Lower Solomon River Subbasin

2008 - Field Analysis Summary

Subbasin Water Resource Management Program

Division of Water Resources
Kansas Department of Agriculture
109 SW Ninth Street – 2nd Floor
Topeka, KS 66612-1283
785-296-6087

Table of Contents

Figures

Table

I. Introduction

The Solomon River Basin is divided into three sections: Upper Forks, Lower Forks and Mainstem. This field summary will cover the Lower Forks section. The Lower Forks include both a North and South stem of the river. The Lower Forks start right below Kirwin and Webster Reservoir flowing east towards Waconda (Glen Elder) Reservoir. The Lower North Fork begins in Phillips County and continues through Smith, Jewell and Mitchell counties. The Lower South Fork begins in Rooks County and continues through Osborne and Mitchell counties. The Lower North and Lower South Fork Solomon join together and flow into Waconda (Glen Elder) Reservoir in Mitchell County.

The Lower Forks sections have two irrigation districts operated out of Webster and Kirwin Reservoir. Water allocations from the reservoir storage are specified in contracts between the U.S. Department of Interior, Bureau of Reclamation and each irrigation district. Webster Irrigation District has not operated since 2004 in which 3,867 acre-feet was released. Kirwin Irrigation District operated in 2007, and released 2,809 acre-feet. Kirwin plans to operate in 2008 at 6 inches.

The Lower Forks flow through the middle range of the Smoky Hills. This area is known as "Post Rock Country" because it is capped by Greenhorn Limestone which was used by early settlers for fence posts. The alluvium consists mainly of gravel, sand, silt and clay that can be found in the channels and flood plains of all the major streams.

Figure 1 is a map of the entire Solomon basin.

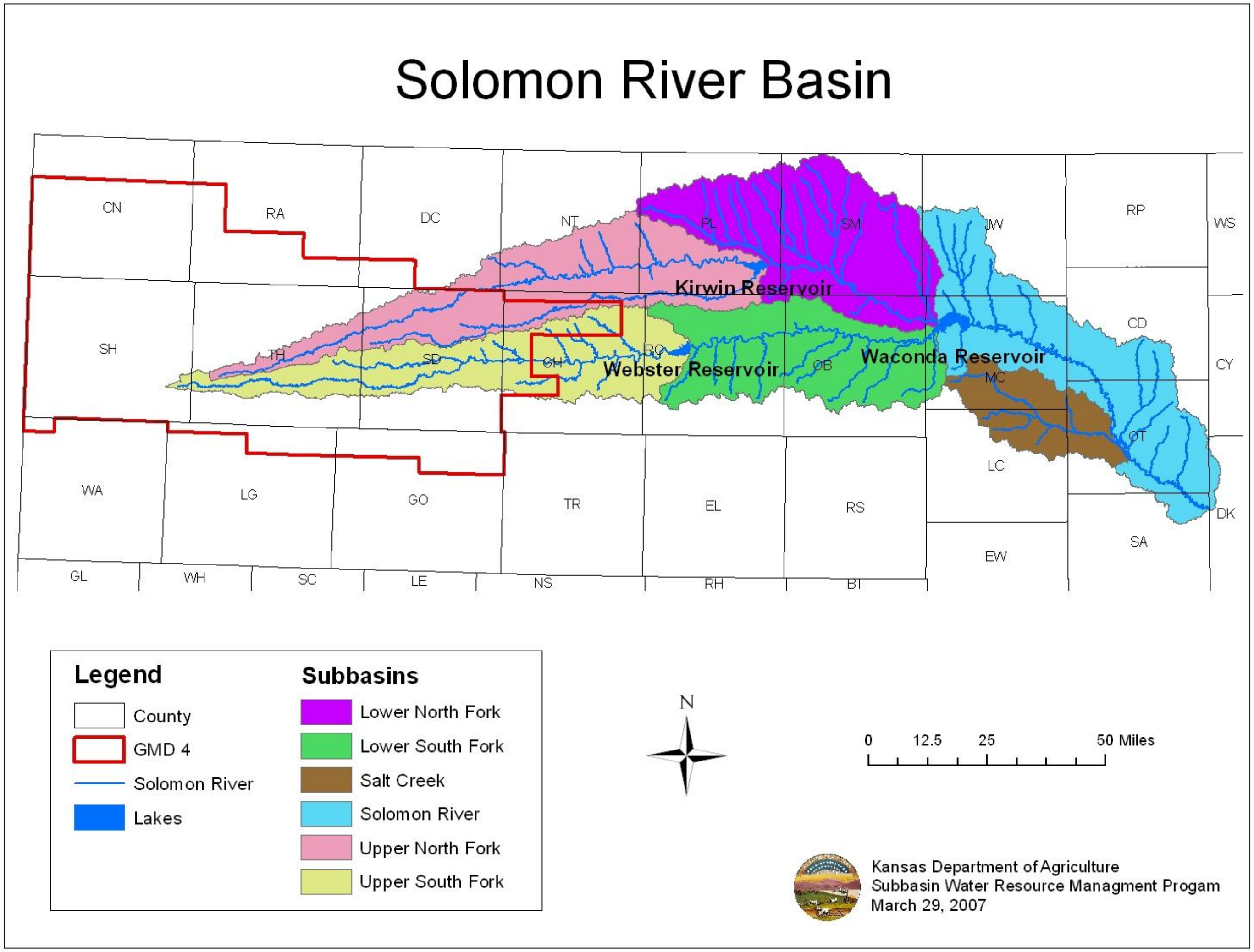

Figure 1: Solomon River Basin divided into subbasins

II. Precipitation

Precipitation in the Lower Solomon subbasin averages 23.41 inches (in.) since 1900. Figure 2 shows the annual variation in precipitation. Both charts are derived from various National Climatic Data Center (NCDC) stations including Phillipsburg, Kirwin, Lebanon, Smith Center, Covert, Alton, Plainville and Webster. The data is downloaded then averaged to create the following charts. The highest precipitation totals occurred in 1993 with 42.87 in. and the lowest in 1905 with 8.22 in. Annual precipitation data available for these NCDC stations is currently available through 2007.

