Lower Solomon River Subbasin

2009 Field Analysis Summary

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Basin Management Team

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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 Reservoirs 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 Reservoir 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. Until 2009, Webster Irrigation District had not operated since 2004 in which 3,867 acre-feet was released. Kirwin Irrigation District operated in 2007 and 2008, and released 2,809 acre-feet and 9,576 acre-feet respectively. In 2009, the Webster Irrigation District released 14,289 acre-feet and the Kirwin Irrigation District released 18,239 acre-feet.

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.

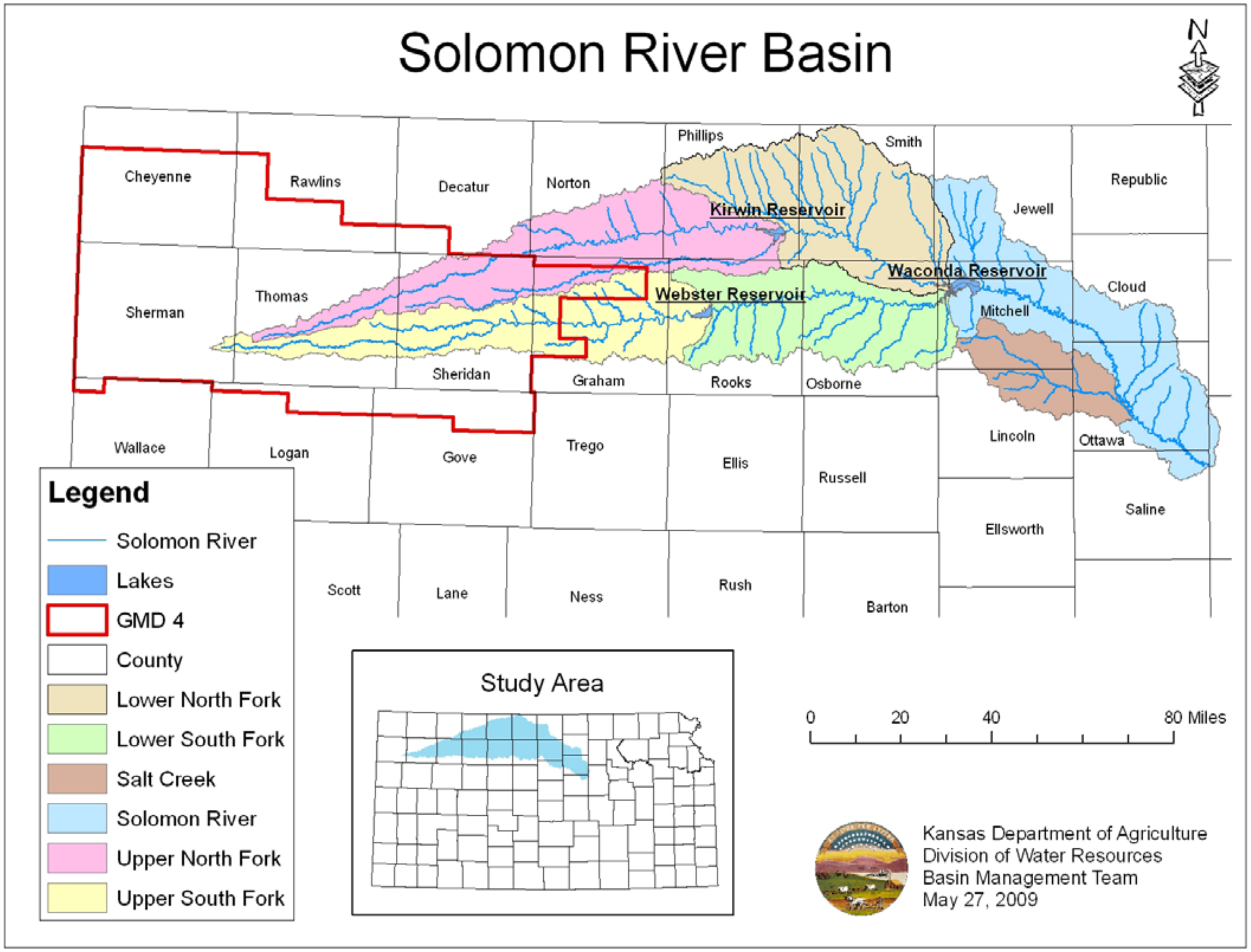

Figure 1: Solomon River Basin divided into subbasins

II. Precipitation

Precipitation in the Lower Solomon subbasin historically averages 23.5 inches per year based on records from seven precipitation stations: Phillipsburg, Kirwin, Lebanon, Smith Center, Covert, Alton, Plainville and Webster. The chart in Figure 2 is based on averaged data from National Climatic Data Center (NCDC) weather stations. The highest precipitation total occurred in 1993 with 42.9 inches and the lowest was in 1905 with 8.2 inches. Annual precipitation data for these NCDC stations is currently available through 2008. The precipitation in 2008 was 37.5 inches, which is above the subbasin historical average.

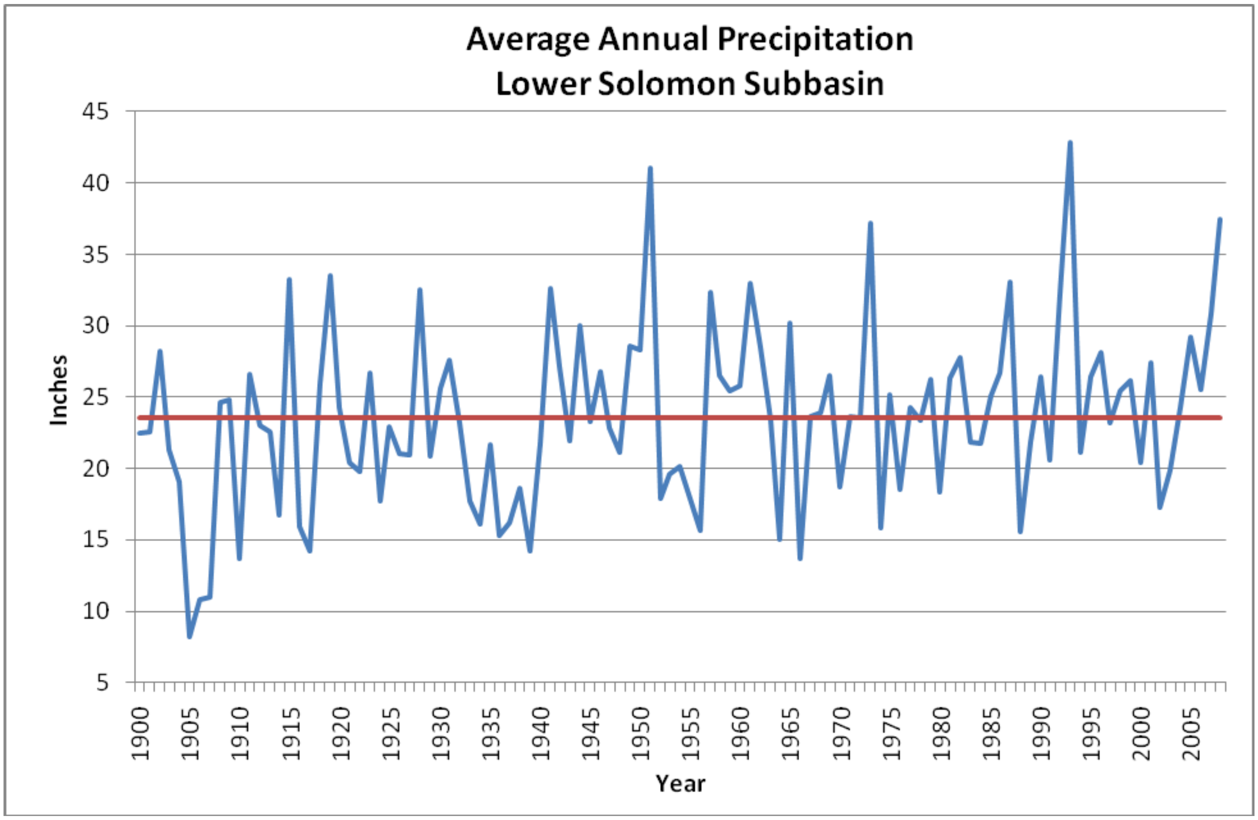

Figure 2: Lower Solomon Subbasin Annual Precipitation 1900-2008

Figure 3 shows precipitation for January 2009 to November 2009 (December is not available). Through November 2009, the subbasin averaged 23.5 inches, which is close to the average annual precipitation total. June had the most precipitation with 5.0 inches and March had the least with no recorded precipitation.

