AIMM Version 3.1.3

Help Manual

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1 Welcome to A.I.M.M. Help

This help document will assist you in finding information about the AIMM program. You can browse the document, or use the "Index" or "Table of Contents" to find the information you need.

2 Introduction

Technological developments within the irrigation industry have advanced significantly over the last few decades. Many of these developments have resulted in on-going improvements to water use efficiency, increased production, higher quality commodities and a decreased labour requirement for irrigation. The ultimate success of the application of this advancing technology still remains with the water management skill level of the irrigation water user. As technology creates greater opportunities, and computerization becomes a larger part of farm business management, the opportunity exists for the application of computer software to assist on-farm irrigation managers in the timing and amounts of their water applications.

3 AIMM - What Is It?

The Alberta Irrigation Management Model is a software package, designed exclusively for use at the farm level to help producers in their irrigation scheduling decisions. The model simulates the growing conditions and crop water use of 52 different crops. The software is designed and built not only to serve as a management and record keeping tool for irrigation operations but as an irrigation management-training tool as well.

4 Output From AIMM

1) Graphical and tabular reports of daily "year to date" soil moisture conditions, evapotranspiration (crop water use), climate data, irrigation application amounts, surface run-off and deep percolation for any number of fields or sites within fields.

2) Predictive assessment on crop water requirements and irrigation timing for designated near-future time periods.

3) Record keeping for crop production information such as fertilizer and chemical use, seeding rate, crop yields, pumps and pumping record information, irrigation applications, and rainfall.

5 Installing AIMM

The most recent version of AIMM is available for download at http://www.agric.gov.ab.ca/app49/imcin/index.jsp; click on the AIMM software tab. Once download is complete, follow the prompts to install the program. The model installs to default directory c:\Program Files\AIMM\ but the directory can be changed at time of installation. After installation, create a shortcut on the desktop to the file AIMM.exe. This can be accomplished by opening Windows Explorer, right click on the file AIMM.exe and choose create shortcut. Then drag the shortcut file onto the desktop and rename to AIMM.

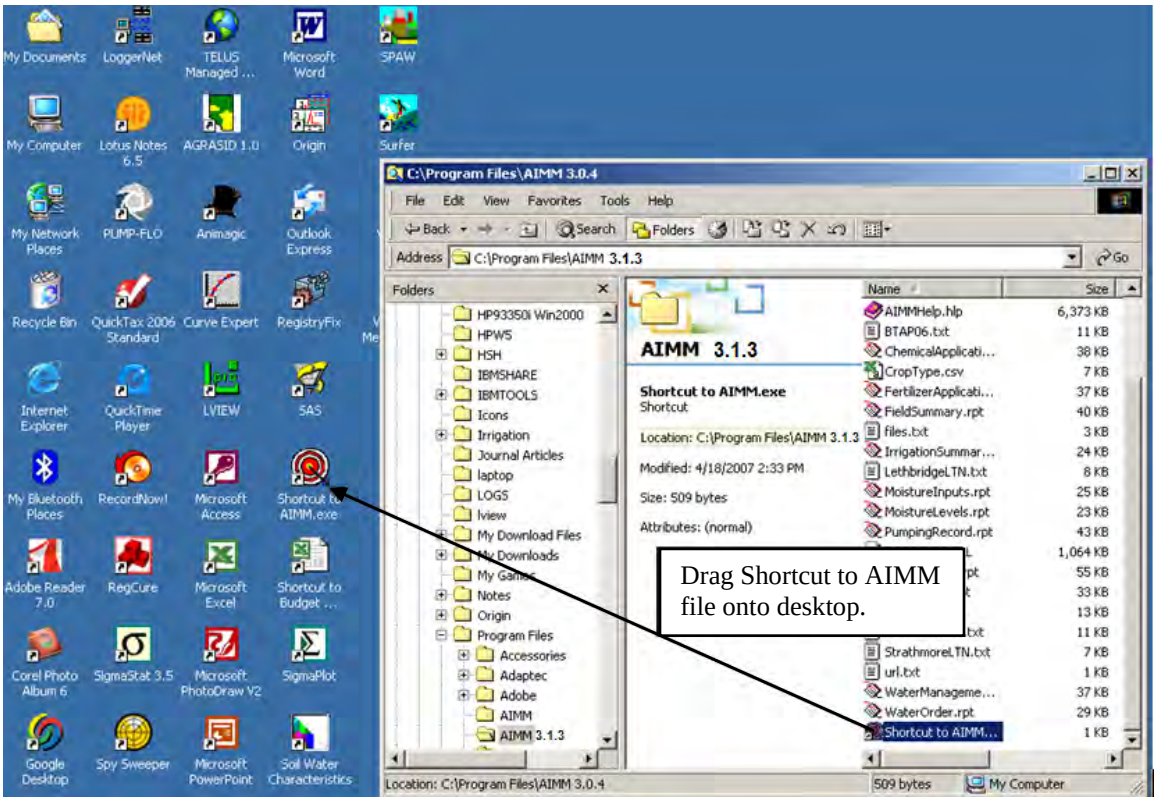


Figure 1. Adding AIMM icon onto desktop.

To run program, double click on AIMM icon.

Figure 2. AIMM Icon

6 Menu Toolbar

6.1 File Tab:

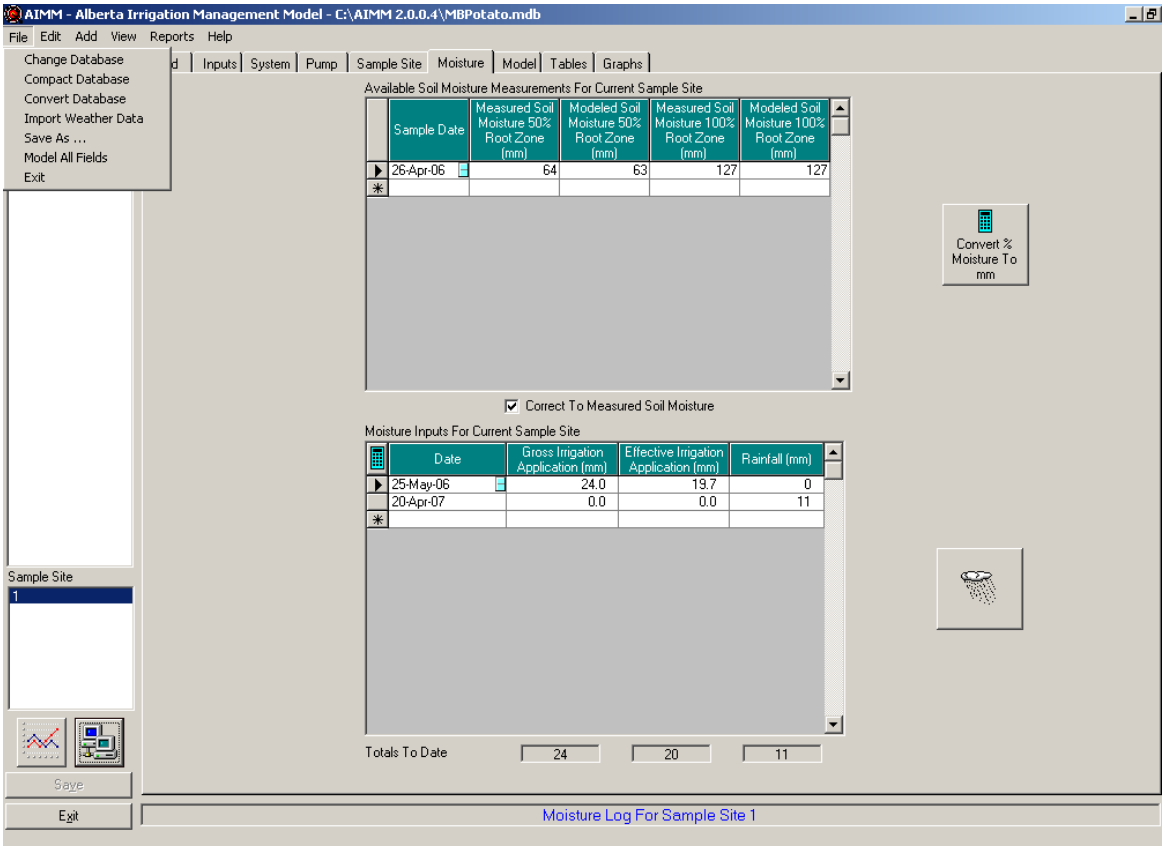


Figure 3. Choices under "File" on the menu bar.

6.1.1 Change Database

Select ‘Change Database’ if the database is not located in the default directory, or if you need to select a different database. After clicking on ‘Change Database’, a window will appear, where the desired database can be chosen.

6.1.2 Compact Database

Using this function will compact the database. AIMM uses a Microsoft Access database, which will grow in size with use, making this a useful feature.

6.1.3 Convert Database

An earlier database version of AIMM (e.g. AIMM 2.0.4 or earlier) can be used in the new version of AIMM 3.1.3 by using the convert database option. Browse your directory by selecting the icon to the right of the dialog box and choose the database you wish to convert. Once selected, click the **convert** button (Figure 4).

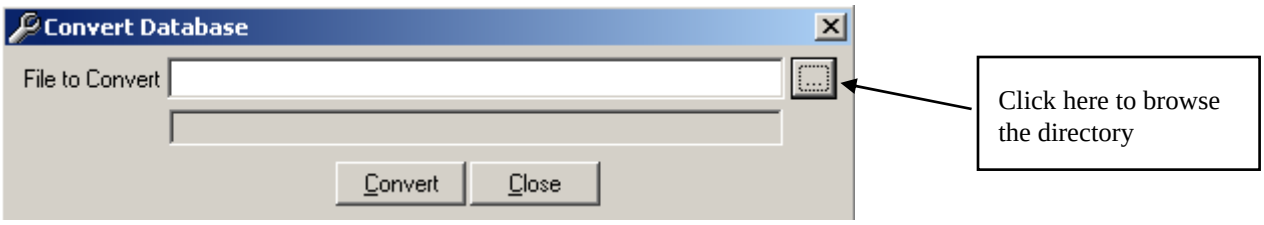


Figure 4. Convert database entry dialog.

6.1.4 Import Weather Data

Generally, the weather files needed as input for the AIMM model are available for download by clicking the download weather file icon ( ). However, other weather data (from a stand alone station in the field, from another provider) can be used providing they are in the proper format for use by the AIMM model (See Appendix IV for format requirements). Each field/site combination requires an average meteorological day (AMD) file (commonly referred to as long-term normals) and a weather file.

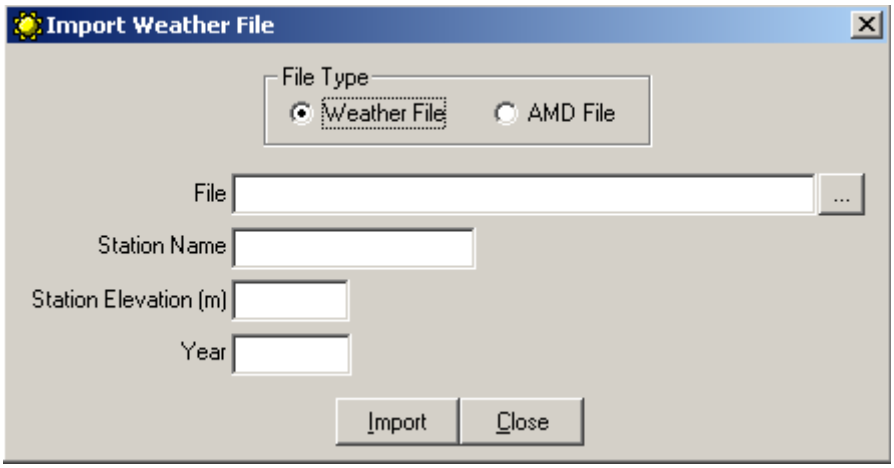


Figure 5. Import weather file entry dialog.

To import an alternate weather data file, rather than the default meteorological stations available in AIMM, type the location of the file or click on the browse button to open the 'Select Weather File to Import' window. Then, use the drop down box to select the file location, and click 'Open'. On the 'Import Weather File' window, enter 'Station Name', and 'Station elevation'. If you have selected 'Weather File' as the 'File Type', you must enter the year. Once these fields are completed, click 'Import' to load data to database. Click OK.

6.1.5 Save as

Selecting 'Save As . . .' will allow you to save any database changes. Check the file name and select location of where the file is to be stored. You can change the name of the default AIMM.mdb to one more suitable. This is useful particularly if you want to create a number of databases.

6.1.6 Model All Fields

The newest version of AIMM, allows multiple field entries. The Model All Fields selection allows all the fields in the current database to "Run" as opposed to doing each field separately using the Run Model button .

6.1.7 Exit

Selecting ‘Exit’ closes AIMM.

6.2 Edit Tab:

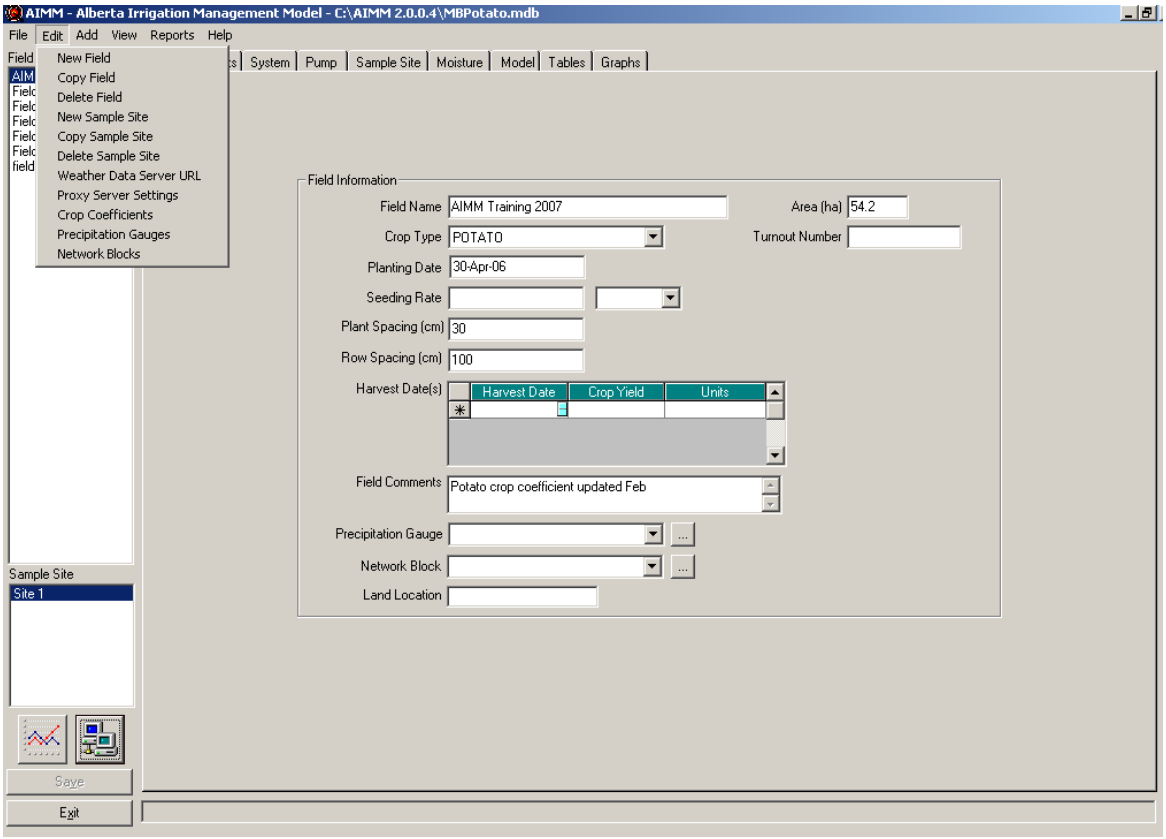


Figure 6. Options under "Edit" on the menu bar.

6.2.1 New Field

Selecting ‘New Field’ creates a new Field to be added to the database. Fill in an appropriate entry for ‘Field Name’ and click ‘Create Field’ button. This feature must be used each time a new Field is added to the database.

6.2.2 Copy Field

Selecting ‘Copy Field’ allows you to copy an existing Field. Enter a new name after ‘New Field Name’, then select the ‘Copy’ button. A new Field name must be given to this copied Field site.

This feature can be used when modeling the same Field on different years and data already saved can be used in successive years. The name change can be as simple as adding a new year after the land location.

6.2.3 Delete Field

Selecting ‘Delete Field’ permanently deletes the Field currently selected. When a Field is deleted, any sample sites associated with the Field are also deleted.

6.2.4 New Sample Site

Selecting 'New Sample Site' creates a new sample site. Enter the name for the new sample site and click 'Create New Sample Site' button. The name given to sample site may be alphanumeric. For each Field entered, a new sample site must be created as data for this site is linked to the Field location. More than one sample site may be needed for a single Field if soil conditions are different or if one area of the Field is higher in elevation than another. Soil moisture conditions could be different and irrigation scheduling may require timing or volume changes.

6.2.5 Copy Sample Site

Selecting 'Copy Sample Site' copies a Field, and adds it to your 'Sample Site' list.

1.) Using the drop down list, select which field is to be copied.
2.) Enter a name for the copied sample site and click the 'Copy' button.

6.2.6 Delete Sample Site

Selecting 'Delete Sample Site' permanently deletes the currently selected sample site.

6.2.7 Weather Data Server URL

Selecting 'Weather Data Server URL' sets or changes the URL where the weather data will download from. In the text box provided, enter the URL of the data source. Meteorological information, for all AIMM stations in Alberta, resides at the URL address, http://www.imcin.net/aimm-files/aimm-cf.htm. If local weather data is not available, check the Alberta Agriculture and Food web site http://www.agric.gov.ab.ca/app49/imcin/index.jsp for the location of the nearest weather station in Southern Alberta.

6.2.8 Proxy Server Settings

If connection to the internet is through a proxy server, it may be necessary to enter the proxy server's IP address to download weather data over the internet. Selecting 'Proxy Server Settings' from the edit menu opens up a 'Proxy Server Settings' window. Simply enter the IP address of the proxy server, and click 'Apply'.

6.2.9 Crop Coefficients

Crop coefficients are used in the model to define how a specific crop uses water compared to an alfalfa reference crop. Crop coefficients are unique to a crop grown, the equation used to estimate reference evapotranspiration and to the particular climatic area. Crop coefficients used in AIMM are calibrated for the semi-arid region of Southern Alberta.

Crop coefficients in AIMM use cumulative growing-degree-days (GDD^5) as the independent axis when constructing the crop coefficient curve. Crop coefficients are in the process of being evaluated and updated by use of the Bowen Ratio Energy Balance Apparatus. New crop coefficients are posted on our AIMM website once they become available. It is good habit, once each spring, to press the Update All Crop Coefficients icon to ensure the newest crop coefficients are available within the current database.

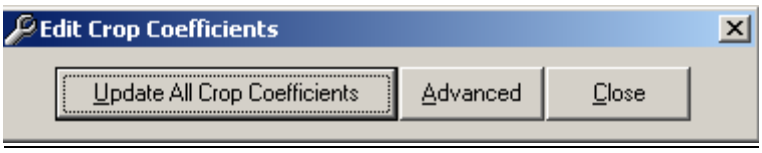


Figure 7. Edit crop coefficients options.

If the model is being applied to fields outside of the area the crop coefficients were calibrated and validated for, the Advanced icon can be used to enter coefficients specific for your area for the crop grown.

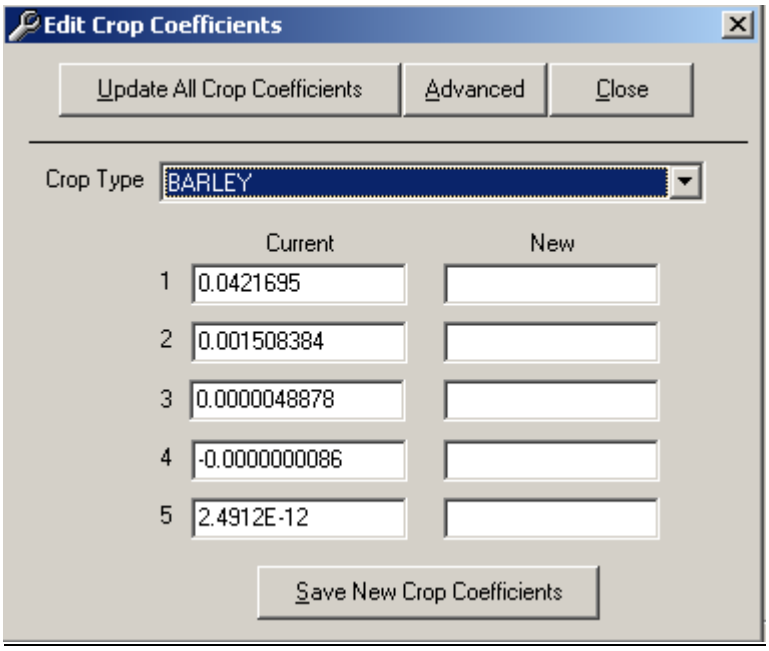


Figure 8. Advanced option for crop coefficients.

The crop coefficient equation is in the form of a 4th degree polynomial in the form of

$$kc = a + bx + cx^2 + dx^3 + ex^4$$

where kc = crop coefficient (dimensionless)

x = cumulative growing-degree days

a, b, c, d, e = coefficients specific to the crop grown (Barley in the example).

Once the locally calibrated crop coefficients are entered, pressing the Save New Crop Coefficients icon will write the new GDD[5] coefficients into the database replacing the default coefficients.

6.2.10 Precipitation Gauges

This selection enables associating multiple fields to local precipitation gauges. For instance, if there is a centrally located precipitation gauge for monitoring rainfall events, associating fields to the precipitation gauge allows one entry of precipitation to be applied to the linked fields, eliminating the necessity for adding rainfall events to each field separately.

