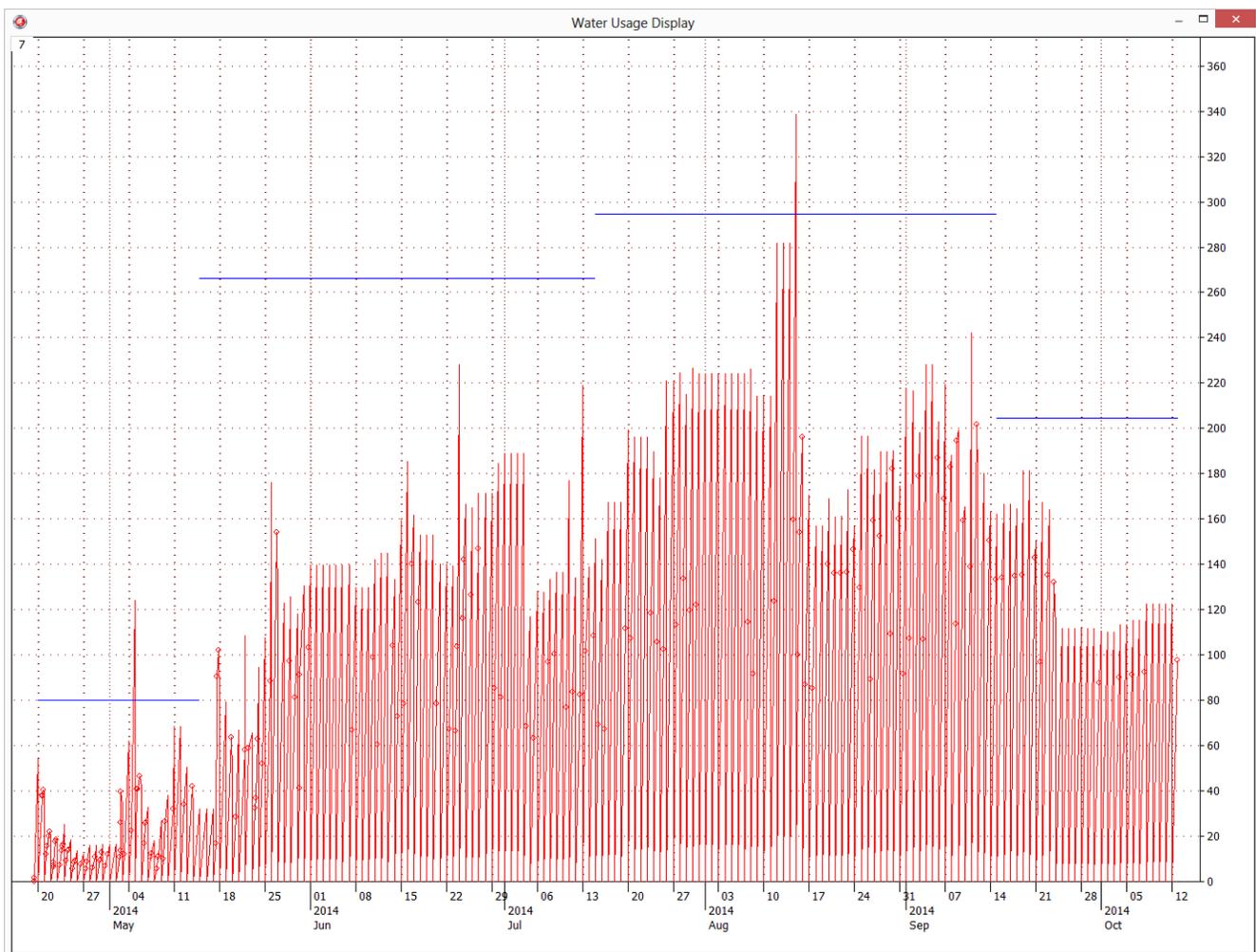


## Water Usage Management Tool

Conserving water in California is no longer a luxury, or even an option, but is an overtly and demonstrable necessity. The Water Usage Management Tool (WUMT) was developed and has been used to do exactly that.

Although one can keep track of their water meter readings, keep track of their daily usage and monthly allotments, all by hand, WUMT makes doing such so much easier – and gives one visual representations, where even a quick glance tells one where they stand. WUMT also can quickly point out when a timer has gotten stuck open, a leak has developed in the plumbing, or a timer has failed to run, possibly killing plants.



*Fig. 1 WUMT daily water usage display*

In fig. 1, one can easily see during the second week of August when the valve in the automatic watering trough for the goats failed to close (quietly flooding the hillside and unnoticed by any humans). Likewise one can see in three cases in May and June when the batteries in a watering timer

had run down enough, so that it was able to open the valve, but not close it. And one can also see in early July and mid-August when two different timers simply stopped working. One can also see that other than the problems cases, that the water usage was under the BVWD mandated limits (the horizontal blue lines being the bi-monthly allocations). ... Yes, one could have done all this with pencil and paper, or maybe a spreadsheet, but WUMT makes it a whole lot easier.

