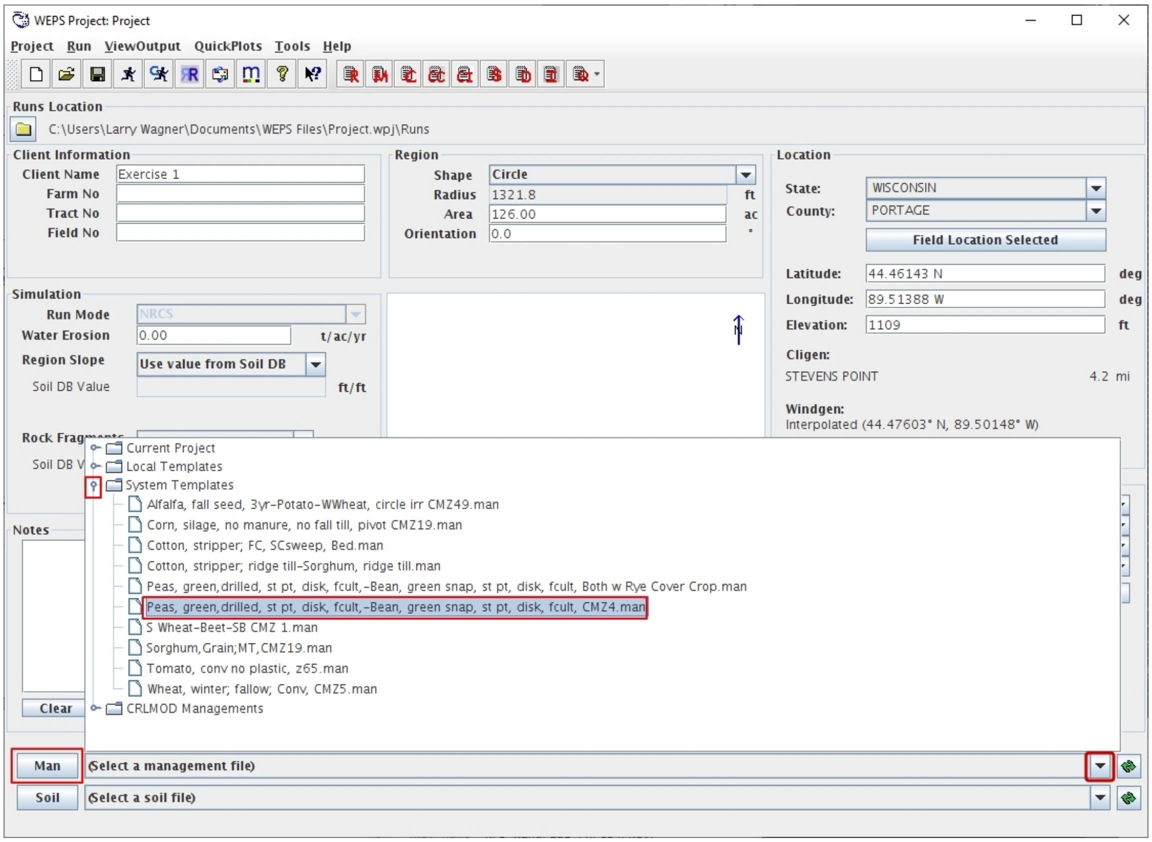



Figure 19.12: Selecting a System Template management file using the management selection drop down list.

*Step 6:* Once MCREW is opened, we will now modify the template record as it does not contain the actual rotation we want to use. Remember, we only selected the template to use as a starting point, hopefully reducing the amount of editing required to construct the actual management rotation desired. We now need to edit the record by changing some entries and their dates.

*Step 6a:* The first rotation year's crop record under the *Crop or Residue* column needs to be changed to accommodate the sweet corn crop. This can be done by clicking the down arrow ▼ to the right of the first existing *Bean, Pea, field, green* crop name. In the drop down menu under *CRLMOD Crops and Residues*, scroll down the list and select ***Corn, sweet, ears.crop*** as shown in Fig. 19.13. Hint, selecting the first character of the name will take you to the first crop record in the sorted listing starting with that character[9], usually speeding up the selection search process.

[9]More precisely, it moves the selection down to the next line beginning with the specified character. In this specific case, one will need to click the letter "***c***" on the keyboard two more times, if the first line currently highlighted as shown in Fig. 19.13; once to get to the "***C***RLMOD Residues" line and another to finally get to the first record "***C***alifornia Brome.crop" line beginning with that letter.

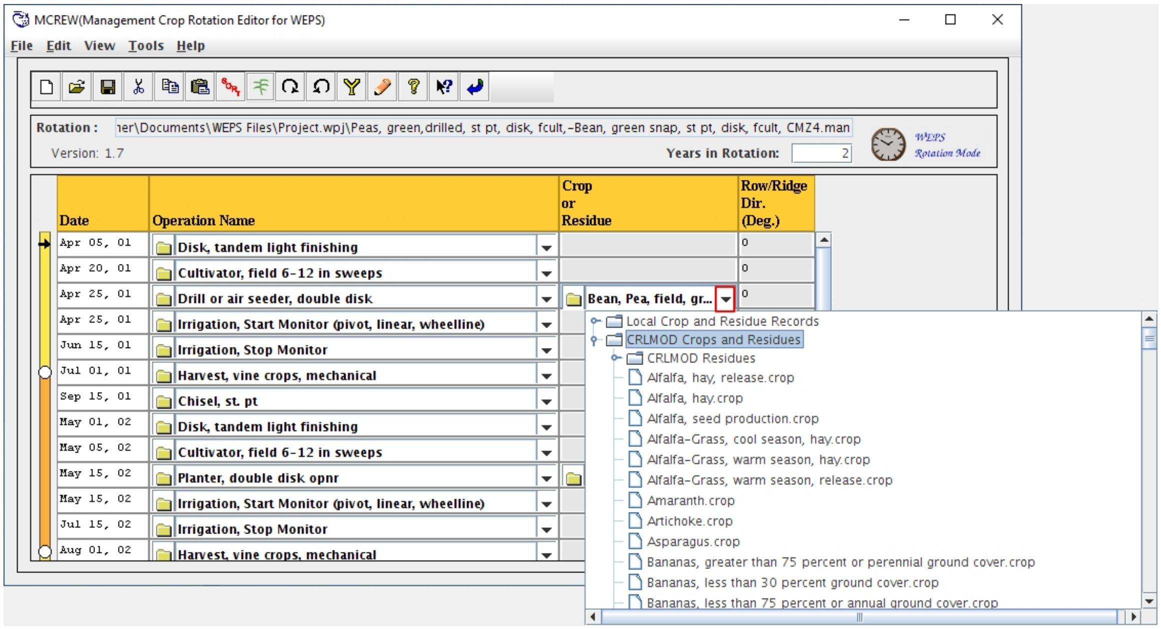



Figure 19.13: Display of selected management in MCREW with crop/residue drop down choice list option highlighted.

*Step 6b:* As with any change in selected *CRLMOD Crops and Residues* records, planting and other operation dates may also need to be modified to reflect local conditions and practices. Since we have changed the crop in this rotation, we need to adjust the planting date to what is more appropriate for the newly selected crop. Double click the left mouse button on the date associated with the desired operation (in this case the ***Drill or air seeder, double disk***), as shown in Fig. 19.14. This will cause a rotation calendar popup window to appear. Select the year, month and day the operation should occur on. Go ahead and change the dates for the **Drill or air seeder, double disk** operations to ***May 9 of rotation year 1***. One can select the OK button or double click the left mouse button on the day box in the calendar to set the date for the specified operation.

*Step 6c:* Also, change the date for the **Irrigation, Start Monitor (pivot, linear, wheelline)** operation to ***May 15 of rotation year 1*** to begin irrigation sooner for the sweet corn.

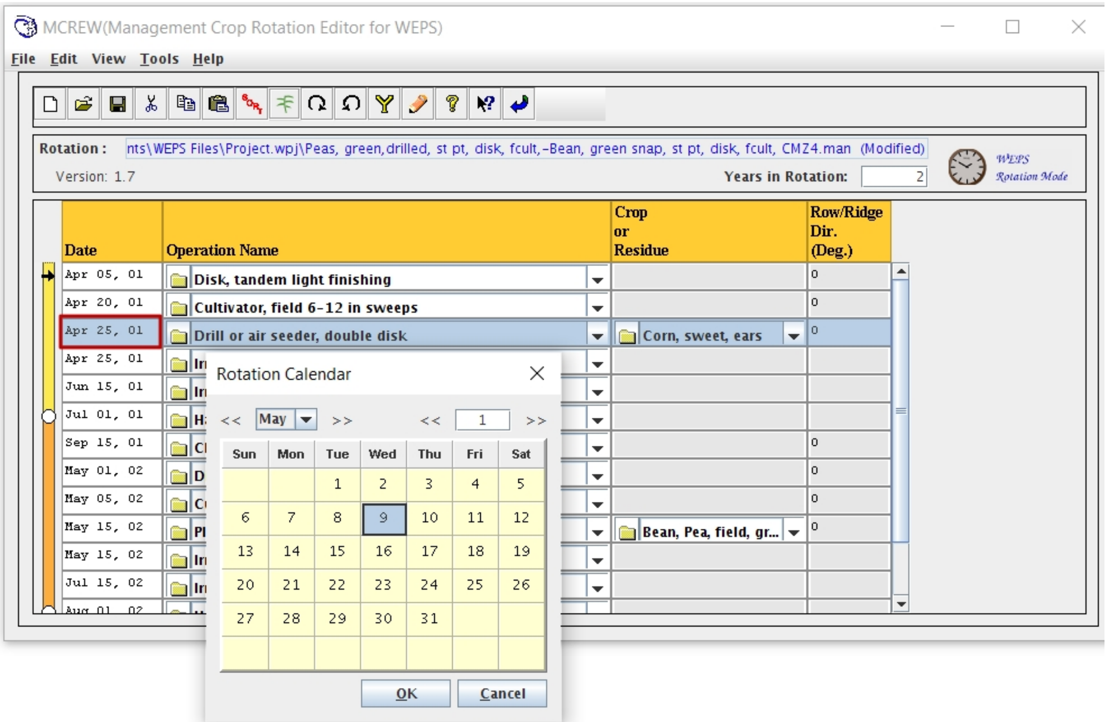



Figure 19.14: Selecting new seeding operation date in MCREW.

*Step 6d:* Depending on the crop (or residue) record selected, operations may also need to be changed. Click the down arrow ▾ next to the operation record you wish to change, as shown in Fig. 19.15 (the first listed **Harvest, vine crops, mechanical** operation in this case). From within the **Operation Name** column, in the specified cell's drop down menu under *CRLMOD Operations*, to select the more appropriate **Harvest, killing crop 50pct standing stubble.oprn** harvest operation for the sweet corn. Hint, clicking the first character of the name will take you to the first operation in the sorted listing starting with that character, speeding up the selection process.

*Step 6e:* To properly adjust for the later harvest date for the newly selected sweet corn, go ahead and change the harvest date for the **Harvest, killing crop 50pct standing stubble** operation to be **July 15, rotation year 1**.

*Step 6f:* Likewise, extend the irrigation time by changing the date for the previous operation **Irrigation, Stop Monitor** to **July 1, rotation year 1** as well.

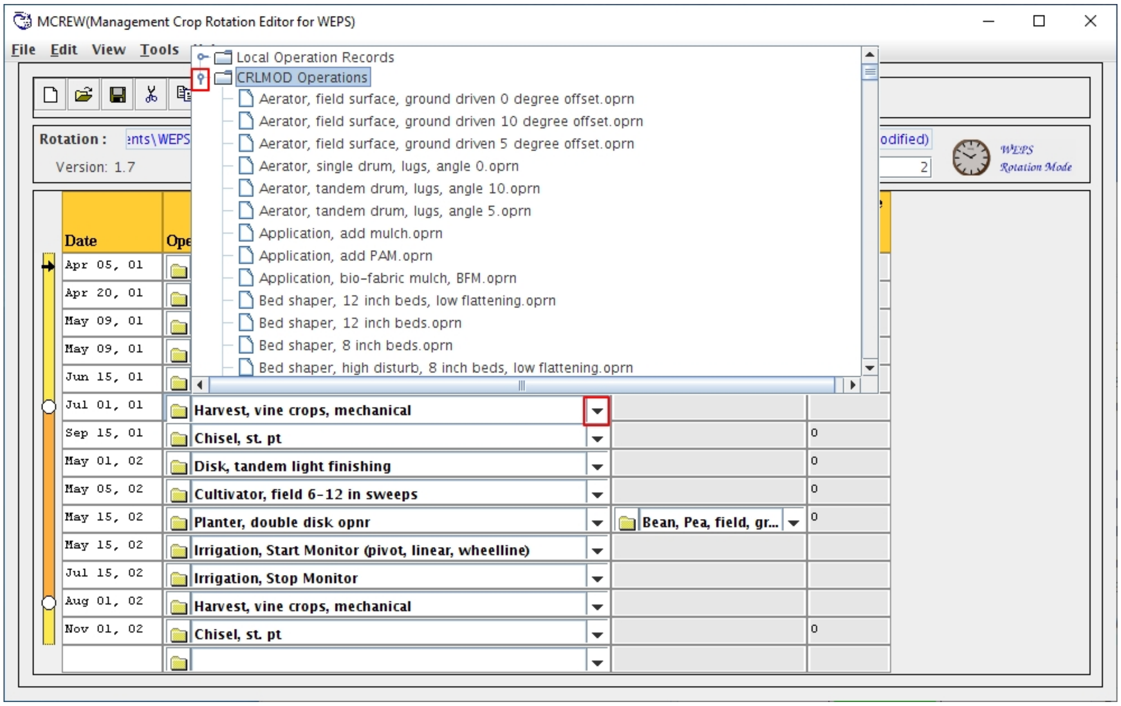



Figure 19.15: Selecting new operation in MCREW.

*Step 7:* Once you modify these Crop or Residue, Operation Name, and Date entries, be sure to save your changes. You will notice at the top of the screen, that the file name will be now highlighted in **blue** with the word **(Modified)** appended to the file name. This is to signify to the user that the management file has been modified (edited) and needs to be saved to retain those changes. There are multiple ways to save the file with the current name (Fig. 19.16). You can press the save button, or one can select the "Save" option under MCREW's "File" menu. Both methods will save the file in the current WEPS Project folder with the displayed name. In addition, the blue return arrow button will also save the file to the currently displayed name, but also automatically close the MCREW window.

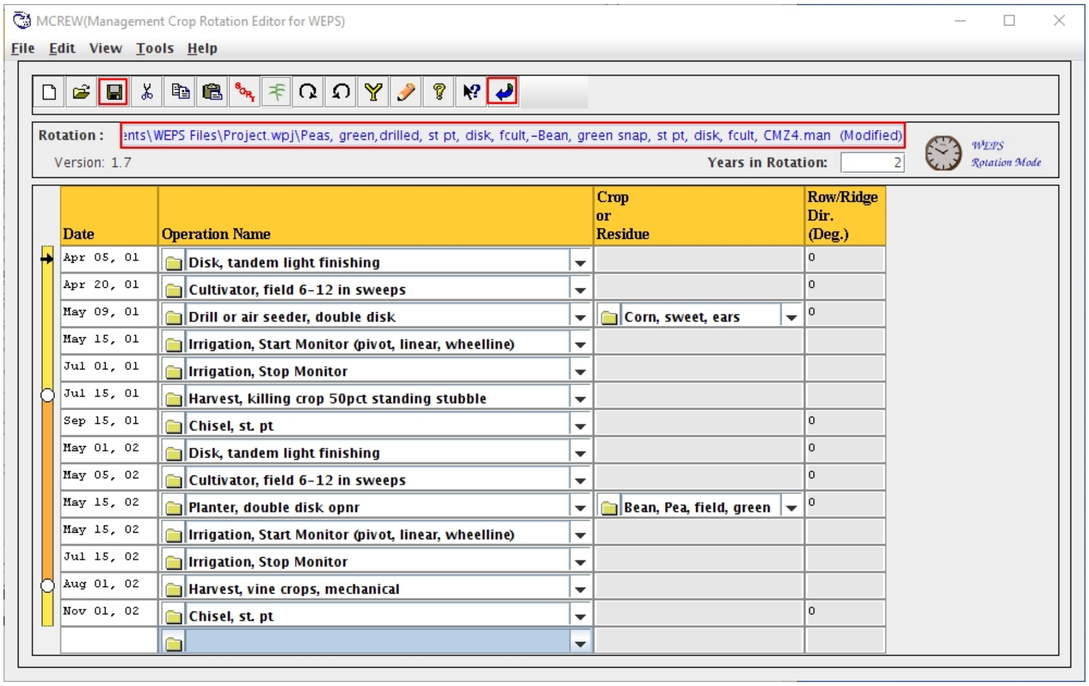



Figure 19.16: Saving changes to existing filename in MCREW.

However, in this case, we will save the management rotation file with a different name that more correctly reflects its new content. To do so, we can select the **Save As...** option under MCREW's **File** menu ((Fig. 19.17). The user can then specify the new management rotation file name they want to use in the FileChooser window that pops up on the screen (Fig. 19.18). We will call it **Sweet corn and green beans**. We can then close MCREW with the new name by clicking on the blue return button .

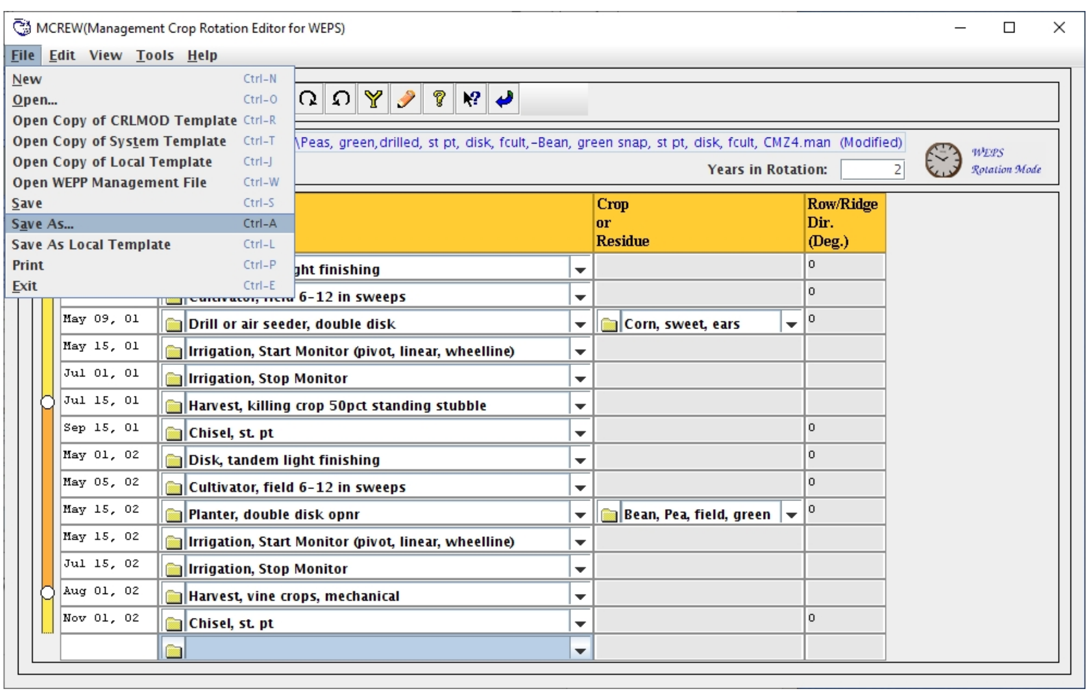



Figure 19.17: Saving changes to a new filename in MCREW.

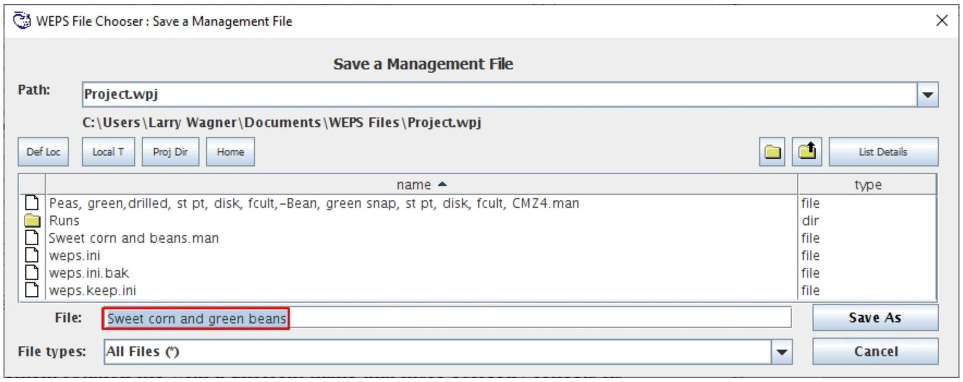



Figure 19.18: Entering new management filename in the FileChooser window.

*Step 8:* Once you have returned to the main WEPS interface screen, click the drop down arrow opposite the Soil button **Soil** near the bottom of the WEPS screen. Use the **CSIP Soil Service** option to select a soil record using the soil selection drop down box. This CSIP service will provide a list of soil components that exist on the specified field site. Expand the *CSIP Soil Service* option by clicking on the key so that it now points down (Fig. 19.19), expand the desired soil map unit name, if necessary, then select the **Richford_W1097_RfA_90_LS.ifc** soil component from the list. Note: the soil files have a *.ifc* extension. The selected soil component will be saved in the current WEPS Project folder. Once selected, the soil name will be displayed near the bottom of the WEPS interface. The user can also select a soil component using the older *NRCS Soil Data Mart db* service. However, the user must know what soil component(s) exists at the site to make an informed decision as it will only show all the soils existing within the County.


Figure 19.19: Selecting a soil component record using the **CSIP Soil Service** via the soil selection drop-down box.

All required information has now been entered into the WEPS main interface screen (Fig. 19.20) and it is ready for a WEPS simulation run to be executed.

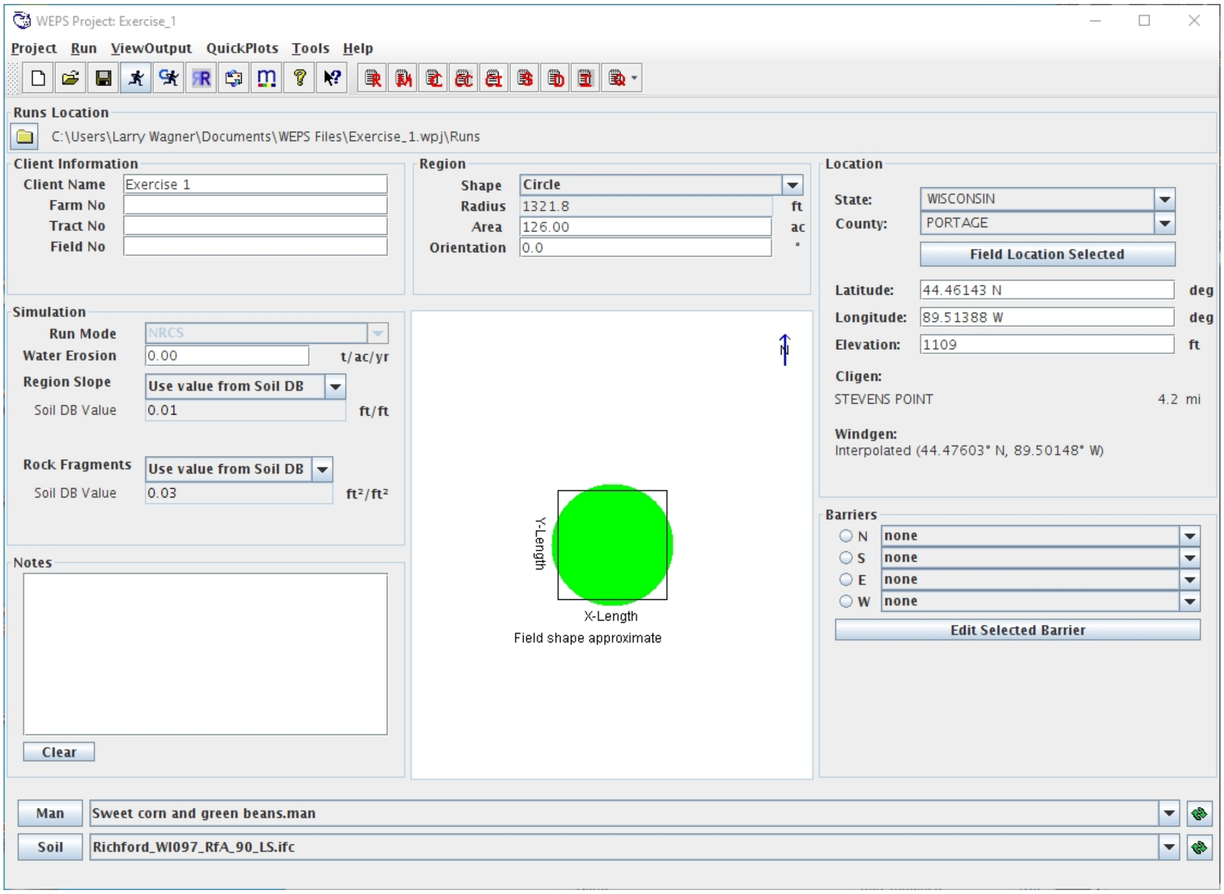



Figure 19.20: The WEPS interface with the correct information for the initial scenario of Exercise 1.

### 19.2.4 Initial Simulation Run

To begin the simulation run, click the Run button. WEPS will prompt you to name the run. Enter **Sweet Corn and beans, green, irr, CMZ4** as the Run Name and click the **OK** button (Fig. 19.21).

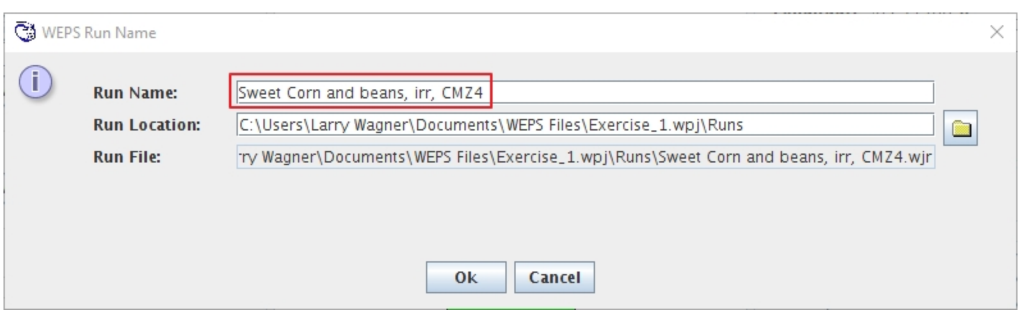



Figure 19.21: WEPS Run Name window showing the run name, location, and file path.

During a simulation run, a window will appear, showing the simulation progress (Fig. 19.22).

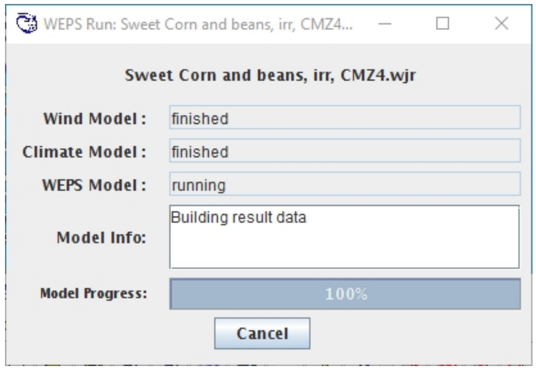



Figure 19.22: WEPS Run Progress Window.

For this simulation, a warning message pops up (Fig. 19.23) displaying information about the sweet corn not reaching maturity when it is harvested. Normally, we don't want to see this message appear when harvesting grain crops, so we will need to modify the harvest date to fully accommodate the growing season for all simulation years for the sweet corn. In this case, there were only four simulation years where we did not obtain enough growing degree day units to fully grow the crop to maturity before harvest. We are well over 90% of reaching maturity for all of the displayed years, so it will likely make little difference in the erosion susceptibility results for this simulation run with this management scenario. However, since this is an example for users to follow, we will go through the process of adjusting the planting and/or harvesting date(s) prior to subsequent simulation runs using this management scenario to eliminate the warning message. Closing this window will complete the simulation run and bring up the Run Summary report.

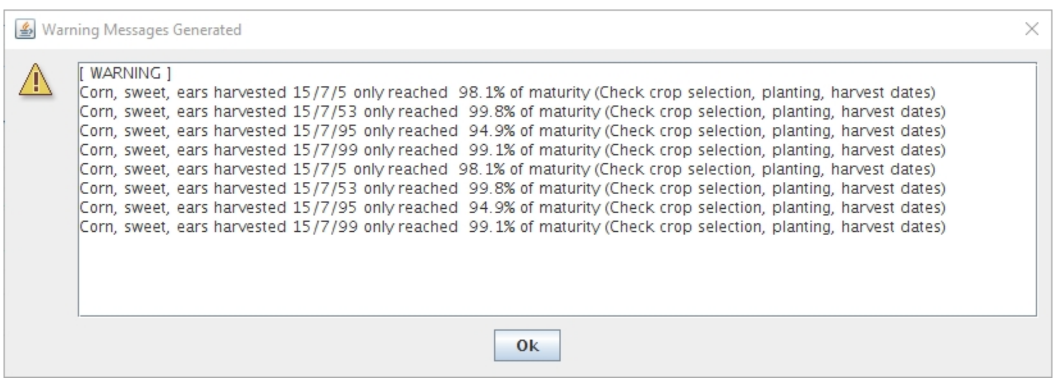
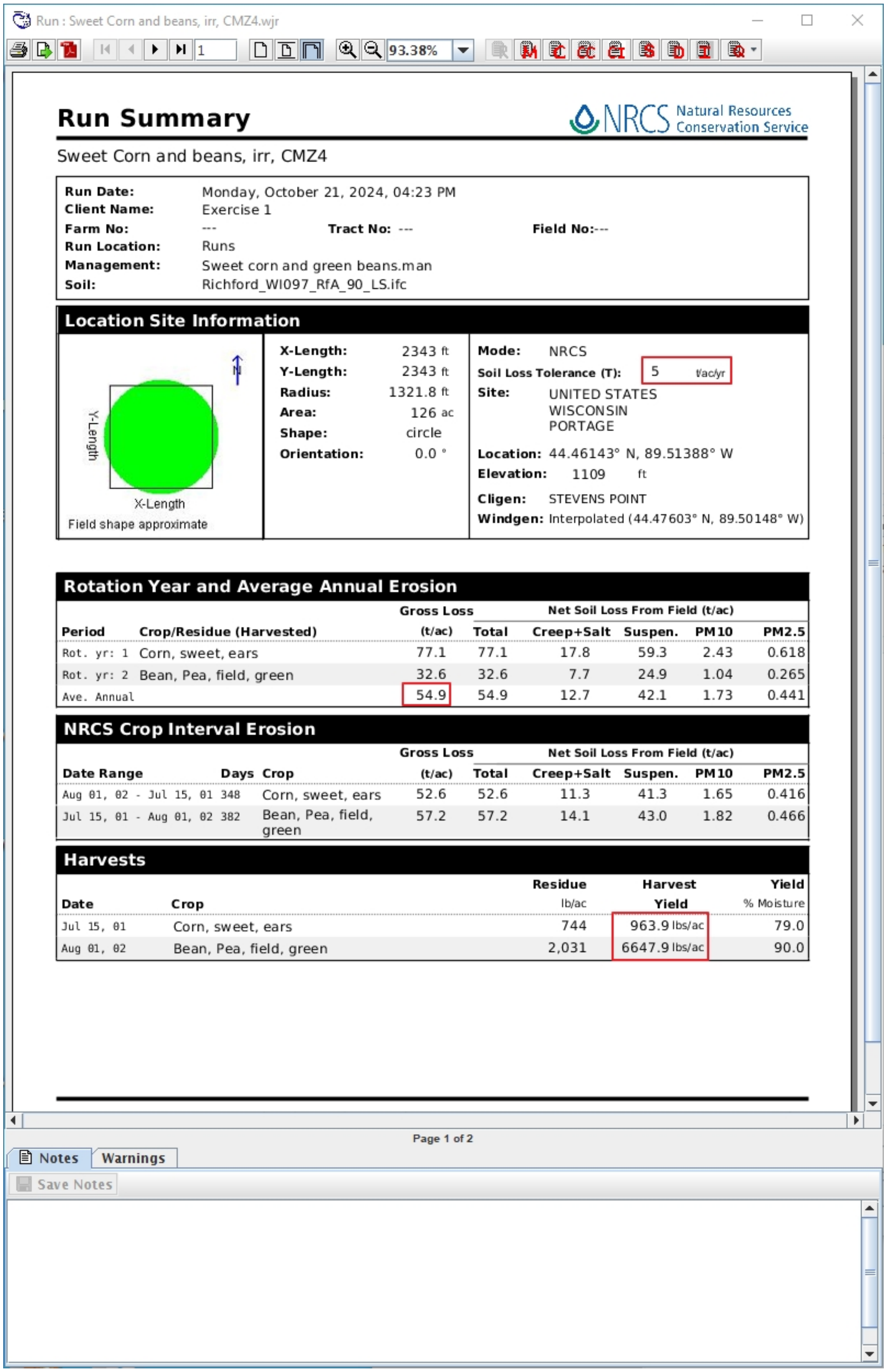



Figure 19.23: Warning message window from the initial simulation.

The WEPS Run Summary report window automatically appears on the screen upon completion of the simulation (Fig. 19.24). The simulation reports an Average Annual Soil Loss of **54.9 t/ac**, several times the acceptable soil loss of **5 t/ac/yr**.

Since crop yields are highly correlated to the amount of biomass produced and thus the actual after-harvest residue available. This in turn affects erosion, so the user should normally check the harvest yields to see if the crop yields are reasonable. In this case, we already know that these yields are lower than our target yields. Therefore, our protective after harvest residue amounts will be lower than desired.

However, we still want to achieve the expected average yields for this region of **14,000 lbs/ac** for sweet corn and **8,100 lbs/ac** for green beans, after we have adjusted the harvest date so we can achieve full maturity of the sweet corn for all simulation years before harvesting it. We will make a "Yield Calibration" run in the next section to adjust those yields to get within ±5% of those expected average yield levels.



Run : Sweet Corn and beans, irr, CMZ4.wjr

## Run Summary

Sweet Corn and beans, irr, CMZ4

| | |
|---|---|
| **Run Date:** | Monday, October 21, 2024, 04:23 PM |
| **Client Name:** | Exercise 1 |
| **Farm No:** | --- **Tract No:** --- **Field No:**--- |
| **Run Location:** | Runs |
| **Management:** | Sweet corn and green beans.man |
| **Soil:** | Richford_WI097_RfA_90_LS.ifc |

**Location Site Information**

X-Length: 2343 ft
Y-Length: 2343 ft
Radius: 1321.8 ft
Area: 126 ac
Shape: circle
Orientation: 0.0 °
Field shape approximate

Mode: NRCS
Soil Loss Tolerance (T): 5 t/ac/yr
Site: UNITED STATES WISCONSIN PORTAGE
Location: 44.46143° N, 89.51388° W
Elevation: 1109 ft
Cligen: STEVENS POINT
Windgen: Interpolated (44.47603° N, 89.50148° W)

**Rotation Year and Average Annual Erosion**

| Period | Crop/Residue (Harvested) | Gross Loss (t/ac) | Net Soil Loss From Field (t/ac) Total | Creep+Salt | Suspen. | PM10 | PM2.5 |
|---|---|---|---|---|---|---|---|
| Rot. yr: 1 | Corn, sweet, ears | 77.1 | 77.1 | 17.8 | 59.3 | 2.43 | 0.618 |
| Rot. yr: 2 | Bean, Pea, field, green | 32.6 | 32.6 | 7.7 | 24.9 | 1.04 | 0.265 |
| Ave. Annual | | 54.9 | 54.9 | 12.7 | 42.1 | 1.73 | 0.441 |

**NRCS Crop Interval Erosion**

| Date Range | Days | Crop | Gross Loss (t/ac) | Net Soil Loss From Field (t/ac) Total | Creep+Salt | Suspen. | PM10 | PM2.5 |
|---|---|---|---|---|---|---|---|---|
| Aug 01, 02 - Jul 15, 01 | 348 | Corn, sweet, ears | 52.6 | 52.6 | 11.3 | 41.3 | 1.65 | 0.416 |
| Jul 15, 01 - Aug 01, 02 | 382 | Bean, Pea, field, green | 57.2 | 57.2 | 14.1 | 43.0 | 1.82 | 0.466 |

**Harvests**

| Date | Crop | Residue lb/ac | Harvest Yield | Yield % Moisture |
|---|---|---|---|---|
| Jul 15, 01 | Corn, sweet, ears | 744 | 963.9 lbs/ac | 79.0 |
| Aug 01, 02 | Bean, Pea, field, green | 2,031 | 6647.9 lbs/ac | 90.0 |

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Notes Warnings
Save Notes

Figure 19.24: WEPS Run Summary report with high erosion rates displayed.

### 19.2.5 Setup Inputs for a Yield Calibration Run

The calibration function allows WEPS to recalculate the crop growth based on the actual yield history of the field evaluated. It adjusts the Harvested Yield simulated to within ±5% of the expected or historic yield entered. To calibrate the example run, first close the Run Summary window. The main interface window should remain on screen.

**Complete the following steps**

*Step 1:* On the main screen, click the ”Man” button to open the Management Crop Rotation Editor for WEPS (MCREW).

*Step 1a:* Within MCREW, change the date of the **Harvest, killing crop 50pct standing stubble** operation to **July 25, rotation year 1** to extend the growing season sufficiently to avoid obtaining simulation years that do not reach 100% maturity when growing the sweet corn.

*Step 1b:* Also, extend the irrigation time by changing the **Irrigation, Stop Monitor** operation to **July 15, rotation year 1**. Both date changes are highlighted in Fig. 19.25.

Now, click the Yield Calibration button on the tool bar (Fig. 19.25). This displays nine additional columns. The MCREW window can be enlarged by grabbing the edge or corner of the window and stretching (or shrinking) the window size horizontally (and vertically) to display the extra columns (and rows) without scrolling. The first four extra columns pertain to the target yield and calibration settings. The target yields can be edited directly on this screen, but the yield units cannot be changed. Remember, the desired target yield is 14000 lbs/ac for sweet corn and 8100 lbs/ac for beans. Those values happen to be the default values for those two crop records, so we don't have to make any changes to those values.

Then make sure the boxes in the **Calib. Yield?** and **Select Harvest for Calib.** columns for both the sweet corn and green bean crops are checked Fig. 19.25. The crop record must be selected for calibration (**Calib. Yield?** column) as well as the harvest operation to be used when harvesting that crop (**Select Harvest for Calib.**) to enable the crop to have its yield calibrated when making a ”Yield Calibration” run.

Since these crops are typically harvested only once, both crops and their harvesting operations default to being selected and used for yield calibration, when a Yield Calibration run is performed. Note that for perennial crops, like Alfalfa, that are typically harvested multiple times, default to not be calibrated. This occurs because the user must select which individual harvest operation (its ”harvested yield”) will be used for calibration. Likewise, typical harvesting operations used for harvesting perennial crops default to not being set for calibration use, since the user must explicitly specify which harvest operation's ”yield” will be used in the calibration process.

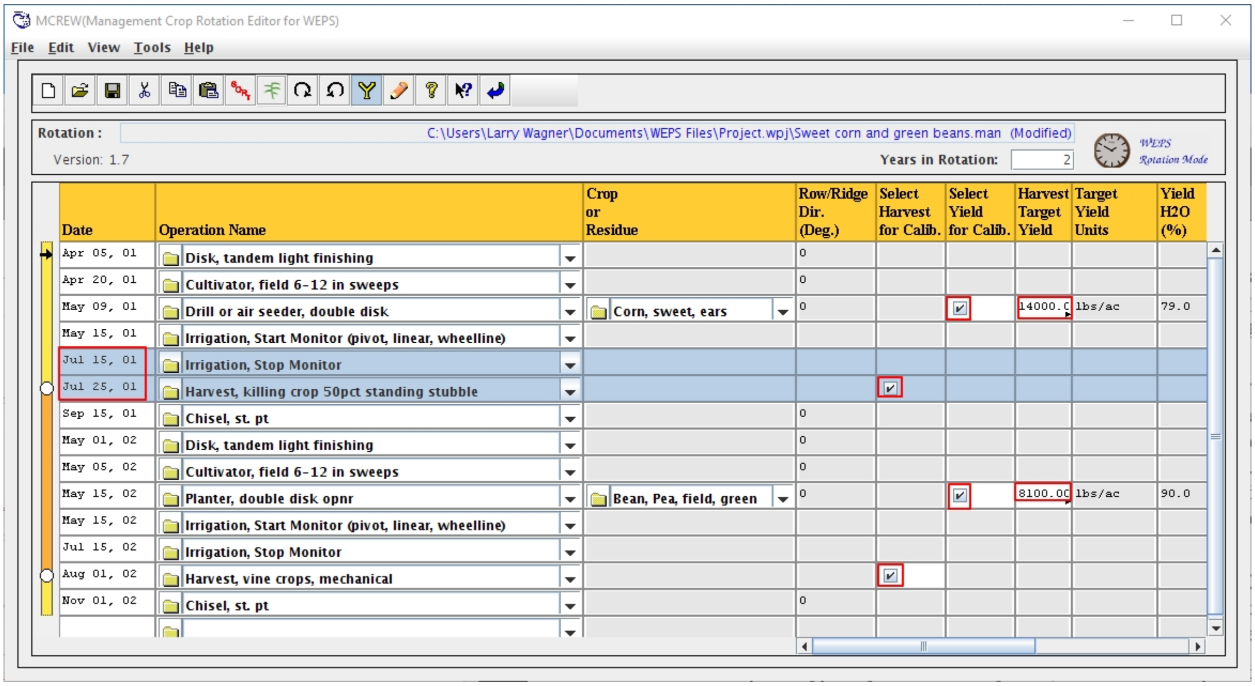



Figure 19.25: MCREW displayed with Yield button selected.

Click the blue return arrow button to save the target yields to the current management file name (**Sweet corn and green beans.man**) by clicking 'Yes' in the popup window to overwrite the existing file located in the current Project. This is what we want to do since the previously saved rotation with this same name contained errors. This changes the contents of the existing copy of the management file with the same named, stored in the Project directory. It does not change the original copy used in the previous WEPS Run simulation, which was copied into and stored in the previous WEPS Run simulation's folder.

Since it can get confusing which "version" of a management file one is using when frequently editing it, it is recommended that the user save edits, especially when they are significant, to another, appropriately named management file. This helps eliminate confusion about which rendition of a management file was used for each specific WEPS simulation run. There is a "Pencil" icon on the MCREW toolbar that can be selected to bring up a popup "Notes" window where the user can enter specific information about the rotation file currently loaded into MCREW for future reference.

### 19.2.6 Make a Yield Calibration Run

On the main interface screen, click *Run* on the main screen menu and then select *Make a Yield Calibration WEPS Run*. or simply click the Yield Calibration Run button on the WEPS toolbar. You will be prompted to enter a Run Name. The default Run Name is the last run name plus "**_calib**" appended to the name, implying that this will be a calibration run. Note, if previous calibration runs have been made with the same run name, an auto-incremented number, beginning with "**_1**" will also be appended to the end of the run name. Click OK to begin the Yield Calibration Run Fig. 19.26. A calibration run can take several minutes to complete.

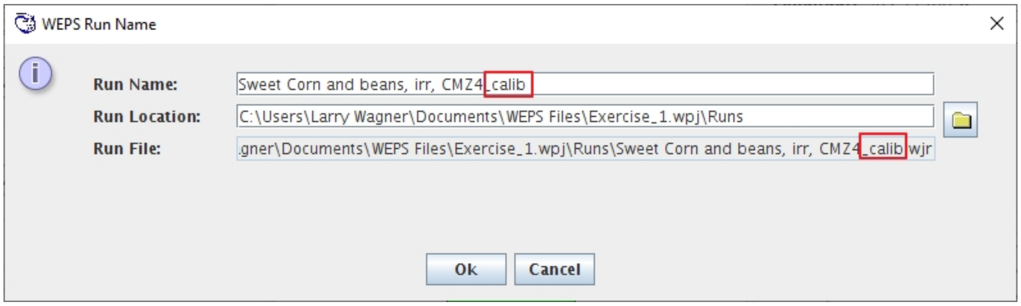



Figure 19.26: WEPS Run Name window showing "_ calib" automatically appended to run name.

WEPS now displays a table showing two Calibration Factors: one for sweet corn and one for green beans (Fig. 19.27). For WEPS to produce the expected sweet corn residue for this farm, yields must increase from approximately 960 lbs/ac to around 14,000 lbs/ac. Therefore, we should expect the factor to be greater than 1.0 and the Biomass Adjustment Factor is **1.960**. The green beans also must increase from approximately 6,650 lbs/acre to around 8,100 lbs/acre. We can see that the Biomass Adjustment Factor is **1.150**. The Biomass Adjustment Factor is a number assigned to each crop record and used as a multiplier to adjust how much the crop grows. Numbers greater than 1.0 increase the final yield, whereas numbers less than 1.0 decrease the final yield of the crop.

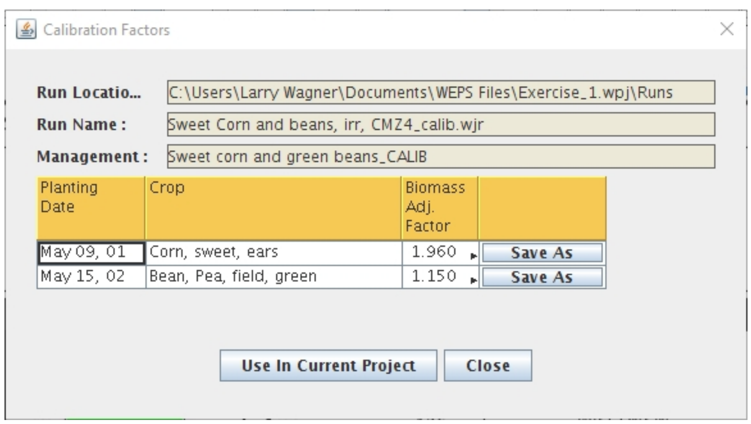



Figure 19.27: Calibration Factors window displaying the Biomass Adjustment Factor for each crop.

The user has three options at the Calibration Factors screen:

**(1)** Clicking the *Use in Current Project* button [Use In Current Project] to apply these calibration factors to both the sweet corn and green peas crop records in the current WEPS management file being used in this example.
**(2)** Clicking the *Save As* button(s) to individually save these locally calibrated versions of the crop records into the user's *local* crop database folder for selection and re-use in later management/crop rotation files that can be edited for future simulation runs in the same region. Since each run takes some time to complete, it is advantageous to save previously calibrated crop records for future simulation runs with the model.
**(3)** Clicking the *Close* button to use the factors only in this current calibration simulation run.

For this exercise, click the *Use In Current Project* button option [Use In Current Project].

WEPS will then temporarily display a message (Fig. 19.28) informing the user that "The current project is now using the calibrated management file." Click the *"OK"* button to close both the Calibration message window (it will close automatically in a few seconds if the user does not close it soon enough) as well as the Calibration Factors window itself.

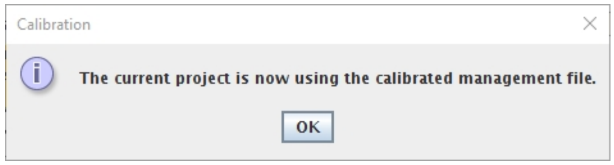



Figure 19.28: Popup window confirming loading of calibrated management file into WEPS interface.

It will first place a copy of the calibrated management/crop rotation file into the current WEPS Project directory, and then automatically load this management file into the WEPS interface (Fig. 19.29). Note also that "_**CALIB**" is appended to the calibrated management file name.

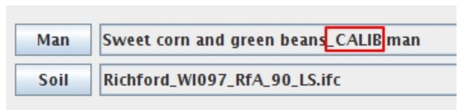
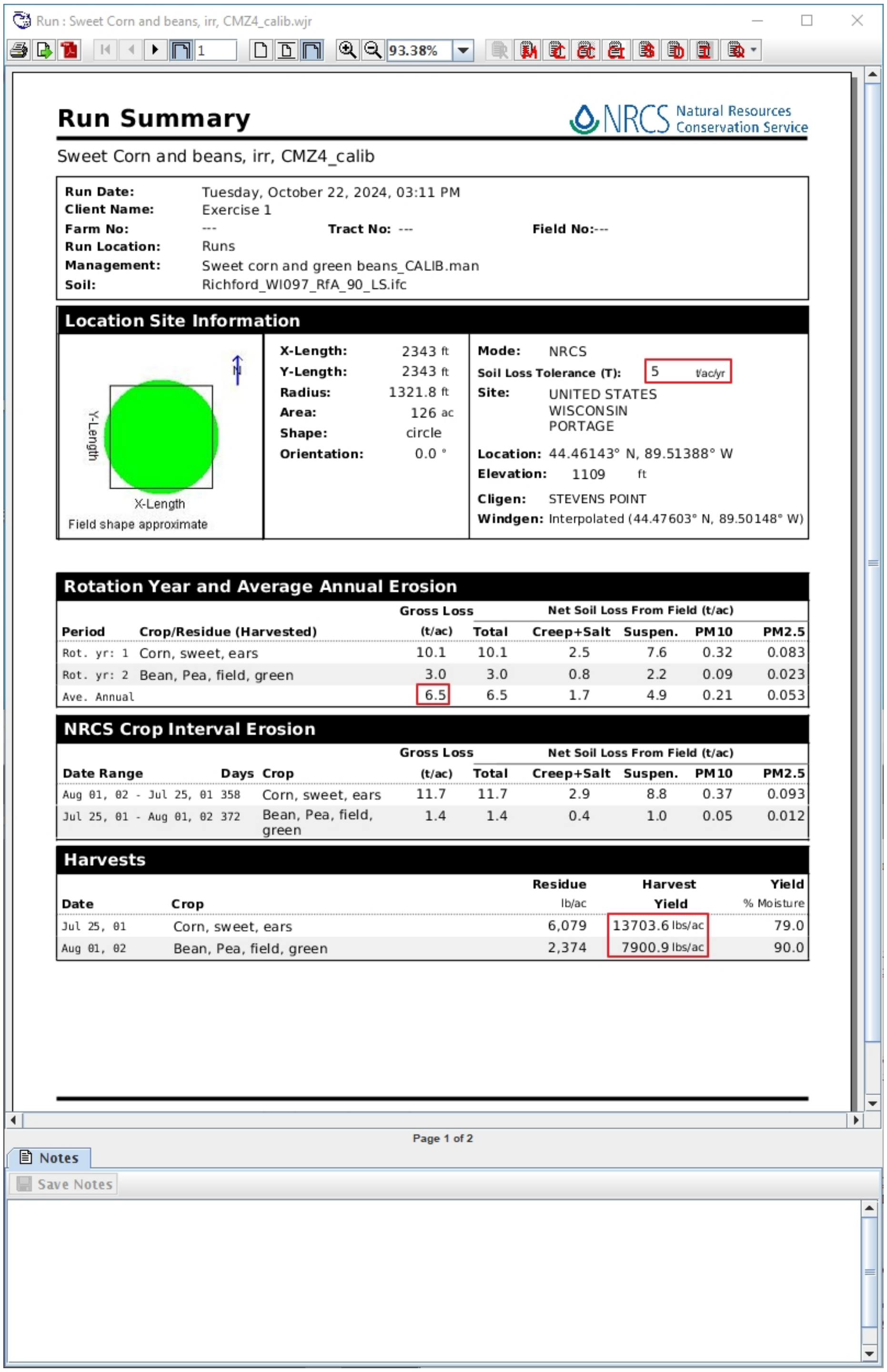



Figure 19.29: Calibrated management file shown loaded automatically into WEPS interface.

Upon completion of the calibration run, the WEPS Run Summary report window also appeared (Fig. 19.30). The Run Summary simulation reports an Average Annual Gross Soil Loss of **6.5 tons/acre**. This still exceeds the T-value (Soil Loss Tolerance) of **5 t/ac/yr**.



Run : Sweet Corn and beans, irr, CMZ4_calib.wjr

**Run Summary**

NRCS Natural Resources Conservation Service

Sweet Corn and beans, irr, CMZ4_calib

**Run Date:** Tuesday, October 22, 2024, 03:11 PM
**Client Name:** Exercise 1
**Farm No:** --- **Tract No:** --- **Field No:**---
**Run Location:** Runs
**Management:** Sweet corn and green beans_CALIB.man
**Soil:** Richford_WI097_RfA_90_LS.ifc

**Location Site Information**

Y-Length
X-Length
Field shape approximate

| | |
|---|---|
| **X-Length:** | 2343 ft |
| **Y-Length:** | 2343 ft |
| **Radius:** | 1321.8 ft |
| **Area:** | 126 ac |
| **Shape:** | circle |
| **Orientation:** | 0.0 ° |

**Mode:** NRCS
**Soil Loss Tolerance (T):** 5 t/ac/yr
**Site:** UNITED STATES WISCONSIN PORTAGE
**Location:** 44.46143° N, 89.51388° W
**Elevation:** 1109 ft
**Cligen:** STEVENS POINT
**Windgen:** Interpolated (44.47603° N, 89.50148° W)

**Rotation Year and Average Annual Erosion**

| Period | Crop/Residue (Harvested) | Gross Loss (t/ac) | Net Soil Loss From Field (t/ac) Total | Creep+Salt | Suspen. | PM10 | PM2.5 |
|---|---|---|---|---|---|---|---|
| Rot. yr: 1 | Corn, sweet, ears | 10.1 | 10.1 | 2.5 | 7.6 | 0.32 | 0.083 |
| Rot. yr: 2 | Bean, Pea, field, green | 3.0 | 3.0 | 0.8 | 2.2 | 0.09 | 0.023 |
| Ave. Annual | | 6.5 | 6.5 | 1.7 | 4.9 | 0.21 | 0.053 |

**NRCS Crop Interval Erosion**

| Date Range | Days | Crop | Gross Loss (t/ac) | Net Soil Loss From Field (t/ac) Total | Creep+Salt | Suspen. | PM10 | PM2.5 |
|---|---|---|---|---|---|---|---|---|
| Aug 01, 02 - Jul 25, 01 | 358 | Corn, sweet, ears | 11.7 | 11.7 | 2.9 | 8.8 | 0.37 | 0.093 |
| Jul 25, 01 - Aug 01, 02 | 372 | Bean, Pea, field, green | 1.4 | 1.4 | 0.4 | 1.0 | 0.05 | 0.012 |

**Harvests**

| Date | Crop | Residue lb/ac | Harvest Yield | Yield % Moisture |
|---|---|---|---|---|
| Jul 25, 01 | Corn, sweet, ears | 6,079 | 13703.6 lbs/ac | 79.0 |
| Aug 01, 02 | Bean, Pea, field, green | 2,374 | 7900.9 lbs/ac | 90.0 |

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Notes

Save Notes

Figure 19.30: WEPS Run Summary report showing new results from the Yield Calibration run.

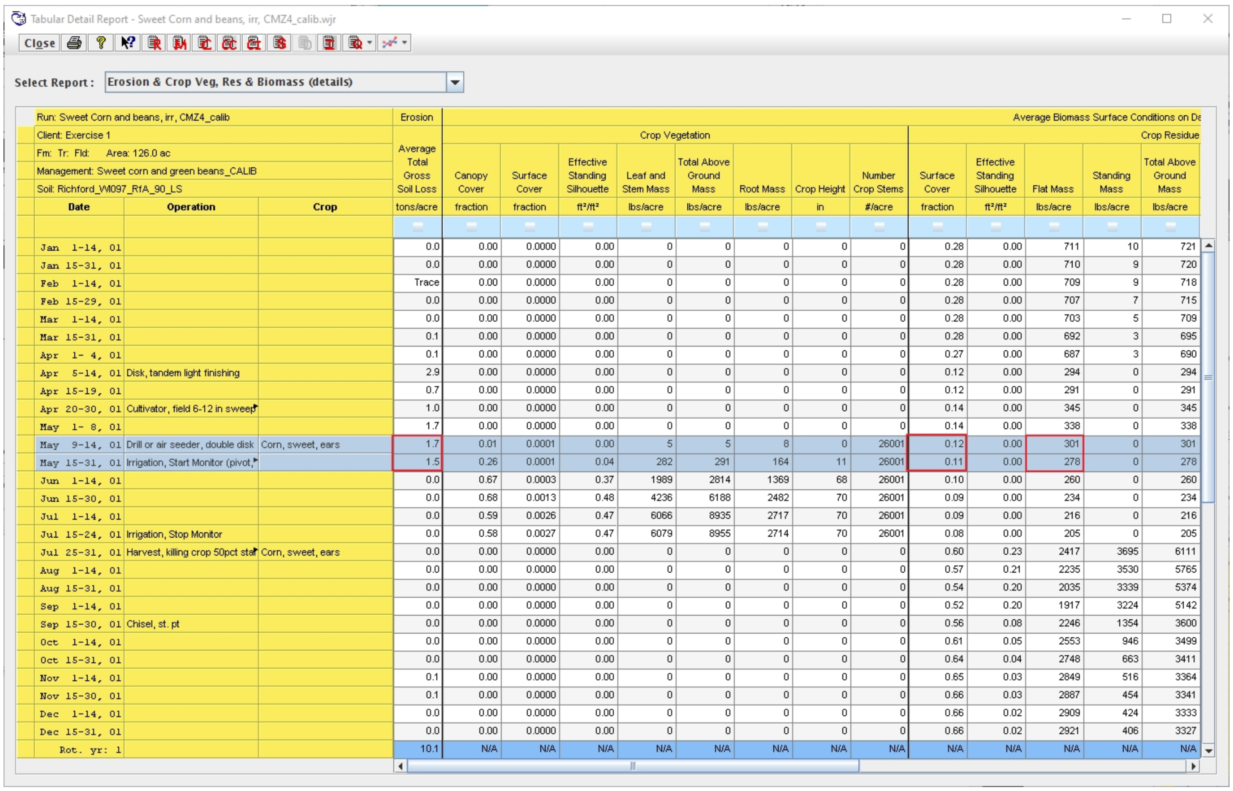
**Question:** Are the yields within the ±5% of the target yields desired now?

**Answer:** Yes, **13,703.6 lbs/ac** of sweet corn is close enough to the target yield of **14,000** and **7,900.9 lbs/ac** of green beans is close enough to **8,100**.

**Question:** Is the percent ground cover and mass of flat residue after seeding adequate to protect both seedling stages of both crops?

Hint: Click the Detailed Tabular Report button in the Summary Report toolbar. Near the top of the Detailed Report there is a window that allows the user to 'Select Report'. This should display *Erosion & Crop Veg, Res & Biomass (details)* as the default. If not, click the drop-down arrow and select it from the list.

The Detail Tabular Report includes a date-ordered list of output parameters by periods (every 15 days or the period between management operations). This detail tabular report shows the viewer the amount of cover and flat residue after seeding each crop (Fig. 19.31 and Fig. 19.32).


Tabular Detail Report - Sweet Corn and beans, irr, CMZ4_calib.wjr

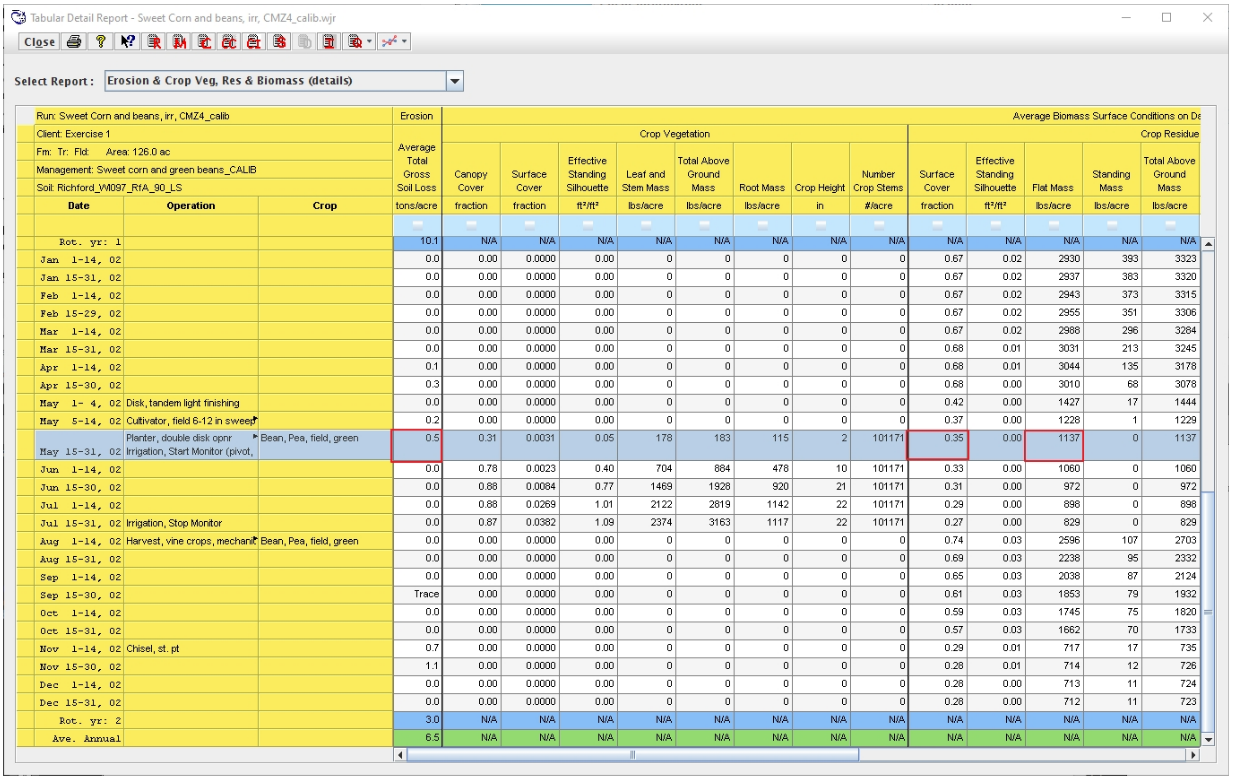
Close

Select Report : Erosion & Crop Veg, Res & Biomass (details)

Run: Sweet Corn and beans, irr, CMZ4_calib
Client: Exercise 1
Fm: Tr: Fld: Area: 126.0 ac
Management: Sweet corn and green beans_CALIB
Soil: Richford_WI097_RfA_90_LS

| | | | Erosion | Average Biomass Surface Conditions on De | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Crop Vegetation | | | | | | | | | Crop Residue | | | | |
| | | | Average Total Gross Soil Loss | Canopy Cover | Surface Cover | Effective Standing Silhouette | Leaf and Stem Mass | Total Above Ground Mass | Root Mass | Crop Height | Number Crop Stems | Surface Cover | Effective Standing Silhouette | Flat Mass | Standing Mass | Total Above Ground Mass |
| Date | Operation | Crop | tons/acre | fraction | fraction | ft²/ft² | lbs/acre | lbs/acre | lbs/acre | in | #/acre | fraction | ft²/ft² | lbs/acre | lbs/acre | lbs/acre |
| Jan 1-14, 01 | | | 0.0 | 0.00 | 0.0000 | 0.00 | 0 | 0 | 0 | 0 | 0 | 0.28 | 0.00 | 711 | 10 | 721 |
| Jan 15-31, 01 | | | 0.0 | 0.00 | 0.0000 | 0.00 | 0 | 0 | 0 | 0 | 0 | 0.28 | 0.00 | 710 | 9 | 720 |
| Feb 1-14, 01 | | | Trace | 0.00 | 0.0000 | 0.00 | 0 | 0 | 0 | 0 | 0 | 0.28 | 0.00 | 709 | 9 | 718 |
| Feb 15-29, 01 | | | 0.0 | 0.00 | 0.0000 | 0.00 | 0 | 0 | 0 | 0 | 0 | 0.28 | 0.00 | 707 | 7 | 715 |
| Mar 1-14, 01 | | | 0.0 | 0.00 | 0.0000 | 0.00 | 0 | 0 | 0 | 0 | 0 | 0.28 | 0.00 | 703 | 5 | 709 |
| Mar 15-31, 01 | | | 0.1 | 0.00 | 0.0000 | 0.00 | 0 | 0 | 0 | 0 | 0 | 0.28 | 0.00 | 692 | 3 | 695 |
| Apr 1- 4, 01 | | | 0.1 | 0.00 | 0.0000 | 0.00 | 0 | 0 | 0 | 0 | 0 | 0.27 | 0.00 | 687 | 3 | 690 |
| Apr 5-14, 01 | Disk, tandem light finishing | | 2.9 | 0.00 | 0.0000 | 0.00 | 0 | 0 | 0 | 0 | 0 | 0.12 | 0.00 | 294 | 0 | 294 |
| Apr 15-19, 01 | | | 0.7 | 0.00 | 0.0000 | 0.00 | 0 | 0 | 0 | 0 | 0 | 0.12 | 0.00 | 291 | 0 | 291 |
| Apr 20-30, 01 | Cultivator, field 6-12 in sweep | | 1.0 | 0.00 | 0.0000 | 0.00 | 0 | 0 | 0 | 0 | 0 | 0.14 | 0.00 | 345 | 0 | 345 |
| May 1- 8, 01 | | | 1.7 | 0.00 | 0.0000 | 0.00 | 0 | 0 | 0 | 0 | 0 | 0.14 | 0.00 | 338 | 0 | 338 |
| May 9-14, 01 | Drill or air seeder, double disk | Corn, sweet, ears | 1.7 | 0.01 | 0.0001 | 0.00 | 5 | 5 | 8 | 0 | 26001 | 0.12 | 0.00 | 301 | 0 | 301 |
| May 15-31, 01 | Irrigation, Start Monitor (pivot, | | 1.5 | 0.26 | 0.0001 | 0.04 | 282 | 291 | 164 | 11 | 26001 | 0.11 | 0.00 | 278 | 0 | 278 |
| Jun 1-14, 01 | | | 0.0 | 0.67 | 0.0003 | 0.37 | 1989 | 2814 | 1369 | 68 | 26001 | 0.10 | 0.00 | 260 | 0 | 260 |
| Jun 15-30, 01 | | | 0.0 | 0.68 | 0.0013 | 0.48 | 4236 | 6188 | 2482 | 70 | 26001 | 0.09 | 0.00 | 234 | 0 | 234 |
| Jul 1-14, 01 | | | 0.0 | 0.59 | 0.0026 | 0.47 | 6066 | 8935 | 2717 | 70 | 26001 | 0.09 | 0.00 | 216 | 0 | 216 |
| Jul 15-24, 01 | Irrigation, Stop Monitor | | 0.0 | 0.58 | 0.0027 | 0.47 | 6079 | 8955 | 2714 | 70 | 26001 | 0.08 | 0.00 | 205 | 0 | 205 |
| Jul 25-31, 01 | Harvest, killing crop 50pct sta | Corn, sweet, ears | 0.0 | 0.00 | 0.0000 | 0.00 | 0 | 0 | 0 | 0 | 0 | 0.60 | 0.23 | 2417 | 3695 | 6111 |
| Aug 1-14, 01 | | | 0.0 | 0.00 | 0.0000 | 0.00 | 0 | 0 | 0 | 0 | 0 | 0.57 | 0.21 | 2235 | 3530 | 5765 |
| Aug 15-31, 01 | | | 0.0 | 0.00 | 0.0000 | 0.00 | 0 | 0 | 0 | 0 | 0 | 0.54 | 0.20 | 2035 | 3339 | 5374 |
| Sep 1-14, 01 | | | 0.0 | 0.00 | 0.0000 | 0.00 | 0 | 0 | 0 | 0 | 0 | 0.52 | 0.20 | 1917 | 3224 | 5142 |
| Sep 15-30, 01 | Chisel, st. pt | | 0.0 | 0.00 | 0.0000 | 0.00 | 0 | 0 | 0 | 0 | 0 | 0.56 | 0.08 | 2246 | 1354 | 3600 |
| Oct 1-14, 01 | | | 0.0 | 0.00 | 0.0000 | 0.00 | 0 | 0 | 0 | 0 | 0 | 0.61 | 0.05 | 2553 | 946 | 3499 |
| Oct 15-31, 01 | | | 0.0 | 0.00 | 0.0000 | 0.00 | 0 | 0 | 0 | 0 | 0 | 0.64 | 0.04 | 2748 | 663 | 3411 |
| Nov 1-14, 01 | | | 0.1 | 0.00 | 0.0000 | 0.00 | 0 | 0 | 0 | 0 | 0 | 0.65 | 0.03 | 2849 | 516 | 3364 |
| Nov 15-30, 01 | | | 0.1 | 0.00 | 0.0000 | 0.00 | 0 | 0 | 0 | 0 | 0 | 0.66 | 0.03 | 2887 | 454 | 3341 |
| Dec 1-14, 01 | | | 0.0 | 0.00 | 0.0000 | 0.00 | 0 | 0 | 0 | 0 | 0 | 0.66 | 0.02 | 2909 | 424 | 3333 |
| Dec 15-31, 01 | | | 0.0 | 0.00 | 0.0000 | 0.00 | 0 | 0 | 0 | 0 | 0 | 0.66 | 0.02 | 2921 | 406 | 3327 |
| Rot. yr: 1 | | | 10.1 | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |

Figure 19.31: Detailed Report showing soil loss and residue amounts after planting sweet corn, Year 1.


Tabular Detail Report - Sweet Corn and beans, irr, CMZ4_calib.wjr

Select Report : Erosion & Crop Veg, Res & Biomass (details)

Run: Sweet Corn and beans, irr, CMZ4_calib
Client: Exercise 1
Fm: Tr: Fld: Area: 126.0 ac
Management: Sweet corn and green beans_CALIB
Soil: Richford_WI097_RfA_90_LS

| | | | Erosion | Average Biomass Surface Conditions on Da | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Crop Vegetation | | | | | | | | Crop Residue | | | | |
| | | | Average Total Gross Soil Loss | Canopy Cover | Surface Cover | Effective Standing Silhouette | Leaf and Stem Mass | Total Above Ground Mass | Root Mass | Crop Height | Number Crop Stems | Surface Cover | Effective Standing Silhouette | Flat Mass | Standing Mass | Total Above Ground Mass |
| Date | Operation | Crop | tons/acre | fraction | fraction | ft²/ft² | lbs/acre | lbs/acre | lbs/acre | in | #/acre | fraction | ft²/ft² | lbs/acre | lbs/acre | lbs/acre |
| Rot. yr: 1 | | | 10.1 | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| Jan 1-14, 02 | | | 0.0 | 0.00 | 0.0000 | 0.00 | 0 | 0 | 0 | 0 | 0 | 0.67 | 0.02 | 2930 | 393 | 3323 |
| Jan 15-31, 02 | | | 0.0 | 0.00 | 0.0000 | 0.00 | 0 | 0 | 0 | 0 | 0 | 0.67 | 0.02 | 2937 | 383 | 3320 |
| Feb 1-14, 02 | | | 0.0 | 0.00 | 0.0000 | 0.00 | 0 | 0 | 0 | 0 | 0 | 0.67 | 0.02 | 2943 | 373 | 3315 |
| Feb 15-29, 02 | | | 0.0 | 0.00 | 0.0000 | 0.00 | 0 | 0 | 0 | 0 | 0 | 0.67 | 0.02 | 2955 | 351 | 3306 |
| Mar 1-14, 02 | | | 0.0 | 0.00 | 0.0000 | 0.00 | 0 | 0 | 0 | 0 | 0 | 0.67 | 0.02 | 2988 | 296 | 3284 |
| Mar 15-31, 02 | | | 0.0 | 0.00 | 0.0000 | 0.00 | 0 | 0 | 0 | 0 | 0 | 0.68 | 0.01 | 3031 | 213 | 3245 |
| Apr 1-14, 02 | | | 0.1 | 0.00 | 0.0000 | 0.00 | 0 | 0 | 0 | 0 | 0 | 0.68 | 0.01 | 3044 | 135 | 3178 |
| Apr 15-30, 02 | | | 0.3 | 0.00 | 0.0000 | 0.00 | 0 | 0 | 0 | 0 | 0 | 0.68 | 0.00 | 3010 | 68 | 3078 |
| May 1- 4, 02 | Disk, tandem light finishing | | 0.0 | 0.00 | 0.0000 | 0.00 | 0 | 0 | 0 | 0 | 0 | 0.42 | 0.00 | 1427 | 17 | 1444 |
| May 5-14, 02 | Cultivator, field 6-12 in sweep | | 0.2 | 0.00 | 0.0000 | 0.00 | 0 | 0 | 0 | 0 | 0 | 0.37 | 0.00 | 1228 | 1 | 1229 |
| May 15-31, 02 | Planter, double disk opnr<br>Irrigation, Start Monitor (pivot, | Bean, Pea, field, green | 0.5 | 0.31 | 0.0031 | 0.05 | 178 | 183 | 115 | 2 | 101171 | 0.35 | 0.00 | 1137 | 0 | 1137 |
| Jun 1-14, 02 | | | 0.0 | 0.78 | 0.0023 | 0.40 | 704 | 884 | 478 | 10 | 101171 | 0.33 | 0.00 | 1060 | 0 | 1060 |
| Jun 15-30, 02 | | | 0.0 | 0.88 | 0.0084 | 0.77 | 1469 | 1928 | 920 | 21 | 101171 | 0.31 | 0.00 | 972 | 0 | 972 |
| Jul 1-14, 02 | | | 0.0 | 0.88 | 0.0269 | 1.01 | 2122 | 2819 | 1142 | 22 | 101171 | 0.29 | 0.00 | 898 | 0 | 898 |
| Jul 15-31, 02 | Irrigation, Stop Monitor | | 0.0 | 0.87 | 0.0382 | 1.09 | 2374 | 3163 | 1117 | 22 | 101171 | 0.27 | 0.00 | 829 | 0 | 829 |
| Aug 1-14, 02 | Harvest, vine crops, mechanic | Bean, Pea, field, green | 0.0 | 0.00 | 0.0000 | 0.00 | 0 | 0 | 0 | 0 | 0 | 0.74 | 0.03 | 2596 | 107 | 2703 |
| Aug 15-31, 02 | | | 0.0 | 0.00 | 0.0000 | 0.00 | 0 | 0 | 0 | 0 | 0 | 0.69 | 0.03 | 2238 | 95 | 2332 |
| Sep 1-14, 02 | | | 0.0 | 0.00 | 0.0000 | 0.00 | 0 | 0 | 0 | 0 | 0 | 0.65 | 0.03 | 2038 | 87 | 2124 |
| Sep 15-30, 02 | | | Trace | 0.00 | 0.0000 | 0.00 | 0 | 0 | 0 | 0 | 0 | 0.61 | 0.03 | 1853 | 79 | 1932 |
| Oct 1-14, 02 | | | 0.0 | 0.00 | 0.0000 | 0.00 | 0 | 0 | 0 | 0 | 0 | 0.59 | 0.03 | 1745 | 75 | 1820 |
| Oct 15-31, 02 | | | 0.0 | 0.00 | 0.0000 | 0.00 | 0 | 0 | 0 | 0 | 0 | 0.57 | 0.03 | 1662 | 70 | 1733 |
| Nov 1-14, 02 | Chisel, st. pt | | 0.7 | 0.00 | 0.0000 | 0.00 | 0 | 0 | 0 | 0 | 0 | 0.29 | 0.01 | 717 | 17 | 735 |
| Nov 15-30, 02 | | | 1.1 | 0.00 | 0.0000 | 0.00 | 0 | 0 | 0 | 0 | 0 | 0.28 | 0.01 | 714 | 12 | 726 |
| Dec 1-14, 02 | | | 0.0 | 0.00 | 0.0000 | 0.00 | 0 | 0 | 0 | 0 | 0 | 0.28 | 0.00 | 713 | 11 | 724 |
| Dec 15-31, 02 | | | 0.0 | 0.00 | 0.0000 | 0.00 | 0 | 0 | 0 | 0 | 0 | 0.28 | 0.00 | 712 | 11 | 723 |
| Rot. yr: 2 | | | 3.0 | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| Ave. Annual | | | 6.5 | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |

Figure 19.32: Detailed Report showing soil loss and residue amounts after planting green beans, Year 2.

By examining the Detailed Report table, you will see that bean residue after planting sweet corn (May 9-14, 01) was 12% (0.12 fraction) Surface Cover and 301 lbs/ac flat mass (Fig. 19.31). The corn residue after planting beans (May 15-31, 02) was 35% (0.35 fraction) surface cover and about 1137 lbs/ac flat mass (Fig. 19.32).

**Answer:** These amounts do not provide enough wind erosion protection and WEPS estimates an Average Total Gross Soil Loss after planting the corn to be **3.5 t/ac**, the sum of gross soil losses (1.9 + 1.6) for the period May 9 - 31, 01. There is a high probability of damage to the young sweet corn seedlings by blowing soil. Only **0.5 t/ac** is lost after planting the green beans for the period May 15 - Jun 14, 02, so the risk is probably low for them.

This is verified by checking the NRCS National Agronomy Manual which has a Crop Tolerance[10] to blowing soil table that lists sweet corn under the heading of **2 t/ac** in the **Moderate** tolerance column (see Table 19.1). The green beans are under the **Low Tolerance** column of **1 t/ac**. Thus, there is a seedling damage issue for the sweet corn in this management scenario and the green beans are ok based on this table's criteria.

[10]Crop tolerance is defined as the maximum wind erosion that a growing crop can tolerate, from crop emergence to field stabilization, without an economic loss to stand, yield, or quality.

Table 19.1: Crop tolerances used by NRCS to design wind erosion control methods (USDA-NRCS, 2000)

| **Tolerant* "T"** | **Moderate (2 t/ac)** | **Low Tolerance (1 t/ac)** | **Very Low (0-0.5 t/ac)** |
|---|---|---|---|
| Barley | Alfalfa (mature) | Broccoli | Alfalfa (seedlings) |
| Buckwheat | Corn | Cabbage | Asparagus |
| Flax | Onions ($>$ 30 days) | Cotton | Cantaloupe |
| Grain Sorghum | Orchard Crops | Cucumbers | Carrots |
| Millet | Soybeans | Garlic | Celery |
| Oats | Sunflowers | Green/Snap Beans | Eggplant |
| Rye | Sweet Corn | Lima Beans | Flowers |
| Wheat | | Peanuts | Kiwi Fruit |
| | | Peas | Lettuce |
| | | Potatoes | Muskmelons |
| | | Sweet Potatoes | Onion (seedlings) |
| | | Tobacco | Peppers |
| | | | Spinach |
| | | | Squash |
| | | | Strawberries |
| | | | Sugar Beets |
| | | | Table Beets |
| | | | Tomatoes |
| | | | Watermelons |

* USDA-NRCS. 2011. National Agronomy Manual, Part 502-Wind Erosion, 190-V NAM. 4th Edition. Washington, D. C.

