



Missouri  
Department of  
Natural Resources

Water Protection Program  
Water Pollution Control Branch

## **LOW FLOW CALCULATIONS FROM USGS GAGE STATION DATA**

This document provides a method for calculating low flow values from USGS gage station data that seems to give consistent results.

There are three (3) sections of instruction:

- I. Retrieving Data from USGS Gage Station**
- II. Formatting the .txt file for the automatic calculator**
- III. Calculating 1Q10, 7Q10, and 30Q10 values**

The instructions were made using MS Office Excel 2010 (part of MS Office Professional Plus 2010), MS Internet Explorer 11.0, and the USGS website that was accessed June 12, 2015. Any program edition differences and/or information extracted from the USGS website after June 15, 2015, may require slightly different instructions than those detailed here.

## I. RETRIEVING DATA FROM USGS GAGE STATION

1. Go to <http://mo.water.usgs.gov/>
2. Choose “Historical Data -- Stream Flow”

The screenshot shows a web browser window displaying the USGS Missouri Water Science Center website. The page title is "Water Resources of Missouri" and the date is "Friday, June 12, 2015 16:00ET". The website features a navigation menu with items like "MOWSC", "projects", "publications", "links", "education", and "contact". A "DATA CENTER" section is visible on the left, with a sub-menu for "Historical data" containing "Streamflow" and "Groundwater". A red box highlights the "Historical data" section, and a red arrow points to the "Streamflow" option. The main content area includes a map of Missouri with various colored dots representing gage stations, a legend for "Current streamflow conditions" (Low, Normal, High), and a "Quick Link to Real-Time Data" section with a search box for USGS site numbers. A welcome message on the right side of the page states: "Welcome to the U.S. Geological Survey (USGS) Web page for the water resources of Missouri; this is your direct link to all kinds of water-resource information. Here you'll find information on Missouri's rivers and streams. You'll also find information about groundwater, water quality, and many other topics. The USGS operates the most extensive satellite network of stream-gaging stations in the state, many of which form the backbone of flood-warning systems. The USGS provides current ('real-time') stream stage and streamflow, water-quality, and groundwater levels for over 200 sites in Missouri."

### 3. Choose "Daily Data" button

The screenshot shows a web browser window displaying the USGS Surface-Water Data for Missouri page. The page title is "USGS Surface-Water Data for Missouri". Below the title, there is a yellow banner with a toggle switch and the text "Click to hide state-specific text". The main content area is divided into several sections:

- Current Conditions** (264 <publicly viewable> sites): Describes current conditions at selected sites based on the most recent data from on-site automated recording equipment. Measurements are commonly recorded at a fixed interval of 15- to 60-minutes and transmitted to the USGS every hour. Values may include "Approved" (quality-assured data that may be published) and/or more recent "Provisional" data (of unverified accuracy and subject to revision). Most current data are provisional.
- Historical Observations** (327 <publicly viewable> sites): Describes the same data accessed by the Current Conditions link above but including both active and discontinued sites with data for any part of the period October 1, 2007, through the present. Values may include "Approved" (quality-assured data that may be published) and/or more recent "Provisional" data (of unverified accuracy and subject to revision).
- Daily Data** (433 <publicly viewable> sites): Describes a summary of all data for each day for the period of record and may represent the daily mean, median, maximum, minimum, and/or other derived value. Values may include "Approved" (quality-assured data that may be published) and/or more recent "Provisional" data (of unverified accuracy and subject to revision). [Example](#).
- Statistics** (418 <publicly viewable> sites): Includes buttons for "Daily", "Monthly", and "Annual". Below these buttons, it states "Statistics are computed from approved daily mean data at".

On the right side of the page, there is an **Introduction** section with the following text:

The U.S. Geological Survey's (USGS) National Water Information System (NWIS) is a comprehensive and distributed application that supports the acquisition, processing, and long-term storage of water data. Water Data for the Nation serves as the publicly available portal to a geographically seamless set of much of the water data maintained within NWIS ([additional background](#)).

Nationally, USGS surface-water data includes more than 850,000 station years of time-series data that describe stream levels, streamflow (discharge), reservoir and lake levels, surface-water quality, and rainfall. The data are collected by automatic recorders and manual [field measurements](#) at installations across the Nation.

