DNR Form SW-001
January 2009

# STATE OF NEBRASKA
# DEPARTMENT OF NATURAL RESOURCES

**PETITION TO THE NEBRASKA DEPARTMENT OF NATURAL RESOURCES**

**FOR LEAVE TO FILE OR CONSIDER AN APPLICATION FOR A NEW SURFACE WATER APPROPRIATION WITHIN A MORATORIUM OR STAY AREA UNDER TITLE 457 N.A.C. CHAPTER 23**

Complete items 1 through 5 by printing in ink or typing the appropriate information and by placing an X in the appropriate box. Attach supporting documentation and a $10 non-refundable filing fee.

**For Department Use Only**

Modification No.: VAR-5348
Date Filed: 3-24-2015
Time Filed: 1:16 PM
SW Appropriation No.: 5348 (if applicable)
Right ID No.: (if applicable)
Water Division: 1-A
Receipt No.: A-4530
Amount: $10.00($20.00)

1. Name and address of petitioner:

Nebraska Public Power District
PO Box 499
Columbus, NE 68602

E-mail address: blbarel@nppd.com Telephone No. (402 )563-5335

2. Check the situation that applies:

- ☐ Application Already Filed — Application Number:
- ☑ Application Not Filed (Enclose copy of proposed application)

3. Description of proposed project:

Outside the irrigation season for baseflow enhancement through ground water recharge, NPPD proposes to divert a maximum of 100 cfs into the Gothenburg Canal. (Headgate located in the NW1/4 SW1/4 19-12-26 Lincoln County). This application is for a temporary appropriation as NPPD's permanent appropriation application is being contested.

4. The Proposed Project — (Check all that apply):

- ☐ 001.01 — Is a non-consumptive use
- ☐ 001.02 — Will replace (offset) any consumptive use (Attach Offset Plan)
- ☑ 001.03 — Is for possible unappropriated water (Attach Analysis)
- ☐ 001.04 — Existed before the stay or moratorium (Attach Proof)
- ☐ 001.05 — Addresses a public safety issue (Attach Explanation)
- ☐ 001.06 — Is a temporary use for public construction (<10 AF)

5. Other reason why a variance should be granted:

See supplemental information

March 24, 2015
Date

Brian L Barels
Signature of Applicant (or authorized agent)

**Send to the following address (along with $10 non-refundable filing fee):**

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

MOD-03242015-5348-Pet

**Nebraska Public Power District**

*Always there when you need us*

March 24, 2015

RECEIVED

MAR 2 4 2015

DEPARTMENT OF NATURAL RESOURCES

Michael Thompson
Nebraska Department of Natural Resources
301 Centennial Mall South
PO Box 94676
Lincoln, NE 68509

Dear Mr. Thompson:

**Re: Application for a Temporary Permit to Appropriate Water for the Gothenburg Canal**

On December 12, 2014, the DNR granted NPPD leave to file an appropriation application for a permanent recharge appropriation and on December 15, 2014 NPPD filed such application. As the application is involved in a contested case hearing, it is unlikely to be acted upon in the near future and therefore, NPPD is pursuing a temporary appropriation for one year to take advantage of potential excess flows. NPPD does not believe the issues of the contested case hearing affect a temporary appropriation.

Additionally the Governance Committee of the Platte River Recovery Implementation Program approved an agreement with NPPD for 2015 groundwater recharge at the Dawson County and Gothenburg Canals. NPPD has signed the agreement and it is being processed by the Program.

Enclosed is a petition for leave to file an application with corresponding supplemental information and other required forms.

If you have any questions, please contact Jeff Shafer at (402) 362-7360 or myself at (402) 563-5335.

Sincerely,

Brian L. Barels
Water Resources Manager

Enclosures

**COLUMBUS GENERAL OFFICE**
1414 15th St. / P. O. Box 499 / Columbus, NE 68602-0499
**Telephone:** (402) 564-8561- / **Fax:** (402) 563-5511
www.nppd.com

**Supplemental Information for Variance Petition**

It is Nebraska Public Power District's (NPPD) desire to acquire a temporary appropriation to divert Platte River waters into the Gothenburg Canal for the beneficial purpose of Platte River baseflow enhancement from ground water recharge. The Nebraska Department of Natural Resources (DNR) on December 12, 2014 granted NPPD leave to file an application for a permanent recharge appropriation, which NPPD did on December 15, 2014. As a third party has requested a hearing on that appropriation application, NPPD is pursuing a temporary appropriation to take advantage of potential excess flows.

**Background**

The Gothenburg Canal has operated as an irrigation canal since the late 1800's. In April 2011, NPPD received a temporary appropriation (A-18775) to divert flows for ground water recharge. Under that appropriation, the Gothenburg Canal main canal was used to recharge ground water both before and after the 2011 irrigation season.

On July 14, 2004, the DNR 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. This moratorium has been continued in the surface water controls included in the individual Natural Resources District (NRD) Integrated Management Plans (IMPs) adopted by the Platte River Basin NRDs and the DNR.

On December 12, 2014, the DNR granted NPPD leave to file an application for a permanent recharge appropriation (Attachment A) and on December 15, 2014 NPPD filed such application. As the application is involved in a contested case hearing, it is unlikely to be acted upon in the near future and therefore, NPPD is pursuing a temporary appropriation to take advantage of potential excess flows. NPPD does not believe the issues of the contested case hearing affect a temporary appropriation.

**Variance Petition**

The DNR's July 14, 2004, order and the provisions of *Neb. Rev. Stat.* § 46-714(3)(n) allow for new surface water diversion if the DNR grants a variance and subsequently approves a permit for such a new use. In addition to requirements of *DNR Rules for Surface Water, Title 457, Neb. Admin. Code* Chapter 23 regarding variances, the following useful definition of variance is found in *Neb. Rev. Stat.* § 46-706(29), which states:

> *Variance means (a) an approval to deviate from a restriction imposed under subsection (1), (2), (8), or (9) of section 46-714 or (b) the approval to act in a manner contrary to existing rules or regulations from a governing body whose rule or regulation is otherwise applicable[.]*

When filing a variance request, a project proponent must offer a clearly stated basis for such request and must offer good cause shown. *DNR Rules for Surface Water, Title 457, Neb. Admin. Code* Chapter 23 requires information to indicate if:

1. The proposed project is for a non-consumptive use; or
2. The applicant has a credible proposal for replacing any consumptive use that will occur in a manner such that the project will not harm other users; or
3. The applicant has credible information that indicates there **may be** unappropriated water available at the proposed location at the time the depletion is likely to occur; or
4. The project existed prior to any informal moratorium, formal moratorium or stay.
5. There is a public safety issue that must be addressed and the proposed project addresses such issue.
6. The proposed use is a temporary use for public construction and the total volume requested is less than ten (10) acre-feet.

NPPD is providing information to indicate that credible information indicates there is unappropriated water available at the proposed location (Attachment B).

In determining the intent and scope of good cause, the DNR has applied the definition supplied by *Neb. Rev. Stat.* § 46-706(23), which states:

> *Good cause shown means a reasonable justification for granting a variance for a consumptive use of water that would otherwise be prohibited by rule or regulation and which the granting agency, district, or organization reasonably and in good faith believes will provide an economic, environmental, social, or public health and safety benefit that is equal to or greater than the benefit resulting from the rule or regulation from which a variance is sought[.]*

**Good Cause**

NPPD is providing the following information to indicate the basis for the good cause for allowing further consideration of the proposed water appropriation application.