There is an alternative method to looking at whether the erosion after planting is possibly severe enough to damage the young seedlings by reviewing one of the default QuickPlots. They are available from the main WEPS GUI Toolbar or via the "QuickPlots" Menu, (Fig. 19.33) as well as from the Toolbars on all of the standard WEPS Reports.

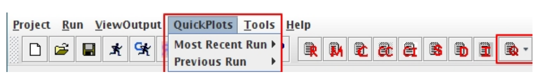



Figure 19.33: QuickPlot Menu and Toolbar options accessible from Main WEPS GUI screen.

Shown here is the default QuickPlot graph titled **Wind Erosion Soil Loss (Creep+Salt, Susp)** displaying the saltation/creep and suspension soil loss by date periods as represented on the plot for the entire two year management rotation (Fig. 19.34). Erosive periods immediately after planting periods, which could contribute to plant damage are identified in **red**.

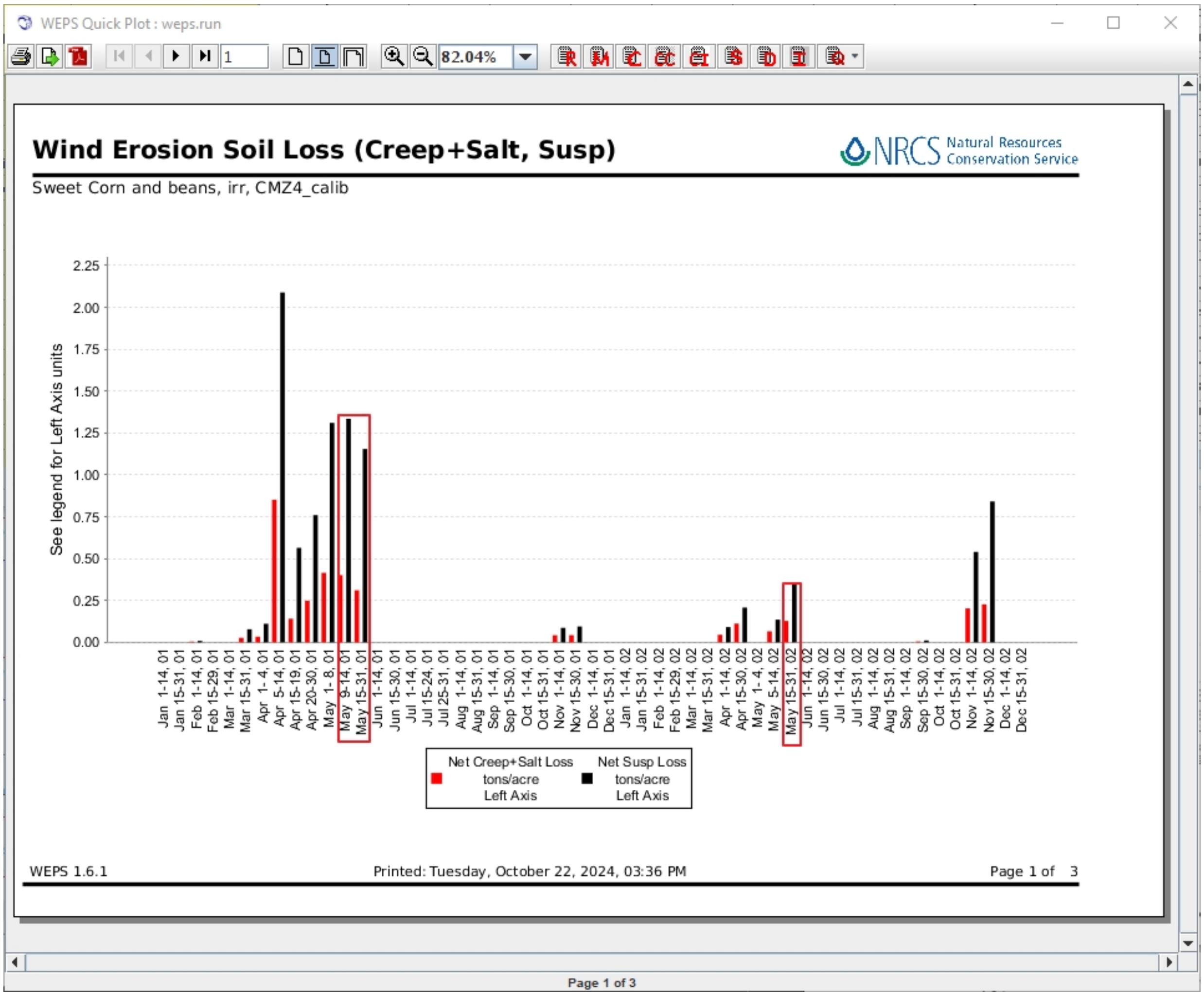



Figure 19.34: QuickPlot erosion loss with after planting periods identified.

Note that since we are displaying the creep and saltation erosion component separately, which is the primary transport mode which usually causes the most damage to young seedlings by bombarding the above ground leaves and stems with saltation size particles, causing physical damage to the plants. In addition, soil loss due to both creep/saltation and direct emissions can also be severe enough to extract sufficient soil mass from the surface to expose seedling roots and potentially blowing out the planted seeds and young seedlings entirely. Likewise, deposition in other areas of the field can bury the entire plant below the surface as well.

### 19.2.7 Select a Cover Crop

Most of the erosion occurs after the green beans are harvested, which may also impact the growing sweet corn seedlings. In addition, there is good rainfall during that time period, so a winter annual such as winter wheat or a rye cover crop could be a solution for helping to better conserve the soil and reduce the risk of wind erosion damage to the young seedlings planted into the cover crop residue.

Since we are wanting to both reduce wind erosion following the harvest of the green beans and better protect the sweet corn seedlings after planting into the limited green bean residue cover, we will insert a rye cover crop following the green bean harvest.

**Complete the following steps**

*Step 1:* Return to the interface and open MCREW again with the recently calibrated management file.

*Step 1a:* Edit that management file by replacing the second **Chisel, st. pt** operation (last operation listed in MCREW) with **Drill or air seeder, double disk** operation.

*Step 1b:* Select the **Rye, cereal, winter, grain** crop record for that planting operation to grow that cover crop.

*Step 1c:* Also change the planting date of the (**Rye, cereal, winter, grain** crop to **Oct 5, rotation year 2** as shown in Fig. 19.35 as well.

The first listed **Disk, tandem light finishing** operation will terminate this cover crop on the date specified for that operation (Apr 05, 01).

*Step 2:* Save the modified rotation file with a new name (**Sweet corn and green beans_CALIB_rye_cover_ crop**) to identify the management rotation as including a rye cover crop.

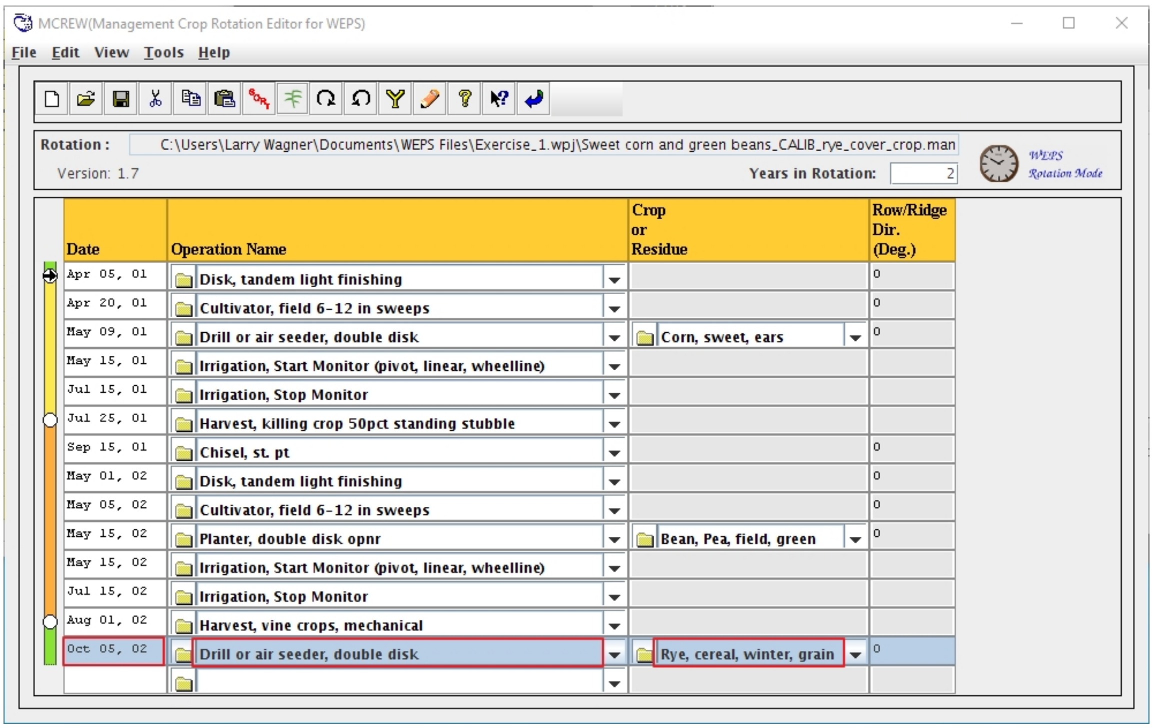



Figure 19.35: Management rotation modified to include Rye Cover Crop.

## 19.2.8 Make a Regular WEPS Run with Cover Crop

Make a new regular WEPS simulation run and name it: **Sweet Corn and beans, green, irr, rye cover crop, CMZ4** to identify the run as having a rye cover crop and to distinguish it from the previous original and yield calibration runs (ignore the cover crop maturity warning messages since the cover crop is not being harvested). Note that we do not want to run another Yield Calibration Run since we have not changed the crops we are growing and we want to be able to detect the effect on crop water availability on the cash crops, if any, due to growing an off-season cover crop. Although, since we have irrigation in this scenario, such an effect should be minimal.

Upon completion of the WebStart WEPS simulation, a warning message will appear that mentions that the rye cover crop did not reach maturity before being terminated. This message can be ignored since we are not harvesting the cover crop for grain.

The WEPS Run Summary report (Fig. 19.36) now shows the Average Annual Soil Loss at **4.4 t/ac**; well below the Soil Loss Tolerance of **5 t/ac**.

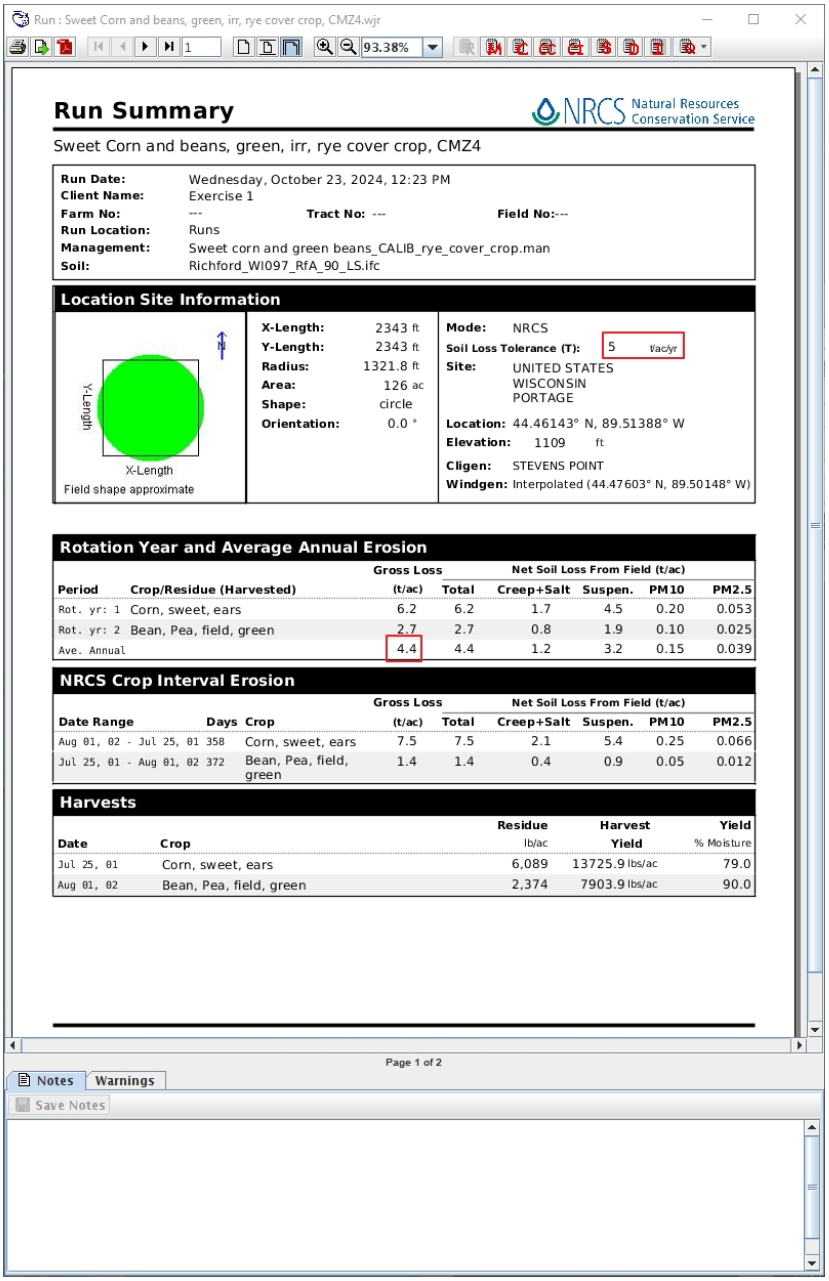
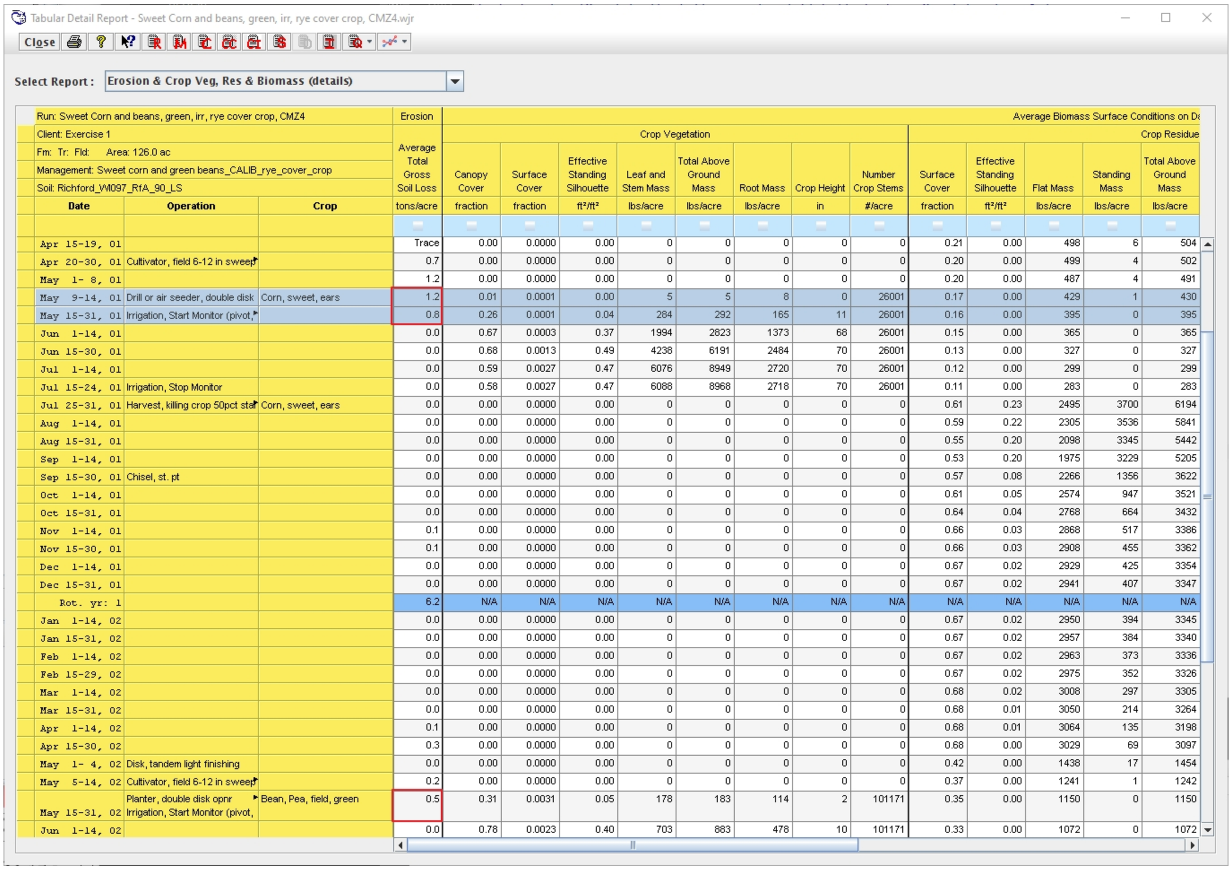



Figure 19.36: Summary Report showing that the rye cover crop reduced Gross Loss below Soil Loss Tolerance.

Reviewing the Tabular Detail Report (Fig. 19.37) shows that the erosion loss after planting time for green beans (**0.5 t/ac**) as shown in Fig. 19.37 are below their erosion damage threshold of **1.0 t/ac** (Table 19.1).

However, the sweet corn seedlings are still at a higher risk to wind erosion damage than desired (**1.2 + 0.8 = 2.0 t/ac**) as shown in Fig. Fig. 19.37, which is at the **2 t/ac** threshold specified in Table 19.1 for sweet corn.



Tabular Detail Report - Sweet Corn and beans, green, irr, rye cover crop, CMZ4.wjr

Close

Select Report : Erosion & Crop Veg, Res & Biomass (details)

Run: Sweet Corn and beans, green, irr, rye cover crop, CMZ4
Client: Exercise 1
Fm: Tr: Fld: Area: 126.0 ac
Management: Sweet corn and green beans_CALIB_rye_cover_crop
Soil: Richford_WI097_RfA_90_LS

| | | | Erosion | Average Biomass Surface Conditions on D… | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Crop Vegetation | | | | | | | | | Crop Residue | | | |
| Date | Operation | Crop | Average Total Gross Soil Loss (tons/acre) | Canopy Cover (fraction) | Surface Cover (fraction) | Effective Standing Silhouette (ft²/ft²) | Leaf and Stem Mass (lbs/acre) | Total Above Ground Mass (lbs/acre) | Root Mass (lbs/acre) | Crop Height (in) | Number Crop Stems (#/acre) | Surface Cover (fraction) | Effective Standing Silhouette (ft²/ft²) | Flat Mass (lbs/acre) | Standing Mass (lbs/acre) | Total Above Ground Mass (lbs/acre) |
| Apr 15-19, 01 | | | Trace | 0.00 | 0.0000 | 0.00 | 0 | 0 | 0 | 0 | 0 | 0.21 | 0.00 | 498 | 6 | 504 |
| Apr 20-30, 01 | Cultivator, field 6-12 in sweep | | 0.7 | 0.00 | 0.0000 | 0.00 | 0 | 0 | 0 | 0 | 0 | 0.20 | 0.00 | 499 | 4 | 502 |
| May 1- 8, 01 | | | 1.2 | 0.00 | 0.0000 | 0.00 | 0 | 0 | 0 | 0 | 0 | 0.20 | 0.00 | 487 | 4 | 491 |
| May 9-14, 01 | Drill or air seeder, double disk | Corn, sweet, ears | 1.2 | 0.01 | 0.0001 | 0.00 | 5 | 5 | 8 | 0 | 26001 | 0.17 | 0.00 | 429 | 1 | 430 |
| May 15-31, 01 | Irrigation, Start Monitor (pivot, | | 0.8 | 0.26 | 0.0001 | 0.04 | 284 | 292 | 165 | 11 | 26001 | 0.16 | 0.00 | 395 | 0 | 395 |
| Jun 1-14, 01 | | | 0.0 | 0.67 | 0.0003 | 0.37 | 1994 | 2823 | 1373 | 68 | 26001 | 0.15 | 0.00 | 365 | 0 | 365 |
| Jun 15-30, 01 | | | 0.0 | 0.68 | 0.0013 | 0.49 | 4238 | 6191 | 2484 | 70 | 26001 | 0.13 | 0.00 | 327 | 0 | 327 |
| Jul 1-14, 01 | | | 0.0 | 0.59 | 0.0027 | 0.47 | 6076 | 8949 | 2720 | 70 | 26001 | 0.12 | 0.00 | 299 | 0 | 299 |
| Jul 15-24, 01 | Irrigation, Stop Monitor | | 0.0 | 0.58 | 0.0027 | 0.47 | 6088 | 8968 | 2718 | 70 | 26001 | 0.11 | 0.00 | 283 | 0 | 283 |
| Jul 25-31, 01 | Harvest, killing crop 50pct sta | Corn, sweet, ears | 0.0 | 0.00 | 0.0000 | 0.00 | 0 | 0 | 0 | 0 | 0 | 0.61 | 0.23 | 2495 | 3700 | 6194 |
| Aug 1-14, 01 | | | 0.0 | 0.00 | 0.0000 | 0.00 | 0 | 0 | 0 | 0 | 0 | 0.59 | 0.22 | 2305 | 3536 | 5841 |
| Aug 15-31, 01 | | | 0.0 | 0.00 | 0.0000 | 0.00 | 0 | 0 | 0 | 0 | 0 | 0.55 | 0.20 | 2098 | 3345 | 5442 |
| Sep 1-14, 01 | | | 0.0 | 0.00 | 0.0000 | 0.00 | 0 | 0 | 0 | 0 | 0 | 0.53 | 0.20 | 1975 | 3229 | 5205 |
| Sep 15-30, 01 | Chisel, st. pt | | 0.0 | 0.00 | 0.0000 | 0.00 | 0 | 0 | 0 | 0 | 0 | 0.57 | 0.08 | 2266 | 1356 | 3622 |
| Oct 1-14, 01 | | | 0.0 | 0.00 | 0.0000 | 0.00 | 0 | 0 | 0 | 0 | 0 | 0.61 | 0.05 | 2574 | 947 | 3521 |
| Oct 15-31, 01 | | | 0.0 | 0.00 | 0.0000 | 0.00 | 0 | 0 | 0 | 0 | 0 | 0.64 | 0.04 | 2768 | 664 | 3432 |
| Nov 1-14, 01 | | | 0.1 | 0.00 | 0.0000 | 0.00 | 0 | 0 | 0 | 0 | 0 | 0.66 | 0.03 | 2868 | 517 | 3386 |
| Nov 15-30, 01 | | | 0.1 | 0.00 | 0.0000 | 0.00 | 0 | 0 | 0 | 0 | 0 | 0.66 | 0.03 | 2908 | 455 | 3362 |
| Dec 1-14, 01 | | | 0.0 | 0.00 | 0.0000 | 0.00 | 0 | 0 | 0 | 0 | 0 | 0.67 | 0.02 | 2929 | 425 | 3354 |
| Dec 15-31, 01 | | | 0.0 | 0.00 | 0.0000 | 0.00 | 0 | 0 | 0 | 0 | 0 | 0.67 | 0.02 | 2941 | 407 | 3347 |
| Rot. yr: 1 | | | 6.2 | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| Jan 1-14, 02 | | | 0.0 | 0.00 | 0.0000 | 0.00 | 0 | 0 | 0 | 0 | 0 | 0.67 | 0.02 | 2950 | 394 | 3345 |
| Jan 15-31, 02 | | | 0.0 | 0.00 | 0.0000 | 0.00 | 0 | 0 | 0 | 0 | 0 | 0.67 | 0.02 | 2957 | 384 | 3340 |
| Feb 1-14, 02 | | | 0.0 | 0.00 | 0.0000 | 0.00 | 0 | 0 | 0 | 0 | 0 | 0.67 | 0.02 | 2963 | 373 | 3336 |
| Feb 15-29, 02 | | | 0.0 | 0.00 | 0.0000 | 0.00 | 0 | 0 | 0 | 0 | 0 | 0.67 | 0.02 | 2975 | 352 | 3326 |
| Mar 1-14, 02 | | | 0.0 | 0.00 | 0.0000 | 0.00 | 0 | 0 | 0 | 0 | 0 | 0.68 | 0.02 | 3008 | 297 | 3305 |
| Mar 15-31, 02 | | | 0.0 | 0.00 | 0.0000 | 0.00 | 0 | 0 | 0 | 0 | 0 | 0.68 | 0.01 | 3050 | 214 | 3264 |
| Apr 1-14, 02 | | | 0.1 | 0.00 | 0.0000 | 0.00 | 0 | 0 | 0 | 0 | 0 | 0.68 | 0.01 | 3064 | 135 | 3198 |
| Apr 15-30, 02 | | | 0.3 | 0.00 | 0.0000 | 0.00 | 0 | 0 | 0 | 0 | 0 | 0.68 | 0.00 | 3029 | 69 | 3097 |
| May 1- 4, 02 | Disk, tandem light finishing | | 0.0 | 0.00 | 0.0000 | 0.00 | 0 | 0 | 0 | 0 | 0 | 0.42 | 0.00 | 1438 | 17 | 1454 |
| May 5-14, 02 | Cultivator, field 6-12 in sweep | | 0.2 | 0.00 | 0.0000 | 0.00 | 0 | 0 | 0 | 0 | 0 | 0.37 | 0.00 | 1241 | 1 | 1242 |
| May 15-31, 02 | Planter, double disk opnr<br>Irrigation, Start Monitor (pivot, | Bean, Pea, field, green | 0.5 | 0.31 | 0.0031 | 0.05 | 178 | 183 | 114 | 2 | 101171 | 0.35 | 0.00 | 1150 | 0 | 1150 |
| Jun 1-14, 02 | | | 0.0 | 0.78 | 0.0023 | 0.40 | 703 | 883 | 478 | 10 | 101171 | 0.33 | 0.00 | 1072 | 0 | 1072 |

Figure 19.37: Detail Report still showing sweet corn seedlings susceptible to wind erosion damage.

### 19.2.9 Modify Cover Crop Planting and Termination Dates

To address the potential excessive risk still existing for the sweet corn seedlings, we will attempt to increase the rye cover crop growing season and hopefully produce a little more late fall and early spring growth. There should be little impact on the cash crops from the rye cover crop's increased water usage since this is a field under irrigation that can easily mitigate that potential negative effect. Since we have some erosion still occurring during the period the rye cover crop is present, this extra biomass growth likely will help reduce the erosion during that period as well, lowering our average annual erosion rate.

**Complete the following steps**

*Step 1:* Return to the interface and open MCREW again with the rye cover crop management file.

*Step 1a:* Edit that management file by changing the rye cover crop planting date to be closer to the harvest date of the green beans (from **Oct 5, rotation year 2** to **Sep 15, rotation year 2**).

*Step 1b:* Also change the dates of the **Disk, tandem light finishing** and **Cultivator, field 6-12 in sweeps** operations from **Apr 05, rotation year 1** and **Apr 20, rotation year 1** respectively to **May 01, rotation year 1** for both operations. as shown in Fig. 19.38.

These date changes will lengthen the growing season in both the fall and spring time periods, producing additional live biomass for increased wind erosion suppression. The earlier planting date will allow additional growth in the fall and delaying the tillage in the spring will likewise allow additional spring growth prior to the terminating tillage operation.

These changes in planting and termination tillage dates obviously must be reasonable for the operator to achieve, based upon his workload and machine capacity available at those times in their operation.

*Step 2:* Save the modified rotation file with a new name (**Sweet corn and green beans_CALIB_rye_cover_crop_1**) to identify the management rotation as a modified variation of the initial rotation including a rye cover crop.

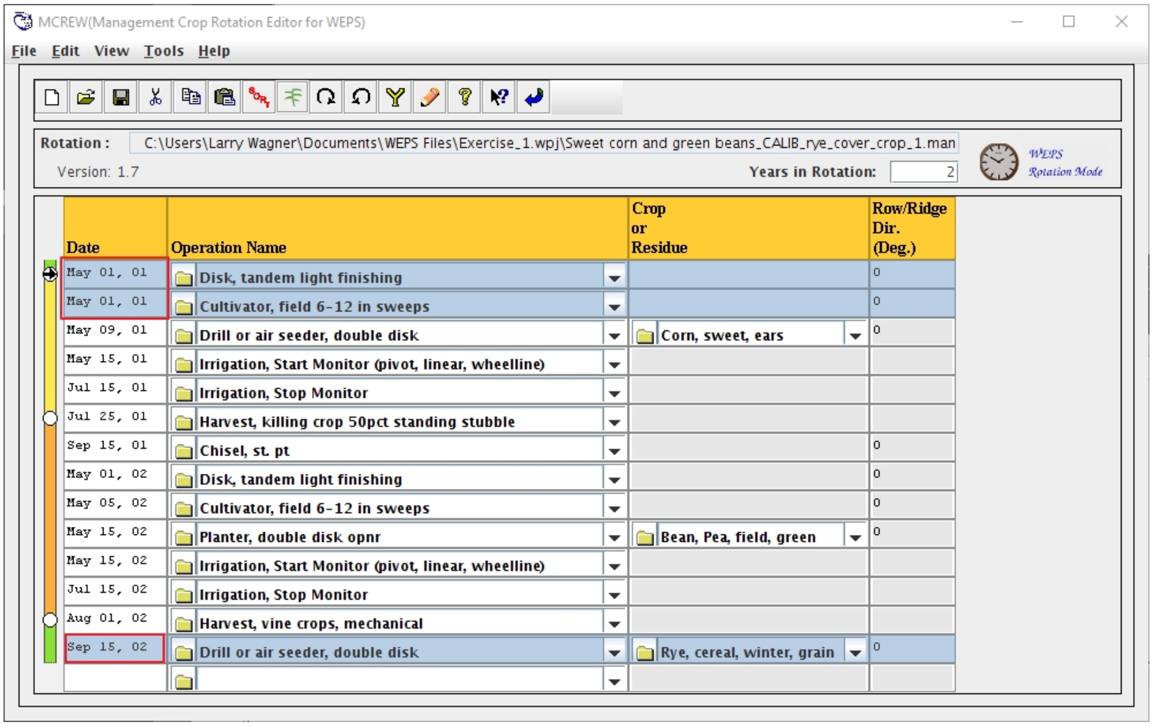


Figure 19.38: Management rotation with modified Rye Cover Crop dates.

### 19.2.10 Make a Regular WEPS Run with Modified Cover Crop

Make a new regular WEPS simulation run and name it: **Sweet Corn and beans, green, irr, rye cover crop, CMZ4_1**, again to identify the run as being a modification of the previous original rye cover crop simulation.

The WEPS Run Summary report (Fig. 19.39) now shows the Average Annual Soil Loss at **3.2 t/ac**; well below the Soil Loss Tolerance of **5 t/ac**.

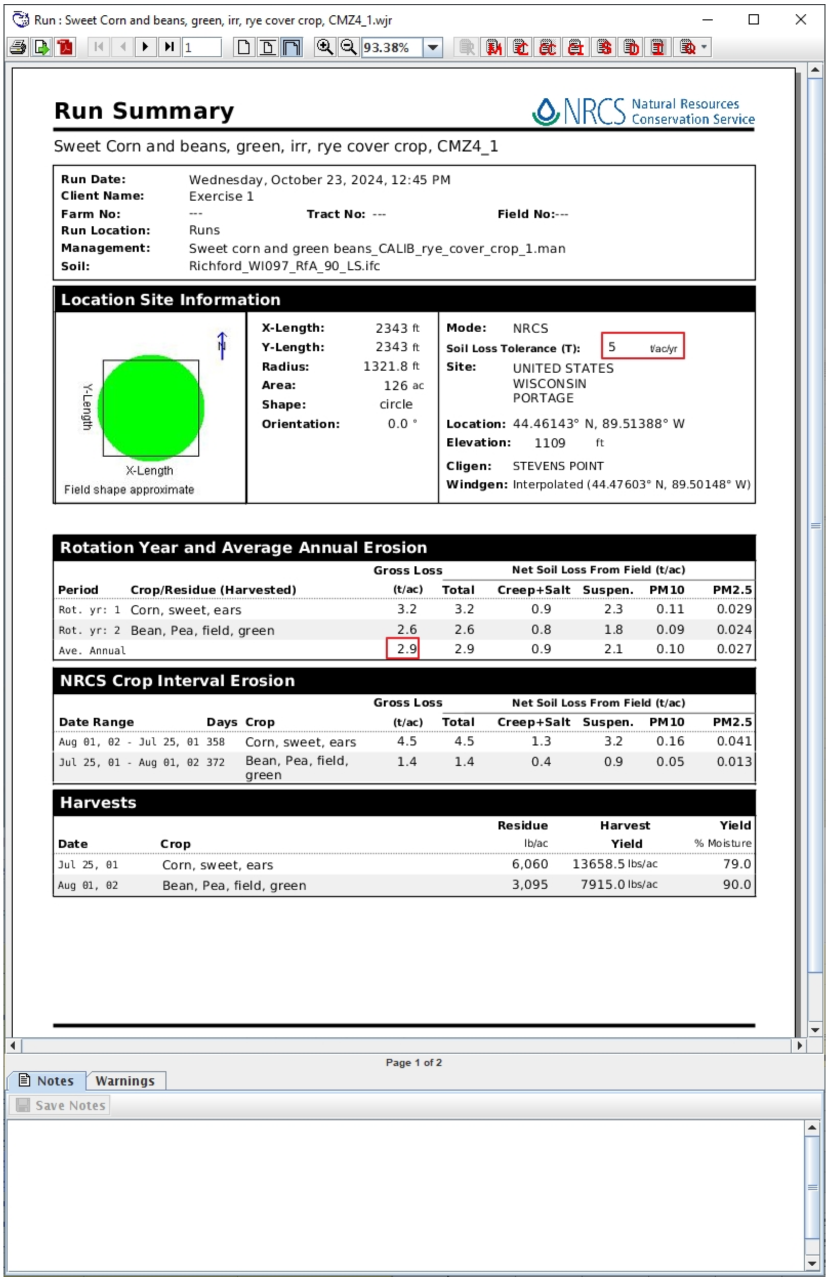



Figure 19.39: Summary Report showing modified rye cover crop dates significantly reduced erosion below Soil Loss Tolerance.

Reviewing the Tabular Detail Report (Fig. 19.40) shows that the erosion loss after planting sweet corn (**1.0 + 0.4 = 1.4 t/ac**) is now also below the **2 t/ac** threshold specified in Table 19.1 for sweet corn.

Tabular Detail Report - Sweet Corn and beans, green, irr, rye cover crop, CMZ4_1.wjr

Close

Select Report : Erosion & Crop Veg, Res & Biomass (details)

Run: Sweet Corn and beans, green, irr, rye cover crop, CMZ4_1
Client: Exercise 1
Fm: Tr: Fld: Area: 126.0 ac
Management: Sweet corn and green beans_CALIB_rye_cover_crop_1
Soil: Richford_WI097_RfA_90_LS

| | | | Erosion | Average Biomass Surface Conditions on D… | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Crop Vegetation | | | | | | | | | Crop Residue | | | | |
| Date | Operation | Crop | Average Total Gross Soil Loss | Canopy Cover | Surface Cover | Effective Standing Silhouette | Leaf and Stem Mass | Total Above Ground Mass | Root Mass | Crop Height | Number Crop Stems | Surface Cover | Effective Standing Silhouette | Flat Mass | Standing Mass | Total Above Ground Mass |
| | | | tons/acre | fraction | fraction | ft²/ft² | lbs/acre | lbs/acre | lbs/acre | in | #/acre | fraction | ft²/ft² | lbs/acre | lbs/acre | lbs/acre |
| Apr 15-30, 01 | | | 0.2 | 0.18 | 0.0001 | 0.03 | 193 | 197 | 145 | 3 | 890308 | 0.46 | 0.00 | 1238 | 1 | 1239 |
| May 1- 8, 01 | Disk, tandem light finishing<br>Cultivator, field 6-12 in sweep | Rye, cereal, winter, grain | 0.9 | 0.00 | 0.0000 | 0.00 | 0 | 0 | 0 | 0 | 0 | 0.22 | 0.00 | 532 | 34 | 566 |
| May 9-14, 01 | Drill or air seeder, double disk | Corn, sweet, ears | 1.0 | 0.01 | 0.0001 | 0.00 | 5 | 5 | 8 | 0 | 26001 | 0.20 | 0.00 | 474 | 20 | 493 |
| May 15-31, 01 | Irrigation, Start Monitor (pivot, | | 0.4 | 0.26 | 0.0001 | 0.04 | 280 | 290 | 164 | 11 | 26001 | 0.19 | 0.00 | 447 | 0 | 447 |
| Jun 1-14, 01 | | | 0.0 | 0.67 | 0.0003 | 0.37 | 1984 | 2808 | 1365 | 68 | 26001 | 0.17 | 0.00 | 409 | 0 | 409 |
| Jun 15-30, 01 | | | 0.0 | 0.68 | 0.0013 | 0.48 | 4231 | 6179 | 2480 | 70 | 26001 | 0.15 | 0.00 | 360 | 0 | 360 |
| Jul 1-14, 01 | | | 0.0 | 0.59 | 0.0026 | 0.47 | 6047 | 8907 | 2710 | 70 | 26001 | 0.14 | 0.00 | 327 | 0 | 327 |
| Jul 15-24, 01 | Irrigation, Stop Monitor | | 0.0 | 0.58 | 0.0027 | 0.47 | 6061 | 8926 | 2707 | 70 | 26001 | 0.13 | 0.00 | 307 | 0 | 307 |
| Jul 25-31, 01 | Harvest, killing crop 50pct sta | Corn, sweet, ears | 0.0 | 0.00 | 0.0000 | 0.00 | 0 | 0 | 0 | 0 | 0 | 0.62 | 0.23 | 2505 | 3682 | 6188 |
| Aug 1-14, 01 | | | 0.0 | 0.00 | 0.0000 | 0.00 | 0 | 0 | 0 | 0 | 0 | 0.59 | 0.21 | 2313 | 3519 | 5833 |
| Aug 15-31, 01 | | | 0.0 | 0.00 | 0.0000 | 0.00 | 0 | 0 | 0 | 0 | 0 | 0.55 | 0.20 | 2103 | 3328 | 5431 |
| Sep 1-14, 01 | | | 0.0 | 0.00 | 0.0000 | 0.00 | 0 | 0 | 0 | 0 | 0 | 0.53 | 0.20 | 1979 | 3213 | 5192 |
| Sep 15-30, 01 | Chisel, st. pt | | 0.0 | 0.00 | 0.0000 | 0.00 | 0 | 0 | 0 | 0 | 0 | 0.57 | 0.08 | 2263 | 1347 | 3610 |
| Oct 1-14, 01 | | | 0.0 | 0.00 | 0.0000 | 0.00 | 0 | 0 | 0 | 0 | 0 | 0.61 | 0.05 | 2568 | 940 | 3508 |
| Oct 15-31, 01 | | | 0.0 | 0.00 | 0.0000 | 0.00 | 0 | 0 | 0 | 0 | 0 | 0.64 | 0.04 | 2760 | 659 | 3419 |
| Nov 1-14, 01 | | | 0.1 | 0.00 | 0.0000 | 0.00 | 0 | 0 | 0 | 0 | 0 | 0.66 | 0.03 | 2859 | 514 | 3372 |
| Nov 15-30, 01 | | | 0.1 | 0.00 | 0.0000 | 0.00 | 0 | 0 | 0 | 0 | 0 | 0.66 | 0.03 | 2897 | 452 | 3349 |
| Dec 1-14, 01 | | | 0.0 | 0.00 | 0.0000 | 0.00 | 0 | 0 | 0 | 0 | 0 | 0.66 | 0.02 | 2919 | 422 | 3341 |
| Dec 15-31, 01 | | | 0.0 | 0.00 | 0.0000 | 0.00 | 0 | 0 | 0 | 0 | 0 | 0.67 | 0.02 | 2931 | 405 | 3335 |
| Rot. yr: 1 | | | 3.2 | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| Jan 1-14, 02 | | | 0.0 | 0.00 | 0.0000 | 0.00 | 0 | 0 | 0 | 0 | 0 | 0.67 | 0.02 | 2940 | 392 | 3331 |
| Jan 15-31, 02 | | | 0.0 | 0.00 | 0.0000 | 0.00 | 0 | 0 | 0 | 0 | 0 | 0.67 | 0.02 | 2946 | 381 | 3328 |
| Feb 1-14, 02 | | | 0.0 | 0.00 | 0.0000 | 0.00 | 0 | 0 | 0 | 0 | 0 | 0.67 | 0.02 | 2952 | 371 | 3323 |
| Feb 15-29, 02 | | | 0.0 | 0.00 | 0.0000 | 0.00 | 0 | 0 | 0 | 0 | 0 | 0.67 | 0.02 | 2965 | 349 | 3314 |
| Mar 1-14, 02 | | | 0.0 | 0.00 | 0.0000 | 0.00 | 0 | 0 | 0 | 0 | 0 | 0.67 | 0.02 | 2997 | 295 | 3292 |
| Mar 15-31, 02 | | | 0.0 | 0.00 | 0.0000 | 0.00 | 0 | 0 | 0 | 0 | 0 | 0.68 | 0.01 | 3040 | 213 | 3252 |
| Apr 1-14, 02 | | | 0.1 | 0.00 | 0.0000 | 0.00 | 0 | 0 | 0 | 0 | 0 | 0.68 | 0.01 | 3052 | 134 | 3186 |
| Apr 15-30, 02 | | | 0.3 | 0.00 | 0.0000 | 0.00 | 0 | 0 | 0 | 0 | 0 | 0.68 | 0.00 | 3017 | 68 | 3085 |
| May 1- 4, 02 | Disk, tandem light finishing | | 0.0 | 0.00 | 0.0000 | 0.00 | 0 | 0 | 0 | 0 | 0 | 0.42 | 0.00 | 1433 | 17 | 1449 |
| May 5-14, 02 | Cultivator, field 6-12 in sweep | | 0.2 | 0.00 | 0.0000 | 0.00 | 0 | 0 | 0 | 0 | 0 | 0.37 | 0.00 | 1237 | 1 | 1239 |
| May 15-31, 02 | Planter, double disk opnr<br>Irrigation, Start Monitor (pivot, | Bean, Pea, field, green | 0.5 | 0.31 | 0.0031 | 0.05 | 179 | 184 | 115 | 2 | 101171 | 0.35 | 0.00 | 1146 | 0 | 1146 |
| Jun 1-14, 02 | | | 0.0 | 0.78 | 0.0023 | 0.40 | 705 | 886 | 479 | 10 | 101171 | 0.33 | 0.00 | 1069 | 0 | 1069 |

Figure 19.40: Detail Report now showing sweet corn seedlings below the susceptible risk level to wind erosion damage.

## 19.3 Ex 2 - Adding a Crop Rotation

### 19.3.1 Skill Building

In this exercise, we begin with a pre-built management file and make a WEPS run. Then we add another crop to the rotation in the management editor (MCREW) and make a second run. We will also consider a strip tillage system and reduced tillage to address the erosion problem.

- Exercise 2 uses a previously built management record as a starting template that is then modified via MCREW (Management/Crop Rotation Editor for WEPS).
- It outlines how to: Select WEPS inputs and make WebStart WEPS Runs
  - Perform a regular (normal) WEPS simulation run
  - Perform a Yield Calibration run to calibrate the average yield for the selected crop record
  - Insert another cropping system (single year rotation) into the current management rotation
  - Convert the existing management rotation into a reduced tillage system
- It demonstrates how to: Modify an existing management rotation within MCREW using basic editing functions:
  - Inserting another management file's content
  - Deleting rows (operation entries)
  - Inserting new operation records
  - Making Target Yield adjustments
  - Correcting length of management rotation when necessary
- Learn how to: Evaluate output reports and interpret results relevant to achieving specific erosion risk goals:
  - Determine if erosion exceeds the Soil Loss Tolerance (T) value for the specified soil
  - Determine whether ground cover is adequate to protect seedlings from wind erosion damage

### 19.3.2 Scenario

- The farm is located in **Lubbock County, Texas**, just south of the airport.

  Note that the centroid of this county is nearby (33.61020º N, 101.82054º W). The county centroid coordinates are close enough one could use those coordinates as has been done with previous versions of WEPS. However, we would like to use the actual site's coordinates, determined by using the WEPS Map Viewer as outlined in Exercise 1. This will ensure that we are selecting a soil that actually exists on the field site by using the CSIP Soil Service selection option.
- The approximate location coordinates we will use for the actual field site are: **33.63260º N, 101.81114º W**.
- 
- Use the default Climate and interpolated Windgen stations automatically selected within the county for the field site.
- The soil in the field is an **Amarillo Fine Sandy Loam**.

- The crop rotation is **continuous Stripper Cotton**. It may be helpful to add Milo or Sorghum to the rotation.
- There is also some new technology from Texas A&M, using **Strip Tillage** and **Ridge Till Planters** that we would like to also model for an alternative.
- The field is a **half section of land (320 acres)** and is **oriented east and west** (see X-length/Y-length green rectangle in center of Fig. 19.41).
- Normal yield for the Cotton is ¾ bale or **375 lbs lint/ac.**
- Sorghum should yield an average of **25 bu/ac.**

### 19.3.3 Populate inputs

We need to populate the inputs based upon the information provided above. Once that is done, we will execute a WEPS simulation Run.

**Complete the following steps**

Start up the WEPS interface and add the information shown in (Fig. 19.41).

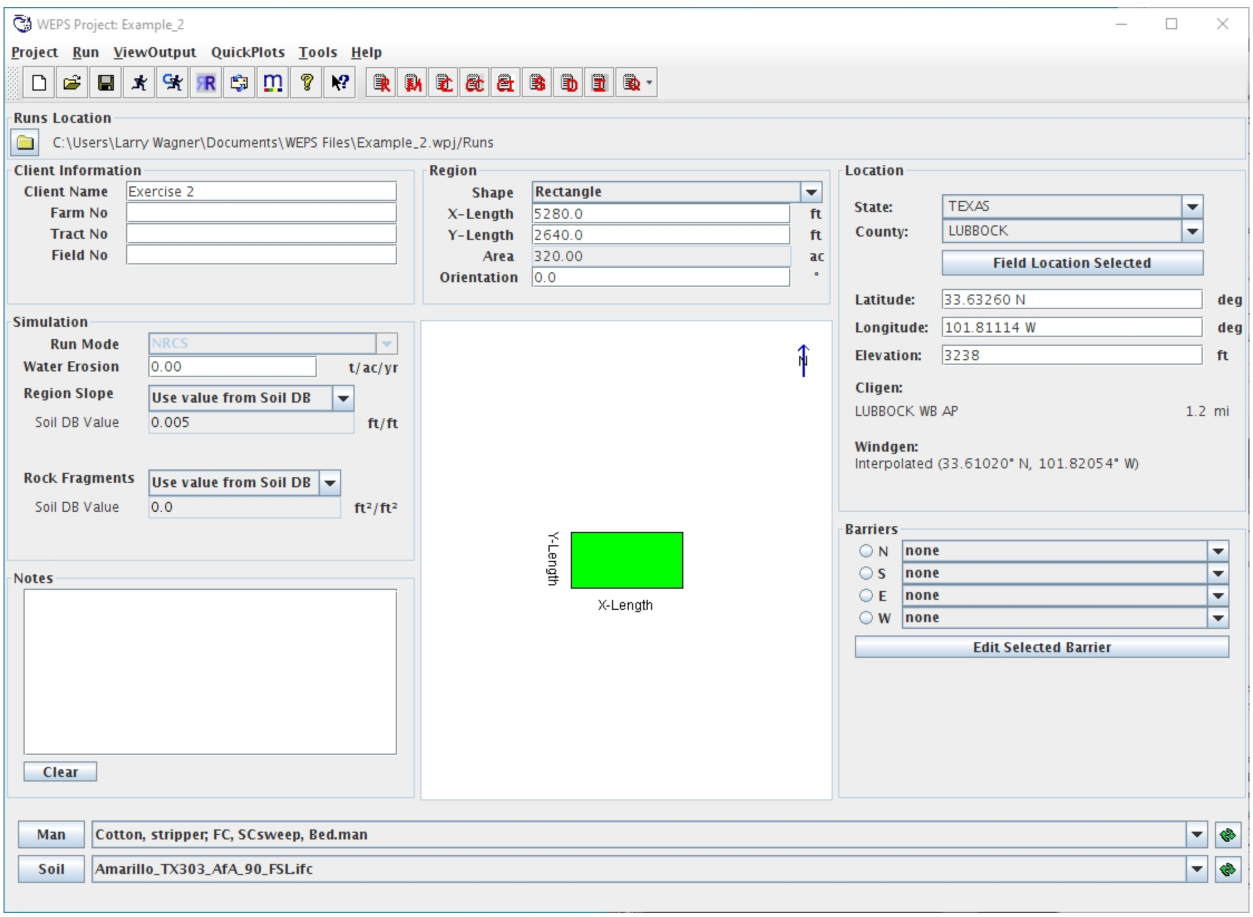



Figure 19.41: WEPS interface loaded for Exercise 2 initial run.

*Step 1:* Under the *Client Information* panel, enter ***Exercise 2*** for **Client Name**. All of the fields under the *Client Information* panel are optional and are not required for a WEPS simulation.

*Step 2:* Under the *Region* panel, for the **Shape** field select ***Rectangle***, if not already selected, by clicking the drop-down arrow ▾. Since this is a rectangular field oriented east/west, we need to specify both the **X-Length** = ***5280 ft*** and **Y-Length** = ***2640 ft*** (The **Area** field should then automatically update and display 320.00 acres).

*Step 3:* Under the *Location* panel, set the **Latitude** and **Longitude** fields to the site coordinates: ***33.63260º N, 101.81114º W***. as shown in (Fig. 19.41)[11].

The **Cligen** station will automatically be selected and displayed. The **Elevation** value will also be updated with the Cligen station's elevation. the **Windgen** station selected for this location will be interpolated and presented with the lat/long values used for the interpolation process. Note that these coordinates match the centroid location of the county as WEPS uses the same Windgen station throughout a county for consistency of WEPS results within a county.

*Step 4:* Click the **Man** pull down black arrow (lower right side) to display the management files under *System Templates*. Load the pre-built file called ***Cotton, stripper; FC, SCsweep, Bed.man*** by clicking the name of the file in the list.

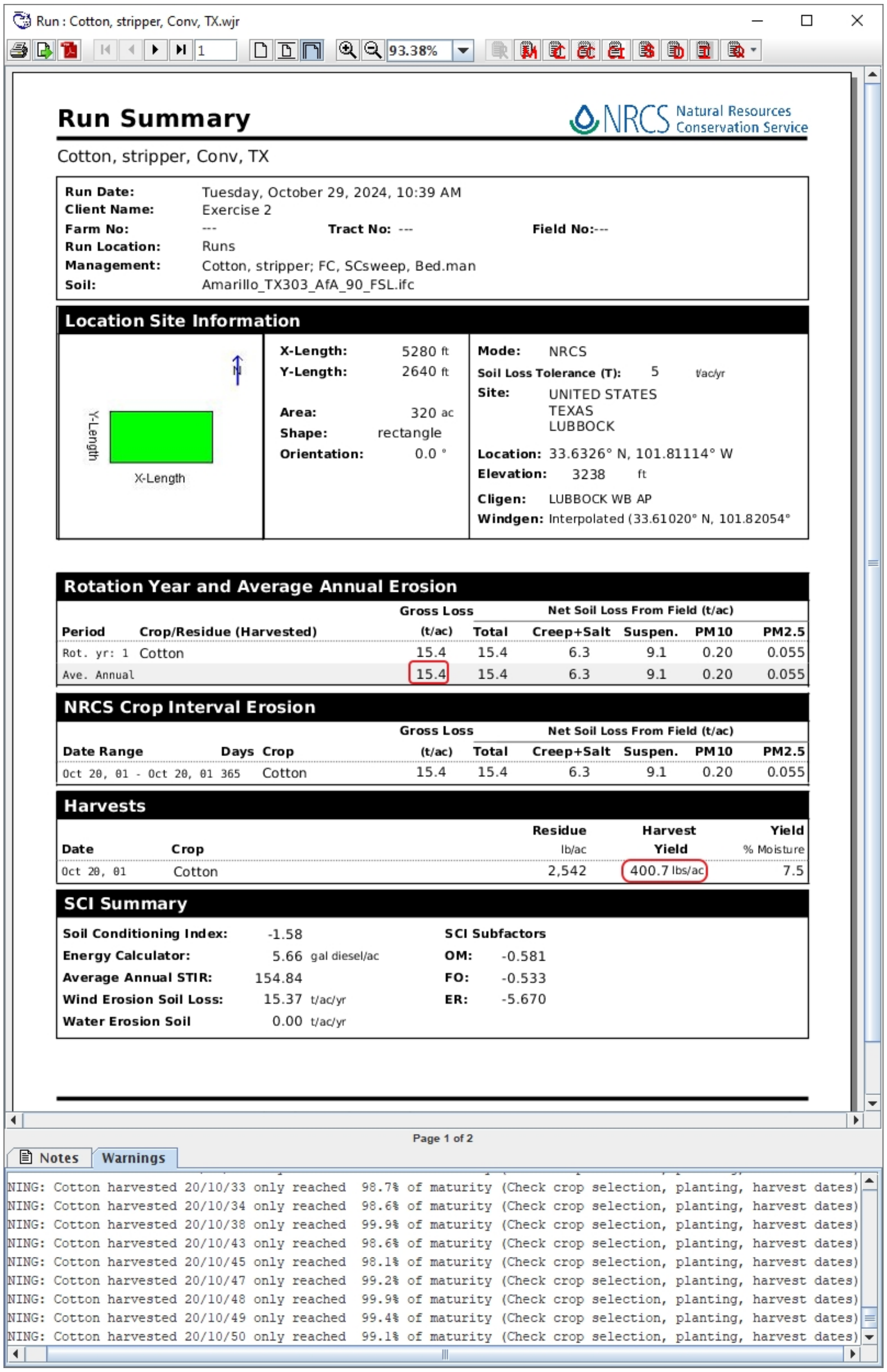
*Step 5:* Click the **Soil** pull down black arrow (lower right side) to display the soils in *TX303 - Lubbock County, Texas* under the *CSIP Soil Service* folder for this site. Open the *AfA - Amarillo fine sandy loam, 0 to 1 percent slopes* folder and load the soil called ***Amarillo_TX303_AfA_90_FSL.ifc*** by clicking the name on the list.

### 19.3.4 Initial Simulation Run

Make a standard run as shown in Exercise 1 by clicking the Run button in the located in the WEPS toolbar. Type in the run name of: ***Cotton, stripper, Conv, TX*** and then click on the button.

Upon completion of the WEPS simulation, a popup window containing warning messages of the crop not reaching maturity during specific simulation years will appear. We will address that issue in the next iteration of this exercise. The Run Summary report window will appear when the popup warning message window is dismissed. Note that these warnings are still accessible if the user clicks on the "Warnings" button at the bottom of the Run Summary report (Fig. 19.42).

[11] Note that when editing the latitude and longitude values, the longitude will display as a negative number in the field while editing the value to represent the "W" (west) longitude orientation. The same behavior also exists if one is using WEPS in the southern hemisphere for the latitude field


Run : Cotton, stripper, Conv, TX.wjr

## Run Summary

NRCS Natural Resources Conservation Service

Cotton, stripper, Conv, TX

**Run Date:** Tuesday, October 29, 2024, 10:39 AM
**Client Name:** Exercise 2
**Farm No:** --- **Tract No:** --- **Field No:**---
**Run Location:** Runs
**Management:** Cotton, stripper; FC, SCsweep, Bed.man
**Soil:** Amarillo_TX303_AfA_90_FSL.ifc

**Location Site Information**



**X-Length:** 5280 ft
**Y-Length:** 2640 ft
**Area:** 320 ac
**Shape:** rectangle
**Orientation:** 0.0 °

**Mode:** NRCS
**Soil Loss Tolerance (T):** 5 t/ac/yr
**Site:** UNITED STATES TEXAS LUBBOCK
**Location:** 33.6326° N, 101.81114° W
**Elevation:** 3238 ft
**Cligen:** LUBBOCK WB AP
**Windgen:** Interpolated (33.61020° N, 101.82054°

**Rotation Year and Average Annual Erosion**

| Period | Crop/Residue (Harvested) | Gross Loss (t/ac) | Net Soil Loss From Field (t/ac) Total | Creep+Salt | Suspen. | PM10 | PM2.5 |
|---|---|---|---|---|---|---|---|
| Rot. yr: 1 | Cotton | 15.4 | 15.4 | 6.3 | 9.1 | 0.20 | 0.055 |
| Ave. Annual | | 15.4 | 15.4 | 6.3 | 9.1 | 0.20 | 0.055 |

**NRCS Crop Interval Erosion**

| Date Range | Days | Crop | Gross Loss (t/ac) | Net Soil Loss From Field (t/ac) Total | Creep+Salt | Suspen. | PM10 | PM2.5 |
|---|---|---|---|---|---|---|---|---|
| Oct 20, 01 - Oct 20, 01 | 365 | Cotton | 15.4 | 15.4 | 6.3 | 9.1 | 0.20 | 0.055 |

**Harvests**

| Date | Crop | Residue lb/ac | Harvest Yield | Yield % Moisture |
|---|---|---|---|---|
| Oct 20, 01 | Cotton | 2,542 | 400.7 lbs/ac | 7.5 |

**SCI Summary**

**Soil Conditioning Index:** -1.58
**Energy Calculator:** 5.66 gal diesel/ac
**Average Annual STIR:** 154.84
**Wind Erosion Soil Loss:** 15.37 t/ac/yr
**Water Erosion Soil** 0.00 t/ac/yr

**SCI Subfactors**
**OM:** -0.581
**FO:** -0.533
**ER:** -5.670

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Notes Warnings

```
NING: Cotton harvested 20/10/33 only reached  98.7% of maturity (Check crop selection, planting, harvest dates)
NING: Cotton harvested 20/10/34 only reached  98.6% of maturity (Check crop selection, planting, harvest dates)
NING: Cotton harvested 20/10/38 only reached  99.9% of maturity (Check crop selection, planting, harvest dates)
NING: Cotton harvested 20/10/43 only reached  98.6% of maturity (Check crop selection, planting, harvest dates)
NING: Cotton harvested 20/10/45 only reached  98.1% of maturity (Check crop selection, planting, harvest dates)
NING: Cotton harvested 20/10/47 only reached  99.2% of maturity (Check crop selection, planting, harvest dates)
NING: Cotton harvested 20/10/48 only reached  99.9% of maturity (Check crop selection, planting, harvest dates)
NING: Cotton harvested 20/10/49 only reached  99.4% of maturity (Check crop selection, planting, harvest dates)
NING: Cotton harvested 20/10/50 only reached  99.1% of maturity (Check crop selection, planting, harvest dates)
```

Figure 19.42: Initial WEPS Summary Report showing average annual soil loss and cotton lint yield.

**Question:** What was the average annual soil loss by wind erosion for this simulation run?

**Answer:** The continuous Cotton run gave a **15.4 t/ac/yr** soil loss (Fig. 19.42).

**Question:** How much cotton lint is harvested?

**Answer:** This rotation produced **400.7 lbs/ac** of cotton lint on average per year (Fig. 19.42).

**Question:** The inventory states that we should have 375 lbs/ac lint. Is this different enough to calibrate the cotton yield?

**Answer:** Although this yield is probably ok since we are close to our ±**5**% threshold, we will follow our guideline and still calibrate the cotton yield. The predicted Harvest Yield is ∼**6.4**% (1.0 - 400.7/375). This is greater than the Expected Yield and exceeds the Expected Yield by greater than **5**%.

### 19.3.5 Setup Inputs for a Yield Calibration Run

The calibration function allows WEPS to recalculate the crop growth based on the actual yield history of the field evaluated. It adjusts the Harvested Yield simulated to within ±5% of the expected or historic yield entered. To calibrate the example run, first close the Run Summary window. The main interface window should remain on screen.

**Complete the following steps**

*Step 1:* On the main screen, click the "Man" button [Man] to open the Management Crop Rotation Editor for WEPS (MCREW).

*Step 2:* Adjust the harvest date and configure for a Yield Calibration Run.

*Step 2a:* Following what was learned in Exercise 1, configure MCREW to make a Yield Calibration run with a target yield of ***375 lbs/ac lint*** for the cotton crop (Fig. 19.43).

*Step 2b:* Move the harvest date forward from ***Oct 20, 01*** to ***Oct 31, 01*** (Fig. 19.43).

Remember that we had a popup window appear at the conclusion of the initial run showing that we had not reached 100% crop maturity prior to harvesting for all of the simulation years. Note that these warning messages are also listed under the "Warnings" tab at the bottom of the Run Summary report (if clicked on) as shown in Fig. 19.42. This new harvest date should now allow sufficient time for the cotton crop to reach maturity for all of the simulated harvests prior to executing the Yield Calibration run.

*Step 2c:* Save the modified management file to a different name to distinguish it from the original unmodified management file. Call it ***Cotton, stripper; FC, SCsweep, Bed-Modified.man***. To do so, in MCREW go to the **File** menu and select the **Save As...** option.

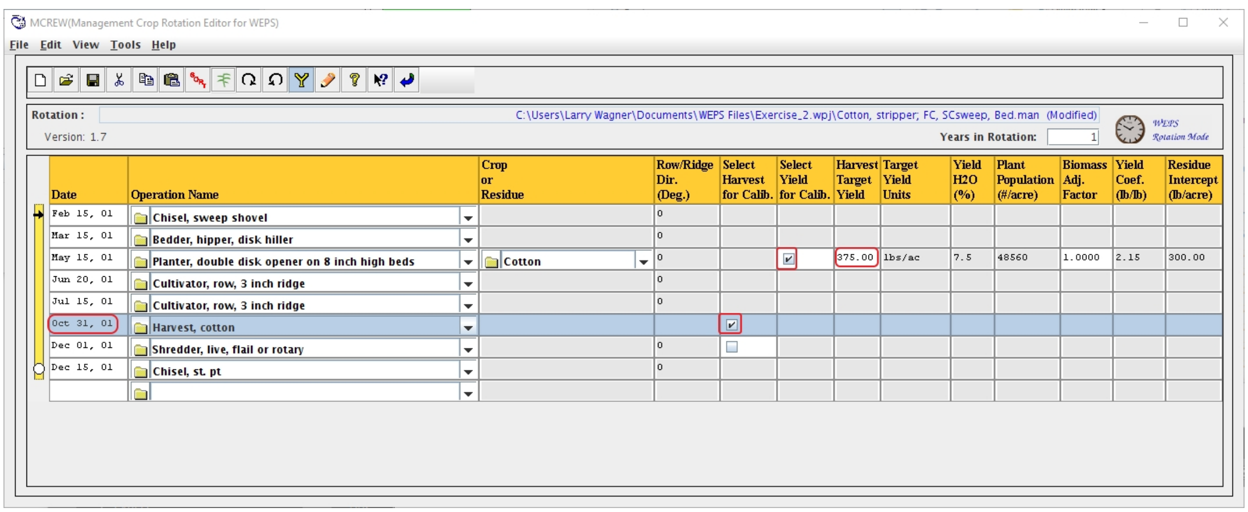



Figure 19.43: Modifications to cotton management file in MCREW.

### 19.3.6 Make a Yield Calibration Run

*Step 1:* Execute a Yield Calibration Run. The default run name will include the text **_calib** appended to it. So, the run name **Cotton, stripper, Conv, TX_calib** will be fine.

*Step 2:* Save a local copy of the calibrated cotton crop record for future retrieval, if desired.

After the calibration run has completed, a Biomass Adjustment Factor of **0.9531** is displayed. First, save a copy of this calibrated record as a local crop record. Do so by clicking on the **Save As** button on the *Calibration Factors* window (Fig. 19.44). This will bring up a WEPS FileChooser window (Fig. 19.45). This calibrated crop will be removed when replacing the planting operation with a reduced till planter later in this exercise. Therefore, saving this file locally will not only allow retrieval for this exercise, but other scenarios in the future.

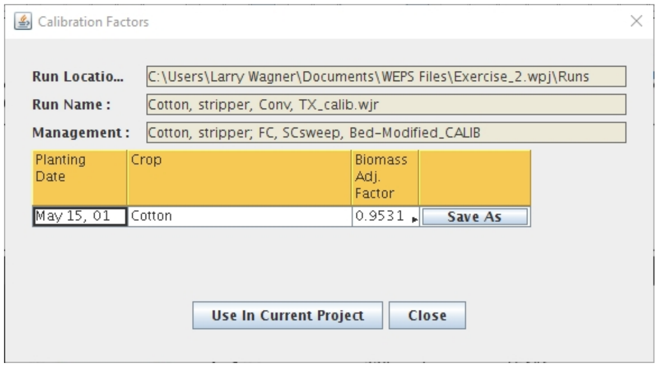



Figure 19.44: Cotton Calibration Factors window.

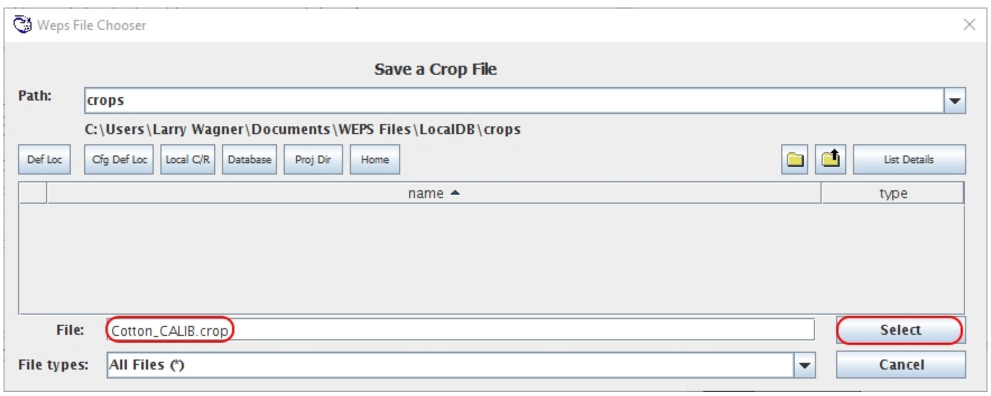



Figure 19.45: Saving calibrated cotton crop record in a local file.

*Step 3:* Select *Use in Current Project*. The new cotton harvest yield estimate is **368.9 lbs/ac lint**, which is within 5% of the Target Yield. However, the average annual soil loss is actually slightly greater than the previous run's result at **15.8 t/ac/yr** (Fig. 19.46). Note that we also received no maturity warning messages for the calibration run, so we resolved that previous Run's maturity issue.

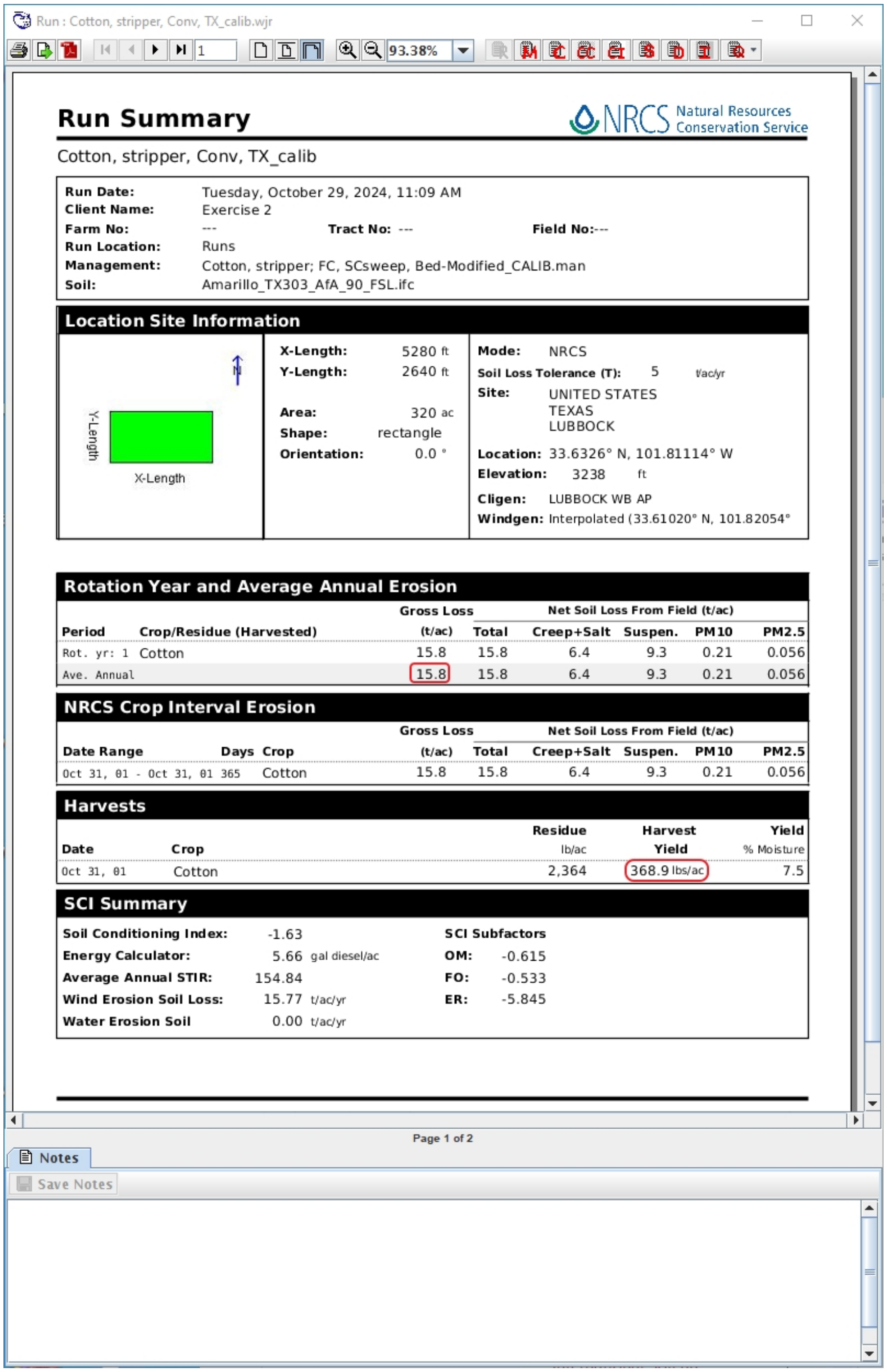



Figure 19.46: Run Summary report from Cotton calibration run.

**Question:** What can be done when the soil loss is too high?

**Answer:** Let's consider some options for lowering soil loss.

First determine when the majority of the erosion is occurring. The quickest way to determine that is to click on the QuickPlot toolbar icon button . and select the first QuickPlot menu option, which is labeled **Wind Erosion Soil Loss (Creep+Salt, Susp)**. The period prior to planting the cotton crop is the most susceptible time for wind erosion to occur as shown in Fig. 19.47. So, we need to make that period less susceptible to wind erosion.

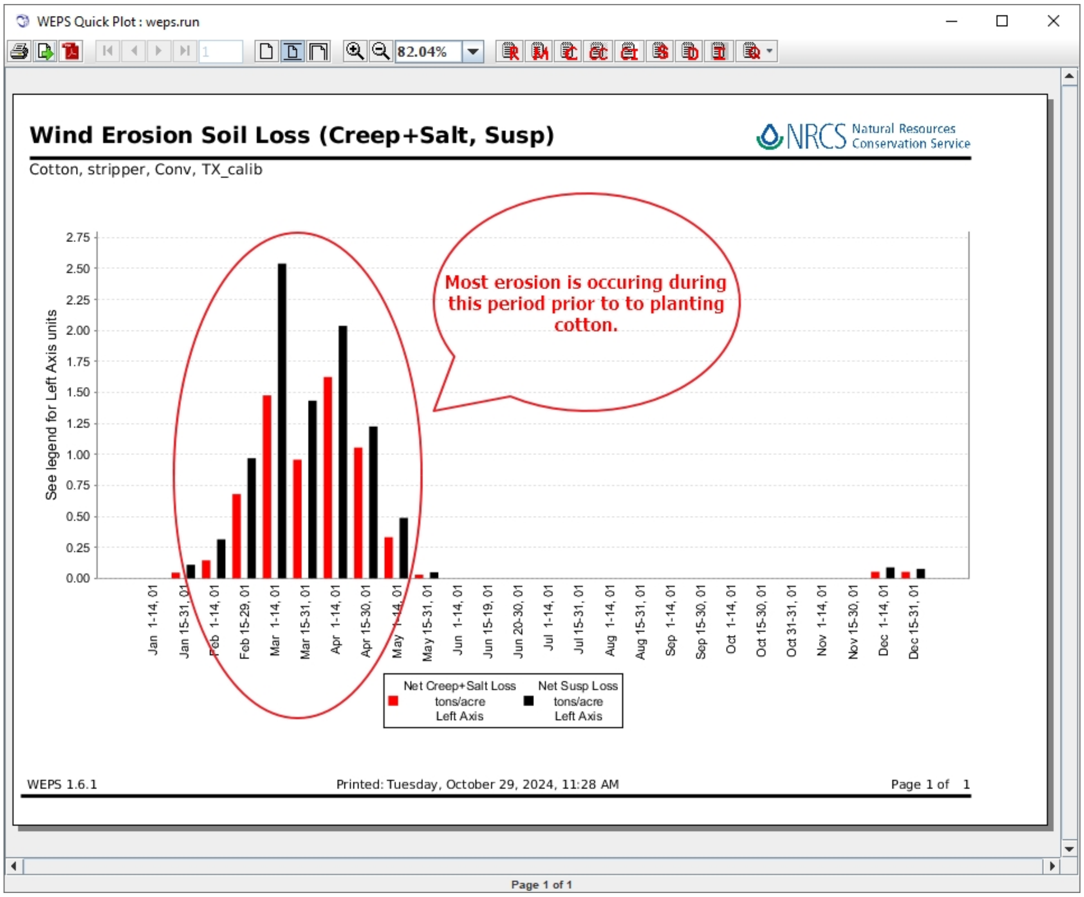
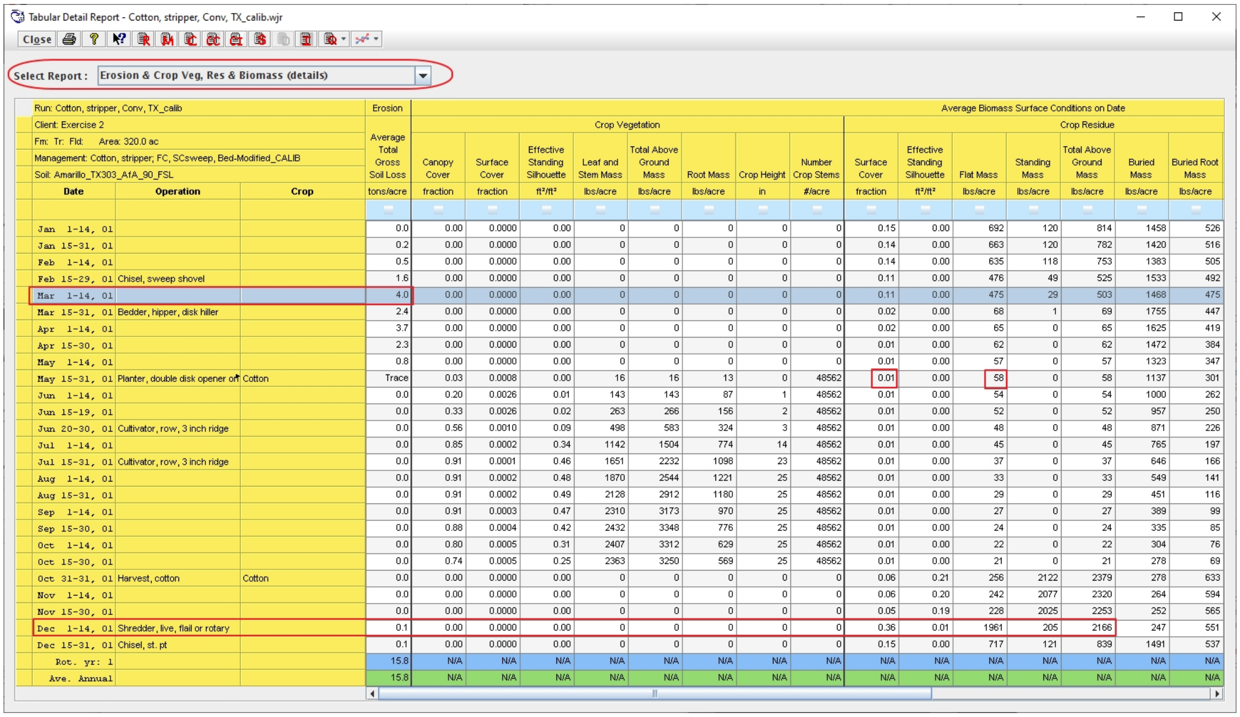



Figure 19.47: QuickPlot of erosion loss for calibrated WEPS Run.

**Question:** What management period has the highest erosion loss? Hint: Open the **Tabular Detail Report** and check the total flat mass of residue at that time on the **Erosion & Crop Veg Res & Biomass (details)** sub-report.

**Answer:** The period **(Mar 1-14, 01)** immediately following the *Chisel, sweep, shovel* operation, had **4.0 tons/ac**, which is also the period prior to planting (Fig. 19.48).



