Review of September 7th, 2013 Severe Weather Event

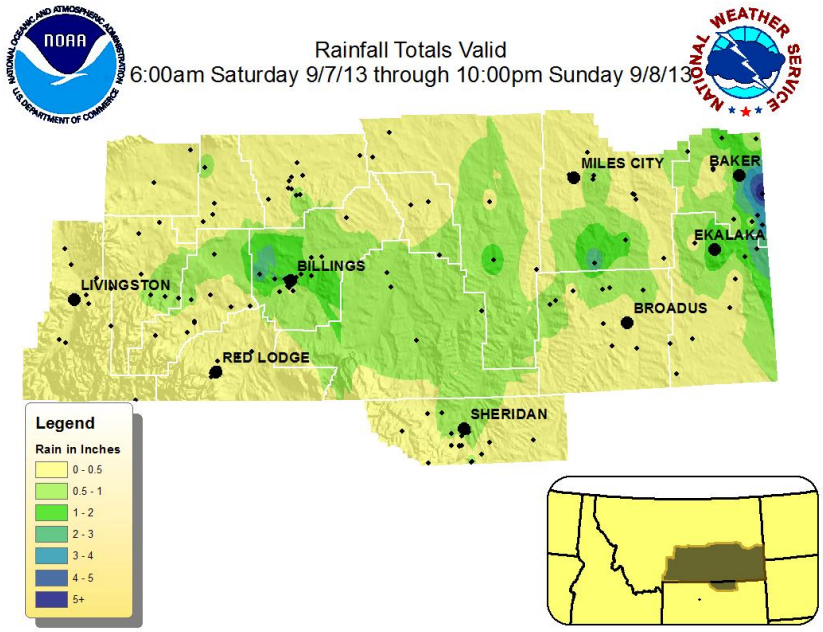

Figure 1: Rainfall total map for Southeastern Montana valid 0600 MDT 9/7/13 through 1000 MDT 9/8/13

The map in Figure 1 summarizes rainfall reports that came into the NWS Billings Forecast Office (both automated and manual) throughout the event on Saturday night (9/7/13) and Sunday morning (9/8/13). A cursory glance shows that the most intense rainfall totals were in and around Billings, as well as in the far eastern portions of the state.

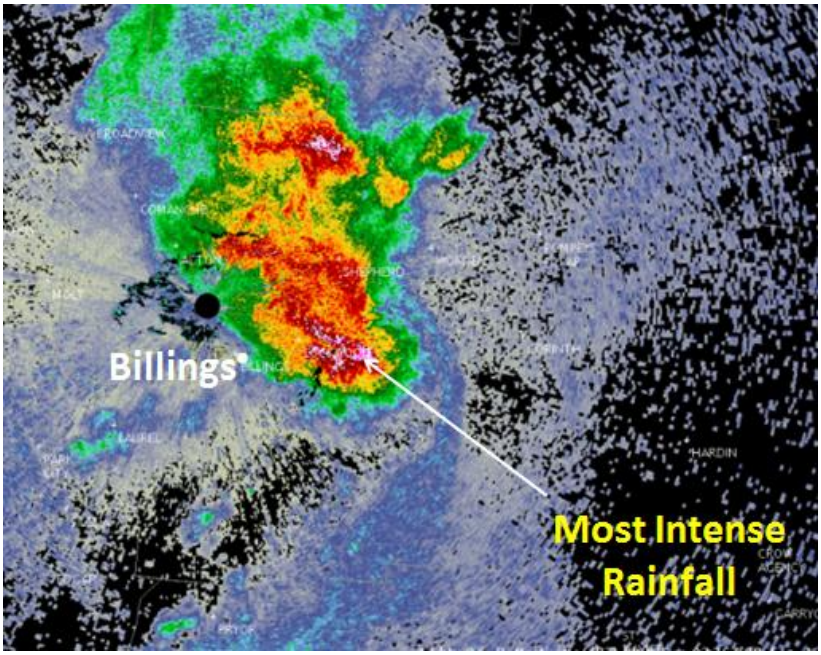

Figure 2: KBLX 0.5 Reflectivity Image valid 0926 MDT 9/7/13

Over a short period of time, NWS Billings received numerous reports of small hail, strong winds and extremely intense rainfall (flooding of some streets and small debris flows around town). Radar reflectivity valid at 0926 MDT on 9/7/13 shown in Figure 2 highlights some of the most intense rainfall as it went east of town.

