

# PALMER DROUGHT SEVERITY INDEX (PDSI) CROP MOISTURE INDEX (CMI) HANDS-ON

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##### [The Palmer Drought Severity Index](#)

The value of the PDSI is reflective of the how the soil moisture compares with normal conditions. A given PDSI value is usually a combination of the current conditions and the previous PDSI value, so the PDSI also reflects the progression of trends, whether it is a drought or a wet spell. That means that a single PDSI value is not representative of just the current conditions, but also of recent conditions to a certain extent.

##### [The Standardized Precipitation Index](#)

The Standard Precipitation Index (SPI) quantifies deficit or excess moisture conditions at a location for a specific time interval. The value computed represents the number of standard deviations the measured precipitation for the interval deviates from the normalized mean of all intervals of the same length in the climate record. The NADSS implementation of the SPI quantifies wet and dry spells for 1 - 104 week or 1 - 24 month intervals.

##### [The Newhall Simulation Model](#)

The Newhall Simulation Model (NSM) was designed to run on monthly normals for precipitation and temperature. The process involves running time-sequence monthly climate data against daily moisture status data, and then summarizing the results according to the rules of soil moisture and temperature regimes, thus classifying the site.



#### Product Documentation

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[PDSI Users Manual](#)

[SPI Users Manual](#)

[Newhall Users Manual](#)

# Overview

- The program allows you to calculate the Original Monthly PDSI, the Self-Calibrating Monthly and Weekly PDSI, as well as the Weekly Crop Moisture Index (CMI).
- If data is not available, it can be represented in the input files by using the value  $-99.00$ . Since the PDSI is an accumulating index (that is, one value depends directly on the previous value), large gaps in the data will have adverse effects
- PDSI also depends on long-term averages used in the water balance equation, so using a small amount of data is also not a good idea. The program requires at least 25 years of data in order to do any calculations.
- AWC is very important to the calculations of the PDSI, so try to use the most accurate information available.

# Input File

- Prepare several specifically named input files.
- To calculate the monthly PDSI, four files are needed:
  - monthly\_T
  - monthly\_P
  - mon\_T\_normal or T\_normal
  - parameter
- To calculate the weekly PDSI, four files are needed:
  - weekly\_T
  - weekly\_P
  - wk\_T\_normal or T\_normal
  - parameter

# Cont...

## 1. monthly\_T and weekly\_T

These files hold the temperature data for a station. Each line starts with the year and is followed by 12 (52) temperature entries. The temperature is the average monthly (weekly) temperature for each of the 12 months (52 weeks) of that year. Shown below are the first three lines from monthly\_T.

```
yyyy tm1/tw1 tm2/tw2 tm3/tw3 tm4/tw4 tm5/tw5 ...  
yyyy tm1/tw1 tm2/tw2 tm3/tw3 tm4/tw4 tm5/tw5 ...  
yyyy tm1/tw1 tm2/tw2 tm3/tw3 tm4/tw4 tm5/tw5 ...
```

Where, yyyy = year

tm1 = temperature month 1 ; etc (until 12 months)


tw1 = temperature week 1 ; etc (until 52 weeks)

Name this file **monthly\_T** and **weekly\_T** and put it in the same directory as the SPI program.

# Cont...

**monthly\_T - WordPad**

File Edit View Insert Format Help




1893	14.371	14.000	26.435	44.250	54.645	70.683	73.355	69.323	63.600	48.806	32.867	19.161
1894	12.705	14.979	37.984	49.700	61.209	71.463	77.935	74.312	65.283	51.516	34.767	29.548
1895	12.519	17.964	33.994	54.506	60.411	66.172	70.548	69.622	65.288	44.795	32.433	23.333
1896	23.258	27.397	26.425	48.833	62.790	68.054	71.365	70.677	57.991	46.355	21.154	28.597
1897	13.758	20.179	26.613	46.700	59.016	66.533	74.032	67.928	71.617	54.613	32.450	18.686
1898	23.645	22.643	33.710	46.633	56.993	69.200	73.604	71.242	64.300	45.161	30.783	20.945
1899	18.758	8.125	18.194	45.662	57.667	68.500	72.065	73.242	61.602	53.226	42.883	20.290
1900	25.919	10.786	30.161	50.967	62.419	68.983	72.887	76.468	62.207	56.677	30.267	26.935
1901	22.355	17.565	33.419	48.567	59.629	69.767	81.903	73.629	60.714	53.806	34.917	18.726
1902	21.468	17.732	35.680	45.889	62.774	63.969	71.790	68.500	58.268	53.500	37.317	18.997

