



TO: THE WATER ADVISORY COMMITTEE
FROM: THE OFFICE OF THE EXECUTIVE DIRECTOR
SUBJECT: SPRING 2013 SDMF RELEASE HYDROLOGIC SUMMARY
DATE: JULY 28, 2014

I. INTRODUCTION

A. Overview of SDMF Release

The U.S. Fish and Wildlife Service (FWS), in coordination with the Platte River Recovery Implementation Program (PRRIP or the Program) and several key Program partners, released water from the Lake McConaughy Environmental Account (EA) in April of 2013 to benefit threatened and endangered species that are the focus of Program actions. The release was also used to collect data for the Program's flow management strategy. The release was a "pulse flow" release that created short duration medium flow (SDMF) conditions in the Program's associated habitat reach. A total of 73,056 acre-feet (AF) of water was released from April 1st through May 1st, 2013; approximately 34,700 AF of this was used to create the SDMF conditions and the remaining 39,356 AF was released to provide water for spring whooping crane migration. Flow in the Platte River at Overton reached a peak of 4,220 cubic feet per second (cfs)¹ during the release.

B. Objectives of the SDMF

The SDMF release served three main objectives: to provide information on the hydrologic behavior of pulse flow releases and the ability of the river and canal system to route flows to the associated habitat, to test coordination procedures between the partners for future pulse flows, and to provide data about the effectiveness of such releases in scouring vegetation from the river channel. This memo focuses on the first of these three objectives.

a. Hydrologic Behavior

Periodic pulse flow releases form an essential part of the Program's flow management strategy. The Program plans to test the ability of short duration high flow (SDHF) releases to help create and maintain habitat for endangered species in the associated habitat reach of the Central Platte River (from Lexington, NE to Chapman, NE). SDHF events are defined in the Program's Water Plan² as "flows of approximately three to five days in duration with magnitudes approaching but not exceeding bankfull channel capacity in the habitat reach". The bankfull capacity in the associated habitat is between 5,000 cfs and 8,000 cfs. The 2013 SDMF release did not produce bankfull flows but it provided information regarding flow travel-time, losses and gains, and peak flow attenuation that will aid in future SDHF planning.

¹ Based on provisional data from the USGS, http://nwis.waterdata.usgs.gov/nwis/uv/?site_no=06768000

² Attachment 5 Section 11 in the Platte River Recovery Implementation Program Document dated December 7, 2005.



b. Flow Routing

The 2013 SDMF release tested the river and canal system's capacity to route flows through and around the North Platte choke point. The safe conveyance capacity of North Platte River at North Platte is 1,560 cfs based on the National Weather Service (NWS) flood stage designation of 6.0 feet. The reach of the North Platte River in the vicinity of North Platte, NE, is referred to as the "choke point" because of the limited safe conveyance capacity. Water released from the EA may be routed around the choke point to the South Platte River through canals with headgates on the North Platte and returns on the South Platte. The Keystone diversion/Sutherland Canal system was used to route flows around the choke point during previous releases³. The 2013 SDMF was designed to evaluate the ability of three smaller canals, the Keith-Lincoln, North Platte, and Suburban canals, to route flows around the choke point.

C. Constraints

Several factors limited the scope of the 2013 SDMF release and restricted its ability to provide bankfull channel capacity through the associated habitat reach. The Platte River basin experienced drought conditions in 2012 and 2013 that resulted in lower than average snow-pack and spring runoff. Lower natural flows in the South Platte limited the SDMF release's peak volume and duration. Another limitation to the size of the release was the amount of water available for release. The total volume of water in the EA account prior to the release was 102,593 AF. Over 70% of the EA water was used in the spring 2013 release (SDMF and whooping crane release combined). If more water had been available in the EA, a larger SDMF release may have been possible. Ramp up rates were limited to 700 cfs to avoid damage to headgates along the North Platte River. High ramp up rates would have allowed more water to be released in a shorter time, potentially resulting in a higher peak flow. In addition to limits on ramp up rates, the North Platte choke point limited the total amount of flow that could be released down the North Platte River to 1,560 cfs as described in the previous section. The capacity of the Keystone/Sutherland system and the smaller canals on the North Platte River limited the amount of water that could be routed around the choke point.