Tabular Detail Report - Cotton, stripper, Conv, TX_calib.wjr

Select Report : Erosion & Crop Veg, Res & Biomass (details)

Run: Cotton, stripper, Conv, TX_calib
Client: Exercise 2
Fm: Tr: Fld: Area: 320.0 ac
Management: Cotton, stripper; FC, SCsweep, Bed-Modified_CALIB
Soil: Amarillo_TX303_AfA_90_FSL

| | | | Erosion | Average Biomass Surface Conditions on Date | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Crop Vegetation | | | | | | | | | Crop Residue | | | | | | |
| Date | Operation | Crop | Average Total Gross Soil Loss (tons/acre) | Canopy Cover (fraction) | Surface Cover (fraction) | Effective Standing Silhouette (ft²/ft²) | Leaf and Stem Mass (lbs/acre) | Total Above Ground Mass (lbs/acre) | Root Mass (lbs/acre) | Crop Height (in) | Number Crop Stems (#/acre) | Surface Cover (fraction) | Effective Standing Silhouette (ft²/ft²) | Flat Mass (lbs/acre) | Standing Mass (lbs/acre) | Total Above Ground Mass (lbs/acre) | Buried Mass (lbs/acre) | Buried Root Mass (lbs/acre) |
| Jan 1-14, 01 | | | 0.0 | 0.00 | 0.0000 | 0.00 | 0 | 0 | 0 | 0 | 0 | 0.15 | 0.00 | 692 | 120 | 814 | 1458 | 526 |
| Jan 15-31, 01 | | | 0.2 | 0.00 | 0.0000 | 0.00 | 0 | 0 | 0 | 0 | 0 | 0.14 | 0.00 | 663 | 120 | 782 | 1420 | 516 |
| Feb 1-14, 01 | | | 0.5 | 0.00 | 0.0000 | 0.00 | 0 | 0 | 0 | 0 | 0 | 0.14 | 0.00 | 635 | 118 | 753 | 1383 | 505 |
| Feb 15-29, 01 | Chisel, sweep shovel | | 1.6 | 0.00 | 0.0000 | 0.00 | 0 | 0 | 0 | 0 | 0 | 0.11 | 0.00 | 476 | 49 | 525 | 1533 | 492 |
| Mar 1-14, 01 | | | 4.0 | 0.00 | 0.0000 | 0.00 | 0 | 0 | 0 | 0 | 0 | 0.11 | 0.00 | 475 | 29 | 503 | 1468 | 475 |
| Mar 15-31, 01 | Bedder, hipper, disk hiller | | 2.4 | 0.00 | 0.0000 | 0.00 | 0 | 0 | 0 | 0 | 0 | 0.02 | 0.00 | 68 | 1 | 69 | 1755 | 447 |
| Apr 1-14, 01 | | | 3.7 | 0.00 | 0.0000 | 0.00 | 0 | 0 | 0 | 0 | 0 | 0.02 | 0.00 | 65 | 0 | 65 | 1625 | 419 |
| Apr 15-30, 01 | | | 2.3 | 0.00 | 0.0000 | 0.00 | 0 | 0 | 0 | 0 | 0 | 0.01 | 0.00 | 62 | 0 | 62 | 1472 | 384 |
| May 1-14, 01 | | | 0.8 | 0.00 | 0.0000 | 0.00 | 0 | 0 | 0 | 0 | 0 | 0.01 | 0.00 | 57 | 0 | 57 | 1323 | 347 |
| May 15-31, 01 | Planter, double disk opener on | Cotton | Trace | 0.03 | 0.0008 | 0.00 | 16 | 16 | 13 | 0 | 48562 | 0.01 | 0.00 | 58 | 0 | 58 | 1137 | 301 |
| Jun 1-14, 01 | | | 0.0 | 0.20 | 0.0026 | 0.01 | 143 | 143 | 87 | 1 | 48562 | 0.01 | 0.00 | 54 | 0 | 54 | 1000 | 262 |
| Jun 15-19, 01 | | | 0.0 | 0.33 | 0.0026 | 0.02 | 263 | 266 | 156 | 2 | 48562 | 0.01 | 0.00 | 52 | 0 | 52 | 957 | 250 |
| Jun 20-30, 01 | Cultivator, row, 3 inch ridge | | 0.0 | 0.56 | 0.0010 | 0.09 | 498 | 583 | 324 | 3 | 48562 | 0.01 | 0.00 | 48 | 0 | 48 | 871 | 226 |
| Jul 1-14, 01 | | | 0.0 | 0.85 | 0.0002 | 0.34 | 1142 | 1504 | 774 | 14 | 48562 | 0.01 | 0.00 | 45 | 0 | 45 | 765 | 197 |
| Jul 15-31, 01 | Cultivator, row, 3 inch ridge | | 0.0 | 0.91 | 0.0001 | 0.46 | 1651 | 2232 | 1098 | 23 | 48562 | 0.01 | 0.00 | 37 | 0 | 37 | 646 | 166 |
| Aug 1-14, 01 | | | 0.0 | 0.91 | 0.0002 | 0.48 | 1870 | 2544 | 1221 | 25 | 48562 | 0.01 | 0.00 | 33 | 0 | 33 | 549 | 141 |
| Aug 15-31, 01 | | | 0.0 | 0.91 | 0.0002 | 0.49 | 2128 | 2912 | 1180 | 25 | 48562 | 0.01 | 0.00 | 29 | 0 | 29 | 451 | 116 |
| Sep 1-14, 01 | | | 0.0 | 0.91 | 0.0003 | 0.47 | 2310 | 3173 | 970 | 25 | 48562 | 0.01 | 0.00 | 27 | 0 | 27 | 389 | 99 |
| Sep 15-30, 01 | | | 0.0 | 0.88 | 0.0004 | 0.42 | 2432 | 3348 | 776 | 25 | 48562 | 0.01 | 0.00 | 24 | 0 | 24 | 335 | 85 |
| Oct 1-14, 01 | | | 0.0 | 0.80 | 0.0005 | 0.31 | 2407 | 3312 | 629 | 25 | 48562 | 0.01 | 0.00 | 22 | 0 | 22 | 304 | 76 |
| Oct 15-30, 01 | | | 0.0 | 0.74 | 0.0005 | 0.25 | 2363 | 3250 | 569 | 25 | 48562 | 0.01 | 0.00 | 21 | 0 | 21 | 278 | 69 |
| Oct 31-31, 01 | Harvest, cotton | Cotton | 0.0 | 0.00 | 0.0000 | 0.00 | 0 | 0 | 0 | 0 | 0 | 0.06 | 0.21 | 256 | 2122 | 2379 | 278 | 633 |
| Nov 1-14, 01 | | | 0.0 | 0.00 | 0.0000 | 0.00 | 0 | 0 | 0 | 0 | 0 | 0.06 | 0.20 | 242 | 2077 | 2320 | 264 | 594 |
| Nov 15-30, 01 | | | 0.0 | 0.00 | 0.0000 | 0.00 | 0 | 0 | 0 | 0 | 0 | 0.05 | 0.19 | 228 | 2025 | 2253 | 252 | 565 |
| Dec 1-14, 01 | Shredder, live, flail or rotary | | 0.1 | 0.00 | 0.0000 | 0.00 | 0 | 0 | 0 | 0 | 0 | 0.36 | 0.01 | 1961 | 205 | 2166 | 247 | 551 |
| Dec 15-31, 01 | Chisel, st. pt | | 0.1 | 0.00 | 0.0000 | 0.00 | 0 | 0 | 0 | 0 | 0 | 0.15 | 0.00 | 717 | 121 | 839 | 1491 | 537 |
| Rot. yr: 1 | | | 15.8 | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| Ave. Annual | | | 15.8 | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |

Figure 19.48: Detailed Report showing loss and residue at the planting and vegetative material at harvest.

**What is the total residue (flat mass) at planting time?**

**Answer:** About **58 lbs/ac** and **1**% surface cover are present at planting as shown in Fig. 19.48.

**Question:** How much total residue do we have after the Shredder, flail or rotary operation?

**Answer:** The ”Total Above Ground Mass” column displays the residue after shredding is **2169 lbs/ac** (1961 lbs/ac flat mass [residue] + 205 lbs/ac standing mass [residue])[12] as shown in Fig. 19.48.

Note: Cotton is a perennial crop. Many cotton crop harvesting operations will not kill the crop. In this case however, the **Harvest, cotton** operation is configured to kill the cotton crop. Similarly, if a defoliant was used before harvest, the leaf residue would have shown up at that time in the residue column, but a defoliant operation would not have killed the crop.

Cotton does not produce enough residue itself to control erosion.

We will now add sorghum to the rotation to see how it affects the residue and erosion rates.

## 19.3.7 Adding a Crop to a Rotation

We will now modify the management rotation by adding an additional crop and extend it to a 2-year rotation.

**Complete the following steps**

Close all the report windows, leaving only the main interface window open.

*Step 1:* Click the **Man** button Man to open the MCREW management editor. The management file loaded in MCREW should still be **Cotton, stripper, FC, SCsweep, Bed-Modified_CALIB.man**.

[12]Note that sometimes the sum of these two columns (”Flat Mass” and ”Standing Mass”) don’t always match the ”Total Above Ground Mass” column value because there are additional residue/age pools that include the reproductive components such as chaffe, pods, etc.) which are not provided in an additional column in the Tabular Detail Report. This column is not provided because this mass is usually insignificant and is also usually not very effective in controlling wind erosion either since it is considered loose light material on the surface with no anchoring to the soil surface. Thus, if the wind is strong enough to move the soil on the surface, it is assumed that this residue mass would also be very susceptible to being moved or removed from the soil surface too.

*Step 2:* Since we have a previously calibrated the **Cotton** crop record (see the 0.9531 Biomass Adj. Factor value in Fig. 19.44), it would be better if we selected the same calibrated crop record that we had saved previously as a local record, but with a crop name that reflects that it has been calibrated. So, we should right click on the dropdown arrow for the Cotton crop record and select the ***Cotton_CALIB.crop*** record from the *Local Crop and Residue Records* list to replace the *Cotton* crop record (Fig. 19.49).

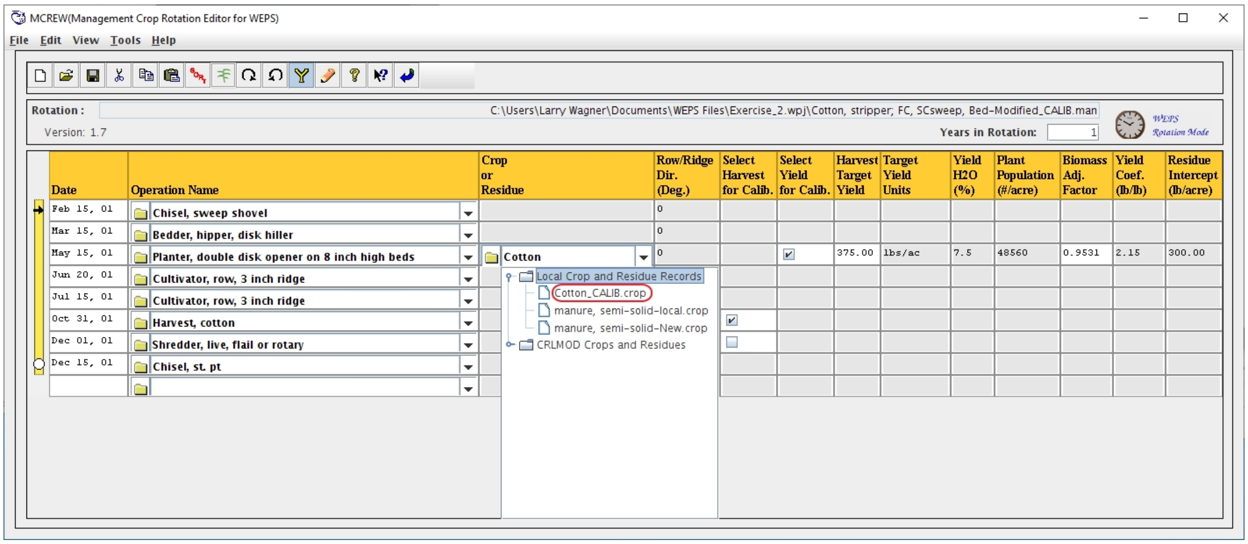



Figure 19.49: Selecting a locally saved calibrated cotton crop record in MCREW.

One can click on the "Yield" button to ensure that it contains the correct calibrated Biomass Adj. Factor value of 0.9531. While in this MCREW view, disable the "Select Yield For Calib." for the **Cotton_Calib** crop by removing the checkmark from the box (Fig. 19.50).

*Step 3:* Right-click the last row in the **Operation Name** column (NOT in the dropdown arrow) of the cotton file in MCREW. A popup menu should appear. Select **Insert Management** and double-click the **Example Mgt. files** directory (if it isn't already selected).

Choose ***Sorghum,Grain;MT,CMZ19.man*** and click the Select button Select.

Note: The sorghum crop comes into the rotation in the second year (Fig. 19.50). MCREW sees that this rotation cannot fit into year one following the last operation listed in MCREW, so it makes an adjustment to the dates. All of these new operation dates in year 2 appear reasonable.

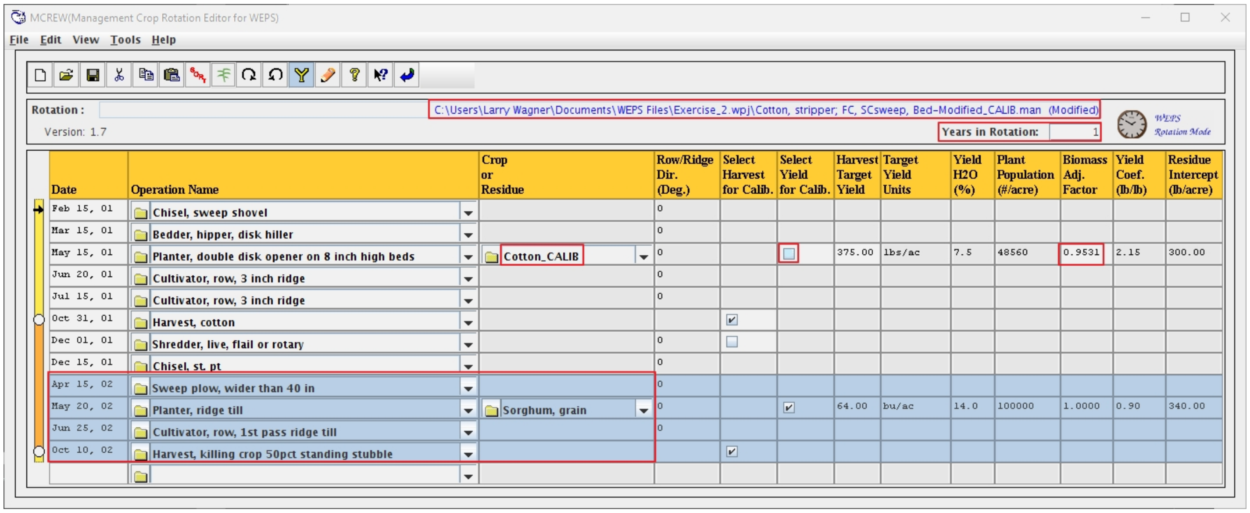



Figure 19.50: MCREW displaying included new sorghum rotation.

*Step 4:* Since the management file has been significantly modified, we should save it with a new name. Note that the rotation name in the **Rotation** field has turned blue, showing that the current management file being edited has been modified (Fig. 19.50).

Click **File** menu and then the **Save as...** menu option. Notice that MCREW has detected that we only have **1** in the **Years in Rotation** box (Fig. 19.51), which we forgot to change prior to saving the management file. Therefore, we must either change the value in the popup window's **Number of years** box to a number greater than 1 or accept the default value of 2. Click ***OK*** to accept the suggested change to a 2-year rotation. MCREW then asks for a new name for the 2-year rotation. Enter ***Cotton, Stripper, Conv-Sorghum, MT, TX***, and click ***Save As***.

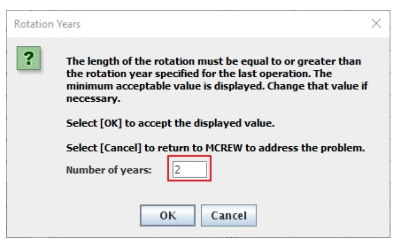



Figure 19.51: MCREW popup window when number of rotation years in rotation exceed the current listed value.

*Step 5:* Note that this new 2-year rotation was saved into the current WEPS Project folder by default. To save a copy as a local template management file, you must (in MCREW) click the **File** menu, then the **Save as Local Template** menu option, and then click on the **Save** button in the FileChooser window.

The default location will be the **LocalDB/man** folder. If one goes to another location and desires to return to the default location, they can click on the **Def Loc** (default location) button [Def Loc] or the **Local T** (local template) button [Local T].[13] You may wish to post it to a shared server site so others in your work group can use the same management file.

*Step 6:* Make a **non-calibrated** run with this 2-year management rotation file. Note that cotton crop was previously calibrated.

[13] This default location applies to NRCS Field Office configured versions of WEPS running Microsoft Windows. Other WEPS configurations and operating systems may vary as to the location of this folder.

Let's see if WEPS will give us an appropriate yield for the sorghum in this rotation. Return to the main interface by clicking the Close button in MCREW. Click the Run button and call the run **Cotton, stripper, Conv-Sorghum, MT, TX**. Note that since we are now running a 2-year rotation, we generate additional simulated climate years, which in this case caused six years of cotton to be harvested slightly before the crop reached 100% maturity (Fig. 19.52). Since it is so close to 100%, we will ignore the message this time.

**Question:** What is the soil loss?

**Answer:** The Run Summary shows an unacceptable predicted average loss of **9.7 t/ac/yr** (Fig. 19.52).

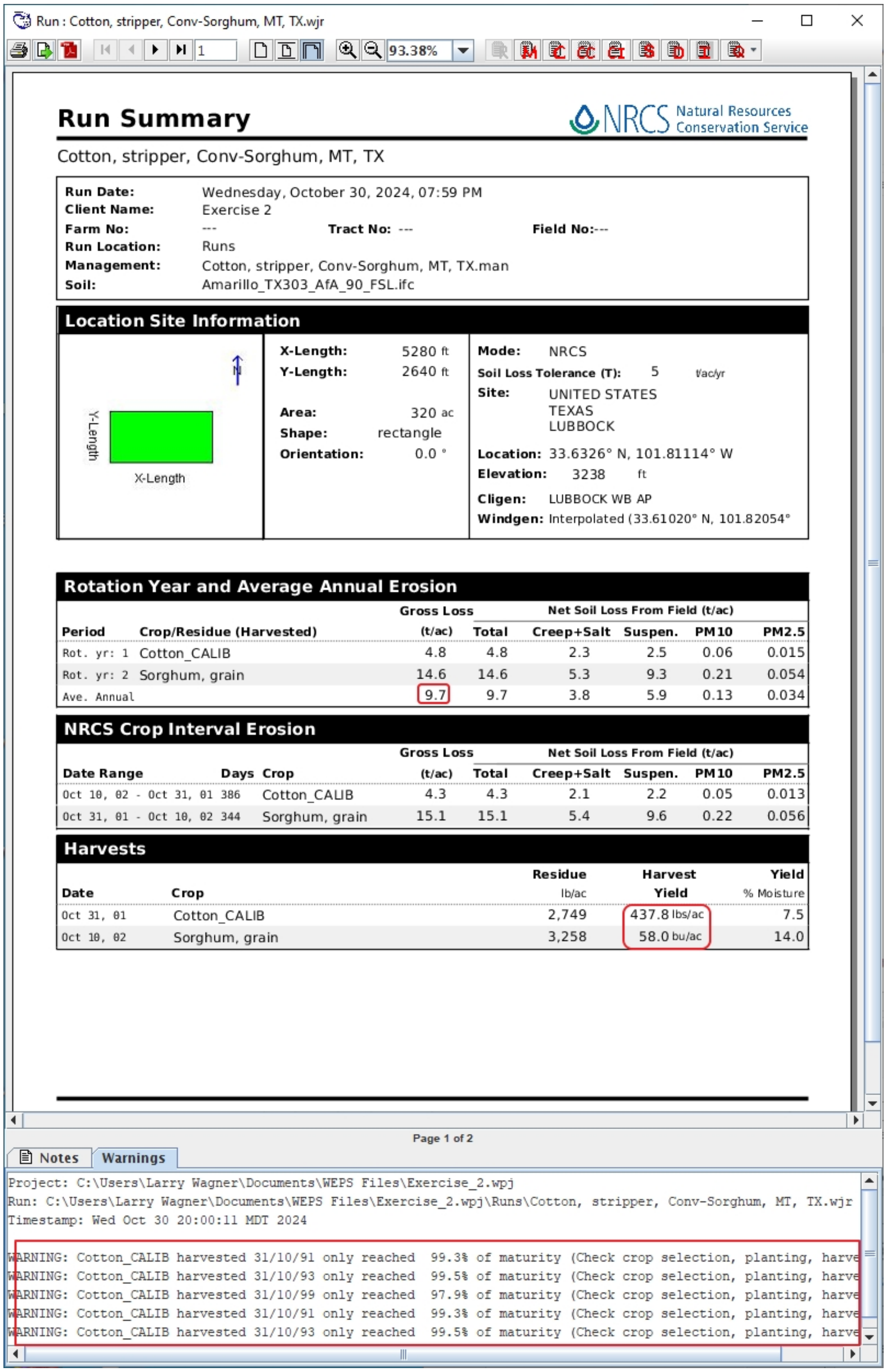



Figure 19.52: WEPS Run Summary screen showing soil loss and yields without calibration.

*Step 7:* Make a **Yield Calibration** run for the sorghum crop only.

The yields for both crops are also higher than the expected (target) yields at 437.8 lb/ac of Cotton lint and 58.0 bu/ac for Sorghum grain.

Close the Run Summary report. We will now prepare to make a Yield Calibration run to calibrate only the sorghum crop. We previously calibrated the cotton crop under a continuous cotton rotation and we are still using that calibrated crop record (one can verify this by checking the *Biomass Adj. Factor* value in MCREW for the cotton crop). By using the previously calibrated record for subsequent simulations, we can see the potential effects of changing the cropping rotation has on the cotton yields. In fact, if the changes to the rotation happen to affect the availability of soil water during the growing season for the cotton crop, re-calibrating that crop would defeat that yield affect feature within WEPS. Since we are interested in the yield impacts due to conservation practice changes, there is no need to re-calibrate the cotton crop. This is the reason we disabled that crop record from being re-calibrated by default in this rotation.

*Step 7a:* Click the Yield Calibration button to display the extra MCREW columns for setting the necessary Yield Calibration fields for the two crops.

*Step 7b:* Enter **25 bu/ac** yield for the **Harvest Target Yield** for the new sorghum crop. Check that the **Select Harvest for Calib.** and the **Select Yield for Calib.** boxes are selected (contain a checkmark).

*Step 7c:* Ensure that the **Select Harvest for Calib.** and the **Select Yield for Calib.** boxes are **NOT** selected for the cotton crop (does not contain a checkmark in at least one of those boxes), since we do not want to re-calibrate the cotton crop.

*Step 7d:* Save the changes to the modified management file and close MCREW by clicking on the blue arrow icon.

*Step 7e:* Execute the Yield Calibration Run. Accept the default run name which should be *Cotton, stripper, Conv-Sorghum, MT, TX_calib*.

*Step 7f:* Upon completion of the Yield Calibration Run and when the ”Calibration Factors” popup window appears, click on the *Use in Current Project* button to switch the listed management rotation file to the newly calibrated management file, which should be named **Cotton, stripper, FC, SCsweep-Sorghum, MT_CALIB.man** (highlighted in ”Calibration Factors” popup window in Fig. 19.53) and should now be displayed at the bottom of the WEPS main interface window.

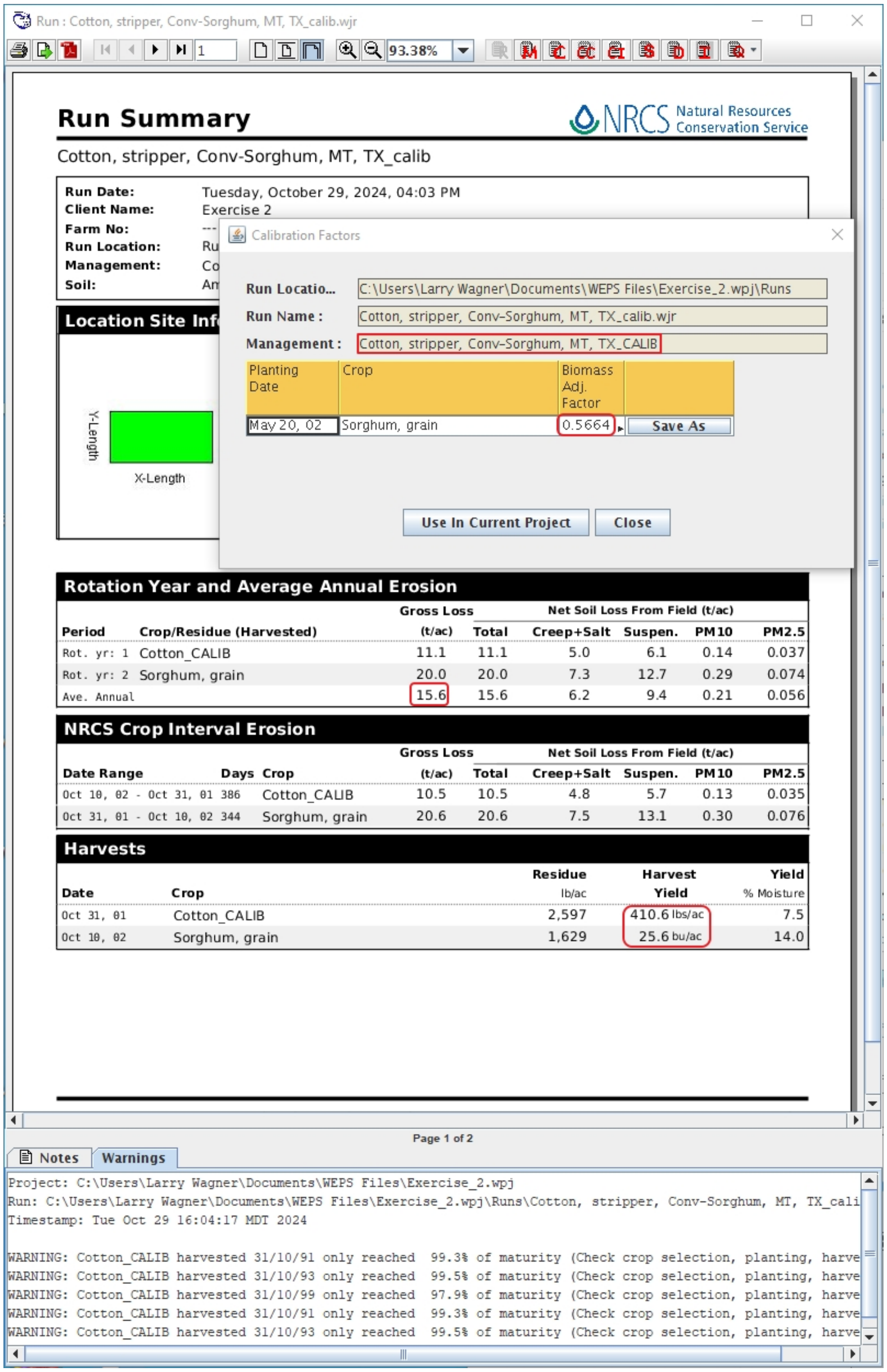
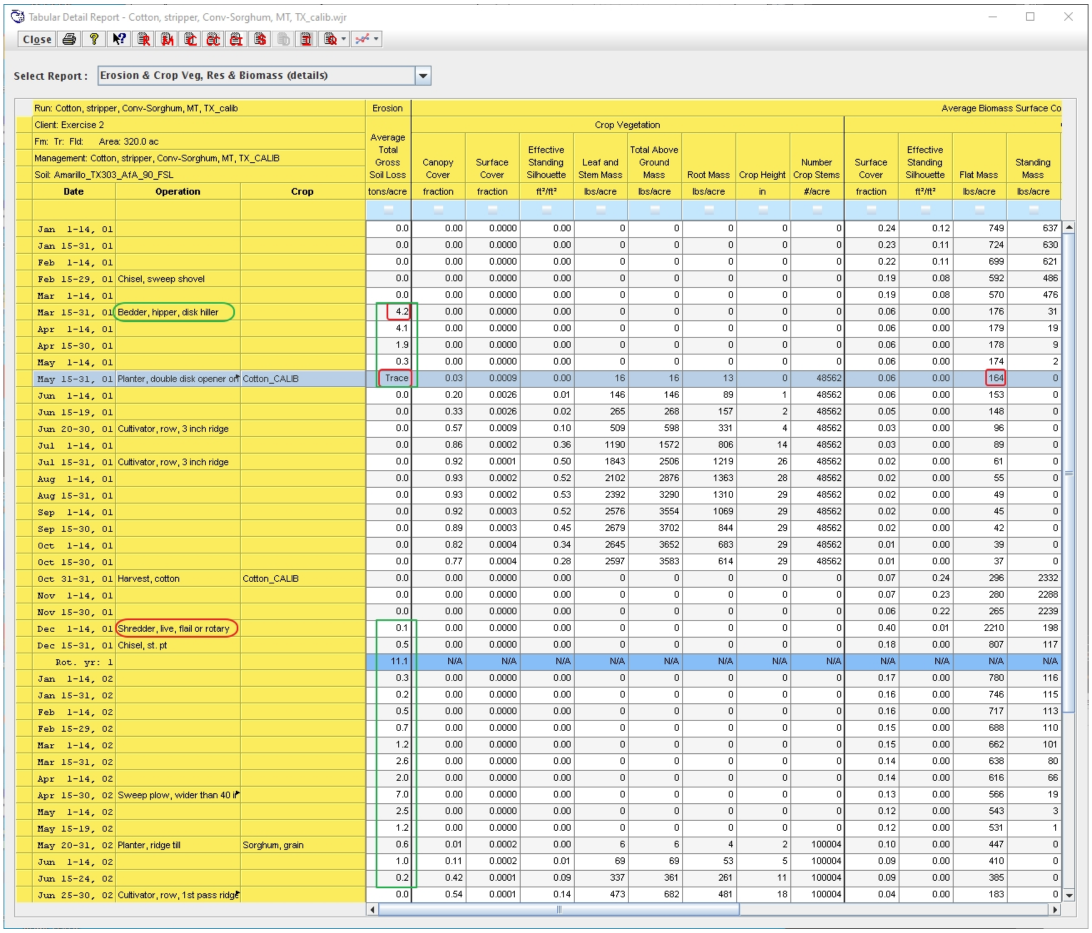


Figure 19.53: Calibration window showing Biomass Adjustment Factor for sorghum and the Run Summary Report.

Predicted yields for the calibration run are reasonable at 410.6 lb/ac cotton lint and 25.6 bu/ac sorghum. The problem of the sorghum yield over estimation is now resolved. Note that the calibrated cotton yield went up due to more soil water availability for the cotton crop in the 2-year rotation compared to the previous one year continuous cotton crop rotation. However, the soil loss is even higher now at **15.6 t/ac** (Fig. 19.53).

**Question:** How much flat mass do we have now after planting Cotton on the detailed report?

**Answer:** Remember to click the Detailed Report and select the *Erosion and Crop Veg, Res & Biomass (details)* screen (which should be the default selection). On **May 15-31 01**, there is about **164 lbs/ac** flat mass and the erosion rate is a **Trace** at the time of cotton planting (Fig. 19.54).




Run: Cotton, stripper, Conv-Sorghum, MT, TX_calib
Client: Exercise 2
Fm: Tr: Fld: Area: 320.0 ac
Management: Cotton, stripper, Conv-Sorghum, MT, TX_CALIB
Soil: Amarillo_TX303_AfA_90_FSL

| Date | Operation | Crop | Erosion: Average Total Gross Soil Loss (tons/acre) | Crop Vegetation: Canopy Cover (fraction) | Surface Cover (fraction) | Effective Standing Silhouette (ft²/ft²) | Leaf and Stem Mass (lbs/acre) | Total Above Ground Mass (lbs/acre) | Root Mass (lbs/acre) | Crop Height (in) | Number Crop Stems (#/acre) | Average Biomass Surface Co: Surface Cover (fraction) | Effective Standing Silhouette (ft²/ft²) | Flat Mass (lbs/acre) | Standing Mass (lbs/acre) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Jan 1-14, 01 | | | 0.0 | 0.00 | 0.0000 | 0.00 | 0 | 0 | 0 | 0 | 0 | 0.24 | 0.12 | 749 | 637 |
| Jan 15-31, 01 | | | 0.0 | 0.00 | 0.0000 | 0.00 | 0 | 0 | 0 | 0 | 0 | 0.23 | 0.11 | 724 | 630 |
| Feb 1-14, 01 | | | 0.0 | 0.00 | 0.0000 | 0.00 | 0 | 0 | 0 | 0 | 0 | 0.22 | 0.11 | 699 | 621 |
| Feb 15-29, 01 | Chisel, sweep shovel | | 0.0 | 0.00 | 0.0000 | 0.00 | 0 | 0 | 0 | 0 | 0 | 0.19 | 0.08 | 592 | 486 |
| Mar 1-14, 01 | | | 0.0 | 0.00 | 0.0000 | 0.00 | 0 | 0 | 0 | 0 | 0 | 0.19 | 0.08 | 570 | 476 |
| Mar 15-31, 01 | Bedder, hipper, disk hiller | | 4.2 | 0.00 | 0.0000 | 0.00 | 0 | 0 | 0 | 0 | 0 | 0.06 | 0.00 | 176 | 31 |
| Apr 1-14, 01 | | | 4.1 | 0.00 | 0.0000 | 0.00 | 0 | 0 | 0 | 0 | 0 | 0.06 | 0.00 | 179 | 19 |
| Apr 15-30, 01 | | | 1.9 | 0.00 | 0.0000 | 0.00 | 0 | 0 | 0 | 0 | 0 | 0.06 | 0.00 | 178 | 9 |
| May 1-14, 01 | | | 0.3 | 0.00 | 0.0000 | 0.00 | 0 | 0 | 0 | 0 | 0 | 0.06 | 0.00 | 174 | 2 |
| May 15-31, 01 | Planter, double disk opener on | Cotton_CALIB | Trace | 0.03 | 0.0009 | 0.00 | 16 | 16 | 13 | 0 | 48562 | 0.06 | 0.00 | 164 | 0 |
| Jun 1-14, 01 | | | 0.0 | 0.20 | 0.0026 | 0.01 | 146 | 146 | 89 | 1 | 48562 | 0.06 | 0.00 | 153 | 0 |
| Jun 15-19, 01 | | | 0.0 | 0.33 | 0.0026 | 0.02 | 265 | 268 | 157 | 2 | 48562 | 0.05 | 0.00 | 148 | 0 |
| Jun 20-30, 01 | Cultivator, row, 3 inch ridge | | 0.0 | 0.57 | 0.0009 | 0.10 | 509 | 598 | 331 | 4 | 48562 | 0.03 | 0.00 | 96 | 0 |
| Jul 1-14, 01 | | | 0.0 | 0.86 | 0.0002 | 0.36 | 1190 | 1572 | 806 | 14 | 48562 | 0.03 | 0.00 | 89 | 0 |
| Jul 15-31, 01 | Cultivator, row, 3 inch ridge | | 0.0 | 0.92 | 0.0001 | 0.50 | 1843 | 2506 | 1219 | 26 | 48562 | 0.02 | 0.00 | 61 | 0 |
| Aug 1-14, 01 | | | 0.0 | 0.93 | 0.0002 | 0.52 | 2102 | 2876 | 1363 | 28 | 48562 | 0.02 | 0.00 | 55 | 0 |
| Aug 15-31, 01 | | | 0.0 | 0.93 | 0.0002 | 0.53 | 2392 | 3290 | 1310 | 29 | 48562 | 0.02 | 0.00 | 49 | 0 |
| Sep 1-14, 01 | | | 0.0 | 0.92 | 0.0003 | 0.52 | 2576 | 3554 | 1069 | 29 | 48562 | 0.02 | 0.00 | 45 | 0 |
| Sep 15-30, 01 | | | 0.0 | 0.89 | 0.0003 | 0.45 | 2679 | 3702 | 844 | 29 | 48562 | 0.02 | 0.00 | 42 | 0 |
| Oct 1-14, 01 | | | 0.0 | 0.82 | 0.0004 | 0.34 | 2645 | 3652 | 683 | 29 | 48562 | 0.01 | 0.00 | 39 | 0 |
| Oct 15-30, 01 | | | 0.0 | 0.77 | 0.0004 | 0.28 | 2597 | 3583 | 614 | 29 | 48562 | 0.01 | 0.00 | 37 | 0 |
| Oct 31-31, 01 | Harvest, cotton | Cotton_CALIB | 0.0 | 0.00 | 0.0000 | 0.00 | 0 | 0 | 0 | 0 | 0 | 0.07 | 0.24 | 296 | 2332 |
| Nov 1-14, 01 | | | 0.0 | 0.00 | 0.0000 | 0.00 | 0 | 0 | 0 | 0 | 0 | 0.07 | 0.23 | 280 | 2288 |
| Nov 15-30, 01 | | | 0.0 | 0.00 | 0.0000 | 0.00 | 0 | 0 | 0 | 0 | 0 | 0.06 | 0.22 | 265 | 2239 |
| Dec 1-14, 01 | Shredder, live, flail or rotary | | 0.1 | 0.00 | 0.0000 | 0.00 | 0 | 0 | 0 | 0 | 0 | 0.40 | 0.01 | 2210 | 198 |
| Dec 15-31, 01 | Chisel, st. pt | | 0.5 | 0.00 | 0.0000 | 0.00 | 0 | 0 | 0 | 0 | 0 | 0.18 | 0.00 | 807 | 117 |
| Rot. yr: 1 | | | 11.1 | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| Jan 1-14, 02 | | | 0.3 | 0.00 | 0.0000 | 0.00 | 0 | 0 | 0 | 0 | 0 | 0.17 | 0.00 | 780 | 116 |
| Jan 15-31, 02 | | | 0.2 | 0.00 | 0.0000 | 0.00 | 0 | 0 | 0 | 0 | 0 | 0.16 | 0.00 | 746 | 115 |
| Feb 1-14, 02 | | | 0.5 | 0.00 | 0.0000 | 0.00 | 0 | 0 | 0 | 0 | 0 | 0.16 | 0.00 | 717 | 113 |
| Feb 15-29, 02 | | | 0.7 | 0.00 | 0.0000 | 0.00 | 0 | 0 | 0 | 0 | 0 | 0.15 | 0.00 | 688 | 110 |
| Mar 1-14, 02 | | | 1.2 | 0.00 | 0.0000 | 0.00 | 0 | 0 | 0 | 0 | 0 | 0.15 | 0.00 | 662 | 101 |
| Mar 15-31, 02 | | | 2.6 | 0.00 | 0.0000 | 0.00 | 0 | 0 | 0 | 0 | 0 | 0.14 | 0.00 | 638 | 80 |
| Apr 1-14, 02 | | | 2.0 | 0.00 | 0.0000 | 0.00 | 0 | 0 | 0 | 0 | 0 | 0.14 | 0.00 | 616 | 66 |
| Apr 15-30, 02 | Sweep plow, wider than 40 in | | 7.0 | 0.00 | 0.0000 | 0.00 | 0 | 0 | 0 | 0 | 0 | 0.13 | 0.00 | 566 | 19 |
| May 1-14, 02 | | | 2.5 | 0.00 | 0.0000 | 0.00 | 0 | 0 | 0 | 0 | 0 | 0.12 | 0.00 | 543 | 3 |
| May 15-19, 02 | | | 1.2 | 0.00 | 0.0000 | 0.00 | 0 | 0 | 0 | 0 | 0 | 0.12 | 0.00 | 531 | 1 |
| May 20-31, 02 | Planter, ridge till | Sorghum, grain | 0.6 | 0.01 | 0.0002 | 0.00 | 6 | 6 | 4 | 2 | 100004 | 0.10 | 0.00 | 447 | 0 |
| Jun 1-14, 02 | | | 1.0 | 0.11 | 0.0002 | 0.01 | 69 | 69 | 53 | 5 | 100004 | 0.09 | 0.00 | 410 | 0 |
| Jun 15-24, 02 | | | 0.2 | 0.42 | 0.0001 | 0.09 | 337 | 361 | 261 | 11 | 100004 | 0.09 | 0.00 | 385 | 0 |
| Jun 25-30, 02 | Cultivator, row, 1st pass ridge | | 0.0 | 0.54 | 0.0001 | 0.14 | 473 | 682 | 481 | 18 | 100004 | 0.04 | 0.00 | 183 | 0 |

Figure 19.54: Detailed Report showing soil loss and flat mass.

**Question:** What is the date of the first erosion period after harvest of the sorghum?

**Answer:** After the *Bedder, hipper, disk hiller* operation listed on **Mar 15-31, 01** shows **4.2 tons/ac** (Fig. 19.54).

**Question:** When do the erosion periods occur in this rotation and what tillage operations created the surface conditions that allowed it to occur?

One might find the *Total Wind Erosion Soil Loss* graph helpful (Fig. 19.56), which is accessible via the *QuickPlot* toolbar icon menu selection (Fig. 19.55) from the main WEPS screen or any of the WEPS Reports for this simulation run.

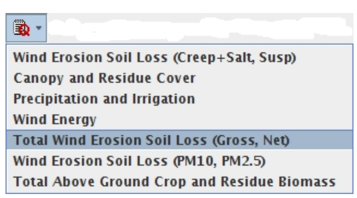



Figure 19.55: QuickPlot icon and menu selection.

**Answer:** From **Mar 15-31, 01** through **May 15-30, 01** following the *Bedder, hipper, disk hiller* operation and **Dec 1-14, 01** through **Jun 15-24, 02** following the *Shredder, live, flail or rotary* operation (Fig. 19.54).

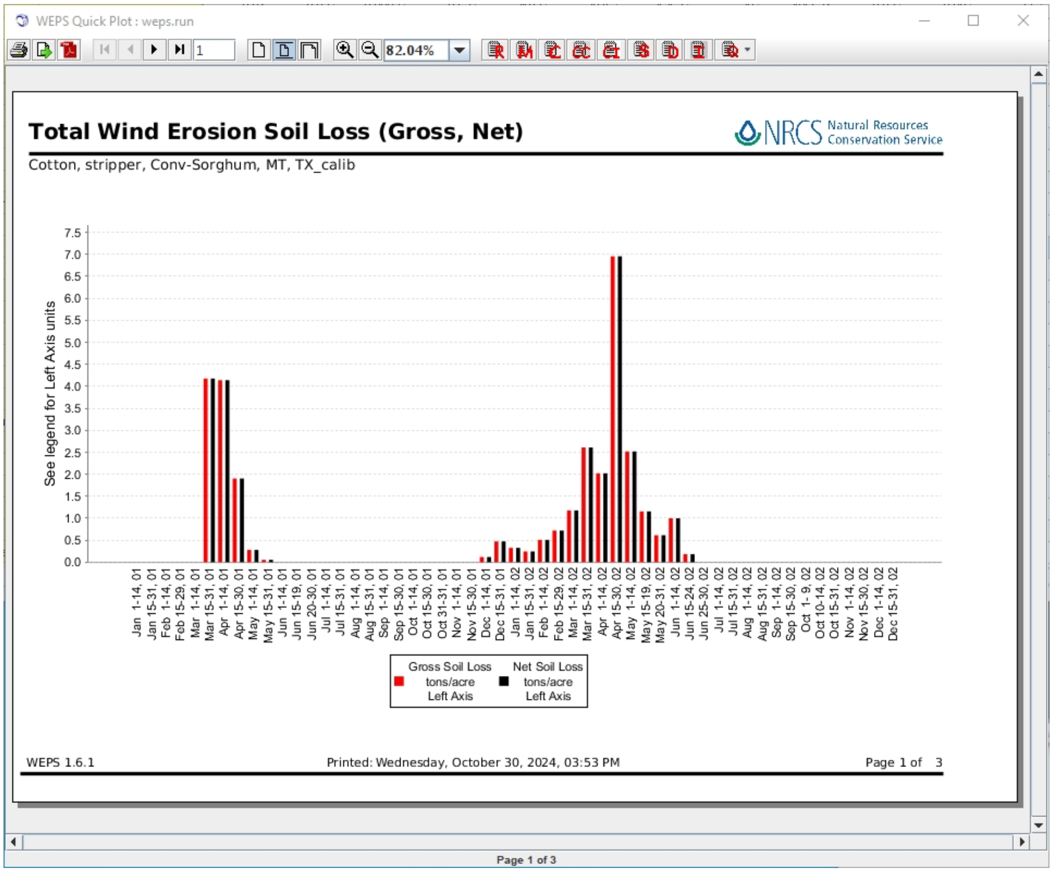



Figure 19.56: Graph of Total Wind Erosion Soil Loss for 2-year cotton and sorghum rotation.

Note that the *Bedder, hipper, disk hiller* operation not only buried most of the remaining above ground sorghum residue but also converted or buried most of the remaining standing residue. This left the field much more susceptible to wind erosion. Likewise, the *Shredder, live, flail or rotary* operation converted most of the remaining standing cotton residue to flat residue. Since standing residue is about 10 times more effective than the same amount (mass) of flat residue, the field surface again became much more susceptible to wind erosion.

Regardless, the average annual wind erosion of **15.6 tons/ac** for this simulation run is still too high. **Reduced tillage** may save a considerable amount of soil at this site.

### 19.3.8 Reduced Tillage Option

Let's try one last set of adjustments to our set of runs. We know cotton is glyphosate ready for weed control and strip-till works for cotton. We also know that standing residue is much more effective than flat residue at controlling wind erosion. So, we will start with the management rotation used in the last run and eliminate some of the tillage. Close the report windows, leaving only the main interface window open.

*Step 1:* Click the 'Man' button on the main interface. Be sure that you have the ***Cotton,Stripper-Sorghum, MT, TX_CALIB.man*** file loaded. We are going to change, remove, or replace many of the tillage operations. Pressing and holding the Control Key on your keyboard while clicking in the *Date* column enables one to select nonconsecutive operations. When all unnecessary operations are highlighted, right-click under the Operation Name column to select **Delete row(s)** as shown in Fig. 19.57 or select the **Delete row(s)** option under the **Edit** menu in MCREW.

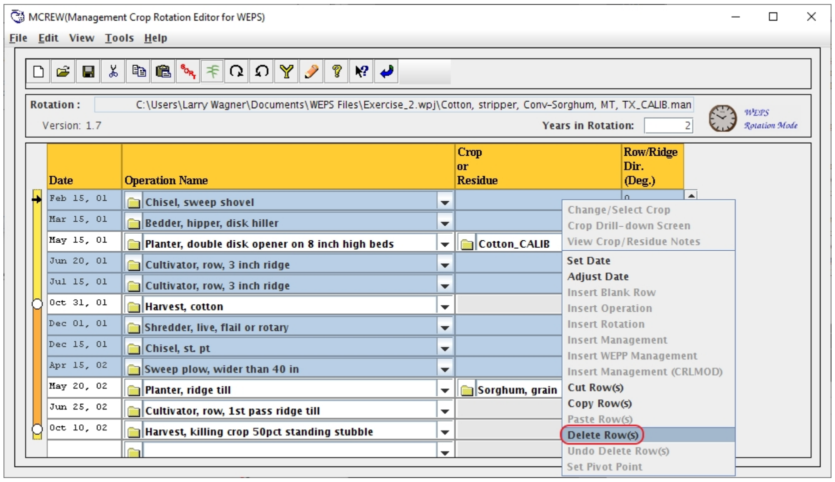


Figure 19.57: Removing excess tillage operations.

*Step 2:* Change the standard planter for the cotton from ***Planter, double disk*** to ***Planter, ridge till*** by clicking the drop-down arrow on the **Planter double disk** row and first selecting the **CRLMOD Operations** folder and then selecting the ***Planter, ridge till*** operation (Fig. 19.58).

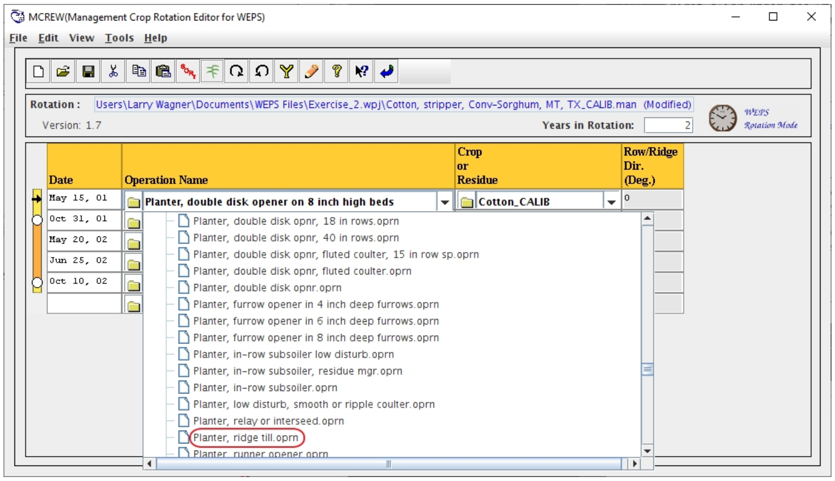


Figure 19.58: Illustration of changing operations.

*Step 3:* You will need to re-select your locally calibrated crop (Cotton_CALIB) after selecting the new operation, since MCREW cannot yet replace a planting operation with another planting operation without also removing the existing crop record (Fig. 19.59).

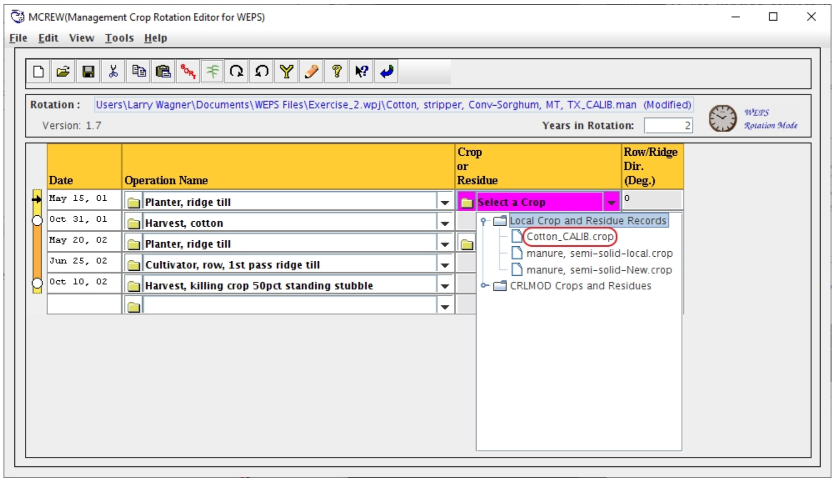


Figure 19.59: Re-selecting the locally saved calibrated cotton record.

*Step 4:* By selecting the dropdown choice list arrow, change ***Cultivator, row, 1st pass ridge till*** on June 25 to ***Sprayer, post emergence*** (under the **CRLMOD Operations** folder (Fig. 19.60).

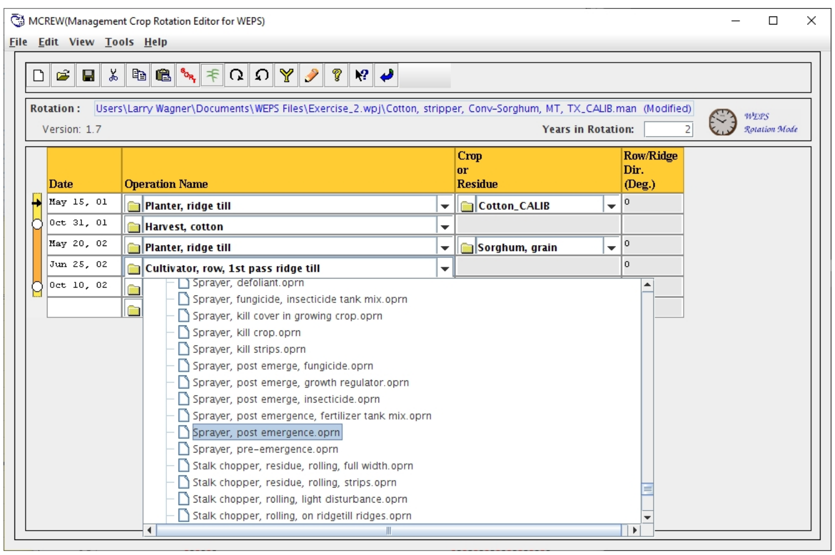


Figure 19.60: Replacing operation in MCREW.

*Step 5:* Add additional operations. Right-click the May 15 operation ***Planter, ridge till*** and select **Insert Operation** from the mouse menu. This will bring up a WEPS FileChooser window.

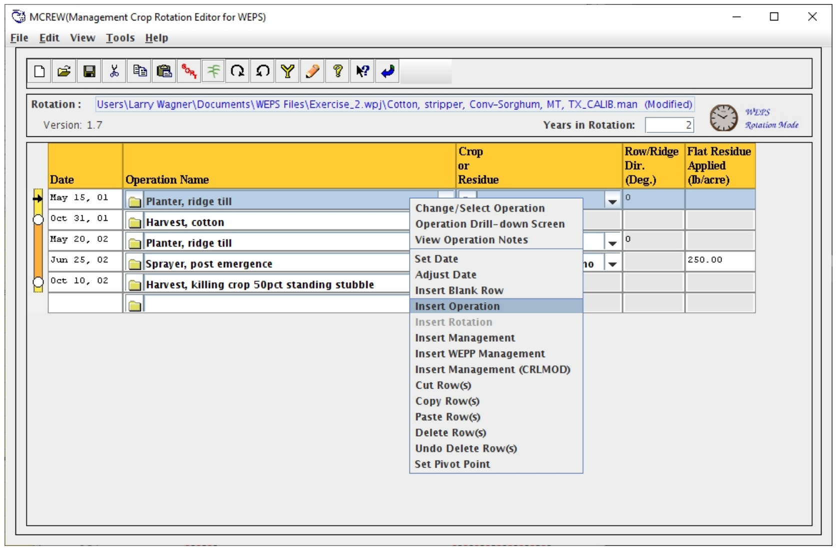



Figure 19.61: Inserting Operation into MCREW.

*Step 6:* In the WEPS FileChooser window, double-click the **CRLMOD Operations** folder (if not already selected) and scroll to find ***Strip till bed conditioner*** operation (Fig. 19.62). Once selected, this operation will be placed above the operation name you clicked to insert it. They will also share the same date as the operation below it until modified appropriately.

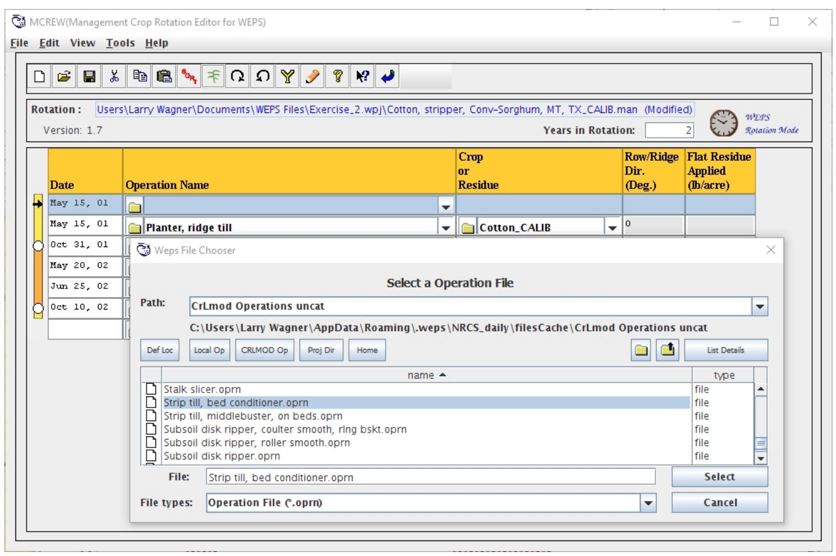



Figure 19.62: Inserting Operation into MCREW via FileChooser selection.

*Step 7:* Continue to delete, change or add operations until the MCREW matches Fig. 19.63, e.g. add another ***Strip till bed conditioner*** operation following the cotton harvesting operation. Set the date for that operation to match the planting date for the sorghum.

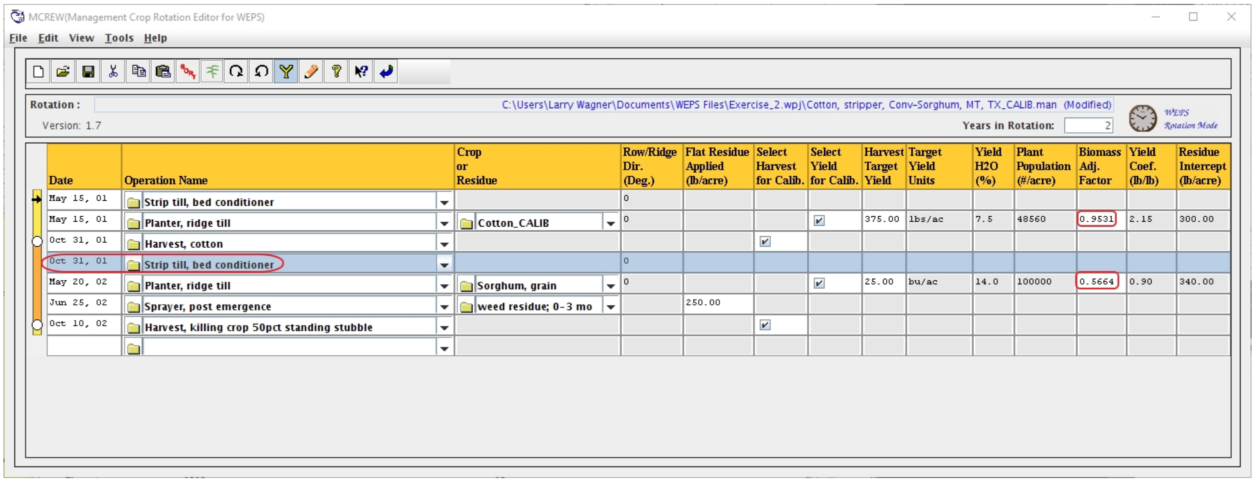
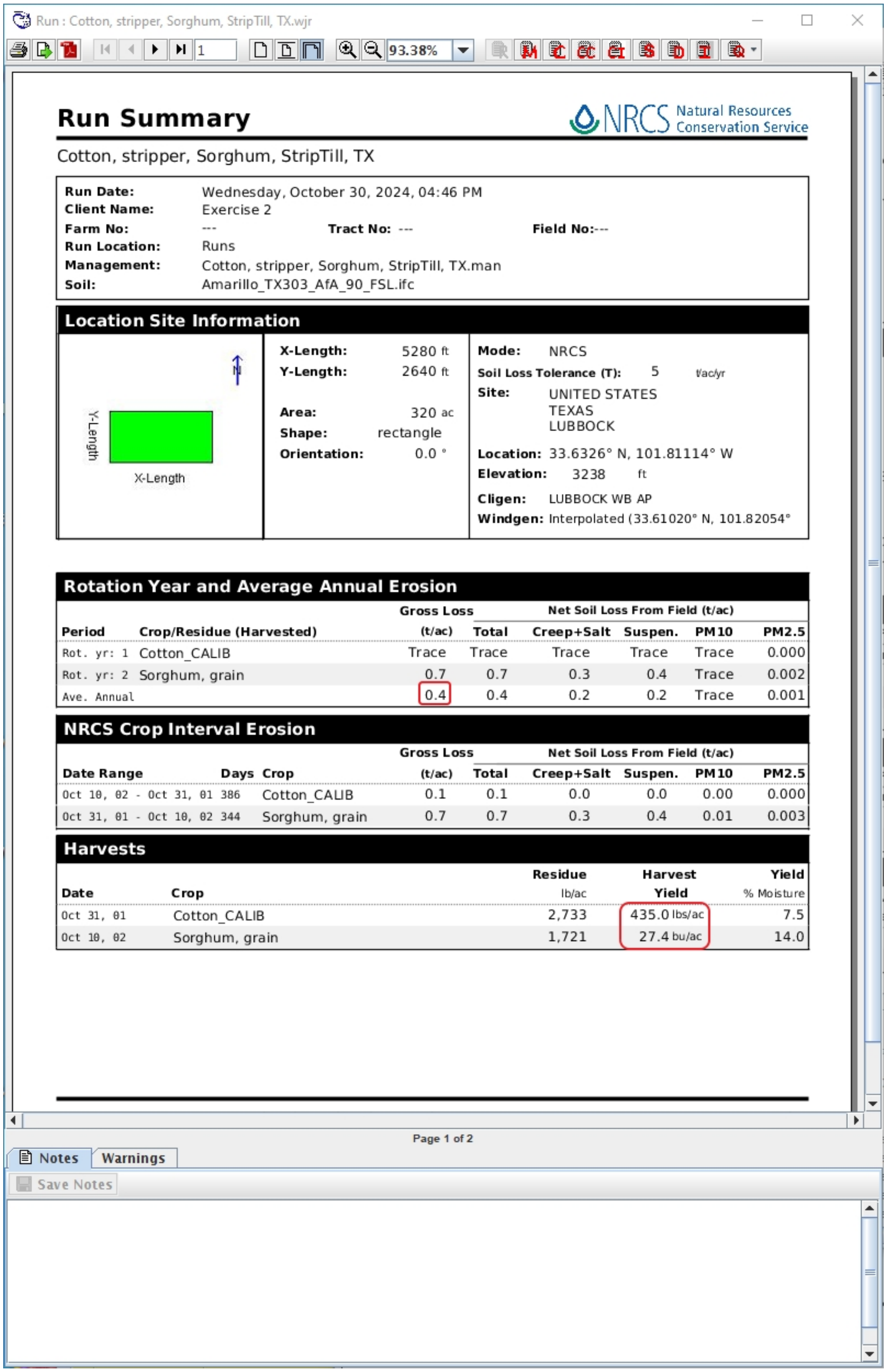


Figure 19.63: Window showing reduced tillage ridge till alternative calibration run.

Be sure the crop records are the previously calibrated ones (e.g. **0.9531** and **0.5664** respectively for the **Biomass Adj. Factor** values). For completeness, also check to ensure that the target yields are set to **375 lbs/ac** for cotton and **25 bu/ac** for sorghum. Save the new file as ***Cotton, stripper, Sorghum, StripTill, TX***, then save and close MCREW to return to the interface.

*Step 8:* Make a normal (non-calibrated) WEPS run for the strip till rotation since we have previously calibrated both the cotton and sorghum crop records. Label the new run ***Cotton, stripper, Sorghum, StripTill, TX*** to reflect the changes made in the management rotation.




**Run Summary**

Cotton, stripper, Sorghum, StripTill, TX

**Run Date:** Wednesday, October 30, 2024, 04:46 PM
**Client Name:** Exercise 2
**Farm No:** --- **Tract No:** --- **Field No:**---
**Run Location:** Runs
**Management:** Cotton, stripper, Sorghum, StripTill, TX.man
**Soil:** Amarillo_TX303_AfA_90_FSL.ifc

**Location Site Information**

**X-Length:** 5280 ft
**Y-Length:** 2640 ft
**Area:** 320 ac
**Shape:** rectangle
**Orientation:** 0.0 °

**Mode:** NRCS
**Soil Loss Tolerance (T):** 5 t/ac/yr
**Site:** UNITED STATES TEXAS LUBBOCK
**Location:** 33.6326° N, 101.81114° W
**Elevation:** 3238 ft
**Cligen:** LUBBOCK WB AP
**Windgen:** Interpolated (33.61020° N, 101.82054°

**Rotation Year and Average Annual Erosion**

| Period | Crop/Residue (Harvested) | Gross Loss (t/ac) | Net Soil Loss From Field (t/ac) Total | Creep+Salt | Suspen. | PM10 | PM2.5 |
|---|---|---|---|---|---|---|---|
| Rot. yr: 1 | Cotton_CALIB | Trace | Trace | Trace | Trace | Trace | 0.000 |
| Rot. yr: 2 | Sorghum, grain | 0.7 | 0.7 | 0.3 | 0.4 | Trace | 0.002 |
| Ave. Annual | | 0.4 | 0.4 | 0.2 | 0.2 | Trace | 0.001 |

**NRCS Crop Interval Erosion**

| Date Range | Days | Crop | Gross Loss (t/ac) | Net Soil Loss From Field (t/ac) Total | Creep+Salt | Suspen. | PM10 | PM2.5 |
|---|---|---|---|---|---|---|---|---|
| Oct 10, 02 - Oct 31, 01 | 386 | Cotton_CALIB | 0.1 | 0.1 | 0.0 | 0.0 | 0.00 | 0.000 |
| Oct 31, 01 - Oct 10, 02 | 344 | Sorghum, grain | 0.7 | 0.7 | 0.3 | 0.4 | 0.01 | 0.003 |

**Harvests**

| Date | Crop | Residue lb/ac | Harvest Yield | Yield % Moisture |
|---|---|---|---|---|
| Oct 31, 01 | Cotton_CALIB | 2,733 | 435.0 lbs/ac | 7.5 |
| Oct 10, 02 | Sorghum, grain | 1,721 | 27.4 bu/ac | 14.0 |

Page 1 of 2

Notes Warnings
Save Notes

Figure 19.64: Run summary showing Average Annual Soil Loss of 0.4 tons/acre.

Average Annual Soil Loss is now predicted to be only **0.4 tons/ac** (Fig. 19.64). This run shows that it is possible to effectively control erosion using a cotton-sorghum rotation as designed in Fig. 19.63. Leaving the cotton stalks standing, in permitted zones in the U.S. (Fig. 19.65)[14] is a very effective method of controlling wind erosion.

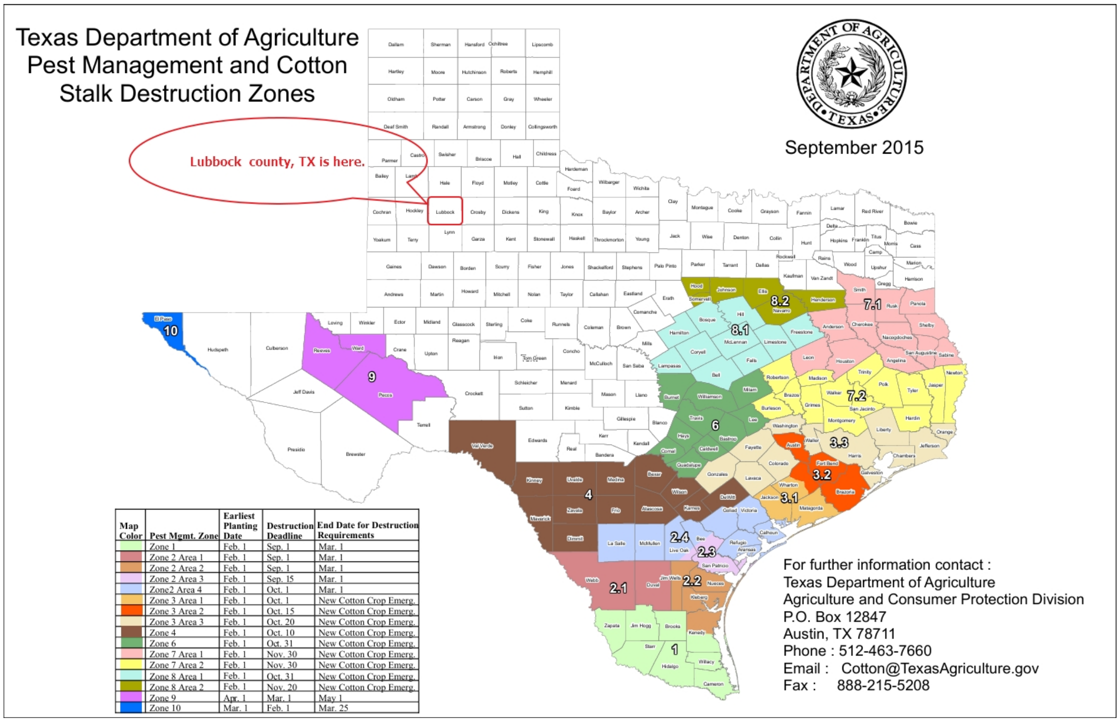
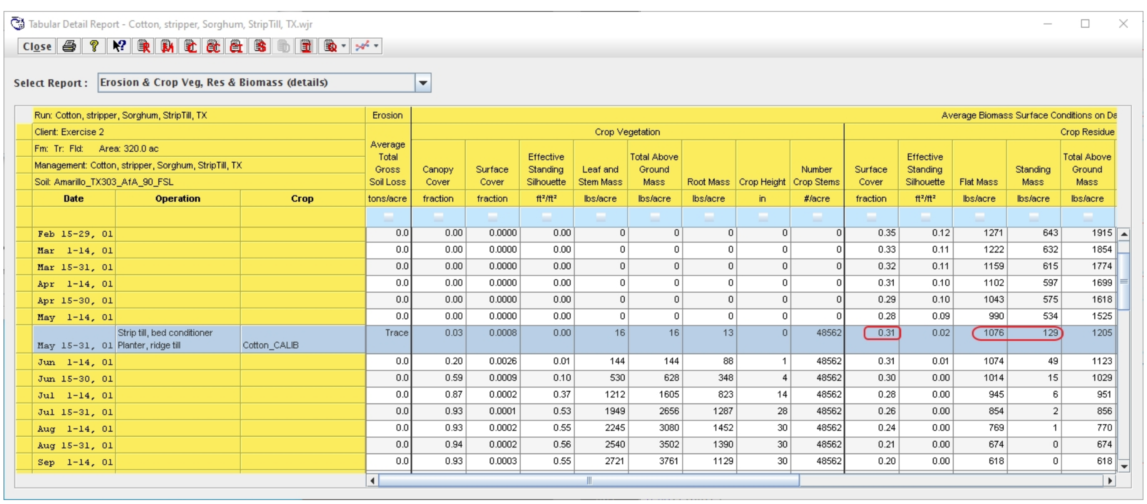



Figure 19.65: Texas Department of Agriculture Cotton Stalk Destruction Zones.

The Detail Report shows there is 1076 lbs/ac Flat Mass and 129 lbs/ac Standing Mass with 31% Surface Cover of sorghum residue after planting cotton (Fig. 19.66).



Tabular Detail Report - Cotton, stripper, Sorghum, StripTill, TX.wjr

Select Report : Erosion & Crop Veg, Res & Biomass (details)

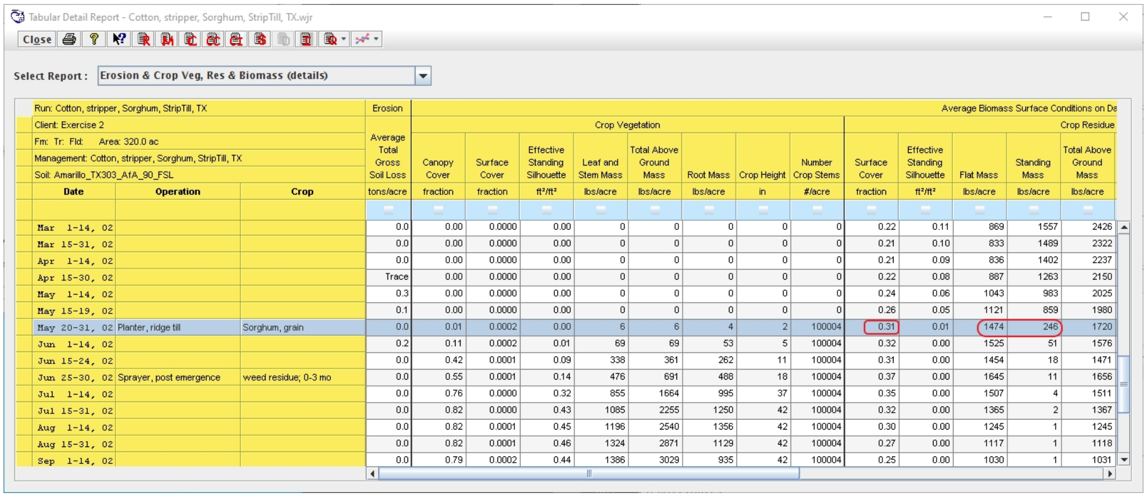
Run: Cotton, stripper, Sorghum, StripTill, TX
Client: Exercise 2
Fm: Tr: Fld: Area: 320.0 ac
Management: Cotton, stripper, Sorghum, StripTill, TX
Soil: Amarillo_TX303_AfA_90_FSL

| Date | Operation | Crop | Erosion: Average Total Gross Soil Loss (tons/acre) | Crop Vegetation: Canopy Cover (fraction) | Surface Cover (fraction) | Effective Standing Silhouette (ft²/ft²) | Leaf and Stem Mass (lbs/acre) | Total Above Ground Mass (lbs/acre) | Root Mass (lbs/acre) | Crop Height (in) | Number Crop Stems (#/acre) | Crop Residue: Surface Cover (fraction) | Effective Standing Silhouette (ft²/ft²) | Flat Mass (lbs/acre) | Standing Mass (lbs/acre) | Total Above Ground Mass (lbs/acre) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Feb 15-29, 01 | | | 0.0 | 0.00 | 0.0000 | 0.00 | 0 | 0 | 0 | 0 | 0 | 0.35 | 0.12 | 1271 | 643 | 1915 |
| Mar 1-14, 01 | | | 0.0 | 0.00 | 0.0000 | 0.00 | 0 | 0 | 0 | 0 | 0 | 0.33 | 0.11 | 1222 | 632 | 1854 |
| Mar 15-31, 01 | | | 0.0 | 0.00 | 0.0000 | 0.00 | 0 | 0 | 0 | 0 | 0 | 0.32 | 0.11 | 1159 | 615 | 1774 |
| Apr 1-14, 01 | | | 0.0 | 0.00 | 0.0000 | 0.00 | 0 | 0 | 0 | 0 | 0 | 0.31 | 0.10 | 1102 | 597 | 1699 |
| Apr 15-30, 01 | | | 0.0 | 0.00 | 0.0000 | 0.00 | 0 | 0 | 0 | 0 | 0 | 0.29 | 0.10 | 1043 | 575 | 1618 |
| May 1-14, 01 | | | 0.0 | 0.00 | 0.0000 | 0.00 | 0 | 0 | 0 | 0 | 0 | 0.28 | 0.09 | 990 | 534 | 1525 |
| May 15-31, 01 | Strip till, bed conditioner Planter, ridge till | Cotton_CALIB | Trace | 0.03 | 0.0008 | 0.00 | 16 | 16 | 13 | 0 | 48562 | 0.31 | 0.02 | 1076 | 129 | 1205 |
| Jun 1-14, 01 | | | 0.0 | 0.20 | 0.0026 | 0.01 | 144 | 144 | 88 | 1 | 48562 | 0.31 | 0.01 | 1074 | 49 | 1123 |
| Jun 15-30, 01 | | | 0.0 | 0.59 | 0.0009 | 0.10 | 530 | 628 | 348 | 4 | 48562 | 0.30 | 0.00 | 1014 | 15 | 1029 |
| Jul 1-14, 01 | | | 0.0 | 0.87 | 0.0002 | 0.37 | 1212 | 1605 | 823 | 14 | 48562 | 0.28 | 0.00 | 945 | 6 | 951 |
| Jul 15-31, 01 | | | 0.0 | 0.93 | 0.0001 | 0.53 | 1949 | 2656 | 1287 | 28 | 48562 | 0.26 | 0.00 | 854 | 2 | 856 |
| Aug 1-14, 01 | | | 0.0 | 0.93 | 0.0002 | 0.55 | 2245 | 3080 | 1452 | 30 | 48562 | 0.24 | 0.00 | 769 | 1 | 770 |
| Aug 15-31, 01 | | | 0.0 | 0.94 | 0.0002 | 0.56 | 2540 | 3502 | 1390 | 30 | 48562 | 0.21 | 0.00 | 674 | 0 | 674 |
| Sep 1-14, 01 | | | 0.0 | 0.93 | 0.0003 | 0.55 | 2721 | 3761 | 1129 | 30 | 48562 | 0.20 | 0.00 | 618 | 0 | 618 |

Figure 19.66: Tabular Detail Report showing surface cover needed to meet Soil Loss Tolerance (year 1).

Likewise the Detail Report also shows 1474 lbs/ac Flat Mass and 246 lbs/ac of Standing Mass with 31% Surface Cover of cotton residue after planting sorghum (Fig. 19.67).

[14] https://texasagriculture.gov/Regulatory-Programs/Cotton-Stalk-Destruction/Cotton-Stalk-Destruction-Methods



Tabular Detail Report - Cotton, stripper, Sorghum, StripTill, TX.wjr

Select Report : Erosion & Crop Veg, Res & Biomass (details)

Run: Cotton, stripper, Sorghum, StripTill, TX
Client: Exercise 2
Fm: Tr: Fld: Area: 320.0 ac
Management: Cotton, stripper, Sorghum, StripTill, TX
Soil: Amarillo_TX303_AfA_90_FSL

| | | | Erosion | Average Biomass Surface Conditions on Da | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Crop Vegetation | | | | | | | | Crop Residue | | | | | |
| | | | Average Total Gross Soil Loss | Canopy Cover | Surface Cover | Effective Standing Silhouette | Leaf and Stem Mass | Total Above Ground Mass | Root Mass | Crop Height | Number Crop Stems | Surface Cover | Effective Standing Silhouette | Flat Mass | Standing Mass | Total Above Ground Mass |
| Date | Operation | Crop | tons/acre | fraction | fraction | ft²/ft² | lbs/acre | lbs/acre | lbs/acre | in | #/acre | fraction | ft²/ft² | lbs/acre | lbs/acre | lbs/acre |
| Mar 1-14, 02 | | | 0.0 | 0.00 | 0.0000 | 0.00 | 0 | 0 | 0 | 0 | 0 | 0.22 | 0.11 | 869 | 1557 | 2426 |
| Mar 15-31, 02 | | | 0.0 | 0.00 | 0.0000 | 0.00 | 0 | 0 | 0 | 0 | 0 | 0.21 | 0.10 | 833 | 1489 | 2322 |
| Apr 1-14, 02 | | | 0.0 | 0.00 | 0.0000 | 0.00 | 0 | 0 | 0 | 0 | 0 | 0.21 | 0.09 | 836 | 1402 | 2237 |
| Apr 15-30, 02 | | | Trace | 0.00 | 0.0000 | 0.00 | 0 | 0 | 0 | 0 | 0 | 0.22 | 0.08 | 887 | 1263 | 2150 |
| May 1-14, 02 | | | 0.3 | 0.00 | 0.0000 | 0.00 | 0 | 0 | 0 | 0 | 0 | 0.24 | 0.06 | 1043 | 983 | 2025 |
| May 15-19, 02 | | | 0.1 | 0.00 | 0.0000 | 0.00 | 0 | 0 | 0 | 0 | 0 | 0.26 | 0.05 | 1121 | 859 | 1980 |
| May 20-31, 02 | Planter, ridge till | Sorghum, grain | 0.0 | 0.01 | 0.0002 | 0.00 | 6 | 6 | 4 | 2 | 100004 | 0.31 | 0.01 | 1474 | 246 | 1720 |
| Jun 1-14, 02 | | | 0.2 | 0.11 | 0.0002 | 0.01 | 69 | 69 | 53 | 5 | 100004 | 0.32 | 0.00 | 1525 | 51 | 1576 |
| Jun 15-24, 02 | | | 0.0 | 0.42 | 0.0001 | 0.09 | 338 | 361 | 262 | 11 | 100004 | 0.31 | 0.00 | 1454 | 18 | 1471 |
| Jun 25-30, 02 | Sprayer, post emergence | weed residue; 0-3 mo | 0.0 | 0.55 | 0.0001 | 0.14 | 476 | 691 | 488 | 18 | 100004 | 0.37 | 0.00 | 1645 | 11 | 1656 |
| Jul 1-14, 02 | | | 0.0 | 0.76 | 0.0000 | 0.32 | 855 | 1664 | 995 | 37 | 100004 | 0.35 | 0.00 | 1507 | 4 | 1511 |
| Jul 15-31, 02 | | | 0.0 | 0.82 | 0.0000 | 0.43 | 1085 | 2255 | 1250 | 42 | 100004 | 0.32 | 0.00 | 1365 | 2 | 1367 |
| Aug 1-14, 02 | | | 0.0 | 0.82 | 0.0001 | 0.45 | 1196 | 2540 | 1356 | 42 | 100004 | 0.30 | 0.00 | 1245 | 1 | 1245 |
| Aug 15-31, 02 | | | 0.0 | 0.82 | 0.0001 | 0.46 | 1324 | 2871 | 1129 | 42 | 100004 | 0.27 | 0.00 | 1117 | 1 | 1118 |
| Sep 1-14, 02 | | | 0.0 | 0.79 | 0.0002 | 0.44 | 1386 | 3029 | 935 | 42 | 100004 | 0.25 | 0.00 | 1030 | 1 | 1031 |

Figure 19.67: Tabular Detail Report showing surface cover needed to meet the Soil Loss Tolerance (year 2).