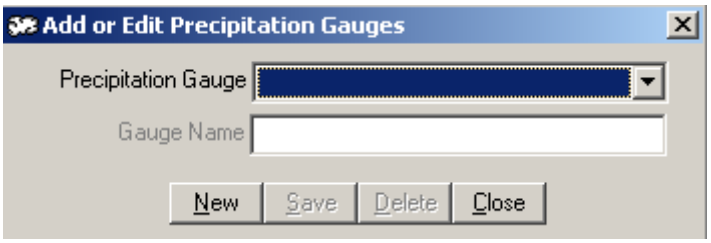


Figure 9. Precipitation gauge dialog entry.

When adding precipitation gauges, click New and the gauge name information can be added. The field presently being entered will be associated with the current gauge name, however if multiple gauges are being used, they will appear in the drop down menu of the Precipitation Gauge selection after entry.

6.2.11 Network Block

This selection enables organizing multiple fields into blocks. It is a feature specific for fields located within an irrigation district where irrigation water is supplied through the districts canal distribution system. This helps to organize the information on who to call when a water order is placed.

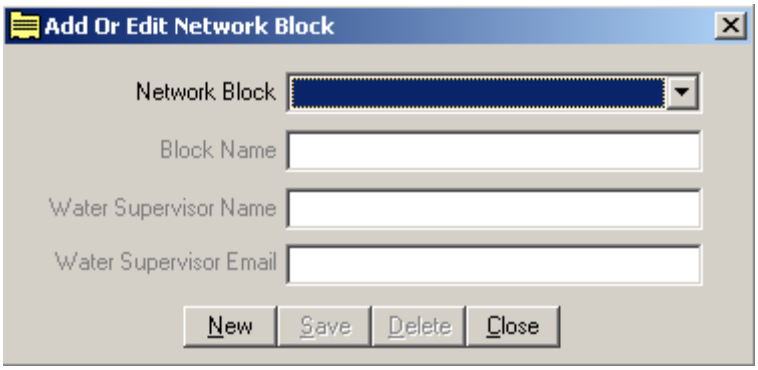


Figure 10. Network block dialog entry.

When entering the information, click on New to add the Block Name, Water Supervisor Name and Water Supervisor Email. The current field you are entering the information for will be associated with the network block information entered. As more network blocks are entered, they will appear in the drop down menu entitled Network Block.

6.3 Add Tab

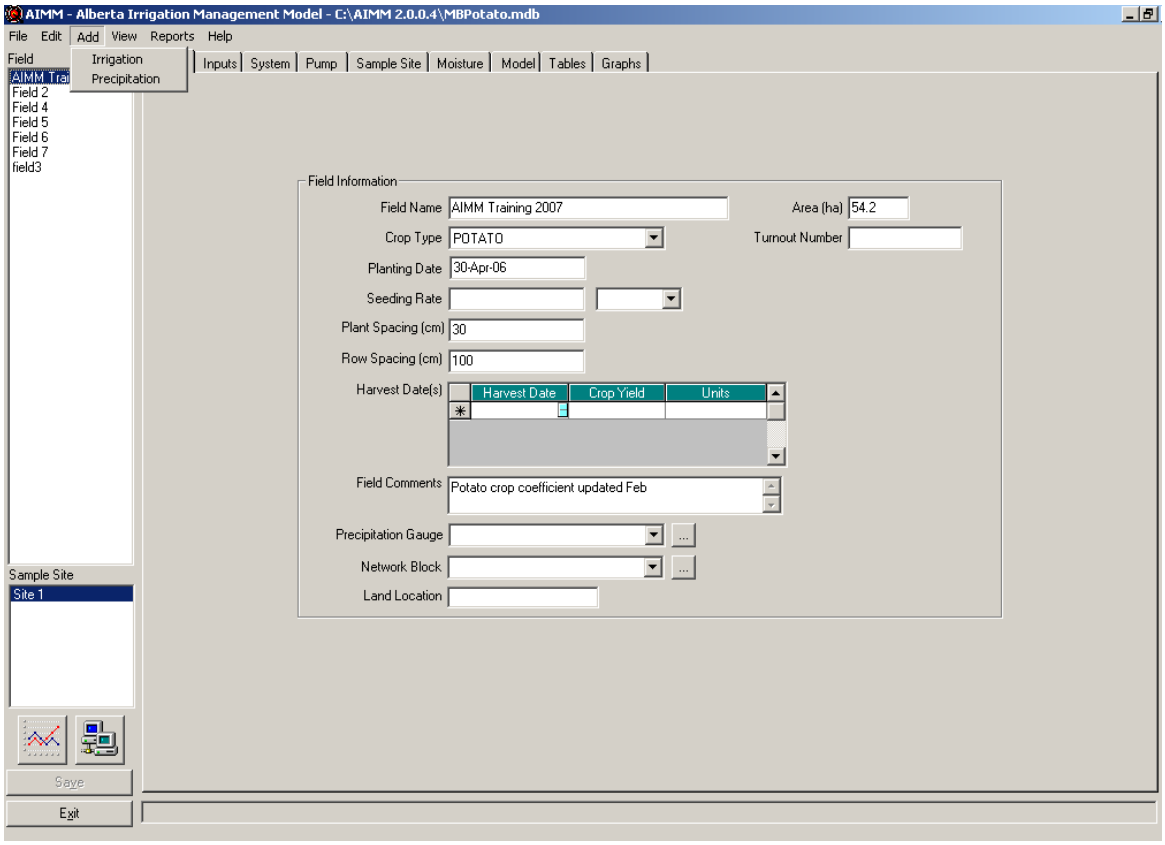


Figure 11. Options under the 'Add' on the menu bar.

6.3.1 Irrigation

This option allows irrigations to be entered all in one interface without the need for highlighting each field in the database. Note: The field must be irrigated with center pivot irrigation to use this option.

For each field enter the gross application per revolution, time per revolution, application efficiency (if different than the default values), irrigation date, irrigation time (how long the irrigation was applied). The gross irrigation application and effective irrigation application will be calculated based on the center pivot operating characteristics, irrigation time and application efficiencies. Clicking the APPLY button will add the irrigations entered to the irrigation input under the "Moisture Tab".

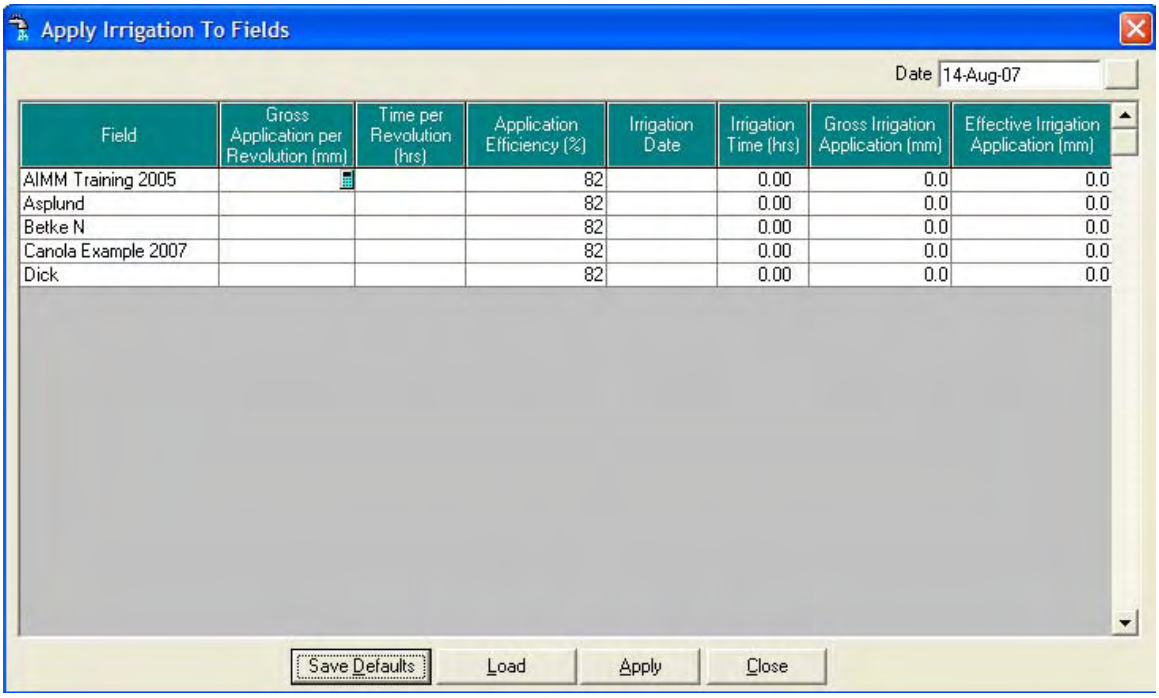


Figure 12. Adding irrigations to multiple fields.

If a Valley CAMS panel with the BaseStation2 software are being used as part of the irrigation system, data from the BaseStation2 software in the form of a comma delimited file can be entered directly into the Add Irrigation table by clicking the 'Load' button. The user must ensure that the field names entered into the BaseStation2 program are identical to the field names entered into AIMM program (Figure 13).

Asplund	6/2/2006 8:59	6/2/2006 10:59	2	0	0	1200			0	Polled Interval
Betke N	6/1/2006 0:07	6/11/2006 0:10	2	0	0	1200			0	Polled Interval

Figure 13. Example of data output from the Valley BaseStation2 software.

6.3.2 Precipitation

This selection is for entry of precipitation events associated with precipitation gauges. Each gauge that was entered from the Edit Menu will appear in the dialog box. Precipitation events will be applied to all fields associated with the specific precipitation gauge.

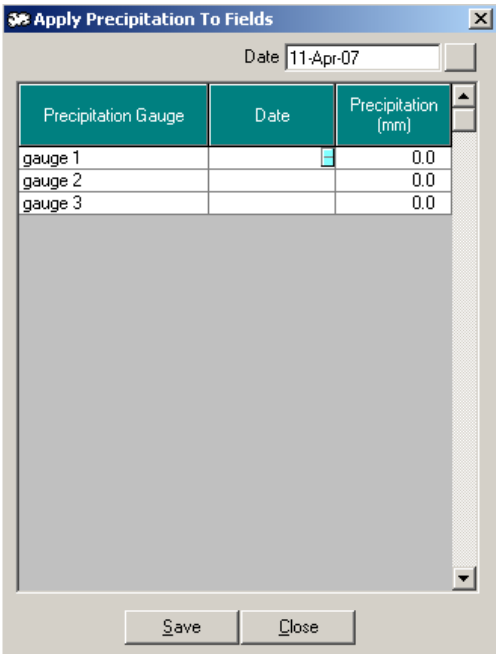


Figure 14. Adding precipitation amounts from local precipitation gauges.

6.4 View Tab:

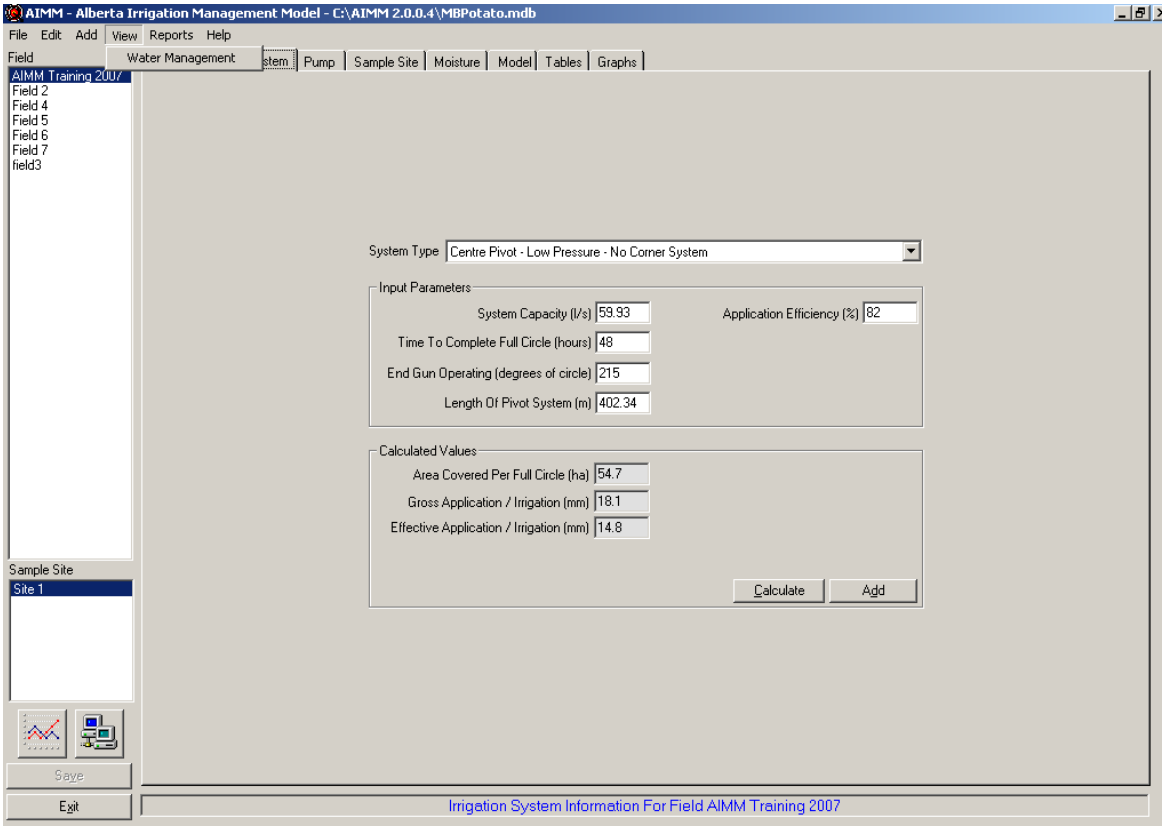
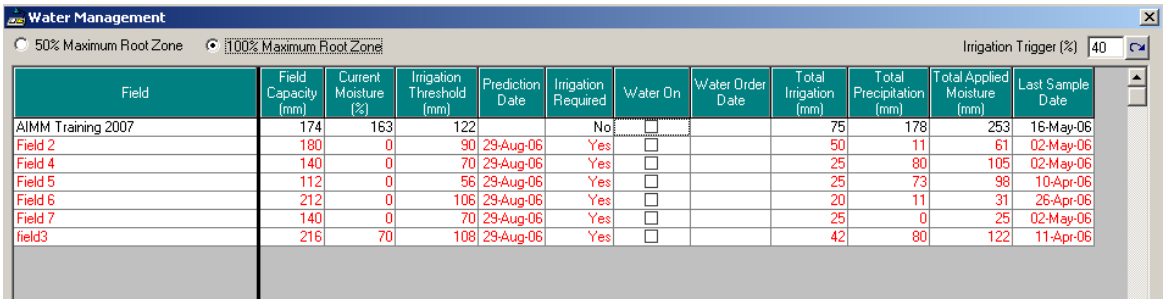


Figure 15. Options under ‘View’ on the menu toolbar.

6.4.1 Water Management Report

This selection summarizes the information for all the fields entered in the database into one worksheet. Information summarized for each field includes, field capacity (based on soil texture), current moisture status, irrigation threshold based on the soil hydraulic properties, prediction date, whether an irrigation is required (No – appears in black, Yes – appears in red), Water On (check box), Water Order Date, and summaries for the season (Total Irrigation, Precipitation and Total Applied Moisture (summed from irrigation and precipitation)), and finally Last Sample Date (last date of manual soil moisture monitoring).



Field	Field Capacity (mm)	Current Moisture (%)	Irrigation Threshold (mm)	Prediction Date	Irrigation Required	Water On	Water Order Date	Total Irrigation (mm)	Total Precipitation (mm)	Total Applied Moisture (mm)	Last Sample Date
AIMM Training 2007	174	163	122		No	☐		75	178	253	16-May-06
Field 2	180	0	90	29-Aug-06	Yes	☐		50	11	61	02-May-06
Field 4	140	0	70	29-Aug-06	Yes	☐		25	80	105	02-May-06
Field 5	112	0	56	29-Aug-06	Yes	☐		25	73	98	10-Apr-06
Field 6	212	0	106	29-Aug-06	Yes	☐		20	11	31	26-Apr-06
Field 7	140	0	70	29-Aug-06	Yes	☐		25	0	25	02-May-06
field3	216	70	108	29-Aug-06	Yes	☐		42	80	122	11-Apr-06

Figure 16. Water management summary for all fields and sites.

Data can be viewed for the entire root zone (100% Maximum Root Zone chosen) or the upper half of the root zone (50% of Maximum Root Zone chosen).

The irrigation trigger allows for the user to set how much reserve water, above the irrigation threshold, to retain in the soil profile while identifying an irrigation is required (data turns to red) (See explanation in Appendix 1).

6.5 Reports Tab:

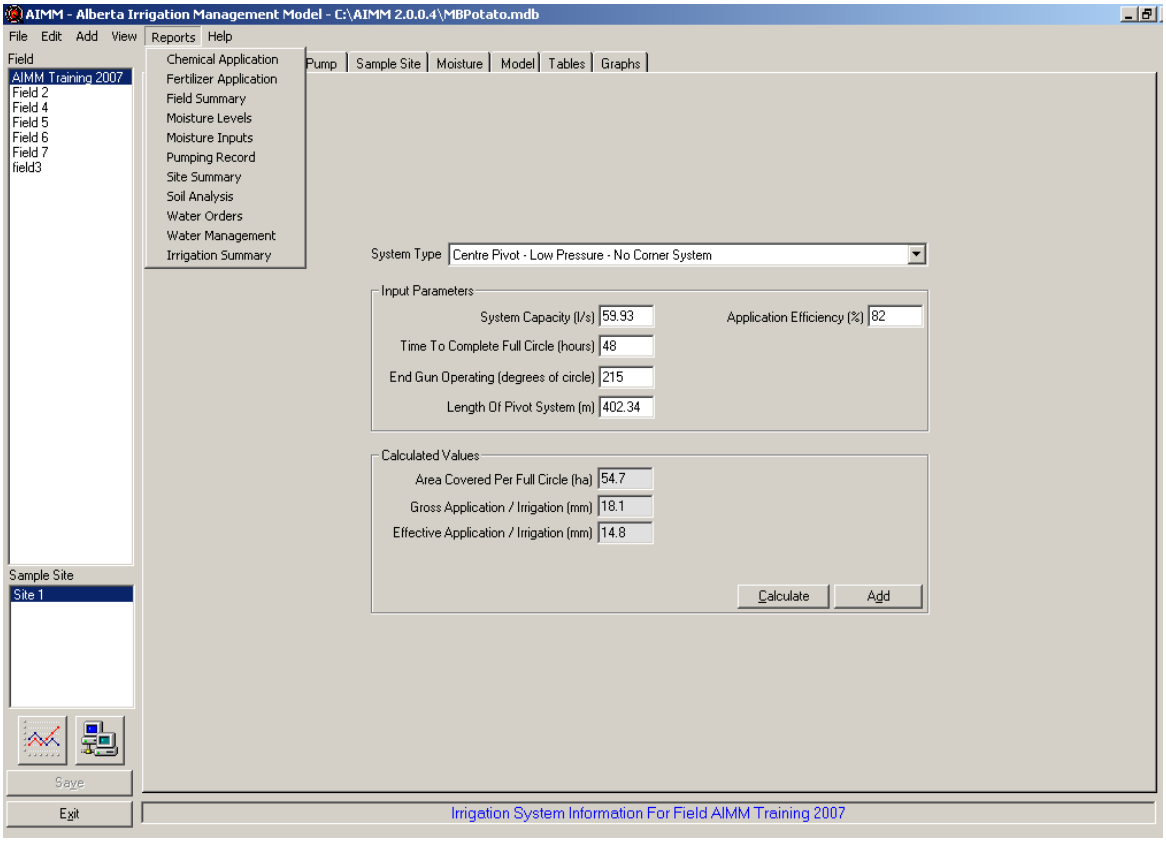


Figure 17. Options under 'Report' on menu toolbar.

The following options are available under the Reports Menu Option:

- Chemical Application
- Fertilizer Application
- Field Summary
- Moisture Levels
- Moisture Inputs
- Pumping Record
- Site Summary
- Soil Analysis
- Water Orders
- Water Management
- Irrigation Summary

The reports listed above were designed to provide a hard copy of AIMM inputs and model results. Once generated, reports can be sent to a printer or exported to a file. Export formats include Microsoft Word, Microsoft Excel and PDF. For more information, see the 'Viewing Reports' topic.

6.5.1 Viewing Reports

After clicking on the report from the Reports menu, a new window will open containing the report. You can now print it, or export it to a number of file formats.

