30 Year Averages

I. Definition

A. Standard 30 Year Average: Averages are calculated from:

1. a complete 30 year data set
2. a nearly complete data set with at least 25 years of data, or
3. correlating the short-term record to a nearby long-term site with a R-squared greater than 0.80

B. Conditional 30 Year Average: Averages are calculated for the period of record if the short-term record does not produce a viable relationship (R-squared > 0.80) with any other site(s).

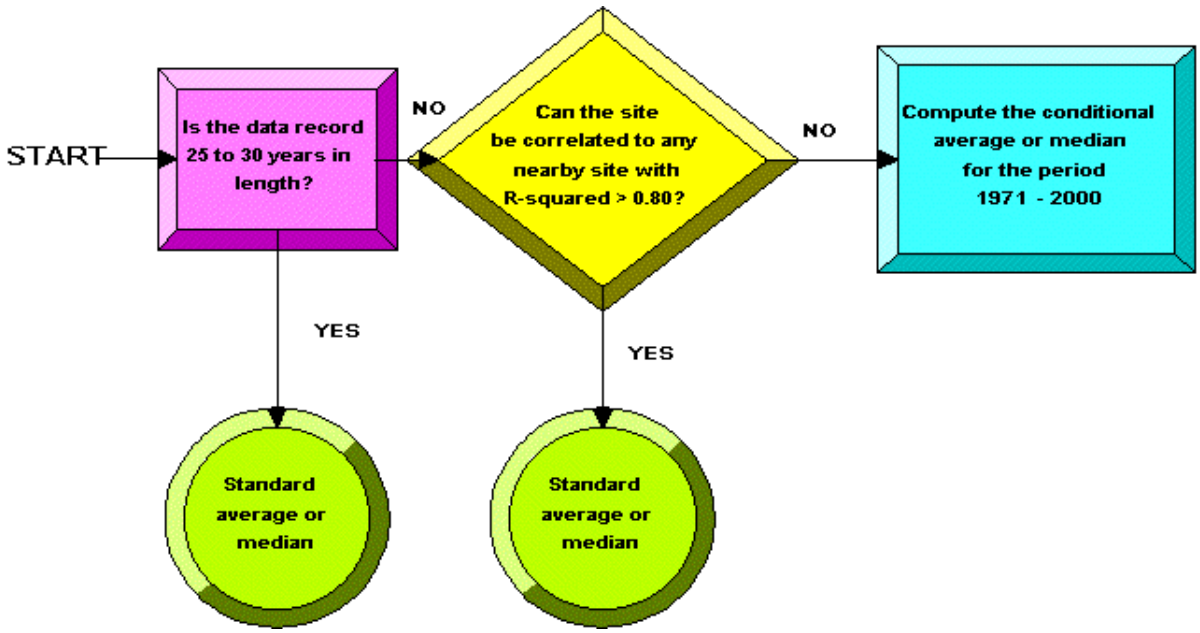
C. Median (applies to streamflow data only): A median is that value of the variable (in an ordered array) that has an equal number of items on either side of it. The median divides a frequency distribution into two halves. When asymmetric distributions are involved, the median is a more representative measure of location than the arithmetic mean.

I.a. Options

A. If the station data set has less than 5 years of data, every effort to produce an average or median should be made, however, "no average" is an option.

B. If the station data set is less than 25 years in length and the correlation is less than 0.90 (R-squared < 0.80), a “conditional” average can be produced.

30 YEAR AVERAGE COMPUTATION FOR GENERAL CASES:



II. Streamflow

A. Definition:

Standard 30-Year Average: Monthly streamflow averages are calculated from:

1. a complete 30 year data set
2. a nearly complete data set with at least 25 years of data, or
3. correlating the short-term record to a nearby long-term station with a R-squared greater than 0.80

Conditional 30 Year Average: Monthly streamflow averages are calculated for the period of record if the short-term record does not produce a viable relationship (R-squared > 0.80) with any other site(s).

Median may be used instead of average, if desired: A median is that value of the variable (in an ordered array) that has an equal number of items on either side of it. The median divides a frequency distribution into two halves. When asymmetric distributions are involved, the median is a more representative measure of location than the arithmetic mean.

Coordination with the National Weather Service is required to establish monthly streamflow averages or medians.