Figure 3: Lightning strikes near Billings, MT valid 0845 - 0930 MDT 9/7/13

Strong lightning activity was very evident at the height of this storm. Each of the yellow barbs shown in Figure 3 represents a single lightning strike. This particular image is a conglomeration of lightning strikes in and around Billings from around 0845 MDT through 0930 MDT on 9/7/13. In cases similar to these, when subtropical moisture is abundant, the number of lightning strikes can sometimes be correlated with very intense rainfall.

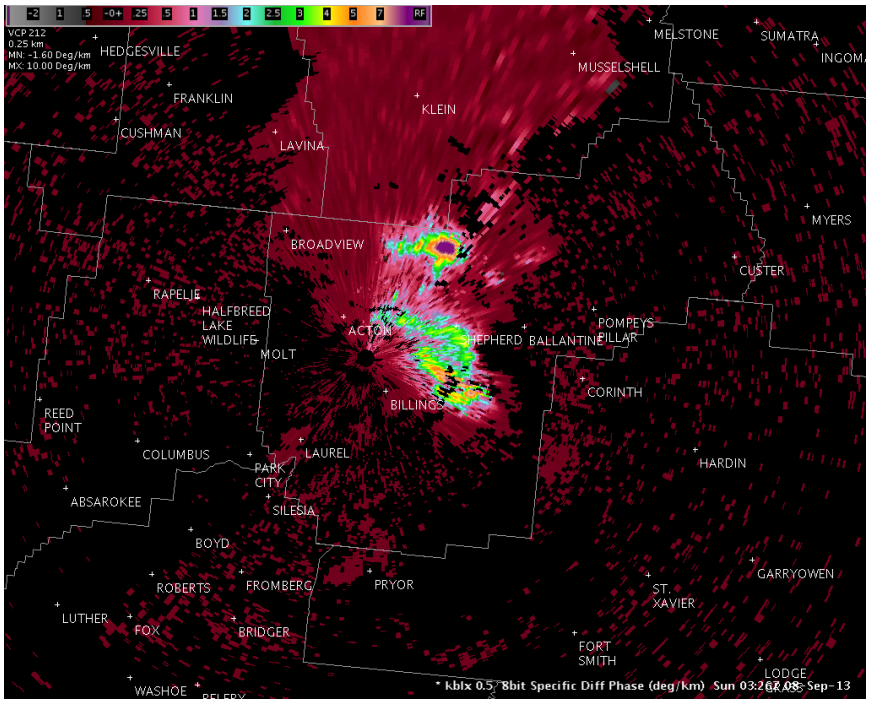

Figure 4: KBLX 0.5 KDP valid 0926 MDT 9/7/13

One of the features of the recent (2011) upgrade of the KBLX radar to Dual Polarization technology is the ability to observe how 'moist' a particular storm system may be. Figure 4 shows what is called the Specific Differential Phase product (KDP). KDP has an operational application to help meteorologists determine the presence of heavy rain, and whether the precipitation is tropical in nature. The 'warmer' colors (yellows, oranges and reds) in Figure 4 indicate that heavy rain is occurring, and that the nature of the rainfall is subtropical in nature. Products like this can help meteorologists issue timely short fuse warning products, most notably those involving the potential for Flash Flooding.

