MEMORANDUM

To: ESPAM Model Files
Fr: Bryce Contor
Date: 4 October 2003

Re: Applying Summary Tools to ESPAM.exe and READINP.exe output.

From the IDWR FTP site, surface-water coalition subdirectory, I downloaded and expanded VB_Utils.zip. In folder "For_Koreny_Data_Request_Sept_2005" are two summary utilities, "WellT.exe" and "Sumry_22_Dec_04.exe." This memo details the use of these utilities to summarize the components of the water budget. It is based on the files generated by the GIS component of the recharge tool (ESPAM.exe) and the FORTRAN component (READINP.exe) in the process of creating MODFLOW input files. Individual folders in the same directory contain the Visual Basic source code for these utilities.

This memo assumes some familiarity with GIS processing and that the reader has reviewed the 3 October 2005 memo regarding the GIS and FORTRAN components of the recharge tool.

WellT.exe

This utility extracts the net recharge information from the summary output files and tabulates it in a format that can be joined in GIS to the model grid for display. The resulting file name is <my simulation>_WTM.txt. There is one record per model grid cell and one field per simulation stress period. The data values are in depth/day for each stress period. In the ESPAM model, depth units are in feet.

To use the utility, double-click on the executable within a Windows Explorer window. The input screen illustrated in Figure 1 appears. Click "Go" and select the *.mdl file of the desired simulation. The files *.cel (GIS tool output) and *.WTM (FORTRAN tool output) must be in the same directory as the *.mdl file. The utility performs its calculations and lists the name of the output path and file in the bottom box. Sample output is illustrated in Figure 2. The value highlighted in spreadsheet cell C5742 indicates that in stress period 2, the net depth of recharge applied to Row 28, Column 98 was 8.61×10^{-4} feet.

In ArcView 3.2, the output table may be joined to the model grid using the "Cell" field as the joining field. Because ArcGIS 8.x works very slowly with text tables, it is helpful to open the output table in Microsoft Excel and save it as a *.dbf file. It is important to select all cells, format cells to "number, eight decimal places,"[1] and format all columns to "auto width" before exporting as *.dbf. Only the cells highlighted will be exported. Figures 3 through 5 show the join operation, setting symbology to display recharge for a

[1] Scientific notation does not work well.

particular stress period, and the resulting map of spatial distribution of recharge. Figure 6 illustrates using a spreadsheet to display the temporal pattern of recharge for a particular model cell.

This utility does not provide any new information; the MODFLOW well file and the MODFLOW recharge file contain essentially the same data, in slightly different units and/or format. The only purpose for using this utility is for convenience in display.

Using Sumry_22_Dec_04.exe

The purpose for this utility is two-fold. First, it creates a data table for each selected water-budget component, in a format that may be joined to the model grid in GIS to display the spatial distribution of the component. Second, it creates a summary data table that allows plotting components through time. Data tables are only generated for the components of the water budget that are calculated within the FORTRAN portion of the recharge tool. Components that are simply passed through (fixed point pumping, offsite pumping,[2] perched river seepage, tributary valley underflow, scenario point recharge and discharge) may be viewed spatially and temporally in their native input data formats. These are included in the summary, however.

The version of the utility that was distributed in the May Training had an error in representation of canal leakage for entities that included both offsite pumping and leaky canals. This did not affect model calibration because the calibration data included no such entities. All versions of this utility lack the ability to represent the impact of PEST-applied multipliers different from 1.0. This does not affect use of the tool for the calibration data set nor for any scenario constructed to date.

This utility is started by double-clicking its entry in Windows Explorer. The input form illustrated in Figure 7 has the components required for balancing the water budget pre-selected. These are summarized below:

*.EIR	Evapotranspiration on irrigated lands.
*.RNI	Recharge on non-irrigated lands.
*.PRI	Precipitation on irrigated lands.
*.SWV	Surface-water volume applied to land surface. This is the *net* volume used in calculations of recharge, calculated as (diversions - returns - canal leakage + offsite pumping).
*.spt	Scenario point volume.
*.off	Offsite pumping volume.
*.fpt	Fixed-point pumping volume.
*.pch	Perched-reach seepage.
*.trb	Tributary basin underflow.