B. Monthly average streamflow values and forecast periods, in acre-feet, are coordinated with the National Weather Service (NWS). If the station has no winter data record, then averages are not produced for those months. The following rounding convention in B.1., was adopted by the SCS and NWS in 1987 and is used for streamflow values.

1. For streamflow averages and observed flow.

Flow		Round To
< 2,000	AF	nearest hundredth
2,000 to 19,999	AF	nearest tenth
20,000 to 199,999	AF	nearest 1,000 AF
200,000 to 999,999	AF	nearest 5,000 AF
> 1,000,000	AF	3 significant digits

Examples:	1,156	AF	1.16	KAF
	17,555	AF	17.6	KAF
	79,495	AF	79	KAF
	533,295	AF	535	KAF
	10,578,000	AF	10,600	KAF

2. The rounding convention, as stated in SCS Manual, Computation Standards for Engineering Work-1968, should be followed in the

computation of averages. Following are examples taken from page 7 of the manual.

Case 1 - When the figure next beyond the last figure or place to be retained is less than 5, the figure in the last place retained should be kept unchanged.

Case 2 - When the figure next beyond the last figure or place to be retained is more than 5, the figure in the last place retained should be increased by 1.

Case 3 - When the figure next beyond the last figure or place to be retained is 5 and:

a. there are no figures, or only zeros, beyond this 5, if the figure in the last place to be retained is "odd", it should be increased by 1; if "even", it should be kept unchanged;

Example:	1.35	1.4
	1.3500	1.4
	1.45	1.4
	1.4500	1.4

b. is followed by any figures other than zero, the figure in the last place retained should be increased by 1, whether "odd" or "even".

Example:	1.3501	1.4
	1.3599	1.4
	1.4501	1.5
	1.4599	1.5

C. We are proposing to:

1. Flag discontinued gaging station forecast points and conditional averages that are in published reports.

D. Options:

1. No development of new averages for a stream gaging station at a forecast point that was discontinued prior to the 1996 water year or that does not meet the requirements outlined in section II.A.

III. <u>Snow Courses</u>

A. Averages are produced for snow courses currently measured.

B. Definition.

Standard averages are based upon:

1. a complete 30 year data set,
2. a nearly complete data set with at least 25 years of data, or

3. the peak snow water equivalent (SWE) average and a regional percentage of the peak for each month, or
4. by correlating the short-term record to a nearby long-term site with a R-squared value greater than 0.80.

Conditional averages are calculated for the period of record, if the short-term record cannot be correlated to produce a viable relationship with other nearby long-term site(s).

C. Averages for non-co-located sites are generated for each month that has historically been measured. The following criteria apply:

1. If measured:

Feb-May:

Feb-May averages are generated, Jan averages are not.

Jan, Mar-May, or when a month is skipped between measurements:

Averages are made for Jan, Mar-May. The DCO may decide to estimate the Feb average from a graph plot of 1st of month averages, if they feel confident about the relationship between the months the snow course measurements are lacking.

Mar-May:

Mar-May averages are generated.

2. Mid-month averages should only be calculated where mid-month measurements are made on a regular schedule.

D. Averages should be produced for Basin Index Points (BIP) only for the month the snow course is currently measured.

E. Co-located snow courses that have been discontinued, or will be discontinued at the close of the 2000 season, should not have new averages generated.

F. Averages are generated for co-located snow courses currently being measured. The averages should be compared to the generated pillow averages, see section III.C.

IV. SNOTEL Pillow

A. The following procedure is the appropriate procedure to use for generating the 30 year SNOTEL pillow averages. If a viable correlation cannot be used, then the average should be flagged as conditional.

SNOTEL Pillow Average Development

1. The first step is to determine the average start and stop dates for pillow accumulation and melt out. Use available period of record (with the "plotdaily" program -- cfs/graphics/plotdaily) to estimate average start and stop dates to the nearest mid-month for each site. Actual dates can be determined for the period of record by saving and viewing the average table. Subjective adjustment will be needed if available period of record is not representative of long-term conditions. If the SNOTEL site has been active for a sufficient amount of time, the "plotdaily" average table may be used as a source for calculating 1st of month and mid-month averages.

2. The best estimate of the first of month pillow average would most likely be the arithmetic mean of back-generated first of month pillow values for the complete period, 1971-2000. In many cases, the complete period for all months will not be available, or in some cases, the site will not be back-generated at all.