*Project Description*

The Gothenburg Canal is owned and operated by NPPD. This project was constructed in the 1890's to provide irrigation water to producers in Lincoln and Dawson County. The project consists of the diversion dam, supply canal and many laterals.

NPPD's request for a variance is to permit a temporary use for the Gothenburg Canal, non-irrigation season ground water recharge to enhance Platte River baseflow. A temporary appropriation (A-18775) was granted in 2011 and used to recharge ground water before and after the 2011 irrigation season. Attachment A is a draft report from DNR which includes data for the recharge project including the days of operation in the spring and fall, the total recharge, the 10 year benefit to the Platte River, and the 50 year benefit to the Platte River.

Recharge operation which occurred under appropriation A-18775 showed that ground water recharge can occur before and after the irrigation season when excess water is available. During

operations in 2011, only the main canal was used for recharge operations with a maximum of 87 cfs diverted.

*Project Operations*

The water appropriation application proposes to divert water in excess to Platte River Recovery Implementation Program (Program) targets before and after the irrigation season into the Gothenburg Canal for the beneficial purpose of Platte River baseflow enhancement from ground water recharge. A maximum of 100 cfs would be diverted into the Gothenburg Canal and its laterals during periods when unappropriated water is available, the diverted water would be allowed to seep into the aquifer as ground water recharge, and then returning to the Platte River to increase baseflow. The project envisions little or no surface water returning to the river during these diversions. NPPD will maintain communication with the Bridgeport field office as to when irrigation operations are occurring under existing appropriations and when recharge operations are occurring under the proposed appropriations.

Diversions will be monitored and recorded using the existing continuous stage recorder and 20 foot Parshall flume located in section 28, T12N-R26W near Brady. Recharge operation returns will be monitored and recorded by staff gages at the Gothenburg Canal river return locations, which will be read and recorded daily.

The water diverted in the main canal before and after the 2011 irrigation season under temporary appropriation A-18775 provides a portion of the basis for requesting 100 cfs. NPPD was able to divert approximately 87 cfs using only the main canal for recharge [Reference: Page 133 of DNR's 2011 Hydrographic Report]. NPPD proposes that an additional 13 cfs will be used to recharge water in laterals.

*Project Accounting*

In calculating the annual recharge, NPPD proposes to apply the following principles:

- Clearly distinguish recharge operations from irrigation operations.
- Confirm the proposed recharge appropriations are in priority.
- Take into account the variable recharge rate that occurs through the year. Larger rates of recharge occur during the initial filling period and less recharge occurring at the end of the irrigation season when the soil profile is saturated. Any recharge that occurs due to operations outside the irrigation season will be accounted using the end of irrigation season recharge rate.

NPPD proposes to annually report to DNR times and volumes of water recharged under the proposed appropriation.

NPPD will not lease the benefits of Platte River base flow enhancement from recharged water to a third party until a proper accounting model has been developed which is acceptable for calculating the timing and rate of the baseflow enhancement.

*Project Benefits*

In 1997, Colorado, Wyoming, Nebraska and the Department of Interior formed partnership with the goal of developing a shared approach for managing the Platte River. Water users from the three states, including NPPD, and local and national conservation groups joined the effort. The Program is the result of that planning effort. NPPD is one of the Downstream Water User representatives on the Program's Governance Committee and it is in NPPD's best interest to see the Program succeed.

During the first increment of the Program, one goal is to reduce shortages to target flows an average of 130,000 to 150,000 acre-feet annually. NPPD is proposing that this appropriation can assist the Program in meeting that goal.

*Moratorium Benefits and Impacts*

The moratorium on new surface water applications in the Platte River basin where the Gothenburg Canal diversion is located is in place due to State Statutes and Nebraska's commitment to the Program.

Because NPPD's proposed application for Platte River baseflow enhancement through ground water recharge of Platte River water is a new use, NPPD must compare the benefits of Platte River baseflow enhancement to the moratorium benefits.

It is NPPD's belief that there will be no negative impacts to the IMP's and the Program should this petition and appropriation be granted. As identified in the *Project Benefits* section above, only water in excess of Program requirements will be retimed such that they return to the Platte River as baseflow at later periods when there may be shortages.

*Environmental and Endangered Species Impacts*

Water appropriation A-17004A, A-17004B, A-17004C, A-17007B, A-17007C, A-17008A, A-17008B, A-17008C, and A-17009, were granted by DNR with the purpose of providing habitat for whooping cranes, sandhill cranes, interior least terns, and piping plovers or to provide habitat for food sources consumed by those bird species. Water appropriations A-17329, A-17330, A-17331 were granted for the beneficial use of maintaining a fish community, and A-17332 was granted for the beneficial use of maintaining roost habitat for whooping cranes.

Because all of these instream flow appropriations would be senior to the proposed water appropriation, these water appropriations would be unaffected by the proposed appropriation. The instream flow appropriations by statute are the minimum necessary to maintain the purposes for which they were granted. Therefore, there would be no endangered species impacts or environmental impacts as a result of the proposed application.

**Summary**

NPPD believes that the benefits from Platte River baseflow enhancement through ground water recharge clearly exceed those envisioned by the moratorium. NPPD also believes that the information provided provides the reasonable good cause justification necessary for granting the variance petition. The reasonable justifications include:

- Excess water supplies are available.
- Any beneficial use of excess water is greater or equal to the benefits envisioned by the moratorium. The direct benefit is the enhancement of Platte River baseflow through groundwater recharge.

NPPD believes that for the reasons provided in this supplement, that the variance petition should be approved and that the proposed baseflow enhancement application should be granted.

Variance
Attachment A

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-3470

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 January 11, 2013, Brian L. Barels, P.E., Water Resources Manager, Nebraska Public Power District (Petitioner), filed petition VAR-3470 for Leave to File or Consider an Application for a Permit to Appropriate Water within a Moratorium Area (variance petition). The draft application attached to the petition is for a permit to appropriate water from the Platte River for the purpose of baseflow enhancement through groundwater recharge via the Gothenburg Canal.

6. For the purposes of this order "Desired Minimum Discharge" (DMD) 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-3470. 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, four of which are held by CPNRD, 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 a temporary permit that was utilized in 2011. 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 aquifer 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 convincingly argued there is likely to be unappropriated water in the future on the Platte River prior to and possibly 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-3470 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-3470 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

December 12, 2014

James C. Schneider, Ph.D.
Acting Director

A copy of this Order was posted on the Department's website. A copy of this Order was provided to the Department's field office in Bridgeport, Nebraska. A copy of this Order was mailed on December 12, 2014, to the following:

Brian L. Barels
Water Resources Manager
Nebraska Public Power District
P.O. Box 499
Columbus, Nebraska 68602-0499

Jeffrey T. Shafer
Nebraska Public Power District
P.O. Box 608
York, Nebraska 68647-0608

**Table A - Desired Minimum Discharge of the Platte River in cfs**

**Measured at the Grand Island Stream Gage**

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

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

**Represents the minimum discharge required by instream flow appropriation, which is greater than PRRIP Target Flows

**Availability of Unappropriated Water**

Credible information exists that indicates unappropriated water is likely to be available for the proposed application.

