

**STATE OF NEBRASKA
DEPARTMENT OF NATURAL RESOURCES
APPLICATION FOR A PERMIT TO APPROPRIATE WATER**

Complete items 1 through 10 by printing in ink or typing the appropriate information and by placing an X in the appropriate box.

For Department Use Only

1. Name and address of owner of land under proposed project. Names must be exactly as described on the deed or document transferring ownership of property. Landowner must sign the application.

Bridgeport Irrigation District
P O Box 1028
Bridgeport, NE 69336-1028

Filed in the office of the Department of
Natural Resources at 8:50 a.m./p.m.
on April 10, 2017

E-mail address: k.anderson@andycofarms.com Telephone No. (308) 489-5658

Application No. A-19505

2. Name, address, and telephone number of applicant if different than landowner.

Map No. _____

Water Division 1-A

Receipt No. A-4919 Amount \$10.00

Right ID 13201

E-mail address: _____ Telephone No. () _____

3a. A permit is sought to:

Use natural flow Use impounded water*

3b. A permit is sought for the purpose of:

Irrigation Manufacturing Domestic
 Other _____
 Temporary** Baseflow enhancement through GW recharge

4a. Identify the source of water (name of stream or reservoir).

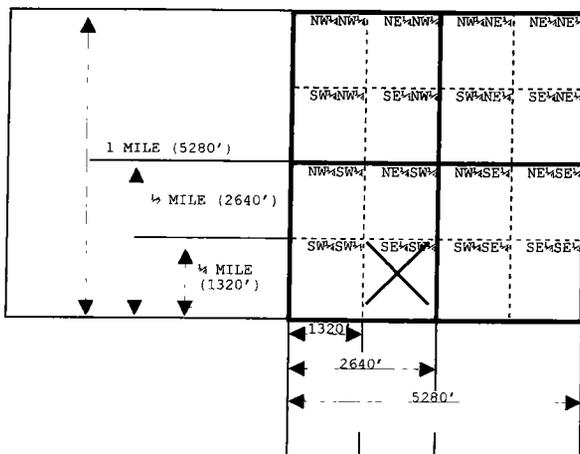
North Platte River

4b. If applicable, identify the facility name for transporting water from the source (portable pump, name of canal or pipeline).

Belmont Canal

5. Identify the location of the Headgate Pump

Section 18, Township 20 North, Range 51 E W County Morrill



The box at left represents one square mile (section). Place an X within each appropriate 40-acre tract to indicate the location(s) of each headgate or pump.

If applicable, indicate the height, in feet, of any diversion or check dams on the line below.

4 ft

* A separate permit to impound water must be obtained.

** A temporary permit maybe granted for a maximum of one year.

sw-04102017-13201-app: (41)

6. If applicable, identify the location of lands by 40-acre subdivisions that will be irrigated.

| LEGAL SUBDIVISIONS | Sec. | Twp. | Rge. | No. of Acres | LEGAL SUBDIVISIONS | Sec. | Twp. | Rge. | No. of Acres |
|--|------|------|------|--------------|--------------------|------|------|------|--------------|
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| TOTAL NUMBER OF ACRES TO BE IRRIGATED: | | | | | | | | | 0.0 |

Enclosed is an aerial photograph that I have marked to show the approximate location of land to be irrigated as described above.

7. State the approximate quantity of water desired for appropriation 100

Gallons per minute
 Cubic feet per second
 Acre-feet (impounded water)

8a. State the estimated time required for completion of all water diversion facilities.
completed

8b. State the earliest date when water will have been used for beneficial purposes.
April 1, 2017, or as soon as water is available

9. Will this project be constructed under a federal program, receive federal funding, or have federal planning assistance?
 No Yes If yes, explain: _____

10. I certify that am familiar with the information contained in this application, and that to the best of my knowledge and belief such information is true, complete and accurate.

4/4/2017 *Philip S Anderson*
 Date Signature of owner or owner's authorized agent (with proper documentation)

A final project map may accompany this application or must be filed within six months following departmental approval of this application, drawn in accordance with NAC Title 457 – Rules for Surface Water, Chapter 10, (<http://dnr.nebraska.gov/swr/surface-water-rules>). At the request of the applicant, the Department will assist with preparation of the project map.

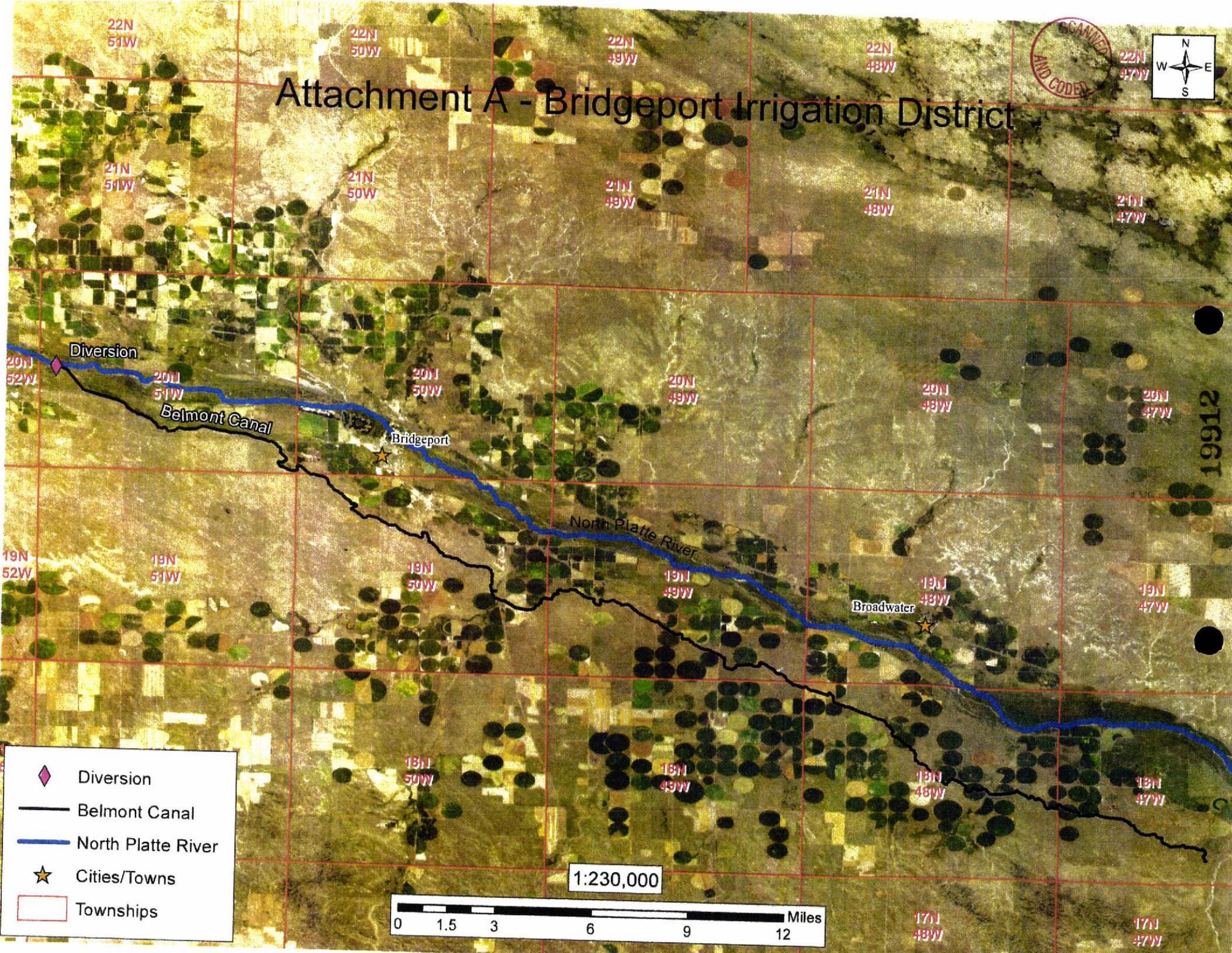
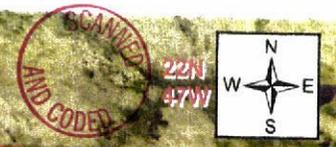
This form must be completed in full. An incomplete or defective application will be returned with 90 days being allowed for resubmission. Failure to resubmit a corrected application within this period shall cause dismissal of the application and consequent loss of priority and fees.

A non-refundable filing fee, payable to the Department of Natural Resources, computed from the table below must accompany this application. Forward this application and applicable fees to:

State of Nebraska
 Department of Natural Resources
 301 Centennial Mall South / P.O. Box 94676
 Lincoln, Nebraska 68509-4676
 (402) 471-2363

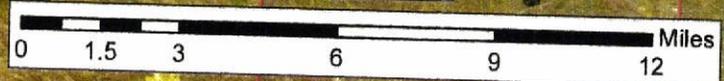
| Nature of Use | Cost | Nature of Use | Cost |
|---|-------|--|------|
| Domestic..... | \$10 | Manufacturing | |
| Agricultural | | General..... | \$10 |
| Irrigation from Stream | | Power Generation for each theoretical 50 horsepower..... | \$5 |
| 0-1,000 acres..... | \$200 | Other..... | \$10 |
| Each additional 1,000 acre unit..... | \$100 | | |
| or portion thereof in excess of the first 1,000 acre unit | | | |
| Irrigation from Storage Reservoir | | | |
| 0-1,000 acres..... | \$50 | | |
| or portion thereof in excess of the first 1,000 acre unit | | | |
| Each additional 1,000 acre unit..... | \$25 | | |
| or portion thereof in excess of the first 1,000 acre unit | | | |

Attachment A - Bridgeport Irrigation District



- Diversion
- Belmont Canal
- North Platte River
- Cities/Towns
- Townships

1:230,000



MARCH 1, 2017 TASK ORDER #17-1 TO NORTH PLATTE NATURAL RESOURCES DISTRICT AGREEMENT #3 FOR EXCESS FLOW DIVERSIONS

I. THE IRRIGATOR AGREES TO PERFORM AS FOLLOWS:

- A. The Irrigator agrees to divert natural flow surface water and convey such water through its delivery system, beginning when directed by the Nebraska Department of Natural Resources (NDNR) Bridgeport Field Office Supervisor after April 1, 2017, as needed to alleviate flooding conditions on the North Platte River, or to take advantage of excess flows available in the North Platte River. The period of diversion for this purpose will be the duration of the excess flow event, from the beginning date of this task order and until the excess flows of such event are no longer available. To receive any compensation under North Platte Natural Resources District (District) Agreement 3, the Irrigator must in good faith divert flows into its system and convey such water for the period of time designated above and as directed by NDNR's Bridgeport field office and the District but which cannot be quantified precisely at this time. A flat rate fee payable to the Irrigator will be agreed upon by all parties prior to diversion of any excess flows.

- B. Prior to the date of the end of the excess flow event, as determined by NDNR, the Irrigator retains the right to suspend or terminate its performance under this Agreement 1) in the event of threatened damage to any of its facilities; 2) threatened injury or damage to the person or property of third parties; 3) if any provisions of the Agreement subjects any part of the Irrigator's appropriation to cancellation, reduction or loss under the laws of the State of Nebraska, then in effect; 4) adversely affects its ability to provide irrigation service during its irrigation season; or 5) the Irrigator commences irrigation deliveries. The Irrigator's sole judgement in these matters will control. In the event that the Irrigator must suspend or terminate its performance pursuant to this paragraph, then it shall promptly notify the District by telephone and in writing. In such events, the District will accordingly determine, based upon the benefit received, any reduction in the payment made to Irrigator

II. THE DISTRICT AGREES TO PERFORM AS FOLLOWS:

- A. Payment will be for no more than \$150 per cfs diverted for flooding mitigation and canal recharge, and will be provided not later than ninety (90) days following the conclusion of diversion for these purposes.

- B. The District will work with NDNR to determine the measurements or methods needed to estimate project benefits (e.g. diversions and return flows). The District will make the agreed-upon measurements in conjunction with NDNR.

III. OTHER CONDITIONS

- A. FORCE MAJEURE - The Irrigator shall not be liable for any delay or failure to perform its obligations under this Agreement caused by an event or condition beyond the reasonable control, and not caused by the fault or negligence, of the Irrigator, including, but not limited to, failure of facilities, flood, earthquake, storm, lightning, fire, severe cold or other weather event, which delays or prevents performance, which the Irrigator could not reasonably have avoided by exercise of due diligence and foresight. Upon the occurrence of such an event or condition, the obligations of the Irrigator under this Agreement shall be excused and suspended without penalty or damages, provided that the Irrigator shall give the District prompt notice of such event or condition. In such events, the District will accordingly determine, based upon the benefit received, any reduction in the payment made to Irrigator.

- B. LIABILITY - Except for injury or damage caused by the District's intentional or grossly negligent acts, the District shall not be liable or held responsible for any injury or damage to the Irrigator's facilities, personnel, or equipment, or any other person or entity's property.

BRIDGEPORT IRRIGATION DISTRICT (Irrigator)

Philip Anderson President
Name and Title

3/8/17
Date

NORTH PLATTE NATURAL RESOURCES DISTRICT (District)

John Berge
John Berge, General Manager

3/8/17
Date

Attachment B

1.0 Introduction

Bridgeport Irrigation District (Applicant) submits this application for a temporary appropriation to divert anticipated excess flows for groundwater recharge and stream baseflow enhancement in the North Platte River. This application includes the following supplemental components, in addition to the application form DNR Form APA-001:

Map of canal (Attachment A)

Application narrative discussing excess flows and beneficial use (Attachment B)

DNR Order granting Variance Petition VAR-6150, allowing Bridgeport Irrigation District to file the attached application (Attachment C)

Agreement and 2017 Task Order executed by Bridgeport Irrigation District and North Platte NRD for excess flow diversion (Attachment D)

Upper Platte River Recharge and Flood Mitigation Demonstration Project: Part of the Conjunctive Management Toolbox, DNR January 2013 Technical Memorandum (Attachment E)

Bridgeport Irrigation District desires to obtain a temporary, one-year, appropriation to divert excess natural flow during the non-irrigation season, for the purpose of groundwater recharge and stream baseflow enhancement. Applicant has partnered with the North Platte Natural Resources District (NRD) again this year to take advantage of anticipated excess flows, and the recharge benefits to be realized from the proposed diversions will assist the NRD in meeting its integrated management plan (IMP) obligations. In addition, the stream baseflow enhancement that will be realized will provide water toward meeting Nebraska's obligations under the Platte River Recovery Implementation Program (PRRIP).