For Help, press F1

**weekly\_T - WordPad**

File Edit View Insert Format Help



1893	22.071	11.857	10.929	17.143	-4.143	6.143	20.143	29.214	14.214	30.000	19.571	25.786	4
1894	8.857	17.218	29.429	-4.741	12.071	21.845	10.856	6.141	39.857	37.143	49.714	32.071	2
1895	15.000	6.357	28.226	2.571	3.643	-2.857	17.857	37.214	34.286	28.000	18.214	41.286	5
1896	11.857	32.929	19.643	20.643	35.357	21.143	23.643	28.071	26.832	25.857	19.571	28.500	3
1897	15.929	23.571	21.571	-3.714	18.429	19.286	24.857	20.000	10.714	23.214	19.071	30.857	4
1898	27.286	26.786	25.214	18.571	14.714	26.786	25.214	19.286	26.929	37.857	38.214	33.214	3
1899	10.786	27.500	26.857	21.143	-5.857	-13.214	18.714	25.857	12.429	21.143	20.429	14.143	1
1900	20.286	33.643	33.286	24.786	11.071	10.571	4.786	14.571	19.143	31.000	26.214	33.357	3

For Help, press F1

# Cont...

## 2. monthly\_P and weekly\_P

These files hold the precipitation data for a station. Each line starts with the year and is followed by 12 (52) precipitation entries. The precipitation is the total monthly (weekly) precipitation for each of the 12 months (52 weeks) of that year.

```
yyyy pm1/pw1 pm2/pw2 pm3/pw3 pm4/pw4 pm5/pw5 ...  
yyyy pm1/pw1 pm2/pw2 pm3/pw3 pm4/pw4 pm5/pw5 ...  
yyyy pm1/pw1 pm2/pw2 pm3/pw3 pm4/pw4 pm5/pw5 ...
```

Where, yyyy = year

pm1 = precipitation month 1 ; etc (until 12 months)

pw1 = precipitation week 1 ; etc (until 52 weeks)

Name this file **monthly\_P** and **weekly\_P** and put it in the same directory as the SPI program.

# Cont...

**monthly\_P - WordPad**

File Edit View Insert Format Help

1893	0.610	1.500	1.730	4.050	1.950	0.790	3.020	2.570	1.430	0.850	1.260	2.350
1894	0.700	0.550	0.580	4.240	2.430	1.150	0.580	1.480	0.550	1.760	0.050	1.000
1895	0.650	0.540	0.520	3.980	2.380	6.240	2.320	3.920	4.770	0.060	1.040	0.000
1896	0.250	0.270	1.670	5.680	6.240	7.740	5.550	1.660	1.810	3.230	3.850	0.230
1897	2.500	0.540	3.010	4.480	0.980	5.820	3.780	1.600	1.010	1.940	0.910	2.950
1898	1.100	0.920	1.230	1.490	6.620	6.030	3.840	3.040	1.100	2.290	0.830	0.250
1899	0.850	1.400	1.450	0.310	7.630	7.680	1.660	3.100	0.440	1.450	0.720	1.260
1900	0.400	1.600	2.340	4.480	3.560	1.900	8.090	2.530	4.090	1.800	0.270	0.950
1901	0.300	1.300	2.180	1.940	2.950	5.050	0.560	2.350	10.970	1.950	1.070	1.500
1902	1.600	0.840	1.490	1.660	2.760	3.430	3.750	4.720	4.850	0.000	0.700	2.120

For Help, press F1

**weekly\_P - WordPad**

File Edit View Insert Format Help

1893	0.350	0.200	0.000	0.060	0.100	0.100	0.650	0.000	0.650	0.870	0.470	0.390
1894	0.200	0.000	0.200	0.200	0.100	0.050	0.100	0.400	0.140	0.040	0.000	0.400
1895	0.000	0.000	0.300	0.350	0.200	0.150	0.020	0.010	0.180	0.170	0.150	0.180
1896	0.000	0.000	0.100	0.050	0.150	0.000	0.000	0.000	0.520	0.100	0.250	0.300
1897	1.300	0.700	0.380	0.120	0.000	0.120	0.100	0.220	0.100	0.990	0.050	1.370
1898	0.000	0.000	0.500	0.600	0.000	0.730	0.000	0.190	0.000	0.400	0.650	0.000
1899	0.100	0.230	0.000	0.420	0.200	0.000	0.000	0.350	1.000	0.050	1.280	0.050
1900	0.150	0.150	0.100	0.000	0.000	0.800	0.700	0.000	0.100	0.300	0.050	0.750

