

A.1.7 Memorandums on the
Calculations of Excess Flows,
Recharge Volumes and
Percentages, and Discharge
Volumes for Canal Recharge

March 15, 2018

rev. June 12, 2018 and June 7, 2019

To: The Platte Overappropriated Area Committee Technical Committee
From: Margeaux Carter and Kari Burgert, Nebraska Department of Natural Resources
Date: March 15, 2018, revised June 12, 2018, revised June 7, 2019
Re: Data Sourcing and Summary of Diversion of Excess Flows for Canal Recharge

Summary

The accepted various diversions of excess flow for canal recharge have been combined into a single file with daily discharge rates for each canal with excess flow for 2011, 2012, and 2013. The final discharge data file is "POAC_2011_2013_FINAL.xlsx."

This memo will list the data sources for the excess flow data which will be used to assess the effectiveness of artificial recharge and streamflow augmentation projects in the Robust Review. The diversion periods described in the 10/26/2017 memo from Tracy Zayac "Memo to POAC Admins on canal recharge for RR rev10262017.pdf" (Zayac memo) are used for the analysis. The records of the diversion period from the sources described in this memo may vary from those described in the Zayac memo. The periods of diversion chosen in the Zayac memo considered information additional to diversion records, including contracts, irrigation season, and other records from the time of the excess flow diversion. The canal diversion sources used for this analysis may have been updated since the memo causing slight variations in the diversion periods.

Data Sources for Excess Flow Diversions

Listed in Table 1 are the canals for which the NeDNR streamgaging website was used to obtain discharge data during periods of excess flow from 2011 to 2013. The canals are listed by their name in the Zayac memo with their stream gage name and number in the NeDNR stream gaging list and index (<https://nednr.nebraska.gov/RealTime/Gage/Index>). Note that Farmers canal is referred to as "Tri-State Canal" and Pathfinder as "Interstate Canal" in the NeDNR Gage Index. According to the Zayac memo, Winters Canal excess flow dates apply to the combined discharge between the "Winters Canal from Winters Creek" and "Winters Canal from North Platte River". These values have been combined in the final excess flow datasheet, but it should be noted that the discharge recorded in Winters Canal from North Platte River during the accepted excess flow dates was zero. Lateral E65 discharge is not available in the NeDNR database. Pathfinder discharge data prior to 2012 and Lisco data between 4/13/2011 and 10/1/2011 are not digitized in the NeDNR streamgaging website and can be found in the annual NeDNR Hydrographic reports. The NeDNR Hydrographic report originally obtained for Pathfinder for this study reported on United States Bureau of Reclamation (USBR) measurements that had since been updated by the USBR. The diversions on Pathfinder Canal used in this study were obtained from the USBR Hydromet website on May 2018.

Table 1. Canals with excess flow between 2011 and 2013 obtained from NeDNR streamgaging database and the canal gage name and number

Canal	NeDNR Gage Name	Gage Number
Belmont	Belmont Canal from North Platte River	9000
Castle Rock	Castle Rock-Steamboat Canal from North Platte River	21000
Central	Central Canal from North Platte River	22000
Chimney Rock	Chimney Rock Canal from North Platte River	24000
Cozad	Cozad Canal from Platte River	33000
Dawson County	Dawson County Canal from Platte River	37000
Enterprise	Enterprise Canal from North Platte River	40000
Farmer's	Tri-State Canal from North Platte	145100
Gothenburg	Gothenburg Canal from Platte River	57000
Kearney	Kearney Canal from Platte River	73000
Keith Lincoln	Keith-Lincoln County Canal from North Platte River	76000
Lisco	Lisco Canal from North Platte River	8200
Minatare	Minatare Canal from North Platte River	99000
Nine Mile	Ninemile Canal from North Platte River	106000
North Platte	North Platte Canal from North Platte River	114000
Orchard-Alfalfa	Orchard-Alfalfa Canal from Platte River	117000
Paxton Hershey	Paxton-Hershey Canal from North Platter	121000
Suburban	Suburban Canal from North Platte River	136000
Thirty Mile	Thirty Mile Canal from Platte River	141000
Western	Western Canal from South Platte River	147000
Winters	Winters Creek Canal from North Platte River	148000
Winters	Winters Creek Canal from Winters Creek	149000

Listed in Table 2 are the data sources for excess flow canal discharge not found in the NeDNR streamgaging database. Daily discharge data for Dawson County and Thirty Mile canals in the fall of 2013 were available in the interactive NeDNR streamgaging database and were corroborated with external data provided in Table 2. Daily discharge data for Lisco canals was available in the Hydrographic reports and also corroborated with externally obtained data provided in Table 2. Digitized discharge data was available for 23 days of Lisco canal's excess flow period in the fall of 2011. Discharge data for E65 Canal and Phelps Canal were provided entirely by CNPPID.