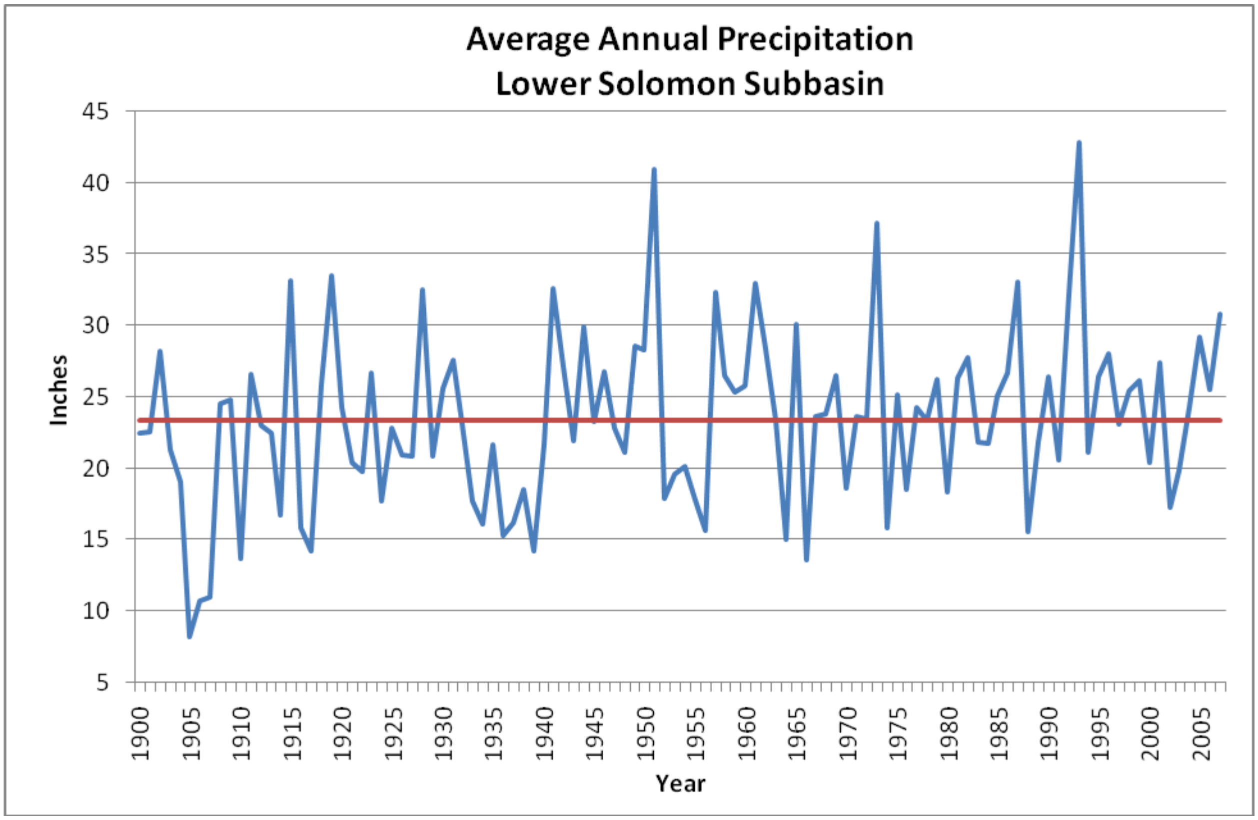

Figure 2: Lower Solomon Subbasin precipitation 1900-2007

Figure 3 shows precipitation for January 2008 to December 2008. In 2008, the subbasin averaged 36.76 inches which is over 13 inches more than the average annual precipitation total. October had the most precipitation with 8.03 in. and December had the least with 0.29 in.

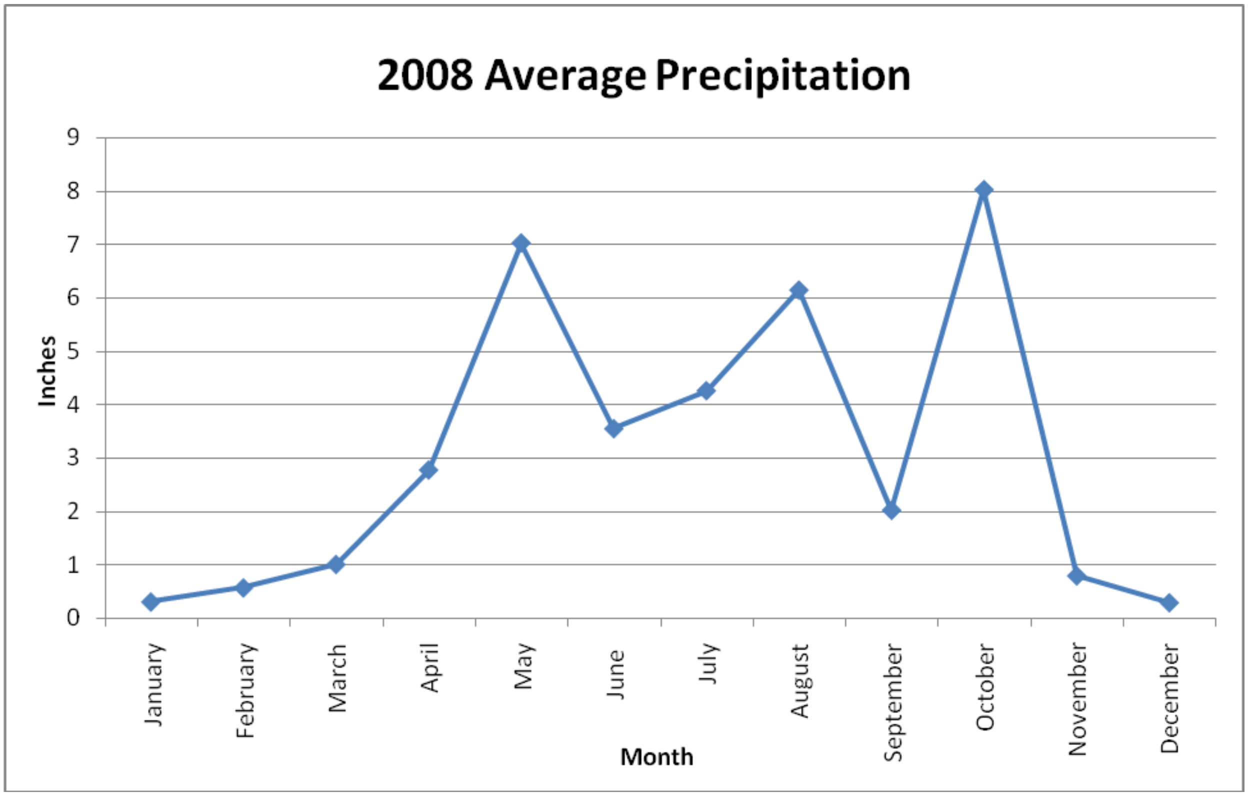

Figure 3: 2008 Monthly Average Precipitation

III. Surface Water

Surface water in the Lower Fork sections is monitored by three USGS gages at Portis, Woodston and Osborne. The Portis gage is on the Lower North Fork while the Woodston and Osborne gages are on the Lower South Fork. Portis has a longer period of record dating back to 1945. Osborne gage began shortly after Portis in 1946 (Figure 4). The Woodston gage began operations in late 1978. Since all the streamflow gages are downstream from reservoirs, the operations of Kirwin and Webster Reservoirs affect the streamflow.

The average flows over the period of record at these three gages were 113.9 cfs at Portis, 20.5 at Woodston and 103.2 cfs at Osborne. During most of the 1990s, streamflow maintained higher levels at these gages averaging 175.3 cfs at Portis, 89.1 at Woodston and 168.2 cfs at Osborne. Significantly reduced flows occurred in the 2000s averaging 33.1 cfs at Portis, 7.5 at Woodston and 19.9 cfs at Osborne (Figure 5).

Overall Portis had more flow this past year compared to Osborne. The subbasin had several large precipitation events that provided streamflow (Figure 6). Streamflow has maintained higher levels than 2007. In fact both Portis and Osborne gages had streamflows higher than 100 cfs at the end of 2008. Woodston was also above its average at 82 cfs at the end of 2008.