*Step 9:* If you do not believe the increased yield levels WEPS predicted with this rotation, one can make another ”Yield Calibration” run to force the yields to match within ±5% of the target yields. The results are not much different, as noted in Fig. 19.68.

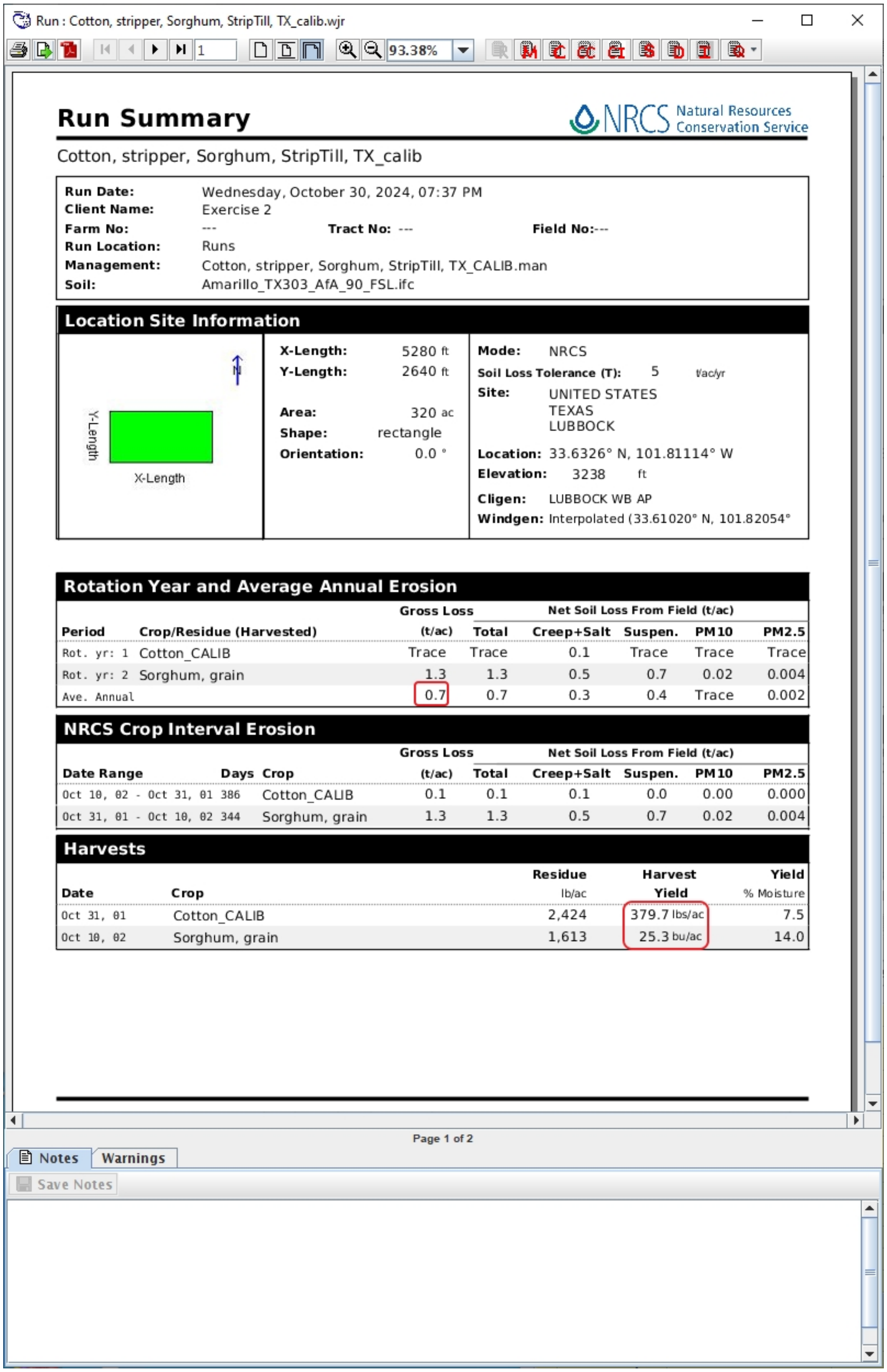



Figure 19.68: Run summary showing Average Annual Soil Loss of 0.7 tons/acre.

## 19.4 Ex 3 – Adding a forage crop and grazing into a rotation

### 19.4.1 Skill Building

This exercise begins with a template management run of winter wheat and fallow. The user will utilize a 2-year management (wheat-fallow), where fallow is replaced with a vegetative cover and conservatively grazed in order to increase soil protection, reduce erosion and improve soil health.

- Exercise 3 uses a previously built management record as a starting template that is then modified via MCREW (Management/Crop Rotation Editor for WEPS).
- It outlines how to: Select WEPS inputs and make WebStart WEPS Runs
  - How to determine which soil is the "critical dominate" soil.
  - Perform a Yield Calibration run to calibrate the average yield for the selected crop record
  - Perform a regular (normal) WEPS simulation run
  - Insert another cropping system (single year rotation) into the current management rotation
- It demonstrates how to: Modify an existing management rotation within MCREW using basic editing functions:
  - How to set a group of operations to be performed at a 45 degree angle to North
  - How to set operation and crop flags for a Yield Calibration Run
  - Making Target Yield adjustments
  - Inserting another management file's content
  - Modfying operation dates
- Learn how to: Evaluate output reports and interpret results relevant to achieving specific erosion risk goals:
  - Determine if erosion exceeds the Soil Loss Tolerance (T) value for the specified soil

### 19.4.2 Scenario

- The field is located in **Haakon County, South Dakota.**
- Manually enter latitude and longitude. Set the latitude as **44.59528° N** and longitude as **101.48097° W**.
- The **Cligen** station is **MILESVILLE**.
- The **Windgen** station is **Interpolated**.
- The critical dominant Soil Map Unit is **Craft_SD055_CtA_80_VFSL**.
- The existing cropping system is **Winter Wheat-fallow**.
- The field shape is a **160 acre square**, oriented **45**° from North.
- Management includes one fall chisel operation performed at 0°angle (North/South) for added wind protection through the winter months when prevailing winds are from the west. All other field operations are performed at a 45°angle, parallel to the field borders.
- The winter wheat harvest produces about **40 bu/ac/yr** on average.
- The dry land yield for **sudangrass** (added later) for this region should be between **1.5-2 ton/ac/yr**.

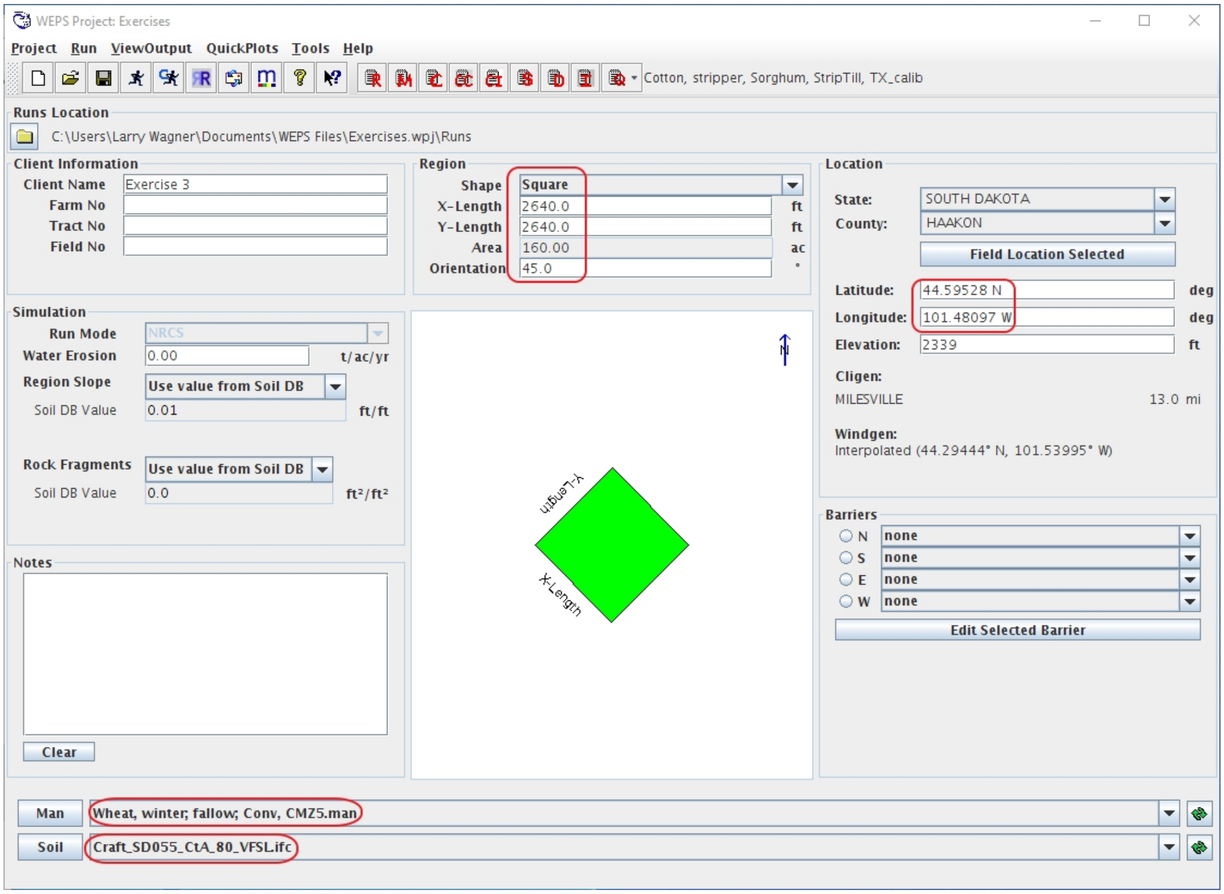



Figure 19.69: The WEPS interface set with the basic information for Exercise 3.

### 19.4.3 Populate inputs

We need to populate the inputs based upon the information provided above. Once that is done, we will execute a WEPS Yield Calibration simulation Run.

Start up the WEPS interface and add the information shown in (Fig. 19.69).

*Step 1:* Under the *Client Information* panel, enter ***Exercise 3*** for **Client Name**. All of the fields under the *Client Information* panel are optional and are not required for a WEPS simulation.

*Step 2:* In the field *Region* information panel, select the **Square** field shape and enter ***160*** into the **Area** field. Both the **X-Length** and **Y-Length** fields will be automatically populated since a square field was selected. Be sure to also change the field **Orientation** to ***45.0***° as well. You will see the field orientation rotate in the *Field View* panel.

*Step 3:* Enter the **latitude** and **longitude** values ***44.59528*** and ***-101.48097*** into their respective fields. The **State** and **County** fields should automatically update with ***SOUTH DAKOTA*** and ***HAAKAN*** respectively. Let's open up the WEPS "Map Viewer" to see the actual field site (Fig. 19.79).

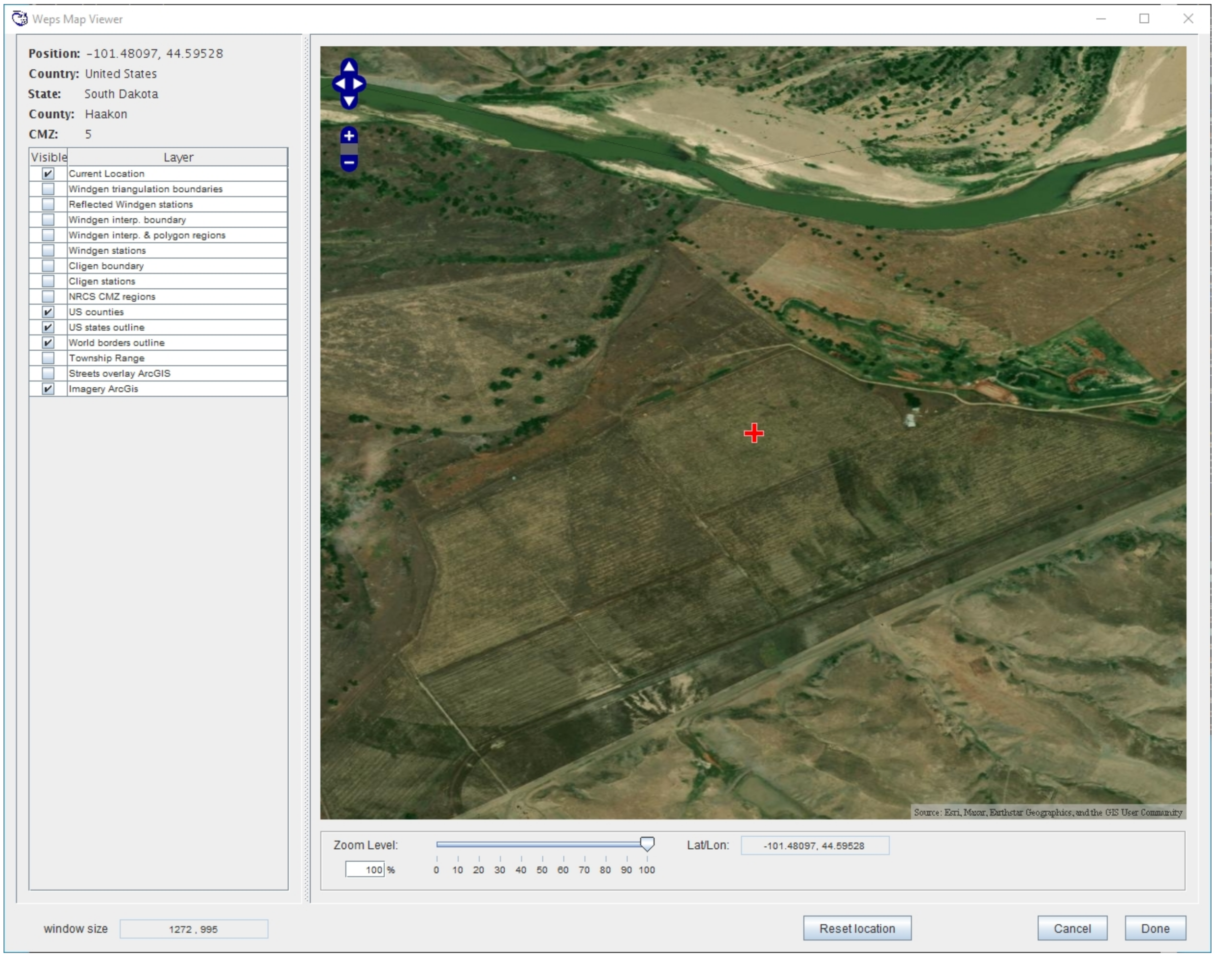



Figure 19.70: WEPS Map Viewer showing field location.

*Step 4:* Select the critical dominant soil for this site. Click on the **Soil** pull down black arrow button (lower right side). Open up the **CSIP Soil Service** option in the tree view and then the *SD055 - Haakon County, South Dakota* option and finally the *CtA - Craft very fine sand loam, 0 to 3 percent slopes, rarely flooded* option. Select the ***Craft_SD055_CtA_80_VFSL*** soil component (Fig. 19.71).

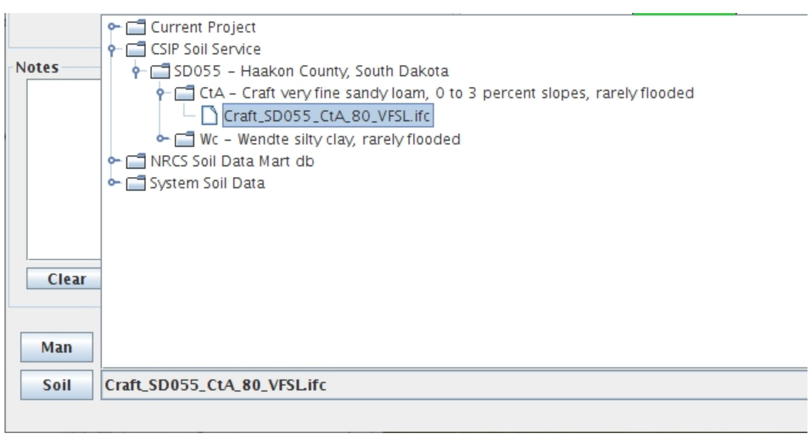



Figure 19.71: CSIP Soil Selection option displaying selected soil.

To see if this soil really is the *critical dominant* soil for this site, we can check using the NRCS Web Soil Survey site (https://websoilsurvey.nrcs.usda.gov/app/WebSoilSurvey.aspx). It shows the **CtA** soil existing on 55.6% of the site and the **Wc** soil with 35.5% (Fig. 19.72). Both of these soils are greater than the 10% threshold for determining the *critical dominate* soil for this site.

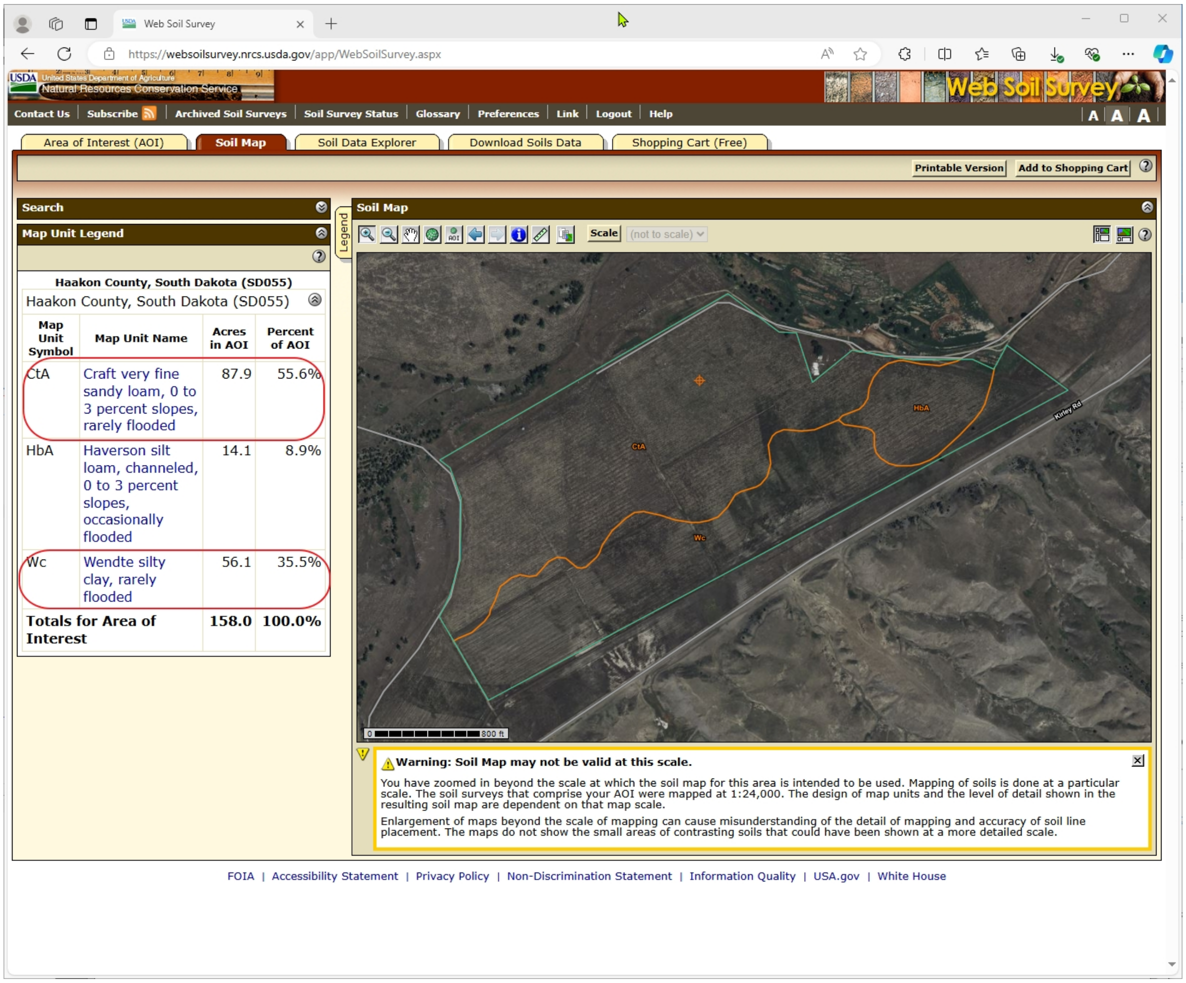



Figure 19.72: NRCS Web Soil Survey displaying the dominate soils on the site.

If we look at the *Wind Erodibility Index* for the soils on this site, we see that all of them are rated at **86 t/ac** (Fig. 19.73). So, the *Wind Erodibility Index* does not help us select the desired soil.

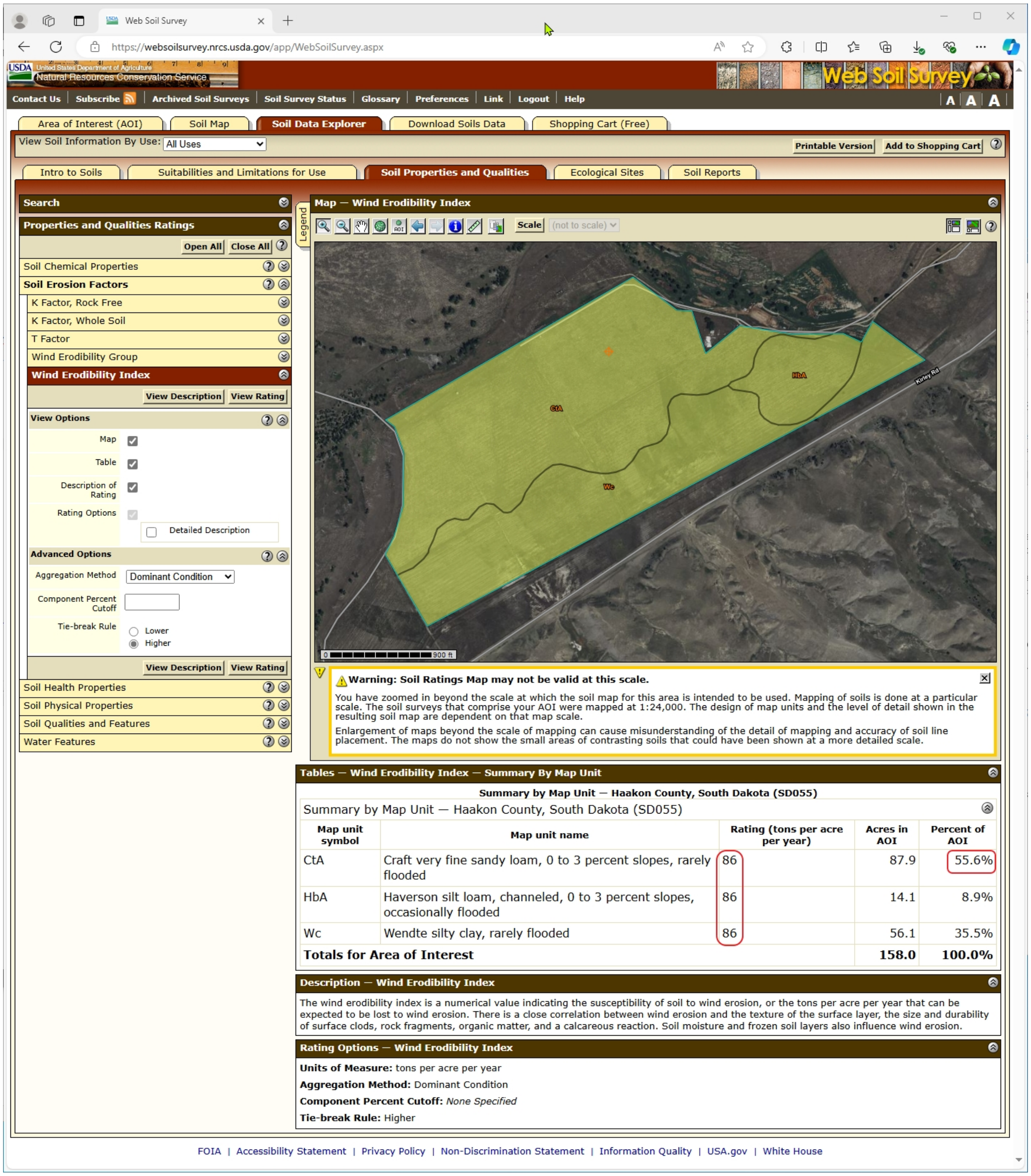



Figure 19.73: NRCS Web Soil Survey displaying the Wind Erodibility Index values for the soils on the site.

If we look at the *Wind Erodibility Group* ratings for the soils on this site, we see that the **CtA** soil has the lowest rating of **3** as shown in Fig. 19.74. So, the *Wind Erodibility Group* rating suggests that we should use the **CtA** soil.

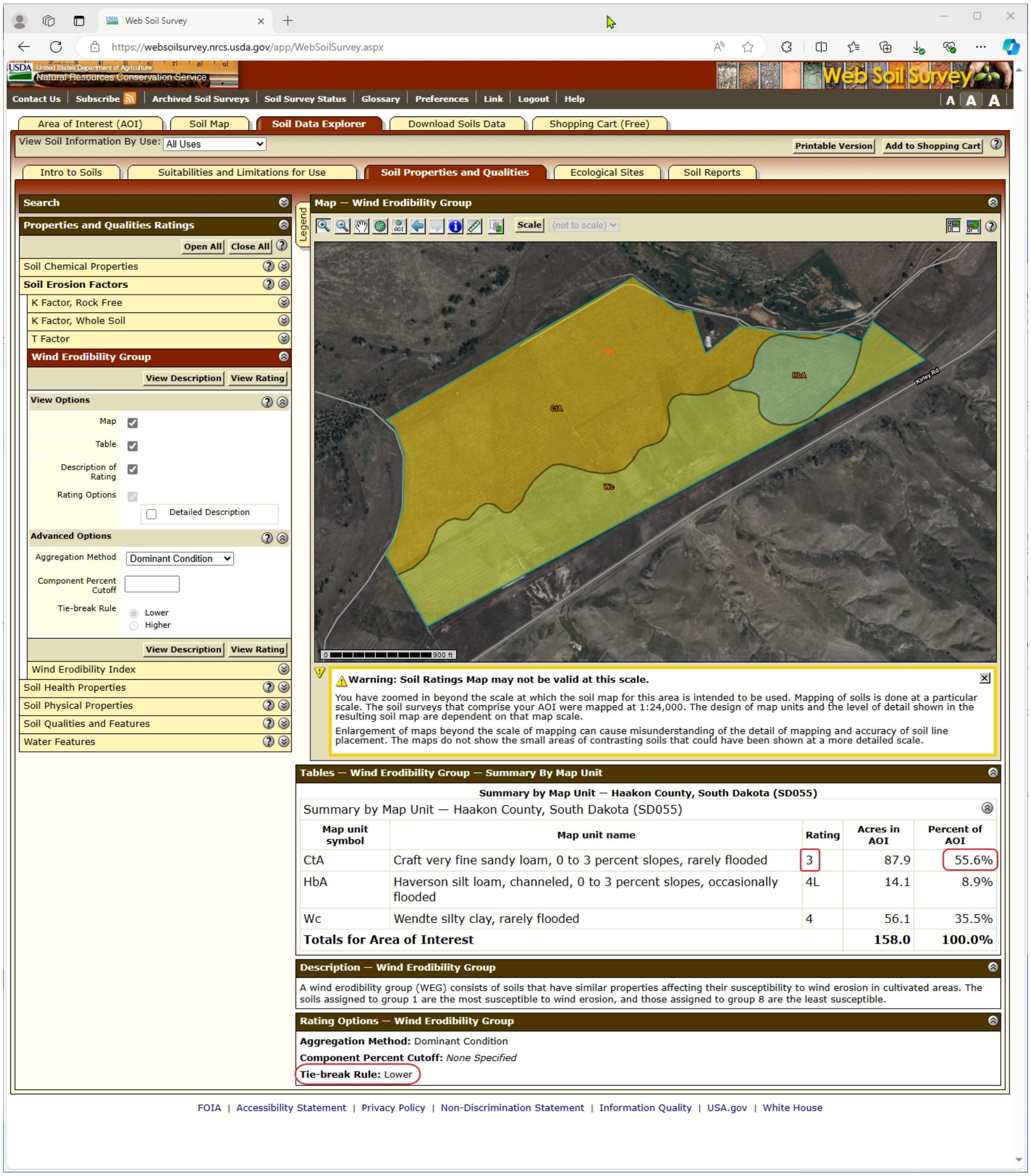



Figure 19.74: NRCS Web Soil Survey displaying the Wind Erodibility Group rating for soils on the site.

*Step 5:* Open a template file by clicking the **Man** dropdown button [▾] to the lower right of the screen. Scroll down to **System Templates**, then select the ***Wheat, winter; fallow; Conv, CMZ5*** template.

*Step 6:* Open MCREW and see that all the operations except the *Chisel, sweep shovel*, are set to **45**° as well. If they are not already oriented, press the left mouse button and drag to highlight all the operations (Fig. 19.75), right-click in the "Row/Ridge Dir. (Deg.)" column (Fig. 19.76), and select the *Set to 45 deg* menu option.

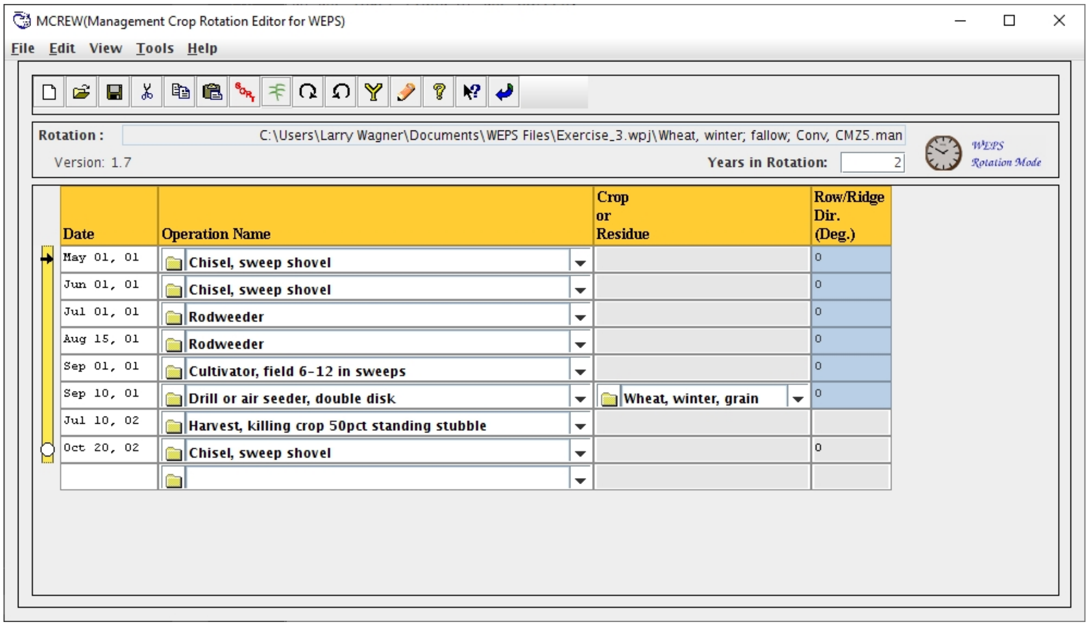


Figure 19.75: MCREW showing multiple ”Row/Ridge Dir” cells selected.

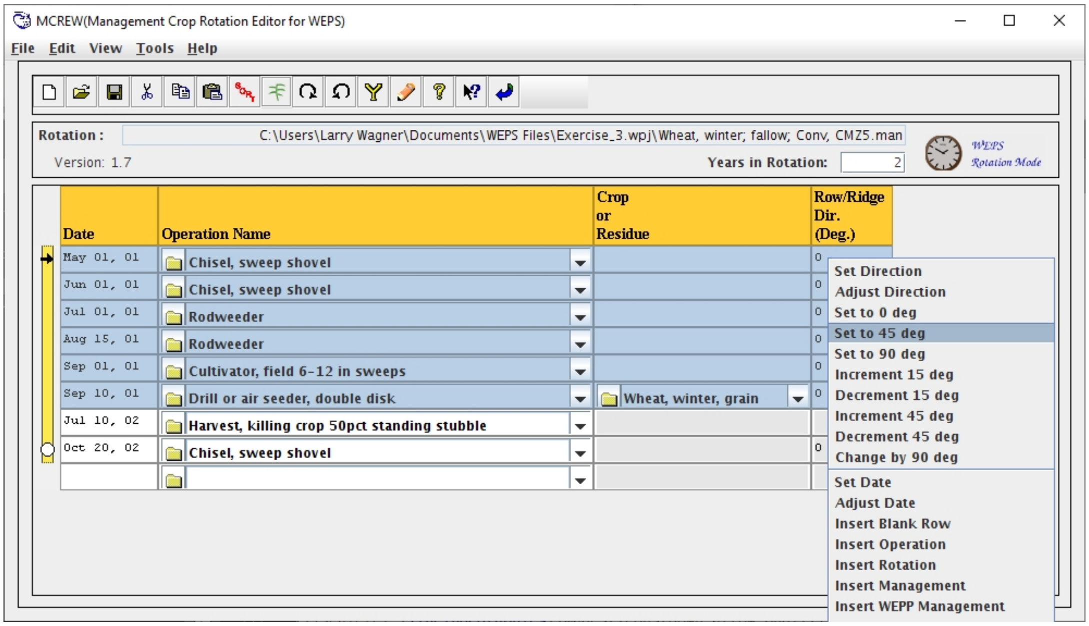


Figure 19.76: MCREW showing ”Set to 45 deg” left button mouse menu option selected.

MCREW should then display all selected operations with *45° Row/Ridge Dir.* values (Fig. 19.77).

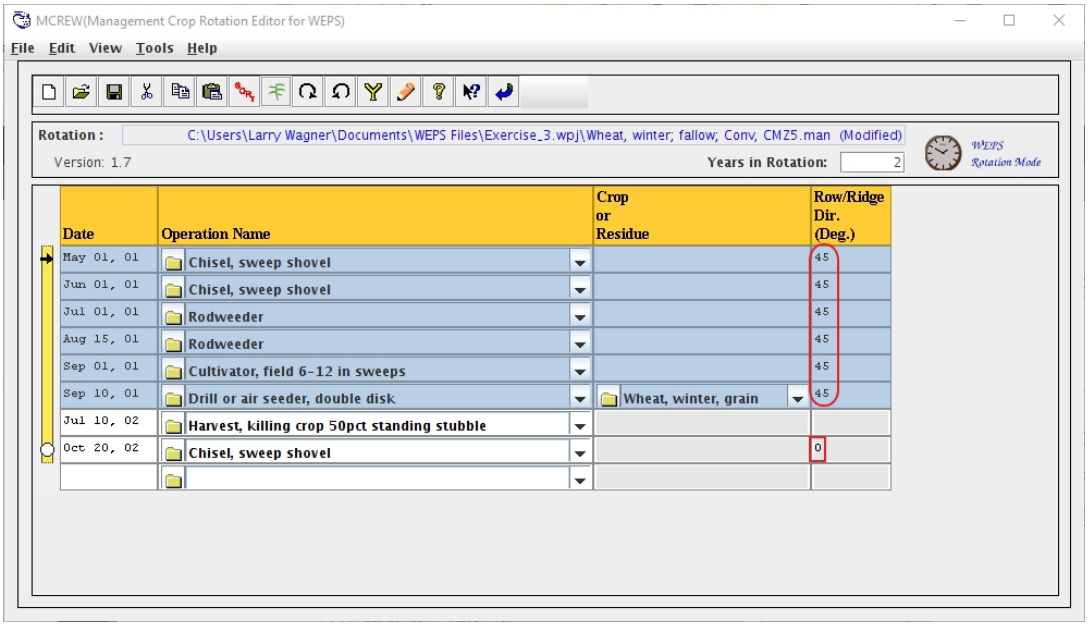



Figure 19.77: Management Crop Rotation Editor showing correct Row/Ridge directions.

The fall chisel (Oct 20, 02) operation's direction should still be **0**° or North as described under the **Scenario** section above, even though the field angle is 45°. Fig. 19.77 displays the correct MCREW setup for this simulation run.

*Step 7:* Click the Yield Calibrate button to turn on the yield function and ensure Target Yield is set to **40 bu/ac** (Fig. 19.78). Click the Return button to close MCREW and return to the WEPS interface.

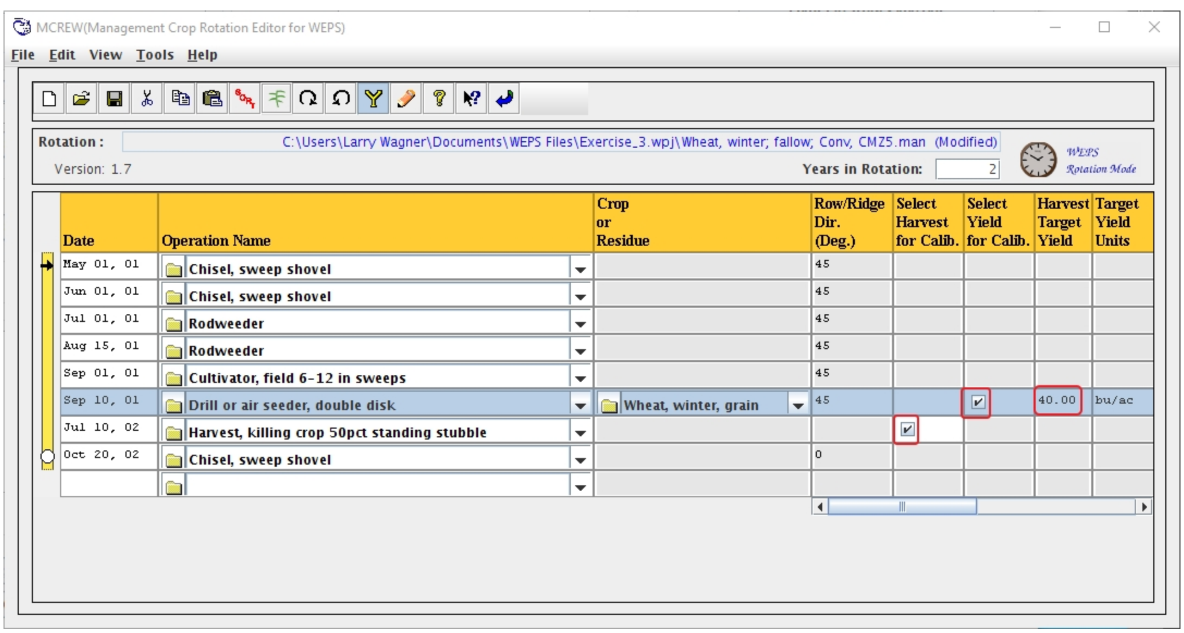



Figure 19.78: MCREW showing the crop is selected for Yield Calibration and it's target yield.

*Step 8:* Make a **Yield Calibration WEPS Run** and name the run ***WWheat-Fallow, Conv, CMZ5_calib***. Upon completion, a *Biomass Adjustment Factor* of **0.9297** is displayed in a popup window. Click ***Use in Current Project*** labeled button in that window.

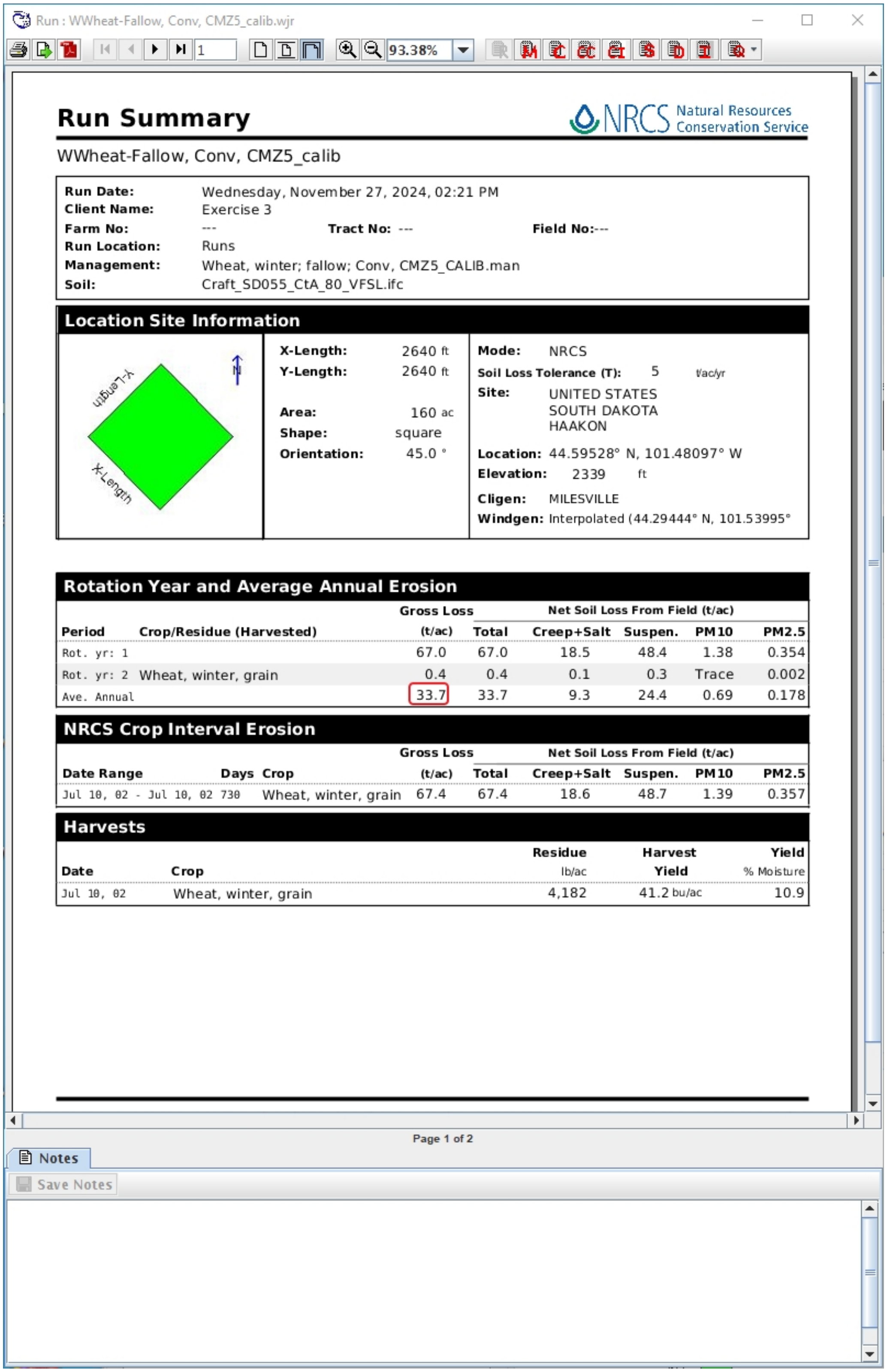



Figure 19.79: WEPS Calibration Run Summary.

The Average Annual Soil Loss is **33.7 ton/ac** (Fig. 19.79).

### 19.4.4 Adding Sudangrass and Grazing

To reduce erosion, it may be beneficial to replace the fallow with a grazed sudangrass forage crop. This planting will take advantage of early moisture for growth, be quickly grazed once, and the residual residue will be allowed to persist through the winter wheat crop.

*Step 1:* Reopen MCREW. Add ***sorghum, sudangrass, forage*** crop and a grazing operation along with additional tillage operations with associated operation dates, as shown in Fig. 19.80.

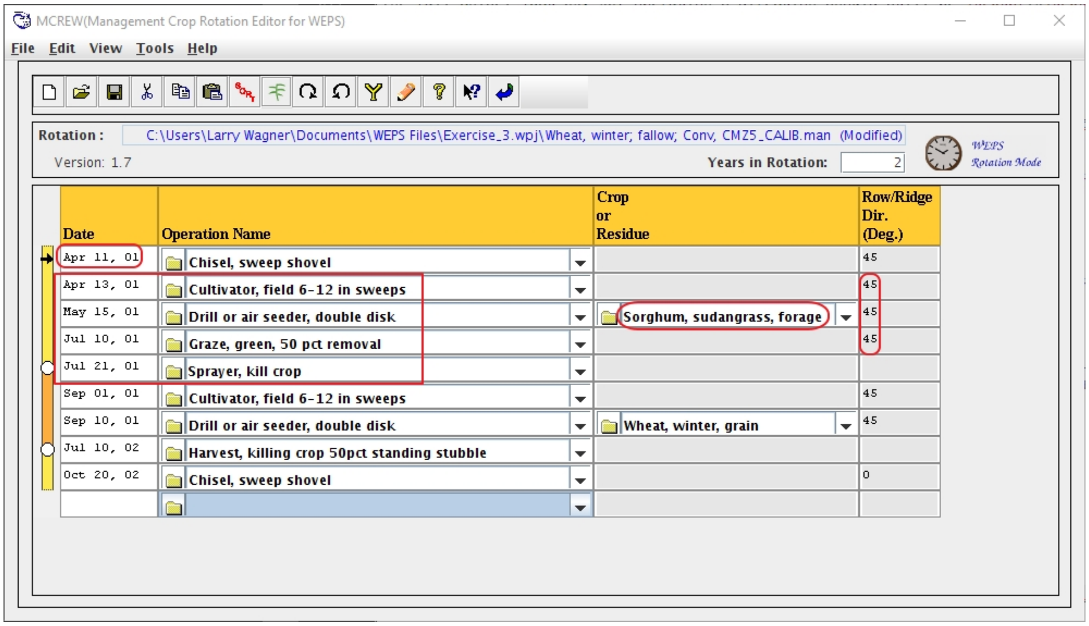



Figure 19.80: WEPS Management file with Sudangrass and grazing operation added.

*Step 2:* The new operations need to be set to ***45*** degrees. The sorghum (previously calibrated), sudangrass, forage should remain uncalibrated for the next Run (Fig. 19.80). *Note*: The perennial crops are not calibrated by default, but can be if desired.

*Step 3:* After new operations are added to the management record (Fig. 19.80), be sure to **Save** the management file to a new name (***WW_Graze50_2yr_Calib.man***) and close MCREW.

*Step 4:* Due to the changes in tillage and operations during the fallow period, we expect that we may achieve a different wheat yield. Since we previously calibrated the winter wheat record for the baseline condition and included the calibrated record into this management file, we don't want to re-calibrate that record so that we can see the potential effect of the modified management on the winter wheat yield (Fig. 19.81). Make a normal WEPS simulation Run and name it ***WWheat-SSGraze50, Conv, CMZ5***.

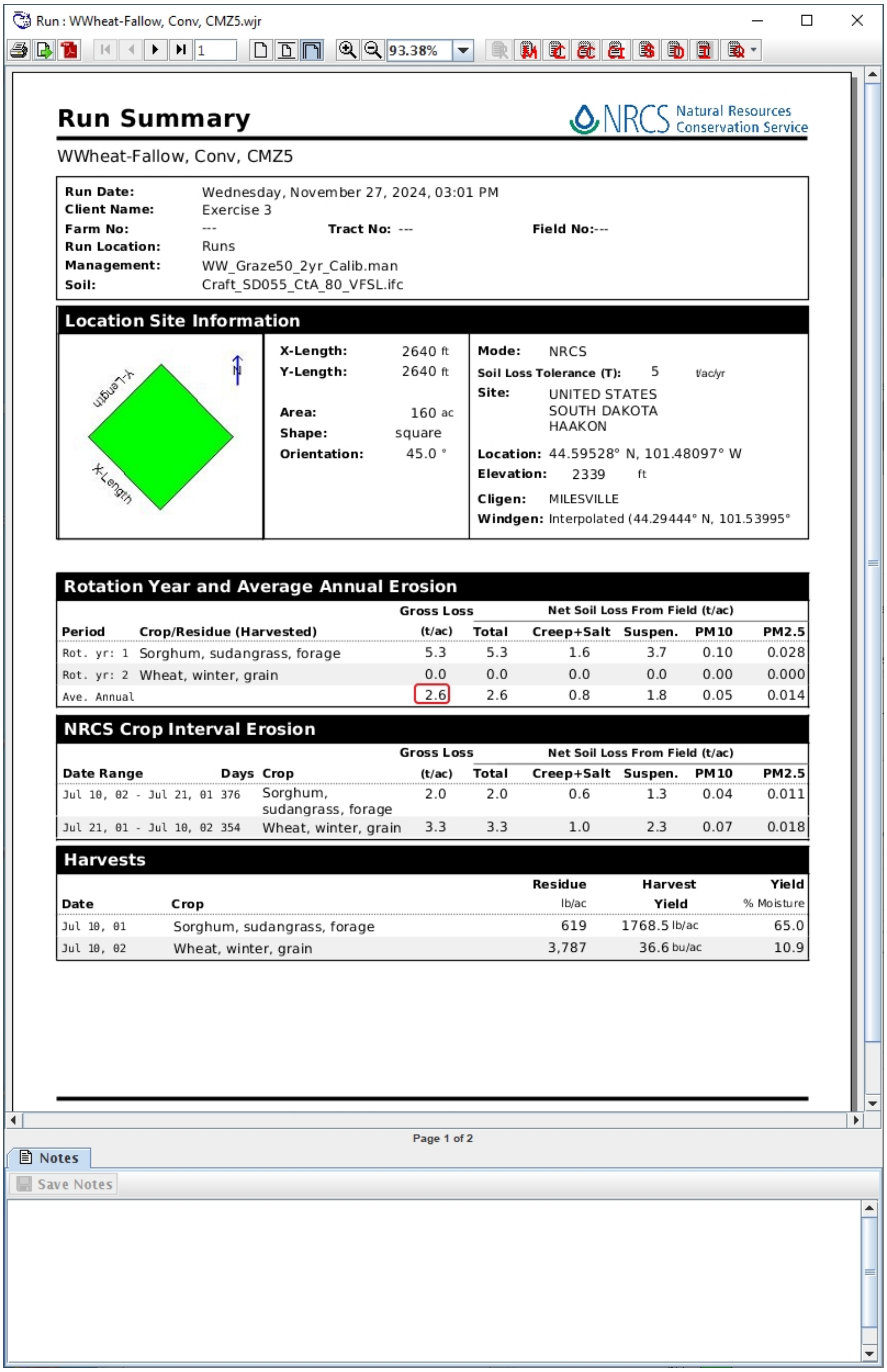



Figure 19.81: Run Summary showing reduced soil loss after adding grazed Sudangrass forage crop.

Adding the Sudangrass and grazing operation has decreased the average annual loss from **33.7 ton/acre** (Fig. 19.79) to below the soil loss tolerance of 5 tons/acre/year. Average annual soil loss is now **2.6 tons/acre**.

## 19.5 Ex 4 – Adding Irrigation

### 19.5.1 Skill Building

This exercise begins with a winter wheat management template. The user will utilize a simple one year rotation to understand how desired yields can be achieved with the implementation of irrigation.

- This exercise uses a previously built management record as a starting template and is modified appropriately via MCREW for this specific scenario.
- It demonstrates how to: Quickly determine if one forgot to add irrigation to a management rotation expecting supplemental water in a region where natural precipitation cannot be relied upon to achieve the specified yields.
- Learn how to: Evaluate ”biomass adjustment factor” values to determine if one forgot to include irrigation to a management rotation where it is expected to include supplemental water.

### 19.5.2 Scenario

- The field is located in **Elmore county, Idaho.**
- The field shape is a **120 acre circle**.
- Manually enter latitude and longitude. Set the latitude as **43.26946° N** and longitude as **115.95191° W**.
- The **Cligen** station is **Boise Lucky Peak DM**.
- The **Windgen** station is **Mountain Home AFB**.
- The soil map unit is **Toll_ID685_2402_85_LS.**
- The cropping system is **wheat, winter, early plant, med residue, fdisk, Z11**. We will cover how to find this management file in the steps below.

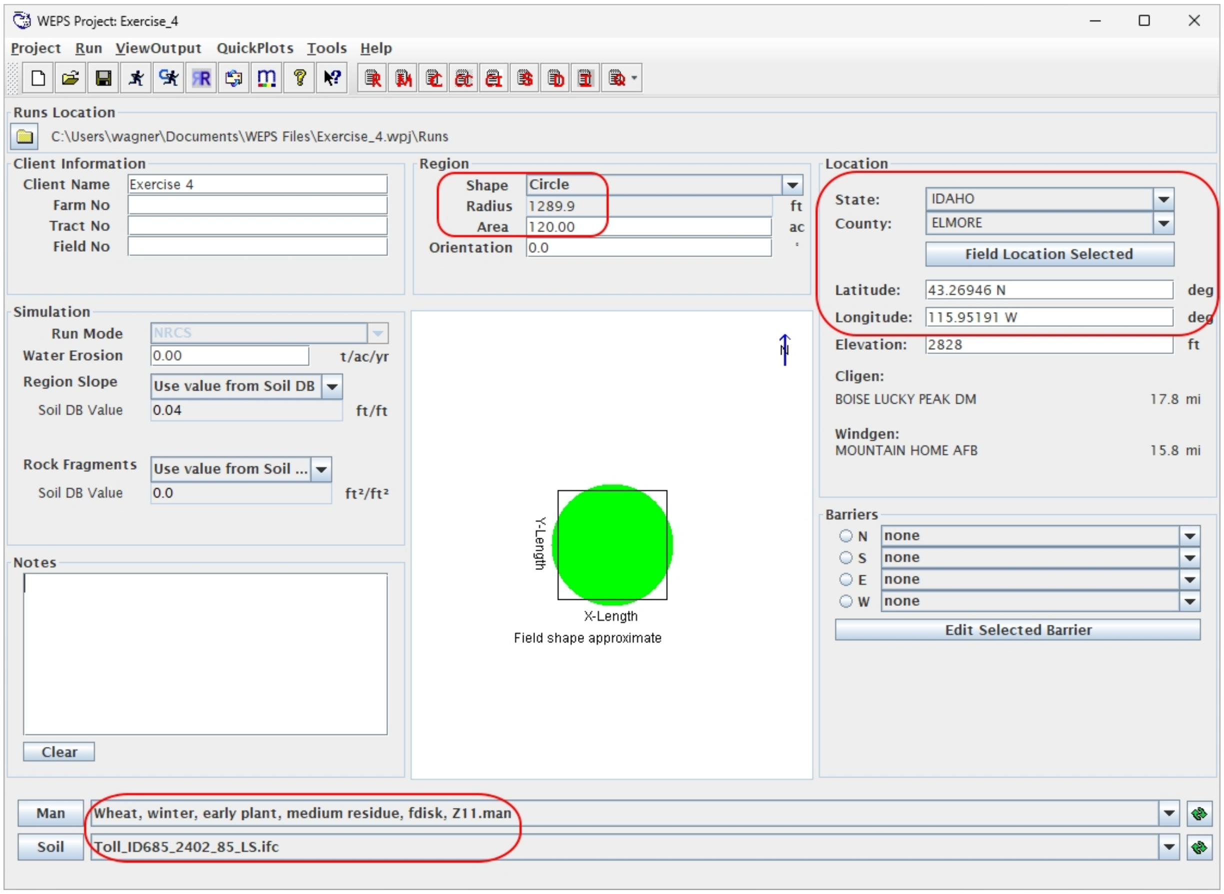



Figure 19.82: The WEPS interface set with the basic information for Exercise 4.

### 19.5.3 Complete the following steps:

*Step 1:* Enter the region shape and field size as shown in (Fig. 19.82).

*Step 2:* Select **IDAHO** for the State and **ELMO** for the county in the Location panel.

*Step 2a:* Click **Please Select Field Location** and set the WEPS Map Viewer zoom level to **60%**. On the main WEPS interface screen, set the latitude as **43.26946**° **N** and longitude as **115.95191**° **W**. The Map Viewer display should automatically update and show the red ”+” character within the desired circular field site as shown in Fig. 19.83.

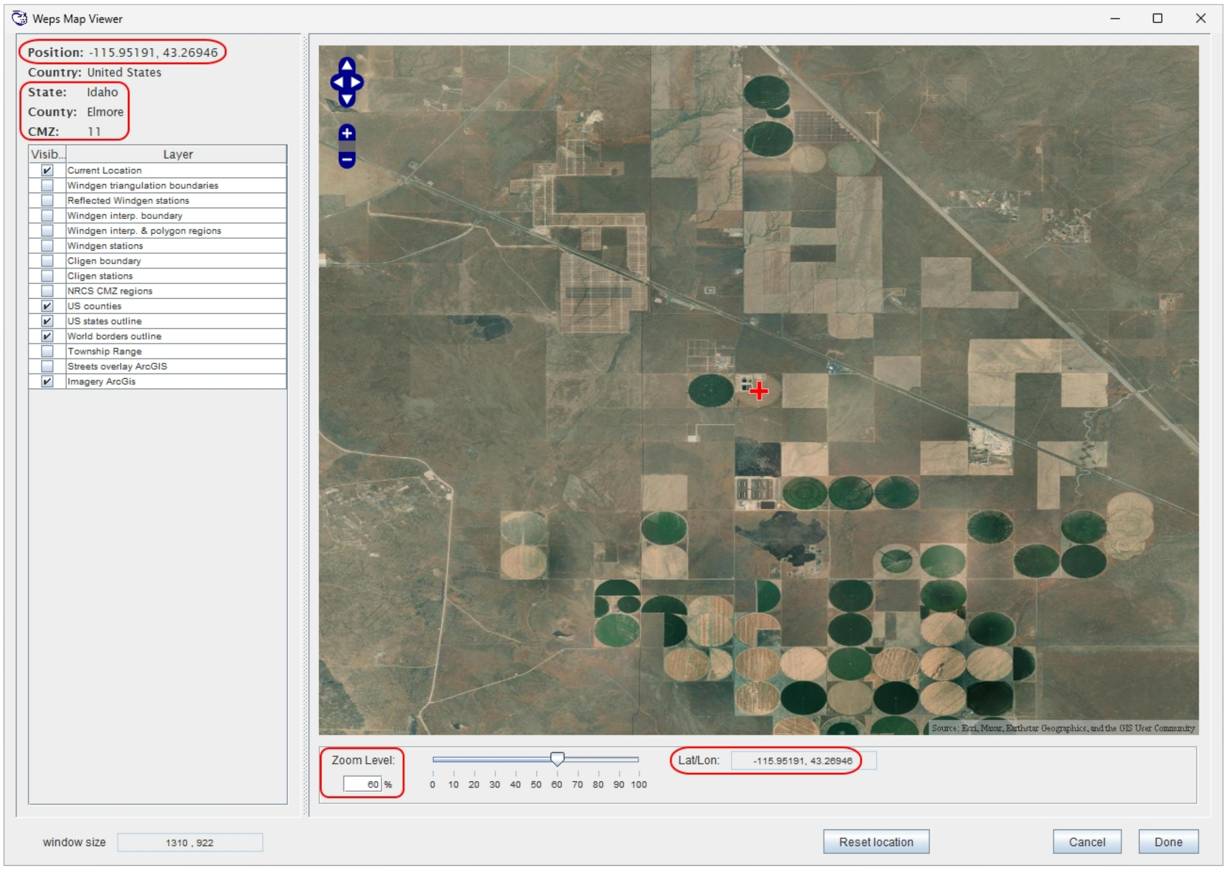



Figure 19.83: WEPS Map Viewer displaying selected field site.

*Step 2b:* Set the zoom level to **50%** for the **WEPS Map Viewer**. Then select (enable) the **NRCS CMZ regions**, **Cligen stations**, **Windgen stations** and **Cligen boundary** layers, while disabling the **Imagery ArcGis** layer. Notice that this area is within **NRCS Crop Management Zone (CMZ) region 11** (Fig. 19.84). It will also be using the **BOISE LUCKY PEAK DM** Cligen station (Cligen boundary lines are shown in **blue** on the map). In addition, it will also be using the nearest Windgen station **MOUNTAIN HOME AFB** as also shown in Fig. 19.84.

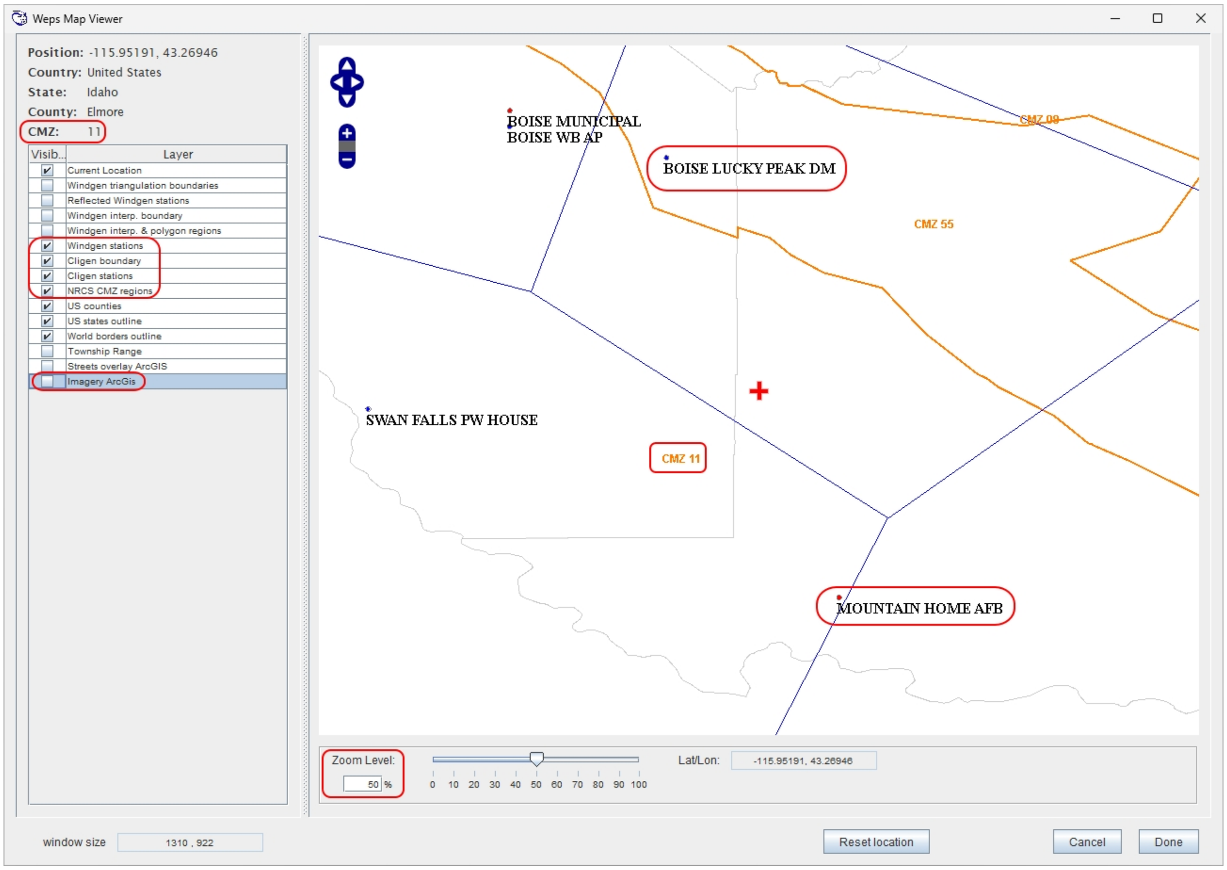



Figure 19.84: WEPS Map Viewer displaying NRCS CMZ regions, Windgen station, and Cligen stations.

*Step 3:* Select an NRCS CMZ management template by clicking the 'Man' dropdown button to the lower right of the screen. Click **'CRLMOD Managements'**, scroll down and select CMZ 11. From the CMZ 11 drop-down, select **Single year single crop treatments**. From this list, select the **Wheat, winter, early plant, medium residue, fdisk, Z11** management Fig. 19.85.

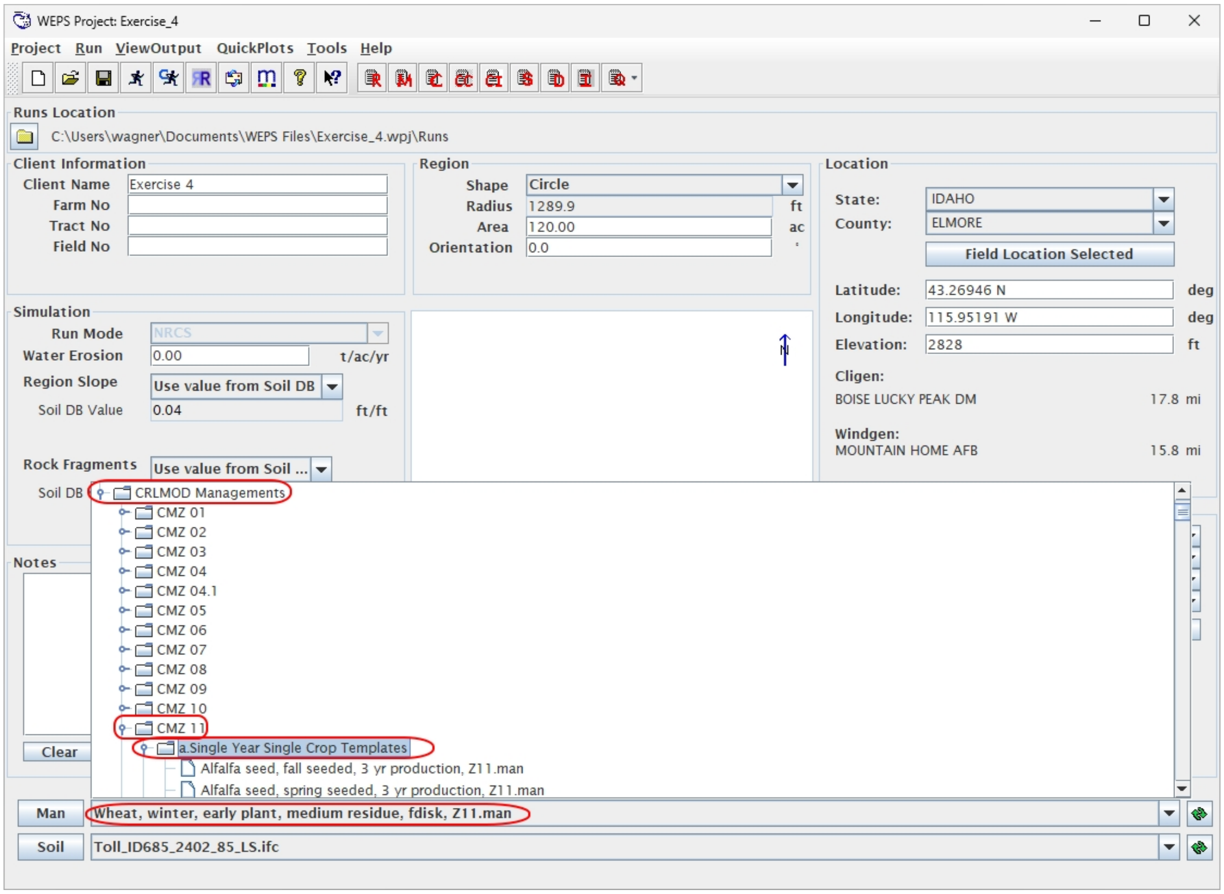



Figure 19.85: Selecting CMZ management template from CSIP CRLMOD Managements Service.

*Step 4:* Choose the soil from the CSIP Soil Service as seen in Fig. 19.86.

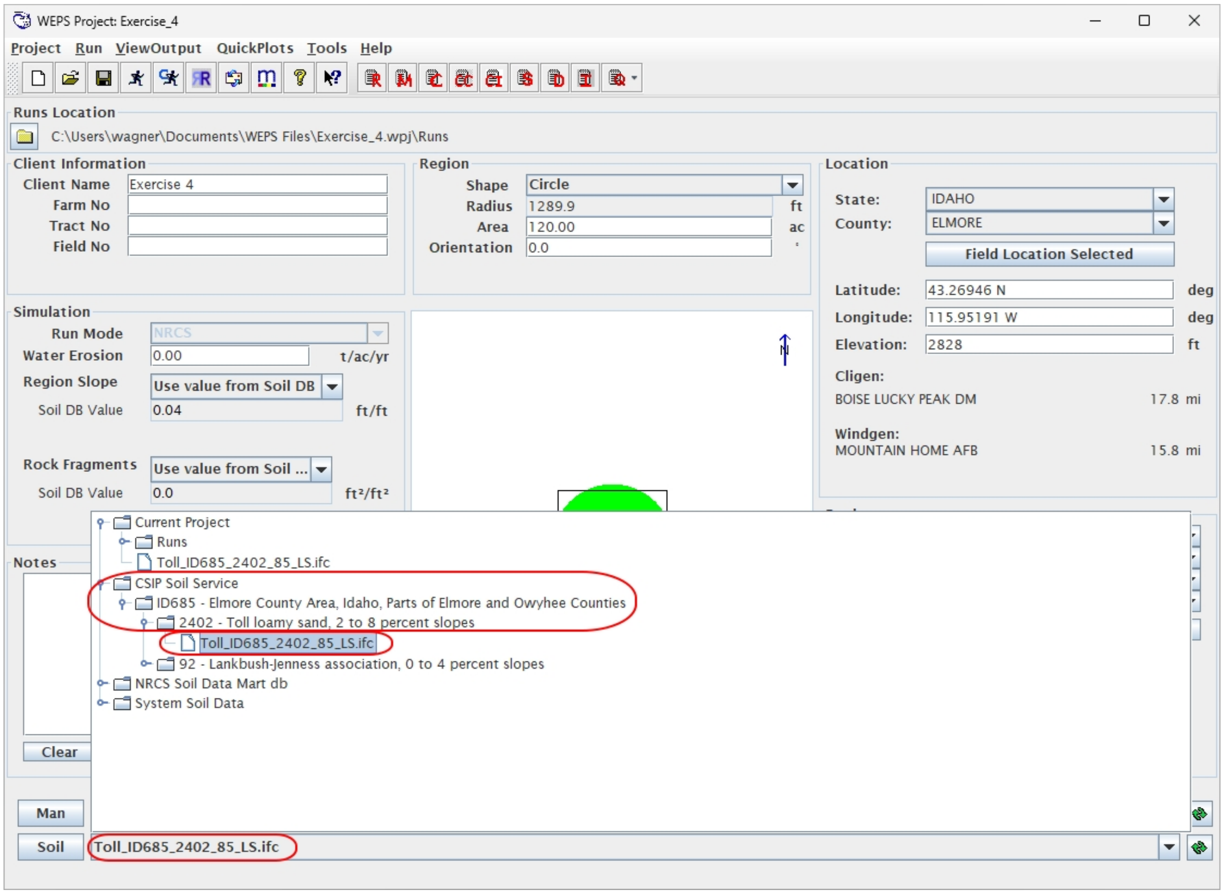



Figure 19.86: Selecting soil from CSIP Soil Service.

*Step 5:* Before we execute a run, we are going to edit the management template. Open MCREW, then edit and add operations so that the management file matches Fig. 19.87. **Set the Harvest Target yield for wheat to 80 bu/ac.** Save the management file to a new name that indicates it was modified. Let's use **Wheat, winter, Z11** for the new name.

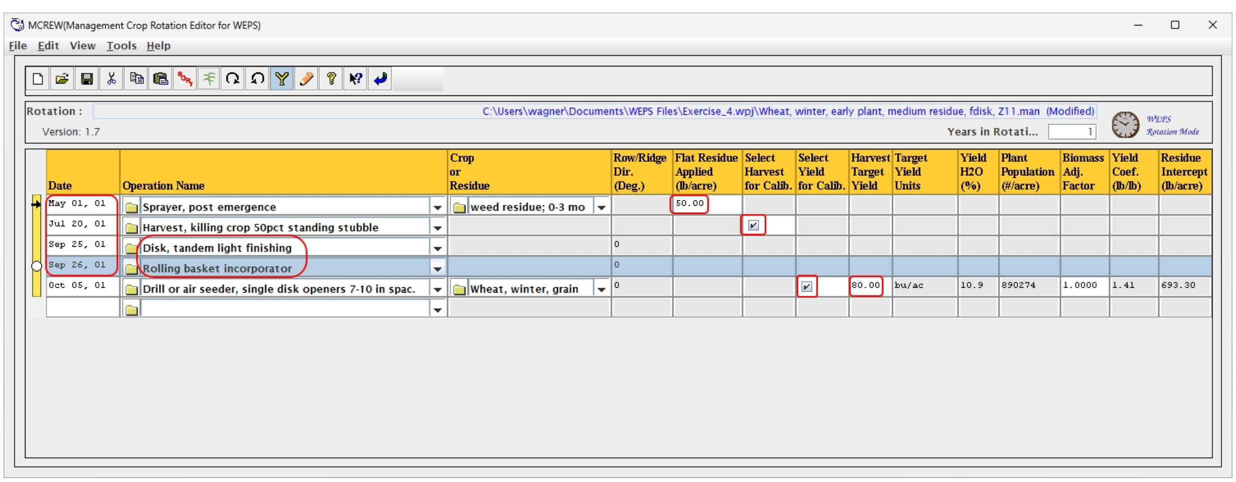
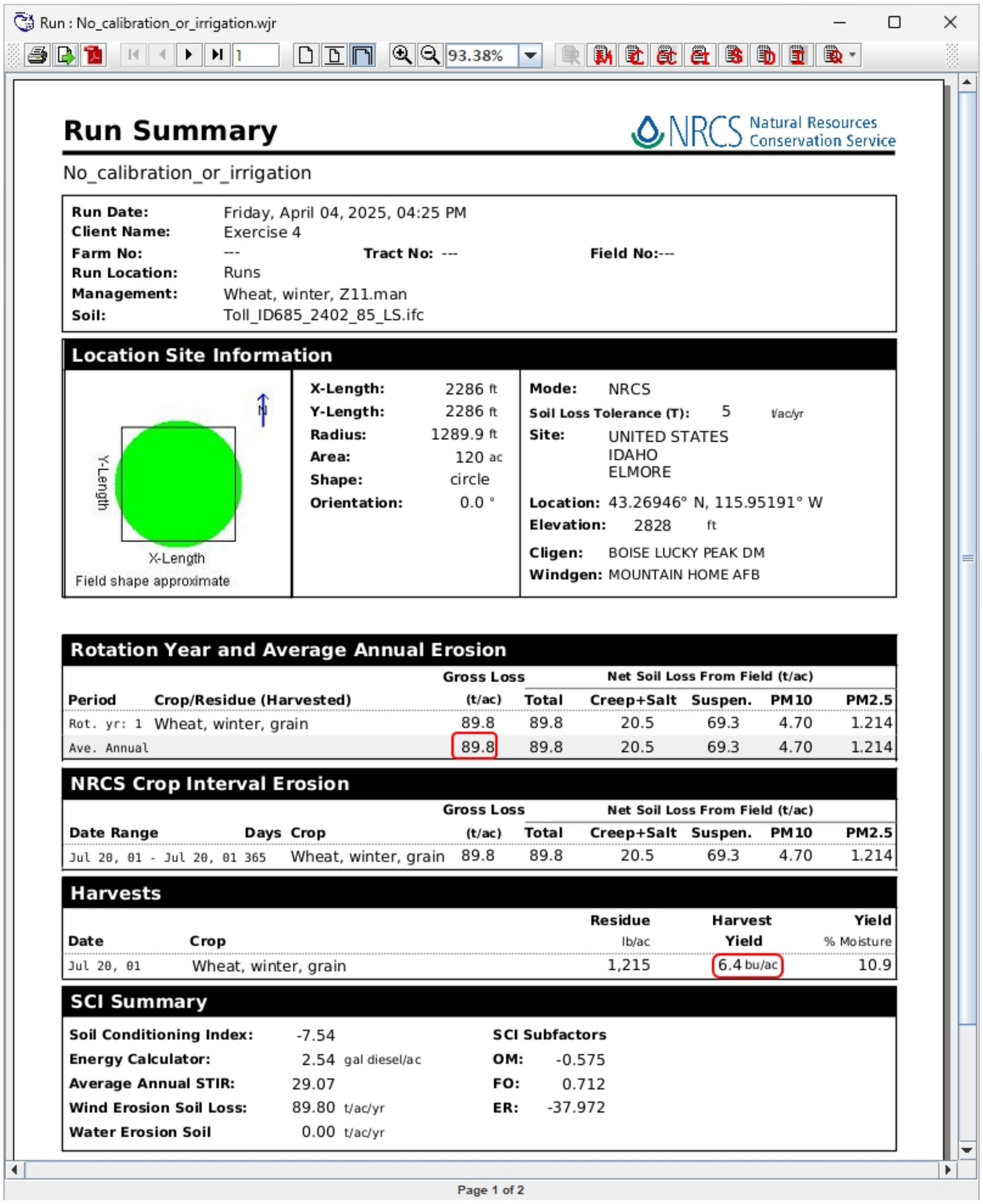



Figure 19.87: Editing Management Templates in MCREW.

*Step 6:* Now execute a regular **WEPS Run** . We will name this test run **No_calibration_or_irrigation**.



