Revisions to Florida Geological Survey Special Publication 52
[Florida Springs Nomenclature Committee (FSNC); December, 2005]

swallet – The opening through which a stream loses all or part of its water to the subsurface; or a place where a stream may sink into alluvium in a streambed without the presence of a depression. It is synonymous with *swallow hole* (Modified from Neuendorf, Mehl, and Jackson, 2005).

swallow hole – See swallet.

ponor – Hole in the bottom or side of a closed depression through which water passes to or from an underground channel (Modified from Field, 1999).

<u>spring magnitude</u> – A category based on the volume of flow from a spring per unit time.

The classification system (Table 2) used in Florida is based on Meinzer (1927).

Table 2a. Spring Magnitude

	Flow	
Magnitude	**Metric Units**	**English Units**
1	≥ 2.832 cms	≥ 100 cfs (≥ 64.6 mgd)
2	≥ 0.283 to 2.832 cms	≥ 10 to100 cfs (≥ 6.46 to 64.6 mgd)
3	≥ 0.028 to 0.283 cms	≥ 1 to 10 cfs (≥ 0.646 to 6.46 mgd)
4	≥ 0.0063 to 0.028 cms	≥ 100 gpm to 1 cfs (≥ 100 to 448gpm)
5	≥ 0.631 to 6.308 lps	≥ 10 to 100 gpm
6	≥ 0.063 to 0.631 lps	≥ 1 to 10 gpm
7	≥ 0.473 to 3.785 lpm	≥ 1 pint/min to 1 gpm
8	< 0.473 lpm	< 1 pint/min

cms = cubic meters per second
cfs = cubic feet per second
mgd = million gallons per day
gpm = gallons per minute
lps = liters per second
pint/min = pints per minute
lpm = liters per minute

Notes regarding magnitude – One discharge measurement is enough to place a spring into one of the eight magnitude categories. However, springs have dynamic flows. A spring categorized as being a first-magnitude spring at one moment in time may not continue to remain in the same category. Furthermore, recent interest in spring monitoring has resulted in large numbers of discharge measurements since 2000. These post-2000 samples bias the long-term flow calculations with regards to determining the magnitude of the spring, unless corrections are taken. Therefore, the FSNC (2005) decided that the magnitude of a spring is to be based on a weighted median value of all discharge measurements for the period of record.

The median of a set of scores is the middle value when the scores are arranged in increasing (or decreasing) order. That is half the data are below the median and half the data are above the median. The steps in computing the median of a data set (Sullivan, 2004) are as follows:

1. Arrange the data in ascending order.
2. Determine the number of observations, n.
3. Determine the observation in the middle of the data set.

> If the number of observations is odd, then the median is exactly in the middle of the data set. That is, the median is the observation that lies in the (n + 1)/2 position.
>
> If the number of observations is even, then the median is the arithmetic mean of the two middle observations in the data set. That is, the median is the arithmetic mean (average) of the data values that lie in the (n/2) and the [(n/2) + 1] positions.

As an example, refer to Table 2b. Note the hypothetical data sets have already been arranged in ascending order.

Table 2b. Median Examples

Example Data Set 1			**Example Data Set 2**	
n = 7 (odd)			n = 8 (even)	
Observation Value	**i^{th} Position**		**Observation Value**	**i^{th} Position**
121	1		122	1
136	2		145	2
139	3		165	3
158	*4*		*165*	*4*
164	5		*166*	*5*
169	6		187	6
198	7		191	7
			196	8
(n + 1)/2 position = (7 + 1)/2 = (8/2) = 4			(n/2) position = (8/2) = 4	
Observation at the 4^{th} position = 158			[(n/2) + 1] position = (4 + 1) = 5	
Median = 158			Mean of obs. at 4^{th} and 5^{th} positions =	
			(165 + 166)/2 = 165.5	
			Median = 165.5	

The revised method for determining the weighted, median flow of a spring is a two step process. First, the median annual flow for each year of the period of record is determined. In years where only one discharge measurement was taken, the single measurement will represent a sample of the flow for that year. If two or more discharge measurements were taken in a single year, then the median of the flow measurements for that year will be used. Second, these median or representative flow values are assumed to represent the years in which measurements were obtained. Thus, the medians or representative samples of all flow measurements will be used to determine the weighted, long-term median flow and magnitude of the spring (FSNC, 2005). An example is found in Table 2c.

Table 2c. Example of Calculation of the Median of Annual Flow Medians

Date	Discharge (CFS)	Annual Representative or Median Flow (CFS)
02/01/1947	135	135 (1947)
03/01/1964	127	127 (1964)
10/15/1980	146	146 (1980)
02/28/2003	87	
03/02/2003	84	87 (2003)
11/24/2003	91	
11/17/2004	102	
06/04/2004	86	91 (2004)
09/01/2004	91	
07/03/2005	90	
08/04/2005	90	90 (2005)
09/02/2005	104	
10/07/2005	80	

Note there are six years in which discharge measurements for the spring were obtained. In ascending order, the median or representative flow values are 87, 90, *91*, *127*, 135, and 146 CFS. Since there is an even number of years with flow measurements, the median annual flow for the period of record is the midpoint between the two middle annual flow medians and representative samples when they are arranged in ascending order. The median annual flow is the mean (midpoint) of 91 and 127 CFS or 109 CFS. For the long-term period of record, the spring is considered a first-magnitude spring.

It is recognized that historically, many springs in Florida have kept one magnitude category, even though the discharge may have changed considerably from when it was first assigned a magnitude. For this reason, a historical category is acceptable in the Florida Springs Classification System. For example, the discharge of a spring may have been taken in 1946. At that time it was classified as a first-magnitude spring. No other measurement was taken until 2001, when three discharge measurements were taken. The median value for the two annual medians reveals that the spring should be re-classified to a second-magnitude spring in 2001. Nevertheless, it can still be considered a historical first-magnitude spring. The term historical refers to the period of time prior to **2001**.

The location of a discharge measurement is critical for defining the magnitude of a spring. Whenever possible, a discharge measurement should be restricted to a vent or seep. However, this is often impractical. For example, the only place to take a measurement may be in a spring run downstream where multiple springs have discharged into the run. For this reason, whenever a discharge measurement or water sample is taken, the springs (vents or seeps) included in the measurement need to be reported. The exact location of the discharge measurement (using a Global Positional System with approved locational specifications) and a standardized locational reference point for each measurement is encouraged.

historical spring magnitude – A special spring classification category based on the median volume of flow from a spring per unit time, based on discharge data obtained prior to the year 2001 (FSNC, 2005). See spring magnitude.

Special Terms

The FSNC believes the meanings of key spring terms and an understanding as to how they differ are extremely important for the hydrogeology community in its efforts to better appreciate the dynamics of Florida's springs. These **special terms** (underlined in the glossary) are listed below in alphabetical order:

historical spring magnitude,
karst window,
offshore spring,
onshore spring,
seep (or spring seep),
spring,
spring group,
spring magnitude,
spring run,
springshed (or spring recharge basin), and
vent (or spring vent).

New References Cited

Neuendorf, K.K.E., Mehl, J.P., and Jackson, J.A., (eds.), 2005, Glossary of Geology, fifth ed.: American Geological Institute, Alexandria, VA, 779 p.)

Sullivan, M., 2004, Statistics, Informed Decisions Using Data, Upper Saddle River, NJ., Prentice Hall, 823 p.