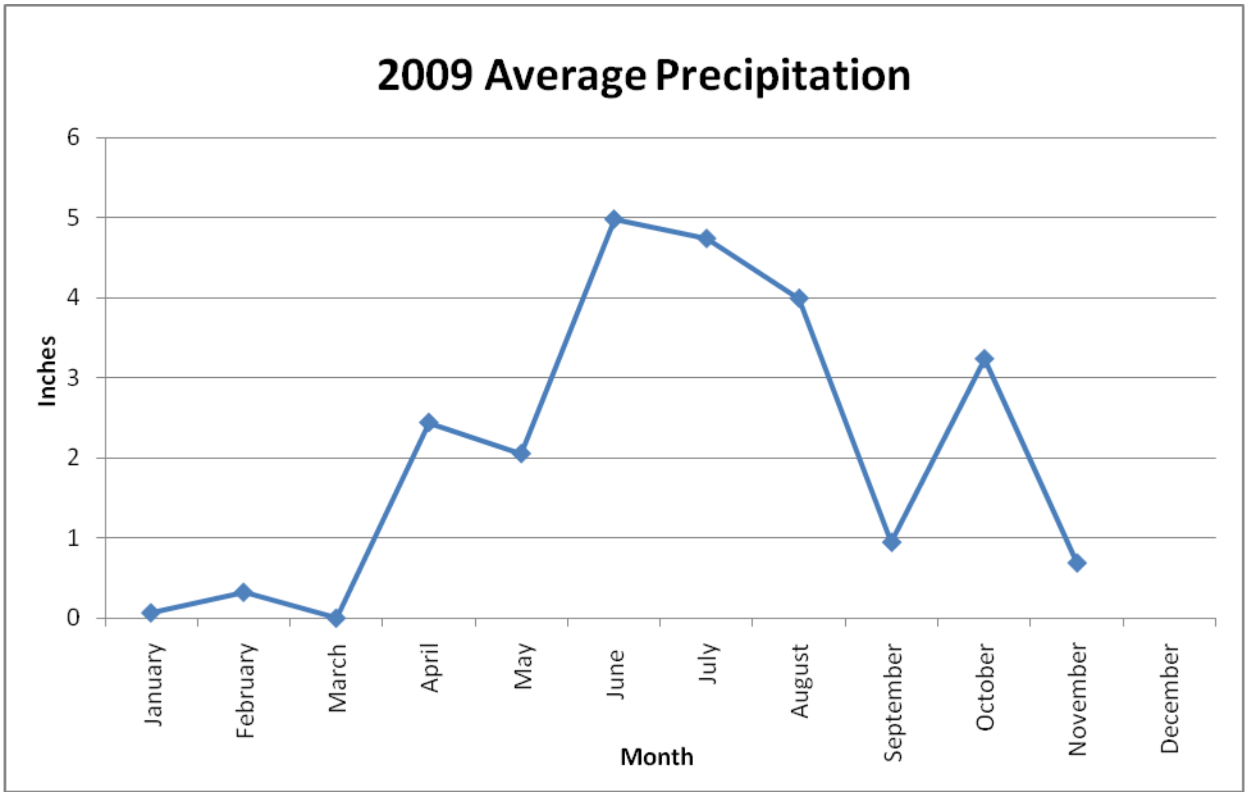

Figure 3: 2009 Monthly Average Precipitation

III. Surface Water

Surface water in the Lower Fork subbasin 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 (Figure 4). Portis has a longer period of record dating back to 1945. The Osborne gage began shortly after Portis in 1946. 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.

Over the periods of record, the average annual streamflow at Portis was 116.1 cfs, Woodston was 41.9 cfs and Osborne was 104.4 cfs. During the 1990s, streamflow maintained higher annual streamflow at these gages averaging 175.3 cfs at Portis, 89.1 cfs at Woodston and 168.2 cfs at Osborne. Average annual streamflow declined during the 2000s with Portis at 57 cfs, Woodston at 16.0 cfs and Osborne at 37.5 cfs (Figure 5).

Overall Portis had more flow in 2009 compared to Osborne. The subbasin had several large precipitation events that provided runoff for additional streamflow (Figure 6). Streamflow has maintained higher levels throughout 2009. In fact, all three gages had streamflows higher than 100 cfs at the end of 2009 before ice affected the gages.