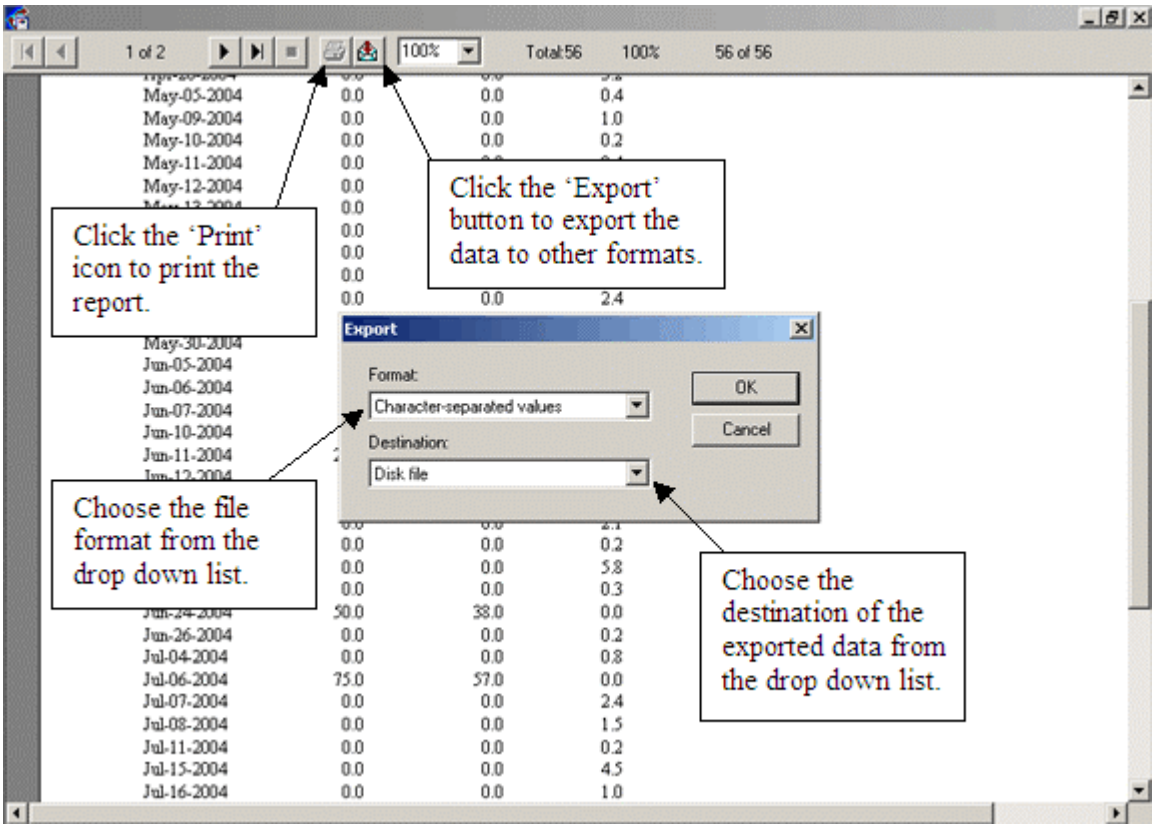


Figure 18. Viewing, printing and exporting reports.

6.6 Help Tab

Contents – Choose this menu option when you want to view this help file.

About – This option contains information on the current version of AIMM, the database version, and copyright information.

For more help options, please see the following topics:

- Getting Help While You Work
- Technical Support

7 Getting Started

7.1 General Information on Entering Data

7.1.1 Conversion Tool

AIMM uses metric values for all the calculations. On many text boxes throughout AIMM, there is a conversion tool available where you can enter the data in familiar units and they will be converted to the metric units for calculations within AIMM. If you place the mouse pointer over the text box and the mouse pointer turns into a calculator (Figure 19), the conversion tool is available for this input. To use the conversion tool, simply double click inside the textbox, and the conversion tool will launch. When launched, simply type the value to be inputted in the textbox labeled 'Convert', and then click on the corresponding unit of the value. Only units that can be converted are listed below the value you just typed in. When finished, click the 'OK' button to complete the conversion, or the 'Cancel' button to cancel and leave the value unchanged.

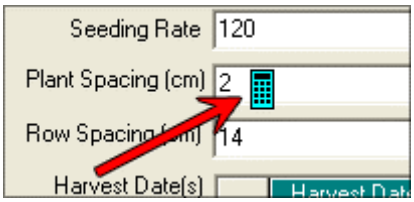


Figure 19. Conversion tool icon.

7.1.2 Calendar Tool

Within several text boxes and grids throughout AIMM, there is a calendar tool available to make it easy to pick a certain date. If you click inside a cell in a grid and a small light blue icon appears (Figure 20), this means the calendar tool is available. Simply click on the icon, and this will launch the calendar tool.

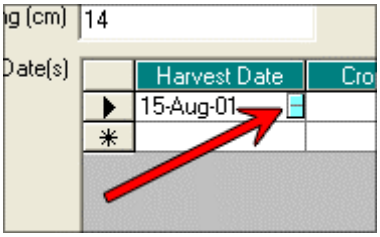


Figure 20. Calendar tool icon, embedded in input field.

If the mouse pointer turns into a small, light blue icon (Figure 20) when the mouse pointer moves over the text box double click anywhere inside the text box to launch the calendar tool.

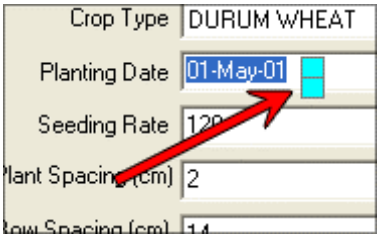


Figure 21. Calendar tool icon, cursor activated.

Once the Calendar tool is launched, select the month and year using the two-drop down lists in the upper right corner. The calendar will then show you the days of the week for that month and year. Click on the date you want, and click 'OK' to select that date and close the tool. Or click 'Cancel' to close and leave the date unchanged.'

7.1.3 Clock Tool

If you click inside a cell in a grid and a small clock icon appears (Figure 22), this means the clock tool is available. Click on the clock icon, and this will launch the clock tool. Once launched, pick any time from the list, and either select 'OK' to select the time, or click on 'Cancel' to close the clock tool and leave the time unchanged. Times are displayed in 15 minute increments.

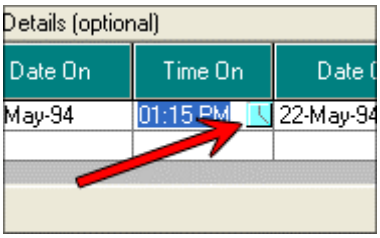


Figure 22. Clock tool.

7.1.4 Program Buttons

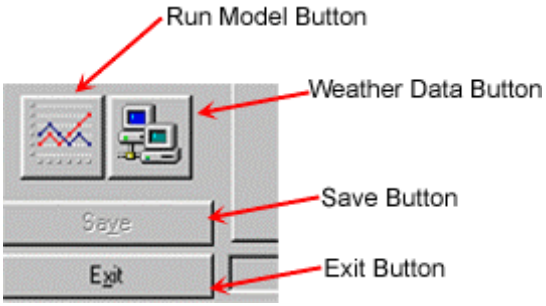


Figure 23. Program buttons.

7.1.4.1 Run Model Button

Click 'Run Model' button to run the current model.

7.1.4.2 Weather Data Button

Click the 'Weather Data' button to download weather data from the Alberta Agriculture and Food web site. A window will launch, containing all the available AIMM meteorological stations available for download (Figure 24). A single record or multiple records may be selected by clicking the check box associated with each entry. Once all desired records are selected, click the 'Download' button – wait for the download complete acknowledgement, and then click 'Exit'.

If unsure of the nearest regional meteorological station, a map identifying the location of all regional stations in Southern Alberta is located at http://www.agric.gov.ab.ca/app49/imcin/met.jsp.

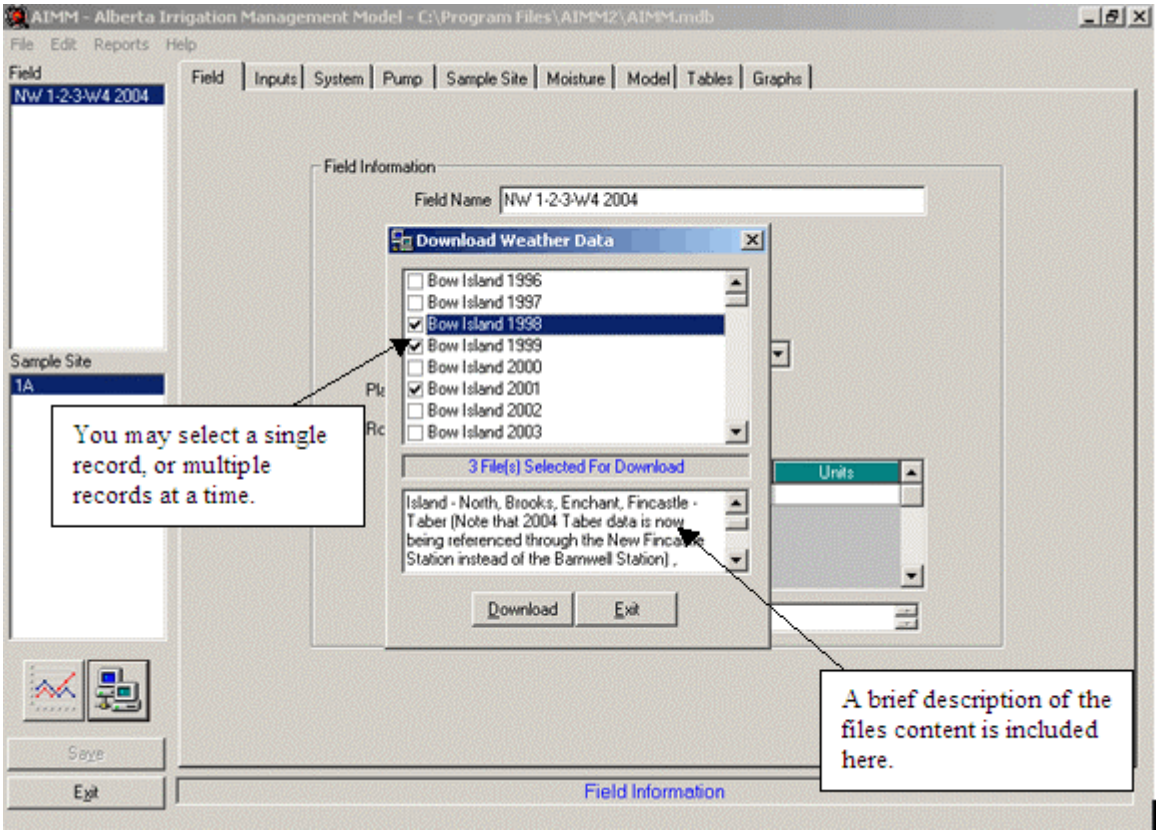


Figure 24. The 'Download Weather Data' window.

7.1.4.3 Save Button

Whenever a change has been made, the file needs to be saved. Once saved, a model run can be carried out. It is important to remember that changes must be saved or the model will not run. It is a good habit to click the 'Save' button when entering data, each time you move to a new input screen.

7.1.4.4 Exit Button

Click on exit to leave the program

8 Field Tab

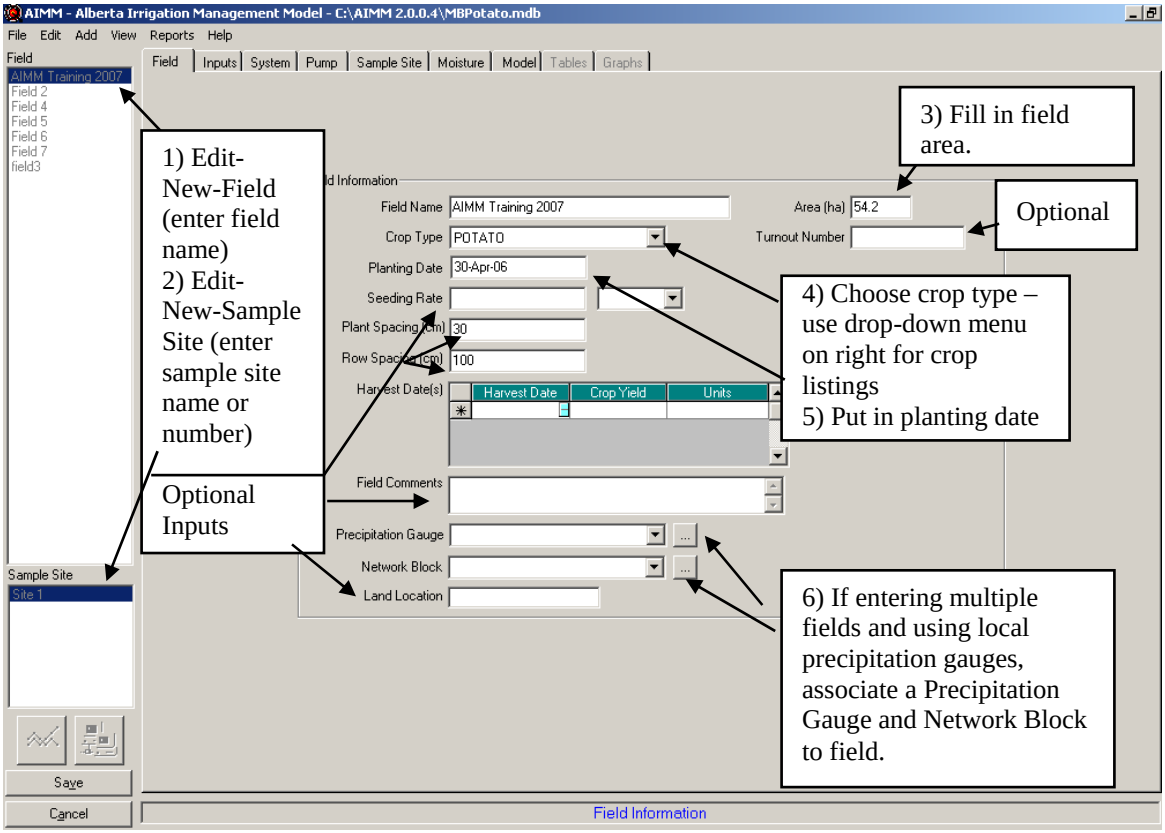


Figure 25. Data requirements for the "Field" tab.

To create a new Field:

- Click on ‘Edit’, then ‘New Field’. Enter the Field Name and click ‘Create Field’ button.
- Click on ‘Edit’, then ‘New Sample Site’. Enter a name (or number) for the sample site and click ‘Create Sample Site’ button.
- Enter the field area as hectares. If you have the field area in another unit, double click on the text box to use the conversion tool. In the ‘Convert to ha’ window, enter the numeric value of the measurement in the text box, then select the appropriate unit below, then click ‘OK’. The conversion tool can convert the field area from acres, square feet, square miles, square kilometers or square meters. Please note that area is displayed in hectares throughout the AIMM application.
- Select the ‘Crop Type’ from drop down menu. Click on the downward arrow on the right side of the box to display and select crop listings.

- Enter ‘Planting Date’ or double click on the text box and select the date from the calendar, click OK. The calendar icon lets you know that a drop down calendar is available.

- If entering multiple fields and using local precipitation gauges, associate a Precipitation Gauge and Network Block to the field by clicking the icon to the right of the dialog box  . This input is not necessary if the multiple field option is not being used.

Please Note: For the model to run, each of the above fields must be filled in or you will get an error message revealing the missing required input Field.

8.1 Optional Inputs on the Field Tab

The following are for information record keeping only and are not required to run the model.

- Enter the ‘Seeding Rate’, then select the drop down box to select units. Click ‘OK’.

- Enter the value for the ‘Plant Spacing’ or double click on the text box to use the conversion tool. In the conversion tool, enter in plant spacing number to convert, then select the appropriate units and click ‘OK’.

- Enter value for the ‘Row Spacing’, or double click on the text box to use the conversion tool. In the conversion tool, enter in the row spacing number to be converted, then select the appropriate units, and click ‘OK’.

- Enter harvest date and crop yield at end of season.

- Select the units for crop yield from the drop down box.

- Enter any comments in the Field Comments box.

- Enter land location.

- Enter turnout number (if applicable).

9 Inputs Tab

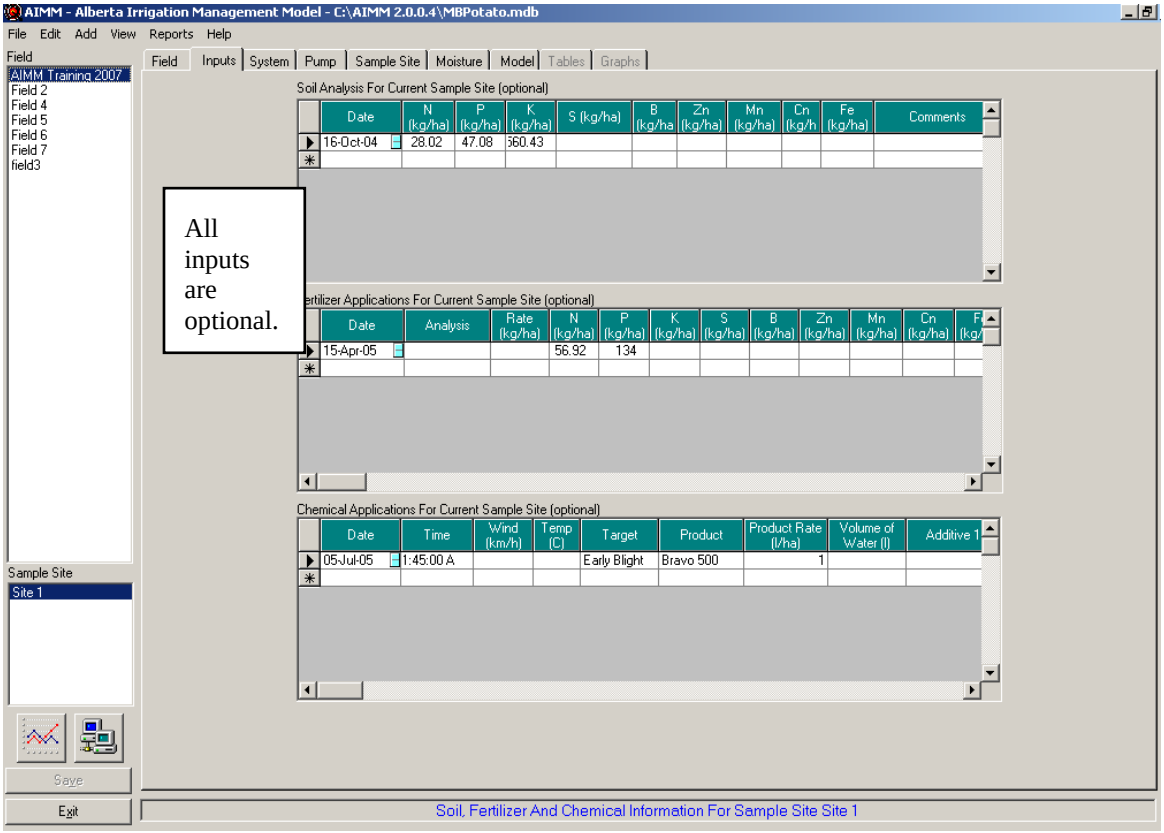


Figure 26. Data requirements for the "Inputs" tab.

Information under this tab is for record keeping and/or information purposes only and not used in any model calculations.

- In the ‘Soil Analysis’, ‘Fertilizer Applications’, or ‘Chemical Applications’ boxes, enter a date using a day-month-year format or click inside the cell, and click on the calendar icon. Select the date from the calendar, and click ‘OK’. For chemical applications, you can also record the time, windspeed and temperature.

- Enter kilogram per hectare values in the appropriate fertilizer boxes (e.g. N, P, K, S, etc), or launch the converter by clicking in the cell, then clicking on the calculator icon. In the converter, enter the data to be converted, select the unit, and then ‘OK’.

- Enter the fertilizer ‘Analysis’ and ‘Rate’ data.

- Enter the chemical ‘Material’ and ‘Rate’ data.

- Enter litres per hectare (l/ha) in the appropriate boxes. Information about any additives used can also be entered.

10 System Tab

10.1 Centre Pivot System Type

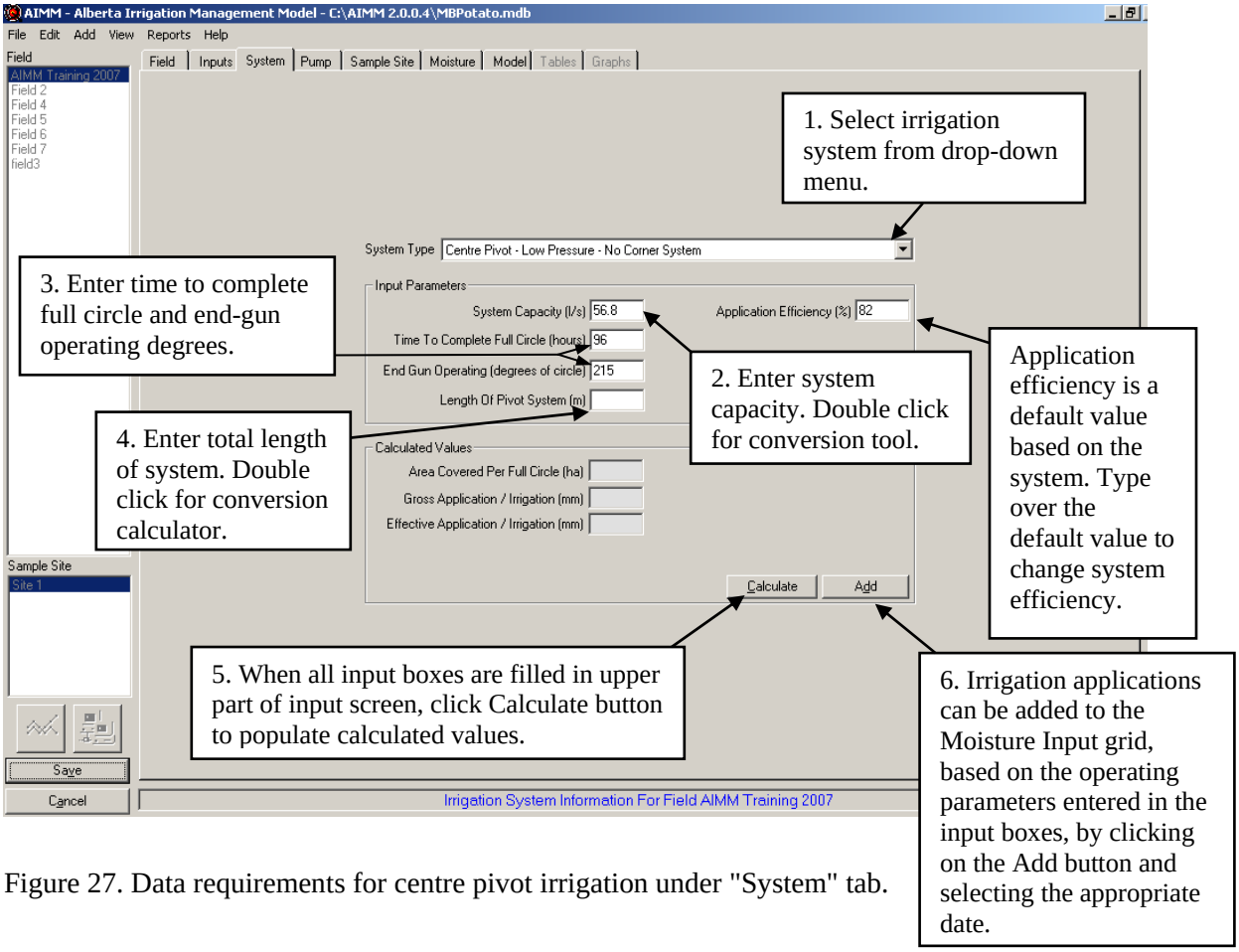


Figure 27. Data requirements for centre pivot irrigation under "System" tab.

