



# 2014 RECHARGE REPORT



May 2014

NEBRASKA GROUNDWATER RECHARGE:  
2013-2014 Phelps County Canal Recharge Report



PLATTE RIVER  
RECOVERY IMPLEMENTATION PROGRAM

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## 1. INTRODUCTION

This report has been prepared by the Executive Director's Office (ED Office) of the Platte River Recovery Implementation Program (Program) to summarize the third season of groundwater recharge operations in the fall of 2013<sup>1</sup> in the Phelps County Canal. Groundwater recharge in the Phelps County Canal is part of the Nebraska Groundwater Recharge project, which is considered a Tier 1 Water Action Plan (WAP)<sup>2</sup> project. The Program completed a Pre-Feasibility Study<sup>3</sup> in 2010 and a Feasibility Study<sup>4</sup> in 2012 to support the advancement of the Nebraska Groundwater Recharge WAP project. The Feasibility Study included a pilot-scale demonstration recharge project completed in the Phelps County Canal. Based on the successful recharge operations from 2011 through 2013, the Water Advisory Committee (WAC) and Governance Committee (GC) supported a permanent Phelps Groundwater Recharge WAP project and the GC approved a project "score"<sup>5</sup> of 1,800 acre-feet per year (AFY) for the Program in 2013<sup>6</sup>.

The purpose of this 2014 report is to summarize the recharge operations during the 2013-2014 non-irrigation season (also referred to as the recharge season) for the Phelps County Canal Groundwater Recharge WAP project. The Phelps County Canal is located within the Central Nebraska Public Power and Irrigation District's (CNPPID) system in Phelps and Gosper Counties, Nebraska, as shown on **Figure 1** (on the following page).

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<sup>1</sup> The recharge season may include recharge in both the fall and the following spring. However, there was no recharge in the spring of 2014.

<sup>2</sup> See the Reconnaissance-Level WAP is in Attachment 5 (Water Plan) of the Final Platte River Recovery Implementation Program Document dated October 24, 2006 and the 2009 Water Action Plan Update by the ED Office and the Water Advisory Committee dated February 23, 2010.

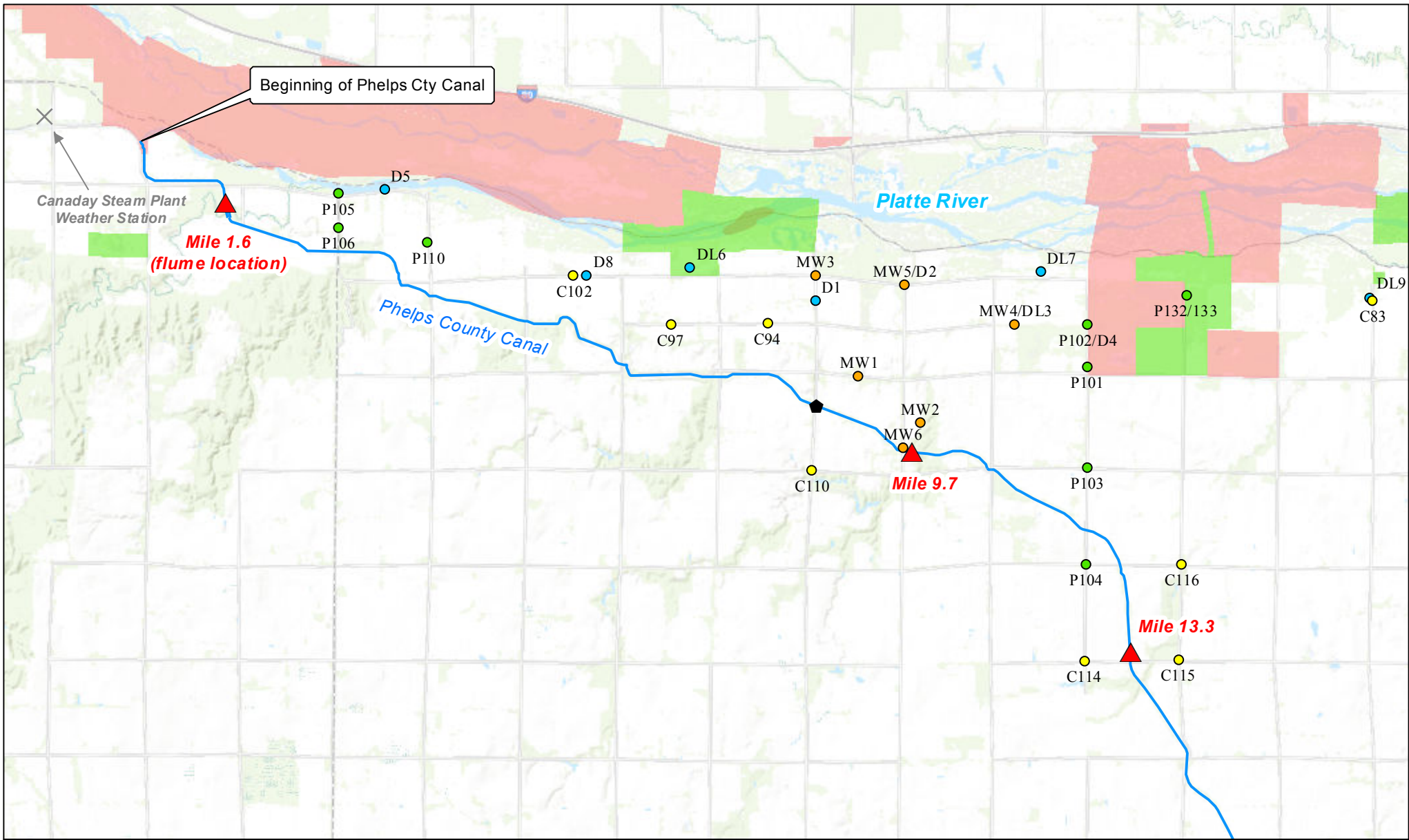
<sup>3</sup> "Platte River Recovery Implementation Program: Nebraska Ground Water Recharge Pre-Feasibility Study" dated August 2010 by the ED Office, WAC, Hahn Water Resources LLC and Ann Bleed and Associates Inc.

<sup>4</sup> "Pilot-Scale Recharge Report for Nebraska Groundwater Recharge Feasibility Study, Platte River Recovery Implementation Program" dated July 2012 by EA Engineering, Science and Technology, Inc. and Daniel B. Stephens & Associates, Inc.

<sup>5</sup> The "score" is in reference to the Program's First Increment Objective of reducing shortages to U.S. Fish and Wildlife Service target flows by an average of 130,000 to 150,000 AFY (WAP projects are 50,000 to 70,000 of that total).

<sup>6</sup> See December 2013 GC Meeting minutes.





### Legend

- ▲ Mile Markers
- Program Monitoring Wells
- CNPPID Monitoring Wells
- TBNRD Monitoring Wells
- Drain Measurement Sites
- ◆ Temperature Sensor
- Phelps County Canal
- Program Lands
- Other Conservation Lands



PLATTE RIVER  
RECOVERY IMPLEMENTATION PROGRAM



0 0.5 1 2  
Miles

FIGURE 1

## GROUNDWATER RECHARGE MONITORING SITES

Date: 05/05/2014

By: SWS

The 2013-2014 recharge operations would not have been possible without cooperation from several key organizations including the CNPPID, the Tri-Basin Natural Resources District (TBNRD), the Nebraska Department of Natural Resources (NDNR), the U.S. Fish and Wildlife Service and the Program through consultation with the WAC and support from the ED Office staff and Special Advisors.

## **2. METHODS & PROCEDURES**

### **2.1. Overview**

Recharge operations during the fall of 2013 occurred in the Phelps County Canal to the check location at Mile Post 13.3<sup>7</sup> for the Program, similar to operations during 2012-2013. A temporary permit to recharge excess flows in the Phelps County Canal was obtained from the NDNR in 2012 that was still in effect through the end of November 2013. The NDNR also allowed all canals in the Platte Basin to divert water for flood relief during this period. A temporary water service agreement was also signed with the CNPPID to allow for recharge during the non-irrigation season.

In September 2013, Colorado experienced record-breaking precipitation that resulted in floodwaters in Colorado and Nebraska. Canals in the Central Platte region diverted water for flood mitigation as well as recharge purposes. During normal recharge operations, the CNPPID would typically check the canal at Mile Post 13.3; however, during the majority of operations in the fall of 2013, the floodwaters were allowed to continue past Mile Post 13.3. The Program only purchased water estimated to have recharged the aquifer up to Mile Post 13.3, per the agreement between the Program and CNPPID.

Deliveries began on September 19, 2013 and continued through October 28, 2013. The total volume delivered was approximately 9,789 acre-feet (AF) of excess flows, as recorded at the Mile Post 1.6 flume. Not all of the diversions were held in the canal sections down to Mile Post 13.3. The canal was filled to MP 13.3 to maximize the seepage rate in those sections of the Phelps County Canal. After the initial fill down to Mile Post 13.3, portions of the diversions were released downstream in the Phelps County Canal for additional recharge and diversion into the Funk Lagoon WPA. On October 22<sup>nd</sup>, the gate at MP 13.3 was closed and all subsequent diversions remained within the upper 13.3 miles and were for recharge purposes. CNPPID estimated the portion of deliveries available for recharge between the flume and Mile Post 13.3 to be 3,890 AF. The Program's portion of the water to Mile Post 13.3 was 50%, or 1,945 AF.

Recharge operations did not occur after October 28, 2013 as there were no or minimal excess flows available to divert into the canal. In addition, RJH Consultants, Inc. completed surveying work in the Phelps County Canal for the J-2 Regulating Reservoir project. During this time, water could not be diverted into the canal.

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<sup>7</sup> 13.3 refers to the approximate distance in miles from the beginning of the Phelps County Canal. There is a check structure in the canal at this location, which enables the canal to function similarly to a recharge basin above this point by impounding water.

## 2.2. Monitoring

### Monitoring Wells

Water level data was continuously monitored, recorded and collected for the Program's six monitoring wells, TBNRD's Overton and Elm Creek Transect Wells and CNPPID's eight monitoring wells equipped with recording pressure transducers. These are the same wells that were monitored during the previous 2012-2013 recharge season. As shown in Figure 1, the network of wells extends over the length of the canal to Mile Post 13.3, and includes wells in the Platte River floodplain and on the terrace south of the floodplain.

### Drains

Drain stages were continuously monitored at four drain sites: DL-3 (Peterson Ditch), DL-6 (North Phelps County Ditch), DL-7 (Batie Ditch) and DL-9 (Peterson Ditch). Weekly staff gage readings were recorded at five other drain sites: D-1 and D-2 (both Batie Ditch), D-4 (Peterson Ditch), D-5 (FX 3.1 Drain) and D-8 (North Phelps County Ditch).

## 2.3. Permitting

CNPPID obtained a temporary permit through the NDNR to appropriate water for groundwater recharge in November 2012. The permit was valid for one year and allowed CNPPID to divert up to 350 cubic feet per second (cfs) or 6,000 AF into the Phelps County Canal. The permit is attached as **Appendix A**. CNPPID also applied for a temporary permit for operations past November 2013; however, the permit is pending and there were no excess flows to divert. CNPPID did not apply to use Environmental Account (EA) water for recharge purposes during the 2013-2014 recharge season.

In September 2012, CNPPID applied for a permanent permit to appropriate water for groundwater recharge in the Phelps County Canal and the E65 Canal. The application is for a total diversion rate of 700 cfs, or 350 cfs in each canal and is pending.

### Operational Thresholds and Outreach

Operational thresholds were developed in coordination with the U.S. Fish and Wildlife Service to serve as project termination triggers in accordance with the Program's "good neighbor policy". It was decided that two Program monitoring wells, MW-1 and MW-2, would serve as the operational threshold monitoring sites<sup>8</sup>:

1. Potential termination of recharge operations would be discussed with U.S. Fish and Wildlife Service, CNPPID and the Program's Nebraska Groundwater Recharge Workgroup if the groundwater levels in Program monitoring wells MW-1 and MW-2 reach their initial elevations for 2011-2012 operations of 2,312.8 feet and 2,312.4 feet, respectively. These two wells are located near the lands where high groundwater was reported during the 2011-2012 recharge

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<sup>8</sup> See memorandum from ED Office to U.S. Fish and Wildlife Service regarding "Use of Environmental Account Water for Groundwater Recharge" dated November 26, 2012.

period, and their groundwater levels showed a noticeable response to the pilot project recharge operations.

2. If groundwater levels in any of the Program monitoring wells consistently approach their initial elevation for 2011-2012 operations, then potential termination of recharge operations to prevent waterlogged fields would be discussed with U.S. Fish and Wildlife Service, CNPPID, and the Program's Nebraska Groundwater Recharge Workgroup. Recharge operations would not be terminated because of short-term water level increases in response to precipitation events.

The water levels in MW-1 and MW-2 did not meet the thresholds during the fall 2013 recharge operations. The water levels also did not reach the threshold in the previous year of operations from 2012-2013.

#### **2.4. Staffing**

Continuous monitoring data was collected on a monthly basis for the six Program wells, nine TBNRD wells, eight CNPPID wells and the four drain sites. In addition, the ED Office staff collected weekly staff gage readings at five additional drain sites. Program well water level and drain stage data were downloaded by the Program's ED Office. TBNRD and CNPPID downloaded data from their wells and provided it to the ED Office. CNPPID also operated the Phelps County Canal for the recharge project and submitted the permit application for temporary operations.

The ED Office analyzed the monitoring well and drain data. The information was distributed to the Nebraska Groundwater Recharge Workgroup after the fall 2013 diversions. The ED Office also presented an update on the recharge operations to the WAC at the February 2014 meeting. For the MW-1 and MW-2 monitoring wells, the ED Office evaluated the water level data monthly to determine if the water levels were approaching the threshold levels.

### **3. RECHARGE RESULTS AND DISCUSSION**

#### **3.1. Recharge Water Balance**

Recharge operations began on September 19, 2013 and continued through October 28, 2013. There were no diversions into the Phelps Canal for recharge after October 28<sup>th</sup> for the 2013-2014 recharge season. The volume of Phelps County Canal groundwater recharge was calculated using the methodology presented in the Feasibility Study and 2013 Report<sup>9</sup>. The rate of recharge was estimated as the volume of water delivered through the flume at Mile Post 1.6 plus the net of evaporation and precipitation occurring on the water surface in the canal. The volume of recharge that was credited in the upper 13.3 miles of the Phelps County Canal consisted of the following: 1) all diversions that were utilized to fill the canal to MP 13.3, 2) an estimated 36 cfs per day rate for all days

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<sup>9</sup> "Nebraska Groundwater Recharge: 2012-2013 Phelps County Canal Recharge Report" dated June 2013 by the ED Office.

when the MP 13.3 check gate was passing water downstream, and 3) all diversions after mid-day October 21<sup>st</sup> after the MP 13.3 gate was closed. CNPPID reported that the leakage through the check structure at Mile Post 13.3 was negligible after it was shut. The estimated delivery rate of 36 cfs per day was determined by the Program and CNPPID staff based on previous recharge period experiences and measurements. The methodology is described further in the following paragraph.

*Estimated Diversions to Mile Post 13.3 through October 21, 2013*

The delivery rate in the canal up to Mile Post 13.3 was estimated during times when the canal was not checked (September 19, 2013 to October 21, 2013), as there was no measurement device to determine the amount flowing below Mile Post 13.3. In general, after the canal fills along its entire length during the first few days of diversions, the delivery rate becomes approximately equal to the recharge rate, as the CNPPID fills the canal based on the amount of seepage lost from the canal. The estimated 36 cfs delivery rate up to Mile Post 13.3 was based on the average unit recharge rate of 3.1 cfs per mile observed during the 2011-2012 recharge season.

The recharge rate from the 2011-2012 season was used because it was thought to be more representative of 2013 conditions. The 2011-2012 operations were completed in the fall, as were the 2013 operations, while 2012-2013 operations occurred in the winter months. This is an important consideration because recharge rates are related to water temperature and its effects on water viscosity. Water temperature data from the U.S. Geological Survey's Platte River near Overton, NE station (Station No. 06768000) was compared for the 2011 and 2013 seasons. Water temperature in the canal was not utilized for this purpose because the temperature sensor was not installed until the end of October 2013.

Water temperatures in the Platte River at Overton were slightly warmer in 2011 as compared to 2013, with an October average of 56°F in 2011 and 54°F in 2013, but given the small difference in water temperatures, it was assumed that October 2013 recharge rates would be comparable the 2011 observed rates. The water temperatures at Overton are shown in **Figure 2**.