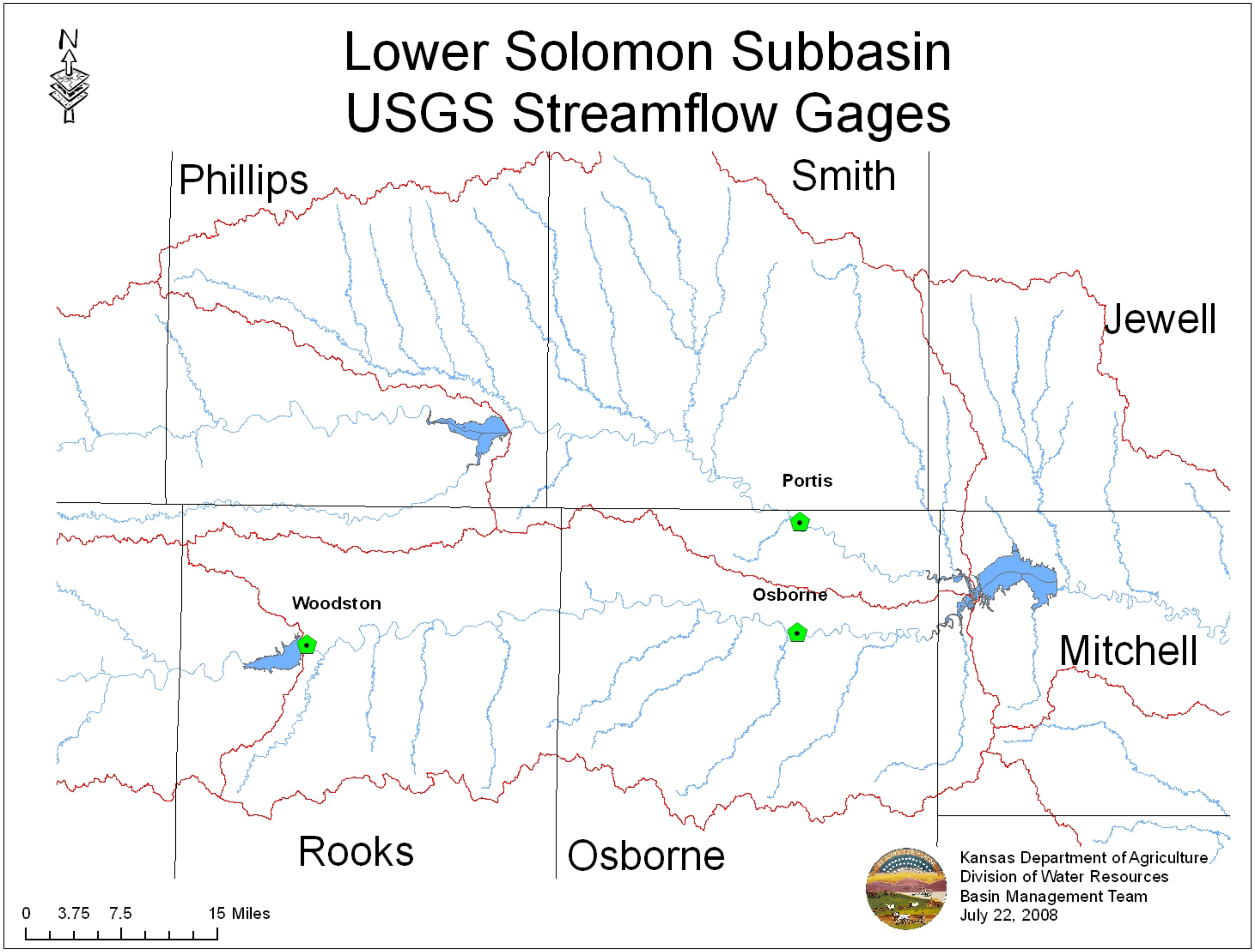

Figure 4: Lower Solomon River USGS Streamflow Gages

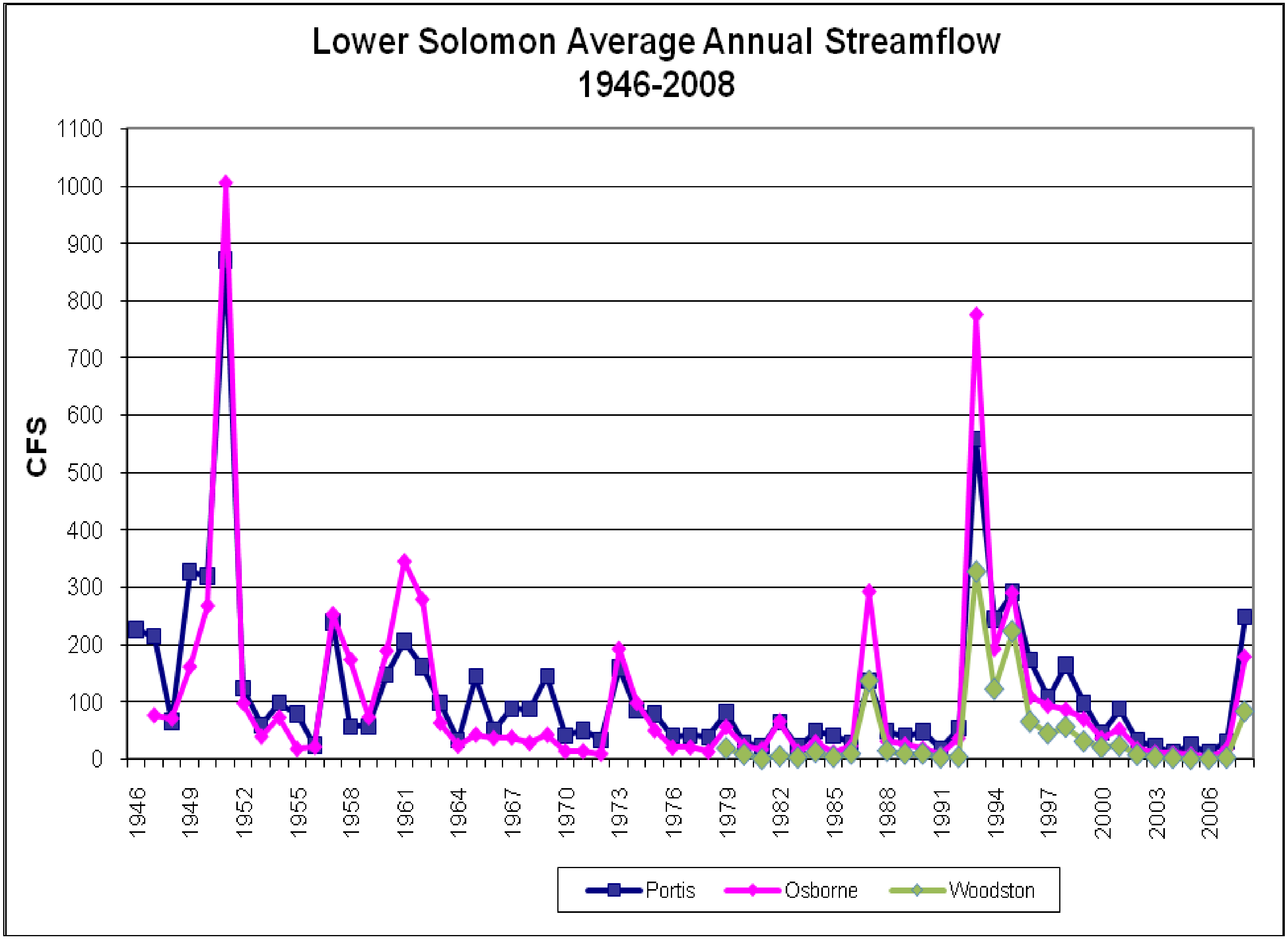

Figure 5: Streamflow at USGS Gages 1946-2008

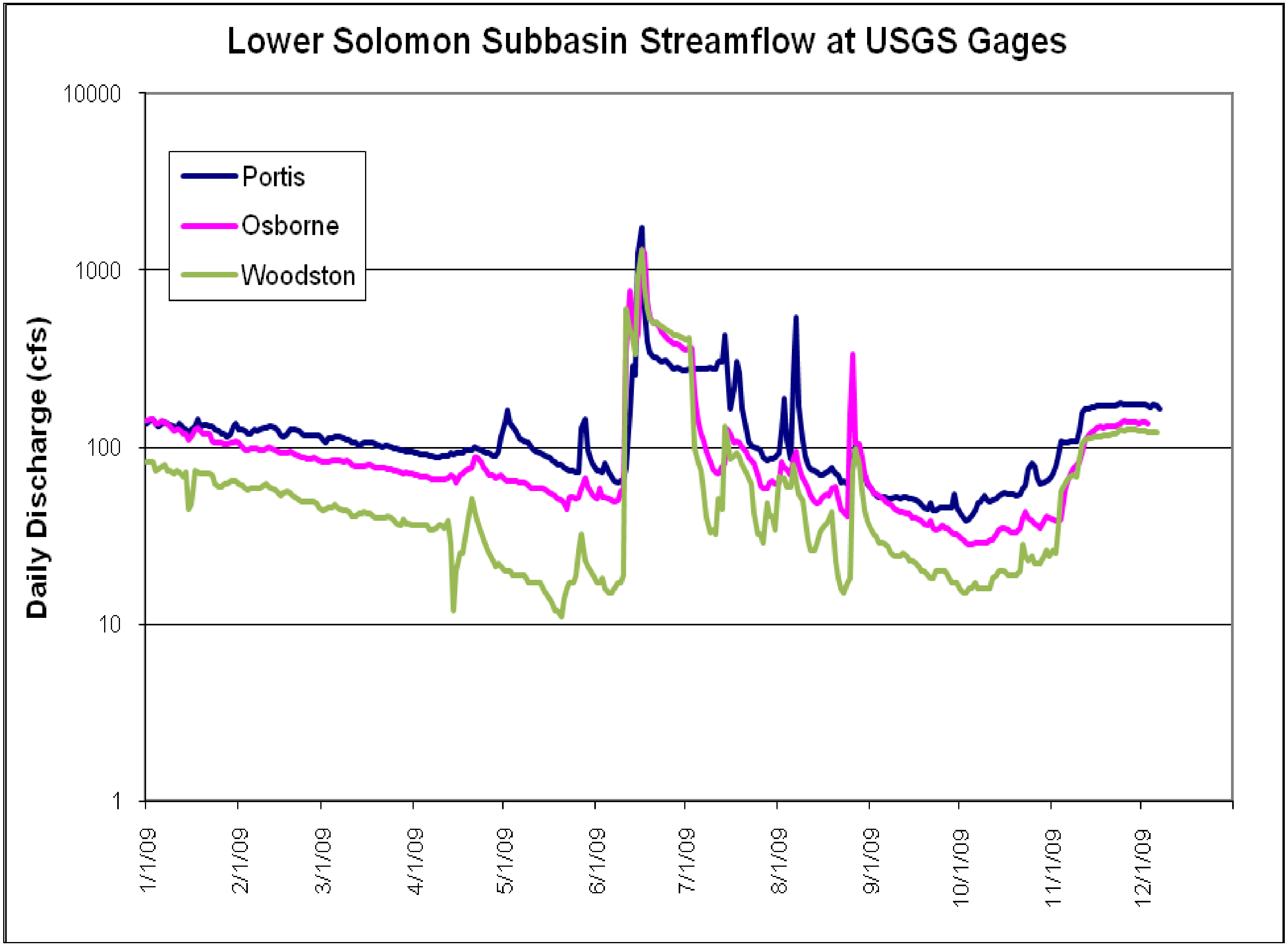

Figure 6: Daily Streamflow for 2009

IV. Groundwater

The Kansas Department of Agriculture, Division of Water Resources (KDA-DWR) measures 37 monitoring wells for groundwater levels in the Lower North and South Forks of the Solomon River subbasin. The monitoring wells were drilled in the alluvial aquifer system (Figure 7). The wells are monitored tri-annually in winter, spring and fall.

Usually only the winter measurements, taken in December, January or February are used for the monitoring well water level charts, since those measurements are considered to the be the least influenced by irrigation well pumping. However, some March measurements are used when winter measurements are not available. These measurements are prior to irrigation season and are measured by the irrigation districts.

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. In 2000, the Kansas State Water Plan targeted the basin and 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.

Figure 8 to Figure 11 chart groundwater levels in all the monitoring wells. Legal descriptions are found in the appendix. The y-axis is labeled DBLS (feet). The DBLS stands for depth below land surface.