In December 2010, DNR published a report titled "Evaluation of Historic Platte River Streamflow in Excess of State Protected Flows and Target Flows". The report identified times and locations when historical streamflows were in excess of target flow requirements established by the U.S. Fish and Wildlife Service for the Program and also in excess of that which could be beneficially used by existing surface water appropriations. This report used very conservative assumptions which skew the available water volumes below what would likely occur. In Table 11 of the report, it is shown that the average natural flow volume in excess of state protected flows during the non-irrigation season totaled over 68,000 acre-feet of water. The average number days during the non-irrigation season when flows were available totaled 96 days.

PLATTE RIVER
RECOVERY IMPLEMENTATION PROGRAM

Office of the Executive Director
4111 4th Avenue, Suite 6
Kearney, NE 68847
Phone: (308) 237-5728
Fax: (308) 237-4651

January 2, 2013

Brian Barels
Water Resources Manager, NPPD
PO Box 499
Columbus, NE 68601

RE: Ground water recharge appropriations for Dawson County and Gothenburg Canals

Dear Mr. Barels,

I am writing to you to confirm that the Platte River Recovery Implementation Program is aware of your pending applications for ground water recharge in the Dawson County and Gothenburg Canals. I support these applications and believe that the benefits of such projects could be beneficial in meeting the water goals of the Program. Specifically, these types of ground water recharge projects would be expected to retime some portion of the excess flows diverted for recharge via ground water return to the Platte River during periods when shortages to Program target flows exist.

Sincerely,

Jerry F. Kenny

Jerry F. Kenny, Ph.D.
Executive Director
Platte River Recovery Implementation Program

DNR Form APA-001
August 2008

# 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.

Nebraska Public Power District
PO Box 499
Columbus, NE 68602

E-mail address: blbarel@nppd.com Telephone No. (402) 563-5335

Filed in the office of the Department of Natural Resources at _____ a.m./p.m.

on _____

Application No. _____

Map No. _____

Water Division _____

Receipt No. _____ Amount _____

Right ID _____

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

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

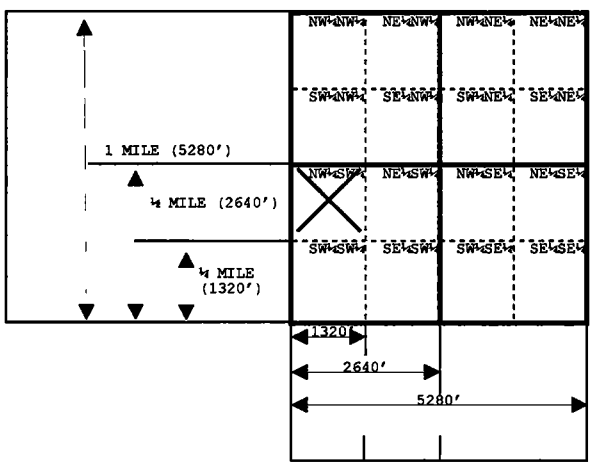
3a. A permit is sought to:
☑ Use natural flow ☐ Use impounded water*

3b. A permit is sought for the purpose of:
☐ Irrigation ☐ Manufacturing ☐ Domestic
☐ Other _____
☑ Temporary** Baseflow enhancement through groundwater recharge

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

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

5. Identify the location of the ☑ Headgate ☐ Pump
Section 19, Township 12 North, Range 26 E ☐ W ☑ County Lincoln




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.

20

* A separate permit to impound water must be obtained.
** A temporary permit maybe granted for a maximum of one year.

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 - see supplemental information

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

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

All facilities completed

8b. State the earliest date when water will have been used for beneficial purposes.

As soon as application is approved and 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.

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.ne.gov/SurfaceWater/Title_457_0608.pdf). 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 |
|---|---|
| Domestic | $10 |
| Agricultural | |
| Irrigation from Stream | |
| 0-1,000 acres | $200 |
| Each additional 1,000 acre unit or portion thereof in excess of the first 1,000 acre unit | $100 |
| Irrigation from Storage Reservoir | |
| 0-1,000 acres or portion thereof in excess of the first 1,000 acre unit | $50 |
| Each additional 1,000 acre unit or portion thereof in excess of the first 1,000 acre unit | $25 |

| Nature of Use | Cost |
|---|---|
| Manufacturing | |
| General | $10 |
| Power Generation for each theoretical 50 horsepower | $5 |
| Other | $10 |

**Supplemental Information for Application for a Permit to Appropriate Water**

It is Nebraska Public Power District's (NPPD) desire to acquire a temporary appropriation to divert Platte River waters into the Gothenburg Canal for the beneficial purpose of Platte River baseflow enhancement from ground water recharge.

**Background**

The Gothenburg Canal has operated as an irrigation canal since the late 1800's. In April 2011, NPPD received a temporary appropriation (A-18775) to divert flows for ground water recharge. Under that appropriation, the Gothenburg Canal main canal was used to recharge ground water both before and after the 2011 irrigation season.

In September and October 2013, the Gothenburg Canal again operated to provide ground water recharge during periods of flooding.

Based on the success of the 2011 and 2013 operations, it is NPPD's desire to obtain a temporary appropriation for ground water recharge for the Gothenburg Canal.

**Project Description**

The Gothenburg Canal is owned and operated by NPPD. This project was constructed in the 1890's to provide irrigation water to producers in Lincoln and Dawson County. The project consists of the diversion dam, supply canal and many laterals.

NPPD's request is for a temporary use for the Gothenburg Canal, non-irrigation season ground water recharge to enhance Platte River baseflow. A temporary appropriation (A-18775) was granted in 2011 and used to recharge ground water before and after the 2011 irrigation season. Appropriation Attachment A is a draft report from DNR which includes data for the recharge project including the days of operation in the spring and fall, the total recharge, the 10 year benefit to the Platte River, and the 50 year benefit to the Platte River.

Recharge operation which occurred under appropriation A-18775 showed that ground water recharge can occur before and after the irrigation season when excess water is available. During operations in 2011, only the main canal was used for recharge operations with a maximum of 87 cfs diverted.

**Project Operations**

The water appropriation application proposes to divert water in excess to Platte River Recovery Implementation Program (Program) targets before and after the irrigation season into the Gothenburg Canal for the beneficial purpose of Platte River baseflow enhancement from ground water recharge. A maximum of 100 cfs would be diverted into the Gothenburg Canal and its laterals during periods when unappropriated water is available, the diverted water would be allowed to seep into the aquifer as ground water recharge, and then returning to the Platte River to increase baseflow. The project envisions little or no surface water returning to the river during

these diversions. NPPD will maintain communication with the Bridgeport field office as to when irrigation operations are occurring under existing appropriations and when recharge operations are occurring under the proposed appropriations.

Diversions will be monitored and recorded using the existing continuous stage recorder and 20 foot Parshall flume located in section 28, T12N-R26W near Brady. Recharge operation returns will be monitored and recorded by staff gages at the Gothenburg Canal river return locations, which will be read and recorded daily.