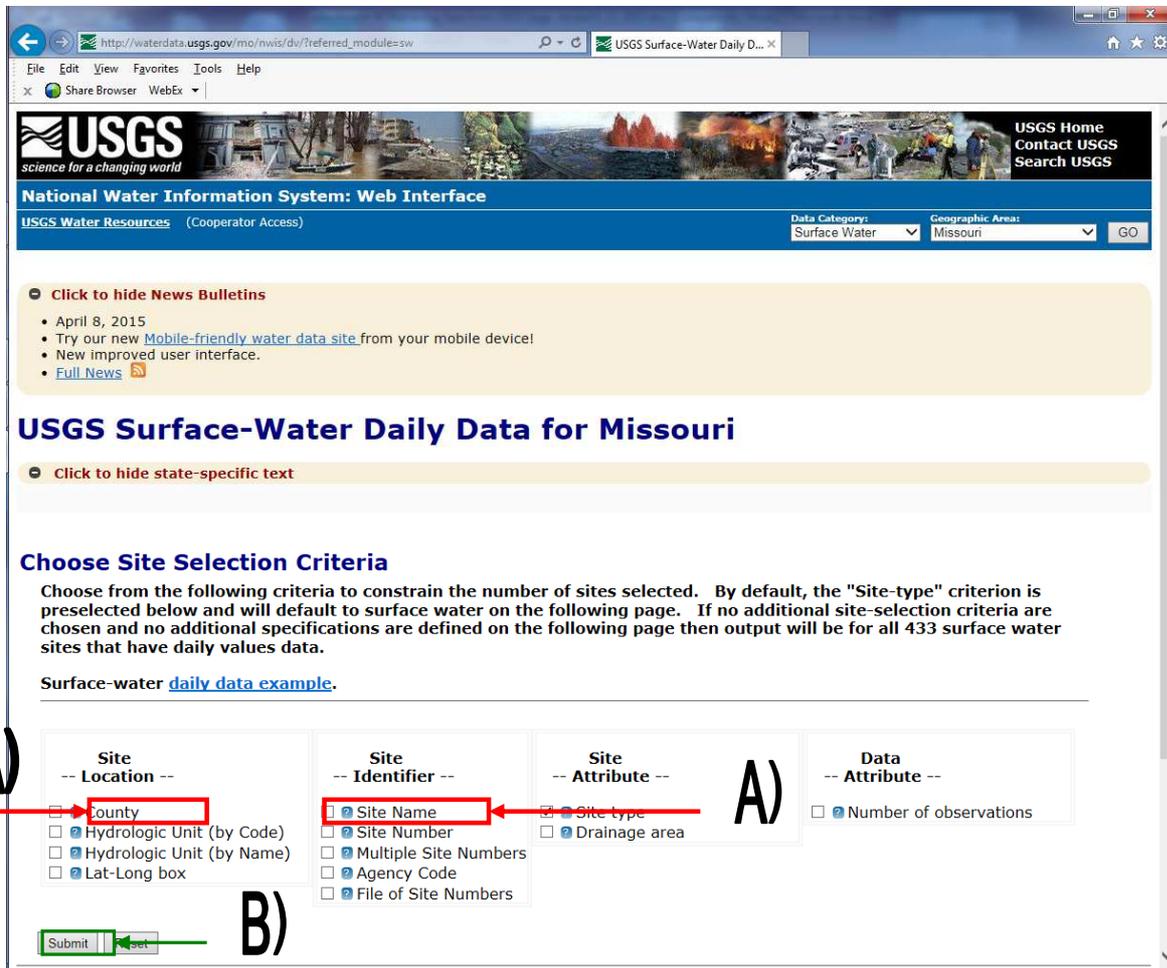
Data are collected by field personnel or relayed through telephones or satellites to offices where it is stored and processed. The data relayed through the Geostationary Operational Environmental Satellite (GOES) system are processed automatically in near real time, and in many cases, [current data](#) are available online within minutes.

Once a complete day of readings are received from a site, [daily summary data](#) are generated and made available online. USGS finalizes data at individual sites on a continuous basis as environmental conditions and hydrologic characteristics permit.

Below the introduction is a **Tutorial** button with the text: "Tutorial explaining how to perform a surface water retrieval and understand the results".

The "Daily Data" button is highlighted with a red box, and a red arrow points to it from the left.