Applicant proposes to divert up to 100 cfs at its headgate located in the SE $\frac{1}{4}$ SW $\frac{1}{4}$ of Section 18, Township 20 North, Range 51 West of the 6th P.M., Morrill County, Nebraska, on the North Platte River. Of the total amount diverted, an anticipated 50 cfs will be spilled back to the North Platte River at three spill locations: (1) Pumpkin Creek Spillway in the NE $\frac{1}{4}$ SE $\frac{1}{4}$ of Section 23, Township 19 North, Range 50 West of the 6th P.M.; (2) Cedar Creek Spillway in the SE $\frac{1}{4}$ NE $\frac{1}{4}$ of Section 23, Township 18 North, Range 48 West of the 6th P.M.; (3) Tail End Spillway in the SE $\frac{1}{4}$ SE $\frac{1}{4}$ of Section 19, Township 18 North, Range 47 West of the 6th P.M., all located in Morrill County, Nebraska. The locations of the Applicant's main canal, river diversion, and spill(s) are shown on the map labeled Attachment A. Water will be diverted at the headgate and run through the main canal but not through the system laterals. That water which does not spill back to the North Platte River will be allowed to soak through the canal perimeter, providing recharge to the underlying aquifer, as has occurred on these projects in previous years.

2.0 Excess flows

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The Applicant believes that excess flows will be available along the North Platte River prior to the beginning of the 2017 irrigation season; the potential for excess flows following the 2017 irrigation season cannot be assessed at this time. As of February 22, 2017, the snowpack in the upper North Platte Basin was at 124% of average, and more snow is expected in the mountains which feed the North Platte drainage before snowmelt season begins (Figure 1). This level of snowpack is in line with previous years in which spring excess flows have occurred. This forecast does not include any spring precipitation event that may add to the total water supply in the North Platte Basin prior to the beginning of irrigation season.

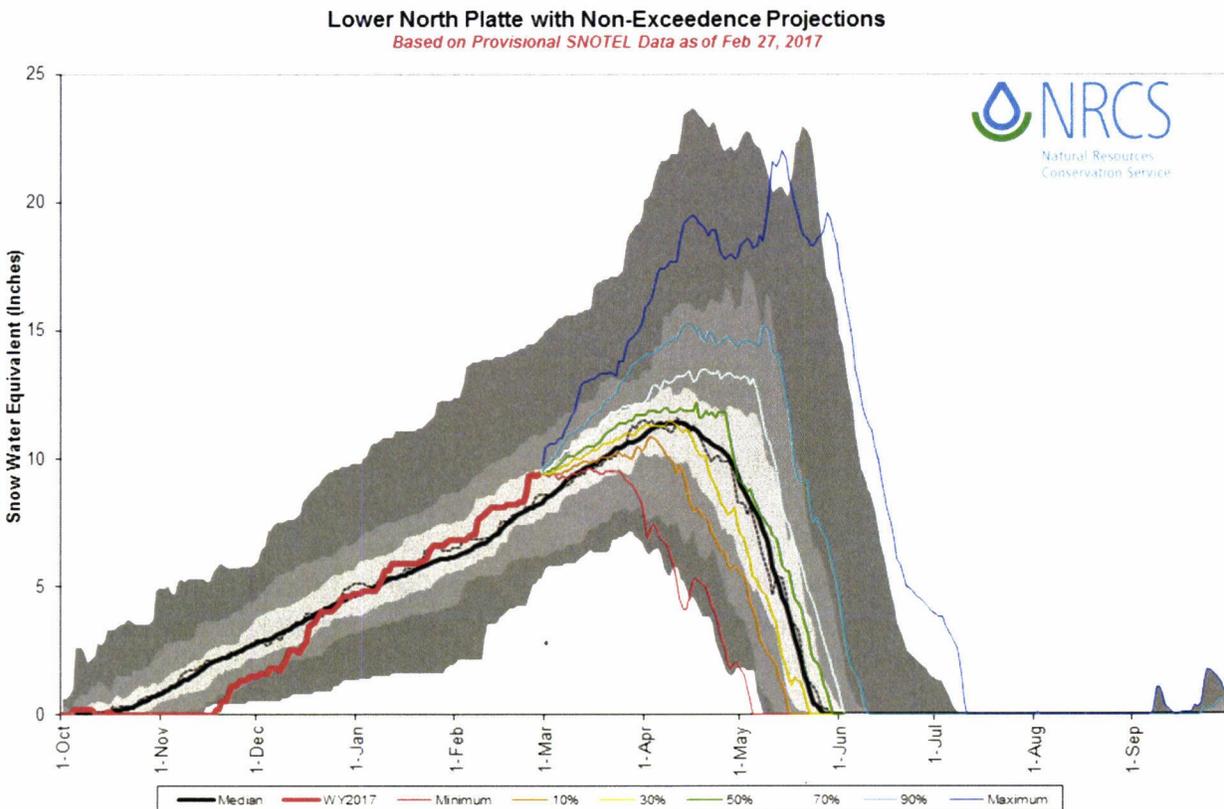


Figure 1: Current and projected snow-water equivalent of snowpack in the lower North Platte Basin below Seminoe Reservoir. (http://www.weather.gov/riw/cms_snotel_quicklinks_graphs, accessed February 27, 2017)

To compound the current state of above-average snowpack, all the US Bureau of Reclamation reservoirs in Wyoming are already full, except for Guernsey, which has been drained for spillway reconstruction (Figure 2).

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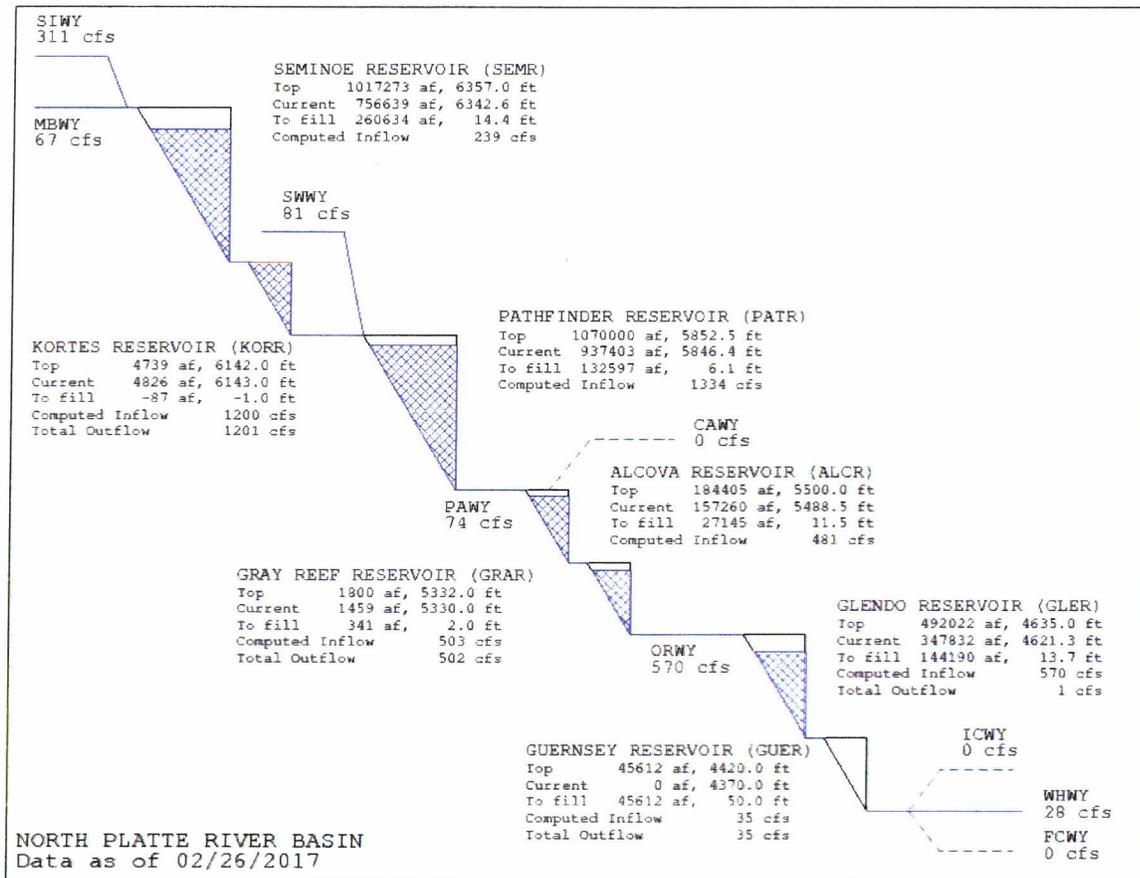


Figure 2: TEACUP model of current Wyoming reservoir levels in the North Platte River system. (https://www.usbr.gov/gp-bin/hydromet_teacup.pl, accessed February 27, 2017)

The Bureau has stated that it will need to release water from storage to make room for snowmelt runoff later in the season, though no flooding conditions are currently forecast for the North Platte system as a result of these releases or snowmelt runoff (Figure 3). These releases, along with any additional releases that may be required to maintain the desired level of storage in the reservoir system through spring and early summer, may generate additional excess flows through the North Platte River system beyond what existing appropriations could either store or beneficially use.

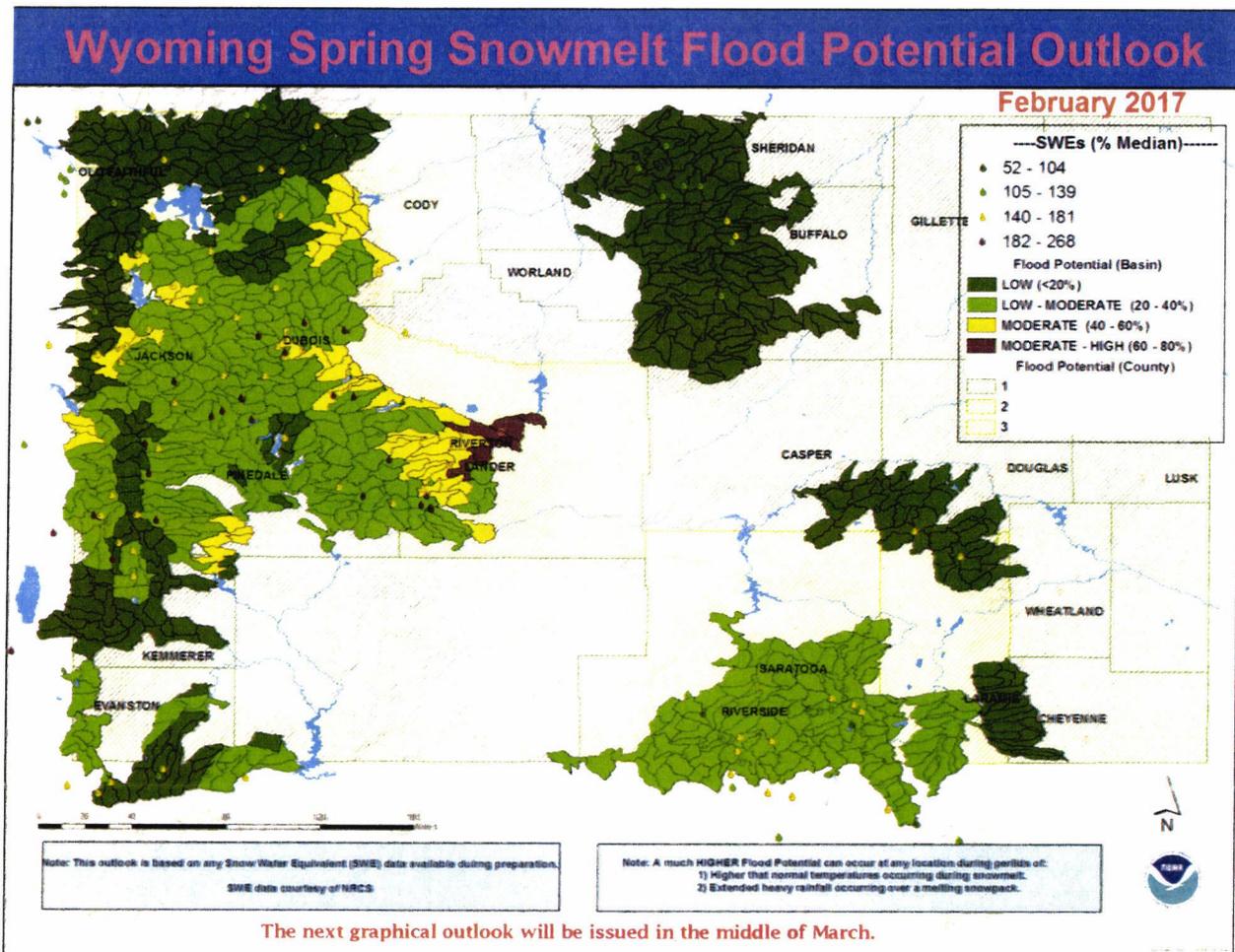


Figure 3: Spring flood potential forecast for the upper North Platte basin, based on anticipated rate of snowmelt and reservoir storage. Note that this outlook does not incorporate abnormally high temperatures, which would accelerate snowmelt, or heavy precipitation events occurring during the snowmelt season. (http://www.weather.gov/riw/cms_snotel_quicklinks_graphs, accessed February 27, 2017)

Because of the factors discussed above, high spring flows along the North Platte River are anticipated to occur before the 2017 irrigation season begins. The Applicant and its partner, the North Platte NRD, believe that these flows will be in excess of both PRRIP target flows and state-protected flows that are required to be available prior to June 1.