The water diverted in the main canal before and after the 2011 irrigation season under temporary appropriation A-18775 provides a portion of the basis for requesting 100 cfs. NPPD was able to divert 87 cfs using only the main canal for recharge. NPPD proposes that an additional 13 cfs will be used to recharge water in laterals.

**Project Accounting**

In calculating the annual recharge, NPPD proposes to apply the following principles:

- Clearly distinguish recharge operations from irrigation operations.
- Confirm the proposed recharge appropriations are in priority.
- Take into account the variable recharge rate that occurs through the year. Larger rates of recharge occur during the initial filling period and less recharge occurring at the end of the irrigation season when the soil profile is saturated. Any recharge that occurs due to operations outside the irrigation season will be accounted using the end of irrigation season recharge rate.

NPPD proposes to annually report to DNR times and volumes of water recharged under the proposed appropriation.

**Project Benefits**

In 1997, Colorado, Wyoming, Nebraska and the Department of Interior formed partnership with the goal of developing a shared approach for managing the Platte River. Water users from the three states, including NPPD, and local and national conservation groups joined the effort. The Program is the result of that planning effort. NPPD is one of the Downstream Water User representatives on the Program's Governance Committee and it is in NPPD's best interest to see the Program succeed.

During the first increment of the Program, one goal is to reduce shortages to target flows an average of 130,000 to 150,000 acre-feet annually. NPPD is proposing that this appropriation can assist the Program in meeting that goal.

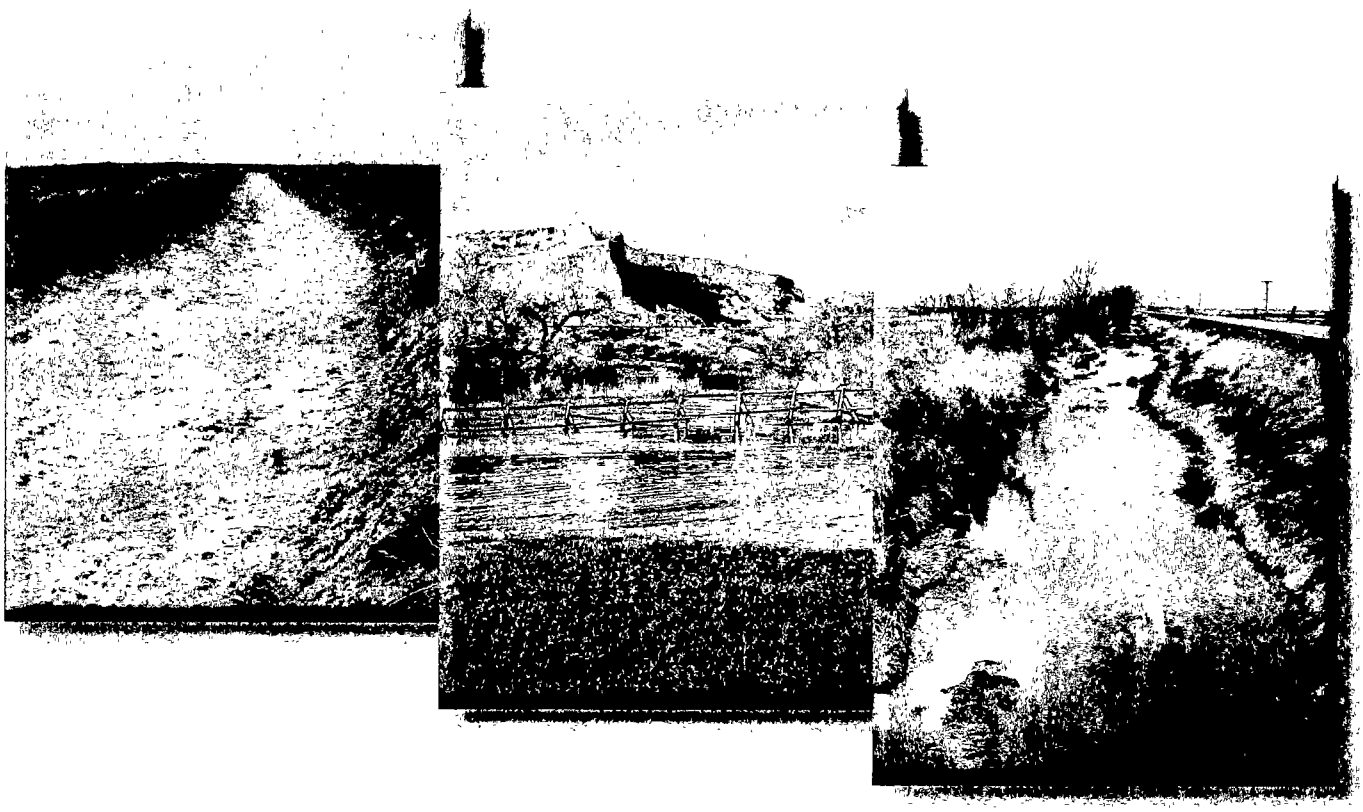
January 2013

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.

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

This equation simplifies as follows:

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

$$= \left(1 - \frac{rate\ masured\ at\ spill}{daily\ diversion\ rate}\right) * 100\%$$

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%** |

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

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

## 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 percent[1] 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.