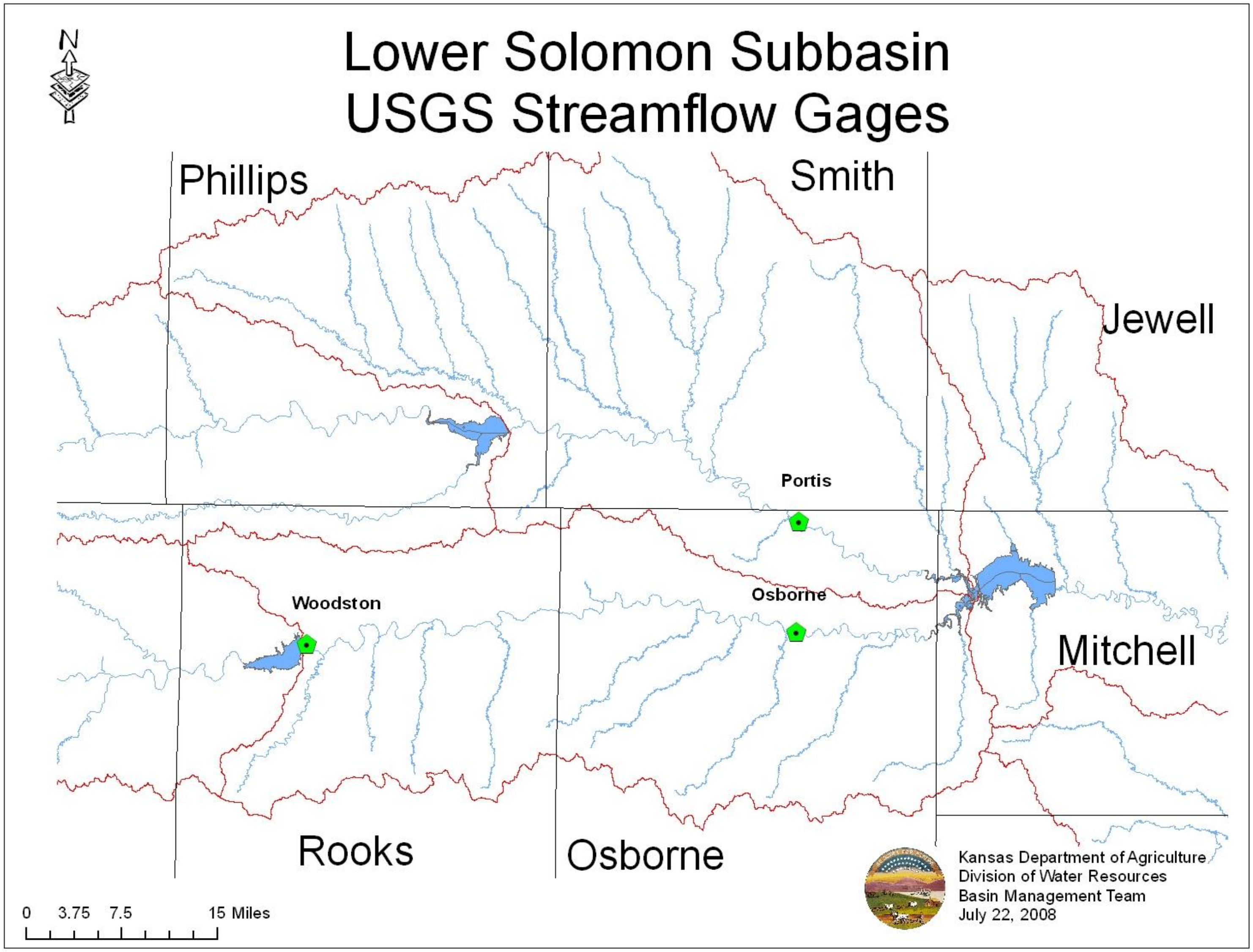

Figure 4: Lower Solomon River USGS Streamflow Gages

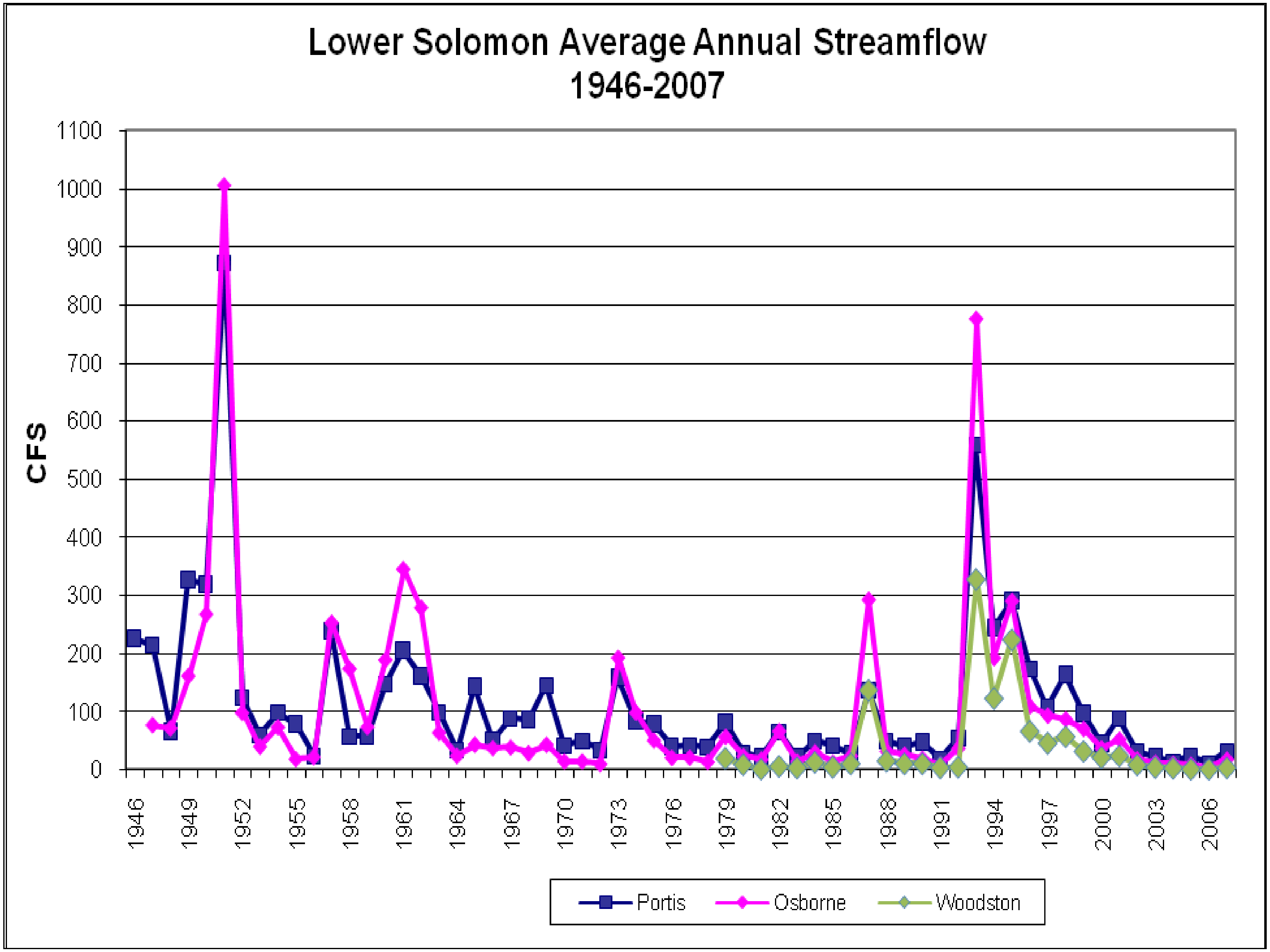

Figure 5: Streamflow at USGS Gages 1946-2007

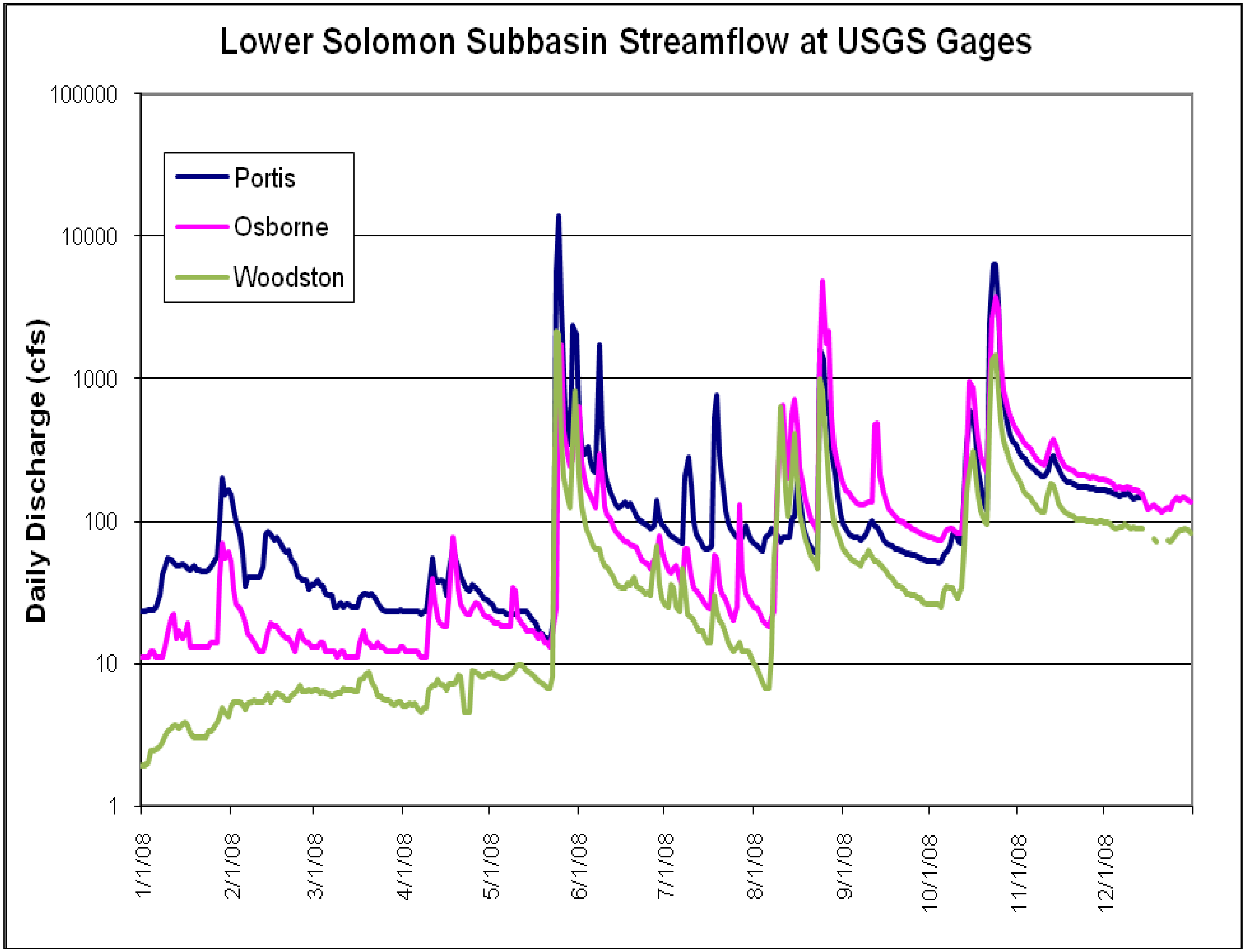

Figure 6: Daily Streamflow for 2008

IV. Groundwater

The Kansas Department of Agriculture, Division of Water Resources (KDA-DWR) Subbasin Water Resources Management Program (SWRMP) measure groundwater levels in the Lower North and South Forks of the Solomon River subbasin. There are 37 monitoring wells used for these measurements. The monitoring wells were drilled in the alluvial aquifer system (Figure 7). The wells are monitored on a tri-annual basis in winter, spring and fall. Only the winter measurements (December to February) are used for this analysis as they are considered to be the least affected by groundwater pumping.

Several of these monitoring wells have been measured since the early to mid 1960s. In the 1980s a number of wells were added to the monitoring network and in 2000 once the SWRMP started work in the subbasin additional monitoring wells were added.

Ongoing observation of water levels is critical to understanding the fluctuations that may occur over time. Historical records from observation wells can provide a hydrologic outlook on the long-term stability or decline of an area.

The water levels in the lower North and South Fork subbasin display pronounced seasonal fluctuations as there is additional influence by the operation of surface water delivery systems of the Kirwin and Webster Irrigation Districts. The canals used for delivery of the water act as artificial recharge systems as seepage of water occurs into the underlying alluvial aquifer. Monitoring wells adjacent to the canals show the increasing water levels during the course of the irrigation delivery season.

Groundwater measurements were not collected in 2007. Therefore, change in groundwater levels is a comparison of 2006 and 2008 water levels. The following figures chart groundwater levels in all the monitoring wells (legal descriptions are available in the appendix) and also the five-year rolling average of those wells. The y-axis is labeled depth below land surface (DBLS) and is measured in feet.