II. 2013 SDMF RELEASE

A. Release Routing

The SDMF release required careful coordination of releases, diversions, and returns to create a pulse flow at the Overton gage. EA water was released to the North Platte River at the Keystone diversion. Water entering the Keystone diversion was routed through the Sutherland canal system and returned to the South Platte River at the Sutherland return. Some of the water sent down the North Platte River was routed through the Keith-Lincoln, North Platte, and Suburban canals to the South Platte River. Flows remaining in the North Platte River could not exceed flood stage at North Platte, NE. Most of the EA water below the confluence of the North and South Platte River was diverted through the Tri-County canal system and released back to the Platte through the Jeffery and J2 return. Some of the water entering the Tri-County system was

³2009 Platte River Flow Routing Test: Results, Information Gleaned, Lessons Learned. PRRIP and USFWS



stored in reservoirs above the J2 return to temporarily retime the flow and allow for a larger release at the J2 return. Releases from the Jeffery and J2 return were timed to coordinate with the pulse of EA water that passed by the Tri-County diversion in the Platte River. **Figure 1** shows a straight-line schematic of the river and canal system used to route the 2013 SDMF release. A timeline of the release is presented in **APPENDIX A**.

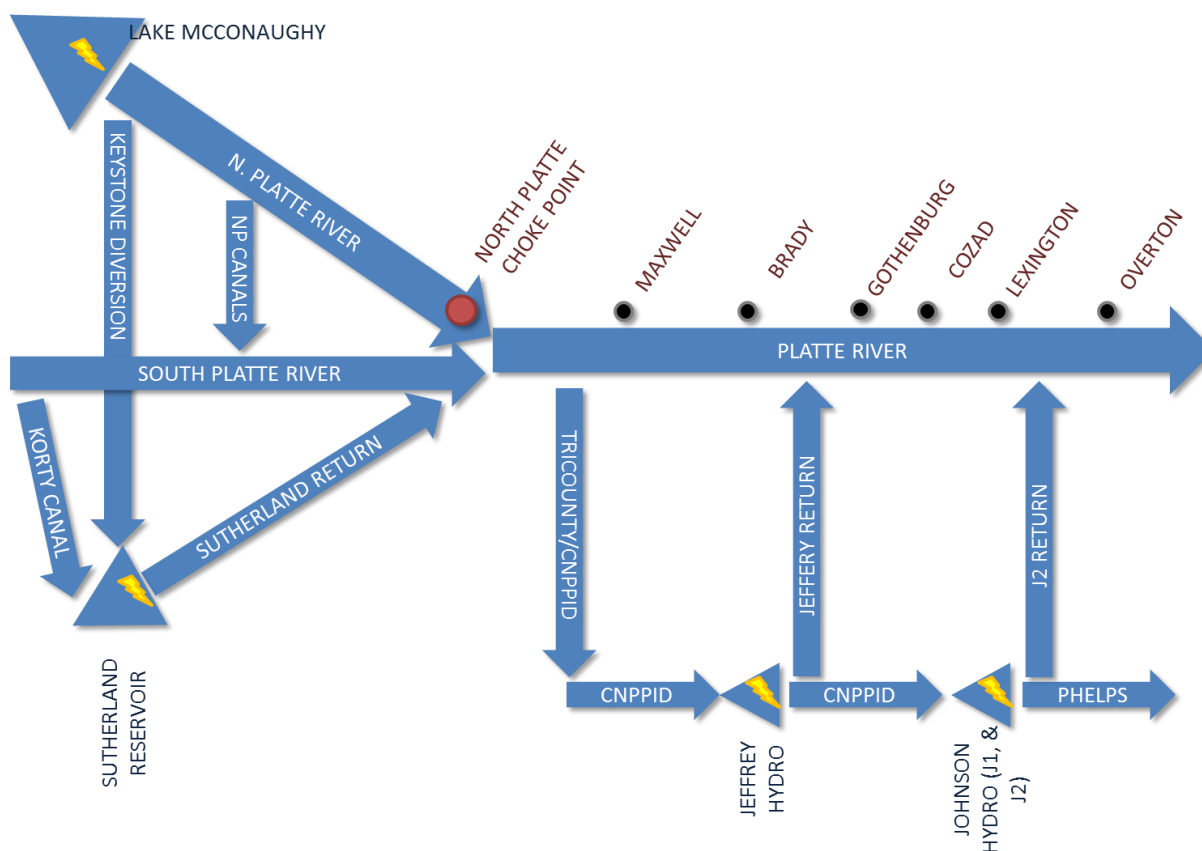


Figure 1. Straight-line diagram of the North, South, and Central Platte River and canal system