Select the 'System Type' from drop down box. Default values have been developed for each method of irrigation. If specific irrigation system information is available, this can be entered into any box in the 'Input Parameters' section. Double clicking on 'System Capacity', 'Time to Complete Full Circle', 'End Gun Operating', or 'Length of Pivot' will launch the conversion tool, where data can be entered along with the appropriate units (feet, gpm, etc.). Select 'OK' to close the conversion tool.

- The default value for 'Application Efficiency' can be over-written with a new (or known) value.

- When all of the boxes in the Input Parameter section (top six boxes) have values in them, selecting the 'Calculate' button in the 'Calculated Values' section will populate the boxes in the lower section of the page.

- Irrigation applications can be added to the Moisture Input grid under the Moisture Tab, based on the operating parameters identified under the System Tab, by clicking on the Add button and selecting the appropriate date of irrigation.

10.2 Wheel Move System Type

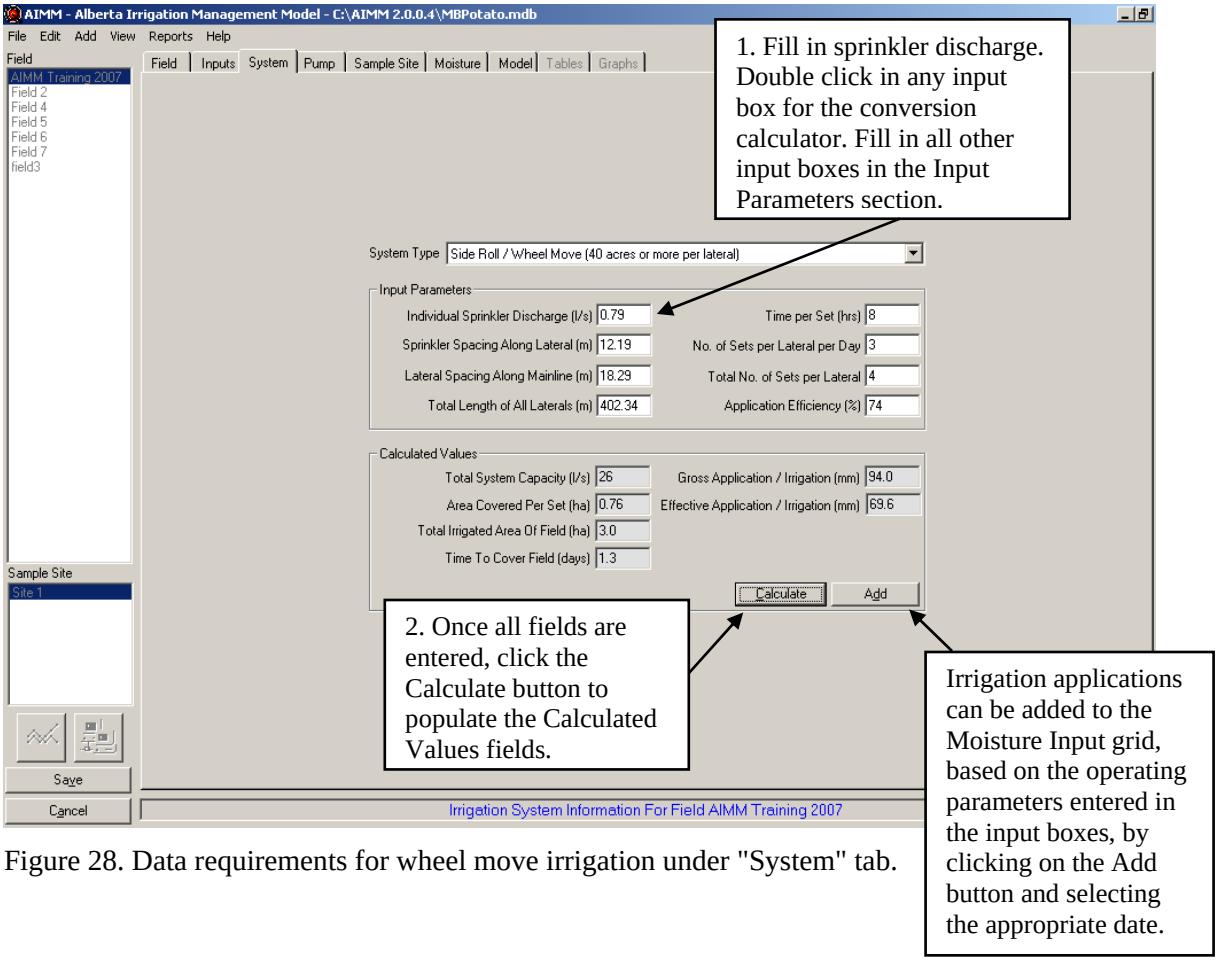


Figure 28. Data requirements for wheel move irrigation under "System" tab.

10.3 Border Dyke System Type

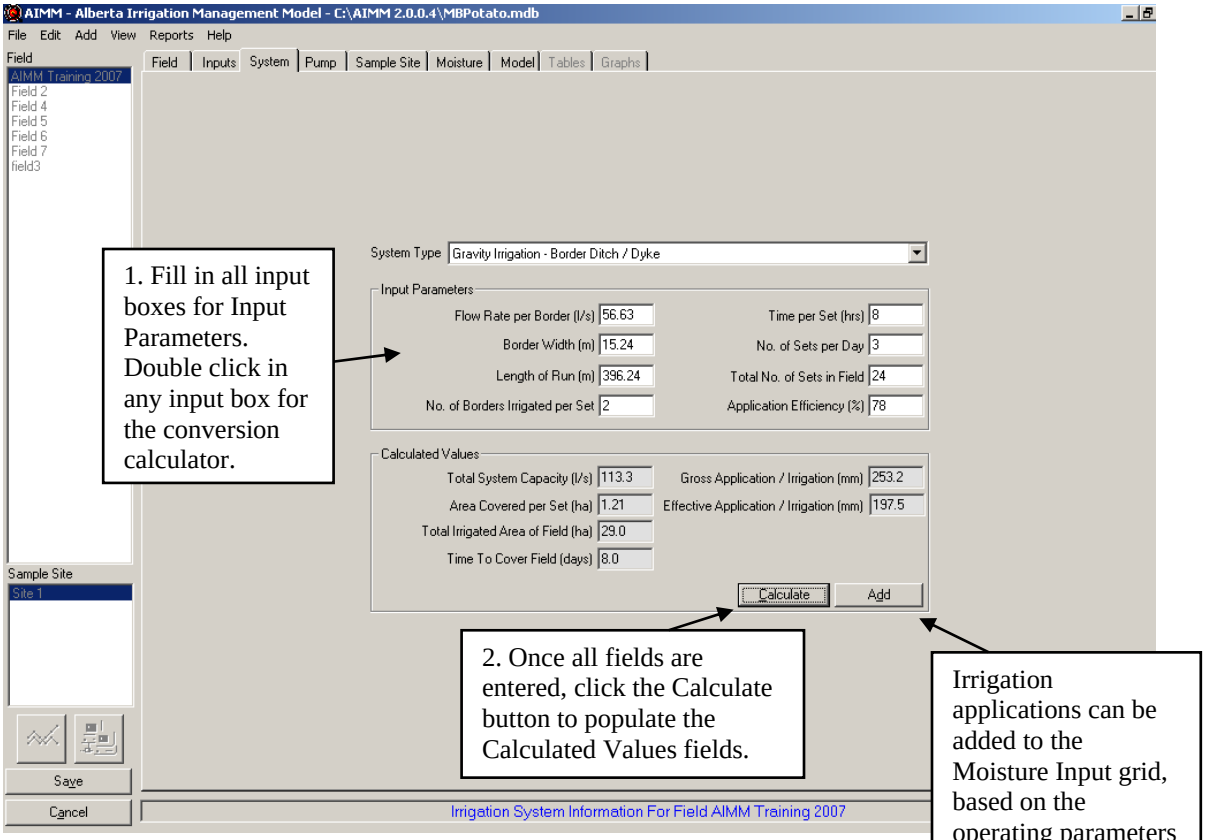


Figure 29. Data requirements for border dyke irrigation under "System" tab.

11 Pump Tab

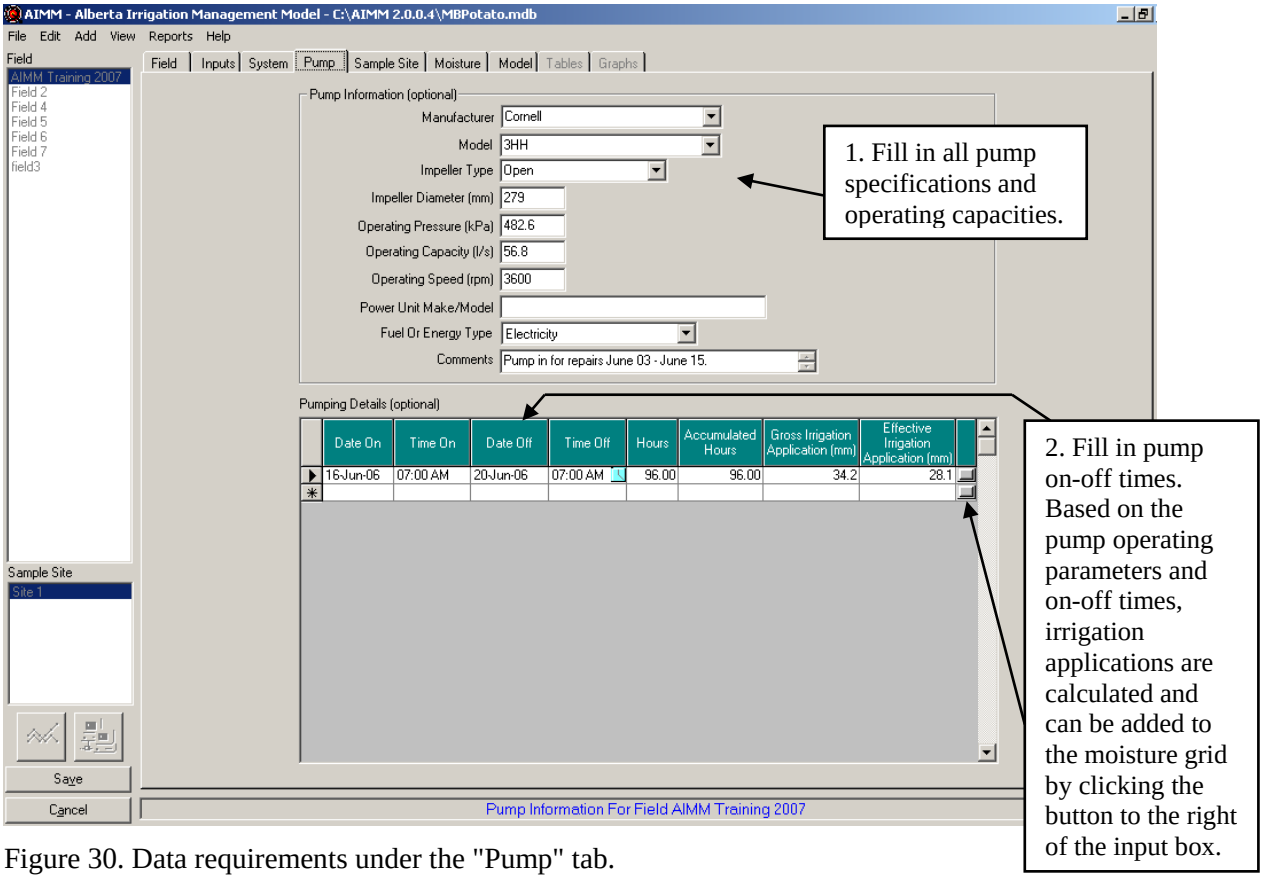


Figure 30. Data requirements under the "Pump" tab.

Input under this tab can be used for information and/or record keeping purposes only, or the irrigation applications can be applied based on pump and pump on-off times.

- Enter the ‘Manufacturer’ of the pump, or select the pump manufacturer from the drop down box.
- Enter the ‘Model’ of pump, or select the pump model from the drop down box.
- Enter the ‘Impeller Type’ of pump or select the ‘Impeller Type’ from the drop down box.
- Enter the ‘Impeller Diameter’, or double click on the textbox to launch the conversion tool, enter the value and choose the corresponding unit. Click on ‘OK’ to close the conversion tool.
- Enter the ‘Operating Pressure’, or double click on the textbox to launch the conversion tool, enter the value and choose the corresponding unit. Click on ‘OK’ to close the conversion tool.
- Enter the ‘Operating Capacity’ or double click on the textbox to launch the conversion tool, enter the value and choose the corresponding unit. Click on ‘OK’ to close the conversion tool.

- Enter the ‘Operating Speed’ (rpm).
- Enter the ‘Power Unit Make/Model’.
- Select the ‘Fuel or Energy Type’ from the drop down box.
- Enter any ‘Comments’ you want to make.
- Select the date range the pump will be active under the corresponding headings of ‘Date On’, ‘Date Off’. Enter the date or click on the calendar icon to launch the Calendar. Click on the appropriate date, and click ‘OK’. Enter a date and for every irrigation event.
- Select the time interval the pump will be active under the corresponding headings of ‘Time On’, ‘Time Off’. Enter the time (and whether AM or PM), or click on the clock icon to open a list of times. Click on the appropriate time, and click ‘OK’. Enter a time for every irrigation event.

Accumulated Hours are automatically determined.

Gross irrigation and effective irrigation are calculated based on the pump operating characteristics and the information from the systems tab. The calculated gross and effective irrigation applications can be added to the Moisture Input grid by clicking the button to the right of the input boxes  .

12 Sample Site

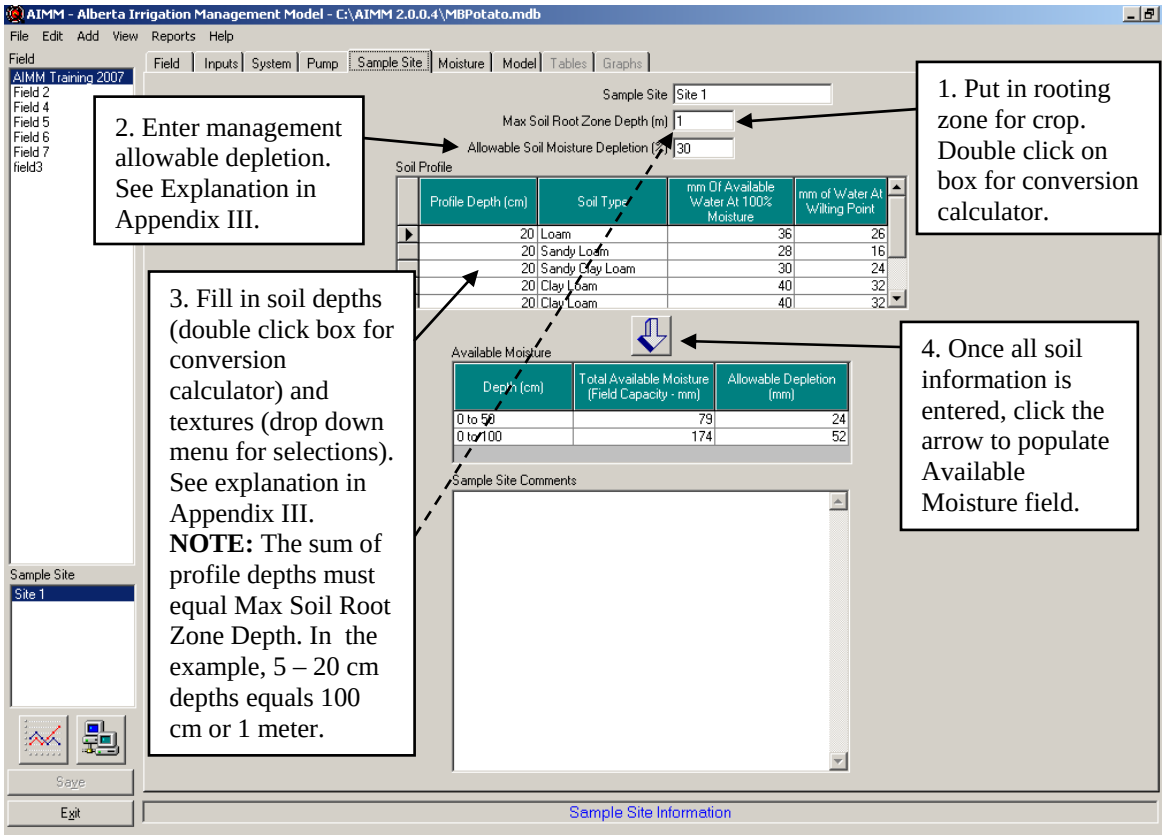


Figure 31. Data requirements under the "Sample Site" tab.

Prior to running the model the boxes on this page must be filled in or the model will produce an error message specific to the information missing or entered incorrectly.

- The ‘Sample Site’ text box is the name of the sample site to be used, from the corresponding Field (see ‘Field Tab’).
- The ‘Max. Soil Root Zone Depth (m)’ is a default value taken from the crop table. You can enter your own value or double click to launch the conversion tool. Here, you enter the value, and select the appropriate unit, and click ‘OK’.
- The ‘Allowable Soil Moisture Depletion (%)’ is a default value taken from the crop table. You can enter your own value if it is known. See ‘Management Allowed Depletion’ in Appendix III for more information.

- **Important:** The sum of the profile depth values must equal the 'Max. Soil Root Zone Depth' (e.g. 5*20 cm profile depths = 1.0m). The profile depth column can be detailed for individual soil layers, or can have a single depth with the same soil texture for the entire soil profile (Figure 32).

- Select a 'Soil Type' for each profile depth. Single click below the 'Soil Type' heading, and select a soil type from the drop down box. See Appendix III (Figure 5) for a flow chart to determine soil texture.

- The 'mm of Available Water at 100% Moisture' and 'mm of water at Wilting Point' values are automatically calculated based on the soil type selected.

- Clicking the large down arrow button below soil type will automatically calculate the 'Total Available Moisture' and 'Allowable Depletion' values for the upper ½ of the root zone and full root zone.

- Under 'Sample Site Comments', enter any comments as needed.

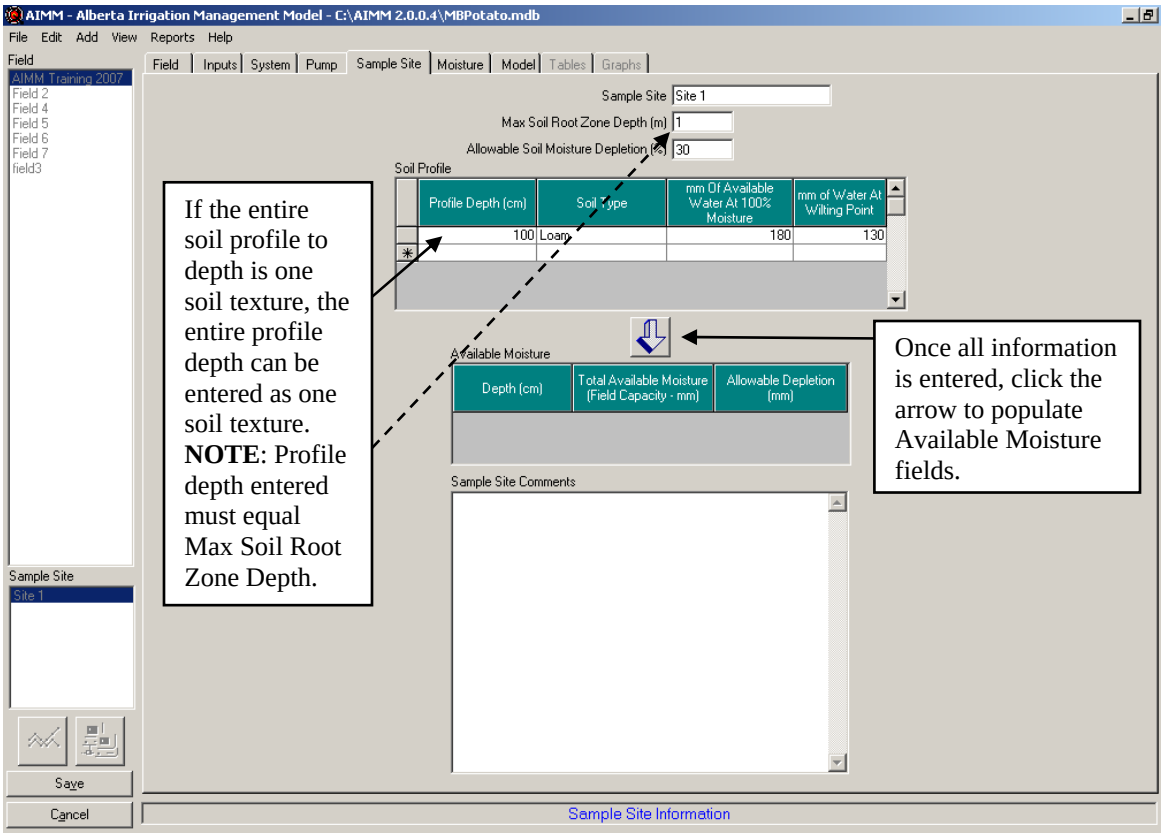


Figure 32. Example of only one soil texture for entire soil profile under "Sample Site" tab.