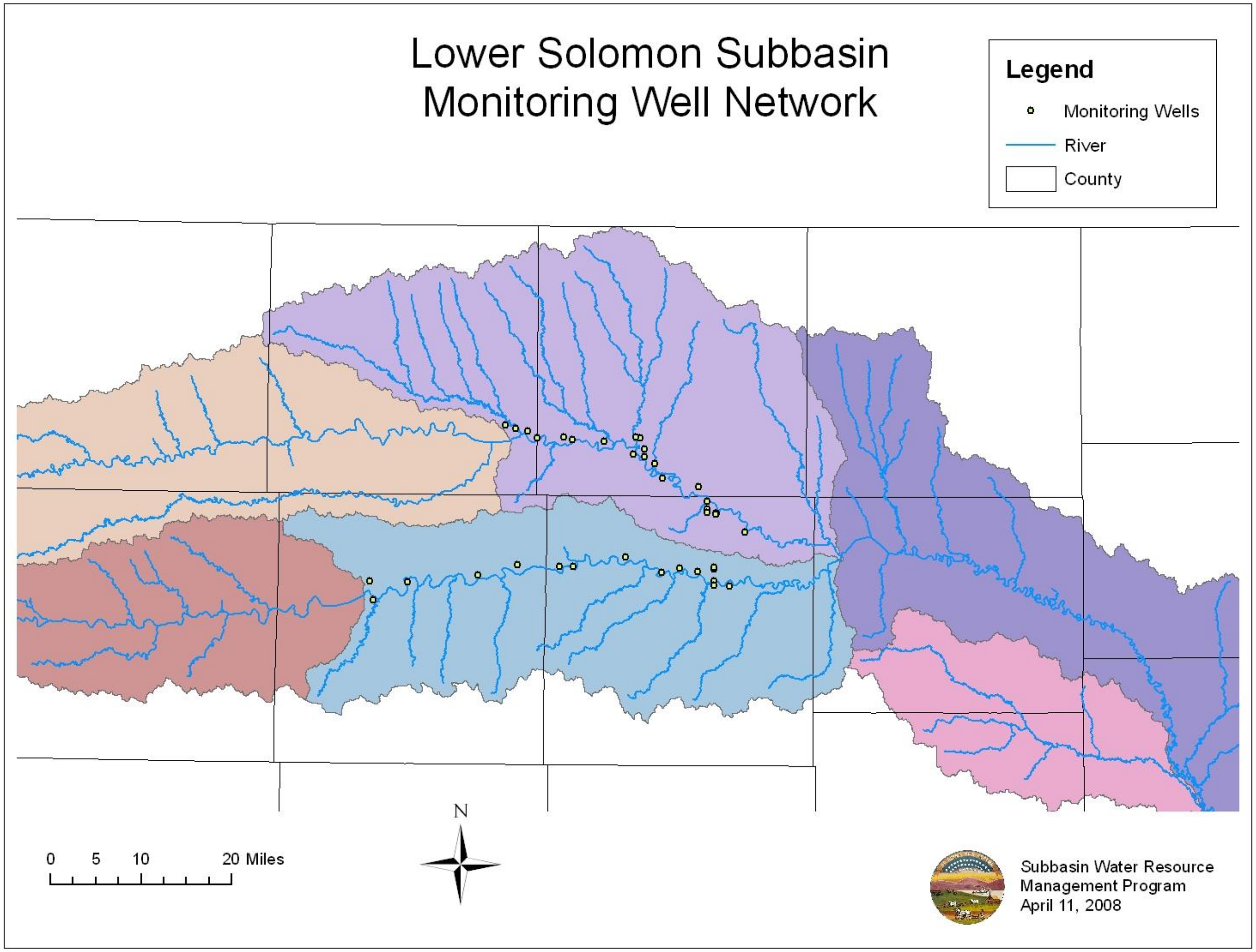

Figure 7: Lower Forks Monitoring Wells

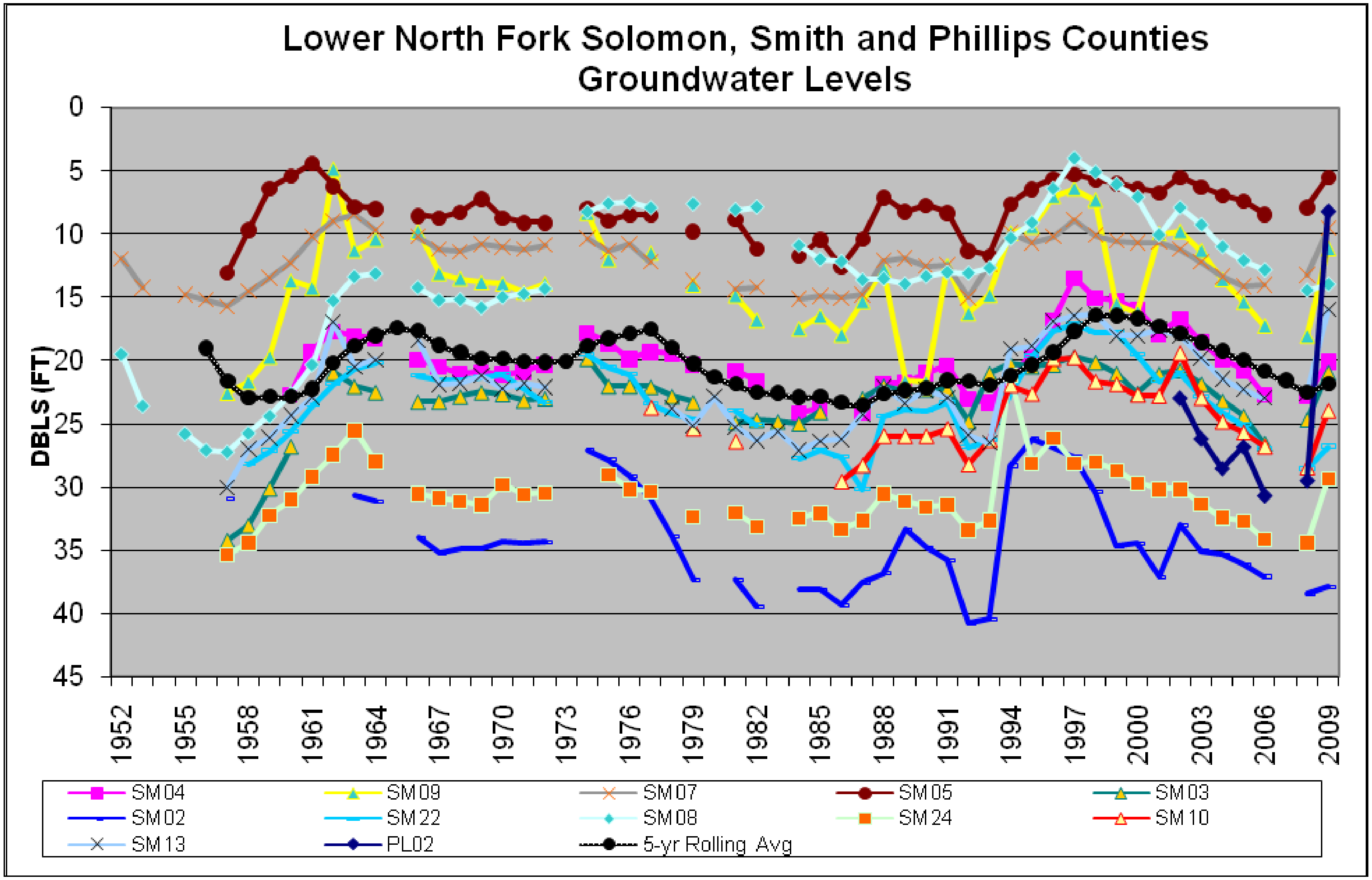

Figure 8: Groundwater levels in Lower North Fork, Smith and Phillips County

The Lower North Fork, Smith County has 11 monitoring wells. In 2009, the average change in groundwater levels is an increase of 4.96 ft. All the monitoring wells increased in water levels from 2008 to 2009. Groundwater measurements have been taken in Smith County since 1942. Since 1952, SM08 has had a net increase of 5.52 ft and since 1957 SM02 has net declined 6.95 ft. The five-year rolling average shows a number of rises and falls in the water table over the years. There has been a downward trend since 1998 (Figure 8), but a slight increase in 2009. The one Phillips County well is also included in this chart. PL02 has a short record beginning in 2002. Initially it declined, but in 2009 the water levels rose about 20 feet.