3.0 Beneficial Use of Canal Recharge

3.1 Canal Recharge and Stream Baseflow Accretions

Applicant and the North Platte NRD have previously partnered to divert excess flows for groundwater recharge, which subsequently enhances the stream baseflow in the North Platte

Attachment B

River. Previous diversion projects in the North Platte NRD occurred in the spring and fall of 2011, as well as the spring of 2016. Below is a set of tables detailing the canals that were used for groundwater recharge during these previous events, along with the estimated amount of recharge that occurred for each canal.

Table 1: Diversion and recharge data from Spring 2011 excess flow diversion project. Estimated recharge values may be refined based on Robust Review of integrated management activities, currently being undertaken by the Platte Basin Coalition and its consultants.

| Spring 2011 Excess Flow Diversion Data | | | | | |
|---|------------------------|----------------------------|-----------------------------|-------------------------------|--------------------------------|
| Irrigation District/ Canal Company | Diversion Dates | Total Days Diverted | Total Diversion (AF) | Estimated Canal Loss % | Estimated Recharge (AF) |
| Pathfinder | 4/1/11 - 4/15/11 | 15 | 12,718 | 55% | 6,995 |
| Farmers | 4/5/11 - 5/7/11 | 33 | 20,288 | 49% | 9,941 |
| Enterprise | 4/1/11 - 5/1/11 | 31 | 2,443 | 42% | 1,026 |
| Central | 4/6/11 - 5/15/11 | 40 | 627 | 42% | 263 |
| Castle Rock | 4/3/11 - 5/3/11 | 31 | 1,497 | 41% | 614 |
| Minatare | 4/1/11 - 4/30/11 | 30 | 2,437 | 24% | 585 |
| Nine Mile | 4/15/11 - 5/14/11 | 30 | 1,579 | 68% | 1,074 |
| Chimney Rock | 4/1/11 - 5/1/11 | 31 | 1,004 | 45% | 452 |
| Belmont | 4/1/11 - 5/1/11 | 31 | 2,084 | 53% | 1,105 |
| Lisco | 4/13/11 - 5/13/11 | 31 | 2,229 | 32% | 713 |
| Total | | | 46,906 | | 22,767 |

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Table 2: Diversion and recharge data from Fall 2011 excess flow diversion project. Estimated recharge values may be refined based on Robust Review of integrated management activities, currently being undertaken by the Platte Basin Coalition and its consultants.

| Fall 2011 Excess Flow Diversion Data | | | | | |
|---|------------------------|----------------------------|-----------------------------|-------------------------------|--------------------------------|
| Irrigation District/ Canal Company | Diversion Dates | Total Days Diverted | Total Diversion (AF) | Estimated Canal Loss % | Estimated Recharge (AF) |
| Central | 9/24/11 - 10/29/11 | 36 | 1,028 | 34% | 350 |
| Castle Rock | 10/5/11 - 11/12/11 | 39 | 1,077 | 43% | 463 |
| Minatare | 10/1/11 - 11/2/11 | 33 | 2,380 | 29% | 690 |
| Nine Mile | 9/14/11 - 10/24/11 | 41 | 1,106 | 68% | 752 |
| Chimney Rock | 9/24/11 - 11/9/11 | 47 | 2,963 | 30% | 874 |
| Belmont | 9/24/11 - 11/9/11 | 47 | 2,009 | 51% | 1,015 |
| Lisco | 9/23/11 - 10/23/11 | 31 | 1,516 | 47% | 713 |
| Winters Creek | 9/23/11 - 11/7/11 | 46 | 882 | 31% | 269 |
| Total | | | 12,961 | | 5,125 |

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Table 3: Diversion and recharge data from Spring 2016 excess flow diversion project. Estimated recharge values may be refined in the future based on additional model analyses.

| Spring 2016 Excess Flow Diversion Data | | | | | |
|---|------------------------|----------------------------|-----------------------------|-------------------------------|--------------------------------|
| Irrigation District/Canal Company | Diversion Dates | Total Days Diverted | Total Diversion (AF) | Estimated Canal Loss % | Estimated Recharge (AF) |
| Minatare | 5/17/16 - 5/19/16 | 3 | 50 | 24% | 12 |
| Lisco | 4/14/16 - 4/18/16 | 5 | 155 | 32% | 50 |
| Mitchell | 5/27/16 - 6/8/16 | 13 | 3,590 | 28% | 1,005 |
| Castle Rock | 5/16/16 - 6/20/16 | 36 | 2,701 | 41% | 1,108 |
| Northport | 5/17/16 - 6/6/16 | 21 | 3,905 | 81% | 3,174 |
| Belmont | 4/1/16 - 6/09/16 | 70 | 7,150 | 53% | 3,790 |
| Farmers | 6/1/16 - 6/15/16 | 15 | 19,765 | 94% | 18,580 |
| Total | | | 37,316 | | 27,718 |

Note that the recharge values in Tables 1 through 3 indicate the amount of water infiltrated into the aquifer and do not represent anticipated changes in stream baseflow that will result from these recharge projects. Anticipated stream baseflow benefits from previous excess-flow diversions will be calculated as part of the integrated management plan Robust Review, which is currently ongoing. DNR published a Technical Memorandum in January 2013 entitled, *Upper Platte River Recharge and Flood Mitigation Demonstration Project: Part of the Conjunctive Management Toolbox*, that provides some preliminary methods for calculating the streamflow benefits anticipated from the 2011 excess-flow diversions (Attachment E). Tables 2 and 3 of this Technical Memorandum summarize these initial calculations and are abstracted as Tables 4 and 5 below for reference.

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Table 4: Reproduction of Table 2 from DNR January 2013 Technical Memorandum, showing estimated annual baseflow accretions to Platte River system, in acre-feet, from 2011 excess-flows diversions. (*Upper Platte River Recharge and Flood Mitigation Demonstration Project: Part of the Conjunctive Management Toolbox*, DNR January 2013 Technical Memorandum, p. 9)

| Year | NPNRD | SPNRD | TPNRD | TBNRD | CPNRD | Annual |
|------|-------|-------|-------|-------|-------|--------|
| 2011 | 3 | 3 | 422 | 0 | 634 | 1,062 |
| 2012 | 83 | 44 | 853 | 21 | 671 | 1,672 |
| 2013 | 229 | 89 | 868 | 69 | 590 | 1,844 |
| 2014 | 328 | 105 | 805 | 104 | 511 | 1,853 |
| 2015 | 381 | 107 | 724 | 121 | 445 | 1,777 |
| 2016 | 405 | 102 | 644 | 126 | 392 | 1,669 |
| 2017 | 414 | 95 | 574 | 125 | 348 | 1,555 |
| 2018 | 413 | 88 | 513 | 121 | 311 | 1,446 |
| 2019 | 406 | 81 | 461 | 115 | 281 | 1,344 |
| 2020 | 396 | 75 | 416 | 109 | 255 | 1,251 |
| 2021 | 384 | 69 | 378 | 103 | 233 | 1,167 |
| 2022 | 371 | 64 | 345 | 97 | 214 | 1,091 |
| 2023 | 357 | 59 | 316 | 91 | 198 | 1,022 |
| 2024 | 343 | 55 | 291 | 86 | 183 | 959 |
| 2025 | 330 | 51 | 269 | 81 | 171 | 903 |
| 2026 | 317 | 48 | 250 | 77 | 159 | 851 |
| 2027 | 305 | 45 | 233 | 72 | 149 | 804 |
| 2028 | 293 | 42 | 218 | 68 | 140 | 761 |
| 2029 | 281 | 40 | 204 | 65 | 132 | 722 |
| 2030 | 271 | 38 | 191 | 62 | 124 | 685 |
| 2031 | 260 | 36 | 180 | 59 | 118 | 652 |
| 2032 | 251 | 34 | 170 | 56 | 111 | 621 |
| 2033 | 241 | 32 | 161 | 53 | 106 | 593 |
| 2034 | 233 | 30 | 152 | 51 | 100 | 567 |
| 2035 | 224 | 29 | 145 | 48 | 96 | 542 |
| 2036 | 216 | 28 | 138 | 46 | 91 | 519 |
| 2037 | 209 | 26 | 131 | 44 | 87 | 498 |
| 2038 | 202 | 25 | 125 | 43 | 83 | 478 |
| 2039 | 195 | 24 | 119 | 41 | 80 | 460 |
| 2040 | 189 | 23 | 114 | 39 | 77 | 442 |
| 2041 | 183 | 22 | 109 | 38 | 74 | 426 |
| 2042 | 177 | 21 | 105 | 36 | 71 | 410 |
| 2043 | 171 | 21 | 101 | 35 | 68 | 396 |
| 2044 | 166 | 20 | 97 | 34 | 66 | 382 |
| 2045 | 161 | 19 | 93 | 33 | 63 | 369 |
| 2046 | 157 | 18 | 90 | 32 | 61 | 357 |
| 2047 | 152 | 18 | 86 | 30 | 59 | 346 |
| 2048 | 148 | 17 | 83 | 30 | 57 | 335 |
| 2049 | 144 | 17 | 80 | 29 | 55 | 324 |
| 2050 | 140 | 16 | 78 | 28 | 53 | 315 |
| 2051 | 136 | 16 | 75 | 27 | 52 | 305 |
| 2052 | 132 | 15 | 73 | 26 | 50 | 296 |
| 2053 | 129 | 15 | 70 | 25 | 48 | 288 |
| 2054 | 126 | 14 | 68 | 25 | 47 | 280 |
| 2055 | 122 | 14 | 66 | 24 | 46 | 272 |

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| Year | NPNRD | SPNRD | TPNRD | TBNRD | CPNRD | Annual |
|-------------|---------------|--------------|---------------|--------------|--------------|---------------|
| 2056 | 119 | 13 | 64 | 23 | 44 | 265 |
| 2057 | 117 | 13 | 62 | 23 | 43 | 258 |
| 2058 | 114 | 13 | 61 | 22 | 42 | 251 |
| 2059 | 111 | 12 | 59 | 21 | 41 | 244 |
| 2060 | 108 | 12 | 57 | 21 | 40 | 238 |
| 10yr | 3,056 | 787 | 6,281 | 911 | 4,439 | 15,474 |
| 50yr | 11,341 | 1,913 | 11,991 | 2,753 | 8,171 | 36,168 |

Table 5: Portion of Table 3 from DNR January 2013 Technical Memorandum, showing estimated baseflow accretions to Platte River system, in acre-feet, from 2011 excess-flows diversions, by individual canals located in the North Platte NRD. Canals downstream of Lake McConaughy have been removed. Data for certain canals shown in this table may differ from that shown in Tables 1 and 2 above; this likely reflect additional sources of information used to generate the values in Tables 1 and 2, which was not used in the DNR Technical Memorandum. (*Upper Platte River Recharge and Flood Mitigation Demonstration Project: Part of the Conjunctive Management Toolbox*, DNR January 2013 Technical Memorandum, p. 10)

| Project | Spring Diversion | Fall Diversion | Total Diversion | Total Recharge | 10-year Benefit | 50-year Benefit |
|---------------------|------------------|----------------|-----------------|----------------|-----------------|-----------------|
| Pathfinder Canal | 12,718 | 0 | 12,718 | 5,087 | 178 | 1,690 |
| Farmers Canal | 18,425 | 0 | 18,425 | 8,660 | 1,470 | 4,471 |
| Enterprise Canal | 2,559 | 0 | 2,559 | 1,689 | 287 | 872 |
| Winters Creek Canal | 0 | 882 | 882 | 42 | 7 | 22 |
| Central Canal | 524 | 1,022 | 1,545 | 331 | 56 | 171 |
| Castle Rock Canal | 1,595 | 1,069 | 2,664 | 1,198 | 42 | 398 |
| Minatare Canal | 2,709 | 2,338 | 5,048 | 1,207 | 205 | 623 |
| Nine Mile Canal | 1,521 | 1,114 | 2,635 | 1,850 | 314 | 955 |
| Chimney Rock Canal | 948 | 2,965 | 3,913 | 1,049 | 178 | 542 |
| Belmont Canal | 2,241 | 2,965 | 5,206 | 2,789 | 98 | 926 |
| Lisco Canal | 2,229 | 1,516 | 3,746 | 1,301 | 221 | 672 |
| Totals: | 45,469 | 13,871 | 59,341 | 25,203 | 3,056 | 11,342 |

The information presented in Tables 4 and 5 will also be reviewed during the Robust Review process and may not represent final accepted values. The magnitude and timing of streamflow benefits from excess-flow diversion events are clear from these tables, however, and indicate the streamflow benefits that may be expected from additional excess-flow diversions, such as that proposed in this application.

3.2 Integrated Management Plan and PRRIP Benefits

The recharge and baseflow accretion benefits described in Section 3.1 above provide offsets for groundwater depletions to streamflow from post-1997 uses, as required by the joint IMP adopted

Attachment B

by the North Platte NRD and DNR, as well as the basinwide integrated management plan, to which the North Platte NRD and DNR are parties. In addition, the streamflow accretions realized from canal recharge provide water toward PRRIP goals of reducing shortages to target flows by 130,000 to 150,000 acre-feet per year. Because streamflow benefits accrue to the river over a long period of time, the total benefits from excess-flow diversions for recharge continue to materialize decades after the diversion events themselves. These long-term accretions will ensure that the North Platte NRD and the State of Nebraska continue to meet their respective depletion-offset obligations into the future.