For Help, press F1



# Cont...

## 3. mon\_T\_normal and wk\_T\_normal

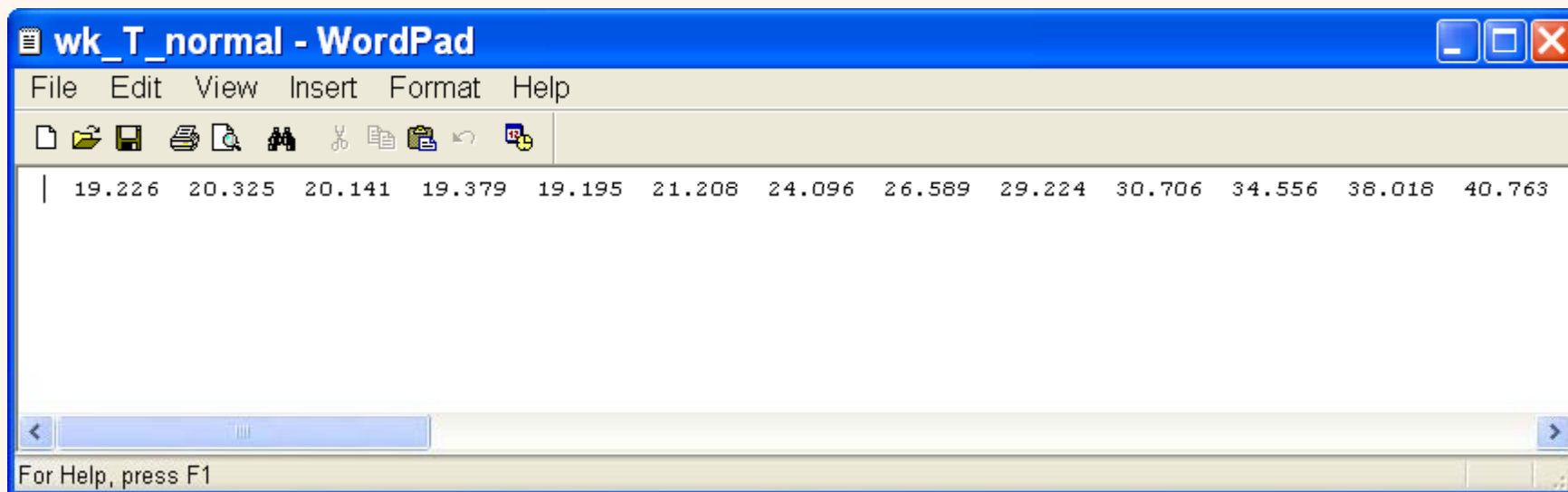
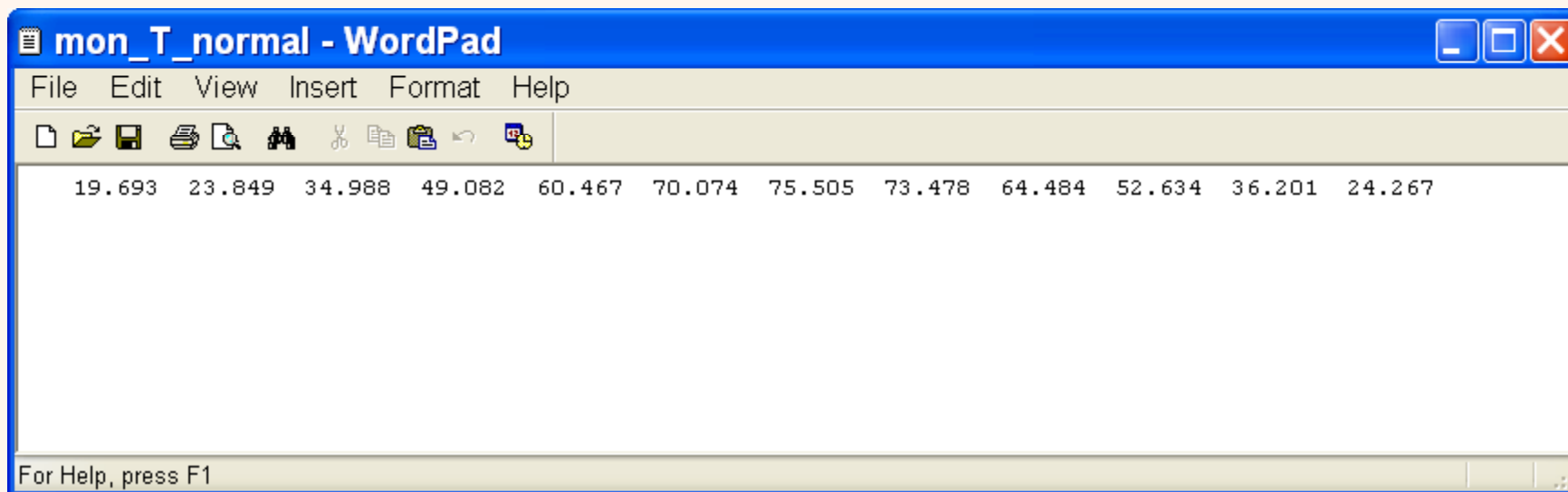
These files have the normal temperature data for a station. It has only 12 (52) entries, all on one line. The values in the file are the normal, or average, temperature over all the years on record for each of 12 months (52 weeks).

```
tnm1/tnw1 tnm2/tnw2 tnm3/tnw3 tnm4/tnw4 tnm5/tnw5 ...
```

Where, tnm1 = temperature normal month 1 ; etc (until 12 months)  
tnw1 = temperature normal week 1 ; etc (until 52 weeks)

Name this file **mon\_T\_normal** and **wk\_T\_normal** and put it in the same directory as the SPI program.