## Installing WUMT

WUMT is a Windows program (Win98 thru Win 8.1), but will run equally well on a Mac using Parallels or any of the other Windows emulator tools available for them.

The installation process is very simply: create a folder to hold WUMT and its files; drop the WUMT .exe file into that folder; and probably, and though not required, create a desktop shortcut to the .exe file. Many people will leave the WUMT folder on their desktop, though it can be put on any of the available disks (even a portable flash-drive if such works best) – though the location the user must have read and write access to. The space required by WUMT is essentially insignificant given the size of today's hard drives – the actual amount is somewhat less than 15 MB [13 MB for the .exe file, and about 2 MB for the user data and its backups].

## WUMT Front Page

WUMT's front page is not surprisingly, the first page presented to the user when it is started; it is also maybe the least important page, other than the fact that the push-buttons which allow the user to get to the Add-Data page or the Graph-Data page are there.

The general usage of WUMT is: for the user to start it, click on the **Add Data Entry** button, add a new data point there, return to the front page, click on the **Graph Data** button to see where the new data item fits in with their overall usage, and then leave WUMT.

Of note: the **Add Data Entry** button when WUMT is first started, is already selected, so by simply hitting Enter on the keyboard, the user will be taken to the Add Data page (when a button is selected [has focus], Windows sees a keyboard Enter as the same as a click on that button. This same approach can be taken when the user returns from the Add Data Page: if they then hit Tab on the keyboard, the **Graph Data** button will become selected, meaning if they then hit Enter they will be taken to that page. This approach can also be used within the Add Data page to add data without ever moving one's hands from the keyboard – and it's much quicker that way. Also true is that for each page, Escape on the keyboard will close that current window, all the way to closing WUMT.

One aspect of the front page that can be sometimes (though hopefully rarely) important, is the display of the water usage data file. If for some reason a data comment needs to be changed, or a data value was incorrectly entered and needs to be corrected, this is the place such is done. The how this is done is explained below under the heading of “Technical Aspects.”

This document, displayed as a HTML file can be accessed via the “**Help**” clickable in the upper right of the front page, just below the red Windows close window X.