The proposed temporary appropriation for excess-flow diversion will provide additional depletion-offset water toward meeting IMP and PRRIP goals. As with previous excess-flow diversions, the benefits from diverting excess flows under the proposed appropriation will continue to accrue to the North Platte River for many years, which will assist the NRD and Nebraska in meeting the goals of the next increment of IMPs. Groundwater recharge, streamflow accretion, and depletion offsets are all recognized beneficial uses of surface water, particularly in a fully or overappropriated area. The temporary appropriation requested here, if granted, will be put to beneficial use through the partnership between Applicant and the North Platte NRD, as outlined in the contract and 2017 task order included as Attachment D to this application.

4.0 Effects on other appropriators

The excess flows discussed in Section 2.0 above are expected to be more than sufficient to provide for PRRIP target flows, as well as for "state-protected flows," a term of art intended to encompass flows needed to satisfy appropriators whose appropriations may be in priority at a given point in time. During the non-irrigation season, this term includes water that Central Nebraska Public Power and Irrigation District could expect to flow into Lake McConaughy, when its appropriations are in priority. These flows also include water for instream-flow and other excess-flow appropriations held by entities downstream of Lake McConaughy, including the Central Platte NRD.

The temporary appropriation sought under this application will receive a 2017 priority date, if granted, and will be permitted to divert when the appropriation is in priority. Just as with any other surface-water appropriation along the North Platte River, the Applicant will not be able to divert excess flows unless and until senior downstream appropriators are satisfied, and the appropriation will be subject to water administration. In an excess-flow event, however, streamflow is consistently present in quantities that will satisfy all in-priority appropriations, as well as PRRIP target flows. Consequently, the granting of this proposed temporary appropriation will have no adverse effect on downstream senior appropriators.

Attachment B

5.0 Conclusion

Bridgeport Irrigation District requests this temporary appropriation for the purpose of diverting excess flows during the non-irrigation season. Diverted water will be run through the Applicant's main canal, and that water which is not spilled back to the river will be allowed to soak away through the canal perimeter to recharge the aquifer. The Applicant has partnered with the North Platte NRD to accomplish this project, which will provide streamflow accretions that assist the NRD and the State of Nebraska in meeting IMP and PRRIP streamflow goals. The Applicant has presented information showing the likelihood of excess flows being available during the non-irrigation season, as well as an outline of the benefits to be expected from the beneficial use of water under the proposed appropriation.

Attachment C

STATE OF NEBRASKA

DEPARTMENT OF NATURAL RESOURCES

ORDER GRANTING LEAVE TO FILE AN APPLICATION FOR
A NEW SURFACE WATER APPROPRIATION WITHIN AN AREA SUBJECT TO A
MORATORIUM BY PETITION VAR-6150

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 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." The individual integrated management plans referenced in the next paragraph are required to be in conformance with the goals and objectives of the BWIMP.
3. On August 13, 2009, the initial 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. There have been subsequent revisions to the IMPs. 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 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 water-related activities on streamflows in the Platte River. The State of Nebraska, through the Department will utilize the integrated management process to achieve the goals of PRRIP (BWIMP and IMPs).

5. On March 14, 2017, Bridgeport Irrigation District (Petitioner) filed petition VAR-6150 for Leave to File or Consider an Application for a Permit to Appropriate Water within a Moratorium Area or Stay Area. The petition requests leave to file an application for a temporary permit to appropriate water for the purpose of groundwater recharge via the Belmont Canal.
6. When the flows are adequate to supply senior appropriations and satisfy the USFWS target flows, for the purposes of this order "Desired Minimum Discharge" describes the water parameter that will be used to determine whether, and to what extent diversion may occur for projects such as that proposed under VAR-6150. Table A (see attached) lists the DMD values for the Platte River, measured in cubic feet per second at the Grand Island streamgage, for specific time periods. The magnitude of these flows differs according to the PRRIP's designation of dry, normal or wet hydrologic conditions, derived from the USFWS's recommendations for species flows and annual pulse flows and found in the PRRIP Water Plan Reference Materials Attachment 5, Section 11, Appendix A-5. These flow values also include instream flow appropriations which must also be met in order for unappropriated water to be considered available for possible diversion.

ANALYSIS

1. The formal moratorium issued by the Department in 2004 has been continued in the surface water controls included in the individual NRD IMPs adopted by the Platte River Basin NRDs and the Department.

Because the Platte River Basin is currently undergoing integrated management for the purposes of reducing depletions to streamflow, any new consumptive use must be examined for its potential effects on extant surface and groundwater users and upon all matters of significant public interest and concern. This includes assessing both positive and negative impacts on the State's ability to comply with interstate agreements, programs, decrees and compacts, including PRRIP. Thus, any proposed project must be scrutinized to prevent conflict with (a) the goals and actions necessary to implement the IMPs adopted by the Platte River Basin NRDs and the Department and (b) the water needs of Water Action Plan projects that will be implemented under PRRIP. Applications for potential beneficial uses that are not clearly non-consumptive will be presumed to be at least partially consumptive. Therefore, an analysis of the effects of a proposed new diversion on these existing uses and responsibilities is required in order to determine whether sufficient good cause exists to grant a variance to apply for a new use.

2. Petitioner provided information that indicates the presence of unappropriated water throughout the Platte River Basin upstream of the confluence of the Loup and Platte Rivers. The information shows that U.S. Fish and Wildlife Service target flows and State protected instream flow appropriations held by the Central Platte NRD and the Nebraska Game and Parks Commission are likely to be exceeded based on historical analysis and experience with temporary permits that were previously utilized. Petitioner acknowledges that protection of target flows must be maintained throughout the year, and Petitioner expects

such to be a condition of any permit approval, if a permit was allowed to be filed and was ultimately granted.

3. Petitioner requests a permit to divert water for the purpose of groundwater recharge to assist in optimizing water management.
4. Petitioner proposes to divert unappropriated water prior to the normal irrigation season and possibly after the irrigation season concludes, if river conditions are such that unappropriated water is available.

CONCLUSIONS

1. Petitioner has provided evidence that indicates there is likely to be unappropriated water in the future on the Platte River prior to and after some irrigation seasons because of flows in excess of appropriated water and Desired Minimum Discharge, as defined above.
2. The diversion project proposed on the attached draft application does not appear to be in conflict with integrated management plan goals and potential conjunctive management projects. In addition, recharge from this project should assist NRDs in meeting their offset responsibilities under the BWIMP and individual NRD IMPs.
3. The potential benefits of groundwater recharge that Petitioner expects to result from the proposed project outweigh the effects of any stream depletions from temporarily diverting the water during times described above.
4. For these reasons, Petitioner should be granted leave to file an application to divert flows in excess of appropriated water and Desired Minimum Discharge for the purpose of groundwater recharge.

ORDER

IT IS HEREBY ORDERED:

1. Petition VAR-6150 meets the requirements of *Department of Natural Resources Rules of Surface Water, Title 457 Neb. Admin. Code Chapter 23, § 001.03*, has shown sufficient good cause, and is GRANTED.
2. This Order granting leave to file or consider an application for a new surface water appropriation within a moratorium or stay area pursuant to petition VAR-6150 shall be in effect for one year from the date this order is signed.
3. This decision shall not bind the Director to approve any application to which it relates, or in any way be used as evidence of prejudice for the Director's future decisions concerning the specific approval requirements of such an application.

DEPARTMENT OF NATURAL RESOURCES

March 24, 2017


Gordon W. Fassett, P.E., Director

Attachment D

NPNRD Excess Flows Agreement # 3

THIS AGREEMENT entered into on this 1st day of June, 2016, by the **NORTH PLATTE NATURAL RESOURCES DISTRICT**, hereinafter referred to as the "**DISTRICT**," and **BRIDGEPORT IRRIGATION DISTRICT**, hereinafter referred to as the "**IRRIGATOR**."

WITNESSETH:

WHEREAS, the Irrigator has surface water appropriation(s) for natural flow from the North Platte River and/or its tributaries and the necessary conveyance structure(s) to transmit such natural flow; and

WHEREAS, the District and the Nebraska Department of Natural Resources have jointly developed and agreed to implement an integrated management plan (IMP) which describes investigating projects to enhance and improve water supply, including the development of new infrastructure and other groundwater projects for the purpose of providing net accretions to the river; and

WHEREAS, the District or the Nebraska Department of Natural Resources may request the Irrigator to 1) divert natural flow into the Irrigator's delivery system during periods when streamflow is in excess of US Fish and Wildlife Service target flows and state-protected flows, without subsequent consumptive use for irrigation, in order to assist the District in its efforts to 1) achieve flood prevention and study groundwater recharge and/or groundwater discharge to streamflow, or 2) other projects with the purpose of meeting the goals and objectives of the IMP; and

WHEREAS, the Irrigator is willing to assist the District to meet the objectives of the IMP in exchange for compensation; and

NOW THEREFORE, in consideration of the mutual covenants made, the compensation agreed to, and other good and valuable consideration the receipt of which is hereby acknowledged, the parties agree as follows:

I. SCOPE OF SERVICES

The Irrigator will make available the diversion structures of the Bridgeport Irrigation canal and the services of a ditch rider or staff member, for the term of this Agreement, to assist District efforts to meet the objectives of the IMP, which may include, but not be limited to, the diversion of streamflows in excess of target flows and state-protected flows for the purpose of retiming streamflow, and any monitoring activities necessary to further understanding of the effects of such activities on streamflow. These efforts will be carried out in accordance with Task Authorizations developed under this Agreement and approved by the Irrigator and District. The purpose of this Agreement is to set forth the terms and conditions applicable to such efforts. During the term of this Agreement, the details of timing and payment shall be described and set forth in separate, numbered Task Authorizations, issued pursuant to the terms of this Agreement. Should a particular Task Authorization ever require revision, such revision shall be accomplished through an amendment to that individual Task Authorization.

II. DURATION OF AGREEMENT

This Agreement is effective on the date signed by the last party and remains effective for five (5) years from the effective date. There will be no extension or renewal of this Agreement unless further agreed to in writing by the parties.

III. THE IRRIGATOR AGREES TO PERFORM AS FOLLOWS:

- A. The Irrigator agrees to divert, only upon request from the District and in accordance with a particular Task Authorization then in operation, up to 100 cfs of natural flow surface water and convey such water through its delivery system.
- B. The Irrigator further agrees not to apply to consumptive use for irrigation any of the water diverted subject to this Agreement.
- C. The Irrigator represents and affirms that, in accordance with all relevant regulations, statutes, and/or procedures, the Irrigator has complied or will comply with all requirements necessary to allow it to enter into this Agreement and perform all actions herein required. If the Irrigator has not complied, or in the future fails to comply, with all relevant regulations, statutes, and/or procedures, this contract is null and void.
- D. The Irrigator retains the right to suspend or terminate its performance under this Agreement 1) in the event of threatened damage to any of its facilities; 2) threatened injury or damage to the person or property of third parties; 3) if any provisions of the Agreement subjects any part of the Irrigator's appropriation to cancellation, reduction, or loss under the laws of the State of Nebraska then in effect; or 4) adversely affects its ability to provide irrigation service during its irrigation season. The Irrigator's sole judgement in these matters will control. In the event that the Irrigator must suspend or terminate its performance pursuant to this paragraph, then it shall promptly notify the District by telephone and in writing.

IV. THE DISTRICT AGREES TO PERFORM AS FOLLOWS:

- A. The District's total annual payment under the five (5) year term of this contract cannot exceed \$150 per cfs of excess flows diverted for flood relief and canal recharge.
- B. Payment will be made according to the terms of each Task Authorization, but not later than 6 months after the last date the Irrigator has diverted under the terms of any individual Task Authorization.

NPNRD Excess Flows Agreement # 3

- C. The District will assist the Irrigator in obtaining all necessary permits from the Department for the purpose of diverting excess flows under this agreement.

V. THE PARTIES MUTUALLY AGREE AS FOLLOWS:

- A. The parties agree that Irrigator has retained and reserved the rights to any additional water that it would be entitled to receive under agreements and contracts between the Bureau of Reclamation or any other entity and the Irrigator that are outside of the provisions of this Agreement.
- B. In executing this Agreement, the parties shall comply with all other applicable state and federal laws.