13 Moisture Tab

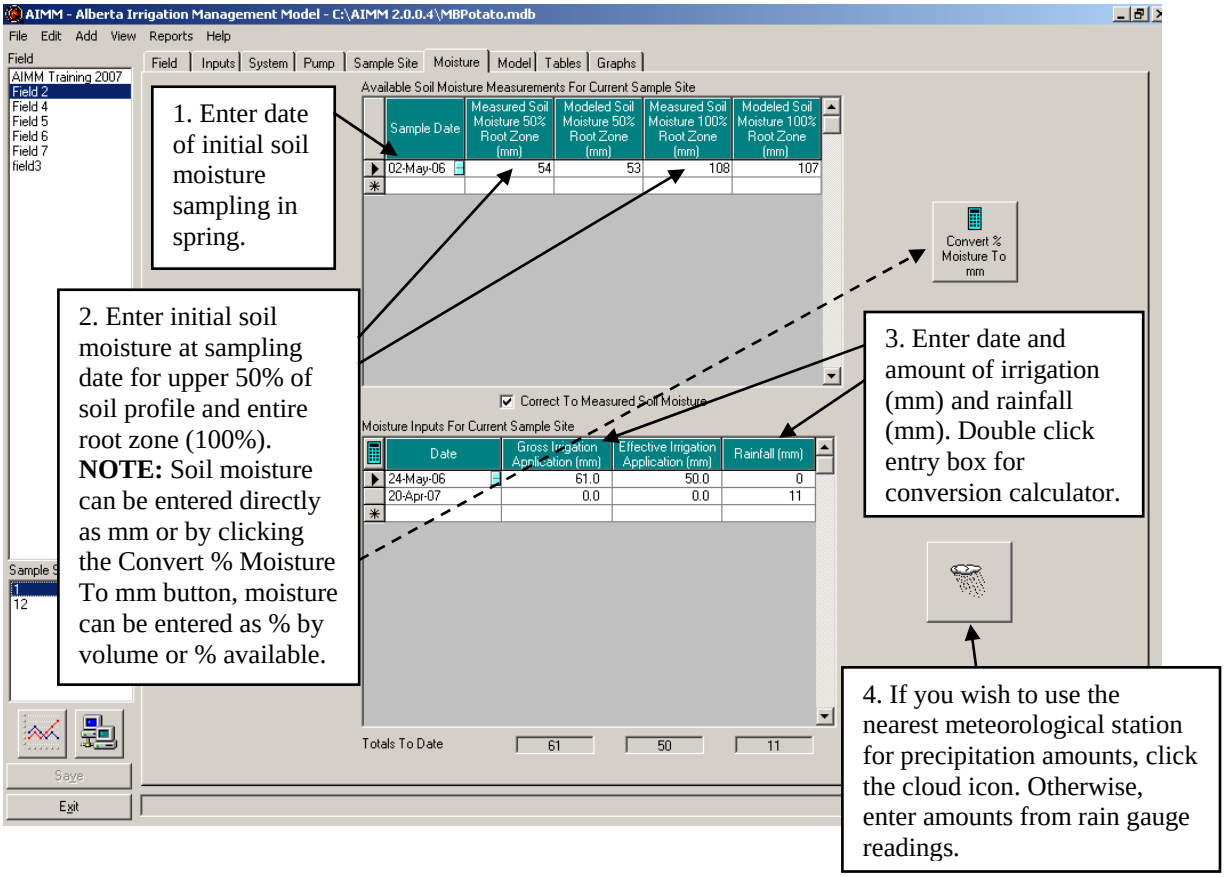


Figure 33. Data requirements under the "Moisture" tab.

Soil moisture has to be measured at least once at the start of the season to identify a starting soil moisture value for model simulations (See Appendix III, Figure III-3 for a flow chart to determine soil moisture using the hand-feel method).

- Double clicking on a blank ‘Sample Date’ box will open a calendar to record the month, day and year of the soil moisture sample. Clicking on the window ‘Convert % Moisture to mm’ will open a second window (Figure 34). Entry of the soil moistures values can be by ‘% Available’ or by ‘% Volume’. The ‘% Available’ option is selected by default. Soil moistures can be entered for each soil profile depth in the ‘Measured Moisture’ cell.

- Select ‘Add to Moisture Measurement Grid’.

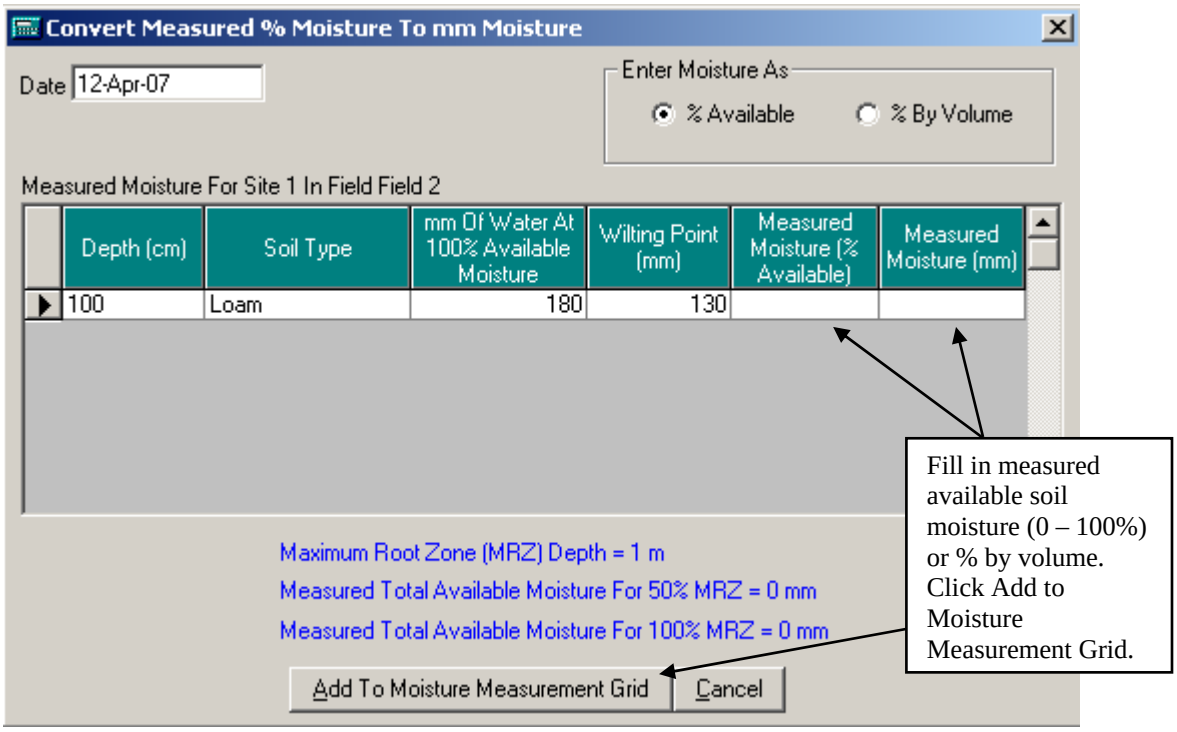


Figure 34. Converting percent soil moisture to millimeters.

- Once the first soil moisture reading has been added, measured soil moisture data can be entered throughout the season to check on model accuracy or to correct model predictions (Figure 35). If you want to use 'Measured Soil Moisture' readings, the 'Correct to Measured Soil Moisture' box must be checked. Otherwise, modeled soil moisture values will be used.

- For the moisture inputs for the 'Current Sample Site', the date can be either entered (day, month, year) or by clicking the small icon to open the calendar. Select the appropriate day, month, year, and when completed, select 'OK'.

- In the 'Gross Irrigation Application' column, enter actual gross amount of water applied. Check the 'System Tab' if you are unsure of the gross irrigation amount (see Add Irrigation under the Menu Tab for multiple entries).

- Effective irrigation application is calculated by multiplying the 'Gross Irrigation Application' by the 'Application Efficiency' (from 'System Tab').

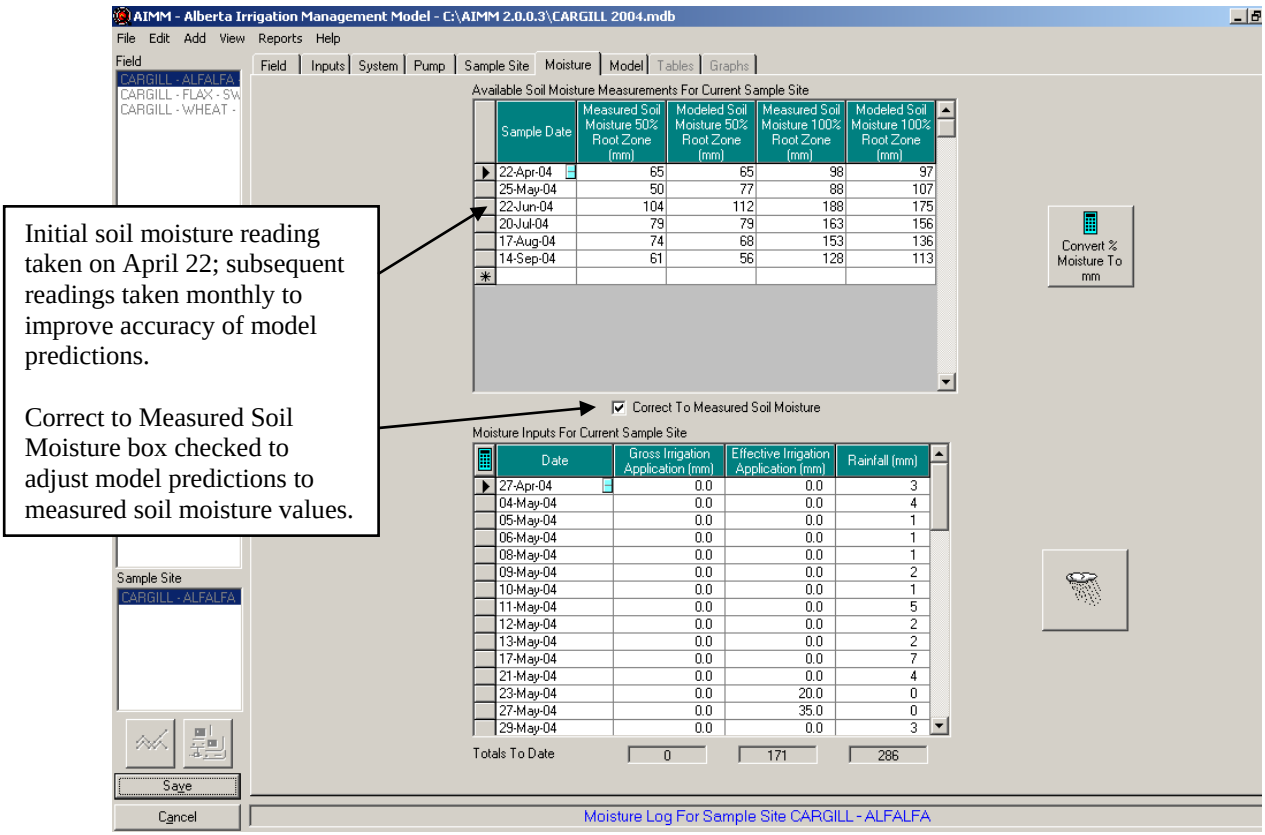


Figure 35. Correct to measured soil moisture option for corrections during year.

13.1 Precipitation Inputs

Rainfall amounts can be obtained either from local precipitation gauges (See Add Precipitation under Menu Toolbar for multiple fields) or regional weather stations. The 'Weather Cloud' button opens the current weather file, where you can select dates when rainfall occurred, if data from local precipitation gauges are not available. A range of rainfall events can be selected by clicking the upper most event (least recent), then while holding down the 'Shift' key, click the last rainfall event to be included (most recent). You can also select multiple rainfall events by holding down the 'Ctrl' keyboard button, and clicking on the rainfall events using the right button on the mouse. Click the 'Add to Moisture Input Grid' to populate the rainfall column.

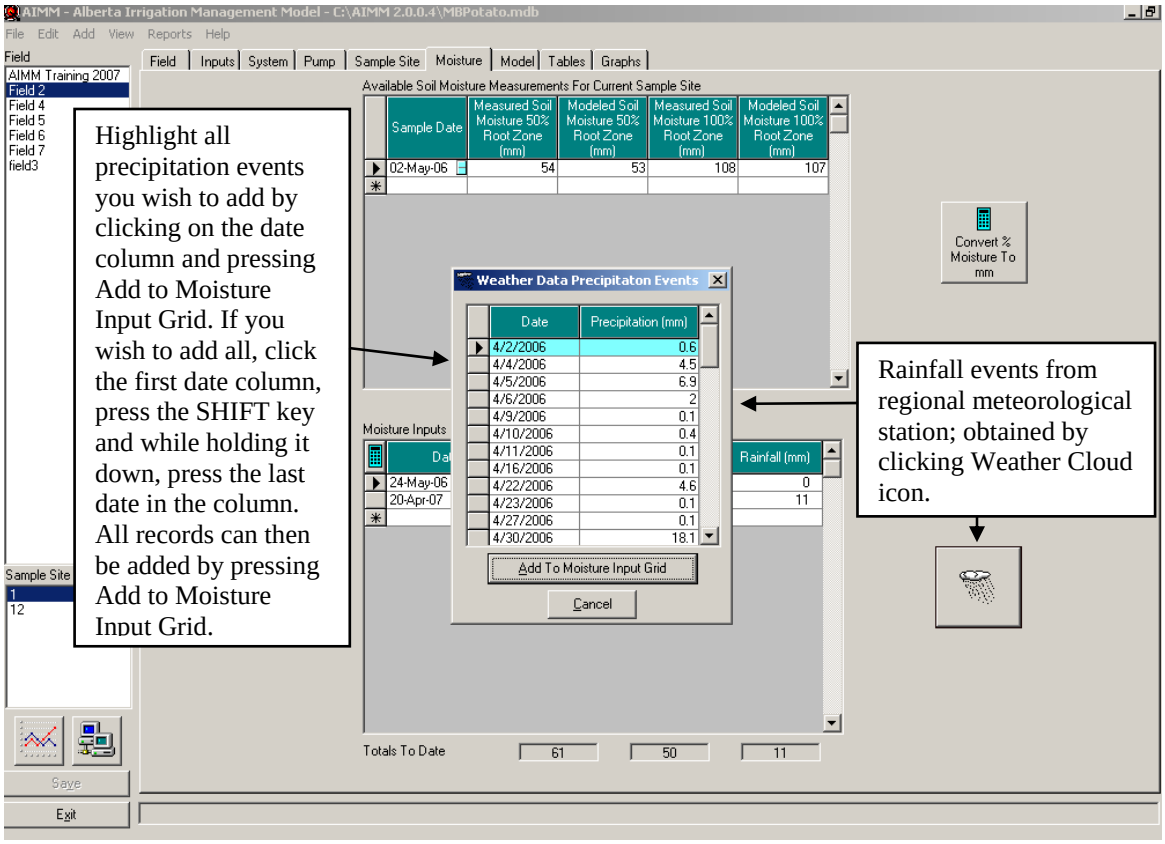
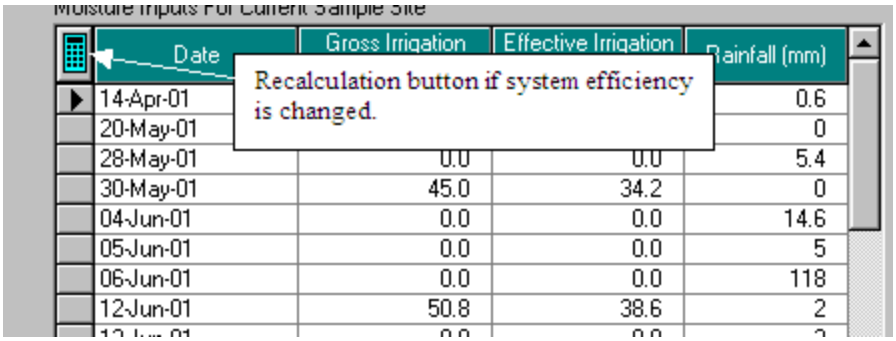


Figure 36. Options for entering rainfall data under "Moisture" tab.

- Clicking on the calculator button found in the top left corner of the 'Moisture Inputs for Current Sample Site' grid will recalculate the Effective Irrigation Application if the Application Efficiency value has changed (Figure 19).



Date	Gross Irrigation	Effective Irrigation	Rainfall (mm)
14-Apr-01			0.6
20-May-01			0
28-May-01	0.0	0.0	5.4
30-May-01	45.0	34.2	0
04-Jun-01	0.0	0.0	14.6
05-Jun-01	0.0	0.0	5
06-Jun-01	0.0	0.0	118
12-Jun-01	50.8	38.6	2

Figure 37. Recalculation button location and use.

- To delete any record(s) in the 'Available Soil Moisture Measurements for Current Sample Site' or 'Moisture Inputs For Current Sample Site' grids, click on the box to the left of the 'Sample Date' or 'Date', and press the delete key found on the keyboard (Figure 20). Consecutive records can be deleted by holding down the 'Shift' key on the keyboard and using the mouse to select the rows to be deleted. Non-consecutive records

can be deleted by holding down the ‘Ctrl’ key on the keyboard and using the mouse to select the rows to be deleted.

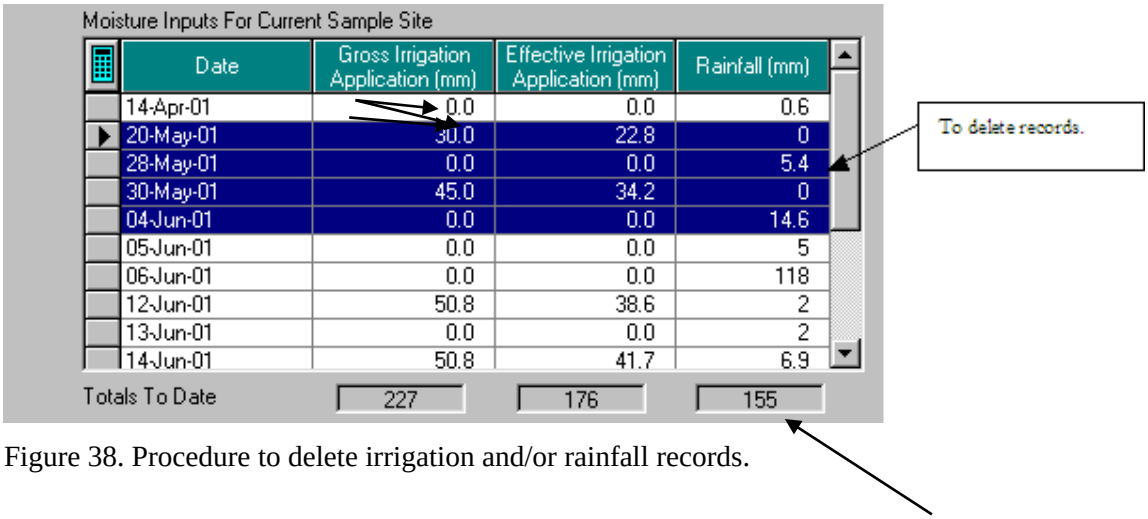


Figure 38. Procedure to delete irrigation and/or rainfall records.

- Note: Moving the cursor over any of the boxes that currently have numbers in them, will convert the metric values into imperial values.

14 Model Tab

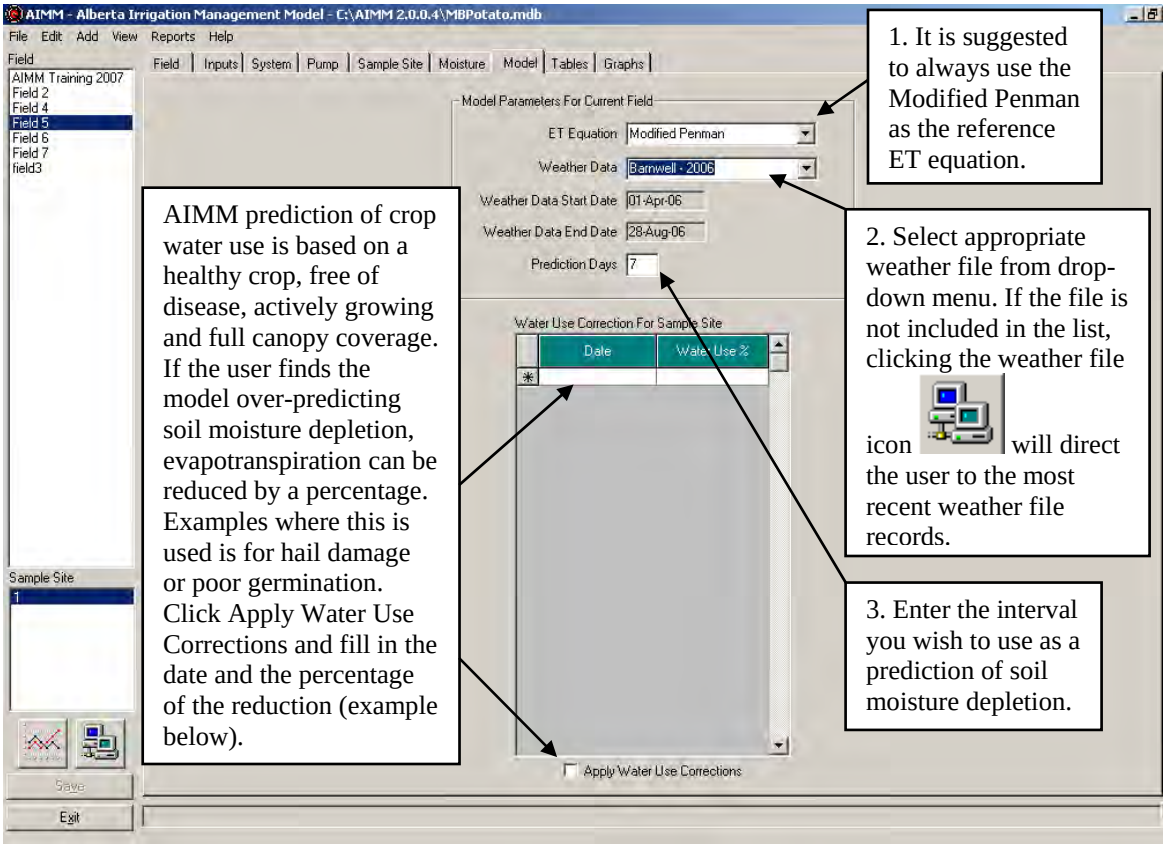


Figure 39. Data requirements, "Model" tab.