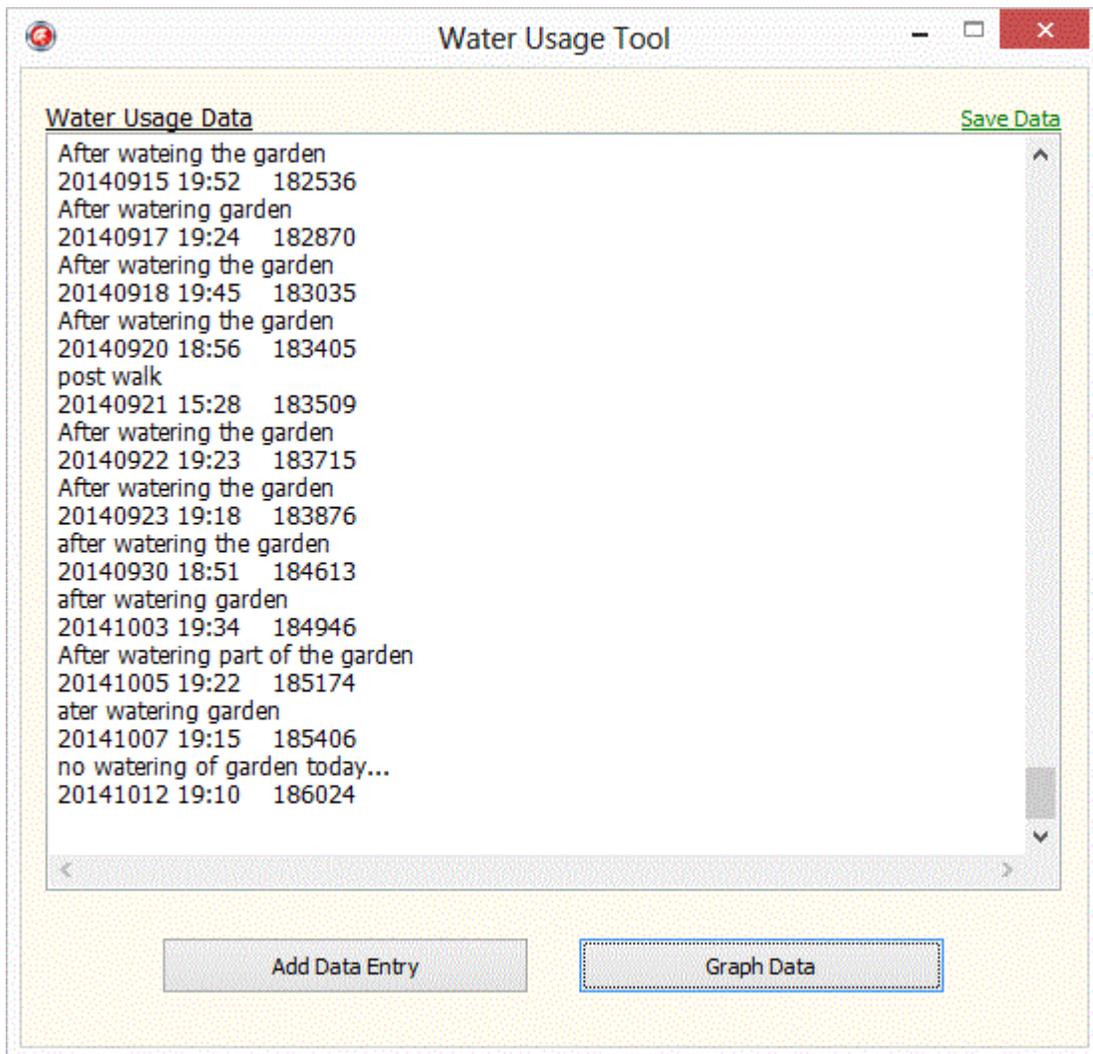


Fig 2. An example of the WUMT front page

### WUMT Add Data

The Add Data window is opened from WUMT's front page by clicking the **Add Data Entry** button at its bottom. It is via this window that one adds water usage data to WUMT's database.

Each entry in WUMT's database is comprised of at least two types of items and possibly a third. The two always present items are: the date/time associated with a water (meter) reading, and the value which was then read. A third optional item is a note (an annotation) that the user may attach to that water reading, eg, after watering garden, or, after fixing leak, etc. The Add Data form/window has a field to input each of these items. An example of the "add data page" is given below.

The three fields that can be added to the database are: a note attached to that data item; the date and time of the (water meter) data reading; and the value of that reading. The note to be attached to the data value is optional – it's intended to allow the user to tie a comment/event with a particular data item. When one opens the "Add Data Page," the date and time field will already be filled in with the

current data and time in the format required by WUMT... meaning if one simply adds the meter reading and clicks on the **Save Data** button, that's all it takes to add an meter reading.

The date and time field assumes that the user just read the meter and is adding that new data item to the database. But in the case where the reading was taken some time before, then the date or time values already in the field can be adjusted accordingly. Of note: the “time” format WUMT expects is that of the “24-hour clock,” eg, 9am is 9:00, while 3pm, is 15:00.

To expedite the entry of data, WUMT has linked the input fields to the Tab key on the keyboard... when one first enters the Add Data form, the cursor will already be in the Comment field. If one enters a comment; or doesn't enter a comment; by hitting Tab on the keyboard (generally to the left of the Q key), the cursor will be moved to the Date/Time field; likewise another Tab will position the cursor in the data value field. This means that one can, if they're not going to enter a comment, hit Tab twice, type the new data value, hit Tab again, and then the Enter key on the keyboard, and be done. Or, if they're going to enter a comment: enter it, hit Tab twice, enter the data value, hit Tab again and then Enter. Maybe the first couple of times entering data one might wish to mouse select the individual fields and then click the Save Data button... but over time, as WUMT becomes more familiar, the Tab method will probably become the norm.

Most of the Bella Vista water meters, not only give a reading in cubic feet – the standard unit of water in WUMT, but also using the sweep arm, in hundredths of cubic feet. WUMT accepts data either as whole cubic feet, or in whole plus fractional cubic feet. For most people whole cubic feet is more than accurate enough; but if one is trying to monitor their usage down to the “gnat's eyebrow”, then WUMT will happily remember the data at whatever precision it is entered.

WUMT only adds a data value to its database, when the **Save Data to Water Usage Database** button is clicked. If the Add Data window is closed via the Windows red X at the top right of the window before **Save Data to Water Usage Database** is clicked, then that data value will not be saved.

After the **Save Data** button has been clicked, and WUMT has inspected the data and found it to be in a usable format, the user will be returned to the WUMT front page. From there one can either exit WUMT, or if they so choose, look at the data graphically: that will be via the **Graph Data** button on the front page.

Of note: WUMT is distributed with a sample water usage database, so that the first time one starts the program one will still be able to make use and become familiar with the graph page and its options. But as soon as one adds the first data point specific to one's own situation, that sample database will disappear and the user's real one will be used exclusively. Likewise WUMT is distributed with a sample set of allocation limits – these will need to be overwritten with the user's own limits.