BRIDGEPORT IRRIGATION DISTRICT (IRRIGATOR)

Phil S. Hearn President.
Name and Title

6/1/16
Date

NORTH PLATTE NATURAL RESOURCES DISTRICT (DISTRICT)

John Berge
John Berge, General Manager

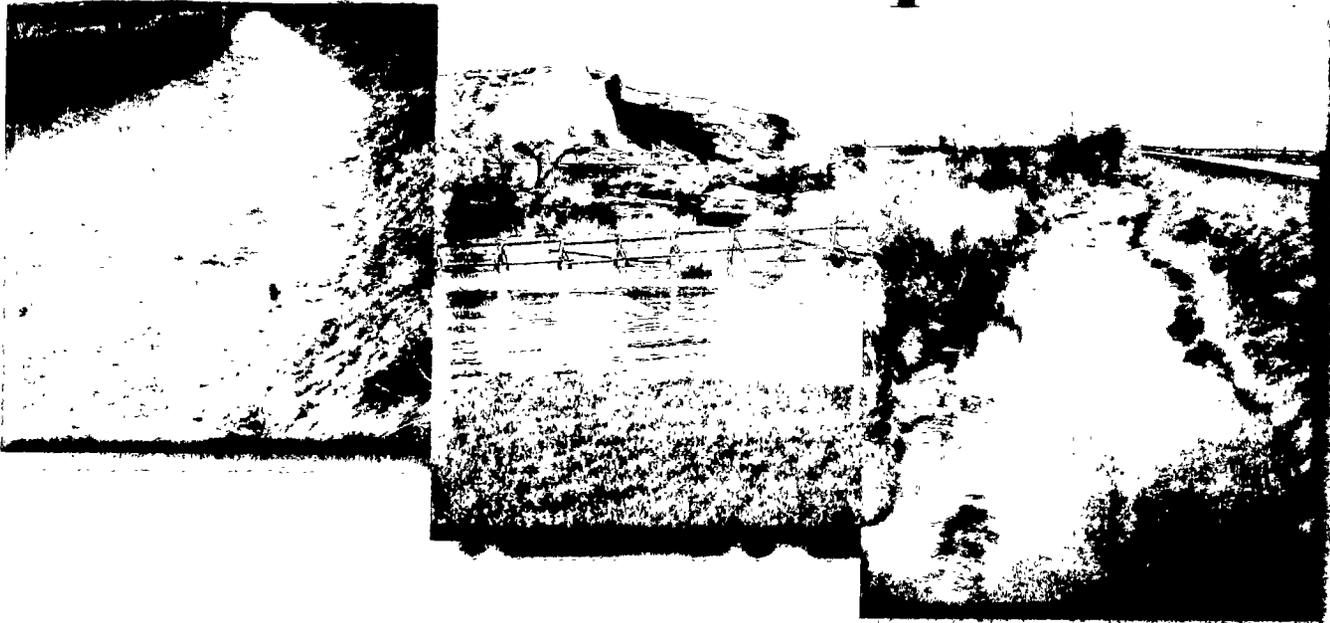
6/1/16
Date

January 2013

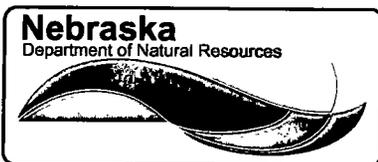
**Nebraska Department of Natural Resources
Integrated Water Management Division**

**Upper Platte River Recharge and Flood
Mitigation Demonstration Project:**

Part of the Conjunctive Management Toolbox



Technical Memorandum- January 2013



Integrated Water Management Division
Nebraska Department of Natural Resources

Technical Memorandum

This technical memorandum (TM) is intended to provide a brief or preliminary summary of a project or experiment without extensive technical analysis. It is not intended to be so in depth that one be able to recreate the experiment based upon the information given, but rather to present a broad overview of the methods and analysis while highlighting the results and conclusions. Although the content is of a technical manner, the TM should be understood by an audience with a general scientific background.

Acknowledgements

The Department would like to thank the natural resources districts and the Irrigation Districts for their hard work, collaborative efforts, and perseverance in carrying out this project. Cooperators include: Central Platte, North Platte, South Platte, Tri-Basin, and Twin Platte Natural Resources Districts; Bridgeport Irrigation District; Castle Rock Irrigation District; Central Irrigation District; Central Nebraska Public Power and Irrigation District; Chimney Rock Irrigation District; Cozad Canal Company; Enterprise Irrigation District; Farmers Irrigation District; Keith Lincoln County Irrigation District; Lisco Irrigation District; Minatare Canal Company; Nebraska Public Power District; Nine Mile Irrigation District; Pathfinder Irrigation District; Paxton-Hershey Water Company; Platte Valley Irrigation District; South Side Irrigation Company; Suburban Irrigation District; Thirty Mile Canal Company; Western Irrigation District; and Winters Creek Canal Company. Without the efforts of all of these parties, this project would not have been as successful.

Funding for the project includes the Central Platte, North Platte, South Platte, Tri-Basin, and Twin Platte Natural Resources Districts; and the Nebraska Environmental Trust.

1.0 Summary

Twenty-one irrigation districts participated in the Spring 2011 Recharge and Flood Mitigation project during the months of April and May. Twenty irrigation districts participated in the Fall 2011 Recharge and Flood Mitigation project during the months of September through December. In order to quantify the volume of water that was recharged by the canals, canal losses were developed for each canal. Canal losses were calculated using diversion and spill discharge measurements or were estimated from existing data sources. Based on the diversion records and calculated losses, recharge volumes were calculated by canal and summarized by natural resource district (NRD). Recharge volumes for each canal were used in conjunction with response functions developed by the technical committee under the Platte Basin Habitat Enhancement Program (PBHEP) to calculate estimated accretions/depletions to the Platte River.

2.0 Method

A total of 23 canals that divert water from the North Platte River, the South Platte River, and Platte River participated in the 2011 Recharge Project in the spring, fall, or both. Each individual canal began diverting at different times depending upon permit requirements and readiness of the canal and its operators. Average daily diversions were used to determine the amount of water that entered each canal for a total of 30 days during the spring. Average daily diversions were used to determine the amount of water that entered each canal subsequent to irrigation operations during the fall. Average daily diversions were used until diversions stopped in the fall, regardless of the number of days. Several of the canals were forced to shut down their canals during the recharge time period due to extreme weather conditions or to make repairs on the canal. The period of time for those canals was extended to include 30 days of actual diversions, with the exception of Pathfinder Irrigation District. Pathfinder Irrigation district did not participate for the full 30 days during the spring due to additional operational requirements of the district.

The Department of Natural Resources' (Department) Bridgeport Field Office was tasked with conducting and coordinating discharge measurements at the spill locations for each canal in order to do water balance calculations. Due to demands on the field office associated with the high water levels during the 2011 water year, a number of canal spills went unmeasured. If canal spill measurements were available, water balance calculations were conducted to determine the percentage of the total diversion that was lost. If measurements were not available, estimates of canal loss were taken from the STELLA model developed under the COHYST 2010 project. Estimated and calculated canal losses were compared against historical seepage measurements and operational efficiencies used and developed by the irrigation districts. Table 1 summarizes the participating projects, the method used to determine canal loss, and the total number of days considered during the spring and fall.

| Irrigation Project | Method | Spring Diversion Days | Fall Diversion Days |
|---------------------------|---------------|------------------------------|----------------------------|
| Pathfinder Canal | Measurement | 15 | 0 |
| Farmers Canal | Measurement | 30 | 0 |
| Enterprise Canal | Measurement | 30 | 0 |
| Winters Creek Canal | Measurement | 0 | 46 |
| Central Canal | Measurement | 30 | 36 |
| Castle Rock Canal | Measurement | 30 | 39 |
| Minatare Canal | Measurement | 30 | 33 |
| Nine Mile Canal | Measurement | 30 | 41 |
| Chimney Rock Canal | Measurement | 30 | 47 |
| Belmont Canal | Seepage Runs | 30 | 47 |
| Lisco Canal | Measurement | 30 | 31 |
| Keith Lincoln Canal | Measurement | 30 | 37 |
| Suburban Canal | Measurement | 30 | 33 |
| North Platte Canal | Model | 30 | 31 |
| Paxton Hershey Canal | Model | 30 | 45 |
| Phelps County Canal | Measurement | 0 | 100 |
| Thirty Mile Canal | Model | 30 | 32 |
| Orchard Alfalfa Canal | Model | 30 | 38 |
| Gothenburg Canal | Model | 30 | 34 |
| Cozad Canal | Model | 30 | 31 |
| Dawson Co. Canal | Model | 30 | 34 |
| Kearney Canal | Model | 30 | 9 |
| Western Canal | Measurement | 30 | 75 |
| Western Ponds | Measurement | 41 | 49 |

Table 1: Projects diverting excess Platte River basin flows for flood mitigation and seepage demonstration during the spring and fall of 2011.

2.1 Measured Canal Loss & Recharge Volume

Water balance calculations were performed on the canals when and where discharge measurements of the spills were available. Some canals had only one spill measurement while other canals had several. For each spill measurement taken the rate of water measured at the canal spill was subtracted from the average daily diversion rate to determine the rate of canal loss. The loss was then divided by the average daily rate of diversion to calculate a daily loss as a proportion of the total volume of water diverted. The equations used are shown below. For canals with multiple measurements the average loss was calculated and used in the next step of the analysis. An example is given below from the Minatare Canal. Four spill measurements were taken with loss rates calculated as 21 percent, 25 percent, 23 percent, and 36 percent. The average value for these calculations is 26 percent. To estimate a total volume of diverted water that seeped into the ground or recharged, the average loss value was multiplied by the volume

diverted. The volume diverted was calculated based upon multiplying the average daily diversion rate (in cubic feet per second) for each day by 1.9835, converting it to a daily volume (acre-feet per day). The daily volumes were summed to calculate the total volume diverted. For Minatare, the total spring diversion was 2,709 acre-feet (AF) and the average loss value was 26 percent. The resultant recharge volume is 704 AF.

$$\text{Canal Loss \%} = \left(\frac{\text{daily diversion rate} - \text{rate measured at spill}}{\text{daily diversion rate}} \right) * 100\%$$

This equation simplifies as follows:

$$\begin{aligned} \text{Canal Loss \%} &= \left(\frac{\text{daily diversion rate}}{\text{daily diversion rate}} - \frac{\text{rate measured at spill}}{\text{daily diversion rate}} \right) * 100\% \\ &= \left(1 - \frac{\text{rate measured at spill}}{\text{daily diversion rate}} \right) * 100\% \end{aligned}$$

The final simplified equation is the version used in the spreadsheet calculations (see appendix A).

| Minatare | | | | |
|-----------------|-----------------------------|--------------------------------|-----------------------|-------------|
| Date | Diversion Rate (cfs) | Measured at Spill (cfs) | Spill Location | Loss |
| 4/5/2011 | 48 | 37.7 | Minatare Spill | 21% |
| 4/13/2011 | 44 | 33.1 | Minatare Spill | 25% |
| 4/20/2011 | 40 | 30.9 | Minatare Spill | 23% |
| 4/26/2011 | 49 | 31.3 | Minatare Spill | 36% |
| | | | Measured: | 26% |
| | | | *Estimated: | |
| | | | Used: | 26% |

$$\text{Canal Recharge} = \text{Canal Diversion} * \frac{\text{Canal Loss \%}}{100\%}$$

$$\text{Minatare Canal Recharge} = 2709 \text{ AF} * \frac{26\%}{100\%} = 704 \text{ AF}$$

2.2 Modeled Canal Loss & Recharge Volume

Estimates of average canal loss based upon total water diverted were obtained from the STELLA model. The loss estimates in the STELLA model were developed by HDR Engineering, Inc. for

the COHYST study. Loss estimates from the STELLA model were calculated at 32 percent¹ of the canal's total diversion. For example, Paxton Hershey Canal did not have measured spill data, the total volume diverted was 1724 AF and the loss rate, from STELLA, was 32 percent so the calculated volume of water recharged was 552 AF.

2.3 Western Canal and Pond Loss & Recharge Volume

Western Canal losses were calculated using the water balance method based on discharge measurement at the canal's spill. In addition to the canal recharge, nine ponds were used as recharge pits to increase the overall amount of recharge to the system. Twin Platte Natural Resource District (TPNRD) placed staff gages at each of the pond sites and established volume quantities at each respective gage height. The staff gages were then read by TPNRD weekly to determine the rate of seepage per day for each pond. Recharge activities varied for each pond, but most of the ponds operated for 41 days. The recorded number of days for each pond was used to calculate the recharge at each site. Diversions into the pond were not used to adjust the water balance calculation when determining the loss along Western Canal. Most of the recharge ponds were not diverting water on the days where discharge measurements were conducted at the canal spill. In addition, the quantity of water diverted from the canal into the ponds was within the discharge measurement error band at the spill.

2.4 Accretions to the Platte River

Estimates of canal and pond recharge volume were combined with depletion functions developed by the technical committee under the PBHEP program to estimate the recharge effects on flows in the Platte River, or accretions. The depletion functions are defined for six zones within each NRD. Legal sections corresponding to the extent of the canal where water was routed were used to calculate an average zone number to determine the appropriate response curve. The depletion functions represent a fixed change that persists through time; therefore, an accretion function was developed to represent the recharge water occurring as a discrete pulse during a single year. This was accomplished by shifting the depletion function curve by one year (one time increment on the curve) and subtracting the shifted value from the original depletion function, thus creating a response function. The response function was then multiplied by the canal loss value to estimate Platte River accretions for the next 50 years. Figure 1 provides an example. Different canals and different distribution patterns regarding diverted flows create different temporal patterns of accretions (figure 2).