Table 2. Data sources for canal discharge not found in NeDNR gage database

Canal	Event	Data Source	Obtained
Lisco	Spring 2011	WISKI NeDNR, "2017-12-04Lisco.xlsx"	12/4/17
Pathfinder	Spring 2011	USBR Hydromet	May 2018
Lisco	Fall 2011	WISKI NeDNR, "2017-12-04Lisco.xlsx"	12/4/17
Dawson County	Fall 2013	NPPD, Jeff Shafer to NeDNR, Jessie Strom, "Dawson County Canal Diversion 2013-09-22 to 2013-10-09.xlsx"	3/13/17
E-65	Fall 2013	CNPPID, "Groundwater Recharge Diversions Summary 4-9-2018.xlsx"	4/9/18
Phelps	Fall 2013	CNPPID, "Groundwater Recharge Diversions Summary 4-9-2018.xlsx"	4/9/18
Thirty Mile	Fall 2013	CPNRD, Duane Woodward to NeDNR, Jessie Strom, "ThirtyMileexcess_Diversion_2013fall.xlsx"	2/21/17

To: The Platte Overappropriated Area Committee Technical Committee
From: Kari Burgert, Nebraska Department of Natural Resources
Date: June 14, 2018, updated October 11, 2018
Re: **CPNRD, TBNRD, and TPNRD Monthly Excess Flow Discharge Volumes, Recharge Percentages, Recharge Volumes, and Locations for the COHYST model**

This memo provides the final recharge volumes from excess flow diversions into Elwood Reservoir and excess flow canal diversions from 2011-2013 for Central Platte Natural Resources District (CPNRD), Tri-Basin Natural Resources District (TBNRD), and Twin Platte Natural Resources District (TPNRD) for use in the COHYST-area portion of the 2018 Robust Review. TPNRD and South Platte Natural Resources District excess flow diversions on Western Canal will be assessed with the Western Water Use Model.

Tables 1-3 have summaries of the monthly volumes of excess flow and resulting estimated recharge volumes for CPNRD, TBNRD, and TPNRD-contracted canal excess flows, respectively. Canal diversion volumes in this memorandum are from the POAC Technical Committee memorandum ExcessFlowData_SourceSummary.docx and associated data spreadsheet POAC_2011_2013.xlsx. Recharge percentages for all excess flow canal diversions except the Fall 2013 E65 diversions and CPNRD canals Cozad, Orchard-Alfalfa, and Thirty Mile were obtained from the spreadsheet PlatteRechargeDateComparison_For POAC_daw.xlsx. The methodology for calculating the recharge percentages in that spreadsheet was to assume recharge up to the rate modeled in the COHYST surface water operations model and average the percentage of the assumed recharge rates to the diversion rates over the period of excess flow diversion. This methodology was applied to the Fall 2013 E65 diversions, and 100% recharge was calculated. Recharge rates for Cozad, Orchard-Alfalfa, and Thirty Mile canals for these recharge events were obtained from CPNRD.

TBNRD contracted 50% of the Fall 2011 and Fall 2013 excess flow events on Phelps Canal; PRRIP contracted the remaining 50% of these events. The total recharge volumes for these events will be included in the model files, and benefits to the Platte Basin from TBNRD management will be calculated as 50% of the modeled accretions from these events. Inclusion of additional excess flow recharge events from Phelps and E65 are discussed in the July 17, 2018, NeDNR memo to the POAC Technical Committee Re: Phelps/E65 Canal Recharge Sensitivity (20180718_PhelpsE65_Sensitivity_Memo.docx).