Also of note: WUMT needs multiple data points to be useful. If one only enters a single data point, although the graph page can be invoked, there will be nothing to see, in that for the two usage as a function of time formats require at least two data items [so as to be able to draw a line, which requires a starting point, and an ending point]. To use the Daily Water usage format graph page, WUMT requires at least three data points, and spanning at least 24 hours. If these two requirements have not yet been met, then one will be presented with a blank display. But as more data is added to WUMT, its graphic displays become more useful. The sample database shipped with the WUMT distribution contains several hundred data points – that is to say: over one year worth of water usage meter readings.

The screenshot shows a web form titled "Add Data". It has a title bar with a close button (red 'x'). The form contains three input fields and one button. The first field is labeled "Water Usage Comments Leading Up to Current Meter Reading" and contains the text "water reading after watering garden". The second field is labeled "YYYYMMDD HH:MM for Data-Point" and contains the text "20141019 21:00". The third field is labeled "Current Water Meter Reading" and contains the text "183190". Below these fields is a button labeled "Save Data to Water Usage Database".

*Fig 3. An example of the WUMT add data page*

### WUMT Graphic Data Display

It is one thing to collect data, but it is very much more powerful to be able to graphically see that data, to see potential patterns in that data; and in the case of BVWD, to see how close one is coming to their allocation limits. WUMT provides three views of the user's water usage data, two similar and one different.

The two similar are like the example immediately below, and are simply graphics of the total water used as a function of time. In the graph below, this is a graph of the actual meter readings (in CF), and the time those values were seen. The other similar graph is also a graph of usage as a function of time, but where the values on the vertical axis have been reduced by the value of the first reading, giving one a graph what starts at zero on the left and measures the amount of water used since then.

The other graph that WUMT provides is instead of being a function linear in time, is a graph of the water used, on a daily basis. It is with that graph one can see how one's usage compares to the BVWD imposed daily allocations. An example of this daily graph is the first graph at the top of this document. (And where the horizontal blue lines are the daily allocations – making it easy to see what one is allowed, and what one in fact used.)

The graph page is accessed via the “**Graph Data**” button on the WUMT front page. The graph page can be, like most Windows windows, be resized or made full-screen, whatever is the user's convenience. The WUMT graph display has an associated options pop-up menu. This menu is accessed by simply right mouse clicking anywhere on the graph area [and example of this pop-menu is shown below].

The top three menu items allow the user to select one of the three graph modes. When one selects one of the three graph modes, the selected mode will appear to be “checked”. In the example below, the Daily Usage graph has been selected.