¹ Engel, J., unpublished data, COHYST 2010, Canal Seepage Estimates.
Upper Platte River Recharge and Flood Mitigation Demonstration Project:
Part of the Conjunctive Management Toolbox
Technical Memorandum – January 2013

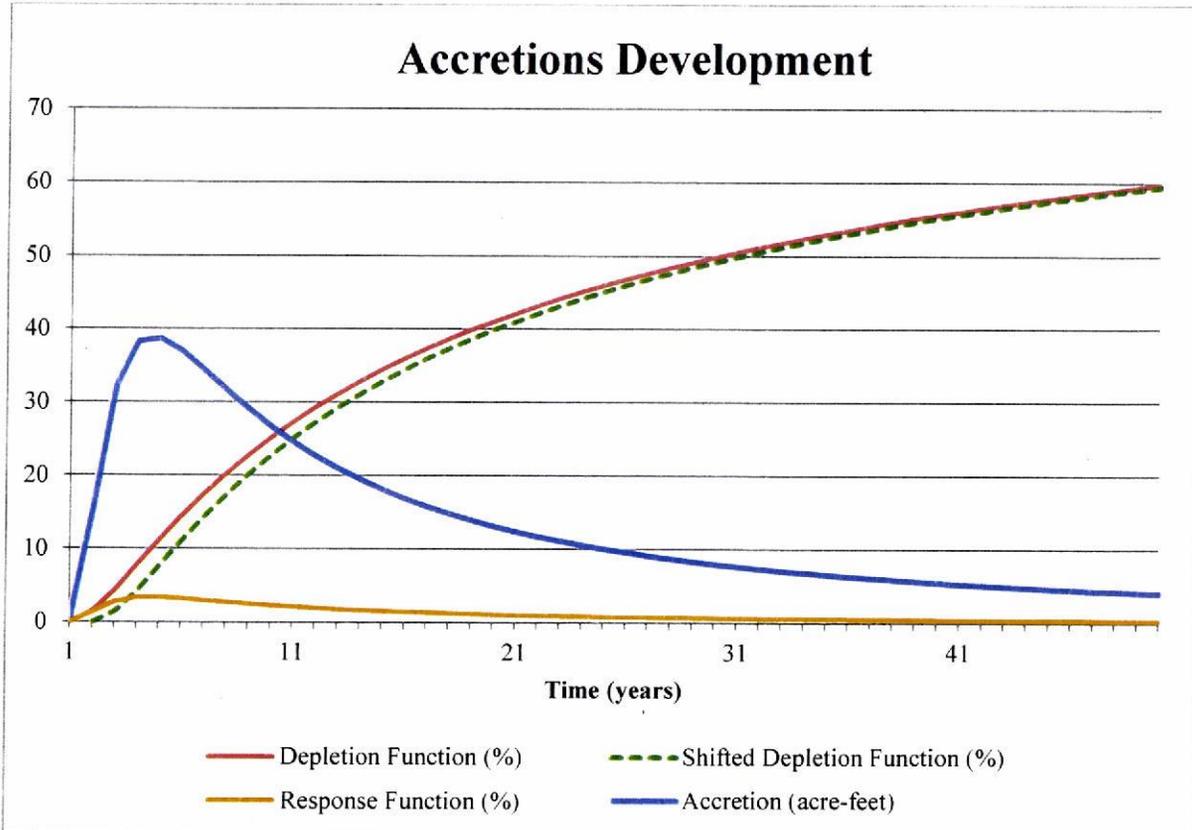


Figure 1: Cartoon illustrating temporal accretions estimation process using PBHEP zone functions (Depletion Functions) to create response function and estimated accretions. Below is a table showing the numbers used to generate the response function and an example of the calculations done to get the estimated accretions.

| Year | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|--------------------------------|-------|-------|-------|-------|--------|--------|--------|--------|--------|--------|
| Depletion Function (%) | 0.083 | 1.496 | 4.353 | 7.737 | 11.155 | 14.412 | 17.442 | 20.234 | 22.800 | 26.684 |
| Shifted Depletion Function (%) | 0.000 | 0.083 | 1.496 | 4.353 | 7.737 | 11.155 | 14.412 | 17.442 | 20.234 | 22.800 |
| Response Function (%) | 0.083 | 1.413 | 2.857 | 3.384 | 3.419 | 3.257 | 3.030 | 2.792 | 2.565 | 2.357 |

Canal Loss = 1132 AF in year 1

$$Accretion_{Year\ 1} = 1132\ AF * \frac{0.083\%}{100\%} = 0.94\ AF$$

$$Accretion_{Year\ 10} = 1132\ AF * \frac{2.357\%}{100\%} = 26.68\ AF$$

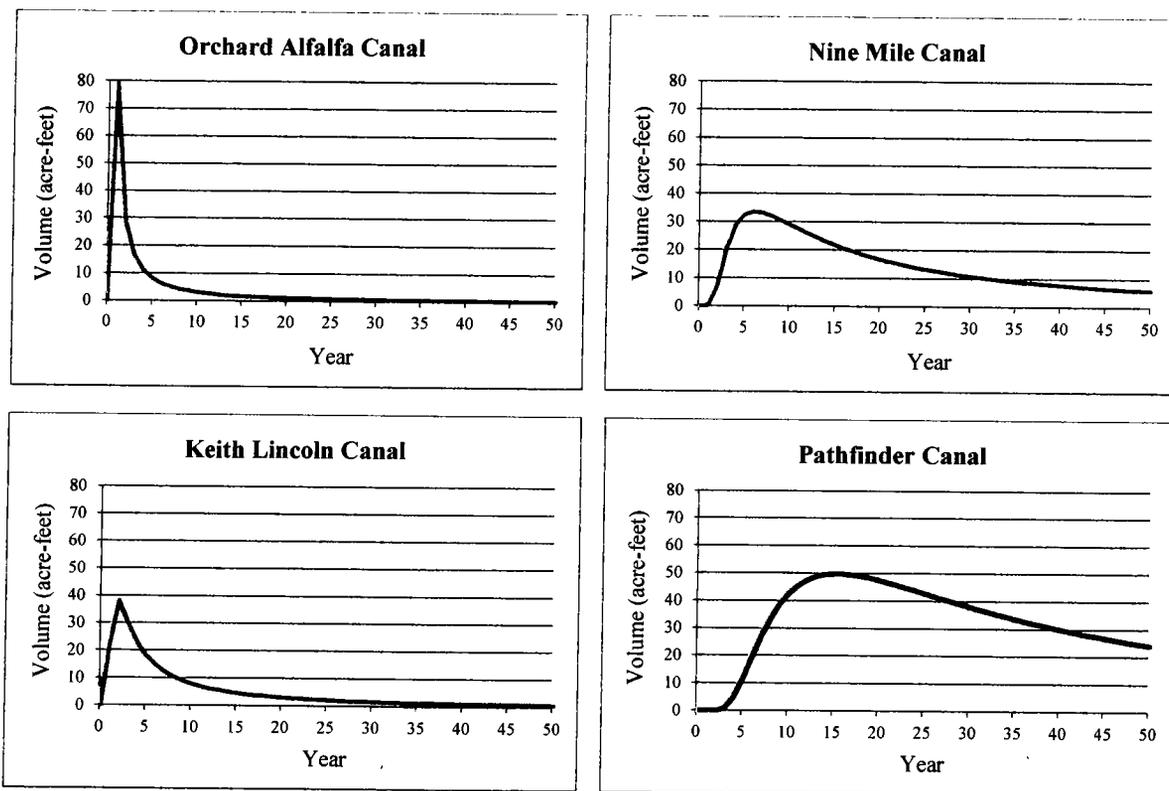


Figure 2: Accretions estimated from four different canals illustrating a variety of temporal patterns in estimated accretions to the Platte River.

3.0 Summary of Results

Results are summarized for each canal and the Western Canal Pond seepage project. These results are then aggregated by natural resources district. The estimated accretions to Platte River streamflow in each natural resources district is shown in table 2. These results estimate that the annual accretion during the first decade is approximately 1,000 to 1,500 AF per year and residual accretions greater than 500 AF per year will persist for 25 years. NRD specific estimates show a 50-year benefit to streamflow of between 2,000 and 12,000 AF, with total 50-year benefits around 36,000 AF. Table 3 presents the canal specific source data indicating that approximately 140,000 AF of water was diverted, of which about 65,000 AF is estimated to have seeped into groundwater storage. This indicates that much of the benefit from this single seepage demonstration may persist well beyond the 50-year planning horizon presented here. Water use and management practices in the interim will fundamentally effect the realization of these benefits, though this project has provided options that would not have been available if the Department and its collaborating partners had not taken the opportunity to divert and store abundant excess flows in the Platte River throughout 2011.

| Year | NPNRD | SPNRD | TPNRD | TBNRD | CPNRD | Annual Total |
|---------------------|--------------|-------------|--------------|-------------|-------------|--------------|
| 2011 | 3 | 3 | 422 | 0 | 634 | 1062 |
| 2012 | 83 | 44 | 853 | 21 | 671 | 1672 |
| 2013 | 229 | 89 | 868 | 69 | 590 | 1844 |
| 2014 | 328 | 105 | 805 | 104 | 511 | 1853 |
| 2015 | 381 | 107 | 724 | 121 | 445 | 1777 |
| 2016 | 405 | 102 | 644 | 126 | 392 | 1669 |
| 2017 | 414 | 95 | 574 | 125 | 348 | 1555 |
| 2018 | 413 | 88 | 513 | 121 | 311 | 1446 |
| 2019 | 406 | 81 | 461 | 115 | 281 | 1344 |
| 2020 | 396 | 75 | 416 | 109 | 255 | 1251 |
| 2021 | 384 | 69 | 378 | 103 | 233 | 1167 |
| 2022 | 371 | 64 | 345 | 97 | 214 | 1091 |
| 2023 | 357 | 59 | 316 | 91 | 198 | 1022 |
| 2024 | 343 | 55 | 291 | 86 | 183 | 959 |
| 2025 | 330 | 51 | 269 | 81 | 171 | 903 |
| 2026 | 317 | 48 | 250 | 77 | 159 | 851 |
| 2027 | 305 | 45 | 233 | 72 | 149 | 804 |
| 2028 | 293 | 42 | 218 | 68 | 140 | 761 |
| 2029 | 281 | 40 | 204 | 65 | 132 | 722 |
| 2030 | 271 | 38 | 191 | 62 | 124 | 685 |
| 2031 | 260 | 36 | 180 | 59 | 118 | 652 |
| 2032 | 251 | 34 | 170 | 56 | 111 | 621 |
| 2033 | 241 | 32 | 161 | 53 | 106 | 593 |
| 2034 | 233 | 30 | 152 | 51 | 100 | 567 |
| 2035 | 224 | 29 | 145 | 48 | 96 | 542 |
| 2036 | 216 | 28 | 138 | 46 | 91 | 519 |
| 2037 | 209 | 26 | 131 | 44 | 87 | 498 |
| 2038 | 202 | 25 | 125 | 43 | 83 | 478 |
| 2039 | 195 | 24 | 119 | 41 | 80 | 460 |
| 2040 | 189 | 23 | 114 | 39 | 77 | 442 |
| 2041 | 183 | 22 | 109 | 38 | 74 | 426 |
| 2042 | 177 | 21 | 105 | 36 | 71 | 410 |
| 2043 | 171 | 21 | 101 | 35 | 68 | 396 |
| 2044 | 166 | 20 | 97 | 34 | 66 | 382 |
| 2045 | 161 | 19 | 93 | 33 | 63 | 369 |
| 2046 | 157 | 18 | 90 | 32 | 61 | 357 |
| 2047 | 152 | 18 | 86 | 30 | 59 | 346 |
| 2048 | 148 | 17 | 83 | 30 | 57 | 335 |
| 2049 | 144 | 17 | 80 | 29 | 55 | 324 |
| 2050 | 140 | 16 | 78 | 28 | 53 | 315 |
| 2051 | 136 | 16 | 75 | 27 | 52 | 305 |
| 2052 | 132 | 15 | 73 | 26 | 50 | 296 |
| 2053 | 129 | 15 | 70 | 25 | 48 | 288 |
| 2054 | 126 | 14 | 68 | 25 | 47 | 280 |
| 2055 | 122 | 14 | 66 | 24 | 46 | 272 |
| 2056 | 119 | 13 | 64 | 23 | 44 | 265 |
| 2057 | 117 | 13 | 62 | 23 | 43 | 258 |
| 2058 | 114 | 13 | 61 | 22 | 42 | 251 |
| 2059 | 111 | 12 | 59 | 21 | 41 | 244 |
| 2060 | 108 | 12 | 57 | 21 | 40 | 238 |
| 10yr Benefit | 3056 | 787 | 6281 | 911 | 4439 | 15474 |
| 50yr Benefit | 11341 | 1913 | 11991 | 2753 | 8171 | 36168 |

Table 2: Estimated annual accretions to the Platte River summarized by Natural Resources District. Units are acre-feet.

| Project | Spring Diversion | Fall Diversion | Total Diversion | Total Recharge | 10 year Benefit | 50 year benefit |
|--------------------------------|-------------------------|-----------------------|------------------------|-----------------------|------------------------|------------------------|
| Pathfinder Canal | 12718 | 0 | 12718 | 5087 | 178 | 1690 |
| Farmers Canal | 18425 | 0 | 18425 | 8660 | 1470 | 4471 |
| Enterprise Canal | 2559 | 0 | 2559 | 1689 | 287 | 872 |
| Winters Creek Canal | 0 | 882 | 882 | 42 | 7 | 22 |
| Central Canal | 524 | 1022 | 1545 | 331 | 56 | 171 |
| Castle Rock Canal | 1595 | 1069 | 2664 | 1198 | 42 | 398 |
| Minatare Canal | 2709 | 2338 | 5048 | 1207 | 205 | 623 |
| Nine Mile Canal | 1521 | 1114 | 2635 | 1850 | 314 | 955 |
| Chimney Rock Canal | 948 | 2965 | 3913 | 1049 | 178 | 542 |
| Belmont Canal | 2241 | 2965 | 5206 | 2789 | 98 | 926 |
| Lisco Canal | 2229 | 1516 | 3746 | 1301 | 221 | 672 |
| Keith Lincoln Canal | 1349 | 1914 | 3263 | 1676 | 833 | 1259 |
| Suburban Canal | 1230 | 1781 | 3010 | 1527 | 759 | 1147 |
| North Platte Canal | 2842 | 4245 | 7088 | 3616 | 1798 | 2716 |
| Paxton Hershey Canal | 1724 | 2483 | 4207 | 1691 | 425 | 1011 |
| Western Ponds (TP) | 0 | 0 | 0 | 3013 | 758 | 1801 |
| Thirty Mile Canal | 4134 | 5141 | 9275 | 2968 | 1640 | 2317 |
| Orchard Alfalfa Canal | 732 | 1871 | 2603 | 833 | 592 | 716 |
| Gothenburg Canal | 4641 | 5729 | 10370 | 3318 | 741 | 1915 |
| Cozad Canal | 1335 | 1714 | 3049 | 976 | 364 | 663 |
| Dawson Co. Canal | 2652 | 3450 | 6101 | 1952 | 104 | 741 |
| Kearney Canal | 4528 | 3832 | 8360 | 2675 | 997 | 1818 |
| Phelps Canal | 0 | 5558 | 5558 | 5163 | 911 | 2753 |
| Western Canal (30% SP, 70% TP) | 4528 | 15158 | 19687 | 9695 | 2439 | 5796 |
| Western Ponds (SP) | 0 | 0 | 0 | 392 | 55 | 174 |
| Totals: | 75,165 | 66,746 | 141,911 | 64,699 | 15,474 | 36,168 |

Table 3: Estimation of 10 and 50 year accretions to the Platte River by canal or contracting entity. Units are acre-feet.