B. Release Flows and Volumes

Peak flows during the 2013 SDMF came within roughly 1,000 cfs of bankfull capacity, with flows at Overton peaking at 4,220 cfs, remaining above 4,000 cfs for 22.5 hours, and above 3,800 cfs for 2.25 days. **Table 1** presents the duration and volume of flow at gages in the associated habitat for the entire SDMF release and **Table 2** presents peak flows reached at various gages during the release and the corresponding date of peak. **Figures 2** shows hydrographs of river flows during the release. High flows lasted for approximately 3 days at each gage location. The attenuation of the pulse peak flow is evident as water moves downstream from the Overton gage to the Grand Island Gage, with flows peaking at only 3,840 cfs at Grand Island. Hydrographs showing release duration and estimated EA volume at the Overton, Kearney, and Grand Island gage can be found in **APPENDIX B, Figures B1-B3**



Table 1. 2013 SDMF duration and volume

Gage	Pulse duration (hr)	Estimated volume (AF)
Overton	97	33,018
Kearney	100	29,794
Grand Island	98	28,462

Table 2. Peak flow during the 2013 SDMF

Gage	Peak flow (cfs)	Date and time of peak	Time above 4,000 cfs
NPR at North Platte	1,445	4/11/2013 11:00 am	0 hours
Overton	4,220	4/13/2013 8:30 pm	22.5 hours
Kearney	4,110	4/14/2013 7:45 am	29 hours
Grand Island	3,840	4/15/2013 2:30 am	0 hours

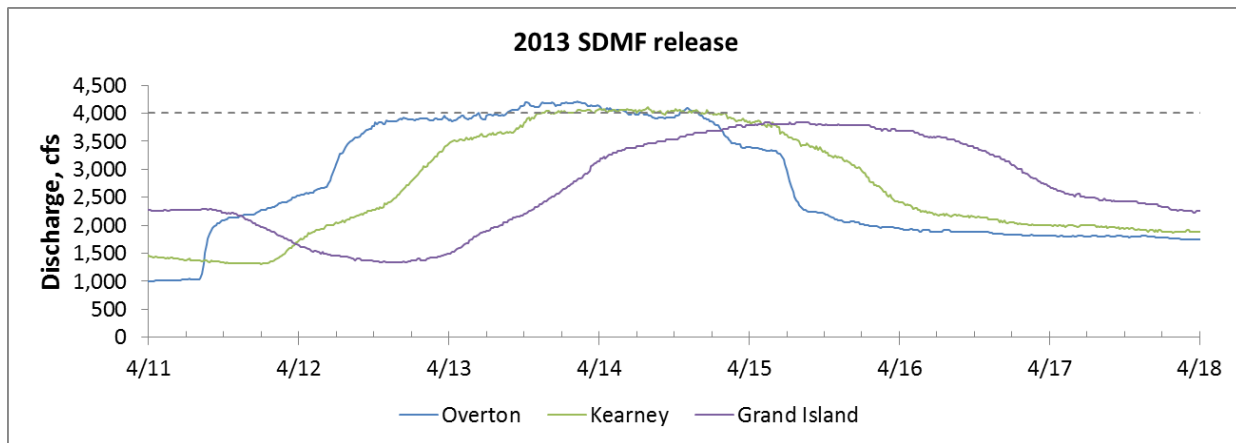


Figure 2. SDMF pulse flows through the associated habitat

Releases to the North Platte River were well controlled to maintain flows below flood stage at the North Platte choke point. The release resulted in peak flows of 1,445 cfs and peak stage of 5.85 feet at the North Platte gage, about 100 cfs below floods flows and 0.15 feet below flood stage, as seen in **Figure 3**.