**Figure 2. Comparison of October 2011 and October 2013 water temperatures in the Platte River at Overton.**

Given the relationship between water temperature and recharge rates, it was assumed that the recharge rate was higher in late September and early October 2013 than what was observed in late October 2013 after the canal was checked, which was calculated as 2.4 cfs per mile. Conversely, there was not sufficient basis to warrant the use of the average October 2011 rate of 3.5 cfs per mile. Therefore, the average recharge rate from the 2011-2012 recharge operations of 3.1 cfs per mile was assumed to be reasonable to estimate the September and October 2013 delivery rate of 36 cfs<sup>10</sup>.

#### Total Diversions to Recharge

Excess flows were the only water source delivered into the Phelps County Canal for groundwater recharge in the fall of 2013. **Figure 3** shows the daily canal delivery rates through the Mile Post 1.6 flume during the fall 2013 recharge operations and **Figure 4** is a comparison of the three years of recharge operations. The delivery data from CNPPID is included in **Appendix B**.

<sup>10</sup> 3.1 cfs per mile × (13.3 canal miles – 1.6 canal miles) = 36 cfs.



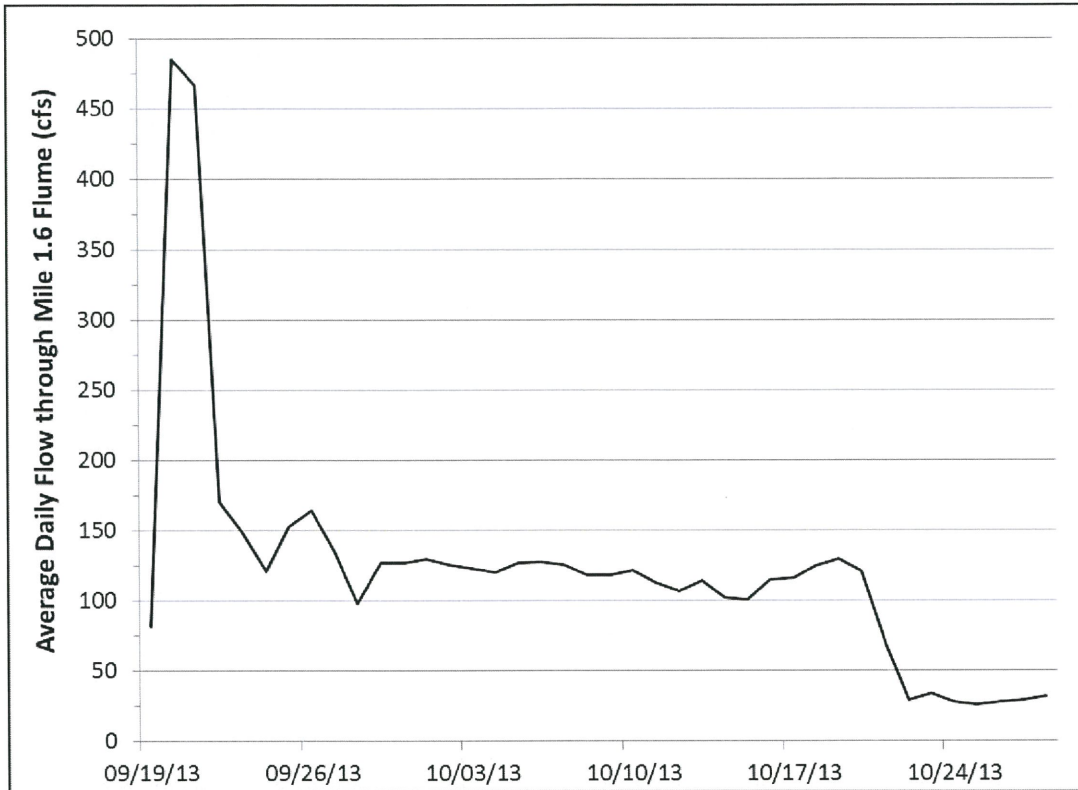


Figure 3. Daily delivery rates through the Mile Post 1.6 flume in fall 2013.

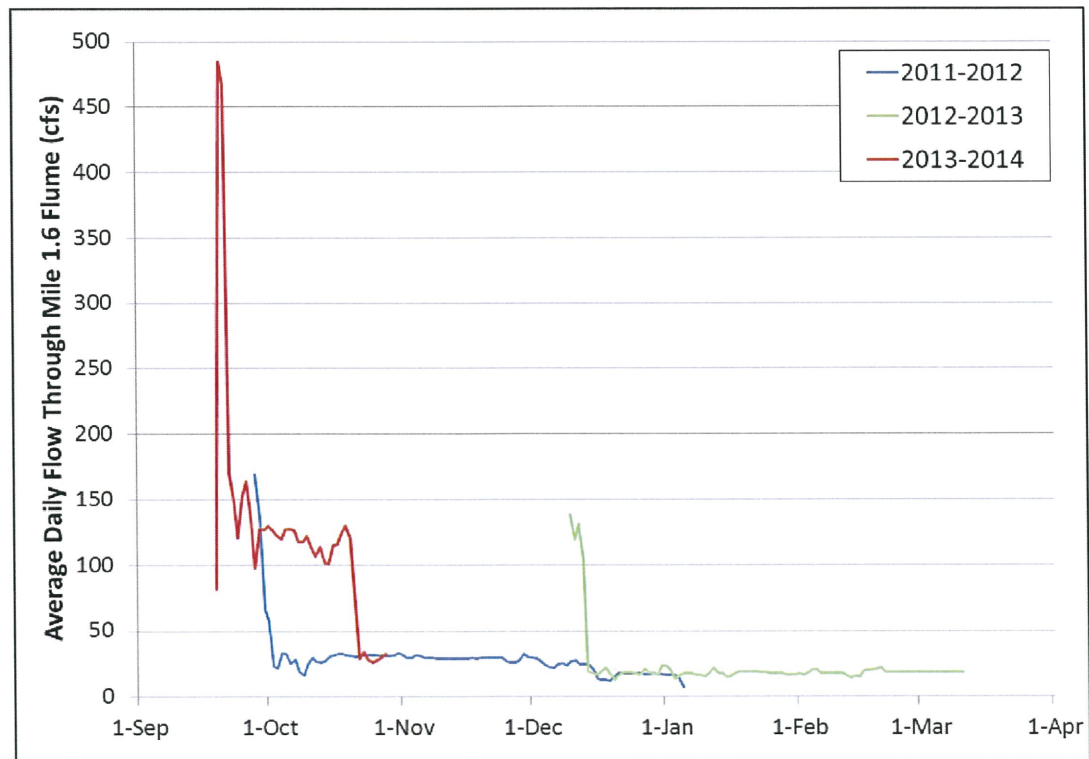


Figure 4. Daily delivery rates through the Mile Post 1.6 flume from 2011-2013.

## Evaporation

Evaporation was calculated using the methodology from the Feasibility Study. In the 2013 Phelps Report, the methodology was modified to assume evaporation was negligible during below-freezing temperatures since an ice cap typically forms on the canal during those periods. In the fall of 2013, temperatures were consistently above freezing; therefore, evaporation losses were deducted from the volume of diversions each month. Air temperature data is included in **Appendix C**. Evaporation was assessed using gross evaporation rates from the Natural Resources Conservation Service for Phelps County<sup>11</sup>. The gross evaporation was applied to the canal surface area during period of recharge operations. **Table 1** is a summary of the mean air temperatures experienced during the period of recharge, gross evaporation in Phelps County and the evaporation calculated for the canal's water surface during recharge operations. In total, 65 AF of deliveries into the canal were lost due to evaporation<sup>12</sup>.

**Table 1. Summary of evaporation estimates during recharge operations.**

| Month  | Days with Recharge Operations | Mean Temperature <sup>1</sup><br>°F | Gross Monthly Evap <sup>2</sup><br>(inches) | Gross Monthly Evap <sup>2</sup><br>(feet) | Calculated Evaporation <sup>3</sup><br>(feet) | Calculated Evaporation to Mile Post 13.3 <sup>4</sup><br>(AF) |
|--------|-------------------------------|-------------------------------------|---|---|---|---|
| Sep-13 | 12                            | 63.7                                | 6.6   | 0.55                                      | 0.22  | 27  |
| Oct-13 | 28                            | 52.1                                | 4.2   | 0.35                                      | 0.32  | 38  |
| Total  | 40                            | -                                   | -   | -   | -   | 65  |

<sup>1</sup>Based on weather data from the Canaday Steam Plant (Station No. 251450) from 9/19/2013 to 10/28/2013. Mean air temperatures based on daily data for days when recharge operations occurred during month.

<sup>2</sup>Monthly evaporation based on NRCS-NE-ENG-81 worksheet provided by EA Engineering, Science, and Technology, Inc.

<sup>3</sup>Gross monthly evaporation is proportioned based on the number of days with recharge.

<sup>4</sup>Surface area based on average canal width of 85 feet, as used in the Feasibility Study. Calculation from the flume to Mile Post 13.3.

## Water Balance Summary

The total volume of water delivered through the flume at Mile Post 1.6 up to Mile Post 13.3 during the 2013-2014 recharge season was 3,890 AF. Of this volume, approximately 3,826 AF of water was recharged from the flume to Mile Post 13.3, after evaporation losses<sup>13</sup>. The Program purchased 50% of the volume delivered into the canal up to Mile Post 13.3. The total Program portion of recharge was approximately 1,913 AF, as shown in **Table 2**.

<sup>11</sup> Provided to the ED Office by EA Engineering, Science, and Technology, Inc. during the Feasibility Study.

<sup>12</sup> Note that the accounting included evaporation during days when there were diversions into recharge. Accounting did not include evaporation for the period following cessation of diversions during which the canal continued to drain – this amount is considered negligible for the purpose of the analysis.

<sup>13</sup> Note that precipitation is not credited towards the Program's recharged volume.



**Table 2. Fall 2013 recharge summary between Mile Post 1.6 and 13.3 (all values in acre-feet\*).**

| Month  | Volume delivered through flume to MP 13.3 | Evaporation | Volume recharged from the flume to MP 13.3 | Program portion of recharge |
|--------|---|-------------|--|-----------------------------|
| Sep-13 | 1,984                                     | 27          | 1,957                                      | 978                         |
| Oct-13 | 1,907                                     | 38          | 1,869                                      | 934                         |
| Total  | 3,890                                     | 65          | 3,826                                      | 1,913                       |

\*Values rounded.

### 3.2. Canal Recharge Rates

Daily recharge and infiltration rates were calculated using a water balance approach based on the delivery data, evaporation rates and precipitation data. Delivery data and evaporation rates were provided in Section 3.1. Precipitation is described in the following paragraph.

#### Precipitation

Precipitation data was obtained for the Canaday Steam Plant climate station (Station No. 251450), located approximately one mile west of the Phelps County Canal headgate. Precipitation data was used to calculate the seepage rate in the canal. Precipitation totaled 4.3 inches during the recharge season from September 19, 2013 through October 28, 2013. Monthly precipitation volumes on the canal were calculated based on an average canal width of 85 feet, and the length of the canal between the flume and Mile Post 13.3. The total gains from precipitation during the recharge period were approximately 44 AF. The monthly precipitation data for September and October 2013 is included in Appendix C.

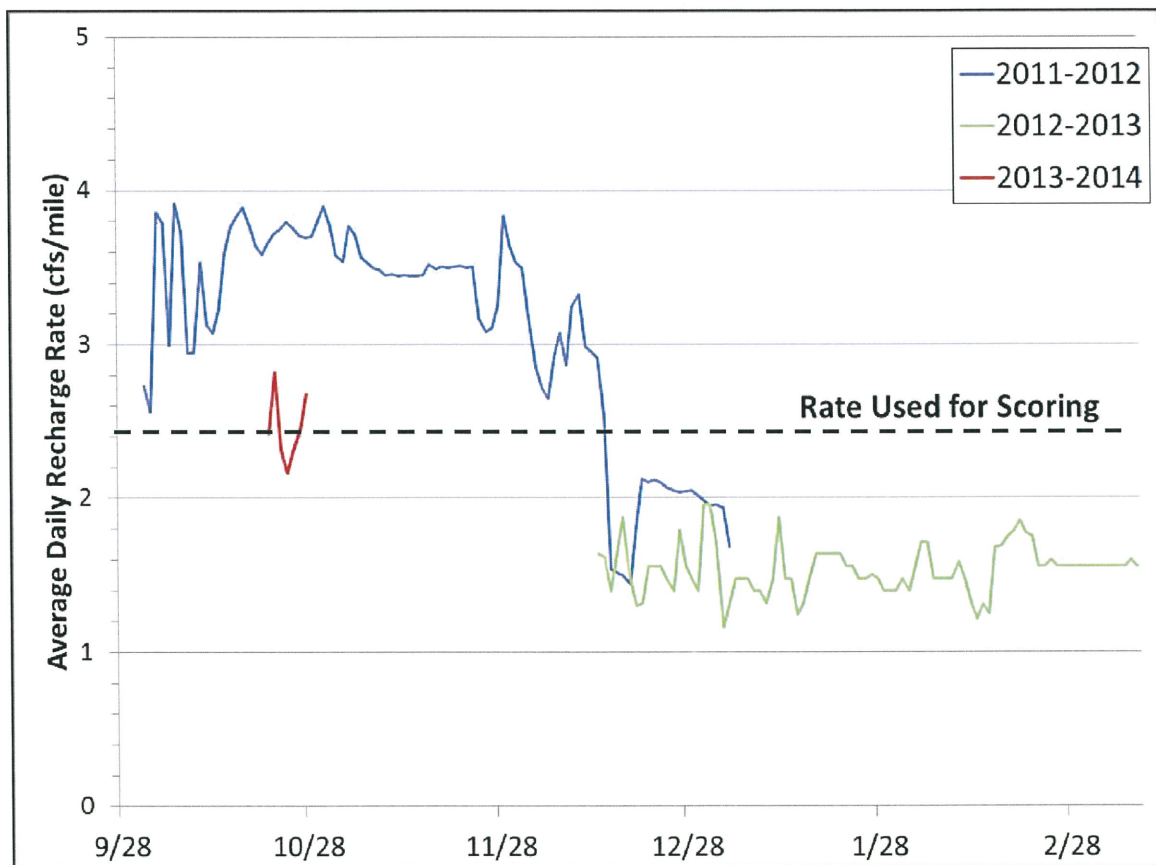
#### Unit Recharge Rate

The canal delivery rates were higher during the first few days of operations in order to fill the canal. The unit recharge rate per mile of canal was calculated when the canal was checked at Mile Post 13.3, which was from October 22<sup>nd</sup> through October 28<sup>th</sup>. The unit recharge rate averaged 2.4 cfs/mile during this time, as shown in Appendix B. A recharge rate was not calculated during the period prior to October 22<sup>nd</sup>, as the check at Mile Post 13.3 was not in place and the volume of water recharged in this canal segment could not be determined. The calculated daily unit recharge rates are shown in **Table 3** and **Figure 5** for the past three years of recharge operations.

**Table 3. Summary of unit recharge rates and infiltration rates during the three recharge seasons.**

| Period    | Parameter          | Units          | Minimum | Average | Maximum |
|-----------|--------------------|----------------|---------|---------|---------|
| 2011-2012 | Unit Recharge Rate | (cfs/mile/day) | 1.4     | 3.1     | 3.9     |
|           | Infiltration Rate* | (feet/day)     | 0.3     | 0.6     | 0.8     |
| 2012-2013 | Unit Recharge Rate | (cfs/mile/day) | 1.2     | 1.5     | 2.0     |
|           | Infiltration Rate* | (feet/day)     | 0.2     | 0.3     | 0.4     |
| 2013-2014 | Unit Recharge Rate | (cfs/mile/day) | -       | 2.4     | -       |
|           | Infiltration Rate* | (feet/day)     | -       | 0.5     | -       |

\*Based on unit recharge rates for each canal mile using a canal width of 85 feet.