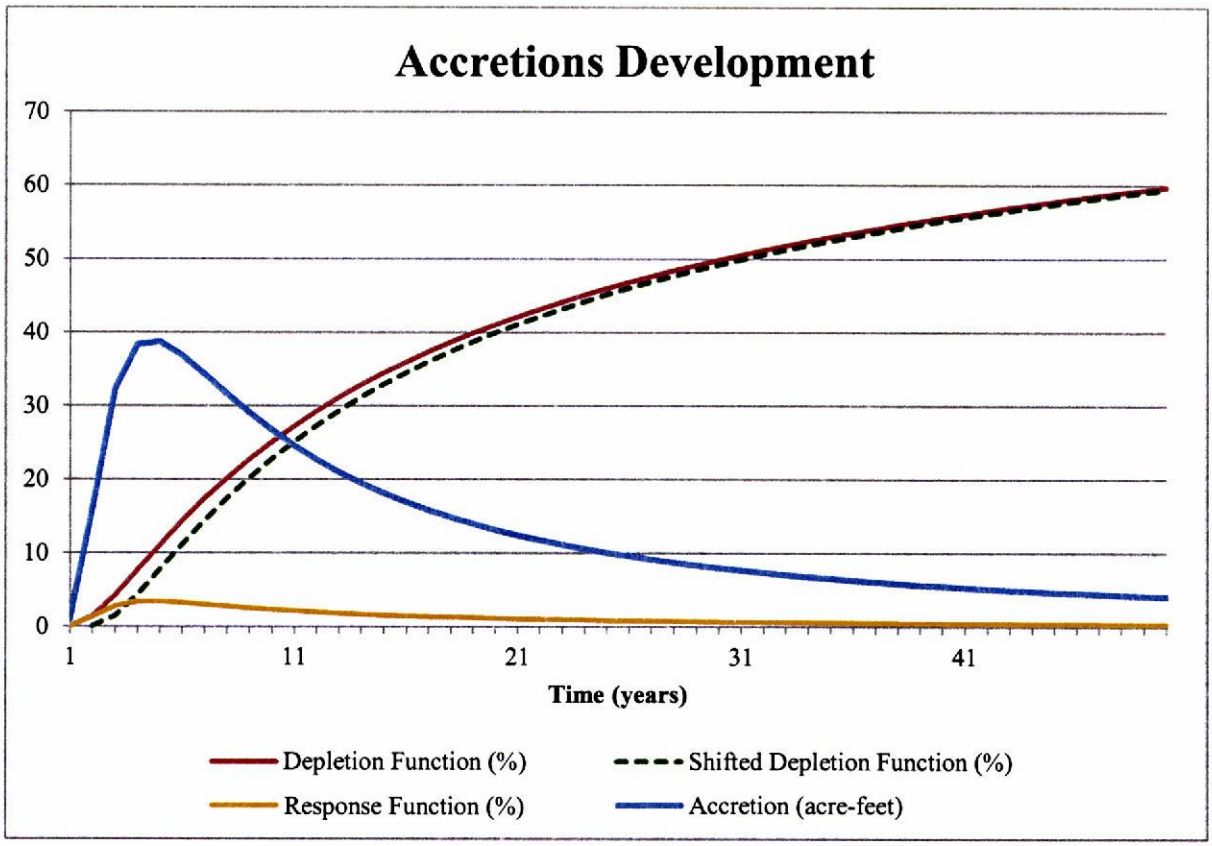



**Figure 1: Cartoon illustrating temporal accretions estimation process using PBHEP zone functions (Depletion Functions) to create response function and estimated accretions. Below is a table showing the numbers used to generate the response function and an example of the calculations done to get the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

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

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

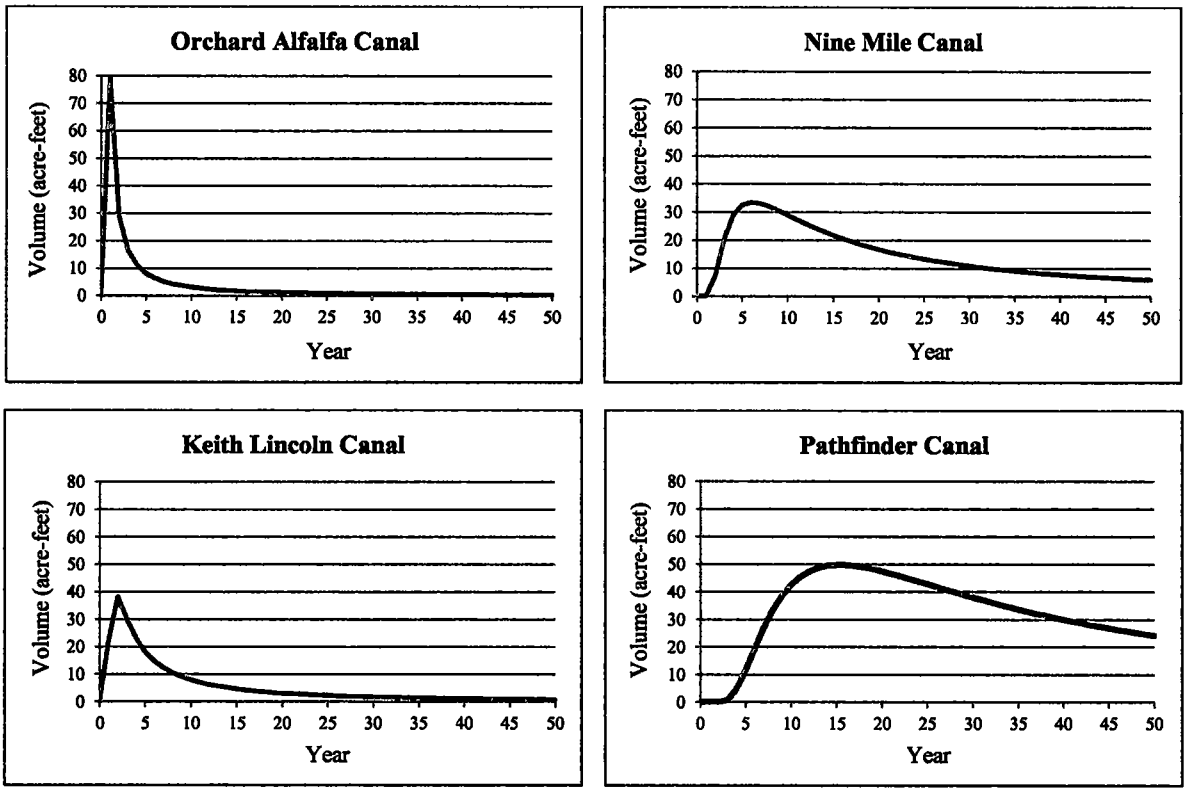



**Figure 2: Accretions estimated from four different canals illustrating a variety of temporal patterns in estimated accretions to the Platte River.**

## 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 committee[2] using COHYST databases and the Hunt[3] (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) database[4]. 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,

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[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.