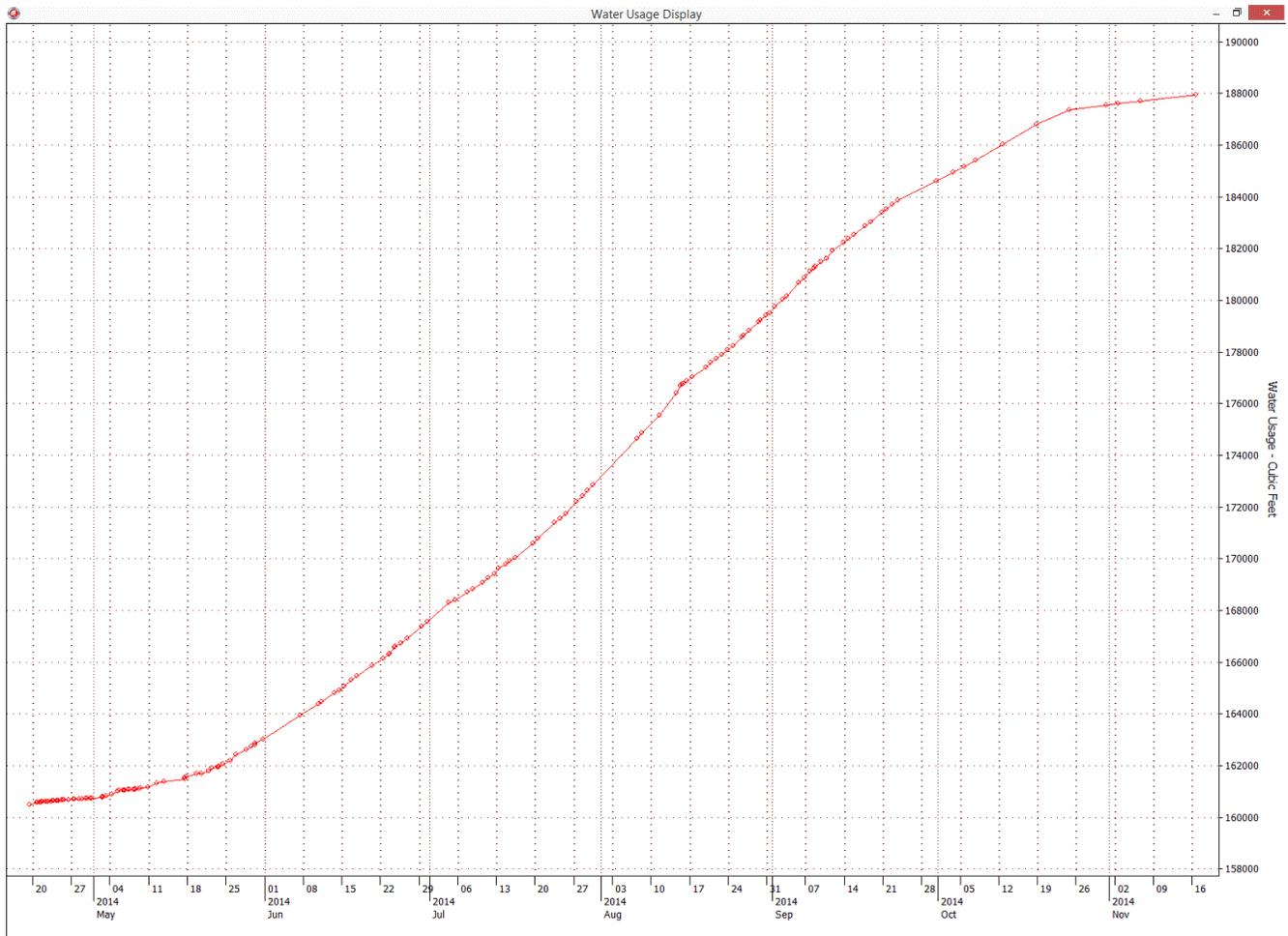
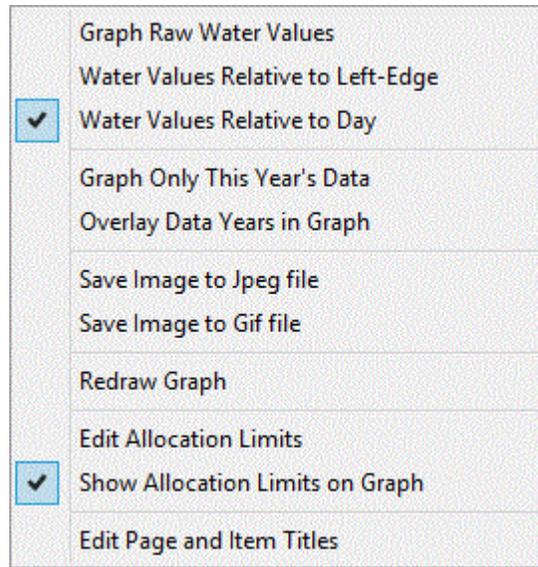


Fig 4. Example of Water Usage as a Function of Time Graph

WUMT will quite happily store and graph multiple year's worth of data. By default WUMT will graph all data known to it from left to right in increasing time order [oldest on the left, newest on the right]. If the user wishes only for the current year's data to be graphed, if they check the "Graph Only This Year's Data," such will be the case. Conversely, if one wishes all the data to be graphed, but with each year's data overlaid per month and day of month, the "Overlay Data Years in Graph" will do such. If "Overlay" is selected, previous year's data will be graphed first, but in gray, and the current year's data will be graphed on top, in red. Overlaying data can be a handy tool to make comparing water usage from previous years relative the current year visually very easy.



*Fig 5. Example of Graph Page Pop-Up*

If one wishes to save a copy of the currently displayed graph, at its current size, one can do such in either .Jpg or .Gif format using “Save Image to Jpeg file” and “Save Image to Gif file” menu items, respectively. In either case the user will be prompted for a file name to save the graphs as.

Allocation limits and if they are displayed or not is controlled by the next two menu items. The “Edit Allocation Limits” item will pop up another window, into which one can enter the BVWD supplied allocation limits, and which can then be displayed along with daily usage data. If those allocation limits are to be included in the graph, that is controlled by the “Show Allocation Limits on Graph” menu item. This is a selectable item. If it has been selected, it will appear with a check mark (as in the example above), and will stay selected until it is “unselected” by the user. Each click of that menu item will toggle it from selected to not selected and back again. More on allocation limits and how to enter them is covered below in the section on Allocation Limits.

The last menu item is a bit esoteric and is covered in more detail in the “WUMT for other than Water” section below. But it turns out that WUMT is not limited to managing only water usage. It can just as well be used to monitor electricity usage, or any other item which is used over time. So that the titles on the graphs and buttons reflect the commodity being used/managed, one can “edit” (change) the titles and captions appropriately. More is covered below on this.