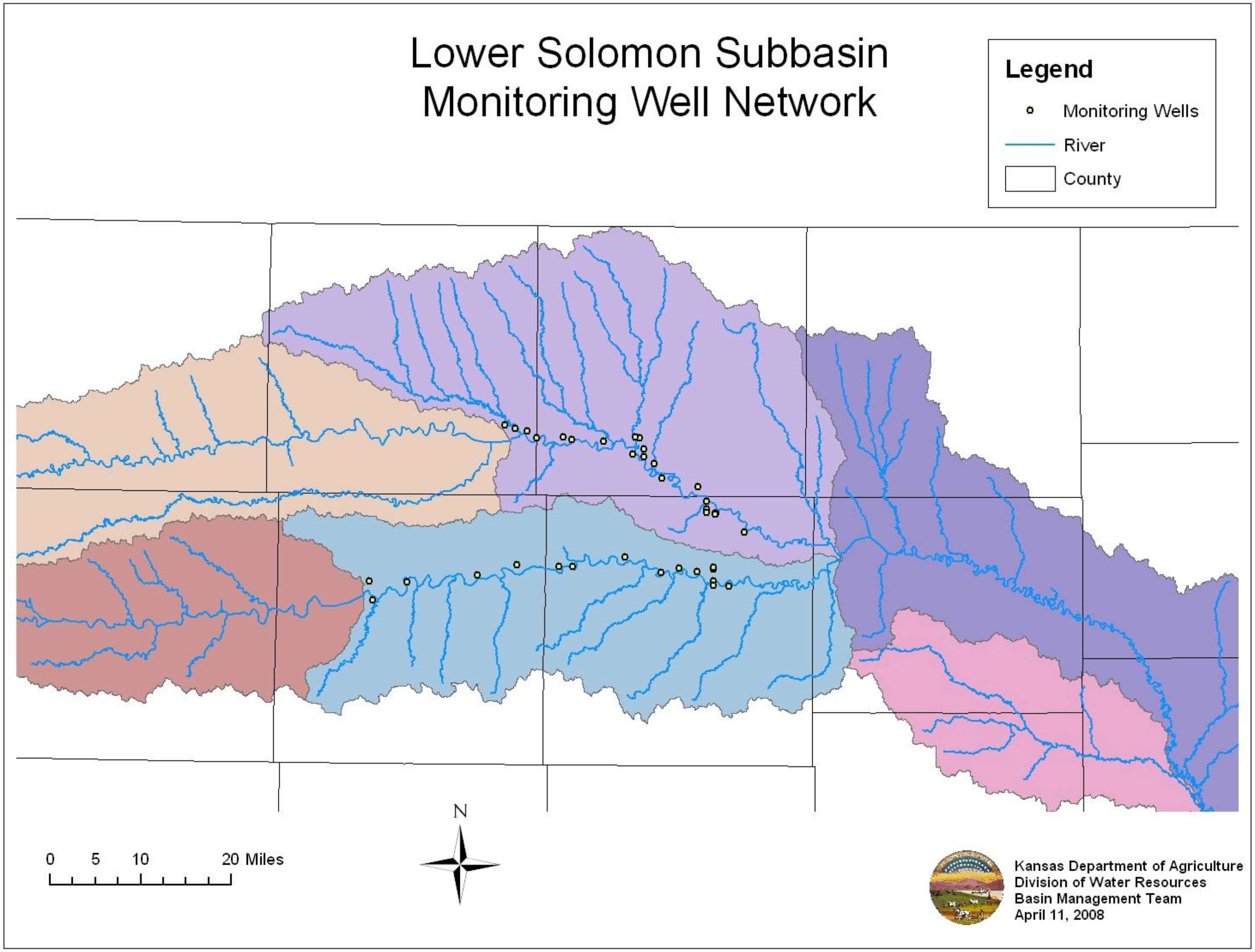

Figure 7: Lower Forks Monitoring Wells

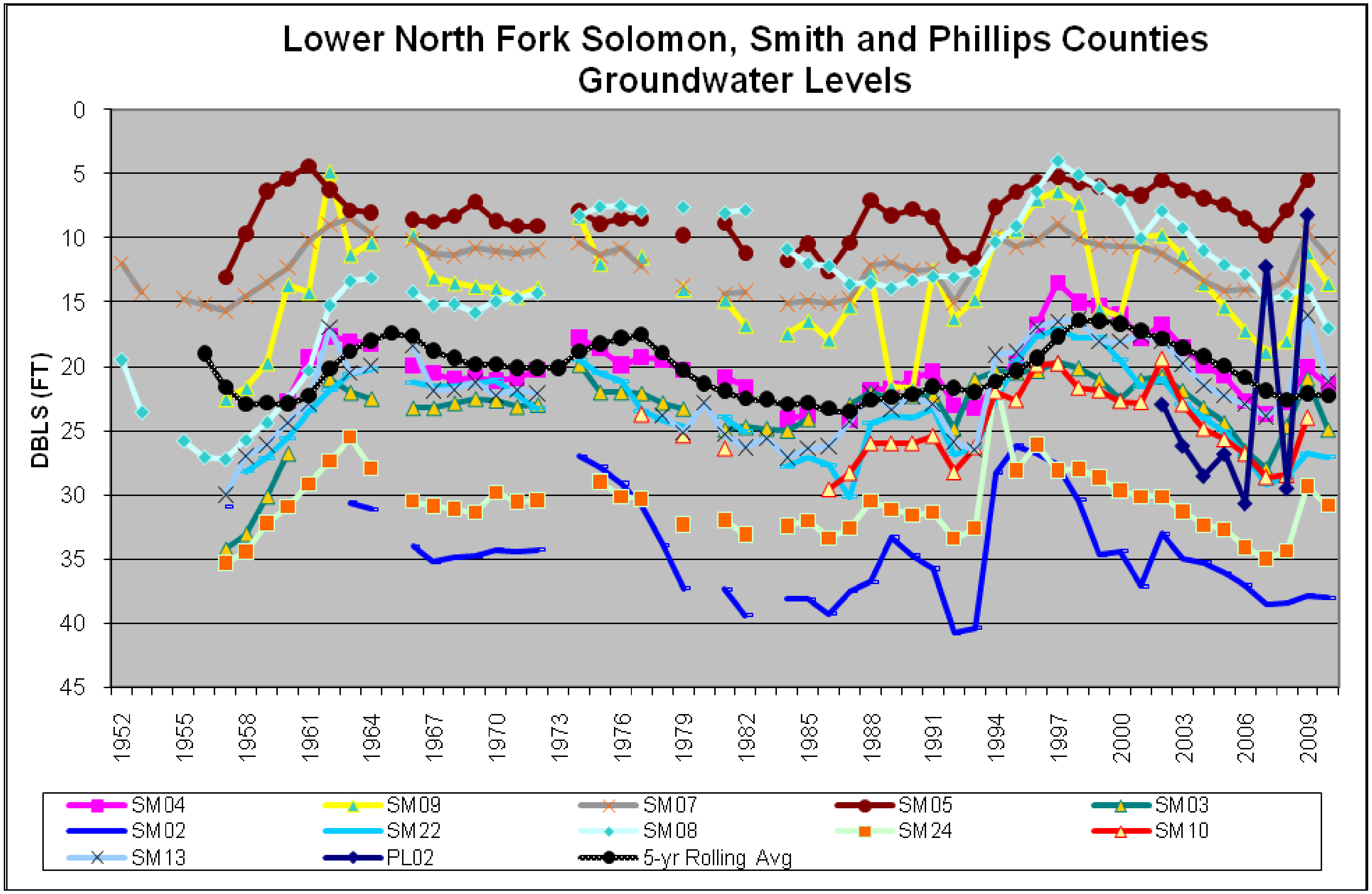

Figure 8: Monitoring well levels in Lower North Fork, Smith and Phillips County

The Lower North Fork, Smith County has 12 monitoring wells. In 2010, the average change in groundwater levels is a decrease of 2.21 feet. Three wells do not have measurements in 2010. All the monitoring wells decreased in water levels from 2009 to 2010. Groundwater measurements have been taken in Smith County since 1942. Since 1952, SM08 has had a net increase of 2.47 feet and since 1957 SM02 has a net decline of 7.10 feet. 