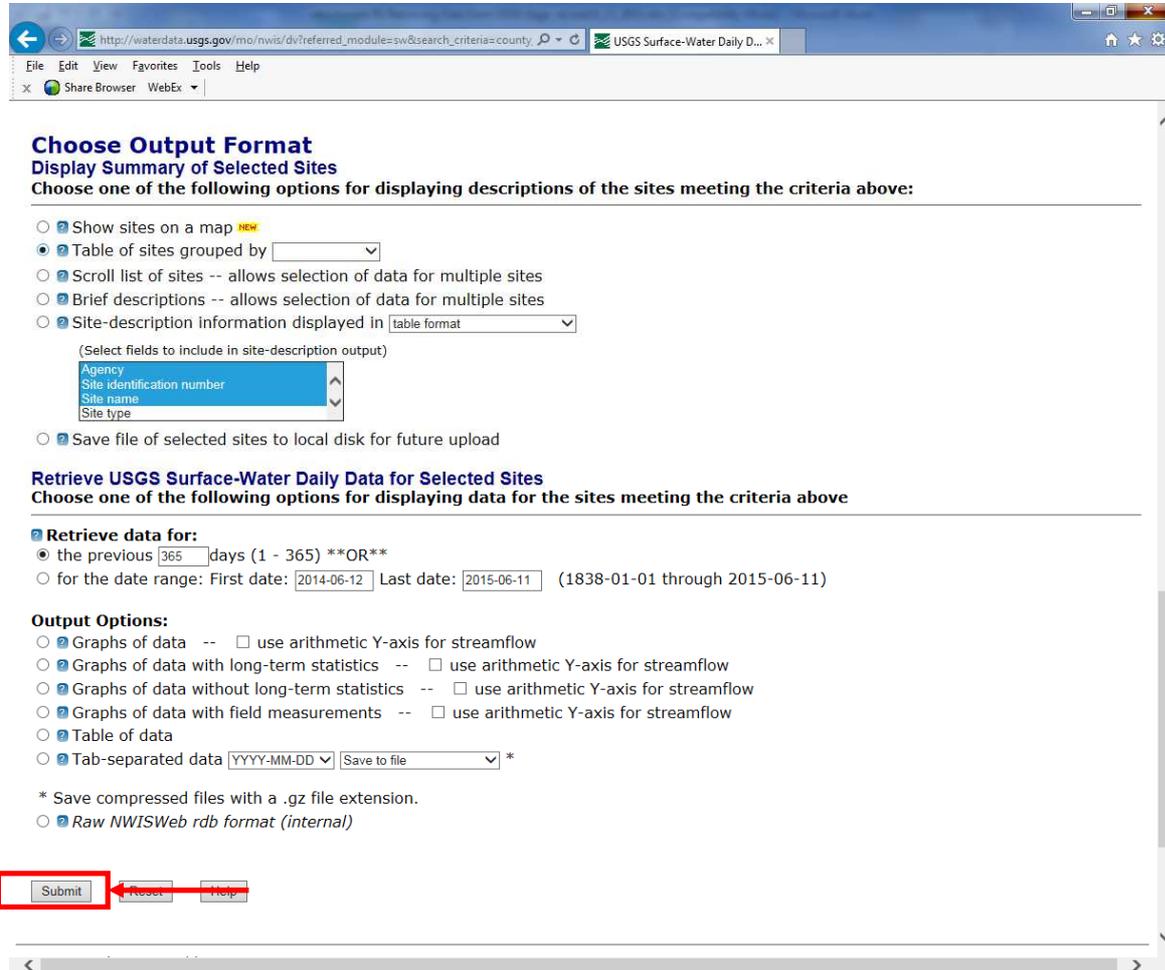
4. A) Check “site selection criteria” if one is known. For example, if you already know the gage station #, check only the “site number” checkbox. If you only know the county, check only the “County” checkbox. etc. B) Click on the “Submit” button.



5. (IF selecting by county) Highlight the county name.

Scroll to bottom and click on “Submit” button

Scroll to bottom and click on “Submit” button



6. Select site relevant to permit and click on corresponding “site number”

**USGS Surface-Water Daily Data for Missouri**

Click to hide state-specific text

**Site Selection Results -- 5 sites found**

Site type = Ocean, Coastal, Estuary, Lake, Stream, Canal, Ditch, Tidal stream  
County = Franklin

Save file of selected sites to local disk for future upload

Data for individual sites can be obtained by selecting the site number below

Agency	Site Number	Site Name
USGS	06935450	Missouri River at Washington, MO
USGS	06935550	Missouri River near Labadie, MO
USGS	07016000	Bourbeuse River near Spring Bluff, MO
USGS	07016500	Bourbeuse River at Union, MO
USGS	07017000	Meramec River at Robertsville, MO

Questions about sites/data? | Data Tips  
Feedback on this web site | Explanation of terms  
Automated retrievals | Subscribe for system changes  
Help | News

Accessibility | Plug-Ins | FOIA | Privacy | Policies and Notices

U.S. Department of the Interior | U.S. Geological Survey  
Title: USGS Surface-Water Daily Data for Missouri  
URL: <http://waterdata.usgs.gov/mo/nwis/dv?>

Page Contact Information: [Missouri Water Data Maintainer](#)  
Page Last Modified: 2015-06-12 17:35:25 EDT  
0.43 0.42 vaviv01

Go to Step 9

7. **(IF selecting by site number)**. Type in gage number into “site number” fill-in box

USGS Surface-Water Daily Data for Missouri

Click to hide state-specific text

Surface-water [daily data example](#).