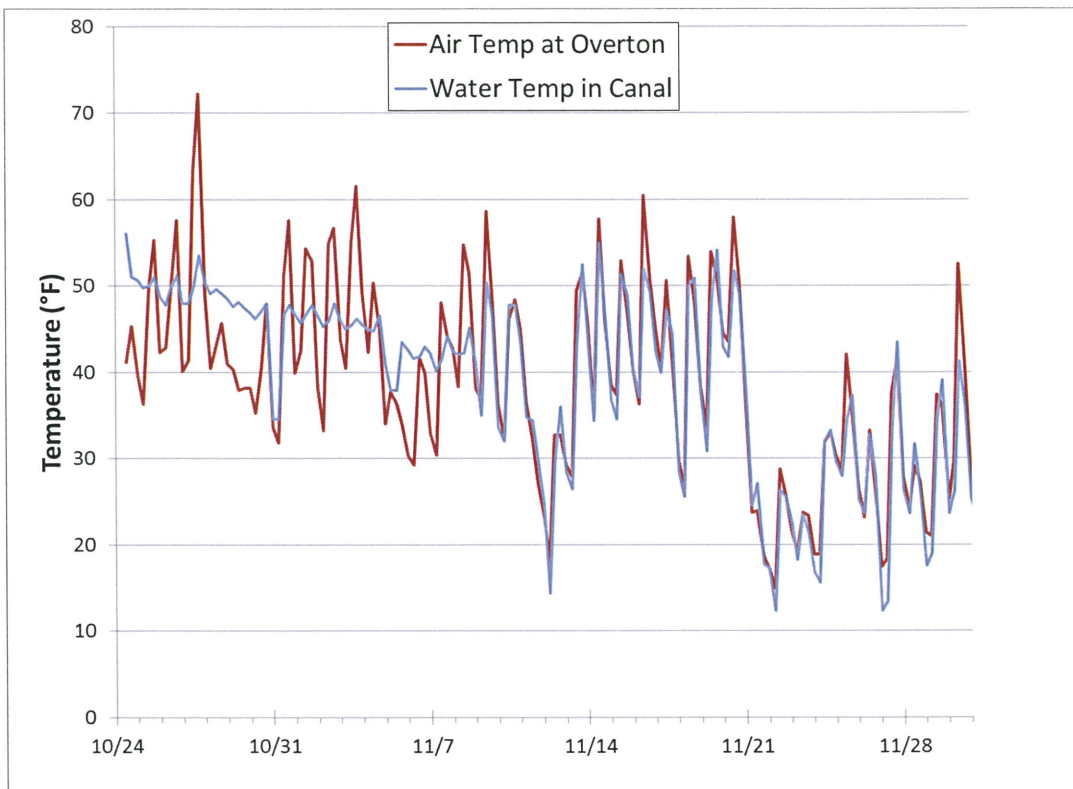


**Figure 5. Daily unit recharge rates in Phelps County Canal from 2011-2013.**

### 3.3. Water Temperature

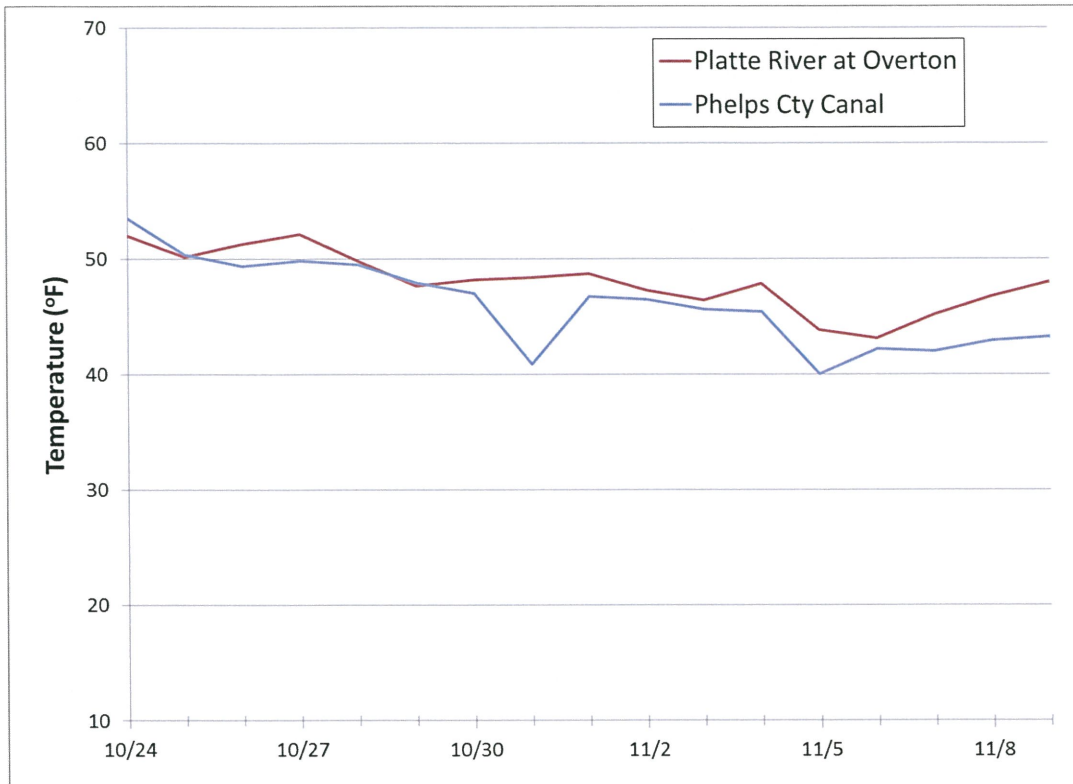
Water temperature data was collected in the Phelps County Canal beginning October 24, 2013. **Figure 6** shows the water temperatures in the canal and the air temperatures at the Platte River near Overton, NE station. The Overton station data was utilized, as hourly data is readily available online. At the end of October, the canal water temperatures appear to be more stable than the air temperatures, which show variation throughout the day and variation from day to day. The temperatures match closely after approximately

the first week of November. It is likely that the canal had drained below the sensor location by this time and the sensor was measuring air temperature.



**Figure 6. Water temperatures in Phelps County Canal compared to air temperatures at Overton.**

The temperature in the Phelps County Canal and in the Platte River at Overton are similar during the approximate dates when the canal temperature sensor was reading water temperature, from October 24<sup>th</sup> (when the sensor was installed) through approximately the first week of November. This is shown in **Figure 7**. Since the water temperatures in the Platte River and the Phelps County Canal are similar, it appears the temperature comparison in Section 3.1 is appropriate to estimate a delivery rate.



**Figure 7. Water temperatures in the Phelps County Canal and the Platte River at Overton.**

### 3.4. Groundwater Level Response

The groundwater levels in the beginning of the 2013-2014 recharge season were lower in comparison to the initial elevations during the previous two years of recharge. The water levels for the Program wells, CNPPID wells and TBNRD wells are described further below.

#### 3.4.1. Program Wells

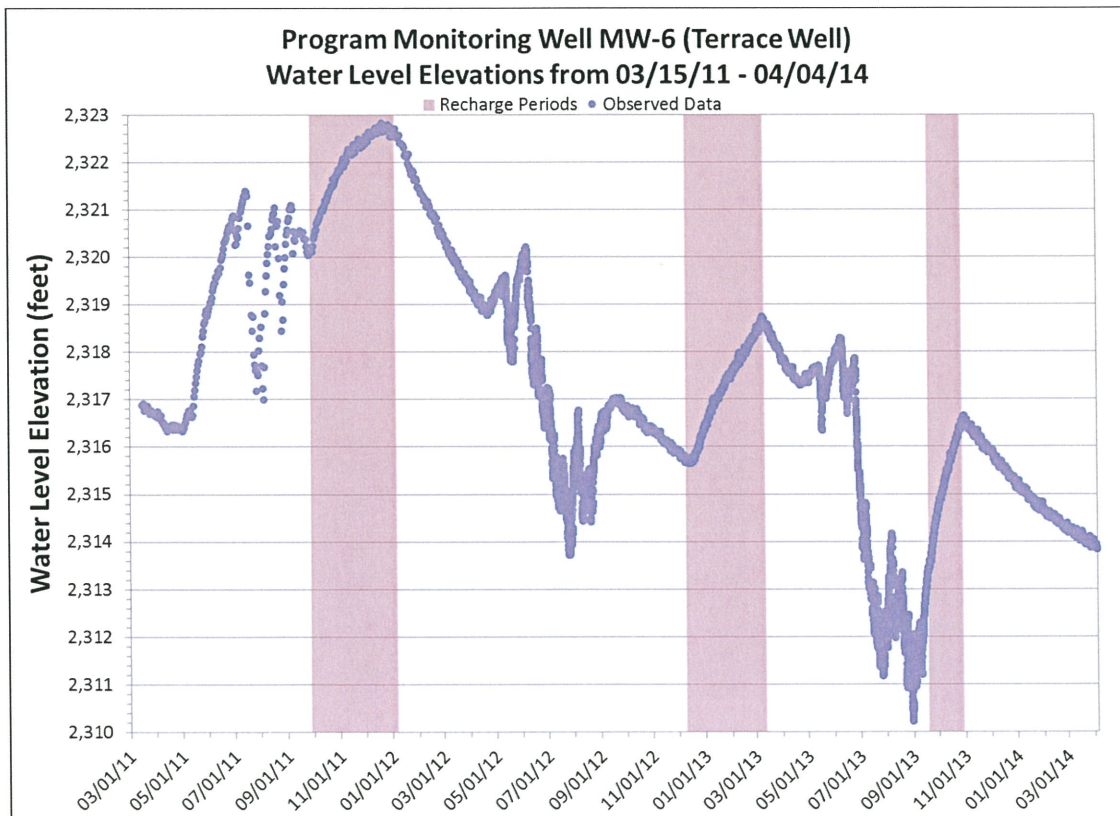
Groundwater levels in the six Program monitoring wells were 1.6 to 4.1 feet lower at the commencement of the 2013-2014 recharge season than the previous season. **Table 4** is a summary of the beginning water levels for each year of recharge.



**Table 4. Summary of pre-recharge water levels in Program monitoring wells.**

| Date*                              | Initial Water Level Elevations (feet) |        |        |        |        |        |
|------------------------------------|---------------------------------------|--------|--------|--------|--------|--------|
|                                    | MW-1                                  | MW-2   | MW-3   | MW-4   | MW-5   | MW-6   |
| 9/27/2011                          | 2312.7                                | 2312.4 | 2304.4 | 2292.3 | 2298.7 | 2320.1 |
| 12/9/2012                          | 2310.2                                | 2309.7 | 2303.4 | 2291.8 | 2297.9 | 2315.7 |
| 9/18/2013                          | 2306.7                                | 2305.6 | 2302.4 | 2289.6 | 2296.3 | 2313.4 |
| <i>Difference (2013 from 2012)</i> | -3.5                                  | -4.1   | -1.0   | -2.2   | -1.6   | -2.3   |

The water levels in the monitoring wells located on the terrace (MW-1, MW-2 and MW-6) increased more than the wells located on the floodplain (MW-3, MW-4 and MW-5) during the recharge period. All of the Program wells showed an increase in levels from 1.5 to 3.1 feet, with the highest increase observed in MW-6, which is located adjacent to the Phelps County Canal (**Figure 8**). Note that the increase in water levels was calculated during the period when canal diversions were made and do not reflect changes in well levels due to lagged return flows occurring after this period. Wells MW-1 and MW-2 wells did not reach their operational thresholds during the recharge period (**Figures 9 and 10**). **Appendix D** includes the floodplain well graphs and a summary table of the water levels in the Program wells.



**Figure 8. MW-6 Water level elevations.**

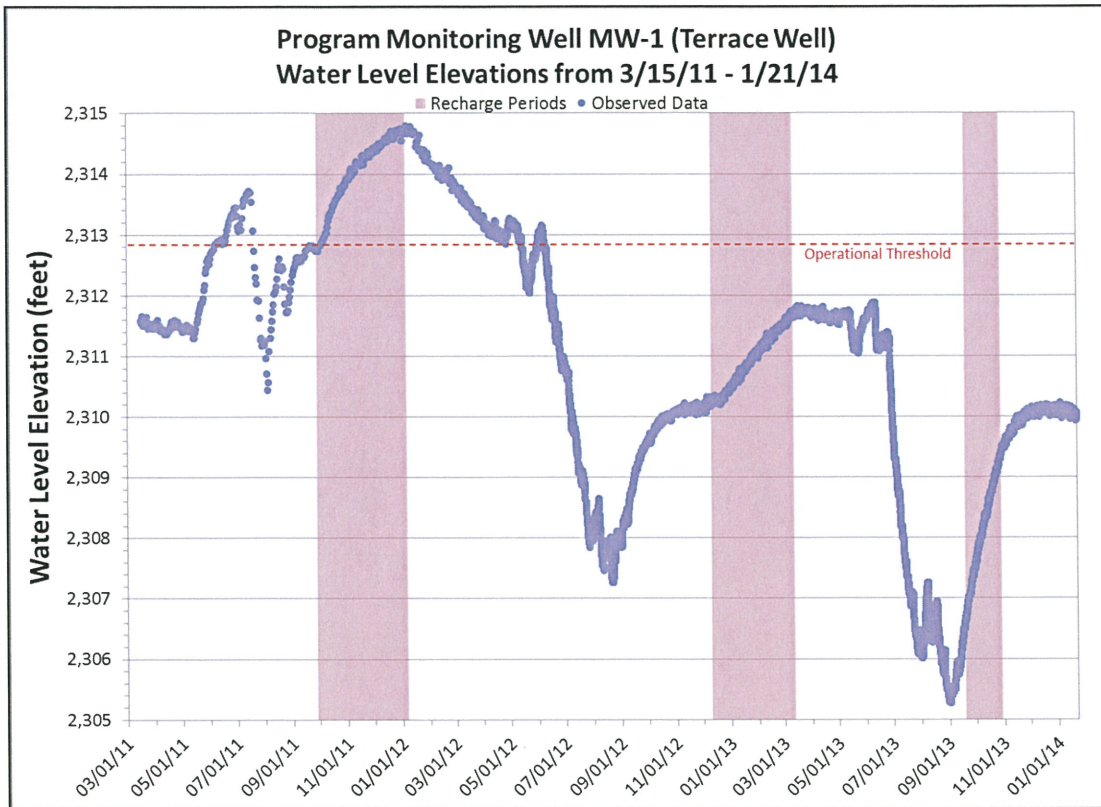


Figure 9. MW-1 Water level elevations.

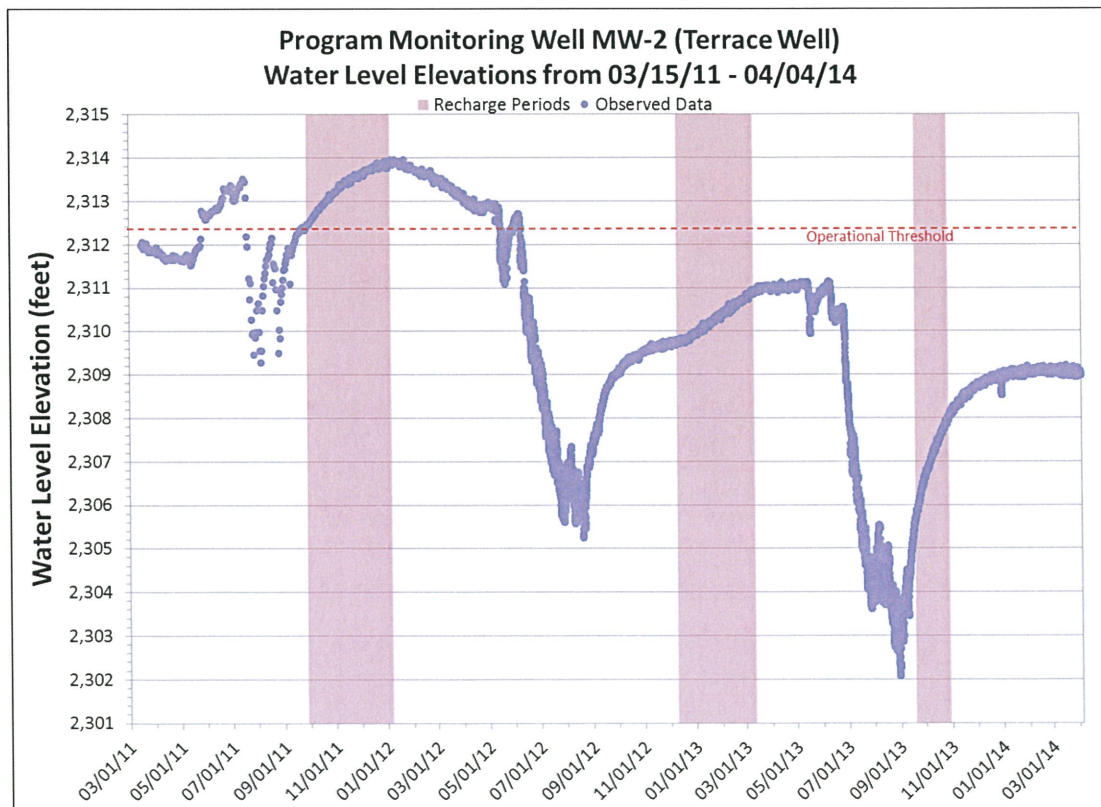
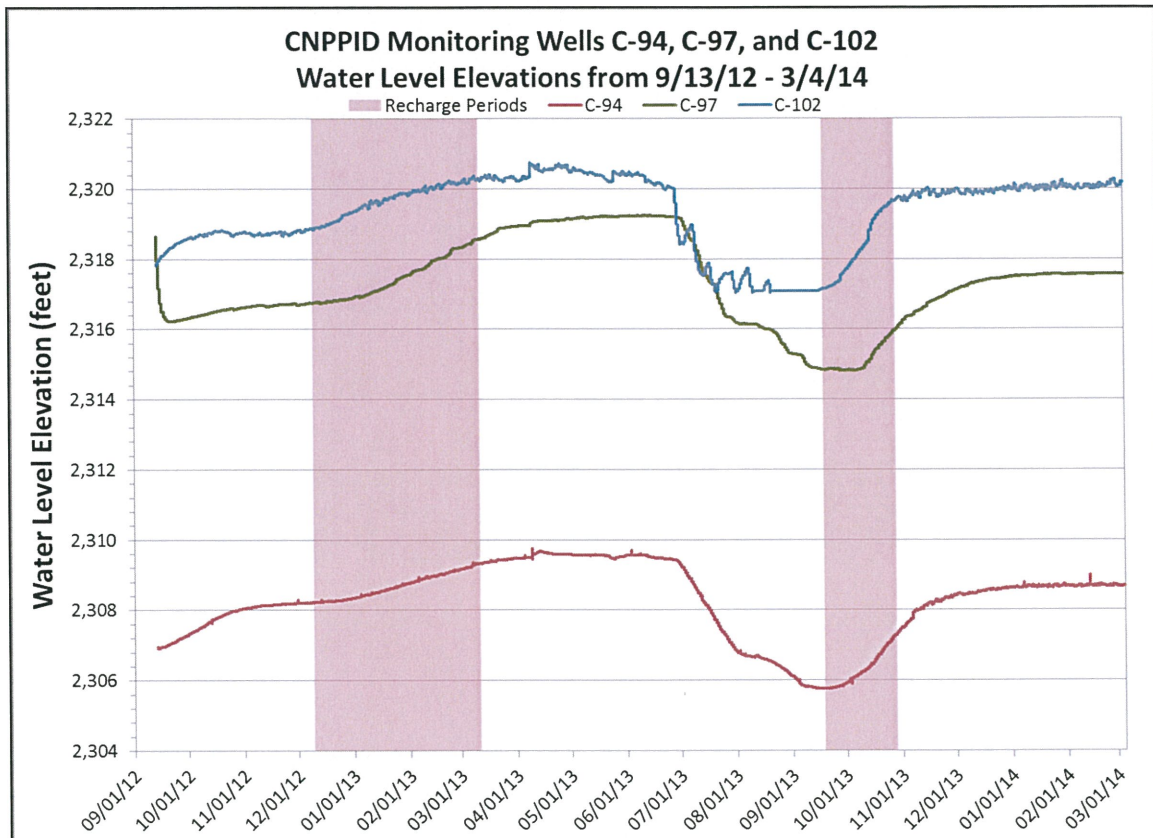