# Cont...



# Cont...

## 4. parameter

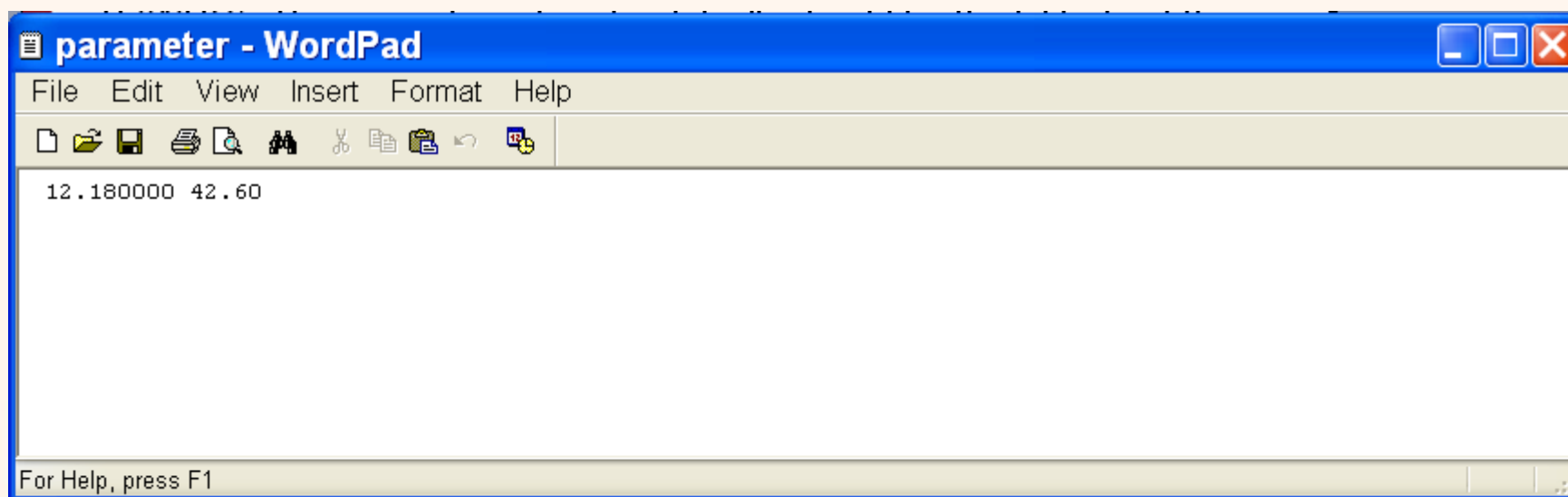
The parameter file contains two numbers. The first number should always be the Available Water Holding Capacity (referred to in this document as the AWC, but also referred to elsewhere as AWHC or RZWHC). The second number, by default, should be the latitude of the station. The latitude should be given in decimal degrees rather than degrees, minutes, seconds.

AWC lat
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Where, AWC = Available Water Content  
lat = latitude of the station (decimal degrees)

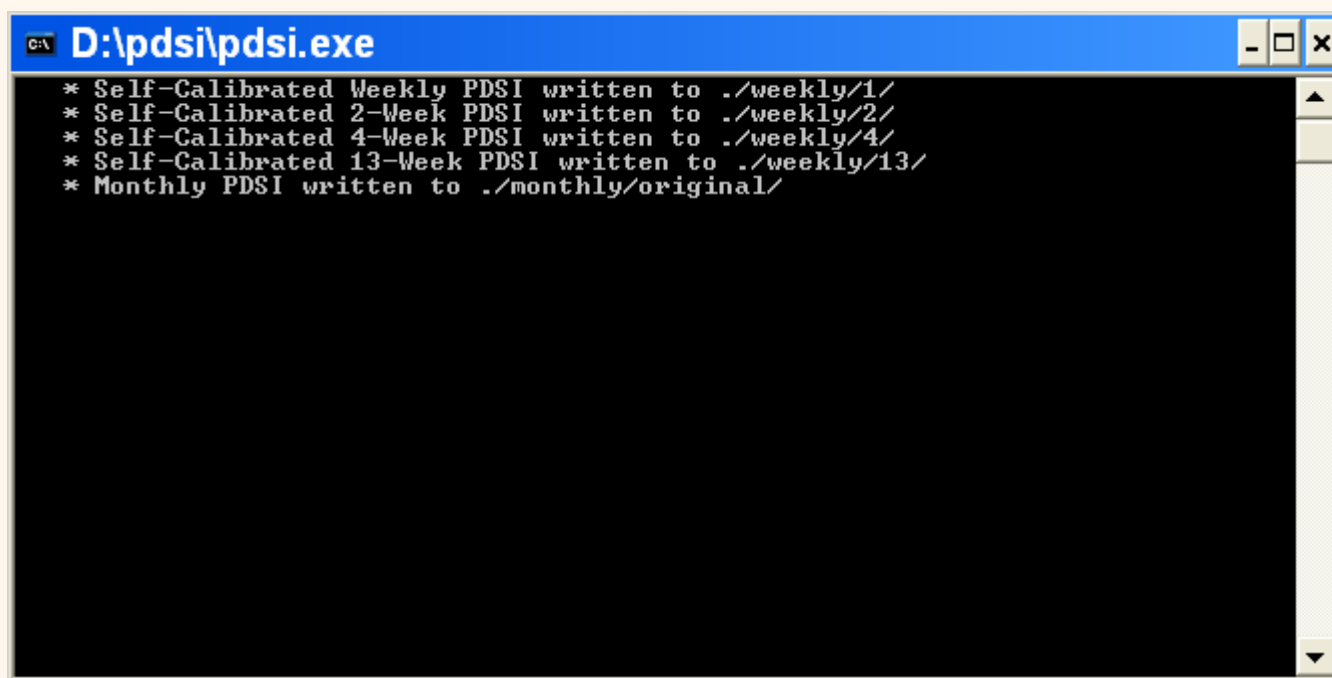
Name this file **parameter** and put it in the same directory as the SPI program.

