Groundwater Toolbox: A map environment in which to work with hydrologic time-series data

USGS Tribal Water Resources Class,
August 2013

Shawnee, Oklahoma

Outline

- Data discovery and downloading
- Hydrograph separation (PART, HYSEP)
- Master recession curve (RECESS)
- Recharge estimation (RORA)
- Estimating recharge from streamflow data (RORA and RECESS)

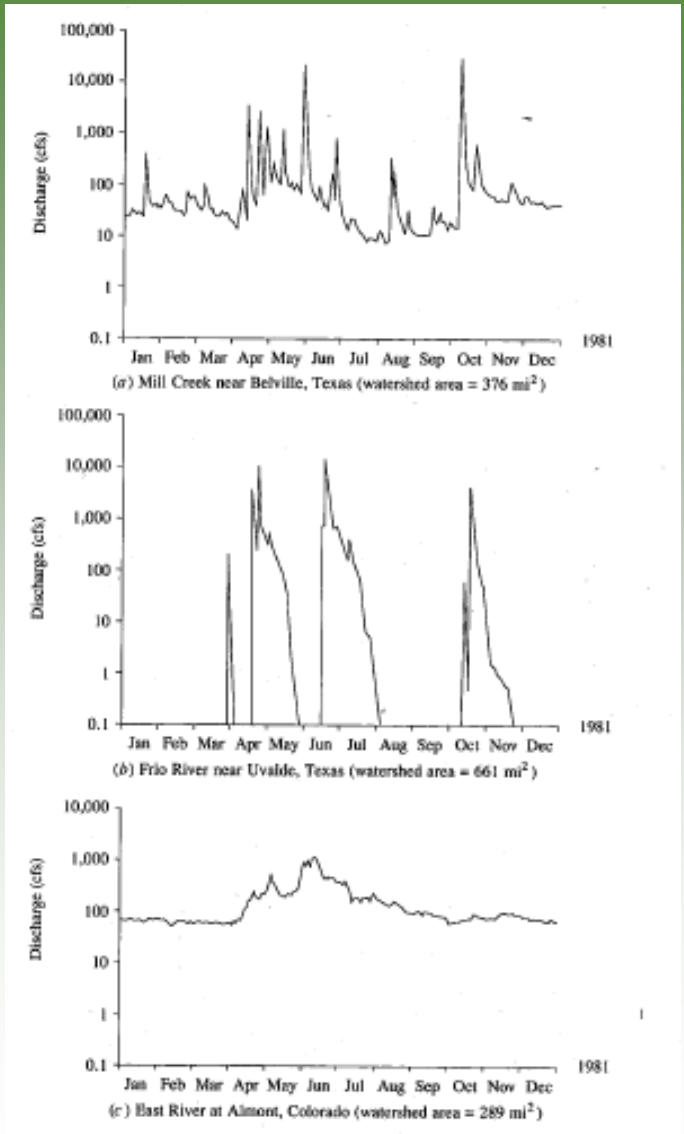
USGS

Ways SW data are used to understand GW-SW Interactions

- Understand effects of basin geology on streamflow, particularly for low-flow investigations
- Hydrograph separation to estimate base-flow contributions to streamflow
- Estimate recharge
- Identify gaining and losing reaches
- Estimate aquifer and streambed properties (with flood-stage data)

USGS

Streamflow Hydrographs



Top: Perennial flow regime

Middle: Ephemeral stream

Bottom: Snow-fed river

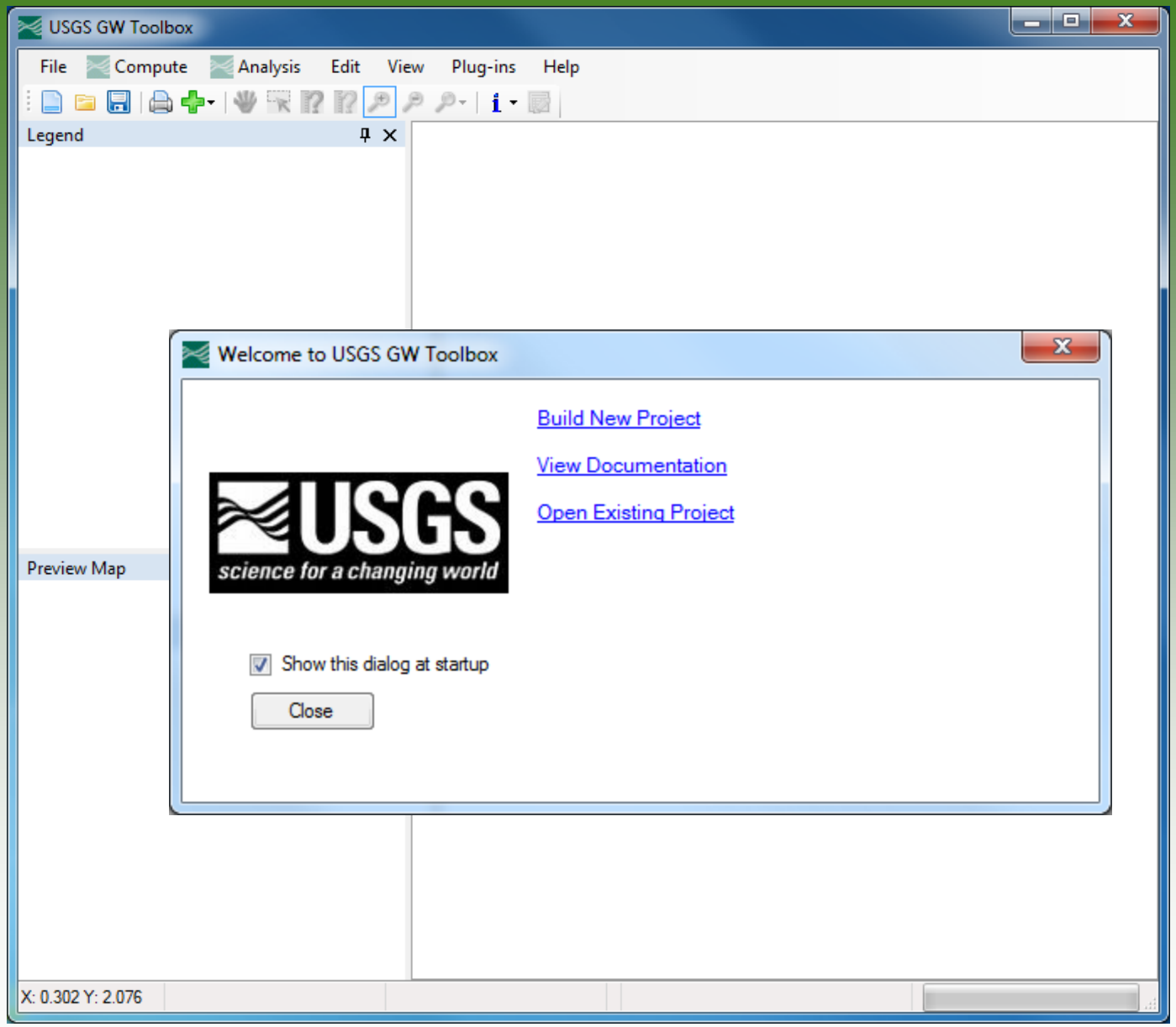
Chow and others (1988)

Developed from the BASINS code

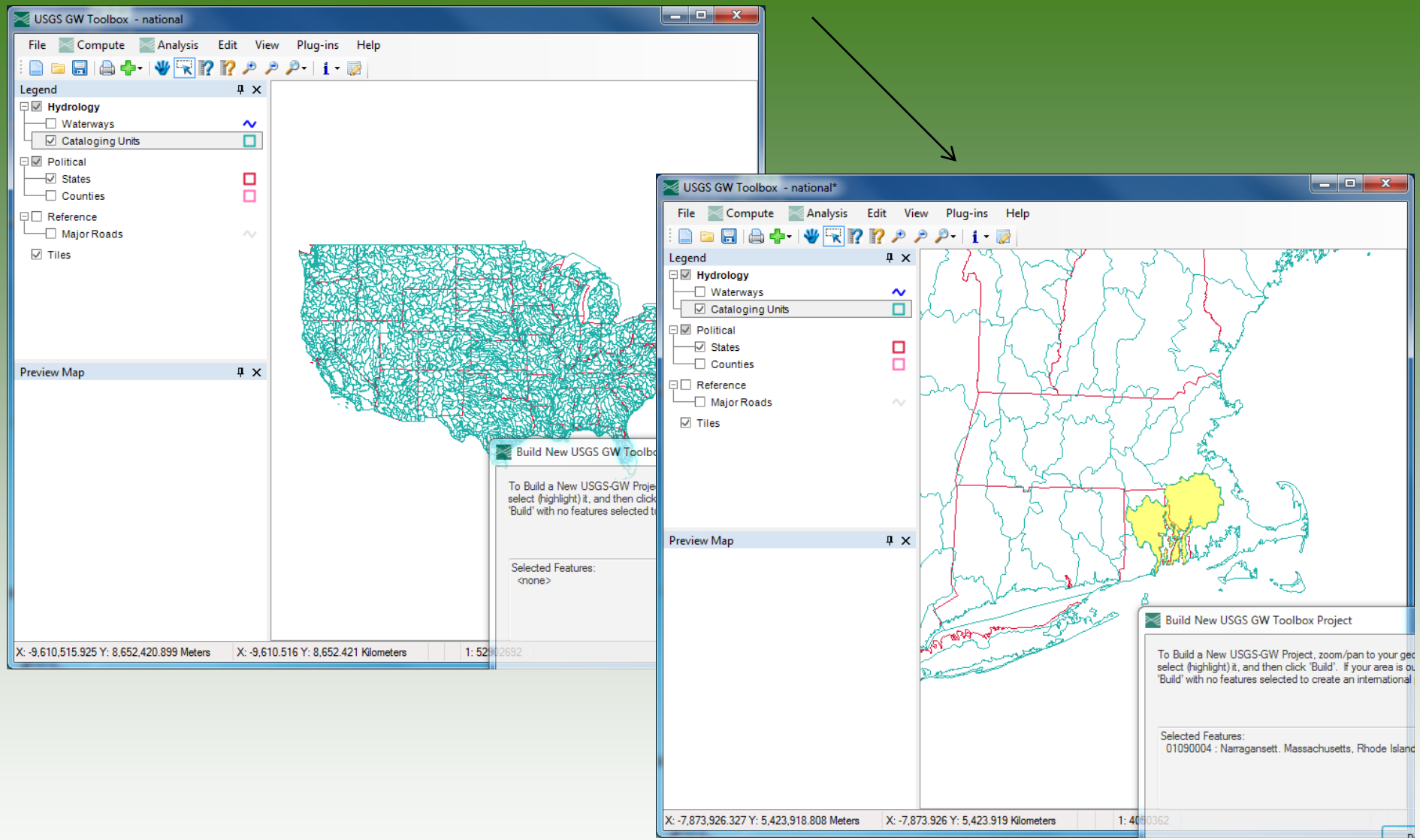
- It’s a Beta version; no firm date has been set for the initial release.
- We’re learning too!
- We’d like your input.

USGS

➢But have you ever seen this in the real world?