Figure 10. MW-2 Water level elevations.



### 3.4.2. CNPPID Wells

There are eight CNPPID wells equipped with recording pressure transducers. Three wells, C-94, C-97 and C-102, are located in close proximity to the canal and lands identified as being potentially sensitive to recharge. These wells show an upward trend in monitoring well water level elevations during the fall 2013 period of recharge. Monitoring well level data for these wells is presented in **Figure 11**.

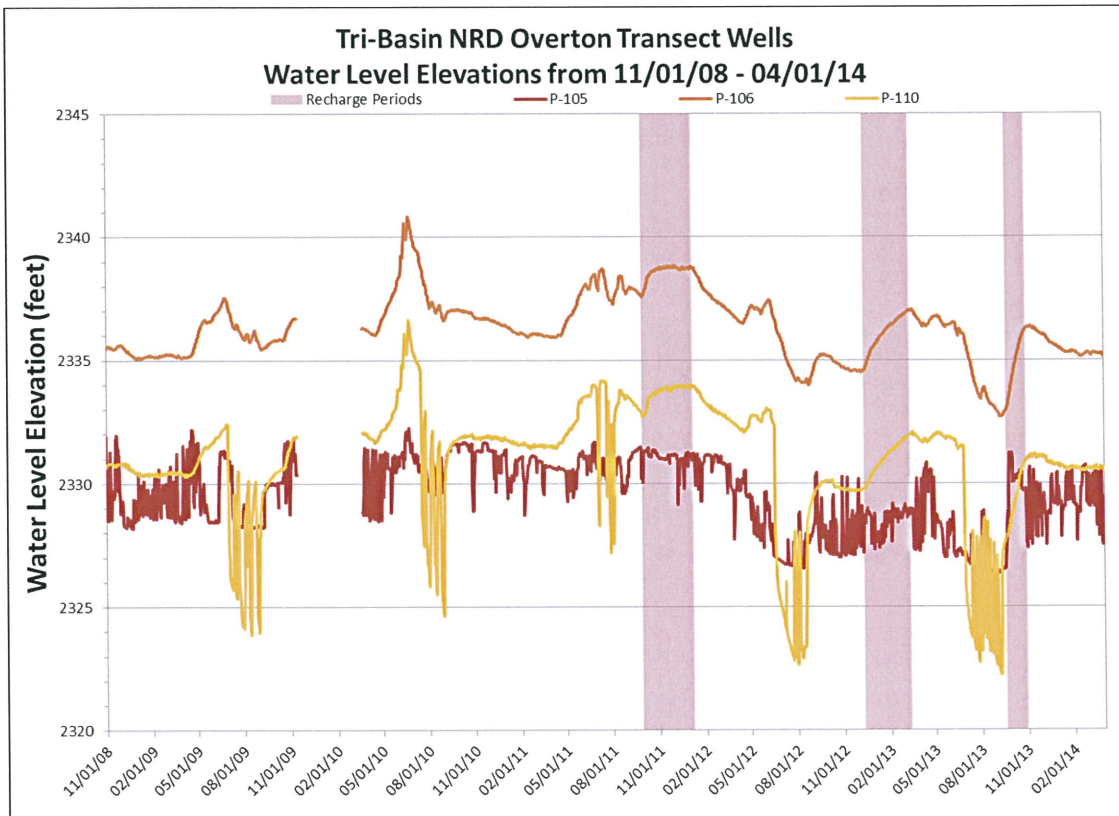


**Figure 11. C-94, C-97 and C-102 water level elevations.**

C-83 is located near the river and may be controlled by river stage. Wells C-110 and C-114 are located upgradient of the Phelps County Canal and were not influenced by the recharge operations. Well C-115 and C-116 are located near Mile Post 13.3. C-115 is located past Mile Post 13.3 and may be influenced by recharge occurring beyond Mile Post 13.3; however, water levels in C-115 and C-116 are difficult to interpret without additional years of data. The water levels for all of the CNPPID monitoring wells located downgradient of the canal increased by 1.1 to 2.5 feet during the recharge period. Water level graphs of the C-83, C-110, C-114, C-115 and C-116 monitoring wells are provided in **Appendix E**. Appendix E also contains a summary table of the water levels in each well during the recharge period.

### 3.4.3. TBNRD Wells

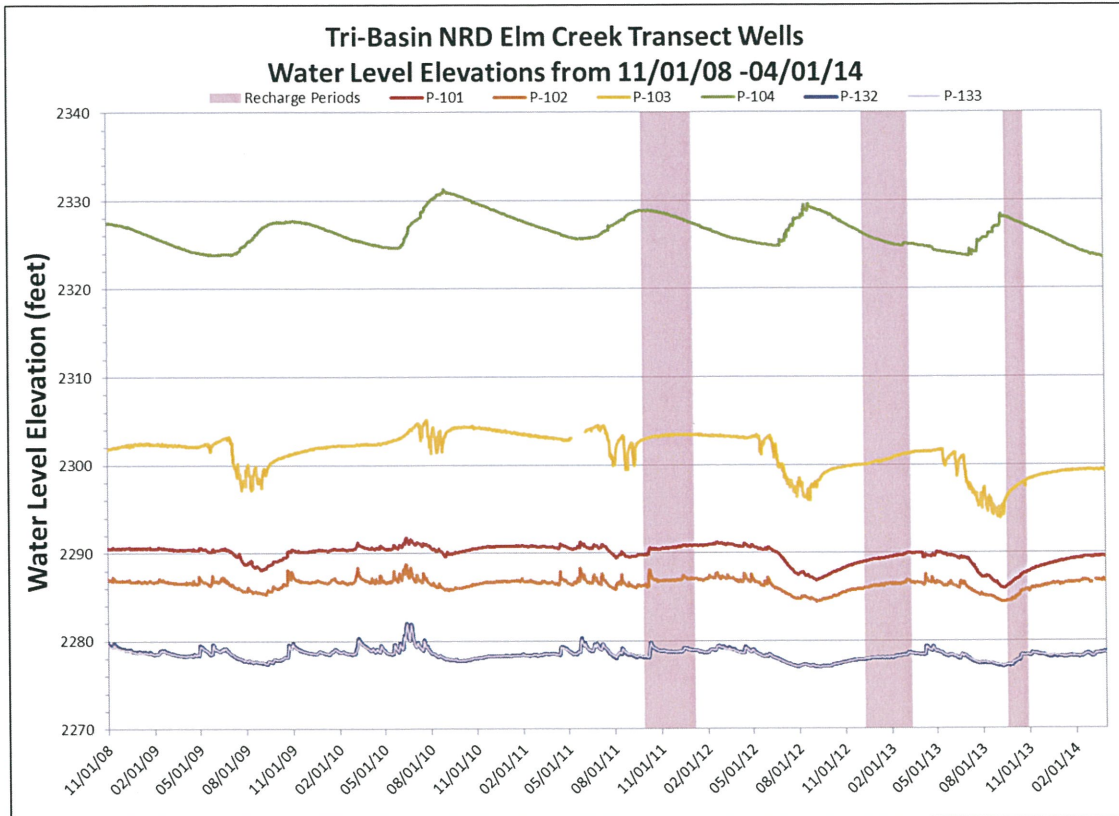
There are nine TBNRD monitoring wells. Three of the wells (P-105, P-106 and P-110) are included in the group of “Overton Transect Wells” and the remaining six wells (P-101 through P-104, P-132 and P-133) are included in the “Elm Creek Transect Wells”. The three Overton Transect Wells are located in the floodplain between the canal and the river and show an increase in water level during the recharge period. P-105 is in close proximity to the river, which appears to significantly influence the water level in the well. P-105 shows an increase in water level of 4.7 feet during the high flow event in September, between September 19<sup>th</sup> and the 25<sup>th</sup>. **Figure 12** shows the water levels in the Overton Transect Wells.



**Figure 12. Overton transect well water level elevations.**

All but one of the Elm Creek Wells are located down gradient of the canal and show an increase in water level during the recharge period. P-104 is located upgradient of the canal and does not show a response to recharge operations. The Elm Creek Transect Well water level elevations are shown in **Figure 13**. The water level elevation data summaries for the TBNRD wells during the fall 2013 recharge period are included as **Appendix F**.





**Figure 13. Elm Creek transect well water level elevations.**

### 3.5. Drains

Stage was continuously monitored at four of the drain sites (DL-3, DL-6, DL-7 and DL-9) and weekly staff gage readings were recorded at the remaining five drain sites (D-1, D-2, D-4, D-5 and D-8). There do not appear to be clear relationships between recharge operations and drain levels at this time. Drain data is included in **Appendix G**.

## 4. CONCLUSIONS

The Phelps County Canal Groundwater Recharge project was successful in recharging excess surface water flows in the fall of 2013. Excess flows were recharged in the canal from September 19, 2013 through October 28, 2013. A total of 3,089 AF of water was delivered into the canal between the measuring flume at Mile Post 1.6 and the check structure at Mile Post 13.3. One-half of this volume, or 1,945 AF, was designated for the Program's Nebraska Groundwater Recharge WAP project. The Program will continue to monitor well levels for the next recharge season beginning in the fall of 2014.

**APPENDIX A:**  
**NDNR PERMIT FOR FALL 2013 OPERATIONS**

STATE OF NEBRASKA  
DEPARTMENT OF NATURAL RESOURCES

APPROVAL OF APPLICATION A-18959

WATER DIVISION 1-A

BACKGROUND

1. On July 14, 2004, the Department of Natural Resources (Department) issued a formal moratorium on all new surface water appropriations in the Platte River Basin upstream of the confluence with the Loup River near Columbus, Nebraska. The moratorium included all tributary streams above the Loup River confluence including the North and South Platte Rivers and tributaries.
2. On January 1, 2007, work officially commenced on the Platte River Recovery and Implementation Program (PRRIP or Program). PRRIP's goals include reducing shortages to U.S. Fish and Wildlife Service target flows and providing additional land habitat for endangered species in the Lexington to Chapman reach of the Platte River. In order to meet these goals, each signatory to PRRIP has adopted depletions plans to address the mitigation of the adverse impacts of certain new water-related activities on streamflows in the Platte River. In addition to focus on new depletion, Nebraska's New Depletion Plan provides that the State of Nebraska will mitigate existing surface water and groundwater uses in order to return to a July 1, 1997, level of water-use development. Portions of the shortages to target flows are intended to be offset through water conservation and water supply projects identified by the PRRIP Governance Committee in the Water Action Plan, which provides guidance in implementing the water component of the Program. A goal of the first thirteen-year increment of the Program is to attempt to retime and improve flows in the central Platte River so as to reduce shortages to target flows by an average of 130,000 to 150,000 acre-feet (AF) per year, as measured at Grand Island.
3. On August 13, 2009, integrated management plans (IMPs) were adopted by order of the Department, pursuant to Neb. Rev. Stat. § 46-718(2), for the following natural resources districts (NRDs): the North Platte NRD, the South Platte NRD, the Twin Platte NRD, the Central Platte NRD, and the Tri-Basin NRD. As part of the surface water controls adopted by the Department pursuant to Neb. Rev. Stat. § 46-716(1)(b), the moratorium on issuing new surface water appropriations was continued.
4. On September 11, 2009, a Basin-Wide Integrated Management Plan (BWIMP) for the overappropriated area of the Platte River Basin was adopted by order of the Department. The BWIMP was also adopted by the following NRDs: the North Platte NRD, the South Platte NRD, the Twin Platte NRD, the Central Platte NRD, and the Tri-Basin NRD. These NRDs are collectively referred to in the BWIMP as the "Platte River Basin NRDs."

5. On July 13, 2012, The Central Nebraska Public Power and Irrigation District (CNPPID), filed petition VAR-2370 for Leave to File or Consider an Application for a Permit to Appropriate Water within a Moratorium Area or Stay Area. The petition requested leave to file an application for a temporary permit to appropriate water for the purpose of groundwater recharge via the Phelps Canal.
6. On August 7, 2012, the Department granted leave to file an application for a permit to appropriate water by approving petition VAR-2370.
7. On August 14, 2012, Don Kraus, P.E., General Manager of CNPPID filed in the Department application A-18959 for a temporary permit to appropriate water for the purpose of groundwater recharge via the Phelps Canal.
8. Temporary permits may not be granted for a term of more than one year.

CONCLUSIONS:

1. Construction of the Tri-County and Phelps Canals has been completed.
2. Applicant has demonstrated there may be unappropriated water in the Platte River during the non-irrigation season.
3. The temporary diversion project proposed by application A-18959 is supported by PRRIP and the U.S. Fish and Wildlife Service.
4. Diversions would occur under the proposed project during the non-irrigation season; therefore, no adverse impacts to existing water users are expected.
5. This project is being implemented pursuant to PRRIP and will only divert water when U.S. Fish and Wildlife Service target flows are exceeded. As such, this project does not constitute a new depletion that requires an offset.

ORDER

IT IS HEREBY ORDERED that application A-18959 is APPROVED subject to the following limitations and conditions:

1. The source of water is the Platte River.
2. The water shall be used for the purpose groundwater recharge via the existing Phelps Canal.
3. The priority date is August 14, 2012.
4. When the specified conditions of this appropriation are met, water may be diverted, at a maximum rate of 350 cubic feet per second, into the headgate of the Tri-County Canal located in Section 8, Township 13 North, Range 29 West of the 6<sup>th</sup> P.M. in Lincoln County.