[2] Offsite pumping is used by FORTRAN in other calculations, but the extraction volume is simply passed through.

The other summary items can be seen in Figure 7. Components with upper-case extensions are generated by READINP.exe. Components with lower-case extensions are pass-through items generated by ESPAM.exe.

The output summary table is named "<my simulation>_SMRY.txt." It contains one record for each component selected. If surface-water irrigation has been selected, it also contains a record for canal leakage. There is one field for each stress period. For the upper-case-extension components, the tool also outputs an individual file with naming convention "<my simulation>_<upper-case extension>.txt."

For any components with extension beginning with letter "A" (ANI, ASW, etc.), the units are in square feet. For all other components the units are in cubic feet. The sign convention follows the sign convention of underlying data. Output of the GIS tool (lower-case components) is aquifer centric; negative numbers are withdrawals and positive numbers are recharge. Output of the FORTRAN tool (upper-case components) uses the convention that typical values are positive. Therefore all ET components (extension beginning with "E") and ground-water recharge components (RGW) use positive numbers for withdrawals. All other components use positive numbers for recharge. Therefore, if only the default components are selected, the entries in <my simulation>_SMRY.txt can be summed to obtain net recharge by subtracting entry "EIR" from the sum of all other entries.

The entries in <my simulation>_SMRY.txt can be displayed as a time-series graph using a spreadsheet. Entries in other output files can be joined to the model grid in GIS to produce spatial maps, as illustrated for the output of WellT.exe.

Figures

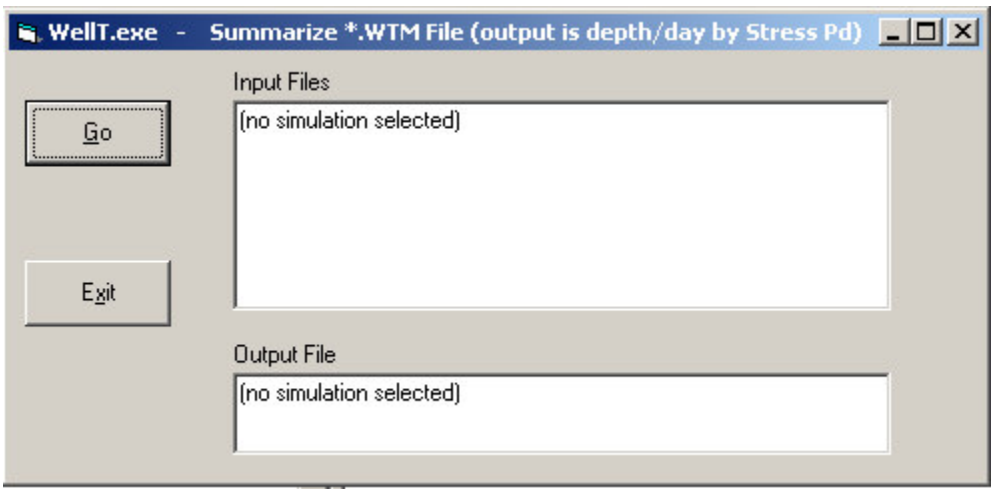
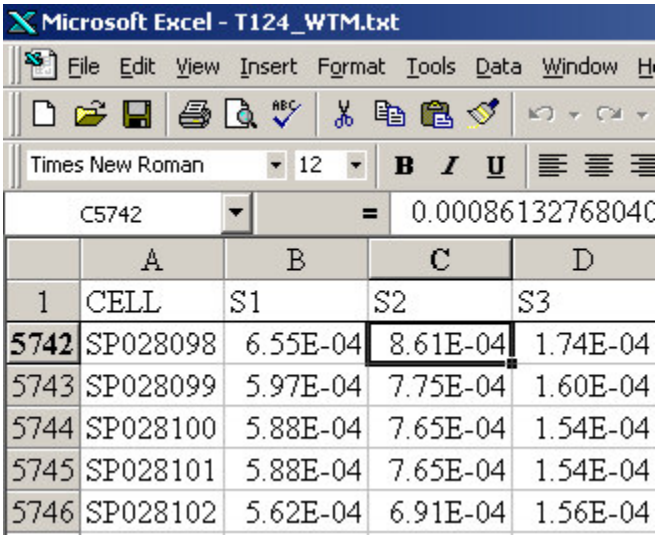


Figure 1. WellT.exe input screen.