Appendix A – Spreadsheet Calculations

A spreadsheet named *Recharge_2011_Final.xlsx* was developed to conduct the recharge calculations and is summarized according to the individual tabs of the spreadsheet below.

Tab 1: “2011_Seepage Extent”

This table is a tabulation of legal sections where water was routed in each canal. It is based upon data contained in maps provided by Irrigation Districts in coordination with the Department’s Bridgeport Field Office showing locations where water was routed during the project. These maps are available with the permit filings and can be obtained by contacting the Department.

Tab 2: “Response zone f’n”

Response functions corresponding to six zones for each natural resources district are included in this tab. Functions assume a permanent introduced stress and were developed by the PBHEP technical committee² using COHYST databases and the Hunt³ (1999) equation. Zone averages calculated by relating the section data from Tab 1 to the response function zone maps (Appendix B) are reported in this tab as well. The spatial relation was performed in ArcGIS. This tab also notates the natural resources district assigned to each canal, as well as the Response Function Zone.

Tab 3: “Total Diversions Spring”

Average daily diversion rates in cubic feet per second from April 1, 2011, through May 31, 2011, for each canal were imported into the spreadsheet from the Platte Water Accounting Program (PWAP) database⁴. Those rates were used to generate a daily volume of water, in acre-feet, diverted using the conversion factor of 1.9835. The gray cells represent the 30 days of diversions that were used to calculate the total acre-feet of water diverted during the recharge period.

Tab 4: “Recharge Rates Spring”

Data from the discharge measurement conducted by Department field office staff and provided by Tom Hayden were entered into the spreadsheet to determine the daily and average percentage of canal loss. Each measurement rate was compared to the average daily diversion rate to calculate a loss value for that day. Multiple daily loss values for one canal were averaged to arrive at a final loss values for a single canal. For canals where measurements were not available,

² Approved by the PBHEP administrators as part of the “Trial Protocol for PBHEP Funds” at the April 7, 2010, meeting in North Platte, NE (Platte Basin Habitat Enhancement Project. *Meeting of the PBHEP Administrators*. 7 April 2010) and, after editorial changes (Czaplewski, Mark. “FW: Revised PBHEP Protocol with Depletion Zone Figures.” Email to PBHEP Administrators. June 17, 2010), finalized on June 30, 2010 (Czaplewski, Mark. “PBHEP.” E-mail to PBHEP Sponsors and Partners. June 30, 2010).

³ Hunt, B. (1999), Unsteady Stream Depletion from Ground Water Pumping. *Ground Water*, 37: 98–102.

⁴ PWAP is an accounting program used by the Department of Natural Resources Bridgeport Field Office to apportion natural flow and track storage.

Appendix A – Spreadsheet Calculations

estimates from the COHYST 2010 STELLA model were entered. The canals are organized by natural resource districts.

Tab 5: “Div + Recharge by NRD Spring”

Based upon the data in the “Total Diversions Spring” tab and “Recharge Rates Spring” tab, the total volume of water recharged is calculated and listed in acre-feet for each canal. The canal diversions and recharge rates are then summarized and listed by natural resources district. Individual canal values relating to each of the NRDs were assigned according to the table in Tab 2 and are reported in the sheet. Because Western Canal is within the bounds of two NRDs, the canal recharge was distributed as 70 percent Twin Platte NRD and 30 percent South Platte NRD. Of the nine ponds utilized under Western Canal, seven of the ponds were located inside Twin Platte NRD and two ponds were located in South Platte NRD. The ponds were measured individually and diversions and canal recharge were assigned according to the NRD where they exist.

Tab 6: “Total Diversions Fall”

Average daily diversions rates in cubic feet per second from September 1, 2011, through November 14, 2011, for each canal were imported into the spreadsheet from the PWAP database. Those rates were used to generate a daily volume of water, in acre-feet, diverted using the conversion factor of 1.9835. Average daily diversions from September 1, 2011, through January 5, 2012, for the Phelps Canal were imported into the spreadsheet from the PWAP database. January diversions for the Phelps Canal are included in this report for 2011. The gray cells represent the days of diversions that were used to calculate the total acre-feet of water diverted during the recharge period.

Tab 7: “Recharge Rates Fall”

Data from the discharge measurement conducted by Department field office staff and provided by Tom Hayden were entered into the spreadsheet to determine the daily and average percent of canal loss. Each measurement rate was compared to the average daily diversion rate to calculate a loss value for that day. Multiple daily loss values for one canal were averaged to arrive at a final loss values for a single canal. For canals where measurements were not available, estimates from the STELLA model were entered. For the Phelps canal, daily monitoring and spill estimation information was provided by Cory Steinke from Central Nebraska Public Power and Irrigation District (CNPPID).

Tab 8: “Div + Recharge by NRD Fall”

Based upon the data in the “Total Diversions Fall” tab and “Recharge Rates Fall” tab, the total volume of water diverted and recharge is calculated and listed in acre-feet for each canal. The

Appendix A – Spreadsheet Calculations

canal diversions and recharge rates are then summarized and listed by natural resource districts. Individual canal values relating to each of the NRDs were assigned according to the table in Tab 2 and are reported in the sheet. Because Western Canal is within the bounds of two NRDs, the canal recharge was distributed as 70 percent Twin Platte NRD and 30 percent South Platte NRD. Of the nine ponds utilized under Western Canal, seven of the ponds were located inside Twin Platte NRD and two ponds were located in South Platte NRD. The ponds were measured individually and diversions and canal recharge were assigned according to the NRD where they exist.

Tab 9: “Total Recharge by NRD 2011”

Data from the “Div + Recharge by NRD Spring” and “Div + Recharge by NRD Fall” tabs are listed in this tab by canal and summed to show the total recharge during 2011.

Tab 10: “Spring Response”

Data from the “Div + Recharge by NRD Spring” and “Response zone f’n” tabs are incorporated in this tab by canal to create annual accretion functions and accretions by canal.

Tab 11: “Fall Response”

Data from the “Div + Recharge by NRD Fall” and “Response zone f’n” tabs are incorporated in this tab by canal to create annual accretion functions and accretions by canal.

Tab 12: “2011summary”

Data from the “Spring Response” and “Fall Response” tabs are incorporated in this tab to aggregate annual accretions by NRD. Data from the “Spring Response” and “Fall Response” tabs, as well the “Div + Recharge by NRD Spring,” “Div + Recharge by NRD Fall,” and the “Total Recharge by NRD 2011” tabs were used to create a diversions and benefits summary by canal.

Appendix B – Response Function Zone Maps by NRD

The following maps were drafted by the PBHEP administrators for the purpose of evaluating the expected relative effects of proposed projects. The maps were developed using simple distance calculations as well as location-specific information believed to influence the relative similarity or difference among projects geographically. The maps are considered draft and while informative are not intended to represent a definitive quantitative assessment of relative response. Modeling tools currently in development are anticipated to provide a more robust measure of the spatial distribution of meaningful response function zones that are expected to supersede these maps upon their completion. The attached maps illustrate the response function zones one (1) through five (5). Response zone 6 is assumed to be any remaining area within the respective natural resources districts.

Appendix B – Response Function Zone Maps by NRD

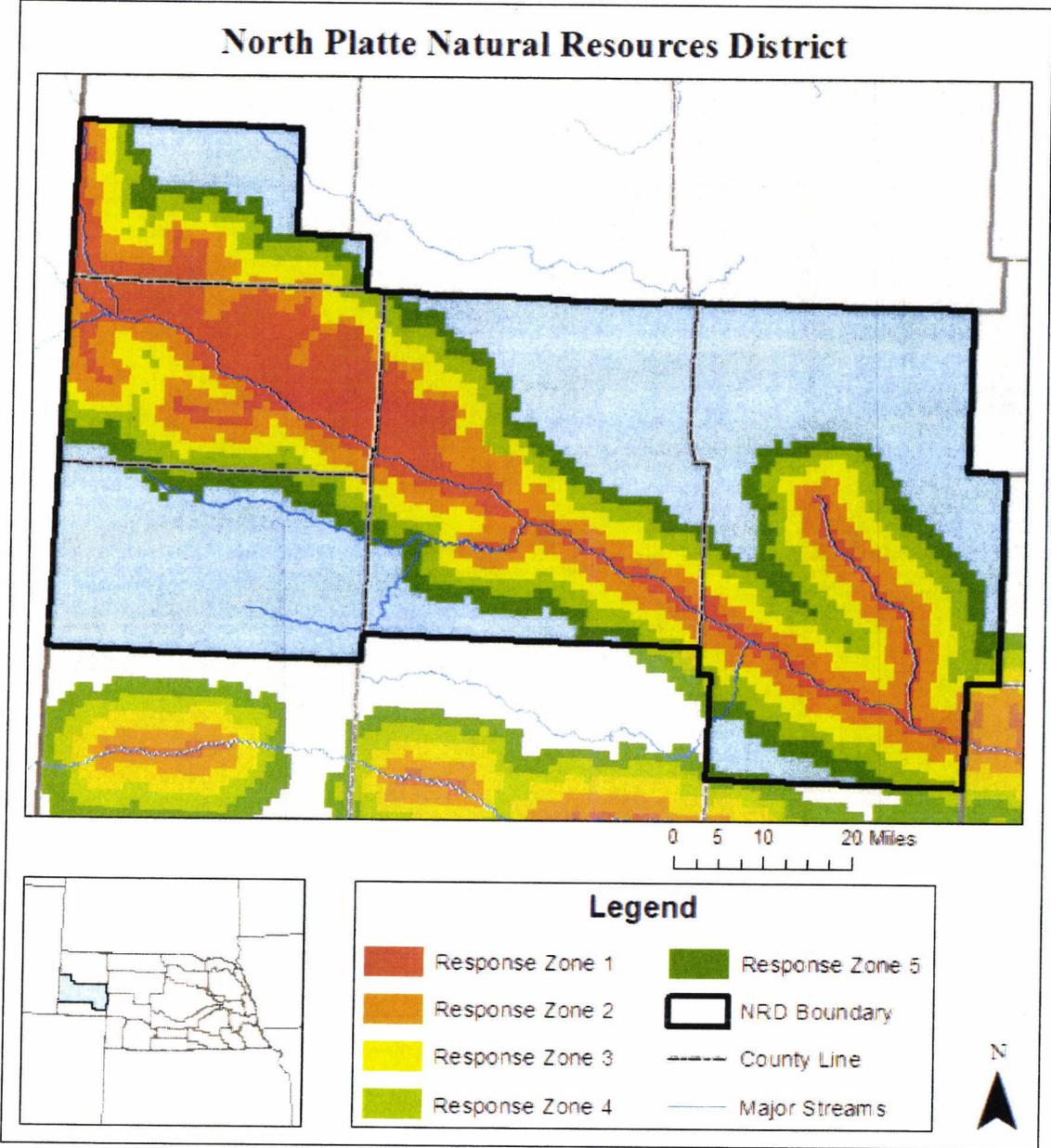


Figure 1: North Platte Natural Resources District response function zones.

Appendix B – Response Function Zone Maps by NRD

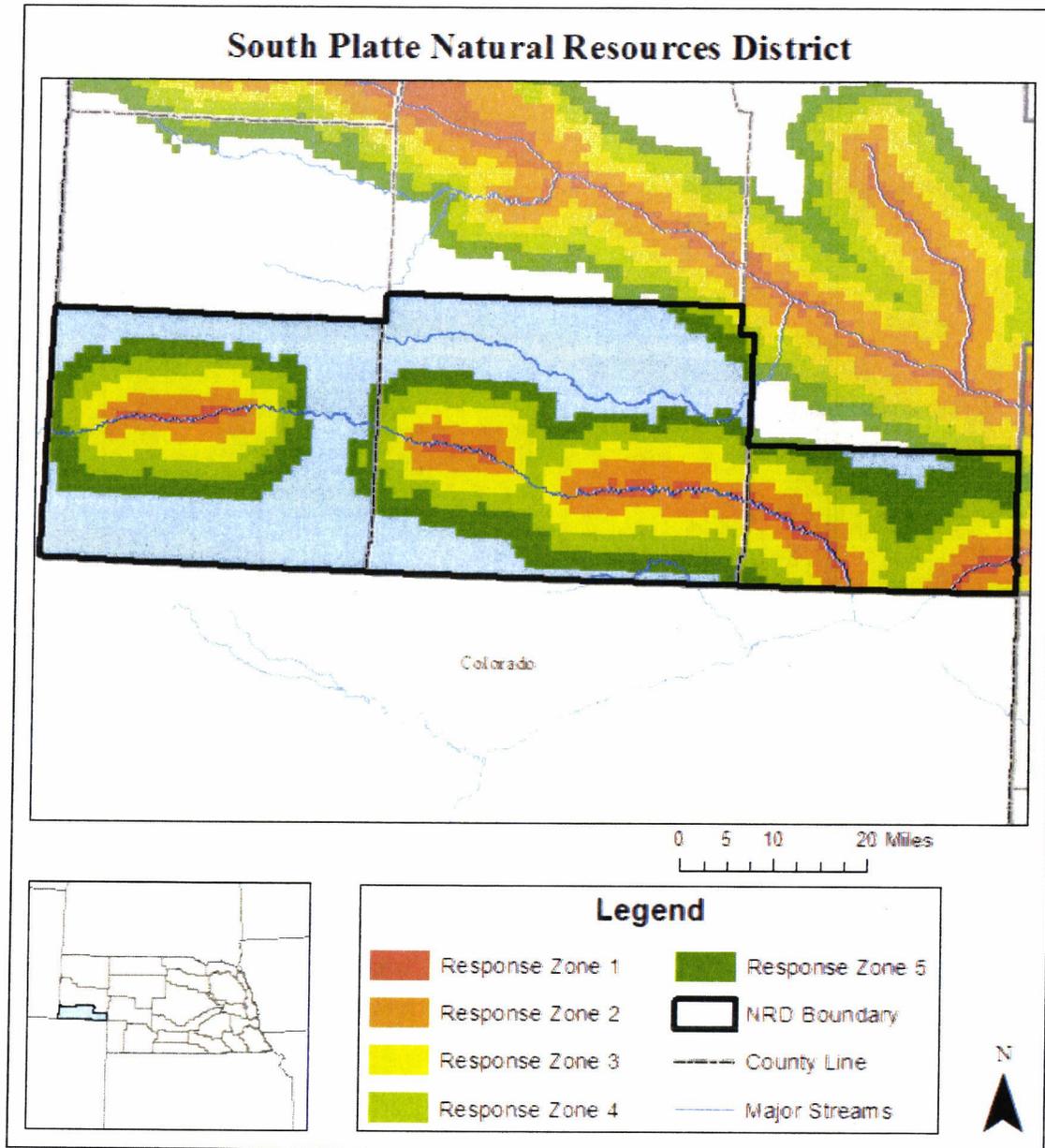


Figure 2: South Platte Natural Resources District response function zones.