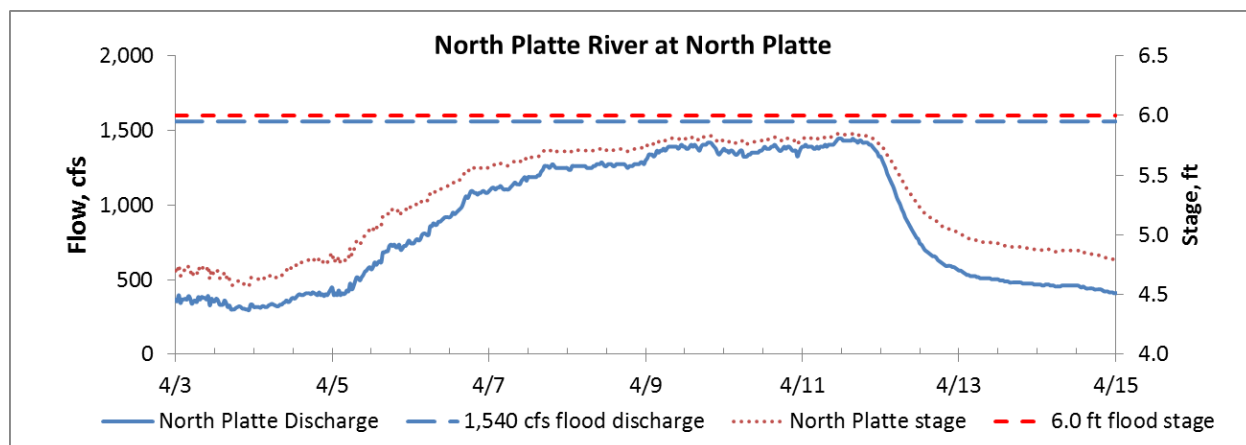


Figure 3. SDMF pulse at North Platte, NE, on the North Platte River

C. Flow Travel Times

Travel times for the initial rise and initial fall in the release are shown in **Table 3**. The travel times of the fall of the hydrographs were much faster than expected after the releases stopped. Gage records on the North Platte showed the travel times of the hydrograph falls were half to two-thirds of the hydrograph's rise. While runoff from precipitation falling on 4/7/2013 through 4/9/2013 may have contributed to the slower rise, the reason for the rapid fall of the release is not entirely clear.

Table 3. Rise and fall travel time from Keystone to Grand Island

Reach	Travel time of initial rise (hrs)	Travel time of release fall (hrs)
Keystone to Sutherland	28	12
Sutherland to North Platte	27	9
North Platte to Maxwell	NA*	NA*
Maxwell to Brady	9	6.5
Brady to Cozad	20	15
Cozad to Lexington	NA*	NA*
Lexington to Overton	57	42
Overton to Kearney	12	15
Kearney to Grand Island	26	27

*Flow data not available at this time

D. Other Factors Impacting the Release

a. Low South Platte River Inflows

As mentioned in the discussion of constraints above, low inflows from the South Platte limited the pulse flow magnitude and duration, as more inflow would allow for a larger and longer



release. April flow in the South Platte at Roscoe, NE, averaged 121 cfs in 2013 which amounts to only 20% of the 601 cfs average that typically occurs in April at Roscoe⁴. **Figure 4** shows a comparison of 2013 April flows with average April flows.

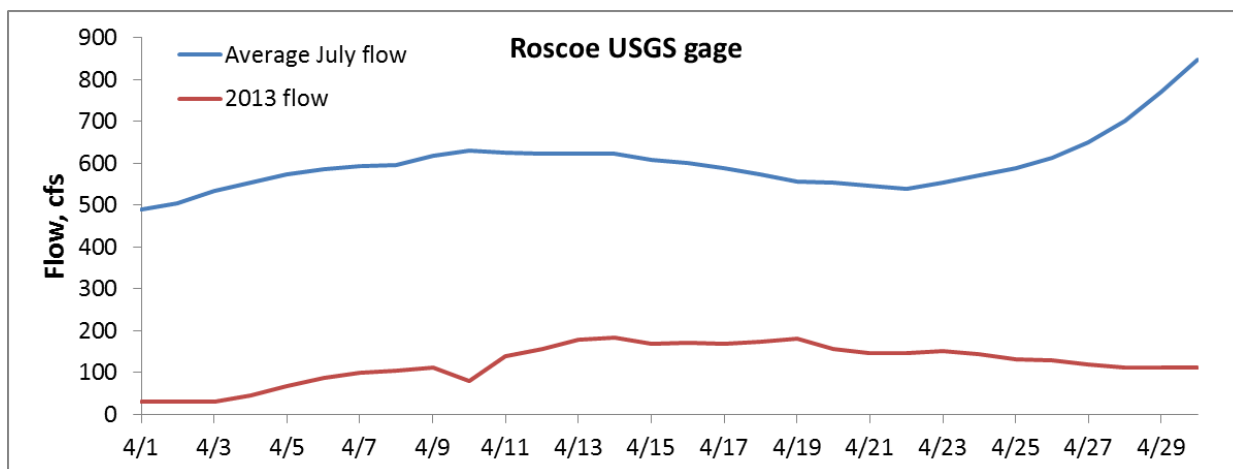


Figure 4. Roscoe USGS gage average and 2013 April flow

b. Precipitation

Daily precipitation at various gages along the North and Central Platte River is shown in **Table C1** of **Appendix C**. Precipitation from 4/7 through 4/9 likely added to the release's total volume; however, it presented challenges to the regulation of flow at the North Platte choke point. Concern that the resulting runoff from the precipitation might cause river levels at North Platte to surpass flood stage resulted in a reduction of the amount of water released down the North Platte River from the 7th to the 9th of April.