	A	B	C	D
1	CELL	S1	S2	S3
5742	SP028098	6.55E-04	8.61E-04	1.74E-04
5743	SP028099	5.97E-04	7.75E-04	1.60E-04
5744	SP028100	5.88E-04	7.65E-04	1.54E-04
5745	SP028101	5.88E-04	7.65E-04	1.54E-04
5746	SP028102	5.62E-04	6.91E-04	1.56E-04

Figure 2. Illustration of WellT.exe output text file.

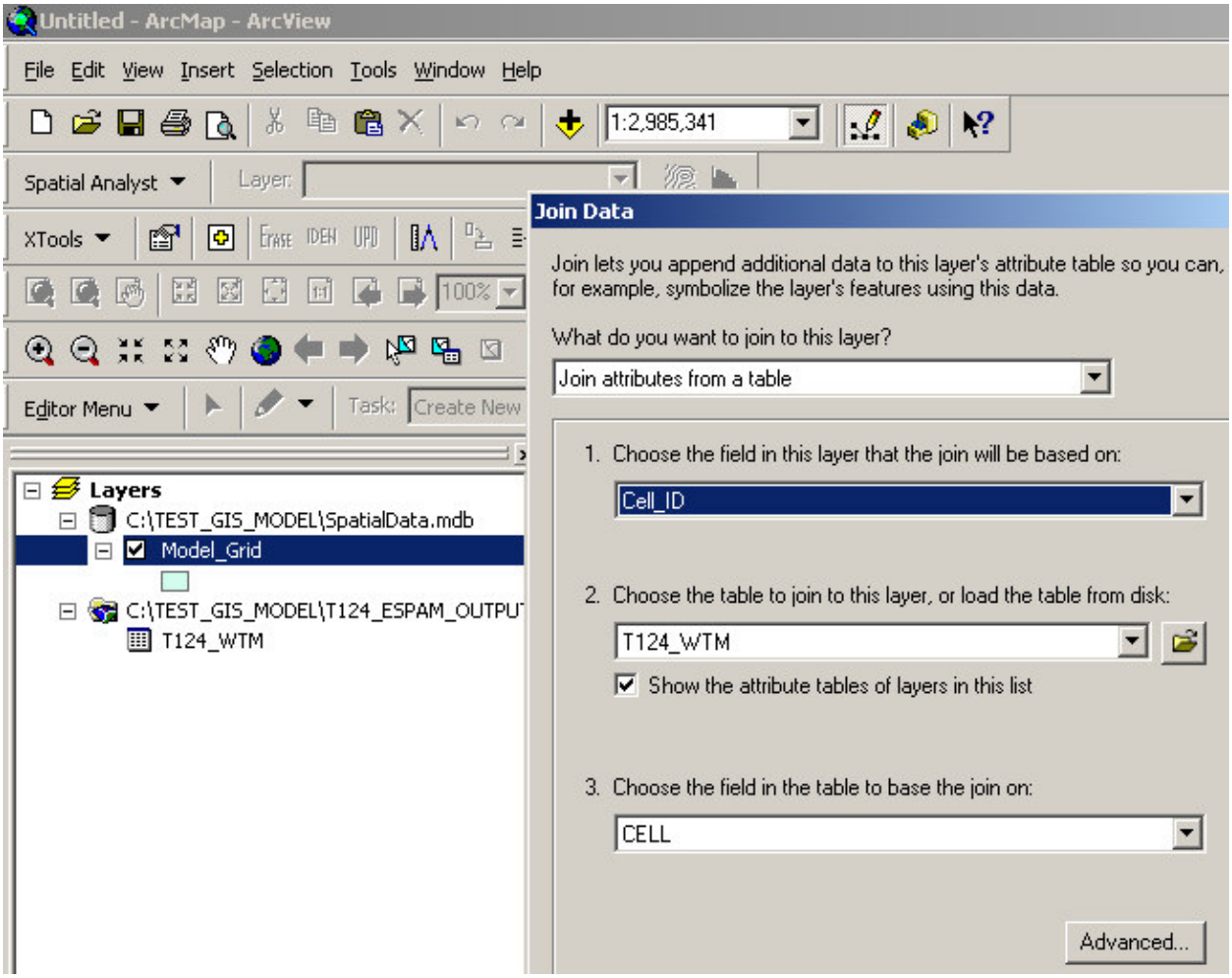


Figure 3. Joining *.dbf (in this case, T123_WTM.dbf) to model grid GIS layer.

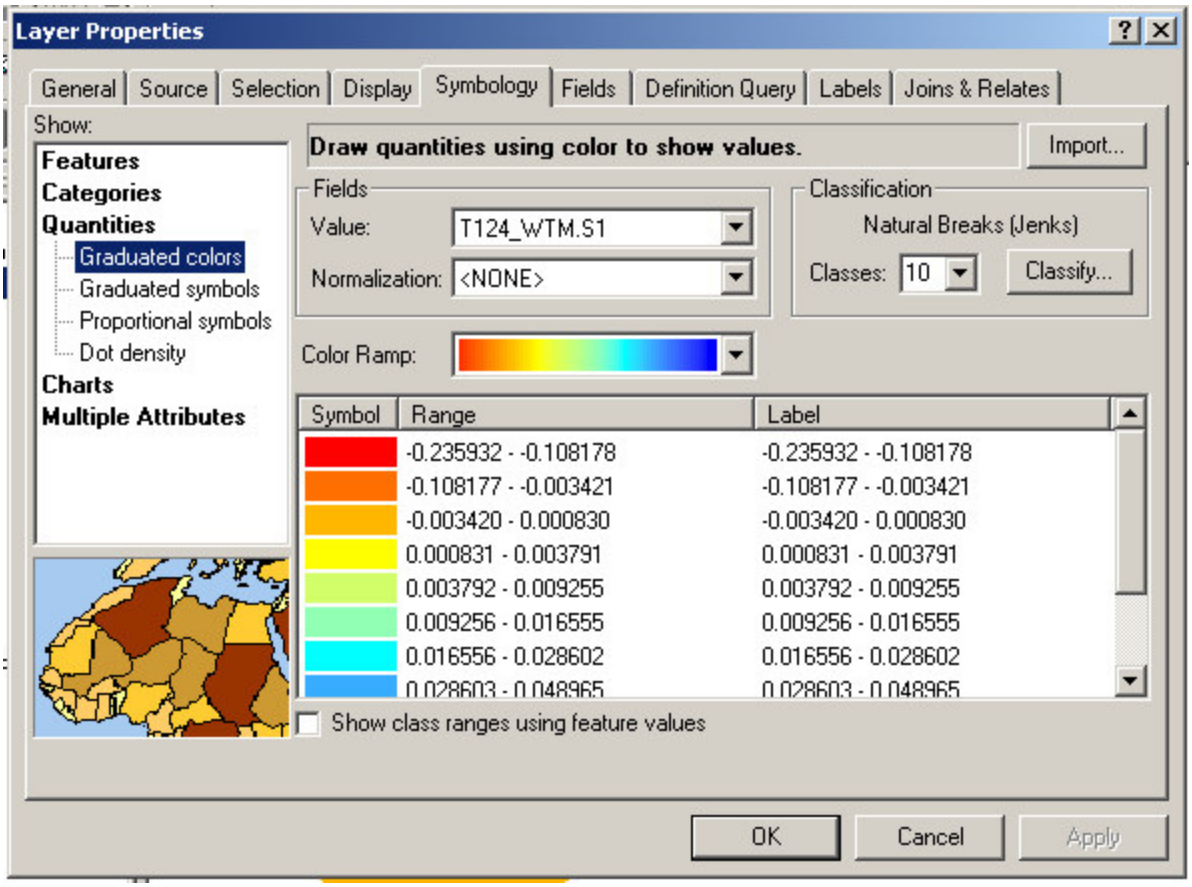


Figure 4. Selecting symbology to display recharge in Stress Period One.