Appendix B – Response Function Zone Maps by NRD

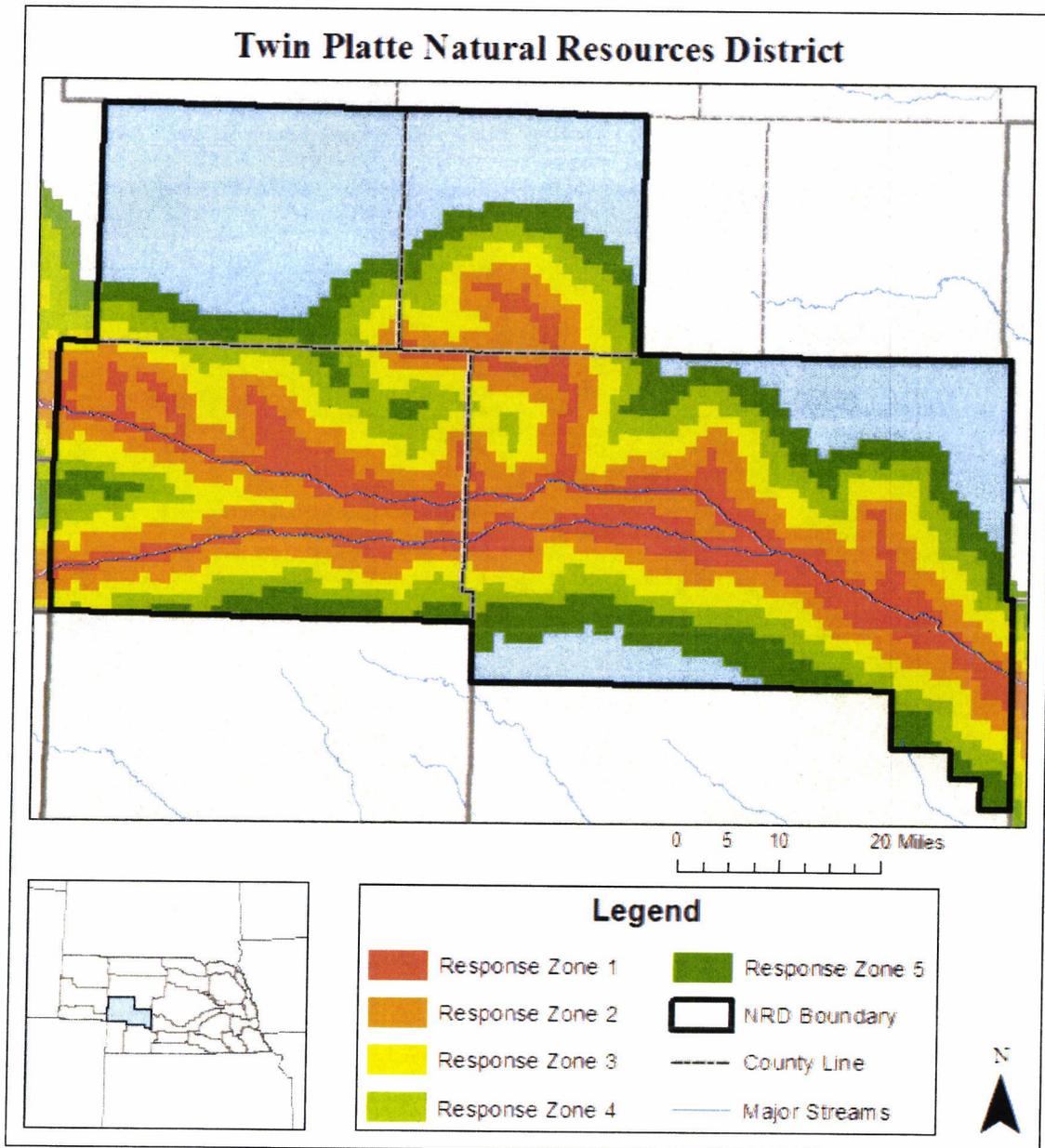


Figure 3: Twin Platte Natural Resources District response function zones.

Appendix B – Response Function Zone Maps by NRD

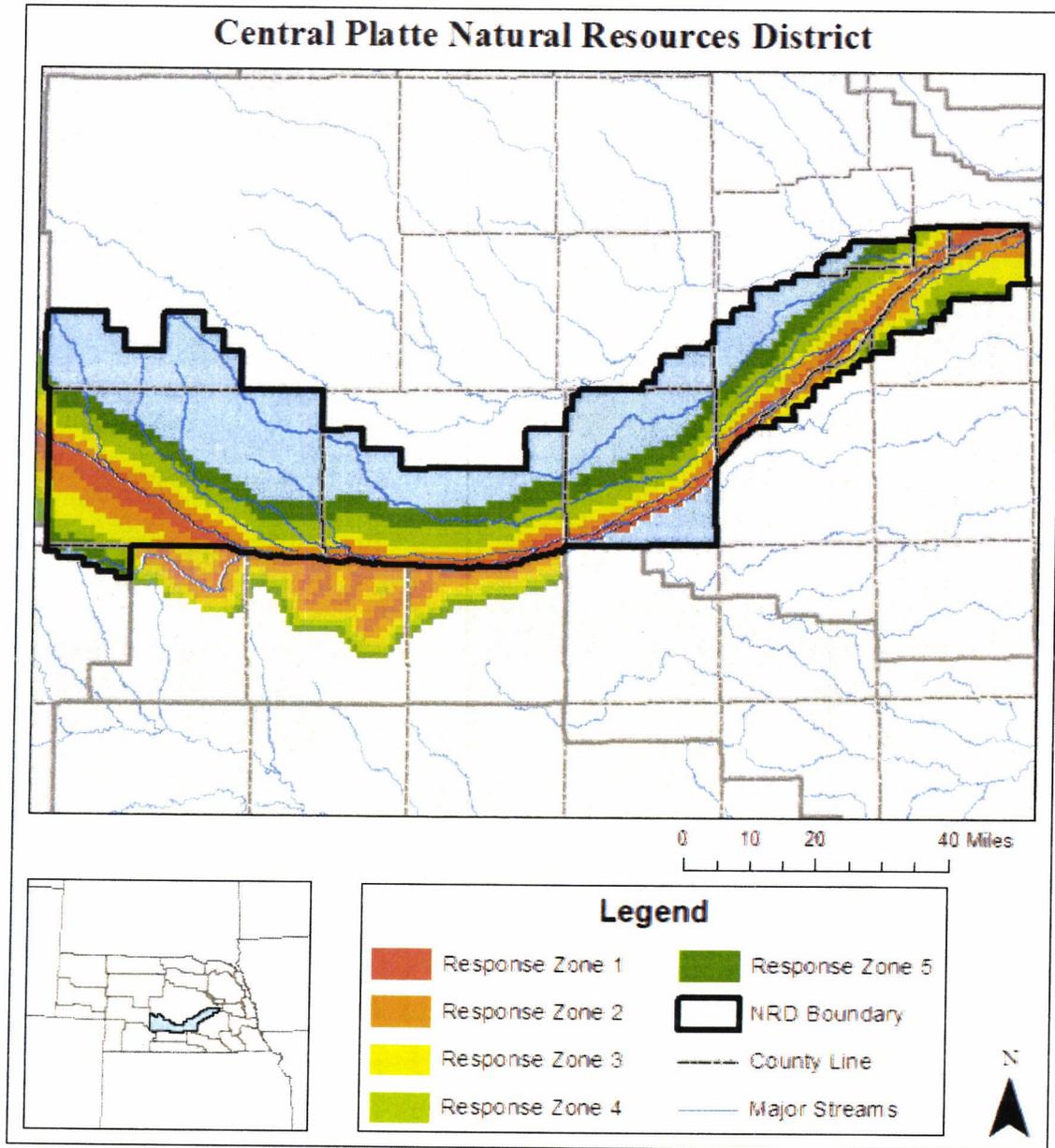


Figure 4: Central Platte Natural Resources District response function zones.

Appendix B – Response Function Zone Maps by NRD

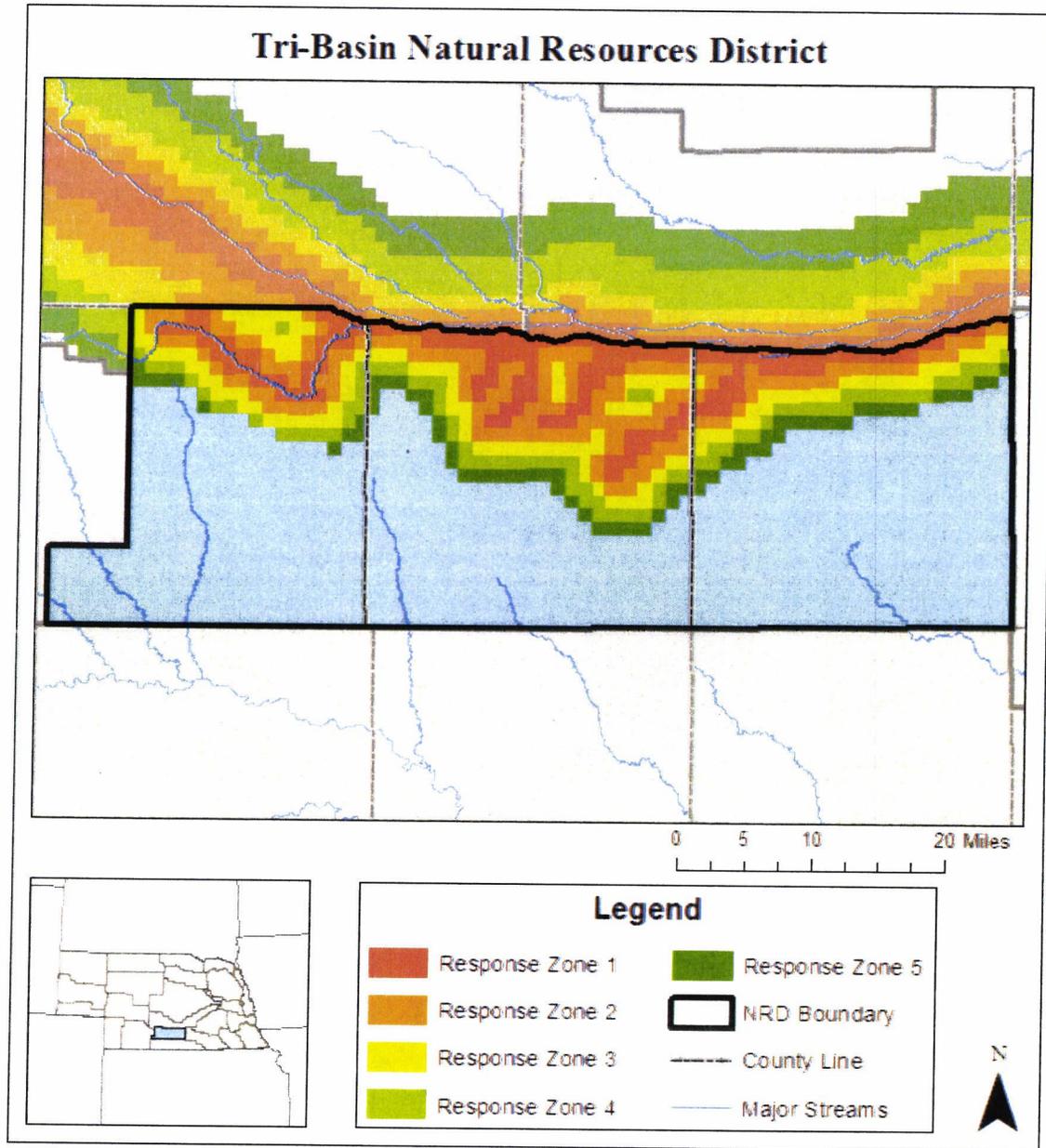


Figure 5: Tri-Basin Natural Resources District response function zones.