5. The water under appropriation A-18959 may be diverted after the end of the 2012 irrigation season, prior to the beginning of the 2013 irrigation season, and after the 2013 irrigation season if applicable, if all conditions of this Order are met. Appropriator must coordinate with Department personnel to determine the end and beginning of the irrigation season for the purpose of administering this permit.
6. This appropriation is subject to all regular water administration. No diversion shall occur if the Department determines that, at the time of intended diversion, there is no unappropriated water available in the Platte River or if the appropriation is out of priority.
7. In addition to regular water administration, no diversion of water under this permit may occur if the U.S. Fish and Wildlife Service-specified target flows are not being met, averaged on a daily basis, at the time of the intended diversion, which are specified on **Table A** on page 5. Appropriator must coordinate with the Department's field office in charge of water administration to confirm that this condition is met prior to diversion of water under this appropriation.
8. The Department reserves the right to make adjustments to the amounts listed on Attachment A.
9. The water diverted under appropriation A-18959 through the Tri-County Canal will flow through the canal system and will be used for groundwater recharge via CNPPID's Phelps Canal during the non-irrigation season.
10. The water diverted under A-18959 through the Tri-County Canal and Phelps Canal system may not be used for direct irrigation by CNPPID's customers. The water diverted under A-18959 may only flow through the headgate, canal and lateral system. Any water diverted for the purpose authorized under this permit that does not seep into the groundwater aquifer shall be returned to the river at established spills and drains.
11. If a relinquishment is not submitted first, then appropriation A-18959 will EXPIRE one year from the date of this Order, and appropriation A-18959 will be CANCELLED without further action by the Department as of that date.
12. Within six months after the final date of diversion under this temporary permit, the appropriator shall file a map that depicts where the water was routed, will provide in-depth quantitative analysis to the Department of the recharge achieved by utilizing the Phelps Canal, including all data provided to the Program pursuant to the "Water Service Agreement-Recharge from Excess Flows Between The Central Nebraska Public Power and Irrigation District and Platte River Implementation Program", and detailed drawings of diversion works that are exclusively used for the purpose of this application.

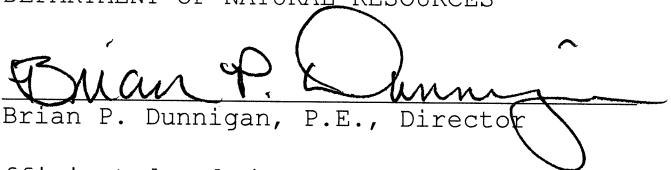
ADDITIONAL INFORMATION

Failure to comply with all laws and regulations pertaining to surface water appropriations, any orders issued by the Director of the Department of Natural Resources, or the provisions of this Approval may result in the cancellation of the appropriation, temporary closing of the appropriation, administrative penalty, criminal prosecution, or any combination thereof.

This appropriation is not a guarantee that water will be available. Nebraska law gives priority to senior appropriations. This appropriation may be closed if there is insufficient water to satisfy senior appropriations.

DEPARTMENT OF NATURAL RESOURCES

November 29, 2012

  
Brian P. Dunnigan, P.E., Director

The applicant and any person with sufficient legal interest who has been or may be substantially affected by this order may request a contested case hearing in accordance with the *Neb. Admin. Procedures Act* §§ 84-901 et. seq. RRS and the Department's *Rules of Practice and Procedure Title 454 Neb. Admin. Code Chapter 7*. The request must be received by the Department at its Lincoln office (Nebraska State Office Building, 4<sup>th</sup> Floor, 301 Centennial Mall South, P.O. Box 94676, Lincoln, Nebraska 68509-4676) within 30 days of the date of the Approval and be accompanied by a filing fee of \$10.

A copy of this approval was posted on the Department's website and provided to the Department's field office in Bridgeport, Nebraska. A copy of this approval was mailed on November 29, 2012, to the following:

Don Kraus, P.E., General Manager  
Central Nebraska Public Power and  
Irrigation District  
P.O. Box 740  
Holdrege, Nebraska 68949-0740

**Table A - Desired Minimum Discharge of the Platte River in cfs**  
**Measured at the Grand Island Stream Gage Relevant to Appropriation A-18959**

| Period                      | PRRIP Target Flows<br>Grand Island |         |         |
|-----------------------------|------------------------------------|---------|---------|
|                             | Wet*                               | Normal* | Dry*    |
| January 1 - January 31      | 1,000                              | 1,000   | 600     |
| February 1 - February 14    | 1,800                              | 1,800   | 1,200   |
| February 15 - February 28   | 3,350                              | 3,350   | 2,250   |
| March 1 - March 15          | 3,350                              | 3,350   | 2,250   |
| March 16 - March 22         | 1,800                              | 1,800   | 1,200   |
| March 23 - March 31         | 2,400                              | 2,400   | 1,700   |
| April 1 - April 14          | 2,400                              | 2,400   | 1,700   |
| April 15 - May 3            | 2,400                              | 2,400   | 1,700   |
| May 4 - May 10              | 2,400                              | 2,400   | 1,700   |
| May 11- May 19              | 1,200                              | 1,200   | 800     |
| May 20 - May 31             | 3,700                              | 3,400   | 800     |
| June 1 - June 20            | 3,700                              | 3,400   | 1,000** |
| June 21 - June 23           | 1,200                              | 1,200   | 1,000** |
| June 24 - July 31           | 1,200                              | 1,200   | 1,000** |
| August 1 - August 22        | 1,200                              | 1,200   | 800     |
| August 23 - August 31       | 1,200                              | 1,200   | 800     |
| September 1 - September 15  | 1,200                              | 1,200   | 800     |
| September 16 - September 30 | 1,000                              | 1,000   | 600     |
| October 1 - October 11      | 2,400                              | 1,800   | 1,350** |
| October 12 - November 10    | 2,400                              | 1,800   | 1,500** |
| November 11 - November 15   | 2,400                              | 1,800   | 1,300   |
| November 16 - December 31   | 1,000                              | 1,000   | 600     |

\* The current Hydrologic Condition, (Wet Normal or Dry) determined by PRRIP can be found at: <http://platteriverprogram.org/PubsAndData/Pages/CurrentHydrologicCondition.aspx>

\*\*Represents the minimum discharge required by instream flow appropriation, which is greater than PRRIP Target Flows, and senior to A-18959

**APPENDIX B:**

**SUMMARY OF UNIT RECHARGE RATE CALCULATIONS UP TO MILE POST 13.3**



Summary of Unit Recharge Rate Calculations up to Mile Post 13.3

| Date       | Total diversions<br>into canal for<br>recharge (cfs) | Diversions up to<br>Mile Post 13.3<br>(cfs) | Volume of<br>diversions up to<br>Mile Post 13.3<br>(AF) | Evaporation<br>from canal<br>surface (AF) | Precipitation on<br>canal surface<br>(AF) | Total volume of<br>recharge (w/precip)<br>(AF) | Unit recharge rate<br>per mile (cfs/mile) |
|------------|--|---|---|---|---|--|---|
|            | (A)  | (B)   | (C)   | (D)                                       | (E)                                       | (F)  | (G)                                       |
| 9/19/2013  | 82.0   | 82.0  | 162.6   | 2.21                                      | 0.05                                      | 160.5  | -   |
| 9/20/2013  | 485.0  | 485.0                                       | 962.0   | 2.21                                      | 0.00                                      | 959.8  | -   |
| 9/21/2013  | 467.0  | 109.0                                       | 216.2   | 2.21                                      | 0.00                                      | 214.0  | -   |
| 9/22/2013  | 170.0  | 36.0  | 71.4  | 2.21                                      | 0.00                                      | 69.2   | -   |
| 9/23/2013  | 149.0  | 36.0  | 71.4  | 2.21                                      | 0.00                                      | 69.2   | -   |
| 9/24/2013  | 121.0  | 36.0  | 71.4  | 2.21                                      | 2.91                                      | 72.1   | -   |
| 9/25/2013  | 153.0  | 36.0  | 71.4  | 2.21                                      | 0.00                                      | 69.2   | -   |
| 9/26/2013  | 164.0  | 36.0  | 71.4  | 2.21                                      | 0.00                                      | 69.2   | -   |
| 9/27/2013  | 135.0  | 36.0  | 71.4  | 2.21                                      | 0.00                                      | 69.2   | -   |
| 9/28/2013  | 98.0   | 36.0  | 71.4  | 2.21                                      | 18.38                                     | 87.6   | -   |
| 9/29/2013  | 127.0  | 36.0  | 71.4  | 2.21                                      | 0.00                                      | 69.2   | -   |
| 9/30/2013  | 127.0  | 36.0  | 71.4  | 2.21                                      | 0.00                                      | 69.2   | -   |
| 10/1/2013  | 130.0  | 36.0  | 71.4  | 1.36                                      | 0.00                                      | 70.0   | -   |
| 10/2/2013  | 126.0  | 36.0  | 71.4  | 1.36                                      | 0.00                                      | 70.0   | -   |
| 10/3/2013  | 123.0  | 36.0  | 71.4  | 1.36                                      | 0.00                                      | 70.0   | -   |
| 10/4/2013  | 120.0  | 36.0  | 71.4  | 1.36                                      | 0.00                                      | 70.0   | -   |
| 10/5/2013  | 127.0  | 36.0  | 71.4  | 1.36                                      | 0.00                                      | 70.0   | -   |
| 10/6/2013  | 128.0  | 36.0  | 71.4  | 1.36                                      | 0.05                                      | 70.1   | -   |
| 10/7/2013  | 126.0  | 36.0  | 71.4  | 1.36                                      | 0.00                                      | 70.0   | -   |
| 10/8/2013  | 118.0  | 36.0  | 71.4  | 1.36                                      | 0.00                                      | 70.0   | -   |
| 10/9/2013  | 118.0  | 36.0  | 71.4  | 1.36                                      | 0.00                                      | 70.0   | -   |
| 10/10/2013 | 122.0  | 36.0  | 71.4  | 1.36                                      | 0.00                                      | 70.0   | -   |
| 10/11/2013 | 113.0  | 36.0  | 71.4  | 1.36                                      | 5.63                                      | 75.7   | -   |
| 10/12/2013 | 107.0  | 36.0  | 71.4  | 1.36                                      | 0.00                                      | 70.0   | -   |
| 10/13/2013 | 114.0  | 36.0  | 71.4  | 1.36                                      | 0.00                                      | 70.0   | -   |
| 10/14/2013 | 102.0  | 36.0  | 71.4  | 1.36                                      | 0.00                                      | 70.0   | -   |
| 10/15/2013 | 101.0  | 36.0  | 71.4  | 1.36                                      | 16.37                                     | 86.4   | -   |
| 10/16/2013 | 115.0  | 36.0  | 71.4  | 1.36                                      | 0.05                                      | 70.1   | -   |
| 10/17/2013 | 116.0  | 36.0  | 71.4  | 1.36                                      | 0.00                                      | 70.0   | -   |
| 10/18/2013 | 125.0  | 36.0  | 71.4  | 1.36                                      | 0.00                                      | 70.0   | -   |
| 10/19/2013 | 130.0  | 36.0  | 71.4  | 1.36                                      | 0.00                                      | 70.0   | -   |
| 10/20/2013 | 121.0  | 36.0  | 71.4  | 1.36                                      | 0.00                                      | 70.0   | -   |
| 10/21/2013 | 69.0   | 36.0  | 71.4  | 1.36                                      | 0.00                                      | 70.0   | -   |
| 10/22/2013 | 29.0   | 29.0  | 57.5  | 1.36                                      | 0.05                                      | 56.2   | 2.4                                       |
| 10/23/2013 | 33.6   | 33.6  | 66.7  | 1.36                                      | 0.05                                      | 65.4   | 2.8                                       |
| 10/24/2013 | 27.8   | 27.8  | 55.0  | 1.36                                      | 0.00                                      | 53.7   | 2.3                                       |
| 10/25/2013 | 26.0   | 26.0  | 51.6  | 1.36                                      | 0.00                                      | 50.2   | 2.2                                       |
| 10/26/2013 | 27.7   | 27.7  | 54.9  | 1.36                                      | 0.00                                      | 53.5   | 2.3                                       |
| 10/27/2013 | 29.3   | 29.3  | 58.2  | 1.36                                      | 0.00                                      | 56.8   | 2.4                                       |
| 10/28/2013 | 32.0   | 32.0  | 63.5  | 1.36                                      | 0.00                                      | 62.1   | 2.7                                       |
| Total      | -  | -   | 3,890   | 65  | 44  | 3,869  | -   |

(A) and (B): provided by CNPPID

(C) : Column (B)  $\times$  1.9835

(D): Calculated using methodology in the Feasibility Study

(E): Data from the Canaday Steam Plant station

(F): Columns (C - D + E)

(G): (Column F  $\div$  1.9835)  $\div$  11.7 miles of canal from the flume to MP 13.3

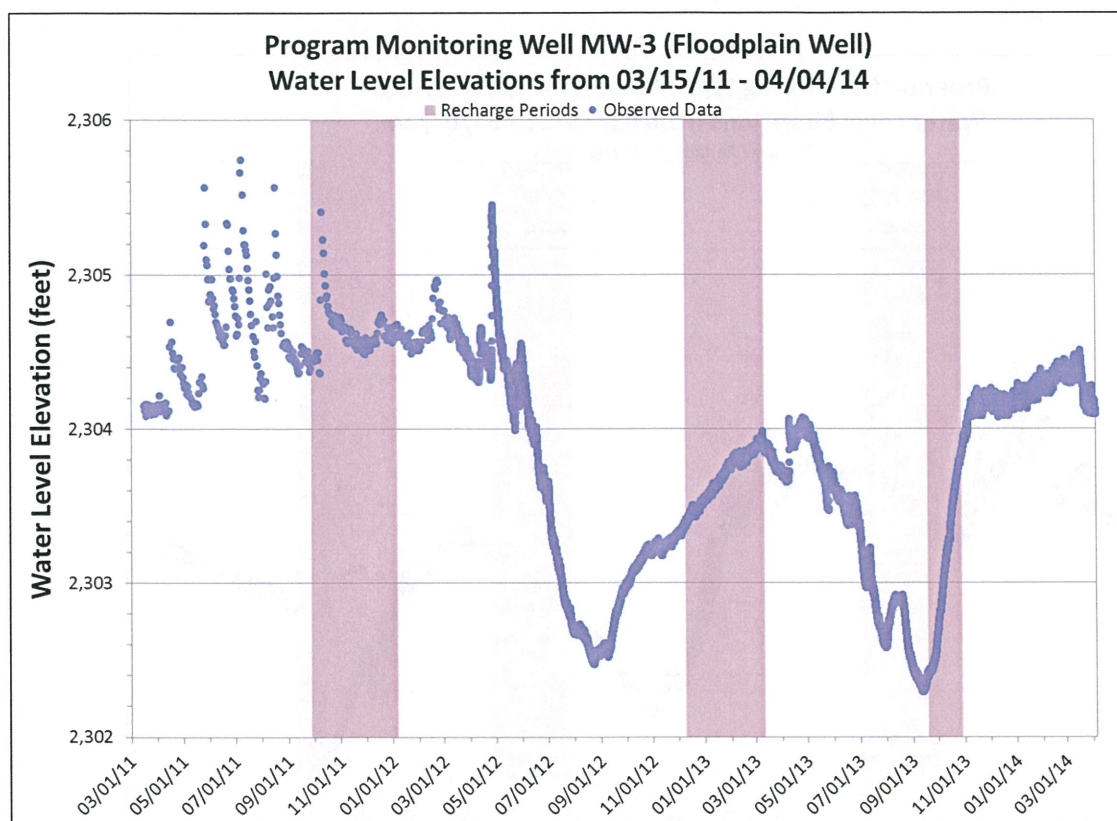
**APPENDIX C:**

**CANADAY STEAM PLANT STATION NO. 254260 DATA**

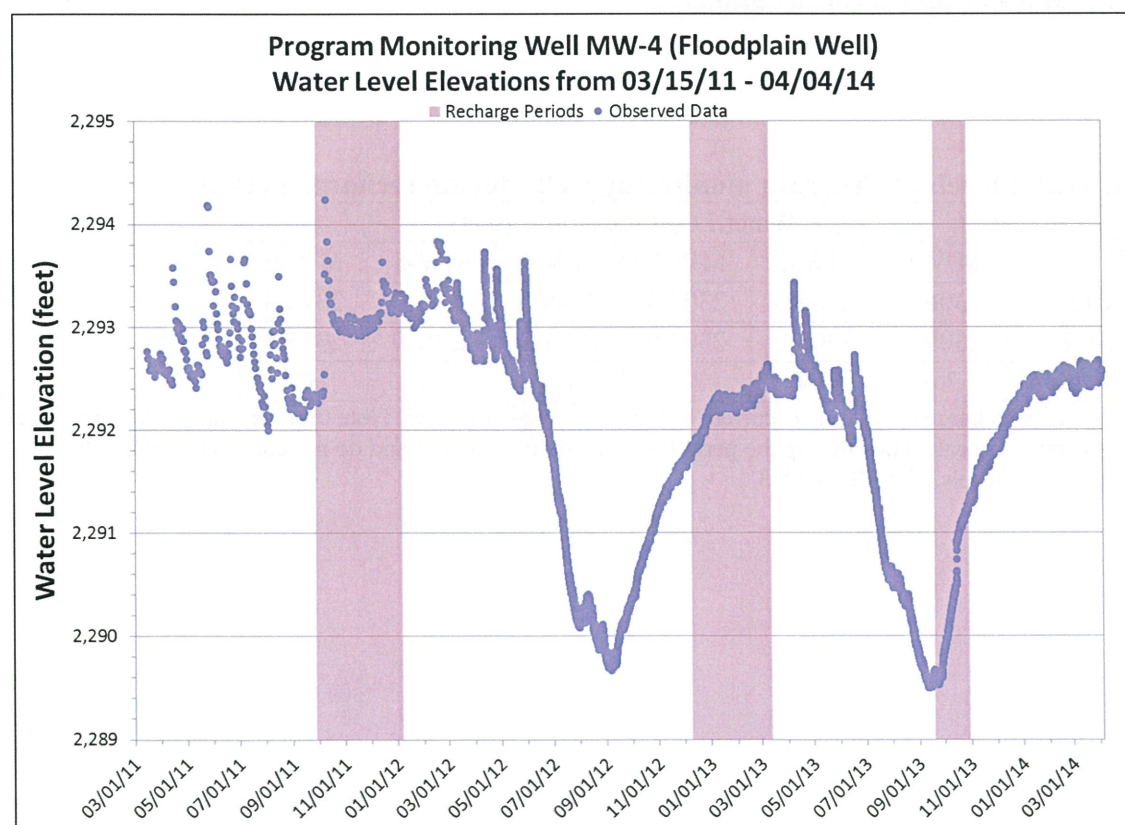
**Canaday Steam Plant Station No. 254260 Data**