One unforeseen benefit of WUMT in daily usage mode, is that it can call out unexpected usage. Like a leak. The unusually high daily usage in mid-August in the first graph of this document is an example of exactly that. By then we had our daily gardening routine down, and knew that we hadn't watered any extra anywhere. But by the third day of unexpectedly high use, we were out walking the pipe lines, checking the hidden faucets – as noted above: it was the valve for the automatic waterer for the goats that had stuck open. But seeing the graph not match expectation told us we had a problem, and it was only a case of finding it. BVWD sells water. They charge the same if that water is used productively, or is leaking worthlessly from a cracked pipe. WUMT can very much save one money.

The graph below is an example of the graph as a function of time, but with the vertical axis starting at zero and showing the total usage over the duration of the graph.

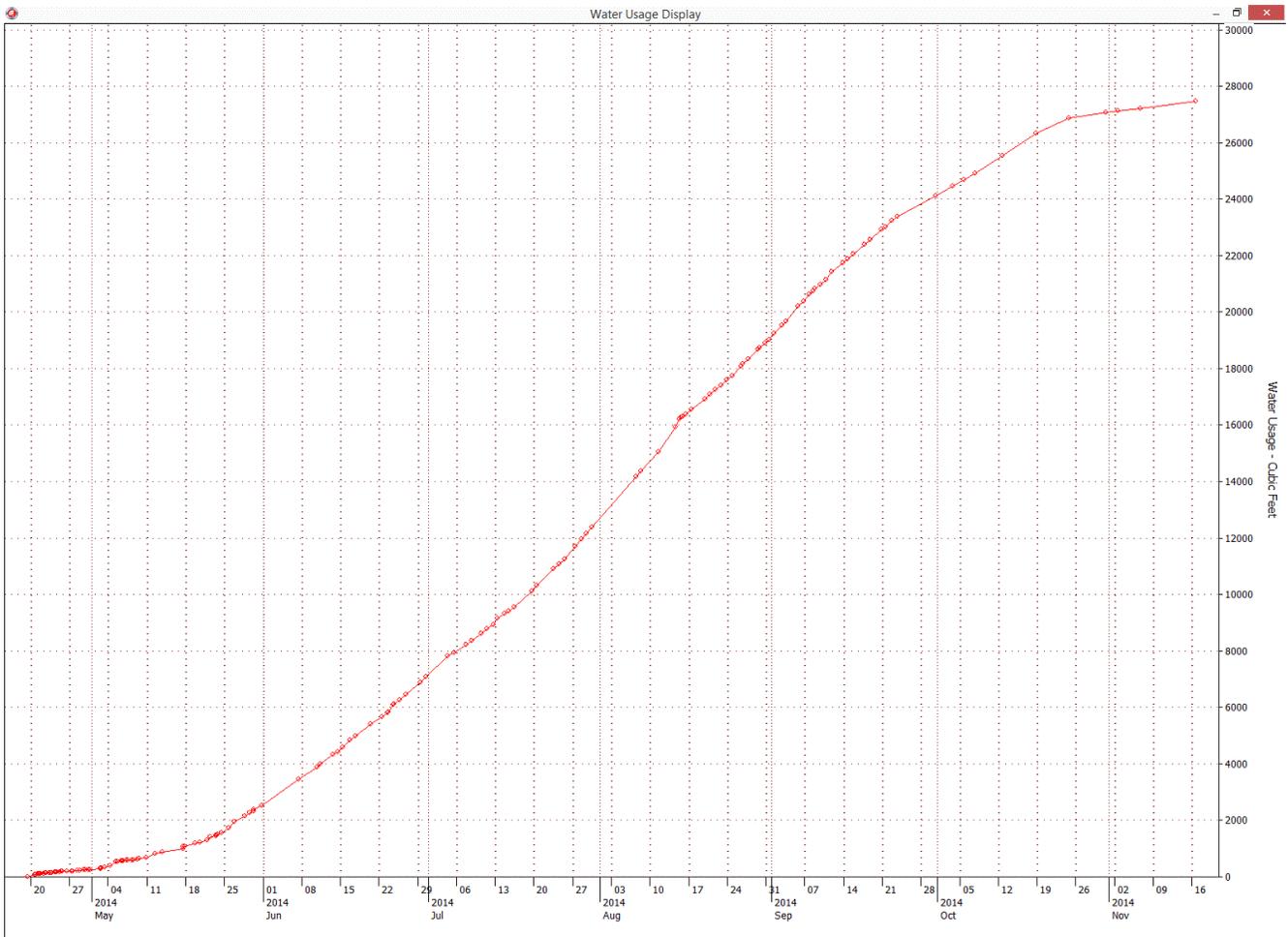


Fig 6. Example of Water Usage as a Function of Time Graph, With Zero Starting Value

Above, in the section on adding data to the WUMT database, one of the items one can add is a tag, some identifier about that data point, eg, “after watering the garden.” These items are displayed as the user moves the mouse over the graph. As one moves the mouse pointer from left to right (or right to left), the data that it is pointing to, if there is identifying data associated with that data, it is displayed at the bottom of the graph area, between the bottom of the window, and the horizontal date axis. The following image is a snippet from the bottom of the graph display window, where the mouse is over some data which was tagged with “After watering the garden”.