c. Whooping Crane Release

The continued release of EA water to provide water for the spring whooping crane migration prevented a straight forward analysis of the receding limb of the 2013 SDMF release hydrograph. Because river flows did not return to base flow at the end of the SDMF release the total release volume and duration are approximated.

III. DISCUSSION

A. EA Efficiency

The total 2013 EA release (combined 2013 SDMF and whooping crane release) experienced relatively low losses with 77% of the EA water released at Lake McConaughy arriving at Grand Island (a loss of 23%). On average approximately 50% of EA water arrived at Grand Island for

⁴ Based on USGS gage data from 1983 through 2014,
http://waterdata.usgs.gov/nwis/dv?referred_module=sw&site_no=06764880



the eight flow releases that have occurred from 2007 through 2013. The two previous spring releases (2009 and 2012) had an average percent loss of EA water of 32%. Losses associated with the 2013 SDMF portion of the 2013 release are estimated to be slightly larger than the whooping crane portion of the release, with only 71% of the EA water arriving at Grand Island (29% loss). The higher losses are likely due to greater losses that occur during the initial rise of the release. EA losses are based on daily EA volumes calculated by the Nebraska Department of Natural Resources (NDNR). **Table 4** presents the percentage of the EA volume released at Lake McConaughy that arrived at various locations along the North and Central Platte River for the full release and the SDMF release.

Table 4. Percent of EA and EA loss from Keystone to Grand Island (as calculated by NDNR)

Reach	Full Release		SDMF Release	
	% Arrival	% Loss	% Arrival	% Loss
Keystone to Maxwell	96%	4%	93%	7%
Keystone to Cozad*	92%	8%	92%	8%
Keystone to Overton	91%	9%	85%	15%
Keystone to Kearney	83%	17%	80%	20%
Keystone to Grand Island	77%	23%	71%	29%

*Includes losses incurred in CNPPID's system.

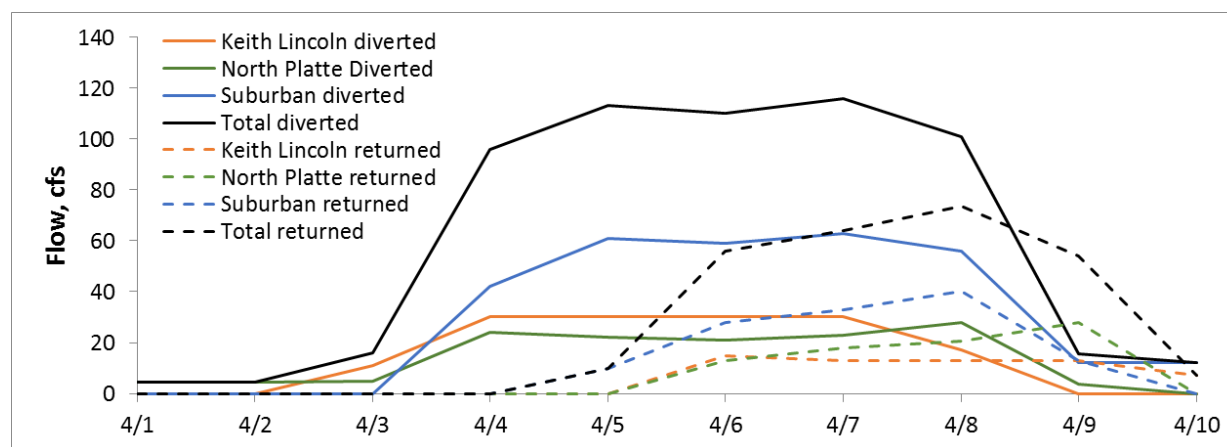
The widespread precipitation event from 4/7/2013 to 4/9/2013, shown in **Table C1** of **Appendix C**, likely played a role in limiting the losses during the release by increasing runoff. Lower than average temperatures during April, shown in **Table C2** of **Appendix C**, likely contributed to lower than average evaporative losses as well.