Recharge from excess flow diversions into Elwood Reservoir were assumed to be 100% of the total pumped. For each excess flow event, all of the excess flow water pumped was assumed be recharged at a constant daily rate over 180 days starting with the first diversion date. The daily volumes pumped into Elwood Reservoir were obtained from the spreadsheet obtained from CNPPID, "CNPPID_Groundwater Recharge Diversions Summary 1-8-2016.xlsx." A total of 44,730 acre-feet of excess flow were diverted to and recharged from Elwood Reservoir from 2006 to 2013. Table 4 provides the Elwood Reservoir diversion/recharge volumes per event. Shown in Figure 1 are the monthly diversion and recharge volumes for the Elwood Reservoir excess flow recharge projects for analysis in the 2018 Robust Review.

Figures of the model cell locations of recharge are also provided (Figures 2-4). The model cell locations for each canal were obtained from the COHYST model table StellaCanalToModflowGrid.csv used for assigning canal recharge from the surface water model to the groundwater model during integrated

runs. The model cell locations for Elwood recharge were obtained from the COHYST model table StellaReservoirToModflowGrid.csv. Figure 2 shows the model cell locations of the CPNRD excess flow recharge events. Figure 3 presents the model cell locations of the TBNRD excess flow recharge events. The Phelps and E65 canal recharge locations were determined from the CNPPID groundwater recharge diversion summaries spreadsheets and the contracts for the events. The TBNRD Fall 2011 event occurred on Phelps canal to Mile Post 9.7. The TBNRD Fall 2013 event occurred on Phelps canal to Mile Post 13.3 (including the section to Mile Post 9.7) and on the E65 canal to Mile Post 23.7, on laterals to and within Cottonwood WPA, and on E65 to Mile Post 36.2S/Loomis. Figure 4 presents the model cell locations of the TPNRD excess flow recharge events. Spring and Fall 2011 excess flow events for TPNRD occurred on all four canals: Keith Lincoln, North Platte, Paxton Hershey, and Suburban. The TPNRD Fall 2013 events occurred on North Platte and Paxton Hershey.

Table 1. CPNRD-contracted monthly excess flow discharge volumes, recharge percentages, and recharge volumes

		Cozad			Orchard-Alfalfa			Thirty Mile		
Year	Month	Diversion (af)	Recharge Fraction	Recharge (af)	Diversion (af)	Recharge Fraction	Recharge (af)	Diversion (af)	Recharge Fraction	Recharge (af)
2011	4	833	0.85	708	144	0.85	122	1,192	0.60	715
2011	5	930	0.85	791	830	0.85	706	4,322	0.60	2,593
2011	9	877	0.85	745	1,010	0.85	858	4,760	0.60	2,856
2011	10	474	0.85	403	506	0.85	430	379	0.60	227
2012	3				78	0.85	66			
2013	9							3693	0.60	2,216
2013	10							3442	0.60	2,065
	Total	3,114		2,647	2,567		21,825	17,789		10,673

		Dawson County			Gothenburg			Kearney			Total
Year	Month	Diversion (af)	Recharge Fraction	Recharge (af)	Diversion (af)	Recharge Fraction	Recharge (af)	Diversion (af)	Recharge Fraction	Recharge (af)	Recharge (af)
2011	4	899	0.998	897	3,124	0.995	3,108	3074	0.286	879	6,430
2011	5	3,148	0.998	3,141	3,154	0.995	3,138	1216	0.286	348	10,717
2011	9	2,436	0.998	2,431	3,602	0.995	3,584				10,474
2011	10	1,018	0.998	1,015	2,126	0.995	2,116				4,191
2012	3										66
2013	9	932	1.000	932	1,481	0.985	1,458				4,607
2013	10	569	1.000	569	748	0.985	737				3,371
	Total	9,001		8,986	14,234		14,141	4,290		1,227	39,856

Table 2. TBNRD-contracted monthly excess flow canal discharge volumes, canal recharge percentages, and canal recharge volumes