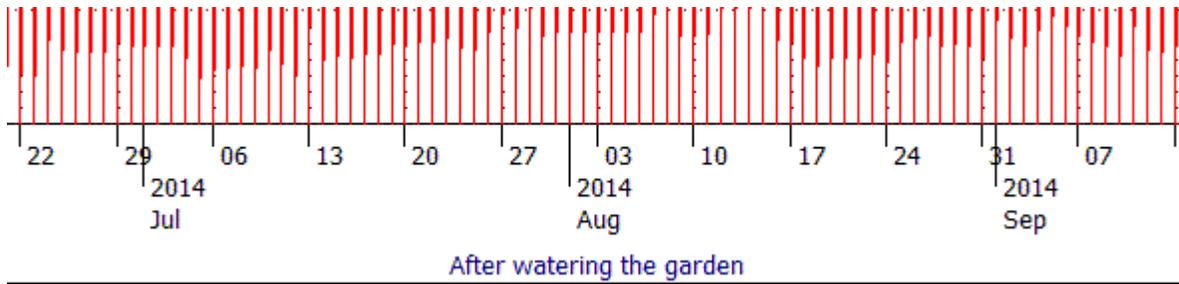


Fig 7. An Example of Identifying Text Being Displayed

### WUMT Working with Allocations

As seen above, WUMT can graph daily usage data, along with daily usage allocation limits – this is seen in the first graph at the top of this document. The window which allows the user to add this information so that WUMT can work with it is accessed via the Graph Page pop-up menu, and by clicking on the “Edit Allocation Limits” item. The window which is displayed is in the form of a small spreadsheet. An example of the window with limits already filled in is shown below.

| Allocation Limits      |                      |                 |
|------------------------|----------------------|-----------------|
| Alloc Begin yyyy-mm-dd | Alloc End yyyy-mm-dd | Alloc Amount CF |
| 2014-01-15             | 2014-03-15           | 3330            |
| 2014-03-15             | 2014-05-15           | 4893            |
| 2014-05-15             | 2014-07-15           | 16233           |
| 2014-07-15             | 2014-09-15           | 18263           |
| 2014-09-15             | 2014-11-15           | 12477           |
| 2015-01-15             | 2015-03-15           | 3330            |
| 2015-03-15             | 2015-05-15           | 4893            |

Save and Use New Limits

Fig 8. Example of Allocation Limits Edit Window

The data entered into the spreadsheet is provided by BVWD. Although WUMT makes use of this data in daily usage terms, the data from BVWD is typically for a two-month billing period. As long as one enters the beginning and ending dates of a billing period and the allocation for that duration, WUMT will make the necessary conversions to be able to use of the data.

Entering the data is simple: click on a cell in the spreadsheet, and type into that cell the appropriate date or value. Though it needs to be said: WUMT is expecting each entry to be in a specific

format. If the data is entered in a format that it is not expecting, the program may crash, or generate non-nonsensical output. So: enter the data carefully.

The date data is expected to be in “yyyy-mm-dd” format, complete with leading zeros as necessary. The example above shows this. The Allocation Amount is expected to be in CF (cubic feet, like the meter reads, though BVWD may provide the limits in HCF – if they do, simply multiply those values by 100 to get the CF values).

One of the features of WUMT is its ability to work with the current year's data, but also using previous years' data as reference material. In the example above, two year's worth of allocation limits have been entered. WUMT can work with up to five years of data.

Once the allocation data has been entered, it needs to be explicitly saved by using the “**Save and use New Limits**” button at the bottom of the window. If the window is simply closed using the red X in the top right, any data that might have been entered will not be save and not used.

Generally, once the allocation data has been entered, it can be ignored and WUMT will simply use it. When a new year's allocations are provided by BVWD, they can be added. There is no problem with entering an entire year's data ahead of time. WUMT will simply use that it needs as it needs it.

### WUMT for other than Water

As alluded to above, although WUMT was written, and initially intended to be used to monitor/manage one's water usage, but it can equally well be used to monitor the usage of any commodity which can be measured on a daily or more frequent basis. And although it can monitor “cat food consumption” with a program which has titles and buttons referring to water usage, the usage would be friendlier, especially if one were to capture the images from that usage to include in web pages or student papers etc, if titles were appropriate per the use.

All the buttons and titles which make reference to water usage can be changed to reflect an alternative usage. Below is an example of the window in which one can specify the adjusted titles. This window as alluded to above is accessed from the pop-up menu that one is presented with by right-clicking on the graph window.

It should be noted that WUMT, per copy, will only support a single “personality.” This means that one needs to make separate copies, in separate folders, if one is going to use WUMT to monitor multiple, even if two, types of usages.