Run : No_calibration_or_irrigation.wjr

93.38%

**Run Summary**

NRCS Natural Resources Conservation Service

No_calibration_or_irrigation

**Run Date:** Friday, April 04, 2025, 04:25 PM
**Client Name:** Exercise 4
**Farm No:** --- **Tract No:** --- **Field No:**---
**Run Location:** Runs
**Management:** Wheat, winter, Z11.man
**Soil:** Toll_ID685_2402_85_LS.ifc

**Location Site Information**



**X-Length:** 2286 ft
**Y-Length:** 2286 ft
**Radius:** 1289.9 ft
**Area:** 120 ac
**Shape:** circle
**Orientation:** 0.0 °

**Mode:** NRCS
**Soil Loss Tolerance (T):** 5 t/ac/yr
**Site:** UNITED STATES IDAHO ELMORE
**Location:** 43.26946° N, 115.95191° W
**Elevation:** 2828 ft
**Cligen:** BOISE LUCKY PEAK DM
**Windgen:** MOUNTAIN HOME AFB

**Rotation Year and Average Annual Erosion**

| Period | Crop/Residue (Harvested) | Gross Loss (t/ac) | Net Soil Loss From Field (t/ac) Total | Creep+Salt | Suspen. | PM10 | PM2.5 |
|---|---|---|---|---|---|---|---|
| Rot. yr: 1 | Wheat, winter, grain | 89.8 | 89.8 | 20.5 | 69.3 | 4.70 | 1.214 |
| Ave. Annual | | 89.8 | 89.8 | 20.5 | 69.3 | 4.70 | 1.214 |

**NRCS Crop Interval Erosion**

| Date Range | Days | Crop | Gross Loss (t/ac) | Net Soil Loss From Field (t/ac) Total | Creep+Salt | Suspen. | PM10 | PM2.5 |
|---|---|---|---|---|---|---|---|---|
| Jul 20, 01 - Jul 20, 01 | 365 | Wheat, winter, grain | 89.8 | 89.8 | 20.5 | 69.3 | 4.70 | 1.214 |

**Harvests**

| Date | Crop | Residue lb/ac | Harvest Yield | Yield % Moisture |
|---|---|---|---|---|
| Jul 20, 01 | Wheat, winter, grain | 1,215 | 6.4 bu/ac | 10.9 |

**SCI Summary**

**Soil Conditioning Index:** -7.54
**Energy Calculator:** 2.54 gal diesel/ac
**Average Annual STIR:** 29.07
**Wind Erosion Soil Loss:** 89.80 t/ac/yr
**Water Erosion Soil** 0.00 t/ac/yr

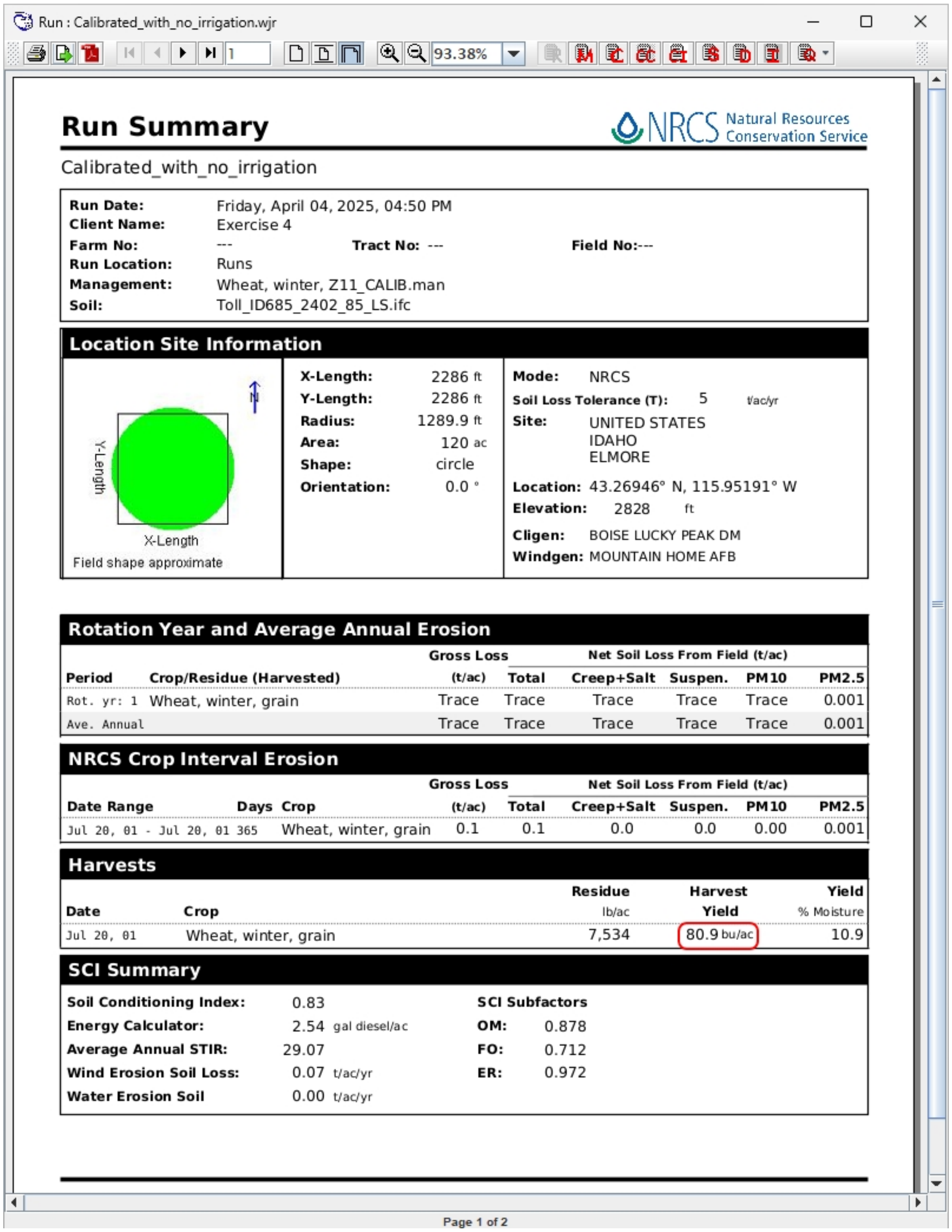
**SCI Subfactors**
**OM:** -0.575
**FO:** 0.712
**ER:** -37.972

Page 1 of 2

Figure 19.88: Uncalibrated WEPS Run with no irrigation.

Note excessive wind erosion of **89.8 t/ac** and very low yield **6.4 bu/ac** under no irrigation as shown in Fig. 19.88.

*Step 7:* Now, execute a **Yield Calibration Run** . Name this test run **Calibrated_with_no_irrigation**.



Run : Calibrated_with_no_irrigation.wjr

# Run Summary

NRCS Natural Resources Conservation Service

Calibrated_with_no_irrigation

**Run Date:** Friday, April 04, 2025, 04:50 PM
**Client Name:** Exercise 4
**Farm No:** --- **Tract No:** --- **Field No:**---
**Run Location:** Runs
**Management:** Wheat, winter, Z11_CALIB.man
**Soil:** Toll_ID685_2402_85_LS.ifc

## Location Site Information

Y-Length
X-Length
Field shape approximate

**X-Length:** 2286 ft
**Y-Length:** 2286 ft
**Radius:** 1289.9 ft
**Area:** 120 ac
**Shape:** circle
**Orientation:** 0.0 °

**Mode:** NRCS
**Soil Loss Tolerance (T):** 5 t/ac/yr
**Site:** UNITED STATES IDAHO ELMORE
**Location:** 43.26946° N, 115.95191° W
**Elevation:** 2828 ft
**Cligen:** BOISE LUCKY PEAK DM
**Windgen:** MOUNTAIN HOME AFB

## Rotation Year and Average Annual Erosion

| Period | Crop/Residue (Harvested) | Gross Loss (t/ac) | Total | Creep+Salt | Suspen. | PM10 | PM2.5 |
|---|---|---|---|---|---|---|---|
| | | | Net Soil Loss From Field (t/ac) | | | | |
| Rot. yr: 1 | Wheat, winter, grain | Trace | Trace | Trace | Trace | Trace | 0.001 |
| Ave. Annual | | Trace | Trace | Trace | Trace | Trace | 0.001 |

## NRCS Crop Interval Erosion

| Date Range | Days | Crop | Gross Loss (t/ac) | Total | Creep+Salt | Suspen. | PM10 | PM2.5 |
|---|---|---|---|---|---|---|---|---|
| | | | | Net Soil Loss From Field (t/ac) | | | | |
| Jul 20, 01 - Jul 20, 01 | 365 | Wheat, winter, grain | 0.1 | 0.1 | 0.0 | 0.0 | 0.00 | 0.001 |

## Harvests

| Date | Crop | Residue lb/ac | Harvest Yield | Yield % Moisture |
|---|---|---|---|---|
| Jul 20, 01 | Wheat, winter, grain | 7,534 | 80.9 bu/ac | 10.9 |

## SCI Summary

**Soil Conditioning Index:** 0.83
**Energy Calculator:** 2.54 gal diesel/ac
**Average Annual STIR:** 29.07
**Wind Erosion Soil Loss:** 0.07 t/ac/yr
**Water Erosion Soil** 0.00 t/ac/yr

**SCI Subfactors**
**OM:** 0.878
**FO:** 0.712
**ER:** 0.972

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Figure 19.89: Calibrated WEPS Run with no irrigation.

You will notice when you executed a calibrated run with no irrigation specified in the management file that we did attain a yield of **80.9 bu/ac**, which is within +/-10% of the target yield as shown in Fig. 19.89.

However, the Biomass Adjustment Factor is **3.328** (Fig. 19.90). This is well outside of the recommended 0.5-2.0 range and should raise suspicion that one or more WEPS inputs are incorrect.

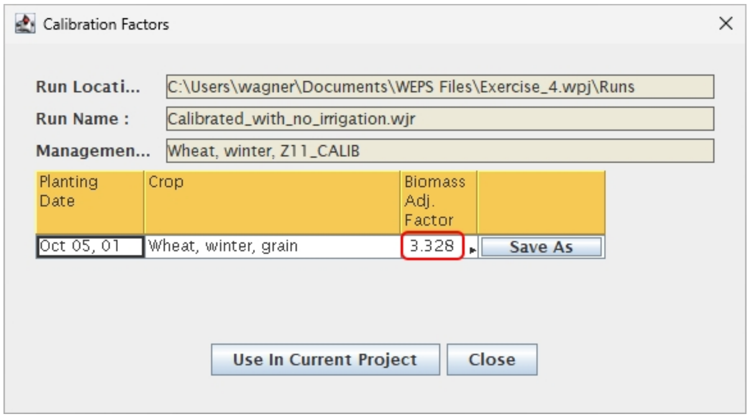



Figure 19.90: High Biomass Adjustment Factor for dryland winter wheat.

Looking more closely at the Weather (summary) Tabular Detail Report, we see that it is improbable that an 80-bushel wheat crop can be produced with no irrigation in an area that received **11 in/yr** on average (Fig. 19.91).

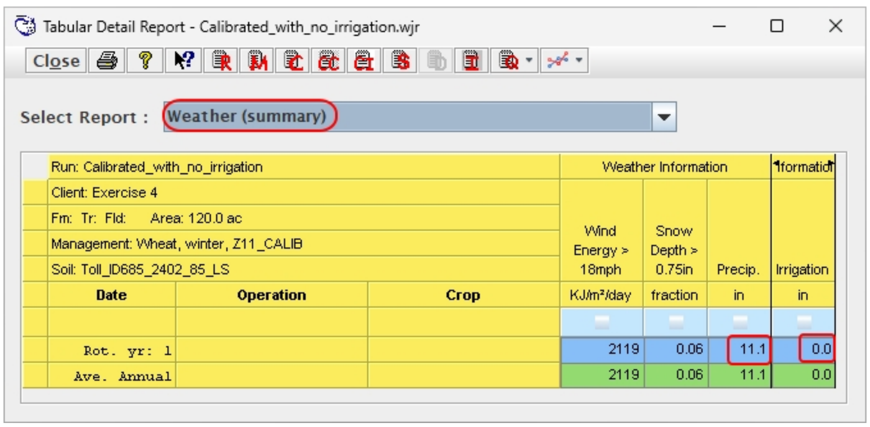



Figure 19.91: Weather (summary) Tabular Detail Report.

*Step 8:* Let's add irrigation to this management (Fig. 19.92) and re-execute the **Yield Calibration Run**. It will be assumed that precision soil monitoring will help the producer accurately apply irrigation water. To best capture this type of irrigation water management, we will add the operations **Irrigation, Start Monitor (pivot, linear, wheeline)** and **Irrigation, Stop Monitor** to the management. Using these managements, irrigation water will be added by WEPS as soil moisture is depleted. Alternatively, WEPS users have the ability to add single irrigation events to the management, regardless of the rainfall that occurs in each of the 50 simulations. We will name the modified management file **Wheat, winter, irrigated, Z11**.

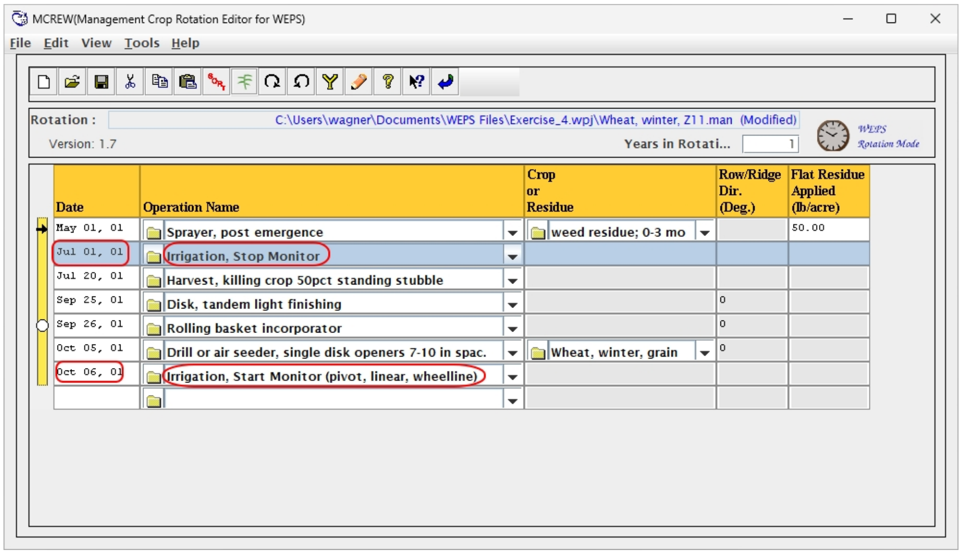
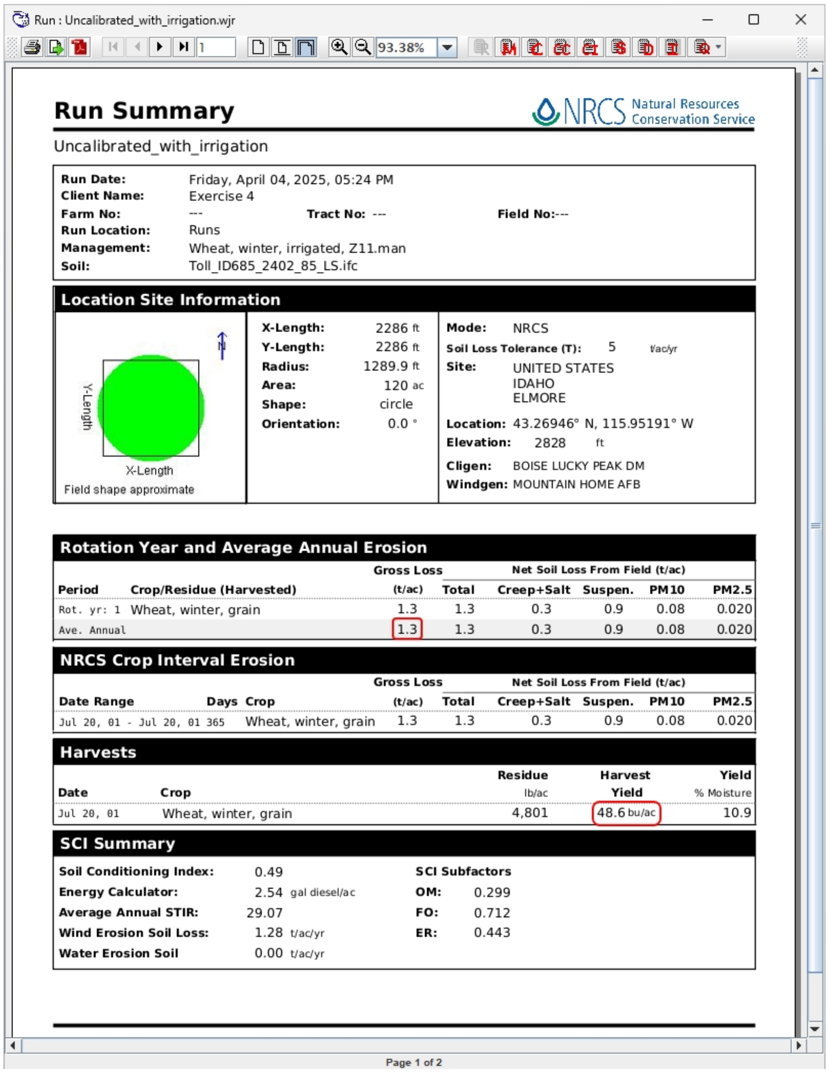



Figure 19.92: MCREW with added irrigation operations.

*Step 9:* For fun, just to see what the uncalibrated crop record provides for yields on this site under irrigation, let's now make an Uncalibrated WEPS Run with the modified management file that includes irrigation. We will name this run **Uncalibrated_with_irrigation**.


Run : Uncalibrated_with_irrigation.wjr

**Run Summary**

Uncalibrated_with_irrigation

| | |
|---|---|
| Run Date: | Friday, April 04, 2025, 05:24 PM |
| Client Name: | Exercise 4 |
| Farm No: | --- Tract No: --- Field No:--- |
| Run Location: | Runs |
| Management: | Wheat, winter, irrigated, Z11.man |
| Soil: | Toll_ID685_2402_85_LS.ifc |

**Location Site Information**

| | | | |
|---|---|---|---|
| X-Length: | 2286 ft | Mode: | NRCS |
| Y-Length: | 2286 ft | Soil Loss Tolerance (T): | 5 t/ac/yr |
| Radius: | 1289.9 ft | Site: | UNITED STATES IDAHO ELMORE |
| Area: | 120 ac | | |
| Shape: | circle | | |
| Orientation: | 0.0 ° | Location: | 43.26946° N, 115.95191° W |
| | | Elevation: | 2828 ft |
| | | Cligen: | BOISE LUCKY PEAK DM |
| | | Windgen: | MOUNTAIN HOME AFB |

Field shape approximate

**Rotation Year and Average Annual Erosion**

| Period | Crop/Residue (Harvested) | Gross Loss (t/ac) | Total | Creep+Salt | Suspen. | PM10 | PM2.5 |
|---|---|---|---|---|---|---|---|
| Rot. yr: 1 | Wheat, winter, grain | 1.3 | 1.3 | 0.3 | 0.9 | 0.08 | 0.020 |
| Ave. Annual | | 1.3 | 1.3 | 0.3 | 0.9 | 0.08 | 0.020 |

**NRCS Crop Interval Erosion**

| Date Range | Days | Crop | Gross Loss (t/ac) | Total | Creep+Salt | Suspen. | PM10 | PM2.5 |
|---|---|---|---|---|---|---|---|---|
| Jul 20, 01 - Jul 20, 01 | 365 | Wheat, winter, grain | 1.3 | 1.3 | 0.3 | 0.9 | 0.08 | 0.020 |

**Harvests**

| Date | Crop | Residue lb/ac | Harvest Yield | Yield % Moisture |
|---|---|---|---|---|
| Jul 20, 01 | Wheat, winter, grain | 4,801 | 48.6 bu/ac | 10.9 |

**SCI Summary**

| | | | |
|---|---|---|---|
| Soil Conditioning Index: | 0.49 | SCI Subfactors | |
| Energy Calculator: | 2.54 gal diesel/ac | OM: | 0.299 |
| Average Annual STIR: | 29.07 | FO: | 0.712 |
| Wind Erosion Soil Loss: | 1.28 t/ac/yr | ER: | 0.443 |
| Water Erosion Soil | 0.00 t/ac/yr | | |

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Figure 19.93: Uncalibrated WEPS Run Summary with added irrigation.

Note that the uncalibrated WEPS Run (Fig. 19.93) provides sufficient protection again soil erosion with **1.3 t/ac** soil loss. However, the average yield is only **48.6 bu/ac**, well short of the expected 80 bu/ac average yields.

*Step 10:* Let's now make a Calibrated WEPS Run with the modified management file that includes irrigation. We will name this run **Calibrated_with_irrigation**.

The **Biomass Adjustment Factor** drops to **1.3** when irrigation water is added to the management system (Fig. 19.94).

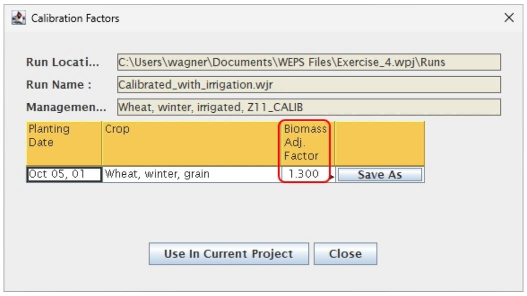



Figure 19.94: Biomass Adjustment Factor with added irrigation.

Also, notice in Fig. 19.95 that annual erosion is well below the Soil Loss Tolerance and the average winter wheat yield is now **80.3 bu/ac**.

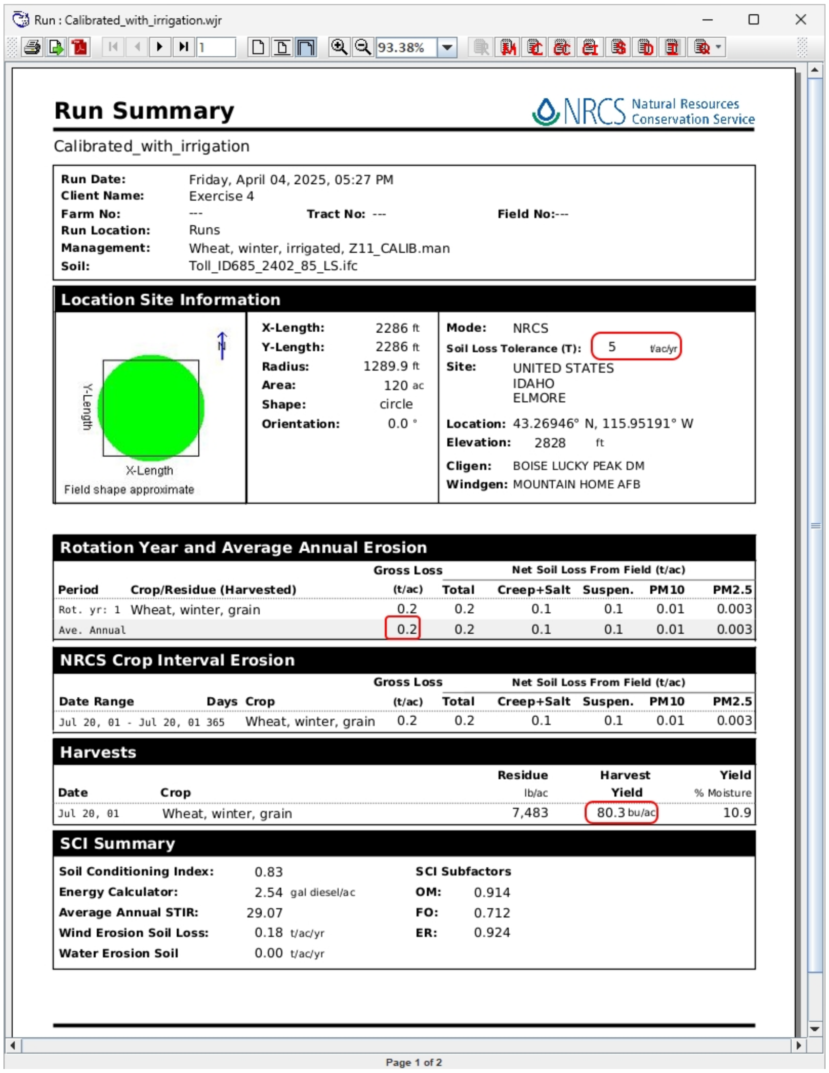



Figure 19.95: WEPS Run Summary with added irrigation.

## 19.6 Ex 5 – Alfalfa Hay, Editing, and More Irrigation

### 19.6.1 Skill Building

In this exercise we use WEPS to simulate a forage crop cut for hay. A year of alfalfa will be added to the initial three year rotation. This will show the power of MCREW. There are many ways to edit data using the copy-paste and increment/decrement editing functions of operations to move seeding and harvesting dates, etc. This exercise will help the user understand the basic format to build other forage crop files. Irrigation can be added in preset or custom amounts, or as needed based upon plant water use. In this example we will model full irrigation and apply water as the crop uses it. Many circles on a quarter section of land (160 acres) have 120 acres "under the iron". In this example there is an end gun that turns on and off as needed when the circle turns. The producer can irrigate 10 more acres for a total of 130 acres.

WEPS can simulate crops being cut multiple times in a growing season such as perennials like alfalfa. Once established, most perennials are normally a low risk to wind erosion due to usually adequate crop cover, even after harvesting a forage crop like alfalfa. However, wind erosion is often a concern due to the land prep practices often used prior to seeding perennial crops like alfalfa and during its initial establishment. This is especially so if the land prep practices leave the surface devoid of vegetation and residue and the bare surface is smoothed and compacted with tillage tools containing compaction rollers, etc. So, these are usually the critical periods to check erosion risk for perennial crops, regardless of the crop's subsequent yields.

If the yields are lower than anticipated in WEPS, we can calibrate multi-harvested crops, but it is more complicated than for single harvested crops. Fortunately, after perennials like alfalfa have been established, they are usually not the cause of wind erosion issues. So, calibrating those crop yields normally are not required since each forage cutting yield that under-performs in the model usually does not affect the erosion rate due to there normally being more than adequate cover remaining to eliminate the risk of wind erosion during each subsequent growing period of the crop. Therefore, if the hay yield is low, one should not automatically reject the run unless there is substantial erosion occurring in the 1-2 week re-growth period. In this exercise though, we will go through the process of calibrating the alfalfa crop in this rotation so that the user knows what to do if and when they need to calibrate a multi-harvested crop. Note though that calibrating a perennial crop's yield often doesn't alter the erosion risk significantly during the establishment phase of a perennial crop. If the original yield(s) are extremely low before calibration, it may shorten the period of susceptibility during the establishment phase, but it will have no effect on the land prepping period. The takeaway here is that calibrating multi-harvested perennial crops often will not achieve desired reductions in wind erosion risk. It will simply improve the model's estimates of the expected perennial crop's yields.

Having said this, regardless whether a perennial crop is calibrated or not, it is still important that the user review the land prep practices prior to seeding a multi-harvested crop like alfalfa and its initial plant establishment phase, because they are usually the critical periods for wind erosion risk for such crops. This is especially so if the land manager is clean tilling and smoothing the surface with compaction rollers, etc.

Although it is recommended that a user build their rotations from scratch, we will use a previously built NRCS CRLMOD CMZ (Crop Management Zone) management record as a starting template for this example. We will then modify it with MCREW (Management/Crop Rotation Editor for WEPS) for this specific scenario.

- This exercise demonstrates how to:
  - Select a CMZ (Crop Management Zone) management template from the CRLMOD CSIP service
  - Perform a regular (normal) WEPS simulation run
  - Perform a Yield Calibration run for all crops, including a multi-harvested crop (alfalfa), to calibrate the average yields to match the target yields specified for all crops selected for calibration
  - How to save a calibrated crop record to the local crop folder for use in future runs. This can save time on subsequent runs when one requires calibated yields.
  - Insert an additional alfalfa year into the rotation
- It demonstrates how to modify an existing management rotation within MCREW using basic editing functions:
  - Copy and paste a section of the management rotation to create an additional year of alfalfa
  - How to increment a group of operation dates by a year
  - Correcting length of management cycle after lengthening the rotation

  - Making Target Yield adjustments for all crops, including multi-harvested crops
  - Saving local copies of modified crop records for re-use, especially calibrated records
- Learn to evaluate output reports and interpret results relevant to achieving specific erosion risk goals:
  - How to identify critical time periods for this rotation to address specific wind erosion risk concerns
  - How to use the Wind Energy monthly statistics report to determine the months with the highest erosive wind energy and what direction the prevailing winds come from for each month.
  - Suggests additional mitigation approaches not evaluated in this exercise that should be considered for this site and desired crop rotation

### 19.6.2 Scenario

- The producer is near **Moses Lake, Washington** in **Grant County**.
- The site is located at the following coordinates: **47.11543° N** and **119.57220° W**.
- The soil is a **Quincy Fine Sand** (Quincy_WA025_97_100_FS.ifc).
- The field has full pivot or **circle** irrigation. The irrigated circle is **130 acres**.
- Potatoes are a high dollar cash rental crop and must be rotated with other crops for disease and nematode control. The rotation is **Alfalfa for 3 yrs**, then **Potatoes** followed by **Winter Wheat**. If the alfalfa stand is good and the price for hay is strong they will leave it in hay for 4 years.
- The annual yield for the **alfalfa** is about **6-7 t/ac/yr** cut 4 times with a 5th cutting in some years. Alfalfa is cut on 30 day cycles.
- The **potato** yield is **30 t/ac** or **600 cwt/ac**.
- The **winter wheat** yield is **100 bu/ac**.
- The erosive wind comes in the spring from the west and tillage/planting direction is currently north and south.

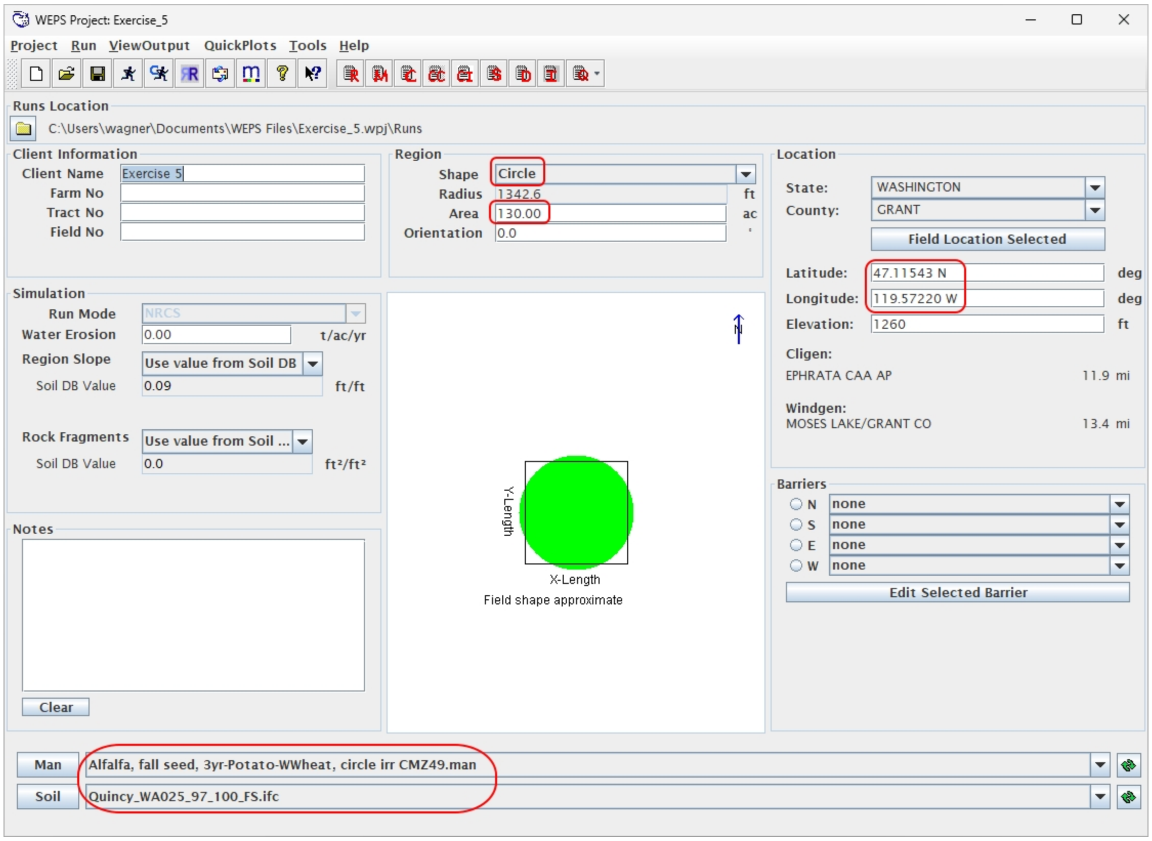



Figure 19.96: WEPS interface loaded for Exercise 5.

### 19.6.3 Complete the following steps:

*Step 1:* Enter all the information into the WEPS interface as shown in Fig. 19.96. Notice when you enter the acreage value of **130** that the radius changes to **1342.6** feet, slightly longer than the 1320 foot border to border of a 160 acre quarter section). Remember that the end gun is controlled so that it is disabled when it nears the quarter section boundary, so the actual field dimensions are not a perfect circle, but it is a close enough representation for our WEPS simulations.

*Step 2:* Select the management template and soil for use in this exercise.

*Step 2a:* Normally one would select a CMZ template from the CRLMOD CMZ CSIP service. However, they get modified/updated over time and this exercise's template has been removed. So, we will select the management/crop rotation file from the ***System Templates*** folder. The name of the desired management template is: **Alfalfa, fall seed, 3yr-Potato-WWheat, circle irr CMZ49.man**.

*Step 2b:* The soil will be selected from the ***CSIP Soil Service*** within the *Grant County, Washington* folder as seen in Fig. 19.97. The older, *NRCS Soil Data Mart db* service can still be used, but the user is required to already know and manually select a representative soil present on the site. The *CSIP Soil Service* uses the site's location to provide only a list of soils that reside on the field site, making it easier to select an appropriate representative soil to use in a WEPS simulation.

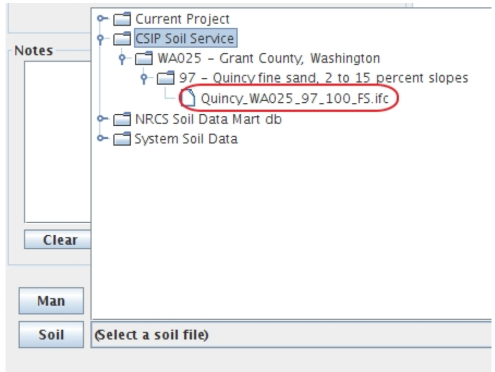



Figure 19.97: Selecting soil component from the CSIP Soil Service.

*Step 3:* Open MCREW and Click the Yield Calibrate button  to review the target yields for all the crops. Correct the yields if necessary. Make sure they all match the inventory values. Likewise, ensure that all crops are selected for Yield Calibration and that their respective harvest operations are checked for use in the yield calibration process.

*Step 3a:* The default yields are 40 bu/ac for winter wheat, probably not a bad value for dryland conditions, but we are under irrigation, so we will need to increase it's target yield. Likewise for the potato target yield as well. Set the desired values of **100 bu/ac** for the winter wheat and **600 cwt/ac** for the potatoes as specified by the producer (Fig. 19.98).

**NOTE:** The alfalfa crop record has a listed default target yield of] 6.5 t/ac (Fig. 19.99), but that is clearly a value based upon an annual basis. At this time, we can only calibrate a single harvest for a multi-harvested crop in WebStart WEPS. So, we must change the target yield to reflect that single harvest's yield being calibrated. Therefore, we will change that target yield to match a single cutting's average yield per year. Taking 6.5 t/ac per year divided by 5 cuttings per year equals 1.3 t/ac per cutting on average. So, we will set the target yield for alfalfa to be **1.3 t/ac** (Fig. 19.100).

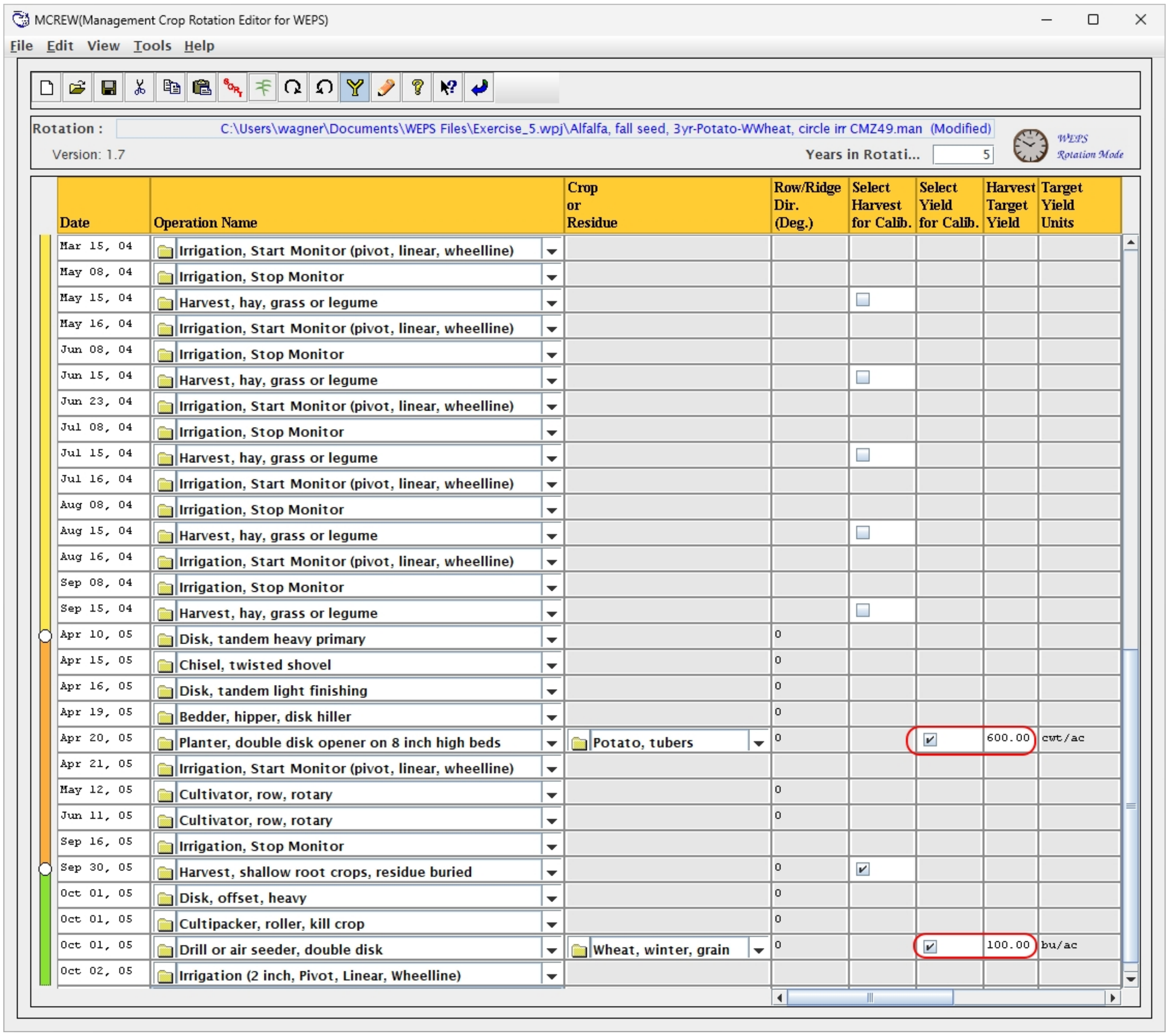



Figure 19.98: MCREW showing potatoes and winter wheat checked for calibration and their target yields set to the specified values.

*Step 3b:* Notice that there is currently no check mark in the **Select Yield for Calib.** column for the alfalfa crop (Fig. 19.99). Checkmark the alfalfa hay crop under the **Select Yield for Calib.** column (Fig. 19.100).

**NOTE:** Multi-harvested crops, such as perennials like alfalfa, are by default not flagged for yield calibration, nor the harvests typically used on such crops. Most single harvested annual crops and the operations typically used to harvest those crops are checked by default, to allow their yields to be calibrated, if the user selects a *Yield Calibration* run. Note that both the crop and a single harvest for that crop must be selected (check marked), before a yield calibration will be performed for that crop. Multiple crops can be selected for yield calibration in a single WEPS *Yield Calibration* run.

It is best that we select a single harvest that is expected to provide consistent yields each year. So, pick the third harvest in the second alfalfa year (**Jul 15, 03**) and place a check mark in the box under the **Select Harvest for Calib.** column as well (Fig. 19.100).

The other crops will also be calibrated if checked in MCREW (Fig. 19.98). The potatoes and winter wheat crops are by default checked for calibration along with their respective harvests. After verifying all the target yields are set to the desired values, click the MCREW *blue arrow Return* (Save and Exit MCREW) button to save the edits and close MCREW.

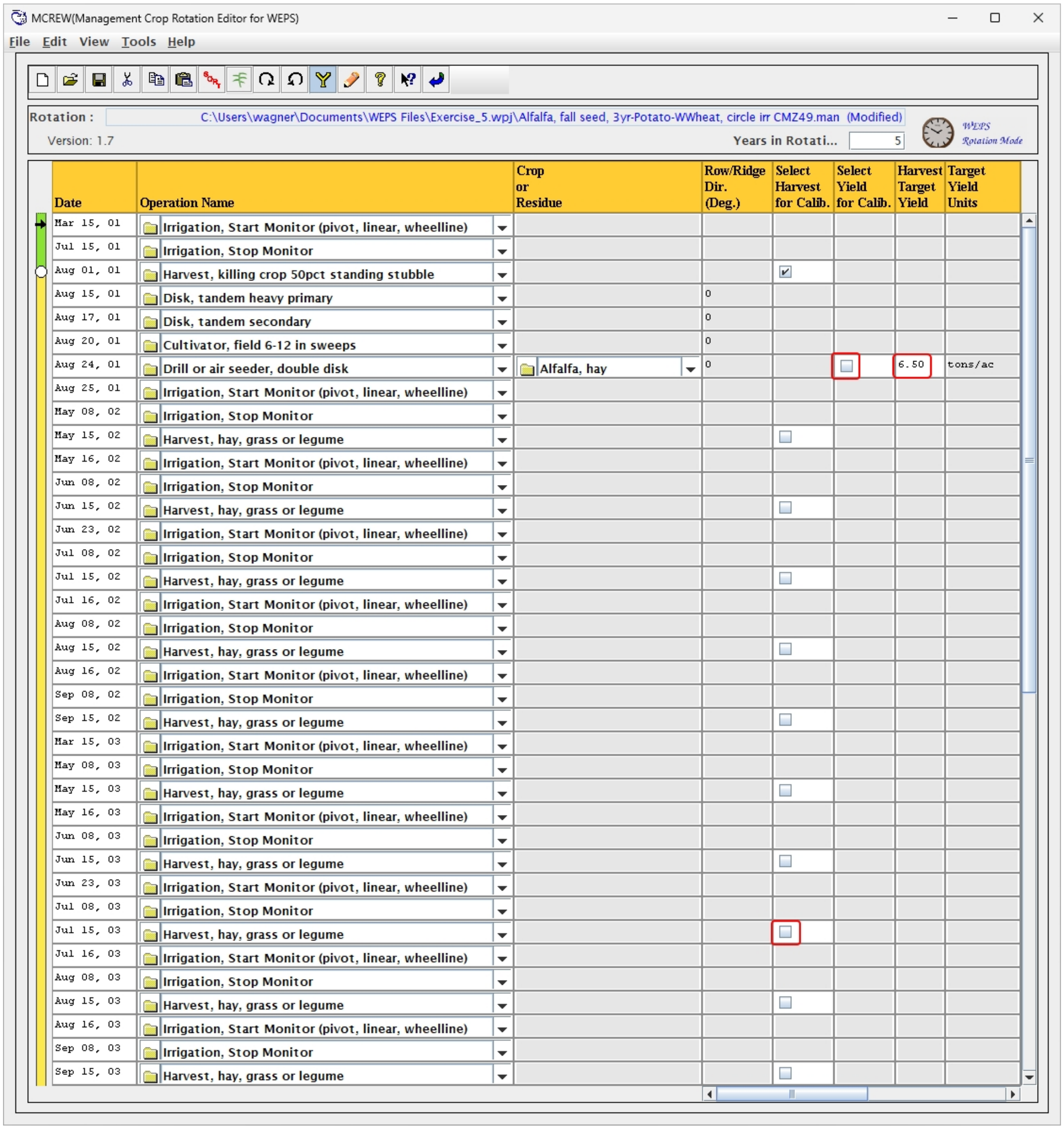


Figure 19.99: Default alfalfa yield and relevant boxes currently unchecked for calibrating this crop.

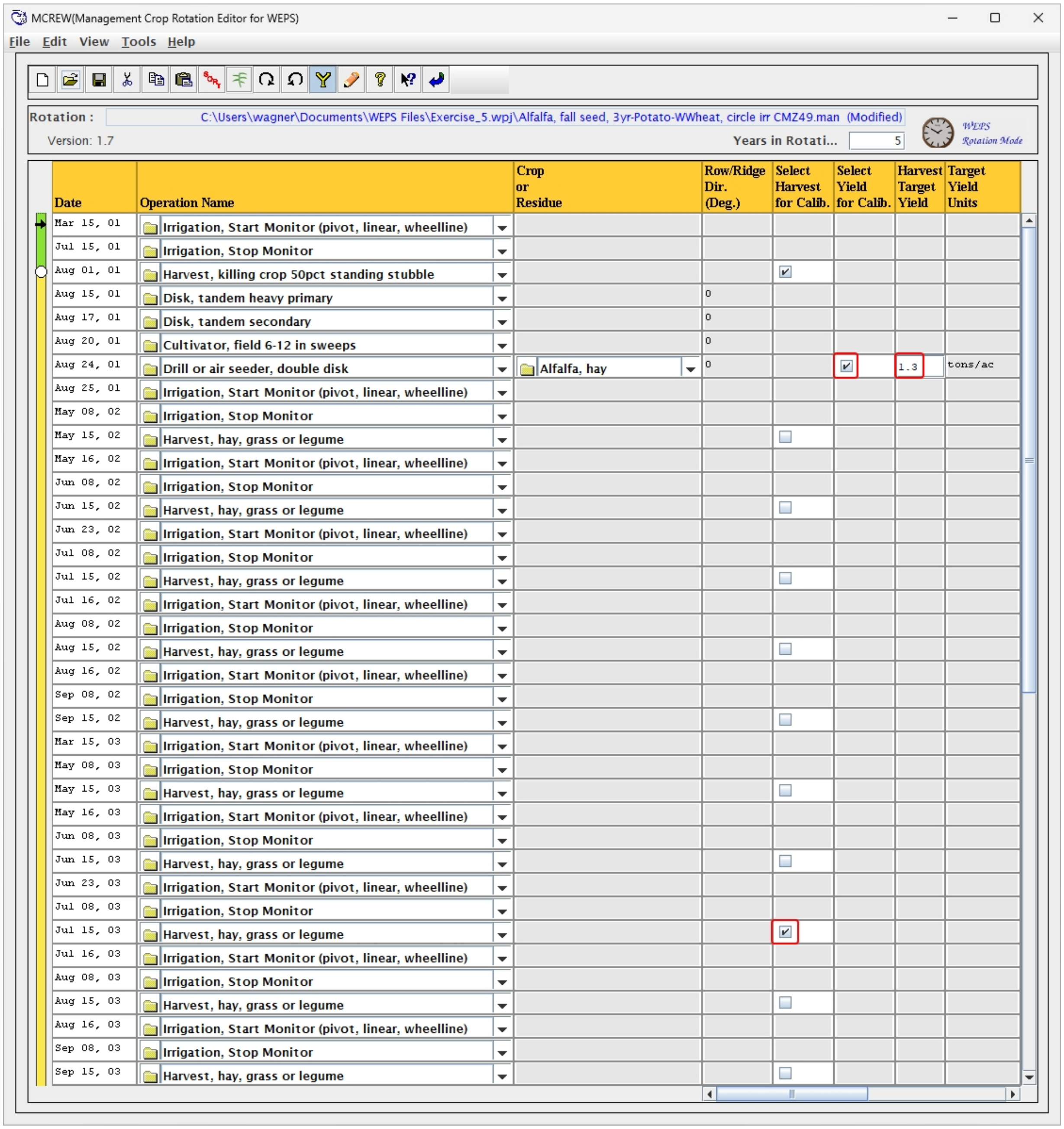
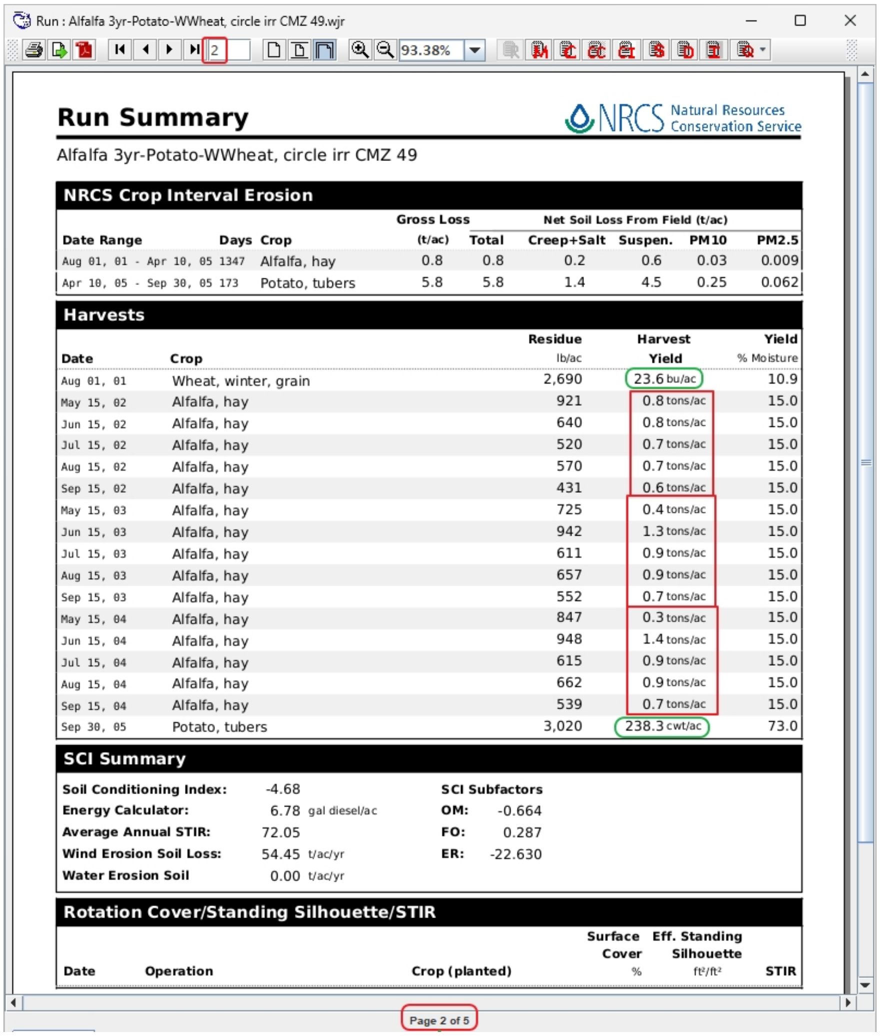



Figure 19.100: Afalfa yield and relevant boxes now checked for calibrating this crop.

*Step 4:* Notice the way the alfalfa crop irrigation and harvests are modeled. Each hay harvest has an *Irrigation, Start Monitor (Pivot, Linear, Wheelline); Irrigation, Stop Monitor*; and *Harvest, hay, legume* operation associated with the harvest. The irrigation is stopped 7 days before harvest to allow the soil surface to dry out enough to help cure the hay.

*Step 5:* Click the WEPS Run button  to see where the yields fall out without calibration. name the run: **Alfalfa 3yr-Potato-WWheat, circle irr CMZ 49**.

The yields in this Run Summary are on the second page. To flip to that page, click the right-arrow  in that report's tool bar. Note that the annual average yields are (0.8+0.8+0.7+0.7+0.6) = **3.6**, (0.4+01.3+0.9+0.9+0.7) = **4.2** and (0.3+1.4+0.9+0.9+0.7) = **4.2 t/ac per year** for each of the three years of alfalfa shown boxed in red within Fig. 19.101. That is significantly less than the desired 6.5 t/ac per year expected. We will calibrate the alfalfa crop to boost its average annual yields as well as the potato and winter wheat crops, shown boxed in green in Fig. 19.101, which are both also under performing for this scenario.




**Run Summary**

NRCS Natural Resources Conservation Service

Alfalfa 3yr-Potato-WWheat, circle irr CMZ 49

**NRCS Crop Interval Erosion**

| Date Range | Days | Crop | Gross Loss (t/ac) | Total | Creep+Salt | Suspen. | PM10 | PM2.5 |
|---|---|---|---|---|---|---|---|---|
| Aug 01, 01 - Apr 10, 05 | 1347 | Alfalfa, hay | 0.8 | 0.8 | 0.2 | 0.6 | 0.03 | 0.009 |
| Apr 10, 05 - Sep 30, 05 | 173 | Potato, tubers | 5.8 | 5.8 | 1.4 | 4.5 | 0.25 | 0.062 |

Net Soil Loss From Field (t/ac)

**Harvests**

| Date | Crop | Residue lb/ac | Harvest Yield | Yield % Moisture |
|---|---|---|---|---|
| Aug 01, 01 | Wheat, winter, grain | 2,690 | 23.6 bu/ac | 10.9 |
| May 15, 02 | Alfalfa, hay | 921 | 0.8 tons/ac | 15.0 |
| Jun 15, 02 | Alfalfa, hay | 640 | 0.8 tons/ac | 15.0 |
| Jul 15, 02 | Alfalfa, hay | 520 | 0.7 tons/ac | 15.0 |
| Aug 15, 02 | Alfalfa, hay | 570 | 0.7 tons/ac | 15.0 |
| Sep 15, 02 | Alfalfa, hay | 431 | 0.6 tons/ac | 15.0 |
| May 15, 03 | Alfalfa, hay | 725 | 0.4 tons/ac | 15.0 |
| Jun 15, 03 | Alfalfa, hay | 942 | 1.3 tons/ac | 15.0 |
| Jul 15, 03 | Alfalfa, hay | 611 | 0.9 tons/ac | 15.0 |
| Aug 15, 03 | Alfalfa, hay | 657 | 0.9 tons/ac | 15.0 |
| Sep 15, 03 | Alfalfa, hay | 552 | 0.7 tons/ac | 15.0 |
| May 15, 04 | Alfalfa, hay | 847 | 0.3 tons/ac | 15.0 |
| Jun 15, 04 | Alfalfa, hay | 948 | 1.4 tons/ac | 15.0 |
| Jul 15, 04 | Alfalfa, hay | 615 | 0.9 tons/ac | 15.0 |
| Aug 15, 04 | Alfalfa, hay | 662 | 0.9 tons/ac | 15.0 |
| Sep 15, 04 | Alfalfa, hay | 539 | 0.7 tons/ac | 15.0 |
| Sep 30, 05 | Potato, tubers | 3,020 | 238.3 cwt/ac | 73.0 |

**SCI Summary**

| | | | |
|---|---|---|---|
| Soil Conditioning Index: | -4.68 | SCI Subfactors | |
| Energy Calculator: | 6.78 gal diesel/ac | OM: | -0.664 |
| Average Annual STIR: | 72.05 | FO: | 0.287 |
| Wind Erosion Soil Loss: | 54.45 t/ac/yr | ER: | -22.630 |
| Water Erosion Soil | 0.00 t/ac/yr | | |

**Rotation Cover/Standing Silhouette/STIR**

| Date | Operation | Crop (planted) | Surface Cover % | Eff. Standing Silhouette ft²/ft² | STIR |
|---|---|---|---|---|---|

Figure 19.101: Alfalfa yields displayed on page 2 of the Run Summary.

*Step 6:* Click the "Yield Calibration" Run button and name the run: **Alfalfa 3yr-Potato-WWheat, circle irr CMZ 49_calib**. Note that the *"_calib"* should get appended automatically since we have specified a "Yield Calibration" run to be performed. This file is a long 5 year rotation. It may take the computer several minutes to calibrate the 250 year run, as 5 years simulated 50 times equals a total 250-year simulation. If you plan to use these calibrated crop records in future runs that are similar to this run, use the **Save As** button to store the Biomass Adjustment Factor's for each of the crops to new records in the local **crops** folder with appropriate names to remind you what they are.

*Step 6a:* In the **Calibration Factors** window that pops up at the conclusion of the Yield Calibration run (Fig. 19.102), click on the **Save As** buttons for each crop and name them **Wheat, winter, grain_CALIB**, **Alfalfa, hay_CALIB** and **Potato, tubers_CALIB** respectively when saving them in the *local* crop records folder. Note that the *"_CALIB"* text should get appended automatically by default. One can always rename the default filename suggestions at this time in the WEPS FileChooser window, if desired.

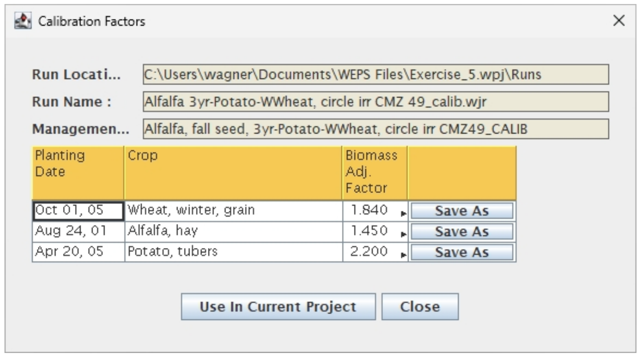



Figure 19.102: Biomass Adjustment Factors for the calibrated crops.

*Step 6b:* Now click **Use in Current Project** to update the management record to use the calibrated crop records. The management record will now automatically have _**CALIB** appended to the management filename.

The yields in this Run Summary are on the second page. To flip to that page, click the right-arrow ▶ in the tool bar.

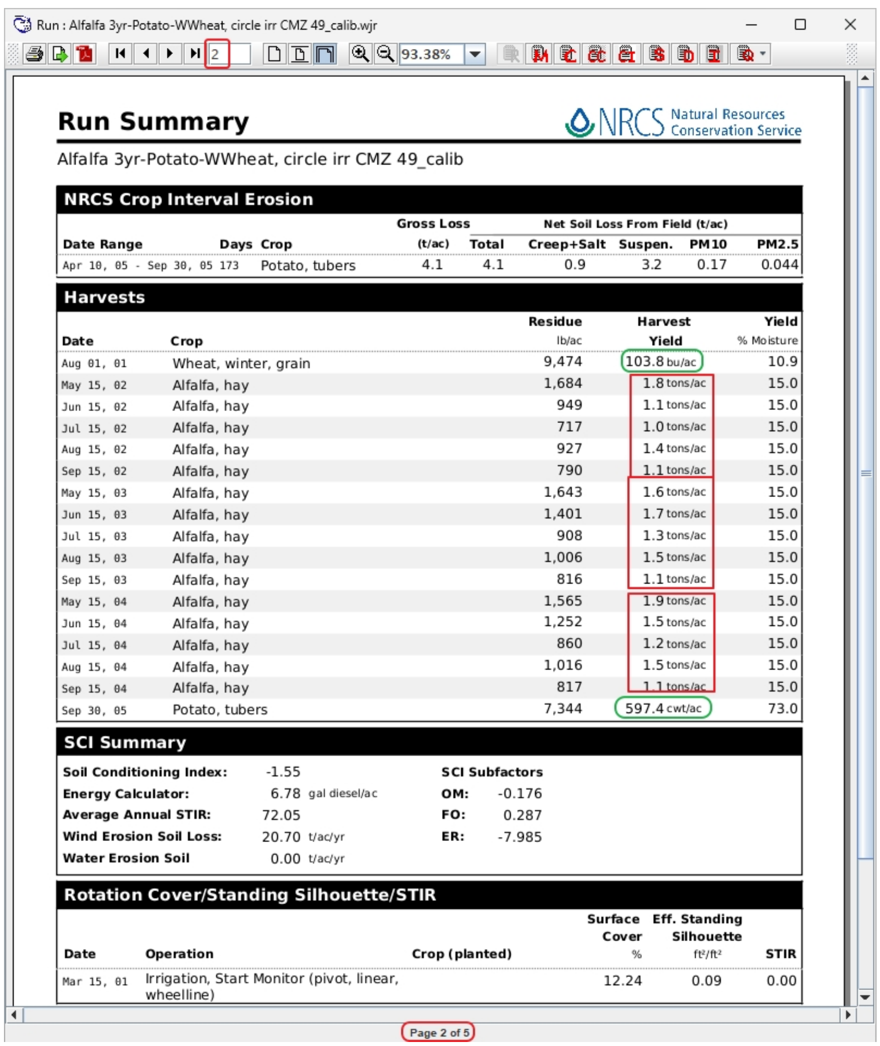



Figure 19.103: Calibrated crop yields displayed on page 2 of the Run Summary.

As mentioned previously in the footnote, WEPS does not calibrate each cutting of hay in a year, but only the average yield for the single selected harvest cutting. All other harvests for that crop will also be automatically adjusted as well, based upon the new calibration value and the climatic effects upon the growth of the crop prior to each harvest. In this example, adding up the yield in each of the three years gives **6.4, 7.2 and 7.2 t/ac per year** in year 02, 03 and 04 respectively, shown boxed in red, for an annual average of **6.9 t/ac** yield of hay per year (Fig. 19.103). Remember the reported yield was 6 to 7 t/ac/yr.

The **Jul 15, 03** date's harvest is boxed in green displaying a yield of **1.3 t/ac per year** for that harvest, which was the designated target yield for that selected harvest date (Fig. 19.103). Both the winter wheat and potato yields are also boxed in green and are now very close to their target yields as well (Fig. 19.103).

*Step 7:* Click back to page 1 of the Run Summary. Year 5 when potatoes are grown and year 1 when winter wheat is seeded have high soil loss (Fig. 19.104) with the specific erosion rates of **31.1 and 72.4 t/ac** provided in Fig. 19.105.

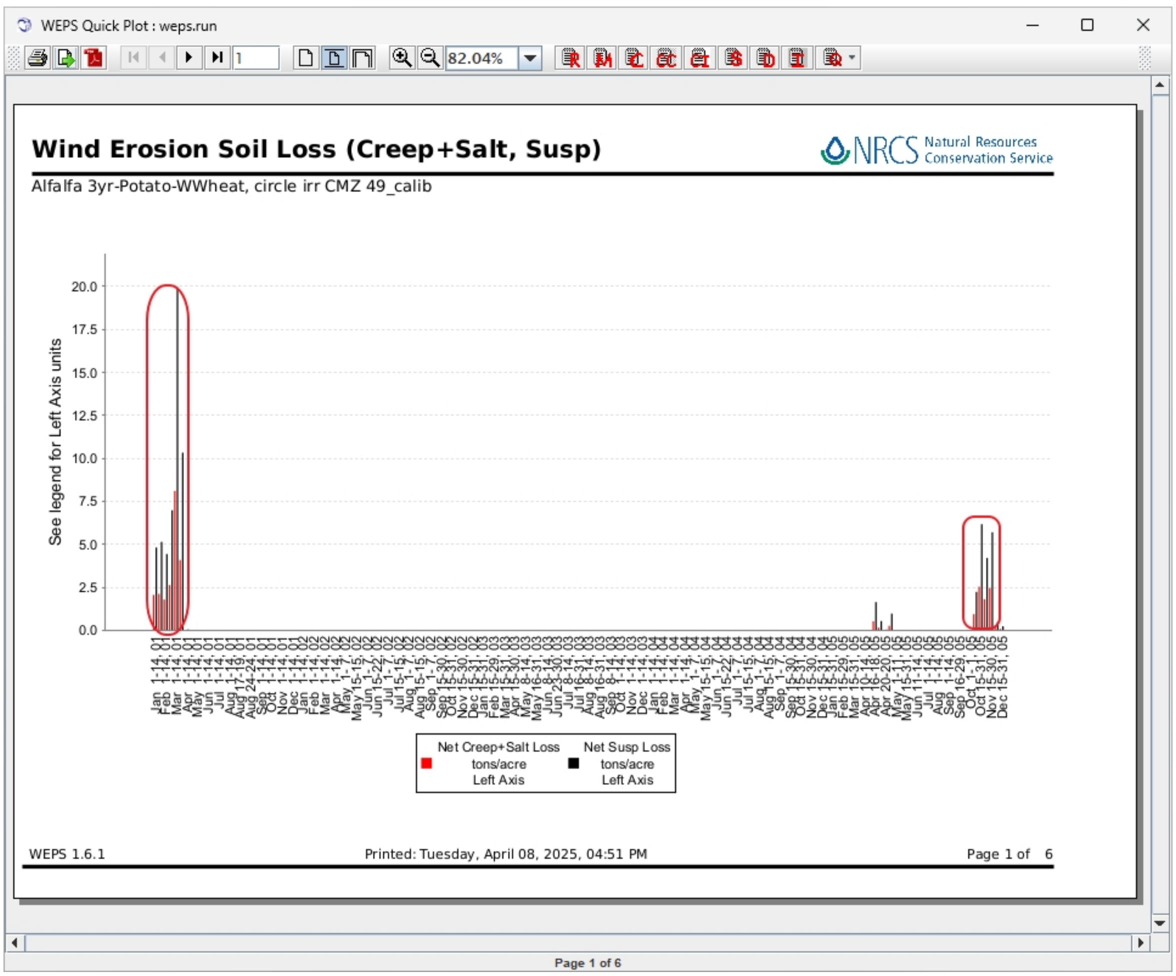



Figure 19.104: QuickPlot Erosion Report showing high soil loss following potato harvest.

This is likely due to low residue and limited above ground biomass winter wheat growth following the potato harvest. This is confirmed in Fig. 19.105 with the **99.4 t/ac** for the NRCS Crop Interval Erosion table for the winter wheat crop interval, because NRCS Crop Intervals include the fallow period prior to the planting of the crop after the harvest of the previous crop.

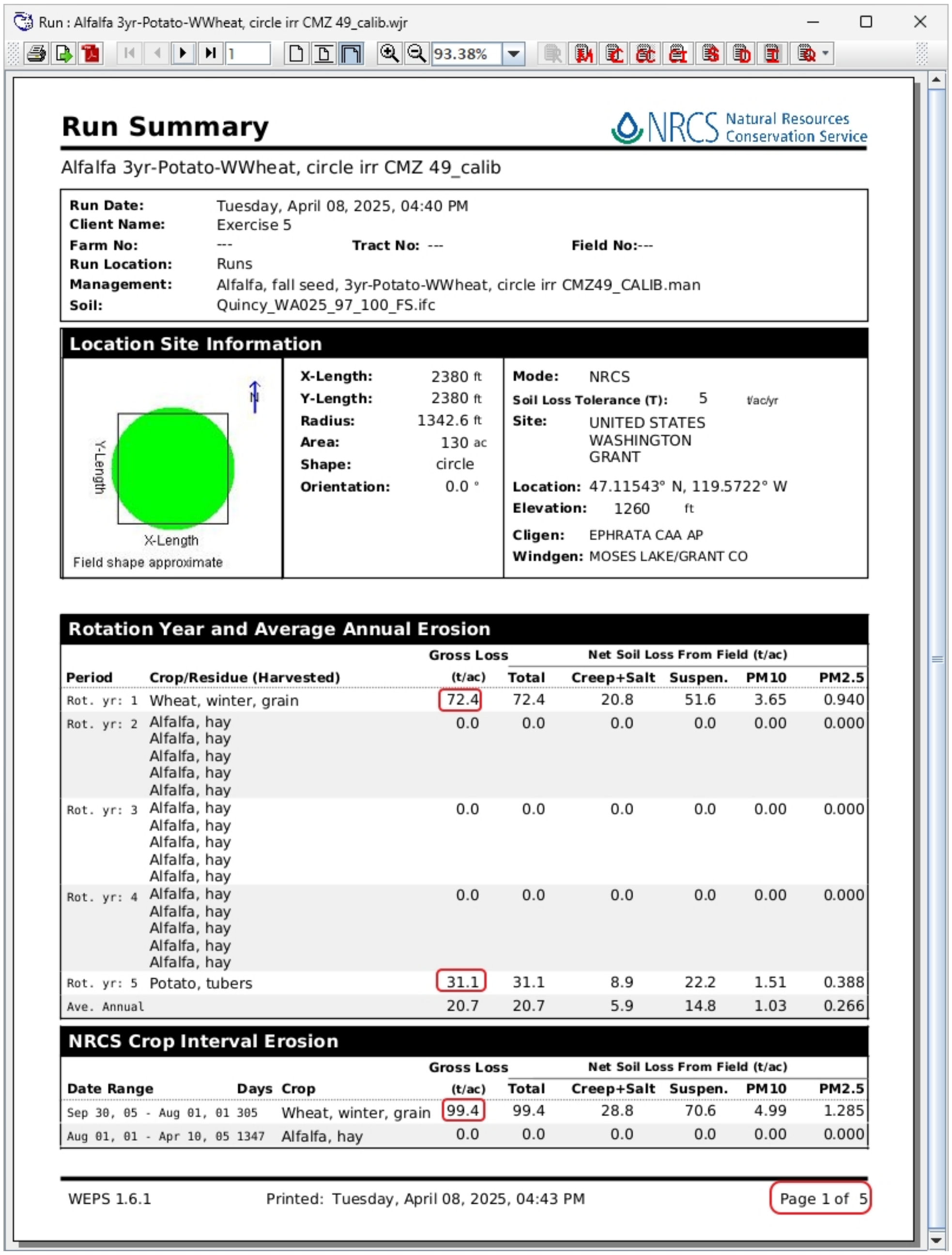
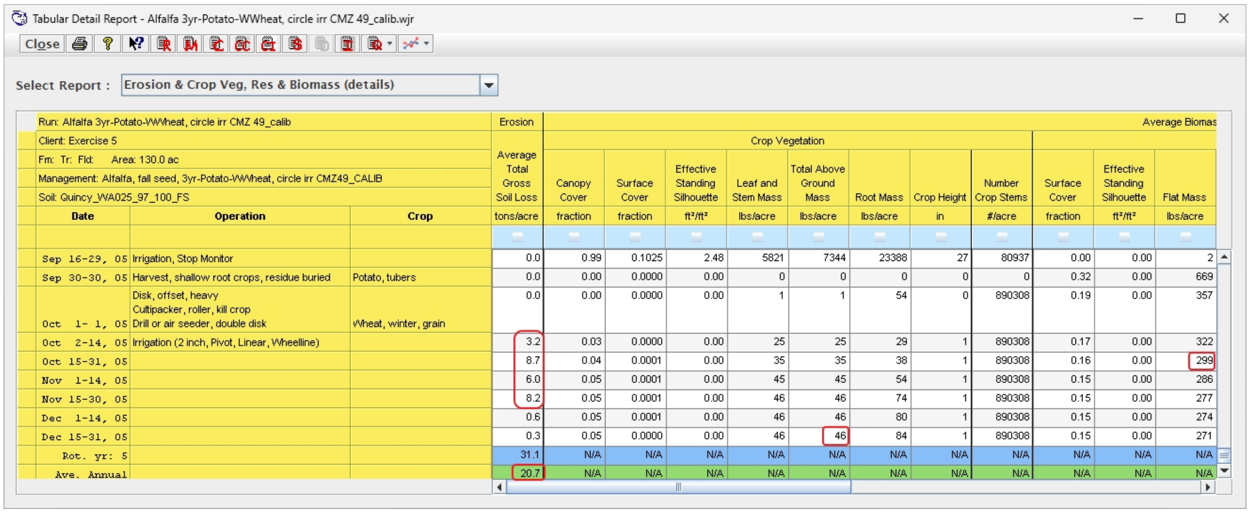



Figure 19.105: fig:Summary Report showing high soil loss in year 1 and 5.

We have suggested that the high erosion rates in year 5 and 1 are likely due to the low after harvest residue following the potato harvest as well as limited above ground biomass growth from the subsequent winter wheat crop going into the winter.

**How can we confirm that is the case?** Go to the Detailed Report.

**Answer**: Potatoes do not produce much residue and the harvest process leaves very little residue on the surface (**299 lbs/ac** of flat mass) after planting the winter wheat (Fig. 19.106). The winter wheat planted after the potato harvest is seeded very late in the year and also does not produce the growth required to control erosion by the end of the calendar year (**46 lbs/ac** of leaf and stem mass) as shown in Fig. 19.106.



Tabular Detail Report - Alfalfa 3yr-Potato-WWheat, circle irr CMZ 49_calib.wjr

Select Report : Erosion & Crop Veg, Res & Biomass (details)

Run: Alfalfa 3yr-Potato-WWheat, circle irr CMZ 49_calib
Client: Exercise 5
Fm: Tr: Fld: Area: 130.0 ac
Management: Alfalfa, fall seed, 3yr-Potato-WWheat, circle irr CMZ49_CALIB
Soil: Quincy_WA025_97_100_FS

| | | | Erosion | Crop Vegetation | | | | | | | | Average Biomas | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Date | Operation | Crop | Average Total Gross Soil Loss (tons/acre) | Canopy Cover (fraction) | Surface Cover (fraction) | Effective Standing Silhouette ($ft^2/ft^2$) | Leaf and Stem Mass (lbs/acre) | Total Above Ground Mass (lbs/acre) | Root Mass (lbs/acre) | Crop Height (in) | Number Crop Stems (#/acre) | Surface Cover (fraction) | Effective Standing Silhouette ($ft^2/ft^2$) | Flat Mass (lbs/acre) |
| Sep 16-29, 05 | Irrigation, Stop Monitor | | 0.0 | 0.99 | 0.1025 | 2.48 | 5821 | 7344 | 23388 | 27 | 80937 | 0.00 | 0.00 | 2 |
| Sep 30-30, 05 | Harvest, shallow root crops, residue buried | Potato, tubers | 0.0 | 0.00 | 0.0000 | 0.00 | 0 | 0 | 0 | 0 | 0 | 0.32 | 0.00 | 669 |
| Oct 1- 1, 05 | Disk, offset, heavy<br>Cultipacker, roller, kill crop<br>Drill or air seeder, double disk | Wheat, winter, grain | 0.0 | 0.00 | 0.0000 | 0.00 | 1 | 1 | 54 | 0 | 890308 | 0.19 | 0.00 | 357 |
| Oct 2-14, 05 | Irrigation (2 inch, Pivot, Linear, Wheelline) | | 3.2 | 0.03 | 0.0000 | 0.00 | 25 | 25 | 29 | 1 | 890308 | 0.17 | 0.00 | 322 |
| Oct 15-31, 05 | | | 8.7 | 0.04 | 0.0001 | 0.00 | 35 | 35 | 38 | 1 | 890308 | 0.16 | 0.00 | 299 |
| Nov 1-14, 05 | | | 6.0 | 0.05 | 0.0001 | 0.00 | 45 | 45 | 54 | 1 | 890308 | 0.15 | 0.00 | 286 |
| Nov 15-30, 05 | | | 8.2 | 0.05 | 0.0001 | 0.00 | 46 | 46 | 74 | 1 | 890308 | 0.15 | 0.00 | 277 |
| Dec 1-14, 05 | | | 0.6 | 0.05 | 0.0001 | 0.00 | 46 | 46 | 80 | 1 | 890308 | 0.15 | 0.00 | 274 |
| Dec 15-31, 05 | | | 0.3 | 0.05 | 0.0000 | 0.00 | 46 | 46 | 84 | 1 | 890308 | 0.15 | 0.00 | 271 |
| Rot. yr: 5 | | | 31.1 | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| Ave. Annual | | | 20.7 | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |

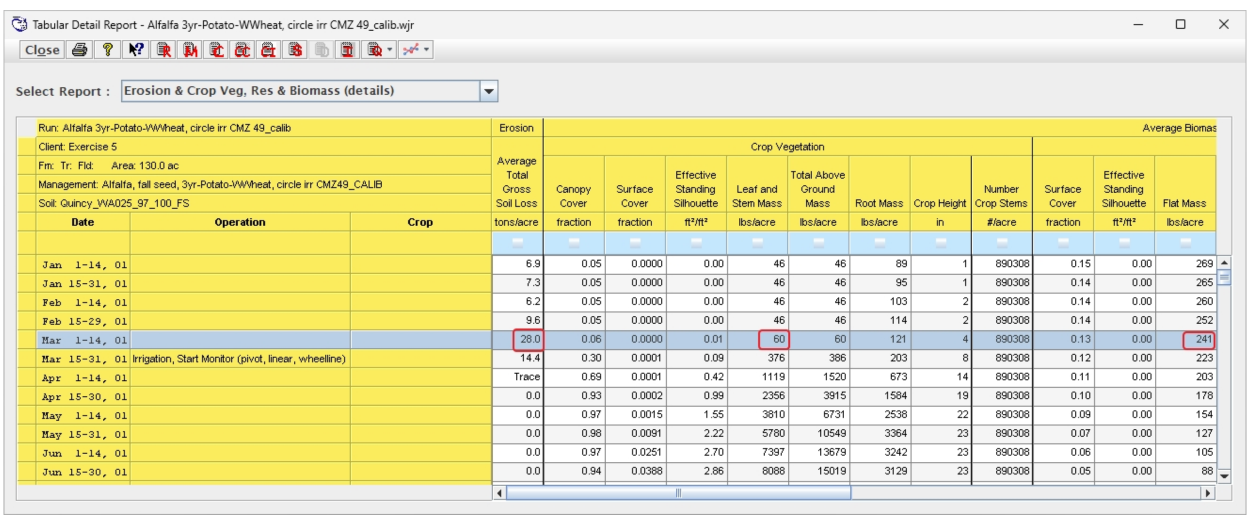
Figure 19.106: Detailed Report showing high soil loss and low biomass after Potato year 5.

**What is the highest period of loss in the Potato year?**

**Answer: Mar 1-14, 01** at **28.0 t/ac** (Fig. 19.107).

**Why is it so high?**

**Answer**: After potatoes, there is only a small amount of potato vine residue left (**241 lbs/ac** of flat mass by this date) and the growing winter wheat has still produced insufficient leaf and stem mass (only **60 lbs/ac**) to protect the field (Fig. 19.107).



Tabular Detail Report - Alfalfa 3yr-Potato-WWheat, circle irr CMZ 49_calib.wjr

Select Report : Erosion & Crop Veg, Res & Biomass (details)

Run: Alfalfa 3yr-Potato-WWheat, circle irr CMZ 49_calib
Client: Exercise 5
Fm: Tr: Fld: Area: 130.0 ac
Management: Alfalfa, fall seed, 3yr-Potato-WWheat, circle irr CMZ49_CALIB
Soil: Quincy_WA025_97_100_FS

| | | | Erosion | Crop Vegetation | | | | | | | | Average Biomas | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Date | Operation | Crop | Average Total Gross Soil Loss (tons/acre) | Canopy Cover (fraction) | Surface Cover (fraction) | Effective Standing Silhouette ($ft^2/ft^2$) | Leaf and Stem Mass (lbs/acre) | Total Above Ground Mass (lbs/acre) | Root Mass (lbs/acre) | Crop Height (in) | Number Crop Stems (#/acre) | Surface Cover (fraction) | Effective Standing Silhouette ($ft^2/ft^2$) | Flat Mass (lbs/acre) |
| Jan 1-14, 01 | | | 6.9 | 0.05 | 0.0000 | 0.00 | 46 | 46 | 89 | 1 | 890308 | 0.15 | 0.00 | 269 |
| Jan 15-31, 01 | | | 7.3 | 0.05 | 0.0000 | 0.00 | 46 | 46 | 95 | 1 | 890308 | 0.14 | 0.00 | 265 |
| Feb 1-14, 01 | | | 6.2 | 0.05 | 0.0000 | 0.00 | 46 | 46 | 103 | 2 | 890308 | 0.14 | 0.00 | 260 |
| Feb 15-29, 01 | | | 9.6 | 0.05 | 0.0000 | 0.00 | 46 | 46 | 114 | 2 | 890308 | 0.14 | 0.00 | 252 |
| Mar 1-14, 01 | | | 28.0 | 0.06 | 0.0000 | 0.01 | 60 | 60 | 121 | 4 | 890308 | 0.13 | 0.00 | 241 |
| Mar 15-31, 01 | Irrigation, Start Monitor (pivot, linear, wheelline) | | 14.4 | 0.30 | 0.0001 | 0.09 | 376 | 386 | 203 | 8 | 890308 | 0.12 | 0.00 | 223 |
| Apr 1-14, 01 | | | Trace | 0.69 | 0.0001 | 0.42 | 1119 | 1520 | 673 | 14 | 890308 | 0.11 | 0.00 | 203 |
| Apr 15-30, 01 | | | 0.0 | 0.93 | 0.0002 | 0.99 | 2356 | 3915 | 1584 | 19 | 890308 | 0.10 | 0.00 | 178 |
| May 1-14, 01 | | | 0.0 | 0.97 | 0.0015 | 1.55 | 3810 | 6731 | 2538 | 22 | 890308 | 0.09 | 0.00 | 154 |
| May 15-31, 01 | | | 0.0 | 0.98 | 0.0091 | 2.22 | 5780 | 10549 | 3364 | 23 | 890308 | 0.07 | 0.00 | 127 |
| Jun 1-14, 01 | | | 0.0 | 0.97 | 0.0251 | 2.70 | 7397 | 13679 | 3242 | 23 | 890308 | 0.06 | 0.00 | 105 |
| Jun 15-30, 01 | | | 0.0 | 0.94 | 0.0388 | 2.86 | 8088 | 15019 | 3129 | 23 | 890308 | 0.05 | 0.00 | 88 |

Figure 19.107: Detailed Report showing high soil loss and low biomass after potato harvest in year 1.