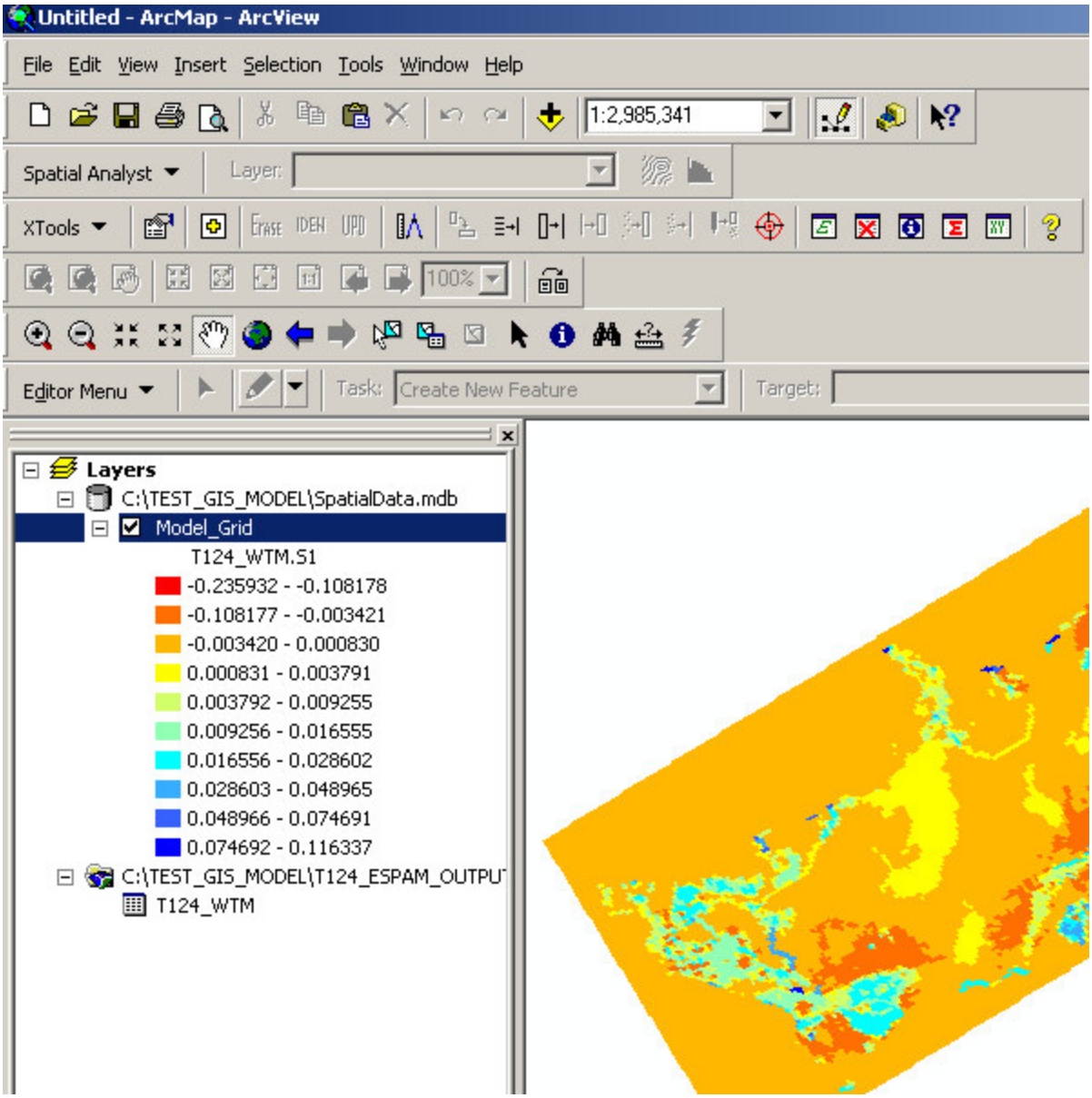


Figure 5. Spatial distribution of Stress Period One recharge.