If one is only going to use WUMT in a subset of all its features, then there is no need to provide alternative titles for all the possible titles and buttons – one need only provide new titles for those that are actually used, and one can leave the rest alone.

Below is an example of the titles which have been adjusted to monitor electricity usage. What one monitors and how WUMT is used it limited only by the user's imagination.

Title Options ✖

|  |  |
|--|--|
| <p><b>Main Page</b></p> <p><u>Form Title</u><br/>Power Usage Tool</p> <p><u>Data Title</u><br/>Power Usage Data</p> <p><b>Add Data Page</b></p> <p><u>Comments Title</u><br/>Power Usage Comments Leading Up to Current Meter Reading</p> <p><u>YMD Title</u><br/>YYYYMMDD HH:MM for Data-Point</p> <p><u>Reading Title</u><br/>Current Power Meter Reading</p> <p><u>Button Title</u><br/>Save Data to Power Usage Database</p> | <p><b>Graph Page</b></p> <p><u>Form Title</u><br/>Power Usage Display</p> <p><u>Graph Raw Clickable</u><br/>&amp;Graph Raw Power Values</p> <p><u>Graph Relative to Left Edge Clickable</u><br/>&amp;Power Values Relative to Left-Edge</p> <p><u>Graph Daily Clickable</u><br/>P&amp;ower Values Relative to Day</p> <p><u>Y-Axis Title</u><br/>Power Usage (kilowatt-hours)</p> <p><b>Allocations Page</b></p> <p><u>Column 1 Title</u><br/>Alloc Begin yyyy-mm-dd</p> <p><u>Column 2 Title</u><br/>Alloc Begin yyyy-mm-dd</p> <p><u>Column 3 Title</u><br/>Alloc Begin yyyy-mm-dd</p> |
|--|--|

Fig 9. Example of a WUMT Configured to Monitor Electricity Usage

### WUMT Technical Aspects

– WUMT keeps two backup copies of the user data: when the user saves the newest data, the previous copy of the data is renamed to be the backup; and the previous backup copy is renamed to backup-2 (and the old backup-2 is deleted). This means that if the user's data gets hopelessly messed up, as long as one hasn't saved the bad data more than once, or even twice, one can get back to the previous or the previous previous' data. As one can see in the following file list from an installed WUMT: the current data is kept in wutData.Dat; the first backup is wutDataBU.Dat; and the second backup is wutDataBU2.dat. To restore a backup copy to the current data: simply delete or rename out of the way the wutData.Dat file (the bad data); and rename either wutDataBU or wutDataBU2 to wutData.Dat. When one restarts WUMT, that back-level data will now be the current data.

| Name   | Date modified      | Type          | Size      |
|--|--------------------|---------------|-----------|
|  AllocLimits.txt    | 6/11/2014 3:57 PM  | Text Document | 1 KB      |
|  WaterUsageTool.exe | 10/17/2014 7:50 PM | Application   | 11,978 KB |
|  wutData.Dat        | 10/12/2014 7:10 PM | DAT File      | 8 KB      |
|  wutDataBU.Dat      | 10/7/2014 7:16 PM  | DAT File      | 8 KB      |
|  wutDataBU2.Dat     | 10/5/2014 7:22 PM  | DAT File      | 8 KB      |

*Fig 10. An example of the nominal files found in the WUMT folder*

– The WUMT data file is not surprisingly, composed of lines of data. Where each data line contains a date and time of the data value/data point, and the data value. Before each data line there is an optional annotation/identifying comment for that data point. If there is no annotation for a data point, then that line is simply not there (ie, no blank placeholder takes its place). The format for each data line is explicit, ie, must be maintained (otherwise WUMT is going to crash and burn). Each data line begins with a YYYYMMDD date tag for the data item. That is followed by a HH:MM time for the data item, but separated from the date by at least one blank. The data value follows the time field, again, separated by at least one blank. This format can be seen in the notes above about the WUMT front page. The annotation line may contain any text, is simply carried with the data item, and in the mouse over situation, is presented to the user; but WUMT ascribes no value or meaning to the text.

The display of the data file on the front page of WUMT is in fact editable – if one clicks in the display area, gets a cursor and starts typing, those characters are going into the data file. This is a real opportunity to mess up the data and render WUMT useless. This is to say: if one must edit the file, one can, but one is best to leave it alone and let it do its job. To make it more difficult to scramble the file and crash WUMT, any changes to the file have to be explicitly saved back to disk. This is only done by clicking the **Save Data** clickable at the top right corner of the data file field. If one makes changes to the file and doesn't save them, they will be lost; or maybe more importantly, will not be included in the running data file. ... edit the data file only when necessary, and be very careful about such. If the data file does become unusable, then one may have to revert to a backup copy of the file (see section above).