# Cont...



# Execute Program

- Double click **pdsi.exe** to execute the program



```
C:\> D:\pdsi\pdsi.exe
* Self-Calibrated Weekly PDSI written to ../weekly/1/
* Self-Calibrated 2-Week PDSI written to ../weekly/2/
* Self-Calibrated 4-Week PDSI written to ../weekly/4/
* Self-Calibrated 13-Week PDSI written to ../weekly/13/
* Monthly PDSI written to ../monthly/original/
```

- Output folder name **monthly** and **weekly** will appear

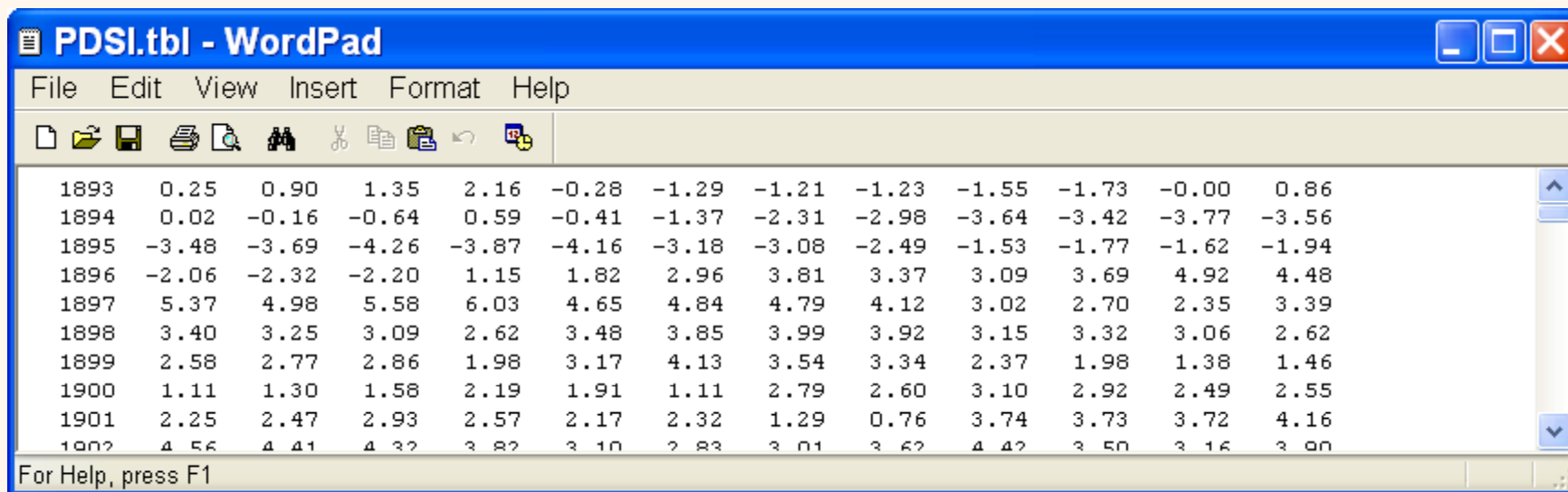
# PDSI Output File

- The PDSI calculations actually result in four different indices, the PDSI, the Weighted PDSI (WPLM), the Palmer Hydrological Drought Index (PHDI) and the Palmer Z-index (ZIND)
- The PDSI program will also attempt to calculate several different types of the PDSI (the original monthly PDSI, the self-calibrated monthly PDSI, the weekly PDSI)

<b>PDSI Type</b>	<b>Subdirectory</b>
Original Monthly	monthly/original/
Self-Calibrated Monthly	monthly/self_cal/
Self-Calibrated Weekly	weekly/1/
Self-Calibrated 2-Week	weekly/2/
Self-Calibrated 4-Week	weekly/4/
Self-Calibrated 13-Week	weekly/13/
Weekly CMI	weekly/CMI/