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), a slight increase in 2009, and a decline 2010. PL02 has a short record beginning in 2002. Initially it declined, but in 2009 the water levels rose about 20 feet.

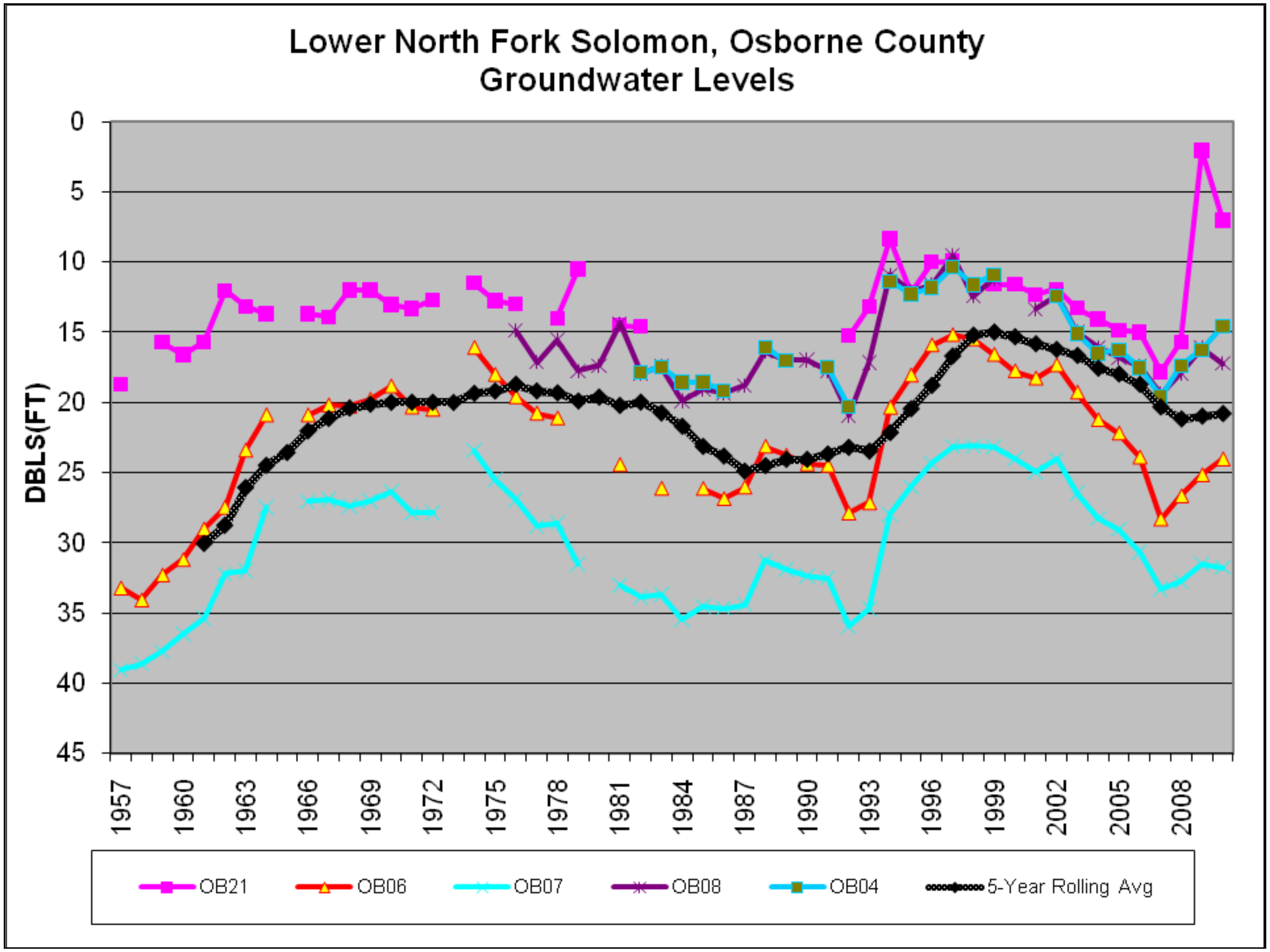

Figure 9: Monitoring well levels in Lower North Fork, Osborne County

The Lower North Fork, Osborne County has five monitoring wells (Figure 9). The average change in water levels is a decline of 0.70 feet in 2010. Some wells have been monitored since 1946. Since 1957, OB21, OB06 and OB07 all show net increases in the water table of 11.67 feet, 9.17 feet, and 7.30 feet, 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 2010.