Select sites which meet all of the following criteria:  
Define one or more values for each of the following site-selection criteria: --- or select [new criteria](#)

**Site Number** -- enter a full or partial site ID (*optional*)  
  exact match  match from the start  match any part

**Site type** -- select one or more (selection of a left-justified option will retrieve any subsequent indented entries)

- Coastal
- Estuary
- Lake
- Stream
- Canal
- Ditch
- Tidal stream
- Spring
- Well
  - Collector or Ranney type well
  - Extensometer well
  - Hydroheic-zone well
  - Interconnected wells
  - Multiple wells
  - Test hole

**Available parameters** -- select sites that have data for the following parameters:  
Select one or more parameters --or-- leave blank to select all:

Water Level/Flow Parameters	Meteorological Parameters
<input type="checkbox"/> Depth to water level, ft below land surface (197 sites)	<input type="checkbox"/> Precipitation, total, in (10 sites)
<input type="checkbox"/> Elevation of reservoir water surface above datum, ft (18 sites)	<input type="checkbox"/> Relative humidity, percent (4 sites)
<input type="checkbox"/> Gage height, ft (249 sites)	<input type="checkbox"/> Temperature, air, °F (5 sites)
<input type="checkbox"/> Stream water level elevation above NAVD 1988, in ft (1 sites)	<input type="checkbox"/> Total solar radiation (direct + diffuse radiation on a horizontal surface), watts/m <sup>2</sup> (4 sites)
<input type="checkbox"/> Streamflow, ft <sup>3</sup> /s (400 sites)	<input type="checkbox"/> Wind direction, degrees clockwise from north (4 sites)

**Water Quality Parameters**

Scroll down to bottom and select the “submit” button

**Choose Output Format**  
**Display Summary of Selected Sites**  
Choose one of the following options for displaying descriptions of the sites meeting the criteria above:

- Show sites on a map NEW
- Table of sites grouped by
- Scroll list of sites -- allows selection of data for multiple sites
- Brief descriptions -- allows selection of data for multiple sites
- Site-description information displayed in

(Select fields to include in site-description output)

- Agency
- Site identification number
- Site name
- Site type

- Save file of selected sites to local disk for future upload

**Retrieve USGS Surface-Water Daily Data for Selected Sites**  
Choose one of the following options for displaying data for the sites meeting the criteria above:

Retrieve data for:

- the previous  days (1 - 365) \*\*OR\*\*
- for the date range: First date:  Last date:  (1838-01-01 through 2015-06-11)

**Output Options:**

- Graphs of data --  use arithmetic Y-axis for streamflow
- Graphs of data with long-term statistics --  use arithmetic Y-axis for streamflow
- Graphs of data without long-term statistics --  use arithmetic Y-axis for streamflow
- Graphs of data with field measurements --  use arithmetic Y-axis for streamflow
- Table of data
- Tab-separated data   \*

\* Save compressed files with a .gz file extension.

- Raw NWISWeb rdb format (internal)

8. Click on corresponding “site number”

The screenshot shows the USGS National Water Information System Web Interface. At the top, there is a navigation bar with "USGS Water Resources" and "Cooperator Access". To the right, there are dropdown menus for "Data Category" (Surface Water) and "Geographic Area" (Missouri), with a "GO" button. Below this is a yellow banner with "Click to hide News Bulletins" and a list of news items dated April 8, 2015. The main heading is "USGS Surface-Water Daily Data for Missouri". Below that is another yellow banner with "Click to hide state-specific text". The section "Site Selection Results -- 1 sites found" contains a blue-bordered box with the text: "Site number contains string = 07017000" and "Site type = Ocean, Coastal, Estuary, Lake, Stream, Canal, Ditch, Tidal stream". Below this is a link to "Save file of selected sites" and a heading "Data for individual sites can be obtained by selecting the site number below". A table with three columns: "Agency", "Site Number", and "Site Name" is shown. The "Site Number" column has a red box around "07017000" with a red arrow pointing to it. The "Site Name" column shows "Meramec River at Robertsville, MO". At the bottom, there are links for "Questions about sites/data?", "Feedback on this web site", "Automated retrievals", "Help", "Data Tips", "Explanation of terms", "Subscribe for system changes", and "News". The footer includes "Accessibility", "Plug-Ins", "FOIA", "Privacy", "Policies and Notices", "U.S. Department of the Interior | U.S. Geological Survey", and the "USA.gov" logo.

9. Make sure only the following are checked: a) 00060 Discharge (Mean), b) Tab-separated. c) Enter the dates ranges, and d). Click on the “GO” button.

USGS  
science for a changing world

National Water Information System: Web Interface

USGS Water Resources (Cooperator Access)

Data Category: Surface Water Geographic Area: Missouri GO

ins

water data site from your mobile device!

ic text

Boating safety tips are available from the U.S. Coast Guard.