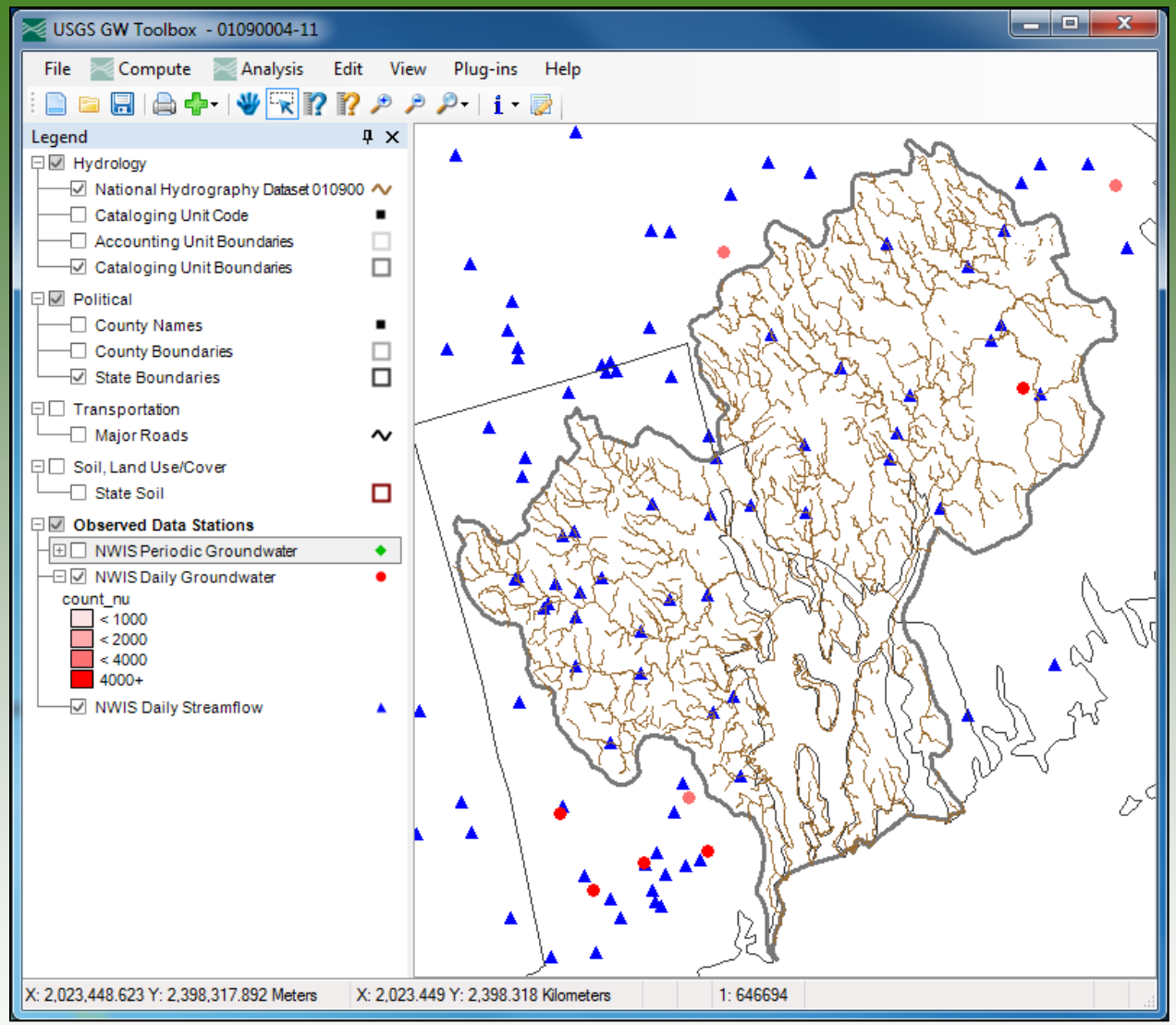


A Project is an area of study

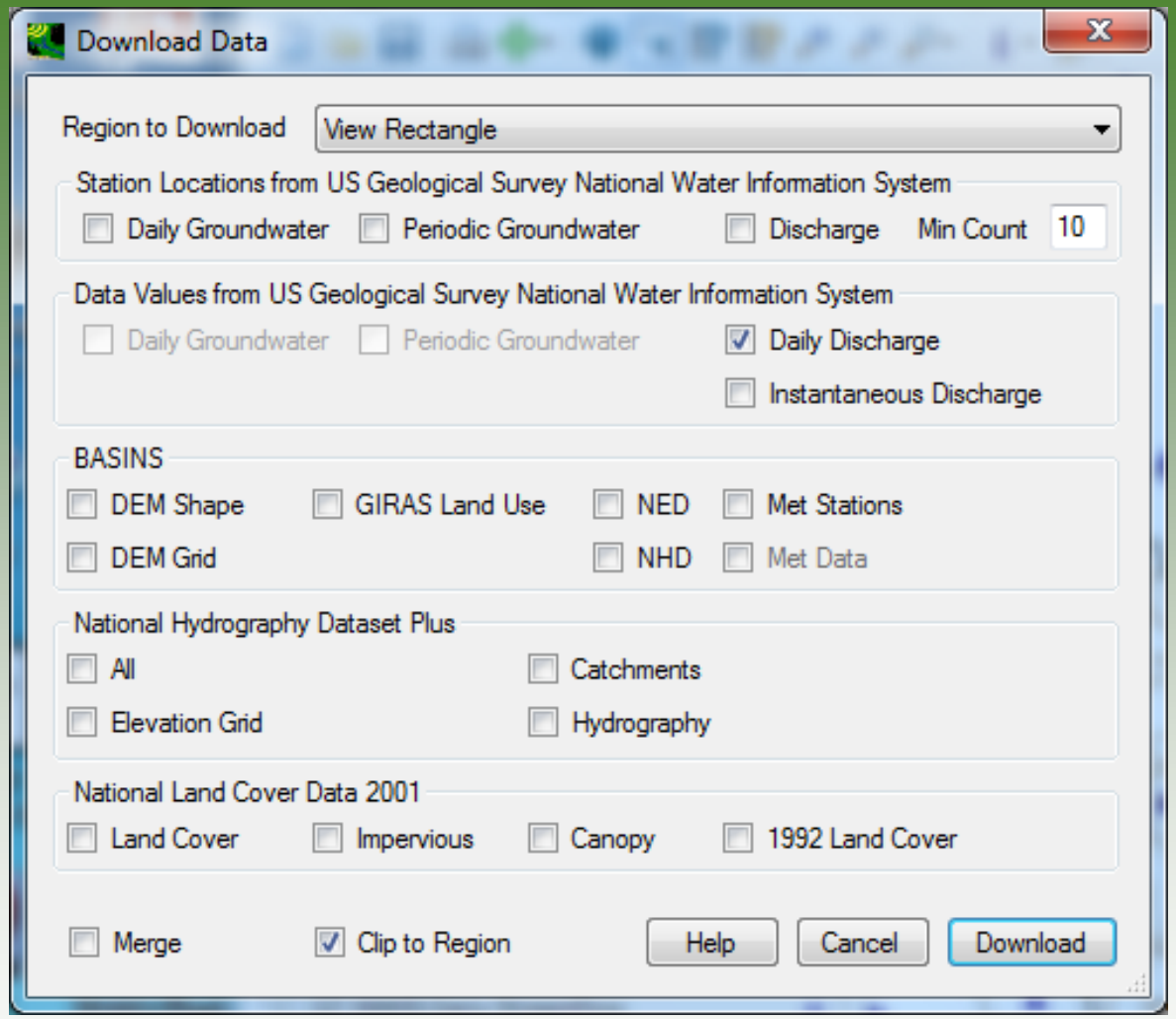


Navigate to location of interest using Zoom/Pan/Select icons. Then Build…

USGS

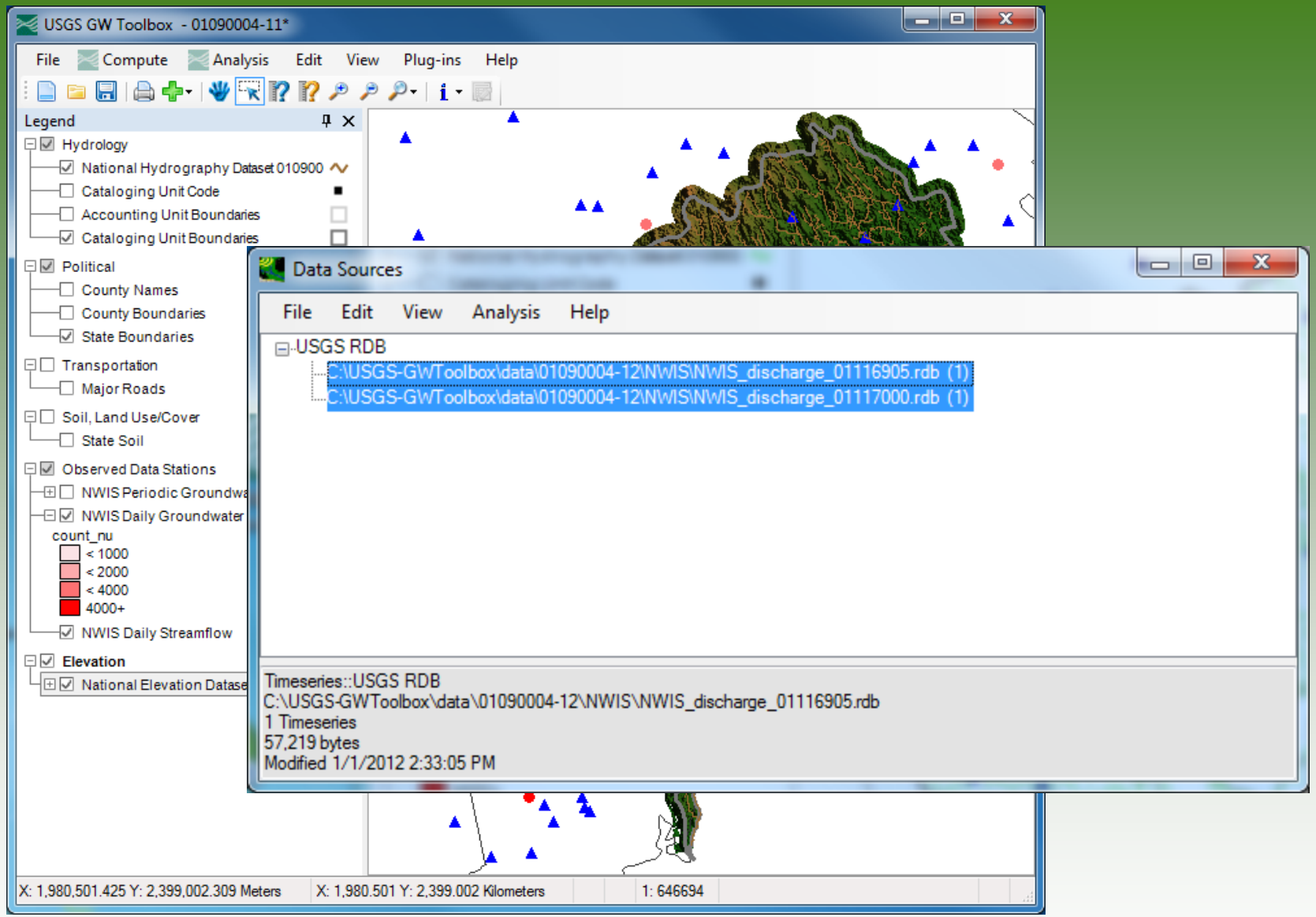


Now, select data of interest using map tools and then bringing down File > Download Data



Note that the Daily Discharge option under the 'Data Values from US…' subframe is already checked. Hit Download

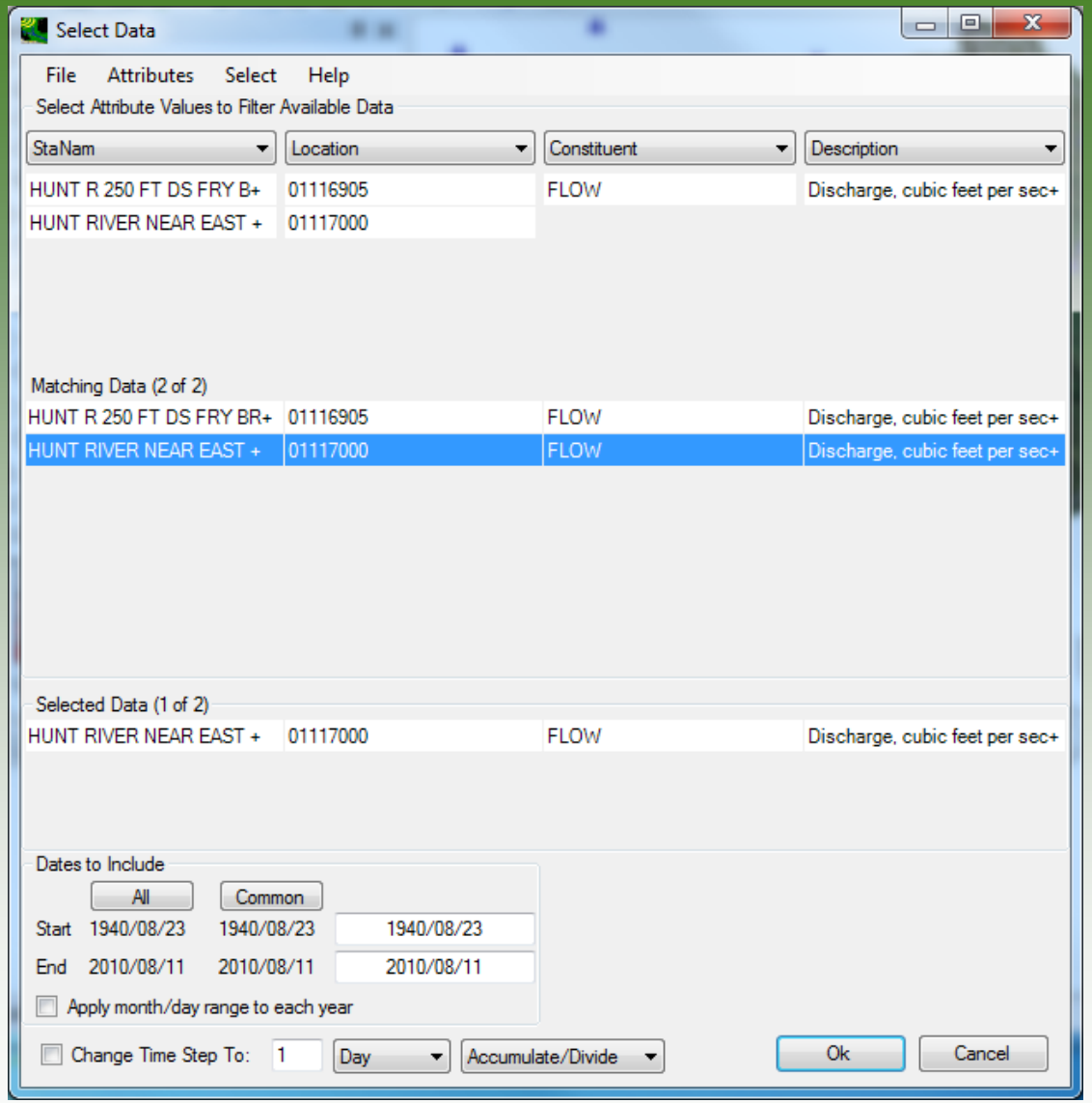
USGS



Data are now available for use—stats, graphing, and analysis.