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

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**

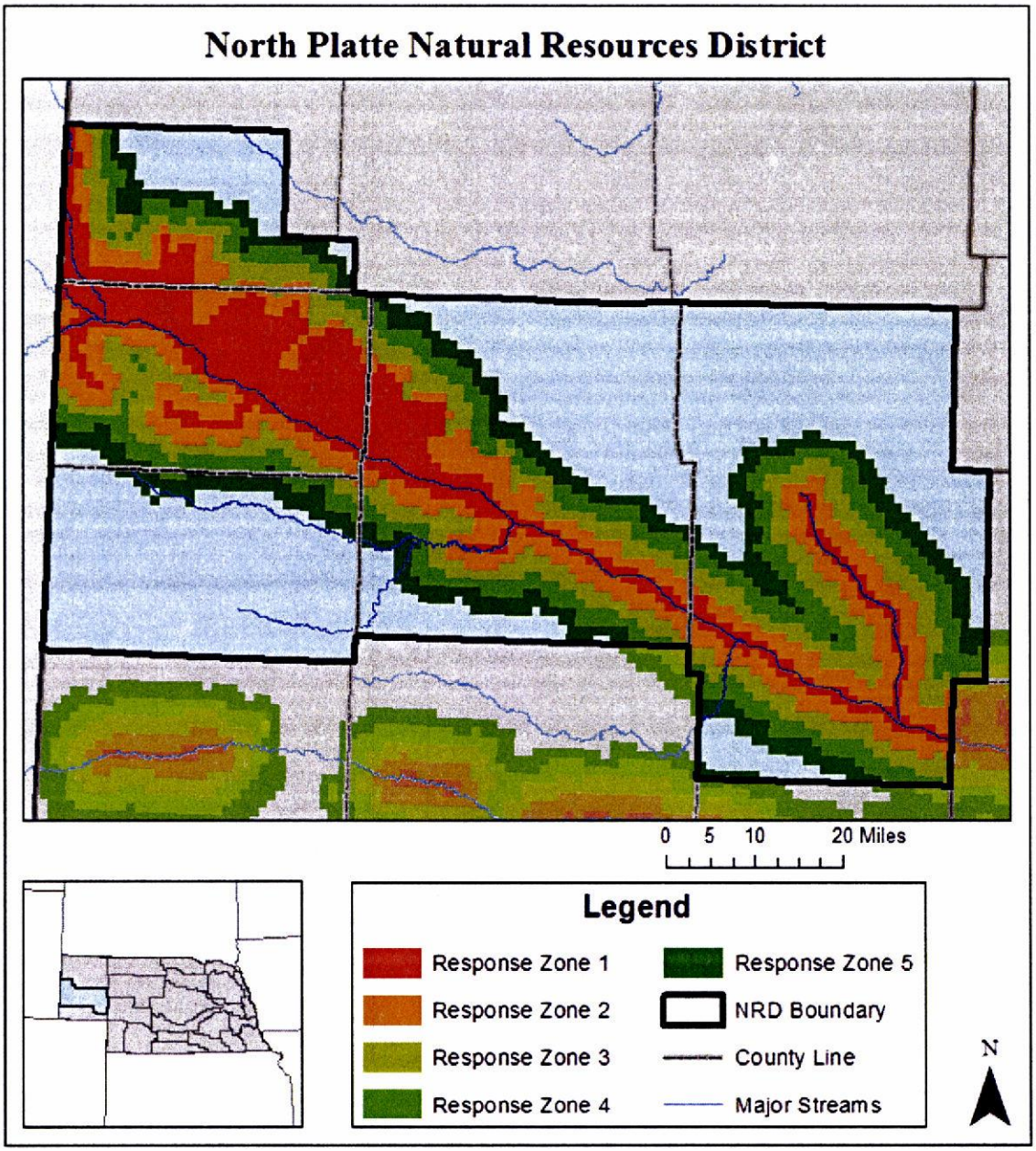



**Figure 1: North Platte Natural Resources District response function zones.**

**Appendix B – Response Function Zone Maps by NRD**

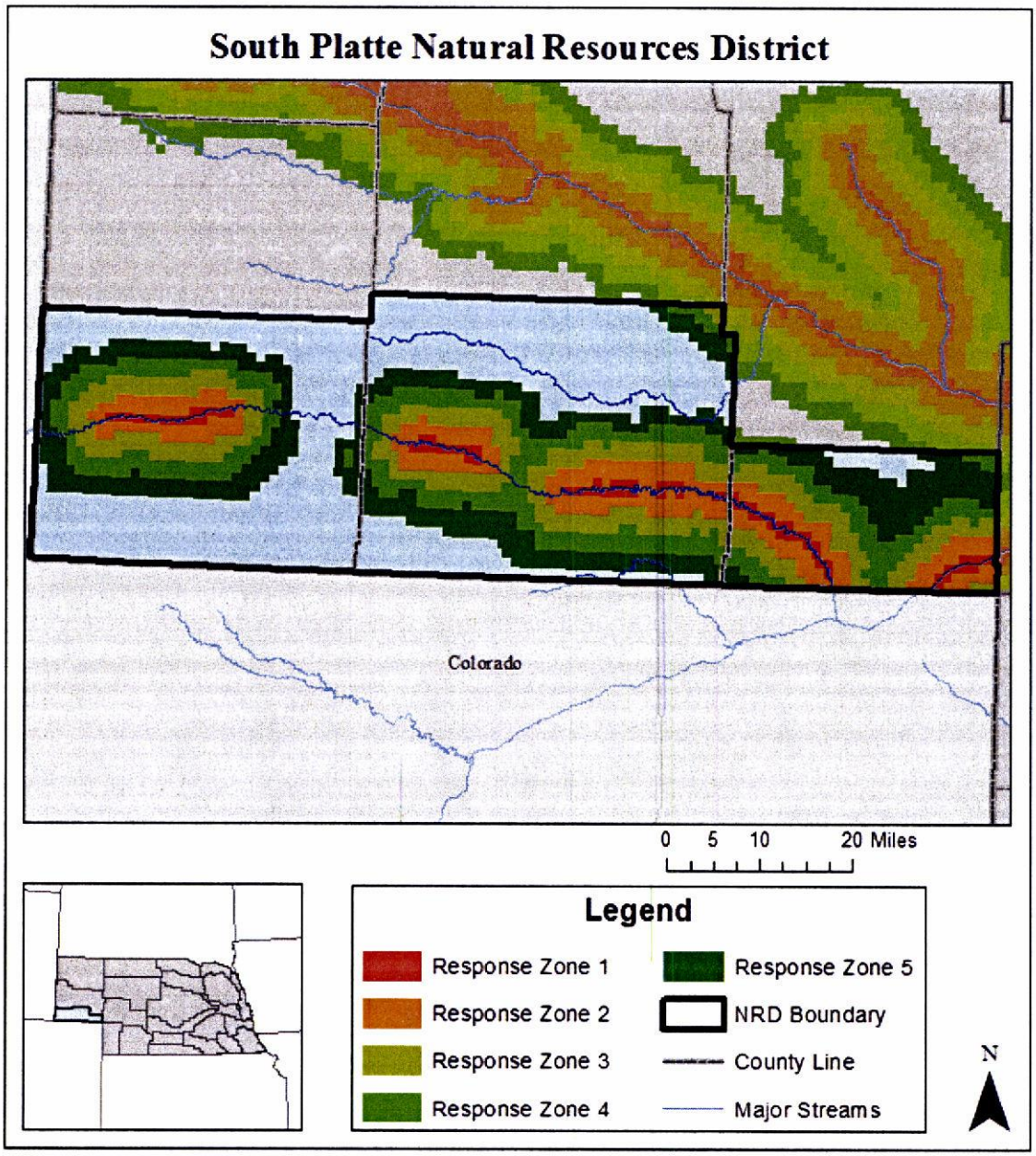