- Select the appropriate 'ET Equation' from the drop down box. The 'Modified Penman' equation is set as the default and is the recommended equation for most uses in Southern Alberta. Choose 'Priestly-Taylor' equation if no wind data is available.

- Select the appropriate 'Weather Data' from drop down box. If the user is unsure of the nearest regional meteorological station, a map identifying the location of all regional stations is located at http://www.agric.gov.ab.ca/app49/imcin/met.jsp. To add meteorological stations to the list under Model Tab, click on the Retrieve Weather Data icon .

- The 'Weather Data Start Date' and 'Weather Data End Date' are taken from the weather file and do not need to be adjusted.

- Enter the interval you wish to predict soil water depletion in the 'Prediction Days' text box. Suggested to predict not further than 14 days ahead.

- In the 'Water Use Correction For Sample Site' section, you can enter a date using the day-month-year format or by clicking on date box, then clicking on the calendar tool icon

and selecting the month, day and year from the calendar. Click OK to use the selected date.

- Under ‘Water Use %’, you can enter any number from 0 to 100.
- In order to use the ‘Water Use %’ value, you must select the Apply Water Use Corrections button.
- Water use correction example – on July 4, 2006 had a hail event that reduced plant populations by 30%. Water use will not be optimum for a while so reduced water use to 70% of optimum on that date. If the crop recovers and it is expected crop water use has recovered, can change the water use percent back up to 100% at a later date, August 2, 2006 in Figure 38.

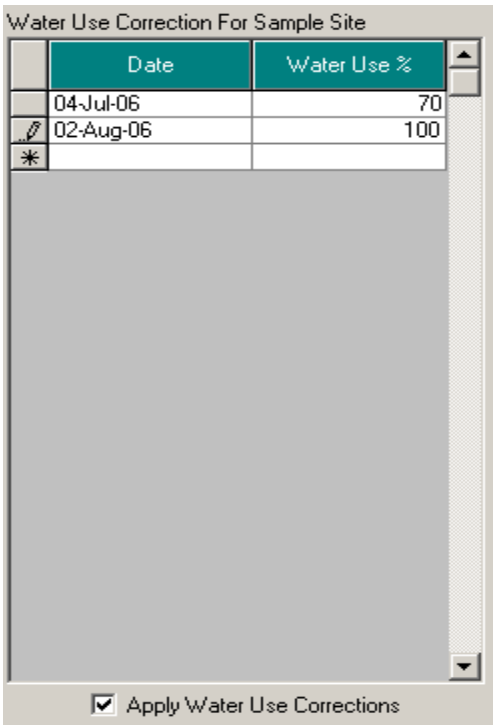


Figure 40. Applying water use corrections.

- Once all the inputs have been entered, click the ‘Save’ button and then the ‘Run Model’ button.

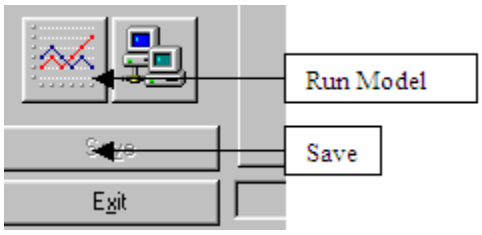
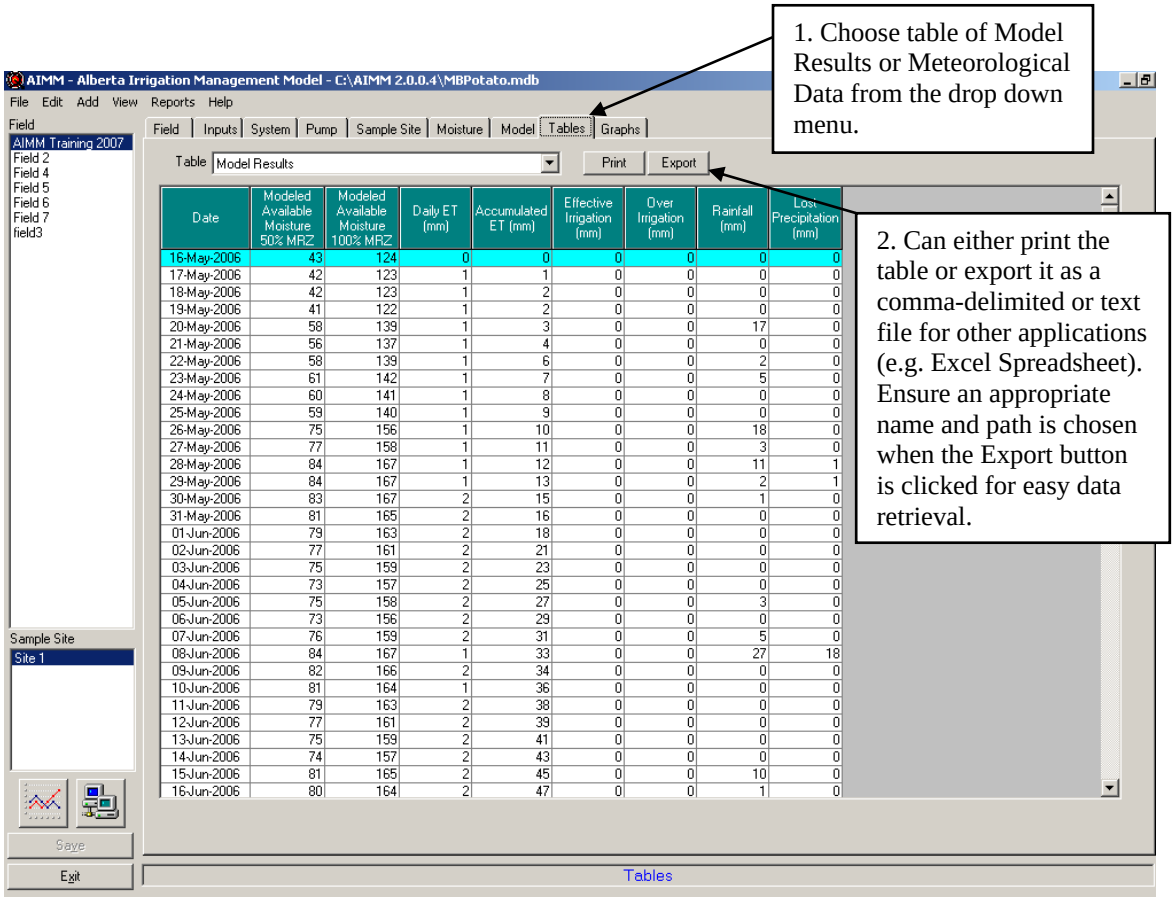


Figure 41. Program buttons ‘Run Model’ and ‘Save’.

- Note: Anytime changes are made under any input tab, you must press the ‘Save’ button before running the model. It is good habit to press the ‘Save’ button each time you are finished with entries for a particular input screen.

15 Table Tab



Date	Modeled Available Moisture 50% MRZ	Modeled Available Moisture 100% MRZ	Daily ET (mm)	Accumulated ET (mm)	Effective Irrigation (mm)	Over Irrigation (mm)	Rainfall (mm)	Lost Precipitation (mm)
16-May-2006	43	124	0	0	0	0	0	0
17-May-2006	42	123	1	1	0	0	0	0
18-May-2006	42	123	1	2	0	0	0	0
19-May-2006	41	122	1	2	0	0	0	0
20-May-2006	58	139	1	3	0	0	17	0
21-May-2006	56	137	1	4	0	0	0	0
22-May-2006	58	139	1	6	0	0	2	0
23-May-2006	61	142	1	7	0	0	5	0
24-May-2006	60	141	1	8	0	0	0	0
25-May-2006	59	140	1	9	0	0	0	0
26-May-2006	75	156	1	10	0	0	18	0
27-May-2006	77	158	1	11	0	0	3	0
28-May-2006	84	167	1	12	0	0	11	1
29-May-2006	84	167	1	13	0	0	2	1
30-May-2006	83	167	2	15	0	0	1	0
31-May-2006	81	165	2	16	0	0	0	0
01-Jun-2006	79	163	2	18	0	0	0	0
02-Jun-2006	77	161	2	21	0	0	0	0
03-Jun-2006	75	159	2	23	0	0	0	0
04-Jun-2006	73	157	2	25	0	0	0	0
05-Jun-2006	75	158	2	27	0	0	3	0
06-Jun-2006	73	156	2	29	0	0	0	0
07-Jun-2006	76	159	2	31	0	0	5	0
08-Jun-2006	84	167	1	33	0	0	27	18
09-Jun-2006	82	166	2	34	0	0	0	0
10-Jun-2006	81	164	1	36	0	0	0	0
11-Jun-2006	79	163	2	38	0	0	0	0
12-Jun-2006	77	161	2	39	0	0	0	0
13-Jun-2006	75	159	2	41	0	0	0	0
14-Jun-2006	74	157	2	43	0	0	0	0
15-Jun-2006	81	165	2	45	0	0	10	0
16-Jun-2006	80	164	2	47	0	0	1	0

Figure 42. Options for output under the "Table" tab

- Select either ‘Model Results’ or ‘Weather Station Data’ from drop down box to view that data in the tables.

- The table can be either printed or exported as a .txt or .csv file. When exporting a file, be sure to name the file and select the directory where the data is to be stored.

16 Graphs Tab

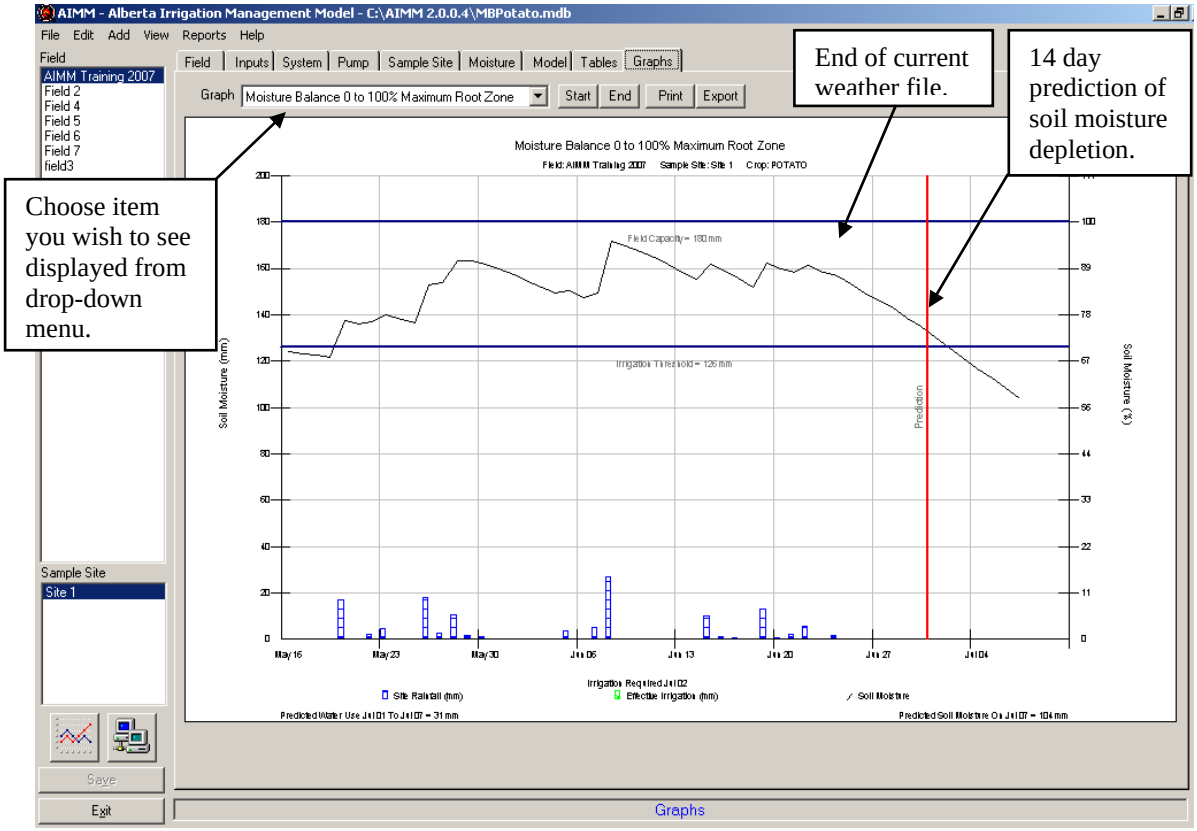


Figure 43. Options for output under the "Graphs" tab.

- Select the graph to be viewed from drop down menu.
- The ‘Start’ and ‘End’ buttons allow you to look at specific segments within the graph. When you click ‘Start’, a calendar box opens and you can select a start date for viewing data. Similarly, selecting ‘End’ launches a calendar box and you can select an end date for viewing data. The start and end date must be within the first and last day of the weather file.
- Graphs can be printed or exported as a bitmap files. When exporting a graph be sure to name the file and select the directory to where the data is to be stored.
- Note: If you click your mouse cursor anywhere on the graphics line, the exact date and soil moisture value will be displayed beneath the graph in blue text.

See Appendix V for interpretation of each of the graphs.

17 Getting Help While You Work

Pressing the ‘F1’ key at any time will launch AIMM Help to a topic related to the current screen. Contents of AIMM Help can be viewed, by browsing through the Table of Contents, the Index, or by searching for keywords.

18 Technical Support

If you are experiencing difficulties downloading climate data or a problem with the AIMM software contact:

Ted Harms @ (403) 362-1347 – ted.harms@gov.ab.ca

Dave Hyland @ (403) 545-2231 – dave.hyland@gov.ab.ca

19 APPENDIX 1

50% MRZ - calculates soil moisture based on the upper 50% of the root zone. (Table 1 in Appendix III)

100% MRZ - calculates soil moisture based on 100% of the root zone. (Table 1 in Appendix III).

Plant Available Moisture – the quantity of moisture available for plant use (see explanation in Appendix III).

Average Meteorological Day (AMD) – a weather set containing mean daily values for an entire year. Based on an average of daily values for the total years of record for the station. If the station does not have multiple years of records, the nearest meteorological station with multiple years of records is used.

Corrected to Measured Soil Moisture – if this option (Moisture Tab) is selected for the current sample site, the model will be corrected to the measured soil moisture values on the days for which measured values exist.

Crop Coefficients – are a function of crop characteristics, rate of crop development, length of growing season, climatic conditions, the time of planting, and the available soil moisture.

Crop coefficients must be adjusted to take into account the available soil moisture. Potential Evapotranspiration (PE) is reduced when the soil moisture level is not at capacity. PE is modified by the ratio of the logarithm of the remaining soil moisture to the maximum available to the crop in the root zone. Minimum Kc value has been set to 0.1. The crop coefficient equations used in this model were obtained from Agriculture and Agri-Food Canada publications, (Foroud and Hobbs, 1983, Foroud and Beke, 1981).

Correction for Soil Moisture (Buchleiter et al. 1988)

$$Kc_a = \frac{Kc \times \log\left(\left(\frac{AW}{AWM}\right) \times 100 + 1.0\right)}{\log 101.0}$$

where Kc_a = crop coefficient adjusted for available soil moisture

Kc = crop coefficient

AW = soil water remaining in profile (mm)

AWM = maximum soil water available to crop within the root zone of a given soil type (mm)

Date Off – the day when the irrigation system is turned off.

Date On – the day when the irrigation system is turned on.

Deep Percolation – any water (irrigation and rainfall) that moves below the root zone and becomes unavailable for crop use. This water is considered to be lost. Water movement is calculated in two phases:

1. In the first phase, if the amount of irrigation and rainfall is greater than the water holding capacity of the upper zone, water percolates from the upper zone into the lower zone. The amount of water above field capacity is added to the lower zone.

2. In the second phase, if the amount of water added is greater than the water holding capacity of the lower zone, water will then move out of the lower zone. Water that moves out of the lower zone is considered lost from the root zone and is accounted for as a percolation loss. The model allows the root zone to exceed the field capacity by 10% in consideration of saturated hydraulic conductivity (Shayya et al. 1991).

Elevation – the elevation of weather station above sea level in meters.

ET (evapotranspiration) – the loss of water from the earth's surface through the combined process of evaporation and transpiration.

Field Capacity – refers to water content in a field soil after the drainage rate has become negligible.

Gross Irrigation Application - the total amount of water applied by an irrigation system.

Growing Degree Day (GDD^5) –the average daily temperature minus the base temperature (5^0C)

$$GDD = \left(\frac{(MaxTemp + MinTemp)}{2} \right) - 5$$

If the minimum temperature is below 0^oC, $GDD = 0$

Harvest Date – the date at which the crop has been cut, swathed, or desiccated. Can be specified by user in the field tab or can be left blank and the harvest date will then be set to the last day of the growing degree/crop coefficient curve. The user must specify harvest dates for any forage crop (alfalfa, barley silage under seeded, grass hay, brome hay, tame pasture, timothy hay, milk vetch, grass seed, and turf sod).

Irrigation Threshold – is a percentage of the total available water that can be used by a crop, prior to starting irrigation – often referred to as management allowed depletion.

Irrigation Trigger – used in the Water Management table under View – Water Management in the menu toolbar. The irrigation trigger is set as a percentage above the irrigation threshold to facilitate notification for water delivery providers. Trigger level is determined by:

$$TriggerLevel = IrrigationThreshold + \frac{(FieldCapacity - IrrigationThreshold) \times TriggerValue}{100}$$

Example: Field Capacity – 250 mm, Irrigation Threshold – 125 mm, Trigger Value 10.

$$TriggerLevel = 125 + \frac{(250 - 125) \times 10}{100} = 125mm + 12.5mm = 137.5mm$$

The data line would turn red (requiring an irrigation) when the profile still has 12.5 mm moisture above the irrigation threshold or management allowed depletion. This allows the irrigator to arrange for water delivery or start the irrigation prior to reaching the irrigation threshold. The higher the irrigation threshold is set, the more water is retained in the profile prior to the data line turning red indicating irrigation is required.

Lost Precipitation – surface runoff from a rainfall event. Determined by maximum soil water storage of soil profile.

Lower Root Zone Moisture Use – percentage of water extracted from the lower half of the root zone. See 'Upper Root Zone Moisture Use' for reference.

Management Allowable Depletion - a percentage of the total available water that can be used by a crop, prior to starting irrigation (See explanation in Appendix III).

Maximum Relative Humidity - maximum daily relative humidity (%) measured at 1.5 m above natural ground level.

Maximum Root Zone Depth – effective rooting depth (m) of a mature irrigated crop.

Maximum Temperature - maximum daily temperature (°C) measured at 1.5 m above natural ground level.

Measured Soil Moisture – measured amount of soil moisture (mm, VWC%, AWC%) present in the field.

Minimum Relative Humidity - minimum daily relative humidity (%) measured at 1.5 m above natural ground level.

Minimum root zone depth - depth to which a crop is seeded (cm).

Minimum temperature - minimum daily temperature (°C) measured at 1.5 m above natural ground level.

Model Start Date – the first day a measured soil moisture reading is entered into the model. It is recommended that a soil moisture measurement be taken at the time of seeding. Crop consumptive use is calculated from the time of the first soil moisture reading to the harvest date.

Modeled Moisture - amount of moisture present in the field as determined by the model.

Net Irrigation Application - the amount of moisture that is actually added to the soil.

$$\text{Net Irrigation Application} = \text{Gross Irrigation Application} \times \text{Efficiency Ratio}$$

Operating Capacity – flow rate of the irrigation system.

Operating Pressure – normal pressure at which the irrigation system is operated.

Operating Speed - speed at which the pump is operated.

Over-irrigation – any excess irrigation applications received, above what can be accepted beyond the 110% of field capacity limits, in both the upper and lower root zone.

PE Equations – the model currently uses the Priestley-Taylor and Modified Penman equations for calculating potential evapotranspiration. The Priestley-Taylor equation should be used when no wind data is available.

Priestley-Taylor:

$$E_p = \frac{\alpha \times \left(\frac{\Delta}{(\Delta + \gamma)} \right) \times (Rn - G)}{\lambda}$$ (Jensen et al. 1990)

where α = calibration constant
Δ = slope of the saturation vapour pressure-temperature curve in kPa/°C
γ = psychrometric constant in kPa/°C
λ = latent heat of vaporization in MJ/kg
Rn = net radiation in MJ/m2/day
G = soil heat flux in MJ/m2/day

Modified Penman:

$$ET_r = \frac{\left(0.408 \times \Delta \times \left(Rn - G\right)\right) + \left(\gamma \times \left(\frac{1600}{\left(T + 273\right)}\right)\right) \times u_2 \times \left(es - ea\right)}{\left(\Delta + \left(\gamma \times \left(1 + \left(0.38 \times u_2\right)\right)\right)\right)}$$ (ASCE 2005)

where ET_r = ET for tall reference crop evapotranspiration in mm/day (alfalfa)
Δ = slope of the saturation vapour pressure-temperature curve in kPa/°C
Rn = net radiation in MJ/m2/day
G = soil heat flux in MJ/m2/day
γ = psychrometric constant in kPa/°C
T = mean daily temperature in°C

This equation uses alfalfa as the reference crop.

Planting Date – used to establish when the growing degree day/crop coefficient curve is to begin.