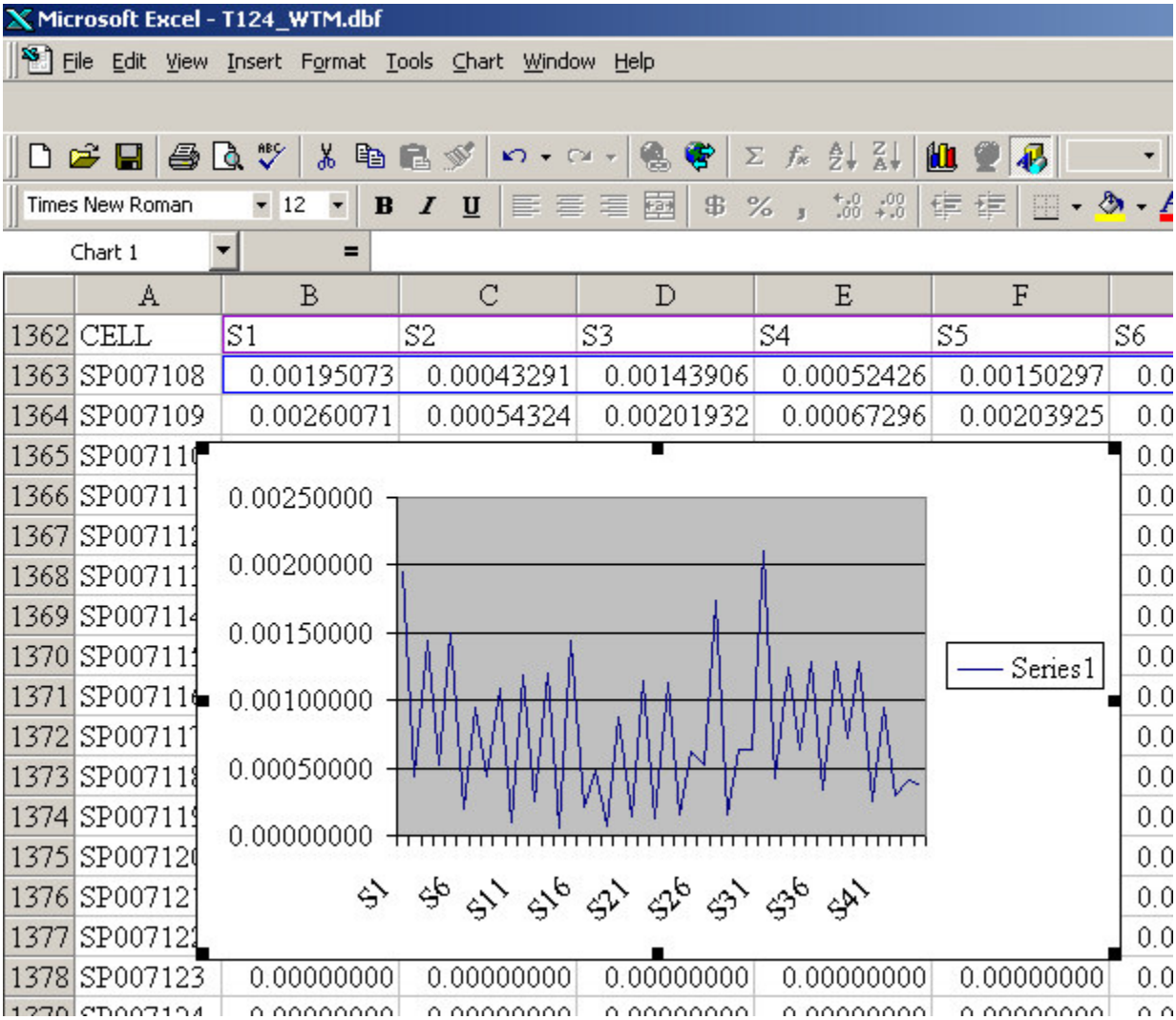


Figure 6. Using a spreadsheet to display the temporal pattern of recharge in Row 7, Column 108.