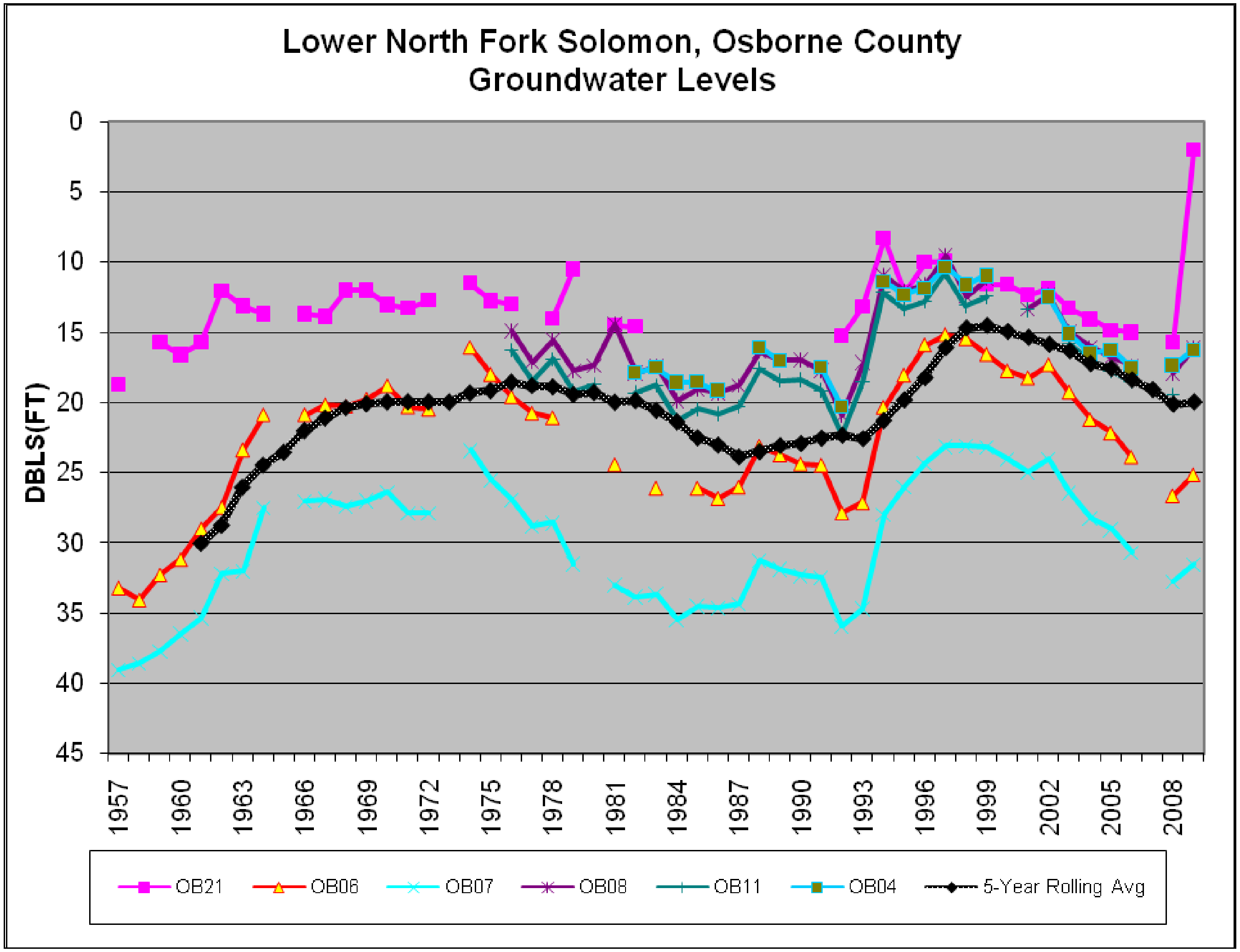

Figure 9: Monitoring well levels in Lower North Fork, Osborne County

The Lower North Fork, Osborne County has six monitoring wells (Figure 9). The average change in water levels is an increase of 3.87 ft in 2009. Some wells have been monitored since 1946. Since 1957, OB21, OB06 and OB07 all show net increases in the water table of 16.64 ft, 8.04 ft, and 7.53 ft, respectively. The five-year rolling average shows rise and falls over time, with a distinct rise in the water table, in the early 1990s until around 1999, where the water levels begin to decline. There is a small rise in the 5-year rolling average in 2009.

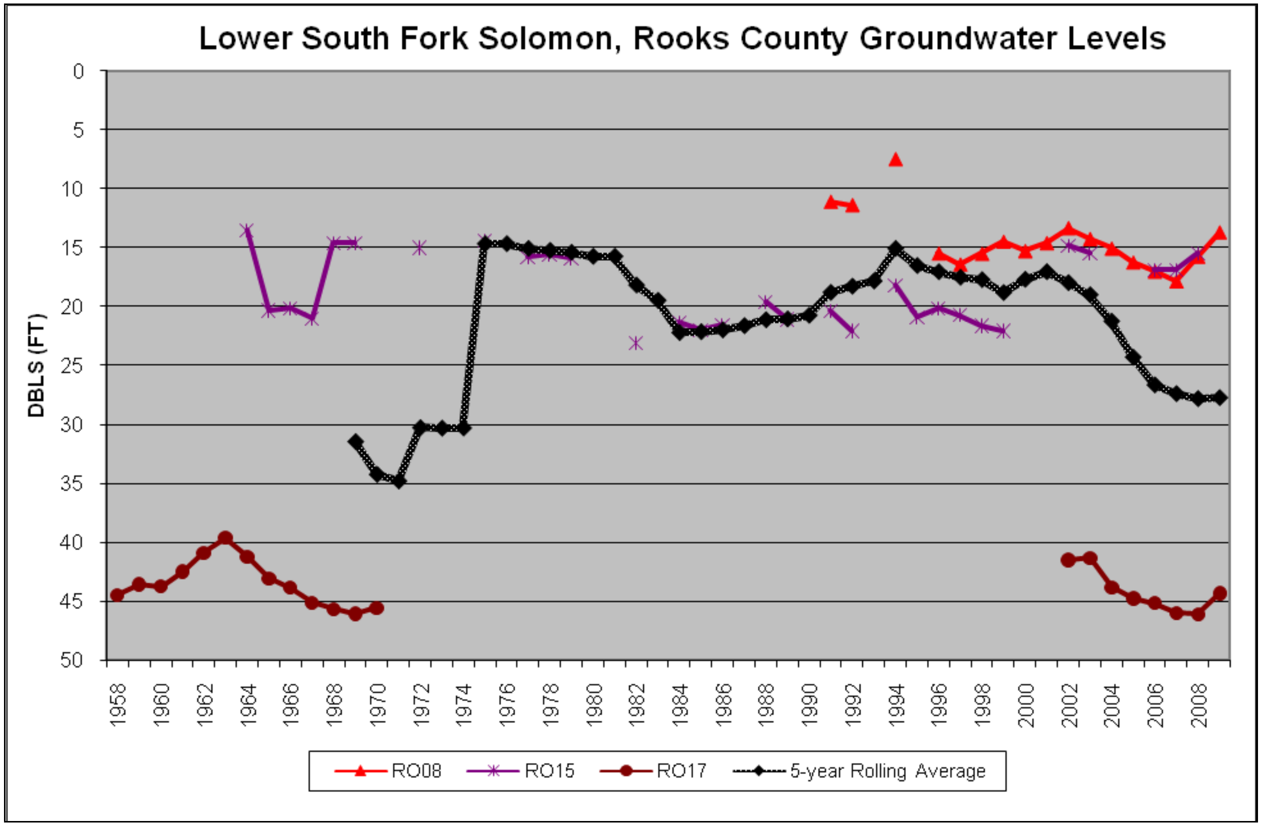

Figure 10: Monitoring well levels in Lower South Fork, Rooks County

The Lower South Fork, Rooks County has three monitoring wells (Figure 10). The average change in water levels in Rooks County in 2008 is an increase of 1.91 ft. RO17 was first measured in 1958 and RO15 was first measured in 1964. RO08 was added to the monitoring network in 1991. Since 1964 RO15 has had a net decline of 1.95 ft. The five-year rolling average shows both rise and falls overtime with water levels currently on the decline.