Potential Evaporation (PE) – maximum amount of water that a crop is capable of using. Generally determined on a daily basis. Theoretical equations are generally used to calculate PE.

Precipitation - in order to simplify how water moves in the soil profile, the assumption is made that whatever falls as rainfall (< 25mm) is 100% applied. The following is the criteria used for determining rainfall runoff (when rainfall is >25 mm):

Rainfall Events > 25mm (1.0 Inch): Infiltration (I)

$$Runoff = \text{Rainfall (R)} - \text{Infiltration (I)}$$

$$I = 0.9177 + 1.811 \times \left(\log eR\right) - 0.0097 \times \left(\log eR\right) \times \left(\frac{SM}{FC}\right) \times 100$$

(Baier and Robertson 1966)

where R = Rainfall (inches)

SM = Soil Moisture (inches). Available soil moisture in the root zone at the end of day i-1, that is, at the morning observation of day i.

FC = Field Capacity (inches)

Prediction of Next Irrigation – forecasting of the next irrigation is based on end of current weather and the number of prediction days entered. If the soil moisture level drops below the irrigation threshold prior to the end of the weather file, the next irrigation will be set for the first day of the selected prediction day. If the soil moisture level remains above the irrigation threshold, the model will predict only to the number of days selected, and an irrigation during this time may not be forecast.

Root Zone Transition Date – the number of days after planting date required for the roots of a plant to enter the lower 50% of the maximum root zone. Dependent on crop type.

Soil Evaporation Loss – after harvest, water lost from the soil profile is set to a growing degree day/crop coefficient of 0.1 until end of the weather file.

Soil Name/Soil Type – texture of soil layer.

Soil Profile Depth – depth of soil layer.

Solar Radiation - incoming short wave radiation measured at 1.5 to 2 m above natural ground level.

Station Name – location of weather station.

Time Off – the time when irrigation system is turned off

Time On – the time when the irrigation system is turned on

Total Available Moisture – is the amount of water that is held between field capacity and wilting point. Allowance has been made for the soil moisture to exceed field capacity by 10%. If the soil moisture is > 10% of field capacity, it is set it to 1.1* field capacity, with the excess water then lost to deep percolation.

Upper Root Zone Moisture Use – percentage of water extracted by roots in the upper portion of the root zone. (Pair, 1975)

Water Use % - default is 100%. Setting this to 100% represents no adjustment to ET. Any value less that 100% will reduce ET by that percentage. No value in the box means that there is no reduction to ET, same as 100% setting.

Weather Data – model requires on a daily basis maximum and minimum temperature, incoming solar radiation, wind travel, maximum and minimum relative humidity, and rainfall. If weather data from a source other than regional meteorological stations are available, they can be used in the AIM model. Weather files use a comma separated file format (.csv) and can be created or edited using most spreadsheet programs.

Wilting Point – is the soil water content below which plants growing in that soil remain wilted and do not regain turgor.

Wind - collected as wind run at 2 meters above natural ground level. If wind is collected at any other height, it can be adjusted using the wind power law:

$$W2 = W1 \times \left(\frac{Z2}{Z1} \right)^{a}$$ (Jensen et.al., 1990)

where $W1$ = measured wind at height Z1 (m/s)

$W2$ = estimated wind at height Z2 (m/s)

$Z1$ = measured wind height (m)

$Z2$ = estimated wind at 2 m

a = constant of 0.2 (Jensen 1974)

20 Appendix II

Equations and Constants for Evapotranspiration Equations

α - calibration constant = 1.70

γ - psychometric constant $= \dfrac{(cp \times P)}{(0.622 \times \lambda)}$, kPa / ° C

Δ - slope of the saturation vapour pressure-temperature curve

$= \left(0.200 \times \left(\left((0.00738 \times T) + 0.8072\right)^{7}\right)\right) - 0.00116$, kPa/ ° C

λ - latent heat of vaporization $= 2.501 - (0.00236 \times T)$, MJ/kg

cp - specific heat at a constant pressure = 0.001013, MJ/kg/ ° C

P - atmospheric pressure

P $= 101.3 \times \left(\dfrac{(T + 273.16) - (0.0065 \times H)}{(T + 273.16)^{5.256}} \right)$, kPa

Rn - net radiation

Rn(W/m^2) $= \left(\dfrac{0.63 \times Rs \times 1000 \times 1000}{43200} \right) - 40$

Rn(MJ/m^2) $= \text{Rn(W/m^2)} \times \dfrac{43200}{1000}$, MJ/m^2

Rs - total incoming solar radiation, MJ/m^2

G - soil heat flux = 0, MJ/m^2 day

U2 - wind speed at 2m, m/s

W2 $= \left(\dfrac{U2}{0.01157407} \right)$, wind travel, km/day

T - mean daily temperature

T $= \left(\dfrac{T\max + T\min}{2} \right)$, °C

(ea-ed) - mean daily vapour pressure deficit

$\text{Satvp} = \exp\left(52.58 - \left(\dfrac{6790.5}{TK} \right) - 5.03 \times \ln(TK) \right)$

Dailyvp $= \dfrac{Satvp \times RHmean}{100}$

Vpd $= Satvp - Dailyvp$, kPa

TK $= T + 273$, °K

H - elevation, m

21 Appendix III

Total Available Moisture

Soils can hold water against the force of gravity due to soil tension forces. Therefore even in situations where water is free to drain out of the root zone, a good portion of the water will be held due to soil tension forces. The amount of water held in the soil profile against the force of gravity after drainage is called field capacity water content.

The qualitative definition of field capacity is: the maximum amount of water a soil profile can retain provided the profile is able to drain freely (no impeding layer of bedrock or water table within the profile). The quantitative definition of field capacity is the water retained in a soil sample after subjecting the sample to a negative pressure of –33Kpa (-10Kpa for sandy textured soils).

Plant roots extract water from the soil for photosynthesis and to retain turgor or stem and leaf strength and structure. As the soil dries, the water remaining in the soil is bound more tightly to the soil particles or tiny spaces within the soil matrix and can no longer be taken up by plant roots. When the plant roots can no longer extract water from the soil they wilt and eventually, if denied water, they die. At the point where the plant can no longer recover turgor once wilted, it is said to have reached its permanent wilting point. The quantitative definition of permanent wilting point soil moisture is the amount of water remaining in a soil sample after the soil is subjected to a suction of -1500 Kpa. Permanent wilting point is an ill-defined concept since plants differ in their abilities to extract water from soils. Soil water between field capacity and wilting point is termed plant available water; available for plant roots to absorb for photosynthesis and transpiration (Figure III-1). Soil texture is the dominant soil feature that determines how much available water the soil can hold (Table IIII-1).

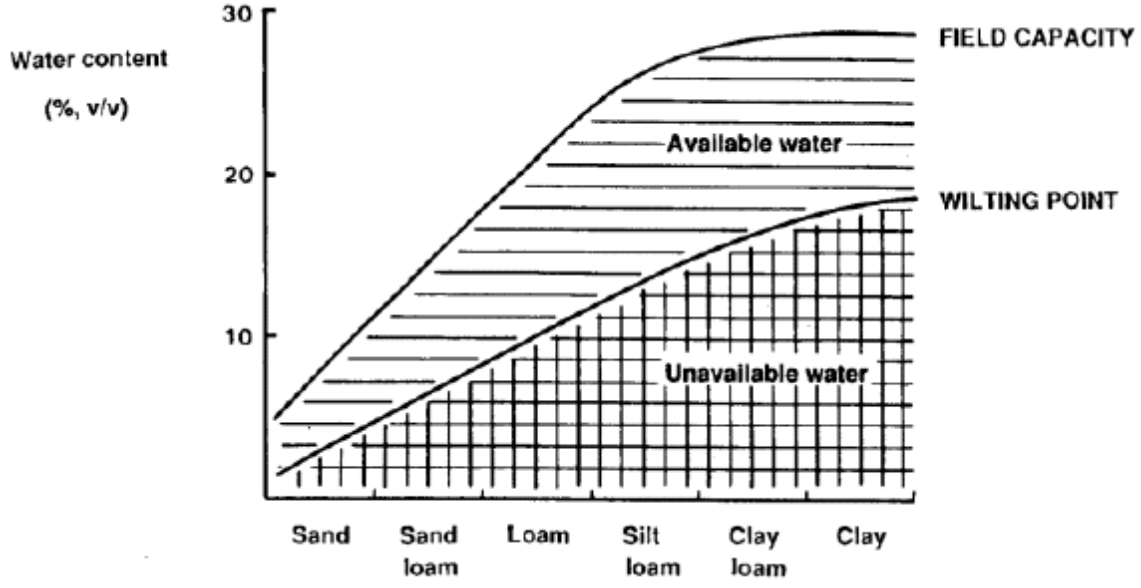


Figure III-1. Plant available moisture between field capacity and wilting point.

Soil Texture	Available moisture per 25 cm soil depth	Wilting point (mm of moisture per 10 cm of soil depth
Loamy Sand	28	6
Sandy Loam	35	8
Loam	45	13
Sandy Clay Loam	38	12
Silt Loam	50	11
Clay Loam	50	16
Silty Clay Loam	55	19
Sandy Clay	43	22
Silty Clay	53	22
Clay	48	22
Fine	52	25
Medium	45	16
Coarse	30	6

Table III-1. Available moisture for various soil textures.

Management Allowable Depletion

The extent to which an irrigator allows the available soil moisture to drop before irrigating depends on the crop grown and the irrigation system used. For most grain, oilseed and forage crops irrigated using surface or wheel move, the suggested management allowable depletion is 50%. Management allowable depletion, for the same crops using centre pivot irrigation system, is around the 30 to 35% range. The suggested management allowable depletion for potatoes is 35%. Some crops, such as sugar beet, alfalfa seed and chickpea require some soil moisture stress to maximize sugar content or encourage flowering for maximum pod development. The management allowable depletion will change throughout the irrigation season for these crops. Management allowable depletion is displayed on the graph of available soil moisture (see Figures III-2a & b).

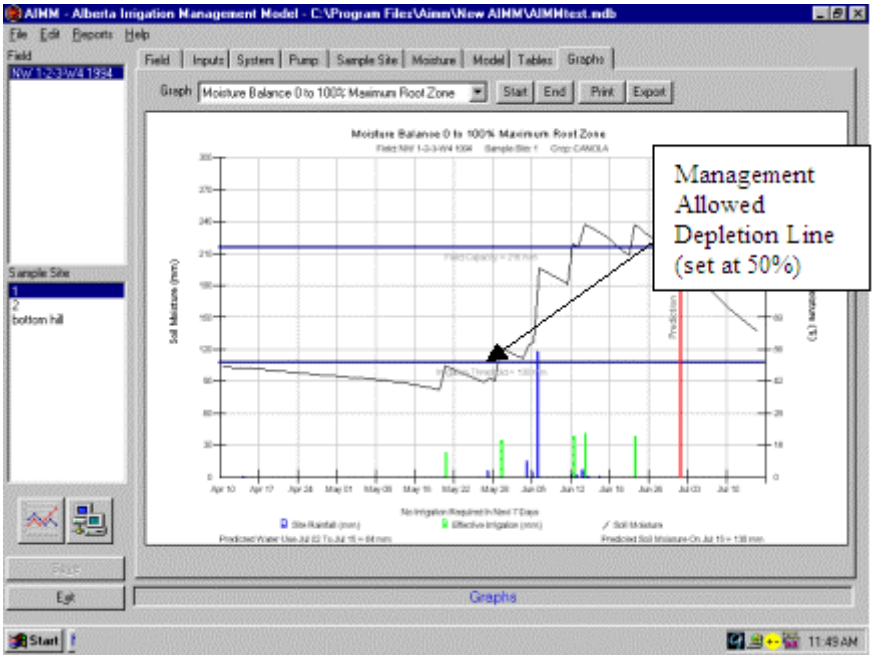


Figure III 2(a). Management allowed depletion set to 50%.

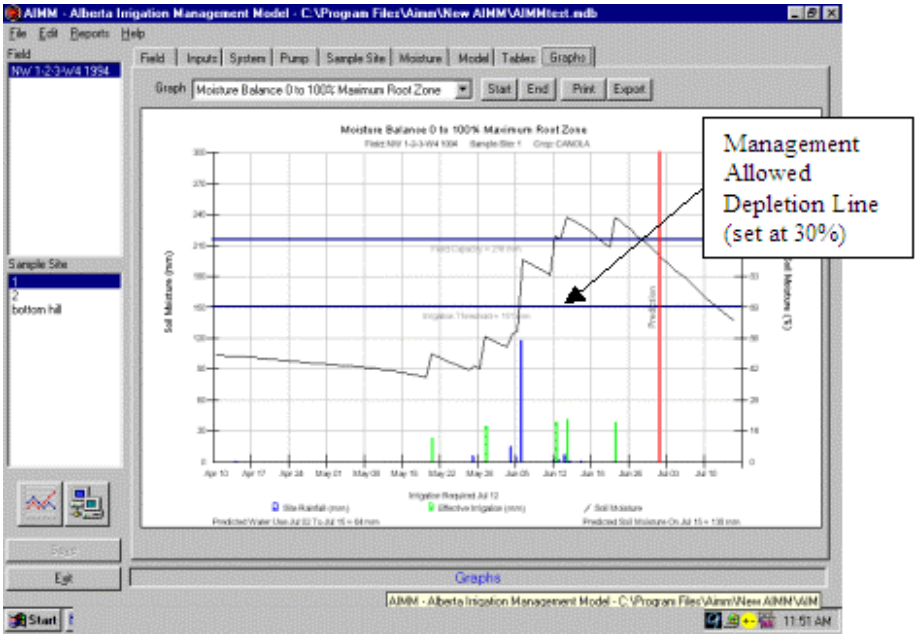


Figure III 2(b). Management allowed depletion set to 30%.

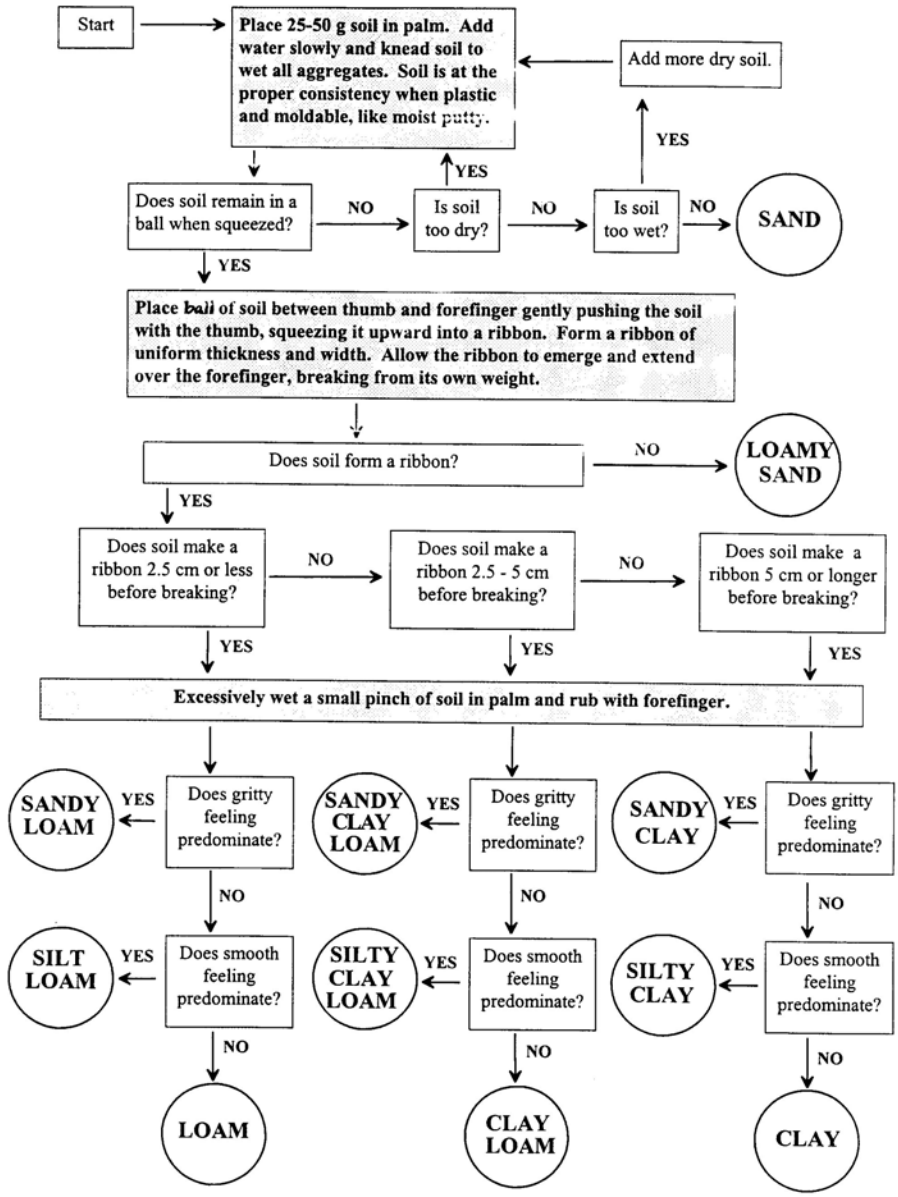


Figure III-3. Hand-feel determination of soil texture.

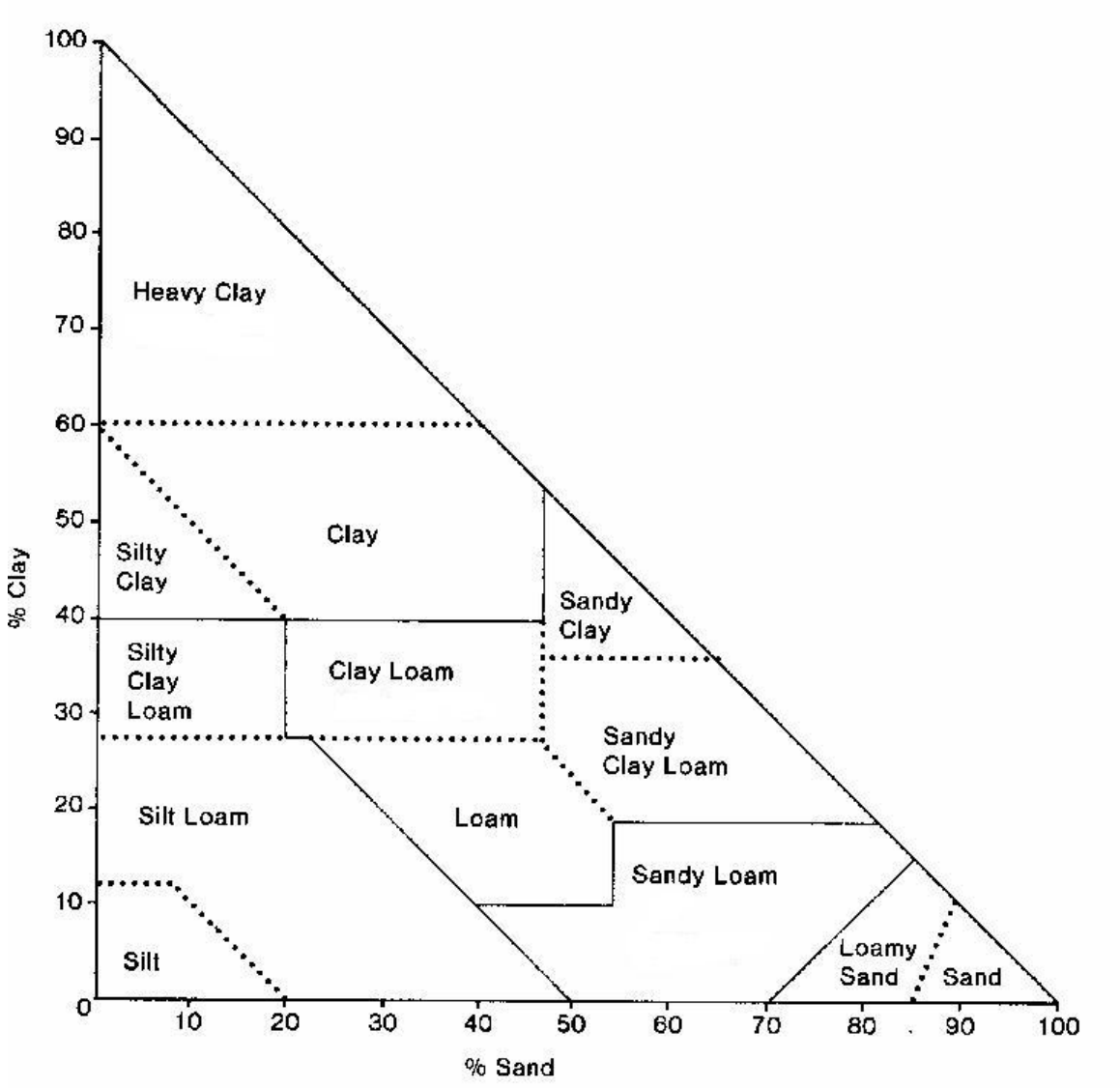


Figure III-4. Soil textural triangle.

	Soil Texture		
Estimate of Available Water	Sandy Loam	Loam/Silt Loam	Clay Loam/Clay
Above field capacity	Upon squeezing, no free water appears on soil but a wet outline of ball is left on hand. Soil will stick to thumb when rolled between thumb and forefinger.	Free water can be squeezed out.	Puddles; free water forms on surface
75-100%	Forms a weak ball but breaks easily when bounced in the hand. Will not slick.	Forms a ball, is very pliable. Slicks readily.	Easily ribbons out between thumb and forefinger, has a slick feeling.
50-75%	Tends to ball under pressure but will seldom hold together when bounced in the hand.	Forms a ball, somewhat plastic, will slick slightly with pressure	Forms a ball, will ribbon out between thumb and forefinger, has a slick feeling
25-50%	Appears to be dry, will not form a ball with pressure.	Somewhat crumbly but will hold together with pressure.	Somewhat pliable, will ball under pressure.
0-25%	Dry, loose, flows through fingers.	Powdery, sometimes slightly crusted but easily broken down into powdery conditions.	Hard, baked, cracked; difficult to break into powdery condition.