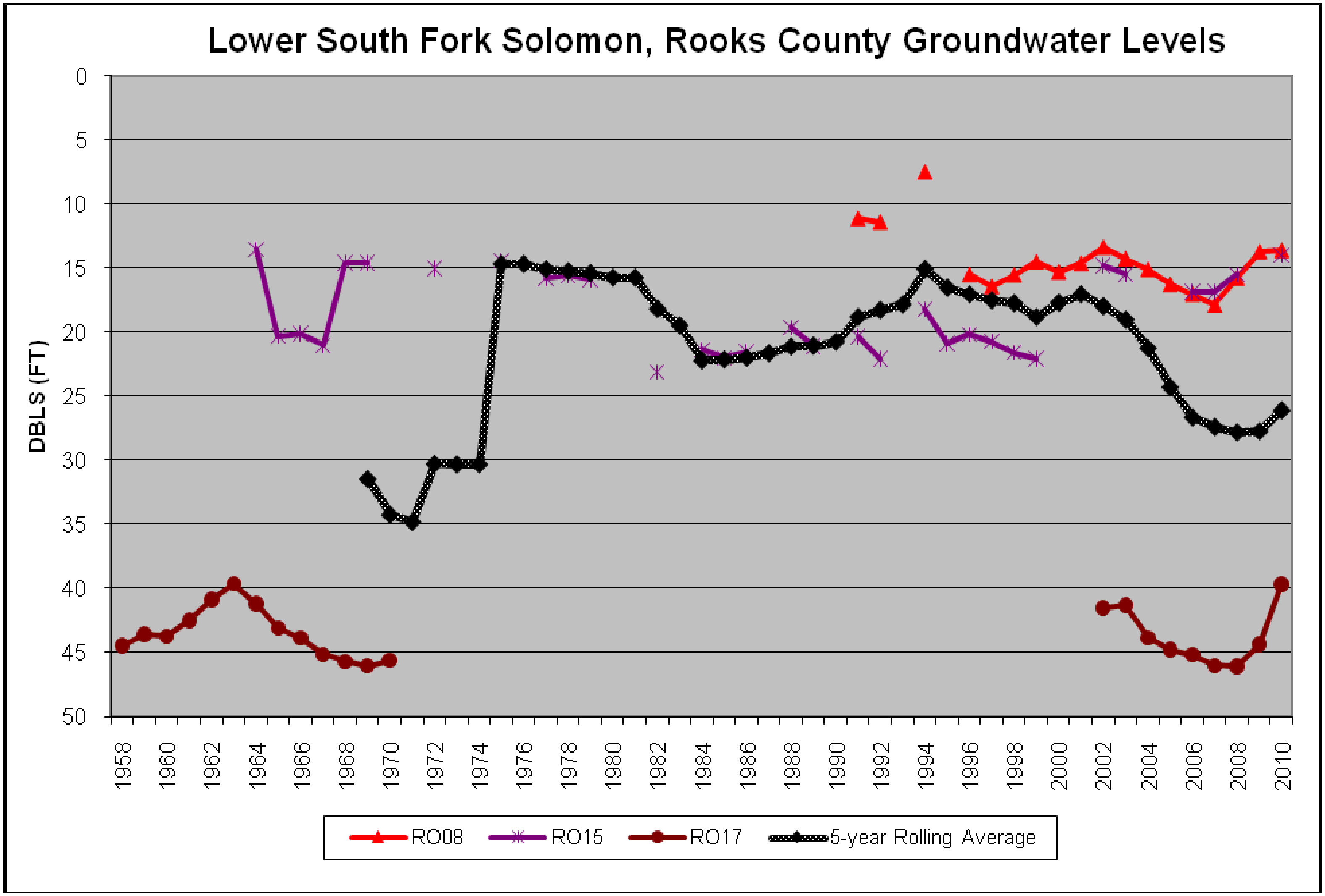

Figure 10: Monitoring well levels in Lower South Fork, Rooks County

The Lower South Fork, Rooks County has three monitoring wells (Figure 10). The average change in water levels in Rooks County in 2010 is an increase of 2.48 feet. 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 0.48 feet, but RO17 has a net increase of 4.79 feet. The five-year rolling average shows both rise and falls over time with water levels currently on the rise.

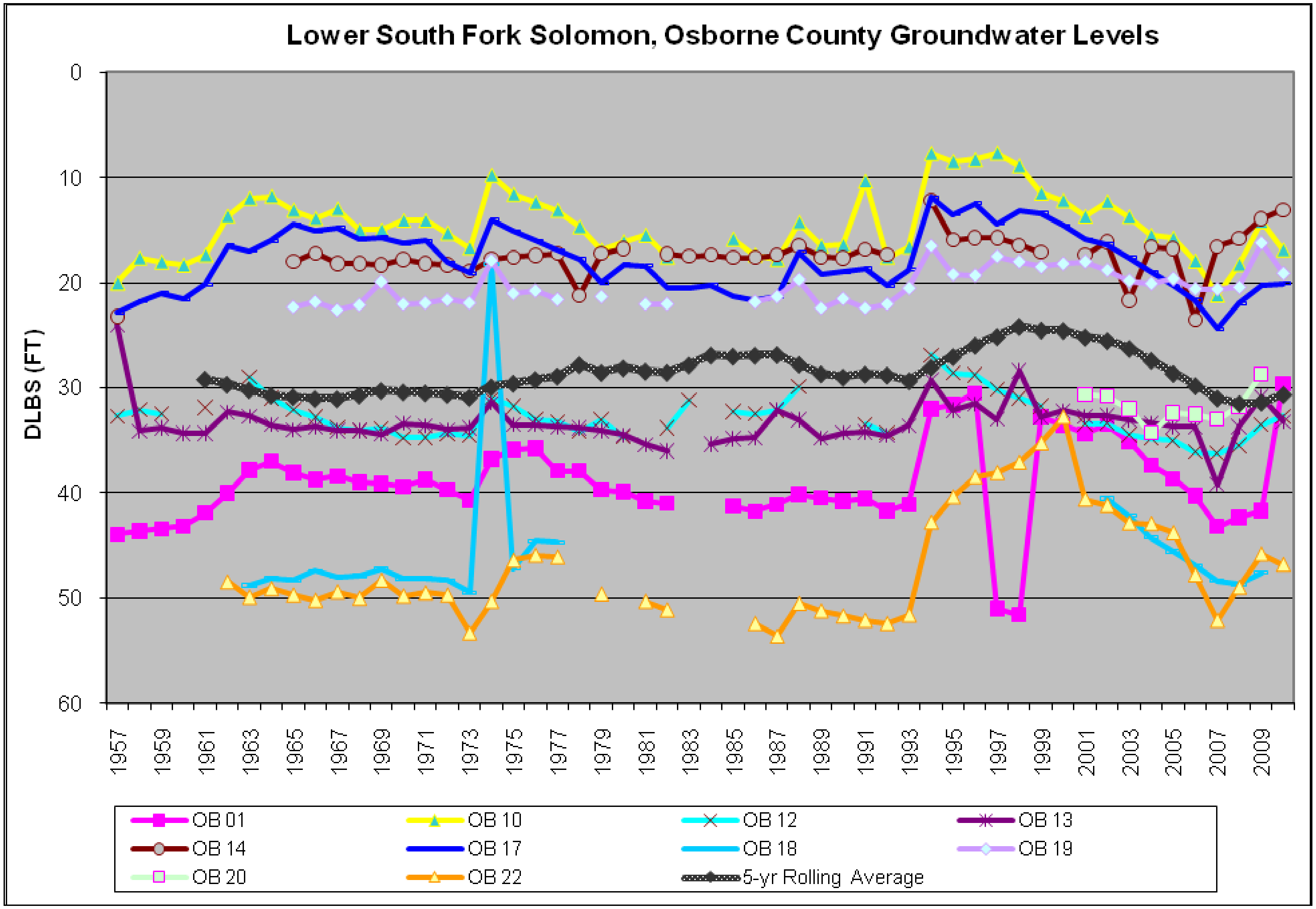

Figure 11: Monitoring well levels Lower South Fork, Osborne County

The Lower South Fork, Osborne County has 10 monitoring wells (Figure 11). The average change in water levels in Osborne County is an increase of 0.62 feet in 2010. OB01 had an increase of 12.10 feet. 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 14.35 feet (OB01) to net declines of 9.2 feet (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 a slight increase in 2009 and 2010.

