Low-Flow Statistics in South Carolina

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In 2008, the U.S. Geological Survey, in cooperation with the South Carolina Department of Health and Environmental Control, initiated a study to update low-flow statistics at continuous-record streamgage stations.

Prior to that, low-flow statistics had not been updated on a state-wide basis since 1987.
Low-Flow Characterization of South Carolina Streams

- Pee Dee River (March 2007)
- Broad River (March 2008)
- Saluda, Congaree, and Edisto Rivers (March 2009)
- Catawba-Wateree and Santee Rivers (March 2012)
- Savannah and Salkehatchie Rivers (March 2014)

Summary report published in 2017

https://pubs.er.usgs.gov/

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Low-Flow Statistics Published

- Annual minimum 1-, 3-, 7-, 14-, 30-, 60-, and 90-day average flows with a 2-, 5-, 10-, 20-, 30-, and 50-year recurrence interval (depending on the available length of record)

- Daily flow durations for the 5, 10, 25, 50, 75, 90, and 95 percentiles
One of the most common low-flow statistics is the 7Q10, which is the annual minimum 7-day average flow with a 10-year recurrence interval.

In terms of probability of occurrence, there is a 1 in 10 (1/10) or 10-percent probability that the annual minimum 7-day average flow at a site will be less than or equal to the estimated 7Q10.
7Q10 in SC State Regulation

7Q10 was adopted as the minimum flow for applying water quality criteria as early as the S.C. Rules and Regulations of 1967.

It is used for such things as:

- Water Quality Standards (Reg. 61-68)
- Source Water Protection (Reg. 61-68)
- Interbasin Transfers (Reg. 121-12)
How is the 7Q10 computed?

Let’s look at an example using climate years 1939-48 (first 10-years of record) at USGS station 02175000, Edisto River near Givhans, SC.

Note: A climate year begins on April 1 and ends on March 31 and is designated by the beginning year.

Why do we use the climate year as opposed to the water year, which begins on October 1 and ends on September 30 and is designated by the ending year?
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Climate year (Apr 1 to Mar 31)

Water year (Oct 1 to Sep 30)

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From the log Pearson Type III statistical distribution, the 7Q10 for this period of record is 516 cubic feet per second ($\text{ft}^3/\text{s}$).
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$7Q_{10} = 516 \text{ ft}^3/\text{s}$

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For the period from 1939 to 2008, the $7Q_{10} = 347 \text{ ft}^3/\text{s}$.
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Annual minimum 7-day average flow for 1939 to 2019.

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Annual flow is the mean of the daily flows for the water year.

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Annual peak flow is the largest instantaneous flow for the water year.

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For comparison purposes, let's look at stations 02173000 and 02173500.

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02173000 South Fork Edisto River near Denmark, SC
DA = 720 mi²
72% from Sand Hills
28% from Coastal Plain

02173500 North Fork Edisto River at Orangeburg, SC
DA = 683 mi²
47% from Sand Hills
53% from Coastal Plain

02175000 Edisto River near Givhans, SC
DA = 2,730 mi²
31% from Sand Hills
69% from Coastal Plain

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Annual min 7-day average flow

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Annual peak flow

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Annual peak flow

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Low-Flow Characterization of South Carolina Streams

With respect to long-term statewide annual precipitation from 1895 to 2019

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With respect to long-term statewide annual precipitation from 1895 to 2019

South Carolina-Statewide

<table>
<thead>
<tr>
<th>Wettest</th>
<th>Driest</th>
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<tbody>
<tr>
<td>Year</td>
<td>Total annual precipitation (inches)</td>
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<tr>
<td>1964</td>
<td>69.32</td>
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<tr>
<td>1929</td>
<td>63.14</td>
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<tr>
<td>1959</td>
<td>60.86</td>
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<td>2015</td>
<td>60.66</td>
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<tr>
<td>1928</td>
<td>59.89</td>
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<tr>
<td>1948</td>
<td>59.74</td>
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<tr>
<td>1971</td>
<td>58.82</td>
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<tr>
<td>1975</td>
<td>58.23</td>
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<tr>
<td>1922</td>
<td>57.90</td>
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<td>2018</td>
<td>57.30</td>
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</tbody>
</table>

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“And it never failed that during the dry years the people forgot about the rich years, and during the wet years, they lost all memory of the dry years. It was always that way.”

–John Steinbeck  *East of Eden*

“The reason we need long-term records is because we have short-term memories.”--TDF