**Figure 2: South Platte Natural Resources District response function zones.**

**Appendix B – Response Function Zone Maps by NRD**

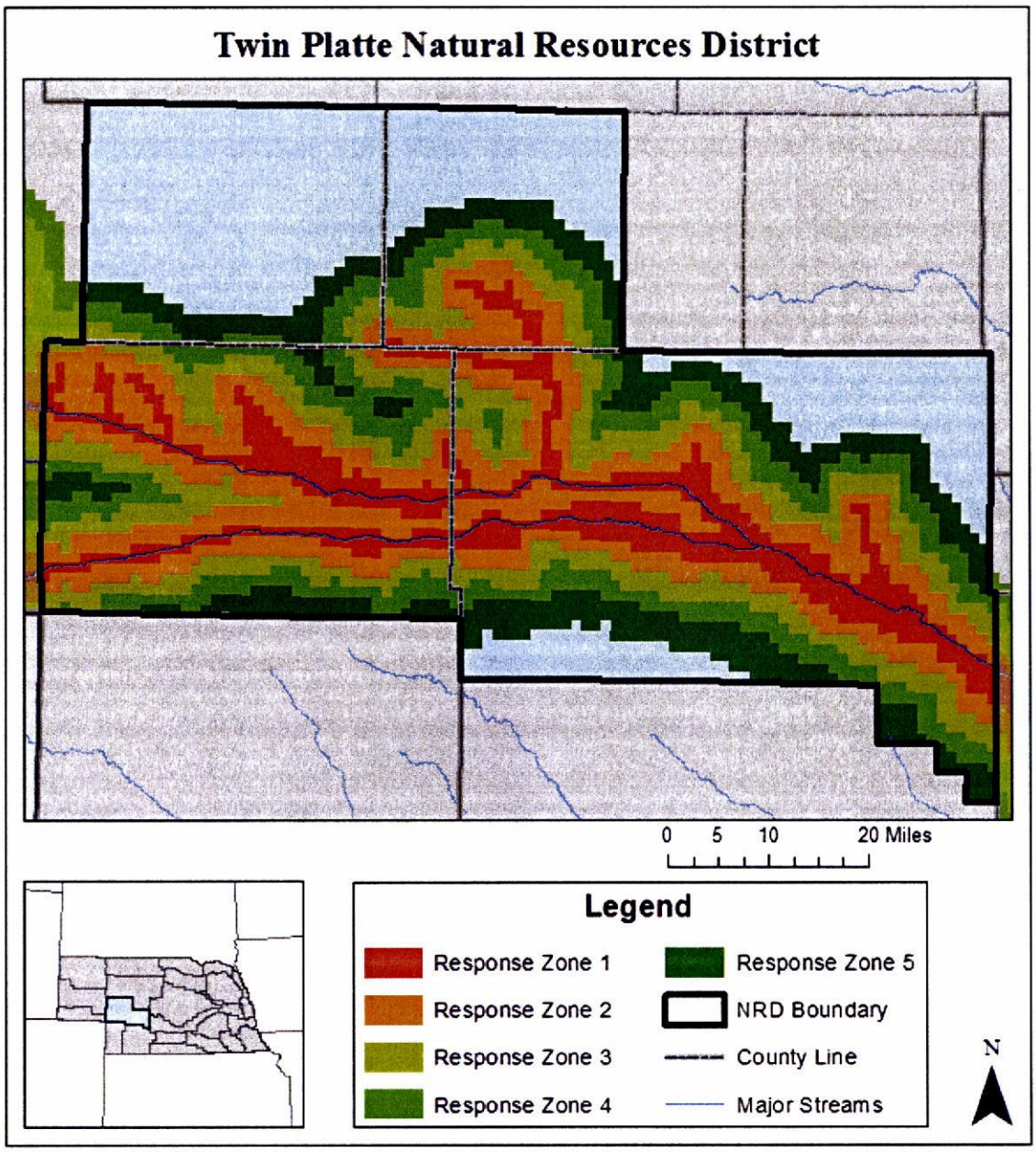



**Figure 3: Twin Platte Natural Resources District response function zones.**

**Appendix B – Response Function Zone Maps by NRD**

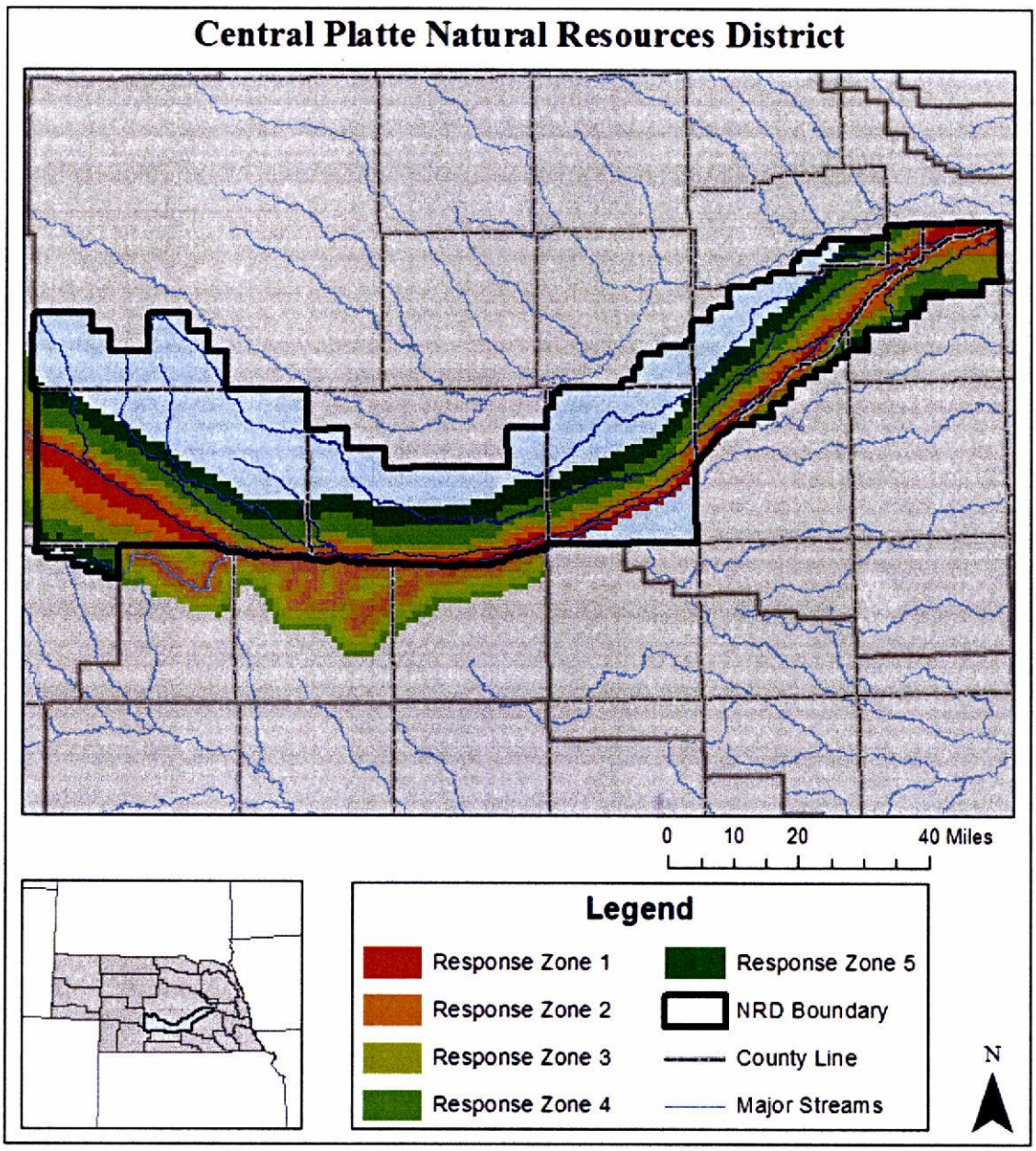