| Date       | Average Temperature (oF) | Precipitation (inches) |
|------------|--------------------------|------------------------|
| 9/1/2013   | 77                       | 0.12                   |
| 9/2/2013   | 69                       | 0                      |
| 9/3/2013   | 70                       | 0                      |
| 9/4/2013   | 71                       | 0                      |
| 9/5/2013   | 79                       | 0                      |
| 9/6/2013   | 79                       | 0                      |
| 9/7/2013   | 83                       | 0                      |
| 9/8/2013   | 81                       | 0                      |
| 9/9/2013   | 80                       | 0                      |
| 9/10/2013  | 81                       | 0                      |
| 9/11/2013  | 77                       | Tr                     |
| 9/12/2013  | 70                       | 0.02                   |
| 9/13/2013  | 68                       | 0                      |
| 9/14/2013  | 62                       | 0                      |
| 9/15/2013  | 68                       | 0.2                    |
| 9/16/2013  | 63                       | Tr                     |
| 9/17/2013  | 56                       | 0.01                   |
| 9/18/2013  | 70                       | 0                      |
| 9/19/2013  | 77                       | Tr                     |
| 9/20/2013  | 56                       | 0                      |
| 9/21/2013  | 59                       | 0                      |
| 9/22/2013  | 62                       | 0                      |
| 9/23/2013  | 63                       | 0                      |
| 9/24/2013  | 65                       | 0.29                   |
| 9/25/2013  | 63                       | 0                      |
| 9/26/2013  | 66                       | 0                      |
| 9/27/2013  | 75                       | 0                      |
| 9/28/2013  | 61                       | 1.83                   |
| 9/29/2013  | 56                       | 0                      |
| 9/30/2013  | 61                       | 0                      |
| 10/1/2013  | 64                       | 0                      |
| 10/2/2013  | 64                       | 0                      |
| 10/3/2013  | 64                       | 0                      |
| 10/4/2013  | 64                       | 0                      |
| 10/5/2013  | 53                       | 0                      |
| 10/6/2013  | 41                       | Tr                     |
| 10/7/2013  | 50                       | 0                      |
| 10/8/2013  | 57                       | 0                      |
| 10/9/2013  | 65                       | 0                      |
| 10/10/2013 | 63                       | 0                      |
| 10/11/2013 | 65                       | 0.56                   |
| 10/12/2013 | 51                       | 0                      |
| 10/13/2013 | 51                       | 0                      |
| 10/14/2013 | 54                       | 0                      |
| 10/15/2013 | 53                       | 1.63                   |
| 10/16/2013 | 40                       | Tr                     |
| 10/17/2013 | 44                       | 0                      |
| 10/18/2013 | 41                       | 0                      |
| 10/19/2013 | 41                       | 0                      |
| 10/20/2013 | 49                       | 0                      |
| 10/21/2013 | 48                       | 0                      |
| 10/22/2013 | 49                       | Tr                     |
| 10/23/2013 | 48                       | Tr                     |
| 10/24/2013 | 51                       | 0                      |
| 10/25/2013 | 40                       | 0                      |
| 10/26/2013 | 46                       | 0                      |
| 10/27/2013 | 47                       | 0                      |
| 10/28/2013 | 55                       | 0                      |
| 10/29/2013 | 40                       | 0.04                   |
| 10/30/2013 | 40                       | 0.03                   |
| 10/31/2013 | 39                       | 0                      |

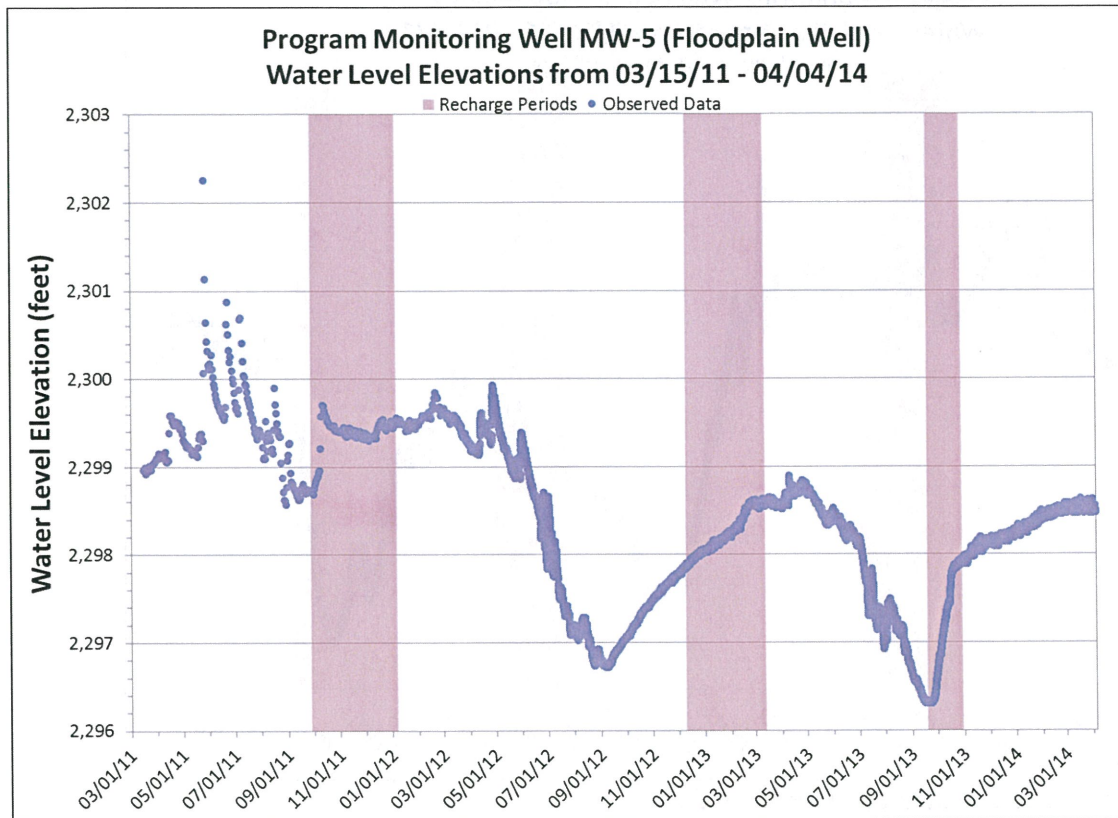
**APPENDIX D:**  
**PROGRAM MONITORING WELL DATA**



**Figure D-1: MW-3 water level elevations.**



**Figure D-2: MW-4 water level elevations.**



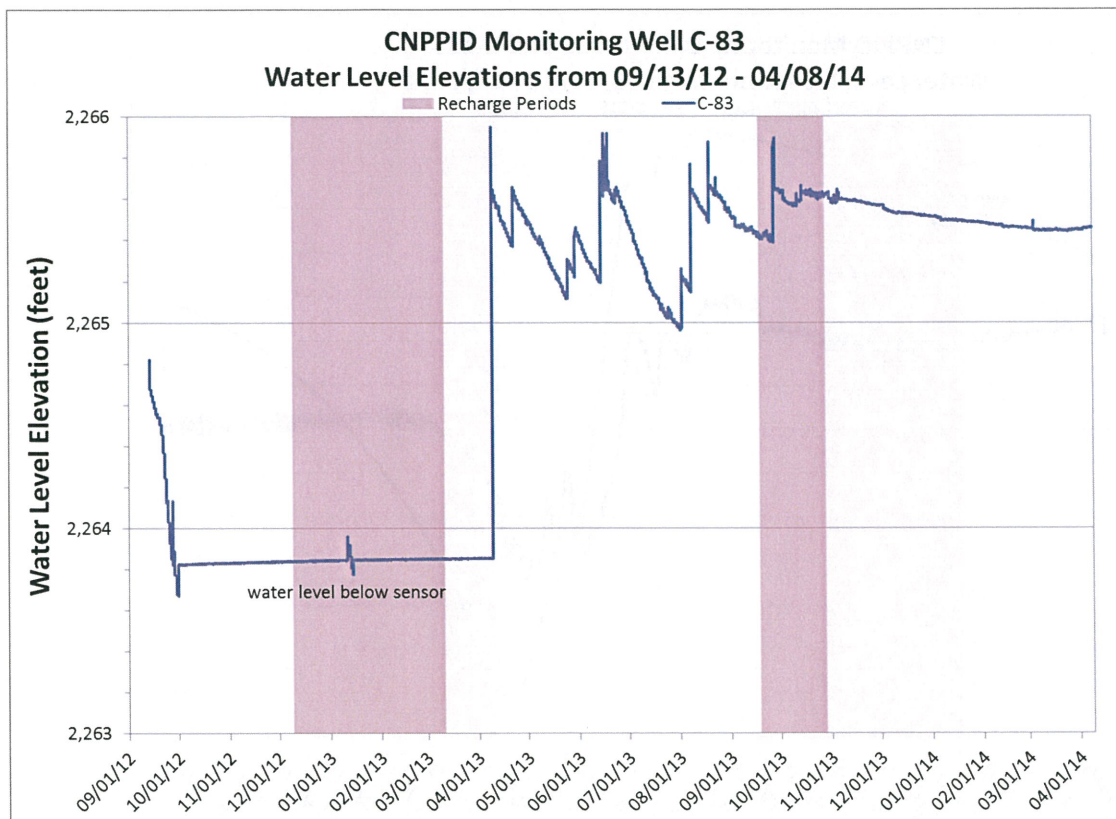
**Figure D-3: MW-5 water level elevations.**

**Table D-1. Water levels in Program monitoring wells during recharge period.**

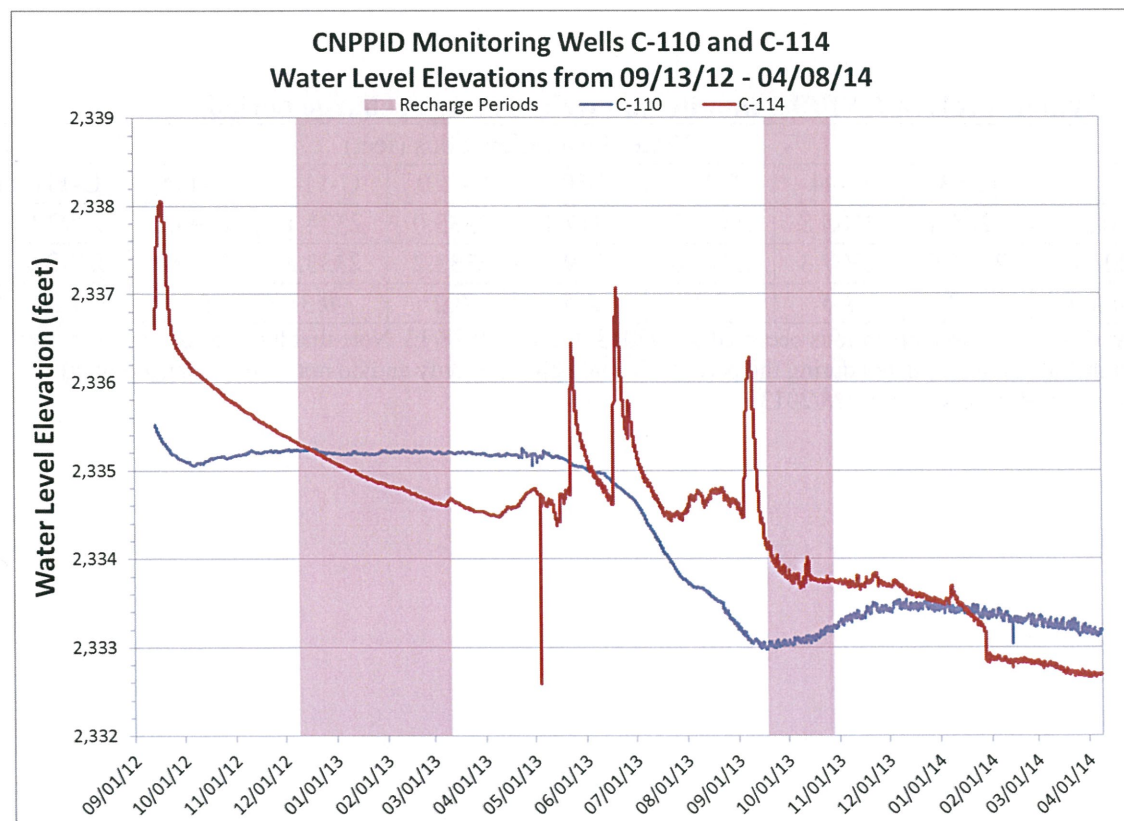
| Date                   | Water Level Elevations (feet) |            |            |            |            |            |
|------------------------|-------------------------------|------------|------------|------------|------------|------------|
|                        | MW-1                          | MW-2       | MW-3       | MW-4       | MW-5       | MW-6       |
| 9/18/2013              | 2306.7                        | 2305.6     | 2302.4     | 2289.6     | 2296.3     | 2313.4     |
| 10/28/2013             | 2309.3                        | 2308.0     | 2303.9     | 2291.2     | 2297.9     | 2316.5     |
| <i>Change in level</i> | <i>2.6</i>                    | <i>2.4</i> | <i>1.5</i> | <i>1.6</i> | <i>1.6</i> | <i>3.1</i> |

\*Canal deliveries for recharge operations occurred 9/19/2013 through 10/28/13. Note that the changes in water level elevations in the table are calculated during the period of canal deliveries only and do not consider lagged return flows that impact well levels after 10/28/2013.