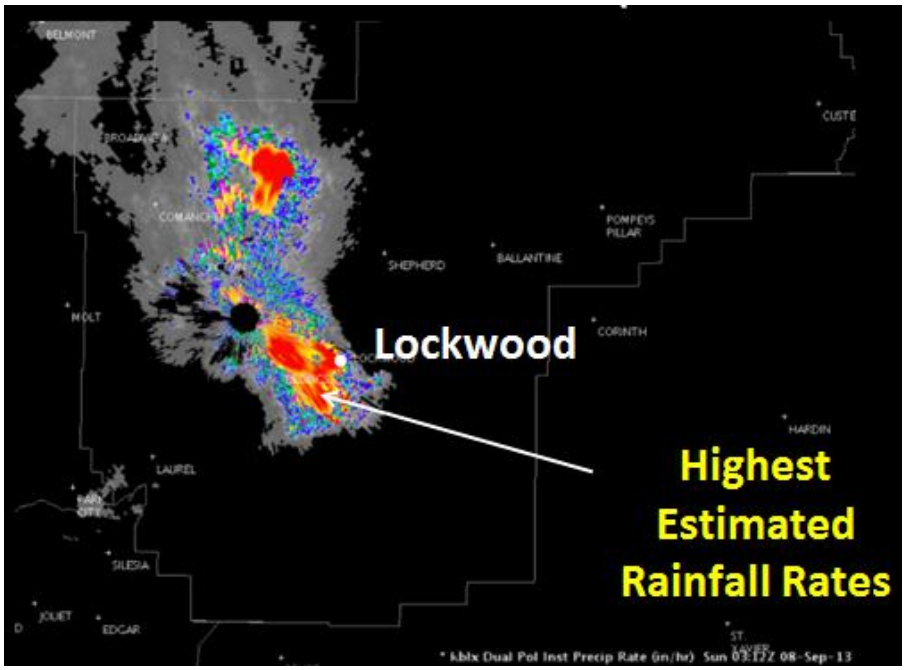

Figure 5: KBLX Dual Polarization Instantaneous Precipitation Rate valid 0912 MDT 9/7/13

Despite the small hail, strong winds and frequent lightning, the real story with this storm system was the rainfall and the incredible intensity with which it fell. Another product meteorologists at the NWS Billings Forecast Office use is radar estimated Dual Polarization Instantaneous Precipitation Rates (DPIPR). When doing a post-mortem on storms similar to these, the actual rainfall rate ultimately has the most lasting impact. Figure 5 shows DPIPR values greater than 6 inches per hour to the southeast of Billings at 0912 MDT 9/7/13. Since the KBLX radar upgrade occurred in October 2011, these amounts were some of the highest that have been observered in southeastern Montana. Rainfall rates this intense can flood roads quickly as well as cause once dormant sediment to morph into dangerous debris flows.

07 Sep 10:11 pm MDT	58	58	100	NNE	9	10.00		SCT065 SCT090 BKN110		30.06	26.314	
07 Sep 9:53 pm MDT	55	55	100	NE	16	10.00	TS	FEW029 SCT100CB SCT120	1016.2	30.07	26.323	1.31
07 Sep 9:37 pm MDT	56	56	100	NNE	15G25	10.00	-TSRA	FEW016 BKN080CB BKN100		30.07	26.323	1.31
07 Sep 9:24 pm MDT	53	52	96	NE	16G37	5.00	TSRA	SCT011 BKN022CB OVC100		30.07	26.323	1.31
07 Sep 9:16 pm MDT	52	51	97	N	30G70	0.25	+TSRAGR	BKN004 BKN020CB OVC110		30.10	26.350	0.53
07 Sep 9:08 pm MDT	57	55	93			0.25	+TSRAGR	SCT009 BKN020CB OVC027		30.10	26.350	T
07 Sep 9:05 pm MDT	61	57	87	W	58G72	0.50	+TSRA FG	SCT020 BKN027CB OVC110		30.08	26.332	T
07 Sep 9:03 pm MDT	62	57	84	W	48G66	5.00	-TSRA	SCT020 BKN027CB BKN110		30.06	26.314	T

Figure 6: Observations from Billings Logan International Airport valid 0903 MDT through 1011 MDT 9/7/13

Further evidence of the incredible rainfall rates can be seen in the observations at Billings Logan International Airport. Looking closely at Figure 6, one will notice how quickly the rainfall amount went from just a Trace at 0903 MDT 9/7/13 to over 1.31 inches just 21 minutes later.

During post mortem analyses on cases such as these allows meteorologists to try and understand not only what actually happened, but what the ultimate impacts were. Obviously, in an event like this, there

were numerous impacts – high winds (a gust of 73 mph at Billings Logan International Airport), small hail, frequent lightning and extremely intense rainfall. The nature of the intense rainfall was compounded by where the storm actually became more intense – over the West End of Billings (near the Rims). Numerous debris flows and mudslides were reported in town causing havoc to travel and homeowners.