Review available datasets: File > Manage Data menu

Or go directly to data from Analysis menu (various options)

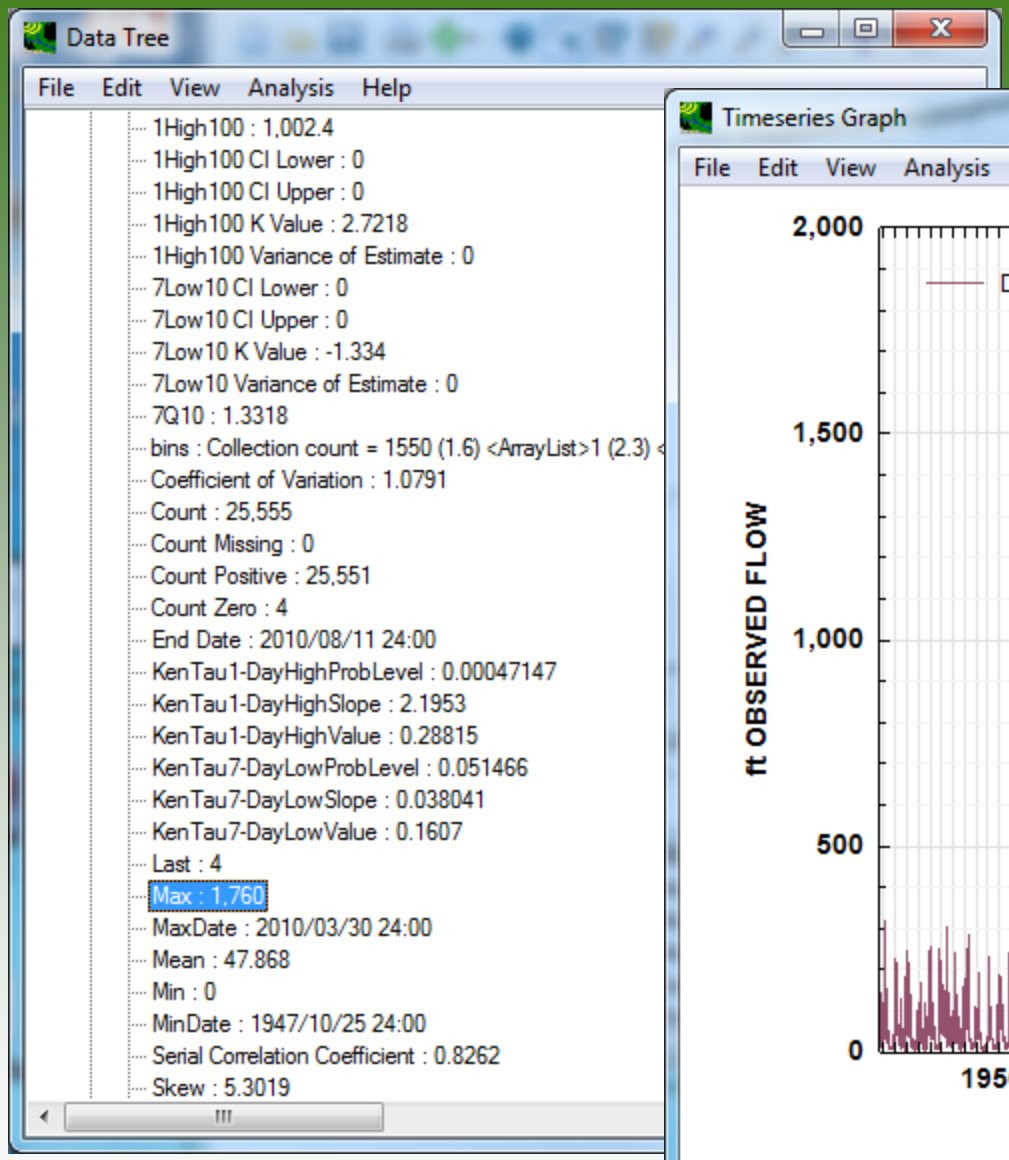


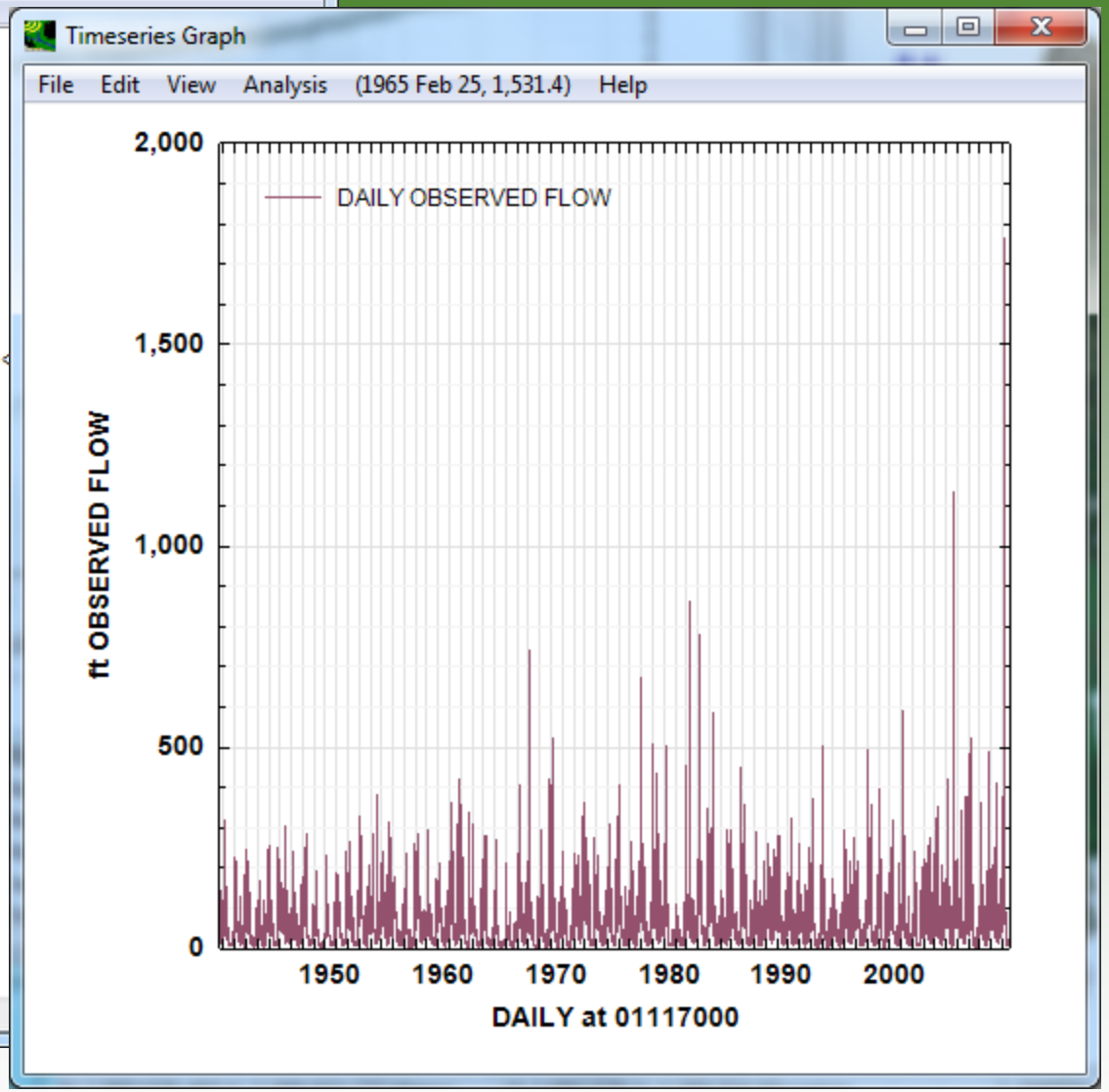
Selection criteria (could have other constituents, such as GW LEVEL)

Datasets matching the selection criteria

Selected data

Now have selected Hunt River near East Greenwich, RI, gaging station. Hit OK, to get a summary of the data…