# Cont...

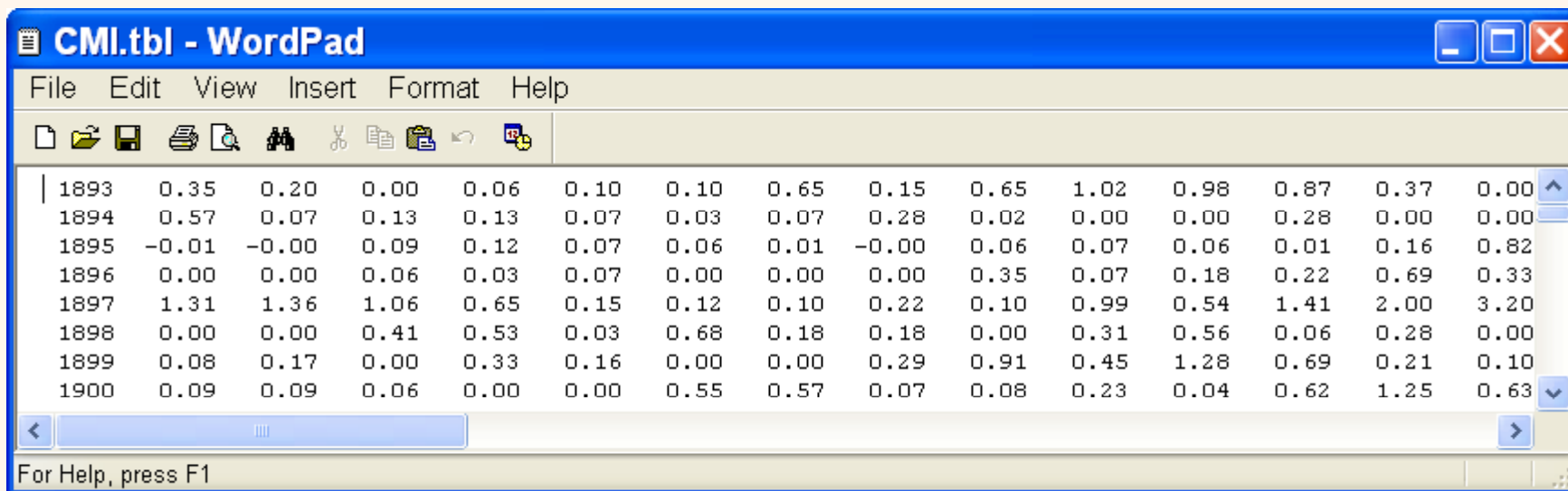
- The PDSI default format is the table format. Each line contains one year of data. The first number is the year, which is followed by a number for each of the 12 months or 52 weeks of the year. The four different indices are written into PDSI.tbl, WPLM.tbl, PHDI.tbl, and ZIND.tbl.



Year	1	2	3	4	5	6	7	8	9	10	11	12
1893	0.25	0.90	1.35	2.16	-0.28	-1.29	-1.21	-1.23	-1.55	-1.73	-0.00	0.86
1894	0.02	-0.16	-0.64	0.59	-0.41	-1.37	-2.31	-2.98	-3.64	-3.42	-3.77	-3.56
1895	-3.48	-3.69	-4.26	-3.87	-4.16	-3.18	-3.08	-2.49	-1.53	-1.77	-1.62	-1.94
1896	-2.06	-2.32	-2.20	1.15	1.82	2.96	3.81	3.37	3.09	3.69	4.92	4.48
1897	5.37	4.98	5.58	6.03	4.65	4.84	4.79	4.12	3.02	2.70	2.35	3.39
1898	3.40	3.25	3.09	2.62	3.48	3.85	3.99	3.92	3.15	3.32	3.06	2.62
1899	2.58	2.77	2.86	1.98	3.17	4.13	3.54	3.34	2.37	1.98	1.38	1.46
1900	1.11	1.30	1.58	2.19	1.91	1.11	2.79	2.60	3.10	2.92	2.49	2.55
1901	2.25	2.47	2.93	2.57	2.17	2.32	1.29	0.76	3.74	3.73	3.72	4.16
1902	4.56	4.41	4.32	3.82	3.10	2.83	3.01	3.62	4.42	3.50	3.16	3.80

# CMI Output File

- The CMI calculations will always produce four output files: CMI.tbl, potentials, WB.tbl, CMI\_calc.tbl
- CMI.tbl has the same format as the PDSI table output files