B. North Platte Canal Routing

The Keith Lincoln, North Platte, and Suburban canals were employed to route water around the North Platte choke point to the South Platte River during the 2013 SDMF release. A total of 588 cfs was diverted through the three canals during the release and 265 cfs (about 45%) returned to the South Platte River. The Keith Lincoln canal was only able to return 61 cfs of the 148 cfs diverted. Due to its low capacity and low percent of water returned (41%), it will not be considered in future flow routing activities. The North Platte canal diverted the least amount of water but returned the highest percentage (59%) of that water to the South Platte. The Suburban canal diverted the largest amount of water but only returned 41% of it to the South Platte. Due to the larger capacity, the Suburban canal will continue to be evaluated for use in future routing activities. The North Platte canal will also be used in future flow routing. Improvements to the North Platte and Suburban canals will allow them to convey more water to the South Platte. The amount of water diverted and returned along with the percent returned is tabulated in **Table 5**. **Figure 5** shows the diversion and return pattern for the canals during the 2013 SDMF release.

**Table 5.** North Platte Canal diversion and returns

Canal	Diverted (cfs)	Returned (cfs)	% Returned
Keith Lincoln	148	61	41%
North Platte	135	80	59%
Suburban	305	125	41%
Total	588	265	45%

**Figure 5.** North Platte Canal diversion and returns during the 2013 SDMF release

IV. CONCLUSIONS

From a hydrologic perspective, the 2013 SDMF release successfully met its objectives. The 2013 SDMF release proved valuable in assessing the ability to route water around the North Platte choke point and testing channel capacity at the choke point. Flow travel times and release strategies will be used to inform future pulse flow releases. The ability of the North Platte and Suburban canal to route flows around the choke point indicates they can play an important role in routing future pulse flows to the South Platte. While the constraints of low South Platte inflows and EA volume prevented the release from achieving bankfull flows in the associated habitat, the release provided useful information on the behavior of pulse flows in the North and Central Platte Rivers.



APPENDIX A: RELEASE TIMELINE

- **4/1/2013:** The SDMF release begins. EA water is released into the Keystone diversion of the Sutherland canal system.
- **4/2/2013:** EA releases into the Keystone diversion increase (ramp up). EA water enters the South Platte River from the Sutherland return and is diverted downstream into the Tri-County canal.
- **4/3/2013:** EA water released into the North Platte River in addition to the Keystone diversion. The Tri-County canal continues to divert all EA water below the confluence of the North and South Platte.
- **4/4/2013:** The Keith-Lincoln, North Platte, and Suburban canals begin diverting EA water. EA releases to the Keystone diversion and North Platte River continue to increase.
- **4/5/2013:** EA releases to the Keystone diversion and North Platte River continue to increase.
- **4/6/2013:** EA water from the North Platte canals enters the South Platte River. EA releases to the North Platte River reach target levels (approximately 1,300 cfs).
- **4/8/2013:** North Platte canals stop diverting EA water. A portion of EA water begins to flow past the Tri-County diversion.
- **4/9/2013:** North Platte River at North Platte reaches peak flow of 1,445 cfs, 5.85 ft stage
- **4/10/2013:** EA releases to the North Platte River stop. Releases to the Keystone diversion continue for the whooping crane release. EA water enters the Platte from the Jeffrey return.
- **4/11/2013:** North Platte River at North Platte reaches a peak flow of 1,445 cfs (5.85 ft stage). EA water enters the Platte from the J2 return and is soon seen at the Overton gage.
- **4/12/2013:** Flows begin to increase at the Kearney gage. Overton flows reach 3,800 cfs. Flows drop at the North Platte gage on the North Platte River.
- **4/13/2013:** Flows begin to increase at the Grand Island gage and flows at Overton and Kearney peak at 4,220 cfs and 4,110 cfs, respectively.
- **4/14/2013:** Flows at Overton begin to recede. Flows at Grand Island rise above 3,600 cfs.
- **4/15/2013:** Flows at Kearney begin to recede. Grand Island flows peak at 3,840 cfs.
- **4/16/2013:** Flows at Grand Island begin to recede.