**NOTE: During cold periods, gage height and streamflow information may be adversely affected by ice.**

**USGS 07017000 Meramec River at Robertsville, MO**  
**PROVISIONAL DATA SUBJECT TO REVISION**

Available data for this site Time-series: Daily data GO

Available Parameters	Period of Record	Output format	Days (365)
<input type="checkbox"/> All 1 Available Parameters for this site	1939-10-01 1951-09-30	<input type="radio"/> Graph	<input type="text"/>
<input checked="" type="checkbox"/> 00060 Discharge(Mean)		<input type="radio"/> Graph w/ stats	-- or --
		<input type="radio"/> Graph w/ meas	Begin date
		<input type="radio"/> Graph w/ (up to 3) parms	2012-06-11
		<input type="radio"/> Table	End date
		<input checked="" type="radio"/> Tab-separated	2015-06-11

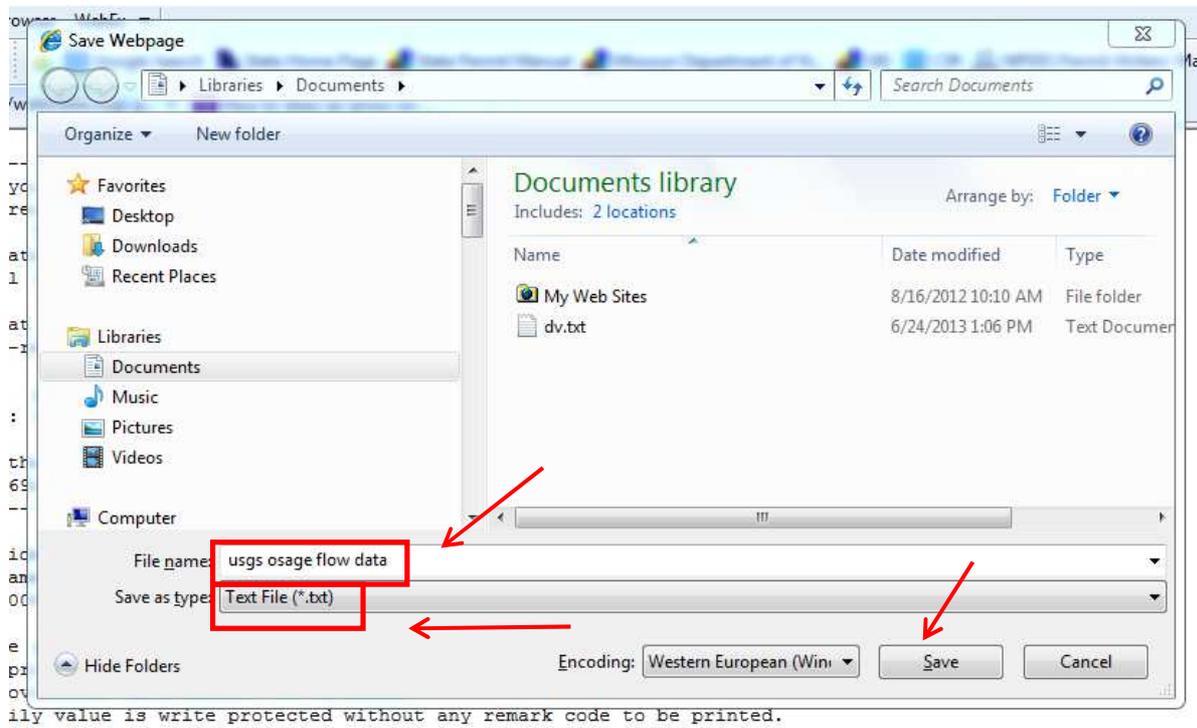
GO

Summary of all available data for this site  
Instantaneous-data availability statement

\*\*\* There are no data available on the Waterdata system for the time period specified, although data may be available in the files of the local USGS office operating the station.

[Questions about sites/data?](#) [Data Tips](#)  
[Feedback on this web site](#) [Explanation of terms](#)