		E65			Phelps				Total
Year	Month	Diversion (af)	Recharge Fraction	Recharge (af)	Diversion (af)	Recharge Fraction	Contracted Fraction	Recharge (af)	Recharge (af)
2011	9				603	1.000	0.50	302	302
2011	10				1,828	1.000	0.50	914	914
2011	11				1,731	1.000	0.50	866	866
2011	12				1,257	1.000	0.50	629	629
2012	1				139	1.000	0.50	70	70
2013	9	1,341	1.000	1,341	1,821	0.981	0.50	893	2,234
2013	10	1,293	1.000	1,293	1,907	0.981	0.50	935	2,228
Total		2,634		2,634	9,286			4,608	7,242

Table 3. TPNRD-contracted monthly excess flow discharge volumes, recharge percentages, and recharge volumes

Year	Month	Keith Lincoln			North Platte		
		Diversion (af)	Recharge Fraction	Recharge (af)	Diversion (af)	Recharge Fraction	Recharge (af)
2011	4	1,256	0.972	1,221	2,102	0.988	2,077
2011	5	1,012	0.972	983	2,557	0.988	2,526
2011	6	99	0.972	96			
2011	9	724	0.972	704	795	0.988	786
2011	10	1,315	0.972	1,278	3,582	0.988	3,539
2013	9				2,261	0.954	2,157
2013	10				1,248	0.954	1,191
Total		4,406		4,283	12,546		12,276

Year	Month	Paxton Hershey			Suburban			Total
		Diversion (af)	Recharge Fraction	Recharge (af)	Diversion (af)	Recharge Fraction	Recharge (af)	Recharge (af)
2011	4	982	0.969	951	925	1.000	925	5,175
2011	5	849	0.969	823	964	1.000	964	5,296
2011	6							96
2011	9	785	0.969	761	924	1.000	924	3,175
2011	10	1,554	0.969	1,505	839	1.000	839	7,162
2013	9	1,117	0.878	980				3,138
2013	10	667	0.878	585				1,776
Total		5,953		5,606	3,652		3,652	25,818

Table 4. Diversion/recharge volumes per Elwood Reservoir excess flow recharge projects for analysis in the 2018 Robust Review.

Start Date of Elwood Recharge Diversions	End Date of Elwood Recharge Diversions	Diverted and Recharged Volume (acre-feet)
1/24/2006	2/13/2006	6,132
8/8/2006	8/10/2006	627
12/22/2006	12/31/2006	2,793
5/30/2007	6/25/2007	7,262
7/9/2007	7/11/2007	419
7/31/2007	8/8/2007	2,277
5/23/2008	6/11/2008	6,963
7/18/2008	7/21/2008	1,169
8/10/2008	8/19/2008	1,193
6/21/2009	8/21/2009	2,906
9/19/2013	10/31/2013	12,989