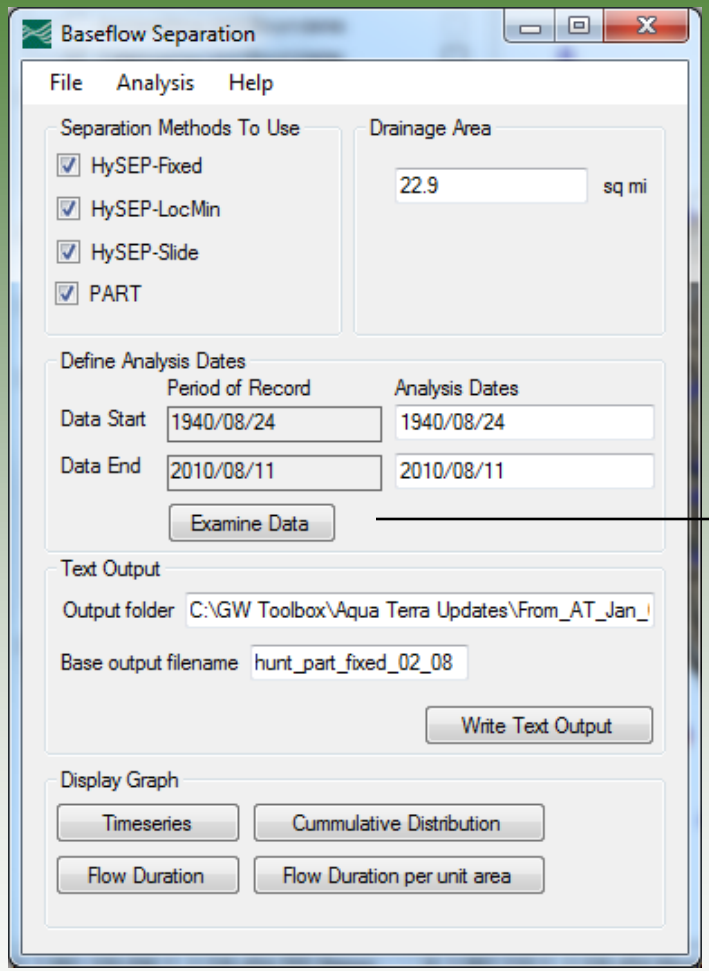


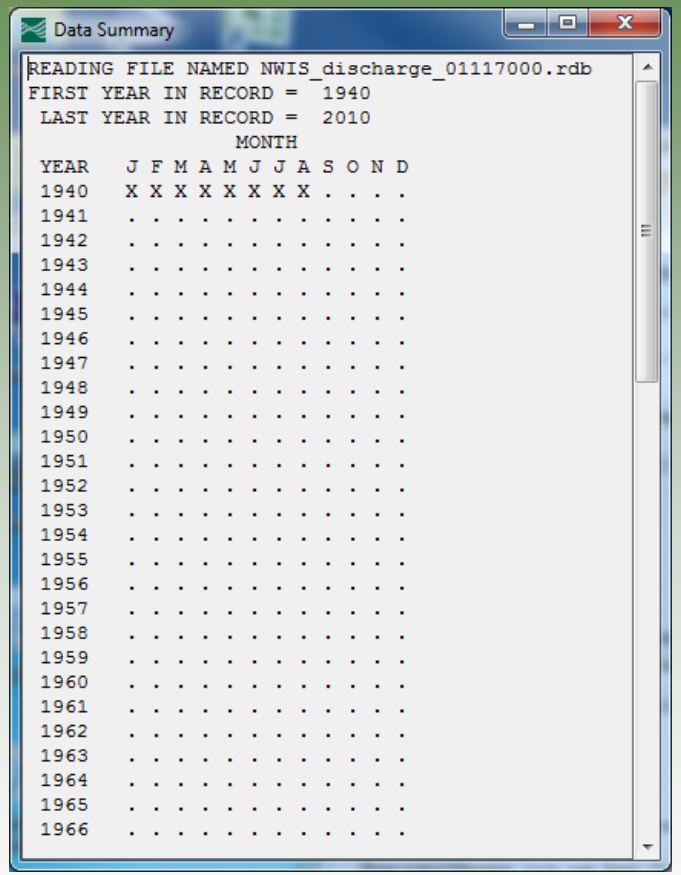
Data Tree

Or generate graphs of the data, including flow-duration curves

USGS

Hydrograph Separation

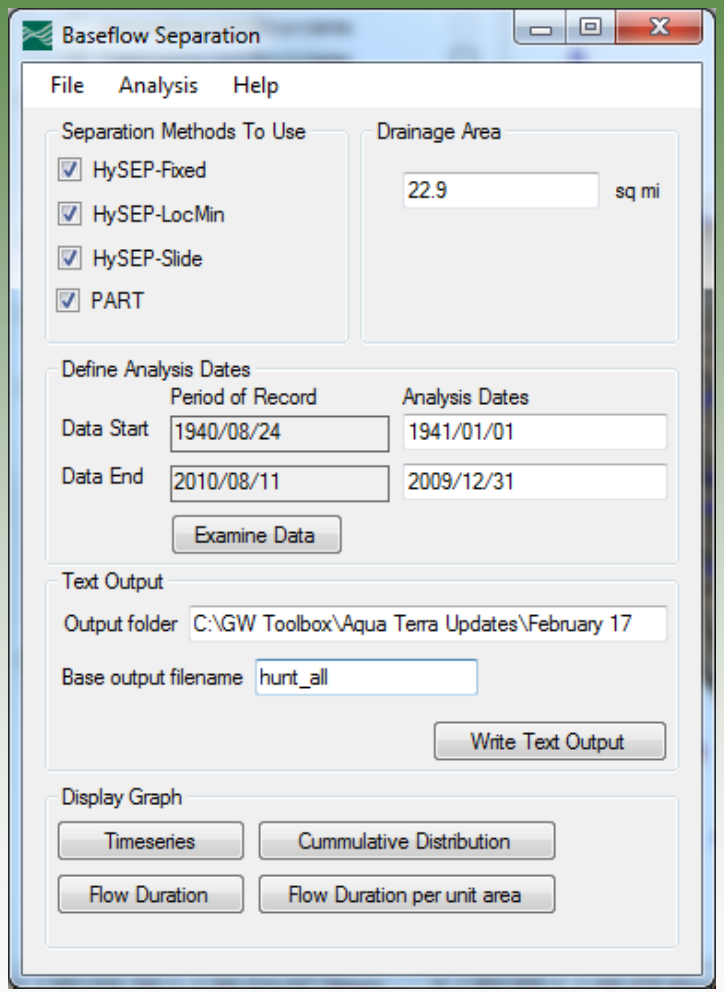




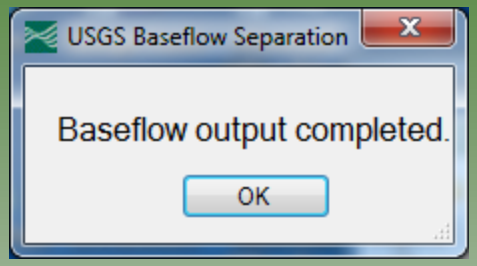
Analysis > USGS Baseflow Separation

Examine Data button

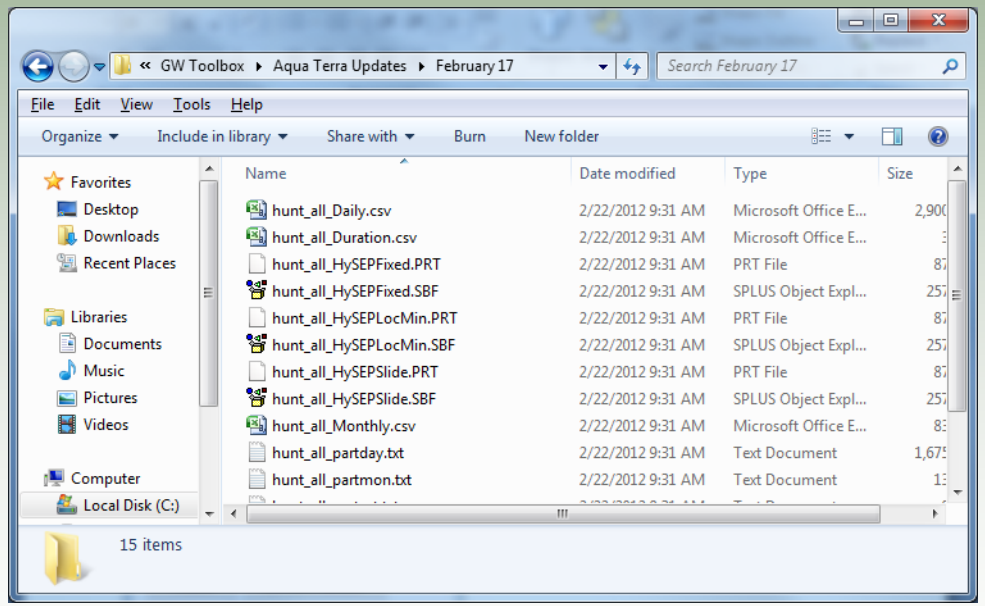
Hydrograph Separation



Analyze 1941 – 2009, and specify Text Output location



First, hit Write Text Output



and several files are created

USGS

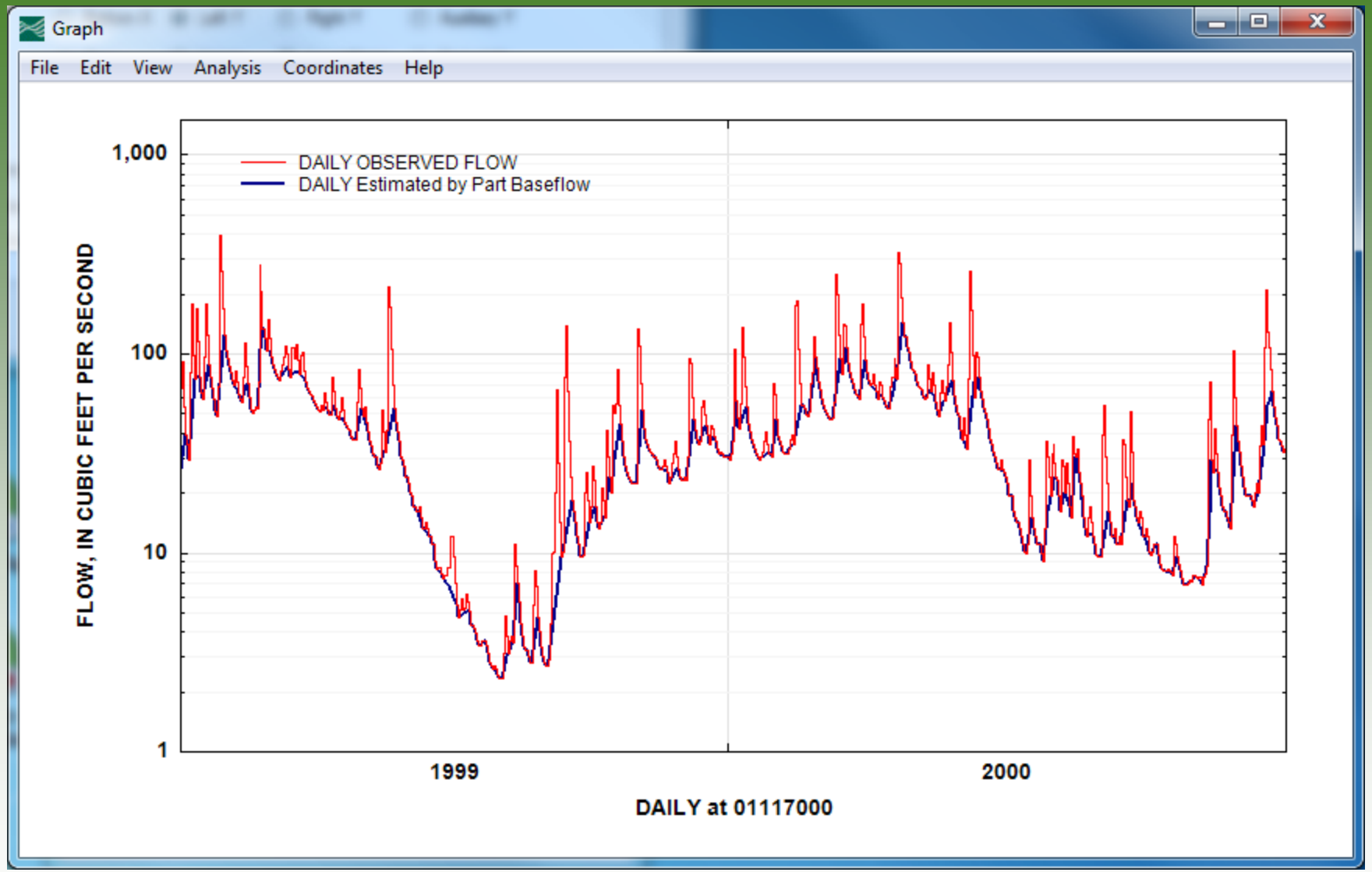
hunt_all_Yearly.csv - Microsoft Excel

A1: Groundwater Toolbox annual output for hydrograph separation (calendar year January 1-December 31)

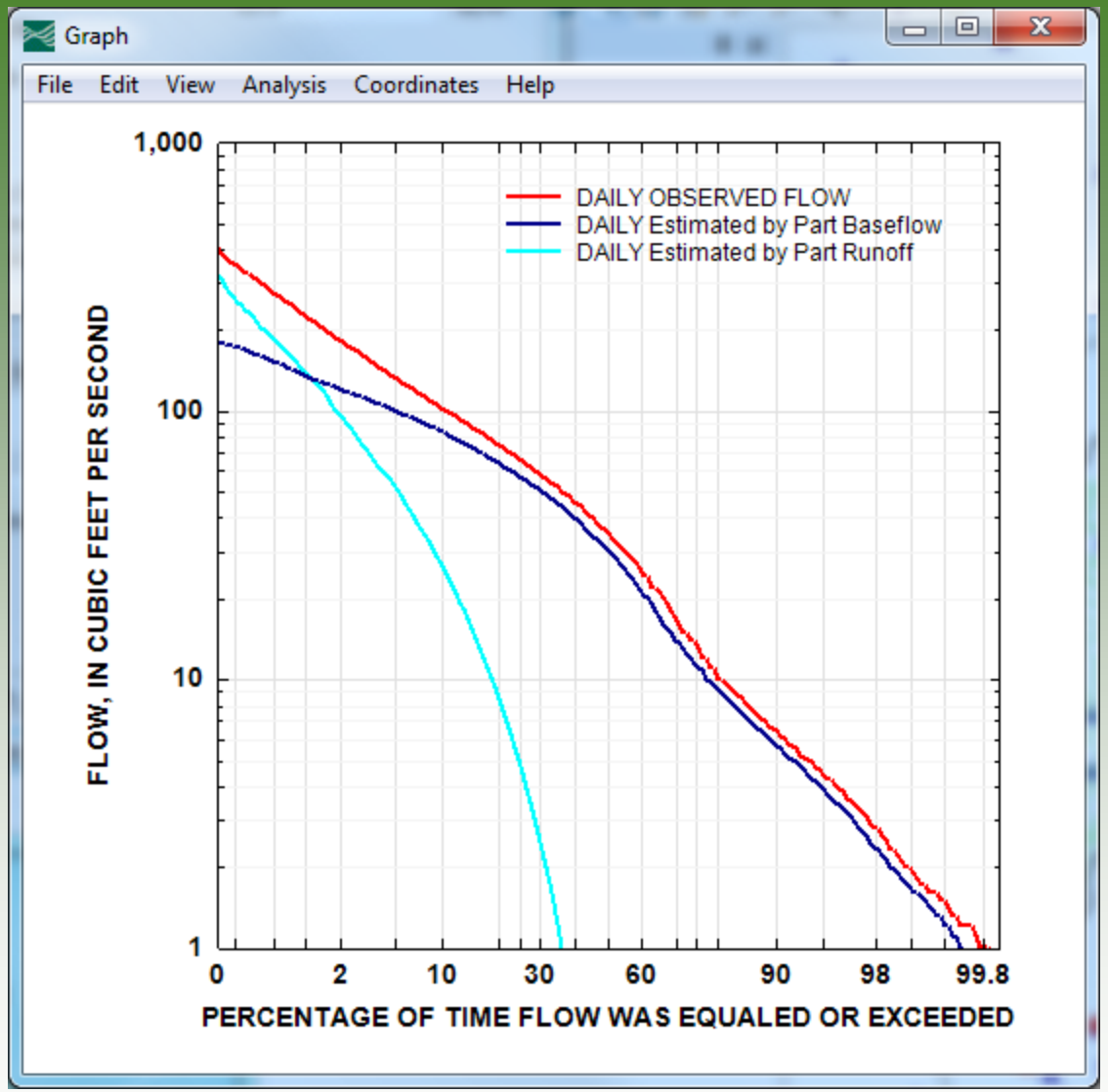
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q
1	Groundwater Toolbox annual output for hydrograph separation (calendar year January 1-December 31)																
2	Station: 01117000 HUNT RIVER NEAR EAST GREENWICH RI																
3	Drainage area: 22.9 square miles																
4	(CFS: average flow for the year (cubic feet per second); IN: flow per drainage area (inches); BFP: Base-Flow Percentage (ratio of base-flow to streamflow multiplied by 100)																
5																	
6							PART					HySEP-Fixed					HySEP-L
7			Streamflow		Baseflow		Runoff		BFP	Baseflow		Runoff		BFP	Baseflow		Runoff
8	Year	Date	CFS	IN	CFS	IN	CFS	IN	(%)	CFS	IN	CFS	IN	(%)	CFS	IN	CFS
9																	
10																	
11	1	1941	26	15.67	22	12.87	5	2.8	82.1	22	13.07	4	2.61	83.4	20	12.06	
12	2	1942	42	24.83	33	19.31	9	5.53	77.7	34	20.18	8	4.65	81.3	30	17.71	1
13	3	1943	34	19.87	28	16.83	5	3.04	84.7	29	17.25	4	2.62	86.8	27	15.89	
14	4	1944	28	16.89	22	12.89	7	4	76.3	22	13.22	6	3.67	78.3	20	11.88	
15	5	1945	41	24.59	34	20.23	7	4.36	82.3	35	20.49	7	4.1	83.3	31	18.43	1
16	6	1946	46	27.46	38	22.69	8	4.76	82.6	39	23.05	7	4.41	83.9	36	21.21	1
17	7	1947	35	20.47	28	16.36	7	4.11	79.9	29	16.97	6	3.5	82.9	26	15.44	
18	8	1948	51	30.26	43	25.81	7	4.46	85.3	44	26.2	7	4.06	86.6	43	25.35	
19	9	1949	30	17.84	26	15.55	4	2.29	87.2	26	15.2	4	2.64	85.2	24	14.43	
20	10	1950	33	19.44	28	16.75	5	2.7	86.1	28	16.51	5	2.94	84.9	26	15.19	
21	11	1951	49	29.09	40	23.99	9	5.1	82.5	41	24.32	8	4.77	83.6	37	21.88	1
22	12	1952	45	26.75	39	23.16	6	3.58	86.6	39	23.15	6	3.6	86.5	35	21.06	1
23	13	1953	64	37.72	51	30.42	12	7.3	80.7	52	30.61	12	7.11	81.1	49	29.12	1
24	14	1954	58	34.63	47	27.84	11	6.79	80.4	48	28.44	10	6.19	82.1	44	25.85	1