Table III-2. Hand-feel determination of available moisture for differing soil textures.

22 Appendix IV

Weather File Format

The weather file must be comma delimited (.csv) file in MS Excel and have the headings and data arranged in the format as shown below:

Year,Month,Day,TMAXC,TMINC,WINDKMD,PRECMM,RHMAX,RHMIN,SRKJD

2001,4,1,11.9,-3.8,314.5,0,92.5,32,16848

2001,4,2,8.9,-5.7,205.8,2.2,99.8,53.7,9590

2001,4,3,0.7,-2.4,214.5,0.8,106.3,77.5,8122

2001,4,4,3.4,-3.7,365.1,1,106.3,57.7,19354

2001,4,5,11.5,-4.2,481.9,0,95.8,38.3,20736

2001,4,6,12.6,-1.5,230.5,0,100.7,33,15984

2001,4,7,14.8,-4,216.2,0,103.2,32.9,19958

2001,4,8,13.1,0.7,227.1,0,97.2,34.9,16416

2001,4,9,12.9,-4.9,180.2,0.2,103.5,40.2,20822

2001,4,10,6.9,-0.1,327.6,0,103.6,41,11059

2001,4,11,5.2,-3.8,193.8,0,96,44.5,18144

2001,4,12,5.7,-5.4,384.5,0,104.9,60.3,9245

2001,4,13,13,-5.9,351.4,0.2,106.6,17.2,18662

2001,4,14,7.6,-3.2,184.7,0.2,98.6,40.5,10627

2001,4,15,4.4,-6.2,225.2,0,91.8,39.8,15293

TMAXC – maximum temperature in (^{o}C)

TMINC – minimum temperature in (^{o}C)

WINDKMD – wind speed in (km per day).

PRECMM – daily precipitation (mm)

RHMAX – maximum relative humidity (%)

RHMIN – minimum relative humidity (%)

SRKJD – incoming short-wave solar radiation (kJ per day)

23 Appendix V

Interpretation of the Graphical Output

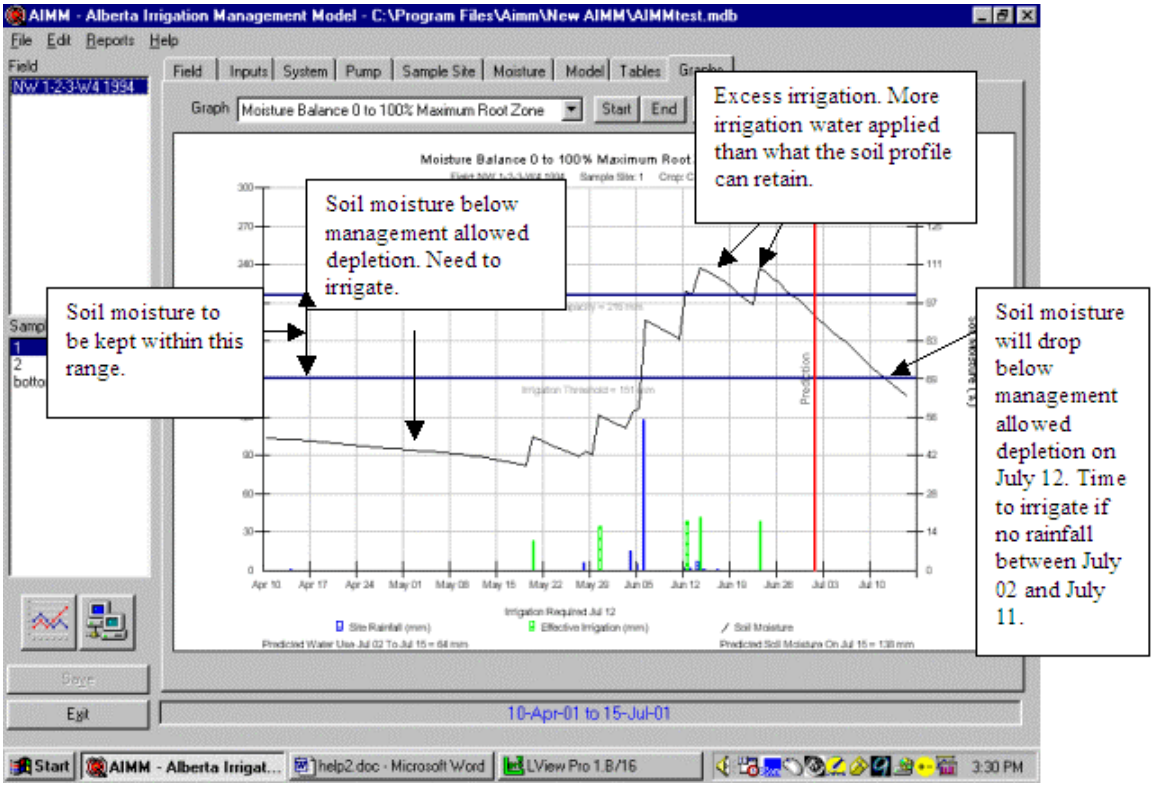


Figure V-1. Graph of moisture balance, 0-100% of root zone.

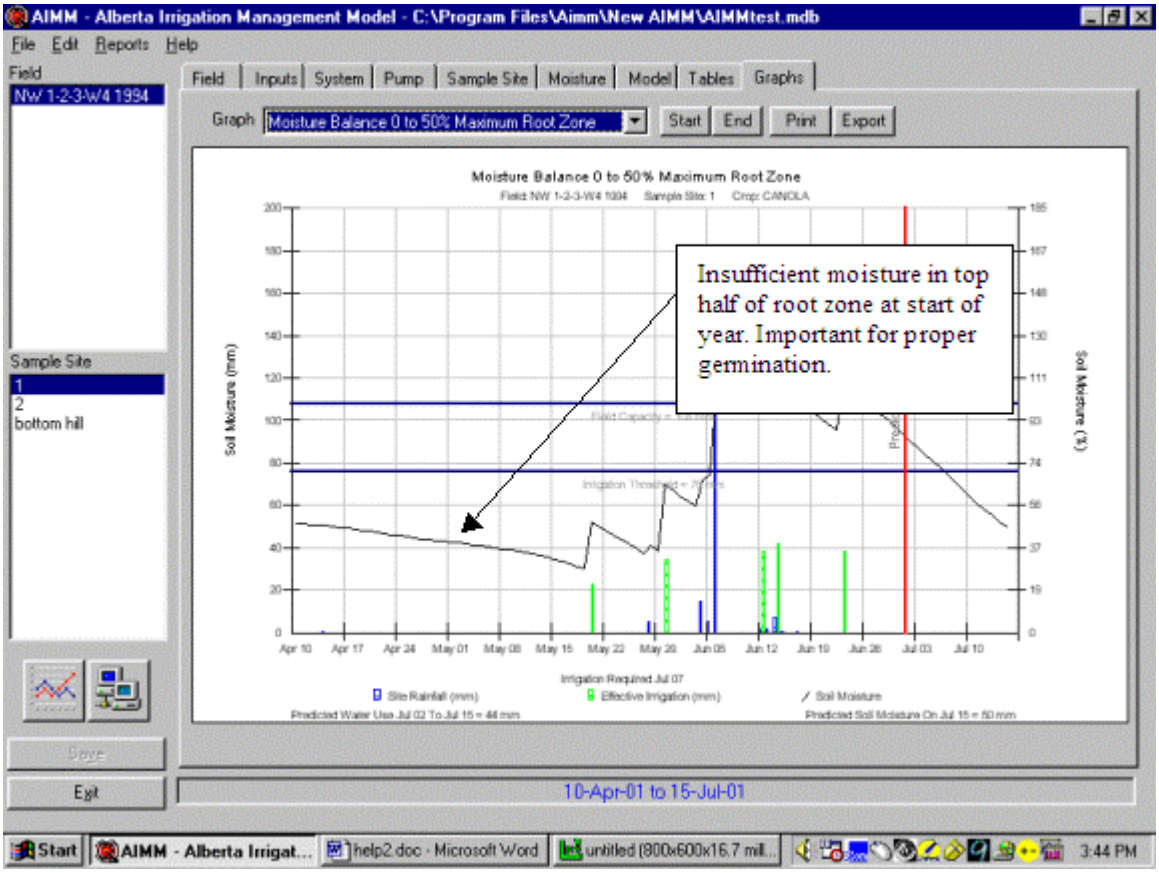


Figure V-2. Graph of moisture balance, 0-50% of root zone.

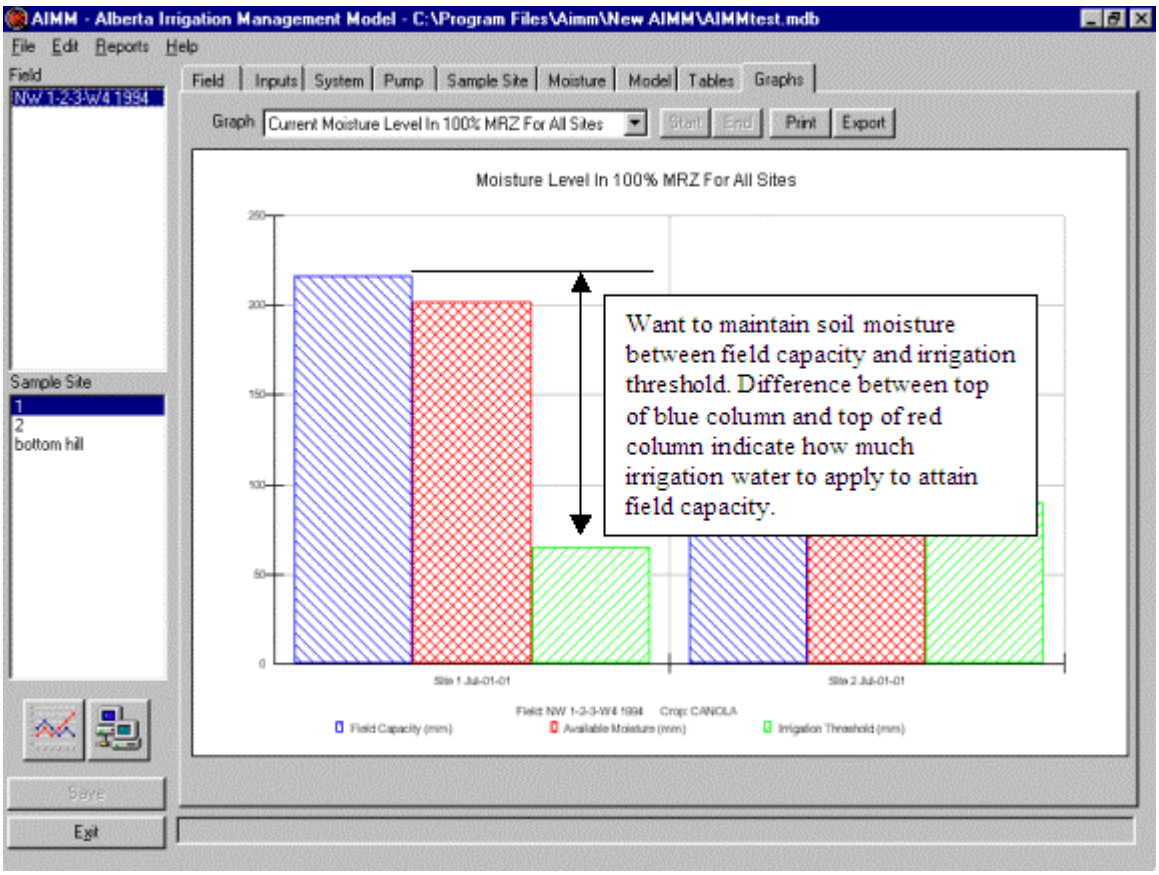


Figure V-3. Graph of current soil moisture level in root zone.

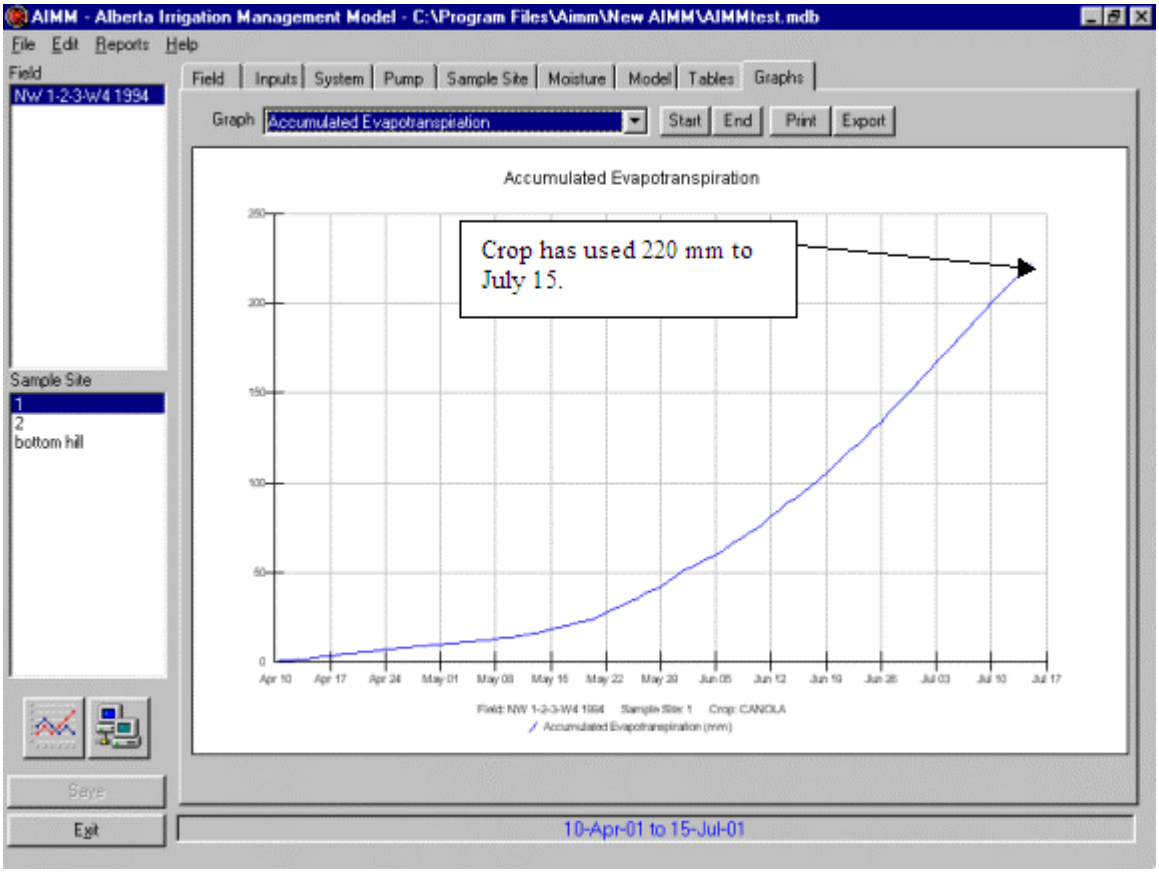


Figure V-4. Graph of accumulated evapotranspiration (crop water use).

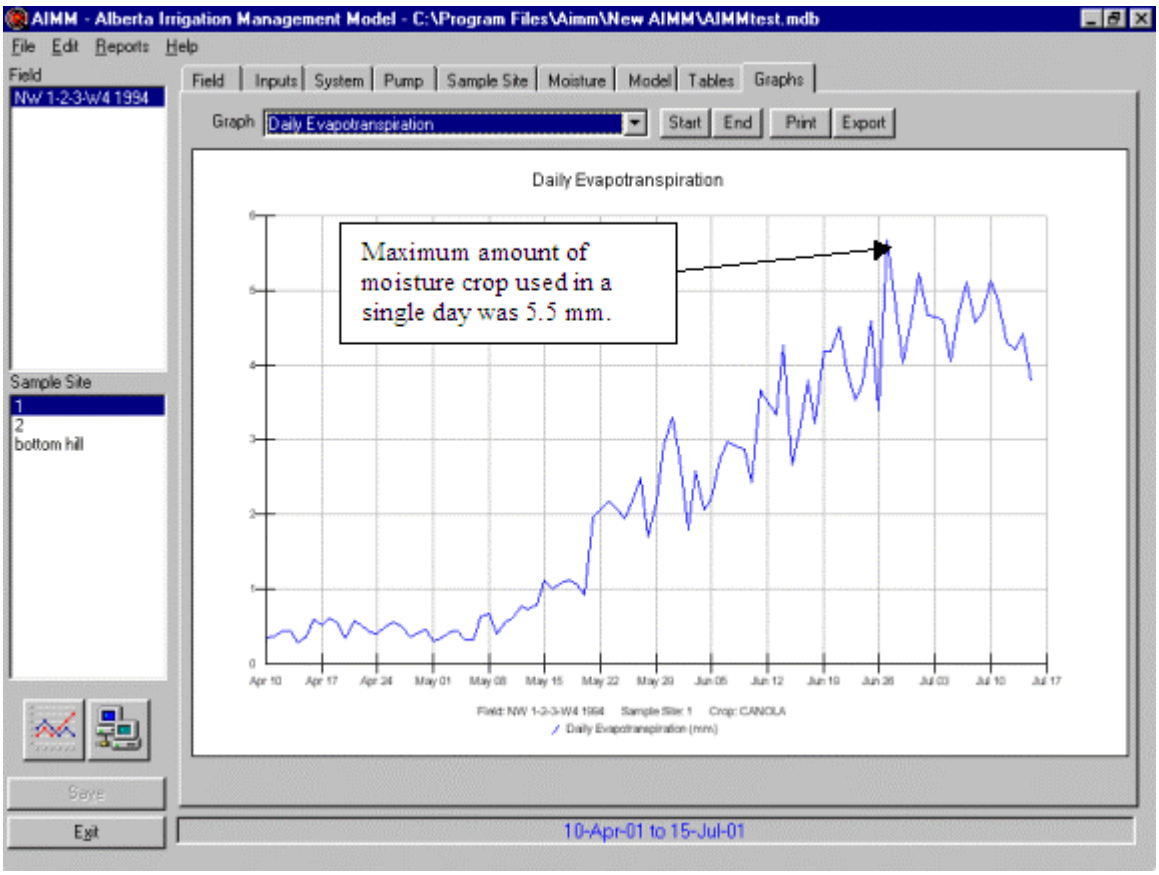


Figure V-5. Graph of daily evapotranspiration (crop water use).

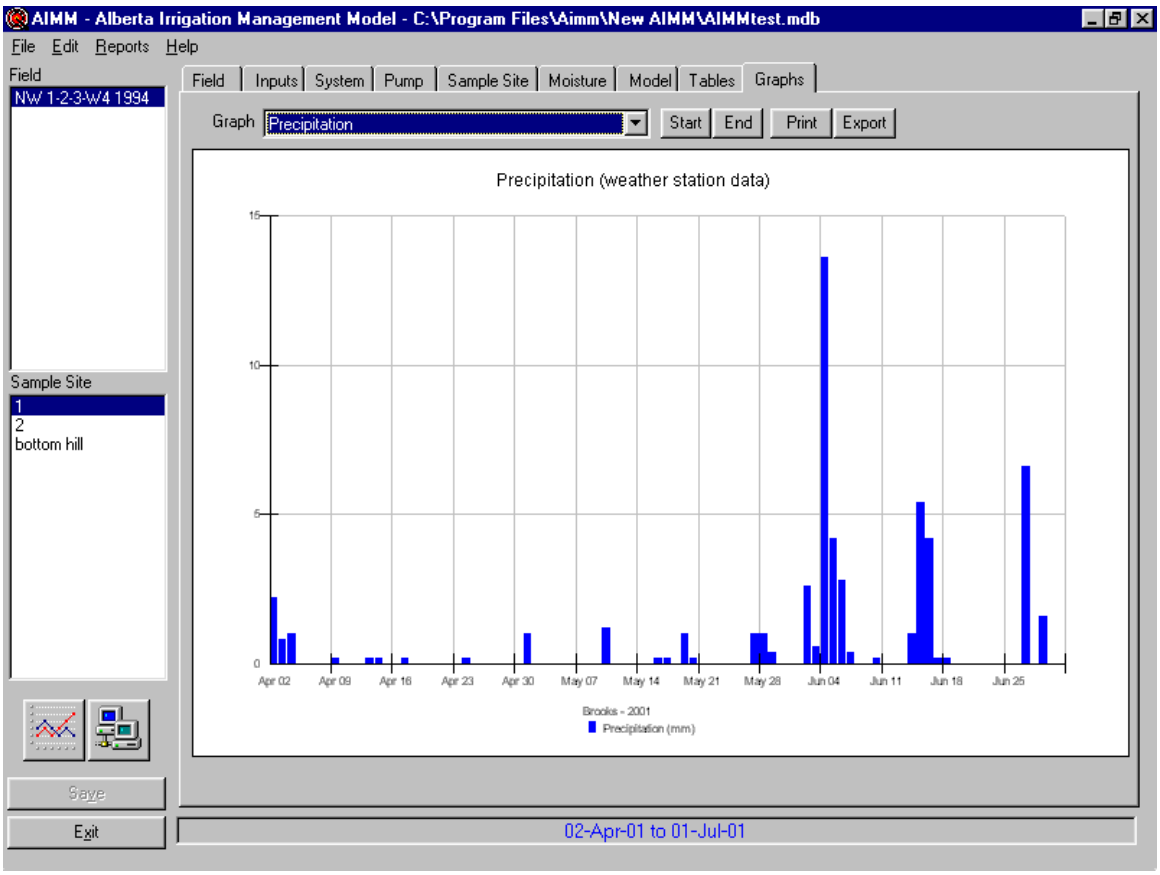


Figure V-6. Graph of daily rainfall amounts.

Figure V-7. Explanation of moisture balance graph components.

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