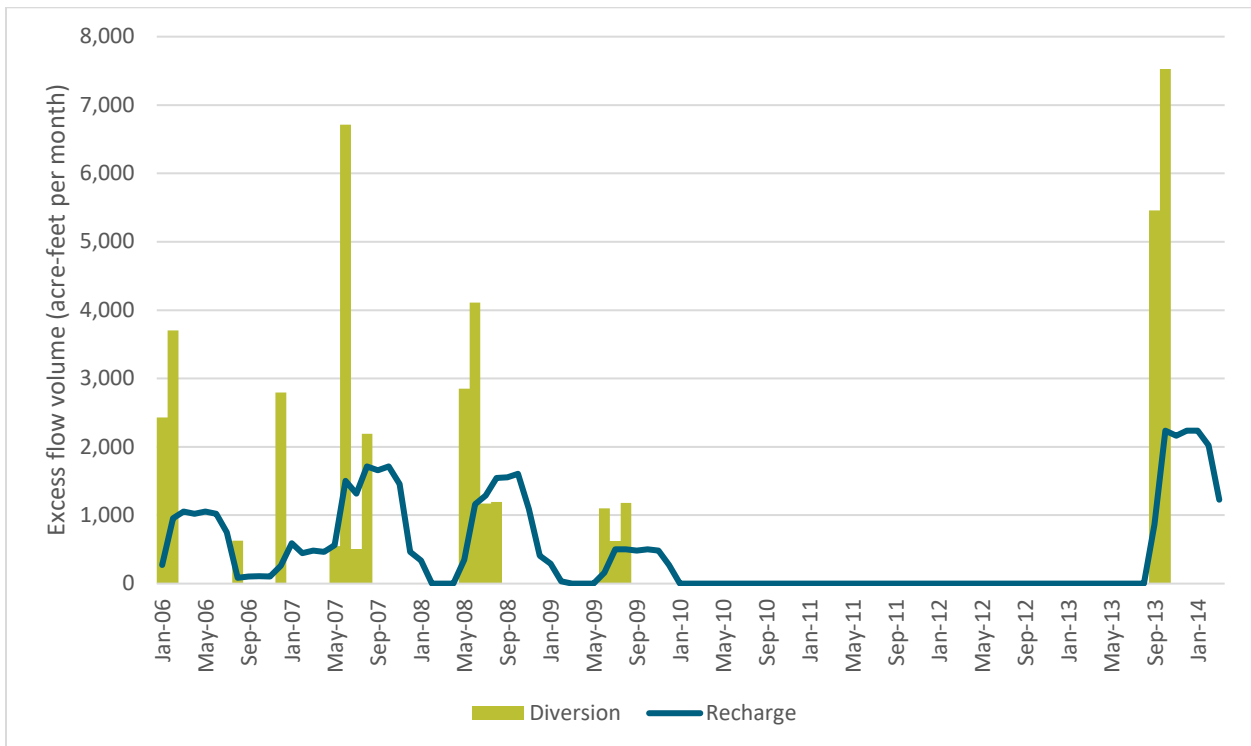


Figure 1. Excess flow monthly volumes pumped into and monthly volumes of excess flow water recharged from Elwood Reservoir.

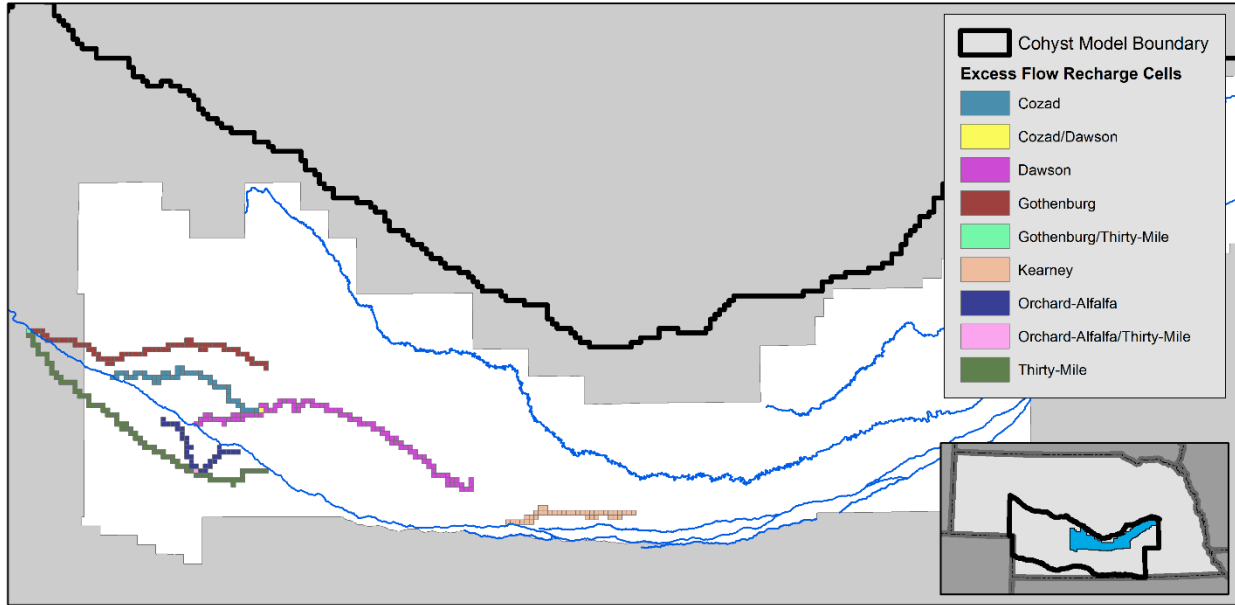


Figure 2. Model cell locations for the CPNRD excess flow recharge events within the COHYST model area.