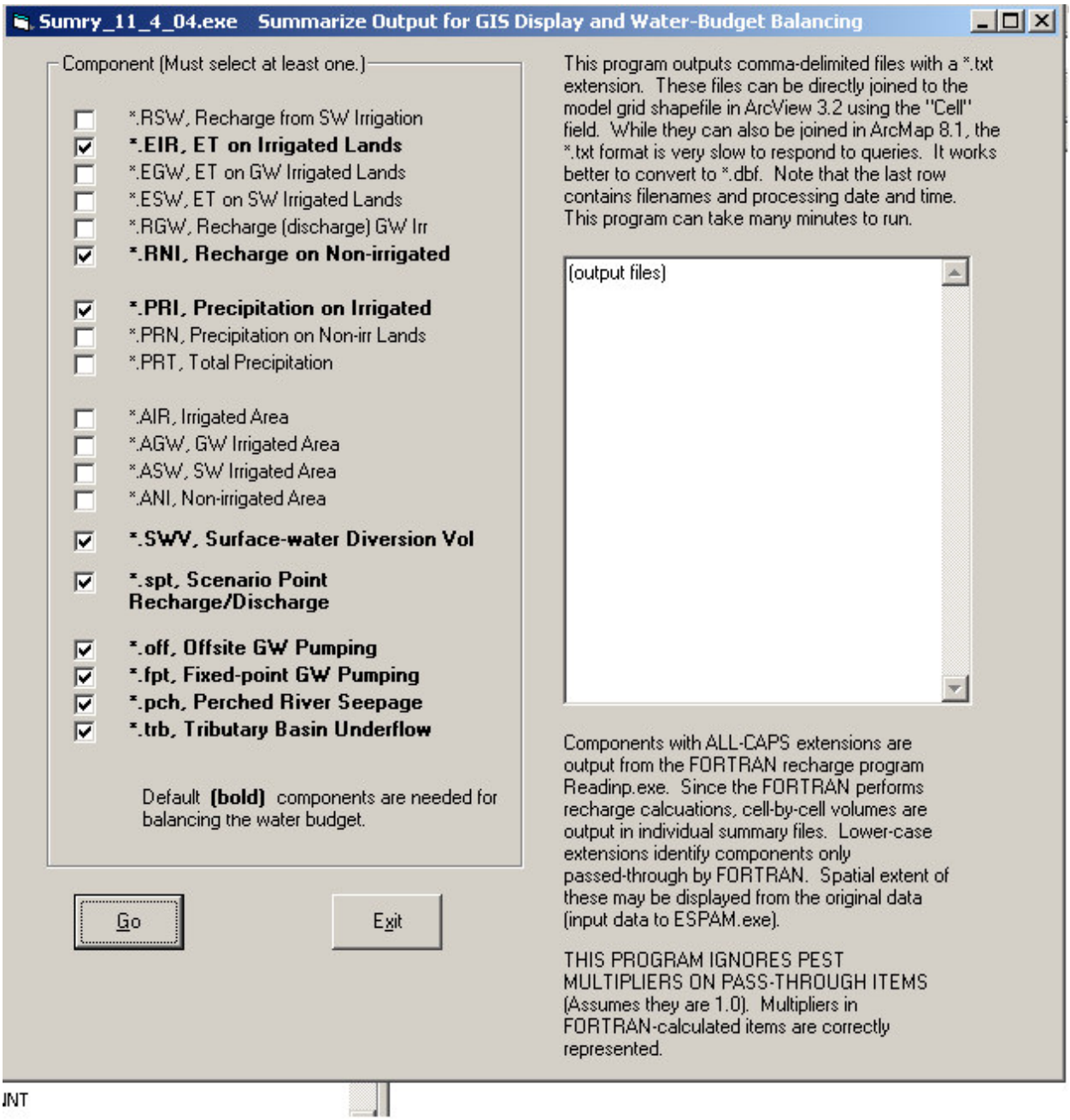


Figure 7. Input screen for Summary utility.