**Why is this period showing even more erosion than the Oct-Dec, year 5 time frame following the potato harvest?**

**Answer:** Because March (and April) have the most erosive wind energy during the year at this location (Fig. 19.108).

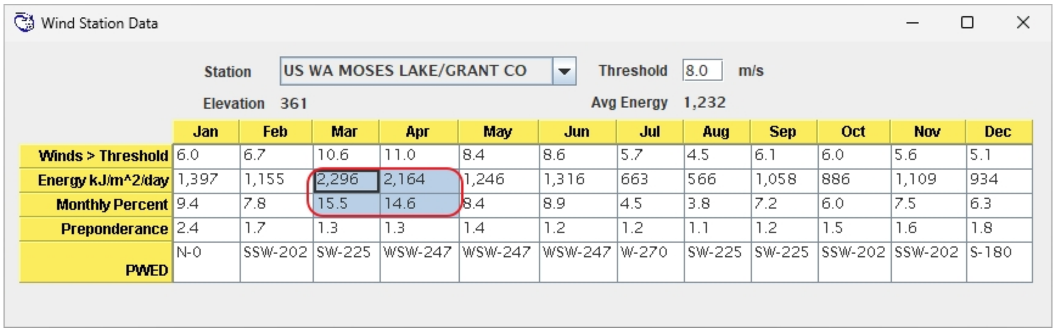



Figure 19.108: Monthly wind energy statistics for Example 5 location.

## 19.6.4 Adding another year of alfalfa

The producer reports that sometimes he adds another year of alfalfa to the rotation if the hay market is promising and the stand of alfalfa is satisfactory. In this part of the exercise, the editing power of MCREW will be put to use.

*Step 1:* Close any remaining report screens. From the main interface, open the management editor Man. Scroll down the *Operation Name* column list until you get to the **Mar 15, 04** date, **Irrigation, Start Monitor (pivot, linear, wheelline)** operation. From there, press the left mouse button and drag down to select all the operations of year 04, then release the left mouse button. Right click in the *Operation Name* column and select the **Copy Row(s)** menu option from the popup menu (Fig. 19.109).

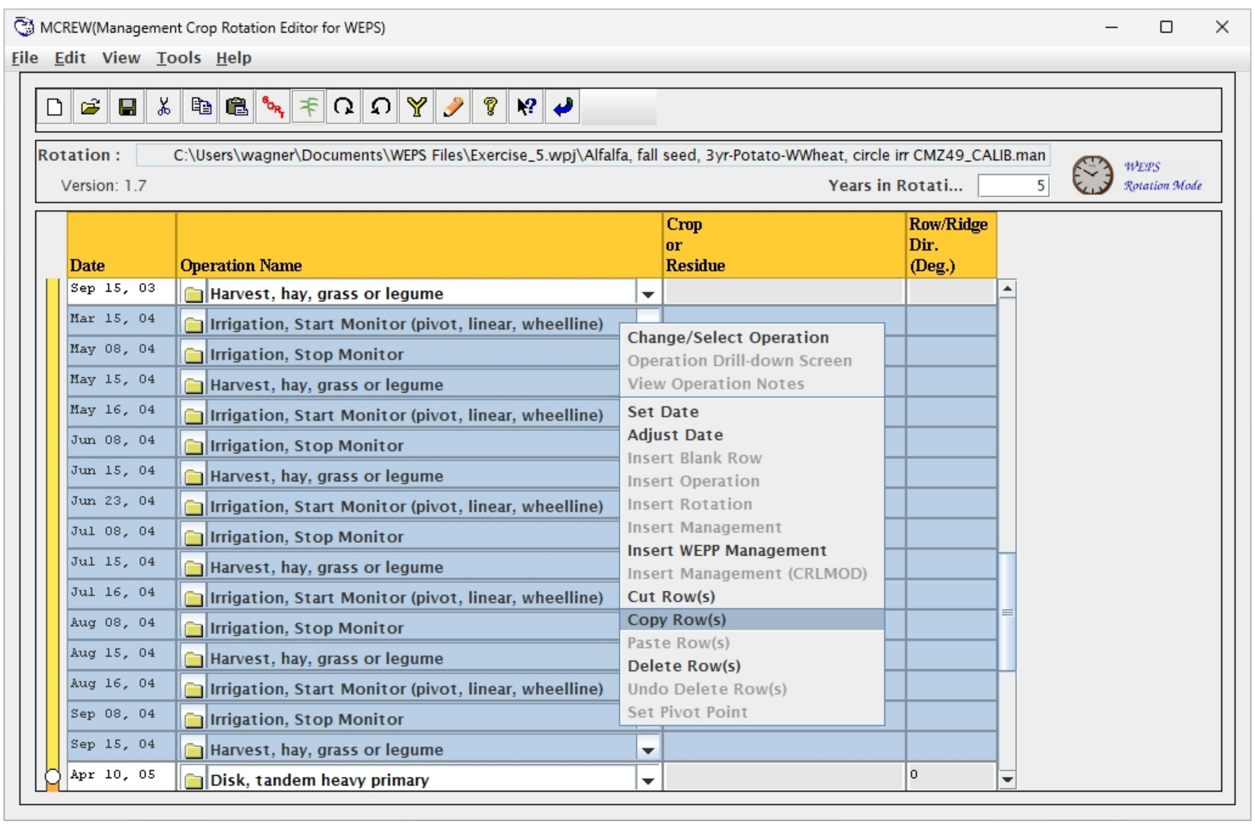



Figure 19.109: Operations for Alfalfa year 04 selected for copying.

*Step 2:* Select the **Disk, tandem heavy primary** operation on **Apr 10, 05** with the mouse pointer. Press and release the left mouse button to select that operation. Right click in the *Operation Name* column and select the

**Paste Row(s)** menu option from the popup menu. This will insert a copy of all of the selected operations immediately prior to the **Apr 10, 05** date in MCREW. You have now made a complete set of operations for another year of alfalfa. Note that the dates still have year 4 instead of year 5. With the group of cells still highlighted, right-click in the *Date* column and select **Increment Year** (Fig. 19.110). This will adjust the selected operation dates forward one year in the rotation.

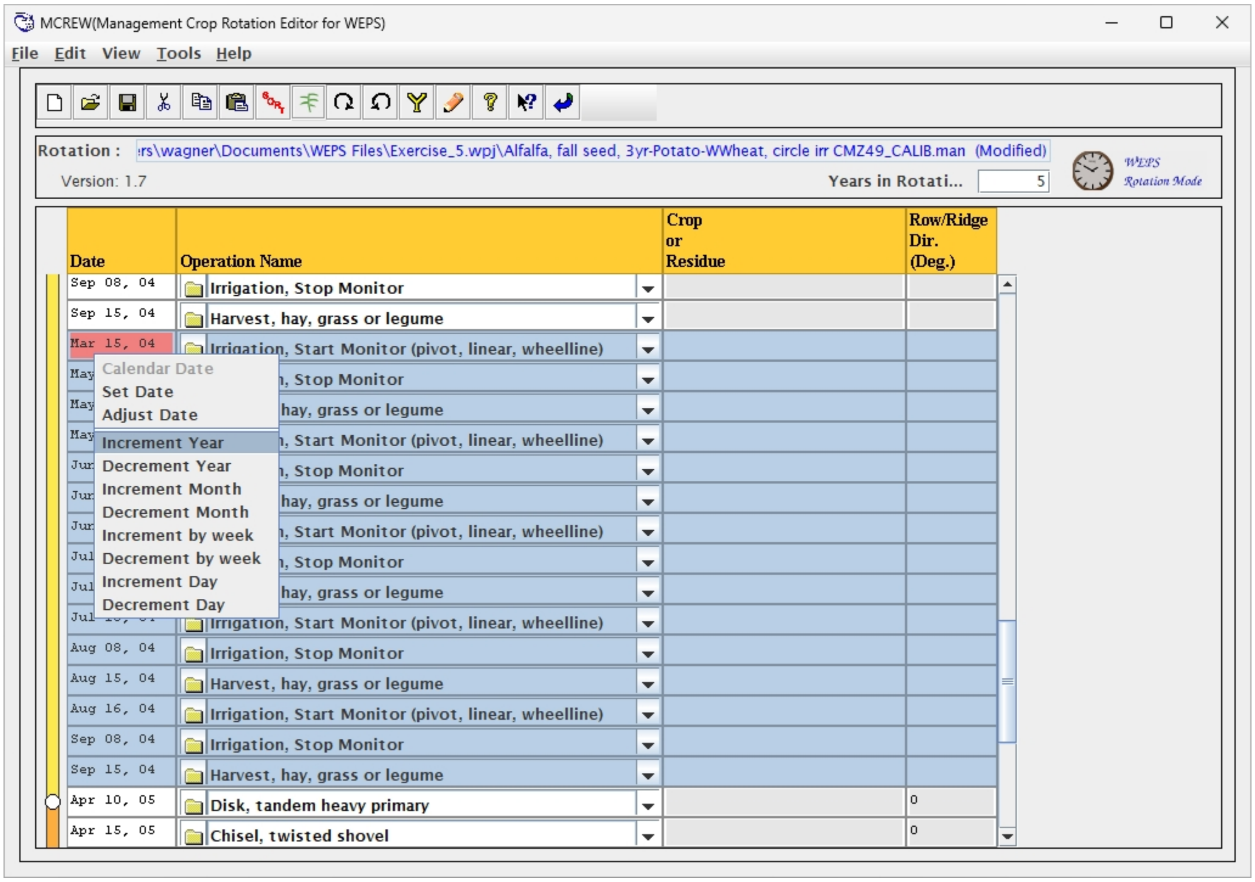



Figure 19.110: Incrementing the year of the copied operations.

*Step 3:* Finally, highlight the Disk from **Apr 10, 05** through the end of the file. Right click the date column and increment the year. The year should now be **06** for all of these selected operation dates (Fig. 19.111).

*Step 4:* We have now added another year to the rotation so we must change the **Years in Rotation** box at the top of the editor screen from 5 to **6** (Fig. 19.111). If we forget to make this change, a popup window will appear reminding us of the rotation length discrepancy when we attempt to save the modified rotation. MCREW will not allow one to save a rotation if there are any operation dates for years listed later than the rotation length.

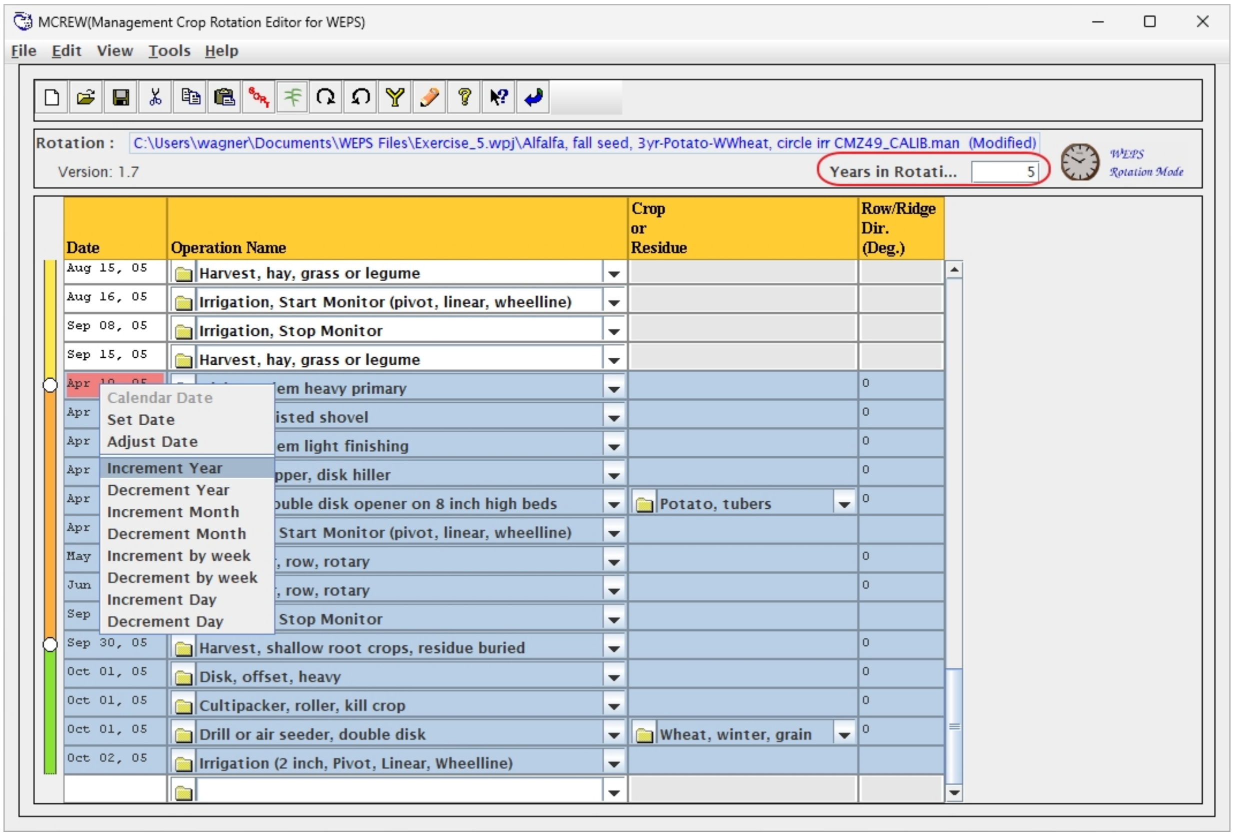


Figure 19.111: MCREW window after adding another year of alfalfa, with dates being adjusted.

Once you are sure all the dates are correct and sequential, click the **File** menu and select the **Save As...** menu option. Name the file **Alfalfa, fall seed, 4yr-Potato-WWheat, circle irr CMZ49_CALIB** and then click on the **Save As** button in the WEPS FileChooser window (Fig. 19.112).

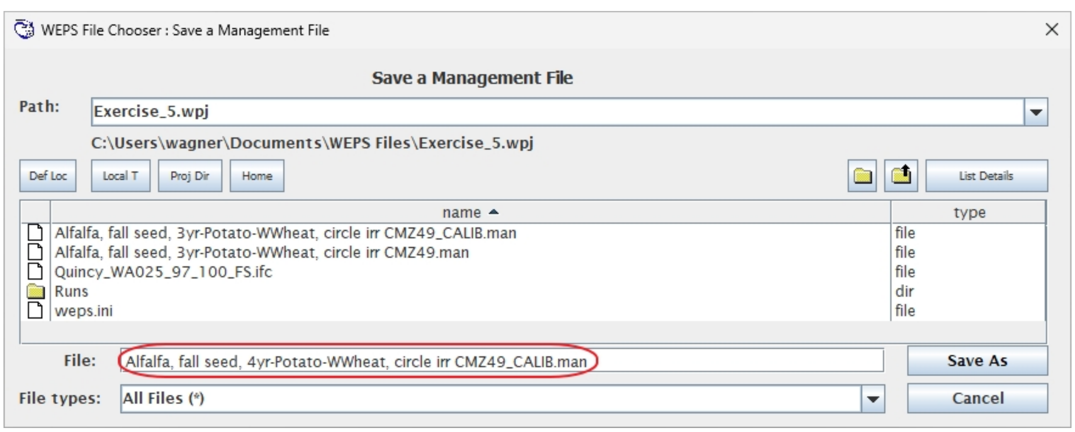



Figure 19.112: MCREW WEPS FileChooser used to name the edited management file.

*Step 5:* We can now run the management without calibration since we saved the previous run and added back to the management file the Biomass Adjustment Factors for alfalfa (1.45), potatoes (2.2), and the winter wheat (1.84). We can verify that we are using these calibration adjusted values by clicking on the **View** menu and selecting the **Calibration** option (enabling the checkmark in the box) (Fig. 19.113). Note that clicking on the

Yield Calibrate button is a shortcut to the View/Calibration menu approach in MCREW (Fig. 19.113).

Additional columns will then display in MCREW (Fig. 19.113). One can scroll horizontally to the left until the **Biomass Adj. Factor** column displays. The user can then scroll vertically to see if the desired values for each crop are correctly set. They should be.

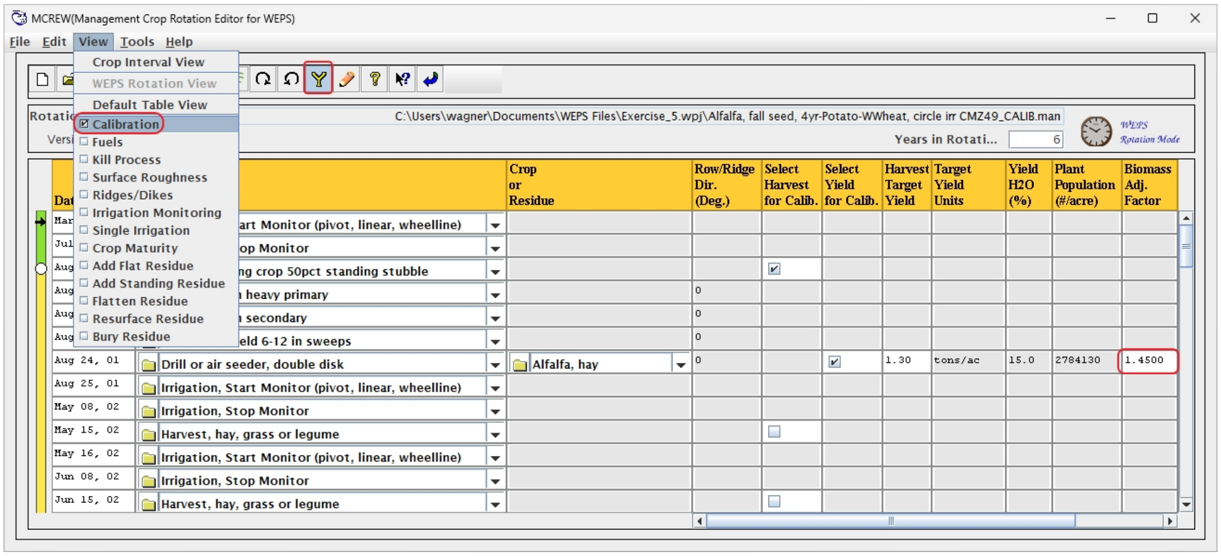
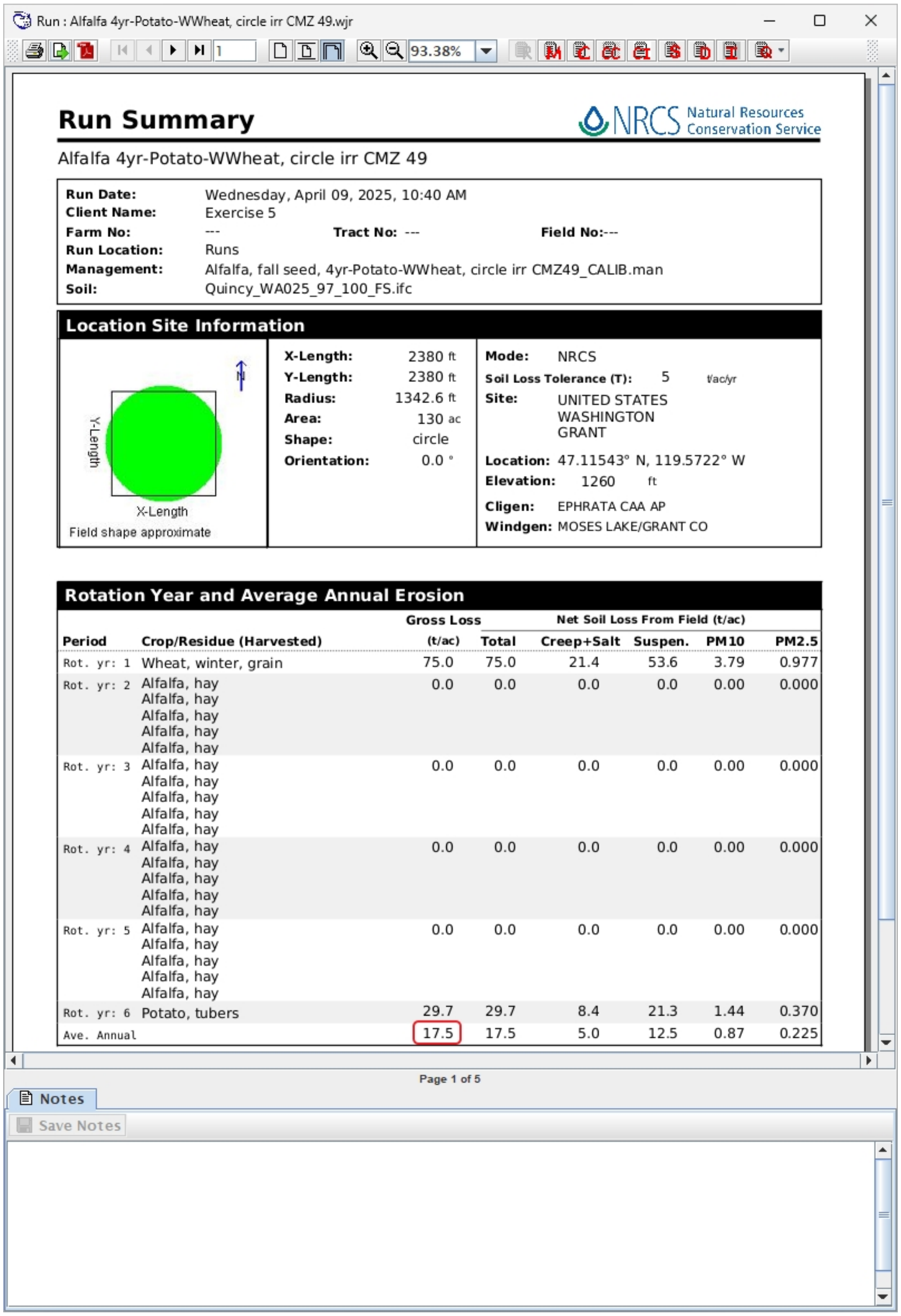



Figure 19.113: View/Calibration menu option with checkmark selected.

*Step 6:* Click Run and name it **Alfalfa 4yr-Potato-WWheat, circle irr CMZ 49**.



Run : Alfalfa 4yr-Potato-WWheat, circle irr CMZ 49.wjr

**Run Summary**

NRCS Natural Resources Conservation Service

Alfalfa 4yr-Potato-WWheat, circle irr CMZ 49

**Run Date:** Wednesday, April 09, 2025, 10:40 AM
**Client Name:** Exercise 5
**Farm No:** --- **Tract No:** --- **Field No:**---
**Run Location:** Runs
**Management:** Alfalfa, fall seed, 4yr-Potato-WWheat, circle irr CMZ49_CALIB.man
**Soil:** Quincy_WA025_97_100_FS.ifc

**Location Site Information**

Y-Length
X-Length
Field shape approximate

**X-Length:** 2380 ft
**Y-Length:** 2380 ft
**Radius:** 1342.6 ft
**Area:** 130 ac
**Shape:** circle
**Orientation:** 0.0 °

**Mode:** NRCS
**Soil Loss Tolerance (T):** 5 t/ac/yr
**Site:** UNITED STATES WASHINGTON GRANT
**Location:** 47.11543° N, 119.5722° W
**Elevation:** 1260 ft
**Cligen:** EPHRATA CAA AP
**Windgen:** MOSES LAKE/GRANT CO

**Rotation Year and Average Annual Erosion**

| Period | Crop/Residue (Harvested) | Gross Loss (t/ac) | Net Soil Loss From Field (t/ac) Total | Creep+Salt | Suspen. | PM10 | PM2.5 |
|---|---|---|---|---|---|---|---|
| Rot. yr: 1 | Wheat, winter, grain | 75.0 | 75.0 | 21.4 | 53.6 | 3.79 | 0.977 |
| Rot. yr: 2 | Alfalfa, hay<br>Alfalfa, hay<br>Alfalfa, hay<br>Alfalfa, hay<br>Alfalfa, hay | 0.0 | 0.0 | 0.0 | 0.0 | 0.00 | 0.000 |
| Rot. yr: 3 | Alfalfa, hay<br>Alfalfa, hay<br>Alfalfa, hay<br>Alfalfa, hay<br>Alfalfa, hay | 0.0 | 0.0 | 0.0 | 0.0 | 0.00 | 0.000 |
| Rot. yr: 4 | Alfalfa, hay<br>Alfalfa, hay<br>Alfalfa, hay<br>Alfalfa, hay<br>Alfalfa, hay | 0.0 | 0.0 | 0.0 | 0.0 | 0.00 | 0.000 |
| Rot. yr: 5 | Alfalfa, hay<br>Alfalfa, hay<br>Alfalfa, hay<br>Alfalfa, hay<br>Alfalfa, hay | 0.0 | 0.0 | 0.0 | 0.0 | 0.00 | 0.000 |
| Rot. yr: 6 | Potato, tubers | 29.7 | 29.7 | 8.4 | 21.3 | 1.44 | 0.370 |
| Ave. Annual | | 17.5 | 17.5 | 5.0 | 12.5 | 0.87 | 0.225 |

Page 1 of 5

Notes
Save Notes

Figure 19.114: Run Summary showing Average Annual Soil Loss.

The erosion rate is now **17.5 t/ac** per year (Fig. 19.114). This is an improvement from the previous **20.7 t/ac** on average for the older and shorter duration rotation, but this is primarily due to the increased length of the modified rotation with another alfalfa year providing zero wind erosion. More will still have to be done to conserve the soil on this field.

Note that increasing the rotation length with low wind erosion risk crops like alfalfa can help a producer achieve the goal of lowering their annual wind erosion rate below the soil loss tolerance value for a given rotation. However, that approach is not addressing the real wind erosion issues on such sites. The periods of high wind erosion rates will still exist if not properly addressed. The producer will still be at risk of blowing out seedlings, filling road ditches with soil, risk reducing the field's long term productivity due to losing the most fertile portion of the soil and possibly causing visibility issues on adjacent and nearby roads downwind of such sites.

### 19.6.5 Reducing wind erosion to acceptable levels

Since this particular scenario is still simulating excessive erosion results, even with four years of alfalfa in the rotation, we must make additional changes in the rotation practices to get it under control.

We know that we have little residue after the potato harvest and the winter wheat does not provide enough growth for adequate vegetative cover going into the winter. So, without modifying the crop rotation and/or the crop varieties grown, we must rely on wind erosion control techniques for nearly bare soil surfaces, such as: a) increasing the surface random and/or oriented roughness; b) setting the ridge/row orientation perpendicular to the prevailing erosive winds; and/or c) shortening the field width perpendicular to the most erosive winds by employing strip cropping practices. We will look at options a) and b) first by attempting to provide additional ridging during the wheat planting operation and re-orienting the ridges to hopefully bring the erosion under control.

From the *Wind Station Data* report (Fig. 19.108), we can see that the prevailing wind direction (PWED) for each month during the late fall, winter and early spring are from the **SSW, S, N, SW and WSW** directions. Previous simulations have been using the default ridge/row orientation of 0°or the North/South direction, which the producer has stated they are currently using. If we select the ridge/row orientation to **-45**°, we will not be parallel with any of these prevailing wind directions.

We also want to create much larger ridges. The current hoe drill only creates an initial 1 inch ridge, with the winter wheat being planted in the furrow. We will select a different planting operation that intentionally creates much taller ridges and still allows the crop to be planted in 8 inch rows, both on the ridge top and within the furrow.

We will see if these proposed changes will adequately reduce our predicted erosion levels on this site.

*Step 1:* Go to MCREW and go to the winter wheat seeding operation. Click on the down arrow to bring up the operation selection menu. Select the **Planter, double disk opener on 12 inch high beds** operation in the **Seeding, Planter** category folder (unless WEPS is configured to list all operations alphabetically instead of by category) to replace the current operation. We are selecting this operation because we don't have any *drills* that we can easily configure to plant on large ridges at this time (probably an oversight on our part).

*Step 2:* Since selecting a replacement seeding operation will also remove the previously selected crop, we will need to re-select the winter wheat crop record. Since we have previously saved a local copy of the calibrated winter wheat record, we will retrieve it here. If one did not save a local copy of the winter wheat crop record, re-select the original CRLMOD crop record and manually set the Bio. Adj. Factor to the calibrated value of 1.84 Fig. 19.115.

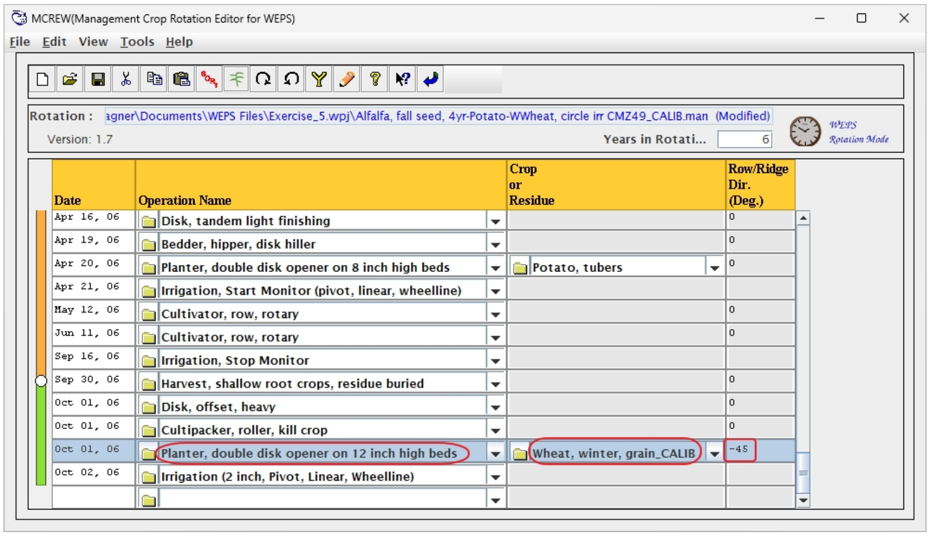


Figure 19.115: Planting operation and local calibrated crop selected.

*Step 3:* Set the *Row/Ridge Dir. (Deg.)* cell for this seeding operation to **-45**° Fig. 19.115.

*Step 4:* Select the folder *drilldown* icon for the **Planter, double disk opener on 12 inch high beds** operation and then select the **Seeding Configuration** tab in the popup window.

*Step 5:* As shown in Fig. 19.116: a) Select the **Use Specified Row Spacing** for the *Type of Planting* field. b) Change the *Crop row spacing* field to **8 inches**. c) Ensure that the **Seed row placed on ridge top** option is specified for the *Seed placement (ridge/furrow)* field.

These settings will allow the winter wheat to be planted on the ridges as well as the furrows to help the limited wheat cover produced better protect the field from wind erosion and allow the ridge roughness to be oriented across the prevailing wind directions.

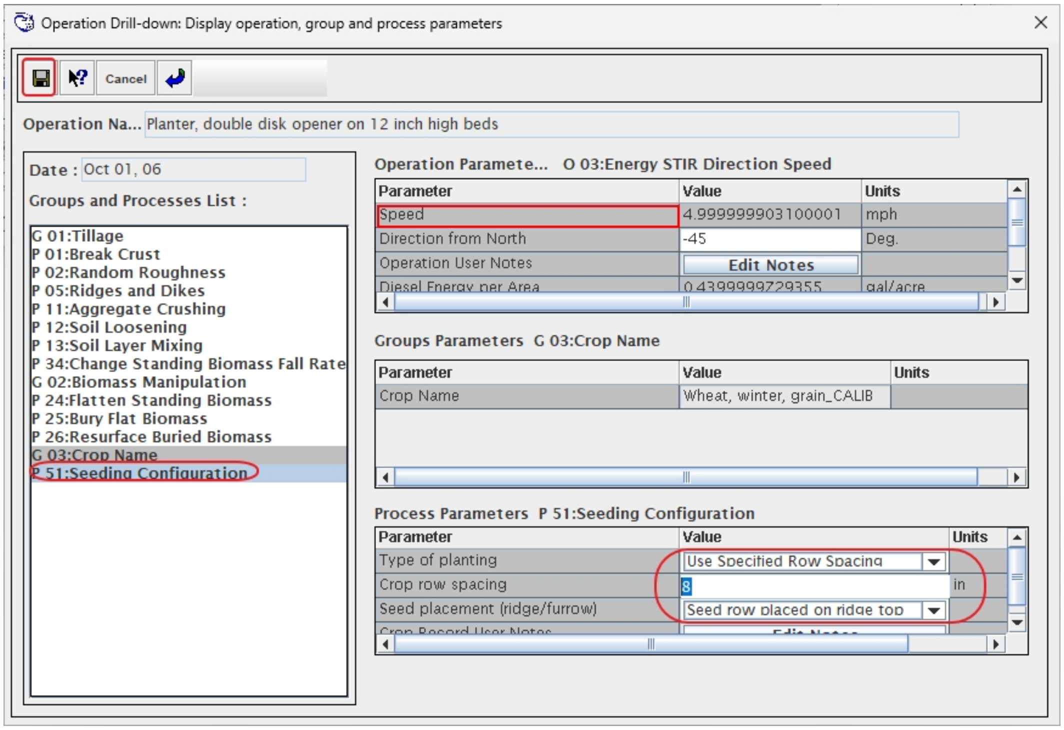



Figure 19.116: Seeding operation drilldown screen settings.

*Step 6:* Save a local copy of the modified operation via the use the **Save As** button on the drilldown screens' toolbar. Name it **Planter, double disk opener on 12 in high beds-8in_spacing**. Select the option in the subsequent popup to save the corresponding crop record with this new local operation. This will allow us to select this locally modified operation (and crop) record in this management file or others without having to make the same local modifications again.

**NOTE:** We could have simply **Saved** the changes via the blue arrow return button into the current operation record stored within MCREW, provided we only wanted to make these local operation changes in this management file and did not anticipate making/using these set of local changes again in another management rotation file. However, this specific drilldown screen **Save** functionality is currently broken in MCREW. This issue will be addressed and fixed soon, probably in the next minor release of WebStart WEPS.

*Step 7:* Save and rename the management rotation file: **Alfalfa, fall seed, 4yr-Potato_WWheat, circle irr CMZ49-drill_on_ridges_CALIB** with the following locally modified operation and crop records Fig. 19.117.

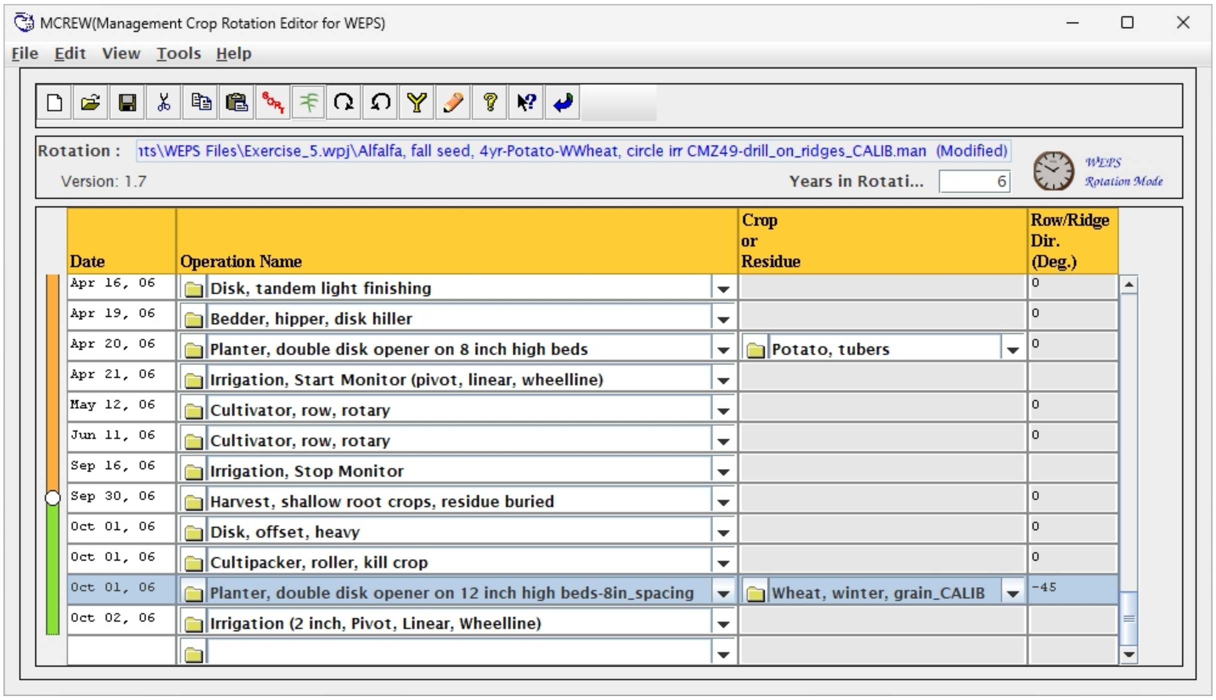
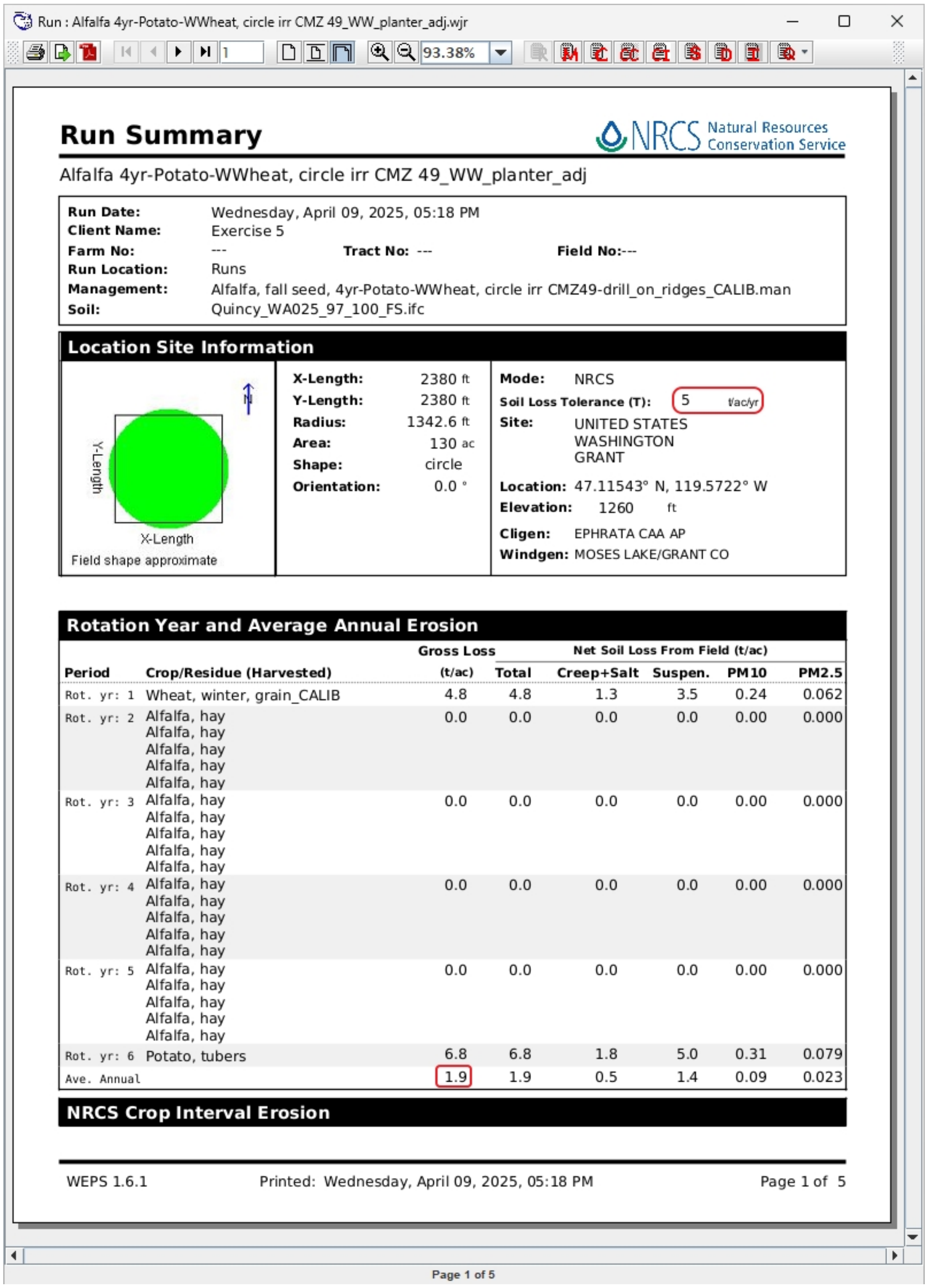



Figure 19.117: New locally modified operation and crop records selected in MCREW.

*Step 8:* Make a standard WEPS run usign the previous calibrated values and name the run: **Alfalfa, fall seed, 4yr-WWheat, circle irr CMZ49_WW_planter_adj**.

The average annual erosion rate is now **1.9 t/a** (Fig. 19.118), which is well within NRCS limits.



Run : Alfalfa 4yr-Potato-WWheat, circle irr CMZ 49_WW_planter_adj.wjr

## Run Summary

Alfalfa 4yr-Potato-WWheat, circle irr CMZ 49_WW_planter_adj

| | |
|---|---|
| **Run Date:** | Wednesday, April 09, 2025, 05:18 PM |
| **Client Name:** | Exercise 5 |
| **Farm No:** | --- **Tract No:** --- **Field No:**--- |
| **Run Location:** | Runs |
| **Management:** | Alfalfa, fall seed, 4yr-Potato-WWheat, circle irr CMZ49-drill_on_ridges_CALIB.man |
| **Soil:** | Quincy_WA025_97_100_FS.ifc |

### Location Site Information



| | |
|---|---|
| **X-Length:** | 2380 ft |
| **Y-Length:** | 2380 ft |
| **Radius:** | 1342.6 ft |
| **Area:** | 130 ac |
| **Shape:** | circle |
| **Orientation:** | 0.0 ° |

| | |
|---|---|
| **Mode:** | NRCS |
| **Soil Loss Tolerance (T):** | 5 t/ac/yr |
| **Site:** | UNITED STATES WASHINGTON GRANT |
| **Location:** | 47.11543° N, 119.5722° W |
| **Elevation:** | 1260 ft |
| **Cligen:** | EPHRATA CAA AP |
| **Windgen:** | MOSES LAKE/GRANT CO |

### Rotation Year and Average Annual Erosion

| | | Gross Loss | Net Soil Loss From Field (t/ac) | | | | |
|---|---|---|---|---|---|---|---|
| **Period** | **Crop/Residue (Harvested)** | **(t/ac)** | **Total** | **Creep+Salt** | **Suspen.** | **PM10** | **PM2.5** |
| Rot. yr: 1 | Wheat, winter, grain_CALIB | 4.8 | 4.8 | 1.3 | 3.5 | 0.24 | 0.062 |
| Rot. yr: 2 | Alfalfa, hay<br>Alfalfa, hay<br>Alfalfa, hay<br>Alfalfa, hay<br>Alfalfa, hay | 0.0 | 0.0 | 0.0 | 0.0 | 0.00 | 0.000 |
| Rot. yr: 3 | Alfalfa, hay<br>Alfalfa, hay<br>Alfalfa, hay<br>Alfalfa, hay<br>Alfalfa, hay | 0.0 | 0.0 | 0.0 | 0.0 | 0.00 | 0.000 |
| Rot. yr: 4 | Alfalfa, hay<br>Alfalfa, hay<br>Alfalfa, hay<br>Alfalfa, hay<br>Alfalfa, hay | 0.0 | 0.0 | 0.0 | 0.0 | 0.00 | 0.000 |
| Rot. yr: 5 | Alfalfa, hay<br>Alfalfa, hay<br>Alfalfa, hay<br>Alfalfa, hay<br>Alfalfa, hay | 0.0 | 0.0 | 0.0 | 0.0 | 0.00 | 0.000 |
| Rot. yr: 6 | Potato, tubers | 6.8 | 6.8 | 1.8 | 5.0 | 0.31 | 0.079 |
| Ave. Annual | | 1.9 | 1.9 | 0.5 | 1.4 | 0.09 | 0.023 |

### NRCS Crop Interval Erosion

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Figure 19.118: Seeding operation drilldown screen settings.

Note that there are additional options that can and probably should be explored as solutions for the erosion issues which occur on this site:

- Stay with a late season potato variety, use series of herbacious wind barriers using WEPS to help design them. This works in other parts of the country.
- Sudan or cheap corn, etc. - need decent height growth - withd of strip 120 inches or 10 ft (3 rows), between strips, max 100 ft (use WEPS to assist in design).
- Harvest strips of early potato variety, get wheat established in strips, then harvest remaining strips of later maturity potato and plant later wheat.

- Plant whole field to earlier maturity potato variety, if possible, to allow earlier wheat seeding in early September.
- When precision irrigation becomes more common, strip cropping the field will be more feasible under a center pivot system.

The last option is probably the best for consistently controlling erosion on this site as it would reduce the potential run length available for dust emissions. This is being suggested because the suspension component of the erosion emissions is greater than the creep/saltation component (around double) for most of the wind erosion events. This is probably best visualized on page 7 of the **Wind Erosion Soil Loss (Creep+Salt, Susp)** QuickPlot graph report (Fig. 19.119).

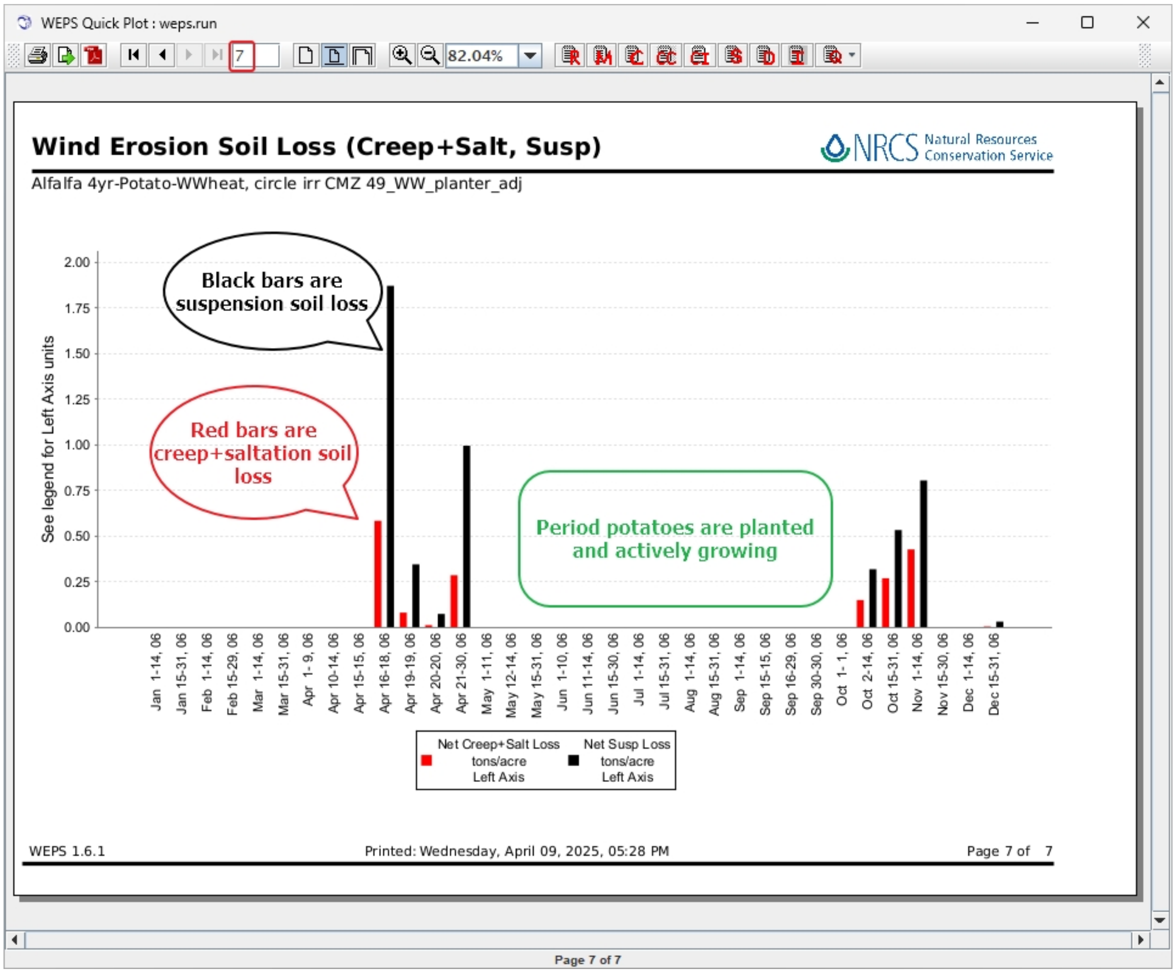
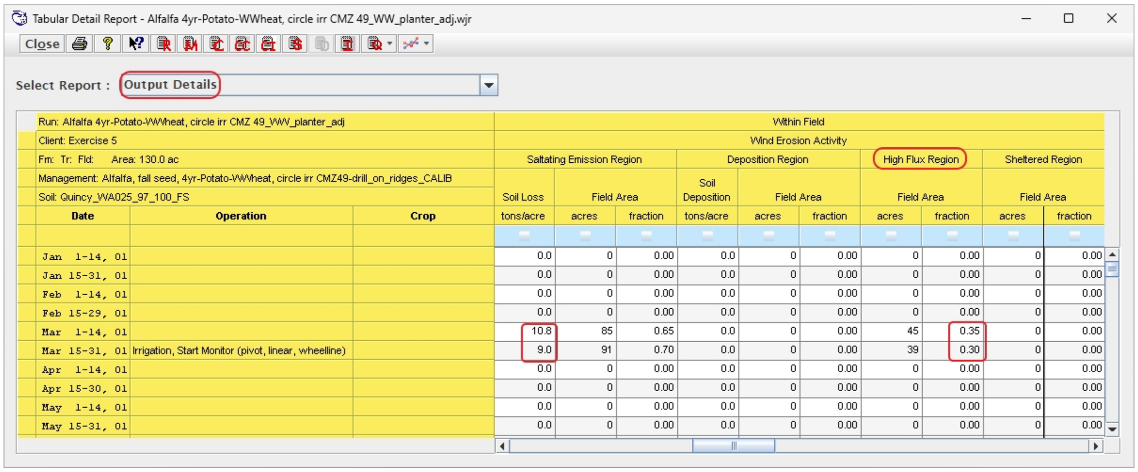



Figure 19.119: QuickPlot Erosion Report showing creep+saltation and suspension soil loss following potato harvest.

Likewise, one can find additional evidence that these wind erosion events are significant due to the high fraction of the total field surface experiencing high flux events. These "high flux" regions are where WEPS computes net erosion as essentially zero for creep and saltation soil loss (suspension soil loss does still occur here though). This is because the creep+saltation soil component load over the surface has reached the maximum that can be carried by the wind. However, these regions' surfaces are still being heavily bombarded by the moving larger saltation and creep size soil components, which breaks down larger particles into the smaller suspension size material that will still be emitted from the surface and carried off the field.

These regions are as high as 67% of the field for some periods in the run (scroll down to the bottom of the **Detailed Tabular Report** and look at the **High Flux Region's Fraction Field Area** column. Even with the large ridges being re-oriented, the average fraction of the surface was still greater than 40% on average for all periods exhibiting wind erosion. Here is an example of some periods with approximately 30%-35% of the area registered as "high flux" regions (Fig. 19.120).


Tabular Detail Report - Alfalfa 4yr-Potato-WWheat, circle irr CMZ 49_WW_planter_adj.wjr

Select Report : Output Details

Run: Alfalfa 4yr-Potato-WWheat, circle irr CMZ 49_WW_planter_adj
Client: Exercise 5
Fm: Tr: Fld: Area: 130.0 ac
Management: Alfalfa, fall seed, 4yr-Potato-WWheat, circle irr CMZ49-drill_on_ridges_CALIB
Soil: Quincy_WA025_97_100_FS

| | | | Within Field – Wind Erosion Activity | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Saltating Emission Region | | | Deposition Region | | | High Flux Region | | Sheltered Region | |
| | | | Soil Loss | Field Area | | Soil Deposition | Field Area | | Field Area | | Field Area | |
| Date | Operation | Crop | tons/acre | acres | fraction | tons/acre | acres | fraction | acres | fraction | acres | fraction |
| Jan 1-14, 01 | | | 0.0 | 0 | 0.00 | 0.0 | 0 | 0.00 | 0 | 0.00 | 0 | 0.00 |
| Jan 15-31, 01 | | | 0.0 | 0 | 0.00 | 0.0 | 0 | 0.00 | 0 | 0.00 | 0 | 0.00 |
| Feb 1-14, 01 | | | 0.0 | 0 | 0.00 | 0.0 | 0 | 0.00 | 0 | 0.00 | 0 | 0.00 |
| Feb 15-29, 01 | | | 0.0 | 0 | 0.00 | 0.0 | 0 | 0.00 | 0 | 0.00 | 0 | 0.00 |
| Mar 1-14, 01 | | | 10.8 | 85 | 0.65 | 0.0 | 0 | 0.00 | 45 | 0.35 | 0 | 0.00 |
| Mar 15-31, 01 | Irrigation, Start Monitor (pivot, linear, wheelline) | | 9.0 | 91 | 0.70 | 0.0 | 0 | 0.00 | 39 | 0.30 | 0 | 0.00 |
| Apr 1-14, 01 | | | 0.0 | 0 | 0.00 | 0.0 | 0 | 0.00 | 0 | 0.00 | 0 | 0.00 |
| Apr 15-30, 01 | | | 0.0 | 0 | 0.00 | 0.0 | 0 | 0.00 | 0 | 0.00 | 0 | 0.00 |
| May 1-14, 01 | | | 0.0 | 0 | 0.00 | 0.0 | 0 | 0.00 | 0 | 0.00 | 0 | 0.00 |
| May 15-31, 01 | | | 0.0 | 0 | 0.00 | 0.0 | 0 | 0.00 | 0 | 0.00 | 0 | 0.00 |

Figure 19.120: Detailed Report showing high flux regions in year 1 following potato harvest.

The only way to address this issue is to somehow reduce or eliminate the unimpeded movement of the saltation and creep size particles, if increasing residue and/or vegetative cover are not options. The best approach is to reduce the effective field length by strip cropping the field or creating wind barriers appropriately spaced to limit or stop the creep and saltation particle movement on the surface.

## 19.7 Ex 6 – Tomatoes, Rye Cover Crop, and Plastic Mulch

### 19.7.1 Skill Building

This exercise begins with a template rotation. Rye for winter cover and plastic mulch are added to the basic run. Often there is no cover between crop rows. This exercise should give the user a sense of value for these conservation practices. The picture below (Fig. 19.121) is an example of a rye inter-furrow cover crop and tomatoes and (Fig. 19.122) is an example of a red plastic mulch around the tomatoes. The current version of WEPS does not directly model temporary barriers (between the rows) or two crops growing simultaneously as shown below, but it can simulate these situations nonetheless.

Figure 19.121: Tomatoes with a rye cover crop between the rows.

Figure 19.122: Tomatoes with a red plastic mulch around the tomatoes.

We will model systems with cover crops planted either in the fall or spring and plastic mulch added to the field at or near planting time for the crop (in this case tomatoes). The plastic mulch is accounted for in WEPS as a *special residue*. Therefore we can grow any other crop with plastic mulch in place. We can count the green cover crop as residue when we plant the tomatoes if we place a "kill crop" operation before planting the tomatoes. This means that even though the rye is still growing, WEPS will not show rye growth. WEPS will however show the amount of rye biomass as dead residue when the tomatoes are planted thus providing the intended protection.

- It uses a previously built management record as a starting template that is then modified via MCREW (Management/Crop Rotation Editor for WEPS).
- It outlines how to: Construct a management rotation to:
  - Apply plastic mulch which is treated as a *special non-decaying residue* in WEPS
  - Correctly remove a plastic mulch from a field
  - Represent temporary barrier effects created from a growing cover crop between the rows, while a cash crop is also growing

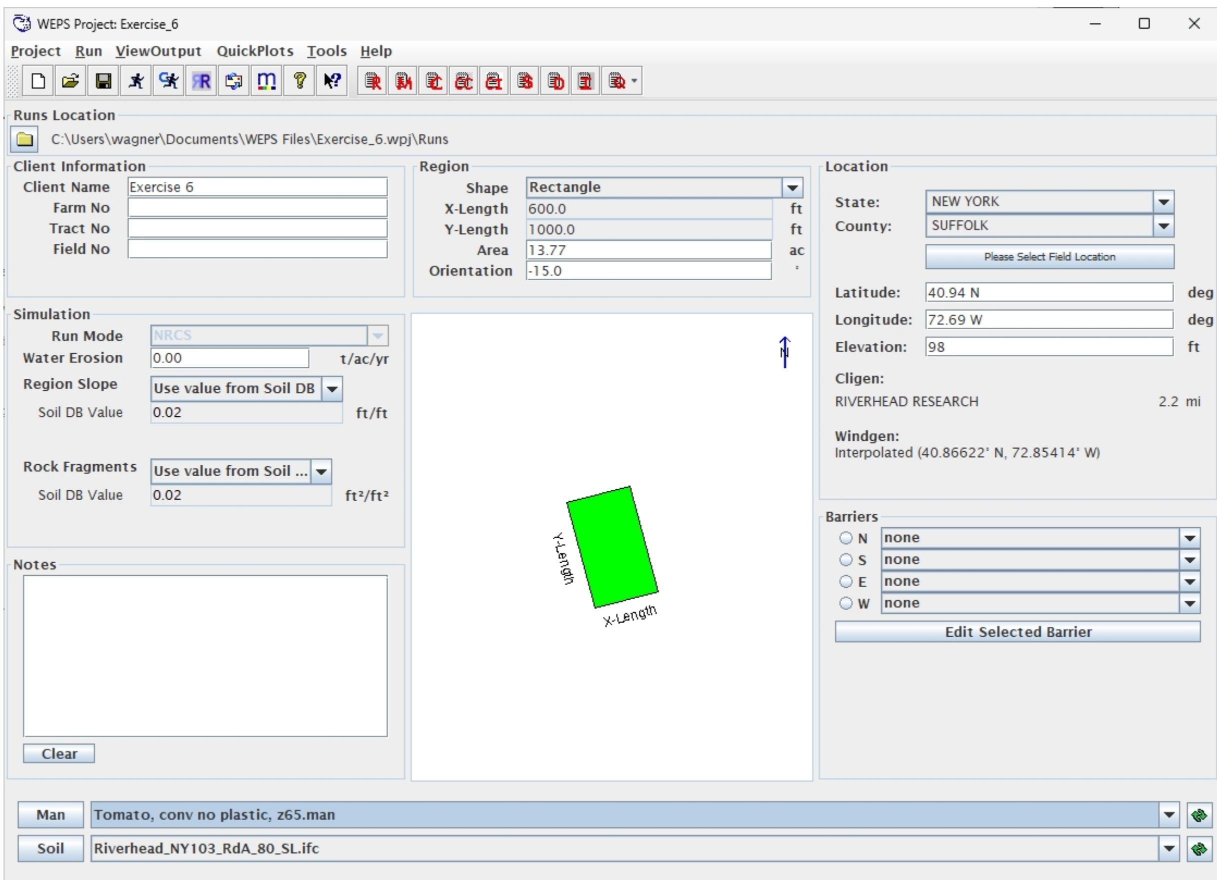



Figure 19.123: WEPS interface with initial run information.

### 19.7.2 Scenario

- The field we are working with is in **Suffolk County, New York**.
- The location coordinates we will use for the actual field site are: **40.94327º N, 72.68764º W**.
- The soil is a Riverhead Sandy Loam (**Riverhead_RdA_80_SL.ifc**).
- The Cligen station is **Riverhead Research**.
- The Windgen station is **Interpolated**.

- The simulation region is **600 ft for the X-Length** and **1000 feet for the Y-Length** to give a field size of **13.77 acres**.
- The field is oriented **-15.0 degrees** from true North (i.e., 345 degrees).
- The producer grows tomatoes, expecting yields of **300 cwt/ac**.
- The field is tilled parallel to its long side.
- The producer indicates that in some years, there is damage to the young tomato transplants from abrasion by blowing soil.

### 19.7.3 Populate inputs

We need to populate the inputs based upon the information provided above. Once that is done, we will execute a WEPS simulation Run.

*Step 1:* Open the WEPS interface and enter the information as shown (Fig. 19.123).

*Step 1a:* Select the soil **Riverhead_NY103_RdA_80_SL** from the *CSIP Soil Service*.

*Step 1b:* Select the **Tomato, conv, no plastic, Z6** management template from *System Templates*. This is the management without the rye cover crop or the plastic mulch applied.

*Step 2:* Open MCREW to check the settings.

The tillage must be parallel to the orientation of the field, so the *Row/Ridge Dir. (Deg.)* column should have all operations set to **-15**°. To set the direction, select all the rows in the *Row/Ridge Dir. (Deg.)* column with values and right-click to bring up the column specific menu and select *Decrement 15 deg*, or adjust the direction by using alternate appropriate options in MCREW. When the settings match Fig. 19.124, click the blue return arrow.

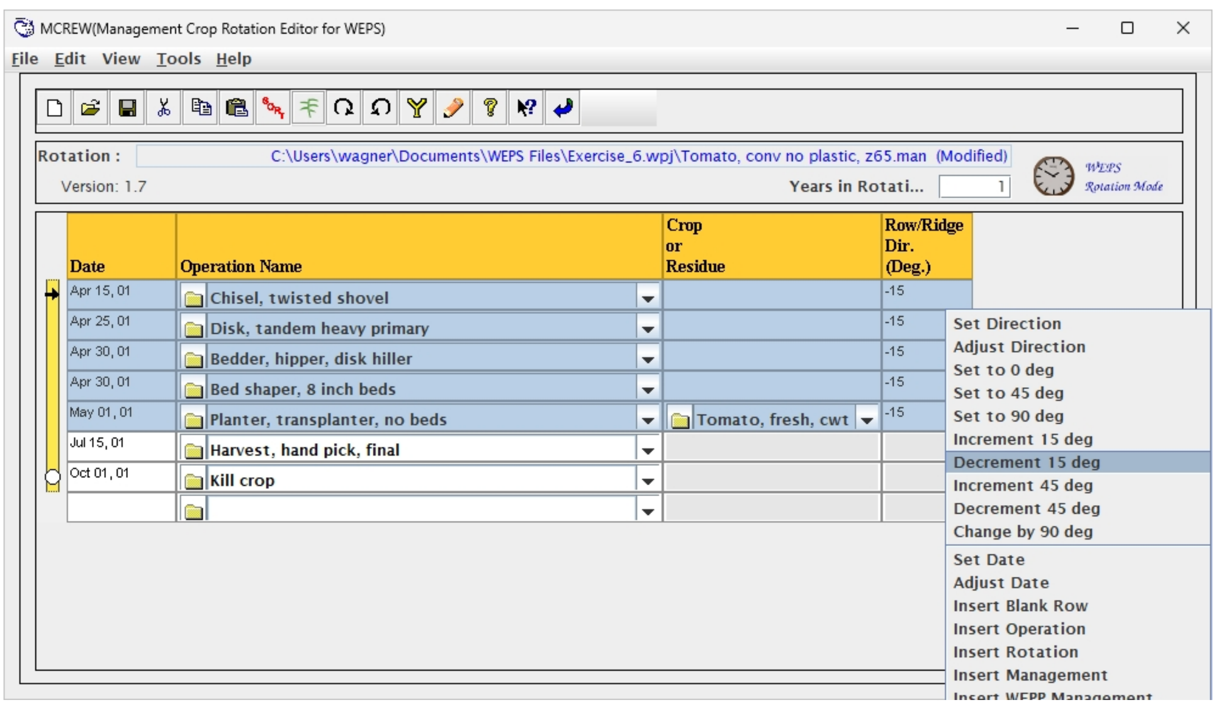



Figure 19.124: Management adjustments for the run.

*Step 3:* Make the run and save it as **Tomato, conv, no plastic, z65**.

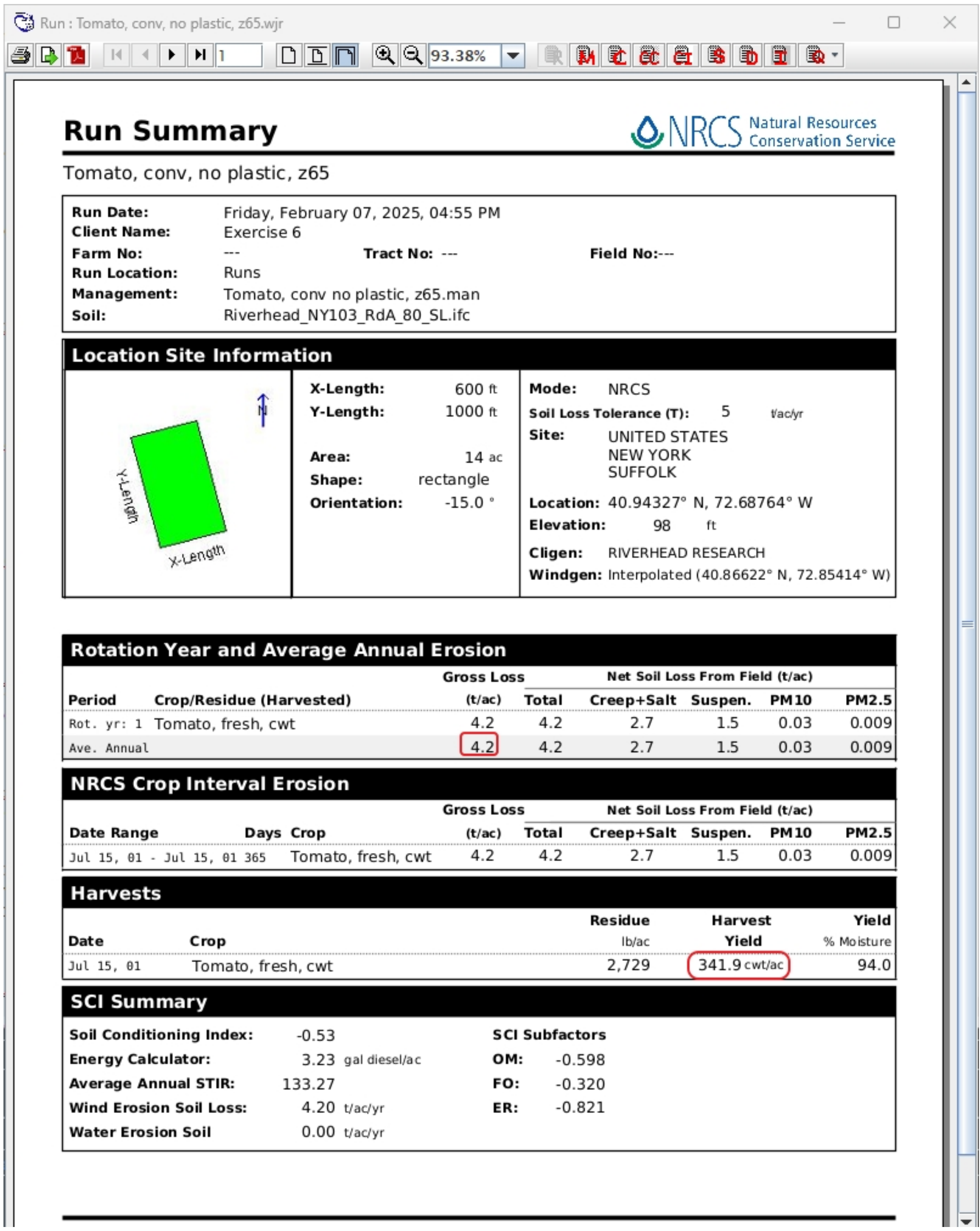
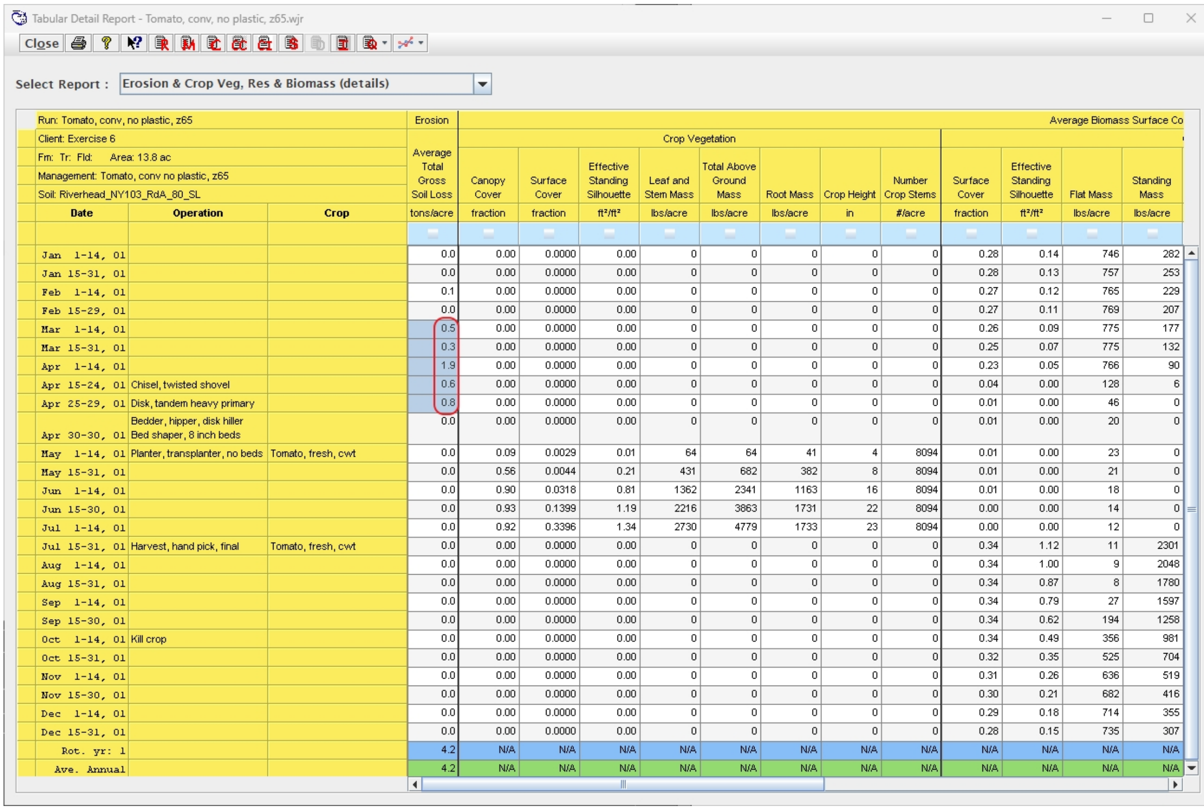



Figure 19.125: Run Summary showing soil loss and yields for the tomato crop.

The yield is close to the expected **300 cwt/ac** at **341.9 cwt/ac** as shown in Fig. 19.125. The average annual gross loss is **4.2 t/ac**. If we look at the Tabular Detail Report though, we will see that most of the erosion occurs before and around planting time (Fig. 19.126). A QuickPlot could also be used to determine when the erosion is occurring such as this *Wind Erosion Soil Loss (Creep+Salt, Susp)* graph (Fig. 19.127) accessible via the QuickPlot's menu on the toolbar of the WEPS main interface or any of the WEPS reports. Regardless, we must protect the young tomatoes better. See the tolerance for tomatoes (see Table 19.2). So, we will test the effect of a rye cover crop.




Run: Tomato, conv, no plastic, z65
Client: Exercise 6
Fm: Tr: Fld: Area: 13.8 ac
Management: Tomato, conv no plastic, z65
Soil: Riverhead_NY103_RdA_80_SL

| | | | Erosion | Crop Vegetation | | | | | | | | | Average Biomass Surface Co | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Date | Operation | Crop | Average Total Gross Soil Loss (tons/acre) | Canopy Cover (fraction) | Surface Cover (fraction) | Effective Standing Silhouette (ft²/ft²) | Leaf and Stem Mass (lbs/acre) | Total Above Ground Mass (lbs/acre) | Root Mass (lbs/acre) | Crop Height (in) | Number Crop Stems (#/acre) | Surface Cover (fraction) | Effective Standing Silhouette (ft²/ft²) | Flat Mass (lbs/acre) | Standing Mass (lbs/acre) |
| Jan 1-14, 01 | | | 0.0 | 0.00 | 0.0000 | 0.00 | 0 | 0 | 0 | 0 | 0 | 0.28 | 0.14 | 746 | 282 |
| Jan 15-31, 01 | | | 0.0 | 0.00 | 0.0000 | 0.00 | 0 | 0 | 0 | 0 | 0 | 0.28 | 0.13 | 757 | 253 |
| Feb 1-14, 01 | | | 0.1 | 0.00 | 0.0000 | 0.00 | 0 | 0 | 0 | 0 | 0 | 0.27 | 0.12 | 765 | 229 |
| Feb 15-29, 01 | | | 0.0 | 0.00 | 0.0000 | 0.00 | 0 | 0 | 0 | 0 | 0 | 0.27 | 0.11 | 769 | 207 |
| Mar 1-14, 01 | | | 0.5 | 0.00 | 0.0000 | 0.00 | 0 | 0 | 0 | 0 | 0 | 0.26 | 0.09 | 775 | 177 |
| Mar 15-31, 01 | | | 0.3 | 0.00 | 0.0000 | 0.00 | 0 | 0 | 0 | 0 | 0 | 0.25 | 0.07 | 775 | 132 |
| Apr 1-14, 01 | | | 1.9 | 0.00 | 0.0000 | 0.00 | 0 | 0 | 0 | 0 | 0 | 0.23 | 0.05 | 766 | 90 |
| Apr 15-24, 01 | Chisel, twisted shovel | | 0.6 | 0.00 | 0.0000 | 0.00 | 0 | 0 | 0 | 0 | 0 | 0.04 | 0.00 | 128 | 6 |
| Apr 25-29, 01 | Disk, tandem heavy primary | | 0.8 | 0.00 | 0.0000 | 0.00 | 0 | 0 | 0 | 0 | 0 | 0.01 | 0.00 | 46 | 0 |
| Apr 30-30, 01 | Bedder, hipper, disk hiller<br>Bed shaper, 8 inch beds | | 0.0 | 0.00 | 0.0000 | 0.00 | 0 | 0 | 0 | 0 | 0 | 0.01 | 0.00 | 20 | 0 |
| May 1-14, 01 | Planter, transplanter, no beds | Tomato, fresh, cwt | 0.0 | 0.09 | 0.0029 | 0.01 | 64 | 64 | 41 | 4 | 8094 | 0.01 | 0.00 | 23 | 0 |
| May 15-31, 01 | | | 0.0 | 0.56 | 0.0044 | 0.21 | 431 | 682 | 382 | 8 | 8094 | 0.01 | 0.00 | 21 | 0 |
| Jun 1-14, 01 | | | 0.0 | 0.90 | 0.0318 | 0.81 | 1362 | 2341 | 1163 | 16 | 8094 | 0.01 | 0.00 | 18 | 0 |
| Jun 15-30, 01 | | | 0.0 | 0.93 | 0.1399 | 1.19 | 2216 | 3863 | 1731 | 22 | 8094 | 0.00 | 0.00 | 14 | 0 |
| Jul 1-14, 01 | | | 0.0 | 0.92 | 0.3396 | 1.34 | 2730 | 4779 | 1733 | 23 | 8094 | 0.00 | 0.00 | 12 | 0 |
| Jul 15-31, 01 | Harvest, hand pick, final | Tomato, fresh, cwt | 0.0 | 0.00 | 0.0000 | 0.00 | 0 | 0 | 0 | 0 | 0 | 0.34 | 1.12 | 11 | 2301 |
| Aug 1-14, 01 | | | 0.0 | 0.00 | 0.0000 | 0.00 | 0 | 0 | 0 | 0 | 0 | 0.34 | 1.00 | 9 | 2048 |
| Aug 15-31, 01 | | | 0.0 | 0.00 | 0.0000 | 0.00 | 0 | 0 | 0 | 0 | 0 | 0.34 | 0.87 | 8 | 1780 |
| Sep 1-14, 01 | | | 0.0 | 0.00 | 0.0000 | 0.00 | 0 | 0 | 0 | 0 | 0 | 0.34 | 0.79 | 27 | 1597 |
| Sep 15-30, 01 | | | 0.0 | 0.00 | 0.0000 | 0.00 | 0 | 0 | 0 | 0 | 0 | 0.34 | 0.62 | 194 | 1258 |
| Oct 1-14, 01 | Kill crop | | 0.0 | 0.00 | 0.0000 | 0.00 | 0 | 0 | 0 | 0 | 0 | 0.34 | 0.49 | 356 | 981 |
| Oct 15-31, 01 | | | 0.0 | 0.00 | 0.0000 | 0.00 | 0 | 0 | 0 | 0 | 0 | 0.32 | 0.35 | 525 | 704 |
| Nov 1-14, 01 | | | 0.0 | 0.00 | 0.0000 | 0.00 | 0 | 0 | 0 | 0 | 0 | 0.31 | 0.26 | 636 | 519 |
| Nov 15-30, 01 | | | 0.0 | 0.00 | 0.0000 | 0.00 | 0 | 0 | 0 | 0 | 0 | 0.30 | 0.21 | 682 | 416 |
| Dec 1-14, 01 | | | 0.0 | 0.00 | 0.0000 | 0.00 | 0 | 0 | 0 | 0 | 0 | 0.29 | 0.18 | 714 | 355 |
| Dec 15-31, 01 | | | 0.0 | 0.00 | 0.0000 | 0.00 | 0 | 0 | 0 | 0 | 0 | 0.28 | 0.15 | 735 | 307 |
| Rot. yr: 1 | | | 4.2 | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| Ave. Annual | | | 4.2 | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |

Figure 19.126: WEPS Tabular Detail Report highlighting when wind erosion occurs.