V. Water Use

The Lower Solomon subbasin has a total of 472 water rights with an authorized quantity of 58,989 acre-feet. A small percentage of the water rights in the subbasin are vested (Table 1). Irrigation, industrial, recreational, municipal, stock and domestic water rights are used for this water use 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	1,047
Appropriated	Surface Water	137	32,273
Vested	Groundwater	17	876
Appropriated	Groundwater	301	24,793

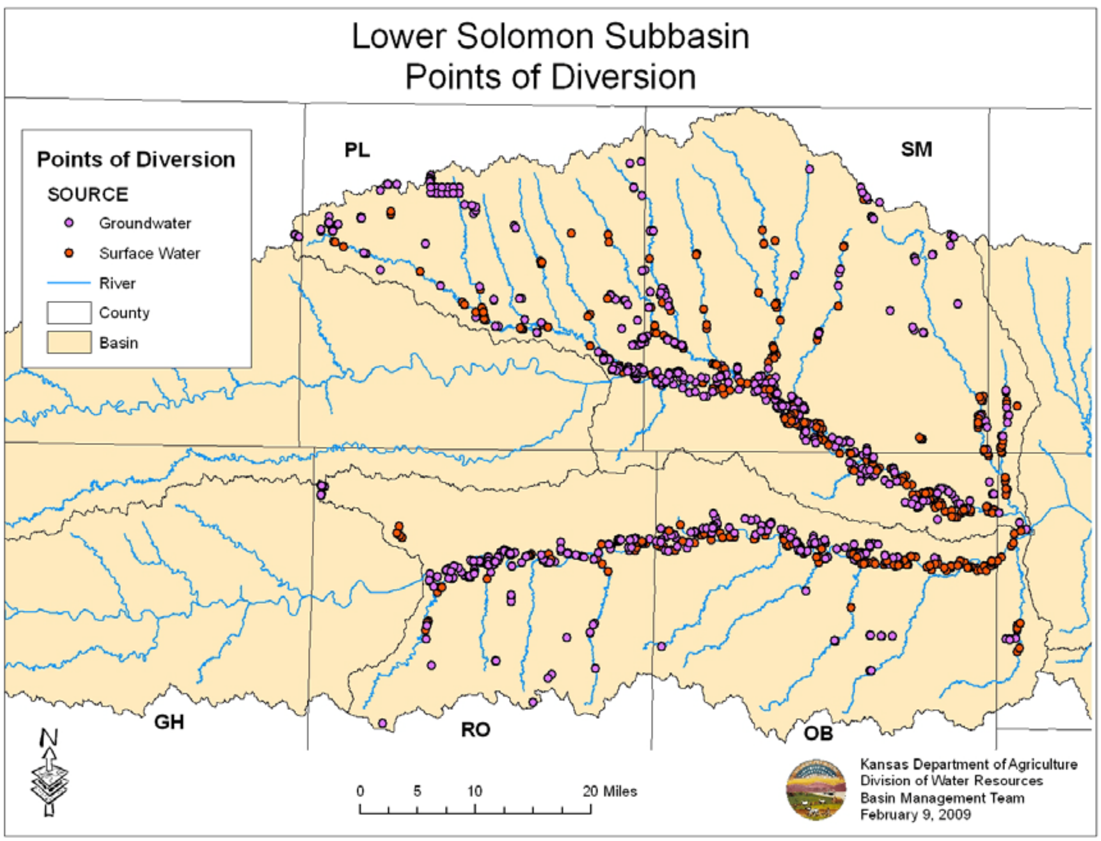

Figure 12: Lower Solomon Subbasin Points of Diversion

The water use in the subbasin ranges from 30,821 acre-feet in 2000 to 5,384 acre-feet in 1993. Since 1988, the average water use for the subbasin was 19,386 acre-feet. Water use in 2008, the most recent year for which complete records are available, was 15,247 acre-feet. This was below the historical average but above the 2007 water use total (Figure 13).