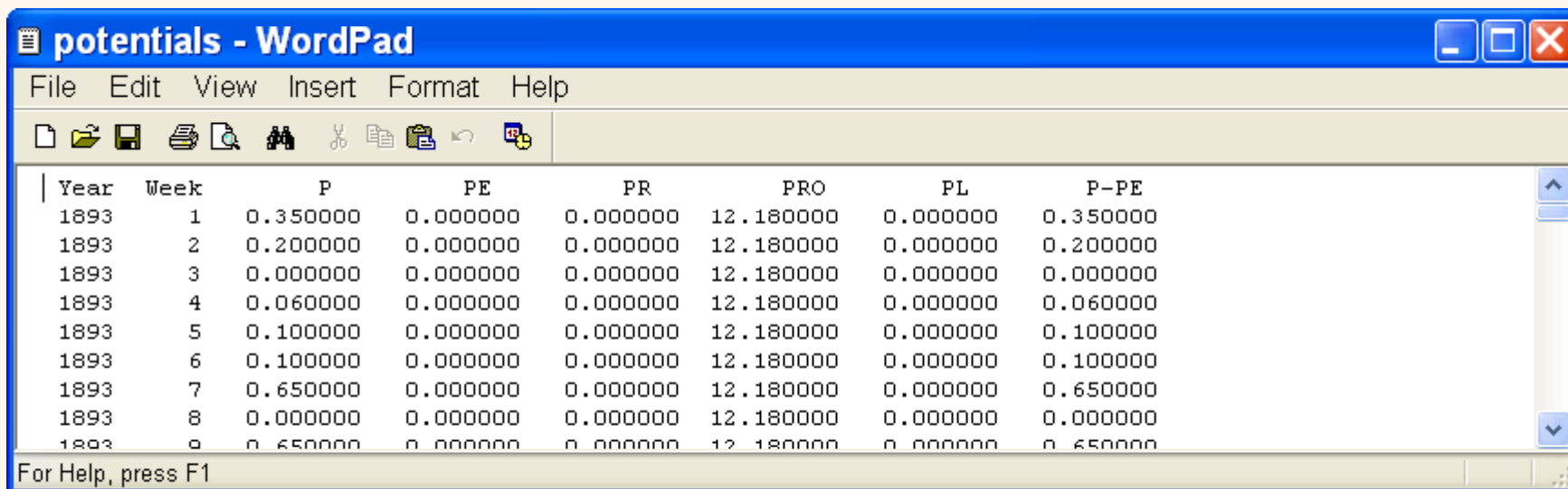


ID	Col 2	Col 3	Col 4	Col 5	Col 6	Col 7	Col 8	Col 9	Col 10	Col 11	Col 12	Col 13	Col 14	Col 15
1893	0.35	0.20	0.00	0.06	0.10	0.10	0.65	0.15	0.65	1.02	0.98	0.87	0.37	0.00
1894	0.57	0.07	0.13	0.13	0.07	0.03	0.07	0.28	0.02	0.00	0.00	0.28	0.00	0.00
1895	-0.01	-0.00	0.09	0.12	0.07	0.06	0.01	-0.00	0.06	0.07	0.06	0.01	0.16	0.82
1896	0.00	0.00	0.06	0.03	0.07	0.00	0.00	0.00	0.35	0.07	0.18	0.22	0.69	0.33
1897	1.31	1.36	1.06	0.65	0.15	0.12	0.10	0.22	0.10	0.99	0.54	1.41	2.00	3.20
1898	0.00	0.00	0.41	0.53	0.03	0.68	0.18	0.18	0.00	0.31	0.56	0.06	0.28	0.00
1899	0.08	0.17	0.00	0.33	0.16	0.00	0.00	0.29	0.91	0.45	1.28	0.69	0.21	0.10
1900	0.09	0.09	0.06	0.00	0.00	0.55	0.57	0.07	0.08	0.23	0.04	0.62	1.25	0.63



# Cont...

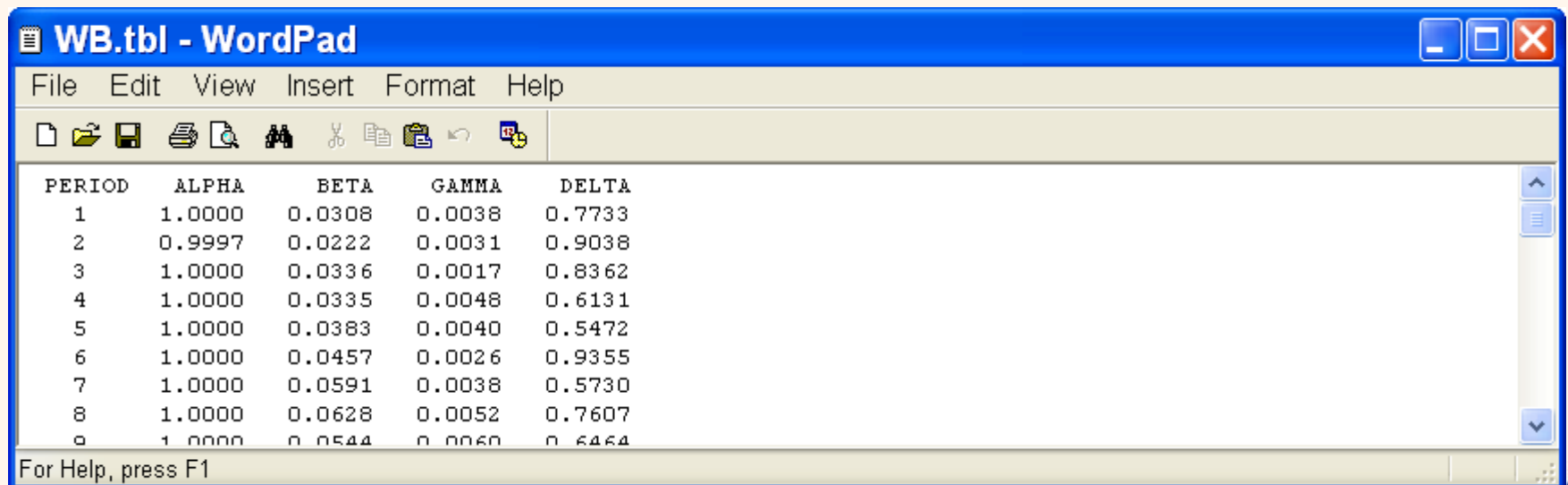
- The potentials file holds the calculated potential values for each week. The first column, labeled **P**, is the precipitation for that period. The second, labeled **PE**, is the potential evapotranspiration (Thornthwaite's). The third column is labeled **PR** and is the potential recharge of the soil moisture. Fourth is the potential runoff, labeled **PRO**, followed by **PL**, which is potential loss. The last column is **P-PE**.