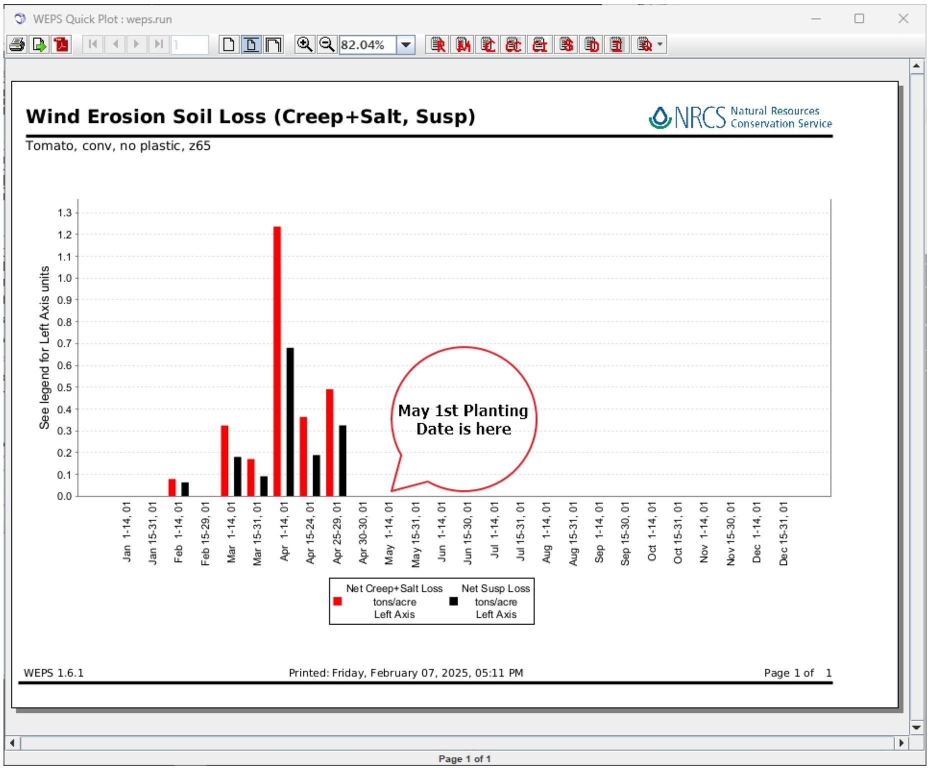



Figure 19.127: WEPS QuickPlot Report highlighting when wind erosion occurs.

Table 19.2: Crop tolerances used by NRCS to design wind erosion control methods (USDA-NRCS, 2000)

| **Tolerant* ”T”** | **Moderate (2 t/ac)** | **Low Tolerance (1 t/ac)** | **Very Low (0-0.5 t/ac)** |
|---|---|---|---|
| Barley | Alfalfa (mature) | Broccoli | Alfalfa (seedlings) |
| Buckwheat | Corn | Cabbage | Asparagus |
| Flax | Onions (> 30 days) | Cotton | Cantaloupe |
| Grain Sorghum | Orchard Crops | Cucumbers | Carrots |
| Millet | Soybeans | Garlic | Celery |
| Oats | Sunflowers | Green/Snap Beans | Eggplant |
| Rye | Sweet Corn | Lima Beans | Flowers |
| Wheat | | Peanuts | Kiwi Fruit |
| | | Peas | Lettuce |
| | | Potatoes | Muskmelons |
| | | Sweet Potatoes | Onion (seedlings) |
| | | Tobacco | Peppers |
| | | | Spinach |
| | | | Squash |
| | | | Strawberries |
| | | | Sugar Beets |
| | | | Table Beets |
| | | | Tomatoes |
| | | | Watermelons |

* USDA-NRCS. 2011. National Agronomy Manual, Part 502-Wind Erosion, 190-V NAM. 4th Edition. Washington, D. C.

### 19.7.4 Adding a Rye Cover Crop after Tomato Harvest

*Step 1:* Make the following adjustments listed here in MCREW as shown in Fig. 19.128.

*Step 1a:* In the MCREW, change the *Kill Crop*[15] (killing frost) operation to **Drill or airseeder, double disk**.

*Step 1b:* Select **Rye, cereal, winter, grain** for the crop to be planted.

*Step 1c:* Change the date to **Aug. 1, 01** for this planting.

*Step 1d:* Now insert a light disk 5 days after harvest (**Disk, tandem light finishing, Jul 20, 01**).

*Step 1e:* Click the Sort icon to arrange the operations in chronological order, if necessary

*Step 1f:* Correct the operation directions to **-15**°.

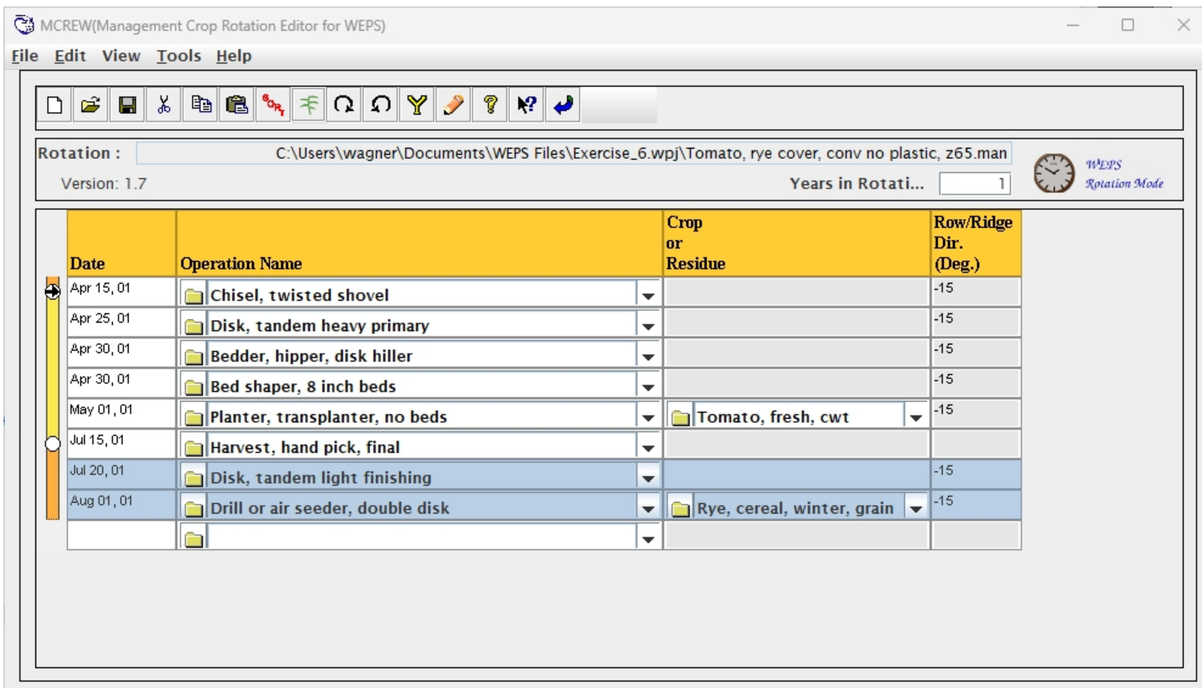



Figure 19.128: MCREW set for the second run.

*Step 1g:* Save the file with a new name by clicking 'File', 'Save as...', and enter **Tomato, rye cover, conv no plastic, z65.man**. Click the Return button.

*Step 2:* Make the run and call it **Tomato, rye cover, conv, no plastic, z65**.

[15]Note that WEPS now automatically kills a crop due to frost, if the crop is expected to terminate under such temperatures. In earlier versions of WEPS, this functionality was not present, So when the rotation was originally created, that was not the case. Therefore, that is likely the reason for its presence in this rotation. Therefore, this operation is technically no longer required to simulate a killing frost condition in WEPS.

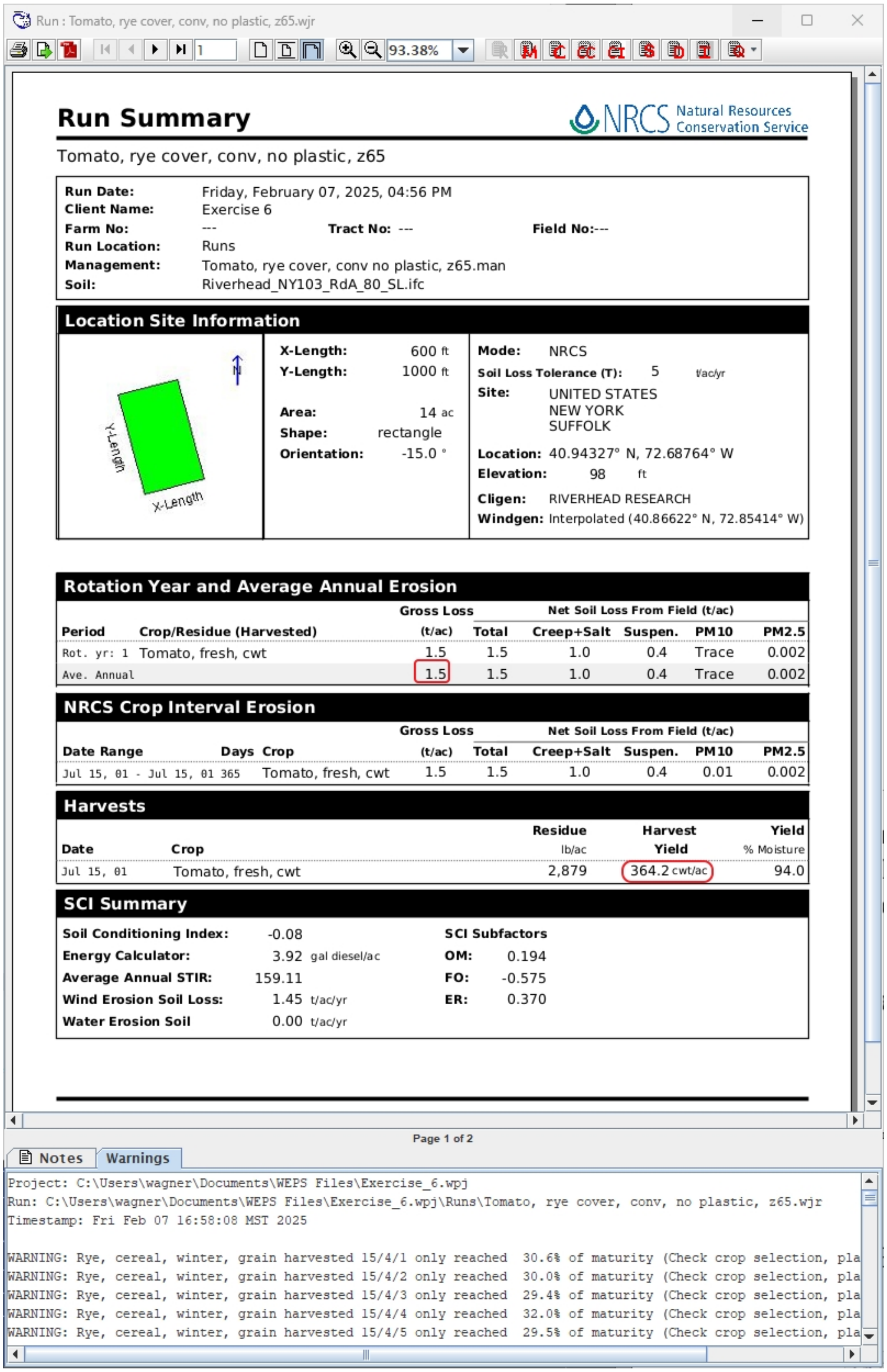
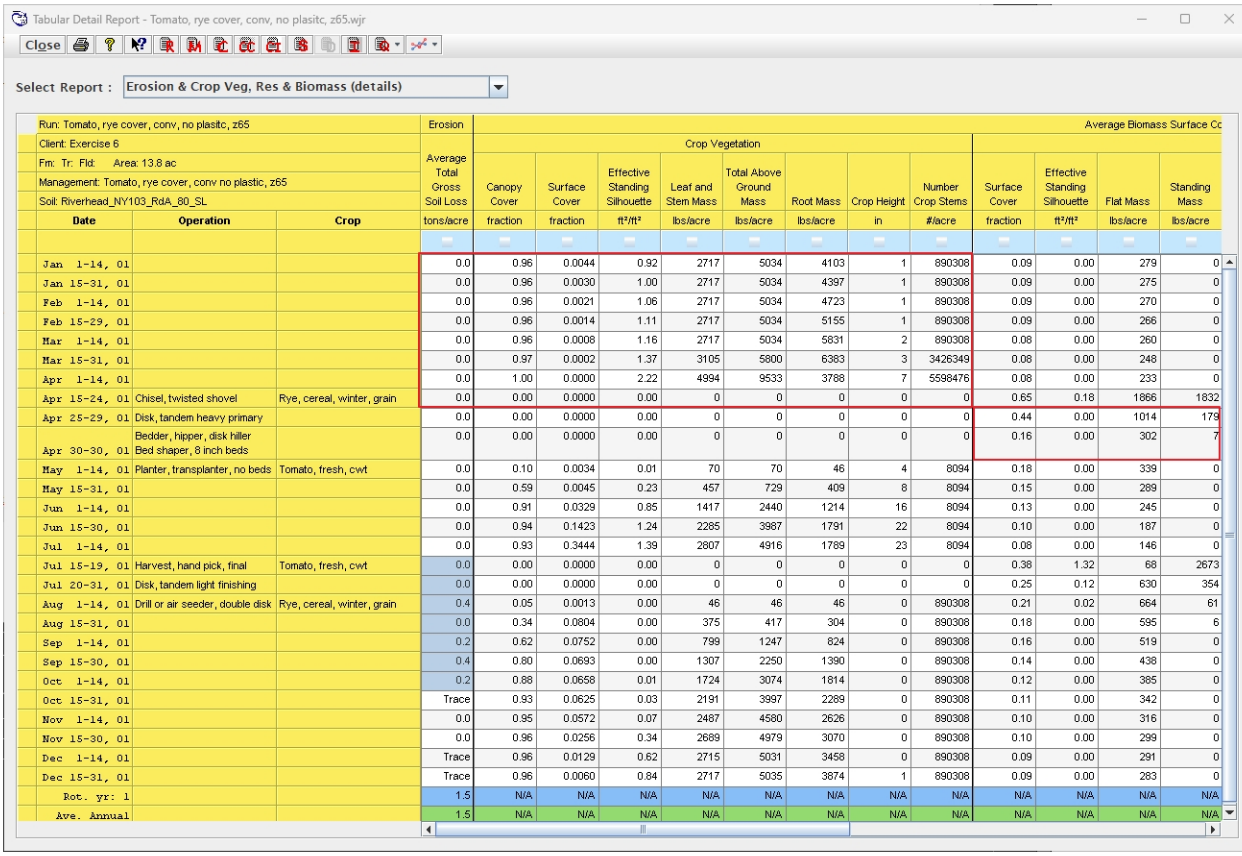



Figure 19.129: Run Summary showing soil loss after adding the rye cover crop.

Soil loss is down to **1.5 t/ac** (Fig. 19.129). This is a reduction well below the soil loss tolerance level.

Harvest yield is a little higher than the target at 300 cwt/ac. In this case, we are now showing no erosion during the early growth of the tomato crop. With a sensitive crop like tomatoes, it may be worthwhile to protect them even more.

Open the Detailed Report to determine which erosion period is the priority.




Run: Tomato, rye cover, conv, no plasitc, z65
Client: Exercise 6
Fm: Tr: Fld: Area: 13.8 ac
Management: Tomato, rye cover, conv no plastic, z65
Soil: Riverhead_NY103_RdA_80_SL

| | | | Erosion | Crop Vegetation | | | | | | | | | Average Biomass Surface Cc | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Date | Operation | Crop | Average Total Gross Soil Loss (tons/acre) | Canopy Cover (fraction) | Surface Cover (fraction) | Effective Standing Silhouette (ft²/ft²) | Leaf and Stem Mass (lbs/acre) | Total Above Ground Mass (lbs/acre) | Root Mass (lbs/acre) | Crop Height (in) | Number Crop Stems (#/acre) | Surface Cover (fraction) | Effective Standing Silhouette (ft²/ft²) | Flat Mass (lbs/acre) | Standing Mass (lbs/acre) |
| Jan 1-14, 01 | | | 0.0 | 0.96 | 0.0044 | 0.92 | 2717 | 5034 | 4103 | 1 | 890308 | 0.09 | 0.00 | 279 | 0 |
| Jan 15-31, 01 | | | 0.0 | 0.96 | 0.0030 | 1.00 | 2717 | 5034 | 4397 | 1 | 890308 | 0.09 | 0.00 | 275 | 0 |
| Feb 1-14, 01 | | | 0.0 | 0.96 | 0.0021 | 1.06 | 2717 | 5034 | 4723 | 1 | 890308 | 0.09 | 0.00 | 270 | 0 |
| Feb 15-29, 01 | | | 0.0 | 0.96 | 0.0014 | 1.11 | 2717 | 5034 | 5155 | 1 | 890308 | 0.09 | 0.00 | 266 | 0 |
| Mar 1-14, 01 | | | 0.0 | 0.96 | 0.0008 | 1.16 | 2717 | 5034 | 5831 | 2 | 890308 | 0.08 | 0.00 | 260 | 0 |
| Mar 15-31, 01 | | | 0.0 | 0.97 | 0.0002 | 1.37 | 3105 | 5800 | 6383 | 3 | 3426349 | 0.08 | 0.00 | 248 | 0 |
| Apr 1-14, 01 | | | 0.0 | 1.00 | 0.0000 | 2.22 | 4994 | 9533 | 3788 | 7 | 5598476 | 0.08 | 0.00 | 233 | 0 |
| Apr 15-24, 01 | Chisel, twisted shovel | Rye, cereal, winter, grain | 0.0 | 0.00 | 0.0000 | 0.00 | 0 | 0 | 0 | 0 | 0 | 0.65 | 0.18 | 1866 | 1832 |
| Apr 25-29, 01 | Disk, tandem heavy primary | | 0.0 | 0.00 | 0.0000 | 0.00 | 0 | 0 | 0 | 0 | 0 | 0.44 | 0.00 | 1014 | 179 |
| Apr 30-30, 01 | Bedder, hipper, disk hiller<br>Bed shaper, 8 inch beds | | 0.0 | 0.00 | 0.0000 | 0.00 | 0 | 0 | 0 | 0 | 0 | 0.16 | 0.00 | 302 | 7 |
| May 1-14, 01 | Planter, transplanter, no beds | Tomato, fresh, cwt | 0.0 | 0.10 | 0.0034 | 0.01 | 70 | 70 | 46 | 4 | 8094 | 0.18 | 0.00 | 339 | 0 |
| May 15-31, 01 | | | 0.0 | 0.59 | 0.0045 | 0.23 | 457 | 729 | 409 | 8 | 8094 | 0.15 | 0.00 | 289 | 0 |
| Jun 1-14, 01 | | | 0.0 | 0.91 | 0.0329 | 0.85 | 1417 | 2440 | 1214 | 16 | 8094 | 0.13 | 0.00 | 245 | 0 |
| Jun 15-30, 01 | | | 0.0 | 0.94 | 0.1423 | 1.24 | 2285 | 3987 | 1791 | 22 | 8094 | 0.10 | 0.00 | 187 | 0 |
| Jul 1-14, 01 | | | 0.0 | 0.93 | 0.3444 | 1.39 | 2807 | 4916 | 1789 | 23 | 8094 | 0.08 | 0.00 | 146 | 0 |
| Jul 15-19, 01 | Harvest, hand pick, final | Tomato, fresh, cwt | 0.0 | 0.00 | 0.0000 | 0.00 | 0 | 0 | 0 | 0 | 0 | 0.38 | 1.32 | 68 | 2673 |
| Jul 20-31, 01 | Disk, tandem light finishing | | 0.0 | 0.00 | 0.0000 | 0.00 | 0 | 0 | 0 | 0 | 0 | 0.25 | 0.12 | 630 | 354 |
| Aug 1-14, 01 | Drill or air seeder, double disk | Rye, cereal, winter, grain | 0.4 | 0.05 | 0.0013 | 0.00 | 46 | 46 | 46 | 0 | 890308 | 0.21 | 0.02 | 664 | 61 |
| Aug 15-31, 01 | | | 0.0 | 0.34 | 0.0804 | 0.00 | 375 | 417 | 304 | 0 | 890308 | 0.18 | 0.00 | 595 | 6 |
| Sep 1-14, 01 | | | 0.2 | 0.62 | 0.0752 | 0.00 | 799 | 1247 | 824 | 0 | 890308 | 0.16 | 0.00 | 519 | 0 |
| Sep 15-30, 01 | | | 0.4 | 0.80 | 0.0693 | 0.00 | 1307 | 2250 | 1390 | 0 | 890308 | 0.14 | 0.00 | 438 | 0 |
| Oct 1-14, 01 | | | 0.2 | 0.88 | 0.0658 | 0.01 | 1724 | 3074 | 1814 | 0 | 890308 | 0.12 | 0.00 | 385 | 0 |
| Oct 15-31, 01 | | | Trace | 0.93 | 0.0625 | 0.03 | 2191 | 3997 | 2289 | 0 | 890308 | 0.11 | 0.00 | 342 | 0 |
| Nov 1-14, 01 | | | 0.0 | 0.95 | 0.0572 | 0.07 | 2487 | 4580 | 2626 | 0 | 890308 | 0.10 | 0.00 | 316 | 0 |
| Nov 15-30, 01 | | | 0.0 | 0.96 | 0.0256 | 0.34 | 2689 | 4979 | 3070 | 0 | 890308 | 0.10 | 0.00 | 299 | 0 |
| Dec 1-14, 01 | | | Trace | 0.96 | 0.0129 | 0.62 | 2715 | 5031 | 3458 | 0 | 890308 | 0.09 | 0.00 | 291 | 0 |
| Dec 15-31, 01 | | | Trace | 0.96 | 0.0060 | 0.84 | 2717 | 5035 | 3874 | 1 | 890308 | 0.09 | 0.00 | 283 | 0 |
| Rot. yr: 1 | | | 1.5 | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| Ave. Annual | | | 1.5 | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |

Figure 19.130: Detailed report with the preeminent erosion period selected.

Although erosion is still occurring in summer and fall, that period is of little concern, because the growing rye is more tolerant of soil loss than tomatoes. May 1-14, 01 is the important time window because there are fragile tomato plants being subjected to soil abrasion (Fig. 19.130). Even though we are showing 0.0 t/ac for that period, the farmer is concerned about using the rye cover crop approach due to potential disease issues. He is interested in looking at additional alternatives that can protect his tomato plants.

## 19.7.5 Adding Plastic Mulch

*Step 1:* Close the reports so that only the WEPS interface remains.

*Step 2:* Open MCREW to view the *Tomato, rye cover, conv no plastic Z65.man* file. Save the file as **Tomato, plastic mulch, conv z65** to rename it.

*Step 3:* Make the following edits in MCREW:

*Step 3a:* Right-click in the operation column on the *May 01, 01*, *Planter, transplanter, no beds* operation. Select *Insert operation*. Select **Plastic mulch applicator 75 percent cover** and set the date to **May 01, 01**.

*Step 3b:* The mulch application requires a Crop or Residue record. Select **plastic or permeable mulch**.

*Step 3c:* Set the angle of tillage to **-15 degrees**. Do not adjust the default amount of 1902.81 lbs/acre under the *Flat Residue Applied (lbs/acre)* column. That is the amount of residue previously determined to simulate the desired effectiveness of the plastic mulch.

*Step 3d:* Replace the *Disk, tandem light finishing* operation on *Jul 20, 01* with **Plastic or permeable weed barrier, remove** the operation by right clicking on the down arrow button. Set the date to **Apr 14, 01**.

*Step 3e:* Change the harvest operation for the tomatoes to **Harvest, vine crops**.

*Step 3f:* Finally Remove the **Drill or air seeder, double** disk operation for the rye.

*Step 4:* Click the Sort icon to arrange the operations in chronological order. The completed management file should appear as in Fig. 19.131.

*Step 5:* Click the blue Return button.

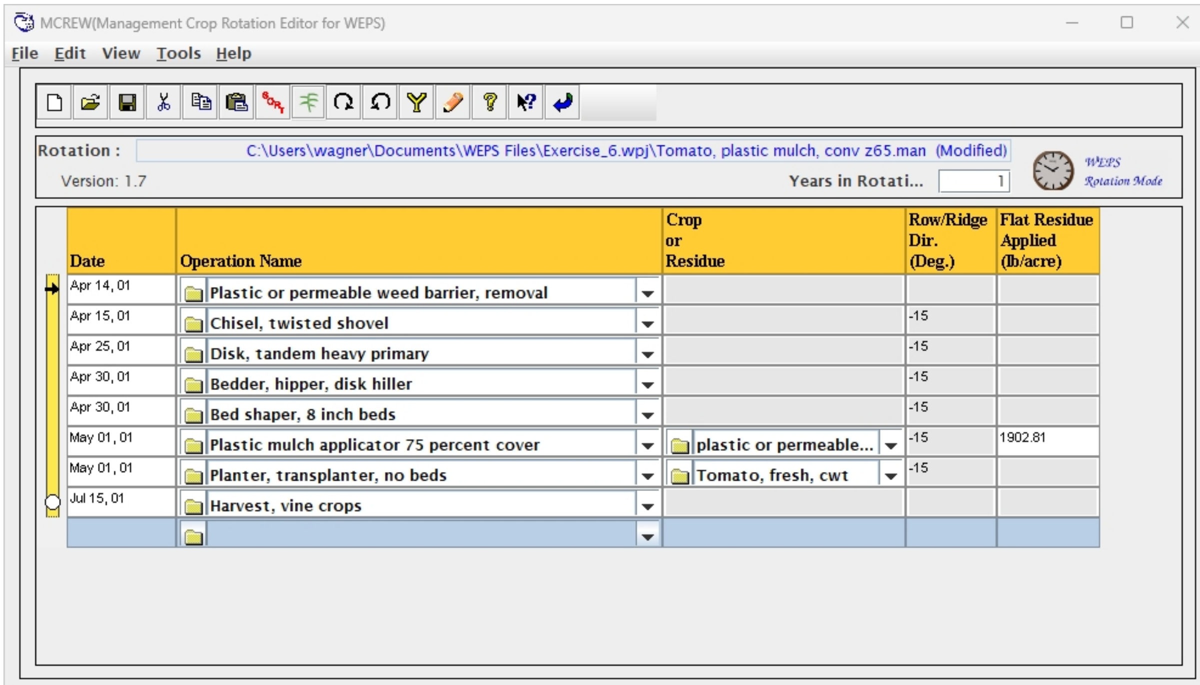
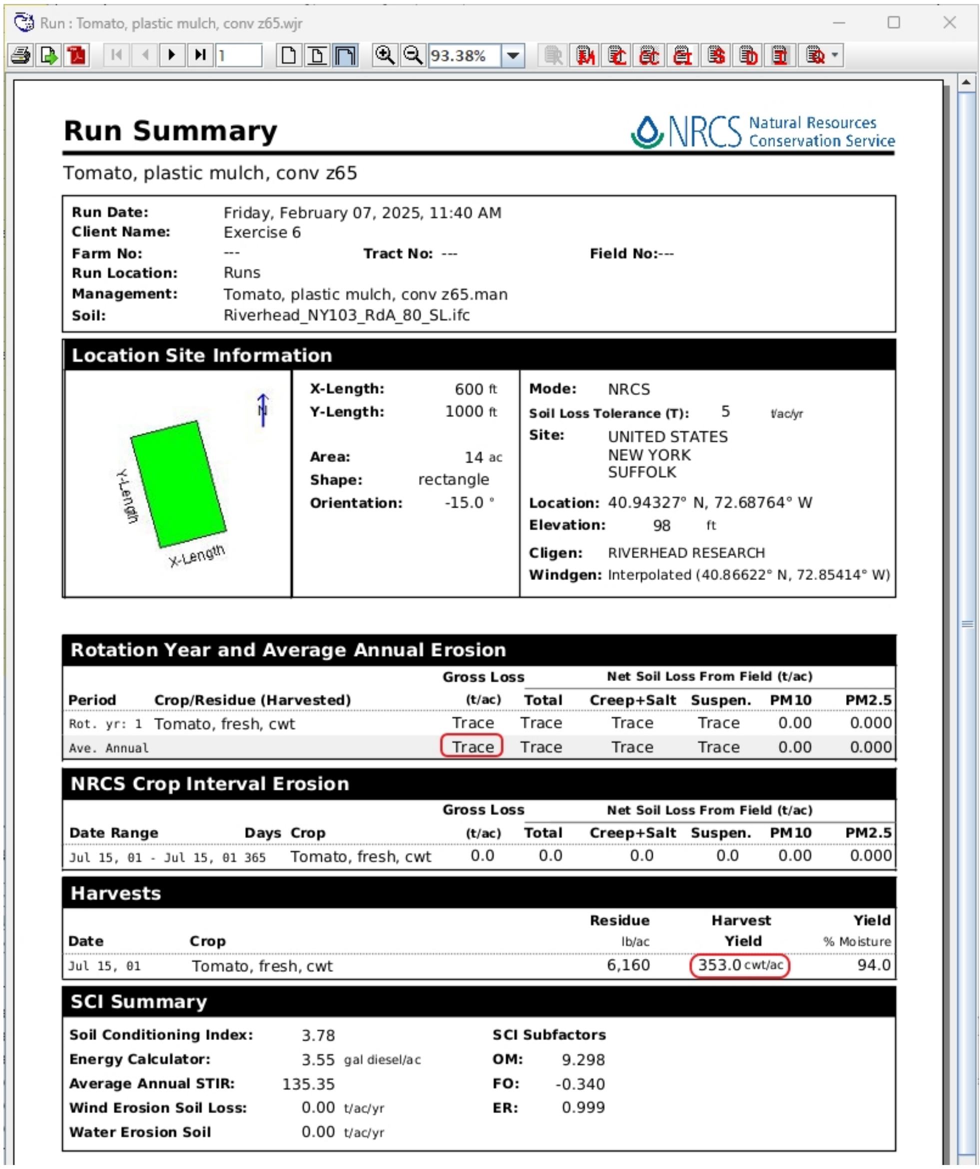



Figure 19.131: Management with plastic mulch added.

*Step 6:* Click Run and save the WEPS Run as **Tomato, plastic mulch, conv z65**.



Run : Tomato, plastic mulch, conv z65.wjr

## Run Summary

NRCS Natural Resources Conservation Service

Tomato, plastic mulch, conv z65

**Run Date:** Friday, February 07, 2025, 11:40 AM
**Client Name:** Exercise 6
**Farm No:** --- **Tract No:** --- **Field No:**---
**Run Location:** Runs
**Management:** Tomato, plastic mulch, conv z65.man
**Soil:** Riverhead_NY103_RdA_80_SL.ifc

### Location Site Information



**X-Length:** 600 ft
**Y-Length:** 1000 ft
**Area:** 14 ac
**Shape:** rectangle
**Orientation:** -15.0 °

**Mode:** NRCS
**Soil Loss Tolerance (T):** 5 t/ac/yr
**Site:** UNITED STATES NEW YORK SUFFOLK
**Location:** 40.94327° N, 72.68764° W
**Elevation:** 98 ft
**Cligen:** RIVERHEAD RESEARCH
**Windgen:** Interpolated (40.86622° N, 72.85414° W)

### Rotation Year and Average Annual Erosion

| Period | Crop/Residue (Harvested) | Gross Loss (t/ac) | Net Soil Loss From Field (t/ac) Total | Creep+Salt | Suspen. | PM10 | PM2.5 |
|---|---|---|---|---|---|---|---|
| Rot. yr: 1 | Tomato, fresh, cwt | Trace | Trace | Trace | Trace | 0.00 | 0.000 |
| Ave. Annual | | Trace | Trace | Trace | Trace | 0.00 | 0.000 |

### NRCS Crop Interval Erosion

| Date Range | Days | Crop | Gross Loss (t/ac) | Net Soil Loss From Field (t/ac) Total | Creep+Salt | Suspen. | PM10 | PM2.5 |
|---|---|---|---|---|---|---|---|---|
| Jul 15, 01 - Jul 15, 01 | 365 | Tomato, fresh, cwt | 0.0 | 0.0 | 0.0 | 0.0 | 0.00 | 0.000 |

### Harvests

| Date | Crop | Residue lb/ac | Harvest Yield | Yield % Moisture |
|---|---|---|---|---|
| Jul 15, 01 | Tomato, fresh, cwt | 6,160 | 353.0 cwt/ac | 94.0 |

### SCI Summary

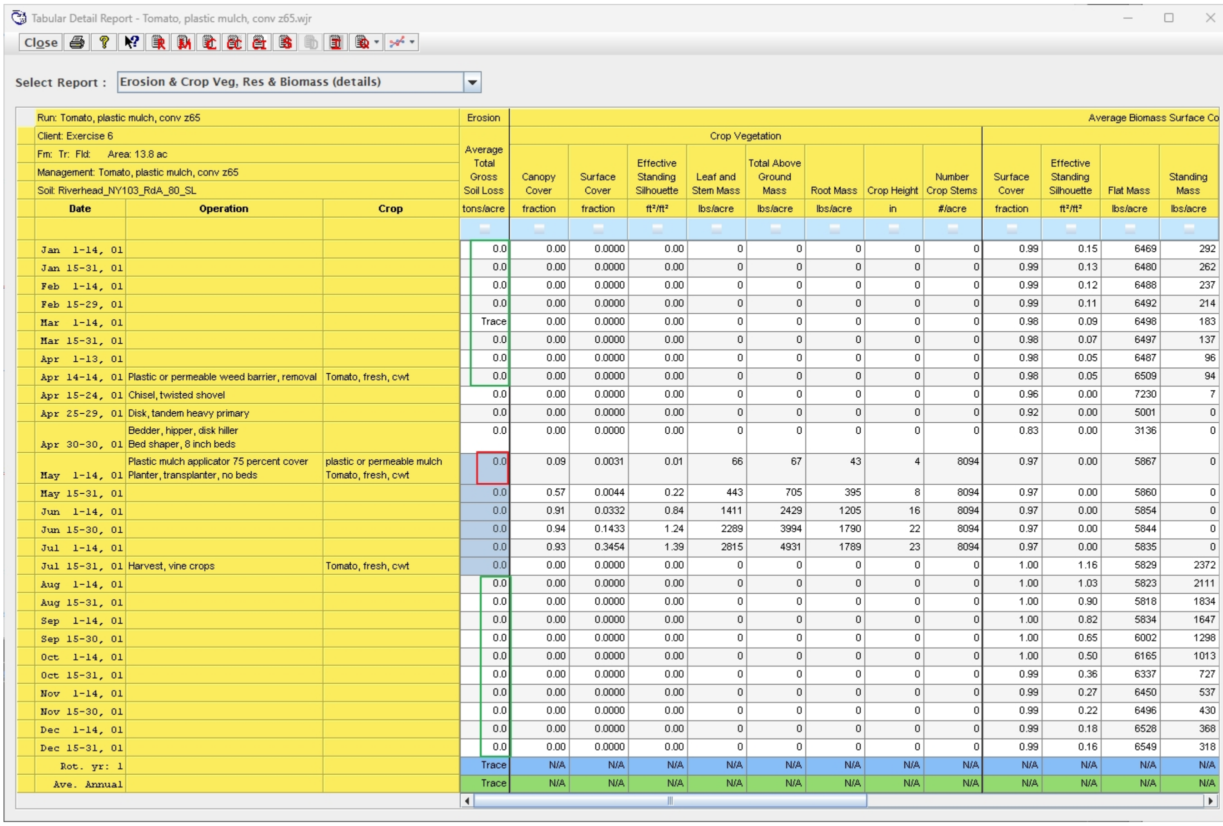
**Soil Conditioning Index:** 3.78
**Energy Calculator:** 3.55 gal diesel/ac
**Average Annual STIR:** 135.35
**Wind Erosion Soil Loss:** 0.00 t/ac/yr
**Water Erosion Soil** 0.00 t/ac/yr

**SCI Subfactors**
**OM:** 9.298
**FO:** -0.340
**ER:** 0.999

Figure 19.132: Run Summary after adding the plastic mulch.

The Run Summary shows similar yield as expected and essentially a zero (Trace) Average Annual Gross Soil Loss (Fig. 19.132). However, the primary concern was specifically about the erosion during tomato planting and growth times which are good.

The Tabular Detailed Report reveals how well the mulch protected both the soil and the tomato plants at the most critical time (May 1-14, 01) (Fig. 19.133). With the plastic mulch in place, no soil is lost to wind erosion. The obvious benefits of the mulch are that the tomatoes are certainly not damaged using the plastic, the yield is similar, and the crop does not have to be replanted.



Tabular Detail Report - Tomato, plastic mulch, conv z65.wjr

Select Report : Erosion & Crop Veg, Res & Biomass (details)

Run: Tomato, plastic mulch, conv z65
Client: Exercise 6
Fm: Tr: Fld: Area: 13.8 ac
Management: Tomato, plastic mulch, conv z65
Soil: Riverhead_NY103_RdA_80_SL

| | | | Erosion | Crop Vegetation | | | | | | | | Average Biomass Surface Co | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Date | Operation | Crop | Average Total Gross Soil Loss (tons/acre) | Canopy Cover (fraction) | Surface Cover (fraction) | Effective Standing Silhouette (ft²/ft²) | Leaf and Stem Mass (lbs/acre) | Total Above Ground Mass (lbs/acre) | Root Mass (lbs/acre) | Crop Height (in) | Number Crop Stems (#/acre) | Surface Cover (fraction) | Effective Standing Silhouette (ft²/ft²) | Flat Mass (lbs/acre) | Standing Mass (lbs/acre) |
| Jan 1-14, 01 | | | 0.0 | 0.00 | 0.0000 | 0.00 | 0 | 0 | 0 | 0 | 0 | 0.99 | 0.15 | 6469 | 292 |
| Jan 15-31, 01 | | | 0.0 | 0.00 | 0.0000 | 0.00 | 0 | 0 | 0 | 0 | 0 | 0.99 | 0.13 | 6480 | 262 |
| Feb 1-14, 01 | | | 0.0 | 0.00 | 0.0000 | 0.00 | 0 | 0 | 0 | 0 | 0 | 0.99 | 0.12 | 6488 | 237 |
| Feb 15-29, 01 | | | 0.0 | 0.00 | 0.0000 | 0.00 | 0 | 0 | 0 | 0 | 0 | 0.99 | 0.11 | 6492 | 214 |
| Mar 1-14, 01 | | | Trace | 0.00 | 0.0000 | 0.00 | 0 | 0 | 0 | 0 | 0 | 0.98 | 0.09 | 6498 | 183 |
| Mar 15-31, 01 | | | 0.0 | 0.00 | 0.0000 | 0.00 | 0 | 0 | 0 | 0 | 0 | 0.98 | 0.07 | 6497 | 137 |
| Apr 1-13, 01 | | | 0.0 | 0.00 | 0.0000 | 0.00 | 0 | 0 | 0 | 0 | 0 | 0.98 | 0.05 | 6487 | 96 |
| Apr 14-14, 01 | Plastic or permeable weed barrier, removal | Tomato, fresh, cwt | 0.0 | 0.00 | 0.0000 | 0.00 | 0 | 0 | 0 | 0 | 0 | 0.98 | 0.05 | 6509 | 94 |
| Apr 15-24, 01 | Chisel, twisted shovel | | 0.0 | 0.00 | 0.0000 | 0.00 | 0 | 0 | 0 | 0 | 0 | 0.96 | 0.00 | 7230 | 7 |
| Apr 25-29, 01 | Disk, tandem heavy primary | | 0.0 | 0.00 | 0.0000 | 0.00 | 0 | 0 | 0 | 0 | 0 | 0.92 | 0.00 | 5001 | 0 |
| Apr 30-30, 01 | Bedder, hipper, disk hiller<br>Bed shaper, 8 inch beds | | 0.0 | 0.00 | 0.0000 | 0.00 | 0 | 0 | 0 | 0 | 0 | 0.83 | 0.00 | 3136 | 0 |
| May 1-14, 01 | Plastic mulch applicator 75 percent cover<br>Planter, transplanter, no beds | plastic or permeable mulch<br>Tomato, fresh, cwt | 0.0 | 0.09 | 0.0031 | 0.01 | 66 | 67 | 43 | 4 | 8094 | 0.97 | 0.00 | 5867 | 0 |
| May 15-31, 01 | | | 0.0 | 0.57 | 0.0044 | 0.22 | 443 | 705 | 395 | 8 | 8094 | 0.97 | 0.00 | 5860 | 0 |
| Jun 1-14, 01 | | | 0.0 | 0.91 | 0.0332 | 0.84 | 1411 | 2429 | 1205 | 16 | 8094 | 0.97 | 0.00 | 5854 | 0 |
| Jun 15-30, 01 | | | 0.0 | 0.94 | 0.1433 | 1.24 | 2289 | 3994 | 1790 | 22 | 8094 | 0.97 | 0.00 | 5844 | 0 |
| Jul 1-14, 01 | | | 0.0 | 0.93 | 0.3454 | 1.39 | 2815 | 4931 | 1789 | 23 | 8094 | 0.97 | 0.00 | 5835 | 0 |
| Jul 15-31, 01 | Harvest, vine crops | Tomato, fresh, cwt | 0.0 | 0.00 | 0.0000 | 0.00 | 0 | 0 | 0 | 0 | 0 | 1.00 | 1.16 | 5829 | 2372 |
| Aug 1-14, 01 | | | 0.0 | 0.00 | 0.0000 | 0.00 | 0 | 0 | 0 | 0 | 0 | 1.00 | 1.03 | 5823 | 2111 |
| Aug 15-31, 01 | | | 0.0 | 0.00 | 0.0000 | 0.00 | 0 | 0 | 0 | 0 | 0 | 1.00 | 0.90 | 5818 | 1834 |
| Sep 1-14, 01 | | | 0.0 | 0.00 | 0.0000 | 0.00 | 0 | 0 | 0 | 0 | 0 | 1.00 | 0.82 | 5834 | 1647 |
| Sep 15-30, 01 | | | 0.0 | 0.00 | 0.0000 | 0.00 | 0 | 0 | 0 | 0 | 0 | 1.00 | 0.65 | 6002 | 1298 |
| Oct 1-14, 01 | | | 0.0 | 0.00 | 0.0000 | 0.00 | 0 | 0 | 0 | 0 | 0 | 1.00 | 0.50 | 6165 | 1013 |
| Oct 15-31, 01 | | | 0.0 | 0.00 | 0.0000 | 0.00 | 0 | 0 | 0 | 0 | 0 | 0.99 | 0.36 | 6337 | 727 |
| Nov 1-14, 01 | | | 0.0 | 0.00 | 0.0000 | 0.00 | 0 | 0 | 0 | 0 | 0 | 0.99 | 0.27 | 6450 | 537 |
| Nov 15-30, 01 | | | 0.0 | 0.00 | 0.0000 | 0.00 | 0 | 0 | 0 | 0 | 0 | 0.99 | 0.22 | 6496 | 430 |
| Dec 1-14, 01 | | | 0.0 | 0.00 | 0.0000 | 0.00 | 0 | 0 | 0 | 0 | 0 | 0.99 | 0.18 | 6528 | 368 |
| Dec 15-31, 01 | | | 0.0 | 0.00 | 0.0000 | 0.00 | 0 | 0 | 0 | 0 | 0 | 0.99 | 0.16 | 6549 | 318 |
| Rot. yr: 1 | | | Trace | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| Ave. Annual | | | Trace | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |

Figure 19.133: Detailed Report showing no loss of soil prior to the time of tomato planting and growth.

## 19.8 Ex 7 – Irrigated Corn Silage: Add Manure and a Winter Forage

### 19.8.1 Skill Building

In this exercise, the user must add each operation independently, without using management templates (i.e., from scratch).

Corn silage is of interest here for being a low residue crop from the wind erosion standpoint because most of the biomass is harvested. There is manure from a dairy to be added, as well as winter wheat, cut for silage in the spring.

### 19.8.2 Scenario

- The dairy is located in **Curry County, New Mexico**, just south of Clovis.
- The approximate location coordinates we will use for the actual field site are: **34.35804º N, 103.26423º W**.
- The soil is an Amarillo loamy fine sand, **Amarillo_NM669_AnB_80_LFS**.
- This field is an irrigated **half circle** on the **west half** of a quarter section of land. It is **62.7 acres** (see WebSoilSurvey map in Fig. 19.134).
- The Cligen station is **PORTALES**.
- The Windgen station is **Interpolated**.
- The producer has a Comprehensive Nutrient Management Plan that requires him to apply **15 t/ac of very dry manure, 25% moisture by weight** (15 tons/ac x 2000 lbs/ton = 30,000 lbs/ac wet wt. or 30,000 lbs/ac x 0.75 = 22,500 lbs/ac on a dry weight basis).
- The option of fall application exists since there is no surface or ground water near the dairy and little rainfall runoff over the winter, but spring application fits the work schedule. A Low Elevation Spray Application (LESA) nozzle package on the pivot can meet the Consumptive Use of both corn and winter forage crops.

| Date | Operation | Crop or Residue | Flat Residue Amount Added (lbs/ac dry wt.) |
|---|---|---|---|
| April 15 | Manure spreader, solid and semi-solid manure, semi-solid | Manure, semi-solid | 22,500 |
| April 15 | Disk, offset, heavy | | |
| April 18 | Cultivator, field 6 - 12 in sweeps | | |
| April 20 | Planter, double disk opener | Corn, silage | |
| April 21 | Irrigation, Start Monitor (pivot,linear,wheelline) | | |
| Sep 1 | Irrigation,Stop Monitor | | |
| Sep 20 | Harvest,silage | | |
| Sep 25 | Disk, tandem heavy primary operation | | |

Table 19.3: System operations for corn silage alone.

The expected wet weight yield for the **corn silage is 23 t/ac** at **65% moisture**. The wet weight for the **winter wheat silage is 7 t/ac** at about **70% moisture** Since WEPS doesn't currently contain a specific winter wheat crop record for silage harvesting, we will use the more generic **Small grain, winter, silage** crop record[16]. The amount of **semi-solid manure residue** added (**22,500 lbs/ac**) contains fairly fine, quickly decomposable organic material. This organic material will have a long-term impact on soil quality.

[16]One could also use the regular **Wheat, winter, grain** crop record, but one would not be able to display the desired harvestable components (and desired units) as being harvested in the WEPS Reports. Also, it would not be easy to correctly calibrate that crop record with the wrong crop component(s) being listed for harvesting, if desired. This is currently a limitation on how WEPS crop records are defined where only one set of harvestable components can be specified within the crop record itself.

| Date | Operation | Crop | Flat Residue Amt Added (lbs/ac) |
|---|---|---|---|
| Mar 1 | Irrigation, Start Monitor (pivot, linear, wheelline) | | |
| Apr 10 | Irrigation, Stop Monitor | | |
| Apr 12 | Harvest, silage | | |
| Oct 3 | Drill or airseeder, double disk | Small grain, winter, silage (Winter Wheat for silage) | |

Table 19.4: Additional operations for the winter wheat silage.

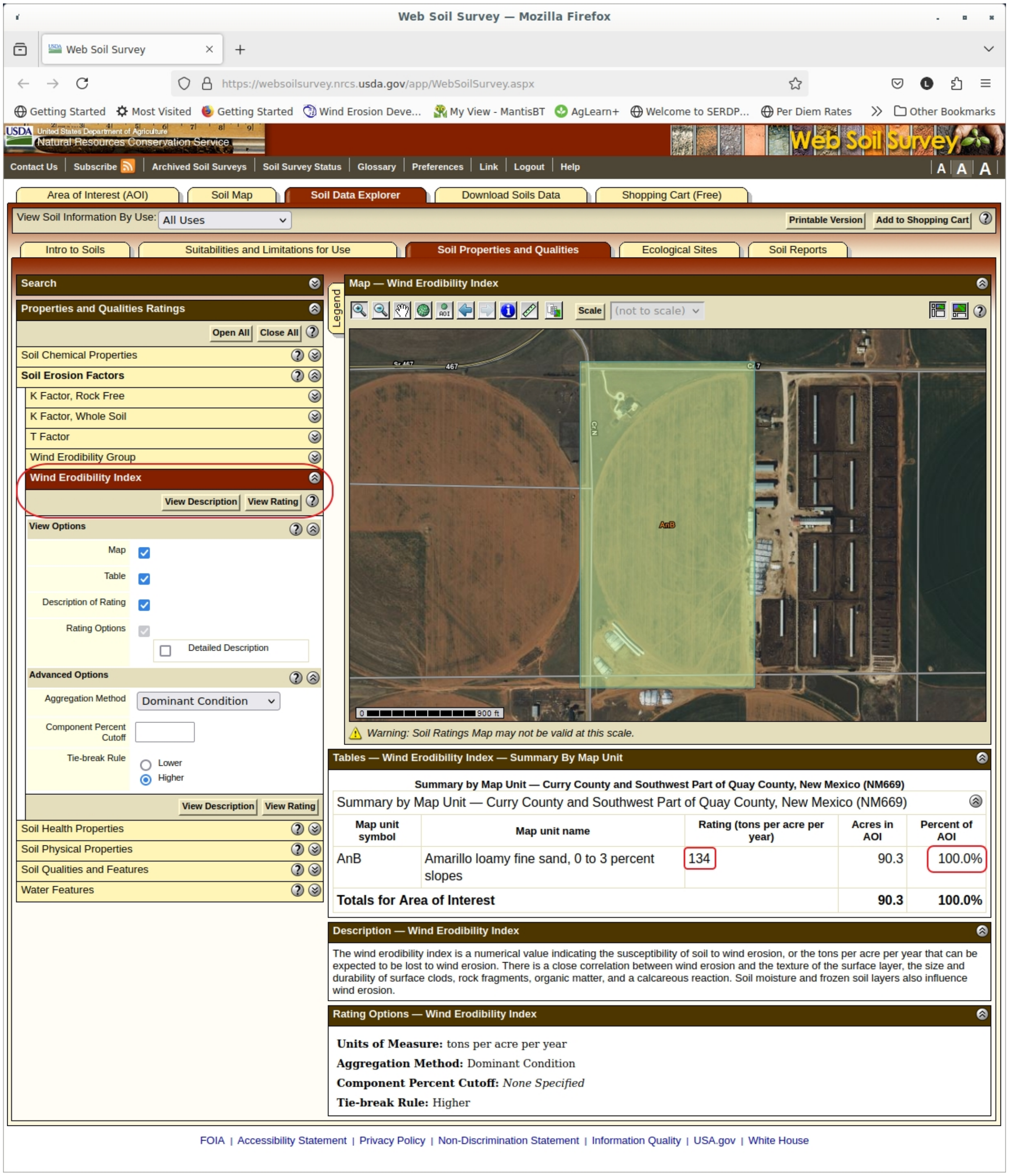



Figure 19.134: WebSoilSurvey Map of the field for Exercise 7 and its Wind Erodibility Index Rating.

### 19.8.3 Make initial run without applying manure

*Step 1:* Enter all the information listed above on the main interface. For the field shape, select the **Half Circle VW** in the Simulation Region panel, indicating the **V**ertical **W**est half of a circle (Fig. 19.135).

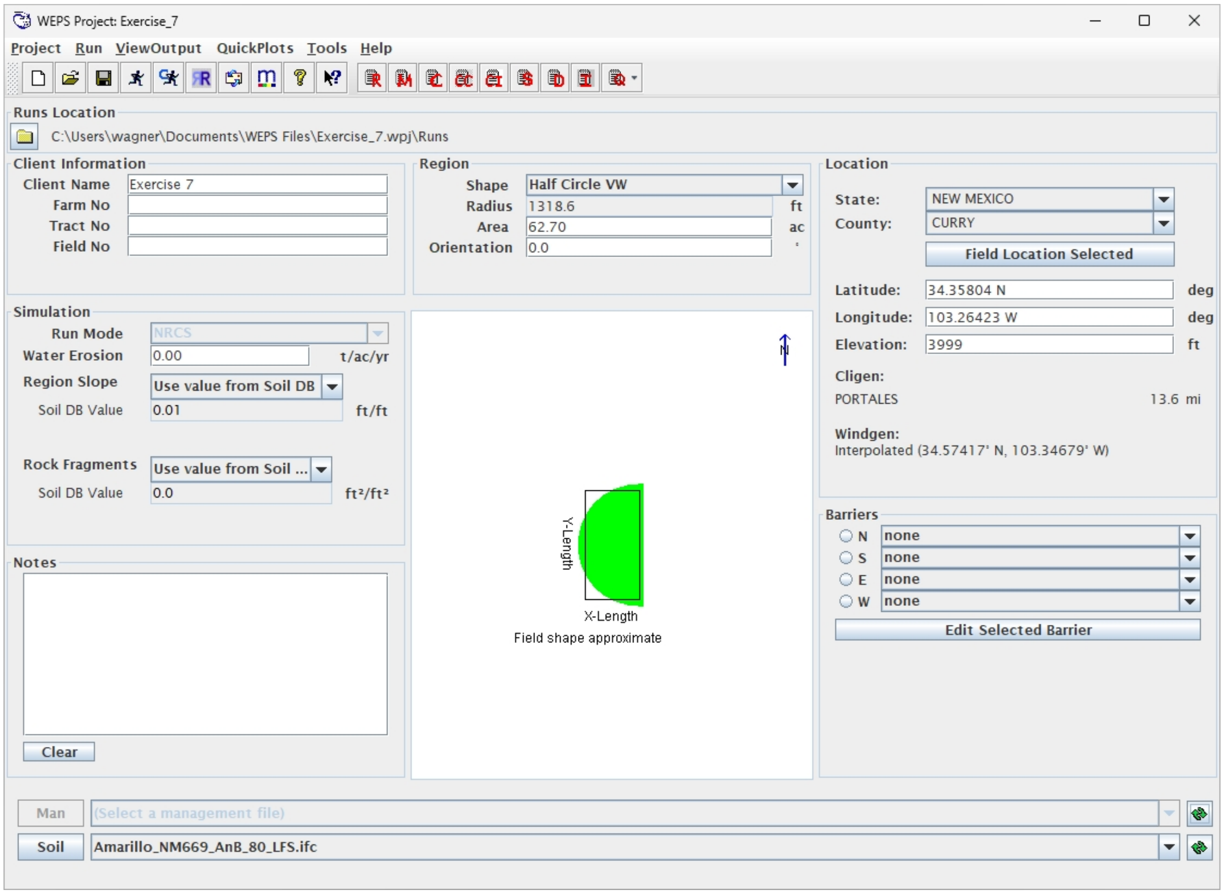



Figure 19.135: WEPS interface ready except for the management.

*Step 2:* Open up the management editor and enter *one at a time* all the operations listed in Table 19.3 except for the April 1 manure spreader (Fig. 19.136). Click **File**, then **Save as...** menu options and call it **Corn, silage, conv, no manure, pivot CMZ19**. Click the Return button  to leave the editor.

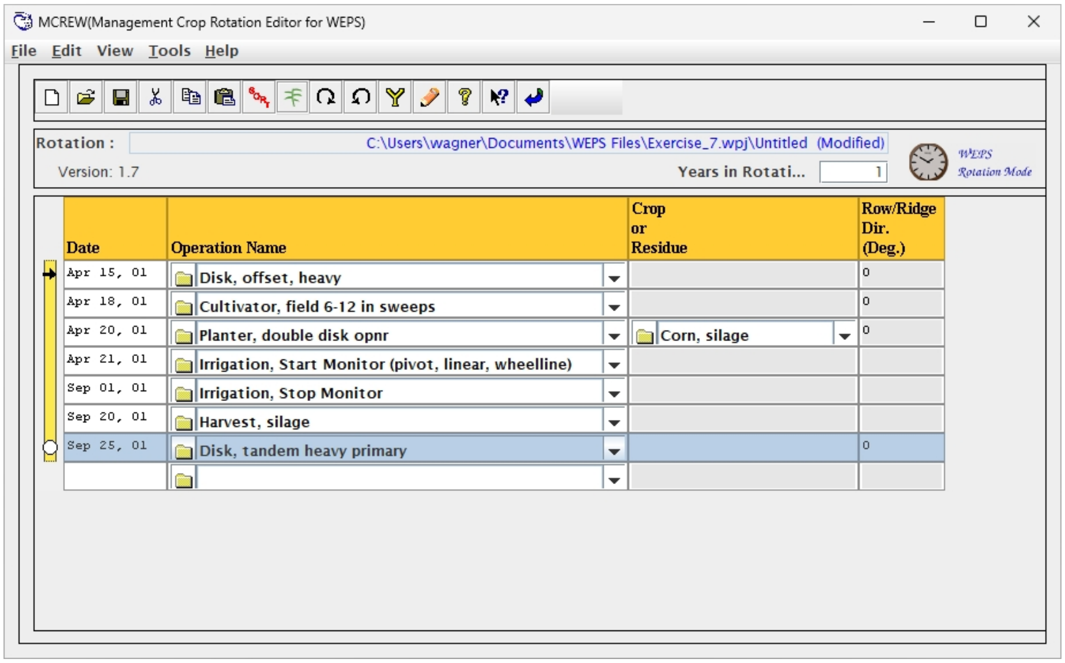
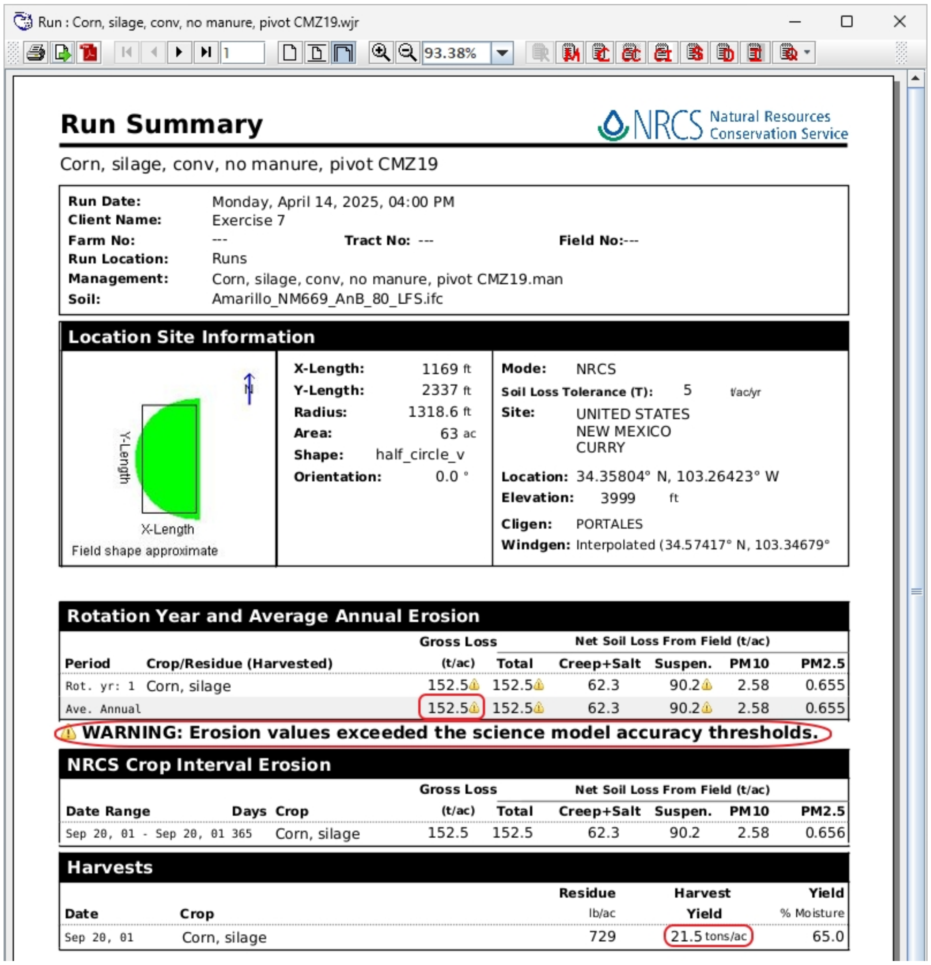



Figure 19.136: Management rotation for ‘Corn, silage, conv, no manure, pivot CMZ19’.

*Step 3:* Click the Run button and name the run after its management file: **Corn, silage, conv, no manure, pivot CMZ19**.



Run : Corn, silage, conv, no manure, pivot CMZ19.wjr

**Run Summary** NRCS Natural Resources Conservation Service

Corn, silage, conv, no manure, pivot CMZ19

**Run Date:** Monday, April 14, 2025, 04:00 PM
**Client Name:** Exercise 7
**Farm No:** --- **Tract No:** --- **Field No:**---
**Run Location:** Runs
**Management:** Corn, silage, conv, no manure, pivot CMZ19.man
**Soil:** Amarillo_NM669_AnB_80_LFS.ifc

**Location Site Information**

Y-Length, X-Length, Field shape approximate

**X-Length:** 1169 ft
**Y-Length:** 2337 ft
**Radius:** 1318.6 ft
**Area:** 63 ac
**Shape:** half_circle_v
**Orientation:** 0.0 °

**Mode:** NRCS
**Soil Loss Tolerance (T):** 5 t/ac/yr
**Site:** UNITED STATES NEW MEXICO CURRY
**Location:** 34.35804° N, 103.26423° W
**Elevation:** 3999 ft
**Cligen:** PORTALES
**Windgen:** Interpolated (34.57417° N, 103.34679°

**Rotation Year and Average Annual Erosion**

| Period | Crop/Residue (Harvested) | Gross Loss (t/ac) | Net Soil Loss From Field (t/ac) Total | Creep+Salt | Suspen. | PM10 | PM2.5 |
|---|---|---|---|---|---|---|---|
| Rot. yr: 1 | Corn, silage | 152.5 | 152.5 | 62.3 | 90.2 | 2.58 | 0.655 |
| Ave. Annual | | 152.5 | 152.5 | 62.3 | 90.2 | 2.58 | 0.655 |

WARNING: Erosion values exceeded the science model accuracy thresholds.

**NRCS Crop Interval Erosion**

| Date Range | Days | Crop | Gross Loss (t/ac) | Net Soil Loss From Field (t/ac) Total | Creep+Salt | Suspen. | PM10 | PM2.5 |
|---|---|---|---|---|---|---|---|---|
| Sep 20, 01 - Sep 20, 01 | 365 | Corn, silage | 152.5 | 152.5 | 62.3 | 90.2 | 2.58 | 0.656 |

**Harvests**

| Date | Crop | Residue lb/ac | Harvest Yield | Yield % Moisture |
|---|---|---|---|---|
| Sep 20, 01 | Corn, silage | 729 | 21.5 tons/ac | 65.0 |

Figure 19.137: Run Summary for “Corn, silage, conv, no manure, pivot, CMZ19”.

**Question:** What is the yield of silage?

**Answer:** **21.5 t/ac** (Fig. 19.137). This is close enough to the 23 t/ac expected.

**Question:** How much soil loss was calculated?

**Answer:** An excessive **152.5 t/ac** (Fig. 19.137).

### 19.8.4 Add manure in the Spring

*Step 1:* Open MCREW.

*Step 1a:* Open up a blank row at the top of the table by right-clicking in the *Operation Column* and selecting the *Insert Blank Row* menu option.

*Step 1b:* Clicking on the down arrow icon in the blank row’s *Operation Name* column, insert the **Manure spreader, solid and simi-solid** operation as shown in Table 19.3.

*Step 1c:* Set the date for this operation for **April 15, 01**.

*Step 1d:* Now in the *Crop or Residue* column, select **manure, semi-solid** residue (under the *CRLMOD Residues* subfolder).

*Step 1e:* Move to the *Total Manure Applied* column and type in the **22,500** lbs/ac manure applied in the spring (Fig. 19.138).

*Step 2:* Now, click *File*, then *Save As...* menu options and save the file as **Corn, silage, conv, spring manure, pivot CMZ19**.

*Step 3:* Finally, click Return to close MCREW and view the main interface.

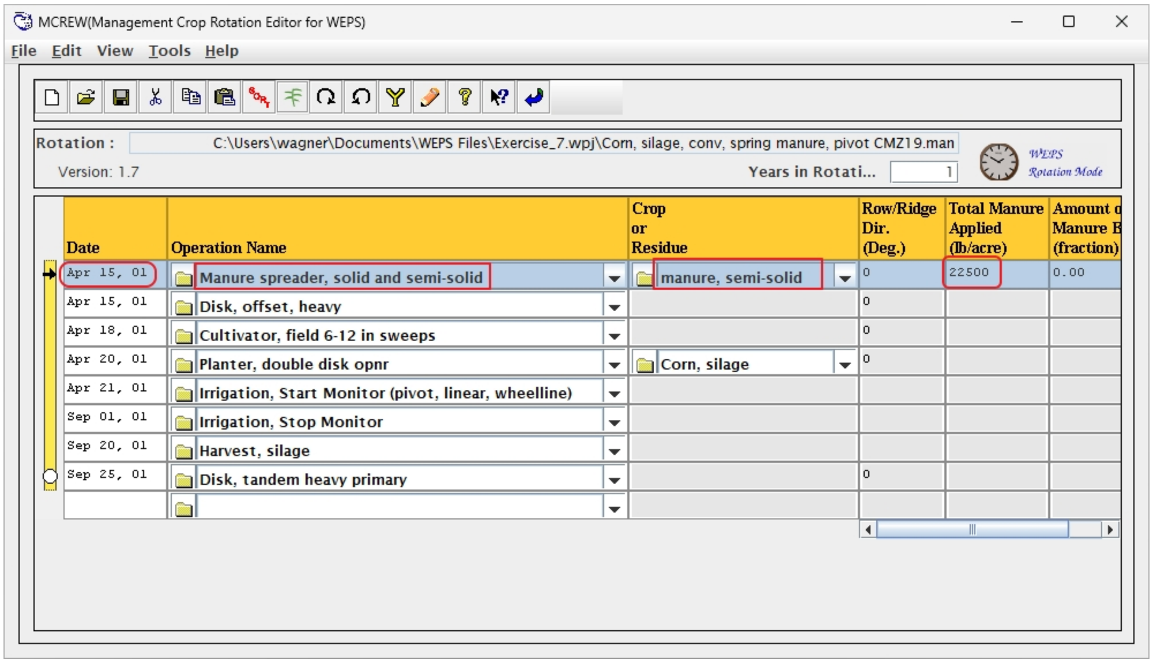
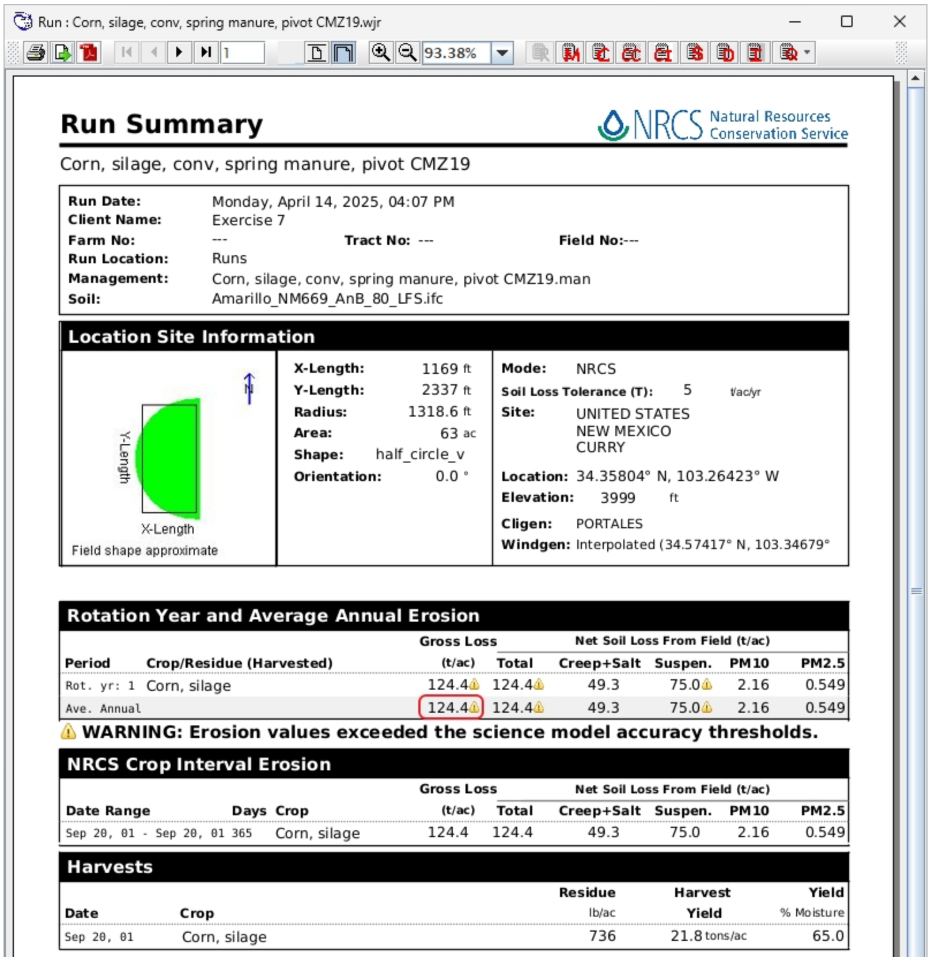



Figure 19.138: The management rotation for 'Corn, silage, conv, spring manure, pivot, CMZ19'.

*Step 4:* Click the Run button on the main toolbar to make the run. Call it **Corn, silage, conv, spring manure, pivot CMZ19.**



Run : Corn, silage, conv, spring manure, pivot CMZ19.wjr

## Run Summary

NRCS Natural Resources Conservation Service

Corn, silage, conv, spring manure, pivot CMZ19

**Run Date:** Monday, April 14, 2025, 04:07 PM
**Client Name:** Exercise 7
**Farm No:** --- **Tract No:** --- **Field No:**---
**Run Location:** Runs
**Management:** Corn, silage, conv, spring manure, pivot CMZ19.man
**Soil:** Amarillo_NM669_AnB_80_LFS.ifc

**Location Site Information**

Y-Length
X-Length
Field shape approximate

**X-Length:** 1169 ft
**Y-Length:** 2337 ft
**Radius:** 1318.6 ft
**Area:** 63 ac
**Shape:** half_circle_v
**Orientation:** 0.0 °

**Mode:** NRCS
**Soil Loss Tolerance (T):** 5 t/ac/yr
**Site:** UNITED STATES NEW MEXICO CURRY
**Location:** 34.35804° N, 103.26423° W
**Elevation:** 3999 ft
**Cligen:** PORTALES
**Windgen:** Interpolated (34.57417° N, 103.34679°

**Rotation Year and Average Annual Erosion**

| Period | Crop/Residue (Harvested) | Gross Loss (t/ac) | Net Soil Loss From Field (t/ac) Total | Creep+Salt | Suspen. | PM10 | PM2.5 |
|---|---|---|---|---|---|---|---|
| Rot. yr: 1 | Corn, silage | 124.4⚠ | 124.4⚠ | 49.3 | 75.0⚠ | 2.16 | 0.549 |
| Ave. Annual | | 124.4⚠ | 124.4⚠ | 49.3 | 75.0⚠ | 2.16 | 0.549 |

⚠ **WARNING: Erosion values exceeded the science model accuracy thresholds.**

**NRCS Crop Interval Erosion**

| Date Range | Days | Crop | Gross Loss (t/ac) | Net Soil Loss From Field (t/ac) Total | Creep+Salt | Suspen. | PM10 | PM2.5 |
|---|---|---|---|---|---|---|---|---|
| Sep 20, 01 - Sep 20, 01 | 365 | Corn, silage | 124.4 | 124.4 | 49.3 | 75.0 | 2.16 | 0.549 |

**Harvests**

| Date | Crop | Residue lb/ac | Harvest Yield | Yield % Moisture |
|---|---|---|---|---|
| Sep 20, 01 | Corn, silage | 736 | 21.8 tons/ac | 65.0 |

Figure 19.139: Run Summary for 'Corn, silage, conv, spring manure, pivot CMZ19'.

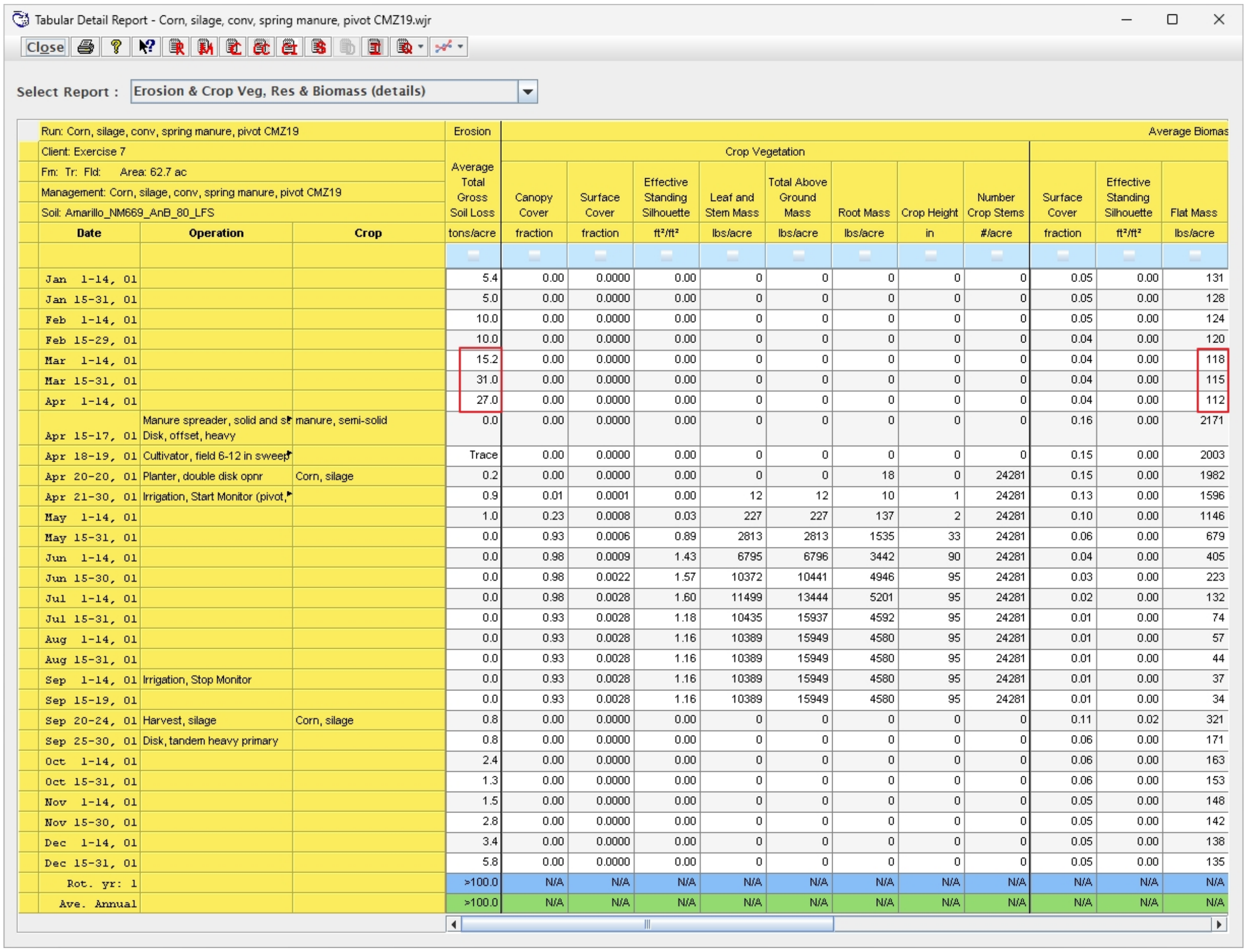
**Question:** What is the soil loss with the manure applied in the spring and tilled in?

**Answer:** **124.4 t/ac** (Fig. 19.139). This is a nice reduction from 152.5 tons per acre, but still far in excess of the Soil Loss Tolerance (5 t/ac/yr).

Open the Detailed Report.