**APPENDIX E:**  
**CNPPID MONITORING WELL DATA**

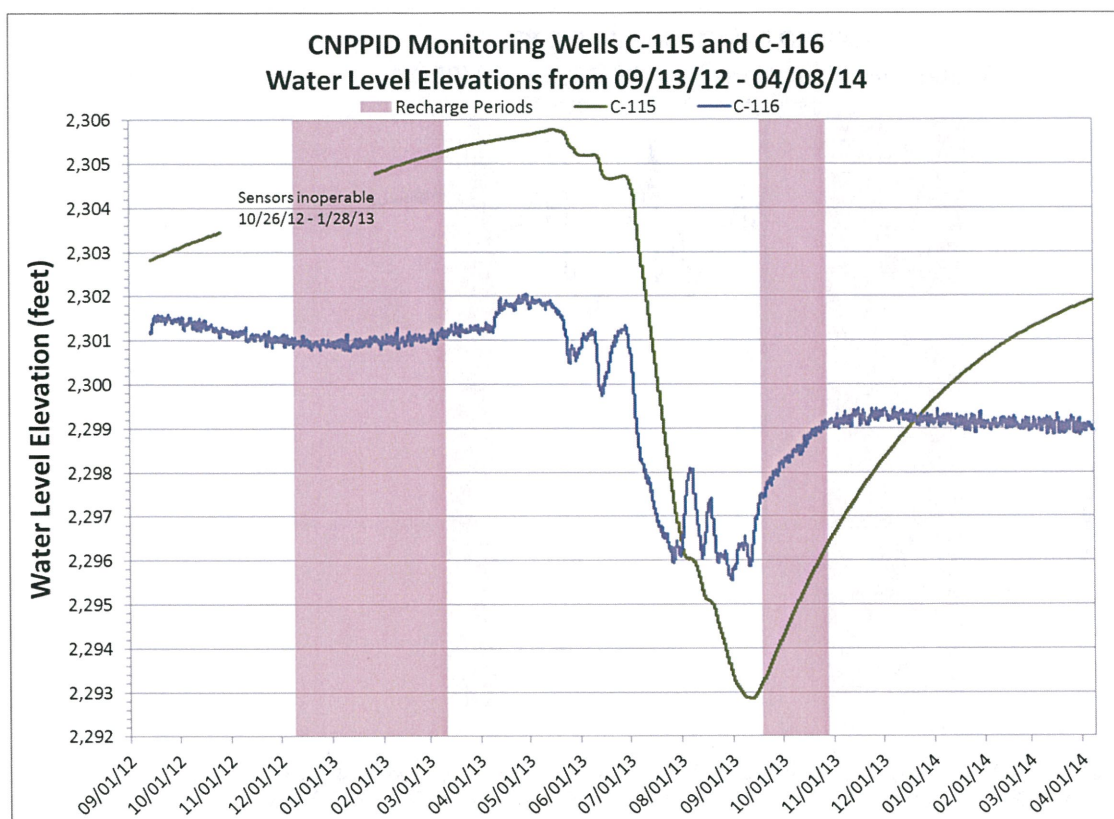


**Figure E-1: C-83 water level elevations.**



**Figure E-2: C-110 and C-114 water level elevations.**





**Figure E-3: C-115 and C-116 water level elevations.**

**Table E-1. Water levels in CNPPID monitoring wells during recharge period.**

| Date                   | Water Level Elevations (feet) |            |            |            |            |             |            |            |
|------------------------|-------------------------------|------------|------------|------------|------------|-------------|------------|------------|
|                        | C-83                          | C-94       | C-97       | C-102      | C-110      | C-114       | C-115      | C-116      |
| 9/18/2013              | 2265.4                        | 2305.8     | 2314.9     | 2317.1     | 2333.0     | 2334.1      | 2293.2     | 2297.5     |
| 10/28/2013             | 2265.6                        | 2307.3     | 2316.0     | 2319.6     | 2333.2     | 2333.8      | 2296.4     | 2299.0     |
| <i>Change in level</i> | <i>0.2</i>                    | <i>1.5</i> | <i>1.1</i> | <i>2.5</i> | <i>0.2</i> | <i>-0.3</i> | <i>3.2</i> | <i>1.5</i> |

\*Canal deliveries for recharge operations occurred 9/19/2013 through 10/28/13. Note that the changes in water level elevations in the table are calculated during the period of canal deliveries only and do not consider lagged return flows that impact well levels after 10/28/2013.

**APPENDIX F:**  
**TRI-BASIN NRD MONITORING WELL DATA**

**Table F-1. Water levels in TBNRD Elm Creek wells during recharge period.**

| Date                   | Water Level Elevations (feet) |            |            |             |            |            |
|------------------------|-------------------------------|------------|------------|-------------|------------|------------|
|                        | P-101                         | P-102      | P-103      | P-104       | P-132      | P-133      |
| 9/18/2013              | 2286.1                        | 2284.5     | 2296.2     | 2328.1      | 2277.2     | 2277.3     |
| 10/28/2013             | 2287.8                        | 2285.8     | 2298.1     | 2327.2      | 2278.3     | 2278.4     |
| <i>Change in level</i> | <i>1.7</i>                    | <i>1.3</i> | <i>1.9</i> | <i>-0.9</i> | <i>1.1</i> | <i>1.1</i> |

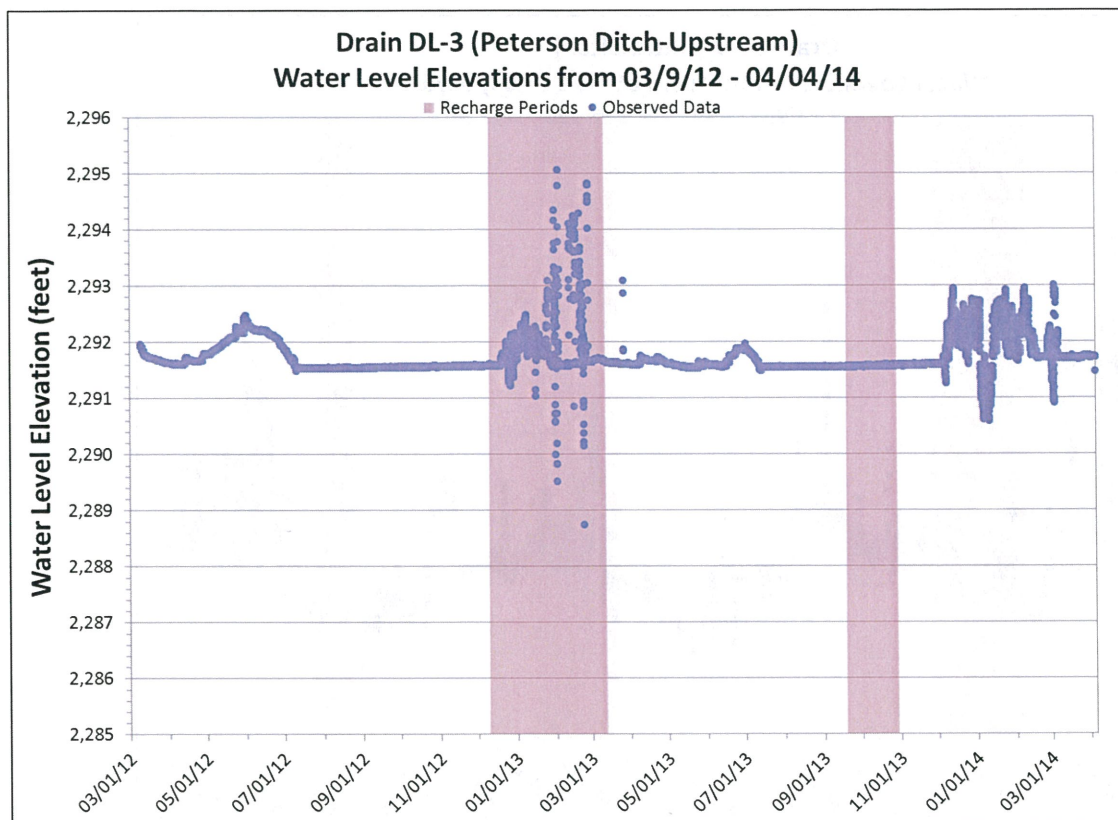
\*Canal deliveries for recharge operations occurred 9/19/2013 through 10/28/13. Note that the changes in water level elevations in the table are calculated during the period of canal deliveries only and do not consider lagged return flows that impact well levels after 10/28/2013.

**Table F-2. Water levels in TBNRD Overton wells during recharge period.**

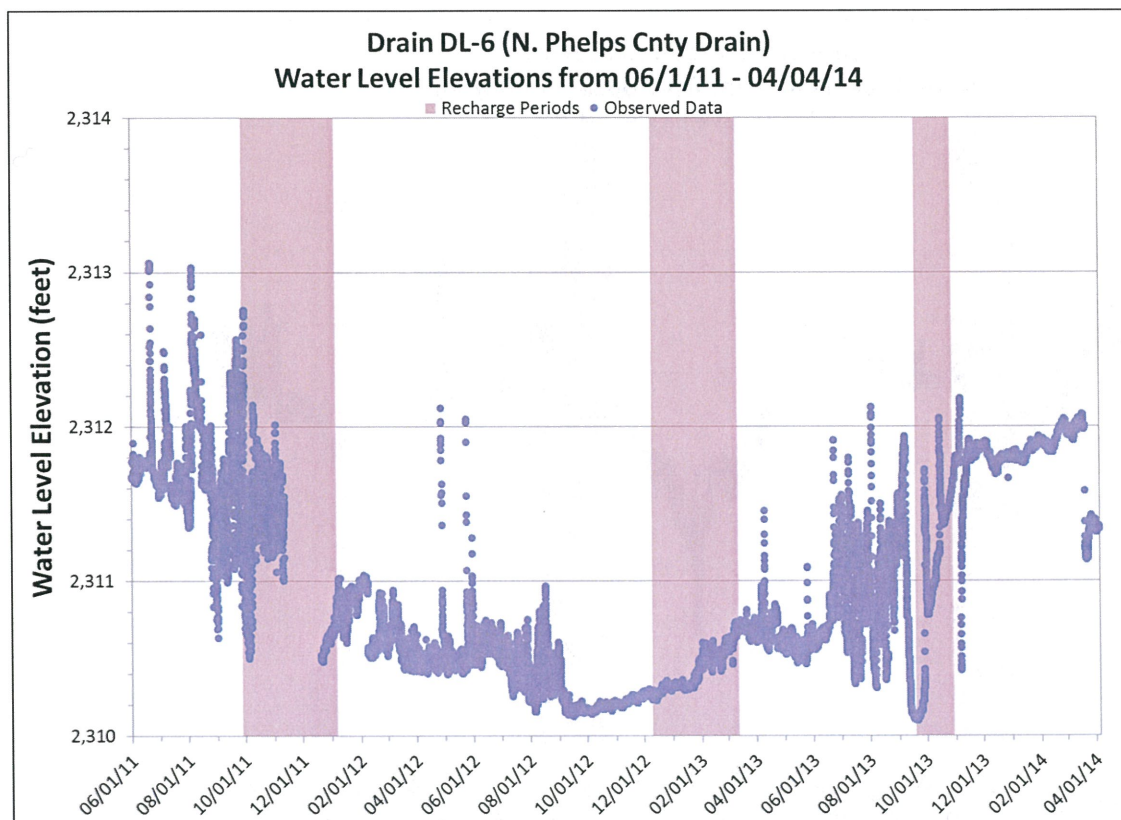
| Date                   | Water Level Elevations (feet) |            |            |
|------------------------|-------------------------------|------------|------------|
|                        | P-105                         | P-106      | P-110      |
| 9/18/2013              | 2326.6                        | 2332.9     | 2327.7     |
| 10/28/2013             | 2329.8                        | 2336.2     | 2330.9     |
| <i>Change in level</i> | <i>3.2</i>                    | <i>3.3</i> | <i>3.2</i> |

\*Canal deliveries for recharge operations occurred 9/19/2013 through 10/28/13. Note that the changes in water level elevations in the table are calculated during the period of canal deliveries only and do not consider lagged return flows that impact well levels after 10/28/2013.

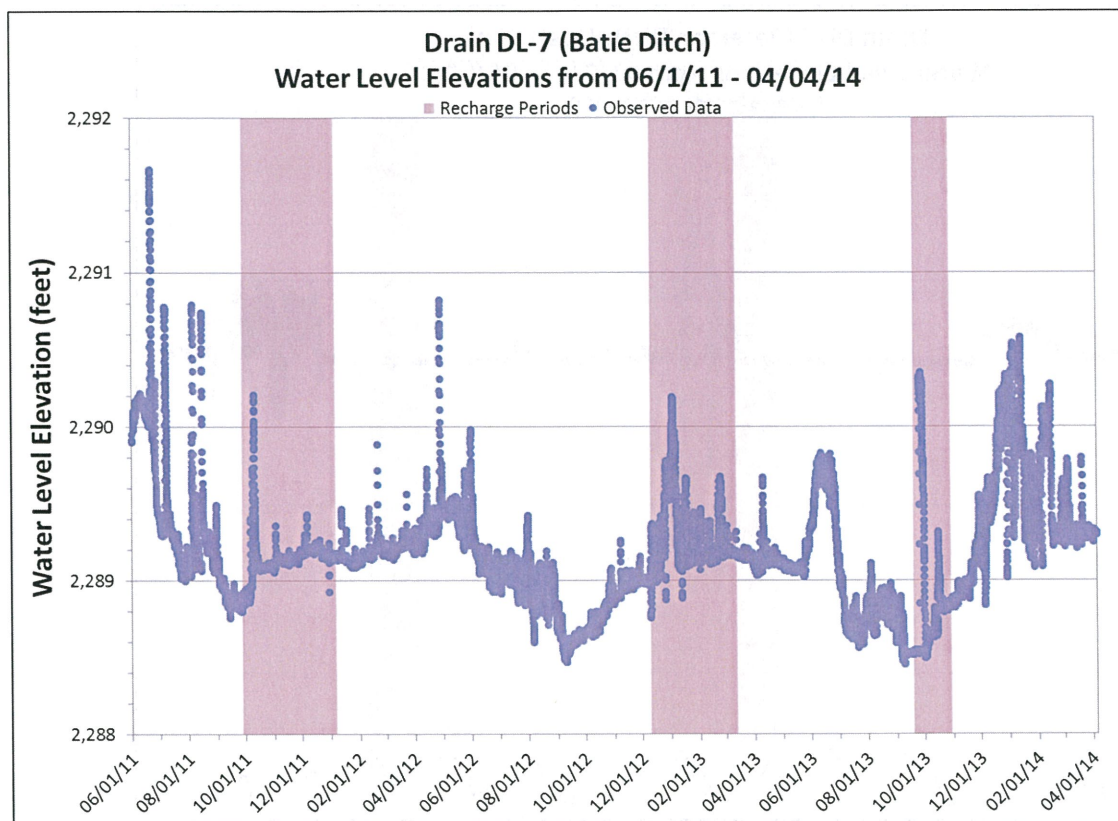
**APPENDIX G:**  
**PROGRAM DRAIN MONITORING DATA**



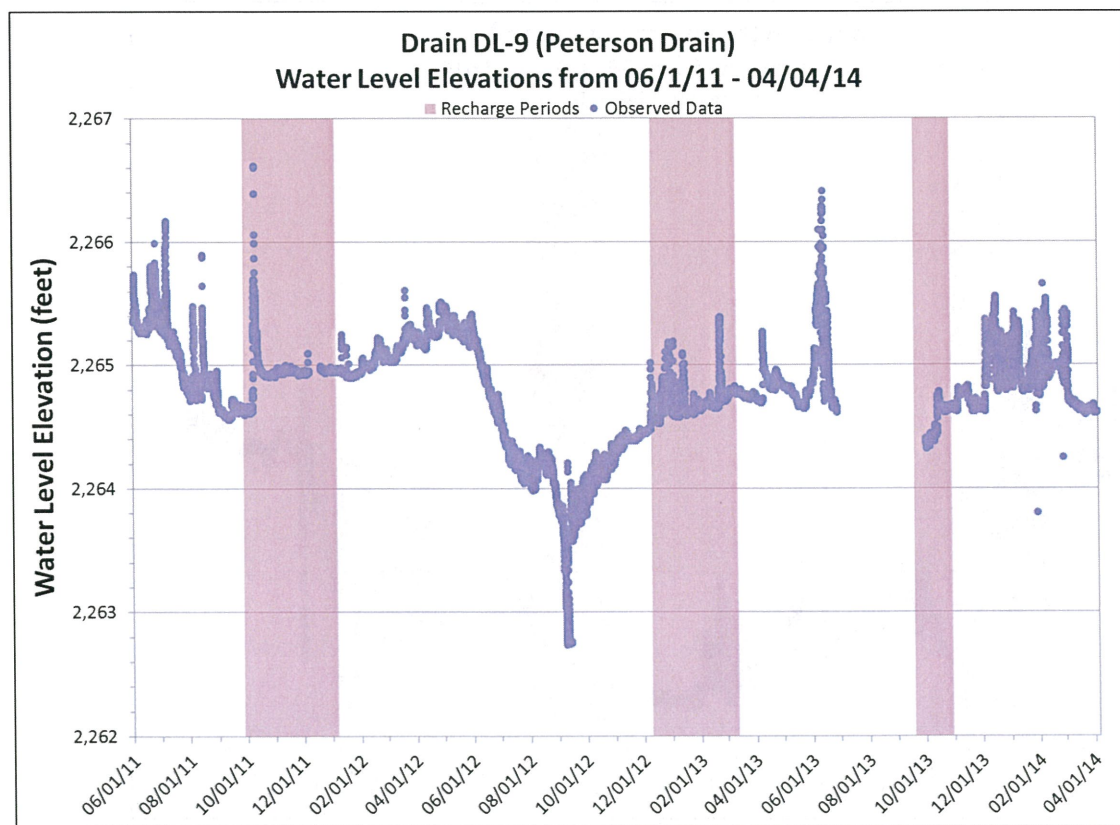
**Figure G-1: Drain DL-3 water level elevations.**