APPENDIX B: SDMF HYDROGRAPHS

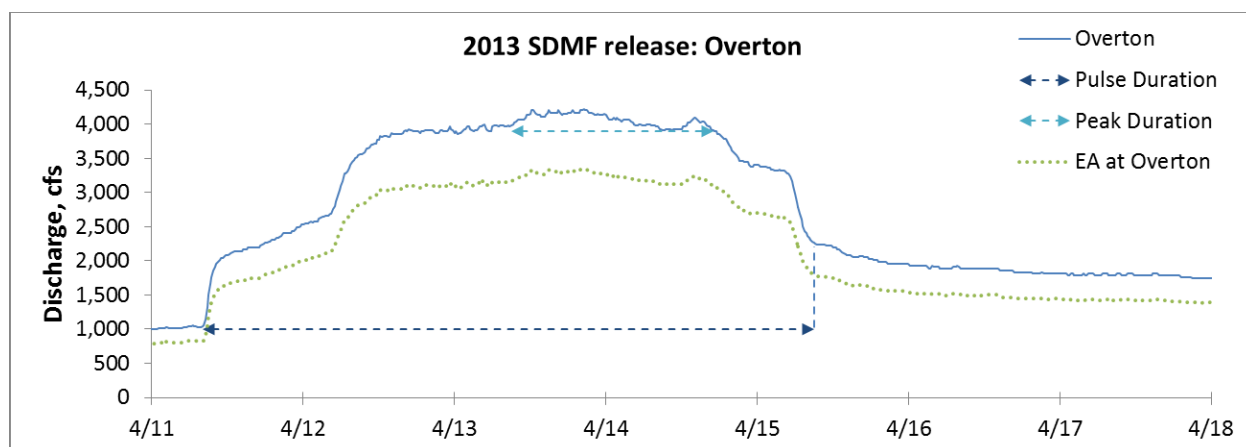


Figure B1. SDMF hydrograph at the Overton USGS gage

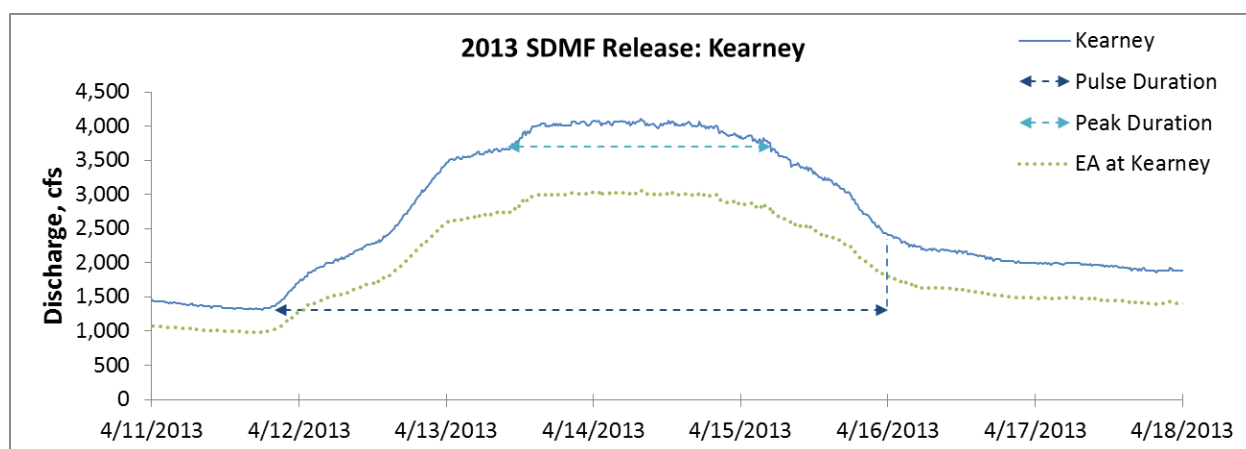


Figure B2. SDMF hydrograph at the Kearney USGS gage

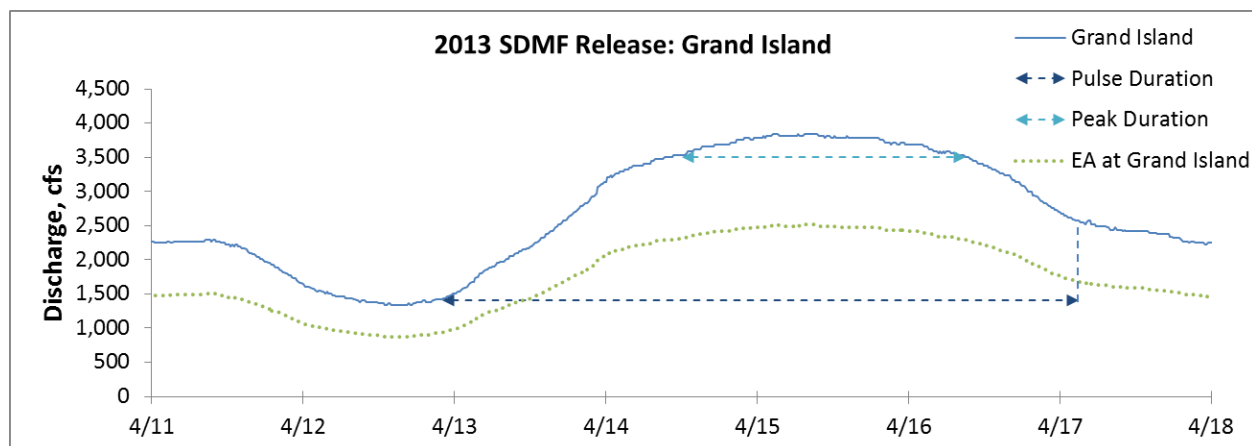


Figure B3. SDMF hydrograph at the Grand Island USGS gage



APPENDIX C: PRECIPITATION AND TEMPERATURE DURING 2013 SDMF RELEASE

Table C1. Daily precipitation at High Plain Regional Climate Center (HPRCC) automatic weather station gages during the EA release

HPRCC AWDN Station Precipitation (in), 4/1/2013 through 5/1/2013								
Date	NORTH PLATTE	GOTHENBURG	COZAD	LEXINGTON	KEARNEY UNK	KEARNEY	SHELTON	GRAND ISLAND
4/1/2013	0	0	0	0	0	0	0	0
4/2/2013	0	0	0	0	0	0	0	0
4/3/2013	0	0	0	0	0	0	0	0
4/4/2013	0	0	0	0	0	0	0	0
4/5/2013	0	0	0	0	0	0	0	0
4/6/2013	0	0	0	0	0	0	0	0
4/7/2013	0.10	0.07	0.09	0	0.32	0.10	0.34	0.67
4/8/2013	0.34	2.02	0.81	1.96	0.45	0.09	0.00	0.12
4/9/2013	0.15	0.73	0.55	0.27	1.56	0.01	0.40	0.90
4/10/2013	0	0	0	0	0	0	0	0
4/11/2013	0.09	0.09	0.19	0	0	0.01	0	0.16