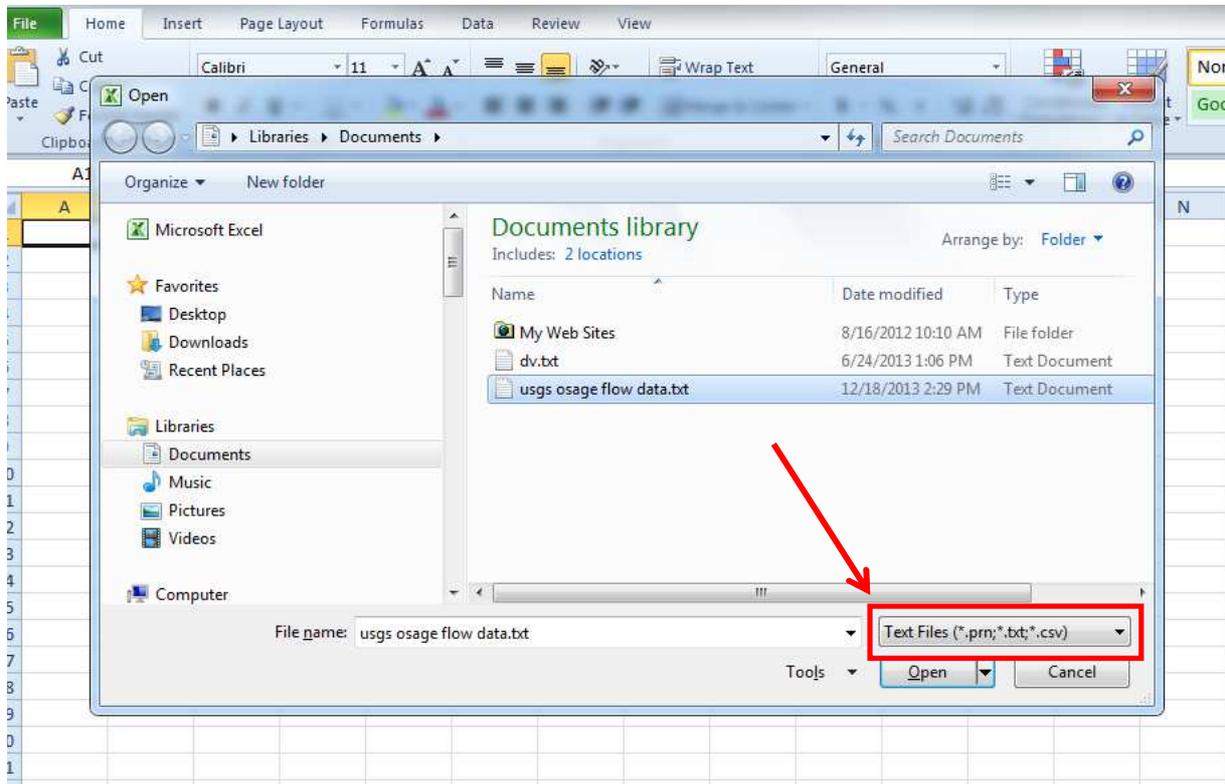
10. Save results as a text file (\*.txt). Go to “File”, “Save as...” Type in desired file name and select “Text File (\*.txt)” as file type. Click on the “Save” button.



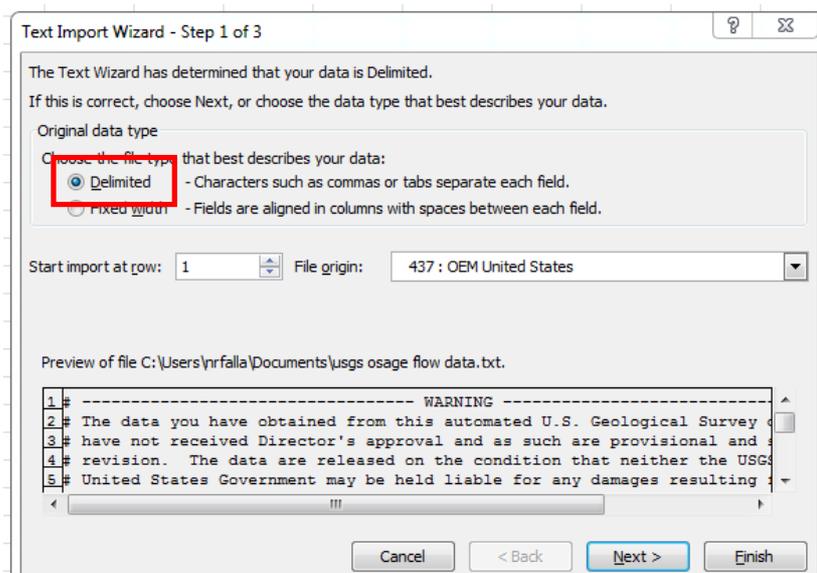
11. Close file but don't forget where you saved this file... you're going to need it soon!!!!!!

## II. FORMATTING THE .TXT FILE FOR THE AUTOMATIC CALCULATOR

1. Open the .txt file you just saved in Microsoft Excel. Make sure that either “All Files” or “Text Filed” is selected from the dropdown box in order to see your .txt file.



2. Excel will automatically open the “Text Import Wizard”. Make sure “Delimited” is selected. Click the “Finish” button.



- In order for the automatic calculator to work, the first data set date MUST be in cell C26. The first data set flow value MUST be in D26. If the data starts in the wrong cells, then you must delete or add rows in order to make the data start in the correct cells.