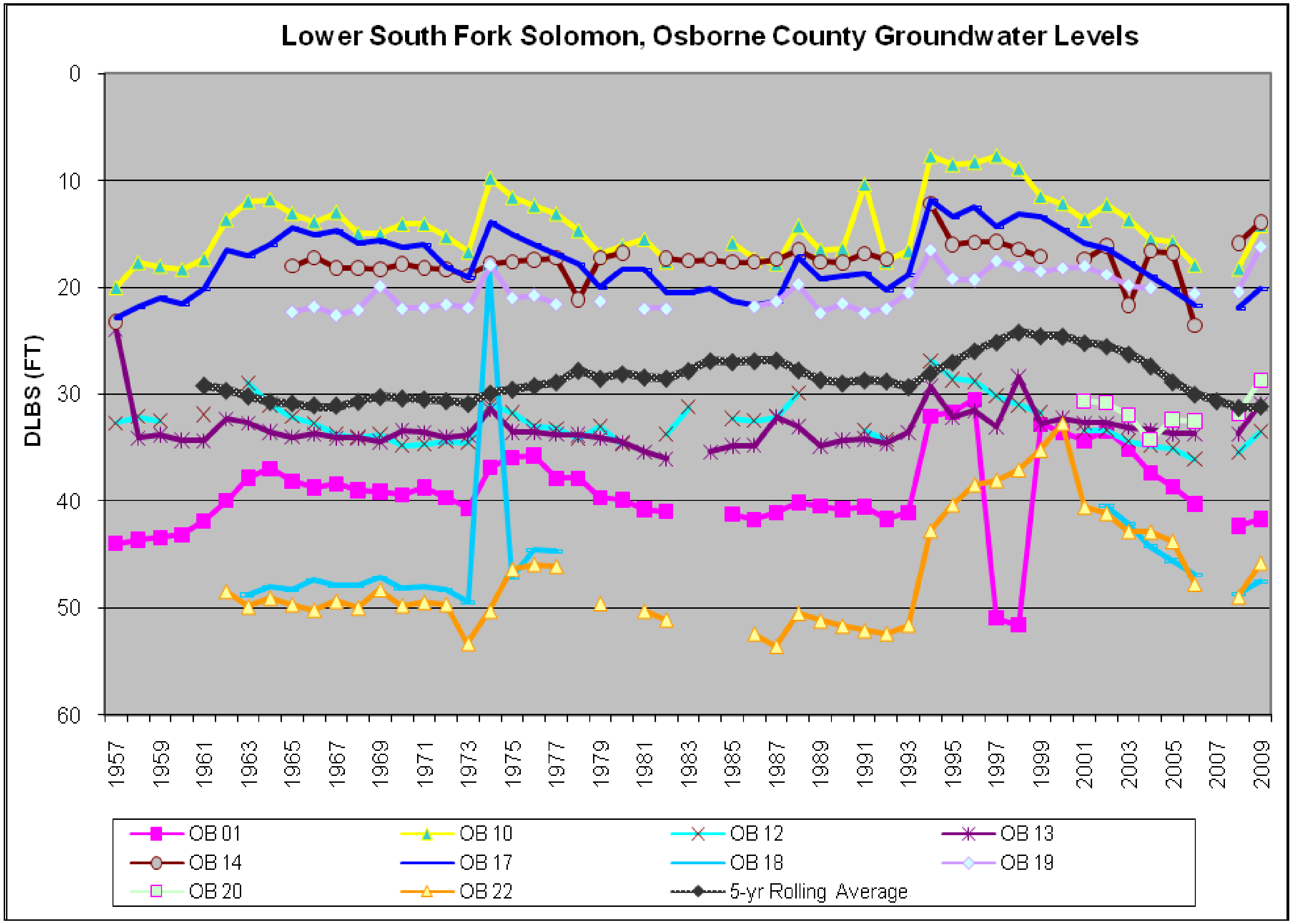

Figure 11: Monitoring well levels Lower South Fork, Osborne County

The Lower South Fork, Osborne County has 11 monitoring wells (Figure 11). The average change in water levels in Osborne County is an increase of 2.48 ft in 2009. A number of wells in this area were first measured in 1957, with some wells added to the network in the 1960s. Since 1957, the changes in the water table have varied with net increases of 9.30 ft (OB14) to net declines of 6.87 ft (OB13). The five-year rolling average shows the rise in the water table in the mid to late-1990s and a declining trend since 1999 with another slight increase in 2009.

V. Water Use

The Lower Solomon subbasin has a total of 472 water rights. The total authorized quantity for these water rights are 58,989.30 acre-feet. Most of the water rights and authorized quantities are appropriated surface and groundwater rights (Table 1). All irrigation, industrial, recreational, municipal, stock and domestic water rights were used in the analysis. The map below shows the points of diversion for both ground and surface water (Figure 12). Some water rights have more than one point of diversion.

Table 1: Water Rights in the Lower Solomon Subbasin

Type	Source	Number of Rights	Authorized Quantity
Vested	Surface Water	17	1047.00
Appropriated	Surface Water	137	32,273.27
Vested	Groundwater	17	875.97
Appropriated	Groundwater	301	24,793.06