4/12/2013	0	0	0	0	0.04	0.29	0	0
4/13/2013	0	0	0.21	0	0	0	0.01	0.12
4/14/2013	0	0	0	0	0	0	0	0
4/15/2013	0	0	0	0	0	0	0	0
4/16/2013	0.12	0.11	0.09	0	0	0	0	0
4/17/2013	0	0	0	0.19	0.02	0	0.01	0.31
4/18/2013	0.03	0.03	0.05	0	0.00	0.05	0.02	0.02
4/19/2013	0.01	0	0	0	0	0	0	0
4/20/2013	0	0	0	0	0	0	0	0
4/21/2013	0	0.02	0	0	0.16	0.11	0.09	0.1
4/22/2013	0.03	0.21	0.3	0.56	0.79	0.78	0.05	0.83
4/23/2013	0	0	0	0	0	0	0	0
4/24/2013	0	0	0	0	0	0	0	0
4/25/2013	0	0	0	0	0	0	0	0
4/26/2013	0	0	0	0	0	0	0	0
4/27/2013	0	0	0	0	0	0	0	0
4/28/2013	0	0	0	0	0	0	0	0
4/29/2013	0	0	0	0	0	0	0	0
4/30/2013	0	0.06	0.01	0.25	0.02	0.03	0.02	0.04
5/1/2013	0.49	0.41	0.38	0.11	0.51	0.55	0	0.77



Table C2. Average April maximum daily temperature at High Plain Regional Climate Center automatic weather station gages during the EA release

AWDN Station	2013 Avg. April Max Temperature (°F)	2007 - 2014 Avg. April Max Temperature (°F)
North Platte	57.7	61.2
Gothenburg	56.9	61
Cozad	57.0	61.2
Lexington	57.1	60.4
Kearney	57.3	61.2
Shelton	57.4	61.6
Grand Island	56.9	61.4
<i>Average</i>	<i>57.3</i>	<i>61.1</i>