	A	B	C	D	E	F	G	
13	#							
14	#	# Data for the following 1 site(s) are contained in this file						
15	#	USGS 06926000 Osage River near Bagnell, MO						
16	#	-----						
17	#							
18	#	# Data provided for site 06926000						
19	#	# DD parameter statistic Description						
20	#	01	00060	00003	Discharge, cubic feet per second (Mean)			
21	#							
22	#	# Data-value qualification codes included in this output:						
23	#	A	Approved for publication -- Processing and review completed.					
24	#	P	Provisional data subject to revision.					
25	#	1	Daily value is write protected without any remark code to be printed.					
26	#	e	Value has been estimated.					
27	#							
28	agency_cc	site_no	datetime	flow	unit	code		
29	5s	15s	20d	14n	10s			
30	USGS	6926000	12/17/1963	741	A			
31	USGS	6926000	12/18/1963	706	A			
32	USGS	6926000	12/19/1963	495	A			
33	USGS	6926000	12/20/1963	1090	A			
34	USGS	6926000	12/21/1963	2030	A			
35	USGS	6926000	12/22/1963	929	A			
36	USGS	6926000	12/23/1963	476	A			
37	USGS	6926000	12/24/1963	470	A			
38	USGS	6926000	12/25/1963	454	A			
39	USGS	6926000	12/26/1963	485	A			
40	USGS	6926000	12/27/1963	2700	A			
41	USGS	6926000	12/28/1963	1770	A			
42	USGS	6926000	12/29/1963	640	A			
43	USGS	6926000	12/30/1963	868	A			
44	USGS	6926000	12/31/1963	469	A			
45	USGS	6926000	1/1/1964	470	A			
46	USGS	6926000	1/2/1964	504	A			

**It should look something like this...**

C26		fx		12/17/1963	
	A	B	C	D	E
13	#				
14	#	Data for the following 1 site(s) are contained in this file			
15	#	USGS 06926000 Osage River near Bagnell, MO			
16	#	-----			
17	#				
18	#	Data provided for site 06926000			
19	#	A Approved for publication -- Processing and review complete			
20	#	P Provisional data subject to revision.			
21	#	1 Daily value is write protected without any remark code			
22	#	e Value has been estimated.			
23	#				
24	agency_ccsite_no	datetime	01_00060_01_00060_0000		
25	5s	15s	20d	14n	10s
26	USGS	6926000	12/17/1963	741	A
27	USGS	6926000	12/18/1963	706	A
28	USGS	6926000	12/19/1963	495	A
29	USGS	6926000	12/20/1963	1090	A

**IF DATA STARTS ON THE WRONG ROW, THEN YOU MUST EITHER DELETE OR ADD ROWS IN ORDER TO MAKE THE DATA START ON THE CORRECT ROW**

4. Save and Close the file. Make sure the file is being saved as a .txt file. Click “Yes” to the dialog box that asks if you want to keep the workbook in its current format.

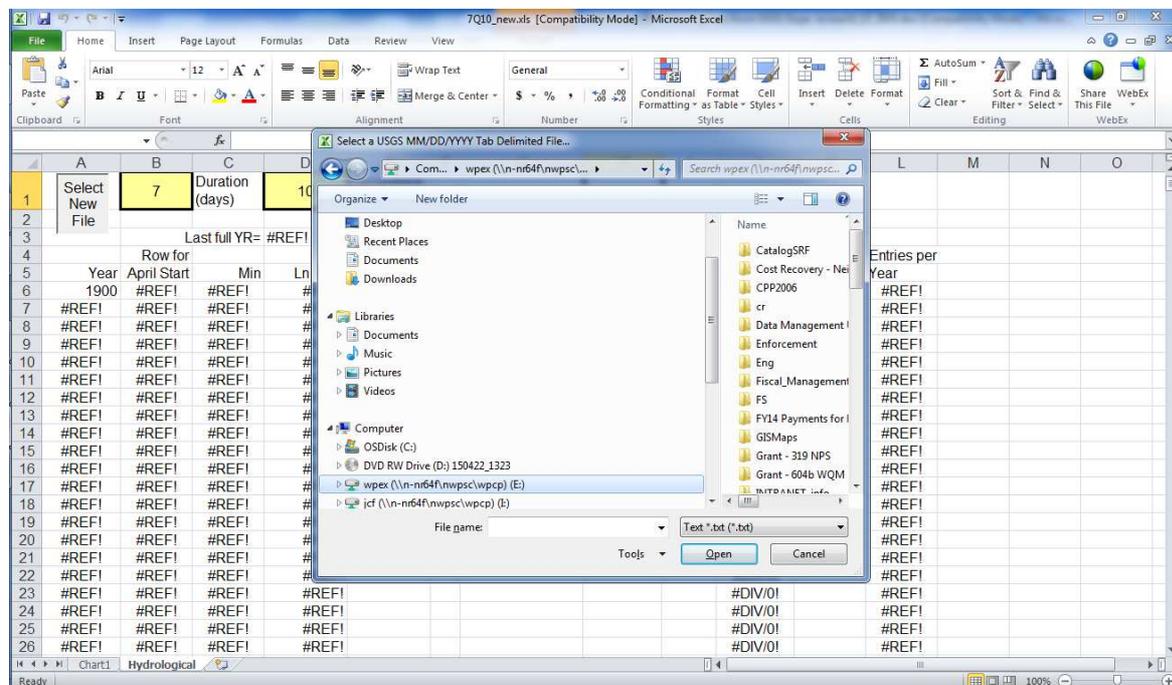
You’re just a few clicks away from having low flow values!!!!!!!!!!!!!!