One of the files created—Yearly summary of results

USGS

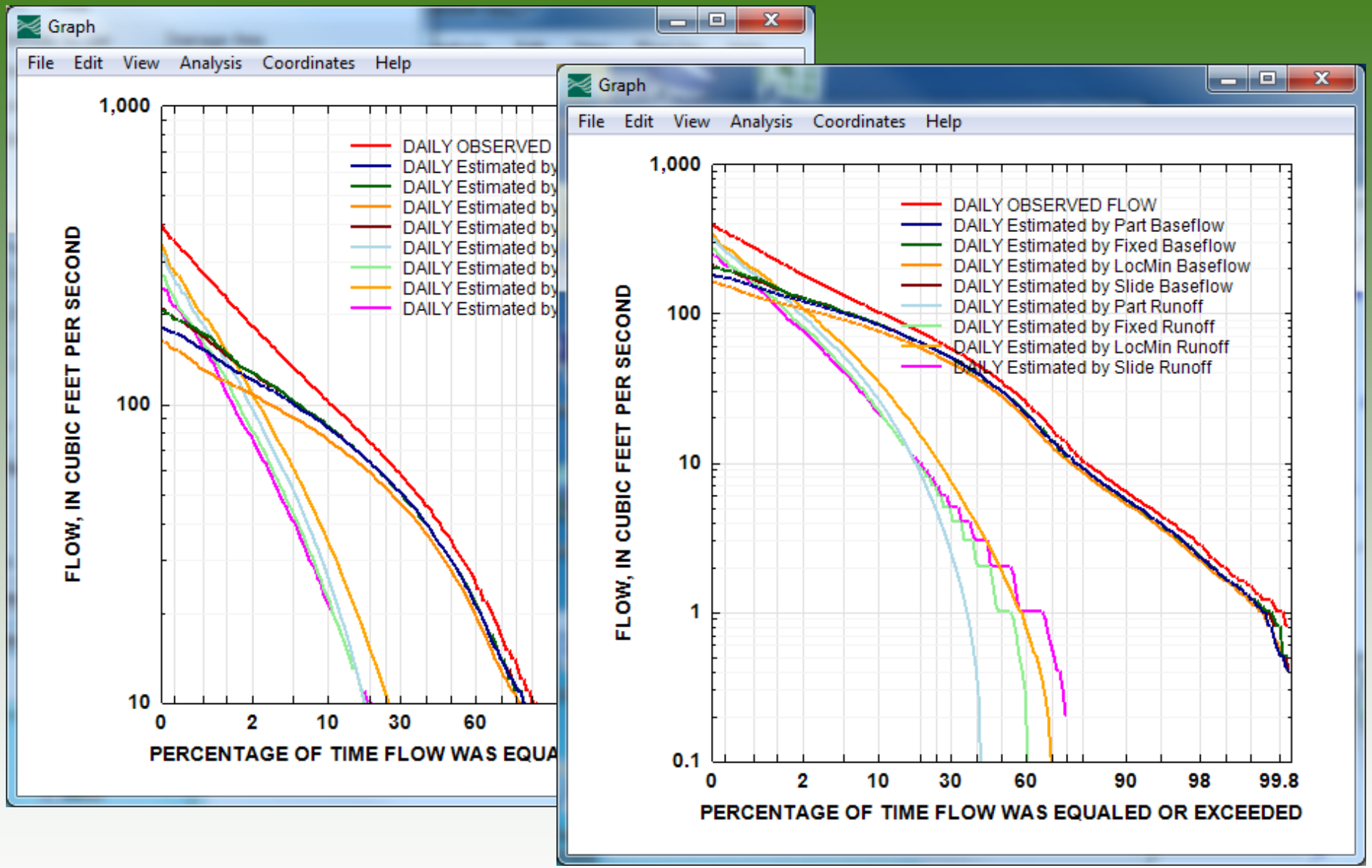


Several graphing options. A section of the PART analysis is shown.



Flow-duration curves for PART-derived output: streamflow, baseflow, and runoff

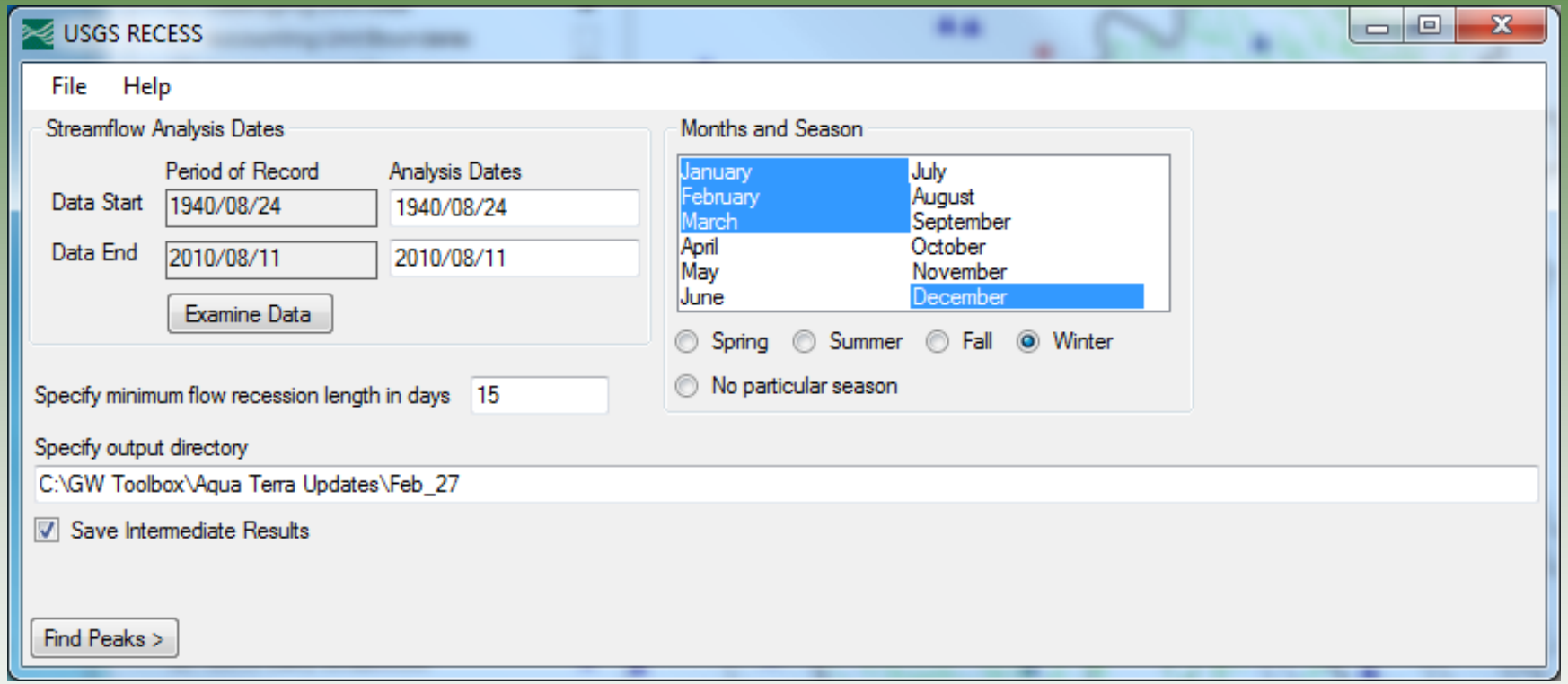
USGS



Flow-duration curves for all four methods: streamflow, baseflow, and runoff

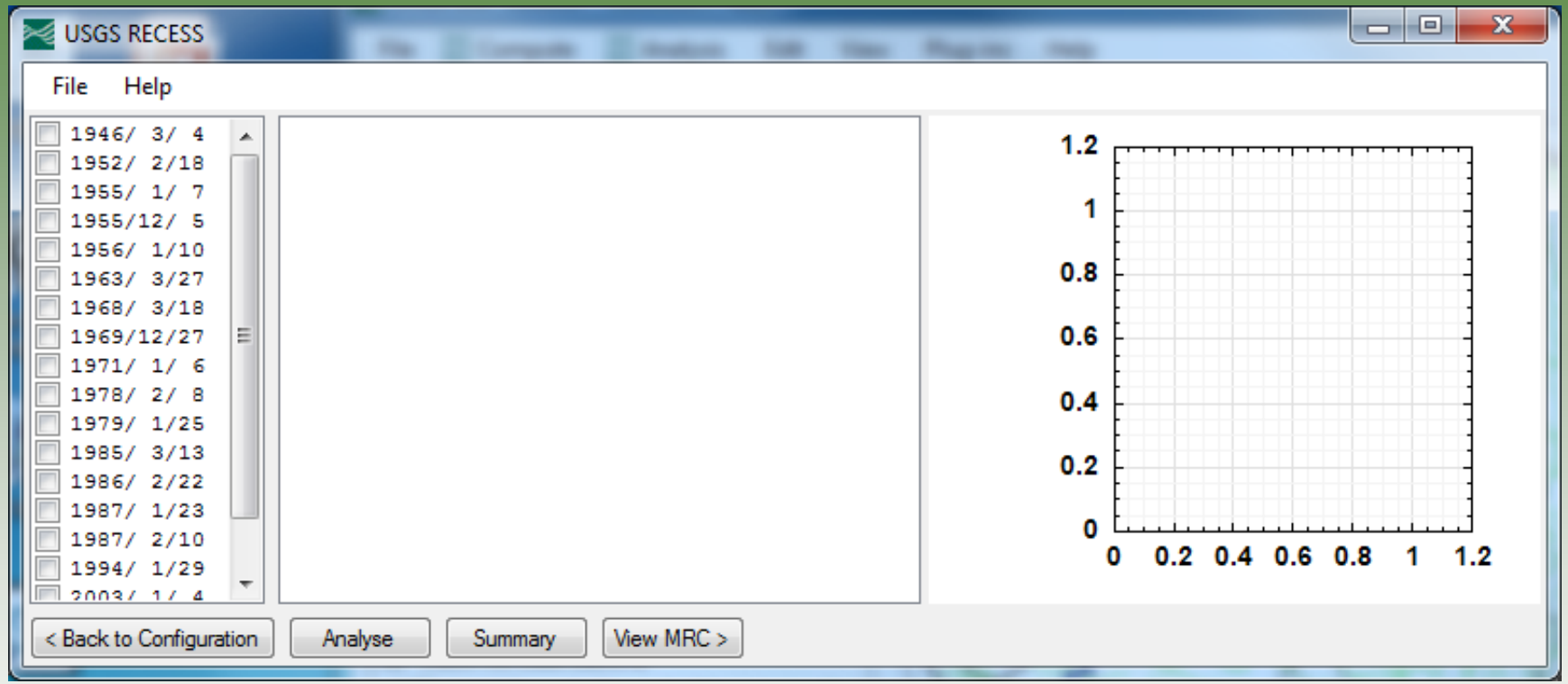
USGS

Recession Analysis



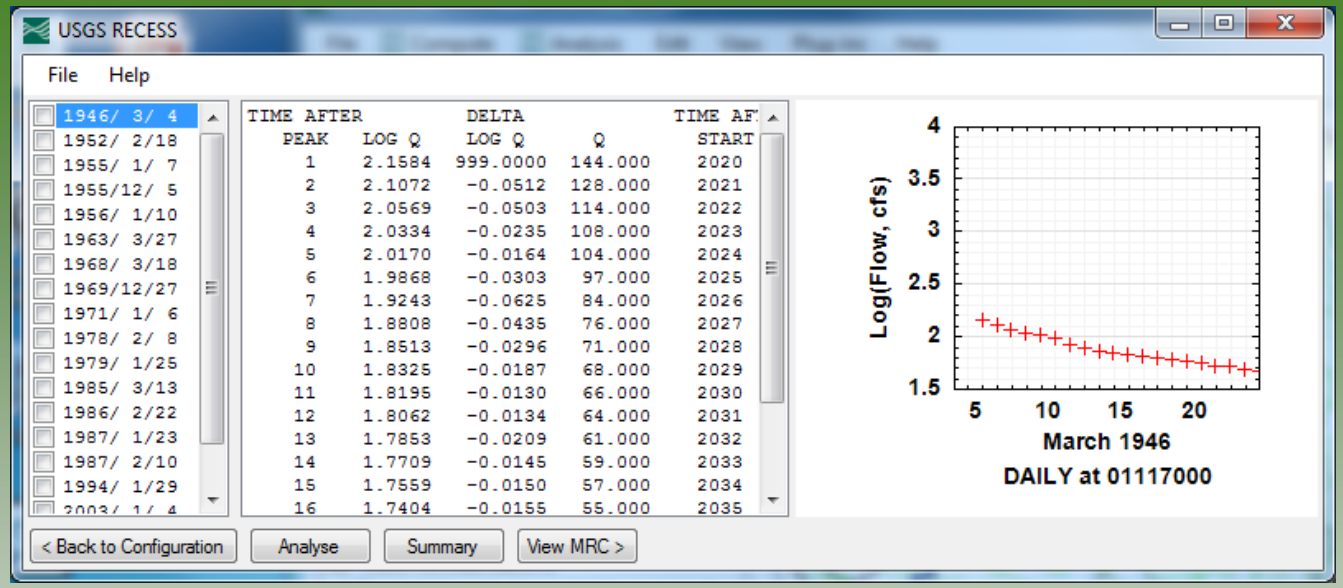
For RECESS, can use entire period of record. Specify Months and Seasons, Minimum number of days of recession, and output directory. Then, hit Find Peaks.