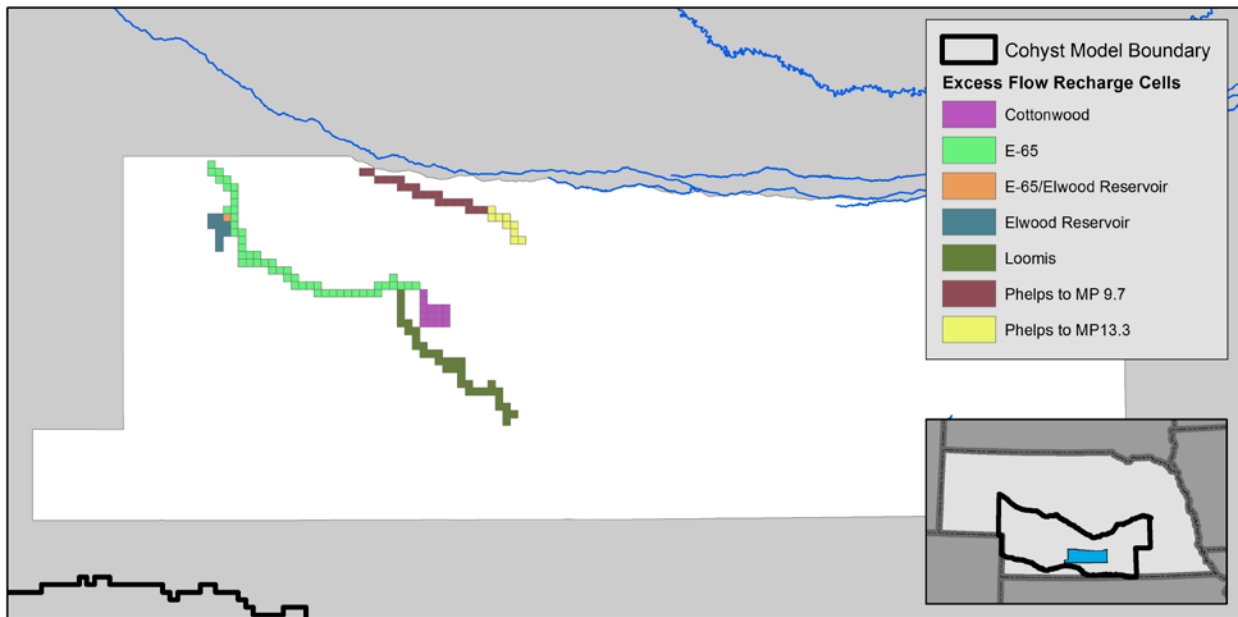


Figure 2. Model cell locations of the TBNRD excess flow recharge events within the COHYST model area.