**Figure G-2: Drain DL-6 water level elevations.**

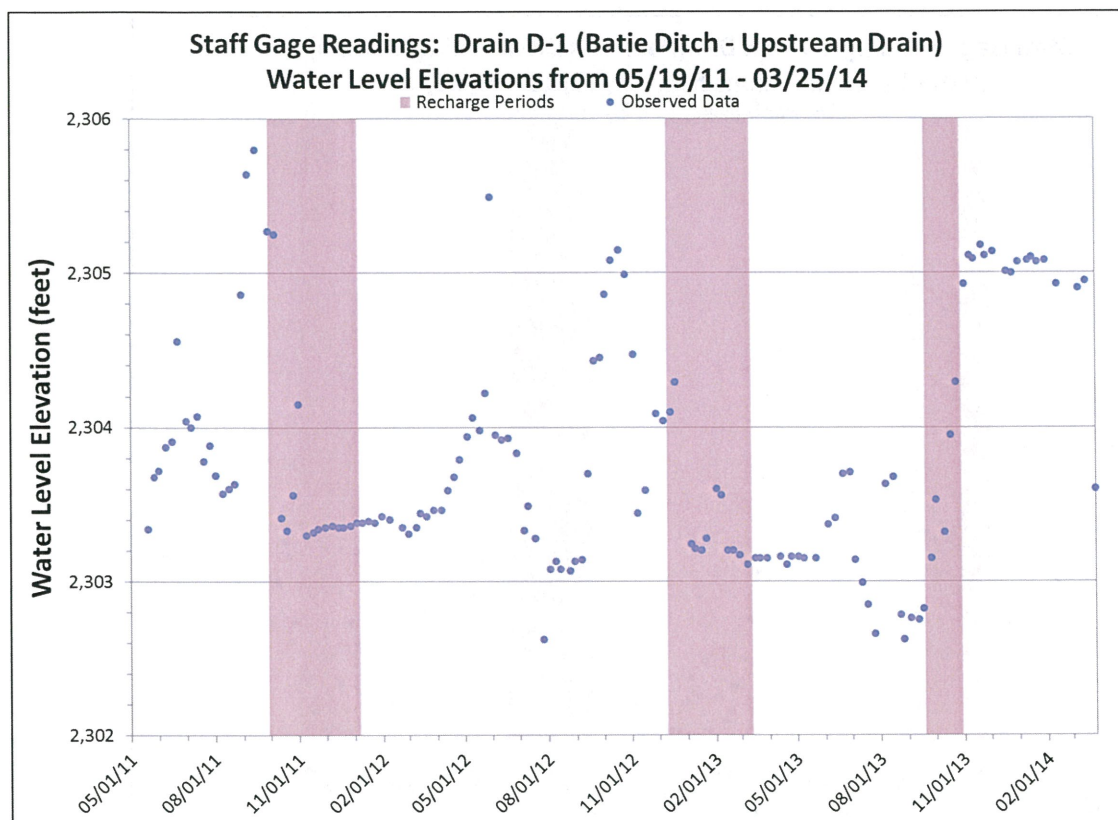


**Figure G-3: Drain DL-7 water level elevations.**

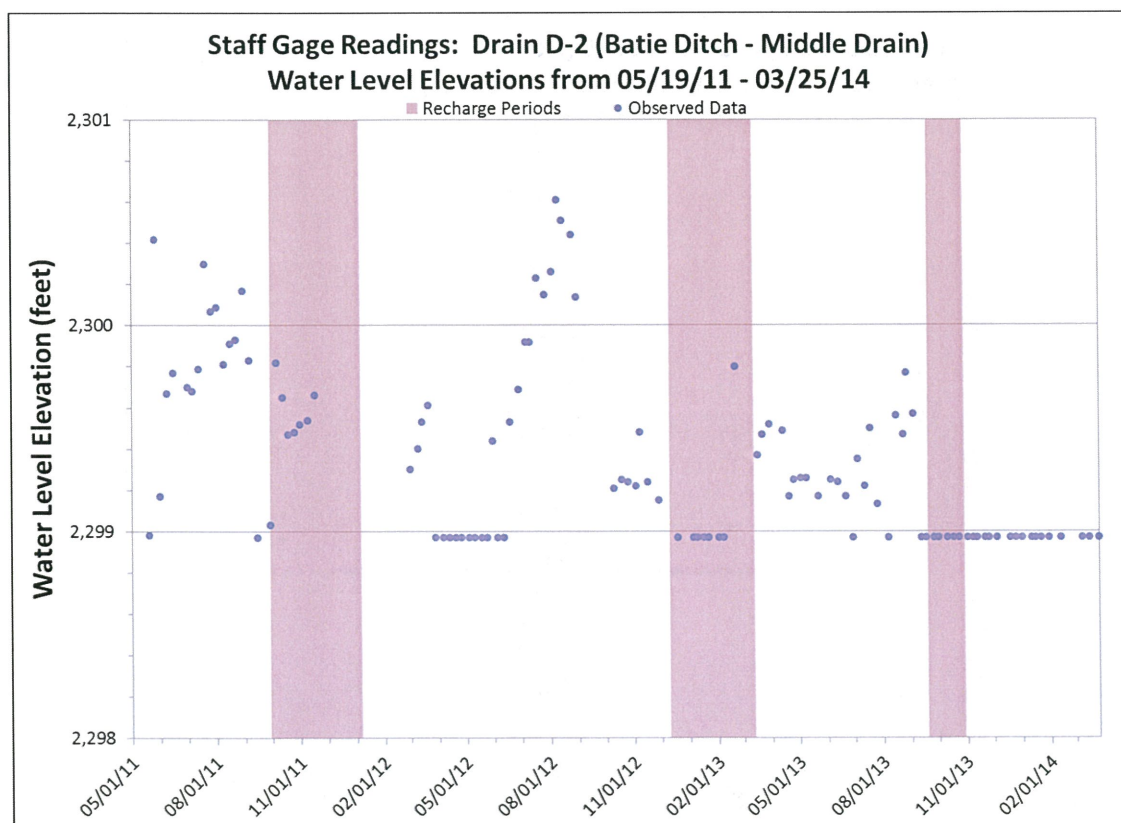


**Figure G-4: Drain DL-9 water level elevations.**

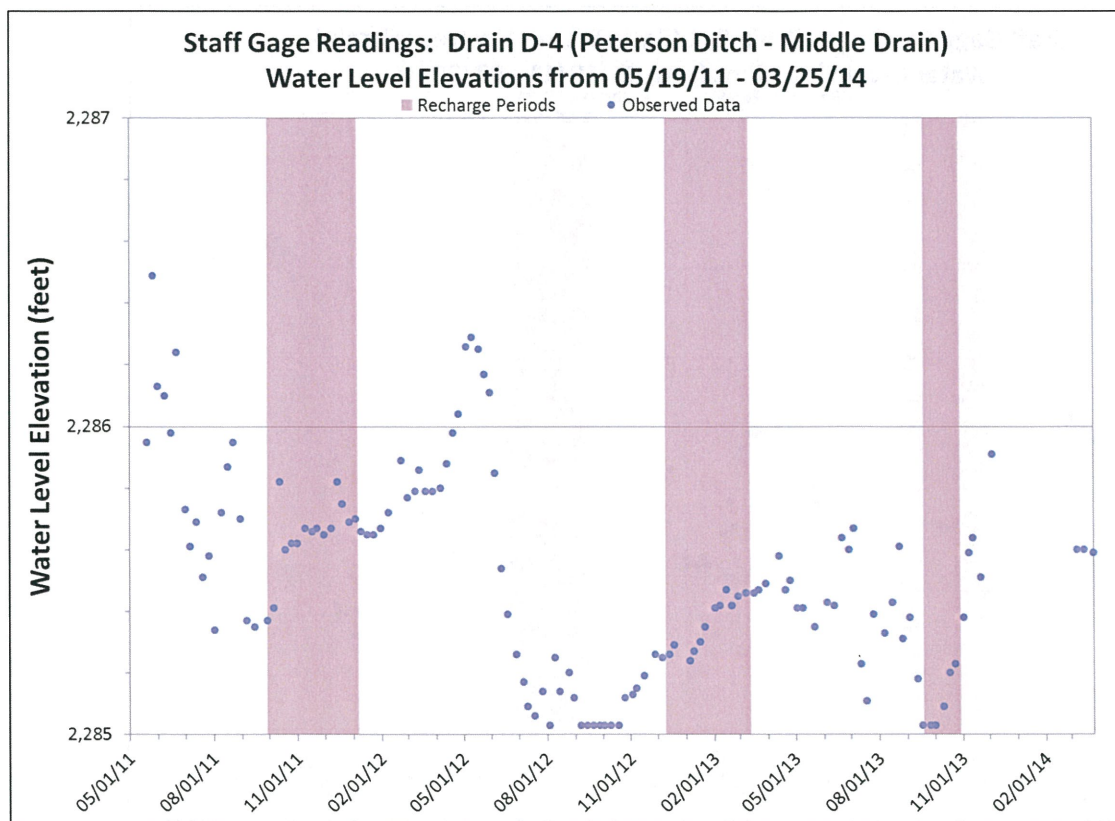




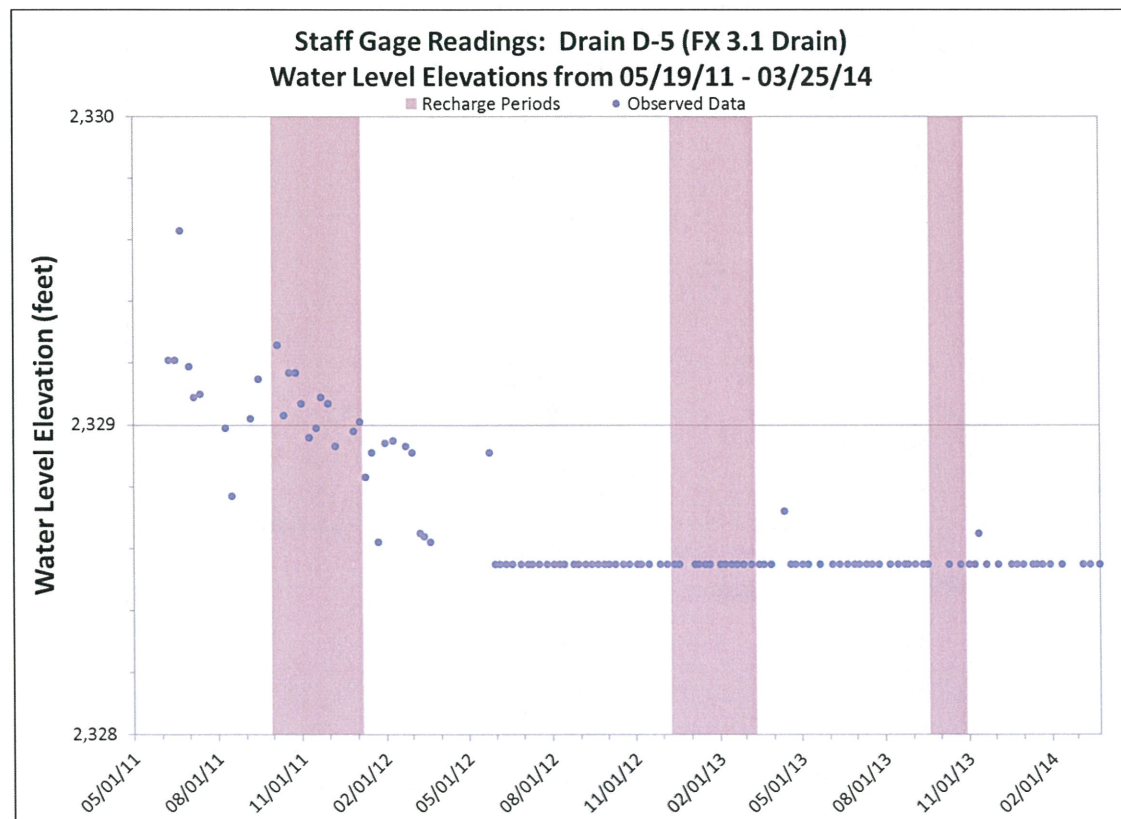
**Figure G-5: Drain D-1 water level elevations.**



**Figure G-6: Drain D-2 water level elevations.**

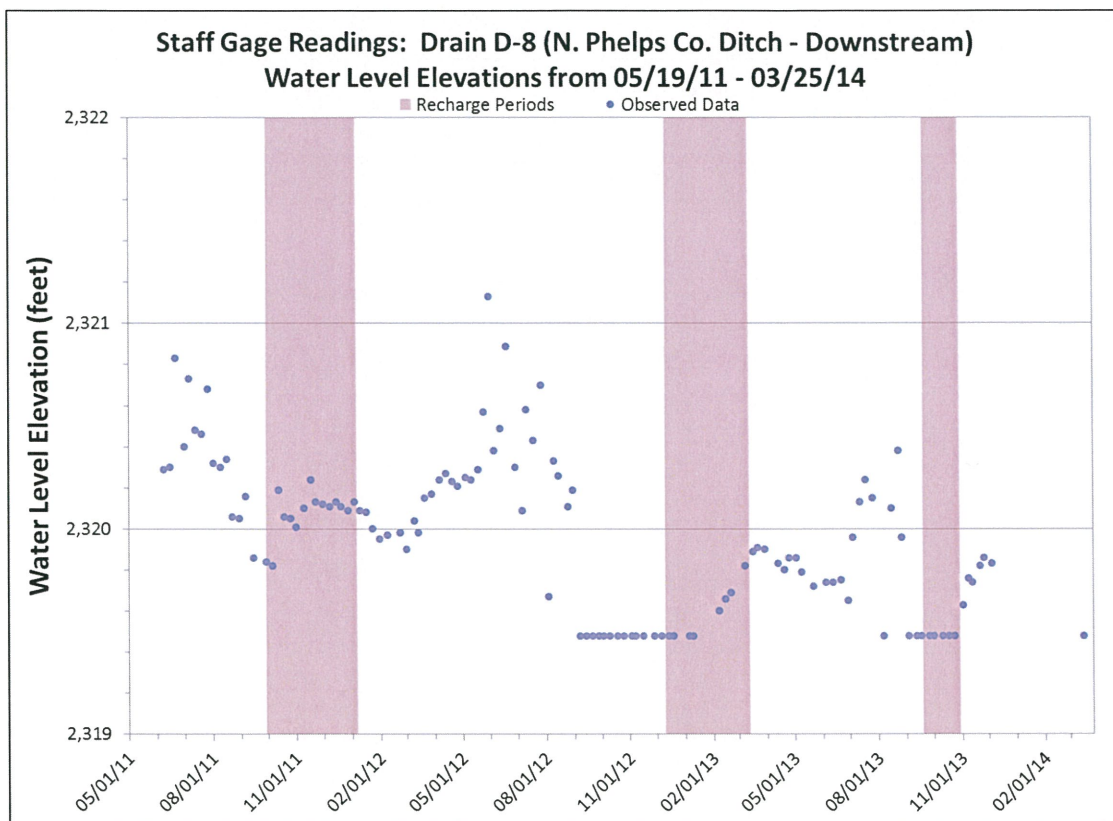


**Figure G-7: Drain D-4 water level elevations.**



**Figure G-8: Drain D-5 water level elevations.**





**Figure G-9: Drain D-8 water level elevations.**

533     **5.     REFERENCES**

534     (2006). *Final Platte River Recovery Implementation Program*.

535  
536     CLIMOD: High Plains Regional Climate Center. (2014, January 24). *Daily Data for a*  
537     *Month* [September 2013 and October 2013]. Retrieved January 24, 2014, from Daily  
538     Data for a Month [Web Interface]: <http://climod.unl.edu/climod/monthly/>

539  
540     EA Engineering, Science, and Technology, Inc. and Daniel B. Stephens & Associates,  
541     Inc. (2012). *Pilot-Scale Recharge Report for Nebraska Groundwater Recharge*  
542     *Feasibility Study, Platte River Recovery Implementation Program*.

543  
544     PRRIP Executive Director's Office. (2013). *Nebraska Groundwater Recharge: 2012-*  
545     *2013 Phelps County Canal Recharge Report*.

546  
547     PRRIP Office of the Executive Director, et al. (2010). *Nebraska Ground Water Recharge*  
548     *Pre-Feasibility Study*.

549  
550     PRRIP Executive Director's Office and the Water Advisory Committee. (2010). *Platte*  
551     *River Recovery Implementation Program 2009 Water Action Plan Update*.

552  
553     U.S. Geological Survey. (2014, January 20). *USGS 06768000 Platte River near Overton,*  
554     *Nebr.* Retrieved January 20, 2014, from National Water Information System: Web  
555     Interface: [http://waterdata.usgs.gov/nwis/uv/?site\\_no=06768000&agency\\_](http://waterdata.usgs.gov/nwis/uv/?site_no=06768000&agency_cd=USGS&referred_module=sw)  
556     *cd=USGS&referred\_module=sw*