Recession Analysis

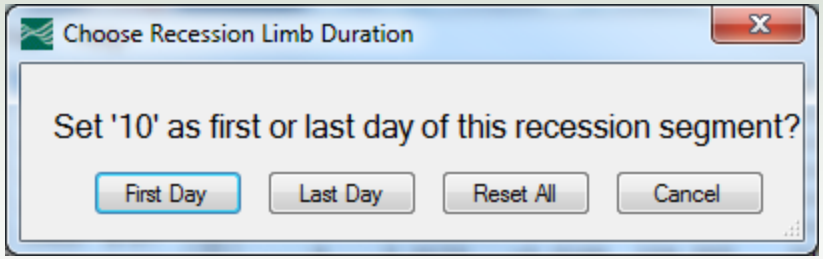


This gives us a list of dates that meet the 15-day minimum criterion. Now evaluate each recession period individually.

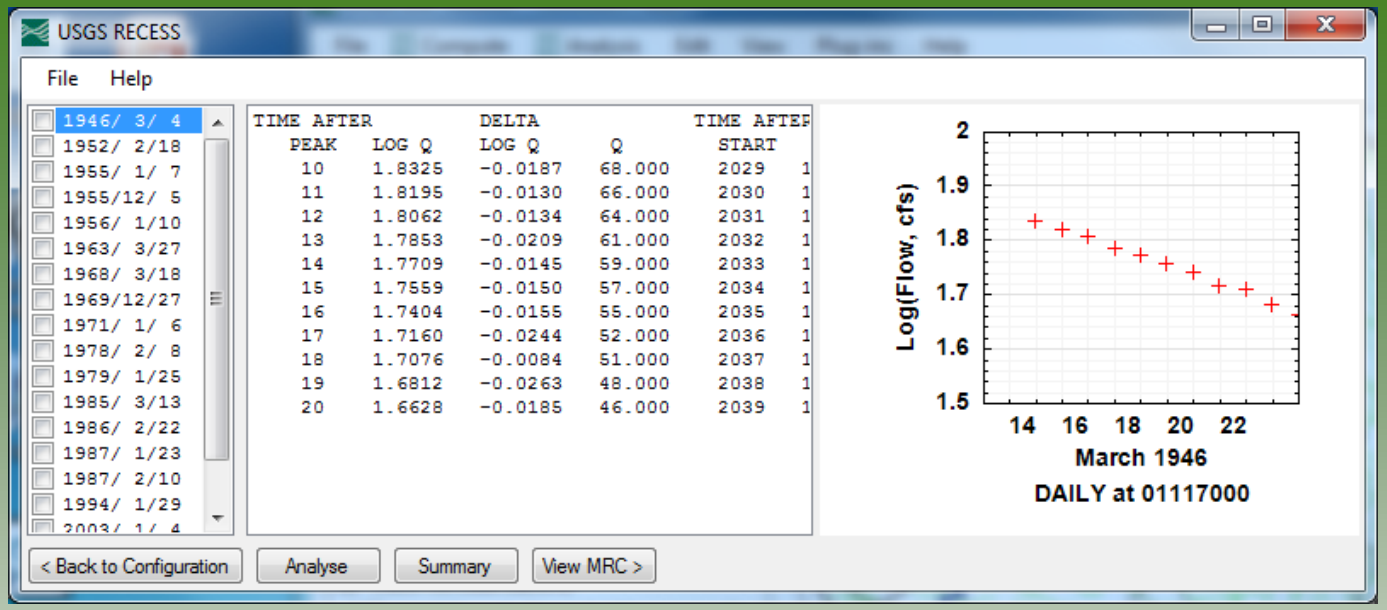
Step 1



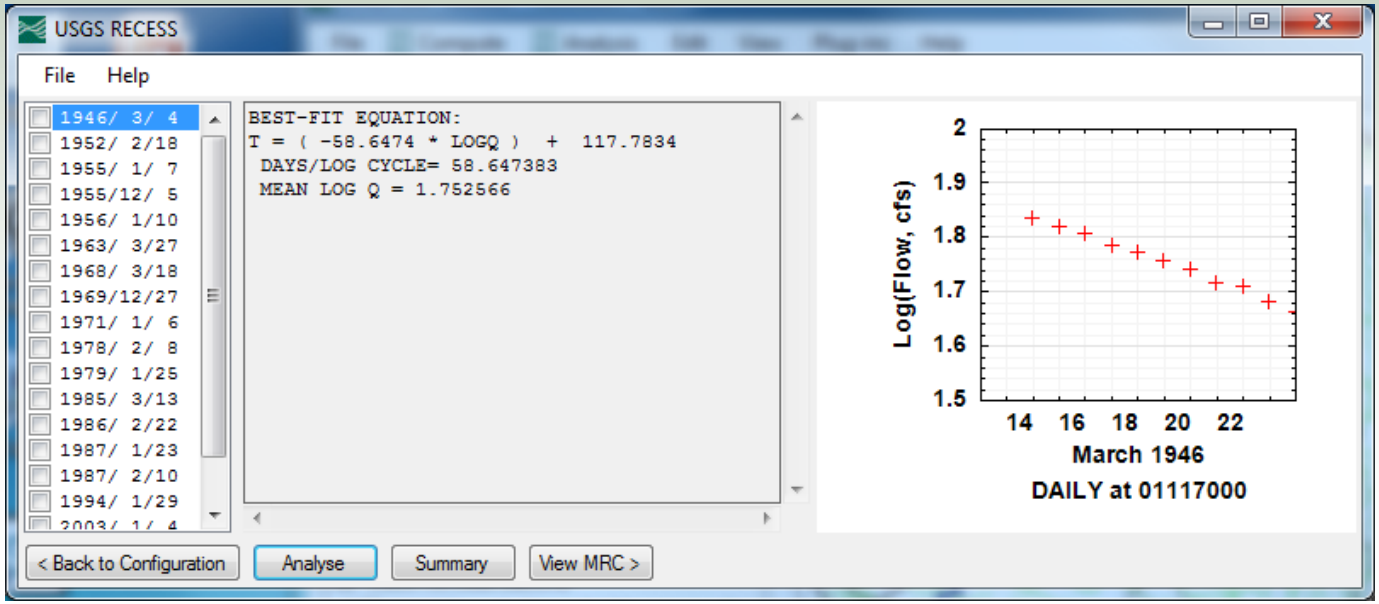
Look at entire recession for the date selected. Click on day 10 after peak and the dialogue box below results (hit First Day option):



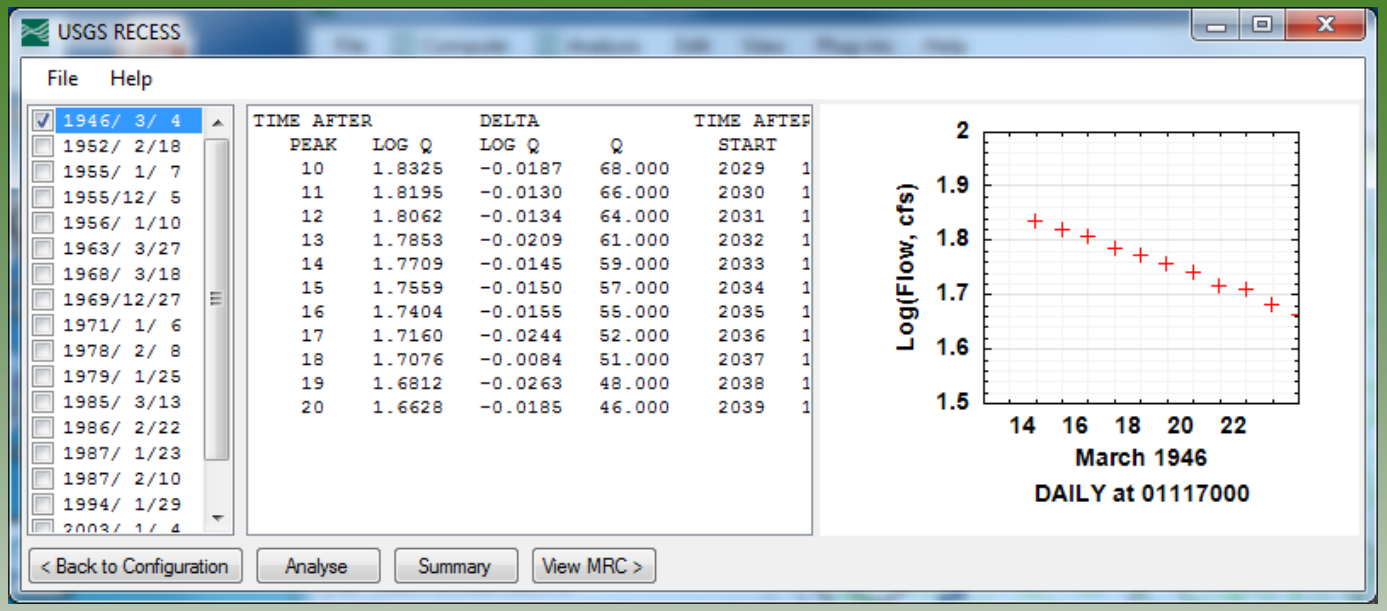
Step 2



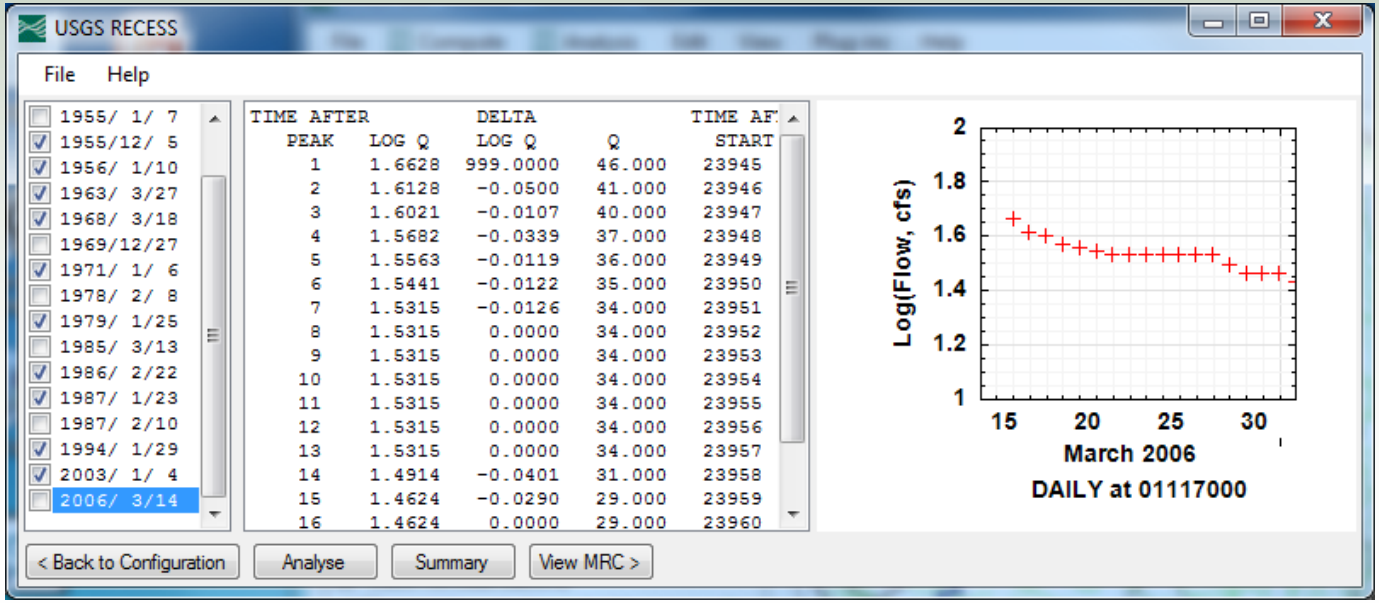
Graph on the right looks linear, which is good. Now click Analyse. K for the segment = 58.65 days per log cycle:



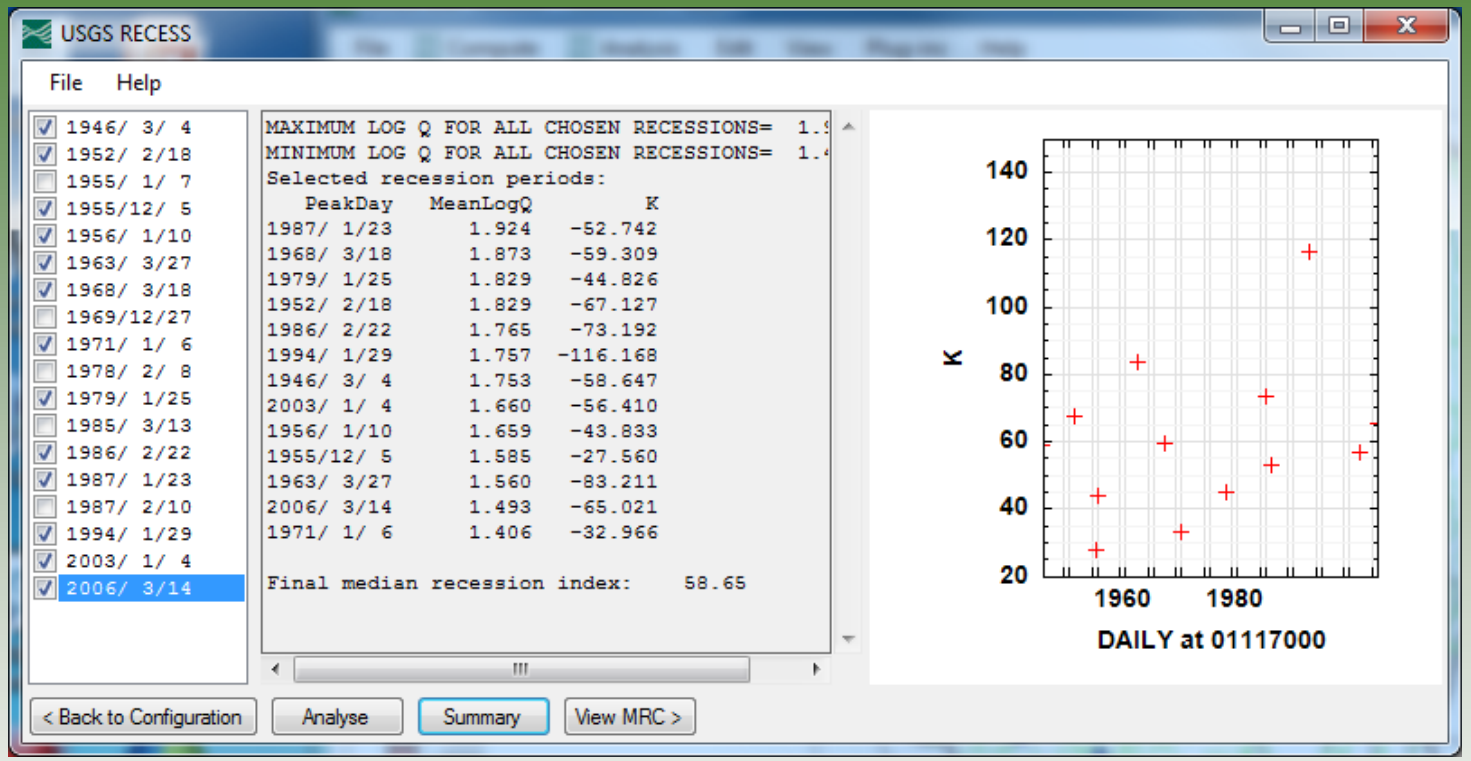
Step 3



Now check the button for the date so that the analysis is saved. Repeat several times, by going through the entire record:

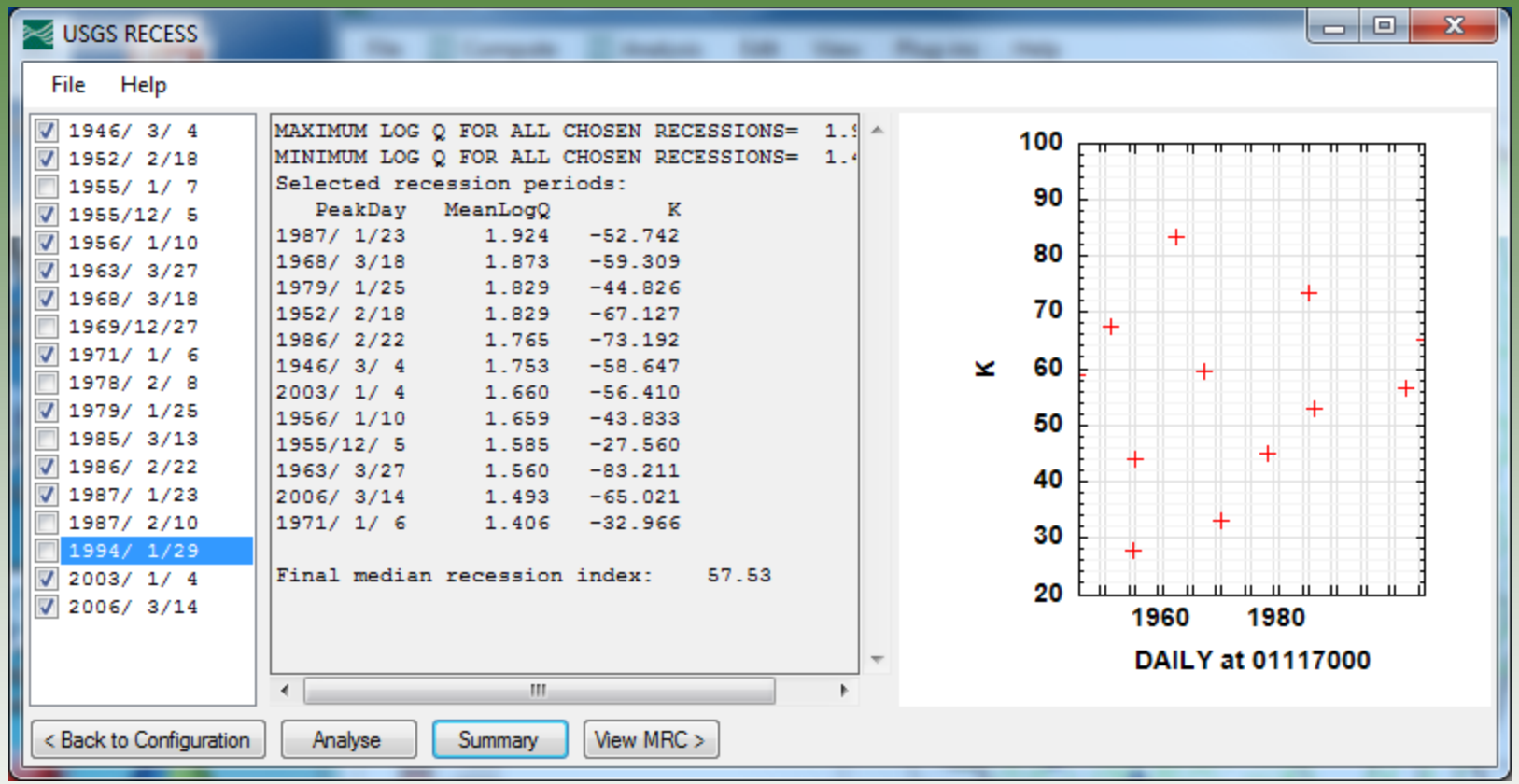


Step 4 Now hit Summary:



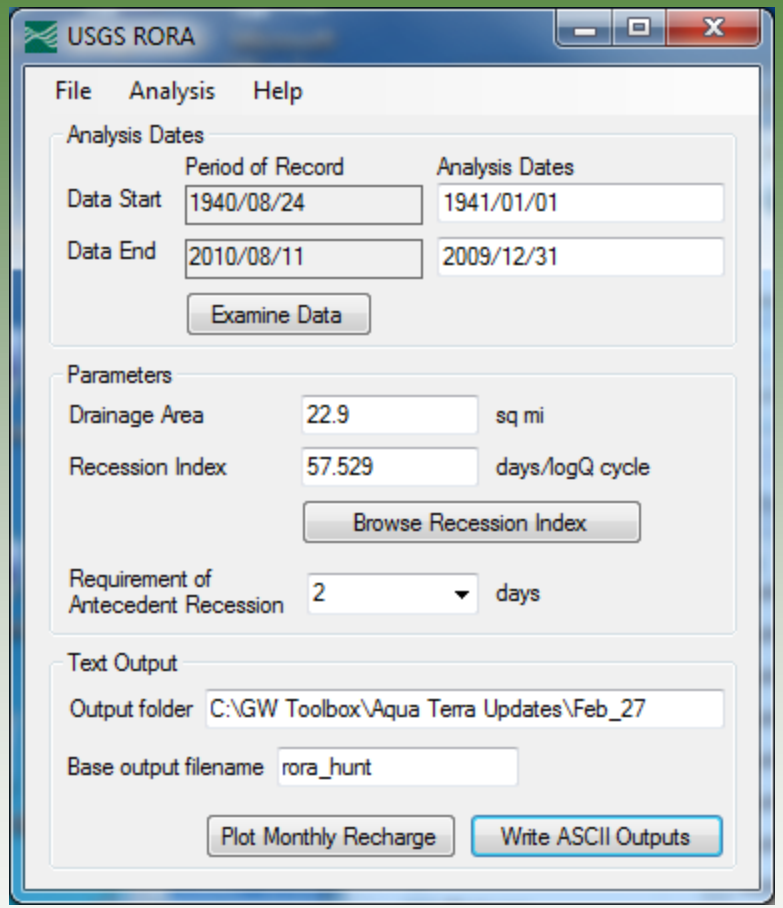
The 116.168 value looks like a possible outlier, so delete it.

Step 5 Hit Summary again:



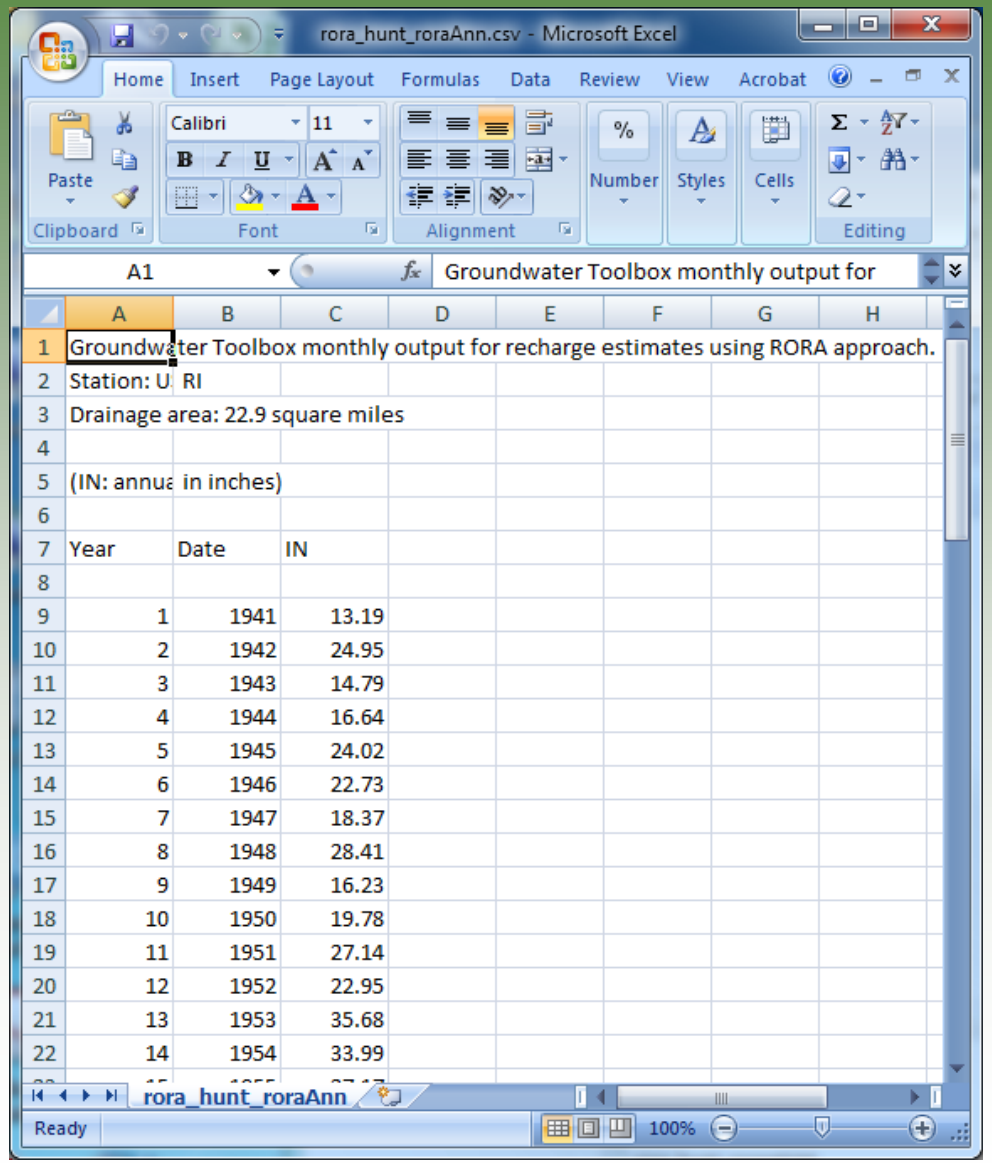
Some variability, but the range is not bad: ~ 28 to 83 days. Median is 57.53 days.