**Figure 4: Central Platte Natural Resources District response function zones.**

## Appendix B – Response Function Zone Maps by NRD

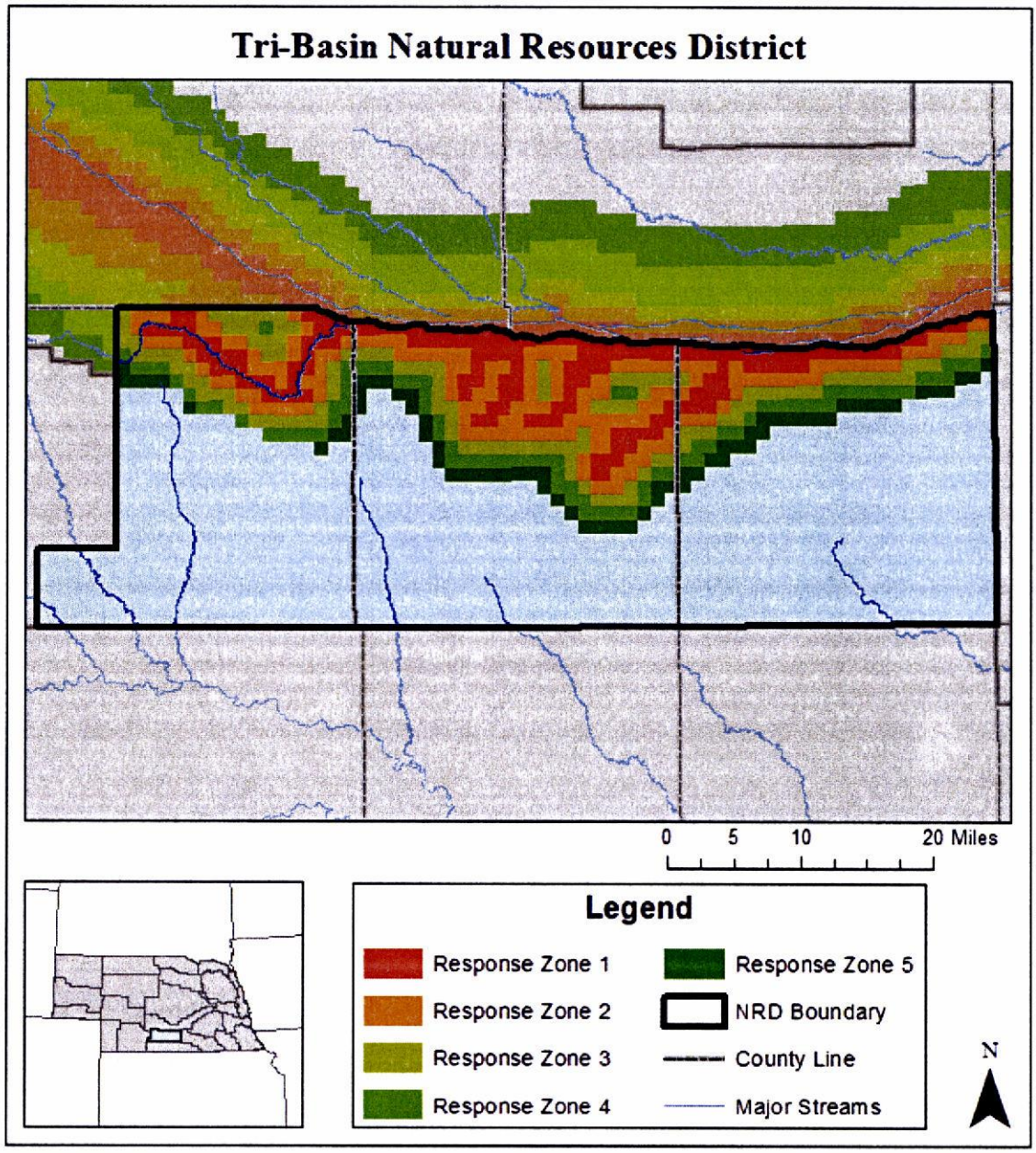
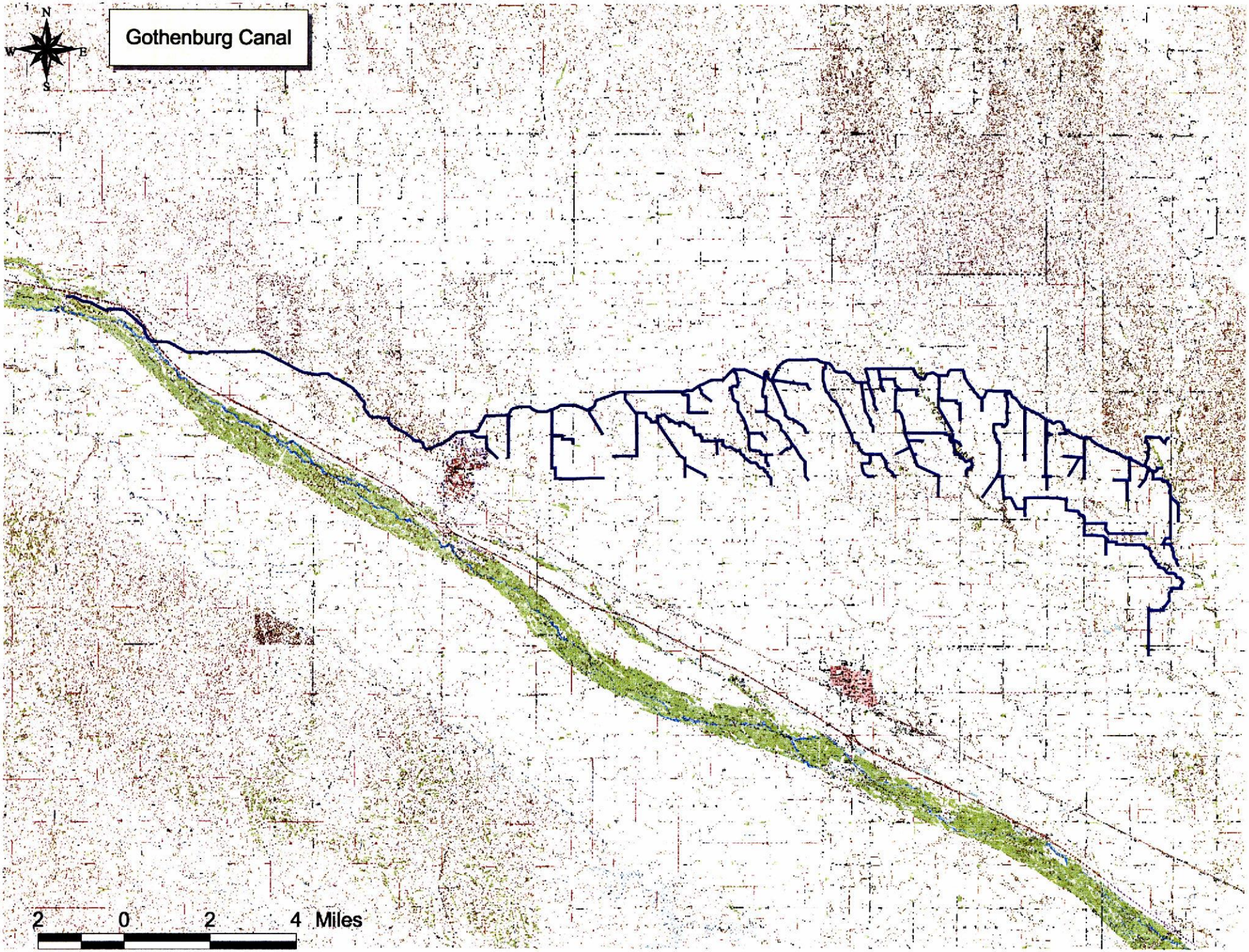



**Figure 5: Tri-Basin Natural Resources District response function zones.**


Gothenburg Canal
N
W
E
S
2 0 2 4 Miles