3. If April 1 first of month pillow values have been back-generated for the entire period, but other months are missing or incomplete, compute the other month's percent of April 1 average, using co-located, or nearby snow courses with a longer record than the SNOTEL site. This distribution for the co-located, or nearby snow course, should apply to the SNOTEL site as well. You can then apply each month's percent to the SNOTEL April 1 average value. These values should be plotted on graph paper and a smooth curve drawn between points to assure that the relationship from month to month is reasonable. This curve can also be used to interpolate mid-month and early/late season averages.

4. If there is insufficient back-generated SNOTEL pillow data to compute arithmetic averages for any month, then regression techniques should be used to produce an estimating equation between snow pillow (y) and long-term snow course (x). Separate equations may be needed for accumulation and melt periods. These equations should then be applied to the snow course averages to estimate SNOTEL averages.

5. After January through May or June averages have been calculated, using the above procedures, a curve can be constructed through these values and to the start and stop dates. The shape of this curve will be based on subjective analysis, using available SNOTEL data. The "plotdaily" program can assist with this analysis. November, December, and perhaps June pillow averages can then be estimated where no actual data exists at the nearby or co-located snow course used for comparison.

B. If a SNOTEL pillow and snow course meet the requirements, as stated in National Instruction No. 290-302, Snow Course Reduction Plan, for back-generating values for the SNOTEL pillow and discontinuing the snow course, then the back-generated values for the SNOTEL pillow are used in computing the new SNOTEL pillow averages; see section III.A.2.

C. If a SNOTEL pillow and snow course do not have a strong enough relationship to meet the requirements, as stated above for discontinuing the snow course, then the

SNOTEL pillow and snow course averages should be generated independently and compared to each other. Since the sites do not meet the requirements for discontinuing the snow course, the back-generated values are not retained in the operational database. However, if the correlation between the sites is viable ($R^2 >$ 0.80), then the regression equations should be applied to the snow course averages for generating the standard 30 year averages; see section III.A.4.

V. SNOTEL Precipitation

A. The following procedure is the appropriate procedure to use for generating the standard 30 year SNOTEL precipitation averages. If a viable correlation cannot be used, then the average should be flagged as conditional.

SNOTEL Precipitation Average Development

1. Nearly all SNOTEL sites will not have a full period of record for the period 1971-2000. However, a few will have 25 plus years of record. Use the "compute" function or the "plotdaily" program to generate an arithmetic average annual precipitation value for the available period.

2. If the SNOTEL site period of record is less than 25 years, compute the mean annual arithmetic average, using correlations with nearby NWS sites for the same period. The NWS values for the short period would then be compared to the 1971-2000 period for the same station. The ratio of the difference would then be applied to the SNOTEL short period to derive a long-term (1971-2000) mean annual precipitation value. In other words, if a group of nearby NWS stations show that the 1986-2000 average annual value was 90% of the 1971-2000 period, then the SNOTEL average for the 1986-2000 period should be adjusted by dividing by 90 percent to estimate the 1971-2000 average.

3. Previous analysis indicates that the monthly average distribution of precipitation at NWS stations may be significantly different from the distribution at SNOTEL sites. Therefore, if at all possible, use the monthly distributions at long-term SNOTEL sites in the same or an adjacent basin to derive the distribution of the SNOTEL mean annual precipitation value over the individual months. Comparison of average SNOTEL monthly precipitation increases with snow pillow or snow course average increases during the winter months can aid in verification of the estimated precipitation averages. Another method that can be used to derive monthly mean averages is outlined by Phil Farnes in his paper entitled "Estimating Monthly Distribution of Average Annual Precipitation in Mountainous areas of Montana", presented at Western Snow Conference, 1995, Sparks, Nevada.

VI. Reservoir End-of-Month Storage

A. Definition:

Standard 30-Year Average: End-of-month "usable" reservoir storage calculated from:

1. a complete 30-year data set
2. a nearly complete data set with at least 25 years of data

Conditional 30-Year Average: End-of-month "usable" reservoir storage calculated for the period of record less than 25 years.

"Usable" storage is determined by the entity that has ownership of, or is responsible for the operation of the reservoir.

VII. Flagging Averages

A. Conditional averages will be flagged and footnoted in all reports and summaries.

B. A specific data type may have more than one flag (standard or conditional) associated with the twelve monthly averages for the water year, e.g., more observations are usually made during the winter season than during the fall or summer.