Recharge Analysis using RORA



Notice how Drainage Area and Recession Index are carried over from previous frames. Requirement of Antecedent Recession (N) is calculated as in Rutledge (1998)

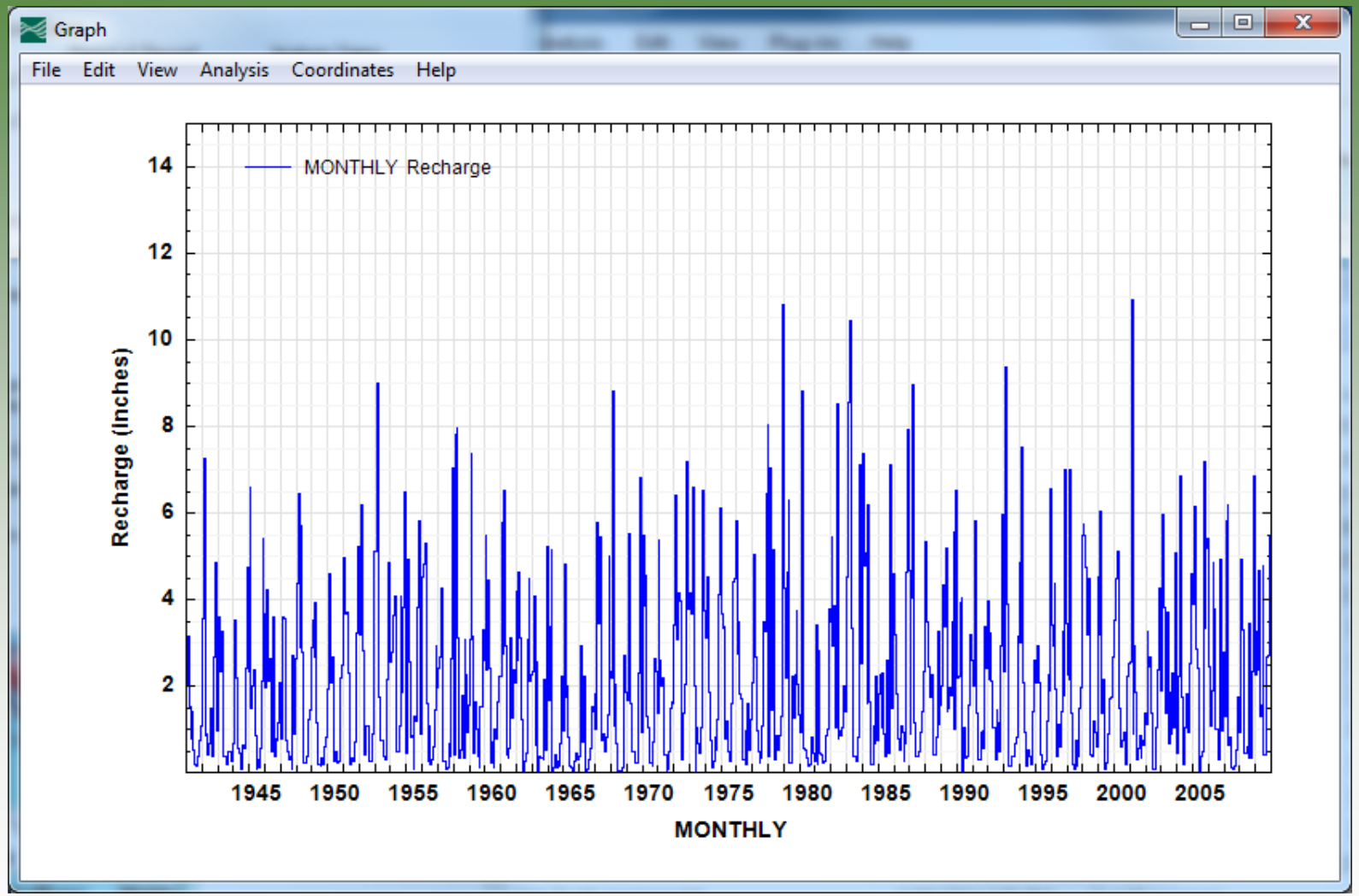
Recharge Analysis using RORA



Several files are created in the selected directory. This one shows the yearly summary of results.

USGS

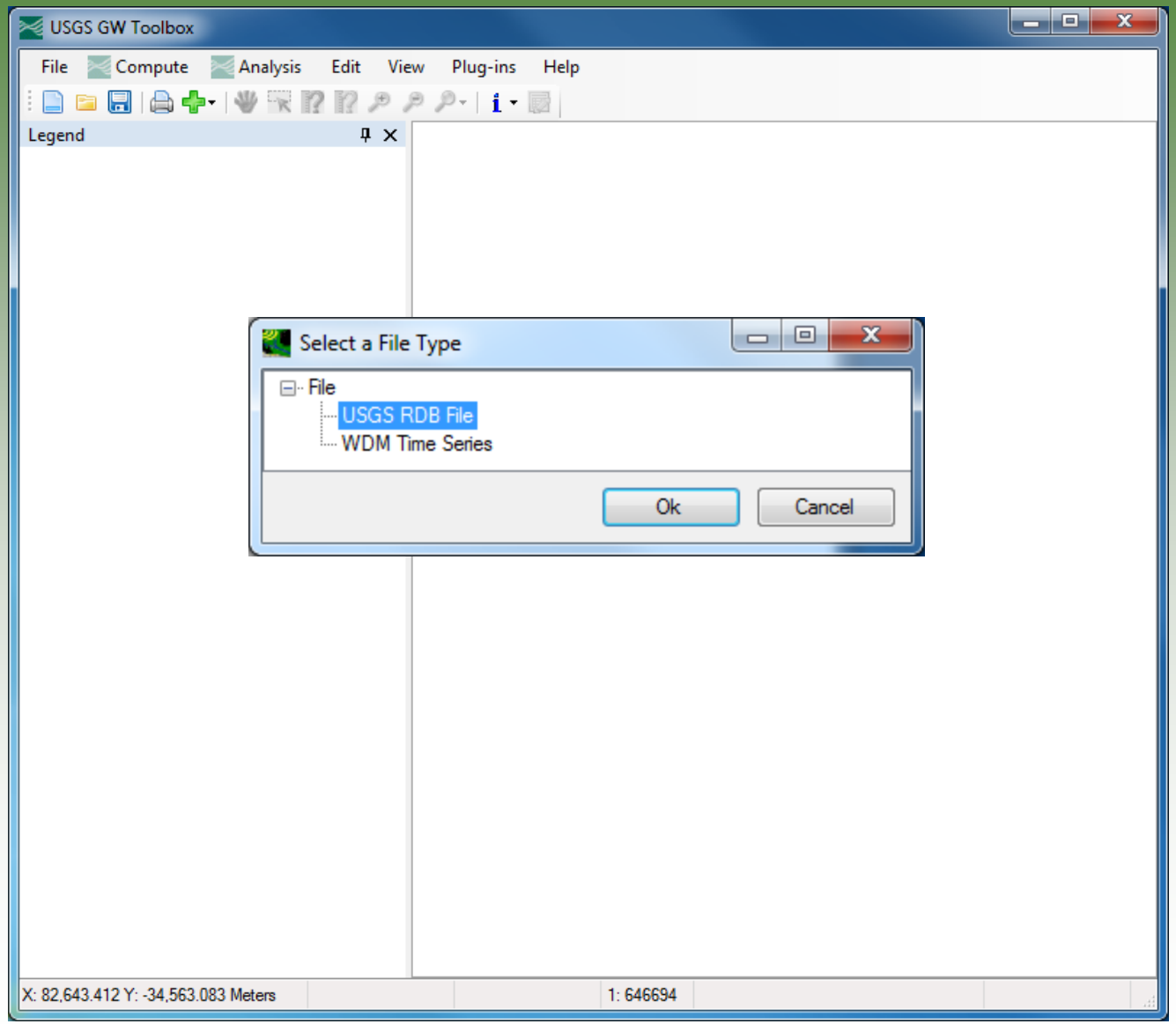
Recharge Analysis using RORA



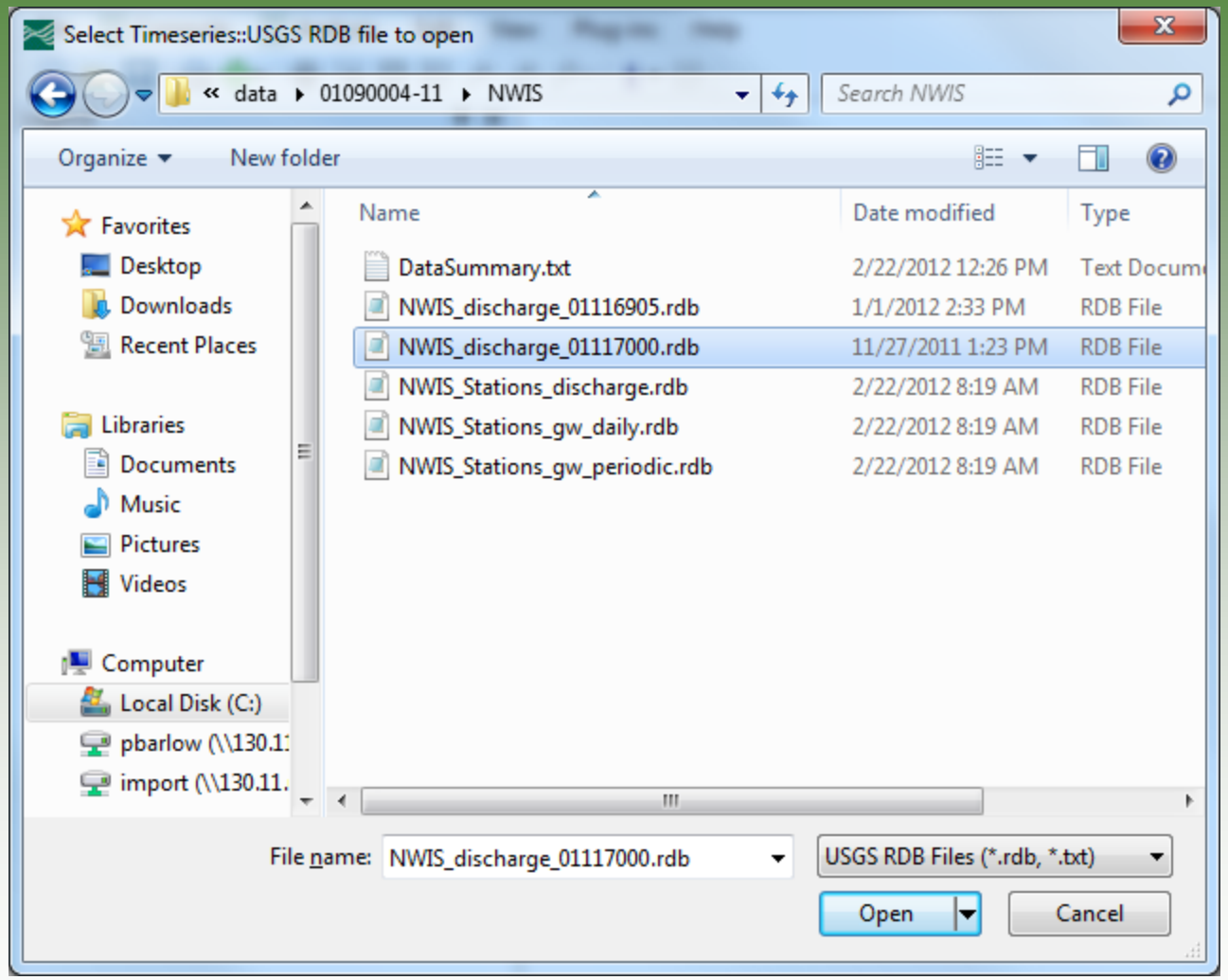
Plot of monthly recharge over the basin

USGS

Loading Data without a Map

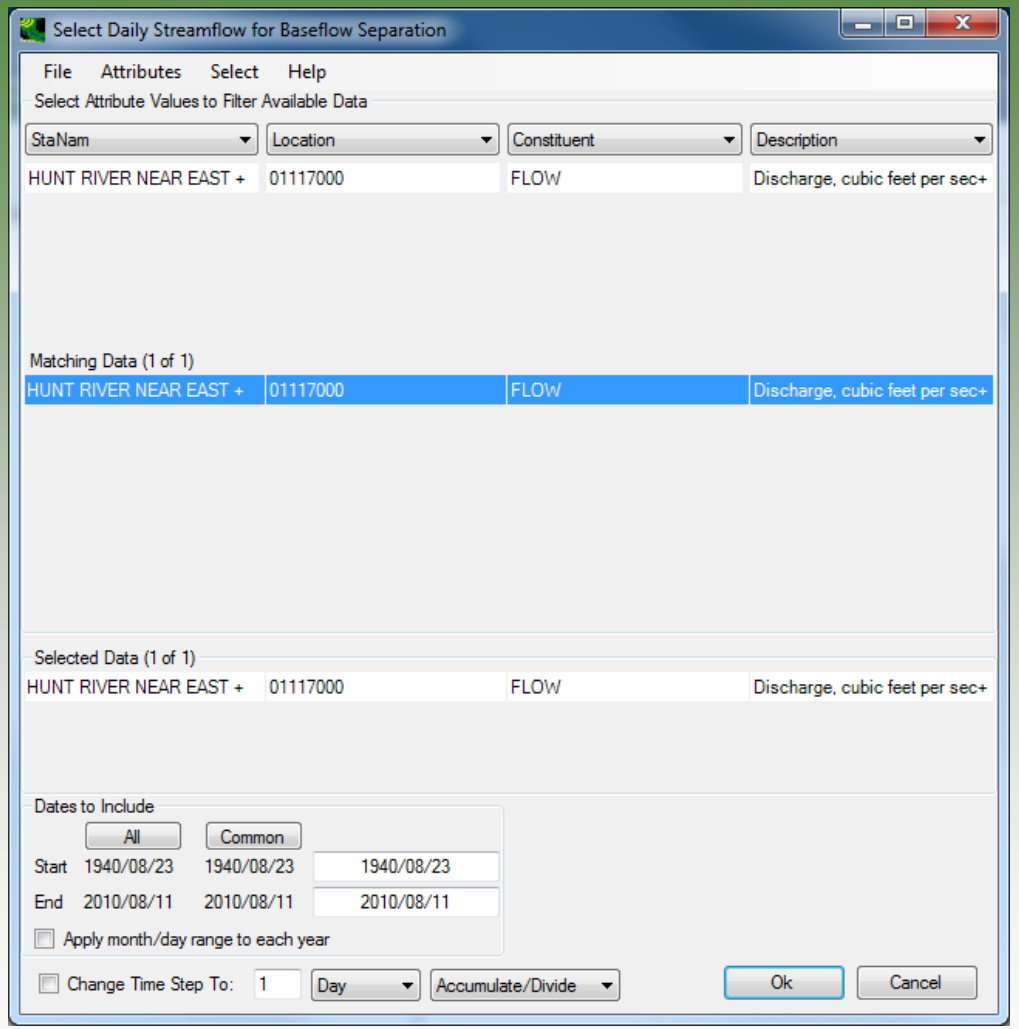


Loading Data without a Map



USGS

Loading Data without a Map



In this example, only the Hunt River near East Greenwich data have been selected. Continue as before.

➢ "You have to study a place for a while before you begin to ask the right questions."