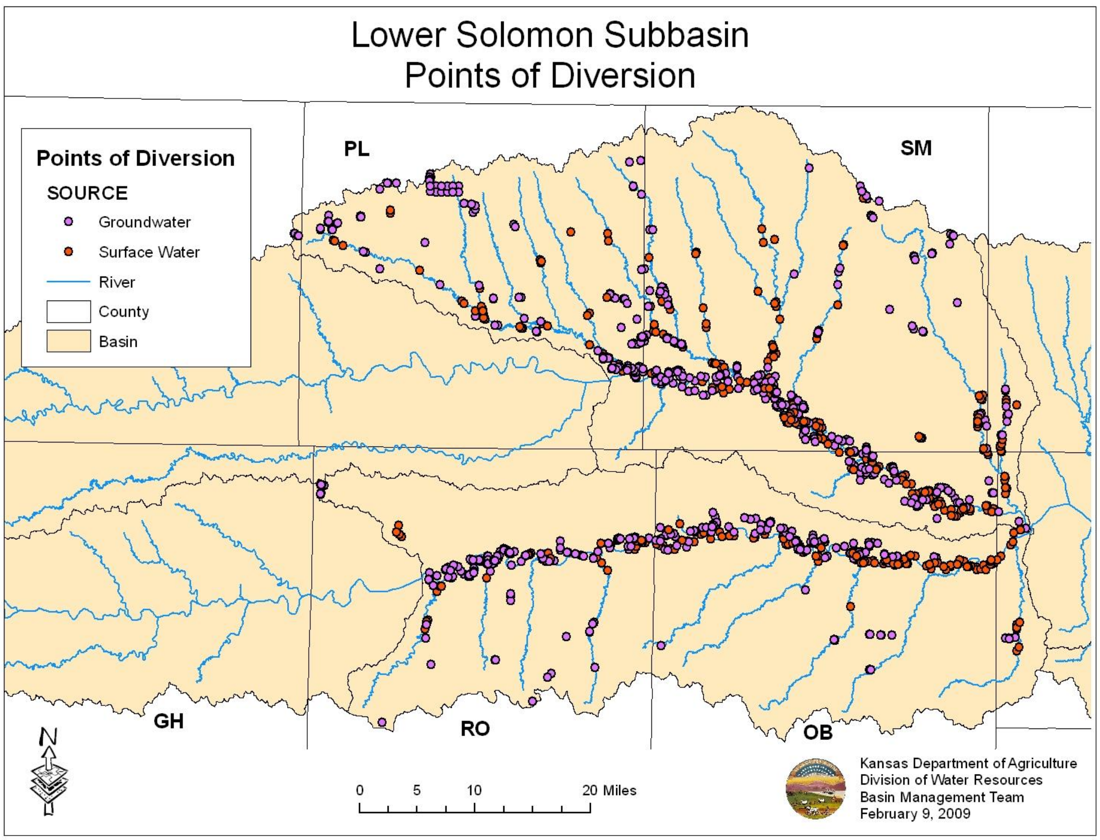

Figure 12: Lower Solomon Subbasin Points of Diversion

The water use ranges from 30,821 acre-feet in 2000 to 5,384 acre-feet in 1993. The average water use for the subbasin from 1987-2007 was 19,277.15 acre-feet. Water use in 2007 was 6,608 acre-feet. This was below both the subbasin average and 2006 usage (Figure 13).

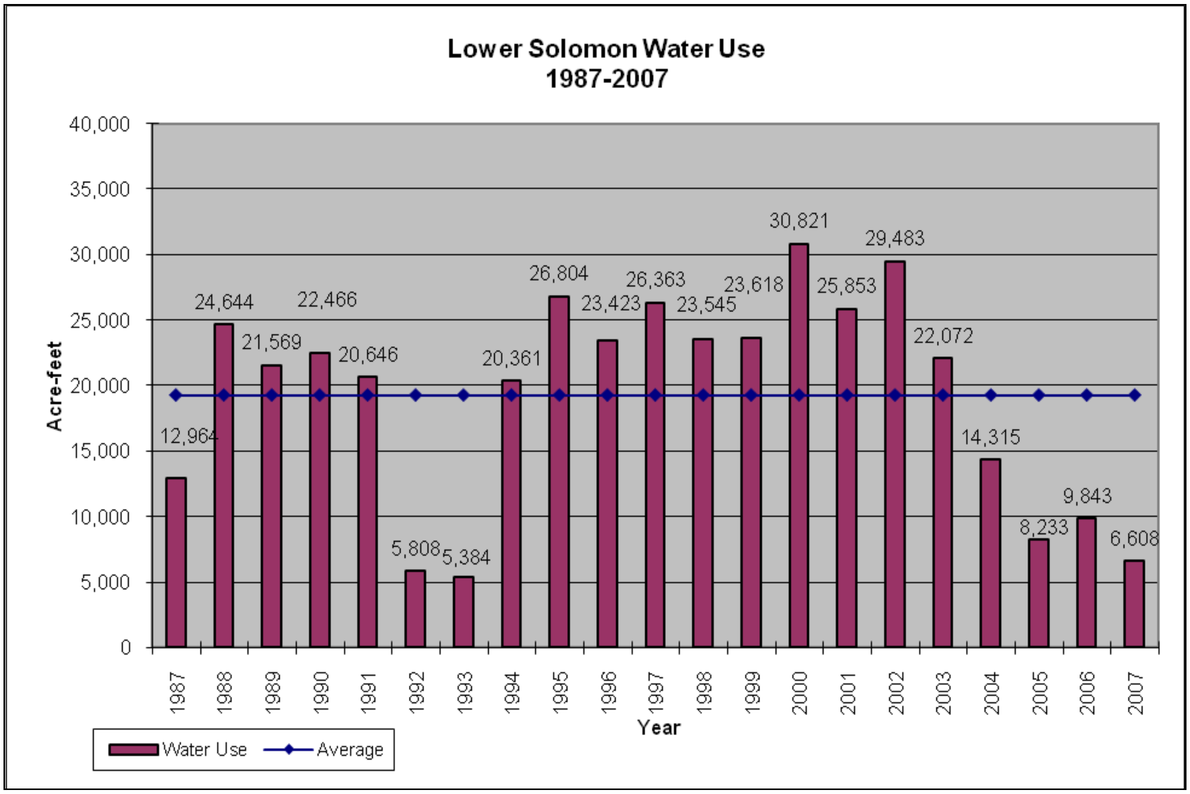

Figure 13: Ground and Surface Water use by year

VI. Conclusions

The Lower Solomon Forks did see some significant precipitation events during 2008 which at times allowed for high streamflow events. Groundwater levels are down throughout the subbasin. Water use increased from 2005, but is still way below the subbasin average. Evaluating this change in hydrologic response to streamflow is an indication of why it is so important to continue to study this basin at the current level to determine the long term effects of current water usage on this basin and existing property rights. It is equally important to understand how fast the system recovers after a recharge event as it is to understand the impacts of pumping and other factors on the hydrologic system.

VII. Appendix

Monitoring Well ID	Legal Description	Subbasin
OB03	06 12W 23 CDC	Lower North Fork
OB04	06 12W 08 CCC	Lower North Fork
OB05	06 12W 08 CCC, 2	Lower North Fork
OB06	06 12W 07 CBB	Lower North Fork
OB07	06 12W 07 CCB	Lower North Fork
OB08	06 12W 08 CCB	Lower North Fork
OB11	06 12W 17 BBB	Lower North Fork
OB21	06 12W 01 DA	Lower North Fork
PL02	04 16W 28 BAD	Lower North Fork
PL04	04 16W 27 DB	Lower North Fork
PL08	04 16W 26 DDD	Lower North Fork

SM02	05 13W 25 DDD	Lower North Fork
SM03	05 13W 17 BCC	Lower North Fork
SM04	04 14W 32 CDD	Lower North Fork
SM05	04 15W 35 CCB	Lower North Fork
SM06	04 15W 34 CBB	Lower North Fork
SM07	04 15W 31 CBC	Lower North Fork
SM08	05 14W 01 DAA	Lower North Fork
SM09	04 14W 36 CAD	Lower North Fork
SM10	05 14W 12 DAD	Lower North Fork
SM13	04 14W 36 CB	Lower North Fork
SM22	05 13W 28 BBB	Lower North Fork
SM24	05 14W 11 ADC	Lower North Fork
OB01	07 13W 13 BCC	Lower South Fork
OB10	07 13W 15 BBB	Lower South Fork
OB12	07 12W 28 ABA	Lower South Fork
OB13	07 13W 17 CBB	Lower South Fork
OB14	07 15W 10 CCC	Lower South Fork
OB15	07 14W 04 DDD	Lower South Fork
OB17	07 15W 08 DCC	Lower South Fork
OB18	07 12W 17 BC	Lower South Fork
OB19	07 12W 19 DAA	Lower South Fork
OB20	07 12W 19 DDA	Lower South Fork
OB22	07 12W 18 AAA	Lower South Fork
RO06	07 19W 23 CDB	Lower South Fork
RO08	07 17W 14CDD	Lower South Fork
RO10	07 18W 21 DCB	Lower South Fork
RO15	07 19W 35 DDC	Lower South Fork
RO17	07 16W 09 DDB	Lower South Fork