Year	Week	P	PE	PR	PRO	PL	P-PE
1893	1	0.350000	0.000000	0.000000	12.180000	0.000000	0.350000
1893	2	0.200000	0.000000	0.000000	12.180000	0.000000	0.200000
1893	3	0.000000	0.000000	0.000000	12.180000	0.000000	0.000000
1893	4	0.060000	0.000000	0.000000	12.180000	0.000000	0.060000
1893	5	0.100000	0.000000	0.000000	12.180000	0.000000	0.100000
1893	6	0.100000	0.000000	0.000000	12.180000	0.000000	0.100000
1893	7	0.650000	0.000000	0.000000	12.180000	0.000000	0.650000
1893	8	0.000000	0.000000	0.000000	12.180000	0.000000	0.000000
1893	9	0.650000	0.000000	0.000000	12.180000	0.000000	0.650000

# Cont...

- This produces a file containing the water balance coefficients, which are called  $\alpha$ ,  $\beta$ ,  $\gamma$ , and  $\delta$ . These values are calculated based on long-term averages and then combined with the potential values to determine the amount of precipitation needed to maintain normal soil moisture conditions. This is then used to compute the moisture departure



WB.tbl - WordPad

File Edit View Insert Format Help

PERIOD	ALPHA	BETA	GAMMA	DELTA
1	1.0000	0.0308	0.0038	0.7733
2	0.9997	0.0222	0.0031	0.9038
3	1.0000	0.0336	0.0017	0.8362
4	1.0000	0.0335	0.0048	0.6131
5	1.0000	0.0383	0.0040	0.5472
6	1.0000	0.0457	0.0026	0.9355
7	1.0000	0.0591	0.0038	0.5730
8	1.0000	0.0628	0.0052	0.7607
9	1.0000	0.0544	0.0060	0.6464

For Help, press F1

# Cont...

- The file named CMI\_calc.tbl is designed to give the information from all the intermediate calculations performed. There is one line for each week, and each line contains the following informations :

year	
week	
PET	Potential Evapotranspiration
ET	Computed 'Actual' evapotranspiration
Alpha	The water balance coefficient of evapotranspiration
R	The total computed recharge
RO	The total computed runoff
Ss	Inches of water stored in the top layer of soil
Su	Inches of water stored in the lower layer of soil
M	Average percent of field capacity during the week
DE	Relative evapotranspiration anomaly for the week
Yprime	First approximation of Y
Y	Index of evapotranspiration deficit
H	A "return to normal" factor
G	Index of excessive moisture
CMI	The Crop Moisture Index

# Cont...

**CMI\_calc.tbl - WordPad**

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year	week	PET	ET	Alpha	R	RO	Ss	Su	M	DE	Yprime	Y
1893	1	0.0000	0.0000	1.0000	0.0000	0.3500	1.0000	11.1800	1.0000	0.0000	0.0000	0.0000
1893	2	0.0000	0.0000	0.9997	0.0000	0.2000	1.0000	11.1800	1.0000	0.0000	0.0000	0.0000
1893	3	0.0000	0.0000	1.0000	0.0000	0.0000	1.0000	11.1800	1.0000	0.0000	0.0000	0.0000
1893	4	0.0000	0.0000	1.0000	0.0000	0.0600	1.0000	11.1800	1.0000	0.0000	0.0000	0.0000
1893	5	0.0000	0.0000	1.0000	0.0000	0.1000	1.0000	11.1800	1.0000	0.0000	0.0000	0.0000
1893	6	0.0000	0.0000	1.0000	0.0000	0.1000	1.0000	11.1800	1.0000	0.0000	0.0000	0.0000
1893	7	0.0000	0.0000	1.0000	0.0000	0.6500	1.0000	11.1800	1.0000	0.0000	0.0000	0.0000

For Help, press F1

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