### III. CALCULATING 1Q10, 7Q10, AND 30Q10 VALUES

1. Open the “xQy\_Low Flow Calculator.xls” file. You can request a copy. Send us an email.
2. Click on the “Select New File” button at the top left corner of the data fields

	A	B	C	D	E	F	G	H	I	J	K	L
1	Select New File	7	Duration (days)	10	Recurrence (years)			1/13/1985	1460	1277.14		
2							31	1/14/1985	1410	1218.57		
3			Last full YR=	2015			\$G\$37	1/15/1985	1350	1154.71		
4			Row for					1/16/1985	1260	1092.43		Entries per
5	Year	April Start	Min	Ln (Min)	mean U	4.434104887		1/17/1985	1210	1037.43		Year
6	1985	79	141.43	4.9518049				1/18/1985	1160	986		365
7	1986	444	74.43	4.3098591	stdev S	0.438771979		1/19/1985	1090	937.71		365
8	1987	809	73.86	4.3021714	skew G	0.231252162		1/20/1985	1050	894		366
9	1988	1175	66.71	4.2003549	Entries NY	30		1/21/1985	963	854.57		365
10	1989	1540	95.57	4.559859	Nzero N	30		1/22/1985	914	826.86		365
11	1990	1905	137.29	4.9220955	Fraction Z F0	0		1/23/1985	875	802.86		365
12	1991	2270	54.43	3.9969155	Recrnc R	10		1/24/1985	850	782.14		366
13	1992	2636	100.86	4.6137334	Excr. Prob P	0.1		1/25/1985	822	763.43		365
14	1993	3001	143.43	4.9658471	StNorm Z	-1.281126151		1/26/1985	784	746		365
15	1994	3366	83.86	4.4291487	Gamma K	-1.253684309		1/27/1985	774	731.14		365
16	1995	3731	87.86	4.4757446	Event	48.61943469		1/28/1985	769	714.57		366
17	1996	4097	54.86	4.0047845				1/29/1985	746	696.71		365

3. Select the .txt file you just formatted and saved



4. Once you open it, the 7Q10 value is listed in red next to “EVENT”

Year	April Start	Min	Ln (Min)	mean U	stdev S	skew G	Entries NY	Nzero N	Fraction Z F0	Reccrnc R	Excr. Prob P	StNorm Z	Gamma K	Event	1/13/1985	1/14/1985	1/15/1985	1/16/1985	1/17/1985	1/18/1985	1/19/1985	1/20/1985	1/21/1985	1/22/1985	1/23/1985	1/24/1985	1/25/1985	1/26/1985	1/27/1985	1/28/1985	1/29/1985	1/30/1985	1/31/1985	2/1/1985	2/2/1985	2/3/1985	2/4/1985	2/5/1985	2/6/1985	2/7/1985	Entries per Year
1985	79	141.43	4.9518049	4.434104887	0.438771979	0.231252162	30	30	0	10	0.1	-1.281126151	1.253884390	48.61943469	1460	1410	1350	1260	1210	1160	1090	1050	963	914	875	850	822	784	774	769	746	730	719	700	680	658	644	638	621	602	365

5. You can get the 1Q10, 30Q10, etc. by changing the value in the yellow-colored duration cell on the top left of the data sheet.

Year	April Start	Min	Ln (Min)	mean U	stdev S	skew G	Entries NY	Nzero N	Fraction Z F0	Reccrnc R	Excr. Prob P	StNorm Z	Gamma K	Event	1/13/1985	1/14/1985	1/15/1985	1/16/1985	1/17/1985	1/18/1985	1/19/1985	1/20/1985	1/21/1985	1/22/1985	1/23/1985	1/24/1985	1/25/1985	1/26/1985	1/27/1985	1/28/1985	1/29/1985	1/30/1985	1/31/1985	2/1/1985	2/2/1985	2/3/1985	2/4/1985	2/5/1985	2/6/1985	2/7/1985	2/8/1985	2/9/1985	2/10/1985	2/11/1985	2/12/1985	2/13/1985	2/14/1985	2/15/1985	2/16/1985	2/17/1985	2/18/1985	2/19/1985	2/20/1985	Entries per Year	
1985	79	139	4.9344739	4.382161775	0.443735628	0.282879328	30	30	0	10	0.1	-1.281126151	-1.246828007	46.01188656	1460	1410	1350	1260	1210	1160	1090	1050	963	914	875	850	822	784	774	769	746	730	719	700	680	658	644	638	621	602	580	566	664	664	1030	1110	1040	1020	1000	966	924	891	863	852	365

**NOTES:**

- There are some hangups with this calculator when you have null flow values in your dataset and you may need to make formats to the dataset (during section II) before the calculator can work properly.