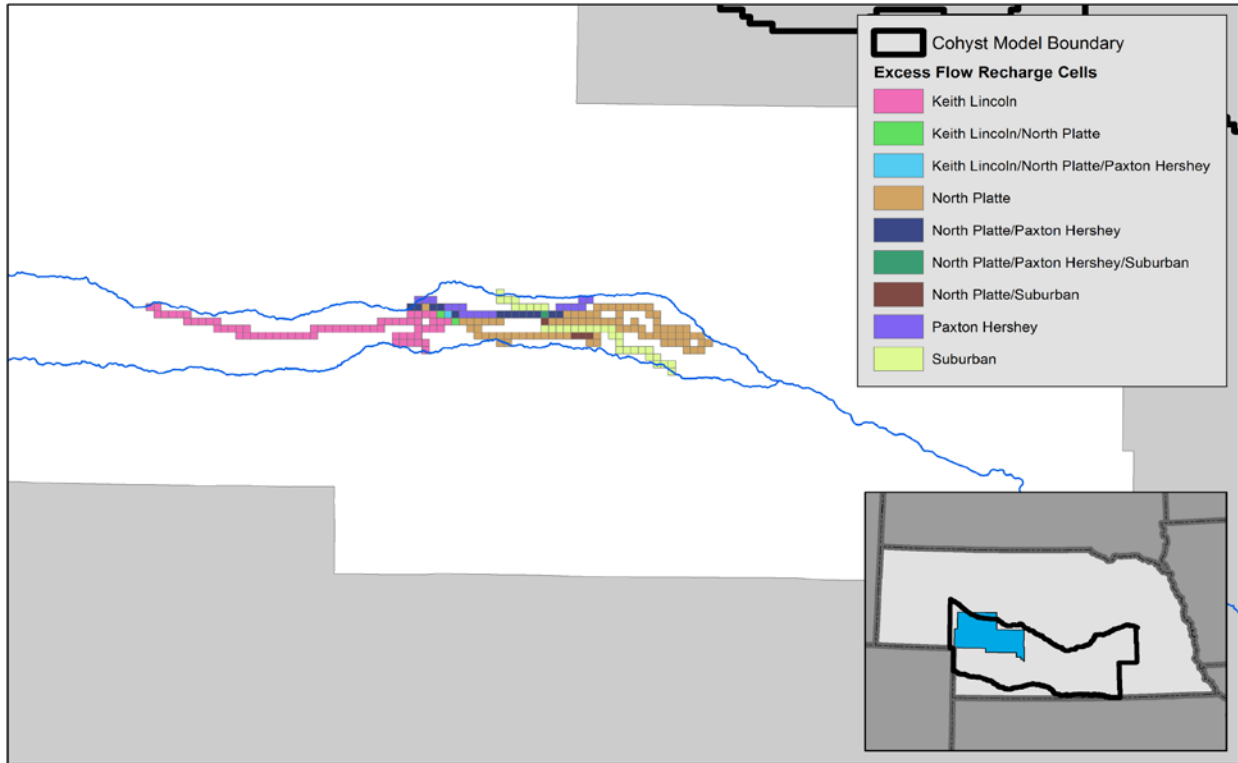


Figure 3. Model cell locations for the TPNRD excess flow recharge events within the COHYST model area.

Date	Belmont	Castle Rock	Central	Chimney Rock	Cozad	Dawson County	Enterprise	E65	Farmer's	Gothenburg	Kearney	Keith Lincoln	Lisco	Minatare	Nine Mile	North Platte	Orchard-Alfalfa	Pathfinder	Paxton Hershey	Phelps	Suburban	Thirty Mile	Western	Winters Creek
11/22/2011	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	29.26976879	0	0	0	0
11/23/2011	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	29.17199244	0	0	0	0
11/24/2011	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	29.19977155	0	0	0	0
11/25/2011	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	26.38807493	0	0	0	0
11/26/2011	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	25.49514785	0	0	0	0
11/27/2011	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	26.31471992	0	0	0	0
11/28/2011	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	27.1202245	0	0	0	0
11/29/2011	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	32.22353539	0	0	0	0
11/30/2011	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	30.19276729	0	0	0	0
12/1/2011	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	29.25784596	0	0	0	0
12/2/2011	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	29.00605042	0	0	0	0
12/3/2011	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	26.26838394	0	0	0	0
12/4/2011	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	23.59863297	0	0	0	0
12/5/2011	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	22.65851702	0	0	0	0
12/6/2011	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	22.1829093	0	0	0	0
12/7/2011	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	24.44082576	0	0	0	0
12/8/2011	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	25.36887359	0	0	0	0
12/9/2011	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	23.73413124	0	0	0	0
12/10/2011	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	27.15072983	0	0	0	0
12/11/2011	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	27.41524308	0	0	0	0
12/12/2011	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	24.86557985	0	0	0	0
12/13/2011	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	24.59032798	0	0	0	0
12/14/2011	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	24.2423059	0	0	0	0
12/15/2011	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	20.82674941	0	0	0	0
12/16/2011	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	13.16926831	0	0	0	0
12/17/2011	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	12.98407558	0	0	0	0
12/18/2011	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	12.81960907	0	0	0	0
12/19/2011	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	12.36881778	0	0	0	0
12/20/2011	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	15.62049278	0	0	0	0
12/21/2011	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	17.91246182	0	0	0	0
12/22/2011	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	17.76136171	0	0	0	0
12/23/2011	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	17.8645644	0	0	0	0
12/24/2011	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	17.72761418	0	0	0	0
12/25/2011	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	17.46246447	0	0	0	0
12/26/2011	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	17.26676907	0	0	0	0
12/27/2011	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	17.17556774	0	0	0	0
12/28/2011	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	17.20950242	0	0	0	0
12/29/2011	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	17.27926976	0	0	0	0
12/30/2011	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	16.98344119	0	0	0	0
12/31/2011	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	16.57826339	0	0	0	0