**Question:** When and where are the high erosion trouble spots?

**Answer:** March and April are the worst months with 73.2 tons of soil per acre blown away before the manure is applied. March and April also has little *Flat Mass* available at approximately 115 lbs/ac (Fig. 19.140).




| | | | Erosion | Crop Vegetation | | | | | | | | Average Biomas | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Date | Operation | Crop | Average Total Gross Soil Loss | Canopy Cover | Surface Cover | Effective Standing Silhouette | Leaf and Stem Mass | Total Above Ground Mass | Root Mass | Crop Height | Number Crop Stems | Surface Cover | Effective Standing Silhouette | Flat Mass |
| | | | tons/acre | fraction | fraction | ft²/ft² | lbs/acre | lbs/acre | lbs/acre | in | #/acre | fraction | ft²/ft² | lbs/acre |
| Jan 1-14, 01 | | | 5.4 | 0.00 | 0.0000 | 0.00 | 0 | 0 | 0 | 0 | 0 | 0.05 | 0.00 | 131 |
| Jan 15-31, 01 | | | 5.0 | 0.00 | 0.0000 | 0.00 | 0 | 0 | 0 | 0 | 0 | 0.05 | 0.00 | 128 |
| Feb 1-14, 01 | | | 10.0 | 0.00 | 0.0000 | 0.00 | 0 | 0 | 0 | 0 | 0 | 0.05 | 0.00 | 124 |
| Feb 15-29, 01 | | | 10.0 | 0.00 | 0.0000 | 0.00 | 0 | 0 | 0 | 0 | 0 | 0.04 | 0.00 | 120 |
| Mar 1-14, 01 | | | 15.2 | 0.00 | 0.0000 | 0.00 | 0 | 0 | 0 | 0 | 0 | 0.04 | 0.00 | 118 |
| Mar 15-31, 01 | | | 31.0 | 0.00 | 0.0000 | 0.00 | 0 | 0 | 0 | 0 | 0 | 0.04 | 0.00 | 115 |
| Apr 1-14, 01 | | | 27.0 | 0.00 | 0.0000 | 0.00 | 0 | 0 | 0 | 0 | 0 | 0.04 | 0.00 | 112 |
| Apr 15-17, 01 | Manure spreader, solid and s<br>Disk, offset, heavy | manure, semi-solid | 0.0 | 0.00 | 0.0000 | 0.00 | 0 | 0 | 0 | 0 | 0 | 0.16 | 0.00 | 2171 |
| Apr 18-19, 01 | Cultivator, field 6-12 in sweep | | Trace | 0.00 | 0.0000 | 0.00 | 0 | 0 | 0 | 0 | 0 | 0.15 | 0.00 | 2003 |
| Apr 20-20, 01 | Planter, double disk opnr | Corn, silage | 0.2 | 0.00 | 0.0000 | 0.00 | 0 | 0 | 18 | 0 | 24281 | 0.15 | 0.00 | 1982 |
| Apr 21-30, 01 | Irrigation, Start Monitor (pivot, | | 0.9 | 0.01 | 0.0001 | 0.00 | 12 | 12 | 10 | 1 | 24281 | 0.13 | 0.00 | 1596 |
| May 1-14, 01 | | | 1.0 | 0.23 | 0.0008 | 0.03 | 227 | 227 | 137 | 2 | 24281 | 0.10 | 0.00 | 1146 |
| May 15-31, 01 | | | 0.0 | 0.93 | 0.0006 | 0.89 | 2813 | 2813 | 1535 | 33 | 24281 | 0.06 | 0.00 | 679 |
| Jun 1-14, 01 | | | 0.0 | 0.98 | 0.0009 | 1.43 | 6795 | 6796 | 3442 | 90 | 24281 | 0.04 | 0.00 | 405 |
| Jun 15-30, 01 | | | 0.0 | 0.98 | 0.0022 | 1.57 | 10372 | 10441 | 4946 | 95 | 24281 | 0.03 | 0.00 | 223 |
| Jul 1-14, 01 | | | 0.0 | 0.98 | 0.0028 | 1.60 | 11499 | 13444 | 5201 | 95 | 24281 | 0.02 | 0.00 | 132 |
| Jul 15-31, 01 | | | 0.0 | 0.93 | 0.0028 | 1.18 | 10435 | 15937 | 4592 | 95 | 24281 | 0.01 | 0.00 | 74 |
| Aug 1-14, 01 | | | 0.0 | 0.93 | 0.0028 | 1.16 | 10389 | 15949 | 4580 | 95 | 24281 | 0.01 | 0.00 | 57 |
| Aug 15-31, 01 | | | 0.0 | 0.93 | 0.0028 | 1.16 | 10389 | 15949 | 4580 | 95 | 24281 | 0.01 | 0.00 | 44 |
| Sep 1-14, 01 | Irrigation, Stop Monitor | | 0.0 | 0.93 | 0.0028 | 1.16 | 10389 | 15949 | 4580 | 95 | 24281 | 0.01 | 0.00 | 37 |
| Sep 15-19, 01 | | | 0.0 | 0.93 | 0.0028 | 1.16 | 10389 | 15949 | 4580 | 95 | 24281 | 0.01 | 0.00 | 34 |
| Sep 20-24, 01 | Harvest, silage | Corn, silage | 0.8 | 0.00 | 0.0000 | 0.00 | 0 | 0 | 0 | 0 | 0 | 0.11 | 0.02 | 321 |
| Sep 25-30, 01 | Disk, tandem heavy primary | | 0.8 | 0.00 | 0.0000 | 0.00 | 0 | 0 | 0 | 0 | 0 | 0.06 | 0.00 | 171 |
| Oct 1-14, 01 | | | 2.4 | 0.00 | 0.0000 | 0.00 | 0 | 0 | 0 | 0 | 0 | 0.06 | 0.00 | 163 |
| Oct 15-31, 01 | | | 1.3 | 0.00 | 0.0000 | 0.00 | 0 | 0 | 0 | 0 | 0 | 0.06 | 0.00 | 153 |
| Nov 1-14, 01 | | | 1.5 | 0.00 | 0.0000 | 0.00 | 0 | 0 | 0 | 0 | 0 | 0.05 | 0.00 | 148 |
| Nov 15-30, 01 | | | 2.8 | 0.00 | 0.0000 | 0.00 | 0 | 0 | 0 | 0 | 0 | 0.05 | 0.00 | 142 |
| Dec 1-14, 01 | | | 3.4 | 0.00 | 0.0000 | 0.00 | 0 | 0 | 0 | 0 | 0 | 0.05 | 0.00 | 138 |
| Dec 15-31, 01 | | | 5.8 | 0.00 | 0.0000 | 0.00 | 0 | 0 | 0 | 0 | 0 | 0.05 | 0.00 | 135 |
| Rot. yr: 1 | | | >100.0 | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| Ave. Annual | | | >100.0 | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |

Figure 19.140: Detailed Report showing soil loss and flat mass in the months of March and April.

### 19.8.5 Adding the Winter Wheat Forage Crop

*Step 1:* Close all reports and reopen the management editor. Add the additional operations for the winter wheat silage listed in to the existing system (Table 19.4 and Fig. 19.141). These can be added to the end of the run and arranged afterward by clicking the Sort button . Then you have them entered and sorted, then click 'File', 'Save as...', and enter the management name as **Corn, silage-WWheat, silage, conv, spring manure, pivot CMZ19**. Close MCREW and return to the main interface.

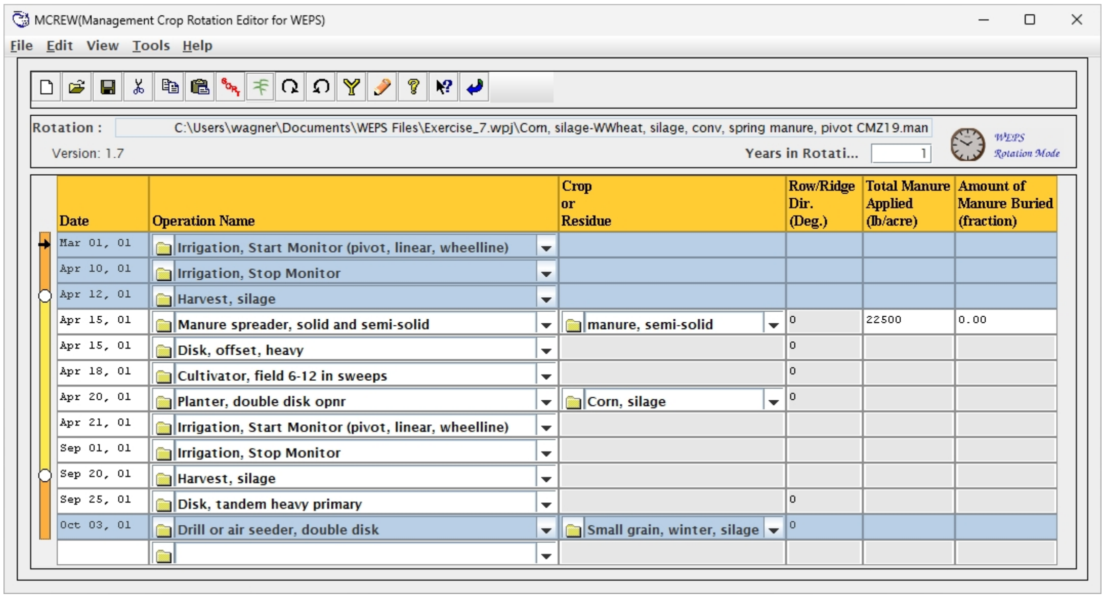



Figure 19.141: MCREW showing winter wheat operations.

*Step 2:* Run the management and call it **Corn, silage-WWheat, silage, conv, spring manure, pivot CMZ19.**

At the end of the run, some warnings are generated (Fig. 19.142). These warnings tell you that the winter wheat did not reach maturity. This is because, as silage, it was harvested before its growth cycle was finished. Close the warning to view the Run Summary.

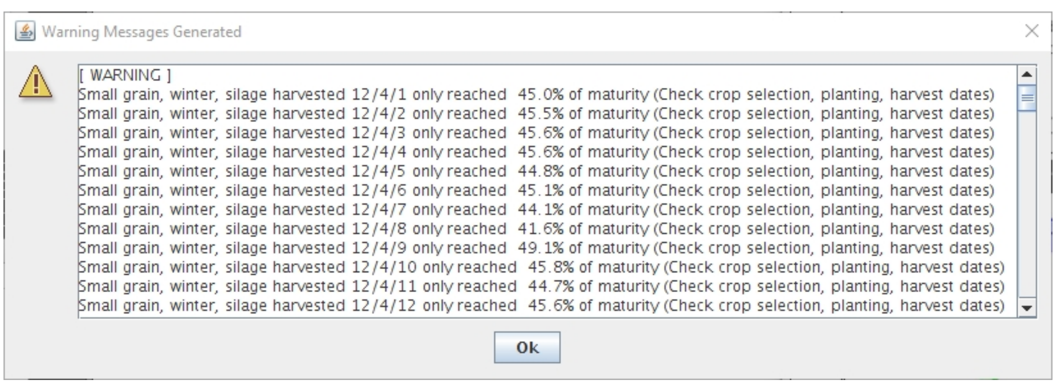
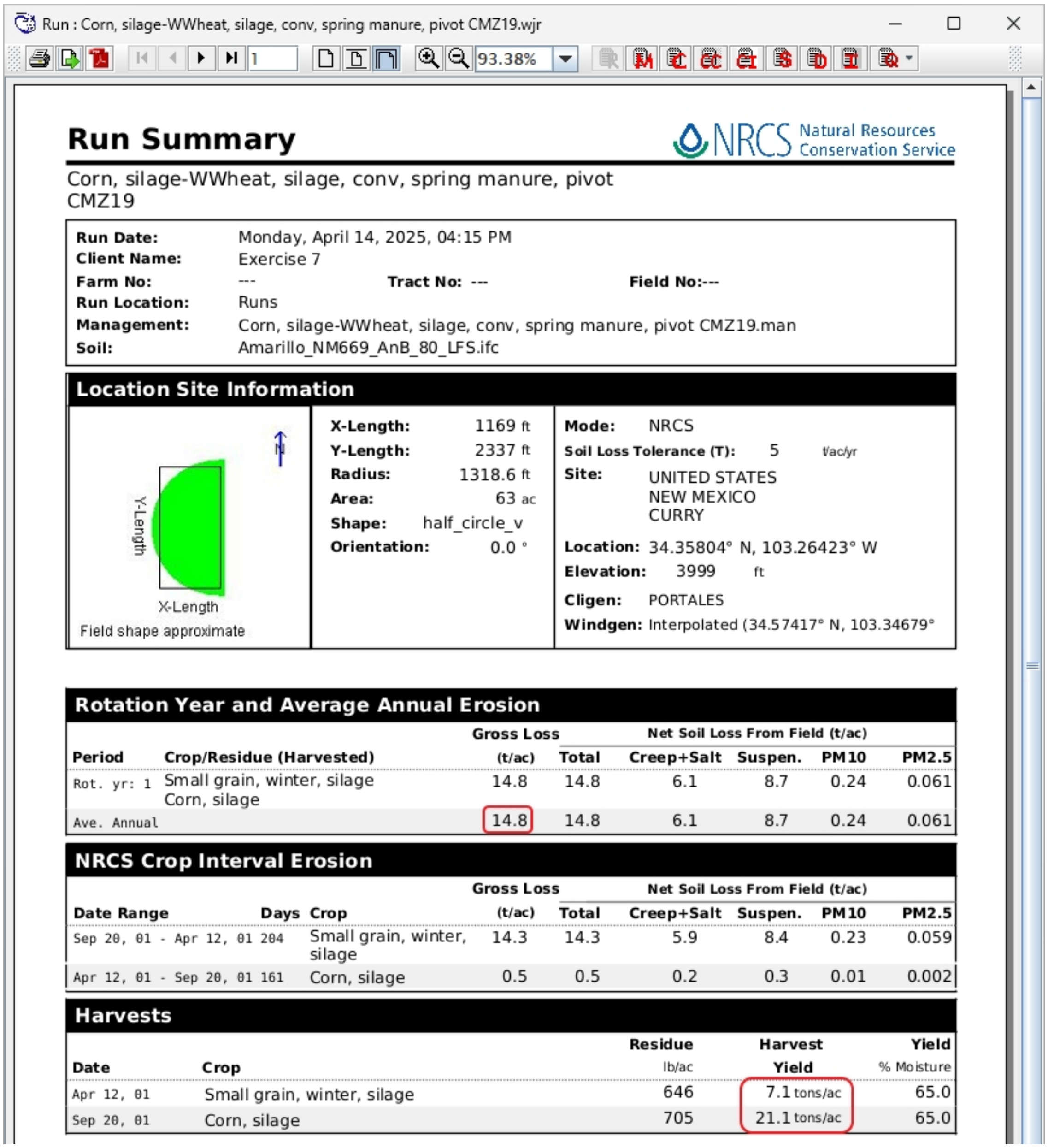



Figure 19.142: Warnings generated after addition of winter wheat silage to the rotation.


Run : Corn, silage-WWheat, silage, conv, spring manure, pivot CMZ19.wjr

**Run Summary**

Natural Resources Conservation Service

Corn, silage-WWheat, silage, conv, spring manure, pivot CMZ19

| | |
|---|---|
| **Run Date:** | Monday, April 14, 2025, 04:15 PM |
| **Client Name:** | Exercise 7 |
| **Farm No:** | --- **Tract No:** --- **Field No:**--- |
| **Run Location:** | Runs |
| **Management:** | Corn, silage-WWheat, silage, conv, spring manure, pivot CMZ19.man |
| **Soil:** | Amarillo_NM669_AnB_80_LFS.ifc |

**Location Site Information**



| | |
|---|---|
| **X-Length:** | 1169 ft |
| **Y-Length:** | 2337 ft |
| **Radius:** | 1318.6 ft |
| **Area:** | 63 ac |
| **Shape:** | half_circle_v |
| **Orientation:** | 0.0 ° |

| | |
|---|---|
| **Mode:** | NRCS |
| **Soil Loss Tolerance (T):** | 5 t/ac/yr |
| **Site:** | UNITED STATES NEW MEXICO CURRY |
| **Location:** | 34.35804° N, 103.26423° W |
| **Elevation:** | 3999 ft |
| **Cligen:** | PORTALES |
| **Windgen:** | Interpolated (34.57417° N, 103.34679° |

**Rotation Year and Average Annual Erosion**

| Period | Crop/Residue (Harvested) | Gross Loss (t/ac) | Net Soil Loss From Field (t/ac) Total | Creep+Salt | Suspen. | PM10 | PM2.5 |
|---|---|---|---|---|---|---|---|
| Rot. yr: 1 | Small grain, winter, silage Corn, silage | 14.8 | 14.8 | 6.1 | 8.7 | 0.24 | 0.061 |
| Ave. Annual | | 14.8 | 14.8 | 6.1 | 8.7 | 0.24 | 0.061 |

**NRCS Crop Interval Erosion**

| Date Range | Days | Crop | Gross Loss (t/ac) | Net Soil Loss From Field (t/ac) Total | Creep+Salt | Suspen. | PM10 | PM2.5 |
|---|---|---|---|---|---|---|---|---|
| Sep 20, 01 - Apr 12, 01 | 204 | Small grain, winter, silage | 14.3 | 14.3 | 5.9 | 8.4 | 0.23 | 0.059 |
| Apr 12, 01 - Sep 20, 01 | 161 | Corn, silage | 0.5 | 0.5 | 0.2 | 0.3 | 0.01 | 0.002 |

**Harvests**

| Date | Crop | Residue lb/ac | Harvest Yield | Yield % Moisture |
|---|---|---|---|---|
| Apr 12, 01 | Small grain, winter, silage | 646 | 7.1 tons/ac | 65.0 |
| Sep 20, 01 | Corn, silage | 705 | 21.1 tons/ac | 65.0 |

Figure 19.143: Run Summary showing soil loss for the corn and winter wheat silage crops.

**Question:** How does the soil loss look now?

**Answer:** It has decreased significantly from the previous **124.4 t/ac** to **14.8 t/ac** (Fig. 19.143). The soil loss may be reduced below loss tolerance "T" by harvesting less of the silage for each crop. Also, looking at the Tabular Detail Report, most of the erosion is occurring following harvest of the corn silage and after planting the winter wheat. Applying some irrigation water may also control erosion during those time periods and also will likely boost the amount of water available for the wheat crop and possibly the corn crop the following year.

The yield for the winter wheat silage(**7.1 tons/ac**) is very close to the producer's stated 7 tons/ac expected yield. The yield has decreased slightly for this scenario for the corn silage to **21.1 t/ac**. However, it is still close enough to the producer's expected 23 tons per acre and the yield differences would have little effect on the susceptibility to wind erosion. Since the crops are being harvested for silage, the yields will have little impact on the after harvest residue amounts retained. Regardless, the slight drop in the corn silage yield would not be unexpected if the winter wheat is using up some of the soil moisture available at planting time, even with irrigation enabled (the auto-irrigate operations do not apply water if no crop is growing and only irrigate if the crop reaches a predefined stress level). If you have trouble with this, contact your NRCS State Wind Erosion Specialist.

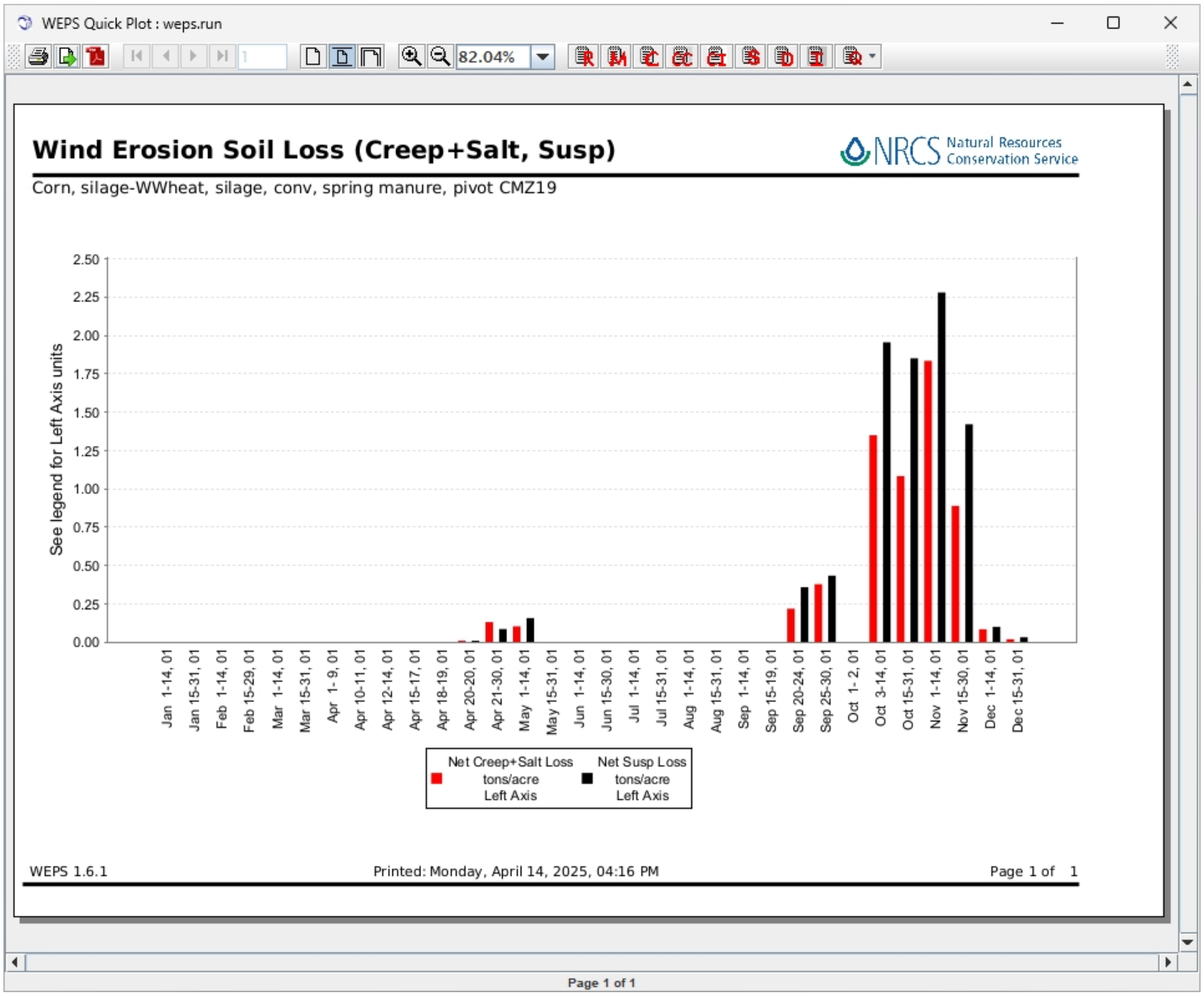



Figure 19.144: QuickPlot showing when erosion is occurring in the rotation.

# 20. Flag and Command Line Options

## 20.1 Submodel Report Flags

To generate various kinds of reports, a flag must be set. To set the option through the interface, use the output tab of the Configuration screen. A flag number is entered in the box in the appropriate submodel. A flag of zero, '0', will result in no output being generated to the listed file. It should be noted that generating these files may create large file sizes and significantly slow the execution of the WEPS model.

| Submodel & Flag No. | File Name(s) | Description |
|---|---|---|
| Hydrology | | |
| 0 | | No output generated |
| 1 | hydro out | Daily output |
| 2 | water out | Hourly output for each day |
| 3 | hydro out & water out | Generates both files |
| 4 | temp out | Daily soil temperature output by layer |
| 5 | temp out & hydro out | Generates both files |
| 6 | temp out & hydro out | Generates both files |
| 7 | temp out & water out & hydro out | Generates all three files |
| Soil | | |
| 0 | | No output generated |
| 1 | soil out | Daily submodel output |
| Management | | |
| 0 | | No output generated |
| 1 | manage out | Daily submodel output |
| Crop | | |
| 0 | | No output generated |
| 1 | crop out | Daily submodel output |
| Decomposition | | |
| 0 | | No output generated |
| 1 | dabove out | Daily above-ground submodel output |
| 2 | dbelow out | Daily below-ground submodel output |
| 3 | dabove.out & dbelow.out | Generates both files |
| Erosion | | |
| 0 | | No output generated |
| 1 | erosion out | currently generates an empty file |
| | eegt out | currently generates an empty file |
| | eros out | currently generates an empty file |
| | subday out | daily wind direction and subdaily (i.e., hourly wind speeds) |
| 3 | emit out | Subdaily (e.g. hourly) suspension |

Table 20.1: Submodel Report Flags.

A flag of one, '1', for any submodel generates the file 'plot.out', which contains a variety of output variables on a daily basis. This file is suitable for input into spreadsheets or plotting packages for plotting of daily data. See the header of the file or contact the WEPS developers for more information on the variables output to 'plot.out'.

**Command Line Options**

Windgen 4

Usage: wind#gen4 -D -V -v -h -l -f dbfile -o outfile -s # -x # -r # -b # -y #-u # -d # -?

| | |
|---|---|
| -D | debug flag |
| -V | display version and exit |
| -v | set the verbose option |
| -h | do not display output title heading |
| -l | display long (additional) output |
| -f dbfile | specify wind database file (wind_gen.wdb) |
| -o outfile | specify output file (stdout) |
| -s # | specify station WBAN no. |
| -x # | specify station database index no. |
| -r # | specify random number seed (default = 54321) |
| -b # | specify beginning simulation (calendar) year (default = 1) |
| -y # | specify number of years to simulate (default = 1) |
| -u # | specify storm duration length in hours (default = 6) |
| -d # | specify number of days to build storms from (default = 5) |
| - ? | Display the available command line options |

Table 20.2: Windgen 4

The wind station WBAN code number is required. Note that only the "-f" option (with the location of the appropriate wind_gen database file to access) is required for WEPS 1.5.20. All other options are either automatically added internally by WEPS 1.5.20 or are optional. Those that WEPS 1.5.20 automatically sets are:

- s # - y # - o outfile

Those that can be added to the command line and should work within WEPS are: - D - v - x # - r # - b # - u # - d #

Those that can't be specified when wind_gen4 is run within WEPS 1.5.20 are:

- V - l - h - ?

Cligen Version 5.2254

CLIGEN V-5.2254 - Climate Generator w/ QC-SNDG

Usage: cligen -S -s -I -o -b -y -f -F -H -r -t -I# -v -V -? -O

-S<state number >

-s<station ID number >

-i<input file name >

-o<output file name >

-b<beginning year >

-y<duration in years >

-f old WEPS record format

-F overwrite output file if it exists

-H omit header output

-r<random seed >

-t<Sim Type (WEPP: 4=SglStm, 5=Contin)>

-I0 no interpolation (default)

-I1 linear interpolation

-I2 Fourier interpolation

-I3 interpolation to preserve avgs

-v

-V verbose

-h, -?, -\ \?, /h help

-O <option 6 – observed data filename >

Make sure there are no spaces between each flag and its parameter. If command line options are omitted, CLIGEN will interactively request the required information. Note that the "-I" option (with the location of the appropriate cligen database file to access), the "- b" option (specifying the start year; usually 1), the "-t" option with value "5", and the "-F" option are all required for WEPS 1.5.20. All other options are either automatically added internally by WEPS 1.5.20, are optional, or not applicable when used with WEPS 1.6.

Those that WEPS 1.5.20 automatically sets are: -S #

-s #

-y #

- ooutfile

Those that can be added to the command line and should work within WEPS 1.6 are:

-r #

-I0

-I1

-I2

-I3

-V

Those that can't be specified when cligen5110 is run within WEPS 1.6 are:

-v

-h

-?

-t# (with options values other than 5)

WEPS 1.6

Usage: weps -? -C# -E# -I# -L# -l# -O# -p# -P./ -R# -S# -s# -w# -Y -X#

<u>WEPS 1.6</u>

Usage: weps -? -C# -E# -I# -L# -l# -O# -p# -P./ -R# -S# -s# -w# -Y -X#

where # represents the options listed:

Valid command line options:

**-?** Display the help screen

**-h** Display the help screen

**-C** WEPS crop calibration mode

- **0** = Do not run crop calibration (default)
- **1** = Run crop calibration

Valid command line options:

**-?** Display the help screen

**-h** Display the help screen

**-C** WEPS crop calibration mode

- **0** = Do not run crop calibration (default)
- **1** = Run crop calibration

Valid command line options:

**-?** Display the help screen

**-h** Display the help screen

**-C** WEPS crop calibration mode

- **0** = Do not run crop calibration (default)
- **1** = Run crop calibration

**-E** Simulate \ “erosion \” in WEPS run

- **0** = Do not run the erosion submodel
- **1** = Run the erosion submodel (default)

**-I** Specify if initialization is done and if so, the # loops

- **0** = No initialization
- **1** = Runs one management cycle (default)
- **2** = Runs x management cycles

**-L** Specify soil layer thickness to scale layer splitting (mm)

Specify -L2 for layer splitting to use 2 mm (no decimals) (default)

**-l** Specify rate of soil layer thickness increase with depth for layer splitting in percent increase of layer thickness.

Specify -l50 to 50 percent for each layer (no decimals). l25 is default.

**-O** Generate stand alone erosion input file on simulation day

Specify -O2932 to output file on simulation day 2932

**-o** Generate stand alone erosion input file on DD/MM/YY

Specify -o020901 to output file on day 2 month 9 year 1. Day and month must be 2 digits, Year can be 1 to 4 digits. Default is no file generated.

**-p** Select soil puddling with saturation all above freezing

- **0** = disable (default)
- **1** = enable

**-P** Specify path to WEPS project run directory

Must be specified if other command line switches are used.

Must be the last option specified. Default is ./

Specifying only the path without the \ "-P \" option only works if no other command line switches are specified (e.g., \ "weps path_to_weps.run_file\")

**-R** WEPS debug messages dumped to screen

**0** = no debug messages sent to screen (default)
**1** = 1st-level debug messages sent to screen
**2** = 1st- and 2nd-level debug messages sent to screen
**3** = 1st-, 2nd-, and-3rd level debug messages sent to screen

**-S** Vary type of value input for 1/3 bar, 15 bar water

**0** = 1/3bar(vol) 15bar(vol)
**1** = 1/3bar(vol) 15bar(grav)
**2** = 1/3bar(grav) 15bar(grav)
**3** = use texture-based calculation
**4** = use Rawls texture for full properties (default). Override 1/3bar, 15bar, bulk density w/ texture estimate

**-s** Specify soil ifc file input format type

**0** = new format (additional parameters) (default)
**1** = old format (slope set in weps.run)

**-w** Specify method of weighting for layer conductivity and flow

**0** = arithmetic mean method (default)
**1** = layer thickness proportional method)
**2** = internodal method, Darcian mean

**-Y** Optional functional yield/residue ratio

**0** = Use full staged biomass partitioning
**1** = Use functional yield/residue ratio (default)

**-X** Specify maximum wind speed cap (m/s)

Specify -X25.0 to limit input wind speeds to a maximum of 25.0 m/s. If -X0, no cap is set (default).

-C0 -E1 -I1 -L2 -l25 -Oo(no file) -p0 -P./ -R0 -S4 -s0 -w0 -Y1 -X0

Note that only the "-P" option is required for WEPS 1.6. It must be the last option specified if more than one option is listed because WEPS 1.5.20 appends the current WEPS Project Run directory path before executing the WEPS science model.

The options that the WEPS 1.6. interface set automatically are: -Ppath

WEPS 1.6 assumes that the user has specified "-P" (as the last option) within the WEPS 1.6 configuration panel without the "path". WEPS 1.5 appends the path of the current WEPS Project Run directory before executing the WEPS science model.

Those that can be added to the command line and should work within WEPS 1.6. are: -I#, -S#, -s#, -R#, -O, -o, -E#, -C#, -Y#

Those that can't be specified when run within the WEPS 1.6 interface are:

-h

-?

# 21. Science Overview

## 21.1 Interface and Science Model Implementation

**Interface**

This section describes the WEPS 1.6 User Interface program implementation and how it interacts with the WEPS science model. The WEPS 'science' model refers to the computer code and executable program that performs the actual calculations of field conditions and erosion processes for a simulation run. A simple flow diagram of the WEPS science model and User Interface is shown in Fig. 21.1. A detailed description of how to operate the WEPS User Interface is described elsewhere in the WEPS User's Guide in a chapter titled 'Interface Reference'.

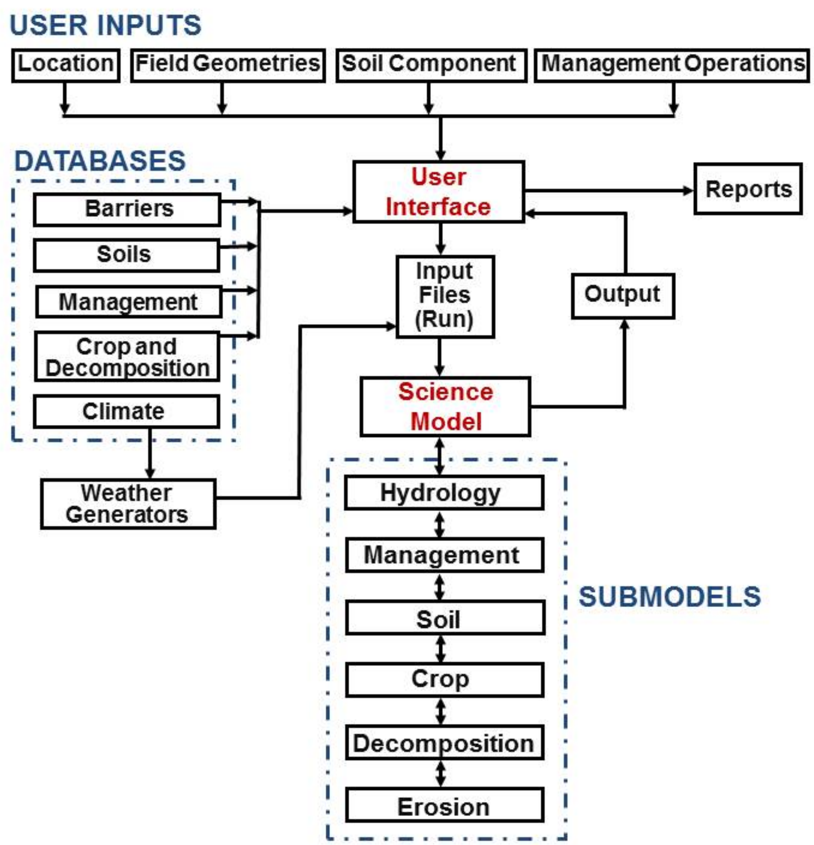



Figure 21.1: A flow diagram of the WEPS science model and User Interface.

A simplified description of the science model is provided later in this chapter. The inputs to the science model reside in a series of ASCII input files. These input files are: a Windgen file (*.win), a Cligen file (*.cli), an initial field conditions file (*.ifc), a management file (*.man), and a run file (weps.run). The science model can be executed from the command line or through the interface. When WEPS is executed, the science model reads the input files, calls each submodel performing daily time-step simulations, and writes output files. The output is written to one or more ASCII files. Building input files by hand, executing the model on the command line, and interpreting the output files can be time consuming and confusing; the WEPS User Interface simplifies this process.

The WEPS User Interface is written in Java. The interface can be thought of as a 'shell' or 'wrapper' around the science model, which does not affect the execution of the science model. Through the interface program, the user can easily enter the information necessary to create and edit the input files. A description of how to enter this information is given elsewhere in the WEPS User's Guide in a chapter titled 'Interface Reference'. Once the field, location, soil, and management are described, pressing the 'Run' button performs a series of commands to execute the science model. The interface first calls the CLIGEN and WINDGEN weather generators, which create the WINDGEN and CLIGEN files for the simulation. Then the WEPS science model is called and executed as described earlier. When the science model is finished, the interface reads and displays the output.

**Main Program**

The MAIN program is the portion of the science model that controls the initialization and execution of a WEPS simulation run. It calls subroutines that read input data and generates the summary and other reports. In addition, MAIN calls submodels on a daily basis, which update the field conditions. If the maximum wind speed for the day exceeds a set velocity great enough to cause soil movement (i.e., 8 m/s or 18 mi/hr), MAIN then calls the EROSION submodel to simulate erosion processes. The current version of WEPS reads in the climate data produced by the WEATHER submodel; performs daily simulation of the hydrologic and soil conditions, crop growth, and residue decomposition; and accounts for management effects. Finally, the model determines soil erosion by wind for the desired simulation period.

**Program Description**

The current version of MAIN requires the following files for a WEPS simulation run: a) a simulation run file that describes the field shape and barriers, simulation period, location of other input files, and types of output ; b) an initial field conditions file that describes soil conditions at the start of a simulation; c) a tillage/management file that describes the management system; and d) two climate files, one each in the CLIGEN and WINDGEN formats, that provide climate data on a daily basis.

The MAIN program begins by initializing local variables and then calls the subroutine INPUT, which reads the simulation run file and the initial field conditions file. The simulation then is executed as a daily loop that controls the counters for the current day. The model can perform any length of simulation on a daily time step, but WEPS performs a simulation for one rotation cycle to initialize surface conditions before simulations of wind erosion are performed. For each simulation day, the daily weather is read from the CLIGEN and WINDGEN data files. As some of the submodels are executed, summary information may be compiled for output. All submodels except EROSION are called within the subregion loop. Once field conditions are updated, if maximum wind speed for the day exceeds a set minimum (i.e., 8 m/s), the EROSION submodel then is called to determine threshold conditions and compute soil erosion. Finally, the MAIN program calls routines to account for field conditions and soil loss for periods throughout the rotation.

The "WEPS Technical Description" provides a more detailed description of the science behind WEPS and is available from WERU. The current WEPS science model is coded in FORTRAN conforming to the ANSI FORTRAN 77 and Fortran 95 standards. The inputs to the science model reside in a series of ASCII input files. These input files are: a WINDGEN file (*.win), a CLIGEN file (*.cli), an initial field conditions file (*.ifc), a management file (*.man), and a run file (weps.run). The science model can be executed from the command line or the interface. When WEPS is executed, the science model reads the input files, accesses necessary databases, calls each submodel daily and performs the simulation, and writes output files. The output is written to one or more ASCII files.

## 21.2 Weather Generators and Databases

WEPS requires wind speed and direction to simulate the process of soil erosion by wind. These and other weather variables (precipitation, air temperature, and solar radiation) are also needed to drive temporal changes in hydrology, soil erodibility, crop growth, and residue decomposition in WEPS.

Often it is not practical to use measured historical wind data with WEPS, because many wind records have missing data. Also, one may want to simulate wind erosion for a longer period than the length of the measured data record (e.g., for 40 years, is the length of a typical WEPS simulation run). In addition, the measured data require much more computer disk space than do wind summary statistics combined with a stochastic wind generator. Therefore, a stochastic wind generator is often more appropriate for use with WEPS than is using the measured data directly.

WINDGEN was developed specifically for use with WEPS. It stochastically generates daily wind direction and hourly wind speed (van Donk et al., 2004). An earlier version of WINDGEN was described by Skidmore and Tatarko (1990). CLIGEN is the weather generator developed for the Water Erosion Prediction Project (WEPP) family of erosion models (Nicks et al., 1987). It is used by WEPS to stochastically generate daily precipitation, maximum and minimum temperature, dew point temperature, and solar radiation. Those interested in CLIGEN and how it simulates these variables should consult the WEPP documentation (Nicks et al., 1995) and the CLIGEN web site (USDA, 2004). Both CLIGEN and WINDGEN are executed under the WEPS user interface.

Statistical distributions of weather variables are needed by stochastic weather generators to be able to generate data. There are two steps in the stochastic generation of wind data. First, statistics need to be calculated from a historical record of measured data, describing the distributions of wind direction and speed. Second, the wind data are stochastically generated from these statistics.

**Calculation of statistics used for stochastic wind generation**

A quality-controlled hourly wind data set (TD-6421, version 1.1), including 1304 stations in the 48 contiguous states of the USA, was obtained from the National Climatic Data Center (NCDC). Stations with less than 5 years of data were excluded, leaving 971 stations for use with a stochastic generator. Wind direction frequencies were calculated for each of 16 directions for each month. Wind speeds less than or equal to 0.5 m/s were treated as 'calm'. For the wind speeds that were not calm, the fraction less than or equal to certain wind speeds was calculated for each month-direction combination (12*16 = 192 combinations per station). The wind speeds used were 0.5, 1.5, 2.5, ..., 20.5, 25.5, ..., and 45.5 m/s. Rather than using the Weibull model, we chose to use the measured wind speed distributions themselves, without fitting to any model, but instead using linear interpolation between the measured distribution points. The reasons for this choice are described by van Donk et al. (2004).

**Stochastic wind generation**

First, one of the 16 cardinal wind directions or calm is selected by using a random number generator with the distribution for the current month. The selected direction is applied for an entire day. Next, 24 hourly wind speeds are generated for this day. If calm was selected in the previous step, 24 wind speeds of 0 m/s are generated. Otherwise, if one of 16 directions was selected, 24 wind speeds are generated from the cumulative wind speed distribution. The distribution for the current month and wind direction is selected, and a wind speed is generated from the linearly interpolated distribution, by using a random number generator.

For more detail on the science behind this submodel, please see the WEPS technical documentation.

**References**

Nicks, A.D., L.J. Lane, and G.A. Gander. 1995. Chapter 2. Weather generator. In USDA – Water erosion prediction project: Hillslope profile and watershed model documentation, D.C. Flanagan and M.A. Nearing, eds. NSERL Report No. 10, USDA-ARS, National Soil Erosion Research Laboratory, West Lafayette, IN

(http://topsoil.nserl.purdue.edu/nserlweb/weppmain/docs/chap2.pdf).

Nicks, A.D., J.R. Williams, C.W. Richardson, and L.J. Lane. 1987. Generating climatic data for a water erosion prediction model. Paper No. 87-2541, International Winter Meeting ASAE, December 15-18, Chicago, IL.

Skidmore, E.L., and J. Tatarko. 1990. Stochastic wind simulation for erosion modeling. Transactions of the ASAE. 33(6): 1893-1899.

USDA. 2004. Cligen Weather Generator, expanded and improved by USDA Agricultural Research Service and U. S. Forest Service. http://horizon.nserl.purdue.edu/Cligen Van Donk, S.J., L.E. Wagner, E.L. Skidmore, and J. Tatarko. 2004. Stochastic wind generation, comparing the Weibull model with a more direct approach. Submitted to Transactions of the ASAE.

## 21.3 Hydrology Submodel

HYDROLOGY submodel of the Wind Erosion Prediction System (WEPS) uses inputs generated by other WEPS submodels, such as WEATHER, CROP, SOIL, MANAGEMENT, and DECOMPOSITION, to predict the water content in the various layers of the soil profile, and at the soil-atmosphere interface, throughout the simulation period. Accurate simulation by the other WEPS submodels requires prediction of the daily changes in soil water profiles. Estimating soil wetness at the soil-atmosphere interface is emphasized however, because it significantly influences the susceptibility of the soil to wind erosion.

The HYDROLOGY submodel of WEPS maintains a continuous, daily, soil water balance by using the equation:

SWC = SWCI + (PRCP + DIRG) + SNOW – RUNOFF – ETA – DPRC **[Equation 5.1]**

where SWC is the amount of water on the soil profile in any given day, SWCI is the initial amount of water in the soil profile, PRCP is the amount of daily precipitation, DIRG is the amount of daily irrigation, SNOW is the daily snow melt minus daily snow accumulation, RUNOFF is the amount of daily surface runoff, ETA is the amount of daily actual evapotranspiration, and DPRC is the amount of daily deep percolation.

The amount of daily precipitation (PRCP) is partitioned between rainfall and snowfall on the basis of the average daily air temperature. If the average daily temperature is 0° C or below, the precipitation takes the form of snowfall; otherwise, it takes the form of rainfall.

The snow term (SNOW) can be either positive, equaling the daily snow melt, or negative, equaling the daily snow accumulation. The melted snow is treated as rainfall and added to the precipitation term in Equation 5.1 when accounting for daily runoff and infiltration. On the other hand, the accumulated snow is subtracted from the daily precipitation during the estimation of the daily soil water balance with Equation 5.1.

Simulation of soil-water dynamics on a daily basis by the HYDROLOGY submodel involves three major sequences. First, the submodel partitions the total amount of water available from precipitation, irrigation, and/or snow melt into surface runoff and infiltration. The submodel stores the daily amount of water available for infiltration into the soil profile. Second, the submodel determines the influence of ambient climatic conditions by calculating the potential evapotranspiration. Third, the submodel redistributes soil water in the soil profile on an hourly basis, which provides hourly estimations of water content in the soil profile. The submodel estimates the actual rate of evapotranspiration by adjusting the potential rate on the basis of soil water availability. Deep percolation from the soil profile is estimated to be equal to the conductivity of the lowermost simulation layer, assuming a unit hydraulic gradient.

HYDROLOGY submodel estimates surface runoff and infiltration for each simulation day that has precipitation and/or irrigation. The submodel estimates the daily amount of water available for infiltration into the soil by subtracting the amount of daily surface runoff from the amount of daily precipitation, snow melt, and/or irrigation. The infiltration water is stored in the uppermost simulation layer, until its water content reaches field capacity. Any excess water then is added to the succeeding lower layer, where it is stored with the same maximum storage restriction. This is repeated until complete water storage is obtained. Any excess water that flows out from the lowest simulation layer becomes a part of deep percolation.

Potential evapotranspiration is calculated by using a revised version of Penman's combination method (Van Bavel, 1966). The total daily rate of potential evapotranspiration then is partitioned on the basis of the plant leaf area index into potential soil evaporation and potential plant transpiration. The potential rate of soil evaporation is adjusted to account for the effect of plant residues in the simulation region. Furthermore, the daily potential rates of soil evaporation and plant transpiration are adjusted to actual rates on the basis of water availability in the soil profile.

The HYDROLOGY submodel uses a simplified, forward finite-difference technique to redistribute soil water with the one-dimensional Darcy equation for water flow. The time step of the soil water redistribution is 1 hour, which allows for an hourly estimation of soil wetness as needed for WEPS. Knowledge of the relationship between unsaturated hydraulic conductivity and soil water content is required for solving the governing transport equations of water movement through the soil. The submodel uses Campbell's (1974) method to calculate the unsaturated hydraulic conductivity of the soil from the more readily available soil water characteristic curve and saturated hydraulic conductivity data. Because water release curve data of the soil are not always available, the submodel provides alternative options to estimate the hydraulic parameters of the water release curve that are needed as inputs to run the soil water redistribution segment of the submodel.

The HYDROLOGY submodel predicts, on an hourly basis, soil wetness at the soil-atmosphere interface by using a combination of two techniques. The submodel extrapolates water content to the soil surface from the three uppermost simulation layers. A numerical solution known as Cramer's rule (Miller, 1982) is used to obtain an estimate of the extrapolated water content at the soil surface by solving the three simultaneous equations that describe the relationship between water content and soil depth for the three uppermost simulation layers. The submodel also interpolates the functional relationship between surface-soil wetness and the hourly evaporation ratio.

**References**

Campbell, G. S. 1974. A simple method for determining unsaturated conductivity from moisture retention data. Soil Sci. 117(6):311-314.

Miller, A. R. 1982. FORTRAN programs for scientists and engineers. SYBEX Inc., Berkeley, CA.

Van Bavel, C. H. M. 1966. Potential evaporation: the combination concept and its experimental verification. Water Resources Res. 2(3):455-467.

## 21.4 Management Submodel

**Introduction**

WEPS is expected to reflect effects of various management practices upon wind erosion. The diversity of current practices applied to crop land by land managers makes this a daunting task, but WEPS must adequately simulate typical cultural practices to accurately assess their effects upon wind erosion control. The MANAGEMENT submodel is assigned the task of handling the cultural practices that affect the soil/surface "state" within WEPS.

**Purpose**

All cultural practices are by definition "human initiated". These human-controlled processes affecting the soil and field surface "state" are initiated by typical management practices such as tillage operations, planting, harvesting, irrigation, etc. Therefore, the purpose of the MANAGEMENT submodel is to model what are considered the major human-controllable actions that can affect the "system state" within WEPS, in particular the system state variables defining the temporal soil and surface conditions.

**Objectives**

The MANAGEMENT submodel objectives are:

- To model the primary human-initiated processes that can affect a site's susceptibility to wind erosion.
- To provide the framework necessary to process a list of specified human-initiated actions (i.e., the cultural practices applied to a field such as a tillage/crop rotation sequence).

**Assumptions and Limitations**

Several assumptions and limitations have been imposed on the MANAGEMENT submodel. The reasons range from simply limiting the scope of the submodel, to inadequate knowledge of specific processes that may have a significant impact on the soil and/or surface. Here is the list of current assumptions and limitations, provided in no particular order, that impact the MANAGEMENT submodel:Total soil water content within the current tillage zone is assumed to be unaffected by a tillage operation.

- The HYDROLOGY submodel is expected to handle changes in surface water content and, therefore, appropriately represent the usual rapid drying of the surface layer after tillage.
- Tillage depth is assumed not to influence how a tillage operation affects the soil and surface, except for determining which soil layers are directly affected by a tillage operation.
- Effects of tillage operations on soil layers below the tillage depth are not considered, (i.e., subsoil compaction below the tillage zone due to tillage)
- Effects of a management operation are assumed homogeneous within a subregion. Effects due to tractor tires will not be considered (except where they may knock down a significant proportion of standing residue). Certain

zone-related tillage operations, such as row cultivator, will be treated in a manner such that the result will be ”averaged” or ”equivalent” values that represent the homogeneous region.

- Ridge and dike geometric specifications (oriented roughness) will be provided by the user. If the tillage depth specified is not sufficient to create or destroy them (for a particular tillage operation that does so), the MANAGEMENT submodel will modify the tillage depth accordingly to obtain the desired ridge and/or dike specifications. Tillage operations that do not modify the current ridge and/or dike specifications will not do so (i.e., ridge tillage equipment).
- Soil tillage depths will be adjusted to the nearest soil layer boundary. This will ensure that the most recent tillage operation modifications on the soil ”state” are adequately represented.
- Aggregate stability and aggregate density are assumed to be unaffected by tillage operations. This decision is based on limited field data analysis. Future research may provide statistically significant affects that could then be modeled. These properties may still change among soil layers within the tillage zone due to aggregate mixing among layers caused by tillage operations.

**Submodel Description**

The approach taken within the MANAGEMENT submodel to deal with the variety of land management actions was to:

- Identify the primary physical processes involved.
- Represent individual management operations as a sequence of those primary physical processes.
- Develop a MANAGEMENT file format allowing the input of user-specified sequences of management operations (i.e. a management practices/crop rotation file). All operations modeled within the MANAGEMENT submodel fall within the defined management categories as listed in Table 21.1.

| Operation Class | Description |
|---|---|
| Primary Tillage | Tillage performed to primarily reduce surface residue, increase short-term infiltration rates, loosen subsoil hardpans, and control weed growth. After-harvest tillage operations usually fall in this category. |
| Secondary Tillage | Tillage typically performed in preparation for seeding or planting operations. These operations usually are intended to smooth the soil surface, reduce the average aggregate size, and control weed growth, if present. |
| Cultivation | Tillage specifically designed to eliminate weed growth after crop germination. |
| Planting/Seeding | Operations required to plant or seed a crop into a field. |
| Harvesting | Operation to remove biomass from a field. Biomass removed may be grain, root material, or the entire above-ground biomass. |
| Irrigation | The artificial application or addition of water to the soil. |
| Fertilization | The application or addition of specific nutrients to a soil. |
| Burning | The removal of surface biomass via burning. |

Table 21.1: Management Operation Classes.

| Operation Class | Description |
|---|---|
| Primary Tillage | Tillage performed to primarily reduce surface residue, increase short-term infiltration rates, loosen subsoil hardpans, and control weed growth. After-harvest tillage operations usually fall in this category. |
| Secondary Tillage | Tillage typically performed in preparation for seeding or planting operations. These operations usually are intended to smooth the soil surface, reduce the average aggregate size, and control weed growth, if present. |
| Cultivation | Tillage specifically designed to eliminate weed growth after crop germination. |
| Planting/Seeding | Operations required to plant or seed a crop into a field. |
| Harvesting | Operation to remove biomass from a field. Biomass removed may be grain, root material, or the entire above-ground biomass. |
| Irrigation | The artificial application or addition of water to the soil. |
| Fertilization | The application or addition of specific nutrients to a soil. |
| Burning | The removal of surface biomass via burning. |

Table 21.2: Management Operation Classes.

When a management or tillage operation is performed, it is simulated through a group of individual physical processes that represent the total effects of that operation. The basic individual physical processes to be modeled within the MANAGEMENT submodel of WEPS have been grouped according to the target of their actions and outlined in Table 21.4.

| Action | Process | Description |
|---|---|---|
| Soil Mass Manipulation | **Crush** | *The application* of forces to the soil to modify the soil aggregate structure by breaking down soil aggregates. |
| | **Loosen/Compact** | *The process* of decreasing soil bulk density and increasing porosity (incorporation of air), or the inverse process of increasing soil bulk density by removing air from the soil. |
| | **Mix** | *The process* of uniting or blending of soil layer properties, including biomass. |
| | **Invert** | *The reversing* of the vertical order of occurrence of soil layers within the current specified tillage zone. |

Table 21.3: Management Submodel Processes.

| Action | Process | Description |
|---|---|---|
| Soil Mass Manipulation | **Crush** | *The application* of forces to the soil to modify the soil aggregate structure by breaking down soil aggregates. |
| | **Loosen/Compact** | *The process* of decreasing soil bulk density and increasing porosity (incorporation of air), or the inverse process of increasing soil bulk density by removing air from the soil. |
| | **Mix** | *The process* of uniting or blending of soil layer properties, including biomass. |
| | **Invert** | *The reversing* of the vertical order of occurrence of soil layers within the current specified tillage zone. |
| Surface Manipulation | **Ridge/Dike** | *The process* of creating or destroying ridges and/or dikes (oriented surface roughness). |
| | **Roughen** | *The process* of modifying the random surface roughness. |
| | **Crush** | *The process* of modifying the soil surface crust characteristics. |
| Biomass Manipulation | **Bury/Lift** | *The process* of moving above-ground biomass into the soil, or the inverse process of bringing buried biomass to the surface. |
| | **Cut** | *The process* of cutting standing biomass to a prescribed height. |
| | **Drop** | *The process* of moving a portion of the standing biomass to the soil surface. |
| | **Kill** | *The death* of live biomass. |
| | **Remove** | *The removal* of biomass from the system (harvest, grazing, and burning). |
| Soil Amendments | **Plant** | *Addition* of seeds/plants to the soil. |
| | **Irrigate** | *Addition* of water to the soil. |

Table 21.4: Management Submodel Processes.

The underlying philosophy behind the MANAGEMENT submodel was to attempt to develop representations based on physical law, if possible, for each of the chosen physical processes. These processes are assumed to be independent with respect to each other and are to be simulated sequentially, even though many of them occur simultaneously in the real world. The order they are initiated in the submodel is dependent upon the specific operation.

The list of management operations performed for a given management plan (crop rotation or cyclical management practices) is specified in a MANAGEMENT input file. The MANAGEMENT submodel checks on a daily basis for any operations to be performed on that day. If operations are needed, the MANAGEMENT submodel will execute the specified routines required to simulate the effects of those operations as instructed in the MANAGEMENT input file. When the last operation is performed for that particular crop rotation cycle, the same sequence will be repeated for the next year(s) of simulation.

A single MANAGEMENT input file may include multiple management operation lists, one for each subregion being simulated.

## 21.5 Crop Submodel

### Introduction

The primary purpose of the WEPS plant growth submodel (CROP) is to obtain realistic estimates of plant growth so that the influence of vegetative cover on soil loss by wind erosion can be properly evaluated. The CROP submodel (Retta and Armbrust, 1995) was adapted from the Erosion Productivity Impact Calculator (EPIC) crop-growth model (Williams et al., 1990). Additional capabilities and modifications have been developed and incorporated into the CROP submodel to meet the need for predicting effects of a growing crop on wind erosion.

Young seedlings provide some protection from wind erosion, but not all plant parts are equally effective. Stems of young plants, on a per-unit area basis, are roughly 10 times more effective than leaves in depleting wind energy. Other differences between leaves and stems are that: a) leaves are more sensitive to sandblast damage than are stems; and b) leaf and stem residues decompose at different rates. To properly account for these differences, the CROP submodel gives daily estimates of leaf and stem growth in mass and area. At harvest, the ‘grain’ is removed and the ‘straw’ may consist of leaves, stems, and ‘chaff’. In most cases, the leaf and ‘chaff’ residue is short-lived, and only the stem residue may provide protection on a longer-term basis. The CROP submodel gives estimates of the amount of leaf, stem, ‘grain’, and ‘chaff’ mass produced on a daily basis.

An important consideration is the effect of plant density on the amount of cover provided by growing seedlings during the early vegetative growth period. Many management practices leave the soil vulnerable to the forces of wind erosion from before seeding until the growing plants develop sufficient cover. During the period from emergence to the development of adequate cover, the amount of cover is directly proportional to the number of seedlings per unit area. The greater the number of plants per unit area, the greater the cover provided by the growing vegetation. To account for the differences in cover due to initial plant density, the leaf and stem area indexes at emergence (which are used by the EROSION submodel in computations of soil loss) are calculated by multiplying the initial areas per plant by the number of seedlings per unit area. Thus, the greater the number of seedlings per unit area at emergence, the greater the protection provided by the young seedlings from wind erosion.

The CROP submodel uses data inputs of plant, weather, hydrology, and management to estimate leaf mass, stem mass, reproductive mass, yield mass, ‘chaff’ mass, and root mass of ‘live’ plants (crops) on a daily basis. Other plant characteristics estimated daily are root mass by soil layer, rooting depth, plant height, and canopy cover.

**Phenological development**

Phenological development of the crop is based on growing-degree-day (GDD) accumulation. The crop growth parameters, for each crop, consist of: a) the potential GDD from planting to physiological maturity; and b) the relative GDD from planting to emergence, to the start of the reproductive phase, and to the start of leaf senescence. CROP uses the same procedures as EPIC for simulating annual or perennial plants and winter or summer crops. Annual plants ’grow’ from planting to the date when the accumulated GDD equal the potential GDD for the crop. For annual winter crops, such as wheat, GDD accumulation (therefore growth) does not occur during the period of dormancy. Perennial crops maintain their root systems throughout the year, although the plant may become dormant after a frost. After the end of dormancy, plants start growing when the average daily air temperature exceeds the base temperature of the plant.

**Emergence**

Emergence occurs when the GDD accumulation from date of planting equals 6GDD. The CROP submodel does not account for effects of soil temperature, soil water, soil crusting, soil strength, seeding depth, or soil removal or deposition caused by wind erosion, any of which can influence germination, seedling emergence, survival, and growth.

**Biomass Production**

Biomass production is determined on the basis of a) the amount of shortwave radiation received, which is used to estimate the amount of photosynthetically active radiation (PAR) intercepted by the canopy; and b) the biomass efficiency factor assigned to the crop.

**Growth Constraints**

Potential growth and yield seldom are achieved, because of stress caused by sub-optimal conditions. The CROP submodel adjusts daily biomass and area growth for water and temperature stresses. Water and temperature stress factors range from 0, where no growth will occur, to 1, no limitation in normal growth. For any simulation day, the minimum value of the water or temperature stress factor determines the adjustment to daily produced biomass.

**References**

Retta, A. and D.V. Armbrust. 1995. WEPS technical documentation: Crop submodel. Proceedings of the WEPP/WEPS Symposium. Soil and Water Conservation Society, Ankeny, IA.

Williams, J.R., C.A. Jones, and P.T. Dyke. 1990. The EPIC Model. An Erosion/Productivity Impact Calculator: 1. Model Documentation. eds. A.N. Sharply and J.R. Williams. USDA Tech. Bulletin No. 1768.l 235pp

**Residue Decomposition Submodel**

This submodel simulates the decrease in crop residue biomass due to microbial activity. The decomposition process is modeled as a first-order reaction with temperature and moisture as driving variables. Decomposition is a function of decomposition days. Under optimum temperature and moisture conditions, one decomposition day per day is accumulated. Only a fraction of a decomposition day is accumulated if conditions are less than optimum. Biomass remaining after harvest is partitioned between standing, flat, buried, and root pools. Below-ground biomass decomposition is calculated for each soil layer.

Residue from different crops may decompose at different rates. Because residue decomposition can require a long period of time, crop residue biomass from sequential harvests is accounted for in three separate pools. Biomass from the most recently harvested crop will be in pool one, biomass from the penultimate crop in pool two, and there is a third pool for biomass from the oldest crop(s). After harvest, any residue biomass remaining from a previous crop is moved into the older age pools, and residue from the just harvested crop is moved into the first residue-decomposition pool.

Standing residue losses not only result from microbial activity, but also from physical forces. Physical transfer of crop residue from the standing biomass pool will reduce both the stem population and standing biomass. A daily estimate of the standing stem population is required to evaluate the vertical stem area that the wind encounters. This area is quantified by the stem area index, which is calculated from standing stem number, stem height, and stem diameter. It affects aerodynamic resistance and, ultimately, wind erosion. Stems start to fall over after a threshold of cumulative decomposition days since harvest has been reached. Stem area index decreases proportionally with decreasing standing stem number.

Both standing and flat crop residue provide cover to the soil surface, protecting it against wind erosion. Soil cover from standing residue is typically small. It is calculated from stem number and stem diameter. Soil cover from flat residue is calculated from flat residue mass. Tillage may alter the amount of residue in the different pools.

For more detail on the science behind this submodel, please see the WEPS technical documentation.

## 21.6 Soil Submodel

**Introduction**

All the soil properties that control soil wind erodibility vary with time. Hence, the objective of the soil submodel is to simulate these temporal soil properties on a daily basis in response to various driving processes. On days when wind erosion or management activities occur, the EROSION and MANAGEMENT submodels may also update some of the same temporal variables. The driving processes that change soil temporal properties are mostly weather related; hence, the sequence of occurrence of individual driving processes is highly variable. Thus, the submodel must be able to update the soil variables, given an arbitrary driving process and the soil conditions for the prior day. This section provides a brief overview of the major processes that are simulated, and the temporal variables that are updated by the SOIL submodel. For an in-depth discussion of the equations used in the SOIL submodel, see the SOIL Submodel Technical Document (Hagen et al., 1995).

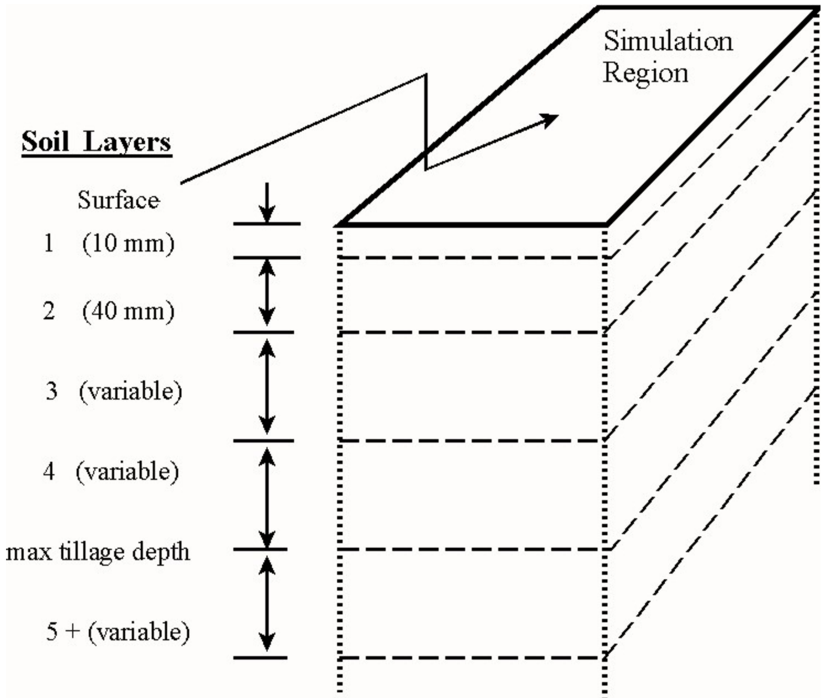



Figure 21.2: Diagram representing the spatial domain of the SOIL submodel.

**Spatial Regime** In the SOIL submodel, the spatial regime is considered to be uniform in the horizontal direction over the simulation region, but non-uniform in the vertical direction (Fig. 21.2). Hence, the vertical direction is divided into layers in each soil profile. Some of the layer boundaries are selected to coincide with the layers determined by the NRCS Soil Survey of each soil. Layers one and two are initially set at 10 and 40 mm (0.39 and 1.57 inches), respectively, to allow simulation of sharp gradients in temporal soil properties near the surface.

**Soil Layering Scheme** The HYDROLOGY and CROP submodels of WEPS depend upon the soil being stratified by layers. Hydrology moves water up and down within the soil in response to the relative wetness of adjacent layers. The CROP submodel estimates of plant growth are based upon several factors, one of the most important being availability of water within the root zone. It is important that WEPS keep track of how much water is available at various soil depths. Hence, WEPS views the soil as a series of layers, each layer possibly having distinct physical characteristics.

WEPS divides the soil into layers on the basis of the National Soil Information System (NASIS) input data. The layering scheme respects the underlying NASIS data. That is, no NASIS layers are combined when creating WEPS layers. Much of the complexity of the layering process is due to the creation of the very thin top layers. The design criteria are:

- Preserve NASIS layering, (i.e., a WEPS layer cannot cross a NASIS layer boundary).
- Define the first three layers to be 10, 40 and 50 mm, if possible.
- Preserve the relative sizes, 1:4:5:5, of the top layers if the absolute size cannot be attained.
- Divide the remaining layers into relatively uniform thicknesses, somewhat thinner at the top and thicker as depth increases.

**Processes Simulated and Variables Updated** The processes simulated and the variables updated are summarized in Table 21.5 and Table 21.6. The effect of the processes on roughness is always to reduce the roughness. In contrast, many of the other variables either increase or decrease in value depending upon the prior-day value, soil intrinsic properties, and the driving process. To simulate the dry stability and aggregate size distribution for a wide range of soils, these variables were first normalized by using the means and standard deviations of the variables for each soil series to give a range from 0 to 1 for each variable. The driving processes were then applied to the normalized ranges to determine the change in the normalized variable. Finally, the updated normalized values were converted to the real values of these variables.

| Surface Processes | | | |
|---|---|---|---|
| Rain | Sprinkler Irrigation | Snow Melt | Soil Temporal Variables |
| | | | **Roughness** |
| X | X | X | Ridge Height |
| X | X | X | Dike Height |
| X | X | X | Random |
| | | | **Crust** |
| X | X | X | Depth |
| X | X | X | Cover Fraction |
| X | X | X | Density |
| X | X | X | Stability |
| X | X | X | Loose mass |
| X | X | X | Loose cover |
| | | | **Aggregates** |
| X | X | X | Size Distribution |
| X | X | X | Dry Stability |
| X | X | X | Density |
| | | | **Layers** |
| X | X | X | Bulk Density |

Table 21.5: SOIL submodel variable and surface process matrix.

| Layer Processes | | | |
|---|---|---|---|
| Wet/dry | Freeze/thaw | Freeze/dry | Soil Temporal Variables |
| | | | **Roughness** |
| | | | Ridge Height<br>Dike Height<br>Random |
| | | | **Crust** |
| X | X | X | Depth<br>Cover Fraction<br>Density<br>Stability<br>Loose mass<br>Loose cover |
| | | | **Aggregates** |
| X | X | X | Size Distribution |
| X | X | X | Dry Stability |
| X | X | X | Density |
| | | | **Layers** |
| | | | Bulk Density |

Table 21.6: SOIL submodel variable and layer process matrix.

**References** Hagen, L.J., T.M. Zobeck, E.L. Skidmore, and I. Elminyawi. 1995. WEPS technical documentation: soil submodel. Proceedings of the WEPP/WEPS Symposium, Soil and Water Conservation Society, Ankeny, IA.

## 21.7 Erosion Submodel

**Introduction** The objective of the EROSION submodel is to simulate the components of soil loss/deposition over a rectangular field in response to wind speed, wind direction, field orientation, and surface conditions, on a sub-hourly basis Figure). In WEPS, barriers may be placed on any or all field boundaries. When barriers are present, the wind speed is reduced in the sheltered area on both the upwind and downwind sides of the barriers. The submodel determines the threshold friction velocity at which erosion can begin for each surface condition. When wind speeds exceed the threshold, the submodel calculates the loss/deposition over a series of individual grid cells representing the field. The soil/loss deposition is divided into components of saltation/creep and suspension, because each has different transport modes, as well as off-site impacts. Finally, the field surface is periodically updated to simulate the changes caused by erosion. This paper provides users with a brief overview of the submodel. For an in-depth description of the equations used in this submodel, see the WEPS Erosion Submodel Technical Description (Hagen, 1995).

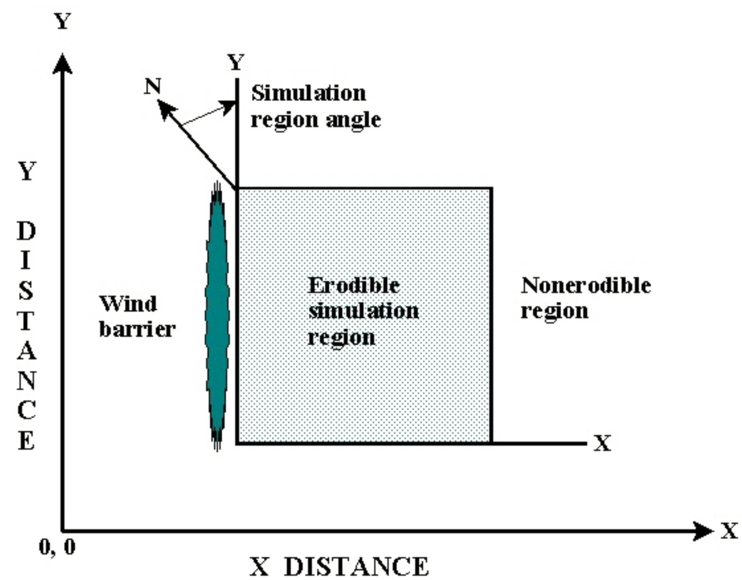



Figure 21.3: Schematic of simulation region geometry. Field orientation, end points of barriers, and opposite corners of the rectangular simulation region are input to the EROSION submodel.

### Parameters Describing Soil Surface Conditions

Surface roughness is represented by both random roughness and oriented roughness. The parameters used are standard deviation of the surface heights for random roughness and the height, width of ridge tops, and spacing of ridges for oriented roughness.

Surface cover is represented on three levels (Fig. 21.3). In the first level, surface rock, aggregates and crust compose 100 percent of the cover. In the second level, the parameter is the fraction of the crusted surface covered with loose, erodible soil. When there is no crust, this parameter is always zero. In the third level, the parameter is the fraction of total surface covered by flat, random biomass.

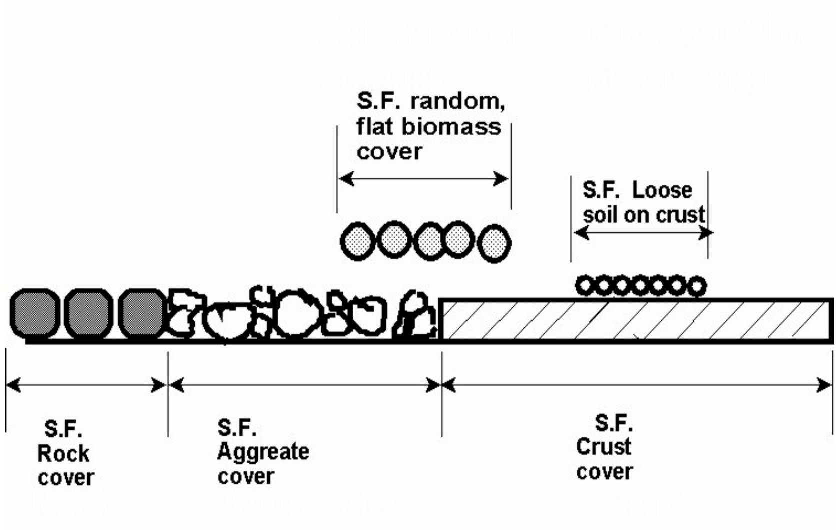



Figure 21.4: Diagram illustrating components of flat surface cover inputs to the EROSION submodel.

The aggregate density and size distribution are soil parameters that indicate soil mobility. The dry mechanical stability of the clods/crust are input parameters that indicate their resistance to abrasion from impacts by eroding soil. Surface soil wetness is also input and used to increase the threshold friction velocity at which erosion begins.

Uniformly distributed standing biomass is 5 to 10 times more effective in controlling wind erosion than is flat biomass, and thus, standing biomass is treated separately. The wind friction velocity above standing biomass is depleted by the leaves and stems to obtain the friction velocity at the surface that is used to drive erosion (Fig. 21.5). Leaves are represented by a leaf area index and stems are represented by a stem silhouette area index.

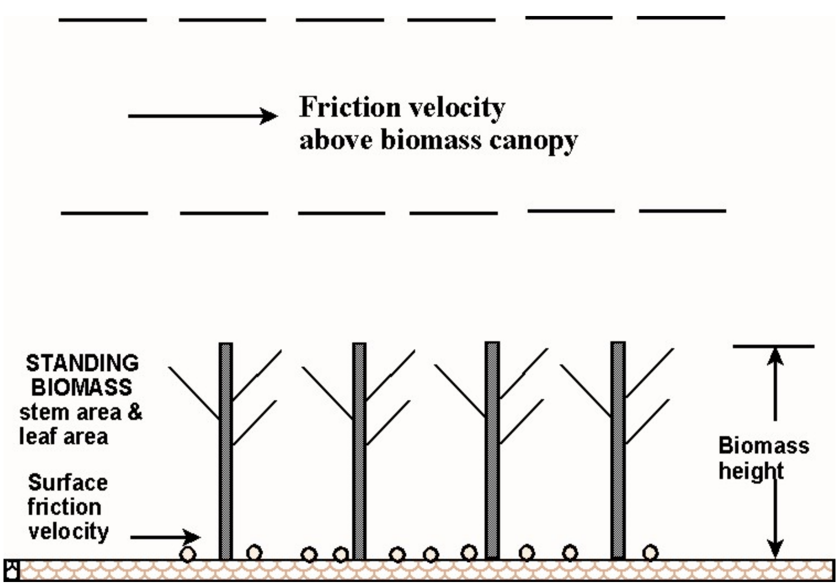



Figure 21.5: Diagram illustrating friction velocity above standing biomass that is reduced by drag of stems and leaves to the surface friction velocity below the standing biomass.

## 21.8 Erosion Processes Simulated

Soil transport during wind erosion occurs in three modes: creep-size aggregates, 0.84 to 2.0 mm (0.033 - 0.079 in.) in diameter, roll along the surface; saltation-size aggregates, 0.10 to 0.84 mm (0.004 - 0.033 in.) in diameter, hop over the surface; and suspension-size aggregates, less than 0.10 mm (0.004 in.) in diameter, move above the surface in the turbulent flow. Variations in friction velocity, aggregate density, and sediment load obviously may change the mass of aggregates moving in a given mode. Saltation and creep are simulated together because they have a limited transport capacity that depends mainly upon friction velocity and surface roughness. The suspension component is simulated with no upper limit on its transport capacity at the field scale. A portion of the suspension component also is simulated as PM-10 (i.e., particulate matter less than 10 micrometers (0.0004 in.) in diameter), which is regulated as a health hazard.

Multiple physical erosion processes are simulated in the erosion submodel, and these are illustrated for a single grid cell in Fig. 21.6. The two sources of eroding soil are emission of loose soil and entrainment of soil abraded from clods and crust. These sources are apportioned between saltation/creep and suspension components on the basis of the source process and soil characteristics. Three processes deplete the amount of moving saltation/creep. These include trapping in surface depressions, interception by plant stems/leaves, and breakage of saltation/creep size particles and aggregates into suspension-size.

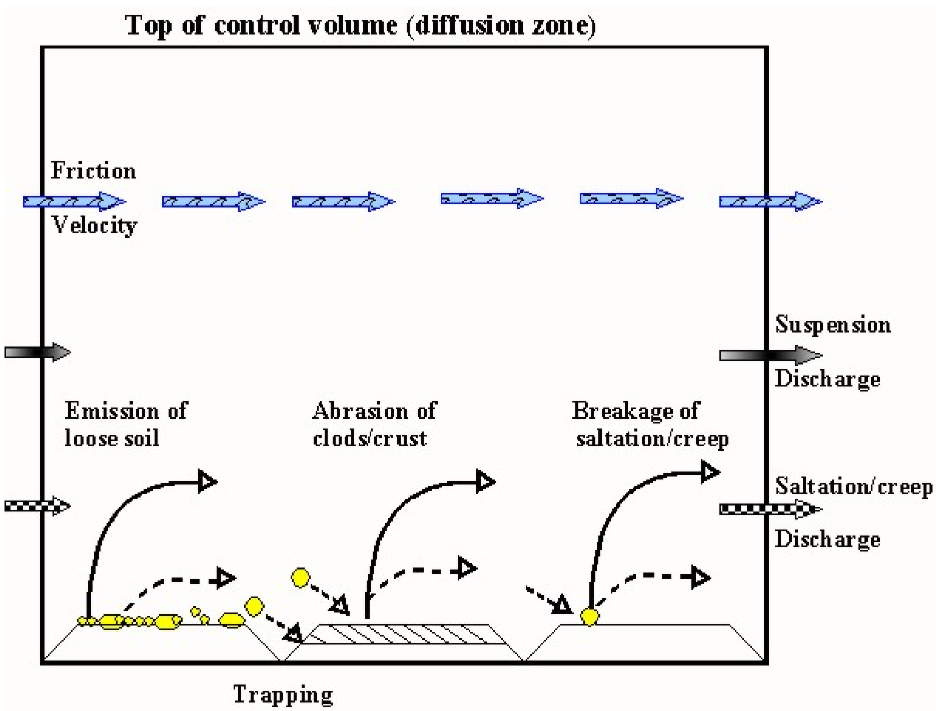



Figure 21.6: Diagram illustrating processes simulated by the EROSION submodel on a bare soil surface in an individual grid cell.

Simulation of surface rearrangement is accomplished by allowing emissions to deplete the loose soil and armor the surface in the upwind field area. In contrast, processes such as abrasion of the protruding aggregates and trapping in depressions dominate in downwind areas and lead to smoothing the surface and a build-up of loose saltation/creep. A build-up of saltation/creep often occurs, because the transport capacity may be satisfied, but abrasion of clods/crust continues to create additional saltation/creep-size soil.

Typical behavior of the downwind soil discharge simulated along a line transect for the saltation/creep and suspension components is illustrated in Fig. 21.7. The suspension component keeps increasing with downwind distance, even though saltation/creep reaches transport capacity. This is because the sources for suspension-size soil are usually active over the entire field. These sources include emissions from impacts on loose soil, abrasion from clods/crust, and breakage from impacting saltation/creep-size aggregates. Moreover, the suspension component has a transport capacity many times larger than that of saltation/creep, so on large fields it is the 'freightliner' for moving soil whereas saltation/creep is merely the 'pickup truck'.

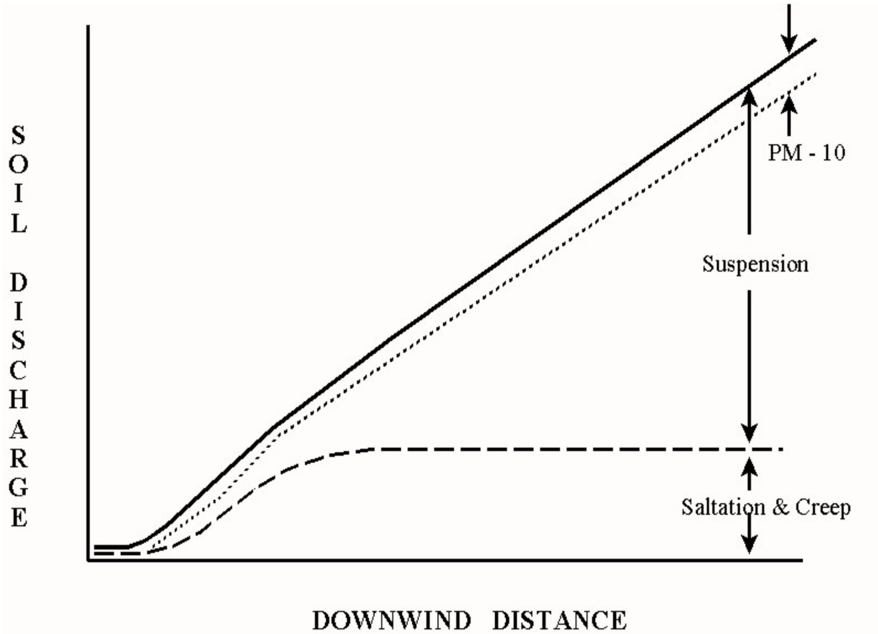



Figure 21.7: Diagram illustrating downwind transport capacity for saltation and creep, but a continuing increase in transported mass of suspension-size soil downwind.

### 21.8.1 Outputs

The EROSION submodel calculates total, suspension, and PM-10 soil loss/deposition at each grid cell in the field. The grid cell data are summarized in other parts of WEPS and reported to users as averages over the field for selected periods. The submodel also calculates the components of soil discharge crossing each field boundary. These are reported to users, according to the size ranges of aggregates as saltation/creep, suspension, and PM-10. These latter outputs are useful for evaluating off-site impacts in any given direction from the eroding field.

**References**

Hagen, L.J. 1995. Wind Erosion Prediction System (WEPS) Technical Description: Erosion submodel. Proceedings of the WEPP/WEPS Symposium. Soil and Water Conservation Society, Ankeny, IA