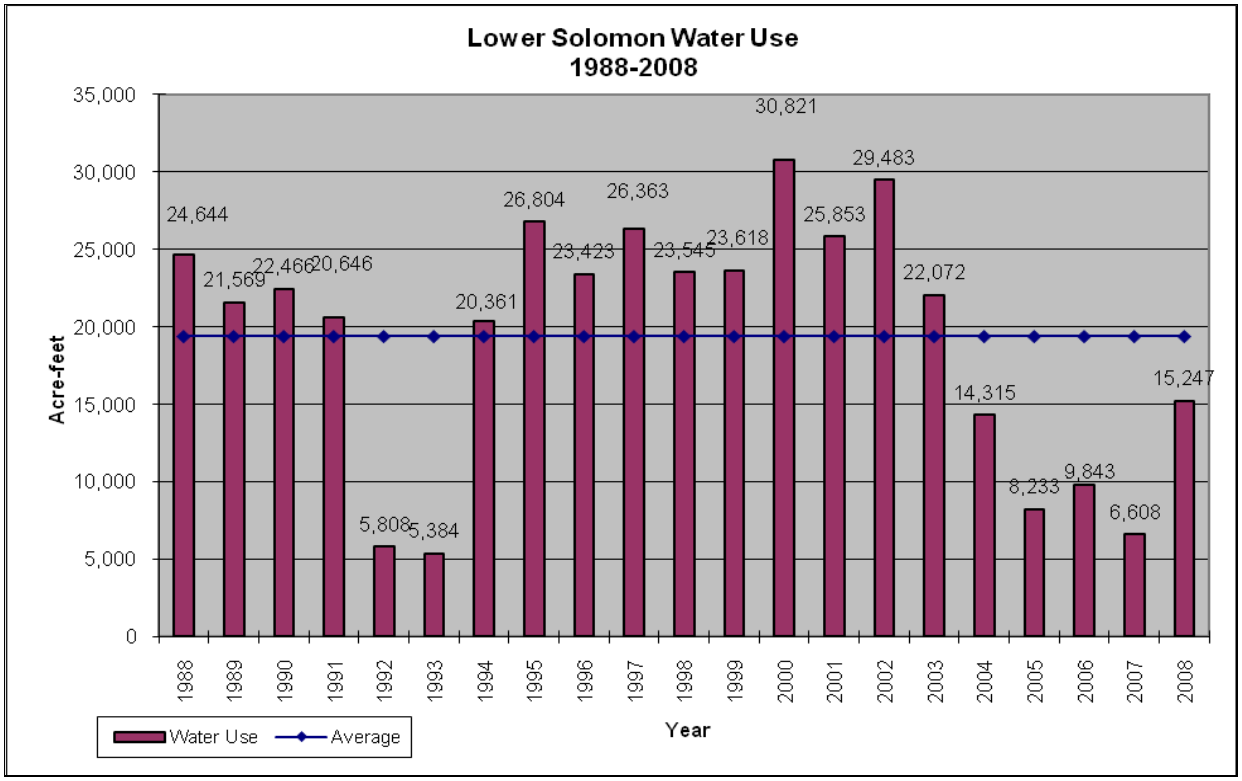

Figure 13: Ground and Surface Water use by year

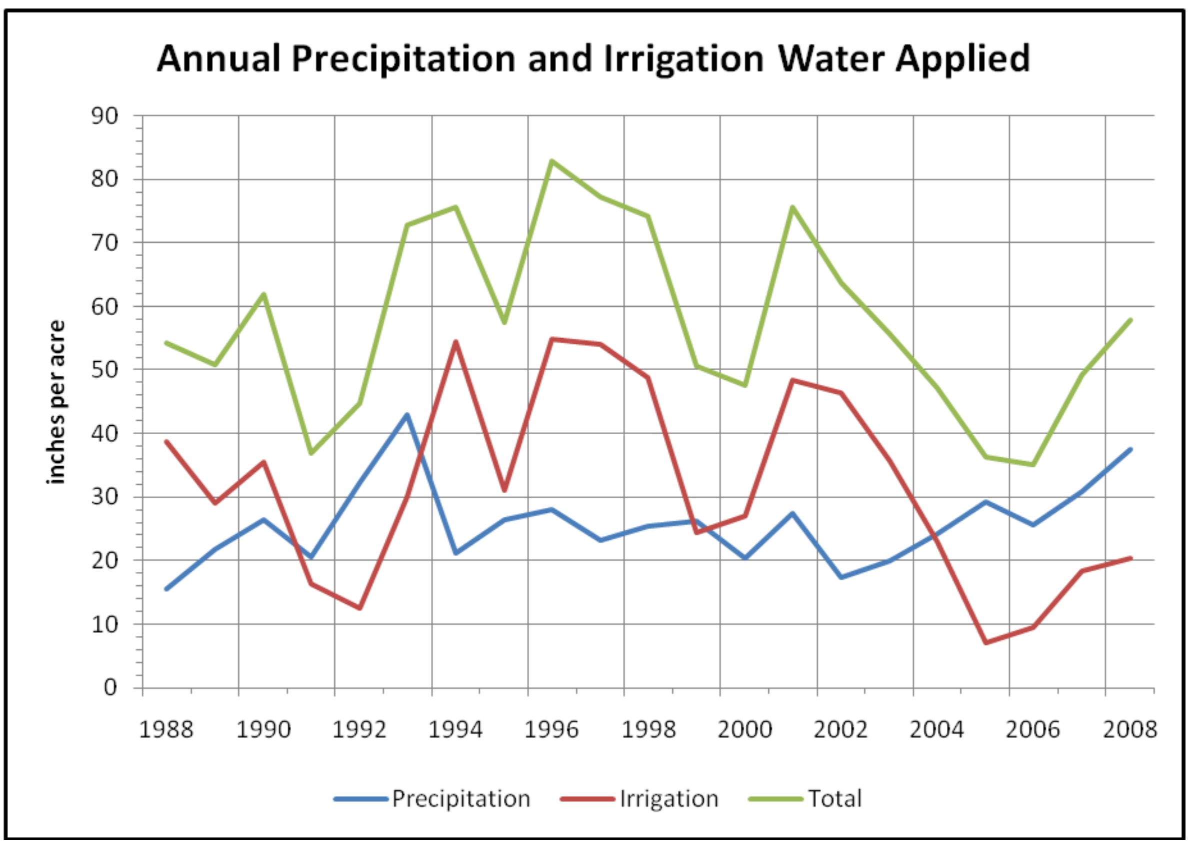

Figure 14: Annual Precipitation and Irrigation (inches per acre) 1988-2008

The Lower Solomon subbasin has two surface water irrigation districts. Their use and efficiency has a large impact on the irrigation value shown in Figure 14. When the reservoirs have sufficient water, the irrigation districts call for water. This increases the use in the subbasin but also decreases the efficiency. Since 1988, the Lower Solomon subbasin averaged 25.8 inches of precipitation and 31.7 inches of irrigation pumping. In 2008, the subbasin received 37.5 inches in precipitation and pumped 20.3 inches. Irrigation season precipitation (Figure 15) averages 18.9, which is nearly seven inches below the annual average.

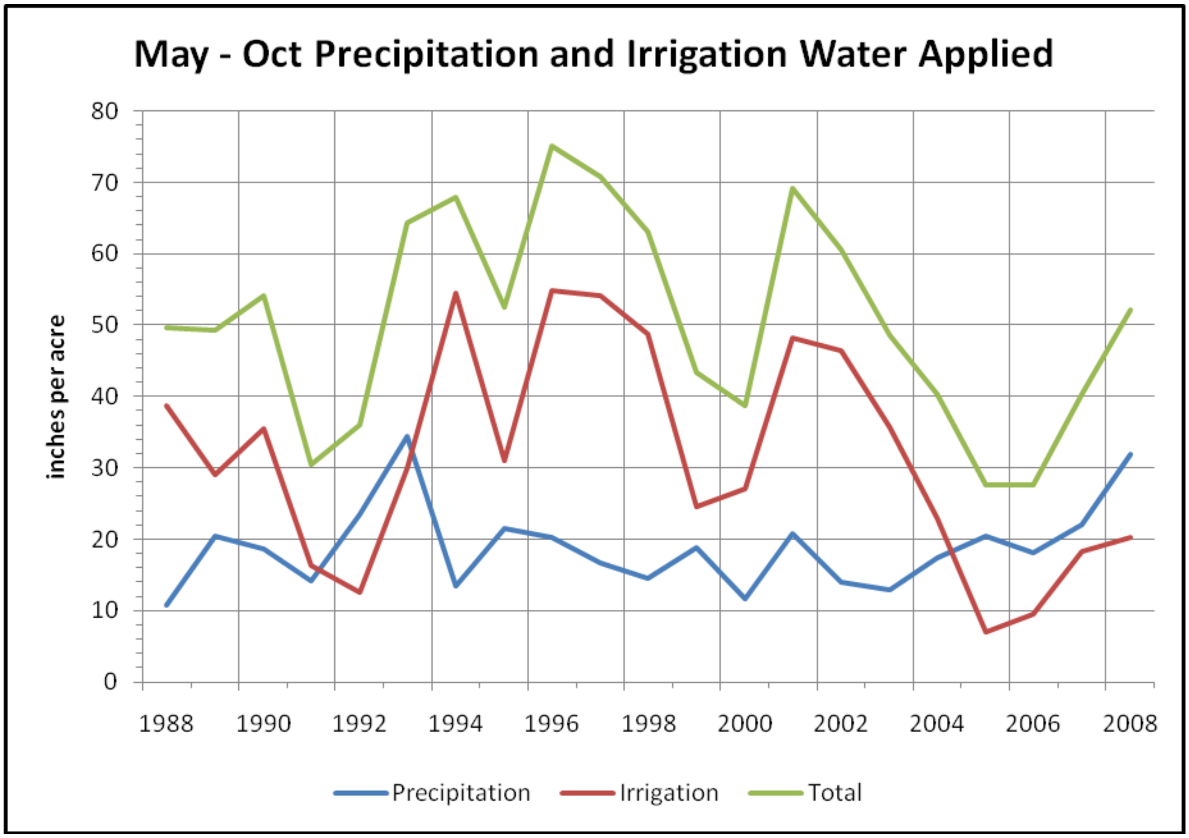

Figure 15: May - October Precipitation and Irrigation (inches per acre) 1988-2008

VI. Conclusions

The Lower Solomon Forks had higher and more consistent streamflows throughout 2009. The groundwater measurements in 2010 are down in most monitoring wells. Water use increased in 2008 compared to 2007, but it is still below the subbasin average. It is important to continue to increase our understanding of the impacts of pumping, how fast the system recovers after recharge events, and other characteristics of the hydrologic system in order to evaluate the long-term effects of water usage on this subbasin, protect property rights, and ensure the benefits of these water resources to future generations.

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 BC	Lower North Fork
OB07	06 12W 07 CC	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 CBB	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